FINAL SITE INSPECTION REPORT
BLADES GROUNDWATER
TOWN OF BLADES, SUSSEX COUNTY
DELAWARE

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Nonresponsive based on revised scope

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRQL	Contract-Required Quantification Limit
Cr(VI)	Hexavalent Chromium
DGS	Delaware Geological Survey
DNREC	Delaware Department of Natural Resources and Environmental Control
DPH	Delaware Division of Public Health
EPCRA	Emergency Planning and Community-Right-to-Know Act
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FEMA	Federal Emergency Management Agency
GC/MS	gas chromatograph/mass spectrometer
HAL	EPA health advisory level
HRS	Hazard Ranking System
kg	kilogram
MACT	Maximum Achievable Control Technology
MCL	Maximum Contaminant Level
mg	milligram
MOE	Ministry of the Environment of Denmark
MSDS	Material Safety Data Sheet
ng/L	nanograms per liter
NOV	Notice of Violation

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LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NPDES	National Pollutant Discharge Elimination System
OASQA	Office of Analytical Services and Quality Assurance
ODW	Office of Drinking Water, Delaware Division of Public Health
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PFAS	perfluoroalkyl/polyfluoroalkyl substance
PFBS	perfluorobutanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
ppb	parts per billon
ppt	parts per trillion
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QL	quantitation level
RBC	EPA Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RDL	reporting detection limit
RI	Remedial Investigation
RSL	EPA Regional Screening Level
SI	Site Investigation
START	Superfund Technical Assessment and Response Team
SVOC	Semivolatile Organic Compound
SWD	Seaford Water Department
TDD	Technical Direction Document
TDL	target distance limit

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LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

URS	Uniform Risk Based Remediation Standards
USFWS	U.S. Fish and Wildlife Service
USGS	U. S. Geological Survey
VOC	Volatile Organic Compound
WESTON®	Weston Solutions, Inc.
WQC	Water Quality Criteria
XRF	x-Ray fluorescence

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1.0 INTRODUCTION

Under the Eastern Area Superfund Technical Assessment and Response Team (START) Contract No. EP-S3-15-02, Technical Direction Document (TDD) No. W503-18-04-001, the U.S. Environmental Protection Agency (EPA) Region III tasked Weston Solutions, Inc. (WESTON®) to conduct a Preliminary Assessment/Site Inspection (PA/SI) of the Blades Groundwater site (the Site) located in the Town of Blades, Sussex County, Delaware.

The SI was conducted in accordance with EPA *Guidance for Performing Site Inspections Under CERCLA* (Reference [Ref.] 1). The purposes of the SI were to collect sufficient analytical data and information concerning conditions at the Site to assess the relative threat posed to human health and the environment with respect to actual or potential releases of hazardous substances, and to determine the need for additional action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) based on criteria as set forth in EPA *Hazard Ranking System; Final Rule* (Ref. 2).

2.0 SITE BACKGROUND

This section presents a description of the Site and its location, provides a discussion of the Site's ownership and history, and presents a summary of previous site investigation activities.

2.1 SITE LOCATION AND DESCRIPTION

The Site is located within the Town of Blades, Sussex County, Delaware. Blades is located in western Sussex County and covers approximately 0.5 square mile. Blades lies between the Nanticoke River to the north and west and Morgan Branch to the south and east (Figure 1). The Site consists primarily of a perfluoroalkyl/polyfluoroalkyl substance (PFAS) groundwater plume. Groundwater is the sole drinking water source for both public and domestic potable water in Blades and its surroundings. Public water is supplied to most residences within the town limits of Blades; however, some residences within town limits and the residences located beyond town limits to the southwest and to the northeast rely on domestic groundwater wells for potable water (Ref. 3).

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Located in Blades, DE, is Procino Plating, an active metal plating facility, as well as the site of the former Peninsula Plating facility, which is currently vacant land. The locations of Procino Plating and former Peninsula Plating are shown in Figure 2.

Procino Plating is located at 901 Market Street in Blades. The Procino Plating facility property consists of 1.16 acres with generally flat topography and is primarily surrounded by residential properties. The facility has been an electroplating facility since the 1980s and has been operated as Procino Plating since 1996. Current operations at the facility consist of cutting and chrome-plating of griddle tops for restaurant use (Ref. 3, pp. 4, 6, and 8).

The Peninsula Plating facility was within the former Blades Commercial Complex located at the intersection of Market Street and River Road, which encompasses approximately 5.8 acres. The property formerly had six warehouse and storage buildings that were historically used for metal plating, vending, trash hauling operations, steel products, and bread distribution (Ref. 4, pp. 7, 9, 10, and 35). The building that formerly contained the Peninsula Plating facility was located in the southwestern portion of the property, near the intersection of River Road and the Conrail line (Ref. 4, p. 35). There are currently no structures remaining on the property.

Additional industrial facilities located in Blades include Anchor Enterprises, a steel fabrication facility; a concrete and cinder-block manufacturer; and Delmarva Aggregate.

2.2 OPERATIONAL HISTORY

2.2.1 Procino Plating

Procino Plating is an active plating facility that began operations in Blades in 1985, performing ornamental/decorative plating with copper, nickel, and chrome (i.e., chromium). Procino Plating applied for and was issued an Industrial Wastewater Contribution Permit by Sussex County which allowed them (subject to permit limitations) to discharge pretreated process wastewater into the sanitary sewer system (Ref. 5, pp. 11 and 12). The sanitary sewer system in the Town of Blades is managed and operated by Sussex County; it is connected to the wastewater treatment plant in Seaford, DE, which is located across the Nanticoke River from the Town of Blades (Ref. 6, p. 12). When Procino Plating moved into the facility, the building had a wooden floor

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underlain by a crawl space with a soil floor. The wood floor and crawl space were removed and a concrete slab was installed by Procino Plating in the late 1990s (Ref. 5, pp. 11 and 75). In approximately 1996, Procino Plating installed a subsurface wastewater collection and treatment system to collect and treat the wash and rinse "bath" water and the floor drains from the plant (Ref. 5, p. 11). Delaware Department of Natural Resources and Environmental Control (DNREC) representatives observed a powdery white and yellow substance on the floor around the drums and in the metal grates in the floor (Ref. 3, pp. 8 and 45). A sump and pump were located in the basement of the building (Ref. 3, p. 48).

The second building on the Site is used for the pretreatment, cutting, grinding and shaping of the metal slabs to be used as griddles. The floor in the second building was concrete and had no drains (Ref. 3, p. 8). Following business downturns, the plating process in the second building was dismantled in 2007, and the wastewater piping system and drains were sealed with concrete (Ref. 5, pp. 11).

In June 1994, Procino received a Notice of Violation (NOV) from DNREC citing labeling, training and operational deficiencies related to the handling of hazardous waste. Corrective action by Procino resulted in an October 1994 DNREC notification letter stating that the deficiencies had been corrected. In October 1995, DNREC again issued a NOV regarding hazardous waste management practices and responsive corrective action was taken and compliance attained as documented in a March 1996 DNREC letter. Another NOV was issued by DNREC in December 1998 with a subsequent corrective action. None of the NOVs cited spillage, discharges, or releases of hazardous wastes (Ref. 5, p. 12).

The EPA conducted compliance inspections of the Procino facility in September 2001 which resulted in the issuance of a February 2002 NOV citing numerous hazardous waste management violations for exceedance of the 90-day onsite storage timeframe; again no spillage, discharges or releases were involved (Ref. 5, p. 12).

In December 2007 and February 2008, DNREC and the EPA conducted inspections, collected samples and interviewed employees at the Procino Plating Site. These inspections coincided with the 2007 discontinuation of plating operations in the second building when equipment was being

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dismantled to create rental space. Procino was issued an NOV through the Resource Conservation and Recovery Act (RCRA). Procino provided a written response and documentation to EPA in October 2010 addressing EPA's concerns regarding the handling and disposal of materials observed on site during the inspections (Ref. 47, pp. 1-58)

In May 2010, the EPA exercised a search warrant and seized the company records and took samples. These actions and the follow up investigation conducted by the USEPA led to criminal charges against Procino Plating (since resolved) regarding the storage of unpermitted hazardous wastes and violations of the wastewater treatment permit, the latter due to newly imposed permit conditions prohibiting certain hazardous wastes from being treated and then discharged into the sewer system. Although the discharge of cyanide was evaluated in EPA's investigation, no evidence was shown that cyanide was spilled, disposed or released from the site. Likewise, no charges were presented indicative of a release of hazardous substances at the site. Subsequently, Procino Plating terminated its use of the industrial wastewater discharge permit, concreted the piping, and modified its operations by use of a closed loop system. Currently small quantities of hazardous waste are generated and are periodically shipped offsite for disposal at a permitted facility (Ref. 5, p. 12).

