

PCB Mass Loading
WCGS-S
SIRB ID: DE-0114
Wilmington, Delaware



BrightFields, Inc.

Appendix 26

WILMINGTON COAL GAS SITE - SOUTH WILMINGTON, DELAWARE

SIRB ID: DE-0114

GENERAL SITE INFORMATION

Site Name: Wilmington Coal Gas Site - South

SIRB ID Number: DE-0114

Site Location and Description:

The Wilmington Coal Gas Site – Southern Parcel (WCGS-S) is located southwest of the intersection of Beech St. and Justison St. in Wilmington, Delaware. The site encompasses approximately 9.7 acres and is bordered by Beech Street to the north, Justison Street to the east, Blue Rocks Stadium Parking lot to the south, and I-95 overpass to the west.

The WCGS-S was undeveloped until 1937, when development activities occurred. A gas holder was built on the property between 1937 and 1953 and the property was used for manufactured gas plant operations. Deconstruction of the Northern and Southern parcels of the Wilmington Coal Gas Site took place sometime between the 1970s and 1980s. The substations, which are currently present on site, were built in 1953 and 1962. During the time period of 1953 to 1980 approximately nine petroleum tanks were located on the site for commercial use.

Delmarva Power currently operates a storage building on top of the former gas holder foundation. The substation continues to operate and is located in a grass field on the southwest corner of the property. The storage area and pole storage area, created by Delmarva, are paved and have been used as overflow parking for the Blue Rocks Stadium. These areas are primarily utilized for parking now.

Previous Site Uses: The WCGS-S is located in an area of the Wilmington Riverfront that has been in continuous industrial use since the late 1700s. Surrounding property uses in the area during the late 1800s included a tannery, gas works, foundry, boiler works, coal yard, lumber yard, planing mill, steam saw mill and carriage factory. Industrial usage of the surrounding properties appears to have continued through at least 1992.

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.

Investigation or Regulatory Report	Dates	Description
Facility Evaluation	1994	This was the first comprehensive investigation conducted on the WCGS-S by DP&L. Surface and subsurface samples were collected from locations SS-101 through SS-112, TP-101 through TP-103, and B-101 through B-105. Five monitoring wells were created from borings B-101 to B-105. This investigation identified the presence of non-aqueous phase liquid (NAPL) in the southwest corner of the site.
Plume Delineation	1994	The plume delineation activities were to further evaluate the presence of NAPL in the southwest corner of the site, found in the Facility Evaluation in 1994.
Focused Feasibility Study (FFS)	1996	The FFS was conducted to evaluate soil and groundwater remediation alternatives involving capping and monitoring, bio-venting/bio-sparging, and excavation with off-site disposal.
Final Plan of Remedial Action	1996	The bio-venting/bio-sparging remediation system was approved for implementation in the southwestern portion of the site. The Final Plan also required a deed restriction and clean-up goals of 1,000 to 2,000 ppm of TPH in the soil.
Remedy Implementation	1997-2005	Following the treatability studies a remediation system was designed and implemented on-site to treat the NAPL found in the soil and groundwater.
Remedy Evaluation Report	2005	Environmental Alliance prepared a remedy evaluation report determining the effectiveness of the remediation system. Environmental Alliance concluded that some of the remedial action objectives were met by the approach.
Additional Remedy Evaluation Report	2005	DP&L contracted ENSR to perform an additional evaluation of the remediation technique and its effectiveness. ENSR concluded that the current remediation system was not effective at removing the NAPL, but more effective of removing the lighter fraction hydrocarbons.
Gas Holder Area Investigation	2005	DP&L investigated the north west portion of the site, which included 27 direct-push soil borings around the gas holder, substation area, and former fleet storage area. Visual confirmation of the presence of NAPL was identified during the investigation. Upon further interpretation by ENSR this NAPL plume was not connected to the previous NAPL area in the southwest corner.

Investigation or Regulatory Report	Dates	Description
Substation Area Investigation	2005	Surface soil samples (HA1 through HA14) were collected and analyzed for parameters associated with long term operations of a substation. Samples were analyzed for TPH, PCBs, arsenic, lead, VOCs, herbicides, and pesticides.
Alternative Remedy Evaluation	2006	Based on the ENSR remedy evaluation an alternative remedy measure was considered for the site. DP&L proposed a combination of excavation and in-situ stabilization (ISS) to replace the on-going remedy instituted by Environmental Alliance in 1997. DP&L has discontinued the existing remedy until further evaluation of the ISS system has been completed.
ISS Treatability Study	2006	DP&L conducted bench-scale treatability studies using the samples collected from the southern and northern parcels to determine the feasibility of the ISS process. The studies indicated the ISS is feasible process for this site.
Summary of Sampling Activities	2006	DP&L submitted a brief summary document in April of 2006 discussing all previous investigations that have taken place on the property. The summary recommended that additional samples be collected in the vicinity of B-119 and B-120.
Supplemental Investigation	2006	DP&L investigated additional areas on the property that were noted to have a lighter sampling density in the summary that occurred in April 2006. This investigation included 24 direct push borings being advanced on the property to further evaluate the surface and sub-surface contaminants.
NAPL Delineation Summary of Findings Report – Stadium Site (DE-1004) Wilmington Coal Gas Western Section	2007	DNREC-SIRB performed a non-aqueous phase liquid (NAPL) investigation on the Stadium site and the Wilmington Coal Gas Western site in June 2006. This investigation included the advancement of 19 borings to distinguish the presence of NAPL in the area. The conclusions of the report cited that the contamination is most likely from the Wilmington Coal Gas South site and these properties will be included in the remedial design for this site.

Current Regulatory Status:

A Final Plan of Remedial Action was approved by DNREC in 1996, which included bio-venting/bio-sparging the area around the southwest portion of the site. Upon further evaluation

by DP&L it was observed that a larger area of contamination was present and that the current remedy was not correcting the conditions of the site. An alternative remedial approach (ISS) is being evaluated, but not yet been approved by DNREC. Currently the existing remedy is no longer being implemented at DNREC's approval.

SUMMARY OF SITE PCB INFORMATION

Site Investigation PCB Findings:

PCBs (Aroclor-1254 and Aroclor 1260) were detected in 15 surface soil sample locations. One composite sample (B_116_118_128_130) was composed of four sample locations and analysis indicated that the sample contained a total PCB concentration of 1.69 mg/kg, which is above the URS value for total PCBs of 1.0 mg/kg. All other samples were well below the 1.0 mg/kg total PCB URS value.

