# REMEDIAL ACTION WORKPLAN

for the

## Rahway Arch Properties Site

**Block 602, Lot 1 and 8; Block 603, Lot 1; Block 705, Lots 17 and 18**
(formerly Block 9.03, Lot 21; Block 10, Lots 8-11 and 12-21 and
Block 11.01, Lots 8-14 and 28)
**Carteret, New Jersey 07008**

Original Report Issued: November 27, 2012
Final Report Issued: July 16, 2013

prepared for:

**Rahway Arch Properties, LLC**
7 Nottingham Drive
Florham Park, New Jersey 07932

prepared by:

***EastStar Environmental Group, Inc.***
10632 Little Patuxent Parkway
Suite 106
Columbia, Maryland 21044

approved by:

Albert P. Free, P.E. CSP, LSRP
LSRP Number 575600
President

Project No. I027

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# 1. INTRODUCTION

Rahway Arch Properties, LLC (Rahway Arch Properties) has contracted with EastStar to provide LSRP services for remediation of the Rahway Arch site in Carteret, New Jersey. The Rahway Arch site is a 125.7 acre property located at the terminus of Salt Meadow Road (formerly Driftway Street). It is more precisely defined as Block 602, Lot 1; Block 603, Lot 1and Block 705, Lot 18. This property was formerly defined as Block 9.03, Lot 21; Block 10, Lots 8-10 and 12-21 and Block 11.01, Lots 8, 10-14 and 28.

The remediation project site also includes portions of two properties owned by the Borough of Carteret. The Borough has entered into an agreement with Rahway Arch Properties and EastStar for remediation of the contaminated areas of these parcels. The Carteret parcels are Block 602, Lot 8 (formerly defined as Block 10, Lot 11) and Block 705, Lot 17 (formerly defined as Block 11.01, Lot 9). Combined these parcels encompass 5.2 acres although the majority of Block 705, Lot 17 is outside the limit of remediation.

The general location of the site is shown on Figure 1.1. The specific location of the site and its boundaries are shown on Figure 1.2. The most recent USGS quadrangle map of the site and vicinity is shown in Figure 1.3. The property boundaries with the block and lot lines is shown in Figure 1.4.

Remediation of the site is being performed in accordance with the requirements of the Site Remediation Reform Act (SRRA), the Administrative Requirements for Remediation of Contaminated Sites (ARRCS) {NJAC 7:26C} and the Technical Requirements for Site Remediation (Tech Rule) {NJAC 7:26E}. Rahway Arch Properties opted-in to the Licensed Site Remediation Program on December 5, 2011 by submitting the LSRP Notification of Retention or Dismissal form to New Jersey Department of Environmental Protection (NJDEP). Albert P. Free of EastStar was retained as the Licensed Site Remediation Professional (LSRP) for the site.

Remedial activities have previously been performed on this site, a Declaration of Environmental Restrictions (DER) was recorded in April 1995 and a restricted use No Further Action (NFA) letter was issued by NJDEP in September 2002. The DER and NFA established non-residential remediation standards as the applicable remediation standards for the site.

The current conditions on the site are no longer protective and additional contamination and areas of concern have been identified that were not known or perhaps not present when the NFA was issued. On March 15, 2013, NJDEP issued a notice of intent to rescind the NFA to Cytec, Incorporated, the former property owner. In addition, the site does not meet the intent of Section 47g (1) of SRRA because no portion of the site is usable for future development or recreational use.

A Preliminary Assessment (PA) for the property was prepared in August 2012. The PA identified 14 Areas of Concern (AOCs) and recommended further investigation of nine AOCs. Because of the known areal extent of the contamination on the site, EastStar decided to forgo the separate Site Investigation (SI) phase and proceed directly to a remedial investigation (RI).

The RI was conducted from June through November 2012 and is described in detail in a remedial investigation report (RIR) dated November 15, 2012. The RI confirmed that the


**FIGURE 1.1**

**General Location Map of the Rahway Arch Site**

EastStar Environmental Group, Inc.
Consulting and Field Services

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Columbia, Maryland 21044

| | | | |
|---|---|---|---|
| Scale: | AS SHOWN | Date: | November 2012 |
| Drawn By: | JAC | Checked By: | APF |


EastStar Environmental Group, Inc.
Consulting and Field Services

10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
www.EastStarEnv.com • Ph: (410) 290-8777 • Fax: (410) 290-9055

Graphic Scale

1,000 500 0 1,000

1 inch = 1,000 feet

Compass

N W E S

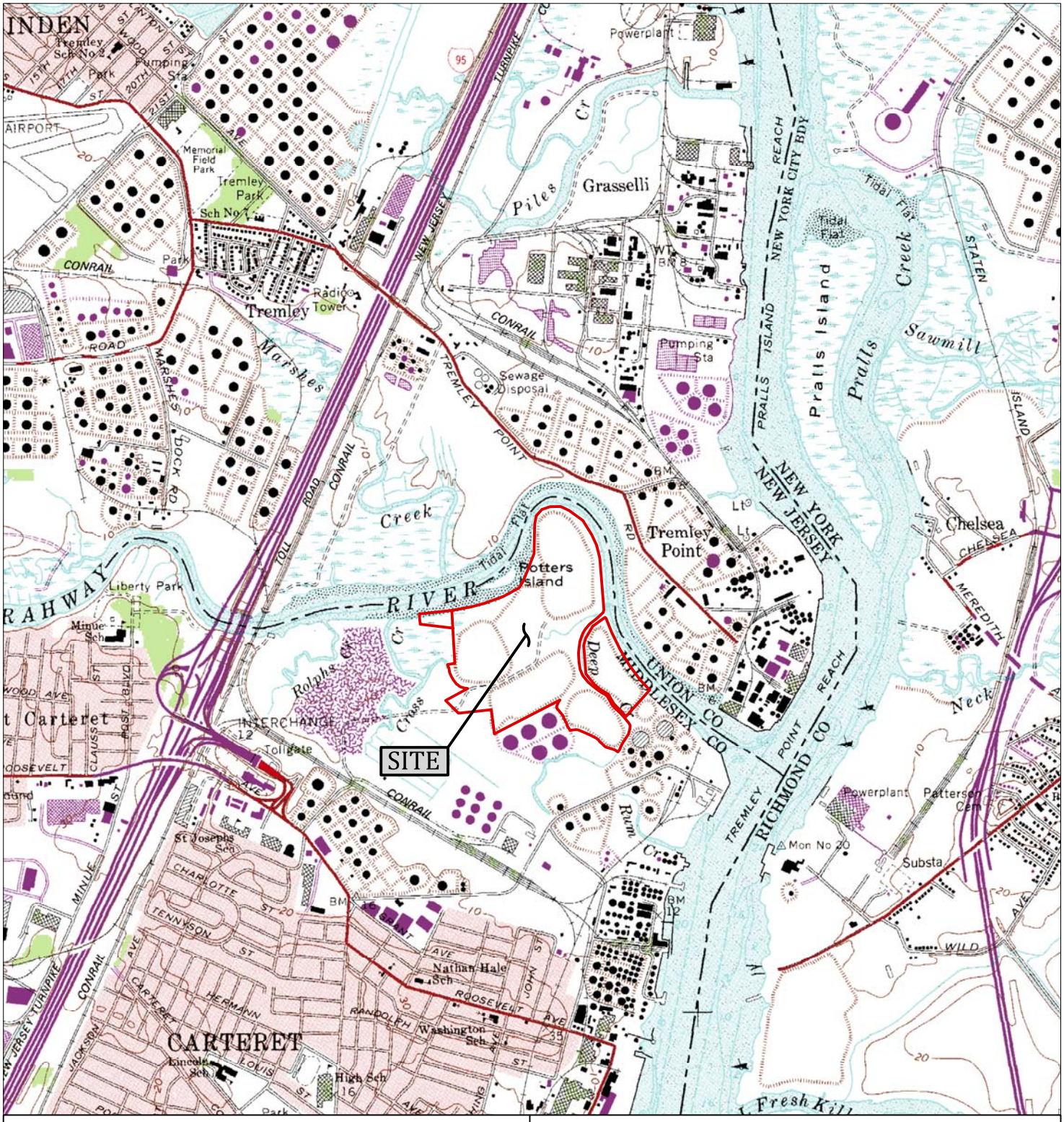
# FIGURE 1.2
# AERIAL PHOTO AND VICINITY MAP

## RAHWAY ARCH PROPERTY SITE

BLOCK 602, LOT 1; BLOCK 603, LOTS 1 & 8 AND
BLOCK 705 LOTS 17 & 18
BOROUGH OF CARTERET
MIDDLESEX COUNTY, NEW JERSEY

Source: Google Imagery, 2011

| Project | Date | Scale |
|---|---|---|
| I027 | 11/14/12 | 1 IN = 1,000 FT |

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

Compass
N W E S

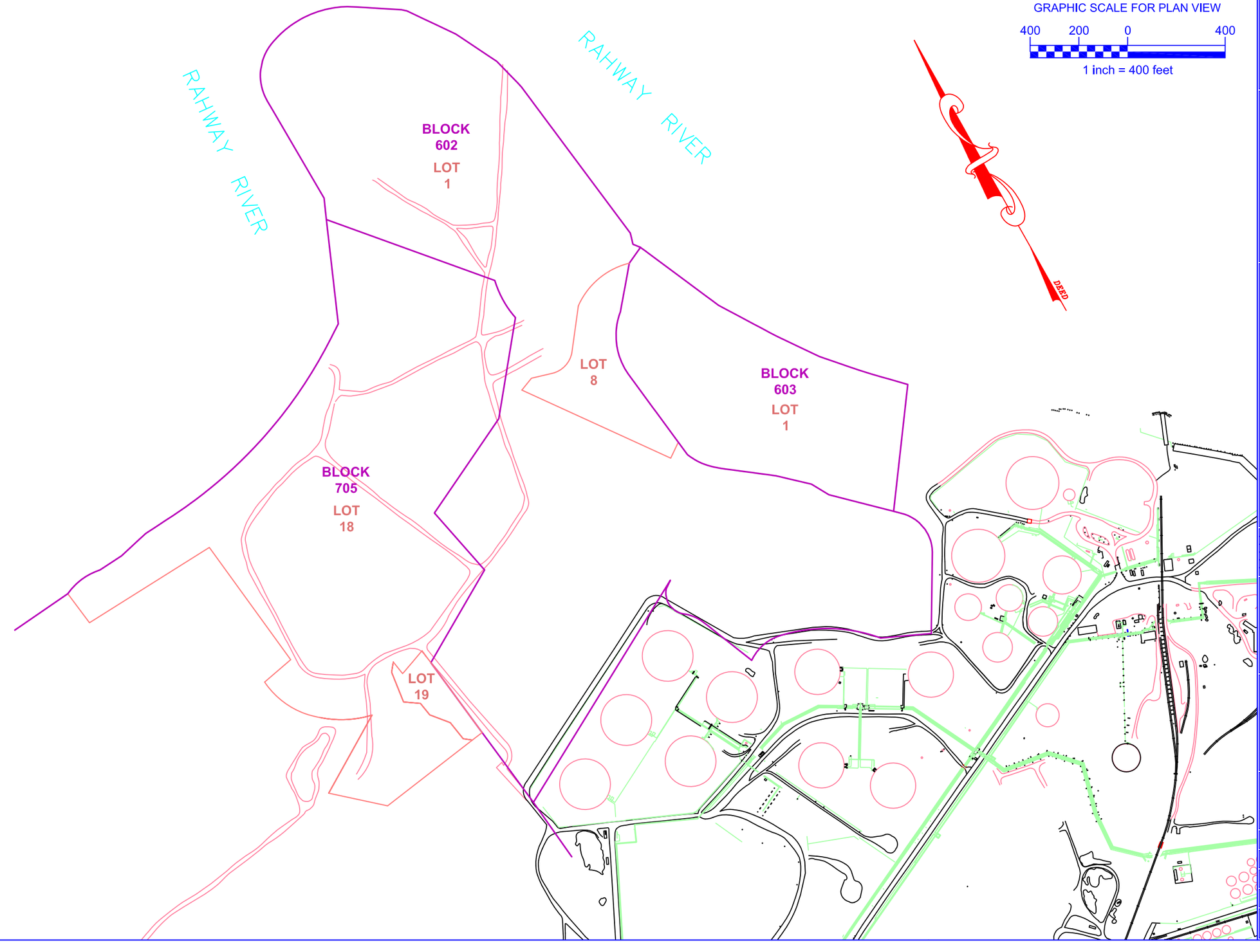
# FIGURE 1.3
## USGS QUADRANGLE SITE LOCATION MAP

## RAHWAY ARCH PROPERTY

BLOCK 602, LOT 1; BLOCK 603, LOTS 1 & 8
BLOCK 708 LOTS 17 & 18
BOROUGH OF CARTERET
MIDDLESEX COUNTY, NEW JERSEY

Source: USGS Arthur Kill, NY-NJ Quadrangle - 7.5 Minute Series, 1979

| Project | Date | Scale |
|---|---|---|
| I027 | 11/14/12 | 1 IN = 2,000 FT |




Rahway Arch

**RAHWAY ARCH PROPERTIES, LLC**

7 Nottingham Drive
Florham Park, New Jersey 07932

# REMEDIAL INVESTIGATION OF THE RAHWAY ARCH SITE

BLOCK 602, LOT 1
BLOCK 603 LOTS 1 &8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

## General Notes and Legend

1. BASE MAP INFORMATION OBTAINED FROM CREST ENGINEERING, INC. PLAN ENTITLED WETLAND LOCATION MAP, DATED 8/7/97.
2. RAHWAY ARCH PROPERTIES LLC PARCELS: BLOCK 602, LOT 1; BLOCK 603, LOT 1; BLOCK 705, LOT 18. FORMERLY BLOCK 9.03, LOT 21; BLOCK 10, LOTS 8-10, 12-21; BLOCK 11.01, LOTS 8,10-14 AND 28.
3. BOROUGH OF CARTERET PARCELS: BLOCK 602, LOT 8 AND BLOCK 705, LOT 17. FORMERLY BLOCK 10, LOT 11; BLOCK 11.01, LOT 9.

Engineer

Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200

EastStar Environmental Group, Inc.
Consulting and Field Services

10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com

## FIGURE 1.4
## BLOCK AND LOT LAYOUT

| | |
|---|---|
| File Name: Site Blocks and Lots.dwg | Scale: 1 Inch = 400 feet |
| Date: November 14, 2012 | Project Number: 1027 |
| Drawn by: MAY | |
| Checked by: APF | |

Sheet 1 of 1 Sheets

undocumented fill material that has been placed on the site and the alum-YPS sludge in the impoundments contain metals, cyanide and PAHs above non-residential soil direct contact remediation criteria and soil impact to groundwater screening levels. The groundwater on the site, sampled through the sixteen existing groundwater monitoring wells, is also contaminated with metals and cyanide. Additionally, the site in its current condition is unusable and poses a safety risk to the public.

The RI included a geotechnical investigation that determined the alum-YPS sludge in the impoundments and the underlying peat and clay layers have minimal strength. In their current condition, these layers cannot support a load that would allow the site to be usable. However, the geotechnical report did identify a construction process for capping the site with engineered fill that would allow:

- Elimination of the unsafe conditions
- Passive recreational use and/or safe habitat
- Possible future development over a portion of the site.

Contained in this report is the Remedial Action Workplan (RAW) for remediating the site in accordance with the SRP regulations and guidelines. This remediation will consist of both engineering and administrative controls that will accomplish these remedial action goals:

- Comply with SRRA and the requirements of the LSRP program
- Comply with SRP regulations and guidance documents
- Comply with all other Federal, State and local requirements
- Eliminate direct contact hazard with contaminated surface fill and alum-YPS sludge
- Prevent precipitation from coming in contact with the contaminated materials and discharging to groundwater or surface water, as occurs currently
- Promote runoff and evapotranspiration of precipitation rather than infiltration
- Ensure the long term integrity of the berms that currently contain the alum-YPS sludge
- Eliminate site safety hazards posed by soft soils and sludge and ponded water in the open impoundments
- Allow possible future development on a portion of the site by the property owners, making at least a portion of the site usable.

This RAW describes capping the site using engineered fill, following the guidelines recommended in the geotechnical report. It has been prepared in accordance with the requirements of the Tech Rule and contains specifics on the cap design and the materials that may be used to construct the engineered fill. It also contains the details on the administrative controls including a deed notice and groundwater classification exception area (CEA).

The specific engineering and environmental requirements for the cap are described in detail in Section 6 of this RAW. The fill use plan for the engineered fill material is described in detail in Section 7. This remedial action has been designed to meet all of these requirements, which must be met prior to issuance of a Response Action Outcome (RAO).

This RAW has been revised from the initial report that was issued on November 27, 2012 following input from the NJDEP Site Remediation Program (SRP). SRP performed a component review of the RAW and provided feedback to EastStar. This feedback has been used in preparing this Final RAW. The remedial design has also been modified slightly because of the new Advisory Base Flood Elevations published by FEMA.

# 2. SITE HISTORY

## 2.1 Historic Site Use

The project site is the old Cytec Impoundments site, a former industrial waste disposal facility operated by American Cyanamid Company (now Cytec Incorporated) from the mid-1930s through 1974 to dispose of a mixture of acidic sludge from an alum manufacturing process and alkaline sludge from a yellow prussiate of soda (YPS) manufacturing process.

American Cyanamid Company owned and operated a chemical manufacturing plant, known as the Warner Plant, located on 30 acres of property in Tremley Point, at the confluence of the Rahway River with the Arthur Kill in Linden, New Jersey, from 1917 to 1998. The plant produced a number of organic and inorganic products including:

- "Ammo-Phos" – a concentrated fertilizer made by reacting ammonia with phosphoric acid. The ammonia was produced by reacting calcium Cyanamid and steam. The phosphoric acid was produced by mixing sulfuric acid with phosphate rock.
- Ammonia and nitric acid for military purposes during World War I
- Alum and aluminum sulfate compounds for water treatment
- Yellow prussiate of soda (YPS)
- Sulfuric acid, acrylamide, polyacrylamide and sodium hydrosulfide
- Paper treatment chemicals
- Mining and ore production chemicals
- Non-persistent organophosphate insecticides including malathion and Cygon
- A broad range of organic chemicals including surfactants, rubber accelerators, motor oil additives and fumigants (hydrocyanic acid)

The Warner Plant was remediated under an Administrative Consent Order issued by NJDEP on August 23, 1990. According to the U.S. EPA, human exposures and migration of contaminated groundwater are considered to be under control at the Warner Plant at this time.

While it was operating, waste alum and YPS sludges from the Warner Plant were slurried and pumped across the Rahway River to the project site. It is not known if any other waste products from the Warner Plant were included in the slurry. Demolition debris from work performed at the Warner Plant was used on the project site for road and berm reconstruction and is part of the undocumented fill identified on the site.

Alum production consisted of digesting bauxite ore with sulfuric acid. The resulting acidic sludge was primarily silica. YPS production consisted of reacting calcium cyanide with hydrated ferrous sulfate and soda ash. The resulting basic sludge was primarily calcium carbonate and contained cyanide salts. The two waste streams were mixed together to form a neutral slurry and were pumped into the impoundments for disposal. Surface water from the

Arthur Kill was used to liquefy the slurry for pumping. River water was also pumped to the site between slurry discharges to prevent sludges from settling in the pipeline. It is not known whether other waste streams or materials were blended with the sludges prior to disposal. YPS sludge disposal at the site ended in 1970. Alum sludge disposal ended in 1974.

The 124.7 acre site contains six impoundments, encompassing approximately 85 acres, located on the Rahway River. The impoundments were constructed above existing grade with wooden and earthen dikes. They currently contain approximately 2,000,000 tons of the cyanide containing alum-YPS sludge. The size and capacity of each of the impoundments varies, as does the thickness of the sludge, which ranges from 5 to 20 feet. A scaled site map showing the location of the six impoundments is provided in Figure 2.1.

Evidence indicates that undocumented fill material has been imported and used on the site over the years to cover the alum-YPS sludge, maintain the dikes and stabilize the surface in several of the impoundments. This fill material was imported from various sites over the years for operations and maintenance of the disposal areas. Because it was imported to the site for operation and maintenance of the impoundments, the fill may not be considered historic fill, as defined by the Tech Rule. However, the undocumented fill has the physical and chemical characteristics of historic fill.

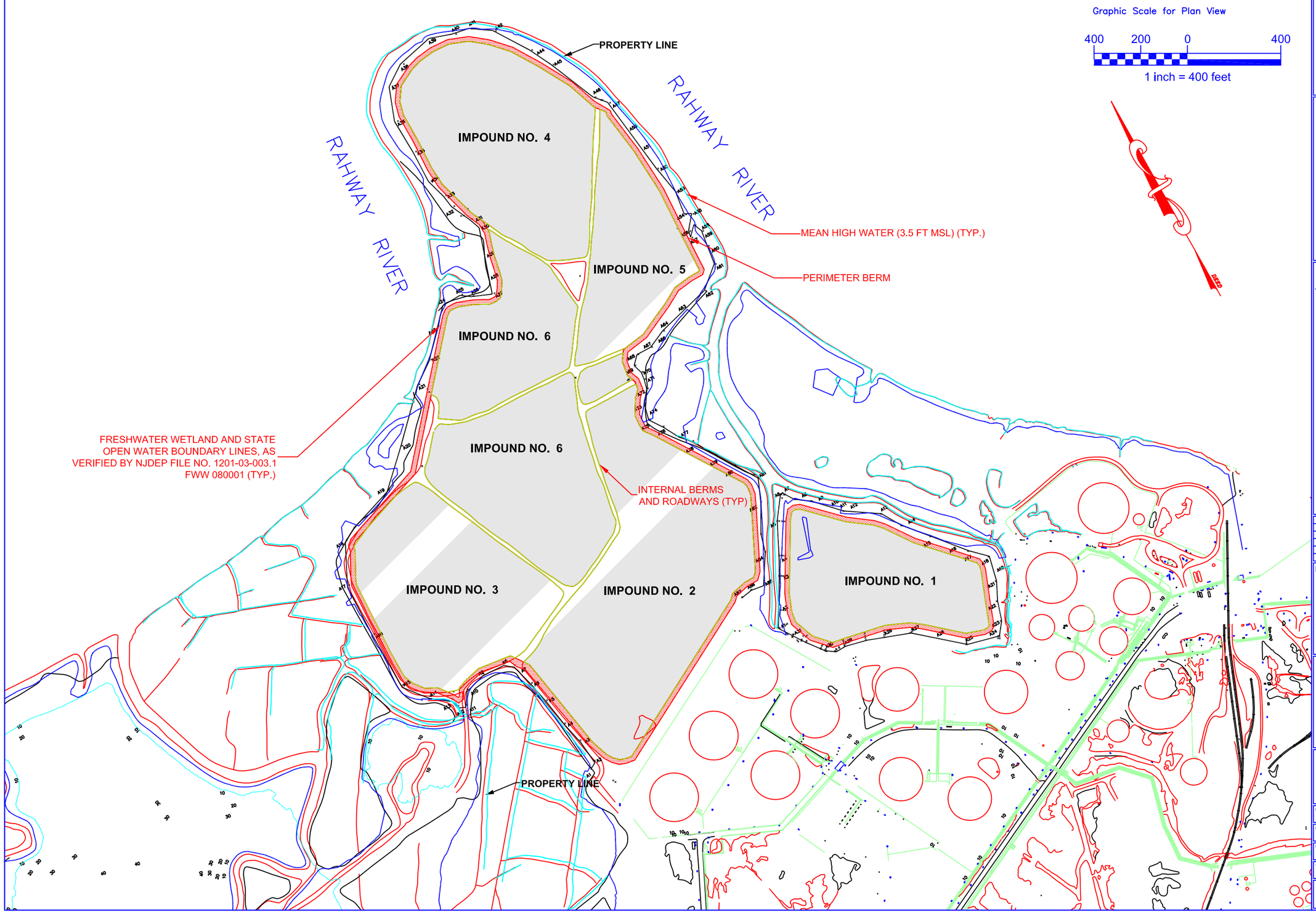
From the time that waste from the Warner Plant was no longer placed in the impoundments until 2005, the site was unused. Various activities were performed during that time to maintain the berms, prevent nuisance dusting, characterize the environmental conditions and monitor the groundwater. Several plans for additional remediation and eventual reuse of the site were developed by Cytec, but none of the plans ever proceeded past the concept stage, likely due to the poor geotechnical conditions posed by the alum-YPS sludge.

In 2005, a portion of the site in Impoundment 2 was leased by Dauman Recycling Company to operate a Class B recycling facility for wood waste and pallets. Dauman operated on the site from 2006 through 2008. Permit violations related to improper storage and handling of the wood waste were recorded. According to the DataMiner, several of these violations are still outstanding. Several piles of wood waste remain on Impoundment 2, and the surface of some areas of Impoundment 2 is covered with wood chips.

## 2.2 Current Site Use

Rahway Arch Properties purchased the site in 2010 from Cytec. No activities or development have occurred on the site since that time other than the site and remedial investigations described in the RIR. At the present time, the site consists of the six sludge impoundments surrounded by the containment berms. Several pathways were built through the impoundments by Cytec to allow access for maintenance or access to the eight existing monitoring well clusters. The berm between Impoundments 4 and 5 is not visible, merging these two impoundments into a single larger impoundment.

In its current condition, the project site is unusable. Most of Impoundments 1 and 6 are filled with standing water. Vegetative cover is either sparse or non-existent over most of the area of the remaining impoundments, with the exception of Impoundment 1 and the low areas of




Graphic Scale for Plan View

400 200 0 400

1 inch = 400 feet

RAHWAY ARCH PROPERTIES, LLC
7 Nottingham Drive
Florham Park, New Jersey 07932

# REMEDIAL INVESTIGATION OF THE RAHWAY ARCH SITE

BLOCK 602, IOT 1
BLOCK 603, LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

## General Notes and Legend

1. BASE MAP INFORMATION OBTAINED FROM CREST ENGINEERING, INC. PLAN ENTITLED WETLAND LOCATION MAP, DATED 8/7/97.

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EastStar Environmental Group, Inc.
Consulting and Field Services
10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com

## FIGURE 2.1
## SCALED SITE MAP OF THE IMPOUNDMENTS

| | |
|---|---|
| File Name: Impoundments.dwg | Scale: 1 Inch = 400 feet |
| Date: November 14, 2012 | Project Number: 1027 |
| Drawn by: MAY | |
| Checked by: APF | |

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Impoundment 3. A 12 inch cover of soil and sewage sludge had been placed over the impoundments from 1986 through 1989 to promote vegetative growth. This work was required under an April 1978 amended administrative consent order issued by New Jersey Superior Court to control dust blowing off of the site and onto the Turnpike. This 12 inch cover has been eroded away in most locations on the impoundments leaving exposed alum-YPS sludge. Phragmites have grown in the soil on the berms and the roadways surrounding the impoundments.

The impoundments are impassable and are unsafe for foot or vehicular traffic because the sludge has no shear strength and cannot bear any weight. A pole or rod can be pushed by hand its full length into the sludge with minimal effort. This creates a dangerous condition for persons, vehicles and wildlife on the site and makes the site, in its current condition, unusable.

Impoundment 3 is the lowest area on the site and appears to have been inundated regularly by the Rahway River. Trash and debris consistent with river water flowing onto the impoundment are visible.

Impoundment 2 has been covered with several feet of soil (undocumented fill) and was used for the aforementioned wood waste recycling operation. That operation was halted in 2008, although wood waste from the operation remains on-site. A portion of the soil surface is covered with wood chips, and several piles of wood chips remain on the site.

A large stockpile of used railroad ties and dock bulkhead is located on Impoundment 5. Cytec used railroad ties as a means of bridging the soft soils and alum-YPS sludge during maintenance and rebuilding of the access roads on the berms. The Fill Investigation documented areas where the railroad ties were used. This stockpile appears to be extra ties that were delivered to the site but never used and additional treated lumber waste from demolition of a dock bulkhead, likely from the Warner Plant. The amount of material in this stockpile far exceeds the volume that would be needed for maintenance of the roads.

# 3. REMEDIAL INVESTIGATION FINDINGS

## 3.1 Remedial Investigation

### 3.1.1 Overview

The field work for the RI was performed in July and August 2012. This work consisted of:

- Environmental sampling of surface and subsurface soils and the alum-YPS sludge from soil borings
- Groundwater sampling in the surface and Brunswick Formation aquifers using the existing 16 groundwater monitoring wells
- Geotechnical investigation using soil borings and cone penetrometer tests in the impoundments, berms and adjoining wetlands

The scope of sampling for the RI was reduced because the physical features of the site clearly delineated the contaminated area. The 85 acre contaminated area was delineated by the six alum-YPS sludge impoundments and the surrounding berms. The approximately 2,000,000 tons of alum-YPS sludge (AOCs 1, 3 and 13) was contained in the six impoundments. The undocumented fill (AOCs 5 and 10) was observed over berms and the six sludge impoundments. The contaminated water percolating through the sludge (AOCs 4, 11 and 12) exists in all six impoundments.

The environmental investigations of the soil and sludge and the groundwater were performed by EastStar. Laboratory analyses of the samples were performed by QC Laboratories. The geotechnical investigation was performed by Michael J. Baker, Jr. Inc. Geotechnical laboratory analyses were performed by URS Corporation.

The results of the environmental sampling are described in detail in the RIR. The results of the geotechnical investigation, completed in October 2012, are described in detail in Baker's geotechnical investigation report and are summarized in the RIR.

### 3.1.2 Soils and Sludge Investigation

The surface soil, alum-YPS sludge and underlying natural materials were all sampled and analyzed in the RI. Previous investigations had shown that the surface soil (undocumented fill) throughout the site is contaminated with polynuclear aromatic hydrocarbons (PAHs) and metals above non-residential remediation standards. Over time, this undocumented fill soil has been placed over all areas of the 85 acres of impoundments that comprise the remediation project. Previous investigations have also shown that the alum-YPS sludge is contaminated with metals and cyanide above non-residential remediation standards.

Because of the existing data showing that these materials are contaminated, only a few samples of the undocumented fill and alum-YPS sludge were collected during the RI. The RI samples were primarily intended to verify the contaminants in these layers, identify other possible contaminants in these layers and determine if the underlying layers were also contaminated.

Samples in each layer collected during the RI were analyzed for metals, cyanide and PAHs, the known contaminants of concern on the site. Selected samples were also analyzed for semi-volatile organic compounds (S-VOCs), volatile organic compounds (VOCs) and petroleum hydrocarbons (EPH).

The RI analytical results confirmed the findings of all of the previous investigations regarding the surface and alum-YPS sludge contamination. The surface soils are contaminated with metals, cyanide and PAHs; and the alum-YPS sludge is contaminated with metals and cyanide. Further, the results determined that the underlying soils were also contaminated with metals above non-residential and impact to groundwater standards. No VOC, S-VOC (except PAHs) or EPH contamination was detected in any of the underlying layers above non-residential or impact to groundwater standards.

The highest measured contaminant concentrations in each layer for contaminants that exceeded a standard are summarized in Table 3.1. All of the soil and sludge sample analysis results from the RI are summarized in Appendix A.

### 3.1.3 Groundwater Investigation

Sixteen groundwater monitoring wells are currently located on the site in eight two well clusters. Each well cluster consists of a shallow well screened in the surface aquifer and a deep well screened in the Brunswick Formation aquifer. Prior to the RI, the 16 monitoring wells were last sampled in 1999. Therefore, prior to sampling, EastStar re-developed the wells. The re-development process is described in the RIR.

After re-development, the sixteen wells were purged and sampled using low flow sampling techniques. Each sample was analyzed for metals, cyanide, PAHs, VOCs and EPH.

The analytical results showed that the groundwater contains metals and cyanide contamination above Class IIB groundwater standards in both the shallow and deep aquifers. No PAH, VOC or EPH contaminants were detected above these standards in either aquifer.

Cytec sampled and analyzed these wells for a limited parameter list in 1995 through 1999. Comparison of the RI results to the results obtained by Cytec in 1999 shows that the highest concentrations of arsenic, manganese and silver concentrations in the groundwater have increased overall on the site and that arsenic, manganese, iron, silver and cyanide concentrations have increased in specific wells from the period from 1999 to present.

The highest measured contaminant concentrations in each aquifer for contaminants that exceeded the groundwater standard are summarized in Table 3.2. These results are compared to the 1999 Cytec results in Table 3.3. All of the groundwater sample analysis results from the RI are summarized in Appendix B.

### 3.1.4 Geotechnical Investigation

The geotechnical investigation identified seven distinct strata from the ground surface to the under lying bedrock of the Brunswick Formation.

**Table 3.1 - Summary of Highest Soil/Sludge Contaminant Concentrations from the RI**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | Surface Fill | Alum-YPS Sludge | Peat | Organic Clay |
|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | |
| Aluminum | mg/kg | none | 3,900 | 20,500 | 29,200 | 25,200 | 13,800 |
| Antimony | mg/kg | 450 | 6 | 7.64 | 1.79 | 6.04 | <2.50 |
| Arsenic | mg/kg | 19 | 19 | 248 | 5.33 | 28.3 | 12.7 |
| Beryllium | mg/kg | 140 | 0.5 | 1.13 | 1.13 | 1.39 | 0.822 |
| Cadmium | mg/kg | 78 | 1 | 1.95 | 4.33 | 12.2 | <0.636 |
| Cobalt | mg/kg | 590 | 59 | 21.4 | 75.3 | 16.5 | 13.2 |
| Lead | mg/kg | 800 | 59 | 757 | 60 | 303 | 40.7 |
| Manganese | mg/kg | 5,900 | 42 | 415 | 356 | 493 | 775 |
| Mercury | mg/kg | 65 | 0.1 | 31.6 | 0.262 | 0.991 | 0.495 |
| Nickel | mg/kg | 23,000 | 31 | 118 | 38.4 | 75.0 | 31.2 |
| Zinc | mg/kg | 110,000 | 600 | 652 | 185 | 796 | 138 |
| | | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | 1,330 | 2,850 | 1,130 | 69.8 |
| **Polynuclear Aromatic Hydrocarbons** | | | | | | | |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | 4,170 | <1,100 | <1,010 | |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | 4,690 | <910 | <840 | |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | 4,010 | <1,170 | <1,080 | |
| Benzo(a)pyrene | ug/kg | 200 | 200 | 4,870 | <1,080 | <996 | |
| Chrysene | ug/kg | 230,000 | 52,000 | 4,620 | <1,050 | <968 | |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | 1,340 | <815 | <752 | |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | 2,920 | <1,050 | <971 | |

**Table 3.2 - Summary of Highest Concentrations in Groundwater from the RI**

| Parameter | Units | GW Quality Criteria | Surface Aquifer | Brunswick Formation |
|---|---|---|---|---|
| **Inorganics** | | | | |
| Aluminum | mg/l | 0.2 | 0.260 | 0.207 |
| Antimony | mg/l | 0.006 | 0.0239 | 0.0927 |
| Arsenic | mg/l | 0.003 | 0.267 | 0.425 |
| Beryllium | mg/l | 0.001 | 0.0019 | 0.0018 |
| Cadmium | mg/l | 0.004 | <0.0011 | <0.0011 |
| Cobalt | mg/l | none | 0.0375 | 0.0076 |
| Lead | mg/l | 0.005 | <0.0175 | <0.0175 |
| Manganese | mg/l | 0.05 | 5.33 | 4.60 |
| Mercury | mg/l | 0.002 | 0.000046 | 0.000033 |
| Nickel | mg/l | 0.1 | 0.0231 | <0.0034 |
| Zinc | mg/l | 2 | 0.120 | 0.0784 |
| | | | | |
| Cyanide | mg/l | 0.1 | 12.40 | 0.391 |
| **Polynuclear Aromatic Hydrocarbons** | | | | |
| Benzo(a)anthracene | ug/l | 0.1 | 0.02 | 0.02 |
| Benzo(b)fluoranthene | ug/l | 0.2 | 0.02 | 0.02 |
| Benzo(k)fluoranthene | ug/l | 0.5 | 0.02 | 0.02 |
| Benzo(a)pyrene | ug/l | 0.1 | 0.02 | <0.02 |
| Chrysene | ug/l | 5 | 0.02 | 0.02 |
| Dibenz(a,h)anthracene | ug/l | 0.3 | <0.02 | 0.03 |
| Indeno(1,2,3-cd)pyrene | ug/l | 0.2 | <0.02 | <0.02 |

**Table 3.3 - Comparison of Groundwater Data to Cytec 1999 Data**

| Parameter | Units | Surface Aquifer | | | Brunswick Formation | | |
|---|---|---|---|---|---|---|---|
| | | Cytec 1999 | RIR 2012 | Change | Cytec 1999 | RIR 2012 | Change |
| **Volatile Organic Compounds** | | | | | | | |
| Benzene | ug/l | 23 | <3.80 | lower | <0.26 | <0.22 | same |
| Chlorobenzene | ug/l | 6.9 | <3.20 | lower | <0.58 | <0.23 | same |
| **Inorganics** | | | | | | | |
| Aluminum | mg/l | 1.21 | 0.260 | lower | 2.92 | 0.207 | lower |
| Antimony | mg/l | n/a | 0.0239 | | n/a | 0.0927 | |
| Arsenic | mg/l | 0.0246 | 0.267 | higher | 0.00995 | 0.425 | higher |
| Beryllium | mg/l | n/a | 0.0019 | | n/a | 0.0018 | |
| Cadmium | mg/l | n/a | <0.0011 | | n/a | <0.0011 | |
| Cobalt | mg/l | n/a | 0.0375 | | n/a | 0.0076 | |
| Iron | mg/l | 24.9 | 28.6 | same | 261 | 39.6 | lower |
| Lead | mg/l | n/a | <0.0175 | | n/a | <0.0175 | |
| Manganese | mg/l | 5.82 | 5.33 | same | 2.58 | 4.60 | higher |
| Mercury | mg/l | n/a | 0.000046 | | n/a | 0.000033 | |
| Nickel | mg/l | n/a | 0.0231 | | n/a | <0.0034 | |
| Silver | mg/l | <0.00147 | 0.0128 | higher | <0.00147 | 0.0347 | higher |
| Thallium | mg/l | 0.00568 | <0.0324 | same | 0.00840 | <0.0324 | same |
| Zinc | mg/l | n/a | 0.120 | | n/a | 0.0784 | |
| | | | | | | | |
| Cyanide | mg/l | 50.0 | 12.4 | lower | 10 | 0.391 | lower |
| **Polynuclear Aromatic Hydrocarbons** | | | | | | | |
| Benzo(a)anthracene | ug/l | n/a | 0.02 | | n/a | 0.02 | |
| Benzo(b)fluoranthene | ug/l | n/a | 0.02 | | n/a | 0.02 | |
| Benzo(k)fluoranthene | ug/l | n/a | 0.02 | | n/a | 0.02 | |
| Benzo(a)pyrene | ug/l | n/a | 0.02 | | n/a | <0.02 | |
| Chrysene | ug/l | n/a | 0.02 | | n/a | 0.02 | |
| Dibenz(a,h)anthracene | ug/l | n/a | <0.02 | | n/a | 0.03 | |
| Indeno(1,2,3-cd)pyrene | ug/l | n/a | <0.02 | | n/a | <0.02 | |

n/a - Cytec did not analyze the groundwater samples for these parameters.



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

***Stratum I: FILL (Existing Berm)***: This stratum was encountered at ground surface to depths ranging from 0.5 feet to 14.9 feet below ground surface within most of the berm borings. Fill was also encountered at ground surface in several impoundment borings. The stratum generally consisted of black to brown to gray, loose to very dense, Silty SAND (SM) with Gravel and red-brown, Clayey GRAVEL (GC) to stiff to very stiff, yellow to light gray, Clayey SILT (ML) and red-brown, Sandy Lean CLAY (CL), with varying amounts of debris (bricks, rail ties, and similar debris). The SPT N-values ranged from 5 to 200 blows per foot (bpf), averaging 43 bpf.

***Stratum II: FILL (Sludge)***: This stratum was encountered in some berm borings, all impoundment borings and one wetland boring. It was found at ground surface or just below berm fill soils to depths ranging from 2.3 feet to 19.8 feet. Soils within this layer can be generally classified as gray to dark gray, very loose to dense, Elastic SILT (MH) with varying amounts of peat and sand. The SPT-N values varied from 0 to 38 bpf, averaging 9 blows bpf, indicating a wide range of density for this layer. The sludge had liquid limits ranging from 59 to 62 percent, averaging 61 percent and plasticity indices ranging from 1 to 10 percent, averaging 5 percent. The moisture content ranged from 73.6 to 269.9 percent, averaging 122 percent.

***Stratum III: Peat***: This stratum was encountered in almost all borings below Stratum I and/or II to depths ranging from 8.7 feet to 29.9 feet below ground surface. In wetland borings, it was encountered at ground surface. Soils within this layer can be generally classified as gray, very loose to very dense, Elastic SILT (MH) with varying amounts of Sand and brown, very loose, Silty SAND (SM) to gray to dark gray, very soft to very stiff, Organic Fat CLAY (CH-OH); very soft to stiff, Organic Lean CLAY (CL) with varying amounts of Sand, and very soft to soft, Sandy Silty CLAY (CL-ML), with varying amounts of plant fiber. The SPT-N values varied from 0 to over 35 bpf, averaging 3 bpf. The higher blow counts were generally found near interfaces with harder soils. The soil was highly plastic with liquid limits ranging from 25.0 to 467.0 percent, averaging 141 percent and plasticity indices ranging from 15 to 256 percent, averaging 69 percent. The moisture content ranged from 26.1 to 375.7 percent, averaging 101 percent.

***Stratum IV: Soft Organic Clay/Silt***: This stratum was encountered in almost all borings, generally below Stratum III and above Stratum V or VI. Soils within this layer can be generally classified as very loose to very dense, Elastic SILT (MH) with varying amounts of Sand to gray to dark gray, very soft to very stiff, Organic Fat CLAY (CH-OH); very soft to stiff and Organic Lean CLAY (CL) with varying amounts of Sand. The SPT-N values varied from 0 to over 7 bpf, averaging 5 bpf.

***Stratum V: Stiff Clay/Silt***: This stratum was encountered in some borings, generally below Stratum III or IV. Soils within this layer can be generally classified as tan to white, very loose to very dense, Poorly-Graded GRAVEL with Silt and Sand, Silty GRAVEL with Sand. The SPT-N values varied from 4 to over 60 bpf, averaging 24 bpf.

***Stratum VI: Alluvial Soil***: This stratum was encountered in almost all borings, generally below Stratum III or IV. Soils within this layer can be generally classified as grey to brown, loose to very dense, Silty GRAVEL (SM) with Sand; Poorly-Graded GRAVEL (GP) with Sand; Clayey SAND (SC); Silty SAND (SM); and Sandy SILT (ML). The SPT-N values varied from 0 to over 200 bpf, averaging 55 bpf.

***Stratum VII: Residual Soil***: This stratum was generally below Stratum V or VI to the boring termination depth. Soils within this layer can be generally classified as red-brown, medium dense to very dense, Clayey SAND (SC) and Clayey SILT (ML) to very stiff to hard, Sandy Lean CLAY (CL); commonly with Shale fragments. The SPT-N values varied from 10 to over 200 bpf, averaging 59 bpf.

## 3.2 Previous Site Investigations

### 3.2.1 Surface Fill and Alum-YPS Sludge Sampling

The RIR describes the results from three previous surface fill and alum-YPS sludge sampling events performed on the site by NJDEP in 1991, New Jersey Turnpike Authority in 2005 and EastStar in 2011. The 2011 EastStar study was the most extensive of the prior site investigations; confirming and expanding on the findings of the 1991 NJDEP and 2005 Turnpike Authority investigations, both of which are fully described in the RIR.

In the 2011 EastStar investigation, 20 test pits were excavated around the site in berms and on the accessible areas of the impoundments. The investigation was specifically designed to locate and characterize the undocumented fill that had been placed on the site over the years. The test pits showed that the undocumented fill material was ubiquitous on the surface of the site, over the entire site.

The analytical results from the 2011 investigation showed that the undocumented surface fill was contaminated with metals, PAHs, cyanide and petroleum hydrocarbons. The PAH contamination was wide-spread throughout the entire site including the berms, roads and the cover material on the impoundments at concentrations exceeding non-residential remediation standards. The contamination could not be isolated to a single area on the site. Fourteen of the 20 samples contained one or more PAH compounds in excess of the non-residential remediation standards. These contaminated samples were scattered over the entire 85 acre investigation area.

Two samples from the 2011 investigation contained benzo(a)pyrene (BaP) at 49,700 ug/kg and 59,300 ug/kg. Note that these two samples were more than 900 feet apart and were not collected from the same area of the site. In addition, neither sample was collected from the area near the old railroad tie stockpile. The highest measured BaP concentration is 300 times the remediation standard.

The highest measured concentrations from these investigations are summarized in Table 3.4. All of the results are summarized in Appendix C. The PAH contamination results are shown on Figure 3.1.

### 3.2.2 Impoundment Sampling

In February 2012, as an initial gauge of current site conditions, EastStar collected three grab samples of alum-YPS sludge from three of the impoundments and four grab samples of water ponded in the impoundments. The objective for collecting these samples was to get a preliminary feel for the environmental conditions of the sludge and the water that was percolating through the sludge into the groundwater.

EastStar collected three sludge samples, one each from Impoundments 3, 4 and 5. These samples were analyzed for TAL metals, cyanide and PAHs. The results showed that concentrations of aluminum, lead, manganese, mercury and cyanide exceeded either the non-residential direct contact remediation standards or the impact to groundwater screening levels. Cyanide concentrations ranged from 547 to 1,570 mg/kg. PAHs were not detected in any of these sludge samples.

Four water samples of standing water in three of the impoundments were also collected. Two samples were collected from Impoundment 3 and one sample each was collected from Impoundments 4 and 6. These samples were analyzed for TAL metals, cyanide and PAHs. The results showed that concentrations of arsenic, copper, lead, thallium and cyanide exceeded the surface water quality criteria for SE water. Cyanide concentrations ranged from 3,980 mg/l to 43,200 mg/l. The cyanide concentrations are up to 308 times the surface water quality criteria. PAHs were not detected in any of the standing water samples.

The highest concentrations from these sample analyses are summarized in Table 3.5. A summary of all of the results is provided in Appendix C.

**Table 3.4 - Highest Measured Concentrations from the Fill Investigation**

| Parameter | | Non-Res Remed Std | Impact to GW Scr Lvl | Alum-YPS Sludge |
|---|---|---|---|---|
| **Inorganics** | | | | |
| Aluminum | mg/kg | none | 3,900 | n/a |
| Antimony | mg/kg | 450 | 6 | n/a |
| Arsenic | mg/kg | 19 | 19 | 32.5 |
| Barium | mg/kg | 59,000 | 1,300 | 339 |
| Beryllium | mg/kg | 140 | 0.5 | n/a |
| Cadmium | mg/kg | 78 | 1 | 5.91 |
| Chromium | mg/kg | none | none | 64.9 |
| Cobalt | mg/kg | 590 | 59 | n/a |
| Lead | mg/kg | 800 | 59 | 792 |
| Manganese | mg/kg | 5,900 | 42 | n/a |
| Mercury | mg/kg | 65 | 0.1 | 7.61 |
| Nickel | mg/kg | 23,000 | 31 | n/a |
| Selenium | mg/kg | 5,700 | 7 | 2.18 |
| Silver | mg/kg | 5,700 | 1 | <0.534 |
| Zinc | mg/kg | 110,000 | 600 | n/a |
| | | | | |
| Cyanide | mg/kg | 23,000 | 13 | 5 |
| **Polynuclear Aromatic Hydrocarbons** | | | | |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | 60,200 |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | 51,600 |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | 52,300 |
| Benzo(a)pyrene | ug/kg | 200 | 200 | 59,300 |
| Chrysene | ug/kg | 230,000 | 52,000 | 57,000 |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | 13,500 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | 23,200 |
| **Petroleum Hydrocarbons** | | | | |
| Diesel Range Organics | mg/kg | none | none | 1,360 |

n/a - Sample not analyzed for that parameter

Graphic Scale for Plan View

400 200 0 400

1 inch = 400 feet

## NOTES

Test pit and monitoring well locations were measured on-site 3/30-31/11 using a hand held GPS.

Samples locations from NJDEP Remedial Investigation are estimated from a sketch provided by NJDEP.

Sample locations from the NJ Turnpike Authority investigation are estimated based upon a drawing prepared by PMK Group, 3/13/06.

Results from NJDEP and NJTA sampling that were below the laboratory reporting limit are shown at one-half of the laboratory reporting limit.

