

PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Appendix 14
Hay Street Sludge Drying
WILMINGTON, DELAWARE

SIRB ID: DE-0024

GENERAL SITE INFORMATION

Site Name: Hay Street Sludge Drying

SIRB ID Number: DE-0024

Site Location and Description: DuPont owns approximately 108 acres of property on Cherry Island in Wilmington, Delaware. In 2001, DuPont agreed to enter into a Voluntary Cleanup Program (VCP) with Delaware's Department of Natural Resources and Environmental Control (DNREC) – Site Investigation and Restoration Branch (SIRB). Only a 22-acre portion of the property was actually entered into the agreement due to the organic compounds that were identified within the iron-rich material. The property is bounded by Shellpot Creek to the north, on the east by the Delaware River, on the south by the 12th Street extension, and on the west by Hay Road.

Previous Site Uses: The Hay Street Sludge Drying site actually received its name during the time that the City of Wilmington utilized the site as sludge drying beds for its waste water treatment solids. From 1997 to 2001, Iron Rich Material was staged on site by DuPont from their Edgemoor White Pigments Plant. This material was sold as a soil substitute for fill for a period of time. When DuPont learned that this material contained some organic compounds at significant quantities they ceased selling the material and entered the site into a VCP with DNREC-SIRB.

Site Regulatory Status: This section briefly summarizes previous investigations performed on the site through the SIRB program. A current SIRB regulatory status is also included.

A number of investigations have been conducted at the Hay Street Sludge Drying Site since 1977. Table 1 lists a chronology of investigations, reports, remedial actions, and regulatory actions.

Chronology of Investigations and Regulatory Actions

Investigation or Regulatory Action	Dates
Geotechnical Investigation Proposed Cherry Island Landfill (Woodward-Clyde Consultants)	August 1977
Supplemental Geotechnical Investigation Proposed Cherry Island Landfill Expansion (Woodward-Clyde Consultants)	June 1979
Geotechnical Investigation Proposed Cell No. 4 Cherry Island Landfill (Woodward-Clyde Consultants)	April 1990
Report of Geotechnical Investigation Cherry Island Landfill Closure (DuPont Engineering 1992)	November 1992
Phase II Investigation at DuPont Cherry Island Landfill (AGS)	July 1997
Proposal for Remedial Action and Transmittal of Pre-design Investigation Results DuPont Cherry Island Landfill (URS Diamond Group)	June 2000
Scope of Work for Remediation of Iron Rich Staging Area DuPont Cherry Island Site (DuPont Engineering)	July 2001
Staging Pile Material Exposure and Risk Evaluation DuPont Cherry Island Facility (ENVIRON International Corporation)	September 2001
2002 Annual Hydrogeological Report Cherry Island Landfill (URS Diamond Group)	January 2003
Final Remedial Investigation/Risk Assessment Report Cherry Island Landfill - Iron Rich Staging Area/Hay Street Sludge Drying Site (DuPont Engineering)	May 2004
Remedial Investigation and Risk Assessment Report Addendum Hay Street Sludge Drying Site (DuPont/URS Diamond CRG)	December 2008
Final Plan of Remedial Action for DuPont Hay Road Sludge Drying "Iron Rich" Site (DNREC-SIRB)	January 2009

Current Regulatory Status:

The Final Plan of Remedial Action for the DuPont Hay Road Sludge Drying “Iron Rich” Site was issued in January 2009. This plan outlined the following objectives to be met by the site owners:

- Construct a capping system over the Iron Rich Material consisting of a multilayer geosynthetic liner system pursuant to a DNREC approved remedial design plan.
- Place an Environmental Covenant (EC) consistent with the Delaware’s Uniform Environmental Covenants Act (UECA) (Title 7, Del. Code Chapter 79, Subtitle II) that will a) prohibit current and future residential or unrestricted use of the property; b) prohibit any digging, drilling, excavating, grading, constructing, earth moving, or any other land disturbing activities on the property without the prior written approval of DNREC; and c) prohibit the installation of any water wells on, or use of groundwater at, the site without the prior written approval of DNREC.
- Develop a DNREC-approved Operation and Maintenance (O&M) Plan to maintain the cap to prevent exposure to site soil contamination and monitoring of on-site wells to evaluate the groundwater contamination. Additional remedial actions may be required based on the results of the on-site monitoring program and the area-wide groundwater investigation.
- Develop and implement a broader area-wide groundwater monitoring program to allow increased evaluation of the hydrogeology and chemistry of the underlying dredge material and groundwater to determine the potential impact to the surrounding environment, including Shellpot Creek. The site-related contaminants present in the Shellpot Creek along with the contaminants from other sources will be addressed through the Shellpot Creek initiative, Delaware Estuary Program and DNREC’s Natural Resource Damage Assessment.

SUMMARY OF SITE PCB INFORMATION

Site Investigation PCB Findings:

Total PCBs were detected in both the “Iron Rich” material and dredge material at relatively low concentrations. PCB congener analysis was utilized to investigate the concentrations of PCBs in the material more precisely. This analysis demonstrated that the “Iron Rich” material contained primarily PCB-209 by weight. The concentrations reported in the “Iron Rich” material are not included in this assessment due to the physical state that the material is currently under. When BrightFields began their assessment of the site, extensive interim remedial actions had been completed to contain the “Iron Rich” material to its location and prevent any further migration of the material to the environment. DuPont completed this by encapsulating the stockpile with a posi-shell (cementitious) layer that is virtually impervious. This material is impermeable; however, minimal infiltrations and runoff occurs when the material cracks or bared areas exist. The resulting assessment concluded that this material was no longer contributing to mass loading via overland runoff or air movement migration (wind erosion). Due to the posi-shell layer there is no longer any leaching of the PCBs to the groundwater table because no significant amount of water is infiltrating the stockpile.

BrightFields did evaluate the dredge material surrounding the stockpile for total PCBs and discovered that this material does not contain PCBs above the reported detection limits of the analysis. BrightFields also evaluated the current state of the groundwater beneath the site to determine the historical impacts the site has had on the groundwater. Multiple groundwater sampling events have taken place at the Hay Street Sludge Drying site and in 2007 DuPont installed an additional three wells around the perimeter of the stockpile. Groundwater concentrations of total PCBs ranged from non-detect to 0.006 µg/L.