PCBs (Aroclor-1248 and Aroclor-1252) were detected in the subsurface soil at TP12-S002 (5.0 to 5.5 feet bgs) at concentrations above the unrestricted URS values for human health, but below the restricted URS values.

Upon further evaluation of the site, some of the former surface soil sample locations are now under an impervious surface, which indicates that they are no longer contributing to the overland mass loading. Once all sample locations that were below an impervious surface were removed from the analysis, BrightFields distinguished two identifiable areas contributing to overland mass loading. Both areas were composed of four sample locations. The 95% UCL of the mean could not be calculated for each distinct identifiable area, because no reliable statistical mean could be produced due to the small data set. In this case the maximum concentration observed in each distinct area was used in the overland mass loading calculations.

There were no PCBs detected in groundwater but there are PCBs in the subsurface that are in contact with the groundwater (saturated soil). The saturated soil detection was evaluated through the equilibrium partitioning equation to approximate a groundwater concentration. Due to the fact that there was only one detection in subsurface saturated soil, this detected value was used in the calculations instead of calculating the 95% UCL of the mean across the site.

Concentrations of PCBs on Site			
Sample Matrix	Corresponding Figure	Analytical Methods	Range of Total PCBs
Surface Soil	Figure 2	Method 8082	Not detected to 1.69 mg/kg
Subsurface Soil (unsaturated)	Figure 3	Method 8082	Not detected
Subsurface Soil (saturated)	Figure 4	Method 8082	Not detected to 0.023 mg/kg
Ground Water	Figure 5	Method 8082	Not detected

A summary of all samples collected for PCBs are presented in the attached Tables 1 through 2.



Acreage where PCBs detected:

The estimated surface soil area impacted by PCBs is 6.05 acres (Figure 2) of which only 2.7 acres may still be contributing to mass via overland flow. The 2.7 acres is divided into two distinguishable areas, one consisting of 1.64 acres in the vicinity of boring B-120 and the other consisting of 1.06 acres in the vicinity of HA-13 (Figure 6). The estimated subsurface saturated area impacted by PCBs is 1.10 acres in the vicinity of TP12 (Figure 4).

PCB Remediation Status:

No PCB remediation has been performed at the WCGS-S.

PCB MASS LOADING SUMMARY

The PCB mass loading rate to surface water via overland flow and via groundwater transport were estimated for the WCGS-S. A summary of the results is included below and the details of the calculations are included as attachments to this Appendix.

OVERLAND FLOW:

Overland flow has been determined on this site by using the Revised Universal Soil Loss Equation (RUSLE). The RUSLE predicts the long term average annual rate of erosion on an area based on rainfall patterns, soil type, topography, cover/canopy factors and support management practices. These specific factors are site specific and rely on local information of the site.

Ground Cover and Canopy:

A site inspection was performed to estimate the current site ground cover and canopy. The cover/management factor (C) assigned to the site and associated flow path is 0.019 and 0.026 for each respective area, which corresponds to at least 75% groundcover of tall weeds or short brush; with the cover at the surface being grass, grass-like plants, decaying compacted duff, or litter at least 2 inches deep.

Site Sediment and Erosion Control Practices:

Currently there are no erosion and sediment controls in place at the WCGS-S.

Input Factors and Results:

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

Area 1: Northeast Portion of the site

RUSLE Factors	Values Provided	Explanation of Selection
E = rainfall/erodibility index (10 ² m-tonne-cm/ha-hr)	170	An appropriate value for R for the site was determined from plots of Rainfall patterns for the Eastern U.S. (Wischmeier and Smith, 1978).
K = soil erodibility (0.01 tonf acre hr/acre ft-ton in)	0.424	The soil erodibility factor was chosen based on the information provided by the boring log for B-168 in the Supplemental Investigation Report (ENSR 2006). The USGS model selected the value based on generalized soil type.

RUSLE Factors	Values Provided	Explanation of Selection
Is = topographic factor (dimensionless)	0.197	The slope length was estimated to 180 feet, which is the distance between the site and the closest storm water discharge location along the overland flow path. The assumed slope (1.5 %) and slope length were used to calculate a topographic factor of 0.197.
C = cover/management factor (dimensionless)	0.019	The cover/management factor C assigned to the site by the USGS windows based application was 0.019, which corresponds to at least 75% groundcover of tall weeds or short brush; with the cover at the surface being grass, grass-like plants, decaying compacted duff, or litter at least 2 inches deep.
P = support practice factor (dimensionless)	1.0	There are no controls in place on the site that impeded the flow of surface runoff.

The average annual erosion rate is based on the windows based RUSLE2 program (RUSLE2 License, version 2006-Jul-24).

The total PCB loading via overland flow for Area 1 is 0.02 grams per year. Please see attached table for specific variables.

Area 2: Western Portion of the site

RUSLE Factors	Values Provided	Explanation of Selection
E = rainfall/erodibility index (10 ² m-tonne-cm/ha-hr)	170	An appropriate value for R for the site was determined from plots of Rainfall patterns for the Eastern U.S. (Wischmeier and Smith, 1978).
K = soil erodibility (0.01 tonf acre hr/acre ft-ton in)	0.365	The soil erodibility factor was chosen based on the information provided by the boring logs for HA1, HA7, HA12, and HA13- in the DP&L - Substation Area Investigation. (ENSR 2005).
Is = topographic factor (dimensionless)	0.119	The slope length was estimated to 328 feet, which is the distance between the site and the closest storm water discharge location along the overland flow path. The assumed slope (0.8 %) and slope length were used to calculate a topographic factor of 0.119.
C = cover/management factor (dimensionless)	0.026	The cover/management factor C assigned to the site by the USGS windows based application was 0.026, which corresponds to at least 75% groundcover of tall weeds or short brush; with the cover at the surface being grass, grass-like plants, decaying compacted duff, or litter at least 2 inches deep.

RUSLE Factors	Values Provided	Explanation of Selection
P = support practice factor (dimensionless)	1.0	There are no controls in place on the site that impeded the flow of surface runoff.