Analytical parameters that exceed Non-residential Remediation Standards are shown in red with bold and itallic font.

| TP-02 (ug/kg) | |
|---|---|
| BaA | 608 |
| BaP | ***608*** |
| BbF | 700 |
| BkF | 448 |
| Chr | 711 |
| DahA | <269 |
| Ideno | 287 |

| TP-03 (ug/kg) | |
|---|---|
| BaA | 303 |
| BaP | ***277*** |
| BbF | 350 |
| BkF | 323 |
| Chr | 343 |
| DahA | <154 |
| Ideno | <131 |

| S-9 (ug/kg) | |
|---|---|
| BaA | 315 |
| BaP | ***315*** |
| BbF | 315 |
| BkF | 315 |
| Chr | 315 |
| DahA | ***315*** |
| Ideno | 315 |

| S-8 (ug/kg) | |
|---|---|
| BaA | 325 |
| BaP | ***325*** |
| BbF | 325 |
| BkF | 325 |
| Chr | 325 |
| DahA | ***325*** |
| Ideno | 325 |

| S-7 (ug/kg) | |
|---|---|
| BaA | 310 |
| BaP | ***310*** |
| BbF | 310 |
| BkF | 310 |
| Chr | 310 |
| DahA | ***310*** |
| Ideno | 310 |

| S-10 (ug/kg) | |
|---|---|
| BaA | 360 |
| BaP | ***360*** |
| BbF | 360 |
| BkF | 360 |
| Chr | 360 |
| DahA | ***360*** |
| Ideno | 360 |

| TP-02A (ug/kg) | |
|---|---|
| BaA | 411 |
| BaP | ***447*** |
| BbF | 496 |
| BkF | 391 |
| Chr | 460 |
| DahA | 71.8 |
| Ideno | 220 |

| S-11 (ug/kg) | |
|---|---|
| BaA | 335 |
| BaP | ***335*** |
| BbF | 335 |
| BkF | 335 |
| Chr | 335 |
| DahA | ***335*** |
| Ideno | 335 |

| S-6 (ug/kg) | |
|---|---|
| BaA | 365 |
| BaP | ***365*** |
| BbF | 365 |
| BkF | 365 |
| Chr | 365 |
| DahA | ***365*** |
| Ideno | 365 |

| TP-13 (ug/kg) | |
|---|---|
| BaA | ***54,200*** |
| BaP | ***49,700*** |
| BbF | ***46,700*** |
| BkF | ***46,200*** |
| Chr | 52,600 |
| DahA | ***11,800*** |
| Ideno | ***20,600*** |

| TP-19 (ug/kg) | |
|---|---|
| BaA | 979 |
| BaP | ***916*** |
| BbF | 696 |
| BkF | 813 |
| Chr | 1,090 |
| DahA | <105 |
| Ideno | 287 |

| TP-05 (ug/kg) | |
|---|---|
| BaA | ***2,090*** |
| BaP | ***2,060*** |
| BbF | 1,600 |
| BkF | 2,070 |
| Chr | 2,150 |
| DahA | <266 |
| Ideno | 773 |

| E-3 (ug/kg) | |
|---|---|
| BaA | 1,960 |
| BaP | ***1,700*** |
| BbF | 950 |
| BkF | 2,260 |
| Chr | 1,820 |
| DahA | ***300*** |
| Ideno | 605 |

| TP-12A (ug/kg) | |
|---|---|
| BaA | ***6,880*** |
| BaP | ***3,610*** |
| BbF | ***7,040*** |
| BkF | 6,580 |
| Chr | 6,860 |
| DahA | ***1,420*** |
| Ideno | ***2,760*** |

| HA-22 (ug/kg) | |
|---|---|
| BaA | 635 |
| BaP | ***615*** |
| BbF | 952 |
| BkF | 548 |
| Chr | 702 |
| DahA | <225 |
| Ideno | 279 |

| TP-09 (ug/kg) | |
|---|---|
| BaA | 674 |
| BaP | ***468*** |
| BbF | 514 |
| BkF | 503 |
| Chr | 800 |
| DahA | <267 |
| Ideno | <226 |

| TP-15 (ug/kg) | |
|---|---|
| BaA | 332 |
| BaP | ***332*** |
| BbF | 464 |
| BkF | 278 |
| Chr | 425 |
| DahA | <114 |
| Ideno | 122 |

| E-2 (ug/kg) | |
|---|---|
| BaA | 34 |
| BaP | ***300*** |
| BbF | 300 |
| BkF | 300 |
| Chr | 56 |
| DahA | ***300*** |
| Ideno | 300 |

| S-5 (ug/kg) | |
|---|---|
| BaA | 19 |
| BaP | ***335*** |
| BbF | 335 |
| BkF | 335 |
| Chr | 335 |
| DahA | ***335*** |
| Ideno | 335 |

| S-2 (ug/kg) | |
|---|---|
| BaA | 10 |
| BaP | ***285*** |
| BbF | 285 |
| BkF | 285 |
| Chr | 11 |
| DahA | ***285*** |
| Ideno | 285 |

| *TP-16 (ug/kg)* | |
|---|---|
| BaA | ***60,200*** |
| BaP | ***59,300*** |
| BbF | ***51,600*** |
| BkF | ***52,300*** |
| Chr | 57,000 |
| DahA | ***13,500*** |
| Ideno | ***23,200*** |

| E-1 (ug/kg) | |
|---|---|
| BaA | 225 |
| BaP | ***253*** |
| BbF | 199 |
| BkF | 249 |
| Chr | 246 |
| DahA | ***300*** |
| Ideno | 83 |

| TP-17 (ug/kg) | |
|---|---|
| BaA | ***2,220*** |
| BaP | ***1,970*** |
| BbF | 1,740 |
| BkF | 1,740 |
| Chr | 2,120 |
| DahA | ***533*** |
| Ideno | 930 |

| TP-08 (ug/kg) | |
|---|---|
| BaA | ***9,840*** |
| BaP | ***8,560*** |
| BbF | ***10,000*** |
| BkF | 2,070 |
| Chr | 10,200 |
| DahA | ***1,640*** |
| Ideno | ***3,520*** |

| S-1 (ug/kg) | |
|---|---|
| BaA | ***2,100*** |
| BaP | ***1,800*** |
| BbF | 1,200 |
| BkF | 1,400 |
| Chr | 2,600 |
| DahA | 160 |
| Ideno | 295 |

| S-3 (ug/kg) | |
|---|---|
| BaA | 13 |
| BaP | ***300*** |
| BbF | 300 |
| BkF | 300 |
| Chr | 15 |
| DahA | ***300*** |
| Ideno | 300 |

| TP-11 (ug/kg) | |
|---|---|
| BaA | ***2,510*** |
| BaP | ***2,530*** |
| BbF | ***2,480*** |
| BkF | 2,490 |
| Chr | 2,660 |
| DahA | ***402*** |
| Ideno | 1,070 |

| PAH Analysis Legend | |
|---|---|
| BaA | Benzo(a) Anthracene |
| BaP | Benzo(a) Pyrene |
| BbF | Benzo(b) Fluoranthene |
| BkF | Benzo(k) Fluoranthene |
| Chr | Chrysene |
| DahA | Dibenz(a,h) Anthracene |
| Ideno | Ideno(1,2,3-cd) Pyrene |

### LEGEND

- TP-01 Test Pit Location
- CRT-4 Existing Monitoring Well Cluster
- Road with Fill over RR Ties
- Road with Fill
- Mixed Fill over RR Ties
- Mixed Fill
- RR Ties
- Construction Fill
- NJTA E-1 - NJ Turnpike Authority Samples, Nov. 2005
- NJDEP S-1 - NJDEP Remedial Investigation Samples, Oct. 1991


Rahway Arch

**RAHWAY ARCH PROPERTIES, LLC**

7 Nottingham Drive

Florham Park, New Jersey 07932


**REMEDIAL INVESTIGATION**
**OF THE**
**RAHWAY ARCH SITE**

BLOCK 602, LOT 1
BLOCK 603, LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

Engineer


Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200

EastStar Environmental Group, Inc.
Consulting and Field Services

10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com


**Figure 3.1**
**Fill Investigation**
**Results for PAHs**

| File Name: RIR Figures 2-2 and 3-1.dwg | Scale: 1 Inch = 400 feet |
|---|---|
| Date: November 14, 2012 | Project Number: 1027 |
| Drawn by: MAY | |
| Checked by: APF | |

Sheet 1 of 1 Sheets

**Table 3.5 - Highest Measured Concentrations from the February 2012 Preliminary Samples**

| Parameter | Non-Res Remed Std (mg/kg) | Impact to GW Scr Lvl (mg/kg) | Alum-YPS Sludge (mg/kg) | Water Quality Criteria (ug/l) | Water in Impoundment (ug/l) |
|---|---|---|---|---|---|
| **Inorganics** | | | | | |
| Aluminum | none | 3,900 | 42,400 | none | 0.770 |
| Antimony | 450 | 6 | <1.45 | 640 | <5.30 |
| Arsenic | 19 | 19 | 9.92 | 0.061 | 6.70 |
| Barium | 59,000 | 1,300 | 214 | none | 50.0 |
| Beryllium | 140 | 0.5 | 0.234 | 42 | <0.120 |
| Cadmium | 78 | 1 | 0.422 | 8.8 | <0.280 |
| Chromium | none | none | 36.4 | 750 | 8.60 |
| Cobalt | 590 | 59 | 8.23 | none | 7.60 |
| Lead | 800 | 59 | 91.9 | 24 | 31.0 |
| Manganese | 5,900 | 42 | 332 | 100 | 92.7 |
| Mercury | 65 | 0.1 | 0.229 | 0.051 | 0.0500 |
| Nickel | 23,000 | 31 | 20.3 | 22 | 1.40 |
| Selenium | 5,700 | 7 | 2.46 | 71 | 29.9 |
| Silver | 5,700 | 1 | <1.34 | 1.9 | <0.780 |
| Zinc | 110,000 | 600 | 42.7 | 81 | 11.4 |
| | | | | | |
| Cyanide | 23,000 | 13 | 1,570 | 140 | 43,200 |
| **Polynuclear Aromatic Hydrocarbons** | | | | | |
| Benzo(a)anthracene | 2 | 0.5 | <0.268 | 0.18 | <0.750 |
| Benzo(b)fluoranthene | 2 | 2 | <0.222 | 0.18 | <0.970 |
| Benzo(k)fluoranthene | 23 | 16 | <0.285 | 1.8 | <0.680 |
| Benzo(a)pyrene | 0.2 | 0.2 | <0.264 | 0.018 | <0.630 |
| Chrysene | 230 | 52 | <0.242 | 18 | <0.620 |
| Dibenz(a,h)anthracene | 0.2 | 0.5 | <0.199 | 0.018 | <0.520 |
| Indeno(1,2,3-cd)pyrene | 2 | 5 | <0.257 | 0.18 | <0.570 |

# 4. PREVIOUS REMEDIAL ACTIVITIES

## 4.1 Current Status

From 1979 through 2002, Cytec performed remedial actions on the site in response to two administrative consent orders. These activities included vegetation of the impoundments, a five-year monitoring program for ground water and surface water and a Declaration of Environmental Restriction (DER). An No Further Action and Covenant Not to Sue (NFA&CNS) letter was issued for the site in 2002 following completion of these remedial actions.

In 2011, as a result of the prevalent current site conditions, coupled with the results of the 2011 EastStar fill investigation, Rahway Arch Properties determined that the remedial actions were no longer protective of human health and the environment. After presentation of the findings to NJDEP, Rahway Arch Properties rescinded the April 2011 biennial certification report on November 23, 2011. On December 5, 2011, as required by SRRA, Rahway Arch Properties opted into the LSRP program. Remediation, starting with the preliminary assessment and the remedial investigation, has been proceeding since that time following SRP requirements.

## 4.2 Cytec Activities

### 4.2.1 Vegetation Activities

During the 1970s numerous complaints were made regarding blowing dust from drying alum-YPS sludge in the impoundments. Anecdotal history of these complaints includes reduction in visibility on the nearby N.J. Turnpike from the blowing dust. In April 1978, the New Jersey Superior Court issued an Amended ACO that, among other items, required American Cyanamid to initiate a program to establish suitable vegetation within the impoundments. The vegetation was required to prevent sludge erosion in the then abandoned impoundments and to minimize wind erosion of the dried surface sediment.

In 1979 American Cyanamid began a study of methods for vegetating and stabilizing the sludge. Since the sludge was deficient of several essential nutrients, composted sewage sludge from Camden and Philadelphia was utilized as a base for vegetative growth. This composted sewage sludge was spread over all of the impoundments.

No data is available regarding the environmental characteristics or possible contamination of the composted sewage sludge and it does not appear that the sludge was ever tested for contaminants. This sludge appears to be the first of the undocumented fill that was brought to the site.

American Cyanamid began vegetating the impoundments in 1986. Sewage sludge was placed over all six impoundments, essentially covering the 85 acres with undocumented fill. By 1989 vegetation efforts were complete on all impoundments.

The vegetation efforts had limited long term success. At the present time the vegetation exists only on portions of Impoundments 1, 3, 4 and 5. Standing water exists on significant portions of Impoundments 1 and 6 and smaller areas of the other impoundments. Exposed alum-YPS sludge is apparent on the surface of all of the impoundments.

### 4.2.2 1995 Remedial Action Plan and Addendum

During the early 1990s, the site was investigated under the direction of the NJDEP-SRP. In 1994, Cytec proposed a remedial action plan consisting of an operation and maintenance program and a Declaration of Environmental Restriction (DER). In response to comments from SRP, Cytec issued a remedial action plan addendum on February 6, 1995 that added a five year groundwater and surface water monitoring program. The groundwater monitoring plan included the installation of three additional monitoring well pairs, including two well pairs near the Rahway River and a more definitive upgradient well pair. NJDEP approved the 1995 Cytec remedial action workplan and addendum based upon data supplied by Cytec and the inclusion of certain engineering and institutional controls, including the Declaration of Environmental Restrictions, described below.

The approved remedial action plan included the following engineering controls to be implemented at the site:

- Maintain the impoundments through quarterly inspections and performing general maintenance and repairs, as needed.
- Place signs along the Rahway River and Arthur Kill to deter trespassers
- Maintain locked gates at the two existing access points
- Fertilize and re-seed, as needed, to maintain vegetative cover
- Clear brush from the monitoring wells to allow access
- Place stone on access roads
- Repair tidal damage to the rip-rap containment system on the outsides of the berms

The monitoring plan conducted at the site consisted of sampling groundwater and surface water semi-annually for the first three years and annually for the last two years. The samples were analyzed for volatile organic compounds (VOCs) and selected inorganic constituents (aluminum, arsenic, total and free cyanide, iron, manganese, silver, and thallium). Trend analysis was performed on the data using Mann-Kendall with the intent to establish a negative trend in the analyte concentrations.

NJDEP asked that additional groundwater and surface water sampling be performed following completion of the initial five year period, based upon the analytical results. Cytec objected to the requirements and this work was never performed. The groundwater sampling program was terminated in 2001, but no additional samples were collected after 1999. The surface water sampling program was terminated in 2002. Limited additional surface water sampling for manganese was performed between 1999 and 2002.

At the present time, the signs do not appear to ever have been installed on the site and the vegetative cover is not well maintained. No tidal damage repairs are apparent. Rahway Arch Properties maintains the gates locked and maintains access to the monitoring wells.

4.2.3 Declaration of Environmental Restrictions

On April 24, 1995, Cytec recorded a Declaration of Environmental Restrictions (DER) for the site in the Middlesex County Land records. The DER is recorded in Liber 4236, Folio 348, and is analogous to a Deed Notice, as currently described in the Tech Rule.

The DER covers the entire site (originally 21 parcels; now three parcels) and establishes that non-residential soil remediation standards would be the basis for site remediation. The DER established institutional controls for the site, references the approved remedial action plan and amendment and requires that any engineering controls implemented as part of the site remediation of the site be maintained.

The institutional controls established by the DER consist of:

- Restricted use of the site
- In the event of any emergency disturbance of the site, DEP must be notified immediately, the area and time of disturbance is limited to the minimums necessary to respond to the emergency, all measured necessary to limit exposures to human health and the environment must be implemented, the affected areas must be restored and a report must be provided to NJDEP.
- No alterations, improvements or disturbances of the site are allowed without prior written approval by NJDEP
- Signage along the Rahway River and Arthur Kill to prevent trespassing, as described in the approved remedial action plan and amendment

The DER is enforceable on the property owner, any lessees and NJDEP. The DER conveys with the property and is enforceable upon all future owners or operators of the property.

4.2.4 No Further Action – Covenant Not to Sue

On September 24, 2002, NJDEP issued a Restricted Use No Further Action and Covenant Not to Sue (NFA&CNS) letter for the project site. This letter was issued at the request of Cytec, following completion of the groundwater monitoring program and acceptance of the results by NJDEP.

The NFA&CNS requires the property owner, and all subsequent property owners, to:

- Maintain the engineering and institutional controls to ensure they remain protective of human health and the environment
- Monitor the engineering and institutional controls for compliance and effectiveness and provide a written certification to DEP every two years that the engineering and institutional controls are being properly maintained and continue to be protective of public health, safety and the environment.

The NFA&CNS may be revoked by NJDEP if the engineering and institutional controls are not maintained and monitored.

Currently, the site is not in compliance with these conditions. The signage does not appear to ever have been installed along the river. The sewage sludge and vegetative cover has eroded off of the alum-YPS sludge in many locations. Additional materials that contribute to the site contamination were brought to the site by Cytec, including:

- Contaminated undocumented fill materials
- Solid waste consisting of used railroad ties and bulkhead timbers
- Wood waste from the former Class B recycling facility

Following completion of EastStar's Remedial Investigation of the site, SRP determined that the NFA was no longer protective of the site. On March 15, 2013, the Department issued as Notice of Intent to Rescind the NFA and CNS to Cytec. On April 15, 2013, Cytec responded to the notice. No further action has been taken regarding the rescission of the NFA since that response.

## 5. AREAS OF CONCERN

The Preliminary Assessment identified 14 Areas of Concern (AOCs) related to the condition of the site. These areas of concern were investigated as part of the Remedial Investigation. The results of the RI determined that one of the AOCs was not contaminated and did not require any further remedial action. The remaining 13 AOCs were determined to be either contaminated or potentially contaminated. Remedial action or further investigation during the remediation of this site was recommended for these AOCs. The remedial actions described in this RAW will fully address all of these 13 contaminated AOCs.

The aerial extents of the following AOCs comprise the entire 85 acres of contaminated impoundments and berms and correspond with the limits of remediation:

AOC 1 – Sludge Chemical Constituents

AOC 4 – Impacts to Surface Water

AOC 5 – Fill Used to Construct Access

AOC 10 – Undocumented Fill

AOC 11 – Contaminated Water in Impoundments

AOC 12 – Groundwater Contamination

AOC 13 – Public Safety from Exposed Sludge

The engineered fill cap, placed to the limits of remediation in accordance with the following sections of this RAW, will remediate all seven of these AOCs. Because of its design, the cap will have the further effect of stabilizing the existing berms (AOC 3) eliminating the risk of berm failure releasing contaminated alum-YPS sludge and undocumented fill materials into the river.

Two remaining contaminated AOCs relate to the solid waste from the railroad ties and dock materials (AOC 8) and the former wood waste recycling facility (AOC 14). Both of these AOCs will also be remediated during the site remediation.

Additional investigation of the surrounding wetlands for impact due to the alum-YPS sludge and the undocumented fill is necessary. These impacts are addressed as AOCs 2, 7 and 9. No impacts were identified in the RI or previous investigations. Additional investigation of these areas, including sampling and analysis in accordance with Section 4.8(b) and 4.8(c) of the Tech Rule and the Ecological Evaluation Technical Guidance document will be performed during the remedial action to ensure there has been no impact. Sampling will be performed in both the wetland areas and the adjacent surface water features. A RAO will not be issued for the entire site until this investigation has been completed, and any impacts identified in this additional investigation have been addressed.

The AOCs, findings of the RI and recommendations for remedial action are provided in Table 5.1.

**Table 5.1 - Rahway Arch Property Areas of Concern and Findings of the Remedial Investigation**

| AOC | Title | Description | Findings | Recommendations |
|---|---|---|---|---|
| 1 | Sludge Chemical Constituents | The alum-YPS sludge may contain other chemical constituents. The Warner Plant produced a number of chemical products and had a number of waste streams. These additional constituents may be mixed with the sludge. Undocumented fill has been placed on top of and mixed with the sludge as part of the vegetation efforts. Additionally, demolition debris from buildings at the Warner Plant were used in the berms. The fill and debris were never tested and are considered undocumented fill. | Inorganc and PAH compounds were detected in the alum-YPS sludge and fill in excess of NRDCRC and IGWSC concentrations. | Place engineered fill cap over impoundments and berms. |
| 2 | Residue Sludge Extent | The sludge is mostly contained within the soil berms. However, a review of historical boring logs in the vicinity of the berms identified a layer of sludge beneath the berms in some locations. In addition, historical reports indicate that in some areas, sludge likely extends beyond the present location of the berms resulting from several incidents of embankment failure. | No impact was identifed outside the impoundments and berms. | Additional investigation, including sampling and analysis, will be performed during the remedial action in both the wetland areas and the adjacent surface water features. |
| 3 | Residue Sludge and Containment Berm Stability | The structural properties of the sludge are very poor. The sludge within the impoundments had negligible shear strength and is not capable of supporting any significant weight, including lightly loaded construction equipment. The sludge is sensitive and thixotropic. The structural stability of the berms is questionable. Previous reports have documented past instances of failures. | The sludge and berms will support the weight of the cap. However, a specific construction sequence, a drainage mat and time between placement of cap lifts to allow excess pore water pressure to dissipate will be necessary. | Place engineered fill cap over impoundments and berms. |

**Table 5.1 - Rahway Arch Property Areas of Concern and Findings of the Remedial Investigation**

| AOC | Title | Description | Findings | Recommendations |
|---|---|---|---|---|
| 4 | Impacts to Surface Water Quality | The portion of the Rahway River that abuts the site is classified as SE3 (saline estuarine).Surface water quality data collected in the 1990s indicates that cyanide and manganese were detected at concentrations that exceed the applicable most stringent surface water quality standard (SWQS). Cyanide is a site-specific contaminant associated with the sludge and could be mobilized by storm water runoff and/or by discharge of shallow groundwater. The relatively high levels of manganese in the surface water were believed to be associated with the high levels of manganese characteristic of the regional groundwater. However, the sludge was not analyzed for manganese to determine if this was a site-specific contaminant. A six inch transite pipe used to discharge sludge onto the site from the former American Cyanamid plant runs across the Rahway River. This pipe, if it was not removed or properly abandoned, may act as preferential pathway for migration of potential contaminants into the Rahway River. Also, NJDEP reported the existence of Outfall No. 7, the NJPDES permitted outfall for discharging supernatant from the impoundments.<br>Discolored surface runoff was observed from the impoundments in 2012. Samples collected of water in the impoundments detected elevated concentrations of cyanide and metals, in excess of surface water quality criteria. | Elevated concentrations of inorganics and PAHs, including cyanide and manganese, were detected in the fill and alum-YPS sludge. These contaminants could leach through the berms and impact surface water. Pieces of transite pipes were observed in Impoundment 5. | Place engineered fill cap over impoundments and berms. Additional sampling and analysis will be performed during the remedial action in the adjacent surface water features. |
| 5 | Fill Used to Construct Access Roads | Fill generated during the demolition of structures at the Warner Plant in Linden was used to construct and maintain the access roads around the embankments. This fill may be potentially impacted by historical operations associated with these structures. Other undocumented fill, including composed sewage sludge, C&D debris and excess soil excavated from re-development sites has been used on the berms and access roads over the years. | Surface fill materials on the berms and the impoundments contained inorganics and PAHs in excess of NRDCRS and IGWSL concentrations. | Place engineered fill cap over impoundments and berms. |
| 6 | Indoor Vapor Intrusion | Groundwater samples from monitoring wells MW-1S and MW-1D contain volatile organic compounds (VOCs), which exceed the applicable NJDEP Generic Vapor Intrusion Screening Levels for groundwater. These impacts were suspected to be associated with operations of Industrial Reclamation Service, an operator on the neighboring property or the Carteret landfill. The extent of the elevated levels of VOCs is not currently known. | VOCs were not detected above indoor air screening levels in the groundwater. | No further action required. |

**Table 5.1 - Rahway Arch Property Areas of Concern and Findings of the Remedial Investigation**

| AOC | Title | Description | Findings | Recommendations |
|---|---|---|---|---|
| 7 | Ecological Evaluation | The discharge of impacted groundwater into the surface water bodies in the vicinity of the site is possibly impacting the local ecology. The literature review did not identify any ecological studies of the site, with the exception of delineation of the extent of wetlands. | Fill and sludge were not detected in the wetland areas. Completed pathways for ecological impact were not identified. | Additional investigation, including sampling and analysis, will be performed during the remedial action in both the wetland areas and the adjacent surface water features. |
| 8 | Solid Waste | A significant pile of railroad ties is located on Impoundment 5. Railroad ties were used to stabilize the access roads. This pile appears to be extra ties delivered to the site but not used.Several piles of chipped wood waste along with scattered wood chips are located on Impoundment 2. These materials appear to be remnants of the wood waste recycling operation that was located on Impoundment 2 in 2005 through 2008. | These materials remain on site. | Remove or use during site remediation. |
| 9 | Natural Resources Damages | A Natural Resource Damages assessment was not performed as a part of this PA or any previous investigations. | No natural resource damages were identified. | Additional sampling and analysis will be performed during the remedial action in the adjacent wetland and surface water features to verify that there have not been any damages. |
| 10 | Undocumented Fill | EastStar performed a fill investigation performed in 2011 and determined that, in addition to the alum-YPS sludge, undocumented fill materials have been placed over most of the site. Sampling and analysis of these fill materials determined that they are contaminated with PAHs, metals and petroleum hydrocarbons. PAH concentrations range up to 300 times the non-residential direct contact remediation criteria. | Inorganc and PAH compounds were detected in the alum-YPS sludge and fill in excess of NRDCRC and IGWSC concentrations. | Place engineered fill cap over impoundments and berms. |

**Table 5.1 - Rahway Arch Property Areas of Concern and Findings of the Remedial Investigation**

| AOC | Title | Description | Findings | Recommendations |
|---|---|---|---|---|
| 11 | Contaminated Water in Impoundments | The impoundments act like bathtubs, trapping precipitation. This precipitation is forced to percolate through the contaminated fill and alum-YPS sludge into the groundwater. Alternatively during periods of heavy rainfall, this water will seep through the sides of the berms or will overtop the berms, threatening the berm stability.Limited sampling performed in 2012 has shown that the water has dissolved contaminants from the impoundment contents. Elevated concentrations of cyanide and metals were measured in four samples collected from three of the impoundments in March 2012. The only discharge paths for this contaminated water are into groundwater or surface water. EastStar estimates that 25,000,000 gallons per year of water will percolate through the sludge and enter the groundwater. In 1986, American Cyanamid's consultant Hydrosystems estimated this quantity could be up to 46,000,000 gallons per year and that the resulting discharge of cyanide could be 100 pounds per day. Hydrosystems calculated that this discharge exceeded the U.S. EPA reporting limit for cyanide discharge under the National Contingency Plan. | Limited amounts of water observed during RI in July-August 2012, but the condition remains unchanged. | Place engineered fill cap over impoundments and berms. |
| 12 | Groundwater Contamination | Groundwater samples were last collected on the site in 1999. However, the contaminants in the sludge have remained exposed to infiltration since that time. As a result, the condition of the groundwater under the site is unknown at this time. The existing 16 groundwater monitoring wells installed by American Cyanamid and Cytec remain on the site. Although unused for a long time, in 2011 the wells were open and appeared to be usable. | Wells were re-developed and sampled. Metals contamination exceeds groundwater standards. | Place engineered fill cap over impoundments and berms. |
| 13 | Public Safety from Exposed Sludge | The sludge in the impoundments has no shear strength and will not support weight. This poses a direct safety hazard to any persons or animals that wander out onto the impoundments. The remedial action plan and the DER discuss engineering controls to limit access by locking to two gates and posting no trespassing signage along the Rahway River and Arthur Kill. While the gates are locked, no signage was observed. | This condition is unchanged. | Place engineered fill cap over impoundments and berms. This will eliminate need for signage. |
| 14 | Former Wood Waste Recycling Facility | A Class B recycling facility for recycling wood waste was operated on Impoundment 2 for several years. This facility had numerous permit violations, including several NOVs that remain outstanding at this time. As discussed in AOC 8, remnants of the operation are visible on the site at this time. | This condition is unchanged. | Remove or use during site remediation. |

# 6. PLANNED REMEDIAL ACTION

## 6.1 Overview of Remedial Action

The RI confirmed that the alum-YPS sludge in the impoundments and the undocumented fill material in the impoundments and on the berms contain metals, cyanide and PAHs above non-residential soil direct contact remediation criteria and soil impact to groundwater screening levels. These contaminants are ubiquitous throughout the 85 acres covered by the sludge impoundments and the berms. The groundwater on the site, sampled through the sixteen existing groundwater monitoring wells, is also contaminated with metals and cyanide.

Additionally, the site in its current condition is unusable and poses a safety risk to the public. Geotechnical data showed that the alum-YPS sludge in the impoundments and the underlying peat and clay layers have minimal strength. These layers, in their present state, cannot support a load that would allow the site to be usable. This unstable and unusable condition exists for all six sludge impoundments and also covers the 85 acre remediation areas (excluding the limited areas covered by the berms). However, the geotechnical report did identify a construction process for capping the site with a specifically designed engineered fill that would stabilize the site and berms and would allow future development over a portion of the site.

Based upon these results, a plan was developed for remediation of the site as required under the SRP regulations and guidelines. The remediation will:

- Eliminate direct contact hazard with contaminated surface fill materials and alum-YPS sludge
- Prevent precipitation from coming in contact with the contaminated materials and discharging to groundwater or surface water
- Promote runoff and evapotranspiration of precipitation rather than infiltration
- Ensure the long term integrity of the berms
- Eliminate site safety hazards posed by soft soils and sludge and ponded water in the impoundments
- Allow safe passive uses, including habitat, and possible future development on a portion of the site by the property owners, making at least a portion of the site usable.

This remedial action will consist of a combination of engineering and administrative controls. An engineered fill cap will achieve the goals of the site remediation. Administrative controls will ensure that the cap remains protective and address contaminant concentrations in the groundwater.

## 6.2 Engineered Fill Cap

### 6.2.1 Engineered Fill Cap Design Guidelines

To achieve the remediation goals, the engineered fill cap must address and meet the following design criteria:

- The remediated site must be raised above high tide levels of the Rahway River and the newly promulgated Advisory Base Flood Elevations (ABFE). The ABFE elevation over most of the site is 15 feet above MSL. Low lying portions of the impoundments are routinely flooded by the Rahway River.

- The existing bathtub-like impoundments that trap precipitation, resulting in infiltration through the contaminated materials, must be filled and graded to no longer retain water.

- Permeability of the cap must be less than the underlying alum-YPS sludge. The design permeability for the reduced permeability cap is $2x10^{-6}$ cm/s.

- The site must be graded to cause stormwater to runoff and not infiltrate into the contaminated soil and sludge. At the present time an estimated 25,500,000 gallons of water per year percolate through the contaminated materials into the groundwater. The cap has been designed to eliminate at least 95% of this infiltration.

- Stormwater must be directed to the berms where it can be discharged to surface water. Recharge of the stormwater through the contaminated materials cannot be permitted.

- The stormwater runoff must be managed and discharged through an engineered stormwater management system to prevent erosion damage and uncontrolled flow over the berms into the river.

- The cap must stabilize the existing berms that were installed in the 1930s. These berms were built directly over the meadow mat and do not have center cores to prevent infiltration of water from the impoundments through the berms. Engineered fill material with structural properties is required to stabilize these berms.

- The cap must provide a stable surface to eliminate the existing, unsafe, very soft conditions with the alum-YPS sludge.

- The cap must provide a barrier layer to prevent direct contact and windblown dust exposure hazards that currently exist on the site.

No other feasible and practical remediation option, other than capping the site with a reduced permeability material, exists that would accomplish these goals. As part of the permit application process to the Division of Land Use Regulation and Permitting (LURP) for the permits to perform this remedial action, EastStar performed a detailed alternatives analysis. This was done using the guidelines contained in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP – 40 CFR 300.430) which involve analyzing the remedial alternatives for a site relative to effectiveness, implementation and cost. Alternatives that meet these requirements are further evaluated based on nine criteria mandated by CERCLA and SARA, consisting of:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness

6. Implementability
7. Cost
8. State acceptance
9. Community acceptance.

The results of this analysis confirmed the conclusion that the remediation, as described by this RAW, is the only technically feasible option that can accomplish the remediation goals and is therefore the only remediation option for this site.

Use of an engineered fill cap over the limit of remediation shown in Figure 6.1 provides further justification for the reduced sampling performed in the RI. The limit of contamination has been delineated by the impoundments and berms and corresponds with the limit of remediation. Since all of the area will be remediated via an engineered fill cap, there is no need for additional samples within the impoundments and berms.

The cap must cover the entire 85 acre limit of remediation shown in Figure 6.1 in order to accomplish all of the remediation goals. Even if limited areas of the site did not exceed direct contact remediation criteria, leaving an area uncapped would not remediate the impacts to ground and surface water, the unstable berms, the existing unstable sludge surface and the windblown dust exposure hazards.

Additionally, the alum-YPS sludge and the undocumented fill are ubiquitous throughout the 85 acre contaminated area. These materials are known to be contaminated above the remediation criteria. This contamination can be expected to exist throughout the entire remediation area.

Leaving an area of the site uncapped would prevent the LSRP from issuing an entire site RAO upon completion of the remedial action.

Kernan Consulting Engineers (Kernan) of Thorofare, New Jersey was retained to develop these design guidelines into a detailed design for permitting and construction. Included in the design plan set are grading plans, cross-sections, stormwater management and design details. EastStar provided a list of design assumptions, the limits of remediation and a typical cross-section to Kernan for use in the design. The design assumptions are given in Table 6.1. The limit of remediation is shown in Figure 6.1 and the typical cross-section is shown in Figure 6.2.

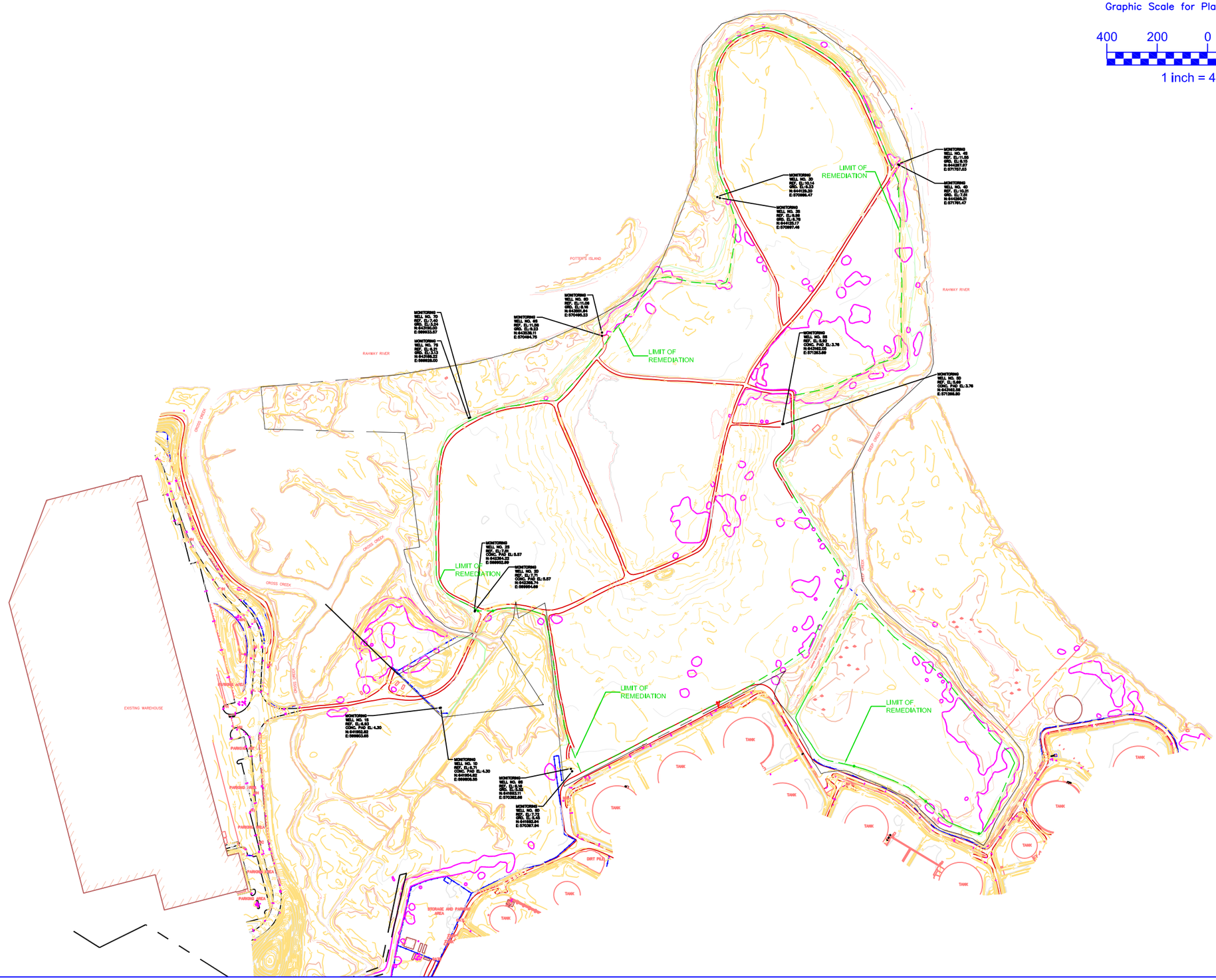
### 6.2.2 Stormwater Management Requirements

The existing impoundments have a bathtub effect on the site specific hydrology. Precipitation is collected in the impoundments and is trapped there until it percolates through the contaminated fill and alum-YPS sludge to the groundwater. As far back as during the 1980s, Impound 6 was described in the historic remediation documents as having a water cover. Likewise, significant portions of Impounds 1, 3, 4 and 5 are also consistently and historically flooded.

In addition to drawing contaminants down into the groundwater, the trapped precipitation causes the soft and unstable conditions that currently exist on the site. As described in the AOCs, these soft conditions create a safety hazard to persons and wildlife on the site and make the entire site unusable.

**Table 6.1 – Engineered Fill Cap Design Assumptions**

| | |
|---|---|
| ***General Assumptions*** | All work done from top of berms inward towards the impoundments. No engineered fill material is to be placed on the outside slopes of the berms. |
| | No engineered fill will be placed in any wetland areas. |
| | Structural integrity of the berms is questionable and, other than their weight, they should not be relied upon to provide support to the cap. |
| ***Stormwater Management Assumptions*** | Because the receiving stream is tidal, quantity control is not required by the regulations. However, some degree of collection, quantity control and management will be necessary to prevent erosion of the cap and on the side slopes of the berms. |
| | Capped site will be vegetated; therefore there will be no increase in impervious surface comparing existing to proposed conditions. |
| ***Engineered Fill Assumptions*** | All engineered fill material is 4" minus. |
| | Some oversized and crushed material will be available for bridging extremely soft/wet areas. |
| | Target placement parameters:<br>❑ Loose Lift Thickness: 8-12 inches<br>❑ Compaction: 90-95% modified proctor<br>❑ Moisture Content: 0-2% above optimum<br>❑ Permeability: $2x10^{-6}$ cm/s or less |
| | Engineered fill placed directly on the sludge cannot be compacted to the target levels. Two to three lifts must be placed and compacted to the extent possible before proper compaction can be achieved. |
| ***Cap Design Assumptions*** | Maximum side slopes = 8H to 1V (to be evaluated in the Geotechnical Report) |
| | Top slopes = between 1% and 4% with a target of 2.5% |
| | Engineered fill will be placed on existing ground surface unless the Geotechnical Evaluation indicates that keying into the sludge is necessary. Any excavated sludge/existing soil would be spread within the impoundments and then capped |




Rahway Arch
**RAHWAY ARCH PROPERTIES, LLC**
7 Nottingham Drive
Florham Park, New Jersey 07932

# REMEDIAL ACTION WORKPLAN RAHWAY ARCH SITE

BLOCK 602 LOT 1
BLOCK 603 LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

## General Notes and Legend

1. BASE MAP, PROPERTY LINES AND TOPOGRAPHY INFORMATION OBTAINED FROM KERNAN ENGINEERING, INC. PLAN ENTITLED "EXISTING CONDITIONS PLAN", DATED 9/11/12.

Engineer

Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200

EastStar Environmental Group, Inc.
Consulting and Field Services
10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com

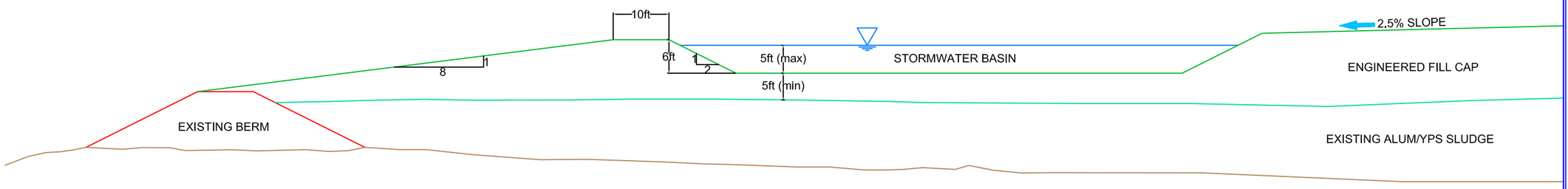
## FIGURE 6.1
## LIMIT OF REMEDIATION

| | |
|---|---|
| File Name: Site Blocks and Lots.dwg | Scale: 1 Inch = 400 feet |
| Date: Septemeber 12, 2012 | Project Number: 1027 |
| Drawn by: MAY | |
| Checked by: APF | |

Graphic Scale for Plan View

20 10 0 20

1 inch = 20 feet





RAHWAY ARCH PROPERTIES, LLC
7 Nottingham Drive
Florham Park, New Jersey 07932


# REMEDIAL ACTION WORKPLAN RAHWAY ARCH SITE

BLOCK 602 LOT 1
BLOCK 603 LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

General Notes and Legend

1. See Rahway Arch Site Remedial Action Workplan Cap Design Parameters for details regarding the cap design and construction requirements.
2. Side Slopes subject to change based upon results of the Geotechnical Investigation.
3. Stormwater Basin sizes to be determined.


Engineer

Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200
NJ LSRP Number 575600

EastStar Environmental Group, Inc.
Consulting and Field Services
10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com


## FIGURE 6.2
## TYPICAL CAP DESIGN
## CROSS-SECTION

| | |
|---|---|
| File Name: Rahway Remediation Concept.dwg | Scale: 1 Inch = 20 feet |
| Date: September 12, 2012 | Project Number: 1027 |
| Drawn by: MAY | |
| Checked by: APF | |

Stormwater management is a critical feature in the remedial design of this site. The extensive ponding of stormwater and infiltration must be eliminated as part of any attempt at site remediation. **Without proper stormwater management, any attempt to cap the site will simply result in a continuation of the existing conditions and will not result in an effective site remediation**.

The stormwater management system for the remediated site must meet these requirements:

- Ensure that all precipitation will runoff the site, eliminating the current bathtubs and any potential for ponding
- Handle all of the stormwater runoff, assuming the reduced permeability cap will result in a RCN of 97 or higher.
- Collect and manage the stormwater to prevent erosion of the cap
- Line any stormwater basins with reduced permeability cap material to ensure that percolation does not occur from the basins.
- Discharge stormwater outside the limits of remediation and do not recharge any of the stormwater within the limits of remediation

As a result of these criteria and the large size of the remediation area (85 acres), the cap will need to consist of more than the minimal cap typically used to prevent direct contact exposure. The elevations of the bottoms of the stormwater management basins will be the controlling elevations for the reminder of the cap design. The basins will also need to be large enough to contain the runoff-volumes. Refer to the Kernan stormwater management basin design report for the stormwater runoff calculations and the details of the basin design.

Five feet of fill will be required under the bottoms of the basins, consisting of three feet of fair drainage material, described in the geotechnical recommendations, and two feet of reduced permeability engineered fill cap. Without this thickness of material, the soft soils and sludge will prevent proper compaction of the engineered fill resulting in a cap that does not meet the permeability specification.

### 6.2.3 Geotechnical Recommendations

In the geotechnical engineering report Baker provided recommendations regarding the design and construction of the engineered fill cap. Key to its concern was addressing settlement of the soft soils on the site and ensuring proper compaction and stabilization of the cap.

Both the settlement and the stability analysis indicate that the proposed grading plan can be safely achieved as long as construction is performed in stages with waiting periods between stages. It is anticipated that the completion of the capping project will take approximately 5 years; therefore this should not be an issue. Based on the current available data, 90% consolidation of the cohesive soil underneath the sludge will take two to three years after the placement of fill. For a sludge layer 13 feet thick, the estimated time required to reach 90% of consolidation is approximately 48 days.

Planned construction sequencing will typically allow 4 to 6 months between loadings. Settlement, consolidation and pore water pressure will be monitored throughout the cap construction process to confirm compliance with the geotechnical requirements

The following construction sequence is recommended:

1. Prepare the subgrade.

   Cut the limited number of trees within the remediation area flush with ground surface.

   Do not remove or disturb root mat or meadow mat.

   Leave small vegetative cover, such as grass and reeds, in place. The vegetation will help to carry the construction equipment load during the site preparation and placing the first several feet of the fill.

2. Place 3 feet of "fair drainage material" on top of the impoundments. The "fair drainage material" is defined as soil materials with permeability greater than $5.0 \times 10^{-5}$ cm/s. The following procedure should be followed for placing the fair drainage material:

   - End-dump the initial fill materials into the impoundment from the adjacent access road. The first lift of the fill should consist of fair drainage material.

     - Use appropriate trucks and equipment compatible with constructability design.
     - End-dump on the previously placed fill
     - To avoid a local bearing failure, limit the height of dumped piles, e.g., to less than 4 ft above the adjacent sludge or 5 feet above the previous fill, to avoid a local bearing failure. Spread piles immediately to avoid local depressions.
     - Use appropriate lightweight dozers and/or front-end loaders to spread the fill.

   Traffic on the first lift should be limited. Localized observations of tire rutting and spot area depressions will guide efforts to employ the appropriate size and weight construction vehicles.

   The first lift should be compacted only by tracking in place with low-ground-pressure bulldozers, end-loaders or similar equipment.

   Once the fair drainage material is at least 2 ft above the original ground, subsequent lifts can be compacted with a smooth drum vibratory roller or other suitable compactor. If localized liquefied conditions occur, the vibrator should be turned off and the weight of the drum alone should be used for compaction.

   Generally, the above procedure applies to Impoundments 1, 4, 5 and 6. Minor adjustment of the thickness of the first lift and the construction sequence might be required during the construction.

3. After the fair drainage material is placed, the geotechnical instrumentation needs to be installed, consisting of: Settlement Plates, Vibrating Wire Piezometers and Slope

Inclinometers. While the detailed requirements for this instrumentation may be modified by the geotechnical engineer during the construction, a brief summary is:

- The settlement plates should be placed at the top of the first lift. The objective of the settlement plate installation is to control the construction sequence.
- For the piezometers located near the river, filters shall be installed in both organic cohesive soil as well as the sludge. At other locations, the filters of the piezometers only need to be installed within the sludge. The objective for the piezometers is to monitor the dissipation of the excess pore pressures generated during the construction. The shear strength of the soil will increase after the dissipation.
- The slope inclinometers should be installed along the edge of the proposed fill to ensure that slope stability is maintained.
- Additional geotechnical in-situ tests such as CPTu and field vane shear testing may be required during the construction

See the following section of this RAW for more details on the geotechnical instrumentation placement.

4. This is the end of Stage One construction. The starting time for the next construction stage will be based on the instrumentation monitoring results. Generally, the criterion for the next construction stage is when the soft material reaches a minimum 90% of the primary consolidation. The estimated waiting period is approximately 38 days.

5. At areas near the river (Impoundments 4 and 6), the fill placement might be controlled by the time required to dissipate the pore pressure of the existing cohesive soils underneath the sludge. Longer waiting period times might be required as determined by the geotechnical monitoring. More frequent instrumentation monitoring will be required to ensure the rate of fill placement is slow enough to allow the dissipation of excess pore pressure.

6. Place the fill for each consecutive construction stage. The thickness of each construction layer should not exceed 5 ft. The fill material needs to be roller compacted.

7. To facilitate the dissipation of the pore water pressure in the in-situ cohesive soil underneath the sludge, the site shall be filled through a pre-determined sequence with relatively equal loading factors.

Due to the relatively high shear strength of the existing surface materials in Impounds 2 and 3, fill materials may be stockpiled 10 feet above adjacent ground. If higher stockpiles are required, the stockpiles should be placed in a staged manner, thereby allowing the underlying soils to consolidate. Once the stockpile has reached the desired height, further staged placement should not be required. The consolidation of the underlying materials should also be monitored with field shear strength testing prior to increasing the stockpile height. In all other areas, piles should be no more than 6 feet high for any prolonged period of time.

### 6.2.4 Geotechnical Monitoring Plan

After the fair drainage material has been placed, the geotechnical instrumentation will be installed and the geotechnical monitoring plan will be implemented. The schedule for placement of any subsequent cap material will be governed by the results of the geotechnical monitoring.

The geotechnical instrumentation will consist of settlement plates, vibrating wire piezometers and inclinometers. Baker has recommended that the instrumentation be placed at the locations provided in Table 6.2 for the settlement plates, Table 6.3 for the vibrating wire piezometers and Table 6.4 for the slope inclinometers.

### 6.2.5 Cap Design

Kernan prepared a detailed cap design that meets the previously outlined remediation objectives, conceptual design and geotechnical requirements. The LSRP has reviewed and approved this design as meeting the requirements for site remediation while minimizing the volume of fill required to construct the cap.

Key features of the cap design include:

- Covering all contaminated AOCs, encompassing the 85 acres of berms and impoundments, with reduced permeability engineered fill to the limits of remediation.
- Maintaining at least 2 feet of reduced permeability engineered fill in all areas of the site including at the bottoms of the stormwater management basins.
- Constructing side slopes at 8 horizontal to 1 vertical (8H:1V) to maintain a factor of safety against slope failure of at least 1.3.
- Constructing the remainder of the cap at 2.5% slope to ensure proper drainage and prevent stormwater infiltration.
- Managing 100% of the stormwater on the site as runoff and conveying this runoff off of the remediation area to prevent percolation into the underlying contaminated materials. The stormwater management system consists of a series of collection swales along the perimeter of the cap, four dry ponds and drainage flumes.

Kernan has developed a 21 sheet set of design drawings that includes the existing conditions, the proposed class B facility, grading plans and profiles, sediment and erosion control plans and construction details and notes. The list of sheets that will be included in the plan set is shown in Figure 6.3. The grading plans from this cap design at 1" = 100' scale are provided in Appendix D to this RAW.

### 6.2.6 Used Railroad Ties

The large pile of railroad ties and wood from demolition of a bulkhead that is located on Impound 5 will be addressed during the site remediation. Some of the ties may be useful during the site remediation and cap construction activities. Cytec has had success using the ties to

**Table 6.2 - Settlement Plate Locations Recommended by Michael Baker, Inc.**

| Settlement Plate Number | Northing (ft) | Easting (ft) |
|---|---|---|
| SP-1 | 570,685.39 | 642,105.83 |
| SP-2 | 570,681.69 | 642,532.11 |
| SP-3 | 570,133.86 | 642,776.74 |
| SP-4 | 570,145.24 | 643,236.96 |
| SP-5 | 570,706.47 | 643,159.61 |
| SP-6 | 571,229.91 | 643,780.89 |
| SP-7 | 571,714.86 | 644,186.74 |
| SP-8 | 571,335.68 | 644,248.12 |
| SP-9 | 571,619.51 | 643,685.98 |
| SP-10 | 571,112.82 | 643,345.78 |
| SP-11 | 571,243.06 | 642,566.99 |
| SP-12 | 571,953.06 | 642,164.95 |
| SP-13 | 571,830.79 | 614,874.42 |

**Table 6.3 - Vibrating Wire Piezometer Locations Recommended by Michael Baker, Inc.**

| Piezometer Number | Northing (ft) | Easting (ft) | Probe Elevation (ft) |
|---|---|---|---|
| VW-1 | 570,688.20 | 642,075.59 | -12, -20 |
| VW-2 | 570,676.04 | 642,502.77 | -12, -20 |
| VW-3 | 570,150.81 | 642,730.35 | -12, -20 |
| VW-4 | 570,084.62 | 643,228.39 | -12, -20 |
| VW-5 | 570,734.91 | 643,146.35 | -12, -20 |
| VW-6 | 571,241.27 | 643,752.38 | -12, -20 |
| VW-7 | 571,689.62 | 644,223.79 | -12, -20 |
| VW-8 | 571,314.74 | 644,279.51 | -12, -20 |
| VW-9 | 571,595.21 | 643,651.00 | -12, -20 |
| VW-10 | 571,127.50 | 643,319.90 | -12, -20 |
| VW-11 | 571,245.56 | 642,603.63 | -12, -20 |
| VW-12 | 571,930.74 | 642,187.58 | -12, -20 |
| VW-13 | 571,850.29 | 641,850.75 | -12, -20 |

**Table 6.4 – Slope Inclinometer Locations Recommended by Michael Baker, Inc.**

| Inclinometer Number | Northing (ft) | Easting (ft) | Bottom Elevation of Probe (ft) |
|---|---|---|---|
| IN-1 | 570,305.94 | 642,055.82 | -35 |
| IN-2 | 569,795.94 | 642,770.90 | -35 |
| IN-3 | 570,114.93 | 643,235.70 | -35 |
| IN-4 | 570,657.78 | 643,607.96 | -35 |
| IN-5 | 571,018.34 | 644,186.03 | -35 |
| IN-6 | 571,336.17 | 644,790.87 | -35 |
| IN-7 | 571,726.89 | 644,241.95 | -35 |
| IN-8 | 571,721.79 | 643,483.05 | -35 |
| IN-9 | 571,419.25 | 642,671.14 | -35 |
| IN-10 | 571,974.44 | 642,141.70 | -35 |

bridge soft areas in the alum-YPS sludge and the underlying materials. If appropriate and approved by the geotechnical engineer, some of these stockpiled ties may be used for this purpose. Any remaining ties not used as part of the site remediation and construction will be removed from the site for appropriate disposal.

## 6.3 Groundwater Remediation

### 6.3.1 Groundwater Characteristics

The general site hydrostratigraphy is described in detail in reports by Blasland, Bouck and Lee (BBL) and Hydrosystems, Incorporated in their prior investigations for Cytec that are detailed in the RIR. Groundwater is contained within two distinct aquifers:

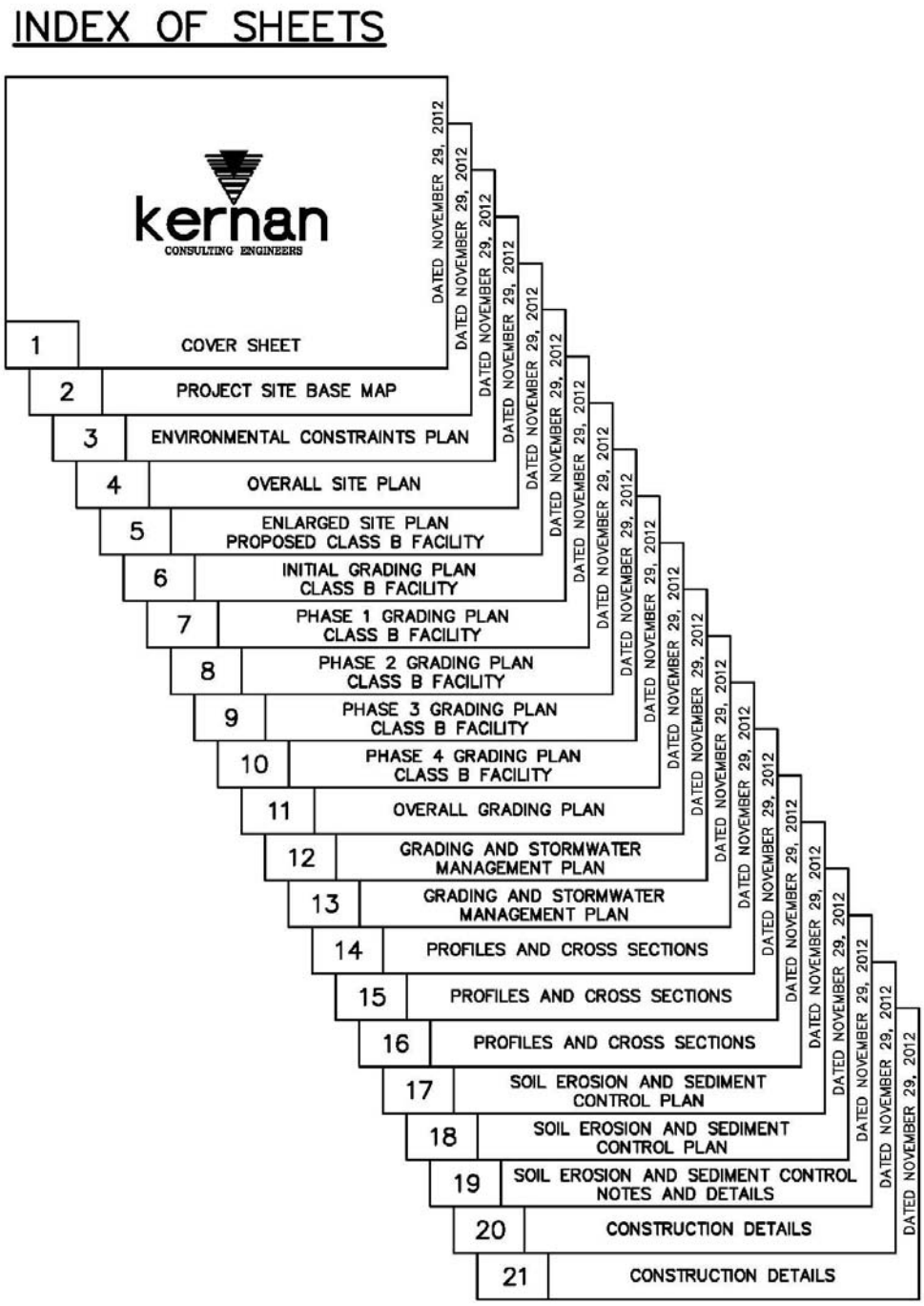
- An unconfined shallow aquifer of permeable fill materials and tidal marsh deposits
- The confined Brunswick Formation shallow bedrock aquifer

A continuous layer of red-brown clay separates these two aquifers and acts as a confining layer for the underlying Brunswick Formation. This clay layer restricts the vertical flow of water between the shallow and bedrock aquifers.

