EA Engineering, P.C. and its Affiliate
EA Science and Technology

269 West Jefferson Street
Syracuse, NY 13202
Telephone: 315-431-4610
www.eaest.com

3 January 2022

Mr. Payson Long
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7012

RE: Contract/WA No: D009806-18
Site/Spill No./Pin: National Heatset Site
Babylon, New York, Suffolk County
Site No. 152140

Dear Mr. Long:

This Corrective Measures Work Plan (CMWP) describes the corrective measures proposed for the National Heatset Site (Number [No.] 152140) (Site) in Babylon, Suffolk County, New York (**Figure 1**). EA Engineering, P.C. and its affiliate EA Science and Technology (EA) is currently performing site management under New York State Department of Environmental Conservation (NYSDEC) Work Assignment No. D009806-18, which was approved on 18 November 2020 (EA performed site management for the site from 2007 to February 2020 under prior contracts; Environmental Assessments and Remediation [EAR] performed site management for the site from March to December 2020). EA's assignment includes monthly/quarterly visits for the density driven convection (DDC) systems and the soil vapor extraction (SVE) system, quarterly system air sampling, and quarterly groundwater sampling. Remedial system details are presented in the NYSDEC-approved Site Management Plan (EA 2013a), which includes the Operation & Maintenance (O&M) Manual for each system. In addition to system O&M, EA was tasked with periodic review of the site systems and remedial site optimization.

EA has prepared this CMWP to address the failure of the DDC systems to function as designed, as detailed in the most recent periodic review report (PRR) prepared by EA in June 2021. The specific objective for the CMWP is to evaluate the existing systems and identify potential alternative system operations or remedial technologies to meet remedial objectives as defined by the Record of Decision (ROD) (NYSDEC 1999); mainly to "Eliminate, to the extent practicable, further off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria."

The protocol and procedures for the CMWP are in accordance NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2010).

1. INTRODUCTION

1.1 SITE DESCRIPTION

The National Heatset Printing Co. (NHP) site is currently a Class 4 site listed on the NYSDEC Registry of Inactive Hazardous Waste Sites (Number [No.] 152140). The site is located at 1 Adams Boulevard in the Hamlet of Farmingdale, Town of Babylon, Suffolk County, New York, and is identified as Block 1.00 and Lot 20.001 on the Town of Babylon Tax Map No. 132.20-1-3.2. A site location map is presented in **Figure 1**. The site contains one industrial building and is 4.5 acres in size. The site is currently owned by 1 Adams Boulevard Realty Corporation, managed by Finkelstein Realty, and leased by a commercial tenant. The site is located in an industrial area and is bounded by railroad tracks to the north, Adams Boulevard and an industrial property to the south, an industrial property to the east, and an industrial property to the west **(Figure 2)**.

1.2 SITE HISTORY

NHP occupied a portion of the building at 1 Adams Boulevard from July 1983 to April 1989. Their operations consisted of lithographic tri-color printing of newspaper and periodical advertisements, and the manufacturer of lithographic printing plates. NHP had been using organic solvents at the site since 1983. An inspection by the Suffolk County Department of Health Services (SCDHS) in 1983 revealed that NHP was discharging photo-plating waste to the onsite sanitary system. In March 1986, an inspection performed by the SCDHS revealed strong evidence of dumping from staining of inks and oils on the ground. The inspection report indicated that drums were being stored improperly both inside and outside of the building.

NHP filed for bankruptcy in 1987. The SCDHS discovered that after filing for bankruptcy, NHP disposed of its chemical inventory by dumping the materials onto the soil and into a leaching pool located off the rear of the building in the northeast side of the property.

In February 1988, a water sample collected by SCDHS from the leaching pool off the northeast side of the building contained elevated levels of volatile organic compounds (VOCs) (i.e., 24,000 parts per billion [ppb] of cis-1,2-dichloroethene [DCE] and 1,000 ppb of p-ethyltoluene). At the request of SCDHS, the leaching pool bottom sediments were excavated to a depth of 15 feet (ft) and end-point samples were collected in November 1988. The end-point soil samples indicated that the remaining leaching pool sediment contained elevated levels of VOCs (i.e., 13,000 parts per million [ppm] of tetrachloroethene [PCE]).

2. REMEDIAL HISTORY

2.1 REMEDIAL INVESTIGATIONS

A remedial investigation (RI)/feasibility study (FS) was completed at the site to determine the nature and extent of contamination in onsite soil, determine the onsite and offsite groundwater conditions, evaluate potential qualitative risks to human health and the environment of site-related contaminants, and determine the best remedial technology to remediate soil and groundwater contamination onsite and offsite (Holzmacher, McLendon, & Murrell, P.C. [H2M] 1999). The results of the RI are described in detail in the RI/FS Report. Potential remedial alternatives for the site were identified, screened, and evaluated in the FS. The RI/FS results are summarized below:

- Soil contamination was primarily identified in subsurface soil samples collected from the saturated soils (greater than 15 ft deep) located directly below the leaching pool. Concentrations of PCE exceeding the NYSDEC recommended soil cleanup objectives in these soil samples ranged from 8.2 to 7,700 ppm.

- Site groundwater contamination was highest in groundwater samples collected from below the onsite leaching pool, with concentrations of PCE (496-7,690 ppb), trichloroethylene (TCE) (162-9,620 ppb), and cis-1,2-DCE (124-12,200 ppb) exceeding the NYSDEC Ambient Water Quality Standard (AWQS) of 5 ppb. Overall, chlorinated volatile organic compound (CVOC)-contaminated groundwater was observed to be migrating offsite in a southeast direction; CVOC concentrations were higher in shallow wells near the southeast corner of the building. Offsite, the highest level of site-related contamination was detected in the deepest sampling intervals collected from just above the Gardiners Clay unit (80–85 ft bgs).

- The RI determined that subsurface soil and groundwater contained CVOCs exceeding the Standards, Criteria, and Guidance (SCGs) for the site, and was to be addressed in the remedy selection.

2.2 REMEDIAL ACTIONS

Potential remedial alternatives for the site were identified, screened, and evaluated during the FS. Based on the RI and FS report (H2M 1999), NYSDEC issued the ROD (NYSDEC 1999), which identified the selected remedy for the site. The remedy included groundwater treatment using pump and treat, or alternate technologies (i.e., in situ chemical oxidation, in-well vapor stripping) for three locations: (1) onsite source area, (2) downgradient edge of the site, and (3) downgradient edge of the offsite plume (**Figure 2**). The site is being remediated in accordance with the ROD, which was implemented via two construction contracts. In situ chemical oxidation (permanganate injection) was implemented in the source area by EnviroTrac in 2005 and DDC in-well vapor stripping systems were installed by EarthTech/AECOM at the downgradient edge of the site in 2006 (pilot study) and 2010 (completion of the installation) and at the downgradient edge of the offsite plume in 2012.

In addition to the remedies included in the ROD, a soil vapor extraction (SVE) system was installed in accordance with the work plan prepared by Shaw Environmental [Shaw] in 2002.

The following sections provide additional detail for the remedial actions conducted at the site.

2.2.1 ONSITE SOURCE AREA

The remedy in the ROD was refined during the remedial design (RD). An additional investigation performed during the RD concluded that injection of sodium and potassium permanganate would be effective at reducing source area contamination. Therefore, an RD and construction contract (Contract No. D005272) was prepared by Shaw and awarded to EnviroTrac for implementation of this remedy. The sodium and potassium permanganate injection was conducted in 2005 via 24 monitoring wells in 10 locations (nested pairs or trios) directly behind the building in the leaching pool area. CVOC concentrations in groundwater collected from within and directly downgradient from the treatment area in the year following the injection activities were observed to decrease from 150 to 250 ppb down to non-detect to 12 ppb, as described in the *Permanganate Injection System Remedial Action Report* (O'Brien and Gere 2007).

Sampling during the RD in 2001 also revealed the presence of contaminated soil beneath the onsite building's slab and indoor air with PCE at a concentration exceeding the NYSDOH guidance value. Due to the indoor air analytical results, the NYSDEC installed a soil vapor extraction (SVE) system to remediate the contaminated soil beneath the building slab and address potential vapor intrusion, consisting of a single vertical monitoring well used as a vapor extraction well. The SVE system began running in September 2002 (**Figure 2**).

Modifications were made to the SVE system in 2014 and 2016 to alter the system to include first one horizontal soil vapor extraction (HSVE) well in 2014 and then five HSVE wells in 2016. The system ran using all five HSVE wells simultaneously from August 2016 to April 2017. From April-June 2017 the system operations were altered to use HSVE wells 1 and 5. In July 2017 operations were switched to HSVE wells 2 and 4. In October 2017 operations were switched to HSVE wells 1, 4 and 5. Aside for some down time associated with high water levels in the moisture separator and carbon changeout, the SVE has continued to operate using this configuration. This system continues to be effective for mass recovery from the source area soil.

2.2.2 ONSITE DOWNGRADIENT EDGE OF SITE

A DDC in-well stripping pilot test was conducted by EarthTech/AECOM (Contract No. D005539) and managed by O'Brien and Gere in 2006. The pilot test system consisted of one DDC well (DDC-1) at the downgradient edge of the onsite groundwater plume, just southeast of the building. The intent of groundwater treatment at the downgradient edge of the site is to mitigate further migration of contaminants offsite.

A DDC in-well stripping well is constructed with two 10-inch diameter stainless steel, 0.020-inch slot well screens, separated by 10-in diameter schedule 40 PVC riser pipe; from the top of the upper riser pipe up to ground surface, the PVC expands to 12-in diameter (**Figure 3**). The upper screen is intended to intercept the groundwater table, while the lower screen is intended to intercept the contaminated groundwater zone, just above the Gardeners Clay unit, which is a confining layer. The upper screen for DDC-1 is 15 ft long from 13 to 28 ft bgs; groundwater was identified at 14 ft bgs at the time of installation. The lower screen is 12 ft long and was installed from 72 to 84 ft bgs; the Gardeners Clay unit was identified at 83.7 ft bgs. The borehole annulus was backfilled with sand pack and three 5-ft thick bentonite pellet annulus seals in the interval between the upper and lower DDC well screens to adequately seal the borehole and prevent short circuiting of groundwater during operation of the DDC well. An eductor pipe is installed within the 10-in riser. The eductor is constructed using 6-in PVC with two 6-in by 10-in packers installed between the upper and lower DDC well screens to provide hydraulic separation between the two screens. During operation, air is injected into the lower screen, and contaminants are lifted through the water column. Volatilized contaminants are removed from the well and the effluent air is treated with GAC.

Although permanganate was identified within the DDC pilot test area, EarthTech/AECOM concluded that the DDC testing performance requirements were achieved and recommended full scale implementation of the DDC technology.