The average annual erosion rate is based on the windows based RUSLE2 program (RUSLE2 License, version 2006-Jul-24).

The total PCB loading via overland flow for Area 2 is 0.1 grams per year. Please see attached table for specific

Uncertainty Analysis Associated with Overland Flow:

Specific Areas and Degree of Uncertainty for the WCGS-S

	Samples Per Acre (site)	Chemical Data Quality*	Topography	Soil Type	Site Coverage	Map Quality	Distance to Discharge Points
Site Specific Information	2.0	Method 8082	Estimated using topography	Detailed logs that are located within the area of concern	Based on a limited site assessment	Scaled Map	134 feet 328 feet
Degree of Uncertainty	Moderate	Low to Moderate	Moderate	Low	Moderate	Moderate	Moderate

* Primary analysis used in the historical samples

Sources of uncertainty for WCGS-S include the following: Reporting limits were not found for all samples. Tables displayed ND for certain Aroclors instead of reporting a quantified limit and the laboratory data could not be located. General development in the area has caused some elevations to change in the vicinity of WCGS-S. This includes minor changes to the site along Justison Street on the east side of the site. The ENSR Additional Remedy Evaluation Investigation consisted of composite samples from various sample locations (ENSR 2005). In these instances BrightFields had to use the concentration found in the composite sample for each individual sample location. Lastly, the mass loading via overland flow was not a direct input into the Christiana watershed. The overland flow discharge points were based on the site storm water drains in the vicinity of the two identified areas. Based on these evaluations the overall level of uncertainty associated with PCB mass loading via overland flow from the WCGS-S site is **moderate**.

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.

Because PCBs were detected in saturated soil, but not in groundwater, the calculated concentration of PCBs in pore water, based on partitioning, was used to calculate the mass loading. The calculated PCB concentration in the pore water ranges from 0.005 to 0.025 $\mu\text{g/L}$. The calculations are presented in Table B in the groundwater transport calculations attachment.

Input Factors:

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

Groundwater Transport Factors	Value Used		Justification/Derivation of Value Used
	min	max	
K = Hydraulic Conductivity (ft/day)	28.3	283	An examination of the drilling logs shows that the groundwater being monitored is within a moderately coarse-grained fill unit that overlies the marsh deposit clay. The fill unit ranges in composition from coarse-grained sandy silt to fine sand. The hydraulic conductivity for coarse-grained sandy silt to fine sand ranges from approximately 1×10^{-3} to 1×10^{-2} cm/sec (Cernica, 1995).
I = Horizontal Groundwater Gradient	0.0018	0.002	Calculations of the horizontal gradient were based on groundwater measurements from surveyed elevations in the shallow wells at the WCGS-S. The gradient is toward the Christina River.
Saturated Thickness (ft)	7	7	Based on the borings logs, the saturated zone above the marsh deposits averages approximately 7 feet thick.
Lateral Discharge Distance (ft)	175	230	The lateral discharge distance was estimated to be equal to the length of the PCB impacted area measured perpendicular to the Christina River.
A= Cross-Sectional Area (ft ²)	1,230	1,610	Calculated from the saturated thickness and lateral discharge distance.
Groundwater PCB Concentration ($\mu\text{g/L}$)	0.005	0.025	The maximum concentration observed in the saturated subsurface soil (0.023 mg/kg) was used to determine the estimated concentration in groundwater.
Distance to Discharge point (ft)	490		Approximate distance from property boundary to closest surface water location.

Mass Loading Via Groundwater Transport Result:

The groundwater discharge is 1,770 to 25,800 L/day (attached Table A). The maximum detected PCB concentration (0.023 mg/kg) was used to calculate the groundwater concentrations for the loading estimate. The estimated minimum and maximum contaminant mass loading contributions are shown in the Table C in the groundwater transport calculations attachment, assuming that there are no contaminant losses due to degradation, dispersion, sorption, volatilization, etc.

The total PCB loading via groundwater discharge is between 0.02 and 0.2 grams per year (attached Table C).

Uncertainty Analysis Associated with Groundwater Transport:

Specific Areas and Degree of Uncertainty for the WCGS-S

	Groundwater PCB Concentration	Sampling Density	Hydraulic Conductivity	Horizontal Groundwater Gradient	Saturated Thickness	Lateral Discharge Distance	Distance to Discharge point
Site Specific Information	Partitioning based on maximum concentration observed in saturated soil	Low sample density	Based on detailed site logs.	Few points with limited number of groundwater measurements.	Few good quality logs	Good groundwater gradient defined and a moderate number of samples collected onsite.	490 feet
Degree of Uncertainty	Moderate - High	Moderate - High	Moderate	Moderate	Moderate	Moderate	High

Based on this evaluation the overall uncertainty associated with mass loading via groundwater transport at the WCGS-S is **moderate to high**.

Site References:

ENSR 2007, Draft Comprehensive Data Summary Report Wilmington Coal Gas Site – Southern Parcel (DE-1043). April 2007.

Delmarva Power & Light Company (DP&L), November 1994. Plume Delineation Southern Parcel of Wilmington Coal Gas Site. South Madison Street, Wilmington, Delaware.

DP&L, January 2006(a). “Addendum to Remedy Evaluation Report.” Wilmington Coal Gas Site – Southern Parcel.

DP&L, January 2006(b). Report of Findings – Subsurface Soil Investigation, Former Gas Holder Area. Wilmington Coal Gas Site South.

DP&L, January 2006(c). Report of Findings – Soil Investigation, Substation Area. Wilmington Coal Gas Site South.

DP&L, February 2006(d). Wilmington Coal Gas Site – Southern Parcel, Changes to Ongoing Investigation. Wilmington Coal Gas Site South

DP&L, July 2006 (e). Wilmington Coal Gas Site – South Summary of Sampling Activities. Wilmington Coal Gas Site South.

DP&L, July 2006 (f). Supplemental Investigation Report, Wilmington Coal Gas Site – South. Wilmington Coal Gas Site South.

Duffield Associates, September 1992. Phase II Environmental Assessment – Wilmington Multi-Purpose Sports Stadium. Duffield, 1992.

Earth Tech, August 1994. “Draft Facility Evaluation Former Wilmington Coal Gas Site.” Wilmington, DE 1994.

