

HAZARD RANKING SYSTEM (HRS) DOCUMENTATION RECORD COVER SHEET

Name of Site: East Basin Road Groundwater

EPA ID No.: DEN000304044

Date Prepared: September 2022

Contact Person: Lorie Baker
U.S. Environmental Protection Agency
Philadelphia, Pennsylvania
(215) 814-3355
Baker.Lorie@epa.gov

Pathways, Components, or Threats Not Scored

The surface water migration pathway, soil exposure and subsurface intrusion pathway, and air migration pathway were not scored in this Hazard Ranking System (HRS) documentation record as they are not expected to contribute significantly to the overall Site score as noted below. The subsurface intrusion component of the soil exposure and subsurface intrusion pathway is of concern to the U.S. Environmental Protection Agency (EPA) and may be considered during a future evaluation.

Surface Water Migration Pathway: The surface water migration pathway was not scored. The source being evaluated is a per- and polyfluoroalkyl substances (PFAS) and chlorinated volatile organic compound (CVOC) groundwater plume with no one identified source(s).

Soil Exposure and Subsurface Intrusion Pathway – Soil Exposure Component: The soil exposure component of the soil exposure and subsurface intrusion pathway was not scored because the source being evaluated is a PFAS and CVOC groundwater plume with no one identified source(s).

Soil Exposure and Subsurface Intrusion Pathway – Subsurface Intrusion Component: The subsurface intrusion component of the soil exposure and subsurface intrusion pathway was not scored. This component of the soil exposure and subsurface intrusion pathway is a concern at the Site due the presence of CVOCs in groundwater samples (**Section 3.1.1** of this HRS documentation record) and may be considered during a future evaluation.

Air Migration Pathway: The air migration pathway was not scored because the source being evaluated is a PFAS and CVOC groundwater plume.

This page intentionally left blank.

HAZARD RANKING SYSTEM (HRS) DOCUMENTATION RECORD

Name of Site: East Basin Road Groundwater
Date Prepared: September 2022
EPA ID No.: DEN000304044
EPA Region: 3
Street Address of Site*: 410 E. Roosevelt Ave.
County and State: New Castle, New Castle County, Delaware 19720
General Location in the State: Northeast Delaware
Topographic Map: Wilmington South, DE
Latitude: * 39.673092° North Longitude: *- 75.597211° West

The reference point for the site latitude and longitude coordinates corresponds to the intersection of School House Lane and Route 13/N. Dupont Highway in New Castle, Delaware, as shown on **Figures 1 and 2** of this Hazard Ranking System (HRS) documentation record (Refs. 3; 4; 5, p. 2; 92, pp. 1, 2).

* The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area 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 the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, EPA considers that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed about where the contamination has come to be located.

Scores

Ground Water ¹ Pathway	100.00
Surface Water Pathway	Not Scored
Soil Exposure and Subsurface Intrusion Pathway	Not Scored
Air Pathway	Not Scored

HRS SITE SCORE 50.00

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.

WORKSHEET FOR COMPUTING HRS SITE SCORE
East Basin Road Groundwater

	<u>S</u>	<u>S²</u>
1. Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	<u>100.00</u>	<u>10,000</u>
2a. Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	<u>Not Scored</u>	
2b. Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	<u>Not Scored</u>	
2c. Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	<u>Not Scored</u>	
3. Soil Exposure and Subsurface Intrusion Pathway Score (S_{sessi}) (from Table 5-1, line 22)	<u>Not Scored</u>	
4. Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	<u>Not Scored</u>	
5. Total of $S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2$	<u>10,000</u>	
6. HRS Site Score Divide the value on line 5 by 4 and take the square root	<u>50.00</u>	

GROUND WATER MIGRATION PATHWAY SCORESHEET
East Basin Road Groundwater

GROUND WATER MIGRATION PATHWAY Factor Categories and Factors	MAXIMUM VALUE	VALUE ASSIGNED
Likelihood of Release		
1. Observed Release	550	550
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	550	550
Waste Characteristics		
4. Toxicity/Mobility	*	10,000
5. Hazardous Waste Quantity	*	100
6. Waste Characteristics	100	32
Targets		
7. Nearest Well	50	50
8. Population		
8a. Level I Concentrations	**	256,487
8b. Level II Concentrations	**	NE
8c. Potential Contamination	**	NE
8d. Population (lines 8a+8b+8c)	**	256,487
9. Resources	5	0
10. Wellhead Protection Area	20	20
11. Targets (lines 7+8d+9+10)	**	256,557
12. Aquifer Score (lines 3x6x11 divided by 82,500)	100	100.00
13. Ground Water Migration Pathway Score (S_{gw})	100	100.00

* Maximum value applies to waste characteristics category.

** Maximum value not applicable.

NE Not Evaluated

REFERENCES

Reference

Number Description of the Reference

1. U.S. Environmental Protection Agency (EPA). Hazard Ranking System, Title 40 *Code of Federal Regulations* (CFR) Part 300, Appendix A (55 Federal Register [FR] 51583, Dec. 14, 1990, as amended at 82 FR 2779, Jan. 9, 2017; 83 FR 38037, Aug. 3, 2018), as published in CFR on July 1, 2019, with two attachments. Attachment A: FR Vol. 55, No. 241. December 14, 1990. Hazard Ranking System Preamble. Attachment B: FR Vol. 82, No. 5, January 9, 2017. Addition of a Subsurface Intrusion Component to the Hazard Ranking System Preamble. Available at <https://semspub.epa.gov/src/document/HQ/100002489>. 197 pages.
2. EPA. Superfund Chemical Data Matrix (SCDM) Query. Last Update, January 2022. A complete copy of SCDM is available at <http://www.epa.gov/superfund/superfund-chemical-data-matrix-scdm>. Accessed on July 20, 2022. 27 pages.
3. EPA. Superfund Site Information, East Basin Road Groundwater (EPA ID: DEN000304044): Site Information. Available at <https://cumulis.epa.gov/supercpad/CurSites/csinfo.cfm?id=0304044> Updated as of August 8, 2022. 1 page.
4. U.S. Geological Survey (USGS). 2019. Wilmington South Quadrangle, Delaware, New Jersey (7.5×7.5-minute series topographic map). 1 map.
5. Tetra Tech, Inc. (Tetra Tech). 2022. Project Note to East Basin Road Groundwater Site File. Subject: Figures. 4 Pages. June 30.
6. Department of Natural Resources and Environmental Control (DNREC). Division of Air and Waste Management and Division of Water Resources. Delaware Health and Social Services. Division of Public Health. 2002. “The Impact of Known and Suspected Contaminant Sources on Select Public Drinking Water Supplies in Delaware.” September. 91 Pages.
7. EA Engineering, Science, and Technology, Inc., PBC (EA). 2021. “Comprehensive Site Inspection Report New Castle Public Wells Groundwater Plume Site (DE-0363) New Castle, Delaware.” EA Project No. 15318.4. April. 366 Pages.
8. DNREC. 2015. “Preliminary Assessment of Zero (0) E. Basin Road Site. PFOS & PFOA Impacted Public Wells in New Castle, Delaware.” DE-0363. March. 370 Pages.
9. EA. 2022. “DRAFT Expanded Site Inspection Report East Basin Road Groundwater Site (DE-0363) New Castle, Delaware.” EA Project No. 1613105. April. 199 Pages.
10. DNREC. 2011. “Preliminary Assessment of Airport Industrial Park Wellfield. DE-0346. September.” 133 Pages.
11. Tetra Tech, Inc. (Tetra Tech). 2022. Project Note to East Basin Road Groundwater Site File. Subject: EPA EnviroMapper. Information Available: <https://geopub.epa.gov/myem/efmap/index.html?ve=12,39.659759,-75.563940&pText=New%20Castle,%20Delaware> April 11. 3 Pages.

Reference

Number Description of the Reference

12. Agency for Toxic Substances and Disease Registry (ATSDR). 2022. "Per- and Polyfluoroalkyl Substances (PFAS) Exposure Assessment Report." New Castle County, Delaware near New Castle Air National Guard Base. February 2. 60 Pages.
13. Reference Number Reserved.
14. Reference Number Reserved.
15. Delaware Geological Survey (DGS). 2005. Geologic Map of New Castle County, Delaware. University of Delaware, Newark. 1 Page.
16. U.S. Geological Survey (USGS). 2015. "Hydrogeologic Framework, Hydrology, and Refined Conceptual Model of Groundwater Flow for Coastal Plain Aquifers at the Standard Chlorine of Delaware, Inc. Superfund Site, New Castle County, Delaware, 2005–12." Scientific Investigations Report 2014–5224. 74 Pages.
17. DGS. 1957. The Water Resources of Northern Delaware. Bulletin No. 6. Volume 1. June. 121 Pages.
18. USGS. 1987. "Hydrogeology, Degradation of Ground-Water Quality, and Simulation of Infiltration from the Delaware River into the Potomac Aquifers, Northern Delaware." Water-Resources Investigations Report 87-4185. 91 Pages.
19. Delaware Geological Survey (DGS). 1987. Geohydrology of the Wilmington Area, Delaware. Hydrologic Map Series No. 3, Sheet 1, Basic Geology. University of Delaware, Newark. 1 Page.
20. DGS. 1973. "Hydrology of the Columbia (Pleistocene) Deposits of Delaware: An Appraisal of A Regional Water-Table Aquifer." Bulletin No. 14. June. 86 Pages.
21. DGS. 1988. Elevation of the Base of Sand in the Upper Part of the Potomac Formation. Hydrologic Map Series No. 3, Sheet 3, Structural Geology. University of Delaware, Newark. 1 Page.
22. DGS. 1987. Elevation of Top and Isopach Map of Upper Sandy Zone, Potomac Formation. Hydrologic Map Series No. 3, Sheet 4, Structural Geology. University of Delaware, Newark. 1 Page.
23. Reference Number Reserved.
24. TestAmerica. 2017. Analytica Report. Job Number 460-139000-1. Job Description: New Castle Public Well Groundwater Plume. August 31. 1836 Pages.
25. TestAmerica. 2017. Analytica Report. Job Number: 460-139006-1. Job Description: New Castle Public Well Groundwater Plume. August 31. 655 Pages.
26. TestAmerica. 2018. Analytica Report. Job Number: 460-164976-1. Job Description: DE-0363 O Basin Rd. October 15. 824 Pages.

Reference

Number Description of the Reference

27. TestAmerica. 2018. Analytica Report. Job Number: 460-165183-1. Job Description: DE-0363 O Basin Rd. October 15. 764 Pages.
28. Eurofins. 2020. Analytica Report. Job Number: 419-11254-1. Job Description: New Castle Public Wells Groundwater. September 11. 1468 Pages.
29. Reference Number Reserved.
30. Eurofins. 2021. Analytical Report. Job Number: 460-246600-1. Job Description: New Castle Ave (DE-0363). December 21. 3191 Pages.
31. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: Artesian Water Company Laboratory Analytical Data (with attachments, Eurofins, and Suburban Testing Labs Analytical Data Reports). June 21. 177 pages.
32. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: New Castle Municipal Services Commission Laboratory Analytical Data (with attachments and Eurofins Analytical Data Reports). June 21. 76 pages.
33. Environmental Data Services, LTD. 2022. Data Validation Report. August 2017-2021 Sampling. Tetra Tech Project No. 103X9034032111001. April 29. 307 Pages.
34. Tetra Tech. 2021. Electronic Mail Correspondence with Carl Armbruster, Eurofins, Regarding Reporting Limit and Method Detection Limit. (Lab Quality Manual Definitions). February. 4 pages.
35. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: Public Well Elevations. Artesian Public Supply Wells & New Castle County Municipal Public Well Supply. May 2. 2 Pages.
36. EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. November. 190 Pages.
37. EPA. 1996. Using Qualified Data to Document an Observed Release and Observed Contamination. November. 18 Pages.
38. EPA. 2020. Method 537.1. Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). EPA Document #: EPA/600/R-20/006. March. 50 Pages.
39. Tetra Tech. 2022. Electronic Mail Correspondence with Stephanie Gordan, DNREC, Regarding Well Permit Applications and/or Completion Reports for New Castle Public Wells (with attached Well Permit Applications and/or Completion Reports). March. 58 Pages.
40. State of Delaware. 2003. Public Water Supply Source Water Assessment for Artesian Water Co. (Collins Park). Department of Natural Resources and Environmental Control. December 31. 39 Pages.

Reference

Number Description of the Reference

41. State of Delaware. 2003. Public Water Supply Source Water Assessment for Artesian Water Co. (Airport Industrial Park). Department of Natural Resources and Environmental Control. December 31. 34 Pages.
42. State of Delaware. 2003. Public Water Supply Source Water Assessment for Artesian Water Co. (Wilmington Manor Gardens 1 and 3). Department of Natural Resources and Environmental Control. December 31. 43 Pages.
43. State of Delaware. 2003. Public Water Supply Source Water Assessment for City of New Castle Delaware. (Municipal Service Commission). Department of Natural Resources and Environmental Control. December 31. 39 Pages.
44. State of Delaware. 2003. Public Water Supply Source Water Assessment for Artesian Water Co. (Llangollen). Department of Natural Resources and Environmental Control. December 31. 41 Pages.
45. State of Delaware. 2003. Public Water Supply Source Water Assessment for Artesian Water Co. (New Castle County Airport). Department of Natural Resources and Environmental Control. December 31. 37 Pages.
46. DNREC. 2013. Site Inspection of New Castle County Airport. DE-0357. December. 224 Pages.
47. Environmental Alliance, Inc. 2020. Remedial Investigation Report, New Castle County Airport, Operable Unit 2 (DE-0357). November 20. 3708 Pages.
48. Weston Solutions, Inc. 2015. Trip Report – New Castle County Airport – Perfluorinated Compounds Site. EPA Contract No. EP-S3-10-05. Technical Direction Document No. WS01-14-07-002. June. 20 Pages.
49. AECOM. 2014. Remedial Investigation Report and Feasibility Study. IRP Site 2. Delaware Air National Guard Base. Contract #: DAHA92-02-D-0012. September. 2568 Pages.
50. Wood. 2021. Final Groundwater Long-Term Monitoring Program Report, Second Semi-Annual Event. Environmental Restoration Program. New Castle Air National Guard Base. August 12. 409 Pages.
51. AECOM. 2017. October 2016 Poly- and Perfluoroalkyl Substance Groundwater Sampling Report. Installation Restoration Program (IRP) Site 9. Delaware Air National Guard Base. Contract #: W9133L-14-D0001. May. 526 Pages.
52. Amec Foster Wheeler. 2019. Final Report FY16 Phase 1 Regional Site Inspections for Per and Poly Fluoroalkyl Substances. Volume I of XII. Delaware Air National Guard Base. Contract #: W9133L-14D-0002. March. 2,597 Pages.
53. EA. 2022. Final Site Inspection Report, Duncan Readiness Center and Army Aviation Support Facility. Per- and Polyfluoroalkyl Substances Impacted Sites ARNG Installations, Nationwide. Contract No. W912DR-19-D-0005. March. 198 Pages.

Reference

Number Description of the Reference

54. Brightfields, Inc (Brightfields). 2014. Final Brownfield Investigation Report, 600 North Dupont Highway (DE-1539). September. 316 Pages.
55. Brightfields. 2017. LTS Groundwater Sampling Report – Second Quarter 2017. 600 North Dupont Highway (DE-1539). June 21. 538 Pages.
56. Brightfields. 2019. Quarterly Groundwater Sampling Report. Jackson Ave. and N. DuPont Highway Groundwater Plume (DE-1678). February 19. 727 Pages.
57. Brightfields. 2012. Phase II-B Groundwater Investigation. Community Plaza Shopping Center. April 16. 87 Pages.
58. Brightfields. 2013. Phase II-D Supplemental Groundwater Investigation Report. Community Plaza Shopping Center. July. 129 Pages.
59. Brightfields. 2015. Remedial Investigation Report. Community Plaza (DE-1567). September. 3,882 Pages.
60. Brightfields. 2021. Long-Term Stewardship Inspection Report, Community Plaza Site, Operable Unit 2. February. 83 Pages.
61. EPA. 2014. Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) Fact Sheet. EPA 505-F-14-001. March. 10 Pages.
62. EPA. 2021. “Multi-Industry Per- and Polyfluoroalkyl Substances (PFAS) Study – 2021 Preliminary Report.” EPA-821-R-21-004. September. 81 Pages.
63. EPA. 2021. Addressing PFOA and PFOS in the Environment: Potential Future Regulation Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act. 40 CFR Part 302 [EPA-HQ-OLEM-2019-0341; FRL-10019-13-OLEM] RIN 2050-AH09. 6560-50-P. January. 30 Pages.
64. EPA. 2022. Our Current Understanding of the Human Health and Environmental Risks of PFAS. Accessed April 4, 2022. Available at: <https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas>. 6 Pages.
65. ATSDR. 2019. Toxicological Profile for Tetrachloroethylene. June. Available at: <https://www.atsdr.cdc.gov/ToxProfiles/tp18.pdf>. 435 Pages.
66. ATSDR. 2019. Toxicological Profile for Trichloroethylene. June. Available at: <https://www.atsdr.cdc.gov/toxprofiles/tp19.pdf>. 511 Pages.
67. ATSDR. 1996. Toxicological Profile for 1,2-Dichloroethene. August. Available at: <https://www.atsdr.cdc.gov/ToxProfiles/tp87.pdf>. 198 Pages.
68. ATSDR. 2006. Toxicological profile for Vinyl Chloride. July. Available at: <https://www.atsdr.cdc.gov/ToxProfiles/tp20.pdf>. 329 Pages.