The system infrastructure initially installed as part of the pilot test was used for what would become Onsite DDC #1 System. In 2010 EarthTech/AECOM added a second DDC well, DDC-2, to complete Onsite DDC #1 System. A second onsite system (Onsite DDC # 2 System) was constructed with two additional DDC wells, DDC-3 and DDC-4, approximately 140 ft downgradient from Onsite DDC #1 System (**Figure 2**). Well locations were selected based on the results of the pilot study and project requirements. Each onsite DDC system has its own system trailer with a blower, heat exchanger, vapor-phase granular activated carbon (VGAC) vessels, and a variable frequency drive (VFD). Systems are automated with a programmable logic control (PLC) system. Detailed descriptions of the onsite remedial systems can be found in Section 1.4.1 of the Site Management Plan (SMP) (EA 2013a) and Section 4.4 of the Final Engineering Report (FER) (EA 2013b).

2.2.3 OFFSITE DOWNGRADIENT EDGE OF PLUME

An offsite DDC system was constructed by EarthTech/AECOM under Contract No. D005539 in 2012 approximately one mile southeast of the site. The intent of the offsite DDC system is to capture contamination at the end of the plume and mitigate further migration of contaminants to the south-southeast. The system consists of six DDC wells located along Benjoe Drive and on the Suffolk County Water Authority (SCWA) –Albany Avenue Well Field (wells DDC-5 through DDC-10). Two shipping containers that house system equipment are also located on the SCWA property (**Figure 2**). One shipping container houses two blowers, moisture separator tanks, heat exchangers, and a VFD. The other shipping container houses six VGAC vessels. The system is operated using one blower at a time; the blowers are alternated every 6 months so that a single blower is used to operate the six DDC wells at one time. Detailed descriptions of the offsite remedial system can be found in Section 1.4.1 of the SMP (EA 2013a) and Section 4.4 of the FER (EA 2013b).

2.3 GROUNDWATER PLUME DELINEATION (2016)

Groundwater sampling and delineation was completed after several years of DDC System operation to further define plume conditions between the onsite and the offsite systems and assess system performance over time (EA 2017). No permanent wells are in the 1700 ft distance between the onsite DDC systems and the Offsite DDC System. Field activities included membrane interface probe (MIP) profiling and groundwater sample collection from temporary points and monitoring wells, resulting in a 3-D groundwater model.

- PCE was the primary COC detected in groundwater, with a thin (i.e., approximately 50 ft thick) plume extending south/southeast from the Site to the offsite treatment system approximately 6,500 ft downgradient from the Heatset building. While PCE was detected at concentrations up to 670 ppb, concentrations were significantly lower than offsite concentrations detected during the RI.

- The highest concentrations of PCE were observed within the deepest sampling intervals (75 to 80 ft bgs)
- The presence of PCE in shallow groundwater samples obtained adjacent to the DDC wells was noted.

3. OPERATIONS OF SITE SYSTEMS

3.1 OPERATIONAL HISTORY

Recent operational history (2018 – 2021) is summarized below for the onsite DDC systems and the Offsite DDC System.

Groundwater elevations typically fluctuate seasonally; however, groundwater elevations were observed 1 – 2 ft higher beginning in 2018 as compared to the average groundwater elevations when the systems were installed. Groundwater elevations in shallow monitoring wells near each of the DDC Systems were graphed and are in Attachment A. When groundwater elevations are high, water enters the air stream and accumulates in the system moisture separator tanks intended to protect the blowers from water damage. Once the high-water level is reached in the tanks, the system alarms and shuts down. When groundwater elevations are high, the tanks fill up faster than the transfer pumps can pump. To restart the system, a site visit is required so that the moisture separator tanks can be pumped down manually.

3.1.1 ONSITE DDC #1 AND DDC #2 SYSTEMS

Onsite DDC #1 System ran with few interruptions from installation in 2010 through 2017. Occasional shutdowns were caused by power loss or high temperature alarms. The system was shut down in March 2018 for GAC replacement moisture separator repair; however, the system remained down due to high water. During the May 2019 site visit, EA attempted to bump the Onsite DDC #1 System. EA personnel started the system and observed excessive vacuum in the moisture separator tank causing the vacuum release valve to open. The vacuum release lines were under pressure indicating an issue with high groundwater table. Water accumulated in the lines at the well head. The system was then shut down. During the August 2019 site visit, EA personnel performed more troubleshooting on the Onsite DDC #1 System and determined there was a problem with the VFD. This system remained shut down until the September 2019 site visit. D&D was onsite with EA personnel to complete more troubleshooting and repairs. It was determined that, in addition to the VFD, the belt tensioner also need to be replaced. The system was left off. Site management operations were conducted by EAR for 2020, and EA resumed site management in 2021; despite further troubleshooting efforts by both EAR and EA, the Onsite DDC #1 System has remained off.

Similar to Onsite DDC #1 System, Onsite DDC #2 System operated with few interruptions from installation in 2010 through 2018. The system was shut down upon EA's arrival on 10 January

2019 due to a high-level alarm in the moisture separator that triggered a shutdown. EA personnel drained the moisture separator tank and restarted the system. The high-level alarm triggered again after the system had run for 15 minutes. The moisture separator tank and the transfer pump were drained a second time and the system was shut off. D&D responded during the site visit to assist in the troubleshooting efforts and determined that the float switch in the moisture separator tank was malfunctioning.

On 09 February 2019 D&D replaced the float switch in the moisture separator tank and started the system. The system ran for 30 minutes before the high-level alarm tripped and the system was shut down. EA personnel then drained the moisture separator tank and restarted the system. After the restart EA personnel noticed a significant amount of water accumulating in the moisture separator tank. The high-level alarm triggered after 5 minutes of the system restart. The system was restarted again after an additional draining which yielded the same result. Local groundwater levels appeared to be elevated. DDC #2 System remained off through 2019, as high groundwater levels persisted. Site management operations were conducted by EAR for 2020 but they did not operate Onsite DDC #2 System; EA resumed site management in 2021 and restarted Onsite DDC #2. The system ran from January 2021 through September 2021, when the system was shut down again due to high groundwater levels.

3.1.2 OFFSITE DDC SYSTEM

The Offsite DDC system is located along the downgradient edge of the dissolved phase groundwater plume and is currently equipped with two blowers (designated as "B-501" and "B-502"). Blowers B-501 and B-502 are used interchangeably to operate all DDC wells (5, 6, 7, 8, 9, and 10). The offsite DDC system operated with few interruptions from installation in 2012 through 2018 but was shut down for much of 2019 due to high groundwater elevations.

During 2020, when EAR had performed site management for the site the offsite DDC system, B-501 was restarted on 2 March 2020 and was operational until May 2020, when a belt broke in B-501. The Offsite DDC system was operated using B-502 until September 2021 when the system had several alarms that could not be investigated due to a broken PLC touchscreen and outdated modem.

3.1.3 SUMMARY OF OPERATIONAL ISSUES

As discussed above, groundwater elevations were observed 1 – 2 ft higher beginning in 2018, as compared to the average groundwater elevations when the systems were installed. High groundwater elevations have been a major cause of system downtime since 2018.

The DDC systems were built between 2006 – 2012; therefore, the systems contain equipment that has been running for 10 – 15 years. As a result, the equipment is requiring repairs more often and can be difficult to acquire parts for and repair in a timely manner. This difficulty in acquiring parts leads to longer system downtime.

The following is a summary of the system downtime within the last three years caused by the operational issues described above:

- Onsite DDC #1 System has been down since March 2018, initially due to equipment repairs; after repairs were completed, the system would not run continuously due to a high groundwater elevation.

- Onsite DDC #2 System was shut down in December 2018 due to high groundwater elevations; the system ran for part of 2021 but is currently shut down again as of October 2021 due to high groundwater elevations and the need for repairs.

- The Offsite DDC System was shut down for much of 2019 due to blower issues; the system was restarted in 2020 but is currently shut down as of September 2021 due to equipment repair issues.

3.2 GROUNDWATER CONCENTRATION TRENDS

3.2.1 ONSITE

As presented in the most recent *Operation & Maintenance and Monitoring Report (July–September 2021)* (EA 2021), PCE, TCE, and/or *cis*-1,2-DCE were detected at concentrations greater than the corresponding AWQS in groundwater samples collected from five of the seven deep monitoring wells (MW-2AD, MW-2D, MW-4D, MW-5D, and MW-15D) and four of the five deep DDC piezometers (DDC-1-PDA, DDC-1-PDB, DDC-2-PD, and DDC-3-PD) sampled during this monitoring event. The samples collected from five locations, MW-E, MW-14S, MW-15S, DDC-3-PS, and DDC-4-PS, were the only onsite shallow groundwater samples with VOC concentrations exceeding the corresponding AWQS.

From 2010 – 2018, while the onsite DDC systems ran with minimal downtime, groundwater monitoring data at deep piezometers DDC-02-PD (near Onsite DDC #1 System) and DDC-04-PD (near Onsite DDC #2 System) showed a general decreasing trend in PCE concentrations (**Figure 4**). Both onsite DDC systems began having intermittent down time in early 2017. Onsite DDC #1 System went down for a longer period beginning in March 2018, followed by Onsite DDC #2 System in December 2018. An increasing PCE concentration trend was observed in both deep piezometers from 2017 – 2021, reaching concentrations similar to or greater than 2010 concentrations, when the systems were in the first years of operation.

During this same period, while the onsite DDC systems ran with minimal downtime, groundwater monitoring data at shallow piezometers DDC-02-PS (near Onsite DDC #1 System) and DDC-04-PS (near Onsite DDC #2 System) showed a similar decreasing trend in PCE concentrations from 2010 to 2017, followed by an increasing trend from 2017 on (**Figure 4**). At DDC-02-PS, the shallow concentration was often higher than at deeper piezometer DDC-02-PD from 2010 – 2017 but shallow concentrations were less than DDC-02-PD from 2017 on. This same relationship between the shallow and deep piezometer concentrations was also observed occasionally in DDC-04-PS and DDC-04-PD.

3.2.2 OFFSITE

As presented in the most recent *Operation & Maintenance and Monitoring Report (July–September 2021)* (EA 2021), PCE, TCE, and/or *cis*-1,2-DCE were detected at concentrations greater than the corresponding AWQS in groundwater samples collected from two of the three deep monitoring well samples (MW-1D OFFSITE and MW-3D OFFSITE). *Cis*-1,2-DCE was detected at a concentration greater than the corresponding AWQS in one of the six shallow DDC piezometers (DDC-6-PS). There were no exceedances of the AWQS for PCE, TCE, or *cis*-1,2-DCE in any of the shallow monitoring wells or deep DDC piezometers. In general, shallow groundwater concentrations are consistently below AWQS.

At MW-1D OFFSITE, which is upgradient from the Offsite DDC System, the concentration of PCE has decreased while the concentrations of TCE and *cis*-1,2-DCE have fluctuated above the AWQS (**Figure 5**). Downgradient from the Offsite DDC System at MW-3D OFFSITE **(Figure 6**), the concentrations of PCE, TCE, and *cis*-1,2-DCE generally increased even while the Offsite DDC System was running. When the Offsite DDC System was restarted in January 2020, concentrations of these contaminants decreased.

