LCP CHEMICALS, INC. SUPERFUND SITE

NEXUS SUMMARY SITE FOR E.I. DUPONT DE NEMOURS AND COMPANY

Introduction

E.I. duPont de Nemours and Company ("DuPont") is liable as the owner of the LCP Site at the time of disposal of hazardous substances, see 42 U.S.C. § 9607(a)(2), and as an entity that arranged for the disposal of hazardous substances, see 42 U.S.C. § 9607(a)(3). There is evidence that during DuPont's ownership period, DuPont introduced industrial fill material in and around the LCP Site, which fill material contained contaminants of concern, including metals and base-neutral compounds. There is also evidence of hazardous substances discharged from another parcel owned by DuPont that reached the LCP Site. Hazardous substances present at the LCP Site (including, but not limited to, arsenic) were known to be utilized in DuPont's operations on adjacent properties, which operations took place from approximately 1880 through 1990.

Ownership

In addition to the adjacent property it still owns on Tremley Point (Block 586, Lots 8, 9 and 11), DuPont has acknowledged its ownership, beginning in 1928, of various portions of the LCP Site (Block 587, Lots 3.01, 3.02 and 3.03): a "Western Property" covering approximately 12.8 acres that it owned through 1949; and an "Eastern Property" that it owned through 1963. DuPont had acquired various parcels in the Tremley Point area of Linden from, and/or through, its acquisition of the assets of Grasselli Chemical Company in 1928, and transferred some, but not all, of that land to I.G. Farben via the sale to I.G. Farben of Grasselli Dyestuff Corporation (later General Aniline Works, Inc.).[1]

[1] DuPont 104(e) Response (March 5, 1999) (Exhibit A) at Item 3; DuPont 104(e) Response (March 22, 1999) (Exhibit B) at 1-3 & Item 3; Brown & Caldwell, Remedial Investigation Report, LCP Chemicals, Inc. Superfund

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Disposal of Hazardous Substances in Fill Material and Surface Discharges

The LCP Site, along with most of the surrounding area, originally consisted of tidal wetlands, and was gradually filled in with non-indigenous materials, including ash, cinders, and other materials. Both soil borings and analysis of historical maps and aerial photographs confirm the presence of anthropogenic fill throughout the LCP Site.[2]

Filling activity took place at the LCP Site during the period of DuPont's ownership. Aerial photographs from 1940 and 1947 show extensive areas of active filling. Most of the filling was done by 1949.[3] Between 1928 and 1975, DuPont dumped coal ash and numerous other wastes on the lands that it owned in Linden.[4] These fill materials contained a wide range of contaminants, including metals (such as lead, cobalt, and arsenic), chlorobenzene, and polycyclic aromatic hydrocarbons, which resulted from the common practice of using combustion residues as fill material. These contaminants are consistent with the industrial fill used at the adjacent DuPont property.[5] DuPont is also known to have disposed of its aqueous manufacturing wastes in the surrounding marshland during the same time period, which waste

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Site, Linden, New Jersey (July 2013) ("RIR") (Exhibit C) at 1-2 to 1-3, Table 1-1, & App. A (describing history of property transfers); Record of Decision (February 2014) (Exhibit D) ¶8 ("GAF Corporation purchased the site from E.I. duPont de Nemours and Company on about September 15, 1949").

[2] RIR (Exhibit C) at 2-2 to 2-3 to Figures 2-2 through 2-4; Record of Decision (February 2014) (Exhibit D) at 1.

[3] RIR (Exhibit C) at 2-3 to 2-4 Figures 2-8 through 2-10; URS Corporation, Final Work Plan; Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey (April 12, 2001) (Exhibit E) at 1-6 ("In 1940, the northern portion of the LCP Chemicals, Inc. site was still undeveloped marshland" except for railroad tracks along Tremby Point Road).

[4] Land Disposal Activity Sheet for Linden, NJ (Exhibit F).

[5] RIR (Exhibit C) at ES-2 and Figure 6-48. Soil contaminants found at both the LCP Site and the adjacent DuPont site include chlorobenzene, mercury, phenanthrene, fluoranthene, pyrene, lead, zinc, cobalt and arsenic. Groundwater contaminants found at both sites include methylene chloride, toluene, barium, cadmium, mercury, chlorobenzene, arsenic, lead, manganese, and cyanide. NUS Site Inspection Report - Executive Summary (January 9, 1985) (Exhibit G) at MAXUS3918677 - MAXUS3918692; NUS Final Site Inspection Report (October 18, 1985) (Exhibit H) at MAXUS3918718 - MAXUS3918728; Revised Phase II Remedial Investigation Work Plan (December 31, 1996) (Exhibit I) at MAXUS3919138 - MAXUS3919147.

resulted from the manufacture of inorganic compounds (*e.g.* phosphate plaster, hypo-muds, silicate muds, and metal sulfides).[6]

In addition to filling activity, DuPont is known to have discharged various COPCs during its operational period, which have been encountered on the LCP Site. In particular, elevated arsenic concentrations in the headwater area of South Branch Creek relate to an off-site source from historic operations at the DuPont Site.[7] Arsenic is not associated with the chlor-alkali process employed on the LCP Site, but is known to have been used in DuPont manufacturing and has been detected in elevated concentrations throughout the DuPont site in both soil[8] and groundwater.[9] DuPont is known to have produced arsenic-containing products at the DuPont site, including but not limited to arsenic acid, lead arsenate and iron arsenate.[10] This contaminant likely migrated from the DuPont site to the LCP Site as a result of overland flow in the swale along the railroad tracks.[11]

Similarly, other contaminants at the LCP Site, including lead, cobalt, zinc, and base-neutral compounds, also likely originated with off-site sources such as DuPont, as they are not believed to be associated with the industrial operations conducted at the LCP Site. These contaminants, as well as mercury, chromium, and nickel, have all been identified in soils and/or

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[6] Remedial Action Selection Report ("RASR") for DuPont Grasselli Site (January 2008) (Exhibit K) at A-1.
[7] RIR (Exhibit C) at 6-11 to 6-12; DuPont Environmental Remediation Services, Operational History of the DuPont Grasselli Facility (September 28, 1990) (Exhibit N) at pg. 33.

[8] Remedial Action Workplan Form, DuPont Grasselli Site (October 15, 2010) (Exhibit L) at pg. 2; Revised Phase II Remedial Investigation Work Plan (Exhibit I) at MAXUS3919019, MAXUS3919031; Parsons, Remedial Action Work Plan, DuPont Grasselli Site (October 2010) (Exhibit M) at pg. 14.

[9] Corporate Remediation Group, Groundwater Current Conditions Report, DuPont Grasselli Site, Linden, New Jersey (July 2009) (Exhibit J) at pg. 8; Remedial Action Workplan Form (Exhibit L) at pg. 2.

[10] Operational History (Exhibit N) at Figure 9.
[11] RIR (Exhibit C) at 6-26 & Figure 2-25.

groundwater at the DuPont Site.[12] Indeed, many contaminants, including arsenic, lead, barium, cadmium and PAHs have been identified as site-wide COPCs at the DuPont Site.[13]

Conclusion

DuPont owned the LCP Site when hazardous substances were disposed of at the LCP Site through filling activity. DuPont itself arranged for those disposal activities. In addition, discharges from a separate DuPont parcel, containing arsenic and other hazardous substances, reached the LCP Site. Accordingly, DuPont is a potentially responsible party under CERCLA and should be issued a General Notice Letter ("GNL") from EPA and contribute toward the investigation and cleanup of the LCP Site.

[12] RASR (Exhibit K) at A-6 - A-17; Remedial Action Workplan Form (Exhibit L) at pg. 2.
[13] RASR (Exhibit K) at A-13; Revised Phase II Remedial Investigation Work Plan (Exhibit I) at MAXUS3919019, MAXUS3919031.

Exhibit A

189991

DUPONT

March 5, 1999

BY FACSIMILIE
(212) 637-3096

Mr. Muthu Sundram
Office of Regional Counsel
New Jersey Superfund Branch
U.S. Environmental Protection Agency
290 Broadway, 17th Floor
New York, NY 10007-1866

Re: LCP Chemicals, Inc. Superfund Site
Linden, Union County, New Jersey

Dear Mr. Sundram:

Enclosed please find an initial response of E. I. du Pont de Nemours and Company ("DuPont") to the Request for Information for the LCP Chemicals, Inc. Superfund Site in Linden, New Jersey. We appreciate the extension of time given to respond.

We have found doing the title search and requisite surveying more difficult and time consuming than anticipated. Both were critical to clarifying ownership issues. We expect to supplement this response next week with the attachments and additional information making DuPont's response to the Request for Information more meaningful.

Very truly yours,

Barbara U. Gravely

Barbara U. Gravely

Printed on Recycled Paper

cc: Ms. Patricia Simmons
Emergency and Remedial Response Division
U. S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866

John McGahren, Esq.
Pitney, Hardin, Kipp & Szuch

Bernard J. Reilly, Esq.
DuPont Legal

John L. Riddle
DuPont Corporate Remediation Group

E. I. DU PONT DE NEMOURS AND COMPANY
RESPONSE TO REQUEST FOR INFORMATION
LCP CHEMICALS, INC. SUPERFUND SITE
LINDEN, NEW JERSEY

1. a. State the legal name of your business.

E. I. du Pont de Nemours and Company

b. State the name and address of the president or the chairman of the board, or other presiding officers of your business.

Charles O. Holliday, Jr.
Chairman, CEO and President
1007 Market Street
Wilmington, DE 19898

c. Identify the state of incorporation of your business and your business agent for service of process in the state of incorporation and in New Jersey.

Incorporated in the State of Delaware in September 1915. For Delaware, E. I. du Pont de Nemours and Company serves as its own registered agent located at 1007 Market Street, DuPont Bldg. 8048, Wilmington, DE 19898, Attention: Corporate Secretary or Assistant Secretary

The registered agent for New Jersey is CT Corporation System, 820 Bear Tavern Road, West Trenton, NJ 08628

d. Provide a copy of your business "Certificate of Incorporation" and any amendments thereto.

Attached.

e. If your business is a subsidiary or affiliate of another company, or has subsidiaries or is a successor to another company, identify these related companies. For each related company, describe the relationship to your business and indicate the date and manner in which each relationship was established.

The DuPont Company is not a subsidiary or affiliate of another company. It is a Fortune 500 company that has been in business nearly 200 years. During the time, DuPont has been affiliated with many other entities through acquisition or merger; it has also subsequently divested itself of entities.

DuPont will be pleased to supply information on any specific entity upon request.

2. Does the business entity identified in Question 1 above have a permit or permits issued pursuant to the Resource Conservation and Recovery Act, 42 U.S.C. Section 6901 *et seq*? Also, if any of the business entities identified in Question 1 above has/had an EPA Identification Number, state it in your answer to this Question.

The DuPont Company currently operates at over 60 locations throughout the United States; historically the number is much larger. It would be very onerous to answer this question and also not relevant to the concerns addressed in this Information Request.

The EPA Identification Number for the Grasselli Plant in Linden is NJD002185965.

If the Agency is interest in the number for any other plant location, it will be given upon request.

3. Do you currently own, operate, lease, or maintain, or have in the past owned, operated, leased, or maintained any real property at the LCP Chemicals, Inc. Site? Provide all relevant documentation, including leases, deeds, or other materials which relate to such premises.

DuPont does not currently own or operate any real property at the LCP Chemicals, Inc. Superfund Site (the "LCP Site" or the "Site"). In the past, however, DuPont owned part of the Site. DuPont acquired title to a portion of the LCP Site on December 1, 1928, when it purchased the assets of The Grasselli Chemical Company (Ohio). Although DuPont immediately transferred the Grasselli (Ohio) assets to its wholly owned subsidiary, The Grasselli Chemical Company (Delaware), it reacquired title to the same portion of the Site on October 31, 1936, when the Grasselli (Delaware) subsidiary dissolved and the Grasselli Chemicals Department of DuPont assumed ownership of its assets. On September 15, 1949, DuPont then sold its portion of the LCP Site to General Aniline & Film Corporation ("GAF").

Throughout DuPont's 1928 through 1949 period of ownership, no operations took place on the LCP Site. Indeed, the evidence suggests that GAF did not construct the first of two chlorine plants at the Site until at least 1952. That evidence includes USEPA Region II's own August 12, 1996 Removal Site Evaluation for the LCP Site. In the evaluation, USEPA states that "GAF had produced chlorine and sodium hydroxide at this location since 1952." An April 6, 1949 resolution of the DuPont Executive Committee confirms USEPA's conclusion. The resolution describes the parcel to be sold to GAF on September 15, 1949 as "idle land." LCP Transportation, Inc.'s September 30, 1988 ECRA Applicability/Nonapplicability Affidavit to NJDEP also describes the LCP Site as a "22 acre facility, which was constructed by GAF in the mid to late 1950's." Thus, GAF did not build its chlorine

production facilities and no operations occurred at the Site until, at the earliest, 1952, three years after DuPont sold its portion of the Site on September 15, 1949.

4. Identify the business entity and provide the exact lot and block numbers of all of the business entity's past and present operations at the Site in Linden, New Jersey. Provide a map identifying the location of these properties. Provide the date(s) of each of the business entity's operations at the above-referenced lot and block numbers.

DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

5. Provide a full description of all past and present operations of each business entity identified in Question 4 above. Your description shall include, but not be limited to, all manufacturing, research and development, processing, maintenance, and/or handling activities. For each type of operation described in the answer to this Question, provide the name(s), and job description(s) of the person or persons responsible for the management of that particular operations. If such person(s) are no longer employed by the company, provide their last known addresses.

DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

6. Has the business entity identified in Question 4 above generated, purchased, used and/or handled in any manner any hazardous substance in any of its operations or maintenance? Is that business entity currently engaged in such practice?

   a. In what years did the business entity generate, purchase, use and/or handle any chemicals, halogenated or non-halogenated.

   b. For what purpose were any halogenated or non-halogenated chemicals generated, purchased, used and/or handled by the business entity.

   c. What was the volume of the halongenated or non-halogenated chemicals chemicals generated, purchased, used and/or handled by the business entity or an annual or any other durational basis?

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

7. Describe <u>all</u> storage and disposal practices employed by your company with respect to all hazardous substances, hazardous wastes and/or "CERCLA waste material" including, but not limited to, mixtures, solvents and degreasers, paints and paint-thinners handled in any way in the operation of the business entity identified in Question 4 above from the time operations commenced until the present. Include all on-site and off-site storage and disposal activities.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

8. Indicate whether the business entity identified in Question 4 above used lagoons, impoundments and/or storage tanks to treat, store and/or dispose of hazardous materials, hazardous waste or "CERCLA waste material". If such units were used, please indicate the following:

   a. The installation date of said unit(s);

   b. The use of said unit(s);

   c. Whether hazardous substances, hazardous wastes and/or CERCLA waste material were stored/disposed of in said unit(s); and

   d. The disposition of said unit(s).

   Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

9. Provide a copy of each document which relates to the generation, purchase, use, handling, hauling, and/or disposal of all hazardous substances, hazardous wastes and/or "CERCLA waste material" identified in response to question 6, 7, and 8 above.

   Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

10. Provide the date of any release of hazardous substances, hazardous wastes and/or "CERCLA waste material" including halogenated or non-halogenated organic chemicals at the business entity identified in Question 4 above and/or property. Provide details of the ultimate disposal of contaminated materials.

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

11. Identify each person (including company, individual, partnership, etc.) having knowledge of the facts relating to the generation and/or disposal of hazardous substances, hazardous waste and/or "CERCLA waste material" identified in response to Questions 6, 7, and 8 above. For each person identified, provide the name, address and telephone number of that person and basis of your belief that he or she has such knowledge.

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

12. Submit a copy of any lease, contract, permit or other written agreement relating to the generation, handling, transport and/or disposal of all hazardous substances, hazardous wastes and/or "CERCLA waste material" at the business entity identified in Question 4 above's facility in Linden, New Jersey. If the documents are unavailable, refer to Question 11, above, for the specific information required.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

13. State whether any agreements or contracts (other than an insurance policy) exist which may indemnify the business entity identified in Question 4 above, present owners of shares in the company or past owners of shares in the company, for any liability that may result under CERCLA for any release or threatened release of a hazardous substance at the Site. If such agreements or contracts exist, please provide a copy of the agreement or contract. Identify any agreement or contract that you are unable to locate or obtain. If the documents are unavailable, refer to Question 11, above, for the specific information required.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

14. State whether an insurance policy has ever been in effect which may indemnify the business entity identified in Question 4 above against any liability which the business entity may have under CERCLA for any release or threatened release of a hazardous substance that may have occurred at the Site. If so, please provide a copy of the policy. Identify any policy that you cannot locate or obtain by the name of the carrier, years in effect, nature and extent of coverage, and any other information you have.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

15. State whether any of the business entities identified in Question 4 above filed for bankruptcy and, if so, provide the following information to the extent available to you.....

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

16. Please supply any additional information which may help EPA to identify sources who disposed of hazardous substances, hazardous wastes and/or "CERCLA waste material" at the Site.

Upon information and belief, the United States Government assumed ownership of a large portion of the LCP Site in 1942 when the Alien Property Custodian seized ownership and control of GAF. Indeed, on February 16, 1942, Secretary of

Treasury Henry Morganthau seized 97% of the GAF's stock under the authority of the Trading with the Enemy Act and with the approval of President Roosevelt. GAF's property, which included 100 acres of land at the Site, was then transferred to the office of the Alien Property Custodian and Leo T. Crowley was appointed to run the company.

Contradicts DOJ's response

After it's seizure, GAF began manufacturing carbonyl iron powder for use by the United States in World War II. The company also held government contracts on dyes for military uniforms and produced photographic and moving picture film. However, no evidence exists to suggest that GAF produced chlorine, for the United States Government or otherwise, in the 1940s.

Still under the control of the Alien Property Custodian, GAF apparently constructed a chlorine facility on the LCP Site in the early 1950s. That facility had a 50 million pound capacity, but construction on a second facility adjacent to the original plant began in 1961. The second facility started up in 1963 with a capacity of 180 million pounds. The original chlorine plant was slated to reopen in 1964, and, by 1965, the second, newer facility was itself producing 200 million pounds annually.

In the 1960s, GAF also continued to manufacture dyes to produce photographic and film products under United States control. The dyes included Azos, Vats, Azoics, Synthetics, Brighteners, Pigments, Organic Intermediates and Reactive Dyes, and other products manufactured by GAF included surfactants and detergents, bulk chemicals (principally chlorine, caustic soda, ethylene oxide, and ethylene glycols), and reproduction equipment.

A description of GAF's Linden facilities in 1964 indicated the presence of forty manufacturing buildings producing pigments, dyestuffs, surfactants, organic intermediates and heavy chemicals. The surfactant, pigment and organic intermediate facilities were "not particularly modern," and the dyestuffs operations, estimated to date back in the 1920s, were "typically unimpressive." The second chlorine plant and the 60 million pound capacity ethylene oxide plant built in 1958 were "modern," had "an excellent appearance," and "operate[d] continuously."

17. Please supply any and all other documents that indicate or show a business relationship(s) between various business entities that had any kind of connection to the LCP Chemicals, Inc. Site, whatsoever it may be.

DuPont does not have any documents responsive to this question, other than those received form USEPA in response to a FOIA request.

18. State the name(s), addresses(s), telephone numbers(s), titles(s) and occupations(s) of the person(s) answering this "Request for Information" and state whether such person(s) has personal knowledge of the answers.

The following people contributed to answering this "Request for Information".

Dr. John L. Riddle
DuPont Corporate Remediation Group
Barley Mill Plaza #27/2212
Rts. 141 & 48
Wilmington, DE 19805

John McGahren, Esq.
Pitney, Hardin, Kipp, & Szuch
P.O. Box 1945
Morristown, NJ 07962

Bernard J. Reilly, Esq.
DuPont Legal, D-7082
1007 Market Street
Wilmington, DE 19898

Barbara U. Gravely
DuPont Legal, D-7083
1007 Market Street
Wilmington, DE 19898

19. Identify each person who assisted in any manner in responding to the "Request for Information" and specify the question for which each person provided assistance in responding.

Chain of Title obtained from: Network Title Services, Inc., Bridgewater, New Jersey

Exhibit B

200347

March 22, 1999

BY OVERNIGHT MAIL

Mr. Muthu Sundram
Office of Regional Counsel
New Jersey Superfund Branch
U. S. Environmental Protection Agency
290 Broadway, 17th Floor
New York, NY 10007-1866

Re: LCP Chemicals, Inc. Superfund Site
Linden, Union County, New Jersey

Dear Mr. Sundram:

Pursuant to my letter of March 5, 1999, transmitting E. I. du Pont de Nemours and Company's ("DuPont") response to the Request for Information for the LCP Chemicals, Inc. Superfund Site in Linden, New Jersey (the "Site"), I am writing to provide additional information regarding DuPont's alleged ownership and operation of the Site.

On December 1, 1928, the Grasselli Chemical Company (Ohio) ("Grasselli Ohio") sold a majority of its assets to DuPont. At the same time, Grasselli Ohio reserved certain assets for transfer to the Grasselli Dyestuffs Corporation ("Grasselli Dyestuffs"), which was both a joint venture of Grasselli Ohio and the Bayer Company and a subsidiary of Germany's I.G. Farbenindustrie ("I. G. Farben"). In this manner, DuPont acquired title to two sections of land partially underlying the Site (the "Western Property" and the "Eastern Property"), and I. G. Farben, which assumed sole ownership of Grasselli Dyestuffs, came to own much of the remainder of the Site's land.

After obtaining title from Grasselli Ohio, DuPont immediately transferred the Western Property and the Eastern Property, as well as the other Grasselli Ohio assets, to its wholly owned subsidiary, The Grasselli Chemical Company (Delaware). However, DuPont's Grasselli subsidiary apparently did not conduct any operations on either the Western Property or the Eastern Property and dissolved in 1936. At that time, the Grasselli Chemicals Department of

DuPont assumed ownership of the Grasselli subsidiary's assets, and thus, on October 31, 1936, DuPont reacquired title to the Western Property and the Eastern Property.

No evidence exists to suggest that DuPont operated on any portion of the Site following the 1936 transfer. Indeed, relevant documents, photographs, and site maps indicate that no operations and no disposal took place on either the Western Property or the Eastern Property during the period of DuPont's ownership.

The Western Property

An April 1, 1949, DuPont memorandum refers to the Western Property as a "long narrow strip of land of irregular shape, approximately 150 feet wide and containing approximately 12.8 acres, lying between the General Aniline[1] property and the railroad yards of the Central Railroad of New Jersey"; it is outlined in blue and designated as "Parcel, DuPont to G.A.F., 9-15-49, D.B. 1776 Pg. 7" on Exhibit A. As also shown on Exhibit A, that portion of the Western Property within the red-outlined lots is within the boundaries of the Site. However, the evidence suggests that no operations and no disposal took place on any part of the Western Property prior to DuPont's sale of that parcel to General Aniline & Film Corporation ("GAF") on September 15, 1949. That evidence includes:

- The April 1, 1949, DuPont memorandum mentioned above, which states that the Western Property was intended "for the establishment of a railroad classification yard" that "was never established";
- an April 6, 1949, resolution of the DuPont Executive Committee, which describes the Western Property as "idle land";
- the aerial photography attached as Exhibit B, which shows no development in the area of the Western Property in 1944;
- USEPA Region II's own August 12, 1996, Removal Site Evaluation for the Site, which states that "GAF had produced chlorine and sodium hydroxide at this location since 1952," three years after DuPont sold the Western Property; and
- LCP Transportation, Inc.'s September 30, 1988, ECRA Applicability/Nonapplicability Affidavit to NJDEP, which describes theSite as a "22 acre facility, which was constructed by GAF *in the mid to late 1950's"* and thus, again, after DuPont's ownership of the Western Property.

The Eastern Property

The Eastern Property is outlined in blue on the Exhibit A and marked as "36.307 ac. DuPont to G.A.F., 7-9-63, D.B. 2648 Pg. 319, Grasselli to DuPont, 10-31-36 D.B. 1330 Pg. 321." As with the Western Property that portion of the parcel that falls within Exhibit A's red outline lies within the boundaries of the Site. Again, however, the evidence suggests that no

[1] I. G. Farben had changed the name of Grasselli Dyestuffs to General Aniline Works, Inc. ("General Aniline") in 1929.

operations and no disposal took place on the Eastern Property prior to DuPont's sale of that parcel to GAF on July 9, 1963.

The portion of the Arthur Kill, N.Y.-N.J. USGS Quadrangle map that is marked in black on Exhibit C shows no development on the Eastern Property as of 1966, three years after DuPont sold that parcel. Moreover, the revisions to the same USGS map shown in magenta demonstrates that, as of 1981, still no operations were taking place on that portion of the Eastern Property that underlies the Site.

Thus, the evidence indicates that no operations or disposal occurred on either the Western Property or the Eastern Property during DuPont's ownership of those parcels. Accordingly, DuPont is not a "person who at the time of disposal of any hazardous substance owned or operated [the Site]," and it did not "arrange[d] for disposal or treatment...of hazardous substances [at the Site]." 42 U.S.C. Section 9607 (a)(2),(3). Therefore, DuPont respectfully declines to enter into any Administrative Consent Order to perform the Site's RI/FS.

We would be pleased to meet with you regarding this information at your request.

Very truly yours,

Barbara U. Gravely

Barbara U. Gravely

Attachments

cc: Ms. Patricia Simmons (w/o attachments)
Emergency and Remedial Response Division
U. S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866

Revised 3/22/99

E. I. DU PONT DE NEMOURS AND COMPANY
RESPONSE TO REQUEST FOR INFORMATION
LCP CHEMICALS, INC. SUPERFUND SITE
LINDEN, NEW JERSEY

1. a. State the legal name of your business.

E. I. du Pont de Nemours and Company

b. State the name and address of the president or the chairman of the board, or other presiding officers of your business.

Charles O. Holliday, Jr.
Chairman, CEO and President
1007 Market Street
Wilmington, DE 19898

c. Identify the state of incorporation of your business and your business agent for service of process in the state of incorporation and in New Jersey.

Incorporated in the State of Delaware in September 1915. For Delaware, E. I. du Pont de Nemours and Company serves as its own registered agent located at 1007 Market Street, DuPont Bldg. 8048, Wilmington, DE 19898, Attention: Corporate Secretary or Assistant Secretary

The registered agent for New Jersey is CT Corporation System, 820 Bear Tavern Road, West Trenton, NJ 08628

d. Provide a copy of your business "Certificate of Incorporation" and any amendments thereto.

Attached.

e. If your business is a subsidiary or affiliate of another company, or has subsidiaries or is a successor to another company, identify these related companies. For each related company, describe the relationship to your business and indicate the date and manner in which each relationship was established.

The DuPont Company is not a subsidiary or affiliate of another company. It is a Fortune 500 company that has been in business nearly 200 years. During

the time, DuPont has been affiliated with many other entities through acquisition or merger; it has also subsequently divested itself of entities. DuPont will be pleased to supply information on any specific entity upon request.

2. Does the business entity identified in Question 1 above have a permit or permits issued pursuant to the Resource Conservation and Recovery Act, 42 U.S.C. Section 6901 *et seq*? Also, if any of the business entities identified in Question 1 above has/had an EPA Identification Number, state it in your answer to this Question.

The DuPont Company currently operates at over 60 locations throughout the United States; historically the number is much larger. It would be very onerous to answer this question and also not relevant to the concerns addressed in this Information Request.

The EPA Identification Number for the Grasselli Plant in Linden is NJD002185965.

If the Agency is interest in the number for any other plant location, it will be given upon request.

3. Do you currently own, operate, lease, or maintain, or have in the past owned, operated, leased, or maintained any real property at the LCP Chemicals, Inc. Site? Provide all relevant documentation, including leases, deeds, or other materials which relate to such premises.

DuPont does not currently own or operate any real property at the LCP Chemicals, Inc. Superfund Site (the "LCP Site" or the "Site"). In the past, however, DuPont owned part of the Site. DuPont acquired title to a portion of the LCP Site on December 1, 1928, when it purchased the assets of The Grasselli Chemical Company (Ohio). Although DuPont immediately transferred the Grasselli (Ohio) assets to its wholly owned subsidiary, The Grasselli Chemical Company (Delaware), it reacquired title to the same portion of the Site on October 31, 1936, when the Grasselli (Delaware) subsidiary dissolved and the Grasselli Chemicals Department of DuPont assumed ownership of its assets. On September 15, 1949, DuPont then sold its portion of the LCP Site to General Aniline & Film Corporation ("GAF").

Throughout DuPont's 1928 through 1949 period of ownership, no operations took place on the LCP Site. Indeed, the evidence suggests that GAF did not construct the first of two chlorine plants at the Site until at least 1952. That evidence includes USEPA Region II's own August 12, 1996 Removal Site Evaluation for the LCP Site. In the evaluation, USEPA states that "GAF had produced chlorine and sodium hydroxide at this location since 1952." An April 6, 1949 resolution of the DuPont Executive Committee confirms USEPA's conclusion. The resolution describes the parcel to be sold to GAF on September 15, 1949 as "idle land." LCP Transportation, Inc.'s September 30, 1988 ECRA Applicability/Nonapplicability

Affidavit to NJDEP also describes the LCP Site as a "22 acre facility, which was constructed by GAF in the mid to late 1950's." Thus, GAF did not build its chlorine production facilities and no operations occurred at the Site until, at the earliest, 1952, three years after DuPont sold its portion of the Site on September 15, 1949.

4. Identify the business entity and provide the exact lot and block numbers of all of the business entity's past and present operations at the Site in Linden, New Jersey. Provide a map identifying the location of these properties. Provide the date(s) of each of the business entity's operations at the above-referenced lot and block numbers.

   DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

5. Provide a full description of all past and present operations of each business entity identified in Question 4 above. Your description shall include, but not be limited to, all manufacturing, research and development, processing, maintenance, and/or handling activities. For each type of operation described in the answer to this Question, provide the name(s), and job description(s) of the person or persons responsible for the management of that particular operations. If such person(s) are no longer employed by the company, provide their last known addresses.

   DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

6. Has the business entity identified in Question 4 above generated, purchased, used and/or handled in any manner any hazardous substance in any of its operations or maintenance? Is that business entity currently engaged in such practice?

   a. In what years did the business entity generate, purchase, use and/or handle any chemicals, halogenated or non-halogenated.

   b. For what purpose were any halogenated or non-halogenated chemicals generated, purchased, used and/or handled by the business entity.

   c. What was the volume of the halongenated or non-halogenated chemicals chemicals generated, purchased, used and/or handled by the business entity or an annual or any other durational basis?

   Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

7. Describe <u>all</u> storage and disposal practices employed by your company with respect to all hazardous substances, hazardous wastes and/or "CERCLA waste material" including, but not limited to, mixtures, solvents and degreasers, paints and paint-thinners handled in any way in the operation of the business entity identified in Question 4 above from the time

operations commenced until the present. Include all on-site and off-site storage and disposal activities.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

8. Indicate whether the business entity identified in Question 4 above used lagoons, impoundments and/or storage tanks to treat, store and/or dispose of hazardous materials, hazardous waste or "CERCLA waste material". If such units were used, please indicate the following:

   a. The installation date of said unit(s);

   b. The use of said unit(s);

   c. Whether hazardous substances, hazardous wastes and/or CERCLA waste material were stored/disposed of in said unit(s); and

   d. The disposition of said unit(s).

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

9. Provide a copy of each document which relates to the generation, purchase, use, handling, hauling, and/or disposal of all hazardous substances, hazardous wastes and/or "CERCLA waste material" identified in response to question 6, 7, and 8 above.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

10. Provide the date of any release of hazardous substances, hazardous wastes and/or "CERCLA waste material" including halogenated or non-halogenated organic chemicals at the business entity identified in Question 4 above and/or property. Provide details of the ultimate disposal of contaminated materials.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

11. Identify each person (including company, individual, partnership, etc.) having knowledge of the facts relating to the generation and/or disposal of hazardous substances, hazardous waste and/or "CERCLA waste material" identified in response to Questions 6, 7, and 8 above. For each person identified, provide the name, address and telephone number of that person and basis of your belief that he or she has such knowledge.

Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

12. Submit a copy of any lease, contract, permit or other written agreement relating to the generation, handling, transport and/or disposal of all hazardous substances, hazardous wastes and/or "CERCLA waste material" at the business entity identified in Question 4 above's facility in Linden, New Jersey. If the documents are unavailable, refer to Question 11, above, for the specific information required.

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

13. State whether any agreements or contracts (other than an insurance policy) exist which may indemnify the business entity identified in Question 4 above, present owners of shares in the company or past owners of shares in the company, for any liability that may result under CERCLA for any release or threatened release of a hazardous substance at the Site. If such agreements or contracts exist, please provide a copy of the agreement or contract. Identify any agreement or contract that you are unable to locate or obtain. If the documents are unavailable, refer to Question 11, above, for the specific information required.

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

14. State whether an insurance policy has ever been in effect which may indemnify the business entity identified in Question 4 above against any liability which the business entity may have under CERCLA for any release or threatened release of a hazardous substance that may have occurred at the Site. If so, please provide a copy of the policy. Identify any policy that you cannot locate or obtain by the name of the carrier, years in effect, nature and extent of coverage, and any other information you have.

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

15. State whether any of the business entities identified in Question 4 above filed for bankruptcy and, if so, provide the following information to the extent available to you.....

    Not applicable. DuPont has never had any operations on the Site. Refer to the response to Question 3 above.

16. Please supply any additional information which may help EPA to identify sources who disposed of hazardous substances, hazardous wastes and/or "CERCLA waste material" at the Site.

Upon information and belief, the United States Government assumed ownership of a large portion of the LCP Site in 1942 when the Alien Property Custodian seized ownership and control of GAF. Indeed, on February 16, 1942, Secretary of Treasury Henry Morganthau seized 97% of the GAF's stock under the authority of the Trading with the Enemy Act and with the approval of President Roosevelt. GAF's property, which included 100 acres of land at the Site, was then transferred to the office of the Alien Property Custodian and Leo T. Crowley was appointed to run the company.

After it's seizure, GAF began manufacturing carbonyl iron powder for use by the United States in World War II. The company also held government contracts on dyes for military uniforms and produced photographic and moving picture film. However, no evidence exists to suggest that GAF produced chlorine, for the United States Government or otherwise, in the 1940s.

Still under the control of the Alien Property Custodian, GAF apparently constructed a chlorine facility on the LCP Site in the early 1950s. That facility had a 50 million pound capacity, but construction on a second facility adjacent to the original plant began in 1961. The second facility started up in 1963 with a capacity of 180 million pounds. The original chlorine plant was slated to reopen in 1964, and, by 1965, the second, newer facility was itself producing 200 million pounds annually.

In the 1960s, GAF also continued to manufacture dyes to produce photographic and film products under United States control. The dyes included Azos, Vats, Azoics, Synthetics, Brighteners, Pigments, Organic Intermediates and Reactive Dyes, and other products manufactured by GAF included surfactants and detergents, bulk chemicals (principally chlorine, caustic soda, ethylene oxide, and ethylene glycols), and reproduction equipment.

A description of GAF's Linden facilities in 1964 indicated the presence of forty manufacturing buildings producing pigments, dyestuffs, surfactants, organic intermediates and heavy chemicals. The surfactant, pigment and organic intermediate facilities were "not particularly modern," and the dyestuffs operations, estimated to date back in the 1920s, were "typically unimpressive." The second chlorine plant and the 60 million pound capacity ethylene oxide plant built in 1958 were "modern," had "an excellent appearance," and "operate[d] continuously."

17. Please supply any and all other documents that indicate or show a business relationship(s) between various business entities that had any kind of connection to the LCP Chemicals, Inc. Site, whatsoever it may be.

DuPont does not have any documents responsive to this question, other than those received form USEPA in response to a FOIA request.

18. State the name(s), addresses(s), telephone numbers(s), titles(s) and occupations(s) of the person(s) answering this "Request for Information" and state whether such person(s) has personal knowledge of the answers.

The following people contributed to answering this "Request for Information".

Dr. John L. Riddle
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Wilmington, DE 19898

19. Identify each person who assisted in any manner in responding to the "Request for Information" and specify the question for which each person provided assistance in responding.

Chain of Title obtained from: Network Title Services, Inc., Bridgewater, New Jersey

Surveying maps obtained from: Harry Berger, Berger & Company, Charleston, West Virginia

CHARTER

OF

E. I. du Pont de Nemours and Company

Incorporated Under The Laws of Delaware

CHARTER

OF

E. I. du Pont de Nemours and Company

INCORPORATED UNDER THE LAWS OF DELAWARE

Authorized Capital

Preferred Stock ..... 23,000,000 Shares No Par Value
Common Stock ..... 900,000,000 Shares $.60 Par Value

Original Certificate	Filed September 4, 1915
Certificate of Amendment	Filed December 4, 1922
Certificate of Amendment	Filed June 19, 1925
Certificate of Amendment	Filed October 27, 1926
Certificate of Amendment	Filed January 19, 1929
Certificate of Amendment	Filed April 23, 1934
Certificate of Amendment	Filed June 18, 1937
Certificate of Amendment	Filed September 29, 1939
Certificate of Amendment	Filed March 15, 1940
Certificate of Amendment	Filed March 10, 1942
Certificate of Change of Resident Agent	Filed April 23, 1946
Certificate of Amendment	Filed April 25, 1947
Certificate of Change of Resident Agent	Filed May 23, 1947
Certificate of Amendment	Filed June 15, 1949
Certificate of Amendment	Filed July 6, 1955
Certificate of Change of Resident Agent	Filed July 6, 1955
Certificate of Amendment	Filed November 13, 1957
Certificate of Change of Resident Agent	Filed June 19, 1963
Certificate of Change of Resident Agent	Filed September 21, 1966
Certificate of Amendment	Filed April 8, 1968
Certificate of Amendment	Filed April 13, 1970
Certificate of Amendment	Filed April 8, 1974
Agreement of Merger Amending Certificate of Incorporation	Filed October 17, 1977
Certificate of Amendment	Filed April 16, 1979
Certificate of Amendment	Filed April 21, 1980
Certificate of Amendment	Filed August 17, 1981
Certificate of Amendment	Filed May 4, 1987
Certificate of Amendment	Filed December 21, 1989
Restated Certificate	Filed December 22, 1989

E. I. DU PONT DE NEMOURS AND COMPANY

RESTATED CERTIFICATE OF INCORPORATION

E. I. du Pont de Nemours and Company, a corporation organized and existing under the Laws of the State of Delaware, hereby certifies as follows:

1. The name of the corporation is E. I. du Pont de Nemours and Company. The date of filing its original Certificate of Incorporation with the Secretary of State was September 4, 1915.

2. This Restated Certificate of Incorporation only restates and integrates and does not further amend the provisions of the Certificate of Incorporation of this corporation as heretofore amended or supplemented and there is no discrepancy between those provisions and the provisions of this Restated Certificate of Incorporation.

3. The text of the Certificate of Incorporation as amended or supplemented heretofore is hereby restated without further amendments or changes to read as herein set forth in full.

First: — The name of the corporation is

E. I. DU PONT DE NEMOURS AND COMPANY

Second: — The principal office of the corporation is to be located at No. 1007 Market Street, in the City of Wilmington, in the County of New Castle, in the State of Delaware. The name of its resident agent is E. I. du Pont de Nemours and Company, whose address is Room 8042, Du Pont Building, No. 1007 Market Street, in the City of Wilmington, County of New Castle, State of Delaware 19898.

Third: — The nature of the business of the corporation and the objects and purposes proposed to be transacted, promoted or carried on by it, are as follows:

(*a*) To manufacture, produce, prepare, experiment with, purchase, and otherwise acquire, import, export, sell, distribute, and otherwise dispose of, and generally to trade and deal in, in any manner whatsoever, (1) chemicals of every description, organic or inorganic, natural or

synthetic, in the form of raw materials, intermediates, or finished products, and chemicals which may be used in the manufacture of any and all products of every kind whatsoever; and (2) chemical products of every kind and description.

(*b*) To engage in research, exploration, laboratory and development work relating to any substance, compound or mixture, now known or which may hereafter be known, discovered or developed, and to perfect, develop, manufacture, use, apply and generally deal in any such substance, compound or mixture.

(*c*) To purchase or otherwise acquire, hold, own, occupy, develop, improve, sell, dispose of and convey real property and any and every interest therein either within or without the State of Delaware and anywhere in the world; to extract, remove, produce or prepare from any such property any animal, vegetable, mineral or other product or material therein or thereon, either by agricultural pursuits, mining, quarrying, or by any other method or means now known or that may hereafter be discovered or invented, and to avail itself in every manner of each and every resource of such property by reducing it to proper form and by use, sale or other disposition thereof.

(*d*) To erect, purchase, sell, lease, manage, occupy and improve buildings and to do and perform all things needful and lawful for the holding, development and improvement of the same for residence, trade and business purposes; to buy, own, operate, improve, lease and occupy, lands and buildings for hotels, apartment houses, dwelling houses, and business structures of all kinds, for the accommodation of the public and of individuals; to manage, operate, conduct, and carry on, hotels, apartment houses, dwelling houses, office buildings, restaurants, cafes, pharmacies, drug stores, theaters, and other places for the accommodation of the public and of individuals.

(*e*) To manufacture, acquire, own, sell or otherwise dispose of all kinds of goods, merchandise and personal property of every nature whatsoever either within or without the State of Delaware and anywhere in the world.

(*f*) To engage in all kinds of business, including the following but without excluding others: All manufacturing, milling, mining, quarrying, building, construction and industrial works and operations; development and utilization of every kind of power; the acquirement, construction, use, operation, sale and other disposition of all kinds of machinery, plants, factories, warehouses, elevators, buildings and other structures, bridges, wharves, docks, slips, dams, power works, water works, boats, ships, engines, cars, equipment and appliances, whether in connection with said business or otherwise, and generally the utilization of all instrumentalities, methods, processes and appliances, in all ways and by all means now known or which may hereafter be discovered or invented.

(*g*) To apply for, obtain, register, purchase, lease or otherwise to acquire, and to hold, use, own, operate and introduce, and to sell, assign or otherwise to dispose of any trademarks, trade names, brands, copyrights, concessions, patents, inventions, formulae, improvements and processes used in connection with or secured under letters patent of the United States, or any other country, or otherwise, and to use, exercise, develop, grant licenses in respect of, or otherwise to turn to account any such trademarks, copyrights, concessions, patents, licenses, processes and the like, or any such property or rights.

(*h*) To subscribe or cause to be subscribed for, and to purchase or otherwise acquire, hold for investment, or otherwise, sell, assign, transfer, mortgage, pledge, exchange, distribute or otherwise dispose of the whole or any part of the shares of the capital stock, bonds, coupons, mortgages, deeds of trust, debentures, securities, obligations, evidences of indebtedness, notes, goodwill, rights,

assets and property of any and every kind whatsoever, or any part thereof of itself or any other corporation or corporations, stock companies, association or associations, now or hereafter existing, and whether created by or under the laws of the State of Delaware, or of any other state, district, territory or colony of the United States, or any other country or otherwise, and to use, operate, manage and control such properties or any of them, either in the name of such other corporation or corporations, stock company or association, or in the name of this corporation, and while owners of any of said shares of capital stock or bonds or other property to exercise all the rights, powers and privileges of ownership of every kind and description, including the right to vote thereon, with power to designate some person for that purpose from time to time to the same extent as natural persons might or could do.

(*i*) To endorse, guarantee and secure the payment and satisfaction of the bonds, coupons, mortgages, deeds of trust, debentures, securities, obligations, evidences of indebtedness, and shares of the capital stock of other corporations, and also to guarantee and secure the payment or satisfaction of dividends on shares of the capital stock of other corporations; also to undertake the whole or any part of the assets and liabilities, existing or prospective, of any person, firm or association, also to procure any other person or corporation to assume any such obligation or obligations.

(*j*) Without in any particular limiting any of the objects and powers of the corporation, it is hereby expressly declared and provided that the corporation shall have power to do all the things hereinbefore enumerated, and also to issue or exchange stock, bonds and other obligations in payment for property purchased or acquired by it, or for any other object in or about its business; to borrow money without limit; to mortgage or pledge its franchises, real or personal property, income and profits accruing to

it, any stocks, bonds or other obligations, or any property which may be acquired by it; to secure any bonds or other obligations by it issued or incurred; to guarantee any dividends, or bonds, or contracts, or other obligations; to make and perform contracts of any kind and description, and in carrying on its business, or for the purpose of attaining or furthering any of its objects, to do any and all other acts and things, and to exercise any and all other powers which a co-partnership or natural person could do and exercise, and which now or hereafter may be authorized by law in any part of the world.

(*k*) To carry on any business whatsoever which the corporation may deem proper or convenient in connection with any of the foregoing purposes or otherwise, or which may be calculated directly or indirectly to promote the interests of the corporation or to enhance the value of its property; and it is the purpose of the corporation from time to time to do any one or more of the acts and things herein set forth; and it may conduct its business in other states, in the territories, the District of Columbia, the colonies and dependencies and in foreign countries and places; it may have one office or more than one office and keep the books of the company outside the State of Delaware, except as otherwise provided by law.

Fourth: — The total authorized stock of the corporation is as follows:

The total number of shares of all classes of stock which the corporation shall have authority to issue shall be Nine Hundred Twenty-Three Million (923,000,000), of which Twenty-Three Million (23,000,000) shares shall be Preferred Stock without par value and Nine Hundred Million (900,000,000) shares shall be Common Stock having a par value of Sixty Cents ($0.60) each.

I. The Preferred Stock may be issued from time to time in one or more series, each of such series to have such

designation, preferences and relative, optional or other rights, and qualifications, limitations or restrictions thereof, as are stated and expressed herein, or in a resolution or resolutions providing for the issue of such series adopted by the Board of Directors as hereinafter provided.

II. (*a*) The 1,688,850 shares of the corporation's Preferred Stock issued and outstanding on April 25, 1947, shall constitute a series of Preferred Stock, designated as "Preferred Stock—$4.50 Series" (hereinafter sometimes called the "$4.50 Series Stock"). The Board of Directors may from time to time authorize the issuance of additional shares of Preferred Stock as $4.50 Series Stock.

(*b*) The shares of $4.50 Series Stock shall bear dividends at the rate of Four Dollars and Fifty Cents ($4.50) per annum from and after April 25, 1947, provided, however, that any shares of said Series issued after April 25, 1947 shall bear dividends from and after such date or dates as the Board of Directors from time to time may determine.

(*c*) In the event of any liquidation or dissolution or winding-up of the corporation, whether voluntary or involuntary, the Preferred Stock—$4.50 Series shall entitle the holders thereof to be paid, in the event of any involuntary liquidation or dissolution or winding-up of the corporation, One Hundred Dollars ($100.00) per share with all unpaid accumulated dividends thereon to the date of such payment or, in the event of any voluntary liquidation or dissolution or winding-up of the corporation, One Hundred Fifteen Dollars ($115.00) per share with all

unpaid accumulated dividends thereon to the date of such payment.

(*d*) The Preferred Stock—$4.50 Series shall be subject to redemption on or before April 25, 1952 at One Hundred Twenty-five Dollars ($125.00) per share and accumulated dividends thereon to the date of redemption, and thereafter at One Hundred Twenty Dollars ($120.00) per share and accumulated dividends thereon to the date of redemption, upon the terms and in the manner as hereinafter provided.

III. Authority is hereby expressly granted to the Board of Directors of the corporation, subject to the provisions of this Article FOURTH, to authorize the issue of one or more series of Preferred Stock in addition to the $4.50 Series and with respect to each such series to fix by resolution or resolutions providing for the issue of such series:

(*a*) The number of shares to constitute such series and the distinctive designation thereof;

(*b*) The dividend rate on the shares of such series and the date or dates from which dividends shall accumulate;

(*c*) The amount per share over and above any accumulated dividends thereon which the shares of such series shall be entitled to receive upon redemption;

(*d*) The amount per share over and above accumulated dividends which such series shall be entitled to receive (1) upon involuntary liquidation or dissolution or winding-up of the corporation, which amount shall not exceed $100.00 a share, and (2) upon voluntary liquidation or dissolution or winding-up of the corporation; and

(*e*) The rights, if any, which the shares of such series may have for conversion into shares of any other class or classes or any other series of the same or any other class or classes of stock of the corporation.

All shares of any one series of Preferred Stock shall be identical with each other in all respects, except that shares of any one series issued at different times may differ as to the dates from which the initial dividends thereon shall accumulate; and all series shall rank equally and be identical in all respects, except as permitted in the foregoing provisions of this Section III.

IV. The Preferred Stock shall entitle the holders thereof to receive, when and as declared from the surplus or net earnings of the corporation, cumulative dividends, payable quarterly on such dates as the Board of Directors may determine, at the rates fixed herein or fixed by the Board of Directors for the respective series, as herein provided, and no more, which dividends shall be paid or set apart before any dividend shall be set apart or paid on the Common Stock. The dividend payment dates for all series of Preferred Stock shall be the same and no dividends shall be declared on any series in respect of any quarterly dividend payment unless there shall likewise be or have been declared on all shares of Preferred Stock of each other series at the time outstanding like proportionate dividends ratably in proportion to the respective annual dividend rates fixed therefor.

V. In the event of any liquidation or dissolution or winding-up of the corporation, whether voluntary or involuntary, the Preferred Stock shall entitle the holders thereof to be paid the amounts fixed herein or fixed by the Board of Directors for the respective series as herein provided, including all unpaid accumulated dividends thereon to the date of such payment, before any amount

shall be paid to the holders of the Common Stock of the corporation.

Such payments to the holders of the Preferred Stock shall be made without preference or priority of one series over any other series and shall be made before any amount shall be paid to the holders of the Common Stock. If the assets of the corporation distributable upon any such liquidation or dissolution or winding-up of the corporation shall be insufficient to permit the payments to the holders of the Preferred Stock of the full amounts above provided for, including an amount equivalent to all unpaid accumulated dividends as aforesaid, the said assets shall be allocated to the respective series of Preferred Stock in the ratios that such aggregate liquidation value of the issued shares of each series bears to the aggregate liquidation value of the issued shares of all series of Preferred Stock as fixed for the respective series of Preferred Stock in the Certificate of Incorporation or in the resolution or resolutions of the Board of Directors providing for the issuance of the respective series, and shall be distributed among the holders of the respective series of Preferred Stock according to their respective shares.

VI. The Preferred Stock of any series shall be subject to redemption at any time in whole or in part at the amount fixed herein, or fixed by the Board of Directors as herein provided, for the redemption of such series including an amount equivalent to all unpaid accumulated dividends thereon, upon not less than sixty days' notice addressed to the respective holders of record of the stock to be redeemed at their addresses as the same shall appear on the stock transfer records of the corporation in such manner as the Board of Directors shall determine.

VII. The holders of the Preferred Stock shall have no voting power on any questions whatsoever except as otherwise provided by law, and except that in the event

that the corporation shall fail to pay any dividend on the Preferred Stock when it regularly becomes due and such default shall continue for the period of six (6) months, then until but not after such time as accumulated and unpaid dividends on all outstanding Preferred Stock of all series shall have been paid, the holders of the outstanding Preferred Stock shall have the exclusive right, voting separately and as a class, to elect two directors or, if the total number of directors of the corporation be only three, then only one director, at each meeting of the stockholders of the corporation held for the purpose of electing directors. At all meetings of stockholders held for the purpose of electing directors at which the holders of Preferred Stock shall have the exclusive right, voting separately and as a class, to elect any directors as aforesaid, the presence in person or by proxy of the holders of a majority of the oustanding shares of Preferred Stock shall be required to constitute a quorum of such class for the election of any directors by holders of Preferred Stock, as a class, provided, however, that the absence of a quorum of the holders of Preferred Stock shall not prevent the election at any such meeting or adjournment thereof of the remaining directors for whose election a class vote of the holders of Preferred Stock is not required, if the necessary quorum of the stockholders entitled to vote in the election of such remaining directors is present in person or by proxy in accordance with the by-laws of the corporation; and provided further, that in the absence of a quorum of the holders of Preferred Stock, a majority of those holders of such Preferred Stock who are present in person or by proxy shall have power to adjourn the election of those directors to be elected by their class from time to time without notice other than announcement at the meeting until the requisite amount of holders of Preferred Stock shall be present in person or by proxy.

The holders of Common Stock shall have the right to

vote on all questions to the exclusion of all other stockholders except as hereinbefore specifically stated.

VIII. Whenever, at any time, full accumulated dividends as aforesaid for all past dividend periods and for the current dividend period shall have been paid, or declared and set apart for payment, on the then outstanding Preferred Stock, the Board of Directors may declare dividends on the Common Stock of the corporation.

IX. Upon any liquidation or dissolution or winding-up of the corporation, whether voluntary or involuntary, the assets and funds of the corporation remaining, after the payments have been made to the holders of the Preferred Stock, as provided in Section V hereof, shall be divided and paid to the holders of the Common Stock according to their respective shares.

X. From time to time the Preferred Stock or the Common Stock may be increased according to law.

XI. From time to time the Preferred Stock and the Common Stock may be issued in such amounts and proportions and for such consideration as may be fixed by the Board of Directors, or, in the case of Common Stock issued upon the exercise of the options referred to in Section XIII hereof, as provided in such Section.

XII. No stockholder of the corporation, of whatever class or series, shall have any preemptive or preferential right of subscription to any shares of any series of the Preferred Stock of the corporation, authorized hereunder or under any amendment hereof, or to any obligations convertible into said Preferred Stock of any series of the corporation, issued or sold, nor any right of subscription to any thereof other than such, if any, as the Board of Directors of the corporation in its discretion from time to time may determine, and the Board of Directors may issue said Preferred Stock of any series of the corporation, or

obligations convertible into said Preferred Stock of any series, without offering said Preferred Stock, or said obligations, either in whole or in part, to any stockholders of the corporation.

No holder of any shares of the Preferred Stock of any series of the corporation shall have any preemptive or preferential right of subscription to any shares of stock of any class of the corporation, or to any obligations convertible into shares of stock of any class of the corporation, issued or sold, nor any right of subscription to any thereof other than such, if any, as the Board of Directors of the corporation in its discretion from time to time may determine.

XIII. The Board of Directors may create and issue to employees (including officers and directors) of this corporation, or of any corporation in which this corporation shall directly or indirectly own fifty per cent or more of the voting stock, options to purchase the corporation's Common Stock in accordance with the terms of any duly adopted compensation plan. The shares of stock so optioned may be unissued, or issued and reacquired shares of Common Stock of the corporation, as shall be determined by the Board of Directors, and the Board shall have power to take all action necessary and appropriate in connection with any such issuance or sale of shares. The options shall be evidenced by such instruments as shall be approved by the Board of Directors. The terms upon which, the time or times at or within which, and the consideration for which such options may be issued, and for which any shares of stock may be issued or sold by the corporation upon the exercise of such options, shall be such as shall be stated in the resolution or resolutions adopted by the Board of Directors providing for the creation and issuance of such options and, in every case, set forth or incorporated by reference in the instrument or instruments evidencing

such options. The judgment of the Board of Directors as to the consideration and sufficiency thereof for the issuance of such options and for the issuance or sale of stock pursuant to the exercise thereof shall be conclusive.

Any standing committee duly designated by resolution passed by a majority of the whole Board of Directors and consisting of two or more of the directors, shall have and may exercise any or all of the rights, powers and functions of the Board of Directors specified in this Section XIII, or otherwise pertaining to any duly adopted compensation plan, to the extent provided in a resolution passed by a majority of the whole Board or in the By-Laws of the corporation.

XIV. The amount of capital stock with which this corporation will commence business is Seventy-five Hundred Dollars ($7500).

Fifth:—The names and places of residence of each of the original subscribers to the capital stock and the number of shares subscribed for by each are as follows:

Name	*Residence*	*Number of Shares*
Pierre S. du Pont	Christiana Hundred, Delaware,	25
John J. Raskob	Brandywine Hundred, Delaware,	25
John P. Laffey	Wilmington, Delaware,	25

Sixth:—The corporation is to have perpetual existence.

Seventh:—The private property of the stockholders shall not be subject to the payment of corporate debts to any extent whatever.

Eighth:—The number of the directors of the corporation shall be fixed from time to time by the by-laws and the number may be increased or decreased as therein provided.

In case of any increase in the number of directors the additional directors shall be elected as provided by the By-laws by the directors or by the stockholders at an annual or special meeting.

In case of any vacancy in the Board of Directors for any cause the remaining Directors by affirmative vote of a majority of the whole Board of Directors may elect a successor to hold office for the unexpired term of the Director whose place is vacant and until the election of his successor.

In furtherance, but not in limitation of the powers conferred by law, the Board of Directors are expressly authorized:

(*a*) To hold their meetings outside of the State of Delaware at such places as from time to time may be designated by the By-laws or by resolution of the Board. The By-laws may prescribe the number of directors necessary to constitute a quorum of the Board of Directors, which number may be less than a majority of the whole number of directors.

(*b*) To appoint the regular officers of the corporation, and such other officers as they may deem necessary for the proper conduct of the business of the Company.

(*c*) To remove at any time any officer elected or appointed by the Board of Directors but only by the affirmative vote of a majority of the whole Board of Directors.

(*d*) To remove any other officer or employe of the corporation or to confer such power on any committee or superior officer of the corporation, unless such removals are otherwise regulated by the By-laws.

(*e*) To appoint standing committees by the affirmative vote of a majority of the whole Board, and such standing committees shall have and may exercise such powers as shall be conferred or authorized by the By-Laws.

(*f*) To issue the stock of every class in such amounts and proportions as they may determine up to the total amount of the authorized capital stock or any increase thereof, subject, however, to the provisions of this certificate.

(*g*) From time to time to fix and determine and to vary the sum to be reserved over and above its capital stock paid in as working capital before declaring any dividends among its stockholders; to direct and determine the use and disposition of any surplus or net profits over and above the capital stock paid in; to fix the time of declaring and paying any dividend, and, unless otherwise provided in the By-laws, to determine the amount of any dividend. All sums reserved as working capital or otherwise may be applied from time to time to the acquisition or purchase of its bonds or other obligations or shares of its own capital stock or other property to such extent and in such manner and upon such terms as the Board of Directors shall deem expedient, and neither the stock, bonds or other property so aequired shall be regarded as accumulated profits for the purpose of declaring or paying dividends unless otherwise determined by the Board of Directors, but shares of such capital stock so purchased or acquired may be resold, unless such shares shall have been retired for the purpose of decreasing the Company's capital stock as provided by law.

(*h*) From time to time to determine whether and to what extent, and at what times and places, and under what conditions and regulations the accounts and books of the

corporation, or any of them, shall be open to the inspection of the stockholders, and no stockholders shall have any right to inspect any account or book or document of the corporation, except as conferred by statute or authorized by the Board of Directors or by a resolution of the stockholders.

(*i*) Subject always to By-laws made by the stockholders, to make By-laws; and, from time to time, to alter, amend or repeal any By-laws; but any By-laws made by the Board of Directors may be altered or repealed by the stockholders at any annual meeting, or at any special meeting, provided notice of such proposed alteration or repeal be included in the notice of the meeting.

(*j*) With the written assent, without a meeting of the holders of two-thirds of its stock, or pursuant to the affirmative vote, in person or by proxy, at any meeting called as provided in the By-laws, of the holders of two-thirds of its stock, issued and outstanding, the Board of Directors may sell, convey, assign, transfer or otherwise dispose of, the property, assets, rights and privileges of the corporation as an entirety, for such consideration and on such terms as they may determine.

Ninth: — A director of the corporation shall not be personally liable to the corporation or its stockholders for monetary damages for breach of fiduciary duty as a director, except for liability (i) for any breach of the director's duty of loyalty to the corporation or its stockholders, (ii) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (iii) under Section 174 of the General Corporation Law of Delaware, or (iv) for any transaction from which the director derived any improper personal benefit. If the General Corporation Law of Delaware is amended after approval by the stockholders

of this article to authorize corporate action further eliminating or limiting the personal liability of directors, then the liability of a director of the corporation shall be eliminated or limited to the full extent permitted by the General Corporation Law of Delaware, as so amended.

Any repeal or modification of the foregoing paragraph by the stockholders of the corporation shall not adversely affect any right or protection of a director of the corporation existing at the time of such repeal or modification.

4. This Restated Certificate of Incorporation was duly adopted by the Board of Directors in accordance with Section 245 of the General Corporation Law of the State of Delaware.

5. This Restated Certificate of Incorporation shall be effective at 5:00 p.m. Eastern Standard Time on December 22, 1989.

IN WITNESS WHEREOF, said E. I. du Pont de Nemours and Company has caused this certificate to be signed by John F. Schmutz, its Senior Vice President and General Counsel, and attested by Roger W. Arrington, its Secretary, this 21st day of December, 1989.

E. I. DU PONT DE NEMOURS AND COMPANY

By: JOHN F. SCHMUTZ

Senior Vice President and General Counsel

ATTEST:

By: R. W. ARRINGTON

Secretary

I hereby certify that the within and foregoing is a true and correct copy of the Restated Certificate of Incorporation of E. I. du Pont de Nemours and Company.

Witness my hand and the corporate seal of the Company this day of 19 .

Secretary

PREFERRED STOCK—$3.50 SERIES

Certificate Authorizing the Issue of Preferred Stock—$3.50 Series	Filed April 30, 1947
Certificate Decreasing the Number of Authorized Shares of Preferred Stock—$3.50 Series	Filed July 6, 1955

CERTIFICATE SETTING FORTH COPY OF RESOLUTION OF THE BOARD OF DIRECTORS OF E. I. DU PONT DE NEMOURS AND COMPANY ESTABLISHING AND AUTHORIZING THE ISSUE OF A NEW SERIES OF PREFERRED STOCK DESIGNATED "PREFERRED STOCK — $3.50 SERIES".

(Pursuant to Section 13 of the General Corporation Law of the State of Delaware and of the Certificate of Incorporation, as amended, of E. I. du Pont de Nemours and Company)

We, W. J. Beadle, a Vice-President, and W. F. Raskob, Secretary, of E. I. du Pont de Nemours and Company, a corporation of the State of Delaware, do hereby certify under the seal of said Corporation as follows:

That at a special meeting of the Board of Directors of the Corporation duly called for the consideration of the resolutions hereinafter set forth and on notice thereof duly given in accordance with the By-Laws of the Corporation and with the laws of the State of Delaware, and held on April 29, 1947, and pursuant to power and authority expressly vested in the Board of Directors by the provisions of the General Corporation Law of the State of Delaware and Article FOURTH of the Certificate of Incorporation, as amended, of E. I. du Pont de Nemours and Company, the Board of Directors duly adopted the following resolutions:

"RESOLVED that the Board of Directors hereby establishes and authorizes the issue of a new series of Preferred Stock without par value of the corporation and hereby fixes the designation, the number of shares to be issued, the dividend rate, the redemption price and the amount payable upon liquidation or dissolution or winding-up of the corporation with respect to such new series of Preferred Stock without par value

as follows, such attributes to be in addition to the other provisions set forth in Article Fourth of the Certificate of Incorporation as amended, which are applicable to all shares of Preferred Stock without par value irrespective of any variations between the shares of Preferred Stock without par value of the different series:

(*a*) The new series of Preferred Stock without par value established by this resolution is hereby designated Preferred Stock—$3.50 Series;

(*b*) Preferred Stock—$3.50 Series be and hereby is authorized to be issued in the amount of 1,000,000 shares;

(*c*) The dividend rate on the Preferred Stock—$3.50 Series shall be $3.50 per share per annum and no more, and dividends on the 1,000,000 shares of Preferred Stock—$3.50 Series herein authorized to be issued shall accumulate from and after April 25, 1947;

(*d*) The amount per share over and above any accumulated dividends thereon which the shares of Preferred Stock—$3.50 Series shall be entitled to receive upon redemption is as follows: if redeemed on or before April 25, 1952, $107.00 a share; thereafter on or before April 25, 1955, $106.00 a share; thereafter on or before April 25, 1958, $105.00 a share; thereafter on or before April 25, 1961, $104.00 a share; thereafter on or before April 25, 1964, $103.00 a share; and thereafter, $102.00 a share; and

(*e*) The amount per share over and above accumulated dividends which the shares of Preferred Stock—$3.50 Series shall be entitled to receive upon involuntary liquidation or dissolution or winding-up of the corporation is

$100.00 a share, and upon voluntary liquidation or dissolution or winding-up of the corporation is $107.00 a share.

FURTHER RESOLVED that a certificate setting forth a copy of the foregoing resolution providing for the establishment and issue of 1,000,000 shares of Preferred Stock—$3.50 Series shall be made under the seal of the corporation, signed by the President or a Vice-President and by the Secretary or an Assistant Secretary of the corporation, acknowledged by such President or Vice-President before an officer authorized by the laws of Delaware to take acknowledgments of deeds, and shall be filed and a copy thereof shall be recorded pursuant to and in the manner provided pursuant to and in the manner provided by Section 13 of the Delaware Corporation Law."

IN WITNESS WHEREOF, we have hereunto signed this certificate and have caused the corporate seal of the Corporation to be hereunto affixed this 29th day of April, A. D. 1947.

E. I. DU PONT DE NEMOURS AND COMPANY

By: W. J. BEADLE
Vice-President

Attest:
W. F. RASKOB
Secretary

E. I. DU PONT DE NEMOURS AND CO.
FOUNDED 1802
SEAL
DELAWARE

STATE OF DELAWARE }
COUNTY OF NEW CASTLE } SS

BE IT REMEMBERED, that on this 29th day of April, A. D. 1947, before the subscriber, a Notary Public in and for the State and County aforesaid, authorized by the laws of Delaware to take acknowledgments of deeds, personally appeared W. J. BEADLE, Vice-President of E. I. du Pont de Nemours and Company, the Corporation mentioned in and which executed the foregoing Certificate, known to me personally to be such, and he, the said W. J. BEADLE, as such Vice-President, acknowledged the said Certificate to be his act and deed and the act and deed of said Corporation, and that the seal thereto affixed is the common and corporate seal of said Corporation duly affixed by its authority, and that his act of executing, acknowledging and delivering said Certificate was duly authorized by the Board of Directors of said Corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this Certificate above written.

J. H. CASSIDY
Notary Public
Appointed July 3, 1946
For Two Years
Delaware

J. H. CASSIDY
Notary Public

CERTIFICATE SETTING FORTH COPY OF RESOLUTION OF THE BOARD OF DIRECTORS OF E. I. DUPONT DE NEMOURS AND COMPANY DECREASING THE AUTHORIZED NUMBER OF SHARES OF PREFERRED STOCK—$3.50 SERIES FROM ONE MILLION SHARES TO SEVEN HUNDRED THOUSAND SHARES.

(Pursuant to Section 151(g) of the General Corporation Law of the State of Delaware and the Certificate of Incorporation, as amended, of E. I. du Pont de Nemours and Company)

WE, L. du P. Copeland, a Vice-President, and F. G. Hess, Assistant Secretary, of E. I. du Pont de Nemours and Company, a corporation of the State of Delaware, DO HEREBY CERTIFY under the seal of said Corporation as follows:

That at a meeting of the Board of Directors of the Corporation duly called, and held on the 20th day of June, 1955, in accordance with the By-Laws of the Corporation and with the laws of the State of Delaware, and pursuant to power and authority expressly vested in the Board of Directors by the provisions of the General Corporation Law of the State of Delaware and Article Fourth of the Certificate of Incorporation, as amended, of E. I. du Pont de Nemours and Company, the Board of Directors duly adopted the following resolution:

"RESOLVED, by the Board of Directors of this Company that pursuant to authority expressly vested in it by the provisions of this Company's Certificate of Incorporation, as amended, the Series of 1,000,000 shares of Preferred Stock, without par value, designated 'Preferred Stock— 3.50 Series' (provided for in a resolution of the Board of Directors of this Company adopted April 29, 1947 and a certificate therefor duly

filed and a copy thereof duly recorded) shall be and stand decreased by 300,000 shares of said 'Preferred Stock—$3.50 Series', that have been duly retired and are not now outstanding, to 700,000 shares thereof by a certificate hereby authorized and directed to be made, signed, acknowledged and filed, and a copy thereof recorded in accordance with the provisions of Title 8, Section 151 of the Revised Code of Delaware of 1953, setting forth a statement that a decrease in said Series of 1,000,000 shares of 'Preferred Stock—$3.50 Series' by 300,000 shares thereof not now outstanding, to 700,000 shares of said 'Preferred Stock—$3.50 Series' without par value, had been authorized and directed by a resolution duly adopted by the Board of Directors of this Company on the 20th day of June, 1955."

IN WITNESS WHEREOF, we have hereunto signed this certificate and have caused the corporate seal of the Corporation to be hereunto affixed this 20th day of June, A. D. 1955.

E. I. DU PONT DE NEMOURS AND COMPANY

By: L. DU P. COPELAND
Vice-President

Attest:
F. G. HESS
Asst. Secretary

E. I. DU PONT DE NEMOURS AND CO.
FOUNDED 1802
SEAL
DELAWARE

STATE OF DELAWARE
COUNTY OF NEW CASTLE } SS.

BE IT REMEMBERED, that on this 20th day of June, A.D. 1955, before the subscriber, a Notary Public in and for the State and County aforesaid, authorized by the laws of Delaware to take acknowledgments of deeds, personally appeared L. DU P. COPELAND, Vice-President of E. I. du Pont de Nemours and Company, the Corporation mentioned in and which executed the foregoing Certificate, known to me personally to be such, and he, the said L. DU P. COPELAND, as such Vice-President, acknowledged the said Certificate to be his act and deed and the act and deed of said Corporation, and that the seal thereto affixed is the common and corporate seal of said Corporation duly affixed by its authority, and that his act of executing, acknowledging and delivering said Certificate was duly authorized by the Board of Directors of said Corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this Certificate above written.

RICHARD H. TALLANT
Notary Public
Appointed October 5, 1953
For Two Years
Delaware

RICHARD H. TALLANT
Notary Public

Exhibit C

Remedial Investigation Report
LCP Chemicals, Inc. Superfund Site
Linden, New Jersey
Volume I of V
Report Text

Prepared for
ISP Environmental Services, Inc.
500 Hercules Road
Wilmington, Delaware 19808-1599

Revised October 2013
July 2013

Project Number: 137005

Brown AND Caldwell
2 Park Way, Suite 2A
Upper Saddle River, New Jersey 07458

693610

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Executive Summary

The LCP Chemicals, Inc. Superfund Site (LCP site) Remedial Investigation (RI) is reported herein. The RI field investigation has been performed in two phases under the regulatory and technical oversight of the USEPA, with a further adjunct investigation of two off-site ditches located adjacent to the site. This report includes a comprehensive characterization of the nature and extent of contamination on the site in addition to assessments of risk to human health and the environment.

This RI Report represents a revision of the version that was submitted in July 2013 and was subsequently approved by USEPA on August 12, 2013. The revisions made herein do not reflect any changes in content from the July 2013 and have been made solely to correct minor typographical errors and also updates to the document format.

Site History

The LCP site is a former chemical manufacturing plant located on an approximate 26 acre property. The site was developed in the early 1950s for the production of chlorine by the brine cell process (mercury cathode carbon anode) also known as the chlor-alkali process. Chlorine manufacturing operations commenced in 1955 and continued until the plant was shut down in 1985. Related operations, including a hydrogen gas processing plant and sodium hypochlorite manufacturing area were also located on the site. While the plant was initially developed and operated by GAF beginning in 1955, the facility was sold to LCP in 1972 and was expanded and operated by LCP until 1985. Activities continued on site (by LCP and others) until 2000.

Hanlin Group, Inc., d.b.a. LCP, filed a petition under Chapter 11 of the bankruptcy code in 1991 and liquidated all of its assets before April 1994 using the proceeds to pay creditors including the USEPA. The Linden, New Jersey property was abandoned by Hanlin Group pursuant to an order of the Bankruptcy court and ownership reverted back from the bankruptcy estate. Title to the property is currently listed as LCP-Chemicals New Jersey, a d.b.a. for Hanlin. Hanlin is a defunct corporate entity. The facility has remained abandoned since 2000.

The site was placed onto the National Priority List (NPL) in 1998. A voluntary Administrative Order was entered into by the USEPA and ISP-ESI in 1999 to perform a Remedial Investigation and Feasibility Study (RI/FS). ISP Environmental Services Inc. (ISP-ESI) is currently the only potentially responsible party, among several, that has cooperated with USEPA to address the site.

The LCP site has a complex history of industrial ownership. The north-central and eastern portions of the property were owned and developed by various companies preceding GAF dating back to the 1880s. Other portions of the property were previously owned by E.I. duPont de Nemours and Central Railroad of New Jersey (now Conrail).

The entire area of the LCP site and nearly all of the surrounding area was historically tidal wetlands. It was necessary to raise the elevation prior to the historic development of these areas for industrial and other uses through the placement of anthropogenic fill. The filling of the property occurred during the prior ownership of the property, before the development of the LCP site in 1955.

The site has been zoned for "heavy industrial use" and continues as such as do the surrounding properties. It is anticipated that the upland portion of the site could possibly be re developed into another industrial use, such as warehousing, transportation or electric power generation.

Contamination Sources

The RI results are summarized by the finding of the widespread presence of mercury in various environmental media as a result of manufacturing activities at the LCP site. Other contaminants potentially related to chlorine production are also found, including hexachlorobenzene (HCB), polychlorinated naphthalenes (PCNs), and polychlorinated dibenzo furans (PCDFs). Polychlorinated biphenyls (PCBs) are also a site-related constituent due their potential presence in electrical equipment on the site. Each of these other site-related constituents is present at levels much less than those of mercury. These other site-related contaminants are co-located with mercury; however the frequency and magnitude of exceedances of soil remediation standards is, respectively, less than that of mercury.

Contamination is also present as a result of the prior placement of anthropogenic fill materials. Contaminants that are ubiquitous in fill materials include metals/metalloids (e.g., lead, chromium, and arsenic), and polycyclic aromatic hydrocarbons (PAHs) as a result of the common practice of using combustion residues (e.g., coal ash and slag) as fill. Other contaminants in the anthropogenic fill are consistent with sources of industrial fill from neighboring properties (e.g., duPont, GAF) and include arsenic and chlorobenzenes. Other various chemicals, including dioxins, are also found from regional sources such as air deposition and sediment transport.

Contamination Conditions

The surficial fill at the LCP site is impacted primarily with mercury which is widely distributed throughout the site. This contamination includes some visual observations of elemental mercury in areas surrounding the main production buildings. However, the horizontal and vertical migration of mercury and other site-related constituents is relatively limited and the underlying soils contain concentrations that are lower than those in the overlying fill.

Groundwater contamination at the site results from the dissolution of the various contaminants from site soils (both LCP related and fill related). Groundwater contamination, however, shows minimal migration either horizontally or laterally and is not moving off site to any significant extent. In addition, groundwater at the site is non-potable as the result of naturally occurring saline conditions. Since the groundwater is saline, alternative groundwater quality criteria (AGWQC) are relevant at the site, and site-specific AGWQC have been developed.

Sediments and low marsh soils in South Branch Creek (an on-site, man-made tidal ditch) are contaminated with mercury and other constituents, especially in the "upstream" areas. The contamination decreases with distance from the manufacturing area of the site and is essentially at background levels where South Branch Creek meets the Arthur Kill. Similar contaminated sediment conditions are observed in the Northern Off-Site Ditch Sediments, albeit at lower concentrations than South Branch Creek. The sediment contamination in South Branch Creek and the Northern Off-Site Ditch do not appear to be due to ongoing sources. Biological specimens (fish and crabs) collected in South Branch Creek contain elevated concentrations of mercury and other constituents compared with those collected in a nearby area.

The Human Health Risk Assessment (HHRA) indicated that exposure to soil and soil vapor by future commercial/industrial workers, site-specific workers, and construction/utility workers may result in adverse non-cancer effects; exposure to soil by future commercial/industrial workers may also result in adverse cancer effects. Dermal contact with groundwater by construction/utility workers has the potential to result in adverse non-cancer effects. Potential non-cancer hazards in soil and soil vapor were driven by mercury; potential non-cancer hazards in groundwater were driven by furans and manganese. No unacceptable cancer or non-cancer risks were identified for current/future trespassers

exposed to sediment/bank soil in South Branch Creek. Hypothetical use of groundwater for potable purposes was also evaluated to support remedial decision-making and risk management; the HHRA indicated future potable use of groundwater by commercial/industrial workers may result in adverse cancer and non-cancer effects.

The Baseline Ecological Risk Assessment (BERA) indicated that contaminants in South Branch Creek sediment, primarily arsenic, barium, and mercury, have the potential to result in adverse ecological effects to benthic macroinvertebrates and sediment-probing birds. Potential ecological risks were also identified for terrestrial mammals (insectivores) and birds (invertivores and, to a lesser extent, carnivores) potentially exposed to contaminants in upland soil, driven primarily by mercury and hexachlorobenzene. However, the former facility offers limited ecological habitat for these receptors as the majority of the Site is paved or occupied by structures.

Section 1

Introduction

This report presents the findings of a multi-phased Remedial Investigation (RI) performed at the LCP Chemicals, Inc. Superfund Site located in Linden, New Jersey. The initial phase (Phase I) of the RI was performed in 2001-2002 and was reported in the document titled, "Site Characterization Summary Report, LCP Chemicals Superfund Site, Linden, New Jersey", (Brown and Caldwell, August 2002). The Phase II RI field investigation was performed during 2006-2007 and the data was reported in the document titled, "Phase II Site Characterization Summary Report, LCP Chemicals Superfund Site, Linden, New Jersey, (Brown and Caldwell, September 2007). In addition an adjunct investigation to the RI was performed in 2011 on the two off-site ditches, in response to EPA comments on the draft RI Report (Brown and Caldwell, September 2008). The RI Report, presented herein, provides a comprehensive presentation and analysis of the RI data.

This RI Report represents a revision of the version that was submitted in July 2013 and was subsequently approved by USEPA on August 12, 2013. The revisions made herein do not reflect any changes in content from the July 2013 and have been made solely to correct minor typographical errors and also updates to the document format.

1.1 Authority

The site was placed onto the National Priority List (NPL) in 1998. On May 13, 1999, Administrative Order No. II CERCLA 02 99 2015 (hereinafter referred to as the Order) was entered into voluntarily by the United States Environmental Protection Agency (USEPA) and ISP Environmental Services Inc. (ISP-ESI). ISP-ESI is currently the only potentially responsible party, among several, that has cooperated with USEPA to address the site. The stated purpose of the Order was to:

"(a)... conduct a remedial investigation ("RI") to determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants at or from the Site; (b) to determine and evaluate alternatives, through the conduct of a feasibility study ("FS"), to remediate said release or threatened release of hazardous substances, pollutants, or contaminants; (c) to provide for the reimbursement to EPA of response and oversight costs incurred by EPA with respect to the Site; and (d) to provide for reimbursement to EPA of response costs incurred by EPA at the Site prior to the effective date of this Consent Order."

In accordance with the provisions of Section VII.25.H of the Order, the RI Report is hereby submitted. The RI report provides an analysis of the horizontal and vertical extent of mercury and other site constituents at the site in the various site media. The RI field investigation and reporting were performed by Brown and Caldwell from 2001 through 2008 under contract to and on behalf of ISP-ESI. The scope of the initial phase of the RI field investigation was performed in accordance with the USEPA-approved Work Plan documents described in Section 1.4.1. The technical objectives and scope of the Phase II RI field investigation was performed in accordance with the USEPA-approved Work Plan documents described in Section 1.4.2.

Baseline Human Health Risk Assessment (BHHRA) and Baseline Ecological Risk Assessment (BERA) have been performed in accordance with a pending amendment to the Administrative Order

Amendment. The BHHRA and BERA were performed by Geosyntec Consultants Inc. under contract to ISP-ESI and are summarized, herein. The full text of BHHRA and BERA reports are provided as Appendices P and Q, respectively.

1.2 Site Description

The LCP Chemicals, Inc. Superfund Site (hereinafter referred to as the LCP site) is located in the Tremley Point section of the City of Linden, Union County, New Jersey. The site is located along the western shore of the Arthur Kill and east of the New Jersey Turnpike as shown on Figures 1-1 and 1-2. It is accessed from the Road to Grasselli, which is reached from Linden via South Wood Avenue and Tremley Point Road. The coordinates of the approximate center of the site are Latitude 40.60832° and Longitude -74.21163°.

The site was formerly an industrial complex with chemical manufacturing operations. A mercury-cell, chlorine production (chlor-alkali) facility was operated at the site from 1955, until cessation of manufacturing operations in 1985, and included a mercury-cell chlorine process area, hydrogen gas processing plant, and sodium hypochlorite manufacturing area, as shown on Figure 1-3. The site was also used as a terminal for products produced at other facilities and various other industrial operations. In addition, a variety of tenants operated on site until the site was closed in August 1994.

The area surrounding the LCP site was historically developed for heavy industrial use, much of which is currently inactive and/or decommissioned. Primary current, active land use in the area is bulk storage and transport of petroleum products and aggregates.

Tidal wetlands are known to have existed historically in the area of the site. The placement of anthropogenic fill to raise the grade for industrial development is known to have occurred starting in the 1880s along the margins of the Arthur Kill.

1.3 Site History

1.3.1 Property Ownership

The real property parcels on which the LCP Chemicals, Inc. Superfund Site is located include City of Linden Block No. 587, Lots No. 3.01, 3.02, and 3.03. The land has a long and complex history of industrial use and property ownership. This ownership history has been researched by Keller & Kirkpatrick (2008) based on a detailed evaluation and reconstruction of the areas represented by various historic deeds that are available from public records from approximately 1909 to the present. Information regarding various property transfers and easements is presented on a series of maps by Keller & Kirkpatrick (Appendix A) and is summarized on Table 1-1. A description of the historic land ownership and easements is described on the basis of this research and on other available information.

1.3.1.1 Historic Land Ownership

The north central portion of the LCP site had a long history of industrial ownership starting in about 1880 with the Standard Chemical Works that was purchased by the Grasselli Chemical Company in 1889. Around 1924, the Grasselli Dyestuff Corporation, which is reported to have been a joint venture of Grasselli Chemical and Bayer AG, was incorporated under the laws of the State of Delaware.

The Grasselli Chemical Company transferred a number of large parcels to the Grasselli Dyestuff Company on October 20, 1928 which included, in part, the northern portion of what became the LCP property. Parallel property transfer records indicate duPont purchased the property in 1928. The

property transfer record indicates this same area was transferred by Grasselli Chemical Company to E.I. duPont de Nemours and Company (duPont) on November 30, 1928. In addition, a strip of property extending to the Arthur Kill east of the tracks was also transferred to Grasselli Dyestuff Company that would later be used for relocation of South Branch Creek.

Grasselli Dyestuff Corporation changed its name to General Aniline Works, Inc. on February 27, 1929. The company then changed its name to General Aniline & Film Corporation on October 30, 1939 and merged into American I.G. Chemical Corporation on October 31, 1939[1].

In 1942, the United States Justice Department seized American I.G. Chemical Corporation as a war asset. While under government control, the General Aniline & Film Corporation completed construction of a chlor-alkali (chlorine manufacturing) plant on the LCP site in 1955. In 1965 the U.S. Government sold the ownership of General Aniline & Film Corporation in a public stock offering. General Aniline & Film Corporation changed its name to GAF Corporation on April 24, 1968.

Other parcels in what became the LCP property were acquired separately. The central portion of the LCP property located west of the railroad tracks was owned by E.I. duPont de Nemours and Company prior to 1949 and transferred to General Aniline & Film Company in 1949. The southern portion of the LCP property located west of the railroad tracks was transferred from Central Railroad Company of New Jersey to General Aniline & Film Company in 1958. A narrow strip of land along what is now the current southern property line and extending to the extreme eastern tip was transferred from Central Railroad Company of New Jersey to General Aniline & Film Company in 1967.

GAF Corporation sold the LCP Site which included the chlor-alkali facility to Linden Chlorine Products, Inc. of Edison, New Jersey on August 24, 1972. LCP Chemicals and Plastics, Inc. conveyed its property to LCP Chemicals-New Jersey, Inc. on December 14, 1979. At some point, the company became known as LCP Chemicals, Inc., a division of the Hanlin Group, Inc.

1.3.1.2 Easements

Numerous easements have been established at the LCP site. These easements include various rights of way for physical access by road and rail to the LCP site, use of utility poles and other utilities, use of the flume and outfall ditch for wastewater drainage, easements for numerous underground and overhead utility lines not specifically related to the LCP site including a historic sanitary sewer trunk line; gas and petroleum transmission lines; water lines; electric lines, access to leaseholds within the LCP site property; and access to other neighboring properties. These easements are listed on Table 1-1.

1.3.1.3 Site Operation

GAF began the chlorine operation at the LCP site in 1955. By 1956, the core of the buildings required for the chlorine productions were present, including Buildings 220 and 230. GAF had stopped operation of the chlor-alkali manufacturing facility in 1971. Linden Chlorine Products, Inc., which was founded in 1972, purchased the site from GAF and subsequently resumed operation of the plant. Another mercury cell building (Building 240) and other site buildings were added by LCP in the early 1970s.

As of 1975, Linden Chlorine Products, Inc. reported that it owned no other manufacturing facilities and that only three products were produced – chlorine, sodium hydroxide, and hydrogen. By the early 1980's, the company had acquired additional chlor-alkali manufacturing facilities, including sites in Syracuse, New York, Moundsville, West Virginia, and Brunswick, Georgia.

[1] The merger into American I.G. Chemical Corporation in 1939 is reported in the deed research by Keller & Kirkpatrick. Other records suggest that ownership by American I.G. Chemical Corporation may have occurred in approximately 1928 or 1929.

Portions of the LCP site were leased to other companies for the operation of other related manufacturing operations at the site. In 1957, part of the property to the west, was leased to Union Carbide Corporation (UCC) to be used as a hydrogen plant utilizing the by-products of the chlorine plant and is known as the Linden Division hydrogen plant. UCC operated its plant through 1990. Kuehne Chemicals, Inc. leased the northern portion of the property in 1972 and opened a sodium hypochlorite manufacturing plant, which also distributed and sold chlorine.

The ownership of the Linden Chlorine Products, Inc. facility became LCP Chemicals-New Jersey, Inc., a subsidiary of Linden Chemicals & Plastics, Inc. The chlor-alkali manufacturing operations had ceased by 1985 and the facility was used as a terminal for products produced at other locations.

Hanlin Group, Inc., d.b.a. LCP, filed a petition under Chapter 11 of the bankruptcy code in 1991 and liquidated all of its assets before April 1994 using the proceeds to pay creditors including the USEPA. The Linden, New Jersey property was abandoned by Hanlin Group pursuant to an order of the Bankruptcy court and ownership reverted back from the bankruptcy estate. Title to the property is currently is listed as LCP-Chemicals New Jersey, a d.b.a. name for Hanlin. Hanlin was formerly incorporated in New Jersey but is now a defunct corporate entity.

In August 1994, the EPA conducted a site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional and that the site was vacated by LCP employees. Active Water Jet Inc., a pipe cleaning company, who was a tenant at the site since about the early 1990s, remained onsite until 2000. The facility has remained abandoned ever since.

1.3.2 Operations and Development

The text in this section has been adapted from the document titled "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000) and updated with information that has been obtained from other available sources. Much of the historic information presented, herein, is compiled from documents dating back to 1975 and earlier. Within these documents there are some contradictions concerning the past operations of the site. This problem is compounded by the fact that much of LCP Chemicals, Inc.'s records were lost or destroyed sometime in the 1980s (Eder, September 1993).

At the time of LCP Chemicals, Inc.'s mercury cell chlorine production, there were three main operating centers at the site; the mercury cell chlorine process area, the hydrogen gas processing plant, and the sodium hypochlorite manufacturing area. Materials needed for processing were shipped in by barge, rail, or by truck. Storage and distribution of chlorine and its related products (including methylene chloride and potassium hydroxide) occurred on this site throughout its history. The manufacturing operations were subject to periodic shutdowns due to changes in market demands for chlorine production. The processes by which the chlorine and its by-products were created are described in the section below.

1.3.2.1 Mercury Cell Chlorine Process Area

The mercury cell was an industrial system that split common salt molecules (NaCl) to produce chlorine gas. A typical mercury cell process used electrolysis to split the salt solution. An electric current was passed through the salt solution (brine) between a graphite anode and a mercury cathode (Figure 1-4) to produce chlorine gas and sodium. The sodium dissolved into the mercury and the sodium-mercury mixture was made to react with water to produce sodium hydroxide and hydrogen gas. All of the material from this process, including the spent brine, hydrogen gas and sodium hydroxide, contained residual amounts of mercury. The mercury was separated from the resulting chlorine and hydrogen gas and sodium hydroxide which were packaged for sale for additional processing and/or for distribution.

The raw materials used in the chlorine production process were salt, water, mercury, and electric power. Documentation of LCP Chemicals, Inc.'s procedure for the handling and storage of chemicals is not available. Rock salt or evaporated salt, which was utilized later, was transported to the site by rail. It was stored in salt silos located by Building 233 (Figure 1-3) and fed to the adjacent saturators to create brine. The brine was treated and filtered in a brine treatment tank in Building 233. To treat the brine, sodium hydroxide, sodium carbonate, and barium chloride were added to precipitate impurities in the solution, such as calcium carbonate, sulfates, and hydroxides. The residual material is known as brine purification mud or "brine sludge". In the mid 1960s, a surface impoundment, the brine sludge lagoon, was constructed and used to dispose the brine sludge and process wastewater. The sludge was mixed with brine and the resulting slurry was pumped to the brine sludge lagoon through overhead pipes. The supernatant, or liquid content of the brine sludge lagoon, was pumped back to the brine purification tank for recycling and for redistribution either to the mercury cells or for the slurry usage. Documentation of the disposal practices for the brine sludge before the construction of the sludge lagoon is not available.

After pre-treatment of the brine, it was piped to the mercury cells in Building 230 and Building 240 to produce gaseous chlorine and a mercury sodium mixture through electrolysis. Once the chlorine was cooled, dried (i.e., water vapor removal) with sulfuric acid, and liquefied in Building 233, it was stored in 100 ton vessels. The used brine was recycled to the treatment tank in Building 233 for re saturation and to repeat the process.

The mercury-sodium mixture was then piped to denuders, or strippers, where it was hydrolyzed to form elemental mercury, a sodium hydroxide solution and gaseous hydrogen. The recovered mercury was returned to the mercury cells. The sodium-hydroxide solution was filtered and stored in above ground storage tanks at the northeast corner of the facility. The hydrogen gas was also filtered by way of a commercial "Purasiv" unit south of Building 231. From there it was piped to the hydrogen facility where it was packaged and distributed by Union Carbide (Linde Division). Occasionally, the hydrogen gas was mixed with water and chlorine to form hydrochloric acid in both gaseous and liquid form. The hydrochloric acid was then stored in tanks near Building 231. In 1985, LCP Chemicals stopped the mercury cell process, thus brine sludge production was also stopped.

Between 1985 and 1994, the site was used as a transfer terminal for products made at other Hanlin Group Facilities. The Hanlin products were shipped to the site via rail or truck and stored in above ground storage tanks. From there they were repackaged and distributed. The products were potassium hydroxide, sodium hydroxide, hydrochloric acid and methylene chloride. Aerial photographs of the facility during full operation in 1966-67 (Building 240 not constructed yet) and shortly after shut down of the mercury cell process are shown on Figures 1-5 and 1-6, respectively.

1.3.2.2 Linde Division Hydrogen Plant

The hydrogen plant was operated by the Linde Division unit of Union Carbide Corporation (Linde) which occupied a 2.1-acre leasehold on the western portion of the site (Figure 1-3) interconnected to the mercury cell process area. The Linde Division hydrogen plant started operation in 1957 and ceased operation in 1990. Hydrogen was supplied from the mercury cells to the plant via overhead pipes. The gas was purified by UCC to remove additional residual mercury (reportedly, at least five pounds of mercury was removed from the gas stream by Linde daily), stored, compressed, and shipped by trailer. Union Carbide, in their 104(e) response claims that one disposal method for the Linde waste mercury was to give it to employees for resale. In 1980, the hydrogen plant stopped using the hydrogen from the chlorine plant, and began to package liquid cryogenic hydrogen that was shipped in from outside sources.

In 1988, in preparation for a new tenant, UCC had the building interior and the hydrogen compressors decontaminated for mercury (IT, April 22, 1988). IT reportedly recovered 30 pounds of free mercury from one compressor and its associated piping.

In May 1990, the Linde Division plant ceased operations after the UCC lease with LCP expired. This triggered the NJDEP's Environmental Cleanup Responsibility Act (ECRA, now known as ISRA). Due to several areas of concern unrelated to the chlorine manufacturing process (i.e., former underground storage tanks, sumps, septic tanks, etc.), ISRA required that a soil and groundwater investigation be conducted within the boundaries of the site. The required investigation and its cleanup took place in the early 1990s. The NJDEP granted a No Further Action (NFA) declaration for the hydrogen facility on June 20, 1995 for soils only. To our knowledge, Praxair (successor to UCC) has had engineering controls on the leasehold.

The Linde Division facility was last used in October 1994 by Liquid Carbonic Corporation. Liquid Carbonic Corporation was later purchased by Praxair, Inc. Liquid Carbonic rented the Linde Division site from LCP Chemicals, Inc., and used it for office space and as a parking area for truck trailers.

1.3.2.3 Hypochlorite Facility

Kuehne Chemical, Inc., leased Lot Nos. 3.02, 3.03 and the northern part of Lot 3.01 from LCP Chemicals, Inc. and started a sodium hypochlorite manufacturing process. The processing area was located to the north of Building 220 and between Avenue C and D and consisted of above ground storage tanks, loading areas and support buildings (Figure 1-3). The manufacturing plant received its raw materials, chlorine and sodium hydroxide, from the LCP chlorine plant via overhead pipes. The raw material were utilized by Kuehne to produce sodium hypochlorite (bleach). Chlorine, sodium hydroxide, hydrochloric acid, and sodium hypochlorite were also stored and distributed by Kuehne. Kuehne Chemical Inc. had vacated the site by February 1981. It is likely Kuehne mercury waste was disposed of along with the LCP mercury waste.

1.3.2.4 Other Operators

Conrail (successor to Central Railroad of New Jersey) constructed and operated a railroad line and railroad yard across the property as described in Section 2.1.1 and as shown on Figure 2-8.

Active Water Jet operated a pipe and tank washing operation on the property from 1990 until 2000. Active Water Jet cleaned, with water blasting, contaminated tanks, filters, pipes, condensers and similar items. Its offices were located in building 220.

Caleb Brett leased a portion of the property from 1988 to 1995; they are known to have stored petroleum crude oil, No. 6 fuel oil, kerosene, asphalt products, pot ash, caustic soda, alcohol, and ketones at the site.

Microcell Technologies leased building 231 from 1987 until 2000 and operated a pilot plant that produced small glass spheres.

1.4 RI Site Investigation

The work plan documents and the technical objectives for each of the RI field investigations are described below.

1.4.1 Phase I RI

Phase I RI Work Plan Documents

The Phase I RI was performed during 2001 and 2002 in accordance with the following USEPA-approved documents:

1. "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000).
2. "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001), hereinafter referred to as the FOP.

3. "Quality Assurance Project Plan, Field Operations Plan, Part II, Draft Sampling and Analysis Plan" (URS, February 12, 2001), hereinafter referred to as the QAPP.
4. "Addendum No. 1, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Cased Deep Borings," (Brown and Caldwell, October 12, 2001).
5. "Addendum No. 2, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Subsurface Utility Clearance," (Brown and Caldwell, November, 2001).
6. "Addendum No. 3, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Sampling Beneath Buildings 230 and 240" (Brown and Caldwell, March 2002).

Agency approval of these Phase I RI Work Plan documents was provided in letters from USEPA in 2001 and 2002.

Phase I RI Objectives

The objectives of the Phase I RI were stated in Section 2 of the "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001):

- Determine the nature and extent of contamination in the soil, groundwater, surface water, and sediment.
- Evaluate stratigraphy on a site-wide basis - confirm the distribution of the Tidal Marsh Deposit and evaluate its effectiveness as a confining layer.
- Define the hydrogeology on a site-wide basis - confirm groundwater gradients, flow directions, and aquifer properties (e.g., hydraulic conductivity, transmissivity, etc.) to predict the direction and flow rate of groundwater contaminant migration.
- Evaluate tidal effects on groundwater and groundwater flow direction.
- Evaluate the potential ecological resources of, and impacts to, South Branch Creek.
- Characterize-anthropogenic fill at the site.
- Develop a conceptual site model.
- Determine risks posed to human health and environment.

The results of the Phase I RI field investigation were presented in the document titled, "Site Characterization Summary Report (SCSR), LCP Chemicals Superfund Site, Linden, New Jersey", (Brown and Caldwell, August 2002).

1.4.2 Phase II RI

Phase II RI Work Plan Documents

The Phase II RI was performed from August 2006 through June 2007 in accordance with the following 14 USEPA-approved documents:

1. "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000).
2. "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001), hereinafter referred to as the FOP.
3. "Quality Assurance Project Plan, Field Operations Plan, Part II, Draft Sampling and Analysis Plan" (URS, February 12, 2001), hereinafter referred to as the QAPP.
4. "Addendum No. 1 (Soil and Groundwater) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site", (Brown and Caldwell, July 2004, Revised April 2006, Revised October 2006).

5. "Addendum No. 2 (South Branch Creek & Ecological Issues) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site", (Brown and Caldwell, July 2004, Revised August 2006, Revised October 2006).
6. "Addendum No. 1, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Cased Deep Borings," (Brown and Caldwell, October 12, 2001).
7. "Addendum No. 2, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Subsurface Utility Clearance," (Brown and Caldwell, November, 2001).
8. "Addendum No. 3, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Sampling Beneath Buildings 230 and 240" (Brown and Caldwell, March 2002).
9. "Addendum No. 4, Field Operations Plan, LCP Chemicals, Inc. Superfund Site (Bedrock Monitoring Wells, Soil Vapor Testing, Groundwater Sampling)", (Brown and Caldwell, April 2006, Revised October 2006).
10. "Addendum No. 5, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Ecological Sampling", (Brown and Caldwell, August 2006, Revised October 2006).
11. "QAPP Addendum for South Branch Creek Sampling," (Brown and Caldwell, August 2006, Revised October 2006).
12. "Supplemental Work Plan: Sediment Toxicity Testing (South Branch Creek), Phase II Remedial Investigation LCP Chemicals, Inc. Superfund Site," (Brown and Caldwell, September 2006, Revised October 2006).
13. "Interim Ecological Risk Assessment Problem Formulation," (Brown and Caldwell, Revised October 2006).
14. "Health and Safety Plan For Phase II Remedial Investigation at the LCP Chemicals, Inc. Superfund Site," (Brown and Caldwell, September 2006).

Agency approval of these Phase II RI Work Plan documents was provided in the following:

- Letter from Ms. Carole Petersen of USEPA dated September 13, 2006 referenced: "Conditional Approvals for Addendum No. 2 (South Branch Creek and Ecological Issues) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site (Revised July 2006); and Addendum No. 5 Field Operations Plan LCP Chemicals, Inc. Superfund Site (Ecological Sampling) (August 2006)."
- Letter from Ms. Carole Petersen of USEPA dated October 5, 2006 referenced: "Conditional Approvals for Addendum No. 1 (Soil and Groundwater) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site (April 2006) and Addendum No. 4 Field Operations Plan, LCP Chemicals Inc. Superfund Site (Bedrock Monitoring Wells, Soil Vapor Testing, Groundwater Sampling) (April 2006)."
- Submittal of revised Phase II Work Plan documents to USEPA by October 13, 2006 in accordance with the conditions set forth in the conditional approval letters.

Phase II RI Objectives

The Phase II RI Work Plan included an approach and methodology to address the following technical objectives:

- Additional delineation of surficial and shallow soils in the western area of the site through the installation and testing of soil from a number of borings.
- Characterization of deep soils through the installation and testing of a number of borings to determine the vertical extent of contamination identified in the shallow soils.
- Characterization of soil quality within the glacial till beneath Building Nos. 230 and 240.

- Determination of the presence of methyl mercury in soil from a number of shallow and deep soil samples obtained in various areas of the site.
- Determination of the specific form of mercury in a number of surficial soil samples including mercuric (Hg+2), mercurous (Hg2+2), and methyl (CH3Hg+).
- Characterization of surficial soil quality near storage tanks remaining at the site that may have had potential releases to the environment.
- Determination of groundwater quality in the bedrock water-bearing zone.
- Additional characterization of groundwater quality in the overburden water-bearing zone through the collection of a second complete round of monitoring well samples, including the use of "ultra-clean" sample collection and handling techniques for mercury.
- Determination of the groundwater flow characteristics in the bedrock water-bearing zone.
- Additional characterization of groundwater flow conditions in the overburden water-bearing zone.
- Determination of the in-place hydraulic conductivity of the unconsolidated and consolidated geologic material screened by the newly installed monitoring wells.
- Determination of the presence of methyl mercury in groundwater from a number of overburden and bedrock groundwater samples obtained in various areas of the site.
- Characterization of soil vapor to address the potential vapor intrusion pathway to future building structures at the site.
- Current wetland delineation and jurisdictional determination.
- Additional delineation of selected constituents in sediment and surface water in South Branch Creek as well as in the confluence area of South Branch Creek and Arthur Kill to address ecological concerns.
- Evaluation of the bioavailability of mercury in the surface water and sediment within South Branch Creek. This includes a determination of the ratio of methyl mercury to total mercury.
- Determination of the influence of mercury speciation and sediment chemistry on bioavailability to aquatic organisms.
- Utilization of a Reference Channel for the purpose of differentiating certain chemical constituents with respect to the background conditions when performing environmental characterization and analysis.2
- Estimation of biota sediment accumulation factors (BSAFs) from sediment to crabs and fish.
- Collection of site-specific information to support the Baseline Ecological Risk Assessment, including a biologic habitat assessment and the collection of tissue residue in selected aquatic biota in South Branch Creek and the confluence area of South Branch Creek and Arthur Kill.
- Evaluation of sediment toxicity.

1.4.3 Off-Site Ditch Investigation

Off-Site Ditch Work Plan Documents

The off-site ditch investigation phase of the RI was performed from July 22, 2011 to July 28, 2011 in accordance with the following two USEPA-approved documents:

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2 The Phase II RIWP documents, dated October 2006, included tasks for the selection and collection of samples from a reference stream. An e-mail message dated August 18, 2006 from Mr. Jon Gorin of USEPA to ISP-ESI that stated " . . . after consulting with BTAG, we've determined that there is no need for a reference stream right now." The approved documents included identification and sampling of a reference stream. This work was therefore conducted in accordance with the approved documents without oversight by USEPA.

- "Revised Scope of Work - Characterization of Off-Site Ditches, LCP, Chemicals Inc. Superfund Site", (Brown and Caldwell, May 14, 2010).
- "Quality Assurance Project Plan, LCP Chemicals, Inc. Superfund Site, Linden, New Jersey", (Brown and Caldwell, May 2010).

Off-Site Ditch Work Plan Objectives

The Off-Site Ditch Scope of Work included an approach and methodology to address the following technical objectives:

- To characterize the extent to which the Northern and Southern Off-Site ditches are tidally influenced.
- To characterize the extent to which the Northern and Southern Off-Site ditches may be impacted by site-related constituents.

1.5 Report Organization

The data presented in this RI Report includes the Phase I and II RI data and is intended to characterize current site conditions for each medium that was investigated. The environmental database (Appendix F) contains the complete laboratory analytical data from both the Phase I and Phase II RI field investigations.

The RI Report is organized as follows:

- Section 1 Introduction
- Section 2 Site Setting
- Section 3 RI Field Investigation Methods and Procedures
- Section 4 Data Management
- Section 5 Physical Characteristics
- Section 6 Nature and Extent of Contamination
- Section 7 Contaminant Fate-and-Transport
- Section 8 Baseline Risk Assessment Summary
- Section 9 Recommendations
- Section 10 References

Appendices to the RI Report are as follows:

- Appendix A Property Transfers
- Appendix B Field Operations Plan
- Appendix C Well Construction and Soil Boring Logs
- Appendix D Hydrogeologic Data
- Appendix E Wetland Delineation
- Appendix F Habitat Assessment Report
- Appendix G Representative Photographic Logs
- Appendix H Analytical Lab Deliverables (DVD)
- Appendix I Data Usability Reports
- Appendix J Tabular Summary of Analytical Data
- Appendix K Environmental Database (CD-ROM)
- Appendix L Sediment Toxicity Testing Report

- Appendix M Regional Studies
- Appendix N NJDEP Technical Regulations Checklist
- Appendix O Human Health Risk Assessment
- Appendix P Ecological Risk Assessment

Section 2

Site Setting

The LCP Chemicals Inc. Superfund Site (LCP site) is located in the Tremley Point section of the City of Linden, Union County, New Jersey as shown on Figure 1-1. The site is located along the western shore of the Arthur Kill and east of the New Jersey Turnpike. It is accessed from the Road to Grasselli which is reached from Linden via South Wood Avenue and Tremley Point Road. The coordinates of the center of the site are Latitude 40.60832° and Longitude -74.21163°.

The LCP site property includes Block 587, Lots 3.01, 3.02, and 3.03. The area of these three lots totals approximately 26 acres. The shape of the property is highly irregular with a maximum east-west dimension of approximately 2,500 feet and a maximum north-south dimension of 1,600 feet (Figure 1-3).

The site is bisected by an inactive railroad spur running north and south that is located on an easement and is operated by the Consolidated Rail Corporation (Conrail). The LCP chlor alkali manufacturing facility was formerly housed in a group of buildings located immediately west of the railroad tracks. The mercury cell buildings (No. 230 and 240) and the liquefaction building (No. 231) are shown on Figure 1-3.

The current alignment of a man-made ditch, known as South Branch Creek, is located east of the railroad tracks along a narrow portion of the property that connects to the Arthur Kill. Occupying most of the remaining portion of the property east of the railroad tracks is a closed RCRA unit, a cooling tower, and the pad for a former sludge roaster. The closed RCRA unit is currently maintained by ISP-ESI.

West of the railroad tracks there are numerous buildings and tanks associated with the LCP Chemicals Inc. facility and its tenants. Several of the buildings also exist on the property that were part of associated processes leased and operated by other companies, including the Linde hydrogen plant predominantly on the western portion of the property, and the Kuehne Chemicals sodium hypochlorite and chlorine packaging facility. Other notable site features on the western portion of the site include an electrical transformer and rectifier yards and an on-site railroad yard. Additionally, engineering and institutional controls consisting of a 0.7 acre asphalt cap and deed restriction were placed on the western portion of the property by former tenant Linde in 1994 pursuant to the New Jersey Environmental Responsibility Act (ECRA) Site No. 90367. This engineering control installed by Linde, the cap, has not been inspected or maintained by Linde or its successors, including Praxair to the knowledge of ISP-ESI, at any time after installation in 1994. The cap is currently in disrepair with major cracks and trees growing out of it. NJDEP, EPA and Praxair have been notified of this situation on several occasions.

The LCP site started chlor-alkali manufacturing operation in 1955 and the core of the manufacturing buildings were present by 1956. Cell Building 240 was added in 1972. Manufacturing of chlorine ceased at the facility by August 1985 and site operation by LCP ended by August 1994; several tenant operators remained until 2001. Additional information regarding the site history, including site operation and development is presented in Section 1.3.

The southern LCP property is adjacent to a pair of parallel railroad tracks operated by Conrail, and further south by two parallel drainage channels hereinafter referred to as the Northern and Southern Off-Site Ditches. The two ditches run parallel with the southern LCP property line, and are not apparently associated with development on the LCP site.

2.1 Land Use and Zoning

The area surrounding the LCP site historically was developed for heavy industrial use, much of which is currently inactive. A map depicting land use as of 2002 is presented in Figure 2-1. The map was developed based on GIS datalayers obtained from the New Jersey Department of Environmental Protection (NJDEP).

The current primary active land use in the area is bulk storage and transport of petroleum products and aggregates. The transport of these materials occurs by ship and barge using dockage along the Arthur Kill as well as by rail, truck, and pipeline. Other active facilities in the area include a municipal wastewater treatment plant, trucking and warehousing, and truck repair. An active, major rail freight line runs parallel to the eastern side of the New Jersey Turnpike, west of the site. A number of large chemical manufacturing facilities formerly operated within one mile of the site, most of which are currently inactive and in various stages of demolition and site remediation.

The industrial properties located immediately adjacent to the LCP site include:

- NuStar Energy Linden Terminal located north and south of South Branch Creek to the east of the inactive Conrail railroad spur.
- The former GAF site manufacturing facility to the north.
- Citgo Petroleum Corp, Linden Transload Terminal located to the south and southwest.
- Linden-Roselle Sewerage Authority (LRSA) sludge barge dock located southeast of the site along the Arthur Kill.

Various undeveloped areas are located within one mile of the site, many of which are either vacant former chemical manufacturing plants or tidal wetlands. The former manufacturing areas are depicted on the Land Use map (Figure 2-1) either as "Industrial", "Undeveloped/Barren/Field", and/or "Scrubland". Areas of tidal wetlands, some of which are partially filled, are located along the Rahway River to the south and Piles Creek to the north. Pralls Island is located northeast of the site and across the Arthur Kill in Richmond County, New York and is a wildlife sanctuary consisting of dredge spoil fill placed over former tidal wetlands. The City of New York, Department of Sanitation Fresh Kills Landfill, is located approximately three miles south of the site.

Most of the currently or formerly developed land in the vicinity is located on what has been mapped by the New Jersey Geologic Survey (2005) as "Historic Fill" in accordance with N.J.S.A. 58:10B-1 et seq. Additional information regarding anthropogenic fill is presented in Section 1.3.2.

The only area of residential development within one mile of the site is the Tremley section of Linden which is located west of the New Jersey Turnpike approximately 3,850 feet (¾ mile) from the nearest (western) edge of the LCP site.

2.1.1 Anthropogenic Fill

The entire area of the LCP site and most of the area surrounding the site formerly consisted of tidal wetlands, as depicted on historic topographic maps in Figures 2-2 through 2-4. It was necessary to raise the grade prior to the historic development of these areas for industrial and other uses. This was accomplished through the placement of non-indigenous materials, that is, materials not originally native to the tidal wetlands, including soil, ash, dredge spoil, demolition debris, and other materials. This material is referred in this report as "anthropogenic fill", namely, fill material that has been placed by humans. The placement of fill in the Tremley Point area allowed for the industrial development of the peninsula.

Historic Placement of Anthropogenic Fill

The presence of anthropogenic fill at the site has been verified by evaluation of soils encountered as part of the extensive soil boring program, which was completed as part of Phase I and II of the RI, as well as prior subsurface investigations conducted by others. This observation has been independently confirmed through an evaluation of the historic placement of anthropogenic fill identified on available historic maps and aerial photographs. Briefly, these sources (Figures 2-5 through 2-17) reveal that the entire area, formerly occupied by tidal marsh, was progressively filled. A chronologic description of the placement of anthropogenic fill is described below.

Historic topographic mapping from 1898 (Figure 2-2) reveals that the entire LCP site was formerly occupied by tidal wetlands that were contiguous with the Arthur Kill. In fact, the only nearby area that was not wetland is the slightly elevated land along Tremley Point Road.

Early industrial development occurred immediately along the margin of the Arthur Kill with the construction and operation of the Standard Chemical Works and later the Grasselli Chemical Company. This presence of the Grasselli Chemical Company is evident on the 1898 topographic map (Figure 2-2).

Aerial photography as of May 8, 1929 (Figures 2-5 and 2-6), reveal what appeared to be extensive filling in the Grasselli East Works area (east of railroad tracks). This land was owned immediately prior to this time by the Grasselli Chemical Company and was later acquired by duPont, with a narrow strip owned by Grasselli Dyestuff Company. The fill was also identified as far south as South Branch Creek, evident by the apparent steep banks on either side of the creek located north of the LCP property (Figure 2-5). The area west of the tracks had apparently not yet been filled.

Available aerial photography from April 28, 1940 reveals extensive areas of filling located on what was likely the duPont property at the time located east of tracks (Figure 2-8). These areas include north and south sides of South Branch Creek between the confluence with Arthur Kill and the eastern-most railroad track, a triangular area immediately south of South Branch Creek and immediately east of the western railroad tracks, and the large area located north of South Branch Creek. Other areas may be filled, including the entire area of the future LCP property east of the tracks, although this is not completely clear from the photograph.

By 1940 the south-western portion of the future LCP property between the railroad tracks was filled in preparation for the construction of a railroad yard (Figure 2-8). This railroad yard was on property that was owned at the time by the Central Railroad Company of New Jersey (Figure 2-11).

An irregular area is evident on the 1940 photograph (Figure 2-8) that appears to have been filled. This possible fill area was located on property owned by duPont that was located immediately north of railroad track, contiguous with South Branch Creek. The area immediately north of South Branch Creek is apparently not filled, as well as the far southeast corner of the future LCP property (west of the tracks).

By July 1947 (Figure 2-10), aerial photographs reveal that the northern portion of the property is covered with raw material piles on property owned by General Aniline & Film Corporation. These material piles and decommissioned process equipment storage yard are located in an area that has obviously been filled. South Branch Creek has now been re-routed to a position further south.

The old alignment of South Branch Creek is evident in the photographs from 1951 in which it and the area surrounding it are in the process of being filled (Figures 2-11 and 2-12). This is located on land that had been acquired by General Aniline & Film Corporation from duPont just shortly before in 1949. The northwestern most corner of the LCP property is partially filled along what appears to be a road leading to the western portion of the GAF facility. A strip of empty land immediately to the south is apparently not yet filled.

As of July 17, 1952, aerial photography indicates that the northern portion of the property remains covered with raw material piles and a process equipment storage yard in an area that has obviously been filled. South Branch Creek has now been re-routed to a position further south. The old alignment of South Branch Creek is still evident in the photograph in which it and the area surrounding it have been filled. The new (southern) alignment of South Branch Creek is evident. The entire western portion of the LCP property has now been filled. The most recent area of filling is partially covered with rows of equipment (Figure 2-12). In a photograph dated May 16, 1954 (Figure 2-13), the entire site east of the tracks appears to have been filled.

In summary, most filling of the LCP property was performed over a long time span likely starting around 1885. Much of the filling occurred by various owners prior to the development of the site for chlor alkali production. Most, but not all of the property, appears to have been filled by 1949.

2.1.2 Regional Industrial History

A brief description of some of the major industrial occupants of the Tremley Point area is presented below. Information contained herein was obtained from NJDEP files, the attached title search summary, or was provided by the property owner. ISP-ESI has not conducted an independent investigation of any of these properties or their operations. The historic regional land use circa 1940 is presented in Figure 2-3.

Former GAF Chemicals Manufacturing Facility

The former GAF Chemicals manufacturing facility, now referred as the GAF site, was first utilized for chemical manufacturing in approximately 1919. Under the various ownerships, chemical products were manufactured at the GAF site from approximately 1919 until closure of the plant in April 1991. Products manufactured at the GAF site primarily consisted of dyestuffs and surfactants, but also included ethylene oxide, tetrahydrofuran and herbicides. The plant ownership and various corporate entities are described in Section 1.3.1. The current owner of the site is Linden Property Holdings LLC.

The GAF site has been remediated. The site remediation conducted to-date has included demolition of site structures, capping, grading and drainage improvements, construction of a shallow groundwater barrier and groundwater collection system, installation of bedrock groundwater extraction wells, LNAPL collection and the construction and operation of a groundwater conveyance and treatment system. NFA letters have been received for site-wide soils and groundwater from the NJDEP. Remedial Action Permits for Groundwater (Permit ID RAP110002) and Soil (Permit ID RAP110001) became effective at the GAF Site on February 22, 2012.

The environmental conditions at the GAF site were documented in a comprehensive Remedial Investigation Report (Eckenfelder, 1991). Raw materials and associated bi-products from the former GAF operations are reported to have included arsenious acid catalysts, arsenic acid, arsenic mercuric sulfate, and mercury oxide catalysts among numerous other organic and inorganic constituents. The predominant organic constituents in soils and groundwater include various VOCs and SVOCs, including chlorobenzene, benzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, naphthalene, 4-chloroaniline, and phenol. The most prominent inorganics in soils and groundwater were mercury, chromium, and arsenic. These constituents are widely distributed across the entire Site with the highest levels observed in the "Old Landfill" and in the former production area. In fact, dissolved mercury concentrations range as high as 2,520 µg/L in the bedrock water-bearing zone.

A groundwater barrier wall formed of sealed-joint, steel sheet piling (Waterloo Barrier) was installed to provide hydraulic containment of shallow groundwater, and to limit the potential for contaminated soil particle migration from the site. The groundwater barrier wall spans a length of approximately

8,523 feet and surrounds an area of approximately 104 acres. Its alignment encompasses the former main plant site of the GAF site (Figure 2-18). The wall penetrates miscellaneous fill materials and is keyed into the underlying organic silt and clay aquitard and/or the glacial till formation.

A shallow groundwater collection system is installed just inside the barrier wall to intercept and control potentially contaminated shallow groundwater and percolations above the aquitard and direct these waters to the on-site wastewater treatment plant. This shallow groundwater collection system, in conjunction with the barrier wall, controls the interior shallow groundwater elevation, such that intragradient conditions (i.e., hydraulic head on the inside of the barrier wall is below that on the outside) prevail along the length of the barrier wall, thus containing shallow groundwater within the limits of the barrier wall and controlling the lateral migration of groundwater from the GAF site. This system consists of a collection drain situated essentially parallel to and a short distance inside the barrier wall alignment. The drain includes a 15-inch diameter high density polyethylene perforated pipe surrounded by drainage stone, which is wrapped in a geotextile blanket. A series of 26 precast concrete manholes serve as inspection and maintenance points along the length of the drain. Collected waters within this system are directed to two pumping stations, each consisting of an above-grade pump house situated over a precast concrete collection sump. Each pump station is equipped with a primary and backup pump, liquid level sensors and controls to operate the pumps and maintain groundwater at the desired elevation. Water discharged from each pump station is conveyed to the WWTP.

A bedrock groundwater extraction system provides areal hydraulic capture of the GAF site. Primary hydraulic capture of the majority of the site is provided by two wells located on the eastern edge of the site, DEW-2 and DEW-4A (Figure 2-18) with well screen intervals of 45 to 65 ft bgs and 45 to 55 ft bgs, respectively. Extraction wells DEW-2 and DEW-4A are operated in a continuous pumping mode at 18-20 gpm each, and have been operational on a nearly continuous basis since 2002. Additional, minor hydraulic capture of the northern edge of the GAF site has been achieved by two extraction wells, EW-2, and DEW-2, that became operational in early 2010, at pumping rates of approximately 1 to 2 gpm each. Water from the bedrock extraction system is conveyed to the on-site waste water treatment facility.

NOPCO

A NOPCO Chemical Company ("NOPCO") chemical manufacturing site was located immediately south of the LCP site on land now occupied by NuStar Energy. The NOPCO facility is observed on a 1966 aerial photograph (Figure 2-16). NOPCO constructed a toluene diisocyanate manufacturing plant on the site in the early 1960s with an initial design capacity of 10 million pounds per year. Raw materials used in the production of toluene diisocyanate include phosgene, chlorobenzene, and dichlorobenzenes, among others. Toluene diisocyanate is used as an intermediate in the production of polyurethane. The NOPCO Linden operation was related to its "Lockfoam" product line.

NOPCO acquired the land to construct the toluene diisocyanate plant from Sinclair Refining on December 28, 1960. The plant was constructed in the early 1960s and full operation was initiated by March and April of 1963. However, the plant operations were discontinued by September 1964 after a long series of design, construction, and operational difficulties. NOPCO sold the property to Allied Chemical Corp on April 5, 1965 (NOPCO Chemical Company, 1960, 1961, 1962, 1963, 1964, 1965). NOPCO Chemical merged into the Diamond Alkali Company who shortly thereafter merged with the Shamrock Oil Company to form the Diamond Shamrock Corporation in 1967.

E. I. duPont de Nemours and Company (duPont) Site

The duPont site is currently located northeast of the LCP site along the Arthur Kill. This former chemical manufacturing site has been decommissioned and is currently in the ISRA process.

The duPont plant manufactured inorganic salts and acids, organic pesticides (including DDT), sulfuric acid, ammonium thiosulfate, and a sodium bisulfate solution. duPont used areas of surrounding marsh

for discharge of aqueous manufacturing wastes from 1928 until the mid-1970s. The wastes disposed of were from the manufacture of inorganic compounds such as phosphate plaster (CaSO4 with 2-3% phosphate residual), hypo muds (diatomaceous earth, sulfur, carbon, and rust particles), silicate muds (sand, filter aid, and minor quantities of sodium silicate), and metal sulfides. The wastes also included coal, coal ash and waste residues. Various arsenic-containing materials are reported to have been manufactured including lead arsenate, iron arsenate, and arsenic acid, in addition to various pesticides that may have included arsenic.

The parcel has been used for chemical manufacturing from about 1880 until 1990 when duPont ceased operations.

Petroleum Product Terminals

Two bulk petroleum product terminal facilities are located on properties immediately adjacent to the LCP site. The NuStar Energy-Linden Terminal is located north and south of South Branch Creek to the east of the inactive Conrail railroad spur on the property previously occupied by NOPCO. This facility has been in existence under various ownerships since the 1970s. The Citgo Petroleum Corp, Linden Transload Terminal located to the south and southwest of the site has been in existence since before 1940. These facilities receive and ship various products including petroleum distillates, gasoline, jet fuel, ethanol, and other residual fuels. The mode of product receipt includes ship, barge, rail and pipeline. The mode of delivery includes ship, barge, pipeline, and truck.

Bayway Refinery

The Bayway Refinery is located west and northwest of the LCP site. The facility is approximately 1,300 acres with a refinery, two chemical plants, tank fields, and a marketing and distribution station. The refinery has been producing petroleum products in continuous operation since 1909. The eastern border of the property abuts the western headwaters of Piles Creek. Various ownership changes have occurred over the years. Standard Oil Company purchased the Bayway property in 1907. Successors included Standard Oil of New Jersey and Exxon. More recent ownership has included Tosco Corp and ConocoPhillips. The facility is currently under an Administrative Order and has triggered ISRA several times. It is our understanding that Exxon-Mobil retains the liability for the environmental cleanup of the site.

On the eastern side of the Bayway Refinery, the New Jersey Turnpike passes through the site, separating the main refinery and process areas from the waterfront area, which borders on the Arthur Kill. Two outlying tank fields (the Rahway River Tank Field and the 40-acre Tank Field) are located southwest of the main refinery and process areas.

The west side chemical plant produces additives for motor oils and high purity propylene. Tanks on site store sulfidic caustic, asphalt, butane, gasoline additives, heavy catalytic naptha, domestic oil, gasoline, petrolite, Celsius, water white, standard white, gas oil, treated naptha, crude naptha, and crude petroleum. The east side chemical plant produced methyl ethyl ketone, tertiary butyl alcohol, secondary butyl alcohol, methyl isobutyl ketone, isopropyl alcohol, acetone, propylene, isophorone, and fuel gas. Finished products stored on site include heating oil, heavy fuel oil, jet fuel, diesel fuel, kerosene, asphalt. There is a tetraethyl lead building. Processes include calatytic cracking, naptha reforming, alkylation, and disulfurization. Early products produced on site (1914-1919) included gasoline and kerosene.

Former American Cyanamid Warners Plant

The former American Cyanamid Warners Plant was located at the tip of the Tremley Point peninsula at the confluence of the Arthur Kill and the Rahway River. The 33-acre site was built in 1916-1917 and originally produced concentrated "ammo-phos" fertilizers. During WWI, the facility produced ammonia and nitric acid for military purposes. The plant also made aluminum sulfate for water treatment and a

range of organic chemicals including rubber, motor oil additives, accelerators, fumigants (hydrocyanic acid) and pesticides. A sulfuric acid production unit started operation in 1970. The facility discontinued operations in 1998.

The site has been decommissioned and an environmental remediation has been performed under RCRA. The property has been sold and is currently awaiting redevelopment.

PSE&G

The PSE&G Linden Generating Station is a 1,526 MW natural gas powered electric power plant located along the Arthur Kill immediately north of Piles Creek. This plant replaced a former oil-fired plant that was also operated by PSE&G.

2.1.3 Current Site Land Use

Manufacturing of chlorine ceased at the LCP facility in 1985 and site operation by LCP ended by August 1994. Several tenant operators, including Active Water Jet, Inc. remained until 2000. Today, the LCP site is unoccupied and unused.

2.1.4 Zoning

The area of the site located east of the New Jersey Turnpike (NJTP) is zoned for heavy industry. Allowable uses in this area include various types of manufacturing (except explosives, fertilizers, and the use of liquefied natural gas); assembly and packaging; warehousing; airports; offices, research facilities; service stations and automotive repair shops; public utility generating stations, truck terminals and tank farms. Residential, consumer retail, and recreational development in the area located east of the NJTP is specifically not allowed.

Some of the areas located along South Wood Avenue, west of the New Jersey Turnpike, are zoned for light industry. Allowable uses for these areas would include manufacturing that employs no chemical or raw material processing, assembly and packaging operations, warehousing, airports, offices and research facilities, and service stations and automotive repair shops.

2.1.5 Anticipated Future Land Use

The Tremley Point area of Linden, located east of the New Jersey Turnpike, is anticipated to undergo brownfields redevelopment on the sites of the former manufacturing facilities. A major transportation infrastructure has been in the planning stages to support this redevelopment. Specifically, New Jersey Department of Transportation (NJDOT, 2008) "Tremley Point Access Local Roadway Improvements", Project ID 9324A is anticipated to be funded as part of the FY 2009 Transportation Capital Program that will consist of a four-lane, 1.1 mile long roadway and bridge to connect Tremley Point with Exit 12 of the New Jersey Turnpike in Carteret. This project is specifically intended to address "the increase in truck traffic anticipated by the redevelopment of the Tremley Point brownfields into more than six million square feet of warehouse and distribution space" (NJDOT, 2008).

Potential future land uses of the LCP site may include power generation, petroleum terminals, warehousing and distribution, and transportation.

2.2 Demography

In the following sections, demographic information (including population, economic indicators, and labor information) is presented and discussed. Data are reported for areas in New Jersey within a one-mile radius of the site's boundaries. Much of the data reported are based on 2000 census data.

2.2.1 Population

Population distribution for cities and townships in the vicinity of the LCP site is summarized on Table 2-1. Included are population data for the Cities of Elizabeth, Linden, and Rahway (of Union County) and the City of Carteret (of Middlesex County). As shown, the City of Elizabeth is the most densely populated (9,865.5 persons per square mile) and also has the largest population (120,568 persons) of the jurisdictional areas evaluated.

Change in population from 1980 to 1988 is also shown in Table 2-1. Union County has experienced an increase in population of 5.8 percent for the period of 1990 to 2000. Elizabeth, Linden, and Rahway have significantly gained in population (9.5 percent, 7.2 percent, and 4.7 percent change in population, respectively). Middlesex County experienced a significant 11.6 percent gain in population over this time period. The population change for Carteret increased 8.9 percent during this time. These data indicate that, in general, the area in the region of the LCP site experienced a growing trend in population during the period of 1990 to 2000.

Only a slight increase in population was expected for Union County for the time period 2000 and 2006 (1.6 percent), while a more sizeable increase in population (4.9 percent) was anticipated for Middlesex County during the same time period.

In Table 2-2, population distribution by age group is presented. As shown, the highest percentage of the population for the jurisdictional areas evaluated is within the working age group of 18 to 64 years. The City of Linden has the greatest amount of residents aged 65 years to older (at 16.3 percent) while the City of Elizabeth has the smallest amount (at 10.0 percent). This is also reflected by median age reported with Linden having the highest median age (38.0 years) and Elizabeth having the lowest (32.6 years).

2.2.2 Economic Indicators

Per capita income for the jurisdictional areas evaluated is reported in Table 2-3. In 1999, per capita income for the cities of Elizabeth, Linden, and Rahway were substantially less than that for Union County, with the City of Elizabeth having the lowest ($15,114). Similarly, the 1987 to 1999 percent increase in income for the City of Elizabeth (42.5 percent) was lower than that for Linden (57.3 percent) or Rahway (60.3 percent). The City of Carteret had a lower per capita income than the rest of Middlesex County; however, the per capita income reported for Woodbridge Township ($25,087) was very close to the number reported for Middlesex County ($26,535). The 1987 to 1999 percentage increase in per capita income was significantly less for Carteret (47.7 percent) compared to Woodbridge Township (71.1 percent).

Household income data reported for 1999 and 2004 are shown in Table 2-4. Median household incomes were somewhat higher for Middlesex County ($60,987) compared to Union County ($55,247). The percent of persons living below the poverty level in the City of Elizabeth was a substantial portion of the population (17.8 percent) and was over twice the number for Union County (6.4 percent). A similar trend was reported for families living below the poverty level in 2000; the percentage reported for the City of Elizabeth was 15.6 percent versus 5.0 percent for the City of Linden.

2.2.3 Labor Information

Available data on the civilian labor force for cities and counties in the vicinity of the LCP site are shown in Table 2-5. In 1999, the City of Carteret had the largest percentage of unemployed (at 5.8 percent) followed by the City of Elizabeth (5.2 percent), the City of Rahway (4.3 percent), and the City of Linden (3.6 percent). Union and Middlesex Counties displayed similar percentages of unemployed residents—3.5 percent and 3.4 percent, respectively.

Employment data by industrial category (1999 data) for Union and Middlesex counties is presented in Table 2-6. Employment trends are slightly different from what they were during the last census. The manufacturing industry accounted for the highest percentage of jobs in Middlesex County at 18.6 percent while the education and healthcare industries accounted for 18.4 percent in Union County. The retail trade industry is also a major employer in both counties. The agricultural and mining industry employs only a minor portion of the employed populations in Middlesex and Union counties (0.1 percent in both counties).

2.2.4 Summary of Demographic Characteristics

In summary, the New Jersey jurisdictional areas within a one-mile radius of the property boundaries are experiencing a slight increase in population. Only a small increase in population was projected in Union County to the year 2006 (1.6 percent increase) and a somewhat greater increase was projected for Middlesex County (4.9 percent). The majority of the population living in the region of the LCP site is of working age (18 to 64 years old). Of the jurisdiction areas evaluated, the City of Linden has the highest percentage of residents over the age of 65 years and also the highest median age (38.0 years).

Per capita income in 1999 for the cities of Elizabeth, Linden, and Carteret is substantially less than their respective counties. The lowest per capita income ($15,114) was reported for the City of Elizabeth. The percentage of persons and families living below the poverty level was also highest for the City of Elizabeth and represents a substantial portion of the population (17.8 and 15.6 percent, respectively). The percentages of persons and families living below the poverty level for the remaining jurisdictional areas were 11.0 percent or less and 8.6 percent or less, respectively.

The percentage of the total civilian labor force that was unemployed ranged from 3.4 percent (Middlesex County) to 5.8 percent (City of Carteret) in 1999. The majority of the work force in Middlesex and Union counties was employed in the manufacturing, education and the health care industry, and retail trade industries as of 1999.

2.3 Climate and Meteorology

Climatological data are recorded at the NOAA measuring station located at Newark Airport in Newark, New Jersey. The LCP site is located approximately seven miles south of the recording station. The elevation and topographic setting of the LCP site are very similar to that of the NOAA station such that the NOAA data provide an accurate representation of the climatology of the site. The climatology for the area was obtained from Comparative Climatic Data for the United States (NOAA, 2000) and monthly summaries up through 1998 (NOAA). Mean temperature and precipitation data contained therein are based upon a thirty-year period of record from 1961 to 1990 referred to as "normals". Wind direction and speeds are based upon records since 1944.

2.3.1 Temperature

Average daily temperatures range from a normal daily maximum of 87.0°F in July to a normal daily minimum of 23.4°F in January. The normal monthly temperatures range from 77.8°F to 30.6°F (Table 2-7) and occur in the months of July and January, respectively. The average 30-year normal of the average monthly temperatures for the period of record is 54.8°F. The average normal daily maximum is 63.4°F and the average normal daily minimum is 46.1°F. Although the average normal monthly temperature varies greatly, with an average deviation of 14.3°F, these temperatures occur in a relatively normal distribution (Figure 2-19), with July being the warmest month and January and February comprising the colder months on either side of the temperature distribution. Occurrences of extreme temperatures have been recorded as high as 105°F in July of 1966 and as low as 8°F in January of 1985.

2.3.2 Precipitation

The 30 year normal of the annual precipitation is recorded as 43.97 inches (Table 2-7). The annual precipitation is fairly uniformly distributed throughout the year (Figure 2-20) with a mean deviation of 0.30 inches. Extreme monthly precipitation values have been reported as high as 13.22 inches in October 2005 and as low as 0.07 inch in June 1949. The mean maximum precipitation for a 24-hour period is reported as 7.84 inches in August 1971. Relative humidity for the region averages 73 percent at sunrise (0700 hours) and 53 percent at sundown (1900 hours). Although slightly higher relative humidity readings are reported for the months of August through January, mean monthly readings occur in a generally uniform distribution throughout the year.

2.3.3 Prevailing Wind Direction and Speed

The prevailing wind direction for the area is from the southwest during the months of May through December as determined by data compiled by NOAA, since 1944. However, during the months of February through April, the prevailing wind direction is from the northwest or west-northwest. The mean wind direction in January is from the northeast.

The mean prevailing wind speed is reported as 10.2 miles per hour (mph), and varies from 11.9 mph in March to 8.7 mph is August (Table 2-7). Higher mean wind velocities occur during the months of November through May, while lower velocities are observed in the months of June through October. The highest wind speed (fastest observed one min value) recorded at the Newark Weather Station is 82 mph in November 1950. The next highest wind speed is recorded at 58 mph in December 1984.

2.4 Surface Water Bodies

In the following sections, information (including surface water features and classifications) is presented and discussed. Information is provided for both the region and for areas within the LCP site's boundaries.

2.4.1 Regional Surface Water Features

Tidal marsh formerly covered the entire area in which the LCP site is now located. Nearly all developed land in the Tremley Point area, inclusive of the LCP site, constitutes man-emplaced fill material laid over the former tidal marsh. Therefore, the topography of the area is relatively flat, with an elevation of only a few feet above sea level. The primary exception is the naturally-occurring high ground southwest of the LCP site along which Tremley Point Road runs. Additional information regarding the placement and distribution of anthropogenic fill is presented in Section 2.1.1.

The LCP site is almost entirely surrounded by tidal water bodies. Most prominent among these is the Arthur Kill, which is a large tidal straight that connects Newark Bay and Kill van Kull to the north and Raritan Bay to the south. The Rahway River, with a drainage area of 41 mi^2 (Rahway River Association, 2008) joins the Arthur Kill just south of the site. Piles Creek is a small tidal creek that connects to the Arthur Kill immediately north of the adjacent GAF site. To the west of the LCP site is the tidal stream known as Marshes Creek, which is a tributary of the Rahway River. Relatively extensive areas of unfilled tidal marsh exist along the lower reaches of the Rahway River, Marshes Creek, and Piles Creek.

Other tidal streams located further from the LCP site include Morses Creek and the Elizabeth River which flow into the Arthur Kill north of the site; and Kings Creek, which is another small tributary of the Rahway River, located west of the site. A number of tidal creeks enter the Arthur Kill from Staten Island including, from north to south, Old Place Creek, Pralls Creek, Sawmill Creek, Neck Creek and Fresh Kills. The locations of each of the surface water bodies are depicted on Figure 2-21.

2.4.2 Surface Water Classifications

The major surface water bodies located near the LCP site, including the Arthur Kill and the Rahway River, have been classified under the NJDEP Surface Water Quality Standards, N.J.A.C. 7:9B-1.15.

The Elizabeth reach Arthur Kill, along which the site is located, is classified as SE3. The designated uses of SE3 waters include: secondary contact recreation; maintenance and migration of fish populations; migration of diadromous fish; maintenance of wildlife; and any other reasonable uses [N.J.A.C 7:26B-1.12(f)].

The lower tidal reach of the Rahway River is classified as SE2. The intended uses of SE2 waters include maintenance, migration and propagation of the natural and established biota; migration of diadromous fish; maintenance of wildlife; secondary contact recreation; and any other reasonable uses [N.J.A.C 7:26B-1.12(e)].

2.4.3 Flood Hazard

Flood insurance studies for Union County, New Jersey (FEMA, 2006) reveal that various areas of the City of Linden are subject to both tidal (coastal) and fluvial (riverine) flooding. The tidal wave velocities are dampened by the meanders of the stream channels such that the tidal influence is less severe than the fluvial flooding along more inland local waterways. The City of Linden is subject to fluvial flooding along Morses Creek, Peach Orchard Brook, and Kings Creek which is caused by rivers and streams overflowing their banks. The Arthur Kill and its tributaries account for tidal flooding in the area. Water levels in these waterways are controlled by tidal conditions.

As stated previously, the site is nearly completely surrounded by tidal water bodies, including the Arthur Kill and its tributaries. The Arthur Kill (and its tributaries) are subject to tidal and coastal flooding influence and are not subject to riverine flood hazards. In addition, the facility is located outside of the influence of fluvial flooding by Morses Creek, Peach Orchard Brook, and Kings Creek. Therefore, the LCP site is not subject to riverine flooding.

Coastal flooding is caused by long and short wave surges that affect the shores of the open ocean, bays, and tidally influenced rivers, streams, and straights (such as the Arthur Kill). The movement of coastal waters is influenced by the astronomic tide and meteorological forces such as northeasters and hurricanes. Flooding is primarily the result of storm surges, wave setup, and wave run-up which occur during hurricanes and northeasters.

The 100-year tidal flood elevation has been established by FEMA (2006) at 8.4 feet NGVD, a level that would flood most of the LCP site.

2.4.4 Navigational Dredging

The Arthur Kill is a large, highly industrialized navigational tidal straight. It is tidally influenced by the New York Harbor and the Atlantic Ocean. Given the depositional character of the water body, it is necessary to periodically dredge the navigation channels to maintain this important waterway for commercial shipping. The dredging responsibility lies with the United States Army Corps of Engineers (USACE).

Dredging in the Arthur Kill has been performed since the 1870s when the navigational channel was first dredged to the depth of 16 feet (New York Times, 1873). In the recent decades, the navigation channel has been maintained at the depth of 35 feet and a width of 600 feet. A massive harbor improvement project is currently underway in which the navigational channels in the Arthur Kill will be deepened by dredging to a depth of 41 feet. The longer term plan will be to further deepen the Arthur Kill navigational channel to 50 feet (Port Authority of New York and New Jersey, 2008). The ongoing and planned future dredging necessarily results in the removal of huge amounts of sediment.

2.5 LCP Structures

2.5.1 Buildings

The chlorine production facilities that comprise the majority of the site were first constructed between 1954 and 1956. Cell Building No. 240 and other structures were not constructed until LCP ownership in the early 1970s. A brief description of the usage and history of the structures involved in the chlorine production, as well as the hypochlorite and hydrogen production facilities still found on the site follows below (Figure 1-3).

Building 223 – Kuehne Chemical Inc., Hypochlorite Facility – This facility was leased in 1972 and produced sodium hypochlorite (Bleach) from chlorine and sodium hydroxide transferred to the structure from the Chlorine facilities via overhead pipes. Chlorine, sodium hydroxide, hydrochloric acid and sodium hypochlorite were also stored and distributed from this facility.

Buildings 230 and 240 - Building 230 was the original mercury cell room that was built with the rest of the plant in the mid 1950s and contained 42 mercury cells. Building 240, the "new" cell room, was constructed sometime around 1972 and it contained 40 mercury cells. Process wastewater, brine spills, and mercury cell wash water in the buildings drained to concrete floor trenches, collected in sumps in the northeast corner of each cell building, pumped to holding tanks, and eventually pumped to a wastewater treatment system. Mercury was reportedly recovered from separators in the sumps and returned to the cells. A new concrete floor was poured over the old one in January 1981 due to the observation of cracks in the old floor.

Building 230 is among the most dilapidated structures at the site. Portions of the concrete block walls and individual concrete roof panels have periodically collapsed. However, this steel-framed building has not shown evidence of catastrophic failure and associated collapse. While the condition of Building 240 appears to be relatively un-degraded, the condition of the members that support a large gantry crane is not known.

Building 231, Liquefaction Building, Purasiv Area – Building 231 originally housed compressors and other equipment for chlorine liquefaction. An HCl burner and a commercial hydrogen gas purification unit ("Purasiv") used for the removal of mercury were located south of the building. A former electric substation, diesel generator, and wastewater area were located immediately north of the building.

Building 233 – Brine Building – Brine was treated and filtered in the brine treatment tank within Building 233. This included adding sodium hydroxide, sodium carbonate, and barium chloride to precipitate impurities out of solution. The remaining precipitates were transferred to the Brine Sludge Lagoon. Prior to the construction of the Brine Sludge Lagoon in the 1960's, it is unknown where the sludge was disposed of. The concrete block walls of this steel-frame building are substantially degraded.

Building 250 - Warehouse – The mortar between the concrete block in the walls appears to be substantially degraded. Portions of the warehouse may be in jeopardy of collapsing. However, the warehouse is a relatively small structure and no hazardous materials are known to presently exist within it.

Linde Hydrogen Plant - This structure was leased from the Owners of the site and operated from 1957 1990. Hydrogen produced from the chlorine process in Buildings 230 and 240 was piped to this facility where it was purified and stripped of mercury. Prior to the occupation by a new tenant, the lessee UCC had the building and equipment decontaminated and sampled for mercury. In 1990 the expiration of the lease prompted an ECRA investigation. An environmental investigation and cleanup followed, with NJDEP approving "No Further Action" (NFA) in 1995. The property was later used by Liquid Carbonic Corporation for office space and truck parking.

Salt Unloading - Salt to be used in the preparation of brine for the chlorine process was unloaded at this location.

Former Brine Sludge Lagoon (now referred to as the "Closed RCRA Unit") - Precipitate sludge from Building 233 was mixed with brine to form slurry, which was pumped into this surface impoundment. The liquid component of the slurry was allowed to settle out then was pumped back to Building 233 to be purified and recycled. The lagoon was closed under a RCRA permit in 1984.

Chemfix Lagoon - The Chemfix Lagoon was constructed in 1976 north of the Brine Sludge Lagoon to conduct a test to determine whether the mercury in the brine sludge could be stabilized, thereby allowing the material to be managed as non-hazardous waste. The lagoon had the rough shape of a triangle with sides of about 60 ft by 80 ft by 80 ft. and was constructed with 8 foot high earthen berms. It was lined with two layers of 0.20 mil thick impermeable geosynthetic liners separated by a sand layer for an underdrain leachate collection system. Leachate collected by the system was pumped to the wastewater treatment system at Building 231. A demonstration run was conducted by Chemfix Technologies Inc. in 1976. Approximately 120,000 gallons of brine sludge (about 460 cubic yards) were treated and stored in the Chemfix lagoon over a four-day period. The process was never repeated and the lagoon was not used again.

In October 1981, LCP Chemicals, Inc., submitted a closure plan for the Chemfix lagoon to the NJDEP and reported that the treated material had the consistency of concrete. The closure strategy consisted of dewatering the lagoon, treating the wastewater in their waste treatment facility, and transferring the solid Chemfix contents, including liners and leachate collection system, to the Brine Sludge Lagoon.

The closure plan was approved by the NJDEP and the Chemfix lagoon materials were transferred to the brine sludge lagoon by September 1983. The Chemfix lagoon was backfilled, graded, seeded, and formally closed by the end of 1983 with NJDEP approval.

Former Sludge Roaster - A pilot sludge roaster unit was constructed south of the brine sludge lagoon in 1978, but the brine sludge material was processed through it only infrequently. By 1980, the final modifications to the sludge roaster were completed and the unit was brought back on line after LCP Chemicals, Inc., was issued a temporary air permit from the NJDEP. In 1985, the unit was dismantled and moved off Site, leaving only the concrete pad.

A number of additional structures are located on the LCP site, including:

- Building 220 – Shops and Service Building
- Building 221 – Lab and Locker Building
- Building 234 – Cooling Tower
- Building 250 – Warehouse
- Building 309 – Cooling Tower
- FRP Fabricating Shop

2.5.2 Tanks

A number of tanks are located on the site that were previously used to store mercury, chlorine, hydrochloric acid, brine, bleach, petroleum and other compounds. The onsite tanks were investigated as part of the Phase I and Phase II RI. The name, location, contents and condition of the tanks are detailed in Table 2-8.

2.6 LCP Waste Handling

2.6.1 Wastewater and Site Drainage

Industrial process water and stormwater flow from the LCP site during operations drained to the Arthur Kill. This drainage occurred historically via the former GAF site drainage system through hydraulic connections to South Branch Creek. After approximately 1976, the wastewater drainage was treated separately from the GAF site. The drainage in and around the LCP site was modified several times, and is described as follows:

Prior to 1947

Prior to 1947, before operations began at the LCP site, South Branch Creek was oriented in what was a relatively natural tidal stream channel that was relatively unimpacted by filling (Figures 2-2 through 2-4). The flow originated from the area located west and south of the GAF site production area and flowed eastward across the center of what would later become the LCP site to discharge to the Arthur Kill (Figure 2-22).

Surface water drainage in the wetlands located to the southwest of the LCP Site flowed into the Northern Off-Site Ditch, and followed a parallel alignment to the future LCP property line towards the southeast and onward to a series of mosquito ditches leading to the Arthur Kill. The remnants of ditches from the western side of the LCP Site and adjacent GAF property directed drainage into the Northern Off-Site Ditch. The Southern Off-Site Ditch runs parallel to the Northern Off-Site Ditch and collected drainage from the future Conoco bulk petroleum storage property, and discharges to the same series of Mosquito Ditches.

1947 to 1951

Starting in 1947, South Branch Creek was diverted to an alignment that looped around the southern area of the future LCP production area prior to discharging to the Arthur Kill. The realignment was associated with the filling of the portion of the creek in what would become the production area of the LCP site. That same year the original creek was filled in. A primary treatment facility was constructed along the southerly loop of South Branch Creek on the LCP site as observed on the April 20, 1951 aerial photo (Figure 2-11).

The Northern Off-Site Ditch has been redirected to a culvert on the downstream end which appears to have directed flows in a northeast direction across the present day alignment of South Branch Creek. The alignment of the Southern Off-Site Ditch remains the same. The Southern Off-Site Ditch was placed in a culvert at its downstream end to re-direct flows in a direct eastward direction towards the Arthur Kill.

1951 to 1966

The construction of the future LCP site began in approximately 1951. The chlorine operation began at the LCP site in 1955. By 1956, the core of the buildings required for the chlorine productions were present, including Buildings 220 and 230. The hydrogen processing facility started operation in 1959. The Brine Sludge Lagoon was reportedly constructed in 1962. Four years later, berms were present along the north and west side of the lagoon area.

The South Branch Creek channel continued to flow to the Arthur Kill from the southeastern portion of the GAF site, as described above, around the southern end of the LCP site, until 1966 (Figure 2-23). During this time, wastewater in South Branch Creek and site drainage from the LCP and GAF sites were treated in the primary wastewater plant area located at the southern end of the South Branch Creek loop on the LCP site as observed on Figures 2-13, 2-14, 2-15 and Figure 2-22.

The process wastewater from the mercury cell buildings drained to concrete floor trenches where it was collected in the northwest corner of each building. The process wastewater was reported to have been pumped to holding tanks and eventually pumped to the on-site wastewater treatment plant.

1966 to 1971

South Branch Creek was relocated by 1966 into a covered channel (or "flume") located along the northern border of the LCP site (Figure 2-24). The primary WWTP located along the southern loop of South Branch Creek was apparently replaced at this time with a treatment area on the GAF site located several hundred feet upstream of the covered channel. The portion of South Branch Creek that previously looped around the southern side of the LCP site was replaced by a continuous concrete drainage trench.

1971 to 2003

In 1971, GAF ceased chlorine manufacturing operations. A year later, in 1972, LCP Chemicals, Inc. purchased the site from GAF and restarted manufacturing operations. Around the same time, the South Branch Creek channel located east of the railroad tracks was relocated into a newly created, narrow, man-made channel that discharged to the Arthur Kill approximately 950 feet south of the former South Branch Creek channel (Figure 2-25). This is the present alignment of the South Branch Creek channel.

A shallow concrete trench surrounding the process area was constructed in the 1970s (Eder, 1992) and was utilized to collect storm water and excess runoff from LCP Buildings 230 and 240. The flows in the trench were routed to a concrete sump south of Building 231 before being pumped to holding tanks outside Building 233. The water was pH adjusted, filtered, polished with carbon, and stored pending discharge to South Branch Creek under a NJPDES permit.

Wastewater treatment was previously reported to have occurred in a pond located along South Branch Creek immediately east of the electrical switchyard on the LCP site (Eder, January 1992) and as noted in an aerial photography analysis by USEPA (1999). Through the review of additional historic information, it is now known that this area was not used for treatment. This area is now known to have represented a wide segment of the ditch that was crossed by a bridge, hereinafter referred as the "Ditch Bridge Area" (Figure 2-14). The treatment area has been correctly located as previously discussed. The Ditch Bridge Area was reportedly excavated, backfilled, and covered with asphalt. The Ditch Bridge Area was still present in mid 1972 (LCP, July 21, 1972) and possibly only backfilled in 1982 (NJDEP, February 1982).

Around 1975-76, GAF constructed a new wastewater treatment facility on the GAF site. With the commencement of that wastewater treatment plant, wastewater flows from the LCP and GAF sites became separate.

The exposed portion of South Branch Creek, located immediately west of the railroad bridge, was blocked off with timber cribbing. This blockage of the creek likely occurred sometime after 1976 when the LCP site drainage was separated from that of the GAF site.

The chlor-alkali operations ceased in 1985. As discussed previously, the site continued to be used as a transfer terminal for other Hanlin products until 1994.

After 2003

Stormwater drainage from a large portion of the LCP site previously drained overland to a ditch that was located on the GAF site located immediately north of the LCP property line. Remedial construction activities at the GAF site including the construction of the shallow groundwater barrier and the site regrading have created a large undrained area in the northern and central areas of the LCP site.

Stormwater drainage from the LCP site is currently poorly defined. Large areas of the site are currently undrained including the aforementioned area along the GAF property line. In addition, much of the former LCP production area is currently undrained given the cessation of stormwater collection and treatment on the LCP site. Remaining areas of the site do drain to South Branch Creek and the unnamed ditch located immediately south of the LCP site. However, drainage from these areas is not well established given a lack of drainage structures and the nearly flat grades on the site. Accordingly, surface water that does drain to South Branch Creek and the unnamed ditch is characterized by undefined pathways and a distinct lack of high velocity flow. Ponding occurs in several areas of the site for long durations depending on rainfall intensity and duration.

2.6.2 Solid and Hazardous Waste Generation

It was reported that mercury-contaminated sludge, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, mercury contaminated process wastewater, spill wash down fluids and stormwater runoff were all waste products generated onsite (Eder, January, 1992).

The main source of mercury waste was the brine purification mud (otherwise known as, brine sludge) and associated process wastewater. In 1981, brine purification mud from mercury cell processes was listed as a hazardous waste by the EPA, No. K071. Associated wastewater treatment sludge was also listed as a hazardous waste, No. K106. The driving chemical behind the new classification was mercury.

A "typical" brine sludge composition as reported by LCP in 1975, was NaCl (20%), $BaSO_4$ (50%), $CaCO_3$ (15%), $CaSO_4$ (15%), metal hydroxides (2%), dirt (2%), mercury (100-500 parts per million – 0.05%). Wastewater treatment sludge was also generated during chlorine production. In a 1975 LCP Preliminary Report on Brine Sludge, LCP estimated that 7.5 tons of sludge was generated everyday and that their current sludge stockpile was an estimated 11,000 cubic yards (Eder, 1992). Eder (1992) reported that up to 20 tons of sludge was generated per day.

Between 1980 and 1981, seven sludge samples were analyzed for selected inorganics (NJDEP, January 8, 1988). The samples showed that the sludge contained mercury concentrations ranging from 272 mg/kg to 4,574 mg/kg. Liquids filtered from the sludge contained mercury concentrations ranging from 40 µg/L to 2,520 µg/L.

A survey plan in a groundwater quality monitoring report by Geraghty & Miller (1982) shows that the brine sludge pile grew to a height of about 40 feet above the ground surface. An estimated 31,000 cubic yards of brine sludge was left in the lagoon at the time of its closure. The contents of the lagoon were dewatered, graded compacted and capped with clay and soil in 1984. This closure was permitted by NJDEP a New Jersey Pollution Discharge Elimination System (NJPDES) Discharge to Groundwater (DGW) Permit. The DGW permit is the New Jersey equivalent of a RCRA permit under USEPA's authorization of New Jersey's Hazardous Waste program.

Other potential sources of contamination included:

- Anthropogenic fill placement by duPont, GAF and Conrail.
- Kuehne Chemical Company, which operated at the site from 1972 to 1981, allegedly dumped bleaches and other caustic materials into South Branch Creek on a daily basis.
- The Linde Division Hydrogen Plant, which received mercury-contaminated hydrogen gas from about 1957 to 1980, processed mercury on a daily basis.
- Eder (September 1993) reported that small quantities of solvents used at the site for general cleaning and degreasing could have been released.
- Transformers were located behind Buildings 230, 240, and 231. (PCB contamination in the oil.)
- Storage tanks at the site used to store a number of different chemicals, including chlorine, sodium hypochlorite, sodium hydroxide, and methylene chloride (NJDEP, January 8, 1988).

- A 300 square-foot concrete drum storage pad with containment berms was located onsite. It was used to store motor oil, waste oil and other lubricants (Eder, 1993). During a NJDEP site inspection in December 1987, it was noted that there was stained soil in the area and vapors were detected.
- Active Water Jet discharged wash water from dirty tanks and pipes onto the site.

2.6.3 Environmental Compliance

2.6.3.1 Summary of Incidents and Enforcement Actions

In September of 1975, LCP was fined $10,000 for discharges of supernatant from the brine sludge lagoon into South Branch Creek in both 1971 and 1974, according to the NJDEP (July, 1991). On September 17, 1981 the NJDEP signed the Administrative Consent Order, which required LCP Chemicals, Inc. to cease use of the brine sludge lagoon by January 1, 1982, submit a closure plan for the sludge lagoon, submit a closure plan for the Chemfix lagoon, conduct air monitoring of the sludge pile and conduct groundwater, surface water, soil and sediment sampling sessions.

By late 1984 both sludge lagoons were closed. Air monitoring of the sludge pile took place on June 4, 1981 (RECON, 1981). Limited groundwater, surface water, soil, and sediment sampling were taken by Geraghty and Miller (1982).

The NJDEP issued an Order dated May 4, 1982 to cease the November 5, 1981 violation of N.J.A.C. 27-8.3(e)2 resulting from a ruptured muffler plate on the sludge roaster, which subsequently allowed mercury emissions to vent through for unpermitted roasting sessions. The sludge roaster was abandoned due to "bugs" in 1981. In a June 4, 1982 letter the NJDEP denied LCP's Hazardous Waste Facility Permit Application due to several deficiencies in the sludge roasting system. LCP responded with a letter promising to fix the issues with the brine stabilization process.

The EPA issued a Complaint/Compliance Order dated August 1982 for lack of freeboard in a surface impoundment (otherwise known as the brine sludge lagoon). LCP was also cited for lack of waste analysis plan, not maintaining a scheduled inspection period, and a lack of a contingency plan. The freeboard penalty held a $1,000 fine; however, the other violations were corrected, thus a fine was avoided.

One year later in 1983 the NJDEP issued two "Notice of Violations". One was for failure to submit a RCRA Treatment, Storage, or Disposal Facility Report. A report was submitted shortly after and so a penalty was avoided. The second was for failure to establish financial assurance for closure and post-closure monitoring of the brine sludge lagoon and to demonstrate financial responsibility for claims. LCP stated that the NJDEP Division of Waste Management now had copies of the necessary documents and that the matter was resolved.

The NJDEP issued an Administrative Order, dated February 11, 1985, requiring that LCP maintain documentation of the job title for each position at the facility related to hazardous management, the name of the employee that filled each job, security of roll-off containers with hazardous waste and to develop an evacuation procedure for employees. LCP corrected the problems and was issued a $900 fine.

2.6.3.2 Summary of Spills and Releases

The following spills/releases are documented by the EPA and NJDEP.

- In October 1972 and February 7, 1974, the NJDEP reportedly observed lagoon overflows into South Branch Creek, quantities and responses unknown. As for LCP, they acknowledged both discharges in September 1975 and were levied a fine by NJDEP of $5,000 for each occurrence (NJDEP, July 1991).

- June 25, 1975 – During a recycle pump failure, nine hours worth of discharge from the brine sludge lagoon spilled into South Branch Creek (LCP, July 27, 1975).
- August 15, 1979 – A salt blockage in a saturator caused an overflow of mercury contaminated brine (LCP, August 20, 1979). A sample of the overflow was taken by LCP and showed a concentration of 8.6 parts per million of TDS.
- In early 1981, a former employee who worked there from '72 to '80 stated he would sometimes analyze effluent water being discharged into South Branch Creek (NJDEP, October 7, 1981). It was noted that one specific time this former employee measured mercury concentrations of eight to ten times greater than the maximum allowances.
- October 7, 1981 – The NJDEP cited the Kuehne Chemical Company for discharging caustic material into the creek (NJDEP, October 7, 1981). Kuehne refused to accept charges and subpoenaed the NJDEP twenty days later for depositions. The outcome is unknown.
- The following spill documentation was noted in a RCRA Facility Assessment for LCP, NJDEP Site Inspection Reports regarding several spills near the 500,000 gallon brine tank (NJDEP January 8, 1988):
  - The first of the documented spills was in September 1980 when an unspecified amount of brine sludge was noted on the gravel near the tank. The second was also in 1980, one month later. While transferring brine sludge from the 500,000 gallon tank to the lagoon some was spilled. (Front end loader and dump trucks were used for this process). LCP stated that the sludge would be flushed to the sump next to the tank.
  - In January 1981, an overhead pipe appeared to have a leak, which dumped wash water from cells onto unpaved ground. Another pipe was observed to have had a leak in 1981. However, this pipe was filled with hydrochloric acid. The final spill located by the 500,000 gallon tank was noted in April 1982. It involved a spill of sodium sulfide crystals.
- Though that was the final spill documented by the tank, it was not the last documented spill on site. Other NJDEP Site Inspection reports cite brine sludge spills/ leaks (NJDEP, January 8, 1988). Three examples were found and are listed below, all in 1981.
  - In January 1981, a former employee who worked on site from 1972 to 1980 stated that brine sludge was removed from the lagoon and spread out on the ground between Building 231 and the railroad tracks (NJDEP January 25, 1981). It was noted that to the former employee's knowledge this only happened one time in either 1973 or 1974.
  - In October 1981, a 1 ft by 15 ft spill of brine sludge slurry leaked from overhead piping between the 500,000 gallon tank and the sludge lagoon. The exact location is not well documented, but noted on the NJDEP sketch maps (NJDEP November 19, 1981).
  - In November of 1981, an overhead line was leaking, resulting in a 30 ft by 125 ft spill along Avenue B railroad tracks.

The information on spills/releases at the LCP site was one factor used to develop the original RI work plan for the site (URS, 2001).

2.6.3.3 LCP Environmental Upgrades

LCP met with the NJDEP by 1975 to investigate waste disposal options for brine sludge, wastewater and the estimated 11,000 cubic yards of sludge material stockpiled in the brine sludge lagoon. LCP Chemicals, Inc. informed the NJDEP that off-site disposal options were too expensive and elected to begin pilot testing a more cost effective stabilization process developed by Chemfix Technologies, Inc.

As required for stabilization, an auxiliary surface impoundment was constructed onsite, the Chemfix lagoon. Its process treated about 120,000 gallons (or 460 cubic yards) of brine sludge over its 4 days existence in 1976. The results were apparently questionable, so the Chemfix process was never continued.

LCP Chemicals, Inc. also tested a sludge roasting process. This stabilization method would volatilize and capture mercury from steam dried brine sludge. LCP received favorable results during bench testing. A pilot sludge roaster unit was constructed south of the brine sludge lagoon in 1978. Throughout the lifespan of the sludge roaster, it was only used infrequently as it required constant "debugging, modification, and repair". Finally in 1980, the sludge roaster was up and running. LCP was issued a temporary air permit from the NJDEP, although a final permit was never issued. In December 1980, LCP Chemicals, Inc. and the NJDEP agreed that the brine sludge lagoon required closure and would formalize the process through an Administrative Consent Order.

In 1982, LCP ceased plant operations during the lagoon closure as a protective measure for plant workers' health and safety, reportedly at the orders of the NJDEP and EPA. A year later the Chemfix lagoon was closed (all materials were transferred to the brine sludge lagoon). The brine sludge lagoon was closed by November 1984 with NJDEP approval. In accordance with law, the lagoon was reportedly dewatered, compacted, covered with a two foot thick clay cap, and then covered again with soil and seeded as part of a RCRA permit for the Closed Brine Sludge Lagoon). This area is now called the closed RCRA Unit. In June 1984, LCP submitted a facility closure plan to the NJDEP. The EPA (1984) stated that LCP Chemicals, Inc. had planned to begin chlor-alkali manufacturing facility operations again in late 1984, but decided to cease all plant production instead. By August 1985, all plant productions were stopped. The facility was dismantled; the equipment was shipped to other LCP facilities along the east coast. The facility was still being used as a storage and transfer station for chlorine-related products, including, sodium hydroxide, potassium hydroxide, methylene chloride, and hydrochloric acid.

The Hanlin Group, Inc. filed for bankruptcy under the Chapter 11 of the U.S. bankruptcy code in July 1991. By April 1994, Hanlin sold all of its company assets and ceased all operations. After a site visit in August 1994, the EPA confirmed that the facility was no longer functional and that all employees were expected off the site by the end of August 1994. On November 10, 1998 the site property was formally abandoned by the bankruptcy trustee by order of the Federal Bankruptcy Court.

2.6.3.4 Environmental Permits

In 1975, a NJPDES - Discharge to Surface Water (DSW) permit was granted to LCP for discharge of treated wastewater.

In August 1974, Kuehne Chemical Company submitted a New Jersey Pollutant Discharge Elimination System (NJPDES) permit application (No. 0027707). It was not until August 1980 that Kuehne received a permit for discharge of cooling water only. One year later, the NJDEP alleged that Kuehne was illegally dumping caustic chemicals. A Notice of Civil Administrative Penalty Assessment was issued to Kuehne. The notice states that a pipe was observed during an NJDEP site visit on January 26, 1981 "connected to the outfall in such a manner as to allow for a physical conduit for the passage of pollutants to the waters of the State." The connection was removed the next day on a follow-up visit by the NJDEP. The notice also stated that the Kuehne operations had ceased and vacated the site on the next day.

A NJPDES-DGW permit (No. NJ0077038) renewal was issued to LCP Chemicals – New Jersey on June 11, 1993 with respect to the RCRA closure of the former brine sludge lagoon. This permit is the equivalent of a RCRA Post Closure permit under the USEPA authorization of New Jersey's Hazardous Waste program.

2.6.3.5 Interim Remedial Actions

Interim Remedial Measure of Former Mercury Cell Buildings

An Interim Removal Action (IRA) was performed by ISP-ESI in the former mercury cell buildings and elsewhere in the production areas on site in 2001 and 2002. The IRA included the removal and disposal of former process equipment, laboratory samples and chemicals, visible elemental mercury that was present at that time, loose asbestos, and miscellaneous debris. Further detail of the IRA is provided in the Interim Removal Action Final Report, prepared by URS dated April 16, 2001.

Proposed Interim Action for South Branch Creek

The conceptual design for an Interim Action (IA) was proposed by ISP-ESI on June 15, 2007, in response to the presence of elevated mercury and other contaminants in sediment and low marsh soils associated with South Branch Creek. The IA was intended to arrest the potential migration of the contaminated low marsh soils and sediments from the site. Implementation of the proposed IA was rejected in a letter from Ms. Carole Petersen of USEPA dated August 8, 2007.

2.7 Regional Geologic Conditions

The area of the site is located on the eastern edge of the Newark Basin, which is located in the Triassic lowlands subprovince of the Piedmont Plateau physiographic province of New Jersey. The Newark Basin contains approximately 15,000 to 20,000 feet of late Triassic and Early Jurassic (135 to 225 million years ago) continental derived sediments, including shales, siltstones, sandstones, and conglomerates. Interbedded among these sediments are three major extrusive basalt flows and one major diabase intrusive, representing volcanic episodes during the early Jurassic period (Olsen, 1980). A thin mantle of Pleistocene glacial and Recent deposits covers much of the Newark Basin rocks today. These units are described in additional detail in the following subsections.

2.7.1 Surficial Geology

Anthropogenic Fill

Anthropogenic filling of the region began in the 1600s as soon as European settlement occurred. Larger scale filling occurred in the late nineteenth and early twentieth century and was largely associated with industrial and transportation infrastructure development. Filling continued in the area to support the Newark Airport and the Port Newark and Port Elizabeth marine terminals until around 1970. A large percentage of the former tidal marshes in the area have now been filled. The emplaced fill materials include sand, gravel, silt, clay, and rock, as well as various man-made materials like cinders, ash, brick, concrete, wood, slag, glass, and trash (Stanford, 2002). The fill is most often less than 10 feet thick but may be thicker in road and rail beds.

Tidal Marsh Deposits

Recent sedimentation in the region includes alluvium (river), tidal marsh, and eolian (windblown) deposits. The alluvium includes floodplain, channel, and backswamp deposits, which include sands, silts and minor gravels and clays with sorting that varies from well to poor, depending on the specific depositional environment.

Tidal marsh material, underlying the anthropogenic fill, is present beneath much of lowland areas that comprise the eastern portion of Linden bordering the Arthur Kill and other coastal and tidal water bodies in New Jersey. Tidal marshes are flat, low lying coastal areas that become regularly inundated during high tide periods. Sediments that have formed in the marsh areas in the vicinity of the site include organic rich silts and clays, as well as peat. The peat typically consists of a horizontal layer of roots of salt tolerant plants in various stages of biological decomposition. The peat occurs in varying states of

weathering and consolidation. Peat typically weathers to organic silt and clay. Thus, it is not unusual to encounter the organic silt and clay beneath peat at the base of the tidal marsh deposits. Fine to coarse grained, well sorted sand sediment that formed as the result of eolian (e.g., wind-blown) deposition may be interbedded with the organic clay and peat (Stanford, 2002).

Glacial Till

The Linden area is situated near the glacial terminus and was covered with a relatively thin layer of glacial ice during the last (Wisconsin) ice advance. During this time, much of New Jersey to the west and northwest was covered with a thicker ice layer, estimated to have been at least one mile thick. As a result of a lighter overburden of ice, glacial deposits near the glacial terminus are considerably less dense and less compacted than those to the west and northwest. As the glacier melted, numerous glacial sediments (tills and moraines) were deposited over much of New Jersey. Ground moraine deposits are typically poorly sorted and not stratified. Much of the area north of the terminal moraine, including Linden, New Jersey, is covered by a sheet of ground moraine more commonly called till.

The Rahway Till found in and around the LCP site varies from silty sand to sandy clayey silt. The till contains some to many pebbles, cobbles and a few boulders. The till can be as thick as 90 feet but is usually less than 20 feet in thickness (Stanford, 2002).

2.7.2 Bedrock Geology

The unconsolidated deposits are underlain by Triassic-Jurassic aged sedimentary rock. The rocks formed following the close of the Paleozoic Era (225 million years ago), when compressive forces that formed the Appalachian Mountains relaxed, and extensional forces associated with the rifting and spreading of the Atlantic Ocean began. A series of isolated troughs called grabens formed east of the Appalachian Chain extending from Nova Scotia to North Carolina. As spreading of the ocean progressed, large blocks of crust down-faulted along extensional fault zones. Synchronous with the down faulting, large quantities of continental sediments produced from the erosion of the Appalachian Mountains were deposited in these troughs. The continued accumulation of sediments overloaded the troughs and contributed to their subsidence. This sinking effect allowed for the thick accumulation of Triassic sediments that exist in the Newark Basin. During the early Jurassic Period (180 million years ago), as rifting continued, faults in the area became progressively deeper and intersected the earth's mantle. Consequently, volcanism occurred in the form of extrusive basalt flows over parts of the basin, forming the Watchung Mountains of New Jersey. Three separate episodes of basalt flows occurred, interrupted by periods of continental sedimentation (Faust, 1975).

Nine formations comprising the Newark Supergroup resulted from the lithification of these basin sediments and volcanic flows (Olsen, 1980). The formations from oldest to youngest are as follows: the Stockton, the Lockatong, the Passaic, the Orange Mountain Basalt, the Feltsville, the Preakness Basalt, the Towaco, the Hook Mountain Basalt, and the Boonton. Contemporaneous with the basalt flow events, intrusive sills and feeder dikes formed the Palisades Diabase. The diabase unit is not classified as part of the Supergroup, despite its stratigraphic presence within the Newark Basin formations.

Three of the nine Newark Super group formations are present below the site, including the Stockton, the Lockatong, and the Passaic. The Stockton and the Lockatong formations were not encountered during the investigation, as they are present only at great depth; therefore, they will not be discussed further in this report. The Passaic formation was observed during the investigation and is discussed below in greater detail.

- **Passaic Formation (JTp):** According to Olsen (1980), the Passaic formation, representing flood bank and fluvial deposits, reaches a thickness of approximately 20,000 feet. This unit consists of reddish brown mudstone (a non fissile equivalent of shale), siltstone, and sandstone interbedded with conglomeratic sandstones along the basin margins.

- **Lockatong Formation (Tl):** The Lockatong Formation, which conformably underlies the Passaic Formation, is approximately 3,800 feet thick in west central New Jersey and thins laterally to the northeast and southwest. This formation was deposited as a large lacustrine lens composed of gray and black shales with argillite, flagstone and impure limestone layers (Wolff, 1977). Regionally, the lower members of the Lockatong Formation are intruded by the Palisades diabase as a sill.
- **Stockton Formation (Tl):** The Stockton formation consists primarily of lacustrine sediments similar to the overlying Lockatong formation. The lower Stockton represents mostly fluvial deposits. The Stockton Formation consists of sandstone, siltstone, arkose conglomerate and mudstone with color ranging from a light brown to dark brown-purple-red. The formation has a maximum thickness of 6,000 feet.

One of the nine Supergroup formations, the Passaic Formation (JTp), is present below the Site. In this area, the Passaic Formation is comprised of two facies: the sand and siltstone facies to the northwest and mudstone facies to the southeast of the area. The Linden area is underlain by the mudstone facies. Typically these sediments form cyclic sequences of cross-bedded units that grade upward from coarser to finer grain size. The dominant facies in the formation are siltstone (60%) and mudstone (40%) with the coarser sandstones and conglomerates comprising only a small fraction of the total percentage. Generally, the overall sequence of the Lower Passaic formation becomes finer from bottom to top with more mudstone and less siltstone going upward (Olsen, 1996). The Upper Passaic formation displays the reverse trend, with increasingly frequent silt and fine sand beds and less frequent gray and black mudstones progressively towards the top of the unit.

The upper shale (mudstone) of the Passaic formation is relatively soft and easily weathered. At surface exposures this rock is intensely and indiscriminately fractured on a small scale (1 to 5 mm) and obtains a hackly to chippy appearance. Unlike the siltstone layers of the Passaic formation, this rock lacks well-developed bedding planes and the regional joint pattern set (Houghton, 1986).