Reference

Number Description of the Reference

69. ATSDR. 2019. Toxicological profile for 1,1-Dichloroethene – April 2022.. Available at: <https://www.atsdr.cdc.gov/ToxProfiles/tp39.pdf>. 240 Pages.
70. ATSDR. 2022. Toxicological profile for 1,2 – Dichloroethane - Draft for Public Comment. January. Available at: <https://www.atsdr.cdc.gov/toxprofiles/tp38.pdf>. 253 Pages.
71. EAWAG Biocatalysis/Biodegradation Database. Tetrachloroethene Pathway Map (Anaerobic). Accessed January 31, 2017. Available at http://eawag-bbd.ethz.ch/tce2/tce2_map.html 3 Pages.
72. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: Car Washes in New Castle. June 6. 2 Pages.
73. BB&E, Inc. 2016. Final Perfluorinated Compounds Preliminary Assessment Site Visit Report. Delaware Air National Guard Base, New Castle, Delaware. January. 1,513 Pages.
74. AECOM. 2019. IRP Site 4B Site Closure Report, Delaware Air National Guard Base, New Castle, Delaware. Contract #: W9133L-14-D0001. August. 57 Pages.
75. DNREC. 2022. Delaware Environmental Navigator Facility Search. Accessed June 2. Available at: <https://den.dnrec.delaware.gov/Search/FacilitySearch.aspx?results=Y&type=advanced&facname=Dry+clean+Central&pitypes=&picount=0&zip=&city=50800&county=&house=&senate=&school=&watershed=&basin=>. 3 Pages.
76. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: Map of Public Supply Wells in New Castle, Delaware (with attached figure depicting public well locations). June 21. 2 Pages.
77. Artesian Resources. 2021. Letter from Administration Engineer, to Mr. Steve Smailer, P.G. Water Supply and Coordinating Council, Department of Natural Resources and Environmental Control. Regarding: Self-Sufficiency Act of 2003 (with attached Report of Consumer Water Conservation Plan and Certification of Adequate Water Supply). June 23. 68 Pages.
78. EPA. 2022. Safe Drinking Water Information System. Water System Search Results – Chester Water Authority. Information Accessed: June 2. Available at: https://ordspub.epa.gov/ords/sfdw/sfdw/r/sdwis_fed_reports_public/200. 1 Page.
79. EPA. 2022. Safe Drinking Water Information System. Water System Search Results – Elkton Water Department. Information Accessed: March 24. Available at: https://ordspub.epa.gov/ords/sfdw/sfdw/r/sdwis_fed_reports_public/200. 1 Page.
80. EPA. 2022. Safe Drinking Water Information System. Water System Search Results – Artesian Water Company. Information Accessed: July 26. Available at: https://ordspub.epa.gov/ords/sfdw/sfdw/r/sdwis_fed_reports_public/200. 1 Page.

Reference

Number Description of the Reference

81. Tetra Tech. 2022. Electronic Mail Correspondence with Mr. Steven Repole, Finance Director, Town of Elkton, Regarding: Elkton Water System. March 29. 3 Pages.
82. Tetra Tech. 2022. Electronic Mail Correspondence with Supervisor of Water Quality, Artesian Water Company, Regarding: Artesian Well in New Castle (with attachments and Allocation Well Limits). April 6. 6 Pages.
83. EPA. 2022. Safe Drinking Water Information System. Water System Search Results – Municipal Services Commission. Information Accessed: March 15. Available at: https://ordspub.epa.gov/ords/sfdw/sfdw/r/sdwis_fed_reports_public/200. 1 Page.
84. Tetra Tech. 2022. Electronic Mail Correspondence with Water Utility Manager, Municipal Services Commission, Regarding: New Castle Public Water System (with attachments and Annual Pumping Data). June 7. 48 Pages.
85. State of Delaware. Wellhead Protection Program. Undated. 40 Pages.
86. DGS. 2022. Delaware Geologic Information Resource (DGIR) Map Viewer. Information Available: <https://www.dgs.udel.edu/projects/delaware-geologic-information-resource-dgir-web-application>. Accessed June 8. 2 Pages.
87. Municipal Services Commission. 2022. MSC Water System Overview – 2022, High Level Description of the Municipal Services Commission Water System. 2 Pages.
88. EPA. 2020. Memo Regarding Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) as a CERCLA Pollutant or Contaminant from Lorie Baker, HRS Coordinator, Region 3 to East Basin Road Groundwater site Hazard Ranking System documentation record. June 20. 4 Pages.
89. EPA. 2022. Technical Fact Sheet: Drinking Water Health Advisories for Four PFAS (PFOA, PFOS, GenX chemicals, and PFBS). Office of Water. EPA-822F-22-002. June. 7 Pages.
90. Artesian Resources. 2015. Artesian Water System New Castle County. Exhibit-III-1. June. 1 Page.
91. Tetra Tech. 2022. Electronic Mail Correspondence with Senior Account Executive, Suburban Labs, Regarding RL Question. June 23. 3 Pages.
92. Tetra Tech. 2022. Site Reference Point. 2 Pages.
93. Gluge, Juliane; London, Rachel; et. al. 2021. Information Requirements under the Essential-Use Concept: PFAS Case Studies. Environmental Science & Technology, 56, 6232-6242. October 5. 11 Pages.
94. Gaines, Linda G. T. PhD, PE (EPA). 2022. Historical and current usage of per- and polyfluoroalkyl substances (PFAS): A literature review. American Journal of Industrial Medicine, 1-26. April 25. 26 Pages

Reference

Number Description of the Reference

95. EPA. 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. September. 248 Pages.
96. Tetra Tech. 2022. Project Note to East Basin Road Groundwater Site File. Subject: New Castle Municipal Services Commission Apportioned Population. July 26. 1 Page.
97. EPA. 1989. Preliminary Assessment New Castle County/Greater Wilmington Airport, New Castle, Delaware. June. 55 Pages.

SITE SUMMARY

The East Basin Road Groundwater Site (the Site) consists of a groundwater plume with no identified source located in the City of New Castle, New Castle County, Delaware (Refs. 3 and 4). The geographic coordinates at the Site are 39.673092° north latitude and -75.597211° west longitude, based on the Intersection of School House Lane and Rte. 13/N Dupont highway (**Figure 1**; Refs. 3; 4; 92). The site consists of groundwater contaminated with per- and polyfluoroalkyl substances (PFAS) and chlorinated volatile organic compounds (CVOCs) as identified by groundwater samples collected from municipal and monitoring wells that meet the criteria for an observed release, as further discussed in **Section 3.1.1** of this HRS documentation record and shown on **Figure 2** provided in Reference 5. The Delaware River is located approximately 1 mile east-southeast from the eastern edge of the plume. Land use within the plume includes an airport in the north and west sections and is a prominent land feature within the plume. Other land uses within the plume include densely populated residential areas in the south, east, and west with mixed commercial land uses including dry cleaners, manufacturing facilities, and automobile repair shops (Refs. 5, p. 2; 11, pp. 1, 2).

The groundwater samples collected from the plume were withdrawn from the Interconnected Columbia and Potomac Aquifers (**Section 3.0.1** and **Tables 4** through **23** of the HRS documentation record). Actual contamination at Level I concentrations of perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and tetrachloroethylene (PCE) have been documented in nine public supply wells that supply drinking water to an apportioned population of approximately 25,648 persons; two public wells have exceeded the maximum contaminant level for PCE and eight public wells have exceeded the noncancer risk screening concentration for PFOS and/or PFOA (**Section 3.3** of this HRS documentation record).

A 2002 report prepared by the Department of Natural Resources and Environmental Control (DNREC) and Delaware Health and Social Services Division of Public Health identified the presence of volatile organic compounds (VOCs) in several Artesian Water (Artesian) public supply wells in New Castle, Delaware: (1) Collins Park Well, (2) Llangollen Well Field, and (3) Airport Industrial Park Wells (Ref. 6, pp. 18, 33-43). VOCs detected in raw, untreated water samples included: tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), carbon tetrachloride, 1,1-dichloroethylene (1,1-DCE), and 1,1,1-trichloroethane (TCA) (Ref. 6, pp. 34, 36, 38, 39, 40, 41, and 42). Contaminants present in the Llangollen wells were associated with two National Priorities List (NPL) Superfund Sites: (1) Delaware Sand and Gravel and (2) Army Creek Landfill, and two state Superfund Sites: (1) Former Amoco Polymer Plant and (2) the Denton Landfill located within 0.5 miles north and northeast of the Llangollen Wellfield, each with documented groundwater contamination by VOCs, semivolatile organic compounds (SVOCs), and metals (Ref. 6, pp. 37, 40). The source of the VOCs in the Collins Park well and the Airport Industrial Park (AIP) wells was not definitively identified; however, the report indicated nearby former dry cleaners, an industrial park, auto repair facilities, and the airport as possible sources (Ref. 6, pp. 34 and 40).

In 2011, DNREC conducted a Preliminary Assessment (PA) of the Artesian AIP Wells #1 and #2 to determine the likely sources of contamination in the wells (Ref. 10, p. 5). The PA provides analytical history of the two wells from 1984 to 2010 that show AIP Well #1 had its highest detection of PCE in 1999 at a concentration of 19 micrograms per liter ($\mu\text{g}/\text{l}$) and had its highest detection of TCE in 1993 at 9.4 $\mu\text{g}/\text{l}$. AIP Well #2 had its highest detection of PCE in 2009 at 21 $\mu\text{g}/\text{l}$ and had its highest detection of TCE in 1984 at 2.7 $\mu\text{g}/\text{l}$. Both wells also had detections of 1,1-DCE, 1,1-DCA, cis-1,2-DCE, and 1,1,1-TCA (Ref. 10, pp. 12, 96, and 97). The PA identified numerous possible sources of the CVOCs including the Delaware Air National Guard (Tenant) Wilmington Airport Site (DANG) (EPA ID: DE0000306286/DE0572824274) – 1950-Present, which has known PCE and TCE contamination; the New Castle County Airport (NCCA), which has several tenants that may have used PCE or TCE for cleaning, degreasing, or paint stripping of aircraft; several landfills; and a number of dry cleaners (Ref. 10, pp. 7, 8, 9, 10, 92-94). Investigations have

been conducted at several of the possible sources of VOCs by DNREC or the property owners; detailed information about these investigations is provided in the **Attribution** section of this HRS Documentation record.

In 2013 and 2014, as part of the federal Third Unregulated Contaminant Monitoring Rule (UCMR 3), drinking water samples were collected from public supply wells in New Castle, Delaware. Concentrations of PFOS and PFOA exceeded the EPA 2009 provisional health advisory levels (HALs) of 200 nanograms per liter (ng/l) and 400 ng/l, respectively (Note: June 2022 HAL update indicates 0.02 ng/l for PFOS and 0.004 ng/l for PFOA [Ref. 89, p. 4]), in five public supply wells: (1) Artesian Wilmington Manor Well #3, (2) Jefferson Farms Well #1, (3) the City of New Castle Municipal Services Commission (NCMSC) Basin Road Well, (4) Schoolhouse Lane Well, and (5) Frenchtown Road Well (Refs. 7, p. 12; 8, pp. 82, 83). PFOA was detected at a maximum concentration of 940 ng/l and PFOS was detected at a maximum concentration of 2,300 ng/l (Refs. 7, p. 12; 8, pp. 82, 83). In addition to the five public wells that contained PFOA and or PFOS above EPA's 2009 provisional HAL, there were several other wells owned by either Artesian or NCMSC that contained concentrations of PFOA and or PFOS investigated as part of the PA (Ref. 8, pp. 64, 82, 83).

In 2015, DNREC conducted a PA to identify the likely source(s) of PFAS (formerly referred to as perfluorinated compounds [PFCs]) groundwater contamination of the public supply wells in New Castle, Delaware (Ref. 8, pp. 1, 2). The PA investigated an approximately 7 square mile area (referred to in the PA as an area of interest [AOI]) surrounding the five public wells that contained PFOA or PFOS at concentrations in exceedance of EPA's 2009 provisional HAL (Ref. 8, pp. 8, 18, 29, 31). The PA identified 16 Areas of Potential Concern (AOPC) that may have used, produced, dispensed, or disposed of compounds products that may contain PFAS (Refs. 7, p. 66; 8 pp. 8-12). The identified areas included several industrial complexes and carpet facilities near contaminated public supply wells; Harry Wood Landfill; several fire training areas for local firefighters, the airport, and military; and airplane or helicopter crashes at the airport as possible sources of PFAS in the groundwater (Refs. 8, pp. 9-12, 32). Extensive investigations have been conducted at DANG and portions of NCCA that document the presence and release of PFAS and CVOCs at these locations as presented in the **Attribution** section.

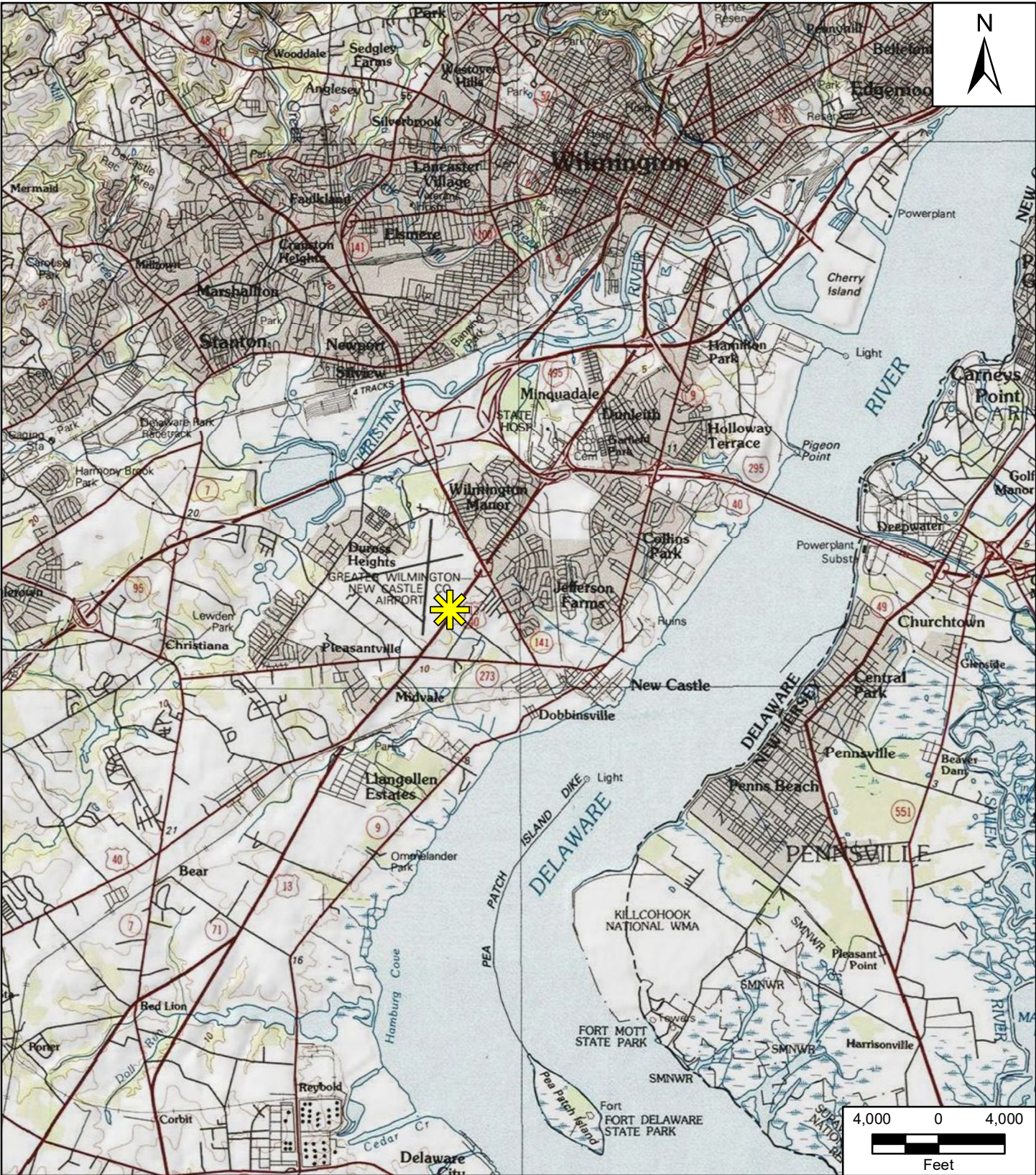
In 2017, 2018, and 2020, DNREC conducted a Site Inspection (SI) that included the installation and sampling of monitoring wells at six of the 16 AOPC, as well as at locations throughout the AOI, to investigate the presence of hazardous substances in groundwater (Ref. 7, pp. 25, 70, 71, 87). As further documented in **Section 3.1.1**, analytical results of the groundwater samples collected from the monitoring wells installed as part of the SI showed the presence of PFOA, PFOS, and VOCs such as TCE, PCE, 1,2-DCA, and vinyl chloride (Ref. 7, pp. 99, 100, 101, 104, 106, 107, 113, 114, 120, and 121).

In 2021, DNREC conducted an Expanded Site Inspection (ESI) that included the installation and sampling of monitoring wells in the northeast portion of the AOI, the sampling of select existing monitoring wells, and the sampling of two Artesian public supply wells and two NCMSC public supply wells (Ref. 9, pp. 26, 28, 29, 121, 124). As further documented in **Section 3.1.1**, analytical results of the groundwater samples collected from the monitoring wells as part of the ESI showed the presence of PFOA, PFOS, and VOCs such as TCE, PCE, 1,2-DCA, cis-1,2-DCE, and vinyl chloride (Ref. 9, pp. 68, 69, 72, 73, 74, 75, 78, 79, 80, 81, 84, 122, and 124).


In 2022, the Agency for Toxicological Substances (ATSDR) published a PFAS Exposure Assessment Report for New Castle County, Delaware (Ref. 12, p. 1). This Exposure Assessment assessed PFAS levels in the blood and urine of New Castle area residents. Test results were compared to PFAS levels in a nationally representative sample. Tap water and indoor dust samples from a subset of households were also analyzed for PFAS (Ref. 12, p. 6). The report found that the levels of several PFAS in the blood of residents

living in the New Castle area were higher than the national average and that the increase may be associated with drinking contaminated water (Ref. 12, p. 8).

The Site is being evaluated as a groundwater plume site with no identified source. As shown on **Figure 3** provided in Reference 5, there are too many known or possible sources for the PFAS and CVOCs in groundwater to reasonably attribute the groundwater contamination to one or more specific source(s), as further discussed in the **Attribution** section of this HRS documentation record (**Section 3.1.1** of this HRS documentation record). A review of the EPA Envirofacts database identified numerous facilities in New Castle, Delaware listed as plastics or resin manufacturing or recycling facilities (approximately 24), auto repair facilities (approximately 9), metal coating, fabrication, or smelting facilities (approximately 6), current dry cleaners (approximately 5), chemical plants or manufacturers (approximately 3), electronics manufacturers (approximately 2), and textiles facilities (approximately 2), as well as several others facilities that may have used, produced, dispensed, or disposed of compounds and products that may contain PFAS or CVOCs (Refs. 5, p. 3; 11, pp. 1, 2). As shown on **Figure 4** of Reference 5, there are 23 public supply wells located within a 4-mile radius of the Site. The wells are completed in the Columbia and Potomac aquifers (Refs. 40, p. 7; 41, p. 7; 42, p. 7; 43, p. 7; 44, p. 7; 45, p. 7). Releases of PFAS and CVOCs from multiple possible sources likely have comingled over time; particularly considering the impacts to local groundwater flow direction as a result of the pumping history of the municipal wells (Ref. 18, pp. 17, 36, 37, 38; **Section 3.0.1**).