4. EVALUATION OF REMEDIAL PROGRESS

4.1 EFFECTIVENESS

The effectiveness of the onsite DDC systems and Offsite DDC System are evaluated through discussions of onsite and offsite groundwater concentrations and comparing the vapor influent concentration of PCE at the onsite DDC systems (using analytical data) to the calculated vapor influent concentration of PCE using Henry's law.

4.1.1 ONSITE GROUNDWATER CONCENTRATIONS

As noted in section 3.2.1 and shown in **Figure 4**, the rebound of PCE concentrations observed in deep piezometers DDC-02-PD and DDC-04-PD after the onsite DDC systems shut down in 2018 could indicate that the decreasing concentrations previously observed was not due to mass removal from the system operation, but rather a slower rate of desorption of CVOCs from contaminated soil into the water column than the rate of removal of volatilized contaminants by the onsite DDC systems. Rebound of PCE concentrations may also be evidence that a there is a remaining source with high concentrations close to the onsite DDC systems. Contaminant rebound is commonly observed when implementing pump and treat technology.

Even if the onsite DDC systems would continue to run as they did from 2010 – 2018 with minimal downtime, there is little evidence that there would be sufficient mass recovery over a reasonable timeframe to get concentrations below AWQS by running the existing systems. This is particularly evident in wells like MW-15D, downgradient of Onsite DDC #2 System, which did not show much of a decrease in PCE concentrations from 2010 – 2018 when the systems were running more consistently (**Figure 7**).

In a DDC System, the system displaces contamination at the deeper screen via volatilization and discharges treated water to the shallow aquifer. DDC-02-PD and DDC-04-PD are screened in the deeper untreated water near the DDC well intake while DDC-02-PS and DDC-04-PS are screened in the shallow aquifer near upper DDC screen (i.e., the treated water). Concentrations in samples collected from DDC-02-PS and DDC-04-PS would be expected to decrease to be lower than the DDC-02-PD and DDC-04-PD concentrations over time as treated water is moved up to the shallow aquifer. As shown in **Figure 4**, instead of seeing lower groundwater concentrations in the shallow aquifer while the system was running from 2010 – 2018 from each pair of wells, shallow concentrations were elevated, higher than deep concentrations during many sampling events. It is possible that the onsite DDC systems are transferring contamination from deep to shallow screens, preventing cleanup of the shallow aquifer.

4.1.2 OFFSITE GROUNDWATER CONCENTRATIONS

In general, offsite shallow groundwater CVOC concentrations are consistently below AWQS; however, contaminant concentrations in the deep groundwater are elevated. As presented in Section 3.2.2, downgradient of the Offsite DDC System (DDC-7-PS/PD, DDC-8-PS/PD, DDC-9-PS/PD, and DDC-10-PS/PD) concentrations of PCE, TCE, and *cis*-1,2-DCE in MW-3D OFFSITE near DDC-6-PD (**Figure 6**) generally increased even while the Offsite DDC System was running, indicating that contamination is still moving through the area and not being captured by the Offsite DDC System. When the Offsite DDC System was restarted in January 2020, concentrations of these contaminants decreased; however, it is not certain if they would continue to decrease, given the previous trend prior to the extended downtime.

4.1.3 NON-EQUILIBRIUM CONDITIONS

Henry's law is a gas law that states that the amount of dissolved gas in a liquid is proportional to its partial pressure above the liquid. Since there is historical groundwater data near the intake screen of the Onsite DDC System wells (piezometers DDC-2-PD at Onsite DDC #1 System and DDC-4-PD at Onsite DDC #2 System) with PCE concentrations from analytical lab data, the concentration of the PCE in the air above the liquid can be calculated using the Henry's constant (Hc) for PCE (0.754) and the influent water concentrations with the equation below. Since the influent air data collected at the system is pre-treated off-gas from the upper screen of the DDC wells, it is reasonable to assume that the air concentrations would be similar to the calculated value.

$$\text{PCE in Air } (\mu g/L) = (Hc) \times (\text{PCE in Water } [\mu g/L])$$

The calculations of PCE in air were completed using the above equation and are provided in **Table 1**.

The calculated concentration of PCE in air above the liquid (x-axis) was plotted against the Onsite DDC System's air influent concentrations from analytical lab data (y-axis). At DDC-2-PD, the R^2 value (statistical measure that represents the proportion of the variance for a dependent variable that is explained by an independent variable or variables in a regression model) was 0.26 (**Figure 8**) while at DDC-4-PD the R^2 value was 0.01 (**Figure 9**).

Upon comparing the calculated PCE air value to the lab PCE air value, neither Onsite DDC System has a strong positive relationship and therefore does not appear to be in equilibrium. This tells us the DDC Systems may not be efficiently removing PCE from the groundwater because the calculated and lab PCE air numbers are not strongly correlated. The calculations were completed at one location at Onsite DDC #1 System and one location at Onsite DDC #2

System and it is assumed that the calculations are representative of the other intake points on the onsite DDC systems and at the Offsite DDC System.

There are several factors that may be influencing the variability of the calculated PCE air value compared to the lab PCE air value including the following: 1) groundwater is slow and the volatile reaction is fast; therefore, it could be that equilibrium conditions are not established, which is why the calculated value may overestimate the true concentration and 2) heterogeneity in the subsurface ultimately defines what the recovered air will be (i.e., two or more intake points feed into each DDC system that are 100 ft away from each other).

4.2 RETURNING SYSTEMS TO OPERATIONAL

The most common issues related to downtime of the DDC Systems are 1) maintenance or replacement of aging equipment and 2) water filling the moisture separator tanks. Each of these issues is discussed in further detail below, along with steps or actions evaluated to try to keep the DDC Systems operational.

4.2.1 EQUIPMENT MAINTENANCE AND REPLACEMENT

The onsite DDC systems were built between 2006 – 2010 and the Offsite DDC System was built in 2012. The equipment and materials in the systems are between 9 – 15 years old. As mentioned in Section 3.1.1 and 3.1.2, there are numerous instances of system downtime because of the need to repair or replace equipment before the system can be restarted. Typical annual maintenance expenses, including carbon changeout and regular blower maintenance are approximately $20,000 and $7,000, respectively. As the blowers age they require additional maintenance, such as bearing replacement ($2,000 each), motor replacement ($3,000 each), moisture separator replacement ($5,000 each), and potentially more. At the Offsite DDC system, both blowers currently require maintenance, but the touchscreen for the programmable logic controller (PLC) needs replacement ($4,000) before additional system troubleshooting can be conducted. If the DDC Systems were to continue to operate, costs associated with repair and maintenance are expected to continue to rise as the system ages.

To keep the DDC Systems operational it would be with the expectation that downtime will continue to occur and more frequent troubleshooting and repair events would need to be conducted.

4.2.2 MOISUTRE SEPARATOR / DDC WELL CONSTRUCTION

If the systems were not down because of the need for equipment repair or replacement, then they were often down because the moisture separator tanks would fill up with water (Section 3.1.1). Before a system can be restarted, the moisture separator tanks need to be emptied manually because the transfer pumps are unable to keep up, which requires additional visits to the site. This has occurred more often in recent years at all the systems due to higher groundwater elevations around the systems, as discussed in Section 3.

Increasing the size of the moisture separator tank was evaluated to overcome this problem of downtime from the tanks filling up. The Onsite DDC #1 System has two 55-gallon moisture separator tanks; the Onsite DDC #2 System has a 30-gallon tank. The tanks at both systems have been observed to fill up within 5 – 15 minutes after restarting the system when groundwater elevations are high. If the tank size were increased to 100 gallons, the tank would fill up in approximately 15 minutes to one hour, would not prevent the DDC Systems from alarming, and would still require a site visit to pump down the tank. Increasing the tank size to larger than 100 gallons is not feasible because of size limitations within the DDC System buildings.

Following the evaluation of changing the size of the moisture separator tank, the construction of the DDC wells was evaluated to determine if the upper screens could be moved up higher to avoid having groundwater fill up the moisture separators while air is being extracted. It was observed that there was not enough room between the existing position of the upper screen and the ground surface to move the screen up to reduce the amount of groundwater being pulled into the moisture separator tanks (**Figure 10**).

4.3 ENGINEERING CONTROLS FOR HUMAN EXPOSURE

Numerous single-family residential properties are located southwest of the site north of the Southern State Parkway and southeast and south of the site on the opposite side of the Southern State Parkway (EA 2017). As part of the selected remedy, as stated in the ROD (NYDEC 1999), public water connections were provided to any residents with private wells identified downgradient from the site. The SCWA – Albany Avenue Well Field is located approximately 6,500 feet (ft) south-southeast (downgradient) of the NHP building, with wells installed at 419–509 ft below ground surface (bgs) (EA 2017). The public supply wells are screened below the contamination and clay confining unit located at approximately 85 ft bgs; the public supply wells are routinely sampled for site contaminants by SCWA. The latest published annual Drinking Water Quality Report (1 January 2019 – 31 December 2019) states that the highest values of PCE, TCE, and *cis*-1,2-DCE detected in 42 samples were below the maximum contaminant level (MCL) of 5 ppb for each contaminant for East Farmingdale Water District (SCWA 2020).

The RI did not identify surface water as an exposure media for human receptors. There are no surface water bodies on the site or directly downgradient. The nearest downgradient surface water body is a creek tributary connected to Avon Lake, approximately 1.7 miles south of the site, south of Sunrise Highway in Amityville. The headwaters of Carmans Creek and Massapequa Creek are located approximately 2 miles south-southeast and southwest of the site, respectively (H2M 1999).

4.4 DATA GAPS

As discussed in Section 4.1.1, the rebound of PCE concentrations observed in deep piezometers DDC-02-PD and DDC-04-PD after the onsite DDC systems shut down in 2018 potentially indicates a residual soil source with high concentrations is close to the onsite DDC systems and likely remains under the building. Any remaining source under the building would need to be clearly defined with high resolution tools such as a Membrane Interface Probe to delineate and estimate remaining mass.

PCE, TCE, and/or cis-1,2-DCE continue to be detected at onsite and offsite monitoring wells at concentrations exceeding the corresponding NYSDEC AWQS of 5 ppb. The distance between the onsite and offsite DDC systems is approximately 7,100 ft; however, there is no established well network aside from the monitoring wells which are currently located in the vicinity of each treatment system. While this is an existing data gap, there is a lack of known downgradient receptors, and further investigation is not currently recommended.

5. CORRECTIVE MEASURES

5.1 SHUT DOWN ONSITE AND OFFSITE SYSTEMS

The effectiveness of the systems when they are operational was evaluated in Section 4.1. Rebound in contaminant concentrations in deep piezometers DDC-02-PD and DDC-04-PD associated with onsite DDC systems when the systems were off for an extended period provides evidence that a source with high concentrations is close to the onsite DDC systems that the systems have been unable to reduce consistently over time (**Figure 4**). Even if the onsite DDC systems would continue to run as they did from 2010 – 2018 with minimal downtime, there is no evidence that there would be sufficient mass recovery within a reasonable timeframe to warrant continuing to run the existing systems (e.g., MW-15D [**Figure 7**]). Evidence was also introduced that onsite DDC systems could be transferring contaminated groundwater from deep to shallow screens and thus preventing cleanup of the shallow aquifer because shallow concentrations continued to stay elevated above deep concentrations during many sampling events at DDC-02-PD and DDC-04-PD (**Figure 4**).