With increasing depth, the shale grades vertically into hard, massively bedded siltstones. The regional joint system is very prominent in these rocks and the bedding planes are very distinctive. The dominant strike of the Passaic Formation is reported to be N50°E with the beds dipping gently to the northwest between 9° and 12°. The shale also has a prominent set of vertical fractures (joints) striking N45°E and a less prominent second set of near vertical fractures striking N75°W. Regionally, this rock outcrops several miles west of the site where it exhibits more resistance to weathering and retains its characteristic features.

2.8 Regional Hydrogeologic Conditions

The Passaic and Lockatong Formations form the widespread Brunswick aquifer which conducts water in the region eastward to discharge to the Arthur Kill. Groundwater is found predominantly in the fracture planes within this rock and flow is directionally controlled by the fracture orientation. Permeability and storage are also controlled by fractures in the mudstone and siltstone facies though not necessarily to the same degree in the sandstone facies (Michalski, 1996). Hydraulic conductivities in the Brunswick Aquifer have been found to range from 6.9×10^{-7} cm/sec to 7.6×10^{-3} cm/sec (New Jersey Geological Survey, 2004; Michalski, *et al.*, 1992).

2.8.1 Groundwater Use

Due to the proximity of the Arthur Kill and other tidal waters to Linden, groundwater within this region, including the Passaic bedrock aquifer(s), is typically saline (Anderson, 1968). Since this water exceeds the New Jersey Safe Drinking Standards for naturally occurring salinity, the area is unsuitable for public water supply wells.

Regionally, brackish groundwater concentrations tend to diminish gradually with increasing distance from the source waters. Further inland from the Arthur Kill and within five miles of the site, the Passaic formation is extensively developed as the primary water supply source. The depths of these wells range from 75 to 570 feet and yield volumes of water between 100 and 400 gallons per minute (see Table 2-9). Locally occurring unconsolidated aquifers have also been tapped for water supply within this region. Relatively fewer in number, these aquifer(s) serve as the primary public water source for the Rahway area. Also, some shallow supply wells screened in the Quaternary sand and gravel, and yielding up to 300 gallons of water per minute, are used as a source of industrial waters.

Six (6) public community water supply wells (Figure 2-26), all upgradient of the site, are located within a four to five (4 to 5) mile radius of the site. As shown in Table 2-9, the depths of these wells typically range from 200 to 500 feet bgs. The pumping rates for these wells are not known but the capacity for wells range from 200 to 450 gallons per minute (gpm). Each of these wells is owned and operated by the New Jersey American Water and are located approximately four miles to the northwest and upgradient of the Arthur Kill. New Jersey American Water is the primary supplier of potable water to the Linden, New Jersey area. At the site, all potable water is provided by the New Jersey American Water.

2.8.2 Groundwater Classification

The "default" groundwater quality classification in New Jersey is Class II-A unless otherwise classified as Classes I, II-B or III. Per N.J.A.C. 7:9C-1.5(e)1, "The primary designated use for Class II-A ground water shall be potable water and conversion (through conventional water supply treatment, mixing or other similar technique) to potable water." Therefore, most groundwater in New Jersey is regulated for potential potable supply."

Notwithstanding the Class II-A classification, there are specific areas in the region and at the site in which groundwater is not suitable for potable uses. Some of these have been formally reclassified to Class III-B pursuant to N.J.A.C. 7:9C-1.5(f)4 in recognition of the naturally-occurring saline condition of the groundwater. Other areas that would not meet the Class III-B reclassification requirements nevertheless are unlikely to be developed for potable water supply given other regulatory constraints. These conditions are described as follows:

Overburden Water-Bearing Zone

While naturally-occurring saline conditions are observed in areas of the overburden water-bearing zone in very close proximity to tidal surface water bodies, the areal distribution of this condition is insufficient for the reclassification of the entire zone at the LCP site. However, at least two (2) separate New Jersey regulations would prevent the overburden water-bearing zone from ever being used at the site as a potable or non-potable water supply through the installation of Category 1 or 2 wells[3].

N.J.A.C. 7:9D (Well Construction and Maintenance; Sealing of Abandoned Wells) states that for potable water supplies installed in unconsolidated formations:

> "All well casing shall be no less than four inches in diameter and no less than 50 feet in depth" (N.J.A.C. 7:9D-2.3(a)3i.); and "All wells shall have a minimum length of 50 feet of grout seal extending from the top of the gravel pack or top of the well screen to grade." (N.J.A.C. 7:9D-2.3(a)3iii.)

[3] Per N.J.A.C. 7:9D-2.1, Category 1 Potable Water Supply Wells are defined as "domestic, non-public, public community supply, and public non-community wells" and Category 2 Non-Potable Water Supply Wells are defined as "fire protection, irrigation, test, industrial, livestock, open loop geothermal and injection or recharge wells."

By application of this regulatory restriction, a water supply well can never be installed within the overburden water-bearing zone at the site since it is required to be entirely sealed off by impermeable casing material. Geologic information presented in Section 5.1 reveals that the depth to the bedrock beneath the site typically ranges between 35 and 50 feet below ground surface. This depth is short of the minimum 50 foot casing and grout requirement specified in N.J.A.C. 7:9D such that it would be physically impossible to install a well in the overburden without violating the 50-foot casing requirement.

In addition to this well construction restriction, N.J.A.C. 7.7E (Coastal Zone Management) restricts groundwater use in areas where coastal resources could be negatively impacted by pumping. With regard to groundwater use, this particular regulation states:

> "Coastal development shall demonstrate, to the maximum extent practicable, that the anticipated groundwater withdrawal demand of the development, alone and in conjunction with other groundwater diversions proposed or existing in the region, will not cause salinity intrusions into the groundwaters of the zone, will not degrade groundwater quality, will not significantly lower the water table or piezometric surface, or significantly decrease the base flow of adjacent water sources." (N.J.A.C. 7.7E-8.6(b))

It is likely that groundwater withdrawals from the overburden water-bearing zone would cause substantial reduction of the water table surface that would potentially cause saltwater intrusion. Thus, approval for the use of overburden groundwater as a drinking water source would not be possible under N.J.A.C. 7.7E.

Nevertheless, despite the actual use or potential use of the resource, the regulatory standards for Class II-A are the applicable standards for the overburden water bearing zone

Bedrock Water-Bearing Zone

The bedrock water-bearing zone at the LCP Site has formally been reclassified as Class III-B as described in the document titled "Request for Class III-B Aquifer Designation, LCP Chemicals Inc. Superfund Site and ISP-ESI Linden Site, Linden, New Jersey" (Brown and Caldwell, April 2008) and as approved by a letter from Messrs. Frank Faranca and Ian R. Curtis of NJDEP dated February 27, 2009.

The groundwater quality within the bedrock water-bearing zone was characterized through the sampling of monitoring wells installed and located on both the LCP site and the adjacent GAF site. The water quality data include the results from chloride and total dissolved solids (TDS) analyses in addition to numerous other analytical parameters. Chloride and TDS are the two parameters specified in N.J.A.C. 7:9C as the parameters used to establish Class III-B classification. N.J.A.C. 7:9C states that:

> "Class III-B ground water consists of all geologic formations or units which contain ground water having natural concentrations or regional concentrations (through the action of salt-water intrusion) exceeding 3,000 mg/l Chloride or 5,000 mg/l Total Dissolved Solids, or where the natural quality of ground water is otherwise not suitable for conversion to potable uses."

The chloride and TDS results for the LCP and GAF sites exceeded the Class III-B criterion of 3,000 mg/L for chloride and the 5,000 mg/L criterion for TDS for all tested bedrock wells on the LCP site. These data demonstrated that the groundwater quality conditions in the bedrock water-bearing zone are impacted as a result of naturally-occurring, salt water intrusion from the nearby tidally influenced surface water bodies.

2.9 Ecologic Conditions

No endangered, threatened, or rare (ETR) species or significant ecological communities have been found within the LCP site's boundaries, nor are there any records at NJDEP of rare wildlife or plant species or ecological communities within the site (NJDEP has reported that foraging habitat for several threatened bird species lies within ¼ mile of the site [black- and yellow-crowned night herons and colonial water birds], but none of these species have actually been observed). Similarly, NYSDEC indicated that two endangered bird species are located within ¼ of the site (yellow-crowned night heron and pied-billed grebe). South Branch Creek represents low-grade habitat for these species and nesting on site is therefore not expected. There is also no suitable habitat in the site area for the two species listed for Union County on the Federal Comprehensive List of Endangered and Threatened species provided on the USFWS's website (one turtle, one bat).

Overall, the flora and fauna found on the site are species typically found in heavily industrialized areas within intertidal marsh ecosystems. Vegetative species found within the site are very common to highly disturbed areas and possess no Federal or New Jersey State protection. Six terrestrial mammals and two terrestrial reptile/amphibian species have been reported. No aquatic mammals have been reported.

South Branch Creek and the Arthur Kill are National Wetlands Inventory (NWI)-mapped wetlands. There are no State designated wetlands on site. A wetlands delineation was performed along South Branch Creek for which a Letter of Interpretation was obtained by NJDEP (Figure 5-18). The border of the nearest NJDEP-mapped wetland is located to the south of the site, approximately 500 feet from the outlet of South Branch Creek to the Arthur Kill.

Pralls Island, located in the Arthur Kill directly opposite to the LCP site off the shoreline of Staten Island, contains areas of New York State Department of Environmental Conservation-mapped Tidal Wetlands. Classified tidal wetlands include areas identified as Intertidal Marsh, High Marsh, and Formerly Connected. The locations of these wetlands are presented in Figure 2-27. Please refer to the Habitat Assessment report (Appendix F) for additional details.

2.10 Regional Studies

As stated previously, most of the region was highly industrial and consists of land that has been created through the filling of tidal wetlands. The Arthur Kill is a large navigable, tidal straight that is tidally influenced from the New York Harbor and the Atlantic Ocean. Likewise, the Rahway River to the south is a tidally influenced tributary of the Arthur Kill traveling through an industrial area. Background contaminant conditions and contributions to the sediments from many sources are widespread. There are numerous NJDEP-contaminated sites in the region, in addition to the LCP site, many of which have the highest remedial level designations of "C3" and "D," indicating high levels of multiple contaminants that may be impacting surface and groundwater. Additionally, there are a number of sites within the Newark Bay complex with extremely high mercury levels that may influence levels in Arthur Kill (NJDEP 2001). In addition, the New Jersey Turnpike, completed in 1954, crosses Piles Creek west of the GAF site. The Turnpike is a regional source of contaminants typical of road runoff, such as heavy metals (particularly lead), BOD/COD, nutrients, oil and grease, PAHs, pesticides, herbicides, and PCBs, as well as of contaminants released through spills and accidents on the roadways.

Numerous studies have addressed specific contaminants and their fate and transport in the New York/ New Jersey Harbor system. Many of these are catalogued and distributed by several regional organizations. Key data from these organization's databases are presented on Figures 2-28 through 2-30. Additional information regarding the regional studies is described below.

2.10.1 Contamination Assessment & Reduction Project (CARP)

Contamination Assessment & Reduction Project (CARP) is a coalition of harbor partners from federal, state and non-governmental branches, headed up by the New York State Department of Environmental Conservation (NYSDEC). The purpose of the project is to find solutions for the harbor's dredged materials. Its main objectives are identifying and quantifying the sources of contamination, establishing baseline levels of contaminants of concern in the water, sediment and fish tissue, and predicting future conditions (CARP, 2008).

CARP uses mathematical modeling to characterize the dioxins/ furans, PAHs, pesticides, and metals present in the harbor system. Their models include point and non-point source loading inputs, estuarine hydrodynamics and sediment transport, contaminant fate and transport, bioaccumulation and toxicity (CARP, 2008). The results used for these models are stored in a database. The database not only stores CARP data but also a range of other data sources, including the EPA's REMAP project.

The EPA's Regional Environmental Monitoring and Assessment Program, otherwise known as REMAP, is a regional study, which obtains information on the New York/ New Jersey Harbor. It was created to "answer ecological questions on a regional scale" (EPA, 2007). The project obtains sediment, water and benthic samples. These results can be found in the CARP database along with several other projects.

In Figures 2-28 and 2-29 CARP's results for mercury and dioxin in the estuary sediment have been plotted. Each figure shows a large number of samples collected in the Lower Passaic region due to its industrial nature, which is a useful comparison for the LCP region.

2.10.2 National Oceanic and Atmospheric Administration (NOAA)

National Status and Trends Program run by the National Oceanic and Atmospheric Administration (NOAA) also monitors the Hudson-Raritan Estuary. The concentrations of contaminants and the biological responses to said contaminants in this area have been compared to other sites around the United States. This study specifically targets point and non-point sources and characterizes the contaminants of concern for each.

The NOAA study was used to determine the current status of the NY/NJ Harbor estuary system. Their samples were taken north of the LCP site, mostly in the Newark Bay and in the lower Passaic River, Figure 2-28 through 2-30. These results were then compared with the CARP data and the LCP data.

2.10.3 Old Place Creek

Old Place Creek was selected to serve as a reference stream. Old Place Creek is a tidal creek consisting of salt marshes and an adjacent successional southern hardwood forest, and is located in Staten Island, New York, on the eastern side of the Arthur Kill (Figure 2-21). The area is located immediately north of the Goethals's Bridge and is surrounded by heavy industrial development. This creek is similar in many respects to SBC, including the width and depth, and provides a tool for evaluation of SBC and other regional data.

Samples of sediment, surface water, and biota were collected in Old Place Creek by BC on behalf of ISP-ESI contemporaneously with the Phase II RI in fall 2008. The purpose of this effort was to characterize regional background conditions. Samples were analyzed for TCL/TAL analytes as well as total and methyl mercury, and Dioxins/Furans. The results of the study of Old Place Creek are presented in Appendix M.

Section 6

Nature and Extent of Contamination

A comprehensive characterization of the nature and extent of contamination in site media was performed through the RI field investigation. The field investigation was performed in two phases from 2001 to 2008 with an additional investigation of the Off-Site Ditches conducted in August 2011.

The RI field investigation included the collection of samples from soil, soil vapor, groundwater, surface water sediment, and biota as described in Section 3.4. The collected samples were submitted for laboratory analysis as described in Section 3.7. This included analyses for the Target Compound List (TCL) organic constituents plus Tentatively Identified Compounds (TICs), Target Analyte List (TAL) inorganic constituents, and hexavalent chromium. Select samples and media were analyzed for additional parameters including PCDDs/PCDFs, methyl mercury, and mercury species, and total organic carbon. Certain media such as biota were subjected to special limited analyses, e.g., co-planar PCBs and speciated arsenic. The specific laboratory analyses are described in detail in Section 3.7.

The distribution and character of the chemical contamination is presented for each site medium in the subsections that follow. When describing specific concentration values, the text uses "ND" to indicate that the constituent was not detected. The descriptions are supported by various data tables and figures. The figures include numerous constituent distribution maps that were developed using the geographical information system (GIS) as described in Section 4.4. The concentration legends for each medium are referenced to various promulgated standards or other relevant criteria, as applicable. The data reported on the tables and maps are reported to three (3) significant figures.

For ease of reference, the discussions below have been addressed by medium and contaminant class. Section 6.9 provides a site-wide summary of the nature and extent of contamination. Further integration of the data into the Conceptual Site Model is provided in Section 7.4.

6.1 Soil

Soil samples were collected during Phases I and II through the full thickness of the overburden soils that underlie the site, including a large number of surficial (0-2 ft) soil samples. The soil samples were obtained as surficial grab samples, shallow direct-push borings, deep borings by hollow-stem auger and fluid rotary drilling and horizontal borings.

The New Jersey Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) are used as benchmarks for the characterization and relative distribution of chemical constituents within surficial and subsurface soils. The NRDCSRS are promulgated remediation standards [N.J.A.C. 7:26D] that are based on theoretical exposures via accidental human ingestion, dermal contact, and/or inhalation of soils. The NRDCSRS represent concentrations below which NJDEP would not have concern about incidental human contact. The unsaturated zone soil data are also compared to default Impact to Ground Water Soil Screening Levels. These are not standards, but default guidance values intended to be used "where no site specific information is available." Since there are ample available groundwater quality data for the Site, these screening levels are simply presented for reference.

Soil quality maps include data from both Phase I and Phase II and are separated into the four (4) depth ranges that reflect the three (3) distinct lithologies found on the site: surficial soil (0 - 2 feet), deep anthropogenic fill (> 2 feet), tidal marsh deposits, and glacial till. In situations in which there are

multiple samples within a single lithology (e.g., deep fill) the sample with the highest constituent is displayed. The "low marsh" soils may, in part, represent the geologic surface exposure or "outcrop" of the tidal marsh deposits along South Branch Creek and are included on the constituent maps of the tidal marsh deposits. However, the low marsh soils are also separately described in Section 6.2.

The constituents, for which soil quality maps were prepared, were selected on the basis of the relative frequency of exceedances of their respective NRDCSRS and relevance as contaminants of concern as related to the site. Descriptive statistics for soil are presented in Tables 6-1a through 6-1d and the exceedances of the NRDCSRS are presented in Tables 6-2a through 6-2d, broken into the distinct layers as described above.

6.1.1 Mercury

Total Mercury

In the surficial fill soils, the total mercury concentrations ranged from non-detect to 7,870 mg/kg, with approximately 57 percent of these detections exceeding the NJ NRDCSRS of 65 mg/kg. The exceedances of the NJ NRDCSRS are presented in Table 6-2a and Figure 6-1a.

Aside from recent surficial sampling performed in May 2008, laboratory samples were not submitted for mercury analysis when samples contained visible elemental mercury. The elemental mercury was generally observed as a very fine spherical particles. Larger masses of elemental mercury have infrequently been observed on the ground surface in the vicinity of the production area in and horizontal borehole samples collected beneath the mercury cell buildings.

Elemental mercury was visually observed in 31 sample locations within the site, as presented in Table 6-3 and shown on Figures 6-1a through 6-1d. Six (6) of these sampling locations contained elemental mercury in the surficial fill only, including DC-SS19, 5K-B4, 5K-B5, 231-B5, SS-08-09, and SS-08-10. At four (4) of these sampling locations, including 5K-B3, 231-B4, 231-B6, and 231-B8, elemental mercury was present in both the surficial and deep fill, as depicted on Figures 6-1a and 6-1b. Surficial samples collected in May 2008 revealed that the highest relative concentration of elemental mercury compared to total mercury, 15%, can be found between Building 231 and immediately west of Building 240 in sample SS-08-07, as presented in Table 6-4. The visual occurrence of elemental mercury and the laboratory results for total mercury in borehole samples demonstrate decreasing mercury concentrations with depth. Moreover, mercury pooling at the ground surface has frequently been observed at the LCP site in apparent response to rainfall events, likely as a result of capillary action as soil pores become saturated with water (see Section 7.1.4). These observations suggest that downward migration of elemental mercury through the overburden material as a result of its density does not appear to be a primary transport mechanism at the LCP site. There is some deeper observed elemental mercury in the vicinity of the production buildings, as presented in Figures 6-1a through 6-1d, which may be attributed to downward migration along building pilings that penetrate the overburden strata.

Total mercury concentrations in the deep fill, ranged from 0.063 to 2,110 mg/kg. Approximately 27 percent of the mercury detections exceeded the NJ NRDCSRS at depths ranging up to 14 feet, as depicted on Figure 6-1b. Of particular note was the presence of visible, elemental mercury observed in samples collected from the horizontal borings within the deep fill located beneath Buildings No. 230 and 240.

Total mercury concentrations tended to be lower in the naturally occurring soil units that underlie the anthropogenic fill, including the tidal marsh deposits and the glacial till. In fact, only five out of 28 tested samples of the tidal marsh deposits exceeded the NJ NRDCSRS of 65 mg/kg. It should be noted,

however, that four (4) of the tidal marsh soils contained visible elemental mercury and were not analyzed (Table 6-3 and Figure 6-1c). These samples were collected from boring MW-25D, located along the probable alignment of the former South Branch Creek channel (see Section 2.6.1), and adjacent to Building No. 231 and the former 500K tank.

The tested borehole samples collected from the glacial till did not exceed the NJ NRDCSRS for total mercury, including the samples collected beneath the production buildings from the horizontal borings. Notable exceptions, however, included two of the glacial till samples collected from horizontal borings beneath Buildings No. 240 that contained visible, elemental mercury (Table 6-3 and Figure 6-1d). These findings would suggest that mercury is normally attenuated at depth within the glacial till but may be subject to sporadic downward vertical migration along features such as building piles or fractures in the till.

Mercury Speciation

Six surficial soil samples were selected for analysis by a selective sequential extraction method after Bloom, *et al.*, 2003. Additional information regarding mercury sequestial extraction is found in the Human Health Risk Assessment (Appendix O). This is a five-step sequence of extractions that was established to separate various groups of mercury compounds into "biogeochemically" distinct categories. Accordingly, the method provides direct information regarding the relative mobility of the various mercury species and is comprised of the following extracts:

- F1 - Water soluble Hg
- F2 – "Stomach acid" soluble
- F3 - organo-chelated Hg
- F4 - elemental Hg and other Hg species
- F5 - mercuric sulfide (cinnabar)

The results of the sequential mercury testing are presented on Table 6-5. The data revealed that mercury in the tested surficial soils was present primarily in insoluble forms including elemental (metallic) mercury and mercury sulfide (cinnabar). Mercury speciation testing revealed some variability in the speciation profile of mercury in fill. In five of the six samples tested (230-B-101-0-1, DSP-101-0-1, 231-102-0-1, LP-102-0-1, and BSL-101-0-1; see Table 6-5), more than half of the mercury extracted in the later fractions (F4 and F5), indicating low mobility potential. In one sample, however (231-101-0-1), just over half the mercury extracted in the F3 fraction (potassium hydroxide, targeted to elute organo-metallic complexes, which can be more mobile than the later-extracting forms). However, the groundwater data clearly support the conclusion that mercury is not mobile. There are wells near sample 231-101-01 that contain only traces of dissolved mercury in the overburden (less than 0.5 µg/L; MW-26S) and no detectable mercury in the bedrock groundwater (MW-25D). Thus while the exact form of mercury appears to vary somewhat by location, the data overall indicate that the mercury present in these samples is not migrating vertically or partitioning into the aqueous phase.

TCLP Mercury

An evaluation of the leachability of mercury from highly contaminated soils was performed as a supplemental study in May 2008. This assessment involved the collection of four (4) surficial soil samples that contained visible elemental mercury. Each sample was subjected to testing for both total mercury and TCLP mercury. TCLP testing involves the recirculation of water at a 20:1 liquid-to-solid ratio under specific, prescribed conditions (e.g., pH, temperature, time) and then measuring the resultant concentration in the leachate.

The results of the TCLP testing are presented in Table 6-6. The ratio of the TCLP mercury to the total mercury is also presented on the table. These data indicate that only a very small fraction of the available mercury in the tested samples was leached from the samples. The proportion of leached mercury ranged from 0.01 to 1.89 percent, with an average value of approximately 0.5 percent. Furthermore, only two of the four samples exceeded the TCLP criterion of 0.2 mg/l. This means that even some samples containing visible elemental mercury would not be characterized as hazardous waste on the basis of TCLP testing.

Summary of Mercury in Soil

Elevated levels of mercury were found in the anthropogenic fill soils throughout nearly the entire site. The highest concentrations are found around the former production area near Buildings No. 230 and 240, including below the buildings, around which visible elemental mercury was also observed. Substantial attenuation of mercury was observed in the underlying natural soils, including the tidal marsh deposits and the glacial till. With the exception of two samples beneath Building No. 240, none of the glacial till samples exceeded the applicable standards.

In addition to mercury detected in analytical samples, there have been observations of visible elemental mercury on the ground surface and in soil borings. Observations of visible elemental mercury on the ground surface appear to coincide with rainfall events, suggesting the movement of mercury through pore spaces in surficial soils is due to capillary action, or with mechanical disturbance (e.g., excavation) of surficial soil. Visible elemental mercury found in soil borings have been primarily found in the fill material; however, limited instances have been observed in the tidal marsh deposits and glacial till in areas where building pilings penetrate the fill material.

Mercury speciation testing revealed that most of the total mercury was present in relatively insoluble forms including mercury sulfide and elemental mercury. The insolubility of the mercury in soil indicates that it is relatively immobile in the subsurface.

Mechanisms that could affect mercury in soils and alter environmental mobility, such as volatilization, are discussed in Section 7.

6.1.2 Arsenic and Other Metals

Arsenic

Arsenic concentrations in the surficial fill ranged from ND to 335 mg/kg, with a NJ NRDCSRS exceedance frequency of approximately 19 percent. The arsenic concentrations in surficial fill are presented on Figure 6-2a. While arsenic exceedances are widely distributed across the site, relatively few exceedances are observed within the former LCP production area. The greatest density of arsenic exceedances and the highest arsenic concentrations in soil were found in the western portion of the site in the former Linde Division leasehold.

The deep fill revealed arsenic concentrations that ranged from ND to 775 mg/kg, with approximately 36 percent of these exceeding the NJ NRDCSRS of 19 mg/kg. The NJ NRDCSRS exceedances in the deep fill ranged up to 16 feet in depth and were widely distributed across the site, as shown on Figure 6-2b. As with the surficial soil, the highest arsenic concentrations were located in the former Linde Division leasehold which is, in fact, higher than the concentrations in the surficial soil. Furthermore, arsenic is not specifically related to the chlor-alkali process. The headwater of South Branch Creek (the "Transect A Area") has historically received drainage from other sources, as discussed in Section 2.6.1. This included comingled wastewater and stormwater from the LCP and GAF sites. In addition, ditches located parallel to both sides of the railroad track conveyed surface drainage from the

north that originated on the GAF and duPont sites. Both the GAF and duPont sites were known to have used arsenic. The arsenic present in South Branch Creek, which is heavily concentrated in the Transect A area, greatly exceeds the concentrations found in LCP site soils, further suggesting an off-site source(s).

As with the surficial soil, the highest arsenic concentrations in the deep fill were located in the former Linde Division leasehold where concentrations were higher than in the surficial soil. Furthermore, arsenic is not specifically related to the chlor-alkali process. There is no history of arsenic use at the Linde Division, although arsenic presence may be related to the placement of anthropogenic fill in preparation for the construction of a Central Railroad Company of New Jersey railroad yard prior to 1940 (see Section 2.1.1).

Arsenic was detected in all but one of the tidal marsh deposit samples at concentrations ranging from ND to 437 mg/kg. Approximately 35 percent of the samples exceeded the NJ NRDCSRS of 19 mg/kg (Figure 6-2c). The highest levels of arsenic in subsurface tidal marsh soils occur in the area of the former Linde Division leasehold.

Arsenic was ND in more than half of the tested glacial till samples. No exceedances of the NJ NRDCSRS for arsenic were observed in the glacial till (Figure 6-2d).

Other Metals

A relatively small number of exceedances of the NJ NRDCSRS were observed for other metals, including cadmium, cobalt, lead, and zinc as presented on Tables 6-2a through 6-2d. These higher concentrations were primarily observed in the anthropogenic fill. Many of the soil samples that exceeded the NJ NRDCSRS for lead were detected within a small well defined area of the Linde Division leasehold. Barium was used in the brine sludge process, where it entered the process as barium sulfate and was converted to barium chloride. Barium's presence is therefore site related. However, barium was not detected above the NRDCSRS in any of the 91 surficial soils samples analyzed and is therefore not a key site COC. Each metal was substantially attenuated at depth in all areas of the site. There were no exceedances of other metals in the underlying glacial till.

Arsenic and Other Metals Summary In Soil

The ubiquitous presence of arsenic and various other metals in areas with no production history, their distribution within the anthropogenic fill without a decreasing concentration gradient, and the absence of an association with the known sources of contamination lead to the conclusion that the occurrences of arsenic and other metals are not associated with site operations; rather they are associated with the presence of anthropogenic fill materials and off-site sources.

This point is made simply to illustrate the prevalence of these metals in anthropogenic fill not as a result of site-specific manufacturing processes. These exceedances were largely related to the elevated levels of arsenic and several other metals, including lead, that were observed in the anthropogenic fill predominantly in the former Linde Division leasehold area.

Concentrations of arsenic and other metals in the underlying natural soils were substantially attenuated with respect to the anthropogenic fill. In fact, relatively few metals exceedances were observed in the tidal marsh deposits. Furthermore, nearly all of the exceedances of arsenic and other metals in the tidal marsh deposits occur within the western portion of the site. This distribution differs from that of mercury, which was concentrated in the former chlor-alkali facility production areas.

No exceedances of arsenic or metals, including mercury, were observed within the glacial till.

6.1.3 PCBs

Polychlorinated biphenyls, or PCBs, are a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl. Theoretically, 209 separate PCB congeners can exist, although only about 130 congeners typically occur in commercial PCB mixtures. Commercial PCBs are referred by their trade name "Aroclor," mixtures that usually contain 50 or more PCB congeners. PCB Aroclors were analyzed for in each of the soil samples.

Aroclor 1254 was the predominant PCB mixture detected within site soils, with Aroclor 1260 occurring less frequently. No other PCB Aroclors were detected on the site. The spatial distribution of the sum of Aroclor 1254 and 1260 is depicted for each of the four (4) depth intervals on Figures 6-3a through 6-3d. Total PCB concentrations (sum of each of the seven individual Aroclors) were compared to the NJ NRDCSRS for total PCBs of 1 mg/kg. As shown on Figure 6-3a, numerous exceedances of the NJ criterion were observed in surficial soil, particularly around the former LCP production area. While 21 percent of the surficial soil samples exceeded the NJ NRDCSRS, the total PCB concentrations were relatively low compared with other regulatory limits. Only one sample in the surficial soil (230-B4), located east of Building 230 in the former rectifier area, exceeds the USEPA Toxic Substances Control Act (TSCA) criterion of 25 mg/kg for soil decontamination in restricted access (industrial) areas per the PCB Rule [40 CFR Part 761.125].

PCBs were undetected (ND) in ¾ of the tested deep fill samples. Total PCB concentrations in the deep fill ranged from ND to 43.2 mg/kg. In the deep fill interval, total PCB concentrations exceeded the 1 mg/kg NJ NRDCSRS in 9 percent of the samples. The 25 mg/kg USEPA criterion was only exceeded, however, in one sample (Aroclor 1254 in 231-B6, located at the southwest corner of Building 231). There were no exceedances of the 1 mg/kg NJ NRDCSRS criterion in samples collected from the tidal marsh deposits or the glacial till.

Aroclor 1254 and Aroclor 1260 were the primary commercial mixtures that were used in electrical equipment in the US around 1950 (Fiedler, 1997). PCBs are not directly related to the chlor-alkali process. It is likely, however, that electrical equipment used at the site was the source of these PCBs in soil given the distribution of PCBs in the surficial soils around the production area. The data suggest, however, that likely PCB spills from electrical equipment were relatively modest given the relatively low concentrations and the fact that they have not penetrated to any substantial degree in subsurface soils.

6.1.4 Polychlorinated Naphthalenes

Polychlorinated naphthalenes (PCNs) are a group of halogenated compounds that are considered to be "dioxin like". They consist of two fused benzene rings, or naphthalene, with one to ten chlorine atoms attached. Commercially available PCNs are mixtures of 75 chlorinated naphthalene congeners and byproducts.

It is possible that the detected PCNs at the site may be related to reactions between the chlorine and the graphite anodes. However, the PCNs present in site soils include only the mono, di-, and tri-chlorinated congeners as presented on Table 6-7. The more toxicologically significant higher chlorinated congeners (penta through hepta) that are of concern at other chlor-alkali sites are not detected at the LCP site. The higher chlorine group congeners would have been detected on the TIC scan if they were present. The analytical laboratory took specific steps to run the GC/MS for sufficient time to allow the higher-chlorine PCNs to elute. The total PCN concentrations ranged from 0.007 mg/kg to 76.8 mg/kg in the surficial fill and 0.012 mg/kg to 19.2 mg/kg in the deep fill. Although low levels of PCNs were also detected in several tidal marsh deposits and glacial till samples, the concentrations were considerably lower than detected in shallower soils.

6.1.5 Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a class of compounds comprised of fused aromatic rings in a variety of structural configurations. PAHs can be formed as products of the incomplete combustion of organic materials and are present in considerable quantities in fossil fuels, including coal, fuel oil, and diesel fuel. Sources of PAHs in soil include emissions from power plants and domestic heating systems that burn oil, coal or wood, gasoline and diesel engine emissions, emissions from waste incineration facilities, and various industrial activities. Accordingly, fill containing combustion residues often contains considerable levels of PAHs. Table 6-8a through -8d and Figures 6-5a through 6-5d presents the sum of the 18 TCL PAHs analyzed in site soils.

PAHs are hydrophobic compounds, and their persistence in the environment is due in large part to their low water solubilities and resistance to biodegradation. Higher-molecular weight PAHs exhibit a greater environmental persistence than lower-molecular weight PAHs due to an increase in hydrophobicity and an increasing resistance to biodegradation as the molecular size of the PAHs increases (up to four or five fused benzene rings). The higher-molecular weight PAHs are more commonly associated with coal or coal by products, including bottom and fly ash, whereas the lower-molecular weight PAHs are more closely associated with petroleum products (see table below).

Low-molecular weight PAHs (2- and 3-ring structures)	High-molecular weight PAHs (4-, 5-, and 6-rings)
Acenaphthene	Benz[a]anthracene
Acenaphthylene	Benzo[a]pyrene
Anthracene	Benzo[b]fluoranthene
Fluorene	Benzo[ghi]perylene
Naphthalene	Benzo[k]fluoranthene
2-Methylnaphthalene	Chrysene
2-Chloronaphthalene	Dibenz[a,h]anthracene
Phenanthrene	Fluoranthene
	Indeno[1,2,3-cd]pyrene
	Pyrene

The high-molecular weight PAHs were frequently detected in the soils and occur across the entire site, including areas with no production history. The frequency of detection in the deep fill (> 2ft) for these constituents ranged from 7 percent (dibenzo(a,h)anthracene) to 74 percent (fluoranthene). The NJ NRDCSRS were infrequently exceeded by the high-molecular weight compounds.

The low-molecular weight PAHs were also detected frequently and occur across the entire site, including areas with no production history. The range for this group of PAHs in the deep fill (> 2 ft) was from a low of 6 percent detections (acenaphthylene) to a high of 68 percent (phenanthrene). The NJ NRDCSRS for the low-molecular weight PAHs were not exceeded.

These observations lead to the conclusion that the PAHs are primarily associated with anthropogenic fill materials and are not the result of site operations.

Carcinogenic PAHs

Eight (8) specific, high-molecular weight PAHs are designated by USEPA as possible human carcinogens. Benzo(a)pyrene (B(a)P) is the most completely studied of the possibly carcinogenic PAHs (cPAHs) and exhibits the highest relative toxicity. Toxic Equivalency Factors (TEFs) are assigned to these cPAHs relative to the carcinogenic potency factor of B(a)P by USEPA (1993) based on the risk of oral exposure,

as presented in Table 6-9. The TEFs are used to develop a Toxicity Equivalency Quotient (TEQ) which is the sum of the quantity of individual cPAHs respective TEF. TEQs allow the comparison of the relative risk of exposure in areas of contamination that vary widely in the composition and level of cPAHs.

A summary of the resultant TEQ values is presented in Tables 6-10a through 6-10d and shown in Figures 6-6a through -6d and Figures 6-7a through -7d. Map pairs of cPAHs are presented for each depth interval. The first map in each pair presents a graphical representation of the relative concentration of each cPAH and lists the total cPAH concentration in the sample. The second map in each pair presents a graphical representation of the relative cPAH TEQ. As with the PCDDs and PCDFs described below, the TEQs are used here to describe the geo-spatial distribution of these compounds and not to represent risk.

The figures reveal that most of the cPAHs were found in the anthropogenic fill layers. This is not surprising, given the likely presence of PAHs at the site as a result of anthropogenic fill placement. cPAHs were infrequently detected in the tidal marsh deposits, except where they were exposed as "low marsh" soils along South Branch Creek. The cPAHs were not detected in the underlying glacial till except beneath the production buildings in which they may have migrated downward along the numerous timber building piles.

The cPAH data revealed that most samples contained relatively even proportions of each of the eight (8) cPAHs, with only a few exceptions in which a single cPAH predominates (e.g., benzo(a)anthracene in the surficial sample at TLS-11).

The cPAH TEQs ranged from non-detectable to a high of 102 mg/kg. The cPAH TEQs are widely distributed across the entire site with no apparent pattern of distribution. The cPAH TEQ values are no higher in the former LCP production area than in any other area of the site. This distribution provides additional evidence of the presence of PAHs as a result of anthropogenic fill.

6.1.6 PCDDs/PCDFs

Polychlorinated dibenzo-p-furans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs) are groups of halogenated organic compounds. There are 210 possible structural congeners of PCDF and PCDD. Of these, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has been shown to be the most toxic. In addition, PCDF and PCDD congeners, in which the lateral 2, 3, 7, and 8 positions are occupied with chlorines (2,3,7,8-substituted congeners), are acknowledged to have a higher relative toxicity than the other congeners (i.e., non-2,3,7,8-substituted congeners).

PCDDs and PCDFs can be formed as by-products in the manufacture of organochlorides, during the incineration of chlorine-containing materials, in the bleaching of paper, and from natural sources such as volcanoes and forest fires (Beychok, 1987). The major current and historical sources of PCDDs and PCDFs include coal fired utilities, municipal waste incinerators, metal smelting, diesel trucks, land application of sewage sludge, burning treated wood, and backyard trash burn barrels (USEPA, 2005).

PCDFs and PCDDs in soils were tested as a part of this investigation in approximately 10 percent of the samples during Phase I and II.

Seventeen (17) specific PCDDs/PCDFs have been assigned Toxic Equivalency Factor (TEFs) by the World Health Organization (WHO, 2005) and these have been adopted by USEPA. The TEFs are based on the chemical's toxicity relative to 2,3,7,8-TCDD, with the toxicity of 2,3,7,8-TCDD being equal to 1.0. The TEFs are used to develop a Toxicity Equivalency Quotient (TEQ) which is defined as "the sum of the quantity of individual PCDD/PCDF congeners multiplied by the respective TEF." TEQs allow the comparison of the relative risk of exposure in areas of contamination that vary widely in the composition

and level of PCDDs/PCDFs. The TEQs are used here to develop a single concentration expression for each sample for the purpose of evaluating the nature and extent of the PCDD/PCDF distribution. These TEQ sums are not intended to represent risk from contact with soils. A summary of the resultant TEQ values is presented in Table 6-11 and shown in Figures 6-4a through 6-4d.

Very low levels of PCDDs and PCDFs were detected in each of the samples analyzed, as presented in Table 6-11. Each of the TEQs were less than 1.0 µg/kg (ppb), ranging from 0.00002 to 0.885 µg/kg. The highest TEQs, which were largely driven by the PCDFs, were observed in the surficial soils, particularly in two samples collected immediately east of Building No. 231 (Samples No. LP-10 and LP-16). Substantial attenuation of TEQ concentrations was observed with increasing depth (Figures 6-4a through 6-4d).

There is some evidence as reported in the literature that PCDDs and particularly PCDFs may be present in the mercury sludge at chlor-alkali sites as a result of the reactions between the chlorine and the graphite anodes, as may be the case in Samples No. LP-10 and LP-16. This is revealed by the higher levels of total CDFs in these samples and the higher relative proportion of the tetra-CDFs and penta-CDFs and lower relative proportion of the octa-CDFs compared to the other site samples.

The PCDDs are not likely to have resulted from site sources. The distribution of PCDD concentrations in the other surficial soils is very heterogeneous, based both on specific concentrations of the various congeners and on the TEQs (Figure 6-4a). This heterogenacity and widespread distribution across the site is not apparently related to the former production area and is likely attributed to regional background conditions. While some of the PCDFs in the soil appear attributable to site operations, much of the PCDFs on the site are due to background conditions, particularly in the areas distant from the production area. The background sources likely include atmospheric deposition on the ground surface as a result of the formation of PCDDs and PCDFs from the various potential sources described above.

6.1.7 Hexachlorobenzene

Hexachlorobenzene (HCB) is a chlorinated hydrocarbon that was formerly used as a fungicide and is frequently produced as an unintended byproduct from various manufacturing processes. HCB is documented to have been produced as a byproduct in chlor-alkali plants through the reaction of the chlorine with the graphite anodes (Environment Canada, 1993).

HCB at the site was generally detected only in the anthropogenic fill with the highest levels being found in the surficial fill in the area of the former production area. Accordingly, the presence and distribution of HCB in soils appears to be related to the chlor-alkali manufacturing process at the LCP site.

HCB concentrations in the surficial fill ranged from ND to 1,440 mg/kg, with 16 percent of these samples exceeding the NJ NRDCSRS of 1 mg/kg for HCB. The exceedances occurred near Building 250, east of the tank car reconditioning shed, west of Building 240 along the former alignment of South Branch Creek, west of the sodium hydroxide tanks, near the bullet tanks, around Building 231, near the closed RCRA unit, and in the western area of the site away from the process areas. The distribution of HCB in surficial fill is presented on Figure 6-8a.

In the deep fill, HCB concentrations ranged from ND to 44 mg/kg. The NJ NRDCSRS exceedance frequency for hexachlorobenzene was 4 percent, with exceedances occurring near the "Ditch Bridge Area" along former South Branch Creek area located east of the electrical switchyard and by Building 231, as presented on Figure 6-8b.

HCB exceedances of the NJ NRDCSCC were not observed in either the tidal marsh deposits or the glacial till (Figures 6-8c and 6-8d).

6.1.8 Other Organic Compounds

A number of other organic compounds revealed infrequent exceedances of their respective NJ NRDCSRS. Only benzene (presented in Figures 6-9a through 6-9c), hexachlorobenzene, methylene chloride and hexachlorobutadiene exceeded the criteria in greater than 1 percent of samples in any depth interval.

Chlorobenzene

Chlorobenzene is a VOC that is not generally related to chlor-alkali manufacturing but was detected within the soils, albeit at concentrations less than the NJ NRDCSRS of 7,400 mg/kg. Chlorobenzene was used in manufacturing operations at the adjacent GAF and NOPCO chemical manufacturing sites. However, chlorobenzene in soils is not at sufficiently elevated concentrations to explain its presence in overburden groundwater. While not widely distributed across the site, chlorobenzene was detected in the deep fill in MW-24S at the Ditch Bridge Area along the former alignment of South Branch Creek and immediately south of Building 231 (Figures 6-10a and 6-10b). These locations are along the historic alignment of drainage from the GAF site, as discussed in Section 2.6.1. Furthermore, chlorobenzene was detected in the subsurface tidal marsh deposits south of Building 231 and in the surficial low marsh soils along South Branch Creek including near well MW-6S (Figure 6-10c).

BTEX

The presence of benzene in the soil appears to be related in many cases to "BTEX" constituents that include benzene, toluene, ethylbenzene, and xylenes, as summarized on Table 6-12a through 6-12d The toluene, ethylbenzene, and xylenes, however, do not exceed the respective NJ NRDCSCC values. The BTEX is present primarily in anthropogenic fill soils and is likely due to spills of fuel or oil on the ground or was present in the fill prior to placement.

Miscellaneous Organic Compounds

Several other organic compounds exceeded their respective NJ NRDCSCC primarily in the anthropogenic fill. These exceedances were primarily observed south of Building 231 and include benzene (Figures 6-9a to Figure 6-9c), hexachlorobutadiene, and tetrachloroethene. Methylene chloride had four exceedances of its criterion, including three near the "Ditch Bridge Area" along the former adjacent South Branch Creek and one north of Building 231. These other organic compounds are not known to be related to manufacturing operations at the site. Some of these other organic compounds were widely used in manufacturing processes at the adjacent GAF site which may be the source within the anthropogenic fill.

Residual Organic Saturation

Visual identification of possible residual saturation of unidentified organic liquids were made in a number of soil samples, as listed on Table 6-13, as were generally characterized by the presence of oily material smudge. This material is not widely distributed across the site. The soil laboratory analysis data yields no additional information regarding this material. In addition, no free phase liquids were observed in monitoring wells.

6.1.9 Tank Contents Sample

As part of the tank assessment, a single sample of the contents of the 150,000 gallon brine tank was taken as part of the Phase II field investigation. The results of this sample are presented in Table 6-14.

6.2 Low Marsh Soil

The "low marsh" soil represents narrow bands of soil located along the margins of South Branch Creek that is generally fine-grained and with a high organic content. This material likely represents sediment that has been deposited along the bank. The low marsh soils may also represent, in part, the geologic surface exposure, or "outcrop," of the tidal marsh deposits. Accordingly, the low marsh soils were also presented on the aforementioned constituent distribution maps for the tidal marsh deposits.

Ninety chemical constituents were detected in the surficial (0-0.5-foot) low marsh soil samples collected along South Branch Creek and 70 chemical constituents were detected in the low marsh soil samples collected along the Arthur Kill at the confluence with South Branch Creek. Table 6-15 summarizes the descriptive statistics of detected constituents in low marsh soil samples, and Tables 6-16a through 6-16c present the data compared to NJ NRDCSRS, the Effects Range – Low (ER-L), and Effects Range – Median (ER-M) screening values (Long, *et al.*, 1995), respectively.

The horizontal and vertical delineation of site-related constituents for low marsh soil is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of low marsh soil may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.2.1 Mercury

Figure 6-11 shows the spatial distribution of mercury in low marsh soil. Mercury was detected in each of the 20 low marsh soil samples collected along South Branch Creek; up to 3,050 mg/kg (Table 6-15, Figure 6-11) at Transect C, near the midpoint of South Branch Creek. The NJ NRDCSRS of 65 mg/kg for mercury was exceeded in 80 percent of the samples; the ER-L and ER-M sediment screening criteria were exceeded in all of the samples. In the four low marsh soil samples collected along the Arthur Kill, all observations were below the NRDCSRS and above the sediment screening criteria, with a maximum concentration of 25.8 mg/kg. The presence of mercury in the low marsh soil is consistent with and generally related to its presence in sediments, as discussed further in Section 6.6.

Methyl Mercury

Methyl mercury was detected in each of the 20 low marsh soil samples collected from South Branch Creek and in all four of the low marsh soil samples from along the Arthur Kill (Table 6-17). The maximum concentrations were 0.1 mg/kg in the South Branch Creek samples and 0.0259 mg/kg in the samples collected from the Arthur Kill area. However, the percentage of methyl mercury as a function of total concentration was low in all of these samples: the maximum proportion of methylated was 0.13 percent in South Branch Creek and 0.1 percent in the Arthur Kill.

6.2.2 Other Metals and Arsenic

Other than mercury, 18 other metals and arsenic were detected in the low marsh soil samples collected in South Branch Creek (Table 6-15). Arsenic, cadmium and lead concentrations exceeded NRDCSRS and all elements exceeded respective ER-Ls and ER-Ms (Tables 6-16a through 6-16c). The frequency of concentrations exceeding the NRDCSRS in South Branch Creek low marsh soil samples ranged from 5 to 75 percent.

Arsenic levels were particularly elevated in the low marsh soil samples collected at the head end of South Branch Creek (Figure 6-12) consistent with the sediment results (Section 6.6.2). In addition to receiving historic discharge from the LCP site, this area receives stormwater drainage from a swale running parallel to the railroad track from the north. Historically, this swale would have carried stormwater that originated, in part, from the duPont and GAF sites located northeast of the LCP site.

These detections do not likely result from LCP site sources as they were considerably higher than arsenic levels observed in site soils within the former LCP production area. Arsenic is not related to chlor-alkali manufacturing facilities.

Arsenic, which is not related to chlor-alkali manufacturing operations, is present in upland surficial fill at an average concentration of 16 mg/kg (maximum 335 mg/kg). Arsenic is relatively heterogeneously distributed in the fill (see Figures 6-2a and b) and shows no "hot spots" or other areas with elevated arsenic (with the exception of a few locations in the Linde area on the western portion of the site, which is not close to South Branch Creek). The low marsh and sediment soils, however, exhibit much higher arsenic concentrations: up to 5,460 in low marsh soils and up to 4,250 mg/kg in sediments. These concentrations cannot be explained by the presence of low-level arsenic throughout the upland fill areas of the site.

In low marsh soil along the Arthur Kill, 18 elements other than mercury were detected, 11 of which have NRDCSRS. Only arsenic concentrations exceeded the NJ NRDCSRS (in 25 percent of the samples). Almost all elements were present at higher concentrations in the low marsh soil samples from South Branch Creek than from the Arthur Kill. Arsenic concentrations were a 100-fold higher; cadmium, barium, lead and zinc had 10-fold higher concentrations.

6.2.3 Organics

6.2.3.1 PCBs

The total Aroclors found in low marsh samples are presented in Figure 6-13. Only one PCB mixture (Aroclor 1260) was detected in one of the Low Marsh Samples in South Branch Creek, at a concentration of 0.356 mg/kg Table 6-15). Aroclor 1260 was also detected in two of the low marsh samples collected from the Arthur Kill in the same concentration range. No other PCB Aroclors were reported. Individual Aroclors do not have NJ NRDCSRS established for them, but there is a NJ NRDCSRS for total PCBs of 1.0 mg/kg, which was not exceeded in any of the samples. The detection of Aroclor 1260 exceeded the NJ NRDCSRS for total PCBs. This sample was the only one in South Branch Creek that exceeded the ER-L and ER-M of 0.023 and 0.18 mg/kg, respectively.

6.2.3.2 PAHs

Of the 18 SVOC TCL chemical constituents analyzed and classified as PAHs, 15 were detected in low marsh soil samples of South Branch Creek. In Arthur Kill low marsh soil samples, 14 PAHs were detected (Table 6-15). The frequency of detection of PAHs in South Branch Creek samples ranged from 5 to 100 percent. In the Arthur Kill samples, 25 to 100 percent contained detectable PAHs. NJ NRDCSRS have been established for 10 PAHs, and ER-Ls/ER-Ms for 16. Six of the South Branch Creek and two Arthur Kill low marsh soil samples exceeded the NRDCSRS for B(a)P (Table 6-16a). ER-Ls for all compounds were exceeded (various locations in both South Branch Creek and the Arthur Kill) (Table 6-16b), but ER-Ms were only exceeded for phenanthrene and pyrene (Table 6-16c), and only in one location (Transect D).

Table 6-18 and Figure 6-14 present the sum of the 18 analyzed PAHs in South Branch Creek and the Arthur Kill. In both there was considerable inter-sample variability, but South Branch Creek and the Arthur Kill had similar average total PAH concentrations, in the range of 2-3.26 mg/kg. Figure 6-15 shows the compound-specific distribution of the carcinogenic PAHs. The array of compounds is similar in all samples areas, with a predominance of fluoranthene and pyrene. In addition, benzo(g,h,i)perylene was also predominant in the Arthur Kill and benzo(k)fluoranthene in South Branch Creek. Figure 6-16 presents the B(a)P equivalents for Low Marsh soil. Only two samples, both at Transect D, had total PAH concentrations above the ER-L of 4 mg/kg; none exceeded the total PAH ER-M of 45 mg/kg. PAHs were detected at concentrations within the same order of magnitude for both South Branch Creek and the Arthur Kill.

As described previously in Section 6.1.6, the ubiquitous presence of PAHs in soil samples collected on site is a result of their presence in the anthropogenic fill. Furthermore, the presence of PAHs is common within sediments of industrialized waterways, such as the Arthur Kill. Accordingly, PAHs in the low marsh soils are attributable to sources other than the LCP site.

6.2.3.3 Other Organic Compounds

PCDDs/PCDFs

The low marsh soil samples were analyzed for 17 PCDDs/PCDFs, 21 pesticides and herbicides, 51 non-PAH SVOCs, and 46 VOCs. Each of the low marsh soil samples collected from South Branch Creek and the Arthur Kill contained detectable dioxins and furans (all analyzed compounds) (Table 6-15). While there is a high total TEQ found in Transect C, the remaining samples collected along South Branch Creek revealed a significantly lower total TEQ than the sample taken along the Arthur Kill (223 pg/g). Table 6-19 shows a summary of individual sample results for PCDDs/PCDFs and TEQs in low marsh soil. The PCDD/PCDF TEQ results are presented in Figure 6-17. As discussed previously in Section 6.1.8, PCDFs are attributed in part to site operations, as reflected in the predominance of PCDFs in the TEQ in landward low marsh soils. Low marsh soils near the Arthur Kill reflect a greater TEQ contribution of PCDDs from regional sources. This pattern of regional contamination, attributable to regional influences, is similar to that observed in sediment (see Section 6.6.3.3).

Pesticides/Herbicides

Four pesticide and herbicide compounds were detected in the South Branch Creek low marsh soils (Table 6-15), with a detection frequency ranging from 15 to 95 percent. In the Arthur Kill, six pesticide and herbicide compounds were detected, ranging from 25 to 100 percent detection frequency. All concentrations were the same order of magnitude. NJ NRDCSRS have been established for 16 pesticide and herbicide compounds, but none of the low marsh soil samples exceeded respective values. ER-Ls/ER-Ms (available for nine pesticide compounds) were also not exceeded.

PCNs

PCNs were not detected in the low marsh soil samples.

Other Organic Compounds

Of the non-PAH SVOCs analyzed, 10 were detected in the low marsh soil samples from South Branch Creek and two in the Arthur Kill samples. Seven VOC compounds were detected in the South Branch Creek low marsh soils and two in the samples collected from the Arthur Kill low marsh soils. As with sediments, VOCs were generally trace: with the exception of chlorobenzene (maximum detected 120 mg/kg, vs. the NRDCSRS of 7400 mg/kg), all other observations were below 3 mg/kg.

Ten non-PAH SVOC compounds were detected in South Branch Creek low marsh soil samples. The detection frequency for these ranged from 5 to 80 percent (Table 6-15). Two SVOCs (bis(2-ethylhexyl phthalate and carbazole) were detected in the Arthur Kill, with a detection frequency of 25 and 75 percent. NRDCSRS have been established for 29 of the analyzed non-PAH SVOC compounds, but none of the low marsh soil samples exceeded respective values. All detected SVOCs had concentrations in the same order of magnitude.

Hexachlorobenzene was detected at low concentrations in only two of the tested samples. The concentrations of 0.047 and 0.175 mg/kg and did not exceed the NJ NRDCSRS of 1 mg/kg. The NJ lowest sediment screening value (used as ER-L by the NJDEP) of 0.020 was exceeded in both samples, but the higher NJ screening value of 24 mg/kg (used as the ER-M) was not.

6.3 Soil Vapor

Soil vapor samples were collected from shallow soil vapor probes as shown on Figure 3-2. Samples from ten (10 probes) were tested for VOCs. Samples from four (4) probes were tested for mercury vapors. The statistical summary of the data are summarized on Table 6-20.

The delineation of site-related constituents for soil vapor is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of soil vapor may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.3.1 Mercury

Mercury vapors were detected in each of the four (4) samples that were tested. The concentrations ranged from 0.2 to 2.5 $\mu g/m^3$. There are no NJDEP Soil Gas Screening Levels for elemental mercury (NJDEP, March 2013). However, none of these values exceed the Draft Vapor Intrusion Guidance value of 3 $\mu g/m^3$ (USEPA, November 2002) that correspond to a hazard of 1. There are no detections of mercury in the samples above this screening level.

6.3.2 Volatile Organic Compounds

The VOCs detected in the soil vapor are similar to those that were detected in the soil. The VOCs in soil vapor include chlorobenzene, BTEX compounds, hexachlorobutadiene, chloroform and TCE. A comparison to New Jersey Soil Gas Screening Levels-Non-Residential (NJSGSLNR, NJDEP, March 2013) reveals a total of 11 exceedances (Table 6-21) of five separate constituents (Hexachlorobutadiene, TCE, PCE, Carbon Tetrachloride, and Chloroform). The exceedances were from various soil vapor probes located along the railroad tracks and the western portion of the site, as well as the central portion west of Building Nos. 230 and 240.

6.4 Groundwater

Two (2) rounds of groundwater quality samples were collected from monitoring wells at the site. These included one (1) round each of the complete group of wells that were available during each phase of the investigation. The Phase I round included the collection of samples from a total of 15 overburden wells in December 2001. The Phase II groundwater data comprised the sampling from 19 overburden and 10 bedrock monitoring wells between January and March 2007.

The horizontal and vertical delineation of site-related constituents for groundwater is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of groundwater may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.4.1 Groundwater Quality Criteria

As discussed in section 2.8.2, the New Jersey Class IIA groundwater quality standards (GWQS) [N.J.A.C. 7:9C] are used as benchmarks for the characterization of overburden groundwater. Comparisons of site-specific overburden groundwater quality data to the Class IIA GWQS are provided in Tables 6-23a and 6-24a and in the following text sections.

While the bedrock groundwater has been granted III-B reclassification based upon concentrations of chloride and total dissolved solids (Table 6-22), no specific procedure that is acceptable to NJDEP currently exists to develop alternate groundwater quality criteria for Class III-B aquifers. In order to be protective of surface water in the Arthur Kill, to which the bedrock groundwater discharges, the New Jersey Surface Water Quality Standards (SWQS) [N.J.A.C. 7:9B] for saline environments are used as benchmarks for the characterization of bedrock groundwater. Comparisons of site-specific bedrock

groundwater quality data to the SWQS are provided in Tables 6-23b and 6-24b and in the text sections that follow including separate comparisons to the Acute and Chronic Aquatic criteria and the Human Health criteria.

6.4.2 Mercury, Other Metals, and Arsenic

Despite the best efforts to minimize suspended solids in groundwater samples using the low-stress (low-flow) sampling technique, it was not possible to completely eliminate solids, particularly in the overburden wells. Given that metals tend to sorb to soil particles, suspended solids in the groundwater sample that originate from the soil in which the wells are screened may cause the over-estimation of metals concentrations in a unfiltered (total metals) sample because of the fact that soil particles are not mobile in groundwater. An exception, however, is that mobile colloidal-size particles containing metals may be present which generally are mobile in groundwater. For the purpose of this investigation, samples for metals analysis were collected in duplicate: one was field filtered through an in-line 0.45 µm filter, and the other was submitted unfiltered. Notwithstanding the issue of colloids and the official agency position regarding this matter, the filtered (dissolved metals) samples are considered to best represent the mobile concentrations of metals in groundwater.

6.4.2.1 Total Mercury

Total mercury in overburden groundwater samples was detected in 40 percent of the filtered (dissolved) samples and 65 percent of the unfiltered samples (Table 6-23a). However, mercury concentrations in overburden groundwater samples exceeded the Class IIA groundwater quality standard of 2 µg/L in ten percent of the filtered samples and 30 percent of the unfiltered samples. The highest mercury readings were in well MW-24S located near the "Ditch Bridge Area" along the former alignment of South Branch Creek at 164 µg/L and 233 µg/L in filtered and unfiltered samples, respectively. The only other well in which a dissolved exceedance of the overburden GWQS was observed was MW-23S which is located west of mercury cell Building No. 230as depicted on Figure 6-18b. Of particular note, however, is the fact that filtered mercury (Figure 6-18a) was ND in most of the samples located between the production area and South Branch Creek, including each of the wells located east of the railroad tracks.

Mercury concentrations in the bedrock water-bearing zone were substantially lower than in the overburden. In fact, none of the bedrock wells in the vicinity of or downgradient of the LCP production area contained detectable levels of mercury. The only mercury in the bedrock was observed in the four upgradient wells (under non-pumping conditions including MW-16D, MW-17D, MW-18D, and MW-20D (Figures 6-18c and 6-18d). The highest concentrations were observed in MW-18D at 10.9 and 11.1 µg/L in filtered and unfiltered samples. Exceedances of the Saline Human Health SWQS of 0.051 µg/L were noted for each well with mercury detections. Exceedances of the ecological CCC and CMC values were noted for wells MW-17D, MW-18D, and MW-20D. Of note is the fact that the filtered and unfiltered sample pairs from bedrock wells were very similar to one another, which is not surprising given the greater ease of collecting low-turbidity samples by the low-stress method in the bedrock relative to that in the overburden wells.

Mercury concentrations in overburden groundwater are relatively low considering the elevated levels of mercury that are present in the soils. Mercury in groundwater is generally restricted to areas of the site in which very high levels of mercury are observed in the soils. These data provide additional confirmation that the mercury in the LCP site soil is present in primarily insoluble forms. Detectable mercury in groundwater is relatively immobile and does not create groundwater plumes that extend laterally from the likely source areas.

Mercury in groundwater was largely undetected around the perimeter of the closed RCRA unit (former brine storage lagoon), demonstrating that that unit is not a source of mercury in groundwater. Exceptions include two low-level detections in unfiltered samples at levels that do not exceed the overburden NJGWQS of 24 µg/L or the NJGWQS of 2 µg/L.

The only bedrock wells that contain detectable levels of dissolved mercury are located northwest of the LCP production area (MW-17D, MW-18D, and MW-20D) and contain mercury concentrations ranging up to10.9 µg/L. Under pumping conditions, groundwater has been demonstrated to originate from the adjacent GAF site, sweeping through the western portion of the LCP site in which these wells are located, and then back to the GAF site to be captured by extraction well DEW-4A (Section 5.2.3.3). Relatively high dissolved mercury concentrations have been observed in nearby wells on the adjacent GAF site, which are the likely source of the mercury in the three LCP bedrock wells. These data demonstrate that the only dissolved mercury detected in bedrock at the LCP site originates from the GAF site.

Evidence of the mercury mobility in bedrock groundwater is provided by the apparent relative mercury solubility differences between the LCP and GAF sites. The mercury sources in soil at the LCP site have been demonstrated to consist primarily of insoluble forms (Section 6.1.1), which is consistent with the generally low levels of dissolved mercury detected in overburden groundwater at the LCP site. Contrasted with this is that dissolved mercury at the GAF site has been observed at concentrations that are orders of magnitude higher than at the LCP site, ranging up to 2,520 µg/L, suggesting the presence of much more soluble forms of mercury at the GAF site. Furthermore, none of the LCP bedrock wells containing detectable mercury were located in overburden groundwater. Only bedrock wells in the northwest portion of the Site had detectable mercury. In summary, the soluble mercury from the GAF site is the likely source of mercury in the LCP bedrock wells and this mercury is being captured by the GAF groundwater extraction system.

6.4.2.2 Methyl Mercury

Methyl mercury was analyzed in six selected wells, three (3) of which were in the overburden and three (3) in the bedrock. Table 6-25 presents the total mercury results (filtered and unfiltered) in comparison to the total methyl mercury results in each respective sample.

The methyl mercury results in the tested overburden groundwater samples ranged from 0.635 µg/L to 168 µg/L, corresponding to 0.32 percent to 102 percent[5] of the total mercury (Figure 6-19a). The highest methyl mercury concentration was detected in monitoring well MW-24S, in which a very high proportion of the total mercury was in the methyl form. This result is in contrast to methyl mercury results in other site groundwater, soil, and sediment samples in which methyl mercury made up a very minor proportion of the total mercury, generally far less than 1 percent. As stated previously, MW-24S is screened in the Ditch Bridge Area along the former alignment of South Branch Creek in which methylation could have occurred in sediments prior to filling of this area after 1972 (Section 2.6.1).

In the tested bedrock groundwater samples, methyl mercury was analyzed in three wells, with results ranging from 0.0192 µg/L to 0.188 µg/L (Figure 6-19b). The proportion of methyl mercury ranged from 0.01 percent to 0.09 percent (Table 6-28), which is similar to methyl mercury proportions in other media at the site.

6.4.2.3 Arsenic

Arsenic in overburden wells was detected in 70 percent of the unfiltered and filtered samples. Overburden groundwater arsenic concentrations ranged up to 588 µg/L (MW-12S) for dissolved (filtered) samples and 275 µg/L (MW-26S) for unfiltered samples. Each detection of arsenic was above the

[5] The calculated percentage of methyl mercury greater than 100 percent of total mercury reflects the variability in the analysis, which was well within acceptable QC criteria established by USEPA.

GWQS of 3 µg/L. The distribution of arsenic in overburden groundwater is depicted on Figures 6-20a and 6-20b. In general, total and dissolved sample concentrations were comparable, indicating that arsenic occurs in groundwater in a soluble form. Anomalous results are observed in well MW-12S in which the filtered result was substantially higher at 588 µg/L compared to 192 µg/L in the corresponding unfiltered sample.

Arsenic in overburden groundwater was widely distributed across the site and appears to be spatially unrelated to the LCP manufacturing area. In fact some of the lower arsenic concentrations in overburden groundwater were observed in the area immediately surrounding the LCP production buildings. In addition, arsenic was undetected in the wells located downgradient of the closed RCRA unit further supporting that arsenic in groundwater is unrelated to LCP operations. Due to the distributed pattern of concentrations in the overburden groundwater, the source of arsenic is most likely from the anthropogenic fill.

Arsenic in bedrock wells was detected in 30 percent of the unfiltered and filtered samples and at concentrations that are substantially lower than in the overburden groundwater. Bedrock groundwater arsenic concentrations ranged to 27.7 µg/L for dissolved samples and 25.2 µg/L for unfiltered samples collected from MW-11D. Exceedances of the Saline Human Health SWQC of 0.061 µg/L were noted in wells MW-11D, MW-16D, MW-23D, and MW-25D. The distribution of arsenic in bedrock groundwater is depicted on Figures 6-20c and 6-20d.

6.4.2.4 Other Metals and Inorganics

Cadmium in overburden groundwater was detected in just 5 percent and 15 percent, respectively of the filtered and unfiltered overburden groundwater samples. Each of these detections exceeded the overburden GWQS of 4 µg/L, in which the maximum concentrations ranged up to 10.5 and 22.9 µg/L in filtered and unfiltered samples, respectively. Concentrations in the filtered and unfiltered samples were generally comparable, with the exception of MW-7S, which showed a concentration of 22.9 µg/L in the unfiltered sample, with no cadmium detected in the filtered sample. Cadmium was not detected in bedrock groundwater.

Barium in overburden groundwater was detected in just 5 percent of both the filtered and unfiltered overburden groundwater samples. One well, MW-21S, revealed exceedances the overburden GWQS of 6000 µg/L, in which the maximum concentrations were 15,300 and 14,200 µg/L in filtered and unfiltered samples, respectively. Barium was detected in 30 percent of both the filtered and unfiltered bedrock groundwater samples, with a maximum detection of 288 µg/L. There are no saline SWQSs for Barium for comparison to bedrock groundwater quality data.

Chromium was detected in 25 percent and 30 percent, respectively, of the filtered and unfiltered overburden and bedrock groundwater samples. One well, MW-18S, revealed exceedances the overburden GWQS of 70 µg/L, in which the concentration was 211 and 233 µg/L in filtered and unfiltered samples, respectively. Chromium was detected in 1 unfiltered bedrock groundwater sample, with at 10.3 µg/L. The result did not exceed the Saline Human Health SWQC of 750 µg/L.

Cyanide in overburden groundwater was detected in 16 percent of groundwater samples. There were three detections of cyanide ranging from 20 to 77 µg/L, each exceeding the overburden GWQS of 0.1 µg/L. The wells with cyanide detection included MW-17S, MW-12S, and MW-18S. Cyanide in two unfiltered bedrock groundwater samples at concentrations of 11 and 12 µg/L. Each of these samples exceeded the USEPA Saline Ecological Criteria Continuous Concentration (CCC) and the USEPA Saltwater Criteria Maximum Concentration (CMC) criteria of 1.0 µg/L.

It is likely that the presence of cadmium, chromium, and cyanide in overburden groundwater are related to the presence of anthropogenic fill.

Lead was detected in 5 percent and 20 percent, respectively, of the filtered and unfiltered overburden groundwater samples and in 80 percent of the filtered and unfiltered bedrock groundwater samples. Dissolved and total concentrations were generally comparable. Two of the unfiltered overburden lead results exceeded the overburden GWQS of 5 µg/L (MW-23S and MW-18S) No exceedances of the lead GWQS were found in dissolved samples from the overburden. Exceedances of the CCC criterion of 8.1 µg/L were noted in 7 dissolved samples and 5 unfiltered samples.

Iron was detected in 90 percent and 100 percent, respectively, of the filtered and unfiltered overburden and bedrock groundwater samples. Eighty-five (85) percent of the unfiltered and filtered samples in the overburden exceeded the GWQS of 300 µg/L. There are no saline SWQC for Iron.

Manganese was detected in 95 percent of both the filtered and unfiltered overburden groundwater samples and in 100 percent of both the filtered and unfiltered bedrock groundwater samples. Dissolved and total concentrations were generally comparable. 85 percent and 90 percent, respectively, of the unfiltered and dissolved overburden manganese results exceeded the GWQS of 50 µg/L. 90 percent and 100 percent, respectively, of the unfiltered and dissolved bedrock results exceeded the Saline Human Health SWQC of 0.061 µg/L.

Lead, iron, and manganese are major constituent in natural soils and rock; hence elevated groundwater levels are not unexpected.

6.4.3 Organics

Several volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) were observed in both overburden and bedrock groundwater at the site. Aside from known and suspected storage of petroleum and heating oil in the vicinity of the Linde Hydrogen Plant, organic compounds are not known to have been used in production at the LCP site. The highest VOC/SVOC detections are attributed to off-site sources including the adjacent NOPCO site and the former GAF site. However, many of these same compounds are also found in the soils at the site and wide distribution within the overburden groundwater may be attributed, in part, to dissolution from the anthropogenic fill. The bulk petroleum product terminal facilities have been located in close proximity to the LCP site for more than 50 years and have likely contributed to regional contamination by VOCs and other fuel-related compounds.

Benzene, various chlorobenzene compounds, and 4-chloroanaline were observed in the overburden groundwater at concentrations that exceed the respective overburden GWQS. The specific exceedances are listed on Table 6-24a. The spatial distributions of benzene and chlorobenzene in overburden groundwater are depicted on Figures 6-22a and 6-23a, respectively. The exceedances of the overburden GWQS were observed in 13 overburden wells.

Substantially elevated levels of benzene, chlorobenzene and 1,2-dichlorobenzene that exceed the overburden GWQS were observed in wells MW-6S, MW-21S, and other overburden wells to the northwest of those wells. These exceedances likely result from residual subsurface materials from the former NOPCO site which was located immediately adjacent to wells MW-6S and MW-21S. Given these observations and the fact that chlorobenzene is not related to chlor-alkali facilities, their presence in these overburden wells is likely due to the former NOPCO site. VOCs in well MW-6S present a potential risk to surface water quality given its proximity to South Branch Creek.

Well MW-24S, located in the former "Ditch Bridge" area was impacted by exceedances of the overburden GWQS for benzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, pentachlorophenol, hexachlorobenzene, methylene chloride, and tetrachloroethene. The presence of these compounds likely results from historic wastewater transport across the LCP site from the adjacent GAF site.

Several VOCs/SVOCs including benzene, toluene, and 1,2,4-trichlorobenzene exceeding the Saline Human Health SWQC, were observed in the three bedrock wells located in the northwestern portion of the site, upgradient of the manufacturing area, including wells MW-17D, MW-18D, and MW-20D, exceeding the Saline . Much lower levels of these compounds were also detected in several other wells around the site. The specific bedrock exceedances are listed on Table 6-24b. The aerial distributions of benzene and chlorobenzene in bedrock groundwater are depicted on Figures 6-22b and 6-23b, respectively.

Benzene and chlorobenzenes were not used in production at the LCP site but are documented to be present in groundwater at the adjacent GAF site. The northwestern bedrock wells in which benzene and chlorobenzenes were detected are within the zone in which the GAF groundwater extraction system has been shown to induce bedrock groundwater flow from the neighboring GAF site. Accordingly, benzene and chlorobenzenes in bedrock is present as a result of the GAF site in the same manner as is mercury. The benzene and chlorobenzene in the northwestern bedrock wells is captured and subsequently treated by the GAF remediation system.

One sample groundwater samples from each zone was analyzed for PCDD/PCDF (Table 6-26, Figures 6-21a and 6-21b). Very low levels of both PCDDs and PCDFs were detected in each sample with TEQs of 0.181 ng/L (0.000181 µg/L) and 0.00882 ng/L (0.00000822 µg/L in the overburden and bedrock, respectively. Given the extremely low solubilities of PCDDs and PCDFs in water, these detections are likely associated with solids in the sample rather than representing dissolved phase constituents. The turbidity of the overburden sample was 16.2 NTU while the bedrock sample was 271 NTU. The overburden TEQ is dominated by the PCDFs in a similar pattern as the fill soils in this unfiltered that further supports site soil impacts on this groundwater sample. The exceedingly low TEQ was in the bedrock groundwater sample may be due to a very small level of cross-contamination that may have occurred either during well installation or during sampling that is observable due to low detection limits for PCDD/PCDF analysis.

No free phase liquids were observed in the groundwater column in either overburden or bedrock monitoring wells.

6.5 Surface Water

Surface water samples were collected from five locations in South Branch Creek and two locations in the Arthur Kill (see Figures 3-1 and 3-2). As discussed in Section 3.3.4, these stations correspond to the transects along which the sediment samples were collected. Additional surface water samples were collected from the Off-Site Ditches from two locations in each ditch.

The complete analytical results of detected constituents in surface water are presented in Appendix J. A total of 13 TCL and 13 TAL chemical constituents were detected in the unfiltered surface water samples collected from South Branch Creek. In unfiltered surface water samples from the Arthur Kill, 1 TCL and 9 TAL chemical constituents were detected. There were 11 TCL and 15 TCL chemical constituents found in surface water samples from the Northern Off-Site ditch, while 8 TCL and 12 TAL constituents were detected in the Southern Off-Site Ditch. Table 6-27 presents a summary of descriptive statistics for surface water chemicals collected in South Branch Creek and the Arthur Kill, and the Off-Site Ditches.

Both chronic and acute toxicity criteria are available for surface water for various constituents including mercury. The chronic value is referred to as Criteria Continuous Concentration (CCC), which is an estimate of the highest contaminant concentration to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The acute value, Criterion Maximum Concentration (CMC), is an estimate of the highest contaminant concentration to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. Applicable water quality criteria have not been developed for any of the detected chemicals on an unfiltered basis. USEPA

National Recommended Water Quality Criteria (NRWQC) for saltwater exist for dissolved arsenic, cadmium, copper, lead, mercury, selenium and zinc; however, filtered inorganics were not analyzed during the Phase I and II investigation with the exception of the tidal evaluation for mercury, described below and the Off-Site Ditch investigation. In addition, due to the tidal influences and the inherently mobile nature of surface water, the surface water data provide limited information on nature and extent of contamination in the water bodies compared with sediment.

The horizontal and vertical delineation of site-related constituents for surface water is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of surface water may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.5.1 Mercury

The unfiltered surface water data indicate higher overall inorganic concentrations in South Branch Creek and the Northern Off-Site than in the Arthur Kill. This observation is likely related to the greater presence of suspended particulates in stations closer to the site.

The maximum mercury concentration observed in South Branch Creek in Phase II was at Transect A (5.8 µg/L). In Phase II, surface water mercury concentrations declined approaching the Arthur Kill, with the lowest concentrations observed at Transects F and G, and concentrations in South Branch Creek approximately 10-fold higher than in the Arthur Kill (Appendix J). However, in Phase I, the maximum observed overall mercury concentration (18.1 µg/L) was at SW-5, in the general vicinity of Transect D. The concentration of unfiltered metals found in surface water is dependent on when in the tidal cycle the sample is collected (as discussed further below). Therefore, it is not possible to directly compare Phase I and Phase II surface water data.

To address the influence of tidal conditions, an additional separate sampling effort was performed to determine whether mercury from South Branch Creek is being transported to the Arthur Kill in either the dissolved or particle-bound phase. Particle-bound mercury, dissolved mercury, and suspended solids were sampled during two-hour intervals throughout an entire tidal cycle in February 2007. The samples were collected from the petroleum terminal bridge spanning South Branch Creek between Transects C and D. The data are summarized on Figure 6-24. Based on filtered surface water results, dissolved mercury was undetected in each of the samples. Therefore, mercury detected in surface water is associated with the suspended solid phase. Mercury was observed in each of the unfiltered surface water samples collected from South Branch Creek at concentrations ranging up to 5.8 µg/L, with a mean concentration of 3.2 µg/L.

Mercury was detected in both unfiltered and dissolved samples in the Northern Off-Site Ditch with a maximum concentration of 13.1 µg/L for unfiltered samples and 0.0173 µg/L for dissolved samples. The difference in mercury concentrations between total and dissolved samples indicated the mercury found in the Northern Off-Site Ditch is primarily associated with suspended particles.

Mercury was also detected in both the unfiltered and dissolved samples in the Southern Off-Site Ditch, however at much lower concentrations. A maximum concentration of 0.022 µg/L for unfiltered samples and 0.001 µg/L for dissolved samples was found in samples from the Southern Off-Site Ditch.

The CCC and CMC values for dissolved mercury are 0.94 and 1.8 µg/L, respectively. The highest unfiltered mercury concentrations in South Branch Creek were measured during ebb tide and the flood when water velocity is highest, which creates the maximum potential for mercury-containing solids to be suspended. The lowest mercury concentrations were measured during periods of high and low slack tide, when water velocity is low. Figure 6-24 shows that the values for total suspended solids and

turbidity follow the same tidal pattern. The pattern of mercury presence in surface water is clearly dependent on the tidal condition. The CCC and CMC values for mercury were not exceeded in dissolved samples from either the Northern or Southern Off-Site Ditches.

6.5.1.1 Methyl Mercury

Methyl mercury was also detected in each of the five unfiltered surface water samples collected at South Branch Creek in the Phase II RI, with a maximum concentration of 19.5 ng/L (0.0195 µg/L). In the two unfiltered surface water samples collected from the Arthur Kill, the maximum concentration of methyl mercury was 0.738 ng/L (Table 6-28). No Saltwater CCC and CMC values have been established for methyl mercury. The percentage methyl mercury of the total mercury concentration was low in all of those samples, with a maximum of 0.34 percent in South Branch Creek, and 0.31 percent in the Arthur Kill surface water samples.

Methyl mercury was also detected in the surface water collected during the regional study within Old Place Creek, where the maximum concentration was 0.091 ng/L (0.00091 µg/L; Appendix M Table N-2). This concentration is more than two order of magnitude below the highest level observed in the surface water in South Branch Creek, which would be expected based on the lower overall surface water mercury concentrations. However, the percentage methyl mercury of the total mercury concentration was 0.07 percent in the samples from the regional study, also lower than in either South Branch Creek or the Arthur Kill. These results indicate a lower rate of methylation.

As discussed further in Section 7.1.6, various factors affect the observed methylmercury presence in each medium. However, the net methylation rate (which accounts for both formation and removal mechanisms) in Old Place Creek surface water is, empirically, several times higher than that in South Branch Creek. In South Branch Creek and the Arthur Kill, methyl mercury represented between 0.05 and 0.16 percent of total mercury; in Old Place Creek, the percentage of mercury in the methylated form ranged from 0.35 to 0.51 percent. A similar pattern is observed in sediment, with South Branch Creek/Arthur Kill samples typically exhibiting less than 0.05 percent methylmercury, while Old Place Creek samples (except W 1 and W 2) contained 0.1 to 0.39 percent methylmercury. These data do not necessarily reflect the initial rate of methylation, but do suggest that overall the South Branch Creek system is producing a lower net rate of mercury methylation.

6.5.2 Other Metals and Arsenic

Of the 22 elements analyzed other than mercury, 12 metals and arsenic were detected in the surface water samples of South Branch Creek, eight in the Arthur Kill, 15 in the Northern Off-Site Ditch and 11 in the Southern Off-Site Ditch (Table 6-27, Appendix J). The frequency of detection for the South Branch Creek samples ranged from 20 to 100 percent. In the Arthur Kill samples, the detection frequency ranged from 50 to 100 percent. In Phase I, arsenic was observed between 59 µg/L and 114 µg/L in the near-facility portions of South Branch Creek (SW-1 through -3), declining to the 40 µg/L range further toward the Arthur Kill (SW-4 and -5) and to ND by the Arthur Kill (SW-6). Several metals (barium, lead, cadmium, iron, and zinc) showed the highest concentrations in the mid-South Branch Creek areas (SW-3 through SW-5) and lower concentrations closer to the former facility and in the Arthur Kill. In Phase II, however, the highest arsenic and metal concentrations were typically in the Transect A and B stations. As indicated above, the tidal influence prevents direct comparison of the results from the two sampling events, and concentrations are related to the presence of suspended material.

Various inorganic constituents were found in unfiltered samples exceeding the Saltwater CCCs and CMCs in the Off-Site Ditches, including arsenic, cadmium, copper, lead, nickel, and zinc, however only arsenic was found to exceed the criteria in dissolved samples. Dissolved arsenic was detected in the

Northern Off-Site Ditch at concentrations up to 152 µg/L, while the highest concentration found in the Southern Off-Site Ditch was 42 µg/L. Additionally manganese was found to exceed saltwater Human Health criteria in dissolved samples in both ditches, with a maximum concentration of 624 µg/L in the Northern Off-Site Ditch and 598 µg/L in the Southern Off-Site Ditch.

6.5.3 Organics

Traces of several PAHs (fluoranthene, fluorene, naphthalene, and phenanthrene, all less than 1 µg/L) were reported in the Phase II surface water samples at Transect A; a fraction of a µg/L of naphthalene was also reported in the Arthur Kill sample at Transect G. PAHs may be present as part of the suspended solids due to erosion of fill material.

Pesticide and PCB compounds, PCNs, and hexachlorobenzene were not detected in surface water.

Benzene and chlorinated benzenes (1,2- and 1,4-dichorobenzene and 1,2,4-trichlorobenzene) were detected in several surface water samples collected in South Branch Creek in both Phase I and II. No aquatic life-basis CCC or CMC values are available for these compounds. However, based on a literature review, aquatic life protection benchmarks were developed for benzene, chlorobenzene, 1,2- and 1,4-dichlorobenzene (Table 6-27). While occurrence was scattered, most of the higher reported concentrations were clustered in the Transects A, C, and D areas. These constituents were detected in groundwater and soil throughout the site. They were also present at substantially elevated concentrations in MW-6, a shallow well about 50 feet from South Branch Creek from which groundwater would be expected to discharge to the creek somewhere between Transects B and C. The chlorinated benzenes in surface water may be due at least in part to shallow groundwater infiltration. However, their widespread occurrence in surface water and sediments (see below) suggests a migration mechanism similar to that of other adsorbed site contaminants including historic wastewater and storm water discharge from the LCP and GAF sites..

Scattered detections of other VOCs (tert-butyl methyl ether and Freons) were reported in South Branch Creek surface water samples. The frequency of detection ranged from 20 to 40 percent. These constituents were not present in shallow groundwater near the stream and do not appear to be related to the site. VOCs were not detected in the surface water samples collected from the Arthur Kill.

6.6 Sediment

Phase II sediment samples were collected along five (5) transects located in South Branch Creek and two transects in the Arthur Kill near the mouth of South Branch Creek. Nine additional 0-0.5-foot samples were collected in the Phase I RI. The samples were collected following methods described in Section 3.3.5.

Phase II sediment samples were sampled to "human refusal", which occurred at depths ranging from 0.5 to 2.5 feet. Sample refusal, the depth at which the manually operated sampler could no longer penetrate, is assumed to correspond to the bottom of the sediment which is believed to be considerably softer than the underlying soils.

As described in Section 3, an extensive list of chemical constituents was analyzed in sediment as described in Section 3.7. The complete analytical results of detected constituents in sediment are presented in Appendix J. Of these, 23 TAL and 63 TCL analytes were detected in South Branch Creek (Transects A through E), and 20 TAL and 45 TCL analytes were detected in the Arthur Kill (Transects F and G). Table 6-29 presents a summary of descriptive statistics for the sediment samples for South Branch Creek and the Arthur Kill. Figures 6-25a through 6-27d show the spatial distribution of mercury, arsenic, and the total PCBs, Aroclor 1254 and Aroclor 1260, in the sediments from South Branch Creek and the Arthur Kill.

A regional study was performed in Old Place Creek in Staten Island, New York, a tributary of the Arthur Kill following the same methods and procedures as used during the LCP Phase II RI in which 86 analytes were detected. A summary of descriptive statistics for sediment samples collected during the regional study can be found in Appendix M, Table N-4.

There are no promulgated regulatory standards for sediment quality. However, the ER-L and ER-M screening values (Long, *et al.*, 1995) are used to provide a context for assessing the sediment data. These screening levels were selected from among several sets of frequently cited benchmarks because they are preferred by the NJDEP (NJDEP, 1998). The ER-Ls and ER-Ms represent the 10th and 50th percentile concentrations, respectively, associated with observed biological effects from systems with multiple contaminants. Correlation between effects and concentrations for many constituents, including mercury, was described by the Long, *et al.* (1995) as "weak." The ER-Ls are used as a threshold below which biological effects are not expected. The ER-Ms are indicators of when effects might be expected. The ER-Ms do not indicate biological hazard, only that additional risk evaluation may be warranted. Tables 6-30a and 6-30b list the ER-L and ER-M values for various constituents, along with exceedances of these screening values for South Branch Creek.

The ER-L value was exceeded for 23 constituents in at least one sample from South Branch Creek, and for 22 in the Arthur Kill. Twenty-two chemicals exceeded respective ER-Ms in South Branch Creek, 17 in the Arthur Kill. This pattern suggests a comparable level of criterion exceedance in both sampled areas.

In the descriptive text that follows, the South Branch Creek samples refer to those collected along Transects A through E, and the Arthur Kill samples refer to Transect F and G which are near the mouth of South Branch Creek. The transect locations are depicted on Figures 3-1 and 3-2, as well as contaminant-specific figures discussed below.

The horizontal and vertical delineation of site-related constituents for sediment is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of sediment may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.6.1 Mercury

Total Mercury

Total mercury was detected in 98 percent of the sediment samples in South Branch Creek, and in 100 percent of the sediment samples in the Arthur Kill (Table 6-29, Figure 6-25a, through 6-25d), and 100 percent of the sediment samples from both Off-Site Ditches (Figure 6-25e). The ER-L and ER-M concentrations for mercury are 0.15 and 0.71 mg/kg, respectively. Mercury concentrations exceeded both the ER-L and ER-M threshold in 48 of the 49 South Branch Creek sediment samples and also in all six of the sediment samples from the Arthur Kill. Although mercury was found in both areas, concentrations of mercury were higher in South Branch Creek than in the Arthur Kill. Mercury concentrations exceeded the ER-L threshold in each of the Off-Site Ditch samples. The ER-M threshold was exceeded in each of the samples from the Northern Off-Site Ditch, and 67% of the Southern Off-Site Ditch. The overall concentrations of mercury in the Northern Off-Site Ditch were elevated, averaging 90.2 mg/kg, although they were generally lower than those found in South Branch Creek. Concentrations of mercury in the Southern Off-Site Ditch were significantly lower, averaging 1.29 mg/kg.

As indicated on Figures 6-25a, there is a pattern of generally declining mercury concentrations in surficial sediment along South Branch toward the Arthur Kill. Maximum mercury concentrations (in the 300-400 mg/kg range) were reported in stations SED-A-1, SED-A-2, and SED-2, each of which was located at the headwaters of South Branch Creek. In the Transect B/SED-3 area, approximately 350 feet closer to the Arthur Kill, concentrations are substantially lower (all below 200 mg/kg). Slight increases are observed in the SED-C area, which is likely related to the depositional nature of this "back-bay" area and possibly to the presence of additional drainage inputs from the large concrete outfall that

is a historic remnant of the City of Linden trunk sewer line. Further toward the Arthur Kill, concentrations continue to decline, with concentrations between 24.5 and 128 mg/kg observed in the first Arthur Kill transect (Transect F). At Transect G, furthest out in the Arthur Kill, mercury ranged from 0.86 to 12.5 mg/kg. These concentrations are similar to those observed throughout the Arthur Kill in both published agency databases and in samples collected in Old Place Creek (Appendix M). Extensive regional information published by various agencies (Figure 2-28) indicates that mercury in the Arthur Kill is generally in the single digit mg/kg range. Samples collected form Old Place Creek to supplement the regional information revealed an average mercury concentration of around 7 mg/kg (Table N-4). Thus the concentrations of mercury in Transect G, which average 5.5 mg/kg, indicates that mercury attenuates to background in the area of the Arthur Kill just beyond the mouth of South Branch Creek.

Similar attenuation is observed for the deeper sediments (Figures 6-25b through 6-25d):, there is more of a distinct increase in mercury accumulation in the Transect C and D areas relative to more near-facility locations than is observed in the 0-0.5-depth interval, but the concentrations in sample SED-6 at Transect F (8.7 mg/kg at 0.5-1.0 feet and 4.8 mg/kg at 1.0-1.5 feet) are well within the range of background.

The pattern of mercury concentrations in surficial sediment in the Northern Off-Site Ditch do not show a decreasing gradient from upstream to downstream, however that is to be expected due to the parallel run of the ditch adjacent to former operations areas of the LCP Site. The concentrations of mercury in the Southern Off-Site Ditch are lower than those found in the Arthur Kill during the Phase II RI. The mercury results of the two off-site ditches indicates the Northern Off-Site Ditch has been impacted by runoff with contaminated sediment from the LCP Site, while the Southern Off-Site Ditch has not.

Table 6-31 and Figure 6-28 present the mercury sediment results in South Branch Creek by depth for each station (along with selected other elements). For clarity of display, the graphical patterns are presented separately for each transect. The pattern of mercury presence by depth is highly variable. In certain locations (such as SED-5 and SED-6) there is a marked gradient with depth such that mercury declines to background levels by the 1.0 to 1.5-foot depth interval. At other stations, there is no apparent decrease with depth, and the location where the deepest sediment was available for collection (SED-D-2) showed essentially no change in concentration down to 2.5 feet. Several stations (notably SED-3) exhibited a maximum observed concentration in the second shallowest depth interval (0.5-1.0 feet). Overall, there appears to be no correlation between the location along the channel and the vertical mercury gradients. This heterogeneity probably reflects the tidal flushing and related processes of deposition and re-suspension that vary by location and have resulted in variable degrees of sediment mixing over time.

Sequential Extraction

Seven samples from three transects were submitted for analysis by a selective sequential extraction method after Bloom, *et al.*, (2003). This five-step sequence of extractions groups mercury compounds into "biogeochemically" distinct categories. These data are presented in Table 6-32.

The majority of the mercury present was associated with fraction F4. F4 comprised between 65 and 88 percent of total mercury, and the proportion was not related to the total mercury detected or the location within the areas evaluated (Transects A through C). The next most common forms of mercury present extracted with the F5 fraction, indicating highly insoluble mercury sulfide. Higher total mercury concentrations appear to be associated with a higher proportion of F5 and a lower proportion of acid soluble (F2) but the correlations are weak and there are an insufficient number of data points to draw any firmer conclusions. There is essentially no soluble mercury in sediments. These results were very similar to the on-site surficial soils in which elemental mercury and mercury sulfides were predominant.

The developers of the sequential extraction procedure indicate in their paper (Bloom, *et al.*, 2003) that the presence of methyl mercury cannot always be definitively linked with one of the sequential extraction fractions, as mercury methylation is variable based on specific conditions (See Section 7 for additional discussion of factors affecting methylation). However, case studies indicate that the methyl fraction may be associated with F3 (organo-chelated forms). The percentage of mercury present in the F3 fraction is South Branch Creek sediments ranged from 0.16 to 4.8 percent of total mercury. Methyl mercury analyses were not performed on these specific samples; however, based on the extremely low presence of methyl mercury as a percentage of total mercury (Table 6-33), it is certainly feasible that the very low concentrations of methyl mercury could be a portion of the F3 fraction.

There are limited data on methyl mercury in the Arthur Kill basin overall. The agency databases report only total mercury results. In the regional study sediment samples collected in Old Place Creek, methyl mercury was detected in all 10 samples (Appendix M, Table N-4). The highest percentage of methyl mercury was 0.39 percent, slightly higher than observed in South Branch Creek or the Arthur Kill.

Methyl Mercury

Methyl mercury was detected in 29 of the 32 sediment samples collected from South Branch Creek and in all six of the sediment samples from the Arthur Kill (Table 6-33). The percentage methyl mercury of the total mercury concentration was low (fractions of a percent) in all of the samples. In general, samples with higher total mercury concentration exhibited lower percentage methyl mercury. Sample SED-C-2-0.5-1.0 from South Branch Creek sediment showed the highest maximum total mercury concentration (901 mg/kg) and the lowest percentage methyl mercury (0.0015 percent). Arthur Kill results for maximum total mercury (30 mg/kg) and percentage methyl mercury were lower than the results from South Branch Creek.

6.6.2 Other Metals and Arsenic

Besides mercury, 22 metals and the metalloid arsenic were detected in sediment (Table 6-29). Of these, ER-L and ER-M values have been established for arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc. ER-L and ER-M exceedance frequency (Tables 6-30a and 6-30b, respectively) for these elements in South Branch Creek sediment samples was 35 to 98 percent, and 2 to 98 percent, respectively. In the Arthur Kill, ER-L values were exceeded in 17 to 100 percent of the samples and ER-M values were exceeded for three of those eight elements with an exceedances frequency of 17 percent. In the Northern Off-Site Ditch, ER-L values were exceeded in 50 to 100 percent of the samples and ER-M values were exceeded for four of those eight elements(arsenic, lead, nickel, and zinc) with an exceedances frequency of 17 to 100 percent. In the Southern Off-Site Ditch, ER-L values were exceeded in 33 to 50 percent of the samples and ER-M values were not exceeded.

Nine metals had the highest concentrations in South Branch Creek and the lowest concentrations in the Arthur Kill. Arsenic concentrations were ten-fold higher overall in South Branch Creek than in the Arthur Kill, with a clear gradient from the Site (as discussed further below). Zinc and lead concentrations in South Branch Creek were approximately five times higher than in the Arthur Kill. Other metals had comparable concentrations in both sampled areas. Barium and cadmium had the highest concentrations in South Branch Creek, approximately ten-fold higher than in the Arthur Kill sediments.

Arsenic concentrations in the Northern Off-Site ditch were approximately 6 times higher than in the Arthur Kill. While the highest concentration of lead in the Northern Off-Site Ditch (242 mg/kg) was higher than the highest found in the Arthur Kill (161 mg/kg), the average concentrations of lead were comparable. Concentrations of other metals in the Southern Off-Site Ditch were comparable or lower than the Arthur Kill.

Arsenic

The distribution of arsenic in sediments at various depths appears on Figures 6-26a through 6-26d, and the depth distribution appears in Table 6-31. Figure 6-28 shows the variation by station and depth. There is an area of marked arsenic elevation in the headwater section of South Branch Creek, with surficial sediments containing up to 4,250 mg/kg arsenic (SED-2). Similar elevated levels of arsenic were similarly detected in this area in the low marsh soils (Section 6.2.2). Arsenic in other surficial sediment samples in the Transect A area ranged from 118 to 2,640 mg/kg.

Moving toward the Arthur Kill, arsenic concentrations decrease dramatically; by Transect F, arsenic ranged from 13 to 47 mg/kg, and by Transect G, the concentrations were between 14 and 16 mg/kg. These levels are comparable to the regional arsenic concentrations in agency databases, which reported arsenic in surficial sediments between 10 and 100 mg/kg, most frequently in the range of 20 mg/kg (Section 2.10). Arsenic concentrations in sediments collected in the regional study from Old Place Creek averaged 35 mg/kg (Appendix M Table N-4). Therefore, the arsenic impact, as with mercury, attenuates to background by the mouth of South Branch Creek.

The elevated arsenic concentration observed in SED-2 appears to be a surficial condition, since the 0.5-1.0-foot and 1.0-1.5-foot samples at that location only contained around 100 mg/kg. A decrease with depth was also observed in SED-6 and SED-E-2, and to a lesser extent in SED-4 and SED-5. Other locations showed no decrement with depth.

The headwater area of South Branch Creek is clearly impacted by elevated arsenic. However, the arsenic enrichment appears to be a relatively isolated condition, as concentrations drop off rapidly with distance from the headwater. This apparent arsenic hot-spot does not likely result from on-site sources. Arsenic is not associated with chlor-alkali facilities and the sediment concentrations are considerably higher than arsenic levels observed in site soils within the former LCP production area. These data suggest that the source of arsenic in this area may have originated from another off-site source, possibly as a result of overland flow in the swale along the railroad tracks from the duPont and GAF sites. The elevated nature of the arsenic concentrations in this area relative to in upland on-site areas has already been described in Section 6.2.2 as part of the low marsh soils discussion. The fish tissue data collected at Transect A (see Section 6.7.2) further indicate that there is an unusual form of arsenic present in this area

Arsenic concentrations found in the Northern Off-Site Ditch, presented in Figure 6-26e, do not appear to follow a clear pattern, with the highest concentration found in the middle B-transect, and comparable concentrations at the A and C transects. As discussed above, the concentrations are significantly elevated over the Arthur Kill, indicating a discharge of Arsenic into the Northern Off-Site Ditch. The highest concentrations of Arsenic in surficial soils on the LCP Site were found in the vicinity of the former Linde Hydrogen Plant, located north of the ditch, indicating runoff from this area of the Site may have impacted the Northern Off-Site Ditch.

Concentrations of Arsenic in the Southern Off-Site Ditch are comparable or lower than those found in the Arthur Kill indicating arsenic is not a concern beyond regional conditions.

Other Metals

Sediment results for other key metals (cadmium, copper, lead, nickel, and zinc) appear in Appendix J and Figures 6-29 through 6-32. In general, as illustrated in the figure, the concentrations of multiple inorganic elements show a high degree of correlation. Key pattern similarities include a decline in concentration with depth at SED-1, SED-C-2, SED-5, and SED-E-2 a concentration elevation at SED-B-1 with relatively consistent concentrations across the rest of Transect B; similar concentrations in all samples at SED-D-2 (all depths) and SED-D-3; and overall declining levels at the mouth of South Branch

Creek and into the Arthur Kill. Mercury generally correlates with the other elements, but shows a more marked decline along South Branch Creek and into the Arthur Kill. The relative immobility may be due to binding of mercury with sulfides to form insoluble cinnabar.

The high correlation among multiple elements suggests that the distribution is related to sediment characteristics (e.g., grain size) and not to specific sources. Visual descriptions of the relative grain size of the sediment are presented in Appendix C.

Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)

AVS/SEM measurements are used as a general indicator of bioavailability of divalent metals (cadmium, copper, nickel, lead, mercury and zinc) in sediment. The major component of AVS; iron sulfide (FeS), reacts with those metals to form metal sulfides. The solubility of these metal sulfides is very low, and they are therefore not considered bioavailable. In sediments that contained a high level of reactive sulfide, the partitioning of divalent metals (Cd, Cu, Ni, Pb, Hg, and Zn) into the aqueous fraction (pore water), which represents the contact medium for aquatic life, will be minimized. Conversely, sediments with SEM greater than AVS are of potential concern with regard to bioavailability from sediment. Specifically, where the AVS/SEM ratio is less than one, there is a potential for the presence of soluble (bioavailable) metals.

Four samples from South Branch Creek had AVS/SEM ratios below one (Table 6-34): two from Transect D and two from Transect E. Similarly, all three samples from Transect G in the Arthur Kill had AVS/SEM levels below one. These results suggest the potential for bioavailability of divalent metals in these sediments, possibly due to the low levels of sulfides associated with coarser-grained substrate. In general, the AVS/SEM ratios do not appear to correlate with the total SEM concentrations. However, as discussed above, bulk concentrations of metals overall are elevated in the portion of ditch closest to the former production facility. The total bulk concentration of metals is not useful in predicting the potential for bioavailability since concentrations of sulfides, which control bioavailability, vary. In fact, the sample with the highest total SEM (SED-B-1-0-0.5 in South Branch Creek, 0.27 µmoles/g) is predicted to have minimal bioavailability due to high AVS, and, conversely, the samples in the Arthur Kill with low total SEM have low proportional AVS and therefore higher predicted bioavailability. The AVS/SEM calculation is based on the total of divalent metals and therefore accounts for competition among individual metals for binding sites. In addition, other variables such as total organic carbon may bind metals. For these reasons, therefore, it appears as if the total concentration of metals is of limited use in predicting bioavailability and ecological risk in this system. Rather, the presence of sulfides and other ligands, likely associated with fine-grained, depositional sediments, may be the controlling factor.

6.6.3 Organics

PCBs

Sediments collected from South Branch Creek had PCBs detected in 16 samples. Those PCBs were identified as Aroclor 1254 and Aroclor 1260 (Table 6-35, Figure 6-27a through 6-27d) which are the same as those observed in the on-site soils. The ER-L and ER-M concentrations for Aroclor 1254 are 0.023 mg/kg and 0.18 mg/kg, respectively. Of the samples with detectable PCBs, 18 percent exceeded the ER-L and 16 of the ER-M threshold.

None of the Arthur Kill sediment samples had detectable PCB concentrations. In the Transect A area, Aroclor 1254 was present, while in the locations closer to the Arthur Kill, PCBs were identified as Aroclor 1260. The maximum observed concentrations was 2.73 mg/kg and 1.12 mg/kg in the surficial samples at station SED-8 and SED-2, respectively. Other PCB results in South Branch Creek were well below 1 mg/kg, and the deeper samples contained less than the shallower (0-5-foot) samples. Overall, the Transect A area contains slightly higher PCBs than the remainder of South Branch Creek. This pattern, and the presence of AR 1254 (found upland), suggests that there could be a contribution from

Site sources, although, as discussed in Section 2.6.1, other sources have historically discharged to this area as well. Additionally, regional studies of the Newark Bay estuary, as discussed in Section 2.10, have shown PCBs to be ubiquitous at concentrations similar to those found in South Branch Creek. These results indicate that there is the possibility of PCB contributions to South Branch Creek in the furthest upland transects.

PCBs were not in the Off-Site Ditch samples with a single minor exception. One sample from the Southern Off-Site Ditch contained total PCBs at 0.0985 mg/kg. These results suggest that PCB contamination is not an issue in the Off-Site Ditches.

PAHs

All eighteen analyzed SVOCs that are classified as polycyclic aromatic hydrocarbons (PAHs) were detected in sediment samples collected from South Branch Creek. The frequency of detection for these 18 chemicals in South Branch Creek samples ranged from 16 to 78 percent (Table 6-30a through 6-30b). ER-L/ER-M values have been established for 12 of these PAHs. The frequency of ER-L exceedances ranged from 4 to 39 percent. The ER-Ms were exceeded for 10 of these constituents, in 2 to 10 percent of the samples. The average total PAH concentration in South Branch Creek sediments was 8.3 mg/kg (Table 6-36 and Figures 6-33a through 6-33d). However, there was considerable variability: a relatively high value (27.6 mg/kg at SED-B-1-0-0.5) and the minimum (0.26 mg/kg at SED-B-2-0.5-1.0) were observed in the same transect.

In sediment samples collected from the Arthur Kill, 17 of the 18 PAHs were detected (2-chloronaphthalene was not detected). The frequency of detected chemicals ranged from 50 to 100 percent, with between 33 and 67 percent of samples exceeding ER-Ls and 17 to 50 percent exceeding ER-Ms. The average total PAH concentration in the Arthur Kill sediment samples (50.2 mg/kg)(Table 6-36) was nearly an order of magnitude higher than in South Branch Creek (8.3 mg/kg). The maximum observed total PAH concentration was in the shallowest sample at station F-3 (225 mg/kg), followed by 49.9 mg/kg and 19.9 mg/kg in SED-F1 and SED-F2, respectively. However, as with South Branch Creek, there was over two orders of magnitude variability within the Arthur Kill sample set.

In sediment samples collected from the Northern Ditch, 16 of the 18 PAHs were detected. The frequency of detected chemicals ranged from 67 to 100 percent. Of those detected, acenaphthene, anthracene, benzo(a)anthracene, chrysene, phenanthrene, dibenzo(a,h)anthracene, fluoranthene, and pyrene were detected above the ER-Ls. Only one sample for anthracene was detected above the ER-Ms. In sediment samples collected from the Southern Off-Site Ditch, 12 of the 18 PAHs were detected. The frequency of detected chemicals ranged from 17 to 100 percent. Of those detected only dibenzo(a,h)anthracene was detected above the ER-Ls. No samples for PAHs were detected above the ER-Ms.

The average total PAH concentrations for the Northern Off-Site Ditch (3.2 mg/kg) and Southern Off-Site Ditch (0.75 mg/kg) were lower than found in the Arthur Kill (50.2), indicating there is not an elevated concern for PAHs in sediment in the Off-Site Ditches compared to the Arthur Kill.

The profile of PAH compounds (Figures 6-34a through 6-34d) is similar at most stations and depths in both South Branch Creek and the Arthur Kill, with a relatively even distribution of various compounds. Total carcinogenic PAHs (cPAHs) in sediments and cPAHs normalized to B(a)P) are shown on Figures 6-35a through 6-35d. This pattern is similar to what was observed in site fill (Section 6.1.6). The exception was the portion of South Branch Creek nearest to the Site (Transect A area), where chrysene and benzo(a)anthracene (B(a)A) represented a higher proportion of PAH species. The samples with the different profile were also ones in which higher total B(a)P equivalents were observed; otherwise, cPAH concentrations were generally comparable throughout South Branch Creek and the

Arthur Kill, or higher in the Arthur Kill. It appears as if the cPAH presence in the Transect A area is from a source other than site fill or regional contribution. As discussed previously, this area has historically received flow from various non-site industrial sources, which appear to account for other contamination observed (notably arsenic).

PAHs are ubiquitous and the low-ppm concentrations observed in South Branch Creek are typical of industrialized waterways (ATSDR, 1995). Comparable concentrations were detected in the regional study samples collected in old Place Creek (which averaged around 5 mg/kg total PAHs; Table N-10). Furthermore, the elevated concentrations in the Arthur Kill sediments (Transect F) compared with South Branch Creek suggest a source unrelated to the Site. The PAHs detected in sediments (as well as low marsh soils) appear to be derived from regional sources, with the exception of some sediment in the Transect A area, which was derived in part from overland flow from neighboring properties.

PCDDs/PCDFs

Sediment samples were analyzed for 17 polychlorinated dibenzo-p-dioxins and -furans (PCDDs/PCDFs), 21 pesticides and herbicides, 51 non-PAH SVOCs and 46 volatile organic compounds (VOCs).

The full suite of analyzed PCDD and PCDF congeners was detected in nearly every sediment sample collected from South Branch Creek and the Arthur Kill. These data were expressed by normalizing to the WHO (2005) TEFs to obtain TEQ. The TEQs have been calculated individually for PCDDs and PCDFs and are presented in Table 6-37 and Figures 6-36a through 6-36c. Discussion of TEFs in assessing risk also appears in the Human Health and Ecological Risk Assessments (Appendices P and Q).

The spatial distribution of TEQ values is presented in Figures 6-36a though 6-36c. The lowest TEQ observed in South Branch Creek was at SED-A-2-1.0-1.5 (2 ng/kg), and the highest at SED-C-3-0-0.5 (170 ng/kg) These differences may be related to variations in depositional conditions; for example, the Arthur Kill has been repeatedly dredged over the years. Furthermore, the PCDDs/PCDFs in each of the study areas are within the range of urban sediment background for Arthur Kill and are substantially lower than the levels in Newark Bay. These data support the conclusion that South Branch Creek is a receiving area for PCDD/PCDF deposition from regional sources in addition to the apparent contributions of PCDFs from the site.

The proportions of PCDFs in the South Branch Creek samples are dominated by PCDFs, particularly in the landward samples (Figures 6-36a through 6-36b). The mid-channel South Branch Creek samples reveal decreasing proportions of PCDFs while the sample collected within the Arthur Kill (Transect G) are comprised nearly entirely of PCDDs. These data suggest that a site related contribution of PCDFs in the South Branch Creek sediments that becomes more progressively dominated by the PCDDs of regional origin in the samples approaching Arthur Kill.

Pesticides/Herbicides

A variety of pesticide and herbicide compounds were reported in sediments: a total of 12 compounds were detected in the South Branch Creek sediments, with a detection frequency ranging from 2 to 49 percent. In the Arthur Kill, six pesticide and herbicide compounds were detected, ranging from 17 to 83 percent detection frequency (Table 6-29).

The highest concentration observed was dieldrin at 15 mg/kg in the 1.0-1.5 foot depth sample at station SED-B-2. This observation appears to be an anomaly, as other dieldrin observations were all below 0.012 mg/kg. The principal pesticides present in sediments are DDT and its daughter products, which were distributed throughout South Branch Creek and the Arthur Kill. There does not appear to be any consistent pattern or relationship to the Site, with highest concentrations in SED-B-2 (1.0-1.5 feet) followed by SED-E-2 (0.5-1 feet), SED-B-2 (1.0-1.5 feet), SED-F-3 (0-0.5 feet), and SED-G-2 (0-0.5 feet).

The total DDT compound average concentrations were slightly higher in the Arthur Kill (1.2 mg/kg, Table 6-31) than in South Branch Creek (0.481 mg/kg), and the lack of an overall pattern indicates that the Site is not a source.

DDT and its daughter products DDE and DDD were also detected in both the Northern and Southern Off-Site Ditches, however their respective concentrations were lower than those found in either South Branch Creek or the Arthur Kill. The maximum detections of DDTin the Northern Off-Site Ditch was 0.244 mg/kg, and 0.0067 in the Southern off Site Ditch.

Chlorinated Benzenes

As in surface water, a variety of chlorinated benzene compounds (chlorobenzene, 1,2- and 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene) were reported in sediments. The maximal chlorinated benzene impact overall was in the Transect A area (up to 0.64 mg/kg chlorobenzene, 7.12 mg/kg 1,2-dichlorobenzene, 15.1 mg 1,4-dichorobenzene, and 11.8 mg/kg 1,2,4trichlorobenzene), although the maximum individual chlorobenzene concentrations were at Transect C (1.1 and 2.3 mg/kg, both at deeper locations at station SED-C-2). A somewhat lower chlorobenzene concentration (0.33 mg/kg) was observed in the 0-0.5-foot depth interval at this location. This pattern of increasing concentration with depth (which was not observed with other site-related constituents) suggests impacts from historic wastewater discharge and/or groundwater discharge that may be responsible for what was observed in sediments in this immediate area. Well MW-6S, which contained 16,200 mg/L of chlorobenzene, is within a couple hundred feet of the Transect C area of South Branch Creek. Similarly, benzene concentrations were highest in sediments at Transect C. Both chlorobenzene and benzene are more soluble than the di- and tri-chlorinated benzenes with lower k_{oc}s and would be expected to be more mobile at the groundwater/surface interface, but then to have lower residence times in surface water. These properties could account for benzene and chlorobenzene having a more pronounced presence in the area of the presumed groundwater intrusion but lower persistence in sediments overall when introduced via run-off/suspended solids.

Chlorinated benzenes were detected in the Northern Off-Site Ditch at concentrations generally between those found in South Branch Creek and the Arthur Kill, with one notable exception. 1,4-Dichlorbenzene was detected on average at 2.5 mg/kg, compared to the average of 0.3 mg/kg South Branch Creek. Chlorinated benzenes were not detected in sediments in the Southern Off-Site Ditch.

Other Organics

Sixteen non-PAH SVOC compounds were detected in South Branch Creek, with a detection frequency ranging from 2 to 57 percent (Table 6-29). Fifteen SVOCs have been detected in the Arthur Kill. The detection frequency for these 15 SVOCs ranged from 17 to 50 percent. Chlorobenzene was detected at concentrations 2 to 3 orders of magnitude higher in South Branch Creek than the Arthur Kill.

Notwithstanding low levels of benzene and chlorobenzene, as discussed above, VOCs were not generally prevalent in sediments. Seventeen VOCs were detected in the South Branch Creek sediments, with a detection frequency between 3 and 84 percent (Table 6-29). In the Arthur Kill sediments, eight VOCs were detected, ranging from 17 to 67 percent. Sixteen (16) VOCs were detected in the Northern Off-Site Ditch, with a detection frequency between 17 and 100 percent. Three VOCs were detected in the Southern Off-Site Ditch, with a detection frequency between 17 and 67 percent. All detected VOCs had concentrations within the same order of magnitude. With the exception of chlorobenzene, acetone, and toluene, VOC concentrations were in the low ug/kg range and are considered trace.

None of the organic compounds other than those discussed in Section 6.6.3.1 through 6.6.3.3 have ER-L and ER-M values established for them.

6.6.4 Sediment Toxicity

Four sediment samples were collected for concurrent sediment toxicity and bulk chemistry analysis. The samples were collected from Stations A-3, C-1, and E-1 in South Branch Creek (Figure 2-1). and Station W-2 in the tributary to Old Place Creek during the regional study (Appendix M, Figure N-1). The sediment toxicity report prepared by American Aquatic Testing of Allentown, Pennsylvania, appears in Appendix H.

Upon receipt and handling, the sediment toxicity testing laboratory, American Aquatic, reported that samples E-1 and C-1 produced mercury vapors (0.3 mg/m^3 and 0.09 mg/m^3, respectively) that could not be managed safely in the laboratory environment. Following extensive discussions with American Aquatic, several additional sediment toxicity testing facilities, and EPA/NJDEP, EPA authorized the elimination of these samples from the program on October 26, 2006. On October 27, 2006, American Aquatic transported these samples to the site where they were combined with the Investigational Derived Waste (IDW) for proper disposal.

Sediment toxicity testing using a 10-day testing protocol proceeded on sample A-3 and a regional control sample (W-2), as required by the method. Percent survival (56%) for the South Branch Creek sample was significantly lower than the laboratory control survival (95%). The site sample is considered acutely toxic because of the reduced survival in the acute testing conditions. Therefore, additional chronic testing was not performed.

Table 6-38 summarizes the 10-day survival rates for the marine amphipod (*Leptocheirus plumulosus*), along with sediment contaminant results, in the South Branch Creek and laboratory control samples. Table 6-38 excludes trace metals that were ND in both samples, common earth elements (aluminum, calcium, magnesium, potassium, and sodium), and PCDDs/PCDFs. The PCDD/PCDF TEQ for sample A-3 is 27 ng/kg (within the range throughout South Branch Creek and the Arthur Kill).

The overall pattern of organic compounds in the two samples is similar and does not suggest that organic contamination accounts for the difference in amphipod survival between the two stations. The differences in observed sediment toxicity are more likely related to differences in mercury concentrations.

6.7 Biota

Fish (mummichog) and crab (fiddler crab) samples were collected in South Branch Creek, and the Arthur Kill in September 2006. Fish samples were collected at the approximate midpoint of each transect, at high tide, and crab samples were collected from each bank of the channel at each transect, at low tide (Figure 3-2 and Appendix M, Figure N-1). Fish and crab samples were rinsed, but not depurated and analyzed on a whole body basis for the list of COPECs (see Section 3.3.6). Detected analytes in tissue samples are presented in Tables 6-39a and 6-39b and Appendix J.

Specimens were inspected for obvious deformities. None were noted in the crabs. An anatomical abnormality was noted in only one individual fish, from sample MC-E. This specimen presented with a bulbous growth under the gill at the ventral side of the fish. The growth was a clear bladder, approximately twice the size of the fish's eye. There was some red visible inside, possibly blood. This particular fish measured 67 mm and weighted approximately 3.5 grams (a just above average size for this sample).

During exploratory seining as part of pilot studies, some mini krill and shrimp were observed. However, this method was not used for the specimen collection. Crabs observed were almost entirely *uca pugnax* (Atlantic marsh fiddler), with an occasional *uca minax* (red-jointed fiddler crab, estimated at 1-5% of the

specimens encountered). Other species noted were blue crab (one notation, several observations, with larger specimens observed towards the mouth of South Branch Creek), black fingered mud crab (one observation of an apparent juvenile, 1 to 1 ½ inches long), and the occasional small unidentified crab.

No incidental observations of fish other than mummichog were noted. However, the fish collection efforts involved the use of minnow traps designed to capture small fish and were not intended to serve as a fish population survey tool.

Fish and crab whole body tissue was analyzed for 10 metals, methyl mercury, arsenic speciation compounds (arsenobetaine, arsenite, arsenate, monomethylarsonate, and dimethylarsinate), percent lipids, percent solids, and 156 PCB Congeners. Tables 6-39a and 6-39b present a summary of descriptive statistics for the fish and crab tissue samples, respectively; Figures 6-37a through 6-38b show the spatial distribution of mercury and arsenic in these samples.

Mummichog and fiddler crab samples were collected in the tributary to Old Place Creek during the regional study in September 2006. A summary of descriptive statistics for fish and crab tissue samples collected during the regional study can be found in Appendix M, Table N-12a , N-12b Figures N-9a through N-10b in Appendix M show the spatial distribution of mercury and arsenic in fish and crab tissue in samples from the regional study

The horizontal and vertical delineation of site-related constituents for biota is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of biota may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.7.1 Mercury

The distribution of mercury concentrations in fish (Figure 6-37a) paralleled those observed in sediment, with the maximum concentration (7.68 mg/kg) reported in sample MC-C (Transect C), somewhat lower concentrations in Transect A (2.59 mg/kg in MC-A), a somewhat lower concentration in Transect B, and diminishing concentrations approaching the Arthur Kill. The one fish sample collected from the Arthur Kill (MC-F) contained 0.535 mg/kg mercury, comparable to the levels in fish collected from Transects D and E. The comparability of the patterns of mercury in fish tissue and sediment reflects the low mobility of this fish species and is consistent with bioaccumulation from the sediment in the immediate habitat area. However, since aquatic animals are consumed whole, for risk estimation purposes, whole body measurements are the most representative. The DERA estimates food chain exposures based on the whole body data.

Typically, the majority of mercury in fish tissue would be present in the methylated form, as was the case in the samples where total mercury was relatively low. However, where fish tissue mercury was highest, the majority of mercury is not methyl mercury (Table 6-40a). Possibly the quantity of mercury in sediments in these areas has resulted in uptake of elemental or inorganic forms via a less typical mechanism. The higher levels of total mercury may result from incidental sediment in the gut.

The distribution of mercury in crab samples differed slightly from that in fish (Table 6-40b, Figure 6-37b). The maximum concentration (70.2 mg/kg) was detected in FC-C-1 (Transect C), but Transect B showed the next highest concentrations, followed by Transects A and D. The total mercury concentration detected in one of the two samples from the Arthur Kill (FC-F-2; 3.74 mg/kg) was comparable to that observed in samples from Transect A.

Tissue samples collected during the regional study (Old Place Creek) contained far lower mercury concentrations than those collected from South Branch Creek, with a maximum concentration of 0.15 mg/kg in fish and 0.19 mg/kg in crab (Appendix M, Tables N-13a and N-13b, Figures N-9a and N-9b).

Crab sample mercury reflected a lower percentage of methyl mercury, ranging from 0.77 to 78 percent in South Branch Creek (Table 6-40b and Appendix M Table N-13b). The crab samples revealed a clear negative relationship between total mercury and percentage methyl mercury. Overall the percentage methyl mercury in biota tissue was higher where the total mercury concentration was lower, although this pattern was more consistent in crabs than in fish.

Crabs and fish contained comparable levels of lipids, approximately 1 percent of body weight.

6.7.2 Arsenic

As with sediment, arsenic concentrations in both fish and crab tissue (presented on Figures 6-38a and 6-38b, respectively) exhibited a notable elevation in the MC-A and FC-A samples (Transect A). Concentrations elsewhere in South Branch Creek and in the Arthur Kill stations were relatively consistent (in the 3 to 6 mg/kg range for fish and the 7-10 mg/kg range for crabs). The regional study arsenic concentrations in fish tissue averaged 2.4 mg/kg (Table N-12a, Appendix M), somewhat lower. However, the regional study total arsenic crab data (average 9.9 mg/kg; Table N-12b) were comparable to those from South Branch Creek and Arthur Kill These data suggest that other than in the area of extremely elevated sediment, arsenic concentrations in crab tissue are not especially sensitive to the immediate sediment quality and may be homeostatically regulated.

Speciation data for arsenic in fish tissue appear in Table 6-41. As predicted based on arsenic's known tendency to predominate in fish tissue in an organic form (ATSDR, 2007) a very small proportion of arsenic was inorganic (typically in the range of 1 percent or less), with the majority present as arsenobetaine (a nontoxic organic form). The exception was in the area of highly elevated arsenic sediment concentrations, MC-A (Transect A), which showed 2-3 percent organic arsenic. In addition, the arsenic species that were analyzed (trivalent inorganic, pentavalent inorganic, arsenobetaine, dimethylarsinate, and monomethylarsonate) accounted for the approximate total arsenic present in most samples. At Transect A, however, the total arsenic concentration did not reflect the sum of these forms, with only 20 to 38 percent of the total arsenic accounted for (Table 6-41). These results suggest that the fish in Transect A have accumulated an unusual form of arsenic that is not typical in the environment, perhaps a complex organic form. This unusual arsenic contamination appears to have no relationship to the former chlor-alkali operations or anthropogenic fill and provides additional evidence of a separate, off-site source of arsenic into the head end of South Branch Creek.

The arsenic tissue data were carefully reviewed and the appropriate moisture corrections were applied. Certainly there are precision issues with comparing the sum of speciated forms with the total for the analyzed element. This imprecision is exacerbated by the fact that the speciation analyses and the bulk analyses were performed by different laboratories. Nonetheless, each of the crab tissue samples in South Branch Creek and the Arthur Kill with the exception of the FC-A samples showed sums of arsenic species that accounted for between 70 and 120 percent of the total arsenic concentration, which is relatively good correlation given the inter-laboratory situation and the matrix effects. The arsenic forms in the FC-A samples, on the other hand, only accounted for 20 to 38 percent of total arsenic. Thus a majority of arsenic in those samples is not inorganic or in the most common organic forms, methylated and betaine, which typically accounts for the majority of arsenic in fish issue (Ackley, *et al.*, 1999). In summary, the arsenic therefore appears to be in some other organic form that is not commonly observed.

The nature and source of the unidentified arsenic species is unknown. However, as detailed in earlier sections of this report (see Section 2.6.1), the headwaters area of South Branch Creek has historically received drainage from the duPont and GAF sites, which are known to have used and potentially discharged arsenicals. It is therefore entirely plausible that the arsenic present in the fish in this area of markedly elevated arsenic concentrations in sediment have accumulated an arsenical that is not commonly found.

6.7.3 Other Metals

Table 6-39a presents the descriptive statistics for fish tissue data for the other inorganic COPECs (barium, chromium, copper, iron, lead, manganese, vanadium, zinc). These eight metals were also detected in the fish tissue sample from the Arthur Kill. In the crab samples from South Branch Creek, these eight metals and arsenic were also detected in all 10 samples collected; as well in both crab tissue samples from the Arthur Kill (Table 6-39b).

Figures 6-39 through 6-41 illustrate the distribution of fish tissue inorganic results. Barium concentrations in fish tissue samples were highest in South Branch Creek samples, approximately 10-fold higher than the Arthur Kill. Fish tissue concentrations for iron, lead, manganese, vanadium, chromium and copper were the lowest in the samples collected from South Branch Creek. All metals but barium were detected in the same order of magnitude in both sample areas. Figures 6-42 through 6-44 show the distribution of inorganics in crab tissue. Barium, zinc, and lead concentrations in crab tissue samples were highest in South Branch Creek samples. Barium concentrations in crab tissue samples collected from South Branch Creek were 10-fold higher than the Arthur Kill. Crab tissue concentrations for iron, manganese, vanadium, and copper were the lowest in the samples collected from South Branch Creek. All other elements were present at comparable concentrations.

Overall, no pattern of elevated fish tissue concentrations is observed with these other metals (Figures 6-40 through 6-41). In crab tissue, barium, iron, lead, and zinc are present at higher concentration in South Branch Creek biota samples than in the Arthur Kill. As with mercury, this observation may reflect retention of impacted sediment in the gut rather than accumulation in tissue.

Further discussion of the biota-sediment accumulation factors appears in Section 6.8.

6.7.4 PCBs

Co-planar PCBs were analyzed in tissue. Of the 156 PCB congeners analyzed, 131 were detected in the fish tissue samples collected from South Branch Creek (Table 6-39a, Figure 6-45). The PCB conger detection frequency ranged from 20 to 100 percent. In the sample collected from the Arthur Kill, 99 PCB congeners were detected. The total concentration of PCBs (sum of the average congener concentrations) was only slightly higher in South Branch Creek (344 ug/kg) than in the Arthur Kill (209 ug/kg), and comparable to the concentration of 278 ug/kg detected in samples from the regional study (Appendix M, Table N-12a). These concentrations are above the fish flesh criterion of 100 ug/kg that has been developed for the most sensitive receptors (mink), but below that estimated for less sensitive receptors such as rabbit (660 ug/kg; Newell, *et al.*, 1987).

The comparability of the PCB data in fish tissue from various locations indicates that PCB bioaccumulation from the South Branch Creek area is comparable with regional conditions.

In crab tissue, total PCBs in South Branch Creek specimens averaged 211 ug/kg, with 86 ug/kg in Arthur Kill samples (Table 6-39b, Figure 6-46), the same total PCB concentrations as observed in the regional study crab samples (Table N-12b, Appendix M). The greater elevation in South Branch Creek crab but not fish tissue concentrations probably reflects the tendency of undepurated crabs to retain sediment in their guts, thereby more closely reflecting the immediate sediment quality.

6.8 Measures of Biological Accumulation

6.8.1 Bioconcentration Factors (BCFs)

Bioconcentration factors (BCFs) reflect the accumulation of contaminant in tissue from water. They are estimated as follows:

$$BCF\left(\frac{l\,water}{kg\,tissue}\right)=\frac{mg/kg\,tissue}{mg/l\,water}$$

Based on the average total mercury concentration in fish and surface water from Transects A through E (2.6 mg/kg and 3.9x 10^{-3} mg/l, respectively; see Tables 6-39a and 6-27 for the data), the bioconcentration factor (BCF) from water to fish is approximately 700 (Table 6-42). Using methyl mercury results (0.68 mg/kg in fish and 5.5 x 10^{-6} µg/L in fish and water, respectively), the approximate BCF for methyl mercury is 1 x 10^{5}. Using the samples from Transect F to represent the Arthur Kill (no fish were obtained at Transect G), the total and methyl mercury BCFs are estimated at 400 and 4 x 10^{5}, respectively. These BCFs are comparable with those that have been reported in the literature (see Section 7.2) and indicate that bioaccumulation is occurring despite the tiny proportion of total mercury present in surface water that is methylated.

6.8.2 Biota-Sediment Accumulation Factors (BSAFs)

Tissue accumulation is not typically a concern for metals. However, the USEPA previously expressed concern about the potential for tissue accumulation and specifically requested tissue analyses for 10 metals. To address the resulting data, Biota-Sediment Accumulation Factors (BSAFs) were calculated for these metals. The BSAFs provide an estimate of the uptake of chemical constituents from sediment to biological tissue by taking the lipid-normalized concentration in organisms divided by the organic carbon-normalized concentration in sediments. The BSAFs for metals are reported as:

$$BSAF\left(\frac{kg\,sediment}{kg\,tissue}\right)=\frac{mg/kg\,tissue}{mg/kg\,sediment}$$

And the BSAFs for total PCB Congeners are reported as:

$$BSAF\left(\frac{kg\,OC}{kg\,lipid}\right)=\frac{mg/kg\,lipid}{mg/kg\,OC}$$

These BSAFs are based on the undepurated data, meaning that the total tissue concentrations reflect sediment retained in the gut. The BSAFs therefore may not provide an accurate representation of contaminants accumulated in tissue. However, mummichog and crab are prey species consumed whole. Therefore, the BSAFs estimated based on the undepurated results reflect the food chain impacts.

The BSAFs for fish and crab tissue are presented in Tables 6-43a and 6-43b, respectively. They are highly variable but all well below 1, indicating that the tissue contains lower concentrations than sediments in the corresponding areas. Thus biomagnification into tissue is not occurring from sediment.

The squares of the regression coefficients (R^2) values are also shown in the tables. These values show the statistical strength of association between the sediment concentration and the tissue concentration; they do not indicate the magnitude of the BSAF (the slope of the relationship, or extent to which tissue will change in response to sediment concentrations). Specifically, the R^2 value (0-1) represents the proportion of change in one variable that can be predicted by the other variable. Note that R^2 values

only give a guide to the "goodness-of-fit" and do not indicate whether an association between the variables is large or statistically significant. R^2 values below 0.69 are considered not to be strong enough to conclude that there is any substantial association.

The analytes with R^2 values above 0.69 for fish in South Branch Creek were total PCBs, barium, and lead. The analytes with the R^2 values above 0.69 for crab in South Branch Creek were arsenic and total PCBs. These results suggest that the tissue concentrations of these analytes are associated to some extent with sediments, although none of the relationships are strong.

6.8.3 Mercury

The highest fish BSAF for mercury in South Branch Creek is 0.023 in Transect B. In the Arthur Kill, the fish BSAF for mercury is 0.0089 (Table 6-43a). In South Branch Creek, the R^2 value is 0.68, below a level indicating a meaningful relationship. These BSAFs indicate minimal dependence of fish tissue concentrations on sediment concentrations within small geographic zones. However, the concentrations of mercury in fish do indicate an overall impact from mercury presence in sediments, since the levels are well above those that have been reported in various New York Harbor estuary samples (USEPA, 1997), which were typically in the 0.2 mg/kg range. The concentrations reported by the USEPA are similar to those observed in the regional study conducted in Old Place Creek, where concentrations in fish ranged up to 0.15 mg/kg, thus indicating that Old Place Creek is representative of regional conditions.

The highest crab BSAF for mercury is 0.31 at station B-2 in South Branch Creek (Table 6-43b). In the Arthur Kill, the highest crab BSAF for mercury is 0.13. The highest crab BSAF for mercury in the regional study is 0.1 at station W-2. Crab BSAFs decrease as mercury sediment concentrations increase, suggesting a saturation of the bioaccumulation mechanism. In cases where exposures impact population dynamics, the appearance of decreases in accumulation with increasing concentrations can be indicative of lethality in the higher-exposed individuals. This phenomenon does not appear to be the case in South Branch Creek. The populations of both fish and crabs in South Branch Creek were observed to be robust and healthy. There were no observed die-offs or apparent deformities associated with the higher-mercury concentrations zones, nor evidence of fewer individuals. Therefore, lethality with increasing concentrations is not a likely explanation for decreasing BSAFs with concentration. Note the uptake functions for mercury (and other metals) in invertebrates have been shown to be logarithmic and generally follow the algorithm $\log(y) = a' + b \log(x)$, where y and x represent the tissue and sediment concentrations, respectively, and the BSAF is estimated as y/x (see Bechtel Jacobs, 1998[6]). Thus mercury BSAFs show a declining relationship with concentration.

No correlation between the crab BSAFs and the sediment mercury concentration was observed in South Branch Creek. As with fish, however, crab mercury tissue burdens in South Branch Creek, which ranged up to 70 mg/kg, were well above mercury invertebrate concentrations that have been reported regionally (0.1 to 0.3 mg/kg; USEPA, 1997), indicating that even if individual sample concentrations cannot be predicted based on localized sediment levels, there is bioaccumulation overall from South Branch Creek sediments.

6.8.4 Other Metals

As mentioned above, metals other than mercury with the high R^2 values for fish in South Branch Creek were barium (0.89) and lead (0.78). The highest fish BSAF for metals other than mercury in South Branch Creek is 0.56 for barium in Transect C (Table 6-43a). The R^2 value for this BSAF barium is 0.89,

[6] Bechtel Jacobs, 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Oak Ridge National Laboratory, Oak Ridge, TN. BJC/OR-112.

indicating a strong relationship between the sediment concentration and tissue concentration. As mentioned above, the other metals with the high R^2 values for fish in South Branch Creek were barium (0.89) and lead (0.78).

However, the fish BSAFs for barium (as well as for manganese, vanadium, zinc, and copper) decrease as concentrations for those metals in South Branch Creek sediments increase. These observations suggest a saturation mechanism where the proportion of uptake decreases as the concentrations increase. As stated above, failure to thrive among higher-exposed individuals is an unlikely explanation for the negative relationship between BSAFs and sediment concentration. In addition, barium is not a bioaccumulative constituent. It is not identified by EPA as a Persistent Bioaccumulative and Toxic (PBT) chemical. A mean bioaccumulation factor (BAF) for earthworms of 0.088 has been reported[7] ; BAFs for small mammals range from 0.014 to 0.019[8]. These low BAFs indicate no propensity for barium to bioaccumulate.

The highest crab BSAF for metals other than mercury in South Branch Creek is 5.6 for barium in Transect A (Table 6-43b). This is also the highest observed crab BSAF for metals. In the Arthur Kill, the highest crab BSAF is 2 for copper. The highest crab BSAF for metals in the regional study is 5.0 at Transect X, also for arsenic. The R^2 value for arsenic is 0.96, indicating a strong relationship between the sediment concentration and tissue concentration and therefore a high confidence in the calculated BSAF. As mentioned above, the other constituent with a high R^2 value for crab in South Branch Creek is total PCBs. In the regional study none of the analytes had R^2 values for crab above 0.69, indicting no meaningful association between tissue and sediment.

6.8.5 Total PCB Congeners

PCB sediment data were analyzed as Aroclors, while tissue data were analyzed as PCB congeners. These data sets are not directly comparable, and therefore BSAFs were not estimated using the measured tissue data. The Baseline Ecological Risk Assessment (BERA: Appendix P) estimated total Aroclor 1254 and 1260 concentrations in tissue using literature-derived BSAFs (1.99 for crab and 2.14 for fish). Please refer to the BERA for additional discussion and application of these BSAFs.

6.9 Summary of Overall Nature of Contamination

6.9.1 Soil Summary

Contaminants derived from manufacturing activities at the LCP site have directly impacted soil quality as a result of site operations. Contaminated soil provides a historic and potential ongoing source of contamination of other media. The soil impacts are primarily observed in the shallow anthropogenic fill soils given the fact that the discharges likely occurred on the ground surface. The underlying natural soils, including the tidal marsh deposits and glacial till, are impacted to a much lesser degree than are the anthropogenic fill soils.

Overall, the only soil constituents that clearly appear to have originated from historic chlor-alkali site operations are mercury, PCNs, and HCB and, to a limited extent, PCDFs. PCBs are also a site-related constituent due their potential presence in electrical equipment on the site. Other constituents that are present in the anthropogenic fill and/or represent regional background conditions include arsenic and other metals, PCDDs, PAHs, BTEX, chlorobenzene, and several other miscellaneous organics.

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[7] Sample, B.E. et al, 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-220.

[8] Sample, B.E. et al, 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-219.

Site related contaminants in soil have been horizontally delineated to the north and west where the LCP property abuts the LPH Site, which itself has been investigated and has received an NFA designation for soil contaminants (Section 2.1.2). Soil contaminants are bounded to the east by South Branch Creek. Contamination in fill material has not been delineated in the area located south of the Linde Hydrogen Plant, however, given the findings of the Off-Site Ditch Investigation have shown site related contaminants in the Northern Off-Site Ditch. It is reasonable to conclude shallow soil contamination in the vicinity of the Linde Hydrogen Plant is bounded to the south by the Northern Off-Site Ditch, particularly given the unimpacted condition of the Southern Off-Site Ditch. Site-related contaminants have been vertically delineated as evidenced by data from the underlying Tidal Marsh Deposits and Glacial Till soils.

Site Operations Constituents

Mercury is the primary site-related contaminant and is present in soil as a result of the chlor-alkali manufacturing process at the LCP site. Elevated levels of mercury, including visible elemental mercury, were found in the anthropogenic fill soils throughout nearly the entire site. The highest mercury concentrations were observed in and around the former production area near Buildings No. 230, 231, and 240, including beneath the buildings. Substantial attenuation of mercury concentrations was observed in the underlying natural soils. No exceedances of NJ NRDCSRS were observed in the glacial till except beneath Building No. 240. The mercury in soil is relatively immobile given the fact that it is primarily present in relatively insoluble forms including mercury sulfide and elemental mercury.

PCBs (Aroclors 1254 and 1260), PCN, and HCB are widely distributed across the site within the anthropogenic fill. Some occurrence of PCDFs may be related to the site. PCBs are associated with the electrical equipment that was formerly used on the site. PCNs, HCB, and sometimes PCDFs formation are formed as byproducts in chlor-alkali plants through the reaction of the chlorine with the graphite anodes. The decreasing vertical distribution of PCBs, PCNs, HCB in the fill suggests on-site surface sources of these other constituents. The site-related occurrences of PCBs, PCNs, HCBs, and PCDFs are generally co-located with samples containing elevated levels of mercury, as shown on Figure 6-47.

Anthropogenic Fill and Regional Constituents

Other constituents that are not related to manufacturing activities at the site are frequently detected in the site soils, particularly in the anthropogenic fill. These include arsenic and other metals, PCDDs, PAHs and other organics, including chlorobenzenes. The ubiquitous presence of arsenic, other metals and PAHs in areas with no production history, the presence of anthropogenic fill, the absence of a decreasing concentration gradient within the fill, and the absence of an association with the known sources of contamination lead to the conclusion that the occurrences are not associated with LCP site operations; rather they are associated with the presence of anthropogenic fill materials and/or neighboring operations as shown on Figure 6-48. Arsenic concentrations found in soil in the vicinity of the former Linde Hydrogen Plant, as well as the upstream areas of South Branch Creek, are elevated beyond the concentrations found typically throughout the site-wide anthropogenic fill material. Arsenic is not a site-related process chemical; however locations where arsenic concentrations are elevated beyond those found in anthropogenic fill are sufficiently co-located with process related contaminants and therefore would be subject to remediation.

Sporadic elevated concentrations of chlorobenzenes and other VOCs are observed in anthropogenic soils. Substantially higher concentrations of chlorobenzenes are observed in the deep fill as compared to the shallow fill which suggests the absence of an on-site source. Chlorobenzenes (mono, di, and tri) were extensively used in the manufacture of organic dyestuffs and pigments at the GAF site, as

described in the GAF RI Report, (Eckenfelder, 1991). As a result, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene are among the most commonly detected organic constituents in soil and groundwater at the GAF site. Chlorobenzenes were generally not detected in the underlying tidal marsh deposits.

6.9.2 Low Marsh Soil Summary

Low marsh soils represent native tidal marsh material that has likely been overlain by deposition of aquatic sediments during tidal surges. Samples collected were shallow (0-0.5- feet deep) and therefore likely reflect the sediment deposition component.

In general, the low marsh sample contamination indicates higher association with sediment than with marsh deposit soils in the upland portion of the site. Mercury was highest in the low marsh samples near Transect C, not along the portion of South Branch Creek closest to the site. Furthermore, the total mercury present in low marsh soils was higher overall than in the tidal marsh deposits upland on the site (Figure 6-1c).

Other site-related constituents were not prevalent in the low marsh material. Hexachlorobenzene, and PCBs, which were present throughout surficial site soils, were minimally detected in low marsh soils. Conversely, arsenic concentrations were higher in low marsh soils than anywhere on site. PCDDs and PCDFs were higher in locations approaching the Arthur Kill than closer to the Site.

The contaminant distribution is similar to that observed in sediments, reflecting only mercury as a principal contaminant of site origin. Additional discussion of the low marsh soils in the context of overall site contamination appears as part of the sediment evaluation (Section 6.6.4).

6.9.3 Groundwater Quality Summary

Surface Water Quality Standards (SWQS) are utilized herein for comparison to bedrock groundwater quality as the bedrock water-bearing zone was formally reclassified as Class III-B due to its natural saline conditions. The SWQS are utilized, in the absence of a NJDEP-approved method for the development of alternate groundwater quality criteria, to be protective of surface water quality in South Branch Creek and the Arthur Kill as a result of discharging bedrock groundwater. The overburden groundwater quality data are compared to the Groundwater Quality Standards (GWQS) given that its classification remains as Class IIA.

The source of groundwater contamination within the overburden water-bearing zone is the dissolution of various constituents from the site soils. Accordingly, mercury is the only site-related contaminant that is generally found in groundwater, albeit at relatively low concentrations. The other site-related constituents, including PCBs, PCNs, HCB and PCDFs, are relatively insoluble and are not detected in groundwater.

Other detected groundwater constituents including arsenic and other metals and several VOCs and SVOCs are not site related. The highest VOC/SVOC detections are attributed to historic off-site sources including the adjacent NOPCO site and the historic wastewater conveyance from the former GAF site. However, many of these same compounds may occur from their dissolution from the anthropogenic fill. Mercury levels in overburden groundwater is either detected at relatively low concentrations or is not detected, and is generally limited to areas of the site in which very high levels of mercury are observed in the soils. These findings provide additional evidence that mercury in soil is present in primarily insoluble forms. Moreover, mercury in groundwater was largely undetected around the perimeter of the closed RCRA unit, demonstrating that that unit is not a source of mercury in groundwater.

Most groundwater constituents in bedrock are undetectable except in the northwest area of the site, upgradient of the LCP production area. Mercury, benzene, and chlorobenzenes are detected within the zone in which the GAF groundwater extraction system has been shown to induce bedrock groundwater

flow from the neighboring GAF site. However, bedrock groundwater is captured and treated by the adjacent GAF groundwater remediation system. None of the detected groundwater constituents form laterally continuous plumes across the site, regardless of whether or not they are related to the site production areas. These sporadic patterns reflect the relatively sporadic distribution of various source materials in the soils (e.g., VOCs).

No free phase organic liquids were observed in the groundwater column in either overburden or bedrock monitoring wells.

Site-related contaminants and arsenic in groundwater have been vertically and horizontally delineated in both the overburden and bedrock water bearing zones. Delineation of non-site related contaminants benzene and chlorobenzene in the overburden groundwater is not complete in the southeast direction, towards the NOPCO facility. No further delineation is necessary of site related contamination in groundwater.

6.9.4 Sediment and Surface Water Quality Summary

South Branch Creek and the Northern Off-Site Ditch exists within the regionally contaminated Arthur Kill system and has also been impacted by numerous localized historical inputs in addition to the LCP site. Thus contamination observed is attributable to impacts from four general sources: site operations; contamination on site due to contaminated soil/fill; discharges from non-site sources; and regional contamination.

Mercury, present throughout sediment and surface water in South Branch Creek and the Northern Off-Site Ditch, is site related. Shallow groundwater in the vicinity contains little or no mercury, so sources are historically related to direct discharges and surface run-off. There is no substantial ongoing drainage from the site to South Branch Creek. It is not specifically known to what degree runoff from the LCP site drains into the Northern Off-Site Ditch although this appears to be a likely transport pathway. Mercury appears in suspended particulates in surface water as well as low marsh soil, which has likely been impacted by upland sediment deposition. Mercury concentrations are highest in the areas of historical inputs, namely Transect A, which has received drainage from multiple sources over the years, and the former City of Linden sewer pipe at Transect C. Mercury concentrations attenuate with distance from the site and are comparable to regional Arthur Kill background by the confluence with the Arthur Kill. Other site-related constituents reported in sediments are low-level PCBs, PCDFs, and chlorinated benzenes, all of which show a similar gradient leading to background or undetected concentrations in the Arthur Kill. Site-related sources of mercury within the South Branch Creek sediment and surface water are primarily related to historic stormwater discharges from the LCP site. Shallow groundwater that discharges to South Branch Creek contains little or no mercury, such that groundwater is not an ongoing mercury migration pathway to South Branch Creek. Furthermore, stormwater discharges from the site to South Branch Creek have been poorly defined since about 1976. Given the estimated stormwater discharge velocities and volumes, ongoing mercury migration via this pathway has been and likely continues to be minimal. The concentration gradient of Mercury found in the Northern Off-Site Ditch is less defined due to the parallel configuration of the Ditch alongside the operations areas of the Site.

As described in Section 2.6.1, no defined stormwater drainage system currently exists at the LCP site. Large areas of the site are currently undrained given the remedial action on the adjacent GAF site in 2003 and the cessation of stormwater collection and treatment on the LCP site upon cessation of operations. The concrete drainage channels on site are now filled and the connection to South Branch Creek was obstructed at some point in the past. Areas that do drain to South Branch Creek and the unnamed ditch likely do so relatively slowly given the lack of drainage structures and the nearly flat grades on the site. Ponding occurs in several areas of the site for long durations depending on rainfall intensity and duration.

Arsenic concentrations in South Branch Creek sediment, low marsh soil, and surface water are markedly elevated in the Transect A area, but the elevated levels relative to those detected on site indicate that arsenic is present due to non-site sources (historic drainage along the railroad tracks from other sites). Arsenic impacts also attenuate with distance along South Branch Creek, reflecting the generally low sediment mobility in the ditch. Arsenic concentrations in the Northern Off-Site Ditch, while lower than found in South Branch Creek, are elevated beyond those found in the Arthur Kill, indicated historic discharge to the Ditch from the LCP site. Other contaminants (metals, PAHs, and CDDs) show minimal relationship to the site and appear to be of regional origin.

Site related contaminants in South Branch Creek have been delineated to levels consistent with regional sediment contaminant conditions in the Arthur Kill. Given the fact that the sediment investigation included the full extent of South Branch Creek, no further delineation of sediment contamination is necessary.

The investigation of sediments in the Northern Off-Site Ditch has not yielded complete delineation of Site Related contaminants in the upstream direction. It is recommended that further delineation sampling, as necessary, would be conducted as a part of a remedial pre-design investigation (PDI). The downstream end of the Northern Off-Site Ditch is believed to be connected via a culvert to South Branch Creek. Further delineation in the downstream direction, toward South Branch Creek, is not necessary.

The concentrations of contaminants in the Southern Off-Site Ditch are significantly lower than those found in the Northern Off-Site Ditch or South Branch Creek, and are more similar to regional conditions found in the Arthur Kill. Based upon the analytical results, the Southern Off-Site Ditch does not appear to have been impacted by contaminants relating to the LCP Site.

Investigation of both South Branch Creek and the Northern and Southern Off-Site Ditches has shown that the presence of contaminants in Surface Water is driven primarily by suspended particles in the water column. Due to the dynamic nature of the medium and the tidal fluctuations, meaningful delineation of contaminants in surface water is not possible.

206230

Remedial Investigation Report
LCP Chemicals, Inc. Superfund Site
Linden, New Jersey
Volume II of V
Appendices A through G

Prepared for
ISP Environmental Services, Inc.
500 Hercules Road
Wilmington, Delaware 19808-1599

July 2013

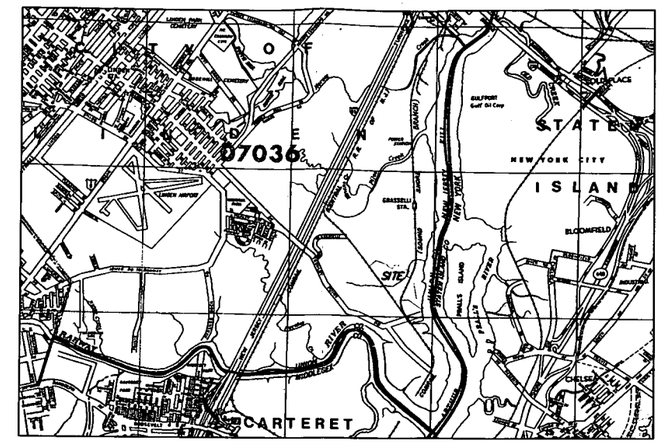
Project Number: 137005

Brown AND Caldwell
2 Park Way, Suite 2A
Upper Saddle River, New Jersey 07458

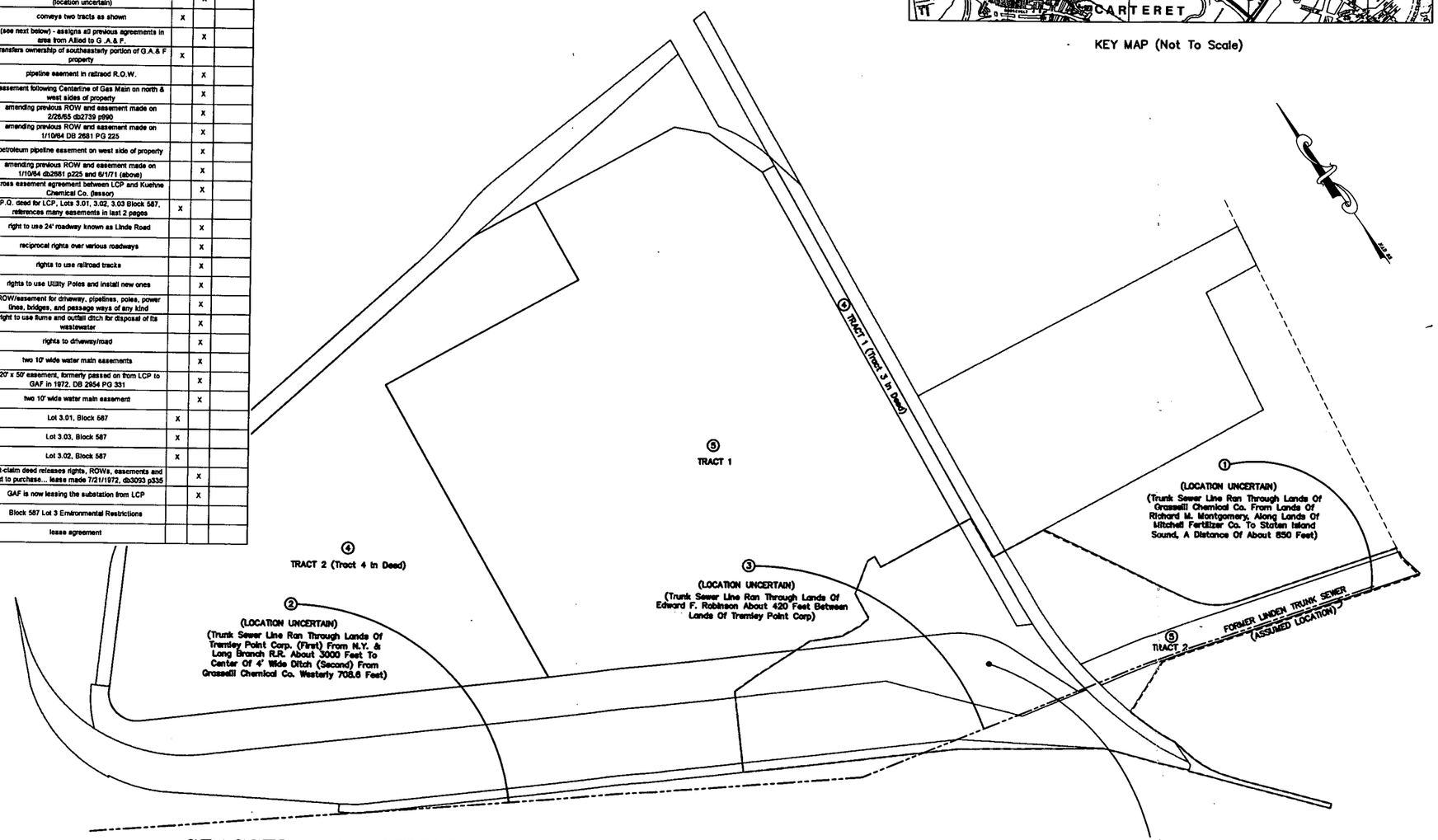
Appendix A: Property Transfers

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
39	12/14/1979	3207	93	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X		
40	12/14/1979	3207	97	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



KEY MAP (Not To Scale)



GRASSELLI DYESTUFF CORPORATION - PRIOR TO 1939

LCP SITE

REVISIONS	
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DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
PROJ.: 2001202 CHKD.: PAGE:

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE F. JAMES, Professional Engineer, Lic. 23313

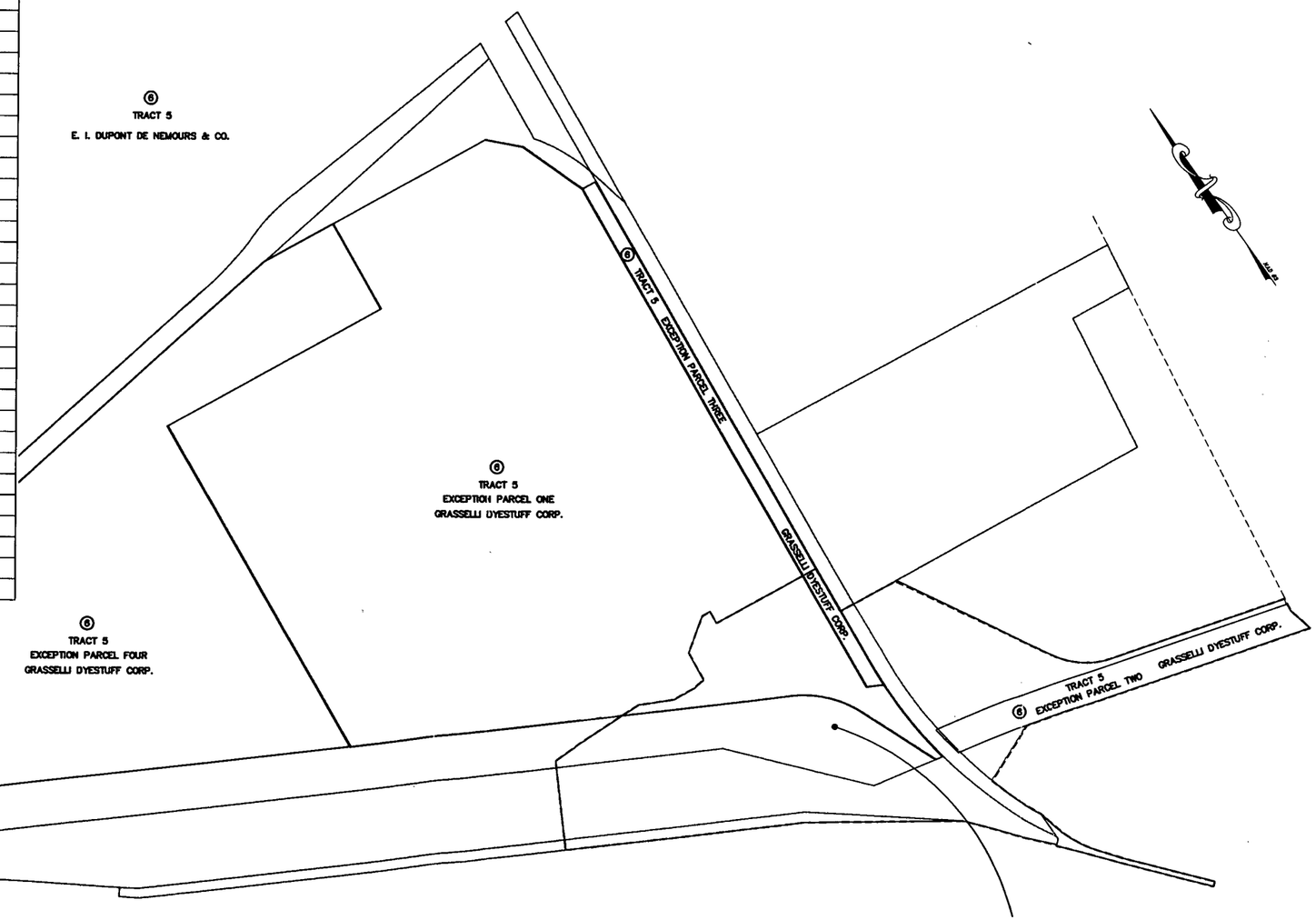
CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 1 OF 6

R2-0003605

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/16/1951	1898	165	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included. believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2948	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/9/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3081	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
39	12/14/1979	3207	93	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X		
40	12/14/1979	3207	97	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1988	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



E.I. DUPONT DE NEMOURS & COMPANY - 1928

LCP SITE

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REVISIONS

DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
PROJ.: 2001202 CHKD.: PAGE:

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2L, Morris Plains, NJ. 07950 973-377-5500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
GEORGE A. HULL, Professional Land Surveyor, Lic. 27301
GEORGE F. JAMES, Professional Engineer, Lic. 28348

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 2 OF 6

R2-0003606

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elitzabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	226	Elitzabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
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29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/8/1975	3033	988	Elitzabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
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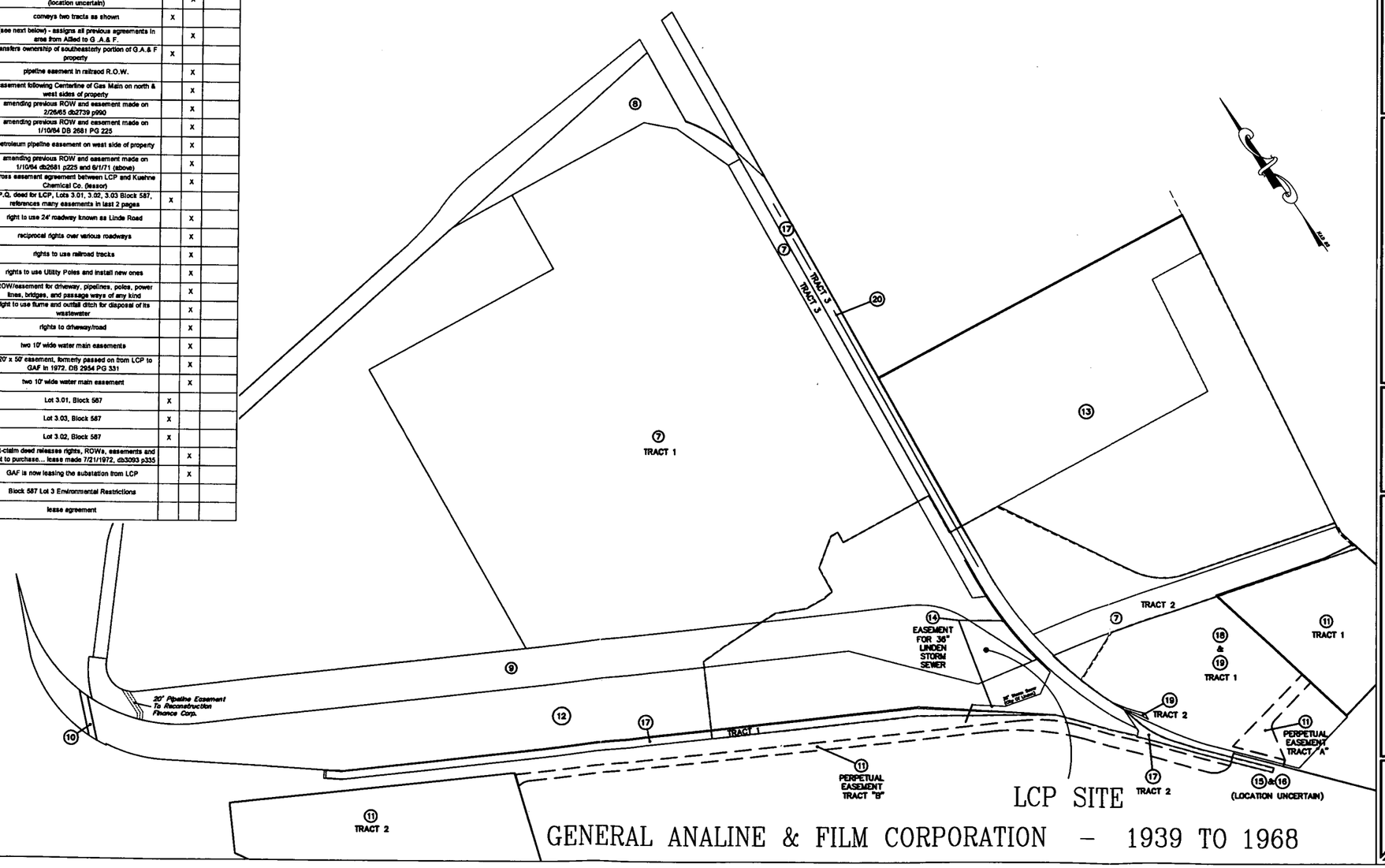
40	12/14/1979	3207	97	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



GENERAL ANALINE & FILM CORPORATION – 1939 TO 1968

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REVISIONS

DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
PROJ.: 2001202 CHKD.: PAGE:

0 100 200 400 800

Keller & Kirkpatrick
Certificate of Authorization #24GA28037400
501 Gibraltar Drive, Suite 2J, Morris Plains, NJ. 07950 973-377-5500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WARREN A. HULL, Professional Land Surveyor Lic. 37291
GEORGE P. JAMES, Professional Engineer Lic. 22344

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 3 OF 6

R2-0003607

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X
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10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X
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19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X	
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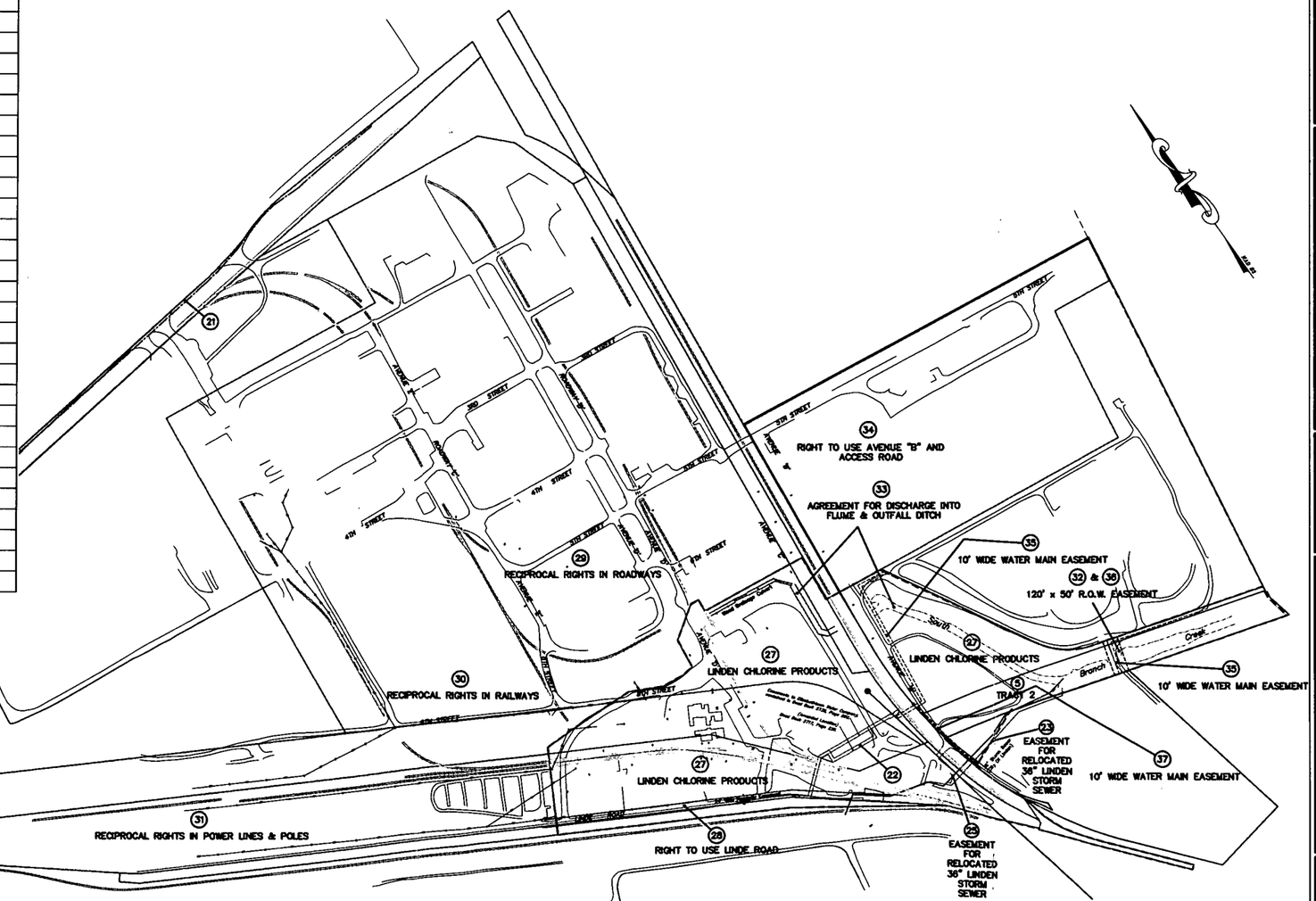
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X	
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X
35	5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X
38	12/14/1979	3207	82	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X	
39	12/14/1979	3207	93	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X	
40	12/14/1979	3207	97	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X	
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions		
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement		



GAF CORPORATION - 1968-1978

LCP SITE

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 17301
EDWIN F. JAMES, Professional Engineer, Lic. 23941

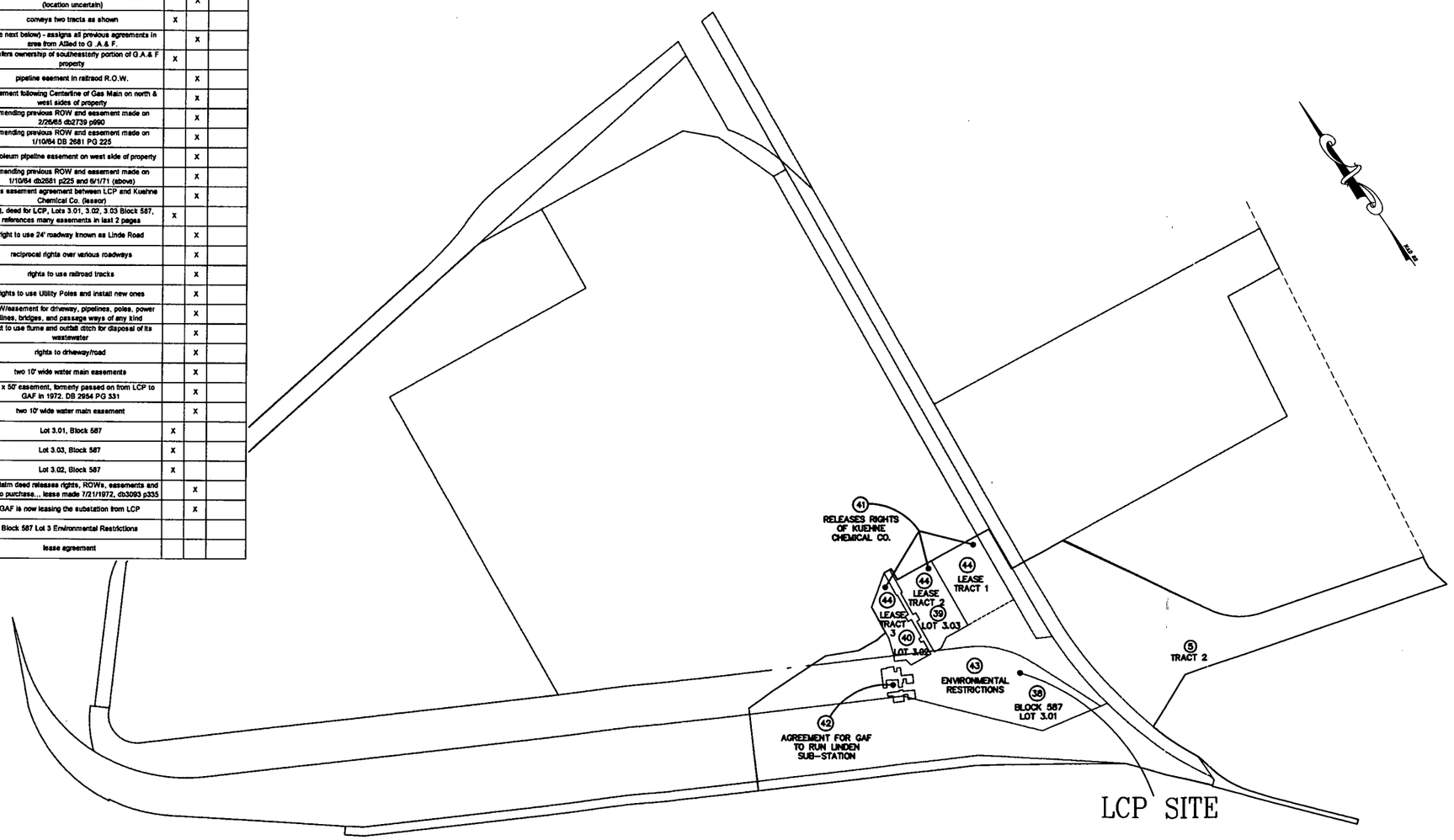
CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 4 OF 6

R2-0003608

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dyestuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	228	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A & F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	228	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2926	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	298	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2985	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/9/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
39	12/14/1979	3207	93	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X		
40	12/14/1979	3207	97	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



LCP CHEMICALS - NEW JERSEY, INC - 1979 TO 1994 & KUEHNE LEASE - 1972

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE F. JAKEL, Professional Engineer, Lic. 22534

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 5 OF 6

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X
4	10/20/1928	1185	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X	
5	10/20/1928	1185	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X	
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X	
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X	
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X
11	4/16/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X	
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X	
13	7/9/1963	2548	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X	
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X	
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X
19	5/15/1967	2802	538	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X	
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X
25	4/17/1972	2948	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X	
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X
35	5/6/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X
38	12/14/1979	3207	82	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X	
39	12/14/1979	3207	93	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X	
40	12/14/1979	3207	97	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X	
41	6/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions		
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement		

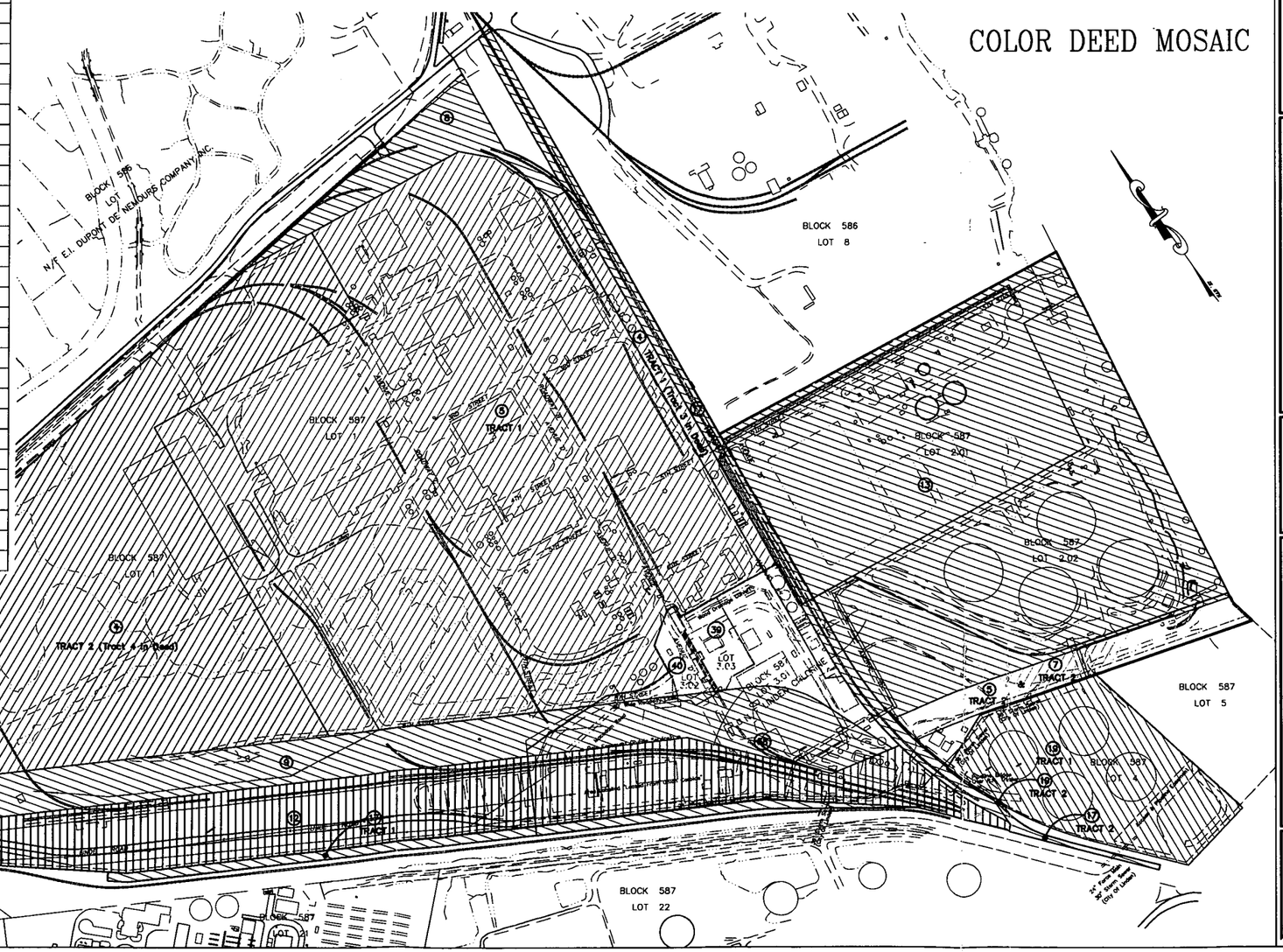
COLOR CHART

- GRASSELLI CHEMICAL COMPANY TO GRASSELLI DYESTUFF CORPORATION – PRIOR TO 1928 (4) & (5)
- TRANSFERRED FROM E.I. DUPONT DE NEMOURS & CO. TO GENERAL ANILINE & FILM CORPORATION – 1940–1963 (8) (9) & (13)
- TRANSFERRED FROM CENTRAL RILROAD CO. OF N.J. TO GENERAL ANILINE & FILM COROPORATION – 1958 (12)
- TRANSFERRED FROM ALLIED CHEMICAL CORP. TO G A F CORPORATION – 1967 (19)
- CONVEYED BY GAF CORPORATION TO LINDEN CHLORINE PRODUCTS – 1972 (27) & CONVEYED BY LINDEN CHLORINE PRODUCTS TO L C P CHEMICALS–NEW JERSEY, INC. – 1979 (38) (39) & (40)

CORPORATE NAME CHANGES

GRASSELLI DYESTUFF CORPORATION WAS INCORPORATED UNDER THE LAWS OF THE STATE OF DELAWARE. ON FEBRUARY 27, 1929, IT CHANGED ITS NAME TO GENERAL ANILINE WORKS, INC. ON OCTOBER 30, 1939, IT BECAME KNOWN AS GENERAL ANILINE & FILM CORPORATION. ON OCTOBER 31, 1939, IT MERGED INTO AMERICAN I.G. CHEMICAL CORPORATION. ON APRIL 24, 1968, IT CHANGED ITS NAME TO GAF CORPORATION. ON AUGUST 24, 1972, GAF CONVEYED PROPERTY TO LINDEN CHLORINE PRODUCTS, INC. ON DECEMBER 14, 1979, LCP CHEMICALS & PLASTICS, INC. CONVEYED ITS PROPERTY TO LCP CHEMICALS–NEW JERSEY, INC.

