FIFTH FIVE-YEAR REVIEW REPORT FOR COLESVILLE MUNICIPAL LANDFILL SUPERFUND SITE BROOME COUNTY, TOWN OF COLESVILLE, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

WQS	Water Quality Standards
CFR	Code of Federal Regulations
COC	Contaminant of concern
DCA	Dichloroethane
DCE	Dichloroethene
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
IRZ	In-Situ Reactive Zone
MCLs	Maximum Contaminant Levels
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and maintenance
OU	Operable Unit
PCE	Tetrachloroethene
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SMP	Site Management Plan
TCA	Trichloroethane
TCE	Trichloroethylene
TOC	Total Organic Carbon
µg/L	micrograms per liter
UU/UE	Unlimited Use/Unrestricted Exposure
VI	Vapor Intrusion
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act Section 121, consistent with the National Contingency Plan (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Colesville Municipal Landfill Superfund site. The triggering action for this statutory review is the completion date of the previous FYR, which was April 5, 2015. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The site is being addressed as a single operable unit (OU), which is the subject of this FYR.

This FYR was conducted by EPA remedial project manager George Jacob. Participants included Urszula Kinahan, EPA risk assessor; Rachel Griffiths, EPA hydrogeologist; Michael Clemetson, EPA ecological risk assessor; Michael Basile, EPA community involvement coordinator; and Payson Long of the New York State Department of Environmental Conservation (NYSDEC).

Site Background

The site is located in the Town of Colesville, Broome County, New York. The 113-acre property on which the 35-acre landfill is situated is bounded by East Windsor Road to the south and by unnamed tributaries of the Susquehanna River to the west-northwest (North Stream) and to the east (South Stream) (Figure 1). Both tributaries discharge to the Susquehanna River, which is located to the south of the landfill. The area surrounding the site includes undeveloped woodlands, as well as agricultural tracts and scattered residential parcels. Many of the residents of the Town of Colesville use private water supply wells. These wells utilize groundwater from both shallow and deep aquifers. Other homes utilize groundwater obtained from springs.

Six residential parcels were located to the south and southeast of the landfill (see Figure 2). Measures were taken to prevent human exposure to site contaminants at these parcels. These measures included Broome County's purchasing of four of the properties, implementation of environmental easements on the four properties, and installation of double-cased wells on the other two properties.

The landfill was owned and operated by the Town of Colesville between 1969 and 1971. Broome County purchased the landfill in 1971 and operated it until 1984 when it closed.

The landfill was primarily used for the disposal of municipal solid waste, although drummed

industrial wastes from various sources were also disposed of between 1973 and 1975. Operational records indicate that these drummed wastes consisted of aqueous dye waste and organic solvent waste. Known waste constituents included benzene, cyclohexane, acetone, isopropyl alcohol, methanol, ethanol, n-hexane, toluene, xylene, dimethyl ether, zinc, aluminum, iron, tin sulfate, and chloride. In practice, drummed wastes were randomly codisposed with the municipal solid wastes and disposed of in segregated areas. The drums were either buried intact or were punctured and crushed prior to burial.

Appendix A, attached, summarizes the documents utilized to prepare this FYR. Appendix B, attached, provides a chronology of site events. Appendix C, attached, summarizes the site's topography and geology/hydrogeology. For more details related to the site, please refer to www.epa.gov/superfund/colesville.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Colesville Municipal Landfill Superfund Site		
EPA ID: NYD980768691		
Region: 22	**State:** NY	**City/County:** Town of Colesville/Broome County Town of Colesville/Broome County

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: State ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): George Jacob
Author affiliation: EPA
Review period: 4/5/2015 - 2/26/2020
Date of site inspection: 10/3/2019
Type of review: Statutory
Review number: 5
Triggering action date: 4/5/2015
Due date *(five years after triggering action date)*: 4/5/2020

III. RESPONSE ACTION SUMMARY

Basis for Taking Action

The site was proposed for inclusion on the Superfund National Priorities List (NPL) in October 1984; it was listed on the NPL in June 1986. NYSDEC was designated the lead agency for this site.

In 1983, samples collected by the Broome County Health Department from residential wells in the vicinity of the site indicated that the Colesville Landfill was contaminating the groundwater beneath and in the immediate vicinity of the site. The sample results prompted the Broome County Department of Public Works to install carbon filters on the affected residences. Samples collected in 1983 indicated the presence of total volatile organics (VOCs) in the groundwater in the vicinity of the landfill ranging from 48 to 2,800 micrograms per liter (µg/l). Concentrations of VOCs in residential wells ranged from 32 µg/l to 415 µg/l.

In 1988, Wehran-New York (Wehran) completed a remedial investigation (RI)[1] at the site on behalf of the Broome County Department of Public Works and GAF Corporation, the Potentially Responsible Parties (PRPs), pursuant to an Order on Consent (Index No. T010687) issued by NYSDEC. The RI found that the landfill was releasing low levels of VOCs into the groundwater. Five VOCs were identified as the major contaminants in the contaminant plume--1,1-dichloroethane (1,1-DCA); 1,1,1-trichloroethane; trichloroethylene (TCE); cis-1,2-dichloroethene (cis-1,2-DCE); and benzene. In 1990, Wehran completed a feasibility study (FS).[2]

Possible human exposure pathways and media evaluated as part of the Baseline Human Health Risk Assessment (HHRA) included consumption of contaminated site groundwater and direct contact with contaminated soil and stream sediments near leachate seeps in the vicinity of the site. The results of the HHRA indicated that the carcinogenic risk (2.85×10^{-4}) and noncancer hazard (3.85) associated with exposure to potable well water at the site exceeded EPA's cancer risk range and non-cancer target threshold value of 10^{-6} to 10^{-4} and 1, respectively. Although the calculated risk of 7.41×10^{-6} associated with direct contact with leachate seep soils/sediments did not exceed EPA's risk range, the RI concluded that remediation of these seeps were warranted in order to minimize any future environmental impacts. No ecological risk assessment was performed as part of the 1988 RI.

Response Actions

Based upon the results of the RI/FS, in 1991, EPA signed a Record of Decision (ROD) for the site. The following remedial action objectives (RAOs) were identified in the ROD:

[1] An RI determines the nature and extent of contamination at a site and evaluates the risk to public health and the environment.

[2] An FS identifies and evaluates remedial alternatives to address the contamination at a site.

- Control the release of VOCs from the site to the glacial outwash aquifer that underlies the project area; properly close the landfill and eliminate leachate seeps and any associated leachate discharges to the North and South streams;
- Eliminate the potential for direct human or animal contact with any active leachate seeps;
- Continue the existing quarterly residential well monitoring program along with the temporary water supply and carbon filtration program for the affected residences until a new water supply is constructed; and
- Restore the groundwater underlying the site to levels consistent with state and federal Maximum Contaminant Levels (MCLs).

The major components of the selected remedy include the following:

- Installation of a multimedia cap on the landfill;
- Installation of a leachate collection system;
- Installation of groundwater extraction wells to contain the groundwater contamination;
- Collection of contaminated groundwater from beneath and downgradient of the landfill;
- Treatment of the extracted groundwater, using metals treatment and air stripping;
- Discharge of the treated water to surface water;
- Imposition of property deed restrictions, if necessary, to prevent the installation of drinking water wells at the site and to restrict activities which could affect the integrity of the cap; and
- Provision of new wells for affected residents in the vicinity of the site.

Status of Implementation

Pursuant to the above-referenced Order on Consent with NYSDEC, Wehran, on behalf of the PRPs, began the engineering design for the selected remedy in 1991. During the initial stages of the design, the PRPs' consultant performed extensive field work to collect additional data for the groundwater portion of the remedial design. By 1993, it was apparent that there were technical issues related to the groundwater extraction and treatment system that would not be easily or promptly resolved. It was, therefore, decided that the landfill cap design and the alternate water supply (double-cased deep wells) design should be completed separately from the groundwater extraction and treatment system design to allow the capping of the landfill and alternate water supply components of the remedy to proceed.

Landfill Cap

In 1994, Wehran completed the engineering design for the capping of the landfill and wetland restoration (creation of a new wetland to replace the three small wetland areas on the landfill's surface), The capping of the landfill and wetland restoration, performed by Tug Hill Construction, Inc., was completed in October 1995.

Alternate Water Supply

An alternate water supply well design (deep wells), which was prepared by Wehran, was approved by NYSDEC in 1995. Deep wells were only installed on two properties, as Broome County purchased the other affected properties.

Groundwater Remedy

Based upon design-related aquifer tests conducted at the site, it was determined that extracting contaminated groundwater at the landfill, as called for in the ROD, would not likely be an effective means of remediating the groundwater at the source in a reasonable time frame. Specifically, the aquifer tests determined that the aquifer near the landfill has a low permeability, which would severely limit the area of influence of the extraction wells and would allow the groundwater to be pumped at only a very low rate (0.25 to 0.5 gallon per minute). Such conditions would necessitate the installation of an inordinate number of extraction wells. This conclusion led to an evaluation of alternative groundwater technologies and the performance of an in-situ reactive zone (IRZ) pilot-scale study to evaluate the effectiveness of one of the more promising technologies, enhanced reductive dechlorination. This process involves injecting the contaminated groundwater with an easily degradable carbohydrate solution (*e.g.,* molasses), which provides excess organic carbon that promotes microbial activity in the aquifer, enhancing the breakdown of chlorinated VOCs. Based upon the results of the pilot study, which showed a significant decline in VOC concentrations, it was concluded that this technology, in combination with the installation of downgradient extraction wells (as called for in the ROD), offered the most technically feasible approach to restoring groundwater quality in a reasonable time frame. This change to the remedy was documented in a September 2000 Explanation of Significant Differences (ESD).

In 2001, while the groundwater remedy was under construction, GAF Corporation declared bankruptcy. Subsequently, NYSDEC and Broome County negotiated a new Order on Consent under which the remaining work was completed.

The groundwater management system, constructed by Clean Earth Technologies, Inc. became operational in 2002. It consists of 17 automated reagent injection wells, three groundwater recovery wells, and an on-site groundwater treatment system.