The DDC Systems have had extended downtime over the last several years (Section 4.2) and are currently off due to required repairs and a high-water table. Due to the aging of the system equipment and materials (built between 2006 and 2012), the systems have frequently been down to evaluate shutdown problems, procure the needed equipment or materials, and complete the repairs. If the DDC Systems would continue as is, equipment and materials repair or replacement costs would continue and likely increase as the systems continue to age. The DDC Systems have also had extended downtime over the last several years due to high groundwater elevations, which causes water to fill up the moisture separator tanks, shut down the system, and require a site visit to pump the tanks down. Larger moisture separator tanks and reconstruction of the DDC wells were evaluated; however, both options were considered not feasible. If the systems were to continue operating under these conditions, there would continue to be considerable downtime.

Residents downgradient of the site were switched over to public water after issuance of the ROD (Section 4.3). The public supply wells are screened at 419-509 ft bgs, below the contamination and confining clay unit which is at approximately 85 ft bgs; the public supply wells are routinely sampled for site contaminants by SCWA. The latest published annual Drinking Water Quality Report (1 January 2019 – 31 December 2019) states that the highest values of PCE, TCE, and *cis*-1,2-DCE detected in 42 samples were below the MCL of 5 ppb for each contaminant for East Farmingdale Water District (SCWA 2020). There are currently no known receptors downgradient from the site.

The DDC systems will remain off while additional investigative activities are undertaken to investigate the continuing source area, discussed below.

5.2 DELINEATION OF THE SOURCE

In 2005, a sodium and potassium permanganate injection was conducted via 24 monitoring wells in 10 locations (nested pairs or trios) directly behind the building in the leaching pool area. While CVOC concentrations in groundwater collected from within and directly downgradient from the treatment area in the year following the injection activities were observed to decrease from 150 to 250 ppb down to non-detect to 12 ppb, it is likely that contaminant concentrations rebounded because sodium and potassium permanganate are faster-acting reagents, and no additional treatments were conducted. Any remaining source under the building will need to be clearly defined horizontally and vertically with high resolution tools such as a MIP to delineate and estimate the remaining mass. Remaining source investigation and delineation will be conducted as remedial site optimization (RSO). Details regarding RSO field activities will be provided as a separate RSO work plan.

5.3 OTHER TREATMENT TECHNOLOGIES

Once delineation of the source area is completed, EA would use the delineation and mass estimation data collected to evaluate treatment technologies such as in situ injections at the source area. Injection of potassium and sodium permanganate was previously effective; however, there has been some rebound due to the faster-acting reagents used. If a similar reagent is used, multiple injections may be required to fully treat the source. Other injection reagents will also be evaluated that contain a secondary method of treatment that reduces the likelihood of rebound associated with other faster-acting reagents with no sustained treatment component.

5.4 REMEDIAL SITE OPTIMIZATION REPORT

After the agreed-upon corrective measures discussed above are completed, EA will prepare a RSO Report that will include a summary of field activities and analytical results, a discussion of the results, an updated Conceptual Site Model, and a basis of design for recommended treatment technologies.

EA will prepare an initial draft and one revision to the RSO Report. Prior to submittal of the initial draft, a meeting will be held with NYSDEC to discuss the findings and recommendations.

Sincerely yours,

EA SCIENCE AND TECHNOLOGY

Megan Miller
Project Manager

EA ENGINEERING, P.C.

Donald F. Conan, P.E., P.G.
Contract Manager

Figures

Tables

Attachments

References

EA Engineering, P.C. and EA Science and Technology. 2013a. *National Heatset Printing Co. State Superfund Site, Suffolk County, Town of Babylon, New York. Site Management Plan. Final.* June.

———. 2013b. *National Heatset Printing Co. State Superfund Site. Suffolk County, Babylon, New York. Final Engineering Report. NYSDEC Site No. 152140.* August

———. 2017. *Groundwater Sampling and Delineation, National Heatset Printing Site*. 25 August.

———. 2021. *Operation & Maintenance and Monitoring Report (July-September 2021)*. 13 October.

Holzmacher, McLendon, &Murrell, P.C. 1999. *Engineering Investigations at Inactive Hazardous Waste Sites, Remedial Investigation/Feasibility Study, National Heatset Printing, Town of Babylon, New York.* February.

New York State Department of Environmental Conservation. 1999. *Record of Decision, National Heatset Printing Site, Town of Babylon, Suffolk County, Site Number 1-52-140*. June.

———. 2010. *DER-10 Technical Guidance for Site Investigation and Remediation.* May.

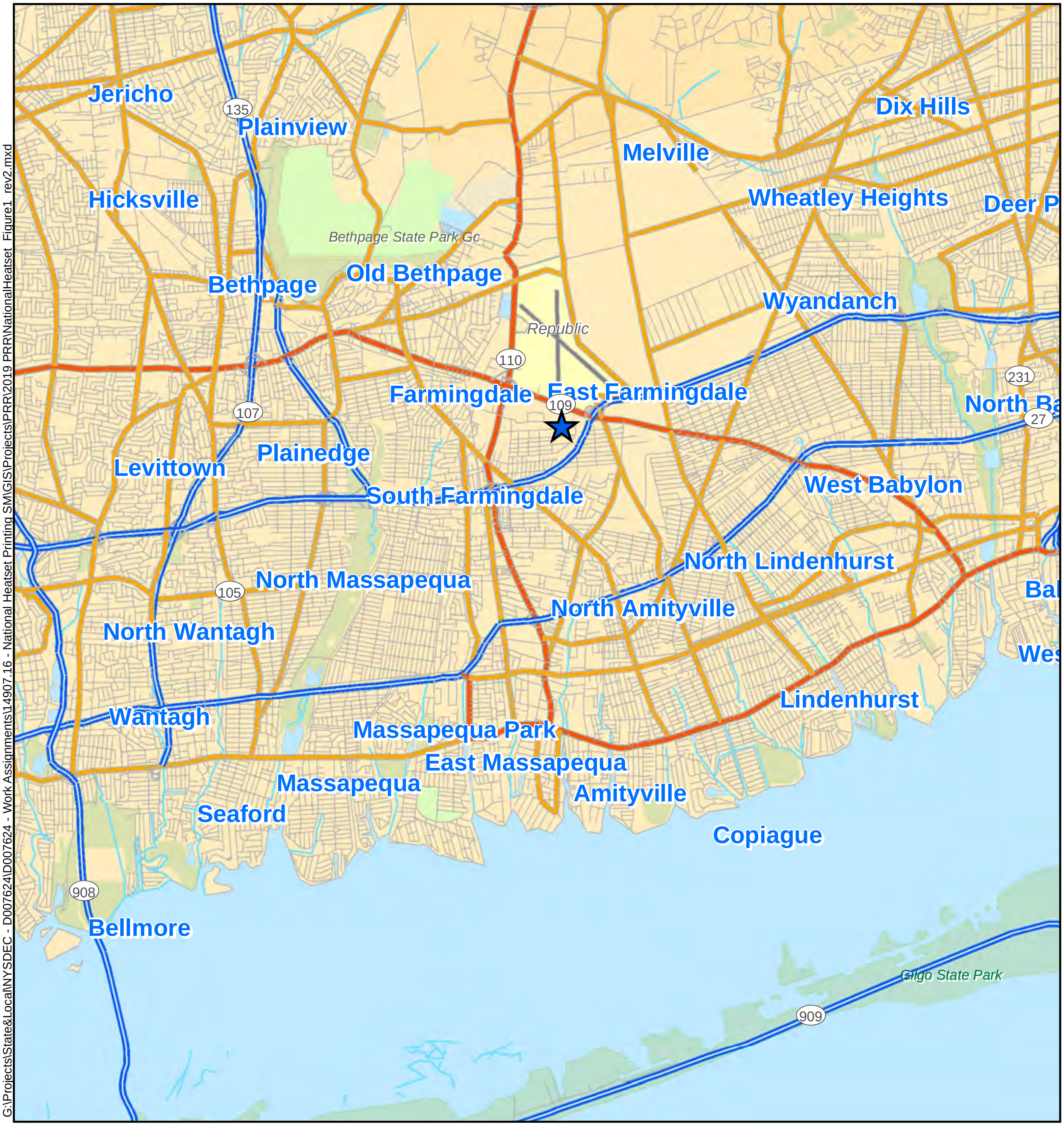
O'Brien and Gere. 2007. *Permanganate Injection System Remedial Action Report.* July.

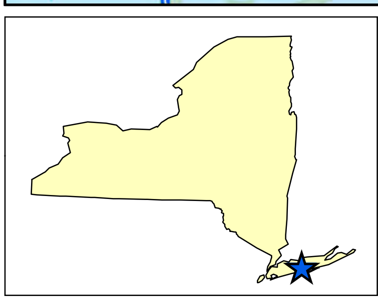
Suffolk County Water Authority. 2020. *2020 Drinking Water Quality Report For the period January 1, 2019 to December 31, 2019*. www.scwa.com.

