HRS DOCUMENTATION RECORD -- COVER SHEET

Name of Site: Blades Groundwater

EPA ID No.: DEN000304203

Date Prepared: November 2019

Contact Person:

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Pathways, Components, or Threats Not Scored

Surface Water Migration Pathway, Soil Exposure and Subsurface Intrusion Pathway, and Air Migration Pathway:

The surface water migration pathway, soil exposure and subsurface intrusion pathway, and air migration pathway were not scored as part of this Hazard Ranking System (HRS) evaluation. These pathways were not included because a documented release to these media would not significantly affect the overall score and because the ground water pathway produces an overall score above the minimum requirement for the Blades Groundwater Site to qualify for inclusion on the National Priorities List (NPL).

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HRS DOCUMENTATION RECORD

Name of Site: Blades Groundwater

Date Prepared: November 2019

EPA ID No.: DEN000304203

EPA Region: 3

Street Address of Site*: Near Triangle Park at Intersection of W. 7th Street and 8th Street

City, County, State, Zip Code: Blades, Sussex County, Delaware 19973

General Location in the State: Central Delaware

Topographic Map: Seaford East, DE

Latitude: * 38° 37' 53.9184"N (38.631644° North)

Longitude: *-75° 36' 37.6812" W (-75.610467° West)

The reference point corresponds to the location of monitoring well SIGW-06 in the central portion of the groundwater contamination plume (see **Figure 1**; Refs. 4; 5, p. 2; 6; 89, Figure 1).

> * The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area where the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed about where the contamination is located.

Scores

Ground Water[1] Pathway	Ex. 5 Deliberative Process (DP)
Surface Water Pathway	Not Scored
Soil Exposure and Subsurface Intrusion Pathway	Not Scored
Air Pathway	Not Scored
HRS SITE SCORE	Ex. 5 Deliberative Process (DP)

[1] "Ground water" and "groundwater" are synonymous; the spelling is different due to "ground water" being codified as part of the HRS, while "groundwater" is the modern spelling.

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WORKSHEET FOR COMPUTING HRS SITE SCORE
Blades Groundwater

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	Ex. 5 Deliberative Process (DP)	
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	Not Scored	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	Not Scored	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	Not Scored	
3a.	Soil Exposure Component Score (S_{se}) (from Table 5-1, line 22)	Not Scored	
3b.	Subsurface Intrusion Component Score (S_{ssi}) (from Table 5-11, line 12)	Not Scored	
3c.	Soil Exposure and Subsurface Intrusion Pathway Score (S_{sessi}) (from Table 5-11, line 13)	Not Scored	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	Not Scored	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2$		Ex. 5 Deliberative Process (DP)
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	Ex. 5 Deliberative Process (DP)	

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TABLE 3-1 GROUND WATER MIGRATION PATHWAY SCORESHEET
Blades Groundwater

GROUND WATER MIGRATION PATHWAY Factor Categories & Factors	MAXIMUM VALUE	VALUE ASSIGNED
Likelihood of Release		
1. Observed Release	550	Ex. 5 Deliberative Process (DP)
2. Potential to Release		
2a. Containment	10	Not Scored
2b. Net Precipitation	10	Not Scored
2c. Depth to Aquifer	5	Not Scored
2d. Travel Time	35	Not Scored
2e. Potential to Release [lines 2a(2b+2c+2d)]	500	Not Scored
3. Likelihood of Release (higher of lines 1 and 2e)	550	Ex. 5 Deliberative Process (DP)
Waste Characteristics		
4. Toxicity/Mobility	*	Ex. 5 Deliberative Process (DP)
5. Hazardous Waste Quantity	*	
6. Waste Characteristics	100	
Targets		
7. Nearest Well	50	Ex. 5 Deliberative Process (DP)
8. Population		
8a. Level I Concentrations	**	0
8b. Level II Concentrations	**	Ex. 5 Deliberative Process (DP)
8c. Potential Contamination	**	Not Scored
8d. Population (lines 8a+8b+8c)	**	Ex. 5 Deliberative Process (DP)
9. Resources	5	0
10. Wellhead Protection Area	20	Ex. 5 Deliberative Process (DP)
11. Targets (lines 7+8d+9+10)	**	
12. Aquifer Score (lines 3x6x11 divided by 82,500)	100	Ex. 5 Deliberative Process (DP)
13. Ground Water Migration Pathway Score (S_{gw})	100	

* Maximum value applies to waste characteristics category.
** Maximum value not applicable.

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SITE SUMMARY

The Blades Groundwater site is located in Blades, Delaware (**Figure 1**; Refs. 4, 6, 90). The geographic coordinates of the site are 38.6316437° North and -75.6104675° West based on the location of monitoring well SIGW-06 located near Triangle Park at the intersection of W. 7th Street and 8th Street (**Figure 1**; Refs. 4; 5, p. 2; 89, Figure 1). The site as scored for HRS purposes consists of a groundwater plume with no one identified source containing perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), chromium, hexavalent chromium, copper, nickel, and zinc (Ref. 89, Figure 1). Level II concentrations of PFOS, PFOA, and metals have been detected in the Town of Blades municipal supply wells, and Level II concentrations of PFOS and PFOA have been detected in seven residential drinking water wells, as further presented in **Sections 3.1.1 and 3.3** of this HRS documentation record (**Table 13 and Table 14**). The Town of Blades water authority provides drinking water to approximately 1,600 people and the seven residential drinking water wells provide drinking water to 15 people (Refs. 16, p. 2; 54, pp. 2, 8, 10, 12, 14, 16, and 22).

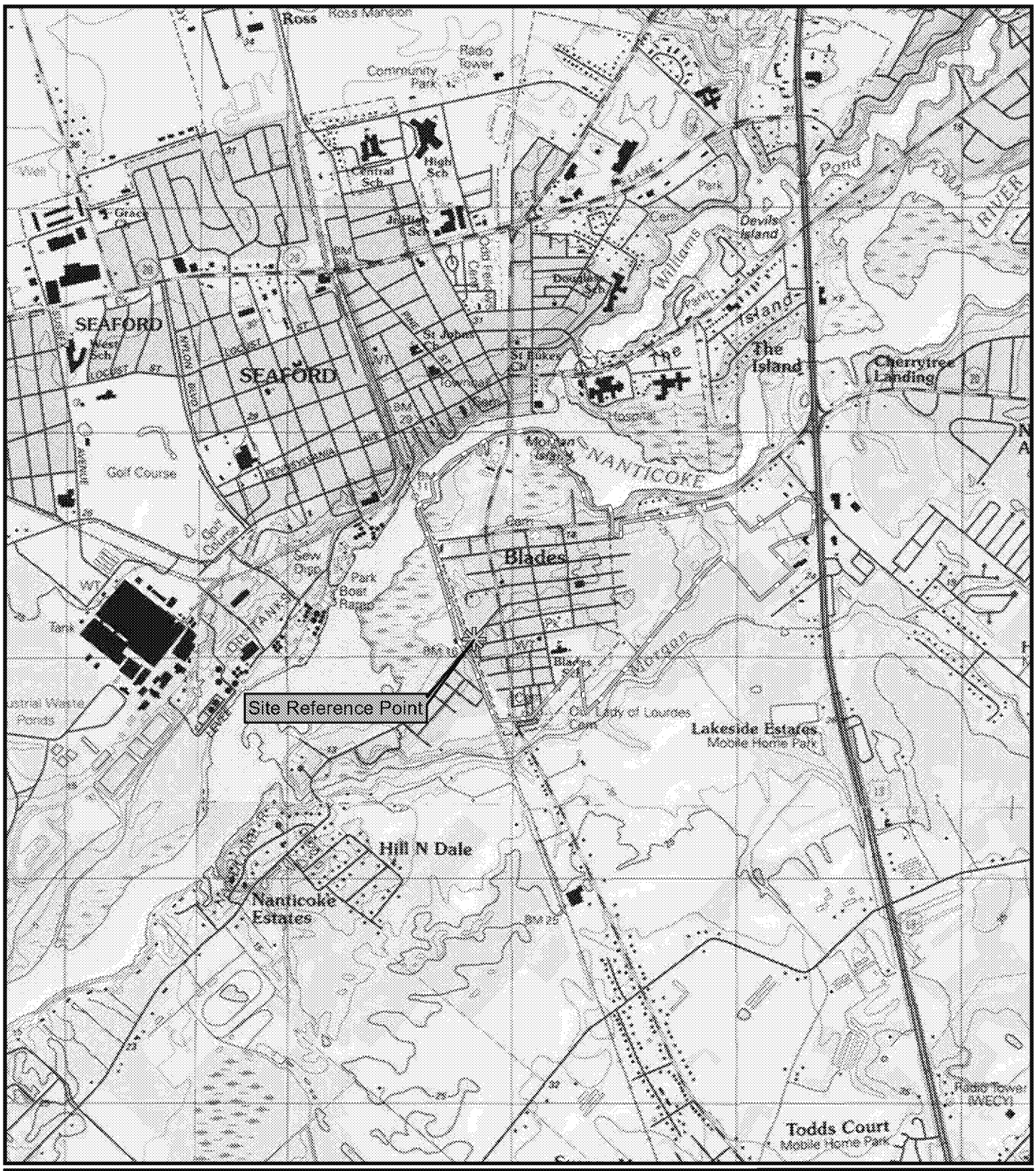
The Delaware Department of Natural Resources and Environmental Control (DNREC) worked with the EPA to determine if there was a potential for the Town of Blades drinking water wells to contain perfluorinated compounds (PFCs [hereinafter referred to as per- and polyfluoroalkyl substances (PFAS)]) due to manufacturing processes that have historically operated in the area. In February 2018, DNREC collected samples from the Town of Blades supply wells for PFAS analysis (Ref. 8, pp. 1, 2). Analytical results indicated that each of the three public supply wells had a total concentration of PFOS and PFOA greater than the EPA health advisory level (HAL) of 70 parts per trillion (ppt) for combined PFOS and PFOA, with concentrations ranging between 96.2 ppt and 187.1 ppt (Ref. 8, p. 2). On February 19, 2018, a carbon filtration system was installed on the water treatment system that significantly reduced the concentrations of PFAS. Post-treatment samples were non-detect for PFOS and PFOA in samples collected on February 28, 2018 (Ref. 8, p. 2).