In November 2018, the Chromic Acid tank was overfilled with water and overflowed into a secondary containment and into a soil crawlspace beneath the building. The tank contained chromium trioxide mixed with deionized water and a small amount of sulfuric acid as well as a catalyst (Atotech Heef 25 MS) and mist suppressant (Atotech Fumetrol 21). Fumetrol 21 is marketed as non-PFOS, and the Safety Data Sheet lists the "hazardous ingredients" as polyfluorosulfonic acid at 1.0 to 2.5 percent and diethylene glycol monobutyl ether at 0.1 to 1.0 percent. Approximately, 1 ¼ gallons of Fumetrol is added to the 500-gallon tank plating solution. The total amount of the solution lost is unknown; however, 600 gallons was captured in secondary containment. At the time of the notification to DNREC and EPA following the spill, Procino was in the process of removing the impacted soil and their contractor, Ten Bears Environmental (Ten Bears), was planning on collecting post-excavation soil samples of the

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impacted soil in the crawlspace. Analytical results were to be submitted to DNREC for review and determination if any additional follow-up actions was required (Ref. 48, pp. 1-7).

2.2.2 Peninsula Plating

Peninsula Plating is an inactive plating facility that operated at its location in Blades from approximately 1992 to 1995 (Refs. 4, p. 10 and 7, p. 2). Peninsula Plating conducted brass, copper, and chrome plating operations. Chemicals present onsite in 1995 as noted by DNREC and EPA include the following (Refs. 4, p. 4; 7, p. 1; and 8, p. 5):

- Nickel sulfate
- Nickel chloride
- Sulfuric acid
- Chromic acid
- Hexavalent chromium, aka Cr(VI)
- Chloride
- Copper cyanide
- Copper sulfate
- Zinc cyanide
- Cadmium fluoroborate

The facility had a discharge permit issued by Sussex County, which was revoked by DNREC on May 30, 1995. DNREC closed the discharge on August 3, 1995 by pouring concrete into the drain system in front of the building (Ref. 7, p. 3). Based on information in the SI, DNREC indicated a possible septic drain field was located in the center of the Blades Commercial Complex property, behind (immediately north) of the former Peninsula Plating facility (Ref. 4, p. 8). A drainage ditch was located in the center of the property heading west towards the railroad tracks (Ref. 4, p. 259). Additionally, according to the Town of Blades Water and Maintenance Supervisor, the property on which Peninsula Plating is located was connected to the county sanitary sewer system in 2002 (Ref. 46, p. 2).

2.2.3 Electroplating and Perfluorinated Compounds

Electroplating is the electrical application of a coating of a metal such as chromium, nickel, or copper onto a surface for decoration, corrosion protection, or durability. An electrical charge is

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applied to a tank (bath) containing an electrolytic salt solution. The electrical charge causes the metal in the bath to fall out of solution and deposit onto objects placed into the plating bath. In an anodizing process, an oxide film is formed on the surface of the part. These electrolytic processes cause mist and bubbles containing Cr(VI), or other metals, to be ejected from the bath, released into the workplace, and eventually dispersed into outdoor ambient air unless controlled with add-on air pollution control equipment or chemical fume suppressants (Ref. 9, p. 5).

Chemical fume suppressants reduce surface tension and thereby control emissions. By reducing surface tension in the plating/anodizing bath, gas bubbles become smaller, and rise more slowly than larger bubbles. Slower bubbles have reduced kinetic energy so that when the bubbles do burst at the surface, the Cr(VI) or other metals, are less likely to be emitted into the air, and the droplets fall back onto the surface of the bath (Ref. 9, pp. 5 and 6).

Cr(VI) is a human carcinogen. Therefore, EPA regulates Cr(VI) electroplating or Cr(VI) anodizing tank operations by applying the Clean Air Act (CAA) Maximum Achievable Control Technology (MACT) limits. The MACT limits require control of Cr(VI) emissions to the atmosphere by either limiting the amount of Cr(VI) through use of add-on air pollution control devices or utilizing a chemical fume suppressant. These facilities are also regulated by the Occupational Safety and Health Administration (OSHA) under 29 Code of Federal Regulations (CFR) Part 1910.1026 to protect workers from occupational Cr(VI) exposure. Employers are required to use engineering and work practice controls to reduce and maintain employee exposure to Cr(VI) (Ref. 9, p. 6). The most common types of fume suppressants used in chromium electroplating and anodizing are those containing fluorinated or perfluorinated compounds or, collectively, fluorosurfactants. The active ingredients are compounds such as organic fluorosulfonate and tetraethyl ammonium perfluorooctyl sulfonate. The fluorosurfactant-based fume suppressants were an improvement over the previous hydrocarbon-based products. Fluorinated sulfonate surfactants are effective in highly acidic solutions because they are resistant to hydrolysis by strong acids. For this and other reasons, fluorosurfactants are able to reduce surface tension to levels that cannot be reached with hydrocarbon surfactants (Ref. 10, p. 87).

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A study of 222 plating facilities in California conducted by the California Air Resources Board in 2003, found that 190 of the 222 facilities used a fume suppressant, either in part or solely, to control Cr(VI) emissions. Almost all of the 190 operations used a chemical fume suppressant with perfluorooctanesulfonic acid (PFOS) as the active ingredient, and 124 facilities reported using the suppressant Fumetrol 140® (Ref. 9, p. 6). Fumetrol 140 contains 1% to 7% organic fluorosulfonate (a building block of PFOS) by weight (Ref. 11).

As noted in a 2010 PA report, the Procino Plating facility in Blades uses the mist suppressant Fumetrol 140 (Ref. 3, p. 40). It was noted in the On-Scene Coordinator (OSC) logbook for the Peninsula Plating facility that the chemical cadmium fluoroborate was present at the facility in containers (Ref. 8, p. 5). Fluoroborates are PFOS-containing compounds (Ref. 12, p. 32).

2.3 Previous Investigations

DNREC has conducted investigations at both the Procino Plating Facilities and the former Peninsula Plating facilities; additionally, EPA conducted a CERCLA Removal Action at the former Peninsula Plating facility.

2.3.1 Procino Plating

In 2010, DNREC performed a PA in cooperation with EPA and recommended a SI due to chemical use and the potential to impact soil and groundwater (Ref. 3). DNREC performed the SI activities in coordination with the Delaware Division of Public Health (DPH), Office of Drinking Water (ODW), in 2010 and 2011. The SI included sampling any registered/permitted private water supply wells within the Town of Blades limits. Water samples from outdoor spigots of residential homes were collected at each registered, accessible private well. Twelve private water supply wells surrounding the facility were sampled. Additionally, 26 soil samples were collected from 13 soil borings, and 6 groundwater monitoring wells were installed and sampled on Procino Plating property (Ref. 13, p. 8).

With the exception of the concentrations of iron in several soil samples, detected soil concentrations of volatile organic compounds (VOCs), semivolatile organic compounds

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(SVOCs), polychlorinated biphenyls (PCBs), pesticides, and inorganics did not exceed applicable DNREC regulatory and screening standards (Ref. 13, p. 12). Results indicated that dieldrin and heptachlor epoxide were detected in on-site monitoring wells at levels exceeding the EPA Regional Screening Level (RSL) for tap water. Chromium was detected in one on-site well at a concentration approximately 10 times the EPA drinking water Maximum Contaminant Level (MCL). Nickel was detected in several on-site groundwater samples; however, at concentrations below the EPA RSL for tap water (Ref. 13, p. 14).

Cyanide was detected at a concentration of 20 micrograms per liter (µg/L) in one off-site drinking water well with a screened interval depth of 43 to 48 feet below ground surface (bgs), well below the MCL of 200 µg/L. However, because cyanide-containing solutions are commonly used in plating operations and a polyethylene tank was noted on the Procino Plating property with the words "Cyanide Treatment 2" stenciled on the side, the presence of cyanide in the private well sample raised concern regarding an undetected release of cyanide from the Procino Plating facility (Ref. 13, pp. 14 and 18). Following DNREC recommendations for further investigation, Procino Plating entered into a Voluntary Cleanup Program agreement with DNREC in 2011 (Ref. 5, p. 13; 13, p. 18).