Figures

This page left intentionally blank

G:\Projects\State&Local\NYSDEC - D007624\D007624 - Work Assignments\14907.16 - National Heatset Printing SM\GIS\Projects\PRR\2019 PRR\NationalHeatset_Figure1_rev2.mxd





0 0.75 1.5 3

Miles

1 inch = 1.5 miles

N

Legend

★ Site Location

Figure 1

SITE LOCATION MAP

NATIONAL HEATSET SITE (152140)

BABYLON, NEW YORK

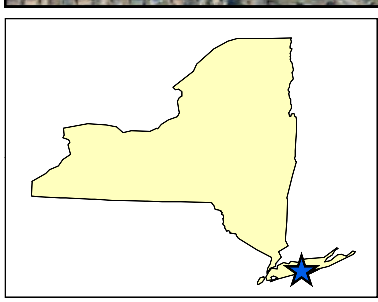
SUFFOLK COUNTY

Map Date: 1/3/2020

Source: ESRI, 2011

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

\\SYRACUSEFP\Syracuse\Projects\State&Local\NYSDEC - D009806\Work Assignments\1602518 National Heatset Printing Co. SM06 GIS\01 MXD\NationalHeatset Figure2 Site Boundary.mxd



0 0.05 0.1 0.2

Miles

N

Legend

- DDC Well Cluster
- Groundwater Monitoring Well
- Vapor Extraction Point
- Permanganate Injection Area
- Site Location

Figure 2

SITE, SURROUNDING AREA, AND MONITORING WELL NETWORK

NATIONAL HEATSET SITE (152140)

BABYLON, NEW YORK

SUFFOLK COUNTY

Map Date: 12/21/2021

Source: ESRI, 2011

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

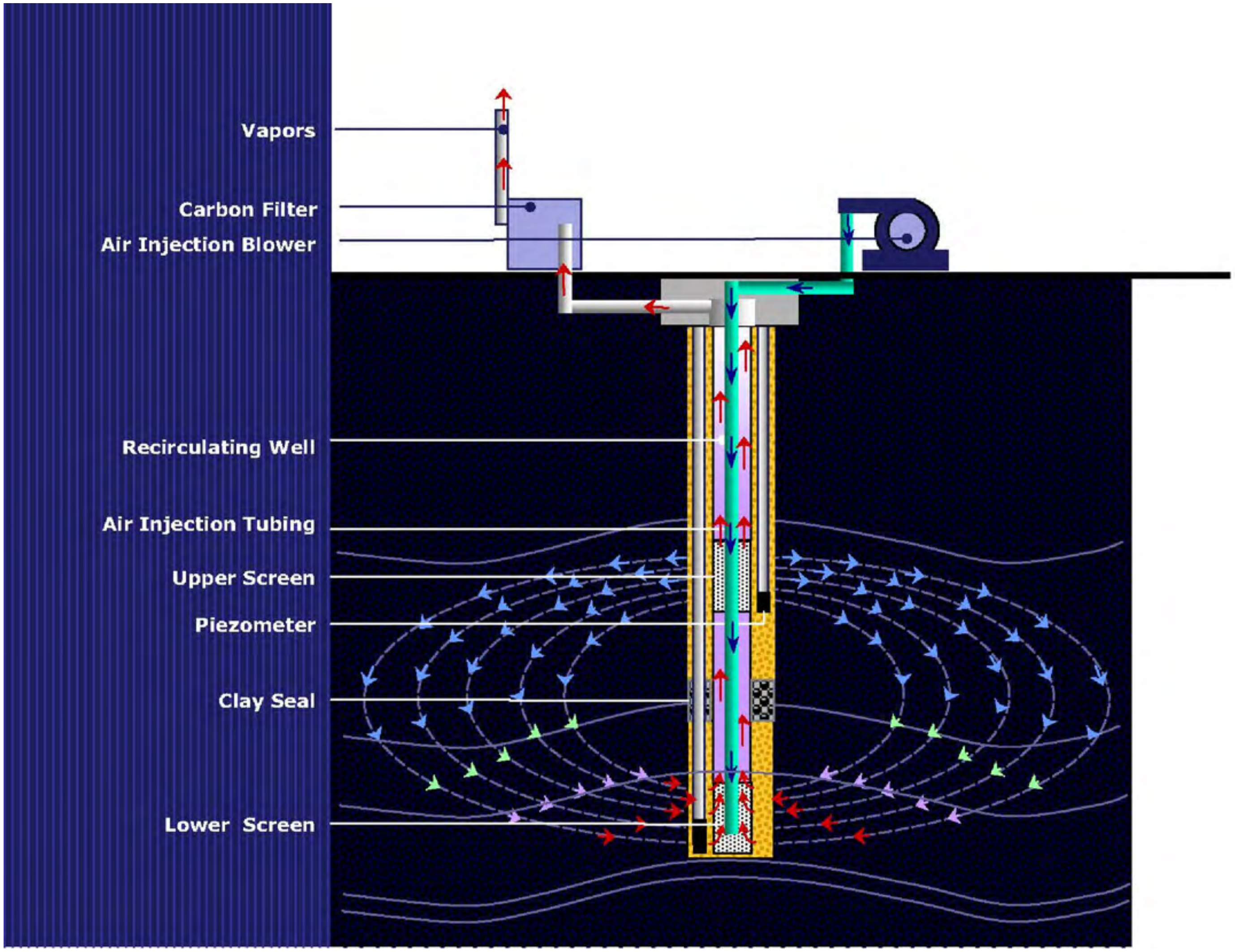


Figure 3
TYPICAL DDC WELL CONSTRUCTION
AND OPERATION DIAGRAM
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Source: Wasatch-Environmental, 2021

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

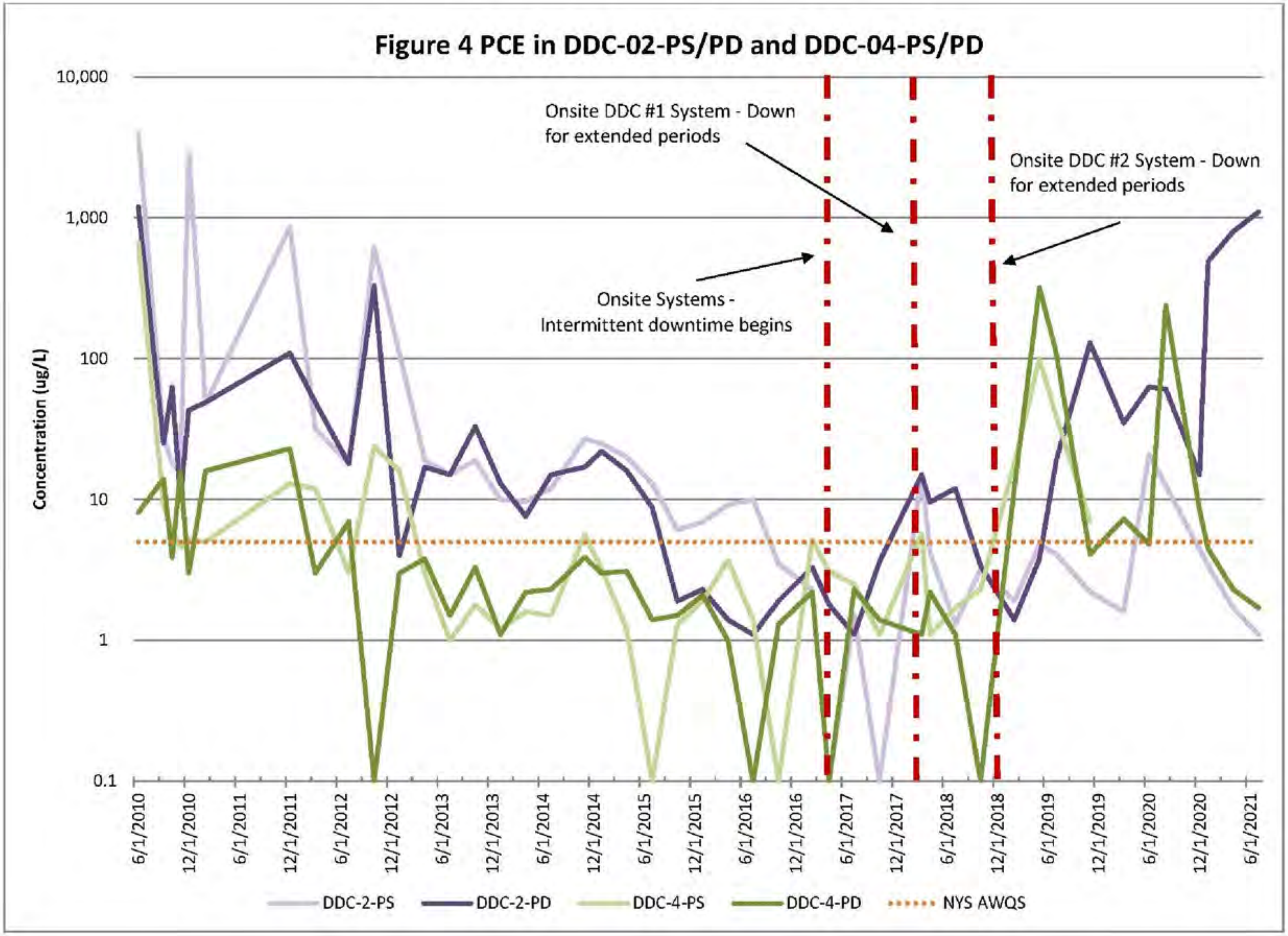


Figure 4
DDC-02 and DDC-04
CONCENTRATION TRENDS
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

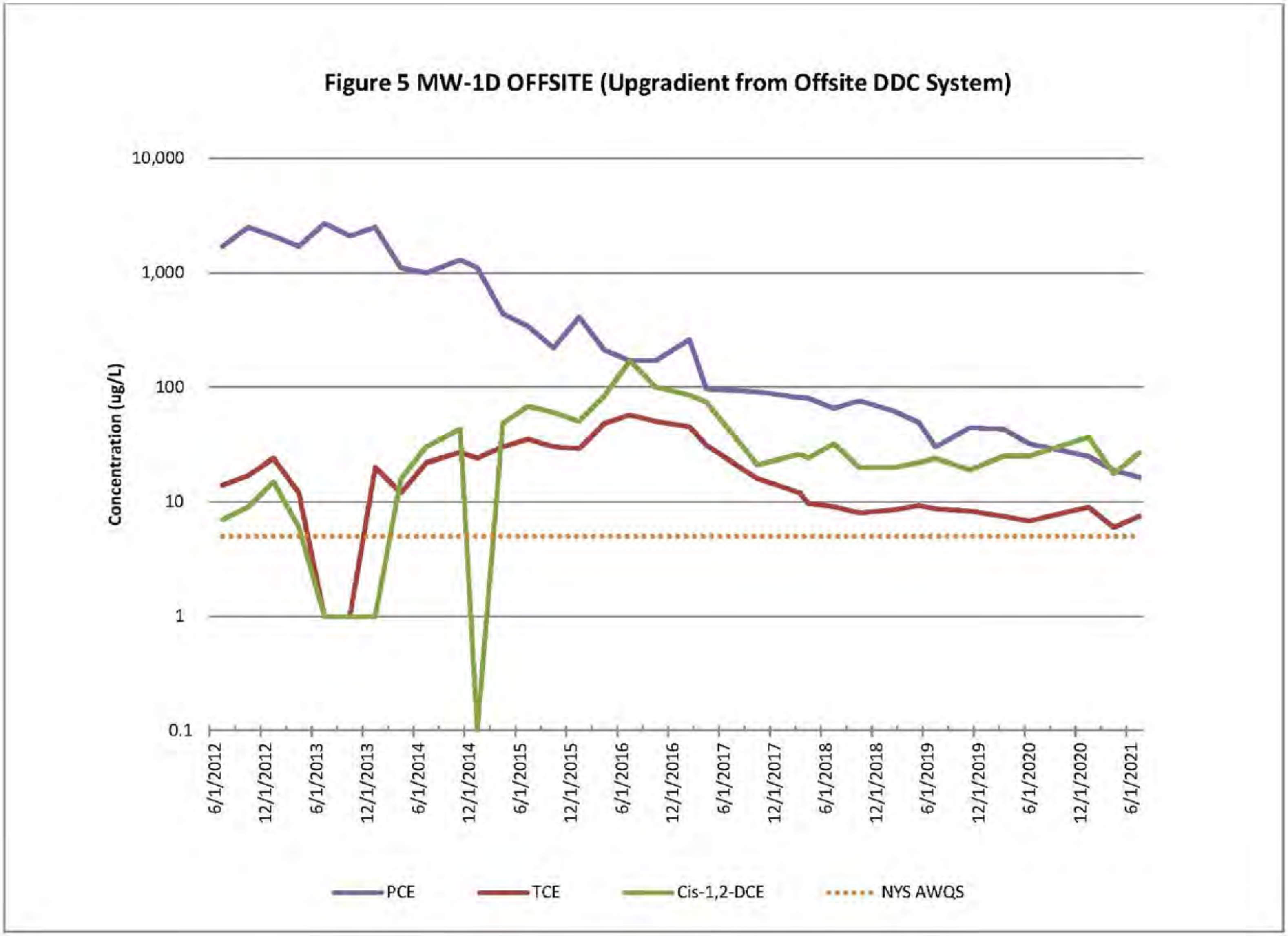


Figure 5
MW-1D OFFSITE (UPGRADIENT FROM OFFSITE DDC SYSTEM)
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