Legend

 Site Reference Point

Note: References 3, p. 1; 92, p. 1 of this HRS documentation record.

Imagery: ESRI Mapping Service
 The source of the map image is ESRI, used by the EPA with ESRI's permission.
 EPA Contract No: 68-HE-032-D0003 TD No: TD603-21-11-001

East Basin Road Groundwater
 New Castle, Delaware

Figure 1
Site Location



Prepared For: EPA R3 START VI Prepared By: M. Kelly
 Coordinate System: NAD 1983 2011 StatePlane Delaware FIPS 0700 FUS

File Path: S:\06_Technical_Documents\93034_START_R303121_11_001\Figure1_SiteLocation.mxd Date Saved: 07/25/22

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Number of the source: 1

Source Type: Other

Name of the Source: Contaminated Groundwater Plume with no identified source

Description and Location of Source (with reference to a map of Site):

The East Basin Road 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 2** of Reference 5 is based on available sample locations that meet the criteria for an observed release to groundwater (**Section 3.1.1**).

For the purpose of this HRS documentation record, analytical data used to document an observed release, **Section 3.1.1**, was limited to groundwater samples collected as part of the SI and ESI conducted by EA Engineering, Science, and Technology, Inc. (EA) under contract with DNREC and analytical data of the public supply wells collected by the public water suppliers Artesian and NCMSC. Analytical data of groundwater samples collected by other entities at locations and facilities throughout New Castle, Delaware that show the presence of PFAS and CVOCs in groundwater is provided as additional supporting data (Refs. 46, pp. 51, 67; 47 pp. 81, 82, 83, 97, 98; 48, pp. 16, 18, 19; 49, pp. 65-67, 71, 73, 98, 99, 101, 102; 50, pp. 35, 52-58; 51, pp. 35, 41; 52, pp. 72, 73, 85-88, 746, 747, 753, 124-142, 1402, 1405, 1406, 1407, 1426, 1427, 2098, 2101, 2102, 2103, 2108; 53, pp. 65, 66; 54, pp. 109; 55, pp. 9, 10, 97, 112, 123, 132, 145, 158, 536; 56, pp. 12, 17, 270, 279, 283, 295, 324, 336, 359, 390, 399, 408, 435; 57, pp. 4, 18, 22; 58, pp. 13, 29; 59, pp. 142, 143, 1895, 1930, 1961, 1990, 2020, 2027, 2054, 2061, 2100, 2852, 2853; 60, pp. 17, 34, 37, 42, 43).

In 2017, 2018, and 2020, DNREC conducted a SI that included the installation and sampling of monitoring wells to investigate the presence of hazardous substances in groundwater (Ref. 7, pp. 25, 70, 71, 87). As further documented in **Section 3.1.1**, analytical results of the groundwater samples collected from the monitoring wells installed as part of the SI documented an observed release to groundwater of PFOA, PFOS, and VOCs such as TCE, PCE, 1,2-DCA, and vinyl chloride (**Section 3.1.1, Tables 4 through 15**).

In 2021, DNREC conducted an ESI that included the installation and sampling of additional monitoring wells, the sampling of select existing monitoring wells, and the sampling of two Artesian public supply wells and two NCMSC public supply wells (Ref. 9, pp. 26, 28, 29, 121, 124). As further documented in **Section 3.1.1**, analytical results of the groundwater samples collected from the monitoring wells installed as part of the ESI documented an observed release to groundwater of PFOA, PFOS, and VOCs such as TCE, PCE, 1,2-DCA, cis-1,2-DCE, and vinyl chloride (**Section 3.1.1, Tables 4 through 15**).

Samples collected by Artesian and NCMSC have shown concentrations of PFAS since 2013 and 2014, respectively (Refs. 7, p. 12; 8, p.82). Most recent available analytical data for samples collected by Artesian documented an observed release to groundwater of PFOA, PFOS, and VOCs such as TCE, PCE, and cis-1,2-DCE (**Section 3.1.1, Tables 16 through 23**).

PFOA and PFOS are fluorinated organic man-made compounds that 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 water-soluble and migrate readily from soil to groundwater, where they can be transported long distances (Ref. 61, pp. 1-3). PFAS, in particular PFOS and PFOA, are associated with a wide variety of industrial and commercial processes such as (Refs. 61, pp. 1, 2; 62, p. 13; 63, pp. 7, 8):

- Aviation operations (North American Industry Classification System [NAICS] code 488119)
- Carpet manufacturers (NAICS code 314110)
- Car washes (NAICS code 811192)
- Chrome electroplating, anodizing, and etching services (NAICS code 322813)
- Coatings, paints, and varnish manufacturers (NAICS code 325510)
- Firefighting foam manufacturers (NAICS code 325998)
- Landfills (NAICS code 562212)
- Municipal fire departments and firefighting training centers (NAICS code 922160)
- Paper mills (NAICS codes 322121 and 322130)
- Petroleum refineries and terminals (NAICS codes 324110 and 424710)
- Photographic film manufacturers (NAICS code 352992)
- Polish, wax, and cleaning product manufacturers (NAICS code 325612)
- Polymer manufacturers (NAICS code 325211)
- Printing facilities where inks are used in photolithography (NAICS codes 323111 and 325910)
- Textile mills (textiles and upholstery) (NAICS codes 313210, 313220, 313230, 313240, and 313320)
- Wastewater treatment plants (NAICS code 221320).

PFOA and PFOS are two of the most widely used compounds in the PFAS group and are used in fire extinguishing foam (aqueous film-forming foams [AFFF]) and are used to extinguish flammable liquid-based fires. Such foams are used in training and emergency response events at airports, shipyards, military bases, firefighting training facilities, chemical plants, and refineries (Refs. 61, p. 2; 62, pp. 58, 59; 64, p. 1).

PCE is primarily used as a dry cleaning solvent, where it is released as fugitive emissions or as liquid waste (Ref. 65, pp. 24, 31, 288). In addition to being used as a dry cleaning solvent, it also has uses as a metal degreasing solvent and as a chemical intermediate (Ref. 65, pp. 23, 283). PCE partitions primarily to the atmosphere when released into the environment, but when present in soil, it can leach and migrate to groundwater (Ref. 65, pp. 24, 288, 294, 295). PCE breaks down into TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride, and to a lesser extent trans-1-2-DCE in the environment (Ref. 71, pp. 2 - 3).

TCE is used as a solvent to remove grease from metal parts and as a chemical that is used to make other chemicals. TCE has also been used as an extraction solvent for greases, oils, fats, waxes, and tars; by the textile processing industry to scour cotton, wool, and other fabrics; in dry cleaning operations; and as a component of adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners

(Ref. 66, p. 23). When released to the environment, TCE migrates readily through soil to groundwater and may occur as an original contaminant or as a result of the breakdown of PCE (Ref. 66, pp. 24, 336).

1,2-DCE is most often used to produce solvents and in chemical mixtures (Ref. 67, p. 17). 1,2-DCE has also been used as a solvent for waxes, resins, acetyl cellulose, perfumes, dyes, lacquers, thermoplastics, fats, and phenols. 1,2-DCE released into the environment can readily evaporate into the atmosphere; however, in the subsurface, 1,2-DCE may dissolve in water, seep deeper into the soil, and possibly contaminate groundwater. Once in groundwater, 1,2-DCE takes approximately 13-48 weeks for half of a given amount to break down (half-life in water). 1,2-DCE can eventually break down into vinyl chloride, which is believed to be a more hazardous chemical (Ref. 67, pp. 17, 94). The majority of 1,2-DCE present in groundwater involves biodegradation processes related to primary pollution from TCE or PCE (Ref. 67, p. 103).

Vinyl chloride is a manufactured substance that does not occur naturally; however, it can be formed in the environment when other manufactured substances such as TCE, TCA, and PCE are broken down by certain microorganisms (Ref. 68, p. 22). Vinyl chloride is used to make a polymer called polyvinyl chloride (PVC), which consists of long repeating units of vinyl chloride. PVC is used to make a variety of plastic products including pipes, wire and cable coatings, and packaging materials. Other uses include furniture and automobile upholstery, wall coverings, housewares, and automotive parts (Ref. 68, pp. 22, 186). Vinyl chloride can migrate to groundwater and can also be in groundwater due to the breakdown of other chemicals (Ref. 68, pp. 23, 189, 194).

The primary use of 1,1-DCE is as a chemical intermediate to make other products such as plastics, packaging materials and flexible films such as plastic wrap, and flame-retardant coatings for fiber and carpet backing (Ref. 69, p. 11). However, it is also found in landfills as the result of breakdown of polyvinylidene chloride products and as the degradation products of other chemicals such as PCE, TCE, and 1,2-DCA in the environment by dehydrochlorination reactions (Ref. 69, pp. 98, 104). 1,1-DCE primarily exists in a vapor phase, although it migrates readily through soil and groundwater when found in these media (Ref. 69, p. 105).

1,2-DCA is primarily used in the production of vinyl chlorides, though it is also used as a dispersant in rubber and plastics, and as a solvent in organic synthesis. 1,2-DCA was previously used as an insect and soil fumigant, in cleaning products (especially for use on textiles), and in adhesives (Ref. 70, p. 145). Up until the ban of leaded gasoline in the 1990s, 1,2-DCA was used as a lead scavenger; however, even after the ban of leaded gasoline, 1,2-DCA has been used in leaded fuel for aviation (Ref. 70, p. 152). It is slightly soluble in water and is expected to be very mobile in the environment (Ref. 70, p. 146).

Documentation of the observed release sample analyses is presented in **Section 3.1.1 Observed Release, Chemical Analysis**. The rationale for the lack of an identifiable source for the groundwater contamination (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, Attribution**.

2.2.2 Hazardous Substances Associated with the Source

The following hazardous substances are associated with the source (**Section 3.1.1** of the HRS documentation record):

- Perfluorooctanesulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- cis-1,2-Dichloroethylene (cis-1,2-DCE)
- trans-1,2-Dichloroethylene (trans-1,2-DCE)
- 1,2-Dichloroethane (1,2-DCA)
- Vinyl Chloride

2.2.3 Hazardous Substances Available to Pathway

Analytical results for groundwater samples collected from monitoring wells and public supply wells indicate that a release of hazardous substances has occurred to the groundwater 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, as shown in **Table 1** (Ref. 1, Section 3.1.2.1, Table 3-2).

TABLE 1 SOURCE NO. 1 CONTAINMENT FACTORS		
Containment Description	Containment Factor Value	References
Gas release to air	NS	NA
Particulate release to air	NS	NA
Release to groundwater: based on evidence of hazardous substance migration (contamination detected in groundwater samples delineating the plume), a containment factor of 10 is assigned.	10	1, Section 3.1.2.1, Table 3-2; Section 3.1.1 of this HRS documentation record
Release via overland migration and/or flood	NS	NA

Notes:

NA = Not applicable

NS = Not scored

2.4.2 Hazardous Waste Quantity

Insufficient information exists to evaluate hazardous constituent quantity and hazardous waste stream quantity. Therefore, the hazardous waste quantity value is calculated using Tier C, the volume of the plume, and source type other (Ref. 1, Section 2.4.2.1) for Source No. 1.

2.4.2.1.1 Hazardous Constituent Quantity (Tier A)

The hazardous constituent quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all CERCLA hazardous substances in the source and releases from 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 (manifests, potentially responsible party [PRP] records, state records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, hazardous waste stream quantity (Ref. 1, Section 2.4.2.1.1).

Hazardous Constituent Quantity (C) Value: Not scored

2.4.2.1.2 Hazardous Waste Stream Quantity (Tier B)

The hazardous waste stream quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the mass of the hazardous waste streams plus the mass of any additional CERCLA pollutants and contaminants in the source and releases from 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 (manifests, PRP records, state records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of the waste stream plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous waste stream quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume (Ref. 1, Section 2.4.2.1.2).

Hazardous Waste stream Quantity (W) Value: Not scored

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 and public supply wells located within the plume contained PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,2-DCA, and vinyl chloride as well as PFOS and PFOA at concentrations significantly above background (**Section 3.1.1**). However, the boundaries and total depths of the plume are not sufficiently defined to reasonably estimate a 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 (yd³), 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 (yd³): greater than (>) 0 yd³
Volume (V) Assigned Value: (> 0)/2.5 = > 0

2.4.2.1.4 Area (Tier D)

The volume of the source has been determined; therefore, the Tier D – area is assigned a hazardous waste quantity value of 0 (Ref. 1, Section 2.4.2.1.3).

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

TABLE 2 SITE SUMMARY OF SOURCE DESCRIPTIONS						
Source Number	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete (Y/N)	Containment			
			Ground Water	Surface Water	Air (Gas)	Air (Particulate)
1	> 0	N	10	NS	NS	NS

Notes:

> = greater than

Y = Yes

N = No

NS = Not scored

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

Regional Geology:

The Site is in northern Delaware, in New Castle, east of the New Castle County Airport, and lies within the Coastal Plain Physiographic Province (Ref. 15, p. 1). The Coastal Plain consists of a sequence of unconsolidated gravels, sands, silts, and clays that form a southeast-dipping wedge resting on older metamorphic, igneous, and consolidated sedimentary basement rocks (Refs. 15, p. 1; 16, pp. 17, 19, 20). Sediments range from Cretaceous Age to Holocene Series of Quaternary Age and were deposited in fluvial, deltaic, and marine environments. Later reworking by modern and ancestral streams and rivers has resulted in the downcutting of Cretaceous age sediments and the deposition of new channel and terrace deposits (Ref. 16, p. 17). The Coastal Plain sediments thicken from a thin line along the edge of the Fall Line with the Piedmont Physiographic Province to the northwest near Newark, Delaware, to more than 800 feet thick to the southeast near Delaware City, Delaware (Refs. 16, p. 19; 17, p. 55).

The uppermost stratigraphic unit underlying the site is the Quaternary Age, Pleistocene Series Columbia Formation (Refs. 15, p. 1; 18, pp. 15, 23) The Columbia Formation is fluvial in origin and is composed primarily of poorly sorted fluvial sands with some interbedded gravels, silts, and clays (Ref. 19, p. 1). The Columbia Formation occurs as channel fillings and thin isolated patches in New Castle County in northern Delaware where the Site is located and as a broad sheet across most of Kent and Sussex Counties in southern Delaware that were deposited by streams entering Delaware from the northeast and spread south and southeast across Delaware (Ref. 20, p. 15). Pleistocene Age paleochannels (extensive erosion of the underlying Potomac sediments) are present in New Castle and resulted from a lowering of sea level during the Pleistocene era and the subsequent downcutting of Pleistocene rivers into the underlying Potomac sediments (Refs. 18, pp. 28, 33; 19, p. 1). The Columbia Formation ranges from less than 10 feet thick to over 100 feet and is characterized by fine to coarse, yellowish- to reddish-brown, sand with varying amounts of gravel. Scattered beds of tan to reddish-gray clayey silt are common. Near the base of the unit, clasts of cobble to small boulder size found in gravel beds ranging from a few inches to three feet thick (Ref. 15, p. 1).

The Cretaceous Age Potomac Formation underlies the Columbia Formation at the Site (Ref. 19, p. 1). The Potomac Formation was deposited in a fluvial setting with the resulting sediment distribution dominated by small-scale, fining-upward sequences, characterized by irregular sand bodies in a silty clay matrix. Sand was separated from the clay and silt fractions by stream action and was deposited mainly in stream channels. The sand bodies, because they were generally confined to the channels of the depositing streams, are elongated and tabular rather than sheet-like (Ref. 18, pp. 17, 18). Individual beds of sand, silt, and clay generally are restricted in areal extent and thickness. Because of the lithologic variability in both the horizontal and vertical direction, it is considered a single stratigraphic unit in Delaware (Ref. 18, p. 12). The Potomac Formation is characterized by dark-red, gray, pink, and white silty clay to clayey silt and very fine to medium sand beds. Beds of gray clayey silt to very fine sand that contain pieces of charcoal and lignite are common. The Potomac ranges in thickness from 20 feet at the up dip to over 1600 feet thick in southern New Castle County (Ref. 15, p. 1).

Regional Hydrogeology:

The hydrogeologic framework of the Columbia and Potomac Formations underlying the Site is complex and the heterogeneity of hydraulic properties of aquifers contained within these formations is enhanced by channel geometry and discontinuous confining layers. Paleochannels and flood-plain deposits from braided,

anastomosed, and meandering fluvial system environments are also found within the formations, further complicating interpretation of the connections between aquifer sand layers (Ref. 16, p. 26). As documented below, the aquifers in the region in descending order are the surficial/water table (i.e., the Columbia Aquifer) and Potomac Aquifers.

The sediments of the Columbia Formation comprise the Columbia aquifer (Ref. 18, p. 28). The Columbia aquifer functions as a water table aquifer and is capable of yielding large quantities of water where thickness is greater than 40 feet (Ref. 18, p. 14, 33; 20, p. 19). The saturated part of the Columbia Formation forms a surficial aquifer. Groundwater in the surficial aquifer is recharged by direct infiltration of precipitation. Flow is generally from higher to lower land-surface elevations, resulting in groundwater discharge to small streams and creeks (Ref. 16, pp. 18, 20). The Columbia aquifer is recharged from the surficial aquifer and is Delaware's most important ground water resource (Ref. 20, pp. 8, 46). The aquifer is composed principally of sands that occur as channel fillings in northern Delaware, where the Site is located, and as a broad sheet across central and southern Delaware (Ref. 20, p. 14). The saturated thickness of the aquifer ranges from a few feet in many parts of northern Delaware to more than 180 feet in southern Delaware (Ref. 20, p. 17). The transmissivity of the aquifer varies greatly reflecting local changes in lithology (from fine sand to coarse sand and gravel) and changes in saturated thickness. However, the hydraulic data indicate that the Columbia deposits effectively act as a medium to coarse sand aquifer (Ref. 20, p. 6). Transmissivity values have been estimated for the New Castle area to be between 2,400 and 8,000 feet squared per day (ft^2/d) (Ref. 20, p. 39). Vertical hydraulic conductivity for the Columbia sediments have been reported to range from 1.7×10^{-6} feet per second (ft/s) for silty sand to 3.8×10^{-4} ft/s for sand and 3.3×10^{-5} ft/s for silty sand and 3.3×10^{-2} for gravel beds (Ref. 18, p. 33). The Columbia aquifer, and the flow system within this aquifer, is unconfined and conceptualized as being controlled mainly by topography and the location of surface-water features (Ref. 16, p. 18).