Concentrations of PCBs on Site		
Sample Matrix	Analytical Methods	Range of Total PCBs
Surface Soil outside of Iron Rich Material	Method 8082	Not detected
Iron Rich Material	Congener Analysis	Not detected to 1.63 mg/kg
Dredge Material under Iron Rich stockpile	Congener Analysis	Not detected to 1.22 mg/kg

Groundwater	Congener Analysis	Not detected to 0.006 µg/L
-------------	-------------------	----------------------------

Summaries of all samples used for this assessment can be found in the historical data tables attached to this appendix.

Acreage where PCBs detected:

The estimated area associated with the “Iron Rich” material is 15.2 acres. The remaining material onsite is associated with historic dredged material, with a layer “clean fill” on top. There have been numerous detections of PCBs within the “Iron Rich” material, but due to the capping system implemented by DuPont there are no longer any PCBs contributing to the external environment through overland flow. However the groundwater has been evaluated on the basis that it has already been impacted and continuing to impact the nearby surface water bodies.

PCB Remediation Status:

In 2001, DuPont discovered that the “Iron Rich” material contained some organic compounds at significant quantities. At this time DuPont worked with the EPA and DNREC to ensure that the material would not continue to contribute to the external environment. DuPont decided to grade the material back from the 22 acre extent in 2001 to approximately 15 acres. Once this was completed they capped the stockpile with a posi-shell layer that would prevent any significant amount of water from infiltrating the material. This cover system also prevents wind erosion to the pile, which played an integral part in the transportation of the material to the environment. The Final Plan of Remedial Action for the site outlines the institution of a multilayer geo-synthetic liner system pursuant to a DNREC approved remedial design plan.

PCB MASS LOADING SUMMARY

During this site evaluation BrightFields determined that the site is no longer was contributing to PCB mass loading via overland flow. This determination was made because of the interim remedial action that was completed on the site to contain the “Iron Rich” material. The surface soil surrounding the “Iron Rich” material does not contain PCBs above analytical detection limits. The PCB mass loading rate to surface water via groundwater transport is discussed below. A summary of the results is included below and the details of the calculations are included as attachments to this Appendix.

GROUNDWATER DISCHARGE ANALYSIS

Groundwater discharge is based on the hydraulic conductivity of the soil, the groundwater gradient, and the cross-sectional area of the aquifer. A breakdown of the individual factors used in the Darcy equation is presented below.

Groundwater was analyzed for PCB congeners; the results indicated that there are relatively low concentrations of PCBs in groundwater. Detected PCB concentrations in groundwater ranged from 743 picograms (pg)/L to 5,950 pg/L (7.43×10^{-4} µg/L to 5.95×10^{-3} µg/L). A numerical mean groundwater PCB concentration (0.0025 µg/L) was used in the calculations.

Based on the RIRA Addendum Groundwater Potentiometric Surface Maps, groundwater discharges to both Shellpot Creek and the Delaware River. Because of the seawall, groundwater appears to preferentially discharge to Shellpot Creek. The site was divided into two zones based the water body receiving the groundwater discharge (Shellpot Creek or the Delaware River).

Input Factors:

A breakdown of the individual factors is presented below with a brief explanation of their choice.

Discharge to the Shellpot

Groundwater Transport Factors	Value Used		Justification/Derivation of Value Used
	min	max	
K = Hydraulic Conductivity (ft/day)	0.59	12.0	Slug tests were performed in four of the wells on the Hay Street Sludge Drying site. The measured horizontal hydraulic conductivity ranged from 2.1×10^{-4} to 4.23×10^{-3} cm/sec.
I = Horizontal Groundwater Gradient	0.005	0.005	The horizontal hydraulic gradient presented in the RIRA Addendum was 0.005 ft/ft.
Saturated Thickness (ft)	10	10	Based on the RIRA Addendum, the saturated thickness is approximately 10 feet.
Groundwater Transport Factors	Value Used		Justification/Derivation of Value Used
	min	max	
Lateral Discharge Distance (ft)	560	800	The lateral discharge distance was estimated to be equal to the length of the PCB impacted area measured parallel to the Shellpot Creek
A= Cross-Sectional Area (ft ²)	5,600	8,000	Calculated from the saturated thickness and lateral discharge distance.
Groundwater PCB Concentration (µg/L)	0.0025	0.0025	The average concentration observed in the groundwater was used in the calculations.
Distance to Discharge point (ft)	Directly adjacent		Approximate distance from property boundary to closest surface water location.

Discharge to the Delaware River

Groundwater Transport Factors	Value Used		Justification/Derivation of Value Used
	min	max	
K = Hydraulic Conductivity (ft/day)	0.59	12.0	Slug tests were performed in four of the wells on the Hay Street Sludge Drying site. The measured horizontal hydraulic conductivity ranged from 2.1×10^{-4} to 4.23×10^{-3} cm/sec.
I = Horizontal Groundwater Gradient	0.005	0.005	The horizontal hydraulic gradient presented in the RIRA Addendum was 0.005 ft/ft.
Saturated Thickness (ft)	10	10	Based on the RIRA Addendum, the saturated thickness is approximately 10 feet.
Lateral Discharge Distance (ft)	1,050	1,250	The lateral discharge distance was estimated to be equal to the length of the PCB impacted area measured parallel to the Delaware River.
A= Cross-Sectional Area (ft ²)	10,500	12,500	Calculated from the saturated thickness and lateral discharge distance.
Groundwater PCB Concentration (µg/L)	0.0025	0.0025	The average concentration observed in the groundwater was used in the calculations.
Distance to Discharge point (ft)	Directly adjacent		Approximate distance from property boundary to closest surface water location.

Mass Loading Via Groundwater Transport Result:

The estimated minimum and maximum contaminant mass loading contributions are shown in the Table C in the groundwater transport calculations attachment. As previously described, these

sorption, volatilization, etc.

The total PCB loading via groundwater discharge is between 0.01 and 0.3 grams per year (attached Table C).