Environmental Alliance, July 1996. Focused Feasibility Study for the Wilmington Coal Gas Site, Southern Parcels. Environmental Alliance 1996.

Environmental Alliance, July 2005. Remedy Evaluation Report for Wilmington Coal Gas Site – South. Environmental Alliance 2005.

PCB Mass Loading
WCGS-S
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Wilmington, Delaware



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Figures



Legend

- Soil Boring Location
- Test Pit Location
- ⊕ Well Location
- Tax Parcel
- WCGS-South Property Boundary

Total Site Area= 9.18 acres



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Historic Sample Locations and Aerial Photograph (2007)
Wilmington Coal Gas Site South
Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	5/11/09	1:960	wcgs-s aerial.mxd
Checked	JPR	5/11/09	Fig. No.	
Project #	0985.26.51		Figure 1	

0 40 80

Feet







Legend

- ND (3.9') PCBs Not Detected and Sample Depth (feet bgs)
- Soil Boring Location
- Test Pit Location
- ⊕ Well Location
- Tax Parcel
- ▭ WCGS-South Property Boundary

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

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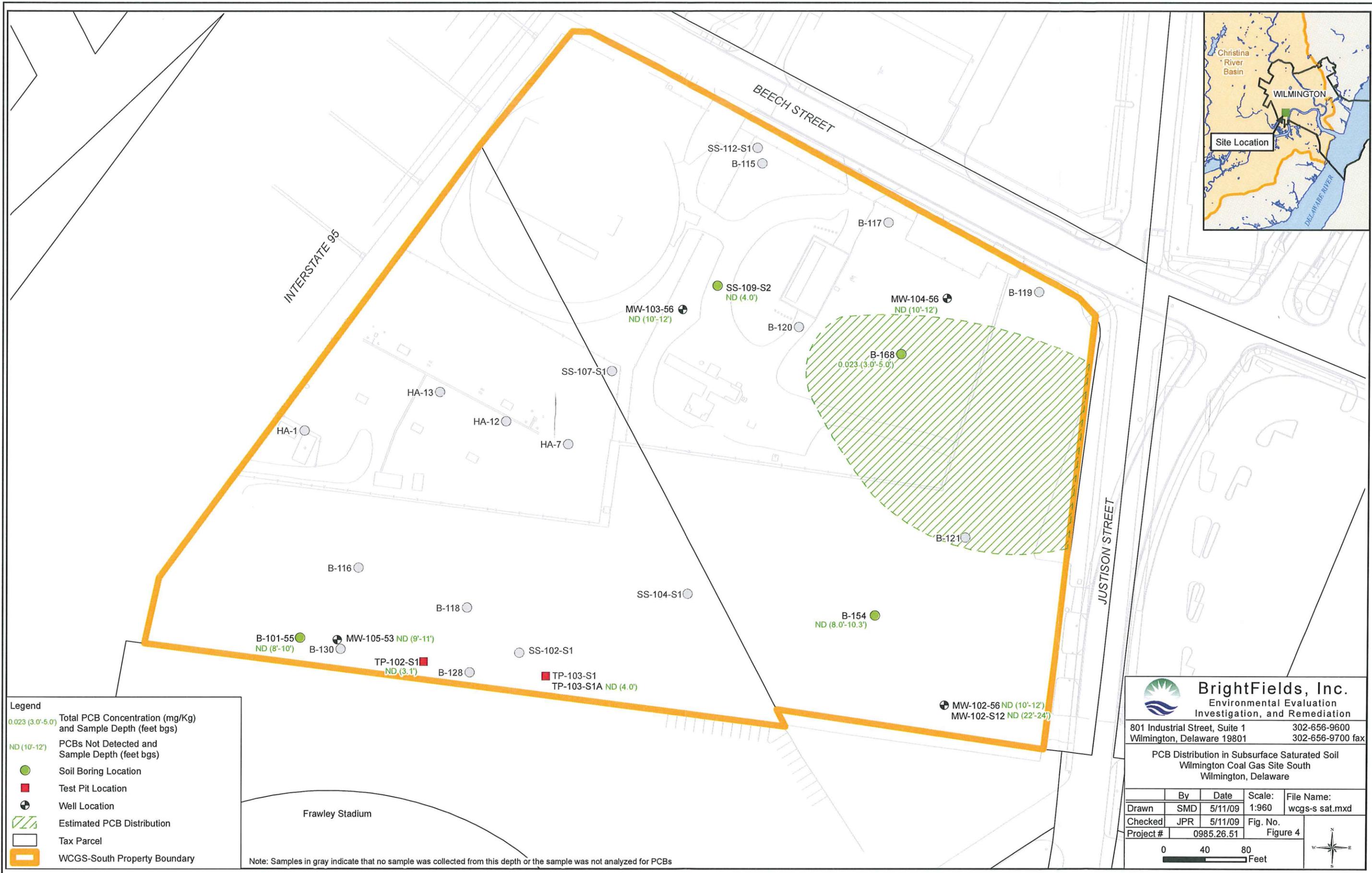
801 Industrial Street, Suite 1
 Wilmington, Delaware 19801

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PCB Distribution in Subsurface Unsaturated Soil
 Wilmington Coal Gas Site South
 Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	5/11/09	1:960	wcgs-s_unsat.mxd
Checked	JPR	5/11/09	Fig. No.	
Project #	0985.26.51		Figure 3	

0 40 80 Feet



Legend

- 0.023 (3.0'-5.0') Total PCB Concentration (mg/Kg) and Sample Depth (feet bgs)
- ND (10'-12') PCBs Not Detected and Sample Depth (feet bgs)
- Soil Boring Location
- Test Pit Location
- ⊕ Well Location
- ▨ Estimated PCB Distribution
- Tax Parcel
- ▭ WCGS-South Property Boundary

Frawley Stadium

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

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PCB Distribution in Subsurface Saturated Soil
 Wilmington Coal Gas Site South
 Wilmington, Delaware

By	Date	Scale:	File Name:
Drawn SMD	5/11/09	1:960	wcgs-s sat.mxd
Checked JPR	5/11/09	Fig. No.	
Project #	0985.26.51	Figure 4	

0 40 80 Feet



Legend

- ND PCBs Not Detected
- Well Location
- Tax Parcel
- WCGS-South Property Boundary

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



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PCB Distribution in Groundwater
Wilmington Coal Gas Site South
Wilmington, Delaware