The shallow groundwater aquifer is brackish and tidally influenced. As a result, the groundwater was classified as IIIB. As part of the remedial action from 1995-1999, Cytec developed a limited list of alternative Class IIIB groundwater quality criteria for the specific contaminants of concern.

Not all of the contaminants detected above Class IIB groundwater criteria in the RI were included in the alternative Class IIIB criteria developed by Cytec. As part of this remedial action, EastStar will re-evaluate the Cytec criteria and will develop a full list of alternate groundwater criteria. In accordance with the Tech Rule, these alternate criteria will be reviewed with NJDEP.

**Figure 6.3 – List of Sheets for the Design Drawings**



### 6.3.2 Groundwater Flow

Groundwater in the surface aquifer flows outward from the impoundments and discharges into surrounding surface water. This water is also tidally influenced so the groundwater flow direction and gradient will vary with the tides. A groundwater flow map, based upon the depth to groundwater data collected during the RI in August 2012, is shown in Figure 6.4.

In 1987 Hydrosystems reported that groundwater mounded beneath the impoundments and flowed radially outward. This assumption is reasonable give that the impoundments contain standing water that is infiltrating into the surface aquifer. However, since the existing monitoring wells are outside the impoundments, this could not be verified during the RI.

Groundwater flow in the Brunswick formation from the site is towards the north or northeast where it also discharges to the surrounding surface water, the Rahway River and the Arthur Kill.

### 6.3.3 Monitoring Sampling and Analysis

The 16 groundwater monitoring wells on the site will be sampled and analyzed semi-annually during the remedial action. These wells are located outside the impoundment berms and are outside the limits of remediation. The locations of the monitoring wells are shown in Figure 6.5.

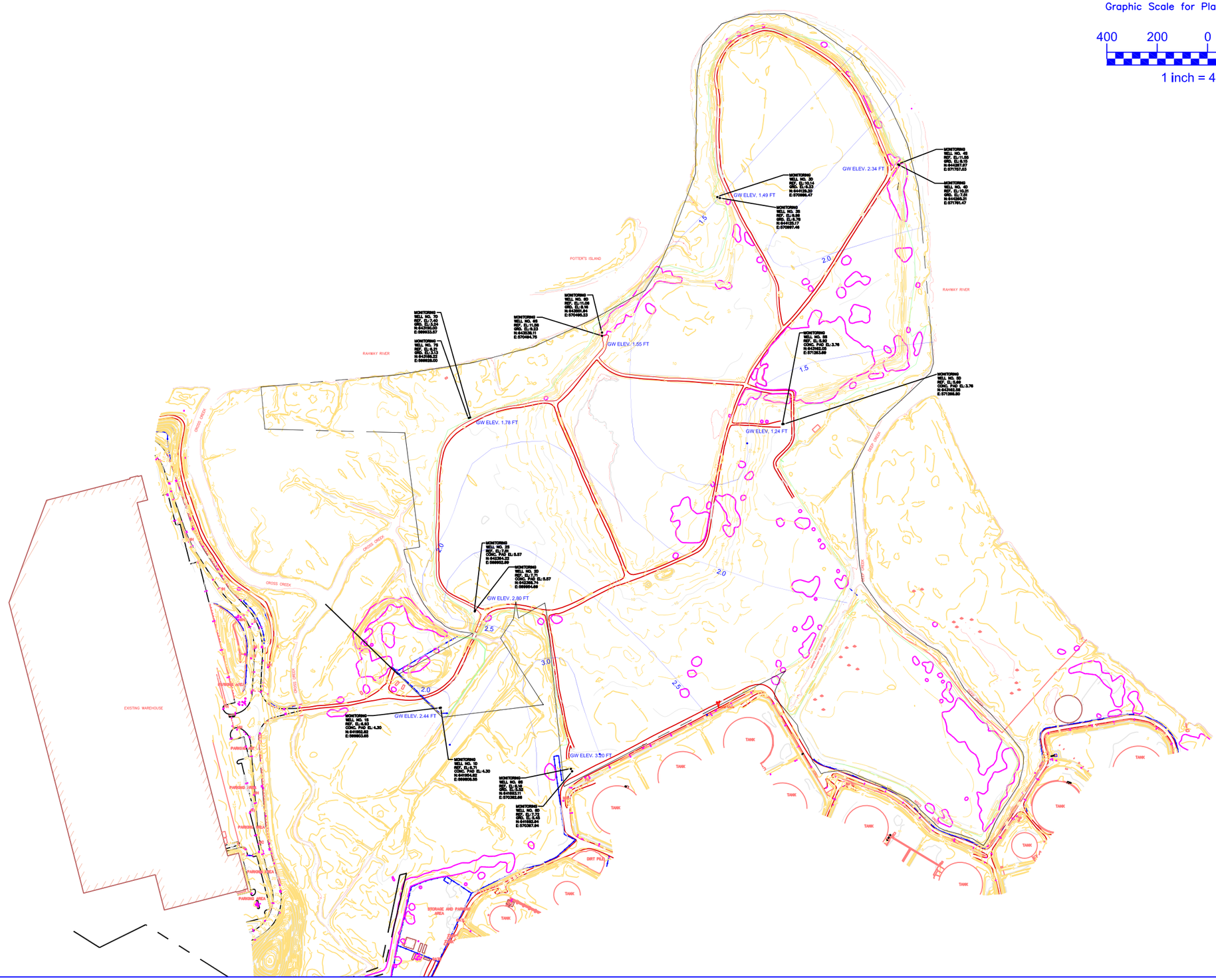
The analytical results from the groundwater samples will be compared to the approved site specific Class IIIB groundwater criteria. Based upon the results, EastStar will determine if a classification exception area (CEA) is necessary for the groundwater. Based upon the results from the RI, a CEA is likely not necessary. However, this determination will be made based upon the longer term results. This evaluation will be performed in accordance with the NJDEP *Groundwater Technical Guidance*.

### 6.3.4 Additional Groundwater Monitoring

Placement of the engineered fill cap will result in consolidation of the saturated alum-YPS sludge and underlying peat and clay layers. Calculations of the consolidation rates and the extent of consolidation were made by Baker as part of the geotechnical evaluation. As described above, monitoring the consolidation and dissipation of the pore water pressure are critical to ensuring the stability of the cap during construction.

At the present time, an estimated 25.5 million gallons per year of water percolate through the contaminated materials on the site and discharge into the surrounding surface water features and the shallow aquifer. This percolation will be eliminated by the engineered fill cap.

During construction of the cap, pore water will be released from the alum-YPS sludge as the material consolidates. EastStar has calculated that 70,000 gallons of excess pore water will be discharged during the first year of remediation. This volume will decrease as the remediation progresses and the consolidation rate slows. While the volume of excess pore water is significantly less than the volume of water currently percolating through the contaminated materials on the site.




**Rahway Arch**

**RAHWAY ARCH PROPERTIES, LLC**
7 Nottingham Drive
Florham Park, New Jersey 07932

# REMEDIAL ACTION WORKPLAN RAHWAY ARCH SITE

BLOCK 602 LOT 1
BLOCK 603 LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

## General Notes and Legend

1. BASE MAP, PROPERTY LINES AND TOPOGRAPHY INFORMATION OBTAINED FROM KERNAN ENGINEERING, INC. PLAN ENTITLED "EXISTING CONDITIONS PLAN", DATED 9/11/12.
2. GROUNDWATER ELEVATION DATA COLLECTED AUGUST 19-20, 2012

Engineer

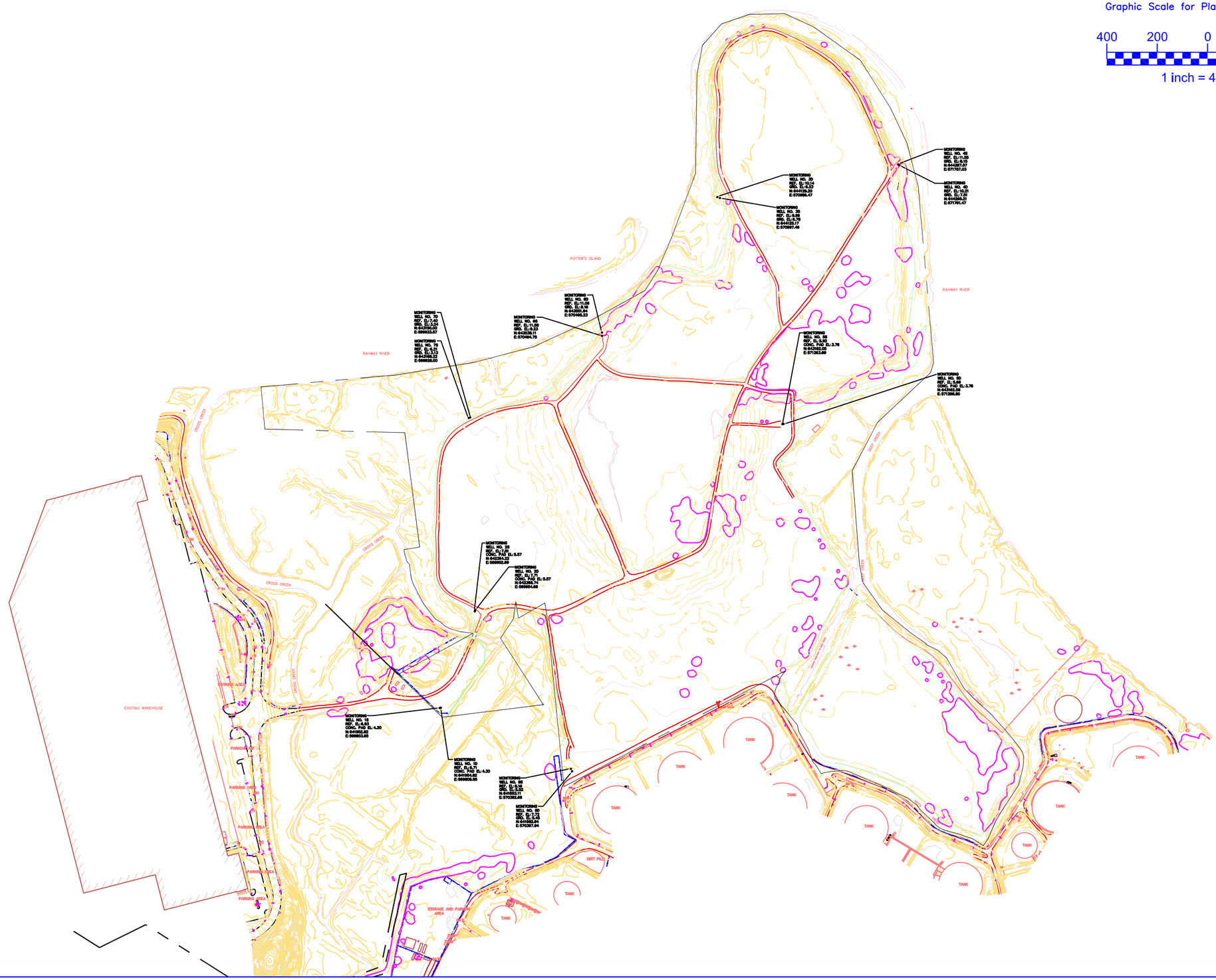
Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200

EastStar Environmental Group, Inc.
Consulting and Field Services
10632 Little Patuxent Parkway, Suite 106
Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com

## FIGURE 6.4 GROUNDWATER GRADIENT DATA

| | |
|---|---|
| File Name: Site Blocks and Lots.dwg | Scale: 1 Inch = 400 feet |
| Date: September 12, 2012 | Project Number: I027 |
| Drawn by: MAY | |
| Checked by: APF | |

Sheet 1 of 1 Sheets




Graphic Scale for Plan View

400 200 0 400

1 inch = 400 feet

Rahway Arch

**RAHWAY ARCH PROPERTIES, LLC**

7 Nottingham Drive
Florham Park, New Jersey 07932

# REMEDIAL ACTION WORKPLAN RAHWAY ARCH SITE

BLOCK 602 LOT 1
BLOCK 603 LOTS 1 & 8
BLOCK 705 LOTS 17 & 18

BOROUGH OF CARTERET
MIDDLESEX COUNTY, NJ

## General Notes and Legend

1. BASE MAP, PROPERTY LINES AND TOPOGRAPHY INFORMATION OBTAINED FROM KERNAN ENGINEERING, INC. PLAN ENTITLED "EXISTING CONDITIONS PLAN", DATED 9/11/12.


Engineer

Albert P. Free, P.E., CSP, LSRP
NJ PE Number 24GE03816200

EastStar Environmental Group, Inc.
Consulting and Field Services

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Columbia, Maryland 21044
Phone: (410) 290-8777 Fax: (410) 290-9055
www.EastStarEnv.com


## FIGURE 6.5 MONITORING WELL LOCATIONS

| | |
|---|---|
| File Name: Site Blocks and Lots.dwg | Scale: 1 Inch = 400 feet |
| Date: Septemeber 12, 2012 | Project Number: I027 |
| Drawn by: MAY | |
| Checked by: APF | |

The potential for contamination from this pore water will be addressed during the remediation. Prior to the start of the cap construction, EastStar will develop a monitoring plan to sample and analyze this water discharge and ensure that is it not creating a release of contaminants to the aquifer and the river. This plan will be implemented prior to placement of cap material near the river and will be continued until the results demonstrate that no contaminant release is occurring.

## 6.4 Ecological Impacts

SRP indicated that additional investigation of the surrounding wetlands for impact due to the alum-YPS sludge and the undocumented fill may be necessary. These impacts are addressed as AOCs 2, 7 and 9.

No impacts were identified in the RI or previous investigations. Additional investigation of these areas, including sampling and analysis in accordance with Section 4.8(b) and 4.8(c) of the Tech Rule and the Ecological Evaluation Technical Guidance document, will be performed during the remedial action to ensure there has been no impact. Sampling will be performed in both the wetland areas and the adjacent surface water features. A RAO will not be issued for the entire site until this investigation has been completed and any impacts identified in this additional investigation have been addressed.

## 6.5 Administrative Controls

### 6.5.1 Existing Declaration of Environmental Restrictions

A Declaration of Environmental Restrictions was recorded for the site by Cytec on May 4, 1995 in the Middlesex County land records. The DER is analogous to a Deed Notice, as currently described in the Tech Rule.

The DER covers all of the Cytec parcels on the project site and establishes that non-residential soil remediation standards would be the basis for site remediation. The DER established institutional controls for the site, references the approved Cytec remedial action plan and amendment and requires that any engineering controls implemented as part of the site remediation of the site be maintained.

The institutional controls established by the DER consist of:

- Restricted use of the site
- In the event of any emergency disturbance of the site, DEP must be notified immediately, the area and time of disturbance is limited to the minimums necessary to respond to the emergency, all measured necessary to limit exposures to human health and the environment must be implemented, the affected areas must be restored and a report must be provided to NJDEP.
- No alterations, improvements or disturbances of the site are allowed without prior written approval by NJDEP

- Signage along the Rahway River and Arthur Kill to prevent trespassing, as described in the approved remedial action plan and amendment

The DER is enforceable on the property owner, any lessees and NJDEP. The DER conveys with the property and is enforceable upon all future owners or operators of the property, including Rahway Arch Properties.

### 6.5.2 Proposed Deed Notice

As part of the current site remediation, the existing declaration of environmental restrictions will be rescinded and replace with a new Deed Notice. This deed notice will identify the engineering controls that will be implemented as part of this remedial action. Use of the site will be restricted to non-residential purposes. The non-residential remediation standards, identified in the declaration of environmental restrictions, will be continued.

The deed notice will be prepared in accordance with the model deed notice contained in Appendix B of ARRCS. A draft copy of the deed notice is contained in Appendix E to this RAW.

# 7. FILL USE PLAN

## 7.1 Source of Cap Material

The cap will be constructed using engineered fill material manufactured by a Class B recycling facility to be temporarily located on the Impoundment 2 area of the site. The Class B facility will be the donor site for characterization of the engineered fill material to ensure compliance with this fill use plan.

This Class B facility, the proposed Metro12 Facility, will be owned and operated by Soil Safe Incorporated (Soil Safe). Once the remediation is complete, the Class B facility will be dismantled and removed from the site.

The operation of the Class B facility is fully described in Soil Safe's Class B permit application. As an overview, the facility will accept source separated ID-27 petroleum contaminated soil.

All soil delivered to the site will be fully characterized prior to acceptance. Generator sites will be required to:

- Sample and analyzed the soil in accordance with Soil Safe's Metro12 Sampling and Analysis Plan
- Provide a signed material characterization report
- Certify that the soil is non-hazardous and does not contain any prohibited or non-conforming materials
- Provide all analytical data.

Processing will begin with the soil being blended to achieve consistent geotechnical properties. The blended soil will then be screened to remove oversize, typically rocks and incidental amounts of asphalt concrete brick and block. Pickers will remove incidental non-recyclable waste materials such as plastic and wood and recyclable metals. The screened soil will be processed in a pugmill where it will be blended with pozzlonic additives. Oversized removed in the screening process will be crushed and either returned to the raw material stockpile for re-processing or will be used on site as crushed aggregate. Recyclable metals and non-recyclable waste will be removed from the site and disposed of in accordance with the Class B permit.

The processed material will be placed in the post process stockpile and sampled. Because all soil will have been fully characterized prior to acceptance at the Metro12 facility, the reduced sampling frequency guidelines in the *Alternative and Clean Fill Guidance for SRP Sites* (Guidance) document will be used. The volume of engineered fill required for the cap will exceed 10,000 yd3. Therefore, following Table 1 of the Guidance, one sample will be collected from every 1,000 cubic yards of engineered fill material produced.

The samples will be analyzed to ensure that the soil meets the environmental criteria contained in this fill use plan. The analytical methods will be determined based upon the pre-acceptance characterization results, but at a minimum will consist of TAL metals and PAHs.

All product sample analyses will be reviewed and approved by the LSRP prior to placing the engineered fill material in the cap.

Permit approvals are currently underway for the Class B facility. Approvals have been obtained from the Borough of Carteret and Middlesex County. NJDEP permit applications have been submitted and are being reviewed. A list of all of the permits required for the site remediation, including the Class B facility is provided in the next section of this RAW.

### 7.2 Requirement for Engineered Fill

The engineered fill used for capping the Rahway Arch Site must meet a specific geotechnical specification to achieve the required remediation goals. Specifically, the capping materials must:

- Have sufficient strength that when placed and compacted, it can provide a stable surface, despite placement over the softer, low strength alum-YPS sludge
- Have sufficient strength to stabilize the perimeter berms to eliminate future berm failures
- Have low permeability to minimize percolation and generate a high percentage of run-off
- Achieve the required properties on a consistent basis over the entire 85 acres of capped area.

Simply importing fill material that is placed over the impoundments cannot meet these requirements. The Soil Safe engineered fill product is the only available material that can reliably and economically meet these requirements for the quantities required at a reasonable timeframe to remediate the site.

Experience with the engineered fill product on other capping sites in New Jersey has shown that the Soil Safe product achieve the consistent geotechnical properties necessary for this project. The product has consistently met an A-2-4 soil classification, can be readily compacted to 92-95% of modified Proctor and when properly placed and compacted achieves permeability in the order of $1x10^{-6}$ cm/s. Product manufactured with slightly plastic soil (PI>7) generally achieves a permeability of $1x10^{-7}$ cm/s.

These consistent properties are achieved by processing the soil through the Class B facility. Incoming soil from various sources is blended, achieving the consistent classification and moisture content, resulting in a consistent grain size distribution and elimination of deleterious and oversized materials allowing proper spreading and compaction. The homogeneous soil is then processed through a pugmill where it is blended with pozzlonic additives. These additives increase the strength and result in lower permeability in the compacted fill.

The engineered fill material is placed in 8-12 inch loose lifts by a bulldozer and compacted with a vibratory roller. The material is placed at a moisture content 0-2% above optimum to further aid in compaction and permeability reduction.

The engineered fill material can be handled and placed as a granular material, and it exhibits the geotechnical properties of the blended feed stock. However, after the material has been placed and compacted, the additives will hydrate and form a solid soil-cement matrix. The ultimate strength of the matrix will depend primarily on the percent of additive used, use of

sufficient water to ensure hydration, the underlying geotechnical properties of the soil and the degree of compaction.

## 7.3 Other Fill Material

In addition to the engineered fill required for the cap, other fill material will be required for the site remediation, including:

- Initial fill to raise the grade of Impound 2 above the Advisory Base Flood Elevation (ABFE) of 15 feet prior to construction of the Class B facility
- Fair drainage material used for the first three feet of capping material in Impounds 1, 4, 5 and 6 as described in the geotechnical recommendations
- Top soil to be used as the final surface material for planting native grasses

Options for the initial fill material include clean fill, alternative fill and processed dredge material (PDM). Options for the fair drainage material include engineered fill from the Class B, modified to achieve higher permeability; alternative fill and PDM. Any fill materials imported to the site for these purposes, including any alternative fill, must meet the requirements and environmental standards contained in this fill use plan and the requirements of the *Alternative and Clean Fill Guidance for SRP Sites* guidance document. The fill must be approved by the LSRP.

If PDM is planned as one of these fill materials, the LSRP will obtain an acceptable use determination (AUD) from the NJDEP Office of Dredging and Sediment Technology for the donor source.

All fill materials must meet the environmental quality criteria described in the following section of this RAW.

## 7.4 Environmental Criteria

### 7.4.1 General Guidelines

The engineered fill used to construct the cap and the additional fill materials required to grade the Class B facility and construct the layer of fair drainage material must comply with the requirements of the NJDEP *Alternative and Clean Fill Guidance for SRP Sites* guidance document.

The existing DER sets non-residential remediation standards as the applicable remediation standard for the project site. This standard will be continued with the new proposed deed notice.

In addition, the engineered fill must comply with the like-on-like requirement in the Tech Rule and Guidance. Under this requirement, any analytical parameters that do not presently exist on the site above residential remediation standards, must be at or below residential remediation standards in the engineered fill from the Class B facility and the other fill materials. Any exceedence of these standards would be considered a variance that must be justified and approved by the LSRP. The requirements for justification are outlined in the Tech Rule. The variance would be reported to SRP in the first document submittal following the variance.

Because of these requirements, the concentrations of all of the analytes in the engineered fill, with the exception of specific analytes that currently exist on site that are discussed in the following section, are anticipated to be below the residential remediation standards.

### 7.4.2 Existing Site Contaminants

The RIR and Section 3 of this RAW describe the current environmental conditions on the site. The existing surface materials, comprised of the undocumented surface fill over the roads, berms and impoundments (AOCs 5 and 10) and the alum-YPS sludge (AOC 1), contain metals, cyanide and PAHs above the residential remediation standards. These contaminants are disbursed over the entire 85 acre remediation area outlined by the Limit of Remediation shown in Figure 6.1. Following the "like-on-like" criteria in the guidance document, the engineered fill materials used in the cap could contain these contaminants at concentrations above the residential standards, based upon the existing on-site concentrations described below.

Specific analytes on site that exceed the residential standards are:

Inorganics
- Arsenic
- Lead
- Mercury
- Vanadium
- Cyanide

PAH Compounds
- Benzo(a) anthracene
- Benzo[a] pyrene
- Benzo[b] fluoranthene
- Benzo[k] fluoranthene
- Chrysene
- Dibenz[a,h] anthracene
- Indeno[1,2,3-cd ] pyrene

### 7.4.3 Existing Concentrations On-site

Accompanying the like-on-like requirement in the Tech Rule is the requirement that the concentrations in the engineered fill may not exceed the existing concentrations on the site. The default method in the Guidance for calculating the maximum concentration that would be acceptable in the engineered fill is to use the 75$^{th}$ percentile of the concentrations from the existing condition data.

The Guidance allows for alternate methods to quantify the existing on-site concentration such as calculation of the Mean or the 95% upper confidence level (95% UCL) of the mean using ProUCL software published by U.S. EPA. Use of these alternate methods is a variance that must be justified by the LSRP, but the variance does not require Department pre-approval.

The criteria in the Guidance to use the Mean or the 95% UCL calculation as the determination for the existing concentration are:

- The database must be sufficiently large
- All of the data must be from discreet samples.
- Outliers may not be excluded
- All other statistical requirements for the evaluation must be met.

As is described in detail in the variance justification section below, the analytical data from this site for these parameters meet these requirements.

The sources of the inorganic contaminants on the site are the undocumented fill and the alum-YPS sludge (AOCs 1, 5 and 10). The existing site concentrations for the inorganics were determined using all of the available surface fill samples and alum-YPS sludge samples from the previous investigations as well as the RIR.

The source of PAH contaminants on the site is the undocumented fill (AOCs 5 and 10). The alum-YPS sludge was likely not a source of PAHs, although the near surface alum-YPS sludge may be contaminated with PAHs from contact and mixing with the undocumented fill. The existing site concentrations for PAHs were determined using all of the available surface analytical data for the undocumented fill and the alum-YPS sludge from the previous investigations as well as the RIR.

The samples used to calculate the existing conditions are listed in Table 7.1.

**Table 7.1 – Samples Used to Evaluate Existing Contamination in AOCs 1, 5 and 10**

| Data Source | Inorganic Contaminants | | PAH Contaminants | |
|---|---|---|---|---|
| | Samples | Summary Table | Samples | Summary Table |
| NJDEP Site Investigation, 1991 | S-1 thru S-12 (11 samples) | Appendix C Table C-1 | S-1 thru S-12 (11 samples) | Appendix C Table C-1 |
| NJTA Tremley Point Investigation | E-1 thru E-3 (3 samples) | Appendix C Table C-2 | E-1 thru E-3 (3 samples) | Appendix C Table C-2 |
| EastStar Fill Investigation, 2011 | Samples 1 thru 22 (21 samples) | Appendix C Table C-5 | Samples 1 thru 22 (20 samples) | Appendix C Table C-4 |
| Remedial Investigation | Surface Fill Samples inside the Limit of Remediation (7 samples) | Appendix A Table A-1 (except Sample 039) | Surface Fill Samples inside the Limit of Remediation (5 samples) | Appendix A Table A-2 (except Sample 039) |
| Remedial Investigation | Alum-YPS Sludge Samples (13 samples) | Appendix A Table A-5 | Alum-YPS Sludge Samples (1 sample) | Appendix A Table A-6 |
| Total Number of Samples | 55 samples | | 40 samples | |

The two samples from the EastStar Fill Investigation with the highest PAH concentrations, samples from TP15 and TP13, have been questioned if they are outliers and are not representative of the site conditions. EastStar has re-reviewed the representativeness of these samples and the analytical data from these two samples following New Jersey, EPA and

USACE data validation guidelines and is confident that the results are correct and the samples are representative of the conditions on the site. Justification for this conclusion includes:

- The samples were collected by the LSRP who ensured that these samples, as well as all of the other samples from the Fill Investigation, were representative of the soil at the sample locations. Extraneous waste, including wood waste or obvious contaminants, was not placed in the sample containers.

- The 20 sample locations for the fill investigation were selected based upon the areas on the site known or suspected to contain undocumented fill. The results, with 14 of the 20 samples containing PAHs above non-residential standards, is consistent with previous investigation data and the fact that historic fill is generally assumed to contain PAHs above remediation standards.

- All of the samples, including the two most contaminated samples were collected properly into the correct containers for the analytical methods, were properly labeled and were properly preserved immediately after sample collection.

- The two most contaminated samples were not taken from adjoining locations. In fact, the two sample locations are more than 900 feet apart.

- The PAH concentrations are not the result of cross contamination between the two samples. The LSRP adhered to proper sampling and decontamination procedures when collecting all of the samples. Additionally, the sample from TP16 was collected at 9:35AM, while the sample from TP13 was collected at 2:51PM. Sixteen other samples were collected between these samples. No indication of cross contamination was detected in the results from any of those samples.

- These samples, along with all of the other samples from the investigation, were analyzed by a laboratory certified to perform these analyses in accordance with the requirements of the Tech Rule.

- The correct analytical methods were used for the analyses of these samples as well as all of the other samples.

- These samples, along with all of the other samples from the investigation, were analyzed within the prescribed holding times for the analytical methods

- All of the laboratory quality control requirements were met for both samples, as well as all of the other samples from the Fill Investigation.

- All 20 Fill Investigation samples were collected and delivered to the laboratory within one day. All holding times were met and strict chain of custody procedures were followed throughout sample handling and delivery. The samples were properly preserved and were received by the laboratory in the sealed cooler. Any cross contamination or outside contamination of the samples during handling would have been observed in all of the samples.

- The PAH analyses for the sample from TP16 were performed at 7:38PM on April 6, 2011. The PAH analyses for the sample from TP13 were performed at 8:38PM on April 7, 2011. Thirteen other samples were analyzed in the time between the analyses of these two samples. Any laboratory or GC/MS contamination would have been reflected in all of the PAH analyses performed between these two samples, not just these two.

### 7.4.4 Results of Existing Conditions Analysis

The analytical data from the samples listed in Table 7.1 were assembled in the ProUCL input files. The input files were assembled in accordance with NJDEP Guidance Document *Directions to Determine 95 Percent Upper Confidence Limits of the Mean Using USEPA ProUCL Version 4.0 Software Package*, June 2008. Two columns were used for each variable. For samples with a numerical result, the result was placed in the first column and a 1 was placed in the second column (D_variable column). For samples that were reported as non-detects, the laboratory reporting limit was placed in the first column and a 0 was placed in the second column.

The Mean and 95% UCL concentrations were calculated using all the samples, including the non-detects. The ProUCL software calculates the 95% UCL using various methods and then recommends a value identified as "Potential UCL to Use". These values were reviewed to ensure the results were reasonable and met the criteria contained in the guidance. The results summarized are in Table 7.2.

The ProUCL input and output files for the inorganics and PAHs are contained in Appendix F to this RAW.

**Table 7.2 Summary of ProUCL Results for Analytes that Exceed Residential Standards**

| Analyte | Residential Remediation Standard | Non-Residential Remediation Standard | Existing Conditions | |
|---|---|---|---|---|
| | | | Mean | 95% UCL |
| | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| **Inorganics** | | | | |
| Arsenic | 19 | 19 | 6.01 | 30.0 |
| Lead | 400 | 800 | 83.1 | 185 |
| Mercury | 23 | 65 | 0.403 | 3.55 |
| Vanadium | 78 | 1,100 | 26.9 | 35.1 |
| Cyanide | 1,600 | 23,000 | 638 | 1,165 |
| **PAH Compounds** | | | | |
| Benzo(a) anthracene | 0.6 | 2.0 | 3.99 | 12.6 |
| Benzo[b] fluoranthene | 0.6 | 2.0 | 3.73 | 11.0 |
| Benzo[k] fluoranthene | 6 | 23 | 3.58 | 10.8 |
| Benzo[a] pyrene | 0.2 | 0.2 | 3.38 | 12.0 |
| Chrysene | 62 | 230 | 3.93 | 12.2 |
| Dibenz[a,h] anthracene | 0.2 | 0.2 | 1.05 | 1.62 |
| Indeno[1,2,3-cd] pyrene | 0.6 | 2.0 | 1.71 | 4.92 |

The results in Table 7.2 show that the Mean and 95% UCL concentrations are below the residential remediation standards for all of the metals. The Mean and 95% UCL concentrations

exceed the residential remediation standards for six of the seven PAH compounds. The results of the statistical analyses are provided in Appendix F to this RAW.

### 7.4.5 Environmental Characterization of Engineered Fill

With the exception of the six like-on-like analytes discussed below, the concentrations of all other analytical parameters in the engineered fill material will be below the residential remediation standards.

The six analytes that are currently above the residential remediation standard for both the Mean and the 95% UCL are:

- Benzo(a) anthracene
- Benzo[b] fluoranthene
- Benzo[k] fluoranthene
- Benzo[a] pyrene
- Dibenz[a,h] anthracene
- Indeno[1,2,3-cd ] pyrene

In accordance with the Guidance, the concentrations of these analytes, may exceed the residential remediation standard, but may not exceed the existing conditions concentrations.

The LSRP, following extensive discussions with SRP, has established limits on the engineered fill for these PAH compounds. The PAH concentrations in the engineered fill will not exceed the Mean concentrations based upon the existing site conditions. As can be seen in Table 7.2, these Mean concentrations are significantly below the 95% UCL concentrations and therefore will result in concentrations in the cap that are significantly below the existing conditions, complying with the intent of the Guidance.

The concentration limits in the engineered fill for of all analytes are summarized in Table 7.3.

### 7.4.6 Petroleum Hydrocarbons

The soil imported to manufacture the engineered fill for the cap will be source separated ID-27 petroleum contaminated soil that will be treated and processed through the Class B facility. Although the incoming soil will be considered petroleum contaminated, the petroleum hydrocarbon concentration in the engineered fill product will not exceed residential remediation standards. This criteria is shown in Table 7.3.

Sampling and analysis for petroleum hydrocarbons in the engineered fill product is discussed below.

### 7.4.7 Surface Layer

The top one foot layer on the surface of the engineered fill cap will consist of topsoil that will be planted with native grasses to form the proposed habitat. The seeding and planting schedule has been approved by the Freehold Soil Conservation District as part of the Soil Erosion and Sediment Control (SESC) permit approval.

## Table 7.3 - Summary of Fill Protocol

| Analyte | Residential Remediation Standard (mg/kg) | Existing Site Data | | | | Maximum Concentration in Cap [4] (mg/kg) | Determining Factor |
|---|---|---|---|---|---|---|---|
| | | Maximum (mg/kg) | Mean (mg/kg) | Median (mg/kg) | 95% UCL (mg/kg) | | |
| **Analytes that Exceed Residential Standard Onsite in One or More Samples** | | | | | | | |
| **Inorganics** | | | | | | | |
| Arsenic | 19 | 49 | 6.0 | 4.69 | 7.79 | | Residential Standard |
| Lead | 400 | 792 | 83.1 | 44.7 | 155 | | Residential Standard |
| Mercury | 23 | 7.6 | 0.403 | 0.190 | 1.03 | | Residential Standard |
| Vanadium | 78 | 87.6 | 26.9 | 28.1 | 32.3 | | Residential Standard |
| Cyanide | 1,600 | 2,850 | 638 | 336 | 1,223 | | Residential Standard |
| **Organics** | | | | | | | |
| Benzo(a) anthracene | 0.6 | 60.2 | 3.99 | 0.633 | 12.6 | 3.99 | Existing Mean (see Note 7) |
| Benzo[a] pyrene | 0.2 | 59.3 | 3.77 | 0.630 | 12.0 | 3.77 | Existing Mean (see Note 7) |
| Benzo[b] fluoranthene | 0.6 | 51.6 | 3.58 | 0.660 | 11.0 | 3.58 | Existing Mean (see Note 7) |
| Benzo[k] fluoranthene | 6 | 52.3 | 3.38 | 0.625 | 10.8 | 3.38 | Existing Mean (see Note 7) |
| Chrysene | 62 | 57.0 | 3.93 | 0.660 | 12.2 | | Residential Standard |
| Dibenz[a,h] anthracene | 0.2 | 13.5 | 1.05 | 0.295 | 2.93 | 1.05 | Existing Mean (see Note 7) |
| Indeno[1,2,3-cd ] pyrene | 0.6 | 23.2 | 1.71 | 0.595 | 4.99 | 1.71 | Existing Mean (see Note 7) |
| **Analytes that Do Not Exceed Residential Standard Onsite** | | | | | | | |
| **Inorganics** | | | | | | | |
| Antimony | 31 | 9.90 | 2.85 | 1.81 | 3.90 | | Residential Standard |
| Barium | 16,000 | 495 | 105 | 75.6 | 128 | | Residential Standard |
| Beryllium | 16 | 1.20 | 0.561 | 0.504 | 0.652 | | Residential Standard |
| Cadmium | 78 | 5.91 | 0.486 | 0.039 | 0.977 | | Residential Standard |
| Cobalt | 1,600 | 75.3 | 8.29 | 4.90 | 11.3 | | Residential Standard |
| Copper | 3,100 | 677 | 44.1 | 14.1 | 130 | | Residential Standard |
| Manganese | 11,000 | 415 | 170 | 149 | 260 | | Residential Standard |
| Nickel | 1,600 | 118 | 15.3 | 9.16 | 19.5 | | Residential Standard |
| Selenium | 390 | 11.0 | 2.85 | 1.00 | 2.20 | | Residential Standard |
| Silver | 390 | 2.10 | 0.358 | 0.136 | none | | Residential Standard |
| Thallium | 5 | 3.45 | 1.50 | 1.21 | none | | Residential Standard |
| Zinc | 23,000 | 1,820 | 160 | 36.9 | 263 | | Residential Standard |
| inorganics without standards | | | | | | | See Note 1 |
| **All other PAHs** | | | | | | | Residential Standard |

## Table 7.3 - Summary of Fill Protocol

| Analyte | Residential Remediation Standard (mg/kg) | Existing Site Data | | | | Maximum Concentration in Cap [4] (mg/kg) | Determining Factor |
|---|---|---|---|---|---|---|---|
| | | Maximum (mg/kg) | Mean (mg/kg) | Median (mg/kg) | 95% UCL (mg/kg) | | |
| **All Other SVOC Compounds** | | | | | | Residential Standard | |
| **All Volatile Organic Compounds** | | | | | | Residential Standard | |
| **All Pesticides** | | | | | | Residential Standard | |
| **All PCBs** | | | | | | Residential Standard | |
| **Extractable Petroleum Hydrocarbons** | | | | | | | |
| Category 1 | 5,100 | | | | | Residential Standard | |
| Category 2 | calculated | | | | | Residential Standard | |

**NOTES**

1. Analytes without residential remediation standards will be addressed by the LSRP in accordance with the Tech Rule.
2. All engineered fill material will be sampled and analyzed before placement in the cap.
3. One sample will be collected from every 1,000 cubic yards of engineered fill.
4. If a sample fails to meet the criteria for any of the parameters listed above, the 1,000 cubic yards of engineered fill represented by the sample will be isolated. One of the following options will be implemented:

   a. The analytical report and the laboratory QC data will be reviewed to ensure that the result meets the criteria for accuracy, representativeness, completeness and repeatability. If the review demonstrates an error in the analysis, the engineered fill will be re-sampled and re-analyzed.

   b. The 1,000 cubic yards of engineered fill will be re-processed. The re-processed fill will then be resampled and re-analyzed to verify that it meets the criteria.

   c. The 1,000 cubic yards of engineered fill will be removed from the site for use at a site permitted to accept the soil.

   d. The LSRP may consider a variance to use the engineered fill in the cap. The variance must be justified and documented by the LSRP in accordance with the Tech Rule and ARRCS.

5. The maximum concentrations for PAHs are based upon the mean of the existing conditions on the surface of the site. The PAHs are contained in the Undocumented Fill (AOCs 5 and 10) that has been placed on the site and may have contaminated the surface of the alum-YPS sludge (AOC 1). The undocumented fill and PAH contaminated materials are ubiquitous throughout the site. The aerial extent of AOCs 1, 5 and 10 is the 85 acre limit of remediation shown in Figure 6.1 of the RAW.

The final surface material will meet residential standards for all analytes, including arsenic and PAHs. This soil will have a higher organic content to meet the topsoil specification and will be less tightly compacted to promote vegetative growth.

### 7.4.9 Engineered Fill Sampling Plan

The engineered fill material will be sampled and analyzed to ensure that it meets the environmental criteria listed in Table 7.3 before it is placed in the cap. The product, following processing in the Class B facility, will be placed in a post-process stockpile until the LSRP verifies that the fill meets the limits. Following the Guidance, the engineered fill product will be sampled at a rate of one sample per 1,000 $yd^3$ of product. The samples will be analyzed by a New Jersey certified laboratory to ensure that the soil meets the environmental criteria.

The analytical methods will initially consist of the target compound list/target analyte list (TCL/TAL plus 30), cyanide and extractable petroleum hydrocarbons. The sampling frequency and analytical methods may be re-evaluated as the project proceeds based upon the pre-acceptance characterization results of the ID-27 soil and analysis of the ongoing results.

Petroleum hydrocarbons will be evaluated by Extractable Petroleum Hydrocarbons (EPH). Sampling and analysis for EPH will follow the requirements outlined in Table 2.1 of the Tech Rule. Evaluation of the residential remediation criteria, needed to determine the allowable concentration in the engineered fill will be evaluated in accordance with the Protocol for Addressing Extractable Petroleum Hydrocarbons. For Category 2 hydrocarbons, the residential standard will be calculated using the EPH Calculator.

If a sample fails to meet the criteria for any of the parameters listed above, the 1,000 cubic yards of engineered fill represented by the sample will be isolated. One of the following options will be implemented:

- The analytical report and the laboratory QC data will be reviewed to ensure that the result meets the criteria for accuracy, representativeness, completeness and repeatability. If the review demonstrates an error in the analysis, the engineered fill will be re-sampled and re-analyzed.
- The 1,000 cubic yards of engineered fill will be re-processed. The re-processed fill will then be resampled and re-analyzed to verify that it meets the criteria
- The 1,000 cubic yards of engineered fill will be removed from the site for use at a site permitted to accept the soil.
- The LSRP may consider a variance to use the engineered fill in the cap. The variance must be justified and documented by the LSRP in accordance with the Tech Rule and ARRCS.

As described in Section 6 of this RAW, the engineered fill cap will be constructed in approximately three foot thick layers constructed from three to four placed and compacted lifts. This method was developed to ensure the geotechnical stability of the site will allow the underlying materials time to consolidate while the site is being capped.

Each three foot thick layer of engineered fill will contain 4,840 $yd^3$ of engineered fill per acre. At a product sampling frequency of one sample per 1,000 $yd^3$, this will result in nearly five samples per acre per layer to characterize the cap material. The cap on this site will be extremely well characterized.

### 7.4.10 Reporting Requirements

The LSRP will review and approve all analytical results on the engineered fill product. Under the requirements of the Tech Rule and Guidance, all of these results will be compiled by the LSRP and will be included in the Remedial Action Report (RAR). The RAR will be submitted to SRP upon completion of the remedial action.

To provide assurances to SRP that the remediation is being performed in accordance with the RAW, EastStar will provide quarterly reports to SRP, upon request, as the project is ongoing. Similar reports will be provided to other Department bureaus to demonstrate compliance with the Class B facility's permits. These reports will include summaries of all of the analytical results from the product testing and updated calculations of the results as they compare to the non-residential and residential remediation standards. Statistical analyses will be performed to show the actual concentrations of each of the analytes. The quarterly reports will be reviewed and approved by the LSRP prior to submission.

## 7.5 Guidance Variance for Use of an Alternate Standard

### 7.5.1 Variance Requirements

The Guidance requires that the maximum concentrations of any contaminants that exceed the residential remediation standards are less than the concentrations that currently exist on the site. The default requirement from the Guidance is that the maximum concentrations should be equal to the 75$^{th}$ percentile of existing concentrations, taking into account all of the sample analysis results ("75$^{th}$ percentile" rule).

The Guidance provides other compliance options besides the "75$^{th}$ percentile" rule using statistical evaluations of the available data. Requirements for using another option include:

- Data must be from discrete samples
- Outliers cannot be excluded
- A large sample set (generally more than 20 samples) is available for analysis
- All other statistical requirements for evaluation are met

Use of alternate criteria by the LSRP is a variance from the Tech Rule. In accordance with the Tech Rule requirements, the LSRP must identify and describe this variance and provide supporting documentation that the variance achieves the objectives of the Tech Rule and furthers the attainment of the remedial action.

As described in the previous section, EastStar used statistical methods to calculate the Mean and the 95% UCL of the existing site conditions for inorganics and PAH compounds. The Mean concentrations of six PAH compounds exceed the residential remediation standards. As shown in Table 7.3, the maximum concentrations of these six PAH compounds in the engineered fill will be less than the calculated Mean concentrations from the existing site data.

### 7.5.2 Variance Justification

The inorganics and PAH concentration datasets meet the guidelines described in the Guidance document for varying from the "75th Percentile" requirement. Specific to the Guidance:

- Data must be from discrete samples – All sample results are discrete grab samples for various locations over the entire project site. None of the analyses were based upon composite samples.
- Outliers cannot be excluded – All of the available historic and current inorganic and PAH data for the site was used in the analyses. No data sets or individual data points were excluded
- A large sample set (generally more than 20 samples) is available for analysis – As shown in Table 7.1, the inorganics dataset consists of 56 discrete samples and the PAH dataset consists of 41 discrete samples. Both datasets contain more than twice the minimum number of samples indicated in the Guidance.
- All other statistical requirements for evaluation are met – all requirements were met

In addition to meeting the guidance criteria, EastStar used a conservative approach by selecting the Mean as the maximum value for the concentration in the engineered fill. The Mean concentrations are approximately 25% of the concentrations that were calculated using the 95% UCL.

Note that the product limit concentrations will be the upper limits for these analytes from the product approval testing. Experience at Soil Safe's other New Jersey facilities has shown that the actual concentrations in the engineered fill material will be less than residential remediation standards.

Use of the Mean for these analytes that exist on-site above the residential remediation standards assists in achieving the remediation goals of this project because it allows a larger number of sources of supply for the soil used to make the engineered fill cap to be considered, expediting, within the geotechnical constraints, the construction of the cap.

# 8. REQUIRED PERMITS FOR REMEDIAL ACTION

The permitting process for this remedial action is currently on-going. The permits required include permits for the RI, the Class B recycling facility and the remedial action. Table 8.1 provides a list of the required permits, the responsible parties and the current status of each permit.

**Table 8.1 – Rahway Arch Site Remediation Permit Requirements**

| Permit Name | Approving Agency/Division | Permit Holder | Status |
|---|---|---|---|
| **Remedial Investigation** | | | |
| 1. CAFRA GP 27 and FWW GP 12 | NJDEP / Land Use Regulation Program | Rahway Arch | complete |
| **Class B Recycling Center** | | | |
| 2. Class B - Carteret Planning Board | Borough of Carteret | Soil Safe | approved |
| 3. Class B - Carteret Borough Council | Borough of Carteret | Soil Safe | approved |
| 4. Middlesex County Planning Board | Middlesex County | Soil Safe | approved |
| 5. Middlesex County SWM Plan Inclusion | Middlesex County SWAC | Soil Safe | approved |
| 6. Middlesex County SWM Plan Inclusion | Middlesex County Freeholders | Soil Safe | approved |
| 7. Middlesex County SWM Plan Approval | NJDEP / Commissioner | Soil Safe | approved |
| 8. Class B Recycling General Approval | NJDEP / Bureau of Solid Waste | Soil Safe | pending |
| 9. Air Quality Permit | NJDEP / Bureau of New Source Review | Soil Safe | pending |
| 10. NJPDES General Construction Permit | NJDEP / Division of Water Quality | Soil Safe | approved |
| 11. DGW Permits (Class B – impoundment) | NJDEP / Division of Water Quality | Soil Safe | approved |
| 12. Water Allocation Permit | NJDEP / Division of Water Quality | Soil Safe | in preparation |
| 13. Flood Hazard Area Waiver | NJDEP / Land Use Regulation Program | Soil Safe | Pending SRP review |
| **Site Remediation** | | | |
| 14. FWW General Permits No. 4 & 11 | NJDEP / Land Use Regulation Program | Rahway Arch | approved |
| 15. CAFRA General Permit No. 15 | NJDEP / Land Use Regulation Program | Rahway Arch | approved |
| 16. Flood Hazard Area Verification | NJDEP / Land Use Regulation Program | Rahway Arch | approved |
| 17. Flood Hazard Area Individual Permit | NJDEP / Land Use Regulation Program | Rahway Arch | approved |
| 18. SESC Plan Cert. and Authorization to Discharge Stormwater | Freehold Soil Conservation District | Soil Safe and Rahway Arch | approved |
| 19. USACE Letter of Non-Jurisdiction | USACE / NY Region II | Rahway Arch | approved |
| 20. DGW/DSW Permits (Site-wide – Emergency outfalls) | NJDEP / Division of Water Quality | Rahway Arch | in preparation |
| 21. Alternative Use Determination | NJDEP / ODST | Soil Safe | if ADM is used |
| 22. Remedial Action Permit - Soil | NJDEP/SRP | Rahway Arch and Borough of Carteret | upon completion of engineering controls |
| 23. Remedial Action Permit - Groundwater | NJDEP/SRP | Rahway Arch and Carteret | if needed |
| 24. Deed Notice | LSRP | Rahway Arch and Carteret | upon completion of engineering controls |
| 25. Response Action Outcome | LSRP | Rahway Arch and Carteret | upon completion of project |

## 9. TIME FRAMES AND REMEDIATION SCHEDULE

The date for initiation of remediation for this site is November 23, 2011. On this date, Rahway Arch Properties submitted a report to NJDEP-SRP identifying previously undocumented contamination and de-certifying the March 2011 biennial report required by the previously issued NFA.

The applicable regulatory time frames and the actual submission dates that these time frames have been met are summarized in Table 9.1. Note that this site is not subject to ISRA, there are no USTs (regulated or unregulated) on the site and there have been no UST discharges.

**Table 9.1 – Summary of Regulatory Time Frames**

| Requirement | Regulatory Time Frame | Required Date | Completed Date |
|---|---|---|---|
| Initiation of remediation | n/a | n/a | 11/23/2011 |
| Notification of LSRP Retention | 45 days | 1/7/2012 | 12/5/2012 |
| Post Public Notification Signage | 14 days prior to RI field investigation | 6/25/2012 | 6/16/2012 |
| Pay initial annual remediation fee | 270 days | 8/22/2012 | 8/22/2012 |
| Prepare Preliminary Assessment | none | n/a | August 7, 2012 |
| Submit Initial Receptor Evaluation Form | 1 year | 11/23/2012 | 10/31/2012 |
| RI completed and RIR submitted | 6 years | 11/23/2017 | 11/23/2012 |
| Submit RAW | 60 days prior to start of remedial action | TBD | 11/27/2012 |
| Submit Revised RAW | 60 days prior to start of remedial action | | 6/11/2013 |
| Submit Remedial Action Report | 5 years after RIR | 11/23/2017 | TBD |

The schedule for commencing the remediation is dependent upon the timing of the permit approvals. The schedule for performing the remediation is dependent upon the rate at which the Metro12 facility can receive and process soil and the results of the geotechnical monitoring as described previously. The overall remediation schedule is provided in Table 9.2.

Metro12 will be permitted to accept and process up to 840,000 tons of soil per year, but the actual volume of soil received and processed is variable and is dependent upon market conditions that are not within the control of Soil Safe or Rahway Arch and these maximum rates are not likely. Therefore, ranges have been estimated for the duration of the remediation activities. The longest duration for the capping activities has been used in calculating the completion dates in Table 9.2.

## Table 9.2 – Estimated Remediation Schedule

| Task | Time Frame | Start Date | Completion Date |
|---|---|---|---|
| Complete Remedial Action Workplan | | | 11/27/2012 |
| Submit LURP Permit Applications | | | 11/30/2012 |
| Submit Revised RAW | | | 6/11/2013 |
| SRP Component Review of RAW | 90 days | 11/28/2012 | ongoing |
| Obtain LURP Permits for Remediation | 120 days | 11/30/2012 | 5/24/2013 |
| Obtain permits for Class B Facility | | | |
| Class B Approval | TBD | 6/25/2012 | 6/28/2013 |
| Air Permit to Construct | TBD | 7/1/2012 | 6/28/2013 |
| DGW Permit | TBD | 9/15/2012 | 1/25/2013 |
| Flood Hazard Waiver | 90 days | 12/1/2012 | 6/28/2013 |
| LURP Permits | 90 days | 12/1/2012 | 5/24/2013 |
| Construct Class B Facility | 6 months | 3/1/2013 | 10/31/2013 |
| Construct Engineered Fill Cap | 3-5 years | 9/1/2013 | 10/31/2018 |
| Monitor Groundwater | 3-5 years | 9/1/2013 | 10/31/2018 |
| Obtain Remedial Action Permit for Soil | Upon completion of cap construction | 9/1/2018 | 11/30/2018 |
| Obtain Remedial Action Permit for Groundwater | Upon completion of groundwater monitoring | 9/1/2018 | 11/30/2018 |
| File Deed Notice | Upon issuance of RAPs | 10/1/2018 | 12/31/2018 |
| Issue Response Action Outcome | Upon recording of deed notice and payment of all fees | 11/1/2018 | 1/31/2019 |

## 10. SUMMARY OF REMEDIAL ACTIONS

This section of the RAW summarizes the remediation activities for the Rahway Arch site that are described in detail throughout this document.

