



# PILOT PROJECT DESIGN AND SAMPLING PLAN

## Sampling Domestic Wells Located Downgradient of Class B Biosolids Application Sites for PFAS

Department of Natural Resources and Environmental Control

Division of Water

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September 2025



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## 1.0 INTRODUCTION

The initial Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Water (Water) Project Design and Sampling Plan for PFAS in Biosolids was prepared in October 2022 (DNREC, 2022), field sampling was completed in April 2024, and a data summary report is available at <https://dnrec.delaware.gov/waste-hazardous/remediation/pfas/and-wastewater/>. The initial study looked at the concentration of PFAS in biosolids from 5 different wastewater treatment facilities and the concentration of PFAS in soil and groundwater at one long term biosolids land application site. A second DNREC Water Project Design and Sampling Plan was developed to further study groundwater impacts at 5 additional biosolids land application sites (DNREC, 2024). This plan was finalized in August 2024 and sampling activities began in November 2024. The second biosolids PFAS study data summary report was published in May 2025 and is available at <https://dnrec.delaware.gov/waste-hazardous/remediation/pfas/and-wastewater/>. The sites that were selected for the second study are shown in Table 1.

Laboratory analytical results of samples collected during the aforementioned biosolids land application studies show that PFAS compounds are not only present in biosolids, but also in soils that received biosolids application and in groundwater sampled from monitoring wells at biosolids land application sites. This document outlines the next phase PFAS study and will address the potential presence of PFAS in drinking water, sampled from domestic wells located downgradient of the Clean Delaware Milton, New Market, and Harbeson biosolids application sites, that are installed in the unconfined aquifer (hereafter, the biosolids “domestic well pilot study”). Domestic wells identified downgradient and nearby the Sussex County Inland Bays site and the Synagro / Town of Georgetown application site will be evaluated in the future during the next phase of DNREC’s domestic well sampling project that is associated with biosolids application sites.

<b>Site Name</b>	<b>Approximate Application Acres</b>	<b>Approximate Number of Private Wells &lt; 0.5 Miles Downgradient</b>	<b>Approximate Years of Biosolids Application</b>
Clean Delaware Milton Site	170	70	30
Clean Delaware New Market Site <sup>1</sup>	34	10	30
Clean Delaware Harbeson Site	24	10	30
Sussex County Hettie Lingo <sup>2,3</sup> and Tower Site	125	15	20 <sup>2</sup>
Synagro / Town of Georgetown Application Site Fields 22 and 24 <sup>4, 5</sup>	306	40	20 <sup>4</sup>

Table 1 - Biosolids sites associated with PFAS in water and drinking water study

<sup>1</sup> Application of biosolids and residuals ceased in 2013. Traditional agricultural practices continue at this site.

<sup>2</sup> Beginning in 1993 through the mid 2000’s, Mountaire was permitted to land apply Class B biosolids at this site. Sussex County applied biosolids beginning in the mid 2000’s and ceased application in 2012.

<sup>3</sup> Spray irrigation activities began in 2012 on the north end of the field and by 2017 the entire field was dedicated to spray irrigation.

<sup>4</sup> Fields 22 and 24 were formerly known as field 7. Currently under the spray irrigation program, field 22 is known as fields 2 and 3 and field 24 is known as field 4.

<sup>5</sup> Spray irrigation activities began in 2009 and continue to date. Class B biosolids application began in 1993 and ceased in 2016.