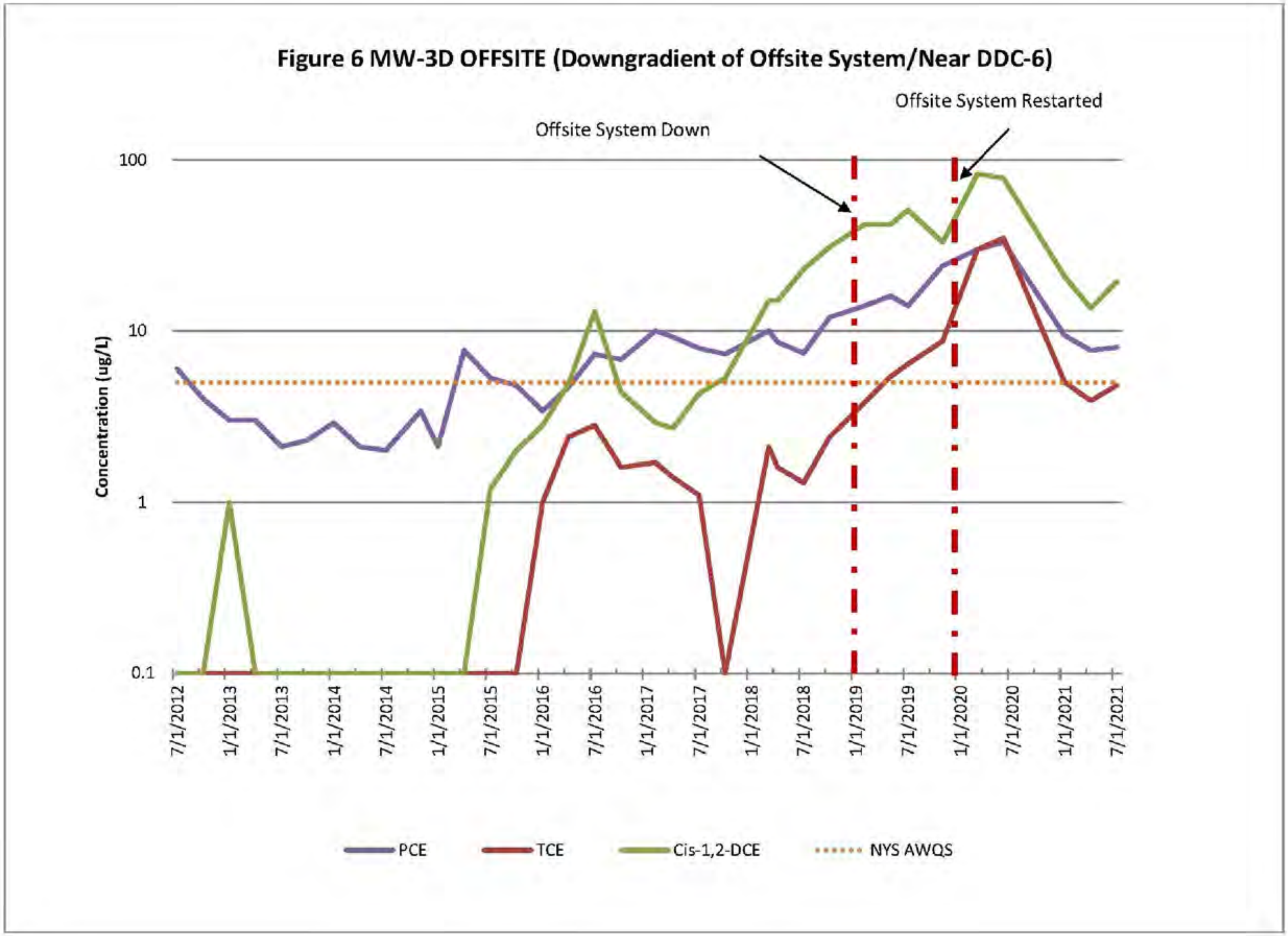


Figure 6
MW-3D OFFSITE
(DOWNGRADIENT-NEAR DDC-6)
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

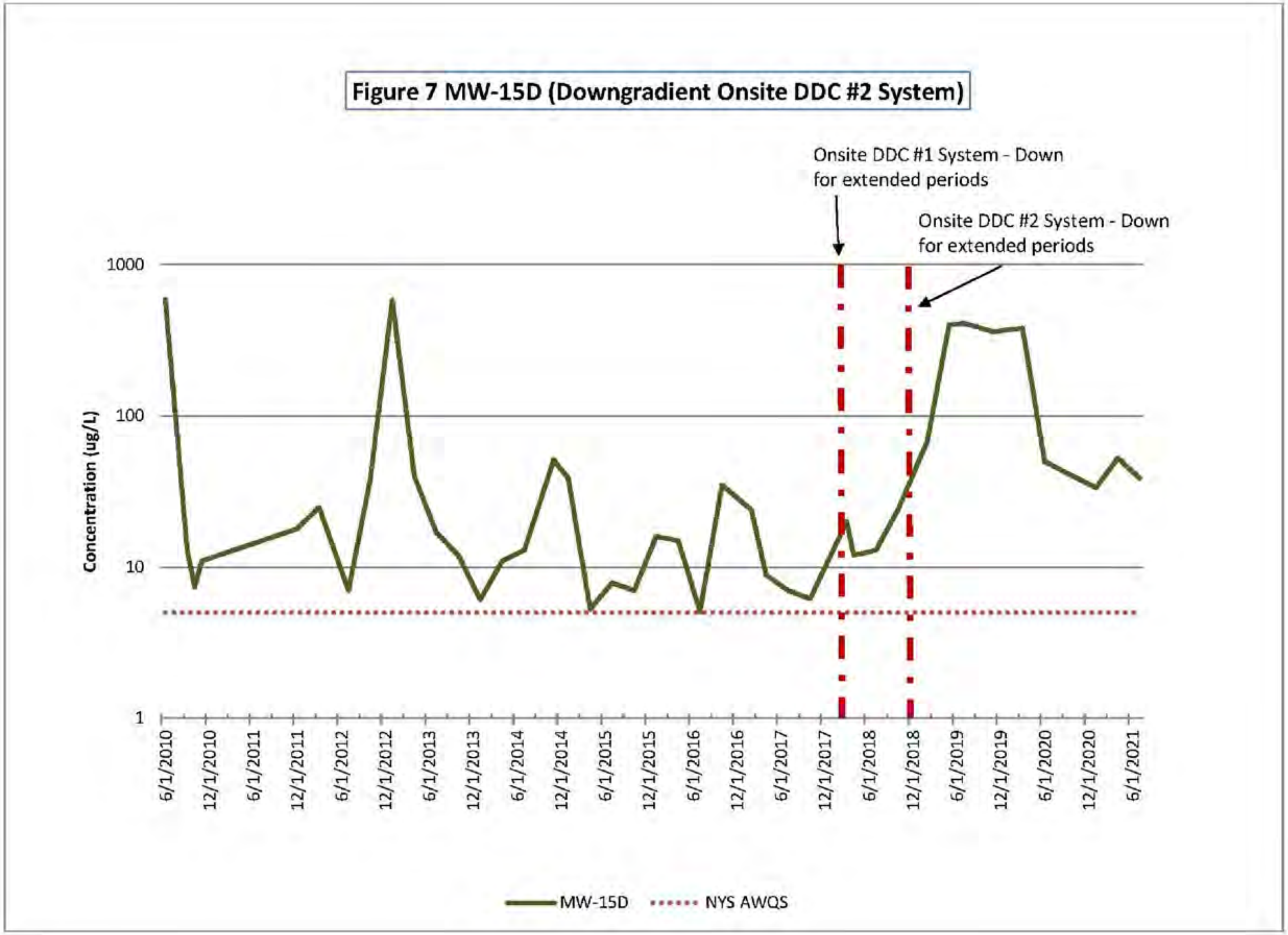


Figure 7
MW-15D (DOWNGRADIENT ONSITE DDC 2 SYSTEM)
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