Engineering Controls:

- A reduced permeability cap will be installed over the berms and impoundments to prevent direct contact and manage stormwater above the cap
- Stormwater will be fully managed to minimize infiltration through the cap and into the contaminated materials
- Groundwater monitoring will be performed semi-annually to evaluate the ongoing groundwater conditions and expanded monitoring will be performed during cap construction to ensure contaminants are not being discharged as a result of the remediation
- Additional investigations into potential impacts to the surrounding wetlands and surface waters will be performed during the cap construction.

Administrative Controls:

- The existing DER will be rescinded and replaced with a Deed Notice that complies with the ARRCS requirements
- Site use will be restricted to non-residential use, consistent with the property zoning
- Remedial Action Permits for soil, and potentially groundwater, will be issued following the completion of the engineering controls
- The need for a CEA and a groundwater remedial action permit will be evaluated based upon the results of the groundwater modeling
- Biennial certification of the effectiveness of the engineering controls will be required.

## 11. REFERENCES

1. *Technical Requirements for Site Remediation (Tech Rule)*, NJAC 7:26E, last amended May 7, 2012.

2. *Administrative Requirements for Remediation of Contaminated Sites (ARRCS)*, NJAC 7:26C, last amended May 7, 2012.

3. EastStar Environmental Group, Inc., *Preliminary Assessment of the Rahway Arch Properties Site*, August 7, 2012.

4. SESI Consulting Engineers, *Preliminary Assessment Report for American-Cyanamid/Cytec Impoundments, Block 9.03, Lot 21; Block 10, Lots 8-10 & 12-21; Block 11.01, Lots 8, 10-14 & 28, 55 Salt Meadow Road, Carteret, NJ 07008,* draft, October 26, 2006.

5. EastStar Environmental Group, Inc., *Environmental Investigation of Fill Material at the Rahway Arch (Old Cytec Landfill) Site*, October 17, 2011.

6. EastStar Environmental Group, Inc., *Remedial Investigation Report for the Rahway Arch Properties Site*, November 15, 2012.

7. Michael Baker, Jr., Inc., *Geotechnical Engineering Report – Rahway Arch Property, Carteret, New Jersey*, November 2012.

8. NJDEP, *Alternative and Clean Fill Guidance for SRP Sites*, Version 2.0, Updated December 29, 2011.

9. NJDEP, *Directions to Determine 95 Percent Upper Confidence Level of the Mean Using USEPA ProUCL Version 4.0 Software Package*, June 2008.

10. Hydrosystems, Inc., *Groundwater and Surface Water Assessment Carteret Impoundments, American Cyanamid Company, Linden, New Jersey*, February 9, 1987.

11. NJDEP, *Groundwater Technical Guidance: Site Investigation, Remedial Investigation, Remedial Action Performance Monitoring*, April 3, 2012.

12. Cytec Industries, *Remedial Action Plan Addendum for Carteret Impoundments, Borough of Carteret, New Jersey*, Revised February 1995.

13. Cytec Industries, Inc., *Declaration of Environmental Restrictions*, May 4, 1995.

14. Blasland, Bouck & Lee, Inc., *Annual Monitoring Report for 1999*, September 1999.

15. NJDEP, *Carteret Impoundments Site, Carteret Borough, Middlesex County, Restricted Use – No Further Action Letter and Covenant Not to Sue, Entire Site*, September 24, 2002.

16. NJDEP-Site Remediation Program, *Notice of Intent to Rescind No Further Action Covenant Not to Sue (NFA/CNS)*, March 15, 2013

17. Cytec Industries Inc., *Response to Notice of Intent to Rescind No Further Action Covenant Not to Sue (NFA/CNS)*, April 15, 2013.

18. NJDEP, *Ecological Evaluation Technical Guidance*, Version 1.1, August 30, 2011.

19. EastStar Environmental Group, Inc., *Rahway Arch Site Remediation – Detailed Alternatives Analysis*, January 17, 2013.

20. NJDEP, *Protocol for Addressing Extractable Petroleum Hydrocarbons"*, August 2010.

# APPENDICES

# APPENDIX A

# SUMMARIES OF ANALYTICAL DATA FROM THE SOIL AND SLUDGE SAMPLES COLLECTED IN THE REMEDIAL INVESTIGATION

*EastStar*

**Table A1 - Surface Fill Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | IS-02-02-04-008 | BS-07R-02-04-009 | ID-01-04-06-021 | BS-05-0-2-023 | BD-05-02-04-027 | ID-04-02-04-030 | W-02-00-04-036 | W-08-00-04-039 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | 8,350 | 7,140 | 8,860 | 10,700 | 10,900 | 10,100 | 20,500 | 9,380 |
| Antimony | mg/kg | 450 | 6 | 1.67 j | <0.988 | <1.43 | 0.956 j | 4.90 j | <1.08 | 7.64 | 1.16 |
| Arsenic | mg/kg | 19 | 19 | 8.60 | 2.82 | <1.38 | **48.5** | 18.0 | 4.34 | **248** | 7.50 |
| Barium | mg/kg | 59,000 | 1,300 | 90.3 | 97.2 | 48.0 | 63.0 | 176 | 75.8 | 495 | 63.9 |
| Beryllium | mg/kg | 140 | 0.5 | **0.687** | 0.329 | 0.156 j | 0.382 | **0.929** | **0.504** | **1.13** | 0.410 |
| Calcium | mg/kg | none | none | 4,180 | 14,200 | 280,000 | 13,300 | 214,000 | 26,100 | 4,190 | 59,300 |
| Cadmium | mg/kg | 78 | 1 | <0.0246 | <0.0255 | <0.0363 | <0.0240 | **1.95** | <0.0274 | <0.0725 | <0.00541 |
| Chromium | mg/kg | none | none | 28.6 | 16.5 | 13.5 | 19.9 | 38.3 | 34.7 | 314 | 20.7 |
| Cobalt | mg/kg | 590 | 59 | 9.00 | 7.91 | 2.57 | 7.89 | 5.17 | 9.15 | 21.4 | 4.23 |
| Copper | mg/kg | 45,000 | 7,300 | 61.3 | 42.2 | 1.85 | 28.4 | 186 | 31.7 | 677 | 41.2 |
| Iron | mg/kg | none | none | 20,100 | 14,100 | 2,150 | 18,100 | 11,900 | 22,900 | 35,200 | 10,700 |
| Lead | mg/kg | 800 | 59 | **112** | **148** | 11.0 | 45.8 | **236** | **112** | **757** | 36.3 |
| Magnesium | mg/kg | none | none | 2,560 | 4,270 | 1,040 | 4,930 | 2,250 | 7,230 | 7,120 | 2,840 |
| Manganese | mg/kg | 5,900 | 42 | **231** | **264** | 37.4 | **294** | **194** | **415** | **270** | **142** |
| Mercury | mg/kg | 65 | 0.1 | **0.317** | **0.469** | <0.0169 | 0.0605 j | **0.226** j | 0.0785 j | **31.6** | 1.03 |
| Nickel | mg/kg | 23,000 | 31 | 21.2 | 14.2 | 3.74 | 15.6 | **50.2** | 20.0 | **118** | 13.1 |
| Potassium | mg/kg | none | none | 970 | 1,860 | 166 | 1,380 | 1,160 | 1,560 | 4,220 | 2,300 |
| Selenium | mg/kg | 5,700 | 7 | <0.399 | <0.413 | 2.18 | <0.389 | <0.978 | <0.444 | 5.55 j | <0.0869 |
| Silver | mg/kg | 5,700 | 1 | <0.0935 | <0.0967 | <0.138 | <0.0911 | 0.311 j | <0.104 | <0.276 | <0.0204 |
| Sodium | mg/kg | none | none | 207 | 433 | 1,330 | 534 | 5,280 | 1,130 | 15,900 | 7,710 |
| Thallium | mg/kg | 79 | 3 | <1.17 | <1.21 | <1.73 | <1.14 | <2.87 | <1.30 | <3.45 | <0.255 |
| Vanadium | mg/kg | 1,100 | none | 36.7 | 31.8 | 14.8 | 39.1 | 87.6 | 28.5 | 91.7 | 23.5 |
| Zinc | mg/kg | 110,000 | 600 | 231 | 124 | 4.21 | 68.4 | 389 | 168 | **652** | 75.3 |
| | | | | | | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | <2.96 | <3.06 | **1,120** | N/A | **66.4** | N/A | **334** | **1,330** |

**Table A2 - Surface Fill Sample Analysis Results**
**Polynuclear Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Compound | Units | Non-Res Remed Std | Impact to GW Scr Lvl | IS-02-02-04-008 | BS-07R-02-04-009 | BS-05-0-2-023 | BD-05-02-04-027 | ID-04-02-04-030 | W-02-00-04-036 |
|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | ug/kg | 3.70E+07 | 74,000 | <492 | <509 | <480 | <121 | <54.9 | <145 |
| Acenaphthylene | ug/kg | 3.00E+08 | na | 766 j | <414 | <390 | <98.1 | <44.6 | <118 |
| Anthracene | ug/kg | 3.00E+07 | 1,500,000 | 1,030 j | <550 | <518 | <130 | 138 j | <157 |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | **4,170** | **771** j | **1,000** j | <93.7 | **506** | <113 |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | **4,690** | 762 j | 1,030 j | <77.8 | 413 | <93.5 |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | 4,010 | 583 j | 800 j | <99.8 | 398 | <120 |
| Benzo(a)pyrene | ug/kg | 200 | 200 | **4,870** | **724** j | **1,030** j | <92.3 | **482** | <111 |
| Benzo(g,h,i)perylene | ug/kg | 3.00E+07 | na | 3,110 | 503 j | <673 | <84.7 | 295 j | <102 |
| Chrysene | ug/kg | 230,000 | 52,000 | 4,620 | 893 j | 967 j | <89.7 | 523 | 112 j |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | 1,340 j | <249 | <553 | <69.6 | 115 j | <83.7 |
| Fluoranthene | ug/kg | 2.40E+07 | 840,000 | 9,400 | 1,520 j | 1,950 j | <84.4 | 915 | 142 j |
| Fluorene | ug/kg | 2.40E+07 | 110,000 | 679 j | <364 | <342 | <86.2 | 50.8 j | <104 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | **2,920** j | 397 j | <715 | <90.0 | 270 j | <108 |
| 2-Methylnaphthalene | ug/kg | 2.40E+06 | 5,000 | <452 | <468 | <440 | <111 | <50.4 | <133 |
| Naphthalene | ug/kg | 17,000 | 16,000 | <555 | <574 | <541 | <136 | <61.9 | <164 |
| Phenanthrene | ug/kg | 3.00E+08 | n/a | 6,710 | 1,210 j | 1,110 j | <92.9 | 523 | 132 j |
| Pyrene | ug/kg | 1.80E+07 | 550,000 | 8,670 | 1,630 j | 2,080 j | <104 | 1,040 | 144 j |

**Tabl A3 - Surface Fill Sample Analysis Results**
**Semi-Volatile Organic Compounds (SVOC) - EPA Method 8270C**
**(excludes PAHs)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-07R-02-04-009 |
|---|---|---|---|---|
| Aniline | ug/kg | none | none | <447 |
| Benzidine | ug/kg | 700 | 700 | <4,580 |
| Benzoic acid | ug/kg | none | none | <8,020 |
| Benzyl alcohol | ug/kg | none | none | <400 |
| Bis(2-chloroethyl)ether | ug/kg | 2,000 | 200 | <604 |
| Bis(2-chloroethoxy)methane | ug/kg | none | none | <435 |
| Bis(2-chloroisopropyl)ether | ug/kg | 67,000 | 3,000 | <632 |
| Bis(2-ethylhexyl) phthalate | ug/kg | 140,000 | 790,000 | 408 j |
| 4-Bromophenyl-phenyl ether | ug/kg | none | none | <370 |
| Butylbenzyl phthalate | ug/kg | 14,000,000 | 150,000 | <405 |
| Carbazole | ug/kg | 96,000 | none | <431 |
| 4-Chloroaniline | ug/kg | none | none | <370 |
| 4-Chloro-3-methylphenol | ug/kg | none | none | <351 |
| 4-Chlorophenyl-phenylether | ug/kg | none | none | <432 |
| 2-Chloronaphthalene | ug/kg | none | none | <387 |
| 2-Chlorophenol | ug/kg | 2,200,000 | 500 | <427 |
| Dibenzofuran | ug/kg | none | none | <487 |
| 1,2-Dichlorobenzene | ug/kg | 59,000,000 | 11,000 | <645 |
| 1,3-Dichlorobenzene | ug/kg | 59,000,000 | 12,000 | <634 |
| 1,4-Dichlorobenzene | ug/kg | 13,000 | 1,000 | <666 |
| 3,3'-Dichlorobenzidine | ug/kg | 4,000 | 200 | <466 |
| 2,4-Dichlorophenol | ug/kg | 2,100 | 200 | <739 |
| Diethyl phthalate | ug/kg | 550,000,000 | 57,000 | <409 |
| 2,4-Dimethylphenol | ug/kg | 14,000,000 | 700 | <349 |
| Dimethyl phthalate | ug/kg | none | none | <1,050 |
| Di-n-butyl phthalate | ug/kg | 68,000,000 | 620,000 | <376 |
| 4,6-Dinitro-2-methyl phenol | ug/kg | 68,000 | 300 | <340 |
| 2,4-Dinitrophenol | ug/kg | 1,400,000 | 300 | <1,680 |
| 2,4-Dinitrotoluene | ug/kg | 3,000 | none | <484 |
| 2,6-Dinitrotoluene | ug/kg | 3,000 | none | <469 |
| Di-n-octylphthalate | ug/kg | 270,000,000 | 3,300,000 | <322 |
| 1,2-Diphenylhydrazine | ug/kg | 2,000 | 700 | <373 |
| Hexachlorobenzene | ug/kg | 1,000 | 200 | <453 |
| Hexachlorobutadiene | ug/kg | 25,000 | 600 | <622 |
| Hexachlorocyclopentadiene | ug/kg | 110,000 | 210,000 | <346 |
| Hexachloroethane | ug/kg | 140,000 | 200 | <469 |
| Isophorone | ug/kg | 2,000,000 | 200 | <335 |
| 2-Methylphenol | ug/kg | 3,400,000 | none | <427 |
| 3 & 4-Methylphenol | ug/kg | 340,000 | none | <649 |
| 2-Nitroaniline | ug/kg | 23,000,000 | none | <427 |
| 3-Nitroaniline | ug/kg | none | none | <480 |
| 4-Nitroaniline | ug/kg | none | none | <384 |

**Tabl A3 - Surface Fill Sample Analysis Results**
**Semi-Volatile Organic Compounds (SVOC) - EPA Method 8270C**
**(excludes PAHs)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-07R-02-04-009 |
|---|---|---|---|---|
| Nitrobenzene | ug/kg | 340,000 | 200 | <613 |
| 2-Nitrophenol | ug/kg | none | none | <426 |
| 4-Nitrophenol | ug/kg | none | none | <409 |
| n-Nitrosodimethylamine | ug/kg | 700 | 700 | <601 |
| n-Nitroso-di-n-propylamine | ug/kg | 300 | 200 | <342 |
| n-Nitrosodiphenylamine | ug/kg | 390,000 | 200 | <692 |
| Pentachlorophenol | ug/kg | 10,000 | 300 | <547 |
| Phenol | ug/kg | 210,000,000 | 5,000 | <393 |
| 1,2,4-Trichlorobenzene | ug/kg | 820,000 | 400 | <600 |
| 2,4,5-Trichlorophenol | ug/kg | 68,000,000 | 44,000 | <378 |
| 2,4,6-Trichlorophenol | ug/kg | 74,000 | 200 | <371 |

## Table A4 - Surface Fill Sample Analysis Results

### Petroleum Hydrocarbons (NJDEP EPH) and Volatile Organic Compounds (EPA Method 8260B)

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-07R-02-04-009 |
|---|---|---|---|---|
| Petroleum Hydrocarbons (EPH) | mg/kg | none | none | 19.5 j |
| | | | | |
| Acetone | ug/kg | na | 12,000 | 33.3 b |
| Benzene | ug/kg | 5 | 5 | <2.00 |
| Bromochloromethane | ug/kg | none | none | <2.09 |
| Bromodichloromethane | ug/kg | 3 | 5 | <2.05 |
| Bromoform | ug/kg | 280 | 20 | <1.54 |
| Bromomethane | ug/kg | 59 | 30 | <2.71 |
| 2-Butanone | ug/kg | 44,000 | 600 | 5.55 j |
| Carbon disulfide | ug/kg | 110,000 | 4,000 | 10.1 j |
| Carbon tetrachloride | ug/kg | 2 | 5 | <2.09 |
| Chlorobenzene | ug/kg | 7,400 | 400 | 27.3 |
| Chloroethane | ug/kg | 1,100 | na | <1.68 |
| Chloroform | ug/kg | 2 | 200 | <1.81 |
| Chloromethane | ug/kg | 12 | na | <2.52 |
| Cyclohexane | ug/kg | none | none | <2.03 |
| Dibromochloromethane | ug/kg | 8 | 5 | <1.58 |
| 1,2-Dibromoethane | ug/kg | 0.04 | 5 | <1.88 |
| 1,2-Dibromo-3-chloropropane | ug/kg | 0.2 | 5 | <2.28 |
| 1,2-Dichlorobenzene | ug/kg | 59,000 | 11,000 | <2.09 |
| 1,3-Dichlorobenzene | ug/kg | 29,000 | 12,000 | 4.59 j |
| 1,4-Dichlorobenzene | ug/kg | 13 | 1,000 | <2.50 |
| Dichlorodifluoromethane | ug/kg | 230,000 | 25,000 | <1.92 |
| 1,1-Dichloroethane | ug/kg | 24 | 200 | <2.24 |
| 1,2-Dichloroethane | ug/kg | 3 | 5 | <1.79 |
| 1,1-Dichloroethene | ug/kg | 50 | 5 | <2.39 |
| cis-1,2-Dichloroethene | ug/kg | 560 | 200 | <1.62 |
| trans-1,2-Dichloroethene | ug/kg | 720 | 400 | <2.13 |
| 1,2-Dichloropropane | ug/kg | 5 | 5 | <1.98 |
| cis-1,3-Dichloropropene | ug/kg | 7 | 5 | <1.73 |
| trans-1,3-Dichloropropene | ug/kg | 7 | 5 | <1.86 |
| 1,4-Dioxane | ug/kg | none | none | <91.5 |
| Ethyl benzene | ug/kg | 110,000 | 8,000 | <2.43 |
| 2-Hexanone | ug/kg | none | none | <4.18 |
| Isopropyl benzene | ug/kg | none | none | <2.32 |
| Methyl acetate | ug/kg | na | 14,000 | <2.28 |
| Methyl tertiary butyl ether | ug/kg | 320 | 200 | <1.83 |
| Methylcyclohexane | ug/kg | none | none | <2.54 |
| Methylene chloride | ug/kg | 97 | 7 | <3.22 |
| 4-Methyl-2-pentanone | ug/kg | none | none | <3.60 |
| Styrene | ug/kg | 260 | 2,000 | <1.90 |

**Table A4 - Surface Fill Sample Analysis Results**

**Petroleum Hydrocarbons (NJDEP EPH) and Volatile Organic Compounds (EPA Method 8260B)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-07R-02-04-009 |
|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | ug/kg | 3 | 5 | <1.96 |
| Tetrachloroethene | ug/kg | 5 | 5 | <2.32 |
| Toluene | ug/kg | 91,000 | 4,000 | 2.73 j |
| 1,2,3-Trichlorobenzene | ug/kg | none | none | <3.67 |
| 1,2,4-Trichlorobenzene | ug/kg | 820 | 400 | <2.84 |
| 1,1,1-Trichloroethane | ug/kg | 4,200 | 200 | <2.15 |
| 1,1,2-Trichloroethane | ug/kg | 6 | 10 | <2.11 |
| Trichloroethene | ug/kg | 20 | 7 | <2.67 |
| Trichlorofluoromethane | ug/kg | 340,000 | 22,000 | <2.32 |
| 1,1,2-Trichloro-1,2,2- trifluoroethane | ug/kg | none | none | <2.45 |
| Vinyl chloride | ug/kg | 2 | 5 | <2.47 |
| m&p-Xylenes | ug/kg | 170,000 | 12,000 | <4.93 |
| o-Xylene | ug/kg | 170,000 | 12,000 | 3.33 j |

**Table A5 - Alum-YPS Sludge Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-02-03-05-001 | BD-02-07-09-003 | ID-05-08-10-006 | BD-01R-03-05-011 | BD-03-06-08-013 | BD-04R-04-06-015 | IS-01-6-8-017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | **7,140** | **3,820** | **14,800** | **6,520** | **14,200** | **6,320** | **29,200** |
| Antimony | mg/kg | 450 | 6 | 1.79 j | <1.66 | <1.33 | <1.50 | <1.53 | <1.48 | <1.81 |
| Arsenic | mg/kg | 19 | 19 | 5.33 | 3.49 | 1.90 | <1.47 | <1.48 | <1.44 | 4.51 |
| Barium | mg/kg | 59,000 | 1,300 | 479 | 30.0 | 107 | 23.3 | 36.6 | 84.8 | 48.2 |
| Beryllium | mg/kg | 140 | 0.5 | **1.13** | 0.347 j | 0.376 | 0.240 j | 0.246 j | 0.203 j | <0.00597 |
| Calcium | mg/kg | none | none | 203,000 | 215,000 | 66,000 | 276,000 | 227,000 | 234,000 | 226,000 |
| Cadmium | mg/kg | 78 | 1 | **4.33** | <0.0427 | 0.329 | <0.0688 | <0.0390 | <0.0378 | <0.0460 |
| Chromium | mg/kg | none | none | 3.69 | | 5.01 | 14.6 | | 2.14 | 38.0 |
| Cobalt | mg/kg | 590 | 59 | **75.3** | 1.77 j | 19.5 | 2.63 | 3.99 | 12.5 | 7.14 |
| Copper | mg/kg | 45,000 | 7,300 | 24.4 | 2.48 | 32.0 | 1.70 j | 1.60 j | 0.837 j | 15.0 |
| Iron | mg/kg | none | none | 13,300 | 3,160 | 18,700 | 2,960 | 6,050 | 1,830 | 9,690 |
| Lead | mg/kg | 800 | 59 | **60.2** | 43.1 | 56.1 | 11.3 | 17.1 | 11.5 | 20.7 |
| Magnesium | mg/kg | none | none | 4,400 | 3,820 | 1,740 | 882 | 1,240 | 773 | 20,700 |
| Manganese | mg/kg | 5,900 | 42 | **156** | **55.8** | **123** | **56.1** | **96.2** | 40.1 | **356** |
| Mercury | mg/kg | 65 | 0.1 | <0.105 | <0.0997 | **0.262** | <0.0906 | <0.0911 | <0.0882 | 0.261 |
| Nickel | mg/kg | 23,000 | 31 | **38.4** | 7.86 | 13.3 | 4.77 | 8.10 | 4.92 | 8.51 |
| Potassium | mg/kg | none | none | 1,170 | 371 | 1,270 | 248 | 800 | 110 | 294 |
| Selenium | mg/kg | 5,700 | 7 | 2.46 j | 2.79 j | <0.548 | 4.45 | 2.61 j | 1.41 | 6.59 |
| Silver | mg/kg | 5,700 | 1 | <0.170 | <0.162 | <0.129 | <0.147 | <0.148 | <0.143 | <0.175 |
| Sodium | mg/kg | none | none | 8,630 | 7,020 | 2,240 | 1,330 | 1,010 | 873 | 2,960 |
| Thallium | mg/kg | 79 | 3 | <2.13 | <2.03 | <1.61 | <1.84 | <1.85 | <1.79 | <2.18 |
| Vanadium | mg/kg | 1,100 | none | 59.1 | 9.19 | 28.1 | 13.8 | 23.1 | 12.8 | 48.0 |
| Zinc | mg/kg | 110,000 | 600 | 185 | 20.9 | 147 | 7.98 | 16.0 | 6.48 | 36.9 |
| | | | | | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | **2,300** | **1,720** | **123** | **405** | **825** | **1,180** | **2,850** |

**Table A5 - Alum-YPS Sludge Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | ID-02-2-4-019 | ID-01-18-20-022 | ID-06-02-04-025 | ID-04-06-08-031 | ID-03R-00-02-033 | BS-03R-02-04-037 |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | **4,330** | **6,830** | 3,430 | **3,980** | **15,000** | 2,990 |
| Antimony | mg/kg | 450 | 6 | <1.37 | <2.78 | <1.91 | 1.13 | <1.89 | <1.21 |
| Arsenic | mg/kg | 19 | 19 | <1.32 | <2.69 | 7.44 | 4.10 | 4.53 | <1.17 |
| Barium | mg/kg | 59,000 | 1,300 | 14.0 | 20.9 | 18.8 | 6.01 | 31.7 | 28.9 |
| Beryllium | mg/kg | 140 | 0.5 | 0.103 j | 0.319 j | 0.326 j | 0.264 | 0.0534 j | 0.232 j |
| Calcium | mg/kg | none | none | 254,000 | 58,100 | 278,000 | 86,800 | 197,000 | 256,000 |
| Cadmium | mg/kg | 78 | 1 | <0.0348 | <0.0707 | <0.0485 | 0.990 | <0.0481 | <0.0308 |
| Cobalt | mg/kg | none | none | 11.6 | 12.9 | 27.3 | 17.7 | 17.4 | 1.64 |
| Chromium | mg/kg | 590 | 59 | 3.56 | 4.99 | 2.19 j | 1.68 | 5.96 | 7.51 |
| Copper | mg/kg | 45,000 | 7,300 | 0.636 j | 7.57 | 14.1 | 17.3 | 14.3 | 1.54 |
| Iron | mg/kg | none | none | 2,440 | 5,880 | 6,860 | 14,500 | 9,820 | 1,900 |
| Lead | mg/kg | 800 | 59 | 10.5 | 12.7 | 28.7 | 22.2 | 2.91 j | <0.650 |
| Magnesium | mg/kg | none | none | 111 | 4,990 | 19,400 | 2,240 | 27,700 | 919 |
| Manganese | mg/kg | 5,900 | 42 | **86.8** | **46.2** | **233** | **76.8** | **307** | 39.7 |
| Mercury | mg/kg | 65 | 0.1 | <0.0813 | <0.165 | **0.131** j | 0.0937 | **0.135** j | <0.0720 |
| Nickel | mg/kg | 23,000 | 31 | 4.55 | 10.9 | 16.4 | 9.16 | 10.4 | 4.49 |
| Potassium | mg/kg | none | none | <19.4 | 1,780 | 306 | 1,070 | 102 j | 82.3 |
| Selenium | mg/kg | 5,700 | 7 | 4.69 | 2.08 b | 3.19 j | <0.0286 | <0.779 | <0.499 |
| Silver | mg/kg | 5,700 | 1 | <0.132 | <0.268 | <0.184 | <0.00677 | <0.183 | <0.117 |
| Sodium | mg/kg | none | none | 634 | 20,400 | 9,470 | 2,840 | 2,430 | 748 |
| Thallium | mg/kg | 79 | 3 | <1.65 | <3.36 | <2.30 | <0.0836 | <2.28 | <1.46 |
| Vanadium | mg/kg | 1,100 | none | 14.4 | 22.7 | 8.02 | 12.9 | 30.7 | 7.39 |
| Zinc | mg/kg | 110,000 | 600 | 43.0 | 14.1 | 141 | 85.5 | 24.7 | 3.44 |
| | | | | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | **190** | **210** | **1,820** | **1,420** | **2,420** | N/A |

**Table A6 - Alum-YPS Sludge Sample Analysis Results**
**Polynuclear Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | ID-01-18-20-022 |
|---|---|---|---|---|
| Acenaphthene | ug/kg | 3.70E+07 | 74,000 | <1,410 |
| Acenaphthylene | ug/kg | 3.00E+08 | na | <1,150 |
| Anthracene | ug/kg | 3.00E+07 | 1,500,000 | <1,530 |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | <1,100 |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | <910 |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | <1,170 |
| Benzo(a)pyrene | ug/kg | 200 | 200 | <1,080 |
| Benzo(g,h,i)perylene | ug/kg | 3.00E+07 | na | <922 |
| Chrysene | ug/kg | 230,000 | 52,000 | <1,050 |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | <815 |
| Fluoranthene | ug/kg | 2.40E+07 | 840,000 | <988 |
| Fluorene | ug/kg | 2.40E+07 | 110,000 | <1,010 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | <1,050 |
| 2-Methylnaphthalene | ug/kg | 2.40E+06 | 5,000 | <1,300 |
| Naphthalene | ug/kg | 17,000 | 16,000 | <1,590 |
| Phenanthrene | ug/kg | 3.00E+08 | n/a | <1,090 |
| Pyrene | ug/kg | 1.80E+07 | 550,000 | <1,210 |

**Table A7 - Peat Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-02-06-08-002 | BD-02-13-14-004 | ID-05-12-14-007 | BS-07R-14-18-010 | BD-01R-19-21-012 | BD-03-19-20-014 | BD-04R-17-19-016 | IS-01-11-13-018 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | **17,800** | **16,900** | **12,400** | **10,400** | **11,900** | **16,300** | **17,800** | **20,700** |
| Antimony | mg/kg | 450 | 6 | <4.21 | <3.27 | <3.26 | <3.94 | <2.92 | <1.59 | <2.28 | <1.71 |
| Arsenic | mg/kg | 19 | 19 | 12.4 | 14.4 | 7.38 | <3.87 | **28.3** | 10.2 | 5.03 | 17.6 |
| Barium | mg/kg | 59,000 | 1,300 | 351 | 337 | 714 | 34.7 | 58.3 | 133 | 41.4 | 42.1 |
| Beryllium | mg/kg | 140 | 0.5 | **0.856** | **0.961** | **0.550** j | **0.582** j | 0.345 j | **0.734** | **0.777** | **0.956** |
| Calcium | mg/kg | none | none | 75,700 | 167,000 | 61,800 | 10,400 | 13,700 | 37,000 | 5,790 | 6,270 |
| Cadmium | mg/kg | 78 | 1 | 0.190 | 0.333 j | <0.0829 | 0.151 j | **12.2** | <0.0405 | <0.0581 | <0.0436 |
| Chromium | mg/kg | none | none | 67.4 | 47.9 | 56.6 | 17.8 | 23.5 |  | 40.2 | 68.1 |
| Cobalt | mg/kg | 590 | 59 | 13.5 | 12.3 | 5.22 | 5.33 | 5.61 | 11.6 | 6.99 | 13.3 |
| Copper | mg/kg | 45,000 | 7,300 | 150 | 21.1 | 319 | 10.9 | 57.5 | 15.4 | 11.8 | 13.4 |
| Iron | mg/kg | none | none | 23,700 | 23,800 | 11,200 | 9,380 | 5,650 | 28,600 | 21,200 | 44,000 |
| Lead | mg/kg | 800 | 59 | **105** | **59.2** | **303** | 18.6 | **90.8** | 17.8 | 7.38 | 11.7 |
| Magnesium | mg/kg | none | none | 9,090 | 6,690 | 7,140 | 6,600 | 7,200 | 7,090 | 7,040 | 8,510 |
| Manganese | mg/kg | 5,900 | 42 | **254** | **178** | **76.2** | **66.5** | **105** | **413** | **147** | **493** |
| Mercury | mg/kg | 65 | 0.1 | <0.254 | **0.470** | <0.194 | <0.238 | <0.176 | <0.0946 | <0.136 | <0.102 |
| Nickel | mg/kg | 23,000 | 31 | **51.7** | **75.0** | **45.9** | 13.7 | **68.8** | 25.7 | 16.7 | 28.5 |
| Potassium | mg/kg | none | none | 3,840 | 3,000 | 2,760 | 2,390 | 2,910 | 3,410 | 4,470 | 4,840 |
| Selenium | mg/kg | 5,700 | 7 | 2.55 j | <1.37 | 8.37 | <1.65 | 6.23 j | <0.656 | <0.942 | <0.707 |
| Silver | mg/kg | 5,700 | 1 | <0.413 | <0.320 | <0.315 | <0.386 | <0.286 | <0.154 | <0.221 | <0.166 |
| Sodium | mg/kg | none | none | 15,900 | 17,800 | 14,900 | 22,400 | 26,300 | 7,490 | 13,300 | 8,110 |
| Thallium | mg/kg | 79 | 3 | <5.16 | <4.01 | <3.94 | <4.83 | <3.58 | <1.92 | <2.76 | <2.07 |
| Vanadium | mg/kg | 1,100 | none | 54.8 | 56.0 | 32.7 | 27.0 | 78.2 | 38.7 | 55.1 | 50.1 |
| Zinc | mg/kg | 110,000 | 600 | 194 | 260 | 103 | 53.8 | **796** | 109 | 48.1 | 137 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| Cyanide | mg/kg | 23,000 | 13 | **857** | **145** | **286** | **1,060** | **1,130** | **92.5** | **164** | **40.6** |

**Table A7 - Peat Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | ID-02-14-16-020 | ID-06-06-08-026 | BD-05-08-10-028 | BS-06-06-08-029 | ID-04-10-12-032 | ID-03R-14-16-034 | BS-03R-13-15-038 |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | **25,200** | **10,500** | **21,300** | **22,300** | **10,000** | **20,100** | **19,200** |
| Antimony | mg/kg | 450 | 6 | <2.14 | <3.93 | 3.04 j | 6.04 | <2.67 | <2.64 | <1.64 |
| Arsenic | mg/kg | 19 | 19 | 10.9 | 10.8 | **20.3** | 14.2 | 5.69 | 14.9 | 14.4 |
| Barium | mg/kg | 59,000 | 1,300 | 33.0 | 22.5 | 58.2 | 351 | 54.9 | 53.0 | 43.2 |
| Beryllium | mg/kg | 140 | 0.5 | **0.571** | 0.386 j | **0.973** | **1.39** | 0.425 j | **0.798** | **0.911** |
| Calcium | mg/kg | none | none | 30,600 | 25,000 | 5,690 | 29,800 | 21,600 | 72,700 | 14,200 |
| Cadmium | mg/kg | 78 | 1 | <0.0544 | <0.100 | <0.0536 | <0.0554 | <0.0680 | <0.0672 | <0.0418 |
| Chromium | mg/kg | none | none | 29.8 | 16.6 | 42.0 | 103 | 36.9 | 39.4 | 32.4 |
| Cobalt | mg/kg | 590 | 59 | 10.7 | 3.64 j | 12.0 | 16.5 | 5.43 | 9.07 | 11.5 |
| Copper | mg/kg | 45,000 | 7,300 | 5.71 | 5.43 | 28.8 | 254 | 16.8 | 22.4 | 12.9 |
| Iron | mg/kg | none | none | 24,400 | 15,700 | 39,100 | 43,400 | 17,300 | 20,700 | 35,000 |
| Lead | mg/kg | 800 | 59 | 15.8 | 5.43 j | 43.5 | **242** | 7.13 | 26.5 | 9.49 |
| Magnesium | mg/kg | none | none | 7,140 | 3,330 | 7,050 | 11,100 | 5,300 | 8,620 | 8,200 |
| Manganese | mg/kg | 5,900 | 42 | **142** | **44.9** | **324** | **255** | **78.5** | **257** | **354** |
| Mercury | mg/kg | 65 | 0.1 | <0.127 | <0.234 | **0.991** | **0.674** | <0.159 | **0.195** j | <0.0977 |
| Nickel | mg/kg | 23,000 | 31 | 23.1 | 13.8 | 28.6 | **52.4** | 15.0 | 24.2 | 25.5 |
| Potassium | mg/kg | none | none | 4,290 | 2,230 | 5,070 | 5,670 | 2,500 | 2,860 | 4,280 |
| Selenium | mg/kg | 5,700 | 7 | <0.882 | <1.62 | <0.868 | 1.80 j | <1.10 | <1.09 | <0.678 |
| Silver | mg/kg | 5,700 | 1 | <0.207 | <0.380 | <0.203 | <0.210 | <0.258 | <0.255 | <0.159 |
| Sodium | mg/kg | none | none | 15,300 | 28,800 | 9,370 | 7,930 | 14,200 | 21,000 | 12,900 |
| Thallium | mg/kg | 79 | 3 | <2.59 | <4.75 | <2.54 | <2.63 | <3.23 | <3.19 | <1.99 |
| Vanadium | mg/kg | 1,100 | none | 47.1 | 31.3 | 53.8 | 55.6 | 37.9 | 46.8 | 46.2 |
| Zinc | mg/kg | 110,000 | 600 | 55.2 | 36.5 | 81.9 | 152 | 39.6 | 69.7 | 68.0 |
| | | | | | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | **530** | **207** | **21.3** | **255** | **61.5** | **857** | **977** |

**Table A8 - Peat Sample Analysis Results**
**Polynuclear Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-02-06-08-002 | BD-02-13-14-004 | ID-05-12-14-007 | BS-07R-14-18-010 | BD-01R-19-21-012 | BD-03-19-20-014 | IS-01-11-13-018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | ug/kg | 3.70E+07 | 74 | <1,300 | <169 | <166 | <203 | 192 j | <81.0 | <87.2 |
| Acenaphthylene | ug/kg | 3.00E+08 | na | <1,060 | <137 | <135 | <165 | <122 | <65.8 | <70.9 |
| Anthracene | ug/kg | 3.00E+07 | 1,500,000 | <1,410 | <182 | <179 | <219 | <163 | <87.4 | <94.1 |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | <1,010 | <131 | <129 | <158 | <117 | <62.9 | <67.7 |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | <840 | <109 | <107 | <131 | <97.0 | <52.2 | <56.2 |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | <1,080 | <139 | <137 | <168 | <125 | <67.0 | <72.1 |
| Benzo(a)pyrene | ug/kg | 200 | 200 | <996 | <129 | <127 | <155 | <115 | <61.9 | <66.7 |
| Benzo(g,h,i)perylene | ug/kg | 3.00E+07 | na | <915 | <118 | <116 | <143 | <106 | <56.8 | <61.2 |
| Chrysene | ug/kg | 230,000 | 52,000 | <968 | <125 | <123 | <151 | <112 | <60.2 | <64.8 |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | <752 | <97.3 | <95.7 | <117 | <86.9 | <46.7 | <50.3 |
| Fluoranthene | ug/kg | 2.40E+07 | 840,000 | <912 | <118 | <116 | 144 j | 227 j | <56.6 | <61.0 |
| Fluorene | ug/kg | 2.40E+07 | 110,000 | <931 | <120 | <118 | <145 | 169 j | <57.8 | <62.3 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | <971 | <126 | <124 | <152 | <112 | <60.3 | <65.0 |
| 2-Methylnaphthalene | ug/kg | 2.40E+06 | 5,000 | <1,200 | <155 | <152 | <187 | 169 j | <74.4 | <80.1 |
| Naphthalene | ug/kg | 17,000 | 16,000 | <1,470 | <190 | <187 | <229 | 537 j | <91.3 | <98.3 |
| Phenanthrene | ug/kg | 3.00E+08 | n/a | 1,030 j | <130 | <128 | 173 j | 528 j | <62.3 | <67.1 |
| Pyrene | ug/kg | 1.80E+07 | 550,000 | <1,120 | <145 | <142 | <174 | 202 j | <69.5 | <74.9 |



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Table A8 - Peat Sample Analysis Results**

**Polynuclear Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BD-04R-17-19-016 | ID-02-14-16-020 | ID-06-06-08-026 | BD-05-08-10-028 | BS-06-06-08-029 | ID-04-10-12-032 | BS-03R-13-15-038 |
|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | ug/kg | 3.70E+07 | 74,000 | <116 | <109 | <200 | <107 | <111 | <272 | <64.9 |
| Acenaphthylene | ug/kg | 3.00E+08 | na | <94.5 | <88.5 | <162 | <87.0 | <90.0 | <221 | <90.3 |
| Anthracene | ug/kg | 3.00E+07 | 1,500,000 | <125 | <118 | <216 | <116 | <120 | <294 | <63.9 |
| Benzo(a)anthracene | ug/kg | 2,000 | 500 | 135 | <84.5 | <155 | <83.2 | <86.0 | <211 | <48.3 |
| Benzo(b)fluoranthene | ug/kg | 2,000 | 2,000 | <74.9 | <70.1 | <129 | <69.0 | <71.4 | <175 | <59.7 |
| Benzo(k)fluoranthene | ug/kg | 23,000 | 16,000 | 169 | <90.0 | <165 | <88.6 | <91.6 | <225 | <62.3 |
| Benzo(a)pyrene | ug/kg | 200 | 200 | 172 | <83.2 | <153 | <81.9 | <84.7 | <208 | <76.8 |
| Benzo(g,h,i)perylene | ug/kg | 3.00E+07 | na | 101 | <76.4 | <140 | <75.2 | <77.7 | <191 | <71.8 |
| Chrysene | ug/kg | 230,000 | 52,000 | 144 | <80.9 | <149 | <79.6 | <82.3 | <202 | <58.5 |
| Dibenz(a,h)anthracene | ug/kg | 200 | 500 | <67.1 | <62.8 | <115 | <61.8 | <63.9 | <157 | <64.3 |
| Fluoranthene | ug/kg | 2.40E+07 | 840,000 | 162 | <76.2 | <140 | <74.9 | <77.5 | <190 | <58.7 |
| Fluorene | ug/kg | 2.40E+07 | 110,000 | <83.0 | <77.7 | <143 | <76.5 | <79.1 | <194 | <53.9 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 2,000 | 5,000 | <86.6 | <81.1 | <149 | <79.8 | <82.5 | <203 | <94.3 |
| 2-Methylnaphthalene | ug/kg | 2.40E+06 | 5,000 | <94.5 | <100 | <184 | <98.4 | <102 | <250 | <68.0 |
| Naphthalene | ug/kg | 17,000 | 16,000 | <131 | <123 | <225 | <121 | <125 | <307 | <83.6 |
| Phenanthrene | ug/kg | 3.00E+08 | n/a | <89.4 | <83.7 | <154 | <82.4 | <85.2 | <209 | <69.2 |
| Pyrene | ug/kg | 1.80E+07 | 550,000 | 206 | <93.4 | <172 | <91.9 | <95.0 | <233 | <62.1 |

**Table A9 - Peat Sample Analysis Results**
**Semi-Volatile Organic Compounds (SVOC) - EPA Method 8270C**
**(excludes PAHs)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BD-04R-17-19-016 | BS-03R-13-15-038 |
|---|---|---|---|---|---|
| Aniline | ug/kg | none | none | <102 | <73.4 |
| Benzidine | ug/kg | 700 | 700 | <1,050 | <752 |
| Benzoic acid | ug/kg | none | none | <1,830 | <1,320 |
| Benzyl alcohol | ug/kg | none | none | <91.4 | <65.7 |
| Bis(2-chloroethyl)ether | ug/kg | 2,000 | 200 | <138 | <99.1 |
| Bis(2-chloroethoxy)methane | ug/kg | none | none | <99.2 | <71.4 |
| Bis(2-chloroisopropyl)ether | ug/kg | 67,000 | 3,000 | <144 | <104 |
| Bis(2-ethylhexyl) phthalate | ug/kg | 140,000 | 790,000 | 111 | <55.1 |
| 4-Bromophenyl-phenyl ether | ug/kg | none | none | <84.4 | <60.7 |
| Butylbenzyl phthalate | ug/kg | 14,000,000 | 150,000 | 109 | <66.5 |
| Carbazole | ug/kg | 96,000 | none | <98.4 | <70.8 |
| 4-Chloroaniline | ug/kg | none | none | <84.4 | <60.7 |
| 4-Chloro-3-methylphenol | ug/kg | none | none | <80.2 | <57.7 |
| 4-Chlorophenyl-phenylether | ug/kg | none | none | <98.7 | <71.0 |
| 2-Chloronaphthalene | ug/kg | none | none | <88.3 | <63.5 |
| 2-Chlorophenol | ug/kg | 2,200,000 | 500 | <97.5 | <70.2 |
| Dibenzofuran | ug/kg | none | none | <111 | <80.0 |
| 1,2-Dichlorobenzene | ug/kg | 59,000,000 | 11,000 | <147 | <106 |
| 1,3-Dichlorobenzene | ug/kg | 59,000,000 | 12,000 | <145 | <104 |
| 1,4-Dichlorobenzene | ug/kg | 13,000 | 1,000 | <152 | <109 |
| 3,3'-Dichlorobenzidine | ug/kg | 4,000 | 200 | <106 | <76.6 |
| 2,4-Dichlorophenol | ug/kg | 2,100 | 200 | <169 | <121 |
| Diethyl phthalate | ug/kg | 550,000,000 | 57,000 | 198 | <61.7 |
| 2,4-Dimethylphenol | ug/kg | 14,000,000 | 700 | <93.3 | <67.1 |
| Dimethyl phthalate | ug/kg | none | none | <79.7 | <57.3 |
| Di-n-butyl phthalate | ug/kg | 68,000,000 | 620,000 | <383 | <275 |
| 4,6-Dinitro-2-methyl phenol | ug/kg | 68,000 | 300 | <239 | <172 |
| 2,4-Dinitrophenol | ug/kg | 1,400,000 | 300 | <77.7 | <55.9 |
| 2,4-Dinitrotoluene | ug/kg | 3,000 | none | <110 | <79.4 |
| 2,6-Dinitrotoluene | ug/kg | 3,000 | none | <107 | <77.0 |
| Di-n-octylphthalate | ug/kg | 270,000,000 | 3,300,000 | <73.5 | <52.9 |
| 1,2-Diphenylhydrazine | ug/kg | 2,000 | 700 | <85.2 | <61.3 |
| Hexachlorobenzene | ug/kg | 1,000 | 200 | <103 | <74.4 |
| Hexachlorobutadiene | ug/kg | 25,000 | 600 | <142 | <102 |
| Hexachlorocyclopentadiene | ug/kg | 110,000 | 210,000 | <79.1 | <56.9 |
| Hexachloroethane | ug/kg | 140,000 | 200 | <107 | <77.0 |
| Isophorone | ug/kg | 2,000,000 | 200 | <76.6 | <55.1 |
| 2-Methylphenol | ug/kg | 3,400,000 | none | <97.5 | <70.2 |
| 3 & 4-Methylphenol | ug/kg | 340,000 | none | <148 | <107 |
| 2-Nitroaniline | ug/kg | 23,000,000 | none | <97.5 | <70.2 |
| 3-Nitroaniline | ug/kg | none | none | <110 | <78.8 |
| 4-Nitroaniline | ug/kg | none | none | <87.8 | <63.1 |

**Table A9 - Peat Sample Analysis Results**
**Semi-Volatile Organic Compounds (SVOC) - EPA Method 8270C**
**(excludes PAHs)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BD-04R-17-19-016 | BS-03R-13-15-038 |
|---|---|---|---|---|---|
| Nitrobenzene | ug/kg | 340,000 | 200 | <140 | <101 |
| 2-Nitrophenol | ug/kg | none | none | <97.3 | <70.0 |
| 4-Nitrophenol | ug/kg | none | none | <93.3 | <67.1 |
| n-Nitrosodimethylamine | ug/kg | 700 | 700 | <137 | <98.7 |
| n-Nitroso-di-n-propylamine | ug/kg | 300 | 200 | <78.0 | <56.1 |
| n-Nitrosodiphenylamine | ug/kg | 390,000 | 200 | <158 | <114 |
| Pentachlorophenol | ug/kg | 10,000 | 300 | <125 | <89.9 |
| Phenol | ug/kg | 210,000,000 | 5,000 | <89.7 | <64.5 |
| 1,2,4-Trichlorobenzene | ug/kg | 820,000 | 400 | <137 | <98.5 |
| 2,4,5-Trichlorophenol | ug/kg | 68,000,000 | 44,000 | <86.4 | <62.1 |
| 2,4,6-Trichlorophenol | ug/kg | 74,000 | 200 | <84.7 | <60.9 |

**Table A10 - Peat Sample Analysis Results**
**Petroleum Hydrocarbons (NJDEP EPH) and Volatile Organic Compounds (EPA Method 8260B)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BD-04R-17-19-016 | BS-03R-13-15-038 | BS-07R-14-18-010 |
|---|---|---|---|---|---|---|
| Petroleum Hydrocarbons (EPH) | mg/kg | none | none | | <72.4 | 107 j |
| | | | | | | |
| Acetone | ug/kg | na | 12,000 | 31.6 | 38.4 b | 71.8 b |
| Benzene | ug/kg | 5 | 5 | 2.73 j | <1.66 | <6.09 |
| Bromochloromethane | ug/kg | none | none | <2.78 | <1.73 | <6.35 |
| Bromodichloromethane | ug/kg | 3 | 5 | <2.73 | <1.70 | <6.22 |
| Bromoform | ug/kg | 280 | 20 | <2.05 | <1.27 | <4.67 |
| Bromomethane | ug/kg | 59 | 30 | <3.61 | <2.24 | <8.23 |
| 2-Butanone | ug/kg | 44,000 | 600 | <5.34 | <3.32 | <12.2 |
| Carbon disulfide | ug/kg | 110,000 | 4,000 | 1,720 j | 21.2 | 391 |
| Carbon tetrachloride | ug/kg | 2 | 5 | <2.78 | <1.73 | <6.35 |
| Chlorobenzene | ug/kg | 7,400 | 400 | <2.84 | <1.77 | <6.48 |
| Chloroethane | ug/kg | 1,100 | na | <2.24 | <1.40 | 5.12 j |
| Chloroform | ug/kg | 2 | 200 | <2.41 | <1.50 | <5.51 |
| Chloromethane | ug/kg | 12 | na | <3.35 | <2.08 | <7.65 |
| Cyclohexane | ug/kg | none | none | <2.70 | <1.68 | <6.16 |
| Dibromochloromethane | ug/kg | 8 | 5 | <2.10 | <1.31 | <4.80 |
| 1,2-Dibromoethane | ug/kg | 0.04 | 5 | <2.50 | <1.55 | <5.70 |
| 1,2-Dibromo-3-chloropropane | ug/kg | 0.2 | 5 | <3.04 | <1.89 | <6.94 |
| 1,2-Dichlorobenzene | ug/kg | 59,000 | 11,000 | <2.78 | <1.73 | <6.35 |
| 1,3-Dichlorobenzene | ug/kg | 29,000 | 12,000 | <3.12 | <1.94 | <7.13 |
| 1,4-Dichlorobenzene | ug/kg | 13 | 1,000 | <3.32 | <2.07 | <7.58 |
| Dichlorodifluoromethane | ug/kg | 230,000 | 25,000 | <2.56 | <1.59 | <5.83 |
| 1,1-Dichloroethane | ug/kg | 24 | 200 | <2.98 | <1.85 | <6.81 |
| 1,2-Dichloroethane | ug/kg | 3 | 5 | <2.39 | <1.48 | <5.45 |
| 1,1-Dichloroethene | ug/kg | 50 | 5 | <3.18 | <1.98 | <7.26 |
| cis-1,2-Dichloroethene | ug/kg | 560 | 200 | <2.16 | <1.34 | <4.93 |
| trans-1,2-Dichloroethene | ug/kg | 720 | 400 | <2.84 | <1.77 | <6.48 |
| 1,2-Dichloropropane | ug/kg | 5 | 5 | <2.64 | <1.64 | <6.03 |
| cis-1,3-Dichloropropene | ug/kg | 7 | 5 | <2.30 | <1.43 | <5.25 |
| trans-1,3-Dichloropropene | ug/kg | 7 | 5 | <2.47 | <1.54 | <5.64 |
| 1,4-Dioxane | ug/kg | none | none | <122 | <75.8 | <278 |
| Ethyl benzene | ug/kg | 110,000 | 8,000 | <3.24 | <2.01 | <7.39 |
| 2-Hexanone | ug/kg | none | none | <5.57 | <3.46 | <12.7 |
| Isopropyl benzene | ug/kg | none | none | <3.10 | <1.93 | <7.07 |
| Methyl acetate | ug/kg | na | 14,000 | 40.5 | <1.89 | 23.0 j |
| Methyl tertiary butyl ether | ug/kg | 320 | 200 | <2.44 | <1.52 | <5.57 |
| Methylcyclohexane | ug/kg | none | none | <3.38 | <2.10 | <7.71 |
| Methylene chloride | ug/kg | 97 | 7 | <4.29 | <2.67 | <9.79 |
| 4-Methyl-2-pentanone | ug/kg | none | none | <4.80 | <2.99 | <11.0 |
| Styrene | ug/kg | 260 | 2,000 | <2.53 | <1.57 | <5.77 |
| 1,1,2,2-Tetrachloroethane | ug/kg | 3 | 5 | <2.61 | <1.63 | <5.96 |
| Tetrachloroethene | ug/kg | 5 | 5 | <3.10 | <1.93 | <7.07 |