NOTE: NOTE: SITE INTERIOR DETAILS SHOWN HEREON REPRESENT SITE CONDITIONS AS OF THE AERIAL SURVEY PERFORMED ON 4/05/02 AND DO NOT REFLECT PRESENT SITE CONDITIONS.



REVISIONS	
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DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
PROJ.: 2001202 CHKD.: PAGE:

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Keller & Kirkpatrick
Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE P. JAKEL, Professional Engineer, Lic. 22534

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 6 OF 6

R2-0003610

Tables

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
Property Transfers							
10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	1, 4	4
10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	1, 4	5
11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dyestuff Corp. (exceptions to Tract 5)	2	6
10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	3, 6	7
5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	3, 6	8
9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	3, 6	9
4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	3, 6	11
1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included. believed to convey the railroad property highlighted	3, 6	12
7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	3, 6	13
1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	3, 6	17
5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	3	19
8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	4	27
12/14/1979	3207	82	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	5	38
12/14/1979	3207	93	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	5	39
12/14/1979	3207	97	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	5	40

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
Easements							
7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound	1	1
9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property	1	2
2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property	1	3
7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property	3	10
1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer	3	14
11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)	3	15
11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)	3	16
5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.	3	18
11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.	3	20
8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property	4	21
2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990	4	22
6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225	4	23
8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property	4	24
4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)	4	25
7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)	4	26
8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road	4	28
8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways	4	29
8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks	4	30
8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones	4	31
8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind	4	32
8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater	4	33
1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road	4	34
5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements	4	35

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331	4	36
3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement	4	37
8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335	5	41
9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP	5	42
Deed Restriction							
9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions	5	43
Lease Agreement							
7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement	5	44

Notes:
1. Deed history for Block No. 587, Lots No. 3.01, 3.02, and 3.03 as researched by Keller & Kirkpatrick, Morris Plains, NJ, July 2008
2. Drawings depicting the locations of the various deeds are presented in Appendix XX.

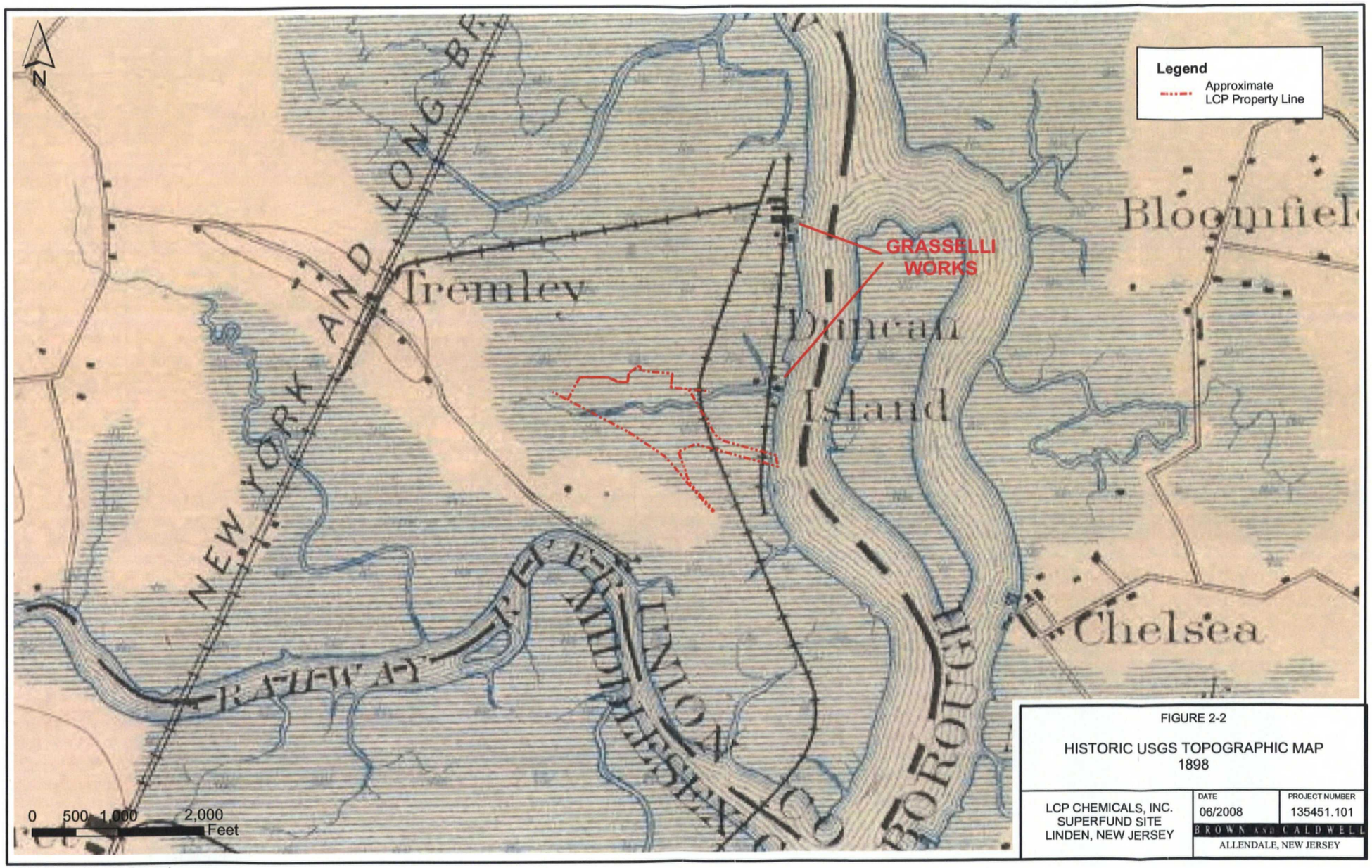


FIGURE 2-2

HISTORIC USGS TOPOGRAPHIC MAP
1898

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1898_Topo.mxd

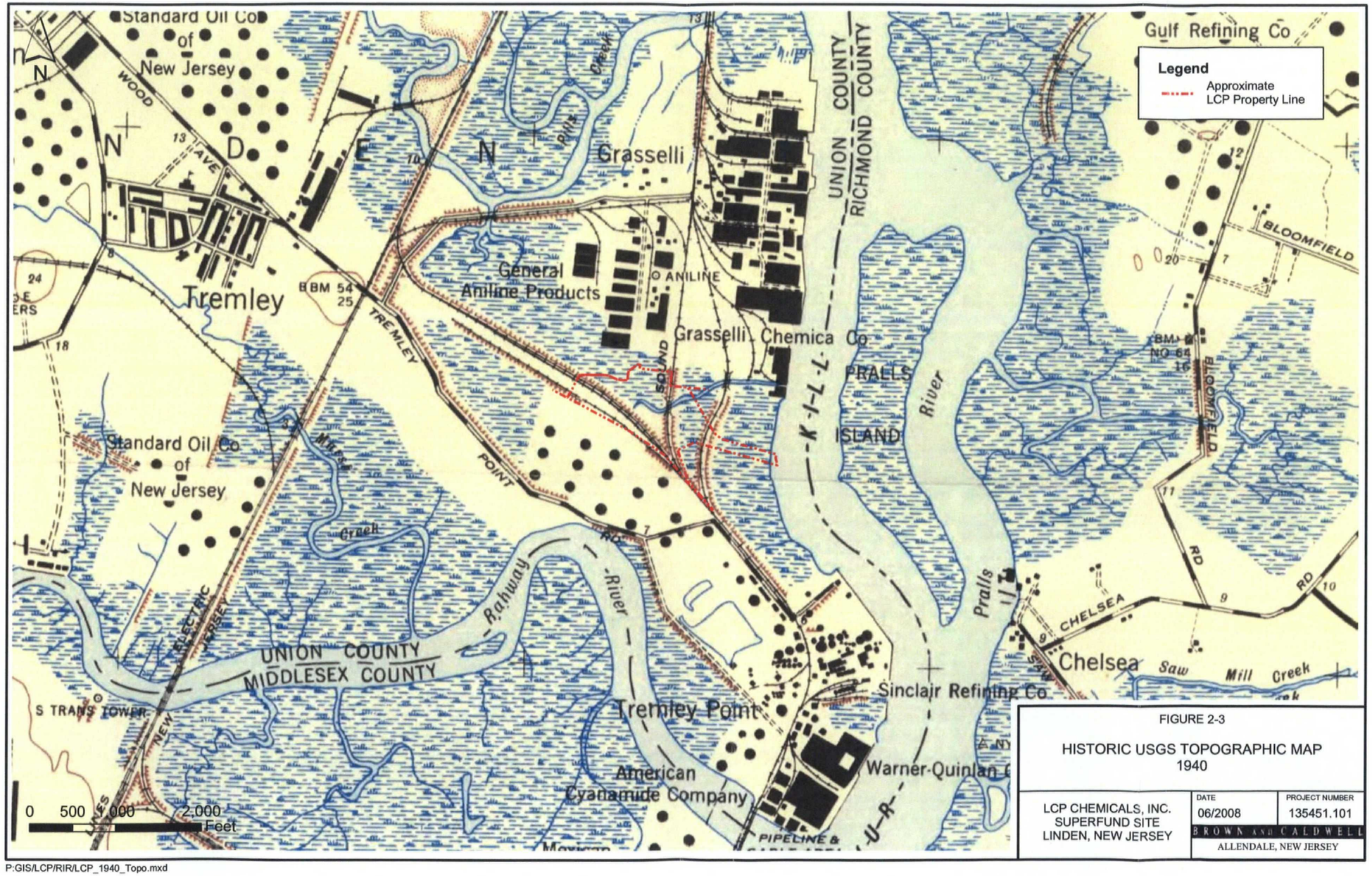


FIGURE 2-3

HISTORIC USGS TOPOGRAPHIC MAP
1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1940_Topo.mxd

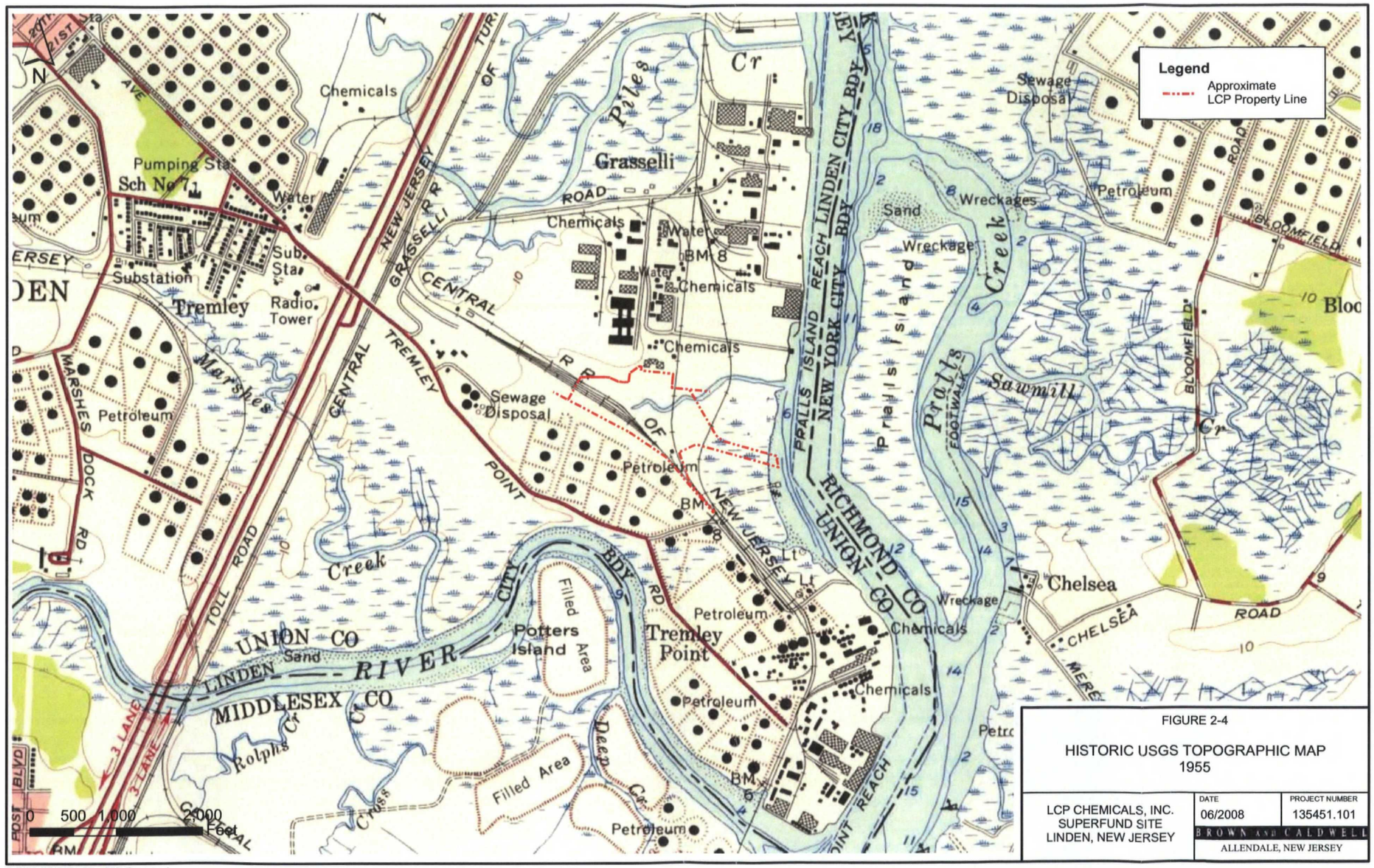


FIGURE 2-4

HISTORIC USGS TOPOGRAPHIC MAP
1955

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1955_Topo.mxd

R2-0003439

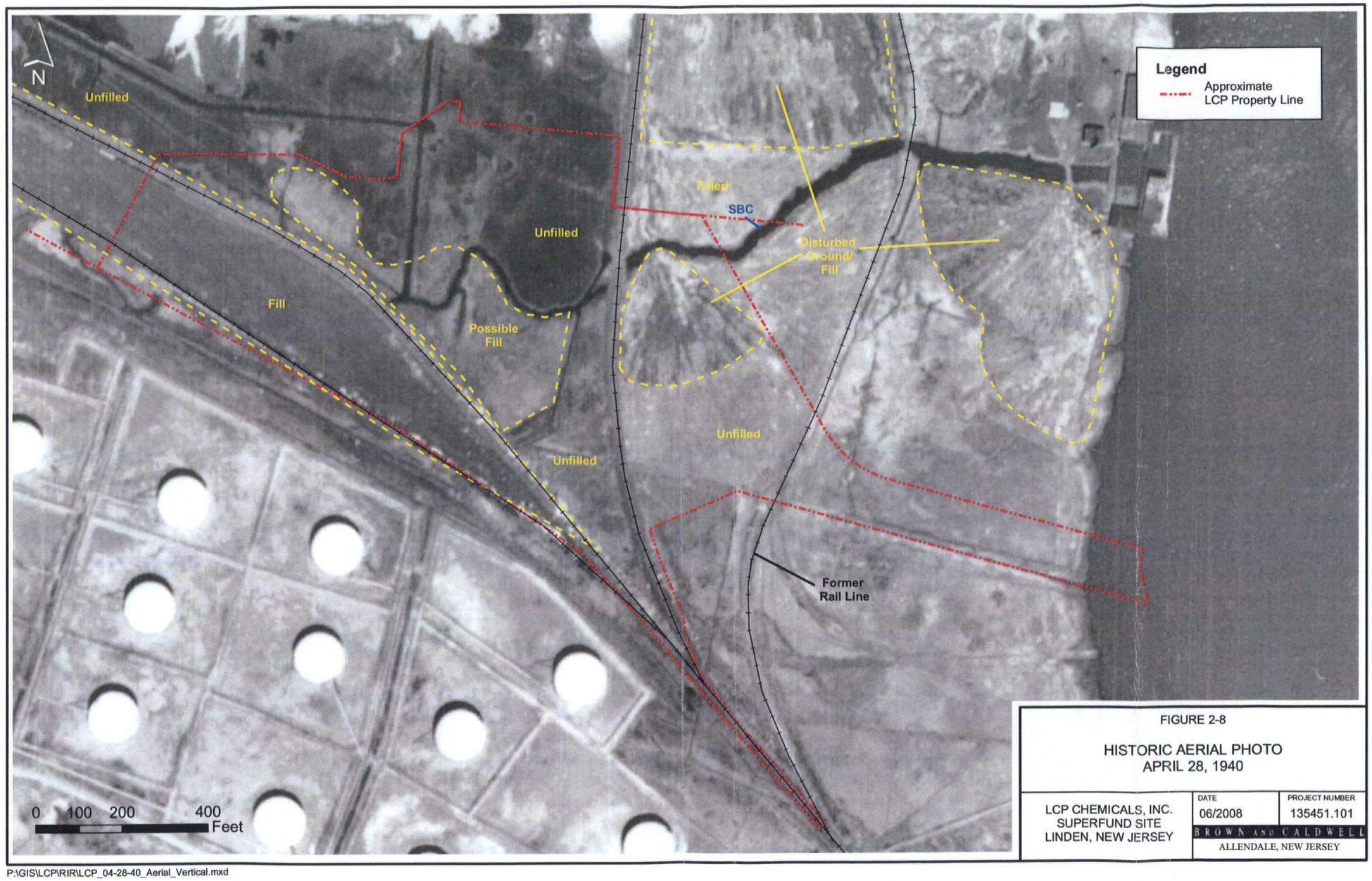


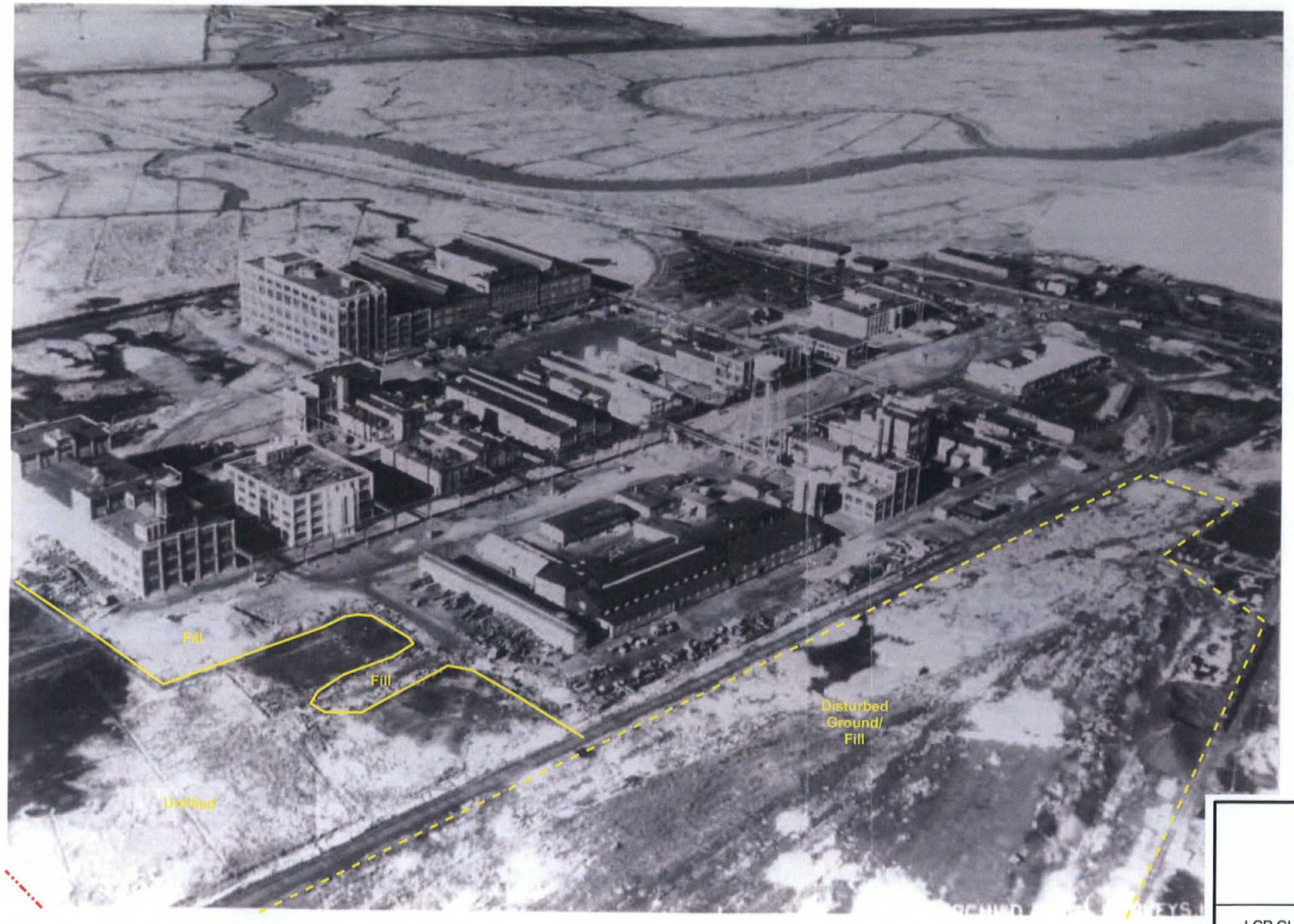
FIGURE 2-8

HISTORIC AERIAL PHOTO
APRIL 28, 1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:\GIS\LCP\RIR\LCP_04-28-40_Aerial_Vertical.mxd

R2-0003443



Legend

Approximate LCP Property Line

N

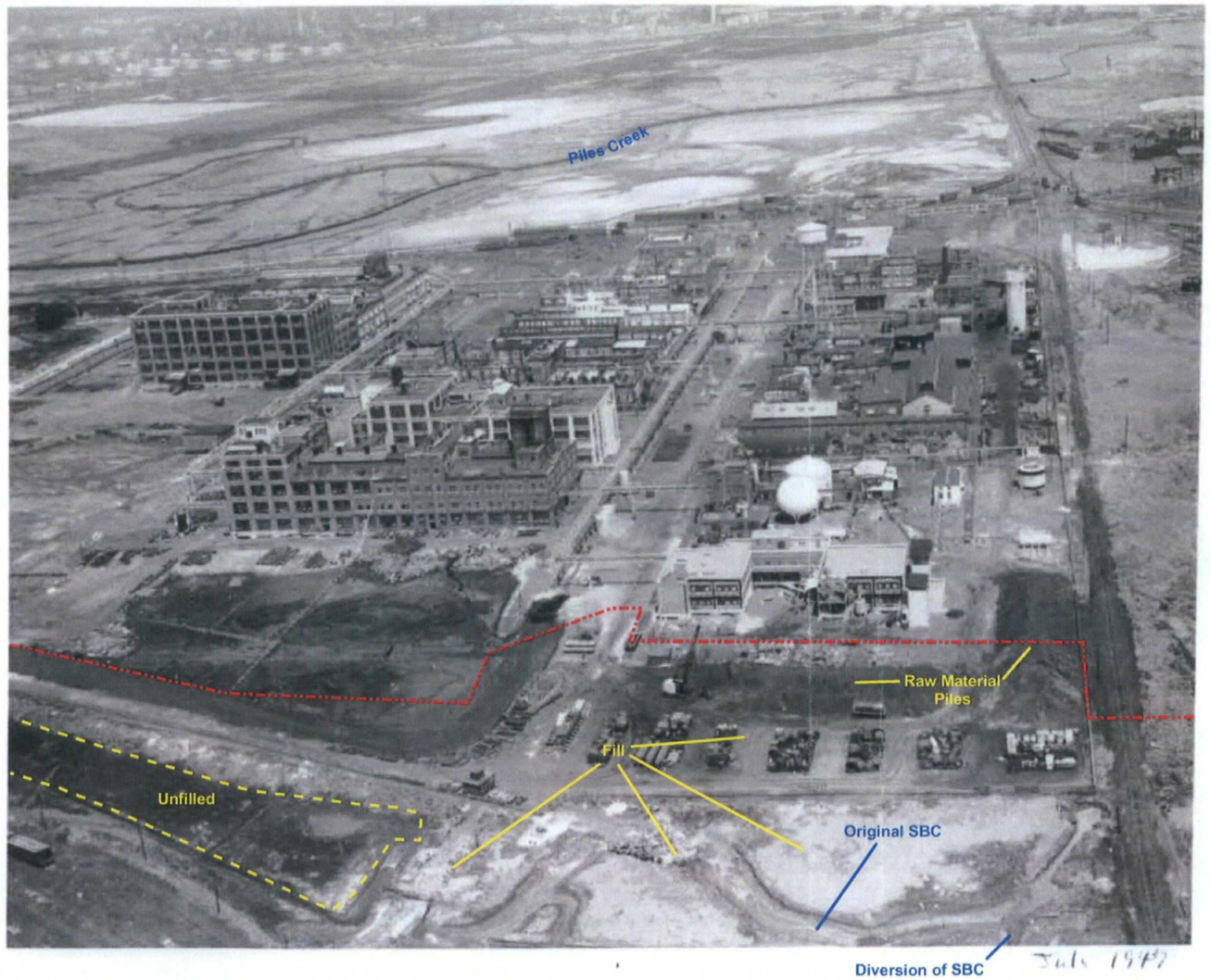
FIGURE 2-9

HISTORIC AERIAL PHOTO
1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:\GIS\LCP\RIR\LCP_1940_Aerial_Oblique.mxd

R2-0003444



Legend

LCP Property Line

Note:
Property Line is estimated.

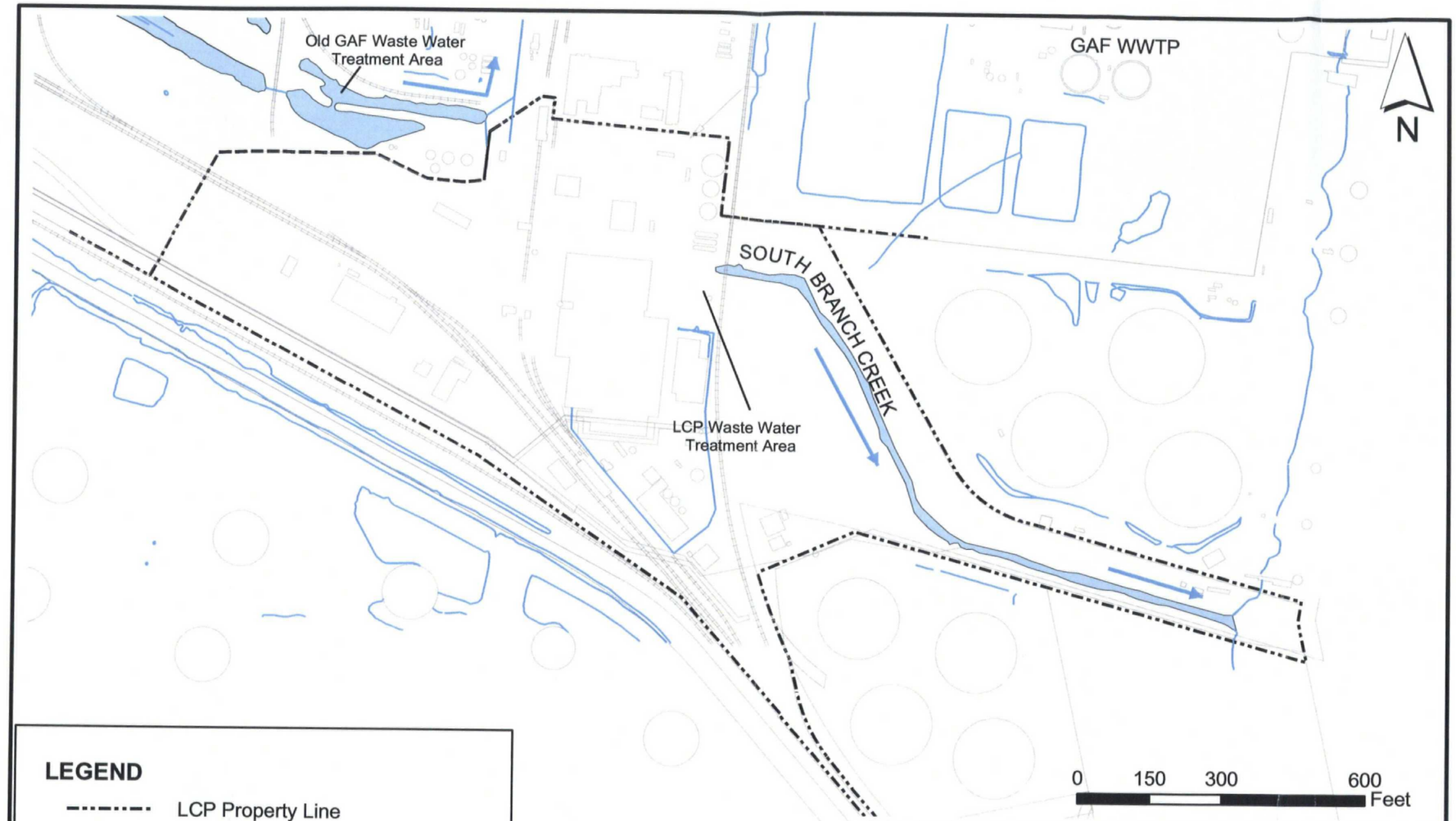
N

FIGURE 2-10
HISTORIC AERIAL PHOTO
JULY 1947

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 04/2007	PROJECT NUMBER 131369.104
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/Fill_History/07-47_Oblique.mxd

R2-0003445



LEGEND

- LCP Property Line
- Site Drainage Channels
- Direction of Flow

NOTES:
1. Site map and existing site features as of 4/05/02 obtained from drawing titled "ALTA/ACSM LAND TITLE SURVEY, ISP ENVIRONMENTAL SERVICES INC., BLOCK 587, LOTS 1 & 2. 10", prepared by Keller & Kirkpatrick, (PROJ NO. 2020408. 10, 8/26/03).

FIGURE 2-25

HISTORIC DRAINAGE PATTERN MAP (1977-PRESENT)

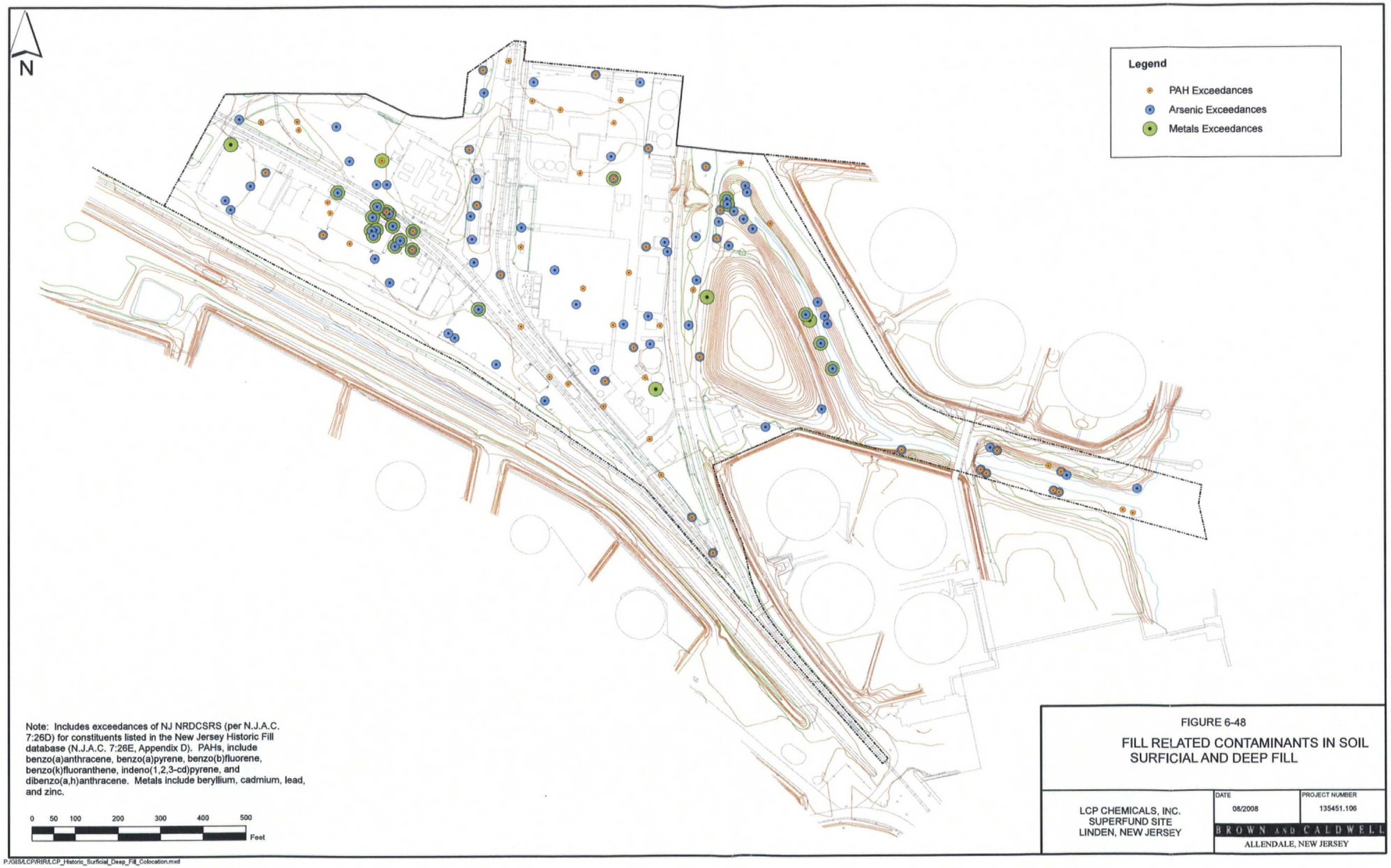
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
06/2008	135451.102

BROWN AND CALDWELL

ALLENDALE, NEW JERSEY

P:/GIS/LCP/RIR/LCP_Drainage_1977-Present.mxd



Note: Includes exceedances of NJ NRDCSRS (per N.J.A.C. 7:26D) for constituents listed in the New Jersey Historic Fill database (N.J.A.C. 7:26E, Appendix D). PAHs, include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluorene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene. Metals include beryllium, cadmium, lead, and zinc.

FIGURE 6-48

FILL RELATED CONTAMINANTS IN SOIL
SURFICIAL AND DEEP FILL

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 08/2008	PROJECT NUMBER 135451.106
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:/GIS/LCP/RIR/LCP_Historic_Surficial_Deep_Fill_Colocation.mxd

R2-0003602

Exhibit D

RECORD OF DECISION

LCP Chemicals Inc, Superfund Site,

Linden, Union County, New Jersey

United States Environmental Protection Agency

Region 2

February 2014

241403

DECLARATION STATEMENT

RECORD OF DECISION

SITE NAME AND LOCATION

LCP Chemicals, Inc., Superfund Site (EPA ID# NJD079303020)
Linden, Union County, New Jersey

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy to address contamination in groundwater, soil, sediments and building material at the LCP Chemicals, Inc., Superfund Site (Site), in Linden, Union County, New Jersey. The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record established for this Site.

The State of New Jersey New Jersey Department of Environmental Protection (NJDEP) concurs with the components of the selected remedy. However, NJDEP does not concur with the contingency remedies for treating elemental mercury as discussed further below. NJDEP believes the contingency remedy should be excavation and off-site removal of the principal threat waste (PTW). In addition, NJDEP believes that the existing data on contamination in Arthur Kill sediments is insufficient to determine cleanup levels for the Northern Off-Site Ditch and South Branch Creek sediments.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect public health or the environment from actual or threatened releases of hazardous substances from the Site into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy described in this document represents the first and only planned remedial phase, or operable unit, for the LCP Chemicals, Inc., Superfund Site.

The major components of the selected remedy include:

- Installation of a capping system to prevent direct contact

with soils and exposure to mercury vapor;

- Treatment of the soil containing visible elemental mercury by mixing with it sulfur to convert the mercury to mercuric sulfide;

- Excavation and on-site disposal of sediments and marsh soils from the Northern Off-Site Ditch and the downstream portion of the South Branch Creek;

- Restoration of the excavated areas;

- Controlled demolition of the Site's buildings, recycling of non-porous material and placement of porous material under the cap;

- Containment and collection of the overburden groundwater layer by a barrier wall and collection/disposal system;

- Groundwater monitoring; and

- Implementation of institutional controls, in the form of a deed notice and Classification Exception Area (CEA).

EPA recognizes that the selected remedy includes a treatment approach for addressing visible elemental mercury that is innovative; therefore EPA is also identifying two contingency remedies in the event that the selected remedy does not meet performance criteria. Further information regarding these contingency remedies can be found in the Decision Summary.

DECLARATION OF STATUTORY DETERMINATIONS

Part 1: Statutory Requirements

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective and utilizes permanent solutions and alternative treatment technologies (or resource recovery) to the maximum extent practicable.

Part 2: Statutory Preference for Treatment

Conversion of visible mercury in soils to mercuric sulfide satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Part 3: Five-Year Review Requirements

Because the remedy will result in hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure, a five-year review will be required.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the administrative record file for the Site.

- Chemicals of concern and their respective concentrations may be found in the Site Characteristics section.
- Baseline risk represented by the chemicals of concern may be found in the Summary of Site Risks section.
- A discussion of cleanup levels may be found in the Remedial Action Objectives section.
- A discussion of materials constituting principal threats may be found in the Principal Threat Waste section.
- Current and reasonably-anticipated future land use assumptions are discussed in the Current and Potential Future Site and Resource Uses section.
- A discussion of potential uses of the Site as a result of the selected remedy is discussed in the Remedial Action Objectives section.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs are discussed in the Description of Alternatives section.

- Key factors that led to selecting the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decisions) may be found in the Comparative Analysis of Alternatives and Statutory Determinations sections.

Walter E. Mugdan, Director
Emergency and Remedial Response Division
EPA - Region 2

FEB. 25, 2014
Date

DECISION SUMMARY

LCP Chemicals, Inc. Superfund Site

Linden, Union County, New Jersey

United States Environmental Protection Agency

Region 2

February 2014

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SITE NAME, LOCATION AND BRIEF DESCRIPTION

The LCP Chemicals, Inc., Superfund Site (Site) is located in an industrial area on the Tremley Point peninsula in Linden, Union County, New Jersey. The twenty-six acre Site is bordered by the Arthur Kill to the east; the former GAF Corporation site to the north; and Northville Industries, BP Corporation, and Mobil to the northeast, south, and west, respectively. South Branch Creek, a man-made drainage ditch that empties into the Arthur Kill, flows through a portion of the Site (Figures 1a and 1b).

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Beginning in the 1880s and into the 1950s, Tremley Point's tidal wetlands were filled to allow for industrial development. Most of the industrial production facilities in the region are no longer operating. The primary current use of the area is bulk storage and transport of petroleum products and aggregates.

In 1955, the General Aniline & Film Corporation (GAF) constructed and began operating a chlor-alkali plant on the Site. By 1956, the core buildings required for chlorine production were present, including Buildings 220 and 230 (Figure 1a). The twenty-six acre property and the chlor-alkali operation were purchased in 1972 by Linden Chlorine Products, Inc. At some point, the company became known as the LCP Chemicals, Inc., a division of the Hanlin Group, Inc. An additional mercury cell building (Building 240) and other buildings were added by the company in the early 1970s.

Portions of the LCP property were leased to other companies for the operation of related manufacturing operations. In 1957 a western portion of the property was leased to Union Carbide Corporation (UCC) to house a hydrogen plant operation that used by-products of the chlorine production. That facility, known as the Linde Division hydrogen plant, operated until 1990. In addition, Kuehne Chemicals, Inc., leased an area on the northern portion of the property to manufacture sodium hypochlorite.

The chlor-alkali manufacturing operations ceased by 1985 and the facility was then used as a terminal for products produced at other locations. In 1991, Hanlin Group, Inc., filed a petition under Chapter 11 of the bankruptcy code, and liquidated its assets by 1994. As part of the bankruptcy, Hanlin Group abandoned the LCP property; ownership reverted to the bankruptcy estate.

In August 1994, EPA conducted a Site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional and that the property was vacated by LCP employees. The Site was placed on the National Priorities List in 1998. In 1999, a potentially responsible party (PRP), ISP-ESI and EPA entered into an Administrative Order to perform a remedial investigation and feasibility study (RI/FS).

Under the oversight of EPA, the PRP's consultants sampled and analyzed soil, sediments, groundwater, surface water and biota. The results of the sampling events, which can be found in the RI report, formed the basis for the FS. The RI and FS reports, which are summarized in this Record of Decision (ROD), can be found in the administrative record for the Site or online at: http://epa.gov/region02/superfund/npl/lcpchemicals/

The LCP property has been abandoned since the last tenant, Active Water Jet, Inc., (a pipe cleaning facility) vacated in 2000. Currently the Site is fenced and secured. The buildings, in particular the mercury cell buildings, are in an advanced state of disrepair.

On October 21, 2013, EPA was informed that James Mathis, the last acting chief executive officer of the Hanlin Group, Inc., signed a quit claim deed on September 19, 2013. The quit claim deed purports to transfer ownership of the LCP property to Cherokee LCP Land, LLC.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

On August 21, 2013, EPA released the RI/FS, a Proposed Plan for Site remediation, and supporting documentation for comment. These documents were made available to the public in the administrative record repositories maintained at the EPA Region 2 office (290 Broadway, New York, New York 10007) and the Linden Public Library, (31 East Henry Street, Linden, New Jersey). The documents were also made available online. EPA published a notice of availability involving the above-referenced documents in the Home News Tribune on August 21, 2013. The public comment period was scheduled from August 21, 2013 to September 20, 2013. On September 17, 2013, the public comment period was extended to October 21, 2013, based on a request from an environmental group.

On August 28, 2013, EPA held a public meeting at the Tremley Point Recreation Building, to inform local officials and

interested citizens about the Superfund process, to discuss the findings of the RI/FS, to present the remedial alternatives for the Site, and to respond to questions and comments from area residents and other attendees.

Responses to the comments received at the public meeting and in writing during the public comment period are included in the Responsiveness Summary section of this ROD (see Appendix V).

SCOPE AND ROLE OF OPERABLE UNIT

This action, referred to as operable unit one (OU1) will be the only action for the Site. It addresses contaminated soils, sediments, building material and groundwater.

The selected remedy will treat soil that contains visible elemental mercury. The remedy will also capture, contain and monitor contaminated groundwater, excavate and contain contaminated sediments, and cap areas of contaminated soil.

SUMMARY OF SITE CHARACTERISTICS

The RI field investigation was performed at the Site in two major phases between July 2001 and May 2008. The Phase I field investigation was conducted between July 2001 and April 2002. It included the collection and analysis of samples from soil, groundwater, surface water and sediments at locations throughout the Site. Data were also collected to provide a geologic, hydrologic and hydrogeologic interpretation of the Site.

The Phase II field investigation was performed at the Site from August 2006 to June 2007. Additional samples were collected in May 2008. The Phase II investigation included samples from soil, soil vapor, groundwater, surface water, sediment and biota. Other work included hydrogeologic testing, habitat assessment and a wetlands assessment.

Soil:

The entire upland area of the Site is covered with about 300,000 cubic yards of anthropogenic fill, which ranges in thickness from approximately 0.7 feet to as much as 17 feet, with an average thickness of roughly nine feet. The fill consists of a heterogeneous mix of soil, ash, wood, brick and glass. Below the fill is a layer of tidal marsh deposits ranging in thickness from five to ten feet. Peat (i.e., loose, soft fibrous material) comprises the upper portion of the tidal marsh deposits and

grades to organic silt and clay. Underlying the tidal marsh deposits is a layer of fine-grained glacial till comprised primarily of silts and clays. The glacial till ranges in thickness from 18.5 feet to 20.5 feet. Finally, below the glacial till is bedrock of the Passaic Formation. The upper portion of the bedrock is highly weathered residual soil composed of fine-grained silts and clays with shale fragments, similar to the overlying glacial till. The layer transitions to competent bedrock with depth.

Two hundred and seventy two surficial and 153 subsurface soil samples were collected during the RI. In addition, horizontal drilling was used to collect 27 soil samples from beneath the dilapidated buildings.

The Site soils are contaminated with constituents including mercury, arsenic and other metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated naphthalenes (PCNs), as well as volatile organic chemicals (VOCs) at levels above the New Jersey non-residential soil remediation standards. The RI found that mercury, at unacceptable concentrations, was dispersed across this entire twenty-six acre Site (Figures 2a-2d). EPA considers mercury to be the primary contaminant of concern (COC), due to its persistence, toxicity and overall mass at the Site. Mercury is typically in the elemental or mercuric sulfide form and at the highest levels (>7,000 milligrams/kilogram (mg/kg)) in the anthropogenic fill. In areas near the chlor-alkali cell buildings, free elemental mercury is present down to a depth of about 17 feet. EPA considers the soil with visible mercury (about 24,000 cubic yards) to be the Site's principal threat waste (PTW) as described later in this document.

South Branch Creek/Northern Off-Site Ditch:

South Branch Creek is a man-made drainage ditch placed in its current location in the early 1970s. It originates in the central portion of the Site and flows east for about 1,200 feet before emptying into the Arthur Kill. The Arthur Kill is a ten-mile long tidal strait, with multiple industrial contaminant sources, that connects Raritan Bay with Newark Bay (Figure 1b). The upstream portion of the South Branch Creek is about 15 feet wide, expanding to about 30 feet wide where it enters the Arthur Kill. It has roughly a five foot tidal range, and becomes dry over most of its course during low tides. The South Branch Creek banks contain a relatively narrow strip of low marsh soils

classified by the New Jersey Department of Environmental Protection (NJDEP) as "intermediate value" wetlands.

Twenty-five surface water samples were collected from the Creek, which showed exceedances of state surface water standards for a number of substances including mercury and arsenic. Mercury was not detected in filtered samples; however, the concentrations in unfiltered samples ranged from 3 parts per billion (ppb) to almost 30 ppb, with the highest concentrations detected during low tides. This seems to indicate that Site-related mercury, attached to suspended sediments, enters the South Branch Creek water column due to tidal stream velocities (Figure 3). Low marsh soils adjacent to the South Branch Creek contained high levels of mercury (maximum concentration of 3,000 mg/kg). Mercury was also detected in the tissue from the six fish (mummichog) and twelve fiddler crabs analyzed, with a mean total mercury concentration of 2.6 mg/kg and 70 mg/kg in fish and fiddler crabs tissue, respectively (Figure 4).

Fifty-eight sediment samples were collected from seven transects across the South Branch Creek and adjacent to the Creek's mouth in the Arthur Kill. Mercury, arsenic, barium and total PCBs were the most frequently detected COCs in the South Branch Creek sediments. Mean concentration of mercury in the sediments was 196 mg/kg, with a high concentration of 901 mg/kg (Figure 5a-5d). Similar to the findings in soils, mercury speciation showed the most common type of mercury was elemental and mercuric sulfide.

The Northern Off-Site Ditch is a man-made ditch located south of the LCP property that empties into the South Branch Creek. Three transects of sediment samples were collected from the Northern Off-Site Ditch. The mercury results indicate that the Ditch was impacted by overland flow from the LCP Site (Figure 6).

Groundwater:

Groundwater at the Site is found in two layers separated by an aquitard consisting of silt and clay. The shallower layer (overburden zone) is within the fill and the peat subunit of the tidal marsh deposits. The deeper layer (bedrock zone) is within the upper portion of the bedrock.

Samples of the overburden groundwater were collected from twenty-one wells and showed exceedances of the applicable state groundwater standards for several constituents, including

mercury, arsenic and some VOCs (Figure 7a-7d). Dissolved mercury concentrations ranged from non-detect (ND) to 164 ppb. Concentrations of other constituents, such as chlorobenzene (from ND to 16,200 ppb), benzene (ND to 848 ppb) and arsenic (up to 275 ppb), showed high levels of exceedances. The overburden groundwater is classified as Class II-A, meaning existing New Jersey Groundwater Quality Standards (NJGWQS) are applicable. However, due to the shallow depth and low production potential of the zone, it could not be used as a source of potable water in New Jersey.

Due to naturally occurring levels of total dissolved solids and chloride, the bedrock zone has been reclassified by the State of New Jersey to Class III-B groundwater, meaning it cannot be used as a source of potable water. Due to the high levels of TDS (i.e., greater than 10,000 parts per million), EPA would also consider this aquifer non-potable. According to NJ regulations (N.J.A.C. 7:9C-1.7(f)), Class III-B groundwater requires the development of site-specific criteria. The criteria shall be more stringent than necessary to ensure that there will be no: impairment of existing uses of groundwater; resulting violation of surface water quality standards; release of pollutants to the ground surface, structures or air in concentrations that pose a threat to human health; or violation of constituent standards for downgradient classification areas to which there is a significant potential for migration of groundwater pollutants.

Those site specific criteria have not yet been developed, so currently the bedrock zone has no applicable standards. In order to protect downgradient surface water, while site specific groundwater criteria are being developed, the NJDEP has suggested using state surface water standards as the bedrock zone's interim criteria.

Sample results from 10 bedrock wells show that mercury and other constituents exceed surface water standards in the bedrock zone. The highest concentrations of mercury, benzene and chlorobenzene were 11 ppb, 383 ppb and 14 ppb, respectively. Potentiometric studies indicate that the groundwater in the bedrock zone underlying the Site is currently being controlled by a pump and treat remedy at the adjacent GAF Corporation site (Figure 8).

Building Debris:

Over ten buildings and structures remain on the LCP property. The buildings are in a state of disrepair and in the case of the

former mercury cell buildings, unsafe to enter. Anecdotal evidence suggests that the buildings' porous material contains free elemental mercury. The amount of building material on Site is roughly 32,000 cubic yards (61,000 tons).

Soil Vapor:

Fourteen soil vapor samples were collected throughout the Site as part of the RI field investigation. Samples from 10 probes were tested for VOCs and samples from 4 probes were tested for mercury vapors.

Mercury vapors were detected in each of the 4 samples that were tested. The concentrations ranged from 0.2 to 2.5 micrograms per cubic meter ($\mu g/m^3$).

The VOCs detected in the soil vapor are similar to those that were detected in the soil. The VOCs in soil vapor include chlorobenzene; benzene, toluene, ethylbenzene and xylenes (BTEX) compounds; hexachlorobutadiene; chloroform and TCE.

Conceptual Site Model

A conceptual site model was developed to integrate all the different types of information collected during the RI.

Contaminants associated with the Site media fall into three general categories:

1) Contaminants associated with Site operations either directly from the chlor-alkali process or from spilled or discharged contaminants related to general facility operations
2) Contaminants that are incidental to anthropogenic fill
3) Contaminants from other sources, such as storm-water runoff or sediment transport from the Arthur Kill

Site-related contamination originated in the upland manufacturing facility area. During the period of chlor-alkali operation, mercury was discharged to the environment atmospherically or to the ground through spills or waste disposal. While the concentrations vary, mercury is a pervasive contaminant dispersed continuously across the Site. High concentrations of mercury remain in soils, including visual evidence of elemental mercury. Vertical migration of mercury in soils beneath the fill appears to have been relatively limited.

The deeper fill contains substantially lower total mercury concentrations than the shallow fill, with only half as many exceedances of the applicable soil standard (New Jersey nonresidential direct contact soil remediation standard, 65 mg/kg). Seventy-five percent of the native material underlying the fill (tidal marsh deposits and the glacial till) contained mercury below that standard.

Six of the twenty unfiltered samples from the overburden groundwater exceeded the New Jersey Groundwater Quality Standard (GWQS) for mercury (2 ppb) (Figure 7a) while only two of the filtered samples exceeded 2 ppb (Figure 9. In addition, dissolved (i.e., filtered samples) levels of mercury were undetected in most of the samples located between the production area and South Branch Creek.

This pattern of mercury groundwater detections appears to indicate that there is a general absence of lateral migration of mercury in overburden groundwater.

Only three of the unfiltered bedrock groundwater samples contained detectable mercury (Figure 10) and those are likely related to an off-site source (i.e., the GAF site). These bedrock mercury detections were limited to the western portion of the LCP Site. Based on the potentiometric surface contours, it appears that pumping from the adjacent GAF Site is effectively capturing the bedrock groundwater under the LCP Site (Figure 8).

These soil and groundwater observations are consistent with the presence of mercury in an insoluble form. The results of the sequential extraction analyses performed on soils confirm that the majority of mercury exists in Site soils as insoluble species (mercuric sulfide and elemental mercury). For this reason, migration in groundwater has been limited and minimal further migration is anticipated.

The mercury detected at high concentrations in South Branch Creek and the Northern Off-Site Ditch (both sediments and the low marsh soils adjacent to the creeks, which reflect sediment deposition during tidal surges or storm events) is likely due to soil-bound mercury moving via advective flow into the nearest surface water body.

The presence of elevated mercury in soils along the alignment of the historic South Branch Creek channel and the southern

boundary of the LCP Site is consistent with the overland release migration mechanism. Both uncontrolled stormwater run-off and piped discharges are likely to have contributed to transport. Mercury that was atmospherically deposited to near-facility surface soils could also have been transported via run-off. Subsequent tidal mixing and continuous suspension/redeposition may explain why clearer gradients with sediment depth are not uniformly observed.

Changes in Site drainage patterns after 1976 and the cessation of chlor-alkali manufacturing activities in 1985 would have dramatically decreased the quantity of overland releases to South Branch Creek after that time. Furthermore, the flat gradient at the Site and lack of drainage structures provide for minimal ongoing stormwater discharge to South Branch Creek.

There is a tendency for elemental mercury to appear at the ground surface during rain events; however, elemental mercury is highly insoluble and should experience negligible entrainment given the minimal run-off overall from the Site to South Branch Creek. Since groundwater is a negligible source of mercury to surface water, the transport of mercury to South Branch Creek can be considered largely historic.

Mercury in South Branch Creek sediments (Figures 5a through 5d) and adjacent low marsh soils is present at the highest concentrations in the areas closest to the former manufacturing facility (Transect A) and the possible drainage inputs from the large concrete pipe that drains at Transect C. The correlation of the existing pattern of mercury presence with historical inputs known to have ceased decades ago strongly indicates that outward mercury migration from the channel is now limited. The attenuation of mercury concentrations in sediments as South Branch Creek reaches the Arthur Kill provides further support for limited sediment transport, since extensive mixing over time would have reduced or eliminated the clear concentration gradient.

Stormwater drainage from the southern portion of the LCP Site, adjacent to the Northern Off-Site Ditch appears to have remained consistent throughout the operational history at the LCP plant. The spatial distribution of mercury found in the Northern Off-Site Ditch sediments is consistent with an overland migration of contaminants in stormwater runoff from the former hydrogen plant area.

The migration of low levels of mercury that suspend in surface water may be environmentally significant because mercury can be of concern in the environment at low concentrations. However, this pathway is unlikely to serve as a mechanism for moving or altering the bulk mass of mercury present in sediments.

There may be some solubilization, chemical transformation, and volatilization of the small amount of mercury that resides in the water column. Again, these processes affect a vanishingly small proportion of the mercury load in sediments and are not significant from a bulk transport perspective. However the small amount (approximately 0.1 to 0.2 percent) of mercury in surface water that has become methylated will have a high bioconcentration factor, meaning it could impact biota even at relatively low concentrations. Sediments are also likely contributing to biological accumulation, as evidenced by the elevated concentrations of mercury in the fiddler crab.

Both fish and crab serve as prey species that can contribute to mercury biomagnifications up the food chain. Therefore, while the significance of this pathway from a bulk transport perspective is unknown, movement from sediment into biota is an environmentally significant migration pathway.

PCBs, PCNs, hexachlorobenzene (HCB), and polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDDs/PCDFs) originating in soils adjacent to the former facility, would be expected to behave in a similar manner as mercury, traveling primarily via run-off adsorbed onto solids. PCBs were generally low in South Branch Creek sediments (undetected or at part-per-billion levels), but demonstrated a similar pattern to mercury, with the highest concentrations at Transects A and C (Figure 11). PCBs were not detected in Arthur Kill sediments, indicating attenuation with distance from the Site. HCB movement appears to have been minimal, as this compound was undetected in South Branch Creek samples except for one occurrence of 1.5 mg/kg in the 0.5-1.0-foot sediments at Transect C and two detections under 0.2 mg/kg in low marsh soils at Transect. HCB was also not detected in the Northern Off-Site Ditch.

Lower-chlorinated chlorobenzenes appear to have migrated to South Branch Creek and the Northern Off-Site Ditch via the same mechanism of adsorption/run-off. These constituents, which have higher solubility than the other COCs, have also partitioned into groundwater, as has benzene. A portion of what is observed in South Branch Creek and the Northern Off-Site Ditch may be

attributable to the localized discharge of chlorobenzenes in shallow groundwater. However, this mechanism is unlikely to account for more than a small proportion of what is observed in sediments. These more soluble COCs have relatively short residence times in surface water due to volatilization and their higher aqueous solubility results in less partitioning to sediment. Thus, relatively little benzene and chlorobenzene is observed in sediment compared with the higher-chlorinated compounds, which are more likely to have migrated, adsorbed to solids.

The presence of contaminants in soils not associated with Site operations is attributable to anthropogenic fill, regional contamination, or other historic sources to South Branch Creek.

The markedly elevated arsenic noted in sediments (concentrations greater than the maximums detected in any of the soil units) appears to be related to a local source likely other than the LCP Site. South Branch Creek received inputs from other nearby facilities, including the GAF site.

CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES:

Groundwater Uses: As described previously, the groundwater at the Site is found in two layers separated by a silt/clay aquitard. The shallower overburden layer is considered by New Jersey to be Class II-A, a source of potable water; however, the water cannot be used as a potable resource. The bedrock zone has been reclassified by New Jersey to be Class III-B groundwater, which means it is unsuitable for potable use.

LCP Property uses: The LCP Site, which includes the LCP property and the Off-Site Ditch area, is currently unused, but is zoned for commercial and industrial uses. EPA has consulted with local municipal authorities and the Site is being considered as part of an area-wide industrial/commercial redevelopment plan. The redevelopment plan would not change the zoning.

SUMMARY OF SITE RISKS

As part of the RI, a baseline risk assessment was conducted to estimate the current and future effects of contaminants on human health and the environment. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects of releases of hazardous substances from a site in the absence of any actions or controls to mitigate such releases,

under current and future land and groundwater uses.

Human Health Risk Assessment

A Baseline Human Health Risk Assessment (BHHRA) was conducted to estimate current and future effects of contaminants on human health. A BHHRA is an analysis of the potential adverse human health effects caused by hazardous substance exposure in the absence of any actions to control or mitigate these exposures under current and future Site uses. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site. Tables 1 through 6 provide a summary of relevant information from the BHHRA (i.e. exposure pathways and chemicals found to pose unacceptable risk to human health).

The risk assessment document for this Site, entitled *Final Human Health Risk Assessment,* dated May 2011 is available in the administrative record file and Site repository.

A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios, as follows.

Hazard Identification - uses the analytical data collected to identify the contaminants of potential concern (COPCs) at the Site for each medium, with consideration of a number of factors explained below.

Exposure Assessment - estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (*e.g.*, ingesting contaminated soil) by which humans are potentially exposed.

Toxicity Assessment- determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of effect (response).

Risk Characterization - summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site-related risks. The risk characterization also identifies contamination with concentrations that exceed acceptable levels, defined by

the NCP as an excess lifetime cancer risk greater than 1 x 10^{-6} - 1 x 10^{-4} or a Hazard Index greater than 1.0; contaminants at these concentrations are considered COCs and are typically those that will require remediation at the Site. Also included in this section is a discussion of the uncertainties associated with these risks.

Hazard Identification
In this step, analytical data collected during the RI was used to identify contaminants of potential concern (COPCs) in the soil, sediment, surface water and groundwater at the Site based on factors such as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants as well as their mobility and persistence.

Surface (less than two feet deep) and subsurface (greater than two feet deep) soil, overburden groundwater, South Branch Creek sediment/bank soil and soil vapor samples were collected between July 2001 and May 2008 as part of the remedial investigation. A comprehensive list of all Site COCs can be found in the Table 2 series of the May 2011 Final Human Health Risk Assessment report.

Exposure Assessment
In this step, the different exposure scenarios and pathways through which people might be exposed to the contaminants identified in the previous step were evaluated.

Consistent with Superfund policy and guidance, the BHHRA is a baseline human health risk assessment and therefore assumes no remediation or institutional controls to mitigate or remove hazardous substance releases. Cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the Site. The RME is defined as the highest exposure that is reasonably expected to occur at a Site.

The exposure assessment identified potential human receptors based on a review of current and reasonably foreseeable future land use at the Site. The Site is located on Tremley Point in Linden, a heavily industrialized peninsula in Union County, New Jersey. Land use surrounding the Site is primarily industrial. The Site is currently zoned heavy industrial. In February of 2009, bedrock groundwater was reclassified to Class III-B non-potable groundwater. Based on the Class III-B reclassification, drinking water wells cannot be drilled and narrative groundwater

criteria would apply to bedrock groundwater in the affected area. NJDEP classified overburden groundwater below the Site as Class II-A groundwater; therefore, future potable use of groundwater was evaluated. Groundwater is not currently used for drinking water at the Site. Future potable use of bedrock groundwater is prohibited and in the overburden is highly unlikely.

Based on information gathered during the RI, such as zoning and demographic information, several exposure scenarios for the Site were selected. For current land use scenario, the following exposure scenario was evaluated:

- adolescent trespassers contacting/ingesting surface water/sediment in South Branch Creek.

For potential future land uses, the following exposure scenarios were evaluated:

- commercial/industrial workers contacting/ingesting surface soil, or inhaling vapors from surface soil;
- site-specific workers contacting/ingesting/inhaling surface soil;
- construction/utility workers contacting/ingesting/inhaling surface/subsurface soil;
- commercial/industrial workers ingesting overburden groundwater;
- construction/utility workers contacting/ingesting/inhaling vapors from shallow groundwater;
- adolescent trespassers contacting/ingesting/inhaling surface soil;
- adolescent trespassers contacting/ingesting surface water/sediment in South Branch Creek; and
- indoor workers inhaling vapors migrating from the subsurface into indoor air.

Table 2 presents all exposure pathways considered in the BHHRA, and the rationale for the selection or exclusion of each pathway. Since the South Branch Creek is generally unsuitable for fish species that are used for human consumption, and considering the industrial setting and substantial barriers to fishing access (i.e., small boat via the Arthur Kill and only during high tide), the fish/shellfish consumption pathway for

South Branch Creek is considered incomplete and was not evaluated in the HHRA.

Toxicity Assessment

In this step, the types of adverse health effects associated with contaminant exposures and the relationship between magnitude of exposure and severity of adverse health effects were determined. Potential health effects are contaminant-specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health effects.

Under current EPA guidelines, the likelihood of carcinogenic risks and noncancer hazards due to exposure to Site chemicals are considered separately. Consistent with current EPA policy, it was assumed that the toxic effects of the Site-related chemicals would be additive. Thus, cancer and noncancer risks associated with exposures to individual COPCs were summed to indicate the potential risks and hazards associated with mixtures of potential carcinogens and non-carcinogens, respectively.

Toxicity data for the human health risk assessment were provided by the Integrated Risk Information System (IRIS) database, the Provisional Peer Reviewed Toxicity Database (PPRTV), or another source that is identified as an appropriate reference for toxicity values consistent with EPA's directive on toxicity values. Toxicity values can be found in Tables 3 and 4. Additional toxicity information for all COPCs is presented in the Table 5 and 6 series of the May 2011 Final HHRA.

Risk Characterization

This step summarized and combined outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site risks. Exposures were evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen, using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk (IUR) for inhalation exposures. Excess lifetime cancer risk for oral and dermal exposures is calculated

from the following equation, while the equation for inhalation exposures uses the IUR, rather than the SF:

Risk = LADD x SF

Where: Risk = a unit-less probability (1×10^{-6}) of an individual developing cancer
LADD = lifetime average daily dose averaged over 70 years (mg/kg-day)
SF = cancer slope factor, expressed as [1/(mg/kg-day)]

The likelihood of an individual developing cancer is expressed as a probability that is usually expressed in scientific notation (such as 1×10^{-4}). For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to Site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk) with 10^{-6} being the point of departure.

For noncancer health effects, a hazard index (HI) is calculated. The HI is determined based on a comparison of expected contaminant intakes and benchmark comparison levels of intake (reference doses, reference concentrations). Reference doses (RfDs) and reference concentrations (RfCs) are estimates of daily exposure levels for humans (including sensitive individuals) which are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (*e.g.*, the amount of a chemical ingested from contaminated drinking water) is compared to the RfD or the RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

HQ = Intake/RfD

Where: HQ = hazard quotient
Intake = estimated intake for a chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (*i.e.*, chronic, subchronic, or acute).

The key concept for a noncancer HI is that a "threshold level" (measured as an HI of less than 1) exists below which noncancer health effects are not expected to occur.

The HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for non-carcinogenic health effects to occur as a result of Site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals which are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncancer health effects on a specific target organ or system. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

The highest noncancer (HI=190) risk was calculated be a future industrial or commercial worker on the unremediated Site. Specific cancer and noncancer risks are summarized in Tables 5 and 6. Exposure to mercury (elemental and inorganic), vanadium and furan in soil and arsenic, cobalt, iron, manganese, mercury, methyl mercury, vanadium, furan, p-chloroaniline, benzene, chlorobenzene and dioxin in shallow groundwater posed an unacceptable human health risk.

EPA anticipates that the remedy will reduce exposure to mercury and other Site COCs in soil, sediment, groundwater and building material, resulting in the interruption of unacceptable risks to trespassers, commercial/industrial workers, site-specific workers, and construction/utility workers.

Ecological Risk Assessment

A part of the RI, ecological risk was evaluated to determine the likelihood that adverse ecological effects are occurring or may potentially occur as a result of the Site-related contamination.

The risk assessment was performed in accordance with EPA's

Ecological Risk Assessment Guidance for Superfund eight step approach. As part of that approach, a Screening Level Ecological Risk Assessment (SLERA) was conducted to identify potential environmental risks associated with the Site. The SLERA indicated there was a potential for adverse ecological effects. Therefore a more thorough study, called a Baseline Ecological Risk Assessment (BERA), was performed.

The BERA evaluated the following potentially complete receptor exposure pathways (and representative receptors):

- Exposure of benthic macroinvertebrates to contaminated sediment/bank soil in South Branch Creek;
- Exposure of estuarine fish to contaminated sediment and surface water in South Branch Creek;
- Exposure of omnivorous mammals (raccoon; *Procyon lotor*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of piscivorous mammals (mink; *Mustela vison*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of sediment-probing birds (spotted sandpiper; *Actitis macularia*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of piscivorous birds (great blue heron; *Ardea herodias*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of invertivorous mammals (short-tailed shrew; *Blarina brevicauda*) to contaminated soil and prey items in the upland area of the Site;
- Exposure of carnivorous mammals (red fox; *Vulpes vulpes*) to contaminated soil and prey items in the upland area of the Site;
- Exposure of invertivorous birds (American woodcock; *Scolopax minor*) to contaminated soil and prey items in the upland area of the Site; and

- Exposure of carnivorous birds (red-tailed hawk; *Buteo jamaicensis*) to contaminated soil and prey items in the upland area of the Site.

Potential risks to benthic macroinvertebrate communities were primarily evaluated by comparing sediment COC concentrations in South Branch Creek to sediment benchmarks; additionally, bulk sediment toxicity testing was performed for lethality and growth (acute toxicity tests). Potential risks to estuarine fish communities in South Branch Creek were evaluated by comparing fish tissue COC concentrations to tissue toxicity reference values (TRVs). Potential risks to populations of upper trophic level (wildlife) receptors at the Site were evaluated using food chain models to calculate dietary doses, which were compared to dietary TRVs to yield a quantitative estimate of risk.

Two exposure levels were considered for evaluating potential ecological risks. The RME scenario considered exposure to upper-bound exposure point concentration (EPC) estimates (95 percent upper confidence levels or maximum concentrations) and the central tendency exposure (CTE) scenario considered mean concentrations.
Note that EPCs did not account for visible elemental mercury as it was not possible to analyze these samples using conventional methods; however, it is assumed that areas with visible elemental mercury pose unacceptable risks to potential ecological receptors. If available, multiple effects levels were also considered. A range of screening levels and tissue toxicity reference values (TRVs) that correspond to various effects were considered for benthic macroinvertebrates and estuarine fish, respectively. For wildlife receptors, both 'no observable adverse effect level' (NOAEL) and 'lowest observed adverse effect level' (LOAEL) TRVs were considered.

The results of the BERA support the following conclusions:

- Several COCs in South Branch Creek sediment have the potential to result in adverse ecological effects to benthic macroinvertebrates as determined by comparison to marine sediment screening levels. Arsenic, barium, mercury, and methyl mercury are expected to be the primary risk drivers. South Branch Creek sediment acute toxicity testing results also indicated a potential for reduced benthic invertebrate survival.

- Fish tissue concentrations measured in South Branch Creek were within the range of tissue TRVs identified in the primary literature, indicating that South Branch Creek COCs are not bioaccumulating to a level likely to adversely affect populations of estuarine fish.

- Ecological risks for omnivorous mammals (raccoons), piscivorous mammals (mink), and piscivorous birds (great blue herons) exposed to COCs in South Branch Creek were below established risk levels. However, there is a potential for ecological risk to sediment-probing birds (spotted sandpiper) exposed to COCs in South Branch Creek. Primary risk drivers are arsenic, barium, and mercury.

Areas of visible elemental mercury contamination in the upland area of the Site could not be quantitatively evaluated. For the purposes of the BERA, areas with visible elemental mercury were assumed to present unacceptable risk for potential ecological receptors.

- No unacceptable risks were identified for carnivorous mammals (red foxes) exposed to COCs in the upland area of the Site. There is a potential for ecological risk to insectivorous mammals (short tailed shrews), invertivorous birds (American woodcocks), and carnivorous birds (red-tailed hawks). Although the Site may serve as a wildlife corridor for terrestrial species, significant ecological exposure to soil is not expected to occur given the highly disturbed habitat, lack of prey species and vegetation, limited exposure potential due to buildings, pavement and gravel on Site, and anticipated future land use. Based on calculated risk estimates, primary risk drivers in the upland area are mercury and hexachlorobenzene.

In summary, elevated HQ risks were estimated in the BERA for benthic invertebrates and sediment probing birds for exposure to several COCs in South Branch Creek. These risks are consistent with the reduced survival in the acute toxicity sediment testing results. These data support the premise that Site contaminants in sediment are sufficient to cause adverse alterations to the functioning of benthic invertebrate communities. Elevated concentrations of the COCs are generally higher in samples closer to the former facility. Arsenic, barium, and mercury are the primary risk drivers in South Branch Creek.

Elevated HQ risks were estimated in this BERA for terrestrial mammals (invertivores) and birds (invertivores and, to a lesser extent, carnivores). Primary risk drivers are mercury (including visible elemental mercury) and hexachlorobenzene. Concentrations tend to be focused in areas near the former operational areas of the Site.

Uncertainties

The procedures and inputs used to assess risks in these evaluations, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental chemistry sampling and analysis
- environmental parameter measurement
- fate and transport modeling
- exposure parameter estimation
- toxicological data

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is uncertainty as to the actual levels present. Environmental chemistry analysis error can stem from several sources, including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the risk assessment provides upper-bound estimates of the risks to populations near the Site, and is highly unlikely to underestimate actual risks related to the Site.

More specific information concerning public health and environmental risks, including a quantitative evaluation of the

degree of risk associated with various exposure pathways, is presented in the HHRA and BERA reports, which can be found in the administrative record for this Site. The response action selected in this ROD is necessary to protect public health and the environment from actual or threatened releases of hazardous substances to the environment.

REMEDIAL ACTION OBJECTIVES:

Remedial Action Objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as Applicable and Relevant or Appropriate Requirements (ARARs) and risk-based levels established in the risk assessment.

The Site is a former industrial property in the midst of other industrial properties that have been subject to separate remedial actions. Thus EPA considered remedies that manage waste in place (a "waste management area") consistent with remedies at neighboring properties.

The RAOs are:

- Reduce or eliminate potential current and future unacceptable risks to human and ecological receptors resulting from ingestion and dermal contact with soils and groundwater.

- Reduce or eliminate potential current and future unacceptable risks to human receptors resulting from inhalation of mercury vapors emanating from soils and marsh deposits

- Reduce or eliminate migration of soil contamination to groundwater or surface water.

- Prevent or minimize migration of contaminated groundwater, and, to the extent practicable, remediate to applicable standards outside the waste management area.

- Reduce or eliminate unacceptable risks to human and ecological health as a result of ingestion or dermal contact with Site sediments.

- Reduce or eliminate human exposure to contaminated building materials and physical hazards that may result in potentially unacceptable risk.

The cleanup levels for the Site's soil (Table 7) including for mercury (65 mg/kg) and other COCs (other than naphthalene), are based on the New Jersey Soil Remediation Standard for direct contact to non-residential soils. For naphthalene, a risk-based cleanup goal has been developed.

EPA has concluded that soil containing visually observable elemental mercury is considered principal threat waste (PTW). The Arthur Kill has numerous sources of mercury contamination; the mercury contamination in the Arthur Kill near the LCP Site does not appear to be distinguishable from the levels found throughout the Arthur Kill/Newark Bay complex. Since any areas of remediated Site sediments in the South Branch Creek and Northern Off-Site Ditch are likely to be impacted by contaminated sediments in the Arthur Kill, the cleanup levels for the sediments will be set at levels consistent with those found in the Arthur Kill.

For groundwater, the cleanup goal for the overburden zone is the New Jersey Groundwater Quality Standard for Class IIA groundwater. The bedrock zone has been classified Class III-B, which requires the development of state approved site specific criteria. The cleanup levels for the COCs in the bedrock aquifer will be the New Jersey Surface Water Standards for saline waters. Should the State proceed with developing criteria for this Class III-B aquifer, EPA will assess the remedy at that time to ensure protectiveness.

DESCRIPTION OF ALTERNATIVES:

Section 121 (b)(1) of CERCLA (42 U.S.C. 9621(b)(1))requires that each remedial alternative be protective of human health and the environment, be cost-effective, comply with other statutory laws, and utilize permanent solutions and alternative treatment technologies and resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility or volume of hazardous substances.

Potential applicable technologies were identified and screened using effectiveness, implementability and cost as the criteria, with the most emphasis on the effectiveness of the remedial action. Those technologies that passed the initial screening were then assembled into five remedial alternatives.

Except for the No Action alternative (Alterative 1), each remedial alternative would be coupled with institutional controls to limit the potential exposure of the public to the Site contaminants. Institutional controls are typically restrictions placed to minimize human exposure, while allowing continued monitoring. Institutional controls are generally used in conjunction with remedial technologies. Consistent with expectations set out in the Superfund regulations, none of the remedies rely exclusively on institutional controls to achieve protectiveness.

The time frames below for construction do not include the time for designing the remedy or the time to procure necessary contracts. Because all the alternatives result in contamination remaining on the Site above levels that would allow for unlimited use and unlimited exposure, a review will be conducted every five years (five-year reviews).

Alternative 1 - No Action

Total Capital Cost	$0
Operation and Maintenance	$0
Total Present Net Worth	$0
Timeframe	0 years

The No Action alternative was retained for comparison purposes as required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the regulation under which EPA implements the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). No remedial actions would be implemented as part of the No Action alternative. This alternative does not include institutional controls.

Alternative 2 - Partial Containment (Treatment Cap)

Total Capital Cost	$19.9 million
Operation and Maintenance	$ 1.1 million[1]
Total Present Net Worth	$21.0
Timeframe	2 Years

1 Operation and maintenance costs for the remedial alternatives are presented as the 30-year present worth of this work.

An impermeable cap would be installed over virtually the entire Site to both prevent direct contact with contaminated soils, prevent overland transport of contamination and to interrupt the potential for inhalation exposure to mercury vapor. The area under the cap, including the overburden layer of groundwater, would be considered the waste management area. The cap would incorporate a soil layer, and a three-inch thick treatment layer of sulfur placed under an impermeable geosynthetic membrane. The geosynthetic membrane (and the sulfur layer for mercury) would serve to prevent vaporization of mercury (and other contaminants) as well as prevent rainwater infiltration into the underlying groundwater.

Since the sediments would likely be recontaminated by sediments from the Arthur Kill, source reduction would be the focus of the sediment remedy. The cleanup level for the South Branch Creek and Northern Off-Site Ditch sediments would be set at levels consistent with Site COC concentrations found in the Arthur Kill sediments. Sediments with unacceptable levels of contaminants in the downstream portion of the South Branch Creek as well as in the Northern Off-Site Ditch would be excavated and placed in the upstream portion of the South Branch Creek. The upstream portion would then be placed under the cap. The downstream portion and the Northern Off-Site Ditch would be restored with clean sediment, and the adjacent wetlands reconstructed. In addition, wetlands mitigation would be implemented at another location for the area that has been lost under the cap.

The buildings on Site would be demolished in a controlled manner. Steel and other non-porous material would be segregated, decontaminated and recycled. Porous material that has visible signs of contamination would be treated with sulfur. The debris would be processed to reduce its size before being placed under the cap.

Alternative 2 would also include collection of groundwater from the overburden aquifer layer. A shallow system would be installed along the limits of the cap. The collected groundwater would be either piped to the adjacent GAF site for treatment, or sent to the local publicly owned treatment works for appropriate treatment and disposal. Groundwater monitoring would be performed in the overburden aquifer to confirm that there is an inward gradient to the Site and in the bedrock aquifer to confirm that the deeper groundwater is not being impacted by the LCP Site, and continues to be captured by the GAF wells.

This remedy would require air monitoring during building demolition and work where the soil or sediments are disturbed. In addition, this remedy would include institutional controls (e.g., a CEA and a deed notice) to prevent exposure to contaminated groundwater and to restrict the property to industrial or commercial use. A long-term monitoring program would be developed to ensure the continued protectiveness of the remedy and also to assess potential migration and natural degradation of the contaminated groundwater.

Alternative 3 Full Containment (Treatment Cap and Barrier Wall)

Total Capital Cost	$23.8 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$24.9 million
Timeframe	3 years

The Alternative 3 remedy for soils is the same as Alternative 2, except it includes a barrier wall, such as sheet piling, to further limit the potential for lateral migration of contaminants off-Site. The low permeability barrier wall would be installed along the limits of the soil cap and tied into the top of the glacial till layer (approximately 15 feet below ground surface (bgs)).

Like Alternative 2, Alternative 3 would include collection of groundwater from the overburden aquifer layer. However, for Alternative 3, the shallow collection system would be installed along the interior limits of the barrier wall. The system would likely consist of a collection pipe with pump stations as needed. Groundwater monitoring would be performed as described in Alternative 2.

Alternative 3 includes the same remedial components for sediments and building materials as Alternative 2, including institutional controls and long-term monitoring.

Alternative 4a and 4b - Full Containment and Partial/Full Depth PTW Stabilization

Alternative 4a

Total Capital Cost	$33.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$34.3 million
Timeframe	4 years

Alternative 4b

Total Capital Cost	$35.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$36.3 million
Timeframe	4 years

Alternative 4a and 4b contains all the components of Alternative 3. Alternatives 4a and 4b also include treatment of the PTW soils through stabilization. Stabilization would be accomplished by in-situ mixing of sulfur with PTW soil through the use of specialized mixing equipment (e.g., augers). The amount of sulfur per volume of soil will be determined during the pre-design studies. Also, specific measures of success will be developed during the design phase. The measures of success would be used to determine if the full scale stabilization remedy was effective at converting the elemental mercury to mercuric sulfide.

The primary goal of stabilization would be to convert the elemental mercury to mercuric sulfide. Mercuric sulfide (i.e., cinnabar) is insoluble, does not generate vapors and is a solid at ambient temperatures. Two approaches were analyzed for this alternative, Alternative 4b is treatment to the full depth of the PTW area (up to 17 feet bgs) and Alternative 4a includes treatment of only the shallower soils (up to 6 feet bgs). The shallower soils contain the majority (more than 80 percent) of the elemental mercury.

Alternative 5 - Full Containment and Partial/Full Depth PTW Excavation and Off-Site Disposal

Alternative 5a

Total Capital Cost	$84.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$85.3 million
Timeframe	3 years

Alternative 5b

Total Capital Cost	$96.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$97.3 million
Timeframe	3 years

Alternative 5 (i.e., 5a and 5b) contains all the components of Alternative 3. Alternative 5 also includes removal and off-site

disposal of the PTW, and some of the contaminated building debris. Post excavation sampling would be performed. Similar to Alternative 4, two approaches were considered, removal to the full depth of the PTW area (up to 17 feet bgs (5b)) and removal of only the shallower (up to 6 feet bgs (5a)) soils.

COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy, EPA considered the factors set out in CERCLA §121, 42 U.S.C. §9621, by conducting a detailed analysis of the viable remedial response measures pursuant to the NCP, 40 CFR §300.430(e)(9) and OSWER Directive 9355.3-01. The detailed analysis consisted of an assessment of the individual response measure against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each response measure against the criteria.

Threshold Criteria *- The first two criteria are known as "threshold criteria" because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.*

---

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 would not provide protection of human health or the environment, since uncontained contamination would persist in the soils, sediments, groundwater and building material. Potential and existing routes of exposure to humans and animals would be unrestricted. Also, there would be no mechanism to monitor the migration of the contamination.

Alternatives 2 through 5 would provide protection of human health and the environment by preventing exposure to contaminated media through installation of an impermeable cap. Alternatives 2 through 5 would also provide protection of human health through implementation of institutional controls to interrupt potential future exposure. The barrier wall included

in Alternatives 3 through 5 would further limit the potential for lateral migration of groundwater contamination.

2. Compliance with applicable or relevant and appropriate requirements (ARARs)

Section 121(d) of CERCLA and NCP '300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy would meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

Concentrations of contaminants exist at levels above the applicable groundwater and soil standards (e.g., the New Jersey Groundwater Quality Standards and the New Jersey Soil Remediation Standards). Except for Alternative 1, all alternatives would address the contaminated soil through containment and address the overburden groundwater through capture, containment and treatment. All alternatives except

Alternative 1 would comply with location and action-specific ARARs.

A list of ARARs can be found in Table 8.

Primary Balancing Criteria *- The next five criteria, criteria 3 through 7, are known as Aprimary balancing criteria@. These criteria are factors with which tradeoffs between response measures are assessed so that the best option will be chosen, given site-specific data and conditions.*

---

3. Long-term effectiveness and permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Alternative 1 would not be effective or permanent, since the contaminants would not be monitored and there would be no mechanism to prevent future exposure. In general, the relative degrees of effectiveness and permanence associated with Alternatives 2, 3, 4a and 4b, and 5a and 5b are comparable; however, Alternatives 4a and 4b would provide an additional component of protection by further reducing the potential mercury vapor pathway through the conversion of the PTW elemental mercury to mercuric sulfide. EPA expects that conversion will be permanent. Similarly, Alternatives 5a and 5b would provide additional protection over Alternatives 2 and 3 by removing the area of PTW.

4. Reduction of toxicity, mobility, or volume

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternative 1 would not reduce the toxicity, mobility and volume (TMV) through treatment as no active treatment occurs. All the action alternatives would reduce the mobility of the contamination through containment, as well as potentially reducing some of the toxicity and mobility through conversion of

elemental mercury at the cap's "treatment layer." Alternatives 3, 4a and 4b and 5a and 5b afford additional reduction of mobility through the use of a barrier wall.

Alternatives 4a and 4b would best meet this criterion by reducing the toxicity and mobility of the mercury through treatment of the visible mercury to convert it to mercuric sulfide. Mercuric sulfide is less toxic, less soluble and less volatile than elemental mercury.

Alternatives 5a and 5b would reduce the mobility, but not toxicity and volume of elemental mercury at the Site through removal and disposal rather than treatment.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

For Alternative 1, protection of the community and workers during remedial activities would not be applicable as no remedial action is occurring.

Alternatives 2, 3 and 5a and 5b would have approximately the same construction period of about two to three years. Alternative 4a and 4b would have the longest construction period (three to four years) due to the time required to perform in-situ mixing, as well as to perform the necessary pilot studies.

All the action alternatives would result in a temporary increase in short-term mercury vapor emissions over baseline conditions. Alternative 5a and 5b would have the largest increase in emissions during the implementation (estimated at between 101 and 197 pounds). In addition, Alternative 5a and 5b would require between 1,000 and 2,000 trucks to first remove the PTW soil and debris, and then to bring in substrate to backfill the excavated areas. Thus, Alternative 5a and 5b is the only option that would significantly increase the truck traffic through the local community.

During the remedial work, Alternative 4a and 4b would have the smallest increase in mercury vapor emissions (0.5 to 0.8 pounds released) because of the widespread use of a sulfur compound.

Vapor emissions could impact on-site construction workers and the local community. Alternatives 2 and 3 would have an increase of an estimated 7.7 pounds.

Health and Safety Plans, which would include air monitoring, engineering controls and appropriate worker personal protective equipment (PPE), would be used to protect the community and workers for Alternatives 2 through 5.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All the action alternatives are implementable with conventional materials and equipment. Alternatives 2 and 3 would be the easiest to implement.

Alternative 4a and 4b would require specialized equipment to mix the soil, as well as methods to address subsurface obstructions. Alternative 4b would be more difficult to implement due to the greater depth and the associated subsurface obstacles.

Alternative 5a and 5b would require disposal of elemental mercury wastes. Currently a single facility, located in Canada, has been identified that can accept this waste stream. Some uncertainty still exists on whether the facility can handle the mass from this Site.

In addition, the Mercury Export Ban Act (MEBA) may place further constraints on how this waste stream can be handled. Signed into law in 2008, MEBA is intended to prevent elemental mercury originating in the United States from reaching foreign markets. In this case, MEBA would also ban elemental mercury recovered from Site soils or sediments from being reused or sold even domestically.

7. Cost

Includes estimated capital and O&M costs, and net present worth value of capital and O&M costs.

Each action alternative includes long-term operation and

maintenance. Therefore, a seven percent discount rate was used to derive each alternative's present net worth cost.

Alternative 1 incurs no cost but provides no protection to human health. Except for Alternative 1, Alternative 2 is the least expensive of the alternatives. Alternatives 5a and 5b are the most expensive alternatives. Alternative 4a and 4b are relatively close in price to Alternatives 2 and 3. The level of operation and maintenance required was similar for each active remedial alternative, so this long-term management cost was not an important factor for comparing casts at the Site.

Modifying Criteria - The final two evaluation criteria, criteria 8 and 9, are called "modifying criteria" because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.

---

8. State acceptance

Indicates whether based on its review of the RI/FS reports and the Proposed Plan, the state supports, opposes, and/or has identified any reservations with the selected response measure.

The NJDEP concurs with the components of the selected remedy. However, NJDEP does not concur with the contingency remedies for treating elemental mercury as discussed further below. NJDEP believes the contingency remedy should be excavation and off-site removal of the PTW. In addition, NJDEP believes that the existing data on contamination in Arthur Kill sediments is insufficient to determine cleanup levels for the Northern Off-Site Ditch and South Branch Creek sediments.

9. Community acceptance

Summarizes the public's general response to the response measures described in the Proposed Plan and the RI/FS reports. This assessment includes determining which of the response measures the community supports, opposes, and/or has reservations about.

EPA solicited input from the community on the remedial response measures proposed for the Site. Verbal comments were recorded

from attendees of the public meeting. Several written comments were received.

Generally, the comments received during the public meeting did not express any particular concerns regarding the preferred alternative. A number of commenters were concerned that if a large storm surge were to occur during the remedial action, their homes could be exposed to Site contaminants entrained within the tidal waters. Some of the written comments expressed preference for removal and disposal of the PTW soils (Alternative 5a or 5b).

In Appendix V, the Responsiveness Summary addresses all comments received; it also includes copies of the written comments and a transcript from the public meeting.

PRINCIPAL THREAT WASTE

Principal threat wastes are considered source materials, i.e., materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. The Superfund Law requires that treatment of PTW be considered wherever practicable.

At the LCP Site, soil containing visible mercury is a PTW and will be treated through the implementation of the selected remedy.

SELECTED REMEDY

Based upon consideration of the results of the investigations, the requirements of CERCLA, the detailed analysis of the remedial alternatives and public comments, EPA has determined that Alternative 4b is the appropriate remedy for the Site. This remedy best satisfies the requirements of CERCLA Section 121 and the NCP's nine evaluation criteria for remedial alternatives, 40 CFR §300.430(e)(9).

The major components of the selected remedy include:

- Installation of a capping system to prevent direct contact with soils and exposure to mercury vapor;

- Treatment of the soil containing visible elemental mercury by mixing it with sulfur to convert the mercury to mercuric

sulfide;

- Excavation and on-Site disposal of sediments and marsh soils from the Northern Off-Site Ditch and the downstream portion of the South Branch Creek;

- Restoration of the excavated areas;

- Controlled demolition of the Site's buildings, recycling of non-porous material and placement of porous material under the cap;

- Containment and collection of the overburden groundwater layer by a barrier wall and collection collection/disposal system;

- Groundwater monitoring; and

- Implementation of institutional controls in the form of a deed notice and a CEA.

A capping system will be installed to both prevent direct contact with soils on a Site-wide basis and to interrupt the potential for inhalation exposure to mercury vapor (Figure 12). The cap will incorporate a soil layer, and a three-inch thick treatment layer of sulfur placed under an impermeable geosynthetic membrane. The treatment layer will be placed over areas of mercury-contaminated soil that are not otherwise treated.

The geosynthetic membrane will serve to prevent vaporization of mercury (and other contaminants) as well to prevent rainwater infiltration into the underlying groundwater. A low permeability barrier wall will be installed along the limits of the soil cap and tied into the top of the glacial till layer (about 15 feet deep). Areas with PTW will be treated by mixing the contaminated soil with sulfur to convert the elemental mercury to mercuric sulfide to a depth of approximately 15 feet. A pilot study, with clearly defined treatment goals, will be performed prior to full implementation of the remedy.

Sediments with unacceptable levels of contamination in the Northern Off-Site Ditch and in the downstream portion of the South Branch Creek will be excavated and placed under the cap. The excavated sediment areas and the adjacent wetlands would be

reconstructed. In addition, wetlands mitigation will be implemented at another location for the area that has been lost under the cap. During the design phase, EPA will determine cleanup levels for the sediments that are consistent with existing levels in the Arthur Kill.

The buildings on Site will be demolished in a controlled manner. Steel and other non-porous material will be segregated, decontaminated and recycled. Porous material that has visible signs of mercury contamination will be treated with sulfur. The debris will be processed to reduce its size then placed under the cap. Air monitoring will be required during building demolitions, and also during other activities where the soil or sediments are disturbed.

Aside from the containment afforded by the barrier wall, the selected remedy will include collection of groundwater from the overburden layer. A shallow system would be installed along the interior limits of the barrier wall. The system would likely consist of a shallow collection pipe with pump stations as needed. The collected groundwater will be either piped to an adjacent site for treatment, or sent to the local POTW. Groundwater monitoring of the overburden aquifer will be performed to ensure that there is an inward gradient to the Site. After the cap is installed, EPA expects the overburden area under the cap to dewater in less than 10 years. Groundwater monitoring in the overburden aquifer and in the bedrock aquifer will be performed to confirm that the contamination is being contained in the waste management unit. In addition, monitoring will determine whether the neighboring GAF site remedy continues to capture the bedrock groundwater underlying the LCP Site.

While the financial costs of the selected alternative are relatively high, the costs are due to the many components and complex nature of this single operable unit. The cost of this remedy is significantly lower than the excavation/off-site removal alternative, so it is the more cost effective of the two alternatives that specifically address the PTW.

The selected remedy will prevent human and ecological exposure to Site contaminants in the soil, sediments, groundwater and building material. In addition, the selected remedy's cap will allow for future commercial use of the property. As contamination above acceptable risk levels will remain on the Site, five-year reviews will be performed.

The remedy was selected over other alternatives principally because it is expected to achieve substantial and long-term risk reduction through treatment of the PTW, as well as containment.

Based on information currently available, EPA believes the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the selected remedy will satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

Consistent with EPA Region 2's Clean and Green policy, EPA will evaluate the use of sustainable technologies and practices with respect to implementation of the selected remedy.

EPA recognizes that the selected remedy includes a treatment approach for PTW that is innovative; therefore, EPA is also identifying two contingency remedies in case the selected remedy does not meet the measures of success, which will be developed during the pre-design studies.

CONTINGENCY REMEDIES

If, after reviewing the pilot study results, EPA determines that treating the PTW to full depth is not technically practicable, EPA will use the first contingency remedy. The first contingency would be Alternative 4a, treatment of the PTW to mid-depth. If EPA determines that the treatment of the PTW waste is not meeting pre-set goals at any depth, then EPA will use the second contingency remedy, Alternative 3. Alternative 3 is the same as the preferred alternative, except without treatment of the PTW.

If EPA chooses to implement one of the contingency remedies, EPA will issue a decision document to record this change in the remedial approach.

Green Remediation Considerations

Green remediation practices can be incorporated into the selected remedy's planning and implementation of pre-design investigation and remediation as follows:

- Minimize number of field mobilizations
- Use local labor to reduce fuel consumption associated with driving to the Site
- Use ultra-low sulfur diesel or fuel-grade biodiesel as fuel for construction vehicles
- Schedule shipments of sulfur and clean fill to minimize the uses of fuel
- Dispose of steel at recycling facility if possible
- Use non-phosphate detergents for decontamination
- Use direct push technology, if feasible, for soil sampling to minimize waste production (drill cuttings) and the uses of fuel
- Schedule sampling to minimize shipping

STATUTORY DETERMINATIONS

As was previously noted, CERCLA §121(b)(1) mandates that a remedial action must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ treatment to permanently and significantly reduce the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants at a site. CERCLA §121(d) further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4).

Protection of Human Health and the Environment

The selected remedy, Alternative 4b, will be protective of human health and the environment through the containment of certain Site contamination. The planned capping system will prevent direct contact with contaminated soils thereby eliminating the risk posed by dermal contact and ingestion. The cap will also significantly reduce the potential for inhalation exposure to mercury vapor.

An impermeable geosynthetic membrane will be incorporated in the cap and will further prevent vaporization of mercury (and other contaminants) as well preventing rainwater infiltration into the underlying groundwater. A barrier wall will further enhance the containment afforded by the impermeable cap.

Sediments with unacceptable levels of contamination in the Northern Off-Site Ditch and in the downstream portion of the South Branch Creek will be excavated and placed under the cap thereby further reducing ecologic risk.

The selected remedy also will be protective of human health and the environment through the treatment of principal threat waste and overburden groundwater.

Areas with principal threat waste will be treated by mixing the contaminated soil with sulfur to convert the elemental mercury to mercuric sulfide to a depth of approximately 15 feet.

Long-term monitoring of the containment remedy and enforcement of institutional controls will ensure that remaining wastes will not impact human health and the environment through direct contact or impact to groundwater.

The selected remedy will provide adequate long-term control of risks to human health and the environment through treatment, capping, institutional controls and long-term monitoring. The selected remedy presents the fewest short-term risks of all action alternatives.

Compliance with ARARs

The selected remedy will comply with ARARs.

A list of ARARs can be found in Appendix Table 8 of this document.

Cost Effectiveness

EPA has determined that the selected remedy is cost-effective and represents a reasonable value. In making this determination, the following definition was used: A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 C.F.R. §300.430(f)(1)(ii)(D)).

EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (*i.e.*, were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness).

Overall effectiveness was then compared to costs to determine cost-effectiveness.

The cost of implementing the selected remedy, Alternative 4b, is approximately $11.4 million more than the cost of implementing Alternative 3. The increased cost of Alternative 4b is related largely to the in-situ stabilization of the elemental mercury. This aspect of the selected remedy greatly increases the long-term effectiveness and permanence of the remedy in that the sulfur treatment ensures the reduction of the risk of exposure to the most dangerous levels of mercury even in the event of a failure of the containment system. The overall effectiveness secured by the additional cost of the selected remedy, over remedies that achieve protectiveness through containment only, was determined by EPA to be proportional to costs and hence the selected remedy represents a reasonable value for the money to be spent.

EPA evaluated Alternative 4b against Alternatives 5a and 5b for cost effectiveness. Alternatives 5a and 5b exceed the cost of the selected remedy by $49 million and $61 million, respectively. While excavation and off-site disposal of the PTW provides for long-term effectiveness and permanence in addressing Site risks, these remedies fall short of the goal of reducing toxicity, mobility and volume through treatment attained by Alternative 4b. Furthermore, the short-term negative impact of the excavation and off-site disposal is considerably greater than the negative impact which will be attributed to the treatment phase of the selected remedy.

EPA found that the additional benefits derived from the off-site disposal remedies do not justify the significant increased costs over the selected remedy and, therefore, EPA determined that the selected remedy is cost effective as it has been determined to provide the greatest overall protectiveness for its present worth costs.

Utilization of Permanent Solutions and Alternative Treatment Technologies

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs to the extent practicable, EPA has determined that the selected remedy provides the best balance

of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and State and community acceptance.

The selected remedy will provide adequate long-term control of risks to human health and the environment through containment of Site-related containments, treatment of the principal threat wastes, long-term monitoring and institutional controls. The selected remedy has the least short-term risks of the action alternatives. The selected remedy employs an innovative technology that could be applied at other sites having soils impacted with high levels of elemental mercury.

Preference for Treatment as a Principal Element

Through the use of sulfur to convert elemental mercury to mercuric sulfide, the selected remedy meets the statutory preference for the use of remedies that employ treatment that reduces toxicity, mobility or volume as a principal element to address the principal threats at the Site.

Five-Year Review Requirements

The selected remedy will result in contamination remaining above levels that allow for unlimited use and unrestricted exposure. Therefore, a statutory review will be conducted within five years of construction completion for the Site to ensure that the remedy is, or will be, protective of human health and the environment.

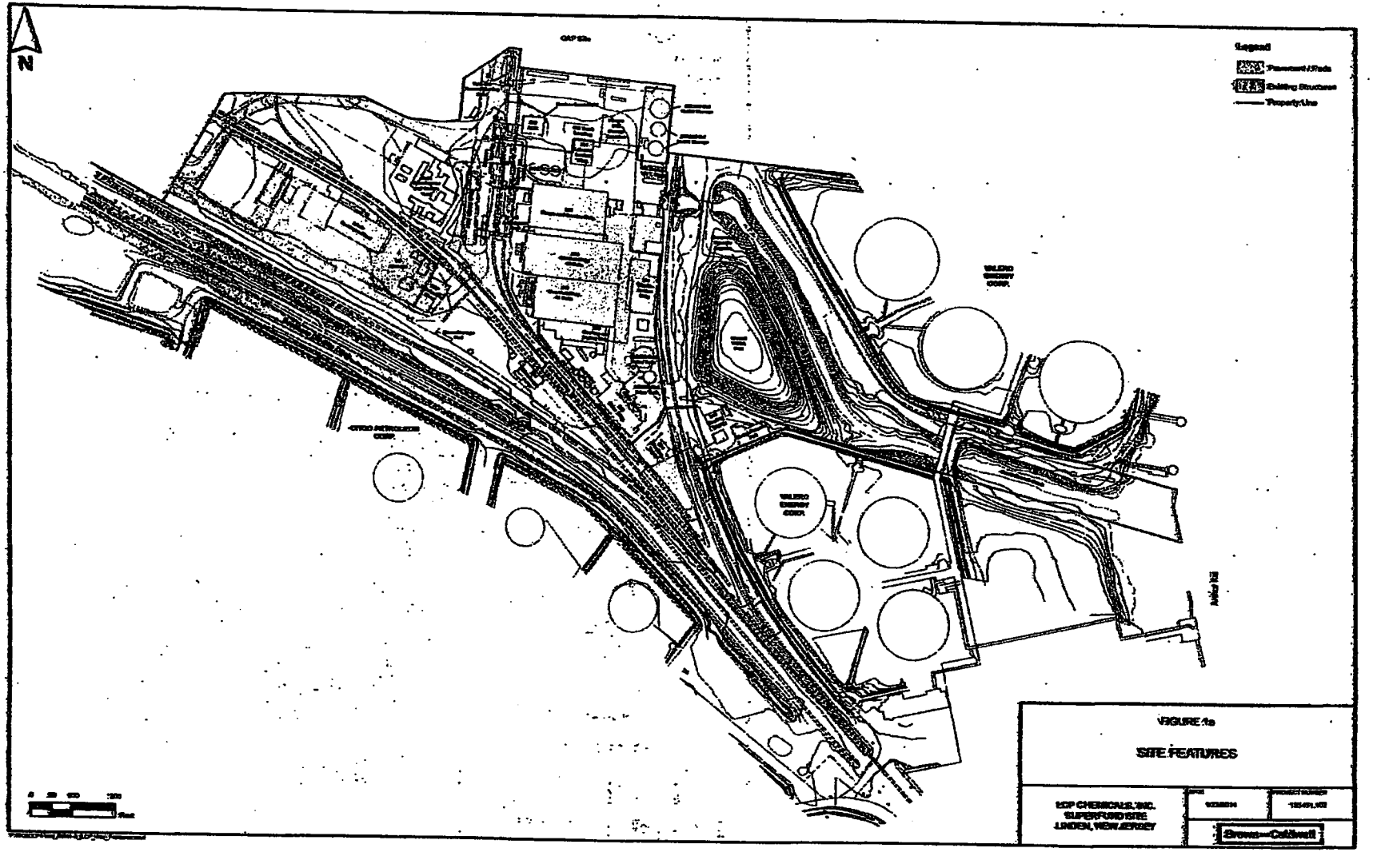
DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the LCP Site was released for public comment on August 21, 2013. An extension was requested by interested parties. On September 17, 2013, EPA granted an extension of the comment period. The comment period closed on October 21, 2013.

The Proposed Plan identified Alternative 4b (full containment and full depth PTW stabilization) as EPA's preferred alternative. EPA reviewed all written and verbal comments submitted during the public comment period. The comments received are documented in the Responsiveness Summary. EPA made no significant changes to the remedy as originally identified in the Proposed Plan.

APPENDIX 1

FIGURES


N
Legend
Property Line
Arthur Kill
FIGURE 1b
SITE FEATURES
KOP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
Brown—Caldwell

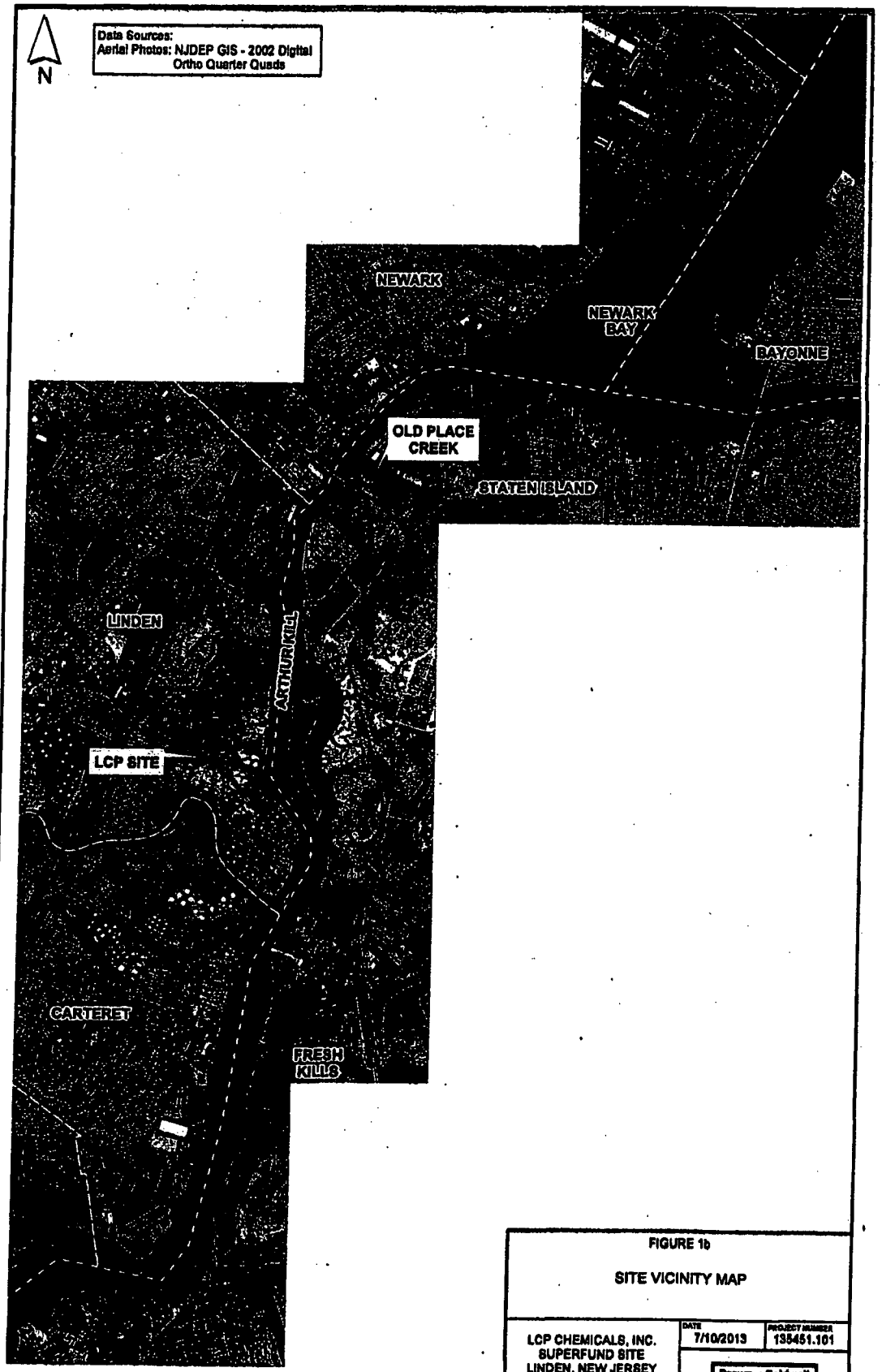


FIGURE 1b

SITE VICINITY MAP

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 7/10/2013	PROJECT NUMBER 135451.101
	Brown AND Caldwell	

P:\GIS\LCP\Final_RIR\1-2_LCP_Site_Vicinity.mxd

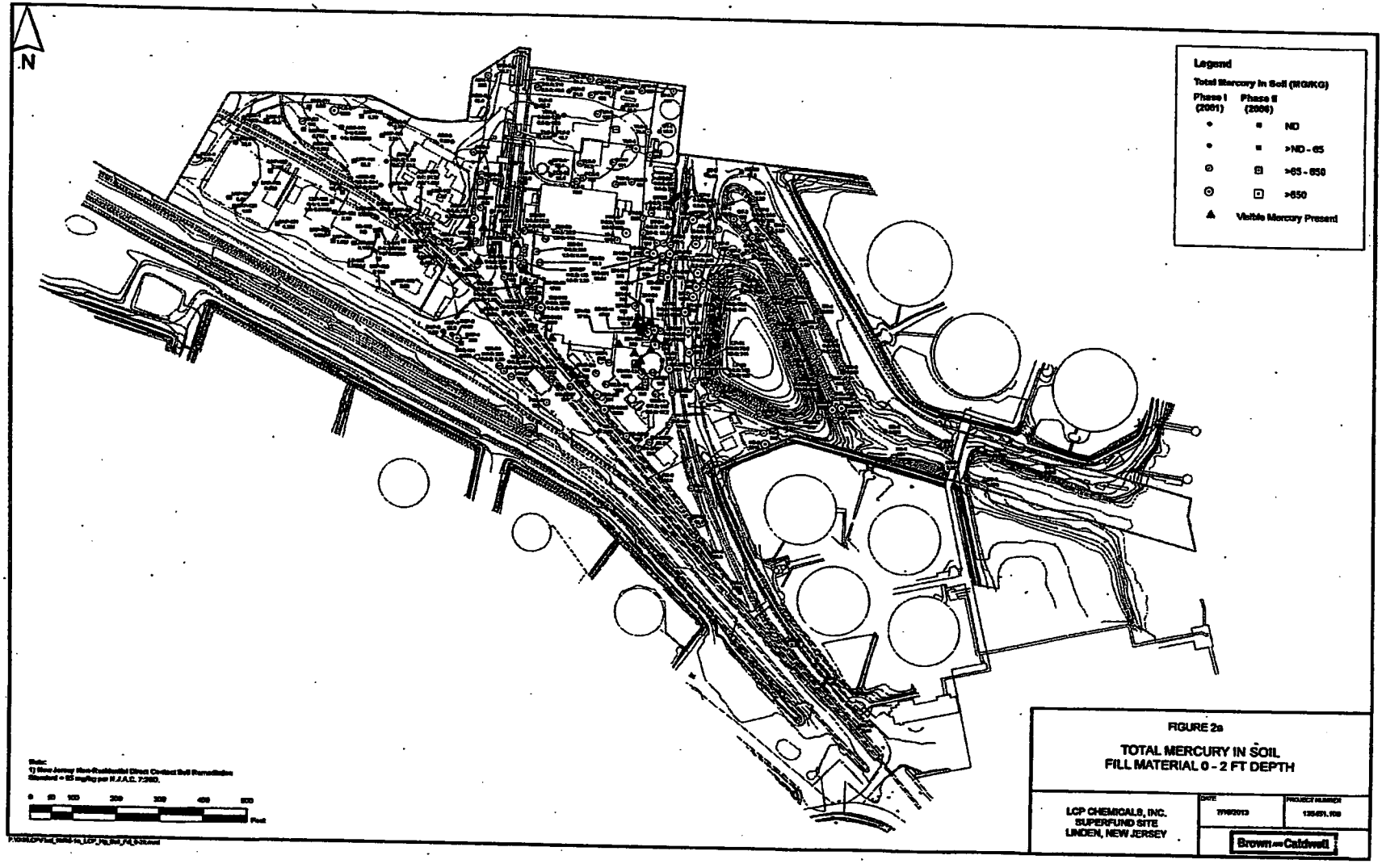


FIGURE 2a

TOTAL MERCURY IN SOIL
FILL MATERIAL 0 - 2 FT DEPTH

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 7/16/2013

PROJECT NUMBER 135451.109

Brown AND Caldwell

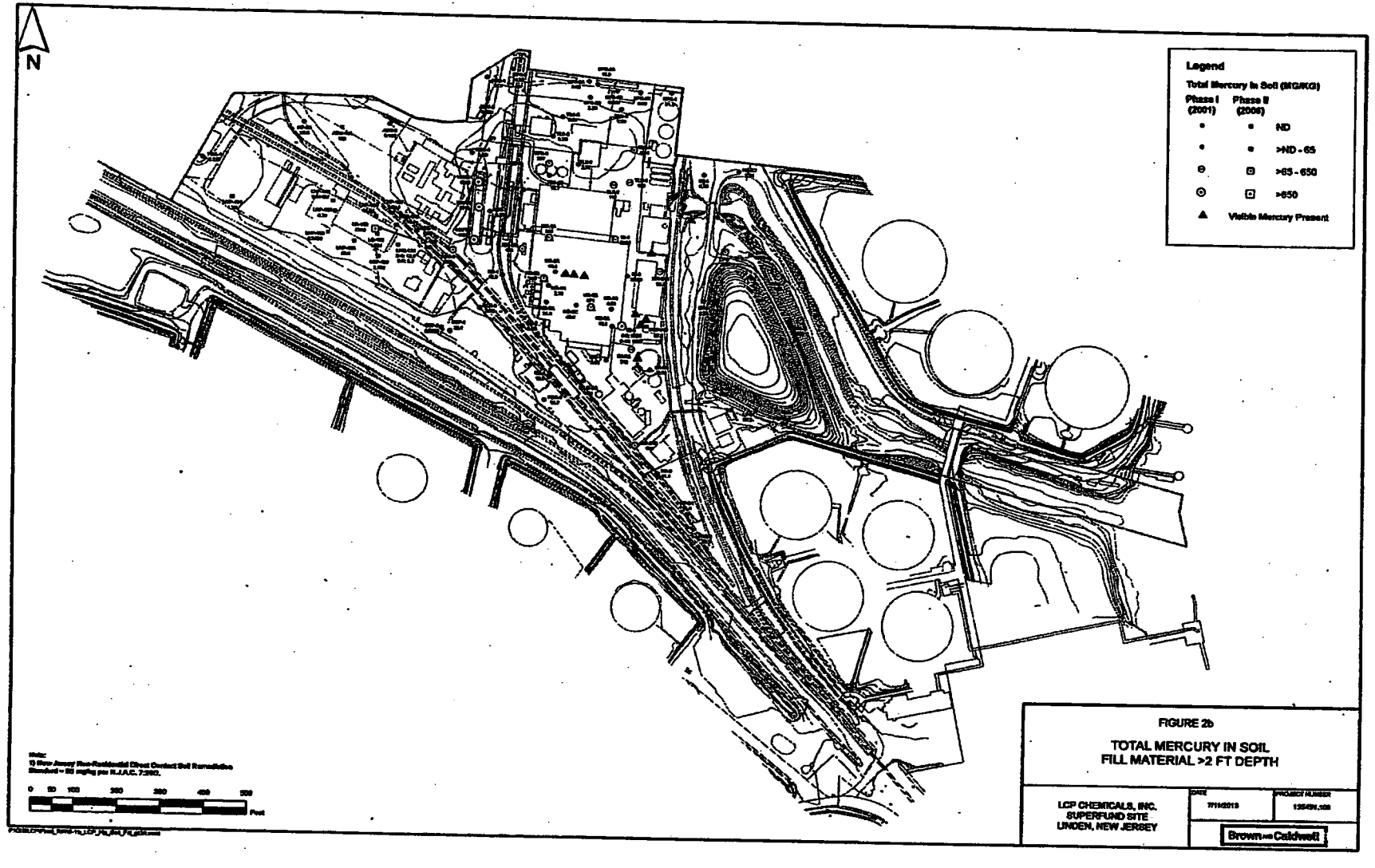


FIGURE 2b

TOTAL MERCURY IN SOIL
FILL MATERIAL >2 FT DEPTH

LCP CHEMICALS, INC.
SUPERFUND SITE
UNDEN, NEW JERSEY

DATE 7/11/2013

PROJECT NUMBER 135459.100

Brown AND Caldwell

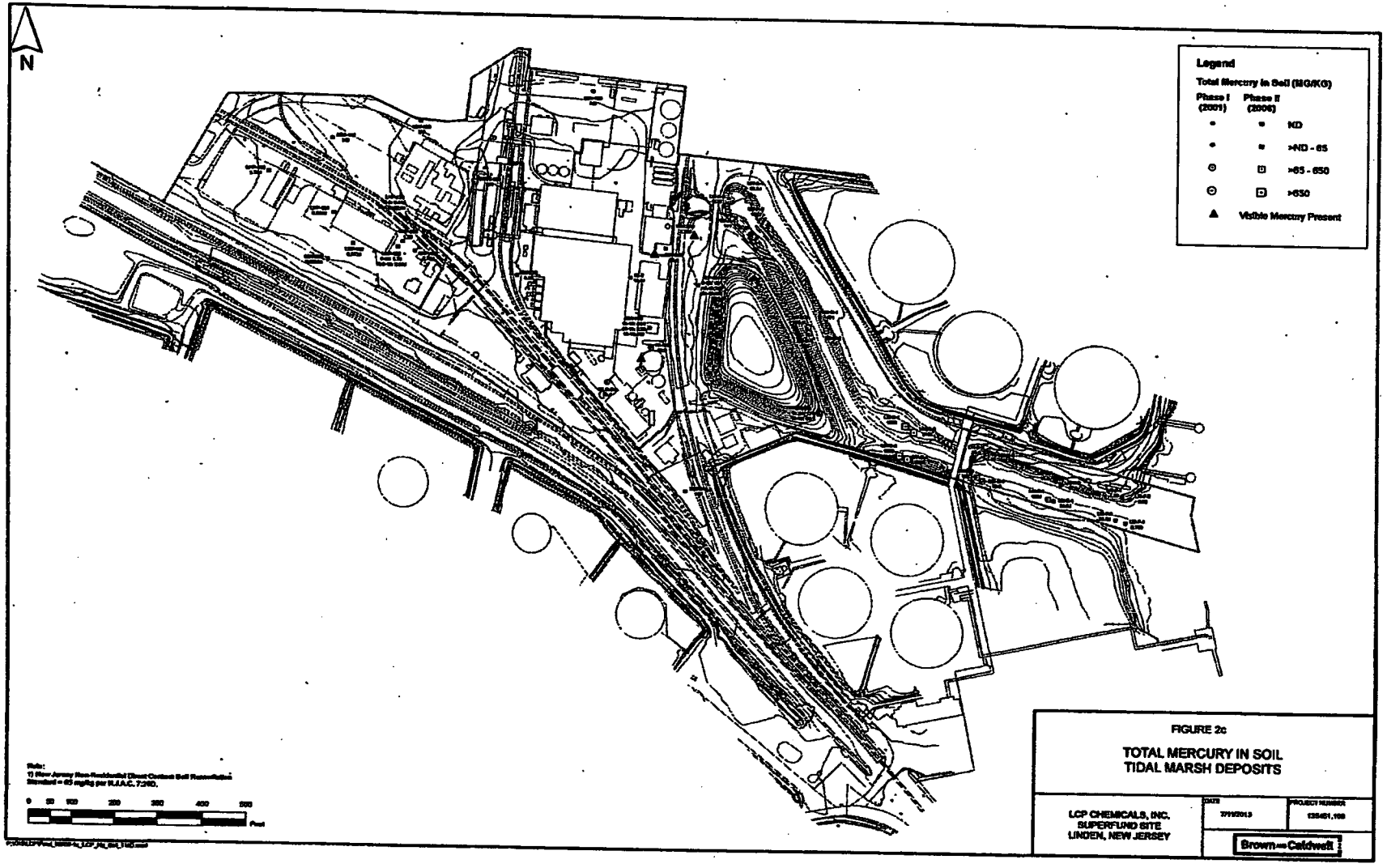


FIGURE 2c

TOTAL MERCURY IN SOIL
TIDAL MARSH DEPOSITS

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 7/11/2013

PROJECT NUMBER 135481.100

Brown AND Caldwell

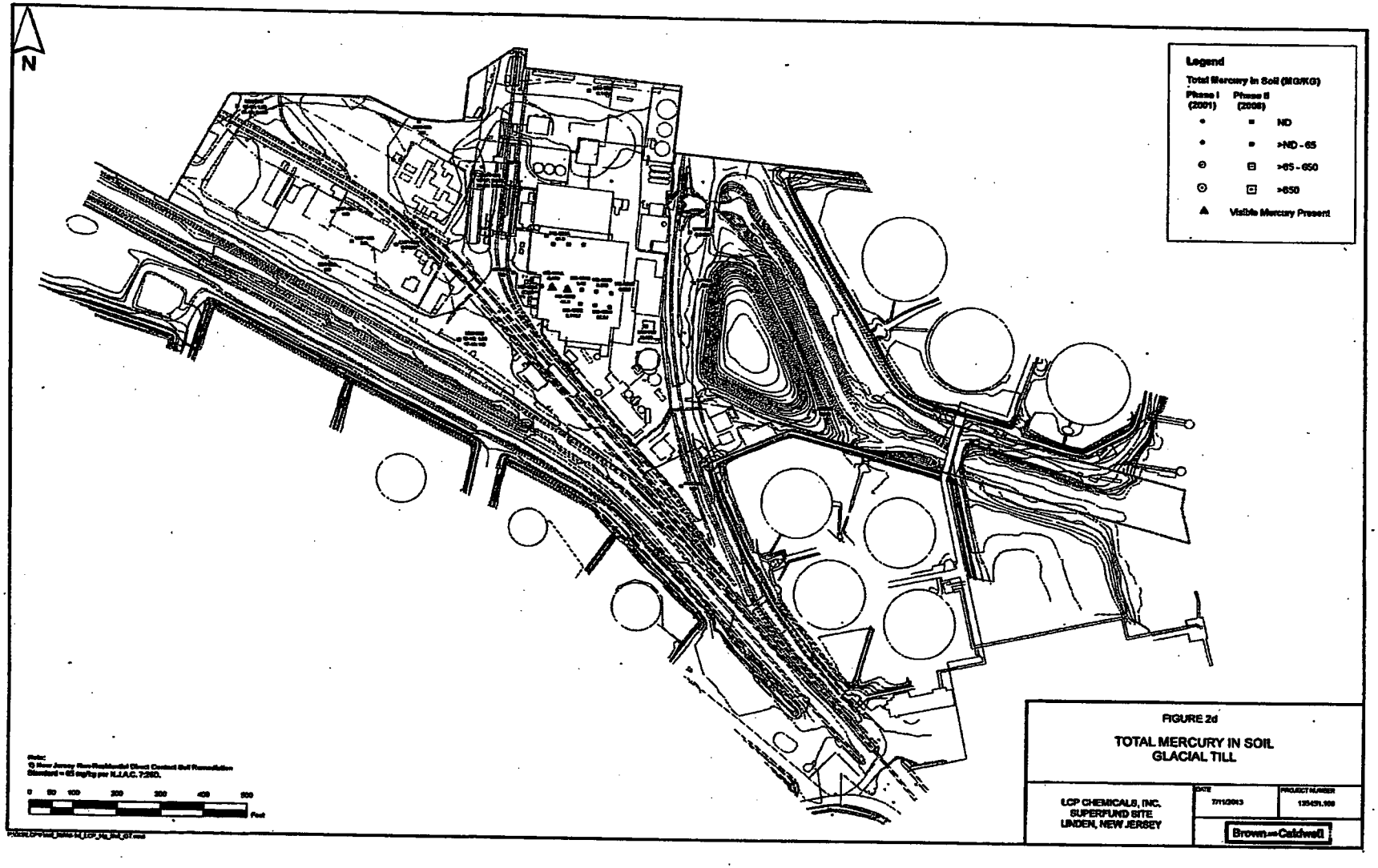


FIGURE 2d

TOTAL MERCURY IN SOIL
GLACIAL TILL

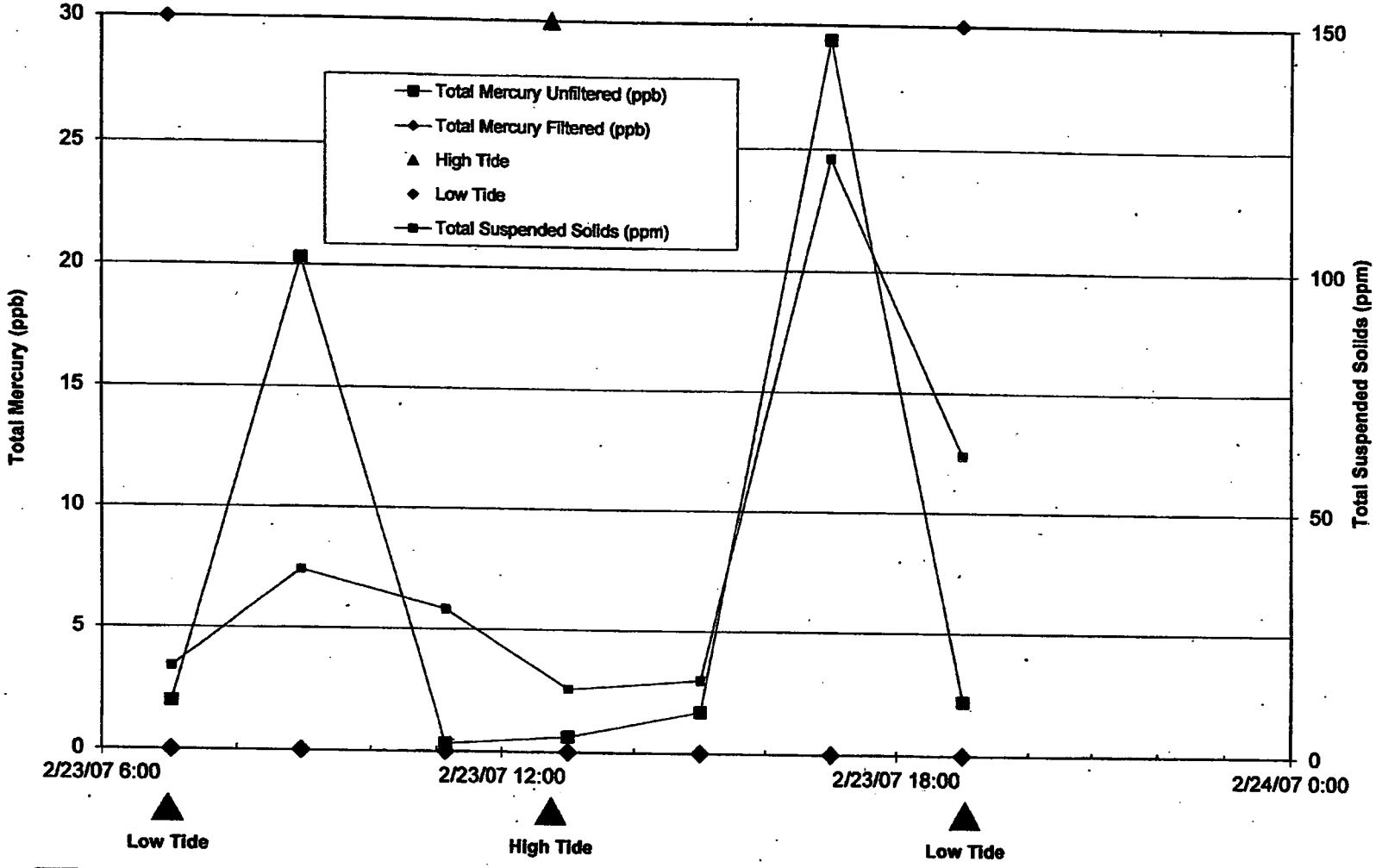
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 7/11/2013

PROJECT NUMBER 135451.100

Brown AND Caldwell

FIGURE 3
Relationship Between Tide and Mercury Concentration in Surface Water
LCP Chemicals Inc., Linden, New Jersey



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P:\LCP\137005(Final_RI_Report)\Final_RI\R_Document\Figures\Section_6\Source_Files\3_SW_Hg_Tide.xlsx\Chart - Lab Data
8/16/2013

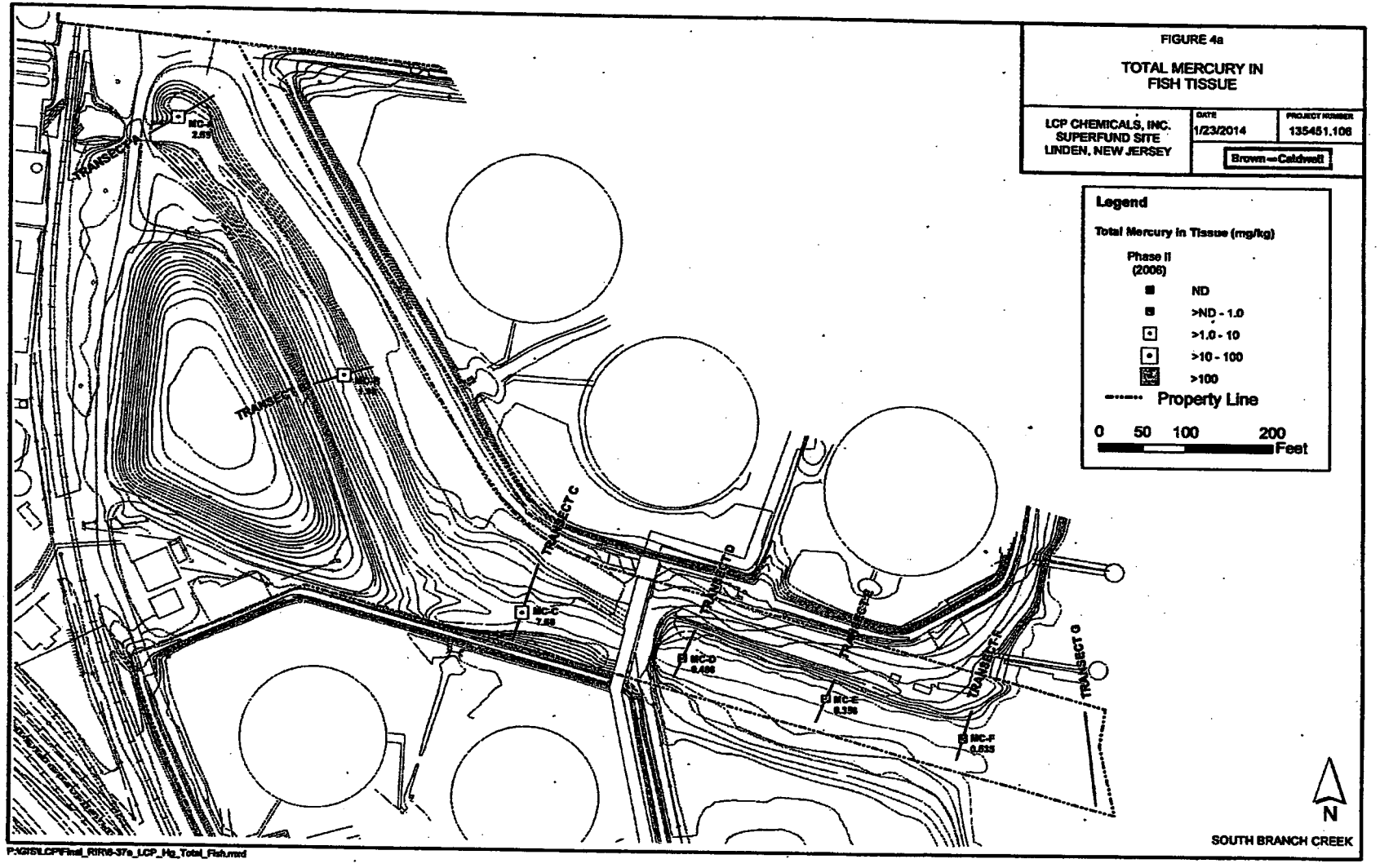
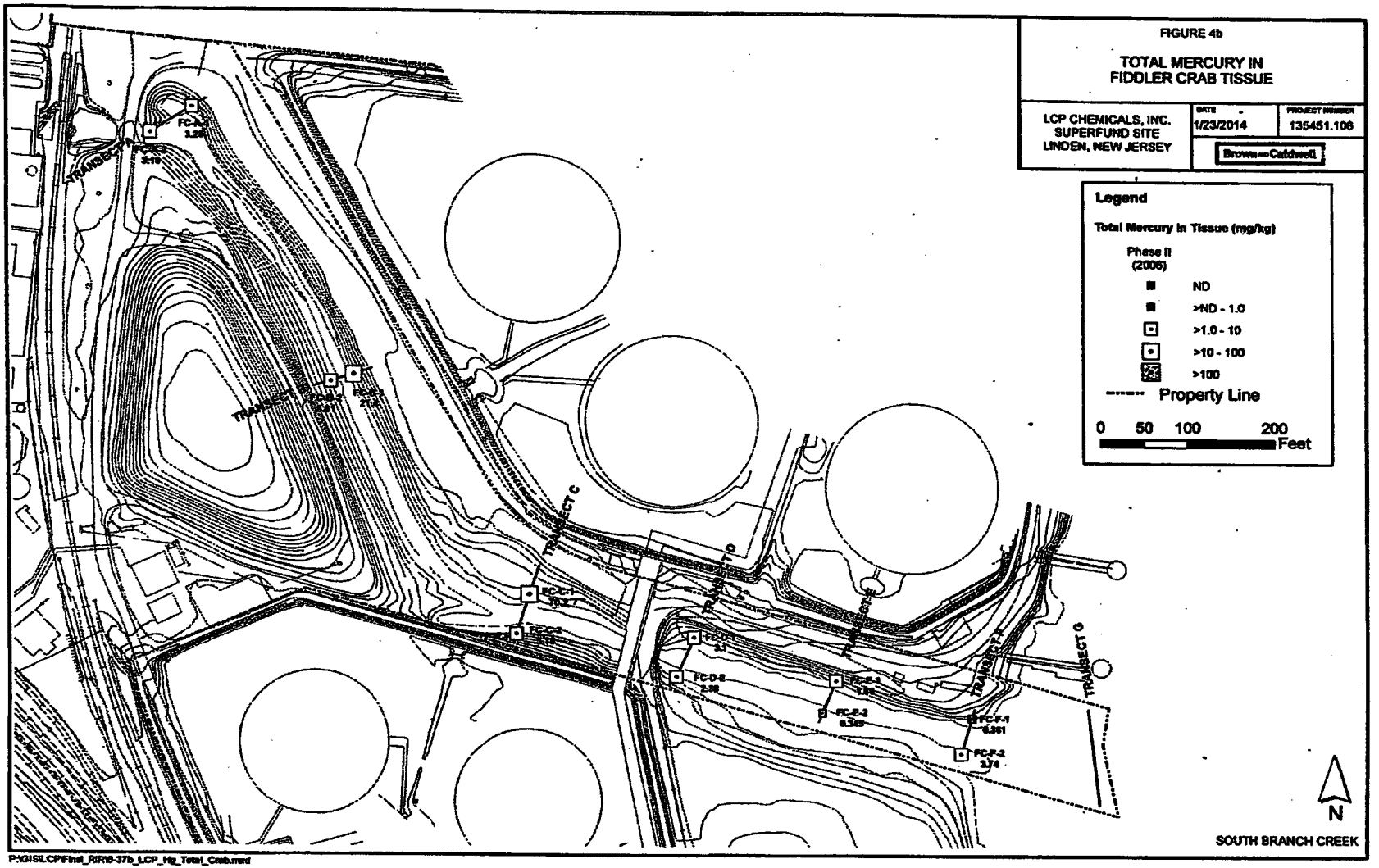
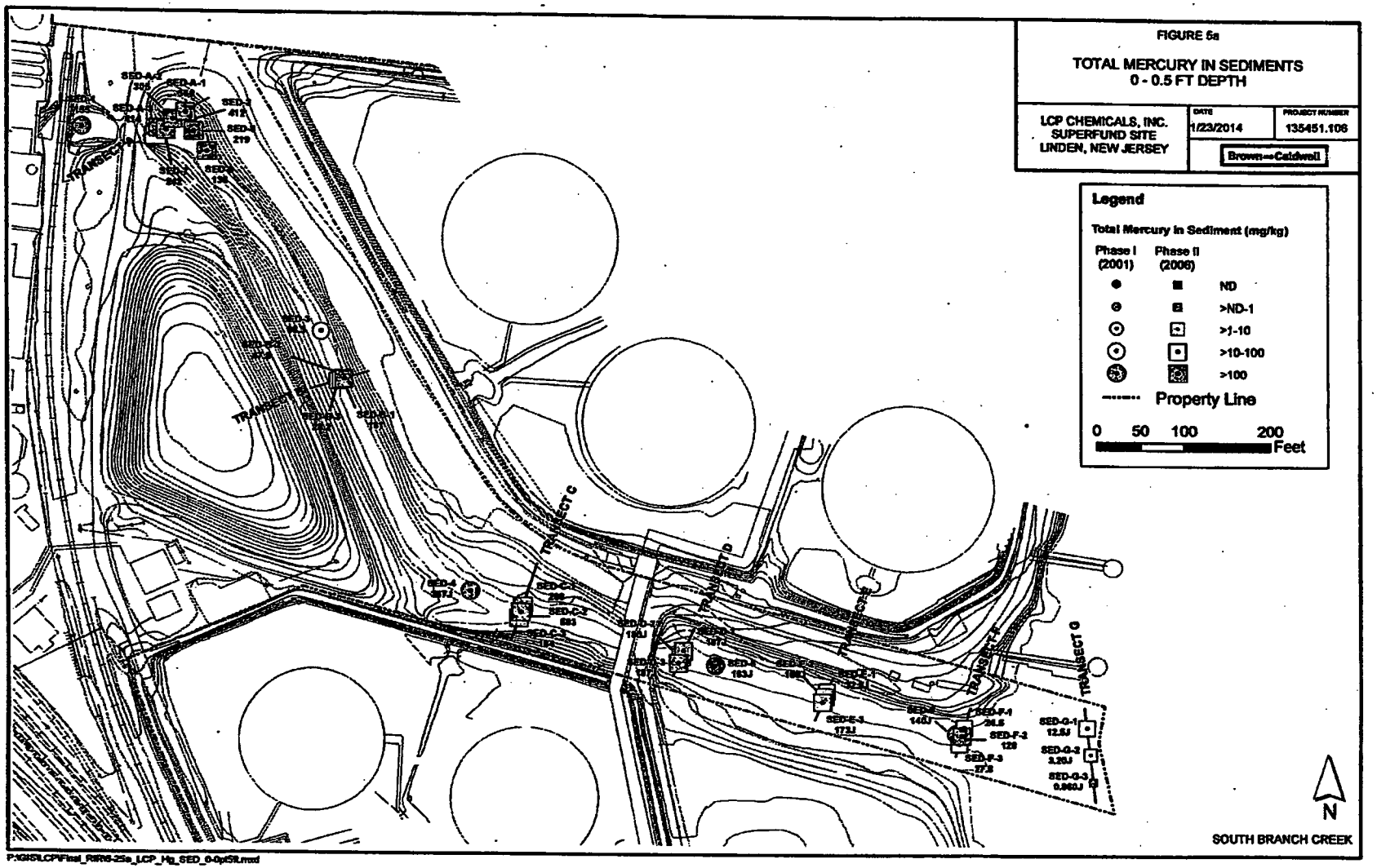


FIGURE 4a
TOTAL MERCURY IN FISH TISSUE
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown—Caldwell
Legend
Total Mercury in Tissue (mg/kg)
Phase II (2006)
ND
>ND - 1.0
>1.0 - 10
>10 - 100
>100
Property Line
0 50 100 200 Feet
N
SOUTH BRANCH CREEK
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
MC-A 2.69
MC-C 7.69
MC-D 0.496
MC-E 0.356
MC-F 0.535
P:\GIS\LCP\Final_RIR\6-37e_LCP_Hg_Total_Fish.mxd



P:\GIS\LCP\Final_RIR\6-37b_LCP_Hg_Total_Crab.mxd



P:\GIS\LCP\Final_RIR\5-25a_LCP_Hg_SED_0-0p5ft.mxd

R2-0062905

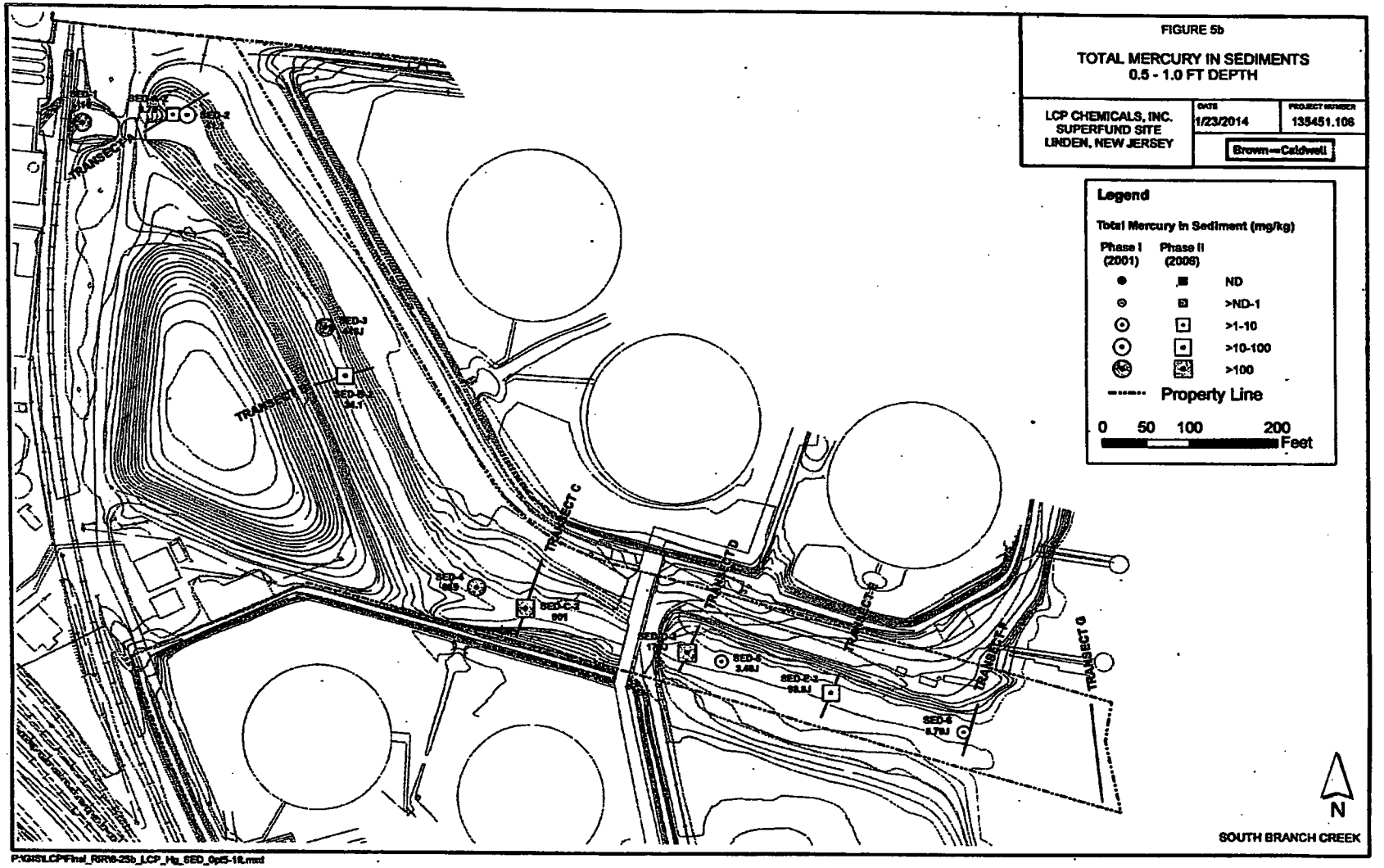


FIGURE 5b

TOTAL MERCURY IN SEDIMENTS
0.5 - 1.0 FT DEPTH

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 1/23/2014	PROJECT NUMBER 135451.106
	Brown=Caldwell	

P:\GIS\LCP\Final_RIR\8-25b_LCP_Hg_SED_0pt5-1ft.mxd

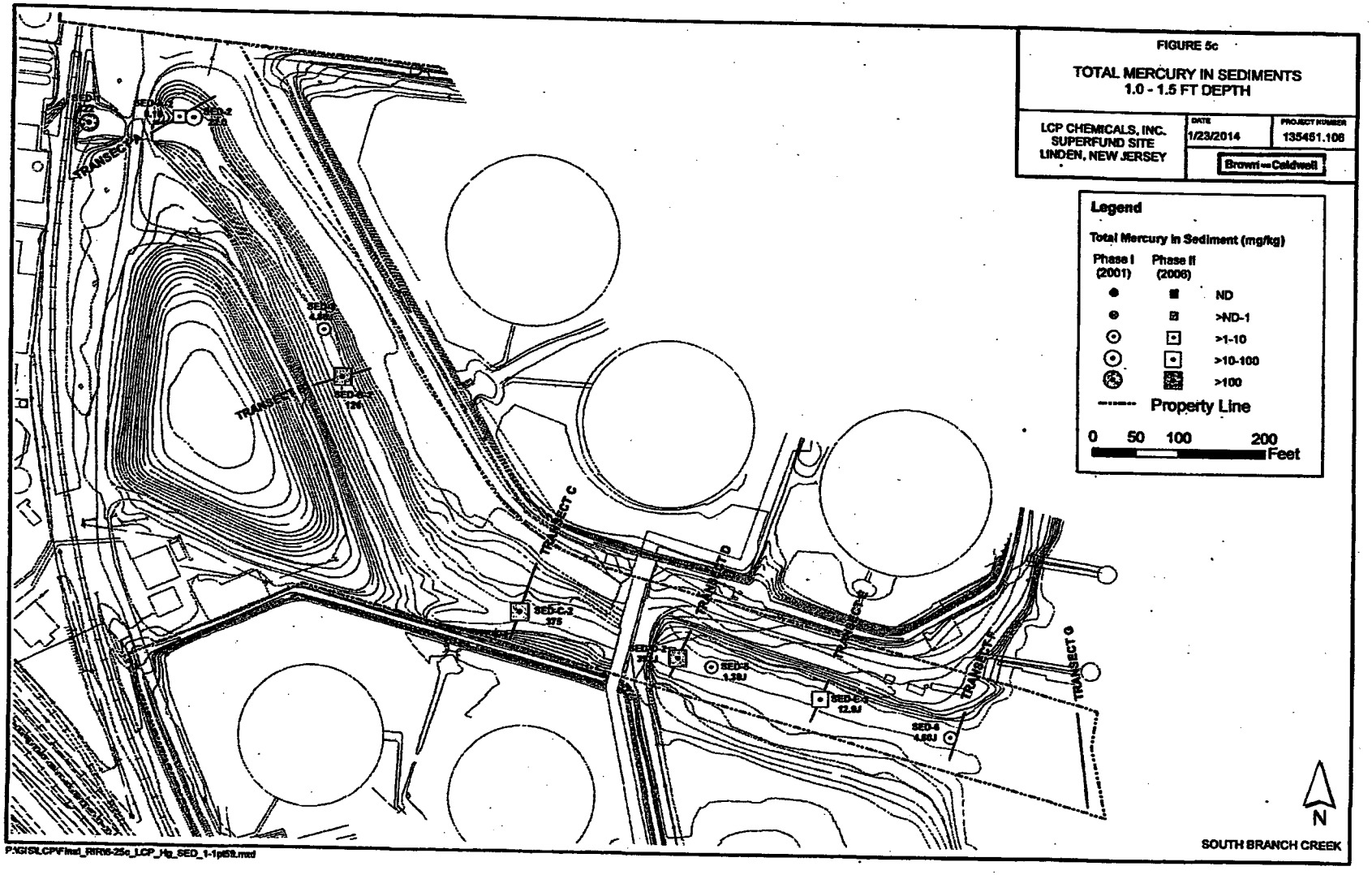


FIGURE 5c
TOTAL MERCURY IN SEDIMENTS
1.0 - 1.5 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total Mercury in Sediment (mg/kg)
Phase I (2001)
Phase II (2006)
ND
>ND-1
>1-10
>10-100
>100
Property Line
0 50 100 200
Feet
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
SED-1
SED-2
SED-3
SED-C-2
SED-C-3
SED-5
SED-6
N
SOUTH BRANCH CREEK
P:\GIS\LCP\Final_RIR06-25c_LCP_Hg_SED_1-1pt52.mxd

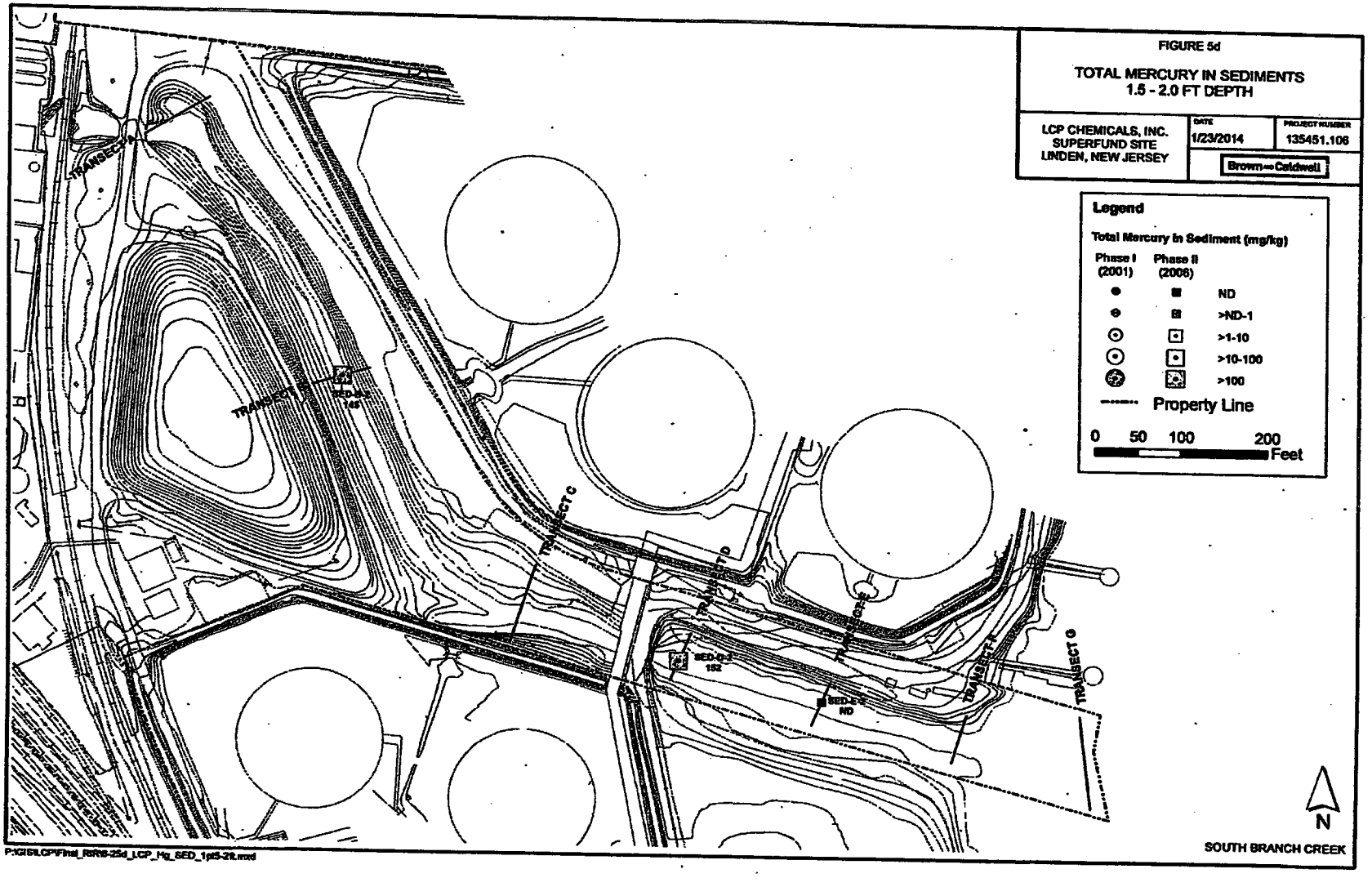


FIGURE 5d

TOTAL MERCURY IN SEDIMENTS
1.5 - 2.0 FT DEPTH

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 1/23/2014	PROJECT NUMBER 135451.106
	Brown AND Caldwell	

P:\GIS\LCP\Final_RIR\6-25d_LCP_Hg_SED_1pt5-2ft.mxd

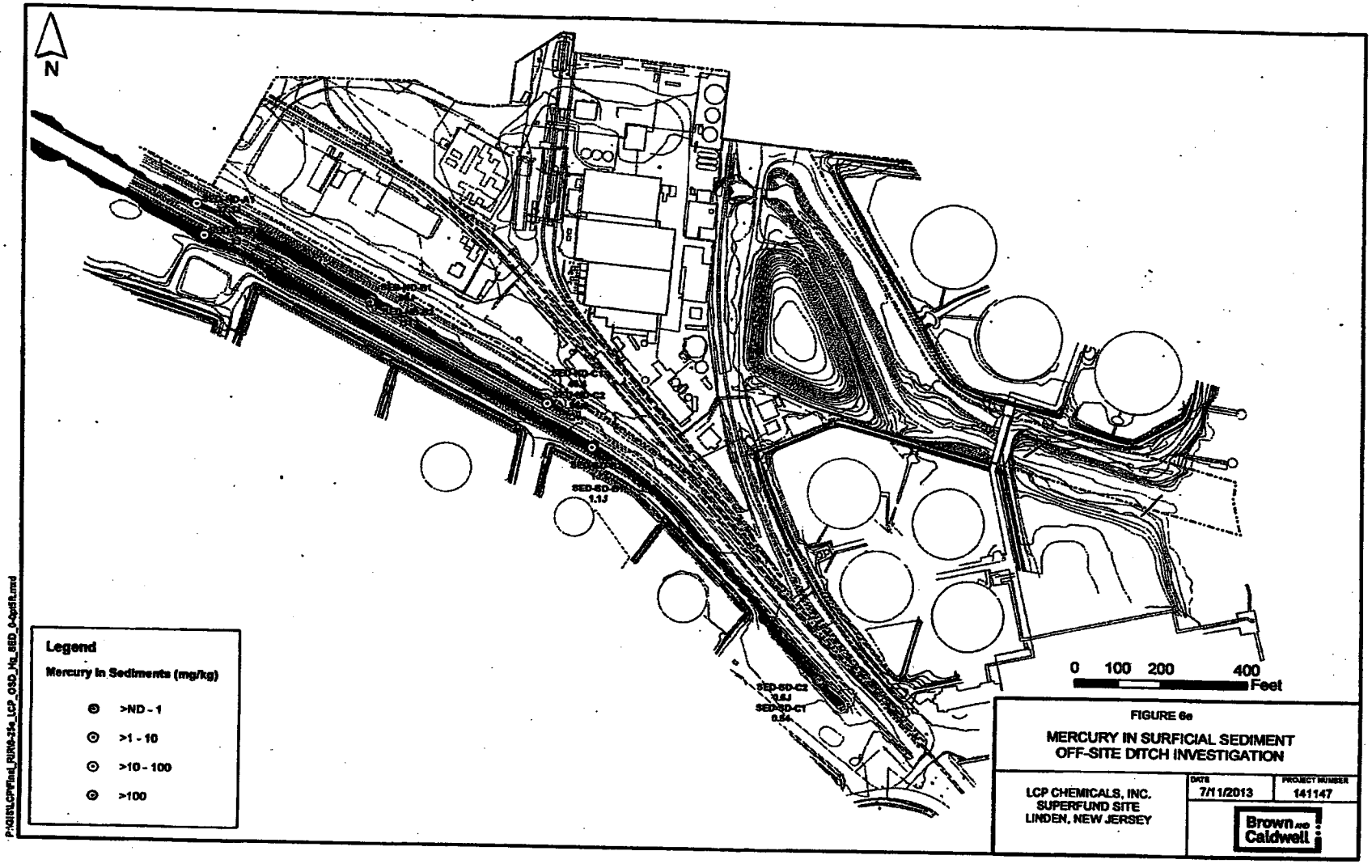


FIGURE 6e

MERCURY IN SURFICIAL SEDIMENT
OFF-SITE DITCH INVESTIGATION

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
7/11/2013	141147

Brown AND Caldwell

P:\GIS\LCP\Final_RI\Rk-23a_LCP_OSD_Hg_SSD_0-6pctl5.mxd

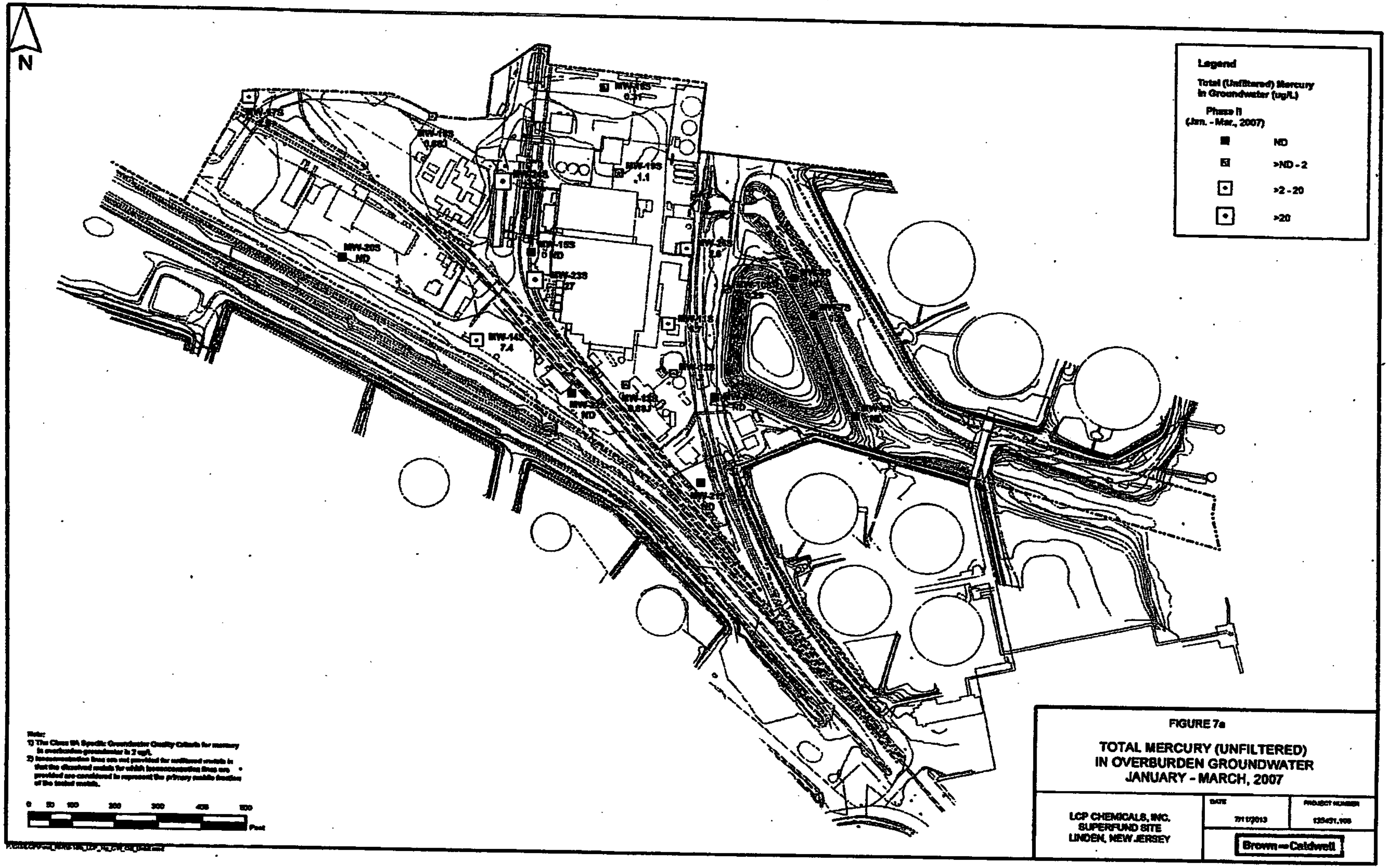


FIGURE 7a

TOTAL MERCURY (UNFILTERED)
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

Brown and Caldwell

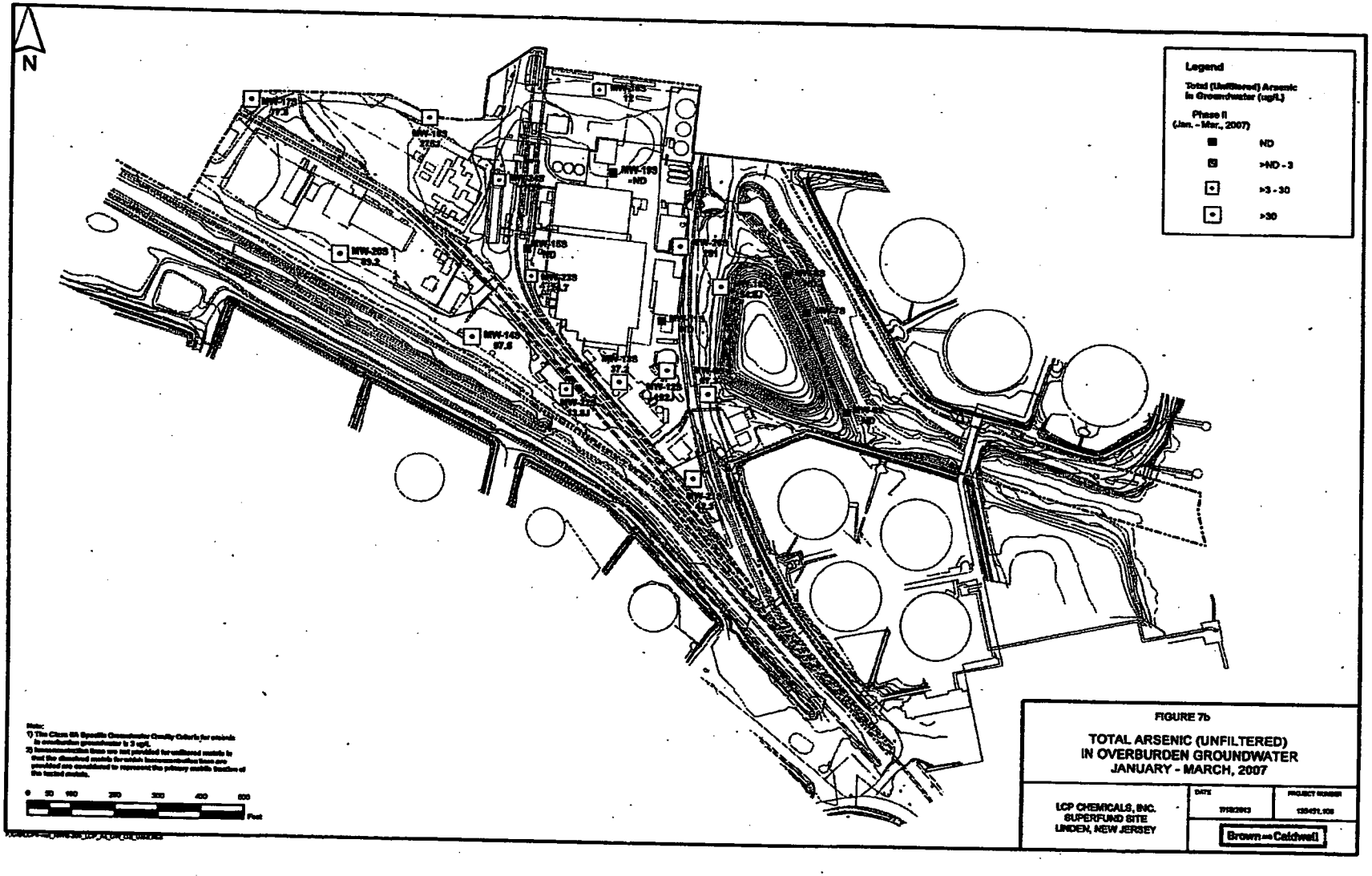


FIGURE 7b

TOTAL ARSENIC (UNFILTERED)
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE

PROJECT NUMBER

Brown AND Caldwell

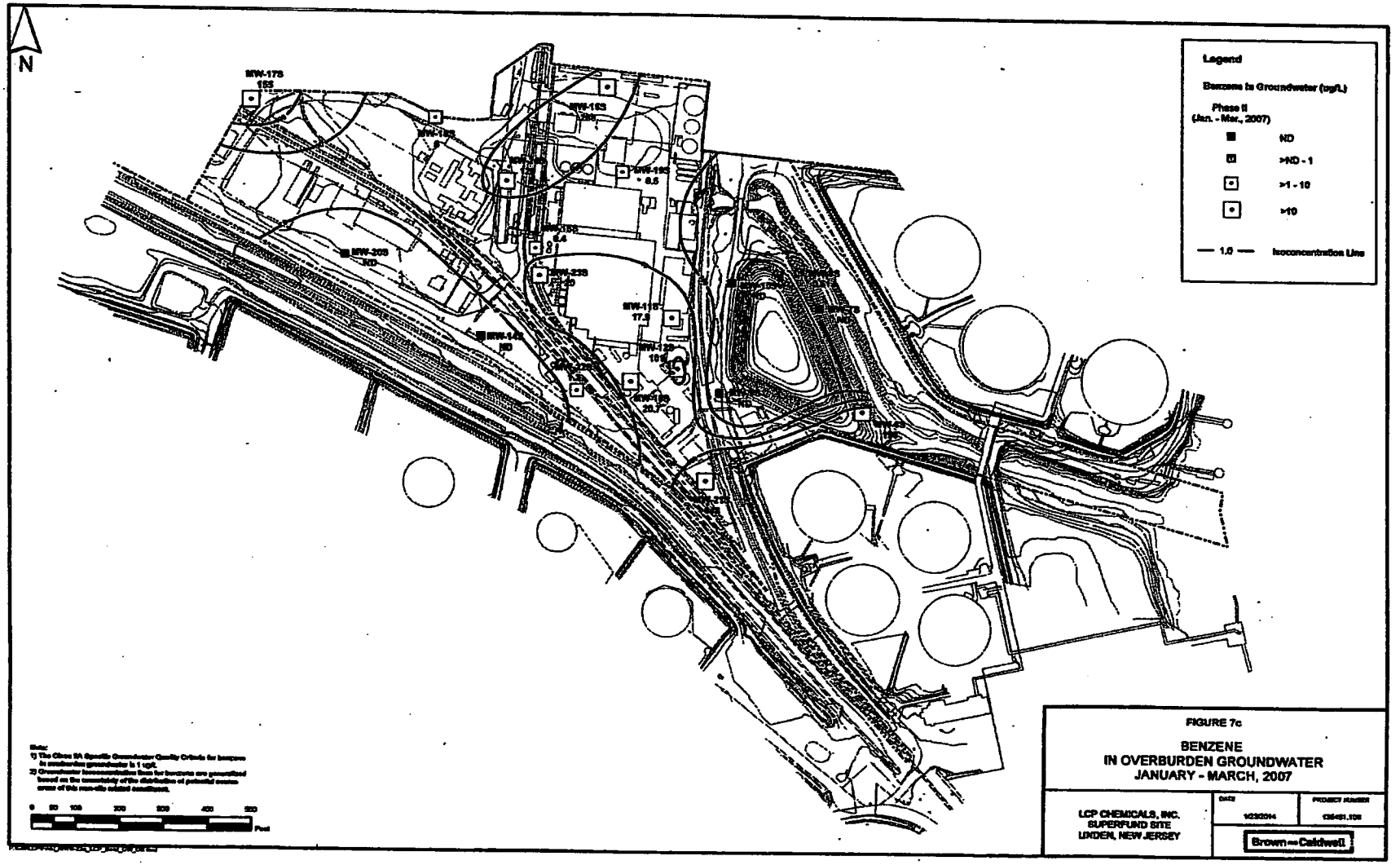


FIGURE 7c

BENZENE
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE: 1/23/2014

PROJECT NUMBER: C05451.108

Brown AND Caldwell

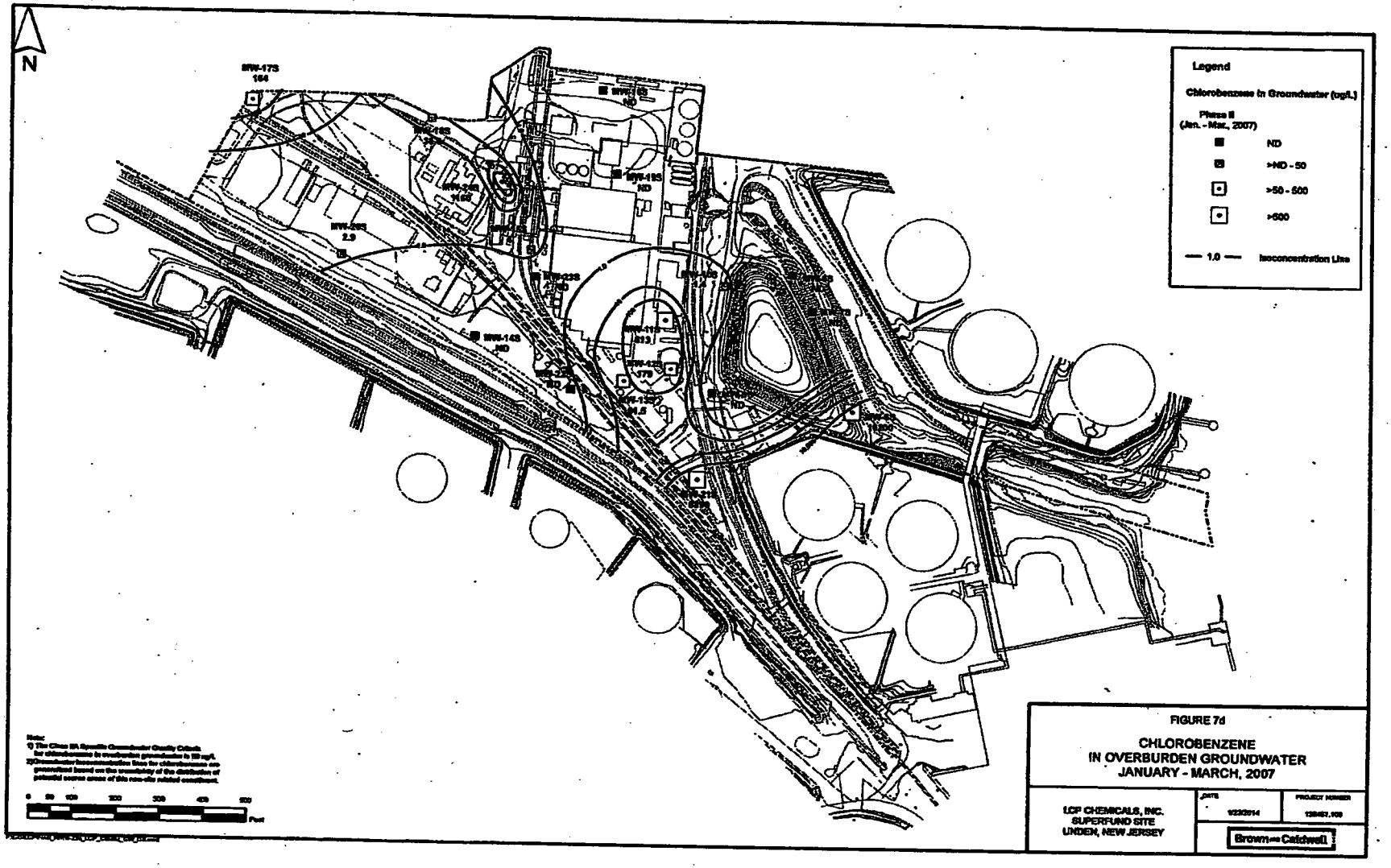


FIGURE 7d

CHLOROBENZENE
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

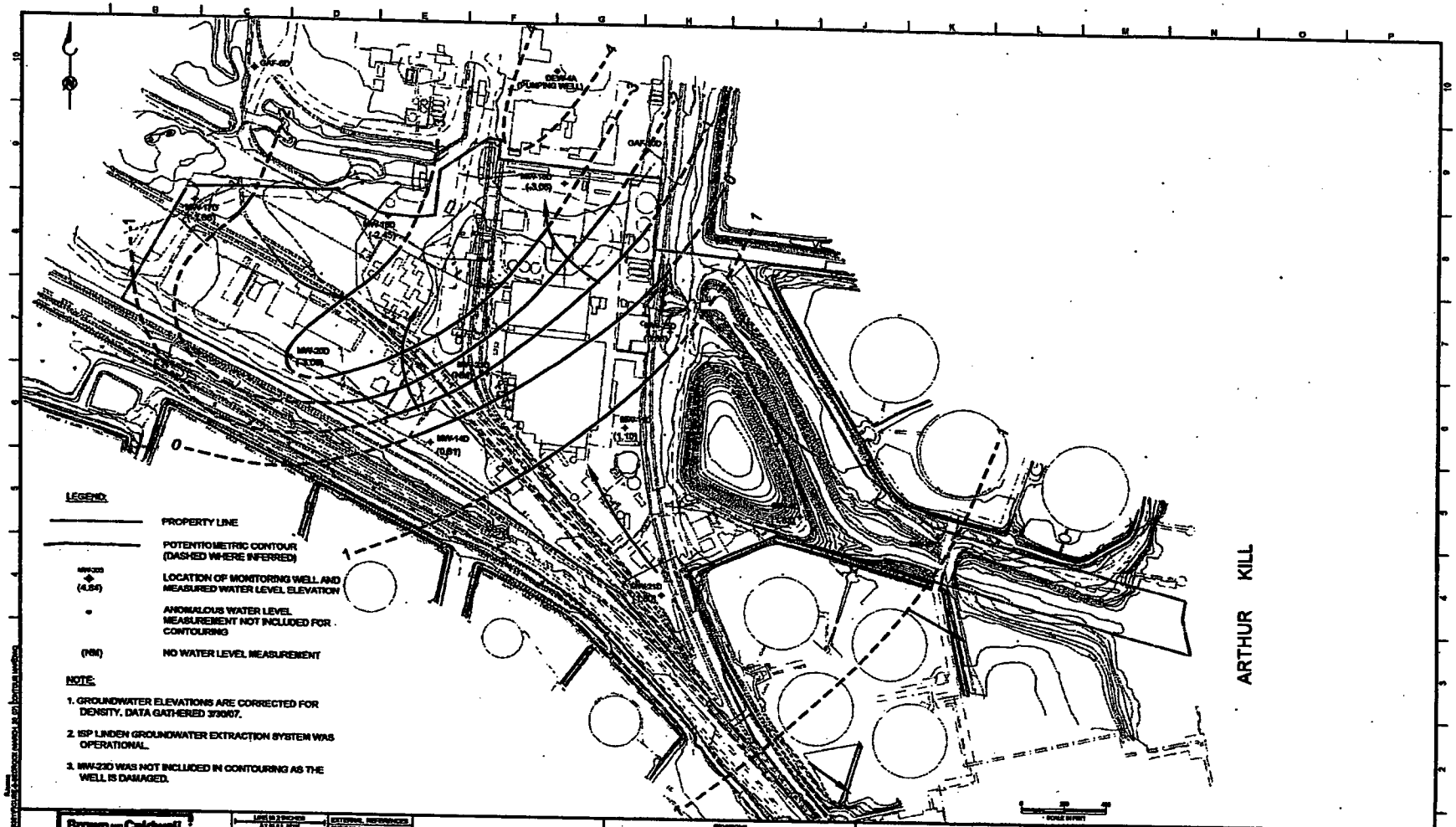
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 1/23/2014

PROJECT NUMBER 138457.100

Brown=Caldwell

R2-0062913



Brown AND Caldwell

UPPER SADDLE RIVER, NEW JERSEY

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

FIGURE 6
CORRECTED POTENTIOMETRIC SURFACE CONTOUR MAP
BEDROCK WATER BEARING ZONE
(MARCH 30, 2007)

LCP REMEDIAL INVESTIGATION

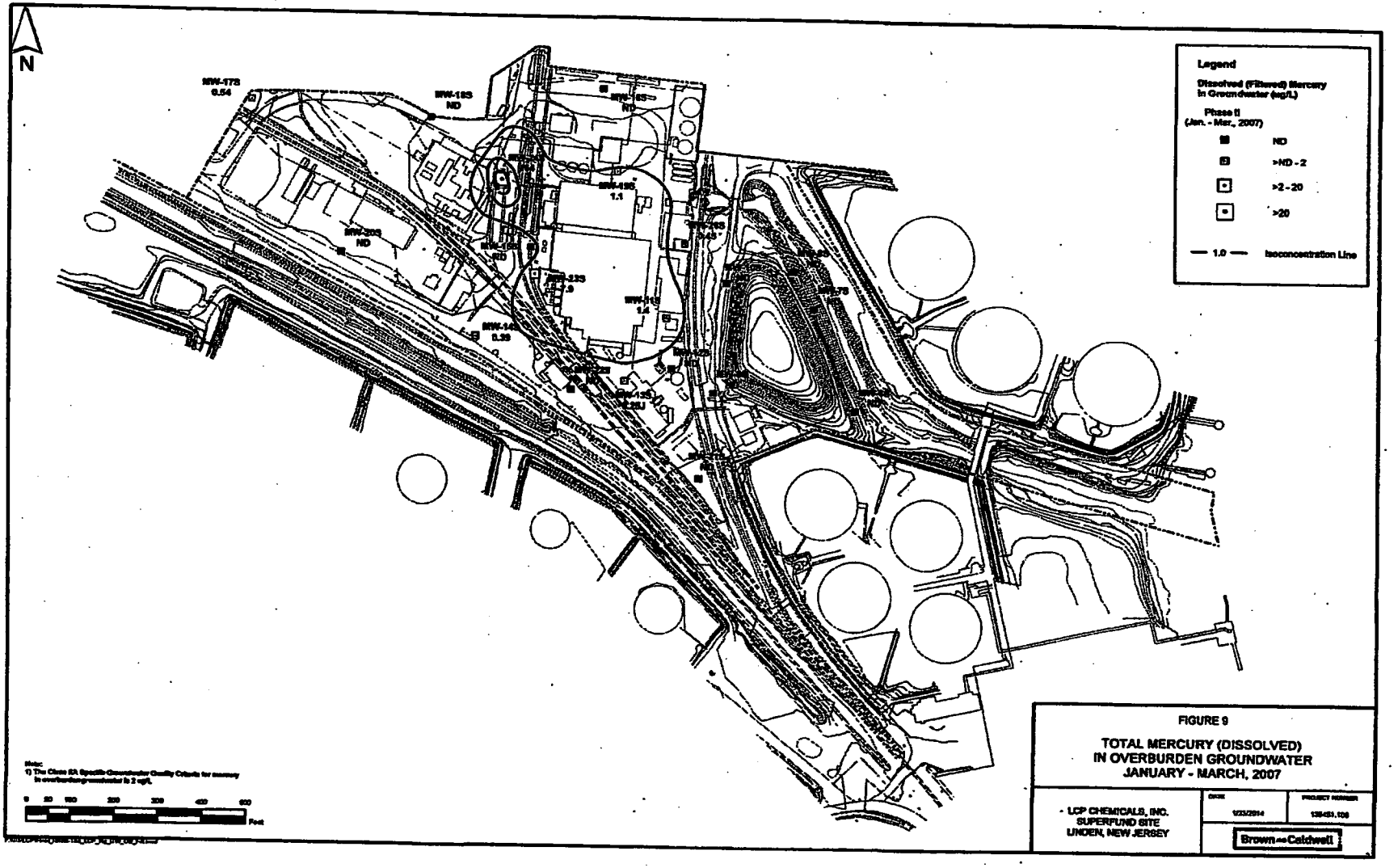


FIGURE 9

TOTAL MERCURY (DISSOLVED)
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
9/23/2014	138451.108

Brown AND Caldwell

R2-0062915

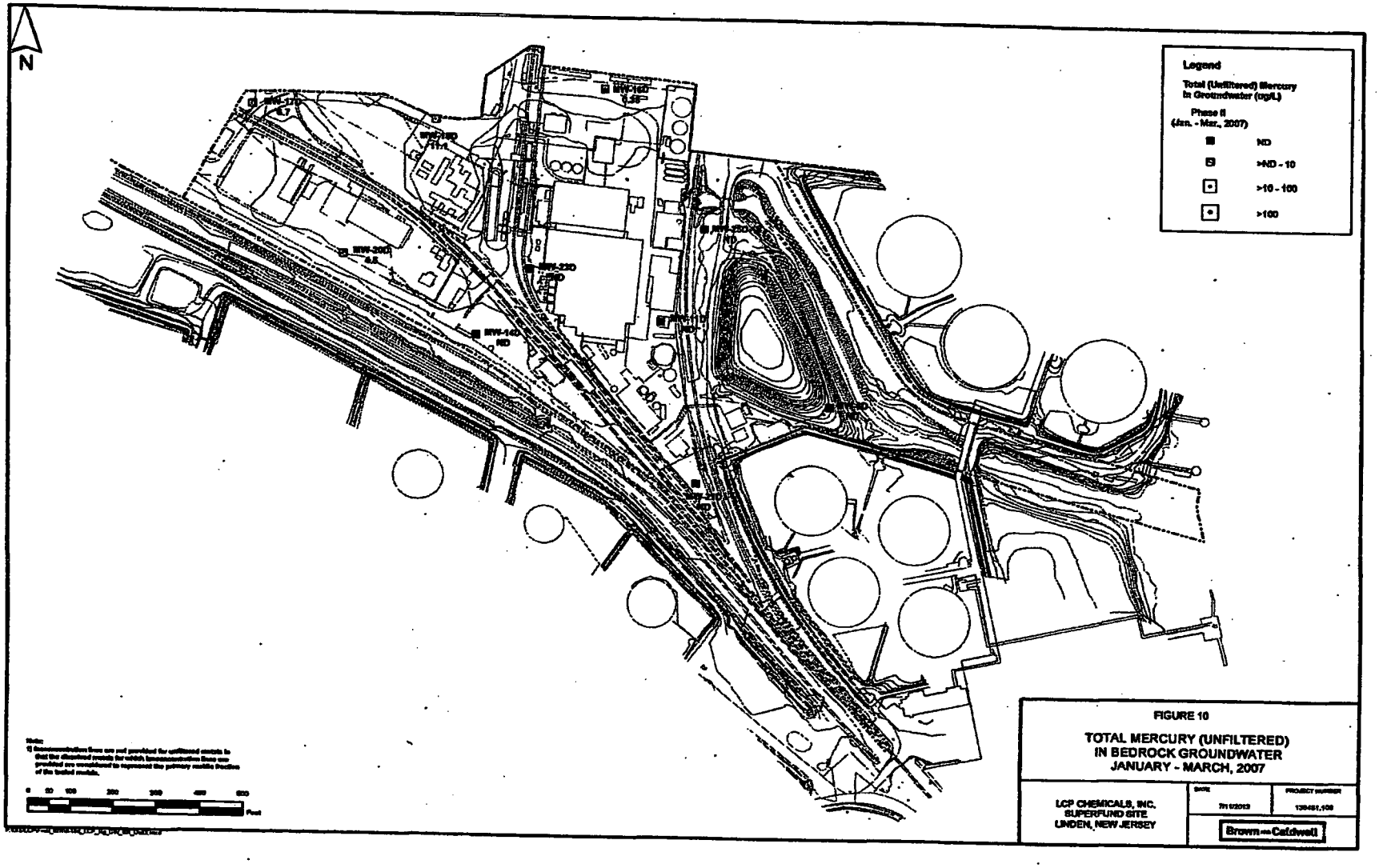


FIGURE 10

TOTAL MERCURY (UNFILTERED) IN BEDROCK GROUNDWATER JANUARY - MARCH, 2007

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 7/11/2013	PROJECT NUMBER 139481,100
	Brown AND Caldwell	

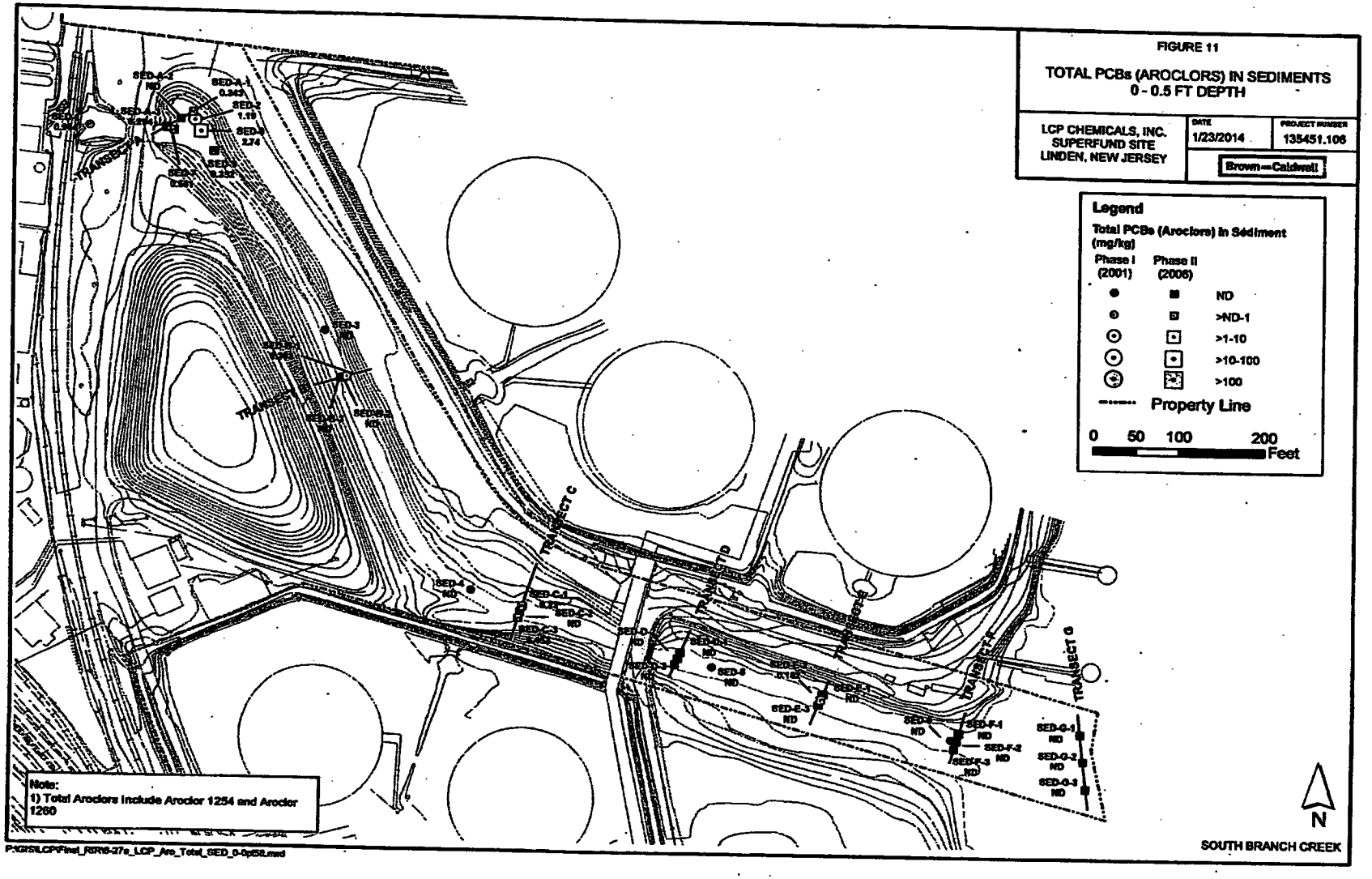
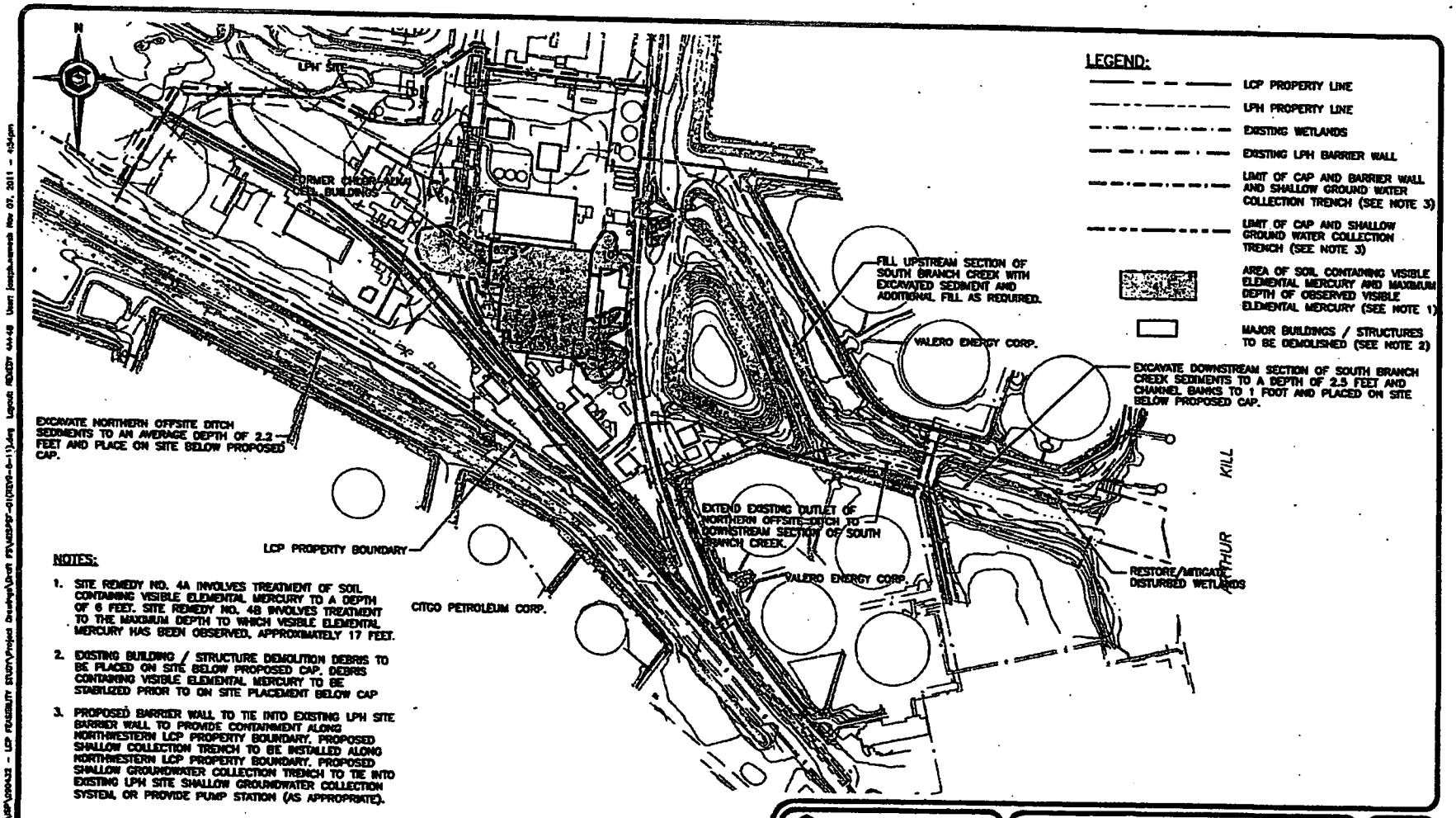


FIGURE 11
TOTAL PCBs (AROCLORS) IN SEDIMENTS
0 - 0.5 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total PCBs (Aroclors) in Sediment (mg/kg)
Phase I (2001)
Phase II (2006)
ND
>ND-1
>1-10
>10-100
>100
Property Line
0 50 100 200
Feet
Note:
1) Total Aroclors include Aroclor 1254 and Aroclor 1260
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
SED-A-1
0.343
SED-A-2
ND
SED-A-3
0.234
SED-2
1.19
SED-B
2.74
SED-3
0.252
SED-4
ND
SED-5
ND
SED-6
ND
SED-C-1
0.25
SED-C-2
0.37
SED-C-3
ND
SED-C-4
0.37
SED-D-1
ND
SED-D-2
ND
SED-D-3
ND
SED-E-1
ND
SED-E-2
0.160
SED-E-3
ND
SED-F-1
ND
SED-F-2
ND
SED-F-3
ND
SED-G-1
ND
SED-G-2
ND
SED-G-3
ND
N
SOUTH BRANCH CREEK
P:\GIS\LCP\Final_RIR\6-27a_LCP_Aro_Total_SED_0-0p5ft.mxd



NOTES:

1. SITE REMEDY NO. 4A INVOLVES TREATMENT OF SOIL CONTAINING VISIBLE ELEMENTAL MERCURY TO A DEPTH OF 6 FEET. SITE REMEDY NO. 4B INVOLVES TREATMENT TO THE MAXIMUM DEPTH TO WHICH VISIBLE ELEMENTAL MERCURY HAS BEEN OBSERVED, APPROXIMATELY 17 FEET.
2. EXISTING BUILDING / STRUCTURE DEMOLITION DEBRIS TO BE PLACED ON SITE BELOW PROPOSED CAP. DEBRIS CONTAINING VISIBLE ELEMENTAL MERCURY TO BE STABILIZED PRIOR TO ON SITE PLACEMENT BELOW CAP
3. PROPOSED BARRIER WALL TO TIE INTO EXISTING LPH SITE BARRIER WALL TO PROVIDE CONTAINMENT ALONG NORTHWESTERN LCP PROPERTY BOUNDARY. PROPOSED SHALLOW COLLECTION TRENCH TO BE INSTALLED ALONG NORTHWESTERN LCP PROPERTY BOUNDARY. PROPOSED SHALLOW GROUNDWATER COLLECTION TRENCH TO TIE INTO EXISTING LPH SITE SHALLOW GROUNDWATER COLLECTION SYSTEM, OR PROVIDE PUMP STATION (AS APPROPRIATE).