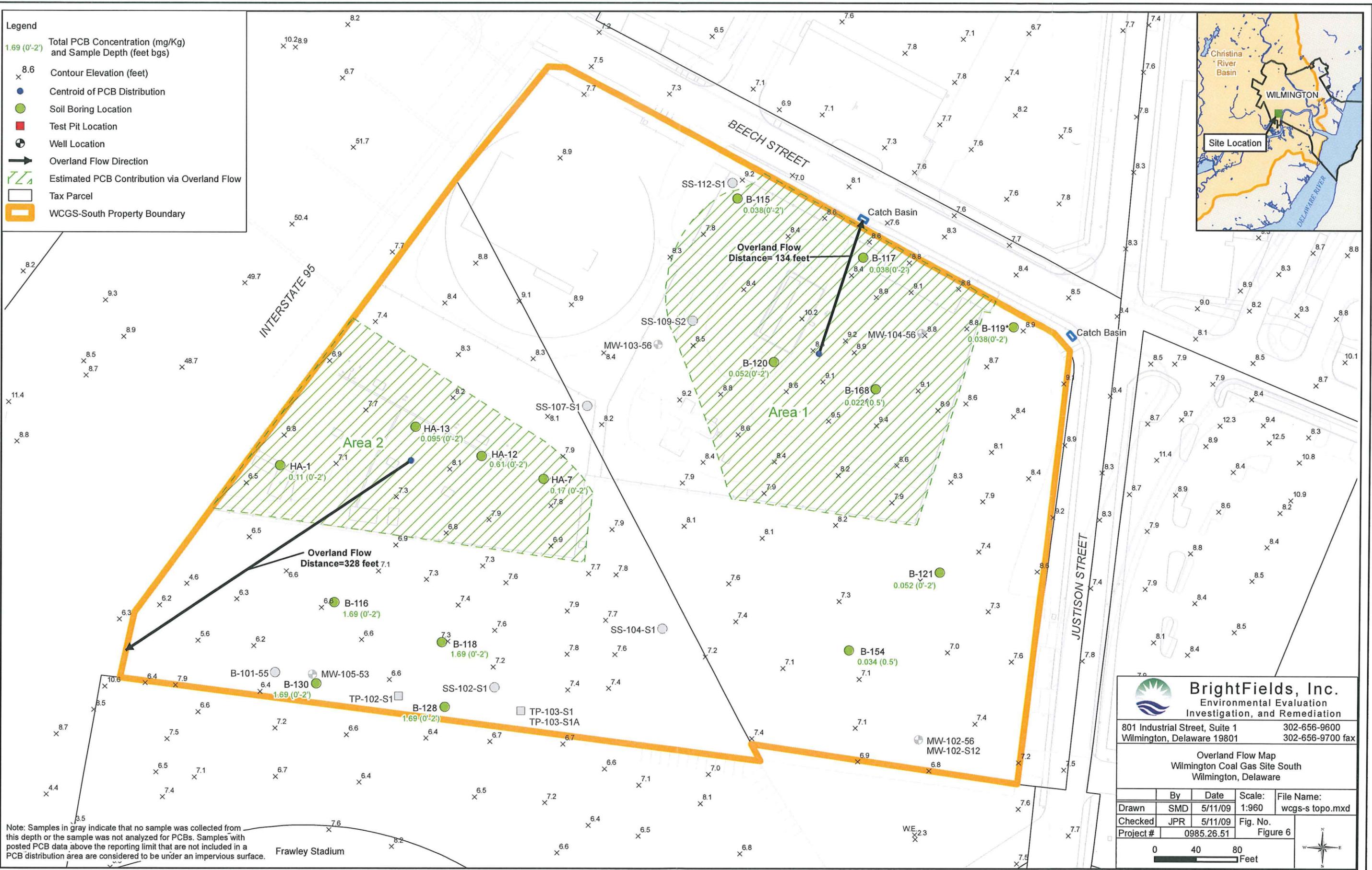
	By	Date	Scale:	File Name:
Drawn	SMD	5/11/09	1:960	wcgs-s gw.mxd
Checked	JPR	5/11/09	Fig. No.	
Project #	0985.26.51		Figure 5	

0 40 80

Feet



- Legend**
- 1.69 (0'-2') Total PCB Concentration (mg/Kg) and Sample Depth (feet bgs)
 - 8.6 Contour Elevation (feet)
 - Centroid of PCB Distribution
 - Soil Boring Location
 - Test Pit Location
 - ⊕ Well Location
 - Overland Flow Direction
 - ▨ Estimated PCB Contribution via Overland Flow
 - Tax Parcel
 - ▭ WCGS-South Property Boundary



Note: Samples in gray indicate that no sample was collected from this depth or the sample was not analyzed for PCBs. Samples with posted PCB data above the reporting limit that are not included in a PCB distribution area are considered to be under an impervious surface.

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Overland Flow Map
 Wilmington Coal Gas Site South
 Wilmington, Delaware

By	Date	Scale:	File Name:
SMD	5/11/09	1:960	wcgs-s topo.mxd
Checked	JPR	5/11/09	Fig. No.
Project #	0985.26.51		Figure 6

0 40 80 Feet



Legend

- 0.023 (3.0'-5.0') Total PCB Concentration (mg/Kg) and Sample Depth (feet bgs)
- ND (10'-12') PCBs Not Detected and Sample Depth (feet bgs)
- Groundwater Flow Direction
- ← 230' → Groundwater Discharge Distance (feet)
- Soil Boring Location
- Test Pit Location
- ⊕ Well Location
- ▨ Estimated PCB Distribution
- Tax Parcel
- ▭ WCGS-South Property Boundary

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

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Groundwater Discharge Map
 Wilmington Coal Gas Site South
 Wilmington, Delaware

	By	Date	Scale:	File Name:
Drawn	SMD	5/11/09	1:960	wcgs-s gw dis.mxd
Checked	JPR	5/11/09	Fig. No.	
Project #	0985.26.51		Figure 7	

0 40 80 Feet

PCB Mass Loading
WCGS-S
SIRB ID: DE-0114
Wilmington, Delaware



BrightFields, Inc.