From February to August 2018, EPA, under the Removal Program, collected groundwater samples from a total of 54 domestic wells for PFAS analysis at residences primarily located outside the town limits of Blades to the west and northeast of the town's boundary; four samples were collected from domestic wells within Blades that are not supplied potable water from the town water authority (Ref. 18, pp. 2-17; 64, p. 50). Concentrations exceeded the combined HAL of 70 ppt for PFOS and PFOA in seven of the domestic wells (**Section 3.1.1, Table 8**; Refs. 8, p. 2; 64, pp. 59-61). DNREC provided water system filters to eight residences with private wells with PFOA/PFOS concentrations above 52.5 nanograms per liter (ng/L) (ng/L is equivalent to ppt) (75% of the HAL) (Ref. 64, p. 22).

PFAS are a group of fluorinated organic man-made compounds, that include PFOS and PFOA, that are used in a wide variety of industrial and commercial process, such as metal plating, oil recovery, and semi-conductors/electronics manufacturing, as well as in numerous consumer products, such as food packaging, stain- and water-repellent fabrics, nonstick products (e.g., Teflon™), polishes, waxes, paints, cleaning products, pesticides and fire-fighting foam (Refs. 10, pp. 1 and 2; 11, pp. 1 and 2). PFAS are chemically and biologically stable in the environment and resist typical environmental degradation processes. As a result, these chemicals are very persistent in the environment. PFOS and PFOA are highly water-soluble and migrate readily from soil to groundwater, where they can be transported long distances (Ref. 11, p. 3).

DNREC has conducted Preliminary Assessment (PA) and Site Inspection (SI) investigations at two known metal plating facilities in Blades, the former Peninsula Plating facility and the active Procino Plating facility (Refs. 14, p. 1; 36, p. 1; 37, p. 1). Additionally, Procino Plating has conducted Remedial Investigation (RI) activities and is enrolled in DNREC's Voluntary Cleanup Program (VCP) as a result of past releases from their chrome plating tanks (Ref. 38, p. 6). However, as PFAS are emerging contaminants, previous investigations did not include the collection of samples for PFAS analysis. EPA has made significant efforts

to identify the specific source(s) of groundwater contamination through the installation and sampling of twenty monitoring wells ranging in depth from 12 feet below ground surface (bgs) to 96 feet bgs (Refs. 19, pp. 2-33; 47, pp. 7-12; 64, pp. 26, 28, 29, 31-33). Analytical results document the presence of site-related contaminants in groundwater (see Section 3.1.1 of this HRS documentation record); however, no specific source or sources could be found in the vicinity of the plume to which groundwater contamination could reasonably be attributed. As a result, the site is being scored as a groundwater plume with no identified source.



Legend

Site Location

Town of Blades Boundary

Ref. 5, p. 2

Background Topoquad:
USGS 7.5 Minute Quadrangle
Seaford East, 1983

The source of this map image is Esri, used by the EPA with Esri's permission

N

Coordinate System:
WGS84 UTM Zone 18N Feet

0 2,000
Feet

Blades Groundwater
Blades, Sussex County, DE

Figure 1
Site Location Map

TDD#: W503-18-04-001
Contract: EP-S3-15-02
Prepared: 7/26/2019

WESTON

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: Contaminated Groundwater Plume Number of source: 1

Source Type: Other - Groundwater Plume with No Identified Source

Description and Location of Source (see Figure 1; Ref. 89, Figure 1):

The Blades Groundwater site is a groundwater plume with no identified source ("Source 1"). Under the HRS, a contaminated groundwater plume can be evaluated as a source when the origin of hazardous substances that have contributed to the plume cannot be reasonably identified (Ref. 1, Section 1.1). The area of the plume shown on Figure 1 of Reference 89 is for HRS scoring purposes only, as defined below, and does not define the extent of all contamination in the area.

For HRS scoring purposes, the area of the groundwater plume is based on available sample locations that meet the criteria for an observed release (Ref. 1, Section 3.0.1.1). The minimum standard to establish an observed release by chemical analysis is analytical evidence of a hazardous substance in the media significantly above the background level. Further, some portion of the release must be attributable to the site (Ref. 1, Section 2.3). According to HRS scoring methodology, if the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit (SQL). If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is 3 times or more above the background concentration and above the SQL (Ref. 1, Table 2-3).

From February to August 2018, EPA, under the Removal Program, collected groundwater samples from a total of 54 domestic wells for PFAS analysis at residences primarily located outside the town limits of Blades to the west and northeast of the town's boundary; four samples were collected from domestic wells within Blades that are not supplied potable water from the town water authority (Refs. 18, pp. 2-17; 64, p. 50).

In October 2018, EPA installed twenty monitoring wells ranging in depth from 12 feet below ground surface (bgs) to 96 feet bgs (Ref. 19, pp. 2-33; 47, pp. 7-12). In October 2018, November 2018 and March 2019, EPA collected groundwater samples from the 20 newly installed monitoring wells; seventeen existing monitoring wells at a metal plating facility, Procino Plating, located in Blades; and from the three public supply wells (Refs. 47, pp. 1-19; 64, pp. 51 and 52).

Analytical results indicated the presence of PFOS, PFOA, chromium, hexavalent chromium, copper, nickel, and zinc in groundwater at concentrations significantly above background (**Section 3.1.1, Tables 8 and 9**). Background and contaminated public well, residential well, and monitoring well locations are shown on Figure 1 of Reference 89.

Documentation of the observed release sample analyses is presented in Section 3.1.1 Observed Release, under Chemical Analysis. The rationale for the lack of an identifiable source for the plume (i.e., that the significant increase in contaminant concentrations cannot be attributed to a release from any individual facility) is presented in Section 3.1.1 Observed Release, under Attribution.

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

Because the source consists of a groundwater plume, the plume contamination is established by sampling, using the observed release criteria presented in HRS Section 2.3 (Ref. 1, Section 2.3). The observed release by chemical analysis is documented in Section 3.1.1 Observed Release. Hazardous substances present in the plume at concentrations significantly above background include PFOS, PFOA, chromium, hexavalent chromium, copper, nickel, and zinc.

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Analytical results for groundwater samples collected from monitoring wells, residential wells, and public supply wells indicate that a release of hazardous substances has occurred to the ground water migration pathway as documented in Section 3.1.1 of this HRS documentation record. Based on this evidence of hazardous substance migration, a containment factor value of 10 is assigned for the ground water migration pathway [Ref. 1, Section 3.1.2.1, Table 3-2].

Table 1. Containment		
Containment Description	**Containment Factor Value**	**References**
Gas release to air:	NS	NA
Particulate release to air:	NS	NA
Release to ground water: The containment factor value of 10 is assigned based on analytical evidence of hazardous substances in groundwater samples from public supply wells, residential wells, and monitoring wells (see Tables 8 and 9 of this HRS documentation record). Therefore, based on evidence of release (evidence of hazardous substance migration from a source area), the highest ground water migration pathway containment factor value of 10 was assigned to Source 1.	Ex. 5 Deliberative Process (DP)	1, Section 3.1.2.1, Table 3-2; see also Section 3.1.1 of this HRS documentation record.
Release via overland migration and/or flood:	NS	NA

NS = Not scored.
NA = Not applicable.

2.4.2 Hazardous Waste Quantity

Insufficient information exists to evaluate hazardous constituent quantity and hazardous wastestream quantity. Therefore, the hazardous waste quantity value will be calculated using Tier C, the volume of the groundwater plume. Tier D is not evaluated for source type "other" [Ref. 1, Section 2.4.2.1].

2.4.2.1.1 Hazardous Constituent Quantity (Tier A)

The hazardous constituent quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all CERCLA hazardous substances in the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.1]. There are insufficient historical and current data (e.g., manifests, potentially responsible party [PRP] records, State records, permits, waste concentration data) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source. Consequently, there is insufficient information to evaluate the source to calculate the hazardous constituent quantity for Source 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous Wastestream Quantity [Ref. 1, Section 2.4.2.1.1].

Hazardous Constituent Quantity (C) Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity (Tier B)

The hazardous wastestream quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the mass of the hazardous wastestreams plus the mass of any additional CERCLA pollutants and contaminants in the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.2]. There are insufficient historical and current data (e.g., manifests, PRP records, State records, permits, waste concentration data) available to adequately calculate the total or partial mass of the wastestream plus the mass of all CERCLA pollutants and contaminants in the source. Consequently, there is insufficient information to evaluate the source to calculate the hazardous wastestream quantity for Source 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume [Ref. 1, Section 2.4.2.1.2].

Hazardous Wastestream Quantity (W) Value: NS

2.4.2.1.3 Volume (Tier C)

The exact volume for Source 1 could not be adequately determined according to the HRS requirements (Ref. 1, Section 2.4.2.1.3). Monitoring wells, residential drinking water wells, and public supply wells located within the plume contained PFOS, PFOA, chromium, hexavalent chromium, copper, nickel, and zinc at concentrations significantly above background (see Section 3.1.1). However, the boundaries and total depths of the plume are not sufficiently defined to get an exact volume. Therefore, based on the presence of hazardous substances in the observed release samples, the volume of the groundwater contamination is at least greater than 0 cubic yards, but the exact volume is unknown. [Ref. 1, Section 2.4.2.1.3, Table 2-5; Sections 2.2 and 2.2.2 of this HRS documentation record].

Dimension of source in cubic yards (yd^3): >0 yd^3
Volume (V) Assigned Value: (>0)/2.5 = >0

2.4.2.1.4 Area (Tier D)

Tier D is not evaluated for source type "other" [Ref. 1, Section 2.4.2.1.3, Table 2-5].