**Table A10 - Peat Sample Analysis Results**
**Petroleum Hydrocarbons (NJDEP EPH) and Volatile Organic Compounds (EPA Method 8260B)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BD-04R-17-19-016 | BS-03R-13-15-038 | BS-07R-14-18-010 |
|---|---|---|---|---|---|---|
| Toluene | ug/kg | 91,000 | 4,000 | <3.27 | <2.03 | <7.45 |
| 1,2,3-Trichlorobenzene | ug/kg | none | none | <4.89 | <3.04 | <11.1 |
| 1,2,4-Trichlorobenzene | ug/kg | 820 | 400 | <3.78 | <2.35 | <8.62 |
| 1,1,1-Trichloroethane | ug/kg | 4,200 | 200 | <2.87 | <1.78 | <6.55 |
| 1,1,2-Trichloroethane | ug/kg | 6 | 10 | <2.81 | <1.75 | <6.42 |
| Trichloroethene | ug/kg | 20 | 7 | <3.55 | <2.21 | <8.10 |
| Trichlorofluoromethane | ug/kg | 340,000 | 22,000 | <3.10 | <1.93 | <7.07 |
| 1,1,2-Trichloro-1,2,2- trifluoroethane | ug/kg | none | none | <3.27 | <2.03 | <7.45 |
| Vinyl chloride | ug/kg | 2 | 5 | <3.29 | <2.05 | <7.52 |
| m&p-Xylenes | ug/kg | 170,000 | 12,000 | <6.56 | <4.08 | <15.0 |
| o-Xylene | ug/kg | 170,000 | 12,000 | <2.64 | <1.64 | <6.03 |

**Table A11 - Organic Clay Sample Analysis Results**
**Inorganics - EPA Methods 6010C, 7471B and 9010/9014**

| Parameter | Units | Non-Res Remed | Impact to GW Scr | BS-01-14-16-005 | BS-05-8-10-024 | ID-03R-22-24-035 |
|---|---|---|---|---|---|---|
| Aluminum | mg/kg | na | 3,900 | **12,800** | **13,800** | **9,780** |
| Antimony | mg/kg | 450 | 6 | <1.00 | <2.50 | <1.12 |
| Arsenic | mg/kg | 19 | 19 | 3.87 | 12.7 | 1.28 j |
| Barium | mg/kg | 59,000 | 1,300 | 141 | 74.9 | 20.5 |
| Beryllium | mg/kg | 140 | 0.5 | **0.822** | **0.648** | 0.332 |
| Calcium | mg/kg | none | none | 15,800 | 7,210 | 2,880 |
| Cadmium | mg/kg | 78 | 1 | <0.0255 | <0.0636 | <0.0309 |
| Chromium | mg/kg | none | none | 23.4 | 30.4 | 13.0 |
| Cobalt | mg/kg | 590 | 59 | 13.2 | 9.48 | 4.91 |
| Copper | mg/kg | 45,000 | 7,300 | 15.7 | 70.9 | 3.99 |
| Iron | mg/kg | none | none | 27,200 | 27,800 | 12,900 |
| Lead | mg/kg | 800 | 59 | 11.4 | 40.7 | 5.80 |
| Magnesium | mg/kg | none | none | 7,760 | 5,530 | 2,890 |
| Manganese | mg/kg | 5,900 | 42 | **775** | **260** | **97.8** |
| Mercury | mg/kg | 65 | 0.1 | 0.0681 | **0.495** | <0.0721 |
| Nickel | mg/kg | 23,000 | 31 | 26.7 | **31.2** | 7.82 |
| Potassium | mg/kg | none | none | 3,250 | 3,180 | 1,100 |
| Selenium | mg/kg | 5,700 | 7 | <0.413 | <1.03 | <0.500 |
| Silver | mg/kg | 5,700 | 1 | <0.0969 | <0.242 | <0.177 |
| Sodium | mg/kg | none | none | 302 | 11,000 | 4,070 |
| Thallium | mg/kg | 79 | 3 | <1.21 | <3.02 | <1.47 |
| Vanadium | mg/kg | 1,100 | none | 33.1 | 41.9 | 24.9 |
| Zinc | mg/kg | 110,000 | 600 | 62.2 | 138 | 20.8 |
| | | | | | | |
| Cyanide | mg/kg | 23,000 | 13 | <6.13 | **69.8** | N/A |

**Table A12 - Organic Clay Sample Analysis Results**
**Petroleum Hydrocarbons (NJDEP EPH)**

| Parameter | Units | Non-Res Remed Std | Impact to GW Scr Lvl | BS-05-8-10-024 |
|---|---|---|---|---|
| Petroleum Hydrocarbons (EPH) | mg/kg | none | none | 51.4 j |

# APPENDIX B

# SUMMARIES OF ANALYTICAL DATA FROM THE GROUNDWATER SAMPLES COLLECTED IN THE REMEDIAL INVESTIGATION

**Table B1 - Shallow Aquifer Groundwater Sample Analysis Results**
**Inorganics - EPA Methods 200.7, 245.1 and SN 4500CN C,E**

| Parameter | Units | GW Quality Criteria | 1S I027-1S-004 | 2D I027-2D-016 | 3D I027-3D-014 | 3D dup I027-3D-015 | 4S I027-4S-008 | 5D I027-5D-005 | 6S I027-6S-012 | 7S I027-7S-011 | 8S I027-8S-001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/l | 0.2 | <0.175 | <0.175 | <0.175 | <0.175 | 0.260 j | <0.175 | <0.175 | <0.175 | <0.175 |
| Antimony | mg/l | 0.006 | <0.0220 | <0.0220 | <0.0220 | <0.0220 | 0.0239 j | <0.0220 | <0.0220 | <0.0220 | <0.0220 |
| Arsenic | mg/l | 0.003 | 0.0669 j | 0.267 | <0.0283 | 0.0789 j | 0.332 | 0.139 | 0.0522 j | 0.0655 j | 0.0981 |
| Barium | mg/l | 6 | 0.5880 | 0.0263 j | 0.196 | 0.200 | 0.0319 j | 0.141 | 0.359 | 0.510 | 0.472 |
| Beryllium | mg/l | 0.001 | 0.0013 j | 0.001 j | 0.0012 j | 0.0012 j | 0.0019 j | 0.0012 j | 0.0015 j | 0.0013 j | 0.0011 j |
| Calcium | mg/l | none | 308 | 870 | 251 | 261 | 1,150 | 420 | 330 | 241 | 255 |
| Cadmium | mg/l | 0.004 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.0110 |
| Chromium | mg/l | none | 0.0118 j | 0.0099 j | 0.0101 j | 0.0127 j | 0.0027 j | 0.0049 j | 0.0093 j | 0.0067 j | 0.0104 j |
| Cobalt | mg/l | none | 0.0055 j | 0.0089 j | 0.0049 j | 0.0058 j | 0.0375 j | <0.0040 | <0.0040 | 0.0060 j | 0.0175 j |
| Copper | mg/l | 1.3 | 0.0149 j | 0.0137 j | 0.0224 j | 0.0221 j | 0.0757 | 0.0107 j | 0.0182 j | 0.0100 j | 0.0125 j |
| Iron | mg/l | 0.3 | 2.75 | 12.5 | 0.696 | 0.565 | 4.78 | 28.6 | 3.89 | 8.24 | 2.31 |
| Lead | mg/l | 0.005 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 |
| Magnesium | mg/l | none | 797 | 890 | 686 | 704 | 159 | 733 | 725 | 641 | 786 |
| Manganese | mg/l | 0.05 | 2.40 | 0.636 | 0.0364 j | 0.0368 j | 0.0514 j | 1.04 | 0.197 | 0.461 | 5.33 |
| Mercury | mg/l | 0.002 | 0.000022 j | 0.000046 j | 0.000033 j | 0.000037 j | 0.000042 j | 0.000021 j | 0.000021 j | 0.000025 j | <0.0000130 |
| Nickel | mg/l | 0.1 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | 0.0231 j | <0.00340 | <0.00340 | <0.00340 | <0.00340 |
| Potassium | mg/l | none | 218 | 98.4 | 221 | 231 | 164 | 190 | 162 | 169 | 172 |
| Selenium | mg/l | 0.04 | <0.0517 | 0.0636 j | 0.0558 j | 0.0558 j | 0.169 | 0.119 | <0.0517 | <0.0517 | <0.0517 |
| Silver | mg/l | 0.04 | 0.0069 j | 0.0128 j | 0.0060 j | <0.00510 | 0.0250 | 0.0074 j | 0.0073 j | 0.0128 j | 0.0064 j |
| Sodium | mg/l | 50 | 6,590 | 4,670 | 5,880 | 6,180 | 9,070 | 6,310 | 5,760 | 5,730 | 6,540 |
| Thallium | mg/l | 0.002 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 |
| Vanadium | mg/l | none | 0.0106 j | <0.00260 | 0.0029 j | 0.0032 j | <0.00260 | <0.00260 | 0.0061 j | 0.0093 j | <0.00260 |
| Zinc | mg/l | 2 | 0.101 | 0.0592 | 0.0442 j | 0.0355 j | 0.120 | 0.0345 | 0.0818 | 0.0245 j | 0.0322 j |
| | | | | | | | | | | | |
| Cyanide | mg/l | 0.1 | <0.0200 | 1.70 | <0.0200 | <0.0200 | 12.4 | <0.0200 | <0.0400 | <0.0250 | 0.0580 |

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**Table B2 - Shallow Aquifer Groundwater Sample Analysis Results**
**Polycyclic Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Parameter | Units | GW Quality Criteria | 1S I027-1S-004 | 2D I027-2D-016 | 3D I027-3D-014 | 3D dup I027-3D-015 | 4S I027-4S-008 | 5D I027-5D-005 | 6S I027-6S-012 | 7S I027-7S-011 | 8S I027-8S-001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | ug/l | none | <0.01 | <0.01 | 0.05 | 0.04 | 0.04 | <0.01 | <0.01 | 0.02 | <0.01 |
| Acenaphthylene | ug/l | 400 | <0.01 | <0.01 | <0.01 | <0.01 | 0.06 | <0.01 | <0.01 | <0.01 | <0.01 |
| Anthracene | ug/l | 2,000 | <0.01 | <0.01 | 0.02 | 0.01 j | 0.03 | <0.01 | 0.02 | <0.01 | <0.01 |
| Benzo(a)anthracene | ug/l | 0.1 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 |
| Benzo(b)fluoranthene | ug/l | 0.2 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(k)fluoranthene | ug/l | 0.5 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(a)pyrene | ug/l | 0.1 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(g,h,i)perylene | ug/l | none | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Chrysene | ug/l | 5 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 |
| Dibenz(a,h)anthracene | ug/l | 0.3 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Fluoranthene | ug/l | 300 | <0.02 | <0.02 | 0.03 | 0.03 | 0.05 | <0.02 | <0.02 | <0.02 | <0.02 |
| Fluorene | ug/l | 300 | <0.02 | <0.02 | 0.02 | 0.02 | 0.06 | <0.02 | <0.01 | <0.02 | <0.02 |
| Indeno(1,2,3-cd)pyrene | ug/l | 0.2 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 2-Methylnaphthalene | ug/l | none | 0.02 | <0.01 | 0.01 j | 0.01 j | 0.81 | <0.01 | 0.01 j | <0.01 | <0.01 |
| Naphthalene | ug/l | 300 | 0.02 | 0.01 j | 0.02 | 0.02 | 0.49 | <0.01 | 0.02 | <0.01 | <0.01 |
| Phenanthrene | ug/l | none | 0.02 | 0.02 | 0.04 | 0.03 | 0.07 | <0.01 | <0.02 | <0.01 | <0.01 |
| Pyrene | ug/l | 200 | <0.02 | <0.02 | 0.02 | <0.02 | 0.04 | 0.04 | <0.02 | <0.02 | <0.02 |

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**Table B3 - Shallow Aquifer Groundwater Sample Analysis Results**
**Petroleum Hydrocarbons (EPH) Method 1664 ASGT and Volatile Organic Compounds (VOCs) EPA Method 8260B**

| Parameter | Units | GW Quality Criteria | 1S I027-1S-004 | 2D I027-2D-016 | 3D I027-3D-014 | 3D dup I027-3D-015 | 4S I027-4S-008 | 5D I027-5D-005 | 6S I027-6S-012 | 7S I027-7S-011 | 8S I027-8S-001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Petroleum Hydrocarbons | mg/l | none | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 | <5.00 |
| Acetone | ug/l | 6,000 | <16.3 | <22.6 | <3.26 | <22.6 | 24.4 | <3.26 | <16.3 | <3.26 | <3.26 |
| Benzene | ug/l | 1 | <1.10 | <3.80 | <0.220 | <3.80 | <1.10 | <0.220 | <1.10 | <0.220 | <0.220 |
| Bromochloromethane | ug/l | none | <1.50 | <4.60 | <0.300 | <4.60 | <1.50 | <0.300 | <1.50 | <0.300 | <0.300 |
| Bromodichloromethane | ug/l | 1 | <1.05 | <3.50 | <0.210 | <3.50 | <1.05 | <0.210 | <1.05 | <0.210 | <0.210 |
| Bromoform | ug/l | 4 | <1.55 | <2.80 | <0.310 | <2.80 | <1.55 | <0.310 | <1.55 | <0.310 | <0.310 |
| Bromomethane | ug/l | none | <2.30 | <4.30 | <0.460 | <4.30 | <2.30 | <0.460 | <2.30 | <0.460 | <0.460 |
| 2-Butanone | ug/l | 300 | <7.20 | <20.1 | <1.44 | <20.1 | <7.20 | <1.44 | <7.20 | <1.44 | <1.44 |
| Carbon disulfide | ug/l | 700 | <3.20 | <6.20 | <0.640 | <6.20 | 25.7 | <0.640 | <3.20 | 1.02 j | <0.640 |
| Carbon tetrachloride | ug/l | 1 | <1.40 | <4.50 | <0.280 | <4.50 | <1.40 | <0.280 | <1.40 | <0.280 | <0.280 |
| Chlorobenzene | ug/l | 50 | <1.15 | <3.20 | <0.230 | <3.20 | <1.15 | <0.230 | <1.15 | <0.230 | <0.230 |
| Chloroethane | ug/l | none | <1.70 | <5.90 | <0.340 | <5.90 | <1.70 | <0.340 | <1.70 | <0.340 | <0.340 |
| Chloroform | ug/l | 70 | <1.15 | <3.40 | <0.230 | <3.40 | <1.15 | <0.230 | <1.15 | <0.230 | <0.230 |
| Chloromethane | ug/l | none | <1.60 | <4.30 | <0.320 | <4.30 | <1.60 | <0.320 | <1.60 | <0.320 | <0.320 |
| Cyclohexane | ug/l | none | <2.20 | <3.20 | <0.440 | <3.20 | <2.20 | <0.440 | <2.20 | <0.440 | <0.440 |
| Dibromochloromethane | ug/l | 1 | <0.700 | <3.70 | <0.140 | <3.70 | <0.700 | <0.140 | <0.700 | <0.140 | <0.140 |
| 1,2-Dibromoethane | ug/l | none | <1.05 | <3.70 | <0.210 | <3.70 | <1.05 | <0.210 | <1.05 | <0.210 | <0.210 |
| 1,2-Dibromo-3-chloropropane | ug/l | 0.02 | <2.35 | <6.60 | <0.470 | <6.60 | <2.35 | <0.470 | <2.35 | <0.470 | <0.470 |
| 1,2-Dichlorobenzene | ug/l | 600 | <1.00 | <3.50 | <0.200 | <3.50 | <1.00 | <0.200 | <1.00 | <0.200 | <0.200 |
| 1,3-Dichlorobenzene | ug/l | 600 | <1.05 | <3.50 | <0.210 | <3.50 | <1.05 | <0.210 | <1.05 | <0.210 | <0.210 |
| 1,4-Dichlorobenzene | ug/l | 75 | <0.850 | <3.70 | <0.170 | <3.70 | <0.850 | <0.170 | <0.850 | <0.170 | <0.170 |
| Dichlorodifluoro methane | ug/l | 1,000 | <2.15 | <3.60 | <0.430 | <3.60 | <2.15 | <0.430 | <2.15 | <0.430 | <0.430 |
| 1,1-Dichloroethane | ug/l | 50 | <1.20 | <4.00 | <0.240 | <4.00 | <1.20 | <0.240 | <1.20 | <0.240 | <0.240 |
| 1,2-Dichloroethane | ug/l | 2 | <1.20 | <4.40 | <0.240 | <4.40 | <1.20 | <0.240 | <1.20 | <0.240 | <0.240 |
| 1,1-Dichloroethene | ug/l | 1 | <1.55 | <3.20 | <0.310 | <3.20 | <1.55 | <0.310 | <1.55 | <0.310 | <0.310 |
| cis-1,2-Dichloroethene | ug/l | 70 | <1.40 | <3.30 | <0.280 | <3.30 | <1.40 | <0.280 | <1.40 | <0.280 | <0.280 |
| trans-1,2-Dichloroethene | ug/l | 100 | <0.700 | <4.10 | <0.140 | <4.10 | <0.700 | <0.140 | <0.700 | <0.140 | <0.140 |

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**Table B3 - Shallow Aquifer Groundwater Sample Analysis Results**
**Petroleum Hydrocarbons (EPH) Method 1664 ASGT and Volatile Organic Compounds (VOCs) EPA Method 8260B**

| Parameter | Units | GW Quality Criteria | 1S I027-1S-004 | 2D I027-2D-016 | 3D I027-3D-014 | 3D dup I027-3D-015 | 4S I027-4S-008 | 5D I027-5D-005 | 6S I027-6S-012 | 7S I027-7S-011 | 8S I027-8S-001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloropropane | ug/l | 1 | <1.00 | <5.70 | <0.200 | <5.70 | <1.00 | <0.200 | <1.00 | <0.200 | <0.200 |
| cis-1,3-Dichloropropene | ug/l | 1 | <1.10 | <3.40 | <0.220 | <3.40 | <1.10 | <0.220 | <1.10 | <0.220 | <0.220 |
| trans-1,3-Dichloropropene | ug/l | 1 | <1.10 | <2.70 | <0.220 | <2.70 | <1.10 | <0.220 | <1.10 | <0.220 | <0.220 |
| 1,4-Dioxane | ug/l | none | <643 | NA | NA | NA | <643 | <129 | <643 | <129 | <129 |
| Ethyl benzene | ug/l | 700 | <1.15 | <3.40 | <0.230 | <3.40 | <1.15 | <0.230 | <1.15 | <0.230 | <0.230 |
| 2-Hexanone | ug/l | none | <4.15 | <5.30 | <0.830 | <5.30 | <4.15 | <0.830 | <4.15 | <0.830 | <0.830 |
| Isopropyl benzene | ug/l | none | <1.35 | <2.90 | <0.270 | <2.90 | <1.35 | <0.270 | <1.35 | <0.270 | <0.270 |
| Methyl acetate | ug/l | 7,000 | <1.80 | <9.10 | <0.360 | <9.10 | <1.80 | <0.360 | <1.80 | <0.360 | <0.360 |
| Methyl tertiary butyl ether | ug/l | 70 | <1.00 | <3.10 | <0.200 | <3.10 | <1.00 | <0.200 | <1.00 | <0.200 | <0.200 |
| Methylcyclohexane | ug/l | none | <1.80 | <7.10 | <0.360 | <7.10 | <1.80 | <0.360 | <1.80 | <0.360 | <0.360 |
| Methylene chloride | ug/l | none | 3.60 j | <4.00 | <0.500 | <4.00 | 3.00 j | <0.500 | 3.100 j | <0.500 | <0.500 |
| 4-Methyl-2-pentanone | ug/l | none | <2.20 | <5.80 | <0.440 | <5.80 | <2.20 | <0.440 | <2.20 | <0.440 | <0.440 |
| Styrene | ug/l | 100 | <1.00 | <3.30 | <0.200 | <3.30 | <1.00 | <0.200 | <1.00 | <0.200 | <0.200 |
| 1,1,2,2-Tetrachloroethane | ug/l | 1 | <1.60 | <3.50 | <0.320 | <3.50 | <1.60 | <0.320 | <1.60 | <0.320 | <0.320 |
| Tetrachloroethene | ug/l | 1 | <1.85 | <3.60 | <0.370 | <3.60 | <1.85 | <0.370 | <1.85 | <0.370 | <0.370 |
| Toluene | ug/l | 600 | <0.950 | <3.70 | <0.190 | <3.70 | <0.950 | <0.190 | <0.950 | <0.190 | <0.190 |
| 1,2,3-Trichlorobenzene | ug/l | none | <1.55 | <3.80 | <0.310 | <3.80 | <1.55 | <0.310 | <1.55 | <0.310 | <0.310 |
| 1,2,4-Trichlorobenzene | ug/l | 9 | <1.80 | <1.60 | <0.360 | <1.60 | <1.80 | <0.360 | <1.80 | <0.360 | <0.360 |
| 1,1,1-Trichloroethane | ug/l | 30 | <1.05 | <3.40 | <0.210 | <3.40 | <1.05 | <0.210 | <1.05 | <0.210 | <0.210 |
| 1,1,2-Trichloroethane | ug/l | 3 | <1.20 | <3.80 | <0.240 | <3.80 | <1.20 | <0.240 | <1.20 | <0.240 | <0.240 |
| Trichloroethene | ug/l | 1 | <1.25 | <2.60 | <0.250 | <2.60 | <1.25 | <0.250 | <1.25 | <0.250 | <0.250 |
| Trichlorofluoromethane | ug/l | 2,000 | <1.90 | <4.30 | <0.380 | <4.30 | <1.90 | <0.380 | <1.90 | <0.380 | <0.380 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | ug/l | none | <2.35 | <4.90 | <0.470 | <4.90 | <2.35 | <0.470 | <2.35 | <0.470 | <0.470 |
| Vinyl chloride | ug/l | 1 | <1.20 | <3.90 | <0.240 | <3.90 | <1.20 | <0.240 | <1.20 | <0.240 | <0.240 |
| m&p-Xylenes | ug/l | 1,000 | <2.30 | <6.20 | <0.460 | <6.20 | <2.30 | <0.460 | <2.30 | <0.460 | <0.460 |
| o-Xylene | ug/l | 1,000 | <1.20 | <2.90 | <0.240 | <2.90 | <1.20 | <0.240 | <1.20 | <0.240 | <0.240 |


10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Table B4 - Brunswick Formation Aquifer Groundwater Sample Analysis Results**
**Inorganics - EPA Methods 200.7, 245.1 and SN 4500CN C,E**

| Parameter | Units | GW Quality Criteria | 1D I027-1D-003 | 2S I027-2S-017 | 3S I027-3S-013 | 4D I027-4D-007 | 5S I027-5S-006 | 6D I027-6D-013 | 7D I027-7D-009 | 7D dup I027-7D-010 | 8D I027-8D-002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/l | 0.2 | <0.175 | <0.175 | <0.175 | 0.207 j | <0.175 | <0.175 | <0.175 | <0.175 | <0.175 |
| Antimony | mg/l | 0.006 | <0.0220 | 0.0280 j | 0.0927 j | <0.0220 | <0.0220 | <0.0220 | <0.0220 | <0.0220 | 0.0529 j |
| Arsenic | mg/l | 0.003 | 0.287 | 0.133 | 0.151 | 0.425 | 0.0655 j | 0.180 | 0.208 | 0.145 | 0.138 |
| Barium | mg/l | 6 | 0.0612 j | 0.0444 j | 0.0938 j | 0.0535 j | 0.2480 | 0.0416 j | 0.0728 j | 0.0717 j | 0.0660 j |
| Beryllium | mg/l | 0.001 | 0.0014 j | 0.0014 j | 0.0014 j | 0.0014 j | 0.0014 j | 0.0015 j | 0.0015 j | 0.0018 j | 0.0018 j |
| Calcium | mg/l | none | 2,040 | 866 | 726 | 1,810 | 298 | 897 | 1,490 | 1,460 | 396 |
| Cadmium | mg/l | 0.004 | <0.001100 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 | <0.00110 |
| Chromium | mg/l | none | <0.00220 | <0.00220 | 0.0095 j | <0.00220 | 0.0191 j | 0.0028 j | <0.00220 | <0.00220 | 0.0029 j |
| Cobalt | mg/l | none | 0.0067 j | 0.0072 j | 0.0057 j | 0.0076 j | 0.0067 j | 0.0041 j | 0.0060 j | 0.0067 j | 0.0041 j |
| Copper | mg/l | 1.3 | 0.0058 j | 0.0063 j | 0.0187 j | 0.0070 j | 0.0390 | 0.0091 j | 0.0093 j | 0.0044 j | 0.0113 j |
| Iron | mg/l | 0.3 | 34.2 | 12.8 | 7.13 | 17.8 | 1.30 | 10.4 | 39.6 | 35.3 | 5.84 |
| Lead | mg/l | 0.005 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 | <0.0175 |
| Magnesium | mg/l | none | 535 | 593 | 648 | 576 | 777 | 677 | 569 | 559 | 640 |
| Manganese | mg/l | 0.05 | 4.60 | 1.19 | 0.708 | 0.835 | 0.0023 j | 0.633 | 1.24 | 1.15 | 0.608 |
| Mercury | mg/l | 0.002 | 0.000023 j | 0.000020 j | 0.000033 j | 0.000030 j | 0.000033 j | 0.000027 j | 0.000021 j | 0.000030 j | 0.000021 j |
| Nickel | mg/l | 0.1 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | <0.00340 | <0.00340 |
| Potassium | mg/l | none | 29.1 | 56.6 | 143 | 47.8 | 233 | 67.0 | 33.2 | 32.8 | 104 |
| Selenium | mg/l | 0.04 | 0.148 | <0.0517 | 0.101 | 0.183 | 0.0647 j | 0.0642 j | 0.112 | <0.0517 | 0.0717 j |
| Silver | mg/l | 0.04 | 0.0347 | 0.0189 j | 0.0172 j | 0.0295 | 0.0075 j | 0.0195 j | 0.0279 | 0.0246 | 0.0112 j |
| Sodium | mg/l | 50 | 3,450 | 5,740 | 5,640 | 4,550 | 6,710 | 4,630 | 3,970 | 3,860 | 6,430 |
| Thallium | mg/l | 0.002 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 | <0.0324 |
| Vanadium | mg/l | none | <0.00260 | <0.00260 | 0.0043 j | <0.00260 | 0.0075 j | <0.00260 | <0.00260 | <0.00260 | <0.00260 |
| Zinc | mg/l | 2 | 0.0758 | 0.0532 | 0.0784 | 0.0658 | 0.0472 j | <0.00260 | 0.0748 | 0.0664 | 0.0331 j |
| | | | | | | | | | | | |
| Cyanide, Total | mg/l | 0.1 | <0.0200 | <0.0400 | 0.0960 | 0.391 | 0.0810 | <0.0400 | <0.0250 | <0.0200 | <0.0200 |

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**Table B5 - Brunswick Formation Aquifer Groundwater Sample Analysis Results**
**Polycyclic Aromatic Hydrocarbons (PAHs) - EPA Method 8270C**

| Parameter | Units | GW Quality Criteria | 1D I027-1D-003 | 2S I027-2S-017 | 3S I027-3S-013 | 4D I027-4D-007 | 5S I027-5S-006 | 6D I027-6D-013 | 7D I027-7D-009 | 7D dup I027-7D-010 | 8D I027-8D-002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | ug/l | | 0.03 | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.02 |
| Acenaphthylene | ug/l | 400 | 0.03 | <0.01 | <0.01 | <0.01 | <0.10 | <0.01 | <0.01 | <0.01 | <0.01 |
| Anthracene | ug/l | 2,000 | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 |
| Benzo(a)anthracene | ug/l | 0.1 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(b)fluoranthene | ug/l | 0.2 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(k)fluoranthene | ug/l | 0.5 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(a)pyrene | ug/l | 0.1 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Benzo(g,h,i)perylene | ug/l | none | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| Chrysene | ug/l | 5 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Dibenz(a,h)anthracene | ug/l | 0.3 | 0.03 | <0.02 | <0.02 | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Fluoranthene | ug/l | 300 | 0.03 | <0.02 | 0.02 | <0.02 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Fluorene | ug/l | 300 | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 |
| Indeno(1,2,3-cd)pyrene | ug/l | 0.2 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 2-Methylnaphthalene | ug/l | none | 0.03 | <0.01 | 0.03 | <0.01 | 0.01 j | <0.01 | <0.01 | 0.03 | 0.02 |
| Naphthalene | ug/l | 300 | 0.02 | 0.01 j | 0.03 | <0.01 | 0.02 | <0.01 | 0.01 j | <0.01 | 0.02 |
| Phenanthrene | ug/l | none | 0.04 | 0.04 | 0.02 | <0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 |
| Pyrene | ug/l | 200 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |

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**Table B6 - Brunswick Formation Aquifer Groundwater Sample Analysis Results**
**Volatile Organic Compounds (VOCs) EPA Method 8260B**

| Parameter | Units | GW Quality Criteria | 1D I027-1D-003 | 2S I027-2S-017 | 3S I027-3S-013 | 4D I027-4D-007 | 5S I027-5S-006 | 6D I027-6D-013 | 7D I027-7D-009 | 7D dup I027-7D-010 | 8D I027-8D-002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acetone | ug/l | 6,000 | <3.26 | <22.6 | <22.6 | <3.26 | <3.26 | <3.26 | <3.26 | <3.26 | <3.26 |
| Benzene | ug/l | 1 | <0.220 | <3.80 | <3.80 | <0.220 | <0.220 | <0.220 | <0.220 | <0.220 | <0.220 |
| Bromochloromethane | ug/l | none | <0.300 | <4.60 | <4.60 | <0.300 | <0.300 | <0.300 | <0.300 | <0.300 | <0.300 |
| Bromodichloromethane | ug/l | 1 | <0.210 | <3.50 | <3.50 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 |
| Bromoform | ug/l | 4 | <0.310 | <2.80 | <2.80 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 |
| Bromomethane | ug/l | none | <0.460 | <4.30 | <4.30 | <0.460 | <0.460 | <0.430 | <0.460 | <0.460 | 0.610 jb |
| 2-Butanone | ug/l | 300 | <1.44 | <20.1 | <20.1 | <1.44 | <1.44 | <1.44 | <1.44 | <1.44 | <1.44 |
| Carbon disulfide | ug/l | 700 | <0.640 | <6.20 | <6.20 | <0.640 | 2.39 | <0.640 | <0.640 | <0.640 | <0.640 |
| Carbon tetrachloride | ug/l | 1 | <0.280 | <4.50 | <4.50 | <0.280 | <0.280 | <0.280 | <0.280 | <0.280 | <0.280 |
| Chlorobenzene | ug/l | 50 | <0.230 | <3.20 | <3.20 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 |
| Chloroethane | ug/l | none | <0.340 | <5.90 | <5.90 | <0.340 | <0.340 | <0.340 | <0.340 | <0.340 | <0.340 |
| Chloroform | ug/l | 70 | <0.230 | <3.40 | <3.40 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 |
| Chloromethane | ug/l | none | <0.320 | <4.30 | <4.30 | <0.320 | <0.320 | <0.320 | <0.320 | <0.320 | <0.320 |
| Cyclohexane | ug/l | none | <0.440 | <3.20 | <3.20 | <0.440 | <0.440 | <0.440 | <0.440 | <0.440 | <0.440 |
| Dibromochloromethane | ug/l | 1 | <0.140 | <3.70 | <3.70 | <0.140 | <0.140 | <0.140 | <0.140 | <0.140 | <0.140 |
| 1,2-Dibromoethane | ug/l | none | <0.210 | <3.70 | <3.70 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 |
| 1,2-Dibromo-3-chloropropane | ug/l | 0.02 | <0.470 | <6.60 | <6.60 | <0.470 | <0.470 | <0.470 | <0.470 | <0.470 | <0.470 |
| 1,2-Dichlorobenzene | ug/l | 600 | <0.200 | <3.50 | <3.50 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 |
| 1,3-Dichlorobenzene | ug/l | 600 | <0.210 | <3.50 | <3.50 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 |
| 1,4-Dichlorobenzene | ug/l | 75 | <0.170 | <3.70 | <3.70 | <0.170 | <0.170 | <0.170 | <0.170 | <0.170 | <0.170 |
| Dichlorodifluoro methane | ug/l | 1,000 | <0.430 | <3.60 | <3.60 | <0.430 | <0.430 | <0.430 | <0.430 | <0.430 | <0.430 |
| 1,1-Dichloroethane | ug/l | 50 | <0.240 | <4.00 | <4.00 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 |
| 1,2-Dichloroethane | ug/l | 2 | <0.240 | <4.40 | <4.40 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 |
| 1,1-Dichloroethene | ug/l | 1 | <0.310 | <3.20 | <3.20 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 |
| cis-1,2-Dichloroethene | ug/l | 70 | <0.280 | <3.30 | <3.30 | <0.280 | <0.280 | <0.280 | <0.280 | <0.280 | <0.280 |
| trans-1,2-Dichloroethene | ug/l | 100 | <0.140 | <4.10 | <4.10 | <0.140 | <0.140 | <0.140 | <0.140 | <0.140 | <0.140 |

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**Table B6 - Brunswick Formation Aquifer Groundwater Sample Analysis Results**
**Volatile Organic Compounds (VOCs) EPA Method 8260B**

| Parameter | Units | GW Quality Criteria | 1D I027-1D-003 | 2S I027-2S-017 | 3S I027-3S-013 | 4D I027-4D-007 | 5S I027-5S-006 | 6D I027-6D-013 | 7D I027-7D-009 | 7D dup I027-7D-010 | 8D I027-8D-002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloropropane | ug/l | 1 | <0.200 | <5.70 | <5.70 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 |
| cis-1,3-Dichloropropene | ug/l | 1 | <0.220 | <3.40 | <3.40 | <0.220 | <0.220 | <0.220 | <0.220 | <0.220 | <0.220 |
| trans-1,3-Dichloropropene | ug/l | 1 | <0.220 | <2.70 | <2.70 | <0.220 | <0.220 | <0.270 | <0.220 | <0.220 | <0.220 |
| 1,4-Dioxane | ug/l | none | <129 | NA | NA | <129 | <129 | <129 | <129 | <129 | <129 |
| Ethyl benzene | ug/l | 700 | <0.230 | <3.40 | <3.40 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 | <0.230 |
| 2-Hexanone | ug/l | none | <0.830 | <5.30 | <5.30 | <0.830 | <0.830 | <0.830 | <0.830 | <0.830 | <0.830 |
| Isopropyl benzene | ug/l | none | <0.270 | <2.90 | <2.90 | <0.270 | <0.270 | <0.270 | <0.270 | <0.270 | <0.270 |
| Methyl acetate | ug/l | 7,000 | <0.360 | <9.10 | <9.10 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 |
| Methyl tertiary butyl ether | ug/l | 70 | <0.200 | <3.10 | <3.10 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 |
| Methylcyclohexane | ug/l | none | <0.360 | <7.10 | <7.10 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 |
| Methylene chloride | ug/l | none | <0.500 | <4.00 | <4.00 | <0.500 | <0.500 | <0.500 | <0.500 | <0.500 | <0.500 |
| 4-Methyl-2-pentanone | ug/l | none | <0.440 | <5.80 | <5.80 | <0.440 | <0.440 | <0.440 | <0.440 | <0.440 | <0.44 |
| Styrene | ug/l | 100 | <0.200 | <3.30 | <3.30 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 | <0.200 |
| 1,1,2,2-Tetrachloroethane | ug/l | 1 | <0.320 | <3.50 | <3.50 | <0.320 | <0.320 | <0.320 | <0.320 | <0.320 | <0.320 |
| Tetrachloroethene | ug/l | 1 | <0.370 | <3.60 | <3.60 | <0.370 | <0.370 | <0.370 | <0.370 | <0.370 | <0.370 |
| Toluene | ug/l | 600 | <0.190 | <3.70 | <3.70 | <0.190 | <0.190 | <0.190 | <0.190 | <0.190 | <0.190 |
| 1,2,3-Trichlorobenzene | ug/l | none | <0.310 | <3.80 | <3.80 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 | <0.310 |
| 1,2,4-Trichlorobenzene | ug/l | 9 | <0.360 | <1.60 | <1.60 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 | <0.360 |
| 1,1,1-Trichloroethane | ug/l | 30 | <0.210 | <3.40 | <3.40 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 | <0.210 |
| 1,1,2-Trichloroethane | ug/l | 3 | <0.240 | <3.80 | <3.80 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 |
| Trichloroethene | ug/l | 1 | <0.250 | <2.60 | <2.60 | <0.250 | <0.250 | <0.250 | <0.250 | <0.250 | <0.250 |
| Trichlorofluoromethane | ug/l | 2,000 | <0.380 | <4.30 | <4.30 | <0.380 | <0.380 | <0.380 | <0.380 | <0.380 | <0.380 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | ug/l | none | <0.470 | <4.90 | <4.90 | <0.470 | <0.470 | <0.470 | <0.470 | <0.470 | <0.470 |
| Vinyl chloride | ug/l | 1 | <0.240 | <3.90 | <3.90 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 |
| m&p-Xylenes | ug/l | 1,000 | <0.460 | <6.20 | <6.20 | <0.460 | <0.460 | <0.460 | <0.460 | <0.460 | <0.460 |
| o-Xylene | ug/l | 1,000 | <0.240 | <2.90 | <2.90 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 | <0.240 |

# APPENDIX C

# SUMMARIES OF ANALYTICAL DATA FROM PRIOR INVESTIGATIONS

**Table C1 - Analytical Data from the NJDEP 1991 Investigation**

| Parameter | Units | Boring Location | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | S-1 | S-2 | S-3 | S-5 | S-6 | S-7 | S-8 |
| **Metals/Inorganics (EPA Methods 6010, 6020 and 7471)** | | | | | | | | |
| Aluminum | mg/kg | 16,400 | 27,700 | 25,800 | 27,200 | 21,400 | 10,400 | 4,450 |
| Antimony | mg/kg | 3.1 | 3.8 | 4.0 | 4.5 | 9.9 | <4.1 | 2.9 |
| Arsenic | mg/kg | 8.0 | 8.9 | 3.0 | 3.5 | 3.5 | <0.94 | <0.98 |
| Barium | mg/kg | 113 | 61.4 | 49.4 | 59.2 | 41.1 | 78.1 | 45.0 |
| Beryllium | mg/kg | 1.2 | 0.94 | 0.56 | 1.0 | 0.81 | 0.6 | 0.4 |
| Cadmium | mg/kg | <0.41 | <0.60 | <0.64 | <0.71 | <0.78 | <0.66 | <0.69 |
| Calcium | mg/kg | 8,690 | 167,000 | 195,000 | 208,000 | 219,000 | 247,000 | 194,000 |
| Chromium (total) | mg/kg | 24.7 | 27.1 | 26.1 | 25.0 | 18.8 | 12.9 | 6.7 |
| Cobalt | mg/kg | 13.1 | 4.4 | 2.4 | 6.3 | 4.8 | <1.6 | <1.6 |
| Copper | mg/kg | 127 | 3.2 | 10.7 | 15.5 | <0.44 | 2.2 | <0.39 |
| Iron | mg/kg | 18,200 | 10,700 | 9,060 | 10,400 | 8,850 | 742 | 1,360 |
| Lead | mg/kg | 174 | 44.6 | 32.3 | 40.9 | 28.9 | 18.3 | 10.7 |
| Magnesium | mg/kg | 4,320 | 13,900 | 15,700 | 12,300 | 31,500 | 752 | 1,650 |
| Manganese | mg/kg | 260 | 310 | 269 | 296 | 281 | 11.4 | 38.8 |
| Mercury | mg/kg | 0.19 | 0.69 | 0.36 | <0..19 | <0.22 | <0.17 | <0.20 |
| Nickel | mg/kg | 27.5 | 4.0 | 6.6 | 13.3 | <4.9 | 7.2 | <4.3 |
| Potassium | mg/kg | 2,920 | 474 | <176 | 774 | 473 | 348 | <189 |
| Selenium | mg/kg | <0.59 | <8.6 | <9.1 | <10.0 | <11.0 | <9.4 | <9.8 |
| Silver | mg/kg | <0.54 | <0.79 | <0.84 | <0.94 | <1.0 | <0.86 | <0.90 |
| Sodium | mg/kg | 1,980 | 2,340 | 3,600 | 2,750 | 11,300 | 2,110 | 5,210 |
| Thallium | mg/kg | <0.59 | <0.86 | <0.91 | <1.0 | <1.1 | <0.94 | <0.98 |
| Vanadium | mg/kg | 30 | 38.3 | 30.0 | 30.2 | 31.5 | 12.3 | 9.9 |
| Zinc | mg/kg | 914 | 38.5 | 29.4 | 32.0 | 15.6 | 3.4 | <0.75 |
| **Cyanide (EPA Method 9010/9014)** | | | | | | | | |
| Cyanide | mg/kg | 3.9 | 337 | 472 | 768 | 153 | 9.7 | 403 |



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Table C1 - Analytical Data from the NJDEP 1991 Investigation**

| Parameter | Units | Boring Location | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | S-1 | S-2 | S-3 | S-5 | S-6 | S-7 | S-8 |
| **Polynuclear Aromatic Hydrocarbons (EPA Method 8270)** | | | | | | | | |
| Acenaphthylene | ug/kg | 89 | <570 | <600 | <670 | <730 | <620 | <650 |
| Acenaphthene | ug/kg | 1,300 | <570 | <600 | 11 | <730 | <620 | <650 |
| Anthracene | ug/kg | 1,400 | 7 | <600 | 18 | <730 | <620 | <650 |
| Benzo(a) anthracene | ug/kg | 2,100 | 19 | 25 | 38 | <730 | <620 | <650 |
| Benzo(a)pyrene | ug/kg | 1,800 | <570 | <600 | <670 | <730 | <620 | <650 |
| Benzo(b) fluoranthene | ug/kg | 1,200 | <570 | <600 | <670 | <730 | <620 | <650 |
| Benzo(k) fluoranthene | ug/kg | 1,400 | <570 | <600 | <670 | <730 | <620 | <650 |
| Benzo(g,h,i) perylene | ug/kg | 1,100 | <570 | <600 | <670 | <730 | <620 | <650 |
| Chrysene | ug/kg | 2,600 | 21 | 30 | 45 | <730 | <620 | <650 |
| Dibenzo(a,h) anthracene | ug/kg | 3,220 | <570 | <600 | <670 | <730 | <620 | <650 |
| Fluoranthene | ug/kg | 4,100 | 44 | 56 | 90 | 22 | <620 | <650 |
| Fluorene | ug/kg | 1,300 | <570 | <600 | <670 | <730 | <620 | <650 |
| Ideno(1,2,3-cd) pyrene | ug/kg | 590 | <570 | <600 | <670 | <730 | <620 | <650 |
| 2-Methylnaphthalene | ug/kg | 1,500 | 5 | 13 | 12 | 11 | <620 | <650 |
| Naphthalene | ug/kg | 610 | 19 | 332 | <670 | <730 | <620 | <650 |
| Phenanthrene | ug/kg | 4,400 | 44 | 31 | 86 | 21 | <620 | <650 |
| Pyrene | ug/kg | 5,100 | 34 | 44 | 77 | 16 | <620 | <650 |
| **Semi-Volatile Organic Compounds (EPA Method 8270)** | | | | | | | | |
| Butyl benzyl phthalate | ug/kg | 290 | <570 | 41 | <670 | 20 | <620 | <650 |
| Bis(2-ethylhexyl) phthalate | ug/kg | 390 | 200 | 150 | 190 | 200 | 110 | 100 |
| Carbazole | ug/kg | 470 | <570 | <600 | <670 | <730 | <620 | <650 |
| Dibenzofuran | ug/kg | 970 | 3 | <600 | 5 | <730 | <620 | <650 |
| Di-n-butylphthalate | ug/kg | 310 | 340 | 340 | 350 | 610 | 410 | 430 |
| Hexachlorobenzene | ug/kg | <780 | 56 | 170 | 110 | 59 | <620 | <650 |
| Pentachlorophenol | ug/kg | <780 | <570 | <600 | <670 | 41 | <620 | <650 |
| All other compounds | ug/kg | <RL | <RL | <RL | <RL | <RL | <RL | <RL |
| **Pesticides (EPA Method 8081)** | | | | | | | | |
| All compounds | ug/kg | <RL | <RL | <RL | <RL | <RL | <RL | <RL |
| **PCBs (EPA Method 8082)** | | | | | | | | |
| All compounds | ug/kg | <RL | <RL | <RL | <RL | <RL | <RL | <RL |



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Table C1 - Analytical Data from the NJDEP 1991 Investigation**

| Parameter | Units | Boring Location | | | |
|---|---|---|---|---|---|
| | | S-9 | S-10 | S-11 | S-12 |
| **Metals/Inorganics (EPA Methods 6010, 6020 and 7471)** | | | | | |
| Aluminum | mg/kg | 3,260 | 15,900 | 11,700 | 8,870 |
| Antimony | mg/kg | <4.2 | 8.8 | <4.5 | <4.3 |
| Arsenic | mg/kg | <0.95 | 2.2 | 1.2 | 1.6 |
| Barium | mg/kg | 105 | 40.7 | 21.9 | 64.5 |
| Beryllium | mg/kg | 0.70 | 1.2 | 0.8 | 1.0 |
| Cadmium | mg/kg | <0.67 | <0.76 | <0.72 | <0.68 |
| Calcium | mg/kg | 233,000 | 264,000 | 218,000 | 264,000 |
| Chromium (total) | mg/kg | 12.0 | 25.1 | 16.4 | 16.7 |
| Cobalt | mg/kg | 4.0 | 5.5 | 2.3 | 3.3 |
| Copper | mg/kg | 4.9 | 11.1 | 1.5 | 11.7 |
| Iron | mg/kg | 3,070 | 5,880 | 2,780 | 3,930 |
| Lead | mg/kg | 21.4 | 25.9 | 12.6 | 30 |
| Magnesium | mg/kg | 3,270 | 12,600 | 2,570 | 4,390 |
| Manganese | mg/kg | 53.1 | 253 | 55.3 | 97.7 |
| Mercury | mg/kg | <0.19 | <0.22 | <0.21 | <0.19 |
| Nickel | mg/kg | 6.7 | 6.7 | <4.5 | 6.5 |
| Potassium | mg/kg | 412 | 300 | <198 | 469 |
| Selenium | mg/kg | <9.5 | <11.0 | <1.0 | <9.7 |
| Silver | mg/kg | <0.88 | <0.99 | <0.95 | <0.89 |
| Sodium | mg/kg | 12,100 | 1,740 | 1,200 | 11,800 |
| Thallium | mg/kg | <0.95 | <1.1 | <1.0 | <0.97 |
| Vanadium | mg/kg | 17.4 | 31.3 | 19.6 | 30.0 |
| Zinc | mg/kg | 10.5 | 22.4 | 2.5 | 25.9 |
| **Cyanide (EPA Method 9010/9014)** | | | | | |
| Cyanide | mg/kg | 972 | 1,020 | 68.7 | 103 |

## Table C1 - Analytical Data from the NJDEP 1991 Investigation

| Parameter | Units | Boring Location | | | |
|---|---|---|---|---|---|
| | | S-9 | S-10 | S-11 | S-12 |
| **Polynuclear Aromatic Hydrocarbons (EPA Method 8270)** | | | | | |
| Acenaphthylene | ug/kg | <630 | <720 | <670 | <630 |
| Acenaphthene | ug/kg | <630 | <720 | <670 | <630 |
| Anthracene | ug/kg | <630 | <720 | <670 | <630 |
| Benzo(a) anthracene | ug/kg | <630 | <720 | <670 | <630 |
| Benzo(a)pyrene | ug/kg | <630 | <720 | <670 | <630 |
| Benzo(b) fluoranthene | ug/kg | <630 | <720 | <670 | <630 |
| Benzo(k) fluoranthene | ug/kg | <630 | <720 | <670 | <630 |
| Benzo(g,h,i) perylene | ug/kg | <630 | <720 | <670 | <630 |
| Chrysene | ug/kg | <630 | <720 | <670 | <630 |
| Dibenzo(a,h) anthracene | ug/kg | <630 | <720 | <670 | <630 |
| Fluoranthene | ug/kg | <630 | <720 | <670 | <630 |
| Fluorene | ug/kg | <630 | <720 | <670 | <630 |
| Ideno(1,2,3-cd) pyrene | ug/kg | <630 | <720 | <670 | <630 |
| 2-Methylnaphthalene | ug/kg | <630 | 7 | <670 | <630 |
| Naphthalene | ug/kg | <630 | <720 | <670 | <630 |
| Phenanthrene | ug/kg | <630 | <720 | <670 | 15 |
| Pyrene | ug/kg | <630 | <720 | <670 | 17 |
| **Semi-Volatile Organic Compounds (EPA Method 8270)** | | | | | |
| Butyl benzyl phthalate | ug/kg | <630 | <720 | <670 | 16 |
| Bis(2-ethylhexyl) phthalate | ug/kg | 150 | 150 | 110 | 240 |
| Carbazole | ug/kg | <630 | <720 | <670 | <630 |
| Dibenzofuran | ug/kg | <630 | <720 | <670 | <630 |
| Di-n-butylphthalate | ug/kg | 620 | 1,000 | 640 | 680 |
| Hexachlorobenzene | ug/kg | <630 | <720 | <670 | <630 |
| Pentachlorophenol | ug/kg | <630 | <720 | <670 | <630 |
| All other compounds | ug/kg | <RL | <RL | <RL | <RL |
| **Pesticides (EPA Method 8081)** | | | | | |
| All compounds | ug/kg | <RL | <RL | <RL | <RL |
| **PCBs (EPA Method 8082)** | | | | | |
| All compounds | ug/kg | <RL | <RL | <RL | <RL |

**Table C2 - Analytical Data from the New Jersey Turnpike**
**Tremley Point Connector Investigation**

| Parameter | Units | Boring Location | | |
|---|---|---|---|---|
| | | E-1 | E-2 | E-3 |
| **Petroleum Hydrocarbons (EPA Method 8015)** | | | | |
| Diesel Range Organics | mg/kg | 119 | <53 | 551 |
| **Metals/Inorganics (EPA Methods 6010, 6020 and 7471)** | | | | |
| Antimony | mg/kg | <1.2 | <2.1 | <1.1 |
| Arsenic | mg/kg | 10.4 | 6.5 | 1.3 |
| Beryllium | mg/kg | <0.59 | <1.0 | <0.56 |
| Cadmium | mg/kg | 1.5 | 2.7 | 0.56 |
| Chromium (total) | mg/kg | 28.2 | 20.6 | 20.6 |
| Copper | mg/kg | 99.8 | 21.5 | 28.7 |
| Lead | mg/kg | 222 | 52.7 | 56.1 |
| Mercury | mg/kg | 0.26 | 0.13 | 0.24 |
| Nickel | mg/kg | 18.0 | 15.5 | 12.0 |
| Selenium | mg/kg | <1.2 | <2.1 | <1.1 |
| Silver | mg/kg | <1.2 | <2.1 | <1.1 |
| Thallium | mg/kg | <1.2 | <2.1 | <1.1 |
| Zinc | mg/kg | 186 | 1,820 | 50.1 |
| **Cyanide (EPA Method 9010/9014)** | | | | |
| Cyanide | mg/kg | 0.47 | 84.80 | 0.65 |
| **Polynuclear Aromatic Hydrocarbons (EPA Method 8270)** | | | | |
| Acenaphthylene | ug/kg | 30.2 | <140 | 38.0 |
| Acenaphthene | ug/kg | 29.7 | <140 | 427 |
| Anthracene | ug/kg | 101 | <140 | 1,040 |
| Benzo(a) anthracene | ug/kg | 225 | 33.8 | 1,960 |
| Benzo(a)pyrene | ug/kg | 253 | <140 | 1,700 |
| Benzo(b) fluoranthene | ug/kg | 199 | <140 | 950 |
| Benzo(k) fluoranthene | ug/kg | 249 | <140 | 2,560 |
| Benzo(g,h,i) perylene | ug/kg | 91.6 | <140 | 728 |
| Chrysene | ug/kg | 246 | 55.9 | 1,820 |
| Dibenzo(a,h) anthracene | ug/kg | <82 | <140 | 129 |
| Fluoranthene | ug/kg | 447 | 87.4 | 3,650 |
| Fluorene | ug/kg | 23.4 | <140 | 331 |
| Ideno(1,2,3-cd) pyrene | ug/kg | 82.9 | <140 | 605 |
| Naphthalene | ug/kg | <82 | <140 | 88.5 |
| Phenanthrene | ug/kg | 288 | 52.3 | 2,540 |
| Pyrene | ug/kg | 515 | 83.9 | 7,940 |
| **Semi-Volatile Organic Compounds (EPA Method 8270)** | | | | |
| Butyl benzyl phthalate | ug/kg | <82 | <140 | 2,260 |
| Bis(2-ethylhexyl) phthalate | ug/kg | 217 | 283 | 6,990 |
| All other compounds | ug/kg | <RL | <RL | <RL |

**Table C2 - Analytical Data from the New Jersey Turnpike**
**Tremley Point Connector Investigation**

| Parameter | Units | Boring Location | | |
|---|---|---|---|---|
| | | E-1 | E-2 | E-3 |
| **Volatile Organic Compounds (EPA Method 8260)** | | | | |
| All compounds | ug/kg | <RL | <RL | <RL |
| **Pesticides (EPA Method 8081)** | | | | |
| 4,4'-DDT | ug/kg | 2.1 | <8.3 | <1.5 |
| Dieldrin | ug/kg | 4.0 | <8.3 | <1.5 |
| All other compounds | ug/kg | <RL | <RL | <RL |
| **PCBs (EPA Method 8082)** | | | | |
| All compounds | ug/kg | <40 | <210 | <38 |