CORNERSTONE Engineering Group, LLC

FEASIBILITY STUDY – LCP CHEMICALS, INC.
SUPERFUND SITE, LINDEN, NEW JERSEY
SITE REMEDY NOs. 4A & 4B
FULL CONTAINMENT AND
SELECTIVE STABILIZATION

FIGURE NO. 12
PROJECT NO. 090432

APPENDIX II

TABLES

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Surface Soil (0-2 ft bgs)
Exposure Medium: Surface Soil (0-2 ft bgs)

Exposure Point	Chemical of Concern	Concentration Detected		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Surface Soil (0 to 2 ft bgs)	Mercury (elemental)	0.041	787	mg/kg	234 / 237	125	mg/kg	99% KM (Chebyshev) UCL
	Mercury (inorganic)	0.269	7,083	mg/kg	234 / 237	1,103	mg/kg	99% KM (Chebyshev) UCL

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: Mixed Soil (0-10 ft bgs)
Exposure Medium: Mixed Soil (0-10 ft bgs)

Exposure Point	Chemical of Concern	Concentration		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration	Statistical Measure
		Min	Max					
Mixed Soil (0 to 10 ft bgs)	Mercury (elemental)	0.063	787	mg/kg	76 / 77	114	mg/kg	99% Chebyshev (Mean, Sd) UCL
	Mercury (inorganic)	0.567	7,083	mg/kg	76 / 77	1,022	mg/kg	99% Chebyshev (Mean, Sd) UCL
	Vanadium	9.7	126	mg/kg	79 / 83	44.8	mg/kg	95% KM (BCA) UCL
	Furan 2,3,7,8-TCDD TEQ	1.41E-06	8.85E-04	mg/kg	5 / 5	7.23E-04	mg/kg	99% Chebyshev (Mean, Sd) UCL

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Concern	Concentration		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration	Statistical Measure
		Min	Max					
Overburden Groundwater	Arsenic	12	275	µg/L	14 / 20	275	µg/L	Maximum
	Cobalt	190	190	µg/L	1 / 20	190	µg/L	Maximum
	Iron	103	346,000	µg/L	20 / 20	346,000	µg/L	Maximum
	Manganese	27.6	219,000	µg/L	18 / 20	219,000	µg/L	Maximum
	Mercury	0.2	233	µg/L	13 / 20	233	µg/L	Maximum
	Methyl Mercury	0.000635	168	µg/L	3 / 3	168	µg/L	Maximum
	Vanadium	54.6	136	µg/L	2 / 20	136	µg/L	Maximum
	Dioxin 2,3,7,8-TCDD TEQ	1.90E-05	1.90E-05	µg/L	1 / 1	1.90E-05	µg/L	Maximum
	Furan 2,3,7,8-TCDD TEQ	1.62E-04	1.62E-04	µg/L	1 / 1	1.62E-04	µg/L	Maximum
	Chloroaniline, p-	1.6	4,460	µg/L	9 / 19	4,460	µg/L	Maximum
	Benzene	0.51	848	µg/L	14 / 19	848	µg/L	Maximum
	Chlorobenzene	1.4	16,200	µg/L	11 / 19	16,200	µg/L	Maximum

Table 2
Selection of Exposure Pathways

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Soil [1]	Surface Soil	Surface Soil	Commercial/ Industrial Worker	Adult	Ingestion	Quant [2]	Commercial/industrial workers may incidentally ingest surface soil.
						Dermal Contact		Commercial/industrial workers may have exposed skin come into contact with surface soil.
		Outdoor Air	Particulates and Vapors (P&V) in Outdoor Air	Commercial/ Industrial Worker	Adult	Inhalation	Quant [2]	Commercial/industrial workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Surface Soil [1]	Surface Soil	Surface Soil	Site-Specific Worker [3]	Adult	Ingestion	Quant [2]	Site-specific workers may incidentally ingest surface soil.
						Dermal Contact		Site-specific workers may have exposed skin come into contact with surface soil.
		Outdoor Air	P&V in Outdoor Air	Site-Specific Worker [3]	Adult	Inhalation	Quant [2]	Site-specific workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Surface Soil [4]	Surface Soil	Surface Soil	Construction/ Utility Worker	Adult	Ingestion	Quant [2]	Construction/utility workers may incidentally ingest surface soil.
						Dermal Contact		Construction/utility workers may have exposed skin come into contact with surface soil.
		Outdoor Air	P&V in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Quant [2]	Construction/utility workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Subsurface Soil [4]	Subsurface Soil	Subsurface Soil	Construction/ Utility Worker	Adult	Ingestion	Quant [2]	Construction/utility workers may incidentally ingest subsurface soil.
						Dermal Contact		Construction/utility workers may have exposed skin come into contact with subsurface soil.
		Outdoor Air	P&V in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Quant [2]	Construction/utility workers may inhale particulates in fugitive dust generated from subsurface soil or inhale vapors that migrate from subsurface soil to air.

Future	Groundwater	Overburden Groundwater [7]	Overburden Groundwater	Commercial/ Industrial Worker	Adult	Ingestion	Quant	Future commercial/industrial worker ingestion of groundwater was quantitatively evaluated to support remedial decisions-making and risk management processes.
		Shallow Groundwater [8]	Shallow Groundwater	Construction/ Utility Worker	Adult	Ingestion	Qual	Construction/utility worker incidental ingestion of shallow (overburden) groundwater while conducting construction/excavation activities near the water table is likely to be relatively insignificant in comparison to dermal contact with groundwater; therefore, this pathway is qualitatively evaluated as part of the uncertainty analysis.
		Shallow Groundwater [8]	Shallow Groundwater	Construction/ Utility Worker	Adult	Dermal Contact	Quant	Construction/utility workers may have exposed skin come into contact with shallow (overburden) groundwater while conducting construction/excavation activities near the water table.
		Shallow Groundwater [9]	Vapors in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Qual	Construction/utility worker inhalation of vapors from shallow (overburden) groundwater while conducting construction/excavation activities near the water table is likely to be relatively insignificant in comparison to dermal contact with groundwater; therefore this pathway is qualitatively evaluated as part of the uncertainty analysis. Areas of the Site containing visible elemental mercury are assumed to present an unacceptable risk.
Future	Surface Soil [3]	Surface Soil	Surface Soil	Adolescent Trespasser	Adult	Ingestion	Qual	Under future land use conditions, the likelihood for trespassing may increase if current barriers to access (e.g., fencing) are removed. Thus, future trespassers may incidentally ingest, have dermal contact with,
						Dermal Contact		
		Outdoor Air	P&V in Outdoor Air	Adolescent Trespasser	Adult	Inhalation	Qual	
Current/Future	Surficial Sediment in/along South Branch Creek	Surficial Sediment in /along SBC	Surficial Sediment in/along SBC	Adolescent Trespasser	Ages 7-16	Ingestion	Quant	Trespassers may incidentally ingest sediment.
						Dermal Contact		Trespassers may have exposed skin come into contact with sediment.

Current/Future	Surface Water in South Branch Creek	Surface Water in SBC	Surface Water in SBC	Adolescent Trespasser	Ages 7-16	Ingestion	Qual	Trespassers may incidentally ingest surface water; however, this pathway is evaluated qualitatively as part of the uncertainty analysis as trespasser exposure to surface water is likely to be insignificant relative to sediment exposure.
						Dermal Contact		Trespassers may have exposed skin come into contact with surface water; however, this pathway is evaluated qualitatively as part of the uncertainty analysis as trespasser exposure to surface water is likely to be insignificant relative to sediment exposure.
Future	Subsurface Soil Vapors (8)	Subsurface Soil Vapors	Vapors in Indoor Air	Indoor Worker	Adult	Inhalation	Quant (2)	Indoor workers may inhale vapors that migrate from the subsurface to indoor air via diffusion, advection, or as a result of heating and ventilation systems.

Notes:

(1) Surface soil includes all soil from the interval 0 to 2 feet below ground surface (ft bgs) not associated with South Branch Creek (SBC).

(2) Areas of visible elemental mercury contamination could not be quantitatively evaluated. For the purposes of this baseline risk assessment, areas with visible elemental mercury were assumed to present an unacceptable risk based on potential direct contact and vapor intrusion pathways. Risks attributed to these areas are based on current (i.e., unremediated) Site conditions.

(3) In addition to the full-time commercial/industrial worker, a reduced-frequency commercial/industrial ("site-specific") worker was also evaluated. Although this scenario is hypothetical, and it is acknowledged that such future land use would require institutional controls, the evaluation of this receptor supports remedial decision-making and risk management process.

(4) Subsurface soil includes all soil from the interval 2 to 10 ft bgs not associated with SBC.

given the salinity and New Jersey regulations. However, the overburden water-bearing zone remains classified as Class II-A (potable). Therefore, future commercial/industrial worker ingestion of overburden groundwater was quantitatively evaluated to provide risk managers with information needed to evaluate the impact of any future changes in groundwater use at the Site.

(6) Future construction/utility workers are assumed to be exposed to shallow groundwater while conducting intrusive activities at the Site. For the purposes of the risk assessment, "shallow" groundwater was assumed to include all overburden groundwater.

(7) Sediment includes all solid media (sediment, bank soil, marsh soil) associated with SBC collected from the interval 0 to 0.5 ft bgs.

(8) Because elemental mercury (which is expected to be the primary risk driver for indoor air) is not soluble, modeling risks from groundwater to indoor air is inappropriate as it would likely result in a gross underestimation of risks from vapor intrusion. Rather, exposure to indoor air was evaluated using soil vapor data and the Johnson and Ettinger (J&E; 1991) vapor intrusion model.

(9) With the exception of subsurface soil vapors, risk associated with environmental media at the Site are presented herein in tabular form in accordance with the standard tables of RAGS Part D. Risks associated with exposure to soil vapors are presented in Attachment E.

Table 3
Non-Cancer Toxicity Data Summary

Pathway: Ingestion/Dermal

Chemicals of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Absorp. Efficiency (Dermal	Adjusted RfD (Dermal)	Adj. Dermal RfD Units	Primary Target Organ	Combined Uncertainty	Sources of RfD Target	Dates of RfD
Arsenic	Chronic	3.0E-04	mg/kg-day	0.03	3.0E-04	mg/kg-day	Cardio/Derm	3	I	Nov 2011
Cobalt	Chronic	3.0E-04	mg/kg-day	--	3.0E-04	mg/kg-day	Blood/Resp/Der	--	P	Nov 2011
Iron	Chronic	7.0E-01	mg/kg-day	--	7.0E-01	mg/kg-day	GI	--	P	Nov 2011
Manganese	Chronic	2.4E-02	mg/kg-day	--	9.6E-04	mg/kg-day	CNS	1.0	I	Nov 2011
Mercury (elemental)	Chronic	1.6E-04	mg/kg-day	--	1.6E-04	mg/kg-day	CNS	--	C	Nov 2011
Mercury (inorganic)	Chronic	3.0E-04	mg/kg-day	--	2.1E-05	mg/kg-day	Immuno/Kidney	--	I	Nov 2011
Methyl Mercury	Chronic	1.0E-04	mg/kg-day	--	1.0E-04	mg/kg-day	CNS/Develop	10	I	Nov 2011
Vanadium	Chronic	7.0E-05	mg/kg-day	--	1.8E-06	mg/kg-day	Blood	--	P	Nov 2011
Furan 2,3,7,8-TCDD TEQ	Chronic	1.0E-09	mg/kg-day	0.03	1.0E-09	mg/kg-day	/Develop/Reprod	--	A	Nov 2011
Chloroaniline, p-	Chronic	4.0E-03	mg/kg-day	0.1	4.0E-03	mg/kg-day	Spleen	3,000	I	Nov 2011
Benzene	Chronic	4.0E-03	mg/kg-day	--	4.0E-03	mg/kg-day	Blood/Immuno	300	I	Nov 2011
Chlorobenzene	Chronic	2.0E-02	mg/kg-day	--	2.0E-02	mg/kg-day	Liver	1,000	I	Nov 2011

Pathway: Inhalation

Chemicals	Chronic/	Inhalation	Inhalation	Primary	Combined	Sources	Dates of RfC
Manganese	Chronic	5.0E-05	mg/m^3	CNS	1,000	I	Nov 2011
Mercury (elemental)	Chronic	3.0E-04	mg/m^3	CNS	30	I	Nov 2011
Vanadium	Chronic	1.0E-04	mg/m^3	Blood	--	A	Nov 2011
Dioxin 2,3,7,8-TCDD TEQ	Chronic	4.0E-08	mg/m^3	velop/Re	--	C	Nov 2011
Furan 2,3,7,8-TCDD TEQ	Chronic	4.0E-08	mg/m^3	velop/Re	--	C	Nov 2011
Chlorobenzene	Chronic	5.0E-02	mg/m^3	Liver	--	P	Nov 2011

Notes:

RfDo and values obtained from USEPA Regional Screening Level (RSL) Tables for Chemical Contaminants at Superfund Sites (updated November 2010).
The RSL Tables cite the following primary sources:

I = IRIS; USEPA's Integrated Risk Information System available at: http://cfpub.epa.gov/ncea/iris/index.cfm

P = PPRTV; the Provisional Peer Reviewed Toxicity Values derived for the USEPA Superfund program (not publicly available). P(X) indicates a withdrawn value.

A = ATSDR; the Agency for Toxic Substances and Disease Registry Minimal Risk Levels (MRLS) available at: http://www.atsdr.cdc.gov/mrls/

C = California EPA toxicity values available at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp

Table 4 Cancer Toxicity Data Summary							
Pathway: Ingestion/ Dermal							
Chemical of Concern	**Oral Cancer Slope Factor**	**Units**	**Adjusted Cancer Slope Factor (for Dermal)**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline**	**Source**	**Date**
Arsenic	1.5E+00	1/(mg/kg-day)	1.5E+00	1/(mg/kg-day)	A	I	Nov 2011
Chloroaniline, p-	2.0E-01	1/(mg/kg-day)	2.0E-01	1/(mg/kg-day)	--	P	Nov 2011
Benzene	5.5E-02	1/(mg/kg-day)	5.5E-02	1/(mg/kg-day)	A	I	Nov 2011

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil (0 to 2 ft bgs)	Surface Soil (0 to 2 ft bgs) and P&V in Outdoor Air	Mercury (elemental)	CNS	7.5E-01	--	4.2E+00	5.0E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (inh)	3.6E+00	--	1.2E-02	3.6E+00
							Exposure Medium Total	1.0E+01
Groundwater	Overburden Groundwater	Potable Groundwater	Arsenic	Cardio/Derm	9.0E+00	--	--	9.0E+00
			Cobalt	Blood/Resp/Derm	6.2E+00	--	--	6.2E+00
			Iron	GI	4.8E+00	--	--	4.8E+00
			Manganese	CNS	8.9E+01	--	--	8.9E+01
			Mercury	CNS/Immuno/Kidney	7.6E+00	--	--	7.6E+00
			Methyl Mercury	CNS/Develop	1.6E+01	--	--	1.6E+01
			Vanadium	Blood	1.9E+01	--	--	1.9E+01
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	1.6E+00	--	--	1.6E+00
			Chloroaniline, p-	Spleen	1.1E+01	--	--	1.1E+01
			Benzene	Blood/Immuno	2.1E+00	--	--	2.1E+00
			Chlorobenzene	Liver	7.9E+00	--	--	7.9E+00
							Exposure Medium Total	1.8E+02

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Site-Specific Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure
Surface Soil	Surface Soil	Surface Soil	Mercury (elemental)	CNS	3.0E-01	--	1.7E+00	2.0E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (inh)	1.4E+00	--	5.0E-03	1.4E+00
							Exposure Medium Total	4.1E+00

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Construction/Utility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure
Mixed Soil	Mixed Soil	Mixed Soil	Mercury (elemental)	CNS	1.2E+00	—	2.0E+00	3.2E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (mh)	5.7E+00	—	6.0E-03	5.7E+00
			Vanadium	Blood	1.1E+00	—	7.9E-05	1.1E+00
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	1.2E+00	1.1E-01	3.2E-06	1.3E+00
							Exposure Medium Total	1.3E+01
Groundwater	Shallow	Shallow	Manganese	CNS	—	3.1E+01	—	3.1E+01
			Mercury	CNS/Immuno/Kidney	—	1.5E+00	—	1.5E+00
			Vanadium	Blood	—	1.0E+01	—	1.0E+01
			Dioxin 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	—	2.1E+00	—	2.1E+00
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	—	1.4E+01	—	1.4E+01
			Chlorobenzene	Liver	—	3.1E+00	—	3.1E+00
							Exposure Medium Total	6.4E+01

Table 6
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Overburden Groundwater	Potable Groundwater	Arsenic	1.4E-03	--	--	1.4E-03
			Chloroaniline, p-	3.1E-03	--	--	3.1E-03
			Benzene	1.6E-04	--	--	1.6E-04
						Exposure Medium Total	4.9E-03

TABLE 7
EDC CLEANUP GOALS

COPC	SOIL	OVERBURDEN GROUNDWATER CLASS IIA	SEDIMENT
	NJDEP NON-RESIDENTIAL REM. STD	NJDEP GW STD	PRG[1]
Units	mg/kg	ug/L	mg/kg
Aluminum		2.0E+01	
Antimony	4.5E+02	6.0E+00	
Arsenic	1.9E+01	3.0E+00	8.2
Barium	5.9E+04	6.0E+03	48
Beryllium	1.4E+02		
Cadmium	7.8E+01	6.0E+00	1.2
Chromium		7.0E+01	81
Cobalt	5.9E+02	-	
Copper			34
Iron	-	3.0E+02	-
Lead	8.0E+02	5.0E+00	47
Manganese		5.0E+01	260
Mercury	6.5E+01	2.0E+00	0.15
Nickel		1.0E+02	21
Selenium	5.7E+03		
Silver			1
Vanadium	1.1E+03	6.0E+01	57
Zinc	1.1E+05		150
Acenaphthene			0.016
Acenaphthylene			0.044
alpha-chlordane	1.0E+00		
Aniline		6.0E+00	
Anthracene			0.085
Benz(a)anthracene	2.0E+00	-	0.261
Benzo(a)pyrene TEQ	2.0E-01		0.43
Benzo(b)fluoranthene	2.0E+00		
Benzo(k)fluoranthene	2.3E+01		
Carbazole		-	
Chloroaniline, p-		3.0E+01	
Chrysene			0.384
Dibenz(a,h)anthracene	2.0E-01		0.063
Fluoranthene			0.6
Fluorene			0.019
Dichlorobenzene, 1,2-		6.0E+02	
Dichlorobenzene, 1,4-	1.3E+01	7.5E+01	
Dichlorophenol, 2,4-		2.0E+01	
Dinitrotoluene, 2,4-	3.0E+00		
Dinitrotoluene, 2,6-	3.0E+00		
Hexachlorobenzene	1.0E+00	2.0E-02	
Hexachlorobutadiene	2.3E+01	1.0E+00	
Indeno(1,2,3-c,d) Pyrene	2.0E+00		
Naphthalene	1.7E+01	3.0E+02	0.16
Nitrobenzene		6.0E+00	
Methylnaphthalene, 2-		-	0.07
PCBs	1.0E+00		0.005
PCDDs		1.0E-05	
PCDFs	-	-	-
Pentachlorophenol		3.0E-01	
Phenanthrene			0.24
Pyrene			0.665
Trichlorobenzene, 1,2,4-	8.2E+02	9.0E+00	
Benzene		1.0E+00	
Chlorobenzene		5.0E+01	
Chloroform	2.0E+00		
Dibromoethane, 1,2-	4.0E-02		
DBCP	2.0E-01		
Ethylbenzene		7.0E+02	
Methylene Chloride	9.7E+01	3.0E+00	
Tetrachloroethylene (PCE)	5.0E+00	1.0E+00	
Trichloroethylene (TCE)	2.0E+01		
Vinyl Chloride		1.0E+00	

Note:
1. Or to levels consistent with Arthur Kill Sediments

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
FEDERAL					
Air: Clean Air Act	42 USC 7401, Section 112	Action specific	Establishes limits on emissions to atmosphere from industrial and commercial activities.	Applicable	Applicable to alternatives that may emit pollutants to the air.
National Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Action specific	Establishes emissions limits for primary and secondary NAAQS	Applicable	Applicable to alternatives that may emit pollutants to the air
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61.01, 61.14	Action specific	Establishes limits on hazardous emissions to the atmosphere	TBC	Applicable to alternative that may emit pollutants to the air. Sets requirements for public exposure to hazardous airborne emissions.
Vapor Intrusion Guidance	OSWER Draft Guidance Document	Chemical specific	Provides soil vapor, indoor air screening levels	TBC	Potentially applicable depending on ultimate redevelopment of the site (i.e., redeveloped with buildings)
Fish and Wildlife: Fish and Wildlife Coordination Act	16 USC 661, 662, 663 40 CFR 6.302(g)	Location specific	Provides protection of fish and wildlife from actions resulting in the control or structural modification of natural streams and water bodies.	Relevant and Appropriate	Potentially applicable to alternatives involving placement of fill in South Branch Creek.
Groundwater: Maximum Contaminant Levels (MCLs)	40 CFR 141.11, 141.31	Chemical specific	Maximum permissible levels of contaminants in water that is delivered to any user of a public water system.	Relevant and Appropriate	Applicable to determining whether groundwater if used from the Site for drinking would require treatment to reduce concentrations to levels below the MCLs. Groundwater at the site is not anticipated to be used.
Identification and Listing of Hazardous Waste	40 CFR Part 261.3, 261.6, 261.10, 261.11, 261.24	Chemical specific	Defines those wastes, which are subject to regulation as hazardous wastes, and lists specific chemical and industry-source wastes.	Applicable	Applicable to determining whether wastes are hazardous, and to brine sludge in closed RCRA unit.
Generators of Hazardous Waste	40 CFR 262 Subparts A,B,C,D,E	Chemical specific	Establishes requirements for generators of hazardous waste (EPA ID numbers and manifests).	Applicable	Applicable to remedial activities that involve the management of a hazardous waste.
Transportation of Hazardous Wastes.	40 CFR 263 Subpart B 49 CFR 107, 171-180	Action specific	Established standards for the transportation of hazardous wastes and/or materials.	Applicable	Applicable to remedial activities that involve the off-site transportation of hazardous waste.

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264 Subparts B, D,E,K	Action, location, and chemical specific	Establishes the minimum standards for the management of hazardous waste and includes regulations for land disposal units.	Applicable	Applicable to remedial activities that include disposal of hazardous wastes, or treatment of hazardous waste at the site.
Land Disposal Restrictions	40 CFR 268	Chemical specific	Identifies hazardous wastes which are restricted from land disposal and identifies treatment requirements prior to disposal	Applicable	Applicable to remedial activities that include disposal of hazardous wastes.
Soil: Mercury Export Ban Act	Public Law 110-414 (122 STAT. 4344 – 4348)	Action and chemical specific	Establishes export and resale ban of elemental mercury containing materials. Remediation wastes may be exported for treatment/disposal but not for sale or reuse of any recovered mercury.	Applicable	Applicable to remedial activities that include international, off-site disposal of elemental mercury.
Surface Water: Clean Water Act (CWA)	33 USC 1342	Action and chemical specific	Sets standards for the restoration and maintenance of chemical, physical and biological characteristics of surface water.	Applicable/ TBC	Applicable for selected remedial technologies (e.g., surface water discharge), and potentially assessment of South Branch Creek.
National Pollutant Discharge Elimination System	40 CFR 122	Action and chemical specific	Requires permits for the discharge of pollutants from any point source into waters of the United States	Applicable	Applicable for selected remedial technologies (e.g., surface water discharge of treated groundwater)
Wetlands and Costal Zone: Section 404 CWA	33 CFR 330	Location and Action Specific	Regulates discharge of dredged or fill material into waters of the United States	Applicable	Applicable to remedial actions that may involve placement of fill in South Branch Creek.
Wetland Permits	40 CFR 230 – 233	Location specific	Provides wetland permitting requirements for actions in and around wetlands and waters of the United States	Applicable	Applicable to remedial actions that may impact wetlands and/or placement of fill in South Branch Creek.
STATE OF NEW JERSEY					

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Air: Permits and Certificates for Minor Facilities	NJAC 7:27-8	Action specific	Governs permits and certificates for facilities classified as minor air pollution sources.	Applicable	Applicable if the selected remediation system qualifies as a minor air pollution source (e.g., groundwater treatment of VOCs).
Ambient Air Quality Standards	NJAC 7:27-13	Action and chemical specific	Establishes air quality standards for the protection of public health and the preservation of ambient air quality.	Applicable	Applicable to remedial alternatives that result in air emissions (e.g., groundwater treatment of VOCs).
Vapor Intrusion Guidance	NJDEP Guidance Document, March 2013	Chemical specific	Provides soil vapor, indoor air, rapid action, and health department notification screening levels	TBC	Potentially applicable depending on ultimate redevelopment of the site.
Groundwater Quality Standards	NJAC 7:9C	Chemical specific	Lists the maximum permissible levels of contaminants in groundwater.	Applicable	Applicable to groundwater remedial alternatives.
Hazardous and Solid Waste: Identification and Listing of Hazardous Waste	NJAC 7:26G-5	Chemical specific	Describes methods for identifying hazardous wastes and lists known hazardous wastes.	Applicable	Applicable to determining whether wastes are hazardous.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	NJAC 7:26G-8	Action specific	Establishes permit requirements and construction and operations standards.	Applicable	Applicable if remedial activities include the treatment, storage, and/or disposal of hazardous waste.
Land Disposal Restrictions	NJAC 7:26G-11	Action and chemical specific	Identifies hazardous wastes that are subject to land disposal restrictions	Applicable	Applicable if remedial activities include the disposal of hazardous waste
Transportation of Hazardous Materials	NJAC 16:49	Action specific	Regulates shipping/transport of hazardous materials.	Applicable	Applicable if action includes off-site transport of hazardous materials

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Solid Waste Regulations And Recycling	NJAC 7:26 Subchapter 1, 2 NJAC 7:26A-1	Action specific	Regulates non-hazardous waste management.	Applicable	Applicable if action includes generation or management of solid wastes.
Sediment Guidance for Sediment Quality Evaluations	NJDEP Ecological Evaluation Technical Guidance August 2012	Chemical specific	Establishes guidance for sediment evaluation to be used in ecological risk assessment process under Site Remediation Program	TBC	Provides basis for determining sediment cleanup criteria for remedial actions
Surface Water: Storm Water Management	NJAC 7:8	Action specific	Establishes requirements for managing and controlling storm water from the site.	Applicable	Applicable if conditions are altered for remedial activities.
Surface Water Standards	NJAC 7:9B	Chemical specific	Sets standards for the restoration and maintenance of chemical, physical and biological characteristics of surface water.	Applicable	Applicable to certain remedial technologies (e.g., surface water discharge), and potentially assessment of South Branch Creek.
Flood Hazard Area Control	NJAC 7:13	Location specific	Controls and limits development in flood plains	Applicable	Applicable to remedial activities in a flood plain.
New Jersey Pollutant Discharge Elimination System Rules	NJAC 7:14A	Action and chemical specific	Establishes standards for surface water discharge for site remediation projects. Takes precedence over National Pollution Discharge Elimination System regulations (40 CFR 122 and 125)	Applicable	Potentially applicable if remedial activities include discharge to surface water.
Treatment Works Approval	NJAC 7:14A-22,23	Action and chemical specific	Regulates the construction and operation of industrial and domestic wastewater collection, conveyance, and treatment facilities.	Relevant and Appropriate	Potentially applicable if remedial activities include a treatment plant or pre-treatment plant with discharge to POTW.
Soil: Soil Erosion and Sediment Control/Mitigation	NJAC 7:13-3.3, 3.4	Action specific	Requires controls for erosion and sediment transport.	Applicable	Applicable to construction activities that disturb soils.

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Remediation Standards	NJAC 7:26D	Chemical specific	Soil site-specific cleanup levels. Includes guidance on development of impact to groundwater soil remediation standards. Regulations also include remediation standards for groundwater and surface water.	Applicable	Provides soil, groundwater, and surface water cleanup objectives.
Wetlands and Costal Zone: Freshwater Wetland Protection Act Rules	NJAC 7:7A	Location specific	Establishes requirements for the protection of freshwater wetlands.	Applicable	Applicable to remedial actions that affect wetland areas, such as adjacent to South Branch Creek.
Coastal Permit Program Rules	NJAC 7:7	Location specific	Establishes requirements for the protection of coastal areas.	Applicable	Applicable to remedial actions that occur within a coastal zone. Coastal zone (CAFRA) is not present adjacent to the site, however, waterfront development requirements would apply.
Other:					
Technical Requirements for Site Remediation	NJAC 7:26E	Action specific	Specifies requirements for remedial activities within New Jersey.	Applicable	State program for implementation of remedial activities and part of Licensed Site Remediation Professional program.
Well Construction and Maintenance, Sealing of Abandoned Wells	NJAC 7:9D	Action specific	Specifies requirements for installation and abandonment of wells.	Applicable	Applicable to remedial action that involve construction or abandonment of wells.

Table 7-7
LCP Chemicals, Inc. Superfund Site, Feasibility Study
Combined Site Remedy No. 4b
Full Containment and Full Depth Stabilization
Detailed Cost Estimate

Capital Costs				Cost Range	
Item	Unit	Unit Price	Quantity	Min	Max
Soil Remedy Components (Alternative 8S-2)					
Mobilization / Demobilization	LS	$105,000	-	$105,000	$105,000
Misc. Site Preparation & Clearing	Ac	$4,600	24.2	$111,000	$111,000
In-situ Stabilization	CY	$80	23,600	$1,888,000	$1,888,000
Stabilization Reagent at 5% S0 Loading	Ton	$500	1,800	$900,000	$9,000,000
Capping	Ac	$250,000	21.9	$5,046,000	$5,046,000
Establish Use Restrictions (Deed Notice)	LS	$50,000	-	$50,000	$50,000
Soil Erosion and Sediment Control/Site Restoration	Ac	$5,000	24.2	$121,000	$121,000
Miscellaneous (HASP, permits, survey)	LS	$50,000	-	$50,000	$50,000
Groundwater Remedy Components (Alternative 2GW)					
Mobilization / Demobilization	LS	$75,000	-	$75,000	$75,000
Misc. Site Preparation & Clearing	Ac	$4,600	24.2	$111,000	$111,000
Barrier Wall	LF	$700	3,900	$2,730,000	$2,730,000
Shallow Groundwater Collection System	LF	$220	5,300	$1,166,000	$1,166,000
Soil Erosion and Sediment Control/Site Restoration	Ac	$5,000	6.1	$30,000	$30,000
Miscellaneous (HASP, permits, survey)	LS	$50,000	-	$50,000	$50,000
Establish Use Restrictions (CEA)	LS	$50,000	-	$50,000	$50,000
Sediment Remedy Components (Alternative 3SD)					
Mobilization / Demobilization	LS	$25,000	-	$25,000	$25,000
Misc. Site Preparation & Clearing	Ac	$4,600	1.3	$6,000	$6,000
Excavate Sediments	CY	$25	4,100	$103,000	$103,000
Stabilization/Solidification*	CY	$150	2,050	$308,000	$308,000
Additional Backfill Upstream Portion of Creek	CY	$28	2,200	$62,000	$62,000
On-Site Disposal	CY	$13	4,100	$53,000	$53,000
Northern Off-Site Ditch Outlet Extension	LS	$50,000	-	$50,000	$50,000
Restore/Mitigate Wetlands	Ac	$150,000	1.3	$200,000	$200,000
Building Remedy Components (Alternative 2B)					
Mobilization / Demobilization	LS	$25,000	-	$25,000	$25,000
Building Demolition	CF	$0.64	6,740,000	$3,674,000	$3,674,000
Debris Processing (crushing, etc.)	CY	$30	32,000	$960,000	$960,000
Stabilization	CY	$150	8,000	$1,200,000	$1,200,000
On-Site Disposal	CY	$13	32,000	$416,000	$416,000
0		$0	-	$0	$0
Subtotal				$20,665,000	$28,665,000
Engineering and Administration	%	10%		$2,067,000	$2,867,000
Subtotal				$22,732,000	$31,532,000
Contingencies	%	30%		$6,797,000	$9,460,000
Total Capital				$29,409,000	$40,992,000
Annual Operation, Maintenance & Monitoring Costs					
Soil Remedy Components (Alternative 8S-2)					
Cap Maintenance	LS	$8,100	-	$8,100	
Maintenance of Institutional Controls (Deed Notice Certification)	LS	$7,500	-	$7,500	
Reporting, 5-year reviews, etc.	LS	$4,300	-	$4,300	
Groundwater Remedy Components (Alternative 2GW)					
Maintenance of Institutional Controls (Deed Notice Certification)	LS	$7,500	-	$7,500	
Reporting, 5-year reviews, etc.	LS	$4,300	-	$4,300	
Quarterly Groundwater Monitoring	LS	$30,000	-	$30,000	
Groundwater Treatment (POTW Discharge)	GAL	$0.0011	315,360	$340	
Sediment Remedy Components (Alternative 3SD)					
Maintenance of Wetlands	LS	$5,200	-	$5,200	
Reporting	LS	$3,000	-	$3,000	
Subtotal				$66,000	
Contingencies	%	30%		$20,000	
Total Annual OM&M				$86,000	
Net Present Worth Annual OM&M (7%, 30 yrs)				$1,092,000	
Total 30 Year Net Present Worth				$30,501,000	$42,084,000

Note:
[1] Range in cost representative of a range of potential sulfur loading in the soil stabilization process between 5% to 50% by weight sulfur per ton of soil

R2-0006988

R2-0062935

APPENDIX III

ADMNISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

DRAFT
08/19/2013

Site Name: LCP CHEMICALS INC.
CERCLIS ID: NJD079303020
OUID: 01
SSID: 02HU
Action:

REGION ID: 02

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Beginning Bates:	Ending Bates:	Addressee Name:	Addressee Organization:	Author Name:	Author Organization:
689020	08/20/2013	COMPREHENSIVE ADMINISTRATIVE RECORD INDEX FOR OU1 FOR THE LCP CHEMICALS INCORPORATED SITE	7	[INDEX]			[]	[]	[,]	[US ENVIRONMENTAL PROTECTION AGENCY]
101550	1111-01-01 00:00:00.0	LCP CHEMICALS, INC. SITE, ADMINISTRATIVE RECORD FILE, INDEX OF DOCUMENTS.	4	[INDEX]			[]	[]	[NOT AVAILABLE, NOT AVAILABLE]	[EPA, REGION 2]
101551	1111-01-01 00:00:00.0	LCP CHEMICALS, INC. SITE, ADMINISTRATIVE RECORD FILE UPDATE, INDEX OF DOCUMENTS.	2	[INDEX]			[]	[]	[NOT AVAILABLE, NOT AVAILABLE]	[EPA, REGION 2]
113600	11/01/1985	Report: Preliminary Assessment for RCRA Corrective Action Program, GAF Linden, Dupont Rd, Foot of Wood Ave., Linden, Union County, NJ, prepared by the Division of Waste Management, Bureau of Hazardous Waste Planning & Classification, prepared...	114	[REPORT]	101359	101472	[,]	[NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[,]	[Bureau of Hazardous Waste Planning & Classification]
113593	09/09/1994	Memorandum to File, U.S. EPA, Region II, from Mr. Nick Magriples, CHMM, On-Scene Coordinator, Technical Support Section, U.S. EPA, Region II, re: Removal Site Evaluation for LCP Corp. (Linden Chemicals and Plastics), Division of Hanlin Group, Linden...	2	[MEMORANDUM]	100001	100002	[FILE,]	[UNKNOWN]	[MAGRIPLES, NICK]	[EPA]
113596	07/24/1995	Report: Final Draft, Site Inspection, LCP Chemicals, Inc., Linden, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 1 of 4, submitted by Mr. David S. Kahlenberg, Site...	158	[REPORT]	100026	100183	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113597	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 2 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steven T. McNulty, Task Leader...	412	[REPORT]	100184	100595	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]

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113598	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 3 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steven T. McNulty, Task Leader...	397	[REPORT]	100595	100990	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113599	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 4 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steven T. McNulty, Task Leader...	368	[REPORT]	100991	101358	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113594	08/12/1996	Memorandum to File, U.S. EPA, Region II, from Mr. Nick Magriples, CHMM, On-Scene Coordinator, U.S. EPA, Region II, re: Removal Site Evaluation for LCP Chemicals, Inc., Division of Hanlin Group, Linden, Union County, New Jersey, August 12, 1996...	21	[CHART / TABLE, MAP, MEMORANDUM]	100003	100023	[FILE,]	[UNKNOWN]	[MAGRIPLES, NICK]	[EPA]
113595	10/25/1996	Memorandum to Ms. Kathleen Callahan, Director, Emergency & Remedial Response Division, U.S. EPA, Region II, from Mr. Conrad Simon, Director, Air & Waste Management Division, U.S. EPA, Region II, re: Referral...	2	[MEMORANDUM]	100024	100025	[CALLAHAN, KATHLEEN]	[EPA, REGION II]	[SIMON, CONRAD]	[EPA]
113601	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 1 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	120	[FIGURE, MAP, REPORT]	101473	101592	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]

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113602	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 2 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	184	[FIGURE, MAP, REPORT]	101593	101776	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113603	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 3 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	363	[CHART / TABLE, FIGURE, LETTER, MAP, MEMORANDUM, REPORT]	101777	102138	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113604	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 4 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	395	[CHART / TABLE, FIGURE, FORM, LETTER, MAP, REPORT]	102139	102533	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113608	04/26/1999	Letter to ISP Environmental Services Inc., c/o Dennis Toft, Esq., Wolff & Samson, from Muthu S. Sundram, Esq., Assistant Regional Counsel, New Jersey Superfund Branch, U.S. EPA, Region II, re: LCP Chemicals, Inc., Superfund Site, Linden, Union...	49	[ADMIN. ORDER , LEGAL DOCUMENT, LETTER]	700001	700049	[ISP ENVIRONMENTAL SERVICES, IN, , TOFT, DENNIS M]	[NONE, WOLFF & SAMSON]	[SUNDRAM, MUTHU S]	[EPA, REGION 2]
113607	06/01/1999	Report: Statement of Qualifications, LCP Chemicals, Inc., Superfund Site, Linden, Union County, New Jersey, prepared by URS Greiner Woodward Clyde, prepared for ISP Environmental Services, Inc., June, 1999.	102	[CHART / TABLE, REPORT]	300001	300102	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS GREINER, INC.]
113605	08/14/2000	Plan: Work Plan, Interim Removal Action (IRA) for LCP Chemicals, Inc., Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services, Inc., August 14, 2000.	36	[CHART / TABLE, REPORT]	200001	200036	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]

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113606	09/07/2000	Plan: Health and Safety Plan, Interim Removal Action (IRA) for LCP Chemicals, Inc., Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services, Inc., September 7, 2000.	317	[CHART / TABLE, FIGURE, FORM, REPORT]	300037	300340	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113611	10/16/2000	Letter to Ms. Patricia Simmons, Emergency and Remedial Response Division, U.S. EPA, Region II, from Mr. Thomas Placiotta, Project Manager, URS Corporation, re: Interim Removal Action Addendum, Subcontractor Health and Safety Plan, and Notification	139	[LETTER, REPORT]	300557	300735	[SIMMONS, PATRICIA]	[EPA]	[PLACIOTTA, THOMAS]	[URS CORPORATION]
113612	11/01/2000	Memorandum to Mr. Tarek Khouri, URS Greiner Woodward Clyde, from Mr. Frank Quinton, Health and Safety Manager, Integrated Technical Services, Inc., re: LCP Chemical HASP (Attachment: Material Safety Data Sheet)	23	[MEMORANDUM, REPORT]	300736	300758	[KHOURI, TAREK]	[URS GREINER, INC.]	[QUINTON, FRANK]	[INTEGRATED TECHNICAL SERVICES, INC.]
113609	04/12/2001	Report: Final Sampling and Analysis Plan, Field Operations Plan, Part I, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental	193	[REPORT]	300103	300295	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113610	04/12/2001	Report: Final Quality Assurance Prelect Plan, Field Operations Plan, Part II, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental	301	[REPORT]	300296	300596	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113613	04/12/2001	Report: Final Work Plan, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental Services Inc.	225	[REPORT]	300759	300983	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]

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113614	04/16/2001	Report: Final Report, Interim Removal Action (IRA) for LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services Inc.	191	[REPORT]	300984	301174	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
198983	10/06/2000	FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	210	[PLAN]			[]	[]	[,]	[URS CORPORATION]
198984	02/12/2001	FINAL SAMPLING AND ANALYSIS PLAN - PART 1 OF THE FIELD OPERATIONS PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	183	[PLAN]			[]	[]	[,]	[URS CORPORATION]
198985	04/12/2001	FINAL QUALITY ASSURANCE PROJECT PLAN - PART 2 OF THE FIELD OPERATIONS PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	293	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
198986	10/12/2001	ADDENDUM NO. 1 TO THE FIELD OPERATIONS PLAN FOR CASED DEEP BORINGS FOR THE LCP CHEMICALS INCORPORATED SITE	4	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198987	11/01/2001	ADDENDUM NO. 2 TO THE FIELD OPERATIONS PLAN FOR SUBSURFACE UTILITY CLEARANCE FOR THE LCP CHEMICALS INCORPORATED SITE	5	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198988	03/01/2002	ADDENDUM NO. 3 TO THE FIELD OPERATIONS PLAN FOR SAMPLING BENEATH BUILDINGS 230 AND 240 FOR THE LCP CHEMICALS INCORPORATED SITE	25	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198990	09/01/2006	HEALTH AND SAFETY PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	131	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198989	10/01/2006	REVISED SUPPLEMENTAL WORK PLAN: SEDIMENT TOXICITY TESTING (SOUTH BRANCH CREEK) - PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	15	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]

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198993	10/01/2006	REVISED ADDENDUM NO. 1 (SOIL AND GROUNDWATER) WORK PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	58	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198994	10/01/2006	REVISED ADDENDUM NO. 2 (SOUTH BRANCH CREEK AND ECOLOGICAL ISSUES) WORK PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	36	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198995	10/01/2006	REVISED ADDENDUM NO. 4 FIELD OPERATIONS PLAN (BEDROCK MONITORING WELLS, SOIL VAPOR TESTING, AND GROUNDWATER SAMPLING) FOR THE LCP CHEMICALS INCORPORATED SITE	29	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198996	10/01/2006	REVISED ADDENDUM NO. 5 FIELD OPERATIONS PLAN (ECOLOGICAL SAMPLING) FOR THE LCP CHEMICALS INCORPORATED SITE	12	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198991	10/05/2006	QUALITY ASSURANCE PROJECT PLAN ADDENDUM FOR SOIL VAPOR SAMPLING FOR THE LCP CHEMICALS INCORPORATED SITE	58	[PLAN]			[FARANCA, FRANK , GORIN, JONATHON]	[EPA, REGION 2, NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[MACMILLIN, SCOTT D]	[BROWN AND CALDWELL]
198992	10/13/2006	REVISED QUALITY ASSURANCE PROJECT PLAN ADDENDUM FOR SOUTH BRANCH CREEK - AUGUST 23, 2006 FOR THE LCP CHEMICALS INCORPORATED SITE	506	[PLAN]			[FARANCA, FRANK , GORIN, JONATHON]	[EPA, REGION 2, NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[MACMILLIN, SCOTT D, SORELL, TAMARA]	[BROWN AND CALDWELL]
688391	12/17/2008	TECHNICAL MEMORANDUM FOR THE IDENTIFICATION OF CANDIDATE TECHNOLOGIES FOR THE LCP CHEMICALS INCORPORATED SITE	31	[REPORT]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198981	05/14/2010	REVISED SCOPE OF WORK - CHARACTERIZATION OF OFF-SITE DITCHES FOR THE LCP CHEMICALS INCORPORATED SITE	13	[LETTER]			[GORIN, JON]	[EPA, REGION 2]	[MACMILLIN, SCOTT D, THORN, PAUL J]	[BROWN AND CALDWELL]
198982	11/01/2010	REVISED QUALITY ASSURANCE PROJECT PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	980	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
688390	05/27/2011	REMEDIAL INVESTIGATION REPORT - APPENDIX P: FINAL HUMAN HEALTH RISK ASSESSMENT - VOLUME 5 OF 6 FOR THE LCP CHEMICAL COMPANY SITE	373	[REPORT]			[]	[]	[ ]	[GEOSYNTEC CONSULTANTS]

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198980	08/01/2013	FINAL FEASIBILITY STUDY REPORT FOR THE LCP CHEMICALS INCORPORATED SITE	359	[REPORT]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[CORNERSTONE ENGINEERING GROUP LLC]

APPENDIX IV

STATE LETTER OF CONCURRANCE

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SITE REMEDIATION
Mail Code 401-06
P. O. Box 420
Trenton, New Jersey 08625-0420
Tel. #: 609-292-1250
Fax. #: 609-777-1914

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

FEB 19 2014

Mr. Walter Mugdan, Director
Emergency and Remedial Response Division
USEPA-Region 2
290 Broadway, Floor 19
New York, NY 10007-1866

Re: LCP Chemicals, Inc. Superfund Site
Record of Decision

Dear Mr. Mugdan:

The New Jersey Department of Environmental Protection (Department) completed its review of the "draft Record of Decision, LCP Chemicals, Inc, Superfund Site, Linden, Union County, New Jersey" prepared by the U.S. Environmental Protection Agency (EPA) Region II in December, 2013. The Department concurs with the proposed concept of in-situ stabilization of the free mercury to a depth of free mercury of 17 feet which includes a multi-layer cap, shallow ground water treatment system, groundwater monitoring and the removal of contaminated sediments in North Off-Site Ditch and the lower part of South Branch Creek. However, the Department cannot concur with the full remedy for the following reasons:

- A treatability study of the in-situ stabilization technology was not performed to determine if the technology would be effective at the LCP site for the selected remedy or the first contingency remedy of treatment to 6 feet. In addition, it has not been determined if there are any obstructions at depth which might hinder in-situ stabilization to 17 feet.

- The Department's position is that the contingency remedy should be excavation and off-site disposal of the free mercury (Alternative 5B). While costly, this alternative appears implementable. Containment alone, which is one of the proposed contingencies, does not address the free mercury.

- The draft ROD states that EPA will determine clean-up levels for the sediments that are consistent with existing levels in the Arthur Kill (i.e. background) or the preliminary

remediation goals determined for the site, if they are higher. EPA has indicated that additional data will not be collected to determine the sediment clean-up level. The Department position is that sufficient data has not been collected in the Arthur Kill to determine background. Once background is determined, additional delineation and possibly remediation may be necessary in the Arthur Kill.

In conclusion, for the reasons listed above, the Department does not concur with the selected remedy in the December 2013 draft Record of Decision. If you have any questions, please contact me.

Sincerely,

Mark J. Pedersen
Acting Assistant Commissioner
Site Remediation Program

c: Jon Gorin, USEPA
Anne Pavelka, NJDEP

APPENDIX V

RESPONSIVENESS SUMMARY

APPENDIX V

RESPONSIVENESS SUMMARY
LCP Chemicals, Inc., Superfund Site
Linden, New Jersey

INTRODUCTION

This Responsiveness Summary provides a summary of the public's comments and concerns regarding the Proposed Plan for the LCP Chemicals, Inc., Superfund Site's preferred remedy, and EPA's responses to those comments. All comments summarized in this document have been considered in EPA's final decision for the selection of remedial alternatives for the Site.

This Responsiveness Summary is divided into the following sections:

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS: This section provides the history of community involvement and interests regarding the Site.

II. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, CONCERNS AND RESPONSES: This section contains summaries of oral comments received by EPA at the public meeting, EPA's responses to these comments, as well as responses to written comments received during the public comment period.

The last section of this Responsiveness Summary includes attachments, which document public participation in the remedy selection process for this site. They are as follows:

Attachment A contains the Proposed Plan that was distributed to the public for review and comment;

Attachment B contains the public notices that appeared in the Home News Tribune;

Attachment C contains the transcripts of the public meeting; and

Attachment D contains the written comments received by EPA during the public comment period.

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

On August 21, 2013, EPA released the Proposed Plan and supporting documentation for the proposed remedy to the public for comment. EPA made these documents available to the public in the administrative record repositories maintained at the EPA Region 2 office (290 Broadway, New York, New York) and the Linden Public Library (31 East Henry Street, Linden, New Jersey). EPA published a notice of availability of these documents in the Home News Tribune newspaper on August 21, 2013. EPA opened a public comment period which ran from August, 21 2013, until September 20, 2012. Due to a request

for a public comment period extension, on September 17, 2013, EPA extended the public comment period to October 21, 2013.

On August 21, 2013, EPA held a public meeting at the Tremley Point Recreation Building, in Linden, NJ to inform local officials and interested residents about the Superfund process, to present the preferred remedial alternatives for the Site, solicit oral comment, and respond to any questions.

II. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, CONCERNS, AND RESPONSES

PART 1: Verbal Comments

This section summarizes comments received from the public during the public comment period along with EPA's responses.

A. SUMMARY OF QUESTIONS AND EPA's RESPONSES FROM THE PUBLIC MEETING CONCERNING THE LCP CHEMICALS INC. SUPERFUND SITE

A public meeting was held August 28, 2013, at 7:00 p.m. in the Tremley Point Recreation Building, in Linden, New Jersey. In addition to a brief presentation of the investigation findings, EPA presented the Proposed Plan and preferred alternative for the Site, received comments from meeting participants, and responded to questions regarding the remedial alternatives under consideration. Attachment C includes the entire transcript of the public meeting.

A summary of comments raised by the public following EPA's presentation is presented below:

Comment #1: *One commenter asked what PTW stood for.*

EPA Response: Principal threat waste, which is the area on Site with visible mercury in soil.

Comment #2: *One commenter asked whether the local sewer authority can handle the overburden groundwater discharge.*

EPA Response: Since it will not be a lot of water, EPA expects that the sewer authority can easily handle the discharge. Also, if they say they cannot accept the water, there are other options such, as treating it at the adjacent GAF site.

Comment #3: *One commenter asked where the mercury, once removed from the water, would be sent.*

EPA Response: The mercury in the groundwater is at a low concentration, so there would not be much mercury removed from the water. Whatever mercury is removed will be disposed of with the sludge by whatever method the selected facility (e.g., sewer authority) uses to dispose of waste.

Comment #4: *Once commenter asked if the plan is to simply bury the contaminated soil.*

EPA Response: No. Some soil (the PTW) will be treated and contained on Site. Other soil, with high levels of mercury but not considered PTW, will also be contained.

Comment #5: *One commenter pointed out that in its presentation EPA referred to a risk number and said it was over a hundred which is high, and should be less than one. What is it a hundred of?*

EPA Response: The number is based on a human health risk calculation for non carcinogens called a "hazard index." One is an acceptable number, anything above one is unacceptable. The hazard index at the site is 190. This is for the quantifiable soil concentrations, not the PTW which is hard to quantify. However, EPA believes that the HI for PTW would be substantially higher than 190. In brief, if someone were working on the Site they would be exposed to an unacceptable level of risk.

Comment #6: *One commenter asked what a geosynthetic membrane is and whether it is impermeable.*

EPA Response: A geosynthetic membrane is essentially a thick piece of plastic. It is commonly used at hazardous waste sites and landfills. In general, the cap will probably consist of a base aggregate, the membrane, some stone, soil and grass or perhaps asphalt. The geosynthetic membrane is basically impermeable and is in compliance with New Jersey regulations.

Comment #7: *Several commenters asked if the remedy, combined with the proposed impermeable cap on a nearby property would increase floodwater problems in the area.*

EPA Response: The EPA staff at the public meeting were not aware of the other cap the commenters were discussing. However, caps are impermeable and issues like rainwater drainage need to be addressed during the design phase. The rainwater running through the stone on top of the cap will not be contaminated, so run-off options could include discharge to the Arthur Kill, for example. The final design would ensure that run-off does not cause additional flooding problems in the area.

Comment #8: *One commenter asked what happens if the responsible parties decide they do not want to pay for the selected remedy and instead they decide to select the less expensive option.*

EPA Response: The responsible parties do not select the remedy. EPA makes that choice and we ask the parties if they want to implement EPA's selected remedy. The parties typically respond positively, because they believe they can do it more effectively and cheaper than EPA. If they refuse, EPA has various enforcement options it can consider.

Comment #9: *One commenter asked about the barrier wall's location, what it's going to be made of and how high will it be.*

EPA Response: EPA can tell where the barrier wall will be, but EPA has yet determined what it will be made of. The wall be installed around the Site, and it will be tied to the glacial till layer. The decision on what it will be made of will be part of the remedial design process, and subject to EPA approval. Typically, barrier walls are made from steel sheeting or bentonite however EPA can accept other options that will hold contaminants on Site. The wall will be below the ground, so it will not be visible from the surface. That will make it easier for the Site to be reused in the future.

Comment #10: *One commenter asked if the sulfur/mercury treatment process has been done elsewhere.*

EPA Response: The process has been recently been tested at other sites, like the Mercury Refining Site in upstate New York. A pilot study is being performed at that site, as we will be performing one at this Site. EPA researchers have confirmed that, chemically, the process should work. The main issue at the

Site is the type of soil we will need to treat. The soil is mainly fill and rubble, where effective mixing will be difficult. That is an engineering issue that will be addressed during the pilot study.

Comment #11: *One commenter asked to see the NRRB comments and the responses.*

EPA Response: The NRRB stands for the National Remedy Review Board. The NRRB reviews proposed Superfund cleanup decisions that meet cost-based review criteria to assure they are consistent with Superfund law, regulations, and guidance. After each review, the board prepares a memo with their findings and recommendations to the region.

The NRRB memo and Region 2's responses can be found at the following:
http://www.epa.gov/superfund/programs/nrrb/pdfs/LCP_Memo.pdf
http://www.epa.gov/region02/superfund/npl/lcpchemicals/pdf/lcp_nrrb_region_2_response_memo.PDF

Comment #12: *One commenter wanted to know if the risk assessment was done prior to Superstorm Sandy, and several commenters wanted to know if the Tremley Point area has been tested after the storm to see if contamination in the Arthur Kill or South Branch Creek affected the area. The commenter wondered whether the residents in the area should be concerned.*

EPA Response: All the investigatory work was done prior to the Storm. EPA is not aware of anyone who has tested the area for effects from the Storm. EPA believes it is unlikely that contamination was spread from the Site, even due to Superstorm Sandy's surge. The reason is that the mercury has stayed in place for over 30 years, including during other storm events, such as Hurricane Gloria and the 1992 Nor'easter. EPA will consider sampling a few adjacent properties to determine if Site contaminants may have migrated.

Comment #13: *One commenter wondered if there was a reason to clean up the Site if it doesn't affect the community.*

EPA Response: Under the Superfund land, EPA has the authority to cleanup sites that pose a current or potential future risk to human health and the environment. There are several reasons to address Site contamination such as to: allow future reuse of the Site for industrial purposes; prevent additional mercury from entering the Arthur Kill; and prevent additional mercury from entering the atmosphere.

Comment #14: *One commenter asked if the people who caused this will be profiting from the cleanup by having their property reused and are the vapors from the mercury putting people are risk.*

EPA Response: The owner has abandoned the Site. The owner is the Hanlin Group. EPA expects someone will take over the Site and redevelop it. EPA has identified an entity that has responsibility for the Site, and they are paying for it. However, they do not own the property.

Data collected on Site, even during hot days when vaporization is highest, do not show an unacceptable risk to the community from atmospheric mercury migrating from the Site.

Comment #15: *One commenter asked the name of the entity paying for the cleanup and whether they own the Site.*

EPA response: Originally it would been LCP, however their liability was passed to ISP and now it is with Ashland Chemical. To date, ISP and Ashland have paid for the remedial work. While Ashland is responsible for the Site cleanup, it does not own the property.

Comment #16: *Several commenters asked how Ashland became responsible.*

EPA Response: Typically what happens is one company buys another company or a piece of another company. As part of that purchase, they have to take over certain liabilities, such as cleaning up a Superfund site.

Comment: *One commenter asked if EPA considered open space or recreation areas for the Site.*

EPA Response: No. The Site is located in an industrial area, surrounded by sites being used or planned to be used for industrial purposes. The Site has limited access. EPA recognizes the remedy will impact a limited area of wetlands near the South Branch Creek. To address this impact, wetland remediation and mitigation will be implemented.

Comment 18: *One commenter asked if the Army Corps or EPA will be remediating the wetlands.*

EPA Response: EPA is not sure at this point who would be doing it, however EPA expects that the responsible party will be paying for the wetlands remediation.

Comment #19: *One commenter asked who is policing the Site, and why the pollution wasn't stopped earlier.*

EPA Response: EPA is the lead regulatory agency in charge of the Site. There are a number of reasons why this Site has taken so long to reach this point. One key issue is the technical complexity of analyzing solutions to address the Site's principal threat waste.

Comment #20: *One commenter asked who has been investigating the adjacent sites, such as the El du Pont property.*

EPA Response: EPA doesn't know who has been investigating those sites. Since they are apparently covered or capped, they are further ahead in the remedial process than LCP.

Comment #21: *One commenter asked how the stabilization will be implemented, and how deep will the remediation go, and will vapors have to be collected.*

EPA Response: The remedy has not been designed yet, but EPA expects the stabilization will incorporate mixing the sulfur and PTW in place. A key question is the amount of sulfur needed per volume of soil. EPA expects to go full depth, as much as 17 feet. However, there is a lot that remains unknown about the depth and the types of debris or pilings that will be encounter. If going to a depth of 17 feet cannot be accomplished, EPA has proposed a contingency to go down to 6 feet. That contingency depth will still address the majority of the visible mercury. A decision on the need for vapor collection will be made during the design.

Comment #22: *One commenter asked about the legal instrument EPA will use to compel the PRPs to perform the remedy especially when the PRP has changed.*

EPA Response: When ISP sold a portion of their company to Ashland, the responsibility to perform the Site investigation and feasibility study – per an Administrative Order on Consent - went with it. After the ROD is signed, EPA will offer Ashland the opportunity to perform the remedy through a Consent Decree. EPA expects they will perform the remedy.

Comment #23: *One commenter asked if the sulfur could convert some chemical in the soils into a chemical that's hazardous.*

EPA Response: EPA does not expect it will happen and EPA will be monitoring the air during the work phases.

Comment #24: *One commenter asked what happens with the mercury in the building, and if there are other chemicals in the building.*

EPA Response: A key to the design and remedial action will be dust and vapor control during demolition as the buildings' porous material is likely heavily contaminated with mercury. The dust/vapor control processes used for buildings demolition are pretty well known and EPA does not expect to find high levels of contaminants aside from mercury.

Comment #25: *One commenter mentioned that he did a demolition project at a site that had used mercury and found the bricks were heavily contaminated with mercury, and vaporization became an issue during hot weather. They stopped work and decided to wait until winter. The commenter also asked where the bricks from the LCP Site would be sent. The commenter was concerned that crushing the brick would release more mercury vapor. Further, the commenter asked if EPA would consider doing the mixing under a bubble or some type of spring form.*

EPA Response: EPA noted the same sort of experience - high levels of mercury in porous brick - during the demolition of a building at a Superfund site in Hoboken, New Jersey. The bricks from LCP's buildings will be treated with sulfur and placed under the cap. EPA recognizes that crushing the brick could release vapor to an unacceptable level, therefore the design will have to account for and prevent that possibility. EPA will consider doing the work inside a temporary structure.

Comment #26: *One commenter asked how long the project will take and if it will be done in all seasons.*

EPA Response: EPA expects the work to go on all year. EPA believes it will take a year and a half for the pilot study, a year for the design, and another year and a half to two years for the construction work to be completed.

Comment #27: *One commenter asked if there was an estimate of the amount of mercury that may have vaporized from the Site over the last thirty years.*

EPA Response: EPA has never made that estimate, but recognizes that vaporization has and continues to occur, which is why EPA would like to implement the remedy as soon as possible.

Comment #28: *One commenter asked how EPA predicted the land use for the risk assessments when there is no land owner.*

EPA Response: For the risk assessments, EPA assumed the land use would be commercial/industrial, which is what the land is currently zoned for. If the Site were to be used for residential purposes, the risk assessment would have found a greater potential risk. Either way, EPA would have decided that the risk posed by the Site needed to be addressed.

Comment #29: *One commenter asked what EPA would have done if this were in a residential area.*

EPA Response: EPA only considered current and potential future uses for the Site, which does not include residences.

Comment #30: *One commenter asked what would happen if during the remedial phase a storm floods the site.*

EPA Response: Based on the nature of mercury, it is unlikely to spread much even during a storm such as Superstorm Sandy. However there will be some contingencies built into the design of the remediation, just in case a hurricane or nor'easter hits while work is underway.

Comment #31: *One commenter asked if, in the future, all water entering the LCP site during rain events, will discharge to the Arthur Kill.*

EPA Response: EPA cannot say that the all the stormwater on Site will eventually discharge to the Arthur Kill. However, the requirements of a New Jersey storm water permit would have to be met by the final design.

Comment #32: *One commenter asked if the South Branch Creek and Northern Offsite Ditch are going to use different cleanup standards due to their proximity to the Arthur Kill. The commenter also expressed concerns that EPA's proposed remedy was inconsistent with EPA's approach to other areas impacting Raritan Bay, where cleanups are performed to prevent further contamination of the Bay. The commenter indicated he was not just concerned about mercury, but also benzene, etc.*

EPA Response: Unlike soil, there are no promulgated standards in New Jersey for sediments. In some cases National Oceanic and Atmospheric Administration screening levels are used for sediments. Those levels are very low. If EPA were to clean up to that level, the sediments would be re-contaminated by the Arthur Kill over a few tide cycles. Therefore, EPA decided to clean the Creek and Ditch to levels consistent with those found in the Arthur Kill. Cleanup of the Creek and Ditch will achieve contaminant levels far below levels currently found in the sediments. This cleanup will interrupt sources of mercury from the Site into the environment. Benzene and the other contaminations in the overburden groundwater will be contained, pumped and treated.

Comment #33: *One commenter asked about a 2002 state bill that required a mercury alert notice throughout the areas, and whether there has been compliance. The commenter indicated that this bill would require signs to be posted in every medical office.*

EPA Response: EPA does not regulate or enforce that state law. EPA's focus is the Site remediation.

Comment #34: *One commenter asked how EPA plans on containing contamination during the remediation that is on worker's feet or on trucks running through the neighborhood.*

EPA Response: That is a concern on nearly every site cleanup, and is addressed through a site-specific health and safety plan. Rules will be in place for people and equipment entering "exclusion zones" and being cleaned of waste before exiting those zones.

Comment #35: *One commenter asked about the mercury ban.*

EPA Response: The mercury ban refers to a restriction in the United States, which prevents movement of elemental mercury across our international borders.

Comment #36: *One commenter asked whether there are birds at the Site eating the contaminated crabs and fish.*

EPA Response: Yes, however, unlike crabs and fish, bird tissue was not sampled. Nevertheless, modeling performed during the risk assessment demonstrated that there is an unacceptable risk to birds, insects and small mammals from the Site contamination.

Comment #37: *One commenter asked about endangered species in the wetlands.*

EPA Response: There is no evidence of any federally endangered species on the Site. However, as part of the remedy, EPA will interrupt exposure to Site contaminants for all species of birds. EPA will be filling in some wetlands on Site but rebuilding them in an area more inviting to wildlife.

Comment #38: *Several commenters asked if there was a government agency that could sample the homes.*

EPA Response: EPA will attempt to find someone who can answer this request, and if found we will put that information up on EPA's website for the Site. EPA notes the concern residents have is not just from the Site, but rather from the water from the Arthur Kill and other local water bodies that may have impacted their homes.

Comment #39: *One commenter asked if the Site might be passed to the NJDEP.*

EPA Response: EPA does not expect that to happen, but if it does EPA and NJDEP will announce it publically.

Comment #40: *One commenter asked whether the 32,000 cubic yard estimate of buildings was their actual space or the amount of total expected debris.*

EPA Response: That is he estimate for the total amount of building material debris expected once the buildings are demolished.

Comment #41: *One commenter asked since the ban went into effect, is EPA doing any kind of work for mercury extraction as a remediation method. Meaning, if something were to come up in 2 or 3 years, could EPA use that instead of the proposed stabilization approach?*

EPA Response: EPA did a thorough search and could not find a practical technology for treatment, aside from the one proposed. However, if something were developed over the next few years, EPA will look at it. EPA can change a remedy if appropriate.

Comment #42: *One commenter asked for a realistic timeframe to begin the remedial action, and whether EPA believes the ROD will be issued in 2013.*

EPA Response: Optimistically, remediation is likely to start approximately four years after the ROD is issued. At the meeting, EPA state an expectation that the ROD would be issued in 2013.

Comment #43: *One commenter asked if EPA considered doing the South Branch Creek remedy while performing the treatability studies.*

EPA Response: Remediating the South Branch Creek as an interim remedy was an idea put forth by the responsible parties during the remedial investigation. After discussions with NOAA and the State, EPA decided to wait until the ROD is issued. However, EPA will consider performing the sediment cleanup while the pilot studies for soils are underway.

Comment #44: *One commenter asked if study results would be accessible during the RD and RA phases.*

EPA Response: The studies will be made available on-line and EPA will have other public meetings or availability sessions to explain results or findings.

Comment #45: *One commenter asked if hard copies could be sent to the library as she had difficulty accessing the information off the discs.*

EPA Response: Libraries generally prefer discs, as the RI/FS documents take up an enormous amount of shelf space. EPA will meet with the Linden librarians to make sure the electronic documents are accessible.

Comment #46: *One commenter asked whether mercury levels will increase by the time the remedy starts.*

EPA Response: No, the Site production is shut down, so there is currently no source adding mercury to the soils or sediments.

Comment #47: *One commenter asked whether the PRPs are responsible for anyone impacted from consuming contaminated fish caught in the Arthur Kill.*

EPA Response: The LCP Site is one of several other sources of mercury to the Arthur Kill, and a limited amount of mercury is still migrating to the Arthur Kill from LCP. Therefore, EPA would prefer to have the remediation completed as soon as possible.

PART 2: Written Comments

Comments from Edison Wetlands Associations et al.:
Comment #1: *Consistency in Superfund Cleanups: LCP Chemicals has been a responsible party at other Superfund sites, and therefore, the selected remedy must be consistent with cleanup remedies. LCP Chemicals had contaminated a similar site in New York adjacent to the Onondaga Lake. The former Linden Chemical and Plastics (LCP) site was a major source of mercury contamination in Geddes Brook,*

Nine Mile Creek and Onondaga Lake. As part of the site remediation, more than eight tons of mercury was removed from the plant property. Additional upland sites, for which there are other responsible parties, are also in various stages of remediation. As of 2010, Records of Decision (ROD) have been signed for cleanup plans at eight Superfund subsites. http://www.dec.ny.gov/chemical/8668.html We strongly recommend that USEPA select Alternative 5a/b (Removal and off---site disposal of the Principal Threat Waste and contaminated building debris). This remedy selection is consistent with other remedy selections like the Geddes brook, Nine Mile Creek and Onondaga Lake cleanup. The current proposed plan contains significant deficiencies in the protectiveness to human health and the environment.

The choosing of Alternative 5a/5b would provide the best of the possible remedies proposed as well as provide consistency with the cleanup of LCP's Superfund Site mercury contamination in Geddes Brook, Nine Mile Creek and Onondaga Lake. As part of the site remediation, more than 8 tons of mercury was removed from the plant property. This important regional resource in the Arthur Kill is no less important than the cleanup of Geddes Brook, Nine Mile Creek and Onondaga Lake.

Alternative 5a/b is the only alternative that offers long---term protection from these hazardous wastes that directly threaten human health and the environment and also provide permanent cleanup of the Principal Threat Waste (PTW) at LCP Chemicals Superfund Site. Cleanup of the PTW is one of the decision making tools used by the USEPA to decide on the Superfund selection remedy process and its ARARs. Only Alternative 5a/b addresses the PTW and provides a permanent cleanup of PTW, mercury, which is a direct threat human health and the environment. Along with the selection of Alternative 5a/b we also want additional mercury cleanup in the sediments that bio-accumulate in wildlife and biota.

EPA Response: The Site to which the commenter refers is the LCP Bridge Street site, located near Syracuse, NY. The remedy at the LCP Bridge Street site called for treatment of the PTW soils through soil washing. As explained in the feasibility study and this ROD, due to the nature of the Site's fill, soil washing would not work at the LCP Linden Site. Also, it should be noted that the eight tons of mercury recovered from soil at Bridge Street. went into the commercial market. As of January 2013, federal agencies are prohibited from selling or distributing elemental mercury under their control or jurisdiction. So even if soil washing were technically feasible at the LCP Linden Site, it would be administratively impracticable to select the treatment approach used at the Bridge Street site.

The LCP Bridge Street site treated a portion of its contaminated soil, specifically the PTW, through soil washing. LCP Linden will treat a portion of its contaminated soils, the PTW, through in-situ stabilization. At both sites, treated soils as well as untreated contaminated soils/sediments are contained on site. Like the LCP Linden Site's selected remedy, the LCP Bridge Street site's containment uses a barrier wall and an impermeable cap. Therefore, fundamentally the LCP Bridge Street site remedy is similar to the remedy selected for LCP Linden, the key difference being the Bridge Street site remedy treated a portion of the soils ex-situ through soil washing, while LCP Linden Site remedy will treat a portion of the soils in-situ through stabilization.

The Geddes Brook and Nine Mile Creek are small water bodies containing mercury contaminated sediments. Those sediments are being excavated and placed under the LCP Bridge Street cap. This is the same approach selected for the Northern Off-Site Ditch and bottom third of the South Branch Creek of the LCP Linden Site. Again, the remedies to which the commenter referred are similar to the remedy selected at LCP Linden.

Alternative 5b is not similar to the remedy at the LCP Bridge Street ste. Rather than treatment,

Alternative 5b called for excavation and off-site disposal of the PTW soils. Alternative 5b was not selected for a number of reasons, such as cost and increased short-term impacts to the community. More importantly, EPA also found that there is a lack of disposal options for soils with visible mercury. Land disposal of soil containing elemental mercury concentrations of over 260 ppm (i.e., all the PTW) is prohibited by the RCRA Land Disposal Restrictions (LDR). Under the LDR, the soils would have to be treated, using high-temperature mercury recovery, before disposal. Once recovered from the waste, elemental mercury has typically been returned to the commercial market as product.

While there are facilities in the United States that can accept and treat soil containing greater than 260 ppm of mercury, none of them could handle the amount of PTW soil requiring treatment at the LCP Site. EPA located only one North American facility (Stablex in Canada) that may be able to handle the quantity of PTW at LCP. However, the facility was not able to say for certain that they could handle the mass.

Comment #2: *NOAA Policy: According to a March 2004 National Oceanic and Atmospheric Administration (NOAA) report, under "Threats and Contaminants Preliminary sampling of soil, surface water, and sediment", it revealed elevated levels of mercury, and other metals. Site contaminants are potentially impacting the Arthur Kill, which is used for recreational boating and fishing. The peregrine falcon, northern harrier, great blue heron, and little blue heron, all state---listed species, are reported to either breed or hunt in the salt marshes near the site. Prall's Island, located approximately 1,000 feet east of the mouth of the South Branch Creek, is a breeding area and rookery for some of these birds. In 1990, the New Jersey Conservation Foundation and the NJ Audubon Society conducted an inventory of the river in which they identified around 200 bird species including nearly 90 species that breed in this area.*

Alternative 4b violates National Estuary Program that was established by Congress in the 1987 amendments to the Clean Water Act. Its purpose is to promote the development and implementation of comprehensive management plans for estuaries of national significance that are threatened by pollution. At the request of the governors of New York and New Jersey, USEPA accepted the New York---New Jersey Harbor & Estuary into the National Estuary Program in 1988. Since that time, it has been an effective partnership for advancing regional efforts to achieve the goals of the Clean Water Act for fishable and swimmable waters throughout the nation.

USEPA's selection of Alternative 4b also violates NOAA's policies on cleaning up and restoring sites in New Jersey. The Office of Response and Restoration's Coastal Protection and Restoration Division (OR&R/CPRD) partners with other agencies and responsible parties to ensure that waste site cleanups not only reduce risk, but also restore natural resources and improve the quality of the environment. NOAA Coastal Resource Coordinators (CRCs) get involved early in site cleanups to:

- *ensure that ecological assessments and the entire cleanup process evaluate and mitigate any risk to sensitive species and habitats;*
- *incorporate environmental restoration into cleanup actions;*

The New Jersey Resource Trustees, which includes the USEPA as a member, states the following in its mission:

> Protecting and Restoring Coastal and Marine Resources: NOAA's Coastal Protection and Restoration Division (CPRD) protects and restores natural resources in marine and coastal environments that are affected by hazardous waste sites. NOAA Coastal Resource Coordinators

(CRCs) work with the U.S. Environmental Protection Agency (EPA), the State of New Jersey, and other trustee agencies to identify risks to natural resources, recommend site cleanups that protect habitat and wildlife, and design projects to restore injured resources and habitats.

USEPA must choose Alternative 5 a/b or they will violate their mandate, through the Congressional National Estuary Program and the Federal Clean Water Act, to protect coastal resources.

EPA Response: A NOAA Regional Resource Coordinator (formally known as a Coastal Resource Coordinator) is represented on EPA Region 2's Biological Technical Assistance Group (BTAG), which reviewed and commented on the Site's investigations, including ecological risk assessments, through a multi-year iterative process. NOAA has not indicated that the selected remedy's containment of contaminated soils and groundwater would fail to comply with any NOAA policies.

The Harbor Estuary Program's (HEP) Comprehensive Conservation and Management Plan and the subsequent 2011-2015 HEP Action Plan seek to reduce toxic contamination to the estuary through a variety of actions, including Superfund site cleanups. Mercury is one of the toxics of concern for HEP. Since the selected remedy will protect human health and the environment in part by reducing mercury contamination to the estuary, it is consistent with the National Estuary Program in general and the HEP specifically.

Comment #3: *Mercury Contamination in the Arthur Kill Estuary: The contamination that has occurred on the LCP Chemicals Superfund Site is of regional importance to New Jersey's waterways and its ecologically sensitive receptors found in the Arthur Kill Estuary and on the receiving end of the Raritan Bay. Due to the proximity of this site to the Arthur Kill and a residential neighborhood, it is of critical importance to properly remediate this site and remove all contamination found on site. The Arthur Kill is currently one of the most heavily contaminated bodies of water found in New Jersey and will continue to be unless action to reduce any further contamination is taken.*

This violation of protecting America's waters has led to the poisoning of biota that is found in the Arthur Kill and has allowed contaminants such as mercury, arsenic, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), volatile organic chemicals (VOCs), chlorobenzene, benzene, and other contaminants to enter the food chain. Fully cleaning up the PTW from LCP Chemicals Superfund site would demonstrate USEPA's mandate to protect human health and the environment is still a core principle of the Superfund Program.

Extensive research has been done on mercury and results were found that in fetuses, infants, and children, the primary health effect of methylmercury is impaired neurological development. Methylmercury exposure in the womb, which can result from a mother's consumption of fish and shellfish that contain methylmercury, can adversely affect a baby's growing brain and nervous system. Impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills have been seen in children exposed to methylmercury in the womb.

The LCP Chemicals Superfund site and its PTW have contributed to the contamination of the Arthur Kill Estuary. This ongoing contamination has become so problematic that the New Jersey Department of Environmental Protection (NJDEP) & the Department of Fish and Wildlife have restricted the consumption of fish and crabs due to the overwhelming contamination of the biota found in the water. This is a clear violation of the Clean Water Act of 1972 and a violation of the Public Trust Doctrine which were passed to ensure the protection of America's waters and access to the water by the public. While in

theory this restriction would provide some protection of public health, the majority of those directly impacted don't speak English and those whose cultural heritage is to fish and crab continue to use the Arthur Kill Estuary as a food source for their families.

EPA Response: EPA agrees and has stated that the contamination at the Site currently puts the local ecology at risk. EPA recognizes that the Site is one of the numerous sites that have impacted the Arthur Kill. EPA also agrees that there would be a risk to human health if people were to work or trespass on the unremedied Site. EPA does not agree that the only way the Site's risks can be interrupted is through removal of the contamination to some other location.

Available data indicate that only a limited mass of mercury is emanating from the Site, mainly through vaporization and possibly sediment transport. The prime driver of risk is direct contact with the soils or sediments on the LCP property. The selected remedy would not only prevent vaporization and sediment transport through treatment and containment, it would also be an excellent and proven way to interrupt direct contact exposure. It should be noted that all the potential alternatives for the Site, including the one with a removal component (Alternative 5a/b), has containment as a principal element.

Comment #4: *Flooding and Severe Weather Storms: USEPA's Proposed Plan will continue to threaten residents who live in this area and who experienced flooding from severe storms and hurricanes just like Hurricanes Irene and Sandy. The contamination from Superfund Sites, like the LCP Chemicals site, have entered the Arthur Kill and then brought back inland after flood waters from the already contaminated Arthur Kill submerged most of this area. With the recent severe weather events in New Jersey, it is important to select remedies for contaminated sites that will not have the potential of creating complications or breaking in the future. Remedy selection 5a/b is the only remedy that provides any protection against future natural disasters.*

These waters have posed a threat to the residents who live in this area and who experience flooding from storms and hurricanes just like Hurricanes Irene and Sandy. The contamination that has come off of sites, such as the LCP Chemicals site, has entered the Arthur Kill and was then brought back inland after flood waters from the already contaminated Arthur Kill submerged most of this area.

EPA Response: EPA recognizes that the Site's remedy will have to be designed and constructed with the understanding that severe flooding will occur on Site sometime in the future. Containment remedies, such as the one at the Scientific Chemical Processing Superfund Site in Carlstadt, New Jersey, have proved to work successfully in flood prone areas, even during the recent storm.

Comment #5: *Incomplete Proposed Alternatives: The USEPA presents several pros to choosing alternative 5a/b yet does not present alternative 5a or 5b as a proposed alternative. In the USEPA's Proposed Plan and evaluation of alternatives, the agency shows that 5a/b meets the criteria for selecting a remedy. Alternative 5a/b meets the following criterion:*

1. *Overall protective of the environment and human health*
2. *Compliance with applicable or relevant appropriate requirements (ARARs)*
3. *Long---term effectiveness and permanence*
4. *Reduction of Toxicity Mobility or Volume Through Treatment*
5. *Short term effectiveness*
6. *Implementability*

7. *Cost*
8. *State/Support Agency Acceptance*
9. *Community Acceptance*

The USEPA states that, "In addition, Alternative 5a and 5b would require between 1,000 and 2,000 trucks to first remove the PTW soil and debris, then to bring in substrate to backfill the excavated areas. Thus Alternative 5a and 5b is the only option that would significantly increase the truck traffic through the local community." However, USEPA has overlooked the possibility of using rail lines to take the contaminated material off site. This area has a plethora of freight rail lines and has the Chemical Coast Sector adjacent to the area. The use of rail lines will highly reduce truck traffic and at the same time reduce the cost of the remediation. This mode of transport has been utilized by USEPA at other Superfund sites such as Horseshoe Road Superfund Site, Atlantic Resources Superfund Site in Sayreville NJ, and Chemical Insecticide Superfund Site in Edison, New Jersey to remove hazardous materials, reduce truck traffic, and drive the remediation cost down as well.

Even if the USEPA must use trucks, this area is well suited to handle the traffic, and the tradeoff of removing the PTW is well worth the use of trucks. This amount of trucks is relatively small in comparison to the removal of this high toxic waste. The area has many major truck routes that already have significant truck traffic.

The volume of trucks is relatively small in comparison to other Superfund site remediations that have been selected in Region 2 where full removal of PTW has been selected. The Ringwood Mines Superfund site in Ringwood, New Jersey is an example where USEPA selected removal of the O'Connor Disposal Area (12,519 truck trips or about 6,260 trucks) for the remedy selection at that site. The remedy selected for the Ringwood Mines Superfund site would generate significantly more trucks on smaller residential roads than Remedy 5 a/b at the LCP Superfund site. USEPA chose the full clean up at that site because of the same exact issues that we are stating for the selection of the remedy at the LCP Chemicals Superfund site.

EPA Response: The criteria "short term-effectiveness" requires considerations of short-term community impacts. Sending several thousand additional trucks through areas of Linden would impact the community through air and noise pollution and the increased risk of accidents. However, that was only one of, and not a key, reason that Alternative 4b was considered preferable to Alternative 5b. Alternative 5b had other short-term community impacts such as increased mercury vaporization. Alternative 5b was also significantly more expensive (criteria 7) and had logistical issues related to implementability (criteria 6) that appeared to be intractable. So even if trains could be used or trucks could somehow bypass the community, it would not have altered EPA's decision.

Comment #6: *Environmental Justice: USEPA states that environmental justice considerations will impact all decision---making the agency does. If this is true, and the USEPA uses environmental justice as a benchmark for their decision---making process, then they must select alternative 5a/b for the remedy at this site. This selected remedy would provide at least a measure of protection for this environmental justice community as it removes the PTW and does not leave it in place for future generations of people and wildlife to suffer its impact. The fact that the public still uses this area for its food source and that these people that live in this community are already suffering from disproportionate amounts of contamination in their air, water, and food makes this environmental justice issue of the highest magnitude. The Tremley Point section of Linden is already a state-recognized Environmental Justice area, one of five cities to get this special assignment.*

As we see with the recent federal government shutdown, assurances that USEPA will be here in perpetuity to maintain a cap that would cover this very toxic waste is not something that can be assured. The federal government shutdown and the funding issues that the United States faces clearly demonstrates that we need to take care of this threatening toxic waste now while we have USEPA to address it. USEPA cannot provide any assurances that they will be funded nor have the mandate in the future to continue to maintain the cap on this operable unit adjacent to the Arthur Kill.
We strongly suggest that USEPA reconsider Alternative 5a/b for a thorough cleanup for the LCP Chemicals Superfund Chemicals Site. Alternative 5a/b is the only alternative that removes the majority of the risk from this site and is protective of human health and the environment. It is also the only alternative that is consistent with other LCP chemical site cleanups throughout the country. USEPA has done the community a disservice if they do not at least remove the main threats of this site and seek to address sediments and other contaminants when funding allows.

We support the vision of the Edison Wetlands Association (EWA), its goal to reduce environmental contamination, reduce the effect that this site on both the Arthur Kill and Raritan Bay, the protection and remediation of public resources, the increase of access to the public, and the long term protection of human health. We would like the full restoration of this area in order to provide a clean and safe habitat for all biota and a fair cleanup for the people marginalized by companies and their pollution. In an area that already experiences flooding and is in close proximity to the Arthur Kill, it is important to provide an avenue which will reduce flooding and provide a vital public service.

We strongly suggest that USEPA select Alternative 5a/b because it is the only alternative that removes the majority of the risk from this site and is protective of human health and the environment. The selection of this remedy ensures the future protection for generations to come and provides a complete and reliable remediation alternative to utilize and implement. Our collective organizations, including our many thousands of members fully support the selection of Alternative 5a/b to remove the mercury and other waste from the LCP Chemicals Superfund site.

EPA Response: EPA understands that in 2005 the Tremley Point Alliance submitted an Environmental Justice Petition for Linden to New Jersey's Environmental Justice Task Force (EJTF). The Petition was conditionally approved contingent on the Alliance submitting an Action Plan. It is unclear whether that action plan was submitted. Nevertheless, the petition highlighted the community's main issues:

- *Performance of a health survey and air quality monitoring in Linden due to the high incidence of asthma and other respiratory illnesses indentified by children and senior citizens.*
- *Protection of wildlife that exists in pockets of habitat and foraging areas in the Seventh Ward by reclassifying the wetland in the area of Linden's Piles Creek and banks of the Rahway River as "exceptional wetlands."*
- *Prior to approval of any projects in the Seventh Ward, i.e., Tremley Point, that have potential to impact human health and/or the environment, an Environmental Impact Study/Statement and meaningful public participation must be required.*

Of all the action alternatives, the selected remedy will have the fewest impacts to local air quality. The selected remedy will not impact wetlands around Piles Creek or the Rahway River. The CERCLA (i.e., Superfund) selection process has meaningful public participation and is considered functionally equivalent to the Environmental Impact Statement process. Therefore, EPA believes the selected

remedy addresses the main concerns of the Environmental Justice Petition.

All of the alternatives considered included a cap requiring long-term operation and maintenance (O&M). The long term O&M of the cap will be performed either by the potentially responsible party (PRP), the future site tenant or the site owner as described by an EPA approved O&M plan and as legally mandated by an institutional control, such as a deed notice. Even if EPA were unfunded in the future, the cap will still be maintained.

Comments from Cherokee LCP Land, LLC
The comment letter (attached) from Cherokee contained summaries of comments provided in more depth by their environmental consultant Impact Environmental. EPA's responses to those can be found under the Comments from Impact Environmental section (directly following this section).

Comments from Impact Environmental, a consultant employed by Cherokee LCP Land, LLC:
Comment #7: *Change Site Name: The site name under Superfund and on the CERCLIS is the "LCP Chemicals, Inc., Superfund Site, Linden, NJ". Comment 1 is a recommendation to change the site name to the "**Ashland** LCP Site, Linden, NJ". This change seems appropriate for framing corporate responsibilities and for general accuracy. There have been many instances in which the name of a Superfund site was changed to reflect changing conditions as a result of public feedback.*

EPA Response: Changing the name of the Site would lead to confusion and is of little value considering the Site has been on the National Priorities List for fifteen years. EPA declines this suggestion.

Comment #8: *At the public hearing and within all of the investigative documents it was established that free, "elemental", mercury was present in the surface soils of the Ashland site. It was indicated that this mercury could be readily observed by visual survey methods. Maps contained within the documents are clear on this matter. Inasmuch as Super-Storm Sandy impacted the site after the mercury in the soil was mapped, and given that no follow-up inspection has been performed, I believe that it is prudent for Ashland to perform this survey again to gauge the impacts of the storm on this surface that is/was laden with elemental mercury. Moreover, as verbalized more than a dozen times at the public hearing, isn't there a responsibility for the PRP to ascertain if mercury concentrations were transported to surrounding residential areas due to the storm-related flooding? At the hearing, an Agency staff member, indicated that similar testing was done by the Agency at and around the areas of the Gowanus Canal in New York, where the staff member lived. My research shows that mercury is much more toxic than any contaminants currently known to exist in the Gowanus Canal.*

Is there a reason why the logic of community-impact testing pertains only to affluent New York City communities and not to the community of Linden - is there an environmental justice issue associated with this site? In recognition of this, I demand the following:

a) *Voluntary testing of Linden residents yard soils by a New Jersey Certified (ELAP) Environmental Testing Laboratory for total mercury. I have performed the necessary re-search and have identified a laboratory that would be willing to test samples, using USEPA test method 6010, at the reduced cost of $35 per sample, inclusive of glassware. While sampling would be performed by the residents, we are prepared to provide a "how-to" website to help ensure a high degree of sampling precision and quality control. The samples could be picked up weekly for a month (on a Friday) at the community recreation center. Screening could also be performed using a hand-held XRF meter that can be rented for several days at a cost that is less than one-thousand dollars.*

b) *The Agency help Impact Environmental coordinate the Edison Wetlands Association and other local community groups interested in the LCP/Ashland site, to provide public notice of the aforementioned volunteer testing program. This can be done in both print and internet media spots.*

c) *The Agency help Impact coordinate local community groups, and offer assistance to-ward obtaining a Technical Assistance Grant (TAG) so that we can interpret and help the community understand technical information about the Ashland site.*

d) *The Agency should demand that a new survey of the Ashland site be performed to understand what, if any, changes occurred to impact the concentration and distribution of elemental mercury as a result of Super-Storm Sandy. As this is somewhat a visual-driven survey, this is a minor expense and inconvenience for the PRP.*

EPA Response: The Gowanus Canal passes through several neighborhoods of variable income levels, including Environmental Justice areas. However, the decision to perform limited sampling of properties adjacent to the Canal was not related to the local demographics.

The Gowanus Canal is 1.8 miles long, 100 feet wide and over 15 feet deep at low tide, with private homes in close proximity to its shoreline. In comparison, LCP's South Branch Creek is an approximately 1000 feet long, six feet wide, one foot deep drainage ditch that lies over a half mile from the nearest home. The flooding of homes/commercial properties along the Gowanus Canal came directly from water in the Gowanus Canal, while the flooding of homes in Linden came from the Arthur Kill and other local waterways, not from the South Branch Creek or Northern Off-Site Ditch.

EPA does not expect that contaminated sediments from the South Branch Creek (or the Northern Off-Site Ditch) could have impacted homes a half mile away in Linden. If Sandy spread LCP contamination off-site, those sediments would be found at one of the adjacent properties. At the public meeting, EPA agreed to sample or oversee sampling of one or more adjacent properties in order to determine if Site related contaminants were spread during the storm. In addition, the LCP Site will be re-surveyed and re-sampled during the remedial design phase.

While EPA has no plans to initiate volunteer sampling at the Site, EPA welcomes and encourages the community to apply for a Technical Assistance Grant. Please contact Wanda Ayala or Natalie Loney to get more information on the EPA's TAG process. Ms Ayala's number is 212 637-3676 and Ms. Loney's number 212 637-3639.

Comment #9: *I believe that both Ashland and ISP have a history of acting as both PRP and cleanup contractor/consultants. My belief stems from the fact that they have staff environmental scientists and chemists, and the name "ISP Environmental Services, Inc". Some current Ashland executives were previously executives at ISP. This appears to represent a conflict of interests, which creates ethical and perception concerns, as the PRP's staff have been integral in guiding investigation and cleanup activities. How can the area residents and Cherokee trust that this process has not been compromised for the purpose of reducing liabilities and on-site remedial costs for ISP to facilitate a sale to Ashland, or by Ashland to mitigate the cleanup and closure costs? In recognition of this, I demand the following:*

a) *Please provide me with information on third-party quality control testing (split samples, sample duplicates, trip blanks, etc.) that the Agency has had performed to insure that design goals were*

executed and reported with the integrity that is paramount to the protection of residents of Linden, Cherokee and the environment.

b) *Please provide information on the number and location of Superfund sites that ISP and Ashland, by extension, are named PRPs. If possible, provide comment on who the contractors of choice were for these projects.*

EPA Response: ISP Environmental Services, Inc., entered into an Administrative Order on Consent with EPA and performed the RI/FS, under EPA oversight, pursuant to and in compliance with that Order. In any of the matters under EPA oversight, if the PRPs have qualified personnel "in house" to perform the studies, that arrangement would be acceptable to EPA. Therefore, the relationship between a PRP and its consultants or contractors is inconsequential.

EPA has not ascertained the number of sites for which Ashland or ISP is a party, nor has EPA contacted the ISP or Ashland requesting names of contractors they use or have used elsewhere.

EPA hired CDM Federal to do field oversight during sampling events performed by ISP's contractors during the Remedial Investigation. CDM collected some split samples during the RI. The split sample results can be found at http://www.epa.gov/region2/superfund/npl/lcpchemicals

Comment #10: *Paramount to the study and the absolute direction of the logic tree used in its remedy selection is that mercury contaminated soil that is hazardous has no off-site legal disposal option. This fact that guides the remedy decision is erroneous. My staff has identified several disposal options for mercury hazardous waste. Many of these options are economical and make excavation of the impacted areas a more economically viable option.*

In recognition of this, I demand the following:

a) *Additional time is necessary to reevaluate this option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.*

EPA Response: While the commenter did not name the facilities to which he refers, EPA recognizes there are facilities in the United States that can handle high concentration mercury wastes. However there are no existing facilities in the United States that could handle the amount of high mercury waste found at the LCP Site. No additional time is required to reevaluate this option.

Comment #11: *It was identified that the transport of mercury waste could lead to community impacts during transport. If the material was transported in sealed drums this exposure potential could be entirely abated. This procedure has been utilized for decades for the removal of excavated soils in many Superfund Sites. In recognition of this, I demand the following:*

a) *Additional time is necessary to re-evaluate this remedial option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.*

b) *PRP should be prompted to identify what soils would need to be removed for acute exposure concerns and the removal should be performed immediately as an Interim Remedial Measure. This is particularly necessary as it is clear that the process of identifying and performing*

appropriate remedial measures is going to require additional delay. Failure to act could result in the dispersion of these contaminants from other acts of god or unintended incidents that could lead to dispersion of these toxic contaminants into the surrounding residences.

EPA response: Driving a few thousand trucks through a community has impacts unrelated to the type of freight the trucks are carrying. Those impacts (e.g., traffic, noise, air pollution, etc) are discussed in the feasibility study, specifically under the short-term impacts section. Rather than abating those impacts, the commenter's suggestion would increase truck traffic to allow for the additional volume required to haul waste in approximately 90,000 individual drums.

In addition, if an excavation remedy (Alternative 5 a/b) were selected, it would have other short-term potential risks to the community and workers, such as increased mercury vapor releases caused by excavating and handling the soil on Site. Since filling drums would require more handling of the PTW, it would likely increase, rather than abate, potential short-term vapor risks to workers and the community. No additional time is required to allow consideration of hauling waste soil in drums.

Comment #12: *It was identified that both the USEPA and the PRP contacted Brookhaven National Laboratory (BNL) for remedy selection. I contacted BNL and they have indicated that contact with the BNL staff was not officially engaged to work on the project. Comment provided by BNL indicated that the decision to dismiss Solidification/Stabilization was "flawed". No follow-up was performed by the Agency or the PRP since this "flawed" assessment was rendered by BNL. Moreover, since 2010, nobody performed any follow-up with BNL. BNL has indicated that they have successfully optimized its patented Sulfur Polymer Stabilization/Solidification Process (SPSS) since 2010 (see attached draft white paper prepared by Dr. P. Kalb of BNL). The SPSS process returned excellent results in the Department of Energy Y-12 site Cleanup. The use of this technology for insitu applications needs a serious re-evaluation. In recognition of this, I request the following:*

a) Additional time is necessary to re-evaluate this remedial option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.

b) BNL needs to be engaged for its true opinion on how this site would be best remedied using its patented techniques. It is my opinion that the Remedial Investigation/Feasibility study is suggesting methods that will infringe upon some of BNL's Patents.

EPA Response: Researchers at BNL are developing an interesting and promising approach to stabilize and solidify mercury contaminated soils. The process (SBSS) first uses sulfur to convert elemental mercury to mercury sulfide. The mercury sulfide is then solidified through a specific process, which could further reduce dispersion and permeability.

EPA considered this approach; however, after several discussions with BNL and EPA's Office of Research and Development, EPA's project team determined that since the SBSS had not yet been field tested, and protocols for field testing have not yet fully developed, it is too early to consider testing the technology. It is EPA's understanding (confirmed by the commenter's "white paper" submittal) that the process has not been used or even tested at the Y-12 site, rather it has been tested at the bench scale level on Y-12 site's contaminated soils.

In addition, considering the type of substrate at LCP, and the fact that – through the selected remedy -

the PTW will not only be converted to mercury sulfide but contained within a barrier wall/cap, EPA believes any potential decrease in permeability from BNL's process will not significantly increase this remedy's over-all protectiveness.

The commenter does not explain for how he believes the selected remedy may be imposing on BNL patents.

Comment #13: *It seems that the toxicity of mercury is being lost somewhere in the toxicity assessments. While mercury is not carcinogenic, it is an acute toxin. Contact with mercury has immediate and irreversible impacts upon various human organs, in particular the central nervous system. This makes it much more dangerous than other volatile contaminants such as benzene; a mere carcinogen. People are exposed to benzene routinely during fill ups, but several laws exist to eliminate any potential for mercury exposure. The entire body of risk assessment work contained within the Feasibility Study appears to be is flawed due to this failure of simple risk-assessment principle. In recognition of this, I demand the following:*

> *a. The risk assessment needs to be re-written with input from medical professionals who can offer alternate risk exposure assessment information for mercury. This includes staff from the Union County and NJ State Health Departments.*
>
> *b. This site, in its current state, appears to represent a severe health hazard. Greater work needs to be performed to insure that mercury dispersion is not occurring daily due to wind, water, wildlife, trespassers, etc. This site requires a 24 hour guard and temporary covering with an impermeable material (HDPE). If stockpiles of soil from residential tank pulls are required to be temporarily covered by New Jersey DEP, then why wouldn't a highly toxic surface require an impermeable cover? This may represent a health emergency and requires immediate emergency response.*
>
> *c. Public notice must be made to identify the danger this site represents. At the public comment meeting two separate participants from the community indicated that they not only walk the area, but partake in recreation hunting and fishing on the areas adjacent to or adjoining the adjacent properties. Why is this site not being treated for the clear and present danger it represents? Why are signs not posted warning people as they are at other Agency administered cleanup sites?*
>
> *d. The selected remedy does little, if anything to treat groundwater impacted by mercury from entering the Arthur Kill. In 1990, the NJ Conservation Foundation and the NJ Audubon Society conducted an inventory of the river and stream corridor, identifying nearly 200 bird species including about 90 species that breed in the watershed.*

EPA Response: EPA assesses both carcinogenic and non-carcinogenic risks during remedy selection. The commenter's assertion that the toxicity risk from mercury was "lost" in the pertinent documents seem perplexing in light of the fact EPA considers elemental mercury to be the Site's primary risk driver and the key contaminant of concern. Additionally, the principal threat waste at the Site is soil with visible mercury.

The commenter gave no specific reasons why he believes the risk assessment, which was conducted by the responsible party's contractor and reviewed by EPA's risk assessment experts, needs input from

other health professionals, such as those employed at state health agencies. Nevertheless EPA notes that Federal and State health agencies have performed an independent analysis of the Site risks. In 1999, the Agency of Toxic Substances and Disease Registry (ATSDR) and the NJ Department of Health and Senior Services (NJDHSS) released a health assessment for the Site. Their conclusions are consistent with the findings of the risk assessments. The report can be found at: http://www.atsdr.cdc.gov/HAC/pha/PHA.asp?docid=446&pg=1#disc

In brief, ATSDR and NJDHSS concluded:

> *Based on the information reviewed, the ATSDR and NJDHSS have concluded that the Linden Chemicals and Plastics (LCP) site currently poses no apparent public health hazard. This evaluation is the result of an absence of any completed human exposure pathway associated with the site.*
>
> *Fishing advisories/restrictions are currently promulgated by the New Jersey Department of Environmental Protection for the South Branch Creek and the Arthur Kill (as part of the Newark Bay Complex). Site data and information indicate that the LCP site may have contributed to the overall contamination problem of these surface water features.*
>
> *Although the ATSDR and the NJDHSS have not identified completed human exposure pathways associated with the LCP site, on-site soil contamination is present at levels of potential public health concern.*

Since the areas of visible mercury are surrounded by dilapidated buildings, there is no way to currently place an HPDE cover. While preventing release of mercury into the atmosphere is part of the overall goal of the selected remedy, air monitoring on and at the perimeter of the Site have not demonstrated an immediate or even long term risk to local residents.

The Site is surrounded by several layers of fencing and locked gates, and there is signage indicating admittance to the Site is not permitted. EPA will consider adding additional locks and installing more fencing.

EPA strongly disagrees with the assertion that the selected remedy does little if anything about the mercury impacted groundwater. The selected remedy will surround the area of Site contaminated groundwater with a barrier wall, and cover the area with an impermeable cap. The groundwater will then be collected and properly disposed. EPA expects the area to effectively dry out in less than a decade, in the meantime the barrier wall will prevent groundwater from migrating off- Site.

Comment #14: *The Feasibility Study fails to identify the impacts that leaving such a high concentration lode of mercury contaminated soil will have on the redevelopment of the Ashland/LCP site. The current intended land-use for the site is commercial/industrial. Cherokee has identified interest in constructing warehousing with 10% office space. The Feasibility Study needs to address if, and how, the building can be constructed without poisoning the construction workers, and future employees. In recognition of this, I demand the following:*

a) *The study must propose a remedy to prevent impacts of the mercury on building occupants. This should include real-time monitoring instruments to detect the efficacy of the remedy ad-infinitum.*

b) *The study must propose a remedy that will allow construction workers to work on the Ashland site without being exposed to mercury during activities such as excavation for drainage, utility and foundation installation, structural pile installation (down to 90') and surface landscaping/hardscaping.*

c) *The remedy must propose a long term Construction Health and Safety Plan for the Ashland site, and attach the plan to the title as part of the Institutional Controls.*

d) *A fund must be established that insures that monies will be available from the PRP to address any and all escalations in construction costs associated with the toxicity of the Ashland site.*

EPA Response: The primary purpose of an FS is to provide information to allow comparison of several remedial alternatives against each other and against the nine criteria. The purpose of an FS is not to design a remedy or to develop health and safety or monitoring protocols for a future owner or tenant.

Since the buildings the purported owner wishes to construct do not presently exist, it's unclear how the FS could perform real-time air monitoring of those buildings. Regardless, impermeable caps are a commonly used element of a hazardous site remedy. It is not uncommon to construct buildings on top of those caps. How the cap can be designed, in general, to accommodate a future use will be considered during the remedial design. Likewise, future buildings would need to be designed so as not to impact the remedy.

As for comments b and c, if the commenter means health and safety requirements for the remedial work need to be developed prior to implementation of the remedy, EPA agrees and those plans will be part of the overall remedial design. However, if the commenter means that the remedy should allow workers to perform sub-cap construction activities after the remedy is implemented, then EPA needs to point out that once the cap is installed, institutional controls will be put in place to prevent current or future owners or lessees from compromising the containment, such as through excavation or pile installation.

In response to comment d, EPA generally requires that PRPs provide financial assurance - such as through a surety performance bond (or other mechanism) – proving that they can complete the work described in EPA's ROD.

Comment #15: *The Feasibility Study fails to identify the impacts that leaving such a high concentration lode of mercury contaminated soil will have on the redevelopment of the Ashland site. The current intended land-use for the site is commercial industrial. Cherokee has identified interest in constructing a warehouse with a minimum of 10% offices. The Feasibility Study needs to address if, and how, the building can be constructed, and after construction, how it can be sustainably operated. In recognition of this, I demand the following:*

a. *The closure plan must identify how the remedy selection will couple with the intended redevelopment of the Ashland/LCP site by Cherokee. This must include a clear plan for soil stabilization for parking areas. Currently, the plan as proposed will render the site unbuildable due to the heavily disturbed condition that it will leave the soils. Will the soils be able to be compacted enough to support roads and driveways? What about footings, basements, etc.?*

b. *The study must include a clear plan for providing drainage for storm water and roof precipitation runoff. The remedy selection does not allow any means for direction runoff to the water table. Where will the runoff go? Will it be contained for Ashland to have removed on a weekly basis, ad-infinitum? The remedy selection, as it stands currently, will not support any other option.*

c. *The study must propose a long term Operations and Maintenance Plan for the Ashland site, and attach the plan to the title as part of the Institutional Controls.*

d. *A fund must be established that insures that monies will be available from the PRP to effect the necessary secondary or tertiary remediation when other unanticipated impacts are encountered at the LCP/Ashland site.*

EPA Response: The types of plans discussed above, such as an O&M plan or a plan for site run-off are developed either in the design phase or after the remedial action has been implemented. Potential impacts of the remedy on future redevelopment can be considered during the remedial design phase.

Comments from Ashland Inc.:
Comment #16: *Mobilization of mercury from the LCP Site as a result of flooding during Hurricane Sandy; it is unlikely that flooding during the Hurricane Sandy caused remobilization of site contaminants, including mercury, to other off-site, inland locations. The LCP site and other nearby industrial properties have been flooded on multiple occasions by extreme weather events prior to and during the course of the RI, such as Hurricane Floyd (1999). Furthermore, the RI data demonstrate (e.g., off-site ditch sampling) that site contaminants in shallow soils were not distributed any significant distance off site in an inland direction, even after the prior flooding known to have occurred. Conditions during Sandy are not likely to have been sufficiently different than prior flooding events with respect to floodwater velocities such that it is unlikely that Sandy flooding would have caused additional off-site contaminant transport from the site in an inland direction. As such, IES, does not believe that there is a need for off-site sampling associated with the LCP site, as was suggested at the public meeting.*

EPA Response: EPA agrees it is unlikely that Superstorm Sandy spread Site contaminants in any significant amount. However, due to the size of the storm and public concern, EPA believes it is prudent to conduct some limited off-site analyses.

Comment #17: *Contaminant sources in the bedrock groundwater; there is no mention in the proposed plan that the RI demonstrated that most groundwater constituents in bedrock are undetectable except in the northwest area of the site, upgradient of the LCP production area, and that these upgradient impacts are associated with the adjacent GAF (LPH) site. Soluble mercury, benzene and chlorobenzenes are detected within an area in which the GAF groundwater extraction system has been shown to induce bedrock groundwater flow from the neighboring GAF site onto the LCP site. However, bedrock groundwater with in this area is subsequently captured and treated by the adjacent GAF groundwater remediation system. In summary, the soluble mercury and other organic constituents from the adjacent GAF site are the likely source of these constituents in the LCP bedrock wells and this mercury is being captured by the GAF groundwater extraction and treatment system. This is an important distinction relative to the remedy including only groundwater monitoring in the bedrock water bearing zone.*

EPA Response: The ROD describes the findings of the RI with respect to the bedrock groundwater. In addition, EPA discussed the bedrock aquifer and likely causes of its contamination (i.e., the GAF site) during the public meeting.

Comment #18: *Selection of Alternative No. 3 "Full Containment"; while IES understands the preference under SARA for remedies that include treatment, the evaluations performed in the USEPA-approved Feasibility Study support selection of Alternative No. 3, Full Containment, as the preferred remedy. It fully controls the sediment/surface water, groundwater and direct contact pathways. In the case of the LCP Site, available and practicable treatment technology is limited to chemical conversion of elemental mercury to mercuric sulfide. Yet, this technology is unproven and more importantly, alters only the form of mercury; the total mass of mercury remains the same. Therefore, without the benefit of the containment components of the remedy, the Site would still exceed the risk benchmarks (for mercury and other contaminants) for protection of human health and the environment. Therefore, the treatment components of Alternative Nos. 4a and 4b add substantial cost without corresponding, meaningful benefit.*

As also indicated in the Feasibility Study, the off-site disposal options, Alternatives No. 5a and 5b, do no provide any more practicable of an alternative. As researched during preparation of the Feasibility Study, and confirmed by the USEPA during the public meeting on August 28, 2013, a practicable disposal facility for the principal threat waste at the LCP Site has not been identified. And, even if one were, such as the USEcology/Stablex facility in Canada, the ultimate management of the mercury would still be via containment; perhaps outside of the US where less stringent regulations would apply (i.e., the land disposal restrictions do not apply in Canada), and the containment remedy (Alternative No. 3) would still be necessary because of the other contaminants associated with the anthropogenic fill and past site operations.

EPA Response: EPA agrees that Alternative 3 is a protective remedy and would employ tested containment features that have been used at other contaminated sites. EPA, however, disagrees with the commenter that the added cost of the treatment components of Alternative 4a and b are not worth the value added. The stabilization of the elemental mercury greatly increases the long-term effectiveness and permanence of the remedy in that the sulfur treatment ensures the reduction of the risk of exposure to the highest levels of mercury even in the event of a failure of the containment system. The overall effectiveness secured by the additional cost of the selected remedy, over remedies that achieve protectiveness through containment only, was determined by EPA to be warranted and hence the selected remedy represents a reasonable value for the money to be spent.

While there may be uncertainties with the selected remedy's treatment component, the prospect of converting a large volume of elemental mercury to mercury sulfide would not only allow compliance with NCP requirements, it would afford additional protection for direct contact and inhalation risks over containment alone.

Comment #19: *Bedrock water-bearing zone points of compliance; the USEPA's proposed plan, dated August 2013, on Page 2 indicates that surface water standards could be applied to the bedrock aquifer (designated Class IIIB) because numerical Class IIIB groundwater quality standards have not been developed by the NJDEP. Surface water standards should not and could not be an ARAR for groundwater. However, as a practical matter, surface water standards can be a reasonable ARAR for groundwater if applied only at the point of discharge of the groundwater to surface water. This would mean comparing groundwater quality to surface water standards only at the down-gradient perimeter of the site adjacent to the surface water body, not at any portions of the aquifer within the interior of the site.*

EPA Response: NJDEP reclassified the bedrock layer as Class IIIB groundwater, so therefore Class IIA groundwater standards do not apply and new site specific standards need to be developed. Until those standards are developed, NJDEP indicated saline surface water standards were to be used as the applicable criteria. When site specific alternative standards are developed, they will become applicable to the bedrock zone.

Comment #20: *Use of vacuuming and sulfur treatment; the USEPA's "Summary of the preferred alternative" on page 10 of the Proposed Plan, states the "Porous material that has visible signs of mercury contamination will be vacuumed and treated with sulfur." The Feasibility Study does not include vacuuming as a component of Alternative No. 4b on an equivalent basis to the addition of sulfur. Rather the FS, in Section 6.4 describing the building materials alternatives, includes vacuuming "...or other similar technique" for visible elemental mercury, only to the extent practicable.*

The limitations on vacuuming are substantial. The cell buildings, where mercury has been observed, are unsafe to enter and so vacuuming cannot be performed prior to demolition. Following demolition, the resultant porous debris (e.g., masonry units) is likely to be crushed and it would be impracticable to vacuum. As such, while the FS does include vacuuming to the extent practicable, it should only be included as a contingent component. This distinction is important to a practicable implementation approach for the alternative. Conversely, where visible elemental mercury may be present in porous building debris, the intent is to add sulfur and then place the material beneath the cap. The sulfur addition is not contingent component.

EPA Response: EPA agrees. The ROD does not include a requirement to vacuum building debris before treatment with sulfur.

Comments from the New Jersey Department of Environmental Protection:
Comment #21: *The Department concurs with the preferred remedial alternative which includes full containment of the contaminated soils and sediments; full stabilization, to a depth of 17 feet, of principal threat wastes; capture and treatment/disposal of overburden groundwater; partial restoration of South Branch Creek; and demolition of Site buildings. A key element of the remedy will be institutional controls and groundwater monitoring. The remedy is the final remedy for the Site and addresses the following contaminated media: soils, soil vapor, sediments and groundwater (Alternative 4b).*

EPA Response: EPA notes NJDEP's concurrence.

Comment #22: *The Department agrees that there should be a contingency remedy. However, it is the Department's position that the contingency remedy should be removal (Alternative 5b) which while more costly, appears implementable. Containment alone, which is one of the contingencies, does not address the principal threat waste.*

EPA Response: NJDEP is correct that EPA's second contingency remedy, Alternative 3, would not use treatment to address the principal threat waste. The NCP makes clear that when treatment is not practicable, engineering controls, such as containment, should be used. EPA found that excavation/disposal of the PTW has limited implementability. Therefore, the only contingency that would be both reasonably implementable and protective is Alternative 3.

Comment #23: *The Department's position is that a backgrounds study that is reviewed/approved by all partner agencies should be conducted during the design phase in accordance with USEPA 1997, USEPA*

1994 and NJDEP 2012. Background concentrations should be established for all contaminants and media for which site-specific ecological risk-based PRGs have been established (e.g., sediment and fish tissue). Ecological remediation goals should be the higher of the site-specific ecological risk-based PRGs or background. Ecological remediation goals should be used to delineate contamination in the Arthur Kill and determine the extent of the remediation in the Arthur Kill.

EPA Response: The Site is primarily a mercury site and mercury is the prime site contaminant found in the Northern Off-Site Ditch and South Branch Creek. Yet, sampling during the RI seems to indicate that levels of mercury found just outside the South Branch Creek's mouth are consistent with levels found elsewhere in the Arthur Kill and in tributaries of the Arthur Kill. Data also indicate it would not be possible to distinguish LCP's mercury from other mercury sources to the Arthur Kill. In addition, it is important to note that Region 2 is about to begin Phase 3 of the Newark Bay Study, which will likely include portions of the Arthur Kill adjacent to the LCP Site. Decisions related to further sampling or remediation of the Arthur Kill would be premature until the boundaries of Phase 3 are settled.

Comment #24: *More specifically, on page 6 (Remedial Action Objectives) and page 10 (Summary of the Preferred Alternative) of the final proposed plan, the text states that because sediments will be recontaminated by the Arthur Kill, EPA will determine a sediment cleanup level that is consistent with existing levels in the Arthur Kill or nearby tributaries during the design phase.*

a. *The phrase "a sediment cleanup level" implies one numeric goal. For the protection of ecological receptors, site-specific ecological risk-based PRGs should be established for all feeding guild/receptor groups and all contaminants for which elevated risk was indicated in the BERA, including mercury and barium (and possibly additional contaminants). The Departments assumes "existing levels in the Arthur Kill" means "background contaminant concentrations." Background data serve as default remediation goals if PRGs are below background levels and aid in contaminant delineation. The ROD should list the PRGs. The design document should list PRGs and justification for reverting to background levels.*

b. *The Department also requests the phrase "will be recontaminated" be revised in the ROD. While contaminants may enter the remediated zone, they would not be expected to reach pre-remedial levels. Additionally, the Department requests that the word "tributaries" be removed. As per the Department's Ecological Evaluation Technical Guidance (EETG NJDEP 2012), tributaries should be excluded from background investigations if data from the smaller, typically more contaminated water body are not representative of prevailing contaminant levels that may re-enter the remediated sediment site form tidal influences. Specially for the South Branch Creek remedy, use of data from nearby tributaries are not appropriate for background, since the nearest tributary, Piles Creek, contains high-level mercury sediment contamination (and other contaminants) from a LCP-related Responsible Party.*

EPA Response: For clarification, EPA recognizes (as did EPA's National Remedy Review Board) that contamination in the Arthur Kill will likely impact the South Branch Creek/Off-Site Ditch after the sediment remedy is implemented. Therefore, the action will focus on remedying the Creek/Ditch to levels consistent with those found in the Arthur Kill (or PRGs if they are higher). Those levels will be determined during the RD either with existing data or, if necessary, additional data.

EPA agrees, the phrase "a sediment cleanup level" indicates that there is only one numeric goal. That is not correct. The ROD makes that clear and a table of PRGs will be included in the final ROD.

The phrase "will be recontaminated" was not meant to imply recontaminated to existing levels. NJDEP's comment on the tributaries is correct. Reference to using the tributaries for development of sediment cleanup levels was not included in the ROD.

EPA is unaware of any evidence that Piles Creek was impacted by the LCP Chemicals, Inc., Superfund Site.

Exhibit E

SDMS Document
113613

FINAL
WORK PLAN

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

F O R T H E

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY

Prepared for:

ISP Environmental Services Inc.
1361 Alps Road
Wayne, New Jersey

Version
April 12, 2001

300759

FINAL
WORK PLAN

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

F O R T H E

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY

Prepared by:

URS Corporation
201 Willowbrook Boulevard
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Version
April 12, 2001

300760

WORK PLAN
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

LCP CHEMICALS, INC.
LINDEN, NEW JERSEY

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This document is a Work Plan to conduct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation and Feasibility Study at the LCP Chemicals, Inc. Superfund Site, in Linden, New Jersey. This Work Plan describes the history and physical characteristics of LCP Chemicals, Inc., the rationale for field investigation activities, the objectives of the activities, and the methods that will be used to conduct the Remedial Investigation (RI) and Feasibility Study (FS). This document is submitted on behalf of ISP Environmental Services Inc., in accordance with the requirements of the U.S. Environmental Protection Agency's (EPA) Administrative Order on Consent ("Consent Order"), Index No. II-CERCLA-02-99-2015, dated May 31, 1999.

1.1 SITE LOCATION

The LCP Chemicals, Inc. Superfund Site (the "site") is located in an industrial area at the foot of South Wood Avenue in Linden, Union County, New Jersey. The general site vicinity is known as Tremley Point. The site is centered at 40 degrees 36 minutes 29 seconds latitude and 74 degrees 12 minutes 41 seconds longitude on the United States Geological Survey Arthur Kill, N.Y./N.J. quadrangle map (Figure 1-1). The site encompasses about 26 acres and consists of the City of Linden Tax Block 587, Lot 3.01, Lot 3.02, and Lot 3.03.

The site is bounded to the north by ISP Environmental Services Inc. (inactive since 1991), to the northeast by Northville Industries' bulk petroleum storage area, to the southeast by the Mobil Gas bulk petroleum storage area, and to the south by the British Petroleum bulk petroleum storage area. A small, rechanneled tidal creek, South Branch Creek, flows eastward from the site and drains into the Arthur Kill.

As shown in Figure 1-1, the main Conrail line (Central Railroad of New Jersey) parallels the New Jersey Turnpike. A Conrail Spur (Sound Shore Branch) parallels the shoreline of Arthur Kill and crosses the site along Avenue B. A set of Conrail spurs, roughly parallel to Tremley Point Road, borders the southern part of the site. The Tremley Point Road spurs and the Sound Shore spur join at the southeast end of the site.

1.2 PROJECT OVERVIEW

The site consists of a former chlorine production plant and ancillary terminalling, packaging, and distribution areas. Between 1955 and 1982, the plant manufactured gaseous chlorine using a technology known as the mercury cell electrolysis process. A by-product of this process was wastewater and sludge that contained residual elemental mercury (a detailed discussion of site operations is presented in Section 1.4.2). Beginning in the early 1980s, both the EPA and the New Jersey Department of Environmental Protection (NJDEP) conducted numerous inspections

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and limited investigations at the site because of environmental concerns associated with the mercury cell process. The results of their investigations indicated that there were mercury releases at the site and to South Branch Creek, although the magnitude and extent of contamination were not determined. In 1985, LCP Chemicals, Inc. stopped their production activities and began to dismantle the facility. In 1995, a Resource Conservation and Recovery Act (RCRA) Facility Investigation Work Plan was prepared for the site (Eder, 1993) to evaluate potential contamination in areas of concern. The Work Plan was approved by the EPA on January 3, 1995 but it was not implemented because the owner of the site did not have the financial resources for remediation work. In 1996, the EPA evaluated the site for a Superfund Removal Action, but determined that there were no acute threats to human health and environment and that consequently, a short-term, emergency cleanup was not warranted. The EPA added the LCP Chemicals, Inc. site, a Division of Hanlin Group, Inc., to the National Priority List (NPL) on July 27, 1998 (which required that a CERCLA RI/FS be conducted for the site). In September 1998, the EPA identified GAF Chemicals Corporation as one of six potentially responsible parties (PRPs) for the site. The other five PRPs identified by the EPA were Caleb Brett (USA), Inc., Kuehne Chemical Company, Inc., Praxair, Inc., Union Carbide Corporation, and LCP Chemicals, Inc. (a division of the Hanlin Group, Inc.).

ISP Environmental Services Inc., which has assumed the liabilities of GAF Chemicals Corporation, executed the Consent Order with the EPA on May 31, 1999. This Remedial Investigation and Feasibility Study Work Plan describes the activities that will be conducted in accordance with the Consent Order. The proposed field investigation, however, is based on assumed site conditions, and a specific site activity, as described in Chapter 5.0, may not be appropriate once the actual conditions become known. Therefore, ISP reserves the right to modify the sampling or testing regime based on preliminary results or actual conditions encountered in the field. If major modifications to the RI/FS work scope described in this document become necessary, they will be submitted to the EPA in the form of a Technical Memorandum or other form of communication and the proposed modifications will not be implemented in the field without EPA approval. This Work Plan also acknowledges that the project objectives discussed below may not be completely fulfilled upon completion of the specific activities described in this document and that additional site investigations may be required before a remedy can be selected.

1.3 PROJECT OBJECTIVES

The environmental concern at the site is the potential for contamination resulting from mercury-bearing wastes that were generated, stored, or disposed of at the site for a period of about 25 years. Other sources of contamination, such as electric transformers that contained oils with polychlorinated biphenyls (PCBs) and former drum storage areas may also have contributed to site contamination.

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The overall objective of the remedial investigation is to identify the nature and extent of contamination that may pose risks to human health and environment and to evaluate proposed remedies for the site. The objective of the feasibility study is to methodically select the most appropriate remedy, on the basis of several factors such as land use, effectiveness, and cost, that will be protective of human health and environment.

1.4 SITE BACKGROUND

This section presents the background history of the site.

1.4.1 Site Ownership

The Grasselli Chemical Company began industrial operations in the vicinity of the site around 1885. Before then, the area was undeveloped marshland. In 1924, the company became the Grasselli Dyestuff Company. It was incorporated in 1929 as American I.G. Chemical Corporation, which was owned by the German company I.G. Farbenindustrie, A.G. In 1939, the company changed its name to General Aniline & Film Corporation. In 1942, 98 percent of the company stock was seized by the United States Justice Department as a war asset and the company was operated by the U. S. Government acting as Alien Property Custodian. The chlorine plant was constructed at the site sometime around 1955; the site was generally undeveloped marshland up until that time. In 1965, the U.S. Government sold the stock in a public offering and in 1968, General Aniline & Film Corporation changed its name to GAF Corporation. In 1971, GAF Corporation shut down the chlorine production plant (the site).

In 1972, GAF Corporation (GAF) sold the plant to Linden Chlorine Products, Inc. of Edison, New Jersey. The company was founded by former GAF employees and formed solely for the reopening and operation of the Linden chlorine plant. In 1975, Linden Chlorine Products, Inc. reported that they owned no other facilities and that they produced only three products - chlorine, sodium hydroxide, and hydrogen.

By the early 1980s, as the company acquired additional chlorine production facilities along the U.S. east coast, Linden Chlorine Products, Inc. became LCP Chemicals-New Jersey, Inc., a subsidiary of Linden Chemicals & Plastics, Inc. Between 1987 and 1989, the company name was changed to LCP Chemicals-New Jersey, a division of Hanlin Group, Inc. On July 10, 1991, Hanlin Group, Inc. filed for bankruptcy under Chapter 11 of the United States Bankruptcy Code and sold all of its operating assets before April 1994. In August 1994, the EPA conducted a site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional, and that the site was vacated by LCP employees. Active Water Jet, Inc., a pipe cleaning company, who was a tenant at the site since about the early 1990s, remains as the only current tenant at the site. Other former site tenants are described later in this chapter.

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1.4.2 Site Operations

At the time of LCP Chemicals, Inc.'s mercury cell chlorine production, there were three main operating centers at the site - the mercury cell chlorine process area, the hydrogen gas processing plant, and the sodium hypochlorite manufacturing area. Process materials were transported to and from the site by tank truck, tank railroad car, or by barge. The storage and distribution of chlorine and related products (including methylene chloride and potassium hydroxide) generally occurred throughout the site's history. The chlorine production operations, however, were subject to periodic shutdowns brought on by changing market demand. The chlorine and related operating centers are described below, following a general description of the mercury cell electrolysis process.

1.4.2.1 Mercury Cell Electrolysis Process

The mercury cell was an industrial system that split common salt to produce chlorine. In a typical mercury cell process, salt solution (brine) passes between a graphite anode and a mercury cathode to produce chlorine and sodium through electrolysis. The chlorine is packaged in gaseous or liquid form for additional processing or distribution. The sodium dissolves in the mercury and the sodium-mercury mixture is made to react with water to produce sodium hydroxide and hydrogen. The products generated from this process, including the spent brine, contain residual amounts of mercury.

1.4.2.2 Chlorine Process Area

At the former chlorine plant, salt, water, mercury, and electricity were the principal raw materials used in the chlorine production process. LCP Chemicals, Inc.'s procedure for mercury handling and storage is not documented. Rock salt (or later evaporated salt) was transported to the site by rail, stored in the salt silos by Building 233 (Figure 1-2), and fed to the adjacent saturators to create brine. The brine was treated and filtered in a brine treatment tank in Building 233. The treatment consisted of adding chemicals such as sodium hydroxide, sodium carbonate, and barium chloride to precipitate impurities like calcium carbonate, sulfates, and hydroxides. This residual material is known as brine purification mud or brine "sludge". In the mid 1960s, a surface impoundment, the brine sludge lagoon, was constructed and used to dispose of the brine sludge and process wastewater. The sludge was mixed with brine and the resulting slurry was pumped to the brine sludge lagoon through overhead pipes. The supernatant, or the liquid content of the brine sludge lagoon, was pumped back to the brine purification tank for recycling and for redistribution either to the mercury cells or for slurry usage. Disposal practices for the brine sludge before the brine sludge lagoon was constructed are not documented.

After treatment, the purified brine was piped to the mercury cells in Building 230 and Building 240 to produce gaseous chlorine and a mercury-sodium mixture. The chlorine was cooled, dried (i.e., water vapor removed) with sulfuric acid, liquefied in Building 233, and stored in 100 ton

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vessels. The spent brine was recycled to the brine treatment tank in Building 233 for resaturation and to repeat the process.

The mercury-sodium mixture was piped to denuders, or strippers, where it was hydrolyzed to form elemental mercury, a sodium hydroxide solution, and gaseous hydrogen. The mercury was recovered and returned to the mercury cells. The sodium hydroxide solution was filtered and stored in above ground storage tanks at the northeast corner of the facility. Hydrogen gas was filtered in a commercial "Purasiv" unit south of Building 231 and piped to the hydrogen plant at the west end of the facility for packaging and distribution. On various occasions, the hydrogen gas was mixed with water and chlorine to form hydrochloric acid in both gaseous and liquid form. The hydrochloric acid was stored in tanks near Building 221. In March 1982, LCP Chemicals stopped the mercury cell process and brine sludge was no longer generated.

Between 1985 and 1994, the site was used as a transfer terminal for products made at other Hanlin Group Facilities. Products including potassium hydroxide, sodium hydroxide, hydrochloric acid, and methylene chloride were shipped to the site by rail or by truck, stored in above ground tanks, repackaged, and distributed. The Hanlin Group sold all of its operating assets by April 1994.

1.4.2.3 Linde Hydrogen Plant

The hydrogen plant, formerly known as Linde Gasses, occupied about 2.1 acres at the west end of the site (Figure 1-2). In 1957, Union Carbide Corporation (UCC) leased the hydrogen plant from GAF and operated it through 1990. Hydrogen was distributed from the mercury cells to the plant through overhead pipes. The gas was purified by UCC to remove entrained mercury (reportedly, up to five pounds of mercury was removed from the gas stream daily), stored, compressed, and shipped for distribution by trailer. This process continued through LCP Chemicals, Inc.'s 1972 purchase of the site from GAF. The hydrogen plant stopped utilizing the hydrogen generated by chlorine plant in 1980 and began packaging liquid cryogenic hydrogen that was brought to the plant from outside sources.

In 1988, in preparation of a new tenant, UCC had the building interior and hydrogen compressors decontaminated for mercury and collected wipe samples to confirm that the cleanup was effective (IT, April 22, 1988). IT reportedly recovered about 30 pounds of free mercury from one compressor and its associated piping.

In May 1990, the Linde plant ceased operations after the UCC lease with LCP expired, which triggered the NJDEP's Environmental Cleanup Responsibility Act (ECRA). Because several areas of environmental concern unrelated to the chlorine manufacturing process were noted at the plant (former underground storage tanks, sumps, septic tanks, etc.), ECRA required that a soil and groundwater investigation be conducted within the general boundaries of the 2.1 acre site.

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An environmental investigation and cleanup took place in the early 1990s and the NJDEP approved no further action for the hydrogen facility on June 20, 1995.

The Linde Gas Facility was apparently last used in October 1994 by Liquid Carbonic Corporation, which was later purchased by Praxair, Inc. Liquid Carbonic rented the Linde Gas site from LCP Chemicals, Inc. and used it for office space and as a parking area for truck trailers. Liquid Carbonic Corporation ended its lease with LCP Chemicals, Inc. in March 1996.

1.4.2.4 Hypochlorite Facility

In 1972, Kuehne Chemical, Inc. participated in the formation of LCP Chemicals, Inc. Kuehne leased Lot 3.02, Lot 3.03, and the northern part of Lot 3.01 from LCP Chemicals, Inc. and started a sodium hydroxide manufacturing process. The processing area, located north of Building 220 and between Avenue C and Avenue D, consisted of above ground storage tanks, loading areas, and support buildings (Figure 1-2). Kuehne obtained the raw materials - chlorine and sodium hydroxide, by overhead pipes from the chlorine plant and blended the chemicals to make sodium hypochlorite (bleach). Chlorine, sodium hydroxide, hydrochloric acid, and sodium hypochlorite were also stored and distributed by Kuehne. Kuehne vacated the site in February 1981.

1.4.3 Site History

Much of the historic information presented in this report is compiled from numerous documents dating back to 1975 and earlier. Within these documents are numerous contradictions concerning the past operations of the site. This problem is compounded by the fact that much of LCP Chemicals, Inc.'s records were lost or destroyed sometime in the early 1980s (Eder, September 1993). Every attempt was made to reconcile these differences through evaluations of supporting evidence such as historic maps, deed records, and aerial photographs. Appendix A presents a timeline that summarizes some of the key milestones that occurred at the site, lists the supporting references, and provides a qualitative assessment of the reliability of data. The historic information presented in this document is based on this timeline, which will likely require updates if, and when, additional sources of information becomes available.

In 1870, all of Tremley Point was undeveloped marshland. By 1903, the tracks of the Sound Shore railroad were present, indicating that backfilling of low areas at the site had begun by that time. In 1923, the Grasselli Chemical Company was operating a large facility on the east side of the tracks north of South Branch Creek. The property on the west side of the tracks was vacant. By May 1929, the core buildings of the GAF Facility were present, but the LCP Chemicals, Inc., site was not developed. The property south of GAF's Building 1 (about 550 feet north of the northern LCP site boundary) was undeveloped and dissected with man-made drainage channels.

In 1940, the northern portion of the LCP Chemicals, Inc. site was still undeveloped marshland, with the exception of the presence of the Sound Shore Railroad tracks and the Central Railroad

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tracks along Tremley Point Road. The British Petroleum tank farm was present (15 tanks). By July 1947, the GAF Facility had expanded southward to South Branch Creek. GAF's Building 204 (Figure 1-2) was present at the northern edge of the site and northern part of the LCP site (just north of Building 220) was used as a laydown area for coal piles, tanks, and drums. Part of South Branch Creek was already filled in.

GAF began the chlorine operation at the LCP site in 1955 and by 1956, the core buildings of the chlorine facility were present, including Building 220 and Building 230. The hydrogen processing facility was constructed by 1959 and GAF leased 2.1 acres of the site to Union Carbide for hydrogen processing. The Brine Sludge Lagoon was reportedly constructed in 1962 and by 1966, berms were present along the north and west side of the lagoon area. The chlorine process waste was reportedly treated in a former wastewater treatment unit before this time. The former wastewater treatment unit system is described in Section 1.6. By 1966, South Branch Creek was filled west of Avenue B and the site drainage was provided by a flume and storm ditch system.

In 1971, GAF ceased chlorine operations and in 1972, LCP Chemicals, Inc. purchased the site from GAF and restarted operations. Between 1968 and 1972, the portion of South Branch Creek east of Avenue B was rechanneled to a location about 750 feet to the south and mercury cell Building No. 240 was constructed.

In 1972, LCP Chemicals, Inc. leased the northern part of the site to Kuehne Chemical Company to operate the sodium hypochlorite facility. In October 1972 and February 1974, the NJDEP reportedly observed lagoon overflows to South Branch Creek, but the quantities and responses are not known. LCP Chemicals, Inc. acknowledged both discharges in September 1975 and was levied a fine by NJDEP of $5,000 for each occurrence (NJDEP, July 1991).

By 1975, LCP Chemicals, Inc. was cooperating with the NJDEP and held meetings to investigate waste disposal options for brine sludge, wastewater, and the estimated 11,000 cubic yards of sludge material stockpiled in the brine sludge lagoon. LCP Chemicals, Inc. informed the NJDEP that off-site disposal options were too expensive and elected to begin pilot testing of a more cost-effective stabilization process developed by Chemfix Technologies, Inc.

LCP Chemicals, Inc. constructed an auxiliary surface impoundment, the Chemfix lagoon, and treated about 120,000 gallons (or about 460 cubic yards) of brine sludge using the Chemfix process. The Chemfix lagoon was used for a period of 4 days in 1976; the effectiveness of the operation was apparently questionable and LCP Chemicals, Inc. never continued with the Chemfix process.

LCP Chemicals, Inc. turned to using a proprietary sludge roasting process which would volatilize and capture mercury from steam dried brine sludge; they received favorable results during laboratory bench testing. A pilot sludge roaster unit was constructed south of the brine sludge

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lagoon in 1978 but the brine sludge material was processed through it only infrequently as the unit required constant "debugging", modification, and repair. By 1980, the final modifications to the sludge roaster were completed and the unit was brought back on line after LCP Chemicals, Inc. was issued a temporary air permit from the NJDEP. In December 1980, LCP Chemicals, Inc. and the NJDEP agreed that the brine sludge lagoon required closure and agreed to formalize the process through an Administrative Consent Order.

In March 1980, the Linde hydrogen plant stopped accepting hydrogen from LCP Chemicals, Inc. because of excess mercury contamination in the gas. In early 1981, Kuehne Chemical was cited by the NJDEP for caustic discharges, allegedly deliberate, into South Branch Creek, and Kuehne vacated the site shortly thereafter. The NJDEP entered into the Consent Order with LCP Chemicals, Inc. in September 1981 which required that, among other items, no more waste be placed in the brine sludge lagoon, a closure plan be developed and submitted for NJDEP approval, and a groundwater investigation be conducted. In November 1981, LCP Chemicals, Inc., abandoned the sludge roaster process because of equipment problems and stopped the generation of brine sludge in March 1982.

In 1982, LCP Chemicals, Inc. ceased plant operations, reportedly at the orders of the NJDEP and EPA, during the lagoon closure work to be protective of plant worker health and safety. The Chemfix lagoon was closed in 1983 (the Chemfix material was transferred to the brine sludge lagoon), and the brine sludge lagoon was closed by November 1984 with NJDEP approval. The lagoon closure consisted of dewatering, compaction, the addition of a two-ft thick clay cap, the addition of soil cover, and seeding. In June 1984, LCP submitted a facility closure plan to the NJDEP to close the production areas because of economic reasons. The EPA (1984) stated that LCP Chemicals, Inc. had planned to return to full chlorine-manufacturing operations in mid July 1984, but they instead ceased all plant production operations by August 1985. The facility began to be dismantled and the equipment was shipped to other LCP facilities along the east coast. Beginning in 1985, the facility was used only as a storage and transfer station for chlorine-related products produced by other LCP facilities, such as sodium hydroxide, potassium hydroxide, methylene chloride, and hydrochloric acid.

In July 1991, the Hanlin Group, Inc. filed under chapter 11 of the U.S. bankruptcy code and by April 1994, Hanlin sold all of its nation wide operating assets and all its chlorine manufacturing ceased. The EPA conducted a site visit in August 1994 and confirmed that the facility was no longer functional and that the employees were expected off the site by the end of August 1994. On November 10, 1998, the site property was formally abandoned by the New Jersey Bankruptcy Court.

1.4.4 Site Layout

The site is in a rough shape of a rectangle with two long, narrow arms extending to the southeast (Figure 1-2). The northern arm borders the course of South Branch Creek to Arthur Kill and the

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southern arm borders the railroad spurs of the Central Railroad of New Jersey for a distance of about 800 feet south.

Avenue B, Avenue C, and Avenue D extend roughly north to south across the site (Figure 1-2). South Branch Creek, the former Chemfix lagoon, the former brine sludge roasting unit, and the closed brine sludge lagoon are east of Avenue B.

The channel to South Branch Creek extends from Arthur Kill westward and ends at the railroad tracks between Avenue B and Avenue C (the original channel was relocated between 1968 and 1972). A wooden flume formerly connected to the creek at this point, extended northward along Avenue C, then extended westward along the northern boundary of the site across Avenue D and connected into the ditch system of the GAF site. The flume system is currently backfilled.

Above ground storage tanks (currently empty) used for sodium hydroxide, chlorine, and brine are located between Avenue B and Avenue C. The chlorine liquefaction and compressor building (Building 231), the former hydrogen filtering unit (Purasiv unit), and the wastewater metering sump are also here. An effluent treatment building was also located just south of the surface water flume to South Branch Creek.

The chlorine and hypochlorite processing areas and the brine treatment area were located between Avenue C and Avenue D in the central part of the site. The north central area consisted of the former hypochlorite processing area, which included a chlorine truck-loading area, a laboratory and locker building (Building 221), and Building 223 (usage unknown). The mid-central area contains the cell buildings (Building 230 and Building 240), the shop and service building (Building 220), and the chlorine cooling and drying building (southern part of Building 240). The south central portion contains the former salt storage tanks, the saturators, the brine storage tanks and the brine processing building (Building 223).

The site is mostly vacant west of Avenue D. This area contains the area of the former hydrogen plant and an existing electrical switchyard. Much of the area was used for employee parking.

1.5 SOLID AND HAZARDOUS WASTE GENERATION

The wastes generated at the site included mercury contaminated sludge, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, mercury contaminated process wastewater, spill wash down fluids, and stormwater runoff (Eder, January 1992).

Brine purification mud (brine sludge) and associated process wastewater were the principal wastes generated at the site. In 1981, the EPA listed brine purification mud from the mercury cell process as hazardous waste No. K071 and associated wastewater treatment sludge as hazardous waste No. K106. The mercury content of these materials is the basis for listing the material as hazardous.

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A "typical" brine sludge composition was reported by LCP Chemicals, Inc. (1975) as NaCl (20%), BaSO4 (50%), CaCO3 (15%), CaSO4 (15%), metal hydroxides (2%), dirt (2%), mercury (100-500 parts per million - 0.05%). Wastewater treatment sludge was also generated during chlorine production. In their 1975 Preliminary Report on Brine Sludge, LCP Chemicals, Inc. reported that an estimated 7.5 tons of sludge was generated every day and that their current stockpile of sludge was an estimated 11,000 cubic yards. Eder (1992) reported that up to 20 tons of sludge were generated per day.

Seven sludge samples were analyzed for selected inorganic constituents between 1980 and 1981 (NJDEP, January 8, 1988). The analyses showed that the sludge contained mercury with concentrations ranging between 272 mg/kg and 4,576 mg/kg. Liquids filtered from the sludge contained mercury at concentrations ranging between 40 ug/l and 2,520 ug/l.

Waste disposal practices for the chlorine plant before construction of the brine sludge lagoon are poorly documented. GAF reportedly used a small pond as a wastewater treatment unit for disposal. The wastewater was pH neutralized, filtered though a carbon unit at the north end of the site, and discharged into South Branch Creek. The location of the discharge point into South Branch Creek is not documented.

A survey plan in a report by Geraghty & Miller (1982) shows that the brine sludge pile grew to a height of about 40 above the ground surface. An estimated 31,000 cubic yards of brine sludge was left in the lagoon at the time of closure. The material in the lagoon was dewatered, graded, compacted, and capped with a clay cover in 1984.

Other sources of potential sources of contamination included:

- Kuehne Chemical Company, which operated at the site from 1972 to 1981, allegedly dumped bleaches and other caustic material into South Branch Creek on a daily basis.
- The Linde Hydrogen Plant, which received mercury-contaminated hydrogen gas from about 1957 to 1980, processed mercury on a daily basis.
- Eder (September 1993) reported that small quantities of solvents used at the site for general cleaning and degreasing could also potentially have been released to the environment.
- Transformers were located behind Building 230 and Building 240, and on the north side of Building 231. The transformers may have contained oil with PCBs.
- Storage tanks at the site were used to store chlorine, sodium hypochlorite, sodium hydroxide, and methylene chloride (NJDEP, January 8, 1988).

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- A 300 square-foot concrete drum storage pad with containment berms was located at the south central edge of the site. The pad was used to store drums of motor oil, waste oil, and other lubricants (Eder, 1993). During their December 22, 1987 inspection, the NJDEP noted stained soils and detected organic vapors around the pad.

1.6 WASTEWATER AND SURFACE WATER HANDLING

Before 1972, wastewater generated by cell washdown and cell maintenance was reportedly processed in a former pond, located east of the electrical switchyard (Eder, January 1992). The pond was originally part of the channel of South Branch Creek (Eckenfelder, September 1989). The wastewater was pH neutralized, filtered though a carbon unit at the north end of the site, and discharged to South Branch Creek. Eder (January 1992) stated that in the mid 1970s, the former wastewater treatment unit was reportedly excavated, backfilled, and covered with asphalt. The treatment unit was still present in mid 1972 (LCP, July 21, 1972) and possibly only backfilled in 1982 (NJDEP, February 1982).

Plant wastewater and sludge were collected in a 500,000 gallon (500K) agitating collection tank and the slurry was piped to Silo No. 4. The supernatant was directed to the effluent treatment system and the settled solids were directed to the brine sludge lagoon, or later, to a 4,500 gallon surge tank at the sludge roaster unit (NJDEP, January 8, 1988).

Storm water runoff at the site collected in a continuous concrete drainage swale/trench that surrounded the process area and was routed to a concrete sump south of Building 231. The runoff was pumped to holding tanks outside Brine Building 233, pH adjusted, filtered, polished with carbon, and stored pending annual or semiannual discharge to South Branch Creek in accordance with their New Jersey Pollutant Discharge Elimination System (NJPDES) permit. The system in Brine Building 233 was operational since the early 1980s.

Process wastewater in the mercury cell buildings drained to concrete floor trenches, collected in sumps in the northeast corner of each cell building, pumped to holding tanks, and eventually pumped to the wastewater treatment system.

1.7 PERMITS

A summary of the permits that were issued to LCP Chemicals, Inc. is presented in Table 1-1. The first reference to Permit No. NJ0003778, the discharge to surface water permit, was made in June 1975, when the facility reported to the EPA that an accidental release of brine sludge to South Branch Creek occurred for an estimated nine-hour period. The conditions of that permit were not described.

The NJDEP reissued the Permit in 1987 and required that LCP Chemicals, Inc. install four new monitoring wells to evaluate the groundwater quality in the water table aquifer.

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Kuehne Chemical Company submitted a National Pollutant Discharge Elimination System (NPDES) permit application, Application No. 0027707, on August 27, 1974. In August 1980, the EPA issued the NPDES permit for the discharge of uncontaminated cooling water only from the sodium hypochlorite process. In 1981, the NJDEP alleged that Kuehne Chemical Company was dumping caustic material into the outfall and issued a Notice of Civil Administrative Penalty Assessment against the company on October 7, 1981. The notice states that a pipe was observed during an NJDEP site visit on January 26, 1981 "connected to the outfall in such a manner as to allow for a physical conduit for the passage of pollutants to the waters of the State". This connection was removed at the time of a follow up visit by the NJDEP on the next day. The notice also states that Kuehne Chemical Company ceased operations and vacated the site that same day.

1.8 REGULATORY VIOLATIONS, ACTIONS, AND INVESTIGATIONS

The section summarizes the regulatory history of the LCP Chemicals, Inc. site.

1.8.1 Summary of Incidents and Enforcement Actions

The NJDEP (July 1991) states that in September 1975, LCP Chemicals, Inc. was fined $10,000 for discharges of supernatant from the brine sludge lagoon to South Branch Creek in October 1971 and February 1974. Details of the discharges are not known.

On September 17, 1981 the NJDEP signed an Administrative Consent Order, dated September 17, 1981 requiring that LCP Chemicals, Inc. perform the following tasks:

- Cease use of the Brine Sludge Lagoon by January 1, 1982;
- Submit a closure plan for the Brine Sludge Lagoon;
- Submit a closure plan for the Chemfix Lagoon;
- Conduct air monitoring of the brine sludge pile; and
- Conduct a soil, sediment, surface water, and groundwater sampling program.

LCP Chemicals, Inc. responded to the requirements of the order and both lagoons were formally closed by November 1984, air monitoring of the sludge pile took place on June 4, 1981 (RECON, 1981), and a limited soil, sediment, surface water, and groundwater investigation was performed by Geraghty and Miller (1982). The results of the investigation are briefly summarized in Section 1.10.4.

The NJDEP issued an Order dated May 4, 1982 to cease the November 5, 1981 violation of N.J.A.C. 27-8.3(e)2 resulting from a ruptured muffler plate on the brine sludge roaster allowing mercury emissions to vent directly to the atmosphere from the operation of four unpermitted propane burners on the unit (Eder, January 1992). LCP Chemicals, Inc., however, abandoned the

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sludge roaster experiment because of equipment problems and had stopped roaster operations in November 1981.

In a letter dated June 4, 1982, the NJDEP denied LCP Chemicals, Inc.'s Hazardous Waste Facility Permit Application because of the severe deficiencies of the sludge roasting system and the inability to process the waste on site. LCP Chemicals, Inc. (June 29, 1982) responded in a letter to the NJDEP that they planned to modify the roaster design to correct these deficiencies. LCP Chemicals, Inc. continued with the lagoon closures and began to dispose of its waste off site.

The EPA issued a Complaint/Compliance Order dated August 25, 1982 for lack of freeboard in a surface impoundment (brine sludge lagoon). LCP Chemicals, Inc. was also cited for lack of a waste analysis plan, not maintaining a schedule of inspections, and lack of a contingency plan. LCP Chemicals, Inc. (August 10, 1984) reported that they were fined $1,000 for the freeboard violation and corrected the other violations with no penalty assessment.

The NJDEP issued a Notice of Violation dated January 7, 1983 for failure to submit a RCRA Treatment, Storage, or Disposal Facility annual report. An annual report was submitted to the NJDEP shortly thereafter on January 17, 1983 and no penalty was assessed.

The NJDEP issued a Notice of Violation dated November 16, 1983 for failure to establish financial assurance for closure and post-closure monitoring of the brine sludge lagoon and to demonstrate financial responsibility for claims. LCP Chemicals, Inc. responded (August 10, 1984) that it was their understanding that the NJDEP Division of Waste Management now had copies of the necessary documents and that the matter was now resolved.

The NJDEP issued an Administrative Order, dated February 11, 1985, requiring that LCP Chemicals, Inc. maintain documentation of the job title for each position at the facility related to hazardous waste management, the name of the employee filling each job, keep a roll-off container with hazardous waste material secure, provide immediate access to telephones and alarm systems within hazardous waste areas of the facility, and to develop an evacuation procedure for employees. LCP Chemicals, Inc. corrected the deficiencies and was assessed a penalty of $900.

1.8.2 Summary of Spills and Releases

Several spills and releases at the site were documented by the NJDEP and the EPA. These incidents are briefly described below.

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1.8.2.1 South Branch Creek

October 30, 1972 - A release occurred from the brine sludge lagoon - location and quantities unknown (NJDEP, July 1991).

February 7, 1974 - A release occurred from the brine sludge lagoon - location and quantities unknown (NJDEP, July 1991). LCP Chemicals, Inc. acknowledged both releases on September 25, 1975 and was fined a total of $10,000.

June 25, 1975 - A nine hour discharge of the contents of the brine sludge lagoon into South Branch Creek occurred when a recycling pump failed (LCP, July 27, 1975).

August 15, 1979 - An estimated 10,000 to 20,000 gallons of mercury-contaminated brine overflowed a saturator for an 8-hour period when it became blocked with salt. The brine discharged into South Branch Creek (LCP, August 20, 1979). A sample from the spill was analyzed by LCP Chemicals, Inc. for mercury and showed a concentration of 8.6 parts per million.

In January 1981, a former employee who worked at the site between 1972 and 1980 stated that he sometimes performed laboratory analyses on the effluent water that was being discharged into South Branch Creek (NJDEP, January 25, 1981). On one occasion, he detected mercury concentrations eight to ten times greater that the maximum allowed (the concentrations were not specified). The employee alleged that his supervisor told him to destroy the results, which he did.

October 7, 1981- Kuehne Chemical Company was cited by the NJDEP for discharging caustic material into South Branch Creek (NJDEP, October 7, 1981). Kuehne Chemical Company contested the NJDEP's action and subpoenaed the NJDEP on October 27, 1981 for depositions. The outcome of this dispute is unknown.

1.8.2.2 500,000 Gallon (500K) Tank

Several releases were documented by the NJDEP near the 500,000 gallon (500K) brine tank. The NJDEP Site Inspection Reports can be found in the RCRA Facility Assessment for LCP Chemicals - New Jersey (NJDEP, January 8, 1988).

On September 17, 1980, an unspecified amount of brine sludge was noted on the gravel near the 500K tank.

On October 9, 1980, brine sludge was transferred from the 500K tank to the brine sludge lagoon by front end loader and dump truck. During the transfer process, some sludge had fallen to the

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ground. LCP told the NJDEP that the spilled sludge would be flushed into the sump next to the 500K tank.

On January 22, 1981, a leak was observed in an overhead pipe north of the 500K tank. Wash water from the cell rooms spilled onto the unpaved ground. The NJDEP was informed that repairs would be made.