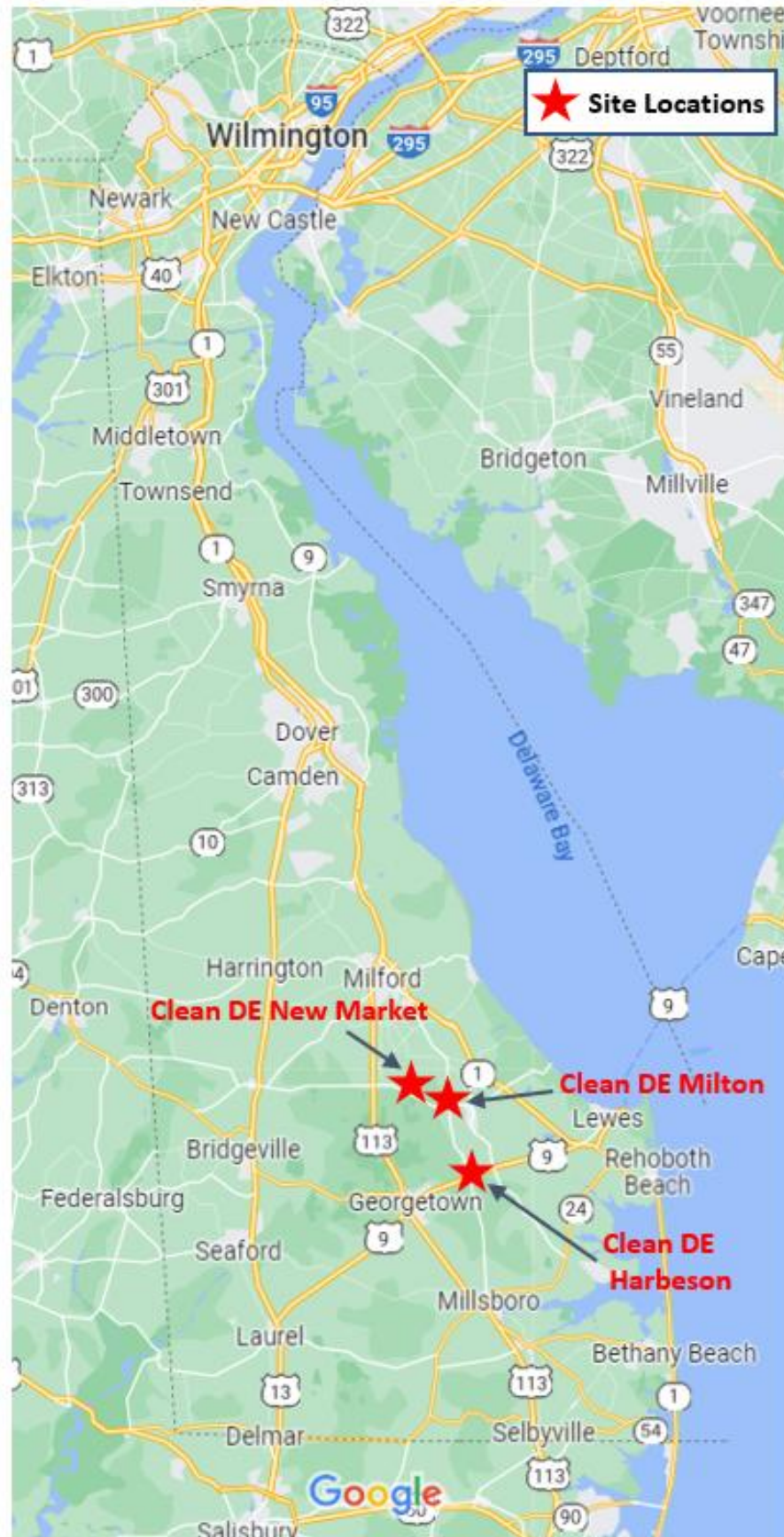


Figure 1. Site Location Map of the Biosolids Domestic Well Pilot Study



As more research and understanding of the impacts of PFAS occurs, Drinking Water Standards are likely to be modified. The most current drinking water standards from USEPA can be found at <https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas>. As of September 2025, EPA's standards are as shown in Table 2.

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
HFPO-DA (commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	1 (unitless) Hazard Index

*Table 2. USEPA PFAS Drinking Water MCLs (MCLG = maximum contaminate level goal)*