Area of source in square feet (ft^2): N/A
Area (A) Assigned Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 1 is >0 for Tier C - Volume [Ref. 1, Section 2.4.2.1.5].

Source Hazardous Waste Quantity Value: >0

ED_005024_00000452-00019

SITE SUMMARY OF SOURCE DESCRIPTIONS

Table 2. Hazardous Waste Quantity and Containment					
Source Number	Source Hazardous Waste Quantity Value	Containment			
		Ground Water	Surface Water	Air (Gas)	Air (Particulate)
1	>0	Ex. 5 Deliberative Process (DP)	NS	NS	NS

NS = Not scored.

Other Possible Sources

Other possible sources for the hazardous substances in the groundwater plume include Procino Plating and Peninsula Plating.

Procino Plating is located within the southeastern portion of the contaminated groundwater plume (Refs. 64, pp. 51 and 52; 89, Figure 1). Procino Plating has been conducting copper, nickel, and chrome electroplating operations at the facility located in Blades, Delaware (Ref. 38, p. 11). Chrome was stored in two tanks inside the process building, which originally had a wooden floor underlain by a crawl space with a soil floor (Ref. 38, p. 11). Soil samples collected in the vicinity of the chrome tanks contained concentrations of chromium ranging from 2.1 milligrams per kilogram (mg/kg) to 199 mg/kg, with the highest concentration detected at a depth of 8.5 feet bgs (Ref. 38, pp. 20, 21, 75, and 101). Additional soil samples collected in the vicinity of the chrome tanks contained concentrations of chromium ranging from 8.8 mg/kg to 751 mg/kg (Ref. 38, pp. 92-95, 106). Chromium contaminated soil was excavated and removed from beneath the chromium bath tanks to the extent practical without compromising the integrity of the building. Soil was excavated in a 10-foot by 10-foot area to a depth of 8 feet bgs (Ref. 38, p. 38). Approximately 14 tons of soil were removed (Ref. 39, p. 8). Post-excavation soil samples indicated that concentrations of chromium ranging from 23.8 mg/kg to 392 mg/kg remain in soil at the Procino Plating facility (Ref. 38, p. 107).

Fluorinated or perfluorinated compounds, also referred to as fluorosurfactants, are used as fume suppressants in chromium electroplating (Ref. 56, p. 87). The fluorosurfactants used as active ingredients in chemical fume suppressants are often referred to as perfluorooctyl sulfonates (PFOS). A 2003 survey of the chromium electroplating industry in California indicated that 190 out of 222 operations were using chemical fume suppressants as a mechanism to control hexavalent chromium emissions. Almost all of these facilities are using a chemical fume suppressant using PFOS as the active ingredient (Refs. 55, p. 6; 56, p. 154). The chemical fume suppressant is usually supplied at concentrations of 5 to 10 percent PFOS. Typically, in plating/anodizing operations the concentration of PFOS in the plating/anodizing bath is 100 parts per million (ppm) (Ref. 56, p. 155). A common chemical fume suppressant in plating facilities is Fumetrol 140®, which contains 1% to 7% organic fluorosulfonate by weight as the active ingredient (Refs. 55, p. 6; 57, p. 1). Procino Plating was documented to have numerous containers labeled Fumetrol 140™ at their facility (Ref. 37, p. 40).

Peninsula Plating was located within the northcentral portion of the contaminated groundwater plume (Refs. 64, pp. 51, 52; 89, Figure 1). The facility conducted electroplating operations from 1992 to 1995 (Ref. 15, p. 2). Peninsula Plating had an industrial wastewater discharge permit to the Sussex County sanitary sewer that contained effluent limitations for cadmium, copper, chromium, lead, nickel, zinc, and cyanide (Ref. 82, p. 4). The owner of the facility indicated that in addition to wastes discharged to the sanitary sewer, wastes were also disposed in a test well (Ref. 86, p. 7). In May 1995, as a result of non-compliance with

its industrial waste discharge permit (failure to report monthly discharge reports and failure to properly manage and dispose toxic and/or deleterious compounds on the premise) and failure to comply with Emergency Planning, and Community Right-to-Know requirements, Sussex County revoked the facility's wastewater discharge permit and permanently plugged its discharge line (Refs. 83, p. 1; 84, p. 1; 85, p. 1). In the spring of 1995, the DNREC Hazardous Waste Management Branch conducted a site inspection of the Peninsula Plating operation (Ref. 14, p. 10). The facility ceased operations and was abandoned (Ref. 14, p. 10). Between August and December 1995, EPA completed a CERCLA Removal Action at the abandoned Peninsula Plating facility. Numerous vats, tanks, drums, and small containers of hazardous materials were found unsecured and abandoned. Chemicals present at the facility included nickel sulfate, nickel chloride, sulfuric acid, chromic acid, hexavalent chromium, copper cyanide, copper sulfate, zinc cyanide, and cadmium fluoroborate (Refs. 14, p. 4; 15, p. 1; 66, p. 5). The EPA Removal Action consisted of the off-site disposal of seventy-eight 55-gallon drums of hazardous waste and 30 cubic yards of hazardous solids and debris (Ref. 14, pp. 11, 237). Soil was not addressed as part of the removal action (Ref. 14, p. 237).

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

The site is located in the Coastal Plain Physiographic Province (Ref. 41, p. 4). The Coastal Plain consists of a seaward-dipping wedge of unconsolidated and semi-consolidated sediments (Ref. 41, p. 7). The sediments that compose the Coastal Plain were deposited in non-marine, marginal marine, and marine environments. Interbedding of fine- and coarse-grained Coastal Plain sediments is complex because of shifting deltaic and alluvial deposition sites and because of repeated transgressions and regressions of the sea (Ref. 41, p. 10).

The soils underlying the site area are Henlopen (40%)-Rosedale (30%)-Urban land complex (20%) (HsA) (Ref. 20, pp. 1, 3-5). The Henlopen and Rosedale soils are somewhat excessively drained to well drained, nearly level soils formed in flats and marine terraces from sandy eolian deposits and loamy fluviomarine sediments (Ref. 20, pp. 4, 5). The Henlopen and Rosedale soils are classified in the hydrologic soil group A, which is indicative of soils with low runoff potential and high infiltration rates, even when thoroughly wetted, and high rates of water transmission (Ref. 20, pp. 4, 5).

The site is directly underlain by the Nanticoke River Group deposits, which consist of heterogeneous units of interbedded fine to coarse sand, clayey silt, sandy silt, and silty clay. The Nanticoke River Group deposits are characterized by brown to light gray, fine to medium quartz sand, and finely laminated to structureless, gray to brown, clayey, sandy silt and silty, clayey sand (Ref. 42). The Nanticoke River Group is approximately 25 feet thick and unconformably overlies the Beaverdam Formation (Ref. 42).

The Beaverdam Formation is a predominantly sandy, heterogeneous unit ranging from very coarse sand with pebbles to silty clay. The predominant lithologies are white to mottled light gray and reddish-brown, silty to clayey, fine to coarse sand. Laminae and beds of very coarse sand with pebbles to gravel are common. Laminae and beds of bluish-gray to light-gray silty clay are also common in the subsurface, ranging in thickness from 2 to 20 feet (Ref. 43, p. 7). The clay-silt layers are not laterally continuous within the Beaverdam deposits (Ref. 44, p. 21). The Beaverdam has a total thickness of approximately 105 feet (Ref. 42). In the vicinity of the site, the Beaverdam Formation unconformably overlies the Manokin Formation, which is present from Seaford to the Delaware/Maryland border (Refs. 42; 44, pp. 20 and 21).

The Manokin Formation consists of a coarsening upward sequence of gray, blue-gray, and brown-gray silty clayey sand and silty sand to light to medium gray or yellow-orange to red-orange (where weathered), fine to coarse sand with common beds of gravelly sand and rare beds of clayey to silty sand. Thickness ranges from a feather-edge to as much as 50 feet. The Manokin Formation is truncated by the overlying Beaverdam Formation (Refs. 42; 45, pp. 9 and 10).

3.0.1.2 Aquifer Boundaries

3.0.1.2.1 Aquifer Interconnections

The aquifer being evaluated is the surficial Columbia Aquifer. Included in the Columbia Aquifer are the Nanticoke River Group deposits, the Beaverdam Formation, and the Manokin and Columbia Formations where present (Ref. 46). In the vicinity of Blades, the fine-grained beds of the Manokin Formation are the base of the Columbia Aquifer (Ref. 46). The aquifer functions as both an unconfined and semiconfined aquifer (Ref. 46). Clay-silt layers are common but not laterally continuous within the Beaverdam Formation (Ref. 44, p. 21). Saturated thickness ranges from 30 to 100 feet (Ref. 46). The Town of Blades public supply wells withdraw water from the unconfined Columbia Aquifer (Refs. 72; 73, pp. 6 and 8). The Well

Head Protection Area (WHPA) for the public supply wells suggests a primary groundwater flow direction to the northwest, towards the public supply wells (Ref. 73, pp. 11, 31).

Soil borings and wells logs indicated groundwater is encountered between 3.22 and 14.97 feet bgs at the site (Refs. 36, pp. 48-60; 38, pp. 202-207, 282-288, 388; 75, pp. 1-39). Sand, fine- to coarse-grained, is present to depths of 92 to 102 feet bgs, with discontinuous clay lenses of various thicknesses at about 20 feet bgs and at about 40 feet bgs (Refs. 19, pp. 1-33; 36, pp. 42, 48-60; 38, p. 29, 32, 100, 202-207, 282-288; 50, pp. 3, 6, and 8). The absence of discernible continuous clay layers, both locally and regionally, demonstrates that a continuous confining layer is not present at the site (Refs. 19, pp. 4, 16, 19, 25, 31; 38, p. 388; 46; 50, pp. 6, 8). Additionally, as presented in **Section 3.1.1** of this HRS documentation record, wells completed and screened at depths ranging from 20 feet bgs to 96 feet bgs show PFOS, PFOA, and metals contamination (**Tables 7** and **8**). The migration of non-naturally-occurring contaminants through the fine-grained sediments and the subsequent presence of contamination throughout the aquifer to a depth of at least 95 feet bgs demonstrates that the interbedded fine-grained units do not act as a local barrier to groundwater flow within the surficial Columbia Aquifer.