Additional Remedial Measures

In April 2000, during an inspection of the site performed as part of the FYR process, EPA inspected a low-lying wet area and a spring on south side of the landfill in the vicinity of spring location SP-5 (see Figure 3). Sample results indicated that these areas were contaminated with site-related contaminants that exceeded NYSDEC's Ambient Water Quality Values. The source of the low-lying wet area was groundwater discharging upward through a vertical, three-foot diameter concrete structure that extends approximately 2.5 feet below the ground surface. The concrete structure appears to have been placed there to enhance the spring as a source of water. Until the contamination was detected, the opening of this structure was partially buried and obscured by dense vegetation. Since contaminated water from the spring and the low-lying wet area could potentially discharge to nearby streams, remedial measures to address these areas were undertaken in September 2003 and July 2004, respectively. The remedy for the low-lying wet area

consisted of a sand filter and a granular activated carbon unit that were placed in the concrete structure (a cover was placed over the top of the structure). The water then flows through a horizontal 4-inch diameter drainage pipe running through the side of the concrete structure. A riprap-lined outlet structure to prevent erosion was installed at the discharge point of the drainage pipe. This system is referred to as the "SP-5 Spring Water Remediation System."

Along the bank of the North Stream, which is as close as 100 to 200 feet to the west of the landfill in some areas, was a spring (SP-4) at the toe of a steep slope that could discharge directly to the stream. The SP-4 remedy consisted of a subsurface stone infiltration bed in the area of the spring which prevents the contaminated spring water from exfiltrating above the land surface. Large boulders were placed between the stream and the infiltration bed to protect the integrity of the infiltration bed during high water conditions. These actions, which were performed by Arcadis, were documented in a July 2004 ESD. The SP-4 remedy resulted in a significant improvement from pre-remediation conditions, with only intermittent minor exfiltration of the spring water occurring in high water conditions, currently.

In an October 2016 ESD, EPA documented the need for an institutional control (IC)[3] to address the potential for vapor intrusion (VI) in the area. The IC requires VI sampling to determine whether this pathway is of concern if buildings are constructed in this area in the future or if the nearby vacant houses are occupied, is needed. To that end, letters were sent by EPA to the Broome County Department of Public Works and the Town of Coleville Office of Code Enforcement indicating that EPA and NYSDEC should be contacted prior to the approval of any building permits or Certificates of Occupancy for the residential properties in the vicinity of the site that do not have environmental easements and restrictive covenants. Periodic reminders will continue to be issued to these agencies. The initial notifications and the subsequent reminders constitute an IC. The IC will remain in place until VI is no longer a viable exposure pathway.

Institutional Controls Summary Table

Table 1, below, summarizes the status of the ICs.

Table 1: Summary of Planned and/or Implemented Institutional Controls

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater and Soil	Yes	Yes	Landfill properties	Protect the integrity of remedy or cause the contaminants to migrate without the express written approval of NYSDEC and EPA and prohibits the installation of	Declaration of Restrictive Covenants; March 19, 2014

[3] ICs are non-engineered controls, such as property or groundwater use restrictions imposed by a property owner by recorded instrument or by a governmental body by law or regulatory activity for the purpose of reducing or eliminating the potential for human exposure to contamination and/or protect the integrity of a remedy.

				drinking water wells on the landfill property and the use of the underlying groundwater for potable or process water.	
Groundwater	Yes	Yes	Two residential properties	Restrict installation of groundwater wells and groundwater	Declaration of Restrictive Covenants; February 13, 2015
Soil Vapor Intrusion	Yes	Yes	Four residential properties	Prevent the VI pathway, if buildings are constructed in future	May 7, 2015 letters to the Broome County Department of Public Works and the Town of Coleville Office of Code Enforcement indicating that EPA and the NYSDEC should be contacted prior to the approval of any building permits or Certificates of Occupancy for the residential properties in the vicinity of the site that are not included in the environmental easements and restrictive covenants.

Systems Operations/Operation & Maintenance

To maintain the integrity and effectiveness of the cap, routine operation and maintenance (O&M) activities are necessary. The inspection/maintenance plan for the cap calls for regular inspection and evaluation of the cap, mowing the vegetation during the growing season, and fence maintenance. Repairs are to be made to the cap, as necessary, to control the effects of settling, subsidence, erosion or other events, and to prevent run-on from eroding or otherwise damaging the final cover. The inspection/maintenance plan has been modified to incorporate long-term groundwater monitoring, the molasses injections, the O&M of the groundwater extraction and treatment facility, and the maintenance of the SP-5 Spring Water Remediation System.

The site is inspected on an annual basis as follows:

- the site is inspected for debris, litter, waste and vandalism;

- the landfill cap is inspected for vegetation loss due to erosion or poor grass growth; annual ground inspections note stressed or undesirable species of vegetation on the landfill surface and side slopes;
- the landfill property is visually inspected for leachate outbreaks (precipitates on the ground surface, intermittent seeps, or soft spots);
- the landfill cap is inspected for cracks, settlement, erosion and deposition, ponding, and animal borrows;
- the gas venting pipes are inspected for damage;
- the site access gate and fence are inspected for operational locks and vandalism;
- the culverts, drainage ditches, and settlement gauges are inspected for sediment buildup or erosion; and
- the groundwater monitoring wells are inspected for operational locks, damage, and vandalism.

Currently, there are 25 groundwater monitoring wells at the site. Groundwater monitoring is performed every fifth quarter using 14 of the monitoring wells. The samples are analyzed for VOCs and metals, while a subset (typically 9 wells) are also analyzed for monitored natural attenuation parameters (*i.e.,* dissolved gases such as ethene, ethane and methane), alternate electron acceptors, and total organic carbon (TOC).

Emerging contaminants sampling was performed in March 2017; seven monitoring locations were analyzed for 1,4-dioxane and per- and poly-fluorinated alkyl substances (PFAS).[4]

Spring water sampling and sediment and surface water sampling are on a semiannual sampling schedule. An annual O&M report that is submitted by the PRP includes a summary of the results of the sampling and findings of the inspections, along with a certification that remedy-related O&M is being performed.

The groundwater extraction and treatment system operated and molasses injections were performed every three months until September 2012. From October 2012 through September 2019, the groundwater was monitored while the molasses injections and the groundwater extraction and treatment system were dormant to evaluate the behavior of site contaminants in natural conditions (In-Situ Reactive Zone Discontinuation Pilot Study). Based on contaminant of concern (COC) trends observed during the pilot study (*i.e.,* increasing levels of contaminants in several monitoring wells), it was decided that substrate injections (molasses) would resume in September 2019 and continue on an "as needed" basis. Contaminant concentrations and geochemistry following the September 2019 injections are to be monitored and used as a primary trigger to initiate future molasses injection events. The secondary trigger for a future injection is to be based on contaminant trends (*i.e.,* if concentrations are not decreasing or persist above MCLs). The groundwater extraction and treatment system remains off but is maintained should it be needed in the future.

Consistent with NYSDEC requirements associated with effecting a Declaration of Covenants and Restrictions and Environmental Easement, the County prepared a site management plan (SMP) in

[4] PFAS are a group of man-made chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS).

2014. The SMP provides for the proper management of all post-construction remedy components, including monitoring.

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site.

II. PROGRESS SINCE THE LAST REVIEW

The protectiveness determinations from the last FYR are summarized in Table 2, below.

Table 2: Protectiveness Determinations/Statements from the 2015 FYR

OU #	Protectiveness Determination	Protectiveness Statement
01	Short-term Protective	The OU1 remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented the remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order for the remedy to be protective in the long-term, natural attenuation parameters need to be evaluated to determine if natural attenuation is occurring, the continuing contaminant contributions from the springs into the stream need to be evaluated, North Stream sediment sampling/scraping needs to continue and technologies need to be evaluated to address increasing groundwater contaminant concentrations in the vicinity of landfill perimeter well PW-7.
Sitewide	Short-term Protective	The sitewide remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented the remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order for the remedy to be protective in the long-term, natural attenuation parameters need to be evaluated to determine if natural attenuation is occurring, the continuing contaminant contributions from the springs into the stream need to be evaluated, North Stream sediment sampling/scraping needs to continue and technologies need to be evaluated to address increasing groundwater contaminant concentrations in the vicinity of landfill perimeter well PW-7.

The previous FYR had several recommendations. The status of the recommendations is summarized in Table 3, below.

Table 3: Status of Recommendations from the 2015 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
01	A pilot study is underway to evaluate the effects of terminating the operation of the groundwater extraction and treatment, and molasses injections.	Complete the pilot study and submit a report containing recommendations to the Agencies	Completed	The In-Situ Reactive Zone Discontinuation Pilot Study was completed. Based on COC trends observed during the pilot study (*i.e.,* increasing levels of contaminants in several monitoring wells), it was decided that substrate injections (molasses) would resume in September 2019 and continue on an "as needed" basis (based on post injection sampling results).	9/15/2015
01	Natural attenuation parameters are not being evaluated in the downgradient monitoring wells.	Conduct a full evaluation of the extent of natural attenuation parameters in the downgradient monitoring wells.	Completed	Sampling for natural attenuation parameters in downgradient monitoring wells was conducted. It was determined that the natural attenuation capacity of the aquifer is not sufficient to continue VOC degradation on its own. Thus, the decision was made to resume adding substrates to the aquifer to promote degradation.	11/6/2017
01	Monitoring results indicate contaminant contributions from the springs into the stream.	Include seep, surface water, sediment sampling and sediment scraping in the site management plan.	Completed	The site management plan was updated to include seep, surface water, sediment sampling.	11/6/2017
01	Groundwater contaminant concentrations are increasing in landfill perimeter well PW-7, which	Evaluate technologies to contain or remediate groundwater contamination in the vicinity of this well.	Completed	A sampling program was implemented to further assess groundwater quality trends in PW-7. Based on four sampling events since September 2014, it was concluded	11/6/2017

	is upgradient of the seep impacting the North Stream.			that current contaminant concentration trends do not warrant further action.	
01	A recently-implemented IC requiring VI sampling if, in the future, buildings are constructed on-site in an area where elevated VOC groundwater contamination is present or if nearby vacate houses are reoccupied is not part of the selected remedy for the site.	An IC requiring VI sampling if, in the future, buildings are constructed on-site where elevated VOC groundwater contamination is present or if nearby vacate houses are reoccupied needs to be incorporated into the remedy via an ESD.	Completed	An ESD to incorporate a vapor intrusion informational IC into the remedy was issued.	10/10/2016

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On October 1, 2019, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, Puerto Rico and the U.S Virgin Islands including the Colesville Municipal Landfill Superfund site. The announcement can be found at the following web address: https://www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, a notice of the commencement of the FYR was sent to local public officials. The notice was provided to the town of Colesville by email on August 19, 2019, with a request that the notice be posted in public areas in the town hall. The purpose of the public notice was to inform the community that the EPA would be conducting a FYR to ensure that the remedy implemented at the site remains protective of public health and is functioning as designed. In addition, the notice included contact information, including addresses and telephone numbers, for questions related to the FYR process or the site.