Maximum Contaminant Levels (MCLs) for drinking water are established under the USEPA National Primary Drinking Water Regulations (USEPA, 2009). MCLs for several PFAS compounds were set by the USEPA in April 2024 (USEPA, 2024a). These criteria are applicable to treated drinking water in regulated public drinking water systems, and not to “raw” water samples collected from a surface water body or from groundwater. In addition to the MCLs for PFNA, PFHxS, PFBS and/or HFPO-DA, these compounds are to be combined and used in the calculation of a Hazard Index MCL, as noted on USEPA's website (USEPA, 2024b), to determine if an exceedance of the Hazard Index criterion has occurred. Currently, when PFAS are detected in private drinking water in Delaware at concentrations above the USEPA's established MCLs for public water systems for PFAS compounds listed in Table 2, DNREC implements a response plan. The response plan may include mitigation, monitoring and studies to determine alternate sources of drinking water, and/or water treatment to ensure that water supplies are safe to consume. USEPA's MCL's are used as threshold concentrations to characterize the downgradient areas for mitigation and have been used by DNREC as threshold concentrations since the values were proposed by EPA in March 2023.

USEPA's MCL's were used to evaluate the levels of PFAS in groundwater sampled from on-site monitoring wells and will also be used to evaluate the potential existence of PFAS in downgradient domestic wells above these standards. The Project Design and Sampling Plan (DNREC, 2024) indicated that 4 groundwater samples would be collected from each selected on-site monitoring well to detect possible seasonal change and to raise statistical confidence level of the data. However, upon reviewing the first 2 sampling events of these monitoring well data, it was determined that all 5 study sites had PFAS levels greater than the MCLs for at least one PFAS compound. At this time, a determination was made that more than 2 samples were unnecessary and that downgradient domestic wells require sampling for PFAS. This pilot study will look at domestic wells

downgradient of the 3 Clean Delaware land application sites in accordance with this Pilot Project Design and Sampling Plan.

Hydrogeological reports prepared by the wastewater treatment facilities as well as by DNREC Water staff were reviewed to determine the groundwater flow direction in the land application areas. Geographic Information System (GIS) was used to identify downgradient domestic wells within 0.5 mile from the site boundaries. Based on the distance from the land application sites, three zones were further delineated to prioritize sequence of sampling: 0-500 ft (Zone 1), 500-1,000 ft (Zone 2), and 1,000 ft – 0.5 mile (Zone 3). Wells within Zone 1 are closest to the land application sites and therefore, they will be sampled first. If PFAS levels are detected above the MCL in samples collected from Zone 1, sampling of wells inside Zone 2 (if applicable) will be conducted. Zone 3 may be sampled if detections above the MCL are found in samples collected from Zone 2 that are consistent with continued downgradient migration of PFAS compounds from the biosolids application site. For all three zones, only domestic wells that are known or believed to be screened in the unconfined aquifer (*shallow wells*) will be sampled.

## 2.0 CLEAN DELAWARE MILTON FARM BIOSOLIDS APPLICATION SITE

### 2.1 Background Information

The Clean Delaware Milton Farm Class B biosolids application site is permitted and currently actively utilized for the land application of several different materials. Sludge (biosolids) from wastewater treatment plants is required to be treated to Class B pathogen reduction requirements, prior to being accepted by Clean Delaware for land application. Septic tank pump-outs are treated on-site by lime stabilization (pH is increased to a pH of 12 for at least 2 hours) and stored in a 200,000 gallon above ground storage tank (AST) prior to application onto designated application fields. Additional materials land applied include brewery wastewater and grease trap waste. The site was originally permitted in 1992 and consists of approximately 170 acres of land suitable for application. The Project Design and Sampling Plan (DNREC, 2024) contains detailed descriptions of site operations, layout, and the locations of PFAS sampling from on-site and nearby groundwater monitoring wells.

In general, groundwater flows from west to east beneath the application area. Five groundwater monitoring wells were selected for the PFAS in Biosolids Study, 3 on-site and 2 off-site. Three monitoring wells are located upgradient and 2 monitoring wells are downgradient. Due to an unusually low water table during sampling activities, to date it was only possible to collect 1 sample from the 2 downgradient monitoring wells. The results of the 1 downgradient well sample was above USEPA's MCLs for PFOA and PFHxS. Sampling of downgradient domestic shallow wells has, therefore, been prioritized.