For HRS scoring purposes, as described above, the aquifer beneath the site is evaluated as a single aquifer, the Columbia Aquifer.

3.0.1.2.2 Aquifer Discontinuities

There are no aquifer boundaries within 4 miles from the site source. As shown on the geologic cross-section and geohydrology maps, the unconfined Columbia Aquifer is continuous throughout the 4-mile target distance limit (TDL), there are no continuous confining layers within or between the units that make up the aquifer, and the Nanticoke River is relatively shallow and does not form hydrological divides (Refs. 42; 44, pp. 23, 24; 46; 72; 89, Figure 2). Based on the extent of the aquifer and the absence of other possible aquifer boundaries such as mountain ranges or oceans, there is no evidence of a potential aquifer boundary, or discontinuity, within 4 miles of the observed limits of groundwater contamination (Refs. 42; 44, pp. 14, 20, 23, 24; 46; 72; 89, Figure 2).

SUMMARY OF AQUIFER(S) BEING EVALUATED

Table 3. Aquifer Summary

Aquifer No.	Aquifer Name	Is Aquifer Interconnected with Upper Aquifer within 2 miles? (Y/N/NA)	Is Aquifer Continuous within 4-mile TDL? (Y/N)	Is Aquifer Karst? (Y/N)
1	Columbia (i.e., surficial)	NA	Y	N

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Aquifer Being Evaluated: Columbia Aquifer

Direct Observation

The aquifer is not evaluated for observed release by direct observation.

Chemical Analysis

An observed release by chemical analysis is established by showing that the hazardous substances in release samples are significantly greater in concentration than in the background level samples and by documenting that at least part of the significant increase is due to a release from the site being evaluated. If the background concentration is not detected, an observed release is established when the sample measurement equals or exceeds the appropriate quantitation limit. If the background sample concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is three times or more above the background concentration and above the appropriate quantitation limit (Ref. 1, Table 2-3). All hazardous substances in the groundwater observed release tables meet these criteria.

Residential domestic well samples were collected by EPA's Superfund Technical Assessment and Response Team (START) contractor as part of the EPA removal assessment between February 2018 and July 2018 (Refs. 18, pp. 4, 5, 6, 7, 14, 16; 23, p. 296; 24, p. 264; 25, p. 409; 26, p. 282; 27, p. 259; 71, pp. 357, 358). The samples were submitted to a non-Contract Laboratory Program (CLP) laboratory for PFAS analysis by EPA Method 537 and validated according to the National Functional Guidelines for Organic Superfund Methods Data Review and applicable EPA Region III modifications by EPA Region III ESAT (Refs. 23, p. 2; 24, p. 2; 25, p. 2; 26, p. 2; 27, p. 2; 71, p. 2).

Groundwater samples from existing monitoring wells at the Procino Plating facility were collected from October 8 through 11, 2018 by START, and submitted to the EPA Region III Environmental Sciences Service Center for PFAS analysis by EPA Method 537 and total metals analysis by ICP-MS (CLP equivalent) (Refs. 28, pp. 1, 9-14; 47, pp. 3-6). Data were validated at Level 2 (IM2) for inorganics and Level 3 (M3) for organics (Ref. 68, pp. 1, 2).

Groundwater samples from newly installed monitoring wells and the public supply wells were collected from November 5 through 18, 2018 by START, for inorganic and hexavalent chromium analysis, and on March 26 and 27, 2019, for PFAS analysis (Refs. 29, pp. 41, 42; 30, pp. 41, 42; 31, pp. 55, 57; 32, pp. 139, 141; 33, p. 554; 34, p. 503; 47, pp. 13, 15, 17-19). Samples for metals analysis were submitted to a CLP laboratory and analyzed according to Statement of Work (SOW) ISM02.4 ICP-MS total metals (Refs. 31, p. 2; 32, p. 2). Samples for hexavalent chromium analysis were submitted to a non-CLP laboratory and analyzed according to EPA Method 218.7 (Refs. 29, p. 2; 30, p. 2). Samples for PFAS analysis were submitted to a non-CLP laboratory and analyzed according to EPA Method 537 (Refs. 33, p. 2; 34, p. 2; 35, p. 2). All analytical results from the newly installed wells and the public supply wells were validated by the EPA Region III ESAT according to the National Functional Guidelines for Inorganic and Organic Superfund Methods Data Review and applicable EPA Region III modifications (Refs. 29, p. 2; 30, p. 2; 31, p. 2; 32, p. 2; 33, p. 2; 34, p. 2; 35, p. 2).

- Background Concentrations

The background groundwater samples listed in **Tables 4, 5, and 6** demonstrate a range in depth (22 to 100 feet bgs) and screened interval (7.99 to –77.39 feet) spanning similar depths (13 to 96 feet bgs) and screened intervals (5.94 to -80.07 feet) as the groundwater samples used to document an Observed Release listed in **Tables 7, 8, and 9**. The depths and screened intervals of several residential wells are not known, but can reasonably be assumed to be completed and screened within the range of the background wells, based on the aquifer characteristics in their surroundings. To demonstrate the significance above background within the aquifer, the observed release samples were compared to the highest concentration of each hazardous substance detected in the background wells.

The background and release samples were collected by Weston Solutions, Inc. under the EPA START contract in accordance with the EPA-approved site-specific Field Sampling and Analysis Plans and START Standard Operating Procedure (SOP) 201, Groundwater Well Sampling, as well as with START SOPs 202, Residential Groundwater Sampling, and 202a, Residential Groundwater Sampling for PFCs, for the residential and public supply wells (Refs. 64, pp. 28, 29; 77; 78; 88, p. 3). Background and release samples were collected in the same type of bottleware with the same preservatives, and they were analyzed by the same analytical methods (Refs. 77, pp. 29-31; 78, p. 18; 88, p. 3). The locations of the background and release well samples are depicted on Figure 1 of Reference 89 of this HRS documentation record. As shown on Figure 1 of Reference 89, the background wells were located outside the plume boundary.

Table 4. Background Sample Information

Sample ID	Surface Elevation NAVD88 (feet)	Completed Well Depth (feet bgs)	Screened Interval (feet bgs/ NAVD88*)	Reference(s)
SIGW-12	13.55	46	35 to 45/ -21.45 to -31.45	19, pp. 18, 19; 42; 46; 49, p. 2
SIGW-14	12.45	18	5 to 15/ 7.45 to -2.55	19, p. 22; 42; 46; 49, p. 2
SIGW-19	17.99	22	10 to 20/ 7.99 to -2.01	19, p. 30; 42; 46; 49, p. 3
RW-245	11.08	50	40/-28.92	42; 46; 65, p. 3; 87, pp. 1, 2
RW-263	12.61	65	55/-42.39	42; 46; 65, p. 3; 87, pp. 1, 2
RW-148	12.61	100	Unknown (-77.39)**	42; 46; 65, p. 2; 87, pp. 1, 2

bgs – below ground surface
NAVD88 - North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established in 1991 and consists of a leveling network on the North American Continent, ranging from Alaska, through Canada, across the United States, affixed to a single origin point on the continent. In 1993 NAVD 88 was affirmed as the official vertical datum in the National Spatial Reference System (NSRS) for the Conterminous United States and Alaska (Ref. 79, p. 1)
* The NAVD88 elevation for the screened interval was determined by subtracting the depth in feet bgs from the surface elevation.
** The exact depth of the screened interval in this well is not known; however, based on available information of screened intervals of residential wells in the area, the screened interval can reasonably be assumed to be within 10 feet of the completed well depth. Therefore, the screened interval was assumed to be at a depth of 90 feet bgs.

Table 5. Background Sample Results - PFAS						
Sample ID	**CLP Sample ID**	**Date**	**Hazardous Substance**	**Concentration (ng/L)**	**RL (ng/L)**	**Reference(s)**
SIGW-14	C0AR0	3/27/19	PFOS	5.2 (15.6)	1.8	33, pp. 5, 269, 554; 47, p. 19; 89, Figure 1
			PFOA	6 J (18J)	5.4	
SIGW-19	C0AR8	3/27/19	PFOS	2.6 (7.8)	1.8	33, pp. 8, 302, 554; 47, p. 19; 89, Figure 1
			PFOA	7.7 (**23.1**)	5.3	
RW-245	C0AJ6	3/22/18	PFOS	35U	35	18, p. 6; 71, pp. 6, 122, 357; 89, Figure 1
			PFOA	17U	17	
RW-263	C0AL2	3/22/18	PFOS	**36U**	36	18, p. 6; 71, pp. 22, 193, 358; 89, Figure 1
			PFOA	18U	18	
RW-148	C0AL1	3/22/18	PFOS	36U	36	18, p. 6; 71, pp. 21, 189, 358; 89, Figure 1
			PFOA	18U	18	

Concentrations in parentheses ( ) indicate the significance above background concentrations (Ref. 1, Table 2-3).
Bold value indicates background concentration used to determine significance above background in release samples.
ng/L = nanograms per liter
J - estimated value – Percent recoveries and Relative Percent Differences (RPDs) for target analytes in the Low Level Matrix Spike/ Low Level Matrix Spike Duplicate (LLMS/LLMSD) analyses of sample C0AR0 were within control limits except for perfluorooctanoic acid (PFOA). The detected concentration for PFOA in the LMS spiked sample C0AR0 is estimated and has been qualified "J". The LMS % recovery was above the upper acceptance limits indicating a possible high bias; therefore, in accordance with *EPA' Fact Sheet for Using Qualified Data to Document an Observed Release and Observed Contamination,* the data was not adjusted. [Refs. 33, pp. 3, 261, and 262; 51, pp. 1-18].
RL = Reporting Limit - The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence taking into account any volume adjustments at the pre/extraction level as well as any sort of dilution done during the analysis (Ref. 69); therefore, the RL is equivalent to the HRS-defined Sample Quantitation Limit (SQL) (Ref. 1, Section 2.3)
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit (Ref. 71, p. 4)