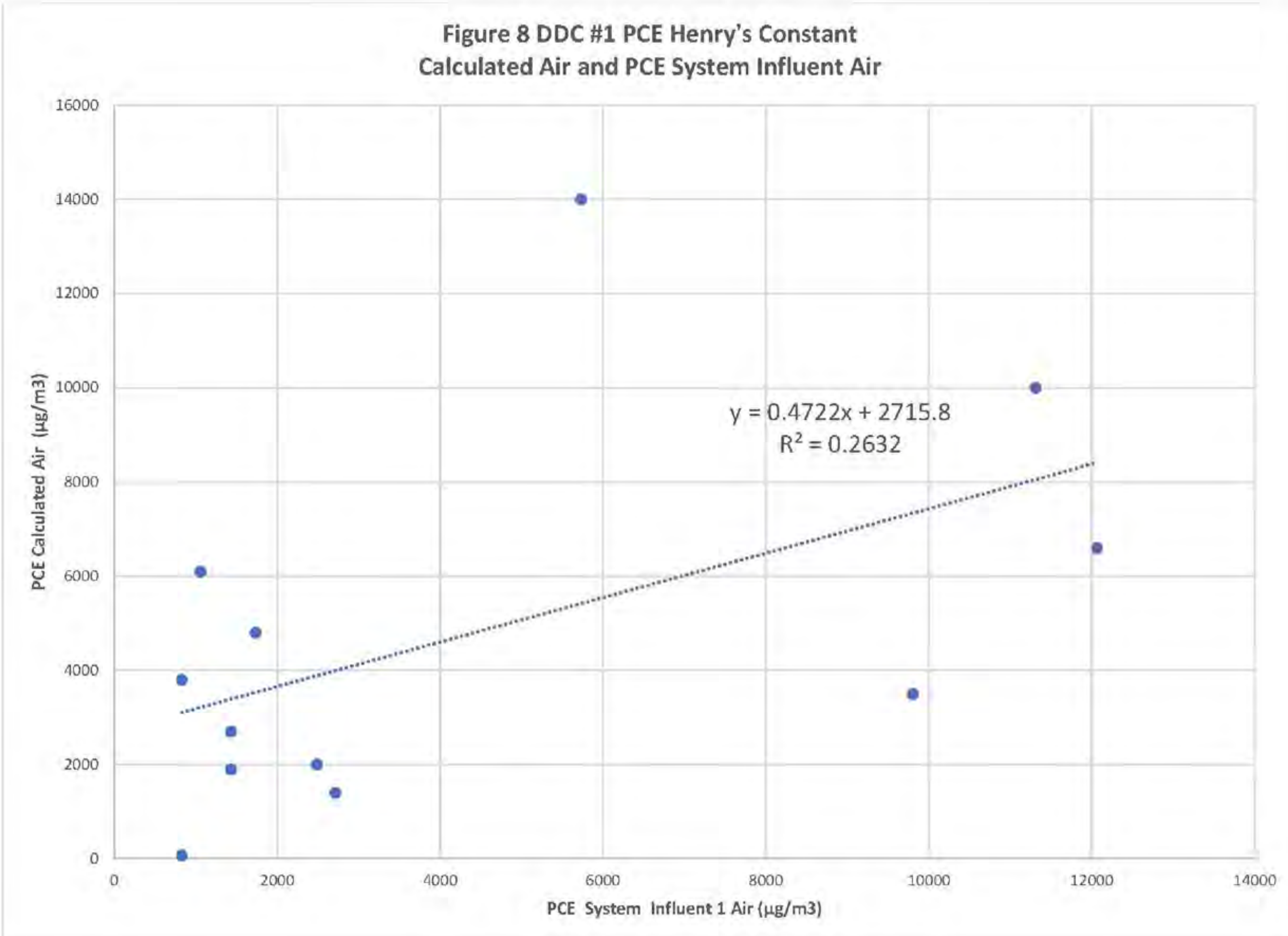


Figure 8
DDC #1 PDC HENRY'S CONSTANT
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

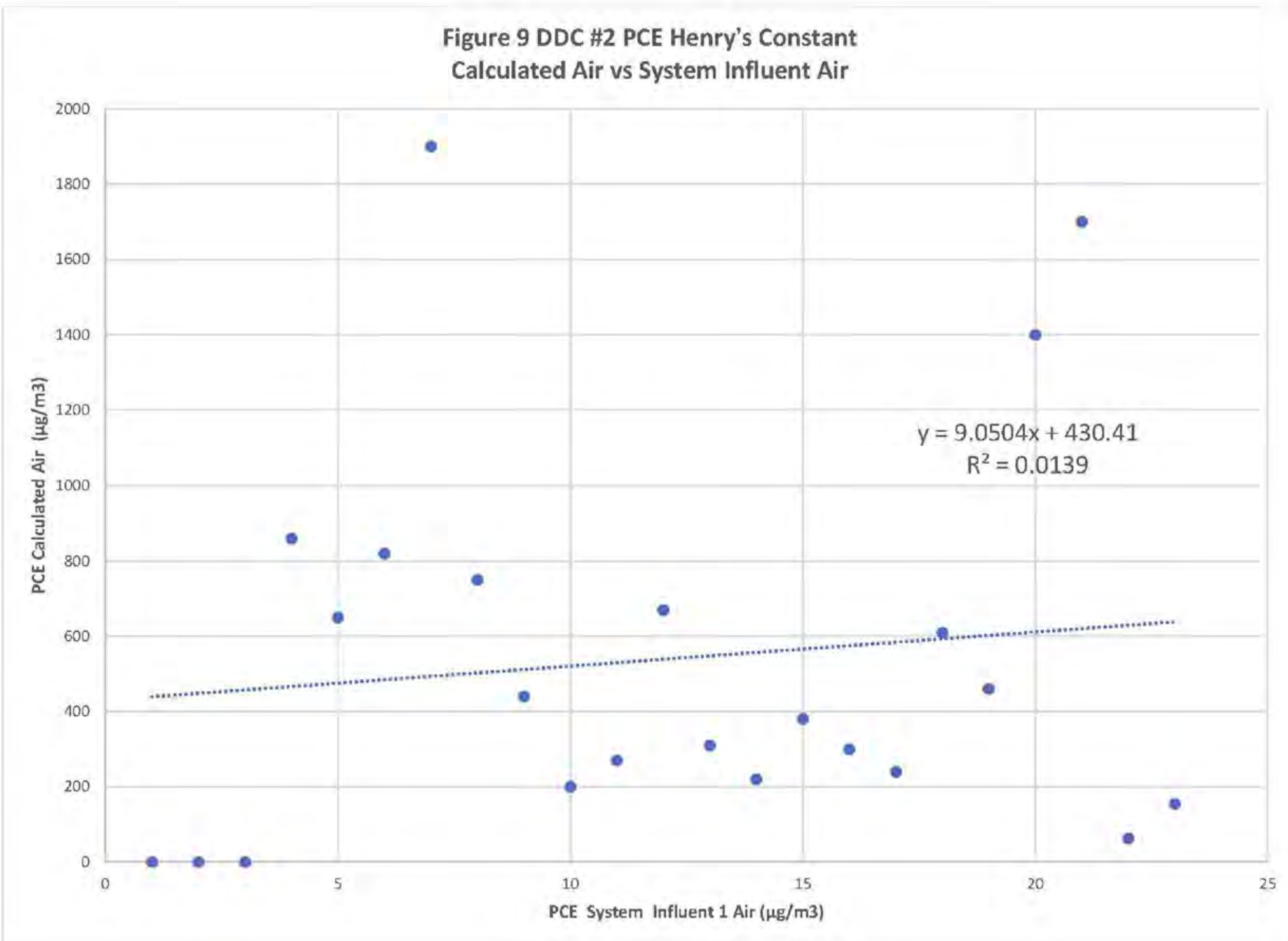


Figure 9
DDC #2 PDC HENRY'S CONSTANT
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY

Map Date: 12/21/2021
Source: ESRI, 2011

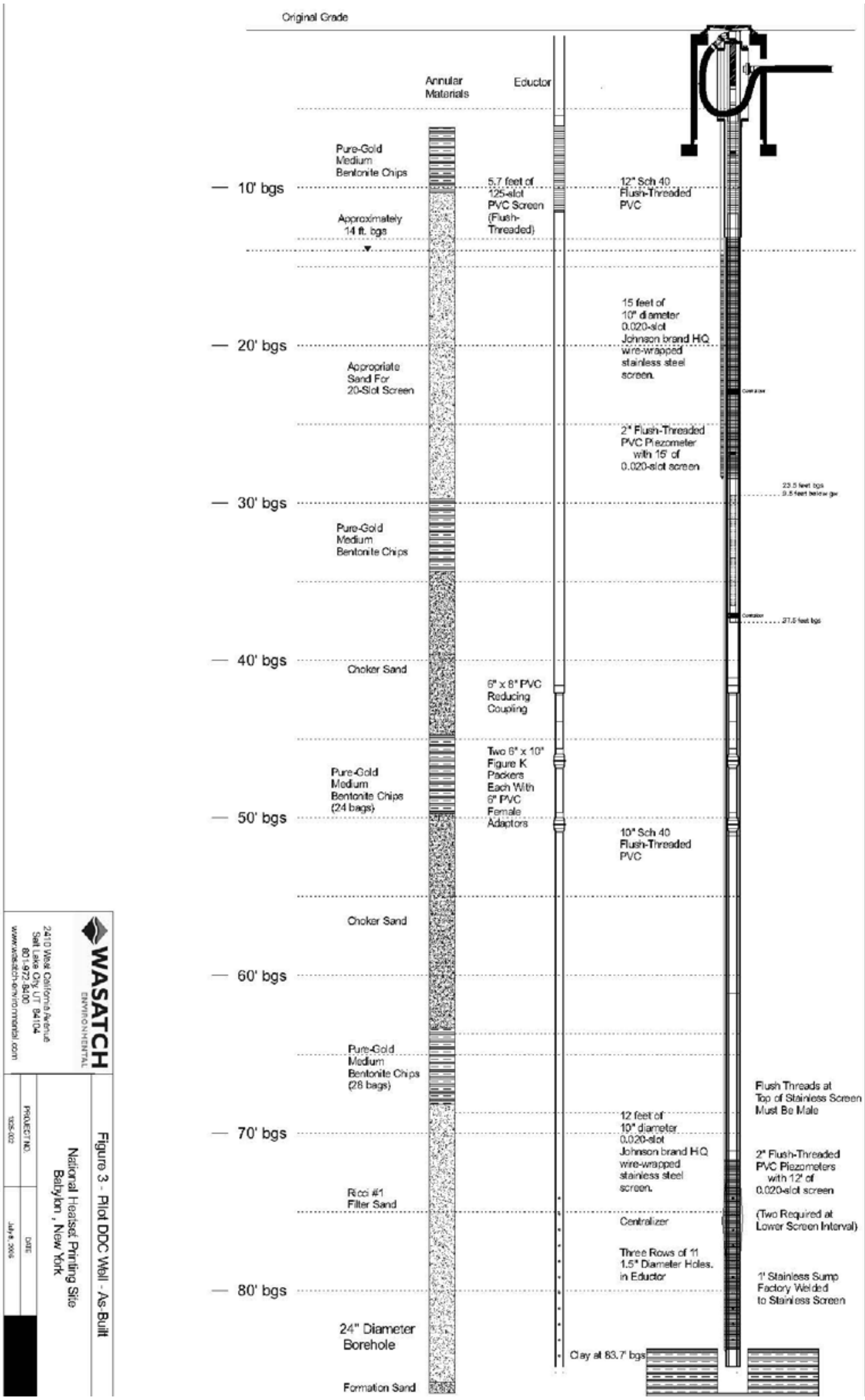


Figure 10
DDC WELL CONSTRUCTION DIAGRAM
NATIONAL HEATSET SITE (152140)
BABYLON, NEW YORK
SUFFOLK COUNTY
Source: Wasatch-Environmental

Tables

This page left intentionally blank

Table 1. Henry's Law Calculations for Onsite DDC #1 System and Onsite DDC #2 System

