Maryland
Department of
the Environment

Larry Hogan, Governor
Boyd K. Rutherford, Lt. Governor

Horacio Tablada, Secretary
Suzanne E. Dorsey, Deputy Secretary

September 30, 2022

Philadelphia District
US Army Corps of Engineers
Attn: Michael Hart, PE
Wannamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Via email: Michael.F.Hart@usace.army.mil

Re: Agency Interest Number: 164964
Tracking Number: 202260905
Emergency Water Quality Certification Number: 22-WQC-0027

Dear Mr. Hart:

Your project did not qualify as a type of project that is covered by the Maryland State Programmatic General Permit (MDSPGP) and its associated 401 Water Quality Certification (WQC), or any other General WQC. This project is an U.S. Army Corps of Engineers (USACE) Navigation project and as such, there is no USACE regulatory program permit. However, an individual 401 WQC is necessary for this project in accordance with Section 401 of the Clean Water Act and USACE interpretation of Section 401 of the CWA with regard to its applicability to USACE navigation projects.

The Water Quality Certification WQC for this project issued by the Maryland Department of the Environment is attached. Please read and review the WQC for this project to ensure that you understand the limits of the certified project and all of the general and special conditions.

You should not begin any work until you have obtained all necessary State, local, and federal authorizations. Please do not hesitate to contact me at danielle.spendiff1@maryland.gov or 410-537-4023 with any questions.

Sincerely,

Danielle A. Spendiff, Chief
Regulatory and Customer Service Division

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
WATER AND SCIENCE ADMINISTRATION

WATER QUALITY CERTIFICATION

CERTIFICATION NUMBER: 22-WQC-0027

ISSUED TO: Philadelphia District
US Army Corps of Engineers
Wannamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390
Attn: Michael Hart, PE

EFFECTIVE DATE: September 30, 2022

EXPIRATION DATE: September 30, 2027

PROJECT LOCATION: Chesapeake & Delaware Canal Federal Navigation Channel
Pearce Creek Dredge Material Containment Site
Cecil & Kent Counties, MD

DESCRIPTION OF CERTIFIED PROJECT: Maintenance dredging of the Chesapeake and Delaware (C&D) Canal and its approach channel and placement of the dredged material at the Pearce Creek Dredged Material Containment Facility (DMCF). Maintenance dredging will be performed as required to maintain the authorized 35-foot project depth within the navigation channel. All material will be removed by bucket, hopper or hydraulic pipeline dredges and placed in the Pearce Creek DMCF, which discharges to Pearce Creek Lake, a Use II waterway. Approximately 500,000 cubic yards to 750,000 cubic yards of material will be dredged from the federal channel each year from the following locations:

1. Southern Approach Channel, Pooles Island to Sassafras River
2. Sassafras River to Courthouse Point
3. Courthouse Point to Maryland State Line within the Canal

WATER QUALITY CERTIFICATION

UNDER AUTHORITY OF SECTION 401 OF THE FEDERAL WATER POLLUTION CONTROL ACT AND ITS AMENDMENTS AND IN ACCORDANCE WITH § 9-313 THROUGH § 9-323, INCLUSIVE, OF THE ENVIRONMENT ARTICLE, ANNOTATED CODE OF MARYLAND, THE MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER AND SCIENCE ADMINISTRATION (DEPARTMENT) HAS DETERMINED THAT THE REGULATED ACTIVITIES DESCRIBED IN THE REQUEST FOR CERTIFICATION WILL NOT VIOLATE MARYLAND'S WATER QUALITY STANDARDS, IF CONDUCTED IN ACCORDANCE WITH THE CONDITIONS OF THIS CERTIFICATION.

This Water Quality Certification (Certification) is issued under authority of Section 401 of the Federal Water Pollution Control Act and its Amendments, Title 9, Subtitle 3 of the Environment Article, and Code of Maryland Regulations (COMAR) 26.08.02.10. The Maryland Department of the Environment (Department or MDE) has determined from a review of the request application file that the project activities described in the above will not violate Maryland's water quality standards, provided that the following conditions are satisfied. This Certification does not relieve any person conducting activities under this Certification (Certification Holder) from the responsibility to obtain any other approvals, licenses, or permits in accordance with federal, State, or local requirements.

The Certification Holder subject to this Certification shall comply with the following conditions:

SPECIAL CONDITIONS

1. Dredging shall not be conducted from April 1 through September 30, inclusive, of any year.

2. The sediments to be dredged from the C&D Canal and its approach channel shall be tested annually in accordance with Environmental Protection Agency regulation/guidelines to ensure the suitability for placement of the dredged material at its designated site. The results of the Corps of Engineers' sediment testing shall be provided to the MDE, Water and Science Administration, Wetlands and Waterway Protection Program for review prior to commencing any dredging and dredged material placement.

3. The Corps of Engineers shall inspect and maintain the liner to ensure that any dredged material placed at the Pearce Creek DMCF will not result in the deterioration/ contamination of groundwater resources.

4. The Corps of Engineers shall continue to implement its MDE-approved plan, "Groundwater Monitoring Plan, Pearce Creek Confined Disposal Facility" (Attachment A) dated January 2017 for monitoring the groundwater in the Magothy, Upper Patapsco Shallow, and Upper Patapsco Deep aquifers. The plan describes the wells to be monitored, the constituents to be monitored at each well, and the frequency of monitoring water levels and constituents for each well. The plan includes scale map(s) showing the location, well identification number, and aquifer monitored for all monitoring wells.

5. The Corps shall submit annually to MDE, Water and Science Administration, Wetlands and Waterway Protection Program, a groundwater monitoring report in accordance with the approved 2017 "Groundwater Monitoring Plan, Pearce Creek Confined Disposal Facility" report by February 1 of each year containing tabular results of the prior year's monitoring, including water level maps and data trends using previous year's data from each monitoring well. The Corps of Engineers shall submit the water quality data and the water level data in .xlsx format, and shall provide groundwater quality trend plots for all data collected.

6. Within 90 days of the effective date of this Certification, the Corps of Engineers shall submit to MDE, Water and Science Administration, Wetlands and Waterway Protection Program, for review and approval, a revised plan for monitoring surface water discharges

from the Pearce Creek DMCF. The discharge monitoring plan must include key parameters such as flow volume/discharge rate, total suspended solids, pH, dissolved oxygen, nutrients, and metals, and additionally, total dissolved solids (TDS), chlorides, and conductivity. The approved plan shall include detailed information for required lab data and field support documentation to be submitted with results. The Corps of Engineers shall continue to implement the MDE-approved plan, "Chesapeake and Delaware Canal Pearce Creek Confined Disposal Facility- 2017 Discharge Monitoring Plan" until such time as the revised monitoring plan is approved by MDE.

7. All surface water monitoring results shall be reported to MDE's Water and Science Administration, Wetlands and Waterways Protection Program, on a monthly basis except when monitoring results indicate exceedances of any water quality standards. Exceedances of water quality standards must be immediately reported to MDE, Water and Science Administration, Wetlands and Waterways Protection Program (i.e., within 24 hours of becoming known). The Corps of Engineers shall take all steps necessary to ensure that discharges of sediment or any other pollutants to waters of the State do not occur at any time during which the DMCF is in operation.

8. The Corps of Engineers shall maintain the structural integrity and stability of the existing dike system at the Pearce Creek DMCF under all modes of operation and weather conditions. The Corps of Engineers shall notify MDE, Water and Science Administration, Wetlands and Waterway Protection Program immediately if any structural stability problems are observed at the DMCF.

9. The Corps of Engineers shall notify MDE, Water and Science Administration, Wetlands and Waterway Protection, prior to any proposed modifications of the Pearce Creek DMCF that could impact the quantity or quality of any discharges from the facility, either to surface or groundwater, or any modification that has the potential to alter the structural stability of the dikes. MDE reserves the right to review and approve any new plans to modify the facility prior to construction.

10. Exterior monitoring of water and sediment quality, benthic community composition, and sediment toxicity shall continue to be conducted at the ten sampling stations currently monitored by MDOT MPA as identified in "Table 1, Target Sampling Coordinates for Pearce Creek Lake and Elk River Exterior Monitoring Locations" (Attachment B). Sampling locations may be modified with prior approval from MDE. Sampling shall be conducted 2 times each year, in the Spring and Fall, and all findings shall to be compared to baseline sampling levels and provided in a technical report annually to MDE's Wetlands and Waterways Protection Program. The Corps of Engineers shall notify MDE, Water and Science Administration, Wetlands and Waterway Protection Program, immediately when monitoring results change significantly from baseline sampling levels. The following parameters are to be included:
    a. Water samples collected shall be analyzed for metals, nutrients, temperature, pH, salinity, total suspended solids and dissolved oxygen.

b. Sediment samples collected shall be analyzed for metals, nutrients, moisture content, grain size, and specific gravity. Sediment will also be analyzed for toxicity using an acute 10-day EPA sediment toxicity test.
c. Benthic samples shall be collected to characterize the benthic community at each station.

11. Within 90 days of the effective date of this Certification, the Corps of Engineers shall provide MDE, Water and Science Administration, Wetlands and Waterway Protection Program, with the 30 Q5 value for the tributary of Pearce Creek Lake.

12. Within 90 days of the effective date of this Certification, the Corps of Engineers shall submit for MDE, Water and Science Administration, Wetlands and Waterway Protection Program review and approval a plan to conduct short-term chronic whole effluent toxicity (WET) monitoring evaluating the toxicity of the discharge twice per year using biomonitoring. Samples shall be collected from the 36-inch pipe that discharges to the tributary of Pearce Creek Lake. Sampling, testing and reporting shall follow the Department's Biomonitoring Protocol (Attachment C).

13. Each WET testing event shall include the *Ceriodaphnia dubia* survival and reproduction test (EPA Method 1002.0) and the *Pimephales promelas* larval survival and growth test (EPA Method 1000.0), or (for estuarine receiving waters) the chronic testing shall include the *Cyprinodon variegatus* (Method 1004.0) or *Menidia beryllina* (Method 1006.0) larval survival and growth tests and *Americamysis bahia AKA Mysidopsis bahia* (Method 1007.0) survival, growth, and fecundity tests. All testing must include one vertebrate species and one invertebrate species.

14. The Corps of Engineers shall take all reasonable steps to minimize or prevent any adverse impact to waters of the State or to human health resulting from noncompliance with Maryland's Water Quality Standards as set forth in COMAR 26.08.02, including accelerated or additional monitoring as necessary to determine the nature and impact of the non complying discharge and appropriate control measures.

15. If sampling indicates ammonia concentrations in excess of water quality standards, the Corps of Engineers shall identify the causes of the higher ammonia concentrations experienced at the Pearce Creek DMCF and identify strategies that can be implemented to reduce ammonia to ensure compliance with water quality standards. The identified strategies must be presented to MDE, Water and Science Administration, Wetlands and Waterway Protection Program as a report along with a plan to put these strategies into effect. The plan should consider pilot testing of potential measures, including consideration/feasibility of water treatment. This Certification provides two years (24 months after the effective date of the Certification) to complete the study and implement the plan if needed for ammonia reduction strategies for ongoing operations.

GENERAL CONDITIONS

1. All water quality-related performance standards and conditions required by the Department in any state issued authorization for activities in tidal wetlands, nontidal waterways, their 100-year floodplains, nontidal wetland buffers, nontidal wetland expanded buffers, or any other water quality requirements of state law or regulation shall be met to ensure that any discharges will not result in a failure to comply with water quality standards in COMAR 26.08.02.

2. The Dredged Material Containment Facility shall be operated in a manner which will not violate Maryland's Water Quality Standards as set forth in COMAR 26.08.02. The applicant shall notify the Water and Science Administration's Compliance Program, at 410-537-3510, ten (10) days prior to the placement of dredged material at the DMCF.

3. The certification holder shall notify the Water and Science Administration, Wetlands and Waterways Protection Program, Regulatory and Customer Service Division, in writing, upon transferring property ownership or responsibility for compliance with these conditions to another person. The new owner/operator shall request, in writing, transfer of this water quality certification to his/her name.

4. The certification holder shall allow MDE and its representatives to inspect the project area at reasonable times and to inspect records regarding this project.

5. This Certification is valid for the project identified herein and the associated federally-approved U.S. Army Corps of Engineers Civil Works Navigation Branch project.

STATEMENTS OF NECESSITY AND CITATIONS

1. Statement of Necessity for Special Condition 1: The time of year restriction is necessary to maintain the designated use- support of estuarine and marine aquatic life and shellfish harvesting.

   Citation: Federal and state laws which authorize this condition include but are not limited to: COMAR: 26.08.02.02B(1)(d); 26.08.02.02B(3); COMAR 26.08.02.02-1

2. Statement of Necessity for Special Conditions 2, 6, 7, 10, 11, 12, 13, 14 & 15 and General Conditions 1 & 2: The condition is necessary to ensure that water quality standards are met and designated uses are maintained.

   Citations: Federal and state laws which authorize this condition include but are not limited to: 33 U.S.C. § 1341(a), (b), & (d); 33 U.S.C. § 1251(b); 33 U.S.C. § 1370; Md. Ann. Code, Env. Article, Title 1, Subtitles 3 and 4; Md. Ann. Code, Env. Article, Title 5, Subtitles 5 and 9; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 16; COMAR 26.08; COMAR 26.08.02.10G(3); COMAR 26.23.02.06; COMAR 26.17.01; COMAR 26.23; COMAR 26.24

3. Statement of Necessity for Special Conditions 2, 6, 7, 10, 11, 12, 13, 14 & 15: Activities which result or may result in a discharge to regulated waters, including dredging and dredged material placement may require monitoring to ensure that water quality standards are met and designated uses are maintained, and to determine if remedial measures are needed to restore compliance with water quality standards if they are not met as a result of the discharge. The condition is necessary to ensure that dredged material does not result in violation of general and numeric water quality standards and interfere with designated uses.