From 2012 through 2015, Ten Bears performed Remedial Investigation (RI) activities on behalf of Procino Plating to characterize subsurface stratigraphy, determine groundwater elevations and groundwater flow direction, determine the extent and magnitude of chromium and cyanide contamination, and assess potential human health risks. As part of the RI, 14 shallow and subsurface soil samples were collected beneath the concrete floor within the facility at the location of the former chrome tanks, and 12 new groundwater monitoring wells were installed and sampled. The RI also included subslab soil gas sampling within the Procino Plating facility (Ref. 5, pp. 19 and 20).

The analytical results for the soil samples collected beneath the former chromium tanks indicated chromium concentrations in the shallow (0 to 2 feet bgs) soil from 11.3 to 105 milligrams per kilogram (mg/kg), in the intermediate depth (2 to 5 feet bgs) from 2.1 to 126 mg/kg, and in the deep soil (5 to 8.5 feet bgs) from 11.6 to 199 mg/kg (Ref. 5, p. 21).

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In the RI report, it was concluded that groundwater flow direction in the water table aquifer beneath the Procino Plating facility is to the south-southwest and that a fine-grained silt or clay layer is present beneath the facility at depths ranging from 22.5 to 27 feet bgs. A deeper clay layer was also encountered at depths ranging from 42.2 to 46 feet bgs (Ref. 5, pp. 25, 29, 33).

In the RI, it was also concluded that dieldrin detected in previous investigations was a background contaminant from an upgradient source (Ref. 5, p. 22). The chromium concentration in groundwater from on-facility well MW-6 was confirmed to be approximately 10 times the drinking water MCL, based on a groundwater sample collected in May 2012 (Ref. 5, p. 30). The chromium concentration had decreased approximately one year later in 2013 (from 1,170 parts per billion [ppb] to 319 ppb) (Ref. 5 p, 30). Downgradient groundwater monitoring well MW-10 had a chromium concentration of 193 ppb in 2013, exceeding the MCL. Chromium concentrations in groundwater samples collected from other wells to the east, south, and west were below the MCL or non-detect, including deeper wells that are co-located with shallow wells MW-8 and MW-9 and are screened below the clay layer described above (Ref. 5, pp. 30, 31). The RI concluded that the human health exposure pathway was incomplete (Ref. 5, p. 50).

In 2015, an interim removal action was completed by Ten Bears, performed on behalf of Procino Plating, that consisted of removing a portion of the facility's concrete slab floor, collecting soil samples for the purpose of delineating chromium concentrations to below the DNREC total chromium soil screening level of 214 mg/kg, and removing impacted soil with a mini-excavator. Approximately 20 cubic yards of soil were removed from a 10-foot by 10-foot area to depths of 6 to 8 feet bgs (Ref. 5, p. 38). A polyvinyl chloride (PVC) piping system was also installed to facilitate potential future remedial injections (Ref. 5, p. 39).

Because PFASs are emerging as hazardous substances of concern with a very recent history of published health standards, previous investigations did not include the collection or analysis of samples for PFASs (Ref. 17, p. 1).

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2.3.2 Peninsula Plating

The former Peninsula Plating facility is located approximately 0.5 mile north of Procino Plating. In 1992 and 1993, Phase I Audits were performed at the Blades Commercial Complex, where Peninsula Plating was located. The Phase I Audits and subsequent Phase II investigations were focused primarily on underground oil tanks and related contamination associated with other businesses on the property, and were not focused on hazardous substances and potential contamination associated with the Peninsula Plating facility (Ref. 4, pp. 9 and 10).

In spring 1995, the DNREC Hazardous Waste Management Branch conducted a site visit at the Peninsula Plating facility (Refs. 4, p. 10 and 11). DNREC noted the presence of plating process chemicals, including nickel sulfate, sulfuric acid, chromic acid, Cr(VI), nickel chloride, copper cyanide, copper sulfate, zinc cyanide, and cadmium fluoroborate. Peninsula Plating closed shortly thereafter, following a history of noncompliance with industrial waste discharge permits and Emergency Planning and Community-Right-to-Know Act (EPCRA) requirements. DNREC Emergency Response and Enforcement Branches informed EPA Region III of the former plating building that contained numerous vats, tanks, drums, and containers of hazardous materials (Ref. 4, p. 10). EPA conducted a CERCLA Removal Action at the abandoned Peninsula Plating facility in mid to late 1995. The removal action included the removal of 78 55-gallon drums of hazardous waste and 30 cubic yards of hazardous solids, including flammable and corrosive liquids, oxidizers, and liquids contaminated with cadmium and chromium (Refs 4, pp. 10 and 11; 7, pp. 1-3; 8, pp. 1-63).

DNREC performed an SI at Peninsula Plating in 1999. Samples collected during the SI included a total of 28 soil samples, 17 shallow (surface to 2 feet bgs) and 11 deep (up to 8 feet bgs or groundwater), collected from 10 test pits and 6 surface areas onsite, and groundwater samples from 3 on-site monitoring wells and 1 public supply well (Ref. 4, pp. 13, 14, 21). Soil samples were field screened with X-ray fluorescence (XRF) for metals and with a gas chromatograph/mass spectrometer (GC/MS) for organics (Ref. 4, pp. 21 and 22). Based on the field screening, three surface soil samples were submitted to a laboratory for inorganic analysis and six soil samples were submitted to a laboratory for organic analysis (Ref. 4, pp. 15, 21, and

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22). With the exception of the concentrations of arsenic, inorganics were not detected in the soil samples at concentrations exceeding EPA or DNREC standards (Ref. 14, pp. 21). Chromium was detected in the three soil samples at concentrations ranging from 2.4 mg/kg to 9.4 mg/kg; however, only one soil sample, TP3, was collected in the vicinity of the former plating facility (Ref. 4, p. 81). Organic analysis of soil samples indicated several polycyclic aromatic hydrocarbons (PAHs) at concentrations exceeding EPA and DNREC standards (Ref. 4, p. 22).

Analysis of groundwater samples indicated concentrations of aluminum, iron, and manganese in the on-site monitoring wells at concentrations above DNREC regulatory standards and/or EPA MCLs. Chromium was not detected in the collected groundwater samples (Ref. 4, pp. 91 and 96). Organic constituents were not detected in groundwater at concentrations exceeding the EPA Risk-Based Concentration (RBC) Tap Water, DNREC Uniform Risk Based Remediation Standards (URS) Groundwater, or Drinking Water MCL (Ref. 4, p. 27).

Because PFASs are emerging as hazardous substances of concern with a very recent history of published health standards, previous investigations did not include the collection or analysis of samples for PFASs.

2.3.3 Public Well Sampling

The Town of Blades maintains three public supply wells approximately 300 to 400 feet north-northeast of the former Peninsula Plating facility. Based on updated information pertaining to the use of PFASs at metal plating facilities and potential hazards associated with consumption of PFASs, DNREC, in coordination with EPA, collected samples from the supply wells for PFAS analysis in early February 2018. Analytical results indicated that each of the three public supply wells had a summed total concentration of perfluorooctanoic acid (PFOA) and PFOS greater than the combined EPA health advisory level (HAL) of 70 parts per trillion (ppt; equivalent to nanograms per liter [ng/L]), ranging between 96.2 ppt and 187.1 ppt (Ref. 14).

DNREC and DPH began distributing alternative water to Blades and area residents on February 8, 2018 (Ref. 14). On February 12, 2018, WESTON, on behalf of EPA, collected groundwater samples from each of the three public supply wells for the Town of Blades as well as from a

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post-treatment point prior to distribution. The samples were analyzed for perfluorinated compounds (i.e., PFASs). Combined PFOS and PFOA concentrations in raw water from the three municipal drinking water wells, as well as the treated water, exceeded the EPA HAL of 70 ng/L (Refs. 14; 15, p. 1). PFOS was detected in the raw water and treated water samples ranging from 53 to 220 ng/L, and PFOA was detected ranging from 18 to 26 ng/L. A summary of the analytical data from February 2018 is shown in Table 1.