Tables

Table 1
 PCB Analytical Results For Soil
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043

Sample ID Sampling Depth (feet bgs) Sampling Date Units Report Issued	DNREC URS for Protection of Human Health Non-critical Water Resource Area mg/Kg		SS-102-S1 0'-0.5' 8/1/94 mg/Kg Earth Tech	SS-104-S1 0'-0.5' 8/1/94 mg/Kg Earth Tech	SS-107-S1 0'-0.5' 8/1/94 mg/Kg Earth Tech	SS-112-S1 0'-0.5' 8/1/94 mg/Kg Earth Tech	TP-102-S1 3.1' 8/1/94 mg/Kg Earth Tech	TP-103-S1 3.9' 8/1/94 mg/Kg Earth Tech
	Unrestricted Use	Restricted Use						
PESTICIDES/PCBS								
Atroclor-1016	5	82	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1221	0.3	3	0.786 U	2.4 U	0.16 U	0.29 U	0.15 U	0.08 U
Atroclor-1232	0.3	3	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1242	0.3	3	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1248	0.3	3	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1254	0.3	3	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1260	0.3	3	0.387 U	1.18 U	0.078 U	0.14 U	0.076 U	0.04 U
Atroclor-1262	nca	nca	NR	NR	NR	NR	NR	NR
Atroclor-1268	nca	nca	NR	NR	NR	NR	NR	NR
All other PCBs were not detected above laboratory detection limits								

Earth Tech - Facility Evaluation, Earth Tech 1994
 DP&L - Substation Area Investigation, ENSR 2005
 ENSR - Additional Remedy Evaluation, ENSR 2005
 ENSR - Supplemental Investigation, ENSR 2006

Qualifiers

- U - The compound was not detected above laboratory detection limits
- NR - Not analyzed.
- nca - no criteria available
- bold - concentration is above DNREC URS unrestricted use criteria
- shaded - concentration is above DNREC URS restricted use criteria

Table 1
 PCB Analytical Results For Soil
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043

Sample ID Sampling Depth (feet bgs) Sampling Date Units Report Issued	DNREC URS for Protection of Human Health Non-critical Water Resource Area mg/Kg		B-101-S5 8'-10' 8/1/94 mg/Kg Earth Tech	MW-102-S6 10'-12' 8/1/94 mg/Kg Earth Tech	MW-103-S6 10'-12' 8/1/94 mg/Kg Earth Tech	MW-105-S3 9'-11' 8/1/94 mg/Kg Earth Tech	B-115 0'-2' 9/14/05 mg/Kg ENSR	B-117 0'-2' 9/14/05 mg/Kg ENSR
	Unrestricted Use	Restricted Use						
PESTICIDES/PCBs								
Aroclor-1016	5	82	0.484 U	0.602 U	0.069 U	0.24 U	ND U	ND U
Aroclor-1221	0.3	3	0.983 U	1.22 U	0.14 U	0.48 U	ND U	ND U
Aroclor-1232	0.3	3	0.484 U	0.602 U	0.069 U	0.24 U	ND U	ND U
Aroclor-1242	0.3	3	0.484 U	0.602 U	0.069 U	0.24 U	ND U	ND U
Aroclor-1248	0.3	3	0.484 U	0.602 U	0.069 U	0.24 U	ND U	ND U
Aroclor-1254	0.3	3	0.484 U	0.602 U	0.069 U	0.24 U	ND U	ND U
Aroclor-1260	0.3	3	0.484 U	0.602 U	0.069 U	0.24 U	0.038	0.038
Aroclor-1262	nca	nca	NR	NR	NR	NR	NR	NR
Aroclor-1268	nca	nca	NR	NR	NR	NR	NR	NR
All other PCBs were not detected above laboratory detection limits								

Earth Tech - Facility Evaluation, Earth Tech 1994
 DP&L - Substation Area Investigation, ENSR 2005
 ENSR - Additional Remedy Evaluation, ENSR 2005
 ENSR - Supplemental Investigation, ENSR 2006

Qualifiers

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- bold - concentration is above DNREC URS unrestricted use criteria
- shaded - concentration is above DNREC URS restricted use criteria

Table 1
 PCB Analytical Results For Soil
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043

Sample ID Sampling Depth (feet bgs) Sampling Date Units	DNREC URS for Protection of Human Health Non-critical Water Resource Area mg/Kg		B-119 0'-2' 9/14/05 mg/Kg ENSR	HA-13 0'-2' 10/20/05 mg/Kg DP&L	HA-12 0'-2' 10/20/05 mg/Kg DP&L	HA-7 0'-2' 10/20/05 mg/Kg DP&L	HA-1 0'-2' 10/20/05 mg/Kg DP&L	B-116 0'-2' 9/14/2005 mg/Kg ENSR	
	Unrestricted Use	Restricted Use							
PESTICIDES/PCBs									
Aroclor-1016	5	82	ND U	ND U	ND U	ND U	ND U	ND U	
Aroclor-1221	0.3	3	ND U	ND U	ND U	ND U	ND U	ND U	
Aroclor-1232	0.3	3	ND U	ND U	ND U	ND U	ND U	ND U	
Aroclor-1242	0.3	3	ND U	ND U	ND U	ND U	ND U	ND U	
Aroclor-1248	0.3	3	ND U	ND U	ND U	ND U	ND U	ND U	
Aroclor-1254	0.3	3	ND U	0.046	ND U	ND U	0.073	1.1	
Aroclor-1260	0.3	3	0.038	0.049	0.061	0.17	0.047	0.59	
Aroclor-1262	nca	nca	NR	NR	NR	NR	NR	NR	
Aroclor-1268	nca	nca	NR	NR	NR	NR	NR	NR	
All other PCBs were not detected above laboratory detection limits									

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Table 1
 PCB Analytical Results For Soil
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043