Once the FYR is completed, the results of the review and the FYR report will be made available online (https://www.epa.gov/superfund/colesville-landfill) and at the site information repositories. The information repositories are maintained at the Town of Colesville Town Hall, Harpursville,

New York and the EPA Region 2 Superfund Records Center, 290 Broadway, 18th Floor, New York, New York.

Data Review

Groundwater

During this review period, groundwater samples were collected in December 2015, March 2017, and June/July 2018, while the groundwater remedy was not operating. Groundwater monitoring data exceeded the NYSDEC Water Quality Standards (WQS) for a number of site-related VOCs. The reoccurring highest levels of VOCs include TCE, cis-1,2-DCE, 1,1-DCA, chloroethane, and chlorobenzene which all have an NYSDEC WQS of 5 micrograms per liter (µg/L), and benzene, which has an NYSDEC WQS of 1 µg/L. Sitewide, contaminant concentrations and the areal extent of contamination has greatly reduced since the implementation of the remedy in 2002 (see Figures 4 and 5).

Emerging contaminants sampling occurred in March 2017 at seven monitoring locations. No PFAS compounds were detected above the EPA Health Advisory Level of 70 nanograms per liter (ng/L). Additionally, the screening value of 0.040 µg/L from the December 19, 2019 "Interim Recommendations to Address Groundwater Contaminated with Perfluorooctanoic Acid and Perfluorooctanesulfonate (OLEM Directive No 9283.1-47)," was not exceeded, with the maximum detected PFAS concentration being 9.8 ng/L of PFOA at monitoring well GMMW-06. The maximum detected concentration of 1,4-dioxane was 1.9 µg/L at monitoring well GMMW-06. Emerging contaminants were not detected in downgradient deep bedrock residential wells.

Because the site covers a large area and there is a radial component to groundwater flow toward the west, southwest, and south toward the discharge boundaries of the North Stream and the Susquehanna River, groundwater conditions are assessed according to locations of monitoring wells. Mid-plume monitoring wells are situated closest to the former injection activities, former recovery wells are situated downgradient of the mid-plume monitoring wells, plume boundary wells are located downgradient and south of the former recovery wells, off-site monitoring wells are serving as sentinel wells are situated downgradient of the southern boundary of the landfill, and perimeter wells are situated along the outer edges of the landfill (see Figure 1).

Mid-Plume Monitoring Wells

Historically, the highest levels of VOCs have been detected in the mid-plume monitoring wells. For this reason, this area was designated for molasses injections. These monitoring wells include GMMW-2, GMMW-5, GMMW-6, PW-3, PW-4, and PW-5.

Overall, the parent compounds, tetrachloroethylene (PCE) and 1,1,1-trichloroethane (TCA), were at low concentrations and were consistently below their respective NYSDEC WQS of 5 µg/L during the review period. Daughter products of both parent compounds were more persistent over the last five years of monitoring. PCE degradation compounds (*i.e.,* TCE, 1,2-DCE) and 1,1,1-TCA degradation compounds (*i.e.,* 1,1-DCA, chloroethane) are present in all the monitoring wells

except PW-05, which has been non-detect for all COCs since 2012. The maximum concentrations of PCE degradation compounds were found in monitoring well GMMW-2 (1,2-DCA at 50 µg/L in March 2017; the NYSDEC WQS is 5 µg/L as shown on Figure 6). The maximum concentrations of 1,1,1-TCA degradation compounds were found in monitoring well GMMW-6 (chloroethane at 200 µg/L in March 2017) as shown on Figure 7. Concentration trends at monitoring well PW-4 increased during the Discontinuation Pilot Study and peaked in 2016, as shown on Figure 8. Though the total concentrations were lower than other mid-plume monitoring locations, the increasing trend suggested the downgradient migration of COCs and was a contributing justification for resuming molasses injections.

Additionally, ethene and ethane are present in all of the monitoring wells, indicating that complete reductive dechlorination is occurring in this portion of the site. Although ethene and ethane are present, samples over the last five years show declining TOC concentrations in injection wells and monitoring wells situated in this reduction zone in absence of the molasses injections. TOC levels are below the 20 milligrams per liter, a level that is recommended to support enhanced reductive dechlorination on a long-term basis. It was determined that the natural attenuation capacity of the aquifer is not sufficient to continue VOC degradation on its own, thus, the decision was made to resume adding substrates to the aquifer to promote degradation. Though total COC concentrations have decreased since the remedy was enacted in 2002, trends have fluctuated during this period and many locations appeared to have an increasing trend until 2018.

Recovery Wells

The recovery wells were not pumping during the Discontinuation Pilot Study. These wells instead served as monitoring wells. The recovery wells with data from the last five years include GMPW-4 and GMPW-5, which are further downgradient than the wells discussed above. GMPW-5 was last sampled in December 2015, after three years of no detections. Concentrations at GMPW-4 displayed an increasing trend of total COCs for the duration of the Discontinuation Pilot Study, peaking in 2014. During the review period, the maximum concentration of cis-1,2-DCE was 14 µg/L and 1,1-DCA was 34 µg/L, both in March 2017. Concentrations of 1,1,1-TCA were below the NYSDEC WQS during the review period. Chloroethane was a maximum of 15 µg/L in December 2015. TCE ranges from 16 µg/L in July 2018 to 32 µg/L in December 2015. Chlorobenzene ranged from 6.5 µg/L in July 2018 to 14 µg/L in March 2017. The increasing trend observed at GMPW-4 (see Figure 9) suggested possible downgradient migration of COCs and was a contributing justification for the decision to resume molasses injections.

Plume Boundary Wells

The area downgradient of the recovery wells is monitored by the monitoring wells W-16S, W-17S, and W-18. While plume boundary wells W-16S and W-17S are sidegradient of the contamination and have shown only low levels of site-related contaminants, monitoring well W-18 has recently shown PCE-related daughter products at concentrations exceeding their respective NYSDEC groundwater criteria and no clear data trend is evident (see Figure 10). Concentrations of chlorobenzene and 1,2-DCA in monitoring well W-16S remain above their NYSDEC WQS of 5 µg/L, with maximum concentrations of 24 µg/L in June 2018 and 11 µg/L in March 2017, respectively. Chlorobenzene showed an increasing trend at this location throughout the Discontinuation Pilot Study. No VOCs exceeded their NYSDEC WQS in monitoring well W-17S

and the majority of results were non-detect. At monitoring well W-18, the concentrations of 1,1-DCA, cis-1,2-DCE, and TCE exceeded their NYSDEC WQS of 5 µg/L throughout the Discontinuation Pilot Study, but as of the June 2018 sampling event, were at their lowest levels at 5.9 µg/L, 6.7 µg/L, and 9.3 µg/L, respectively.

Downgradient Wells

Monitoring well W-20S is situated downgradient of the south side of the landfill and serves as a sentinel well. It has shown no exceedances of site-related contaminants.

Landfill Perimeter Wells

Landfill perimeter wells are located along the outer edges of the landfill. Monitoring well W-7 is located along the south side of the landfill and sidegradient of where the groundwater contaminant plumes have been identified in the mid-plume area. This monitoring well had not shown any exceedances of site-related contaminants until 2015, when concentrations of chlorobenzene were detected at 5.2 µg/L and again in 2017 at 7.2 µg/L. Monitoring well GMMW-7 is located along the southwest landfill boundary, upgradient of the injection activities. COC concentrations at this location spiked in 2012 at the beginning of the Discontinuation Pilot Study, but decreased during the review period (see Figure 11). Monitoring well PW-7 is situated along the northwest boundary of the landfill, upgradient of where the injections occurred. Concentrations of VOCs at monitoring well PW-7 have been sporadic, first demonstrating a significant increase in 2011 that persisted until 2015 as shown on Figure 12. During the review period, concentrations trends have somewhat stabilized with 1,1-DCA, chlorobenzene, chloroethane, cis-1,2-DCE, and TCE remaining above their NYSDEC WQS of 5 µg/L. Of the detected COCs, concentrations of 1,1-DCA were the highest, peaking at 48 µg/L in 2017.

Surface Water and Sediment Monitoring

Surface water samples were collected at locations SW-2, SW-3, SW-4, and F-6 locations (see Figure 3) during the review period. Surface water samples were collected as direct grab samples from the North Stream at areas collocated with the spring samples, and at a location further downgradient of the springs (F-6) in accordance with the SMP. Surface water samples were collected and analyzed by ALS Laboratory for VOCs and metals and field analyzed for dissolved oxygen, specific conductance, pH, oxidation- reduction potential, temperature, and turbidity.
VOC and metals concentrations in surface water in the vicinity of the SP-5 Spring Water Remediation System continue to be low or non-detect and consistent with historical data, despite the presence of VOCs and metals in the spring water.

Sediment samples were collected during the monitoring events where the SP-3 spring exfiltrates from the large riprap area onto the stream bank. Sediment samples collected at the SP-3 area during the review period were generally consistent with the background sediment sample for most metals, with the exception of arsenic.

In the vicinity of the SP-5 Spring Water Remediation System, sediment quality results during July and December 2018 were significantly improved in comparison with the June 2018 data. Lower

metals concentrations were detected; this is most likely attributable to the lower percent moisture content in the July and December samples. The results of a sediment sample collected in December 2018 show concentrations that are consistent Class A sediment (low risk to aquatic life).

Spring Water Monitoring

Spring water samples were collected as grab samples at locations SP-2, SP-3, and SP-4 during the review period. The samples were analyzed for VOCs and total metals and field analyzed for specific conductance, pH, oxidation-reduction potential, temperature and turbidity. In addition, a spring water inspection was completed during sampling events to evaluate the presence and appearance/condition of existing springs. A number of VOCs were detected at the SP-2 spring water location in May 2017 at relatively low concentrations (*i.e.,* < 7.4 µg/L), with the exception of a 20 µg/L detection of DCA. The results at SP-2 in May 2017 were atypical in comparison with the low-level concentrations that are typically observed during previous sampling events since 2012. VOC concentrations at the SP-3 and SP-4 spring water locations have been relatively stable in terms of the compounds present and concentration trend since discontinuation of IRZ injections.