Table 6. Background Sample Results - Metals						
Sample ID	**CLP Sample ID**	**Date**	**Hazardous Substance**	**Concentration (µg/L)**	**RDL/ MDL* (µg/L)**	**Reference(s)**
SIGW-12	MC0AH4	11/6/18	Chromium	0.76J (2.28J)	2	31, pp. 18, 36, 55; 47, p. 13; 52, pp. 1, 2; 89, Figure 1
			Copper	0.41J (1.23J)	2	
			Nickel	3 (**9**)	1	
			Zinc	9.4 (28.2)	2	
			Hexavalent Chromium	0.03U	0.0061*	29, pp. 9, 41; 47, p. 13; 89, Figure 1
SIGW-14	MC0AH6	11/7/18	Chromium	0.8J (2.4J)	2	32, pp. 48, 88, 139; 47, p. 17; 52, pp. 1, 7, 8; 89, Figure 1
			Copper	1.3J (**3.9J**)	2	
			Nickel	0.53J (1.59J)	1	
			Zinc	0.97J (2.91J)	2	
			Hexavalent Chromium	0.019J (0.057J)	0.0061*	30, pp. 9, 41; 47, p. 17; 89, Figure 1
SIGW-19	MC0AK7	11/7/18	Chromium	1.4J (**4.2J**)	2	32, pp. 66, 94, 141; 47, p. 17; 52, pp. 1, 9; 89, Figure 1
			Copper	1.2J (3.6J)	2	
			Nickel	0.69J (2.07J)	1	
			Zinc	18.8 (**56.4**)	2	
			Hexavalent Chromium	0.063 (**0.189**)	0.0061*	30, pp. 13, 42; 47, p. 17; 89, Figure 1

Concentrations in parentheses ( ) indicate the significance above background concentrations (Ref. 1, Table 2-3).
µg/L = micrograms per liter
J - estimated value – The result is ≥ the Method Detection Limit (MDL) and < Reporting Detection Limit (RDL), as such the J-flagged results are associated with no bias, and therefore require no adjustment (Refs. 29, pp. 2, 3; 30, pp. 2, 3; 32, pp. 3, 4; 51, pp. 1-18).
U = the analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit (Refs. 29, p. 3; 30, p. 3; 32, pp. 4)
MDL = Method Detection Limit - the lowest concentration of analyte that a method can detect reliably in either a sample or blank (Ref. 1, Section 1.1)
RDL = Reporting Detection Limit - equivalent to the HRS defined Contract-required Quantitation Limit (CRQL), adjusted for sample weight, volume, dilution, and percent solid [Refs. 1, Section 1.1; 53, pp. 102, 242].
* For analyses not performed under the CLP, the MDL is used in place of the HRS-defined SQL (Ref. 1, Section 2.3)

- Contaminated Samples

Table 7. Contaminated Sample Information				
Sample ID	**Surface Elevation NAVD88 (feet)**	**Completed Well Depth (feet bgs)**	**Screened Interval (feet bgs/ NAVD88*)**	**Reference(s)**
GW-01/ MW-01	16.16	18	8 to 18/ 8.16 to -1.84	36, pp. 20, 55; 42; 46; 49, p. 3
GW-02/ MW-02	15.91	18	8 to 18/ 7.91 to -2.09	36, pp. 20, 56; 42; 46; 49, p. 3
GW-03/ MW-03	17.30	18	8 to 18/ 9.3 to -0.7	36, pp. 20, 57; 42; 46; 49, p. 3
GW-04/ MW-04	19.29	18	8 to 18/ 11.29 to 1.29	36, pp. 20, 58; 42; 46; 49, p. 3
GW-05/ MW-05	18.88	19	9 to 19/ 9.88 to -0.12	36, pp. 20, 59; 42; 46; 49, p. 4
GW-07/ MW-07	18.02	27.5	7.5 to 27. 5/ 10.52 to -9.48	38, pp. 202, 203; 42; 46; 49, p. 4
GW-08/ MW-08	15.25	24	4 to 24/ 11.25 to -8.75	38, pp. 204, 205; 42; 46; 49, p. 3
GW-09/ MW-09	14.86	27	7 to 27 7.86 to -12.14	38, pp. 206, 207; 42; 46; 49, p. 3
GW-10/ MW-10	16.83	24	4 to 24/ 12.83 to -7.2	38, p. 282; 42; 46; 49, p. 4
GW-11/ MW-11	15.50	25	5 to 25/ 10.5 to -9.5	38, p. 283; 42; 46; 49, p. 3
GW-12/ MW-12	15.19	24	4 to 24/ 11.19 to -8.81	38, p. 284; 42; 46; 49, p. 3
GW-13/ MW-13	17.96	16	6 to 16/ 11.96 to 1.96	38, p. 385; 42; 46; 49, p. 4
GW-14/ MW-14	17.20	15	5 to 15/ 12.2 to 2.2	38, p. 386; 42; 46; 49, p. 2
GW-15/ MW-15	15.95	16	6 to 16/ 9.95 to -0.05	38, p. 387; 42; 46; 49, p. 2
SIGW-05	17.94	18	12 to 17/ 5.94 to 0.94	19, p. 8; 42; 46; 49, p. 2
SIGW-07	13.84	13	3 to 13/ 10.84 to 0.84	19, p. 11; 42; 46; 49, p. 2
DMW-01	15.30	44	34 to 44/ -18.7 to -28.7	38, pp. 285, 286; 42; 46; 49, p. 3
DMW-02	14.76	43	33 to 43/ -18.24 to -28.24	38, pp. 287, 288; 42; 46; 49, p. 3
DMW-03	16.00	34	24 to 34/ -8 to -18	38, p. 388; 42; 46; 49, p. 2
SIGW-04	14.08	36	25 to 35/ -10.92 to -20.92	19, pp. 6, 7; 42; 46; 49, p. 2
SIGW-06	18.06	42	30 to 40/ -11.94 to -21.94	19, pp. 9, 10; 42; 46; 49, p. 2

Table 7. Contaminated Sample Information (concluded)				
Sample ID	**Surface Elevation NAVD88 (feet)**	**Completed Well Depth (feet bgs)**	**Screened Interval (feet bgs/ NAVD88*)**	**Reference(s)**
SIGW-13	13.45	52	42 to 52/ -28.55 to -38.55	19, pp. 20, 21; 42; 46; 49, p. 2
RW-115	12.98	Unknown	Unknown	54, p. 2; 87, pp. 1, 2
RW-170	15.36	50	43 to 48/-27.64 to -32.64	48, pp. 1, 2; 54, p. 8; 87, pp. 1, 2
RW-173	12.98	Unknown	Unknown	42; 46; 54, p. 10; 87, pp. 1, 2
RW-182	12.98	Unknown	Unknown	42; 46; 54, p. 12; 87, pp. 1, 2
RW-197	13.76	Unknown	Unknown	42; 46; 54, p. 14; 87, pp. 1, 2
RW-209	16.94	40	Unknown	42; 46; 54, p. 16; 87, pp. 1, 2
RW-275	13.76	Unknown	Unknown	54, p. 22; 87, pp. 1, 2
PW-01	20.28	96	66 to 96/ -45.72 to -75.72	13, p. 8; 42; 46; 50, p. 3; 61, pp. 1-3
PW-02	20.54	96	66 to 96/ -45.46 to -75.46	13, p. 8; 42; 46; 50, p. 4; 61, pp. 4-6
PW-03	16.78	95	65 to 90/ -48.22 to -73.22	42; 46; 50, pp. 5, 6; 87, pp. 1, 2
SIGW-18	14.93	96	65 to 95/ -50.07 to -80.07	19, pp. 27-29; 42; 46; 49, p. 3
SIGW-20	18.00	76	67 to 72/ -49 to -54	19, pp. 31-33; 42; 46; 49, p. 4

bgs – below ground surface
* The NAVD88 elevation for the screened interval was determined by subtracting the depth in feet bgs from the surface elevation.