### 2.2 Downgradient Domestic Well Sampling

A total of 18 domestic wells in Zone 1 were identified downgradient to the Clean Delaware Milton land application area. In addition, a randomization function of the ArcGIS Geostatistical Analyst Toolbox was used to randomly select 9 upgradient and side-gradient wells for inclusion in this study. Therefore, a total of 27 domestic wells surrounding the Clean Delaware Milton site were selected for initial sampling in this study. Table 3 provides basic information about the selected wells and Figure 2 shows the location of the wells relative to the site.



Local ID	Total Depth (ft)	Date Installed	Well Location
CM-DW01	60	3/30/2003	Milton, DE
CM-DW02	102	7/8/1976	Milton, DE
CM-DW03	66	5/23/1991	Milton, DE
CM-DW04	60	4/6/1991	Milton, DE
CM-DW05	50	7/29/1991	Milton, DE
CM-DW06	55	Unknown	Milton, DE
CM-DW07	50	7/11/1997	Milton, DE
CM-DW08	50	Unknown	Milton, DE
CM-DW09	55	Unknown	Milton, DE
CM-DW10	50	Unknown	Milton, DE
CM-DW11	55	8/15/1985	Milton, DE
CM-DW12	70	6/15/1990	Milton, DE
CM-DW13	50	3/5/1990	Milton, DE
CM-DW14	76	7/16/1990	Milton, DE
CM-DW15	70	11/13/1990	Milton, DE
CM-DW16	50	Unknown	Milton, DE
CM-DW17	80	7/30/1992	Milton, DE
CM-DW18	90	10/14/2024	Milton, DE
CM-DW19	90	10/14/2024	Milton, DE
CM-DW20	90	12/18/2024	Milton, DE
CM-DW21	Unknown	Unknown	Milton, DE
CM-DW22	Unknown	Unknown	Milton, DE
CM-DW23	Unknown	Unknown	Milton, DE
CM-DW24	Unknown	Unknown	Milton, DE
CM-DW25	Unknown	Unknown	Milton, DE
CM-DW26	Unknown	Unknown	Milton, DE
CM-DW27	Unknown	Unknown	Milton, DE

Table 3. Selected domestic wells to be sampled downgradient of the Clean DE Milton Farm application site.





Figure 2. Sampling Location Map – Domestic wells (Zone 1) adjacent to Clean Delaware Milton Farm Application site

## 3.0 CLEAN DELAWARE NEW MARKET FARM BIOSOLIDS APPLICATION SITE

### 3.1 Background Information

The Clean Delaware New Market Farm Class B biosolids application site was historically permitted for the land application of sludge (biosolids) from 1992 to 2013. Biosolids were required to be treated to Class B pathogen reduction requirements prior to being accepted by Clean Delaware for land application. Additional materials that were land applied include brewery wastewater and grease trap waste. The site was originally permitted in 1992 and consists of approximately 34 acres of land suitable for application. The Project Design and Sampling Plan (DNREC, 2024) contains detailed descriptions of site operations, site layout and the locations of PFAS sampling from on-site groundwater monitoring wells.

In general, groundwater flows to the north and northeast beneath the application area. Four groundwater monitoring wells were selected for the PFAS in Biosolids Study, 1 upgradient, 1 side gradient, and 2 downgradient. One or more of the 2 downgradient wells sampled were above USEPA's MCLs for PFOA, PFOS, and PFHxS. Sampling of downgradient domestic shallow wells has, therefore, been prioritized.

### 3.2 Downgradient Domestic Well Sampling

A total of 11 domestic wells in Zone 1 were identified downgradient of the Clean Delaware New Market land application site and were selected for sampling in this study. Table 4 provides basic information about these wells and Figure 3 shows the location of the wells relative to the site.