Uncertainty Analysis Associated with Groundwater Transport:

Specific Areas and Degree of Uncertainty for the Hay Street Sludge Drying Site

	Groundwater PCB Concentration	Hydraulic Conductivity	Horizontal Groundwater Gradient	Saturated Thickness	Lateral Discharge Distance	Distance to Discharge point
Site Specific Information	Based on groundwater congener analyses	Conductivity based on Aquifer Testing - Slug test	Gradient based on multiple numbers of professionally surveyed wells	High quality logs with consistent saturated thickness	High density sample data, good ground-water flow data	Directly adjacent
Degree of Uncertainty	Low	Low	Low	Low	Low	Low

Based on this evaluation the overall uncertainty associated with the Hay Street Sludge Drying Site is **Low**.



Site References:

AGS, 1997, Phase II Investigation at DuPont Cherry Island Landfill, Report dated 7/7/97.

Department of Natural Resources and Environmental Control (DNREC), Site Investigation and Restoration Branch (SIRB), 2009, Final Plan of Remedial Action for DuPont Hay Road Sludge Drying "Iron Rich" Site (DE 0024), Wilmington, DE, Report dated January 2009.

DuPont/URS Diamond CRG, 2008, Remedial Investigation and Risk Assessment Report Addendum, Hay Road Sludge Drying Site (DE-024), Wilmington, Delaware, December 8, 2008.

DuPont/URS Diamond CRG, 2002 Annual Hydrogeological Report Cherry Island Landfill, Wilmington, DE, Report dated 1/29/03

DuPont Engineering, 2001, Scope of Work for Remediation of Iron Rich Staging Area DuPont Cherry Island Site, Wilmington, DE, Report dated 7/24/01

DuPont Engineering, 1992, Report of Geotechnical Investigation Cherry Island Landfill Closure, Wilmington, DE, Report dated 11/9/92.

ENVIRON International Corporation, 2001, Staging Pile Material Exposure and Risk Evaluation DuPont Cherry Island Facility, Wilmington, DE, Report dated September 2001.

URS Diamond Group, 2000, Proposal for Remedial Action and Transmittal of Pre-design Investigation Results DuPont Cherry Island Landfill, Wilmington, DE, Report dated 6/9/00.

Woodward-Clyde Consultants, 1990, Geotechnical Investigation Proposed Cell No.4 Cherry Island Landfill, Plymouth Meeting, PA, Reported dated 4/2/90.

Woodward-Clyde Consultants, 1979, Supplemental Geotechnical Investigation Proposed Cherry Island Landfill Expansion Area, Plymouth Meeting, PA, Reported dated 6/13/79.

Woodward-Clyde Consultants, 1977, Geotechnical Investigation Proposed Cherry Island Landfill, Plymouth Meeting, PA, Reported dated 8/4/77.

PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Figures



Legend

- Cone Penetrometer Test Location
- Piezometer Location
- Soil Boring Location
- Surface Water Sample Location
- Test Pit Location
- Well Location
- Tax Parcel
- Iron Rich Material
- Dupont Property Boundary
- Hay Street Sludge Drying Site

Total Site Area= 26.89 Acres



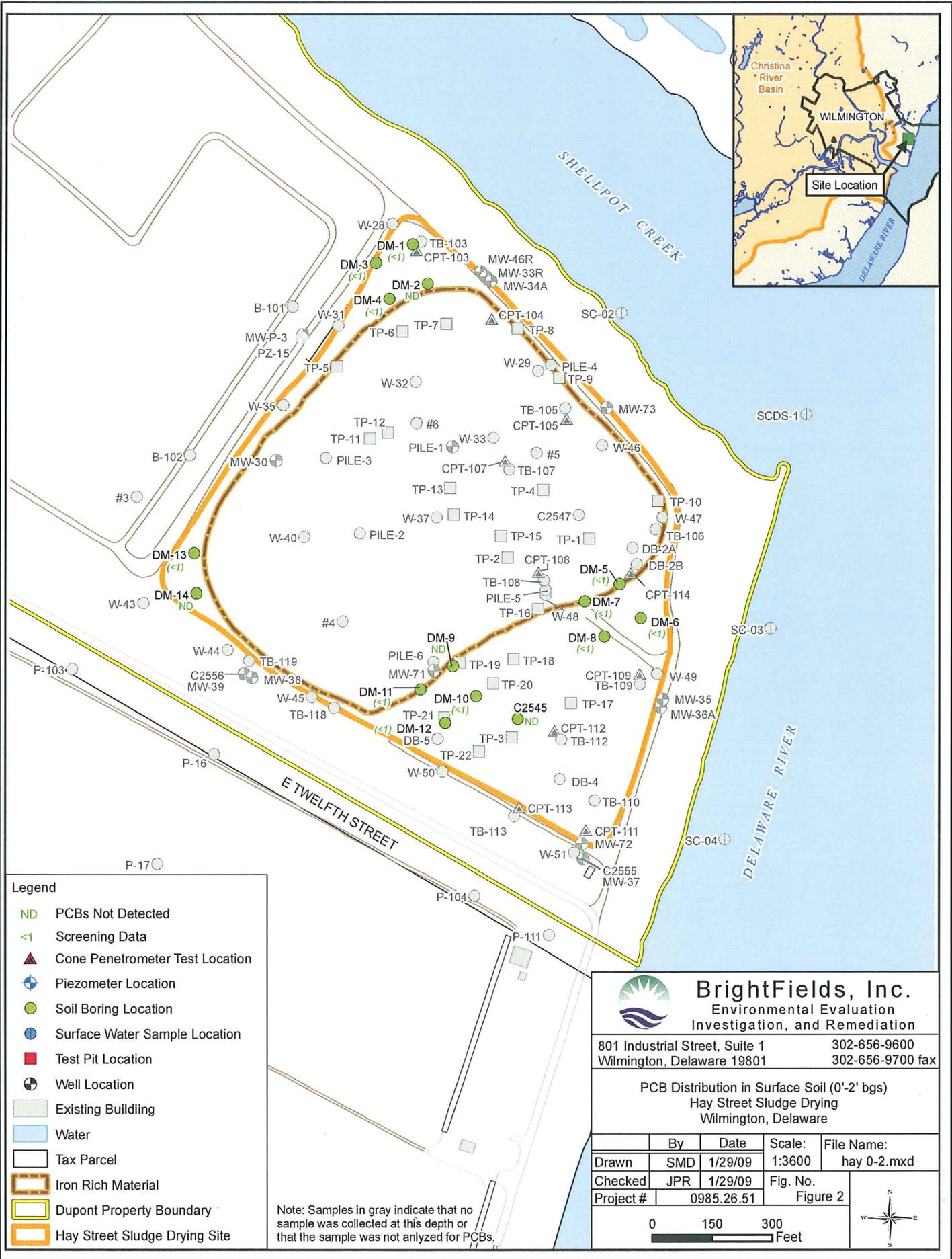
BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