At the SP-5 Spring Water Remediation System, the concentration of VOCs generally decreased during the review period when compared with historical data. Overall, the VOC concentrations at SP-5 decreased in conjunction with lower concentrations in the site groundwater and in response to active biodegradation processes that will be sustained with continued IRZ injections.

Site Inspection

A FYR inspection of the site was conducted on October 3, 2019. In attendance were George Jacob and Urszula Kinahan from EPA, Jeffrey Dyber and Payson Long from NYSDEC, Debra Smith, Laurie Haskell, and Richard Hand from Broome County, and Steven Feldman from Arcadis. The purpose of the inspection was to assess the protectiveness of the remedy.

No issues were observed during the inspection, impacting current and/or future protectiveness. The cap and vegetative cover are intact and in good condition; the fence around the cap within the site is intact and in good repair; the monitoring wells are functional; and there is no evidence of trespassing or vandalism;

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

The remedy selected in the ROD, as modified by the ESDs, calls for the capping of the landfill, leachate collection, molasses injections near the landfill, downgradient contaminated groundwater collection and treatment, imposition of property deed restrictions, if necessary, to prevent the installation of drinking water wells at the site and to restrict activities which could affect the integrity of the cap, and an IC requiring VI sampling if, in the future, buildings are constructed on-

site where elevated VOC groundwater contamination is present or if nearby vacate houses are reoccupied.

In October 2012, the extraction wells were shut down and molasses injections were discontinued to conduct an In-Situ Reactive Zone Discontinuation Pilot Study. The study ended in October 2014 and a report was submitted in September 2015. Based upon its review of the results of the pilot study, EPA concluded that the natural attenuation capacity of the aquifer was not sufficient on its own to degrade the COCs and that resuming molasses injections would enhance the naturally-occuring biodegradation of site contaminants to help the site groundwater achieve Applicable or Relevant and Appropriate Requirements. The PRPs resumed the molasses injections in September 2019.

Sitewide, contaminant concentrations and the areal extent of contamination has greatly reduced since the implementation of the remedy in 2002; however, exceedances exist in the mid-plume, recovery and plume boundary wells. During the Discontinuation Pilot Study, some wells exhibited increasing concentrations as the geochemical and biological effects of the previous molasses injections wore off. It is expected that the injections will encourage further degradation in site wells and reduce contaminant concentrations. Monitoring will confirm this and be used to determine whether additional injections are necessary. ICs are in place and the sentinel well shows no detections.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The exposure assumptions and toxicity data used to estimate potential risks and hazards to human health followed general risk assessment practices at the time the risk assessment was conducted. Although the risk assessment process has since been updated, and specific parameters and toxicity values may have changed, the risk assessment process that was used is consistent with current practice and the need to implement the remedial action remains valid.

As called for in the ROD, a multimedia cap was constructed over the landfill which has effectively eliminated the potential for direct contact exposures to landfill materials. In addition, a fence is present around the perimeter of the site to further restrict unauthorized access and help protect the integrity of the cap.

As for potential groundwater exposures, the nearest residences in the vicinity of the site have either been demolished, vacated, or are currently using a double-cased bedrock well. Analytical results collected from the two residential bedrock wells in the vicinity of the site do not show any exceedances of VOCs above state and federal MCLs. These wells were also sampled and analyzed for 1,4-dioxane and PFAS, including PFOA and PFOS. 1,4-dioxane and PFOS were not detected in any of the wells. Low levels of PFOA were found ranging from non-detect to 1 ng/L. These concentrations are well below current levels of concern. Ongoing site-wide groundwater monitoring continues to ensure contamination emanating from the landfill is not impacting nearby potable wells. Furthermore, environmental easements preventing the installation and use of groundwater wells on nearby residential properties are in place, ensuring future use of groundwater is also an incomplete exposure pathway.

The RAOs identified in the decision documents and remain valid for the site.

The groundwater cleanup goals selected at the time of the ROD were the more stringent of state and federal MCLs. Although some of the NYSDEC groundwater quality standards have changed since the time of the decision document, most notably those for 1,2-DCA 1,1-DCE, and benzene, the ROD-established cleanup levels remain protective of human health.

The soil vapor intrusion (VI) into indoor air pathway was not evaluated in the original risk assessment, however based on recommendations from previous FYRs this evaluation was conducted in 2008. Based on the sampling results of the VI evaluation, the previous FYR concluded that if structures were to be built downgradient of the landfill, the VI pathway could be of concern. Consistent with previous FYRs, this determination remains valid for the current review period, however, because no buildings are currently occupied in the immediate area of the elevated sample location, this pathway remains incomplete. An ESD, signed in 2016, documented EPA's determination that to ensure protectiveness of the selected remedy, an IC requiring a VI investigation in the event that buildings are constructed in the vicinity of the site or if currently vacant houses are reoccupied is needed. This IC ensures that the VI pathway remains incomplete in the current and future timeframes.

Although the ecological risk assessment screening and toxicity values used to support the 1991 ROD may not necessarily reflect the current values, the landfill cap eliminates any potential risk from surface soil contaminants to terrestrial receptors. Any potential ecological risks associated with the North Stream have been addressed by sediment excavations conducted by Broome County officials. The North Stream sediment sampling scraping should continue.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No

VI. ISSUES/RECOMMENDATIONS

Table 4, below, notes that there are no recommendations or follow-up actions for this FYR.

Table 4: Issues and Recommendations

Issues/Recommendations	
OU(s) without Issues/Recommendations Identified in the Five-Year Review:	
OU1	
Issues and Recommendations Identified in the Five-Year Review:	
OU(s): **OU1**	**Issue Category: Remedy Performance** Remedy Performance

	Issue: A number of wells that monitor the migration of the plume continue to show exceedances of WQS. Some of the monitoring wells have increasing trends. As a result, molasses injections were restarted in September 2019. It is expected that the injections will encourage further contaminant degredation and reduce contaminant concentrations. Monitoring will confirm this and will be used to determine whether additional molasses injections are necessary.			
	Recommendation: Monitor trends to determine whether contaminant concentrations are decreasing and whether additional molasses injections are necessary.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	12/30/2022

OTHER FINDINGS

There are no other findings for this FYR.

VII. PROTECTIVENESS STATEMENT

Table 5, below, presents the operable unit and sitewide protectiveness statements.

Table 5: Protectiveness Statements

Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The OU1 remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order to be protective in the long-term, contaminant trends need to be evaluated to determine whether concentrations are decreasing and whether additional injections are necessary.		
Sitewide Protectiveness Statement		
Protectiveness Determination: Short-term Protective		*Planned Addendum Completion Date:* Click here to enter a date

Protectiveness Statement: The sitewide remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order to be protective in the long-term, contaminant trends need to be evaluated to determine whether concentrations are decreasing and whether additional injections are necessary.

VIII. NEXT REVIEW

The next FYR report for the Colesville Municipal Landfill Superfund site is required five years from the completion date of this review.

APPENDIX A – DOCUMENTS, DATA, AND INFORMATION REVIEWED IN COMPLETING FIVE YEAR REVIEW

Documents, Data, and Information Reviewed in Completing Five-Year Review	
Table 4: Documents, Data, and Information Reviewed in Completing Five Year Review	
Remedial Investigation/Feasibility Study, Wehran Engineering	1990
Record of Decision, EPA	1991
Operation and Maintenance Monitoring Manual, Arcadis	1994
Groundwater Remediation System Engineering Report, Arcadis	2000
First Five-Year Review Report, EPA	2000
Explanation of Significant Differences, EPA	2000
LTM (Long Term Monitoring) Plan, Arcadis	2002
Spring Remedy, Arcadis	2003
Explanation of Significant Differences, EPA	2004
Preliminary Close-Out Report, EPA	2004
Interim Remedial Action Report, Arcadis	2004
Annual Monitoring Reports, Arcadis	2009-2014
Second Five Year Review Report, EPA	2005
Third Five Year Review Report, EPA	2010
Plume Delineation Report, Arcadis	2012
DCR&EE, EPA, NYSDEC	2014
Sediment Report, Arcadis	2014
Third Five Year Review Report Addendum, EPA	2014
Fourth Five Year Review Report, EPA	2015
In-Situ Reactive Zone Discontinuation Pilot Study Report	2015
Annual Reports	2015-2020
EPA guidance for conducting five-year reviews and other guidance and regulations to determine if any new Applicable or Relevant and Appropriate Requirements relating to the protectiveness of the remedy have been developed since EPA issued the ROD.	

APPENDIX B: CHRONOLOGY OF SITE EVENTS

Chronology of Site Events	
Event	Date
Landfill Operations	1969 1984
Samples collected by Broome County Health Department from residential wells in the vicinity of site indicate that landfill contaminating groundwater	1983
Site is placed on NPL	1986
ROD signed	1991
Landfill Cap Remedial Design	1991 1994
Landfill Cap Remedial Action	1995
Alternate Water Supply Well Remedial Design approved by NYSDEC	1995
Explanation of Significant Differences by EPA	2000
Groundwater Remedial Design	2000-2004
First Five Year Review conducted	2000
Alternate Water Supply Well Remedial Action	2002
Groundwater Remedial Action	2002-2004
Explanation of Significant Differences by EPA	2004
Preliminary Site Close Out Report	2004
Second Five-Year Review conducted	2005
Subsurface stone infiltration bed damaged during flood event	2006
Infiltration bed repaired and extended and stone retaining wall	2006
Soil Vapor evaluation performed	2008
Third Five-Year Review conducted	2010
Plume delineation report submitted	2012
Institutional Controls implemented at the Landfill	2014
Third Five-Year Review Report Addendum completed	2014
Institutional Controls implemented at the affected private parcel	2015
Fourth Five Year Review conducted	2015
In-Situ Reactive Zone Discontinuation Pilot Study	2012-2015
Molasses injections restarted	2019

Residential Property Distribution

Property	Property Distance from Landfill (ft.)	Occupancy Status	Environmental Easement?	Double-Cased Well?
Property 1	400	Demolished	Yes	N/A
Property 2	1,140	Vacant	Yes	No
Property 3	560	Vacant	Yes	No
Property 4	900	Occupied	No	Yes
Property 5	1,240	Vacant	No	Yes
Property 6	2,000	Demolished	Yes	N/A

APPENDIX C: SITE TOPOGRAPHY, GEOLOGY, AND HYDROGEOLOGY

Site Geology/Hydrogeology

The Colesville Landfill Superfund site is characterized as rural and includes large tracts of undeveloped woodlands, as well as agricultural tracts and scattered residential parcels. Of the 113 acres on which the site is situated, the landfill occupies approximately 35 acres. The property's topography ranges from approximately 1,400 feet above mean sea level in the east to about 970 feet above mean sea level in the west.