On October 22, 1981, a 10 ft by 4 ft hydrochloric acid spill resulting from a leaking overhead pipe was observed about 15 ft northwest of the 500K tank.

On April 13, 1982, a spill of sodium sulfide crystals was observed just north of the 500K tank.

1.8.2.3 Releases Near the Brine Sludge Lagoon

NJDEP Site Inspection reports document releases of brine sludge from leaks from the overhead pipes leading from Building 233 to the brine sludge lagoon. The NJDEP Site Inspection Reports can be found in the RCRA Facility Assessment for LCP Chemicals - New Jersey (NJDEP, January 8, 1988).

On October 22, 1981, a 1 ft by 15 ft spill of brine sludge slurry resulted from a leaking overhead transfer line between the 500K tank and the brine sludge lagoon. The spill occurred on Avenue B, between the railroad tracks and the brine sludge lagoon. The exact location of the overhead line is not well documented, but NJDEP sketch maps (e.g., NJDEP, November 19, 1981) indicate that it extended from the 500K Tank/Building 233 area to the southwest corner of the brine sludge lagoon.

On November 19, 1981, the overhead line was again leaking, which resulted in a 30 ft by 125 ft spill along the Avenue B railroad tracks.

In January 1981, a former employee who worked at the site between 1972 and 1980 stated that sometime in 1973 or 1974, brine sludge was removed from the brine sludge lagoon and the material was spread out on the ground between Building 231 and the railroad tracks (NJDEP, January 25, 1981). To his knowledge, this occurred on only one occasion.

1.9 PHYSICAL SETTING

The general physical setting of the LCP Chemicals, Inc. site is presented in this section.

1.9.1 Topography and Drainage

The site is relatively flat, with the exception of the former brine sludge lagoon, at an elevation of about 8 feet above mean sea level (Figure 1-1). The former brine sludge lagoon has a footprint

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of about 150 ft by 250 ft and it reaches a height of about 15 ft above grade. The mound is vegetated, although several shallow erosion gullies are present along the flanks.

The 100-year flood elevation for the Linden, New Jersey area is estimated to be about 9 ft mean sea level (Eckenfelder, 1991) and therefore, most of the site is located within a 100-year flood zone. A map showing the site in relation to the 100 year and 500 year flood plain is shown in Appendix B.

Storm water runoff at the site collects in drainage swales that surrounded the process area and routes to a concrete sump south of Building 231. The runoff is reportedly periodically pumped into holding tanks outside Building 233, pH adjusted, filtered, polished with carbon, and stored pending annual or semiannual discharge to South Branch.

1.9.2 Geology

The geology across the site is defined only in a few locations. Subsurface data east of Avenue B were collected from borings that were advanced to bedrock immediately around the brine sludge lagoon (Geraghty & Miller, February 1982). The following four stratigraphic units are identified in the area around the former brine sludge lagoon (Figure 1-3):

- Fill Unit - industrial fill and imported sands (5-10 ft thick)
- Tidal Marsh Deposits - dark gray organic clay (10 ft thick)
- Till Unit - red brown silt and clay , +/- red-brown weathered shale (20-30 ft thick)
- Bedrock - siltstone and shale of the Passaic Formation.

Fill Unit - the Fill Unit is a heterogeneous mixture of silt to gravel-sized particles containing industrial material including slag, crushed stone, and brick. On the basis of its geographic location (i.e., in lowlands), date of deposition (beginning in the late 1920s), and composition, this material likely meets the definition of "Historic Fill", as defined by the NJDEP in N.J.A.C. 7:26E-1.8.

Tidal Marsh Deposits - This unit consists of dark gray clay with organic matter and tidal grasses, with occasional layers of peat and silt. A subunit of organic silty sand with shells was also identified.

Till Unit - This unit consists of reddish brown clay, silt, sandy silt, and gravel. Some of this material, at depths close to bedrock, is derived from the weathering of bedrock.

Bedrock - Bedrock consists of the reddish brown shale and siltstone of the Passaic Formation of the Newark Supergroup.

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This same stratigraphic package was also identified immediately north of the site at the GAF Chemicals Corporation facility (hereafter called the ISP Environmental Services Inc. site) by Eckenfelder (1991).

The subsurface geology west of Avenue B was never investigated in detail. During the ECRA investigation of the Linde Hydrogen Plant, eight borings were advanced, but only to depths of about 15 feet (IT, 1991). IT identified the material underlying the 2.1 acre site, from top to bottom, as 8 feet of fill, consisting of black cinders, black sand, and pieces of rock and gravel, and an undetermined thickness of gray clay, peat, and red and gray silt (Tidal Marsh Deposit). The Tidal Marsh Deposit was apparently not completely penetrated at the former hydrogen plant.

1.9.3 Hydrogeology

The groundwater characteristics of the site are not well defined. On a regional scale, the groundwater flow direction is inferred to be predominately eastward toward Arthur Kill. Data from previous investigations indicate that the water table is between 3 and 6 feet below the ground surface with an elevation of approximately 5 to 6 feet above mean sea level.

Geraghty & Miller (1982) installed six monitoring wells (MW-1, MW-1A, and MW-2 through MW-5) around the former brine sludge lagoon. The length of the well screens varied from 5 ft to 30 ft (Table 1-2) and the screens were set at different depths and within different stratigraphic units (Figure 1-3). As such, these wells are considered suspect for any evaluation of contamination and the groundwater elevation data from these wells are not useful to identify groundwater gradients and flow directions. Permeability tests and the evaluation of tidal influences on these wells were apparently never conducted.

Eder installed four shallow groundwater wells in 1990 (MW-6 through MW-9) with screens set across the water table (Figure 1-2), but did not report groundwater elevations, flow directions, or possible tidal influences on groundwater (Eder, January 1992; September, 1993).

In the west portion of the site, IT Corporation installed 8 shallow monitoring wells between 1991 and 1992 (MW-1 through MW-8; herein called IT-MW-1 through IT-MW-8) around the Linde hydrogen plant (Figure 1-2) as part of an ECRA investigation (IT, May 1992). On the basis of data collected during two rounds of water level measurements, IT reported that the groundwater flow direction was south to southwest toward the Rahway River (Figure 1-1). Groundwater data can no longer be collected from these wells because they were sealed, with NJDEP approval, on October 13, 1993 in response to the NJDEP's no further action decision for the hydrogen plant (IT, June 1994).

Eckenfelder (1991) reports that the shallow groundwater flow direction in the northwestern portion of the site is to the north based on work conducted on the neighboring ISP Environmental Services Inc. Site.

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An evaluation of the available historic boring and monitoring well data (Table 1-2) allows several inferences to be made about groundwater at the site. Data from monitoring well pair MW-1 and MW-1A (Figure 1-3) suggests that a potential downward vertical gradient exists between the upper and deeper water-bearing zones, although the transient effects of tides on site groundwater have not been investigated in detail. The water table appears to occur within the fill unit (see Eder and IT data in Table 1-2) just above the Tidal Marsh Deposit. The Tidal Marsh deposit may be locally acting as a confining layer to infiltrating precipitation which could cause the local groundwater to exist under perched conditions. A substantial saturated thickness is not present above the TMD. The historic data shown in Table 1-2 suggest that only an average of 2 to 3 ft of water is present above the TMD. This conceptual geologic and hydrogeologic model of the site will be further evaluated during this RI.

1.9.4 Wetlands

Malcolm Pirnie (1995), as an EPA Contractor, conducted a wetland delineation survey in 1995 along South Branch Creek using 1989 U.S. Federal wetland determination criteria (EPA and others, January 1989). Malcolm Pirnie reported that a narrow corridor of wetlands existed along both banks of South Branch Creek for its entire length. Malcolm Pirnie estimated that about 2,300 lineal feet (0.43 miles) of wetlands frontage existed along South Creek basin and within the boundaries of the site, although the total acreage was not reported. The wetlands were classified as estuarine emergent wetlands. Malcolm Pirnie (1995) also reported that there are no terrestrial sensitive areas on or within 200 feet of the site property. Malcolm Pirnie's report of the wetland delineation survey is presented in Appendix C. Malcolm Pirnie's wetland delineation map is also included in Appendix C, although the delineation lines apparently were not reproducible from the original because the extent of wetlands in not visible on the map.

1.9.5 Surface Water

The center of the site is located within 1,500 feet of the Arthur Kill. Arthur Kill is a tidal channel that joins Newark Bay and Raritan Bay. Pralls Island is in the center of the Arthur Kill opposite the site.

South Branch Creek, a local tidal tributary of Arthur Kill, drains the site and discharges to the Arthur Kill. Originally, South Branch Creek flowed across the center of the site, roughly beneath the area where Building 230 now stands, and extended to the area now occupied by the former hydrogen plant. By 1947, the creek was beginning to be filled and diverted from its original channel west of Avenue B.

The course of South Branch Creek between Avenue B and Arthur Kill was altered sometime between 1968 and 1972. The original discharge point of the Creek was about 750 feet north of the current discharge point. By 1966, South Branch Creek was no longer present west of

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Avenue B (Eckenfelder, 1989) and a system of wooden flumes and concrete trenches were installed to provide drainage west of Avenue B.

Arthur Kill is classified by the NJDEP as saline estuarine waters - SE3 (N.J.A.C. 7:9B) with designated usages of secondary contact recreation (i.e., boating, fishing, minimal ingestion), maintenance of wildlife, and maintenance and migration of the natural and established biota. The Rahway River is located about 1,500 south of the site. The Rahway River is classified as SE2 (N.J.A.C. 7:9B) which has similar uses as SE3 waters.

1.9.6 Tidal Data

Tidal influences on groundwater or South Branch Creek are not well defined. NUS (1984) states that there are 2 foot tides in South Branch Creek. High tide and low tide differences measured at the Rahway River Station (about 1 mile southwest of the site) average about 5 ft per cycle (Tide Tables, 1996). Tidal influences on Eder's shallow monitoring wells MW-6 through MW-9 have not been reported.

1.9.7 Land Use

The site is located between the Arthur Kill to the east, the New Jersey Turnpike to the west, and the Rahway River to the south. The area is mostly industrial. The only residential area within a mile radius is in the Tremley section of Linden, about 0.75 miles west of the site. The area immediately surrounding the site is zoned by the City of Linden as H-1, Heavy Industrial District. The permitted uses of this zone include manufacturing (with no chemical or raw material processing), research and laboratory offices, service stations, truck terminals, and tank farms. The zoning regulations do not currently allow residential development east of the New Jersey Turnpike (Eckenfelder, 1991).

Current land use is within an approximate 1-mile radius of the site is primarily industrial, with pockets of wooded wetlands, saline marshes, and surface water bodies (NJDEP, 1996). A map showing land use in the site vicinity is presented in Appendix B. The New Jersey Turnpike forms a major geographic boundary separating Tremley Point from the rest of the City of Linden, New Jersey.

1.9.8 Well Search

Potable water supplies in the vicinity of the site have been researched by Malcolm Pirnie (July 1995). Groundwater is not used as a source of drinking water within four miles of the site. Although the Passaic Formation is a state aquifer, there are no potable wells within four miles of the site. There are no designated or proposed Wellhead Protection Areas within four miles of the site. A preliminary compilation of Public-Community Water-Supply (PCWS) Wells conducted for New Jersey by the NJ Geological Survey (July, 1997) indicates that there are no PCWS wells

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within 3.5 miles of the site. A decision to update the well search for the site vicinity will be conducted after an evaluation of the hydrogeologic and groundwater quality data generated during the RI field investigation.

1.9.9 Ecological Resources

A Greenway project was initiated for the Arthur Kill as part of a response to a 1990 Bayway Refinery oil spill. Numerous salt marsh habitats were identified inside the Arthur Kill watershed area close to the site. The Peregrine Falcon, the northern harrier, the great blue heron, the yellow crowned night heron, and the little blue heron are reported to either breed or hunt in the surrounding marshes. A habitat restoration project was ongoing at Pralls Island as of 1996 to protect these NJ state-listed species. An ecological evaluation of South Branch Creek was apparently never performed. There are no terrestrial sensitive environments within 200 feet of the site (U.S. EPA, 1996).

1.9.10 Climate

The National Oceanic and Atmospheric Administration/Cooperative Institute for Research in Environmental Sciences Climate Diagnostics Center (April 2000) report the following climate data for the site area (Newark, NJ). From 1961 through 1990, the average monthly maximum temperatures range from 85.7 degrees Fahrenheit in July to 37.7 degrees Fahrenheit in January. Temperature extremes range from a high of 105 degrees Fahrenheit in July 1966 to a low of -8 degrees Fahrenheit in January 1985.

The 30-year normal annual precipitation (1961 through 1990) is 43.9 inches with its distribution relatively uniform throughout the year. The mean annual snowfall is 26.6 inches. Eckenfelder (1991) report that in the site area, the prevailing wind direction is from the southwest, west, and northwest. Relative humidity for the area averages about 73 percent in the morning to about 61 percent in the evening.

1.9.11 Aerial Photographs

A set of aerial photographs was compiled by Eckenfelder (1989) for the ISP Environmental Services Inc. site which borders the site to the north. An evaluation of the photographs, which include the LCP site, is presented in Appendix D. Reproductions of the aerial photographs from the years 1929, 1947, 1952, 1956, and 1967 are also included in Appendix D. The EPA (1999) also compiled an evaluation of aerial photographs of the site. The EPA evaluation was used to identify historic potential areas of concern such as areas of stained soil and areas of standing water (Section 1.11.15). Data from the EPA aerial photograph interpretation were used in the selection of proposed sampling locations, which is detailed in Section 5.0.

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1.10 OVERVIEW OF PREVIOUS INSPECTIONS AND INVESTIGATIONS

Table 1-3 presents a summary of the regulatory site inspections and investigations conducted at the site. A brief discussion of those investigations which generated analytical data is presented below. This summary is not intended to provide detailed information on the nature and extent of site contamination because much of the analytical data generated to date is old, unsupported, and consequently suspect and unusable for site decisions. Some of the analytical results (such as data from filtered groundwater samples) are not plotted or tabulated in this report because the data has no regulatory value. The intent of this section is to present a broad overview of the previous investigations to provide a general historic perspective of the site.

To provide a point of reference for the discussion of the historical results, the current NJDEP cleanup criteria (May, 1999) for mercury, the primary constituent of concern, is presented. The NJDEP Residential Direct Contact Soil Cleanup Criterion for mercury is 14 mg/kg, the NJDEP Non Residential Direct Contact Soil Cleanup Criterion for mercury is 270 mg/kg, and the NJDEP groundwater criterion for mercury is 2 ug/l. New analytical data collected during this RI/FS will be compared against the current Applicable or Relevant and Appropriate Requirements, as required by CERCLA.

1.10.1 1978 NJ Department of Health Sampling

An aqueous sample was collected from the "leachating drainage ditch tributary to Arthur Kill" on May 31, 1978 (Table 1-4). The collector is unknown. The pH of the sample was 12, which represents caustic conditions. The exact location of the sample is not known.

1.10.2 1980 NJ Department of Health Sampling

A total of seven sediment samples (C05786, C05784, C05782, C05851, C05793, C05790, and C05788) were collected from South Branch Creek on August 12, 1980 for unspecified reasons. The collector is unknown and the locations of some samples can only be inferred because maps were not provided. The mercury concentrations of the samples ranged between 7.8 mg/kg to 87.7 mg/kg (Table 1-5). The current NJDEP sediment guidance screening value for mercury is 0.71 mg/kg (medium effect range for estuarine sediments). Figure 1-4 provides the inferred sediment sample locations and the analyte concentrations.

1.10.3 RECON Systems 1981 Sludge Pile Air Sampling

On June 4, 1981, RECON Systems, Inc. conducted real-time mercury air monitoring of the waste pile in the brine sludge lagoon. They estimated that the pile emitted an average 113 grams/day of mercury. They cautioned, however, that because of numerous atmospheric variables used to calculate the emission rate (e.g., temperature, wind speed, etc.), the results were valid for that day

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only. Mercury emissions at active chlorine production facilities currently cannot exceed 2,300 grams/day (EPA, 40 CFR Part 61).

1.10.4 1981 Geraghty & Miller Groundwater Investigation

The first formal investigation at the site occurred in 1981 with the installation of six monitoring wells around the brine sludge lagoon in September and October 1981 to comply with the NJDEP September 1981 Consent Order and with RCRA groundwater monitoring requirements. Geraghty & Miller (1982) installed one water table monitoring well (MW-1A) and five wells (MW-1 through MW-5) that were screened either below or across the Tidal Marsh Deposit (Figure 1-3). As previously stated, these wells are suspect for any data previously collected and will not be used in any future investigations.

Soil samples collected from the upper 10 feet (Fill Unit) of the monitoring well borings had mercury concentrations that ranged from 1.0 mg/kg to 772 mg/kg (Table 1-6). The concentration of mercury in soil decreased with depth, and generally decreased distinctly at the base of the fill layer (Figure 1-5). The soil data indicates that the screens for the Geraghty & Miller monitoring wells MW-1, MW-2, MW-3 and MW-4 were set below the depth of significant mercury contamination in soil.

The monitoring well network (MW-1, MW-1A, and MW-2 through MW-5) established by Geraghty & Miller (1982) is not effective in monitoring shallow groundwater quality around the brine sludge lagoon. The screens for these monitoring wells were set within different geologic horizons (described in Section 1.9.3 and shown in Figure 1-3) and, as described above, below the depth of mercury contamination in saturated soil. The groundwater data from these wells, according to the NJDEP, were not useful to support further action or no further action decisions for the site. In 1987, the NJDEP (January 1987) downgraded the status of these wells to piezometers and required that LCP Chemicals, Inc. install four new water table monitoring wells. The new wells were installed by Eder in 1990 (Figure 1-2).

Geraghty & Miller submitted two rounds of dissolved (filtered) groundwater samples to the site laboratory for mercury analysis in October 1981 and one round of groundwater samples to an independent laboratory in November 1981. The analytical results showed mercury concentrations of less than 1 ug/l.

Four surface soil samples (S-1 through S-4) and one sediment sample (GM-Sed) were collected by Geraghty & Miller and analyzed by the site laboratory. Mercury concentrations in the soil samples (Table 1-6 and Figure 1-6) ranged between 27 mg/kg and 1,580 mg/kg and the mercury concentration in the sediment sample was 46 mg/kg (Table 1-5 and Figure 1-4).

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1.10.5 March 1982 Groundwater Samples to ETC laboratory

Filtered groundwater samples (MW-1, MW-2, MW-3, and MW-4) were collected on March 15, 1982 by LCP Chemicals, Inc. and submitted to ETC Laboratories for the analysis of selected metals, selected pesticides, one herbicide (silvex), radiological parameters, bacteria, and water quality parameters. Arsenic (10 ug/l) and cadmium (10 ug/l) exceeded the current NJDEP Groundwater Criteria of 8 ug/l and 4 ug/l, respectively.

1.10.6 1984 NUS Corporation Investigation

On September 27, 1984, NUS, as contractors for the EPA, collected three groundwater samples (GW-1 through GW-3), two surface soil samples (S-1 and S-2), and two sets of surface water/sediment samples (SW-1/SD-1 and SW-2/SD-2) from areas around the brine sludge lagoon. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals.

The three groundwater samples, designated by NUS as 3348-GW-1, 3348-GW-2, and 3348-GW-3, were collected from MW-2, MW-4, and MW-5, respectively. The samples contained concentrations of arsenic, chromium, and lead, that exceeded the current NJDEP groundwater standard of 8 ug/l, 100 ug/l, and 10 ug/l, respectively (Table 1-7). Mercury concentrations in MW-4 (253 ug/l) and MW-5 (116 ug/l) exceeded the current NJDEP mercury groundwater standard of 2.0 ug/l.

The two surface soil samples collected from east of the brine sludge lagoon (3348-S-1) and from the surface of the excavated Chemfix lagoon (3348-S-2) exceeded the NJDEP arsenic cleanup criterion of 20 mg/kg with concentrations of 26 mg/kg and 50 mg/kg, respectively (Table 1-6 and Figure 1-6). The mercury concentrations were 2.6 mg/kg and 53 mg/kg, respectively.

Surface water sample 3348-SW-1 was collected from the drainage flume and sample 3348-SW-2 was collected east of the brine sludge lagoon (Figure 1-7). Samples 3348-SW-1 and 3348-SW-2 contained mercury at concentrations of 20 ug/l and 212 ug/l, respectively (Table 1-4). Sediment collection points were collocated with the surface water samples (1-4). Sediment sample 3348-SD-1 contained arsenic at a concentration of 44 mg/kg and mercury at a concentration of 784 mg/kg. Sediment sample 3348-SD-2 contained arsenic at a concentration of 54 mg/kg (Table 1-5).

1.10.7 LCP 1987 Quarterly Groundwater Results

Four rounds of groundwater samples were collected from monitoring wells MW-1 through MW-4 by LCP in 1987. The concentrations of dissolved mercury were generally undetected in the samples.

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1.10.8 1988 Blasland, Bouck & Lee Soil Investigation

In August 1988, Blasland, Bouck & Lee conducted a soil investigation around Building 231 for the proposed expansion of that building. Soil samples were collected from areas both south and north of the building, including the proposed southern expansion area (Figure 1-8). Selected samples were submitted for the analysis of VOCs, base neutral compounds, pesticides/PCBs, and inorganic constituents (Table 1-6). Nineteen samples were collected from fourteen locations. The constituents that exceeded the current NJDEP Non-Residential or Impact to Groundwater soil cleanup criteria were chlorobenzene (1.6 mg/kg), chloroform (1.1 mg/kg), hexachlorobenzene (20 mg/kg), arsenic (43 mg/kg), and mercury (up to 41,400 mg/kg). The laboratory reported that the sample with the maximum mercury concentration (S231-2A) contained visible beads of mercury.

1.10.9 Geraghty & Miller 1988 Groundwater Sampling Round

In 1988, in an attempt to demonstrate the adequacy of the monitoring well network around the brine sludge lagoon, Geraghty & Miller (1989) conducted a pressure packer study. The packer test was used to isolate the upper five feet of monitoring well screen from the rest of the boring. The packer test was conducted on monitoring wells MW-2 through MW-5. The test was not conducted on either monitoring well MW-1A, because the screen was too short (5 ft) for a packer or monitoring well MW-1, because the well was discovered to be silted up. The purpose of the packer test was to demonstrate that measurements and analytical results of groundwater quality were not dependent on the length of screen. Groundwater samples were collected from each well without a packer installed and with a packer installed and the samples were submitted for laboratory analyses. Geraghty & Miller concluded on the basis of the similarity of the analytical results of the no-packer/packer samples that the installation of additional monitoring wells was not required around the brine sludge lagoon.

1.10.10 1990-1992 Eder Shallow Groundwater Investigation

In March 1990, Eder installed four additional monitoring wells, MW-6, MW-7, MW-8, and MW-9 (Figure 1-2), to resolve the issues surrounding the effectiveness of the MW-1 through MW-5 monitoring well network. Detailed boring logs or well construction logs are not available but it appears that the base of the well screens were generally installed in the Tidal Marsh Deposit (Table 1-2).

Eder conducted eight quarterly sampling rounds between 1990 and 1992. The groundwater samples were collected from monitoring wells MW-6 through MW-9 and submitted for the analysis of six metals and water quality parameters. Groundwater sampling logs are not available so it is not known whether the samples were filtered or not.

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The analyses of individual inorganic constituents in samples collected from any given well were not performed on a consistent basis. Samples collected from monitoring wells MW-6 through MW-8 generally did not contain detectable concentrations of mercury (Table 1-7). Samples from MW-9 were never analyzed for mercury. In general, the concentrations of metals in groundwater samples only exceeded NJDEP groundwater criteria for arsenic (up to 210 ug/l in MW-9) and cadmium (up to 67 ug/l in MW-7).

1.10.11 1990-1995 Linde Gases ECRA Cleanup

As described in Section 1.4.2.3, a NJDEP ECRA investigation and cleanup was conducted at the former 2.1 acre hydrogen facility in the late 1980s and early 1990s and the NJDEP approved no further action for the facility on June 20, 1995. A deed notice was required for the site because of the presence of historic fill and the presence of associated organic and inorganic constituents in groundwater and soil. The investigation showed that benzene (up to 43 ug/l), arsenic (up to 590 ug/l), lead (up to 46 ug/l) and mercury (up to 32 ug/l) impacted shallow groundwater at the Linde site. IT (1994), however, reported "Any elevated levels of contaminants in the shallow groundwater of this area are documented in the NJDEPE files as the result of off-site sources. No remediation was conducted for this area of concern".

A macadam "cap" was the remedial action for the site. With the exception of possible investigation of the distribution of historic fill across the site, additional investigations were not required by the NJDEP at this facility. It is not known whether a biennial certification for the maintenance of the engineering control (i.e., cap) is provided to the NJDEP, in accordance with current deed notice requirements.

1.10.12 1995 Malcolm Pirnie Site Inspection Sampling Event

On January 11, 1995, Malcolm Pirnie, an EPA contractor, conducted a site inspection and sampling event at the LCP site. Three surface soil samples (SL1 to SL3), ten surface water samples (SW-1 to SW-10), and eight sediment samples (SED1, SED3-SED7, SED9, and SED10) were collected for inorganic analysis. The surface soil analytical results were generally good, with detected mercury concentrations below the current NJDEP soil cleanup criterion (Non-Residential) of 270 mg/kg (Figure 1-6). In surface water, the maximum mercury concentration of 93 ug/l was detected in sample SW3 (Figure 1-7) and in sediment, the maximum mercury concentration of 1,060 mg/kg was detected in sample SED3 (Figure 1-4). These samples were collected about 40 feet downstream of the LCP and GAF outfalls. Other constituents including arsenic, cadmium, and lead also exceeded NJDEP cleanup criteria in both sediments and surface water. Malcolm Pirnie (1995) concluded that the analytical results of the surface water and sediment samples documented that a release of mercury had occurred from the site to the surface water pathway.

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1.10.13 1994 Through 1998 NJPDES Permit Groundwater Sampling

Between 1994 and 1998, groundwater samples were collected from monitoring wells MW-6, MW-7, MW-8, and MW-9 on an annual basis and analyzed for selected metals. The analyses were performed to satisfy the LCP Chemicals, Inc. stormwater discharge monitoring requirements for NJPDES Permit No. 0077038. The collection of groundwater samples and analyses stopped after 1998 when the Hanlin Group, Inc officially abandoned the site.

The analytical data, provided by the EPA (March 14, 2000), are summarized in Table 1-8. The inorganic constituents of concern, as shown by these historic data, are arsenic, cadmium, lead, and mercury, although the quality of the analytical data are suspect. For example, the July 1998 analytical data for monitoring well MW-9 shows high concentrations of several constituents (up to 169 ug/l mercury), but the next round of data shown for October 1998 shows concentrations of the same constituents that are far less than their respective regulatory criteria. Neither the method of sampling (i.e., low-flow versus conventional bailer techniques) nor the analytical methods were described.

1.11 POTENTIAL SOURCES AND AREAS OF CONCERN

On the basis of the information collected during the NJDEP's and EPA's Site Inspections (NUS, 1984; NJDEP, 1988; NJDEP 1991, Malcolm Pirnie, 1995) and information compiled in this chapter, several potential sources and areas of concern were identified (Figure 1-2) and are described below. The areas of proposed investigation and the rationale for the proposed work are described in Chapter 5.0 - Scope of Work.

1.11.1 Brine Sludge Lagoon

The Brine Sludge Lagoon was an earthen surface impoundment (reported to be both unlined and lined with a spray of hot tar) in which the mercury cell process wastes were disposed. The lagoon was probably constructed in the mid 1960s. The lagoon had a trapezoid shape with an approximate footprint of 275 ft by 200 ft by 220 ft by 80 ft. Earthen dikes, about seven feet high, surrounded the impoundment. The final total volume of waste material in the lagoon was estimated to be about 31,000 cubic yards and the sludge pile grew to a height of up to 40 feet.

The normal disposal procedure was to pump brine sludge and wastewater in the lagoon. The supernatant was pumped back to the wastewater treatment system for salt resaturation and treatment from a sump located in a pump house at the southeast corner of the lagoon. The solid waste was stored in the center of the impoundment. A crane was used (at least once in 1981) to shape the solid sludge pile and to improve the supernatant flow to the pump house.

In March 1982, the chlorine production stopped at the site because of poor market conditions. In July 1982, when the sludge roaster permit was rejected by the NJDEP, LCP Chemicals was

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Exhibit F

~~DRAFT~~

FOR INTERNAL USE ONLY

Location Linden, NJ

LAND DISPOSAL ACTIVITY

(A) Past Practice

General Description of Disposal Facility	Disposal Dates	General Description of Wastes	Facility Construction	Site and/or Groundwater Conditions	Mainly Du Pont Use	Current Site Ownership
1) 8 on site landfills	1928-75	•coal ash •strontium nitrate muds •calcium sulfate •with residual phosphate •silicate muds •hypo muds (sulfur, carbon, iron oxide) •sodium sulfate •strontium sulfide •sulfur •alminum chloride •hydrochloric acid	these 8 sites amount to 20 acres where waste was either pumped into ground or spread on top of ground •no dikes	unknown	Yes	Du Pont
2) off site contractor-Scientific Chemical Processing, Cardlstadt, NJ	1972-75	2000 20,000 tons; •insecticides •fungicides •other organics •carbon tetrachloride •ketones & aldehydes •pharmaceutical waste	incinceration and landfill of residual	unknown	unknown	Scientific Chemical Processing
3) [1] off site-Kin Buc Landfill, Edison, NJ	1972-75	13,800 tons; •salts •acid solutions	•landfill •drummed waste •co-disposed with municipal waste •neutralization	unknown	unknown	unknown

Comments:

[1] Facility closed in 1977

PLAINTIFF'S EXHIBIT PAGANO-9 11/12/95

EXHIBIT 1

EXHIBIT 111

Exhibit G

NUS CORPORATION
A Halliburton Company

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
EXECUTIVE SUMMARY

E.I. DuPont-Grasselli Plant **Site Name**	NJD002185965 **EPA Site ID Number**
South Wood Avenue Linden, New Jersey **Address**	02-8412-18 **TDD Number**

Date of Site Visit: January 9, 1985 BAA000025

SITE DESCRIPTION

This 206 acre site in Linden, Union County, New Jersey has been the location for numerous chemical manufacturers for over 100 years. The site was originally developed by Standard Chemical Company in the 1800's. In 1885, the plant was sold to the Grasselli Chemical Company, which produced three (3) unknown products. In 1928, the plant became part of the DuPont Chemical Corporation. Principal products produced by DuPont at this site include sulfuric acid, sodium silicate, strontium nitrate and chloro sulfonic acid.

Presently, the site holds several permits (both State and Federal) for discharging materials into the air, Arthur Kill, and the Atlantic Ocean. DuPont has also installed approximately $1 million in environmental control facilities including fume scrubbers, monitoring systems, and effluent alarms.

A site inspection of the E.I. DuPont-Grasselli Plant was conducted on January 9, 1985 by personnel from NUS Corporation, Region II office. The site inspection was considered necessary because of lack of sufficient files and due to a congressional study entitled the Eckhardt Report stating that approximately 7951 tons of chemical waste have been disposed of at this site between 1928 and 1979.

Two (2) surface water samples, one (1) sediment sample, and fourteen (14) soil samples were collected from predetermined locations on the site. The samples were sent to three EPA - contracted laboratories for analysis of organic and inorganic hazardous substance list pollutants.

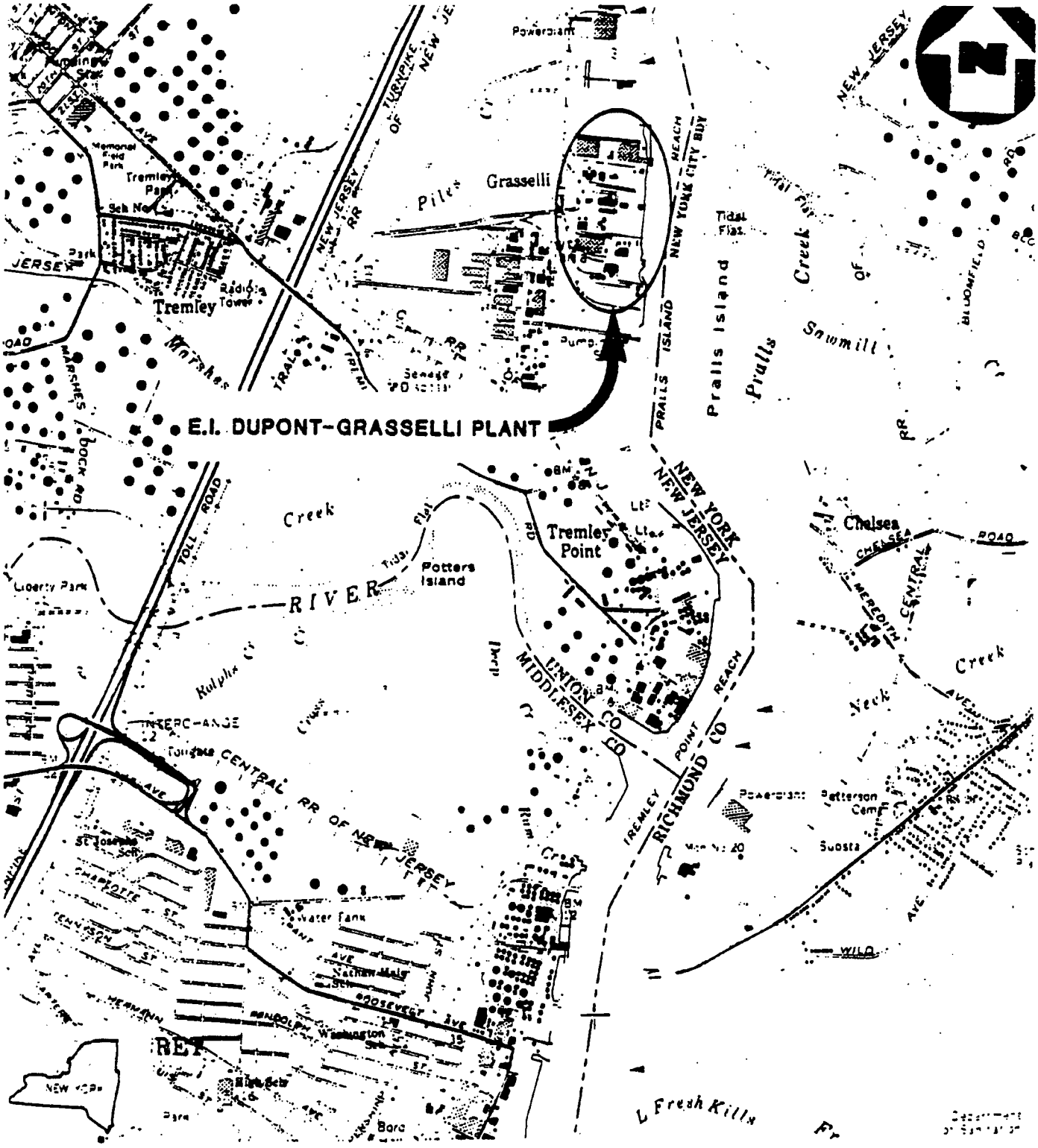
HAZARD RANKING SCORE: $S_m = 6.13$ ($S_{gw} = 2.94$, $S_{sw} = 10.18$ $S_a = 0$)

$S_{fe} = 43.75$, $S_{dc} = 0$

Prepared by: Nelson J. Abrams of NUS Corporation

Date: 9/13/85

MAXUS3918673



(QUAD) ARTHUR KILL, N.J.

FIGURE 1

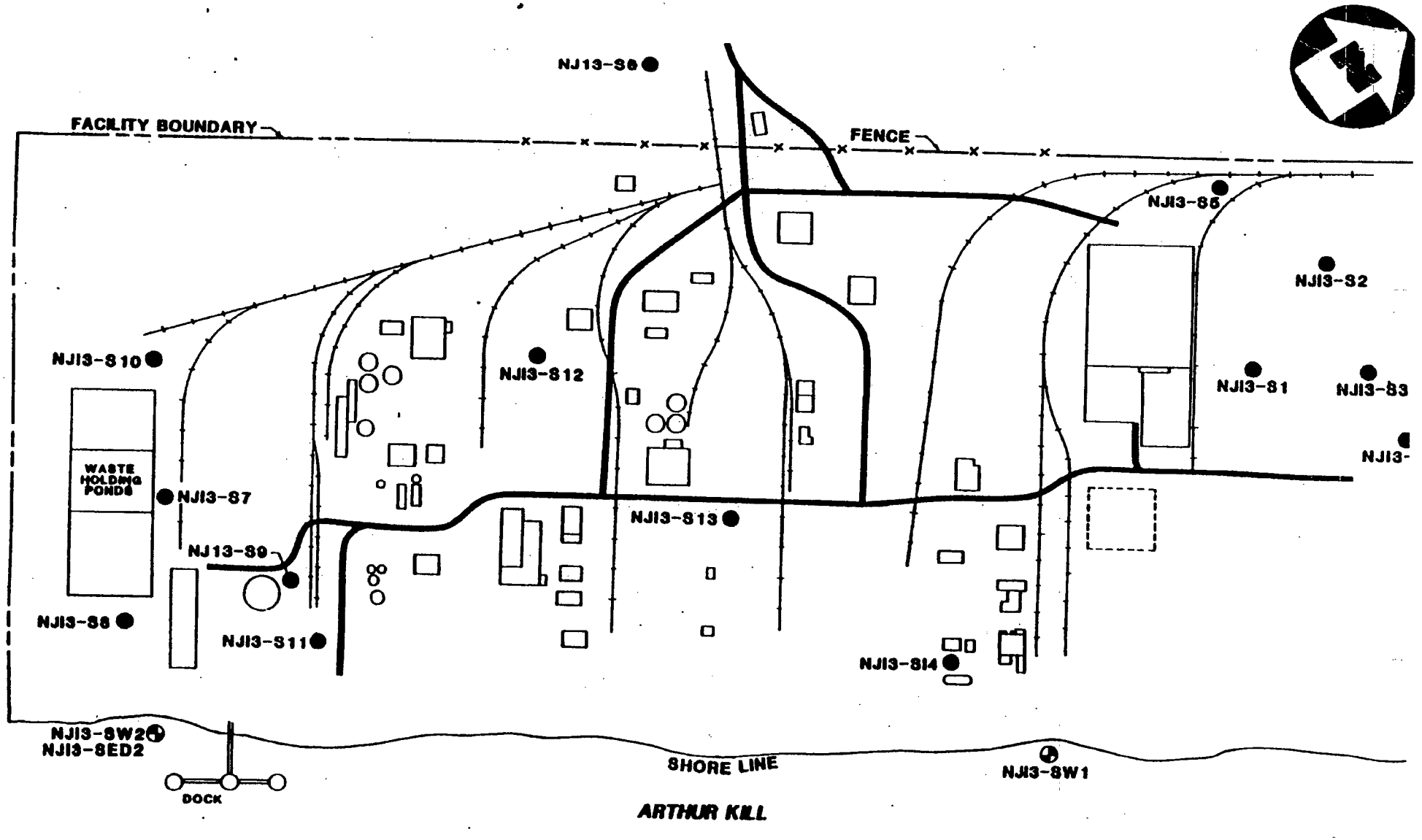
SITE LOCATION MAP

E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

SCALE: 1" = 2000'

NUS CORPORATION
A Halliburton Company

MAXUS3918674



LEGEND:
SURFACE WATER SAMPLE
SOIL SAMPLE

SAMPLE LOCATION MAP

E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

(NOT TO SCALE)

FIGURE 2

NUS CORPORATION
A Halliburton Company

MAXUS3918675

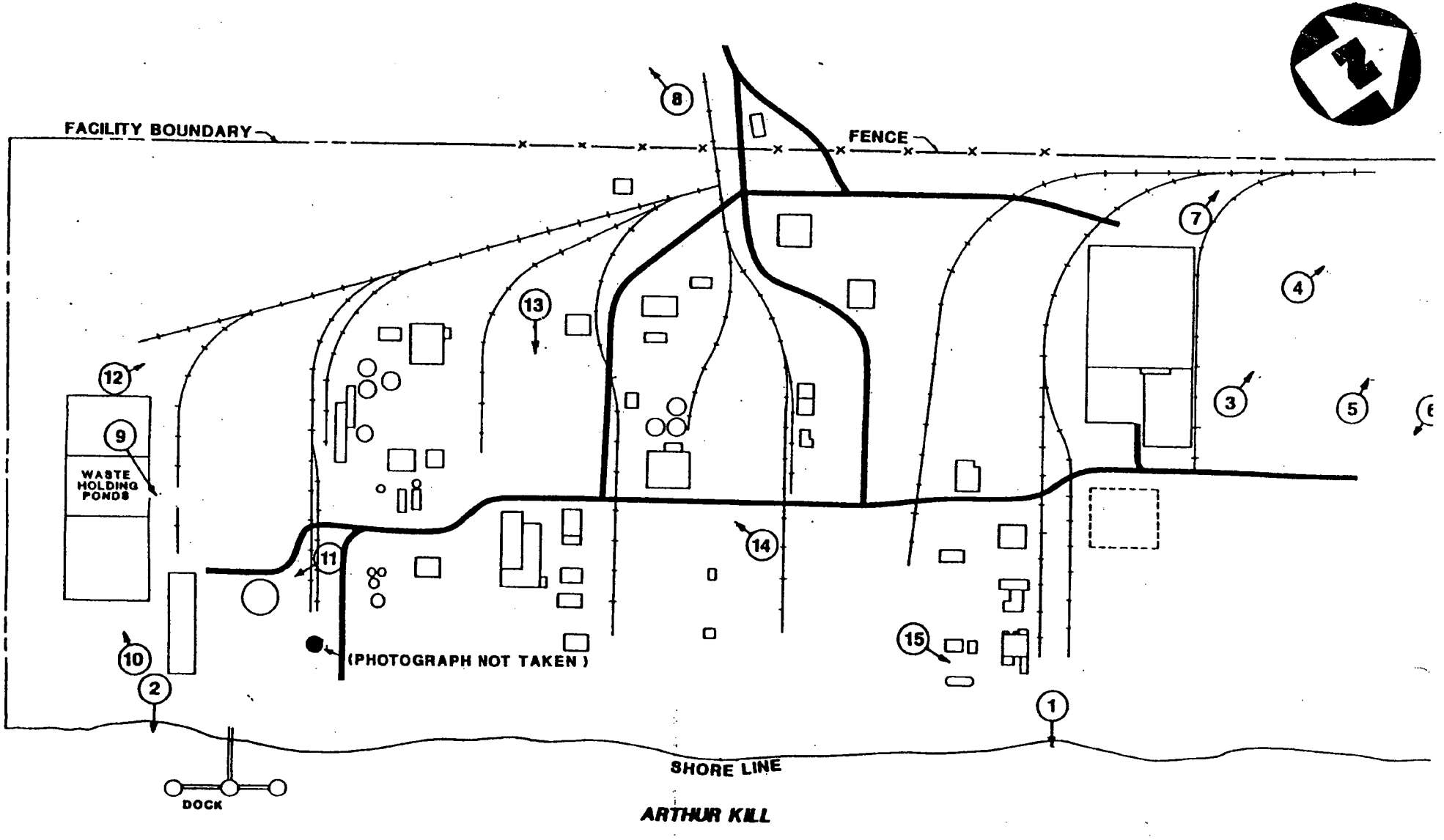


FIGURE 3

PHOTOGRAPH LOCATION MAP

E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

(NOT TO SCALE)

NUS CORPORATION
A Halliburton Company

MAXUS3918676

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

VOLATILES

SAMPLE NUMBER	NJI3-SW-B	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
Chloromethane									
Bromomethane									
Vinyl Chloride									
Chloroethane									
Methylene Chloride		7.0 B	8.0 B	E	E	E	E	E	E
Acetone	7.3	10.0	15.0	E	E	E			
Carbon Disulfide									
1,1-Dichloroethene									
1,1-Dichloroethane									
Trans-1,2-Dichloroethene									
Chloroform									
1,2-Dichloroethane									
2-Butanone	16 B	17.0 B	17.0 B						
1,1,1-Trichloroethane	9.0 B	9.0 B	9.0 B						
Carbon Tetrachloride									
Vinyl Acetate									
Bromodichloromethane									
1,1,2,2-Tetrachloroethane									
1,2-Dichloropropane									
Trans-1,3-Dichloropropene									
Trichloroethene									
Dibromochloromethane									
1,1,2-Trichloroethane									
Benzene									
Cis-1,3-Dichloropropene									
2-Chloroethylvinylether									
Bromoform									
2-Hexanone									
4-Methyl-2-Pentanone									
Tetrachloroethene									
Toluene	14								
Chlorobenzene									
Ethylbenzene									
Styrene									
Total Xylenes									

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918677

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3701

VOLATILES									
SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	BA421	BA422	BA423	BA424	BA425	BA426	BA427	BA428	BA429
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
Chloromethane				E	E	E	E	E	E
Bromomethane				E	E	E	E	E	E
Vinyl Chloride				E	E	E	E	E	E
Chloroethane				E	E	E	E	E	E
Methylene Chloride	E	E	E	E	E	E	E	E	E
Acetone	E	E	E	E	E	E	E	E	E
Carbon Disulfide				E	E	E	E	E	E
1,1-Dichloroethene				E	E	E	E	E	E
1,1-Dichloroethane				E	E	E	E	E	E
Trans-1,2-Dichloroethene				E	E	E	E	E	E
Chloroform				E	E	E	E	E	E
1,2-Dichloroethane				E	E	E	E	E	E
2-Butanone				E	E	E	E	E	E
1,1,1-Trichloroethane				E	E	E	E	E	E
Carbon Tetrachloride				E	E	E	E	E	E
Vinyl Acetate				E	E	E	E	E	E
Bromodichloromethane				E	E	E	E	E	E
1,1,2,2-Tetrachloroethane				E	E	E	E	E	E
1,2-Dichloropropane				E	E	E	E	E	E
Trans-1,3-Dichloropropene				E	E	E	E	E	E
Trichloroethene				E	E	E	E	E	E
Dibromochloromethane				E	E	E	E	E	E
1,1,2-Trichloroethane				E	E	E	E	E	E
Benzene				E	E	E	E	E	E
Cis-1,3-Dichloropropene				E	E	E	E	E	E
2-Chloroethylvinylether				E	E	E	E	E	E
Bromoform				E	E	E	E	E	E
2-Hexanone				E	E	E	E	E	E
4-Methyl-2-Pentanone				E	E	E	E	E	E
Tetrachloroethene				E	E	E	E	E	E
Toluene				E	E	E	E	E	E
Chlorobenzene				E	E	E	E	E	E
Ethylbenzene				E	E	E	E	E	E
Styrene				E	E	E	E	E	E
Total Xylenes				E	E	E	E	E	E

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918678

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/05
CASE: 3701

SEMI-VOLATILES

SAMPLE NUMBER	NJI3-SW-B	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
N-Nitrosodimethylamine									
Phenol									
Aniline									
Bis(2-Chloroethyl)Ether									
2-Chlorophenol									
1,3-Dichlorobenzene									
1,4-Dichlorobenzene									
Benzyl Alcohol									
1,2-Dichlorobenzene									
2-Methylphenol									
Bis(2-Chloroisopropyl)Ether									
4-Methylphenol									
N-Nitroso-Di-n-Propylamine									
Hexachloroethane									
Nitrobenzene									
Isophorone									
2-Nitrophenol									
2,4-Dimethylphenol									
Benzoic Acid									
Bis(2-Chloroethoxy)Methane									
2,4-Dichlorophenol									
1,2,4-Trichlorobenzene									
Naphthalene									
4-Chloroaniline									
Hexachlorobutadiene									
4-Chloro-3-Methylphenol									
2-Methylnaphthalene									
Hexachlorocyclopentadiene									
2,4,6-Trichlorophenol									
2,4,5-Trichlorophenol									
2-Chloronaphthalene									
2-Nitroaniline									
Dimethyl Phthalate									
Acenaphthylene									
3-Nitroaniline									
Acenaphthene									
2,4-Dinitrophenol									
4-Nitrophenol									
Dibenzofuran									
2,4-Dinitrotoluene									
2,6-Dinitrotoluene									
Diethylphthalate									
4-Chlorophenylphenyl ether									
Fluorene									

MAXUS3918679

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

SEMI-VOLATILES

SAMPLE NUMBER	NJI3-SW-B	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
4-Nitroaniline									
4,6-Dinitro-2-Methylphenol									
N-Nitrosodiphenylamine									
4-Bromophenylphenyl ether									
Hexachlorobenzene									
Pentachlorophenol									
Phenanthrene									5200
Anthracene									
Di-n-Butylphthalate						B	E		
Fluoranthene					J			J	6000
Benzidine									
Pyrene				J	J		J	J	6300
Butylbenzylphthalate									
3,3'-Dichlorobenzidine									
Benzo(a)Anthracene					J			J	J
Bis(2-Ethylhexyl)Phthalate									
Chrysene					J			J	J
Di-n-Octyl Phthalate									
Benzo(b)Fluoranthene									
Benzo(K)Fluoranthene									
Benzo(a)Pyrene					J				J
Indeno(1,2,3-cd)Pyrene									
Dibenzo(a,h)Anthracene									
Benzo(ghi)Perylene									

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918680

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3701

SEMI-VOLATILES

SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	BA421	BA422	BA423	BA424	BA425	BA426	BA427	BA428	BA429
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
N-Nitrosodimethylamine	E			E	E	E	E	E	E
Phenol	E			E	E	E	E	E	E
Aniline	E			E	E	E	E	E	E
Bis(2-Chloroethyl)Ether	E			E	E	E	E	E	E
2-Chlorophenol	E			E	E	E	E	E	E
1,3-Dichlorobenzene	E			E	E	E	E	E	E
1,4-Dichlorobenzene	E			E	E	E	E	E	E
Benzyl Alcohol	E			E	E	E	E	E	E
1,2-Dichlorobenzene	E			E	E	E	E	E	E
2-Methylphenol	E			E	E	E	E	E	E
Bis(2-Chloroisopropyl)Ether	E			E	E	E	E	E	E
4-Methylphenol	E			E	E	E	E	E	E
N-Nitroso-Di-n-Propylamine	E			E	E	E	E	E	E
Hexachloroethane	E			E	E	E	E	E	E
Nitrobenzene	E			E	E	E	E	E	E
Isophorone	E			E	E	E	E	E	E
2-Nitrophenol	E			E	E	E	E	E	E
2,4-Dimethylphenol	E			E	E	E	E	E	E
Benzoic Acid	E			E	E	E	E	E	E
Bis(2-Chloroethoxy)Methane	E			E	E	E	E	E	E
2,4-Dichlorophenol	E			E	E	E	E	E	E
1,2,4-Trichlorobenzene	E			E	E	E	E	E	E
Naphthalene	E			E	E	E	E	E	E
4-Chloroaniline	E			E	E	E	E	E	E
Hexachlorobutadiene	E			E	E	E	E	E	E
4-Chloro-3-Methylphenol	E			E	E	E	E	E	E
2-Methylnaphthalene	E			E	E	E	E	E	E
Hexachlorocyclopentadiene	E			E	E	E	E	E	E
2,4,6-Trichlorophenol	E			E	E	E	E	E	E
2,4,5-Trichlorophenol	E			E	E	E	E	E	E
2-Chloronaphthalene	E			E	E	E	E	E	E
2-Nitroaniline	E			E	E	E	E	E	E
Dimethyl Phthalate	E			E	E	E	E	E	E
Acenaphthylene	E			E	E	E	E	E	E
3-Nitroaniline	E			E	E	E	E	E	E
Acenaphthene	E			E	E	E	E	E	E
2,4-Dinitrophenol	E			E	E	E	E	E	E
4-Nitrophenol	E			E	E	E	E	E	E
Dibenzofuran	E			E	E	E	E	E	E
2,4-Dinitrotoluene	E			E	E	E	E	E	E
2,6-Dinitrotoluene	E			E	E	E	E	E	E
Diethylphthalate	E			E	E	E	E	E	E
4-Chlorophenylphenyl ether	E			E	E	E	E	E	E
Fluorene	E			E	E	E	E	E	E

MAXUS3918681

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

SEMI-VOLATILES

SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	BA421	BA422	BA423	BA424	BA425	BA426	BA427	BA428	BA429
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
4-Nitroaniline	E			E	E	E	E	E	E
4,6-Dinitro-2-Methylphenol	E			E	E	E	E	E	E
N-Nitrosodiphenylamine	E			E	E	E	E	E	E
4-Bromophenylphenyl ether	E			E	E	E	E	E	E
Hexachlorobenzene	E			E	E	E	E	E	E
Pentachlorophenol	E			E	E	E	E	E	E
Phenanthrene	E			E	E	E	E	E	E
Anthracene	E			E	E	E	E	E	E
Di-n-Butylphthalate	E			E	E	E	E	E	E
Fluoranthene	E			E	E	E	E	E	E
Benzidine	E			E	E	E	E	E	E
Pyrene	E			E	E	E	E	E	E
Butylbenzylphthalate	E			E	E	E	E	E	E
3,3'-Dichlorobenzidine	E			E	E	E	E	E	E
Benzo(a)Anthracene	E			E	E	E	E	E	E
Bis(2-Ethylhexyl)Phthalate	E			E	E	E	E	E	E
Chrysene	E			E	E	E	E	E	E
Di-n-Octyl Phthalate	E			E	E	E	E	E	E
Benzo(b)Fluoranthene	E			E	E	E	E	E	E
Benzo(K)Fluoranthene	E			E	E	E	E	E	E
Benzo(a)Pyrene	E			E	E	E	E	E	E
Indeno(1,2,3-cd)Pyrene	E			E	E	E	E	E	E
Dibenzo(a,h)Anthracene	E			E	E	E	E	E	E
Benzo(ghi)Perylene	E			E	E	E	E	E	E

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918682

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

PESTICIDES/PCBs									
SAMPLE NUMBER	NJI3-SW-D	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Alpha-BHC				E	E	E	E	J	E
Beta-BHC				E	E	E	E	J	E
Delta-BHC				E	E	E	E	E	E
Gamma-BHC (Lindane)				E	E	E	E	J	E
Heptachlor				E	E	E	E	E	E
Aldrin				E	E	E	E	E	E
Heptachlor Epoxide				E	E	E	E	E	E
Endosulfan I				E	E	E	E	E	E
Dieldrin				E	E	E	E	E	E
4,4'-DDE				J	E	E	J	J	J
Endrin				E	E	E	E	E	E
Endosulfan II				E	E	E	E	E	E
4,4'-DDD				J	E	E	E	E	E
Endosulfan sulfate				E	E	E	E	E	E
Endrin Aldehyde				E	E	E	E	E	E
4,4'-DDT				J	E	E	J	J	J
Methoxychlor				E	J	E	J	J	E
Endrin Ketone				E	E	E	E	E	E
Chlordane				E	E	E	E	E	E
Toxaphene				E	E	E	E	E	E
Aroclor-1016				E	E	E	E	E	E
Aroclor-1221				E	E	E	E	E	E
Aroclor-1232				E	E	E	E	E	E
Aroclor-1242				E	E	E	E	E	E
Aroclor-1248				E	E	E	E	E	E
Aroclor-1254				E	E	E	E	E	E
Aroclor-1260				E	E	E	E	E	E

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918683

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3701

PESTICIDES/PCBs									
SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	BA421	BA422	BA423	BA424	BA425	BA426	BA427	BA428	BA429
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Alpha-BHC	E	E	E	E	E	E	E	E	E
Beta-BHC	E	E	E	E	E	E	E	E	E
Delta-BHC	E	E	E	E	E	E	E	E	E
Gamma-BHC (Lindane)	E	E	E	E	E	E	E	E	E
Heptachlor	E	E	E	E	E	E	E	E	E
Aldrin	E	E	E	E	E	E	E	E	E
Heptachlor Epoxide	E	E	E	E	E	E	E	E	E
Endosulfan I	E	E	E	E	E	E	E	E	E
Dieldrin	E	E	E	E	E	E	E	E	E
4,4'-DDE	E	E	E	E	E	E	E	E	E
Endrin	E	E	E	E	E	E	E	E	E
Endosulfan II	E	E	E	E	E	E	E	E	E
4,4'-DDD	E	E	E	E	E	E	E	E	E
Endosulfan sulfate	E	E	E	E	E	E	E	E	E
Endrin Aldehyde	E	E	E	E	E	E	E	E	E
4,4'-DDT	E	E	E	E	E	E	E	E	E
Methoxychlor	E	E	E	E	E	E	E	E	E
Endrin Ketone	E	E	E	E	E	E	E	E	E
Chlordane	E	E	E	E	E	E	E	E	E
Toxaphene	E	E	E	E	E	E	E	E	E
Aroclor-1016	E	E	E	E	E	E	E	E	E
Aroclor-1221	E	E	E	E	E	E	E	E	E
Aroclor-1232	E	E	E	E	E	E	E	E	E
Aroclor-1242	E	E	E	E	E	E	E	E	E
Aroclor-1248	E	E	E	E	E	E	E	E	E
Aroclor-1254	E	E	E	E	E	E	E	E	E
Aroclor-1260	E	E	E	E	E	E	E	E	E

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

MAXUS3918684

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

INORGANICS

SAMPLE NUMBER	NJI3-SW-D	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	MBA 727	MBA 728	MBA 729	MBA 732	MBA 733	MBA 734	MBA 735	MBA 736	MBA 737
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum			J	12800	6490	780	12000	8330	5370
Antimony									
Arsenic				23	39	J	41	10	188
Barium				775	1380	142	6330	10300	3660
Beryllium				J	J		J	J	J
Cadmium							10	42	
Calcium		221000	221000	16300	58700	195000	7970	6270	J
Chromium				43	181	11	60	221	59
Cobalt				J	J			J	J
Copper				170	146	19	141	227	150
Iron		1000	J	22900	19200	3940	25100	38000	14000
Lead	14			330	299	26	966	1710	213
Magnesium		672000	671000	6170	35700	115000	7260	4800	J
Manganese		J	J	287	175	223	221	296	128
Mercury		J	J	J	J	J	J	J	J
Nickel			J	105	37	J	56	39	J
Potassium		206000	205000	J	J		J	J	J
Selenium					5.7		4.1	7.2	
Silver								J	
Sodium		6100000	6100000	13300	2940	5410	7870	J	J
Thallium		E	E						
Tin				26	23			56	
Vanadium				E	30	J	78	89	35
Zinc				710	243	36	446	2460	155

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit

MAXUS3918685

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

INORGANICS

SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	MBA 738	MBA 739	MBA 740	MBA 741	MBA 742	MBA 743	MBA 744	MBA 745	MBA 746
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	7050	9670	1910	12900	4500	1870	2370	12200	6310
Antimony				47					
Arsenic	12	16	7.1	13	39		6.2	13	J
Barium	207	183	J	645	582	217	J	307	206
Beryllium	J	J	J	5.1		J		J	J
Cadmium			3.9	88				3^3 x 2.7	
Calcium	6210	39700	J	8090	5630	151000	J	24500	117000
Chromium	17	28	20	108	21	13	11	30	29
Cobalt	J	J		45	J	J		J	J
Copper	119	115	46	402	144	54	107	56	74
Iron	20900	27300	5350	85600	11200	8210	10400	29400	19600
Lead	42	126	14	364	195	61	56	66	39
Magnesium	7460	32600	J	10500	J	93200	J	12800	76300
Manganese	239	243	12	332	71	229	39	314	398
Mercury	J	J	J	J	J	J	J	J	E
Nickel	31	30	J	143	J	J	J	28	35
Potassium	J			3430	J			3670	
Selenium									
Silver				7.4					
Sodium	3990	3440	7270	5000	J	3690	J	J	4120
Thallium									
Tin				94		23			
Vanadium	52	51	39	147	J	J	J	43	30
Zinc	68	90	27	1100	79	98	33	143	324

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit

MAXUS3918686

Subject: QUALITY ASSURANCE REVIEWED CLP DATA

Conserve space.
Forward original and one copy.

RECEIVER (*Replier to message*):
Reply below the message, keep copy, return one copy.

From :

Ron Naman
FIT/NUS Corporation
Raritan Plaza III
Fieldcrest Avenue
Edison, New Jersey 08837

DATE OF MESSAGE: 7/24/85

ROUTING SY

SIGNATURE OF ORIGINATOR: Darvene Adams

TITLE OF ORIGINATOR: Environmental Scientist

FOLD

INITIAL MESSAGE

Attached are the EPA Region II Quality Assuranced CLP data for the following sit

SITE	CASE #	LABORATORY	ANALYSIS
E.I. DuPont (Graselli)	3112	Chemtech	Inorganics soil, wate
		Compuchem(Mead)	Organics soil, wate
E.I. DuPont (NJ)	3781	RMAL	Inorganics soil, wate
		NUS	Organics soil
		Accurex	Organics soil
		ETC	Organics water

REPLY MESSAGE

These SI reports are due Friday August 9, 1985 COB.

Red-lined data are rejected and should not be used. Please return all raw data to me when the deliverables for this case are due to EPA.

Please sign and date in the spaces provided below and return page 2 to verify that you have received the above data.

DATE OF REPLY: 7/24/85

ROUTING SY

SIGNATURE OF REPLIER: Ronald M Naman

TITLE OF REPLIER: Asst. Reg Mgr

To :

Darvene Adams
U.S. Environmental Protection Agency
Region II - Woodbridge Avenue
Edison, New Jersey 08837

5027-106

2. TO BE RETURNED TO ORIGINATOR (*Receiver*)

OPTIONAL FORM 27 (Rev 7
GSA FPMR (41 CFR) 101-11

MAXUS3918687

Organics Analysis Data Sheet
(Page 1)

Laboratory Name: ETC Corp.
Case No: 3781
Lab Sample ID No: G4951
QC Report No: QC2832
Sample Matrix: water
Contract No: 68-01-6766, 6788, 6789, 6790
Data Release Authorized By: K. Baker
Date Sample Received: 1/9/85

Volatile Compounds

Concentration: Low Medium (Circle One)
Date Extracted/Prepared: 1/15/85
Date Analyzed: 1/15/85
Conc/Dil Factor: 1 pH
Percent Moisture:
Percent Moisture (Decanted):

CAS Number		ug/l or ug/Kg (Circle One)	
74-87-3	Chloromethane	4.0U	
74-83-9	Bromomethane	4.0U	
75-01-4	Vinyl Chloride	4.0U	
75-00-3	Chloroethane	4.0U	
75-09-2	Methylene Chloride	~~7~~ 4.0U	MM
67-64-1	Acetone	7.3	MM
75-15-0	Carbon Disulfide	4.0U	
75-35-4	1, 1-Dichloroethene	4.0U	
75-34-3	1, 1-Dichloroethane	4.0U	
156-60-5	Trans-1, 2-Dichloroethene	4.0U	
67-66-3	Chloroform	4.0U	
107-06-2	1, 2-Dichloroethane	4.0U	
78-93-3	2-Butanone	16B ~~15.9B~~	R
71-55-6	1, 1, 1-Trichloroethane	9.0B ~~4.0U~~	MM
56-23-5	Carbon Tetrachloride	4.0U	
108-05-4	Vinyl Acetate	4.0U	
75-27-4	Bromodichloromethane	4.0U	

CAS Number		ug/l or ug/Kg (Circle One)	
79-34-5	1, 1, 2, 2-Tetrachloroethane	4.0U	
78-87-5	1, 2-Dichloropropane	4.0U	
10061-02-6	Trans-1, 3-Dichloropropene	4.0U	
79-01-6	Trichloroethene	4.0U	
124-48-1	Dibromochloromethane	4.0U	
79-00-5	1, 1, 2-Trichloroethane	4.0U	
71-43-2	Benzene	4.0U	
10061-01-5	cis-1, 3-Dichloropropene	4.0U	
110-75-8	2-Chloroethylvinylether	4.0U	
75-25-2	Bromoform	4.0U	
591-78-6	2-Hexanone	4.0U	
108-10-1	4-Methyl-2-Pentanone	4.0U	
127-18-4	Tetrachloroethene	4.0U	
108-88-3	Toluene	14 ~~4.0~~	R
108-90-7	Chlorobenzene	4.0U	
100-41-4	Ethylbenzene	4.0U	
100-42-5	Styrene	4.0U	
	Total Xylenes	4.0U	

Data Reporting Qualifiers

For reporting results to EPA, the following results qualifiers are used. Additional flags or footnotes explaining results are encouraged. However, the definition of each flag must be explicit.

Value — If the result is a value greater than or equal to the detection limit, report the value.

U — Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., 10U) based on necessary concentration/dilution actions. (This is not necessarily the instrument detection limit.) The footnote should read: U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.

J — Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound that meets the identification criteria but

C — This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides ≥10 ng/ul in the final extract should be confirmed by GC/MS.

B — This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

Other — Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

015

MAXUS3918688

Organics Analysis Data Sheet
(Page 2)

K. Baker

Semivolatile Compounds

Concentration: Low Medium (Circle One)

Date Extracted/Prepared: 1/21/85

Date Analyzed: 3/24/85

Conc/Dil Factor: 1

CAS Number		ug/l or ug/Kg (Circle One)
62-75-9	N-Nitrosodimethylamine	20.0U
108-95-2	Phenol	40.0U
62-53-3	Aniline	20.0U
111-44-4	bis(-2-Chloroethyl)Ether	20.0U
95-57-8	2-Chlorophenol	40.0U
541-73-1	1, 3-Dichlorobenzene	20.0U
106-46-7	1, 4-Dichlorobenzene	20.0U
100-51-6	Benzyl Alcohol	20.0U
95-50-1	1, 2-Dichlorobenzene	20.0U
95-48-7	2-Methylphenol	40.0U
39638-32-9	bis(2-chloroisopropyl)Ether	20.0U
106-44-5	4-Methylphenol	40.0U
621-64-7	N-Nitroso-Di-n-Propylamine	20.0U
67-72-1	Hexachloroethane	20.0U
98-95-3	Nitrobenzene	20.0U
78-59-1	Isophorone	20.0U
88-75-5	2-Nitrophenol	40.0 ~~40~~ U NM
105-67-9	2, 4-Dimethylphenol	40.0U
65-85-0	Benzoic Acid	40.0U
111-91-1	bis(-2-Chloroethoxy)Methane	20.0U
120-83-2	2, 4-Dichlorophenol	40.0U
120-82-1	1, 2, 4-Trichlorobenzene	20.0U
91-20-3	Naphthalene	20.0U
106-47-8	4-Chloroaniline	20.0U
87-68-3	Hexachlorobutadiene	20.0U
59-50-7	4-Chloro-3-Methylphenol	40.0U
91-57-6	2-Methylnaphthalene	20.0U
77-47-4	Hexachlorocyclopentadiene	20.0U
88-06-2	2, 4, 6-Trichlorophenol	40.0U
95-95-4	2, 4, 5-Trichlorophenol	40.0U
91-58-7	2-Chloronaphthalene	20.0U
88-74-4	2-Nitroaniline	20.0U
131-11-3	Dimethyl Phthalate	20.0U
208-96-8	Acenaphthylene	20.0U
1-09-2	3-Nitroaniline	20.0U

CAS Number		ug/l or ug/Kg (Circle One)
83-32-9	Acenaphthene	20.0U
51-28-5	2, 4-Dinitrophenol	40.0U
100-02-7	4-Nitrophenol	40.0U
132-64-9	Dibenzofuran	20.0U
121-14-2	2, 4-Dinitrotoluene	20.0U
606-20-2	2, 6-Dinitrotoluene	20.0U
84-66-2	Diethylphthalate	20.0U
7005-72-3	4-Chlorophenyl-phenylether	20.0U
86-73-7	Fluorene	20.0U
100-01-6	4-Nitroaniline	20.0U
534-52-1	4, 6-Dinitro-2-Methylphenol	40.0U
86-30-6	N-Nitrosodiphenylamine (1)	20.0U
101-55-3	4-Bromophenyl-phenylether	20.0U
118-74-1	Hexachlorobenzene	20.0U
87-86-5	Pentachlorophenol	40.0U
85-01-8	Phenanthrene	20.0U
120-12-7	Anthracene	20.0U
84-74-2	Di-n-Butylphthalate	20.0U
206-44-0	Fluoranthene	20.0U
92-87-5	Benzidine	20.0U
129-00-0	Pyrene	20.0U
85-68-7	Butylbenzylphthalate	20.0U
91-94-1	3, 3'-Dichlorobenzidine	20.0U
56-55-3	Benzo(a)Anthracene	20.0U
117-81-7	bis(2-Ethylhexyl)Phthalate	20.0U
218-01-9	Chrysene	20.0U
117-84-0	Di-n-Octyl Phthalate	20.0U
205-99-2	Benzo(b)Fluoranthene	20.0U
207-08-9	Benzo(k)Fluoranthene	20.0U
50-32-8	Benzo(a)Pyrene	20.0U
193-39-5	Indeno(1, 2, 3-cd)Pyrene	20.0U
53-70-3	Dibenz(a, h)Anthracene	20.0U
191-24-2	Benzo(g, h, i)Perylene	20.0U

(1)-Cannot be separated from diphenylamine

016

Form I

4/84

MAXUS3918689

Environ...
P. O. Box 818, Alexandria, Virginia 2 703/557-2490

BA410
K. Baker

Organics Analysis Data Sheet
(Page 3)

Pesticide/PCBs

Concentration: (Low) Medium (Circle One)

Date Extracted/Prepared: 1/23/85

Date Analyzed: 3/21/85

Conc/Dil Factor: 1

CAS Number		(ug/l) or ug/Kg (Circle One)
319-84-6	Alpha-BHC	.02u
319-85-7	Beta-BHC	.02u
319-86-8	Delta-BHC	.06u
58-89-9	Gamma-BHC (Lindane)	.02u
76-44-8	Heptachlor	.035u
309-00-2	Aldrin	.035u
1024-57-3	Heptachlor Epoxide	.23u
959-98-8	Endosulfan I	.06u
60-57-1	Dieldrin	.09u
72-55-9	4, 4'-DDE	.07u
72-20-8	Endrin	.12u
33213-65-9	Endosulfan II	.07u
72-54-8	4, 4'-DDD	.02u
7421-93-4	Endrin Aldehyde	.20u
1031-07-8	Endosulfan Sulfate	.43u
50-29-3	4, 4'-DDT	.035u
72-43-5	Methoxychlor	.53u
53494-70-5	Endrin Ketone	.07u
57-74-9	Chlordane	.20u
8001-35-2	Toxaphene	2.0u
12674-11-2	Aroclor-1016	1.1u
11104-28-2	Aroclor-1221	0.9u
11141-16-5	Aroclor-1232	0.1u
53469-21-9	Aroclor-1242	0.73u
12672-29-6	Aroclor-1248	0.6u
11097-69-1	Aroclor-1254	0.3u
11096-82-5	Aroclor-1260	0.3u

V_i = Volume of extract injected (ul)

V_s = Volume of water extracted (ml)

W_s = Weight of sample extracted (g)

V_t = Volume of total extract (ul)

V_s 1000 or W_s _____ V_t 10000 V_i 3

- 017

MAXUS3918690

U.S. EPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 - Alexandria, VA 22313
703/557-2490 FTS: 8-557-2490

EPA Sample No.
MBA727

Date 02/22/85

INORGANIC ANALYSIS DATA SHEET

LAB NAME ROCKY MOUNTAIN ANALYTICAL
SOW NO. 784
LAB SAMPLE ID. NO. -

CASE NO. 3781
QC REPORT NO. 5604

Elements Identified and Measured

Concentration: Low X Medium ____
Matrix: Water X Soil ____ Sludge ____ Other ____

ug/L

1.	ALUMINUM	35U	P	13.	MAGNESIUM	390U	P
2.	ANTIMONY	51U	P ~~R~~ KEO	14.	MANGANESE	4U	P ~~R~~ KEO
3.	ARSENIC	3u	F	15.	MERCURY	0.1u	CV
4.	BARIUM	12U	P	16.	NICKEL	7U	P
5.	BERYLLIUM	0.6U	P	17.	POTASSIUM	1200U	P
.	CADMIUM	5U	P ~~R~~ KEO	18.	SELENIUM	2u	F R
7.	CALCIUM	330U	P	19.	SILVER	5U	P R
8.	CHROMIUM	4U	P	20.	SODIUM	720U	P
9.	COBALT	6U	P	21.	THALLIUM	10u	F
10.	COPPER	5U	P	22.	TIN	28U	P R
11.	IRON	10U	P	23.	VANADIUM	5U	P
12.	LEAD	14	F	24.	ZINC	3U	P

Cyanide NR Percent Solids (%) ____

Footnotes: For reporting results to EPA, standard result qualifiers are used as defined on Cover Page. Additional flags or footnotes explaining results are encouraged. Definition of such flags must be explicit and contained on Cover Page, however.

Comments: ____

Lab Manager [signature]

MAXUS3918691

(Page 1)

Laboratory Name: ETC Corp.
Lab Sample ID No: G4952
Sample Matrix: water
Data Release Authorized By: K. Bak

Case No: 3781
QC Report No: QC 2832
Contract No: 68-01-6766, 6788, 6789, 6790
Date Sample Received: 1/9/85

Volatile Compounds

Concentration: Low Medium (Circle One)
Date Extracted/Prepared: 1/15/85
Date Analyzed: 1/15/85
Conc/Dil Factor: 1 pH
Percent Moisture:
Percent Moisture (Decanted):

CAS Number		ug/l or ug/Kg (Circle One)
74-87-3	Chloromethane	4.0U
74-83-9	Bromomethane	4.0U
75-01-4	Vinyl Chloride	4.0U
75-00-3	Chloroethane	4.0U
75-09-2	Methylene Chloride	7.0B
67-64-1	Acetone	10.0
75-15-0	Carbon Disulfide	4.0U ~~7.0B~~ MM
75-35-4	1, 1-Dichloroethene	4.0U
75-34-3	1, 1-Dichloroethane	4.0U
156-60-5	Trans-1, 2-Dichloroethene	4.0U
67-66-3	Chloroform	4.0U
107-06-2	1, 2-Dichloroethane	4.0U
78-93-3	2-Butanone	17.0B
71-55-6	1, 1, 1-Trichloroethane	9.0B
56-23-5	Carbon Tetrachloride	4.0U
108-05-4	Vinyl Acetate	4.0U
75-27-4	Bromodichloromethane	4.0U

CAS Number		ug/l or ug/Kg (Circle One)
79-34-5	1, 1, 2, 2-Tetrachloroethane	4.0U
78-87-5	1, 2-Dichloropropane	4.0U
10061-02-6	Trans-1, 3-Dichloropropene	4.0U
79-01-6	Trichloroethene	4.0U
124-48-1	Dibromochloromethane	4.0U
79-00-5	1, 1, 2-Trichloroethane	4.0U
71-43-2	Benzene	4.0U
10061-01-5	cis-1, 3-Dichloropropene	4.0U
110-75-8	2-Chloroethylvinylether	4.0U
75-25-2	Bromoform	4.0U
591-78-6	2-Hexanone	4.0U
108-10-1	4-Methyl-2-Pentanone	4.0U
127-18-4	Tetrachloroethene	4.0U
108-88-3	Toluene	4.0U
108-90-7	Chlorobenzene	4.0U
100-41-4	Ethylbenzene	4.0U
100-42-5	Styrene	4.0U
	Total Xylenes	4.0U

Data Reporting Qualifiers

For reporting results to EPA, the following results qualifiers are used. Additional flags or footnotes explaining results are encouraged. However, the definition of each flag must be explicit.

Value If the result is a value greater than or equal to the detection limit, report the value.

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J Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound that meets the identification criteria but

C This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides ≥10 ng/ul in the final extract should be confirmed by GC/MS.

B This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

046

Other Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

Exhibit H

NUS CORPORATION
A Halliburton Company

COMPLETED

FINAL DRAFT
SITE INSPECTION REPORT
AND HAZARDOUS RANKING SYSTEM MODEL
E.J. DUPONT-GRASSELLI PLANT
LINDEN, NEW JERSEY

PROJECT FOR PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS SUBSTANCE FACILITIES—ZONE 1

BAA000027

NUS CORPORATION
SUPERFUND DIVISION

MAXUS3918694

02-8412-18-SI

FINAL DRAFT
SITE INSPECTION REPORT
AND HAZARDOUS RANKING SYSTEM MODEL
E.J. DUPONT-GRASSELLI PLANT
LINDEN, NEW JERSEY

PREPARED UNDER

TECHNICAL DIRECTIVE DOCUMENT NO. 02-8412-18
CONTRACT NO. 68-01-6699

FOR THE

ENVIRONMENTAL SERVICES DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

OCTOBER 18, 1985

NUS CORPORATION
SUPERFUND DIVISION

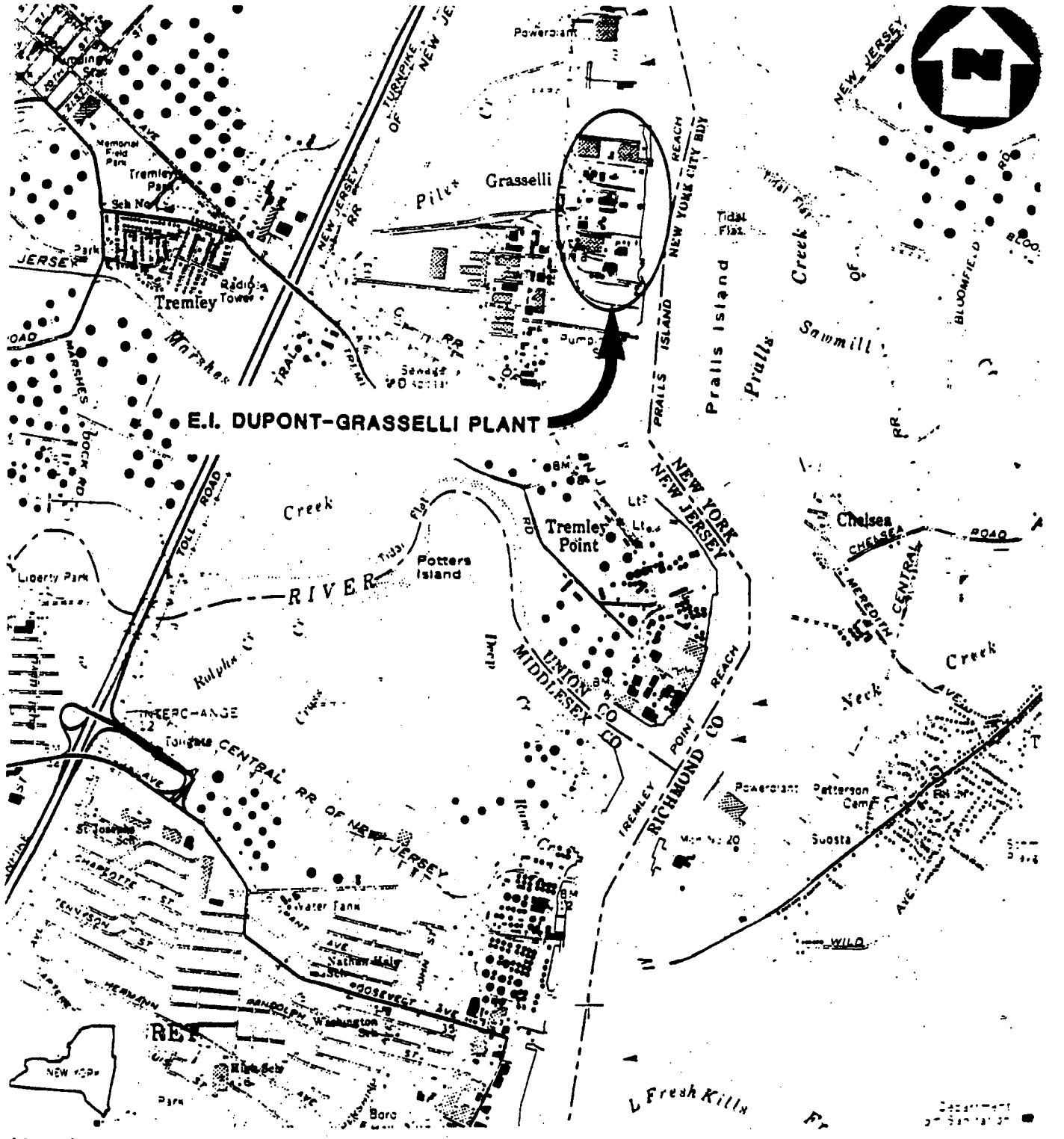
SUBMITTED BY

NELSON J. ABRAMS
PROJECT MANAGER

REVIEWED/APPROVED BY

RONALD M. NAMAN
REGIONAL PROJECT MANAGER

MAXUS3918695



(QUAD) ARTHUR KILL, N.J.

SITE LOCATION MAP

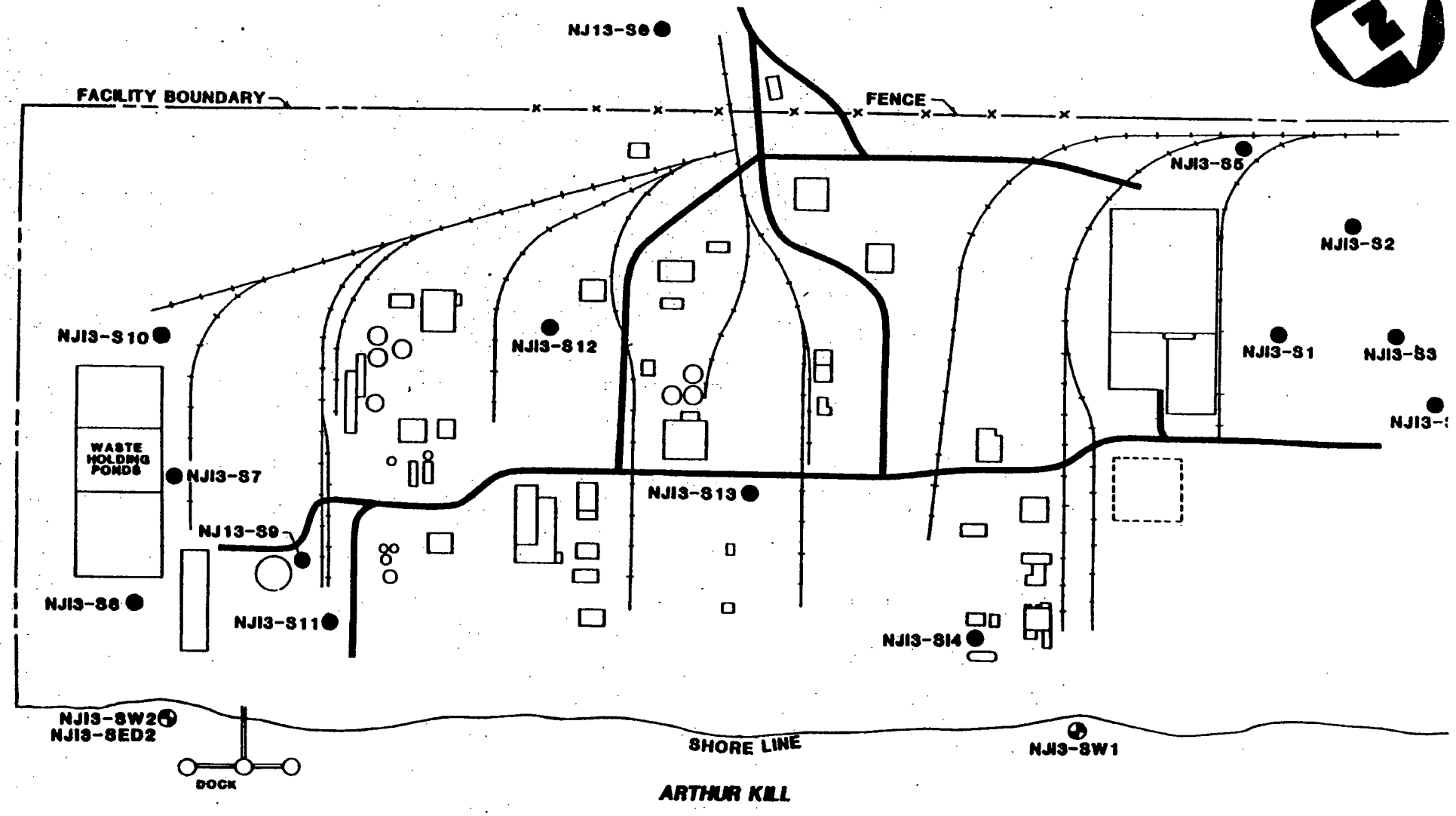
E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

SCALE: 1" = 2000'

FIGURE 1

NUS CORPORATION
A Halliburton Company

MAXUS3918696



LEGEND:
SURFACE WATER SAMPLE
SOIL SAMPLE

FIGURE 2

SAMPLE LOCATION MAP
E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

(NOT TO SCALE)

NUS CORPORATION
A Halliburton Company

MAXUS3918697

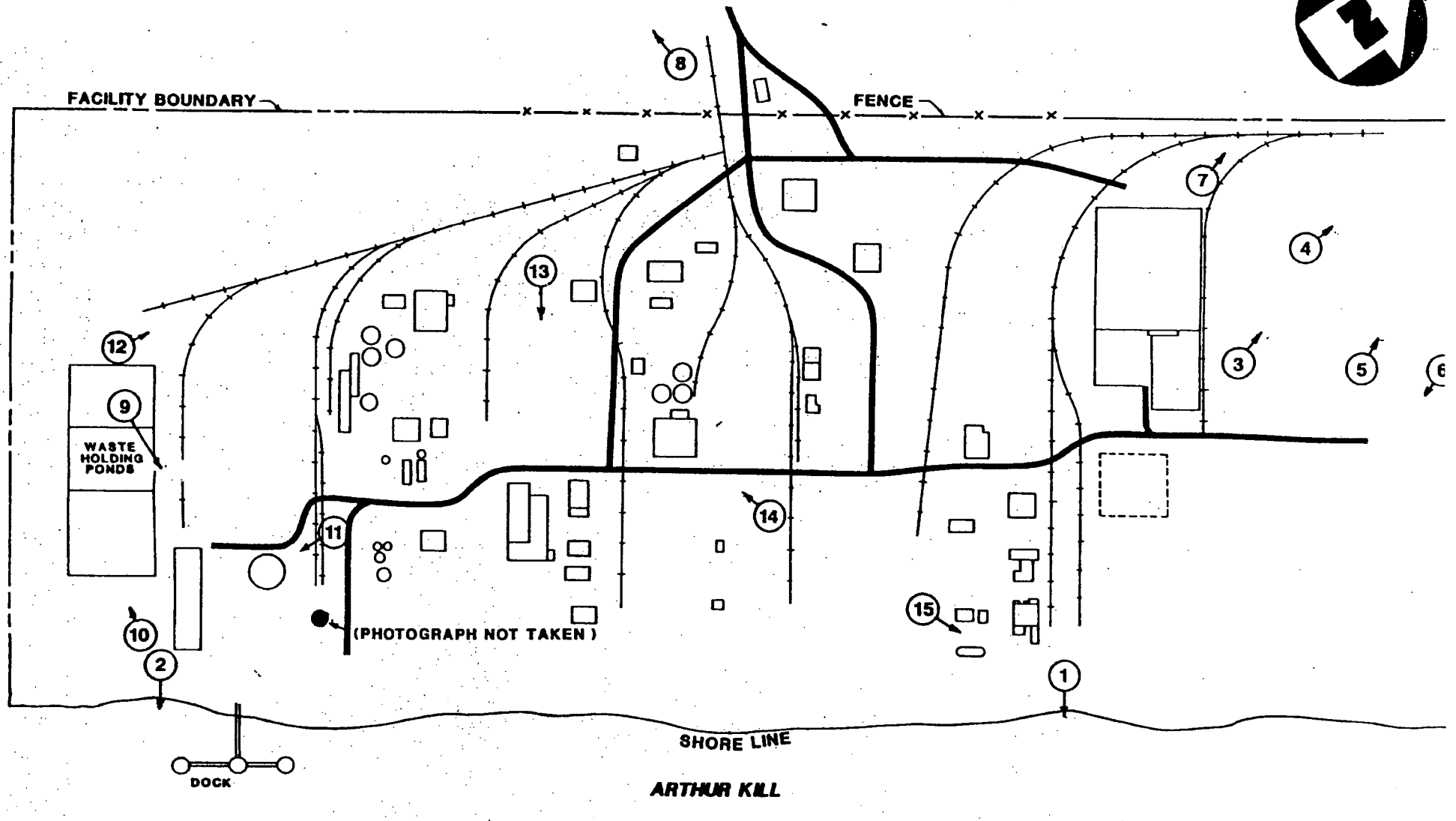


FIGURE 3

PHOTOGRAPH LOCATION MAP

E.I. DUPONT-GRASSELLI PLANT LINDEN, N.J.

(NOT TO SCALE)

NUS CORPORATION
A Halliburton Company

MAXUS3918698

FIT QUALITY ASSURANCE TEAM

DOCUMENTATION RECORDS

FOR

HAZARD RANKING SYSTEM

INSTRUCTIONS: As briefly as possible summarize the information you used to assign the score for each factor (e.g., "Waste quantity = 4,230 drums plus 800 cubic yards of sludges"). The source of information should be provided for each entry and should be a bibliographic-type reference. Include the location of the document.

FACILITY NAME: E.I. DuPont-Grasselli Plant

LOCATION: South Wood Avenue, Linden, New Jersey

DATE SCORED: October 8, 1985

PERSON SCORING: Nelson J. Abrams

PRIMARY SOURCE(S) OF INFORMATION (e.g., EPA region, state, FIT, etc.):
NJDEP Files.
U.S. EPA Files.

FACTORS NOT SCORED DUE TO INSUFFICIENT INFORMATION:

COMMENTS OR QUALIFICATIONS:
The Organic Vapor Analyzer (OVA) was used during site reconnaissance on January 4, 1985 and site inspection on January 9, 1985. The OVA detected the presence of organic vapors in the western portion of the site, but it cannot be determined if the vapors were produced by E.I. DuPont. Therefore, the air route on the MITRE Model was scored zero.

MAXUS3918699

GROUNDWATER ROUTE

1 OBSERVED RELEASE

Contaminants detected (5 maximum):

Samples not obtained.

Rationale for attributing the contaminants to the facility:

* * *

2 ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern:

Triassic siltstone of the Brunswick Formation.

Ref: #1

Depth(s) from the ground surface to the highest seasonal level of the saturated zone water table(s) of the aquifer of concern:

40-50 feet.

Ref: #1

Depth from the ground surface to the lowest point of waste disposal/storage:

Unknown.

MAXUS3918700

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal):

44 inches.

Ref: #2

Mean annual lake or seasonal evaporation (list months for seasonal):

32 inches.

Ref: #2

Net precipitation (subtract the above figures):

12 inches.

Permeability of Unsaturated Zone

Soil type in unsaturated zone:

Soils in the area are loamy, containing silty and sandy strata, and are usually located along streams or intermittent streams.

Ref: #3

Permeability associated with soil type:

10^{-4}-10^{-6} cm/sec.

Ref: #2

Physical State

Physical state of substances at time of disposal (or at present time for generated gases):

Liquids.

Ref: #6

* * *

MAXUS3918701

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Unsound run-on diversion structure with no liner.

Refs: #2, 5

Method with highest score:

Method listed above.

Ref. #2

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

Sulfuric Acid
Reagent Grade Chemicals
Agricultural Chemicals
Aluminum Sulfate
Ammonium Thiosulfate
Sodium Bisulfite Solution
Chlorosulfonic Acid
Dimethyl Sulfate
Formaldehyde
Sulfamic Acid

Ref: #6

Compound with highest score:

Sulfuric Acid.

Ref: #7

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

7,951 hundred tons = 1,987,750 drums.

Refs: #2, 4

Basis of estimating and/or computing waste quantity:

Ref: #4

* * *

MAXUS3918702

5 TARGETS

Groundwater Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility:

Commercial, Industrial.

Refs: #1, 8

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:

None.

Ref: #8

Distance to above well or building:

Greater than 3 miles.

Ref: #8

Population Served by Groundwater Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each:

All drinking water comes from either wells from the city of Rahway or reservoir water from northern New Jersey.

Refs: #1, 8

Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1.5 people per acre).

None.

Ref: #9

Total population served by groundwater within a 3-mile radius:

None.

Refs: #1, 8, 9

MAXUS3918703

SURFACE WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

Surface water samples were not taken .

Ref: #5

Rationale for attributing the contaminants to the facility:

Not Applicable.

* * *

2 ROUTE CHARACTERISTICS

Facility Slope and Intervening Terrain

Average slope of facility in percent:

0-5%.

Refs: #5, 9

Name/description of nearest downslope surface water:

Arthur Kill.

Ref: #9

Average slope of terrain between facility and above-cited surface water body in percent:

0-5%.

Refs: #5, 9

Is the facility located either totally or partially in surface water?
No.
Ref: #5

MAXUS3918704

Is the facility completely surrounded by areas of higher elevation?

No.

Ref: #9

1-Year 24-Hour Rainfall in Inches

2.5 - 3.0 inches.

Ref: #2

Distance to Nearest Downslope Surface Water

Adjacent to site.

Ref: #9

Physical State of Waste

Liquids.

Ref: #4

* * *

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Piles on site not covered, waste unconsolidated, landfill not covered.

Ref: #2

Method with highest score:

Method listed above.

Ref: #2

MAXUS3918705

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated

Pentachlorophenol

Fluoranthene

Pyrene

Lead

Ref: #13

Compound with highest score:

Pentachlorophenol

Lead

Ref: #13

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

7,951 hundred tons = 1,987,750 drums.

Refs: #2, 4

Basis of estimating and/or computing waste quantity:

Ref: #4

* * *

5 TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance:

Commercial, Industrial.

Refs: #5, 6, 8

MAXUS3918706

Is there tidal influence?

Yes.

Refs: #5, 9

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

0.6 miles.

Refs: #5, 9

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

0.5 miles

Ref: #5, 9

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:

Not applicable.

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake:

None-Population is supplied by ground water in Rahway, or from reservoirs from northern New Jersey.

Refs: #1, 8

MAXUS3918707

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre):

None.

Ref: #9

Total population served:

None.

Name/description of nearest of above water bodies:

Not applicable.

Distance to above-cited intakes, measured in stream miles.

Not applicable.

MAXUS3918708

AIR ROUTE

1 OBSERVED RELEASE

Contaminants detected:

OVA detected the presence of organic vapors in the wrestern portion of the site, but the origin of the vapors could not be determined. Therefore, the Air Route was scored zero.

Date and location of detection of contaminants

Methods used to detect the contaminants:

Rationale for attributing the contaminants to the site:

* * *

2 WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound:

Most incompatible pair of compounds:

MAXUS3918709

Toxicity

Most toxic compound:

Hazardous Waste Quantity

Total quantity of hazardous waste:

Basis of estimating and/or computing waste quantity:

* * *

3 TARGETS

Population Within 4-Mile Radius

Circle radius used, give population, and indicate how determined:

0 to 4 mi 0 to 1 mi 0 to 1/2 mi 0 to 1/4 mi

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

MAXUS3918710

Distance to critical habitat of an endangered species, if 1 mile or less:

Land Use

Distance to commercial/industrial area, if 1 mile or less:

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

Distance to residential area, if 2 miles or less:

Distance to agricultural land in production within past 5 years, if 1 mile or less:

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

MAXUS3918711

FIRE AND EXPLOSION

1 CONTAINMENT

Hazardous substances present:

Sulfuric Acid, Chlorosulfuric Acid, Sodium Bisulfonic Acid, Sodium Bisulfite, Sulfur Tioximde, Ammonium Thiosulfate, Sulfur Dioxide, Formaldehyde, Dimethyl Sulfate, Dimethyl Hydroxylamine, Dimethyl Phthalate, Pentachlorophenol, Fluoranthene, Pyrene, Lead.

Refs: #6, 13

Type of containment, if applicable:

Piles on site not covered, waste unconsolidated, landfill not covered.

* * *

2 WASTE CHARACTERISTICS

Direct Evidence

Type of instrument and measurements:

None.

Ref: #5

Ignitability

Compound used:

Formaldehyde.

Ref: #10

Reactivity

Most reactive compound:

Dimethyl Phthalate.

Ref: #12

Incompatibility

Most incompatible pair of compounds:

Chlorosulfonic Acid and water.

Refs: #10, 12

* * *

MAXUS3918712

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility:

7,951 hundred tons = 1,987,750 drums.

Refs: #2, 4

Basis of estimating and/or computing waste quantity:

Ref: #4

* * *

3 TARGETS

Distance to Nearest Population

1 mile.

Ref: #5

Distance to Nearest Building

Buildings on site.

Refs: #5, 9

Distance to Sensitive Environment

Distance to wetlands:

0.5 mile.

Refs: #5, 9

Distance to critical habitat:

Not applicable.

Land Use

Distance to commercial/industrial area, if 1 mile or less:

Adjacent to site.

Refs: #5, 9

MAXUS3918713

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:
Greater than 2 miles.
Ref: #9

Distance to residential area, if 2 miles or less:
0.5 miles.
Ref: #9

Distance to agricultural land in production within past 5 years, if 1 mile or less:
Greater than 1 mile, area surrounding site is highly industrialized.
Refs: #5, 9

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:
Greater than 1 mile, area surrounding site is highly industrialized.
Refs: #5, 9

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?
No.
Ref: #5

Population Within 2-Mile Radius
9,319.
Ref: #11

Buildings Within 2-Mile Radius
3,206.
Ref: #11

MAXUS3918714

DIRECT CONTACT

1 OBSERVED INCIDENT

Date, location, and pertinent details of incident:

None observed.

Ref: #5

* * *

2 ACCESSIBILITY

Describe type of barrier(s):

Site is fenced and guarded.

Ref: #5

* * *

3 CONTAINMENT

Type of containment, if applicable:

Possibly piles not covered, waste unconsolidated, landfill not covered.

Ref: #2

* * *

4 WASTE CHARACTERISTICS

Toxicity

Compounds evaluated:

Pentechlorophenol

Fluoranthene

Pyrene

Lead

Ref: #13

Compound with highest score:

Pentachlorophenol

Lead

Ref: #13

* * *

MAXUS3918715

5 TARGETS

Population Within One-Mile Radius

226.

Ref: #11

Distance to Critical Habitat (of Endangered Species)

None present in area.

Ref: #5

MAXUS3918716

SITE: NUMBER 1703 PAGE 1 FOR THIS SITE
GRASSELLI PLANT
X----
LINDEN,NJ 07036

COMPANY: COMPANY-FACILITY NUMBER 16035
E.I. DUPONT DE NEMOURS & CO. INC.
CHEMICALS, DYES & PIGMENTS DEP
GRASSELLI PLANT
X----
LINDEN,NJ 07036

FIRST YEAR USED: 1928
LAST YEAR USED: 1979

HUNDRED TONS: 7951
THOUSAND CUBIC YDS.: .
THOUSAND GALLONS: .

COMPOSITION OF WASTE:

HEAVY1			HEAVY4			
ORGAN1	ORGAN2	ORGAN3	ORGAN4		ORGAN6	ORGAN7
			ORGAN12			
ORGAN17	ORGAN18	ORGAN19		ORGAN21	ORGAN22	ORGAN23
INORG1	INORG2					
MISC1			MISC4	MISC5		

Attachment 1B

LEGEND: IF LISTED, THEN PRESENT IN WASTED. IF NOT LISTED, THEN ITEM NOT PRESENT. NOT KNOWN IF PRESENT OR NOT [illegible]

MAXUS3918717

SUMMARY STATEMENT

E.I. DUPONT-GRASSELLI PLANT
LINDEN, NEW JERSEY

This 206 acre site in Linden, Union County, New Jersey has been the location for numerous chemical manufacturers for over 100 years. The site was originally developed by Standard Chemical Company in the 1800s. In 1885, the plant was sold to the Grasselli Chemical Company, which produced three (3) unknown products. In 1928, the plant became part of the DuPont Chemical Corporation. Principal products produced by DuPont at this site include sulfuric acid, sodium silicate, strontium nitrate and chlorosulfonic acid.

Presently, the site holds several permits (both State and Federal) for discharging materials into the air, Arthur Kill, and the Atlantic Ocean. DuPont has also installed approximately $1 million in environmental control facilities including fume scrubbers, monitoring systems, and effluent alarms.

A site inspection of the E.I. DuPont-Grasselli Plant was conducted on January 9, 1985 by personnel from NUS Corporation, Region II office. The site inspection was considered necessary because of lack of sufficient files and due to the Eckhardt List stating that approximately 7,951 tons of chemical waste have been disposed of at this site between 1928 and 1979.

MAXUS3918718

2-Way Memo

Use routing symbols whenever possible.

SENDER (*Originator of message*):
Use brief, informal language.
Conserve space.
Forward original and one copy.

RECEIVER (*Replier to message*):
Reply below the message, keep one copy, return one copy.

Subject: QUALITY ASSURANCE REVIEWED CLP DATA

From : Ron Naman
FIT/NUS Corporation
Karitan Plaza III
Fieldcrest Avenue
Edison, New Jersey 08837

DATE OF MESSAGE	ROUTING SYMBOL
7/24/85	

SIGNATURE OF ORIGINATOR: Darvene Adams

TITLE OF ORIGINATOR: Environmental Scientist

FOLD — INITIAL MESSAGE — FOLD

Attached are the EPA Region II Quality Assuranced CLP data for the following sites:

SITE	CASE #	LABORATORY	ANALYSIS
E.I. DuPont (Graselli)	3112	Chemtech	Inorganics soil, water
		Compuchem(Mead)	Organics soil, water
E.I. DuPont (NJ)	3781	RMAL	Inorganics soil, water
		NUS	Organics soil
		Accurex	Organics soil
		ETC	Organics water

REPLY MESSAGE

These SI reports are due Friday August 9, 1985 COB.

Red-lined data are rejected and should not be used. Please return all raw data to me when the deliverables for this case are due to EPA.

Please sign and date in the spaces provided below and return page 2 to verify that you have received the above data.

To : Darvene Adams
U.S. Environmental Protection Agency
Region II - Woodbridge Avenue
Edison, New Jersey 08837

DATE OF REPLY	ROUTING SYMBOL
7/24/85	

SIGNATURE OF REPLIER: Ronald M Naman

TITLE OF REPLIER: Asst. Reg Mgr.

5027-106 — 2. TO BE RETURNED TO ORIGINATOR (*Receiver*) — OPTIONAL FORM 27 (Rev 7-77) GSA FPMR (41CFR) 101-11.6

MAXUS3918719

Sample #
BA425

Organics Analysis Data Sheet
Page 3
Pesticides/PCBs

Concentration: Low
Date Extracted: Jan 16 1985
Date Analyzed: Feb 25 1985
Conc. Factor: .6

CAS #		ug/Kg
319-84-6	Alpha-BHC	3 U
319-85-7	Beta-BHC	3 U
319-86-8	Delta-BHC	3 U
58-89-9	Gamma-BHC (Lindane)	3 U
76-44-8	Heptachlor	3 U
309-00-2	Aldrin	3 U
1024-57-3	Heptachlor Epoxide	3 U
959-98-8	Endosulfan I	3 U
60-57-1	Dieldrin	5 U
72-55-9	4,4'-DDE	5 U
72-20-8	Endrin	5 U
33213-65-9	Endosulfan II	5 U
75-54-8	4,4'-DDD	28
7421-93-4	Endrin Aldehyde	5 U
1031-07-8	Endosulfan Sulfate	5 U
50-29-3	4,4'-DDT	96
72-43-5	Methoxychlor	30 U
53494-70-5	Endrin Ketone	5 U
57-74-9	Chlordane	30 U
8001-35-2	Toxaphene	50 U
12674-11-2	Aroclor-1016	30 U
11104-28-2	Aroclor-1221	30 U
11141-16-5	Aroclor-1232	30 U
53469-21-9	Aroclor-1242	30 U
12672-29-6	Aroclor-1248	30 U
11097-69-1	Aroclor-1254	50 U
11096-82-5	Aroclor-1260	50 U

Weight of soil extracted (g): 30
Volume of total extract (uL): 10000
Volume of extract injected (uL): 2

SAMPLE NUMBER: BA426

ORGANICS ANALYSIS DATA SHEET

JORATORY NAME: ACUREX
LAB SAMPLE ID NO.: 840101603
SAMPLE MATRIX: SOIL
DATA RELEASE AUTHORIZED BY: R. Scott

CASE NO.: 3781
QC REPORT NO.:
CONTRACT NO.: 68-01-6768
DATE SAMPLE RECEIVED: 1-10-85

VOLATILES

CONCENTRATION: LOW
DATE EXTRACTED/PREPARED: 01/21/85
DATE ANALYZED: 01/21/85
PERCENT MOISTURE: 8
pH: 8.45

PP#	CAS #	COMPOUND	UG/KG
		CHLOROMETHANE	11 U
		BROMOMETHANE	11 U
		VINYL CHLORIDE	11 U
		CHLOROETHANE	11 U
		METHYLENE CHLORIDE	57
		ACETONE	11 U
		CARBON DISULFIDE	5 U
		1,1-DICHLOROETHENE	5 U
		1,1-DICHLOROETHANE	5 U
		TRANS-1,2-DICHLOROETHENE	5 U
		OROFORM	10
		-DICHLOROETHANE	5 U
		2-BUTANONE	11 U
		1,1,1-TRICHLOROETHANE	5 U
		CARBON TETRACHLORIDE	5 U
		VINYL ACETATE	11 U
		BROMODICHLOROMETHANE	5 U
		1,1,2,2-TETRACHLOROETHANE	5 U
		1,2-DICHLOROPROPANE	5 U
		TRANS-1,3-DICHLOROPROPENE	5 U
		TRICHLOROETHENE	5 U
		DIBROMOCHLOROMETHANE	5 U
		1,1,2-TRICHLOROETHANE	5 U
		BENZENE	5 U
		CIS-1,3-DICHLOROPROPENE	5 U
		2-CHLOROETHYLVINYLETHER	11 U
		BROMOFORM	5 U
		2-HEXANONE	11 U
		4-METHYL-2-PENTANONE	11 U
		TETRACHLOROETHENE	5 U
		TOLUENE	42
		CHLOROBENZENE	5 U
		ETHYLBENZENE	23
		STYRENE	5 U
		TOTAL XYLENES	140

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = INDICATES AN ESTIMATED VALUE OR CONCENTRATION BELOW DETECTION LIMIT
B = POSSIBLE/PROBABLE BLANK CONTAMINATION
C = PESICIDE IDENTIFICATION CONFIRMED BY GC/MS

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

INORGANICS

SAMPLE NUMBER	NJI3-S6	NJI3-S7	NJI3-S8	NJI3-S9	NJI3-S10	NJI3-S11	NJI3-S12	NJI3-S13	NJI3-S14
TRAFFIC REPORT NUMBER	MBA 738	MBA 739	MBA 740	MBA 741	MBA 742	MBA 743	MBA 744	MBA 745	MBA 746
MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Aluminum	7050	9670	1910	12900	4500	1870	2370	12200	6310
Antimony				47					
Arsenic	12	16	7.1	13	39		6.2	13	J
Barium	207	183	J	645	582	217	J	307	206
Beryllium	J	J	J	5.1		J		J	J
Cadmium			3.9	88				3^3 X 2.7	
Calcium	6210	39700	J	8090	5630	151000	J	24500	117000
Chromium	17	28	20	108	21	13	11	30	29
Cobalt	J	J		45	J	J		J	J
Copper	119	115	46	402	144	54	107	56	74
Iron	20900	27300	5350	85600	11200	8210	10400	29400	19600
Lead	42	126	14	364	195	61	56	66	39
Magnesium	7460	32600	J	10500	J	93200	J	12800	76300
Manganese	239	243	12	332	71	229	39	314	398
Mercury	J	J	J	J	J	J	J	J	E
Nickel	31	30	J	143	J	J	J	28	35
Potassium	J			3430	J			3670	
Selenium									
Silver				7.4					
Sodium	3990	3440	7270	5000	J	3690	J	J	4120
Thallium									
Tin				94		23			
Vanadium	52	51	39	147	J	J	J	43	30
Zinc	68	90	27	1100	79	98	33	143	324

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit

MAXUS3918722

Environmental Protection Agency, CLP Sample Management Office,
P. O. Box 818, Alexandria, Virginia 22313 703/557-2490

BA427

Organics Analysis Data Sheet
(Page 1)

3781 264

Laboratory Name: Acutex
Case No: 3781
Lab Sample ID No: 8501-016-4
QC Report No:
Sample Matrix: Soil
Contract No: 68-01-6768
Data Release Authorized By: R. Scott
Date Sample Received: 1-10-85

Volatile Compounds

Concentration: Low Medium (Circle One)
Date Extracted/Prepared: 1-23-85
Date Analyzed: 1-23-85
Conc/Dil Factor: 1g purged pH 9.71
Percent Moisture: 16
Percent Moisture (Decanted): —

CAS Number		ug/l or ug/Kg (Circle One)
74-87-3	Chloromethane	60 U
74-83-9	Bromomethane	60 U
75-01-4	Vinyl Chloride	60 U
75-00-3	Chloroethane	60 U
75-09-2	Methylene Chloride	80
67-64-1	Acetone	90
75-15-0	Carbon Disulfide	30 U
75-35-4	1, 1-Dichloroethene	30 U
75-34-3	1, 1-Dichloroethane	30 U
156-60-5	Trans-1, 2-Dichloroethene	30 U
67-66-3	Chloroform	30 J B
107-06-2	1, 2-Dichloroethane	30 U
78-93-3	2-Butanone	60 U
71-55-6	1, 1, 1-Trichloroethane	30 U
56-23-5	Carbon Tetrachloride	30 U
108-05-4	Vinyl Acetate	60 U
75-27-4	Bromodichloromethane	30 U

CAS Number		ug/l or ug/Kg (Circle One)
79-34-5	1, 1, 2, 2-Tetrachloroethane	30 U
78-87-5	1, 2-Dichloropropane	30 U
10061-02-6	Trans-1, 3-Dichloropropene	30 U
79-01-6	Trichloroethene	30 U
124-48-1	Dibromochloromethane	30 U
79-00-5	1, 1, 2-Trichloroethane	30 U
71-43-2	Benzene	30 J
10061-01-5	cis-1, 3-Dichloropropene	30 U
110-75-8	2-Chloroethylvinylether	60 U
75-25-2	Bromoform	30 U
591-78-6	2-Hexanone	60 U
108-10-1	4-Methyl-2-Pentanone	60 U
127-18-4	Tetrachloroethene	30 U
108-88-3	Toluene	30 U
108-90-7	Chlorobenzene	30 U
100-41-4	Ethylbenzene	30 U
100-42-5	Styrene	30 U
	Total Xylenes	30 U

Data Reporting Qualifiers

For reporting results to EPA, the following results qualifiers are used. Additional flags or footnotes explaining results are encouraged. However, the definition of each flag must be explicit.

Value If the result is a value greater than or equal to the detection limit, report the value.

U Indicates compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., 10U) based on necessary concentration/dilution actions. (This is not necessarily the instrument detection limit.) The footnote should read: U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.

J Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero. (e.g., 10J)

C This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides ≥10 ng/ul in the final extract should be confirmed by GC/MS.

B This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

Other Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

MAXUS3918723

Environmental Protection Agency, CLP Sample Management Office,
P. O. Box 818, Alexandria, Virginia 22313 703/557-2490

Sample Number
BA 427

Organics Analysis Data Sheet
(Page 2)

Semivolatile Compounds

Concentration: Low Medium (Circle One)

Date Extracted/Prepared: 1-16-85

Date Analyzed: 3-22-85

Conc/Dil Factor: 24

CAS Number		ug/l or ug/Kg (Circle One)
62-75-9	N-Nitrosodimethylamine	200 U
108-95-2	Phenol	200 U
62-53-3	Aniline	200 U
111-44-4	bis(-2-Chloroethyl)Ether	200 U
95-57-8	2-Chlorophenol	200 U
541-73-1	1, 3-Dichlorobenzene	200 U
106-46-7	1, 4-Dichlorobenzene	200 U
100-51-6	Benzyl Alcohol	200 U
95-50-1	1, 2-Dichlorobenzene	200 U
95-48-7	2-Methylphenol	200 U
39638-32-9	bis(2-chloroisopropyl)Ether	200 U
106-44-5	4-Methylphenol	200 U
621-64-7	N-Nitroso-Di-n-Propylamine	200 U
67-72-1	Hexachloroethane	200 U
98-95-3	Nitrobenzene	200 U
78-59-1	Isophorone	200 U
88-75-5	2-Nitrophenol	200 U
105-67-9	2, 4-Dimethylphenol	200 U
65-85-0	Benzoic Acid	1000 U
111-91-1	bis(-2-Chloroethoxy)Methane	200 U
120-83-2	2, 4-Dichlorophenol	200 U
120-82-1	1, 2, 4-Trichlorobenzene	200 U
91-20-3	Naphthalene	200 U
106-47-8	4-Chloroaniline	200 U
87-68-3	Hexachlorobutadiene	200 U
59-50-7	4-Chloro-3-Methylphenol	200 U
91-57-6	2-Methylnaphthalene	200 U
77-47-4	Hexachlorocyclopentadiene	200 U
88-06-2	2, 4, 6-Trichlorophenol	200 U
95-95-4	2, 4, 5-Trichlorophenol	1000 U
91-58-7	2-Chloronaphthalene	200 U
88-74-4	2-Nitroaniline	1000 U
131-11-3	Dimethyl Phthalate	200 U
208-96-8	Acenaphthylene	200 U
99-09-2	3-Nitroaniline	1000 U

CAS Number		ug/l or ug/Kg (Circle One)
83-32-9	Acenaphthene	200 U
51-28-5	2, 4-Dinitrophenol	1000 U
100-02-7	4-Nitrophenol	1000 U
132-64-9	Dibenzofuran	200 U
121-14-2	2, 4-Dinitrotoluene	200 U
606-20-2	2, 6-Dinitrotoluene	200 U
84-66-2	Diethylphthalate	200 U
7005-72-3	4-Chlorophenyl-phenylether	200 U
86-73-7	Fluorene	200 U
100-01-6	4-Nitroaniline	1000 U
534-52-1	4, 6-Dinitro-2-Methylphenol	1000 U
86-30-6	N-Nitrosodiphenylamine (1)	200 U
101-55-3	4-Bromophenyl-phenylether	200 U
118-74-1	Hexachlorobenzene	200 U
87-86-5	Pentachlorophenol	1000 U
85-01-8	Phenanthrene	200 U
120-12-7	Anthracene	200 U
84-74-2	Di-n-Butylphthalate	200 JB
206-44-0	Fluoranthene	200 J
92-87-5	Benzidine	1000 U
129-00-0	Pyrene	30 J
85-68-7	Butylbenzylphthalate	200 U
91-94-1	3, 3'-Dichlorobenzidine	400 U
56-55-3	Benzo(a)Anthracene	30 J
117-81-7	bis(2-Ethylhexyl)Phthalate	200
218-01-9	Chrysene	200 U
117-84-0	Di-n-Octyl Phthalate	200 U
205-99-2	Benzo(b)Fluoranthene	200 U
207-08-9	Benzo(k)Fluoranthene	200 U
50-32-8	Benzo(a)Pyrene	200 U
193-39-5	Indeno(1, 2, 3-cd)Pyrene	200 U
53-70-3	Dibenz(a, h)Anthracene	200 U
191-24-2	Benzo(g, h, i)Perylene	200 U

(1)-Cannot be separated from diphenylamine

MAXUS3918724

Sample #
BA428

Organics Analysis Data Sheet
Page 3
Pesticides/PCBs

Concentration: Low
Date Extracted: Jan 16 1985
Date Analyzed: Feb 25 1985
Conc. Factor: .6

CAS #		ug/Kg
319-84-6	Alpha-BHC	2 U
319-85-7	Beta-BHC	2 U
319-86-8	Delta-BHC	2 U
58-89-9	Gamma-BHC (Lindane)	2 U
76-44-8	Heptachlor	2 U
309-00-2	Aldrin	2 U
1024-57-3	Heptachlor Epoxide	2 U
959-98-8	Endosulfan I	2 U
60-57-1	Dieldrin	5 U
72-55-9	4,4'-DDE	290
72-20-8	Endrin	5 U
33213-65-9	Endosulfan II	5 U
75-54-8	4,4'-DDD	28
7421-93-4	Endrin Aldehyde	5 U
1031-07-8	Endosulfan Sulfate	5 U
50-29-3	4,4'-DDT	420
72-43-5	Methoxychlor	20 U
53494-70-5	Endrin Ketone	5 U
57-74-9	Chlordane	20 U
8001-35-2	Toxaphene	50 U
12674-11-2	Aroclor-1016	20 U
11104-28-2	Aroclor-1221	20 U
11141-16-5	Aroclor-1232	20 U
53469-21-9	Aroclor-1242	20 U
12672-29-6	Aroclor-1248	20 U
11097-69-1	Aroclor-1254	50 U
11096-82-5	Aroclor-1260	50 U

Weight of soil extracted (g): 30
Volume of total extract (uL): 10000
Volume of extract injected (uL): 2

ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

VOLATILES

SAMPLE NUMBER	NJI3-SW-B	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Chloromethane									
Bromomethane									
Vinyl Chloride									
Chloroethane									
Methylene Chloride		7.0 B	8.0 B	E	E	E	E	E	E
Acetone	7.3	10.0	15.0	E	E	E			
Carbon Disulfide									
1,1-Dichloroethene									
1,1-Dichloroethane									
Trans-1,2-Dichloroethene									
Chloroform									
1,2-Dichloroethane									
2-Butanone	16 B	17.0 B	17.0 B						
1,1,1-Trichloroethane	9.0 B	9.0 B	9.0 B						
Carbon Tetrachloride									
Vinyl Acetate									
Bromodichloromethane									
1,1,2,2-Tetrachloroethane									
1,2-Dichloropropane									
Trans-1,3-Dichloropropene									
Trichloroethene									
Dibromochloromethane									
1,1,2-Trichloroethane									
Benzene									
Cis-1,3-Dichloropropene									
2-Chloroethylvinylether									
Bromoform									
2-Hexanone									
4-Methyl-2-Pentanone									
Tetrachloroethene									
Toluene	14								
Chlorobenzene									
Ethylbenzene									
Styrene									
Total Xylenes									

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

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ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

INORGANICS

SAMPLE NUMBER TRAFFIC REPORT NUMBER MATRIX UNITS	NJI3-SW-B MBA 727 BLANK ug/l	NJI3-SW-1 MBA 728 WATER ug/l	NJI3-SW-2 MBA 729 WATER ug/l	NJI3-SED2 MBA 732 SEDIMENT mg/kg	NJI3-S1 MBA 733 SOIL mg/kg	NJI3-S2 MBA 734 SOIL mg/kg	NJI3-S3 MBA 735 SOIL mg/kg	NJI3-S4 MBA 736 SOIL mg/kg	NJI3-S5 MBA 737 SOIL mg/kg
Aluminum			J	12800	6490	780	12000	8330	5370
Antimony									
Arsenic				23	39	J	41	10	188
Barium				775	1380	142	6330	10300	3660
Beryllium				J	J		J	J	J
Cadmium							10	42	
Calcium		221000	221000	16300	58700	195000	7970	6270	J
Chromium				43	181	11	60	221	59
Cobalt				J	J			J	J
Copper				170	146	19	141	227	150
Iron		1000	J	22900	19200	3940	25100	38000	14000
Lead	14			330	299	26	966	1710	213
Magnesium		672000	671000	6170	35700	115000	7260	4880	J
Manganese		J	J	287	175	223	221	296	128
Mercury		J	J	J	J	J	J	J	J
Nickel			J	105	37	J	56	39	J
Potassium		206000	205000	J	J		J	J	J
Selenium					5.7		4.1	7.2	
Silver								J	
Sodium		6100000	6100000	13300	2940	5410	7870	J	J
Thallium		E	E						
Tin				26	23			56	
Vanadium				E	30	J	78	89	35
Zinc				710	243	36	446	2460	155

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit

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ANALYTICAL DATA
E.I. DUPONT - GRASSELLI PLANT
SAMPLING DATE: 01/09/85
CASE: 3781

SEMI-VOLATILES

SAMPLE NUMBER	NJI3-SW-B	NJI3-SW-1	NJI3-SW-2	NJI3-SED2	NJI3-S1	NJI3-S2	NJI3-S3	NJI3-S4	NJI3-S5
TRAFFIC REPORT NUMBER	BA410	BA411	BA412	BA415	BA416	BA417	BA418	BA419	BA420
MATRIX	BLANK	WATER	WATER	SEDIMENT	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
4-Nitroaniline									
4,6-Dinitro-2-Methylphenol									
N-Nitrosodiphenylamine									
4-Bromophenylphenyl ether									
Hexachlorobenzene									
Pentachlorophenol									
Phenanthrene									
Anthracene									
Di-n-Butylphthalate									5200
Fluoranthene						D	E		
Benzidine					J				
Pyrene								J	6000
Butylbenzylphthalate				J	J		J	J	6300
3,3'-Dichlorobenzidine									
Benzo(a)Anthracene									
Bis(2-Ethylhexyl)Phthalate					J			J	J
Chrysene									
Di-n-Octyl Phthalate					J			J	J
Benzo(b)Fluoranthene									
Benzo(K)Fluoranthene									
Benzo(a)Pyrene									
Indeno(1,2,3-cd)Pyrene					J				J
Dibenzo(a,h)Anthracene									
Benzo(ghi)Perylene									

NOTES:
Blank space - compound analyzed for but not detected
E - analysis did not pass QA/QC requirements
J - compound present below the specified detection limit
B - compound found in blank as well as the sample, indicates possible/probable blank contamination

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Exhibit I

REVISED PHASE II REMEDIAL INVESTIGATION WORK PLAN

DuPont Grasselli Site
Linden, New Jersey

December 31, 1996 **DERS Project No. 1755**

BAA000067

Prepared by

DuPont Environmental Remediation Services
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REVISED PHASE II REMEDIAL INVESTIGATION WORK PLAN

DuPont Grasselli Site
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December 31, 1996 **DERS Project No. 1755**

Prepared by

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1.0 INTRODUCTION AND SITE HISTORY

The DuPont Grasselli site, located in Linden, Union County, New Jersey, is currently undergoing a remedial investigation (RI) under the Industrial Site Recovery Act (ISRA). Manufacturing activities ceased at the facility in the early 1990s, triggering the Environmental Cleanup Responsibility Act (ECRA) process. The DuPont Grasselli plant filed an Initial Notice under the New Jersey ECRA on March 10, 1992.

Prior to submitting this work plan, DuPont conducted a site operational history review and the following environmental studies, the results of which have been submitted previously:

- *Operational History of the Grasselli Site* (September 1990)
- Voluntary environmental investigation (VEI; winter 1990/1991)
- *ECRA Investigation Report*—ECRA Case No. 92142 (November 1993)

The data collected for these investigations is provided in either the June 12, 1992, *ECRA Field Sampling Plan* or the November 23, 1993, *ECRA Investigation Report*. The *ECRA Investigation Report* has also been referred to as the Phase I RI report in accordance with *New Jersey Technical Requirements for Site Remediation* (NJTRSR) nomenclature.

An interim remedial measure (IRM) was initiated at area of concern (AOC) M (Wade Brothers Yard), where petroleum product was found on the water table. Remedial activities included installing an interceptor trench and belt skimmer to skim product in the trench and in a preexisting sump. The proposed IRM was initially presented in the DuPont Environmental Remediation Services (DERS) 1992 *Wade Brothers Site Fuel Oil Spill Interim Remedial Measures Work Plan*.

The scope of work proposed in this document is based on the following:

- Response to a New Jersey Department of Environmental Protection (NJDEP) September 27, 1994, comment letter regarding the *ECRA Investigation Report* (DERS 1993) and addendum (DERS 1994)
- A January 9, 1996, meeting between the NJDEP and DuPont

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- A May 23, 1995, site walk through
- Personal communication between the NJDEP Case Team and DERS

DERS submitted a copy of all soil and groundwater analytical data as well as field sample data to the NJDEP in May 1995 in the electronic format specified for the New Jersey Hazardous Site Information Application Electronic Data Interchange. DERS personnel also met with NJDEP personnel to discuss data base management and proper protocol to preserve the integrity of the analytical data base.

DERS submitted a Phase II remedial investigation work plan (RIWP) to the NJDEP on October 2, 1995. The following documents were also submitted as companion documents to the work plan:

- A supplement to the *ECRA Investigation Report* that contains tables comparing previous soil results to New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC) or Impact-to-Groundwater (IGW) numbers (whichever is more stringent)
- Tables that compare previous groundwater results to New Jersey surface-water quality standards (SWQS).

This revised work plan (addendum) incorporates issues discussed in NJDEP February 23, 1996 and October 2, 1996, comment letters, and DuPont's response to comments letter dated April 12, 1996.

1.1 Site Physical Conditions

The Grasselli site is located in an industrial area in eastern Linden, New Jersey (see Figure 1). The property currently covers approximately 105 acres. The site is bounded on the east by the Arthur Kill, to the north by Piles Creek and Public Service Electric and Gas Company, to the south by General Aniline Film (GAF), and to the west by the New Jersey Turnpike Authority's (NJTA's) Piles Creek East Wetlands Mitigation Project.

The wetlands mitigation project occupies a parcel of land that had been a largely undeveloped part of the Grasselli site. In the fall of 1992, the NJTA condemned

approximately 112 acres of the Grasselli site for wetlands enhancement and reclamation. Dames & Moore conducted an environmental investigation for the NJTA in the winter of 1992/1993. The wetlands mitigation project has since been approved by the NJDEP and implemented. West of the wetlands project is the Perth Amboy, Elizabeth Port Branch Railroad, and the New Jersey Turnpike (see Figure 2).

The Grasselli site originally consisted of tidal marshlands that were reclaimed by emplacement of fill. The most recent National Wetlands Inventory map is included as Appendix A. Past manufacturing at the plant included production of sulfuric acid, inorganic salts, and organic pesticides. The complete operational history of the site is included in the *ECRA Investigation Report*. An aerial photograph history is included in the *ECRA Sampling Plan*. These reports also contain more detailed information on soil types found at the site. All of the site's manufacturing buildings have been razed, and current site operations consist of a sulfuric acid transfer station and a concrete crushing/recycling operation in the southern part of the site (see Figure 2). The majority of the site's surface is covered by gravel, crushed stone, or soil, with paved and unpaved roads and two small paved parking lots. A topographic map of the site generated from a flyover in 1992 is included as Appendix B.

Geologically, the Grasselli site is situated in the Newark Basin and is underlain by fill deposits ranging in thickness from 10 to 18 feet. The fill consists of fine to coarse sand and in places contains gravel, silt, clay, brick, crushed stone, sulfur, coal, and wood. Underlying the fill are Recent age marsh deposits consisting of brown peat and organic clay, ranging in thickness from 10 to 15 feet. Below the peat are Pleistocene glacial till deposits varying in thickness from 6 to 18 feet that consist of red-brown, silty clay with sand and gravel. The Jurassic/Triassic age Passaic Formation, also known as the Brunswick Shale, underlies the glacial till and consists of a weathered red shale at the Grasselli site. The thickness of the Passaic Formation was not fully penetrated at this location but is estimated to be approximately 8,700 feet thick based on regional geologic mapping.

The upper hydrologic unit identified at the Grasselli site is within the fill layer and has been called Hydrologic Unit A or the shallow aquifer. The depth to groundwater is very shallow and ranges from a few inches to 6 feet below ground surface (BGS). The lower

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hydrologic unit is below the peat layer and in places below the clay portion of the glacial till within the sandier portion of the Pleistocene till. This hydrogeologic unit, which has been called Hydrologic Unit B or the deep aquifer, may behave as a confined aquifer. The two hydrologic units are separated by the thick marsh deposits of peat and clay and in some areas by the clayey glacial till deposits. Shallow groundwater within Hydrogeologic Unit A flows toward the Arthur Kill and Piles Creek in a radial pattern outward from the center of the site (see Figure 3). Deep groundwater in Hydrogeologic Unit B flows toward the Arthur Kill, although it is unknown whether it discharges to the Arthur Kill. Additional details regarding the regional and site-specific stratigraphy and hydrogeology are provided in the *ECRA Investigation Report*.

1.2 Previous Investigation Findings

The *ECRA Investigation Report* summarized the findings of the soil and groundwater investigations to date. Groundwater samples were collected in the winter of 1990/1991 and in the summer of 1992 and analyzed for the target analyte list of organic compounds and the target compound list of inorganic compounds. Filtered groundwater results for inorganic compounds and pesticides and unfiltered volatile organic compound (VOC) and semivolatile organic compound (SVOC) results were compared to marine ambient water-quality criteria (AWQC), which was the applicable standard at the time that the ECRA report was prepared. Based on comparison of the New Jersey SWQS and concentrations found in groundwater, metals and pesticides may be constituents of concern in shallow groundwater (see Table 16 in the supplement to the *ECRA Investigation Report*). Other elevated compounds found in groundwater are VOCs detected in wells MW-24A, MW-26A, and MW-28A. Groundwater from the B zone appears to potentially have a minor, if any, impact on surface water.

In a February 14, 1995, letter to the NJDEP, DuPont presented a discussion and justification for using New Jersey NRDCSCC for the purpose of soil delineation at the Grasselli site. The soil analytical results had been compared to the New Jersey nonresidential criteria in the ECRA report. In a letter received May 15, 1995, and through verbal communication from the NJDEP Case Team, DuPont has been required to use residential criteria as the standard for delineation. To prepare a scope of work for this

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sampling plan, soil analytical results were compared to New Jersey RDCSCC and to New Jersey IGW criteria. These tables are included in the October 2, 1995, supplement to the *ECRA Investigation Report.* A sampling plan is included in this RIWP for each of the following 12 AOCs requiring soil delineation for specific constituents:

- AOC C—Former DMHA Waste Holding Ponds
- AOC D—Former West Fuel Oil Storage Tanks
- AOC E—South (Building 54 Shop) Septic System
- AOC F—Former E. Fuel Oil ASTs
- AOC G—Central (Main Office) Septic System
- AOC H—North Septic System
- AOC I—Former DDT and Methoxychlor Manufacturing Area
- AOC J—Former N. Fuel Oil Storage Tanks
- AOC K—Former Disposal Area
- AOC M—Wade Brothers Yard
- AOC O—Former Lithopone Production Area
- AOC U—Former Unlined Pond Area (formerly part of AOC K)

All AOCs are summarized in Appendix C in accordance with the NJTRSR.

In addition to constituents associated with specific AOC activities, arsenic, lead, and polynuclear aromatic hydrocarbons (PAHs) appear to be distributed in a manner independent of AOC activities or AOC boundaries. In the February 14, 1995, letter, DuPont requested a variance from the NJTRSR, which require delineation on an AOC-by-AOC basis. The NJDEP agreed that these constituents may be delineated sitewide but requested that more sampling and analysis be conducted to verify the delineation maps provided in the letter. This additional sampling is proposed for AOC P—Eastern Area.

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1.3 Phase II Remedial Investigation Objectives

Based on meetings and conversations with the NJDEP Case Team, the objectives of the Phase II RI have been developed. The objectives of the groundwater investigation are to

- Collect data to assess whether groundwater discharge impacts the Arthur Kill and Piles Creek.
- Evaluate whether trends in groundwater concentrations are evident.

The objectives of the soil investigation are to

- Assess further the impact that site activities may have had on soil.
- Delineate soil to New Jersey RDCSCC or to IGW criteria, whichever is more stringent.

Arsenic, lead, and PAHs will be sampled on a sitewide basis. Soil at 12 other AOCs will be sampled and analyzed for constituents that historically exceeded the more stringent criteria and that are related to those AOC activities.

2.0 PROPOSED GROUNDWATER INVESTIGATION

2.1 Objectives

The objectives of the Phase II groundwater investigation are as follows:

- Collect data to assess groundwater discharge to the Arthur Kill and Piles Creek.
- Determine if groundwater concentration trends exist for potential constituents of concern.

These objectives will be accomplished by conducting a round of groundwater sampling and analysis and by determining hydraulic conductivity in the shallow aquifer. All wells in the shallow and deep aquifers will be sampled and analyzed for potential constituents of concern. Calculation of hydraulic conductivity may be accomplished by conducting a tidal study in shallow wells adjacent to the surface-water bodies or by conducting single well slug tests. Together, the hydraulic conductivity of the shallow aquifer and the chemical analysis of groundwater will allow calculation of groundwater discharge volume and mass loading to the Arthur Kill.

Groundwater-quality results will be compared to previous analytical results. Time versus concentration charts will be generated to evaluate whether trends in groundwater quality are apparent.

2.2 Scope of Work

The sampling plan includes a complete round of groundwater sample collection and analysis for all 28 existing monitoring wells (see Figure 3). Prior to sampling, water levels will be measured at high and low tides, and wells will be tested for the presence of free product.

The samples will be analyzed by a New Jersey certified laboratory for the priority pollutant list (PPL) of inorganic compounds, PPL pesticides and, for selected wells, the volatile constituent list. A complete list of sample parameters is provided in the quality assurance project plan (QAPP) provided in Appendix D.

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Sampling will be conducted in accordance with the protocols described in the NJDEP's May 1992 *Field Sampling Procedures Manual*, with modifications as indicated in the text of this work plan.

Hydraulic conductivity in the shallow aquifer will be determined by conducting a tidal study or by another appropriate method, such as slug tests. A summary table of the proposed groundwater investigation is provided in Table 1. Data collection at monitoring well clusters MW-8A and MW-8B will be contingent on agreement by the NJTA to access the property.

Since the last groundwater sampling event in 1993, three monitoring wells have been abandoned. One of these wells (i.e., well MW-34A) was located in the southeastern portion of the site and was damaged because of Grasselli Point Industries' recycling activities. An abandonment form is included in Appendix E with the well construction logs. The other wells that have been abandoned are located in the western portion of the site in the wetlands reclamation area. Dames & Moore abandoned wells MW-5A and MW-6A for the NJTA. Abandonment forms for these wells have been filed with the NJDEP (Dames & Moore personal communication).

2.3 Sampling Protocols

2.3.1 Sampling Preparation

A New Jersey certified laboratory will provide the pre-preserved sample containers, coolers, and chain-of-custody forms. Chain-of-custody procedures are provided in Appendix D. DERS will arrange for sample shipment to a New Jersey certified analytical laboratory and will be responsible for all laboratory coordination.

The following list of equipment will be preassembled in preparation for well purging and sampling:

- Prepreserved sample containers (laboratory provided)
- Ice for sample shipment
- Field sampling records (i.e., field logbooks, chain-of-custody forms)

- Decontamination solutions (e.g., *Alconox*®, brushes, wash basins, American Society for Testing Materials [ASTM] Type II rinsewater)
- pH meter, specific conductance meter, dissolved oxygen meter, turbidity meter, temperature probe (and appropriate buffer solutions for daily instrument calibration)
- Photoionization detector (PID) for organic vapor screening
- Water-level indicator/oil-water interface probe
- Polypropylene tubing (ASTM drinking-water grade) with foot valves dedicated for use at a single well
- Helical-rotor Redi-Flo2 submersible pump or bladder pumps
- Gas-powered generator
- Stopwatch
- Calibrated bucket (for estimating purge rates)
- Polyethylene sheeting
- Bottom-loading *Teflon*® bailers (laboratory-decontaminated and wrapped in foil for dedicated use at a single well)
- *Teflon*®-coated stainless-steel leader cable
- Filtration apparatus (with 0.45-micron filters)

2.3.2 Water-Level and Free-Product Measurements

After initial removal of the well cap at each location, the well headspace will be screened using a calibrated PID, and the results will be recorded in the field notes. Well-cap removal and well-casing access will be conducted in accordance with the site health and safety plan (HASP; see Appendix F).

Before each well is purged, water levels and total well depth will be measured and recorded for use in calculating well volumes. An oil-water interface probe will be used to test for the presence of immiscible fluids (i.e., free product), and the results will be recorded in the field notes. If free product is detected, the interface probe will be used to measure the layer's thickness.

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Static water-level measurements will be obtained from each well at high and low tides before well purging and sampling are initiated. Measurements at both high and low tides will supplement previously collected data. All measurements will be referenced to the surveyor's mark located at the top of the inner casing and will be recorded to the nearest 0.01 foot.

A bound field notebook will be prepared for this project before personnel go to the field. Information that can be preprinted before fieldwork begins will be entered in the notebook (e.g., permit number, well number, and depth from top of inner casing to top of screen).

2.3.3 Well Evacuation

For well purging, the pump intake will be placed near the top of the water column initially and lowered as the water level decreases. This practice, which ensures that all stagnant water is removed from the well, will also serve as an early-warning system for slow-recharge wells to avoid overpumping these wells to dryness. Recharge rates of the shallow monitoring wells range from 0.3 gallons per minute (gpm) to 5 gpm, with most being in the 1.5 gpm range. Deep aquifer wells have lower recharge rates (see Appendix E).

Well volumes will be calculated initially based on depth-to-water and total well-depth measurements (4-inch wells on-site contain 0.653 gallons of water per linear foot, and 2-inch wells contain 0.163 gallons of water per linear foot). Well construction diagrams and field notes from previous sampling events are included in Appendix E.

Submersible helical-rotor pumps (rated from approximately 0.1 to 40 liters per minute [l/min]) or bladder pumps (rated from 0 to 24 l/min) will be used to purge the wells. Every effort will be made to avoid purging wells to dryness by lowering the pumping rate as much as possible to avoid dewatering the well. If it is impossible to lower the purge rate enough to avoid dewatering the well before field parameters have been stabilized, the well will be purged to dryness at a low rate, to minimize disturbance, and sampled when it has recovered sufficiently to produce a sample. The time between purging and

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sampling should not exceed two hours unless more time is required to allow the well to recover sufficiently for sampling.

Field parameters, temperature, pH, specific conductance, dissolved oxygen, and turbidity will be monitored and recorded during purging (at a minimum, after purging of each well volume). Sampling will begin after purging of at least one well volume and the stabilization of these parameters. Stabilization is reached when three consecutive sets of field readings collected in three-minute intervals are within 10 percent of each other. If stabilization is not reached, the wells will be sampled when a maximum of four well volumes have been evacuated or when the well has been evacuated to dryness.

All equipment will be decontaminated properly after use at each well using procedures outlined in Section 2.3.5.

2.3.4 Sample Acquisition

Plastic sheeting will be placed around each well for staging sampling equipment and sample containers. After well sampling is completed, the plastic and personal protective equipment (PPE) will be disposed of in accordance with the site's waste management plan (WMP). Surgical gloves will be changed between sample locations.

Groundwater samples will be collected using either method described below. If a low flow bladder pump or helical rotor pump is used for purging, groundwater samples will be collected directly from the discharge tubing at a reduced flow rate (no greater than 100 to 250 milliliters per minute [ml/min]).

Alternatively, dedicated bottom-loading *Teflon®* bailers (decontaminated according to approved procedures) with dedicated bailer rope may be used for sample collection. Samples will be obtained by gently lowering the bailer into the water column until it is fully submerged, taking care to minimize sample agitation and aeration. The bailer will be subsequently retrieved from the well, and the sample will be transferred to appropriate containers. Samples will be collected in the following order: VOCs, total petroleum hydrocarbons, total pesticides, total metals, filtered pesticides, filtered metals, sulfate,

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sulfide, sulfite, and chloride, preserved inorganic constituents, and nonpreserved inorganic constituents.

Samples for filtered metals and pesticides analysis will initially be collected in laboratory-provided, nonpreserved polyethylene containers. The samples will be field-filtered through an in-line, disposable, 0.45-micron metals filter. The filtration apparatus will be disposed of according to the WMP. In the event that the in-line filter does not function properly, more conventional methods for field-filtering may be used.

Field sample measurements for pH, temperature, specific conductivity, dissolved oxygen, and turbidity will be collected immediately following sample collection and recorded in the bound logbook. Samples will be placed in coolers on ice immediately following sample collection.

2.3.5 Equipment Decontamination

The following procedures will be followed for pump decontamination:

- Wash with *Alconox*® detergent and tap water (surface).
- Rinse with tap water (surface).
- Flush with potable water (20 gallons) using a dedicated plastic bag.
- Rinse with distilled/deionized water (external).

2.3.6 Sampling Schedule

The sampling sequence was established so that wells with higher constituent concentrations will be sampled last to minimize the potential for cross-contamination. The deep wells will be sampled first, followed by the shallow wells. Within each grouping, the sampling sequence has been prioritized based on previous sampling results. The recommended sampling sequence is presented in Table 2, which should be used as a general guideline for determining sampling order (revisions may be made in the field).

2.4 Analytical Parameters and Methods

All site monitoring wells will be sampled and analyzed for the following parameters:

- Filtered and unfiltered PPL inorganic constituents
- Filtered and unfiltered PPL pesticides
- Phosphorus
- Sulfate
- Sulfide
- Sulfite
- Chloride
- Total residual
- Total petroleum hydrocarbons
- Nitrate-nitrogen
- Hardness
- Fluoride
- Ammonia-N
- Field parameters temperature, pH, specific conductance, turbidity, and dissolved oxygen (to be recorded in the field logbooks)

Wells MW-15A, MW-24A, MW-26A, and MW-28A will also be sampled and analyzed for the VOC list provided in the QAPP (see Appendix D, Table 2). Some of the parameters listed previously (e.g., ammonia and nitrate-nitrogen) will be used to define groundwater geochemistry for preliminary remedial alternatives, if needed. Parameter lists have been expanded further in the QAPP (see Appendix D). The QAPP also summarizes the bottle types, preservation methods, holding times, and analytical methods that will be used for each parameter or parameter group.

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2.5 Quality Assurance and Quality Control

The following quality assurance and quality control (QA/QC) samples will be collected during the groundwater sampling event (see Appendix D for further definition of QA/QC samples):

- Field duplicate samples
- Trip blanks (laboratory-sealed) to accompany each sample shipping container that contains VOC analysis
- Equipment blanks for each day of sampling
- Matrix spike (MS) samples and matrix spike duplicate (MSD) samples

Equipment blanks will be obtained at a rate of one per day by pouring laboratory-supplied ASTM Type II distilled/deionized water over the sampling equipment and transferring the water into sample containers. The blank sample will be shipped with the other samples collected that day.

The samples will be shipped to the laboratory on the day of collection. Samples and chain-of-custody forms will be placed in coolers with the original bottles, packed in wet ice, and sealed for custody purposes. The laboratory chain-of-custody forms will be used to document sample possession and the requested analytical parameters. Samples will be shipped to the laboratory by a courier provided by the laboratory or overnight shipping.

Field activities associated with groundwater sample collection will be documented in the field logbooks. A copy of the notes will be provided to the team lead after sampling is completed. The field notes must contain sufficient detail to recreate the sampling events (see Exhibit 1 of Appendix D). Specific information to be recorded in the field notes includes, but is not limited to, the following:

- Well identification
- PID headspace and breathing-zone screening results
- Depth from top of casing to well screen
- Results of free-product check (i.e., thickness, if detected)
- Total well depth
- Well volume calculations

- Purge method
- Time of purging initiation
- Purge rate and duration (checked periodically with stopwatch and calibrated bucket); not to exceed 1 gpm for last well volume
- Field parameter measurements and description of purge water (i.e., color, turbidity) after evacuation of each well volume and following sampling
- Time of purging completion
- Total volume purged
- Sampling time
- Weather conditions at time of sampling

2.6 Data Evaluation and Reporting

Groundwater analytical results will be reviewed and evaluated with results obtained from previous sampling rounds. The analytical results will be reported, and data interpretation will be provided in the Phase II RI report. A description of field activities, completed field logbooks, and properly executed chain-of-custody forms will be provided in the report.

2.7 Health and Safety

The DERS HASP will be used to ensure overall site safety during groundwater sampling (see Appendix F). All field personnel will be required to comply with the health and safety procedures set forth in the site HASP.

2.8 Waste Management

Purge water disposal will be addressed in the site-specific WMP that will be prepared before any field activities begin.

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2.9 Determination of Hydraulic Conductivity in the Shallow Aquifer

A limited tidal study was conducted during the 1991 VEI. Tidal studies may be used to calculate hydraulic conductivity in wells adjacent to a tidal surface-water body (Pinder et al. 1969 and Ferris 1963). The available data at the Grasselli site will be analyzed to evaluate whether this method may be applied to the site. If the data lends itself to this type of analysis, a comprehensive tidal study will be conducted.

Wells (from south to north) MW-15A, MW-18A, MW-20A, MW-29A, MW-24A, MW-28A, MW-26A, MW-14A, and MW-9 would be included in this study (see Figure 3). Prior to implementing this tidal study, a plan will be prepared in accordance with the NJTRSR and submitted to the NJDEP. If current data indicates that a tidal study is not appropriate for determining hydraulic conductivity in the wells adjacent to the surface-water bodies, slug tests or another appropriate test will be conducted.

3.0 PROPOSED SOIL INVESTIGATIONS

The proposed soil investigation consists of the following two sampling programs:

- Proposed sampling for specific constituents at 12 AOCs
- Proposed sampling for arsenic, lead, and PAHs throughout the site (AOC P)

The objective of the sitewide sampling program is to delineate soil to New Jersey RDCSCC or IGW criteria, whichever is more stringent. The objectives of the AOC-specific sampling programs are to assess whether AOC activities have resulted in constituent concentrations above the New Jersey soil criteria and to delineate constituents of concern already identified in soil at concentrations above the criteria.

The proposed soil sampling is summarized in Table 3, and AOCs that will be sampled further are shown on Figure 4. Maps of individual AOCs with proposed sampling locations are included as Figures 5 through 16. Figures 17 through 19 show the proposed sampling locations in AOC P for the sitewide constituents of concern (i.e., arsenic, lead, and PAHs) and include the current estimated extent of contamination compared to the New Jersey RDCSCC. The estimated extent of contamination will be revised after Phase II RI results are obtained and evaluated.

Sampling and analysis will be conducted as indicated in Sections 3.1 through 3.16 for each AOC. The analytical parameters for the samples at each AOC are based on constituents associated with AOC activities or those historic soil concentrations that exceed either the New Jersey RDCSCC or the IGW numbers. All arsenic, lead, and PAH delineation sampling is addressed in the AOC P sampling plan. In all cases, a discrete 6-inch interval is specified, as required in the NJTRSR., Although the sample interval of the original data point may be greater than 6 inches, the 6-inch interval of the proposed sample for horizontal delineation always lies within the depth range of the original sample that exceeded the criteria.

3.1 AOC C—Former DMHA Waste Holding Ponds

3.1.1 Background and Objective

The former dimethylhydroxylamine (DMHA) waste holding ponds consisted of three ponds with *Hypalon*® liners that temporarily held dilute aqueous DMHA waste before disposal. The DMHA ponds were decommissioned in 1990. After removal of the liner, 15 soil samples were collected in the area and from borings at locations MW-15A, MW-16A, and MW-17A (see Figure 5).

In addition to the sitewide constituents of concern (i.e., arsenic and PAHs), barium was the only constituent concentration that exceeded the New Jersey RDCSCC. In the sample collected at location MW-15A, at a depth of 2.0 to 3.5 feet BGS, barium was detected at a concentration of 1,590 milligrams per kilogram (mg/kg), which is greater than the New Jersey RDCSCC of 700 mg/kg. At sample location MW-17A, a soil sample was collected from the saturated zone from 4 to 5.5 feet BGS that contained 3,480 mg/kg of barium, which also exceeds the New Jersey RDCSCC. The original grade of the area is overlain by concrete and aggregate piles from the Grasselli Point Industries recycling operations.

The objective of this sampling event is to further delineate barium constituent concentrations in the area of location MW-15A to the residential criteria.

3.1.2 Soil Sample Locations

Four soil samples are proposed as indicated on Figure 5. Three soil samples (samples CSB-01, CSB-02, CSB-03) will be collected around location MW-15A at a depth of 2 to 2.5 feet BGS, and one additional soil sample (sample CSB-04) will be collected near location MW-15A at a depth of 4.0 to 4.5 feet BGS. Samples collected surrounding location MW-15A will be biased based on discolored soil or drainage patterns, if possible. Barium chloride and barium sulfate are colorless to white solids. The sample locations shown on Figure 5 are placed in upgrade (sample CSB-03) and downgrade (samples CSB-01 and CSB-02) positions relative to location MW-15A based on 1992 topographic data. The sample to be collected adjacent to the monitor well location (sample CSB-04) will be collected approximately 2 feet from the well and

surrounding concrete pad. The location will remain as close as possible to the monitor well location.

The soil samples will be collected and analyzed for barium. The proposed sampling locations are preliminary and will be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample location will be relocated in an area without a surface barrier that will still allow a data point for delineation.

3.1.3 Sampling Procedures

Soil samples will be collected using a clean, stainless-steel, 4-inch-diameter hand-auger. The hand-auger will be used to collect a soil sample from a discrete 6-inch interval. Alternate sampling equipment (e.g., split spoon samplers) may be used if the hand auger cannot be advanced to the specified sampling interval (see Section 3.2.3). All sampling techniques will be in accordance with the methods described in the 1992 NJDEP *Field Sampling Procedures Manual*. These procedures will be followed at all investigation boring locations.

3.1.4 Sample Collection and Analysis

After the auger has been advanced to the beginning of the sampling interval, the sample material will then be collected from the interval and placed into a sample container suitable for inorganic compound analysis. The sample containers will be retained until the boring is completed. A geologist will classify the sample material visually using the Unified Soil Classification System (USCS).

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for the constituent described using the Environmental Protection Agency (EPA) document SW-846 analytical methods defined in Appendix D. Samples collected at AOC C (samples CSB-01, CSB-02, CSB-03) will be analyzed for barium. Sample CSB-04 will be collected and analyzed for barium, arsenic, and carcinogenic PAHs (i.e., benzo(b)flouranthene, benzo(a)anthracene, benzo(a)pyrene,

benzo(k)flouranthene, ideno(1,2,3-cd)pyrene, chrysene, and dibenz(a,h)anthracene [the constituents other than barium are necessary for delineation of sitewide constituents]).

3.1.5 Decontamination Procedures

Sampling equipment will be decontaminated in accordance with the 1992 NJDEP *Field Sampling Procedures Manual.* The general decontamination procedures to be used at all sampling areas, unless specified otherwise, are described in the paragraphs that follow.

Drilling rigs and backhoes will be steam cleaned thoroughly or manually scrubbed after initial arrival on-site and between drilling or excavation locations. After the initial washing, cleaning may be reduced to those areas that are in close proximity to materials being sampled. The backhoe bucket and extension arm will be cleaned between each individual sample depth and between each test pit excavation. Drilling rig items (e.g., auger flights, drill rods, and drill bits) will be cleaned between sample locations.

Large equipment and machinery will be steam-cleaned at the temporary decontamination pad. Small equipment (e.g., hand augers, split-spoons, and trowels) will be decontaminated at the edge of the exclusion zone.

3.1.5.1 Soil Sampling Equipment Decontamination

The field sampling equipment cleaning and decontamination procedures are as follows:

- Laboratory-grade glassware detergent and tap water scrub to remove visual contamination
- Generous tap water rinse
- Distilled and deionized (ASTM Type II) water rinse

The hand auger will be decontaminated prior to sample collection for laboratory analysis. Before the soil borings are initiated and following soil boring completion, the hand auger bucket and extensions will be decontaminated.

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All decontamination fluids and wastes will be containerized for testing and proper disposal. The outside of all sample containers will be decontaminated prior to packaging.

3.1.5.2 Personnel Decontamination

All personnel will decontaminated according to the procedures outlined in the HASP.

3.2 AOC D—Former West Fuel Oil Storage Tanks

3.2.1 Background and Objectives

AOC D consists of four former aboveground fuel oil storage tanks within a diked area (see Figure 6). Based on historical records, the northern tank contained gasoline. Records do not specify the type of fuel oil stored in the remaining three southern tanks. The bermed area was approximately 60 feet by 80 feet in area. Aerial photographs show the presence of these tanks as early as 1940 through April 1959. No tanks are evident in a 1961 aerial photograph, and the years of actual active tank use are not known.

A shallow soil sample (sample SS-36) collected from the center of the diked area during the ECRA investigation was analyzed for PPL VOCs, PPL base-neutral compounds, and total petroleum hydrocarbons (TPH). The results were compared to the New Jersey RDCSCC and the New Jersey IGW numbers. Benzo(b)fluoranthene was the only constituent to exceed the criteria, with a concentration of 1.0 mg/kg compared to the New Jersey RDCSCC of 0.9 mg/kg. This concentration is only 10 percent above the criteria, which is not considered significant based on reproducibility of results in the laboratory. No other sampling is proposed within the bermed area. To date, no samples have been collected outside of the bermed area.

The objective of this phase of investigation is to complete the site investigation at AOC D in accordance with the NJTRSR for soil around aboveground storage tanks on paved surfaces.

3.2.2 Soil Sample Locations

In accordance with the NJAC 7:26E-3.9(a)2, nine soil samples are proposed (see Figure 6). Placement of the proposed locations is slightly biased toward the northeastern and eastern side of the AOC, which is down grade and also downgradient of groundwater flow (locations DSB-01, DSB-02, DSB-03, DSB-04). Each of the remaining three sides of the AOC will be sampled at two locations (see Figure 6).

At each location, a split-spoon sampler will be advanced to the water table in 2-foot increments. Soil from each boring will be collected from the discrete 6-inch interval that shows the highest PID reading.

The proposed sampling locations are preliminary and will be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample will be relocated in an area without a surface barrier that will allow sample collection. Samples may also be moved based on field evidence of potential contamination, such as discolored soil. Any moved location will be placed as close to the proposed location as possible or will be justified in field notes.

3.2.3 Sample Collection

All soil samples will be collected using a drilling rig with continuous-flight hollow-stem augers in accordance with the NJDEP 1992 *Field Sampling Procedures Manual*. The drilling rig will be used to advance 2- or 3-inch-diameter split-spoon samplers ahead of the lead auger over 24-inch intervals down to the water table. Groundwater is estimated to occur between approximately 2 and 3 feet BGS. Each 2-foot split-spoon sample will be screened immediately using a PID, and the reading will be recorded. The 6-inch interval in the split-spoon sampler yielding the highest PID reading will be placed in containers suitable for VOC, SVOC, and metals analysis and will be retained until the boring is completed. After the boring is completed, the sample with the highest PID reading from the unsaturated zone will be submitted for analysis. If no PID readings are indicated, a soil sample will be collected from the interval 0 to 6 inches above the water table for laboratory analysis.

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A geologist will visually inspect and classify the material contained in the split-spoon samplers retrieved from the boreholes using the USCS. The samples will be described carefully in terms of the nature of the substances present (e.g., fill material, disturbed sand or clay, native bedded soil).

Drill cuttings will be managed in accordance with a site-specific WMP that will be prepared before field activities begin.

3.2.4 Sample Analysis

The discrete soil sample at each boring location with the highest PID reading will be submitted to a NJDEP-certified laboratory and will be analyzed for the PPL VOCs, total lead, and TPH. PAH analysis will be conducted on 25 percent of those samples with TPH concentrations greater than 100 parts per million (ppm). If all TPH concentrations are less than 100 ppm, only the sample with the highest TPH concentration will be analyzed for PAHs. Analyses will be conducted using the EPA document SW-846 analytical methods defined in Appendix D.

3.2.5 Decontamination Procedures

Sampling equipment will be decontaminated in accordance with the NJDEP 1992 *Field Sampling Procedures Manual.* Specifics for decontamination of sampling equipment are provided in Section 3.1.5.

3.3 AOC E—South Septic System (Building 54)

3.3.1 Background and Objective

An inactive subsurface septic tank and drain field (South Septic System) are located in AOC E (see Figure 7). The approximate location and orientation of the drain field were obtained from an August 10, 1992, plant map (Drawing No. NJ-76117-SE) entitled *Plant Map; Sewers, Outfalls, and Septic Systems.* The subsurface piping shown on the map indicates that the South Septic System received wastes only from adjacent Building 54

(S.A. Shop). No plant records exist that show construction or design specifications for the septic system.

Previous investigation at AOC E included the collection of an aqueous-phase (supernatant) sample (Building 54-B) from the septic tank. A sludge sample could not be obtained at this location because of insufficient recovery. Trace levels of VOCs, pesticides, phenol, and metals were detected in the supernatant sample. Monitor well MW-33A was also installed and sampled during the ECRA investigation to evaluate potential impact to groundwater from the septic field drainage. Soil samples were not collected because the depth to groundwater in the area was less than 2 feet BGS during the 1991 VEI. Arsenic, mercury, lindane, and heptachlor epoxide exceeded the marine AWQC in groundwater samples collected during July and August 1993. Of these constituents, only arsenic, lindane, and heptachlor epoxide were detected at levels exceeding the New Jersey Groundwater-Quality Criteria for Class II-A (GWIIA) aquifers.

The objective of this sampling event is to investigate soil quality beneath the drainage field at AOC E in accordance with NJAC 7:26E-3.9(e)3ii. Four subsurface samples are proposed for analysis of metals and pesticides within the drain field. The septic tank will be abandoned in accordance with city of Linden Health Department requirements during remedial activities.

Soil samples will be collected with 2- to 3-inch split spoons advanced by hollow-stem auger methods following procedures detailed in Sections 3.2.3 and 3.1.5.

3.3.2 Soil Sample Locations

Four subsurface samples are proposed, as indicated on Figure 7. The four samples (samples ESB-01, ESB-02, ESB-03, and ESB-04) will be collected at a depth of 0 to 6 inches below the infiltrative surface (the interface between filter material in the drain field and the underlying soil or fill), as defined in NJAC 7:9A-2.1.

Preliminary locations for the proposed subsurface samples are shown on Figure 7. Sample locations were selected to represent the entire drain field. The lateral extent of

the drain field will be verified in the field using a probe rod or other means. Actual sample locations will be biased based on professional judgment and field indications of the drain field limits. The depth of the infiltrative surface will be determined in the field based on visual observations during soil boring installation.

The proposed sample locations are preliminary and will be modified based on field-determined drain field limits or if rubble, asphalt, or concrete prevent soil sample collection. Sample borings will be moved to areas near the corners of the drain field without surface barriers that meet the requirements of NJAC 7:26E-3.9(e)3ii. Any relocated samples will remain as close to the proposed locations as possible, and movement will be justified in field notes.

3.3.3 Sample Collection and Analysis

After augers have been advanced to the beginning of the sampling interval (below the infiltrative surface) at each sample location, sample material will be collected from the designated sample interval and placed into containers suitable for inorganic compound and pesticides analysis. The sample containers will be retained until the boring is completed and will subsequently be packed in coolers for shipment to the laboratory. A geologist will visually classify the sample material using the USCS. Any remaining drill cuttings will be managed in accordance with a site-specific WMP that will be prepared before field activities begin.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for PPL metals, PPL pesticides, and methoxychlor using the EPA document SW-846 analytical methods defined in Appendix D.

3.4 AOC F—Former East Fuel Oil Storage Tanks

3.4.1 Background and Objective

This area contained aboveground petroleum fuel tanks. During the VEI, soil sample MW-19A (0.5 to 2.0 feet) was collected. Arsenic (221 mg/kg) and lead (2,030 mg/kg) were detected above the New Jersey RDCSCC (20 mg/kg and 400 mg/kg,

respectively). These sitewide constituents of concern will be addressed in the AOC P sampling plan. Antimony (45.5 mg/kg), copper (800 mg/kg), and thallium (5.3 mg/kg) were also detected at concentrations greater than the New Jersey RDCSCC (14 mg/kg, 600 mg/kg, and 2 mg/kg, respectively). In addition, a TPH concentration of 14,000 mg/kg was reported.

Five soil samples (samples SS-25, SS-37, SS-38, SS-39, SS-40) were collected in June 1993 near sample location MW-19A (see Figure 8). The TPH concentrations for the additional samples were between one and two orders of magnitude lower than the concentration reported from the previous sample (sample MW-19A). TPH concentrations were 5,800 mg/kg, 470 mg/kg, 230 mg/kg, and 520 mg/kg for samples SS-37 through SS-40, respectively. These results, in conjunction with their locations, indicate that the elevated TPH concentration at AOC F has been delineated.

The objective of this sampling event is to further delineate the antimony, copper, and thallium concentrations to NJ RDCSCC. Sampling procedures and decontamination procedures will follow procedures detailed in Sections 3.1.3 and 3.1.5.

3.4.2 Soil Sample Locations

Four soil samples are proposed, as indicated in Figure 8. Three soil samples will be collected at a depth of 0.5 to 1.0 feet BGS (samples FSB-01, FSB-02, FSB-03) to laterally delineate the area surrounding location MW-19A. To vertically delineate location MW-19A, subsurface sample FSB-04 will be collected at 2.0 to 2.5 feet BGS.

Samples collected surrounding the central location are approximately 50 feet from the central location. Sample location FSB-01 is located up grade of location MW-19A, while locations FSB-02 and FSB-03 are located down grade. However, sampling will be biased in the field based on drainage patterns and any evidence of stressed vegetation or other field indicators at locations surrounding the MW-19A location. The sample to be collected adjacent to the monitor well (location FSB-04) will be collected approximately 2 feet from the well and surrounding concrete pad. The location will remain as close as possible to the monitor well location.

The selected sampling locations are preliminary and will be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample location will be relocated in an area without a surface barrier that will still allow a data point for delineation.

3.4.3 Sample Collection and Analysis

After the auger has been advanced to the beginning of the sampling interval, the sample material will then be collected from the interval and placed into a container suitable for inorganic compound analysis. The sample material will be retained until the boring is completed. A geologist will visually classify the sample material using the USCS. The remaining boring cuttings and sample intervals not chosen for analysis will be placed back into the borehole after sample collection is completed, provided that the boring was not advanced below the water table.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for antimony, copper, and thallium using the EPA document SW-846 analytical methods defined in Appendix D.

3.4.4 Sampling Procedures and Decontamination

Sampling will be conducted as described in Section 3.1.3. Decontamination will be conducted in accordance with the NJDEP 1992 *Field Sampling Procedures Manual* and Section 3.1.5.

3.5 AOC G—Central (Main Office) Septic System

3.5.1 Background and Objective

An inactive subsurface septic tank and drain field (Central Septic System) are located in AOC G (see Figure 9). The approximate location and orientation of the drain field were obtained from an August 10, 1992, plant map (Drawing No. NJ-76117-SE) entitled *Plant Map; Sewers, Outfalls, and Septic Systems*. The subsurface piping shown on the map indicates that the Central Septic System received wastes only from the adjacent

Administration Building (Main Office). No plant records exist that show construction or design specifications for the septic system.

Previous investigation at AOC G included the collection of an aqueous-phase (supernatant) sample (sample Admin-B) from the septic tank. A sludge sample could not be obtained at this location because of insufficient recovery. Toluene, 1,4-dichlorobenzene, traces of phenolics, 4,4,4-DDD, copper, and zinc were detected in the supernatant sample. Monitor well MW-31A was also installed adjacent to the septic system and was sampled during the ECRA investigation to evaluate potential impact to groundwater from the septic drainage. Soil samples were not collected because the depth to groundwater in the area was less than 2 feet BGS during the 1991 VEI. Arsenic, copper, nickel, zinc, and 4,4'-DDT were detected at levels exceeding the New Jersey AWQC in groundwater samples collected from well MW-31A during July and August 1993. However, only arsenic was detected at levels exceeding the New Jersey GWIIA criteria. Arsenic concentrations in groundwater and soil are elevated across the Grasselli site.

The objective of this sampling event is to investigate soil quality beneath the drainage field at AOC G in accordance with NJAC 7:26E-3.9(e)3ii and to determine if drainage from the septic field is a significant source of arsenic to groundwater. Four subsurface samples are proposed for arsenic analysis within the drain field area. The septic tank will be abandoned in accordance with city of Linden Health Department requirements during remedial activities.

Soil samples will be collected using a split-spoon sampler and will be advanced applying hollow-stem auger methods following procedures detailed in Section 3.2.3. Sampling equipment will be decontaminated between samples following the procedures outlined in Section 3.1.5.

3.5.2 Soil Sample Locations

Four subsurface samples are proposed, as indicated on Figure 9. The four samples (samples GSB-01, GSB-02, GSB-03, and GSB-04) will be collected at a depth of 0 to 6 inches below the infiltrative surface, as defined in NJAC 7:9A-2.1.

Preliminary locations for the proposed subsurface samples are shown on Figure 9. Sample locations were selected to represent the entire drain field. The lateral extent of the drain field will be verified in the field to the extent possible using a probe rod or other means. Actual sample locations will be biased based on professional judgment and field indications of the drain field limits. The depth of the infiltrative surface will be determined in the field based on probe rod indications or visual observations during soil boring installation.

The proposed sample locations are preliminary and will be modified based on field-determined drain field limits or if rubble, asphalt, or concrete prevent soil sample collection. Sample borings will be moved to areas adjacent to the drain field without surface barriers that meet the requirements of NJAC 7:26E-3.9(e)3ii. Any relocated samples will remain as close to the proposed locations as possible, and movement will be justified in field documentation.

3.5.3 Sample Collection and Analysis

After augers have been advanced to the beginning of the sampling interval (below infiltrative surface) at each sample location, sample material will be collected from the designated sample interval and placed into containers suitable for arsenic analysis. The sample containers will be retained until the boring is completed and will subsequently be packed in coolers for shipment to the laboratory. A geologist will visually classify the sample material using the USCS. Any remaining drill cuttings will be managed in accordance with a site-specific WMP that will be prepared before field activities begin.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for arsenic using the EPA document SW-846 analytical methods defined in Appendix D.

3.6 AOC H—North (Change House) Septic System

3.6.1 Background and Objective

An inactive subsurface septic tank and drain field are located in this area. The approximate location and orientation of the drain field were obtained from an August 10, 1992, plant map (Drawing No. NJ-76117-SE) entitled *Plant Map; Sewers, Outfalls, and Septic Systems*. The subsurface piping shown on the map indicates that the North Septic System received wastes only from adjacent Building 133 (Change House). No plant records exist that show construction or design specifications for the septic system. During the VEI, DuPont installed shallow monitor well MW-23A and collected a soil sample at this location.

In the soil sample collected at location MW-23A (at a depth of 0.5 to 2.0 feet BGS), barium was detected at a concentration of 3,990 mg/kg, which is greater than the New Jersey RDCSCC of 700 mg/kg. Cadmium was also detected in the soil sample collected from location MW-23A at a concentration of 1.1 mg/kg. This result is less than 10 percent greater than the New Jersey RDCSCC of 1 mg/kg. The EPA document SW-846 methodology protocol duplicate requirement in soil is 35 percent. Furthermore, in the septic tank sludge phase sample collected from the septic tank (BLDG133-A), cadmium was not detected (less than 0.63 mg/kg). Because the cadmium result at location MW-23A is only 10 percent greater than the criterion, and because cadmium was not detected in sample BLDG133-A, no additional sampling for cadmium is recommended at AOC H.

The soil sample collected at location MW-23A did contain elevated levels of some carcinogenic PAHs such as benzo(a)pyrene and benzo(a)anthracene (see Figure 10).

The objectives of this sampling event are to further delineate the barium constituent concentrations to residential criteria around location MW-23A and to investigate PAH concentrations in soil beneath the drainage field at AOC H in accordance with NJAC 7:26E-3.9(e)3ii..

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3.6.2 Soil Sample Locations

Eight samples are proposed, as indicated on Figure 10. Three surface samples (samples HSB-01, HSB-02, and HSB-03) will be collected around location MW-23A (at a depth of 0.5 to 1.0 feet BGS), and one subsurface sample (sample HSB-04) will be collected adjacent to location MW-23A (at a depth of 2.5 to 3.0 feet BGS). In addition, four subsurface samples (samples HSB-05, HSB-06, HSB-07, and HSB-08) will be collected at a depth of 0 to 6 inches below the drain field infiltrative surface, as defined by NJAC 7:9A-2.1.

Preliminary locations for the proposed surface and subsurface samples are shown on Figure 10. The lateral extent of the drain field will be verified in the field using a probe rod or other means. Actual sample locations will be biased based on professional judgment and field indications of drain field limits for the four drain field samples, and on drainage patterns, discolored soil, stressed vegetation and other field indicators for other samples. The subsurface sample adjacent to the monitor well (location HSB-04) will be collected approximately 2 feet from the well and surrounding concrete pad. The location will remain as close as possible to the monitor well and previous sample location.

The proposed sampling locations are preliminary and will be modified if filter material within the drain field is not found (applies to locations HSB-05, HSB-06, HSB-07, and HSB-08) or if rubble, asphalt, or concrete prevent soil sample collection. The sample location will be relocated in an area without a surface barrier that will still allow a data point for delineation. Any moved location will be as close to the proposed location as possible, and movement will be justified in field documentation.

3.6.3 Sample Collection and Analysis

After augers have been advanced to the beginning of the sampling interval at each sample location, sample material will be collected from the designated interval and placed into containers suitable for analysis of specified constituents (see Table 3). The sample containers will be retained until the boring is completed and will subsequently be packed in coolers for shipment to the laboratory. A geologist will visually classify sample

material using the USCS. Any remaining drill cuttings will be managed in accordance with a site-specific WMP that will be prepared before field activities begin.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for the constituents described in Table 3 using the EPA document SW-486 analytical methods defined in Appendix D. Surface samples collected from AOC H (samples HSB-01, HSB-02, and HSB-03) will be analyzed for barium. Subsurface sample HSB-04 will be collected and analyzed for barium and arsenic (arsenic is being analyzed as part of delineation program for sitewide constituents of concern). Samples collected from the drain field (samples HSB-05, HSB-06, HSB-07, and HSB-08) will be analyzed for PP SVOCs.

3.6.4 Sampling Procedures and Decontamination

Soil samples will be collected using a split-spoon sampler and will be advanced applying hollow-stem auger methods, as outlined in Section 3.2.3. Decontamination will be conducted in accordance with the NJDEP 1992 *Field Sampling Procedures Manual* and Section 3.1.5.

3.7 AOC I—Former DDT and Methoxychlor Manufacturing Area

3.7.1 Background and Objective

DDT and methoxychlor were manufactured and stored in this area. Figure 11 shows the layout of the former buildings in this area before their demolition between 1976 and 1978. No plant records or plans exist that show the detailed construction of the buildings. During the years of manufacturing, a railroad spur ran along the northern side of the area, and a shipping dock was located east of the manufacturing area. Over the past 20 years since demolition, the area has probably been regraded several times, resulting in the redistribution of potentially contaminated soil.

During the VEI, a soil sample was collected at location MW-24A (see Figure 11). Two additional VEI sample locations (locations SP-1 [A and B] and SP-2 [A and B]) were selected based on a review of historical maps, aerial photography, and interviews with

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site personnel. These previous soil samples were collected within the footprint of the buildings. Samples SP-1A and SP-2A were collected from the 0- to 6-inch depth interval, and sample SP-1B was collected from the 3- to 4-foot interval. Sample SP-2B soil was collected below the water table from the 4- to 6-foot interval. The approximate depth to groundwater is 4.5 to 5.5 feet BGS near well MW-24A.

The soil results at sample location SP-2A indicated the presence of 4,4'-DDT and 4,4'-DDE at concentrations (18 mg/kg and 5.2 mg/kg, respectively) above the New Jersey RDCSCC of 2.0 mg/kg. Soil sampling at sample location SP-1B indicated the presence of zinc (2,010 mg/kg) above the New Jersey RDCSCC of 1,500 mg/kg. Beryllium, zinc, barium, vanadium, cadmium, and mercury were detected in the soil sample collected from location MW-24A above the NJ RDCSCC (see Figure 11).