Table 8. Observed Release Sample Results - PFAS						
Sample ID	**CLP Sample ID**	**Date**	**Hazardous Substance**	**Concentration (ng/L)**	**QL/RL* (ng/L)**	**Reference(s)**
GW-01/ MW-01	C0AD2	10/9/18	PFOS	183	43.1	28, pp. 9, 19; 47, p. 4; 89, Figure 1
GW-02/ MW-02	C0AD8	10/9/18	PFOS	2,820	216	28, pp. 9, 15; 47, p. 4; 89, Figure 1
GW-03/ MW-03	C0AD9	10/9/18	PFOS	156	44.6	28, pp. 11, 16; 47, p. 3; 89, Figure 1
			PFOA	29.1	8.93	
GW-04/ MW-04	C0AE0	10/8/18	PFOS	73.2	8.93	28, pp. 11, 22; 47, p. 3; 89, Figure 1
			PFOA	33.5	8.93	
GW-05/ MW-05	C0AE1	10/8/18	PFOS	215	43.1	28, pp. 11, 23; 47, p. 3; 89, Figure 1
			PFOA	27.9	8.62	
GW-07/ MW-07	C0AE3	10/10/18	PFOS	347	44.6	28, pp. 11, 24; 47, p. 5; 89, Figure 1
			PFOA	35.1	8.93	
GW-08/ MW-08	C0AE4	10/11/18	PFOS	155	8.77	28, pp. 11, 25; 47, p. 6; 89, Figure 1
GW-09/ MW-09	C0AE5	10/9/18	PFOS	241	43.1	28, pp. 11, 26; 47, p. 4; 89, Figure 1
GW-10/ MW-10	C0AE6	10/11/18	PFOS	1,300	86.2	28, pp. 11, 27; 47, p. 6; 89, Figure 1
GW-11/ MW-11	C0AE7	10/11/18	PFOS	228	43.9	28, pp. 11, 28; 47, p. 6; 89, Figure 1
GW-12/ MW-12	C0AE8	10/11/18	PFOS	156	8.93	28, pp. 11, 29; 47, p. 6; 89, Figure 1
GW-13/ MW-13	C0AE9	10/8/18	PFOS	265	43.1	28, pp. 11, 30; 47, p. 3; 89, Figure 1
GW-14/ MW-14	C0AF0	10/11/18	PFOS	465	89.3	28, pp. 12, 31; 47, p. 6; 89, Figure 1
GW-15/ MW-15	C0AF1	10/10/18	PFOS	190	43.9	28, pp. 12, 32; 47, p. 5; 89, Figure 1
DMW-01	C0AG0	10/10/18	PFOS	122	8.77	28, pp. 10, 21; 47, p. 5; 89, Figure 1
DMW-02	C0AF3	10/9/18	PFOS	74.2	8.93	28, pp. 9, 20; 47, p. 4; 89, Figure 1
DMW-03	C0AF4	10/10/18	PFOS	151	43.9	28, pp. 9, 17; 47, p. 5; 89, Figure 1
SIGW-04	C0AR6	03/26/19	PFOA	39	5.3*	34, pp. 8, 240, 503; 47, p. 18; 89, Figure 1
SIGW-05	C0AS2	03/26/19	PFOA	34	5.3*	34, pp. 10, 270, 503; 47, p. 18; 89, Figure 1
SIGW-06	C0AR4	03/26/19	PFOS	190	1.8*	34, pp. 6, 7, 221, 231, 503; 47, p. 18; 89, Figure 1
			PFOA	610	26*	
SIGW-13	C0AR2	03/27/19	PFOS	50	1.8*	33, pp. 7, 289, 554; 47, p. 19; 89, Figure 1
			PFOA	72	5.3*	
RW-115	C0AL4	2/27/18	PFOS	44	34*	18, p. 7; 25, pp. 36, 124, 409; 89, Figure 1

Table 8. Observed Release Sample Results - PFAS						
Sample ID	**CLP Sample ID**	**Date**	**Hazardous Substance**	**Concentration (ng/L)**	**QL/RL* (ng/L)**	**Reference(s)**
RW-170	C0AF2	2/16/18	PFOS	350	340*	18, p. 4; 23, pp. 42, 144, 296; 89, Figure 1
RW-173	C0AF3	2/16/18	PFOS	57	36*	18, p. 4; 23, pp. 43, 149, 296; 89, Figure 1
RW-182	C0B23	6/06/18	PFOS	170	39*	18, p. 14; 26, pp. 35, 147, 282; 89, Figure 1
RW-197	C0AJ2	2/19/18	PFOS	180	35*	18, p. 5; 24, pp. 37, 132, 264; 89, Figure 1
RW-209	C0B52	7/11/18	PFOA	40	19*	18, p. 16; 27, pp. 28, 119, 259; 89, Figure 1
RW-275	C0AM1	2/28/18	PFOS	51	35*	18, p. 7; 25, pp. 43, 166, 409; 89, Figure 1
PW-01	C0AR9	03/26/19	PFOS	48	1.8*	35, pp. 11, 292, 710; 47, p. 18; 89, Figure 1
			PFOA	32	5.4*	
PW-02	C0AS0	03/26/19	PFOS	140	1.7*	35, pp. 12, 305, 710; 47, p. 18; 89, Figure 1
PW-03	C0AS1	03/26/19	PFOS	95	1.8*	35, pp. 13, 316, 710; 47, p. 18; 89, Figure 1

ng/L = nanograms per liter
* Indicates RL as the reporting detection limit as opposed to the QL as the reporting detection limit.
QL = Quantitation Limit - The lowest concentration of an analyte that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method and that takes into account analytical adjustments made during sample preparation and analysis (Ref. 28, p. 83); therefore, the QL is equivalent to the HRS-defined SQL (Ref. 1, Section 2.3)
RL = Reporting Limit - The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence taking into account any volume adjustments at the pre/extraction level as well as any sort of dilution done during the analysis (Ref. 69); therefore, the RL is equivalent to the HRS-defined SQL (Ref. 1, Section 2.3)

Table 9. Observed Release Sample Results - Metals						
Sample ID	**CLP Sample ID**	**Date**	**Hazardous Substance**	**Concentration (µg/L)**	**QL/MDL*/RDL** (µg/L)**	**Reference(s)**
GW-07/ MW-07	MC0AE3	10/10/18	Chromium	28.2	2	28, pp. 14, 64; 47, p. 5; 89, Figure 1
			Nickel	25.1	1	
GW-10/ MW-10	MC0AE6	10/11/18	Chromium	22.8	2	28, pp. 14, 67; 47, p. 6; 89, Figure 1
			Nickel	324	1	
			Zinc	304	2	
GW-11/ MW-11	MC0AE7	10/11/18	Nickel	33.2	1	28, pp. 14, 68; 47, p. 6; 89, Figure 1
GW-15/ MW-15	MC0AF1	10/10/18	Chromium	16.9	2	28, pp. 14, 72; 47, p. 5; 89, Figure 1
SIGW-07	MC0AG9	11/7/18	Hexavalent Chromium	0.25	0.0061*	30, pp. 16, 41; 47, p. 15; 89, Figure 1
PW-01	MC0AN6	11/5/18	Copper	6.4	2**	31, pp. 27, 39, 57; 47, p. 16; 52, pp. 1, 3; 89, Figure 1
PW-02	MC0AN4	11/5/18	Copper	61.7	2**	31, pp. 24, 38, 57; 47, p. 16; 52, pp. 1, 2, 3; 89, Figure 1
			Zinc	254	2**	
PW-03	MC0AN3	11/5/18	Copper	7.7	2**	31, pp. 21, 37, 57; 47, p. 16; 52, pp. 1, 2; 89, Figure 1
SIGW-18	MC0AJ0	11/7/18	Chromium	4.7	2**	32, pp. 60, 92, 141; 47, p. 17; 52, pp. 1, 8, 9; 89, Figure 1
SIGW-20	MC0AN9	11/7/18	Chromium	13.6	2**	31, pp. 30, 40, 57; 47, p. 17; 52, pp. 1, 3; 89, Figure 1

µg/L = micrograms per liter
MDL = Method Detection Limit - the lowest concentration of analyte that a method can detect reliably in either a sample or blank (Ref. 1, Section 1.1)
RDL = Reporting Detection Limit - equivalent to the HRS defined Contract-required Quantitation Limit (CRQL), adjusted for sample weight, volume, dilution, and percent solid [Refs. 1, Section 1.1; 53, pp. 102, 242].
QL = Quantitation Limit - The lowest concentration of an analyte that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method and that takes into account analytical adjustments made during sample preparation and analysis (Ref. 28, p. 83); therefore, the QL is equivalent to the HRS-defined SQL (Ref. 1, Section 2.3)
* For analyses not performed under the CLP, the MDL is used in place of the HRS-defined SQL (Ref. 1, Section 2.3)
**Denotes RDL

Attribution:

The site consists of a PFOS, PFOA, and metals (copper, chromium, hexavalent chromium, nickel and zinc) contaminated groundwater plume with no identified source(s) that has contaminated three public supply wells and seven residential domestic wells (**Section 3.1.1**, **Tables 8 and 9**). The significant increase in the contaminated public supply wells and residential wells is not attributable to a specific source at a facility. Therefore, the site is evaluated as contaminated groundwater plume with no identified source (Ref. 1; Ref. 1, Sections 1.1, 3.1.1). The primary contaminants of concern, PFAS, in particular PFOS and PFOA, are manufactured chemicals not known to occur naturally, and non-detected concentrations in some background wells show that they are not ubiquitous throughout the area (see **Section 3.1.1, Table 5** of this HRS documentation record). PFAS are a group of fluorinated organic man-made compounds, that include PFOS and PFOA, that are used in a wide variety of industrial and commercial processes, such as metal plating, oil recovery, and semiconductors/electronics manufacturing, as well as in numerous consumer products, such as food packaging, stain- and water-repellent fabrics, nonstick products (e.g., Teflon™), polishes, waxes, paints, cleaning products, pesticides, and firefighting foam (Refs. 10, pp. 1 and 2; 11, pp. 1 and 2). PFAS are chemically and biologically stable in the environment and resist typical environmental degradation processes. As a result, these chemicals are very persistent in the environment. PFOS and PFOA are highly water-soluble and migrate readily from soil to groundwater, where they can be transported long distances (Ref. 11, p. 3).

A 2002 Source Water Assessment (SWA) for the Town of Blades indicated seven discrete potential sources of contamination located within the WHPA (three underground storage tank facilities, three hazardous waste generators, and one Superfund site), including the Peninsula Plating and Procino Plating facilities discussed in further detail below, as well as Anchor Enterprises (Ref. 13, pp. 12 and 13). Anchor Enterprises is a major steel fabrication facility and is listed as a hazardous waste generator (Refs. 13, p. 12; 59, pp. 1-4; 80, p. 1).