   Citation: COMAR 26.08.02.03-3A(5); COMAR 26.08.02.03-3(C(5); COMAR 26.08.02.01B(2); COMAR 26.08.02.02B(1) COMAR 26.08.02.02B(3); COMAR 26.08.02.03B; COMAR 26.08.02.02B(1); 26.08.02.03B(1)(b); 26.08.02.03B(2)(e); 26.08.02; 26.08.01.02A; 26.08.02.09A; 26.08.02.02B(1)(d); COMAR 26.24; 26.08.02.03-3C(9)(a); COMAR 26.08.02.03B(2); COMAR 26.08.02.02B(1)(d);

4. Statement of Necessity for Special Conditions 3, 4 & 5: Dredged material may contain pollutants in amounts toxic to aquatic or human life if the pollutant enters groundwater. Groundwater may be used as potable drinking water or for irrigation of crops, and may enter surface waters. The condition is necessary to ensure that the quality of groundwater is safe for human use and aquatic life and meets designated uses.

   Citation: COMAR 26.02.08.09C and D; COMAR 26.08.02.02B; COMAR 26.08.02.03

5. Statement of Necessity for Special Conditions 8 & 9: The condition is necessary to ensure that water quality standards are met under unique circumstances for inadvertent discharges and that designated uses of waters are maintained. Releases of significant amounts of sediment can impact aquatic environments and if unchecked can alter them to an uninhabitable state.

   Citation: Federal and state laws that authorize this condition include but are not limited to: 33 U.S.C. § 1341(a), (b), & (d); 33 U.S.C. § 1251(b); 33 U.S.C. § 1370; Md. Ann. Code, Env. Article, Title 1, Subtitles 3 & 4; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 5, Subtitles 5 and 9; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 16; COMAR 26.08; COMAR 26.08.02.10G(3); COMAR 26.17.04; COMAR 26.23; COMAR 26.24; COMAR 26.23.02.06, COMAR 26.08, COMAR 26.08.02.10E; COMAR 26.08.02.09C(3); COMAR 26.08.02.03B(1)(b); COMAR 26.08.02.03B(2); COMAR 26.08.02.03-3; COMAR 26.08.02.02B(2); COMAR 26.08.02.02B(4); COMAR 26.08.02.02B(6); COMAR 26.08.02.02B(8)

6. Statement of Necessity for General Condition 3: The condition is necessary to clarify the scope of this certification to ensure compliance with water quality regulations, without limiting restrictions through other requirements.

   Citation: Federal and state laws which authorize this condition include but are not limited to: 33 U.S.C. § 1341(a), (b), & (d); 33 U.S.C. § 1251(b); 33 U.S.C. § 1370; Md. Ann. Code, Env. Article, Title 1, Subtitles 3 and 4; Md. Ann. Code, Env. Article, Title 5, Subtitles 5 and 9; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 16; COMAR 26.08, COMAR 26.08.02.10E; COMAR 26.23.02.06; COMAR 26.17.04; COMAR 26.23; COMAR 26.24

7. Statement of Necessity for General Condition 4: Conditions of certification involve precise actions to comply with water quality standards. Site inspection may be necessary to ensure that limits, methods, and other requirements are met to ensure that water quality standards are met and designated uses are maintained.

   Citation: Federal and state laws that authorize this condition include but are not limited to: 33 U.S.C. § 1341(a), (b), & (d); 33 U.S.C. § 1251(b); 33 U.S.C. § 1370; Md. Ann. Code, Env. Article, Title 1, Subtitles 3 and 4; Md. Ann. Code, Env. Article, Title 5, Subtitles 5 and 9; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 16; COMAR 26.08; COMAR 26.23.02.06; COMAR 26.23; COMAR 26.24; COMAR 26.17.04

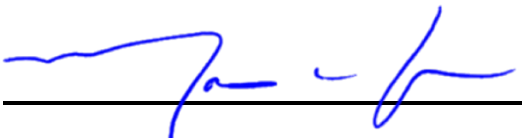
8. Statement of Necessity for General Condition 5: This condition is necessary to qualify the period of applicability of the terms and conditions of this Certification to be protective of Maryland water quality standards.

   Citations: Federal and state laws which authorize this condition include but are not limited to: 33 U.S.C. § 1341(a), (b), & (d); 33 U.S.C. § 1251(b); 33 U.S.C. § 1370; 40 C.F.R. 121, 15 C.F.R. 930, Md. Ann. Code, Env. Article, Title 1, Subtitles 3 and 4; Md. Ann. Code, Env. Article, Title 5, Subtitles 5 and 9; Md. Ann. Code, Env. Article, Title 9, Subtitle 3; Md. Ann. Code, Env. Article, Title 16; COMAR 26.08; COMAR 26.17.04; COMAR 26.23; COMAR 26.24

Based on the aforementioned conditions, the Department has determined that the proposed dredging and the utilization of the Pearce Creek DMCF for the placement of the dredged material is consistent with the State's federally-approved Coastal Zone Management Program, as required by Section 307 of the Federal Coastal Zone Management Act of 1972, as amended.

Failure to comply with these conditions may subject the Certification Holder to criminal and/or civil penalties or other enforcement action in accordance with applicable law.

CERTIFICATION APPROVED: DATE:



9/30/2022

D. Lee Currey, Director
Water and Science Administration

Tracking Number: 202260905
Agency Interest Number: 164964
Effective Date: September 30, 2022

cc: WSA Inspection & Compliance Program

Attachments: A- Groundwater Monitoring Plan, Pearce Creek Confined Disposal Facility
B- Table 1, Target Sampling Coordinates for Pearce Creek Lake and Elk River Exterior Monitoring Locations
C- MDE Biomonitoring Protocol

ATTACHMENT A

US Army Corps
of Engineers
Philadelphia District

GROUNDWATER MONITORING PLAN

Pearce Creek Confined Disposal Facility

January 2017

1. INTRODUCTION

This Groundwater Monitoring Plan has been developed to support the design, installation, and operations and maintenance by the USACE Philadelphia District of a liner system at the Pearce Creek Confined Disposal Facility (CDF), located in Earleville, Cecil County, Maryland.

1.1 Objective

The objective of this Groundwater Monitoring Plan is to monitor potential changes in groundwater quality resulting from the installation of an impermeable liner which is designed to mitigate the effects of future and past dredge disposal at the Pearce Creek CDF.

1.2 Previous Similar Applications

The USACE Philadelphia District has conducted monitoring projects of this type previously. As an example, the currently ongoing New Jersey CDF Monitoring Program was initiated in 2002 in cooperation with the New Jersey Department of Environmental Protection (NJDEP). The monitoring program was initiated by the USACE Philadelphia District and is being conducted voluntarily as a proactive means of monitoring groundwater conditions at several New Jersey CDFs on a continuing basis.

1.3 Assumptions

In designing the Pearce Creek Groundwater Monitoring Plan, several assumptions were made, including:

1. Program includes Magothy, Upper Patapsco Shallow, and Upper Patapsco Deep aquifers
2. Data collected will include groundwater characterization (groundwater analytical samples) and groundwater levels
3. No monitor wells inside the CDF will be included as they will be abandoned in accordance with Maryland Department of the Environment (MDE) requirements
4. Monitor wells and piezometers included in the study are located on government property, in road rights-of-way, and on private properties
5. Study area consists of Pearce Creek CDF and up to approximately 0.5 mile outside CDF perimeter
6. No residential drinking water samples will be tested
7. No river/creek/surface water samples will be tested
8. Total duration of monitoring program is indefinite at this time. Monitoring is expected to occur in all years of and intermediate years during placement of dredge material, and a period of time thereafter
9. Site performance standards are Federal MCL/SMCL and MDE drinking water values

2. SITE DESCRIPTION AND HYDROGEOLOGY

This section provides a brief physical description of the Pearce Creek CDF. The site hydrogeology is summarized, especially as it relates to, and influences, the well installation and well sampling activities.

2.1 Site Description

The Pearce Creek CDF is located in Cecil County, Maryland, immediately south of Pearce Creek and the eastern shore of the Elk River, a major tributary of the Chesapeake Bay. The CDF encompasses 260 acres, and is defined by a dike that encircles the facility and has a perimeter length of approximately 2.5 miles. The CDF is bounded by residential properties to the west, by residential, agricultural, and undeveloped properties to the south and east, and by Pearce Creek and the Elk River to the north. The interior of the CDF is generally covered with phragmites and other hydrophilic plants (Kleinfelder, 2013). The United States Geological Survey Scientific Investigations Report 2012-5263 concluded the Pearce Creek CDF degraded local groundwater quality and negatively impacted domestic wells in the area. As a consequence, all properties in the communities of Bay View Estates, West View Shores and Sunset Pointe are in the process of connecting to public water.

2.2 Site Hydrogeology

The Pearce Creek CDF is located in the Atlantic Coastal Plain physiographic province, which consists of a largely unconsolidated, thick wedge of continental, coastal, and marine sediments of Cretaceous to Recent age. The sediments in the Atlantic Coastal Plain are underlain unconformably by Precambrian and lower Paleozoic crystalline rock. The coastal plain sediments in the vicinity of Pearce Creek are estimated to be approximately 900 feet thick (USGS, 2012).

The United States Geological Survey (USGS) (2012) has interpreted an alternating series of aquifers and confining units underlying the site. In stratigraphic order from the ground surface downward, the youngest units in general consist of anthropogenic (fill and dredged material) material that intermix with the surficial Matawan Formation (composed of clay and silty clay) to form a surficial confining unit that is approximately 20 to 40 feet thick. Because the new well locations are located outside of the CDF, it is unlikely that the fill and dredged materials will be encountered.

The Magothy Aquifer underlies the Matawan Formation, is predominantly composed of coarse sand and gravel, and is the shallowest water-bearing unit beneath the site. The Magothy Aquifer generally ranges in thickness from 40 to 50 feet, except west of the CDF where it thins to less than 20 feet in the vicinity of the Elk River.

A confining unit underlies the Magothy Aquifer. The confining unit between the Magothy Aquifer and Upper Patapsco Shallow Aquifer is absent over a portion of the site. It is generally present within the project area and is composed of clays and silty clays, and ranges in thickness from about 10 to 50 feet.

The Upper Patapsco Shallow Aquifer underlies the confining unit, and is the principle water-bearing zone for the majority of the residential wells in the area. This aquifer unit is encountered at a subsurface depth of approximately 40 feet beneath the ground surface, and is approximately 60 feet in thickness. The Upper Patapsco Shallow Aquifer is composed

predominantly of fine sands and thin beds of gravel, although clay and silt stringers ranging from 5 to 10 feet in thickness are common.

Another confining unit underlies the shallow aquifer and separates the Upper Patapsco Shallow Aquifer from the Upper Patapsco Deep Aquifer. The confining unit is approximately 80 feet thick beneath the West View Shores residential community, and consists predominantly of clay and silty clay.

The Upper Patapsco Deep Aquifer is the deepest hydrogeologic unit beneath the project area under study. Based on the USGS (2012) interpretation, the Upper Patapsco Deep Aquifer in this area should be encountered between the depths of approximately 190 to 235 feet.

The USGS (2012) report contains a description and data regarding historical groundwater flows and contours.

3. PLAN DESCRIPTION

3.1 Components

The Pearce Creek Groundwater Monitoring Program will include collection of groundwater samples and groundwater level data. Both data types will be collected over the course of the program, both prior to reuse of the lined CDF for placement of dredge material and afterwards.

Groundwater samples will be collected for chemical analysis using standard USEPA low-flow sampling procedures, and submitted for analysis of the following parameters:

1. Total Metals: Aluminum, Arsenic, Beryllium, Cadmium, Calcium, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Sodium, and Zinc
2. General Chemistry Parameters: Alkalinity, Total Dissolved Solids, Total Suspended Solids, Fluoride, Chloride, Bromide, Sulfate, Nitrogen (nitrite and nitrate), Nitrogen (nitrate), and Nitrogen (nitrite)
3. Radiologic Parameters: Radium 226, Radium 228, Gross Alpha, and Gross Beta

Groundwater samples will be analyzed using approved USEPA methods of analysis, and will be performed by a laboratory having related certifications by MDE. All groundwater sampling and related field work will be performed by MDE certified sampling personnel.

In addition to the above laboratory analyses, field water quality parameters (pH, specific conductance, temperature, oxidation-reduction potential, turbidity, and dissolved oxygen) will be recorded and reported. Periodically the USACE may also collect samples for dissolved metals using a 0.45 micron filter, thereby allowing a comparison of total and dissolved metals in an effort to evaluate what metals may be migrating from the site in groundwater.

Groundwater level data will be collected four times per year (January, April, July, and October) in order to develop groundwater contour maps over the study area and take into account seasonal variations. These contour maps will be used to determine groundwater flow direction and assess the effects on the groundwater table resulting from the liner construction.

3.2 Monitor Wells and Piezometers in Study

The monitoring program will include existing monitor wells and require installation of several new monitor wells and piezometers. Both the existing and new monitor wells and piezometers will be screened in the Magothy, Upper Patapsco Shallow, and Upper Patapsco Deep aquifers that underlie the site.

Table 5-1 contains a list of the existing and proposed monitor wells and piezometers to be included in the monitoring plan (a total of 37 monitor wells and piezometers). These wells and piezometers are located on government property as well as on private properties. USACE anticipates that the proposed new monitor wells will be installed after liner construction and prior to initiation of placement of new dredge material into the CDF. This is projected to occur in winter or early spring of 2017.

A comparison of well locations and modeling results was performed. The groundwater model documented in the Final Groundwater Model Report, Pearce Creek Dredge Material Containment Area, Cecil County, MD, May 2013, was updated to include the effects of the impermeable liner within the CDF during operating conditions. The changes are documented in the Addendum to the Final Groundwater Model Report dated February 2015.

Figures 5-1a and 5-1b, 5-2a and 5-2b, and 5-3a and 5-3b show groundwater elevation contours and particle tracks for water particles released beneath the CDF for the Magothy, Upper Patapsco Shallow and Upper Patapsco Deep aquifers, respectively. The a and b suffix in the figure names indicates the direction of the cross section located on the bottom half of the figure. The 43 randomly-selected particle starting locations are the same horizontal locations as those shown in the May 2013 report. The black points in the figures show the starting locations and the yellow points show how the particles move from the starting location over 25 years in the direction indicated by the groundwater elevation contours. Also shown in the figures are the existing and proposed monitoring wells and piezometers to be included in the monitoring plan.