The objectives of this sampling event are to further evaluate the soil surrounding the former buildings and to further delineate the constituents already detected in soil to the residential criteria. Eight new surface soil sampling locations are proposed to delineate the constituents detected at locations SP-2A, SP-1B, and MW-24A. Because locations MW-24A and SP-2A are in close proximity to one another, only four samples will be necessary to delineate the soil laterally. Location SP-2A has been vertically delineated for 4,4'-DDT and 4,4'-DDE. A fifth sample location has been selected to vertically delineate specific metals in the soil near location MW-24A. Two samples are proposed to delineate the zinc constituent concentration laterally at location SP-1B, and one sample is proposed to vertically delineate location SP-1B.

To further evaluate the soil surrounding the production and storage pad area, soil will be collected from 19 locations and analyzed for PPL metals and PPL pesticides plus methoxychlor. Locations ISB-02, ISB-03, ISB-07 will also aid in delineating previous sampling data. Sample SB-06 is also designated as a delineation point for sitewide constituents of concern.

Sampling procedures and decontamination procedures will follow procedures detailed in Sections 3.1.3 and 3.1.5.

3.7.2 Soil Sample Locations

Twenty-four samples are proposed, as shown on Figure 11. Five soil samples (samples ISB-01, ISB-04, ISB-05 ISB-06, ISB-08) will be collected within the footprint of the pad to delineate elevated concentrations of specific metals detected during previous sampling events. The sample to be collected adjacent to monitor well MW-24A (location ISB-05) will be collected approximately 2 feet from the well and surrounding concrete pad. The location will remain as close as possible to the monitor well location.

In addition, 19 soil samples will be collected surrounding the pad of the former buildings to assess whether any metals or pesticides are present in soil at concentrations above the New Jersey RDCSCC. In accordance with the NJTRSR, samples are located adjacent to and surrounding the pad. Because the area has not been an active manufacturing and storage area for nearly 20 years and because the soil has been regraded, a waiver of the NJTRSR (NJAC 7:26E-3.9[b]1) for the number of soil samples around the pad is requested. Soil sampling is proposed at a reduced frequency of four samples per side, except on the northern and eastern sides where the potential for spills during product loading and unloading is greater. Five soil samples will be collected on the northern side of the pad (adjacent to the former railroad spur), and six samples will be collected on the eastern side of the pad where a shipping dock was located. Locations ISB-21 and ISB-22 are located within the area of the former shipping dock (see Figure 11). Based on the current inactive status of the area, the proposed number of samples is considered sufficient to determine adequately if activities from the manufacturing and storage areas have adversely impacted soil quality surrounding the pad. Based on results of the proposed soil samples, additional sampling and analysis may be necessary to delineate constituents of concern in soil.

The proposed sampling locations are preliminary and will biased based on discolored soil, stressed vegetation, drainage patterns, and other field indicators. Sample locations will also be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample will be relocated in an area without a surface barrier that will still allow a data point for delineation.

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3.7.3 Sample Collection and Analysis

After the auger has been advanced to the beginning of the sampling interval, the sample material will then be collected from the interval and placed into a container suitable for inorganic and pesticides analysis. The sample containers will be retained until the boring is completed. A geologist will visually classify the sample material using the USCS.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for the constituents described using the EPA document SW-846 analytical methods defined in Appendix D. Samples will be analyzed for the constituents shown in Table 3 and on Figure 11.

3.8 AOC J—Former North Fuel Oil Storage Tanks

3.8.1 Background and Objective

AOC J is located within AOC K (Former Disposal Area) and previously contained aboveground petroleum fuel tanks. In addition, three tanks of sodium styrene sulfonate (SSS) still bottoms were temporarily buried in AOC J. In 1993, six shallow soil samples (samples SS-1, SS-2, SS-3, SS-3A, SS-4, and SS-4A) were collected from the 0- to 6-inch depth interval and analyzed for PAHs and TPH. Results for two of these samples (samples SS-3 and SS-4) exceeded the surface soil screening criteria for benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, ideno(1,2,3-cd)pyrene, and chrysene (see Figure 12).

Soil samples were collected at monitor wells MW-25 and MW-35, which are located within AOC J. At location MW-35, benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(g,h,i)perylene, ideno(1,2,3-cd)pyrene, and chrysene were detected in soil at levels above the New Jersey RDCSCC. PAH detection limits in samples from location MW-25 were above the New Jersey RDCSCC. Although the carcinogenic PAHs are sitewide constituents of concern, these constituents may be directly related to activities at this AOC, therefore warranting delineation on an AOC-specific basis. At location MW-25, barium and cadmium were detected at levels above the New Jersey RDCSCC.

The objective of this sampling event is to further delineate the constituents to residential criteria. Eight new sampling locations are proposed to delineate the inorganic and PAH constituents detected at locations SS-3, SS-4, MW-25, and MW-35. Because locations MW-25, MW-35 and SS-3 are in close proximity to one another, only three surface samples (JSB-01, JSB-05, and JSB-06) will be collected to delineate the constituents laterally. A shallow sample (JSB-08) will also be collected to the south of location SS-4 to laterally delineate the PAHs at this location. A sample will be collected near previous sample locations (locations SS-3, SS-4, MW-25, and MW-35) to vertically delineate constituents of concern.

Sampling procedures and decontamination procedures will follow procedures detailed in Sections 3.1.3, 3.2.3, and 3.1.5.

3.8.2 Soil Sample Locations

Eight soil samples are proposed, as indicated on Figure 12 (see Table 3 for a summary of the proposed analyte list and proposed sampling depths).

Three samples will be collected and analyzed for PAHs. One soil sample (sample JSB-08) will be collected to the south of sample SS-4 at a depth of 0.5 to 1.0 feet BGS. Two soil samples (samples JSB 01 and JSB-06) will be collected in the center of AOC J, around locations MW-25, MW-35, and SS-3 (also at a depth of 0.5 to 1.0 feet BGS). A sample is proposed at location JSB-05 barium and cadmium analysis. Sample locations JSB-01, JSB-05, JSB-06, and JSB-08 are preliminary and may be adjusted in the field based on discolored soil, stressed vegetation, drainage patterns, or other field indicators.

To vertically delineate specific PAHs in AOC J, deeper soil samples will be collected at each sampling location. At locations SS-3 and SS-4, soil samples JSB-04 and JSB-07 will be collected at 3.5 to 4.0 feet BGS. At locations MW-25 and MW-35, deeper soil samples will be collected. The samples to be collected adjacent to the monitor wells (JSB-02 and JSB-03) will be collected approximately 2 feet from the well and

surrounding concrete pad. The location will remain as close as possible to the monitor well location.

The proposed sampling locations will be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample location will be relocated in an area without a surface barrier that will still allow a data point for delineation. An explanation for relocation will be included in the field notes.

3.8.3 Sample Collection and Analysis

After the auger has been advanced to the beginning of the sampling interval, the sample material will then be collected from the interval and placed into a container suitable for inorganic and SVOC analysis. The sample containers will be retained until the boring is completed. A geologist will visually classify the sample material using the USCS. The remaining boring cuttings and sample intervals not chosen for analysis will be placed back into the borehole after sample collection is complete.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for the constituents described using the EPA document SW-846 analytical methods defined in Appendix D. The following analysis will be conducted:

- Samples JSB-03 and JSB-05 will be analyzed for barium and cadmium.
- Samples JSB-01, JSB-02, JSB-04, JSB-06, JSB-7, and JSB-08 will be analyzed for the following carcinogenic PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, ideno(1,2,3-cd)pyrene, and chrysene.

3.9 AOC K—Former Disposal Area

3.9.1 Background and Objective

This area was used to dispose of various types of waste. During the VEI, soil samples were collected from locations MW-9A, MW-14A, and MW-26A. Barium was detected at sampling locations MW-9A and MW-14A (see Figure 13) above the New Jersey RDCSCC. Cadmium and zinc were also detected at location MW-14A above the

New Jersey RDCSCC. During the ECRA investigation, 13 additional soil samples were collected. At sample points SP-4A and SP-6A, cadmium was detected above the New Jersey RDCSCC. In addition to the cadmium detected at these two locations, zinc and antimony were detected at sample point SP-6A above the New Jersey RDCSCC. Hexachlorobenzene and methoxychlor were detected at location SP-4A at concentrations above the criteria. Methoxychlor was detected at location SP-3A above the New Jersey IGW numbers.

The objective of this sampling event is to further delineate the constituents to residential criteria. Eighteen additional soil sampling locations are proposed to delineate the constituents detected in AOC K at concentrations above the criteria. Three samples are proposed to delineate the constituents laterally for each of the following sampling locations: MW-9A, SP-3A, MW-14A, and SP-4A. Two samples will be collected to delineate location SP-6A laterally. A deeper soil sample will be collected at locations MW-9A, MW-14A, and SP-6A to vertically delineate specific constituents at these locations.

Sampling and decontamination procedures will follow protocols detailed in Sections 3.1.3, 3.2.3, and 3.1.5.

3.9.2 Soil Sample Locations

Eighteen soil samples are proposed to delineate constituents of concern in soil, as indicated on Figure 13. Fourteen soil samples will be collected at a depth of 0.5 to 1.0 feet BGS. Three shallow soil samples (samples KSB-01, KSB-02, KSB-03) will be collected around location MW-9A. Three shallow soil samples (samples KSB-05, KSB-06, KSB-07) will be collected around location MW-14A. Three shallow soil samples (samples KSB-09, KSB-10, KSB-11) will be collected around location SP-4A. Three shallow soil samples (samples KSB-16, KSB-17, KSB-18) will be collected around location SP-3A. Two shallow soil samples (samples KSB-13 and KSB-14) will be collected around location SP-6A. To vertically delineate constituents in AOC K, deeper soil samples will be collected at four sampling locations. At location MW-14A (sample KSB-08), a soil sample will be collected at 3.0 to 3.5 feet BGS. At

location SP-6A (sample KSB-15), a soil sample will be collected at 2.5 to 3.0 feet BGS, and at location MW-9A (sample KSB-04), a soil sample will be collected at 2.0 to 2.5 feet BGS. Methoxychlor is vertically delineated at location SP-4A by sample SP-4B results. However, an additional deep sample (sample KSB-12) is proposed to vertically delineate hexachlorobenzene and cadmium. A deeper soil sample will not be collected near location SP-3A because constituents are vertically delineated by the SP-3B sample (see Figure 13).

Sample locations surrounding the original locations where the criteria were exceeded are approximate (see Figure 13). Actual sampling locations will be biased based on discolored soil, stressed vegetation, drainage patterns, PID readings, or other field indicators. The samples to be collected adjacent to the monitor well locations MW-9A and MW-14A (samples KSB-04 and KSB-08) will be collected approximately 2 feet from the well and surrounding concrete pads. The location will remain as close as possible to the monitor well location.

The sampling locations may also be modified if rubble, asphalt, or concrete prevent soil sample collection. The sample location will be relocated in an area without a surface barrier that will still allow a data point for delineation. A moved location will be explained in the field notes.

3.9.3 Sample Collection and Analysis

After the auger has been advanced to the beginning of the sampling interval, the sample material will then be collected from the interval and placed into a container suitable for inorganic compounds, SVOCs, and pesticides analysis. The sample containers will be retained until the boring is completed. A geologist will visually classify the sample material using the USCS. The remaining boring cuttings and sample intervals not chosen for analysis will be handled in accordance with the waste management plan that will be prepared before field implementation.

Each sample will be submitted to a NJDEP-certified laboratory and will be analyzed for the constituents described using the EPA document SW-846 analytical methods defined in Appendix D. The following analysis will be conducted:

- Samples KSB-01, KSB-02, KSB-03, and KSB-04 will be collected and analyzed for barium.
- Samples KSB-05, KSB-06, KSB-07, and KSB-08 will be collected and analyzed for barium, cadmium, and zinc.
- Samples KSB-13, KSB-14, and KSB-15 will be collected and analyzed for cadmium, antimony, and zinc.
- Samples KSB-09, KSB-10, and KSB-11 will be collected and analyzed for cadmium, methoxychlor, and hexachlorobenzene.
- Sample KSB-12 will be collected and analyzed for cadmium and hexachlorobenzene.
- Samples KSB-16, KSB-17, and KSB-18 will be collected and analyzed for methoxychlor.

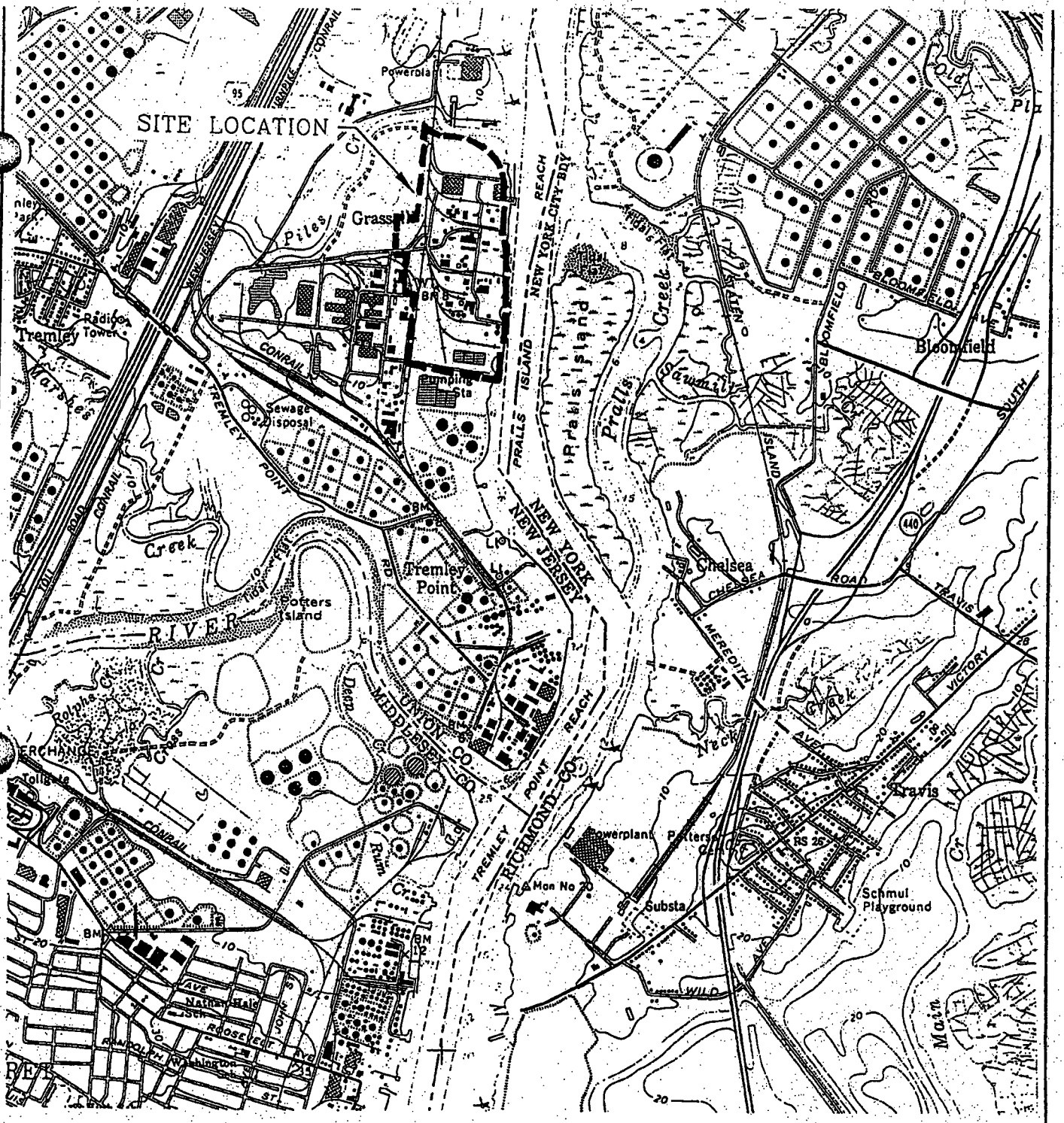
3.10 AOC M—Wade Brothers Yard

3.10.1 Background and Objective

Wade Brothers leases this yard from DuPont for the operation of their contracting business. While installing boring MW-7A, a soil sample was collected from the 0.5- to 2-foot interval. Barium, beryllium, and cadmium concentrations in the soil samples exceeded the New Jersey RDCSCC of 700 mg/kg, 1 mg/kg, and 1 mg/kg, respectively.

The objective of this sampling event is to further delineate the inorganic constituents in AOC M to the New Jersey RDCSCC. Four new surface and subsurface-soil samples are proposed to delineate barium, beryllium, and cadmium detected at AOC M. Three surface samples are proposed to delineate the constituents laterally around location MW-7A. A subsurface sample will be collected adjacent to well MW-7A to vertically delineate the inorganic compounds at this location.

Surface samples will be collected using a hand auger following the sampling procedures outlined in Section 3.1.3. The subsurface sample will be collected using a split-spoon sampler and will be advanced applying hollow-stem auger methods following the



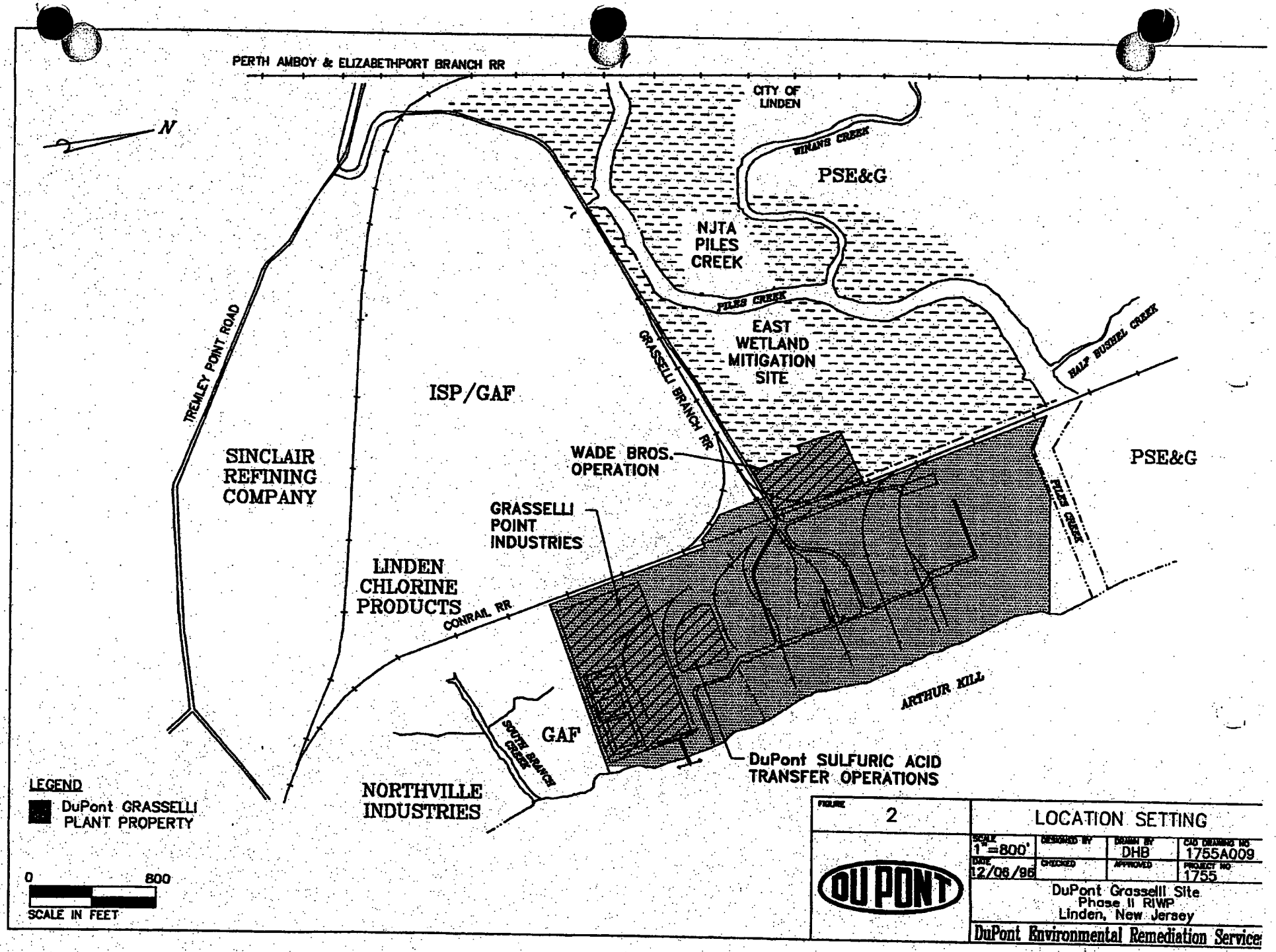
SOURCE: ARTHUR KILL, NY-NJ QUADRANGLE 7.5' SERIES

FIGURE 1	SITE LOCATION MAP		
	SCALE 1" = 2000'	DESIGNED BY	DRAWN BY	CAD DRAWING NO SITEMAPS
	DATE 12/06/96	CHECKED	APPROVED	PROJECT NO 1755
DUPONT	DuPont Grasselli Site Linden, New Jersey			
	DuPont Environmental Remediation Services			

MAXUS3919055

FIGURES

MAXUS3919056



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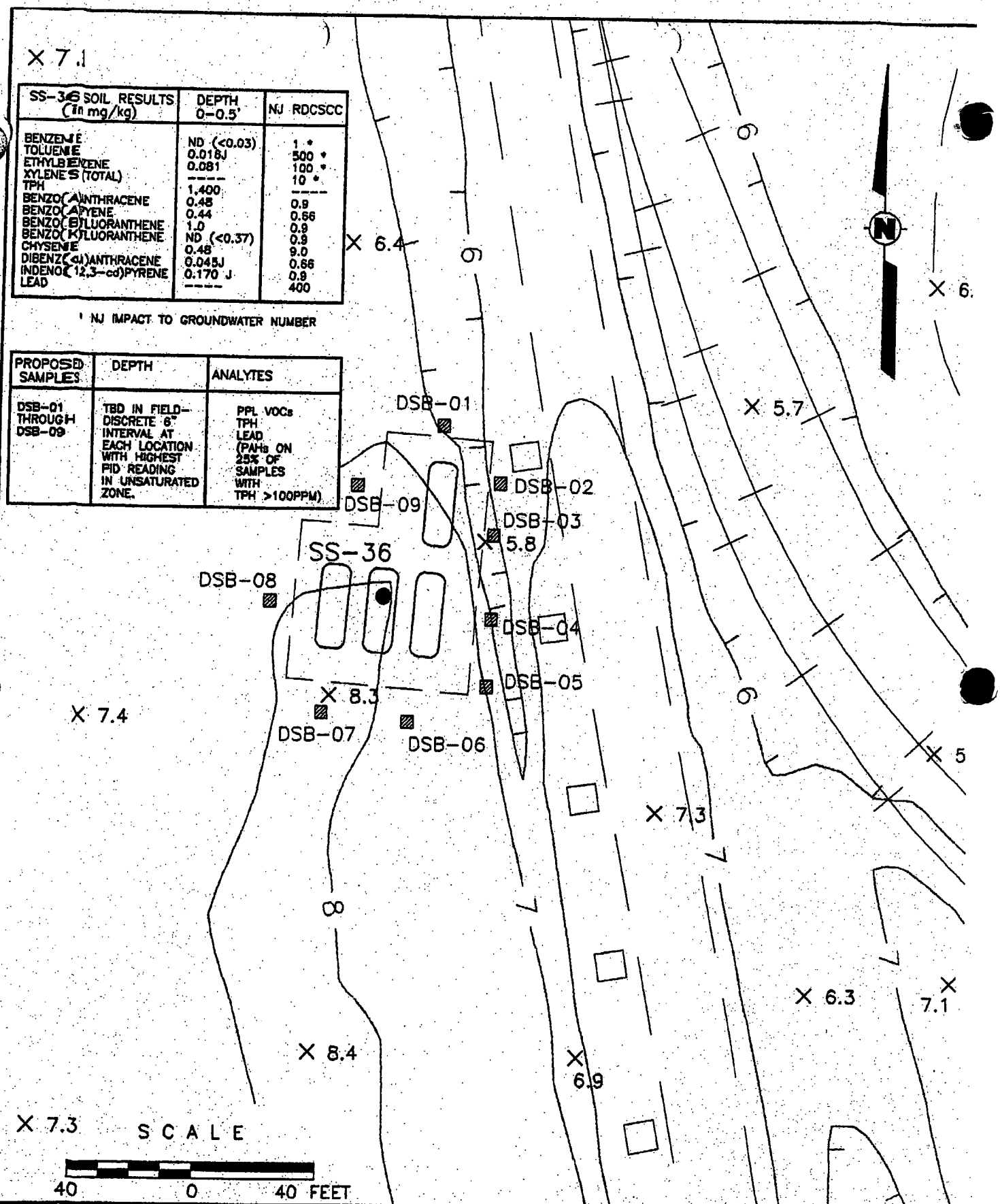


SS-36 SOIL RESULTS (in mg/kg)	DEPTH 0-0.5'	NJ RDCSCC
BENZENE	ND (<0.03)	1 *
TOLUENE	0.018J	500 *
ETHYLBENZENE	0.081	100 *
XYLENES (TOTAL)	----	10 *
TPH	1,400	----
BENZO(A)ANTHRACENE	0.48	0.9
BENZO(A)PYRENE	0.44	0.66
BENZO(B)FLUORANTHENE	1.0	0.9
BENZO(K)FLUORANTHENE	ND (<0.37)	0.9
CHYSENE	0.48	9.0
DIBENZ(a,h)ANTHRACENE	0.045J	0.66
INDENO(1,2,3-cd)PYRENE	0.170 J	0.9
LEAD	----	400

* NJ IMPACT TO GROUNDWATER NUMBER

PROPOSED SAMPLES	DEPTH	ANALYTES
DSB-01 THROUGH DSB-09	TBD IN FIELD- DISCRETE 6" INTERVAL AT EACH LOCATION WITH HIGHEST PID READING IN UNSATURATED ZONE.	PPL VOCs TPH LEAD (PAHs ON 25% OF SAMPLES WITH TPH >100PPM)

LEGEND:

- ● SOIL SAMPLING POINT
- NA NOT ANALYZED OR NOT AVAILABLE
- X 6.1 TOPOGRAPHIC ELEVATION BASED ON 1992 FLYOVER (FT MSL) CONTOUR INTERVAL = 1 FT
- ▨ PROPOSED SOIL SAMPLE LOCATION

FIGURE 6

DUPONT

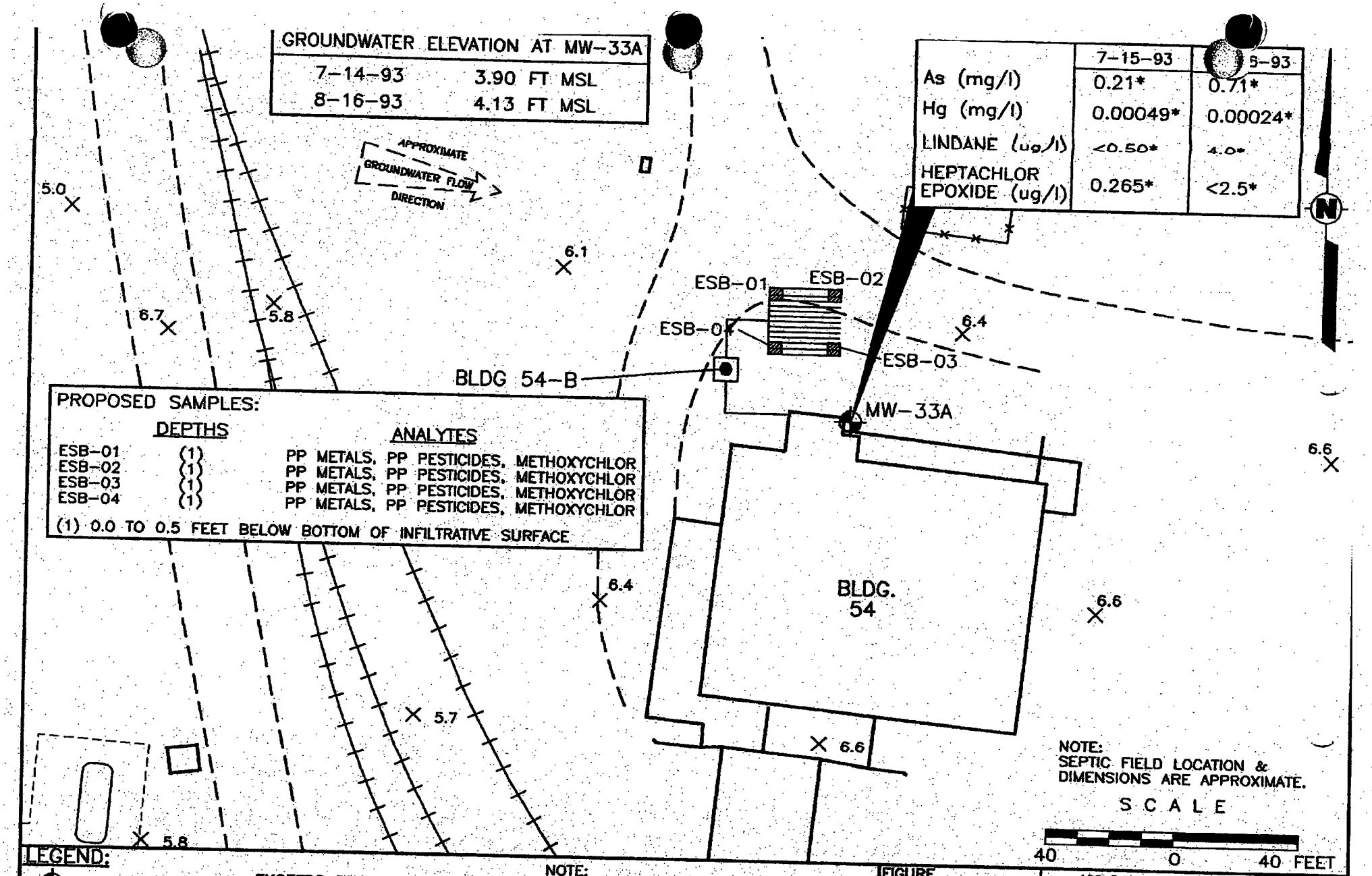
AOC D MAP-FORMER WEST FUEL OIL STORAGE TANKS

SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO
1"=40'		DHB	1755A007
DATE 12-96	CHECKED	APPROVED	PROJECT NO 1755

GRASSELLI SITE
PHASE II RIWP
LINDEN, NEW JERSEY

DuPont Environmental Remediation Servic

MAXUS3919058



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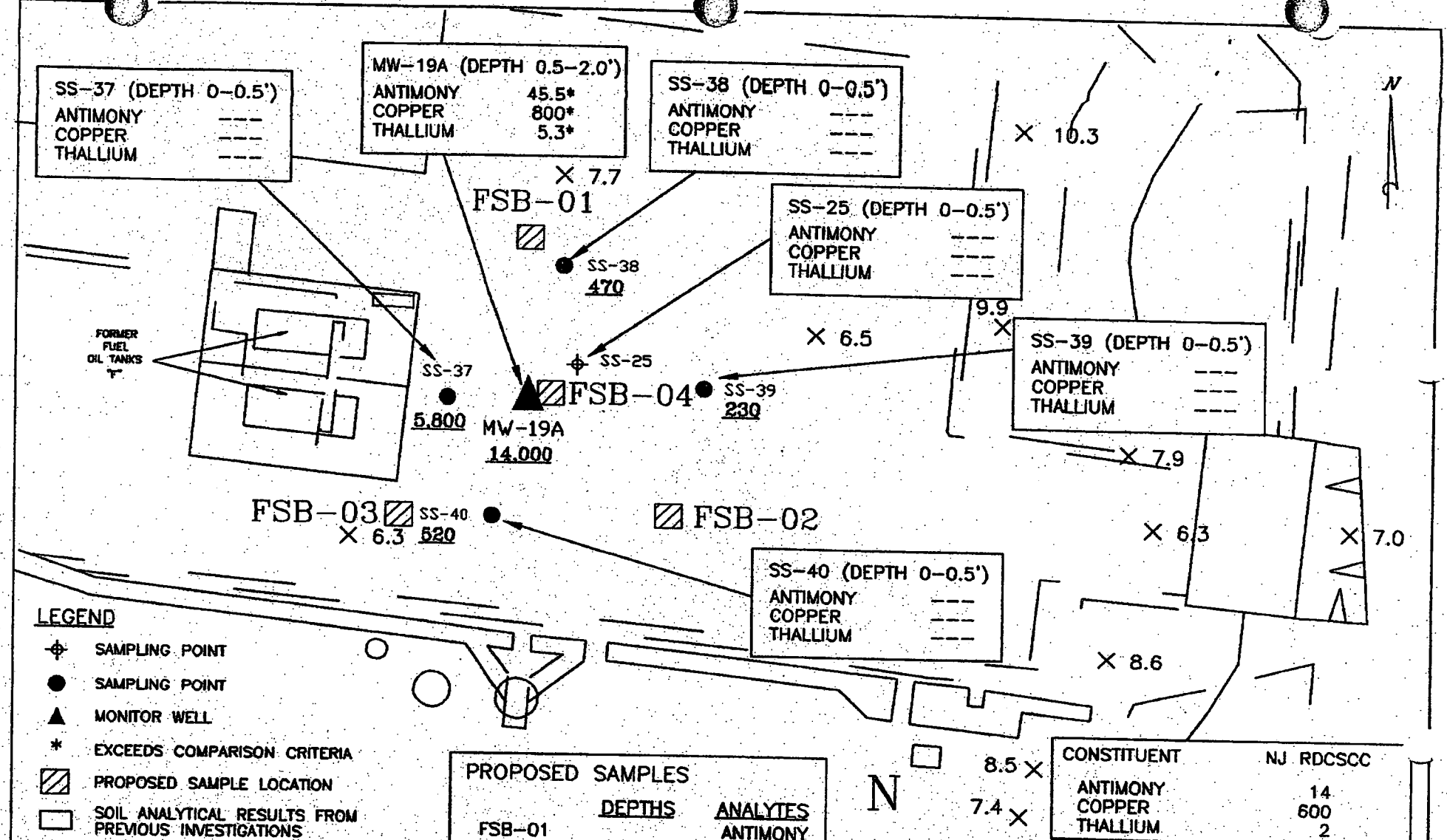


LEGEND

- SAMPLING POINT
- SAMPLING POINT
- MONITOR WELL
- * EXCEEDS COMPARISON CRITERIA
- PROPOSED SAMPLE LOCATION
- SOIL ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS
- 5,800 TPH VALUES ADJACENT TO SAMPLE LOCATION
- --- NOT ANALYZED
- 6.3 × TOPOGRAPHIC ELEVATION (FT MSL)

ALL CONCENTRATIONS IN mg/kg

NOTE: DEPTH TO WATER ~ 3.5-4.0 FT. BGS at MW-19A

PROPOSED SAMPLES

	DEPTHS	ANALYTES
FSB-01 FSB-02 FSB-03	0.5-1'	ANTIMONY COPPER THALLIUM
FSB-04	2.0-2.5'	ANTIMONY COPPER THALLIUM

CONSTITUENT	NJ RDCSCC
ANTIMONY	14
COPPER	600
THALLIUM	2

FIGURE 8

AOC F MAP-FORMER EAST FUEL OIL STORAGE TANK PROPOSED SAMPLING LOCATIONS

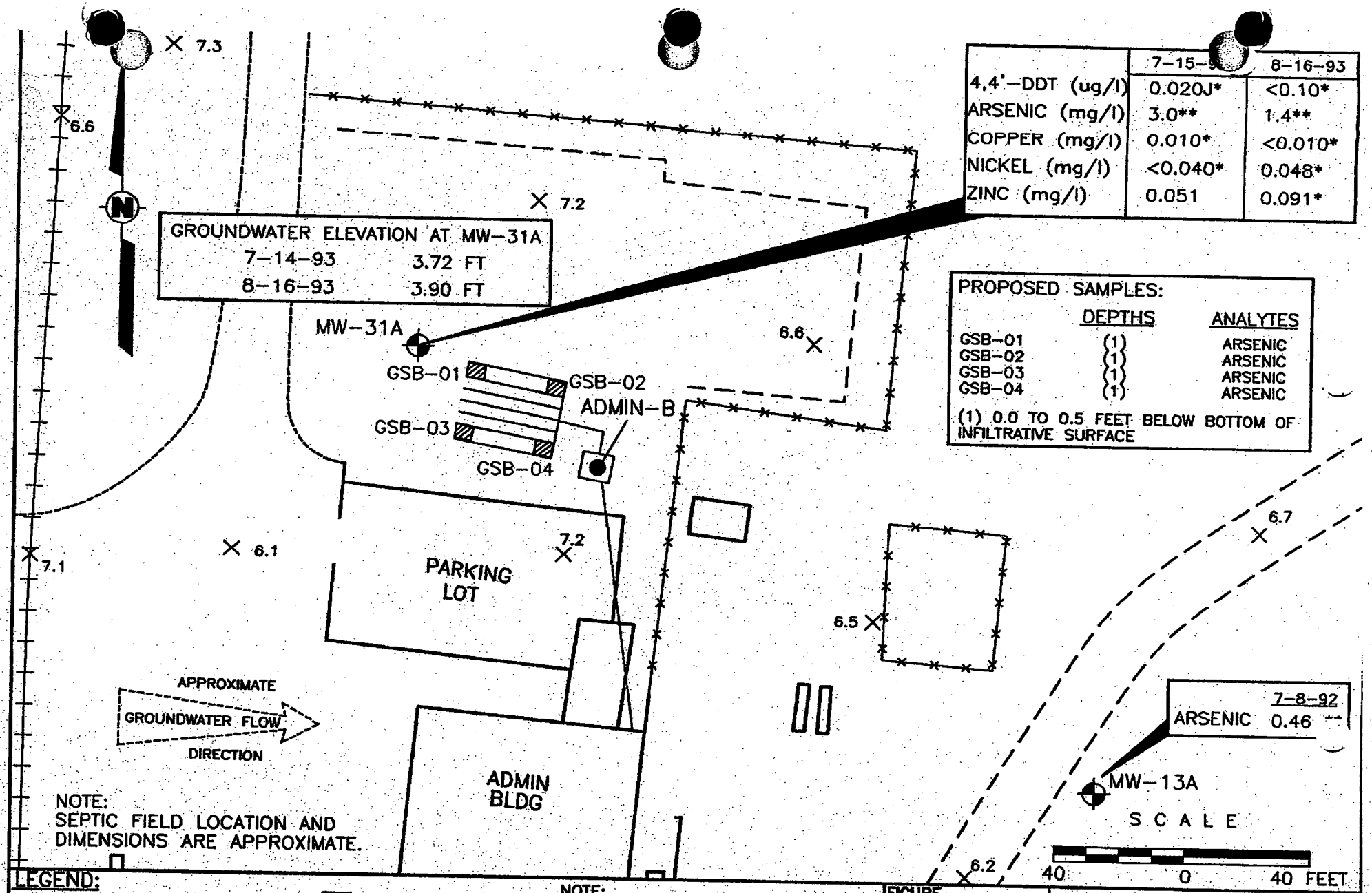
SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO
1"=40'		TIQ	1755A008
DATE 12/96	CHECKED	APPROVED	PROJECT NO 1755

DUPONT

DUPONT GRASSELLI SITE PHASE II RIWP
LINDEN, NJ

DuPont Environmental Remediation Services

MAXUS3919060



	7-15-93	8-16-93
4,4'-DDT (ug/l)	0.020J*	<0.10*
ARSENIC (mg/l)	3.0**	1.4**
COPPER (mg/l)	0.010*	<0.010*
NICKEL (mg/l)	<0.040*	0.048*
ZINC (mg/l)	0.051	0.091*

PROPOSED SAMPLES:

	DEPTHS	ANALYTES
GSB-01	(1)	ARSENIC
GSB-02	(1)	ARSENIC
GSB-03	(1)	ARSENIC
GSB-04	(1)	ARSENIC

(1) 0.0 TO 0.5 FEET BELOW BOTTOM OF INFILTRATIVE SURFACE

LEGEND:

- MONITOR WELL
- SAMPLING POINT
- J ESTIMATED CONCENTRATION
- 7.2 TOPOGRAPHIC ELEVATION (FT MSL)
- SEPTIC TANK & DRAIN FIELD
- PROPOSED SOIL SAMPLE LOCATION
- * EXCEEDS SALT WATER AMBIENT WATER QUALITY CRITERIA
- ** EXCEEDS GW-IIA CRITERIA

NOTE:
UNFILTERED DATA WAS USED FOR VOLATILES AND SEMI-VOLATILES, WHILE FILTERED DATA WAS USED FOR PESTICIDES/PCBs AND INORGANICS.

FIGURE 9

DUPONT

AOC G MAP-CENTRAL (MAIN OFFICE)
SEPTIC SYSTEM PROPOSED SAMPLING LOCATIONS

SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO.
1"=40'		TJG	1755A002
DATE	CHECKED	APPROVED	PROJECT NO.
12/96			1755

GRASSELLI SITE
PHASE II RIWP
LINDEN, NEW JERSEY
DuPont Environmental Remediation Services

MAXUS3919061

PROPOSED SAMPLES:

	DEPTHS	ANALYTES
HSB-01	0.5-1.0'	BARIUM
HSB-02	0.5-1.0'	BARIUM
HSB-03	0.5-1.0'	BARIUM
HSB-04	2.5-3.0'	ARSENIC, BARIUM
HSB-05	(1)	PP SVOCs
HSB-06	(1)	PP SVOCs
HSB-07	(1)	PP SVOCs
HSB-08	(1)	PP SVOCs

(1) 0.0 TO 0.5 FEET BELOW BOTTOM OF INFILTRATIVE SURFACE

GROUNDWATER ELEVATION AT MW-23A

7-14-93	3.56 FT MSL
8-16-93	3.47 FT MSL

CONSTITUENT	NJ RDCSCC
BARIUM	700 mg/kg
CADMIUM	1 mg/kg
BENZO(a)ANTHRACENE	0.9 mg/kg
BENZO(a)PYRENE	0.66 mg/kg
BENZO(b)FLUORANTHENE	0.9 mg/kg
BENZO(k)FLUORANTHENE	0.9 mg/kg
DIBENZ(a,h)ANTHRACENE	0.66 mg/kg

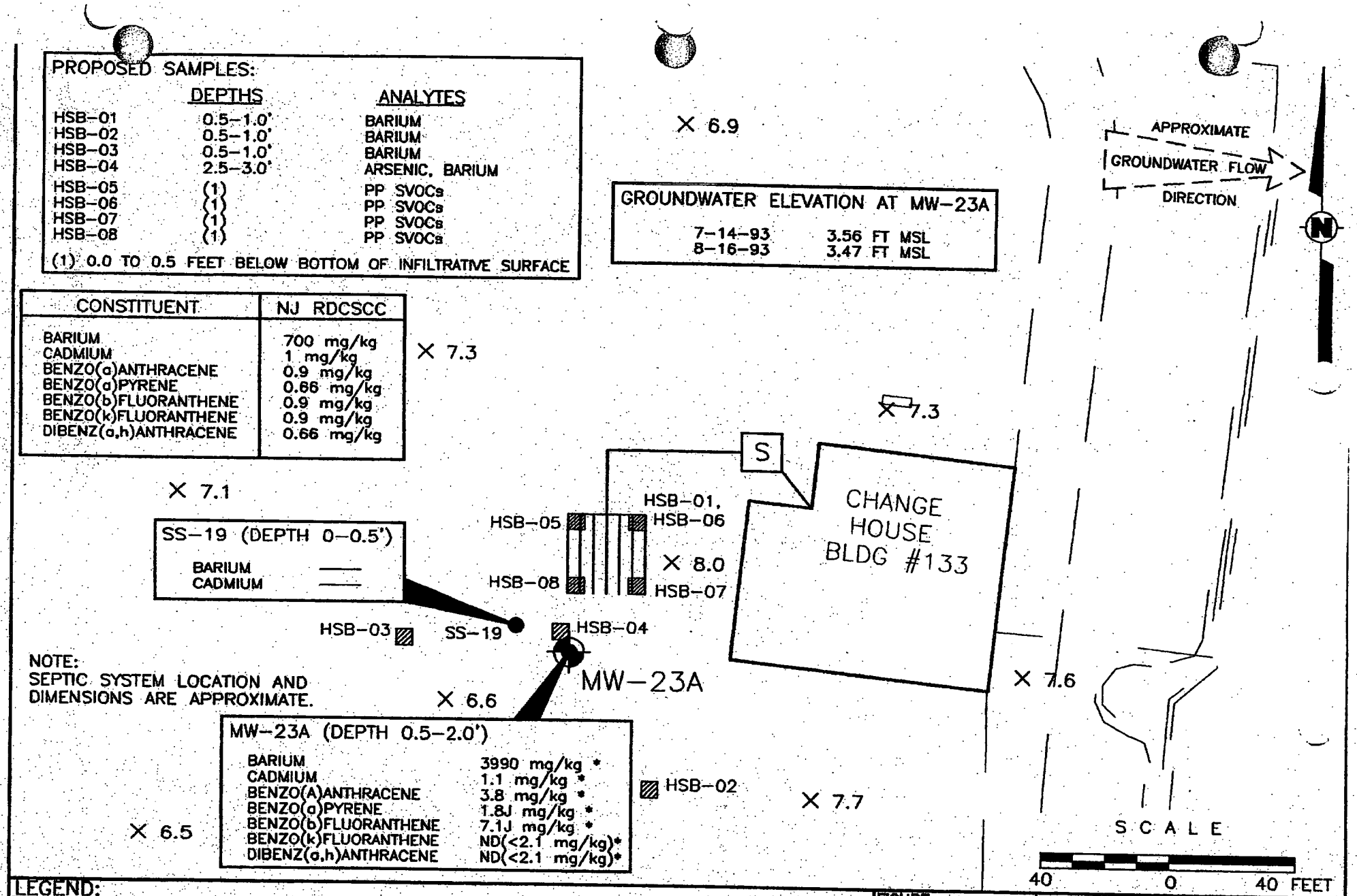
SS-19 (DEPTH 0-0.5')

BARIUM	——
CADMIUM	——

MW-23A (DEPTH 0.5-2.0')

BARIUM	3990 mg/kg *
CADMIUM	1.1 mg/kg *
BENZO(A)ANTHRACENE	3.8 mg/kg *
BENZO(a)PYRENE	1.8J mg/kg *
BENZO(b)FLUORANTHENE	7.1J mg/kg *
BENZO(k)FLUORANTHENE	ND(<2.1 mg/kg)*
DIBENZ(a,h)ANTHRACENE	ND(<2.1 mg/kg)*

NOTE:
SEPTIC SYSTEM LOCATION AND DIMENSIONS ARE APPROXIMATE.



LEGEND:

- MONITOR WELL
- SAMPLING POINT
- X 6.1 TOPOGRAPHIC ELEVATION (FT MSL)
- PROPOSED SOIL SAMPLE LOCATION
- * EXCEEDS COMPARISON CRITERIA
- —— NOT ANALYZED
- SEPTIC TANK & DRAIN FIELD
- SOIL ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS

FIGURE 10

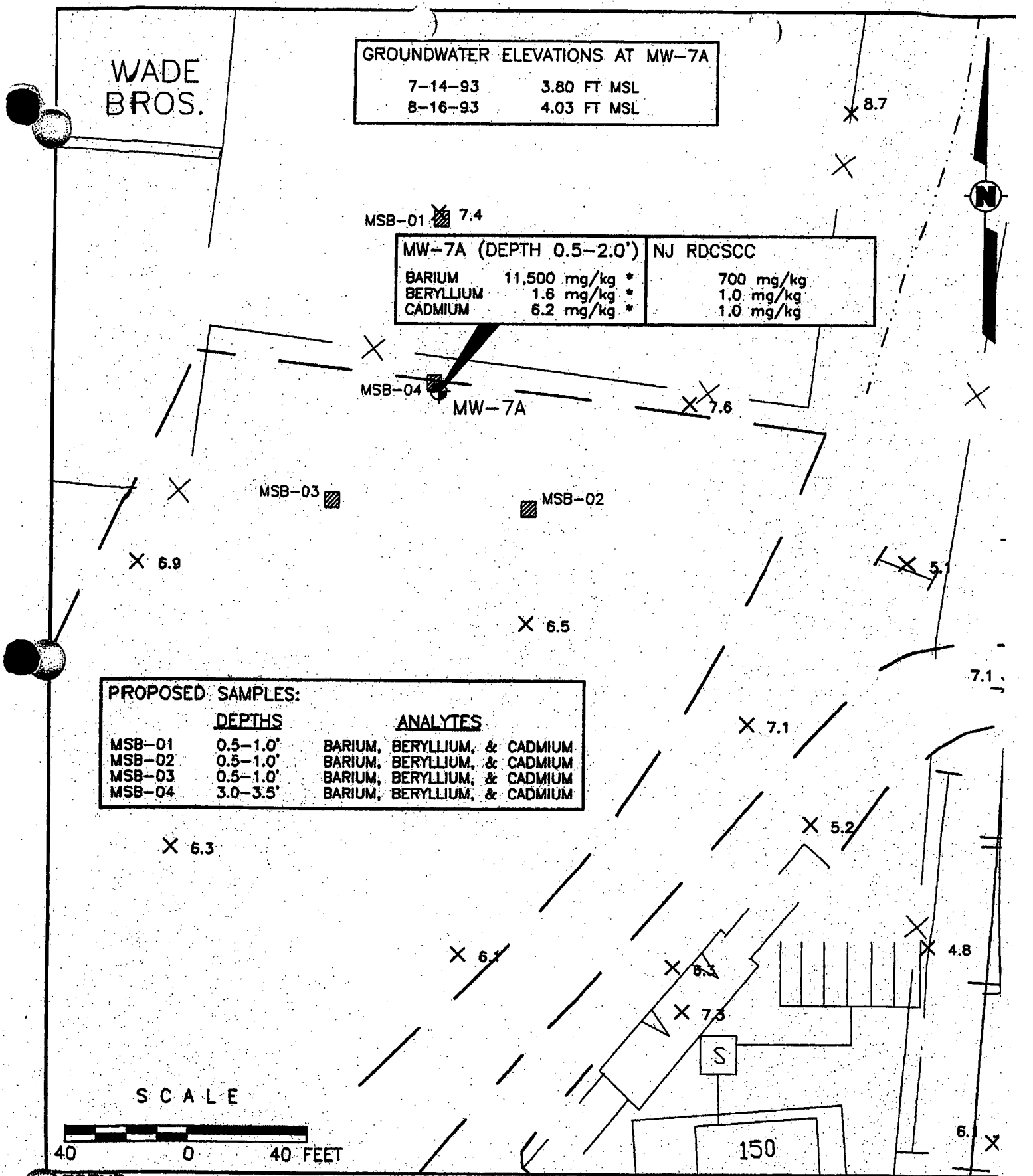
DUPONT

AOC H MAP NORTH SEPTIC SYSTEM
PROPOSED SAMPLING LOCATIONS

SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO.
1"=40'		TIQ	1755A005
DATE 12/96	CHECKED	APPROVED	PROJECT NO. 1755

GRASSELLI SITE
PHASE II RIWP
LINDEN, NEW JERSEY
DuPont Environmental Remediation Services

MAXUS3919062



LEGEND:

- MONITOR WELL
- 8.1 TOPOGRAPHIC ELEVATION (FT MSL)
- SOIL ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS
- * EXCEEDS COMPARISON CRITERIA
- PROPOSED SOIL SAMPLE LOCATION

FIGURE 14

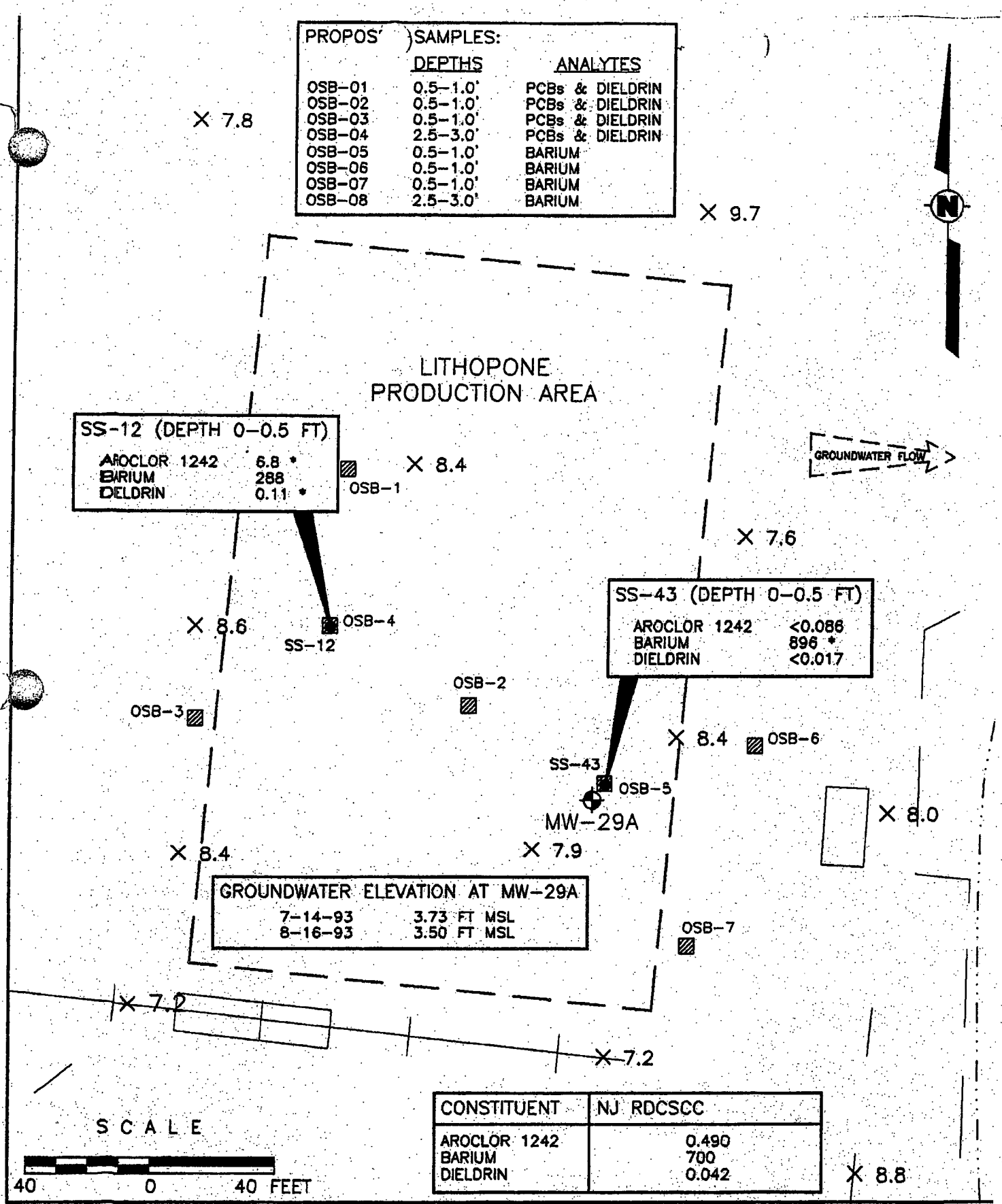
DUPONT

AOC M MAP - WADE BROS. YARD
PROPOSED SAMPLING LOCATIONS

SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO
1"=40'		TIQ	1755A003
DATE	CHECKED	APPROVED	PROJECT NO
12/96			1755

GRASSELLI SITE
PHASE II RIWP
LINDEN, NEW JERSEY
DuPont Environmental Remediation Servic

MAXUS3919063



LEGEND:

- MONITOR WELL
- SAMPLING POINT
- 6.1 TOPOGRAPHIC ELEVATION (FT MSL)
- PROPOSED SOIL SAMPLE LOCATION
- * EXCEEDS COMPARISON CRITERIA
- ALL CONCENTRATIONS IN mg/kg
- SOIL ANALYTICAL RESULTS FROM PREVIOUS INVESTIGATIONS

FIGURE 15

DUPONT

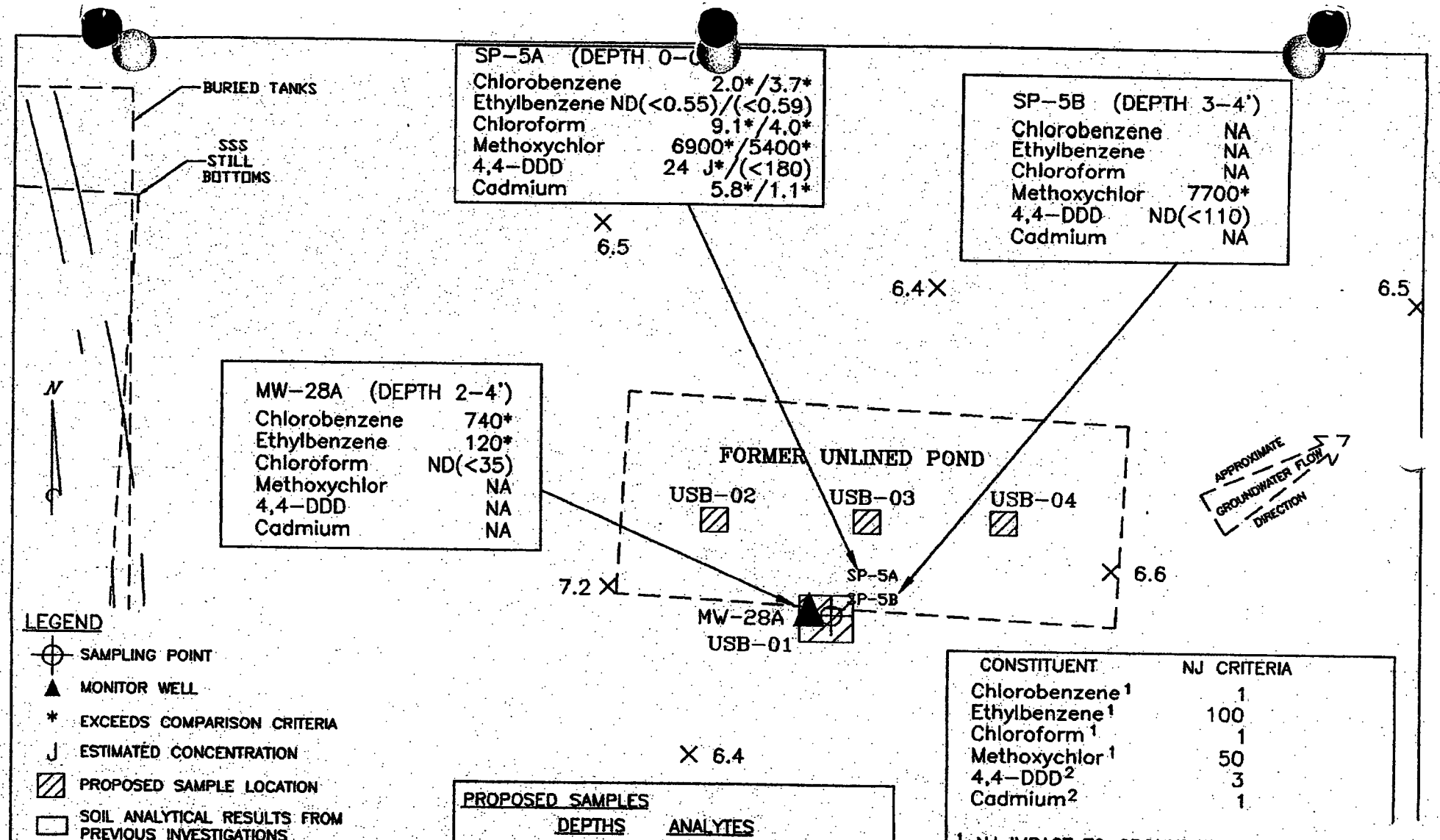
AOC O MAP-LITHOPONE PRODUCTION AREA PROPOSED SAMPLING LOCATIONS

SCALE	DESIGNED BY	DRAWN BY	CAD DRAWING NO
1"=40'		TIQ	1755A004
DATE	CHECKED	APPROVED	PROJECT NO
12/98			1755

GRASSELLI SITE
PHASE II RIWP
LINDEN, NEW JERSEY

DuPont Environmental Remediation Services

MAXUS3919064

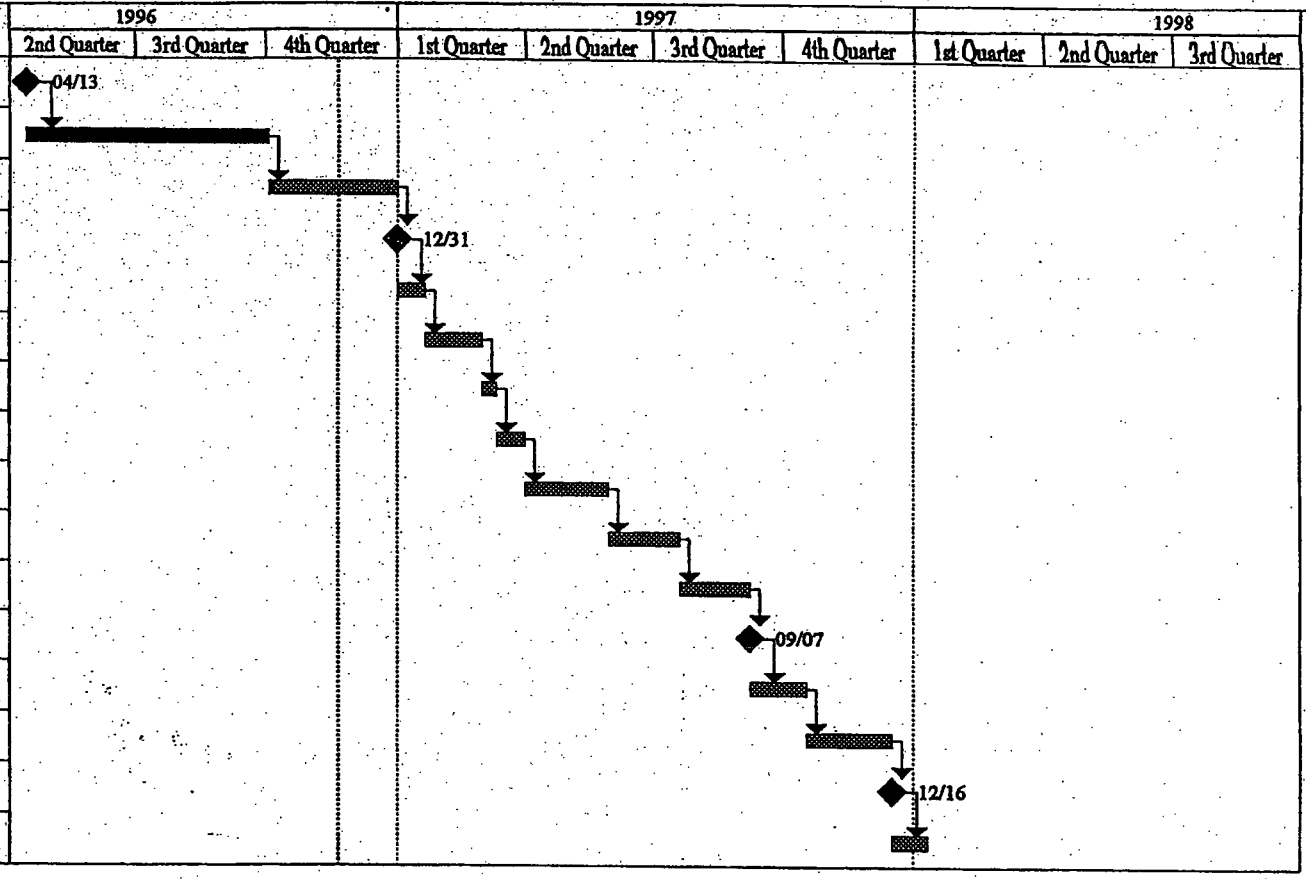


MAXUS3919065

Figure 21

DuPont Grasselli Site Phase II Remedial Investigation Schedule

Name	Duration
Submit Response to Comments to NJDEP	0d
Estimated Time for NJDEP Review and Comment	24w
Develop and Submit sampling plan Addendum	90d
Submit Addendum to NJDEP	0d
NJDEP Review and Approval (Estimated)	4w
Drilling and sampling contractor Approved and Mobilized	8w
On Site Groundwater Investigation	2w
On Site Soil Investigation	4w
Sample Analysis, Laboratory Evaluation and Database Management	12w
Data Evaluation and Interpretation	10w
Draft Phase II Report	10w
Submit Phase II RI report to NJDEP	0d
NJDEP Review and Comment (Estimated time)	8w
Prepare Final Phase II Report	12w
Final Phase II RI Report to NJDEP	0d
NJDEP Review and Approval (Estimated)	5w



Project: Grasselli Phase II RI schedule
Date: 11/20/96

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

MAXUS3919066

TABLES

MAXUS3919067

Table 1

PROPOSED GROUNDWATER INVESTIGATION SUMMARY

Type	Location	Sampling Points	Analyses	Sampling Method	Number of Locations	Number of Samples
W Groundwater	Section 2.3 Figure 2	Shallow and deep wells	PPL metals, filtered and unfiltered PPL Pesticides, filtered and unfiltered Field Parameters	Low flow pump or Bailer	28	28
	Section 2.3 Figure 2	Shallow wells MW-24A MW-26A MW-28A	PPL Volatiles	Low flow pump or Bailer	3	3
	Figure 2 Section 2.9	Shallow wells	Determination of hydraulic conductivity	Tidal study*	9 wells	NA

*If tidal study analysis is not suitable for determination of hydraulic conductivity, slug tests will be conducted.

MAXUS3919068

Table 2

RECOMMENDED WELL SAMPLING ORDER

Deep Well	
1.	MW-8B
2.	MW-20B
3.	MW-11B
4.	MW-18B
Southern Area	
5.	MW-19A
6.	MW-11A
7.	MW-12A
8.	MW-20A
9.	MW-16A
10.	MW-10A
11.	MW-18A
12.	MW-32A
13.	MW-33A
14.	MW-15A
Middle Area	
15.	MW-8A
16.	MW-9A
17.	MW-14A
18.	MW-29A
19.	MW-23A
20.	MW-22A
21.	MW-7A
22.	MW-31A
23.	MW-13A
24.	MW-35A
25.	MW-30A
26.	MW-26A
27.	MW-24A
28.	MW-28A

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PHASE II RIWP-PROPOSED AOC SOIL SAMPLING SUMMARY

AOC	Number/Type	Sample Locations	Depth	Analytical Parameters	Work Plan Reference/Comments
C Former DMHA Holding Ponds Section 3.1	3 soil (around MW-15A location)	CSB-01, CSB-02, CSB-03	2 to 2.5 feet	barium	See Figure 5
	1 soil (near MW-15A location)	CSB-04	4.0 to 4.5 feet	arsenic, barium, and carcinogenic, PAHs	
D Former West Fuel Oil Storage Tanks Section 3.2	9 soil (around the bermed area)	DSB-01, DSB-02, DSB-03, DSB 04, DSB-05, DSB-06, DSB-07, DSB-08, DSB-09	Discrete soil interval with highest PID reading within the unsaturated zone. TBD in the field	PPL VOCs, lead, TPH	See Figure 6
	1 to 2 soil	TBD based on TPH results	TBD	PAHs	Add samples at AOC D (see attached)
E South (Bldg 54 Shop) Septic System Section 3.3	4 soil (within septic drain field)	ESB-01, ESB-02, ESB-03, ESB-04	0.0 to 0.5 feet below infiltrative surface	PPL metals, PPL pesticides, +methoxychlor	See Figure 7
F Former E. Fuel Oil Storage Tanks Section 3.4	3 soil (around MW-19A location)	FSB-01, FSB-02, FSB-03	0.5 to 1.0 feet	antimony, copper, and thallium	See Figure 8
	1 soil (near MW-19A location)	FSB-04	2.0 to 2.5 feet		
G Central (Main Office) Septic System Section 3.5	4 soil (within septic drain field)	GSB-01, GSB-02, GSB-03, GSB-04	0.0 to 0.5 feet below infiltrative surface	arsenic	See Figure 9
H North Septic System Section 3.6	3 soil (around MW-23A location)	HSB-01, HSB-02, HSB-03	0.5 to 1 feet	barium	See Figure 10
	1 soil (near MW-23A location)	HSB-04	2.5 TO 3.0 feet	barium and arsenic	
	4 soil (within septic drain field)	HSB-05, HSB-06, HSB-07, HSB 08	0.0 to 0.5 feet below infiltrative surface	PP SVOCs	
I Former DDT and Methoxychlor Manufacturing Area Section 3.7	2 soil (around MW-24A location)	ISB-01, ISB-04	0.5 to 1 foot	barium, beryllium, cadmium, mercury, vanadium, and zinc	See Figure 11 SP-2A is vertically delineated 4,4'-DDE and 4,4'-DDT and to west in surface soil by [illegible]/-24A
	1 soil (near MW-24A location)	ISB-05	3.5 to 4.0 feet		
	1 soil (around SP-1B location)	ISB-06	3.0 to 3.5 feet		
	1 soil (near SP-1B location)	ISB-08	4.0 to 4.5 feet	zinc	
	1 soil	ISB-07	3.0 to 3.5 feet	PPL metals	
	17 soil located around perimeter of pad	ISB-02, ISB-03, ISB-09, ISB-10, ISB-11, ISB-12, ISB-13, ISB-14, ISB-15, ISB-16, ISB-17, ISB-19, ISB-20, ISB-21, ISB-22, ISB-23	0.5 to 1.0 feet	PPL pesticides +methoxychlor	

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PHASE II RIWP-PROPOSED AOC SOIL SAMPLING SUMMARY

AOC	Number of Samples	Sample Location	Depth	Analytical Parameters	Work Plan Reference/Comments
J Former N. Fuel Oil Storage Tanks Section 3.8	1 soil (around SS-4 location) 1 soil (near SS-4 location)	JSB-08 JSB-07	0.5 to 1 feet 3.5 to 4.0 feet	carcinogenic PAHs	See Figure 12
	1 soil (around SS-3 location) 1 soil (near SS-3 location)	JSB-06 JSB-04	0.5 to 1 feet 3.5 to 4.0 feet	carcinogenic PAHs	
	1 soil (near MW-25 location) 1 soil (around MW-25 location)	JSB-03 JSB-05	2.5 to 3.0 feet 0.5 to 1.0 feet	barium and cadmium	
	1 soil (near MW-35 location) 1 soil (around MW-35 location)	JSB-02 JSB-01	7.0 to 7.5 feet 0.5 to 1.0 feet	carcinogenic PAHs	
K Former Disposal Area Section 3.9	1 soil (near MW-9A location) 3 soil (around MW-9A location)	KSB-04 KSB-01, KSB-02, KSB-03	2.0 to 2.5 feet 0.5 to 1.0 feet	barium	See Figure 13
	1 soil (near MW-14A location) 3 soil (around MW-14A location)	KSB-08 KSB-05, KSB-06, KSB-07	3.0 to 3.5 feet 0.5 to 1.0 feet	barium, cadmium, and zinc	
	1 soil (near SP-4A location)	KSB-12	3.0 to 3.5 feet	cadmium and hexachlorobenzene	
	3 soil (around SP-4A location)	KSB-09, KSB-10, KSB-11	0.5 to 1.0 feet	cadmium, hexachlorobenzene, and methoxychlor	
	1 soil (near SP-6A location) 2 soil (around SP-6A location)	KSB-15 KSB-13, KSB-14	2.5 to 3.0 feet 0.5 to 1.0 feet	antimony, cadmium and zinc	
	3 soil (around SP-3A location)	KSB-16, KSB-17, KSB-18	0.5 to 1.0 feet	methoxychlor	
M Wade Bros. Yard Section 3.7	1 soil (near MW-7A location) 3 soil (around MW-7A location)	MSB-04 MSB-01, MSB-02, MSB-03	3 to 3.5 feet 0.5 to 1.0 feet	beryllium, barium and cadmium	See Figure 14
O Lithopone Prod. Area Section 3.11	1 soil (near SS-12 location) 3 soil (around SS-12 location)	OSB-04 OSB-01, OSB-03 OSB-02	2 to 2.5 feet 0.5 to 1.0 feet 0.5 to 1.0 feet	PCBs and dieldrin PCBs and dieldrin PCBs, dieldrin, barium	See Figure 15
	3 soil (around SS-43 location) 1 soil (near SS-43 location)	OSB-06, OSB-07 OSB-05	0.5 to 1.0 feet 2 to 2.5 feet	barium	
U Unlined Pond (formerly part of AOI K) Section 3.13	1 soil (near SP-5A location)	USB-01	4.5 to 5.0 feet	PPL VOCs, PPL pesticides +methoxychlor, cadmium	See Figure 16
	3 soil (along centerline of former pond)	USB-02, USB-03, USB-04	within sludge layer or 0.0 to 0.5 feet below pond invert	PPL VOCs, PPL pesticides +methoxychlor, phenols, PPL metals	

MAXUS3919071

PHASE II RIWP-PROPOSED AOC SOIL SAMPLING SUMMARY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sitewide P	25 surface samples	SB-06	0.5 to 1.0 feet	PPL metals, PPL pesticides +methoxychor, carcinogenic PAHs	See Figures 17, 18, and 19
		SB-01, SB-05, SB-07 TO SB-25	0.5 to 1.0 feet	arsenic, lead, and carcinogenic PAHs	
P	5 subsurface		Refer to Sitewide Subsurface Sampling Summary (Table 4)	arsenic	See Figure 18
P	8 subsurface			lead	See Figure 19
P	9 subsurface			carcinogenic PAHs	See Figure 17
Sitewide P	9 surface samples	PSB-01 to PSB-06 PSB-07 to PSB-09	0.5 to 1.0 feet	barium	See Figure 20
Section 3.14	3 subsurface samples	PSB-10 PSB-11 PSB-12	2.0 to 2.5 feet 4.0 to 4.5 feet 2.0 to 2.5 feet	barium an cadmium	

Note: Carcinogenic PAHs are: benzo(b)flouranthene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)flouranthene, ideno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, chrysene
Method of collection for samples will be by hand auger, or an appropriate method according to the *New Jersey Field Sampling Procedures Manual* (1992)
NS = Not sampled
DTW = Depth to water
BGS = Below ground surface
--- = Not available

MAXUS3919072

PROPOSED SUBSURFACE SOIL SAMPLING SUMMARY
SITEWIDE CONSTITUENTS OF CONCERN

Work Plan Reference	Medium	Sample Identification	Constituents	Depth of Sample (feet BGS)	Approximate DTW (feet BGS)	Proposed Sample Depth (feet BGS)
Figures 17	Soil	SBB-03	B(b)F, B(a)A,	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-01	B(a)P, B(k)F,	0 to 0.5	—	2.0 to 2.5 feet
Section 3.14	Soil	SBB-02	I(1,2,3-cd)P	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-04	D(a,h)A, and	0 to 1.5	2.0 to 3.7	2.0 to 2.5 feet
	Soil	SBB-05	Chrysene	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-06		0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-07		0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-08		NS	3.0 to 3.5	2.0 to 2.5 feet
	Soil	CSB-04	B(b)F, B(a)A, B(a)P, B(k)F, I(1,2,3-cd)P, D(a.,h)A, Arsenic, Chrysene, and Barium	2.0 to 3.5	1.5 to 4.0	4.5 to 5.0 feet
Figure 19	Soil	SBB-01	lead	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-02	lead	0 to 0.5	—	2.0 to 2.5 feet
Section 3.14	Soil	SBB-12	lead	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-13	lead	0 to 1.5	2.0 to 3.0	2.0 to 2.5 feet
	Soil	SBB-10	lead	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-14	lead	0.5 to 2.0	2.0 to 3.0	3.0 to 3.5 feet
	Soil	SBB-11	lead	0.5 to 2.0	3.0 to 4.0	3.0 to 3.5 feet
	Soil	SBB-15	lead	0 to 2.0	2.5 to 8.0	3.0 to 3.5 feet
Figures 17 and 18	Soil	SBB-02	arsenic	0 to 0.5	—	2.0 to 2.5 feet
	Soil	HSB-04	arsenic and barium	0.5 to 2.0	3.0 to 3.5	3.0 to 3.5 feet
Section 3.14	Soil	SBB-10	arsenic	0 to 0.5	—	2.0 to 2.5 feet
	Soil	SBB-11	arsenic	0.5 to 2.0	3.0 to 4.0	3.0 to 3.5 feet
	Soil	CSB-04	B(b)F, B(a)A, B(a)P, B(k)F, I(1,2,3-cd)P, D(a.,h)A, Arsenic, Chrysene, and Barium	2.0 to 3.5	1.5 to 4.0	4.5 to 5.0 feet

Method of collection for samples will be by hand auger, or an appropriate method according to the *New Jersey Field Sampling Procedures Manual* (1992).
NS = Not sampled
DTW = Depth to water
BGS = Below ground surface
— = NA

MAXUS3919073

APPENDIXES

MAXUS3919074

Appendix A

NATIONAL WETLANDS INVENTORY MAP

MAXUS3919075

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 PROJECT NUMBER 1755

MAXUS3919076

Appendix B

TOPOGRAPHIC MAP

MAXUS3919077

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 PROJECT NUMBER 1755

MAXUS3919078

Appendix C

AOC SUMMARY TABLE

MAXUS3919079

Appendix C

AOC SUMMARY TABLE

AOC Location	Dimensions* (Acres)	Status
A-pipeline rights of way	2.2	No further action per NJDEP 10/19/92
B-former marsh disposal	12	NJTA reclaimed area for wetlands mitigation
C-DMHA waste holding ponds	5.89	[illegible]
D-west fuel oil AST	0.1	[illegible]
E-building 54 septic system	2.36	[illegible]
F-former E. fuel oil storage ASTs	2.45	[illegible]
G-main office septic system	2.36	[illegible]
H-N. septic system	2.36	[illegible]
I-former DDT and methoxychlor area	2.36	[illegible]
J-former N. fuel oil tanks	2.36	[illegible]
K-former disposal area	17.64	[illegible]
L-pH adjustment ponds	2.36	No further action per NJDEP 10/30/92
M-Wade Bros yard	2.815	[illegible]
N-ditches	0.43	Compared to property status of ditch east of AOC B under review NOAA ER-M
O-Former lithopone production area	2.48	[illegible]
P-eastern portion of site	105	[illegible]
Q-western portion of site	~93	NJTA property: wetlands mitigation project
R-septic systems	0.59	Septic systems addressed individually
S-gasoline AST tank #25	2.36	No further action per NJDEP February 23, 1996
T-spill E building	~0.01	[illegible]
U-former unlined pond (new area)	2.83	[illegible]
W-groundwater	~105	[illegible]

N/A = not applicable
NJTA = New Jersey Turnpike Authority
Shading indicates additional sampling proposed during the Phase II investigation
*All areas are estimated

MAXUS3919080

Appendix D

QUALITY ASSURANCE PROJECT PLAN

MAXUS3919081

QUALITY ASSURANCE PROJECT PLAN

DuPont Grasselli Site
Linden, New Jersey

December 31, 1996 **DERS Project No. 1755**

Prepared by

DuPont Environmental Remediation Services
Barley Mill Plaza 27
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MAXUS3919082

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EXHIBITS

Exhibit 1 Laboratory Quality Assurance Plans

Exhibit 2 Field Extraction/Preservation of Soil Samples with Methanol for VOC Analysis Method

MAXUS3919087

of the city of Linden; and to the south by the property of General Aniline Film (GAF) Company.

1.2 Site History

The current DuPont property was purchased in 1928 from the Grasselli Chemical Company, which owned and operated the plant and property since 1885. Prior to the Grasselli Chemical Company, the property was owned by the Standard Chemical Company, which purchased the land from several individual owners and first developed the tract for industrial use in the early 1880s.

The Grasselli plant most recently manufactured sulfuric acid, ammonium thiosulfate, and a sodium bisulfate solution. However, in the past the plant manufactured many different types of chemical compounds, including inorganic salts and acids and organic pesticides. A complete description of the operational history of the plant through time titled *Operational History of the DuPont Grasselli Facility* was submitted to the NJDEP as Attachment 6 in the March 1992 *ECRA Initial Notice Submittal*. That document also contained details concerning the general environmental setting, including the geographic setting, surrounding land use, climate, topography, drainage, soil, and regional geology and hydrogeology.

Based on the information compiled in the operational history, a voluntary environmental investigation (VEI) was conducted to determine if the identified areas of potential environmental interest have detrimentally impacted the quality of soil and water as well as the overall environmental quality in and around the Grasselli plant.

1.3 Recent Investigations

DuPont has conducted studies of the site which have been used to prepare this sampling plan. These studies include an operational history of the site, a VEI, and an ECRA Investigation (Phase I RI). The operational history was used to identify potential areas of environmental interest (AEIs). During the VEI and ECRA investigation, additional data

MAXUS3919088

1.0 PROJECT DESCRIPTION

This quality assurance project plan (QAPP) for the DuPont Grasselli site located in Linden, New Jersey, has been prepared in an agreement between the New Jersey Department of Environmental Protection (NJDEP), and DuPont. This QAPP is a part of the Phase II remedial investigation work plan (RIWP) for the site. The objective of this QAPP is to specify the terms, policies, organization, objectives, functional activities, and specific quality assurance and quality control (QA/QC) activities that will ensure that data quality goals of the project are met. The Environmental Protection Agency (EPA's) *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005/80) has been used for guidance in preparation of this QAPP.

The associated RIWP provides a summary of site data, a site characterization plan, and a schedule for implementation of all activities. The RIWP and health and safety plan detail the methodologies, safety procedures, and personnel and equipment needs for the project.

This QAPP describes the scope of work, rationale, sampling and analytical procedures for sample handling and tracking, laboratory analyses, QC, data reporting, and assessment for the project.

Tables referenced in the text are attached. The laboratory QA plans are included as Exhibit 1.

1.1 Site Location

The Grasselli site is located in an industrial park in eastern Linden, New Jersey. The plant tract covers approximately 105 acres. Approximately 112 acres located west of the site are undeveloped and mainly tidal wetlands which have been claimed by the New Jersey Turnpike Authority for wetlands reclamation and enhancement. The site is bounded on the east by the Arthur Kill; on the north by the properties of the Public Service Electric and Gas Company; on the west by the Perth Amboy and Elizabeth Port Branch Railroad (part of Conrail), the New Jersey Turnpike, and an undeveloped property

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was collected from these AOIs through soil and groundwater sampling. DERS conducted these tasks for the Grasselli plant.

A report on the operational history of the Grasselli plant was completed in September 1990. This report identified the general environmental setting of the plant and compiled the chemical manufacturing and waste disposal history of the plant. The report was submitted to the NJDEP as Attachment 6 of the March 1992 *ECRA Initial Notice Submittal.*

In late 1990 and early 1991, DERS conducted the VEI, which was designed to determine if any AOI had impacted the quality of soil and groundwater and to collect site-specific geologic and hydrogeologic information. The scope of work and findings of the soil sampling are presented in and were used to design the ECRA sampling plan. The ECRA investigation was conducted in the summer of 1993 and the ECRA report submitted November 13, 1993. The Phase II RIWP is designed to collect data to delineate soil to the New Jersey Residential Direct Contact Soil Cleanup Criteria (NJRDCSCC) or impact to groundwater criteria and to collect data to assess the impact of groundwater on the surface water bodies, if any. A discussion of groundwater results is not included in this plan; however, it will be included in the sampling plan report.

At the Wade Brothers Yard—a small area that is leased by DuPont to a construction contractor—a fuel oil release investigation has been completed. A petroleum hydrocarbon seep was detected in a drainage ditch at the edge of this yard. DuPont conducted an investigation to determine the extent of petroleum hydrocarbon in the subsurface. The *Report on the Investigation to Define the Extent of Petroleum at the Wade Brothers Site* was submitted to the NJDEP in January 1991. DuPont is currently operating a product recovery system to remove free product from the groundwater.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

DERS has been contracted by DuPont to conduct the facility evaluation. Laboratory analytical testing will be conducted by Lancaster Laboratories, Incorporated (LLI), of Lancaster, Pennsylvania.

A description of the program organization is provided in this section. The responsibilities associated with the positions are described in the following paragraphs.

2.1 Project Manager

Mr. Michael U. DeStefano (DERS) is the project manager for the site. He will be the primary point of contact with DuPont and will be responsible for all technical, financial, and scheduling matters. His other responsibilities will include

- Assigning duties to the project team and orientation of the team to the needs and requirements of the project.
- Disseminating project-related information from DuPont.
- Liaison with subcontractor organizations (unless specifically delegated to others).
- Interacting with the QA officer and health and safety officer to ensure that these programs are functioning effectively.
- Serving as the collection point for project team reporting of nonconformance with QA procedures or changes in project documents and activities.

2.2 Technical Lead

Ms. Nancy R. Grosso (DERS) is the technical lead for the project. Her other responsibilities will include

- Providing senior level review of technical activities.
- Providing direction involving groundwater assessments and hydrogeologic investigations.

- Approving project-specific procedures and internally prepared plans, drawings, and reports.
- Providing guidance to the project geologist.

2.3 Project Geologist

Ms. Laurie A. Plante (DERS) is the project geologist for the project. Her responsibilities will include

- Coordinating or leading the site investigation and sampling teams.
- Interacting with the independent analytical laboratory regarding sampling events.
- Evaluating site groundwater and soil data.
- Leading the preparation of reports and documentation.

2.4 Quality Assurance Officers

Mr. Michael J. Lukas (DERS) and Ms. Kimberly P. Johnson (DERS) or their designates, will be the QA officers for the project. Their responsibilities will include

- Developing, reviewing, and approving the QAPP.
- Administering the QAPP.
- Supervising day-to-day QA activities.
- Notifying personnel of nonconformance or changes in procedures.
- Determining the system and performance audit schedules.

2.5 Health and Safety Officer

Mr. Brian Ambrose (DERS) is the health and safety officer for the project. He will be responsible for development, review, and approval of the project health and safety plan. He will also ensure that the project health and safety plan is consistent with all applicable state and federal regulations and will also be responsible for implementing the plan.

2.6 Laboratory Personnel

LLI will provide analytical services for this project. LLI is currently participating in the Resource Conservation and Recovery Act (RCRA) Performance Evaluation Program for inorganic and organic analyses. Exhibit 1 contains additional information on the qualifications, capabilities, and certifications of LLI.

The key laboratory personnel for this project will be the laboratory project manager and the laboratory QA officer. The analytical laboratory project manager will be responsible for execution of the analytical testing program for the project. The laboratory project manager will be responsible for laboratory analyses and data processing. They will be the point of contact for the site coordinator and QA officer. They will be assisted by the laboratory QA director, who is responsible for ensuring that laboratory internal QA procedures are followed and for processing QA data. These procedures are detailed in the laboratory QA plans (LQAP; see Exhibit 1).

The laboratory will sign a contract with DuPont, detailing the terms and conditions for services. This contract will include a guarantee to dispose of samples following analysis, in accordance with all pertinent federal, state, and local laws and ordinances.

2.7 Technical Consultants

Senior staff members with expertise in the disciplines associated with the facility evaluation are available to the project as needed. Participation of these individuals in the project will be arranged by the project manager.

2.8 Technical and Support Staff

Individuals in this category will participate in the many technical activities associated with the project. They will be coordinated by the technical lead or project manager.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

The primary purpose and objectives of the remedial investigation are presented in the RIWP. To ensure that the data generated during the program are of adequate and consistent quality for the stated purpose, data quality objectives (DQOs)—in terms of precision, accuracy, and completeness—have been established.

The sampling and analysis and associated QA efforts are aimed at achieving these objectives in a safe, timely, and cost-effective manner.

3.1 Data Quality Characteristics

DQOs are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental measurements. The uncertainty for sample parameter results may arise from a combination of factors that include sampling procedures, sample matrix characteristics, nonhomogeneity of samples, and the inherent accuracy and precision limitations of analysis methods. DQOs are quantitatively and qualitatively described in terms of data quality characteristics that include precision, accuracy, representativeness, completeness, and comparability (see Section 12.0). These characteristics are defined as follows:

- *Accuracy*
  Accuracy is the degree of agreement of a measurement with an accepted true value.
- *Precision*
  Precision is defined as the agreement between numeric values for two or more measurements that have been obtained in an identical fashion.
- *Completeness*
  Completeness is a measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under normal conditions.

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- *Representativeness*
  Representativeness expresses the degree to which sample data accurately and precisely represents a selected characteristic of a population, parameter variations at the sampling point, a process condition, or an environmental condition.
- *Comparability*
  Comparability expresses consistency in sampling and analytical procedures so that one data set can be compared to another.

3.2 Data Quality Objectives for the Groundwater Investigation

The purpose of the groundwater investigation is to assess the impact of groundwater discharge to surface water. This will be accomplished by comparing the groundwater result to New Jersey groundwater and surface water criteria (see Section 7.3). The accuracy and precision acceptance criteria required for the groundwater investigation are listed in Table 1. All measurement data will be calculated and reported in units consistent with specified methodologies to ensure comparability of historical data (see Section 7.0).

All sampling events will follow the standard operating procedures described in the RIWP to provide common ground for the comparison of data between seasons and locations. The use throughout the program of the November 1992 RCRA *Groundwater Monitoring Draft Technical Guidance* document and EPA document SW-846 sampling and analytical methods will ensure representative and comparable results of known accuracy and precision.

3.3 Data Quality Objectives for the Soil Investigation

The purpose of the soil investigation is to delineate soil in areas of investigation (AOI) and sitewide for soil constituents of concern to New Jersey soil cleanup criteria (see Section 7.3). To accomplish this, the accuracy and precision acceptance criteria required for the soil investigation are listed in Table 1. All measurement data will be calculated and reported in units consistent with specified methodologies to ensure comparability of historical data.

3.4 Laboratory Quality Objectives

The laboratory quality objectives (LQOs) are designed to provide consistent results of known and documented quality. The project QA officer is responsible for performing periodic performance audits with participating laboratories to ensure that acceptable precision and accuracy are maintained (see Section 12.0). Specific laboratory QC procedures for analyses can be found in the EPA documents describing specified analytical methodologies, including the *Test Method for Evaluating Solid Waste Physical/Chemical Methods* (EPA document number SW-846, third edition) and the *Methods for Chemical Analysis, Water and Wastes* (EPA document 600/179-020).

EPA methodologies require the use of instrument performance checks, laboratory control samples, method blanks, duplicate samples, replicate assays, calibration checks, and matrix spike samples for the evaluation of laboratory precision and accuracy during metals analysis. The frequency and application of QC sample analysis is further defined in the respective methods.

4.0 SAMPLING PROCEDURES

The RIWP presents the sampling procedures and field measurement techniques to be used during the field investigation at the former DuPont Grasselli plant. The RIWP will adhere to the QA/QC policies and procedures outlined in this QAPP. The project geologist will be accountable for all field sampling and associated documentation procedures.

4.1 Sample Locations, Types, and Parameters

During the course of the project plan, groundwater and soil samples will be collected to determine the existence and extent of constituents of concern at the site. Groundwater and soil samples will be collected from monitoring wells and soil boring locations at the site. Table 1 summarizes the DQOs, and Tables 2 and 3 summarizes the analytical list of parameters to be analyzed for during the investigation.

4.2 Sample Containers

Only new sample containers (i.e., I-CHEM 200, *Eagle-Picher*®, or the equivalent) will be used for sample collection. The appropriate size and type of container will be provided with the applicable preservative and analyzed within the specified holding times, as specified in Table 4. Containers will be supplied by a New Jersey certified laboratory prior to use in accordance with EPA document SW-846, third edition, Chapters 2, 3, and 4.

Each sample aliquot may be analyzed for multiple parameters provided that the sample is of adequate volume and that identical container, preservation, and handling considerations have been satisfied.

4.2.1 Sample Labels

Sample labels are prepared by a New Jersey certified laboratory and placed on bottles at the same time the preprinted chain-of-custody (COC) forms are prepared. This allows for

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the least confusion in the field. The preprinted COC forms and labeled bottles are sent to the field a day prior to sampling to allow samplers a final check on accuracy.

4.3 Sample Preservation

Water and soil samples will be placed in sample containers that have been laboratory prepared with the appropriate preservative, as specified in Table 4. Preservation procedures are those specified in EPA document SW-846, third edition, Chapters 2, 3, and 4, which reference water and solid matrices. In this manner, samples will be preserved in the field immediately following collection.

Once collected, each containerized sample will be labeled and placed as soon as possible into an insulated sample cooler. The cooler will serve as a shipping container and should be provided by the laboratory along with the appropriate sample containers. If temperature preservation is required, the chest will be packed with wet ice. The containers will be repacked into the same ice chest in which they were received. In this way, the integrity of trip blanks and sets of containers can be maintained.

Reagents used on-site will be provided by the laboratory and will be of sufficient purity to yield blank results at levels below the practical quantitation limit for each parameter. Preservation techniques will be documented on the COC records and in the field sampling logbook. This documentation includes the use of ice for temperature preservation. Samples will be transported to the laboratory promptly to provide ample time for analyses to be conducted within applicable holding times. The maximum interval between sample collection and shipment should be one day. The site coordinator will arrange with the laboratory for sample pickup or sample shipment using an overnight delivery service. Samples will be shipped using an insulated sample cooler and wet ice to keep the samples cool. The shipper is responsible for ensuring adherence with current U.S. Department of Transportation regulations concerning the shipment of environmental samples to a laboratory for analysis.

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4.3.1 Procedures for Reagents or Supplies

Reagents (preservatives) are supplied by the New Jersey certified laboratory. All bottles will be pre-preserved by the laboratory.

4.3.2 Preservation of Soil Samples for VOC Analysis

Soil samples to be analyzed for VOCs will be preserved with methanol. The NJDEP *Field Extraction/Preservation of Soil Samples with Methanol for VOC Analysis* draft guidance will be followed for this project. A copy of this draft is attached to this document as Exhibit 2. The maximum time between the laboratory preserving the bottles with methanol for shipment to the field and receiving the bottles from the field for laboratory analysis is five days.

4.4 Special Handling Considerations

Groundwater samples should be collected and containerized in order of decreasing volatility. Temperature, pH, and specific conductivity measurements will be made in the field during purging and after groundwater sample collection.

A sufficient sample of each matrix type from each location will be collected to serve the needs of all analyses, including matrix spikes, matrix spike duplicates, matrix or field duplicates, and split samples (to be sent to a second laboratory) where required in the QAPP. If it becomes necessary to retrieve additional sample material from an adjacent location in order to obtain the necessary sample volumes to meet sampling requirements, this requirement will be noted in the field logbook, and the site coordinator will be notified.

Water samples to be analyzed for volatile organic constituents will be collected and capped with zero headspace. The water sample containers for volatile assays require the use of a special cap fitted with a septum lined with Teflon® and must be filled full by pouring from the sampling device. Once the containers are capped securely, the container must be inverted, shaken, tapped, and visually inspected for air bubbles. If air bubbles are observed, the process must be repeated. Occasionally water samples containing high levels of carbonate salts will fizz when contact is made with the acid preservative in the bottle. If

this is observed, the samples should be collected in containers without acid preservative, the label and COC form should be marked accordingly, and the project manager should be notified immediately.

Each sample container will be labeled immediately after it is filled and capped. Prelabeled containers will be used, if possible (see Section 5.0).

Holding time requirements for sample containers include arriving on-site within one day of their preparation in the laboratory, remaining on-site for a maximum of two days, and arriving back at the laboratory within one day of shipment from the field.

4.5 Sampling Equipment and Procedures

Detailed procedures for sampling the groundwater matrix involved in the project are included in the work plan. These procedures include specific instructions for sampling equipment use, documentation, and decontamination procedures.

4.5.1 Groundwater

The groundwater sampling procedures and requirements are outlined in the May 1992 NJDEP *Field Sampling Procedures Manual* and November 1992 RCRA *Groundwater Monitoring: Draft Technical Guidance Document* and EPA document SW-846, third edition, Chapters 9 and 11. The operations and maintenance plan provides a complete listing of the groundwater sampling procedures. The procedures include specific information on monitoring well initial inspection, groundwater-level measurements, field data collection, field sample custody documentation, detection of immiscible layers, well evacuation, approved methods for withdrawing sample material from monitoring wells, and sample container filling, capping, and labeling.

4.5.2 Soil Sampling

The field team leader will be responsible for the soil sampling task. LLI will provide necessary sample containers with shipping containers (shuttles). The field team leader will be responsible for laboratory coordination. Containers, and any preservation added to containers, will be in accordance with NJDEP's *Field Sampling Guide* (May 1992). All samples requiring refrigeration will be shipped at 4°C (± 4°).

4.5.3 Equipment List

The equipment for this activity is as follows:

- ❑ Generator (gas-powered)
- ❑ pH meter
- ❑ Temperature indicator
- ❑ Conductivity meter
- ❑ Turbidity meter
- ❑ Two-inch submersible or centrifugal low flow pumps
- ❑ Water-level meter
- ❑ Oil and water interface probe
- ❑ Decontamination supplies (i.e., *Alconox*®, isopropyl alcohol, sponges, brushes, spray can of deionized water, and buckets)
- ❑ Personal protective equipment (i.e., disposable gloves, positive air-purifying respirators, disposable *Tyvek*® suits, and disposable booties)
- ❑ Sample containers, preservative, and COC documentation
- ❑ Field logbooks
- ❑ Office supplies (e.g., pens, calculator, paper, and watch)
- ❑ Calibration fluids
- ❑ Ice
- ❑ Photoionization detector (PID)
- ❑ Keys to locked wells
- ❑ Plastic bags (e.g., garbage and decontamination uses)
- ❑ Paper towels

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- Miscellaneous tools

4.6 Preliminary Planning Activities

At a minimum, the following checklist will be reviewed by the project manager and the sampling personnel for preplanning prior to the sampling event

- Coordinate with laboratory staff to ensure that sample arrival is properly anticipated (especially if weekend delivery will occur).
- Determine that all appropriate forms and logbooks are available for use during the sampling event.
- Establish accountability and responsibility for each activity to be conducted by the sampling team personnel.
- Conduct a preliminary inspection, inventory, and precleaning of all field equipment. Ensure that preventive maintenance is up-to-date. Calibrate and recheck all field analytical instrumentation.
- Review the work plan to determine that each individual is aware of the protocols and required procedures.
- Review the Health and Safety (H&S) plan for health and safety requirements. Double-check the location of all underground and overhead utilities. Determine what level of personal protective clothing and equipment will be needed for each location. Review the procedures for decontamination of protective equipment and use and removal of respiratory and personal protective clothing to avoid personal exposure to potentially hazardous sample materials. Review emergency escape and medical emergency procedures.
- Review the H&S plan to determine the location of specified decontamination areas for sampling equipment.
- Review the work plan to determine what types of devices are to be used for withdrawal and collection of each sample matrix type. The H&S plan includes decontamination procedures for all sampling equipment.

4.6.1 Determining Proper Sampling Locations

To ensure the exact location of sample collection, a map detailing sampling points is included in the work plan.

4.6.2 Data and Sampling Locations

A dedicated, bound, field groundwater notebook is kept for every site. The former DuPont Grasselli plant will have a bound notebook where field data from each well will be recorded individually. This field data will later be extended into the corporate environmental data base (if necessary) for reporting reasons.

4.6.3 Calibration of Field Devices

Field devices are calibrated prior to each sampling event. A record of this calibration is kept in the bound fieldbook.

4.6.4 Collection of Replicate Measurements

A record of field data is kept in the groundwater notebook for all groundwater wells. Replicate field data may include such data as pH, temperature, specific conductivity, and depth to water.

4.6.5 Order of Field Data Collection

For groundwater sampling, the order in which field measurements will be made is as follows:

- PID and flame-ionization detector (FID) readings for headspace and breathing zone
- Depth to water
- Specific conductance
- pH
- Temperature

4.7 Field Documentation

Each sampling team leader is responsible for maintaining a field notebook. The notebooks will be used to provide daily records of significant events, observations, and measurements

during field investigations. The notebooks must be bound, with each page numbered and completed in waterproof ink. Each page will be signed by the user and dated. All members of the field sampling team will have access to a field notebook. These notebooks will be maintained as permanent records and will remain the property of DuPont. The project manager will provide serialized notebooks and will secure them when not in use.

Field notebooks are intended to provide sufficient data and observations to reconstruct events that occurred during sampling events and to refresh the memories of sampling team members if required to give testimony during legal proceedings. In legal proceedings, notes, if referred to, are subject to cross-examination and may be admissible as evidence. The field notebook entries should be legible, factual, detailed, and objective. Corrections may be made by lining out errors, initialing and dating the errors, and entering correct information.

Information to be entered in field notebooks will include, but not be limited to, the items listed in Section 5.2. Other field documentation procedures, including sample labeling and chain-of-custody documentation, are covered in Section 5.0.

4.7.1 Chain-of-Custody Forms

The COC standardized field tracking form is taken to the field along with the COC form. Field sampling personnel complete a logbook dedicated to the site. Each field employee may also collect additional details in their individual field notebooks. Example COC forms can be found in the LQAPs contained in Exhibit 1 of this document.

4.8 Decontamination Procedures

A policy of using disposable or dedicated equipment is to be implemented on-site. Where this is not applicable, the following decontamination procedures will be followed.

4.8.1 Laboratory Decontamination Procedure

Sampling equipment may be laboratory-cleaned at Conoco's New Jersey laboratory in the following manner:

- Nonphosphate detergent plus tap water wash
- Tap-water rinse
- Pesticide-grade hexane or methanol rinse
- Acetone (pesticide-grade) rinse
- Distilled and deionized (ASTM Type II) water rinse
- Total air drying

Sampling equipment is wrapped in aluminum foil and stored in polyethylene bags. The aluminum foil is oven baked at 105°C. *Teflon*® leaders and foot valves are stored in polyethylene bags.

4.8.2 Field Decontamination Procedures

All sampling equipment will be field-decontaminated in accordance with the procedure described in Section 4.8.1 of this QAPP.

New polyethylene tubing (used for purging) is cleaned with a laboratory-grade glassware detergent, rinsed with distilled and deionized water, and stored in polyethylene bags prior to use. A new piece of tubing is used for each well.

5.0 SAMPLE CUSTODY

The sample custody procedures outlined in this section ensure the tracing of possession and handling of individual samples from the time of field collection through laboratory analysis.

5.1 Sample Labels and Security Seals

Each sample container will have a sample label affixed to the outside of the container in an obvious location. The label will specify the container number (or lot number), sample identification number, name of the collector, location sampled, date and time sampled, preservatives used, and parameters to be analyzed. Information will be recorded on the sample label with waterproof ink.

Samples shipped from the facility to an outside laboratory by a commercial courier will be transported in a refrigerated shipping container sealed with tamper-evident tape or a tamper-evident seal. Also, security seals showing the initials of the collector and the date the sample was taken should be placed over the cap of each sample container. If any security seal is received broken, that fact will be recorded on the COC form, and the site coordinator will be notified.

5.2 Field Logbooks

The field sampler will complete the appropriate sample collection report (see Section 4.7) for each sample location, noting the following information as required:

- Sample location
- Sample identification number
- Sample source, (e.g., monitoring well, leachate standpipe, stream)
- Sample type and collection equipment, (e.g., grab sample, composite sample, bailer, pump)
- Evacuation date and time

- Volume purged (note if purged to dry)
- Personnel present
- Depth to bottom, depth to water, and casing volume
- Weather conditions
- Date and time of sample withdrawal if different from time of purging
- Sample appearance (e.g., color, turbidity, odor, sediment)
- Weather conditions at time of sample withdrawal
- Field measurements for aqueous samples (e.g., temperature, pH, specific conductance)
- Number of containers for each aliquot collected
- Container size, type, and preservative used in each sample aliquot
- Parameters (analytes from each sample aliquot)
- Comments and observations at time of sample withdrawal
- Signature and date of field logbook completion

5.3 Chain-of-Custody Record

Each sample may consist of several individual sample aliquots contained in separate, numbered sample containers. Each sample container will be logged in on the COC form prior to shipment to the laboratory. The COC form will be initiated at the laboratory when the sample containers are shipped to the field.

The following information will be recorded on the COC form:

- Origin of sample containers
- Sample source (e.g., monitoring well, stream)
- Collector's name
- Dates and times of sample collection
- Sample identification numbers
- Sample location
- Number of containers for each sample aliquot
- Container size

- Type of preservation (including ice)
- Parameters (analytes from each sample aliquot)
- Rush analyses (if requested)
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual possessing the samples
- Shipping container seal number or shipping container identification number and condition (used only if transported by commercial courier)

The COC form will be signed by each individual responsible for custody of the sample containers and will accompany the samples to the laboratory.

Custody of the samples will be defined as actual physical possession, in view after physical possession, or locked and/or sealed in a tamper-resistant container after physical possession. At the time of custody transfer, the individual relinquishing the samples will observe as the transferee inspects the samples for integrity and number and dates and signs the COC form. The original, signed COC form will accompany the samples to the laboratory and be returned to the DERS project manager once the sample analysis is complete. The project geologist or designate will be responsible for custody of the samples taken during the field investigation.

5.4 Laboratory Receipt and Analysis Request Log

The laboratory will designate a sample custodian for the project. This person is responsible for inspecting and verifying correctness of COC records when received and for verifying that all samples are accounted for and that custody seals remain intact. The custodian is also responsible for verifying that sample temperatures when received are appropriate for the level of preservation required. When the samples are received, the sample custodian will sign the COC form and note the sample conditions on it. The sample custodian will immediately notify the QA officer of any discrepancies.

As samples are received by the laboratory, they will be entered into a sample management system. The following minimum information will be provided:

- Laboratory sample number/identification
- Field sample designation
- List of analyses requested for each sample container

Immediately after receipt, samples will be transferred to a secure storage area with appropriate temperature control (as established by EPA document SW-846, third edition, Chapters 2, 3, and 4), to await preparation and analysis. Only authorized laboratory personnel will have access to the locked storage area(s). The laboratory will maintain written records to show the handling chronology for each sample by various individuals at the laboratory during the analysis process. The laboratory sample custodian is responsible for providing a laboratory identification number for each trip blank so that comparison may be made later to the samples shipped in the same cooler. Field blanks must also be given unique laboratory identification numbers so that comparisons may be made to associated sample sets.

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6.0 CALIBRATION PROCEDURES AND EQUIPMENT FOR MONITORING ANALYTICAL EQUIPMENT

The manufacturers' instructions will be followed to calibrate analytical equipment. The technician assigned to maintain each unit will calibrate the equipment. The project geologist or designate will supervise overall equipment calibration and maintenance.

6.1 Field Calibration

The frequency of field calibration for instruments used on this site is outlined in Table 4. Calibration of equipment will occur daily prior to its use in the field. The site coordinator is responsible for ensuring adherence to the calibration schedule and each operator's understanding of the proper usage, maintenance, and storage of each instrument. A calibration logbook is kept with each instrument to record the field calibration. Each logbook contains the date of calibration, the operator's initials, the calibration measurements, and observations about the instrument or calibration procedures. A complete set of manufacturers' directions for equipment calibration should accompany the instruments on-site.

Brief summaries of the calibration procedures for each major piece of field measurement equipment follow:

- *pH Meter*

  Calibration is performed at the start of each sampling day using standard buffer solutions that bracket the pH range expected in the samples. To calibrate the instrument, place the pH electrode in pH 7.0 buffer solution and set the temperature control knob at the mark indicating the solution temperature. Turn the on/off switch to "pH" and adjust the ADJ knob until the meter reads 7.0 pH. Measure the temperature of the 4.0 buffer solution and set the temperature knob to agree. Then, rinse the electrode with distilled water and place it in the 4.0 buffer solution. Make the instrument read 4.0 by adjusting the SLOPE adjust with a screwdriver. Now test the known solutions. Calibrate the pH meter with the pH 10.00 buffer solution for readings above 7.0.

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- *Conductivity Meter*

  Calibration is performed at the start of each sampling day using an instrument self-check and potassium chloride (KCl) standard solutions made by the instrument manufacturer. The levels of the standards are selected to bracket the range of value expected in the samples. The meter is calibrated in the same manner as the pH meter. The meter must read within 10 percent of the standards to be considered "in control" and should read within 5 percent (7 percent is considered a warning level) of the standards. If the calibration indicates the meter is "out of control," a backup unit should be employed; if one is not available, the data will be flagged to note the percent difference between the meter and standard. Readings from conductivity meters are normally stable; thus, calibration checks are usually limited to checks at the beginning and end of the sampling day.

  To calibrate the conductivity meter, set the control switch to CON, the range switch to 1,000 (for Model 72) or 10,000 (for Model 76), and the temperature compensation knob to 35°C. Then, unplug the electrode. Adjust the STANDARDIZE control for a reading of 1,000 (for Model 72) or 10.00 (for Model 76).

- *MSA® Model 361 Oxygen/Lower Explosive Limit/Hydrogen Sulfide (O_2/LEL/H_2S) Meter*

  Calibration of the O_2/LEL/H_2S meter will be conducted prior to shipment and at the start of each sampling day using standard calibration gases obtained from the manufacturer. The MSA device can be calibrated with calibration check gas consisting of 0.75 percent pentane (by volume) and 15 percent oxygen in nitrogen, with 50 percent LEL. Calibration will be based on the parameters of interest, but will always include oxygen and LEL. Additional calibration will be made in the field if the unit experiences abnormal perturbations or readings become erratic.

  For oxygen calibration, put the MSA in the Oxygen Display Mode. Carefully adjust the OXYSPAN control for display indication of 20.9 percent. If this procedure cannot be successfully completed, the sensor is exhausted and must be replaced.

  For LEL calibration, put the MSA in the LEL Real-Time Display Mode. Carefully adjust the EXPZERO control until the display indicates 0 percent or matches the ambient conditions. Connect the calibration gas cylinder to the aspirator attachment to the MSA grill with the polarization arrow pointing toward the front of the MSA. Turn the gas on and allow it to flow for at least five minutes. Then, cancel the alarms and select the LEL Real-Time Display Mode—check that the display has settled. Carefully adjust the EXPSPAN control until the display reads the same as the value recorded on the gas cylinder. Turn off the gas and

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disconnect the gas cylinder. Replace the calibration and switch the O_2/LEL/H_2S meter off.

- *MicroTIP® Photoionization Detector (PID)*

  Periodic calibration is required for PID output changes because of the potential for inlet filter restriction, lamp window cleanliness, sample pump wear, and other factors.

  During calibration, the *MicroTIP®* PID is first exposed to Zero Gas. A small signal is generated, and this zero signal is stored by the microprocessor.

  In high-sensitivity operation, the microprocessor subtracts the zero signal from the PID signal and multiplies the difference by 1,000. This number is then displayed.

  When one of the 5 Cal Memories is selected, the *MicroTIP®* PID is next exposed to Span Gas. This span signal is stored. The microprocessor subtracts the zero signal from the span signal and divides the difference by the user-entered Span Gas concentration. The resulting sensitivity is stored in the selected Cal Memory with the zero signal. In operation, the microprocessor first subtracts the zero signal from the PID signal and then divides the difference by the sensitivity. The number is then displayed.

  The microprocessor accumulates all readings over a 15-second interval and determines the minimum, average, and medium readings. It stores these numbers along with the highest-priority instrument status and the most recent time, date, and event number that occurred during the 15-second interval. The *MicroTIP®* PID automatically records these results for 12 hours of operation.

  The recorded data can now be played back on the PID's display. The display is identical to the numeric or bar-graph display, but the instrument status is "Play" indicating that recorded data, not real-time data, are being displayed. During playback, the PID continues to analyze and record new data.

  Recorded data can also be printed as either a table or a graph. The data may be automatically averaged to fit on one 8½-inch-by-11-inch page or all recorded; the data may be printed or graphed. The averaging interval and number of readings averaged are shown at the top of the page. (Note: For each averaging interval, the PID prints the minimum of all the minima, the average of all the averages, and the maximum of all the maxima.)

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7.0 ANALYTICAL PROCEDURES

DuPont has retained LLI, to conduct the analytical testing for the project. Other qualified laboratories may be used for the testing. If a change in laboratory is required, DuPont will submit laboratory qualifications to the NJDEP for approval prior to their project involvement.

The project QA officer is responsible for communicating DQOs, required methods of analysis, and specific parameter lists to the laboratory. The project geologist is responsible for communicating sampling and analysis schedules to the laboratory with sufficient lead time to meet contractual agreements with the laboratory.

The analytical program presented in this document describes the procedures that DuPont, its contractors, and its laboratories will use during implementation of the project. The LQAPs are presented as Exhibit 1. The laboratories will follow the QA/QC procedures listed in the methods referenced in this QAPP. Report deliverable requirements are discussed in Section 8.2.

7.1 Laboratory Analytical Methods

Groundwater and soil samples collected during the project will be analyzed using EPA document SW-846 Methods for volatile, semivolatile, pesticide, metals, and inorganic parameters. The analytical methodologies are described in Table 6.

Method selection criteria for the project were determined analytical methods used in past investigations and by the DQOs, coupled with the required method detection limits achievable for each parameter. Each analytical method was chosen to address the intended use of the data (generated at a particular sampling point) in a timely and cost-effective manner.

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7.2 Laboratory Quality Control

The laboratory procedures for internal QC are described in the LQAPs (see Exhibit 1). The minimum acceptable level of laboratory QC procedures are defined by the methods and protocols cited for analysis, requirements for laboratory certification and operation mandated by the EPA and NJDEP, and any other requirements governing this project.

7.3 Reporting Limits

Quantitative reporting threshold limits are sample dependent and may vary as the sample matrix varies. Factors influencing the threshold limits include the actual method used, sample matrix, interferences, and high concentrations of analytes. Threshold limits presented in this plan for the parameters are general estimates taken from practical quantitation limits (PQLs) listed in EPA document SW-846 methods. The actual PQLs may vary from sample to sample in accordance with standard laboratory practices (e.g., dilution resulting from high analyte concentration).

The RCRA 40 CFR 264, Appendix IX, parameters include suggested PQL values for each recommended method. Other specific PQL values may be found in the LQAPs (see Exhibit 1). PQLs for soil samples are also listed in the LQAPs. One field parameter with a method-referenced PQL is specific conductance (25 µmhos at 25°C).

Groundwater sample results will be reported down to method detection limit (MDL) values. MDL values are below New Jersey Groundwater IIA Criteria, however, may not be below New Jersey Surface Water Quality Standards for some compounds (see Table 2).

Soil sample results will be reported down to PQL values. Soil PQL values are below Residential Direct Contact Soil Cleanup Criteria and Impact to Groundwater Soil Cleanup Criteria (see Table 3).

7.4 Field Measurements

Because of the physical and chemical instability of several parameters, immediate analysis of such parameters is necessary. Temperature, pH, and specific conductance are three such parameters that will be measured in the field immediately following collection of groundwater samples at a given location.

Each instrument used for field analyses will be calibrated according to the operation manual specifications described in Section 6.0. Temperature, pH, and specific conductance will be measured with appropriate devices. Because of the proximity of the facility to the contractor's office, malfunctioning field equipment can be quickly replaced to eliminate lengthy project delays.

Water-level measurements will be conducted using an electronic instrument such as the QED Model 6000 electronic water-level indicator or similar device. Measurements will be made from the surveyed top-of-well reference point to the static water level and recorded to the nearest 0.01 foot. This value will be subtracted from the surveyed top-of-well elevation to obtain the elevation of the potentiometric surface above mean sea level (MSL). The probe and tape that were in contact with monitoring well water will be cleaned with deionized water after each measurement.

7.5 Field Quality Control

The quality and integrity of samples collected at the facility will be monitored by routine preparation of various QA/QC blanks, equipment calibration documentation, and equipment decontamination documentation. Table 7 summarizes the QA/QC samples. The field supervisor is responsible for ensuring that all field quality control samples are properly taken, labeled, and shipped in the appropriate shipping containers.

Trip blanks will consist of a series of certified cleaned sample containers filled with analyte-free water and precertified by analysis at the laboratory providing the blank water. Trip blanks will be prepared by the laboratory analyzing the samples. The trip blanks will be put in sample containers identical to the monitoring samples. One trip blank per medium collected will be handled and transported in the same ice chest as the field samples going to

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the laboratory. The trip blanks will only be analyzed for volatile organic compounds. Trip blanks will be identified by the laboratory using the sample ice chest identification number in which they were transported and the date received. Holding time limitations include arriving on-site within one day of their preparation in the laboratory, remaining on-site for a maximum of two days, and arrival at the laboratory within one day of shipment from the field.

Equipment blanks will be prepared by passing deionized water through clean, nondedicated sampling equipment (e.g., bailers, trowels). The rinsate will be transferred to sample containers and handled as other samples. Equipment blanks will be analyzed for the same parameters as other samples collected using the same device. The source of any contaminants detected in the equipment blank will be identified and corrected. In the event that dedicated sampling equipment is used at each sampling location, one field blank consisting of the direct transfer of ASTM Type II distilled water (or an equivalent) to the sample containers will be collected for each matrix (aqueous and solid). The minimum frequency for equipment blanks is one per day per sampling event.

The project geologist is responsible for scheduling duplicate sample submission. Duplicate samples will be collected in the same manner as routine monitoring samples. The sample labels and COC forms will not indicate where the duplicate sample was collected. The sample will be analyzed for the same parameters as the original sample, and the analytical results will be compared with those of the original sample. The analytical results of the original sample and the duplicate sample should be used to evaluate the cumulative precision because of the limitations of the analytical method, sample matrix, and sample collection techniques.

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8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 Data Reduction

Data reduction involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements, and calculations.

Data reduction occurs with

- The work plan through sample locations and naming conventions.
- The field sampling process through use of field logs and field measurements.
- Field communications with the laboratory in sample analysis requests.
- Field operations with collection, preservation, and COC documentation.
- Laboratory operations with sample receipt and handling, sample preparation and analysis, collation of raw data, and generation of laboratory results.
- Post-laboratory operations with collation of analytical results in a format suitable for documents such as reports, maps, and trend plots.

Data reduction steps include field operations, laboratory operations, and report preparation operations.

Specific QC measures developed to ensure accuracy throughout the data reduction process are described in Sections 10.0 and 12.0.

8.2 Data Validation

Data validation is the process of verifying that qualitative and quantitative information generated relative to a given sample is complete and accurate.

Data validation is conducted by an independent reviewer who is not involved in the actual processes of data reduction and reporting. The project will involve sampling for groundwater and soil over several sampling events. Each sampling event will include field

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samples plus quality control samples. The samples will be analyzed for various compounds by EPA SW-846, 3rd Edition.

The laboratory will be requested to provide both full and reduced NJDEP deliverables for each of the sampling events. The data will be assessed against the quality assurance/quality control procedures and acceptance criteria specified in SW-846, 3rd Edition, and the project data quality objectives.

8.2.1 Data Validation Procedures Inherent in the QAPP

Data validation processes for field operations, laboratory operations, and post laboratory special report generation processes are described in Sections 3.0, 9.0, 10.0, 12.0, 13.0, and 14.0. Section 3.0 quantitatively defines DQOs in terms of performance levels of accuracy, precision, and completeness. Section 9.0 defines the internal QC checks put in place to measure the quality of data and results. Section 10.0 describes the interrelated, periodic processes of system and performance audits for field and laboratory operations. Section 12.0 describes specific procedures in place to assess data precision, accuracy, and completeness. Section 13.0 specifies corrective action paths for situations involving nonconformance with the QAPP objectives. Section 14.0 describes QA reporting for management to document the overall processes previously described.

QA policies and objectives for the field and post-laboratory operations have been described previously. QA policy objectives for laboratory operations are described in this QAPP and in the LQAPs (see Exhibit 1). Data validation has been used in a very general context when referring to these QAPP-specific procedures.

8.2.2 Data Validation Required by Mutual Consent

An additional level of data validation for this project has not been suggested by DuPont. Data will be reviewed for QC problems as it is received by the laboratory and by DERS. The project manager is accountable for all analytical data. The project QA officer is responsible for determining the schedule for periodic review of project work.

8.3 Data Reporting

Significant figure conventions given in EPA document SW-846 or the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, (EPA-600/4-79-019, March 1979) will be followed. Reported concentrations will not be corrected for contaminants found in associated method, field, and trip blanks. Deliverables will be 100 percent full New Jersey deliverables for potable water analysis, using the non-contract laboratory program (CLP) format and reduced NJDEP, non-CLP deliverables for all other analysis.

The following will be included as the full and reduced deliverables packages:

- Full New Jersey Deliverables non-CLP
  - Title page
  - Sample analysis request form, chain of custody
  - Laboratory chronicle
  - Method summary
  - Method references
  - Sample data:
    - Analytical reports
    - All raw sample data including instrument printouts
    - Maximum detection limits (MDLs)
  - Quality Control Summary:
    - Duplicate, matrix spike/matrix spike duplicate recoveries, blank, LCS, LCSD, and surrogate recovery summary forms
    - GC/MS tuning summary
  - Standard Data
    - Initial and continuing calibration summary forms
    - All raw initial and continuing calibration and standardization data including instrument printouts
  - Raw Quality Control Data
    - All raw quality control data including printouts
    - Extraction logs

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- — Run logs

- New Jersey Reduced Deliverables Non-CLP
  - Title page
  - Sample analysis request form, field chain-of-custody form
  - Laboratory chronicle
  - Method summary
  - Method references
  - Sample Data
    - — Analytical reports
    - — MDLs
    - — All raw sample data including instrument printouts for GC and GC/MS only
  - Quality Control Summary
    - — Duplicate, matrix spike, matrix spike duplicate, blank, and LCS if applicable and surrogate recovery summary forms
    - — GC/MS tuning summary
    - — Summaries of calibration and standardization
  - Raw Quality Control Data
    - — Blank raw data for GC and GS/MC only
    - — Extraction logs

9.0 INTERNAL QUALITY CONTROL CHECKS

QC checks are the operational techniques and activities that are used to fulfill the requirements of QA policies. QC is an integrated system of activities in the area of quality planning, quality assessment, and quality improvement included to provide the program with a measurable assurance that the required standards of quality are met. The QC checks described in this document generally fall into several categories: field practices, laboratory practices, system and performance audits, corrective action, and QA reports. The interrelation of these QC checks is described below.

9.1 Field Quality Control

9.1.1 Field Quality Control Samples

Basically, three types of field QC samples exist, including trip blanks, field blanks, and field duplicates. A detailed description and the frequency of collection for each is provided in Section 7.5. The analytical results for these QC samples become the quantitative focus of the field performance audits.

9.1.2 Field Measurement Checks

These checks include pH and conductance meter verification checks with verified proficiency standards (see Section 10.1.2). They should be randomly conducted. Report summaries are kept in the project file.

9.1.3 Field Data Integrity Checks

Field data integrity checks are described in Section 10.1.2. These checks are to be conducted randomly. Report summaries are kept in the project file.

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9.1.4 Field Performance Audits

The nature of field performance audits are described in Section 10.1.2. Field QC sample results should be audited at a rate of 100 percent for available data since the most recent audit. The performance audit process can occur at a random frequency.

Field duplicate sample checks are designed to evaluate the representativeness of the sampling and analysis process. The entire system—from sample containers, to the sampling operation, to laboratory preparation and analysis—influences the results. If the acceptance criteria are not met, the entire system should be checked, and corrective action should be taken.

9.1.5 Field System Audits

Field system audits are an integral part of the internal QC process. The frequency, reporting, corrective action, and coverage of system audits is detailed in Section 10.1.1.

9.2 Laboratory Quality Control

9.2.1 Laboratory Quality Control Practices

Basically, two levels of laboratory control exist, including internal QC practices documented in the LQAP (see Exhibit 1) and laboratory QC standards imposed by DuPont. The LQAP must, at least meet the QC standards described in Section 3.3 of this QAPP. In addition, the laboratory must provide at least three levels of data review prior to reporting the results to DuPont. These levels include

- Initial review of method compliance with respect to sample preparation, analysis, and QC acceptance criteria and a check of accuracy of calculations and presentation of results.
- A second person's review of the raw data, which may be conducted by the laboratory supervisor or a designate and must be documented.
- A check for completeness and appropriateness, which entails an overview by a third party to ensure that all requested tests are appropriate and that all requested sample results have been provided.

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Written reports must be signed by the laboratory manager or a designate. All supporting hard-copy documentation generated by the laboratory must be maintained in an archive for a period of three years and must not be disposed of without written consent from DuPont.

9.2.2 Laboratory Audits

The frequency and acceptance criteria for system and performance audits of the laboratory are detailed in Section 10.2.2. All performance audits must be followed up with corrective action summaries, where appropriate. Reviewing these summaries is the responsibility of the project QA officer. Once the reviews are complete, the project director is responsible for determining if the results are satisfactory. If the results are unsatisfactory, the alternative may be to use another laboratory for future work.

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10.0 PERFORMANCE AND SYSTEM AUDITS

The following section summarizes the laboratory and field system and performance audits that will be used during the course of the project.

10.1 Field Audits

10.1.1 System Audit

System audits are characterized by systematic on-site qualitative reviews and will be conducted in conjunction with all field-related QC activities. The project QA officer will be responsible for defining the system audit format, and the project manager will approve the format. The project manager will name the field system audit team including an individual with extensive experience in field sampling activities. The project QA officer will prepare the final system audit report, which will be directed to the project manager and project director (see Section 14.0).

System audits will be performed at the discretion of the project director in the event of a significant incident involving safety, an unfavorable performance audit, or another reason deemed appropriate. At a minimum, the on-site qualitative review will cover the following:

- *Organization and Responsibility*
  Is the QA organization effective and efficient?
- *Sample Collection*
  Are the written procedures for sample collection available and appropriate to meet regulatory requirements, and are they being followed?
- *Chain of Custody*
  Have the appropriate steps been followed to ensure the traceability of sample origin and integrity?

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- *Operational Procedures*

  Are the appropriate checks being made in the field, and are records of these checks being properly maintained?

- *Equipment*

  Is the specified equipment available and maintained in good working order?

- *Training*

  Are field teams adequately trained?

- *Records*

  Are record-keeping procedures adequate and functional?

- *Corrective Action*

  Is the appropriate action being conducted in response to situations? Are these situations properly documented on the Corrective Action Form? Has follow-up been done to correct the situation after it has been reported?

- *Health and Safety*

  Are the proper procedures, precautions, equipment, training, being implemented to protect the team members adequately during the field operation?

10.1.2 Performance Audit

Performance audits are characterized by a quantitative check for accuracy in field measurements, field QC sample results, and field data transfer procedures. The field performance audits consist of the periodic evaluation of analytical results of field and trip blanks to assess the field procedures used, to check for and minimize nonsample-related contamination, and to ensure that representative samples are being provided for testing, evaluation, and interpretation.

The field performance audit format will be developed in the same manner described for field system audits. Performance audits will be conducted and reported as described for field system audits.

The project manager will be responsible for naming the individual who will perform the field performance audits. This person should have a working knowledge of both the

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analytical techniques and field sampling procedures being used. All trip blanks and field blanks collected during the project should be reviewed. The verification samples will be spot-checked. At a minimum, the performance audits will include the following:

- *pH Meter Verification*
  Check with a certified standard from an outside vendor.
- *Conductance Meter*
  Check with a certified standard from an outside vendor.
- *Data Integrity Check*
  Randomly check to determine if field data has been accurately transferred to final reports; verification of well identifications, and aquifers sampled.
- *Trip Blanks*
  Is there any evidence of significant trip blank contamination (For SW-846 methods, see the RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER 9950.1, for quality acceptance criteria) Provide a summary report showing all trip blanks and associated sample identification numbers for each sampling event audited and highlight the samples that may have data adversely affected by trip blank contaminants.
- *Field Blanks*
  Is there any evidence of significant contamination of blanks and related samples from improperly cleaned sampling equipment? (See Section 7.0 for a description of field blanks.) Evaluation criteria may be obtained as described for trip blanks. Provide a summary report in conjunction with the trip blank audit report.
- *Field Duplicates*
  Is there a significant difference in reported results for any analytical parameters between the sample pairs? The acceptance criteria for the maximum relative percent difference (%RPD) should generally be less than 35 percent. Provide a summary report in conjunction with the trip blank summary report.

10.2 Laboratory Audits

10.2.1 Laboratory System Audit

Laboratories that will be employed for this project have been prequalified by a satisfactory system audit performed by DERS, as described in Section 10.0. An audit may be scheduled at the discretion of the project director or project manager if data evaluation and review suggest that a laboratory quality issue exists. The LQAP (see Exhibit 1) describes the QA/QC program in place at the laboratory. At a minimum, the QAPP and laboratory performance audits must address the

- Custody and storage of samples and sample aliquots within the laboratory.
- Procedures for sample preanalysis preparation.
- Techniques of calibration for each analytical method, including standards preparation.
- Procedures for raw data management and calculation of results.
- Policies and procedures for complying with methodologies and protocols, including required QC steps and acceptance criteria.
- Preventive and corrective maintenance of instrumentation.
- Methods for determining acceptable limits of detection, precision, and accuracy.
- Procedures for cross-checking calculated results.
- Procedures for notifying the client of method nonconformance situations that might arise at the laboratory or after samples are received.

10.2.2 Laboratory Performance Audit Checkpoints

Internal QC checks for laboratory operation will include submission by the laboratory of the most recent EPA *Water Pollution Proficiency Study and Evaluation Report*, and a corrective action report. Minimum acceptable performance will be 90 percent overall. (The study must include parameters being assayed in the project, which are available in the work plan study.)

The project QA officer may, at his discretion, send split samples to alternate laboratories and compare the results with those of the primary laboratory. Double-blind samples from a supplier of certified reference samples can be submitted during the program.

On a random basis, a routine performance audit will be conducted on all laboratory results to determine if the DQOs stated in Section 3.2.2 are being met. Checkpoints to be reviewed include method blanks, laboratory replicates, matrix spikes, and matrix spike duplicates. samples will be grouped into QC batches of not more than 20 samples of similar matrix type.

Accuracy will be evaluated for each batch using the corresponding matrix spike and surrogate standard recovery for each batch (see Sections 3.2.2 and 12.4), coupled with acceptance criteria listed in the appropriate methods. Laboratory control sample recovery data can be used to qualify corresponding batch data if matrix spike or surrogate standard recoveries do not meet method acceptance criteria or if insufficient sample material was received to complete the matrix spike duplicate assays. Data resulting from method blank contamination will be qualified based on professional judgment of the reviewer.

Precision will be evaluated for each batch using %RPD from either matrix spike duplicates or laboratory sample replicates (see Sections 3.2.2 and 12.3). Again, laboratory control sample duplicate %RPD results can be used to qualify data if insufficient sample material was received to evaluate either a laboratory replicate assay or a matrix spike duplicate.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

Preventive maintenance of laboratory and field equipment is essential to obtaining accurate data. Unnecessary resampling and analysis can also be avoided if equipment is well maintained.

11.1 Field Maintenance

A calibration and maintenance checklist for each piece of equipment used on-site will be maintained by the field sampling team. In this manner, the frequency of calibration, the technician in charge of the calibration, and any notes regarding the maintenance of the instrument can be recorded. The field sampling team is ultimately responsible for ensuring that field equipment is cleaned and maintained according to procedures detailed by the manufacturer. Complete manufacturers' instructions for calibration and maintenance are found with each piece of equipment. The field equipment will be serviced when routine daily inspections indicate the need for maintenance.

Routine maintenance of field equipment includes

- Removing surface dirt and debris.
- Cleaning OVA filters.
- Ensuring proper storage of equipment.
- Inspecting equipment prior to use.
- Calibrating equipment according to Section 6.0.
- Charging battery packs when not in use.
- Maintaining spare and replacement parts in the field to minimize downtime.

The following is a representative list of spare parts for this program:

- Batteries, as required, for all equipment used
- Extra sample containers and preservatives
- OVA igniters and filters
- Health and safety equipment (i.e., gloves, filters, boots, *Tyvek*® clothing)

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- Extra coolers and packing equipment and sample location stakes
- Locks
- Flagging tape
- Buffer solutions
- Calibration solutions and gases
- Tubing
- Air filters

In the event that a piece of equipment needs to be repaired, a list of manufacturers' addresses, phone numbers, and contact persons will be kept on-site.

11.2 Laboratory Maintenance

Standard operating and maintenance procedures for any laboratory equipment used by the laboratory are provided in EPA document SW-846.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The DQOs for the project were established in terms of representativeness, comparability, precision, accuracy, and completeness of the data set. Accuracy for this project will be quantitatively assessed through the evaluation of relative percent recoveries of matrix spikes and matrix spike duplicates, laboratory control samples and control sample duplicates, surrogate standards. Accuracy will be qualitatively assessed through the evaluation of instrument performance checks such as surrogate recoveries and interelement interference checks; where applicable to a specific method. Precision will be quantitatively assessed through the evaluation of %RPD values for matrix spikes, laboratory control samples, field duplicates, and laboratory replicates. Blank and field duplicate samples will be prepared or collected. Field duplicate samples will be identified as a regular sample. Comparison of results of field duplicates will assist in evaluation of overall representativeness of the data. The appropriate laboratory QC procedure is specified in each analytical method. Completeness will be determined following periodic evaluation of the accuracy and precision results of the project data sets.

The LQAP (see Exhibit 1) will be used to specify the quality of data and define the analytical techniques required to produce the DQOs. The LQAP provides an assessment of the laboratory's analytical capabilities and staff qualifications to perform the specified level of quality.

12.1 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a measured characteristic of a population, parameter variations at the sampling point, a process condition, or an environmental condition.

The degree of representativeness is dependent on the objectives of the measurement results. Thus, representativeness can be classified into the following four objective levels:

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- *Level 1*

  Sample is only representative of the point of sampling (e.g., drum, storage tank, single point within a stream or land area).

- *Level 2*

  Sample is part of a set and represents a defined area or portion of land or water—not just the point of sampling (e.g., a stream transect, sampling grid of a land area, underground aquifer).

- *Level 3*

  Sample represents a relationship between the source of contamination and the location sampled (e.g., source and monitoring well, source and stream).

- *Level 4*

  Sample is nonrepresentative. Sample is used for assessment purposes only (e.g., preliminary assessment, spot check).

The objective of sampling and analysis will be that results are representative of the medium monitored and its condition, to a degree consistent with the desired objective level. Objective Levels 1, 2, and 3 will be used to accomplish project objectives.

12.2 Comparability

For this project, all measurement data will be calculated and reported in units consistent with standard practice to allow comparability of data. Data comparability also includes trends.

12.3 Precision

Precision means the measurement of agreement of a set of replicate results among themselves without assumption of any prior information as to the true result. Precision is assessed by means of duplicate/replicate sample analysis. To determine the precision of the analytical methods, a program of replicate analyses will be followed. The laboratory will split a sample into two subsamples and analyze each independently at the frequency listed in the appropriate method. This approach is followed for laboratory control samples,

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laboratory control sample duplicates, matrix spikes, matrix spike duplicates, and matrix replicates.

The results of the replicate analysis will be used to calculate the QC parameter (%RPD) for precision evaluation. The following equation is used to calculate relative %RPD:

$$RPD = \frac{D_2 - D_1}{(D_1 + D_2)/2} X 100 \quad (1)$$

where,
D_1 is defined as the first subsample value
D_2 is defined as the second subsample value

The frequency of laboratory replicate is described in Exhibit 1. In addition to evaluation of the method precision, duplicate or split samples will be collected in the field and analyzed independently. The results will be used to evaluate the total system's variability, including sampling variations. The identity of the field splits will not be known by laboratory personnel.

The analytical precision produced by laboratory replicate analyses will be evaluated by both the laboratory and DuPont, while field splits will be evaluated only by DuPont. Evaluation of both types of data will be in accordance with the referenced methods and this plan.

12.4 Accuracy

Accuracy means the nearness of a result or the mean of a set of results to the true value. Accuracy is assessed by means of reference samples and percent recoveries. To determine the accuracy of an analytical method, a program of sample spiking will be followed. The spiking frequency is stated in the referenced methods. The results of sample spiking will be used to calculate the QC parameter percent recovery for accuracy evaluation. The following equation will be used:

$$\% Recovery = \frac{SSR - SR}{SA} X 100$$

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where,

SSR = Spiked sample result

SR = Sample result

SA = Spike added

The frequency for the spiking is described in Exhibit 1. In addition to a spiking program, samples, standards, and blanks subject to organic analyses will be spiked with surrogate compounds. Laboratory performance on individual samples will be established by the recovery of surrogate compounds.

12.5 Completeness

The objectives of the work plan are to delineate groundwater or soil to certain criteria. Completeness for each parameter is calculated as follows:

$$\frac{\textit{Valid Data}}{\textit{Total Data Generated}} X\,100 = \%\ \textit{Complete}$$

Valid data will be determined in accordance with the referenced method (see Section 9.0). The percent complete will be used to determine whether the data quality meets the objectives for the project.

If the completeness objectives are not met for individual parameters, the reasons for the invalid data will be reviewed by DuPont. Depending on the reasons (e.g., holding time exceeded) and the effect of the incomplete data on the accomplishment of the project objectives, additional samples may be collected and analyzed. A subjective evaluation will also be conducted if a sample does not generate data for a parameter category (e.g., volatile organic constituents, metals). Such a data gap could result from sample container breakage or loss or sample custody not being maintained. If DuPont determines that the missing results are critical to accomplishing the work plan objectives, additional sampling will be conducted to obtain the missing data. An example of this would be if a downgradient groundwater sample for volatile organic constituents were lost.

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13.0 CORRECTIVE ACTION

Corrective action is required for any lack of compliance with the requirements of this QAPP. Each employee working in the program is responsible for identifying QA problems and for initiating corrective action.

A more detailed discussion of corrective actions associated with the analytical laboratory is provided in the LQAP (see Exhibit 1).

Significant QA corrective actions at the laboratory will be documented. The documentation of such actions associated with the analytical laboratory will be forwarded to the site coordinator. Other corrective actions will be documented in reports. A corrective action form will be filled in by the person initiating the corrective action. This will be forwarded to the immediate supervisor or to the site coordinator for implementation of appropriate corrective action. The follow-up and outcome will be documented on the same form. The completed corrective action form will then be forwarded to the project QA officer and the project director for review. The DuPont project coordinator and the project manager are responsible for ensuring that the corrective actions adequately address root causes and are implemented in a responsive manner. They will also be responsible for confirming that corrective actions have been effective.

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14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Periodic reports detailing the results of QA/QC activities described in previous sections (see Sections 9.0, 10.0, and 13.0) will be submitted to the project director through the project manager. These documents will include reports on

- Significant deviations from protocol as stated in the RIWP or the QAPP.
- Field system and performance audits.
- Laboratory system and performance audits.
- Corrective action and follow-up.

Copies of quality assurance reports will be submitted to the technical lead, project manager, and the NJDEP (as required).

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15.0 DOCUMENT CONTROL

A process will be in place to ensure that relevant documentation is at hand and can be expeditiously accessed. The project manager is accountable for maintaining project record files and storage archives to meet the requirements of the project. The project manager is also responsible for providing facilities for adequate storage space, security, and confidentiality.

The project manager will be responsible for indexing, issuing, and maintaining files for all field logbooks, field notebooks, project correspondence, system and performance audits, corrective action reports, data validation reports, sample data reports, QA reports to management, and other associated documentation. A centralized location will be identified for this purpose, and a document custodian will be chosen. DuPont will maintain this archived information for seven years following completion of the project. The laboratory will maintain all hard-copy documentation associated with the project for five years following completion of the program. The laboratory will also maintain disposal records for all project samples for thirty years.

TABLES

MAXUS3919138

Table 1

PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES

[illegible]	[illegible]	[illegible]	[illegible]
Volatile organic compounds	SW-846 Method 8240	20/40	60-140*
Semivolatile organic compounds	SW-846 Method 8270	NA/40	10-140*
Pesticides	SW-846 Method 8080	20/40	10-140*
Metals	SW-846 Methods 6010-7000 series	20/40	70-130*
Inorganic compounds	SW-846 or EPA methods	25/NA	50-150*

*See Appendix A for exact percent recovery values concerning each method.
NA = Not applicable

Table 2

GROUNDWATER ANALYTICAL LIST/ COMPARISON OF LABORATORY DETECTION LIMITS TO NJDEP CRITERIA FOR VOCs (µg/l)

Compound	NJGWIIA Criteria	NJSWQS Criteria	PQL	MDL
Acetone	700	—	20	6
2-butanone	—	—	10	3
Benzene	1	71	5*	1
Bromodichloromethane	1	22	5*	1
Bromoform	4	360	5*	1
Carbon tetrachloride	2	6.31	5*	1
Chlorobenzene	4	21,000	5*	1
Chloroethane	—	—	5	3
Chloroethyl vinyl ether, 2-	100	—	10	2
Chloroform	6	470	5	1
Dibromochloromethane	10	—	5	2
Dichloroethane, 1,1-	70	—	5	2
Dichloroethane, 1,2-	2	99	5*	2
Dichloroethylene, 1,1-	2	—	5*	1
Dichloroethylene, cis-1,2	10	—	5	2
Dichloroethylene, trans 1,2	100	—	5	2
Dichloropropane, 1,2-	1	—	5*	1
Dichloropropene, cis-1,3	—	1,700	5	1
Dichloropropene, trans-1,3	—	1,700	5	1
Ethylbenzene	700	27,900	5	2
Bromomethane	10	4,000	5	3
Chloromethane	30	—	5	3
Methylene chloride	2	1,600	5*	2
Tetrachloroethane, 1,2,2-	2	—	5*	2
Tetrachloroethylene	1	4.29	5*	1
Toulene	1,000	20,0000	5	2
Trichloroethane, 1,1,1-	30	—	5	1
Trichloroethane, 1,1,2-	3	—	5*	2
Trichloroethylene	1	81.0	5	1
Vinyl chloride	5	525	5	2
Xylene	40	—	5	1

*PQL exceeds NJSWQS criteria, report down to MDL
— = Not listed in NJDEP criteria
NJGWIIA = New Jersey Groundwater IIA Criteria
NJSWQS = New Jersey Surface Water Quality Standards for a Saline Estuary (SE II)
(µg/l) = Micrograms per liter

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Table 2

GROUNDWATER ANALYTICAL LIST/ COMPARISON OF LABORATORY DETECTION LIMITS TO NJDEP CRITERIA FOR PESTICIDES

Compound	NJGWIIA	NJSWQS	PQL	MDL
Aldrin	0.04	0.000144	0.01*	0.0034
Dieldrin	0.03	0.000144	0.01*	0.0042
Chlordane	0.5	0.000283	0.3	0.070
4,4-DDT	0.1	0.000591	0.01*	0.0062
4,4-DDD	0.1	0.000837	0.01*	0.0059
4,4-DDE	0.1	0.000591	0.01*	0.0042
Endosulfan I	0.4	0.0087	0.01	0.0084
Endosulfan II	0.4	0.0087	0.01	0.0027
Endosulfan sulfate	0.4	2.0	0.03	0.0054
Endrin	2	0.0023	0.01	0.0042
Heptachlor	0.4	0.000214	0.01*	0.0038
Heptachlor epoxide	0.2	0.000106	0.01*	0.0026
Methoxychlor	40	0.03	0.05	0.027
Endrin aldehyde	—	0.81	0.10	0.0079
Alpha-BHC	0.02	0.0131	0.01	0.0015
Beta-BHC	0.2	0.460	0.01	0.0066
Delta-BHC		—	0.01	0.0039
Gamma-BHC	0.2	0.16	0.01	0.0014
Toxaphene	50	0.0002	4.00	0.82

*PQL exceeds NJSWQS criteria, report down to MDL
— = Not listed in NJDEP criteria
NJGWIIA = New Jersey Groundwater IIA Criteria
NJSWQS = New Jersey Surface Water Quality Standards for a Saline Estuary (SE II)
(µg/l) = Micrograms per liter

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Table 2

GROUNDWATER ANALYTICAL LIST/ COMPARISON OF LABORATORY DETECTION LIMITS TO NJDEP CRITERIA FOR METALS

[illegible]	[illegible]	[illegible]	[illegible]
Arsenic (AS)[2]	8	0.163*	2.3
Cadmium (Cd)[1]	4	6.3	2.6
Chromium (Cr)[1]	100	47	7.3
Lead (Pb)[2]	10	8.1	1.7
Mercury (Hg)[3]	2	0.00437*	0.03
Selenium (Se)[2]	50	69	1.5
Silver (Ag)[1]	20	—	5.8
Antimony (Sb)[2]	20	4,300	1.3
Beryllium (Be)[1]	20	306	1.2
Copper (Cu)[1]	1,000	5.6	4.2
Zinc (Zn)[1]	5,000	57	6.4
Nickel (Ni)[1]	100	9.5*	10.3
Thallium (Tl)[2]	10	6.22	2.2

*MDL exceeds NJ SWQS criteria
— = Not listed in NJDEP criteria
NJ GWIIA = New Jersey Class IIA Groundwater
NJSWQS = New Jersey Surface Water Quality Standards for a Saline Estuary (SE II)
(µg/l) = Micrograms per liter
[1] ICP
[2] GFAA
[3] CVAA

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Table 2

GROUNDWATER ANALYTICAL LIST/ COMPARISON OF LABORATORY DETECTION LIMITS TO NJDEP CRITERIA FOR INORGANIC ANALYSES

Compound	NJGWIIA Criteria	NJSWQS Criteria	Laboratory Detection Limit
Ammonia-nitrogen	500	—	1000*
Chloride	250,000	230,000	1000
Fluoride	2000	—	100
Hardness	—	—	1000
Nitrate-nitrogen	10,000	—	500
Phosphorous	—	100	50
Sulfate	250,000	—	2000
Sulfide	—	2[1]	2000
Sulfite	—	—	2000
Total Petroleum Hydrocarbons (TPH)	None Noticable	—	300
Total Dissolved Solids (TDS)	500,000	—	30,000

*Exceeds NJGWIIA criteria
— = Not listed in criteria
NJGWIIA = New Jersey Groundwater IIA Groundwater
NJSWQS = New Jersey Surface Water Quality Standards for a Saline Estuary (SE II)
[1] = As Hydrogen Sulfide

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Table 3

SOIL ANALYTICAL LIST/ COMPARISON OF LABORATORY DETECTION LIMITS TO NJDEP CRITERIA USING SW-846 METHODS

Compound	[illegible]	[illegible]	[illegible]
VOCs			
1,1,1-Trichloroethane	210	50	0.005
1,1,2,2-Tetrachloroethane	34	1	0.005
1,1,2-Trichloroethane	22	1	0.005
1,1-Dichloroethane	570	10	0.005
1,1-Dichlorethene	8	10	0.005
1,2-Dichloroethane	6	1	0.005
1,2-Dichloropropane	10	—	0.005
2-Chloroethylvinyl Ether	—	—	0.01
Acrolein	—	—	0.1
Acrylonitrile	1	1	0.05
Benzene	3	1	0.005
Bromodichloromethane	11	1	0.005
Bromoform	86	1	0.005
Bromomethane	79	1	0.005
Carbon tetrachloride	2	1	0.005
Chlorobenzene	37	1	0.005
Chloroethane	—	—	0.005
Chloroform	19	1	0.005
Chloromethane	520	10	0.005
Cis-1,3-Dichloropropene	4	1	0.005
Dibromochloromethane	110	1	0.005
Ethylbenzene	1000	100	0.005
Methylene Chloride	49	1	0.005
Tetrachloroethene	4	1	0.005
Toluene	1000	500	0.005
Trans-1,2-Dichloroethene	1000	50	0.005
Trans-1,3-Dichloropropene	4	1	0.005
Trichloroethene	23	1	0.005
Vinyl chloride	2	10	0.005
Xylenes	410	10	0.005
SVOCs			
1,2,4-Trichlorobenzene	68	100	0.33
1,2-Dichlorobenzene	5100	50	0.33
1,2-Diphenylhydrazine	—	—	0.33
1,3-Dichlorobenzene	5100	100	0.33
1,4-Dichlorobenzene	570	10	0.33
2,4-Dinitrotoluene	1	10	0.33

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Table 3
(Continued)

[illegible]	[illegible]	[illegible]	[illegible]
2,6-Dinitrotoluene	1	10	0.33
2-Chloronaphthalene	—	—	0.33
3,3'-Dichlorobenzidine	2	100	0.67
4-Bromophenyl Phenyl Ether	—	—	0.33
4-Chlorophenyl Phenyl Ether	—	—	0.33
Acenaphthene	3400	100	0.33
Acenaphthylene	—	—	0.33
Anthracene	10000	100	0.33
Benzidine	—	—	3.3
Benzo(a)anthracene	0.9	500	0.33
Benzo(a)pyrene	0.66	100	0.33
Benzo(b)fluoranthene	0.9	50	0.33
Benzo(ghi)perylene	—	—	0.33
Benzo(k)fluoranthene	0.9	500	0.33
Bis(2-chloroethoxy)methane	—	—	0.33
Bis(2-chloroethyl)ether	0.66	10	0.33
Bis(2-chloroisopropyl)ether	2300	10	0.33
Bis(2-ethylhexyl)phthalate	49	100	0.33
Butyl benzyl phthalate	1100	100	0.33
Chrysene	9	500	0.33
Di-n-butyl phthalate	5700	100	0.33
Di-n-octyl phthalate	1100	100	0.33
Dibenz(a,h)anthracene	0.66	100	0.33
Diethyl phthalate	10000	50	0.33
Dimethyl phthalate	10000	50	0.33
Fluoranthene	2300	100	0.33
Fluorene	2300	100	0.33
Hexachlorobenzene	0.66	100	0.33
Hexachlorobutadiene	1	100	0.33
Hexachlorocyclopentadiene	400	100	0.33
Hexachloroethane	6	100	0.33
Indeno(1,2,3-c,d)pyrene	0.9	500	0.33
Isophorone	1100	50	0.33
N-nitrosodi-n-propylamine	0.66	10	0.33
N-nitrosodimethylamine	—	—	0.33
N-nitrosodiphenylamine	140	100	0.33
Naphthalene	230	100	0.33
Nitrobenzene	28	10	0.33
Phenanthrene	—	—	0.33
Pyrene	1700	100	0.33
2,4,6-Trichlorophenol	62	10	0.33

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Table 3
(Continued)

Compound	[illegible]	[illegible]	[illegible]
2,4-Dichlorophenol	170	10	0.33
2,4-Dimethylphenol	1110	10	0.33
2,4-Dinitrophenol	110	10	0.83
2-Chlorophenol	280	10	0.33
2-Nitrophenol	—	—	0.33
4,6-Dinitro-2-methylphenol	—	—	0.83
4-Chloro-3-methylphenol	10000	10	0.33
4-Nitrophenol	—	—	0.33
Pentachlorophenol	6	100	0.83
Phenol	10000	50	0.33
Pesticides and PCBs			
4,4'-DDD	3	50	0.01
4,4'-DDE	2	50	0.01
4,4'-DDT	2	500	0.01
Aldrin	0.04	50	0.01
Alpha-BHC	—	—	0.01
Beta-BHC	—	—	0.01
Chlordane	—	—	0.05
Delta-BHC	—	—	0.01
Dieldrin	0.042	50	0.01
Endosulfan I	340[2]	50[2]	0.01
Endosulfan II	340[2]	50[2]	0.01
Endosulfan Sulfate	—	—	0.03
Endrin	17	50	0.01
Endrin aldehyde	—	—	0.1
Gamma-BHC	0.52	50	0.01
Heptachlor	0.15	50	0.01
Heptachlor Epoxide	—	—	0.01
Methoxychlor	280	50	0.05
PCB-1015	0.49[1]	50[1]	0.2
PCB-1221	0.49[1]	50[1]	0.2
PCB-1232	0.49[1]	50[1]	0.2
PCB-1242	0.49[1]	50[1]	0.2
PCB-1248	0.49[1]	50[1]	0.2
PCB-1254	0.49[1]	50[1]	0.2
PCB-1260	0.49[1]	50[1]	0.2
Toxaphene	0.10	50	2
Inorganics			
Antimony	14	—	20
Arsenic	20	—	1
Beryllium	1	—	0.5

MAXUS3919146

Table 3
(Continued)

[illegible]	[illegible]	[illegible]	[illegible]
Cadmium	1	—	2
Chromium	500[3]	—	4
Copper	600	—	4
Lead	400	—	0.5
Mercury	14	—	0.1
Nickel	250	—	5
Selenium	63	—	0.5
Silver	110	—	2
Thallium	2	—	2
Zinc	1500	—	10
Cyanide	1100	—	0.1
Phenols	10000	50	0.1

— Not listed in criteria
(mg/kg) = Milligrams per kilogram
RDCSC = Residential Direct Contact Soil Cleanup
IGWSC = Impact to Groundwater Soil Cleanup
(1)Criteria for total PCBs
(2)Criteria for Endosulfan
(3)Proposed

MAXUS3919147

Table 4

SUMMARY OF HOLDING TIMES AND PRESERVATION†

Parameter	Matrix	Holding time	Preservation
VOCs	Water	14 days	HCl to pH < 2
	Soil	14 days	Methanol[2]
SVOCs	Soil	14 days to extraction 40 days to analysis	—
Pesticides/PCBs	Water	7 days to extraction 40 days to analysis	—
	Soil	14 days to extraction 40 days to analysis	—
Metals*	Water	6 months	HNO_3 to pH <2
	Soil	6 months	—
Ammonia-nitrogen	Water	28 days	H_2SO_4 to pH<2
Chloride	Water	28 days	—
Fluoride	Water	1 month	—
Hardness	Water	6 months	HNO_3 to pH<2
Nitrate-nitrogen	Water	48 hours	—
Total Phosphorous	Water	28 days	H_2SO_4 to pH<2
Sulfate	Water	28 days	—
Sulfide	Water	7 days	Zinc Acetate to pH>9
Sulfite	Water	Analyze immediately	—
TPH	Water	7 days	—
TDS	Water	7 days	—

VOCs = Volatile organic compound
SVOCs = Semivolatile organic compounds
[1]All samples are to be stored at 4°C.
[2]See field extraction/preservation of soil samples with methanol for VOC analysis, NJDEP, April 1995 (draft) for details.
†See SW846, third edition, Chapter 2, Table 2-16, and Chapters 3 and 4, September 1986, for other preservation details.
*Except mercury, hold time for mercury is 28 days.

Table 5

CALIBRATION FREQUENCY FOR FIELD TEST EQUIPMENT

Equipment	Calibration Frequency
pH Meter	Beginning of each sampling day and intermittently during the sampling period at frequency that results in little or no calibration adjustment.
Conductivity Meter	Beginning of each sampling day and intermittently during the sampling period at frequency that results in little or no calibration adjustment.
Thermometer	Factory-calibrated. Checked at least once per field trip using a quality-grade thermometer.
MicroTIP	Prior to shipment, at the beginning of each sampling day, and in the field, if necessary.

Table 6

ANALYTICAL METHODOLOGY

[illegible]	[illegible]
Volatile organic compounds	8240*
Field parameters pH Specific conductance Temperature	 150.1(**) 120.1(**) 170.1(**)
Semivolatile organic compounds	8270*
Pesticides/PCBs	8080*
Metals (ICP)	6010*
As-Se-TI-Pb (GFAA)	7060, 7740, 7841, 7241*
Hg (CVAA)	7470, 7471*
Ammonia-nitrogen	350(**)
Chloride	325(**)
Fluoride	340(**)
Hardness	130(**)
Nitrate-nitrogen	353(**)
Total Phosphorous	365(**)
Sulfate	375(**)
Sulfide	376(**)
Sulfite	377(**)
TPH	418.1(**)
TDS	160.1(**)

*Methods are from *Test Methods for Evaluating Solid Waste* (SW-846), third edition, unless noted otherwise. The preparation and analytical method may change based on sample concentration, matrix, or other factors.

**Methods are from *Methods for Chemical Analysis of Water and Waste* EPA, 1979.

Table 7

SUMMARY OF QUALITY CONTROL SAMPLES

Matrix	Analyte	Trip Blank	Field Duplicate	Equipment Rinsate	MS	MSD
Groundwater	VOCs	1	1	1	1	1
	Pesticides/PCBs	0	1	1	1	1
	Metals	0	1	1	1	1
	Inorganic Compounds	0	1	1	1	1
Soil	VOCs	0	1	1	1	1
	SVOCs	0	1	1	1	1
	Pesticides/PCBs	0	1	1	1	1
	Metals	0	1	1	1	1

MS=Matrix spike
MSD=Matrix spike duplicate
[1]Per sample shipment
[2]Per 20 samples
[3]Solid matrix: per day per sampling equipment
Aqueous matrix: per day (not required for potable well sampling or when the sample is collected directly from the source into a sample container)
[4]Per project field samples or per 20 field samples within a project (maximum of 14 day period for project)

EXHIBITS

Exhibit 1

LABORATORY QUALITY ASSURANCE PLANS

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 PROJECT NUMBER 1755

MAXUS3919154

Exhibit 2

FIELD EXTRACTION/PRESERVATION OF SOIL SAMPLES WITH METHANOL FOR VOC ANALYSIS METHOD

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 PROJECT NUMBER 1755

MAXUS3919156

Appendix E

WELL CONSTRUCTION LOGS AND WELL ABANDONMENT FORMS

MAXUS3919157

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 PROJECT NUMBER 1755

MAXUS3919158

Appendix F

HEALTH AND SAFETY PLAN

MAXUS3919159

REFER TO CORRESPONDING APPENDIX
IN THE PHASE II REMEDIAL INVESTIGATION WORK PLAN
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY
OCTOBER 2, 1995 · PROJECT NUMBER 1755

MAXUS3919160

Appendix G

PRINCIPAL PERSONNEL DESCRIPTIONS

MAXUS3919161

EMPLOYEE DESCRIPTIONS

Michael U. DeStefano, PE, Project Manager

AAS, Engineering Technology, 1986, Delaware Technical and Community College

BS, Engineering Technology, 1994, University of Delaware

Responsible for all aspects of project management and implementation. Primary contact to NJDEP case manager on routine communications.

(302) 992-5994

Nancy R. Grosso, Senior Geologist

BS, Earth Science, 1978, Adelphi University

MS, Geophysical Sciences, 1980, University of Chicago

Technical lead for remedial investigation phase of remedial process. Responsible for technical content of investigation of all media.

(302) 992-6783

Michael J. Lukas, Project Quality Officer

BS, Civil Engineering, 1982, Drexel University

MS, Environmental Engineering, 1990, Villanova University

Provides senior-level technical input into the design and implementation of site investigations and remediation programs. Provides technical QA/QC to work products and deliverables.

(302) 992-6892

Sathya Yalvigi, Senior Engineer

BS, Civil Engineering, 1984, University of Bangalore, India

MS, Civil Engineering, 1987, University of Oklahoma

Technical lead for remediation and remedial selection process. Responsible for technical aspects of the remediation phase of the site remedial process.

(302) 892-8035

MAXUS3919163

Appendix H

CERTIFICATION STATEMENTS

MAXUS3919164

PROTESTATION
HIGHEST RANKING OFFICIAL RESPONSIBLE FOR SITE

The Certification provided by me under the Provisions of NJAC 7:26C1.2(b) for the attached document is provided under protest because the required language for the certification is overly broad and requires me to possess knowledge that is beyond the scope of my role and duties in the corporation.

Notwithstanding any language to the contrary in the certification, I hereby declare that I believe the information in the *Phase II Remedial Investigation for the Grasselli Site*, dated December 31, 1996, to be accurate based on information I have acquired by interviewing the employee or employees responsible for gathering that information. I have been told by employee or employees of DuPont Environmental Remediation Services, a subsidiary of DuPont, that the information is true, accurate, and complete and I have no reason to doubt these statements.

With the exception of the foregoing explanation of my role, I have taken no other steps and do not consent to assume any other responsibility for the truth of the information in the attached document.

12-31-96
Dated

David L. Wickersham
David L. Wickersham
Remediation Program Manager

CERTIFICATION
HIGHEST RANKING INDIVIDUAL RESPONSIBLE FOR SITE

As provided in 7:26C1.2(b), I certify under penalty of law that the information provided in this document, *Phase II Remedial Investigation for the Grasselli Site*, dated December 31, 1996, is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties (see attached Protestation).

12-31-96
Dated

David L. Wickersham
David L. Wickersham
Remediation Program Manager

CERTIFICATION
DULY AUTHORIZED REPRESENTATIVE OF
VICE PRESIDENT

As provided in 7:26C1.2(c), I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties (see attached Delegation) (see attached Protestation).

12-31-96
Dated

David L. Wickersham
David L. Wickersham
Remediation Program Manager

SECRET

LIBRARY DOCUMENTATION PLAN
LOG NO. 3809
FILE NO. 8-31-114

BAC00000[illegible]

DECLASSIFIED
Authority 710622
By SC NARA Date 12/14/82

SECRET

Exhibit J

GROUNDWATER CURRENT CONDITIONS REPORT DUPONT GRASSELLI SITE LINDEN, NEW JERSEY

ISRA Case No. 92142

Date: July 2009

DuPont Project No.: 507745
URS Project No.: 18985537.09003

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

Barley Mill Plaza, Building 19
Wilmington, Delaware 19805

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Figure 9 Methylene Chloride Shallow Aquifer Isoconcentration Map – 5/08
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APPENDICES

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EXECUTIVE SUMMARY

In February 2008, E.I. du Pont de Nemours and Company (DuPont) initiated a voluntary program of groundwater monitoring at the DuPont Grasselli site (the site) in Linden, New Jersey. The purpose of the monitoring program was to determine current groundwater quality in the shallow fill aquifer and deep unconsolidated aquifer beneath the site and to collect data to inform remedial action decisions. Five quarters of analytical data have been collected to date and the program is ongoing.

DuPont has prepared this current conditions report to summarize and document site conditions. Data summaries are based on the May 2008 round of sampling, which include all site monitoring wells and piezometers. All five rounds of sampling results are presented, and significant variations from the May data are noted.

The shallow fill aquifer underlies the whole site and is the result of historic fill placement in the late 19th and early 20th century. General groundwater flow is from west to east under a low hydraulic gradient toward the Arthur Kill, with local components of flow toward Piles Creek in the northern portion of the site. A groundwater trough occurs in the southern portion of the site with overall flow toward the Arthur Kill. Flow in this area is complicated by the construction of a perimeter sheet pile wall and groundwater extraction on the ISP (International Specialty Products) property at the southwestern end of the site.

Groundwater quality in the shallow aquifer has been impacted by chlorinated organic compounds historically deposited in Area of Concern (AOC) U – the Unlined Pond in the northeastern portion of the site. Non-aqueous phase liquid (NAPL) was delineated within the footprint of AOC U and the adjacent AOC I – the Pesticide Manufacturing Area. Monitoring wells around the periphery of this area contain concentrations of benzene; chlorobenzene; chloroform; 1,4-dichlorobenzene; and methylene chloride that exceed New Jersey Class II-A groundwater quality standards (GWQS). These volatile organic compounds (VOC) are restricted to this portion of the site. Review of analytical results from monitoring well MW-38A, located downgradient of AOC U, show intermittent occurrences of chloroform and methylene chloride at concentrations exceeding GWQS.

Pesticides in shallow groundwater are associated with the AOC U and AOC I described above. There are also occurrences in isolated areas in the southern and central portion of the site, but these occurrences are intermittent and do not constitute a consistent plume of impacted groundwater, nor do they indicate a large or persistent source.

Arsenic occurs over a large portion of the shallow aquifer at concentrations exceeding the New Jersey Class II-A criteria. Two plumes of elevated concentrations are noted: one in the southern portion of the site and another in the central portion of the site. Both plumes are located within areas previously identified as containing elevated levels of arsenic in the soil and were identified for remedial action in the *Sitewide Remedial Action Selection Report* (DuPont, 2008).

The deep unconsolidated aquifer at the site is monitored by a network of five perimeter wells. Significant concentrations of chlorinated organic compounds associated with AOC U are evident in monitoring well MW-38B in the northeastern portion of the site.

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Although the observed concentrations in monitoring well MW-38B are generally higher than those noted in the shallow monitoring wells in the AOC U area, no NAPL has been observed in the deep monitoring well. Additionally, benzene has been persistently measured in MW-18B at concentrations marginally exceeding GWQS.

Arsenic is identified in four of five deep monitoring wells at levels exceeding GWQS but orders of magnitude less than the elevated plumes of the shallow aquifer. Regional groundwater and surface water is heavily impacted by arsenic, and the source of arsenic in the deep aquifer cannot be reliably identified.

Chloride and total dissolved solids are found throughout the deep aquifer at the site at concentrations exceeding both New Jersey Class II-A criteria and Class III-B criteria. These conditions are a result of the high salinity of the Arthur Kill and saltwater intrusion into the aquifer by the river.

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1.0 INTRODUCTION

This *Groundwater Current Conditions Report* has been prepared for the E.I. du Pont de Nemours and Company (DuPont) Grasselli site (the site) (ISRA Case No. 92142) located in Linden, Union County New Jersey (see Figure 1). DuPont initiated voluntary quarterly groundwater sampling and analysis in February 2008. The purpose of the monitoring program is to determine current site groundwater conditions, to monitor trends in groundwater quality, and to provide reliable data to evaluate remedial options.

This report includes the results from five quarterly groundwater sampling events. Included are the results from the sampling and gauging of 45 wells in February, March, and May of 2008; the sampling and gauging of 24 wells in August and December 2008; and the sampling and gauging of 23 wells in February 2009.

1.1 Site Background

The site is located within an industrial area in the eastern portion of Linden, New Jersey (see Figure 1). The former manufacturing site covers approximately 105 acres. The site does not include undeveloped property located west of the site, which was donated by DuPont to the New Jersey Turnpike Authority (NJTA) as a long-term conservation easement known as the NJTA Piles Creek East Wetlands Mitigation Project.

The site originally consisted of tidal marshlands that, over time, were reclaimed by fill emplacement. In the early 1880s, the Standard Chemical Company purchased the land from several individual owners and developed the tract for industrial use. From 1885 until 1928, the Grasselli Chemical Company owned and operated the site. In 1928, DuPont purchased the site.

Historical manufacturing at the site included the production of sulfuric acid, ammonium thiosulfate, sodium bisulfate, inorganic salts, acids, and organic pesticides. Chemical production at the site was terminated in the fall of 1990. Since then, all of the site manufacturing buildings have been dismantled. Current site operations consist of a tenant rock and concrete crushing/recycling operation on 14 acres in the southern portion of the site. The majority of the site surface is covered by gravel, crushed stone, soil, or foundations of former manufacturing buildings, with paved and unpaved roads and two small paved parking lots.

In March 2009, DuPont executed a contract for the sale of the Grasselli property to PurGen One, LLC. PurGen has prepared plans to construct a 500 megawatt electric generating and manufacturing facility at the site. The proposed facility uses coal feedstock for gasification to produce both electricity and a range of commodity chemicals for sale. The plant is designed to capture carbon dioxide and sequester it 175 miles offshore beneath deep ocean sediments.

In May 2009, responsibility for New Jersey Department of Environmental Protection (NJDEP) oversight of the site remediation was transferred to the Office of Brownfield Reuse. The site remediation will be conducted under the new Site Remediation Reform Program on a fast-tracked basis. It is the stated commitment of NJDEP and DuPont to

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complete remediation by the end of 2012, consistent with the permitting timeframe of the PurGen project.

To facilitate site development, DuPont contracted with Clean Earth, Inc. for the placement of up to one million cubic yards of processed dredge material (PDM) at the site. These sediments are dredged from the Port of New York/New Jersey waters, processed at an off-site location to produce soil suitable for structural fill, and then trucked to the site. In addition to raising the general grade of the site, the PDM will be used to surcharge the site to induce consolidation of underlying soils and improve their geotechnical and load-bearing properties. Trucking of PDM to the site began in September 2008 for stockpiling in a designated area. Approximately 130,000 cubic yards of PDM have been stockpiled to date.

The complete operational history of the site is presented in the *Operational History of the DuPont Grasselli Facility* [DuPont Environmental Remediation Services (DERS), 1990]. An aerial photograph history is included in the *Environmental Cleanup Responsibility Act (ECRA) Field Sampling Plan* (DERS, 1992).

The site has been the subject of remedial investigations since 1992 under ECRA, now the Industrial Site Recovery Act (ISRA). A summary of these remedial investigations and their findings may be found in the *Sitewide Remedial Action Selection Report* (DuPont, 2008).

1.2 Site Location and Topography

The site is located in an industrial area in the eastern portion of Linden, New Jersey. The former manufacturing site covers approximately 105 acres. The site is bounded on the east by the Arthur Kill, to the north by Piles Creek and Public Service Enterprise Group, to the south by International Specialty Products/General Aniline Film (ISP/GAF), and to the west by the Perth Amboy Railroad (Elizabeth Port Branch) and the New Jersey Turnpike. Figure 2 identifies the site property boundary and neighboring properties.

The site is located within the Arthur Kill drainage basin. This basin is drained by perennial tidal streams that approximately follow pre-glacial buried river channels. The streams that drain into the Arthur Kill in the general region of the site include Piles Creek, Morses Creek, and Half Bushel Creek. Because the site is situated adjacent to the Arthur Kill, the topographic elevation of the site is generally 10 feet or less above mean sea level (MSL).

1.3 Site Geology and Hydrogeology

Geologically, the site is situated within the Newark Basin. The site is underlain by fill deposits that range in thickness from 10 to 18 feet and consist predominantly of fine to coarse sand. Some locations within the site contain gravel, silt, clay, brick, crushed stone, sulfur, coal, and wood. Underlying the fill deposits are recent marsh deposits consisting of brown peat and organic clay, ranging in thickness from 10 to 15 feet. Pleistocene glacial till deposits are found below the peat, varying in thickness from 6 to 18 feet, and consist of red-brown, silty clay with sand and gravel. The Jurassic/Triassic

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Age Passaic Formation, also known as the Brunswick Shale, underlies the glacial till and consists of weathered red shale.

The upper hydrologic unit identified at the site is within the fill layer and is referred to as either the Hydrologic Unit A or the shallow aquifer. The depth to groundwater is shallow and ranges from a few inches to 6 feet below ground surface (bgs). The lower hydrologic unit underlies the peat layer and, in some areas, is below the clay portion of the glacial till. This hydrogeologic unit, referred to as either the Hydrologic Unit B or the deep aquifer, may behave as a confined aquifer. The two hydrologic units are separated by the thick marsh deposits of peat and clay and, in some areas, by the clayey glacial till deposits.

Groundwater within the shallow aquifer historically flows outward from a divide centered over the undeveloped western portion of the site toward the Arthur Kill and Piles Creek. However, the soil excavation for the NJTA Piles Creek East Wetlands Mitigation Project created a groundwater sink that has significantly altered flow in the shallow aquifer. The shallow aquifer groundwater divide has now shifted eastward, with a north-to-south orientation through the center of the former manufacturing portion of the plant. Groundwater flow is further complicated by the installation of a sheet pile wall paralleling Piles Creek for the NJTA Piles Creek East Wetlands Mitigation Project and a perimeter sheet pile wall around the majority of the ISP/GAF property adjacent to the site.

Regional groundwater in the deep unconsolidated aquifer flows east toward the Arthur Kill. At the site, the regional flow direction predominates. However, in the southwestern portion of the site, there is a flow reversal with a component of flow towards the ISP property.

Natural groundwater quality in the vicinity of the site is heavily degraded by saltwater intrusion into the bedrock aquifer and surficial deposits. High concentrations of chlorides and total dissolved solids (TDS) are found in groundwater from the site and from adjacent properties. The Bayway refinery northeast of the site and the ISP/GAF property, immediately south and west of the site, have had groundwater aquifers beneath their site re-classified as New Jersey Class III-B criteria. New Jersey Class III-B criteria refer to groundwater that is not suitable for potable water use due to natural water quality conditions that result from saltwater intrusion from tidal water bodies.