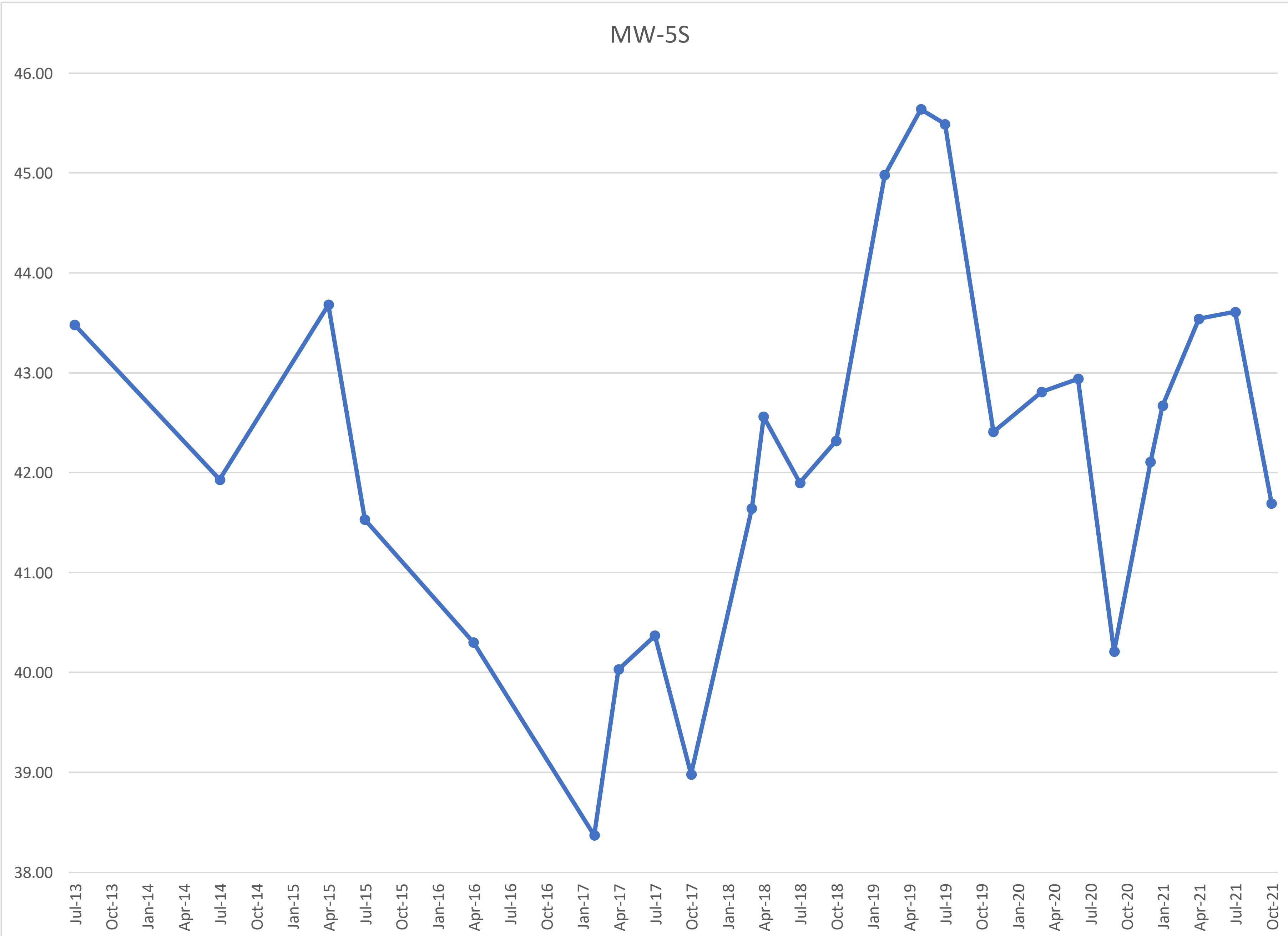
DDC #1 System Groundwater Sample Date	PCE DDC-2-PD Water (µg/L)	PCE Calculated Air (µg/L)	**PCE Calculated Air (µg/m³)**	DDC #1 System Air Sample Date	PCE System Influent 1 Air (mg/m³)	**PCE System Influent 1 Air (µg/m³)**
7/15/2013	15	11.31	**11310**	7/16/2013	10	**10000**
1/29/2014	13	9.802	**9802**	1/20/2014	3.5	**3500**
4/30/2014	7.6	5.7304	**5730.4**	4/23/2014	14	**14000**
4/20/2015	16	12.064	**12064**	4/21/2015	6.6	**6600**
10/13/2015	1.9	1.4326	**1432.6**	10/13/2015	2.7	**2700**
1/19/2016	2.3	1.7342	**1734.2**	1/21/2016	4.8	**4800**
4/13/2016	1.4	1.0556	**1055.6**	4/12/2016	6.1	**6100**
7/12/2016	1.1	0.8294	**829.4**	7/11/2016	0.072	**72**
10/26/2016	1.9	1.4326	**1432.6**	10/26/2016	1.9	**1900**
2/6/2017	3.3	2.4882	**2488.2**	2/7/2017	2	**2000**
7/18/2017	1.1	0.8294	**829.4**	7/18/2017	3.8	**3800**
10/16/2017	3.6	2.7144	**2714.4**	10/17/2017	1.4	**1400**
DDC #2 System Groundwater Sample Date	PCE DDC-2-PD Water (µg/L)	PCE Calculated Air (µg/L)	**PCE Calculated Air (µg/m³)**	DDC #2 System Air Sample Date	PCE System Influent 1 Air (mg/m³)	**PCE System Influent 1 Air (µg/m³)**
7/15/2013	1.5	1.131	**1131**	7/16/2013	0.86	**860**
4/30/2014	2.2	1.6588	**1658.8**	4/23/2014	0.65	**650**
7/30/2014	2.3	1.7342	**1734.2**	7/24/2014	0.82	**820**
11/5/2014	3.9	2.9406	**2940.6**	10/29/2014	1.9	**1900**
1/14/2015	3	2.262	**2262**	1/15/2015	0.75	**750**
4/20/2015	3.1	2.3374	**2337.4**	4/21/2015	0.44	**440**
10/13/2015	1.5	1.131	**1131**	10/13/2015	0.2	**200**
1/19/2016	2.1	1.5834	**1583.4**	1/21/2016	0.27	**270**
4/13/2016	1	0.754	**754**	4/12/2016	0.67	**670**
7/12/2016	0.1	0.0754	**75.4**	7/11/2016	0.31	**310**
10/26/2016	1.3	0.9802	**980.2**	10/26/2016	0.22	**220**
2/6/2017	2.2	1.6588	**1658.8**	2/7/2017	0.38	**380**
7/17/2017	2.3	1.7342	**1734.2**	7/18/2017	0.3	**300**
10/17/2017	1.4	1.0556	**1055.6**	10/17/2017	0.24	**240**
3/19/2018	1.1	0.8294	**829.4**	3/20/2018	0.61	**610**
4/17/2018	2.2	1.6588	**1658.8**	4/16/2018	0.46	**460**
7/5/2018	1.1	0.8294	**829.4**	7/5/2018	1.4	**1400**
10/23/2018	0.1	0.0754	**75.4**	10/23/2018	1.7	**1700**
4/20/2021	2.3	1.7342	**1734.2**	4/19/2021	-	**62.4**
7/21/2021	1.7	1.2818	**1281.8**	7/21/2021	-	**155**

Notes:
PCE Henry's Law constant (Hc, dimensionless) = 0.754
PCE Calculated in Air (µg/L) = Hc / PCE in Water (µg/L)

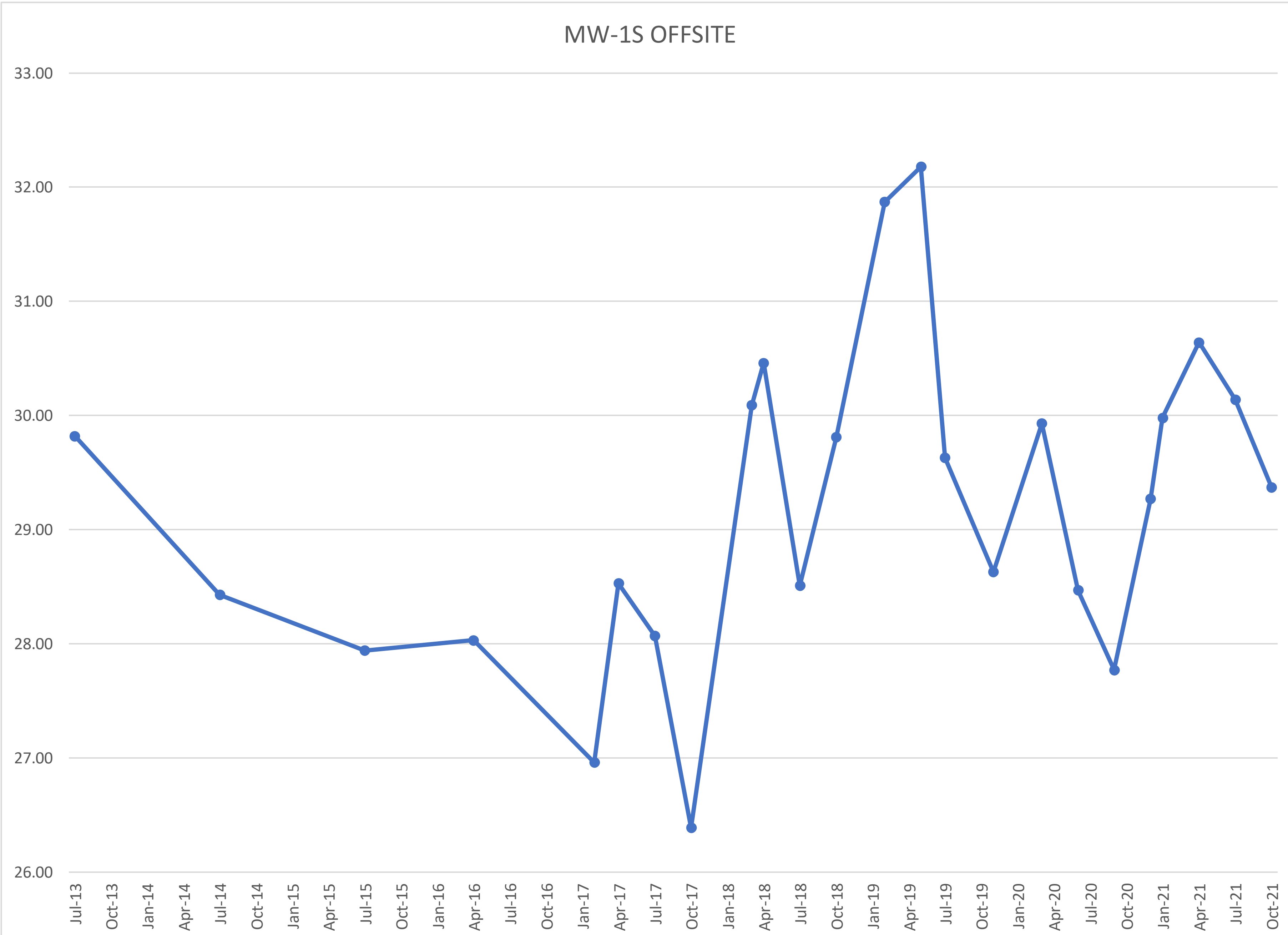
Attachment A

Groundwater Elevations Trend Graphs

This page left intentionally blank



MW-5S
46.00
45.00
44.00
43.00
42.00
41.00
40.00
39.00
38.00
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21



MW-1S OFFSITE
33.00
32.00
31.00
30.00
29.00
28.00
27.00
26.00
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21