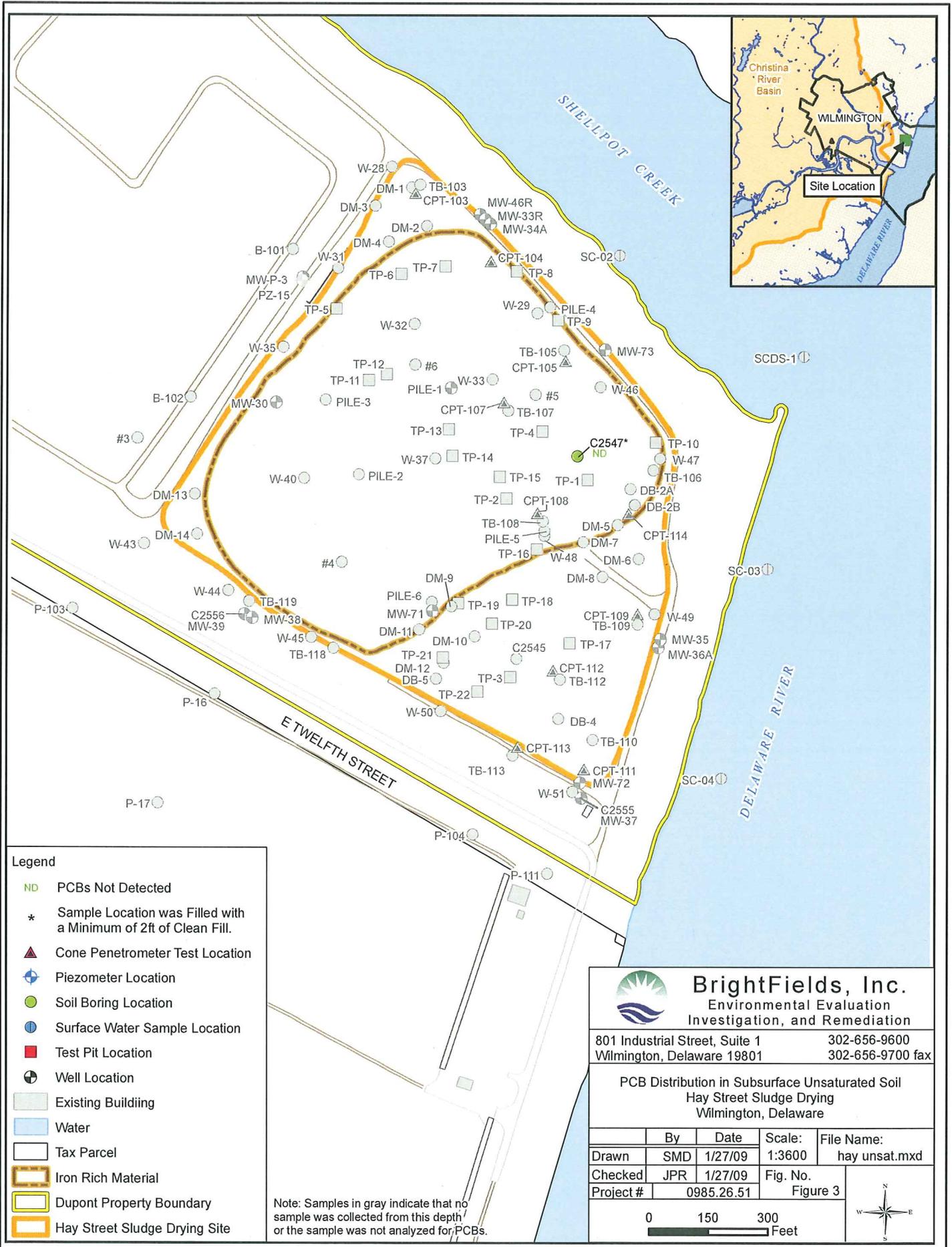
801 Industrial Street, Suite 1 302-656-9600
Wilmington, Delaware 19801 302-656-9700 fax

Historic Sample Locations and Aerial Photograph (2007)
Hay Street Sludge Drying
Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	1/27/09	1:3600	hay aerial.mxd
Checked	JPR	1/27/09	Fig. No.	
Project #	0985.26.51		Figure 1	







Legend

- ND PCBs Not Detected
- * Sample Location was Filled with a Minimum of 2ft of Clean Fill.
- ▲ Cone Penetrometer Test Location
- ⊕ Piezometer Location
- Soil Boring Location
- ⊙ Surface Water Sample Location
- Test Pit Location
- ⊕ Well Location
- ▭ Existing Building
- ▭ Water
- ▭ Tax Parcel
- ▭ Iron Rich Material
- ▭ Dupont Property Boundary
- ▭ Hay Street Sludge Drying Site