A carbon filtration system was installed on the Blades water supply system on February 19, 2018, which significantly reduced the total PFAS concentration to 3.4 ppt (Ref. 14). DNREC and DPH announced on February 28, 2018 that a follow-up sampling of the treated Blades water supply showed non-detect levels for PFAS (Ref. 14).

2.3.4 Residential Well Sampling

The majority of the residences within Blades are supplied with public water; however, residences outside the town limits are served by private domestic wells. In February, March, and April 2018, WESTON, on behalf of EPA, collected groundwater samples from 54 domestic wells for PFAS analysis at residences located to the northeast and west of Blades; a few samples were collected from domestic wells within the town limits not supplied potable water from the town water authority. Sample locations are shown in Figure 3. As shown in Table 2, PFAS concentrations exceeded the combined HAL of 70 ng/L for PFOS and PFOA concentrations in seven of the domestic wells located west of Blades. PFOS was the main contaminant detected with concentrations ranging from 44 to 350 ng/L.

Subsets of the domestic wells were resampled in April, May, June, July, and August 2018. A review of the analytical data from those sampling events indicated concentrations in the respective domestic wells similar to the original samples, with the exception of two wells, RW-185 and RW-209. The May 2018 sample collected from RW-185, which was previously non-detect for PFOS, contained an estimated 16 ng/L. The July 2018 sample from RW-209, which previously had combined detections below the EPA HAL, now contained combined PFOS and PFOA concentrations totaling above the EPA HAL of 70 ng/L.

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DNREC provided drinking water filters to all residents with private wells impacted by PFOA/PFOS above 52.5 ng/l (75% of the HAL). DNREC provided the filters to a total of 8 residences in February, March and July 2018, as well as replacement filters in February 2019.

A summary of the residential well analytical results for the initial sampling, and the two resampled wells with differing results, is shown in Table 2 and further discussed in Section 4.5.2. Locations of the residential wells sampled and the PFAS concentrations detected during the residential well sampling event are shown in Figure 3.

3.0 SOURCE DESCRIPTION

For Hazard Ranking System (HRS) purposes, a source is defined as an area where a hazardous substance has been deposited, stored, or placed, as well as those soils that have become contaminated from the migration of a hazardous substance.

The source at the Site consists primarily of a PFAS groundwater plume that has impacted public and domestic drinking water wells, as documented by groundwater samples containing concentrations of PFASs, particularly PFOS, above background. Additionally, an observed release to groundwater of several inorganics, including hexavalent chromium, has been documented. Analytical results for groundwater samples collected from monitoring wells and the public supply wells as part of this SI are presented and discussed in Section 4.5. Previous analytical results for groundwater samples collected from the public supply wells and nearby domestic wells are discussed in Sections 2.2.3 and 2.2.4 of this SI Report.

As discussed in Section 2.1.3, Procino Plating and Peninsula Plating used PFAS-based chemicals as part of the plating operations, as documented by the presence of PFAS-based chemicals at the facilities. Procino Plating facility used the mist suppressant Fumetrol 140® and Peninsula Plating facility used the chemical cadmium fluoroborate (Refs. 3, p. 40; 8, p. 5). Fluoroborates are PFOS-containing compounds, and cadmium fluoroborate is a compound used to prepare electroplating baths for high steel strengths (Refs. 12, p. 32; 16, p. 2).

Previously collected soil samples were not analyzed for PFASs; however, the Procino Plating facility had a documented release from their chrome plating tanks, as noted by soil samples

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containing concentrations of chromium as high as 199 mg/kg at 8 feet bgs (Ref. 5, p. 21). Because the PFAS-containing mist suppressant Fumetrol 140® is used in conjunction with the chrome plating activities, it can be concluded that a release from the chrome tanks also contained PFOS.

At the former Peninsula Plating facility, chromium was detected in the three collected surface soil samples at concentrations ranging from 2.4 mg/kg to 9.4 mg/kg; however, only one soil sample, TP3, was collected in the vicinity of the former plating facility (Ref. 4, pp. 42 and 81). Samples collected adjacent to the building were not submitted for analysis. Additionally, soil boring samples were not collected beneath the foundation of the building or below tanks containing chemicals.

Additional possible sources for the PFAS in groundwater include Anchor Enterprises, a metal fabrication facility located 0.1 mile north of the public supply wells along High Street, and the Blades Fire Department, located 0.25 mile west of the public supply wells.

PFASs, including PFOS and PFOA, are chemically and biologically stable in the environment and resist typical environmental degradation processes, including atmospheric photo oxidation, direct photolysis, and hydrolysis. As a result, these chemicals are extremely persistent in the environment. PFOS and PFOA have very low volatility because of their ionic nature. Therefore, they will be persistent in water and soil. PFOA and PFOS are water-soluble and can migrate readily from soil to groundwater, where they can be transported long distances (Ref. 18, p. 3).

As part of the SI, four soil samples, two surface and two subsurface, were collected from two borings installed on the Procino Plating facility property and analyzed for PFASs. Soil sampling locations and analytical results are discussed in Sections 6.3 and 6.4 of this SI Report.

4.0 GROUNDWATER MIGRATION PATHWAY

This section describes the Site's hydrogeological setting, targets associated with the groundwater migration pathway, and conclusions regarding the groundwater migration pathway.

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4.1 REGIONAL AND SITE GEOLOGY

The Site is located in the Coastal Plain Physiographic Province (Ref. 18, p.4). The Coastal Plain consists of a seaward-dipping wedge of unconsolidated and semiconsolidated sediments (Ref. 18, p. 7). The sediments that compose the Coastal Plain were deposited in nonmarine, marginal marine, and marine environments. Interbedding of fine- and coarse-grained Coastal Plain sediments is complex because of shifting deltaic and alluvial deposition sites and because of repeated transgressions and regressions of the sea (Ref. 18, p. 10).

The Site is directly underlain by the Nanticoke River Group deposits, which consist of the Turtle Branch and the Kent Isle Formations (Refs. 19; 20, p. 20, 21). The Nanticoke River Group is comprised of deposits related to a rise and high stand of sea level that consisted of beach (well-sorted, cross-bedded sand), tidal flat (well-sorted sand with clay laminae), open estuary (clayey silt with oyster shells), marsh (organic silts with grass plant fragments), swamp (organic silt to organic sand with woody fragments), and fluvial (poorly-sorted sand and gravelly sand) depositional environments (Ref. 20, p. 20, 21). In Delaware, these deposits underlie terraces that flank the margins of the present Nanticoke River and its tributaries.

The Nanticoke River Group consists of heterogeneous units of interbedded fine to coarse sand, clayey silt, sandy silt, and silty clay. The Nanticoke River Group deposits are characterized by brown to light gray, fine to medium quartz sand, and finely laminated to structureless, gray to brown, clayey, sandy silt and silty, clayey sand (Ref. 19). The Nanticoke River Group is commonly capped by well-sorted, fine to medium sand within dunes found primarily on the southeast side of the Nanticoke River (Ref. 19). The Nanticoke River Group is approximately 25 feet thick and unconformably overlies the Beaverdam Formation (Ref. 19). The Nanticoke River Group sands are distinct and readily discernable from those of the Beaverdam Formation; the Nanticoke River Group sands are more well-sorted and less feldspathic, and they lack the distinctive white silty matrix of the Beaverdam Formation (Ref. 20, p. 22)

The Beaverdam Formation is a predominantly sandy, heterogeneous unit ranging from very coarse sand with pebbles to silty clay. The predominant lithologies are white to mottled light-gray and reddish-brown, silty to clayey, fine to coarse sand. Laminae and beds of very

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coarse sand with pebbles to gravel are common. Laminae and beds of bluish-gray to light-gray silty clay are also common in the subsurface, ranging in thickness from 2 to 20 feet (Ref. 20, p. 7). The clay-silt layers are not laterally continuous within the Beaverdam deposits (Ref. 21, p. 21). The Beaverdam has a total thickness of approximately 105 feet. In the vicinity of the Site, the Beaverdam Formation unconformably overlies the Manokin Formation, which is present from Seaford to the Delaware/Maryland border (Refs. 19; 21, pp. 20 and 21).