Surface water drainage at the site is via two tributaries of the Susquehanna River—the North Stream and the South Stream. The North Stream, located to the north and west of the landfill, flows southwesterly to the Susquehanna River. To the east and south of the landfill is the South Stream, which flows to the south-southwest into a low-lying wet area. Both tributaries join the Susquehanna River approximately 0.5 miles north of Doraville.

The Susquehanna River is classified as Class B surface water in the vicinity of the site. Class B waters are suitable for both primary1 and secondary2 contact recreation, as well as for fish propagation. The North Stream and South Stream are Class C and D waters, respectively. These waters are suitable for secondary contact recreation and fish propagation only.

Vegetation patterns at the site are a mixture of herbaceous field, weed, and grass species. Both open-field and forested habitats characterize the surrounding area. These habitats support a large variety of avian and mammalian species. No New York State Department of Environmental Conservation (NYSDEC) Significant Habitat Areas are found on-site, although the site is located within the range of several migratory endangered or threatened species. The predominant aquatic species found in the Susquehanna River include small mouth bass, rock bass, and white suckers.

Glacial outwash deposits at the site consist of a heterogeneous mixture of gravel, sand, clay and silt. The average hydraulic conductivity of these materials is approximately 0.3 feet per day. Water moving within the glacial outwash aquifer beneath the landfill is part of a shallow groundwater subsystem that discharges into nearby surface-water bodies. In this type of hydrogeologic setting, essentially all of the areal recharge to the glacial outwash aquifer moves horizontally because of the dense glaciolacustrine clay confining unit that underlies the glacial outwash aquifer. The direction of groundwater flow at the Colesville Landfill site is toward the west, southwest, and south discharging to the North Stream and Susquehanna River. Although groundwater is present in the till and glaciolacustrine clay, the low permeabilities of these units limit their potential for groundwater flow. A very small portion of the base flow to the Susquehanna River is derived from groundwater flow moving upward from the bedrock aquifer, through the glaciolacustrine clay into the overlying glacial outwash aquifer, where it ultimately seeps into the Susquehanna River.

The area surrounding the site includes large tracts of undeveloped woodlands, as well as agricultural tracts and scattered residential parcels.

Many of the residents of the Town of Colesville use private water supply wells. These wells utilize groundwater from both shallow and deep aquifers. Other homes utilize groundwater obtained from springs.

The nearest residential parcels to the landfill are located to the south and southeast along East Windsor Road. Measures have been taken at six properties that are impacted by site contamination to prevent human exposure to site contaminants. The measures included purchase by Broome County, implementation of environmental easements and installation of double-cased wells. Table 2 provides the status of the six properties and Figure 2 shows the locations of the properties on a Tax Map.