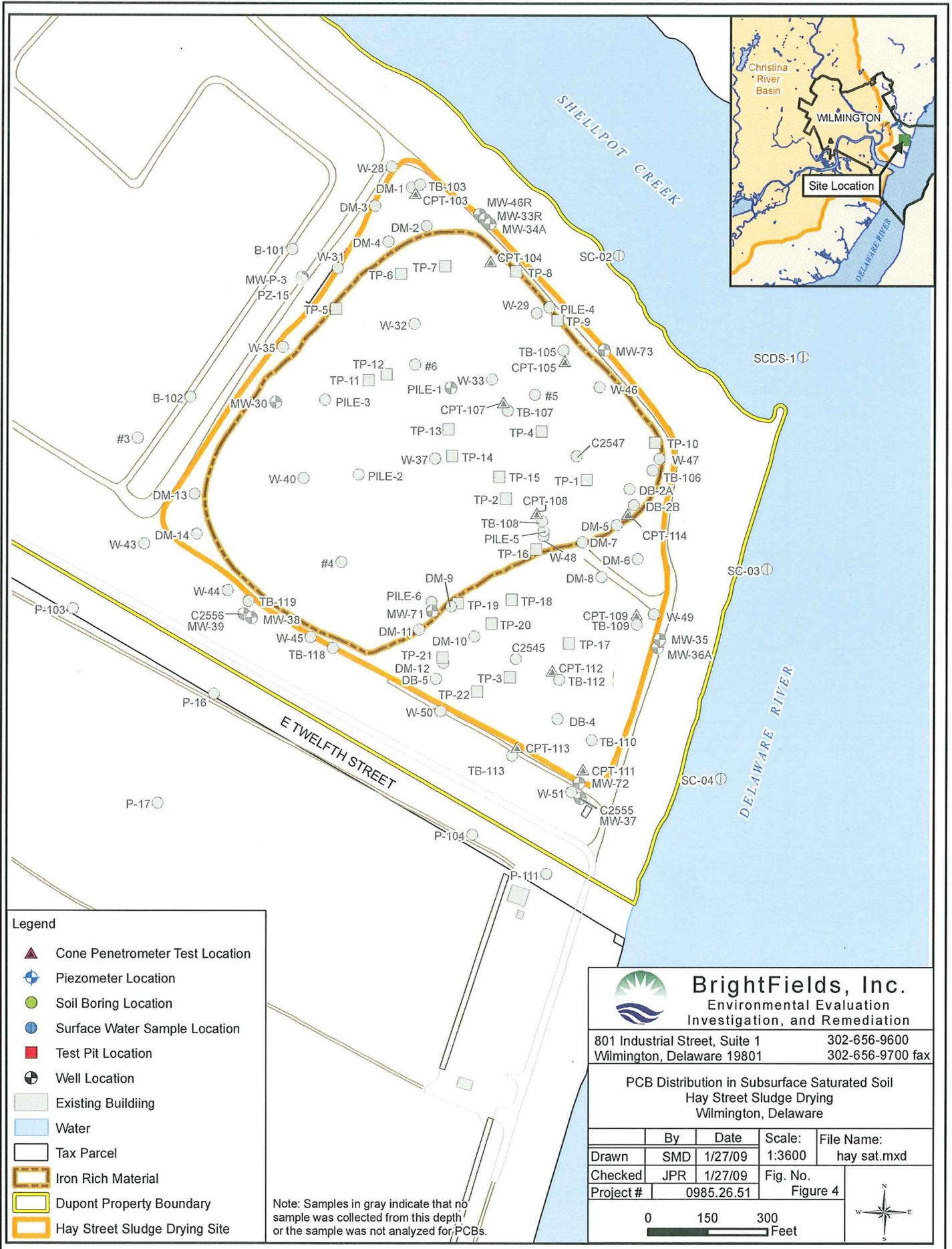
Note: Samples in gray indicate that no sample was collected from this depth or the sample was not analyzed for PCBs.



BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

801 Industrial Street, Suite 1 Wilmington, Delaware 19801		302-656-9600 302-656-9700 fax	
PCB Distribution in Subsurface Unsaturated Soil Hay Street Sludge Drying Wilmington, Delaware			
	By	Date	Scale:
Drawn	SMD	1/27/09	1:3600
Checked	JPR	1/27/09	Fig. No.
Project #	0985.26.51		Figure 3
0 150 300		Feet	





Legend

-  Cone Penetrometer Test Location
-  Piezometer Location
-  Soil Boring Location
-  Surface Water Sample Location
-  Test Pit Location
-  Well Location
-  Existing Building
-  Water
-  Tax Parcel
-  Iron Rich Material
-  Dupont Property Boundary
-  Hay Street Sludge Drying Site

Note: Samples in gray indicate that no sample was collected from this depth or the sample was not analyzed for PCBs.