Underlying the Columbia aquifer is the Potomac aquifer (Ref. 18, pp. 15, 18, 19, 21-25). The source of groundwater for the Potomac aquifers is recharge from the overlying Columbia aquifer. Most of the recharge occurs near the updip extent of the aquifers where sandy zones of the Potomac Formation crop out at, or near, the land surface and from the Columbia aquifer where confining units are thin or absent (Refs. 16, p. 18; 18, p. 36). During pre-pumping conditions, much of the water in the Columbia aquifer discharges as base flow into local streams or lakes. The remainder of the groundwater flows into the deeper Potomac aquifers (Ref. 18, p. 36). Reported recharge into the Potomac aquifers from the Columbia aquifer was from 0.1 to 2.0 inches per year (in/yr), including in the confined Potomac aquifers in northern Delaware (Ref. 18, p. 36). Reported transmissivity values of the Potomac Formation range from 454 to 8,480 ft^2/d (Ref. 18, p. 26).

The vertical and horizontal variability of sediment distribution in the Potomac Formation makes aquifer correlation complex (Ref. 18, p. 18). The formation has been differentiated into sub-aquifers: an upper, middle, and lower, comprised of discontinuous sandy units separated by silty clay confining layers (Refs. 16, pp. 19, 20; 18, pp. 14, 15, 18, 21, 22, 23, 24, 25, 26, 27). The sediment variability of the Potomac Formation is reflected in the wide range of values for aquifer properties. The range in values is primarily a function of the lithology, thickness, lateral extent, and degree of interconnection of sand bodies within a localized area (Ref. 18, p. 26). The regional flow system within the aquifers of the Potomac Formation is characterized by relatively slow downdip (southeast) flow, controlled mainly by hydrostratigraphy (Ref. 16, pp. 18-20).

The downward erosion of river channels during Pleistocene era resulted in the removal of underlying Cretaceous sediments. The channel-fill sediments deposited after the erosional episodes consisted of sand and gravel of the Columbia Group and Holocene sediments. These sediments have a greater permeability than the Potomac confining unit that had overlain the Potomac aquifers. Therefore, the paleochannels will influence groundwater in the Potomac aquifer and may act as a conduit for water to leak out of or into the

Potomac aquifer units (Refs. 18, pp. 33, 34; 19, p. 1). The sediments of the Columbia Formation fill that eroded surfaces within the underlying Potomac Formation formed a paleochannel that trends northeast to southwest with a thickness of approximately 70 ft. within the vicinity of the Site (Ref. 7, pp. 13, 68). Due to erosion, the Upper Potomac clay may be discontinuous or missing entirely within the paleochannels. As presented below, the Upper Potomac clay is absent in places from the NCCA, as documented in boring logs from select monitoring wells (Ref. 7, p. 13). Groundwater in the Columbia Formation (with public supply wells located in the paleo-channel filled with Columbia Formation sediments) is rapid and expected to be in the hundreds of feet per year based on a fate and transport assessment of PFAS compounds in groundwater at NCCA and DANG and at the public supply wells located in and around the paleochannel (Ref. 9, pp. 58, 132).

The hydraulic gradient between the aquifers and the Delaware River is affected by pumpage from the aquifers. In areas where the aquifers are relatively unstressed, potentiometric heads are above the altitude of the river, resulting in groundwater discharge to the river. Conversely, gradients are from the river to the aquifers in areas where pumping has lowered potentiometric heads below the river level (Ref. 18, p. 17). Water in the Potomac aquifer units not affected by pumpage flows southeast and eventually discharges into overlying sediments and the Delaware River (Ref 18, p. 36).

Site Geology/Hydrogeology and Aquifer Descriptions:

The aquifers evaluated for this HRS evaluation are the interconnected Columbia Aquifer and Potomac Aquifer that comprise the Columbia/Potomac Aquifer System. Well logs of monitoring and public supply wells throughout the Site and New Castle, Delaware, demonstrate the variability in the subsurface material indicative of the formations that comprise the Columbia/Potomac Aquifer System such as the Columbia and Potomac formations (Refs. 7, pp. 70, 71, 240-247, 252, 258, 261, 262, 299-305, 316-321; 9, pp. 121, 129-131, 164-167; 39, pp. 6, 9, 11, 15, 31, 34; 76. p. 2). The wells logs and cross-sections show intervals of clay, sand, gravel, sandy-gravel, sandy-clay, silty-clay, silty-gravel, silty-sand, silty, sandy-gravel ranging in thickness from just a few feet to tens of feet thick.

In the vicinity of the Site, groundwater flow within the Columbia and Potomac Aquifers is influenced by pumping from public supply wells, as wells as a possible surficial groundwater divide across the NCCA (Ref. 8, p. 16). Surface elevations at the airport reach 85 feet at the airport and lessen to sea level at the Delaware River located approximately 2 miles to the east-southeast and at the Christina River located between 0.5-mile west and 1 mile north of the airport (Ref. 8, pp. 16, 30, 47, p. 28). Based on review of groundwater gauging over a nine year period, an apparent groundwater divide in the surficial aquifer is present north of the east-west runway at the NCCA (Ref. 7, pp. 55, 77). Along the east side of the NCCA, surficial groundwater flows to the east-southeast toward the Delaware River while on the west side of the NCCA surficial groundwater is likely to flow to the west-northwest toward the Christina River. The presence of the groundwater divide may be related to the thinning of the Columbia Aquifer at the NCCA (Ref. 7, pp. 14, 77). Additionally, a groundwater mound has been observed in the southeastern portion of the DANG facility located in the northeast portion of the NCAA with shallow groundwater flowing in a west-southwesterly direction (Refs. 7, p. 77; 52, pp. 25, 81). A northerly groundwater flow direction is also inferred radiating from the groundwater mounding at the DANG facility (Refs. 7, p. 77; 52, p. 84). The apparent groundwater divide was also noted at a facility just north of the airport with shallow groundwater flow observed to be towards the northwest on the western portion of the facility and towards the southeast on the eastern portion of the facility (Ref. 56, pp. 4, 11).

Aquifer 1 – Columbia Aquifer:

A hydrogeologic cross section prepared from boring logs Cc55-18, Cd 51-8, and Cd 52-27,13 (section D to D') in the vicinity of the Site in New Castle illustrates the thickness of the Columbia aquifer (Ref. 18,

pp. 15, 23). The cross section shows the presence of the Columbia Aquifer overlying the Upper Potomac Aquifer. The maximum local thickness of the aquifer is approximately 70 feet (Ref. 18, p. 23). Wells completed in a paleochannel of the Columbia aquifer indicate that the aquifer has a thickness of approximately 70 feet, and the aquifer is present at elevations of 40 feet above sea level to approximately -30 feet below sea level (boreholes Cd42-16, 17) (Refs. 18, pp. 15, 25; 19, p. 1). In the northern portion of the Site, underlying the Castle Hills and Collins Park well fields, south of the Delaware Memorial Bridge, a hydrogeologic cross section prepared from borings logs Cd42-16, 17, Cd43-4, Cd-43-16, Cd43-1, and Cd-43-2 (section F to F') illustrates the approximate thickness of the Columbia aquifer ranging from 30 feet to 70 feet and is present at elevation of 40 to -40 feet (Refs. 18, pp. 15, 25; 19, p. 1). In this area, the Columbia the Potomac aquifer. The cross-section illustrates a possible paleochannel cutting into the middle Potomac aquifer (Ref. 18, pp. 25, 26). To the south of New Castle, in the southern portion of the Site, the Columbia aquifer is fairly thin and overlies the upper Potomac aquifer (Ref. 18, pp. 15, 21, 22). However, a paleochannel is present at the Llangollen well field where the Columbia aquifer is approximately 50 feet thick (Ref. 19, p. 1).

Aquifer 2 – Potomac Aquifer

The vertical and horizontal variability of sediment distribution in the Potomac Formation makes aquifer unit correlation difficult; the Potomac aquifer is considered a single stratigraphic unit in Delaware, but regionally it has been subdivided into an upper, middle, and lower aquifer units separated by discontinuous layers of fine-grained sediments (Refs. 16, pp. 19, 20; 18, pp. 12, 14, 15, 18, 21, 22, 23, 24, 25, 26, 27).

Underlying the Columbia aquifer in the vicinity of the Site in New Castle is the discontinuous upper Potomac confining unit; where this confining unit is present it can range in thickness from about 15 feet (borehole Cc55-18) to approximately 90 feet (borehole Dc24-19) (Ref. 18, pp. 21, 23, 27). The upper confining unit is not present adjacent to the Delaware River just south of New Castle (borehole Dd21-1), to the west of the New Castle in boreholes (Dc14-3 and Dc14-42), or in monitoring well boreholes NCPW-MW18 and NCPW-MW21 where the Columbia aquifer is in direct contact with the sands of the upper Potomac (Ref. 7, pp. 299-303, 316-321; 18, pp. 15, 22, 27; 19, p. 1). Vertical hydraulic conductivities of the upper Potomac confining unit, where present, range from 3.3×10^{-10} to 4.9×10^{-6} ft/s (Ref. 18, p. 28).

The upper Potomac unit is present in the western and southern portions of New Castle but becomes thin and discontinuous or is absent completely in the vicinity of the Delaware River and in the northern portion of New Castle (Refs. 18, pp. 15, 20, 21, 22, 23, 24, 25; 21, p. 1; 22, p. 1).

The base of the upper sand in the Potomac Aquifer unit increases in depth towards the east and reaches a depth of approximately 160 feet below mean sea level (msl) at the Delaware River (Ref. 21, p. 1). The thickness of the upper sandy zone in New Castle ranges from 20 to 120 feet thick (Ref. 22, p. 1). In the vicinity of the Site, the thickness of the upper Potomac aquifer unit ranges from approximately 18 feet to 42 feet beneath the western part of the New Castle (boreholes Dc15-13, Cc15-16, and Cc15-18), but is approximately 10 feet thick under the eastern part (borehole Cd52-27) (Refs. 18, pp. 15, 23; 21, p. 1; 22, p. 1).

A discontinuous confining unit overlying the middle Potomac aquifer is present in eastern New Castle (borehole Cd52-27) and northeast of New Castle (Ref. 18, pp. 15, 23, 25, 27). The middle Potomac confining unit, where present, ranges greatly in thickness and has intervals of sand bodies (Ref. 18, pp. 15, 23, 24, and 25).

In the vicinity of the Site, in east New Castle, the middle Potomac aquifer is present at approximately 100 feet below sea level (borehole Cd52-27) and has a thickness of approximately 30 feet (Ref. 18, pp. 15, 20, 23). The middle Potomac aquifer is continuous to the northwest, at a depth of 48 to 60 feet below sea level,

with a thickness of about 20 to 30 feet (Ref. 18, pp. 25). A Columbia paleochannel is likely documented at borehole Cd43-16 located north of New Castle at 60 to 76 feet below sea level based on a mineral analysis of the sand and supports that the Columbia aquifer is in direct contact with the sand unit of the Middle Potomac Aquifer (Ref. 18, pp. 15, 18, 25, 26).

All wells at this Site are finished in the Upper or Middle Potomac aquifer units and therefore the Lower Potomac aquifer unit is not described. While discontinuous confining units can be found within the Potomac Aquifer system, no local or continuous confining units restrict the movement of water between the Potomac aquifer units and these units act as one aquifer (Ref. 7, pp. 299-303, 316-321; 18, p. 12; Ref. 19, p. 1).

3.0.1.1 Target Distance Limit

The target distance limit defines the maximum distance from the source(s) at the Site over which targets are evaluated. In accordance with HRS **Section 3.0.1.1**, the targets associated with the ground water migration pathway are evaluated within a 4-mile radius from the source(s) at the Site. **Figure 4** in Reference 5 of this HRS documentation record depicts the 4-mile radius target distance limit based on center of the plume.

3.0.1.2 Aquifer Boundaries

3.0.1.2.1 Aquifer Interconnections

The absence of discernible continuous clay layers, both locally and regionally, demonstrates that a continuous (greater than 2 miles) confining layer is not present in the formations that comprise the Columbia/Potomac Aquifer System in the vicinity of the groundwater plume (Refs. 9, 129-131; 19, p. 1; 47, p. 100). The upper Potomac aquifer units are not laterally continuous, and to the northeast of the airport much of the Potomac formation has been eroded and filled with Columbia sediments of the Pleistocene Age (Refs. 21, p. 1; 22, p. 1). Boreholes (Dc14-3 and Dc14-42) establish that the Columbia Aquifer is in direct contact with the sands of the Upper Potomac Aquifer (Ref. 19, p. 1). Monitoring wells located within the boundaries of the groundwater plume further demonstrate that there is no continuous confining unit; boreholes logs for wells NCPW-MW18 and NCPW-MW21 indicate that no HRS qualifying confining unit is present down to a depth of approximately 90 feet below msl (Ref. 7, pp. 299-303, 316-321; 9, p. 130). There is also evidence that sand of the Columbia formation are also in direct contact with sand of the middle Potomac where a paleochannel eroded the Potomac formation and created a paleochannel with deposited sands of the Pleistocene Age Columbia Group as shown in boreholes Cd43-4 and Cd-43-16 (Ref. 18, pp. 18, 25, 26). The Pleistocene erosion removed the overlying Potomac confining unit which resulted in deposition of more permeable sediment and provided a conduit for water to leak out of or into the Potomac aquifers (Ref. 18, p. 33).

The migration of non-naturally occurring contaminants through the fine-grained sediments and the subsequent presence of contamination throughout the Columbia/Potomac Aquifer System to a depth of at least -103 feet in elevation demonstrates that the interbedded fine-grained units do not act as a local barrier to groundwater flow within the Columbia/Potomac Aquifer System. Site contaminants, such as PFOS, PFOA, and CVOCs, have been detected in groundwater monitoring and public supply wells screened within sands of the Columbia and Upper Potomac Aquifers as documented in Section 3.1.1 (wells screened at depths ranging from an elevation of 5.2 feet to elevation of -103.25 feet as shown on **Figure 2** in Reference 5 and **Tables 4** through **23** of this HRS documentation record). Vertical distribution has likely been influenced by the many active public groundwater pumping wells located within the vicinity of the Site, and has likely caused a downward vertical migration from the numerous source areas to production well screens over 100 ft. bgs. Rapid horizontal and vertical transport of contaminants has been observed within

the generally more permeable paleochannel sands and gravels, where the production wells are generally located (Ref. 7, pp. 56, 77).

For HRS scoring purposes, as described above, and consistent with the HRS, the Columbia and Potomac Aquifers are interconnected (evidence of observed migration of hazardous substances and no continuously present confining units) and evaluated as a single hydrologic unit (Ref. 1, Section 3.0.1.2.1).

Both Artesian and the NCMSC public supply wells withdraw water from the Columbia/Potomac Aquifer System (**Tables 18** and **22** of this HRS documentation record).

3.0.1.2.2 Aquifer Discontinuities

For HRS scoring purposes, an aquifer discontinuity occurs when a geologic, topographic, or other structure or feature entirely transects an aquifer within the 4-mile target distance limit, thereby creating a continuous boundary to groundwater flow within this limit (Ref. 1, Section 3.0.1.2.2).

As shown on the Geologic Map for the New Castle County, Delaware, there are no aquifer boundaries, such as mountain ranges, deep rivers, continuous HRS qualifying confining units, or faults, within 4 miles from the Site that entirely transects any portion of the aquifer within the 4-mile TDL and would constitute an aquifer discontinuity (Ref. 15, p. 1; **Figure 4** in Reference 5 of this HRS documentation record). The Christina River is relatively shallow and does not form a hydrological divide (Refs. 16, pp. 19 and 20; 19, p. 1).

TABLE 3 SUMMARY OF AQUIFER(S) BEING EVALUATED				
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 Aquifer	Y	Y	N
2	Potomac Aquifer	Y	Y	N

Notes:

> = greater than

Y = Yes

N = No

NA = Not applicable

NS = Not scored

TDL = Target distance limit

3.1 LIKELIHOOD OF RELEASE

3.1.1 Observed Release

Aquifer Being Evaluated: Columbia/Potomac Aquifer System

As discussed in **Section 3.0.1**, the Columbia Formation ranges in depth from 10 to 100 feet below ground surface (bgs), below which is the Potomac Formation that has a maximum thickness of 1,600 feet. As shown on **Tables 6, 7, 10, 11, 14, 15, 18, 19, 22, and 23** of this HRS documentation record, samples containing PCE, and PCE breakdown products, as well as PFOS and PFOA, were collected from monitoring and public supply wells to a maximum depth of 137 feet bgs (-110 feet elevation); therefore, an observed release in the Columbia/Potomac Aquifer System is documented.

Direct Observation

The aquifers are not evaluated for observed release by direct observation.

Chemical Analysis

An observed release by chemical analysis is established by demonstrating that the hazardous substance in release samples is significantly greater in concentration than in the background samples, and by documenting that at least part of the significant increase is due to a release from the Site being evaluated. The significant increase can be documented in one of two ways for HRS purposes. If the background concentration is not detected, an observed release is established when the sample measurement in a similar sample 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 in a similar sample is three times or more the background concentration and above the appropriate quantitation limit (Ref. 1, Section 2.3). **Tables 4 through 23** of this HRS documentation record provide the hazardous substances concentrations and additional sample and well information for the groundwater samples used to establish observed releases. Background and Observed Release sample locations are shown on **Figure 2** in Reference 5 of this HRS documentation record (Ref. 5, p. 2).

Groundwater samples from monitoring wells were collected by EA, under contract with DNREC, as part of the SI in 2017, 2018, and 2020 (Ref. 7, pp. 28, 33, 232, 351-364). EA, under contract with DNREC, collected additional groundwater samples from monitoring wells and four public supply wells in 2021 as part of the ESI (Ref. 9, pp. 28, 29, 154-158, 182-190). Sample collection included the collection of quality assurance (QA) and quality control (QC) samples which consisted of field duplicates, matrix spike (MS)/matrix spike duplicates (MSDs), field blanks, rinsate blanks, and trip blanks (Refs. 7, p. 35; 9, p. 29). Samples were analyzed for VOCs by EPA Method SW846 8260 and for PFAS by modified version of EPA Method 537 (for monitoring well samples), and by EPA Method 537.1 (for drinking water samples) (Refs. 7, p. 35; 9, p. 31). Analytical results were validated by a third-party contractor, Environmental Data Services, Ltd., according to Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537, EPA 910-R-18-001 (November 2018) and EPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review, OLEM 9240.0-51, EPA-540-R-20-005 (November 2020) (Ref. 33, pp. 2, 21, 45, 59, 79, 113, 125, 143, 155, 223).

Water samples were collected from the public supply wells by the respective public supply facilities, Artesian, and NCMSC for PFAS and VOCs by EPA Methods 537 (and 537.1) and 524.2, respectively, (Refs. 31, p. 1; 32, p. 1).