Sample ID Sampling Depth (feet bgs) Sampling Date Units Report issued	DNREC URS for Protection of Human Health Non-critical Water Resource Area mg/Kg		B-118 0'-2' 9/14/05 mg/Kg ENSR	B-128 0'-2' 9/14/05 mg/Kg ENSR	B-130 0'-2' 9/14/05 mg/Kg ENSR	B-120 0'-2' 9/14/05 mg/Kg ENSR	MM-104-S6 10'-12' 8/1/94 mg/Kg Earth Tech	B-121 0'-2' 9/14/05 mg/Kg ENSR
	Unrestricted Use	Restricted Use						
PESTICIDES/PCBS								
Aroclor-1016	5	82	ND U	ND U	ND U	ND U	0.15 U	ND U
Aroclor-1221	0.3	3	ND U	ND U	ND U	ND U	0.31 U	ND U
Aroclor-1232	0.3	3	ND U	ND U	ND U	ND U	0.15 U	ND U
Aroclor-1242	0.3	3	ND U	ND U	ND U	ND U	0.15 U	ND U
Aroclor-1248	0.3	3	ND U	ND U	ND U	ND U	0.15 U	ND U
Aroclor-1254	0.3	3	1.1	1.1	1.1	ND U	0.15 U	ND U
Aroclor-1260	0.3	3	0.99	0.99	0.99	0.052	0.15 U	0.052
Aroclor-1262	nca	nca	NR	NR	NR	NR	NR	NR
Aroclor-1268	nca	nca	NR	NR	NR	NR	NR	NR
All other PCBs were not detected above laboratory detection limits								

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Table 1
 PCB Analytical Results For Soil
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043

Sample ID Sampling Depth (feet bgs) Sampling Date Units Report Issued	DNREC URS for Protection of Human Health Non-critical Water Resource Area mg/Kg		B-154 0.5' 6/15/06 mg/Kg ENSR*	B-168 0.5' 6/16/06 mg/Kg ENSR*	SS-109-S2 4.0' 8/1/94 mg/Kg Earth Tech	TP-103-S1A 4.0' 8/1/94 mg/Kg Earth Tech	MW-102-S12 22'-24' 8/1/94 mg/Kg Earth Tech	B-154 6.2' 6/15/06 mg/Kg ENSR*	B-168 3.0' 6/16/06 mg/Kg ENSR*
	Unrestricted Use	Restricted Use							
PESTICIDES/PCBS									
Aroclor-1016	5	82	0.004 U	0.004 U	0.53 U	0.41 U	0.416 U	0.006 U	0.005 U
Aroclor-1221	0.3	3	0.006 U	0.006 U	0.108 U	0.832 U	.0845 U	0.009 U	0.007 U
Aroclor-1232	0.3	3	0.004 U	0.004 U	0.53 U	0.41 U	0.416 U	0.006 U	0.005 U
Aroclor-1242	0.3	3	0.004 U	0.004 U	0.53 U	0.41 U	0.416 U	0.006 U	0.005 U
Aroclor-1248	0.3	3	0.004 U	0.004 U	0.53 U	0.41 U	0.416 U	0.006 U	0.005 U
Aroclor-1254	0.3	3	0.004 U	0.014 J	0.53 U	0.41 U	0.416 U	0.006 U	0.023 J
Aroclor-1260	0.3	3	0.034	0.009 J	0.53 U	0.41 U	0.416 U	0.006 U	0.005 U
Aroclor-1262	nca	nca	NR	NR	NR	NR	NR	NR	NR
Aroclor-1266	nca	nca	NR	NR	NR	NR	NR	NR	NR
All other PCBs were not detected above laboratory detection limits									

Earth Tech - Facility Evaluation, Earth Tech 1994
 DP&L - Substation Area Investigation, ENSR 2005
 ENSR - Additional Remedy Evaluation, ENSR 2005
 ENSR - Supplemental Investigation, ENSR 2006

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- shaded - concentration is above DNREC URS restricted use criteria

Table 2
 PCB Analytical Results For Groundwater
 Wilmington Coal Gas Site - Southern Parcel
 Wilmington, DE
 SIRB ID: DE-1043
 (DE-1335 DE-1040)

Sample ID Sampling Date Units Report Issued	DNREC URS for Protection of Human Health ug/L		MW105 11-Nov-04 ug/L BrightFields	MW02-W001 11-Nov-04 ug/L BrightFields	MW03-W001 11-Nov-04 ug/L BrightFields	MW04-W001 11-Nov-04 ug/L BrightFields
	Unrestricted Use	Restricted Use				
PESTICIDES/PCBs						
Aroclor-1016	0.1		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1221	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1232	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1242	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1248	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1254	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1260	0.03		0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1262	nca		0.5 U	0.5 U	0.5 U	0.5 U
All other PCBs were not detected above laboratory detection limits						

BrightFields - Final Remedial Investigation Report. BrightFields 2005

Qualifiers

- U - The compound was not detected above laboratory detection limits
- NR - Not analyzed.
- nca - no criteria available
- bold - concentration is above DNREC URS unrestricted use criteria
- shaded - concentration is above DNREC URS restricted use criteria

PCB Mass Loading
WCGS-S
SIRB ID: DE-0114
Wilmington, Delaware



BrightFields, Inc.

Site Photographs

**PCB Mass Loading Evaluation
Wilmington Coal Gas Site - South**



Grass cover on site.



Grass and stone mulch ground cover on site.

**PCB Mass Loading Evaluation
Wilmington Coal Gas Site – South**



Asphalt and stone driveway.



Stone and grass ground cover.



**PCB Mass Loading Evaluation
Wilmington Coal Gas Site - South**



Overland flow drains across adjacent parking lot.



Stone and dirt covered entrance way.

**PCB Mass Loading Evaluation
Wilmington Coal Gas Site - South**



Drainage area



Drainage pipe

PCB Mass Loading
WCGS-S
SIRB ID: DE-0114
Wilmington, Delaware



BrightFields, Inc.