Figure 1: Site Location Map

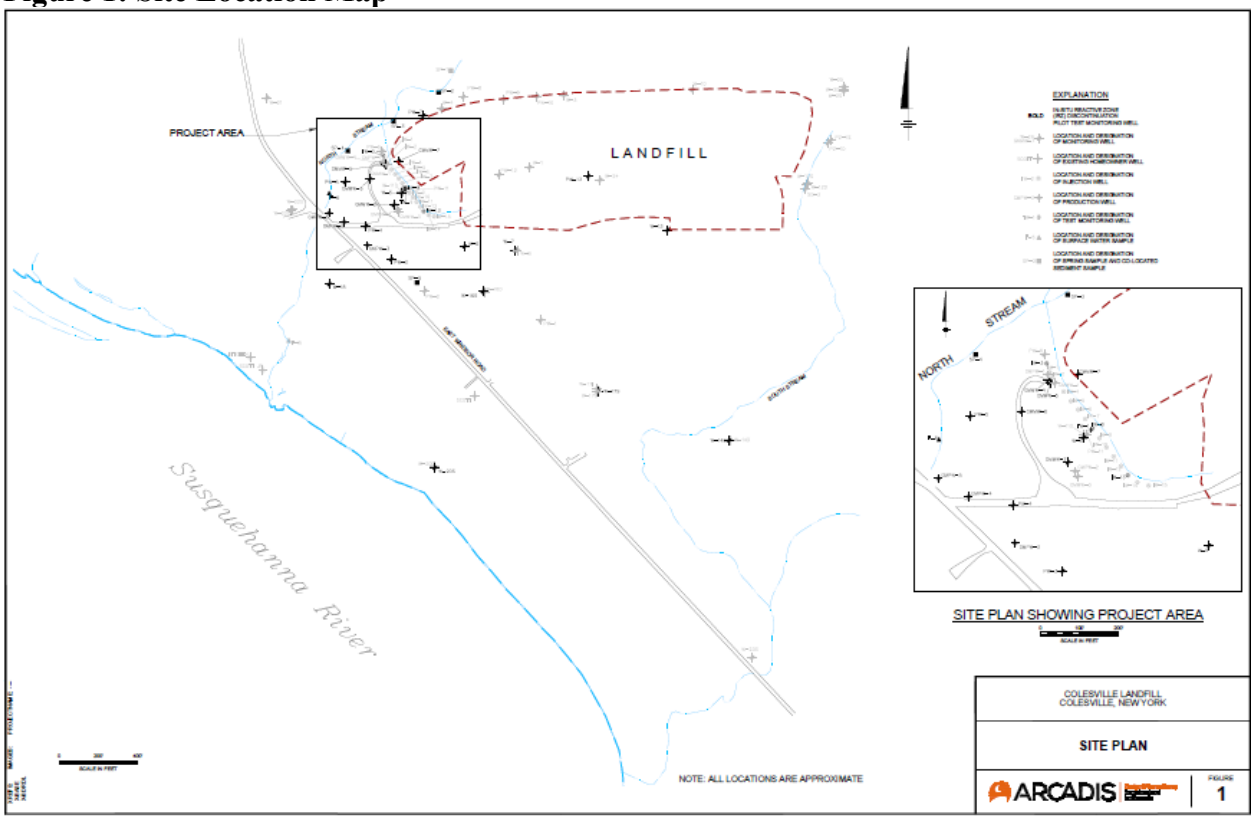

Figure 2: Residential Parcels

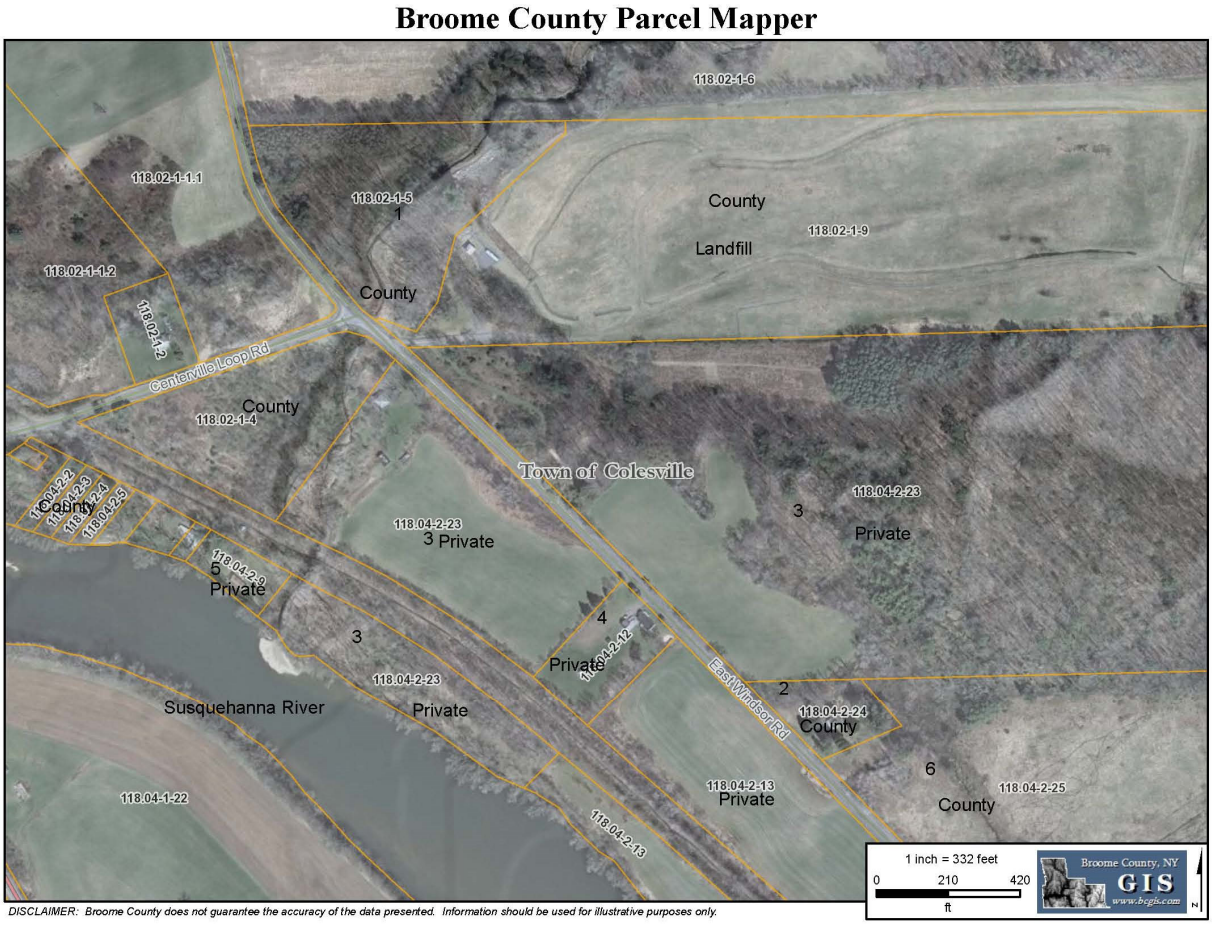

Figure 3: Spring Water and Surface Water sampling locations

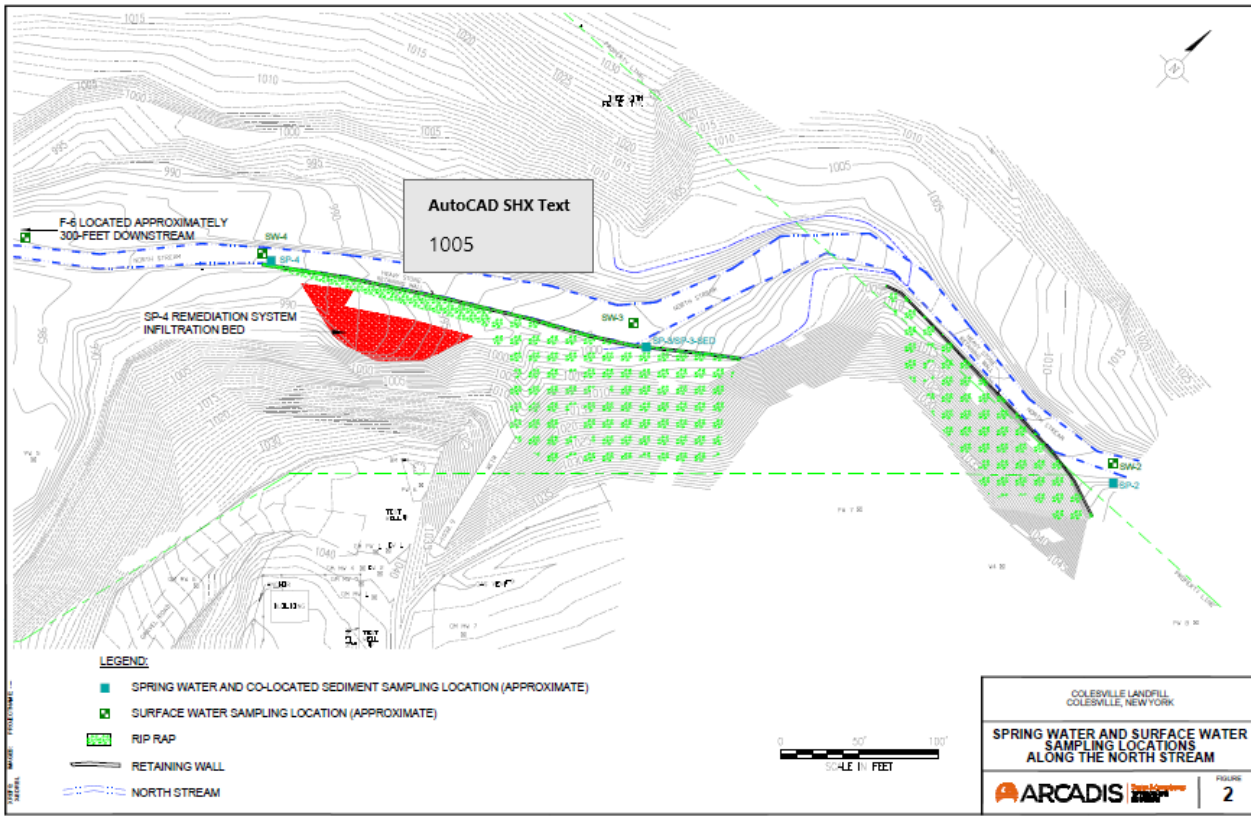

Figure 4: Chlorinated VOC Concentrations in Groundwater – July 2002

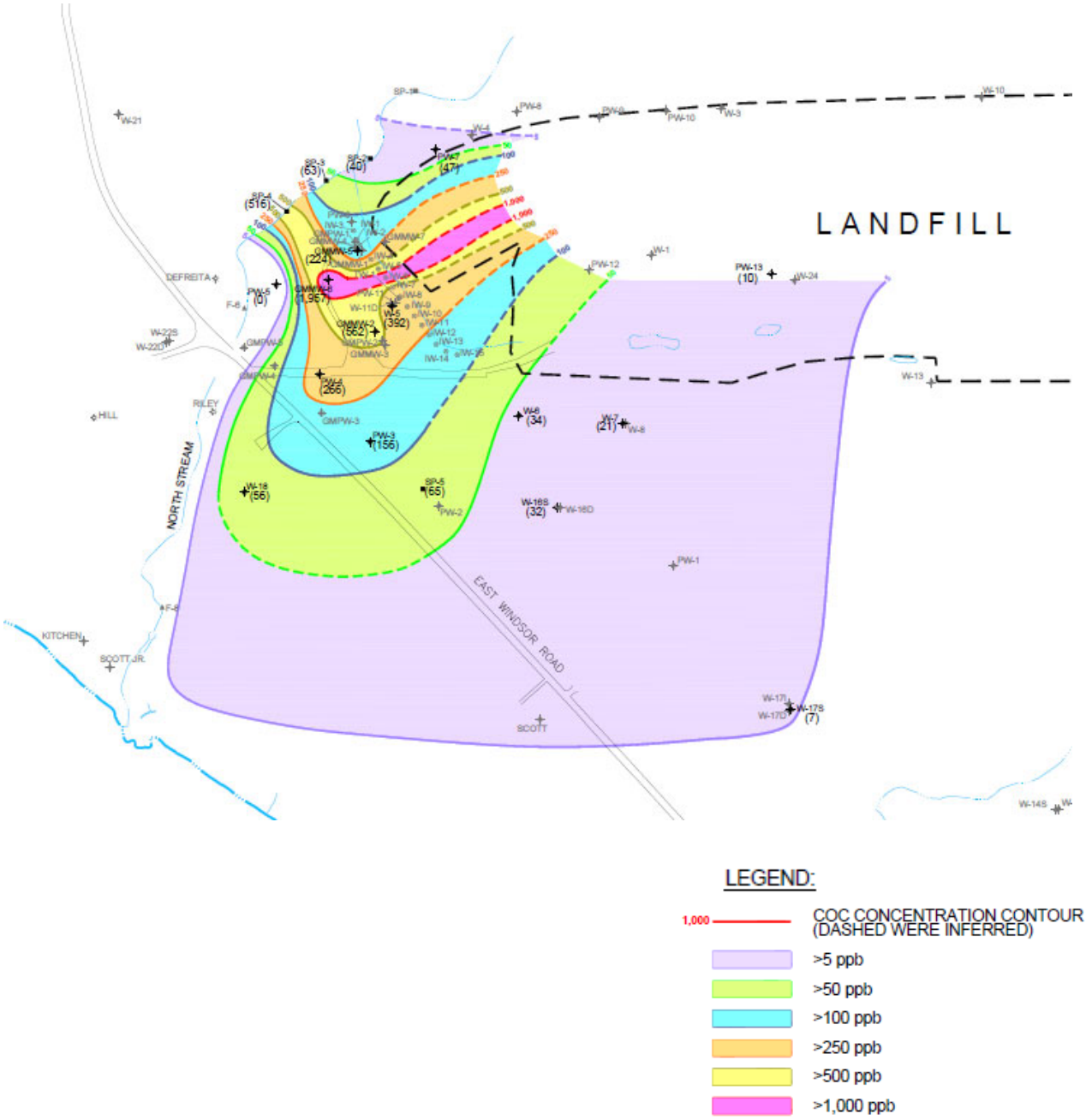