Selection of Background

In general, hazardous substances associated with the Site, particularly PFAS compounds, were detected in all groundwater samples collected during the SI, ESI, and recent sampling of the public supply wells by the water authorities. Wells chosen to document background conditions are wells located on the farthest edges of the plume and show that groundwater samples collected to document an observed release are greater than three times (or more) the concentrations detected in the background sample locations. Therefore, the observed release wells delineate an area of significant increase. For background similarity, and to meet the criteria for establishing an observed release, wells are separated into five categories, as described below. This ensures that background wells are screened within the same relative depth within the Columbia/Potomac Aquifer and have similar construction as the contaminated wells with which they are being compared:

- Shallow monitoring wells are screened at depths ranging from 50.84 to 10.97 feet elevation (**Tables 4 and 6**)
- Intermediate monitoring wells are screened at depths from 5.2 feet msl to -23.38 feet elevation (**Tables 8 and 10**)
- Deep monitoring wells are screened at depths ranging from -45.34 to -87.91 feet elevation (**Tables 12 and 14**)
- Public supply wells are only compared with other public supply wells, due to longer screen lengths and larger casing diameters than the monitoring wells; however, to ensure similar screened intervals within the aquifer, public supply wells are evaluated as:
 - Intermediate public supply wells, screened at depths from ranging from -15 to -69.75 feet elevation (**Tables 16 and 18**)
 - Deep public supply wells, screened at depths ranging from -50.5 to -141.2 feet elevation (**Tables 20 and 22**)

Background levels for each analyte in each well category are identified in **bold**.

TABLE 4 BACKGROUND SHALLOW MONITORING WELL INFORMATION						
Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
NCPW-MW24 (275657)	50.20	30 (20.2)	14.71 to 29.71 (35.49 to 20.49)	2	Intervals of sand and clay	9, pp. 67, 131, 166, 167, 170

Notes:

¹Elevation based on ground surface. Elevation based on NAVD88.

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

MW= Monitoring well

NAVD88 = North American Vertical Datum

NCPW = New Castle Public Wells

**TABLE 5
BACKGROUND SHALLOW MONITORING WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	RL (ng/l or µg/l) ¹	Reference(s)
NCPW-MW24 (NCPW- MW24- 11032021)	11/03/21	PFOS	0.52U	1.91	9, pp. 157, 190; 30, pp. 1656, 3185; 33, pp. 176-182, 219
		PFOA	4.33	1.91	9, pp. 157, 190; 30, pp. 1656, 3185; 33, pp. 176-182, 219
		trans-1,2-DCE	0.24U	1.0	9, pp. 157, 190; 30, pp. 461, 3173; 33, pp. 223-230, 271
		cis-1,2-DCE	0.22U	1.0	9, pp. 157, 190; 30, pp. 461, 3173; 33, pp. 223-230, 271
		TCE	0.31U	1.0	9, pp. 157, 190; 30, pp. 461, 3173; 33, pp. 223-230, 271
		PCE	0.25U	1.0	9, pp. 157, 190; 30, pp. 461, 3173; 33, pp. 223-230, 271

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

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 (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

U = Indicates the analyte was analyzed for but not detected (Ref. 9, p. 242).

µg/l = micrograms per liter

ng/l = nanograms per liter

1,1-DCA = 1,1-dichloroethane

cis-1,2-DCE = cis-1,2-dichloroethylene

trans-1,2-DCE = trans-1,2-dichloroethylene

PCE = Tetrachloroethylene

TCE = Trichloroethylene

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP = Contract Laboratory Program

ID = Identifier

MW= Monitoring well

NCPW = New Castle Public Wells

VOC = Volatile organic compound

**TABLE 6
OBSERVED RELEASE SHALLOW MONITORING WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
NCPW-A9-MW05 (259014)	42.97	35 (7.97)	17 to 32 (25.97 to 10.97)	1.5	Intervals of clay and sand	7, pp. 80, 87, 244, 245, 273
NCPW-A11-MW06 (259018)	68.87	47 (21.87)	37 to 47 (31.87 to 21.87)	1.5	Intervals of silty sand, sand and gravel; little clay	7, pp. 80, 87, 246, 247, 276
NCPW-A13-MW12 (259003)	74.80	50 (24.8)	40 to 50 (34.80 to 24.80)	1.5	Intervals of silty sand, sand, and sandy clay	7, pp. 80, 87, 252, 253, 283
NCPW-A13-MW13 (259005)	61.33	40 (21.33)	29 to 39 (32.33 to 22.33)	1.5	Intervals of sand and sandy clay	7, pp. 80, 87, 254, 255, 286
NCPW-A13-MW14 (259002)	70.69	50 (20.69)	40 to 50 (30.69 to 20.69)	1.5	Intervals of sand and clayey sand	7, pp. 80, 87, 256-258, 289
NCPW-A14-MW16 (259016)	69.84	37 (32.84)	19 to 29 (50.84 to 40.84)	1.5	Intervals of sand and sandy clay	7, pp. 80, 87, 261, 262, 294
NCPW-MW23 (275658)	60.74	50 (10.74)	39.6 to 49.6 (21.14 to 11.14)	2	Sand; limited intervals of clay	9, pp. 67, 132, 164, 165, 169

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

MW = Monitoring well

NAVD88 = North American Vertical Datum

NCPW = New Castle Public Wells

**TABLE 7
OBSERVED RELEASE SHALLOW MONITORING WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	RL (ng/l or µg/l) ¹	Reference(s)
NCPW-A9-MW05 (NCPW-A09GW-05)	9/17/18	PFOS	262	1.68	26, pp. 338, 821; 33, pp. 113-119, 123
		PFOA	162	1.68	26, pp. 338, 821; 33, pp. 113-119, 123
NCPW-A11-MW06 (NCPW-A11GW-06)	8/9/17	PFOS	15.4	1.94	25, pp. 270, 652; 33, pp. 79-85, 87
		PFOA	24.1	1.94	25, pp. 270, 652; 33, pp. 79-85, 87
NCPW-A13-MW12 (AREA13-MW12-11012021)	11/01/21	PFOS	18	1.80	30, pp. 1189, 3182; 33, pp. 176-184, 189
		PFOA	71.1	1.80	30, pp. 1189, 3182; 33, pp. 176-184, 189
		trans-1,2-DCE	2.9	1.0	30, pp. 326, 3171; 33 pp. 223-232, 237
		cis-1,2-DCE	2.3	1.0	30, pp. 326, 3171; 33 pp. 223-232, 237
		TCE	19	1.0	30, pp. 326, 3171; 33, 223-232, 237
		PCE	2.8	1.0	30, pp. 326, 3171; 33, 223-232, 237
NCPW-A13-MW13 (NCPW-A13GW-13)	9/19/18	PFOA	71.3	1.73	27, pp. 270, 761; 33, pp. 143-149, 151
NCPW-A13-MW14 (AREA13-MW14-11022021)	11/2/21	PFOS	28.3	1.94	30, pp. 1447, 3183; 33, pp. 176-184, 206
		PFOA	107	1.94	30, pp. 1447, 3183; 33, pp. 176-184, 206
NCPW-A14-MW16 (NCPW-A14GW-16)	9/17/18	PFOS	111	1.76	26, pp. 316, 821; 33, pp. 113-119, 121
		PFOA	67.6	1.76	26, pp. 316, 821; 33, pp. 113-119, 121
NCPW-MW23 (NCPW-MW23-11032021)	11/03/21	PFOS	8.35	1.87	30, pp. 1696, 3185; 33, pp. 177-184, 222
		PFOA	39.1	1.87	30, pp. 1696, 3185; 33, pp. 177-184, 222

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

Data was validated in accordance with EPA Contract Laboratory Program National Functional Guidelines (NFG) for Organic Superfund Methods Data Review, OLEM 9240.0-51, EPA-540-R-20-005, November 2020 (Ref. 33, pp. 125, 132, 137).

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 (Refs. 32, p. 24 34. 2).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

µg/l = micrograms per liter

ng/l = nanograms per liter

cis-1,2-DCE = cis-1,2-dichloroethylene

trans-1,2-DCE = cis-1,2-dichloroethylene

PCE = Tetrachloroethylene
 TCE = Trichloroethylene
 PFOS = Perfluorooctanesulfonic acid
 PFOA = Perfluorooctanoic acid

CLP = Contract Laboratory Program
 ID = Identifier
 MW = Monitoring well
 NCPW = New Castle Public Wells
 VOC = Volatile organic compound

**TABLE 8
 BACKGROUND INTERMEDIATE MONITORING WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
NCPW-MW22 (275659)	17.10	24 (-6.9)	13.74 to 23.74 (3.36 to -6.64)	2	Intervals of clay, sand, and clay with sand	9, pp. 67, 131, 162

Notes:

¹Elevation based ground surface. Elevation based on NAVD88.

bgs = Below ground surface
 DNREC = Delaware Department of Natural Resources and Environmental Control
 ID = Identifier
 in = inch
 msl = mean sea level
 NAVD88 = North American Vertical Datum

**TABLE 9
BACKGROUND INTERMEDIATE MONITORING WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	RL (ng/l or µg/l) ¹	Reference(s)
NCPW-MW22 (NCPW- MW22- 11032021)	11/03/21	PFOS	0.51U	1.90	9, pp. 157, 188; 30, pp. 1625, 3185; 33, pp. 176-182, 217
		PFOA	41.5	1.90	9, pp. 157, 188; 30, pp. 1625, 3185; 33, pp. 176-182, 217
		1,2-DCA	0.43U	1.0	9, pp. 157, 188; 30, pp. 455, 3173; 33, pp. 223-230, 269
		cis-1,2-DCE	0.22U	1.0	9, pp. 157, 188; 30, pp. 455, 3173; 33, pp. 223-230, 269
		TCE	0.31U	1.0	9, pp. 157, 188; 30, pp. 455, 3173; 33, pp. 223-230, 269

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

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 (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

U = Indicates the analyte was analyzed for but not detected (Ref. 9, p. 242).

µg/l = micrograms per liter

ng/l = nanograms per liter

1,2-DCA = 1,2-dichloroethane

cis-1,2-DCE = cis-1,2-dichloroethylene

trans-1,2-DCE = trans-1,2-dichloroethylene

PCE = Tetrachloroethylene

TCE = Trichloroethylene

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP = Contract Laboratory Program

ID = Identifier

MW = Monitoring well

NCPW = New Castle Public Wells

VOC = Volatile organic compound

**TABLE 10
OBSERVED RELEASE INTERMEDIATE MONITORING WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
NCPW-A8-MW01 (259009)	3.26	12 (-8.74)	2 to 12 (1.26 to -8.74)	1.5	Sand, silty sand	7, pp. 80, 87, 240, 264
NCPW-A8-MW02 (259010)	5.99	15 (-9.01)	5 to 15 (0.99 to -9.01)	1.5	Sand, silty sand; little clay	7, pp. 80, 87, 241, 267
NCPW-A8-MW03 (259011)	10.15	15 (-4.85)	5 to 15 (5.15 to -4.85)	1.5	Sand, silt	7, pp. 80, 87, 242, 269
NCPW-A9-MW04 (259013)	25.20	30 (4.8)	20 to 30 (5.2 to -4.8)	1.5	Intervals of sand and clay	7, pp. 80, 87, 243, 271
NCPW-MW19s (270406)	49.88	68.17 (-18.29)	57.92 to 67.92 (-8.04 to -18.04)	2	Sand, silty sand	7, pp. 81, 87, 304-307, 323
NCPW-MW20s (270409)	42.04	65.67 (-23.63)	55.42 to 65.42 (-13.38 to -23.38)	2	Sand, silty sand; little clay	7, pp. 81, 87, 309-312, 324

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

MW = Monitoring well

NAVD88 = North American Vertical Datum

NCPW = New Castle Public Wells

TABLE 11
OBSERVED RELEASE INTERMEDIATE MONITORING WELL CONCENTRATIONS

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	RL (ng/l or µg/l) ¹	Reference(s)
NCPW-A8-MW01 (NCPW-A08GW-01)	8/8/17	PFOS	97.8	2.68	7, p. 351; 24, pp. 421, 1831; 33, pp. 45-51, 53
		PFOA	177	2.68	7, p. 351; 24, pp. 421, 1831; 33, pp. 45-51, 53
NCPW-A8-MW02 (NCPW-A08GW-02 DL for PFOS and PFOA; NCPW-A08GW-02 for CVOCs)	8/8/17	PFOS	3400	47.8	7, p. 352; 24, pp. 448, 1831; 33, pp. 45-51, 55
		PFOA	560	47.8	7, p. 352; 24, pp. 448, 1831; 33, pp. 45-51, 55
		cis-1,2-DCE	2.7	1.0	7, p. 352; 24, pp. 105, 1831; 33, pp. 59-66, 69
		TCE	5.7	1.0	7, p. 352; 24, pp. 105, 1831; 33, pp. 59-66, 69
NCPW-A8-MW03 (NCPW-A08GW-03)	8/8/17	PFOS	34.5	2.5	7, p. 353; 24, pp. 459, 1831; 33, pp. 45-51, 56
NCPW-A9-MW04 (AREA09-MW04- 11012021)	11/1/21	PFOS	729	17.77	9, pp. 154, 183; 30, pp. 14, 3182; 33, pp. 176-182, 192
		PFOA	170	1.77	9, pp. 154, 183; 30, pp. 1218, 3182; 33, pp. 176-182, 191
NCPW-MW19s (NCPW-MW19S- 081720201450)	8/17/20	PFOS	59	1.7	7, pp. 232, 362; 28, pp. 435, 1465; 33, pp. 2-7, 20
NCPW-MW20s (NCPW-MW20S- 11022021)	11/2/21	PFOS	152	1.90	9, pp. 155, 187; 30, pp. 1493, 3184; 33, pp. 176-184, 209
		1,2-DCA	4.7	1.0	9, pp. 155, 187; 30, pp. 395, 3172; 33, pp. 223-332, 257

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

Data was validated in accordance with EPA Contract Laboratory Program National Functional Guidelines (NFG) for Organic Superfund Methods Data Review, OLEM 9240.0-51, EPA-540-R-20-005, November 2020 (Ref. 33, pp. 59, 223).

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 (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

MDL = Method detection Limit. This is the minimum measured quantity of a substance that can be reported with 99 percent confidence that the concentration is distinguishable from method blank results, consistent with 40 CFR Part 136 Appendix B, August 2017 (Ref. 34, p. 2).

µg/l = micrograms per liter

ng/l = nanograms per liter

1,2-DCA = 1,2-dichloroethane

cis-1,2-DCE = cis-1,2-dichloroethylene

trans-1,2-DCE = trans-1,2-dichloroethylene

PCE = Tetrachloroethylene

TCE = Trichloroethylene

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP = Contract Laboratory Program

ID = Identifier

MW = Monitoring well

NCPW = New Castle Public Wells

QAPP = Quality Assurance Project Plan

VOC = Volatile organic compound

**TABLE 12
BACKGROUND DEEP MONITORING WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
NCPW-MW18 (270431)	11.09	99 (-87.91)	89 to 99 (-77.91 to -87.91)	2	Intervals of sand and silt	7, pp. 81, 87, 299-303

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

MW = Monitoring well

NAVD88 = North American Vertical Datum

NCPW = New Castle Public Wells

**TABLE 13
BACKGROUND DEEP MONITORING WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l)	RL (ng/l)	Reference(s)
NCPW-MW18 (NCPW- MW18- 11022021)	11/2/21	PFOS	7.14	1.82	30, pp. 1288, 3182; 33, pp. 176-184, 196

Notes:

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 (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

ng/l = nanograms per liter

CLP=Contract Laboratory Program

ID = Identifier

MW = Monitoring well

NCPW = New Castle Public Wells

PFOS = Perfluorooctanesulfonic acid

**TABLE 14
OBSERVED RELEASE DEEP MONITORING WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Referenc e(s)
NCPW-MW21	55.41	111 (-55.59)	100.75 to 110.75 (-45.34 to -55.34)	2	Intervals of sand, silty sand, gravel; little clay	7, pp. 81, 87, 316- 321, 325

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

MW= Monitoring well

NAVD88 = North American Vertical Datum

NCPW = New Castle Public Wells

**TABLE 15
OBSERVED RELEASE DEEP MONITORING WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l)	RL (ng/l)	Reference(s)
NCPW-MW21 (NCPW-MW21-081720200933)	8/17/20	PFOS	99	1.9	7, p. 364; 28, pp. 309, 1465; 33, pp. 2-7, 12

Notes:

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 (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. RL presented above is most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3).

ng/l = nanograms per liter

CLP=Contract Laboratory Program

ID = Identifier

MW = Monitoring well

NCPW = New Castle Public Wells

PFOS = Perfluorooctanesulfonic acid

**TABLE 16
BACKGROUND INTERMEDIATE PUBLIC WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet ¹	Completed Well Depth feet bgs (elevation-feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Lithology	Reference(s)
Midvale Well 1R (259062)	57	87 (-30)	72 to 84 (-15 to -27)	10	Intervals of silt and sand; little clay/Columbia-Potomac	35, pp. 1, 2; 39, pp. 10, 11; 82, p. 5
Midvale Well 2R (259060)	45	77 (-32)	60 to 75 (-15 to -30)	10	Intervals of silt, sand and clay/Columbia-Potomac	35, pp. 1, 2; 39, pp. 41, 42; 82, p. 5
Collins Park Well 1 (40146)	55.25	---	100-125 (-44.75 to -69.75)	10	Potomac Group	35, pp. 1, 2; 40, p. 7

Notes:

¹Elevation based on ground surface. Elevation based on NAVD88.

--- Indicates could not be documented with available information.

bgs = Below ground surface

ID = Identifier

in = inch

msl = mean sea level

NAVD88 = North American Vertical Datum

TABLE 17 BACKGROUND INTERMEDIATE PUBLIC WELL CONCENTRATIONS					
Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	MRL/RL ² (ng/l or µg/l) ¹	Reference(s)
Collins Park (4427323 for PFOS and PFOA; 9094439-01 for CVOCs)	9/18/19	PFOS	24	2	31, pp. 56, 58
		PFOA	72	2	31, pp. 56, 58
	9/30/19	TCE	< 0.5	0.5	31, pp. 62, 65, 66, 67
		PCE	0.6	0.5	31, pp. 62, 65, 66, 67
Midvale 1R (7121398-01)	10/15/19	PFOS	11	2	31, pp. 144, 145
		PFOA	53	2	31, pp. 144, 145
	12/13/17	TCE	< 0.5	0.5	31, pp. 124, 130, 131, 132
		PCE	< 0.5	0.5	31, pp. 124, 130, 131, 132
Midvale 2R (10038 Well 2 for PFOS and PFOA; 8014661-01 for CVOCs)	10/15/19	PFOS	14	2	31, pp. 144, 145
		PFOA	46	2	31, pp. 144, 145
	1/30/18	TCE	< 0.5	0.5	31, pp. 136, 138, 139, 140
		PCE	< 0.5	0.5	31, pp. 136, 138, 139, 140

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

²MRLs are associated with the PFOS and PFOA data and RLs are associated with the VOC data.