No monitor wells inside the CDF are included in the Monitoring Plan as these interior wells were abandoned prior to initiating the liner construction work because they could have represented a potential for leakage into aquifers beneath the CDF. These interior monitor wells were abandoned in accordance with MDE requirements. Well abandonment details were provided in a separate Well Abandonment submittal, and Water Well Abandonment – Sealing Report Forms were submitted to MDE and the Cecil County Health Department.

No residential drinking water wells will be included in the Monitoring Plan. There are several reasons why the USACE cannot effectively monitor these wells. The USACE cannot be sure of construction details of these wells; USACE does not know which residents may abandon their home supply wells in favor of piped in municipal water; and, Cecil County Health Department is responsible for sampling residential home supply wells should there be health-related issues. However, USACE has installed monitor wells to the west of the Pearce Creek CDF, as well as in other nearby locations, and several of these monitor wells are included in the Monitoring Plan.

During the USGS investigation in 2010, additional Magothy wells were planned along the western border of the site at the locations where Upper Patapsco Shallow wells CSW-9 and 18B are located. These locations are in between proposed new Magothy wells CSW-29 and PZ-1. However, during drilling at the 18B location (CE Dd 156), the Magothy was encountered at the surface and only extended to about 8.5' bgs. In addition, according to the USGS boring log, only about 4' of sand capable of transmitting water was encountered at this location. Below 8.5', a silty clay unit was present to a depth of 60'.

Also at location CSW-9, a well 9A (CE Dd 144) was installed by the USGS and initially classified by them as a Magothy well. However, after groundwater sampling and evaluating water level data, the USGS reclassified this well as perched water based on water quality and hydrologic conditions, despite having referred to this material as Magothy in the boring log in the USGS report.

The reasons discussed above are why the USGS did not install additional Magothy monitoring wells along the western border of the site, and why the USACE has not proposed additional Magothy drilling in this area.

It should be noted that monitor wells CSW-8 and 22 were not included in the plan since each of these wells are located near other wells that are included in the monitoring plan and are screened in the same aquifer.

CSW-8 is located on private property and is approximately 100 feet east of Well 8A, which is in the monitoring plan. Both of these wells are placed in the Upper Patapsco Shallow aquifer and are each located on different private properties.

Well 22 is located on private property on Pond Neck Rd and is approximately 700 feet southeast and upgradient of Well 21S, which is in the monitoring plan. Both of these wells are placed in the Magothy aquifer and are screened at very similar elevations. Well 22 is screened at elevation -34.72 to -44.72 feet, while 21S is screened at -35.40 to -45.40 feet.

Figure 5-4 shows the Magothy formation monitor wells and piezometers to be used in the monitoring plan. Figure 5-5 shows the Upper Patapsco Shallow formation monitor wells to be used in the monitoring plan. Figure 5-6 shows the Upper Patapsco Deep formation monitor wells to be used in the monitoring plan.

Descriptions of placement and installation of the proposed monitor wells and piezometers are below:

3.2.1 Magothy Aquifer

1. Piezometers PZ-1 through PZ-3 are located along the eastern perimeter of the CDF, while PZ-4 and PZ-5 continue along the southeast edge of the CDF.
2. Monitor wells CSW-30 and CSW-32 are located along the eastern perimeter of the CDF. CSW-30 is located midway between monitor well 11C and piezometer PZ-2. CSW-32 is located midway between PZ-2 and PZ-3.
3. Monitor well CSW-27 is located approximately midway along the southwest edge of the CDF, which is aligned parallel with Pond Neck Rd. It is approximately midway between monitor wells 16A and 12R.
4. Monitor well CSW-29 is located along the west edge of the CDF approximately 600 feet to the northeast of monitor well 16A.

3.2.2 Upper Patapsco Shallow Aquifer

1. Monitor wells CSW-31 and CSW-33 are paired up with CSW-30 and CSW-32 respectively, along the east edge of the CDF.
2. Monitor well CSW-28 is located approximately midway along the southwest edge of the CDF, which is aligned parallel with Pond Neck Rd. It is approximately midway between monitor wells CSW-10 and 14R.
3. Monitor well CSW-37 is located to the north of the CDF near PZ-1.

3.2.3 Upper Patapsco Deep Aquifer

1. Monitor well CSW-34 is located approximately midway along the southwest edge of the CDF, which is aligned parallel with Pond Neck Rd.
2. Monitor well CSW-35 is located near the front entrance to the CDF.
3. Monitor well CSW-36 is located near the southeast corner of the CDF.
4. Monitor well CSW-38 is located approximately midway along the eastern perimeter of the CDF.
5. Monitor well CSW-39 is located on the northwestern edge of the site.

4. METHODOLOGY

4.1 Monitor Well/Piezometer Installation

A Maryland-licensed driller will install the proposed monitor wells and piezometers in accordance with USACE, MDE, and Cecil County Health Department regulations and guidance. The monitor wells and piezometers will be constructed of 4-inch and 2-inch diameter PVC, respectively. Due to the required depths and local geology, they will likely be installed using either mud-rotary or sonic drilling equipment. A 5-foot or 10-foot long well screen will be installed, whichever is appropriate. All proposed new monitor wells and piezometers are located on Government property and will be stickup wells. Table 5-2 contains a summary of the proposed monitor wells to be installed. For comparison purposes, Table 5-3 contains a summary of the existing monitor wells included in the Groundwater Monitoring Plan.

Prior to installing any wells, the driller will place one pilot borehole at each proposed single well location or location of multiple wells. The purpose of the pilot boreholes is to establish the stratigraphy and locate the desired aquifer and screening interval. The pilot borehole will be drilled and sampled from the surface level for each well, and be utilized for the well installation.

Continuous sonic soil cores or split-spoon soil sampling will be performed using standard methods while drilling the pilot borings. The soil borings will be logged by a qualified geologist. While drilling the pilot borehole, one 2-foot split spoon sample will be collected every 5 feet until a depth is reached approximately 10 feet above the top of the expected screening range of the monitor well to be installed. At this point continuous split-spoon sampling will be done to confirm the well screening and well bottom depths.

Several of the wells will be installed as pairs or 3-well groupings consisting of a shallower well and one or two deeper wells. These well pairs or groupings will be drilled and installed within approximately 10 horizontal feet of each other. The pilot boring for the deeper monitor well in the pair or grouping will be drilled, sampled, and logged first. The pilot boring depth will be equal to the depth of the deep well in the associated well pair. The data obtained from logging this boring will be used to select the depth and screen interval of the shallower well. The borehole for the shallower well will be blind drilled to within approximately 10 feet of the appropriate depth selected for this well, based on logging of the pilot borehole. At this point, continuous split spoon sampling may be done to confirm the well screening and well bottom depths. At all new monitor well locations, when the target depth range is reached, the boring will be terminated once a sufficient length of screenable material is encountered (i.e., five-foot or ten-foot length of screenable sand).

In addition, the USACE may also consider using a downhole gamma log or other borehole geophysical methods to aid in characterizing the hydrogeology at a given location.

4.2 Groundwater Sampling

After construction of the liner system and prior to placement of new dredge material, a groundwater sampling event will be performed to establish baseline conditions. Samples will be collected from all of the monitor wells and piezometers in the monitoring program (see Table 5-1). A total of 37 monitoring wells and piezometers will be sampled in the monitoring program. A complete synoptic round of groundwater level readings for all of these monitor wells and piezometers will also be recorded during the sampling event. A second synoptic round of pre-construction groundwater levels will also be collected at a later time.

After construction of the liner system, two analytical groundwater sampling events will be conducted each year (spring and fall) for the duration of the monitoring program. This sampling will begin in 2017. It should be noted that there may be certain years when dredge material is not placed in the CDF. During these times the USACE may request from MDE that sampling be performed less frequently. Synoptic rounds of groundwater level readings will be obtained four times per year for the duration of the monitoring program. After five years, synoptic rounds of groundwater level readings will be limited to wells in the Magothy aquifer and the Upper Patapsco Shallow aquifer.

Transducers will be installed in four monitor wells located around the perimeter of the CDF and set in the Magothy aquifer. The transducers will be used to collect groundwater elevation data for a period of one month prior to the beginning of a dredging cycle, during the dredging cycle, and for one month after the completion of the dredging cycle. The transducers will be programmed to collect measurements every hour. Local precipitation data will be used to adjust and correct water level changes during the data collection period. These data will allow evaluation and comparison of groundwater flow patterns before, during, and after dredging operations. This task using transducers will be only done once, for the initial dredging cycle.

4.2.1 Method of Analytical Sampling

Sampling will follow standard USEPA low flow operating procedures. The following field parameters will be real-time monitored as per the low flow procedure using a groundwater quality meter to determine when the purged groundwater has stabilized prior to sampling:

- specific conductance
- pH
- temperature
- oxidation-reduction potential
- turbidity
- dissolved oxygen

These data will be reported along with laboratory analytical results for the groundwater samples. Depth to water shall also be monitored to track drawdown rates during purging. A Grundfos 2-inch adjustable speed submersible pump/controller, or approved similar equipment, will be used for all groundwater sample collection in combination with a continuous flow-through cell suitable for taking water quality measurements using the groundwater quality meter. The groundwater quality meter must be calibrated for all measured parameters on a daily basis, and must be documented in the field notebook. Daily instrument calibration will be performed in

accordance with the standard low flow sampling procedures, MDE certification requirements, and instrument manufacturer recommendations.

The same sampling method will be used for all sample locations in the monitoring program. Bailers and other sampling methods will not be used in this sampling program unless specifically approved by the USACE and MDE. If insufficient groundwater is available to use the low flow sampling technique, no groundwater sample will be collected. If the water level in the well approaches the low flow drawdown limit and/or the well turbidity exceeds 20 NTUs, the USACE will make a determination as to whether a groundwater sample will be collected. The cause of turbidity (i.e. well not developed properly, improper well construction, iron, etc.) will be investigated if no sample is collected, and a plan will be developed and implemented to address the elevated turbidity.

All sampling equipment, including pumps and cells, etc. shall be decontaminated prior to each sample location. Pumps shall be subjected to daily and between-well decontamination procedures, as discussed in the procedure.

Preservation, sample bottles, and holding times for samples collected for chemical and radiological analysis shall be in accordance with the associated methods. The sampling crew will ship the samples the same day of sample collection via laboratory courier or overnight delivery service for either same day or next day delivery to the laboratory. Field quality control (QC) samples, including blind field duplicates, rinsate blanks, laboratory duplicates, and matrix spike/matrix spike duplicate samples will be collected at frequencies consistent with regulatory protocols.

5. DATA ANALYSIS AND REPORTING

Soil boring logs and well construction logs from new monitor well installation will be developed for each of the three underlying aquifers and added to the site database to further clarify the Pearce Creek site conceptual model. Water level data will be used to generate groundwater flow contours. This will be done on a continuing basis to identify whether any changes in groundwater flow take place over time. When sufficient groundwater level data has been collected the USACE will evaluate differences in groundwater levels relative to pre-construction data. Noticeable differences may provide an indication as to whether groundwater levels in one area are substantially different compared to those in other areas. Transducer data will be used to generate graphs of groundwater elevation vs. time. This will allow evaluation and comparison of groundwater levels in the Magothy aquifer before, during, and after a dredging operation.

Laboratory results will be reported in a legally defensible USEPA Contract Laboratory Program (CLP)-type data package, including raw data that can be validated by an external third party. Data shall be maintained in an electronic format that can be imported to an Access database to permit rapid selection and mathematical manipulation of data. Electronic Data Deliverables (EDDs) compliant with the USACE's Automated Data Review (ADR) specification will also be obtained from the laboratory. These deliverables will allow the project data review chemist to complete an automated review of the laboratory data through the ADR process, and apply data validation qualifiers for QC outliers based on results for selected laboratory and field QC samples. The ADR output files with the reviewed and qualified results will then be uploaded into the Environmental Data Management System (EDMS) database file for the project. These validated results will be utilized in the generation of project reports, and will incorporate a comparison with the Federal MCLs and SMCLs and MDE drinking water criteria.

The USACE will develop a database for the project, and generate trend plots of various groundwater analytical parameters at each well location. This will allow evaluation of groundwater chemistry changes over time.

6. SUBMITTALS

The USACE will provide MDE with a project summary report on an annual basis over the duration of the site monitoring activities. Site monitoring activities are intended to occur while site is active and for a period of time thereafter. This report will describe all work performed during the past year. It will include boring logs, well construction details, laboratory analytical results from groundwater samples, water level readings, groundwater contour maps, site figures showing monitor well and piezometer locations, and other data or figures that are appropriate for the work completed during the year. The reports will include recommendations for future actions, if appropriate, including recommended modifications to the monitoring plan as more groundwater data is collected. With the exception of the initial report in 2017, annual reports will be submitted to MDE by February 1 of each year in accordance with Water Quality Certification requirements.

The USACE will submit the initial report in March 2017. This report will include a summary of previous sampling results from historical data collected before the USGS investigation, the USGS data, and analytical results from a subset of the wells sampled by the USACE in 2012. The March 2017 report will also include sampling results (2014 and 2016) from the 4 Upper Patapsco Deep wells installed on private properties in West View Shores and Bay View Estates (note that these wells will be abandoned when the public water supply is available to property owners so they are not a part of the long-term groundwater monitoring plan), and results from the existing wells sampled by the USACE in the fall 2016 (note that only a subset of the existing wells were sampled due to private property access agreements and access issues due to the ongoing liner construction). The USACE will develop a database of this historical data and prepare trend plots of the wells showing various parameters in groundwater over time.

The second annual report will be submitted in February 2018 and include data from the 18 new wells (scheduled for installation in the spring of 2017) and 19 existing wells that will be regularly sampled (twice/year in the spring and fall) as part of this Groundwater Monitoring Program. Updated groundwater trend plots, groundwater contour maps, and other pertinent information will be included in this and subsequent annual reports.

7. REFERENCES

1. U.S. Geological Survey, 2012. Hydrologic Framework, Hydrology, and Water Quality in the Pearce Creek Dredge Material Containment Area and Vicinity, Cecil County, Maryland, 2010-11.