## Table C3 - Summary of Fill Investigation Analytical Results for PAHs and S-VOCs

| Parameter | Units | TP-01<br>TP01-16<br>8-10 ft | TP-02<br>TP02-17<br>2-3 ft | TP-02A<br>TP02A-18<br>1-2 ft | TP-03<br>TP03-15<br>1-2 ft | TP-05<br>TP05-10<br>2-3 ft | TP-06<br>TP06-14<br>3-4 ft | TP-07<br>TP07-09<br>4-5 ft | TP-08<br>TP08-11<br>1-2 ft | TP-09<br>TP09-07<br>2-3 ft | TP-10<br>TP10-06<br>4-5 ft | TP-11<br>TP11-05<br>2-3 ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatic Hydrocarbons (EPA Method 8270)** | | | | | | | | | | | | |
| Acenaphthylene | ug/kg | <32.8 | <165 | 85.3 | <95.1 | 171 | <159 | <34.4 | 782 | <165 | <65.6 | 195 |
| Acenaphthene | ug/kg | <34.3 | <173 | <33.9 | <99.7 | 318 | <167 | <36.0 | 709 | <173 | <68.8 | 379 |
| Anthracene | ug/kg | 34.1 | 161 | 67.4 | <62.5 | 932 | <105 | <22.6 | 2,980 | 366 | <43.1 | 850 |
| Benzo(a) anthracene | ug/kg | 90.8 | 608 | 411 | 303 | 2,090 | <299 | <64.4 | 9,840 | 674 | <123 | 2,510 |
| Benzo(a)pyrene | ug/kg | 88.6 | 608 | 447 | 277 | 2,060 | <254 | <54.8 | 8,560 | 468 | <105 | 2,530 |
| Benzo(b) fluoranthene | ug/kg | 93.1 | 700 | 496 | 350 | 1,600 | <274 | <59.1 | 10,000 | 514 | <113 | 2,480 |
| Benzo(k) fluoranthene | ug/kg | 74.9 | 448 | 391 | 323 | 2,070 | <307 | <66.3 | 2,070 | 503 | <126 | 2,490 |
| Benzo(g,h,i) perylene | ug/kg | <40.2 | 241 | 247 | <117 | 853 | <196 | <42.1 | 3,590 | <202 | <80.4 | 1,160 |
| Chrysene | ug/kg | 343 | 711 | 460 | 343 | 2,150 | <334 | <72.0 | 10,200 | 800 | <137 | 2,660 |
| Dibenzo(a,h) anthracene | ug/kg | <53.1 | <269 | 71.8 | <154 | <266 | <259 | <55.8 | 1,640 | <267 | <106 | 402 |
| Fluoranthene | ug/kg | 191 | 1,180 | 788 | 482 | 3,950 | <330 | <71.0 | 22,300 | 1,720 | <136 | 5,500 |
| Fluorene | ug/kg | <38.5 | <195 | <38.1 | <112 | 546 | <188 | <40.4 | 1,170 | 297 | <77.1 | 482 |
| Ideno(1,2,3-cd) pyrene | ug/kg | <45.0 | 287 | 220 | <131 | 773 | <219 | <47.2 | 3,520 | <226 | <90.1 | 1,070 |
| 2-Methylnaphthalene | ug/kg | <40.2 | <203 | <39.7 | <117 | 341 | <196 | <42.1 | <216 | <202 | <80.4 | 310 |
| Naphthalene | ug/kg | <41.2 | <208 | <40.7 | <120 | 341 | <200 | <43.2 | <221 | <207 | <82.4 | 471 |
| Phenanthrene | ug/kg | 120 | 746 | 344 | 178 | 3,530 | <213 | <22.6 | 12,100 | 1,770 | <87.4 | 3,480 |
| Pyrene | ug/kg | 213 | 1,070 | 739 | 594 | 2,090 | 354 | <63.4 | 19,800 | 1,520 | <121 | 4,860 |
| **Semi-Volatile Organic Compounds (EPA Method 8270)** | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | ug/kg | | | | | | | | | | | |
| Dimethyl phthalate | ug/kg | | | | | | | | | | | |
| All other compounds | ug/kg | | | | | | | | | | | |

Samples collected March 29-30, 2011



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

## Table C3 - Summary of Fill Investigation Analytical Results for PAHs and S-VOCs

| Parameter | Units | TP-12<br>TP12-12<br>2-3 ft | TP-12A<br>TP12A-13<br>0-1 ft | TP-13<br>TP13-20<br>2-3 ft | TP-14<br>TP14-19<br>0-1 ft | TP-15<br>TP15-04<br>4-5 ft | TP-16<br>TP16-03<br>4-5 ft | TP-17<br>TP17-02<br>3-4 ft | TP-18<br>TP18-01<br>4-5 ft | TP-19<br>TP19-08<br>2-3 ft | HA-22<br>HA22-21<br>0-1 ft |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatic Hydrocarbons (EPA Method 8270)** | | | | | | | | | | | |
| Acenaphthylene | ug/kg | <35.2 | 219 | 921 | <264 | <70.4 | 2,240 | 66.9 | | 80.8 | <139 |
| Acenaphthene | ug/kg | <36.9 | 323 | 8,480 | <325 | <73.8 | 8,070 | 298 | | 71.8 | <145 |
| Anthracene | ug/kg | 29.3 | 1,240 | 18,200 | <350 | 83.0 | 24,500 | 762 | | 269 | 144 |
| Benzo(a) anthracene | ug/kg | 112 | 6,880 | 54,200 | <252 | 332 | 60,200 | 2,220 | | 979 | 635 |
| Benzo(a)pyrene | ug/kg | 97.6 | 3,610 | 49,700 | <248 | 332 | 59,300 | 1,970 | | 916 | 615 |
| Benzo(b) fluoranthene | ug/kg | 142 | 7,040 | 46,700 | 222 | 464 | 51,600 | 1,740 | | 696 | 952 |
| Benzo(k) fluoranthene | ug/kg | 115 | 6,580 | 46,200 | <268 | 278 | 52,300 | 1,740 | | 813 | 548 |
| Benzo(g,h,i) perylene | ug/kg | <43.2 | 2,740 | 21,500 | <228 | 137 | 23,100 | 914 | | 314 | 288 |
| Chrysene | ug/kg | 127 | 6,860 | 52,600 | <241 | 425 | 57,000 | 2,120 | | 1,090 | 702 |
| Dibenzo(a,h) anthracene | ug/kg | <57.1 | 1,420 | 11,800 | <187 | <114 | 13,500 | 533 | | <105 | <225 |
| Fluoranthene | ug/kg | 181 | 12,900 | 118,000 | 308 | 644 | 127,000 | 4,390 | | 1,680 | 1,230 |
| Fluorene | ug/kg | <41.4 | 254 | 6,460 | <232 | <82.8 | 9,200 | 302 | | 94.3 | <163 |
| Ideno(1,2,3-cd) pyrene | ug/kg | <48.3 | 2,760 | 20,600 | <242 | 122 | 23,200 | 930 | | 287 | 279 |
| 2-Methylnaphthalene | ug/kg | <43.2 | <204 | 1,090 | <298 | <86.3 | 465 | <40.8 | | <79.4 | <170 |
| Naphthalene | ug/kg | <44.2 | <209 | 2,020 | <366 | <88.4 | 747 | 152 | | <81.4 | <174 |
| Phenanthrene | ug/kg | 95.2 | 4,080 | 62,800 | <250 | 376 | 66,100 | 2,580 | | 1,050 | 567 |
| Pyrene | ug/kg | 200 | 12,900 | 117,000 | <279 | 600 | 106,000 | 3,500 | | 2,100 | 1,290 |
| **Semi-Volatile Organic Compounds (EPA Method 8270)** | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | ug/kg | | | | 312 | | | | | | |
| Dimethyl phthalate | ug/kg | | | | 1,130 | | | | | | |
| All other compounds | ug/kg | | | | <RL | | | | | | |

Samples collected March 29-30, 2011

***EastStar Environmental Group, Inc.***
www.EastStarEnv.com

10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

## Table C4 - Summary of Fill Investigation Analytical Results for Metals, Cyanide and TPH

| Parameter | Units | TP-01<br>TP01-16<br>8-10 ft | TP-02<br>TP02-17<br>2-3 ft | TP-02A<br>TP02A-18<br>1-2 ft | TP-03<br>TP03-15<br>1-2 ft | TP-05<br>TP05-10<br>2-3 ft | TP-06<br>TP06-14<br>3-4 ft | TP-07<br>TP07-09<br>4-5 ft | TP-08<br>TP08-11<br>1-2 ft | TP-09<br>TP09-07<br>2-3 ft | TP-10<br>TP10-06<br>4-5 ft | TP-11<br>TP11-05<br>2-3 ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Petroleum Hydrocarbons (EPA Method 8015)** | | | | | | | | | | | | |
| Diesel Range | mg/kg | | | | <264 | <273 | | | | | <273 | <276 |
| **Metals/Inorganics (EPA Methods 6010, 6020 and 7471)** | | | | | | | | | | | | |
| Arsenic | mg/kg | 5.33 | 8.76 | 4.68 | 5.94 | 6.94 | 5.52 | 6.22 | 4.05 | 10.1 | 6.01 | 10.2 |
| Barium | mg/kg | 105 | 101 | 258 | 75.4 | 140 | 51.3 | 122 | 63.3 | 75.3 | 114 | 261 |
| Cadmium | mg/kg | <0.0159 | <0.0161 | <0.0157 | <0.0154 | <0.0159 | <0.0155 | <0.0167 | <0.0171 | <0.0160 | <0.0256 | <0.0161 |
| Chromium (total) | mg/kg | 22.6 | 20.3 | 26.0 | 22.5 | 23.1 | 13.0 | 23.2 | 15.3 | 13.4 | 20.6 | 21.0 |
| Lead | mg/kg | 18.5 | 172 | 102 | 45 | 190 | 66.0 | 21.5 | 44.7 | 792 | 17.5 | 296 |
| Mercury | mg/kg | 0.333 | 0.683 | 0.101 | 0.211 | 0.191 | <0.0343 | <0.0369 | <0.0379 | <0.0354 | <0.0352 | 1.47 |
| Selenium | mg/kg | <0.933 | <0.943 | <0.923 | <0.904 | <0.935 | <0.909 | <0.980 | <1.00 | <0.939 | <0.684 | <0.944 |
| Silver | mg/kg | <0.126 | <0.127 | <0.125 | <0.122 | <0.126 | <0.123 | <0.132 | <0.136 | <0.127 | <0.0973 | <0.127 |
| **Cyanide (EPA Method 9010/9014)** | | | | | | | | | | | | |
| Cyanide | mg/kg | | | | | | | | | | | |

Samples collected March 29-30, 2011

## Table C4 - Summary of Fill Investigation Analytical Results for Metals, Cyanide and TPH

| Parameter | Units | TP-12<br>TP12-12<br>2-3 ft | TP-12A<br>TP12A-13<br>0-1 ft | TP-13<br>TP13-20<br>2-3 ft | TP-14<br>TP14-19<br>0-1 ft | TP-15<br>TP15-04<br>4-5 ft | TP-16<br>TP16-03<br>4-5 ft | TP-17<br>TP17-02<br>3-4 ft | TP-18<br>TP18-01<br>4-5 ft | TP-19<br>TP19-08<br>2-3 ft | HA-22<br>HA22-21<br>0-1 ft |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Petroleum Hydrocarbons (EPA Method 8015)** | | | | | | | | | | | |
| Diesel Range | mg/kg | | | 1,360 | | <293 | 1,530 | <277 | | <269 | <1,150 |
| **Metals/Inorganics (EPA Methods 6010, 6020 and 7471)** | | | | | | | | | | | |
| Arsenic | mg/kg | 6.14 | 5.84 | 4.69 | 9.97 | 11.4 | 11.0 | 5.34 | 7.18 | 4.34 | 32.5 |
| Barium | mg/kg | 95.1 | 339.0 | 148 | 236 | 154 | 94.7 | 170 | 57.7 | 85.2 | 111 |
| Cadmium | mg/kg | <0.0171 | <0.0161 | <0.0167 | 0.179 | 5.91 | <0.0171 | <0.0162 | <0.0158 | <0.0157 | <0.0673 |
| Chromium (total) | mg/kg | 29.5 | 18.9 | 24.8 | 10.1 | 19.5 | 18.5 | 21.4 | 18.3 | 20.3 | 64.9 |
| Lead | mg/kg | 55.8 | 142 | 68.2 | 100 | 226 | 173 | 112 | 50.3 | 26.7 | 221 |
| Mercury | mg/kg | 0.0537 | 0.148 | 0.34 | 1.17 | 0.217 | 7.61 | 0.848 | 0.266 | <0.0348 | 2.24 |
| Selenium | mg/kg | <1.00 | <0.948 | <0.983 | 2.18 | <1.00 | <1.01 | <0.949 | <0.926 | <0.923 | <3.95 |
| Silver | mg/kg | <0.135 | <0.128 | <0.133 | <0.217 | <0.135 | <0.136 | <0.128 | <0.125 | <0.125 | <0.534 |
| **Cyanide (EPA Method 9010/9014)** | | | | | | | | | | | |
| Cyanide | mg/kg | | | 4.95 | | | | | | | |

Samples collected March 29-30, 2011



10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Table C6 - Sludge and Impoundment Water Sampling - February 21, 2012**
**Initial Sample Results - Inorganics**

| Location | Sludge Samples | | | | | Water Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Impound 3 | Impound 4 | Impound 5 | Remediation Standards | | Impound 3 | Impound 3 | Impound 4 | Impound 6 | Water Quality |
| Sample Number | M12-014 | M12-008 | M12-011 | Direct Contact | Impact to GW | M12-020 | M12-021 | M12-004 | M12-002 | Criteria |
| | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | ug/l | ug/l | ug/l | ug/l | ug/l |
| **Metals** | | | | | | | | | | |
| Aluminum | **25,000** | **42,400** | **21,400** | | 3,900 | 247 | 770 | 280 | 195 | |
| Antimony | <1.16 | <1.45 | <1.29 | 450 | 6 | <5.30 | <5.30 | <5.30 | <5.30 | 640 |
| Arsenic | 9.07 | 4.54 | 9.92 | 19 | 19 | <5.80 | <5.80 | **6.70** | <5.80 | 0.061 |
| Barium | 46.6 | 38.4 | 214 | 59,000 | 1,300 | 35.8 | 50.0 | 40.0 | 16.1 | |
| Beryllium | 0.234 | 0.0707 | <0.145 | 140 | 0.5 | <0.120 | <0.120 | <0.120 | <0.120 | 42 |
| Cadmium | <0.0554 | <0.0692 | 0.422 | 78 | 1 | <0.280 | <0.280 | <0.280 | <0.280 | 8.8 |
| Calcium | 253,000 | 212,000 | 717 | | | 417,000 | 341,000 | 395,000 | 225,000 | |
| Chromium | 28.3 | 36.4 | 7.25 | | | 5.50 | 8.60 | 4.70 | <0.310 | 750 |
| Cobalt | 6.59 | 8.23 | 6.62 | 590 | 59 | 7.10 | 5.70 | 7.60 | 1.90 | |
| Copper | 13 | 16.4 | 9.80 | 45,000 | 7,300 | <0.580 | <0.580 | **3.10** | 3.00 | 3.1 |
| Iron | 7,820 | 9,880 | 3,420 | | | 18,600 | 13,700 | 17,900 | 248 | |
| Lead | 17.0 | 14.1 | **91.9** | 800 | 59 | 21.2 | **31.0** | **28.5** | 21.4 | 24 |
| Magnesium | 17,000 | 17,200 | 69.1 | | | 310,000 | 388,000 | 312,000 | 41,600 | |
| Manganese | **332** | **314** | **102** | 5,900 | 42 | 76.5 | 92.7 | 74.0 | 45.6 | 100 |
| Mercury | **0.229** | **0.116** | **0.110** | 65 | 0.1 | <0.0470 | 0.0500 | <0.0470 | <0.0470 | 0.051 |
| Nickel | 10.7 | 20.3 | 2.71 | 23,000 | 31 | 1.10 | 1.40 | 0.930 | <0.770 | 22 |
| Potassium | 200 | 244 | 1,470 | | | 44,000 | 120,000 | 43,600 | 7,190 | |
| Selenium | 1.52 | 2.46 | <1.46 | 5,700 | 7 | 29.9 | <95.7 | 23.0 | <9.60 | 71 |
| Silver | <0.107 | <0.134 | <0.120 | 5,700 | 1 | <0.780 | <0.780 | <0.780 | <0.780 | 1.9 |
| Sodium | 1,830.0 | 1,300 | 1,330 | | | 1,180,000 | 2,450,000 | 1,170,000 | 49,500 | |
| Thallium | <0.867 | <1.08 | <0.968 | 79 | 3 | <6.20 | **7.10** | **9.40** | **6.50** | 0.47 |
| Vanadium | 39.6 | 48.3 | 30.0 | 1,100 | | <0.950 | 2.30 | 1.10 | <0.950 | |
| Zinc | 42.7 | 39.3 | 12.9 | 110,000 | 600 | 3.60 | 10.5 | 11.4 | 8.50 | 81 |
| **Cyanide** | **M12-015** | **M12-009** | **M12-012** | | | **M12-017** | **M12-016** | **M12-005** | **M12-003** | |
| Total Cyanide | **1,570** | **1,420** | **547** | 23,000 | 13 | **43,200** | **4,030** | **3,980** | 29.0 | 140 |

**Notes:**

1. Sludge sample analysis results are reported on a dry weight basis.
2. Results with a less than sign indicate that the paramter was not detected at the laboratory reporting limit.
3. Remediation Standard for sludge samples is the Non-residential Direct Contact Soil Remediation Standard from NJAC 7:26D.
4. Impact to Groundwater standards are the Default Impact to Groundwater Soil Screening Levels from SRP Guidance Document "Development of Site Specific Impact to Groundwater Soil Remediation Standards Using the Soil Water Partitioing Equation", December 2008
5. Water Quality Criteria for water samples is Surface Water Quality Criteria for Toxic Substances for saline (SE) water from NJAC 7:9B.
6. Results shown in **bold** exceed one or more applicable standards.

**Table C7 - Sludge and Lagoon Sampling - February 21, 2112**

**Initial Sample Results - PAHs**

| Location | Sludge Samples | | | | | Water Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Impound 3 | Impound 4 | Impound 5 | Remediation Standard | | Impound 3 | Impound 3 | Impound 4 | Impound 6 | Water Quality Criteria |
| Sample Number | M12-013 | M12-007 | M12-010 | Direct Contact | Impact to GW | M12-018 | M12-019 | M12-006 | M12-001 | |
| | ug/kg | ug/kg | ug/kg | ug/kg | ug/kg | ug/l | ug/l | ug/l | ug/l | ug/l |
| Acenaphthylene | <249 | <280 | <267 | 300,000,000 | | <0.700 | <0.700 | <0.700 | <0.700 | |
| Acenapthene | <306 | <345 | <345 | 37,000,000 | 74,000 | <0.750 | <0.750 | <0.750 | <0.750 | 990 |
| Anthracene | <331 | <372 | <355 | 30,000,000 | 1,500,000 | <0.770 | <0.770 | <0.770 | <0.770 | 40,000 |
| Benzo(a)anthracene | <238 | <268 | <255 | 2,000 | 500 | <0.750 | <0.750 | <0.750 | <0.750 | 0.18 |
| Benzo(b)fluoranthene | <197 | <222 | <212 | 2,000 | 2,000 | <0.970 | <0.970 | <0.970 | <0.970 | 0.18 |
| Benzo(k)fluoranthene | <253 | <285 | <272 | 23,000 | 16,000 | <0.680 | <0.680 | <0.680 | <0.680 | 1.8 |
| Benzo(a)pyrene | <234 | <264 | <251 | 200 | 200 | <0.630 | <0.630 | <0.630 | <0.630 | 0.018 |
| Benzo(g,h,i)perylene | <215 | <242 | <231 | 30,000,000 | | <0.790 | <0.790 | <0.790 | <0.790 | |
| Chrysene | <228 | <256 | <244 | 230,000 | 52,000 | <0.620 | <0.620 | <0.620 | <0.620 | 18 |
| Dibenz(a,h)anthracene | <177 | <199 | <190 | 200 | 500 | <0.520 | <0.520 | <0.520 | <0.520 | 0.018 |
| Fluoranthene | <214 | <241 | <230 | 24,000,000 | 840,000 | <0.560 | <0.560 | <0.560 | <0.560 | 140 |
| Flourene | <219 | <246 | <235 | 24,000,000 | 110,000 | <0.650 | <0.650 | <0.650 | <0.650 | 5,300 |
| Indeno(1,2,3-CD)pyrene | <228 | <257 | <245 | 2,000 | 5,000 | <0.570 | <0.570 | <0.570 | <0.570 | 0.18 |
| Naphthalene | <345 | <389 | <371 | 17,000 | 16,000 | <0.860 | <0.860 | <0.860 | <0.860 | |
| Phenanthrene | <236 | <265 | <253 | 300,000,000 | | <0.650 | <0.650 | <0.650 | <0.650 | |
| 2-Methylnaphthalene | <281 | <317 | <302 | 2,400,000 | 5,000 | <0.800 | <0.800 | <0.800 | <0.800 | |
| Pyrene | <263 | <296 | <282 | 18,000,000 | 550,000 | <0.670 | <0.670 | <0.670 | <0.670 | 4,000 |

**Notes:**

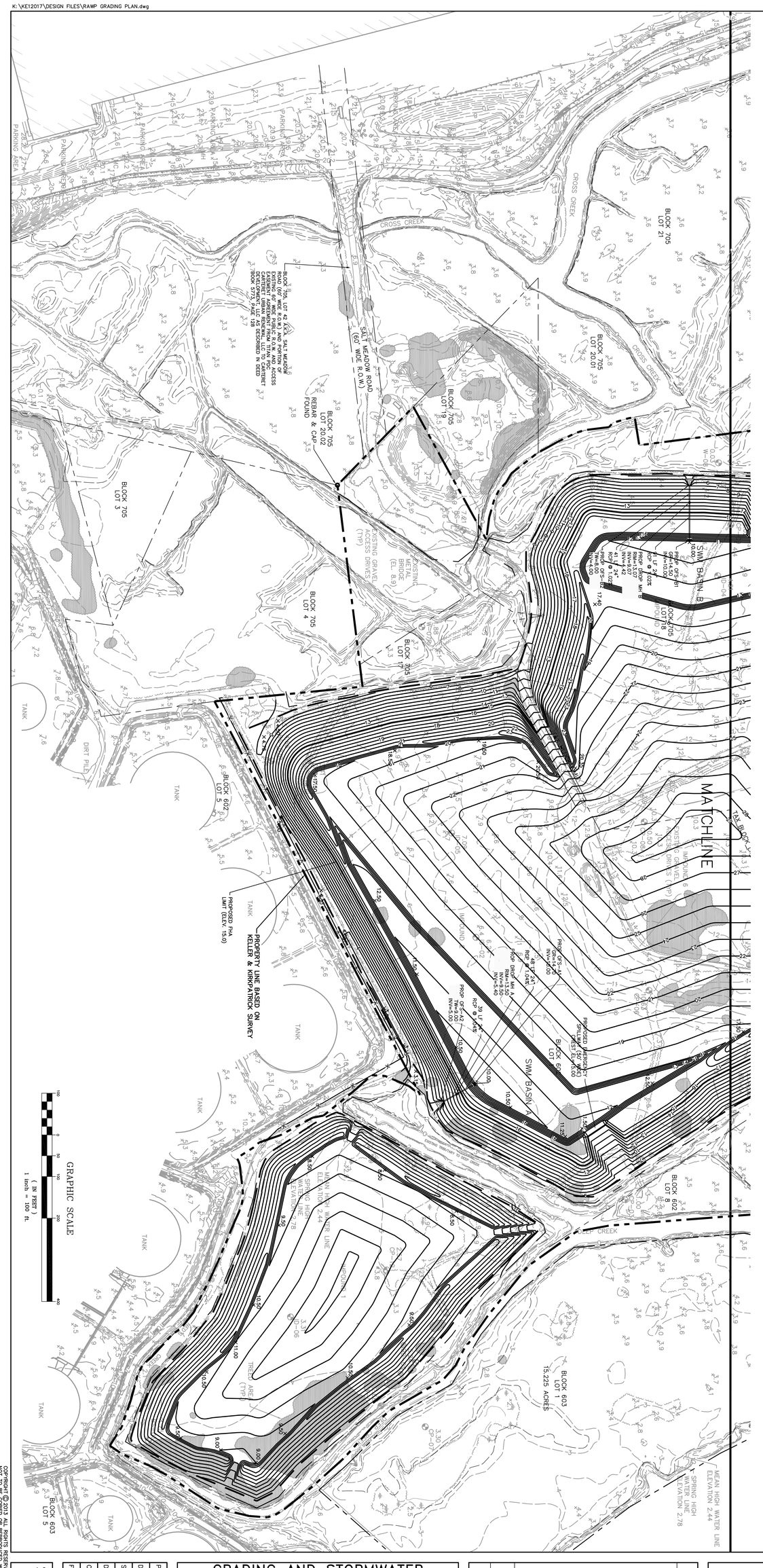
1. Sludge sample analysis results are reported on a dry weight basis.
2. Results with a less than sign indicate that the paramter was not detected at the laboratory reporting limit.
3. The laboratory reporting limits reported for these analyses are the method detection limits.
4. Remediation Standard for sludge samples is the Non-residential Direct Contact Soil Remediation Standard, NJAC 7:26D
5. Impact to Groundwater standards are the Default Impact to Groundwater Soil Screening Levels from SRP Guidance Document "Development of Site Specific Impact to Groundwater Soil
6. Water Quality Criteria for water samples is Surface Water Quality Criteria for Toxic Substances for saline (SE) water, NJAC 7:9B.

# APPENDIX D

## CAP DESIGN DRAWINGS

(see enclosed packet containing drawings)

K:\KE12017\DESIGN FILES\RAWP GRADING PLAN.dwg




**SITE MAP**
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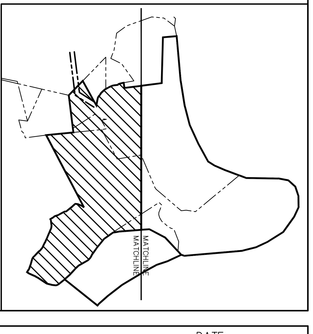




SHEET NO. 2 OF 2

PROJECT NO.: KE12017
DATE: NOVEMBER 20, 2012
SCALE: 1" = 100'
DRAWN BY: CRC
CHECKED BY: PJP
FILE: RAWP GRADING PLAN.dwg

# GRADING AND STORMWATER MANAGEMENT PLAN

## RAHWAY ARCH PROPERTIES – SITE REMEDIATION

SALT MEADOW ROAD
BLOCK 602, LOT(S) 1 AND 8; BLOCK 603, LOT 1;
AND BLOCK 705, LOT(S) 17 AND 18
BOROUGH OF CARTERET, MIDDLESEX COUNTY, NEW JERSEY

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| 2 | 5/16/13 | REVISED FLOOD HAZARD AREA PER FEMA'S ABFE MAPPING AND CLASS B FACILITY LAYOUT PER NJDEP LAND USE REVIEW | CRC |
| 1 | 1/23/13 | REVISED PER NJDEP'S DEFICIENCY LETTER DATED 12/28/12 | CRC |

kernan CONSULTING ENGINEERS
J. Timothy Kernan, Inc.
KINGSWAY COMMONS
935 KINGS HIGHWAY ▼ SUITE 100
THOROFARE ▼ NEW JERSEY ▼ 08086
(856) 251-9500 ▼ FAX (856) 853-1310
CERTIFICATE OF AUTHORIZATION #24GA28040800, EXP. DATE 8/31/14

DATE:

PAMELA J. PELLEGRINI
PROFESSIONAL ENGINEER, N.J. LICENSE No. 40878
PROFESSIONAL PLANNER, N.J. LICENSE No. 05836

# GRADING AND STORMWATER MANAGEMENT PLAN

## RAHWAY ARCH PROPERTIES - SITE REMEDIATION

SALT MEADOW ROAD
BLOCK 602, LOT(S) 1 AND 8; BLOCK 603, LOT 1;
AND BLOCK 705, LOT(S) 17 AND 18
BOROUGH OF CARTERET, MIDDLESEX COUNTY, NEW JERSEY

| | |
|---|---|
| PROJECT NO.: | KEI2017 |
| DATE: | NOVEMBER 20, 2012 |
| SCALE: | 1" = 100' |
| DRAWN BY: | CRC |
| CHECKED BY: | PJP |
| FILE: | RAMP GRADING PLAN.dwg |

SHEET NO.
1 OF 2

| REV. | DATE | DESCRIPTION | BY |
|---|---|---|---|
| 1 | 1/23/13 | REVISED PER N.J.D.E.P.'S DEFICIENCY LETTER DATED 12/28/12 | CRC |
| 2 | 5/16/13 | REVISED FLOOD HAZARD AREA PER FEMA'S ABFE MAPPING AND CLASS B FACILITY LAYOUT PER NJDEP LAND USE REVIEW | CRC |


kernan
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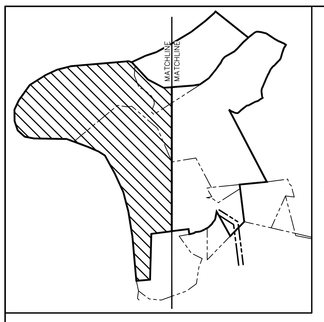
THOROFARE ▲ NEW JERSEY ▲ 08086
(856) 251-9500 ▲ FAX (856) 853-1310


CERTIFICATE OF AUTHORIZATION #24GA28048000, EXP. DATE 8/31/14

PAMELA J. PELLEGRINI
PROFESSIONAL ENGINEER, N.J. LICENSE No. 40878
PROFESSIONAL PLANNER, N.J. LICENSE No. 05836

DATE:

SITE MAP
SCALE: 1"=800'







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# APPENDIX E

# DRAFT DEED NOTICE

DEED NOTICE

This shell document contains blanks and matter in brackets [ ]. These blanks shall be replaced with the required site information prior to recording.

Matter bracketed [ ] is not intended for deletion, but rather is intended to be descriptive of the variable information that may be contained in the final document.

IN ACCORDANCE WITH N.J.S.A. 58:10B-13, THIS DOCUMENT IS TO BE RECORDED IN THE SAME MANNER AS ARE DEEDS AND OTHER INTERESTS IN REAL PROPERTY.

Prepared by: _____
[Signature]

____Albert P. Free, P.E., CSP, LSRP_____
[Print name below signature]

Recorded by: _____
[Signature, Officer of County Recording Office]

_____
[Print name below signature]

DEED NOTICE

This Deed Notice is made as of the _____ day of _____, ____, by Rahway Arch Properties, LLC, located at 7 Nottingham Drive, Florham Park, New Jersey 07932; and the Borough of Carteret, located at 61 Cooke Avenue, Carteret, New Jersey 07008 *[Insert the full legal name and address of each current property owner*] (together with his/her/its/their successors and assigns, collectively "Owner").

1. THE PROPERTY. Rahway Arch Properties, LLC, located at 7 Nottingham Drive, Florham Park, New Jersey 07932; and the Borough of Carteret, located at 61 Cooke Avenue, Carteret, New Jersey 07008 [*Insert the full legal name and address of each current property owner*] are [*Insert as appropriate: "is", or "are"*] the owner in fee simple of certain real property designated as Block(s) 602, Lot 1; Block 603, Lots 1 and 8 and Block 705, Lots 17 and 18 on the tax map of the Borough [*Insert, as appropriate: City/Borough/Township/Town*] of Carteret [*Insert the name of municipality*], Middlesex [*Insert the name of county*] County; the New Jersey Department of Environmental Protection Program Interest Number (Preferred ID) for the contaminated site which includes this property is G000007844 [*Insert the Program Interest Number (Preferred ID)*]; and the property is more particularly described in Exhibit A, which is attached hereto and made a part hereof (the "Property").

2. REMEDIATION.

i. Albert P. Free, LSRP License Number 575600 [*Insert name of the Licensed Site Remediation Professional and LSRP License No. of the LSRP that approved this Deed Notice*] has approved this Deed Notice as an institutional control for the Property, which is part of the remediation of the Property.

ii. N.J.A.C. 7:26C-7 requires the Owner, among other persons, to obtain a soil remedial action permit for the soil remedial action at the Property. That permit will contain the monitoring, maintenance and biennial certification requirements that apply to the Property.

3. SOIL CONTAMINATION. Rahway Arch Properties, LLC [*Insert the full legal name of the person that was responsible for conducting the remediation*] has remediated contaminated soil at the Property, such that soil contamination remains in certain areas of the Property that contains contaminants in concentrations that do not allow for the unrestricted use of the Property; this soil contamination is described, including the type, concentration and specific location of such contaminants, in Exhibit B, which is attached hereto and made a part hereof. As a result, there is a statutory requirement for this Deed Notice and engineering controls [*include if appropriate:* and engineering controls] in accordance with N.J.S.A. 58:10B-13.

4. CONSIDERATION. In accordance with the remedial action for the site which included the Property, and in consideration of the terms and conditions of that remedial action, and other good and valuable consideration, Owner has agreed to subject the Property to certain statutory and regulatory requirements that impose restrictions upon the use of the Property, to restrict certain uses of the Property, and to provide notice to subsequent owners, lessees and operators of the restrictions and the monitoring, maintenance, and biennial certification requirements outlined in this Deed Notice and required by law, as set forth herein.

5A. RESTRICTED AREAS. Due to the presence of contamination remaining at concentrations that do not allow for unrestricted use, the Owner has agreed, as part of the remedial action for the Property, to restrict the use of certain parts of the Property (the "Restricted Areas"); a narrative description of these restrictions is provided in Exhibit C, which is attached hereto and made a part hereof. The Owner has also agreed to maintain a list of these restrictions on site for inspection by governmental officials.

5B. RESTRICTED LAND USES. The following statutory land use restrictions apply to the Restricted Areas:

i. The Brownfield and Contaminated Site Remediation Act, N.J.S.A. 58:10B-12.g(10), prohibits the conversion of a contaminated site, remediated to non-residential soil remediation standards that require the maintenance of engineering or institutional controls, to a child care facility, or public, private, or charter school without the Department’s prior written approval, unless a presumptive remedy is implemented; and

ii. The Brownfield and Contaminated Site Remediation Act, N.J.S.A. 58:10B-12.g(12), prohibits the conversion of a landfill, with gas venting systems and or leachate collection systems, to a single family residence or a child care facility without the Department's prior written approval.

[*Insert the following paragraph when engineering controls are also implemented at the site:*

5C. ENGINEERING CONTROLS. Due to the presence and concentration of these contaminants, the Owner has also agreed, as part of the remedial action for the Property, to the placement of certain engineering controls on the Property; a narrative description of these engineering controls is provided in Exhibit C.]

6A. CHANGE IN OWNERSHIP AND REZONING.

i. The Owner and the subsequent owners and lessees, shall cause all leases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring all holders thereof to take the Property subject to the restrictions contained herein and to comply with all, and not to violate any of the conditions of this Deed Notice. Nothing contained in this Paragraph shall be construed as limiting any obligation of any person to provide any notice required by any law, regulation, or order of any governmental authority.

ii. The Owner and the subsequent owners shall provide written notice to the Department of Environmental Protection on a form provided by the Department and available at www.nj.gov/srp/forms within thirty (30) calendar days after the effective date of any conveyance, grant, gift, or other transfer, in whole or in part, of the owner's interest in the Restricted Area.

iii. The Owner and the subsequent owners shall provide written notice to the Department, on a form available from the Department at www.nj.gov/srp/forms, within thirty (30) calendar days after the owner's petition for or filing of any document initiating a rezoning of the Property to residential.

6B. SUCCESSORS AND ASSIGNS. This Deed Notice shall be binding upon Owner and upon Owner's successors and assigns, and subsequent owners, lessees and operators while each is an owner, lessee, or operator of the Property.

7A. ALTERATIONS, IMPROVEMENTS, AND DISTURBANCES.

i. The Owner and all subsequent owners and lessees shall notify any person, including, without limitation, tenants, employees of tenants, and contractors, intending to conduct invasive work or excavate within the Restricted Areas, of the nature and location of contamination in the Restricted Areas, and, of the precautions necessary to minimize potential human exposure to contaminants.

ii. Except as provided in Paragraph 7B, below, no person shall make, or allow to be made, any alteration, improvement, or disturbance in, to, or about the Property which

disturbs any engineering control at the Property without first obtaining a soil remedial action permit modification pursuant to N.J.A.C. 7:26C-7. Nothing herein shall constitute a waiver of the obligation of any person to comply with all applicable laws and regulations including, without limitation, the applicable rules of the Occupational Safety and Health Administration.

iii. Notwithstanding subparagraph 7Aii., above, a soil remedial action permit modification is not required for any alteration, improvement, or disturbance provided that the owner, lessee or operator:

(A) Notifies the Department of Environmental Protection of the activity by calling the DEP Hotline, at 1-877-WARN-DEP or 1-877-927-6337, within twenty-four (24) hours after the beginning of each alteration, improvement, or disturbance;

(B) Restores any disturbance of an engineering control to pre-disturbance conditions within sixty (60) calendar days after the initiation of the alteration, improvement or disturbance;

(C) Ensures that all applicable worker health and safety laws and regulations are followed during the alteration, improvement, or disturbance, and during the restoration;

(D) Ensures that human exposure to contamination in excess of the remediation standards does not occur; and

(E) Describes, in the next biennial certification the nature of the alteration, improvement, or disturbance, the dates and duration of the alteration, improvement, or disturbance, the name of key individuals and their affiliations conducting the alteration, improvement, or disturbance, a description of the notice the Owner gave to those persons prior to the disturbance.

7B. EMERGENCIES. In the event of an emergency which presents, or may present, an unacceptable risk to the public health and safety, or to the environment, or immediate environmental concern, see N.J.S.A. 58:10C-2, any person may temporarily breach an engineering control provided that that person complies with each of the following:

i. Immediately notifies the Department of Environmental Protection of the emergency, by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337;

ii. Hires a Licensed Site Remediation Professional (unless the Restricted Areas includes an unregulated heating oil tank) to respond to the emergency;

iii. Limits both the actual disturbance and the time needed for the disturbance to the minimum reasonably necessary to adequately respond to the emergency;

iv. Implements all measures necessary to limit actual or potential, present or future risk of exposure to humans or the environment to the contamination;

v. Notifies the Department of Environmental Protection when the emergency or immediate environmental concern has ended by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337; and

vi. Restores the engineering control to the pre-emergency conditions as soon as possible, and provides notification to the Department of Environmental Protection within sixty (60) calendar days after completion of the restoration of the engineering control, including: (a) the nature and likely cause of the emergency; (b) the potential discharges of or exposures to contaminants, if any, that may have occurred; (c) the measures that have been taken to mitigate the effects of the emergency on human health and the environment; (d) the measures completed or implemented to restore the engineering control; and (e) the changes to the engineering control or site operation and maintenance plan to prevent reoccurrence of such conditions in the future.

8. TERMINATION OF DEED NOTICE.

i. This Deed Notice may be terminated only upon filing of a Termination of Deed Notice, available at N.J.A.C. 7:26C Appendix C, with the office of the County Clerk [*Insert as appropriate the County Clerk/Register of Deeds and Mortgages*] of Middlesex [*Insert the name of the County*] County, New Jersey, expressly terminating this Deed Notice.

ii. Within thirty (30) calendar days after the filing of a Termination of Deed Notice, the owner of the property shall apply to the Department for termination of the soil remedial action permit pursuant to N.J.A.C. 7:26C-7.

9. ACCESS. The Owner, and the subsequent owners, lessees and operators agree to allow the Department, its agents and representatives access to the Property to inspect and evaluate the continued protectiveness of the remedial action that includes this Deed Notice and to conduct additional remediation to ensure the protection of the public health and safety and of the environment if the subsequent owners, lessees and operators, during their ownership, tenancy, or operation, and the Owner fail to conduct such remediation pursuant to this Deed Notice as required by law. The Owner, and the subsequent owners and lessees, shall also cause all leases, subleases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring that all holders thereof provide such access to the Department.

10. ENFORCEMENT OF VIOLATIONS.

i. This Deed Notice itself is not intended to create any interest in real estate in favor of the Department of Environmental Protection, nor to create a lien against the Property, but merely is intended to provide notice of certain conditions and restrictions on the Property and to reflect the regulatory and statutory obligations imposed as a conditional remedial action for this site.

ii. The restrictions provided herein may be enforceable solely by the Department against any person who violates this Deed Notice. To enforce violations of this Deed Notice, the

Department may initiate one or more enforcement actions pursuant to N.J.S.A. 58:10-23.11, and N.J.S.A. 58:10C, and require additional remediation and assess damages pursuant to N.J.S.A. 58:10-23.11, and N.J.S.A. 58:10C.

11. SEVERABILITY. If any court of competent jurisdiction determines that any provision of this Deed Notice requires modification, such provision shall be deemed to have been modified automatically to conform to such requirements. If a court of competent jurisdiction determines that any provision of this Deed Notice is invalid or unenforceable and the provision is of such a nature that it cannot be modified, the provision shall be deemed deleted from this instrument as though the provision had never been included herein. In either case, the remaining provisions of this Deed Notice shall remain in full force and effect.

12A. EXHIBIT A. Exhibit A includes the following maps of the Property and the vicinity:

i. Exhibit A-1: Vicinity Map - A map that identifies by name the roads, and other important geographical features in the vicinity of the Property (for example, USGS Quad map, Hagstrom County Maps);

ii. Exhibit A-2: Metes and Bounds Description - A tax map of lots and blocks as wells as metes and bounds description of the Property, including reference to tax lot and block numbers for the Property;

iii. Exhibit A-3: Property Map - A scaled map of the Property, scaled at one inch to 200 feet or less, and if more than one map is submitted, the maps shall be presented as overlays, keyed to a base map; and the Property Map shall include diagrams of major surface topographical features such as buildings, roads, and parking lots.

12B. EXHIBIT B. Exhibit B includes the following descriptions of the Restricted Areas:

i. Exhibit B-1: Restricted Area Map - A separate map for each restricted area that includes:

(A) As-built diagrams of each engineering control, including caps, fences, slurry walls, (and, if any) ground water monitoring wells, extent of the ground water classification exception area, pumping and treatment systems that may be required as part of a ground water engineering control in addition to the deed notice

(B) As-built diagrams of any buildings, roads, parking lots and other structures that function as engineering controls; and

(C) Designation of all soil and sediment sample locations within the restricted areas that exceed any soil or sediment standard that are keyed into one of the tables described in the following paragraph.

ii. Exhibit B-2: Restricted Area Data Table - A separate table for each restricted area that includes either (A) or (B) through (F):

(A) Only for historic fill extending over the entire site or a portion of the site and for which analytical data are limited or do not exist, a narrative that states that historic fill is present at the site, a description of the fill material (e.g., ash, cinders, brick, dredge material), and a statement that such material may include, but is not limited to, contaminants such as PAHs and metals;

(B) Sample location designation from Restricted Area map (Exhibit B-1);

(C) Sample elevation based upon mean sea level;

(D) Name and chemical abstract service registry number of each contaminant with a concentration that exceeds the unrestricted use standard;

(E) The restricted and unrestricted use standards for each contaminant in the table; and

(F) The remaining concentration of each contaminant at each sample location at each elevation.

12C. EXHIBIT C. Exhibit C includes narrative descriptions of the institutional controls and engineering controls [*Insert as appropriate: and engineering controls*] as follows:

i. Exhibit C-1: Deed Notice as Institutional Control: Exhibit C-1 includes a narrative description of the restriction and obligations of this Deed Notice that are in addition to those described above, as follows:

(A) Description and estimated size of the Restricted Areas as described above;

(B) Description of the restrictions on the Property by operation of this Deed Notice; and

(C) The objective of the restrictions.

[*Insert the following if engineering controls are part of the remedial action for the site*:

ii. Exhibit C-2: Engineered Fill Cap [*Insert the name of the first engineering control*]: Exhibit C-2 includes a narrative description of the Engineered Fill Cap [*Insert the name of the first engineering control*] as follows:

(A) Description of the engineering control;

(B) The objective of the engineering control; and

(C) How the engineering control is intended to function.

[*Repeat the contents of Exhibit C-2, renumbering accordingly, for each separate engineering control that is part of the remedial action for the site.*]

13. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

[If Owner is an individual]

WITNESS: _____
[Signature]

_____
[Print name below signature]

STATE OF [State where document is executed] SS.:
COUNTY OF [County where document is executed]

I certify that on _____, 20__, [Name of Owner] personally came before me, and this person acknowledged under oath, to my satisfaction, that this person [or if more than one person, each person]

(a) is named in and personally signed this document; and

(b) signed, sealed and delivered this document as his or her act and deed.

_____

_____, Notary Public
[Print Name and Title]

14. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

[If Owner is a corporation]

ATTEST: [Name of corporation]

_____ By_____

_____ _____
[Print name and title] [Signature]

STATE OF [State where document is executed] SS.:
COUNTY OF [County where document is executed]

I certify that on _____, 20__, [Name of person executing document on behalf of Owner] personally came before me, and this person acknowledged under oath, to my satisfaction, that:

(a) this person is the [secretary/assistant secretary] of [Owner], the corporation named in this document;

(b) this person is the attesting witness to the signing of this document by the proper corporate officer who is the [president/vice president] of the corporation;

(c) this document was signed and delivered by the corporation as its voluntary act and was duly authorized;

(d) this person knows the proper seal of the corporation which was affixed to this document; and

(e) this person signed this proof to attest to the truth of these facts.

_____
[Signature]

_____
[Print name and title of attesting witness]

Signed and sworn before me on _____, 20__

_____, Notary Public

_____
[Print name and title]

## EXHIBIT A

Exhibit A will be prepared upon completion of the remediation project and will consist of:

- Exhibit A-1: Vicinity Map
- Exhibit A-2: Metes and Bounds Description
- Exhibit A-3: Property Map

## EXHIBIT B

Exhibit B will be prepared upon completion of the remediation project and will consist of:

- Exhibit B-1: Restricted Area Map
- Exhibit B-2: Restricted Area Data Table

## EXHIBIT C

Exhibit C will be prepared upon completion of the remediation project and will consist of:

- Exhibit C-1: Deed Notice as Institutional Control
- Exhibit C-2: Narrative Description of Engineering Fill Cap

# APPENDIX F

# EXISTING CONDITIONS STATISTICAL ANALYSIS

*EastStar*

**Rahway Arch Property Site**
**Existing Surface PAH Data for Statistical Analysis**

| Sample Number | Benzo(a) anthracene (ug/kg) | d_ | Benzo(a) pyrene (ug/kg) | d_ | Benzo(b) flouranthene (ug/kg) | d_ | Benzo(k) flouranthene (ug/kg) | d_ | Chrysene (ug/kg) | d_ | Dibenz(a,h) anthracene (ug/kg) | d_ | Indeno(1,2,3-cd) pyrene (ug/kg) | d_ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 2,100 | 1 | 1,800 | 1 | 1,200 | 1 | 1,400 | 1 | 2,600 | 1 | 320 | 1 | 590 | 1 |
| S2 | 19 | 1 | 570 | 0 | 570 | 0 | 570 | 0 | 21 | 0 | 570 | 0 | 570 | 0 |
| S3 | 25 | 1 | 600 | 0 | 600 | 0 | 600 | 0 | 30 | 1 | 600 | 0 | 600 | 0 |
| S5 | 38 | 1 | 670 | 0 | 670 | 0 | 670 | 0 | 45 | 1 | 670 | 0 | 670 | 0 |
| S6 | 730 | 0 | 730 | 0 | 730 | 0 | 730 | 0 | 730 | 0 | 730 | 0 | 730 | 0 |
| S7 | 620 | 0 | 620 | 0 | 620 | 0 | 620 | 0 | 620 | 0 | 620 | 0 | 620 | 0 |
| S8 | 650 | 0 | 650 | 0 | 650 | 0 | 650 | 0 | 650 | 0 | 650 | 0 | 650 | 0 |
| S9 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 |
| S10 | 720 | 0 | 720 | 0 | 720 | 0 | 720 | 0 | 720 | 0 | 720 | 0 | 720 | 0 |
| S11 | 670 | 0 | 670 | 0 | 670 | 0 | 670 | 0 | 670 | 0 | 670 | 0 | 670 | 0 |
| S12 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 | 630 | 0 |
| TP-01 | 90.8 | 1 | 88.6 | 1 | 93.1 | 1 | 74.9 | 1 | 343 | 1 | 53.1 | 0 | 45.0 | 0 |
| TP-02 | 608 | 1 | 608 | 1 | 700 | 1 | 448 | 1 | 711 | 1 | 269 | 0 | 287 | 1 |
| TP-02A | 411 | 1 | 447 | 1 | 496 | 1 | 391 | 1 | 460 | 1 | 71.8 | 1 | 220 | 1 |
| TP-03 | 303 | 1 | 277 | 1 | 350 | 1 | 323 | 1 | 343 | 1 | 154 | 0 | 131 | 0 |
| TP-05 | 2,090 | 1 | 2,060 | 1 | 1,600 | 1 | 2,070 | 1 | 2,150 | 1 | 266 | 0 | 773 | 1 |
| TP-06 | 299 | 0 | 254 | 0 | 274 | 0 | 307 | 0 | 334 | 0 | 259 | 0 | 219 | 0 |
| TP-07 | 64.4 | 0 | 54.8 | 0 | 59.1 | 0 | 66.3 | 0 | 72.0 | 0 | 55.8 | 0 | 47.2 | 0 |
| TP-08 | 9,840 | 1 | 8,560 | 1 | 10,000 | 1 | 2,070 | 1 | 10,200 | 1 | 1,640 | 1 | 3,520 | 1 |
| TP-09 | 674 | 1 | 468 | 1 | 514 | 1 | 503 | 1 | 800 | 1 | 267 | 0 | 226 | 0 |
| TP-10 | 123 | 0 | 105 | 0 | 113 | 0 | 126 | 0 | 137 | 0 | 106 | 0 | 90 | 0 |
| TP-11 | 2,510 | 1 | 2,530 | 1 | 2,480 | 1 | 2,490 | 1 | 2,660 | 1 | 402 | 1 | 1,070 | 1 |
| TP-12 | 112 | 1 | 97.6 | 1 | 142 | 1 | 115 | 1 | 127 | 1 | 57.1 | 0 | 48.3 | 0 |
| TP-12A | 6,880 | 1 | 3,610 | 1 | 7,040 | 1 | 6,580 | 1 | 6,860 | 1 | 1,420 | 1 | 2,760 | 1 |
| TP-13 | 54,200 | 1 | 49,700 | 1 | 46,700 | 1 | 46,200 | 1 | 52,600 | 1 | 11,800 | 1 | 20,600 | 1 |
| TP-14 | 252 | 0 | 248 | 0 | 222 | 1 | 268 | 0 | 241 | 0 | 187 | 0 | 242 | 0 |
| TP-15 | 332 | 1 | 332 | 1 | 464 | 1 | 278 | 1 | 425 | 1 | 114 | 0 | 122 | 1 |
| TP-16 | 60,200 | 1 | 59,300 | 1 | 51,600 | 1 | 52,300 | 1 | 57,000 | 1 | 13,500 | 1 | 23,200 | 1 |
| TP-17 | 2,220 | 1 | 1,970 | 1 | 1,740 | 1 | 1,740 | 1 | 2,120 | 1 | 533 | 1 | 930 | 1 |
| TP-19 | 979 | 1 | 916 | 1 | 696 | 1 | 813 | 1 | 1,090 | 1 | 105 | 0 | 287 | 1 |
| HA-22 | 635 | 1 | 615 | 1 | 952 | 1 | 548 | 1 | 702 | 1 | 225 | 0 | 279 | 1 |

# *EastStar*

| Sample Number | Benzo(a) anthracene | d_ | Benzo(a) pyrene | d_ | Benzo(b) flouranthene | d_ | Benzo(k) flouranthene | d_ | Chrysene | d_ | Dibenz(a,h) anthracene | d_ | Indeno(1,2,3-cd) pyrene | d_ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-1 | 225 | 1 | 253 | 1 | 199 | 1 | 249 | 1 | 246 | 1 | 82.0 | 0 | 82.9 | 1 |
| E-2 | 33.8 | 1 | 140 | 0 | 140 | 0 | 140 | 0 | 55.9 | 1 | 140 | 0 | 140 | 0 |
| E-3 | 1,960 | 1 | 1,700 | 1 | 950 | 1 | 2,260 | 1 | 1,820 | 1 | 129 | 1 | 605 | 1 |
| IS-02-S | 4,170 | 1 | 4,870 | 1 | 4,690 | 1 | 4,010 | 1 | 4,620 | 1 | 1,340 | 1 | 2,920 | 1 |
| BS-07R-S | 771 | 1 | 724 | 1 | 762 | 1 | 583 | 1 | 893 | 1 | 249 | 0 | 397 | 1 |
| BD-05-S | 1,000 | 1 | 1,030 | 1 | 1,030 | 1 | 800 | 1 | 967 | 1 | 553 | 0 | 715 | 0 |
| ID-04-S | 506 | 1 | 482 | 1 | 413 | 1 | 398 | 1 | 523 | 1 | 115 | 1 | 270 | 1 |
| ID-01-A | 1,100 | 0 | 1,080 | 0 | 910 | 0 | 1,170 | 0 | 1,050 | 0 | 815 | 0 | 1,050 | 0 |
| BD-05S2 | 93.7 | 0 | 92.3 | 0 | 77.8 | 0 | 99.8 | 0 | 89.7 | 0 | 69.6 | 0 | 90.0 | 0 |

**Legend:**

1. d_ denotes if sample result was a non-detect. A 1 indicates analyte was detected. A 0 indicatges analyte was not detected.
2. Analysis result accompanying d_ values of 0 is the reporting limit
3. S1 - S12: Samples collected by NJDEP 1991
4. E1 - E3: Samples collected by N.J. Turnpike Authority
5. TP1 - TP19 & HA22: Samples collected by EastStar March 2011
6. All other samples collected by EastStar in the RI, July 2012.