Figure 5: Chlorinated VOC Concentrations in Groundwater - June 2018

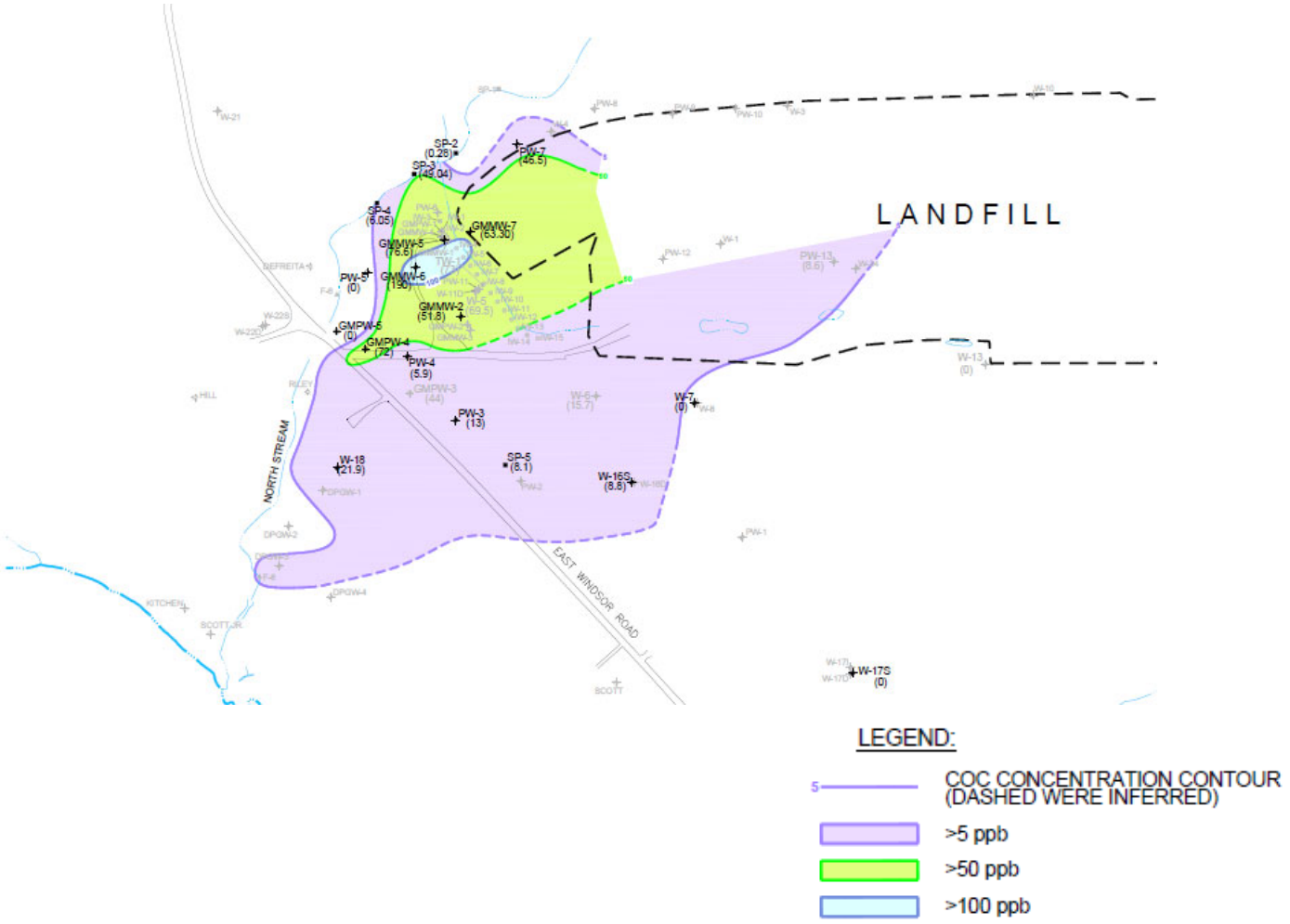

Figure 6: GMMW-02 VOC Degradation Chart

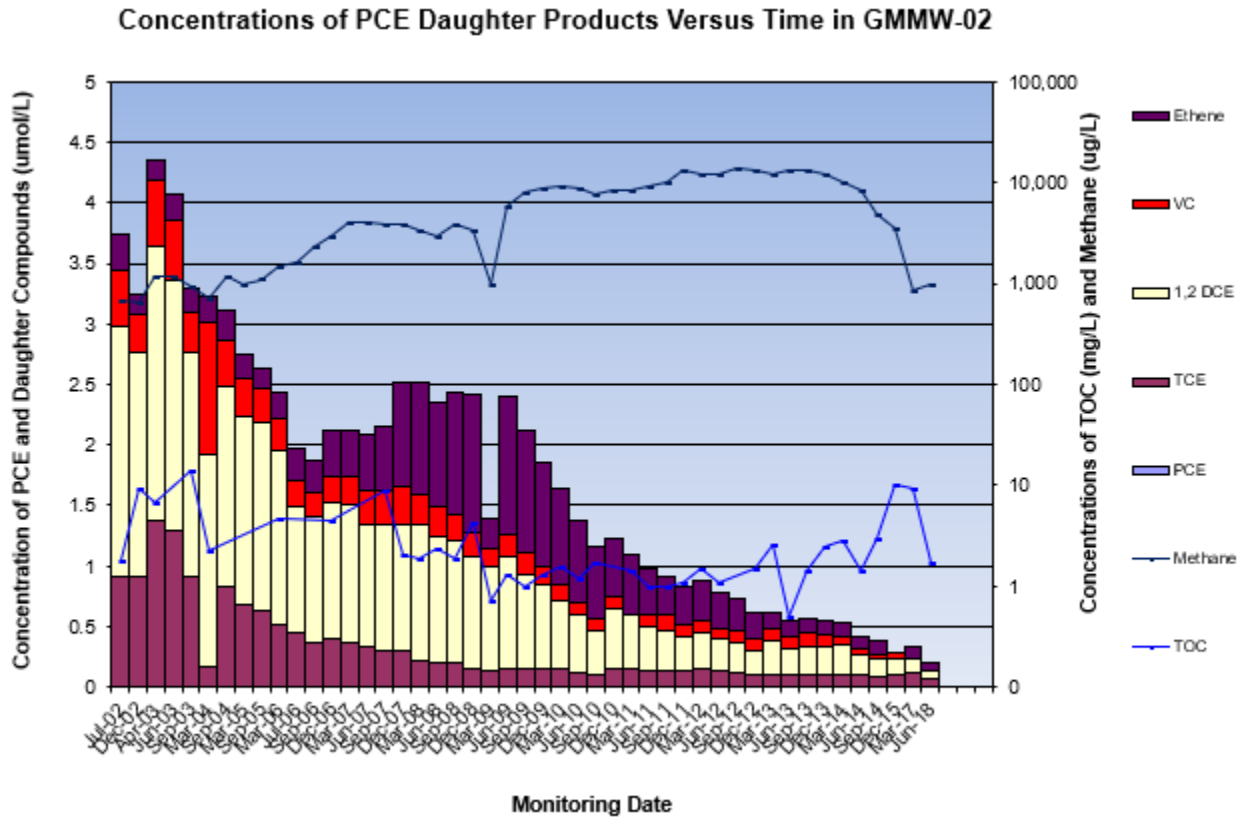

Figure 7: GMMW-06 VOC Degradation Chart

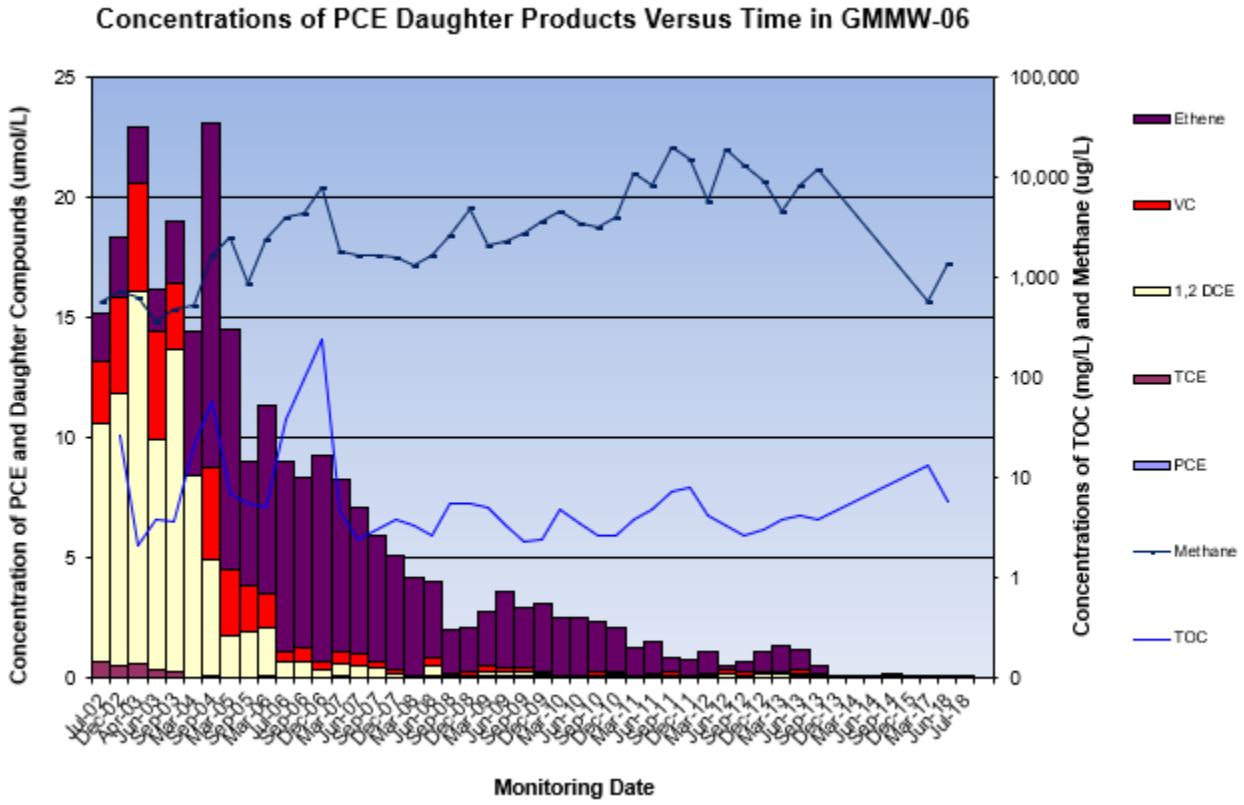

Figure 8: PW-4 Time Concentration Graph