The Manokin Formation consists of a coarsening upward sequence, informally subdivided into two subunits, A and B. The lower unit (A) consists of gray, blue-gray, and brown-gray silty clayey sand and silty sand. Where exposed to oxidizing conditions, the lower unit is yellow to red. In some locations, the lower subunit is not present. The upper unit (B) consists of light to medium gray or yellow-orange to red-orange (where weathered), fine to coarse sand with common beds of gravelly sand and rare beds of clayey to silty sand. Thickness ranges from a feather-edge to as much as 50 feet. The Manokin Formation is truncated by the overlying Beaverdam Formation (Refs. 19; 22, pp. 9 and 10).

4.2 REGIONAL AND SITE HYDROGEOLOGY

The surficial aquifer (a.k.a. Columbia aquifer) extends over large parts of the Delmarva Peninsula. The aquifer consists of unconsolidated sand and gravel of marine and nonmarine origin, depending on the locality (Ref. 18, p. 11). Included in the Columbia aquifer are the Nanticoke River Group deposits, the Beaverdam Formation, and the Manokin and Columbia Formations where present. The aquifer contains water predominantly under unconfined conditions, but clay beds can create locally confined conditions. The transmissivity of the surficial aquifer (the rate at which water will move through the aquifer) is variable, ranging from 8,000 feet squared per day in the Delmarva Peninsula to 20,000 feet squared per day in buried channels (Ref. 18, p. 11).

In the vicinity of Blades, the fine-grained beds of the Manokin Formation are the base of the Columbia aquifer (Ref. 23). The aquifer functions as both an unconfined and semiconfined aquifer. Saturated thickness ranges from 30 to 100 feet. The variation in aquifer type and

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thickness is due to the complex interlaying of aquifer and semiconfining beds (Ref. 23). Clay-silt layers are common but not laterally continuous within the Beaverdam Formation (Ref. 21, p. 21).

Soil borings and monitoring wells installed in 2011 by DNREC around the perimeter of Procino Plating indicate primarily tan fine to coarse sand to a depth of 20 feet bgs. Two monitoring well logs indicate silty clay encountered at 20 feet bgs. Shallow groundwater was encountered between 9 and 12 feet bgs (Ref. 13, pp. 42, 48-60).

From 2012 to 2015, Ten Bears, on behalf of Procino Plating, installed 12 wells both onsite and offsite, nine shallow (15 to 27.5 feet bgs) and three deep (34 to 44 feet bgs), as shown on Figures 4a and 4b. The shallow wells were completed and screened just above a localized clay layer and the deeper wells were completed and screened in a sandy layer below the localized clay layer. Depth to groundwater was measured on several occasions at these wells, as well as the wells installed by DNREC. Groundwater was encountered at depths ranging from 6.43 to 12.41 feet bgs (Ref. 5, pp. 73, 82, 87, 100, 202-207, 282-288, 385-388). Shallow groundwater flow direction was determined to be slightly west of due south (Ref. 5, pp. 76, 77, 80, 84, 86, 88). Silt and/or clay layers were encountered in the subsurface at depths below 20 feet. An apparent clay layer was encountered in DMW-1 from 29.9 feet to 33.5 feet, underlain by sands to a depth of approximately 46 feet, where a second apparent clay unit was encountered. The well screen was placed from 34 to 44 feet bgs to monitor the sandy zone below the first encountered apparent clay. In DMW-2, apparent clay extended from 25 feet to 33.6 feet, below which sands were encountered down to 42.2 feet. The screen was placed from 33 to 43 feet bgs to monitor the sandy zone below the clay unit (Ref. 5, p. 29, 32, 100, 202-207, 282-288). A clay layer was not observed in DMW-3, which was drilled to 34 feet bgs and screened from 24 to 34 feet bgs. A silty layer was likely observed at approximately 24 to 33.5 feet bgs (Ref. 5, p. 388).

In October and November 2018, WESTON installed 20 monitoring wells, 10 shallow (less than 20 feet bgs), 8 intermediate (25 to 50 feet bgs), and 2 deep (76 and 96 feet bgs), throughout the Town of Blades (Figures 4a and 4b). The lithology of the wells is consistent with previous investigations: a band of clay generally observed around 20 feet bgs and a second band observed around 40 feet bgs, as shown in the well logs provided in Appendix A. However, the wells logs

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indicate that the clay layers are not contiguous because there is no significant clay layer in boring SIGW-17 at or around 20 feet bgs and no discernible clay layer at this depth in boring and SIGW-20. Additionally, no discernible clay layer was observed at or around 40 feet bgs in borings, SIGW-02, SIGW-10, and SIGW-12.

4.3 GROUNDWATER TARGETS

Potential groundwater targets include persons who obtain drinking water from private domestic wells within the 4-mile radius target distance limit (TDL) of the Site and persons supplied drinking water from public water suppliers whose water source is from groundwater wells within the 4-mile TDL. The 4-mile TDL is shown in Figure 5.

Town of Blades municipal authority provides potable water to approximately 1,600 persons within the town limits (Ref. 46, p. 2). The Town of Blades water sources are three groundwater wells completed in the Columbia aquifer at depths ranging from 95 to 102 feet bgs, screened between 65 and 95 feet bgs, and located in the vicinity of the Town Hall approximately 300 to 400 feet north-northeast of the former Peninsula Plating facility (Ref. 25, pp. 2 and 7). The wells have estimated daily usage of 160,000, 300,000, and 300,000 gallons per day (Ref. 26). The groundwater from each well is pumped to a single treatment system prior to distribution (Ref. 43, p. 16).

Seaford Water Department (SWD) supplies drinking water to 6,928 persons (Ref. 27, p. 1). Seaford's water sources are five groundwater wells that are completed in the Columbia aquifer and range in depth from 88 to 114 feet bgs (Ref. 28, p. 9). Four of the SWD wells are located between 1 and 2 miles from the Site, and the fifth well is located between 2 and 3 miles from the Site. There are numerous mobile home parks within the 4-mile TDL that supply potable water from groundwater wells to their residences and are summarized in the table below (Ref. 29). Because the exact location of public supply wells is confidential information in accordance with the Department of Homeland Security, the locations of Seaford's supply wells and the small community supply wells are not depicted on Figure 5. The general location of the public wells within 4 miles of the Site and within the TDL distance rings, as well as the populations served, is provided in the table below.

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Radial Distance (miles)	Public Supply Wells	Population Served	Total Population Served
0.00 to 0.25	3 (Blades)	1,600	1,600
0.25 to 0.50	0	0	0
0.50 to 1.0	0	0	0
1.0 to 2.0	2 (UCMHP) 4 (SWD) 2 (HVMP) 3 (TMC) 1 (SMMHP) 2 (MG)	65 5,359 207 189 279 476	6,575
2.0 to 3.0	1 (SWD) 1 (PRMHP) 2 (Green Acres)	1,340 222 213	1,775
3.0 to 4.0	1 (Dove Estates) 4 (LVMHP) 1 (Glen Acres) 3 (VCB)	111 918 40 654	1,723
Total	29	11,673	11,673

UCMHP – Upcountry Mobile Home Park
SWD = Seaford Water Department
HVMP = Holly View Mobile Home Park
TMC = Todd's Mobile Court
SMMHP = Sussex Manor Mobile Home Park
MG = Mobile Gardens I
PRMHP = Pine Ridge Mobile Home Park
LVMHP = Laurel Village Mobile Home Park
VCB = Village of Cool Branch

As presented in Section 6.2, there are approximately 19,573 people who live within a 4-mile radius of the Site (Ref. 42). For the purpose of this SI, assuming those persons who reside within the 4-mile TDL not supplied public water rely on private domestic wells for drinking water, there are approximately 7,900 persons within the 4-mile TDL who obtain drinking water from domestic wells.

4.4 SAMPLING LOCATIONS

From October 8 through 11, 2018, WESTON collected 18 groundwater samples, including a duplicate, from 17 existing monitoring wells located on and in the immediate vicinity of Procino

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Plating in accordance with *Final Field Sampling and Analysis Plan for Blades, DE* (Ref. 31). However, a sample could not be collected from Procino monitoring well MW-6 because of an obstruction in the well. Between October 16 and November 1, 2018, EPA installed 21 additional monitoring wells throughout the Town of Blades. WESTON collected groundwater samples from the newly installed wells on November 6 and 7, 2018. The new wells were installed, developed, and sampled in accordance with *Final Field Sampling and Analysis Plan for Blades, DE* (Ref. 31). On November 5 and 6, 2018, WESTON also collected groundwater samples from the three Town of Blades public supply wells as well as a groundwater sample from the Triangle Park Well owned by the Town of Blades.