Local ID	Total Depth (ft)	Date Installed	Well Location
CN-DW01	Unknown	Unknown	Ellendale, DE
CN-DW02	Unknown	Unknown	Ellendale, DE
CN-DW03	Unknown	Unknown	Ellendale, DE
CN-DW04	Unknown	Unknown	Ellendale, DE
CN-DW05	Unknown	Unknown	Ellendale, DE
CN-DW06	Unknown	Unknown	Ellendale, DE
CN-DW07	Unknown	Unknown	Ellendale, DE
CN-DW08	Unknown	Unknown	Ellendale, DE
CN-DW09	Unknown	Unknown	Ellendale, DE
CN-DW10	Unknown	Unknown	Ellendale, DE
CN-DW11	54	3/18/2004	Ellendale, DE

*Table 4. Selected Domestic Wells to be sampled downgradient of Clean Delaware New Market Farm Application Site*



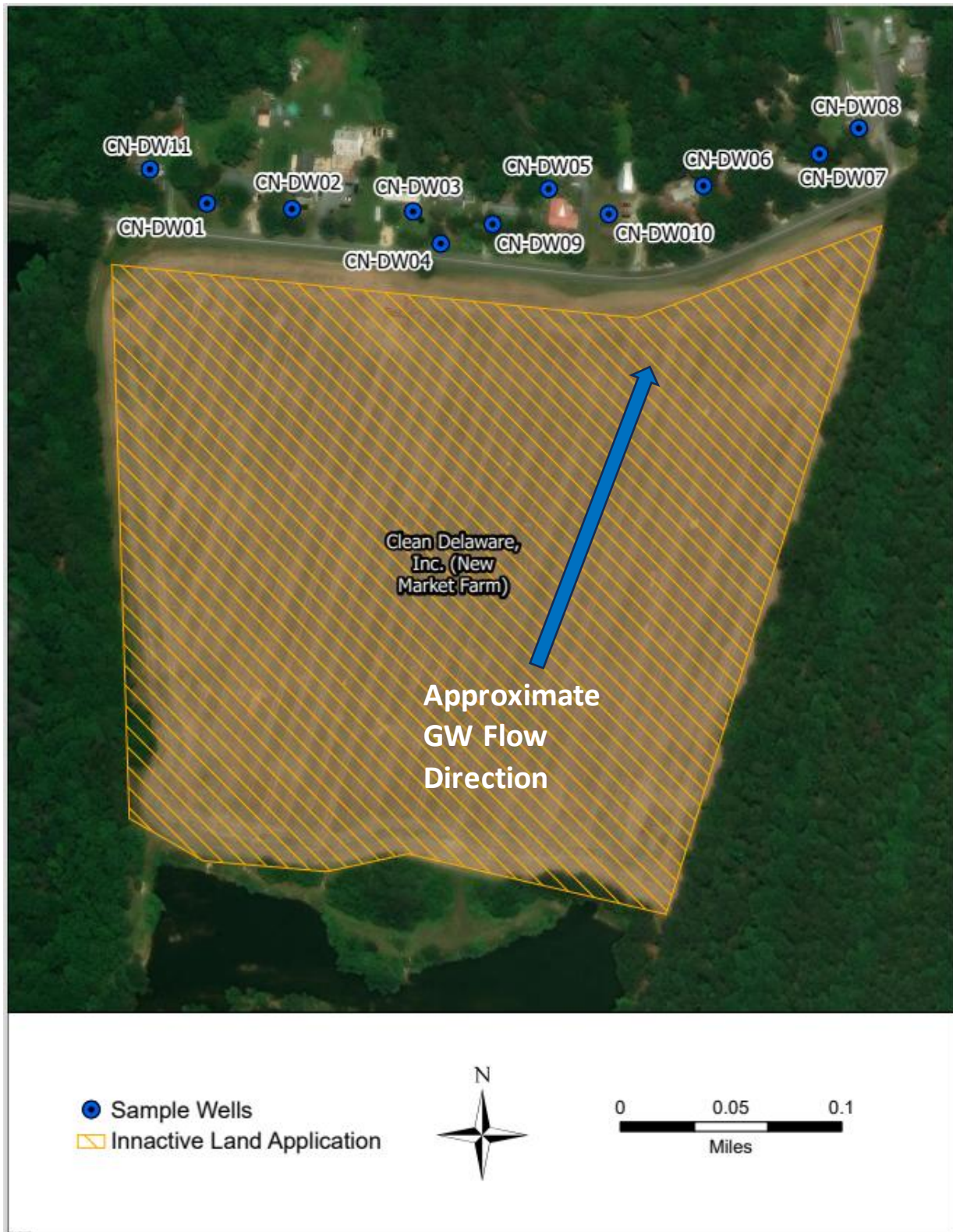


Figure 3. Sampling Location Map – Domestic wells (Zone 1) adjacent to Clean Delaware New Market Application Site