# *EastStar*

From File: C:\Users\Al\Desktop\071613 PAH Data.wst

### Summary Statistics for Raw Full Data Sets

| Variable | NumObs | Minimum | Maximum | Mean | Median | Variance | SD | MAD/0.675 | Skewness | Kurtosis | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a) anthracene | 40 | 19 | 60200 | 3988 | 632.5 | 156900000 | 12527 | 648.6 | 4.161 | 16.61 | 3.141 |
| Benzo(a) pyrene | 40 | 54.8 | 59300 | 3773 | 630 | 142500000 | 11937 | 558.2 | 4.238 | 17.32 | 3.164 |
| Benzo(b) flouranthene | 40 | 59.1 | 51600 | 3577 | 660 | 116100000 | 10774 | 446.3 | 4.107 | 16.25 | 3.012 |
| Benzo(k) flouranthene | 40 | 66.3 | 52300 | 3383 | 625 | 115500000 | 10748 | 493 | 4.235 | 17.13 | 3.177 |
| Chrysene | 40 | 21 | 57000 | 3925 | 660 | 143800000 | 11992 | 617.5 | 4.129 | 16.36 | 3.056 |
| Dibenz(a,h) anthracene | 40 | 53.1 | 13500 | 1045 | 294.5 | 7452646 | 2730 | 352.8 | 4.193 | 16.93 | 2.613 |
| Indeno(1,2,3-cd) pyrene | 40 | 45 | 23200 | 1711 | 595 | 22665169 | 4761 | 510 | 4.149 | 16.59 | 2.782 |

### Percentiles for Raw Full Data Sets

| Variable | NumObs | 5%ile | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a) anthracene | 40 | 25 | 38 | 112 | 225 | 630 | 1100 | 2090 | 4170 | 9840 | 57800 |
| Benzo(a) pyrene | 40 | 88.6 | 97.6 | 253 | 277 | 630 | 1080 | 1800 | 3610 | 8560 | 55460 |
| Benzo(b) flouranthene | 40 | 77.8 | 113 | 222 | 350 | 650 | 952 | 1200 | 4690 | 10000 | 49640 |
| Benzo(k) flouranthene | 40 | 74.9 | 115 | 268 | 307 | 620 | 1170 | 1740 | 2490 | 6580 | 49860 |
| Chrysene | 40 | 30 | 55.9 | 137 | 246 | 650 | 1090 | 2120 | 4620 | 10200 | 55240 |
| Dibenz(a,h) anthracene | 40 | 55.8 | 69.6 | 106 | 115 | 269 | 650 | 670 | 1340 | 1640 | 12820 |
| Indeno(1,2,3-cd) pyrene | 40 | 47.2 | 82.9 | 131 | 219 | 590 | 720 | 773 | 2760 | 3520 | 22160 |

***EastStar Environmental Group, Inc.***
www.EastStarEnv.com

10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Phone: (410) 290-8777 Fax: (410) 290-9055

| | | | |
|---|---|---|---|
| | **General UCL Statistics for Full Data Sets** | | |
| **User Selected Options** | | | |
| From File | C:\Users\Al\Desktop\071613 PAH Data.wst | | |
| Full Precision | OFF | | |
| Confidence Coefficient | 95% | | |
| Number of Bootstrap Operations | 2000 | | |
| | | | |
| | | | |
| **Benzo(a) anthracene** | | | |
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 39 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 19 | Minimum of Log Data | 2.944 |
| Maximum | 60200 | Maximum of Log Data | 11.01 |
| Mean | 3988 | Mean of log Data | 6.386 |
| Median | 632.5 | SD of log Data | 1.803 |
| SD | 12527 | | |
| Coefficient of Variation | 3.141 | | |
| Skewness | 4.161 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.33 | Shapiro Wilk Test Statistic | 0.954 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 7325 | 95% H-UCL | 8248 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 7415 |
| 95% Adjusted-CLT UCL | 8638 | 97.5% Chebyshev (MVUE) UCL | 9438 |
| 95% Modified-t UCL | 7542 | 99% Chebyshev (MVUE) UCL | 13412 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.343 | Data appear Lognormal at 5% Significance Level | |
| Theta Star | 11632 | | |
| MLE of Mean | 3988 | | |
| MLE of Standard Deviation | 6811 | | |
| nu star | 27.43 | | |
| Approximate Chi Square Value (.05) | 16.48 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 7246 |
| Adjusted Chi Square Value | 16.16 | 95% Jackknife UCL | 7325 |
| | | 95% Standard Bootstrap UCL | 7188 |
| Anderson-Darling Test Statistic | 3.816 | 95% Bootstrap-t UCL | 25098 |
| Anderson-Darling 5% Critical Value | 0.846 | 95% Hall's Bootstrap UCL | 22938 |
| Kolmogorov-Smirnov Test Statistic | 0.269 | 95% Percentile Bootstrap UCL | 7716 |
| Kolmogorov-Smirnov 5% Critical Value | 0.15 | 95% BCA Bootstrap UCL | 8832 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 12621 |

| | | | |
|---|---|---|---|
| | | 97.5% Chebyshev(Mean, Sd) UCL | 16357 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 23695 |
| 95% Approximate Gamma UCL | 6636 | | |
| 95% Adjusted Gamma UCL | 6767 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Chebyshev (Mean, Sd) UCL | 12621 |
| | | | |
| | | | |

**Benzo(a) pyrene**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 40 | Number of Distinct Observations | 38 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 54.8 | Minimum of Log Data | 4.004 |
| Maximum | 59300 | Maximum of Log Data | 10.99 |
| Mean | 3773 | Mean of log Data | 6.601 |
| Median | 630 | SD of log Data | 1.49 |
| SD | 11937 | | |
| Coefficient of Variation | 3.164 | | |
| Skewness | 4.238 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.32 | Shapiro Wilk Test Statistic | 0.913 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 6953 | 95% H-UCL | 4611 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 4938 |
| 95% Adjusted-CLT UCL | 8228 | 97.5% Chebyshev (MVUE) UCL | 6159 |
| 95% Modified-t UCL | 7164 | 99% Chebyshev (MVUE) UCL | 8558 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.389 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 9704 | | |
| MLE of Mean | 3773 | | |
| MLE of Standard Deviation | 6051 | | |
| nu star | 31.1 | | |
| Approximate Chi Square Value (.05) | 19.36 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 6877 |
| Adjusted Chi Square Value | 19.01 | 95% Jackknife UCL | 6953 |
| | | 95% Standard Bootstrap UCL | 6866 |
| Anderson-Darling Test Statistic | 5.069 | 95% Bootstrap-t UCL | 27864 |
| Anderson-Darling 5% Critical Value | 0.835 | 95% Hall's Bootstrap UCL | 22864 |
| Kolmogorov-Smirnov Test Statistic | 0.293 | 95% Percentile Bootstrap UCL | 6978 |
| Kolmogorov-Smirnov 5% Critical Value | 0.149 | 95% BCA Bootstrap UCL | 8849 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 12000 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 15560 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 22553 |
| 95% Approximate Gamma UCL | 6060 | | |
| 95% Adjusted Gamma UCL | 6171 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 22553 |

| Benzo(b) flouranthene | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 38 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 59.1 | Minimum of Log Data | 4.079 |
| Maximum | 51600 | Maximum of Log Data | 10.85 |
| Mean | 3577 | Mean of log Data | 6.604 |
| Median | 660 | SD of log Data | 1.471 |
| SD | 10774 | | |
| Coefficient of Variation | 3.012 | | |
| Skewness | 4.107 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.336 | Shapiro Wilk Test Statistic | 0.898 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 6448 | 95% H-UCL | 4422 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 4774 |
| 95% Adjusted-CLT UCL | 7561 | 97.5% Chebyshev (MVUE) UCL | 5947 |
| 95% Modified-t UCL | 6632 | 99% Chebyshev (MVUE) UCL | 8249 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.4 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 8940 | | |
| MLE of Mean | 3577 | | |
| MLE of Standard Deviation | 5655 | | |
| nu star | 32.01 | | |
| Approximate Chi Square Value (.05) | 20.08 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 6379 |
| Adjusted Chi Square Value | 19.73 | 95% Jackknife UCL | 6448 |
| | | 95% Standard Bootstrap UCL | 6394 |
| Anderson-Darling Test Statistic | 5.275 | 95% Bootstrap-t UCL | 19553 |
| Anderson-Darling 5% Critical Value | 0.832 | 95% Hall's Bootstrap UCL | 18795 |
| Kolmogorov-Smirnov Test Statistic | 0.323 | 95% Percentile Bootstrap UCL | 6742 |
| Kolmogorov-Smirnov 5% Critical Value | 0.149 | 95% BCA Bootstrap UCL | 7543 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 11003 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 14216 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 20527 |
| 95% Approximate Gamma UCL | 5703 | | |
| 95% Adjusted Gamma UCL | 5805 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 20527 |
| | | | |
| | | | |

| Benzo(k) flouranthene | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 37 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 66.3 | Minimum of Log Data | 4.194 |
| Maximum | 52300 | Maximum of Log Data | 10.86 |
| Mean | 3383 | Mean of log Data | 6.556 |
| Median | 625 | SD of log Data | 1.429 |
| SD | 10748 | | |
| Coefficient of Variation | 3.177 | | |
| Skewness | 4.235 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.312 | Shapiro Wilk Test Statistic | 0.904 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 6246 | 95% H-UCL | 3833 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 4207 |
| 95% Adjusted-CLT UCL | 7394 | 97.5% Chebyshev (MVUE) UCL | 5223 |
| 95% Modified-t UCL | 6436 | 99% Chebyshev (MVUE) UCL | 7219 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.402 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 8422 | | |
| MLE of Mean | 3383 | | |
| MLE of Standard Deviation | 5337 | | |
| nu star | 32.13 | | |
| Approximate Chi Square Value (.05) | 20.18 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 6178 |
| Adjusted Chi Square Value | 19.82 | 95% Jackknife UCL | 6246 |
| | | 95% Standard Bootstrap UCL | 6147 |
| Anderson-Darling Test Statistic | 5.272 | 95% Bootstrap-t UCL | 28480 |
| Anderson-Darling 5% Critical Value | 0.832 | 95% Hall's Bootstrap UCL | 21758 |
| Kolmogorov-Smirnov Test Statistic | 0.305 | 95% Percentile Bootstrap UCL | 6417 |
| Kolmogorov-Smirnov 5% Critical Value | 0.149 | 95% BCA Bootstrap UCL | 7771 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 10790 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 13995 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 20291 |
| 95% Approximate Gamma UCL | 5387 | | |
| 95% Adjusted Gamma UCL | 5484 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 20291 |
| | | | |
| | | | |

| Chrysene | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 38 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 21 | Minimum of Log Data | 3.045 |
| Maximum | 57000 | Maximum of Log Data | 10.95 |
| Mean | 3925 | Mean of log Data | 6.489 |
| Median | 660 | SD of log Data | 1.73 |
| SD | 11992 | | |
| Coefficient of Variation | 3.056 | | |
| Skewness | 4.129 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.336 | Shapiro Wilk Test Statistic | 0.954 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 7119 | 95% H-UCL | 7481 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 7061 |
| 95% Adjusted-CLT UCL | 8366 | 97.5% Chebyshev (MVUE) UCL | 8949 |
| 95% Modified-t UCL | 7326 | 99% Chebyshev (MVUE) UCL | 12658 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.361 | Data appear Lognormal at 5% Significance Level | |
| Theta Star | 10861 | | |
| MLE of Mean | 3925 | | |
| MLE of Standard Deviation | 6529 | | |
| nu star | 28.91 | | |
| Approximate Chi Square Value (.05) | 17.64 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 7043 |
| Adjusted Chi Square Value | 17.3 | 95% Jackknife UCL | 7119 |
| | | 95% Standard Bootstrap UCL | 7086 |
| Anderson-Darling Test Statistic | 3.851 | 95% Bootstrap-t UCL | 24414 |
| Anderson-Darling 5% Critical Value | 0.842 | 95% Hall's Bootstrap UCL | 20987 |
| Kolmogorov-Smirnov Test Statistic | 0.28 | 95% Percentile Bootstrap UCL | 7198 |
| Kolmogorov-Smirnov 5% Critical Value | 0.15 | 95% BCA Bootstrap UCL | 9238 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 12189 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 15766 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 22790 |
| 95% Approximate Gamma UCL | 6433 | | |
| 95% Adjusted Gamma UCL | 6556 | | |
| | | | |
| Potential UCL to Use | | Use 95% Chebyshev (Mean, Sd) UCL | 12189 |

| Dibenz(a,h) anthracene | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 38 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 53.1 | Minimum of Log Data | 3.972 |
| Maximum | 13500 | Maximum of Log Data | 9.51 |
| Mean | 1045 | Mean of log Data | 5.841 |
| Median | 294.5 | SD of log Data | 1.272 |
| SD | 2730 | | |
| Coefficient of Variation | 2.613 | | |
| Skewness | 4.193 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.35 | Shapiro Wilk Test Statistic | 0.918 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 1772 | 95% H-UCL | 1352 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 1559 |
| 95% Adjusted-CLT UCL | 2060 | 97.5% Chebyshev (MVUE) UCL | 1910 |
| 95% Modified-t UCL | 1820 | 99% Chebyshev (MVUE) UCL | 2600 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.536 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 1948 | | |
| MLE of Mean | 1045 | | |
| MLE of Standard Deviation | 1427 | | |
| nu star | 42.9 | | |
| Approximate Chi Square Value (.05) | 28.88 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 1755 |
| Adjusted Chi Square Value | 28.45 | 95% Jackknife UCL | 1772 |
| | | 95% Standard Bootstrap UCL | 1772 |
| Anderson-Darling Test Statistic | 3.539 | 95% Bootstrap-t UCL | 5687 |
| Anderson-Darling 5% Critical Value | 0.807 | 95% Hall's Bootstrap UCL | 5489 |
| Kolmogorov-Smirnov Test Statistic | 0.269 | 95% Percentile Bootstrap UCL | 1851 |
| Kolmogorov-Smirnov 5% Critical Value | 0.147 | 95% BCA Bootstrap UCL | 2094 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 2926 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 3740 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 5339 |
| 95% Approximate Gamma UCL | 1552 | | |
| 95% Adjusted Gamma UCL | 1575 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 5339 |
| | | | |
| | | | |

| Indeno(1,2,3-cd) pyrene | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Observations | 40 | Number of Distinct Observations | 37 |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum | 45 | Minimum of Log Data | 3.807 |
| Maximum | 23200 | Maximum of Log Data | 10.05 |
| Mean | 1711 | Mean of log Data | 6.134 |
| Median | 595 | SD of log Data | 1.396 |
| SD | 4761 | | |
| Coefficient of Variation | 2.782 | | |
| Skewness | 4.149 | | |
| | | | |
| **Relevant UCL Statistics** | | | |
| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
| Shapiro Wilk Test Statistic | 0.346 | Shapiro Wilk Test Statistic | 0.924 |
| Shapiro Wilk Critical Value | 0.94 | Shapiro Wilk Critical Value | 0.94 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 2979 | 95% H-UCL | 2340 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 2599 |
| 95% Adjusted-CLT UCL | 3477 | 97.5% Chebyshev (MVUE) UCL | 3219 |
| 95% Modified-t UCL | 3062 | 99% Chebyshev (MVUE) UCL | 4436 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.467 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 3666 | | |
| MLE of Mean | 1711 | | |
| MLE of Standard Deviation | 2505 | | |
| nu star | 37.34 | | |
| Approximate Chi Square Value (.05) | 24.35 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.044 | 95% CLT UCL | 2949 |
| Adjusted Chi Square Value | 23.96 | 95% Jackknife UCL | 2979 |
| | | 95% Standard Bootstrap UCL | 2957 |
| Anderson-Darling Test Statistic | 4.03 | 95% Bootstrap-t UCL | 9202 |
| Anderson-Darling 5% Critical Value | 0.816 | 95% Hall's Bootstrap UCL | 8619 |
| Kolmogorov-Smirnov Test Statistic | 0.3 | 95% Percentile Bootstrap UCL | 3217 |
| Kolmogorov-Smirnov 5% Critical Value | 0.148 | 95% BCA Bootstrap UCL | 3659 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 4992 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 6412 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 9201 |
| 95% Approximate Gamma UCL | 2624 | | |
| 95% Adjusted Gamma UCL | 2667 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 9201 |
| | | | |
| | | | |

## Rahway Arch Property Site
## Existing Surface Inorganc Data for Statistical Analysis

| Aluminum | d_ | Antimony | d_ | Arsenic | d_ | Barium | d_ | Beryllium | d_ | Cadmium | d_ | Calcium | d_ | Chromium | d_ | Cobalt | d_ | Copper | d_ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | |
| 8,350 | 1 | 1.67 | 1 | 8.6 | 1 | 90.3 | 1 | 0.687 | 1 | 0.024 | 0 | 4,180 | 1 | 28.6 | 1 | 9 | 1 | 61.3 | 1 |
| 7,140 | 1 | 0.988 | 0 | 2.82 | 1 | 97.2 | 1 | 0.329 | 1 | 0.025 | 0 | 14,200 | 1 | 16.5 | 1 | 7.91 | 1 | 42.2 | 1 |
| 8,860 | 1 | 1.43 | 0 | 1.38 | 0 | 48 | 1 | 0.156 | 1 | 0.036 | 0 | 280,000 | 1 | 13.5 | 1 | 2.57 | 1 | 1.85 | 1 |
| 10,700 | 1 | 0.956 | 1 | 48.5 | 1 | 63 | 1 | 0.382 | 1 | 0.024 | 0 | 13,300 | 1 | 19.9 | 1 | 7.89 | 1 | 28.4 | 1 |
| 10,900 | 1 | 4.9 | 1 | 18 | 1 | 176 | 1 | 0.929 | 1 | 1.95 | 1 | 214,000 | 1 | 38.3 | 1 | 5.17 | 1 | 186 | 1 |
| 10,100 | 1 | 1.08 | 0 | 4.34 | 1 | 75.8 | 1 | 0.504 | 1 | 0.027 | 0 | 26,100 | 1 | 34.7 | 1 | 9.15 | 1 | 31.7 | 1 |
| 9,380 | 1 | 1.16 | 1 | 7.5 | 1 | 63.9 | 1 | 0.41 | 1 | 0.005 | 0 | 59,300 | 1 | 20.7 | 1 | 4.23 | 1 | 41.2 | 1 |
| 7,140 | 1 | 1.79 | 1 | 5.33 | 1 | 479 | 1 | 1.13 | 1 | 4.33 | 1 | 203,000 | 1 | 3.69 | 1 | 75.3 | 1 | 24.4 | 1 |
| 3,820 | 1 | 1.66 | 0 | 3.49 | 1 | 30 | 1 | 0.347 | 1 | 0.042 | 0 | 215,000 | 1 | 5.01 | 1 | 1.77 | 1 | 2.48 | 1 |
| 14,800 | 1 | 1.33 | 0 | 1.9 | 1 | 107 | 1 | 0.376 | 1 | 0.329 | 1 | 66,000 | 1 | 14.6 | 1 | 19.5 | 1 | 32 | 1 |
| 6,520 | 1 | 1.5 | 0 | 1.47 | 0 | 23.3 | 1 | 0.24 | 1 | 0.068 | 0 | 276,000 | 1 | 2.14 | 1 | 2.63 | 1 | 1.7 | 1 |
| 14,200 | 1 | 1.53 | 0 | 1.48 | 0 | 36.6 | 1 | 0.246 | 1 | 0.039 | 0 | 227,000 | 1 | 38 | 1 | 3.99 | 1 | 1.6 | 1 |
| 6,320 | 1 | 1.48 | 0 | 1.44 | 0 | 84.8 | 1 | 0.203 | 1 | 0.037 | 0 | 234,000 | 1 | 11.6 | 1 | 12.5 | 1 | 0.837 | 1 |
| 29,200 | 1 | 1.81 | 0 | 4.51 | 1 | 48.2 | 1 | 0.005 | 0 | 0.046 | 0 | 226,000 | 1 | 12.9 | 1 | 7.14 | 1 | 15 | 1 |
| 4,330 | 1 | 1.37 | 0 | 1.32 | 0 | 14 | 1 | 0.103 | 1 | 0.034 | 0 | 254,000 | 1 | 27.3 | 1 | 3.56 | 1 | 0.636 | 1 |
| 6,830 | 1 | 2.78 | 0 | 2.69 | 0 | 20.9 | 1 | 0.319 | 1 | 0.07 | 0 | 58,100 | 1 | 17.7 | 1 | 4.99 | 1 | 7.57 | 1 |
| 3,430 | 1 | 1.91 | 0 | 7.44 | 1 | 18.8 | 1 | 0.326 | 1 | 0.048 | 0 | 278,000 | 1 | 17.4 | 1 | 2.19 | 1 | 14.1 | 1 |
| 3,980 | 1 | 1.13 | 1 | 4.1 | 1 | 6.01 | 1 | 0.264 | 1 | 0.99 | 1 | 86,800 | 1 | 1.64 | 1 | 1.68 | 1 | 17.3 | 1 |
| 15,000 | 1 | 1.89 | 0 | 4.53 | 1 | 31.7 | 1 | 0.0534 | 1 | 0.048 | 0 | 197,000 | 1 | 24.7 | 1 | 5.96 | 1 | 14.3 | 1 |
| 2,990 | 1 | 1.21 | 0 | 1.17 | 0 | 28.9 | 1 | 0.232 | 1 | 0.03 | 0 | 256,000 | 1 | 27.1 | 1 | 7.51 | 1 | 1.54 | 1 |
| 16,400 | 1 | 3.1 | 1 | 8 | 1 | 113 | 1 | 1.2 | 1 | 0.41 | 0 | 8,690 | 1 | 26.1 | 1 | 13.1 | 1 | 127 | 1 |
| 27,700 | 1 | 3.8 | 1 | 8.9 | 1 | 61.4 | 1 | 0.94 | 1 | 0.6 | 0 | 167,000 | 1 | 25 | 1 | 4.4 | 1 | 3.2 | 1 |
| 25,800 | 1 | 4 | 1 | 3 | 1 | 49.4 | 1 | 0.56 | 1 | 0.64 | 0 | 195,000 | 1 | 18.8 | 1 | 2.4 | 1 | 10.7 | 1 |
| 27,200 | 1 | 4.5 | 1 | 3.5 | 1 | 59.2 | 1 | 1 | 1 | 0.71 | 0 | 208,000 | 1 | 12.9 | 1 | 6.3 | 1 | 15.5 | 1 |
| 21,400 | 1 | 9.9 | 1 | 3.5 | 1 | 41.1 | 1 | 0.81 | 1 | 0.78 | 0 | 219,000 | 1 | 6.7 | 1 | 4.8 | 1 | 0.44 | 0 |
| 10,400 | 1 | 4.1 | 0 | 0.94 | 0 | 78.1 | 1 | 0.57 | 1 | 0.66 | 0 | 247,000 | 1 | 12 | 1 | 1.6 | 0 | 2.2 | 1 |
| 4,450 | 1 | 2.9 | 1 | 0.98 | 0 | 45 | 1 | 0.36 | 1 | 0.69 | 0 | 194,000 | 1 | 25.1 | 1 | 1.6 | 0 | 0.39 | 0 |
| 3,260 | 1 | 4.2 | 0 | 0.95 | 0 | 105 | 1 | 0.7 | 1 | 0.67 | 0 | 233,000 | 1 | 16.4 | 1 | 4 | 1 | 4.9 | 1 |
| 15,900 | 1 | 8.8 | 1 | 2.2 | 1 | 40.7 | 1 | 1.2 | 1 | 0.76 | 0 | 264,000 | 1 | 16.7 | 1 | 5.5 | 1 | 11.1 | 1 |
| 11,700 | 1 | 4.5 | 0 | 1.2 | 1 | 21.9 | 1 | 0.79 | 1 | 0.72 | 0 | 218,000 | 1 | 28.2 | 1 | 2.3 | 1 | 1.5 | 1 |
| 8,870 | 1 | 4.3 | 0 | 1.6 | 1 | 64.5 | 1 | 0.99 | 1 | 0.68 | 0 | 264,000 | 1 | 20.6 | 1 | 3.3 | 1 | 11.7 | 1 |
| | | 1.2 | 0 | 10.4 | 1 | 105 | 1 | 0.59 | 0 | 1.5 | 1 | | | 20.6 | 1 | | | 99.8 | 1 |
| | | 2.1 | 0 | 6.5 | 1 | 101 | 1 | 1 | 0 | 2.7 | 1 | | | 22.6 | 1 | | | 21.5 | 1 |
| | | 1.1 | 0 | 1.3 | 1 | 258 | 1 | 0.56 | 0 | 0.56 | 1 | | | 20.3 | 1 | | | 28.7 | 1 |
| | | | | 5.33 | 1 | 75.4 | 1 | | | 0.015 | 0 | | | 26 | 1 | | | | |
| | | | | 8.76 | 1 | 140 | 1 | | | 0.016 | 0 | | | 22.5 | 1 | | | | |
| | | | | 4.68 | 1 | 51.3 | 1 | | | 0.015 | 0 | | | 23.1 | 1 | | | | |
| | | | | 5.94 | 1 | 122 | 1 | | | 0.015 | 0 | | | 13 | 1 | | | | |
| | | | | 6.94 | 1 | 63.3 | 1 | | | 0.015 | 0 | | | 23.2 | 1 | | | | |
| | | | | 5.52 | 1 | 75.3 | 1 | | | 0.015 | 0 | | | 15.3 | 1 | | | | |
| | | | | 6.22 | 1 | 114 | 1 | | | 0.016 | 0 | | | 13.4 | 1 | | | | |
| | | | | 4.05 | 1 | 261 | 1 | | | 0.017 | 0 | | | 20.6 | 1 | | | | |
| | | | | 10.1 | 1 | 95.1 | 1 | | | 0.016 | 0 | | | 21 | 1 | | | | |
| | | | | 6.01 | 1 | 339 | 1 | | | 0.025 | 0 | | | 29.5 | 1 | | | | |
| | | | | 10.2 | 1 | 148 | 1 | | | 0.016 | 0 | | | 18.9 | 1 | | | | |
| | | | | 6.14 | 1 | 236 | 1 | | | 0.017 | 0 | | | 24.8 | 1 | | | | |
| | | | | 5.84 | 1 | 154 | 1 | | | 0.016 | 0 | | | 10.1 | 1 | | | | |
| | | | | 4.69 | 1 | 94.7 | 1 | | | 0.016 | 0 | | | 19.5 | 1 | | | | |
| | | | | 9.97 | 1 | 170 | 1 | | | 0.179 | 1 | | | 18.5 | 1 | | | | |
| | | | | 11.4 | 1 | 57.7 | 1 | | | 5.91 | 1 | | | 21.4 | 1 | | | | |
| | | | | 11 | 1 | 85.2 | 1 | | | 0.017 | 0 | | | 18.3 | 1 | | | | |
| | | | | 5.34 | 1 | | | | | 0.016 | 0 | | | 20.3 | 1 | | | | |
| | | | | 7.18 | 1 | | | | | 0.015 | 0 | | | | | | | | |
| | | | | 4.34 | 1 | | | | | 0.015 | 0 | | | | | | | | |

## Rahway Arch Property Site
## Existing Surface Inorganic Data for Statistical Analysis

| Iron | d_ | Lead | d_ | Magnesium | d_ | Manganese | d_ | Mercury | d_ | Nickel | d_ | Potassium | d_ | Selenium | d_ | Silver | d_ | Sodium | d_ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | |
| 20,100 | 1 | 112 | 1 | 2,560 | 1 | 231 | 1 | 0.317 | 1 | 21.2 | 1 | 970 | 1 | 0.399 | 0 | 0.093 | 0 | 207 | 1 |
| 14,100 | 1 | 148 | 1 | 4,270 | 1 | 264 | 1 | 0.469 | 1 | 14.2 | 1 | 1860 | 1 | 0.413 | 0 | 0.096 | 0 | 433 | 1 |
| 2,150 | 1 | 11 | 1 | 1,040 | 1 | 37.4 | 1 | 0.016 | 0 | 3.74 | 1 | 166 | 1 | 2.18 | 1 | 0.138 | 0 | 1,330 | 1 |
| 18,100 | 1 | 45.8 | 1 | 4,930 | 1 | 294 | 1 | 0.0605 | 1 | 15.6 | 1 | 1380 | 1 | 0.389 | 0 | 0.091 | 0 | 534 | 1 |
| 11,900 | 1 | 236 | 1 | 2,250 | 1 | 194 | 1 | 0.226 | 1 | 50.2 | 1 | 1160 | 1 | 0.978 | 0 | 0.311 | 1 | 5,280 | 1 |
| 22,900 | 1 | 112 | 1 | 7,230 | 1 | 415 | 1 | 0.0785 | 1 | 20 | 1 | 1560 | 1 | 0.444 | 0 | 0.104 | 0 | 1,130 | 1 |
| 10,700 | 1 | 36.3 | 1 | 2,840 | 1 | 142 | 1 | 1.03 | 1 | 13.1 | 1 | 2300 | 1 | 0.086 | 0 | 0.02 | 0 | 7,710 | 1 |
| 13,300 | 1 | 60.2 | 1 | 4,400 | 1 | 156 | 1 | 0.105 | 0 | 38.4 | 1 | 1170 | 1 | 2.46 | 1 | 0.17 | 0 | 8,630 | 1 |
| 3,160 | 1 | 43.1 | 1 | 3,820 | 1 | 55.8 | 1 | 0.099 | 0 | 7.86 | 1 | 371 | 1 | 2.79 | 1 | 0.162 | 0 | 7,020 | 1 |
| 18,700 | 1 | 56.1 | 1 | 1,740 | 1 | 123 | 1 | 0.262 | 1 | 13.3 | 1 | 1270 | 1 | 0.548 | 0 | 0.129 | 0 | 2,240 | 1 |
| 2,960 | 1 | 11.3 | 1 | 882 | 1 | 56.1 | 1 | 0.09 | 0 | 4.77 | 1 | 248 | 1 | 4.45 | 1 | 0.147 | 0 | 1,330 | 1 |
| 6,050 | 1 | 17.1 | 1 | 1,240 | 1 | 96.2 | 1 | 0.091 | 0 | 8.1 | 1 | 800 | 1 | 2.61 | 1 | 0.148 | 0 | 1,010 | 1 |
| 1,830 | 1 | 11.5 | 1 | 773 | 1 | 40.1 | 1 | 0.088 | 0 | 4.92 | 1 | 110 | 1 | 1.41 | 1 | 0.143 | 0 | 873 | 1 |
| 9,690 | 1 | 20.7 | 1 | 20,700 | 1 | 356 | 1 | 0.261 | 1 | 8.51 | 1 | 294 | 1 | 6.59 | 1 | 0.175 | 0 | 2,960 | 1 |
| 2,440 | 1 | 10.5 | 1 | 111 | 1 | 86.8 | 1 | 0.081 | 0 | 4.55 | 1 | 19.4 | 0 | 4.69 | 1 | 0.132 | 0 | 634 | 1 |
| 5,880 | 1 | 12.7 | 1 | 4,990 | 1 | 46.2 | 1 | 0.165 | 0 | 10.9 | 1 | 1780 | 1 | 2.08 | 1 | 0.268 | 0 | 20,400 | 1 |
| 6,860 | 1 | 28.7 | 1 | 19,400 | 1 | 233 | 1 | 0.131 | 1 | 16.4 | 1 | 306 | 1 | 3.19 | 1 | 0.184 | 0 | 9,470 | 1 |
| 14,500 | 1 | 22.2 | 1 | 2,240 | 1 | 76.8 | 1 | 0.0937 | 1 | 9.16 | 1 | 1070 | 1 | 0.028 | 0 | 0.006 | 0 | 2,840 | 1 |
| 9,820 | 1 | 2.91 | 1 | 27,700 | 1 | 307 | 1 | 0.135 | 1 | 10.4 | 1 | 102 | 1 | 0.779 | 0 | 0.183 | 0 | 2,430 | 1 |
| 1,900 | 1 | 0.65 | 0 | 919 | 1 | 39.7 | 1 | 0.072 | 0 | 4.49 | 1 | 82.3 | 1 | 0.499 | 0 | 0.117 | 0 | 748 | 1 |
| 18,200 | 1 | 174 | 1 | 4,320 | 1 | 260 | 1 | 0.19 | 1 | 27.5 | 1 | 2920 | 1 | 0.59 | 0 | 0.54 | 0 | 1,980 | 1 |
| 10,700 | 1 | 44.6 | 1 | 13,900 | 1 | 310 | 1 | 0.69 | 1 | 4 | 1 | 474 | 1 | 8.6 | 0 | 0.79 | 0 | 2,340 | 1 |
| 9,060 | 1 | 32.3 | 1 | 15,700 | 1 | 269 | 1 | 0.36 | 1 | 6.6 | 1 | 176 | 0 | 9.1 | 0 | 0.84 | 0 | 3,600 | 1 |
| 10,400 | 1 | 40.9 | 1 | 12,300 | 1 | 296 | 1 | #VALUE! | 0 | 13.3 | 1 | 774 | 1 | 10 | 0 | 0.94 | 0 | 2,750 | 1 |
| 8,850 | 1 | 28.9 | 1 | 31,500 | 1 | 281 | 1 | 0.22 | 0 | 4.9 | 0 | 473 | 1 | 11 | 0 | 1 | 0 | 11,300 | 1 |
| 742 | 1 | 18.3 | 1 | 752 | 1 | 11.4 | 1 | 0.17 | 0 | 7.2 | 1 | 348 | 1 | 9.4 | 0 | 0.86 | 0 | 2,110 | 1 |
| 1,360 | 1 | 10.7 | 1 | 1,650 | 1 | 38.8 | 1 | 0.2 | 0 | 4.3 | 0 | 189 | 0 | 9.8 | 0 | 0.9 | 0 | 5,210 | 1 |
| 3,070 | 1 | 21.4 | 1 | 3,270 | 1 | 53.1 | 1 | 0.19 | 0 | 6.7 | 1 | 412 | 1 | 9.5 | 0 | 0.88 | 0 | 12,100 | 1 |
| 5,880 | 1 | 25.9 | 1 | 12,600 | 1 | 253 | 1 | 0.22 | 0 | 6.7 | 1 | 300 | 1 | 11 | 0 | 0.99 | 0 | 1,740 | 1 |
| 2,780 | 1 | 12.6 | 1 | 2,570 | 1 | 55.3 | 1 | 0.21 | 0 | 4.5 | 0 | 198 | 0 | 1 | 0 | 0.95 | 0 | 1,200 | 1 |
| 3,930 | 1 | 30.4 | 1 | 4,390 | 1 | 97.7 | 1 | 0.19 | 0 | 6.5 | 1 | 469 | 1 | 9.7 | 0 | 0.89 | 0 | 11,800 | 1 |
| | | 222 | 1 | | | | | 0.26 | 1 | 18 | 1 | | | 1.2 | 0 | 1.2 | 0 | | |
| | | 52.7 | 1 | | | | | 0.13 | 1 | 15.5 | 1 | | | 2.1 | 0 | 2.1 | 0 | | |
| | | 56.1 | 1 | | | | | 0.24 | 1 | 12 | 1 | | | 1.1 | 0 | 1.1 | 0 | | |
| | | 18.5 | 1 | | | | | 0.333 | 1 | | | | | 0.933 | 0 | 0.126 | 0 | | |
| | | 172 | 1 | | | | | 0.683 | 1 | | | | | 0.943 | 0 | 0.127 | 0 | | |
| | | 102 | 1 | | | | | 0.101 | 1 | | | | | 0.923 | 0 | 0.125 | 0 | | |
| | | 45.1 | 1 | | | | | 0.211 | 1 | | | | | 0.904 | 0 | 0.122 | 0 | | |
| | | 190 | 1 | | | | | 0.191 | 1 | | | | | 0.935 | 0 | 0.126 | 0 | | |
| | | 66 | 1 | | | | | 0.034 | 0 | | | | | 0.909 | 0 | 0.123 | 0 | | |
| | | 21.5 | 1 | | | | | 0.036 | 0 | | | | | 0.98 | 0 | 0.132 | 0 | | |
| | | 44.7 | 1 | | | | | 0.037 | 0 | | | | | 1 | 0 | 0.136 | 0 | | |
| | | 792 | 1 | | | | | 0.035 | 0 | | | | | 0.939 | 0 | 0.127 | 0 | | |
| | | 17.5 | 1 | | | | | 0.035 | 0 | | | | | 0.684 | 0 | 0.097 | 0 | | |
| | | 296 | 1 | | | | | 1.47 | 1 | | | | | 0.944 | 0 | 0.127 | 0 | | |
| | | 55.8 | 1 | | | | | 0.0537 | 1 | | | | | 1 | 0 | 0.135 | 0 | | |
| | | 142 | 1 | | | | | 0.148 | 1 | | | | | 0.948 | 0 | 0.128 | 0 | | |
| | | 68.2 | 1 | | | | | 0.344 | 1 | | | | | 0.983 | 0 | 0.133 | 0 | | |
| | | 100 | 1 | | | | | 1.17 | 1 | | | | | 2.18 | 1 | 0.217 | 0 | | |
| | | 226 | 1 | | | | | 0.217 | 1 | | | | | 1 | 0 | 0.135 | 0 | | |
| | | 173 | 1 | | | | | 7.61 | 1 | | | | | 1.01 | 0 | 0.136 | 0 | | |
| | | 112 | 1 | | | | | 0.848 | 1 | | | | | 0.949 | 0 | 0.128 | 0 | | |
| | | 50.3 | 1 | | | | | 0.266 | 1 | | | | | 0.926 | 0 | 0.125 | 0 | | |
| | | 26.7 | 1 | | | | | 0.034 | 0 | | | | | 0.923 | 0 | 0.125 | 0 | | |

## Rahway Arch Property Site
## xisting Surface Inorganic Data for Statistical Analys

| Thallium | d_ | Vanadium | d_ | Zinc | d_ | Cyanide | d_ |
|---|---|---|---|---|---|---|---|
| (mg/kg) | | (mg/kg) | | (mg/kg) | | (mg/kg) | |
| 1.17 | 0 | 36.7 | 1 | 231 | 1 | 2.96 | 0 |
| 1.21 | 0 | 31.8 | 1 | 124 | 1 | 3.06 | 0 |
| 1.73 | 0 | 14.8 | 1 | 4.21 | 1 | 1120 | 1 |
| 1.14 | 0 | 39.1 | 1 | 68.4 | 1 | 66.4 | 1 |
| 2.87 | 0 | 87.6 | 1 | 389 | 1 | 334 | 1 |
| 1.3 | 0 | 28.5 | 1 | 168 | 1 | 1330 | 1 |
| 0.255 | 0 | 23.5 | 1 | 75.3 | 1 | 1720 | 1 |
| 2.13 | 0 | 59.1 | 1 | 185 | 1 | 123 | 1 |
| 2.03 | 0 | 9.19 | 1 | 20.9 | 1 | 405 | 1 |
| 1.61 | 0 | 28.1 | 1 | 147 | 1 | 825 | 1 |
| 1.84 | 0 | 13.8 | 1 | 7.98 | 1 | 1180 | 1 |
| 1.85 | 0 | 23.1 | 1 | 16 | 1 | 2850 | 1 |
| 1.79 | 0 | 12.8 | 1 | 6.48 | 1 | 190 | 1 |
| 2.18 | 0 | 48 | 1 | 36.9 | 1 | 210 | 1 |
| 1.65 | 0 | 14.4 | 1 | 43 | 1 | 1820 | 1 |
| 3.36 | 0 | 22.7 | 1 | 14.1 | 1 | 1420 | 1 |
| 2.3 | 0 | 8.02 | 1 | 141 | 1 | 2420 | 1 |
| 0.083 | 0 | 12.9 | 1 | 85.5 | 1 | 3.9 | 1 |
| 2.28 | 0 | 30.7 | 1 | 24.7 | 1 | 337 | 1 |
| 1.46 | 0 | 7.39 | 1 | 3.44 | 1 | 472 | 1 |
| 0.59 | 0 | 29.6 | 1 | 914 | 1 | 768 | 1 |
| 0.86 | 0 | 38.3 | 1 | 38.5 | 1 | 153 | 1 |
| 0.91 | 0 | 30 | 1 | 29.4 | 1 | 9.7 | 1 |
| 1 | 0 | 30.2 | 1 | 32 | 1 | 403 | 1 |
| 1.1 | 0 | 31.5 | 1 | 15.6 | 1 | 972 | 1 |
| 0.94 | 0 | 12.3 | 1 | 3.4 | 1 | 1020 | 1 |
| 0.98 | 0 | 9.9 | 1 | 0.75 | 0 | 68.7 | 1 |
| 0.95 | 0 | 17.4 | 1 | 10.5 | 1 | 103 | 1 |
| 1.1 | 0 | 31.3 | 1 | 22.4 | 1 | 0.47 | 1 |
| 1 | 0 | 19.6 | 1 | 2.5 | 1 | 84.8 | 1 |
| 0.97 | 0 | 30 | 1 | 25.9 | 1 | 0.65 | 1 |
| 1.2 | 0 | | | 186 | 1 | 4.95 | 1 |
| 2.1 | 0 | | | 1820 | 1 | | |
| 1.1 | 0 | | | 50.1 | 1 | | |

# *EastStar*

From File: \\SERVER\EastStar\Project Files\I-2011 Project Folders\I027 Rahway Arch Rahway LSRP Services\Remedial Action Workplan\UCL Analysis Existing Conditions\071613 Existing Rahway Inorganics Data for ProUCL.wst

## Summary Statistics for Raw Full Data Sets

| Variable | NumObs | Minimum | Maximum | Mean | Median | Variance | SD | MAD/0.675 | Skewness | Kurtosis | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 31 | 2990 | 29200 | 11518 | 9380 | 58819021 | 7669 | 7309 | 1.094 | 0.301 | 0.666 |
| Antimony | 34 | 0.956 | 9.9 | 2.708 | 1.8 | 4.414 | 2.101 | 1.016 | 2.024 | 4.524 | 0.776 |
| Arsenic | 54 | 0.94 | 48.5 | 6.012 | 4.685 | 46.78 | 6.839 | 3.892 | 4.745 | 28.59 | 1.138 |
| Barium | 51 | 6.01 | 479 | 97.43 | 75.4 | 7628 | 87.34 | 46.85 | 2.392 | 7.211 | 0.896 |
| Beryllium | 34 | 0.005 | 1.2 | 0.544 | 0.457 | 0.12 | 0.346 | 0.337 | 0.449 | -0.928 | 0.635 |
| Cadmium | 54 | 0.005 | 5.91 | 0.494 | 0.038 | 1.138 | 1.067 | 0.0341 | 3.664 | 14.92 | 2.16 |
| Calcium | 31 | 4180 | 280000 | 174376 | 214000 | 8.854E+09 | 94095 | 62268 | -0.803 | -0.933 | 0.54 |
| Chromium | 52 | 1.64 | 38.3 | 19.37 | 20.1 | 64.63 | 8.039 | 7.191 | -0.0357 | 0.418 | 0.415 |
| Cobalt | 31 | 1.6 | 75.3 | 7.869 | 4.8 | 172.3 | 13.13 | 3.558 | 4.824 | 25.08 | 1.668 |
| Copper | 34 | 0.39 | 186 | 25.43 | 12.9 | 1585 | 39.81 | 16.8 | 2.786 | 8.397 | 1.565 |
| Iron | 31 | 742 | 22900 | 8775 | 8850 | 39656494 | 6297 | 8377 | 0.611 | -0.622 | 0.718 |
| Lead | 54 | 0.65 | 792 | 83.13 | 44.65 | 14588 | 120.8 | 39.66 | 4.134 | 22.31 | 1.453 |
| Magnesium | 31 | 111 | 31500 | 7000 | 3820 | 68002798 | 8246 | 3825 | 1.701 | 2.198 | 1.178 |
| Manganese | 31 | 11.4 | 415 | 166.9 | 142 | 13653 | 116.8 | 151.1 | 0.353 | -1.229 | 0.7 |
| Mercury | 52 | 0.016 | 7.61 | 0.403 | 0.19 | 1.126 | 1.061 | 0.145 | 6.409 | 43.79 | 2.632 |
| Nickel | 34 | 3.74 | 50.2 | 12.28 | 8.835 | 101.2 | 10.06 | 6.39 | 2.275 | 6.069 | 0.819 |
| Potassium | 31 | 19.4 | 2920 | 766.2 | 469 | 527602 | 726.4 | 490.7 | 1.317 | 1.34 | 0.948 |
| Selenium | 54 | 0.028 | 11 | 2.798 | 1 | 11.41 | 3.377 | 0.706 | 1.507 | 0.699 | 1.207 |
| Silver | 54 | 0.006 | 2.1 | 0.36 | 0.136 | 0.178 | 0.422 | 0.0489 | 1.946 | 4.214 | 1.172 |
| Sodium | 31 | 207 | 20400 | 4301 | 2340 | 21951371 | 4685 | 2175 | 1.786 | 3.393 | 1.089 |
| Thallium | 34 | 0.083 | 3.36 | 1.442 | 1.205 | 0.489 | 0.699 | 0.556 | 0.625 | 0.679 | 0.485 |
| Vanadium | 31 | 7.39 | 87.6 | 26.85 | 28.1 | 275.7 | 16.6 | 15.12 | 1.804 | 5.039 | 0.618 |
| Zinc | 34 | 0.75 | 1820 | 145.4 | 34.45 | 115688 | 340.1 | 45.4 | 4.19 | 19.04 | 2.34 |
| Cyanide | 32 | 0.47 | 2850 | 638.1 | 335.5 | 575043 | 758.3 | 492.2 | 1.388 | 1.406 | 1.188 |

***EastStar Environmental Group, Inc.***
www.EastStarEnv.com

10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Phone: (410) 290-8777 Fax: (410) 290-9055

# *EastStar*

**Percentiles for Raw Full Data Sets**

| Variable | NumObs | 5%ile | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 31 | 3139 | 3469 | 4354 | 5853 | 9125 | 14850 | 15720 | 25360 | 27425 | 28735 |
| Antimony | 34 | 0.978 | 1.088 | 1.192 | 1.27 | 1.79 | 3.9 | 4.12 | 4.5 | 6.07 | 9.526 |
| Arsenic | 54 | 0.971 | 1.24 | 1.478 | 2.05 | 4.68 | 7.31 | 8.12 | 10.16 | 11.12 | 32.03 |
| Barium | 51 | 16.64 | 22.04 | 37.42 | 44.03 | 75.35 | 108.5 | 120.4 | 175.4 | 259.4 | 407.6 |
| Beryllium | 34 | 0.0389 | 0.124 | 0.238 | 0.255 | 0.41 | 0.8 | 0.931 | 1 | 1.151 | 1.2 |
| Cadmium | 54 | 0.015 | 0.015 | 0.016 | 0.016 | 0.037 | 0.65 | 0.682 | 0.906 | 2.175 | 5.057 |
| Calcium | 31 | 6661 | 13390 | 58340 | 64325 | 211000 | 237250 | 252600 | 264000 | 276900 | 279380 |
| Chromium | 52 | 3.07 | 7.38 | 12.94 | 13.5 | 19.9 | 24.7 | 25.06 | 28.02 | 31.58 | 38.14 |
| Cobalt | 31 | 1.6 | 1.689 | 2.32 | 2.528 | 4.6 | 7.605 | 7.906 | 12.17 | 15.98 | 58 |
| Copper | 34 | 0.425 | 0.716 | 1.588 | 1.775 | 11.7 | 28.55 | 31.76 | 53.66 | 108 | 165.9 |
| Iron | 31 | 1082 | 1837 | 2508 | 2915 | 7855 | 12250 | 13940 | 18190 | 19330 | 22032 |
| Lead | 54 | 8.223 | 11.12 | 17.42 | 19.6 | 44.6 | 107 | 118 | 183.6 | 229 | 524.2 |
| Magnesium | 31 | 463.6 | 783.9 | 1080 | 1548 | 3545 | 8498 | 12540 | 19030 | 23850 | 30322 |
| Manganese | 31 | 25.7 | 38.89 | 47.58 | 54.75 | 132.5 | 265.3 | 278.6 | 305.9 | 330.7 | 396.7 |
| Mercury | 52 | 0.0346 | 0.0362 | 0.0795 | 0.09 | 0.19 | 0.262 | 0.327 | 0.689 | 1.086 | 4.417 |
| Nickel | 34 | 3.922 | 4.376 | 4.726 | 4.91 | 8.51 | 14.85 | 15.76 | 20.72 | 30.77 | 46.19 |
| Potassium | 31 | 54 | 102.8 | 178.6 | 195.8 | 440.5 | 1163 | 1250 | 1758 | 2058 | 2728 |
| Selenium | 54 | 0.298 | 0.425 | 0.76 | 0.916 | 1 | 2.7 | 4.498 | 9.46 | 9.86 | 11 |
| Silver | 54 | 0.0697 | 0.0964 | 0.125 | 0.126 | 0.136 | 0.426 | 0.844 | 0.946 | 1.03 | 1.614 |
| Sodium | 31 | 331.3 | 544 | 900.4 | 1100 | 2290 | 5715 | 7572 | 11117 | 11935 | 17827 |
| Thallium | 34 | 0.203 | 0.698 | 0.948 | 0.975 | 1.2 | 1.845 | 2.044 | 2.24 | 2.471 | 3.193 |
| Vanadium | 31 | 7.737 | 9.261 | 12.82 | 13.58 | 25.8 | 31.35 | 31.74 | 39.02 | 53 | 78.77 |
| Zinc | 34 | 1.975 | 3.416 | 7.68 | 12.3 | 32 | 132.5 | 151.2 | 213 | 546.5 | 1512 |
| Cyanide | 32 | 0.578 | 2.98 | 6.85 | 66.4 | 334 | 1020 | 1156 | 1660 | 2060 | 2712 |

***EastStar Environmental Group, Inc.***
www.EastStarEnv.com

10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Phone: (410) 290-8777 Fax: (410) 290-9055

| | |
|---|---|
| | General UCL Statistics for Data Sets with Non-Detects |
| **User Selected Options** | |
| From File | \\SERVER\EastStar\Project Files\I-2011 Project Folders\I027 Rahway Arch Rahway LSRP Services\Rem |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Aluminum**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 30 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 2990 | Minimum of Log Data | 8.003 |
| Maximum | 29200 | Maximum of Log Data | 10.28 |
| Mean | 11518 | Mean of log Data | 9.143 |
| Median | 9380 | SD of log Data | 0.665 |
| SD | 7669 | | |
| Coefficient of Variation | 0.666 | | |
| Skewness | 1.094 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.863 | Shapiro Wilk Test Statistic | 0.956 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 13856 | 95% H-UCL | 14999 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 18045 |
| 95% Adjusted-CLT UCL | 14073 | 97.5% Chebyshev (MVUE) UCL | 20849 |
| 95% Modified-t UCL | 13901 | 99% Chebyshev (MVUE) UCL | 26357 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 2.324 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 4956 | | |
| MLE of Mean | 11518 | | |
| MLE of Standard Deviation | 7555 | | |
| nu star | 144.1 | | |
| Approximate Chi Square Value (.05) | 117.4 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 13784 |
| Adjusted Chi Square Value | 116 | 95% Jackknife UCL | 13856 |
| | | 95% Standard Bootstrap UCL | 13709 |
| Anderson-Darling Test Statistic | 0.428 | 95% Bootstrap-t UCL | 14439 |
| Anderson-Darling 5% Critical Value | 0.755 | 95% Hall's Bootstrap UCL | 14108 |
| Kolmogorov-Smirnov Test Statistic | 0.0958 | 95% Percentile Bootstrap UCL | 13634 |
| Kolmogorov-Smirnov 5% Critical Value | 0.159 | 95% BCA Bootstrap UCL | 14039 |
| Data appear Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 17523 |

| | | | |
|---|---|---|---|
| | | 97.5% Chebyshev(Mean, Sd) UCL | 20121 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 25224 |
| 95% Approximate Gamma UCL | 14143 | | |
| 95% Adjusted Gamma UCL | 14306 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 14143 |
| | | | |

| Antimony | | | |
|---|---|---|---|
| | | | |
| **General Statistics** | | | |
| Number of Valid Data | 34 | Number of Detected Data | 13 |
| Number of Distinct Detected Data | 13 | Number of Non-Detect Data | 21 |
| | | Percent Non-Detects | 61.76% |
| | | | |
| **Raw Statistics** | | **Log-transformed Statistics** | |
| Minimum Detected | 0.956 | Minimum Detected | -0.045 |
| Maximum Detected | 9.9 | Maximum Detected | 2.293 |
| Mean of Detected | 3.739 | Mean of Detected | 1.061 |
| SD of Detected | 2.828 | SD of Detected | 0.757 |
| Minimum Non-Detect | 0.988 | Minimum Non-Detect | -0.0121 |
| Maximum Non-Detect | 4.5 | Maximum Non-Detect | 1.504 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 30 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 4 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 88.24% |
| | | | |
| **UCL Statistics** | | | |
| **Normal Distribution Test with Detected Values Only** | | **Lognormal Distribution Test with Detected Values Only** | |
| Shapiro Wilk Test Statistic | 0.848 | Shapiro Wilk Test Statistic | 0.948 |
| 5% Shapiro Wilk Critical Value | 0.866 | 5% Shapiro Wilk Critical Value | 0.866 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 2.069 | Mean | 0.35 |
| SD | 2.212 | SD | 0.821 |
| 95% DL/2 (t) UCL | 2.711 | 95% H-Stat (DL/2) UCL | 2.338 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | N/A | Log ROS Method | |
| **MLE yields a negative mean** | | Mean in Log Scale | 0.322 |
| | | SD in Log Scale | 0.761 |
| | | Mean in Original Scale | 1.977 |
| | | SD in Original Scale | 2.214 |
| | | 95% Percentile Bootstrap UCL | 2.613 |
| | | 95% BCA Bootstrap UCL | 2.78 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 1.662 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 2.249 | | |
| nu star | 43.22 | | |
| | | | |
| A-D Test Statistic | 0.329 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.743 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.743 | Mean | 2.118 |
| 5% K-S Critical Value | 0.239 | SD | 2.138 |
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 0.387 |

| | | | |
|---|---|---|---|
| | | 95% KM (t) UCL | 2.774 |
| **Assuming Gamma Distribution** | | 95% KM (z) UCL | 2.755 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 2.715 |
| Minimum | 0.956 | 95% KM (bootstrap t) UCL | 3.129 |
| Maximum | 9.9 | 95% KM (BCA) UCL | 3.016 |
| Mean | 3.797 | 95% KM (Percentile Bootstrap) UCL | 2.837 |
| Median | 3.766 | 95% KM (Chebyshev) UCL | 3.806 |
| SD | 1.725 | 97.5% KM (Chebyshev) UCL | 4.537 |
| k star | 4.691 | 99% KM (Chebyshev) UCL | 5.972 |
| Theta star | 0.809 | | |
| Nu star | 319 | **Potential UCLs to Use** | |
| AppChi2 | 278.6 | 95% KM (t) UCL | 2.774 |
| 95% Gamma Approximate UCL | 4.347 | | |
| 95% Adjusted Gamma UCL | 4.376 | | |
| Note: DL/2 is not a recommended method. | | | |