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2.0 GROUNDWATER MONITORING PROGRAM

DuPont initiated quarterly groundwater monitoring at the site on a voluntary basis to provide up-to-date data regarding site conditions and to support remedial action. In December 2007, all monitoring wells and piezometers at the site were redeveloped to ensure that the wells provided reliable and representative groundwater samples. A total of 46 monitoring wells and piezometers were located, identified and redeveloped. Five of the monitoring wells were completed in the deep aquifer and these wells are denoted by a "B" following the well number in their name. Figure 3 shows the locations of all monitoring wells and piezometers on-site.

One monitoring well, MW-28A, contained non-aqueous phase liquid (NAPL). This well was excluded from the groundwater sampling program, and periodic NAPL extraction was initiated.

The first round of groundwater sampling and analysis was conducted in February 2008 to obtain baseline data for the monitoring program. All 45 remaining monitoring wells and piezometers were sampled and groundwater analyzed for the full range of constituents. A second round of baseline sampling was conducted on all 45 monitoring wells and piezometers in May 2009.

Following review of the resulting analytical data, the sampling program was refined to 24 key monitoring wells completed in both the shallow and deep aquifers. All five monitoring wells completed in the deep aquifer were included in the sampling program. The monitoring wells in the sampling program are located mainly on the perimeter of the site but include interior wells that contain groundwater with elevated concentration of the constituents of concern.

Quarterly monitoring continued with sampling and analysis in August 2008, November 2008, and February 2009. One interior monitoring well of the sampling program, MW-16A, was destroyed by site commercial operations in January 2009. The well was located and abandoned in accordance with NJDEP requirements by a licensed New Jersey driller. The monitoring program was subsequently reduced to 23 wells for the February 2009 sampling event.

Section 3.0 below presents current groundwater conditions at the site based on the second baseline sampling event of May 2008. Appendix A provides a summary of all five quarterly sampling events and a discussion of the results from each sampling event.

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3.0 SUMMARY OF GROUNDWATER CONDITIONS

Current groundwater conditions at the site are based on water-level measurements and analytical results from the May 2008 round of baseline groundwater sampling. These results are representative of the five rounds of quarterly sampling and are the most comprehensive data set. Appendix A presents water-level data and analytical results from all five rounds of quarterly sampling collected to date.

3.1 Groundwater Flow

Synoptic water-level data and well condition updates were collected as part of the reporting activities on May 12, 2008. Groundwater elevations and the reference survey elevation for each well were calculated from these measurements (see Table 1).

Separate groundwater equipotential maps for wells screened in the shallow water-bearing zone and wells screened in the deep aquifer were prepared (see Figures 4 and 5). In accordance with N.J.A.C. 7:26E-3.13(d) 5, the required contour map reporting forms are presented in Appendix B. A complete discussion of the geologic units at the site is presented in the *Phase II Remedial Investigation Report* (DERS, 2000).

Groundwater flow at the site is generally horizontal within the shallow water-bearing fill and the deeper sand aquifer and vertical within the confining units because of the contrast in hydraulic conductivities between fill, sand, and clay.

Within the shallow fill aquifer, hydraulic gradients are very flat with a general direction of flow to the east towards the Arthur Kill (see Figure 4). In the northern portion of the site, there is a flat gradient towards Piles Creek. Flow direction in the southern portion of the site is more complex with a slight groundwater depression in the area of MW-42A, MW-47A, and MW-48A. This is consistent with historic piezometric elevations, but the construction of an impermeable sheet pile wall on the ISP property along the southeastern site boundary has further complicated this condition.

The deep unconsolidated aquifer is confined at the site and has historically demonstrated flow across the site from west to east towards the Arthur Kill (see the *Phase II Remedial Investigation Report*; DERS, 1998). However, a groundwater divide now occurs at the site, running northwest to southeast, with groundwater north of the divide migrating east towards the Arthur Kill under a relatively flat hydraulic gradient (see Figure 5). Deep groundwater south of the hydraulic divide appears to move southwest towards the ISP property. ISP has installed a groundwater collection system inside their perimeter sheet pile wall to induce an inward gradient across the wall. This pumping system may be the cause of the change in groundwater flow in the deep aquifer.

All five deep monitoring wells are paired with a shallow monitoring well around the perimeter of the site. A downward vertical gradient was measured in four of the five well pairs. The exceptions were wells MW-18A and MW-18B in the southeastern corner of the site. A slight upward gradient was measured at this location.

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3.2 Groundwater Quality

Analytical results from groundwater samples collected during the May 2008 sampling event were reviewed to evaluate groundwater quality. All groundwater samples were collected via low-flow sampling procedures in accordance with the *Field Sampling Procedure Manual* (FSPM) (NJDEP, 2005). The groundwater samples were analyzed for metals by method SW 846 6010B/60207 470A, volatile organics by method SW 846 8260B, and pesticides by method SW 846 8081A. Complete analytical data summaries are presented in Table 2 for shallow aquifer monitoring wells and Table 3 for deep aquifer monitoring wells. The Groundwater Analytical Data and Data Validation Reports are included as Appendix C. The Field Sampling Sheets are provided in Appendix D, and the Electronic Data Deliverables are provided in Appendix E. Groundwater quality trend analyses for select monitoring wells are provided in Appendix F.

Analytical data posts for constituents of concern are provided for the shallow and deep aquifers in Appendix A, Figure A-9, and Appendix A, Figure A-10, respectively. Data post figures are provided for benzene; chloroform; chlorobenzene; 1,4-dichlorobenzene; methylene chloride; alpha BHC; beta BHC; 4,4-DDD; arsenic (dissolved and total); lead dissolved and total); and zinc.

3.2.1 Shallow Aquifer Groundwater Quality

Groundwater samples were collected and analyzed from 40 monitoring wells and piezometers completed in the shallow aquifer during the May 2008 sampling event. A review of the analytical results from this event indicated exceedences of New Jersey Class II-A groundwater quality criteria for the constituents of concern presented below. Appendix A, Figure A-9, presents posted concentrations of key constituents from all five rounds of quarterly sampling. References to specific chemical concentrations from various sampling events can be confirmed on this figure or by review of Table A-2.

Semi-volatile organic compounds (SVOC) were analyzed in the February 2008 round of sampling in all shallow and deep sampling locations. There were no exceedences of New Jersey Class II-A criteria in any of the samples, and the decision was made to drop SVOCs from the list of analytical parameters. Subsequent sampling efforts did not analyze for these compounds.

Benzene

Benzene concentrations were detected above the groundwater quality standard (GWQS) of 1 ug/l in three of the 40 shallow sampling points: MW-24A (65 ug/l), MW-26A (52 ug/l), and MW-37A (59 ug/l). Figure 6 shows the distribution of benzene concentrations in the shallow aquifer. The distribution of the benzene exceedences was limited to monitoring wells within the northeastern portion of the site in the immediate vicinity of area of concern (AOC) U, the Unlined Pond, and the adjacent AOC I, the Pesticide Manufacturing Area. The benzene in the shallow aquifer is derived from the historic disposal of NAPL compounds originating in the AOC U source area and is confined to this portion of the site. Monitoring well MW-38A, located downgradient of the AOC U source area and adjacent to the Arthur Kill, consistently does not contain detectable concentrations of benzene.

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Chlorobenzene

Chlorobenzene concentrations were detected above the New Jersey Class II-A GWQS of 50 ug/l in three of the 40 wells sampled: MW-24A (5,500 ug/l), MW-26A (7,900 ug/l), and MW-37A (2,900 ug/l). Additionally, chlorobenzene is a primary component of NAPL identified in monitoring well MW-28A. Chlorobenzene exceedences in the shallow aquifer occur in the same monitoring wells as benzene, and the distribution is shown in Figure 7. Chlorobenzene was limited to wells within the northeastern portion of the site in the immediate vicinity of AOC U, the Unlined Pond, and the adjacent AOC I, the Pesticide Manufacturing Area. The chlorobenzene in the shallow aquifer is derived from the historic disposal of NAPL compounds originating in the AOC U source area and is confined to this portion of the site. Monitoring well MW-38A, located downgradient of the AOC U source area and adjacent to the Arthur Kill, did not contain detectable limits of chlorobenzene in four of the five sampling events.

AOC I
AOC U

Chloroform

Chloroform did not exceed the GWQS of 70 ug/l in any of the 40 shallow aquifer sampling locations during the May 2008 sampling event, and the distribution is shown in Figure 8. Across all five sampling events, chloroform has been found at detectable limits only in shallow monitoring well MW-38A, located downgradient of AOC U. Chloroform concentrations have exceeded GWQS in two of the five sampling events in MW-38A with a maximum concentration of 300 ug/l.

1,4-Dichlorobenzene

1,4-Dichlorobenzene was detected above the GWQS of 75 ug/l in three of 40 shallow aquifer sampling locations: monitoring well MW-24A (480 ug/l), MW-26A (160 ug/l), and MW-37A (1,800 ug/l). The distribution of these exceedences was limited to wells within the northeastern portion of the site and is co-incident with the exceedences and distribution of chlorobenzene. 1,4-Dichlorobenzene was not detected in any of the five sampling events in monitoring well MW-38A, downgradient of AOC-U.

Methylene Chloride

Methylene chloride did not exceed the GWQS of 3 ug/l in any of the 40 shallow aquifer sampling locations during the May 2008 sampling event, and the distribution is shown in Figure 9. However, methylene chloride was detected in monitoring well MW-38A, located downgradient of AOC U, at a concentration exceeding GWQS in one of the five sampling events with a maximum concentration of 32 ug/l.

Alpha-BHC

Alpha-BHC concentrations were detected above the GWQS of 0.02 ug/l in five of 40 shallow aquifer sampling locations during the May 2008 sampling event. The wells in which the exceedences were identified are located within the western-central portion of the site, MW-07A (0.056 ug/l); the southeastern portion of the site, MW-18A, (0.11 ug/l); and the northeastern portion of the site, MW-24A (2.4 ug/l), MW-37A (50 ug/l), and MW-38A (0.49 J ug/l). Figure 10 presents isoconcentrations of Alpha-BHC distribution in the shallow aquifer. The higher concentrations are found in the immediate vicinity of AOC U, the Unlined Pond, and the adjacent AOC I, the Pesticide Manufacturing Area.

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Beta-BHC

Beta BHC concentrations were detected above the GWQS of 0.04 ug/l in three of the 40 shallow aquifer sampling locations during the May 2008 sampling event. The wells in which the exceedences occurred are located in the western-central portion of the site, MW-07A (0.044 ug/l) and MW-13A 0.49 ug/l), and in the northeastern corner of the site, MW-26A (6.8 ug/l). Figure 11 presents isoconcentrations of beta-BHC distribution in the shallow aquifer. 3|40

4,4-DDD

4,4-DDD concentrations were detected above the GWQS of 0.1 ug/l in four of the 40 shallow aquifer sampling locations during the May 2008 sampling event: monitoring wells MW-24A (5.9 ug/l), MW-26A (1.5 ug/l), MW-37A (2.6 ug/l), and MW-38A (0.13 ug/l). The distribution of these exceedences is limited to the northeastern portion of the site in the immediate vicinity of AOC U, the Unlined Pond, and the adjacent AOC I, the Pesticide Manufacturing Area. Figure 12 presents isoconcentrations of Alpha-BHC distribution in the shallow aquifer. 4|4

Arsenic

Total arsenic concentrations were detected above the GWQS of 3 ug/l in 28 of the 40 shallow aquifer sampling locations during the May 2008 sampling event. The distribution of total arsenic exceedences are shown in Figure 13 and occur throughout the entire site, with the exception of the northwestern and southeastern corners of the site. The areas of highest concentrations occur in the southern portion of the site, in the vicinity of monitoring wells MW-15A (661 ug/l) and MW-16A (9,470 ug/l). A second elevated plume occurs in the central portion of the site in the vicinity of monitoring wells MW-13A (488 ug/l) and MW-30A (636 ug/l) and extends west to the vicinity of PZ-07A (1,520 ug/l) and PZ-01A (748 ug/l). These two areas are generally consistent with two areas of elevated concentrations of arsenic in soil identified as AOC P – Sitewide Arsenic 28|40

Lead

Total lead concentrations were detected above the GWQS of 5 ug/l in 17 of the 40 shallow aquifer sampling locations during the May 2008 sampling event. The distribution of total lead exceedences occurred throughout the site, with the general exception of the northern end of the site. The maximum total lead concentration identified during this sampling event was in groundwater from monitoring well MW-10A (138 ug/l) in the southeastern corner of the site. Isoconcentration maps showing the distribution of total lead concentrations from this sampling event is included as Figure 14. 17|40

Chlorides

Total chloride concentrations were analyzed during the February 2009 sampling event and were detected above the New Jersey Class II-A GWQS of 250,000 ug/l in 11 of 19 shallow monitoring wells. The highest concentration was found in monitoring well MW-18A at 6,130,000 ug/l, a value that exceeds the New Jersey Class III-B GWQS of 3,000,000 ug/l. The high concentration of chlorides within this well could be a function of the upward gradient from the deeper aquifer, which contains much higher concentrations of chlorides, into the shallow aquifer in this area. Analytical results are presented in Table 2. 11|19

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Total Dissolved Solids

Total dissolved solids were analyzed during the February 2009 sampling event and were detected above the New Jersey Class II-A GWQS of 500,000 ug/l in 16 of 19 shallow monitoring wells. The highest concentration was found in monitoring well MW-18A at 11,300,000 ug/l, a value that exceeds the New Jersey Class III-B GWQS of 5,000,000 ug/l. The high concentration of total dissolved solids within this well could be a function of the upward gradient from the deeper aquifer, which contains much higher concentrations of chlorides, into the shallow aquifer in this area. Analytical results are presented in Table 2.

TDS ↑ Chlorides

3.2.2 Deep Aquifer Groundwater Quality

Groundwater samples were collected and analyzed from five monitoring wells, and piezometers were completed in the deep aquifer during the May 2008 sampling event. The same constituents of concern, identified for the shallow aquifer and discussed in Section 3.2.1, are presented below for review. Appendix A, Figure A-10, presents posted concentrations of key constituents from all five rounds of quarterly sampling. References to specific chemical concentrations from various sampling events can be confirmed on this figure or by review of Appendix A, Table A-3.

SVOCs were analyzed in the February 2008 round of sampling in all shallow and deep sampling locations. There were no exceedences of New Jersey Class II-A criteria in any of the samples, and the decision was made to drop SVOCs from the list of analytical parameters. Subsequent sampling efforts did not analyze for these compounds.

Benzene

Benzene concentrations were detected above the GWQS of 1 ug/l in monitoring well MW-38B at a concentration of 170 ug/l and MW-20B at a concentration of 6 ug/l. MW-38B is located downgradient of AOC U, the Unlined Pond source area, and suggests that constituents from AOC U has impacted the deep aquifer in this area. Isoconcentration contours showing the distribution of benzene concentrations from this sampling event is included as Figure 15.

Chlorobenzene

Chlorobenzene concentrations were detected above the GWQS of 50 ug/l in one monitoring well, MW-38B, at a concentration of 25,000 ug/l. Data from this well, located downgradient of AOC U, the Unlined Pond, suggests that constituents from AOC U have impacted the deep aquifer in this area. Isoconcentration contours showing the distribution of chlorobenzene concentrations from this sampling event is included as Figure 16.

Chloroform

Chloroform was detected above the GWQS of 70 ug/l in one monitoring well, MW-38B, at a concentration of 380 ug/l. Data from this well, located downgradient of AOC U, the Unlined Pond, suggests that constituents from AOC U have impacted the deep aquifer in this area. Isoconcentration contours showing the distribution of chloroform concentrations from this sampling event is included as Figure 17.

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1,4-Dichlorobenzene

1,4-Dichlorobenzene was detected above the GWQS of 75 ug/l in one monitoring well, MW-38B, at a concentration of 670 ug/l. Data from this well, located downgradient of AOC U , suggests that AOC U has impacted the deep aquifer in this area.

Methylene Chloride

Methylene chloride was detected above the GWQS of 3 ug/l in one monitoring well, MW-38B, at a concentration of 22,000 ug/l. Data from this well, located downgradient of AOC U, suggests that AOC U has impacted the deep aquifer in this area. Isoconcentration contours showing the distribution of methylene chloride concentrations from this sampling event is included as Figure 18.

Alpha-BHC

Alpha-BHC concentrations were detected above the GWQS of 0.02 ug/l in one monitoring well, MW-18B, at a concentration of 0.073 ug/l. This well is located in the southeastern portion of the site. Isoconcentration contours showing the distribution of alpha-BHC concentrations from this sampling event is included as Figure 19.

Beta-BHC

Beta-BHC concentrations were not detected above the GWQS of 0.04 ug/l in any of the five monitoring wells completed in the deep aquifer during any of the five sampling events. Isoconcentration maps showing the distribution of beta-BHC concentrations for this sampling event is included as Figure 20.

4,4-DDD

4,4-DDD concentrations were not detected above the GWQS of 0.1 ug/l in any of the five monitoring wells completed in the deep aquifer during any of the five sampling events. Isoconcentration maps showing the distribution of 4,4-DDD concentrations for this sampling event is included as Figure 21.

Monitoring well MW-37B contained aldrin in three of five sampling events, suggesting a local and limited source of this compound. Aldrin was not found elsewhere on-site.

Arsenic

Total arsenic concentrations were detected above the GWQS of 3 ug/l in four of five monitoring wells completed in the deep aquifer. These included monitoring well MW 11B (7.9 ug/l), MW-18B (7.9 ug/l), MW-20B (63.1 ug/l), and MW-38B (42.6 ug/l). Arsenic distribution is not consistent with the distribution of arsenic in the shallow aquifer or with the arsenic distribution in site soil. This may be in part due to known elevated concentrations of arsenic in soil, groundwater, and surface water throughout the region. Isoconcentration maps showing the distribution of arsenic concentrations for this sampling event is included as Figure 22.

Lead

Total lead concentrations were not detected above the GWQS of 5 ug/l in any of the five monitoring wells completed in the deep aquifer during any of the five sampling events. Isoconcentration maps showing the distribution of lead concentrations for this sampling event is included as Figure 23.

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Chlorides

Total chloride concentrations were analyzed during the February 2009 sampling event and were detected above both the New Jersey Class II-A GWQS of 250,000 ug/l and the New Jersey Class III-B GWQS of 3,000,000 ug/l in all five deep monitoring wells at the site. Concentrations varied from a low of 5,270,000 ug/l in monitoring well MW-18B to a high of 19,300,000 ug/l in MW-38B. Analytical results are presented in Table 3.

Total Dissolved Solids

Total dissolved solids were analyzed during the February 2009 sampling event and were detected above both the New Jersey Class II-A GWQS of 500,000 ug/l and the New Jersey Class III-B GWQS of 5,000,000 ug/l in all five deep monitoring wells at the site. Concentrations varied from a low of 9,760,000 ug/l in monitoring well MW-18B to a high of 28,900,000 ug/l in MW-38B. Analytical results are presented in Table 3.

3.3 Non-Aqueous Phase Liquid Occurrence and Recovery

Prior to the initiation of quarterly groundwater sampling activities in February 2008, a monitoring well rehabilitation program was completed on all wells proposed for sampling. During these activities, the presence of NAPL was noted in monitoring well MW-28A. This well is located within AOC U, the Unlined Pond, where NAPL compounds were disposed during historic plant operation. Extent of the NAPL has been delineated as part of remedial investigations.

NAPL composition is composed primarily of carbon tetrachloride, chloroform, and chlorobenzene, with smaller quantities of methylene chloride, with lesser amounts of other compounds such as carbon disulphide and ethylbenzene. NAPL also contains elevated levels of the pesticide, methoxychlor, which is soluble in organics but not in water.

To address the presence of NAPL in this well, interim remedial activities were implemented that involved monthly pumping and recovery of accumulated NAPL. To date, an estimated 3.75 liters of NAPL have been recovered.

The initial event was completed on August 18, 2008, and an estimated 0.75 liters of NAPL was recovered. Two additional events were completed during January 2009 that involved the pumping and recovery of an estimated 2.25 liters of NAPL. Subsequent recovery events have resulted in a consistent decrease in recoverable volume. After the April NAPL recovery resulted in minimal amounts of product, the program was suspended to determine if recovery would occur over a longer period of time.

All recovered NAPL was staged on-site in a steel 55-gallon drum. The drum was kept in secure, vented storage, properly labeled and staged on a secondary containment spill pad with a total volume capacity of 440 gallons. Weekly inspections were completed to verify the structural integrity of the subject drum and spill pad. Accumulated NAPL was transported to a permitted facility for disposal in June 2009.

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4.0 SUMMARY AND CONCLUSIONS

The key findings and conclusions of the sampling events are presented below.

4.1 Groundwater Flow

- Groundwater flow directions and gradients at the site have not changed substantially from those established from the 1994 to 2000 timeframe over the majority of the site
- Groundwater flow in the shallow fill aquifer is generally to the east toward the Arthur kill but is locally influenced in the north towards Piles Creek.
- A local groundwater depression occurs in the vicinity of monitoring well MW-42A, consistent with historical groundwater flow. The installation of an impermeable sheet pile wall on the perimeter of the ISP property further complicates flow in this area.
- The deeper aquifer is confined at the site, overlain by a tight clayey till and interbedded organic silt and clay marsh deposits. Groundwater flow in the deep aquifer is easterly across the site towards the Arthur Kill in the northern half of the site. Deep groundwater south of the hydraulic divide appears to move southwest towards the ISP property under influence of groundwater pumping by ISP.
- Vertical gradients are downward from the shallow water-bearing zone to the deep aquifer over the majority of the site. A local upward gradient is noted at monitoring well cluster MW-18.

4.2 Groundwater Quality

4.2.1 Shallow Aquifer Groundwater Quality

- Chlorinated organic compounds at concentrations exceeding New Jersey Class II-A criteria were identified in monitoring wells associated with AOC-U, the Unlined Pond, and the adjacent AOC I, Pesticide Manufacturing Area, located in the northeastern portion of the site. The chlorinated compounds in the shallow aquifer are derived from the historic disposal of NAPL compounds originating in the AOC U source area. The compounds of concern include benzene, chlorobenzene, and 1,4-dichlorobenzene. These compounds were all identified above New Jersey Class II-A criteria in monitoring wells MW-24A, MW-26A, and MW-37A. None of these compounds were identified in monitoring well MW-38A, immediately downgradient of AOC U.
- Chloroform and methylene chloride were noted intermittently at concentrations exceeding New Jersey Class II-A criteria in one monitoring well, MW-38A, immediately downgradient of the AOC U source area. These compounds are derived from the AOC U source area.

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- NAPL was identified in monitoring well MW-28A, located within the footprint of AOC U – the Unlined Pond. A NAPL plume was delineated as part of the Phase III remedial investigation. However, NAPL does not appear to be migrating towards the Arthur Kill as evidenced by the lack of NAPL in monitoring well MW-38A, immediately downgradient of the AOC U source area.
- SVOCs are not found at the site in concentrations exceeding New Jersey Class II-A criteria in the shallow fill aquifer.
- The pesticide compounds of concern are alpha-BHC, beta-BHC, and 4,4-DDD. These compounds are identified at concentrations exceeding GWQS in monitoring wells in the vicinity of AOC U, the Unlined Pond, and the adjacent AOC I, Pesticide Manufacturing Area, located in the northeastern portion of the site. Monitoring wells MW-24A (alpha-BHC, beta-BHC, and 4,4-DDD), MW-26A (alpha-BHC, beta-BHC, and 4,4-DDD), MW-37A (alpha-BHC, beta-BHC, and 4,4-DDD), and MW-38A (alpha-BHC, beta-BHC, and 4,4-DDD) contained varying concentrations of pesticides. The pesticides in this area are associated with manufacturing and disposal practices.
- Pesticides occur intermittently and in a dispersed pattern in other portions of the site. These locations are isolated from each other and do not indicate a widespread plume, but isolated areas of groundwater exceed New Jersey Class II-A criteria. Monitoring wells MW-15A and MW-18A in the southeastern part of the site contain alpha-BHC exceeding the GWQS. In the central portion of the site, exceedences occur in monitoring wells MW-7A (alpha-BHC and beta-BHC) and MW-13A (alpha-BHC and beta-BHC).
- Arsenic is found throughout the site at concentrations exceeding the GWQS of 3 ug/l, with the exception of the northwestern and southeastern corners of the site. Concentrations as high as 9,470 ug/l were noted in MW-16A as part of a plume of elevated concentrations in the southern portions of the site and encompassing monitoring well MW-15A. A second plume of arsenic is found in the central portion of the site with concentrations as high as 1,520 ug/l in PZ-07A, including monitoring wells MW 13A, MW-30A, and PZ-01A.
- Arsenic plumes are generally co-located with areas of elevated concentrations of arsenic in soil, as identified in the remedial investigations.
- Lead concentrations in shallow groundwater vary across the site with 17 of 40 sampling locations containing exceedences of the New Jersey Class II-A criteria. However, only two monitoring wells contain concentrations exceeding 25 ug/l, MW-39A (105 ug/l) in the central portion of the site and MW-10A (138 ug/l) in the southwestern corner of the site.
- Chloride and total dissolved solids are found throughout the site at concentrations exceeding New Jersey Class II-A criteria. These conditions are a result of the high salinity of the Arthur Kill, frequent flooding of the site, and aquifer intrusion by the river.

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4.2.2 Deep Aquifer Groundwater Quality

- Chlorinated compounds derived from the AOC U, the Unlined Pond, are found in monitoring well MW-38B, located downgradient from AOC U. This well contains elevated levels of benzene; chlorobenzene; chloroform; 1,4-dichlorobenzene; and methylene chloride at concentrations greater than those noted in any of the shallow monitoring wells. All of these compounds are found in NAPL from the AOC U source area.
- Benzene was the only volatile compound identified in deep monitoring wells throughout the rest of the site. Monitoring well MW-20B contained benzene at a concentration of 6 ug/,l suggesting a local limited source impacting groundwater.
- SVOCs are not found at the site in the deep aquifer at concentrations exceeding New Jersey Class II-A criteria.
- Only one key pesticide was noted in any of the deep monitoring wells during all sampling events. Alpha-BHC concentrations were detected above the GWQS of 0.02 ug/l in one monitoring well, MW-18B, at a concentration of 0.073 ug/l.
- Monitoring well MW-37B contained aldrin in three of five sampling events, suggesting a local and limited source of this compound. Aldrin was not found elsewhere on-site.
- Arsenic was detected above the GWQS of 3 ug/l in four of five monitoring wells completed in the deep aquifer at concentrations as high as 63.1 ug/l. Arsenic distribution is not consistent with the distribution of arsenic in the shallow aquifer or with the arsenic distribution in site soil. Regional groundwater and surface water is heavily impacted by arsenic, and the source of arsenic contamination cannot be determined.
- Lead is not found at the site in the deep aquifer at concentrations exceeding the New Jersey Class II-A criteria.
- Chloride and total dissolved solids are found throughout the deep aquifer at the site at concentrations exceeding both New Jersey Class II-A criteria and Class III-B criteria. These conditions are a result of the high salinity of the Arthur Kill and saltwater intrusion into the aquifer by the river.

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LINDEN-OPRA-008763

Exhibit K

REMEDIAL ACTION SELECTION REPORT
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY

VOLUME I

ISRA Case No. 92142

Date: January 2008

DuPont Project No.: 507439
URS Project No.: 18984572

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

Barley Mill Plaza, Building 19
Wilmington, Delaware 19805

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EXECUTIVE SUMMARY

This *Remedial Action Selection Report* (RASR) presents the remedial action to address potential media of concern and exposure pathways and to mitigate potential threats to human health and the environment at the DuPont Grasselli site located in Linden, Union County, New Jersey. This RASR revises and supersedes the October 23, 1998, RASR for the Facilities Area portion of the site and the January 6, 2006, RASR for the balance of the site (Sitewide), both previously submitted to the NJDEP by DuPont. This comprehensive RASR takes into consideration new developments for the property and addresses the entire site, replacing both of the previous RASRs.

The focus of this RASR is to address soil and groundwater throughout the site, including five source areas, areas of concern (AOCs) D, M, I, U, and P. The remedial action objectives (RAOs) for the site were established to provide overall protection of human health and the environment and return the site to beneficial reuse. Individual RAOs were developed for each AOC. The criteria in establishing RAOs were as follows:

- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide soil that exhibits constituents of potential concern (COPCs) at concentrations in excess of applicable soil criteria.
- Prevent migration of soil material that exhibits COPCs at concentrations in excess of applicable soil criteria through surface runoff.
- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide groundwater that exhibits COPCs at concentrations in excess of the applicable groundwater criteria.
- Eliminate further degradation of groundwater quality by addressing identified source areas.
- Prevent migration of contaminants from soil to groundwater by minimizing infiltration of surface water.
- Prevent groundwater use or consumption through institutional controls.
- Restrict future use of the property to nonresidential commercial or industrial uses through institutional controls.
- Maintain protection of adjacent surface water quality and ecological receptors.

The overall objective of the recommended remedial actions are to provide a cost-effective remedy that meets all requirements of the applicable NJDEP Technical Requirements for Site Remediation and established RAOs for the site. The remedial action is integrated with the site re-development, currently envisioned as large commercial warehousing structures. The site has been designated as "in need of re-development" by the City of Linden. The current DuPont/ISP Re-Development Plan, adopted by the Linden City Council on October 19, 2004, includes large warehousing and distribution operations to support the Port of New York and New Jersey activities.

DuPont's remedy, as proposed in this RASR, accomplishes the following three primary objectives:

- Protection of human health and the environment
- Beneficial reuse of a large volume of processed dredge material (PDM), filling a critical need for capacity in the New York and New Jersey Harbor region
- Re-development of the site into large warehousing operations, supporting the Portfields Initiative and providing jobs for the local community and increased tax ratables for the City of Linden

There is currently a critical need for suitable upland sites in which to place processed materials from dredging operations within the New York/New Jersey Harbor. The DuPont Grasselli property has been identified by the NJDEP Office of Dredging and Sediment Technology as a suitable and desirable location to place dredge materials.

DuPont has teamed with Clean Earth, Inc., to place up to one million cubic yards of PDM on-site. This material will be used to preload the site to improve bearing capacities and other geotechnical properties of the soil and to raise the site grade above the 100-year floodplain to facilitate the planned site re-development. This approach has been incorporated into this RASR, which includes a Material Acceptance Protocol for the proposed use of PDM.

The phased RI originally identified 22 AOCs at the site. These AOCs were each characterized and delineated, and the majority received determinations that no further action was necessary. Further delineation and remedial action is required for six AOCs. In general, the remedial action includes activities at AOCs D [West Fuel Aboveground Storage Tanks (ASTs)], I (Former DDT and Methoxychlor Area), M (Wade Brothers Company), P (re-defined as Sitewide Arsenic), U (Former Unlined Pond), and W (Sitewide Groundwater). The major components of the remedy are as follows:

- Free product and contaminated soil removal in identified source areas by soil excavation and off-site disposal
- Backfill excavations and required grading
- An isolation layer using PDM with a thickness ranging from a minimum of 1 foot up to several feet in depth over all remaining soils that exceed NRDCSCC or IGWSCC
- Final engineered controls will consist of a barrier layer consisting of the planned re-development hardscape, which includes concrete building slabs and asphalt paved parking areas)
- Deed restrictions to maintain the cover, control the excavation or exposure to site soils, and restrict future site use
- A Classification Exception Area and long-term groundwater monitoring

A pre-design investigation is included as part of this RASR to resolve data gaps, complete delineation of soil and groundwater constituents, and refine source areas (AOCs D, I, M, P, and U) delineation for remediation.

1.0 INTRODUCTION

This *Remedial Action Selection Report* (RASR) has been prepared for the DuPont Grasselli Site (ISRA Case No. 92142) located in Linden, New Jersey (see Figure 1-1). The RASR was prepared to satisfy the requirements of the New Jersey Department of Environmental Protection (NJDEP) in accordance with the *Technical Requirements for Site Remediation,* N.J.A.C. 7:26E-5.2, dated February 3, 2003 (Tech Regs). This RASR revises and supersedes the October 23, 1998, RASR for the Facilities Area portion of the site and the January 6, 2006, RASR for the remainder of the site (Sitewide), both previously submitted to the NJDEP by DuPont.

The original 1998 RASR was prepared for a portion of the site that was to be developed by the Liberty Generating Company, LLC, the redeveloper designated by the City of Linden for the Site at the time. The 1998 RASR was approved by NJDEP, but Liberty Generating ultimately cancelled their planned development project. In their ongoing effort to stimulate redevelopment, the City of Linden amended their redevelopment plan for the Tremley Point area to include construction of a large industrial warehousing complex on the DuPont property and adjoining industrial properties. This RASR takes into consideration these new developments for the property, addresses the entire site, and includes a pre-design investigation work plan to complete delineation of select areas of concern (AOCs).

1.1 Site Background

The DuPont Grasselli site is located in an industrial area in the eastern portion of Linden, New Jersey (see Figure 1-1). The former manufacturing site covers approximately 105 acres and is the area addressed by this RASR. The site does not include undeveloped property located west of the site that donated by DuPont to the New Jersey Turnpike Authority (NJTA) as a long-term conservation easement known as the NJTA Piles Creek East Wetlands Mitigation Project.

The Grasselli site originally consisted of tidal marshlands that, over time, were reclaimed by fill emplacement. In the early 1880s, the Standard Chemical Company purchased the land from several individual owners and developed the tract for industrial use. From 1885 until 1928, the Grasselli Chemical Company owned and operated the site. In 1928, DuPont purchased the site.

Historical manufacturing at the site included the production of sulfuric acid, ammonium thiosulfate, sodium bisulfate, inorganic salts, acids, and organic pesticides. Chemical production at the site was terminated in the fall of 1990. Since then, all of the site manufacturing buildings have been dismantled. Current site operations consist of a tenant concrete crushing/recycling operation in the southern portion of the site. The majority of the site surface is covered by gravel, crushed stone, or soil, with paved and unpaved roads and two small paved parking lots.

The complete operational history of the site is included in the *Operational History of the DuPont Grasselli Facility* [DuPont Environmental Remediation Services (DERS), 1990].

An aerial photograph history is included in the *Environmental Cleanup Responsibility Act (ECRA) Field Sampling Plan* (DERS, 1992).

1.2 Recommended Remedial Action

The recommended remedial actions for the site include source removal and off-site disposal, capping of the site, and institutional controls. Sitewide groundwater will be addressed through source removal, natural remediation of groundwater, creation of a Classification Exception Area (CEA) covering the entire site, and long-term groundwater monitoring to document groundwater quality improvement. This approach will maintain the protection of surface water and other ecological receptors. It should be noted that the Phase III Remedial Investigation (RI) confirmed previous evaluation results that showed that contaminated groundwater is not impacting surface water.

Source removal activities are proposed for the following five AOCs:

- AOC D [West Fuel Aboveground Storage Tanks (ASTs)]
- AOC M (Wade Brothers Company)
- AOC I (DDT and Methoxychlor Area)
- AOC U (Former Unlined Pond)
- AOC P (re-defined as Sitewide Arsenic)

AOC W (Sitewide Groundwater) will be addressed through the source removal activities in the five AOCs identified above, combined with natural attenuation, institutional controls, and long-term groundwater monitoring.

Supplemental delineation activities are proposed for these AOCs to effectively implement the remedial action. A pre-design investigation work plan is included as Section 5.0 of this report to facilitate NJDEP approvals and accelerate implementation of the remedial action. The remedial action for AOC I is conditional on the results of the delineation activities. Figure 1-2 shows the locations of all AOCs at the site.

Implementation of the remedial action will address all outstanding issues raised by the NJDEP and resolve the status of the six AOCs that have not received determinations of "no further action."

1.3 Site Re-Development Plan

The Grasselli site has been designated "in need of re-development" by the City of Linden. The current re-development plan for the DuPont site and adjacent ISP property includes large warehousing and distribution operations. Figure 1-3 provides a conceptual plan for site re-development in accordance with the City of Linden's re-development plans. The conceptual plan provides an illustration of the details of engineering controls that will be incorporated into the re-development of the site. The four large warehouses and paved areas provide an impermeable barrier layer to underlying soils to protect human health and the environment.

Completion of the source removal activities and placement of a sitewide soil cover will facilitate re-development of the site. Specifically, a proposal to accept beneficial use materials meeting a defined acceptance criteria is part of this RASR. The potential sources of material include processed dredge materials (PDM). PDM will be placed at the site for construction pre-loading and will be regraded as the secondary sitewide cover. The PDM will be covered by a minimum of 1 foot of clean fill [i.e., clean fill is defined as fill meeting the Nonresidential Direct Contact Soil Cleanup Criteria (NRDCSCC)]. DuPont has contracted Clean Earth, Inc., to provide PDM and manage the PDM on-site for construction pre-loading and final site cover.

PDM will be transported to the site and will be used as surcharge to consolidate site soils in anticipation of site re-development and bring the site to construction grade elevations. This approach will provide an effective soil barrier for the site following remediation in addition to providing a secondary level of protection to the primary soil sitewide cover.

The recommended remedial actions will address environmental concerns rapidly, return the site to beneficial use, and reduce the potential contact pathways. The recovery and removal of contaminated material and replacement with permitted backfill will assist in the site re-development by improving the geotechnical properties of the subgrade for construction. Remediated on-site areas can be readily developed for either industrial or commercial purposes.

1.4 RASR Organization

This RASR conforms to requirements set forth in NJAC 7.26E-5 of the Tech Regs. Table 1-1 provides a cross reference of the Tech Regs [N.J.A.C. 7:26E-5.1(b) through 5.2(e)] to the section of the RASR where the particular requirement is addressed.

This RASR is organized into the following six sections:

- Section 2.0 provides details on the AOCs; background on the site setting, geology, and hydrogeology; and a summary of previous investigations.
- Section 3.0 presents the remedial action objectives (RAOs).
- Section 4.0 provides a summary of the recommended remedial actions for each AOC and compares the remedial actions against the NJDEP evaluation criteria.
- Section 5.0 provides the details on the pre-design investigation that are necessary before the remedial action can be initiated. Section 6.0 provides a list of references.

Tables and figures are presented separately at the end of the text. Additional detail about AOC history and sampling methodologies are provided in Appendices A and B, respectively. A Material Acceptance Protocol for Review and Certification of Off-Site Recyclable Fill Materials is provided in Appendix C. The site-specific Health and Safety Plan (HASP) is provided in Appendix D. The site-specific Quality Assurance Project Plan (QAPP) for all sampling activities described herein is provided in Appendix E.

2.0 SUMMARY OF SITE CONDITIONS

2.1 Site Location and Topography

The DuPont Grasselli site is located in an industrial area in the eastern portion of Linden, New Jersey. The former manufacturing site covers approximately 105 acres. The site is bounded on the east by the Arthur Kill, to the north by Piles Creek and Public Service Enterprise Group, to the south by International Specialty Products/General Aniline Film (ISP/GAF), and to the west by the Perth Amboy Railroad (Elizabeth Port Branch) and the New Jersey Turnpike. Figure 2-1 identifies the site property boundary and neighboring properties.

Two main topographic features are present within Union County: the Watchung Mountains on the western border of Union County and the gently undulating Piedmont Plain on the eastern side of the Watchung Mountains. The rolling plain slopes to the southeast from an elevation of 150 feet adjacent to the mountains to sea level at the Arthur Kill. Because the DuPont Grasselli site is situated adjacent to the Arthur Kill, the topographic elevation of the site is generally 10 feet or less above mean sea level (MSL).

The DuPont Grasselli site is located within the Arthur Kill drainage basin. This basin is drained by perennial tidal streams that approximately follow preglacial buried river channels. The streams that drain into the Arthur Kill in the general region of the DuPont Grasselli site include Piles Creek, Morses Creek, and Half Bushel Creek.

2.2 Geology and Hydrogeology

Geologically, the DuPont Grasselli site is situated within the Newark Basin. The site is underlain by fill deposits that range in thickness from 10 to 18 feet and consist predominantly of fine to coarse sand. Some locations within the site contain gravel, silt, clay, brick, crushed stone, sulfur, coal, and wood. Underlying the fill deposits are recent marsh deposits consisting of brown peat and organic clay, ranging in thickness from 10 to 15 feet. Pleistocene glacial till deposits are below the peat, varying in thickness from 6 to 18 feet and consisting of red-brown, silty clay with sand and gravel. The Jurassic/Triassic age Passaic Formation, also known as the Brunswick Shale, underlies the glacial till and consists of weathered red shale in the area of the DuPont Grasselli site.

The upper hydrologic unit identified at the DuPont Grasselli site is within the fill layer and is referred to as either Hydrologic Unit A or the shallow aquifer. The depth to groundwater is very shallow and ranges from a few inches to 6 feet below ground surface (bgs). The lower hydrologic unit is below the peat layer and, in some areas, below the clay portion of the glacial till. This hydrogeologic unit, referred to as either Hydrologic Unit B or the deep aquifer, may behave as a confined aquifer. The two hydrologic units are separated by the thick marsh deposits of peat and clay and, in some areas, by the clayey glacial till deposits. A cross section location map and associated lithologic cross sections are provided in Figures 2-2, 2-3, and 2-4.

Contoured groundwater elevations representing high and low tide conditions on September 5, 2000, for the shallow aquifer are shown in Figures 2-5 and 2-6, respectively. The potentiometric surface of the deep aquifer is shown in Figure 2-7. Groundwater within the shallow aquifer historically flows outward from a divide centered over the undeveloped western portion of the site toward the Arthur Kill and Piles Creek. However, the soil excavation for the NJTA wetland mitigation project created a groundwater sink that has significantly altered flow in the shallow aquifer. The shallow aquifer groundwater divide has now shifted eastward, with a north-to-south orientation through the center of the former manufacturing portion of the plant. Groundwater in the deep aquifer flows toward the Arthur Kill.

2.3 Summary of Previous Investigations

The Grasselli site has been the subject of a RI since 1992 under ECRA, now the Industrial Site Recovery Act (ISRA).

In 1990, DERS completed the *Operational History of the DuPont Grasselli Facility* (DERS, 1990) that identified the general environmental setting and determined the chemical manufacturing and waste disposal history of the plant. Most importantly, however, the operational history document identified the following 22 AOCs:

- AOC A (Pipeline Right-of-Way)
- AOC B (Former Marsh Disposal)
- AOC C (DMHA Waste Holding Pond)
- AOC D (West Fuel Oil ASTs)
- AOC E (Building 54 Septic System)
- AOC F (Former East Fuel Oil ASTs)
- AOC G (Main Office Septic System)
- AOC H (North Septic System)
- AOC I (Former DDT and Methoxychlor Area)
- AOC J (Former North Fuel Oil Tanks)
- AOC K (Former Disposal Area)
- AOC L (pH Adjustment Ponds)
- AOC M (Wade Brothers Company)
- AOC N (Ditches)
- AOC O (Former Lithopone Production Area)
- AOC P (re-defined as Sitewide Arsenic)
- AOC Q (West Portion of Site)
- AOC R (Septic Systems)
- AOC S (Gasoline AST #25 and Pump)

- AOC T (Spill E, Building 3)
- AOC U (Former Unlined Pond)
- AOC W (Sitewide Groundwater)

Investigations were initiated to determine if these AOCs were detrimentally impacting the soil and/or water quality as well as overall site environmental quality. The subsections below summarize the general activities implemented during the four previous environmental investigations on-site: a voluntary environmental investigation, an ECRA investigation, a Phase II RI, and a Phase III RI.

2.3.1 Voluntary Environmental Investigation

The environmental investigation was conducted as a voluntary preliminary site assessment to determine if AOCs identified in the *Operational History of the DuPont Grasselli Facility* (DERS, 1990) had impacted the quality of soil, sediment, and water in and around the site. In addition, the investigation focused on the site geology and flow regimes associated with the surrounding surface water and site groundwater. Investigation results identified several AOCs as needing further evaluation. More detailed information about this investigation is provided in the complete report (DERS, 1991).

2.3.2 ECRA Investigation

An ECRA investigation (considered by DuPont as a Phase I RI) was performed to build on the data collected during the previous environmental investigation. ECRA investigation results showed that arsenic was the most pervasive constituent in site soil and that lead and polyaromatic aromatic hydrocarbons (PAHs) were sporadically distributed in site soil. Metals and pesticides were identified as constituents of potential concern (COPCs) in shallow groundwater based on a comparison of groundwater concentration results against the New Jersey Surface Water Quality Standards (SWQS) and New Jersey Class IIA groundwater (GWIIA) criteria. Volatile organic compounds (VOCs) were identified as COPCs and were detected in select shallow groundwater monitoring wells. Deep zone groundwater was found to have little, if any, impact on surface water. More detailed information about this investigation is provided in the complete report (DERS, 1993).

2.3.3 Phase II RI

The Phase II RI was designed in accordance with the N.J.A.C. 7.26E that allows for the use of the NRDCSCC for soil delineation where property use is restricted to industrial purposes (NJDEP, 2002). According to the Tech Regs, the site perimeter must still be delineated to the Residential Direct Contact Soil Cleanup Criteria (RDCSCC). These criteria were used to delineate 12 AOCs during the Phase II RI. Because arsenic, lead, and PAHs appeared to be distributed in a manner independent of AOC activities or AOC boundaries, DuPont requested a variance from the TRSR. The NJDEP agreed that these constituents could be delineated sitewide, but requested additional sitewide sampling and analysis for these constituents.

Phase II RI results showed that no further action was required at three AOCs. Based on investigation results, DuPont concluded that no further investigation was required at five AOCs and recommended additional investigative work at four AOCs (AOCs I, J, K, and U). In a January 29, 1999, letter, the NJDEP generally concurred with these conclusions and recommendations, but also identified additional issues at some AOCs as needing further evaluation. The additional work was conducted as part of a Phase III RI. More detailed information about the Phase II RI is provided in the complete report (DERS, 1998).

After completion of the Phase II RI, a *Remedial Action Selection Report* was prepared for a portion of the site identified as the Facilities Area (DuPont, 1998). The Facilities Area RASR was followed by a *Remedial Action Work Plan* (DuPont, 2000), which was submitted to and subsequently approved by the NJDEP in December 2000. The Facilities Area was an approximately 43-acre portion of the property that was to become the site of an electrical generating station owned and operated by Liberty Generating Company, LLC. Liberty Generating Company subsequently went bankrupt, and plans for the generating station were abandoned.

2.3.4 Phase III RI

In 2000, DuPont completed a Phase III RI. The Phase III RI was conducted to address those NJDEP concerns that required additional investigations within specific AOCs. The following additional activities were required:

- AOC-specific soil delineation
- Sitewide and AOC-specific groundwater characterization
- Surface water quality impact evaluation
- Baseline ecological evaluation (BEE)

The results of these activities are summarized below. More detailed information about the Phase III RI is provided in the complete report (DuPont, 2001). The Phase III RI was approved by the NJDEP, and the conclusions of the Phase III RI Report were endorsed in a letter dated December 27, 2001 from Lois Arbegast, Supervisor of BEECRA to Mr. Ralph Sloat of DuPont.

Soil Delineation

Eight AOCs (AOCs D, E, I, J, K, M, P, and U) were investigated to complete delineation of soil COPCs. The results and conclusions are summarized below.

- AOCs D, J, K, and U were delineated, and no further investigation was required.
- No further action was recommended for AOC E because soil concentrations were below applicable criteria, and groundwater quality was only slightly above GWIIA criteria.
- AOCs I and P were not fully delineated, but soil and groundwater were sufficiently characterized to allow development of a RASR, which was submitted to the NJDEP in January 2006 (DuPont, 2006).

- Delineation efforts indicated that the fate of fuel oil in groundwater at AOC M may have been influenced by construction of wetlands to the west; therefore, further delineation was required.

Groundwater Characterization

During the Phase III RI, DuPont collected additional data to characterize groundwater in both the shallow and deep zones. Analytical results of groundwater from 28 shallow zone wells and four deep zone wells were evaluated on a sitewide basis (AOC W). Constituent concentrations were compared with 10 years of analytical data. Trend evaluations determined that, in both shallow and deep wells, overall concentrations were stable and no further groundwater investigation was recommended for sitewide constituents. Additional groundwater delineation related to specific AOCs, as described above, was required.

Surface Water Quality Evaluation

Surface water samples were collected from Piles Creek and the Arthur Kill, both upstream and downstream of the site. Data from Piles Creek showed higher upstream concentrations of COPCs than downstream samples. Data from the Arthur Kill samples showed no significant upstream/downstream pattern. Additionally, Piles Creek, containing base flow contaminants, discharges to the Arthur Kill between the upstream and downstream sampling locations. No significant impact to the Arthur Kill from site groundwater could be determined because of the data variability and the Piles Creek contribution.

Based on the data from the Phase III RI and conservative fate and transport calculations performed during the Phase II RI, the NJDEP and DuPont determined that surface water has not been significantly impacted by the site. This was confirmed by the NJDEP in a letter dated December 27, 2001 from Lois Arbegast, Supervisor of BEECRA to Mr. Ralph Sloat of DuPont.

Baseline Ecological Evaluation

A BEE was conducted as part of Phase III RI activities. Potential ecological receptors were identified using current land and water use exposure scenarios. The BEE identified the following three ecologically sensitive areas adjacent to the site: Piles Creek and associated wetland areas, Arthur Kill, and Prall's Island. DuPont and the NJDEP concurred that additional ecological assessment was not warranted because of the documented poor quality of Arthur Kill surface water and sediments, reflecting a complex urban/industrial drainage system. DuPont and the NJDEP also concurred that additional ecological assessment was not warranted.

Potential migration pathways for COPCs in environmental media at the site were identified and evaluated based on existing information regarding current conditions at the site and on readily available information regarding human and environmental populations. Based on the chemical and physical properties of the preliminary COPCs and the known physical, topographic, meteorological, and hydrologic conditions at the site, the potential pathways are as follows:

- Overland runoff of site COPCs from surface soil to downgradient surface water bodies (including sediment) during precipitation events

- Airborne transport of particulates generated by wind erosion of site surface soil and physical disturbance of site surface and subsurface soil to downwind locations
- Leaching of constituents in site soil (surface and subsurface) to shallow groundwater
- Migration of dissolved constituents in site groundwater beneath the former DuPont Grasselli plant to downgradient surface water bodies

2.4 Current Status

The RI originally identified 22 AOCs at the site. These AOCs were each characterized and delineated and the majority received determinations that no further action was necessary. Upon completion of the Phase III RI in 2000, the NJDEP issued a letter to DuPont dated December 27, 2001, approving the completion of investigation of all AOCs at the site with the exception of AOCs D, I, M, P, U and W. In the December 2001 letter, the NJDEP stated that these remaining data gaps could be addressed in a pre-design investigation, which is included as part of this RASR (see Section 5.0). Table 2-1 summarizes the current status of each AOC.

3.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

Remedial actions for each AOC were selected to be consistent with future site use, achieve AOC-specific RAOs, and meet applicable NJDEP remediation standards. The RAOs for the site were established to provide overall protection of human health and the environment and return the site to beneficial use. The criteria in establishing RAOs are as follows:

- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide soil that contains COPCs at concentrations in excess of applicable soil criteria.
- Prevent migration of soil material that contains COPCs at concentrations in excess of applicable soil criteria through surface runoff.
- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide groundwater that contains COPCs at concentrations in excess of the applicable groundwater criteria.
- Eliminate further degradation of groundwater quality by addressing identified source areas.
- Prevent migration of contaminants from soil to groundwater by minimizing infiltration of surface water.
- Prevent groundwater use or consumption through institutional controls.
- Restrict future use of the property to nonresidential, commercial, or industrial uses through institutional controls.
- Maintain protection of adjacent surface water quality and ecological receptors.

3.1 Conceptual Site Re-Development

The planned site re-development is for nonresidential use and is compatible with re-development under a commercial use setting and the New Jersey Portfields Initiative. The Grasselli site has been designated "in need of re-development" by the City of Linden. The current re-development plan for the DuPont site and adjacent ISP property includes large warehousing and distribution operations. The site's re-development plan has not been finalized. For purposes of this RASR, a conceptual re-development plan is provided that is consistent with preliminary re-development plans contemplated for the site and considers existing access and egress points. The conceptual plan considers four large warehouse structures with associated parking lots, paved loading and unloading areas, drainage control areas, and other associated features shown in Figure 1-3. The conceptual plan meets the zoning classification for this area. All major utilities are available in sufficient capacity to support re-development. Storm water can be managed on-site by storm water retention basins in accordance with current regulations and ordinances.

There is currently a critical need for suitable upland sites in which to place processed materials from dredging operations within the New York/New Jersey Harbor. The site has been identified by the NJDEP Office of Dredging and Sediment Technology as a suitable and desirable location to place dredge materials. DuPont has contracted Clean Earth, Inc., to place up to 1 million cubic yards of PDM on the site. This material will be used to (1) preload the site to improve bearing capacities and other geotechnical properties of the soil and (2) raise the site grade above the 100-year floodplain to facilitate the planned site re-development.

The conceptual plan provides an illustration of the details of engineering controls that will be incorporated into the re-development of the site. The four large warehouses and paved areas provide an impermeable barrier layer to underlying soils in a manner that is protective of human health and the environment. This barrier layer is the primary soil sitewide cover, with the underlying PDM providing a secondary level of protection.

The final configuration of the buildings and site layout may change as re-development plans progress. However, the conceptual plan shown in Figure 1-3 is sufficient for determining the appropriateness of the proposed RAOs and cleanup goals and the ability of the proposed remedial approach to coordinate with and support the proposed site re-development.

3.2 Applicable Remediation Standards

The following two media of concern have been identified on the site:

- Soil – As previously indicated, impacted soil has been identified in the following AOCs: West Fuel Oil ASTs (AOC D), Wade Brothers Company (AOC M), Former DDT and Methoxychlor Area (AOC I), Former Unlined Pond (AOC U), and Sitewide Arsenic (AOC P)
- Sitewide Groundwater (AOC W)

Proposed remediation standards for these media of concern are provided below. The proposed remediation standards are consistent with the requirements of Section 7:26E-1.13 of the Tech Regs addressing surface and groundwater remediation standards.

Consistent with the Tech Regs, DuPont proposes a "Restricted Use Remedial Action" that will require the continued use of engineering and institutional controls to meet the established health risk or environmental standards. The proposed applicable remediation standards, with which soils in the above-referenced AOCs will be compared, include the following based on current and anticipated future site use:

- RDCSCC (last revised May 12, 1999)
- NRDCSCC (last revised May 12, 1999) and Impact to Groundwater (IGWSCC)

The proposed applicable remediation standard for Sitewide Groundwater (AOC W), based on current and potential future site use, is the GWIIA criteria dated January 30, 2002.

3.3 AOC D Remedial Action Objectives

Given the existing soil quality data and the applicable remediation standards, the following RAOs are proposed for AOC D (West Fuel Oil ASTs):

- Remove visually impacted soils and associated petroleum hydrocarbons in areas where petroleum hydrocarbon residue in soil or nonaqueous phase liquids (NAPL) is observed. Removed soils and NAPL will be disposed of off-site.
- Implement engineering controls by constructing a passive barrier layer that covers remaining on-site soils containing VOC, metal, and semi-VOC (SVOC) concentrations above the NRDCSCC to prevent direct contact.
- Use institutional controls where direct contact cannot be avoided during re-development construction by preparing a soil reuse plan and defining required worker protection.
- Select engineering controls to protect against impact to groundwater where concentrations remain above the IGWSCC. These controls will also protect against transport by air or surface water erosion while coordinating with surface improvements that will be made for site re-development.
- Implement engineering controls as necessary to protect any future occupied building against intrusion of unacceptable levels of organic vapors from VOCs or SVOCs in soil. Implementation of engineering controls will be determined during the remedial action work plan after preparation of the re-development plans that will provide actual locations of occupied buildings.

3.4 AOC M Remedial Action Objectives

Given the existing soil quality data and the applicable remediation standards, the following RAOs are proposed for AOC M (Wade Brothers Company):

- Remove visually impacted soils and associated petroleum hydrocarbons in areas where petroleum hydrocarbon residue in soil or NAPL is observed. Removed soils and NAPL will be disposed of off-site.
- Implement engineering controls by constructing a passive barrier layer that covers remaining on-site soils containing VOC, metal, and SVOC concentrations above the NRDCSCC to prevent direct contact.
- Use institutional controls where direct contact cannot be avoided during re-development construction by preparing a soil reuse plan and defining required worker protection.
- Select engineering controls to protect against impact to groundwater where concentrations remain above the IGWSCC. These controls will also protect against transport by air or surface water erosion while coordinating with surface improvements that will be made for site re-development.
- Implement engineering controls as necessary to protect any future occupied building against intrusion of unacceptable levels of organic vapors from VOCs or

SVOCs in soil. Implementation of engineering controls will be determined during the remedial action work plan after preparation of the re-development plans that will provide actual locations of occupied buildings.

3.5 AOC I Remedial Action Objectives

Given the existing soil quality data and the applicable remediation standards, the following RAOs are proposed for AOC I (Former DDT and Methoxychlor Area):

- Remove visually impacted soils and associated dense NAPL (DNAPL) in areas where DNAPL is observed. These areas are associated with the DNAPL observed in the Former Unlined Pond (AOC U) and will be remediated in conjunction with the remedial action at AOC U. Soils and DNAPL will be disposed of off-site.
- Implement engineering controls by constructing a passive barrier layer that covers remaining on-site soils containing VOC, metal, and SVOC concentrations above the NRDCSCC to prevent direct contact.
- Use institutional controls where direct contact cannot be avoided during re-development construction by preparing a soil reuse plan and defining required worker protection.
- Select engineering controls to protect against impact to groundwater where concentrations remain above the IGWSCC. These controls will also protect against transport by air or surface water erosion while coordinating with surface improvements that will be made for site re-development.
- Implement engineering controls as necessary to protect any future occupied building against intrusion of unacceptable levels of organic vapors from VOCs or SVOCs in soil. Implementation of engineering controls will be determined during the remedial action work plan after preparation of the re-development plans that will provide actual locations of occupied buildings.

3.6 AOC U Remedial Action Objectives

Given the existing soil quality data and the applicable remediation standards, the following RAOs are proposed for AOC U (Former Unlined Pond):

- Remove visually impacted soils and associated DNAPL in areas where DNAPL is observed. Soils and DNAPL will be disposed of off-site.
- Implement engineering controls by constructing a passive barrier layer that covers remaining on-site soils containing VOC, metal, and SVOC concentrations above the NRDCSCC to prevent direct contact.
- Use institutional controls where direct contact cannot be avoided during re-development construction by preparing a soil reuse plan and defining required worker protection.
- Select engineering controls to protect against impact to groundwater where concentrations remain above the IGWSCC. These controls will also protect

against transport by air or surface water erosion while coordinating with surface improvements that will be made for site re-development.

- Implement engineering controls as necessary to protect any future occupied building against intrusion of unacceptable levels of organic vapors from VOCs or SVOCs in soil. Implementation of engineering controls will be determined during the remedial action work plan after preparation of the re-development plans that will provide actual locations of occupied buildings.

3.7 AOC P Remedial Action Objectives

Two specific areas within AOC P with elevated arsenic concentrations have been designated for remedial action based on soil delineation activities: an area near monitoring well MW-15A and an area near monitoring well MW-13A. These areas are further identified in Section 4.0. Given the existing soil quality data and the applicable remediation standards, the following RAOs are proposed for AOC P (Sitewide Arsenic):

- Remove arsenic-impacted soil with arsenic concentrations greater than 300 milligrams per kilogram (mg/kg). Soils containing arsenic with concentrations greater than 300 mg/kg will be disposed of off-site.
- Implement engineering controls by constructing a passive barrier layer that covers remaining on-site soils containing VOC, metal, and SVOC concentrations above the NRDCSCC to prevent direct contact.
- Use institutional controls where direct contact cannot be avoided during re-development construction by preparing a soil reuse plan and defining required worker protection.
- Select engineering controls to protect against impact to groundwater where concentrations remain above IGWSCC. These controls will also protect against transport by air or surface water erosion while coordinating with surface improvements that will be made for site re-development.
- Implement engineering controls as necessary to protect any future occupied building against intrusion of unacceptable levels of organic vapors from VOCs or SVOCs in soil. Implementation of engineering controls will be determined during the remedial action work plan after preparation of the re-development plans that will provide actual locations of occupied buildings.

3.8 AOC W Remedial Action Objectives

Given the existing groundwater quality data and the applicable remediation standards, the following RAOs are proposed for AOC W (Sitewide Groundwater):

- Control the potential for groundwater COPCs to migrate to downgradient surface water bodies.
- Protect as necessary against intrusion of vapors that may be generated by elevated concentrations of VOCs in groundwater into occupied structures that may be constructed.

- After soil remediation and engineered controls are implemented, implement institutional controls (CEA) to prevent use of on-site groundwater until GWIIA criteria are achieved through natural processes.

4.0 REMEDIAL ACTION SELECTION

This section provides an overview of the proposed remedial approach that was developed based on existing site data and the RAOs established in Section 3.0. The recommended remedial actions for each AOC were developed to meet the RAOs based on all available information from the RI and an evaluation of a wide range of potentially applicable remedial alternatives. Discussions of the details of how the RAOs will be achieved for each AOC are presented below.

The remedial actions for the site will be protective of human health and the environment by removing sources to groundwater contamination, providing effective engineering barriers and institutional controls to isolate soils and prevent direct contact, and allowing site access while restoring it to productive use. Both the placement of PDM to raise the site grade and the construction of concrete foundations and asphalt paved areas provide effective primary and secondary barriers and are consistent with planned site use.

4.1 Overview of the Proposed Remedial Action

The remedial actions are designed to achieve source removal and prevent direct contact with remaining site soils exceeding the NRDCSCC or IGWSCC. All excavated source area soils will be disposed of in permitted off-site facilities. The proposed remedial actions will not cause an uncontrolled discharge or result in the transfer of contaminants to other media.

Prior to the start of the remedial action, monitoring wells that are located within the footprint of the proposed excavation areas will be removed to prevent the well from being lost and/or damaged. The wells will be removed by a New Jersey licensed well driller in accordance with N.J.A.C. 7:9 *Sealing of Abandoned Wells*. After completion of the abandonment procedures, the contracted driller will submit the required well abandonment forms to the NJDEP Bureau of Water Allocation. Following completion of the remedial activities (including final PDM placement), select wells will be reinstalled for long-term monitoring. A network of monitoring wells, approved by the NJDEP, will be established as part of the long-term groundwater monitoring program to monitor both the shallow and deep water-bearing units.

Soil excavation beneath the water table is proposed for several of the AOCs, as described below. These excavations will be sloped or retained by sheet piling as required to maintain safe working conditions and prevent sloughing of material. Details of any required sheeting or shoring will be finalized after completion of the pre-design investigation and determination of the horizontal and vertical limits of excavations.

The fine-grained nature of the fill materials that comprise the shallow water-bearing zone results in the low transmission of groundwater through these soils. It is anticipated that construction dewatering of excavations will not be required based on the nature of the soils and experience at adjacent and nearby sites.

4.1.1 Institutional Controls

The remedial actions described below for each AOC will be supplemented by institutional controls in the form of deed restrictions for the site and establishment of a CEA to prevent use of site groundwater. Deed restrictions will limit excavation and use/disposal of site soil as well as limitations on future use consistent with the nature of the site. The CEA will be supplemented by long-term groundwater monitoring to ascertain the improvements in groundwater quality that are expected after source removal actions are complete.

A Deed Notice will be prepared and recorded for the remedial action. The Deed Notice will identify postremediation site conditions and institutional controls. The site is currently zoned for nonresidential use, which is consistent with the remediation standards proposed herein using NJDEP criteria established for nonresidential exposures. A draft Deed Notice will be included in the remedial action work plan and will address the following:

- The types, concentrations and spatial extent of COPCs in excess of RDCSCC
- The engineering controls applicable to the property
- The specific use restrictions to the applicable property due to contamination, including a nonresidential use limitation and an approved soil reuse plan establishing procedures for proper handling of contaminated soil and implementation of health and safety control measures if impacted soil is disturbed during future site development work and/or maintenance
- Maintenance and monitoring procedures of the Deed Notice, including biennial certifications certifying that the following is true:
  - Periodic inspections of engineering controls have been performed
  - Engineering controls continue to be protective
  - Land use is consistent with use restrictions
  - No disturbance has occurred within the restricted area enumerated in the Deed Notice that presents an unacceptable risk to public health, safety, or the environment.

The Grasselli site is owned by DuPont, and deed restrictions to restrict future site use and to prevent uncontrolled excavations is acceptable to the Corporation. A Deed Notice based on Appendix E in N.J.A.C. 7:26E will be prepared and recorded with the actual property deed.

A CEA will be prepared and submitted for groundwater within the shallow and deep water-bearing units at the site. The proposed remedial action and PDM placement will necessitate the removal and replacement of the majority of the monitoring wells at the site. The new wells will be incorporated into a groundwater monitoring program to support the CEA application. The condition of existing wells will be ascertained as part of the pre-design investigation to be conducted prior to remedial action. Available monitoring wells will be sampled to provide baseline conditions for the CEA application and support development of a new monitoring program.

4.2 AOC D - West Fuel Oil ASTs

A tar-like residue from degraded petroleum hydrocarbons was noted in soils at this AOC. The total volume of contaminated soil is estimated to be approximately 10,000 cubic yards, but this volume may be subject to revision after further delineation is performed. The remedial standard will be based on the observation of petroleum hydrocarbon residue in soil or NAPL in the shallow groundwater zone. Excavation limits will be confirmed by visual observation during the remedial action. All soils containing the visual evidence of hydrocarbon residue or NAPL will be removed.

The proposed remediation activities for this AOC include the excavation of soils exceeding the remediation standard and direct loading of material into lined trucks for transportation to a permitted treatment or disposal facility. The excavation in this AOC will extend below the water table. Groundwater will be managed as necessary to verify that RAOs are achieved. Excavation dewatering is not anticipated in this area due to the fine-grained nature of the soils. Excavations will be supported as necessary to prevent slumping.

Excavations will be backfilled with PDM or clean granular fill derived from off-site sources. Backfill soil will be placed in discrete lifts and compacted by a bulldozer or roller. After completing re-development construction, the AOC will be capped by placing additional permitted fill materials over an impermeable hardscape of asphalt paving or concrete floor slabs. This approach will provide a minimum of 12 inches of permitted soil and an engineered barrier over the residual AOC soil.

Finally, a Deed Notice as described in Section 4.1.1 will be prepared to document future land use restrictions, chemicals present in soil in excess of RDCSCC and/or NRDCSCC, required engineering controls (e.g., caps and/or vapor intrusion controls), and maintenance and inspection requirements for the engineered controls.

4.3 AOC M - Wade Brothers Company

Soil contaminated by petroleum products is present in this area. Free-phase diesel fuel or a similar product will likely be encountered. The total volume of contaminated soil is estimated to be approximately 1,500 cubic yards, but may be subject to revision after further delineation is performed. If free-phase product is identified in recoverable quantities during delineation activities, product recovery and treatment will be instituted on an interim basis prior to sitewide remedial excavation activities. The remedial standard will be based on the observation of petroleum hydrocarbon NAPL or visible soil contamination. Excavation limits will be confirmed by visual observation during the remedial action. All soils containing NAPL will be removed.

The proposed remediation activities for this AOC include the excavation of soils exceeding the remediation standard and direct loading of material into lined trucks for transportation to a permitted treatment or disposal facility. The excavation in this AOC will extend below the water table. Groundwater will be managed as necessary to verify that RAOs are achieved. Excavation dewatering is not anticipated in this area due to the fine-grained nature of the soils. Excavations will be supported as necessary to prevent slumping.

Excavations will be backfilled with PDM or clean granular fill derived from off-site sources. Backfill soil will be placed in discrete lifts and compacted by a bulldozer or roller. After completing re-development construction, the AOC will be capped by placing additional permitted fill materials over an impermeable hardscape of asphalt paving or concrete floor slabs. This approach will provide a minimum of 12 inches of permitted soil and an engineered barrier over the residual AOC soil.

Finally, a Deed Notice as described in Section 4.1.1 will be prepared to document future land use restrictions, chemicals present in soil in excess of RDCSCC and/or NRDCSCC, required engineering controls (e.g., caps and/or vapor intrusion controls), and maintenance and inspection requirements for the engineered controls.

4.4 AOC I – Former DDT and Methoxychlor Area

Pesticides and metals exist in soil at this former manufacturing area; however, the extent and total volume of contaminated soil is unknown at this time and further delineation is required. The location of this AOC is adjacent to AOC U, and the COPCs associated with AOC U may be found to extend to AOC I. Horizontal and vertical delineation activities will provide the information needed to determine the soil quantities that will need to be remediated. The remedial standard will be based on the observation of chlorinated hydrocarbon DNAPL or visible soil contamination. Excavation limits will be confirmed by visual observation during remedial action. All visibly impacted soils and soils containing DNAPL or residual product will be removed.

The proposed remediation activities for this AOC include the excavation of soils exceeding the remediation standard and direct loading of material into lined trucks for transportation to a permitted treatment or disposal facility. If necessary, the excavated soils will be conditioned adjacent to the excavation prior to loading the soil into trucks. Conditioning will be limited to the addition of lime kiln dust, cement, or similar materials to ensure that the soils meet transportation requirements.

The excavation in this AOC will extend below the water table. Groundwater will be managed as necessary to verify that RAOs are achieved. Excavation dewatering is not anticipated in this area due to the fine-grained nature of the soils. Excavations will be supported as necessary to prevent slumping.

Excavations will be backfilled with PDM or clean granular fill derived from off-site sources. Backfill soil will be placed in discrete lifts and compacted by a bulldozer or roller. After completing re-development construction, the AOC will be capped by placing additional permitted fill materials over an impermeable hardscape of asphalt paving or concrete floor slabs. This approach will provide a minimum of 12 inches of permitted soil and an engineered barrier over the residual AOC soil.

Finally, a Deed Notice as described in Section 4.1.1 will be prepared to document future land use restrictions, chemicals present in soil in excess of RDCSCC and/or NRDCSCC, required engineering controls (e.g., caps and/or vapor intrusion controls), and maintenance and inspection requirements for the engineered controls.

4.5 AOC U – Former Unlined Pond

Free-phase DNAPL is anticipated to be present in this AOC, with the primary constituents being methoxychlor, carbon tetrachloride, chlorobenzene, and chloroform. The total volume of contaminated soil is estimated to be approximately 7,000 cubic yards, but may be subject to revision after further delineation is performed. It is anticipated that the area delineated for AOC U may extend into AOC I and that the delineated areas for each AOC may overlap. Supplemental horizontal and vertical delineation during the pre-design investigation is required to determine the limits of excavation. The remedial standard will be based on the observation of chlorinated hydrocarbon DNAPL or visibly impacted soil. Excavation limits will be confirmed by visual observation during remedial action. All visibly impacted soils and soils containing DNAPL or residual product will be removed.

The proposed remediation activities for this AOC include the excavation of soils exceeding the remediation standard and direct loading of material into lined trucks for transportation to a permitted treatment or disposal facility. If necessary, the excavated soils will be conditioned adjacent to the excavation prior to loading the soil into trucks. Conditioning will be limited to the addition of lime kiln dust, cement, or similar materials to ensure that the soils meet transportation requirements.

The excavation in this AOC will extend below the water table. Groundwater will be managed as necessary to verify that RAOs are achieved. Excavation dewatering is not anticipated in this area due to the fine-grained nature of the soils. Excavations will be supported as necessary to prevent slumping.

Excavations will be backfilled with PDM, beneficial use materials, or clean granular fill derived from off-site sources. Backfill soil will be placed in discrete lifts and compacted by a bulldozer or roller. After completing re-development construction, the AOC will be capped by placing additional permitted fill materials over an impermeable hardscape of asphalt paving or concrete floor slabs. This approach will provide a minimum of 12 inches of permitted soil and an engineered barrier over the residual AOC soil.

Finally, a Deed Notice as described in Section 4.1.1 will be prepared to document future land use restrictions, chemicals present in soil in excess of RDCSCC and/or NRDCSCC, required engineering controls (e.g., caps and/or vapor intrusion controls), and maintenance and inspection requirements for the engineered controls.

4.6 AOC P - Sitewide Arsenic

Elevated levels of arsenic are present in two areas within the overall AOC. A source was tentatively identified to the northeast of monitoring well MW-15A. A second source was identified near well MW-13A. Because the total volume of contaminated soil is unknown, supplemental sampling will be performed to delineate the source horizontally and vertically for arsenic to levels below the selected action level of 300 mg/kg. This work will allow determination of the total amount of material to be remediated.

The proposed remedial action for this AOC is the excavation of the delineated soil and off-site disposal. Postexcavation samples will be collected to verify that soils exceeding the selected action level were not left in place. Soil will be transported off-site in lined

trucks to a permitted facility. Excavations will be backfilled with PDM or clean granular fill derived from off-site sources.

The excavation in this AOC will extend below the water table. Groundwater will be managed as necessary to verify that RAOs are achieved. Excavation dewatering is not anticipated in this area due to the fine-grained nature of the soils. Excavations will be supported as necessary to prevent slumping.

Soils containing arsenic levels exceeding the NRDCSCC of 20 mg/kg will be left in place over significant portions of the site. These soils will be covered by PDM or beneficial use material that will be placed in discrete lifts and compacted by a bulldozer or roller. After completing re-development construction, the entire AOC will be capped by placing additional permitted fill materials over an impermeable hardscape of asphalt paving or concrete floor slabs. This approach will provide a minimum of 12 inches of permitted soil and an engineered barrier over the residual AOC soil.

Finally, a Deed Notice as described in Section 4.1.1 will be prepared to document future land use restrictions, chemicals present in soil in excess of RDCSCC and/or NRDCSCC, required engineering controls (e.g., caps and/or vapor intrusion controls), and maintenance and inspection requirements for the engineered controls.

4.7 AOC W - Sitewide Groundwater

The primary RAOs for groundwater are to control the potential for COPCs in groundwater to migrate to downgradient surface water bodies and to reduce COPC concentrations to ultimately reach GWIIA criteria. No groundwater use receptors are impacted by site groundwater. The only potential surface receptor is surface water located hydraulically downgradient of the site. In addition, the site is located within a region characterized by industrial sites, many of which have groundwater contamination in excess of GWIIA criteria. Based on these factors, the remedial action selected to achieve the RAOs for groundwater is source removal and natural groundwater attenuation.

4.7.1 Source Removal

Source removal will be accomplished by the excavation and off-site disposal of soils above the remediation standard within AOCs D, M, I, U, and P. This approach will result in the extensive mass removal of the COPCs that contribute to overall groundwater quality degradation from key locations throughout the site.

4.7.2 Natural Attenuation

Natural attenuation processes include a variety of physical, biological, and chemical processes that, under favorable conditions, will act to reduce the mass, toxicity, mobility, volume, and concentrations of COPCs in groundwater. These natural processes include biodegradation, dispersion, dilution, sorption, volatilization, chemical or biological stabilization, and transformation or destruction of contaminants. Natural attenuation is considered to be an appropriate remedial action when it can be demonstrated to be capable of achieving the RAOs in a timeframe that is reasonable compared to other

alternatives. The phased RI performed for the site identified COPCs in excess of GWIIA criteria that are commonly affected by natural processes, such as xylene, chlorobenzene, carbon tetrachloride, chloroform, and arsenic.

One condition necessary for the acceptance of natural attenuation is to determine whether downgradient receptors are being impacted by site groundwater. The only downgradient receptors are surface water bodies located adjacent to the site. Surface water samples have been collected from Piles Creek and the Arthur Kill, both upstream and downstream of the site. Data from Piles Creek showed higher upstream concentrations of COPCs than downstream samples. Data from the Arthur Kill samples showed no significant upstream/downstream pattern. Additionally, Piles Creek, containing base flow contaminants, discharges to the Arthur Kill between the upstream and downstream sampling locations. No significant impact to the Arthur Kill from site groundwater could be determined because of the data variability and the Piles Creek contribution.

Based on the data from the Phase III RI and conservative fate and transport calculations performed during the Phase II RI, the NJDEP and DuPont determined that surface water has not been significantly impacted by the site. This was confirmed by the NJDEP in a letter dated December 27, 2001, from Lois Arbegast, Supervisor of BEECRA to Mr. Ralph Sloat of DuPont.

4.7.3 Groundwater Monitoring

A groundwater monitoring program will be developed to demonstrate the viability of natural attenuation to achieve the RAOs for sitewide groundwater. The monitoring program will be developed in accordance with the requirements of the NJDEP Tech Regs (N.J.A.C. 7:26E-6.3e), which includes a quarterly monitoring program for a minimum of eight quarters or two years to statistically evaluate the data. The results of the quarterly monitoring will be used to demonstrate declining concentration trends, degradation rates of specific COPCs, and the predicted time when GWIIA criteria will be met. The data will also be used to revise, if necessary, the predicted downgradient extent of COPCs, which can be used in establishing a CEA for the site in conjunction with the natural remediation approach. If the effectiveness of natural remediation cannot be demonstrated to achieve RAOs and GWIIA criteria, then an alternative remedy will be considered. Details of the proposed groundwater monitoring program will be provided in the remedial action work plan.

After source area removal activities are complete, a long-term groundwater monitoring program will be designed and implemented to monitor the effectiveness of the source removal and groundwater quality improvements. This program will include the abandonment and replacement of existing monitoring wells, preparation of a groundwater monitoring plan, revision of the existing CEA and long-term groundwater monitoring.

It is anticipated that many, if not all, existing monitoring wells will be destroyed or buried by either source remediation activities, the PDM placement and management, or the ensuing site re-development. Therefore, as the project moves from source removal to PDM placement, monitoring wells potentially subject to destruction will be abandoned in accordance with NJDEP requirements by a licensed New Jersey well driller.

The groundwater monitoring plan will identify the remaining monitoring wells that will be used in the ongoing groundwater monitoring program, as well as the location of new monitoring wells to provide adequate coverage of the site. The resulting array of monitoring wells will provide perimeter coverage of the site for both the shallow water-bearing zone and deeper aquifer. All wells will be sampled initially for VOCs, SVOCs, total and dissolved metals, and pesticides.

A CEA (ID # 1843, issued on September 20, 2001, to Liberty Generating Company, LLC) was formerly in place for a portion of the site. It is DuPont's understanding from the NJDEP that this CEA has been lifted (e-mail correspondence from R. Posey, NJDEP, October 16, 2007). Therefore, an application for a new CEA covering the entire site will be made after completion of remedial action with the baseline contaminant concentrations established from groundwater quality dated collected during the pre-design site studies described in this RASR.

4.7.4 Classification Exception Area

A CEA will be established to provide restrictions on groundwater use in the areas where the GWIIA criteria are exceeded and establish the duration of the CEA. The CEA will present the following information:

- The COPCs in excess of GWIIA criteria
- The vertical and horizontal extent of the CEA with the boundary provided in geographic information system (GIS) format
- The expected rate of improvement of groundwater quality and a timeframe for groundwater to meet GWIIA criteria
- The specific use restrictions of groundwater within the CEA boundary area

The CEA will be monitored and maintained as generally described in this RASR. A detailed description of how the CEA will be monitored and maintained will be provided in the remedial action work plan.

4.8 Evaluation of Recommended Remedial Actions

The following sections provide a detailed evaluation of the recommended remedial actions for the AOCs described above to satisfy the Tech Regs requirements provided in NJAC 7.2E-5.1(c). Evaluation results show that the recommended remedial actions for the AOCs are protective of human health and the environment in the long and short term, are easily implementable in a reasonable timeframe, and address community concerns.

As described above, four primary remedial actions are proposed: free-phase product recovery, contaminated source material removal, site capping, and monitored natural remediation of groundwater quality. These remedial actions are evaluated and discussed together in the subsections below.

4.8.1 Protection of Human Health and the Environment

Product recovery, contaminated source material removal, and capping provide the highest level of protection to human health and the environment in the long term by eliminating the following:

- Potential direct contact exposure pathways (i.e., ingestion, dermal contact, and inhalation) and associated risks
- Potential surface runoff and erosion of contaminated soil from the site to adjoining surface water bodies
- Both potential contact with infiltrated precipitation and contaminant migration to underlying aquifers

Although the proposed remedial actions will increase the disturbance of on-site contaminated material in the short term, exposure pathways will be eliminated in the long term. The long-term effectiveness of product recovery, source removal for off-site disposal, and capping are proven and demonstrated, thereby protecting human health and the environment.

4.8.2 Implementability

Free-phase product recovery, contaminated source material removal, and capping are common measures for site remediation that have been implemented successfully at many other sites. The equipment, material, and labor required for the construction activities associated with these tasks are readily commercially available. From a technical standpoint, no particular site conditions would restrict the implementation of these remedial actions.

Constructability issues associated with these remedial actions include the use of heavy equipment (e.g., trackhoes, bulldozers, front-end loaders, compactors, dump trucks) for moving existing soil. Other issues include excavating, handling, stockpiling, and loading contaminated soil material. Construction activities will be implemented in a phased approach to reduce the amount of exposed contaminated material and keep stockpiled source material intended for off-site disposal to a minimum.

Additional implementability issues include the following:

- Development and installation of erosion and sediment controls to accommodate each remedial action and AOC
- Coordination of traffic patterns to accommodate truck traffic flow delivering PDM, beneficial use material, or clean material and removing contaminated material or product
- Establishment of truck tarping stations for trucks hauling contaminated soil material to assure that the material does not spill or leak during hauling operations
- Installation and compaction of clean backfill material to a specified level for the removal action
- Management of soil throughout the period of site pre-loading using PDM

- Long-term maintenance of engineering and institutional controls

As stated above, all of these issues are common to the remedial construction industry and/or general construction and have been safely executed on numerous projects at many other sites.

The recommended remedial action can be implemented in a relatively short time frame. The entire volume of contaminated material could be recovered or removed within one year.

Maintenance of engineering controls will become a function of the general maintenance of the warehousing facility. The smooth functioning of this facility will require that both concrete slabs and asphalt paving be maintained in good condition to support the volume of traffic and throughput of material required of such facilities within the New York/New Jersey transportation network.

4.8.3 Consistency with Other Applicable Laws and Regulations

The recommended remedial actions comply with applicable federal, state, and local laws and regulations. Several federal, state, and local permits; plans; and approvals are potentially required to implement the remedial actions. These may include, but may not be limited to, the following:

- Nationwide Permit 38
- Erosion and sedimentation control plans to address soil erosion and surface runoff during and after completion of the remedial actions
- Permits for acceptance and use of recycled or beneficial use materials
- Permits to crush concrete derived from existing foundations and slabs remaining on-site
- Permits for the discharge of storm water from the site
- Waterfront Development Permit
- General construction permits and approvals
- Miscellaneous municipal construction permits
- Other county and/or local permits (as needed)

A site-specific HASP will protect workers during implementation of the remedial actions. The HASP clearly defines potential Occupational Safety and Health Administration (OSHA) requirements, health and safety concerns associated with the remedial actions, and measures planned to mitigate such concern. The HASP is provided in Appendix D.

4.8.4 Potential Impact to Community

It is expected that the recommended remedial actions will be accepted by the community. The proposed remedial action will achieve the following:

- Improve the appearance of the site

- Eliminate the presence of contaminants and potential exposure risks
- Place the site back into beneficial use consistent with the desired property re-development
- Increase the number of jobs available within the community
- Increase the tax ratables

Once the remedial action is complete, contaminated source material will have been removed and any remaining soils containing constituents above either IGWSCC or NRDCSCC will be covered and capped, thereby preventing direct contact and minimizing infiltration.

4.8.5 Permanence

The degree of permanence offered by the remedial actions described is total and complete. The actions will eliminate the risk associated with contaminant exposure pathways by removing the material off-site.

4.8.6 Potential Natural Resource Injury

The remedial actions will remove the long-term potential for injury to natural resources after implementation; however, a potential low risk exists in the short term during recovery and removal operations. This risk will be reduced by adhering to proper construction practices during implementation.

4.9 Recyclable Fill Acceptance Protocol

DuPont proposes to utilize up to one million cubic yards of PDM for grading fill and capping material in the remedial action. The purpose of the fill material is to raise grades and provide an engineered barrier to eliminate site COPC exposure to the environment.

If the volume of soil required to grade and cap the site is large, DuPont plans to accept PDM and possibly other recyclable fill and beneficial use materials for this purpose. The PDM and other beneficial use materials will be prequalified as described in the Material Acceptance Protocol (see Appendix C) and will be used below the final surface cover. This approach will ensure that such materials are controlled and located below the environmentally protective surface cover.

In addition to PDM, the types of beneficial fill materials proposed to be used at the site include clean fill, recycled asphalt, recycled masonry, construction fill, and fill from recycling facilities. The handling of fill materials will require only normal construction techniques for stockpiling, placement, compaction, and grading. No soil treatment beyond standard soil augmentation (i.e., adding quick lime, kiln dust, or Portland cement) will be performed on-site.

The protocol presented in Appendix E will provide a means to verify that fill material meets the NRDCSCC or other approved alternate acceptance criteria and a methodology for the acceptance and tracking of the material on-site. Specifically, the protocol presents the following:

- Testing frequency of proposed fill sources
- Categories of acceptable fill material
- Alternate acceptance criteria for acceptance and use of materials at the site
- Procedures for review and certification of fill material sources
- Procedures for management of materials on-site
- Sampling and analytical requirements

All PDM or other beneficial use materials that exceed the NRDCSCC will be covered by a minimum of 1 foot of clean fill. This clean fill will provide temporary cover of the imported materials until site re-development begins. The re-development hardscape of building foundations and asphalt paving will provide the final and primary engineered barrier control, thereby preventing direct contact with site soils.

5.0 PRE-DESIGN INVESTIGATION PLAN

As discussed in Section 3.0, before initiating full-scale remediation activities at the site, a pre-design investigation will be implemented. The investigation will be conducted to achieve the following objectives:

- Resolve data gaps remaining after the Phase III RI and complete delineation of soil and groundwater constituents in the following areas:
  - AOC D — Further evaluate the extent of sheen and dissolved constituents in groundwater.
  - AOC M — Reevaluate the product recovery system.
  - AOC I — Perform additional vertical delineation of zinc and pesticides in soil.
  - AOC U — Complete the vertical delineation of methoxychlor and chlorobenzene in groundwater.
- Define source areas (AOCs D, M, P, and U) for remediation. Additional delineation is needed at AOCs D, M, I, P, and U to define the extent of free product and visually impacted soils that will be targeted for removal.

The table below provides a summary of background information about the AOCs included in the pre-design investigation and the rationale for the proposed remedial work. More detail about previous investigations at these areas is provided in Appendix A.

AOC	Background
Data Gap Resolution and Final Delineation	
AOC D	Soil borings advanced at AOC D during previous investigations delineated the lateral extent of AOC-related constituents (PAHs) in soil and determined the extent of residual petroleum product in the unsaturated zone. Product was not detected in groundwater, but a sheen on top of the water table was delineated. As requested by the NJDEP, DuPont will conduct an evaluation of the extent of the sheen and characterize dissolved phase constituents related to this AOC.
AOC I	The Phase III RI characterized and partially delineated the extent of COPCs in soil in AOC I. Analytical results showed that metals (including arsenic, beryllium, zinc, and lead) exceed the applicable soil remediation criteria. Likewise, pesticide constituents (including 4,4-DDT; DDD; 4,4-DDE; aldrin; dieldrin; and methoxychlor) were detected at elevated levels, exceeding standards in soil. Delineation of these COPCs was complete except for the vertical delineation of zinc; 4,4-DDE; 4,4-DDT; and methoxychlor. DuPont will complete vertical delineation of these COPCs in AOC I.
AOC M	A product recovery system was installed in 1992 to recover fuel oil that had leaked from an AST at this AOC. The system operated for three years and recovered up to 900 gallons of product. The groundwater flow regime was altered when a wetlands mitigation project was completed to the west of the yard. Phase III RI results showed that product was not present in the recovery trench and sumps but rather concentrated in the area to the southeast of the garage. The groundwater flow direction was further altered by the installation of a sheet pile wall installed around the mitigated wetland. Post construction monitoring showed that product had not appeared in the trench or

	sumps and that the groundwater flow direction had been directed to the southeast. Because the current conditions are not clear, the NJDEP has directed DuPont to reevaluate the extent of product and initiate product recovery if needed. DuPont will determine the extent of product and, if viable, initiate temporary product recovery until remediation of this AOC is undertaken.
AOC U	In Winter 2002, DuPont adjusted the location for the deep zone well and installed a triple-cased well east of the unlined pond. Sampling of that new well (MW-38B) detected chlorobenzene and methylene chloride above the GWIIA criteria. The results were discussed in a meeting between DuPont and the NJDEP on March 28, 2002. In that meeting, DuPont proposed institutional and engineering controls as a remedial action. It was agreed that concentrations detected in the deep zone must be verified before proceeding further. Additional sampling and analysis of MW-38B will be completed as part of a sitewide groundwater sampling program to re-establish baseline groundwater quality data at the site.
Source Area Delineation	
AOC D	The former ASTs at this AOC have been removed, but the leakage that occurred has left residual petroleum product in the soil that contain PAHs and lead. Previous sampling has visually delineated the soil impacted by residual product and has mapped the extent of visible product and sheen in the water. Additional delineation is necessary to better define the volume of impacted soil targeted for removal.
AOC M	NAPL may remain in the vicinity of AOC M and needs to be evaluated. Well inspections after sheet pile wall installation indicate that NAPL movement may follow a more southerly direction toward the parking lot. Additional delineation is required to confirm the extent of NAPL and visually impacted soils to better define the volume of soil targeted for removal.
AOC P	Arsenic has been delineated on a sitewide basis because of the random distribution of arsenic in soil. Two areas, one near MW-15A and a second near MW-13A, have exhibited the highest concentrations in groundwater and soil. Both areas are considered potential source areas for arsenic, and additional delineation is required. Further delineation to the remediation standard of 300 mg/kg is required to define the volume of soil to be removed.
AOC I	DNAPL compounds originating in AOC U were identified in AOC I during the phases of the RI. Additional delineation of the extent of DNAPL and visually impacted soils will be conducted in conjunction with the AOC U delineation sampling to define the extent of soil targeted for removal.
AOC U	The former unlined pond at AOC U has undergone a thorough evaluation as a result of the DNAPL study that was completed in the Phase III RI. DNAPL was detected in monitoring well MW-28 during installation. Samples of the DNAPL indicated that the primary constituents were carbon tetrachloride, chlorobenzene, chloroform, and methoxychlor. Areas potentially containing DNAPL in the interstitial pore spaces were delineated. Further delineation is required to establish the limits of DNAPL and visually impacted soils that will be targeted for removal.

All sampling will be conducted in accordance with the *New Jersey Field Sampling Procedures Manual* (NJDEP, 2005). Because of varying site conditions, a combination of drilling and sampling procedures will be employed as described in Appendix B.

Appropriate quality assurance requirements pursuant to NJTRSR 7:26E-2.1 and 7:26E-2.2 will be followed during the implementation of pre-design investigation plan. This includes the development of a QAPP (per NJTRSR 7:26E-2.2), which is presented in Appendix E.

5.1 Sitewide Groundwater Investigation

Because groundwater sampling has not been conducted on the majority of site monitoring wells since 2000, a reconnaissance of the site will be conducted to determine the status of all monitoring wells. Well conditions will be established, and damaged wells will be repaired if possible. The integrity of all monitoring wells will be established. Monitoring wells determined to be damaged beyond repair will be removed by a New Jersey-certified contractor in accordance with NJDEP requirements.

All functioning wells located during the reconnaissance (see Table 5-1) will be re-developed and allowed to equilibrate for a period of two weeks prior to groundwater sampling activities. The wells will be sampled and analyzed for VOCs, SVOCs, metals and pesticides. Wells will be sampled in accordance with NJDEP low flow procedures as detailed in the NJDEP *Field Sampling Procedures Manual* (NJDEP, 2005).

The analytical results will be used to establish current groundwater quality conditions in the shallow and deep water-bearing units and to determine changes in quality since the last sampling event.

5.2 Data Gap Resolution and Final Delineation

Data gaps at AOCs D, M, I, and U must be addressed before proceeding with remedial activities at the site. Additional soil and groundwater delineation will be conducted to complete the investigation process as described in the subsections below. Table 5-2 provides a summary of the sample locations, depths, and analyses for the AOCs included in the pre-design investigation. A description of the methodologies associated with these activities is provided in Appendix B.

5.2.1 AOC D - West Fuel Oil ASTs

To define the lateral limits of sheen and dissolved phase fuel oil groundwater constituents in groundwater, the existing wells in this AOC will be evaluated for the presence of product sheen (see Figure 5-1).

The wells will be visually inspected for the presence of product using an oil-water interface probe or Teflon® bailer. If product is observed, a passive collection system will be installed in each affected well until remedial activities commence.

5.2.2 AOC I - Former DDT and Methoxychlor Area

To complete the vertical delineation of constituents at AOC I, seven soil borings will be advanced (see Figure 5-2). Constituents and concentrations in soil are known to a depth of 12 feet based on previous soil sampling results (see Appendix A). Therefore, 6-inch soil samples will be collected from each 2-foot interval beginning at 12 feet and

extending to a maximum depth of 16 feet. To prevent cross contamination of aquifers, soil borings will not be advanced through the peat layer or into the lower sand unit (deep zone), which is approximately 17 feet bgs. Soil samples will be analyzed for zinc; 4,4-DDE; 4,4-DDT; and methoxychlor.

5.2.3 AOC U - Former Unlined Pond

The groundwater monitoring program will include sampling the deep monitoring well MW-38B. Deep groundwater at this location contained chlorobenzene and methylene chloride above the GWIIA criteria, and further sampling is required for trend analysis. The new analytical data will supplement the data collected previously and will serve as a baseline for future long-term monitoring. Samples will be analyzed for VOCs, SVOCs, metals, and pesticides. The thickness of DNAPL compounds in the well, if present, will be measured.

5.2.4 AOC M - Wade Brothers Company

DuPont will conduct a field investigation at AOC M to determine if NAPL is present and, if present, to determine the direction of any migration through the soil. If recoverable quantities are identified, DuPont will recover free product on an interim basis until remedial action implementation.

DuPont will inventory all wells in the vicinity of AOC M. The inspection will document wells, piezometers, catch basins, recovery trenches, sumps, and surface water measurements. Inspections will be performed at high and low tide to confirm previously observed tidal effects. Inspections will include water level measurements, groundwater flow analysis, and NAPL measurement (if present).

The following monitoring wells and piezometers will be used in the evaluation: PZ-1A, PZ-2A, PZ-3A, PZ-7A, PZ-8A, PZ-9A, PZ-10A, MW-7A, MW-30A, MW-31A, MW-IRM-4, and MW-IRM-5. Surface water locations SW-1, SW-2, SW-3, and SW-4 will be evaluated. The condition of the decommissioned product recovery system (Sump #1, Sump #2, and the product recovery trench) will also be evaluated.

Using the information obtained from the above activities, a current assessment of the extent of product and groundwater flow direction will be made. If NAPL is found and delineated, it will be removed during the remedial action.

5.3 Source Area Delineation Sampling

To delineate sources that have the greatest likelihood of contributing to groundwater contamination, AOC-specific testing will be conducted at each of the potential source areas (AOCs D, M, P, I, and U). The subsections below present a sampling plan to achieve source area delineation.

5.3.1 AOC D - West Fuel Oil ASTs

The Phase III RI completed the delineation of residual product in the soil and sheen in groundwater. Sheen in groundwater will be addressed as discussed in Section 5.2 of this

report. The sitewide groundwater monitoring will also provide information on the current impact on groundwater from this AOC. However, soils impacted by residual petroleum product remain and require additional delineation to facilitate planning of the remedial action.

The AOC D source area was defined on the basis of visual identification of soils impacted by petroleum hydrocarbons or the presence of NAPL. Previous borings identified an area in the shallow fill containing tar-like substances in the soil, which will be removed during the remedial action. To delineate this source area, soil samples will be visually inspected for residual petroleum product or NAPL. Soil borings will be advanced using a geoprobe at the locations shown in Figure 5-1. The borings will be advanced to the top of the peat layer, approximately 8 to 10 feet bgs, and the continuous samples will be visually inspected for the presence of residual petroleum products. Based on visual observations of subsurface soils, the source area will be delineated.

Three soil samples will be collected from borings in the source area to characterize the material for future disposal. These samples, shown in Figure 5-1, will be analyzed for toxicity characteristic leachate procedure (TCLP) VOCs, SVOCs, and metals.

5.3.2 AOC I – Former DDT and Methoxychlor Area

DNAPL originating in AOC U was identified during RI activities in AOC I. Further delineation of the DNAPL impacted area will be conducted in both AOC U and AOC I at the same time as part of the same overall program. Boring locations are shown in Figure 5-3. Visual identification of DNAPL in soil samples will be used to delineate the extent of the source area.

5.3.3 AOC U - Former Unlined Pond

To delineate the area to be remediated, a total of 38 soil borings will be drilled at locations shown in Figure 5-3. Soil borings will be advanced using a geoprobe around the perimeter of the DNAPL zone to better define the extent of soils targeted for removal. Continuous samples will be collected by the geoprobe, and the sample core will be screened with a flame ionization detector/photoionization detector (FID/PID). Visual observation of the soil cores will be used to determine the presence of DNAPL and impacted soils. Additional soil borings may be required based on field observations.

5.3.4 AOC M - Wade Brothers Company

Delineation of free petroleum product in groundwater was undertaken as part of the Phase III RI at the Wade Brothers garage area. Because of the change in groundwater flow directions resulting from the wetlands mitigation project and subsequent sheet pile wall interim remedial measure (IRM), the current extent of product in groundwater is not certain. Current groundwater conditions in this AOC will be assessed as part of the sitewide groundwater monitoring program.

DuPont proposes to delineate the area of petroleum-impacted soil by advancing geoprobe borings at the perimeter of the previously defined area, collecting continuous core samples, and inspecting soil samples visually for the presence of petroleum product or

residual product. Boring locations are provided in Figure 5-4. The source area to be remediated will be defined by the extent of visually impacted soils.

5.3.5 AOC P - Sitewide Arsenic

The NJDEP previously agreed that delineation of soils within AOC P was complete (NJDEP letter dated December 27, 2001). Previous studies identified the area near monitoring well MW-15A as a potential source of arsenic contamination of groundwater and proposed further delineation. In addition, DuPont has identified soils with elevated arsenic concentrations near monitoring well MW-13A as a potential source of groundwater contamination. DuPont proposes further delineation in both of these areas to support the remedial action. Delineation of arsenic in soil to the IGWSCC and to the defined remediation standard of 300 mg/kg will be conducted in both areas.

To evaluate arsenic concentrations in the area near MW-15A, soil samples will be collected from locations within the 50-foot grid shown in Figure 5-5. Note that the grid only extends to the property boundary on the southern end. Soil conditions are not conducive to geoprobe drilling and sampling. As a consequence, borings will be advanced using hollow-stem auger techniques and continuous split-spoon samples will be collected to a depth of 21 feet, which is the maximum depth of elevated arsenic concentrations identified during the RI. Each 2-foot, split-spoon sample will be analyzed for arsenic beginning with the 0- to 2-foot interval and analyzed in the sequence described below.

To complete delineation of arsenic concentrations in soil near monitoring well MW-13A, soil samples will be collected by geoprobe drilling techniques from the locations shown in Figure 5-6. Samples will be collected in 4-foot intervals from ground surface to the top of the confining layer. Each 4-foot sampling tube will be cut into 1-foot samples, and the soil recovered will be analyzed for arsenic.

Once the samples are collected and shipped to the laboratory, a phased analytical approach will be used. Starting with boreholes with the closest proximity to previously identified exceedences, all samples from the soil profile will be analyzed with a rapid turnaround time. If all samples from the borehole do not exceed the remediation standard (300 mg/kg), the horizontal delineation in this direction will have been determined. If a sample within the soil profile exceeds the action level, then the samples from the next borehole extending outward from the source will be analyzed. The process will be repeated until delineation to the action level is achieved in all directions from the source area. Using these results, the lateral and vertical extent of the arsenic source to be remediated will be defined.

5.4 Health and Safety Plan

All remediation activities at the site, including equipment decontamination will be conducted in accordance with a site-specific HASP (per NJTRSR 7:26E-6.2[a]11). The HASP, presented in Appendix D, was prepared in accordance with all applicable federal, state, and local requirements including, but not limited to, OSHA regulations 29 CFR Part 1910 (Occupational Safety and Health Standards) and 29 CFR Part 1926 (Safety and Health Regulations for Construction).

5.5 Quality Assurance Requirements

Appropriate quality assurance requirements pursuant to NJTRSR 7:26E-2.1 and 7:26E-2.2 will be followed during the implementation of remedial action activities, including the development of a QAPP (per NJTRSR 7:26E-2.2) (see Appendix E).

6.0 REFERENCES

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NJDEP. 2005. *Field Sampling Procedures Manual.* August.

NJDEP. 2002. *Chapter 26E: Technical Requirements for Site Remediation.*

TABLES

Table 1-1
Regulatory Requirements
DuPont Grasselli Site Linden, New Jersey

N.J.A.C. 7:26E-	Technical and Administrative Requirements	Included: Yes / No / NA	Page #
Remedial Action Selection Objectives			
5.1(b)	Have the objectives been properly identified for each AOC?	Yes	12 - 14
5.1(c)1	Are selected remedial actions protective of public health and safety and the environment?	Yes	23
5.1(c)2	Are selected remedial actions implementable?	Yes	23 - 24
5.1(c)3	Are selected remedial actions consistent with applicable laws and regulations?	Yes	24
5.1(c)4	Are impacts of the selected remedial action on the local community acceptable?	Yes	25
5.1(c)5	Do selected remedial actions pose low potential to cause injury to natural resources?	Yes	25
5.1(d)	Is the required information included and adequate to support approval of the use of an innovative technology?	N/A	
5.1(e)	Does the selected remedial action include compliance with the requirements for the use of engineering and institutional controls N.J.A.C. 7:26E-8 when applicable?	Yes	11 - 14
Remedial Action Selection Report			
5.2(a)1	Has RASR been submitted for a restricted use remedial action?	Yes	11
5.2(a)2	Has RASR been submitted for a remedial action involving the use of innovative technology?	No	2 - 3
5.2(a)3	Has RASR been submitted for a remedial action that will take more than five years to complete?	No *	2 - 3
5.2(a)4	Has RASR been submitted for a remedial action involving groundwater, surface water, sediment or ecological impacts?	Yes	14
5.2(c)1	Is a detailed description of the selected remedial action included and adequate?	Yes	15 - 22
5.2(c)2	Is a list of remediation standards that will be achieved for each media at each AOC included and adequate?	Yes	11 - 14
5.2(c)3	Is a discussion of how the remedial action satisfies applicable criteria included and adequate?	Yes	11 - 14
5.2(c)4	Has adequate additional required information to support remedy selection been submitted?	Yes	27 - 33, Appendices C, D, E
5.2(d)	Has the RASR been submitted with the RI Report or the RA Work Plan, when Department pre-approval of the Remedial Action Work Plan is sought or required per 6.1(b)?	No	
5.2(e)	Has the RASR been submitted with the RA Report when Department pre-approval of the Remedial Action Work Plan is not sought or required per 6.1(b)?	No	
Certification			
Varies	Has the required certification been submitted?	Yes	Enclosed with RASR

* Natural remediation of groundwater may require greater than 5 years to achieve

Areas of Environmental Concern/Area of Concern	NJDEP Determina	DuPont's Activities Pending
A– Pipeline Right-of-Way	10/2	
B– Former Marsh Disposal	9/20,	
C– DMHA Waste Holding Pond	1/21,	
D– West Fuel Oil ASTs	1/21/9 4/19/01	ally contaminated soils and petroleum sheen during followed by remediation
E– Bldg. 54 Septic System	1/21/9 4/19/01	ning of septic system completed
F– Former East Fuel Oil ASTs	1/21/	
G– Main Office Septic System	1/21/	ning of septic system completed
H– North Septic System	1/21/	ning of septic system completed
I– Former DDT and methoxychlor area	4/19/	and pesticides in soils
J– Former North Fuel Oil Tanks	4/19/	
K– Former Disposal Area	4/19/	
L– pH Adjustment Ponds	10/29	
M– Wade Brothers Company	4/19/	ally impacted soil and presence of NAPL during PDI mediation
N– Ditches [2,3]	9/20/	
O– Former Lithopone Production Area	1/21/	
P– Soil, sitewide constituents	4/19/	ate arsenic in soils near MW-15A and MW-13A owed by remediation
Q– West Portion of Site	9/20/	
R– Septic Systems		ing of septic system completed
S– Gasoline AST # 25 and pump	9/20/	
T– Spill E Building 3	9/15/	
U– Former unlined pond	4/19/	ampled a deep well in 2002 to satisfy need for ation. Will conduct visual delineation of NAPL during PDI followed by remediation
W– Groundwater, site-wide constituents	4/19/	wide groundwater monitoring program and lemental investigations during PDI followed by

Notes:

[1] While NJDEP uses the term Area of Concern (AOC), Du n Investigation in 2008

[2] AOC N consists of two ditches: one along the west bound sey Transit Authority

[3] The Sept. 15, 1994 NJDEP letter states that DuPont com emedial Measure determination was granted. The September 20, 1996 NJ able action to comply with ISRA regulations.

Table 5-1
Pre-Design Investigation Sampling Summary - Groundwater
DuPont Grasselli Site
Linden, New Jersey

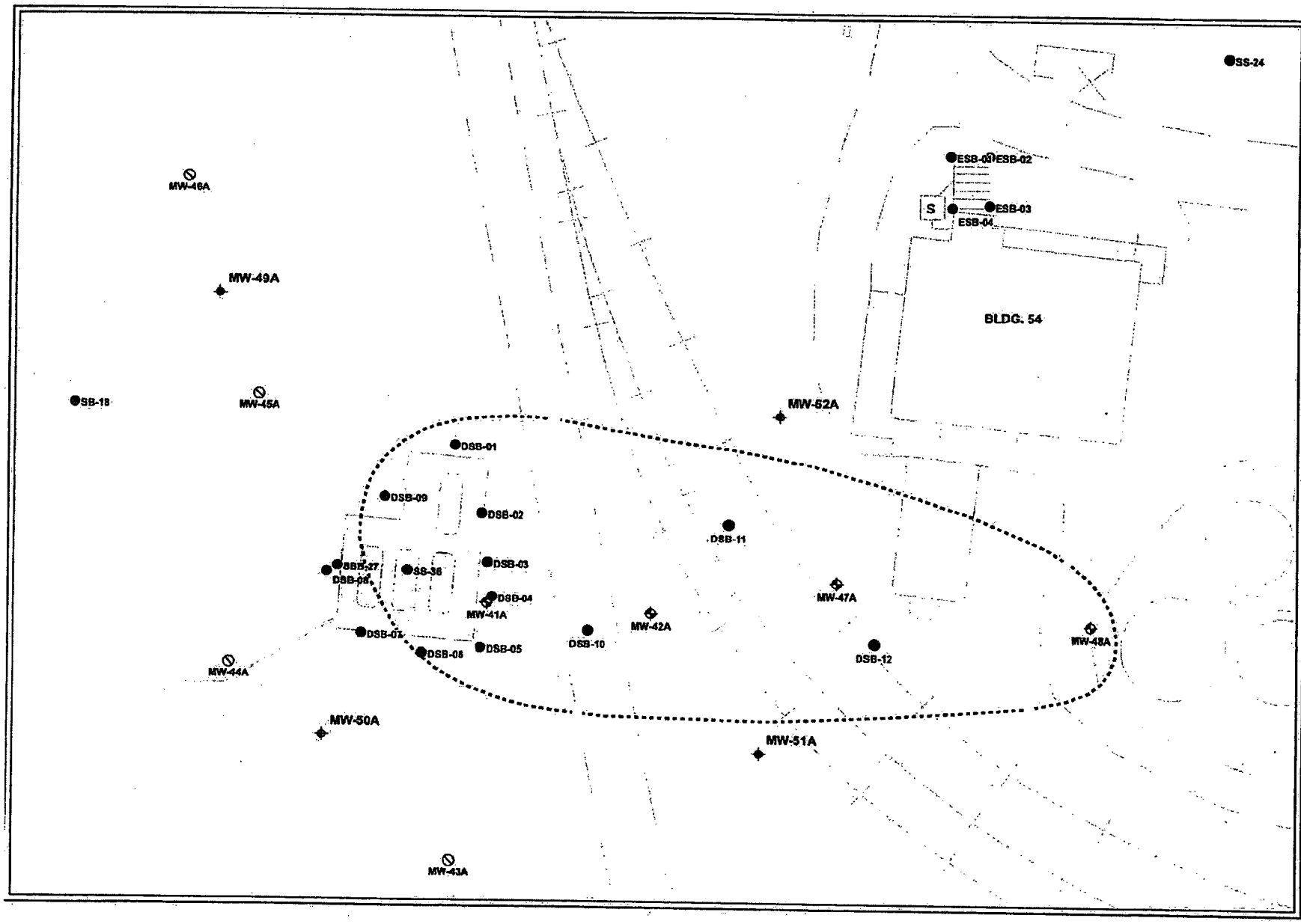
MONITORING WELL ID	ANALYSIS	METHODOLOGY
All functioning* site monitoring wells including:		
MW-1A, MW-2A, MW-3A, MW-7A, MW-8A, MW-8B, MW-9A, MW-10A, MW-11A, MW-11B, MW-12AR, MW-13A, MW-14A, MW-15A, MW-16A, MW-18A, MW-18B, MW-19A, MW-20A, MW-20B, MW-22A, MW-23A, MW-24A, MW-26A, MW-28A, MW-29A, MW-30A, MW-31A, MW-32A, MW-33AR, MW-35A, MW-36A, MW-37A, MW-38A, MW-38B, MW-39A, MW-40A, MW-41A, MW-42A, MW-43A, MW-44A, MW-45A, MW-46A, MW-47A, MW-48A, MW-IRM-4, MW-IRM-5, PZ-1A, PZ-2A, PZ-3A, PZ-7A, PZ-8A, PZ-9A, PZ-10A	Metals	SW 846 Method 6010 and 6020
	VOC	SW 846 Method 8260B
	SVOC	SW 846 Method 8270C
	Pesticides	SW 846 Method 8081A

* A survey of existing wells will be conducted to determine condition. Damaged wells will be repaired, if possible, or removed. All remaining wells will be re-developed prior to sampling.

Table 5-2
Pre-Design Investigation Sampling Summary- Soil
DuPont Grasselli Site
Linden, New Jersey

AOC	Media	Sample ID	No. of Sampling Locations	Depth (feet)	Method	Analysis
D	Soil	DSB-10 through DSB-12	3	10	Geoprobe	Metals, VOA, SVOC
M	Soil	W-S-1 through W-S-16	16	10	Geoprobe	Visual Observations Only
I	Soil	ISB-31 through ISB-37	7	12 to 16**	Geoprobe	zinc, DDE, DDT, methoxychlor
P	Soil	P-S-1 through P-S-12	12	21**	HSA	Total arsenic
P	Soil	P-S-13 through P-S-35	23	21**	Geoprobe	Total arsenic
U	Soil	USB-16 through USB-53	38	10	Geoprobe	Visual Observations Only

Notes:
** Phased analytical; only analyze sample if sample above exceeds criteria.
HSA = hollow-stem auger
B/N = base/neutral compounds



Legend

- Existing Well Location
- Abandoned Well Location
- Soil Sample Location
- Proposed Waste Characterization Samples
- Proposed Monitoring Well Location
- Estimated Residual Petroleum in Soil

N
W E
S

0 40 80
Feet
1" = 40'

DUPONT
CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond
BMP 19
Barley Mill Plaza
Wilmington, DE 19805

AOC D - Former Fuel Oil Storage Tanks

DuPont Grasselli Site
Linden, New Jersey

Created/Revised: C. ALT	DuPont Project Number: 7439
Date: 01/31/2008	URS Project Number: 18984572.00002
Rev Number: 0	Figure Number: 5-1
File Name: Fig5-1_AOC_D.mxd	

APPENDIX A
SUMMARY OF AOCS

Summary of Areas of Concern

This appendix summarizes the conclusions reached for each area of concern (AOC) at the DuPont Grasselli site based on information found in the following site investigation reports and the *Sitewide Remedial Action Selection Report* (RASR) (DuPont, 2006):

- Voluntary Environmental Investigation
- Environmental Cleanup Response Liability Act (ECRA) Investigation
- Phase II Remedial Investigation (RI)
- Phase III RI

This appendix also presents the history and current status of each AOC.

AOC A – Pipeline Right-of-Way

Several companies own petroleum pipelines that are buried in the marsh area of the former DuPont Grasselli plant property.

Voluntary Environmental Investigation

As part of this investigation, soil samples associated with AOC A were collected at or below the water table interface to represent both soil and groundwater. No free petroleum was observed when collecting soil samples near the pipeline. Based on the values reported for total petroleum hydrocarbons (TPHs), total semivolatile organic compounds (VOCs), and total VOCs, the pipelines do not appear to be affecting soil quality [DuPont Environmental Remediation Services (DERS), 1991]. Therefore, DuPont concluded that the results associated with this area did not indicate significant detrimental degradation to soil or groundwater.

DuPont recommended no further action for AOC A, and the New Jersey Department of Environmental Protection (NJDEP) agreed in a letter dated October 29, 1992.

AOC B – Former Marsh Disposal

This AOC was used for disposing of aqueous manufacturing wastes from 1928 until the mid-1970s. All wastes disposed of resulted from the manufacture of inorganic compounds (e.g., phosphate plaster, hypo-muds, silicate-muds, metal sulfides).

Voluntary Environmental Investigation

Based on the soil and groundwater data collected as part of this investigation, DuPont concluded that this AOC has not detrimentally impacted soil or groundwater quality in the area.

ECRA Investigation

A comprehensive investigation was conducted by Dames and Moore for the New Jersey Turnpike Authority (NJTA), and groundwater data obtained were reviewed as part of the ECRA investigation (DERS, 1993). Based on the data assessment, DuPont concluded

that this AOC does not warrant further consideration. Arsenic was detected in levels above the Ambient Water Quality Criteria (AWQC) in MW-6A, but was not detected above the AWQC in either filtered or unfiltered groundwater in wells MW-5A or MW-8A. These wells are located in the central portion of AOC B.

In the mid-1990s, as part of the Interchange 11 and 15 widening project, the NJTA was required to mitigate the filling of 12.2 acres of wetlands. The DuPont Grasselli wetlands adjacent to Piles Creek, which contain AOC B, were identified as a potential wetlands mitigation site (DERS, 1995). The *Phase III Remedial Investigation Report* (DuPont 2001) states that the NJTA had reclaimed the AOC B area for wetlands mitigation purposes and, therefore, AOC B will be addressed as part of the wetlands mitigation project.

AOC C – DMHA Waste Holding Pond

This AOC consisted of three ponds with Hypalon® liners that temporarily held dilute aqueous DMHA waste before it was disposed of at sea. These ponds were decommissioned in 1990.

Voluntary Environmental Investigation

As part of this investigation, soil and groundwater samples were collected in the area of AOC C during the installation of borings associated with MW-15A, MW-16B, and MW-17A.

A review of the analytical results indicates that the soil and groundwater quality associated with hydrologic unit A in the area of the waste holding ponds has been degraded, particularly in the area of MW-15A. It is uncertain whether the degradation is occurring as a result of material that was stored in the ponds, the silt-like fill material adjacent to the ponds, or the manufacture and storage of arsenic acid and lead acetate.

ECRA Investigation

Groundwater data collected as part of this investigation, as well as a reassessment of previous investigation data, concluded that no potential impact to groundwater exists. For potential contact with surface soil, arsenic, benzo(a)pyrene, and benzo(b)fluoranthene were detected in concentrations that exceeded the soil screening criteria in one surface soil sample.

Phase II RI

As part of the Phase II RI, analytical results from previous investigations were reassessed. The data from these previous investigations showed that, with the exception of the sitewide constituents of concern (i.e., arsenic and PAHs) that would be addressed as a separate AOC (AOC P), barium was the only constituent that exceeded the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC).

The Phase II RI activities conducted at AOC C delineated the constituent barium, the only constituent of concern, to the applicable soil cleanup standard. The Phase II RI soil and groundwater analytical data obtained from samples collected at AOC C delineated

the areal extent of barium adjacent to the site perimeter to Nonresidential Direct Contact Soil Cleanup Criteria (NRDCSCC). The vertical extent of barium in soil was also delineated to the NRDCSCC. As a result, no additional investigation of this AOC is required.

A letter from the NJDEP dated January 21, 1999, stated that the delineation of AOC C was adequate and no further investigation is required.

AOC D – West Fuel Oil ASTs

AOC D consists of four former aboveground storage tanks (ASTs) within a diked area. Historical records indicate that gasoline was stored in the northern tank; records do not specify the type of fuel oil that was stored in the remaining three tanks.

Voluntary Environmental Investigation

As part of this investigation, groundwater and soil samples were collected in the area of AOC D. The monitoring well installed near AOC D was identified as MW-11A. Soil samples collected as part of the installation of MW-11A contained a total VOC concentration at a low 0.043 milligrams per kilogram (mg/kg). No SVOCs or TPHs were detected in soil.

No free product was detected in the installed well when gauged or sampled. Total VOCs in MW-11A (hydrologic unit A groundwater) indicated a concentration of 1.4 milligrams per liter (mg/l), which appears to reflect background for the area. No SVOCs or TPHs were detected in the groundwater sample collected from MW-11A. Based on the above information, DuPont concluded that the fuel oil storage at this location has not impacted soil or groundwater.

ECRA Investigation

A part of this investigation, soil samples were collected for laboratory analysis. In the area of AOC D, no analytes were detected at concentrations above either the NJDEP NRDCSCC or the Impact to Groundwater Soil Screening Criteria (IGWSCC). Several constituents that do not have screening criteria were detected in surface soil; however, the concentrations of these constituents were not considered a potential concern. Therefore, DuPont concluded that soil sample results showed no potential concern for either NRDCSCC or IGWSCC criteria.

Phase II RI

During the ECRA investigation, soil sample SS-36 (see Phase II RI for location) contained the constituent benzo(b)fluoranthene at a concentration of 1.0 mg/kg. This concentration exceeded the RDCSCC for this area. The objective of the Phase II sampling in AOC D was to complete the investigation of this area in accordance with the NJDEP Technical Requirements for Site Remediation (TRSR) for soil around the ASTs.

The Phase II RI at AOC D delineated the lateral extent of AOC-related constituents (PAHs) in soil. Additionally, the investigation identified and determined the extent of residual petroleum product on the water table.

PAHs detected in AOC D were only slightly above the NRDCSCC in samples with elevated TPH concentrations. The extent of product was delineated based on visual observations and flame ionization detector (FID) readings. The elevated lead concentration detected does not appear to be an AOC-related constituent, and it was recommended that lead be considered a sitewide constituent of potential concern (COPC).

Phase III RI

As part of the Phase III RI, DuPont installed four temporary wells and four permanent wells and drilled two open boreholes to delineate the extent of product on the water table. The wells and open boreholes were tested for the presence of free-product using a bailer.

Based on historical data and observations during the Phase III RI, it was determined that residual product had impacted soil and had been delineated. Product was not detected in groundwater, but a sheen on top of the water table was delineated. Based on DuPont's experience that such sheens are virtually unrecoverable, no recovery effort was recommended.

However, the NJDEP policy with regard to free product requires removal to the maximum extent practicable. Therefore, the NJDEP required that DuPont make an effort to recover the sheen. DuPont agreed to evaluate the persistence of the sheen and address dissolved plume constituents, if detected, in a remedial action selection report. The NJDEP accepted the DuPont proposed approach in a December 27, 2001, letter addressing the Phase III RI.

AOC E – Building 54 Septic System

This AOC includes an inactive subsurface tank and drain field that covers approximately 1,300 square feet. The location and orientation of the drain field were obtained from an August 10, 1992, plant map. The utilities depicted on the map indicate that the septic system received wastes only from adjacent Building 54. Site demolition activities have removed any surface evidence of the drain field location.

Voluntary Environmental Investigation

A soil boring associated with MW-12A was advanced adjacent to AOC E. Soil analytical results for total VOCs, total pesticides, and lead were elevated in comparison to other site soil samples. However, corresponding values of these parameters in groundwater were all well below the average.

Groundwater did not appear to be impacted by VOCs associated with AOC E, but a groundwater pH at 10.2 units indicates that groundwater has been impacted by basic compounds. (This result was based on a laboratory measurement, not a field measurement.) Based on these data, it appears that a basic compound from the septic system near this AOC is impacting groundwater.

ECRA Investigation

Only groundwater and an aqueous sample from the septic tank were evaluated for this area as agreed to by the NJDEP. In the groundwater, sporadic detections of pesticides

were observed. Despite individual pesticide levels exceeding the AWQC, the inconsistent detections of pesticides suggest that pesticides do not represent a concern in this area. In the filtered groundwater, arsenic and mercury were the only constituents detected in levels above the AWQC. Arsenic has been identified as a sitewide COPC and is probably not related to this septic system. Mercury was detected at very low concentrations just above its detection limit.

Criteria are not available for septic tanks. However, the low concentrations detected indicate that no further consideration is warranted.

Phase II RI

The soil samples collected at AOC E during the Phase II RI indicate that pesticides and metals in soil are not present at levels exceeding the relevant criteria. Because soil sample concentrations were below NRDCSCC, AOC E does not appear to be a source for the elevated constituent concentrations detected in groundwater samples from well MW-33A or cross-gradient well MW-33AR.

Phase III RI

Due to the excavation of the mitigated wetlands, groundwater flow direction was altered. MW-33AR, installed as part of the Phase II RI, was actually upgradient of AOC E. Therefore, during the Phase III RI, DuPont installed a monitoring well, MW-36A, hydraulically downgradient of the septic field to assess groundwater associated with AOC E.

Based on Phase III RI results, groundwater downgradient of AOC E does not appear to be adversely impacted by activities in this AOC. Because soil was delineated below the applicable criteria during the Phase II RI, DuPont recommends no further action at this AOC. The NJDEP concurred with this recommendation in a December 27, 2001, letter addressing the Phase III RI.

AOC F – Former East Fuel Oil ASTs

This area contained petroleum fuel ASTs.

Voluntary Environmental Investigation

MW-19A was installed adjacent to AOC F. Soil and groundwater samples associated with MW-19A were collected during this investigation. No VOCs or SVOCs were detected in soil. However, TPH was detected in soil at 14,000 mg/kg. Although this is an elevated concentration, groundwater results indicate that the groundwater has been minimally impacted by petroleum compounds.

Xylene and bis(2-ethylhexl)phthalate were detected in groundwater from MW-19A at concentrations of 1 and 15 micrograms per liter (µg/l), respectively. Both values are relatively low and appear to be at background levels for the plant. No free-phase petroleum was detected.

ECRA Investigation

As part of this investigation, additional characterization was completed at AOC F to delineate the TPH detected during the voluntary environmental investigation. The high TPH was delineated and was determined to be of limited extent. One sample was also analyzed for PAHs because the sample analyzed during the previous investigation contained elevated practical quantification limits (PQLs) for PAHs. Results from both sampling events indicate no VOCs or SVOCs above applicable criteria in soil or groundwater. Any release from the fuel oil tanks would have been detected in VOC and SVOC results. Therefore, this AOC does not warrant further consideration for VOCs.

One soil sample also confirmed the presence of elevated concentrations of arsenic and lead. Arsenic and lead are considered to be sitewide COPCs for surface soil. Because arsenic and lead have been identified as sitewide COPCs, DuPont concluded that this AOC does not warrant further consideration.

Phase II RI

During the voluntary environmental investigation, a soil sample was collected during the installation of MW-19A that contained copper and thallium at concentrations greater than the NRDCSCC. The objective of the Phase II RI was to laterally and vertically delineate the elevated copper and thallium concentrations associated with AOC F.

Samples collected in AOC F show that thallium and copper have been laterally delineated to below the NRDCSCC. Thallium has also been delineated vertically in this AOC. Therefore, additional lateral delineation of this constituent is unwarranted. Furthermore, because the elevated copper concentration detected at FSB-04 was within an order of magnitude of the criterion, it was concluded that additional vertical delineation of copper is unwarranted.

A letter from the NJDEP dated January 21, 1999, stated the following regarding AOC F: "Additional samples were taken and analyzed to complete the delineation of the area." "These results are satisfactory and no additional soil sampling is required."

AOC G – Main Office Septic System

This AOC is being addressed as part of the RASR for the Facilities Area. Additional information regarding this AOC is provided in the *Remedial Action Selection Report* (DuPont, 1998).

Area H – North Septic System

This AOC is being addressed as part of the RASR for the Facilities Area. Additional information regarding this AOC is provided in the *Remedial Action Selection Report* (DuPont, 1998).

AOC I – Former DDT and Methoxychlor Area

The compounds DDT and methoxychlor were manufactured and stored in this AOC. Former buildings in this AOC were demolished between 1976 and 1978. During

manufacturing, a railroad spur was present along the northern side of the area and a shipping dock was located east of the manufacturing area. Since demolition, the area has likely been regraded several times.

Voluntary Environmental Investigation

As part of this investigation, monitoring well MW-24A was installed adjacent to AOC I. Sampling results for MW-24A indicated above average concentrations of total pesticides in soil and above average concentrations of total VOCs and total SVOCs, total pesticides, and TPH in groundwater. DuPont concluded that this manufacturing process has impacted both soil and groundwater quality.

ECRA Investigation

Elevated concentrations of zinc and mercury detected in soil during the voluntary environmental investigation were not confirmed by the subsequent ECRA sampling results. Mercury was not considered a potential concern because the detected concentrations did not exceed the appropriate screening criteria. Zinc did not appear to be elevated throughout the AOC sampling locations and, therefore, is unlikely to be a potential concern. DDT was detected above the NRDCSCC in one soil sample; however, the average DDT concentration for the AOC did not exceed the criteria. Therefore, DDT was not considered to be a potential concern at AOC I.

For groundwater, numerous organic compounds, including chlorobenzene, chlorinated benzenes, and isomers of BHC were detected. Copper, nickel, and zinc were detected above the AWQC. DuPont concluded that this AOC warranted additional consideration.

Phase II RI

The Phase II RI activities at AOC I characterized and partially delineated the extent of constituents in soil and groundwater. Based on the results from the Phase II RI activities, DuPont made the following recommendations:

- Because arsenic and lead are sitewide COPCs that are not known to be associated with AOC I activities, exceedances of soil criteria at AOC I should be evaluated as part of the sitewide COPCs (AOC P) investigation.
- Additional vertical and lateral delineation of zinc in soil will be necessary along the western and eastern pad perimeters.
- Further lateral and vertical delineation for the following pesticides will be necessary along northern, eastern, and southern pad perimeters: 4,4'-DDT; 4,4'-DDE; 4,4'-DDD; dieldrin; and methoxychlor.
- Arsenic in groundwater was only slightly above New Jersey Groundwater Class IIA (GWIIA) criteria and, therefore, requires no further investigation. However, pesticide constituents detected above GWIIA criteria (4,4'-DDD and 4,4'-DDT) appear to originate within AOC I and should be further evaluated to determine whether temporal concentration trends exist.
- The source of VOCs (i.e., benzene, chlorobenzene, and methylene chloride) in groundwater beneath AOC I should be further investigated.

Phase III RI

Additional soil borings were advanced during the Phase III RI to further delineate zinc and pesticides in the lateral and vertical direction. Phase III RI results indicated that soil was laterally delineated (except for pesticides) in an easterly direction toward the Arthur Kill. The shoreline did not allow for further sampling to the east. In a December 2001 letter addressing the Phase III RI, the NJDEP concurred that horizontal delineation of AOC-specific soil was complete but indicated that additional sampling was required to complete vertical delineation. DuPont agreed with the NJDEP and recommended that an additional soil investigation be performed as part of remedial design activities. The NJDEP agreed to postpone vertical delineation to the design phase because the constituents in question are not mobile (DuPont, 2006).

Results from previous shallow zone groundwater sampling at AOC I indicated the presence of metals, pesticides, and VOCs above applicable groundwater standards. The presence of VOCs were attributed to adjacent AOC U (former unlined pond) and metals were considered sitewide COPCs.

Although a few pesticides associated with AOC I were detected in groundwater at concentrations exceeding the GWIIA criteria, DuPont concluded that groundwater was sufficiently characterized to proceed to remedy selection. Based on this conclusion, DuPont recommended no further investigation for this AOC.

In a December 2001 letter addressing the Phase III RI, the NJDEP agreed that pesticides are the COPCs at AOC I and that these COPCs had been adequately delineated. The NJDEP concurred with DuPont that no further investigation of groundwater was needed (DuPont, 2006).

AOC J – Former North Fuel Oil Tanks

Aboveground petroleum fuel tanks were formerly located in AOC J. In addition, three tanks of sodium styrene sulfonate (SSS) still bottoms were temporarily buried in this AOC.

Voluntary Environmental Investigation

During this investigation, a soil boring was advanced at location MW-25A and a soil sample was collected. A well was not installed. The sample collected contained a visible tar-like substance. TPH was reported at a concentration of 200,000 mg/kg. Total SVOCs were reported at 55.2 mg/kg and total VOCs were reported at 0.0051 mg/kg. Based on these data, fuel oil storage appears to have impacted soil quality.

Monitoring wells located downgradient of soil sample location MW-25A indicate elevated concentrations of TPH, total VOCs, and total SVOCs. It is unclear whether these elevated concentrations are related to this AOC.

ECRA Investigation

In 1993, as part of the ECRA investigation, six shallow soil samples were collected from the 0- to 6-inch interval and were analyzed for PAHs and TPH. PAH constituents exceeded the NRDCSCC at two locations: SS-3 and SS-4. The sample from location

SS-3 contained benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene above the NRDCSCC. The sample from SS-4 contained benzo(a)pyrene above the NRDCSCC.

Phase II RI

The Phase II RI of AOC J partially delineated the vertical and horizontal extent of COPCs (PAHs) in soil. Soil sample results indicate that the lateral extent of PAH constituents in soil have not been completely delineated to the west of MW-35A and to the northeast of JSB-02 (west of the unlined pond). Further lateral delineation is necessary to meet the requirements of the TRSR. In addition, further vertical delineation of PAHs in soil is necessary at JSB-02.

Phase III RI

Phase III RI activities consisted of additional soil delineation sampling to meet the requirements of the TRSR. Phase III soil sampling results completed the vertical delineation of PAH constituents associated with this AOC. However, horizontal delineation was not completed, and DuPont concluded that PAH constituents appeared to be part of the sitewide distribution of PAHs.

The NJDEP concurred with DuPont in a December 2001 letter regarding the Phase III RI. In the letter, the NJDEP indicated that PAH levels appear to be more indicative of a sitewide problem characteristic of industrialized areas and not reflective of releases from the fuel oil tanks. The NJDEP also indicted that no further delineation of soil or groundwater was required for AOC J (DuPont, 2006).

AOC K – Former Disposal Area

This AOC was used for the disposal of various types of wastes. The wastes disposed of included aqueous wastes such as silicate muds, stormwater pond dredge material, strontium nitrate muds, hypo-muds, sodium sulfate salt cake, dimethyl sulfate piping and scaffolding, and symmetrel. In addition, an unlined pond in AOC K was used for the disposal of wastes generated from the production of methoxychlor and chloroneb.

Voluntary Environmental Investigation

As part of this investigation, soil and groundwater quality for this AOC was assessed by collecting both soil samples during boring advancing and groundwater samples after well installation (MW-9A, MW-14A, and MW-26A). Analytical results indicate that soil and groundwater in the area of AOC K are degraded with pesticides and SVOCs. Degradation is highest in the eastern portion by well MW-26A. TPH and lead were also above average in concentration in hydrologic unit A (shallow aquifer).

ECRA Investigation

As part of this investigation, additional soil samples were collected and a new well (MW-28A) was installed.

In soil, several organic constituents were detected at concentrations exceeding the NRDCSCC. In evaluating the average concentrations in AOC K, benzo(a)pyrene and

arsenic were the only compounds that exceeded the screening criteria. Because the average AOC concentrations were only slightly higher than the NRDCSCC, both constituents were not considered a significant concern.

Using the NJDEP IGWSCC criteria, three compounds in two soil samples were identified as a potential concern in the former unlined pond area. In surface soil, chlorobenzene, chloroform, and methoxychlor were present in one sample in elevated concentrations. In the subsurface soil sample at the same location, methoxychlor was detected in a concentration greater that the NJDEP IGWSCC criteria.

In groundwater, carbon tetrachloride, chlorobenzene, chloroform, methylene chloride, and phenol were identified as a potential concern in the former unlined pond area. Arsenic, mercury, nickel, and zinc were also considered potential concerns because they were detected in filtered samples in concentrations exceeding the AWQC. Based on the information presented, DuPont concluded that further consideration of the former unlined pond area may be warranted.

Phase II RI

Phase II RI activities at this AOC included the collection of soil samples to determine the horizontal and vertical extent of zinc and methoxychlor. Sampling results indicated that zinc was vertically and horizontally delineated. However, additional lateral delineation of methoxychlor was necessary to meet the requirements of the TRSR.

Phase III RI

Additional sampling for methoxychlor in soil was conducted in the Phase III RI at this AOC. DuPont collected a single soil sample to complete the horizontal delineation. Samples collected at depth exceeded the GWIIA criteria. To determine a true impact, a groundwater sample was collected and analyzed. Results of the groundwater analysis did not exceed the groundwater standard. Based on the soil and groundwater sample results, the NJDEP stated that horizontal delineation was satisfactory for AOC K and that there was no impact to groundwater (December 2001 letter). Therefore, the NJDEP concluded that no further soil or groundwater sampling was required for AOC K (DuPont, 2006).

AOC L – pH Adjustment Ponds

The pH adjustment ponds were used to adjust the pH of stormwater and noncontact cooling water prior to discharge into the Arthur Kill.

Voluntary Environmental Investigation

As part of this investigation, monitoring well MW-20A was installed to monitor groundwater conditions in hydrologic unit A by the pH adjustment ponds. A soil sample was also collected for soil quality. A petroleum sheen was noted in soil cuttings during the drilling of well MW-20B along with petroleum odors. As a result, MW-20B was constructed with a double casing. Subsequent gauging of water elevation during groundwater sampling in December 1990 revealed no free-phase petroleum in the well.

Based on soil and groundwater results, DuPont concluded that soil appears to have been degraded by petroleum as evidenced by petroleum sheens and odors during MW-20A

drilling. Soil data indicated above average total VOCs and total pesticides. Groundwater data for hydrologic unit A indicated above average concentrations of total SVOCs and TPH. In addition, total dissolved solids (TDS), chlorides, sodium, sulfate, and lead were present at above average concentrations. Based on these observations, the pH adjustment ponds have impacted both the quality of soil and groundwater.

ECRA Investigation

As part of this investigation, groundwater sampling was performed at this AOC. An assessment of the historic and current groundwater data determined that several VOCs and SVOCs were detected above their respective detection limits or AWQC. DDT was the only pesticide detected in filtered groundwater above the AWQC; it was detected in only one sampling round at a low estimated concentration. Arsenic was the only metal detected in the filtered sample at a concentration greater than the AWQC.

Based on this assessment, DuPont concluded that arsenic was the only constituent detected above its AWQC in multiple sampling events in the filtered groundwater samples. However, because arsenic has been identified as a sitewide COPC, further consideration of this AOC in and of itself is not warranted.

The NJDEP approved no further action for this AOC in a letter dated October 29, 1992.

AOC M – Wade Brothers Company

The Wade Brothers Company leases this area from DuPont for the operation of their contracting business.

Voluntary Environmental Investigation

A previous report prepared by DERS entitled *Report on the Investigation to Define the Extent of Petroleum at the Wade Brothers' Site Located at the DuPont Grasselli Plant* was prepared in October 1990. During this investigation, diesel had been detected in the water table. This 1990 report documents the history and approximate extent of petroleum at this AOC.

As part of this investigation, MW-7A was installed adjacent to this AOC. One soil sample was retained for analysis during installation. Due to the presence of petroleum, no groundwater samples were collected from MW-7A. The petroleum thickness in this well was approximately 1 foot on January 18, 1991.

Soil sample analytical results associated with MW-7A indicated the presence of pesticides and barium at above average concentrations. No VOCs were detected; total SVOC concentrations were well below concentrations at other soil sampling locations.

ECRA Investigation

Remediation activities, involving the installation of an interceptor trench associated with a fuel oil spill at AOC M, were implemented during the ECRA investigation. The field activities associated with this interim remedial measure (IRM) are described in the *Wade Brothers Site Fuel Oil Spill Interim Remedial Measures Work Plan* (DERS, 1992).

Phase II RI

During the installation of MW-7A, a soil sample was collected from 0.5 to 2.0 feet. This sample contained concentrations of barium above the RDCSCC but below the NRDCSCC. Beryllium was also detected in this sample at a concentration above the NRDCSCC. The objective of the Phase II RI in this area was to delineate these constituents vertically and horizontally around MW-7A. Soil and groundwater samples were collected for laboratory analysis.

The analytical results indicate that the soil near MW-7A has been adequately delineated for barium to concentrations below the NRDCSCC; therefore, no further action is recommended for this constituent. Although beryllium was detected at concentrations slightly exceeding the soil criteria, the slight exceedances do not warrant further delineation of this constituent.

Phase III RI

Fuel oil in groundwater at AOC M was delineated in 1990 and addressed with an IRM from 1992 through 1995. During the Phase II and Phase III sampling events, a sheen was observed on purge water, but no measurable thickness of product was found. The Phase III RI delineation efforts indicated that product fate may have been influenced by construction of wetlands to the west. In 2000, an independent IRM addressing groundwater seepage into the adjacent wetlands area was undertaken. Since the independent groundwater IRM would likely change the groundwater flow direction again, DuPont proposed to address any necessary future fuel oil product recovery after the IRM construction when groundwater levels were expected to return to pre-wetlands levels. The NJDEP concurred with this approach in a December 2001 letter regarding the Phase III RI.

Currently, DuPont is reevaluating the recovery system as part of a post-construction monitoring program initiated to assess the effectiveness of the wetlands area sheet pile wall (DuPont, 2006).

AOC N – Ditches

Stormwater from the plant was channeled to an open ditch system that leads to the pH adjustment ponds. Open process ditches were used to convey fluid to outfalls 008 and 009. A drainage ditch also runs from just east of AOC M north to Piles Creek.

ECRA Investigation

As part of the ECRA investigation field activities, sediment samples were collected from the ditches leading to the New Jersey Pollutant Discharge Elimination System (NJPDES) outfalls 008 and 009, from the ditch leading to the former pH adjustment ponds, and from the ditch east of AOC B.

The analytical results associated with the outfall ditches and the pH adjustment pond ditches were compared to the GWIIA criteria; no constituents were identified as potential concerns. DuPont recommended no further action for the former NJPDES ditches and the pH adjustment pond ditches.

The ditch east of AOC B flows northward into Piles Creek. Based on the sediment screening criteria, several metals may be of limited potential concern at one outfall location. Arsenic was detected above the criteria in both outfall locations in at least one sample.

Surface water within the ditch originates from surface runoff and groundwater discharge. This ditch does not constitute a high quality stream. Therefore, comparison with the median effects range (ER-M) and background soil levels was considered to be more appropriate. The only metals exceeding the ER-M were arsenic, lead, and zinc. Lead and zinc were detected at maximum concentrations of 308 and 325 mg/kg, respectively. These concentrations are generally lower than concentrations detected in site surface soil. Arsenic has been identified as a potential sitewide concern in both soil and groundwater. Arsenic in the ditch sediment is likely the result of surface runoff or groundwater discharge. Arsenic is considered the only constituent of potential concern for the ditch sediment.

A letter from the NJDEP dated September 20, 1996, stated the following regarding the ditches in this AOC:

> "DuPont states that according to site maps, the ditch east of AOC B is no longer part of the DuPont Grasselli site. This property is part of the property condemned by the NJTA. DuPont is currently trying to determine the status of this property. As previously stated, the NJDEP will hold in abeyance any requirements for this area until the status of this property has been determined."

AOC O – Former Lithopone Production Area

This AOC is being addressed as part of the Facilities Area RASR. Additional information regarding this AOC is provided in *Remedial Action Selection Report, DuPont Grasselli Site, Linden New Jersey* (DuPont, 1998).

AOC P – Soil, Sitewide COPCs

This AOC encompasses the sitewide distribution of arsenic, lead, barium, cadmium, and PAHs that are not associated with any specific AOC. Previous sampling performed as part of the voluntary environmental investigation, the ECRA investigation, and the Phase II RI provided a general understanding of the distribution of arsenic, lead, barium, cadmium, and PAHs across the site. The results affirmed that elevated levels of these constituents are distributed in general areas and are not related to point sources.

Voluntary Environmental Investigation

AOC-specific soil sampling was performed as part of this investigation. The need for sitewide sampling had not been identified at that time; however, the data collected were used as appropriate to assist in understanding the distribution of the identified sitewide COPCs.

ECRA Investigation

As part of the ECRA investigation, the NJDEP approved the sitewide surface soil sampling program for lead and arsenic and required that PAHs also be analyzed as part of the sitewide sampling program.

The results of the sitewide sampling program determined that arsenic and lead were sitewide COPCs in surface soil. Further consideration of these COPCs throughout the eastern portion of the site may be warranted. PAH concentrations above the NRDCSCC are primarily limited to AOC K. Further consideration of PAHs in surface soil should be limited to this area.

Phase II RI

The Phase II RI sitewide soil samples were collected to fill previous data gaps and provide a better understanding of the distribution of arsenic, lead, barium, cadmium, and PAHs across the site. The results affirm that elevated levels of these constituents are distributed in general areas and are not related to point sources. Based on Phase II results, additional horizontal and vertical delineation of these constituents to the applicable standards is necessary to meet the TRSR.

Phase III RI

The Phase III RI for this area involved horizontally and vertically delineating arsenic, lead, PAHs, and barium to the applicable criteria. Lateral and vertical delineation was accomplished for lead, barium, and PAHs in soil. Based on off-site data obtained from a Freedom of Information Act (FOIA) file search of NJDEP records, soil in which arsenic exceeds the applicable soil criteria originated both on the ISP and Grasselli properties. As a result, the source of arsenic in soil cannot be attributed solely to either site. Therefore, DuPont proposed that the extent of arsenic in soil attributed to DuPont be defined as the property boundary.

The NJDEP concurred with the DuPont proposed delineation of arsenic in a December 27, 2001, letter regarding the Phase III RI and concluded that no further investigation of AOC P was needed.

AOC Q – West Portion of Site

A letter from the NJDEP dated September 20, 1996, stated the following regarding AOC Q Ditches:

> "AOC Q, the undeveloped area of the site, involves the area which is being transferred from DuPont to the New Jersey Turnpike Authority (NJTA). DuPont states that it is currently trying to determine what declaration of environmental restrictions (DER) or other conservation easements have been placed on the property.
>
> The NJDEP will hold in abeyance any requirements with respect to AOC Q until such time as the DER or conservation easement has been reviewed by the NJDEP."

AOC R – Septic Systems

The septic systems associated with AOC R include the septic system associated with Building 148 and the septic system associated with Building 309 (NJDEP letter dated September 15, 1994). In addition, included in this AOC are the septic systems for Buildings 133, 54, and the Administration Building.

A DuPont letter to the NJDEP dated April 12, 1996, states that the septic systems will be addressed individually as separate AOCs. Specifically, the DuPont letter states the following:

> "Each septic system is addressed in a separate area of concern (i.e., AOC H addresses the septic system located near Building 133, AOC E for Building 54, and AOC G for the Administration Building)."

Additional information regarding these AOCs is provided in the sections on the referenced AOCs.

AOC S – Gasoline AST #25 and Pump

The gasoline AST and pump refer to former Tank #25 which was located south of the former change house (Building 133). This tank and its associated pump and piping were dismantled.

ECRA Investigation

As part of the ECRA investigation, prior to dismantlement, and with NJDEP agreement, soil sample locations were identified. Soil samples from beneath the tank, the piping, and the pump were analyzed for Priority Pollutant List (PPL) volatiles, lead, and TPH. Based on a review of the soil sample analytical results, DuPont concluded that there was no potential for concern for either direct contact or impact to groundwater (DERS, 1993).

A letter from the NJDEP dated February 23, 1996, stated that the "proposal for no further action is acceptable" for AOC S.

AOC T – Spill E Building

In the DERS document *Supplement to November 23, 1993, ECRA Investigation Report, ISRA Case No. 92142* (DERS, 1995), DuPont stated the following:

> "Because of a recent spill outside of the Spill E Building 103 machine shop oil leaked from an air compressor. A 10-by-10-foot area was excavated and the stained soil was placed in drums."

A letter from the NJDEP dated September 15, 1994, stated that a recent spill outside the Machine Shop was "observed during an August 26, 1992 site inspection. DuPont agreed to excavate the area, and no post-excavation samples were required, due to the recent nature of the spill."

A letter from the NJDEP dated May 19, 1997, stated that DuPont planned to appropriately dispose of the drummed soil at a permitted waste disposal facility using the

characterization results that were previously obtained, and that no additional samples will be collected. In this letter, the NJDEP stated that this proposal was acceptable.

AOC U – Former Unlined Pond

AOC U contains a former unlined pond that was used for the disposal of wastes generated from the production of methoxychlor and chloroneb between approximately 1947 and 1977. The wastes were pumped into the pond and allowed to evaporate or seep into the ground. The approximate pond location has been estimated based on historic site maps, stressed vegetation, and aerial photographs. The pond was reportedly dismantled and excavated by Rollins Environmental in 1978 (DERS, 1990). The disposal area was subsequently covered with a poorly sorted sand and gravel.

ECRA Investigation and Phase II RI

Initial sampling of soil and groundwater at AOC U performed as part of the ECRA investigation and Phase II RI activities, indicated that metals, pesticides, and VOCs exceeded criteria. The lateral extent of copper; cadmium; beryllium; 4,4'-DDE; PCP; carbon tetrachloride; methylene chloride; bromodichloromethene; tetrachloroethene; trichloroethene; and ethylbenzene were all previously delineated. Previous sampling of the peat layer underlying the AOC has demonstrated that this peat barrier had prevented the vertical migration of the constituents (DERS, 1998). As a result, this marsh deposit delineated the vertical extent of constituents associated with AOC U.

Phase III RI

During the Phase III RI, additional sampling for arsenic; lead; zinc; and 4,4'-DDT was necessary. Surface soil samples were collected and analyzed for the constituents requiring delineation. Constituent concentrations at the perimeter sample locations were found to be near or below the applicable soil standard. Based on the results and in a December 2001 letter, the NJDEP concluded that delineation of these constituents was complete.

DuPont was also required to delineate nonaqueous phase liquid (NAPL) horizontally and vertically during the Phase III RI. The NAPL was delineated in soil using the NAPLANAL analytical model. Based on this analytical model, DuPont concluded that NAPL has been adequately delineated, excluding the east direction due to the location of the Arthur Kill. NAPL components were not detected in surface water samples from the Arthur Kill; therefore, DuPont concluded that the delineation was complete. The NJDEP concurred with this conclusion in a December 2001 letter regarding the Phase III RI.

The NJDEP required DuPont to investigate the potential impact to the deep aquifer beneath the former unlined pond. DuPont installed a deep zone monitoring well in 2002 (MW-38B). Sampling results from the new well showed that deep groundwater beneath the former unlined pond contained chlorobenzene and methylene chloride at concentrations above GWIIA criteria. However, DuPont concluded that the groundwater did not present an unacceptable risk to human health and the environment for the following reasons:

- Contaminant levels in the deeper aquifer were lower than levels in the shallow groundwater.
- Surface water in Piles Creek and the Arthur Kill are the only receptors of shallow and deep groundwater discharges from the site.
- Samples of these surface water bodies and conservative fate and transport calculations did not show measurable impact from COPCs in groundwater at the site.

AOC W – Groundwater, Sitewide COPCs

Groundwater quality has been investigated and thoroughly characterized at the Grasselli site over a 10-year period. During the Phase III RI, DuPont collected additional data on the quality of sitewide groundwater. Groundwater results from 28 shallow zone wells and four deep zone wells were evaluated on a sitewide basis. Additionally, a file search of NJDEP records was conducted to obtain off-site data from the neighboring ISP plant, located hydraulically upgradient and side gradient from the Grasselli site. The results of the Phase III RI and data collected from the file search were used to characterize groundwater in both the shallow and deep zones.

In the shallow groundwater zone, constituents that exceed the GWIIA criteria in more than one well during previous investigations of the site include antimony; arsenic; lead; cadmium; chromium; nickel; mercury; zinc; benzene; chlorobenzene; methylene chloride; chloroform; alpha-BHC; beta-BHC; gamma-BHC; 4,4'-DDD; DDE; DDT; methoxychlor; fluoride; ammonia; and sulfate. The greatest metal concentrations occur in the southern portion of the site near the former DMHA waste holding ponds, the sulfuric acid transfer facilities, and the ISP property. Conversely, the highest VOC and pesticide groundwater concentrations are located in the northeastern portion of the site, near the former pesticide manufacturing area and former unlined pond area.

Based on the file search, both nickel and arsenic were identified as COPCs on the ISP property. Using these data, nickel and arsenic were delineated along the southern property line near MW-15A. However, arsenic is a persistent contaminant in the adjacent ISP property as well and available data indicate that arsenic exceeds the criteria in the shallow aquifer on both properties. Because of the direction of groundwater flow toward the Arthur Kill and parallel to the property boundary, it is likely that elevated arsenic concentrations noted in the southern property boundary area originate from both properties. The NJDEP concurred with the DuPont use of the data from the ISP site to delineate metals along the southern property line of the Grasselli site.

For VOC and pesticide concentrations in the northeastern portion of the site, DuPont and the NJDEP agreed that gradients calculated during the Phase III RI can be used to delineate contamination between monitoring wells where constituents were detected and nearby surface water bodies (i.e., Piles Creek and the Arthur Kill). Gradient calculations were necessary because additional sampling north of MW-37 was not possible due to a pipeline right-of-way. The NJDEP agreed with this delineation method due to the physical constraints and the determination that Piles Creek and the Arthur Kill have not been significantly impacted by the site.

The constituents that exceed the criteria in the deep aquifer are arsenic, cadmium, antimony, and chromium. However, as stated by the NJDEP in a December 2001 letter, the levels of contamination in the deep aquifer seem to be lower than in the shallow aquifer and are close to GWIIA criteria. Although the data show that the site has impacted the deep aquifer, DuPont and the NJDEP agreed that additional delineation was not necessary.

Exhibit L

DuPont Corporate Remediation Group
Chestnut Run Plaza, Building 715
4417 Lancaster Pike
Wilmington, DE 19805

October 15, 2010

Mr. Ian Curtis
Office of Brownfield Reuse
New Jersey Department of Environmental Protection
401 East State Street
PO Box 028
Trenton, NJ 08625-028

Revised Remedial Action Work Plan
DuPont Grasselli Site, Linden, NJ

Dear Mr. Curtis:

Based on your comments of October 1, 2010 via electronic mail, and our subsequent telephone conversations, DuPont has completed revisions to the *Remedial Action Work Plan* (RAW) for the Redevelopment Parcel of the DuPont Grasselli Site in Linden, NJ. Enclosed please find a CD with the entire revised document, along with four revised pages for insertion into your paper copy, including a new cover page with todays date. There is also a revised Figure 6, showing the locations of the AOCs, monitoring wells, and conceptual alignment of the slurry wall.

Also enclosed is a revised Case Inventory Document with minor clarifications to the original provided with the draft RAW.

DuPont is committed to timely completion of the Linden site remediation following your approval of the RAW. Please call me at 302-999-2850 if you have aditional questions or if there is any way I can be of assistance.

Sincerely,

John E. Vidumsky, P.E.
Project Director

New Jersey Department of Environmental Protection
Site Remediation Program

REMEDIAL ACTION WORKPLAN FORM

Date Stamp
(For Department use only)

SECTION A. SITE NAME AND LOCATION

Site Name: DuPont Grasselli Site

List all AKAs:

Street Address: Foot of Tremley Point Road

Municipality: Linden (Township, Borough or City)

County: Union Zip Code: 07036

Mailing Address if different than street address: Chestnut Run Plaza, Bldg. 715, Wilmington, DE 19805

Program Interest (PI) Number(s): N/A Case Tracking Number(s): 92142

Date Remediation Initiated Pursuant to N.J.A.C. 7:26C-2.2 or 2.3(b): 03/10/1992

State Plane Coordinates for a central location at the site: Easting: 573280 Northing: 649045

Municipal Block(s) and Lot(s): Block # 586 Lot # 8

Block # 586	Lot # 9	Block # 586	Lot # 11 (partial)
Block #	Lot #	Block #	Lot #
Block #	Lot #	Block #	Lot #
Block #	Lot #	Block #	Lot #

SECTION B. REQUIRED TECHNICAL SUBMITTALS

	Not Applicable	Included in This Submission	Previously Submitted	Date of Submission	Date of Revised Submission
Immediate Environmental Concern Report	☒	☐	☐		
Immediate Response Action Plans	☒	☐	☐		
Preliminary Assessment Report	☐	☐	☒	11/23/1993	
Receptor Evaluation	☐	☐	☒	06/01/1998	
Site Investigation Report	☐	☐	☒	06/01/1998	
Remedial Investigation/Remedial Action Work Plan	☐	☒	☐	10/15/2010	
Feasibility Study Report	☒	☐	☐		
Remedial Action Outcome Report	☒	☐	☐		
Permit Application	☒	☐	☐		

SECTION C. SITE USE

Current Site Use (check all that apply)

☒ Industrial ☐ Agricultural
☐ Residential ☐ Park or recreational use
☐ Commercial ☐ Vacant
☐ School or child care ☐ Government

Intended Future Site Use, if known (check all that apply)

☒ Industrial ☐ Park or recreational use
☐ Residential ☐ Vacant
☐ Commercial ☐ Government
☐ School or child care ☐ Future site use unknown

SECTION D. PUBLIC FUNDS

Did the remediation utilize public funds? ☐ Yes ☒ No

If "Yes," check applicable: ☐ UST Grant ☐ UST Loan ☐ Brownfield Reimbursement Program
☐ HDSRF Grant ☐ HDSRF Loan ☐ Landfill Reimbursement Program
☐ Spill Fund ☐ Schools Development Authority

SECTION E. GENERAL

1. Does the RAW address:

   ☒ Area(s) of Concern Only (If submitted for specific AOC(s), attach Section B1. of the PA/SI form)

   ☐ Full Site (Based on a completed and submitted Preliminary Assessment/Site Investigation)

2. Does the report contain a permit(s) request that requires Site Remediation Program approval prior to implementation of the remedial action(s)? ☒ Yes ☐ No

   If "Yes," please list the type and the page(s) of the report that contain the permit request(s).

Discharge to Groundwater - Permit by Rule; Appendix A of RAW

3. As of May 7, 2010, is the remediation initiated for new construction or a change in the use of the site proposed for the purposes of residential use, use as a licensed child care center or use as a school? ☐ Yes ☒ No

   If "Yes," is an unrestricted use or a presumptive remedy being proposed? ☐ Yes ☐ No

4. Is the proposed remedial action an alternative remedy pursuant to Section 35. g (10) of P.L. 1993. c. 139 [SRRA]? ☐ Yes ☒ No

   If "Yes," specify the Section/page(s) of the RAW where the alternative remedy is proposed:

5. Is any radiological contamination currently present at the AOC/Site? ☐ Yes ☒ No
6. Did any of the site contain Ordnance and Explosives/unexploded ordnance (OE/UXO)? ☐ Yes ☒ No
7. Does the proposed remedial action involve containment of free product? ☐ Yes ☒ No
8. Have any of the following compounds/elements ever been detected in sediment above the ecological screening levels:

   ☒ Arsenic ☐ Dioxin ☒ Mercury ☐ PCBs

9. Have past deficiencies been addressed in this submittal? ☒ Yes ☐ No
10. Will the proposed remedial action render the property unusable for future redevelopment or for recreational use [SRRA 47g(1)]? ☐ Yes ☒ No

SECTION F. SITE CONDITIONS

Check each media-type and highest concentration of contamination currently present above any applicable standards/criteria:

Soil in ppm						GW = Ground Water in ppb						SW = Surface Water in ppb						Sed = Sediment in ppm					
	Soil ppm	GW ppb	SW ppb	Sed ppm			Soil ppm	GW ppb	SW ppb	Sed ppm			Soil ppm	GW ppb	SW ppb	Sed ppm			Soil ppm	GW ppb	SW ppb	Sed ppm	
*VOCs	☐	☐	☒	☒	<100		☐	☐	☐	☐	100–1,000		☒	☒	☐	☐	>1,000						
*SVOCs	☐	☐	☒	☒	<100		☒	☐	☐	☐	100–1,000		☐	☐	☐	☐	>1,000						
*PAHs	☐	☐	☐	☒	<10		☒	☐	☐	☐	10–100		☐	☐	☐	☐	>100						
*Metals	☐	☐	☐	☐	<100		☐	☐	☒	☐	100–1,000		☒	☒	☐	☒	>1,000						
PCBs	☒	☐	☐	☐	<10		☐	☐	☐	☐	10–100		☐	☐	☐	☐	>100						
*Pesticides	☐	☐	☒	☐	<1		☐	☐	☐	☒	1-10		☒	☒	☐	☐	>10						
Dioxin (ppb)	☐	☐	☐	☐	<1 ppb		☐	☐	☐	☐	1-10 ppb		☐	☐	☐	☐	>10 ppb						
Chromium	☐	☐	☐	☐	<100		☐	☒	☐	☒	100–1,000		☐	☐	☐	☐	>1,000						
Mercury	☒	☐	☐	☒	<100		☐	☐	☐	☐	100–1,000		☐	☐	☐	☐	>1,000						
Arsenic	☐	☐	☐	☐	<10		☐	☐	☒	☐	10–100		☒	☒	☐	☒	>100						
TPHC	☐			☒	<1,700		☐			☐	1,700–5,100		☒			☐	>5,100						

1. For any contaminant group (*) checked above, identify the compound/element with the highest concentration over its applicable remediation standard:
   Chlorobenzene | Phenol | Benzo(a)pyrene | Methoxychlor | Arsenic

2. Were the laboratory reporting minimum detection limits below applicable remediation standards/ criteria required for the site? ☐ Yes ☒ No

3. Are any of the following conditions currently present (check all that apply):

Groundwater:
- ☒ Contaminated ground water in the overburden aquifer
- ☒ Contaminated ground water in a confined aquifer
- ☐ Contaminated ground water in the bedrock aquifer
- ☐ Contaminated ground water in multiple aquifer units
- ☐ Multiple distinct ground water plumes
- ☒ Contaminated ground water migrating off-site
- ☐ Co-mingled onsite ground water plumes
- ☐ Co-mingled ground water plumes from both on-site and offsite sources
- ☒ Contaminated ground water discharging to surface water
- ☒ Residual or free product
- ☐ Radionuclides

Soil:
- ☐ On-site discharge(s) impacting soil off-site
- ☐ Chromate Production Waste
- ☐ Munitions and explosives of concern
- ☒ Contaminated soil in the saturated zone
- ☐ Historic pesticide impacts to soil
- ☒ Residual or free product
- ☐ Radionuclides
- ☒ Historic Fill
- ☐ Soil contamination due to naturally occurring background conditions

4. Check each of the following that applies to the primary objective of the remedial action:

☒ Treatment of:	☒ Ground Water	☒ Soil	☐ Sediments	☐ LNAPL	☒ DNAPL	☐ Soil Gas
☒ Removal of:	☒ Ground Water	☐ Soil	☐ Sediments	☐ LNAPL	☐ DNAPL	☐ Soil Gas
☒ Containment/Control of:	☒ Ground Water	☒ Soil	☐ Sediments	☐ LNAPL	☐ DNAPL	☐ Soil Gas

With migration pathway(s) to:
- ☐ Indoor Air
- ☒ Ground Water
- ☒ Surface Water
- ☐ Sediments
- ☐ Other

With exposure to:
- ☒ Human receptors
- ☒ Eco receptor(s)
- ☒ Offsite impacts

5. Is the remedial action an Interim Remedial Measure that was being implemented at the site? ☐ Yes ☒ No

SECTION G. ALTERNATIVE STANDARD / DEVIATIONS

Alternative remediation standard

If proposing an alternative remediation standard pursuant to N.J.A.C. 7:26D-7.4, check here and attach the Alternative Soil Remediation Standard Application Form as an addendum. ☐

Deviation from regulations

If the Licensed Site Remediation Professional has varied from the Technical Rules, provide the citation(s) from which the remediation varied and the page(s) in the attached document where the rationale for the deviation is provided.

N.J.A.C. 7:26E- _____ Page _____

N.J.A.C. 7:26E- _____ Page _____

N.J.A.C. 7:26E- _____ Page _____

SECTION H. APPLICABLE REMEDIATION STANDARDS

Indicate the Remediation Standards used for all compounds (check all that apply).

- ☒ Default (check all that apply below)
  - ☒ Direct Contact
  - ☒ Impact to Groundwater Soil Screening Levels
  - ☐ Ecological Screening Levels
- ☐ Alternate Remediation Standards for the Ingestion/Dermal Pathway
- ☐ Alternate Remediation Standards for the Inhalation Pathway

☐ Site Specific Standards for the Impact to Groundwater Pathway (check all that apply below)
☐ Soil-Water Partitioning Equation ☐ SPLP ☐ Sesoil ☐ Sesoil/AT123D
☐ Ecological Remediation Goals

What is the ground water classification for this site as per N.J.A.C. 7:9C (check all that apply)?

☐ Class I-A ☒ Class II-A
☐ Class I-PL Pinelands Protection Area ☐ Class III-A
☐ Class I-PL Pinelands Preservation Area ☐ Class III-B

SECTION I. SOIL/SEDIMENT REUSE

1. Will material **other than certified clean soil** be imported from an off-site source? ..... ☒ Yes ☐ No
2. Will the remedial action involve on-site reuse of the contaminated media (soil or other materials)? ..... ☒ Yes ☐ No
3. Will the remedial action involve exporting contaminated media off-site for reuse? ..... ☐ Yes ☒ No
4. Will the remedial action involve soil blending for applied pesticides for agricultural purposes prior to any reuse? ..... ☐ Yes ☒ No

SECTION J. REMEDIAL ACTION WORKPLAN INFORMATION

General

1. Are NJDEP-approved permits, other than any permits needing SRP approval, required prior to the implementation of the remedial action? ..... ☐ Yes ☒ No

   If "Yes," please list the type. _____

Soils

2. Check each type of remediation being proposed:

   ☐ No remedial action required ☐ Excavation
   ☒ Capping/other Engineering Control ☐ Bioremediation
   ☒ Institutional Control ☐ Soil Vapor Extraction
   ☒ Chemical Oxidation ☒ Chemical Reduction
   ☐ Thermal desorption ☐ Soil Washing
   ☐ Other (specify):_____

3. Does the proposed remedial action address all saturated zone source material, if applicable?** ..... ☒ Yes ☐ No
4. If an engineering control is proposed, indicate the receptor(s) each engineering control is intended to protect (check all that apply):

   ☒ Human ☒ Ecological ☒ Offsite impacts

5. If a restricted use is being proposed, has consent from all involved property owners been obtained?* .... ☒ Yes ☐ No
6. Is the proposed remedial action a presumptive remedy? ..... ☐ Yes ☒ No

Ground Water

7. Check each type of remediation being proposed:

   ☐ No remedial action required ☒ Containment
   ☐ Multiple Phase Extraction System ☒ Hydraulic Control
   ☐ SVE/Air Sparging ☐ Monitored Natural Attenuation
   ☐ Ozone Sparging ☒ Chemical Oxidation
   ☐ Pump & Treat ☐ Other (specify):_____

Ecological

8. Check each type of remediation being proposed:

   ☐ No remedial action required ☐ Capping
   ☐ Excavation/Dredging ☐ Other (specify):_____

Indoor Air

9. Are soil gas concentrations currently >10x SGSLs? ..... ☐ Yes ☐ No

10. Check each type of remediation being proposed:

- ☒ No remedial action required
- ☐ Sealed Vapor Barrier
- ☐ Soil Vapor Extraction System
- ☐ Other (specify): _____
- ☐ Subsurface Depressurization System
- ☐ Sealing of Openings and Cracks
- ☐ Monitoring and Maintenance Schedule

SECTION K. MISCELLANEOUS

1. Will any injured natural resources be restored concurrent with the remedial action? If so, is the Office of Natural Resources Restoration involved? ☐ Yes ☒ No
2. Is the proposed remedial action a presumptive remedy? ☐ Yes ☒ No

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

Full Legal Name of the Person Responsible for Conducting the Remediation: _____

Representative First Name: John Representative Last Name: Vidumsky

Title: Project Director

Phone Number: (302) 999-2850 Ext: _____ Fax: _____

Mailing Address: Chestnut Run Plaza, Bldg. 715

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

Email Address: john.e.vidumsky@usa.dupont.com

Developer Certification Included ☐ or Filed _____ Date of Filing

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with SRRA Section 16 d. and Section 30 b.2.

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

Signature: _____ Date: _____

Name/Title: John E. Vidumsky, Project Director

SECTION M. LICENSED SITE REMEDIATION PROFESSIONAL INFORMATION AND STATEMENT

LSRP ID Number: _____

First Name: _____ Last Name: _____

Phone Number: _____ Ext: _____ Fax: _____

Mailing Address: _____

City/Town: _____ State: _____ Zip Code: _____

Email Address: _____

This statement shall be signed by the LSRP who is submitting this notification in accordance with SRRA Section 16 d. and Section 30 b.2.

I certify that I am a Licensed Site Remediation Professional authorized pursuant to N.J.S.A. 58:10C to conduct business in New Jersey. As the Licensed Site Remediation Professional of record for this remediation, I:

[SELECT ONE OR BOTH OF THE FOLLOWING AS APPLICABLE]:

☐ *directly oversaw and supervised all of the referenced remediation, and\or*

☐ *personally reviewed and accepted all of the referenced remediation presented herein.*

I believe that the information contained herein, and including all attached documents, is true, accurate and complete.

It is my independent professional judgment and opinion that the remediation conducted at this site, as reflected in this submission to the Department, conforms to, and is consistent with, the remediation requirements in N.J.S.A. 58:10C-14.

My conduct and decisions in this matter were made upon the exercise of reasonable care and diligence, and by applying the knowledge and skill ordinarily exercised by licensed site remediation professionals practicing in good standing, in accordance with N.J.S.A. 58:10C-16, in the State of New Jersey at the time I performed these professional services.

I am aware pursuant to N.J.S.A. 58:10C-17 that for purposely, knowingly or recklessly submitting false statement, representation or certification in any document or information submitted to the board or Department, etc., that there are significant civil, administrative and criminal penalties, including license revocation or suspension, fines and being punished by imprisonment for conviction of a crime of the third degree.

LSRP Signature: _____ Date: _____

LSRP Name/Title: _____

Company Name: _____

Exhibit M

REMEDIAL ACTION WORK PLAN

NJDEP CASE NUMBER 92142
REDEVELOPMENT PARCEL
DUPONT GRASSELLI SITE
LINDEN, NEW JERSEY

Prepared for:

DuPont Corporate Remediation Group
Chestnut Run Plaza 715
Route 141 and Faulkland Road
Wilmington, DE, 19805

Prepared by:

PARSONS
200 Cottontail Lane
Somerset, New Jersey, 08873

October 2010

DuPont PN 507890
Parsons PN 445438

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Appendix C Pre Design Investigation Aquifer Hydraulic Testing
Appendix D Draft Groundwater Classification Exception Area
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LIST OF ACRONYMS

AEI	Areas of Environmental Impact
AOC	Area of Concern
AST	Aboveground Storage Tank
BEE	Baseline Ecological Evaluation
BHC	Benzene Hexachloride
CEA	Classification Exception Area
cm/sec	centimeters per second
COPC	Constituents of Potential Concern
CQA	Construction Quality Assurance
CRG	DuPont Corporate Remediation Group
DDD	Dichloro Diphenyl Dichloroethane
DDT	Dichloro Diphenyl Trichloroethane
DERS	DuPont Environmental Remediation Services
DuPont	E. I. du Pont de Nemours and Company
ECRA	Environmental Cleanup Responsibility Act
GWQS	Ground Water Quality Standards
GW-IIA	NJDEP Groundwater Class IIA Standards
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
H_2O_2	Hydrogen Peroxide
IRM	Interim Remedial Measure
ISRA	Industrial Site Recovery Act
ISP	International Specialty Products
MnO_2	Manganese Dioxide
MnO_4^-	Permanganate ion
NAPL	Non-Aqueous Phase Liquid
NJDEP	New Jersey Department of Environmental Protection
NJTA	New Jersey Turnpike Authority
NRD	Natural Resource Damage
NRDCSCC	Non-Residential Direct Contact Soil Cleanup Criteria
NRDCSRS	Non-Residential Direct Contact Soil Remediation Standards
$O_2^{\cdot -}$	Superoxide radical
OH	Hydroxyl radical
PAH	Polynuclear Aromatic Hydrocarbon
PAMP	Perimeter Air Monitoring Plan
PDI	Pre-Design Investigation
PDM	Processed Dredge Material
PurGen	PurGen One, LLC
RASR	Remedial Action Selection Report
RA	Remedial Action
RAO	Response Action Outcome
RAR	Remedial Action Report
RAW	Remedial Action Work Plan
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RDCSCC	Residential Direct Contact Soil Cleanup Criteria
RDCSRS	Residential Direct Contact Soil Remediation Standards
SBCW	Soil-Bentonite Cutoff Wall
SESC	Soil Erosion and Sediment Control
SVOC	Semi-Volatile Organic Compound
TDS	Total Dissolved Solids
TRSR	Technical Requirements for Site Remediation
VOC	Volatile Organic Compound
µg/l	micrograms per liter

EXECUTIVE SUMMARY

The DuPont Grasselli Site in Linden, New Jersey was used for the manufacture of a variety of chemicals, primarily industrial acids, starting in 1865. Manufacturing operations were shut down in 1992, at which time the facilities were dismantled and demolished. A series of Remedial Investigations and Interim Remedial Measures were conducted from the time of plant closure, and continue to the present day.

This Remedial Action Work Plan (RAW) presents a comprehensive remedial action plan for the Redevelopment Parcel of the site. The Redevelopment Parcel comprises approximately 106 acres of land that is the subject of a redevelopment plan currently being enacted by the City of Linden, and includes the entire former manufacturing area of the property. In March 2009, DuPont executed a contract of sale with PurGen One LLC (PurGen) who plans to develop the 106-acre parcel into an industrial complex that will include commercial electric power generation and chemical manufacturing.

The remedial action plan presented in this RAW has the following major components:

- Site-wide groundwater containment through the installation of a perimeter slurry wall combined with groundwater extraction for hydraulic control,
- Treatment of extracted groundwater at the adjacent International Specialty Products facility,
- Source treatment and destruction of free product by in-situ chemical oxidation and reduction in AOC U, the Former Unlined Pond Area, and AOC I, the Former DDT and Methoxychlor Area,
- A site-wide cap / final cover, and
- Engineering and Institutional Controls including a Deed Notice and Groundwater Classification Exception Area.

The overall goals of the planned site remedy are protection of human health and the environment, compliance with all applicable environmental regulations and requirements, and redevelopment and reuse of the property.