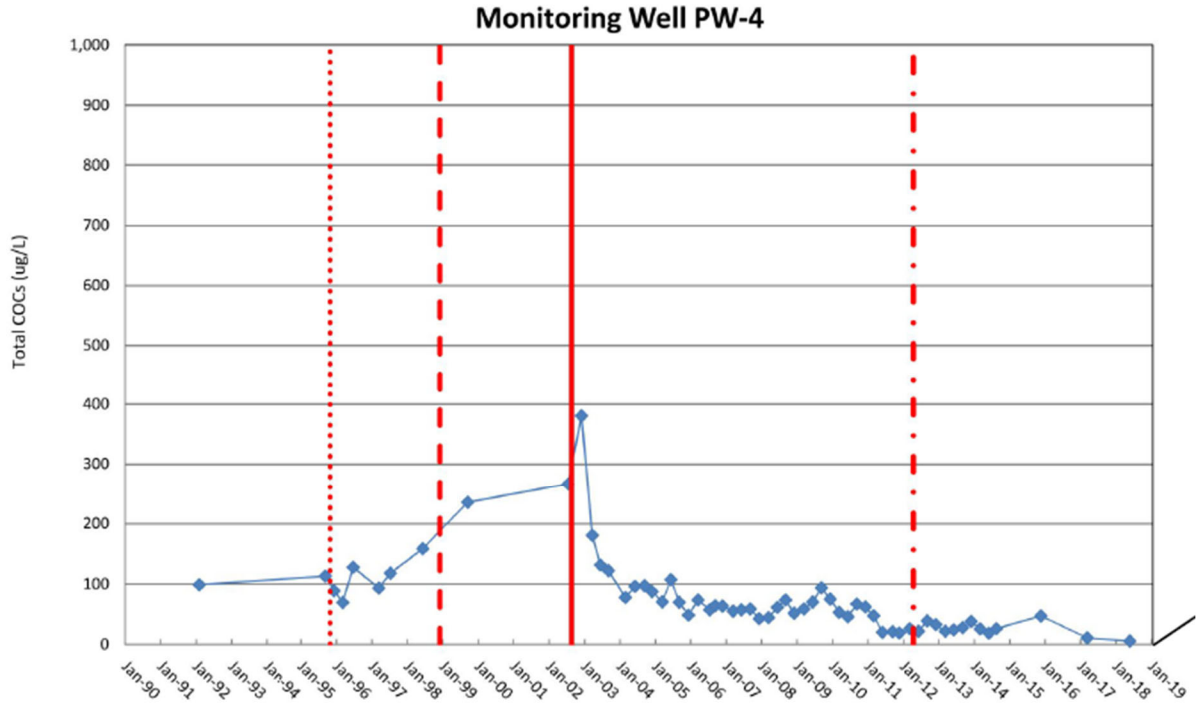

Figure 9: GMPW-4 Time Concentration Graph

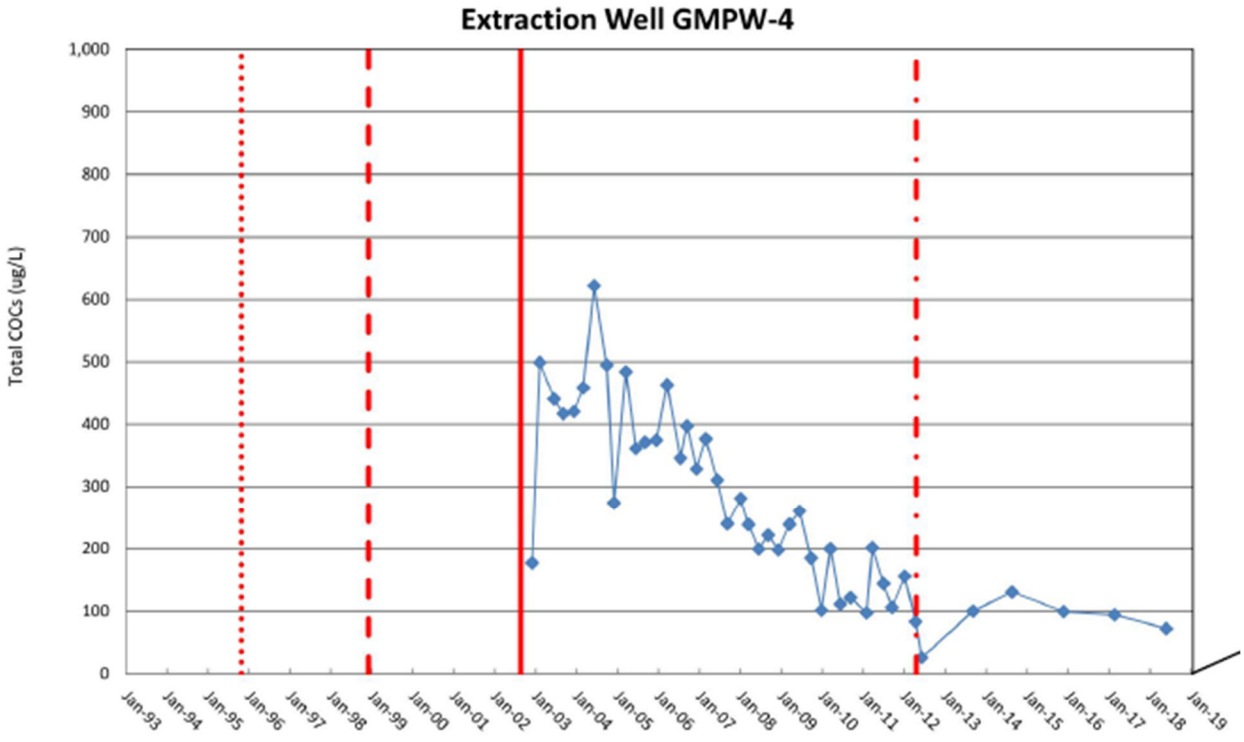

Figure 10: W-19 Time Concentration Graph

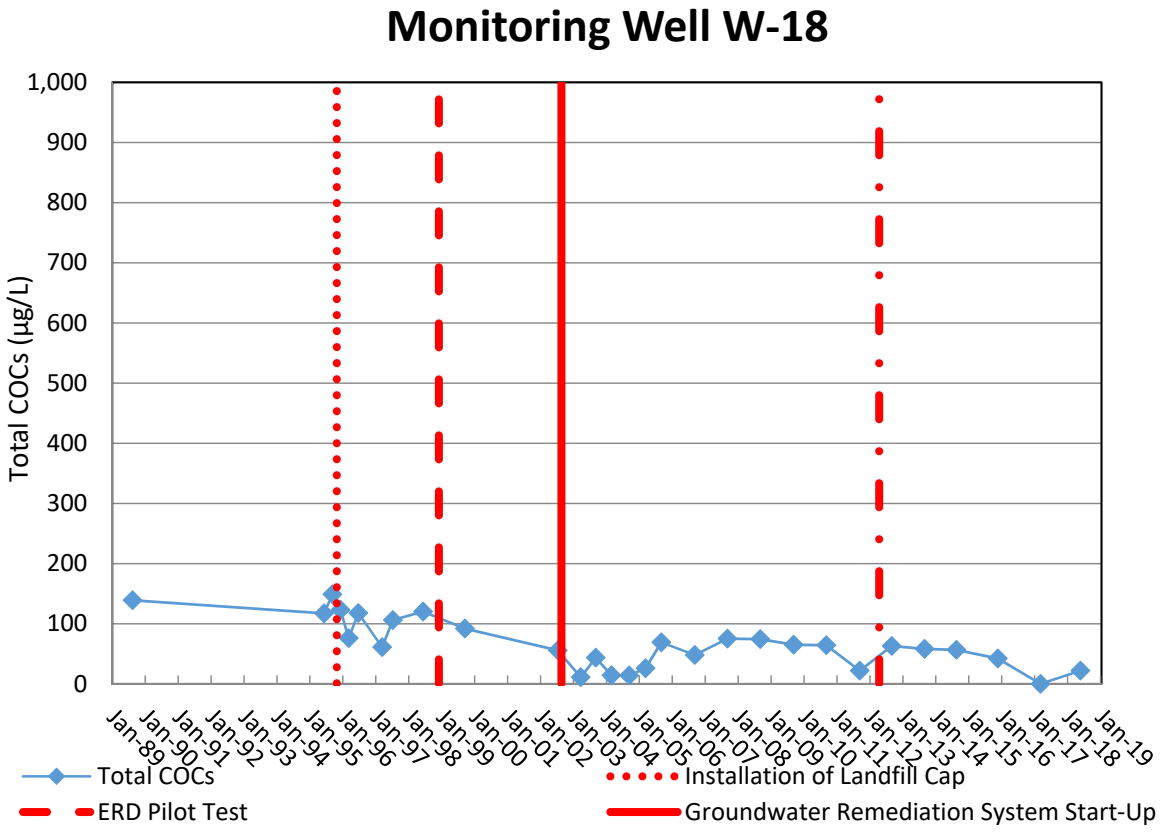

Figure 11: GMMW-07 Time Concentration Graph

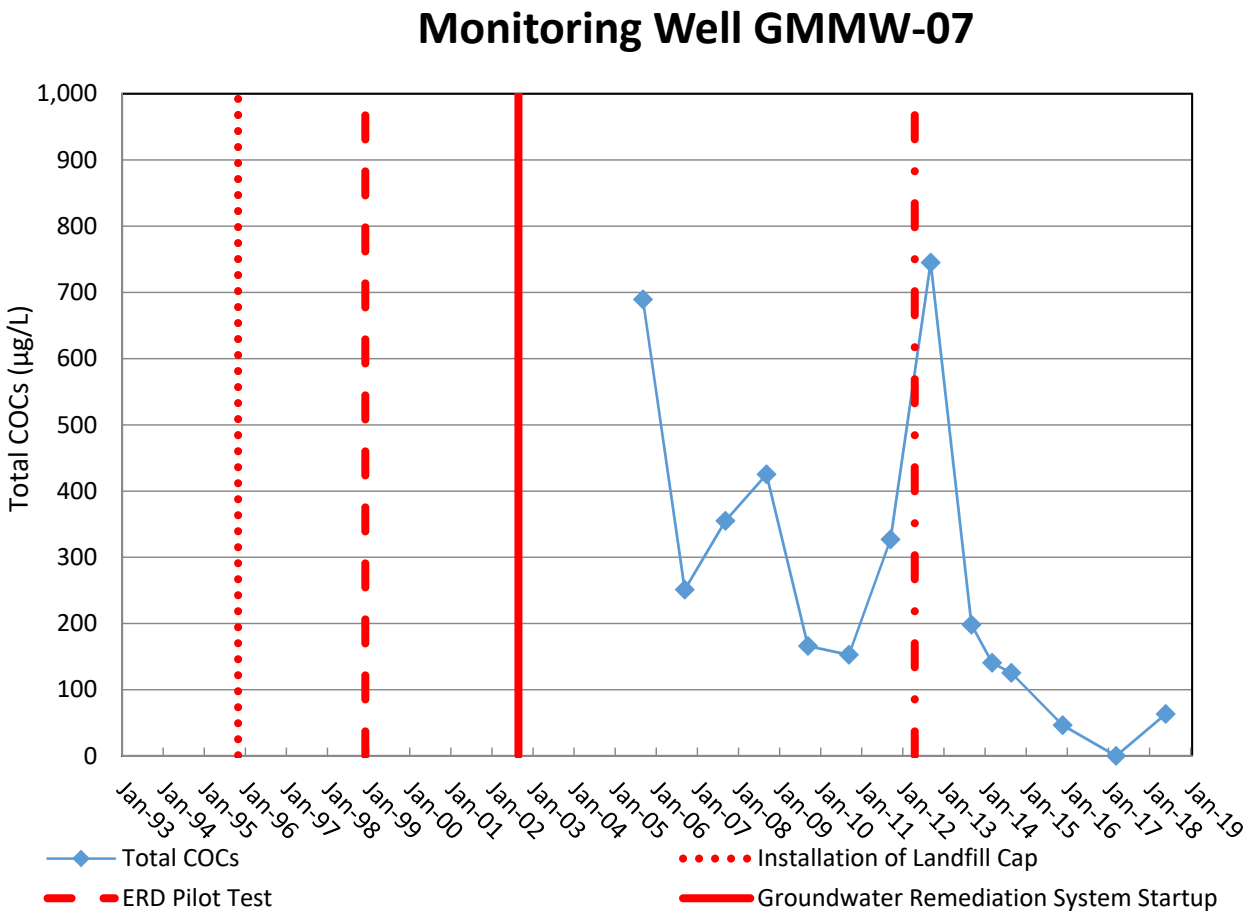

Figure 12: PW-7 Time Concentration Graph