**Arsenic**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 54 | Number of Detected Data | 44 |
| Number of Distinct Detected Data | 41 | Number of Non-Detect Data | 10 |
| | | Percent Non-Detects | 18.52% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 1.2 | Minimum Detected | 0.182 |
| Maximum Detected | 48.5 | Maximum Detected | 3.882 |
| Mean of Detected | 7.064 | Mean of Detected | 1.706 |
| SD of Detected | 7.175 | SD of Detected | 0.675 |
| Minimum Non-Detect | 0.94 | Minimum Non-Detect | -0.0619 |
| Maximum Non-Detect | 2.69 | Maximum Non-Detect | 0.99 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 15 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 39 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 27.78% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.549 | Shapiro Wilk Test Statistic | 0.961 |
| 5% Shapiro Wilk Critical Value | 0.944 | 5% Shapiro Wilk Critical Value | 0.944 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 5.884 | Mean | 1.313 |
| SD | 6.93 | SD | 1.039 |
| 95% DL/2 (t) UCL | 7.463 | 95% H-Stat (DL/2) UCL | 7.868 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 4.714 | Mean in Log Scale | 1.447 |
| SD | 8.242 | SD in Log Scale | 0.82 |
| 95% MLE (t) UCL | 6.592 | Mean in Original Scale | 6.009 |
| 95% MLE (Tiku) UCL | 6.644 | SD in Original Scale | 6.838 |
| | | 95% Percentile Bootstrap UCL | 7.705 |
| | | 95% BCA Bootstrap UCL | 8.43 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 2.029 | Data Follow Appr. Gamma Distribution at 5% Significance Level | |
| Theta Star | 3.482 | | |
| nu star | 178.5 | | |
| | | | |
| A-D Test Statistic | 1.027 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.759 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.759 | Mean | 5.983 |
| 5% K-S Critical Value | 0.135 | SD | 6.793 |

| | | | |
|---|---|---|---|
| Data follow Appr. Gamma Distribution at 5% Significance Level | | SE of Mean | 0.935 |
| | | 95% KM (t) UCL | 7.548 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 7.521 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 7.532 |
| Minimum | 0.0753 | 95% KM (bootstrap t) UCL | 8.937 |
| Maximum | 48.5 | 95% KM (BCA) UCL | 7.778 |
| Mean | 5.922 | 95% KM (Percentile Bootstrap) UCL | 7.706 |
| Median | 4.685 | 95% KM (Chebyshev) UCL | 10.06 |
| SD | 6.907 | 97.5% KM (Chebyshev) UCL | 11.82 |
| k star | 1.013 | 99% KM (Chebyshev) UCL | 15.29 |
| Theta star | 5.847 | | |
| Nu star | 109.4 | Potential UCLs to Use | |
| AppChi2 | 86.25 | 95% KM (BCA) UCL | 7.778 |
| 95% Gamma Approximate UCL | 7.511 | | |
| 95% Adjusted Gamma UCL | 7.56 | | |
| Note: DL/2 is not a recommended method. | | | |

**Barium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 51 | Number of Distinct Observations | 50 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 6.01 | Minimum of Log Data | 1.793 |
| Maximum | 479 | Maximum of Log Data | 6.172 |
| Mean | 97.43 | Mean of log Data | 4.26 |
| Median | 75.4 | SD of log Data | 0.832 |
| SD | 87.34 | | |
| Coefficient of Variation | 0.896 | | |
| Skewness | 2.392 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Lilliefors Test Statistic | 0.209 | Lilliefors Test Statistic | 0.0693 |
| Lilliefors Critical Value | 0.124 | Lilliefors Critical Value | 0.124 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 117.9 | 95% H-UCL | 128.7 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 156 |
| 95% Adjusted-CLT UCL | 121.9 | 97.5% Chebyshev (MVUE) UCL | 180.6 |
| 95% Modified-t UCL | 118.6 | 99% Chebyshev (MVUE) UCL | 228.9 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 1.628 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 59.85 | | |
| MLE of Mean | 97.43 | | |
| MLE of Standard Deviation | 76.36 | | |
| nu star | 166 | | |
| Approximate Chi Square Value (.05) | 137.2 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0453 | 95% CLT UCL | 117.5 |
| Adjusted Chi Square Value | 136.5 | 95% Jackknife UCL | 117.9 |
| | | 95% Standard Bootstrap UCL | 118.1 |
| Anderson-Darling Test Statistic | 0.474 | 95% Bootstrap-t UCL | 127.2 |
| Anderson-Darling 5% Critical Value | 0.765 | 95% Hall's Bootstrap UCL | 126.5 |
| Kolmogorov-Smirnov Test Statistic | 0.105 | 95% Percentile Bootstrap UCL | 118.8 |
| Kolmogorov-Smirnov 5% Critical Value | 0.126 | 95% BCA Bootstrap UCL | 123.9 |
| Data appear Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 150.7 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 173.8 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 219.1 |
| 95% Approximate Gamma UCL | 117.9 | | |
| 95% Adjusted Gamma UCL | 118.5 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 117.9 |

**Beryllium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 34 | Number of Detected Data | 30 |
| Number of Distinct Detected Data | 29 | Number of Non-Detect Data | 4 |
| | | Percent Non-Detects | 11.76% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 0.0534 | Minimum Detected | -2.93 |
| Maximum Detected | 1.2 | Maximum Detected | 0.182 |
| Mean of Detected | 0.545 | Mean of Detected | -0.841 |
| SD of Detected | 0.345 | SD of Detected | 0.758 |
| Minimum Non-Detect | 0.005 | Minimum Non-Detect | -5.298 |
| Maximum Non-Detect | 1 | Maximum Non-Detect | 0 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 30 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 4 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 88.24% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.912 | Shapiro Wilk Test Statistic | 0.942 |
| 5% Shapiro Wilk Critical Value | 0.927 | 5% Shapiro Wilk Critical Value | 0.927 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 0.513 | Mean | -1.012 |
| SD | 0.341 | SD | 1.135 |
| 95% DL/2 (t) UCL | 0.612 | 95% H-Stat (DL/2) UCL | 0.95 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 0.704 | Mean in Log Scale | -0.928 |
| SD | 0.252 | SD in Log Scale | 0.782 |
| 95% MLE (t) UCL | 0.777 | Mean in Original Scale | 0.509 |
| 95% MLE (Tiku) UCL | 0.973 | SD in Original Scale | 0.34 |
| | | 95% Percentile Bootstrap UCL | 0.604 |
| | | 95% BCA Bootstrap UCL | 0.613 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 2.079 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 0.262 | | |
| nu star | 124.8 | | |
| | | | |
| A-D Test Statistic | 0.385 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.757 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.757 | Mean | 0.512 |
| 5% K-S Critical Value | 0.162 | SD | 0.339 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 0.06 |
| | | 95% KM (t) UCL | 0.614 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 0.611 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 0.613 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 0.619 |
| Maximum | 1.2 | 95% KM (BCA) UCL | 0.608 |
| Mean | 0.525 | 95% KM (Percentile Bootstrap) UCL | 0.609 |
| Median | 0.42 | 95% KM (Chebyshev) UCL | 0.773 |
| SD | 0.337 | 97.5% KM (Chebyshev) UCL | 0.887 |
| k star | 0.726 | 99% KM (Chebyshev) UCL | 1.109 |
| Theta star | 0.723 | | |
| Nu star | 49.36 | Potential UCLs to Use | |
| AppChi2 | 34.23 | 95% KM (BCA) UCL | 0.608 |
| 95% Gamma Approximate UCL | 0.757 | | |
| 95% Adjusted Gamma UCL | 0.771 | | |
| Note: DL/2 is not a recommended method. | | | |

**Cadmium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 54 | Number of Detected Data | 9 |
| Number of Distinct Detected Data | 9 | Number of Non-Detect Data | 45 |
| | | Percent Non-Detects | 83.33% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 0.179 | Minimum Detected | -1.72 |
| Maximum Detected | 5.91 | Maximum Detected | 1.777 |
| Mean of Detected | 2.05 | Mean of Detected | 0.21 |
| SD of Detected | 1.957 | SD of Detected | 1.175 |
| Minimum Non-Detect | 0.005 | Minimum Non-Detect | -5.298 |
| Maximum Non-Detect | 0.78 | Maximum Non-Detect | -0.248 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 48 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 6 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 88.89% |

Warning: There are only 9 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.878 | Shapiro Wilk Test Statistic | 0.969 |
| 5% Shapiro Wilk Critical Value | 0.829 | 5% Shapiro Wilk Critical Value | 0.829 |
| Data appear Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 0.418 | Mean | -3.012 |
| SD | 1.066 | SD | 2.073 |
| 95% DL/2 (t) UCL | 0.661 | 95% H-Stat (DL/2) UCL | 0.745 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | N/A | Log ROS Method | |
| **MLE yields a negative mean** | | Mean in Log Scale | -3.872 |
| | | SD in Log Scale | 2.153 |
| | | Mean in Original Scale | 0.355 |
| | | SD in Original Scale | 1.079 |
| | | 95% Percentile Bootstrap UCL | 0.614 |
| | | 95% BCA Bootstrap UCL | 0.703 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.822 | Data appear Normal at 5% Significance Level | |

| | | | |
|---|---|---|---|
| Theta Star | 2.495 | | |
| nu star | 14.79 | | |
| | | | |
| A-D Test Statistic | 0.15 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.741 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.741 | Mean | 0.493 |
| 5% K-S Critical Value | 0.286 | SD | 1.026 |
| **Data appear Gamma Distributed at 5% Significance Level** | | SE of Mean | 0.148 |
| | | 95% KM (t) UCL | 0.742 |
| **Assuming Gamma Distribution** | | 95% KM (z) UCL | 0.737 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 0.69 |
| Minimum | 0.179 | 95% KM (bootstrap t) UCL | 0.873 |
| Maximum | 5.91 | 95% KM (BCA) UCL | 1.359 |
| Mean | 2.105 | 95% KM (Percentile Bootstrap) UCL | 1.013 |
| Median | 2.09 | 95% KM (Chebyshev) UCL | 1.139 |
| SD | 0.795 | 97.5% KM (Chebyshev) UCL | 1.419 |
| k star | 5.372 | 99% KM (Chebyshev) UCL | 1.968 |
| Theta star | 0.392 | | |
| Nu star | 580.2 | **Potential UCLs to Use** | |
| AppChi2 | 525.3 | 95% KM (t) UCL | 0.742 |
| 95% Gamma Approximate UCL | 2.325 | 95% KM (Percentile Bootstrap) UCL | 1.013 |
| 95% Adjusted Gamma UCL | 2.331 | | |
| Note: DL/2 is not a recommended method. | | | |


10632 Little Patuxent Parkway, Suite 106, Columbia, MD 21044
Ph: (410) 290-8777 Fax: (410) 290-9055

**Calcium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 30 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 4180 | Minimum of Log Data | 8.338 |
| Maximum | 280000 | Maximum of Log Data | 12.54 |
| Mean | 174376 | Mean of log Data | 11.69 |
| Median | 214000 | SD of log Data | 1.167 |
| SD | 94095 | | |
| Coefficient of Variation | 0.54 | | |
| Skewness | -0.803 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.826 | Shapiro Wilk Test Statistic | 0.707 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 203060 | 95% H-UCL | 414718 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 477734 |
| 95% Adjusted-CLT UCL | 199571 | 97.5% Chebyshev (MVUE) UCL | 585471 |
| 95% Modified-t UCL | 202654 | 99% Chebyshev (MVUE) UCL | 797097 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 1.357 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 128539 | | |
| MLE of Mean | 174376 | | |
| MLE of Standard Deviation | 149714 | | |
| nu star | 84.11 | | |
| Approximate Chi Square Value (.05) | 63.97 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 202174 |
| Adjusted Chi Square Value | 63 | 95% Jackknife UCL | 203060 |
| | | 95% Standard Bootstrap UCL | 201739 |
| Anderson-Darling Test Statistic | 3.422 | 95% Bootstrap-t UCL | 201138 |
| Anderson-Darling 5% Critical Value | 0.764 | 95% Hall's Bootstrap UCL | 197732 |
| Kolmogorov-Smirnov Test Statistic | 0.335 | 95% Percentile Bootstrap UCL | 201283 |
| Kolmogorov-Smirnov 5% Critical Value | 0.161 | 95% BCA Bootstrap UCL | 198851 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 248041 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 279916 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 342528 |
| 95% Approximate Gamma UCL | 229268 | | |
| 95% Adjusted Gamma UCL | 232821 | | |
| | | | |
| **Potential UCL to Use** | | Use 99% Chebyshev (Mean, Sd) UCL | 342528 |

**Chromium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 52 | Number of Distinct Observations | 48 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 1.64 | Minimum of Log Data | 0.495 |
| Maximum | 38.3 | Maximum of Log Data | 3.645 |
| Mean | 19.37 | Mean of log Data | 2.828 |
| Median | 20.1 | SD of log Data | 0.628 |
| SD | 8.039 | | |
| Coefficient of Variation | 0.415 | | |
| Skewness | -0.0357 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Lilliefors Test Statistic | 0.0673 | Lilliefors Test Statistic | 0.192 |
| Lilliefors Critical Value | 0.123 | Lilliefors Critical Value | 0.123 |
| Data appear Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 21.24 | 95% H-UCL | 24.5 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 28.91 |
| 95% Adjusted-CLT UCL | 21.2 | 97.5% Chebyshev (MVUE) UCL | 32.54 |
| 95% Modified-t UCL | 21.24 | 99% Chebyshev (MVUE) UCL | 39.68 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 3.631 | Data appear Normal at 5% Significance Level | |
| Theta Star | 5.335 | | |
| MLE of Mean | 19.37 | | |
| MLE of Standard Deviation | 10.17 | | |
| nu star | 377.6 | | |
| Approximate Chi Square Value (.05) | 333.6 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0454 | 95% CLT UCL | 21.21 |
| Adjusted Chi Square Value | 332.4 | 95% Jackknife UCL | 21.24 |
| | | 95% Standard Bootstrap UCL | 21.22 |
| Anderson-Darling Test Statistic | 1.871 | 95% Bootstrap-t UCL | 21.24 |
| Anderson-Darling 5% Critical Value | 0.754 | 95% Hall's Bootstrap UCL | 21.19 |
| Kolmogorov-Smirnov Test Statistic | 0.154 | 95% Percentile Bootstrap UCL | 21.07 |
| Kolmogorov-Smirnov 5% Critical Value | 0.124 | 95% BCA Bootstrap UCL | 21.23 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 24.23 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 26.33 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 30.46 |
| 95% Approximate Gamma UCL | 21.93 | | |
| 95% Adjusted Gamma UCL | 22.01 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Student's-t UCL | 21.24 |

**Cobalt**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 31 | Number of Detected Data | 29 |
| Number of Distinct Detected Data | 29 | Number of Non-Detect Data | 2 |
| | | Percent Non-Detects | 6.45% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 1.68 | Minimum Detected | 0.519 |
| Maximum Detected | 75.3 | Maximum Detected | 4.321 |
| Mean of Detected | 8.301 | Mean of Detected | 1.68 |
| SD of Detected | 13.48 | SD of Detected | 0.796 |
| Minimum Non-Detect | 1.6 | Minimum Non-Detect | 0.47 |
| Maximum Non-Detect | 1.6 | Maximum Non-Detect | 0.47 |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.421 | Shapiro Wilk Test Statistic | 0.921 |
| 5% Shapiro Wilk Critical Value | 0.926 | 5% Shapiro Wilk Critical Value | 0.926 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 7.817 | Mean | 1.557 |
| SD | 13.15 | SD | 0.904 |
| 95% DL/2 (t) UCL | 11.83 | 95% H-Stat (DL/2) UCL | 9.14 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 7.292 | Mean in Log Scale | 1.561 |
| SD | 13.49 | SD in Log Scale | 0.897 |
| 95% MLE (t) UCL | 11.41 | Mean in Original Scale | 7.821 |
| 95% MLE (Tiku) UCL | 11.05 | SD in Original Scale | 13.15 |
| | | 95% Percentile Bootstrap UCL | 12.25 |
| | | 95% BCA Bootstrap UCL | 14.89 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 1.176 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 7.057 | | |
| nu star | 68.23 | | |
| | | | |
| A-D Test Statistic | 1.779 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.768 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.768 | Mean | 7.874 |
| 5% K-S Critical Value | 0.166 | SD | 12.91 |
| Data not Gamma Distributed at 5% Significance Level | | SE of Mean | 2.36 |
| | | 95% KM (t) UCL | 11.88 |
| **Assuming Gamma Distribution** | | 95% KM (z) UCL | 11.76 |

| | | | |
|---|---|---|---|
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 11.87 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 21.01 |
| Maximum | 75.3 | 95% KM (BCA) UCL | 13.21 |
| Mean | 7.766 | 95% KM (Percentile Bootstrap) UCL | 12.35 |
| Median | 4.8 | 95% KM (Chebyshev) UCL | 18.16 |
| SD | 13.18 | 97.5% KM (Chebyshev) UCL | 22.61 |
| k star | 0.353 | 99% KM (Chebyshev) UCL | 31.35 |
| Theta star | 21.97 | | |
| Nu star | 21.91 | **Potential UCLs to Use** | |
| AppChi2 | 12.27 | 95% KM (Chebyshev) UCL | 18.16 |
| 95% Gamma Approximate UCL | 13.87 | | |
| 95% Adjusted Gamma UCL | 14.33 | | |
| Note: DL/2 is not a recommended method. | | | |
| | | | |

**Copper**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 34 | Number of Detected Data | 32 |
| Number of Distinct Detected Data | 32 | Number of Non-Detect Data | 2 |
| | | Percent Non-Detects | 5.88% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 0.636 | Minimum Detected | -0.453 |
| Maximum Detected | 186 | Maximum Detected | 5.226 |
| Mean of Detected | 27 | Mean of Detected | 2.352 |
| SD of Detected | 40.55 | SD of Detected | 1.514 |
| Minimum Non-Detect | 0.39 | Minimum Non-Detect | -0.942 |
| Maximum Non-Detect | 0.44 | Maximum Non-Detect | -0.821 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 2 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 32 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 5.88% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.647 | Shapiro Wilk Test Statistic | 0.957 |
| 5% Shapiro Wilk Critical Value | 0.93 | 5% Shapiro Wilk Critical Value | 0.93 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 25.42 | Mean | 2.121 |
| SD | 39.82 | SD | 1.742 |
| 95% DL/2 (t) UCL | 36.98 | 95% H-Stat (DL/2) UCL | 81.66 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 23.94 | Mean in Log Scale | 2.142 |
| SD | 40.92 | SD in Log Scale | 1.698 |
| 95% MLE (t) UCL | 35.81 | Mean in Original Scale | 25.43 |
| 95% MLE (Tiku) UCL | 34.92 | SD in Original Scale | 39.82 |
| | | 95% Percentile Bootstrap UCL | 36.69 |
| | | 95% BCA Bootstrap UCL | 40.86 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.608 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 44.42 | | |
| nu star | 38.9 | | |
| | | | |
| A-D Test Statistic | 0.6 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.797 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.797 | Mean | 25.45 |
| 5% K-S Critical Value | 0.163 | SD | 39.21 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 6.833 |
| | | 95% KM (t) UCL | 37.01 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 36.69 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 36.99 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 44.9 |
| Maximum | 186 | 95% KM (BCA) UCL | 38.32 |
| Mean | 25.41 | 95% KM (Percentile Bootstrap) UCL | 37.61 |
| Median | 12.9 | 95% KM (Chebyshev) UCL | 55.23 |
| SD | 39.83 | 97.5% KM (Chebyshev) UCL | 68.12 |
| k star | 0.299 | 99% KM (Chebyshev) UCL | 93.43 |
| Theta star | 84.91 | | |
| Nu star | 20.35 | Potential UCLs to Use | |
| AppChi2 | 11.11 | 95% KM (Chebyshev) UCL | 55.23 |
| 95% Gamma Approximate UCL | 46.54 | | |
| 95% Adjusted Gamma UCL | 48 | | |
| Note: DL/2 is not a recommended method. | | | |

**Iron**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 29 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 742 | Minimum of Log Data | 6.609 |
| Maximum | 22900 | Maximum of Log Data | 10.04 |
| Mean | 8775 | Mean of log Data | 8.753 |
| Median | 8850 | SD of log Data | 0.906 |
| SD | 6297 | | |
| Coefficient of Variation | 0.718 | | |
| Skewness | 0.611 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.919 | Shapiro Wilk Test Statistic | 0.939 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 10694 | 95% H-UCL | 13985 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 16859 |
| 95% Adjusted-CLT UCL | 10768 | 97.5% Chebyshev (MVUE) UCL | 20102 |
| 95% Modified-t UCL | 10715 | 99% Chebyshev (MVUE) UCL | 26471 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 1.536 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 5712 | | |
| MLE of Mean | 8775 | | |
| MLE of Standard Deviation | 7080 | | |
| nu star | 95.24 | | |
| Approximate Chi Square Value (.05) | 73.73 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 10635 |
| Adjusted Chi Square Value | 72.68 | 95% Jackknife UCL | 10694 |
| | | 95% Standard Bootstrap UCL | 10573 |
| Anderson-Darling Test Statistic | 0.474 | 95% Bootstrap-t UCL | 10857 |
| Anderson-Darling 5% Critical Value | 0.762 | 95% Hall's Bootstrap UCL | 10757 |
| Kolmogorov-Smirnov Test Statistic | 0.126 | 95% Percentile Bootstrap UCL | 10585 |
| Kolmogorov-Smirnov 5% Critical Value | 0.16 | 95% BCA Bootstrap UCL | 10858 |
| Data appear Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 13705 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 15838 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 20028 |
| 95% Approximate Gamma UCL | 11334 | | |
| 95% Adjusted Gamma UCL | 11498 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 11334 |

**Lead**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 54 | Number of Detected Data | 53 |
| Number of Distinct Detected Data | 50 | Number of Non-Detect Data | 1 |
| | | Percent Non-Detects | 1.85% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 2.91 | Minimum Detected | 1.068 |
| Maximum Detected | 792 | Maximum Detected | 6.675 |
| Mean of Detected | 84.68 | Mean of Detected | 3.84 |
| SD of Detected | 121.4 | SD of Detected | 1.09 |
| Minimum Non-Detect | 0.65 | Minimum Non-Detect | -0.431 |
| Maximum Non-Detect | 0.65 | Maximum Non-Detect | -0.431 |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Lilliefors Test Statistic | 0.252 | Lilliefors Test Statistic | 0.0735 |
| 5% Lilliefors Critical Value | 0.122 | 5% Lilliefors Critical Value | 0.122 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 83.12 | Mean | 3.748 |
| SD | 120.8 | SD | 1.274 |
| 95% DL/2 (t) UCL | 110.6 | 95% H-Stat (DL/2) UCL | 142.5 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 81.78 | Mean in Log Scale | 3.788 |
| SD | 121.2 | SD in Log Scale | 1.147 |
| 95% MLE (t) UCL | 109.4 | Mean in Original Scale | 83.17 |
| 95% MLE (Tiku) UCL | 107 | SD in Original Scale | 120.8 |
| | | 95% Percentile Bootstrap UCL | 111.9 |
| | | 95% BCA Bootstrap UCL | 128.2 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.926 | Data appear Lognormal at 5% Significance Level | |
| Theta Star | 91.49 | | |
| nu star | 98.11 | | |
| | | | |
| A-D Test Statistic | 1.248 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.781 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.781 | Mean | 83.17 |
| 5% K-S Critical Value | 0.126 | SD | 119.6 |
| Data not Gamma Distributed at 5% Significance Level | | SE of Mean | 16.44 |
| | | 95% KM (t) UCL | 110.7 |
| **Assuming Gamma Distribution** | | 95% KM (z) UCL | 110.2 |

| | | | |
|---|---|---|---|
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 110.6 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 129.6 |
| Maximum | 792 | 95% KM (BCA) UCL | 114.4 |
| Mean | 83.12 | 95% KM (Percentile Bootstrap) UCL | 111.2 |
| Median | 44.65 | 95% KM (Chebyshev) UCL | 154.8 |
| SD | 120.8 | 97.5% KM (Chebyshev) UCL | 185.8 |
| k star | 0.577 | 99% KM (Chebyshev) UCL | 246.7 |
| Theta star | 144.2 | | |
| Nu star | 62.27 | **Potential UCLs to Use** | |
| AppChi2 | 45.12 | 95% KM (Chebyshev) UCL | 154.8 |
| 95% Gamma Approximate UCL | 114.7 | | |
| 95% Adjusted Gamma UCL | 115.7 | | |
| Note: DL/2 is not a recommended method. | | | |
| | | | |

**Magnesium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 31 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 111 | Minimum of Log Data | 4.71 |
| Maximum | 31500 | Maximum of Log Data | 10.36 |
| Mean | 7000 | Mean of log Data | 8.188 |
| Median | 3820 | SD of log Data | 1.265 |
| SD | 8246 | | |
| Coefficient of Variation | 1.178 | | |
| Skewness | 1.701 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.75 | Shapiro Wilk Test Statistic | 0.965 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 9513 | 95% H-UCL | 15128 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 16879 |
| 95% Adjusted-CLT UCL | 9919 | 97.5% Chebyshev (MVUE) UCL | 20866 |
| 95% Modified-t UCL | 9589 | 99% Chebyshev (MVUE) UCL | 28698 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.817 | Data Follow Appr. Gamma Distribution at 5% Significance Level | |
| Theta Star | 8570 | | |
| MLE of Mean | 7000 | | |
| MLE of Standard Deviation | 7745 | | |
| nu star | 50.64 | | |
| Approximate Chi Square Value (.05) | 35.3 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 9436 |
| Adjusted Chi Square Value | 34.58 | 95% Jackknife UCL | 9513 |
| | | 95% Standard Bootstrap UCL | 9325 |
| Anderson-Darling Test Statistic | 0.733 | 95% Bootstrap-t UCL | 9969 |
| Anderson-Darling 5% Critical Value | 0.781 | 95% Hall's Bootstrap UCL | 9808 |
| Kolmogorov-Smirnov Test Statistic | 0.183 | 95% Percentile Bootstrap UCL | 9579 |
| Kolmogorov-Smirnov 5% Critical Value | 0.163 | 95% BCA Bootstrap UCL | 10027 |
| Data follow Appr. Gamma Distribution at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 13456 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 16249 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 21736 |
| 95% Approximate Gamma UCL | 10042 | | |
| 95% Adjusted Gamma UCL | 10249 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 10042 |

**Manganese**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 31 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 11.4 | Minimum of Log Data | 2.434 |
| Maximum | 415 | Maximum of Log Data | 6.028 |
| Mean | 166.9 | Mean of log Data | 4.791 |
| Median | 142 | SD of log Data | 0.909 |
| SD | 116.8 | | |
| Coefficient of Variation | 0.7 | | |
| Skewness | 0.353 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.899 | Shapiro Wilk Test Statistic | 0.911 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 202.6 | 95% H-UCL | 267.7 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 322.7 |
| 95% Adjusted-CLT UCL | 202.9 | 97.5% Chebyshev (MVUE) UCL | 384.9 |
| 95% Modified-t UCL | 202.8 | 99% Chebyshev (MVUE) UCL | 507.1 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 1.538 | Data do not follow a Discernable Distribution (0.05) | |
| Theta Star | 108.5 | | |
| MLE of Mean | 166.9 | | |
| MLE of Standard Deviation | 134.6 | | |
| nu star | 95.36 | | |
| Approximate Chi Square Value (.05) | 73.84 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 201.5 |
| Adjusted Chi Square Value | 72.79 | 95% Jackknife UCL | 202.6 |
| | | 95% Standard Bootstrap UCL | 201 |
| Anderson-Darling Test Statistic | 0.997 | 95% Bootstrap-t UCL | 204.9 |
| Anderson-Darling 5% Critical Value | 0.762 | 95% Hall's Bootstrap UCL | 200.9 |
| Kolmogorov-Smirnov Test Statistic | 0.177 | 95% Percentile Bootstrap UCL | 200.8 |
| Kolmogorov-Smirnov 5% Critical Value | 0.16 | 95% BCA Bootstrap UCL | 202.3 |
| Data not Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 258.4 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 298 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 375.8 |
| 95% Approximate Gamma UCL | 215.6 | | |
| 95% Adjusted Gamma UCL | 218.7 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Chebyshev (Mean, Sd) UCL | 258.4 |

**Mercury**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 52 | Number of Detected Data | 31 |
| Number of Distinct Detected Data | 31 | Number of Non-Detect Data | 21 |
| Number of Missing Values | 1 | Percent Non-Detects | 40.38% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 0.0537 | Minimum Detected | -2.924 |
| Maximum Detected | 7.61 | Maximum Detected | 2.029 |
| Mean of Detected | 0.599 | Mean of Detected | -1.258 |
| SD of Detected | 1.346 | SD of Detected | 1.036 |
| Minimum Non-Detect | 0.016 | Minimum Non-Detect | -4.135 |
| Maximum Non-Detect | 0.22 | Maximum Non-Detect | -1.514 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 34 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 18 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 65.38% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.369 | Shapiro Wilk Test Statistic | 0.938 |
| 5% Shapiro Wilk Critical Value | 0.929 | 5% Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 0.38 | Mean | -2.008 |
| SD | 1.067 | SD | 1.311 |
| 95% DL/2 (t) UCL | 0.628 | 95% H-Stat (DL/2) UCL | 0.421 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | N/A | Log ROS Method | |
| **MLE yields a negative mean** | | Mean in Log Scale | -2.114 |
| | | SD in Log Scale | 1.344 |
| | | Mean in Original Scale | 0.372 |
| | | SD in Original Scale | 1.069 |
| | | 95% Percentile Bootstrap UCL | 0.642 |
| | | 95% BCA Bootstrap UCL | 0.81 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.74 | Data appear Lognormal at 5% Significance Level | |
| Theta Star | 0.809 | | |
| nu star | 45.91 | | |
| | | | |
| A-D Test Statistic | 2.278 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.786 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.786 | Mean | 0.384 |
| 5% K-S Critical Value | 0.164 | SD | 1.056 |

| | | | |
|---|---|---|---|
| Data not Gamma Distributed at 5% Significance Level | | SE of Mean | 0.149 |
| | | 95% KM (t) UCL | 0.633 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 0.629 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 0.63 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 1.255 |
| Maximum | 7.61 | 95% KM (BCA) UCL | 0.685 |
| Mean | 0.456 | 95% KM (Percentile Bootstrap) UCL | 0.658 |
| Median | 0.214 | 95% KM (Chebyshev) UCL | 1.033 |
| SD | 1.062 | 97.5% KM (Chebyshev) UCL | 1.313 |
| k star | 0.285 | 99% KM (Chebyshev) UCL | 1.865 |
| Theta star | 1.603 | | |
| Nu star | 29.61 | Potential UCLs to Use | |
| AppChi2 | 18.18 | 95% KM (Chebyshev) UCL | 1.033 |
| 95% Gamma Approximate UCL | 0.743 | | |
| 95% Adjusted Gamma UCL | 0.753 | | |
| Note: DL/2 is not a recommended method. | | | |

**Nickel**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 34 | Number of Detected Data | 31 |
| Number of Distinct Detected Data | 29 | Number of Non-Detect Data | 3 |
| | | Percent Non-Detects | 8.82% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 3.74 | Minimum Detected | 1.319 |
| Maximum Detected | 50.2 | Maximum Detected | 3.916 |
| Mean of Detected | 13.03 | Mean of Detected | 2.343 |
| SD of Detected | 10.24 | SD of Detected | 0.655 |
| Minimum Non-Detect | 4.3 | Minimum Non-Detect | 1.459 |
| Maximum Non-Detect | 4.9 | Maximum Non-Detect | 1.589 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 8 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 26 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 23.53% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.769 | Shapiro Wilk Test Statistic | 0.965 |
| 5% Shapiro Wilk Critical Value | 0.929 | 5% Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 12.08 | Mean | 2.209 |
| SD | 10.24 | SD | 0.762 |
| 95% DL/2 (t) UCL | 15.05 | 95% H-Stat (DL/2) UCL | 14.19 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 10.56 | Mean in Log Scale | 2.245 |
| SD | 12 | SD in Log Scale | 0.703 |
| 95% MLE (t) UCL | 14.05 | Mean in Original Scale | 12.18 |
| 95% MLE (Tiku) UCL | 14.1 | SD in Original Scale | 10.14 |
| | | 95% Percentile Bootstrap UCL | 15.03 |
| | | 95% BCA Bootstrap UCL | 15.82 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 2.18 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 5.974 | | |
| nu star | 135.2 | | |
| | | | |
| A-D Test Statistic | 0.588 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.756 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.756 | Mean | 12.23 |
| 5% K-S Critical Value | 0.159 | SD | 9.949 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 1.735 |
| | | 95% KM (t) UCL | 15.17 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 15.09 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 15.16 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 16.77 |
| Maximum | 50.2 | 95% KM (BCA) UCL | 15.36 |
| Mean | 11.97 | 95% KM (Percentile Bootstrap) UCL | 15.4 |
| Median | 8.835 | 95% KM (Chebyshev) UCL | 19.79 |
| SD | 10.36 | 97.5% KM (Chebyshev) UCL | 23.06 |
| k star | 0.611 | 99% KM (Chebyshev) UCL | 29.49 |
| Theta star | 19.58 | | |
| Nu star | 41.58 | Potential UCLs to Use | |
| AppChi2 | 27.8 | 95% KM (BCA) UCL | 15.36 |
| 95% Gamma Approximate UCL | 17.9 | | |
| 95% Adjusted Gamma UCL | 18.27 | | |
| Note: DL/2 is not a recommended method. | | | |

**Potassium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 31 | Number of Detected Data | 27 |
| Number of Distinct Detected Data | 27 | Number of Non-Detect Data | 4 |
| | | Percent Non-Detects | 12.90% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 82.3 | Minimum Detected | 4.41 |
| Maximum Detected | 2920 | Maximum Detected | 7.979 |
| Mean of Detected | 858.1 | Mean of Detected | 6.352 |
| SD of Detected | 734.8 | SD of Detected | 0.984 |
| Minimum Non-Detect | 19.4 | Minimum Non-Detect | 2.965 |
| Maximum Non-Detect | 198 | Maximum Non-Detect | 5.288 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 8 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 23 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 25.81% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.876 | Shapiro Wilk Test Statistic | 0.96 |
| 5% Shapiro Wilk Critical Value | 0.923 | 5% Shapiro Wilk Critical Value | 0.923 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 756.8 | Mean | 6.045 |
| SD | 734.7 | SD | 1.275 |
| 95% DL/2 (t) UCL | 980.7 | 95% H-Stat (DL/2) UCL | 1262 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 638.2 | Mean in Log Scale | 6.115 |
| SD | 879.2 | SD in Log Scale | 1.119 |
| 95% MLE (t) UCL | 906.2 | Mean in Original Scale | 760.1 |
| 95% MLE (Tiku) UCL | 915.4 | SD in Original Scale | 731.4 |
| | | 95% Percentile Bootstrap UCL | 990.6 |
| | | 95% BCA Bootstrap UCL | 1004 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 1.255 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 683.6 | | |
| nu star | 67.79 | | |
| | | | |
| A-D Test Statistic | 0.334 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.765 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.765 | Mean | 760.6 |
| 5% K-S Critical Value | 0.172 | SD | 719.2 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 131.6 |
| | | 95% KM (t) UCL | 984 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 977.1 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 982.7 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 1023 |
| Maximum | 2920 | 95% KM (BCA) UCL | 1014 |
| Mean | 750.6 | 95% KM (Percentile Bootstrap) UCL | 993.2 |
| Median | 469 | 95% KM (Chebyshev) UCL | 1334 |
| SD | 740.6 | 97.5% KM (Chebyshev) UCL | 1583 |
| k star | 0.432 | 99% KM (Chebyshev) UCL | 2070 |
| Theta star | 1736 | | |
| Nu star | 26.8 | Potential UCLs to Use | |
| AppChi2 | 16 | 95% KM (BCA) UCL | 1014 |
| 95% Gamma Approximate UCL | 1258 | | |
| 95% Adjusted Gamma UCL | 1295 | | |
| Note: DL/2 is not a recommended method. | | | |

**Selenium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 54 | Number of Detected Data | 11 |
| Number of Distinct Detected Data | 10 | Number of Non-Detect Data | 43 |
| | | Percent Non-Detects | 79.63% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 1.41 | Minimum Detected | 0.344 |
| Maximum Detected | 6.59 | Maximum Detected | 1.886 |
| Mean of Detected | 3.148 | Mean of Detected | 1.055 |
| SD of Detected | 1.512 | SD of Detected | 0.439 |
| Minimum Non-Detect | 0.028 | Minimum Non-Detect | -3.576 |
| Maximum Non-Detect | 11 | Maximum Non-Detect | 2.398 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 54 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 0 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 100.00% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.865 | Shapiro Wilk Test Statistic | 0.955 |
| 5% Shapiro Wilk Critical Value | 0.85 | 5% Shapiro Wilk Critical Value | 0.85 |
| Data appear Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 1.72 | Mean | -0.178 |
| SD | 1.923 | SD | 1.317 |
| 95% DL/2 (t) UCL | 2.158 | 95% H-Stat (DL/2) UCL | 2.59 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | N/A | Log ROS Method | |
| **MLE method failed to converge properly** | | Mean in Log Scale | -0.188 |
| | | SD in Log Scale | 0.696 |
| | | Mean in Original Scale | 1.136 |
| | | SD in Original Scale | 1.228 |
| | | 95% Percentile Bootstrap UCL | 1.419 |
| | | 95% BCA Bootstrap UCL | 1.477 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 4.134 | Data appear Normal at 5% Significance Level | |
| Theta Star | 0.761 | | |
| nu star | 90.96 | | |
| | | | |
| A-D Test Statistic | 0.43 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.731 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.731 | Mean | 1.835 |
| 5% K-S Critical Value | 0.256 | SD | 1.032 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 0.161 |
| | | 95% KM (t) UCL | 2.106 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 2.101 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 2.232 |
| Minimum | 1.41 | 95% KM (bootstrap t) UCL | 2.193 |
| Maximum | 6.59 | 95% KM (BCA) UCL | 2.637 |
| Mean | 3.139 | 95% KM (Percentile Bootstrap) UCL | 2.551 |
| Median | 3.148 | 95% KM (Chebyshev) UCL | 2.539 |
| SD | 0.658 | 97.5% KM (Chebyshev) UCL | 2.843 |
| k star | 25.25 | 99% KM (Chebyshev) UCL | 3.441 |
| Theta star | 0.124 | | |
| Nu star | 2727 | Potential UCLs to Use | |
| AppChi2 | 2607 | 95% KM (t) UCL | 2.106 |
| 95% Gamma Approximate UCL | 3.283 | 95% KM (Percentile Bootstrap) UCL | 2.551 |
| 95% Adjusted Gamma UCL | 3.288 | | |
| Note: DL/2 is not a recommended method. | | | |

**Silver**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 54 | Number of Detected Data | 1 |
| Number of Distinct Detected Data | 1 | Number of Non-Detect Data | 53 |
| | | Percent Non-Detects | 98.15% |

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

s suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BT

The data set for variable Silver was not processed!

**Sodium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 30 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 207 | Minimum of Log Data | 5.333 |
| Maximum | 20400 | Maximum of Log Data | 9.923 |
| Mean | 4301 | Mean of log Data | 7.812 |
| Median | 2340 | SD of log Data | 1.12 |
| SD | 4685 | | |
| Coefficient of Variation | 1.089 | | |
| Skewness | 1.786 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.782 | Shapiro Wilk Test Statistic | 0.98 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 5729 | 95% H-UCL | 7817 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 9117 |
| 95% Adjusted-CLT UCL | 5974 | 97.5% Chebyshev (MVUE) UCL | 11123 |
| 95% Modified-t UCL | 5774 | 99% Chebyshev (MVUE) UCL | 15063 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 0.957 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 4494 | | |
| MLE of Mean | 4301 | | |
| MLE of Standard Deviation | 4396 | | |
| nu star | 59.35 | | |
| Approximate Chi Square Value (.05) | 42.63 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 5685 |
| Adjusted Chi Square Value | 41.85 | 95% Jackknife UCL | 5729 |
| | | 95% Standard Bootstrap UCL | 5647 |
| Anderson-Darling Test Statistic | 0.574 | 95% Bootstrap-t UCL | 6204 |
| Anderson-Darling 5% Critical Value | 0.775 | 95% Hall's Bootstrap UCL | 6134 |
| Kolmogorov-Smirnov Test Statistic | 0.153 | 95% Percentile Bootstrap UCL | 5671 |
| Kolmogorov-Smirnov 5% Critical Value | 0.162 | 95% BCA Bootstrap UCL | 5946 |
| Data appear Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 7969 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 9556 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 12674 |
| 95% Approximate Gamma UCL | 5987 | | |
| 95% Adjusted Gamma UCL | 6100 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 5987 |

**Thallium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 34 | Number of Detected Data | 0 |
| Number of Distinct Detected Data | 0 | Number of Non-Detect Data | 34 |
| | | Percent Non-Detects | 100.00% |

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Thallium was not processed!

**Vanadium**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Observations | 31 | Number of Distinct Observations | 30 |

| **Raw Statistics** | | **Log-transformed Statistics** | |
|---|---|---|---|
| Minimum | 7.39 | Minimum of Log Data | 2 |
| Maximum | 87.6 | Maximum of Log Data | 4.473 |
| Mean | 26.85 | Mean of log Data | 3.124 |
| Median | 28.1 | SD of log Data | 0.592 |
| SD | 16.6 | | |
| Coefficient of Variation | 0.618 | | |
| Skewness | 1.804 | | |

**Relevant UCL Statistics**

| **Normal Distribution Test** | | **Lognormal Distribution Test** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.847 | Shapiro Wilk Test Statistic | 0.964 |
| Shapiro Wilk Critical Value | 0.929 | Shapiro Wilk Critical Value | 0.929 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| 95% Student's-t UCL | 31.91 | 95% H-UCL | 33.65 |
| **95% UCLs (Adjusted for Skewness)** | | 95% Chebyshev (MVUE) UCL | 40.16 |
| 95% Adjusted-CLT UCL | 32.79 | 97.5% Chebyshev (MVUE) UCL | 45.89 |
| 95% Modified-t UCL | 32.07 | 99% Chebyshev (MVUE) UCL | 57.15 |
| | | | |
| **Gamma Distribution Test** | | **Data Distribution** | |
| k star (bias corrected) | 2.881 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 9.319 | | |
| MLE of Mean | 26.85 | | |
| MLE of Standard Deviation | 15.82 | | |
| nu star | 178.6 | | |
| Approximate Chi Square Value (.05) | 148.7 | **Nonparametric Statistics** | |
| Adjusted Level of Significance | 0.0413 | 95% CLT UCL | 31.75 |
| Adjusted Chi Square Value | 147.2 | 95% Jackknife UCL | 31.91 |
| | | 95% Standard Bootstrap UCL | 31.67 |
| Anderson-Darling Test Statistic | 0.491 | 95% Bootstrap-t UCL | 33.38 |
| Anderson-Darling 5% Critical Value | 0.752 | 95% Hall's Bootstrap UCL | 35.8 |
| Kolmogorov-Smirnov Test Statistic | 0.122 | 95% Percentile Bootstrap UCL | 32.11 |
| Kolmogorov-Smirnov 5% Critical Value | 0.159 | 95% BCA Bootstrap UCL | 33.08 |
| Data appear Gamma Distributed at 5% Significance Level | | 95% Chebyshev(Mean, Sd) UCL | 39.85 |
| | | 97.5% Chebyshev(Mean, Sd) UCL | 45.47 |
| **Assuming Gamma Distribution** | | 99% Chebyshev(Mean, Sd) UCL | 56.52 |
| 95% Approximate Gamma UCL | 32.25 | | |
| 95% Adjusted Gamma UCL | 32.58 | | |
| | | | |
| **Potential UCL to Use** | | Use 95% Approximate Gamma UCL | 32.25 |

**Zinc**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 34 | Number of Detected Data | 33 |
| Number of Distinct Detected Data | 33 | Number of Non-Detect Data | 1 |
| | | Percent Non-Detects | 2.94% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 2.5 | Minimum Detected | 0.916 |
| Maximum Detected | 1820 | Maximum Detected | 7.507 |
| Mean of Detected | 149.8 | Mean of Detected | 3.719 |
| SD of Detected | 344.4 | SD of Detected | 1.6 |
| Minimum Non-Detect | 0.75 | Minimum Non-Detect | -0.288 |
| Maximum Non-Detect | 0.75 | Maximum Non-Detect | -0.288 |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.445 | Shapiro Wilk Test Statistic | 0.978 |
| 5% Shapiro Wilk Critical Value | 0.931 | 5% Shapiro Wilk Critical Value | 0.931 |
| Data not Normal at 5% Significance Level | | Data appear Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 145.4 | Mean | 3.581 |
| SD | 340.1 | SD | 1.77 |
| 95% DL/2 (t) UCL | 244.1 | 95% H-Stat (DL/2) UCL | 424.8 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 138.7 | Mean in Log Scale | 3.599 |
| SD | 341.6 | SD in Log Scale | 1.724 |
| 95% MLE (t) UCL | 237.8 | Mean in Original Scale | 145.4 |
| 95% MLE (Tiku) UCL | 227.5 | SD in Original Scale | 340.1 |
| | | 95% Percentile Bootstrap UCL | 249.7 |
| | | 95% BCA Bootstrap UCL | 316.6 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.469 | Data appear Lognormal at 5% Significance Level | |
| Theta Star | 319.5 | | |
| nu star | 30.93 | | |
| | | | |
| A-D Test Statistic | 1.436 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.812 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.812 | Mean | 145.4 |
| 5% K-S Critical Value | 0.162 | SD | 335.1 |
| Data not Gamma Distributed at 5% Significance Level | | SE of Mean | 58.35 |
| | | 95% KM (t) UCL | 244.2 |
| **Assuming Gamma Distribution** | | 95% KM (z) UCL | 241.4 |

| | | | |
|---|---|---|---|
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 244.1 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 501.2 |
| Maximum | 1820 | 95% KM (BCA) UCL | 259.8 |
| Mean | 145.4 | 95% KM (Percentile Bootstrap) UCL | 248.1 |
| Median | 34.45 | 95% KM (Chebyshev) UCL | 399.8 |
| SD | 340.1 | 97.5% KM (Chebyshev) UCL | 509.9 |
| k star | 0.331 | 99% KM (Chebyshev) UCL | 726.1 |
| Theta star | 439.6 | | |
| Nu star | 22.49 | **Potential UCLs to Use** | |
| AppChi2 | 12.7 | 99% KM (Chebyshev) UCL | 726.1 |
| 95% Gamma Approximate UCL | 257.3 | | |
| 95% Adjusted Gamma UCL | 264.9 | | |
| Note: DL/2 is not a recommended method. | | | |
| | | | |

**Cyanide**

**General Statistics**

| | | | |
|---|---|---|---|
| Number of Valid Data | 32 | Number of Detected Data | 30 |
| Number of Distinct Detected Data | 30 | Number of Non-Detect Data | 2 |
| | | Percent Non-Detects | 6.25% |

| Raw Statistics | | Log-transformed Statistics | |
|---|---|---|---|
| Minimum Detected | 0.47 | Minimum Detected | -0.755 |
| Maximum Detected | 2850 | Maximum Detected | 7.955 |
| Mean of Detected | 680.5 | Mean of Detected | 5.273 |
| SD of Detected | 764.9 | SD of Detected | 2.343 |
| Minimum Non-Detect | 2.96 | Minimum Non-Detect | 1.085 |
| Maximum Non-Detect | 3.06 | Maximum Non-Detect | 1.118 |
| | | | |
| Note: Data have multiple DLs - Use of KM Method is recommended | | Number treated as Non-Detect | 4 |
| For all methods (except KM, DL/2, and ROS Methods), | | Number treated as Detected | 28 |
| Observations < Largest ND are treated as NDs | | Single DL Non-Detect Percentage | 12.50% |

**UCL Statistics**

| Normal Distribution Test with Detected Values Only | | Lognormal Distribution Test with Detected Values Only | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.831 | Shapiro Wilk Test Statistic | 0.859 |
| 5% Shapiro Wilk Critical Value | 0.927 | 5% Shapiro Wilk Critical Value | 0.927 |
| Data not Normal at 5% Significance Level | | Data not Lognormal at 5% Significance Level | |
| | | | |
| **Assuming Normal Distribution** | | **Assuming Lognormal Distribution** | |
| DL/2 Substitution Method | | DL/2 Substitution Method | |
| Mean | 638 | Mean | 4.969 |
| SD | 758.4 | SD | 2.563 |
| 95% DL/2 (t) UCL | 865.4 | 95% H-Stat (DL/2) UCL | 37939 |
| | | | |
| Maximum Likelihood Estimate(MLE) Method | | Log ROS Method | |
| Mean | 577.3 | Mean in Log Scale | 5.017 |
| SD | 825 | SD in Log Scale | 2.48 |
| 95% MLE (t) UCL | 824.6 | Mean in Original Scale | 638.2 |
| 95% MLE (Tiku) UCL | 817.4 | SD in Original Scale | 758.3 |
| | | 95% Percentile Bootstrap UCL | 872.8 |
| | | 95% BCA Bootstrap UCL | 893.3 |
| | | | |
| **Gamma Distribution Test with Detected Values Only** | | **Data Distribution Test with Detected Values Only** | |
| k star (bias corrected) | 0.479 | Data appear Gamma Distributed at 5% Significance Level | |
| Theta Star | 1422 | | |
| nu star | 28.72 | | |
| | | | |
| A-D Test Statistic | 0.368 | **Nonparametric Statistics** | |
| 5% A-D Critical Value | 0.809 | Kaplan-Meier (KM) Method | |
| K-S Test Statistic | 0.809 | Mean | 638 |
| 5% K-S Critical Value | 0.169 | SD | 746.5 |

| | | | |
|---|---|---|---|
| Data appear Gamma Distributed at 5% Significance Level | | SE of Mean | 134.2 |
| | | 95% KM (t) UCL | 865.6 |
| Assuming Gamma Distribution | | 95% KM (z) UCL | 858.8 |
| Gamma ROS Statistics using Extrapolated Data | | 95% KM (jackknife) UCL | 865.3 |
| Minimum | 1E-09 | 95% KM (bootstrap t) UCL | 908.7 |
| Maximum | 2850 | 95% KM (BCA) UCL | 857.9 |
| Mean | 638 | 95% KM (Percentile Bootstrap) UCL | 859.4 |
| Median | 335.5 | 95% KM (Chebyshev) UCL | 1223 |
| SD | 758.5 | 97.5% KM (Chebyshev) UCL | 1476 |
| k star | 0.25 | 99% KM (Chebyshev) UCL | 1973 |
| Theta star | 2556 | | |
| Nu star | 15.97 | Potential UCLs to Use | |
| AppChi2 | 7.942 | 95% KM (Chebyshev) UCL | 1223 |
| 95% Gamma Approximate UCL | 1283 | | |
| 95% Adjusted Gamma UCL | 1334 | | |
| Note: DL/2 is not a recommended method. | | | |