2. Kleinfelder, 2013. Subsurface Exploration Report, Pearce Creek Confined Disposal Facility, Earleveille, Cecil County, MD

3. U.S. Army Corps of Engineers, 2013. Final Groundwater Model Report, Pearce Creek Dredge Material Containment Area, Cecil County, MD

8. TABLES AND FIGURES

Table 5-1: Monitoring Wells Included in Monitoring Plan

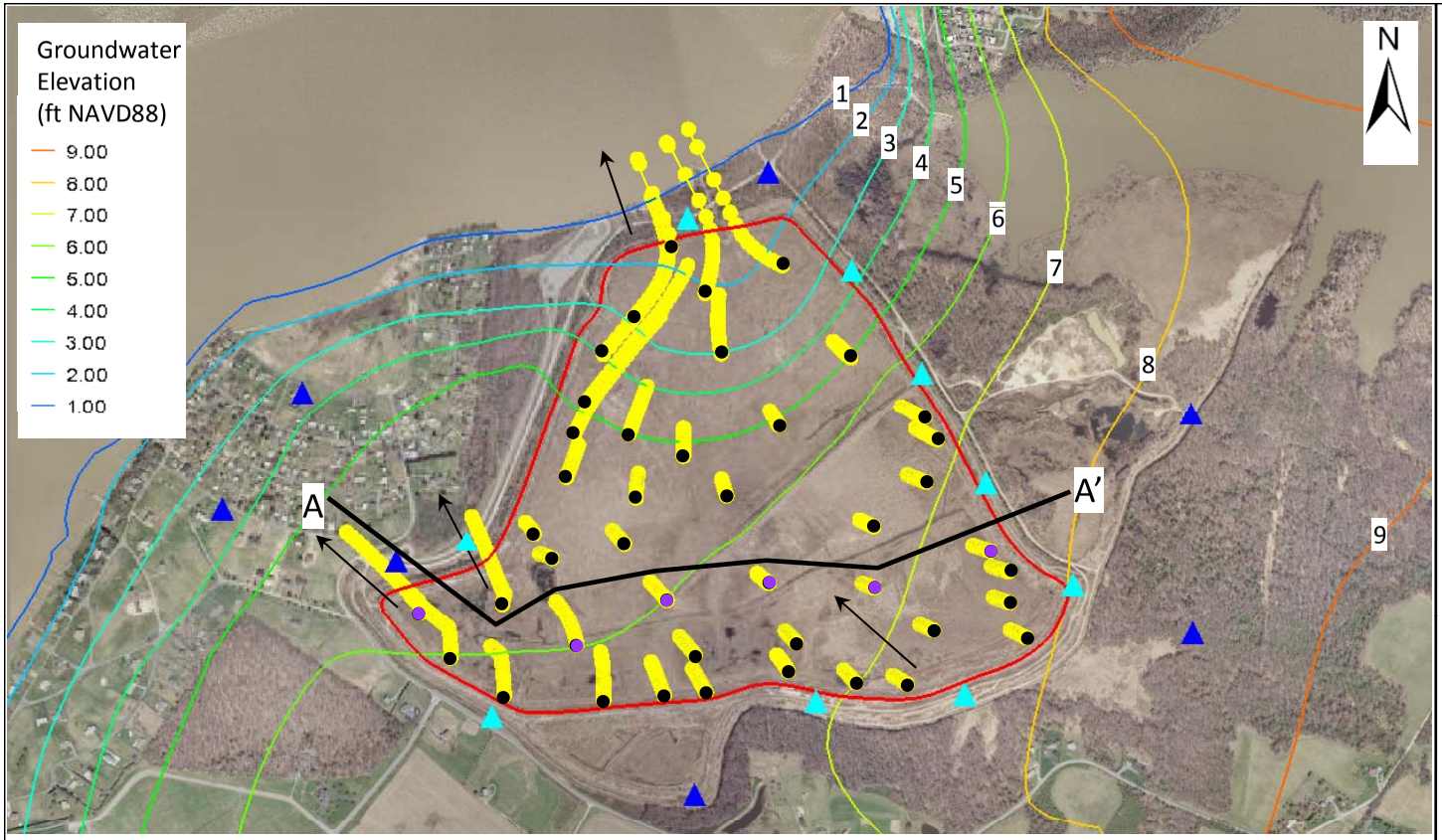
Existing/Proposed	Designation	Monitor Well/ Piezometer	Aquifer	Government/ Private Property
Existing	CSW-5	Monitor Well	Magothy	Private
	CSW-7		Up Pat Shallow	Private
	CSW-9		Up Pat Shallow	Government
	CSW-10		Up Pat Shallow	Government
	CSW-13		Magothy	Government
	7A		Magothy	Private
	7B		Up Pat Deep	Private
	8A		Up Pat Shallow	Private
	8B		Magothy	Private
	11A		Up Pat Deep	Government
	11C		Magothy	Government
	11R		Up Pat Shallow	Government
	12R		Magothy	Government
	13A		Up Pat Shallow	Government
	14R		Up Pat Shallow	Government
	16A		Magothy	Government
	18B		Up Pat Shallow	Government
	21S		Magothy	Government
	21D		Up Pat Shallow	Government
Proposed	CSW-27		Magothy	Government
	CSW-28		Up Pat Shallow	Government
	CSW-29		Magothy	Government
	CSW-30		Magothy	Government
	CSW-31		Up Pat Shallow	Government
	CSW-32		Magothy	Government
	CSW-33		Up Pat Shallow	Government
	CSW-34		Up Pat Deep	Government
	CSW-35		Up Pat Deep	Government
	CSW-36		Up Pat Deep	Government
	CSW-37		Up Pat Shallow	Government
	CSW-38		Up Pat Deep	Government
	CSW-39		Up Pat Deep	Government
	PZ-1	Piezometer	Magothy	Government
	PZ-2		Magothy	Government
	PZ-3		Magothy	Government
	PZ-4		Magothy	Government
	PZ-5		Magothy	Government
	Total = 37			

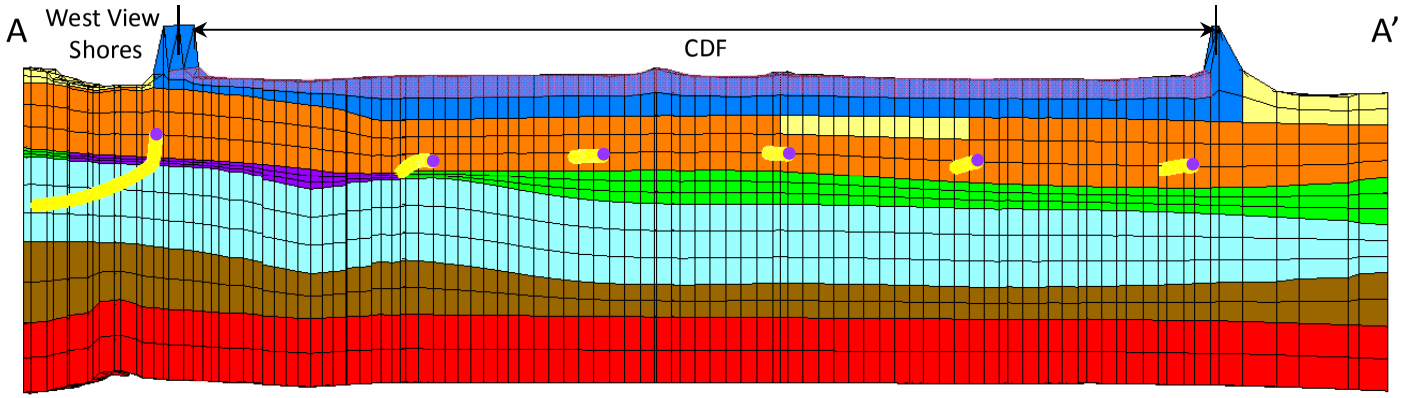
Table 5-2: Proposed New Monitor Wells at Pearce Creek CDF

No.	Well Desig	Desciption/Location	Diameter (inches)	Latitude/Longitude		Approx Depth Range (ft bgs)*	Aquifer
1	CSW-27	SW perimeter of CDF adjacent to Pond Neck Rd	4	39°25'25"	75°59'21"	35 to 65	Magothy
2	CSW-28	SW perimeter of CDF adjacent to Pond Neck Rd	4	39°25'25"	75°59'21"	40 to 120	Up Pat Shallow
3	CSW-29	W perimeter of CDF adjacent to Stemmers Run	4	39°25'41"	75°59'20"	30 to 50	Magothy
4	CSW-30	East perimeter of CDF	4	39°25'56"	75°58'48"	20 to 40	Magothy
5	CSW-31	East perimeter of CDF	4	39°25'56"	75°58'48"	100 to 150	Up Pat Shallow
6	CSW-32	East perimeter of CDF	4	39°25'41"	75°58'37"	50 to 80	Magothy
7	CSW-33	East perimeter of CDF	4	39°25'41"	75°58'37"	65 to 150	Up Pat Shallow
8	CSW-34	SW perimeter of CDF adjacent to Pond Neck Rd	4	39°25'25"	75°59'21"	200 to 220	Up Pat Deep
9	CSW-35	W perimeter of CDF by front gate	4	39°25'36"	75°59'28"	200 to 270	Up Pat Deep
10	CSW-36	SE perimeter of CDF	4	39°25'27"	75°58'37"	200 to 220	Up Pat Deep
11	CSW-37	North perimeter of CDF adjacent to Elk River	4	39°26'00"	75°59'3"	180 to 220	Up Pat Shallow
12	CSW-38	East perimeter of CDF	4	39°25'49"	75°58'42"	170 to 230	Up Pat Deep
13	CSW-39	Northwest perimeter of CDF	4	39°25'52"	75°59'16"	160 to 200	Up Pat Deep
14	PZ-1	North perimeter of CDF adjacent to Elk River	2	39°26'00"	75°59'3"	20 to 40	Magothy
15	PZ-2	East perimeter of CDF	2	39°25'49"	75°58'42"	55 to 80	Magothy
16	PZ-3	East perimeter of CDF	2	39°25'34"	75°58'29"	70 to 95	Magothy
17	PZ-4	South perimeter of CDF	2	39°25'27"	75°58'39"	35 to 85	Magothy
18	PZ-5	South perimeter of CDF	2	39°25'26"	75°58'52"	50 to 90	Magothy

Table 5-3: Existing Monitor Wells at Pearce Creek CDF

No.	Well Desig	Diameter (inches)	Screen Length (ft)	Well Screen Depth (ft bgs)	Aquifer
1	CSW-5	4	10	80 to 90	Magothy
2	CSW-7	4	10	81 to 91	Up Pat Shallow
3	CSW-9	4	10	115 to 125	Up Pat Shallow
4	CSW-10	2	15	100 to 115	Up Pat Shallow
5	CSW-13	4	5	48 to 53	Magothy
6	7A	4	5	11 to 16	Magothy
7	7B	4	5	217 to 222	Up Pat Deep
8	8A	4	10	79 to 89	Up Pat SHallow
9	8B	4	5	39 to 44	Magothy
10	11A	4	10	188 to 198	Up Pat Deep
11	11C	4	10	20 to 30	Magothy
12	11R	4	10	118.5 to 128.5	Up Pat Shallow
13	12R	4	5	35 to 40	Magothy
14	13A	4	10	135 to 145	Up Pat Shallow
15	14R	4	10	108 to 118	Up Pat Shallow
16	16A	4	10	30 to 40	Magothy
17	18B	4	10	77 to 87	Up Pat Shallow
18	21S	4	10	57 to 67	Magothy
19	21D	4	10	145 to 150	Up Pat Shallow





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Magothy below the CDF. Particles were placed on the bottom element of the aquifer.

Total track time = 25 yrs

Section A-A' is along several selected particle tracks. Most particles stay within the Magothy Aquifer. Where the confining unit is thin in the southwest, the particles pass into the Upper Patapsco Shallow Aquifer.

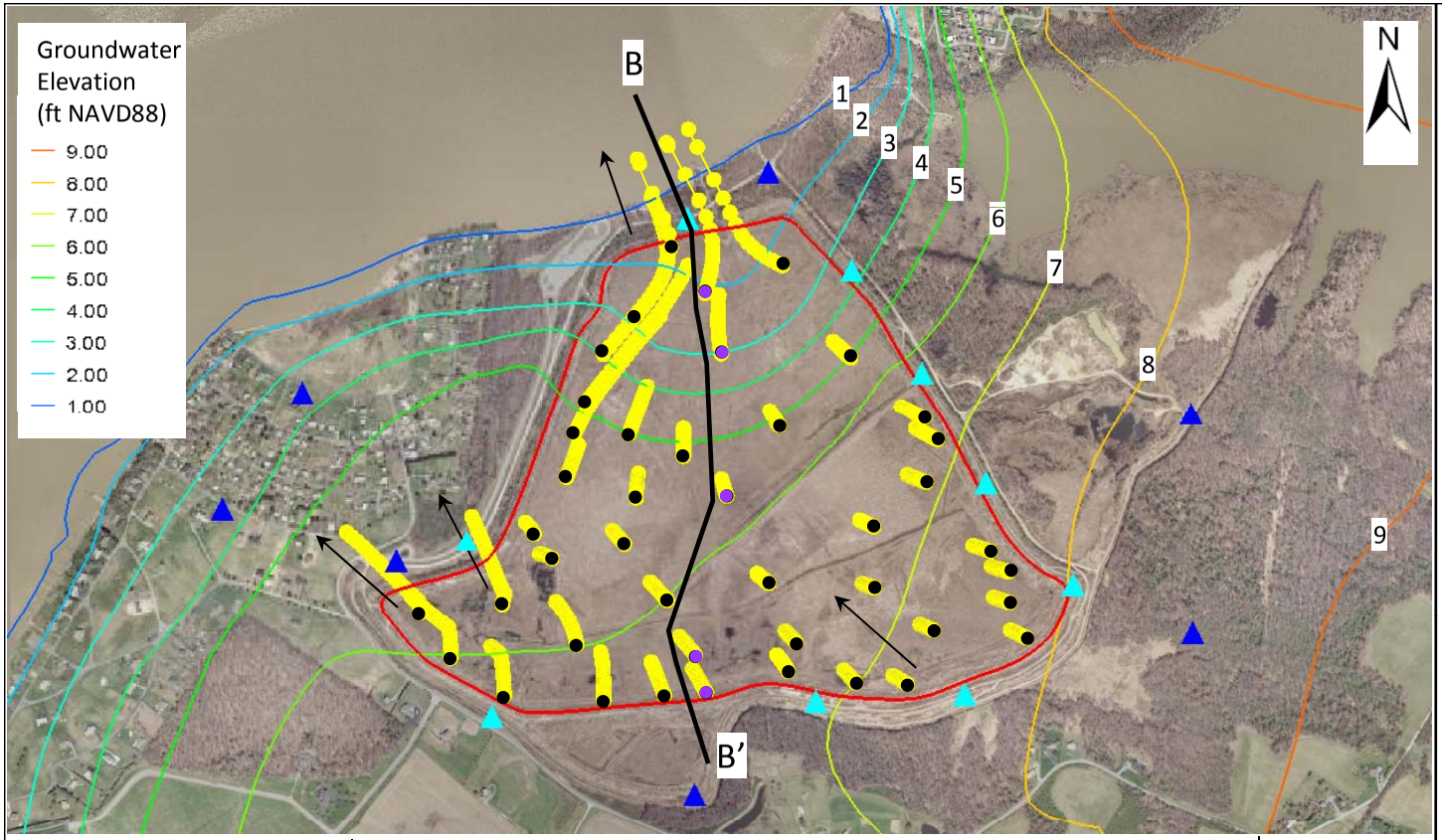
This figure is comparable to Figure 6.14 in the Groundwater Modeling Report that shows Operating Conditions without the liner.