The MRLs and RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3). However, it cannot be documented with available information whether the above noted MRLs and RLs are sample-specific.

MRL = Minimum reporting limit - The minimum concentration that can be reported as a quantitated value for a method analyte in a sample following analysis. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte and can only be used if acceptable QC criteria for this standard are met. (Ref. 38, p. 6). In accordance with EPA Method 537, laboratories are required to demonstrate they can meet the MRL (Refs. 31, pp. 55, 143; 38, pp. 3, 18, 19).

RL = Reporting limit – The concentrations of a compound below which results are reported as nondetect or less than for this sample set (Ref. 91, p. 1).

< = less than

µg/l = micrograms per liter

ng/l = nanograms per liter

cis-1,2-DCE = cis-1,2-dichloroethylene

PCE = Tetrachloroethylene

TCE = Trichloroethylene

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP=Contract Laboratory Program

ID = Identifier

QC = Quality criteria

SQL = Sample Quantitation Limit

VOC = Volatile organic compound

**TABLE 18
OBSERVED RELEASE INTERMEDIATE PUBLIC WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Borehole Lithology/ Screened Formation	Reference(s)
Airport Industrial Park 1 (48941)	60	122 (-62)	100 to 112 (-40 to -52)	10	Layers of clay with intervals of sand and gravel/ Potomac Group	35, pp. 1, 2; 39, pp. 5, 6; 41, p. 7
Airport Industrial Park 2 (52445)	63.75	126 (-62.25)	104 to 114 (-40.25 to -50.25)	10	Interval of sand beneath layers of clay/Potoma c Group	35, pp. 1, 2; 39, pp. 8, 9; 41, p. 7
Jefferson Farms 2R (241858)	44	105 (-61)	90 to 100 (-46 to -56)	12	Columbia- Potomac	35, pp. 1, 2; 39, p. 45; 82, p. 5
Wilmington Manor 3 (10041)	24	92 (-68)	48 to 72 (-24 to -48)	17	Columbia Group	35, pp. 1, 2; 39, pp. 12, 13; 42, p. 7
Basin Road (10060)	21.5	---	68 to 83 (-46.5 to -61.5)	10	Potomac Group	35, pp. 1, 2; 43, p. 7

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

--- Indicates could not be documented with available information

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

NAVD88 = North American Vertical Datum

**TABLE 19
OBSERVED RELEASE INTERMEDIATE PUBLIC WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	MRL/RL² (ng/l or µg/l) ¹	Reference(s)
Airport Industrial Park 1 (NCPW-AIPW1-11032021)	11/3/21	PCE	7.5	1.0	30, pp. 426, 3172; 33, 223-232, 261
Airport Industrial Park 2 (52445 Well 2 for PFOS; 9042776-01 for CVOCs)	10/29/19	PFOS	90	2	31, pp. 5, 7
	4/25/19	PCE	20.7	0.5	31, pp. 19, 21, 22, 23
		TCE	1.1	0.5	31, pp. 19, 21, 22, 23
Jefferson Farms 2R (NCPW-JF2R-11032021)	11/3/21	PFOS	203	1.88	30, pp. 1590, 3184; 33, pp. 176-184, 215
Wilmington Manor 3 (00552/10041 Well 3 for PFOS. 0034348-03 for CVOCs)	4/16/20	PFOS	1,700	2	31, pp. 158, 160
	4/3/20	PCE	2.2	0.5	31, pp. 150, 152, 153
Basin Road (NCPW-BASIN-11022021)	11/2/21	PFOS	3,240	32.3	30, pp. 1413, 3183; 33, pp. 176-184, 204
		PFOA	269	1.62	30, pp. 1396, 3183; 33, pp. 176-184, 203

Notes:

¹Units for PFOS and PFOA are ng/l and for VOCs are µg/l.

²MRLs are associated with the PFOS and PFOA data and RLs are associated with the VOC data.

Data was validated in accordance with EPA Contract Laboratory Program National Functional Guidelines (NFG) for Organic Superfund Methods Data Review, OLEM 9240.0-51, EPA-540-R-20-005, November 2020 (Ref. 33, p. 223).

Qualified data were used in accordance with EPA’s fact sheet “Using Qualified Data to Document an Observed Release and Observed Contamination”. No adjustment factor for J qualified data was needed or used (Ref. 37, pp. 4, 8).

MRL = Minimum reporting limit. The minimum concentration that can be reported as a quantitated value for a method analyte in a sample following analysis. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte and can only be used if acceptable QC criteria for this standard are met (Ref. 38, p. 6). In accordance with EPA Method 537, laboratories are required to demonstrate they can meet the MRL (Refs. 31, pp. 4, 157; 38, pp. 3, 18, 19).

RL = Reporting limit – The concentrations of a compound below which results are reported as nondetect or less than in this Suburban laboratories analysis (Ref. 91, p. 1). In the Eurofins laboratories analyses, reporting limits are the minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence (Refs. 32, p. 24; 34, p. 2).

The samples were analyzed by a non-CLP laboratory. The MRLs and RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3). However, it cannot be documented with available information whether the above noted MRLs and RLs are sample-specific.

µg/l = micrograms per liter

ng/l = nanograms per liter

PCE = tetrachloroethylene

TCE = trichloroethylene

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP=Contract Laboratory Program

ID = Identifier

QC = Quality criteria

SQL = Sample Quantitation Limit

VOC = Volatile organic compound

**TABLE 20
BACKGROUND DEEP PUBLIC WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Comple ted Well Depth feet bgs (elevatio n-feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Borehole Lithology/ Screened Formation	Reference(s)
Llangollen Well 6R (259051)	53.6	172 (-118.4)	105 to 145 (-51.4 to -91.4)	12	Intervals of sand, silt, gravel, clay/Upper Potomac	35, pp. 1, 2; 39, pp. 46- 49; 82, p. 5
Llangollen Well 2 (35081)	61.5	164 (-102.5)	122 to 160 (-60.5 to -98.5)	10	Intervals of sandy clay, sand, gravel, clay/Upper Potomac	35, pp. 1, 2; 39, p. 50; 44, p. 7; 82, p. 5
Llangollen Well 7 (10049)	45	180 (-135)	115 to 175 (-70 to -130)	12	Intervals of coarse sand and gravel, clay, fine sand/Upper Potomac	35, pp. 1, 2; 39, p. 51; 49, p. 51; 44, p. 7; 82, p. 5
Wilmington Airport 3R (108453)	44	160 (-116)	135 to 154 (-91 to -110)	12	Intervals of fine to medium sand and clay/Potomac	35, pp. 1, 2; 39, pp. 52, 53; 82, p. 6
Llangollen G3R (240617)	15.8	160 (-144.2)	102-157 (-86.32 to -141.2)	12	Medium to coarse sand, some gravel and clay intervals/Upper Potomac	35, pp. 1, 2; 39, pp. 54, 55; 82, p. 5
Wilmington Airport 1 (10029)	70.5	---	187 to 197 (-116.5 to -126.5)	8	Potomac Group	35, pp. 1, 2; 45, p. 7

Notes:¹Elevation based on ground elevation. Elevation based on NAVD88.

--- Indicates could not be documented with available information

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

NAVD88 = North American Vertical Datum

**TABLE 21
BACKGROUND DEEP PUBLIC WELL CONCENTRATIONS**

Well ID (Sample ID)	Sample Date	Hazardous Substance	Concentration (ng/l or µg/l) ¹	MRL (ng/l)	Reference(s)
Llangollen Well 6R (3838226)	12/12/17	PFOS	5	2	31, pp. 104, 106
		PFOA	33	2	31, pp. 104, 106
Llangollen Well 2 (4147747)	12/10/18	PFOS	4.4	2	31, pp. 87, 89
		PFOA	24	2	31, pp. 87, 89
Llangollen Well 7 (4104888)	10/29/18	PFOS	6.3	2	31, pp. 110, 112
		PFOA	40	2	31, pp. 110, 112
Wilmington Airport 3R (4427334)	9/18/19	PFOS	< 2	2	31, pp. 170, 172
		PFOA	5.9	2	31, pp. 170, 172
Llangollen Well G3R (4147746)	12/10/18	PFOS	17	2	31, pp. 87, 89
		PFOA	79	2	31, pp. 87, 89
Wilmington Airport 1 (4427332)	9/18/19	PFOS	< 2	2	31, pp. 169, 172
		PFOA	< 2	2	31, pp. 169, 172

Notes:

MRL = Minimum reporting limit - The minimum concentration that can be reported as a quantitated value for a method analyte in a sample following analysis. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte and can only be used if acceptable QC criteria for this standard are met (Ref. 38, p. 6). In accordance with EPA Method 537, laboratories are required to demonstrate they can meet the MRL (Refs. 31, pp. 86, 103, 109, 168, 169; 38, pp. 3, 18, 19).

The samples were analyzed by a non-CLP laboratory. RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3). However, it cannot be documented with available information whether the above noted MRLs and RLs are sample-specific.

< = less than

µg/l = micrograms per liter

ng/l = nanograms per liter

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

CLP=Contract Laboratory Program

ID = Identifier

QC = Quality criteria

SQL = Sample Quantitation Limit

VOC = Volatile organic compound

**TABLE 22
OBSERVED RELEASE DEEP PUBLIC WELL INFORMATION**

Well ID (DNREC permit ID)	Elevation Feet¹	Completed Well Depth feet bgs (elevation- feet in msl)	Screened Interval feet bgs (elevation-feet in msl)	Well Diameter (in)	Borehole Lithology/ Screened Formation	Reference(s)
Jefferson Farm 1R (237552)	36.75	140 (-103.25)	92 to 140 (-55.25 to - 103.25)	12	Sand, minimal clay/Potomac	35, pp. 1, 2; 39, pp. 56- 58; 82, p. 5
Frenchtown Road (35665)	40	135 (-95)	99-125 (-59 to -85)	12	Intervals of sand and clay/ Potomac Group	35, pp. 1, 2; 39, p. 15; 43, p. 7
Schoolhouse Lane (137)	37.5	---	88 to 128 (-50.5 to -90.5)	12	Intervals of sand and clay/ Potomac Group	35, pp. 1, 2; 39, pp. 34, 35; 43, p. 7
Crossroads (242100)	27	137 (-110)	100 to 130 (-73 to -103)	12	Intervals of sand and clay	35, pp. 1, 2; 39, p. 30, 31

Notes:

¹Elevation based on ground elevation. Elevation based on NAVD88.

--- Indicates could not be documented with available information

bgs = Below ground surface

DNREC = Delaware Department of Natural Resources and Environmental Control

ID = Identifier

in = inch

msl = mean sea level

NAVD88 = North American Vertical Datum

**TABLE 23
OBSERVED RELEASE DEEP PUBLIC WELL CONCENTRATIONS**

Sample ID	Sample Date	Hazardous Substance	Concentration (ng/ or µg/l) ¹	MRL/RL/LOQ (ng/l)	Reference(s)
Jefferson Farm 1R (3044531)	6/18/14	PFOS	200	40 ¹	31, pp. 175, 177
Frenchtown Road (GW 9975950)	1/28/19	PFOS	520	18 ²	32, pp. 11, 15
Schoolhouse Lane (NCPW-SCHOOL-11022021 DL)	11/2/21	PFOS	878	8.49 ³	30, pp. 1369, 3183; 33, pp. 176-184, 201
Crossroads	1/28/19	PFOS	680	17 ²	32, pp. 10, 15
		PFOA	290	87 ²	32, pp. 10, 15

Notes:

¹ Indicates the value is an MRL.

² Indicates the value is a limit of quantitation.

³ Indicates the value is an RL.

The samples were analyzed by a non-CLP laboratory. The MRLs, LOQs, and RLs presented above are most equivalent to the SQL as defined by HRS Section 1.1 (Ref. 1, Sections 1.1 and 2.3). However, it cannot be documented with available information whether the above noted MRLs, LOQs, and RLs are sample-specific (Ref. 1, Sections 1.1 and 2.3).

LOQ = Limit(s) of quantitation 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 (Ref. 34, p.2).

MRL = Minimum reporting limit - The minimum concentration that can be reported as a quantitated value for a method analyte in a sample following analysis. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte and can only be used if acceptable QC criteria for this standard are met (Ref. 38, p. 6). In accordance with EPA Method 537, laboratories are required to demonstrate they can meet the MRL (Refs. 31, p. 174; 38, pp. 3, 18, 19).

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 (Refs. 32, p. 24; 34, p. 2).

µg/l = micrograms per liter

ng/l = nanograms per liter

CLP=Contract Laboratory Program

ID = Identifier

PFOS = Perfluorooctanesulfonic acid

PFOA = Perfluorooctanoic acid

QC = Quality criteria

SQL = Sample Quantitation Limit

VOC = Volatile organic compound

Additional Supporting Data

Groundwater investigations for VOCs and PFAS have been conducted by various entities at several properties throughout New Castle, Delaware. The data from these numerous investigations were not used to score the Site because sufficient data presented above document a significant increase in the contaminated plume with no identified source scored in this HRS documentation record (**Tables 7 to 23** of this HRS documentation record). However, analytical data does exist that shows PFAS and VOC groundwater contamination throughout New Castle, Delaware. The discussion of the below properties, and their use and handling of hazardous substances associated with the Site, are provided as additional supporting data. The data also provides support for evaluating the Site as a contaminated groundwater plume with no identified sources because the significant increase cannot be attributed to specific source.

NCCA

VOCs, such as PCE, TCE, and cis-1,2-DCE, have been detected in monitoring wells installed at New Castle County Airport (NCCA) as early as 2012 (Ref. 46, pp. 31, 51, 67). Monitoring wells containing concentrations of CVOCs are primarily located along the southeastern and southwestern corner of the property (Ref. 46, pp. 51, 67). The contaminated monitoring wells are screened at depths ranging from 12 to 22 feet bgs (55.52 to 45.52 msl) to 100 to 110 feet bgs (-38.62 to -48.62 msl) (Ref. 46, pp. 31, 198-223). Lithology of the wells show intervals of sand, silt, and clay (Ref. 46, pp. 198-223). Groundwater samples collected in 2017, 2018, and 2019 from the NCCA monitoring wells in the southwestern portion of the property continued to show concentrations of PCE (up to 650 µg/l), TCE (up to 45 µg/l), cis-1,2-DCE (up to 10 µg/l), and vinyl chloride (up to 2 µg/l) (Ref. 47, pp. 81, 82, 83, 97). The monitoring wells are screened in the Columbia and Upper Potomac formations (Ref. 47, pp. 78, 79, 98-102).

In 2015, EPA collected groundwater samples from eleven monitoring wells located along the northern, western, and southern boundaries at the NCCA for PFAS (formerly referred to as PFCs [perfluorinated compounds]) (Ref. 48, pp. 16, 18). Analytical results showed the presence of PFOS and PFOA at concentrations up to 268 ng/l (equivalent to 0.268 µg/l) and 96 ng/l (equivalent to 0.096 µg/l), respectively. The monitoring wells are screened at depths ranging from 16 to 6 feet bgs (52.27 to 62.87 ft msl) to 100 to 110 feet bgs (-38.86 to -48.86 ft msl) (Ref. 48, pp. 16, 18). Additionally, a sample collected in 2014 from a residential drinking water well north of the airport contained 41 ng/l PFOA (equivalent to 0.041 µg/l) (Ref. 48, pp. 12, 18). Groundwater collected from one monitoring well, MW-10, was also analyzed for VOCs. Analytical results showed the presence of cis-1,2-DCE (5.2J µg/l), PCE (290 µg/l), and TCE (15 µg/l) (Ref. 48, pp. 16, 19).

DANG

In 2014, the Delaware Air National Guard (Tenant) Wilmington Airport Site (DANG) (EPA ID: DE0000306286/DE0572824274) – 1850-Present, which occupies the northeast portion of the NCCA, conducted a Remedial Investigation/Feasibility Study to investigate numerous identified areas of contamination on the property (Ref. 49, pp. 9, 93). Groundwater samples collected from direct-push borings and from existing and newly installed monitoring wells contained concentrations of cis-1,2-DCE (up to 3.7 µg/l), TCE (10.3 up to µg/l), and PCE (5.8 up to µg/l) (Ref. 49, pp. 65-67, 71, 73, 98, 99, 101, 102). Monitoring wells installed as part of the RI/FS are screened at depths ranging from 19 to 45 feet bgs (ground surface elevations ranging from 32.34 to 12.26 msl) (Ref. 49, pp. 46, 113-136, 237-248). Lithology of the wells show primarily sand with some gravel, minimal intervals of clay (Ref. 46, pp. 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136). Groundwater samples collected from monitoring wells at DANG from 2015 to 2020 continued to show concentrations of cis-1,2-DCE, TCE, and PCE, as well as vinyl

chloride (up to 14 µg/l), with MW 403 containing the highest and most consistent concentrations of CVOCs (Ref. 50, pp. 52-58, 35). Monitoring well 403 is screened between 75 and 105 feet bgs (Ref. 50, p. 35).

In 2016, DANG began monitoring groundwater at the facility for PFAS in an effort to identify potential sources of PFAS in public water supply wells in the area surrounding the base (Ref. 51, p. 9). PFOS and PFOA were detected in all groundwater samples collected from monitoring wells located on the base, with the exception of one well located on the eastern boundary of the property, at concentrations up to 4,600 ng/l (equivalent to 4.6 µg/l) for PFOA and 11,000 ng/l (equivalent to 11 µg/l) for PFOS (Ref. 51, pp. 35, 41). The monitoring wells at the facility are completed within the Columbia and Potomac Formations ranging in depth from shallow (less than [$<$] 60 ft bgs), intermediate (75 to 105 ft bgs), and deep ($>$ 200 ft bgs) (Ref. 18, pp. 21, 23, 27; 51, pp. 35, 41). In 2017, DANG conducted a PFAS site investigation to assess PFAS in groundwater at the base and investigate potential on-base release locations (Ref. 52, p. 13). Groundwater samples were collected from both existing monitoring wells at the base, as well as newly installed temporary wells (Ref. 52, p. 36). PFOS was detected up to 16,900 ng/l (equivalent to 16.9 µg/l) and PFOA up to 1,240 ng/l (equivalent to 1.24 µg/l) (Ref. 52, pp. 72, 73, 85-88, 746, 747, 753, 124-142, 1402, 1405, 1406, 1407, 1426, 1427, 2098, 2101, 2102, 2103, 2108). The newly installed temporary wells were installed to depths of 15 to 40 feet bgs (Ref. 52, pp. 108-114). Lithology of the wells show intervals of sand and clay (Ref. 52, pp. 108-114).