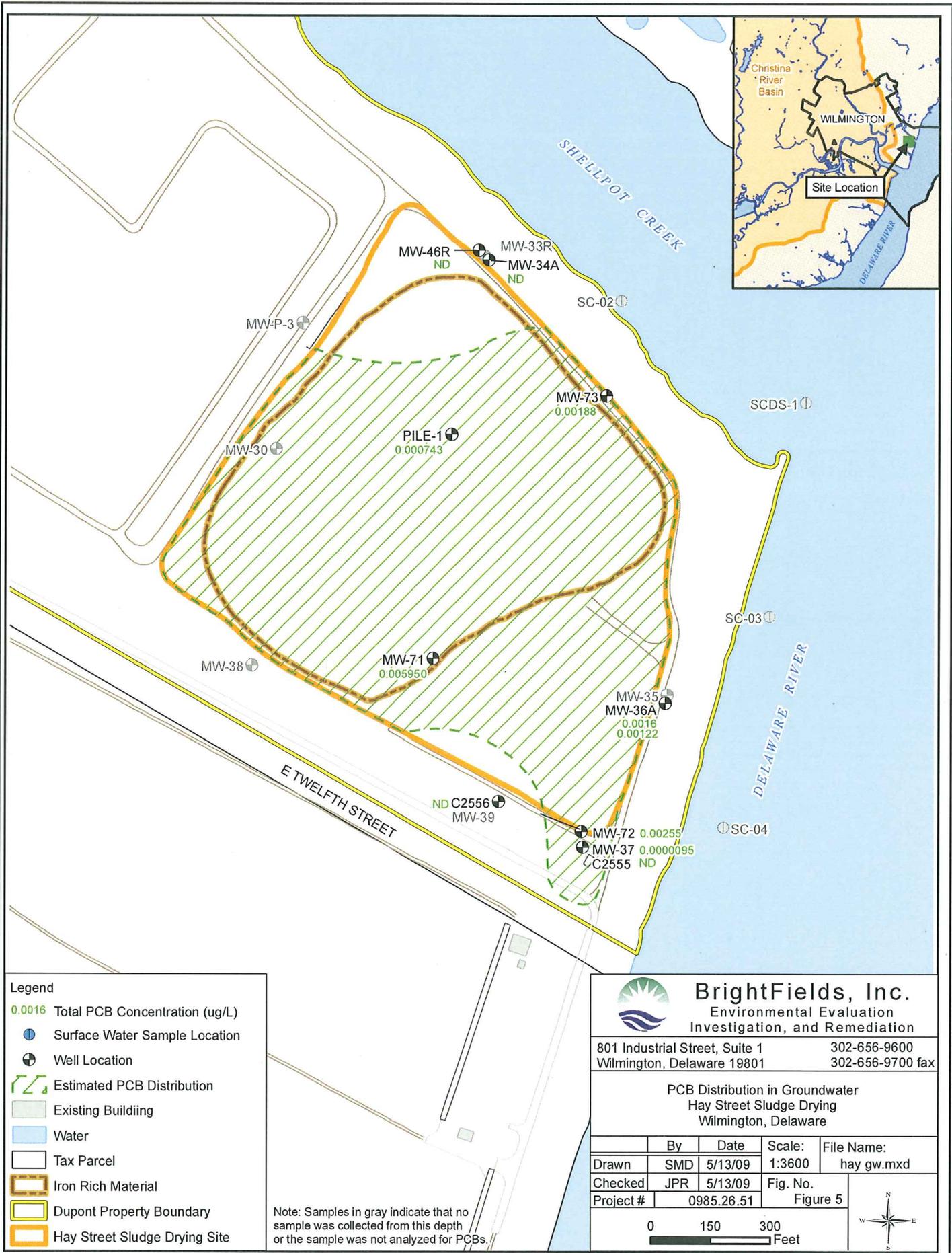
BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

801 Industrial Street, Suite 1 302-656-9600
Wilmington, Delaware 19801 302-656-9700 fax

PCB Distribution in Subsurface Saturated Soil
Hay Street Sludge Drying
Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	1/27/09	1:3600	hay sat.mxd
Checked	JPR	1/27/09	Fig. No.	
Project #	0985.26.51		Figure 4	





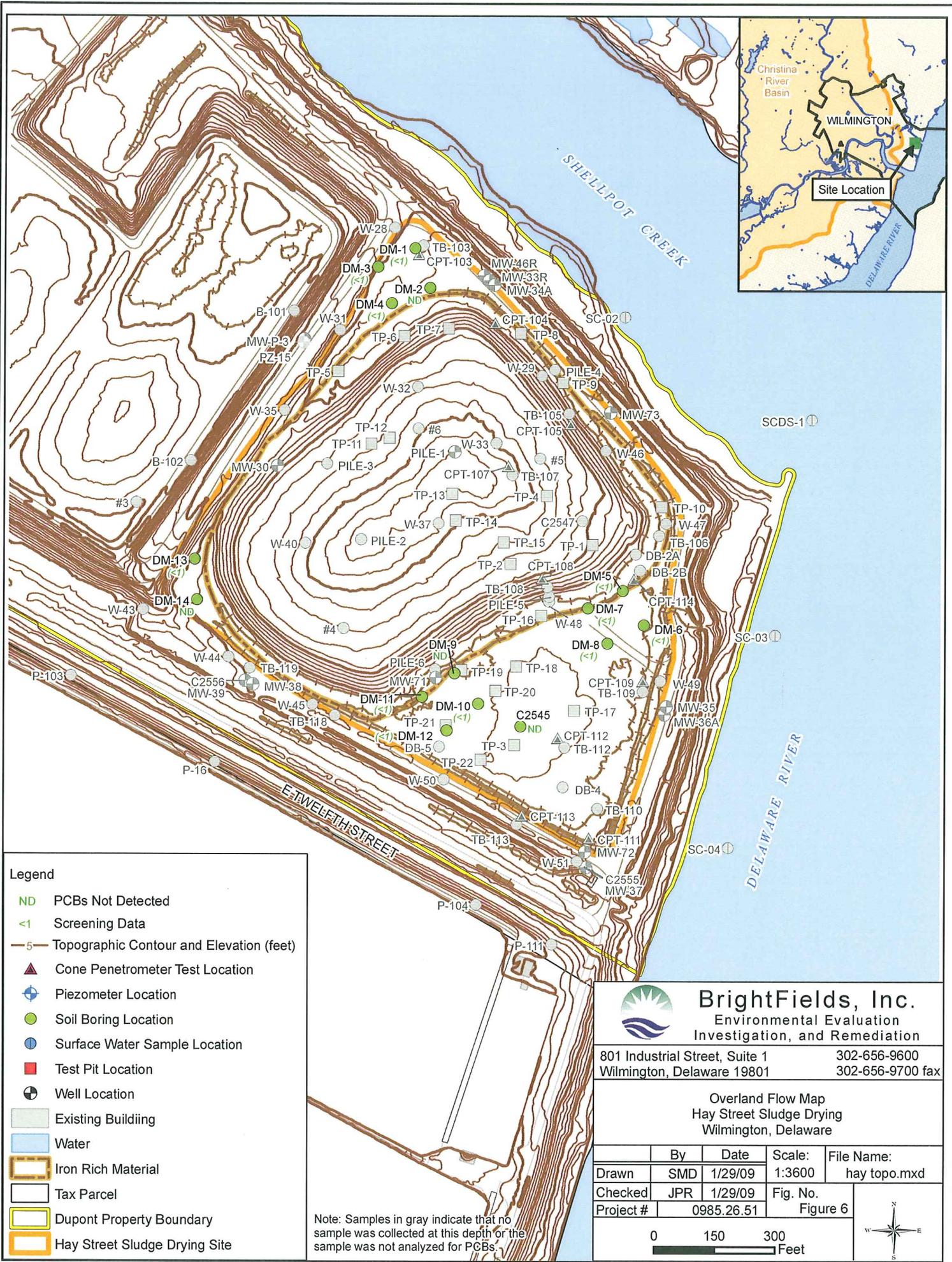
- Legend**
- 0.0016 Total PCB Concentration (ug/L)
 - ⊕ Surface Water Sample Location
 - ⊕ Well Location
 - ▨ Estimated PCB Distribution
 - ▭ Existing Building
 - ▭ Water
 - ▭ Tax Parcel
 - ▭ Iron Rich Material
 - ▭ Dupont Property Boundary
 - ▭ Hay Street Sludge Drying Site

Note: Samples in gray indicate that no sample was collected from this depth or the sample was not analyzed for PCBs.



BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

801 Industrial Street, Suite 1		302-656-9600		
Wilmington, Delaware 19801		302-656-9700 fax		
PCB Distribution in Groundwater Hay Street Sludge Drying Wilmington, Delaware				
	By	Date	Scale:	File Name:
Drawn	SMD	5/13/09	1:3600	hay gw.mxd
Checked	JPR	5/13/09	Fig. No.	
Project #	0985.26.51		Figure 5	
0 150 300 Feet				



Legend

- ND PCBs Not Detected
- <1 Screening Data
- Topographic Contour and Elevation (feet)
- ▲ Cone Penetrometer Test Location
- ⊕ Piezometer Location
- Soil Boring Location
- ⊙ Surface Water Sample Location
- Test Pit Location
- ⊗ Well Location
- Existing Building
- Water
- Iron Rich Material
- Tax Parcel
- Dupont Property Boundary
- Hay Street Sludge Drying Site

Note: Samples in gray indicate that no sample was collected at this depth or the sample was not analyzed for PCBs.



BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

801 Industrial Street, Suite 1 302-656-9600
 Wilmington, Delaware 19801 302-656-9700 fax

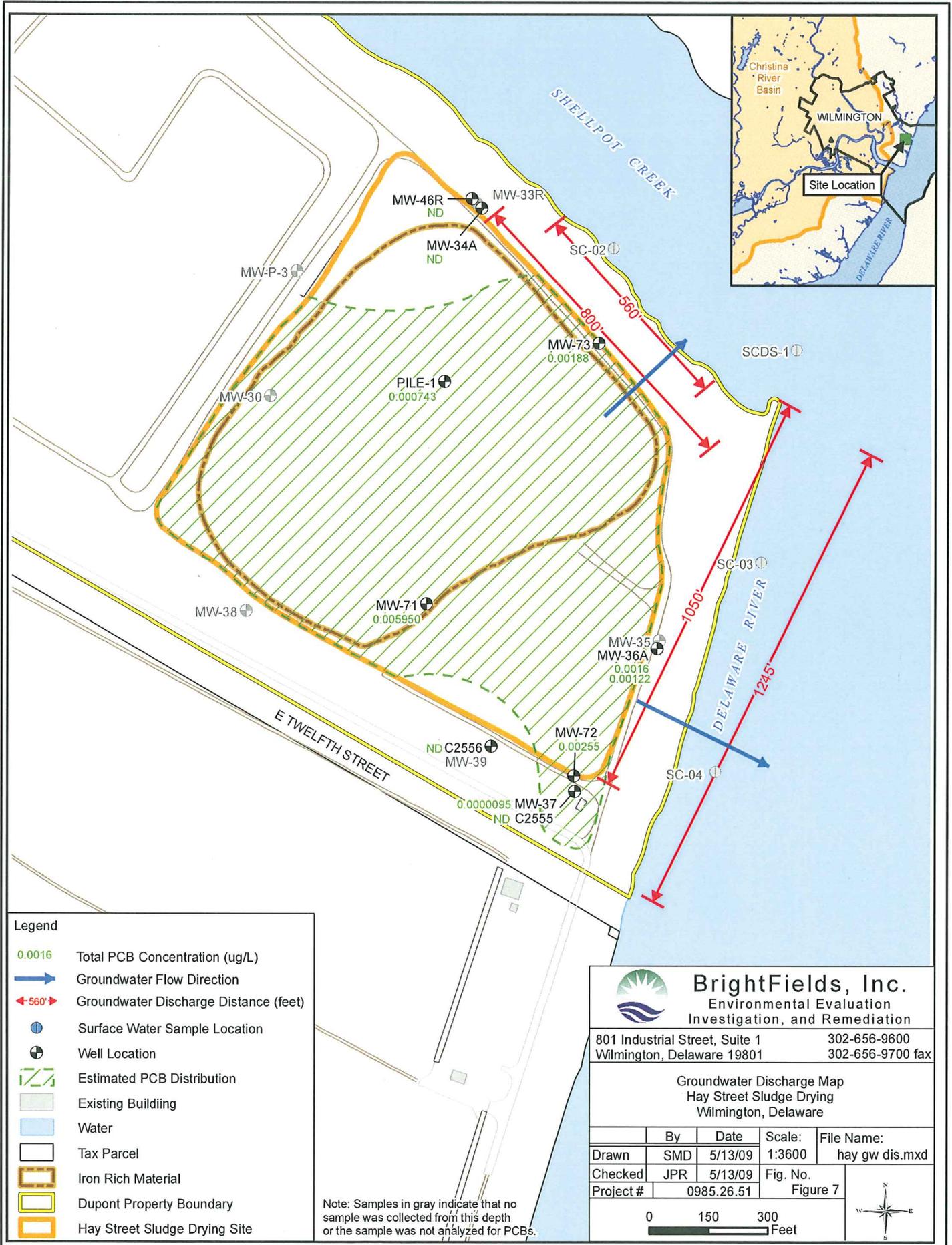
Overland Flow Map
 Hay Street Sludge Drying
 Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	1/29/09	1:3600	hay topo.mxd
Checked	JPR	1/29/09	Fig. No.	
Project #	0985.26.51		Figure 6	

0 150 300

Feet





Legend

- 0.0016 Total PCB Concentration (ug/L)
- Blue Arrow Groundwater Flow Direction
- Red Arrow with Distance Groundwater Discharge Distance (feet)
- Blue Circle with Center Point Surface Water Sample Location
- Black Circle with Center Point Well Location
- Green Hatched Area Estimated PCB Distribution
- Gray Hatched Area Existing Building
- Blue Area Water
- White Outline Tax Parcel
- Orange Outline Iron Rich Material
- Yellow Outline Dupont Property Boundary
- Orange Outline Hay Street Sludge Drying Site

Note: Samples in gray indicate that no sample was collected from this depth or the sample was not analyzed for PCBs.