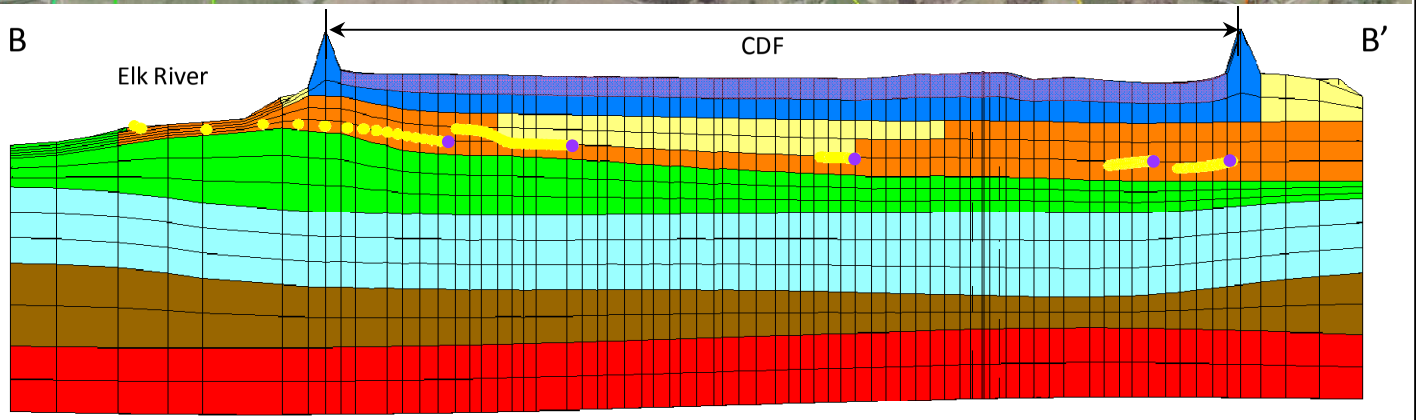
Particle Forward Tracks from Magothy Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-1a

February 2015





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Magothy below the CDF. Particles were placed on the bottom element of the aquifer.

Total track time = 25 yrs

Section B-B' is along several selected particle tracks. Most particles stay within the Magothy Aquifer. Where the confining unit is thin in the southwest, the particles pass into the Upper Patapsco Shallow Aquifer.

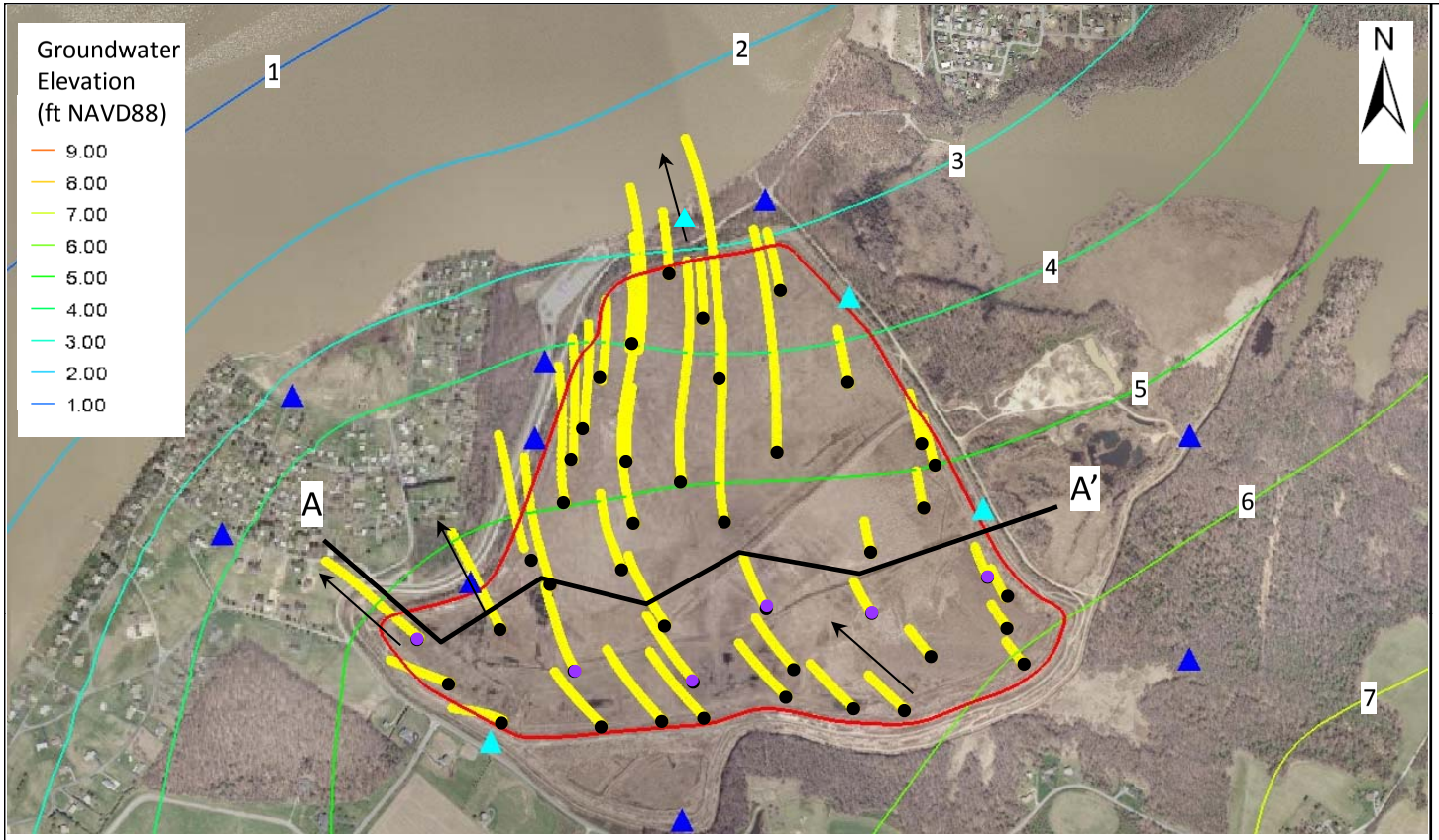
This figure is comparable to Figure 6.14 in the Groundwater Modeling Report that shows Operating Conditions without the liner.

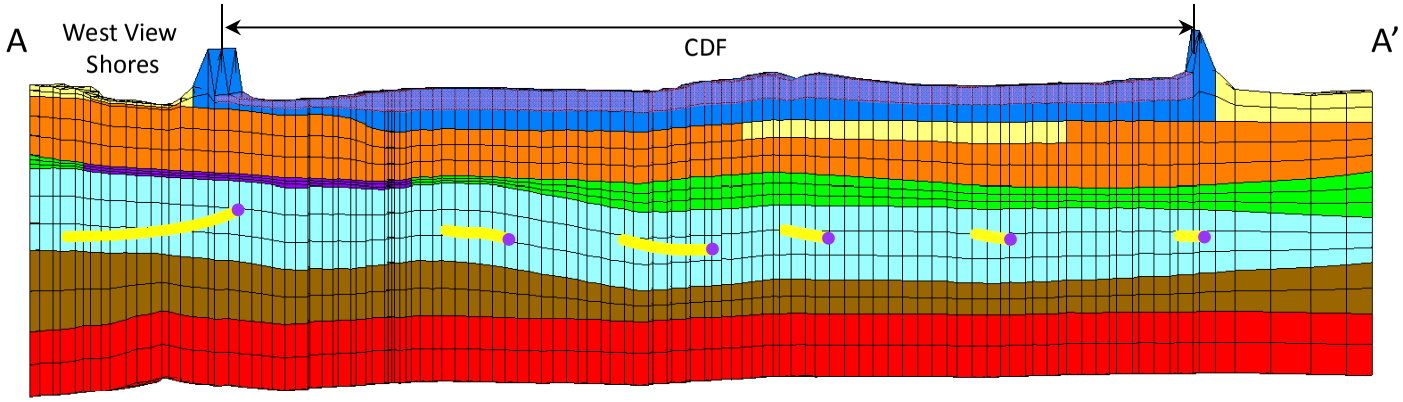
Particle Forward Tracks from Magothy Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-1b

February 2015





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Upper Patapsco Shallow Aquifer below the CDF. Particles were placed on the middle element of the aquifer.

Total track time = 25 yrs

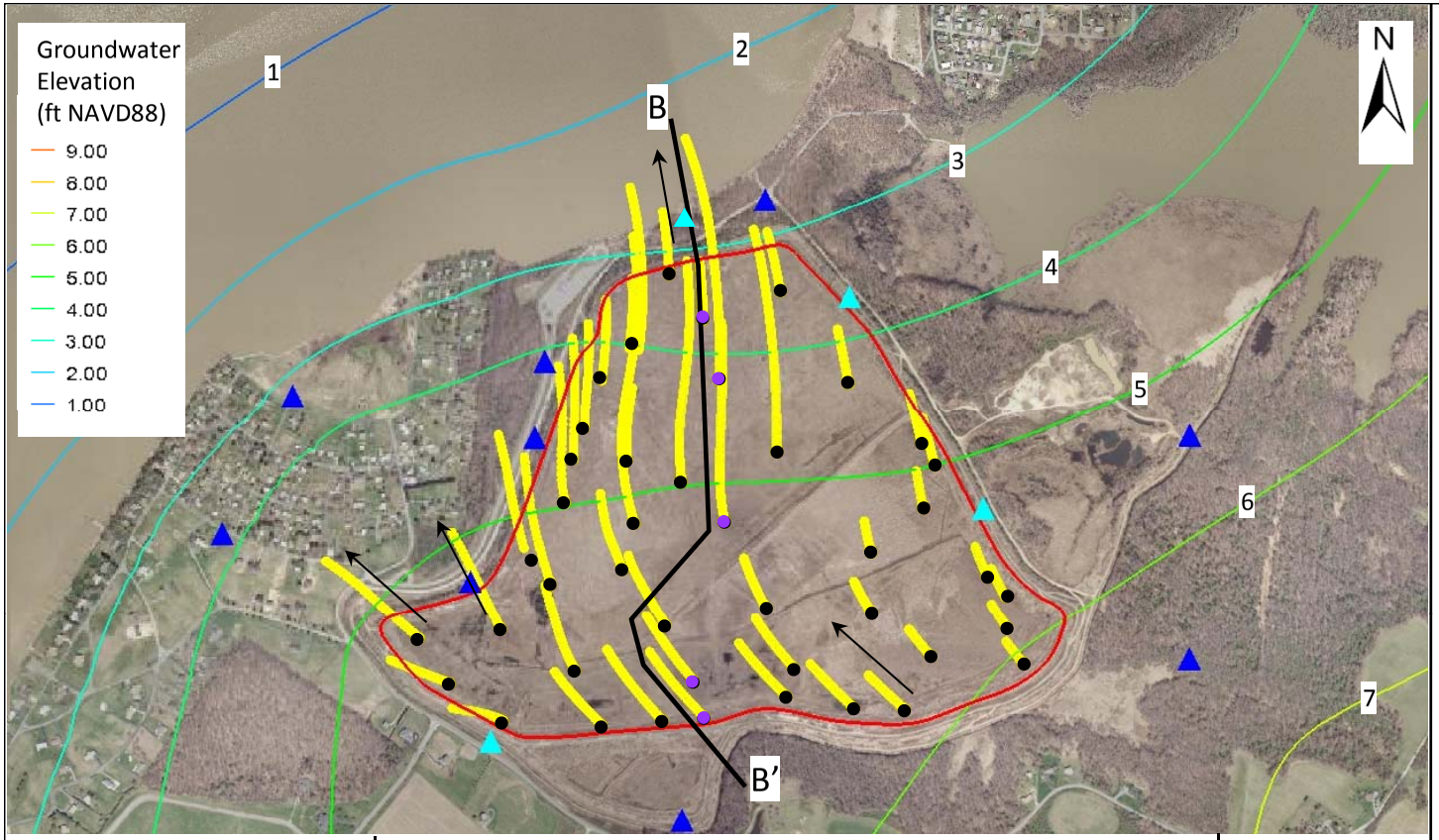
Section A-A' is along several selected particle tracks. The particles stay within the Upper Patapsco Shallow Aquifer. Particles that move the furthest are closest to the location where the Upper Confining Unit is thin or not present.