DEARNG

In 2021, the Delaware Army National Guard, Duncan Readiness Center and Army Aviation Support Facility (ARNG) – 1971-Present conducted an SI to determine the presence or absence of PFOA, PFOS, and other PFAS at the Duncan Readiness Center (RC) and Army Aviation Support Facility (AASF) located along the northwest boundary of the NCCA; the Delaware ARNG (DEARNG) leases the property from the NCCA (Ref. 53, pp. 9, 23). Groundwater samples were collected from temporary monitoring wells and one existing monitoring well (Ref. 53, pp. 48, 55). Analytical results of groundwater samples showed PFOS up to 150 ng/L and PFOA up to 280 ng/l (Ref. 53, pp. 65, 66). Temporary wells were installed between 20 and 45 ft bgs (33.25 feet elevation to 19.79 feet elevation) (Ref. 53, p. 53, 137-143, 154, 174, 176, 178, 180, 182, 184, 186). Lithology of the wells show intervals of sand, silty sand, sandy clay (Ref. 53, pp. 137-143, 173, 175, 177, 179, 181, 183, 185).

600 Dupont Highway/Jackson Ave. and North Dupont Highway

In 2014, a Brownfields investigation was conducted for an automobile service station property located at 600 Dupont Highway (Ref. 54, pp. 8, 9, 82). The property is located adjacent to a dry cleaners (Ref. 54, p. 83). As part of the investigation, four monitoring wells were installed to depths of 15 to 30 ft bgs (42 to 26.71 feet elevation) (Ref. 54, pp. 94, 241-244). Cross-sections and boring logs wells show the lithology is intervals of sands, silts, and clays (Ref. 54, pp. 86 87, 218, 219, 222, 223, 224, 229, 230). Analytical results of groundwater samples contained concentrations of cis-1,2-DCE (up to 4.4 µg/l), TCE (up to 1.1 µg/l), and PCE (up to 35 µg/l) (Ref. 54, pp. 109). Groundwater samples collected from the existing monitoring wells throughout 2014, 2015, and 2016 continued to contain concentrations of cis-1,2-DCE, TCE, and PCE, as well as some detections of 1,2-DCA (Ref. 55, pp. 10). Analytical results from the samples collected in 2017, from both existing and newly installed monitoring wells contained concentrations of cis-1,2-DCE (up to 4.8 µg/l), TCE (up to 15 µg/l), and PCE (up to 970 µg/l) (Ref. 55, pp. 9, 10, 97, 112, 123, 132, 145, 158, 536). The newly installed wells were installed at similar elevations and similar lithology as the existing wells (Ref. 55, pp. 9, 12-18, 19-21, 23). In 2018, two additional wells were installed, and groundwater samples were collected from the nine monitoring wells (Ref. 56, pp. 10, 721). Analytical results of the monitoring well samples showed concentrations of cis-1,2-DCE (up to 6.6 µg/l), TCE (up to 150 µg/l), PCE (up to 450 µg/l), and 1,2-DCA (up to 0.83 µg/l) (Ref. 56, pp. 12, 17, 270, 279, 283, 295, 324, 336, 359,

390, 399, 408, 435). The newly installed wells were installed at similar elevations and similar lithology as the existing wells (Ref. 56, pp. 28-30, 32-33, 48).

287 Christiana Road – Community Plaza

Since 2012, VOCs, such as PCE, TCE, and cis-1,2-DCE, have been detected in monitoring wells at installed the Community Plaza at 287 Christiana Road, that contains a dry cleaners (Refs. 57, pp. 4, 11, 18, 22; 58, pp. 13, 29). In 2014, analytical results of the groundwater samples collected as part of an RI from existing monitoring wells and newly installed monitoring wells contained concentration of cis-1,2-DCE (up to 290 µg/l), trans-1,2-DCE (58 up to µg/l), TCE (up to 17 µg/l), PCE (up to 180 µg/l), and vinyl chloride (up to 0.77 µg/l) (Ref. 59, pp. 142, 143, 1895, 1930, 1961, 1990, 2020, 2027, 2054, 2061, 2100, 2852, 2853). Monitoring well at the property are screened between 11 and 38 feet bgs (34.7 to 11.9 feet elevation (Refs. 57, pp. 38-40; 58, pp. 53-55; 59, pp. 129, 192-196). The lithology of the wells shows intervals of sand, silt and clay (Refs. 57, pp. 31-36; 58, pp. 46-51; 59, pp. 159-190). The most recent available groundwater samples collected from a select number of monitoring wells in 2020 showed concentrations of cis-1,2-DCE (up to 240 µg/l), TCE (up to 130 µg/l), PCE (up to 1,200 µg/l), and vinyl chloride (up to 0.47 µg/l) (Ref. 60, pp. 17, 34, 37, 42, 43).

Attribution

The East Basin Road Groundwater Site is a documented release of PFOA, PFOS, and CVOCs that include PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,2-DCA, and vinyl chloride. Observed releases to groundwater have been established resulting in the contamination of nine active municipal wells (**Section 3.1.1 Tables 19 and 23** of this HRS documentation record). The specific source(s) causing the significant increase of the contamination at the East Basin Road Groundwater Site cannot reasonably be attributed at this time because of the presence of multiple known and possible sources of PFAS and CVOCs and the mixing of groundwater.

In an effort to identify the source(s) of PFAS and CVOCs in groundwater in New Castle, Delaware, DNREC has conducted or overseen investigations at the following locations:

- NCCA
- DANG
- DEARNG
- BMX Fire Training Area
- 600 Dupont Highway/Jackson Ave. and North Dupont Highway
- Community Plaza

NCCA

In 1941, the New Castle County Airport Commission (NCCA) acquired the land for use as a civilian airport (Ref. 97, p. 6). From 1941 to 1946, the NCCA was occupied and operated as the U.S. Army, New Castle Army Airfield (EPA ID: DEN000305948) under the War Department (known today as the Department of Defense) (Refs. 47, p. 17; 97, p. 6). The U.S. Army utilized the property as an airbase and training facility from 1941 to 1946 (Refs. 47, pp. 17, 18; 97, pp. 6, 9). After World War II, from 1946 to 1949, the War Department transitioned the airfield back to New Castle County as a civilian airport [In 1947, the Army Air Corps split from the Department of the Army and became the Department of Air Force - U.S. Air Force, New Castle Army Airfield (EPA ID: DEN000305948)] (Ref. 97, p. 9). However, the military, including the Delaware Air National Guard (DANG) and the Delaware Army National Guard (DEARNG), has continued to maintain a presence at the airport (Ref. 47, p. 18; 97, pp. 9, 10). The Site remains an active airport facility, which is currently owned by NCC and since 1995 the Site has been operated and leased by Delaware River and Bay Authority (DRBA) (Ref. 47, pp. 17, 18). A Preliminary Assessment (PA) was conducted by EPA Region III in 1988 at the then New Castle County/Greater Wilmington Airport. The EPA was investigating formerly owned DOD facilities to determine the historic use and disposal of hazardous substances. The EPA PA indicates that materials and fuels containing hazardous substances had been managed at the Site during World War II under the DOD and following the development of the municipal airport thereafter (post-1946). The materials listed in the EPA PA included solvents, paints, and paint strippers composing of unknown constituents. Past tenants were also reported to have used cleaning solvents and paint removers that potentially contained hazardous substances. The former tenants listed in the EPA PA and known current tenants subsequent to the EPA PA include Atlantic Aviation, Aero-Taxi, Hawker Beechcraft Services, Dawn Aeronautics, Rollins, Hercules, and Rapidgear Repair (Ref. 47, p. 18).

In addition to the use and possible releases of chlorinated solvents at the NCCA, many of the airport buildings and hangars contain foam fire suppressant systems (Ref. 8, pp. 12, 48, 77, 210, 211, 223, 232, 237). Since the properties use as a military airbase, there have been several plane and helicopter crashes at

the airport. The last crash occurred in 2007, which showed the use of foam (Ref. 8, pp. 12, 48, 92, 93). Additionally, there is a fire training area located on the north end of Runway #19 that airport personnel have confirmed this area was used by the airport for fire training activities and that aqueous film forming foam (AFFF) may have been used (Ref. 8, pp. 11, 41).

As presented in **Additional Supporting Information**, CVOCs and PFOS and PFOA have been detected in groundwater samples collected from monitoring wells located at the NCCA. However, shallow and deep soil samples collected in 2013 (34 samples) and 2016 (two samples) did not contain concentrations of CVOCs (Refs. 46, pp. 45-47, 67; 47, pp. 80, 96). Collected soil samples have not been analyzed for PFAS (Refs. 46, p. 16; 47, pp. 44, 45).

DANG

DANG occupies approximately 57 acres at the northeast corner of the NCCA (Ref. 7, p. 70). A PA conducted by DNREC in 2015 indicated a possible fire training area located on the DANG property (Ref. 8, pp. 11, 16). However, in 2016, DANG conducted a separate PA that indicated there is no evidence that a fire training area is, or was located, within the current footprint of the DANG property boundary and that DANG utilized the fire training area located on NCCA property, north of the runway (Ref. 73, p. 13). A SI conducted by DEARNG indicates that DANG uses an area to the south of the DEARNG property for fire training (Ref. 53, pp. 32, 35). The DANG PA did indicate several areas where AFFF has been stored or released and may include crash sites, hangars, fuel spill areas, hazardous waste storage facilities, firefighting equipment testing areas, and others (Ref. 73, pp. 15, 16, 33). Of particular note is the Wash Rack area which is a concrete area, approximately 175 feet by 120 feet. The area is not sheltered and there is a central drain. According to fire station personnel, annual nozzle testing using AFFF was conducted at the Wash Rack until approximately two years ago. The Wash Rack has one drain that is equipped with a valve that can divert drainage to either the storm water system or the sanitary sewer. AFFF was likely diverted into the sanitary system; however, had the potential to drain to the South Stormwater Retention Basin (Outfall 2) if the valve in the drain was not diverted. Gaps between the concrete were visible in the Wash Rack area (Ref. 73, pp. 16, 33, 36, 37). The DNREC PA indicates that two buildings on the DANG property contain AFFF and that at one of the buildings, a full systems check dispensed its entire contents of AFFF after installation (Ref. 8, pp. 11, 42). However, the DANG PA indicates these two buildings do not contain AFFF but rather high expansion foam (HEF) suppression systems (Ref. 73, pp. 16, 17 18, 33). Soil samples collected in 2017, contained concentrations of PFOS and PFOA at several areas (Ref. 52, pp. 70, 71, 85, 86, 87). As presented in **Additional Supporting Information**, PFOS, and PFOA have been detected in groundwater samples collected from monitoring wells located at DANG.

An area of CVOC contaminated soil was documented on the DANG property, referred to as IRP Site 4B, where the improper disposal of waste solvents, particularly the burial of an aircraft fuel cell containing spent solvent, resulted in contamination of soil and groundwater with the CVOCs such as PCE, TCE, and their daughter products cis-1,2-DCE and vinyl chloride (Ref. 74, pp. 10, 24, 26). CVOCs were detected in soil samples at this location as early as 2004 with one soil sample collected in 2011 containing PCE at 3,000 µg/kg, TCE at 120,000 µg/kg, and cis-1,2-DCE at 22,000 µg/kg (Ref. 74, pp. 28, 32). In 2011 and 2012, approximately 100 tons of contaminated soil was removed and a soil vapor extraction system (SVE) was installed (Ref. 74, pp. 10, 28). Additionally in 2011 and 2012, bioremediation was conducted of the groundwater in the vicinity of IRP Site 4B (Ref. 74, p. 10). As presented in **Additional Supporting Information**, CVOCs, such as PCE, TCE, and cis-1,2-DCE have been detected in groundwater samples collected from monitoring wells located at DANG.

DEARNG

DEARNG encompasses approximately 17.3 acres adjacent to the NCCA (Ref. 53, pp. 9, 23). Soil samples collected on the property as part of a SI conducted by DEARNG in 2021, showed concentrations of PFOS and PFOA (Ref. 53, pp. 55, 64). Soil samples were not analyzed for VOCs as part of the SI (Ref. 53, pp. 45). The PFOS and PFOA detected in soil on the DEARNG property are possibly associated with a helicopter crash that occurred in the 1970s and the fire suppression system in the hangar, which was discharged in 2011 when it was retrofitted with Jet-X 2 percent high expansion foam (Ref. 53, p. 31). As presented in **Additional Supporting Information**, PFOS and PFOA were also detected in groundwater samples collected from monitoring wells located at DEARNG.

BMX Fire Training Area

The BMX Fire Training Area (referred to as Area 9) is owned by New Castle County (Ref. 8, p. 10). Local fire fighters confirmed that the area was used as a fire training area but could not confirm whether AFFF containing PFAS was used during fire training exercises. Historically, the property contained a three-story incinerator and two ammunition bunkers used by the military (Refs. 7, p. 19; 8, p. 40). The BMX fire Training Area was one of the locations investigated by DNREC in 2017 as part of the SI conducted by DNREC. Soil samples, primarily surface soil (0 to 2 feet bgs), collected from the BMX fire training area did not contain concentrations of CVOCs (Ref. 7, pp. 46, 69, 73, 89, 90, 94, 95). Soil samples collected by DNREC as part of the SI were not analyzed for PFAS (Ref. 7, p. 26). As presented in **Section 3.1**, PFOS and PFOA were also detected in groundwater samples collected from monitoring wells located at the BMX Fire Training Area as part of the DNREC SI.

600 Dupont Highway/Jackson Ave. and North Dupont Highway

The 600 Dupont Highway property has been used as an automobile service station, gas station, and towing facility since the early 1960s (Ref. 54, p. 9). In 2014, as part of a Brownfields investigation, soil samples were collected from the property; two of the collected samples showed detections of PCE at 0.04 milligrams per kilogram (mg/kg) and 0.011 mg/kg (Ref. 54, pp. 83, 91, 104, and 105). A dry cleaners is across Jackson Ave from the property (Ref. 54, p. 83).

To further investigate chlorinated solvent contamination detected in groundwater monitoring wells in the vicinity of the 600 North DuPont Highway property, sampling was conducted at a property directly adjacent to the dry cleaners (Ref. 56, pp. 1, 9, 10). One of two collected soil samples, which was collected near the corner of the dry cleaners, contained concentrations of PCE at 0.1 mg/kg (Ref. 56, pp. 10, 16).

As presented in **Additional Supporting Information**, CVOCs, such as PCE, TCE, and cis-1,2-DCE have been detected in groundwater samples collected from monitoring wells located on these properties in the vicinity of the dry cleaners.

A search of Delaware's Environmental Navigator Database did not provide any results for the dry cleaning facility (Ref. 75, pp. 1, 2).

Community Plaza

An RI was conducted at Community Plaza, a strip mall that contains a dry cleaners, at 287 Christiana Road in New Castle, Delaware in 2014 (Ref. 59, pp. 8, 111). Three soil samples collected from two soil borings closest to the dry cleaners contained concentrations of PCE (0.14 mg/kg), TCE (0.075 mg/kg), cis-1,2-DCE (up to 0.074 mg/kg), and trans-1,2-DCE (0.75 mg/kg) (Ref. 59, pp. 120, 139). As presented in **Additional**

Supporting Information, CVOCs, such as PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride have been detected in groundwater samples collected from monitoring wells located on this property.

Other Possible Sources

As shown in Reference 5, there are too many known or possible sources within the vicinity of the Site to reasonably attribute the significant increase in the PFAS and CVOCs in the groundwater to one or more specific source(s).

Industrial facilities that manufacture organic chemicals, plastics, and synthetic fibers may have PFAS at the facility for numerous reasons such as: to specifically manufacture PFAS through electrochemical fluorination, telomerization, or other processes in production of such products; as a polymerization processing aid; for the production of plastic, rubber, and resin; and in the manufacturing of commercial chemical products (e.g., carpet cleaning sprays, cleaning agents, protective coatings) (Ref. 62, pp. 13, 32). Twenty seven facilities in the vicinity of the Site are identified in the EPA Enviromapper database as plastics or resin manufacturing facilities, or chemical plants or manufacturers (Ref. 5 p. 2; 11).

PFAS are found in chemicals used as wetting agents, mist and fume suppressants to prevent air emissions of toxic metal fumes, agents to reduce mechanical wear, and surface coatings to impart certain characteristics (e.g., reduced corrosion, enhanced appearance) at a variety of metal finishing facilities such as electroplating, electroless plating, anodizing, coating, printed circuit board manufacturing, and chemical etching and milling (Ref. 62, pp. 13, 42). Eight facilities in the vicinity of the Site are identified in the EPA Enviromapper database as metal coating, fabrication, or smelting facilities, or as electronic manufacturers (Ref. 5, p. 2; 11).

Textile mills use PFAS chemicals to impart outdoor gear, clothing, household, and other textile products with water, oil, soil, and heat resistance (Ref. 62, pp. 13, 54). Two facilities in the vicinity of the Site are identified in the EPA Enviromapper databased as textile facilities (Refs. 5, p. 2; 11).

PFAS lower the surface tension and improve wetting and rinse-off in a variety of industrial and household cleaning products, including car wash products, as they reduce streaks and improve reflection of cleaned glass (Refs. 93, p. 3; 94, pp. 3, 4). Approximately 15 car washes are located within New Castle Delaware (Ref. 72, p. 2).

PCE, which breaks down into TCE, cis/trans-1,2-DCE, DCE, and vinyl chloride, is a commercially important chlorinated hydrocarbon solvent and chemical intermediate. It is used as a dry cleaning and textile-processing solvent and for vapor degreasing in metal-cleaning operations (Ref. 65, pp. 279, 302; 95 p. 39). Historically, the most important use of TCE has been vapor degreasing of metal parts, which is closely associated with the automotive and metals industries (Ref. 66, p. 324). TCE has also been used by the textile processing industry to scour cotton, wool, and other fabrics, as well as in waterless drying and finishing operations (Ref. 66, p. 324). TCE has been used as a solvent or a component of a solvent blend for adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners and in the production of polyvinyl chloride (Ref. 66, p. 324). The EPA Enviromapper databased identified a total of 26 facilities that fell into the category of metal coating and fabrication, dry cleaning, auto repair, chemical plants or manufacturers, and textiles facilities (Refs. 5, p. 2; 11).