DNREC has conducted PA and SI investigations at two known metal plating facilities in Blades, the former Peninsula Plating facility and the active Procino Plating facility (Refs. 14, p. 1; 36, p. 1; 37, p. 1). Additionally, Procino Plating has conducted Remedial Investigation (RI) activities and is enrolled in DNREC's Voluntary Cleanup Program (VCP) as a result of past releases from their chrome plating tanks (Ref. 38, p. 6). Fluorinated or perfluorinated compounds, also referred to as fluorosurfactants, are used as fume suppressants in chromium electroplating (Ref. 56, p. 87). The fluorosurfactants used as active ingredients in chemical fume suppressants are often referred to as perfluorooctyl sulfonates (PFOS). A 2003 survey of the chromium electroplating industry in California indicated that 190 out of 222 operations were using chemical fume suppressants as a mechanism to control hexavalent chromium emissions. Almost all of these facilities are using a chemical fume suppressant using PFOS as the active ingredient (Ref. 55, p. 6; 56, p. 154). The chemical fume suppressant is usually supplied at concentrations of 5 to 10 percent PFOS. Typically, in plating/anodizing operations the concentration of PFOS in the plating/anodizing bath is 100 ppm (Ref. 56, p. 155). A common chemical fume suppressant in plating facilities is Fumetrol 140®, which contains 1% to 7% organic fluorosulfonate by weight as the active ingredient (Refs. 55, p. 6; 57, p. 1). However, as PFAS are emerging contaminants, previous investigations did not include the collection of samples for PFAS analysis. In an effort to identify the source of PFOS and PFOA detected in the town of Blades public supply wells in February 2018, EPA reviewed the available PA, SI, and RI reports for both metal plating facilities that had operated or are currently operating in Blades, Delaware. Additionally, the metals detected in the groundwater, including hexavalent chromium are typical contaminants associated with plating facilities (Ref. 81, p. 21). A summary of DNREC investigations at each plating facility is provided below.

Peninsula Plating facility operations

From 1992 to 1995, the Peninsula Plating facility conducted electroplating operations in a portion of a building located in the southwestern corner of the Blades Commercial Complex (Refs. 14, pp. 8, 9, 35, and 239; 15, p. 2). Peninsula Plating had an industrial wastewater discharge permit to the Sussex County sanitary sewer that contained effluent limitations for cadmium, copper, chromium, lead, nickel, zinc, and cyanide (Ref. 82, p. 4). The owner of the facility indicated that in addition to wastes discharged to the sanitary sewer, wastes were also disposed in a test well (Ref. 86, p. 7). In May 1995, as a result of non-compliance with their industrial waste discharge permit (failure to report monthly discharge reports and failure to properly manage and dispose toxic and/or deleterious compounds on the premise) and failure to comply with Emergency Planning, and Community Right-to-Know requirements, the Sussex County revoked the facility's waste water discharge permit and permanently plugged its discharge line (Refs. 83, p. 1; 84, p. 1; 85, p. 1). In the spring of 1995, the DNREC Hazardous Waste Management Branch conducted a site inspection of the Peninsula Plating operation (Ref. 14, p. 10). The facility ceased operations and was abandoned (Ref. 14, p. 10). Between August and December 1995, EPA completed a CERCLA Removal Action at the abandoned Peninsula Plating facility. Numerous vats, tanks, drums, and small containers of hazardous materials were found unsecured and abandoned. Chemicals present at the facility included nickel sulfate, nickel chloride, sulfuric acid, chromic acid, hexavalent chromium, copper cyanide, copper sulfate, zinc cyanide, and cadmium fluoroborate (Refs. 14, pp. 2, 10; 15, p. 1; and 66, pp. 5, 6). The EPA Removal Action consisted of the off-site disposal of seventy-eight 55-gallon drums of hazardous waste and 30 cubic yards of hazardous solids and debris (Ref. 14, pp. 11, 237). Soil was not addressed as part of the removal action (Ref. 14, p. 237). It was noted in the On-Scene Coordinator (OSC) logbook for the Peninsula Plating facility that the chemical cadmium fluoroborate was present at the facility in containers (Ref. 66, p. 6). Cadmium fluoroborate is used to prepare electroplating baths for high strength steels where the normal cyanide baths cause problems of hydrogen embrittlement (Ref. 58, p. 2). Fluoroborates may be PFOS-containing compounds (Ref. 70, p. 32).

In 1999, DNREC performed a CERCLA SI at the former Peninsula Plating facility. As part of the SI, soil and groundwater samples from installed on-site monitoring wells were collected from the entire Blades Commercial Complex property as well as a groundwater sample from Town of Blades public supply wells adjacent to the north side of the Blades Commercial Complex (Ref. 14, pp. 13-15, 17, 21 and 42). With the exception of iron and manganese in several monitoring well samples, detected inorganics in the groundwater samples did not exceed DNREC regulatory standards (Ref. 14, pp. 18). With the exception of the concentrations of arsenic in two of the three soil samples analyzed for inorganics, detected concentrations did not exceed DNREC regulatory standards (Ref. 14, p. 22).

In 2007, DNREC issued a Final Plan for the Peninsula Plating facility that indicated No Further Action based on a Phase II Investigation conducted by BrightFields in 2006. The Phase II investigation included soil borings, test pits, and soil and groundwater sampling that were submitted to a laboratory for a full suite of possible contaminants. The investigation report concluded that there were no adverse environmental impacts remaining on the property. Two underground storage tanks were removed from the property under the appropriate regulations in April 2007 (Ref. 74, pp. 1, 4, and 5).

Procino Plating facility operations

Since 1985, Procino Plating has been conducting copper, nickel, and chrome electroplating operations at the facility located in Blades, Delaware (Ref. 38, p. 11). Chrome was stored in two tanks inside the process building, which originally had a wooden floor underlain by a crawl space with a soil floor. The wood floor and crawl space were removed, and a concrete slab was installed by Procino Plating in the late 1990s. A second building was added in 1993, primarily to house silver and electroless nickel plating for commercial and military customers (Ref. 38, p. 11).

In 2010, DNREC conducted a CERCLA Preliminary Assessment (PA) at Procino Plating (Ref. 37, p. 6). The PA noted a yellow and white powdery substance on the floor and in metal floor grates (Ref. 37, pp. 8 and 45). The PA also noted numerous containers labeled Fumetrol 140™ (Ref. 37, p. 40). In 2011, DNREC conducted a CERCLA SI at the Procino Plating facility. As part of the SI, DNREC collected groundwater samples from 13 private drinking water wells, 26 soil samples from 13 borings, and 6 groundwater samples from monitoring wells installed on the property (Ref. 36, pp. 8, 29, and 42). Of the 26 soil samples, 5 were submitted for laboratory analysis (Ref. 36, p. 11). With the exception of the concentration of iron in four soil samples, concentrations of contaminants were not detected above applicable DNREC soil screening levels (Ref. 36, pp. 12, 24). Chromium was detected in groundwater from a monitoring well at the facility at concentrations exceeding DNREC and EPA groundwater screening levels (Ref. 36, pp. 14 and 28). Barium, manganese, and zinc were detected in residential groundwater samples at concentrations exceeding DNREC or EPA screening levels (Ref. 36, pp. 14 and 29).

In 2011, Procino Plating entered into a VCP agreement with DNREC (Ref. 38, p. 13). From 2012 through 2015, Procino Plating, under the VCP, conducted Remedial Investigations and Remedial Actions at the facility. Soil samples collected in the vicinity of the chrome tanks contained concentrations of chromium ranging from 2.1 mg/kg to 199 mg/kg, with the highest concentration detected at a depth of 8.5 feet bgs (Ref. 38, pp. 20, 21, 75, and 101). Additional soil samples collected in the vicinity of the chrome tanks contained concentrations of chromium ranging from 8.8 mg/kg to 751 mg/kg (Ref. 38, pp. 92-94, 106). Chromium contaminated soil was excavated and removed from beneath the chromium bath tanks to the extent practical without compromising the integrity of the building. Soil was excavated in a 10-foot by 10-foot area to a depth of 8 feet bgs (Ref. 38, p. 38). Approximately 14 tons of soil were removed (Ref. 39, p. 8). Post-excavation soil samples indicated that concentrations of chromium ranging from 23.8 mg/kg to 392 mg/kg remain in soil at the Procino Plating facility (Ref. 38, p. 107). In 2012, a groundwater sample collected from the monitoring well immediately south of the former chrome tanks (MW-6) contained concentrations of chromium of 1,170 µg/L (Ref. 38, pp. 61, 73, 103).

Shallow groundwater flow in the vicinity of the Procino Plating facility has been observed to be towards the south (Ref. 38, pp. 77, 80, 81, 84, 86, and 88). However, the 2002 Source Water Assessment (SWA) for Town of Blades water supply, which at that time included two active public supply wells, shows that the wellhead protection area (WHPA) for the supply wells encompassed both the former Peninsula Plating facility and the active Procino Plating facility (Ref. 13, p. 26). The SWA also indicated seven discrete potential sources of contamination located within the WHPA (three underground storage tank facilities, three hazardous waste generators, and one Superfund site), including the Peninsula Plating and Procino Plating facilities (Ref. 13, pp. 12 and 13). A revised SWA completed in 2018, which includes the addition of the third Blades public supply well, no longer contains either of the two plating facilities within the WHPA (Ref. 73, p. 31). However, the revised WHPA suggests the public supply wells influence the groundwater to flow primarily in a northwest direction in the immediate vicinity of both plating facilities (Ref. 73, p. 31). Additionally, a calculated radius of influence for the public supply wells more closely resembles the WHPA as depicted in the 2002 SWA (Refs. 62, pp. 1-4; 63, p. 15).

No other possible sources for the groundwater contamination comprising the plume have been identified. A search of DNREC's environmental database identified four other facilities within the vicinity of Blades (Ref. 59, pp. 1-9). The facilities are listed as underground storage tank facilities, air permit facilities, and a hazardous waste generator (dry cleaners). No violations or enforcement actions were noted at any of the facilities (Ref. 59, pp. 1-9).

Though a source (contaminated soil) for the presence of chromium in the groundwater could reasonably be attributed to Procino Plating, the site is being scored as a groundwater plume with no one identified source

because a source(s) for the remaining contaminants present in the groundwater, PFOS, PFOA, hexavalent chromium, copper, nickel, and zinc, has not been documented.