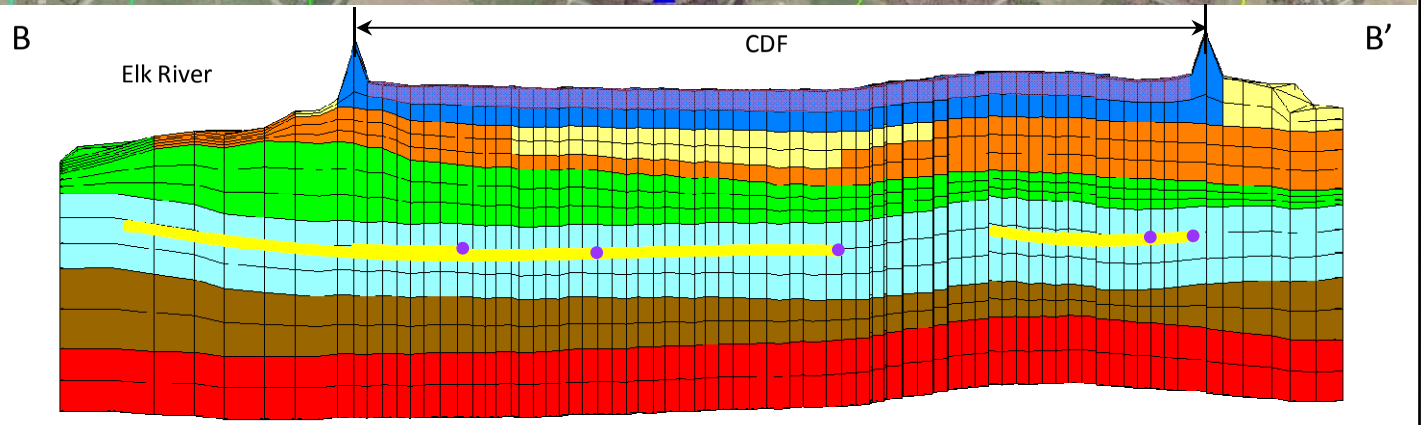
Particle Forward Tracks from Upper Patapsco Shallow Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-2a

February 2015





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Upper Patapsco Shallow Aquifer below the CDF. Particles were placed on the middle element of the aquifer.

Total track time = 25 yrs

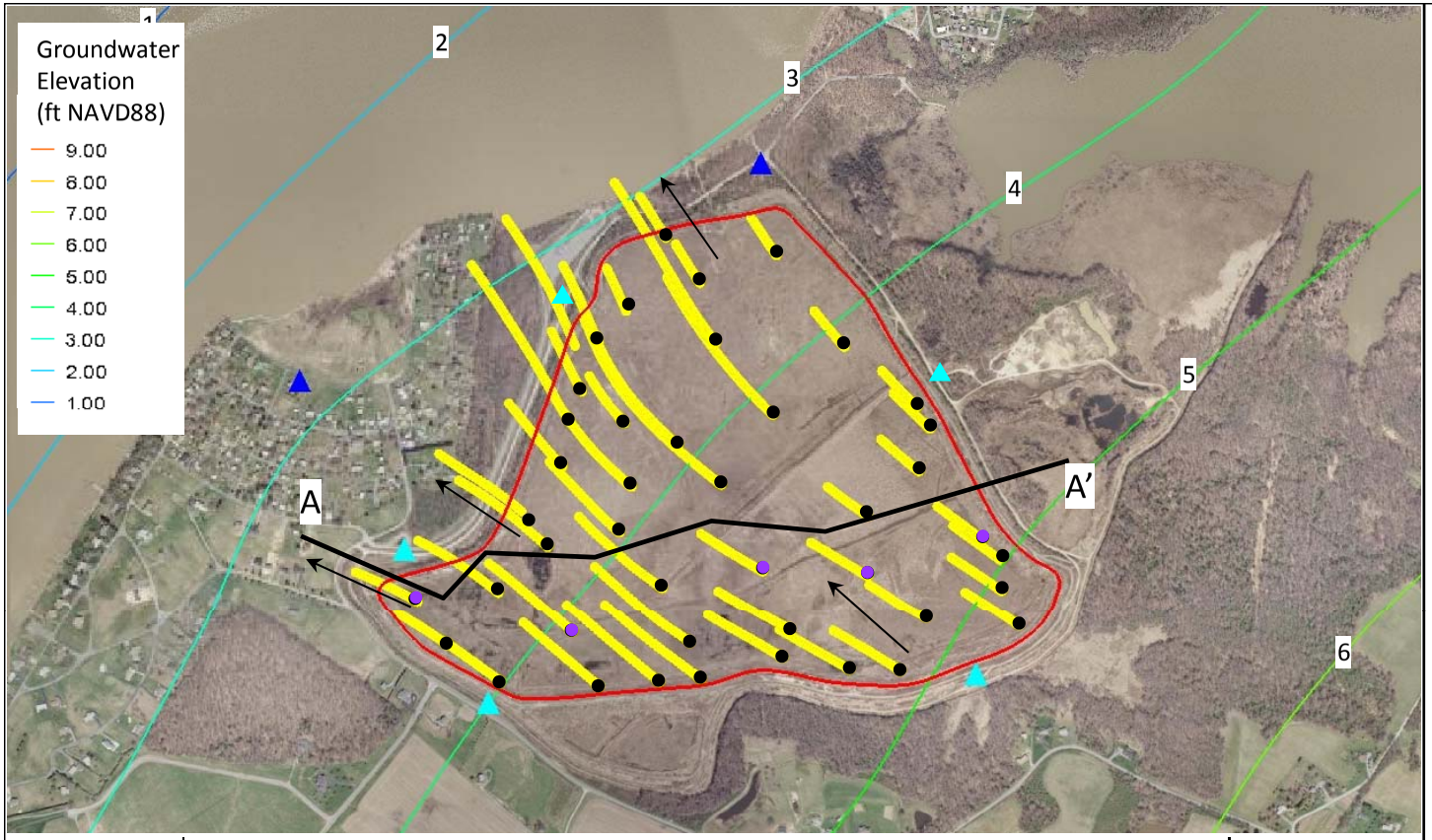
Section B-B' is along several selected particle tracks. The particles stay within the Upper Patapsco Shallow Aquifer.

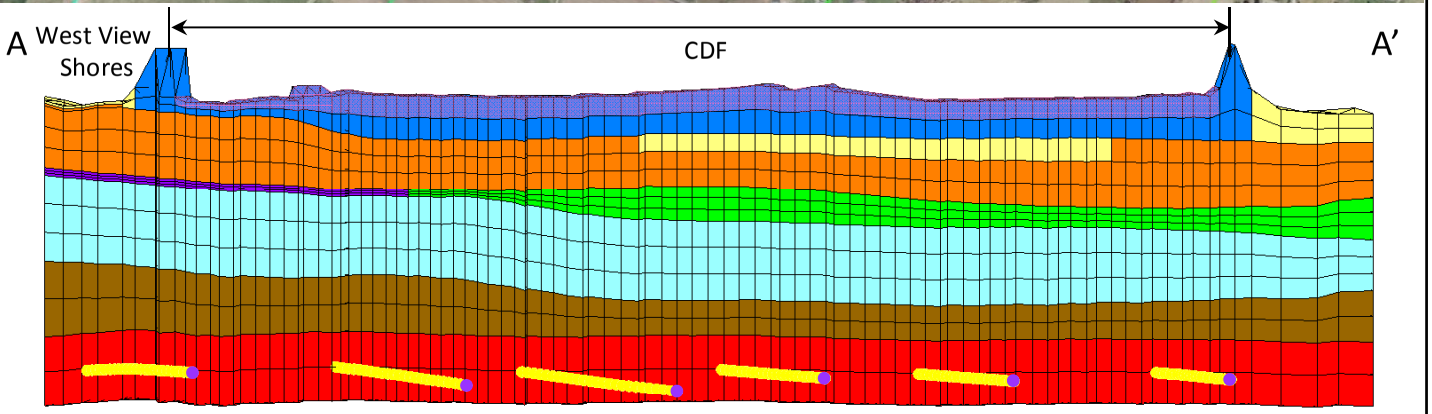
Particle Forward Tracks from Upper Patapsco Shallow Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-2b

February 2015





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Upper Patapsco Deep Aquifer below the CDF. Particles were placed on the bottom element of the aquifer.

Total track time = 25 yrs

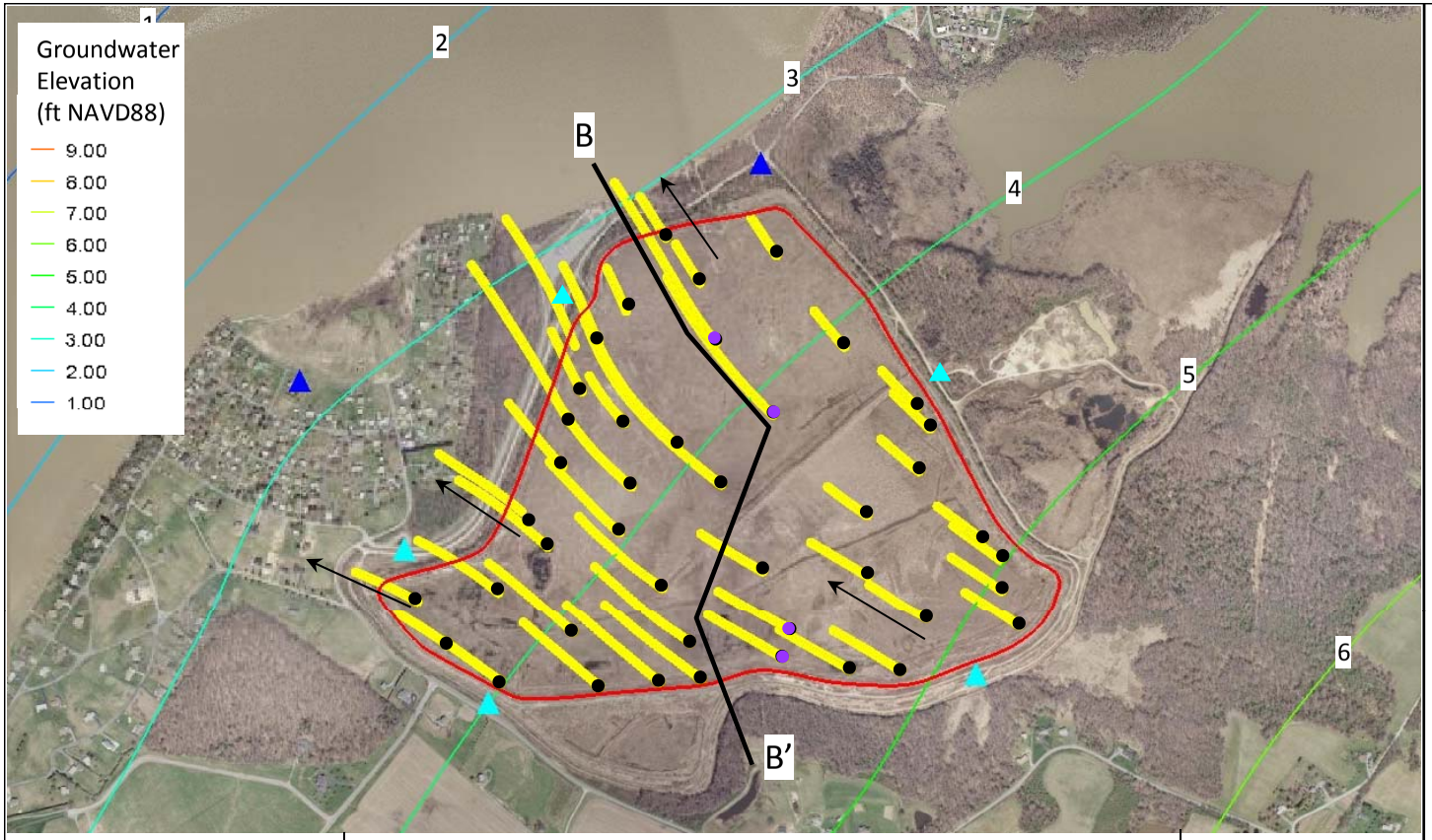
Section A-A' is along several selected particle tracks. The particles stay within the Upper Patapsco Deep Aquifer.

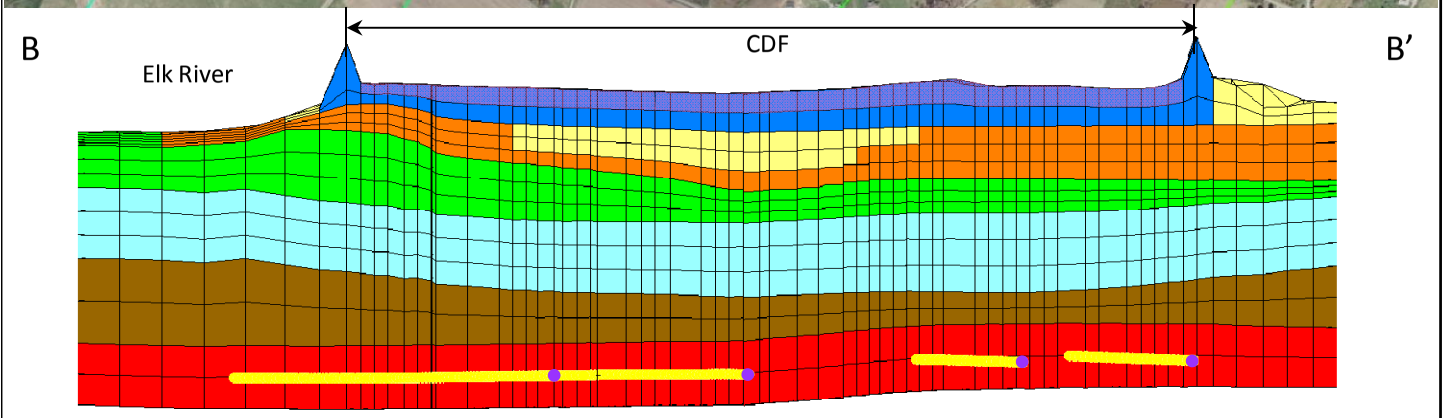
Particle Forward Tracks from Upper Patapsco Deep Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-3a

February 2015





Cross Section Legend:

- Surficial Deposits
- Magothy Aquifer
- Upper Confining Unit
- Upper Patapsco Shallow Aquifer
- Lower Confining Unit
- Upper Patapsco Deep Aquifer
- Upper Confining Unit thin or not present
- Impermeable Liner
- Dredge Material above Liner

Plan View Legend:

- Particle release point
- Particle track (each pt = 1 yr)
- Selected particle track release points
- Pearce Creek CDF outline
- Existing Monitoring Well
- New Monitoring Well

Notes:

Particles released from the Upper Patapsco Deep Aquifer below the CDF. Particles were placed on the bottom element of the aquifer.