All PFAS results for the groundwater samples collected from the newly installed wells in November 2018 were qualified or rejected because the pH of the samples were not within the specified range of the method. On March 26 and 27, 2019, WESTON resampled 16 wells for PFAS analysis. Resampled wells included a combination of newly installed wells, existing wells at Procino Plating, and the public supply wells.

The sample locations are shown in Figures 4a and 4b. Well logs are provided in Appendix A and field logbook notes and field data sheets are provided in Appendix B.

4.5 ANALYTICAL RESULTS

The groundwater samples were analyzed for pesticides, total metals (including mercury), cyanide, hexavalent chromium, and PFASs. Analytical summary tables for results detected above the respective reporting limits are provided in Tables 1 through 7. Table 4 is a summary of the PFAS-qualified data for the November 2018 sampling event. The table is provided for informational purposes only; the data associated with these samples is not discussed below and was not used to evaluate site conditions.

The groundwater analytical results were compared to EPA RSLs for tap water based on a cancer target risk of 1E-6 and a hazard quotient of 0.1 (Ref. 32), and to EPA drinking water MCLs (Ref. 33). RSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. The RSLs are considered by EPA to

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be protective for human health over a lifetime. They are used for site screening and are not cleanup standards. The RSLs are used to help identify areas, contaminants, and conditions that may require further action at a particular site. EPA MCLs are legally enforceable standards that apply to public drinking water systems only. However, EPA MCLs are frequently used for evaluating and, in some cases, as a basis for remediating, contaminated sites. They are included here for comparison purposes only. Additionally, the PFAS analytical results were compared to EPA's HAL (Ref. 15). The EPA HAL is the level at or below which adverse health effects are not anticipated to occur over a lifetime of exposure.

Sample result qualifiers, where applicable, are included in the analytical summary data tables; however, they are not included in the following discussion of analytical results. The tables also reflect the elevated concentrations of compounds or elements that were detected in the samples three times above the concentrations detected in the background samples, SIGW-19 for shallow wells (screened below 20 feet bgs), SIGW-08 for intermediate wells (screened between 30 and 60 feet bgs), and TBW-01 for the deep wells (screened above 60 feet bgs) from the March 2019 sampling event. Samples containing compounds or elements that were not detected above the reporting detection limit (RDL)/quantitation level (QL) in the background sample are considered to be elevated if they were detected at a concentration equal to or greater than the background sample RDL/QL. For samples submitted to an EPA assigned contract laboratory program (CLP) laboratory or a WESTON subcontracted Tier IV laboratory, the analytical data was validated by the Environmental Services Assistance Team (ESAT) contractor under the direction of the Office of Analytical Services and Quality Assurance (OASQA) Branch. Organic and inorganic data were validated at EPA Region 3 Organic Level 2 and Inorganic Level 2, respectively, in accordance with *EPA National Functional Guidelines for Organic Superfund Methods Data Review*, USEPA-540-R-2017-002 (Ref. 11). For samples submitted to the EPA Region 3 Environmental Science Center Laboratory in Fort Meade, Maryland, the analytical data was reviewed by the EPA OASQA Branch. Laboratory analytical data packages and data validation reports are included in Attachment 1.

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4.5.1 Pesticide Analytical Results

Several pesticides, including dieldrin, were detected at low concentrations in a few groundwater samples. Detected concentrations did not exceed or approach MCLs. There is no MCL for dieldrin; however, the detected concentrations of dieldrin were generally above the EPA RSL of 0.0018 µg/L. Dieldrin was not detected in the background groundwater sample.

4.5.2 PFAS Analytical Results

As shown in Tables 1 and 5, the concentrations of the analyzed PFAS compounds in the public supply wells were elevated with respect to background (TBW-01). Samples collected form the public wells in February 2018 by the EPA Removal Program contained PFOS concentrations ranging from 53 ng/L to 210 ng/L and PFOA concentrations ranging form 19 ng/L to 26 ng/L. The concentrations of PFOS in the supply well samples collected in November 2018 ranged from 27 to 160 ng/L and the concentrations of PFOA ranged from 14 to 27 ng/L. The March 2019 public well samples had PFOS concentrations ranging from 48/ng/L to 140 ng/L and PFOA concentrations ranging from 19 ng/L to 32 ng/L. Groundwater collected from all three supply wells in February 2018 and March 2019 and from wells 1 and 3 collected in November 2018 exceed the EPA HAL of 70 ng/L for combined PFOS and PFOA. Groundwater collected from well 2 in November 2019 did not contain total PFOS and PFOA concentrations in exceedance of the EPA HAL of 70 ng/L.

As shown in Table 2, PFAS concentrations exceeded the combined HAL of 70 ppt for PFOS and PFOA concentrations in 7 of the 54 domestic wells located west of Blades that were sampled as part of the EPA removal assessment. PFOS was the main contaminant detected, with concentrations ranging from 44 ng/L in sample RW-206 to 350 ng/L in sample RW-170. PFOA concentrations in these wells ranged from 14 to 47 ng/L. An additional eight residences contained PFOS concentrations greater than three times the concentration detected in the corresponding monitoring well background sample collected as part of the SI. PFOS concentrations in these eight wells ranged from 15 ng/L in sample RW-194 to 57 ng/L in sample RW-173. As shown in Table 2, additional PFAS compounds were also detected in the wells.

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As shown in Table 3, PFOS was detected in all the existing Procino wells at elevated concentrations with respect to the corresponding background, with concentrations ranging from 73.2 ng/L in sample GW-04 to 2,820 ng/L in sample GW-02. The concentrations of PFOS alone in all the wells exceed EPA's combined PFOS and PFOA HAL of 70 ng/L. PFOA was also detected in the majority of the samples at concentrations elevated with respect to background ranging from 20.9 ng/L to 35.1 ng/L. Perfluorobutanesulfonic acid (PFBS) was also detected at elevated concentrations in all the Procino wells. The concentrations of PFBS did not exceed EPA's RSL of 40,000 ng/L.

As shown in Table 5, of the resampled newly installed wells (SIGW), PFOS and PFOA were detected at elevated concentrations with respect to background in one shallow well (SIGW-05) and three intermediate wells (SIGW-04, SIGW-06, and SIGW-13) ranging from 25 ng/L to 190 ng/L and from 34 ng/L to 610 ng/L, respectively. Concentration of the combined PFOS and PFOA in the three intermediate well samples exceeded the EPA HAL of 70 ng/L. These four wells also contained elevated concentrations of other PFAS compounds. Table 5 also provides a summary of the resampled existing Procino wells and public supply wells.

Figure 4a, depicts groundwater sample locations that have PFOS and PFOA concentrations that exceed three times the concentrations detected in in the applicable background well, as well as concentrations that exceed the EPA HAL.

4.5.3 Inorganic Analytical Results

As shown in Table 6, inorganics such as arsenic (5 samples), cobalt (2 samples), copper (2), chromium (3 samples), manganese (4 samples), mercury (1 sample), nickel (8 samples), vanadium (3 samples), and zinc (3 samples) were detected in the existing Procino wells at elevated concentrations with respect to background. Elevated concentrations of arsenic, cobalt, manganese, and mercury in several samples exceeded the EPA RSL; however, they were below applicable MCLs. Additionally, hexavalent chromium was detected in 12 of the 17 wells at elevated concentrations ranging from 0.17 µg/L to 20 µg/L. Hexavalent chromium was detected in all the wells, except DMW-01, at concentrations exceeding the EPA RSL of 0.035 µg/L; however, concentrations did not exceed the EPA MCL of 100 µg/L for total chromium. Cyanide

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was detected in laboratory blanks associated with these samples. Samples with reported detected concentrations for cyanide less than the Contract-Required Quantification Limit (CRQL) are reported at the CRQL (10 µg/L) and were qualified as non-detect.