BrightFields, Inc.
Environmental Evaluation
Investigation, and Remediation

801 Industrial Street, Suite 1 Wilmington, Delaware 19801		302-656-9600 302-656-9700 fax	
Groundwater Discharge Map Hay Street Sludge Drying Wilmington, Delaware			
By	Date	Scale:	File Name:
Drawn SMD	5/13/09	1:3600	hay gw dis.mxd
Checked JPR	5/13/09	Fig. No.	Figure 7
Project #	0985.26.51		
0 150 300 Feet			

PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Historic Data

Table 2

Dredge Material Analysis Compared to DNREC Uniform Risk-based Remediation Standards

CAS No.	Analyte Name:	Sample DM-2, Analyzed by Lancaster, Taken by DuPont 10/15/02 Concentration (mg/kg)*:	Sample DM-9, Analyzed by Lancaster, Taken by DuPont 10/15/02 Concentration (mg/kg)*:	Sample DM-14, Analyzed by Lancaster, Taken by DuPont 10/15/02 Concentration (mg/kg)*:	DNREC Human Health, Soil Remediation Standards (mg/kg):
Organics Analyses:					
TCL Volatile Organic Compounds:					
		[none detected]	[none detected]	[none detected]	
TCL Semi-Volatile Organic Compounds:					
118-74-1	Hexachlorobenzene	1.2	1.1	0.330 J	4
87-68-3	Hexachlorobutadiene	0.097 J	0.140 J	ND (<0.043)	73
87-86-5	Pentachlorophenol	ND (<0.220)	ND (<0.240)	ND (<0.220)	48
206-44-0	Fluoranthene	0.092 J	ND (<0.047)	0.095 J	5,000
129-00-0	Pyrene	0.100 J	ND (<0.047)	0.100 J	5,000
85-68-7	Butylbenzylphthalate	0.078 J	ND (<0.047)	0.098 J	8
56-55-3	Benzofluoranthene	0.110 J	ND (<0.047)	0.057 J	8
117-81-7	bis(2-Ethylhexyl)phthalate	0.160 J	0.130 J	0.150 J	410
218-01-9	Chrysene	0.110 J	ND (<0.047)	0.063 J	780
205-99-2	Benzofluoranthene	0.200 J	ND (<0.047)	0.099 J	8
207-08-9	Benzo(k)fluoranthene	0.074 J	ND (<0.047)	ND (<0.043)	78
50-32-8	Benzo(a)pyrene	0.140 J	ND (<0.047)	0.061 J	0.8
193-39-5	Indeno(1,2,3-cd)pyrene	0.120 J	ND (<0.047)	0.054 J	8
191-24-2	Benzo(g,h,i)perylene	0.110 J	ND (<0.047)	0.053 J	No Standard (NS)
TCL Pesticides and PCB (Aroclors only):					
		[none detected]	[none detected]	[none detected]	

*All Concentrations, RLs, and MDLs are corrected for percent solids, i.e. reported on a "dry weight basis".

Exceeds DNREC's URS for Protection of Human Health, Non-Critical Water Resource Area, Restricted Use, Surface Soil (mg/kg), 12/99.

J = Estimated Value

no voc's
pest/RB
clippin

DM-2	very low level Hexachlorobenzene	a little Hg
DM-4	very low level Hexachlorobenzene	
DM-5	clean	a little Hg
DM-6	clean	" Hg
DM-7	clean	no metals
DM-8	clean	no metals
DM-9	very low level Hexachlorobenzene	no metals
DM-10	clean	no metals
DM-11	very low level Hexachlorobenzene	not metals
DM-12	clean	no metals
DM-13	Tic's	no metals
DM-14	LOW PAH, Some Tic's	a little a Hg

DM-2

-4

-5

-6

-7

-8

-9

-10

-11

-12

-13

TIC'S

-14



PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Site Photographs (Not Applicable)

PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Overland Flow Calculations

(Not Applicable)

PCB Mass Loading
Hay Street Sludge Drying
SIRB ID: DE-0024
Wilmington, Delaware



BrightFields, Inc.

Groundwater Transport Calculations

PCB Loading Calculations - Groundwater Discharge to Surface Water
Hay Street Sludge Drying Site
Wilmington, DE
DE-0024

TABLE A
Groundwater Discharge Calculations

Location	Hydraulic Conductivity (K) (ft/day)	Horizontal Gradient (i) (ft/ft)	Cross-sectional Area (A) (ft ²)	Groundwater Discharge*	
				Liters/day	Gallons/day
Discharge to Shellpot					
Minimum	0.59	0.005	5,600	470	120
Maximum	12	0.005	8,000	14,000	3,600
Discharge to Delaware River					
Minimum	0.59	0.005	10,500	880	230
Maximum	12	0.005	12,500	21,000	5,600
TOTAL					
Minimum	0.59	0.005	16,000	1,400	350
Maximum	12	0.005	21,000	35,000	9,200

* - Groundwater Discharge (Q) = KiA

TABLE B
Potential Groundwater PCB Concentration Calculation

Location	Maximum Soil PCB (µg/kg)	f _{oc} (fraction of organic carbon)	Groundwater PCB Concentration (µg/L)	
			Minimum	Maximum
to Shellpot			0.0254	0.0254
to Delaware			0.0254	0.0254

TABLE C
Estimated Mass Loadings of PCBs in Groundwater to Surface Water

Location	Detected Groundwater Concentration (µg/L)	Estimated PCB Mass Loading (g/yr)	
		Minimum	Maximum
to Shellpot	0.0254	0.004	0.13
to Delaware	0.0254	0.008	0.20
TOTAL		0.012	0.32