Total track time = 25 yrs

Section B-B' is along several selected particle tracks. The particles stay within the Upper Patapsco Deep Aquifer.

Particle Forward Tracks from Upper Patapsco Deep Aquifer: Full Liner Conditions

Addendum to Final Groundwater Modeling Report

Figure 5-3b

February 2015

US Army Corps of Engineers
Philadelphia District

DESIGNED BY
DRAWN BY
CHECKED BY
QUALITY CONTROL BY
SUBMITTED BY
APPROVED BY
DATE
CONTRACT NUMBER
FILE NAME
DESCRIPTION

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DELAWARE RIVER TO CHESAPEAKE BAY
DELAWARE AND MARYLAND
PEARCE CREEK CONFINED DISPOSAL FACILITY
MODIFICATIONS
PLAN - MAGOTHY MONITORING

SHEET NUMBER
5-4

US Army Corps of Engineers
Philadelphia District

DELAWARE RIVER TO CHESAPEAKE BAY
DELAWARE AND MARYLAND
PEARCE CREEK CONFINED DISPOSAL FACILITY
MODIFICATIONS
PLAN - UPPER PATAPSCO SHALLOW MONITORING

SHEET NUMBER
5-5

1 PLAN - UPPER PATAPSCO DEEP MONITORING
SCALE = 1" = 200'

0 100 200 400
SCALE IN FEET

LEGEND

COORDINATE MARKER	+
EXISTING MONITORING WELL	
PROPOSED MONITORING WELL	

NOTES:

1. TOPO SHOWN WAS DEVELOPED USING LIDAR DATA FROM 2014.

US Army Corps of Engineers
Philadelphia District

MARK	ACTION	DESCRIPTION	DATE	BY

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
PHILADELPHIA, PA 19107-3390
www.nap.usace.army.mil

DWN BY: SJP | DESIGNED BY: MFM | ISSUE/RELEASE DATE: 100% 27 JAN 15
CKD BY: - | REVIEWED BY: - | PROJ. NUMBER: -
SOLICITATION NUMBER: RFP W912BU-1X-XXXX
DWG SCALE: 1"=200' | CONTRACT NUMBER: -
DWG. SIZE: 30"x42" Arch E1 | FILE NAME: 5-6 PLAN - UPPER PATAPSCO DEEP MONITORING.dwg

DELAWARE RIVER TO CHESAPEAKE BAY
DELAWARE AND MARYLAND
PEARCE CREEK CONFINED DISPOSAL FACILITY
MODIFICATIONS
PLAN - UPPER PATAPSCO DEEP MONITORING

SHEET NUMBER
5-6

ATTACHMENT B

Table 1

Target Sampling Coordinates for Pearce Creek Lake and Elk River Exterior Monitoring Locations

Location	Northing[a]	Easting[a]
Pearce Creek Lake (PCL)		
PCL-01	645421.62	1601449.92
PCL-02	645673.92	1602091.27
PCL-03	645728.45	1602660.52
PCL-04	646083.56	1603384.24
PCL-05	644981.31	1603730.92
PCL-06	645893.42	1604042.10
PCL-07	645815.78	1601048.96
PCL-REF	645766.29	1606146.22
Elk River (ER)		
ER-01	646646.48	1599844.56
ER-REF	648252.23	1597392.63

Notes:

a. Coordinates are in Maryland State Plane, North American Datum of 1983.

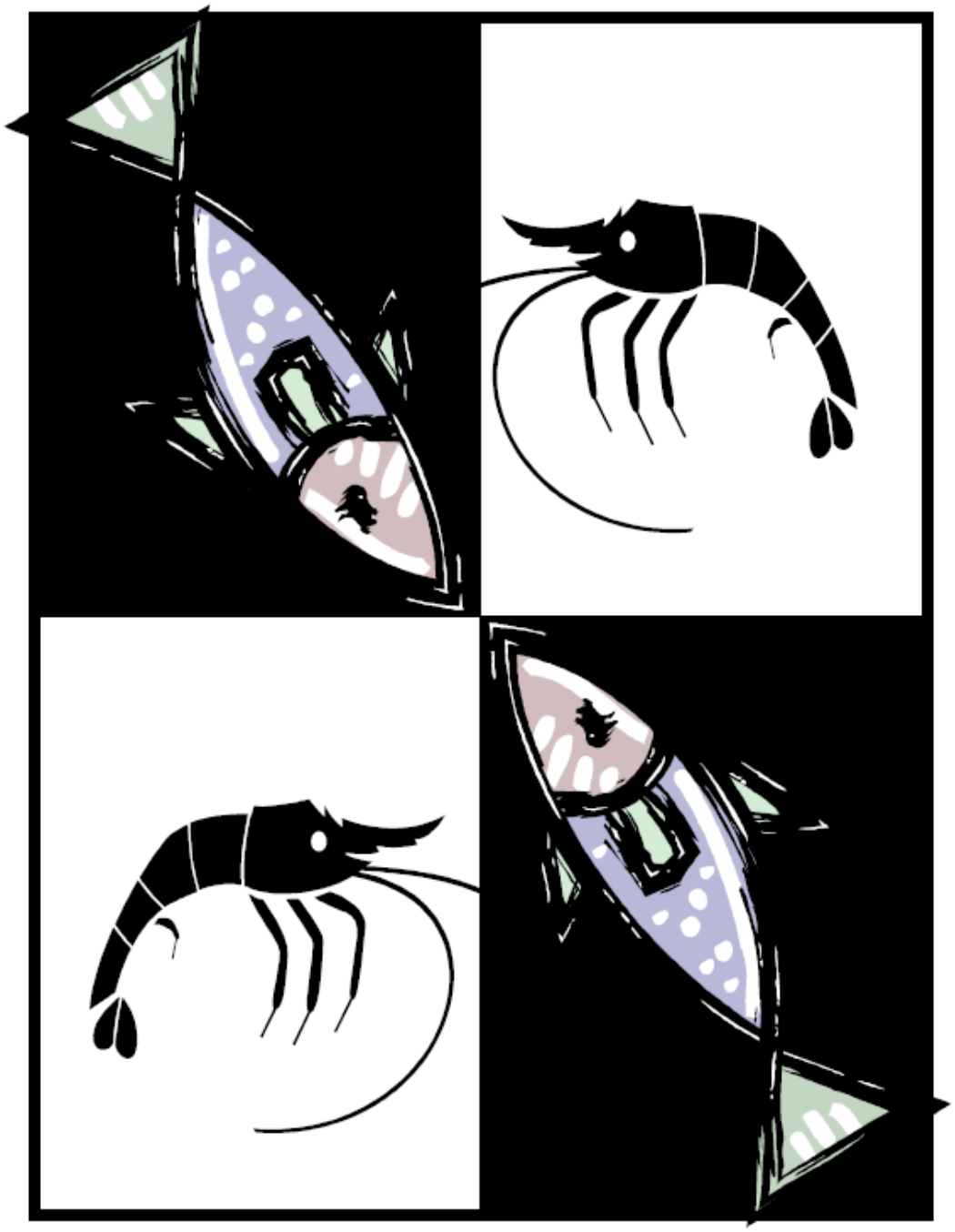
REF: reference location

ATTACHMENT C

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101 • http://www.mde.state.md.us

WASTEWATER PERMITS PROGRAM

EFFLUENT BIOTOXICITY TESTING PROTOCOL FOR INDUSTRIAL AND MUNICIPAL EFFLUENTS



Revisions: 1/23/2019, 5/14/2018, 12/14/2012

The Department's biomonitoring program continues to evolve. As such, this document will be periodically updated to reflect changes in toxicity testing methodologies, toxicity reduction evaluation protocols, and other issues related to the control of toxic discharges.

I. PROGRAM DESCRIPTION

Since 1980, the Maryland Department of the Environment (MDE) has utilized whole effluent toxicity (WET) testing to assess acute and chronic toxicity in discharges to Maryland surface waters. In 1987 the emphasis greatly increased with the addition of the State Biomonitoring Laboratory. The current effort relies on toxicity testing of effluents performed by the permittee. In addition to these routine toxicity testing efforts, MDE may request dischargers to perform toxicity testing outside of the permit process. All tests consist of separate experiments using both a vertebrate (fish) and an invertebrate (crustacean) as the test species.

A finding of no toxicity in the effluent of a facility does not relieve the permittee from the obligation to provide best available treatment technology or to comply with water quality standards. In all cases, MDE reserves the authority to require additional biotoxicity testing and a toxicity reduction evaluation (TRE). This authority to require biomonitoring appears in COMAR 26.08.03.07 entitled "Control of the Discharge of Toxic Substances to Surfaces Waters". Specific provisions are found in sections A and D.

A. Permit Required Toxicity Testing

Biotoxicity testing is required in new or renewed discharge permits for all major and selected non-major dischargers. Maryland regulation (COMAR 26.08.03.07D(1)) specifically requires the following:

D. Applicability to Dischargers.

(1) Dischargers Required to Conduct Monitoring for Toxic Substances. The Department shall require any permittee who has a discharge that falls into one of the following categories to perform biological or chemical monitoring for toxic substances:
  (a) A POTW with a pretreatment program established in accordance with COMAR 26.08.08;
  (b) An industrial discharger or POTW treatment plant with a wastewater flow greater than or equal to 1,000,000 gallons per day;
  (c) A discharger whose discharge has demonstrated actual or potential toxicity; or
  (d) A discharger whose discharge the Department has reason to believe may cause toxicity as determined by an evaluation of manufacturing processes, indirect discharges, treatment processes, effluent or receiving water data, or other relevant information.

Maryland regulation (COMAR 26.08.03.07D(2)) specifically requires the following:

(2) NPDES Permit Monitoring Requirements.

(a) A discharger identified in §D(1) of this regulation shall have requirements for toxic substance monitoring included in its permit at the time of permit issuance or reissuance.

(b) Modifications to these requirements may be allowed on a case-by-case basis if the:

(i) Specific conditions of the discharge suggest that a full scale toxics monitoring program is not necessary; or

(ii) Characteristics of the receiving water indicate that a full scale toxics monitoring program is not needed.

(c) Data submitted under any previous toxic substance monitoring program may be used to satisfy these requirements if the data is indicative of the current process and treatment conditions.

(d) Any toxic substance monitoring, including test protocols, shall be approved by the Department before initiation of the testing. All data generated shall be within the quality assurance and quality control specifications of the test protocol.

(e) Measurements below the minimum level may be reported as BML (below minimum level).

(f) If the Department determines through the monitoring described in §D(1) of this regulation, that a discharge causes or has the potential to cause the discharge of toxic substances or an impact on surface waters, the Department may modify the discharge permit to require the discharger to collect data to verify or rule out the existence of an impact from a toxic substance.

NPDES biotoxicity testing requirements for major facilities generally consist of four quarterly tests to be conducted during the first year of the permit for industrial facilities. As required by 40 CFR 122.21(j)(5)(iv), municipal facilities must submit (A) results of a minimum of four quarterly tests for a year, from the year preceding the permit application; or (B) results from four tests performed at least annually in the four and one half year period prior to the application (Appendices A & B). The Department has chosen option B as the standard permit requirement. Where the discharge flow is less than 10% of the receiving water flow, the permit requirements usually consist of three acute tests and one chronic test. Where the effluent flow is greater than 10% of the receiving water flow, chronic testing is emphasized. In estuarine waters where the discharge flow exceeds 10% of the receiving water flow, the permittee is required to use estuarine test organisms.

NPDES permit requirements for dischargers of lower concern where there is reason to believe a potential for toxicity exists generally consist of two quarterly acute tests to be conducted during the first year of the permit (Appendices C & D). Chronic, instead of acute, tests may be required in sensitive discharge situations such as discharges to intermittent streams.

Additional effluent toxicity testing beyond that specifically described in the permit may be required by MDE of dischargers upon findings of toxicity or upon the performance of testing

inconsistent with the permittee's approved biomonitoring study plan for that facility. A permittee will be required to repeat the permit required toxicity testing when initial findings of acute toxicity are not confirmed (COMAR 26.08.03.07E(4)f). The reporting of permittee test results must be consistent with MDE's document entitled "Reporting Requirements for Effluent Biomonitoring Data" (Appendix E). A toxicity reduction evaluation (TRE) is required when a review of the data indicates unacceptable toxicity.

The test organisms utilized in permittee toxicity testing are those recognized in federal guidance or local species approved by the Department (Appendix F).

II. INTERPRETATION OF BIOTOXICITY MONITORING RESULTS

Acute toxicity is broadly defined as the ability of a substance to cause deleterious effects to living organisms during a short-term exposure. In practice, acute toxicity testing of effluents involves the measurement of lethality or immobilization of aquatic organisms exposed to several effluent dilutions for time periods usually lasting up to 48 hours. The results of an acute toxicity test are expressed as an LC_{50} (effluent concentration at which 50% of the test organisms die during the test) or EC_{50} (effluent concentration at which 50% of the organisms are killed or disabled during the test). In order to calculate an LC_{50} (or EC_{50}), at least one of the test concentrations must cause more than 50% mortality (or immobilization) and at least one of the test concentrations must cause less than 50% mortality (or immobilization). The lower the LC_{50} or EC_{50}, the more toxic the effluent. For example, an LC_{50} (or EC_{50}) of greater than 100% means that full strength effluent (100%) did not kill (or immobilize) at least half the test organisms. An LC_{50} (or EC_{50}) of 50% means that half strength effluent (50%) killed (or immobilized) 50% of the test organisms.