## 4.0 CLEAN DELAWARE HARBESON FARM BIOSOLIDS APPLICATION SITE

### 4.1 Background Information

The Clean Delaware Harbeson Farm Class B biosolids application site is permitted and currently actively utilized for the land application of sludge (biosolids). Biosolids are required to be treated to Class B pathogen reduction requirements prior to being accepted by Clean Delaware for land application. Additional materials that are land applied include brewery wastewater and grease trap waste. The site was originally permitted in 1992 and consists of approximately 24 acres of land suitable for application. The Project Design and Sampling Plan (DNREC, 2024) contains detailed descriptions of site operations, site layout, and the locations of PFAS sampling from the on-site groundwater monitor wells.

In general, groundwater flows to the northeast beneath the application area. Four groundwater monitoring wells were selected for the PFAS in Biosolids Study, 1 upgradient and 3 downgradient. Due to an unusually low water table during sampling activities, to date it was only possible to collect 1 sample from the upgradient monitoring well. One or more of the 3 downgradient wells sampled were above USEPA's MCLs for PFOA, PFOS, PFNA and PFHxS. Sampling of downgradient domestic shallow wells has, therefore, been prioritized.

### 4.2 Downgradient Domestic Well Sampling

A total of 10 domestic wells in Zone 1 were identified downgradient of the Clean Delaware Harbeson land application site and were selected for sampling in this study. Table 5 provides basic information about these wells and Figure 4 shows the location of the wells relative to the site.

Local ID	Total Depth (ft)	Date Installed	Well Location
CH-DW01	Unknown	Unknown	HARBESON, DE
CH-DW02	Unknown	Unknown	HARBESON, DE
CH-DW03	Unknown	Unknown	HARBESON, DE
CH-DW04	Unknown	Unknown	HARBESON, DE
CH-DW05	Unknown	Unknown	HARBESON, DE
CH-PW06	Unknown	Unknown	HARBESON, DE
CH-PW07	Unknown	Unknown	HARBESON, DE
CH-PW08	70	10/11/2005	HARBESON, DE
CH-PW09	77	4/26/1978	HARBESON, DE
CH-PW10	55	6/14/1977	HARBESON, DE

*Table 5. Selected Domestic Wells to be sampled downgradient of the Clean Delaware Harbeson Farm Application Site*