Hazardous Substances Released:

PFOS
PFOA
Chromium
Copper
Nickel
Zinc
Hexavalent chromium

==========

Ground Water Observed Release Factor Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

Table 10. Toxicity/Mobility					
Hazardous Substance	**Source Numbers**	**Toxicity Factor Value**	**Mobility Factor Value***	**Toxicity/ Mobility**	**Reference(s)**
PFOS	1, OR	10,000	1.0	10,000	9, p. 189; 21, p. 1
PFOA	1, OR	10,000	1.0	10,000	7, p. 256; 21, p. 1
Chromium	1, OR	10,000	1.0	10,000	2, p. 1
Hexavalent Chromium	1, OR	10,000	1.0	10,000	2, p. 4
Copper	1, OR	100	1.0	100	2, p. 7
Nickel	1, OR	10,000	1.0	10,000	2, p. 10
Zinc	1, OR	10	1.0	10	2, p. 13

OR = Observed Release
* – Hazardous substances meeting the criteria for an observed release by chemical analysis to an aquifer underlying a source are assigned a mobility factor value of 1 [Refs. 1, Section 3.2.1.1; 1a, Section 2.4.1.1].

3.2.2 Hazardous Waste Quantity

Table 11. Hazardous Waste Quantity (HWQ)		
Source Number	**Source Hazardous Waste Quantity (HWQ) Value (Ref. 1 Section 2.4.2.1.5)**	**Is source hazardous constituent quantity data complete? (yes/no)**
1	>0	No
Sum of Values:	>0	

The sum corresponds to a hazardous waste quantity factor value of 1 in Table 2-6 of the HRS [Refs. 1, Section 2.4.2.2; 1a, Section 2.4.1.1]. However, because the hazardous constituent quantity is not adequately determined (see Section 2.4.2.1.1 of this HRS documentation record) and targets are subject to Level I and/or Level II concentrations (see Section 3.3.2.3 of this HRS documentation record), a hazardous waste quantity factor value of 100 is assigned if it is greater than the hazardous waste quantity value from Table 2-6 (i.e., 1) [Refs. 1, Section 2.4.2.2; 1a, Section 2.4.1.1]. Therefore, a hazardous waste quantity factor value of 100 is assigned for the ground water pathway [Refs. 1, Section 2.4.2.2; 1a, Section 2.4.1.1].

3.2.3 Waste Characteristics Factor Category Value

PFOS, PFOA, chromium, hexavalent chromium, and nickel correspond to the toxicity/mobility factor value of 10,000, as shown previously (see Section 3.2.1 of this HRS documentation record).

Toxicity/Mobility Factor Value (10,000) x Hazardous
Waste Quantity Factor Value (100): 1,000,000

The product (1,000,000) corresponds to a Waste Characteristics Factor Category Value of 32 in Table 2-7 of the HRS [Refs. 1, Section 2.4.3.1; 1a, Section 2.4.1.1].

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Toxicity/Mobility Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 32

3.3 TARGETS

The Town of Blades municipal authority consists of three active wells (Wells 1, 2 and 3) and provides potable water to approximately 1,600 persons within the town limits of Blades (Refs. 12, pp. 2, 7; 16, p. 2-3). The three wells are the only water sources associated with the Town of Blades public water supply system (Ref. 73, p. 23). The Town of Blades supply wells are completed in the Columbia Aquifer at depths ranging from 95 to 102 feet bgs and screened between 65 and 96 feet bgs (Ref. 12, pp. 2, 7; 50, pp. 3-8). In general, the three wells are pumped on a 24-hour cycle and not run concurrently, unless in an emergency (Ref. 16, p. 2). The groundwater from the wells is pumped into the same treatment system and blended prior to distribution (Ref. 16, p. 2). On a monthly average, no single well contributes more than 40 percent of the total system production; therefore, the population is apportioned equally among the three wells (533.33 people per well) (Refs. 1, Section 3.3.2; 16, pp. 2, 3, 4-54).

The majority of the residences within Blades are supplied with public water; however, residences outside the town limits are served by private domestic wells. Groundwater samples collected by EPA in 2018 from seven residences contain PFOS or PFOA at concentrations significantly above background (see **Section 3.1.1, Table 8**). Information regarding the depths, well construction, screened interval, and surface elevation of the domestic wells was not available for all the target wells presented in this HRS documentation record. Available information for residential wells in the vicinity of Blades indicates that residential wells are completed at depths ranging from 20 feet bgs to 115 bgs (Ref. 65, pp. 1-3).

Applicable benchmarks for the contaminants detected in the Town of Blades public supply wells and residential wells, presented here in µg/L for consistency with reported data, are as follows:

Table 12. Benchmarks

Substance	MCL/MCLG	CRSC	NCRSC	Reference(s)
PFOS	NA	NA	NA	
PFOA	NA	NA	NA	
Copper	1,300	NA	800	2, p. 7
Chromium	100	0.05	60	2, p. 1
Nickel	NA	NA	400	2, p. 10
Zinc	NA	NA	6,000	2, p. 13
Hexavalent chromium	100	0.05	60	2, p. 4

CRSC - Cancer Risk Screen Concentration
NCRSC - Non-Cancer Risk Screen Concentration
MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
NA – Not Available

3.3.1 Nearest Well

As specified in the HRS (Ref. 1, Section 3.3.1, Table 3-11), if one or more drinking water wells are subject to Level II concentrations, a Nearest Well Factor Value of 45 is assigned. Level II concentrations were detected in the three public supply wells and seven residential wells (see **Section 3.3.2.3** of this HRS documentation record).

Nearest Well Factor Value: 45
[Ref. 1, Table 3-11]

3.3.2 Population

3.3.2.1 Level of Contamination

Section 3.3.2.3 provides the number of people drinking from wells that have documented actual contamination based on hazardous substance concentrations that meet the observed release criteria (see **Section 3.1.1** of this HRS documentation record). Maximum Contaminant Level/Maximum Contaminant Level Goal (MCL/MCLG) and Non-Cancer Risk Screen Concentration (NCRSC) are used as benchmarks to evaluate the level of contamination [Ref. 1, Section 2.5.2].

3.3.2.2 Level I Concentrations

No Level I contamination attributable to the site has been documented at this time.

3.3.2.3 Level II Concentrations

Table 13. Level II - PFAS						
Location ID	**Population**	**Substance**	**Concentration (ng/L)**	**RL (ng/L)**	**Benchmark (ng/L)**	**Reference(s)**
PW-1	533.33*	PFOS	48	1.8	NA	16, p. 2; 23; 35, pp. 11, 292, 710
		PFOA	32	5.4	NA	
PW-2	533.33*	PFOS	140	1.7	NA	16, p. 2; 35, pp. 12, 305, 710
PW-3	533.33*	PFOS	95	1.8	NA	16, p. 2; 35, pp. 13, 316, 710
RW-115	1	PFOS	44	34	NA	25, pp. 36, 124, 409; 54, p. 2
RW-170	2	PFOS	350	340	NA	23, pp. 42, 144, 296; 54, p. 8
RW-173	2	PFOS	57	36	NA	23, pp. 43, 149, 296; 54, p. 10
RW-182	2	PFOS	170	39	NA	26, pp. 35, 147, 282; 54, p. 12
RW-197	2	PFOS	180	35	NA	24, pp. 37, 132, 264; 54, p. 14
RW-209	2	PFOA	40	19	NA	27, pp. 28, 119, 259; 54, p. 16
RW-275	4	PFOS	51	35	NA	25, pp. 43, 166, 409; 54, p. 22

ng/L = nanograms per liter
RL = Reporting Limit - The minimum levels, concentrations, or quantities of a target variable (e.g.., target analyte) that can be reported with a specified degree of confidence taking into account any volume adjustments at the pre/extraction level as well as any sort of dilution done during the analysis (Ref. 69); therefore, the RL is equivalent to the HRS-defined SQL (Ref. 1, Section 2.3)
* On a monthly average, no single well contributes more than 40 percent of the total system production; therefore, the population is apportioned equally among the three wells (1,600 people/3 wells = 533.33 people per well) (Refs. 1, p. Section 3.3.2; 16, pp. 2, 4-54).
NA = Not Available

Table 14. Level II - Metals						
Location ID	**Population**	**Substance**	**Concentration (µg/L)**	**RDL (µg/L)**	**Benchmark (µg/L)**	**Reference(s)**
PW-1	533.33	Copper	6.4	2	800	2, p. 7; 16, p. 2; 31, p. 27; 52, pp. 1, 3
PW-2	533.33	Copper	61.7	2	800	2, pp. 7, 13; 16, p. 2; 31, p. 24; 52, pp. 1, 2, 3
		Zinc	254	2	6,000	
PW-3	533.33	Copper	7.7	2	800	2, p. 7; 16, p. 2; 31, p. 21; 52, pp. 1, 2

µg/L = micrograms per liter

Population Served by Level II Wells: 1,614.99
Level II Concentrations Factor Value: 1,614.99
[Ref. 1, Section 3.3.2]

3.3.2.4 Potential Contamination

The potential contamination factor was not scored because targets subject to actual contamination at Level II concentrations (see **Sections 3.3.1 and 3.3.2.3**) and an impacted Wellhead Protection Area (see **Section 3.3.4**) are sufficient to achieve the maximum pathway score for this site.

Potential Contamination Factor Value: Not Scored

3.3.3 Resource

Resource use of the combined aquifers within the target distance limit does not include any documented Resource Factors. Therefore, a Resource Factor value of 0 is assigned (Ref. 1, Section 3.3.3).

Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The contaminated groundwater plume lies within the Town of Blades Wellhead Protection Area (Ref. 13, p. 26; 73, p. 31; 89, Figure 1). Wellhead Protection Areas in Delaware are designated by EPA in accordance with Section 1428 of the Safe Drinking Water Act (Ref. 60, pp. 1,2). Therefore, the Wellhead Protection Area Factor Value of 20 is assigned (Ref. 1, Section 3.3.4).

Wellhead Protection Area Factor Value: 20