This RAW does not address Piles Creek or the associated wetlands and upland areas to the west of the former manufacturing area. These areas are being addressed through separate, parallel environmental programs.

1.0 INTRODUCTION

This Remedial Action Work Plan (RAW) has been prepared for the Redevelopment Parcel of the former E. I. du Pont de Nemours and Company (DuPont) Grasselli site located at Tremley Point in the city of Linden, Union County, New Jersey. A revised Site-Wide Remedial Action Selection Report (RASR) was submitted to the New Jersey Department of Environmental Protection (NJDEP) in January of 2008, proposing a comprehensive remediation plan for the site (DuPont Corporate Remediation Group [CRG], 2008). A series of discussions between DuPont and the Department have lead to a consensus that the appropriate next step is the preparation and submittal of this RAW, even though the 2008 RASR has not been formally approved. Based on those same discussions, and in consideration of the planned industrial redevelopment of the site, the site-wide remedy presented in this RAW expands on the remedy presented in the 2008 RASR by including a total site containment system consisting of a perimeter physical barrier wall and groundwater pumping system.

The proposed remedial action includes the construction of a subsurface cutoff barrier wall at the perimeter of the former manufacturing area, a soil cover / cap, a groundwater extraction system, and institutional controls including a Deed Notice and the establishment of a groundwater Classification Exception Area (CEA). An application for groundwater Class III-B aquifer designation is being prepared and will be submitted to the NJDEP under separate cover. The Class III-B designation is appropriate because of the saline character of the site groundwater. Total dissolved solids (TDS) and chlorides both exceed the Class II-A criteria.

1.1 Site Description

The DuPont Linden site is located in an industrial area in the eastern portion of Linden, New Jersey (see Figure 1). The 106-acre Redevelopment Parcel includes the main former manufacturing area (Parcel 1) and a smaller adjacent parcel (Parcel 2) west of the former manufacturing area. Parcel 1 is approximately 98 acres and located between the Arthur Kill on the east and the Sound Shore Branch railroad tracks on the west. Parcel 2 is approximately eight acres located immediately west of the Sound Shore Branch railroad tracks near the central portion of the site.

The scope of this remedial action does not include undeveloped property located west of the manufacturing area that was leased by DuPont to the New Jersey Turnpike Authority (NJTA) as a long-term conservation easement (known as the NJTA Piles Creek East Wetlands Mitigation Project), Piles Creek, or the wetlands to the west of Piles Creek.

The DuPont Linden site originally consisted of tidal marshlands that, over time, were reclaimed by fill emplacement. In 1865, the Standard Chemical Company purchased the land from several individual owners and developed the tract for industrial use. From 1885 until 1928, the Grasselli Chemical Company owned and operated the site. In 1928, DuPont purchased the site. Historical manufacturing at the site included the production of sulfuric acid, phosphoric acid, ammonium thiosulfate, sodium bisulfate, inorganic salts, acids, and organic pesticides. Chemical production at the site was terminated in the fall of 1990. Since then, all of the site manufacturing buildings and infrastructure have been demolished and removed.

Current site operations consist of a tenant rock and concrete crushing/recycling operation in the southern portion of the site. The majority of the site surface is covered by gravel, crushed stone or soil, with paved and unpaved roads and vegetation.

1.2 Areas of Concern

The DuPont Linden site has been the subject of remedial investigations since 1992 under the Environmental Cleanup Responsibility Act (ECRA), now the Industrial Site Recovery Act (ISRA). In 1993, DuPont submitted an ECRA Investigation Report (DuPont Environmental Remediation Services [DERS], 1993), which identified 15 Areas of Environmental Impact (AEI) and other areas of potential environmental impact (see Figure 2). These AEIs were expanded to 22 Areas of Concern (AOC) in the Phase II Remedial Investigation Report (DERS, 1998). The status of each AOC is as follows:

- No Further Action Determination by NJDEP:
  - AOC A (Pipeline Right-of-Way)
  - AOC E (Building 54 Septic System)
  - AOC L (pH Adjustment Ponds)
  - AOC O (Former Lithopone Production Area)
  - AOC S (Gasoline Aboveground Storage Tank [AST] #25 and Pump)
  - AOC T (Spill E, Building 3)

- Addressed in this RAW:
  - AOC C (DMHA Waste Holding Pond)
  - AOC D (West Fuel Oil ASTs [above-ground storage tanks])
  - AOC F (Former East Fuel Oil ASTs)
  - AOC G (Main Office Septic System)
  - AOC H (North Septic System)
  - AOC I (Former DDT and Methoxychlor Area)
  - AOC J (Former North Fuel Oil Tanks)
  - AOC K (Former Disposal Area)
  - AOC M (Wade Brothers Company)
  - AOC N (portion)
  - AOC P (Soil, Site-Wide Constituents)

- AOC R (Septic Systems)
- AOC U (Former Unlined Pond)
- AOC W (Groundwater, Site-Wide Constituents)

- Outside the boundary of the Redevelopment Parcel and not addressed by this RAW:
  - AOC B (Former Marsh Disposal)
  - AOC N (portion)
  - AOC Q (West Portion of Site)

1.3 Planned Site Redevelopment

In March 2009, DuPont executed a contract for the sale of the Redevelopment Parcel of the Linden property to PurGen One, LLC (PurGen). PurGen plans to construct an industrial complex on the site that will include commercial power generation and chemical manufacturing. In May 2009, following the sale of the property to PurGen, responsibility for NJDEP oversight of the Linden remediation project was transferred to the Office of Brownfield Reuse. It is the stated commitment of both NJDEP and DuPont to complete the remediation in a timeframe consistent with the permitting timeframe of the PurGen project.

PurGen's development plans require the general site grade to be raised to approximately 16 feet above sea level, an increase of nine feet above the average existing site grade. One advantage of this elevation is that it will allow construction of foundations and utilities in imported fill material without penetrating underlying soils containing residual site contamination. To facilitate site development, DuPont contracted with Clean Earth, Inc. for the placement of more than one million cubic yards of processed dredge material (PDM) or other acceptable fill material at the site. In addition to raising the general grade of the site, the PDM and fill are being used to surcharge the site to induce consolidation of underlying soils and improve their geotechnical and load-bearing properties. Ultimately, the PDM, along with other approved fill material, will be used and incorporated into the soil cover/cap component of the remedy. Delivery and stockpiling of PDM began in September of 2008 in designated areas. Approximately 400,000 cubic yards of PDM have been stockpiled to date.

1.4 Remedial Action Work Plan Organization

This RAW is organized into the following eight sections.

- Section 1.0 provides an introduction.
- Section 2.0 presents site characteristics information.
- Section 3.0 summarizes previous investigations.
- Section 4.0 describes the remedial action selection process.

- Section 5.0 provides a discussion of proposed remedial actions, the required construction plans, and the estimated costs.
- Section 6.0 summarizes institutional controls including the draft CEA and the draft Deed Notice.
- Section 7.0 provides additional details on the planned remedial activities and the schedule.
- Section 8.0 provides a list of reference documents cited in the text of this report.

2.0 PHYSICAL SETTING AND BACKGROUND

The DuPont Linden Site is located along the Arthur Kill in the Tremley Point section of the city of Linden, Union County, New Jersey. The site location is shown on a portion of the United States Geological Survey 7.5 minute topographic map in Figure 1. The Redevelopment Parcel covers an area of approximately 106 acres. The site is located in a highly industrial section of Linden. The site is bounded on the east by the Arthur Kill, to the north by Piles Creek and Public Service Enterprise Group, to the south by International Specialty Products (ISP), and to the west by the Sound Shore Branch railroad tracks, and includes an eight-acre parcel immediately to the west of the railroad tracks. The Rahway River is located approximately one-half mile south from the site.

2.1 Subsurface Stratigraphy

The DuPont Linden site is situated on fill material, tidal marshlands, glacial silts and sands, river sediments, and shale bedrock. Geologically, the Linden site is located within the Newark Basin. The site is underlain by fill deposits, which range in thickness from 10 to 18 feet and consist predominantly of fine to coarse sand. Some locations within the site contain gravel, silt, clay, brick, crushed stone, and other anthropogenic materials. This upper water-bearing zone is denoted as the A Zone at the site. Underlying the fill deposits are recent marsh deposits consisting of brown peat and organic clay, ranging in thickness from 10 to 15 feet. River sediments are generally found below the recent marsh deposits and consist of sand with varying amounts of silt. These water-bearing deposits vary in thickness from 5 to 20 feet and are designated as the B Zone. Pleistocene glacial till deposits occur below the B Zone sands, varying in thickness from 6 to 18 feet. They consist of red-brown, silty clay with sand and gravel. The Jurassic/Triassic age Passaic Formation, also known as the Brunswick Shale, underlies the glacial till.

2.2 Groundwater Flow

Forty-six groundwater monitoring wells have been installed at the site. Water levels range from approximately 1 to 12 feet below grade. A monitoring well location map is presented as Figure 3. Two hydrologic units (shallow and deep aquifers) are identified at the site. The upper aquifer unit is within the fill layer and is referred to as either A Zone or the shallow aquifer. There are 41 monitoring wells screened in the shallow aquifer. Groundwater flow in the shallow fill aquifer is generally to the east toward the Arthur Kill. A low permeability peat layer underlies the A Zone, separating it from the lower hydrologic unit or B Zone aquifer below.

The lower hydrologic unit may behave as a confined aquifer with a downward gradient from the A Zone to the B Zone. Five wells are installed in the B Zone aquifer. The two hydrologic units (A and B zones) are separated by thick marsh deposits of peat and clay. Regional groundwater in the deep unconsolidated aquifer flows east toward the Arthur Kill. At the majority of the site, the regional flow direction predominates. However, there is a flow reversal in the southwestern portion of the site with a component of flow towards the ISP property, likely as a result of groundwater pumping on the ISP property.

Regional bedrock groundwater flow beneath the site is to the east towards the Arthur Kill. NJDEP approved a Remedial Investigation Work Plan (RIWP) (DuPont CRG, 2010a) to

install four monitoring wells on the site perimeter, completed in the uppermost portion of the bedrock. These four bedrock wells were installed and sampled in the spring of 2010, and will provide data to determine flow directions and groundwater quality in the upper bedrock. Data from these wells were not available at the time of preparation of this RAW, but will be presented in an updated Groundwater Current Conditions Report later in 2010.

2.3 Groundwater Quality

Groundwater samples have been collected from 40 shallow (A Zone) monitoring wells and six deep (B Zone) monitoring wells. Samples were analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and inorganic compounds. Table 1 presents a summary of groundwater analytical data from February 2008 through February 2009. The groundwater data are presented with highlights of compounds exceeding the NJDEP Ground Water Quality Standards (GWQS) for Class IIA aquifers (GW-IIA). A proposal for a groundwater Class III-B aquifer designation will be submitted to the NJDEP under separate cover. The Class III-B designation is appropriate because of the saline character of the site groundwater. TDS and chlorides both exceed the Class II-A criteria.

2.3.1 Shallow Aquifer (A Zone) Groundwater Quality

The groundwater sampling events conducted between February 2008 and February 2009 were presented in the DuPont CRG report submitted to the NJDEP in July 2009, titled: Groundwater Current Conditions Report, DuPont Grasselli Site, Linden, New Jersey, July, 2009. The key findings of the report are summarized below.

- VOCs including benzene, chlorobenzene, chloroform, 1,4-dichlorobenzene, and methylene chloride exceeded GW-IIA criteria in monitoring wells associated with AOC U, the Former Unlined Pond, and the adjacent AOC I, the Former DDT and Methoxychlor Area, located in the northeastern portion of the site.
- Non-Aqueous Phase Liquid (NAPL) was identified in monitoring well MW-28A, located within the footprint of AOC U, – the Former Unlined Pond.
- SVOCs were generally not detected at the site in concentrations exceeding GW-IIA criteria in the shallow fill aquifer. Note that the detection limits for some compounds were greater than the applicable GW-IIA criteria.
- The pesticides alpha-Benzene Hexachloride (BHC), beta-BHC, and 4,4-dichloro diphenyl dichloroethane (DDD) are identified at concentrations exceeding GWQS in monitoring wells in the vicinity of AOC U and the adjacent AOC I.
- Pesticides occur intermittently and in a dispersed pattern in other portions of the site. These locations are isolated from each other and do not indicate a widespread plume, but isolated areas of groundwater exceed GW-IIA criteria.

- Arsenic is found throughout the site at concentrations exceeding the GWQS of 3 ug/l, with the exception of the northwestern and southeastern corners of the site.
- Lead concentrations in shallow groundwater vary across the site with 17 of 40 sampling locations containing exceedances of the GW-IIA criteria.
- Chloride and total dissolved solids are found throughout the site at concentrations exceeding GW-IIA criteria. These conditions are a result of the high salinity of the Arthur Kill, frequent flooding of the site, and aquifer intrusion by the river.

In summary, VOCs in shallow groundwater are largely limited to the northeast portion of the site, and are associated with an area where free product has been identified within the footprints of AOC U, the Former Unlined Pond, and AOC I, the former DDT and Methoxychlor Area. Metals (lead and arsenic) appear to be broadly distributed across the site and not associated with any particular AOCs.

2.3.2 Deep Aquifer (B Zone) Groundwater Quality

Groundwater samples were collected and analyzed from five monitoring wells with the results presented in the Groundwater Current Conditions Report (DuPont CRG, 2009). These results are summarized below.

- VOCs including benzene, chlorobenzene, chloroform, 1,4-dichlorobenzene, and methylene chloride are found in monitoring well MW-38B, located downgradient from AOC U, the Former Unlined Pond.
- No NAPL has been identified in any monitoring well in the B Zone aquifer.
- Benzene was the only VOC identified in deep monitoring wells other than MW-38B.
- SVOCs were generally not detected at the site in concentrations exceeding GW-IIA criteria in the deep aquifer. Note that the detection limits for some compounds were greater than the applicable GW-IIA criteria.
- The pesticide alpha-BHC was detected above the GWQS of 0.02 ug/l in MW-18B, at a concentration of 0.073 ug/l.
- Monitoring well MW-38B contained the pesticide aldrin in three of five sampling events.
- Arsenic was detected above the GWQS of 3 ug/l in four of five monitoring wells. Deep aquifer arsenic distribution is not consistent with the distribution of arsenic in the shallow aquifer or with the arsenic distribution in site soil. Regional groundwater and surface water is heavily impacted by arsenic, and the source of arsenic contamination cannot be determined.
- Lead is not found at the site in the deep aquifer at concentrations exceeding the GW-IIA criteria.
- Chloride and TDS are found throughout the deep aquifer at the site at concentrations exceeding both GW-IIA criteria and Class III-B criteria. These

conditions are a result of the high salinity of the Arthur Kill and saltwater intrusion into the aquifer by the tidal river.

In summary, the distribution of contaminants in the lower aquifer appears to be similar to the distribution in the shallow aquifer, although with lower concentrations, based on a more limited data set. VOCs are localized in the northeast portion of the site associated with AOCs U and I.

3.0 SUMMARY OF PREVIOUS INVESTIGATIONS

The Linden site has been the subject of remedial investigations since 1992 under ECRA, (now ISRA). In 1993, DuPont submitted an ECRA Investigation Report (DERS, 1993), which identified 15 AEIs and other areas of potential environmental impact. These AEIs were expanded to 22 AOCs in the Phase II Remedial Investigation Report (DERS, 1998). (See Figure 2.) The current remediation status of each AOC was previously discussed in Section 1.0.

Investigations were initiated to determine if these AOCs were detrimentally impacting the soil and/or water quality at the site. The subsections below summarize the general activities implemented during the four previous environmental investigations onsite: a voluntary environmental investigation, an ECRA Investigation, a Phase II Remedial Investigation (RI), and a Phase III RI. Over the course of these investigations, a significant number of delineation activities were completed, including the following:

- 300+ soil borings
- 50+ groundwater monitoring wells and piezometers installed and sampled
- 200+ soil samples analyzed
- 400+ groundwater samples analyzed
- Test Pits
- Surface Water and Sediment Samples in Arthur Kill and Piles Creek

3.1 Voluntary Environmental Investigation

The initial environmental investigation was conducted as a voluntary preliminary site assessment to determine if manufacturing and waste disposal activities had impacted the quality of soil, sediment, and water in and around the site. In addition, the investigation focused on the site geology and flow regimes associated with the surrounding surface water and site groundwater. Investigation results identified several AEIs (later identified as AOCs) as needing further evaluation. Results of the preliminary site assessment were used to prepare the work plan for the ECRA investigation. More detailed information about this investigation is provided in the ECRA Investigation Report (DERS, 1993).

3.2 ECRA Investigation

An ECRA investigation (considered by DuPont as a Phase I RI) was performed to build on the data collected during the previous voluntary environmental investigation. ECRA investigation results showed that arsenic was the most pervasive constituent in site soil and that lead and polynuclear aromatic hydrocarbons (PAHs) were sporadically distributed in site soil. Metals and pesticides were identified as constituents of potential concern (COPCs) in shallow groundwater based on a comparison of groundwater concentration results against the New Jersey Surface Water Quality Standards and the GW-IIA GWQS. VOCs were identified as COPCs and were detected in select shallow groundwater monitoring wells. More detailed information about this investigation is provided in the complete report (DERS, 1993).

3.3 Phase II Remedial Investigation

The Phase II RI was designed in accordance with the Technical Requirements for Site Remediation N.J.A.C. 7.26E (TRSR) that allow for the use of the Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC) for soil delineation where property use is restricted to industrial purposes (NJDEP, 2002). According to the 2002 TRSR, the site perimeter must still be delineated to the Residential Direct Contact Soil Cleanup Criteria (RDCSCC). These criteria were used to delineate 12 AOCs during the Phase II RI. DuPont requested a variance from TRSR because arsenic, lead, and PAHs appeared to be distributed in a manner independent of AOC activities or AOC boundaries. The NJDEP agreed that these constituents could be delineated sitewide, but requested additional sitewide sampling and analysis for them.

3.4 Phase III Remedial Investigation

In 2000, DuPont completed a Phase III RI in accordance with an approved work plan (DuPont CRG, 1999). The Phase III RI was conducted to address those NJDEP concerns that required additional investigation within specific AOCs. The following additional activities were required:

- AOC-specific soil delineation
- Sitewide and AOC-specific groundwater characterization
- Surface water quality impact evaluation
- Baseline ecological evaluation (BEE)

The results of these activities are summarized below. More detailed information about the Phase III RI is provided in the complete report (DuPont CRG, 2001). The Phase III RI was approved by the NJDEP, and the conclusions of the Phase III RI Report were endorsed in a letter dated December 27, 2001 (NJDEP, 2001).

3.4.1 Soil Delineation

Eight AOCs (AOCs D, E, I, J, K, M, P, and U) were investigated to complete delineation of soil COPCs. The results and conclusions are summarized below.

- AOCs D, J, K, and U were delineated, and no further investigation was required.
- No further action was recommended for AOC E because soil concentrations were below applicable criteria and groundwater quality was only slightly above GWQS.
- AOCs I and P were not fully delineated, but soil and groundwater were sufficiently characterized to allow development of the sitewide RASR that was submitted to the NJDEP in January 2006 (DuPont CRG, 2006).
- AOC M had been the subject of an interim remedial measure (IRM) to remove diesel fuel from groundwater between 1992 and 1995. Additional delineation was deferred until after completion of wetlands construction and sheet pile installation in 2001.

3.4.2 Sitewide Groundwater Characterization

During the Phase III RI, DuPont collected additional data to characterize groundwater in both the shallow and deep zones. The approach to characterization of groundwater transitioned from AOC-specific to a sitewide basis, and Sitewide Groundwater was designated AOC W. Analytical results from 28 shallow zone wells and four deep zone wells were evaluated. Constituent concentrations were compared with ten years of analytical data. Trend evaluations determined that overall concentrations were stable in both shallow and deep wells. Additional groundwater delineation was required (NJDEP, 2001), notably in the area of AOC U. As a result, supplemental investigations were conducted in 2002 in order to collect data to evaluate groundwater conditions in the area of AOC U.

In addition, a sitewide quarterly groundwater monitoring program was initiated in February 2008 and is ongoing to this date.

3.4.3 Surface Water Evaluation

Surface water samples were collected from Piles Creek and the Arthur Kill, both upstream and downstream of the site. Data collected from Piles Creek showed higher concentrations of COPCs in upstream samples than downstream samples. Data from Arthur Kill water samples showed no significant upstream/downstream pattern. Piles Creek contained chemical constituents originating upstream of the site and discharges to the Arthur Kill at a location between the upstream and downstream sampling locations for the site. Due to the data variability in the Arthur Kill sample results and the contribution of upstream contaminants in Piles Creek, no significant impact to the Arthur Kill from the DuPont site groundwater was determined (NJDEP, 2001). Note that Piles Creek is currently being investigated as part of a Natural Resource Damage (NRD) Assessment as discussed in the following section.

Based on the data from the Phase III RI, and conservative fate and transport calculations performed during the Phase II RI, the NJDEP and DuPont determined that surface water has not been significantly impacted by the site. This was confirmed by the NJDEP in a letter dated December 27, 2001 (NJDEP, 2001).

3.4.4 Baseline Ecological Evaluation

A BEE was conducted as part of Phase III RI activities. Potential ecological receptors were identified using current land and water use exposure scenarios. The BEE identified the following three ecologically sensitive areas adjacent to the site:

- Piles Creek and associated wetland areas,
- Arthur Kill, and
- Prall's Island.

Potential migration pathways for COPCs in environmental media were identified and evaluated based on existing information regarding current conditions at the site and on readily available information regarding human and environmental populations. Based on the chemical and physical properties of the preliminary COPCs and the known physical,

topographic, meteorological, and hydrologic conditions at the site, the potential pathways were identified as follows:

- Overland runoff of site COPCs from surface soil to downgradient surface water bodies (including sediment) during precipitation events;
- Airborne transport of particulates generated by wind erosion of site surface soil and physical disturbance of site surface and subsurface soil to downwind locations;
- Leaching of constituents in site soil (surface and subsurface) to shallow groundwater; and
- Migration of dissolved constituents in site groundwater beneath the site to downgradient surface water bodies.

At the time the BEE was conducted, DuPont and the NJDEP concurred that additional ecological assessment was not warranted because of the documented poor quality of Arthur Kill surface water and sediments, reflecting a complex urban/industrial drainage system. DuPont and the NJDEP also concurred that additional ecological assessment was not warranted. The BEE was presented as part of the Phase III RI report (DuPont CRG, 2001).

The Federal Trustees (the National Oceanic and Atmospheric Administration and the US Fish and Wildlife Service) are currently conducting a NRD assessment of Piles Creek both upstream and in the vicinity of the DuPont property. DuPont and other potentially responsible parties are cooperating with the Trustees and participating in the NRD assessment.

3.5 Summary of Current Delineation Status by Area of Concern

At the completion of the Phase III RI, it was determined that additional delineation was necessary for only seven of the 22 AOCs:

1. AOC B – Former Marsh Disposal*
2. AOC D – West Fuel Oil ASTs
3. AOC I – Former DDT and Methoxychlor Area
4. AOC M – Wade Brothers Company
5. AOC P – Soil, Sitewide Constituents
6. AOC U – Former Unlined Pond
7. AOC W – Groundwater, Sitewide Constituents

* Note that AOC B is not located within the Redevelopment Parcel and is not addressed by this RAW.

The status of the seven AOCs that required additional action at the end of the Phase III RI is presented below.

AOC B – Former Marsh Disposal

AOC B is part of the parcel leased to the NJTA and falls outside of the physical limits of the Redevelopment Area (see Figure 2). It is therefore outside the scope of this RAW. Supplemental investigations to complete delineation have been initiated after discussions in 2009 and 2010 with the NJDEP. An RIWP for AOC B (DuPont CRG, 2010b) was approved by the NJDEP on April 9, 2010, and the field work was completed in the spring of 2010. A report on the findings of that study will be submitted late in 2010.

AOC D – West Fuel Oil ASTs

At the end of the Phase III RI, NJDEP required the delineation of sheen from petroleum products on the water table in the vicinity of AOC D, with remediation if necessary. Groundwater sampling conducted in 2008 and 2009 in the vicinity of AOC D did not find evidence of a sheen on the water table, and analytical results from monitoring wells in the area did not exhibit organic compounds exceeding NJDEP GWII-A standards (DuPont CRG, 2009). Delineation of AOC D is therefore considered to be complete.

AOC I – Former DDT and Methoxychlor Area

Complete delineation of pesticides in soils was not completed in AOC I during the phased RI. This AOC is immediately adjacent to AOC U (see Figure 2). The northern part of AOC I, where free product was identified, will be included in the IRM in-situ chemical treatment process for AOC U. Delineation will be completed during the implementation of the in-situ chemical treatment remedy as described in Section 4.0. A detailed design and implementation work plan for the IRM of AOC U and AOC I is provided in Appendix A.

Following the IRM, AOC I will be included in the sitewide remedial action that includes a total site containment system (slurry wall and groundwater extraction system) and a cap. Delineation of AOC I is therefore sufficient in the context of the planned sitewide remedy.

AOC M – Wade Brothers Company

Free phase diesel fuel associated with a release was identified on the water table in this AOC in 1991. An IRM was undertaken with the installation of a collection trench and removal of free product from the groundwater. This system was operated until free product was no longer evident. Ongoing observations of the collection trench and of the drainage ditch adjacent to this area have been negative for the presence of petroleum sheen on the water. Current groundwater sampling from wells and piezometers shows the intermittent occurrence of benzene at concentrations slightly exceeding the NJDEP GW-IIA criterion, as evidenced in Table 1. A more detailed evaluation is provided in the Current Groundwater Conditions Report (DuPont CRG, 2009).

AOC M is included in the sitewide remedial action that includes a total site containment system and a cap. Delineation of AOC M is therefore sufficient in the context of the planned sitewide remedy.

AOC P – Soil, Sitewide Constituents

Arsenic, lead, and PAHs were identified at concentrations exceeding NJDEP soil remediation standards in locations not directly associated with specific AOCs and are therefore grouped as sitewide soils. The primary compound of interest is arsenic, with elevated concentrations in a range of locations across the site.

AOC P is included in the sitewide remedial action that includes a total site containment system and a cap to prevent direct contact with COPCs in the soils. Additionally, the reduction of surface water infiltration due to the cap, combined with groundwater containment and treatment will effectively mitigate any potential impacts to groundwater from AOC P soils. Delineation of AOC P is therefore sufficient in the context of the planned sitewide remedy.

AOC U – Unlined Pond

Complete delineation of VOCs and pesticides in soils was not completed in AOC U during the phased RI. AOC U will be addressed by an IRM consisting of in-situ chemical treatment to remediate free product. Delineation will be completed during the implementation of the in-situ chemical treatment remedy as described in Section 4.0. A detailed design and implementation work plan for the remediation of AOC U and AOC I is provided in Appendix A.

Following the IRM, AOC U will be included in the site-wide remedial action that includes a total site containment system and a cap. Delineation of AOC U is therefore sufficient in the context of the currently planned IRM and sitewide remedy.

AOC W – Groundwater, Sitewide Constituents

As described previously, the remedy for sitewide groundwater has been expanded to include a total site containment system. A perimeter barrier wall will be installed across the surficial water-bearing zones (A Zone and B Zone), and keyed into the underlying glacial till. A groundwater extraction system will be installed to maintain an inward gradient across the barrier wall. The extracted groundwater will be treated at an adjacent, permitted facility. Details of the total site containment remedy are presented in Section 5.0.

In the context of this expanded remedy, the groundwater is sufficiently delineated in the shallow surficial aquifer (A Zone). Further delineation of site groundwater in the deep surficial aquifer (B Zone) and upper bedrock zone is ongoing. The results of these investigations will not impact the selection of the final groundwater remedy as described above. However, the results of this ongoing delineation of B Zone and bedrock groundwater will be used in the detailed final design of the groundwater extraction system described in Section 5.3. If necessary, the sitewide groundwater remedy can be expanded to include the upper bedrock zone, in addition to the A Zone and B Zone, if the results of ongoing bedrock groundwater delineation indicate a need to do so.

3.6 Interim Remedial Measures

In addition to the investigations discussed above, multiple IRMs have been conducted at the site since manufacturing operations ceased. IRMs to date include the following.

- In 1978, DuPont conducted excavation and offsite disposal of pond sediments and some underlying soils from AOC U.
- In 1991, DuPont closed AOC C - DMHA Waste Holding Pond by removal of the pond contents, liner and underlying soils.
- In1992, a spill outside the Machine Shop (AOC T) was observed during an NJDEP site inspection. DuPont excavated the impacted area and stained

soil was placed in drums for disposal. NJDEP stated in letter dated September 20,1996 that no further action was required

- Between 1992 and 1996, DuPont installed and operated a fuel oil interceptor trench and recovery program at AOC M – Wade Brothers Company.
- In 2001, DuPont performed a wetlands seep mitigation IRM which also address contamination at AOC M. This IRM consisted on the installation of 1,486 feet of sheet pile for the NJTA wetlands mitigation project.
- In 2009 and 2010, DuPont conducted an IRM / in-situ chemical treatment field pilot test in AOC U – The Former Unlined Pond to demonstrate the feasibility of treating free product using in-situ chemical oxidation and reduction. A significant mass of COPCs was destroyed during the field pilot test. The results of the successful pilot study are presented in the report "In-Situ Chemical Treatment Pilot Test, Area of Concern U, Former Unlined Pond, DuPont Grasselli Facility, Linden, New Jersey", Geo-Cleanse International, Inc., June 2010, submitted under separate cover.

4.0 REMEDIAL ACTION SELECTION APPROACH

A revised Site-Wide RASR was submitted to the NJDEP in January of 2008, proposing a comprehensive remediation plan for the site (DuPont CRG, 2008). Discussions between DuPont and the Department have lead to a consensus that the appropriate next step is the preparation and submittal of this RAW, even though the 2008 RASR has not been formally approved. Based on those same discussions, and in consideration of the planned industrial redevelopment of the Site, the sitewide remedy presented in this RAW expands on the remedy presented in the 2008 RASR by including a total site containment system consisting of a perimeter physical barrier wall and groundwater pumping system.

4.1 Applicable Remediation Standards

The media of concern identified on the DuPont Linden site are impacted soils and sitewide groundwater. The proposed remediation standards for these media of concern are provided below, and are consistent with the requirements of N.J.A.C. 7:26E-1.13.

DuPont proposes a "Restricted Use Remedial Action" that will require the continued use of engineering and institutional controls to prevent exposure to contamination above applicable remediation standards. Based on current and anticipated future use, the applicable remediation standards for in the DuPont Linden site are the November 2009 NJDEP Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS).

The proposed restricted use remedy envisions that soils will remain in place at the site with concentrations of COPCs above the NRDCSRS as part of a total site containment system, as allowed by N.J.A.C. 7:26E-5.1(c), which states the following:

> "The person responsible for conducting the remediation shall select a remedial action that reduces contamination to below all applicable remediation standards or eliminates exposure to contamination above applicable remediation standards based on the current and future land use for the site."

In order to meet the remedial action requirements of N.J.A.C. 7:26E-6.1 within the context of the total site containment remedy, the primary treatment objective for AOC U and I is to eliminate NAPL to the extent practical as allowed by N.J.A.C. 7:26E-6.1(d), which states:

> "Free and/or residual product determined to be present pursuant to N.J.A.C. 7:26E-2.1(a)14 shall be treated or removed when practicable, or contained when treatment or removal are not practicable. Likewise, natural ground water remediation for dissolved phase contamination may be implemented if it is determined by the Department that active ground water remediation for the dissolved phase is impracticable or not cost-effective. Decisions regarding the practicability of a remedial decision shall be made by the Department on a case by case basis. Natural remediation of free and/or residual product will not be allowed."

The total site containment remedy proposed herein will eliminate any health risk and environmental exposure to contaminants remaining on site above the NRDCSRS, based on the planned industrial redevelopment of the property. The remedy utilizes engineering and institutional controls to protect the public health and safety and the environment by eliminating the potential for direct contact. The technical performance and effectiveness of

the total site containment is well established in New Jersey as being effective, reliable, and in compliance with the applicable regulations.

The remedy will effectively eliminate the mobility of contaminants by containment. Offsite migration of contamination through surface or subsurface migration pathways will be mitigated or eliminated, and the remedy will be constructed using proven technologies.

Additional institutional controls in the form of a Deed Notice will ensure that the total site containment system is maintained and inspected. The surface cap will not be breached without proper notifications and controls and vapor intrusion issues, if present, will be identified and mitigated prior to future construction.

A CEA will be put in place to restrict groundwater use and consumption. DuPont is preparing an application for classification of sitewide groundwater as a Class III-B aquifer consistent with the saline nature of the waters. Specific Class III-B GWQS will be developed for the aquifer and presented to the NJDEP for approval. These criteria will become the applicable remediation standards for groundwater.

In addition, all free product identified at the site will be treated or removed. Free product has only been identified in AOC U and part of AOC I.

4.2 Remedial Objectives

The remedy presented in this RAW is consistent with the objectives of the revised RASR (DuPont CRG, 2008) but has been modified based on additional site data and on discussions with the NJDEP. The remedial action objectives for the site were established to provide overall protection of human health and the environment and to return the site to beneficial use. The criteria used in establishing the objectives included the following.

- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide soil that exhibits COPCs at concentrations in excess of applicable soil criteria.
- Prevent migration of soil material that exhibits COPCs at concentrations in excess of applicable soil criteria through surface runoff.
- Prevent direct contact exposure (ingestion, inhalation, and dermal contact) to sitewide groundwater that exhibits COPCs at concentrations in excess of applicable groundwater criteria.
- Eliminate free product as a source of contamination to groundwater.
- Prevent migration of contaminants from soil to groundwater by minimizing infiltration of surface water.
- Prevent groundwater use or consumption through institutional controls.
- Restrict future use of the property to nonresidential commercial or industrial uses through institutional controls.
- Maintain protection of adjacent surface water quality and ecological receptors.

The remedy presented in the RASR accomplished three primary DuPont objectives for the site:

- Protection of human health and the environment,
- Compliance with all applicable environmental regulations and requirements, and
- Redevelopment and re-use of the property.

Consistent with these objectives, the city of Linden and Union County, in cooperation with DuPont, are enacting a redevelopment plan for the site that involves the construction of an industrial complex that will include commercial electrical power generation and chemical manufacturing. This proposed redevelopment enables DuPont to complete a remedial action consistent with the remedial action objectives of the RASR as well as the beneficial reuse of large volumes of PDM. The preliminary site development plan requires a general site elevation of 16 feet above mean sea level, which provides opportunity for placement of more than one million cubic yards of PDM on the site as part of the overall site improvements. Figure 4 presents the preliminary site plan for the proposed site redevelopment.

4.3 Modifications to the 2008 RASR

Following completion of the 2008 RASR, quarterly groundwater monitoring was initiated at the site and groundwater conditions were updated from this data as presented in the Current Conditions Report for Groundwater (DuPont CRG, 2009). The conclusions of this report and the strong preference of the NJDEP for a remedy that included a groundwater containment system led to the modification of the proposed remedy. The proposed remedial action includes containment of groundwater within the surficial water-bearing zone including a perimeter slurry wall and groundwater extraction and treatment for hydraulic control.

Data from the Current Conditions Report demonstrated that there was no ongoing groundwater impact from historic fuel oil releases in AOC D and AOC M, and that these areas were no longer sources contributing to groundwater degradation. As a result, the proposed remedy was modified to eliminate excavation and offsite disposal of soils from these AOCs. Instead, the engineering controls of the soil cover / cap will be used to prevent direct contact with the soil and to minimize surface water infiltration.

The perimeter slurry wall and groundwater control will effectively limit groundwater exhibiting arsenic concentrations that exceed the NJDEP GWII-A standard from migrating beyond the site boundaries. Additionally, the soil cover will prevent direct contact with arsenic in soil and minimize surface water infiltration. Therefore, based on the total site containment approach for groundwater, and the use of engineering controls to isolate the impacted soils, the proposed remedy for AOC P was modified to eliminate the excavation of soils.

In-situ chemical treatment of free product at AOC U and AOC I will replace the originally proposed excavation and offsite disposal of NAPL-impacted soils from AOC U. The in-situ treatment is equally effective and protective of the environment. It has the additional benefit of providing a more sustainable remediation and eliminating the need for transporting thousands of truckloads of excavated soils from Linden to an approved

treatment / disposal facility. A description of the in-situ chemical treatment process is presented in Section 5.1. The detailed design and implementation work plan for this approach is presented in Appendix A.

4.4 Summary of Remedial Action

DuPont will complete the requirements of N.J.A.C.7:26E-6A through the implementation of the remedy presented herein. The elements of the proposed remedial action include the following:

- In-situ treatment of free product within AOC U and AOC I through chemical oxidation/reduction.
- Construction of a soil-bentonite cutoff wall around the site perimeter to prevent offsite groundwater migration.
- Groundwater pumping within the water-bearing zones to create an inward gradient across the barrier wall.
- Treatment of extracted groundwater by conveyance to the permitted groundwater treatment facility on the adjacent ISP property.
- Placement of an isolation layer of PDM or other approved fill material over the site in coordination with the site redevelopment to prevent direct contact with site soils, minimize infiltration of precipitation, and to raise the overall site grade.
- Deed restrictions to control future site use and to maintain the Engineering Controls.
- A CEA to restrict groundwater use and consumption.

The individual components of the remedial action are presented in greater detail in the following section.

5.0 PROPOSED REMEDIAL ACTION

The proposed remedial action is comprised of in-situ chemical treatment of free product, barrier wall installation, groundwater extraction and offsite treatment, a soil cover, and institutional control measures. Institutional controls include a Deed Notice and the establishment of a groundwater CEA. The proposed remedial activities will prevent migration of site groundwater to the Arthur Kill or other offsite areas and restrict human contact. The proposed remedy is practical and well suited for the planned industrial redevelopment of the property.

5.1 AOC U and AOC I In-Situ Chemical Treatment

The proposed remedy for AOC U and AOC I is based upon successful bench-scale and pilot-scale testing of the in-situ injection of reactants to destroy and degrade free product within the limits of AOC U. The results of the successful pilot study are presented in the report "In-Situ Chemical Treatment Pilot Test, Area of Concern U, Former Unlined Pond, DuPont Grasselli Facility, Linden, New Jersey", Geo-Cleanse International, Inc., June 2010, submitted under separate cover.

The limits of free product in AOC U and AOC I, as determined during the Phase III RI, are shown in Figure 5. The limits of free product will be updated and confirmed during the implementation of the remedy. The updated free product limits and quantity estimates will be used to determine final injection point locations, injection point spacing, and quantities of reactants to be employed.

Free product within the subsurface will be addressed in a multi-stage injection process. The method is comprised of the following steps:

1. Installation of a network of injection wells.
2. Injection of a sodium permanganate solution. The permanganate ion (MnO_4^-) is reduced and precipitated as manganese dioxide (MnO_2), in which the manganese is in the +4 valence state.
3. Injection of a phosphate buffer solution. The phosphate performs two functions:
    a. Buffers the groundwater pH in a circumneutral condition. A pH of 6.8 or higher is necessary for the key chemical reactions to occur efficiently.
    b. Forms a ligand with MnO_2 and thus stabilizes (slows and controls) the reaction of hydrogen peroxide with the MnO_2. This allows hydrogen peroxide to be distributed in the subsurface before reacting.
4. Injection of a hydrogen peroxide (H_2O_2) solution with additional phosphate buffer solution. The H_2O_2 reacts with MnO_2 to produce the superoxide radical ($O_2\cdot^-$). Superoxide is a reductant and nucleophile, which has been found by other researchers to destroy carbon tetrachloride and chloroform effectively, including in a NAPL phase.
5. The H_2O_2 will also react with naturally occurring iron present in soil and groundwater to produce hydroxyl radicals ($OH\cdot$). Hydroxyl radicals are strong chemical oxidants that destroy chlorobenzene and methoxychlor; thus production of both $O_2\cdot^-$ and $OH\cdot$

provides an approach to destroy both oxidizable and reducible compounds present at the site.

After treatment, the results will be evaluated through the collection of soil samples within the treated area and visual determination of the presence of free product. Additional injection of reactants will be employed in areas of incomplete NAPL destruction.

A detailed remedial design and implementation work plan for the chemical treatment of AOC U and AOC I is provided in Appendix A.

5.2 Perimeter Barrier Wall

This section presents a description of the proposed barrier wall, a discussion of design considerations, and a description of construction techniques to be employed.

5.2.1 Barrier Wall Design

The objective of the barrier wall system is to prevent groundwater within the surficial water-bearing zones from leaving the site. To achieve this objective, a low-permeability wall will be constructed around the perimeter of the site extending from the existing ground surface into the glacial till layer overlying the bedrock. The preliminary alignment of the barrier wall is shown in Figure 6.

Based on an evaluation of barrier wall technologies, a soil-bentonite cutoff wall (SBCW) will be constructed around the perimeter of the former manufacturing area. The SBCW will be keyed into the glacial till layer. The glacial till layer consists of clay, silts, and sands intermixed with appreciable amounts of gravel and cobbles; is dense to very dense; and has a fines content (silt- and clay-sized soil fraction) typically in excess of 55 percent. As a result, it is anticipated that the till layer will have sufficiently low permeability to function as a confining layer to key in the proposed SBCW. Field permeability tests will be performed in the till layer as part of a pre-design investigation (PDI) to develop design parameters for the slurry wall.

The proposed SBCW will be two to three feet wide (width of the excavator bucket), approximately 8,200 feet long (based on the alignment shown on Figure 6), and an average 30 feet deep.

A geotechnical investigation conducted onsite in 2007 (Golder, 2007) advanced approximately 20 borings into the till formation. The till was consistently characterized as a dense clay-based formation containing varying amounts of sand and rock fragments. The high clay content and dense nature of the formation indicates that the till will possess low hydraulic conductivity and will provide an ideal bottom and key for an SBCW. The hydraulic and geotechnical parameters of the till will be confirmed during the PDI described below. The geotechnical PDI work plan is provided in Appendix B.

The PDI will be conducted to collect the necessary field data to prepare a final design for the barrier wall system. This investigation will consist of a series of borings along the wall alignment to obtain stratigraphic information, determine design depth, and obtain soil samples for testing. Bench-scale testing (mixing site soils and groundwater with different quantities of bentonite clay) will be undertaken to verify bentonite compatibility with site groundwater and determine optimum bentonite quantities to achieve a backfill permeability of less than 1×10^{-7} centimeters per second (cm/sec).

Based on the results of the testing described above, a suitable soil-bentonite backfill mixture will be proposed. For the proposed backfill mixture, minimum bentonite content, minimum fines content, and maximum long-term permeability will be specified. The performance requirement for long-term permeability of the backfill mixture will be defined as permeability of no more than $1x10^{-7}$ cm/sec when tested under specified test conditions. The testing frequency and methodology for evaluating compliance with the performance requirements will be specified.

5.2.2 Barrier Wall Alignment

The proposed alignment of the SBCW is indicated in Figure 6. On the north side of the site, the SBCW will extend around AOC U and will be installed 100 feet south of the existing utility corridor for power and gas lines. On the east side, the SBCW will be set back a minimum of 20 feet from the Arthur Kill above the mean high water line to avoid interference with a future wharf and associated deadmen anchoring system that may be constructed along the river. On the south side, the SBCW will be offset a minimum of ten feet from the property boundary. On the west side of the site, the SBCW will be installed parallel to the existing railroad line.

Several utilities (above and underground) have been noted in the vicinity of the alignment proposed for the SBCW. These utilities will be located and surveyed as part of the field investigation program outlined above. The proposed alignment of the SBCW may need to be modified depending on the exact locations and alignment of these utilities. Further, based on the available information, some of the utilities will need to be crossed during construction of the SBCW. These construction activities will be coordinated with the affected utilities and SBCW contractor to ensure that appropriate safeguards are taken.

5.2.3 Barrier Wall Construction

The SBCW will be constructed using traditional construction techniques for this type of wall. A working pad will be prepared along the wall alignment. The top of the pad will be a minimum of three feet above the water table and will be elevated as necessary to maintain this minimum freeboard. The work pad will extend approximately 75 feet on the inboard side of the wall to serve as a mixing platform. The general construction method will be:

- The trench will be excavated the width of the excavator bucket and extend a minimum of three feet into the till unit.
- The trench will be continually filled with bentonite slurry to maintain its integrity.
- Excavated soils will be staged onto the mixing pad.
- A tracked dozer will blend and mix the excavated soils with bentonite slurry and dry bentonite into a consistent thick backfill.
- The backfill will be introduced into the trench by sliding it down an incline based on the angle of repose of the backfill.

Construction quality control will verify the depths of excavation along the alignment, viscosity of slurry, bentonite content of the backfill mixture, and integrity of the trench throughout construction.

After the construction of the SBCW is completed, a compacted soil berm will be constructed on top of the wall as a cap. The berm will have a minimum top width of the trench width and will be at least two feet high. At areas where roads cross the SBCW, a geotextile fabric will be used to reinforce the barrier wall cap. The SBCW cap berm will incorporate drainage features, as needed, to effectively manage site storm water runoff until such time as the barrier wall and cap are covered by fill material as the overall site grade is raised to meet site development requirements.

5.3 Groundwater Management System

The upper water-bearing hydrologic unit at the site is within the fill layer and is referred to as the A Zone or shallow aquifer. The lower hydrologic unit is below the peat layer and, in some areas, below the clay portion of the till layer. This hydrologic unit is referred to as the B Zone or deep aquifer and may behave as a confined aquifer. The two hydrologic units are separated by thick marsh deposits of peat and clay and, in some areas, by the clayey till deposits. This section presents groundwater controls that will be installed in the shallow and deep aquifers after construction of the SBCW is complete. A detailed design for both the shallow and the deeper groundwater management system components will be prepared following approval of the RAW. Conceptual drawings are provided in Figures 7 and 8.

5.3.1 Shallow Aquifer (A Zone) Collection System

A groundwater collection system will be installed in the A Zone after the SBCW has been constructed. The proposed groundwater collection system will be designed to prevent pore water pressure build-up and maintain an inward gradient across the slurry wall.

The groundwater collection system will consist of a gravity drainage system and sumps with manholes. The drain will consist of a perforated high density polyethylene (HDPE) pipe surrounded by gravel and wrapped in a non-woven geotextile filter fabric. Sump manholes will be installed at a minimum frequency (such as every 500 feet) to allow cleaning and maintenance of the drainage system. A header pipe will be installed to convey the collected groundwater from sump manhole(s) to the adjacent offsite groundwater treatment plant.

The collected groundwater will be pumped to the existing groundwater treatment plant on adjacent property (the ISP Environmental Services Inc. facility). Discussions with ISP personnel confirm their willingness to accept the water for treatment, the ability of the treatment plant to handle the anticipated quantities and chemical constituents, and the plant's ability to continue to meet discharge criteria.

5.3.2 Deeper Surficial Aquifer (B Zone) Extraction System

After construction of the SBCW is completed, extraction wells will be installed in the B Zone to maintain an inward gradient across the SBCW. Groundwater collected from the extraction wells will be pumped to the existing groundwater treatment plant on the adjacent ISP property. Header pipe(s) will be installed, as needed, to convey groundwater to the groundwater treatment plant.

The extraction wells will be constructed of six-inch diameter, wire-wrapped polyvinyl chloride (PVC) well screens completed and sealed within the B Zone. Wells will contain

individual submersible pumps of adequate lift and pumping characteristics to pump the groundwater to the treatment facility. Final design parameters will be determined after completing a PDI for groundwater that addresses the B Zone and includes a pumping test. (Appendix C) The data derived from the test will be used to determine:

- The required number of wells
- Well spacing and locations
- Pump capacities
- Header sizes

The final design and layout of the site redevelopment will also be taken into account to ensure well locations are compatible with the redevelopment plan.

5.4 Cap / Soil Cover

The cap will function as an engineering control to prevent direct contact or exposure with contaminated site soils and to minimize surface water infiltration into the site. The cap will be comprised of PDM and other approved fill that will raise the grade across the site and provide several feet of cover to isolate site soils containing COPCs in excess of NRDCSRS. The fill will be placed in lifts and compacted to meet specific geotechnical criteria, determined as part of the remedial design. The PDM will function as a structural fill to support utilities and structures placed on shallow foundations.

The DuPont Linden site was identified by NJDEP Office of Dredging and Sediment Technology as a suitable site to meet a critical need for upland sites to place/dispose of PDM. Placement of PDM at the site was approved by the NJDEP Bureau of Industrial Site Remediation in 2008. Stockpiling operations have been ongoing since September 2008 in two designated areas of the site, and approximately 400,000 cubic yards of material have been stockpiled at this time.

The ultimate goals of the program include using the PDM as a structural fill material to:

- Preload the site to induce consolidation of the underlying peaty-clay soil deposits and improve the load bearing capacity of the site soils
- Provide an engineered soil cover over site soils to prevent contact with soils containing COPCs exceeding the current NRDCSRS
- Raise the general site elevation to approximately 16 feet above mean sea level for site redevelopment
- Provide a suitable compacted structural fill to support non-critical elements of site redevelopment such as roadways and parking areas

The dredge sediments are primarily silt and fine sand and are treated with eight percent Portland cement prior to transport to the site. Laboratory tests to evaluate the physical and engineering characteristics of PDM were performed by Golder Associates Inc. (Golder, 2009). Additional testing will be performed to develop specifications for compaction requirements for the final placement of fill as structural fill.

The existing elevation of the site varies from EL. 4.4 feet to EL. 7.3 feet (NAVD88). PDM will be used to raise the existing elevation of the site to post-settlement grade EL. 16 feet. It is anticipated that 1- to 1.5-million cubic yards of PDM will be required to raise the site elevation. The top area of the PDM fill will be graded to manage storm water effectively. The side slope of the PDM fill will be maintained at a slope no steeper than three horizontal to one vertical. The protective cap will be compacted to 95 percent relative compaction in accordance with ASTM D1557. The limits of the PDM fill will be governed primarily by the post-remediation redevelopment plans for the site and the location of existing utilities.

A 12-inch surface layer of clean fill meeting the Residential Direct Contact Soil Remediation Standards (RDCSRS) will be placed above the grading fill prior to the surface development of the property as discussed below. Above the 12-inch clean fill layer will be either a layer of topsoil and vegetation, or the surface development of the property (asphalt paved areas, building slabs, etc.), depending on the status of the redevelopment project at that time. A conceptual cross section of the cap is provided in Figure 9.

5.4.1 Surface Development of the Property

While not specifically part of the remedy, the final site development will further isolate the soils below and prevent water infiltration into the subsurface. The currently planned development involves an industrial complex including commercial electric power generation and chemical manufacturing. The redeveloper is PurGen One LLC, the contract purchaser of the property.

After the construction of the development project, the site will be covered by site infrastructure and paved areas. This surface cover will serve as an impermeable cap for an engineering control. The surface cover will consist of the concrete floor slabs and equipment foundations of the proposed buildings and the associated asphalt paving of roadways and parking areas. The design will incorporate surface water handling and run-off in a method that will minimize infiltration into the subsurface soils of the site. Figure 4, the Preliminary Site Redevelopment Plan, provides PurGen's draft site layout, indicating that the surface cover will effectively cover the whole site.

5.5 Statement of Completion of Remedial Action Requirements

DuPont will complete all applicable requirements of N.J.A.C. 7:26E (Remedial Action). The NJDEP and city of Linden will be notified of the intended remedial action. The remedial action will be constructed to meet the following criteria:

- Be approved by NJDEP prior to implementation
- Comply with the remediation standards presented in Section 4.0
- Comply with applicable federal, state and local laws, regulations and requirements
- Not, in and of itself, cause an uncontrolled or unpermitted discharge or transfer of contaminants from one media to another

5.6 Construction Quality Assurance Plan

A Construction Quality Assurance (CQA) plan will be developed to ensure that the project requirements and technical specifications are being met during remedial action implementation. The CQA plan will include the following elements:

- Scope of work
- Material requirements
- Minimum qualifications for the manufacturer, installer, contractor, CQA personnel, and/or the testing laboratories
- Material testing required by the manufacturer
- Construction and installation procedures
- Construction/installation monitoring, testing, and reporting requirements.

The testing requirements will specify the tests that will be performed, applicable standard testing procedures, minimum testing frequencies, and the minimum/maximum requirements that must be met.

As a minimum, the CQA plan will be developed for the SBCW, the groundwater control system, and earthwork (SBCW cap and PDM placement/compaction). For the SBCW, the CQA plan will include requirements for the excavated trench, fresh bentonite slurry, slurry in trench, onsite or offsite borrow materials (if any), and the soil-bentonite backfill. For the groundwater control system, the CQA plan will include requirements for the pipe, gravel, filter fabric, sumps, valves, and pumps. For earthwork, the CQA plan will include placement and compaction requirements for the SBCW cap and the PDM fill.

5.7 Permits and Notifications

The following federal, state, or local permits and/or notifications may be needed to implement the proposed remedial action. The project schedule provides a timeline for the permitting process that will include the following elements:

- City of Linden Construction Permit
- Waterfront Development/Upland Waterfront Permit (N.J.S.A. 12:5-3)
- Soil Erosion and Sediment Control Plan Certification for Land Disturbance Control (N.J.A.C. 2:90)
- New Jersey Pollutant Discharge Elimination System
- Treatment Works Approval (N.J.S.A. 58:12A-1 et seq.; N.J.A.C. 14A-22)
- Stream Encroachment Permit (Construction within a Flood Plain; N.J.S.A. 58:16A-50 et seq.; N.J.A.C. 7:8-3.15)
- Well Drilling Permit and Well Certification Forms A & B (N.J.S.A. 58:4A-14; N.J.A.C. 7:9D)
- Well Abandonment Form

- Public Notification
- Groundwater Remedial Action Permit (subsequent to construction)
- Remedial Action Soil Permit (subsequent to construction)

The Public Notification will include a posted sign at the front gate measuring two feet by three feet and shall include the date posted and the following statement: "Environmental Investigation/Cleanup in Progress at This Site. For Further Information Contact PARSONS/ DUPONT" followed by the name and telephone number for the person responsible for conducting the remediation as well as the telephone number for the NJDEP's Office of Community Relations. The Site's preferred identification number will also be provided. The sign will be posted 14 days prior to initiating the approved remedial action. The NJDEP Case Manager, the Linden municipal clerk and designated local health official will be notified 14 days prior to the start of field activities associated with the approved remedial action.

5.8 Construction Monitoring Plans

The environmental controls that will be implemented during the remedial action are noted below. These controls are intended to comply with applicable local and state regulations governing remedial activities.

5.8.1 Perimeter Air Monitoring Plan

A Perimeter Air Monitoring Plan (PAMP) will be prepared and implemented during performance of the proposed remedial activities. The PAMP is intended to provide a measure of protection for site workers from potential airborne contaminants during the remedial action implementation. The PAMP will present upwind and downwind receptor requirements for the various remedial activities. Action levels for respiratory protection will be set forth in the Health and Safety Plan (HASP) based on the work activity, the area of the site, the COPCs present and the nature of engineering controls that are employed.

5.8.2 Soil Erosion and Sediment Control Plan

The Soil Erosion and Sediment Control (SESC) plan will detail all temporary soil erosion control measures that will be used to control erosion and sedimentation from work areas, around soil stockpiles, and around storm water management systems during the remedial activities. Control measures may include items such as silt fence or hay bales to prevent migration of soil offsite or to a nearby storm water management system. Methods for securing the controls in place such as wooden and/or metal posts will also be specified in the SESC plan. The SESC plan will be submitted to the Somerset-Union Soil Conservation District for approval. No earthwork will be initiated until all the specified erosion control measures have been installed in accordance with the approved SESC plan. The erosion control measures will be inspected on a frequent, periodic basis and after each rainfall to check effectiveness and to evaluate any conditions needing action/repairs. Control measures will be maintained to maximize effectiveness during the construction period.

PDM stockpiling activities that are currently occurring onsite are proceeding in accordance with SESC measures that are defined in a plan approved in 2009.

5.8.3 Soil Reuse Plan

Excess soil excavated for the SBCW, the shallow groundwater collection system or other required excavation will be managed onsite. All such excavated soils will be placed in thin lifts of no more than 18 inches and covered by the PDM fill that will comprise the soil cover for the site. Blending of excavated soils with the PDM may be required to reduce moisture content or meet the necessary compaction requirements.

Concrete foundations from the original Plant structures are still present on portions of the site. Shallow foundations and building slabs will be excavated prior to PDM placement and crushed either for beneficial reuse onsite as temporary road base or placement directly beneath the PDM soil cover. The concrete will be sampled and analyzed in accordance with NJDEP requirements for beneficial reuse. A concrete sampling plan will be prepared as part of the remedial design.

No excavated soil is expected to be transported off the site for reuse. If excavated material cannot be placed onsite beneath the PDM, it will be sampled and sent offsite for disposal in accordance with applicable regulations.

5.8.4 Health and Safety Plan

A HASP has been prepared for the DuPont Linden site for investigation activities. The procedures outlined in the plan are followed by DuPont and Parsons personnel, contractors, and all other team members involved with the remediation project.

A construction HASP will be prepared for the remedial action to encompass the expanded scope of construction activities. The HASP will address the specific activities proposed in this RAW including construction of the perimeter slurry wall, installation of groundwater extraction wells and piping systems, full-scale in-situ chemical treatment, construction of utility trenches and groundwater collection trenches, and placement of the PDM soil cover.

5.9 Estimated Costs

Costs were developed for the proposed remedy as presented above. It is expected that groundwater remediation will continue for as long as necessary to maintain an inward gradient across the barrier wall. For cost estimating and planning purposes the projected duration was set at 30 years.

The total estimated capital cost to construct this remedial action is approximately $13 million. Annual operating costs are estimated to be $1.0 million based on the treatment of groundwater using the permitted treatment system at the adjacent ISP facility. This is an order of magnitude engineering cost estimate that is expected to be within -30 to +50 percent of the actual project cost.

5.10 Remedial Action Progress Reports

Remedial Action Progress Reports will be prepared twice per year for NJDEP review. The progress reports will be prepared in accordance with NJDEP requirements and will include:

- A description of each remedial action conducted within the reporting period and identification of problems or delays related to the approved schedule

- Discussion of problems and delays, including proposals for corrections
- Proposed deviations from the approved RAW
- A revised schedule reflecting delays or modifications
- Status of permit applications
- Remedial actions to be performed in the next reporting period
- Costs of each remedial action incurred to date and estimate for activities to be performed
- A tabulation of sampling results received during the reporting period
- A summary of groundwater treated, including elevation contour maps and changes in contaminant concentrations
- A description of wastes generated including characterization sampling, quantities disposed, and the identification of transporter and disposal facility

5.11 Remedial Action Report

A Remedial Action Report (RAR) will be prepared at the conclusion of the active site remediation, consistent with NJDEP requirements. The report will include the following elements:

- A summary of the multi-phase RI Reports including site history, physical setting, COPCs, and AOCs
- A summary of all remedial actions completed
- Remediation standards achieved for each remedial action
- As-built drawings for all remedial activities including the PDM / soil cover, perimeter barrier wall, groundwater collection trenches, groundwater extraction wells and piping systems
- Description of site restoration activities
- A summary of remediation costs including estimated costs of ongoing monitoring of groundwater conditions and management of engineering controls
- A copy of the filed Deed Notice and Remedial Action Permit form
- Fully executed manifests for any offsite transportation and disposal of wastes
- Graphical presentation and summary table of groundwater quality data
- Discussion of Mann-Whitney U-Test results for groundwater quality, as applicable
- Conclusions related to groundwater contamination trends and requirement for a groundwater CEA

- An updated receptor evaluation pursuant to N.J.A.C. 7:26E-1.15(d)
- A completed case inventory document

6.0 INSTITUTIONAL CONTROLS

6.1 Classification Exception Area

A request will be submitted for a groundwater CEA. The establishment of the CEA will define boundaries of the property where localized groundwater quality standards for Class II-A groundwater will not be met for an indeterminate duration. Most of the supporting data on the hydrogeologic characteristics of the site as well as on the nature and the extent of groundwater contamination have been provided in previous reports to the NJDEP. A copy of the draft CEA is included in Appendix D. The geographic coordinates of the CEA will be obtained by a professional surveyor subsequent to the installation of the barrier wall. The final CEA document, including electronic data and meta data, and the CEA/Well Restriction Area Permit Fact Sheet form will be submitted to the NJDEP with the RAR.

An application for a groundwater remedial action permit will be submitted towards the end of the groundwater remedial action, i.e. after construction of the SBCW and groundwater management system is complete and hydraulic control has been demonstrated to meet the remediation goals, typically for one year. An application for groundwater Class III-B aquifer designation is being prepared and will be submitted to the NJDEP under separate cover. The Class III-B designation is appropriate because of the saline character of the site groundwater. TDS and chlorides both exceed the applicable criteria.

6.2 Draft Deed Notice

Institutional and engineering control measures are proposed for the property. A copy of the Draft Deed Notice is included in Appendix E. Institutional controls will provide notice to future owners regarding the location of the contaminants and limit human and environmental exposure to the contaminants. Table 2 presents a summary of the soil samples collected from the site that exceeded the NRDCSRS.

The final deed notice application, exhibit maps, and maintenance plans will be completed subsequent to the construction of the engineering controls. A licensed professional surveyor will be used to prepare the metes and bounds locations of the subsurface barrier wall and property boundary with soil contamination above the NRDCSRS.

Pursuant to N.J.S.A. 58:10B-13.1, the compliance and effectiveness of the institutional and engineering controls will be monitored. A written certification that the institutional and engineering controls are being properly maintained and continue to be protective of public health and safety and the environment will be submitted to the NJDEP every two years. Maintenance will be conducted as necessary to continually maintain the integrity of the engineering controls. The results of all inspections and maintenance and any disturbances of the controls will be documented in a logbook that will be made available on site to the NJDEP upon request.

Because this is a restricted use remediation that employs engineering and institutional controls as a remedy for soil contamination, a remedial action permit will be obtained. The engineering controls and deed notice will be in place before the application for the soil remedial action permit is submitted to NJDEP.

7.0 REMEDIAL ACTIVITIES AND SCHEDULE

This RAW describes the following major remedial action components, which will be implemented in the order shown below:

- AOC U and AOC I IRM
- Slurry Wall Containment System
- Groundwater Extraction & Treatment
- PDM / Soil Cover

Following construction of the major remedy components, the following additional activities will be performed:

- Remedial Action Report
- Site Closure (Remedial Action Permits)

The preliminary schedule for these remedial activities is presented in Figure 10.

7.1 AOC U and AOC I IRM

The detailed design and implementation work plan for the chemical treatment of free product in AOC U and AOC I is presented as Appendix A to this RAW. This remedial component is presented as an IRM, so that it can be approved and initiated independently and ahead of full RAW approval. It is anticipated that the duration of this IRM will be two years. This remedy component can be initiated and completed first because it is has a complete detailed design and no additional pre-design investigations are required.

7.2 Slurry Wall Containment System

Additional pre-design investigation work is required before the detailed design of the perimeter slurry wall can be completed. The PDI Geotechnical Investigation Work Plan for the slurry wall is presented in Appendix B of this RAW. The PDI field activities can begin immediately upon NJDEP approval of the PDI Work Plan. Following the field work, a PDI Geotechnical Report will be completed and the resulting data will be incorporated into the detailed slurry wall design. The detailed slurry wall design will be submitted to NJDEP for approval prior to initiation of construction.

Following NJDEP approval of the detailed design, a Bid Package for the slurry wall construction will be prepared that includes the detailed design, construction specifications, and contractual terms and conditions. After pre-qualifying a short list of eligible bidders, DuPont will conduct a site walk and host a pre-bid meeting. Bids will be evaluated by DuPont and a construction contract awarded. Upon approval by NJDEP, DuPont will mobilize the construction contractor to the site to construct the slurry wall as designed.

7.3 Groundwater Extraction System

Construction of the groundwater extraction system will begin following construction of the slurry wall containment system. Additional pre-design investigation work is required before the detailed design of the groundwater extraction system can be completed. The proposed

PDI Aquifer Testing Program is presented in Appendix C of this RAW. The PDI field activities can begin immediately upon NJDEP approval of the PDI Work Plan. Following the field work, a PDI Aquifer Testing Report will be completed and the resulting data will then be incorporated into the detailed groundwater extraction system design. The detailed design of the groundwater extraction system will be submitted to NJDEP for approval prior to initiation of construction.

Following NJDEP approval of the detailed design of the groundwater extraction system, a Bid Package for the groundwater extraction system will be prepared that includes the detailed design, construction specifications, and contractual terms and conditions. After pre-qualifying a short list of eligible bidders, DuPont will conduct a site walk and host a pre-bid meeting. Bids will be evaluated by DuPont and a construction contract awarded.

Upon approval by NJDEP, DuPont will mobilize the contractor to the site to construct the groundwater extraction system as designed. After approximately one year of system operation, a Groundwater Remedial Action Permit application will be submitted to NJDEP.

7.4 Capping / Final Cover

PDM placement at the site is currently ongoing. As part of the remedial Action (RA), PDM will be placed across the entire redevelopment property to raise the site elevation as necessary for future development. It is anticipated that some final grading of the PDM will be required subsequent to the construction of the total containment system. In addition, a minimum of 12 inches of material (PDM or other), which meets RDCSRS, will be placed on top of the graded PDM. An additional six inches of topsoil and seeding will be added, or the site may be paved, depending on the near term redevelopment plans for the site.

7.5 Remedial Action Report

A RAR will be prepared that addresses the AOC U IRM, the slurry wall and the groundwater extraction system. The RAR will include the final Deed Notice and the CEA.

7.6 Site Closure

In order to obtain site closure, DuPont will request a soil remedial action permit after the slurry wall has been installed. A groundwater remedial action permit will be requested after the groundwater extraction system has operated for approximately one year and demonstrated performance. Upon review and approval by NJDEP, DuPont anticipates receiving a response action outcome (RAO) for site soil and groundwater.

7.7 Deliverables for NJDEP Review

The following deliverables will be submitted to NJDEP for review or for informational purposes:

- PDI report for slurry wall
- PDI report for groundwater extraction system
- Detailed design of slurry wall

- Detailed design of groundwater extraction system
- Construction Plans
  - Health and Safety Plan
  - CQA Plan
  - Perimeter Air Monitoring Plan
  - Soil Reuse Plan
- Permits
  - Waterfront Development/Upland Waterfront Permit
  - New Jersey Pollutant Discharge Elimination System
  - Treatment Works Approval
  - Stream Encroachment Permit
  - Well Drilling Permit and Well Certification Forms A & B
  - Well Abandonment Forms
  - NJ Discharge to Groundwater Permit by Rule
- Remedial Action Progress Reports
- Remedial Action Report AOC U and AOC I IRM
- Remedial Action Report for Slurry Wall, Groundwater Extraction System and Capping / Final Cover
- Remedial Action Soil Permit (subsequent to construction of slurry wall and soil cover/cap)
- Remedial Action Groundwater Permit (subsequent to one year of operation)

7.8 Schedule

The preliminary schedule for the RA activities has been developed and is presented as Figure 10. The RA will be conducted upon receiving NJDEP approval of the RAW and other required approvals. The schedule is partially dependent on major milestones for the site redevelopment and reflects DuPont's commitment to proceed with implementation of the remedy in an efficient and streamlined manner.

Within 30 calendar days after NJDEP approval of the RAW, the RA schedule will be revised to identify the projected month and year for the initiation and completion of each task. Construction activities will be coordinated consistent with seasonal variations, weather conditions, redevelopment activities and site access. The revised schedule will be submitted to the NJDEP.

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NJDEP, 2010b. Approval letter dated April 9, 2010, from Ian R. Curtis, Office of Brownfield Reuse, to John E. Vidumsky, DuPont.

Exhibit N

OPERATIONAL HISTORY
OF THE
DU PONT GRASSELLI FACILITY
LINDEN, NEW JERSEY

DERS JOB NO. 90170

BAA000045

September 28, 1990

Prepared for:

The Du Pont Grasselli Facility
Linden, New Jersey
Attention: Mr. Michael O'Brien
and
Du Pont Engineering Services Division
Attention: Calvin C. Chien, Ph.D., P.E.

Prepared by:

Du Pont Environmental Remediation Services, Inc.
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MAXUS3918804

1.0 INTRODUCTION

The Du Pont Grasselli facility in Linden, New Jersey, (Grasselli) is initiating a voluntary environmental investigation. The investigation will consist of a Remedial Investigation (RI), a Feasibility Study, and a Remedial Action. This Operational History document will be used as the basis for preparing the RI Work Plan. The Operational History of the Grasselli Facility includes information on both the environmental setting and the plant history.

Du Pont Environmental Remediation Services (DERS) has compiled information on the plant history starting in 1885 -- when the Grasselli Chemical Company acquired the facility -- until the present. The plant history is divided into 10-year increments to provide a detailed chronology of construction activities, manufacturing processes, and waste disposal practices. A series of maps have been prepared to highlight the changes that have occurred at the site.

This Operational History has been developed by utilizing the existing information concerning the Grasselli facility. By coordinating this information into one document, a foundation is provided from which an efficient and effective RI work plan can be developed. This focused-approach enables Du Pont to limit its site investigation on potential areas of concern, which will reduce cost.

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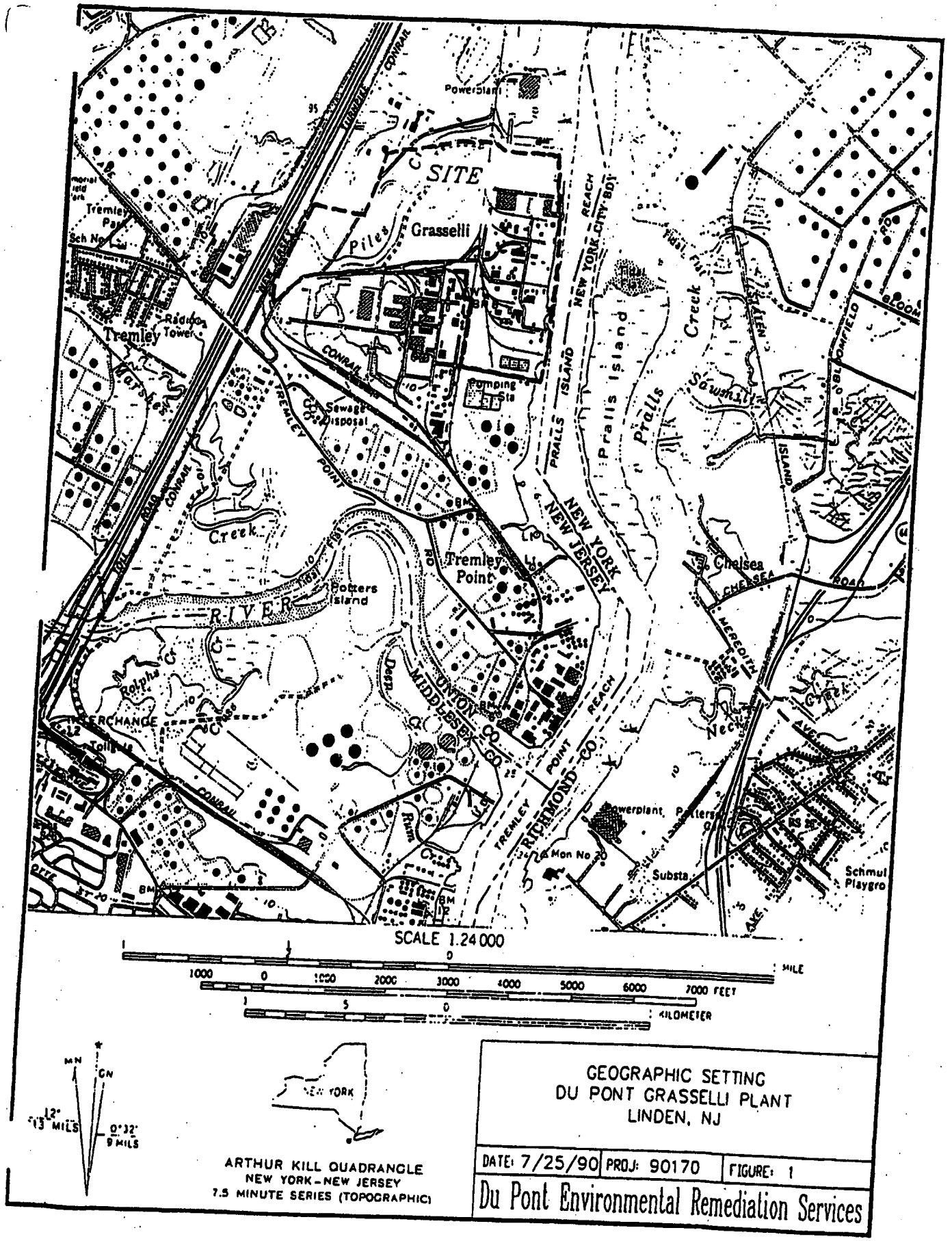

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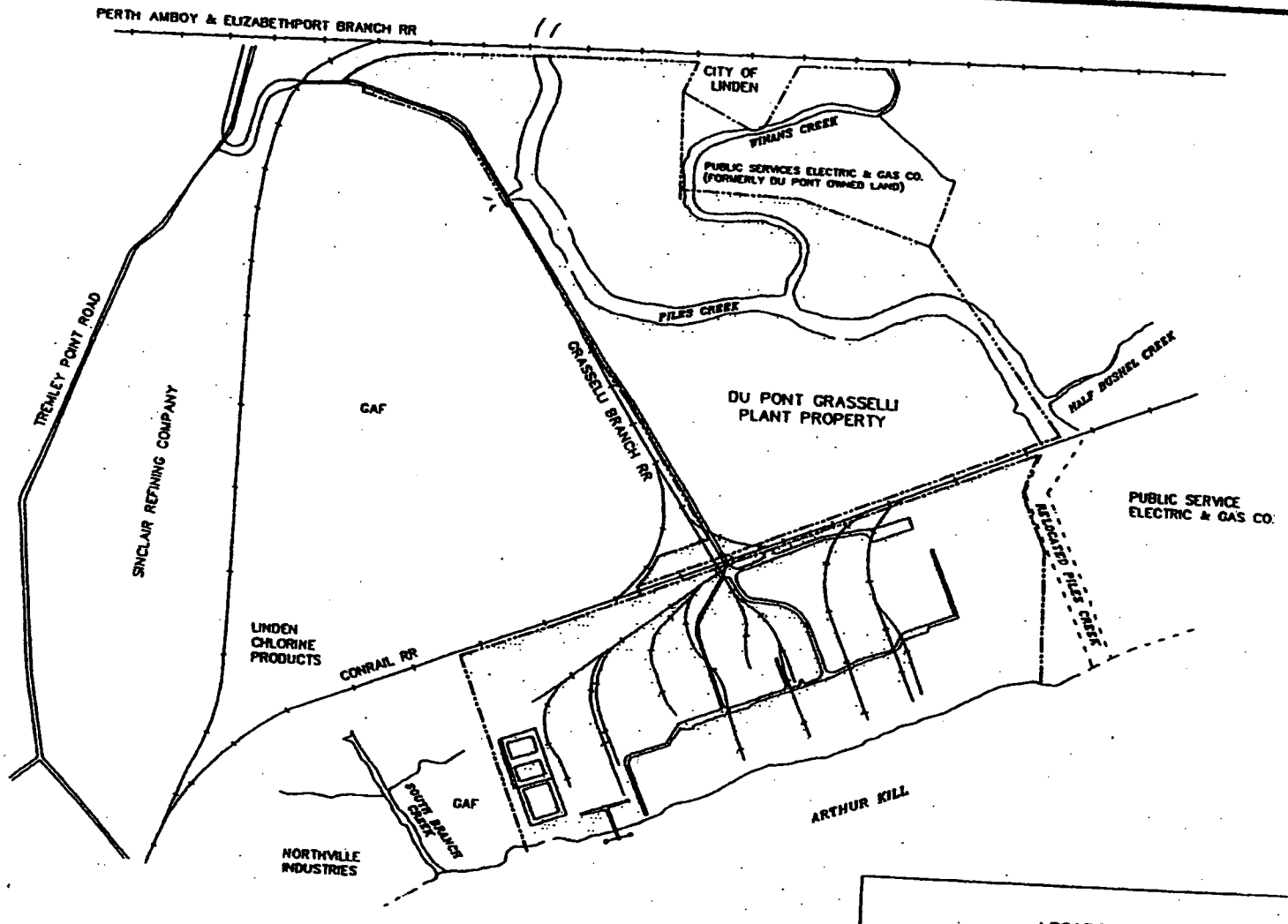

LOCATION SETTING
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 6/14/90	PROJ: 90170	FIGURE: 2

Du Pont Environmental Remediation Services

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The growing season is approximately 180 days from mid- to late April to late October. The prevailing winds are from the northwest during October through April and from the southwest from May to September.

2.4 Topography and Drainage

Within Union County there are two main topographic features: the Watchung Mountains which are on the western border of Union County, and the gently undulating plain which starts on the eastern side of the Watchung Mountains and slopes to the southeast.

The Watchung Mountains attain a maximum altitude of about 550 feet and the elevation of the rolling plain adjacent to the mountains is 150 feet and slopes to the southeast to sea level at the Arthur Kill. Much of the elevation of the Grasselli Plant is under 10 feet above mean sea level, as it is situated within the plain by the Arthur Kill.

Union County has five major drainage basins as depicted in Figure 3. They are: the Passaic River Basin, the Raritan River Basin, the Rahway River Basin, the Arthur Kill Drainage Basin, and the Elizabeth River Basin. The Grasselli Plant is in the Arthur Kill Drainage Basin. It is drained by perennial tidal streams which follow approximately preglacial buried river channels. Published hydrologic data on the Arthur Kill Drainage Basin does not exist as best as DERS can determine at this time, although statistics have been published by Langbein and others (1947) on the neighboring Rahway Drainage Basin. Langbein reports that the Rahway Drainage Basin has a stream density of 2.02 linear miles of stream per square mile of land area, a principal stream length of 19 miles, a mean altitude of 204 feet, and a surface water area of 0.2 square miles. The average flow (1921-1966) of the Rahway River, which drains an area of 40.9 square miles, is 43.3 cubic feet per second. The hydrologic characteristics of the Arthur Kill Drainage Basin may be similar to the Rahway Drainage Basin, although its drainage area is less than one-quarter of the

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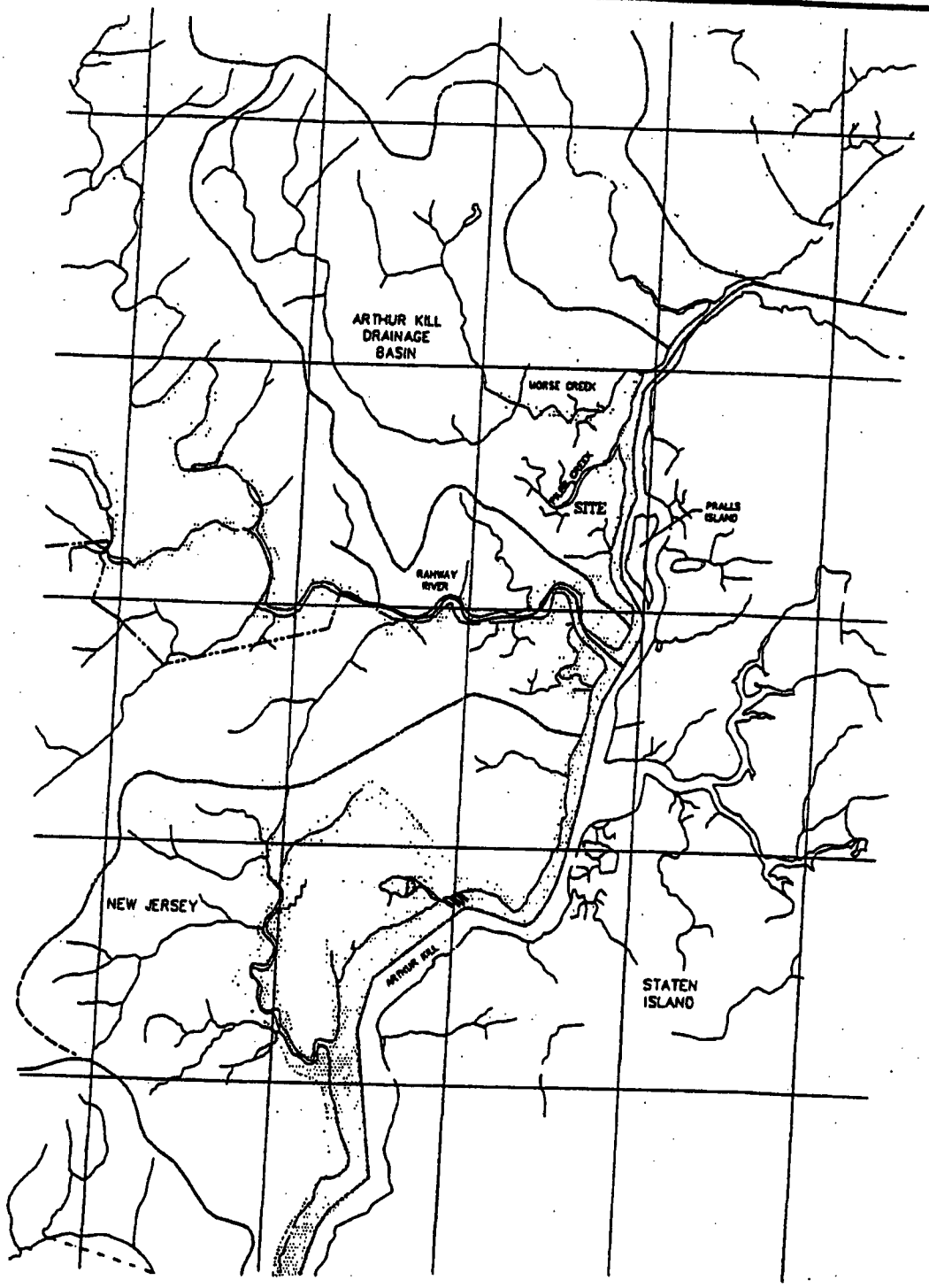

COUNTY BOUNDARY
DRAINAGE BASIN BOUNDARY
RIVER BASIN BOUNDARY

STREAMS & RIVERS
FLOOD PRONE AREAS

FLOOD PRONE AREAS NEAR GRASSELLI
& THE ARTHUR KILL DRAINAGE BASIN
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 7/02/90	PROJ: 90170	FIGURE: 3

Du Pont Environmental Remediation Services

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Rahway. The streams that drain into the Arthur Kill (in the portion relevant to the Grasselli Plant) include Piles Creek, Morses Creek, and Half Bushel Creek.

Figure 3 is a map which depicts flood-prone areas near the Grasselli Plant. It shows that the eastern portion of the Grasselli property along the Arthur Kill and Piles Creek is prone to flooding, most likely due to tidal surges from the Arthur Kill and heavy precipitation which causes peak flow periods in streams of the Arthur Kill Drainage Basin.

To determine when the Grasselli Plant may have been subjected to flooding, searches were made to determine the closest fresh and salt water gauging stations to the plant. The closest freshwater gauging station is on the Rahway River at Rahway Station 1395. The United States Geological Survey maintains records for this station. Appendix A is a printout of discharges in cubic feet per second (cfs) which exceed the base discharge of 600 cfs for Station 1395. Gauging records have been kept annually from 1921 to the present, and are taken continuously throughout the year. Historical sea level elevation data has been ordered from the National Oceanic and Atmospheric Administration (NOAA) from the closest gauging stations to the Grasselli Plant which are Battery, New York, and Sandy Hook, New Jersey. The combination of peak fresh water flow periods, coupled with the peak sea level elevations, will be used to speculate when flooding most likely occurred at the Grasselli Plant. Sea level elevation data has not been received by DERS at this time.

2.5 General Geology

The Du Pont Grasselli Plant is located within the eastern most portion of the geologic Newark Basin. This basin was produced during the late Triassic Epoch by down faulting and is part of a series of northeast-southwest trending basins in the Piedmont Plateau from Nova Scotia to North Carolina. The Newark Basin is comprised of sedimentary rocks and basalt flows of the early Jurassic and late Triassic periods (approximately 180 million years ago). The basin dips to the north forming a wedge 33,000 feet thick.

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Underlying the Passaic Formation are older sedimentary Triassic age rocks of the Stockton Formation. This formation is approximately 550 to 2700 feet thick and is comprised of sandstones, conglomerates, siltstones and shales. Unconformably underlying the Stockton Formation is the Wissahickon Formation, primarily composed of schist and gneiss of early Paleozoic age. Figure 4 presents a generalized stratigraphic section of the Grasselli Plant.

2.6 General Hydrogeology

Based on Du Pont's geotechnical boring logs, depth to the water table ranges from 2-10 feet below ground surface at the Grasselli Plant. Anderson (1968) prepared a water level contour map (Figure 5) of the Rahway area. This map shows that the movement of groundwater is generally easterly toward the Arthur Kill and tributaries of the Kill. The groundwater that flows beneath the Grasselli plant probably mimics the regional flow pattern and discharges to the Arthur Kill and to local tributaries such as Piles Creek and the Rahway River.

Figure 6 depicts the typical water table fluctuation for a well in Union County from 1943 to 1969. Nemickas (1976) reports that the water table in Union County generally rises from the end of October to the middle of April when evapotranspiration is at its lowest, and declines from April to October when discharge exceeds recharge and evapotranspiration is at its highest. The depth of the water table conditions vary, but are known to extend into the Brunswick Shale as reported by Anderson (1968).

The most productive water supply wells in the area are tapped in the Brunswick Shale and stratified glacial drift. According to Anderson (1968), 90 percent of the wells tap the Brunswick Shale and 10 percent tap stratified glacial drift. The availability of groundwater to wells in the Brunswick Shale is controlled by secondary features such as fractures and joints. The more numerous the secondary features, the greater the potential for productivity in the well. Typical statistics for well tapping the Brunswick Shale in the Rahway area are listed as follows:

MAXUS3918811

CENOZOIC	QUATERNARY AGE	RECENT	FILL	CINDER, CONCRETE, COAL, SAND, BRICK, ET CETERA(5-16' THICK)
			SALT MARSH DEPOSITS	ORGANIC MUDS AND SANDS (2-10' THICK)
		PLEISTOCENE	GROUND MORAINE	CLAY, SILT, SAND GRAVEL AND BOULDERS(40-70' THICK)
MESOZOIC		JURASSIC/ TRIASSIC	PASSAIC FORMATION	SHALE, SILTSTONE, SANDSTONE AND CONGLOMERATE(8,700' THICK)
		TRIASSIC	STOCKTON FORMATION	SANDSTONES, CONGLOMERATES, SILTSTONES AND SHALE (550-2,700' THICK)
PALEOZOIC			WISSAHICKON FORMATION	SCHIST AND GNEISS (THICKNESS UNKNOWN)

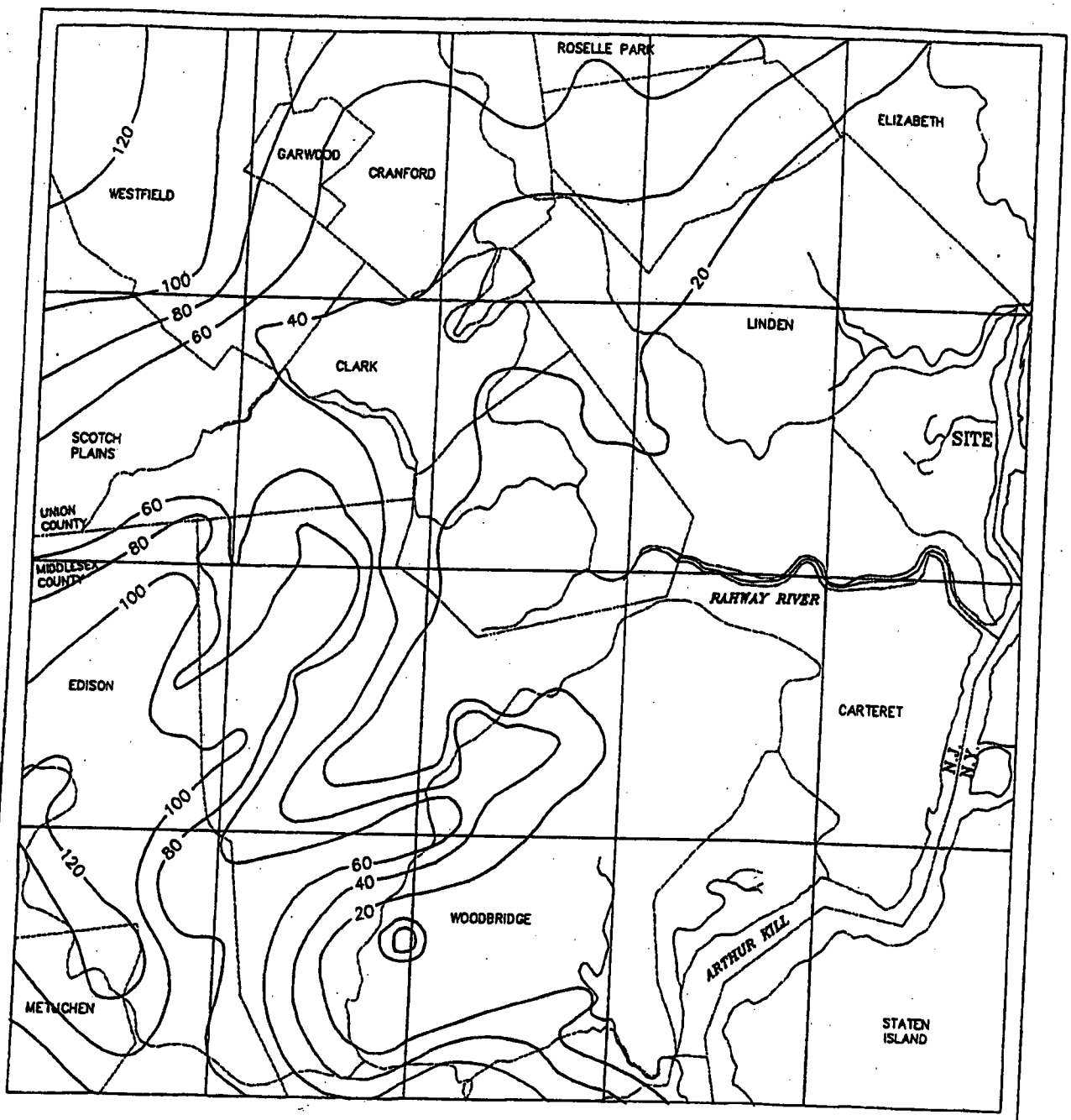
NOTE: BASED ON PUBLISHED GEOLOGIC LITERATURE AND DU PONT GEOTECHNICAL BORING LOGS

GENERALIZED STRATIGRAPHIC SECTION OF THE GRASSELLI PLANT
DU PONT GRASSELLI
LINDEN, NJ

DATE: 6/25/90 | PROJ: 90170 | FIGURE: 4

Du Pont Environmental Remediation Services

MAXUS3918812



—— WATER TABLE ELEVATION CONTOUR (FEET ABOVE MEAN SEA LEVEL)

NOTE: TAKEN FROM STATE OF N.J. DEPT. OF CONSERVATION & ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY, GEOLOGY & GROUNDWATER RESOURCES OF THE RAHWAY AREA, N.J. SPECIAL REPORT No. 27, 1968

0 7000'
SCALE

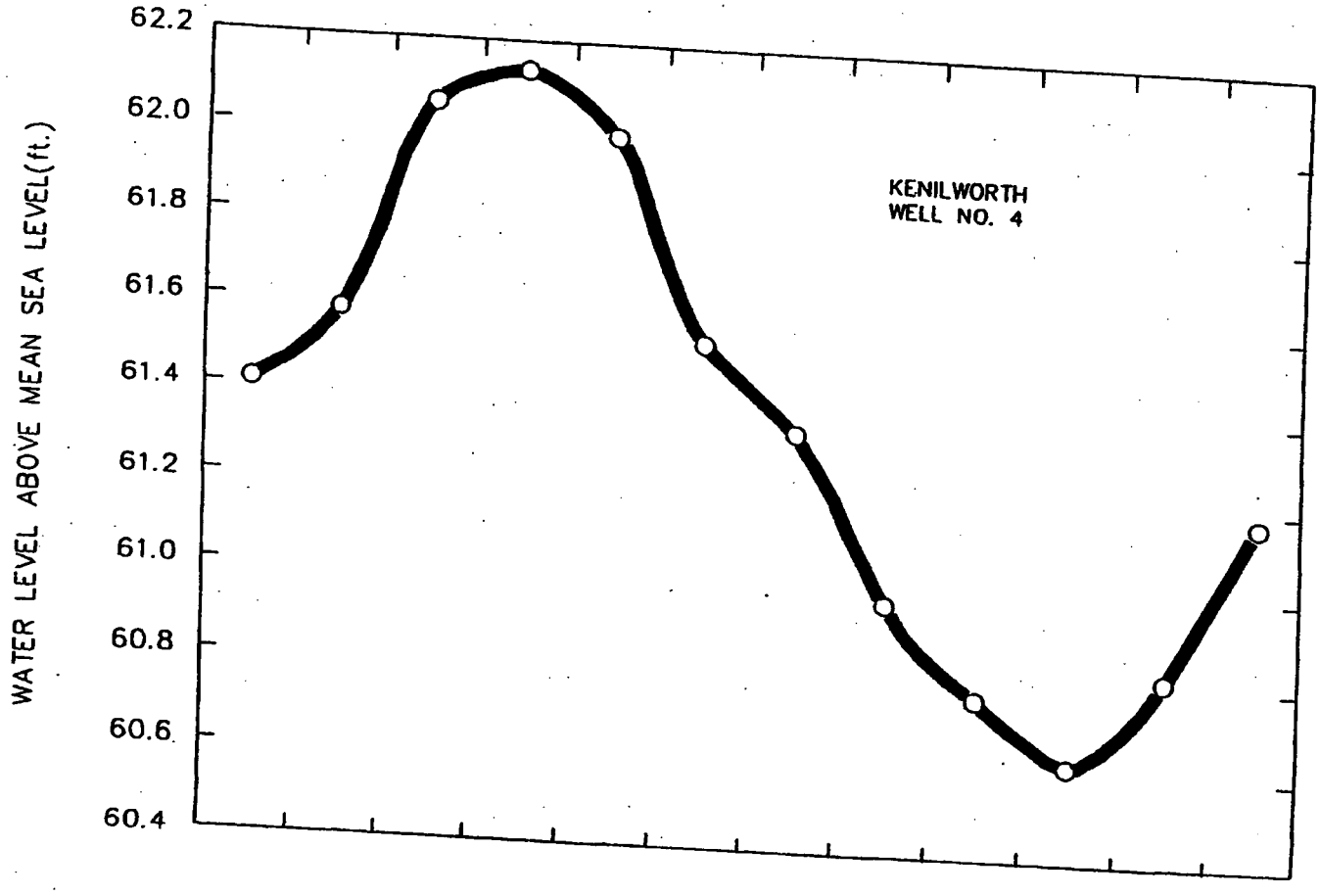
WT

WATER TABLE ELEVATION MAP
FOR AN AREA NEAR THE
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 7/30/90	PROJ: 400903	FIGURE: 5

Du Pont Environmental Remediation Services

MAYUS2048842



NOTE: TAKEN FROM NEMICKAS (1976)

WATER TABLE FLUCTUATION
FOR A WELL IN UNION COUNTY
(KENILWORTH No. 4 1943-1969)
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 7/26/90	PROJ: 90170	FIGURE: 6

Du Pont Environmental Remediation Services

MAXIIS3048844

PARAMETER	RANGE	AVERAGE
Depth (Feet)	60-1,566	218
Yield (gpm)	2-660	75
Specific Capacity (gpm/ft of drawdown)	0.1 - 25	2.2
Temperature °F	(wells 0-800 ft)	55°
Temperature °F	(wells >800 ft)	70-90°

NOTE: Wells less than 6 inches in diameter

2.7 Groundwater Quality

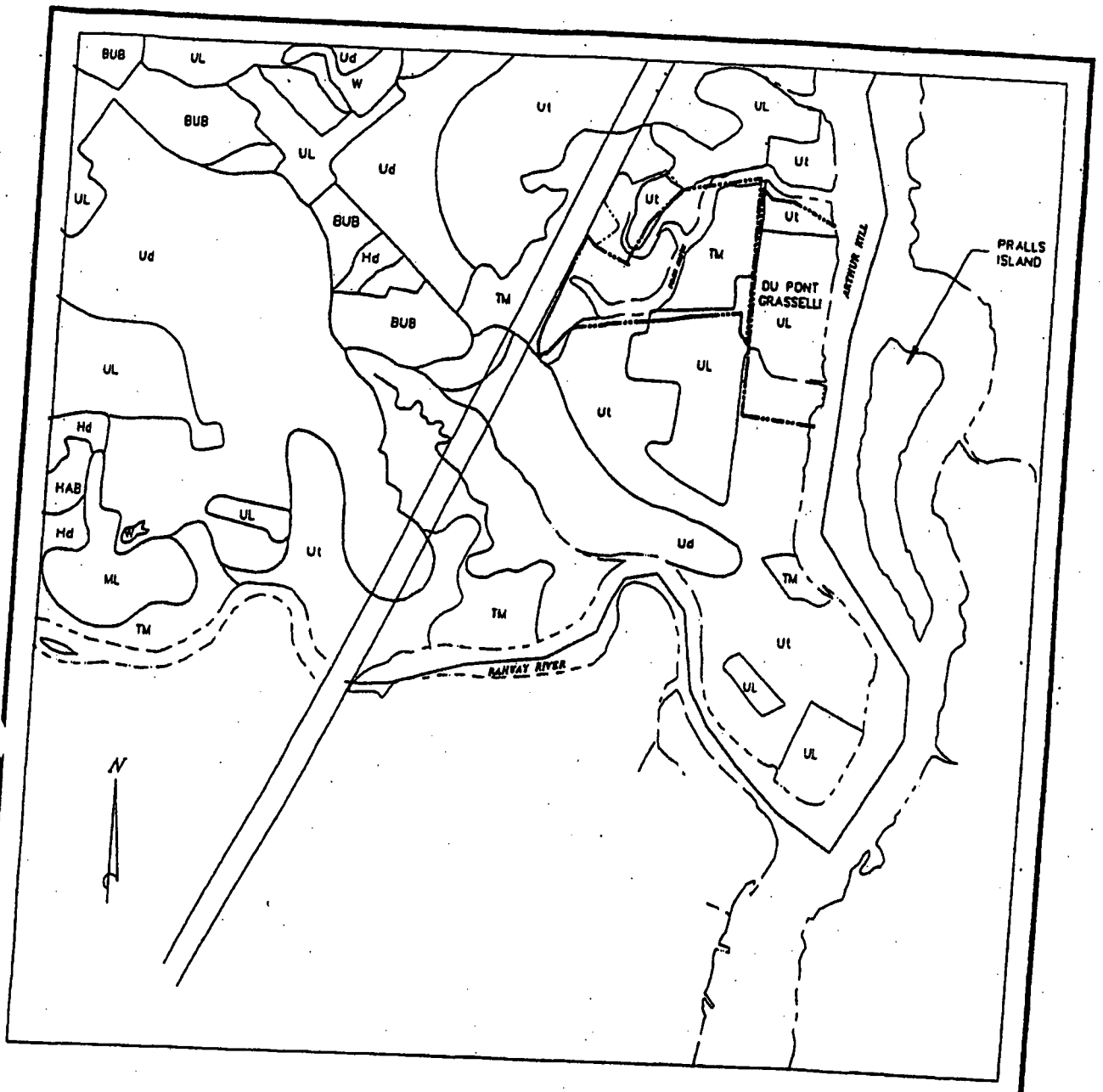
The quality of groundwater in Union County from Pleistocene deposits is generally good, although it is not readily available to water wells in sufficient quantities to be productive, except in stratified glacial drift. Groundwater pH ranges from 6.4 to 8.5, the average hardness is 137 mg/l, the average sulfate concentration is 65 mg/l, and total dissolved solid content averages 256 mg/l.

The Passaic Formation (Brunswick Shale) produces potable water in abundant quantities; therefore, it is the major water supply aquifer in Union County. This aquifer has a tendency to have iron and manganese in concentrations above the limits set by the New Jersey Department of Public Health (0.3 mg/l and 0.05 mg/l, respectively). Nemickas (1976) reports that sulfate and total hardness may exceed allowable standards, especially as dissolved solid content increases. The pH of groundwater from the Brunswick Shale is similar to the pH of groundwater from Pleistocene deposits, ranging from 6.3 to 8.5.

2.8 Soils

The soils of the Grasselli Plant and surrounding area have been mapped by the U.S. Soil Conservation Service (U.S. SCS). The latest mapping of the area was done in 1983. Figure 7 depicts the areal distribution of soils at the plant. The soils at the plant consist of three main categories: the Sulfihemists and Sulfaquents, the Udorthents, and Urban Land. The majority of the soil at the property is Urban Land. The definition of Urban

MAXUS3918815



LEGEND

UL URBAN
Ut UDORTHENTS, ORGANIC SUBSTRATUM
TM SULFIHEMISTS AND SULFUQUENTS, FREQUENTLY FLOODED

NOTE: TAKEN FROM THE U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, 1983

SOILS MAP FOR THE
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 7/27/90	PROJ: 90155	FIGURE: 7

Du Pont Environmental Remediation Services

Land as defined by U. S. SCS is, "areas which are more than 85% covered by impervious structures such as pavements and building. . . and the uncovered portions, as a rule, have been disturbed so that natural soil profiles no longer exist." The Sulfihemists and Sulfaquents are generally deep, poorly drained soils subject to tidal flooding. The Udorthents are characterized by variable fill material, although dredge material is the most prevalent. Complete descriptions of these three soil types are presented in Appendix B.

2.9 Surrounding Land Use

The present land use surrounding the Grasselli Plant is industrial. Figure 8 depicts the neighbors immediately adjacent to the plant, they are: the General Aniline Film (GAF) Company, who operate a chemical manufacturing facility, Conrail railroad lines, and the Public Service Electric and Gas Company who operate an electric generating station. Immediately to the east of the Grasselli Plant is the Arthur Kill, which is heavily used by sea-going vessels to ship goods.

The land adjacent to the property (to the south and west) is owned by the GAF Corporation. GAF acquired the property in 1964 from the U. S. Government -- which operated the plant from 1941. The original owner of the property was I. G. Faben, a German chemical manufacturer. From 1911 to the present, various chemicals have been manufactured on this property. Major products manufactured have been dyes and pigments, surfactants, and phenolic compounds. Approximately 500 different chemicals have been manufactured at this facility at one time or another. There is a landfill on the property and it is not known whether the U. S. Government or I. G. Faben ever used it. However, this landfill was used by GAF for the disposal of bulk and drummed chemical waste from 1964 to 1971. Current hazardous wastes generated by GAF include benzene, halogenated benzenes, dioxane, dichloroethene, phenol, propylene oxide, and silver. The NJDEP inspected the landfill in 1981. They reported that the area was covered with small lab jars. Also, many severely corroded drums were observed protruding from the ground of the landfill. Several hundred severely corroded and empty drums were also observed along a water ditch that runs by the landfill.

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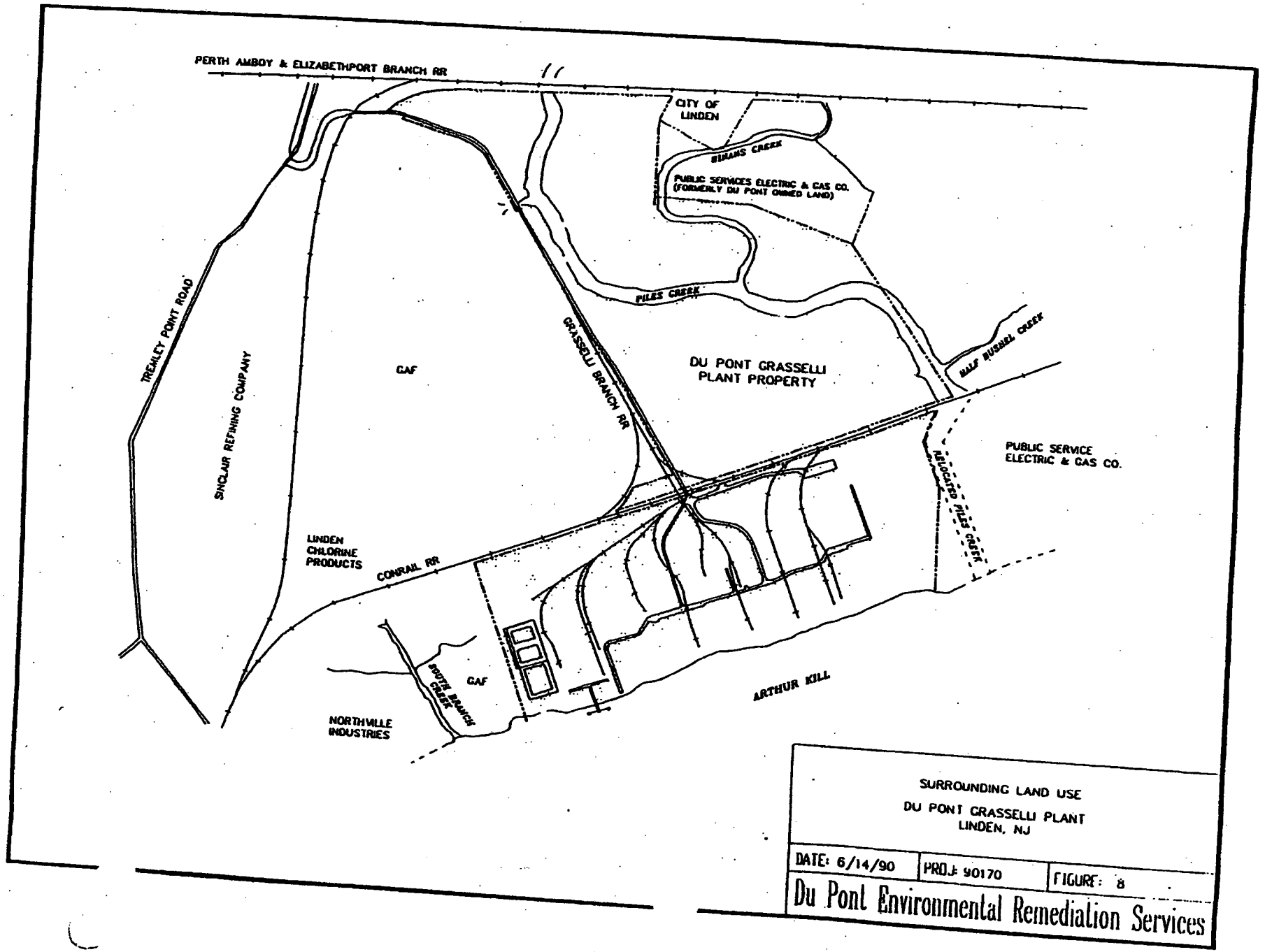


SURROUNDING LAND USE
DU PONT GRASSELLI PLANT
LINDEN, NJ

DATE: 6/14/90	PROJ: 90170	FIGURE: 8

Du Pont Environmental Remediation Services

Process wastes generated at the site are collected in unlined earthen ditches. The water in these ditches is collected and treated prior to discharge to the Arthur Kill. The NJDEP inspection of the landfill also noted several areas in these ditches that indicated heavy contamination.

GAF is in the process of conducting a RI/FS at the site. This work is being completed under an Administrative Consent Order from the NJDEP. Prior investigations have discovered the presence of "phenolic oil" floating on the groundwater table under the site. Also, the presence of dioxins at the plant has been determined.

A review of the NJDEP files did not provide information on the environmental quality at the other surrounding properties. No other surrounding property owner is currently undergoing a state mandated investigation.

MAXUS

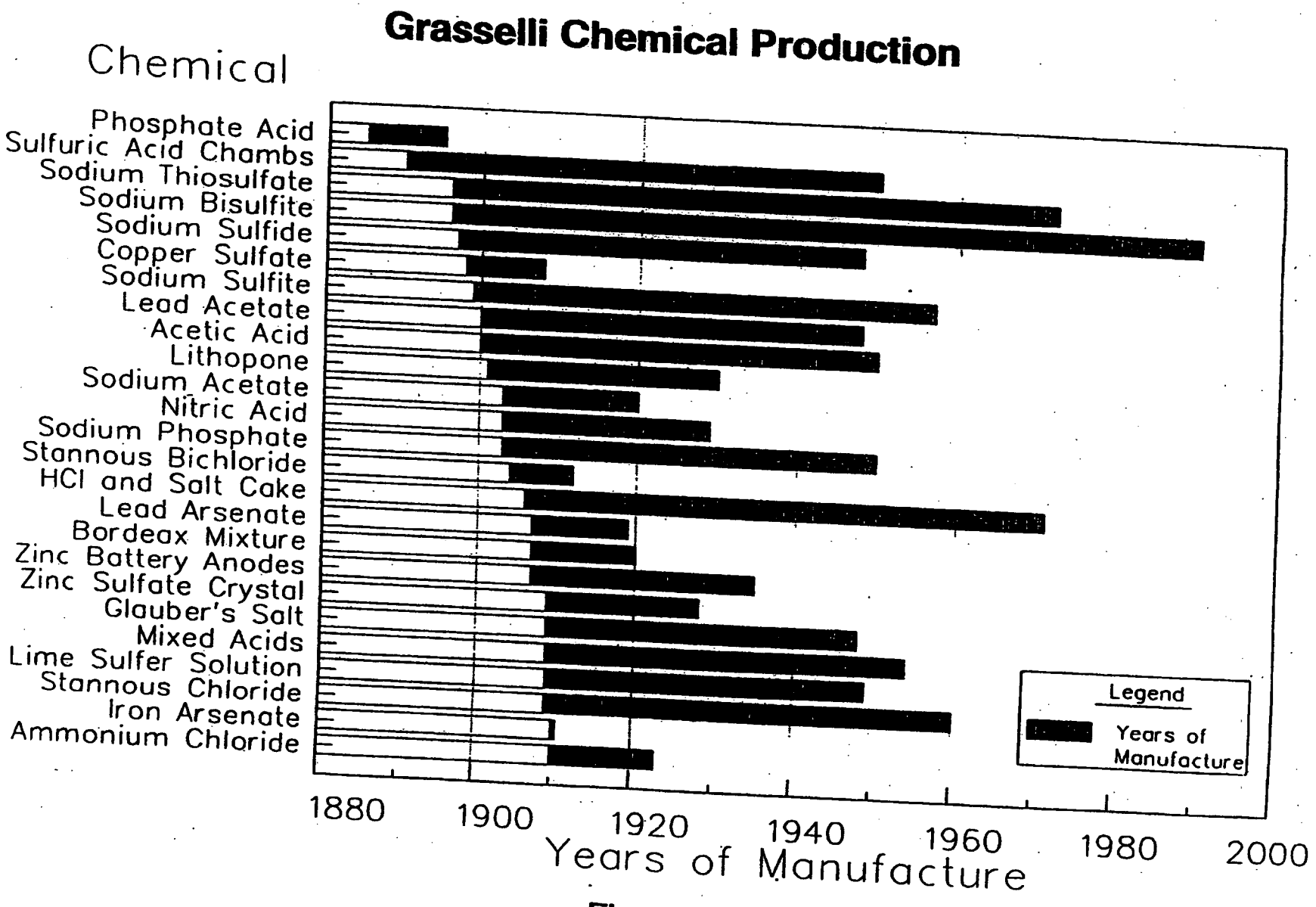

Grasselli Chemical Production
Chemical
Phosphate Acid
Sulfuric Acid Chambs
Sodium Thiosulfate
Sodium Bisulfite
Sodium Sulfide
Copper Sulfate
Sodium Sulfite
Lead Acetate
Acetic Acid
Lithopone
Sodium Acetate
Nitric Acid
Sodium Phosphate
Stannous Bichloride
HCl and Salt Cake
Lead Arsenate
Bordeax Mixture
Zinc Battery Anodes
Zinc Sulfate Crystal
Glauber's Salt
Mixed Acids
Lime Sulfer Solution
Stannous Chloride
Iron Arsenate
Ammonium Chloride
Legend
Years of Manufacture
1880
1900
1920
1940
1960
1980
2000
Years of Manufacture

Figure 9

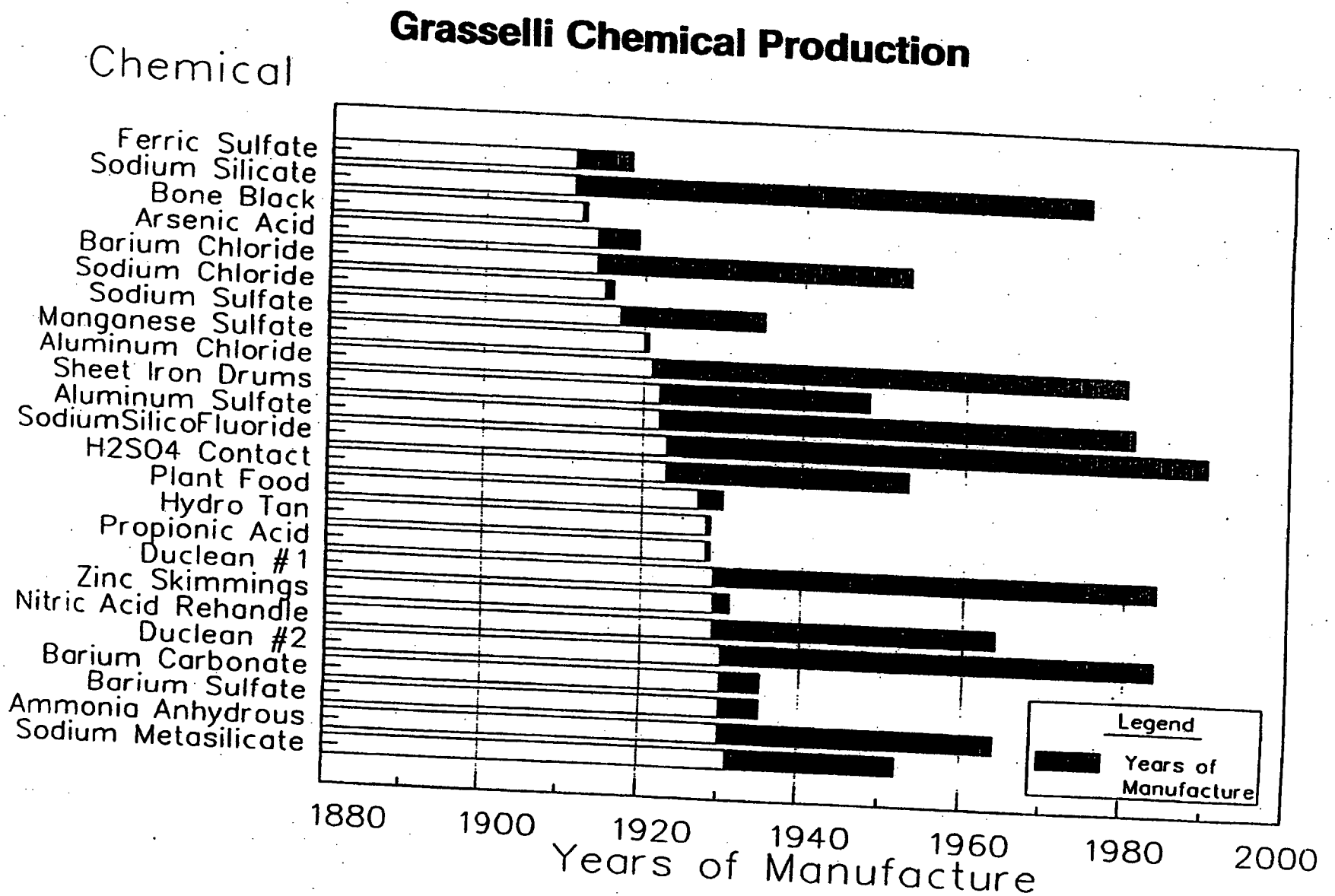


Figure 9 (continued)

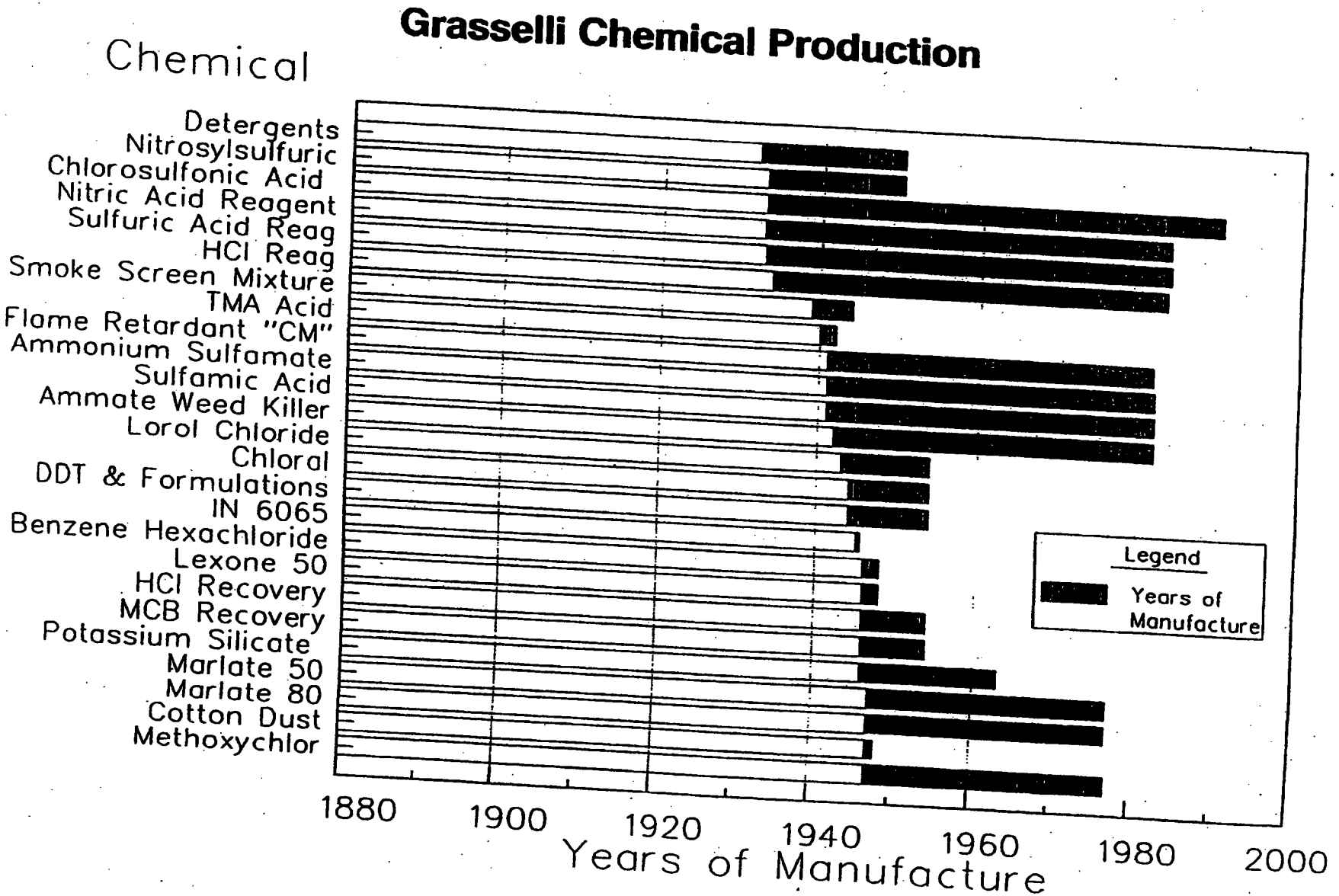
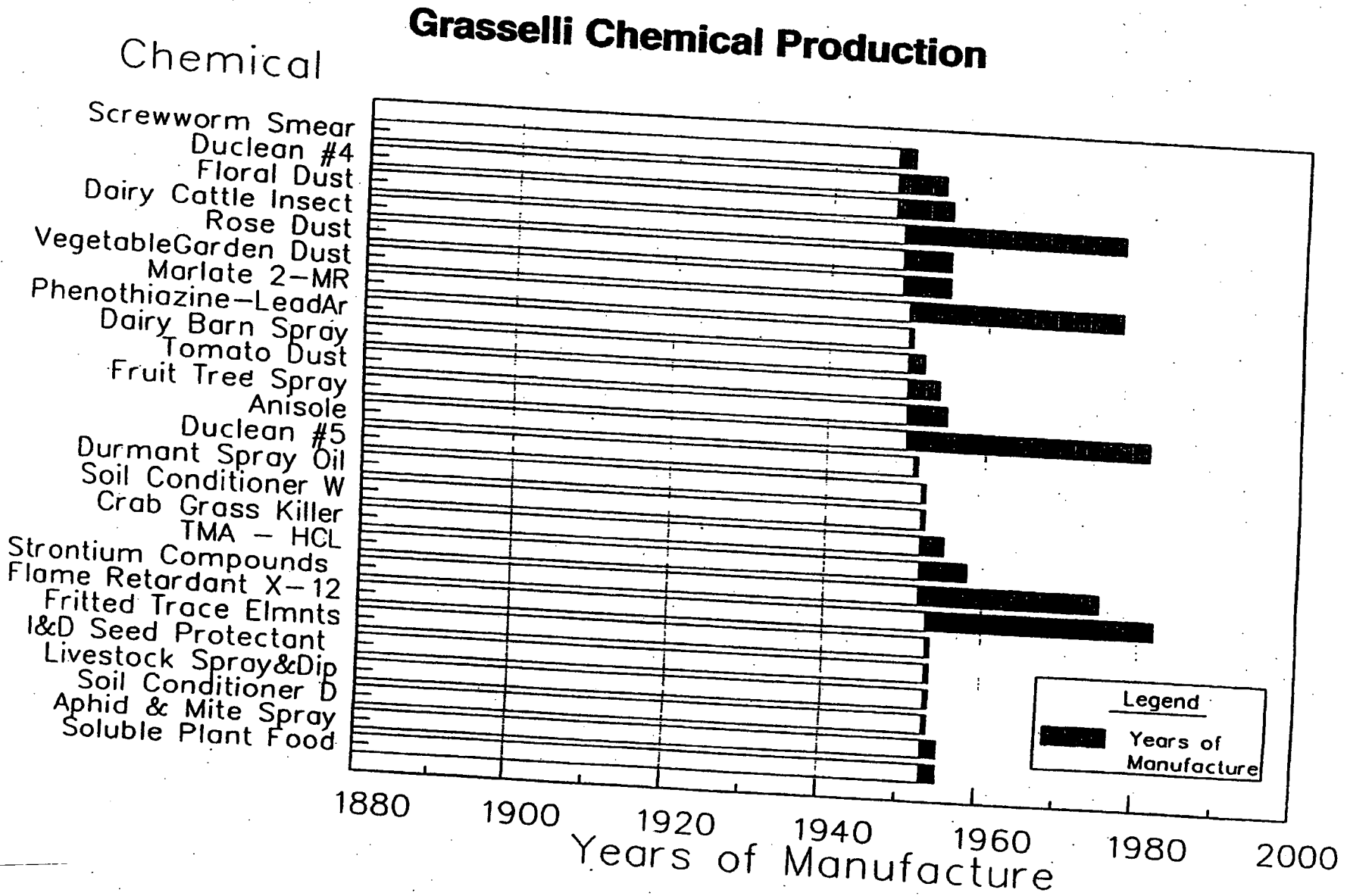


Figure 9 (continued)



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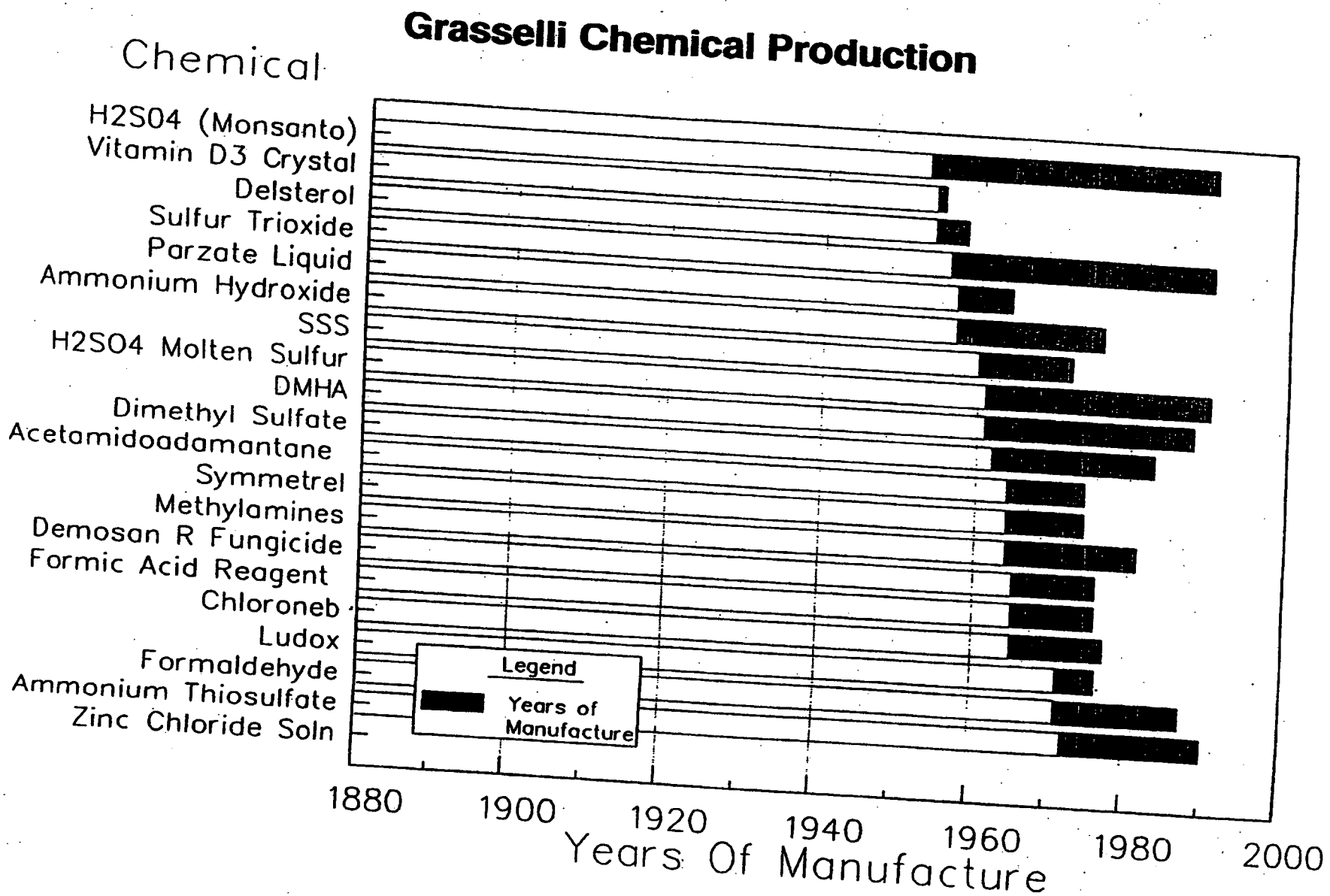

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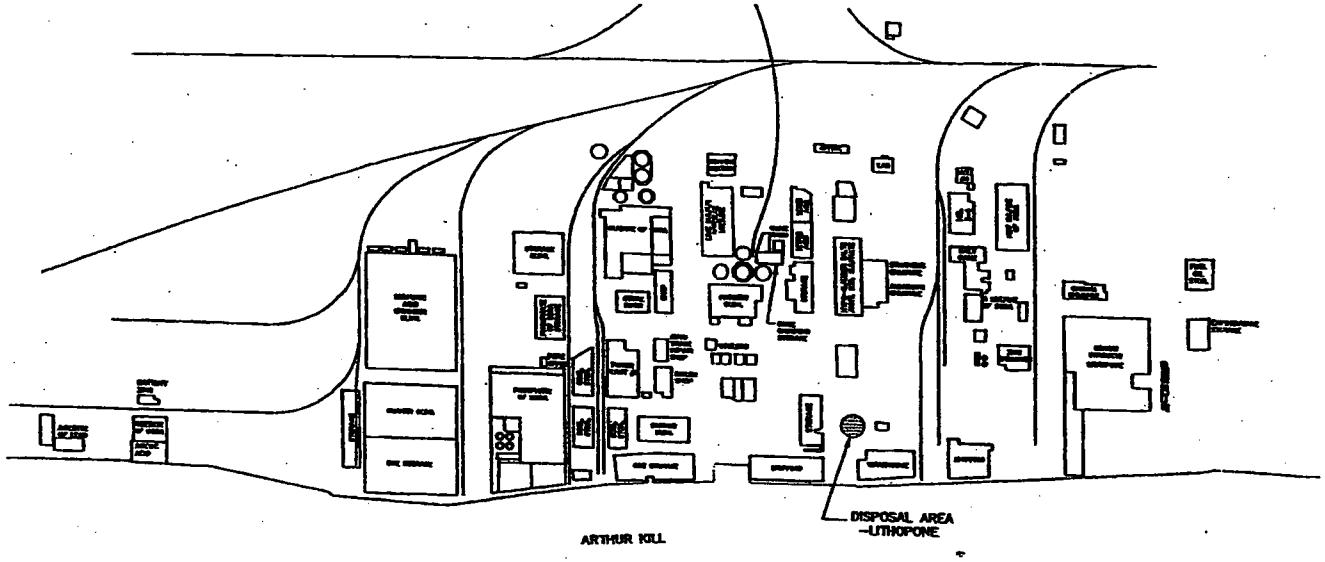
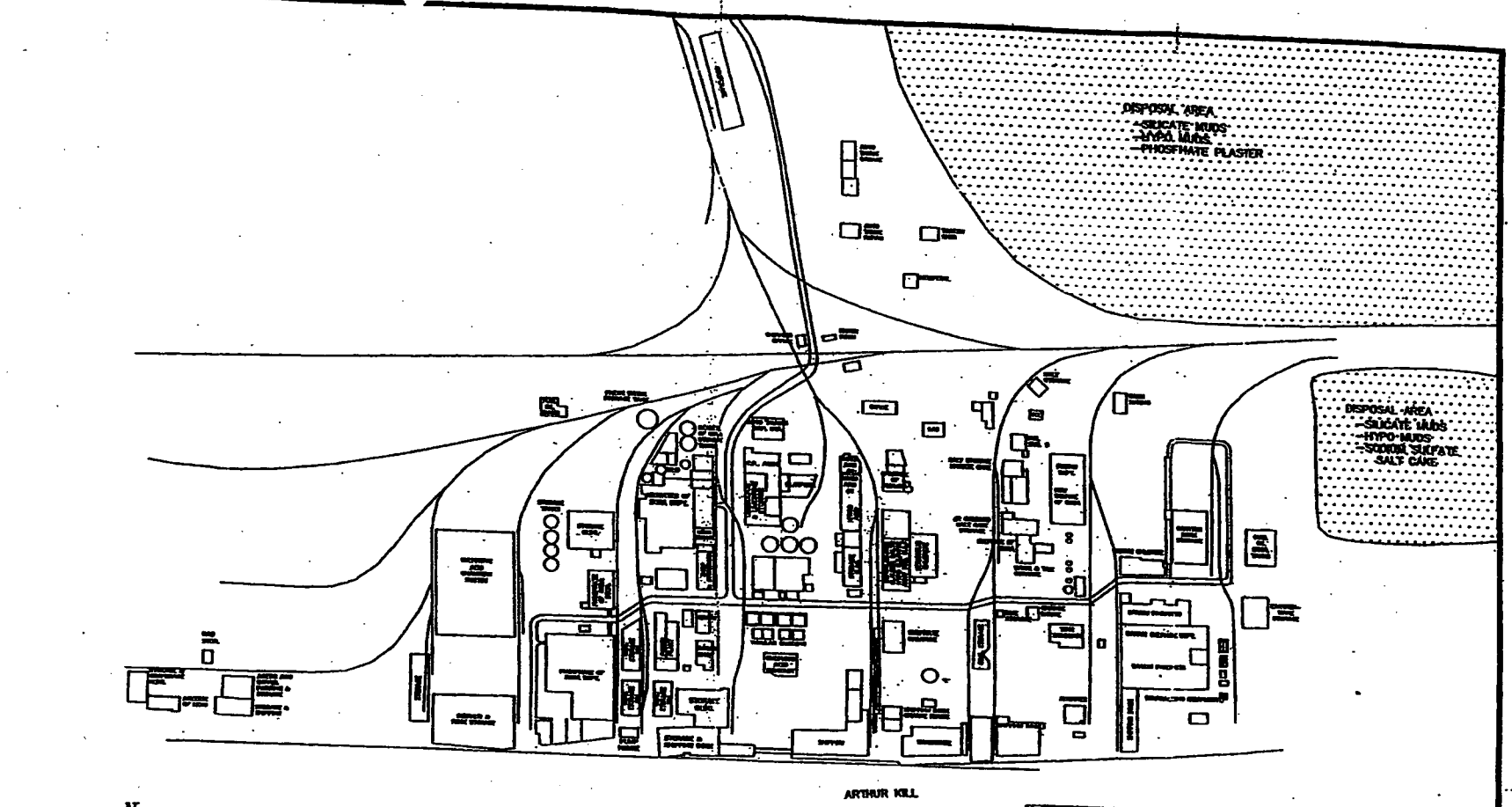


SITE MAP 1919
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 10

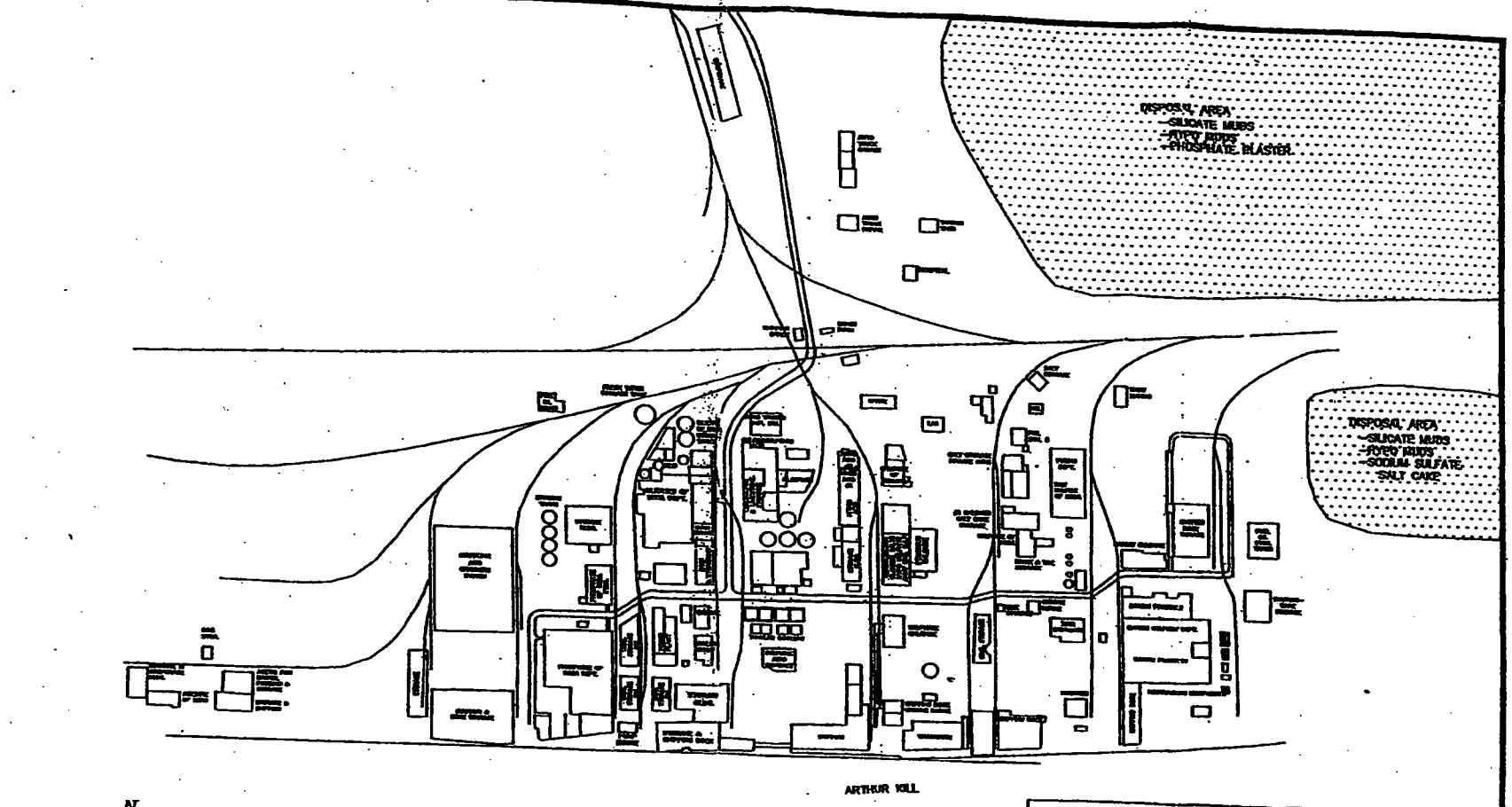
Du Pont Environmental Remediation Services



SITE MAP 1930
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 11

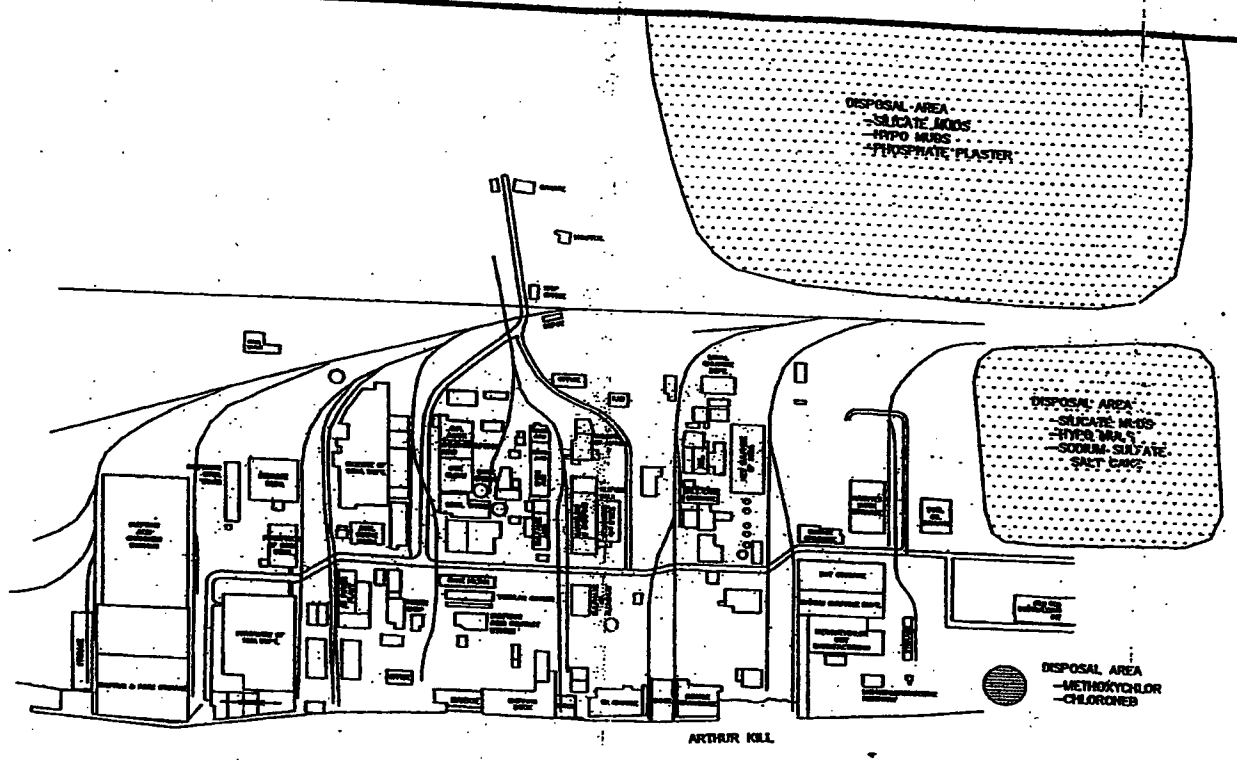
Du Pont Environmental Remediation Services



SITE MAP 1940
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 12

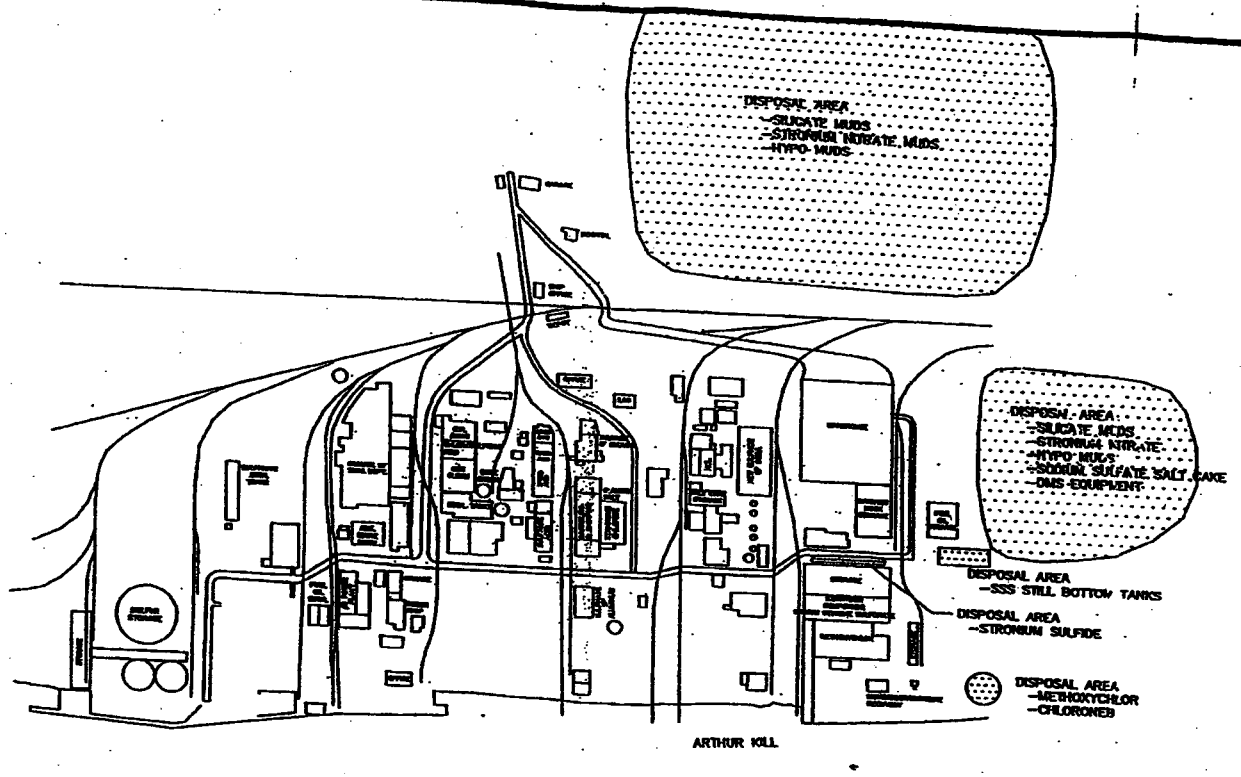
Du Pont Environmental Remediation Services



SITE MAP 1950
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 13

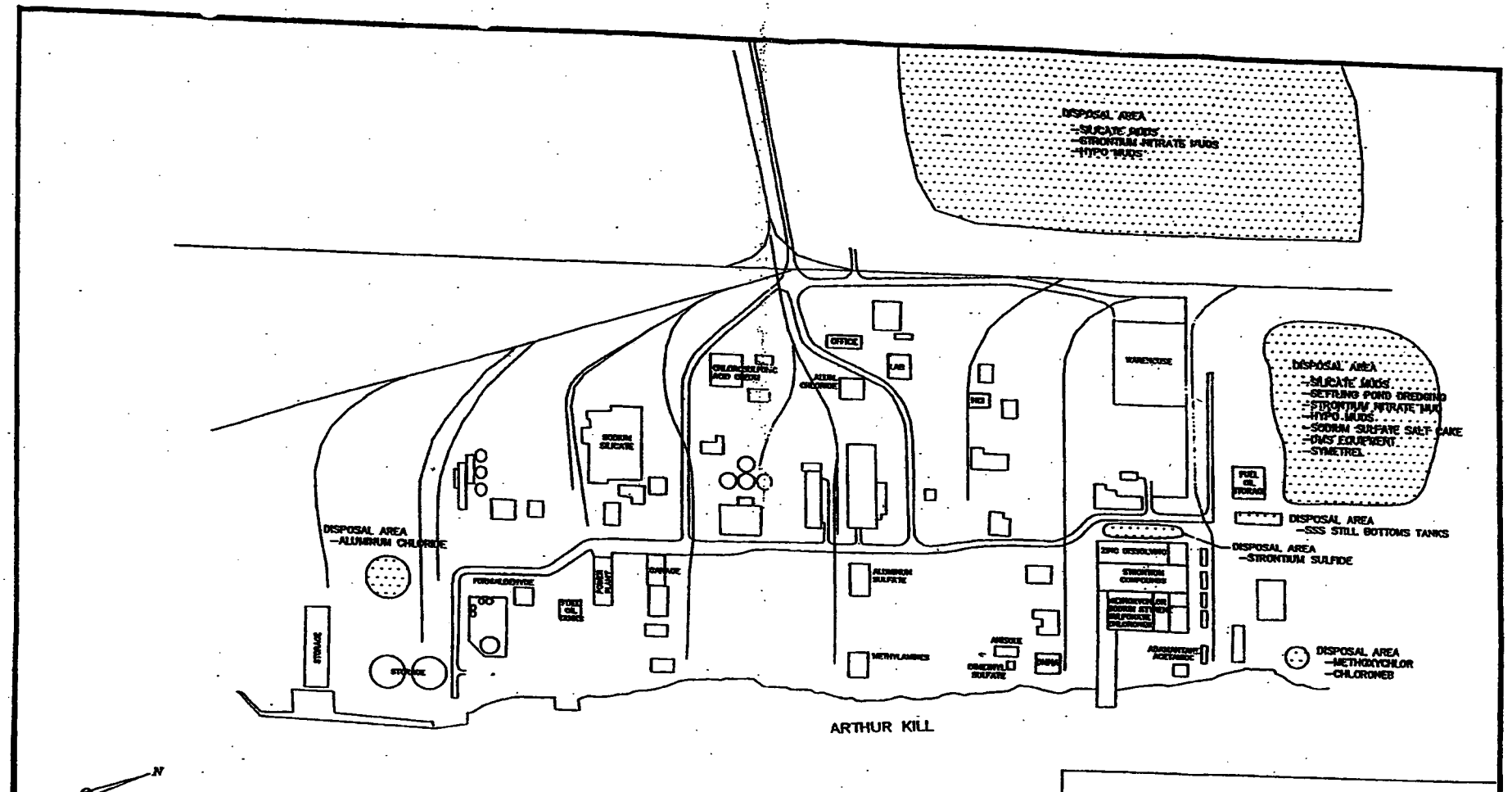
Du Pont Environmental Remediation Services



SITE MAP 1961
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 14

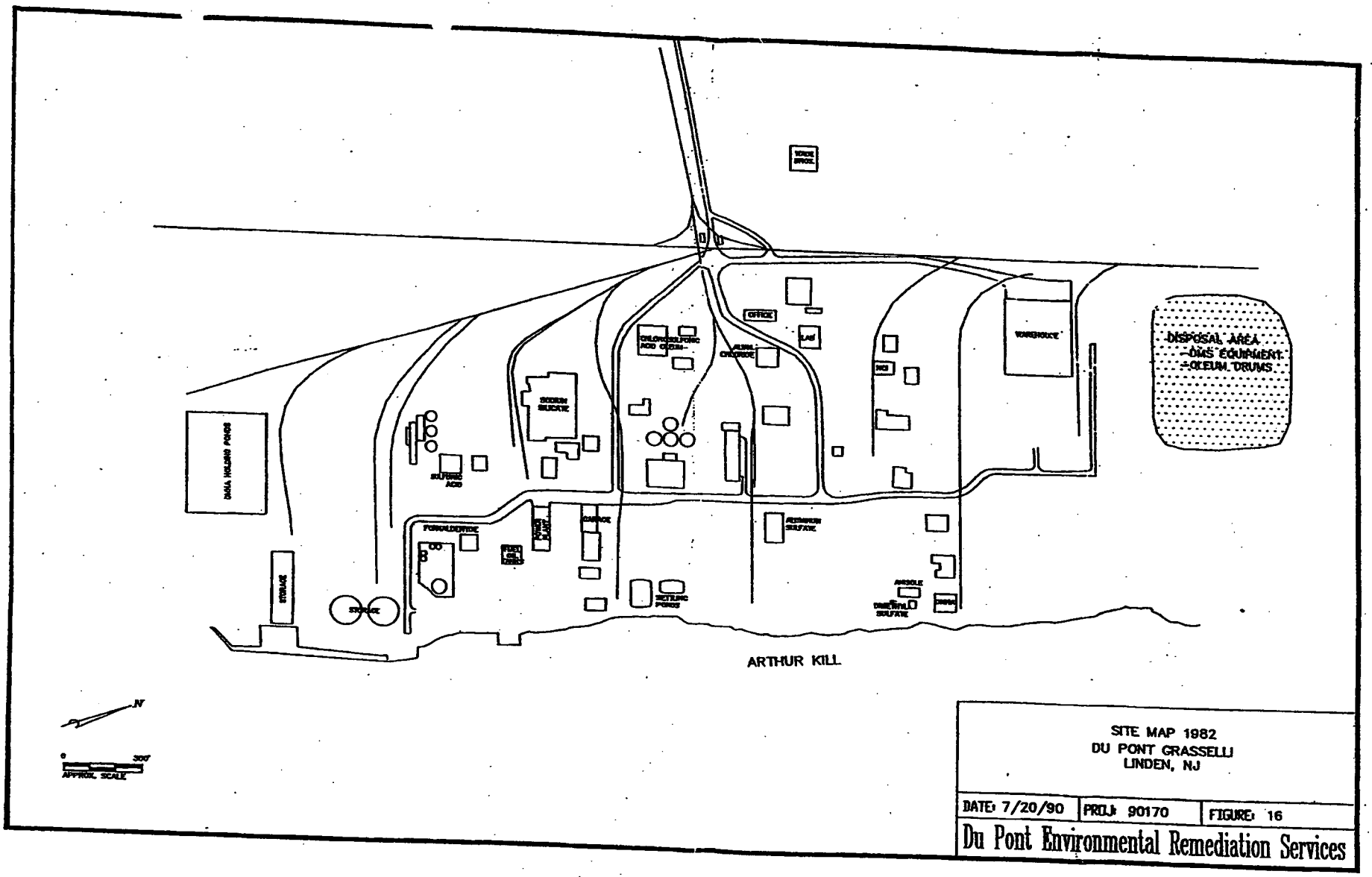
Du Pont Environmental Remediation Services



SITE MAP 1971
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 15

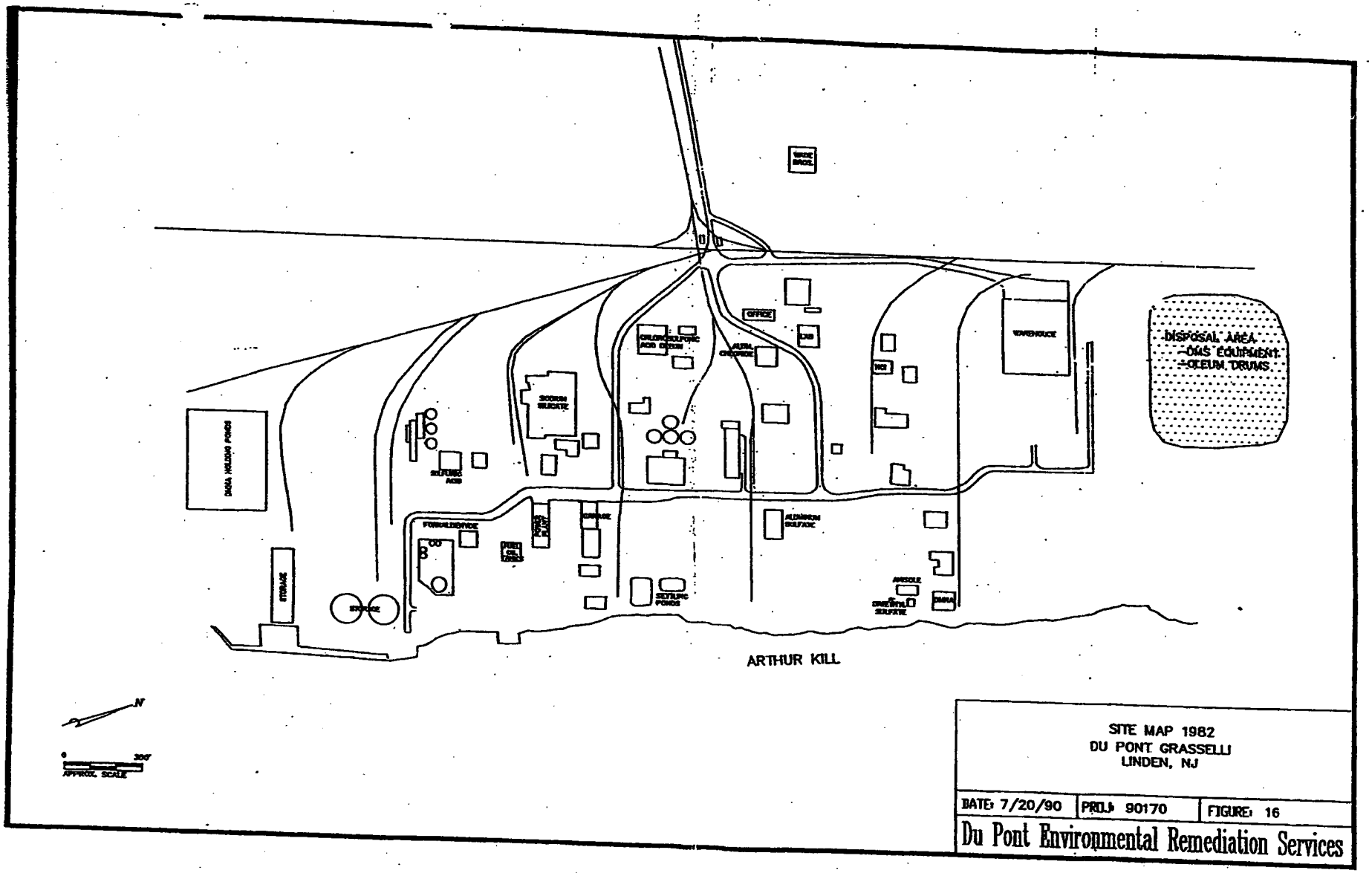
Du Pont Environmental Remediation Services



SITE MAP 1982
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 16

Du Pont Environmental Remediation Services



SITE MAP 1982
DU PONT GRASSELLI
LINDEN, NJ

DATE: 7/20/90	PROJ: 90170	FIGURE: 16

Du Pont Environmental Remediation Services

Manufacturing Processes

Several new chemicals were introduced during this decade. These chemicals were: sulfuric acid (1890 by the chambers process), sodium thiosulfate (1896), sodium bisulite solution (1896), sodium sulfide (1897), blue vitriol - also known as copper sulfate (1890), and sodium sulfite crystals (1899). The process for manufacturing phosphate acid was discontinued in 1895.

Waste Disposal Practices

No information on waste disposal practices is available for this time period.

3.3 1900-1909

Construction Activities

Construction that occurred on the site during 1900 to 1909 included the following:

- Power Plant Number 2 was built in 1906;
- Number 1 and 2 Hand Systems for the manufacture of hydrochloric acid and salt cake were constructed before 1906. Mechanical Systems Numbers 3 and 4 were constructed in 1906;
- Sulfuric acid Chamber System Number 3 was constructed in 1905;
- Construction on the sulfuric acid contact Q-"Verein" was started in 1905.

Manufacturing Process

This period showed rapid growth in the types of chemicals produced. New introductions during this decade were: lead acetate (1900), acetic acid (1900), lithopone (1901), sodium acetate (1903), nitric acid (1903), sodium phosphate (1903), stannous bichloride (1904), hydrochloric acid and salt cake (before 1906), lead arsenate (1907), bordeaux mixture (1907), zinc battery anodes (1907), zinc sulfate crystals (before 1909), Glauber's salt (before 1909), mixed acids (before 1909), lime sulfur solution (1909), and stannous chloride (1909). The manufacture of blue vitriol was discontinued in 1908.

3.5 1920-1929

Construction Activities

Construction activities for 1920-1929 included the following:

- In 1925, the concrete road that connects the plant to the main highway was constructed;
- In 1926, a brick office building was constructed;
- In 1927, sulfuric acid Chamber Systems Numbers 3 and 4 were converted to ammonia oxidation. In 1929, Chamber Systems Numbers 5, 6, and 7 were converted to ammonia oxidation;
- In 1923, sulfuric acid Contact Systems Numbers 1 and 2 were constructed. The Glenns Falls rotary burner for these systems was installed in 1927. Contact System Number 3 was constructed in 1926 and Contact System Number 4 was constructed in 1927.

Manufacturing Processes

The 1920s saw the introduction of the following chemicals: manganese sulfate (1920), aluminum chloride solution (1921), aluminum sulfate (1922), sodium silico fluoride (1923), sulfuric acid (1923 by the contact system process), aluminum chloride crystal (1923), plant food (1927), hydro tan (1923), propionic acid (1928), Duclean #1 (1929), and zinc skimmings (1929). In addition, nitric acid was purchased in bulk and repackaged (1929), and iron drums (1922) were manufactured.

Chemicals no longer produced were: sodium acetate (1920), nitric acid (1929), bordeaux mixture (1920), zinc sulfate crystals (1928), ammonium chloride (1923), manganese sulfate (1920), hydro tan (1928), and propionic acid (1928).

Waste Disposal Practices

Information, on the disposal of waste materials at the plant, is not available for the time period before Du Pont took over operations in 1928.

As of 1928, phosphate plaster ($CaSO_4$ with 2-3% phosphate residual), silicate mud (sand, filter aid, and minor quantities of sodium silicate), Hypo mud (diatomaceous earth, sulfur, carbon, and rust particles), and sodium sulfate salt cake were disposed of by pumping

Waste Disposal Practices

No new wastes were being disposed of during the 1930s. The same materials were still being pumped into the marsh as in the 1920s.

3.7 1940-1949

Construction Activities

Construction activities for 1940 to 1949 included the following:

- The C & R Office Building was constructed in 1948;
- Sodium silicate Furnace Number 1 was dismantled in 1940. Furnaces Numbers 2 and 3 were rebuilt in 1945;
- In 1940, Sulfuric acid Contact Systems Numbers 3 and 4 had three tube stills installed to the SO_3 conversion pan. In 1941, a fourth tube still was installed. Chambers Systems Numbers 5 and 6 were rearranged in series in 1945.

Manufacturing Processes

The 1940s saw the introduction of many new chemicals, as well as the discontinuance of many others. Those chemicals introduced were: TMA acid (1940), flame retardant "CM" (1941), ammonium sulfamate (1941), sulfamic acid (1941), ammate weed killer (1942), lorol chloride (1943), chloral (1944), DDT and its formulations (1944), IN 6065 (1945), benzene hexachloride (1946), lexone 50 (1946), marlate 50 (1947), marlate 80 (1947), cotton dust (1947), methoxychlor and its formulations (1947), screwworm smear (1948), Duclean #4 (1948), floral dust (1948), dairy cattle insecticide (1949), rose dust (1949), and vegetable garden dust (1949). In addition, processes for the recovery of hydrogen chloride and chlorobenzene were started (1946). Potassium silicate was repackaged (1946).

Chemicals no longer in production were: sodium sulfide (1948), lead acetate (1948), Glauber's Salt (1948), lime sulfur solution (1949), smoke screen mixture (1944), TMA acid (1942), IN 6065 (1945), benzene hexachloride (1948), lexone 50 (1948), and cotton dust (1948). Also, iron drums were no longer manufactured (1948).

Waste Disposal Practices

During this time, a small pond was constructed in the northern portion of the plant for the disposal of aqueous wastes from the production of chloroneb and methoxychlor. The pond lining was not impervious. These wastes were pumped into the pond and allowed to evaporate and seep into the ground.

Pumping into the marsh continued.

3.8 1950-1959

Construction Activities

Construction activities for 1950 to 1959 include the following:

- The warehouse was constructed in 1952;
- The power plant was rearranged and modernized in 1958. After the power plant was rearranged, Power Plant Number 3 was discontinued;
- In 1950, the process for manufacturing ammate weed killer was converted from a batch operation to continuous operation;
- In 1958, hydrochloric acid mechanical system number 6 was constructed;
- Sodium silicate Furnace Number 2 was rebuilt in 1955. Furnace Number 3 was rebuilt in 1957;
- In 1950, sulfamic acid crude facilities were expanded and the technical grade acid manufacturing process was converted from batch to continuous;
- In 1953, the process of manufacturing sulfuric acid was changed to the Monsanto process. Operating contact systems were discontinued.

Manufacturing Processes

The 1950s was another decade of expansion. New chemicals manufactured were: Marlate 2-MR (1950), phenothiazine-lead arsenate mixture (1950), dairy barn spray (1950), tomato dust (1950), fruit tree spray (1950), anisole (1950), Duclean #5 (1951), dormant spray oil (1952), soil conditioner W (1952), crab grass killer (1952), Trimethylamine-HCl (1952), strontium compounds (1952), flame retardant X-12 (1953), fritted trace elements (1953), I&D seed protectant (1953), livestock spray and dip (1953), soil conditioner D (1953), aphid and mite spray (1953), soluble plant food (1953), sulfuric acid (1953 by the Monsanto process), vitamin D3 crystal in oil (1954), delsterol (1954), stabilized sulfur trioxide (1956), parazate liquid (1957), and reagent grade ammonium hydroxide (1957).

Chemicals that were no longer produced were: sulfuric acid (chambers and contact systems 1953), sodium sulfite crystals (1957), sodium phosphate (1950), mixed acids (1954), barium chloride (1953), acetic acid (1950), sodium metasilicate (1952), detergents (1950), nitrosylsulfuric acid (1950), lorol chloride (1954), chloral (1954), DDT (1954), screwworm smear (1950), Duclean #4 (1954), floral dust (1955), rose dust (1955), vegetable garden dust (1955), phenothiazine-lead arsenate mixture (1950), dairy barn spray (1952), tomato dust (1954), fruit tree spray (1955), Duclean #5 (1951), dormant spray oil (1952), soil conditioner W (1952), crab grass killer (1955), Trimethylamine-HCl (1958), fritted trace elements (1953), I&D seed protectant (1953), livestock spray and dip (1953), soil conditioner D (1953), aphid and mite spray (1955), soluble plant food (1955), vitamin D3 crystals in oil (1955), and delsterol (1958).

Waste Disposal Practices

In the 1950s, strontium sulfide and strontium nitrate mud (coal, coal ash, and celestite residues), were also pumped into the marsh along with the other materials. The pumping of phosphate plaster was discontinued in 1950.

3.9 1960-1969

Construction Activities

Construction activities for 1960 to 1969 included the following:

- The Power Plant Number 41 boiler was put out of service in 1960. In 1961, the old Power Plant Number 3 was converted into shops and a truck garage. The old truck garage was then discontinued;
- The laboratory offices were modernized in 1965;
- The contact stack was extended in 1968 as a pollution abatement method. The organic waste disposal facility incinerator was constructed in 1968. This incinerator was not in operation at this time, due to the cost of fuels;
- In 1969, Change House Number 5 was modernized;
- Sodium styrene sulfonate manufacturing capacities were increased in 1963, 1964 and 1969;
- DMHA capacities were increased in 1962, 1966, and 1967; SO_3 manufacturing was expanded in 1965;
- In 1961, the facilities for manufacturing sulfuric acid from molten sulfur were installed.

Manufacturing Processes

The 1960s saw the introduction of: sodium styrene sulfonate (1960 [illegible]), dimethylhydroxyamine (1961 DMHA), sulfuric acid (1961 by the molten sulfur process), dimethyl sulfate (1962 DMS), acetamidoadamantane (1964), symmetrel (1964), solution [illegible] methylamines (1964), demosan R fungicide (1965), reagent grade formic acid (1965 repackaged only), and chloroneb (1965).

The following chemicals were discontinued: stannous chloride (1960), aluminum chloride crystals (1967), the repackaging of nitric acid (1964), anhydrous ammonia (1964), the repackaging of potassium silicate (1963), and parazate liquid (1964).

Waste Disposal Practices

During the 1960s several new wastes were handled. $AlCl_3$ and hydrochloric acid wastes were discharged into a diked area in the southern portion of the plant in 1964. Approximately 8000 gallons of this waste were disposed of in this manner. Also, symmetrel (which had degraded) was disposed of by dumping it onto the ground in the northern portion of the plant.

The DMHA process generated aqueous wastes. These wastes were stored in three hypalon lined ponds which were constructed along the southern boundary of the plant. After a sufficient volume of waste had accumulated in the ponds, the waste was loaded into barges and disposed of at sea. This procedure was conducted under a permit from the Army Corps of Engineers and subsequently, the U. S. Environmental Protection Agency. Aqueous waste from anisole manufacturing was also disposed of along with the DMHA waste. A small amount of aqueous waste from SSS and AAA manufacturing may have been disposed of with the DMHA waste.

The process of manufacturing DMS generated piping and wood scaffolding that became contaminated with the chemical. These pieces of equipment were decontaminated with a weak ammonium hydroxide solution and were buried in the northern portion of the plant. This practice was started in the early 1960s and continued until 1983.

Part of the process of manufacturing SSS was a distillation step. This distillation generated an amount of still bottoms. These consisted of polystyrene, bromoethylbenzene, and tars. Three tanks of this material were buried in the northern portion of the plant between 1960 and 1971.

Prior to 1960, sulfur used in the manufacture of sulfuric acid was stored in a large pile. Due to process changes, solid sulfur was no longer required for the sulfuric acid process. Therefore, the practice of storing sulfur on the ground was discontinued. The aqueous wastes were still being disposed of in the marsh.

3.10 1970-1979

Construction Activities

The northern area office building was constructed in 1970. The incinerator, which had never been operated, was also dismantled in 1970.

Manufacturing Processes

Chemicals introduced in the 1970s were: Ludox (1971), formaldehyde (1971), and ammonium thiosulfate (1972).

Chemicals that were no longer produced were: sodium thiosulfate (1972), hydrochloric acid and salt cake (1971), sodium silicate (1975), marlate 50 (1977), marlate 80 (1977), methoxychlor (1977), dairy cattle insecticide (1977), marlate 2-MR (1977), strontium compounds (1975), ammonium hydroxide reagent (1976), sodium styrene sulfonate (1972), acetamidoadamantane (1974), symmetrel (1974), Demosan R fungicide (1977), formic acid reagent (1977), chloroneb (1977), and Ludox (1976).

Waste Disposal Practices

During the 1970s, all of the aqueous wastes that were being pumped into the marsh were stopped (the sodium sulfate salt cake in 1971, the hypo mud in 1972, the strontium nitrate mud in 1975, the silicate mud in 1975, and the strontium sulfides in 1975).

The discharge of chloroneb and methoxychlor wastes were stopped in 1977. The ponds were dismantled and deinventoried by Rollins Environmental in 1978.

In 1970, the dredgings from the settling ponds of outfall 008 were removed from the pond and placed on the ground with no dikes to contain runoff. This practice was continued throughout the 1970s, until 1980.

In 1978, drums of oleum (SO_3), which had frozen, needed to be disposed of. This was accomplished by placing the drums in a hole, puncturing the drums, and then covering them with limestone.

In 1978, the tanks containing the SSS still bottoms were excavated and cleaned by Rollins Environmental. All of the contents of the tanks were removed by Rollins.

Aqueous waste from the formaldehyde manufacturing process was removed for off-site disposal by Rollins-Purle. Rollins-Purle took the waste to Logan Township, New Jersey, for bio-degradation. Rollins-Purle also removed adamantane isomerizer waste for chemical treatment and incineration at their Logan Township facility.

Hexane/methanol filtrate from the AAA process was incinerated in Bayonne, New Jersey, by Criterion Tank Cleaning. Criterion Tank Cleaning also removed material from the organic area waste pond, Ludox filter aid slurry and off quality product, and sodium silicate filter mud slurry for disposal in a sanitary landfill in Edison, New Jersey.

Also disposed of in the sanitary landfill in Edison, New Jersey, by Elizabeth Disposal, were aluminum chloride and aluminum oxide, Ludox polishing filter mud, and any trash generated at the plant.

3.11 1980-1989

Construction Activities

No new facilities were constructed during the 1980s. Several processes were dismantled during this period.

Manufacturing Processes

The 1980s saw the decline of chemical production at Grasselli. No new chemicals were introduced.

Aluminum chloride solution (1980), aluminum sulfate (1981), Duclean #1 (1984), Duclean #2 (1984), sulfuric acid reagent (1984), Nitric acid reagent (1984), hydrochloric acid reagent (1984), flame retardant "CM" (1982), ammonium sulfamate (1982), sulfamic acid (1982), ammate weed killer (1982), anisole (1981), flame retardant X-12 (1982), solutions of methylamines (1981), DMHA (1987), and formaldehyde (1989) were no longer produced.

Waste Disposal Practices

In 1983, decontaminated piping and scaffolding from the DMS process were no longer buried in the ground. In 1987, the DMHA process was discontinued; therefore, the DMHA wastes were no longer barged to the sea.

3.12 1990-Present

Construction Activities

No new construction is planned for 1990. The DMHA manufacturing area is being dismantled. Additional buildings are also being dismantled.

Manufacturing Processes

No new chemicals are scheduled for the Grasselli plant at this time. The only chemicals that are being produced are sulfuric acid, ammonium thiosulfate and sodium bisulfite solution. Chlorosulfonic acid was discontinued during 1990.

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Waste Disposal Practices

All wastes generated at the plant are disposed of by licensed disposal facilities. In March of 1990, some buried drums were discovered. These drums were removed by Chem Waste Management. No hydrocarbons or hazardous materials were found associated with these drums. The date that these drums were buried is unknown.

4.0 REFERENCES

4.1 References for Environmental Setting

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4.2 References for Plant History

Letter, H. W. McDowell to C. C. Quarles, I & E Dept., Wilmington, Attn: R. C. Ott, dated 11/5/71.

- Plant map noting past and present production and disposal areas.
- Listing of all products with dates of manufacture.

Letter, H. W. McDowell to M. R. Blankenship, CD & P, Wilmington, dated 9/22/78.

- Inactive on-plant land disposal sites.

Listing titled "Industrial and Biochemical Department, Grasselli Plant," Rev. 3/69.

- Listing of historic plant dates and products manufactured.

Letter, H. W. McDowell to R. C. Ott, Industrial Chemicals Department, Wilmington, dated 4/27/72.

- Summary of current waste disposal practices, both on and off site.

Letter, H. W. McDowell to M. R. Blankenship, ICD, Wilmington, dated 5/6/75.

- Revised on-site chemical waste disposal sites, update of 11/5/71 letter.

Du Pont Hall of Records.

Du Pont Engineering Drawing Files

Grasselli Plant Files