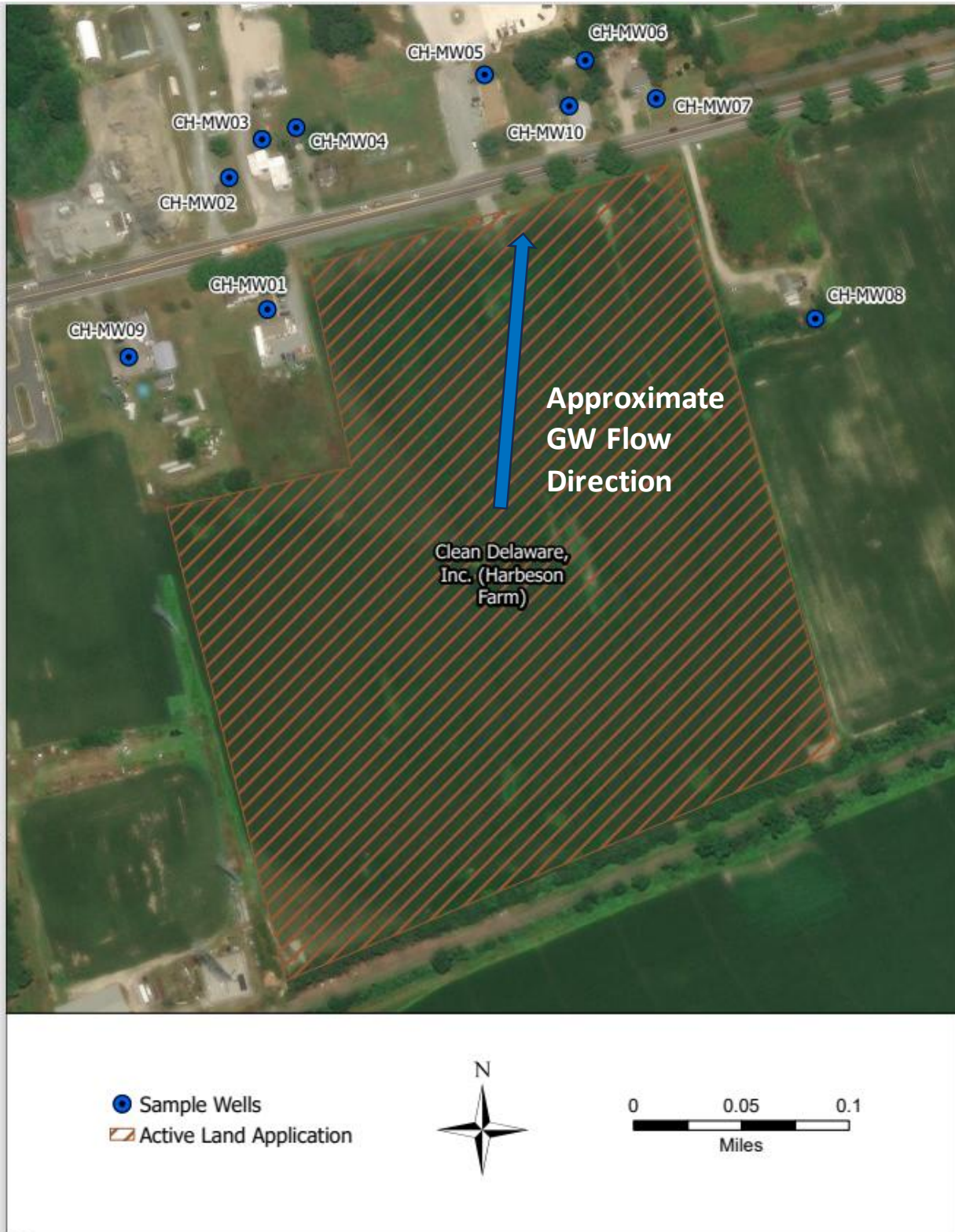


Figure 4. Sampling Location Map – Domestic wells (Zone 1) adjacent to Clean Delaware Harbeson Application Site

## 5.0 SAMPLE IDENTIFICATION AND LABELING

Samples collected from domestic wells for this study will be identified using the following labeling format:

Site Code-GW+DNREC ID, where Site Code is defined as CM=Clean Delaware Milton Farm, CH= Clean Delaware Harbeson Farm, and CN=Clean Delaware New Market Farm,; GW = groundwater; DNREC ID is the unique well permit ID issued by DNREC; and *Quarter* is the number of the quarter of the sampling event. For example, **CM-GW242592-2** will be the groundwater sample collected from the Clean Delaware Milton Farm site, from DNREC well ID 242592, during the second (quarter) sampling event.

For this study, every effort will be made to collect a groundwater sample prior to any treatment at each residence. If it is not possible to collect a pre-treatment sample, a post-treatment sample will be collected. “-POST” will be added to the sample ID if a sample is collected post treatment and the type of treatment will be noted in the field sampling log. If at a residence where a treatment system is (or multiple treatment systems are) in operation, and it is possible to collect samples from each end, two samples: one pre-treatment and one post-treatment will be collected. “-POST” will be added to the sample ID of the post-treatment sample. The type of treatment (i.e., reverse osmosis, activated carbon), treatment location (i.e., point of use, or point of entry), and the date of last maintenance (such as filter/membrane replacement) will be noted in the field sampling log. For PFAS analysis, sediment or ceramic filtration, ultraviolet purification and water softener systems will not be considered a “treatment system” in this study, and there is no need to collect a “-POST” sample. For the analysis of Division of Public Health (DPH) parameters (DHSS, 2024), however, pre-treatment and post-treatment samples will be collected for any well with treatment system(s) installed at the residence.