Summary

As presented above, many known or possible current and historical users of PFAS and CVOCs are located in the area of the Site. Any releases of PFAS, PCE, or other CVOCs to the Columbia/Potomac Aquifer System from known or possible users in this area would likely have co-mingled over time (**Section 3.1.1**

of the HRS documentation record). This co-mingling could be the result of changes in local groundwater flow directions caused by pumping groundwater from the aquifer from the numerous public supply wells located within the area of the Site (Ref. 18, pp. 17, 36, 37, 38). The specific source(s) causing the significant increase of the contamination at the East Basin Road Groundwater Site cannot reasonably be attributed at this time because of the presence of multiple known and possible sources of PFAS and CVOCs and the mixing of groundwater. PFAS and CVOCs have been commonly used for many purposes and released to the environment from numerous sources where they persist for long periods of time in groundwater (Refs. 61, pp. 1, 3; 65, pp. 23, 294; 66, pp. 23, 24, 327; 67, pp. 17, 103; 68, pp. 22, 23, 189; 69, pp. 11, 105; 70, pp. 10, 154, 155; 71, pp. 2, 3; 95, p. 39). The persistence of PFAS and CVOCs in groundwater contribute to the difficulty in attributing the PFAS and CVOC contamination in groundwater to a specific source.

Hazardous Substances Released

- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- cis-1,2-Dichloroethylene (cis-1,2-DCE)
- trans-1,2-Dichloroethylene (trans-1,2-DCE)
- 1,2-dichloroethane (1,2-DCA)
- Vinyl Chloride
- Perfluorooctanesulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)

Ground Water Observed Release Factor Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

TABLE 24 TOXICITY AND MOBILITY – WASTE CHARACTERISTICS					
Hazardous Substance	Source Numbers	Toxicity Factor Value	Mobility Factor Value ¹	Toxicity/Mobility	References
Tetrachloroethylene (PCE) ²	1, OR	100	1.0	100	1, Section 2.4.1.1; 2, p. 17
Trichloroethylene (TCE) ²	1, OR	1,000	1.0	1,000	1, Section 2.4.1.1; 2, p. 20
cis-1,2-Dichloroethylene (cis-1,2-DCE) ²	1, OR	1,000	1.0	1,000	1, Section 2.4.1.1; 2, p. 5
trans-1,2-Dichloroethylene (trans-1,2-DCE) ²	1, OR	100	1.0	100	1, Section 2.4.1.1; 2, p. 8
1,2-dichloroethane (1,2-DCA) ²	1, OR	100	1.0	100	1, Section 2.4.1.1; 2, p. 1
Vinyl Chloride ²	1, OR	10,000	1.0	10,000	1, Section 2.4.1.1; 2, p. 23
Perfluorooctanesulfonic acid (PFOS) ²	1, OR	10,000	1.0	10,000	1, Section 2.4.1.1; 2, p. 11; 88, pp. 1-3
Perfluorooctanoic acid (PFOA) ²	1, OR	10,000	1.0	10,000	1, Section 2.4.1.1; 2, p. 14; 88, pp. 1-3

Notes:

OR = Observed Release

¹ 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 3.2.1.2).

²As presented in Sections 2.2 and 3.1.1 of this Hazard Ranking System (HRS) documentation record, PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,2-DCA, vinyl chloride, PFOS, and PFOA were detected in the contaminated groundwater plume, also evaluated as the source at this Site.

3.2.2 Hazardous Waste Quantity

TABLE 25 HAZARDOUS WASTE QUANTITY		
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, rounded to 1 (Ref. 1, Section 2.4.2.2)	

The sum corresponds to a hazardous waste quantity factor value of 1 in Table 2-6 of the HRS (Ref. 1, Section 2.4.2.2). However, because the hazardous constituent quantity is not adequately determined (Section 2.4.2.1.1 of this HRS documentation record) and targets are subject to Level I concentrations (Section 3.3.2.2 and Table 27 of this HRS documentation record), a pathway 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) (Ref. 1, Section 2.4.2.2). Therefore, a hazardous waste quantity factor value of 100 is assigned for the ground water migration pathway (Ref. 1, Section 2.4.2.2).

Hazardous Waste Quantity Factor Value: 100

3.2.3 Waste Characteristics Factor Category Value

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

Toxicity/Mobility Factor Value (10,000) x Hazardous
Waste Quantity Factor Value (100): 1×10^6

The product (1×10^6) corresponds to a Waste Characteristics Factor Category Value of 32 in Table 2-7 of the HRS (Ref. 1, Section 2.4.3.1).

Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 32

3.3 TARGETS

The Artesian Water Company supplies drinking water to 209,706 persons (Ref. 80, p. 1). Artesian's water supply system consists of 19 wellfields and 53 groundwater supply wells in New Castle County, Delaware (Refs. 90; 77, pp. 9, 40-42; 82, pp. 4-6). Artesian also purchases 0.5 million gallons of water per day from Chester Water Authority, whose source water is surface water (Ref. 77, pp. 10, 11; 78, p. 1). The system is a single interconnected distribution system with no one well or purchased water source providing more than 40 percent of the total volume of supplied water (Refs. 77, p. 9; 82, pp. 1, 4, 5, 6). Artesian also maintains interconnections with several additional adjacent water utilities for emergency purposes only and are not regularly used (Ref. 77, pp. 10, 11). These interconnections were not considered when evaluating the capacity of the system. In addition to the population served by the Artesian system in Delaware, Artesian also supplies water to the Town of Elkton (Refs. 77, p. 11; 81, p. 2). The purchased water from Artesian (8.77 million gallons) is mixed with Elkton's finished surface water (35.46 million gallons) and groundwater from four wells (9.96 million gallons) in a reservoir (Ref. 81, p. 2). Nineteen of Artesian's 53 public supply wells, are located within a 4-mile radius of the Site (**Figure 4** in Ref. 5). The public supply wells located within a 4-miles radius of the Site are completed in the Columbia/Potomac Aquifer System [Refs. 39, pp. 4, 5, 6, 7-13; 40, p. 7; 41, p. 7; 42, p. 7; 44, p. 7; 45, p. 7; 82, pp.4-6]. As documented in **Section 3.1.1**, five of Artesian's public supply wells completed within the Columbia/Potomac Aquifer System have contamination meeting the observed release criteria.

New Castle Municipal Services Commission (NCMSC) has four groundwater supply wells in New Castle and supplies drinking water to 6,000 persons (Refs. 83, p. 1; 84, p. 2). MSC uses one well at a time for water supply, resting the other wells. However, within the last 2 years, MSC has stopped using the Basin Road well due to the high concentrations of PFAS contamination. This well is actively maintained and annually tested for PFAS contamination levels but will not be used for water supply except in an emergency. The remaining three active water supply wells are rotated on a monthly basis then rested for approximately 60 days. All water is pumped to the only water treatment facility for treatment and pumped into the distribution system (Ref. 84, pp. 2). MSC does not purchase or sell well to other entities but does maintain an interconnection with Artesian for emergency purposes (Ref. 84, pp. 2, 3). NCMSC wells are completed within the Potomac Group Aquifer (Refs. 43, p. 7; 87, p. 1). The Frenchtown Road well has cumulatively provided more than 40 percent of the total volume of water annually over the past 5.5 years; therefore, each well's contribution is apportioned by percentage contributed to the total supply (Refs. 84, pp. 12, 21, 30, 38, 46, 48; 96, p. 1). Of the total 792,559,876 gallons of water pumped from 2017 through 2022 to date, the approximate percentages contributed by the four NCMSC wells to that total are as follows:

- Basin Road Well – (43,695,900 gallons / 792,559,876 gallons) = 0.055132617
- Frenchtown Road Well – (347,242,150 gallons / 792,559,876 gallons) = 0.43812734
- School Lane Well – (282,670,100 gallons / 792,559,876 gallons) = 0.35665457
- Cross Roads Well – (118,951,726 gallons / 792,559,876 gallons) = 0.15008548
(Ref. 84, pp. 12, 21, 30, 38, 46, 48; 96, p.1).

The target population is apportioned as follows:

For the Town of Elkton, because the surface water intake contributes more than 40 percent to the total volume of the system, the population is apportioned by percentage contributed to the total supply (Refs. 1, Section 3.3.2; 81, p. 2):

- 8.77 million gallons (purchased water from Artesian) divided by 54.19 million gallons (total water supply of the City of Elkton) = 0.16, times 15,625 (total population served by the Town of Elkton) = 2,500 persons (Refs. 79, p. 1; 81, p. 2).

For Artesian, because no one well or purchased water source contributes more than 40 percent of the total water supply, the target population is apportioned evenly among the 54 water sources (53 wells and 1 purchased water source) (Refs. 1, Section 3.3.2; 77, pp. 9, 10, 11, 40-42; 82, pp. 1, 4, 5, 6):

- 209,706 persons plus 2,500 (persons apportioned to purchased Artesian water in Elkton) = 212,206 (total persons supplied water by Artesian) divided by 54 (53 wells plus 1 purchased water source) = 3,929.74 persons per well (Refs. 77, pp. 9, 10, 40-42; 79, p. 1; 80, p. 1; 81, p. 2).

For NCMSC, the Frenchtown Road well has cumulatively provided more than 40 percent of the total volume of water annually over the past 5.5 years; therefore, the population is apportioned by percentage contributed to the total supply (Refs. 1, Section 3.3.2; 84, pp. 12, 21, 30, 38, 46, 48):

Based on the approximate percentages contributed by the four NCMSC wells described above, the population apportioned to the four NCMS wells is as follows:

- Basin Road Well – 0.055132617 x 6,000 persons = 330.80 persons
- Frenchtown Road Well – 0.43812734 x 6,000 persons = 2,628.76
- School Lane Well – 0.35665457 x 6,000 persons = 2,139.93 persons
- Cross Roads Well – 0.15008548 x 6,000 persons = 900.51 persons (Refs. 83, p. 1; 84, pp. 12, 21, 30, 38, 46, 48; 96, p. 1).

Table 26 lists the applicable benchmarks against which analytical results of the observed release samples were compared.

TABLE 26 BENCHMARKS				
Substance	MCL/MCLG (µg/l)¹	CRSC (µg/l or ng/l)²	NCRSC (µg/l or ng/l)	Reference(s)
PCE	5	37.1	120	2, p. 17
TCE	5	1.19	10	2, p. 20
Cis-1,2-DCE	70	NA	40.1	2, p. 5
Trans-1,2-DCE	100	NA	401	2, p. 8
1,2-DCA	5	0.856	120	2, p. 2
Vinyl Chloride	2	0.0214	60.2	2, p. 23
PFOS	NA	NA	40.1	2, p. 11
PFOA	NA	1,110	60.2	2, p. 14

Notes:

¹ Units are presented in µg/l for consistency with reported data.

² Units are in µg/l for VOCs and ng/l for PFAS.

µg/l = micrograms per liter
 ng/l = nanograms per liter
 CRSC = Cancer Risk Screening Concentration
 MCL = Maximum Contaminant Level
 MCLG = Maximum Contaminant Level Goal
 NCRSC = Non-cancer Risk Screening Concentration
 1,2-DCA = 1,2-Dichloroethane
 cis-1,2-DCE = cis-1,2-dichloroethylene
 PCE = Tetrachloroethylene
 PFOA = Perfluorooctanoic acid (PFOA)
 PFOS = Perfluorooctanesulfonic acid (PFOS)
 TCE = Trichloroethylene
 trans-1,2-DC = Trans-1,2-dichloroethylene
 VOC = Volatile organic compound

The following public supply wells are subject to Level I and each is assigned a population as calculated above. Per HRS Section 2.5.2, if more than one benchmark applies to a hazardous substance, Level I is assigned if the concentration of the hazardous substance equals or exceeds the lowest applicable benchmark concentration. The benchmarks listed below in **Table 27** represent the lowest applicable benchmark for PFOS, PFOA and PCE (see **Table 26** of this HRS documentation record).

TABLE 27 LEVEL I CONCENTRATIONS				
Well	Substance	Concentration (µg/l or ng/l) ¹	Benchmark (µg/l or ng/l) ¹	Reference(s)
Jefferson Farm 1R	PFOS	200	40.1 (NCRSC)	2, p. 11; 31, p. 175
Jefferson Farm 2R	PFOS	203	40.1 (NCRSC)	2, p. 11; 30, p. 1590
Airport Industrial Park 1	PCE	7.5	5 (MCL)	2, p. 17; 30, p. 426
Airport Industrial Park 2	PFOS	90	40.1 (NCRSC)	2, p. 11; 31, pp. 5, 7
	PCE	20.7	5 (MCL)	2, p. 17; 31, p. 19, 21
Wilmington Manor 3	PFOS	1,700	40.1 (NCRSC)	2, p. 11; 31, pp. 158, 160
	PFOA	180	60.2 (NCRSC)	2, p. 14; 31, pp. 158, 160
Basin Road	PFOS	3,240	40.1 (NCRSC)	2, p. 11; 30, p. 1413
	PFOA	269	60.2 (NCRSC)	2, p. 14; 30, p. 1396
Schoolhouse Lane	PFOS	878	40.1 (NCRSC)	2, p. 11; 30, p. 1369
Crossroad	PFOS	680	40.1 (NCRSC)	2, p. 11; 32, p. 10
	PFOA	290	60.2 (NCRSC)	2, p. 14; 32, p. 10
Frenchtown Road	PFOS	520	40.1 (NCRSC)	2, p. 11; 32, p. 11

Notes:

¹ Units are in µg/l for VOCs and ng/l for PFAS.

µg/l = micrograms per liter

ng/l = nanograms per liter

MCL = EPA Maximum Contaminant Level.

NCRSC = Non cancer risk screening concentration

PCE = tetrachloroethylene

PFOA = Perfluorooctanoic acid

PFOS = Perfluorooctanesulfonic acid

TABLE 28 TARGET WELLS				
Well	Distance from Source (mi.)¹	Population	Level I Documented	Reference(s)
Artesian Wells				
Jefferson Farm 1R	1-2	3,929.74	Y	5, Figure 4 ; 2, p. 11; Sections 3.1.1 and 3.3 of this HRS documentation record
Jefferson Farm 2R	1-2	3,929.74	Y	5, Figure 4 ; 2, p. 11; Sections 3.1.1 and 3.3 of this HRS documentation record
Airport Industrial Park 1	0.5-1	3,929.74	Y	5, Figure 4 ; 2, p. 17; Sections 3.1.1 and 3.3 of this HRS documentation record
Airport Industrial Park 2	0.5-1	3,929.74	Y	5, Figure 4 ; 2, pp. 11, 17; Sections 3.1.1 and 3.3 of this HRS documentation record
Wilmington Manor 3	0.5-1	3,929.74	Y	5, Figure 4 ; 2, pp. 11, 14; Sections 3.1.1 and 3.3 of this HRS documentation record
NCMSC Wells				
Basin Road	0.5-1	330.80	Y	5, Figure 4 ; 2, pp. 11, 14; Sections 3.1.1 and 3.3 of this HRS documentation record
Schoolhouse Lane	0.5-1	2,139.93	Y	5, Figure 4 ; 2, p. 11; Sections 3.1.1 and 3.3 of this HRS documentation record
Fenchtown Road	0.5-1	2,628.76	Y	5, Figure 4 ; 2, p. 11; Sections 3.1.1 and 3.3 of this HRS documentation record
Crossroad	1-2	900.51	Y	5, Figure 4 ; 2, p. 11, 14; Sections 3.1.1 and 3.3 of this HRS documentation record

Notes:

¹ Distances are measured from Source (**Figure 4** of Ref. 5).

mi = mile

N = No

Y = Yes

3.3.1 Nearest Well

As identified in **Section 3.3** of this HRS documentation record, nine public supply wells are subject to Level I concentrations. Therefore, a nearest well factor value of 50 is assigned (Ref. 1, Section 3.3.1, Table 3-11).

Nearest Well Factor Value: 50

3.3.2 Population

3.3.2.2 Level I Contamination

As identified in **Section 3.3** of this HRS documentation record, nine public supply wells (five Artesian and four NCMSC) are subject to Level I concentrations. The populations assigned to the wells are also explained in **Section 3.3** of this HRS documentation record.

TABLE 29 LEVEL I POPULATION TARGETS		
Level I Wells	Population	Reference(s)
Jefferson Farm 1	3,929.74	Section 3.3 of this HRS documentation record
Jefferson Farm 2	3,929.74	
Airport Industrial Park 1	3,929.74	
Airport Industrial Park 2	3,929.74	
Wilmington Manor 3	3,929.74	
Basin Road	330.80	
Schoolhouse Lane	2,139.93	
Crossroad	900.51	
Frenchtown Road	2,628.76	

The total population served by drinking water from points of withdrawal subject to Level I concentrations is 25,648.7 (Ref. 1, Section 3.3.2). This population is multiplied by 10 to determine the Level I concentrations factor value, as shown below (Ref. 1, Section 3.3.2.2).

Total Level I Population: 25,648.7
 Level I Concentration Factor Value: $25,648.7 \times 10 = 256,487$
 (Ref. 1, Section 3.3.2.2)

3.3.2.3 Level II Concentrations

As documented in sections **3.3** and **3.3.1** of this HRS documentation record, all drinking water wells evaluated as targets were documented to contain Level I concentrations; therefore, per HRS Section 3.3.2.3, no wells were evaluated as subject to Level II contamination. Also, Level I concentrations result in a maximum score of 100.00 for the groundwater migration pathway; therefore, the Level II Factor Value was not scored.

Level II Concentration Factor Value: Not Evaluated

3.3.2.4 Potential Contamination

Level I concentrations result in a maximum score of 100.00 for the groundwater migration pathway; therefore, the Potential Contamination Factor Value was not scored.

In addition to the five AWC public wells and four NCMSC public wells that contain Level I concentrations (see **Section 3.3, Table 27**), AWC has an additional 14 public supply wells within a 4-mile radius of the Site (**Figure 4** of Ref 5). The potential target population served by these wells were not evaluated as it would not impact the overall site score.

Potential Contamination Factor Value: Not Evaluated

3.3.3 Resources

The Resources Factor Value was not scored because it would not significantly contribute to the overall Site score.

=====

Resources Factor Value: 0

3.3.4 Wellhead Protection Area

The contaminated groundwater plume lies within AWC and NCMSC Well head Protection Areas (Ref. 86, pp. 1, 2; **Figure 2** in Reference 5 of this HRS documentation record). Wellhead protection areas in Delaware are designated by EPA in accordance with Section 1428 of the Safe Drinking Water Act (Ref. 85, 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