Overland Flow Calculations

**PCB Loading Calculations from the Revised Universal Soil Loss Equation
Wilmington Coal Gas Site - Southern Parcel
Area 1
Wilmington, DE
DE-1043**

Surface PCB Concentration 0.052 mg/kg

Symbol	Factor	Value	Units
R	Rainfall/Runoff Erosivity Index	170	10 ² ft-tonf in/acre hr
K	Soil Erodibility	0.424	0.01 tonf acre hr/ac ft-ton in
	Estimated Slope Length	134	Feet
	Estimated Elevation Difference	2	Feet
	Slope	1.5	Percent
	Erodeable Area	1.64	Acres
LS	Topographic Factor	0.197	Dimensionless
C	Cover and Management Factor	0.019	Dimensionless
P	Support Practice Factor	1	Dimensionless
	Average Annual Soil Loss	0.28	ton/ac/yr

PCB Loading via Overland Flow 0.022 grams/year - PCBs

WCGS-South Overland Flow Calculations (Area 1)

Location:

|

Manage Soil Topo
 Net C factor: 0.019
 Net LS factor: 0.197
 Net K factor: 0.424
 Net contour factor: 1.0
 Net ridge factor: 1.0
 Net ponding factor: 1.0

Rock cover, %: 0
 Adjust rock cover: | Set By user:
 General yield level:
 Surf. res. cov. values:
 Adjust res. burial level:

Soil conditioning index:

Avg. slope steepness, %: | Slope length (horiz), ft: | Crit. slope length, ft:
 Detachment on slope, t/ac/yr: | Soil loss erod. portion, t/ac/yr:
 Sediment delivery, t/ac/yr: | Soil loss for cons. plan, t/ac/yr:
 T value, t/ac/yr:

Fuel type for entire run:

Equiv. diesel use for entire simulation, gal/ac:
 Fuel cost for entire simulation, US\$/ac:

Energy use for entire simulation, BTU/ac:

Align of oper on segments | General composite segment info | Biomass by layer | Biomass summary | C subfactor by period | C subfactor by operation
 Ridges, contour by day | Erosion by day | Erosion by period | Erosion by operation | Erosion by year | Extra C, L, crit. length values | Hydrology | Management output by day
 Management output by period | Residue values | Roughness | STRIPS_AND_BARRIERS | MANAGEMENT_STRIP_BUILDER | Runoff / Sediment overall results
 Runoff / Sediment results by day | Sediment results by flow path | Sediment by segment | Sediment by segment by day | Soil output by day | Yield values | Visuals | Info
Soil | MISC_CALCULATIONS1 | Topography | Management | Strips / Barriers | Irrigation / Subsurface drainage | Diversion/terrace, sediment basin

Slope Soils

Segment	Soil	Seg length (horiz), ft	Soil loss, t/ac/yr	Sed. del., t/ac/yr	Consolidation time, yr
1	Generic Soils'silt loam (frn OM, v. slo perm)	130	0.28	0.28	7

(A)

**PCB Loading Calculations from the Revised Universal Soil Loss Equation
Wilmington Coal Gas Site - Southern Parcel
Area 2
Wilmington, DE
DE-1043**

Surface PCB Concentration 0.61 mg/kg

Symbol	Factor	Value	Units
R	Rainfall/Runoff Erosivity Index	170	10 ² ft-tonf in/acre hr
K	Soil Erodibility	0.365	0.01 tonf acre hr/ac ft-ton in
	Estimated Slope Length	328	Feet
	Estimated Elevation Difference	2.5	Feet
	Slope	0.8	Percent
	Erodeable Area	1.06	Acres
LS	Topographic Factor	0.119	Dimensionless
C	Cover and Management Factor	0.026	Dimensionless
P	Support Practice Factor	1	Dimensionless
	Average Annual Soil Loss	0.19	ton/ac/yr

**PCB Loading via Overland
Flow** 0.111 **grams/year - PCBs**

WCGS-South Overland Flow Calculations (Area 2)

Location: USA\Delaware\New Castle County

Net C factor: 0.026
 Net LS factor: 0.1119
 Net K factor: 0.3665
 Net contour factor: 1.0
 Net ridge factor: 1.0
 Net ponding factor: 0.94

Rock cover, %: 0
 Adjust rock cover: open
 General yield level: Set by user
 Surf. res. cov. values: Surf. cover
 Adjust res. burial level: Normal res. burial
 Soil conditioning index: open

Energy use for entire simulation, BTU/ac: 2500000

Energy use for entire simulation, gal/ac: 1.8
 Fuel cost for entire simulation, US\$/ac: 5.51

Align of oper on segments | General composite segment info | Biomass by layer | Biomass summary | C. subfactor by day | C. subfactor by period | C. subfactor by operation
 Ridges, contour by day | Erosion by day | Erosion by period | Erosion by operation | Erosion by year | Extra C. L. crit. length values | Hydrology | Management output by day
 Management output by period | Residue values | Roughness | STRIPS_AND_BARRIERS | MANAGEMENT_STRIP_BUILDER | Runoff / Sediment overall results
 Runoff / Sediment results by day | Sediment results by flow path | Sediment by segment | Soil output by day | Soil output by day | Yield values | Visuals | Info

Soil: MISC_CALCULATIONS1 | Topography | Management | Strips / Barriers | Irrigation / Subsurface drainage | Diversion/terrace, sediment basin

Soil: Slope Soils

Segment	Soil	Seg length (horiz), ft	Soil loss, t/ac/yr	Sed. del., t/ac/yr	Consolidation n time, yr
1	Generic Soils\clay loam (low-mod OM, v. slo perm)	330	0.19	0.19	7

Manage Soil Topo

Add break | Erase break

Avg. slope steepness, %: 0.80
 Detachment on slope, t/ac/yr: 0.19
 Sediment delivery, t/ac/yr: 0.19

Slope length (horiz), ft: 330
 Crit. slope length, ft: 0.19
 Soil loss erod. position, t/ac/yr: 0.189
 Soil loss for cons. plan, t/ac/yr: 0.189
 T value, t/ac/yr: 3.0

Fuel type for entire run: (none)

PCB Mass Loading
WCGS-S
SIRB ID: DE-0114
Wilmington, Delaware



BrightFields, Inc.

Groundwater Transport Calculations

**PCB Loading Calculations - Groundwater Discharge to Surface Water
Wilmington Coal Gas Site - Southern Parcel
Wilmington, DE
DE-0114**

**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
GP02					
Minimum	28.3	0.0018	1,200	1,700	460
Maximum	283	0.002	1,600	26,000	6,800

* - Groundwater Discharge (Q) = KiA

**TABLE B
Potential Groundwater PCB Concentration Calculation**

Location	Maximum Soil PCB (µg/kg)	f _{oc} (fraction of organic carbon)		Pore Water PCB (µg/L)	
				Minimum	Maximum
GP02	23	0.01	0.05	0.005	0.025

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

LOCATION	Subsurface Soil Concentration/ Converted to Pore Water Concentration (µg/L)	Estimated PCB Mass Loading (g/yr)	
		Minimum	Maximum
GP02	0.025	0.016	0.24