## 6.0 QUALITY ASSURANCE AND QUALITY CONTROL

A Quality Assurance Project Plan (QAPP) will be developed for this study before the start of sampling. DNREC Water will select qualified contractors and laboratories to perform sample collection and analysis. These contractors will be required to submit Standard Operating Procedures (SOPs) and Quality Assurance and Quality Control Plans (QA/QC) to DNREC for approval prior to contracting. All samples will be analyzed using DNREC modified USEPA Method (1633M). Appendix I presents the analyte list of Method 1633M.

## 7.0 SAMPLING FREQUENCY AND PROJECT SCHEDULE

One-time sampling will be conducted from selected wells as specified in Sections 2.0 through Section 6.0 for this study. USEPA MCLs (EPA, 2024a) will be used as threshold concentrations to characterize the downgradient areas for mitigation. If detections from domestic wells exceed PFAS threshold concentrations, treatment options will be made available to homeowners (free of charge). Additional sampling may be conducted when deemed necessary.

This project design and sampling plan was finalized in September 2025 and it is anticipated that field sampling will first occur in Q4 2025. Sampling will be coordinated with the Division of



Public Health (DPH), from Department of Health and Social Services, who has indicated the desire to collect samples with DNREC for analysis of general drinking water parameters (DHSS, 2024).

## 8.0 SUMMARY

DNREC Water intends to conduct a follow-up study on the impacts of the land application of Class B biosolids to groundwater by sampling domestic wells downgradient of biosolids application sites where groundwater from onsite monitoring wells were found to contain PFAS. For this Pilot Study, a total of 47 domestic wells, downgradient of three current or historic Class B biosolids land application sites, will be sampled. A potential total number of approximately 70 groundwater samples will be collected (assuming pre- and post- treatment samples need to be collected from 15 residences and 8 additional samples need to be collected after the initial sampling event to further delineate potential PFAS impacts to domestic wells in Zone 2). This estimated total number of samples does not include any QA/QC samples collected by the field team. Field sampling is for this pilot study expected to start in November 2025. The full scale downgradient domestic well study for the other selected Class B biosolids application facilities is anticipated to commence in Q1 or Q2 2026.

## REFERENCES

- DHSS, 2024: Private Well Owners (<https://dhss.delaware.gov/dph/lab/privdw.html>)
- DNREC, 2022: PROJECT DESIGN AND SAMPLING PLAN- PFAS -PFAS in Biosolids: Characterization and Fate (<https://documents.dnrec.delaware.gov/dwhs/remediation/watar/PFAS-Project-Design-and-Sampling-Plan-Biosolids.pdf>)
- DNREC, 2024: PROJECT DESIGN AND SAMPLING PLAN – PFAS in Groundwater Associated with Class B Biosolids Land Application Sites (<https://documents.dnrec.delaware.gov/dwhs/remediation/watar/PFAS-Project-Design-and-Sampling-Plan-Biosolids-Monitor-Wells.pdf>)
- USEPA, 2009. National Primary Drinking Water Regulations: <https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>
- USEPA, 2021. Method 1633: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS: [https://www.epa.gov/system/files/documents/2021-09/method\\_1633\\_draft\\_aug-2021.pdf](https://www.epa.gov/system/files/documents/2021-09/method_1633_draft_aug-2021.pdf)
- USEPA, 2024a: EPA’s Final PFAS National Primary Drinking Water Regulation: Monitoring and Reporting ([https://www.epa.gov/system/files/documents/2024-04/pfas-npdwr\\_fact-sheet\\_monitoring\\_4.8.24\\_0.pdf](https://www.epa.gov/system/files/documents/2024-04/pfas-npdwr_fact-sheet_monitoring_4.8.24_0.pdf))
- USEPA, 2024b. Fact Sheet – Understanding the Final PFAS National Primary Drinking Water Regulation Hazzard Index Maximum Contaminant Level: [https://www.epa.gov/system/files/documents/2024-04/pfas-npdwr\\_fact-sheet\\_hazard-index\\_4.8.24.pdf](https://www.epa.gov/system/files/documents/2024-04/pfas-npdwr_fact-sheet_hazard-index_4.8.24.pdf).