As shown in Table 6, inorganics such as aluminum (3 samples), arsenic (6 samples), cadmium (1 sample), cobalt (7 samples), copper (2 samples), chromium (4 samples), iron (7 samples), lead (3 samples), manganese (11 samples), nickel (4 samples), and zinc (4 samples) were detected at elevated concentrations in the newly installed wells. Elevated concentrations of arsenic, cobalt, and manganese in several samples exceeded the EPA RSL; however, they were below applicable MCLs. Five samples contained an elevated concentration of hexavalent chromium ranging from 0.11 µg/L to 0.25 µg/L. Cyanide was not detected in the newly installed wells.

Figure 4b, depicts groundwater sample locations that have at least one inorganic with concentrations that exceed three times the concentration detected in in the applicable background well.

4.6 GROUNDWATER CONCLUSIONS

Based on analytical results, a PFAS groundwater plume has been documented at the Site. Public, domestic, and monitoring well samples document the presence of primarily PFOS in groundwater at concentrations three times above background levels. Additionally, the concentrations of PFOS in the public supply wells and the combined concentration of PFOS and PFOA in seven domestic wells exceed the EPA HAL of 70 ng/L. Approximately 1,600 persons are supplied drinking water by the Town of Blades public supply wells. Analytical results also show a documented metals contamination in groundwater, including hexavalent chromium.

5.0 SURFACE WATER MIGRATION PATHWAY

This section describes the Site's hydrologic setting, targets associated with the surface water migration pathway, and conclusions regarding the surface water migration pathway.

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5.1 HYDROLOGIC SETTING

As shown in Figure 6, the Town of Blades is situated inside a bend of the Nanticoke River, a major tributary to Chesapeake Bay. The Nanticoke River is located approximately 2,000 feet northwest of the former Peninsula Plating facility and approximately 1,300 feet west of the Procino Plating facility. There is no direct surface water pathway from the facilities to the river. Surface water runoff from the facilities is expected to flow into the Nanticoke River though a combination of overland flow and through storm drains. Some surface water may flow along the railroad right-of way located to the west of both facilities, then into the Nanticoke River. In general, the direction of surface water flow, based on topography, appears to be westerly toward the Nanticoke River.

The locations of the two metal plating facilities are outside the Federal Emergency Management Agency (FEMA)-designated 1% annual chance flood zone (i.e., 100-year floodplain) (Ref. 34). The Nanticoke River at Seaford and Town of Blades is tidal (Ref. 35). The 15-mile downstream TDL is completed in the Nanticoke River as shown in Figure 5.

Both the Peninsula Plating and Procino Plating facilities had National Pollutant Discharge Elimination System (NPDES) discharge permits for treated process water to the Town of Blades sanitary sewer system (Refs. 5, pp. 11 and 12; 8, p. 8). The Town of Blades sewer system is owned and operated by Sussex County. The effluent is then conveyed to Seaford's treatment plant, which is along the north side of the Nanticoke River at the southwest corner of the City of Seaford (Ref. 6, p. 12).

5.2 SURFACE WATER TARGETS

There are no drinking water intakes located along the Nanticoke River within the 15-mile TDL (Ref. 29).

The Nanticoke River is recreationally fished for many species, such as white and yellow perch, pickerel, catfish, largemouth bass, bluefish, sea trout, blue crab, and rockfish (i.e., striped bass) (Ref. 36, p. 2). There are two public boat launches in Seaford and a marina in Blades (Ref. 37). The Nanticoke River, as a tributary to the Chesapeake Bay, could potentially provide suitable

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habitat for the Federally-designated threatened species the shortnose sturgeon (*Acipenser brevirostrum)*; however, this species is mostly known to inhabit the Potomac and Susquehanna Rivers (Refs. 38, p. 2; 39, p. 2). Two state-listed endangered fish species, the blackbanded sunfish (*Enneacanthus chaetodon)* and the Ironcolor shiner *(Notropis chalybaeus),* are known to occur in Wicomico County, Maryland (Ref. 40, p. 3). The Nanticoke River State Wildlife Area is located along both the eastern and western banks of the river between 4 and 7 miles downstream of the Site (Figure 6). Approximately 15 miles of wetland frontage are located along the Nanticoke River within the 15-mile TDL (Ref. 41).

5.3 SAMPLING LOCATIONS

On September 19 and 20, 2018, WESTON collected 10 co-located surface water and sediment sample pairs, including 1 duplicate sample of each matrix. Seven surface water and seven sediment samples, including the duplicate samples and upstream background samples at two locations, were collected from Morgan Branch, a tributary to the Nanticoke River; two surface water and two sediment samples (SW/SD-05 and SW/SD-06) were collected from a marshy area along the Nanticoke River; and one surface water and one sediment sample were collected from the Nanticoke River at the marina. The surface water and sediment sample locations are shown in Figure 7. Field logbook notes are provided in Appendix A.

5.4 ANALYTICAL RESULTS

Surface water and sediment samples were submitted for laboratory analysis of metals (including mercury), cyanide, hexavalent chromium, PFASs, and pesticides. Analytical summary tables for results detected above detection limits are provided in Tables 8 through 10. The surface water sample results were compared to EPA National Recommended Water Quality Criteria for the consumption of water and organisms as well as to EPA Region 3 Biological Technical Assistance Group (BTAG) freshwater screening criteria (Refs. 43 and 44). Sediment sample results were compared to EPA Region 3 BTAG screening criteria (Ref. 44). The table also reflects the elevated concentrations of compounds or elements that were detected in the samples three times above the concentrations detected in the background samples (SW-07/SD-07 and SW-09/SD-09 for samples collected from the Morgan Branch and SW-08/SD-08 for samples

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collected from the Nanticoke River). Compounds or elements that were not detected above the detection limits in the background samples are considered to be elevated in a sample if they were detected at a concentration equal to or greater than the background sample detection limit. Sample result qualifiers, where applicable, are included in the analytical summary data tables; however, they are not included in the following discussion of analytical results. For samples submitted to an EPA assigned CLP laboratory or a WESTON subcontracted Tier IV laboratory, the analytical data were validated by the Environmental Services Assistance Team (ESAT) contractor under the direction of the OASQA Branch. Organic and inorganic data were validated at EPA Region 3 Organic Level 2 and Inorganic Level 2, respectively, in accordance with EPA National Functional Guidelines for Organic Superfund Methods Data Review, USEPA-540-R-2017-002 (Ref. 11). For samples submitted to the EPA Region 3 Environmental Science Center Laboratory in Fort Meade, Maryland, the analytical data were reviewed by OASQA. Laboratory analytical data packages and data validation reports are included in Attachment 1.

Pesticides were not detected above detection limits in the surface water and sediment samples.

As shown in Table 8, PFOS was detected in surface water sample SW-03 at an elevated concentration of 16 ng/L. PFOS, as well as PFOA, were not detected in any other surface water samples. Perfluorononanoic acid (PFNA) was detected in surface water samples SW-03, SW-04, and background sample SW-09 (and its duplicate) ranging from 14.2 to 16.6 nanograms per liter (ng/L). As shown on Table 7, low-level estimated concentrations of several PFASs were detected in the majority of the sediment samples. PFOS was only detected at an estimated concentration in the upstream background sample, SD-09 (and its duplicate), collected from Morgan Branch. PFOA was detected at estimated concentrations in SD-01, the farthest downstream location on Morgan Branch, and the background sample SD-09. PFOA was also detected at an estimated concentration of 2.1 micrograms per kilogram (µg/kg) in sample SD-06 collected in a marsh area along the Nanticoke River.

Table 9 provides a summary of the concentrations of inorganics in the surface water samples. With the exception of the concentration of lead in surface water sample SW-03, inorganics detected in samples collected from Morgan Branch were not elevated with respect to

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background. The surface water samples collected from the marsh area along the Nanticoke River, SW-05 and SW-06, contained concentrations of inorganics, such as barium, beryllium, chromium, cobalt, copper, iron, lead, nickel, vanadium, and zinc, at elevated concentrations with respect to the background sample collected from the Nanticoke River (SW-08). Sample SW-02 collected from Morgan Branch Creek contained an elevated concentration of lead. The elevated concentrations of cobalt, copper, iron, lead, vanadium, and zinc exceeded EPA BTAG screening values, but were below the EPA Water Quality Criteria (WQC). Additionally, cyanide was detected at estimated concentrations in samples SW-02 and background sample SW-09 from Morgan Branch and samples SW-05 and SW-06 from the Nanticoke River. Hexavalent chromium was detected in one surface water sample, sample SW-07, collected upstream on Morgan Branch.

As shown in Table 10, numerous inorganics were detected at elevated concentrations in sediment samples SD-01 and SD-02 collected from Morgan Branch Creek and SD-05 and SD-06 collected from the Nanticoke River. The elevated concentrations of arsenic, chromium, lead, manganese, nickel, selenium and zinc exceeded EPA BTAG screening values. There were no hexavalent chromium detections above the detection limits in the sediment samples, and results below the detection limits were qualified as unusable because hexavalent chromium was detected in the method blank associated with the sediment samples. Cyanide was not detected in the sediment samples.

5.5 SURFACE WATER CONCLUSIONS

With the exception of the concentration of PFOS in one surface water sample collected from Morgan Branch Creek, SW-03, PFASs were not detected at elevated concentrations in the surface water and sediment samples. Elevated concentrations of numerous inorganics were detected in three surface water samples and four sediment samples.

Potential targets associated with the surface water migration pathway include the Nanticoke River as a fishery, one federal-designated and two state-designated threatened or endangered species, the Nanticoke River State Wildlife Area, and the approximate 15 miles of wetland frontage located along the Nanticoke River within the 15-mile TDL.

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6.0 SOIL EXPOSURE AND AIR MIGRATION PATHWAYS

This section provides information regarding the physical conditions of the Site and targets associated with the soil exposure and air migration pathways.

6.1 PHYSICAL CONDITIONS

The Site consists primarily of a PFAS-contaminated groundwater plume within the Town of Blades. The PFAS-contaminated groundwater plume is at least partially attributable to Procino Plating, an active metal plating facility, as well as the former Peninsula Plating facility, which is currently vacant land. The locations of Procino Plating and former Peninsula Plating are shown on Figure 2.

The majority of the Procino Plating facility property is occupied by several buildings and a warehouse, as well as an asphalt parking lot. There is minimal exposed soil on the property. The location of the former Peninsula Plating facility is currently vacant land. The entire property is covered with exposed soil, vegetation, and crushed stone. The property is not fenced and is accessible to the public.

6.2 SOIL AND AIR TARGETS

There are residential properties that directly border the Procino Plating facility to the south and across 9th Street to the north. A public park and residential properties are located across River Road from the former Peninsula Plating facility. However, a soil source has not been identified associated with the Site. No residences, schools, or daycare centers are located on or within 200 feet of possible source areas. The estimated population and wetland acreage within a 4-mile radius of the Site are summarized in the tables below (Refs. 41 and 42).

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Radial Distance from Site (miles)	Population (number of persons)
0.00 - 0.25	97
>0.25 - 0.50	312
>0.50 - 1.0	2,750
>1.0 - 2.0	5,905
>2.0 - 3.0	5,308
>3.0 - 4.0	5,201
Total	19,573

Ref. 42

Radial Distance from Site (miles)	Wetlands (acreage)
0.00 - 0.25	1.88
>0.25 - 0.50	89.58
>0.50 - 1.0	136.85
>1.0 - 2.0	705.45
>2.0 - 3.0	1545.14
>3.0 - 4.0	1803.61
Total	4282.51

Ref. 41

6.3 SAMPLING LOCATIONS

On October 29 and 31, 2018, WESTON collected two surface (0 to 24 inches bgs) soil samples, plus a duplicate sample for quality assurance/quality control (QA/QC), and two subsurface (4 to 10 feet bgs) soil samples from soil borings SIGW-18 and SIGW-20 installed on the Procino Plating facility. Soil samples were not collected from the former Peninsula Plating facility property. Additionally, a background soil sample was not collected for PFAS analysis. Sampling locations are shown in Figure 4 and the field logbook notes are provided in Appendix A.

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6.4 ANALYTICAL RESULTS

The soil samples were analyzed for PFAS in accordance with a modified EPA Method 537. Analytical summary tables for results detected above detection limits are provided in Table 11. Sample result qualifiers, where applicable, are included in the analytical summary data tables; however, they are not included in the following discussion of analytical results. The analytical data were validated by the ESAT contractor under the direction of the OASQA Branch. Organic and inorganic data were validated at the EPA Region 3 Organic Level 2 and Inorganic Level 2, respectively, in accordance with *EPA National Functional Guidelines for Organic Superfund Methods Data Review*, USEPA-540-R-2017-002 (Ref. 11). Laboratory analytical data packages and data validation reports are included in Attachment 1.

The analytical results were compared to residential RSLs based on target cancer risk of 1E-06 and target hazard quotient of 1.0 (Ref. 45). RSLs for PFOS and PFOA in industrial soil have not been established. EPA RSLs are generic risk-based concentrations that are intended to assist risk assessors and others in initial screening level evaluations of environmental measurements. RSLs combine human health toxicity values with standard exposure pathway (i.e., inhalation, dermal, and ingestion) factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by EPA to be health protective based on human exposures over a lifetime. RSLs do not address impacts to ecological targets. RSLs are included here for site screening and to help identify areas, contaminants, and conditions that may require further action.

As shown in Table 10, surface soil sample SS-01, and its duplicate, contained 11 µg/kg PFOS and estimated concentrations, below detection limits, of PFOA, PFBS and other PFAS compounds. The subsurface soil sample collected at this location, SS-04, from 4 to 6 feet bgs, contained 2.6 µg/kg PFOS. Surface soil sample SS-02 contained 2.3 µg/kg PFOS and the subsurface soil sample at this location, SS-03 collected from 8 to 10 feet bgs, contained 0.54 µg/kg PFOS. The detected concentrations of PFOA and PFOS in the soil samples were significantly below the applicable RSLs for residential soil of 16,000 µg/kg and 6,000 µg/kg, respectively.

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6.5 SOIL EXPOSURE AND AIR MIGRATION PATHWAY CONCLUSIONS

The site consists of a PFAS-contaminated groundwater plume. With the exception of the four soil samples (two shallow and two deep) collected from soil borings on the Procino Plating facility property, soil samples were not collected as part of this SI. The four soil samples collected contained detectable concentrations of PFOA, PFOS, and PFBS. The detected concentrations were significantly below RSLs for residential soil. A background sample was not collected.

7.0 SUMMARY

The Site is located within the Town of Blades, Sussex County, Delaware. The site consists primarily of a PFAS groundwater plume. Groundwater is the sole drinking water source for both public and domestic potable water. Public water is supplied to residences within the town limits of Blades; however, some residences within town limits and the residences located beyond town limits to the southwest and to the northeast rely on domestic groundwater wells for potable water.

Located in Blades, DE, is Procino Plating, an active metal plating facility, as well as the site of the former Peninsula Plating facility, which is currently vacant land. Based on updated information pertaining to the use of PFASs at metal plating facilities and potential hazards associated with consumption of PFASs, DNREC, in coordination with EPA, collected samples from the Blades public supply wells for PFAS analysis in early February 2018. Analytical results indicated that all three public supply wells had a summed total concentration of PFOA and PFOS greater than the EPA drinking water HAL of 70 ppt, ranging between 96.2 ppt and 187.1 ppt.

Public, domestic, and monitoring well samples document the presence of primarily PFOS in groundwater at concentrations three times above background levels. Elevated concentrations of metals, including hexavalent chromium, were also detected in monitoring well samples. The concentrations of PFOS in the public supply wells and the combined concentration of PFOS and

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PFOA in seven domestic wells exceed the EPA HAL of 70 ng/L. Approximately 1,600 persons are supplied drinking water by the Town of Blades public supply wells.

With the exception of the concentration of PFOS in one surface water sample, SW-03, PFASs were not detected at elevated concentrations in the surface water and sediment samples. Elevated concentrations of numerous inorganics were detected in three surface water samples and four sediment samples. Potential targets associated with the surface water migration pathway include the Nanticoke River as a fishery, one federal-designated and two state-designated threatened or endangered species, the Nanticoke River State Wildlife Area, and the approximate 15 miles of wetland frontage located along the Nanticoke River within the 15-mile TDL.

The Site consists of a PFAS-contaminated groundwater plume. With the exception of the four soil samples (two shallow and two deep) collected from soil borings on the Procino Plating facility property, soil samples were not collected as part of this SI. The four soil samples collected contained detectable concentrations of PFOA, PFOS, and PFBS. The detected concentrations were significantly below RSLs for residential soil. A background soil sample was not collected.

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