Chronic toxicity testing is broadly defined as the ability of a substance to cause deleterious effects to living organisms during a long-term exposure. In practice, chronic toxicity testing of effluents usually involves the measurement of survival, growth, reproduction, and hatchability of aquatic organisms exposed to several effluent dilutions for time periods lasting up to 7 days. Generally, the "sub-lethal" endpoints of growth, reproduction, and hatchability are more sensitive indicators of chronic toxicity than survival. Because chronic toxicity tests involve the measurement of more sensitive endpoints over longer exposure periods compared to acute tests, chronic tests are considered to be more sensitive for measuring effluent toxicity.

The results of chronic toxicity testing are generally expressed as the NOEC (highest concentration at which no observable effect occurred), LOEC (the lowest concentration at which an observable effect occurred), Chronic Value (the geometric mean of the NOEC and LOEC) and the IC_{25} (effluent concentration which causes a 25% reduction in growth or reproduction and survival). In addition to these measures of chronic toxicity, acute toxicity data, in the form of LC_{50}s or EC_{50}s, can be gathered during the first 48 hours of chronic toxicity testing.

A. Acute Toxicity of Effluents

For purposes of determining the acute toxicity of effluents, the following criteria apply.

1. An effluent is considered to be acutely toxic when its 48-hour LC_{50} or EC_{50} (as determined from acute or chronic toxicity testing) is 100% or less.

2. An effluent is generally considered not acutely toxic when its 48-hour LC_{50} or EC_{50} (as determined from acute or chronic toxicity testing) is greater than 100%.

Upon consistent findings of acute toxicity, a permittee shall be required to conduct a TRE (see section III).

B. Chronic Toxicity of Effluents

For purposes of determining the chronic toxicity of effluents, the following criteria apply.

1. An effluent is considered to be chronically toxic when its IC_{25} is less than or equal to the in-stream waste concentration.[1]

2. An effluent is generally considered not chronically toxic when its IC_{25} is greater than the in-stream waste concentration.

Upon consistent findings of chronic toxicity, a permittee shall be required to perform a TRE (see Section III).

III. Toxicity Reduction Evaluation (TRE)

When effluent toxicity is confirmed, the discharger is required to perform a TRE. A TRE is an investigation conducted to identify the cause(s) of effluent toxicity or isolate the source(s) and determine the effectiveness of control options, implement the necessary control measures and then confirm the reduction in toxicity (see appendix H). TREs range widely in complexity. They may be as simple as the dechlorination of municipally supplied noncontact cooling water in response to measurements of toxic levels of chlorine. Alternatively, they may involve the performance of an in-depth investigation to determine the source or type of toxicity, evaluate control measures, and implement those selected. Guidance documents covering the various tiers, phases, and other aspects of a TRE are under continuous development by the EPA and its contractors (see Section V).

IV. Permit Limitations and Compliance Schedule

MDE will include a specific limitation for effluent toxicity and a compliance schedule for the elimination of the effluent toxicity in the facility's discharge permit as indicated below:

[1] $IWC = Q_D/(Q_D+Q_{RW})x100$ where $Q_{RW} = 30Q5$

Situations in which a Permit Limitation and Compliance Schedule will be included.

When issuing a NPDES permit renewal, MDE will include a permit limitation for effluent toxicity when toxicity testing demonstrates a reasonable potential for the discharge to cause or contribute to a violation of water quality standards. Reasonable potential is determined by the Department as at least one test from all current test results showing toxicity as defined in Sections II. A & B, unless there are a sufficient number of tests over time that provide for a statistical basis for concluding no reasonable potential. A compliance schedule could be considered, if necessary, which would outline the activities needed to eliminate the toxicity. During the compliance schedule period, the permittee is required to conduct a TRE as specified in Section III above, unless the basis of the schedule is to implement significant treatment system upgrades or major process modifications which are expected to address the toxicity. If the results of the TRE identify the chemical specific parameter(s) causing the toxicity, the whole effluent toxicity permit limit could be replaced with the chemical specific effluent limitation(s).

As described in the "Determination of discharge permit WET limitations" section below, the determination of discharge permit limitations may incorporate dilution resulting from mixing zone allowances in accordance with COMAR 26.08.02.05. However, when determining whether a TRE must take place to eliminate the toxicity under COMAR 26.08.03.07.E(4)(e), dilution is not considered when determining if an effluent is acutely toxic.

As indicted in I.A above, 40 CFR 122.21(j)(5)(iv) requires that municipal facilities must submit (A) results of a minimum of four quarterly tests for a year, from the year preceding the permit application; or (B) results from four tests performed at least annually in the four- and one-half year period prior to the application. Permit limitations expressed in toxic units and a compliance schedule will be included in a municipal facility's discharge permit when any of the four 40 CFR 122.21(j)(5)(iv) required tests show toxicity. A component of the compliance schedule will require eighteen months of quarterly whole effluent toxicity testing resulting in six individual test that are the same type of test that determined the original toxicity. If none of the six tests show toxicity, the permittee may request a permit modification to remove the permit limit and the compliance schedule. If any of the six tests are toxic, the permit limit will go into effect and a TRE will begin to discover the source of the toxicity and explore solutions to remove that toxicity.

To address federal NPDES requirements for WET testing and limits, MDE shall implement permit limits in a new or renewal permit when a WET test result shows reasonable potential for toxicity unless it can be demonstrated that the source of toxicity has been eliminated, inappropriate test procedures were utilized, or the source has been controlled via a chemical specific permit limitation. Where reasonable potential has been assumed based on one test result, the permit shall include a WET limit effective within the term of the permit unless the

effluent shows no toxicity in six follow-up quarterly tests.

Determination of discharge permit WET limitations

The determination of discharge permit limits may incorporate dilution resulting from mixing zone allowances in accordance with COMAR 26.08.02.05.

Acute Conditions

To protect aquatic life against acute effects, the ambient toxicity should be less than 1.0 acute toxic unit (TU_a) where a TU_a is defined as 100 divided by the LC_{50} value resulting from the first 48 hours of a valid acute or chronic toxicity test.

Chronic Conditions

To protect aquatic life against chronic effects, the effluent's IC_{25} shall be greater than the in-stream waste concentration (IWC).

Using the formula for IWC shown in footnote 1 and the requirement that the effluent's IC_{25} shall be greater than the in-stream waste concentration (IWC) the below relationship for allowable effluent toxicity can be expressed in chronic toxic units (TU_c) where a TU_c is defined as 100 divided by the IC_{25} value resulting from a valid chronic toxicity test.

For effluent not to be chronically toxic

$IC_{25} > IWC$

$100/TU_c > IWC$

$100/[(TU_c)(IWC)] > 1$

$100/[\{TU_c\}\{Q_D/(Q_D + Q_{RW})\}\{100\}] > 1$

Therefore Allowable Effluent Chronic Toxicity = $TUc < (Q_D + Q_{RW})/Q_D$

Example WET Limit Calculations - for discharge situations when 1/3 of the receiving stream flow is the limiting factor for determination of the mixing zone for the effluent.

Acute WET Limit

Using the below mass balance equation

$C_R = [(C_D)(Q_D) + (C_{RW})(Q_{RW})]/[Q_D + Q_{RW}]$

Where:

Facility Flow = Q_D = 6.8 MGD = 10.52 cfs
Facility Toxicity = C_D
Upstream Receiving Stream 7Q10 flow = Q_{RW} = 45.81 cfs
Allowable Acute Mixing Zone flow = (1/3)(Q_{RW}) = (1/3)(45.81 cfs) = 15.27 cfs
Assumed Upstream Receiving Stream Toxicity = C_{RW} = 0 TU_a
Downstream Receiving Stream Toxicity = C_R
Allowable C_R < 1.0 TU_a

Assuming Allowable In-Stream Toxicity = 0.9999 TU_a

$0.9999\ TU_a = [(C_D)(Q_D) + (C_{RW})(Q_{RW})]/[Q_D + Q_{RW}]$

$0.9999\ TU_a = [(C_D)(10.52\ cfs) + (0\ TU_a)(15.27\ cfs)]/[10.52\ cfs + 15.27\ cfs]$

Permit Acute WET Limit = C_D < 2.45 TU_a

Chronic WET Limit

Using the below equation for allowable effluent chronic toxicity

Allowable Effluent Chronic Toxicity = TUc < $(Q_D + Q_{RW})/Q_D$

Where:

Facility Flow = Q_D = 6.8 MGD = 10.52 cfs
Facility Toxicity = C_D
Upstream Receiving Stream 30Q5 flow = Q_{RW} = 23.75 cfs
Assumed Upstream Receiving Stream Toxicity = C_{RW} = 0 TU_C

Permit Chronic WET Limit = C_D = TUc < $(Q_D + Q_{RW})/Q_D$

Permit Chronic WET Limit = C_D = TUc < (10.52 cfs + 23.75 cfs)/10.52 cfs

Permit Chronic WET Limit = C_D < 3.26 TUc

V. Relevant Guidance Documents

Maryland Department of the Environment, Water Management Administration. "Reporting Requirements for Effluent Biomonitoring Data." 3/21/03

Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms Fourth Edition, EPA-821-R-02-013, October, 2002

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms Third Edition, EPA-821-R-02-014, October 2002

Generalized Methodology for Conducting Industrial Toxicity Reduction Evaluations (TREs). EPA/600/2-88/070. USEPA, March 1989

Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants. EPA/833B-99/002. USEPA, Office of Wastewater Management, Washington DC

Methods for Aquatic Toxicity Identification Evaluations - Phase I Toxicity Characterization Procedures. EPA-600/6-91/003. USEPA, Second Edition, February 1991

Methods for Aquatic Toxicity Identification Evaluations - Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA/600/R-92/080. USEPA, September 1993

Methods for Aquatic Toxicity Identification Evaluations - Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA-600/R-92/081. USEPA, September 1993

Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I. EPA/600/6-91/005. USEPA, June 1991

Appendix A

BIOMONITORING PROGRAM (Significant concern and effluent flow is greater than 10% of the receiving water low flow)

1. Within three months of the effective date of the permit, the permittee shall submit to the Department for approval a study plan to evaluate wastewater toxicity at Outfall by using biomonitoring. The study plan should include a discussion of:
   a. wastewater and production variability
   b. sampling & sample handling
   c. source & age of test organisms
   d. source of dilution water
   e. testing procedures/experimental design
   f. data analysis
   g. quality assurance/quality control
   h. report preparation
   i. testing schedule

2. For industrial facilities:
   The testing program shall consist of definitive quarterly chronic testing for one year. This testing shall be initiated no later than three months following the Department's acceptance of the study plan.

   For municipal facilities:
   The testing program shall consist of four quarters of definitive annual chronic testing. The testing events shall be conducted annually during January or February of each of the first four years after approval of the study plan. This testing shall be initiated no later than the January or February following the Department's acceptance of the study plan. If results from any of the required annual tests show toxicity in the effluent, the permittee shall repeat the required chronic test within 30 days as a follow-up test. If toxicity is observed from the results of the follow-up test, the permittee shall be subject to the requirements specified in Special Condition
II. D.10.

For Freshwater Receiving Stream

Each annual testing event shall include the Ceriodaphnia survival and reproduction test and the fathead minnow larval survival and growth test.

For Estuarine Receiving Stream

Testing shall include the sheepshead minnow (*Cyprinodon* variegatus) or inland silverside (*Menidia beryllina*) larval survival and growth tests and mysid shrimp (*Americamysis bahia* AKA *Mysidopsis bahia*) survival, growth, and fecundity

tests. Testing must include one vertebrate species and one invertebrate species. Test results shall be expressed as NOEC, LOEC, ChV, and IC_{25}.

3. The samples used for biomonitoring shall be collected at the same time and location as the samples analyzed for the effluent limitations and monitoring requirements for this outfall. For chlorinated effluents, samples shall be collected after dechlorination. The permittee shall collect 24-hour flow–proportioned composite samples unless the Department has given prior approval of an alternative sampling type.

4. The following EPA document discusses the appropriate methods:

For Freshwater Receiving Stream

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms Fourth Edition, EPA-821-R-02-013, October, 2002

For Estuarine Receiving Stream

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms Third Edition, EPA-821-R-02-014, October 2002

5. Test results shall be submitted to the Department within one month of completion of each set of tests.

6. Test results shall be reported in accordance with MDE/WMA "Reporting Requirements for Effluent Biomonitoring Data," revised 11/2/2018.

7. As a minimum, the reported chronic results shall be expressed as NOEC, LOEC, ChV, and IC_{25}.

8. The 48-hour LC_{50} shall be calculated and reported along with the chronic results

9. If testing is not performed in accordance with MDE-approved study plan, additional testing may be required by the Department.

10. If the test results of any two consecutive valid toxicity tests show acute or chronic toxicity (LC_{50} equal to or less than 100% for acute tests and an IC_{25} equal to or less than the in-stream waste concentration for chronic tests), the permittee shall repeat the test within 30 days to confirm the findings of acute or chronic toxicity. Intermittent toxicity or other concerns may require additional testing or limits. If acute and/or chronic toxicity is confirmed, the permittee shall:

    a. Eliminate the source of toxicity through operational changes as soon as

possible but in any case not longer than within three months, or

b. Perform a TRE. If the permittee repeats the toxicity testing as stated above and the results of the repeat test do not confirm the acute or chronic toxicity, the Department will require the permittee to repeat the toxicity testing as stated above to reconfirm a finding of no acute or chronic toxicity. After reconfirmation, the permittee shall complete any remaining quarterly testing required.

11. If the permittee completes a TRE in accordance with II.E.10.b and unacceptable toxicity is confirmed, a Whole Effluent Toxicity (WET) permit limit and a compliance schedule will be required.

12. To address federal NPDES requirements for WET testing and limits, MDE shall implement permit limits in a new or renewal permit when a WET test result shows reasonable potential for toxicity unless it can be demonstrated that the source of toxicity has been eliminated, inappropriate test procedures were utilized, or the source has been controlled via a chemical specific permit limitation. Where reasonable potential has been assumed based on one test result, the permit shall include a WET limit effective within three years unless the effluent shows no toxicity in six follow-up quarterly tests. The permit may be modified to remove the WET limit if the six follow-up quarterly tests show no toxicity.

13. If plant processes or operations change so that there is a significant change in the nature of the wastewater, the Department may require the permittee to conduct a new set of tests.

*14. If a significant industrial user locates within the service area so that significant change in the nature of the wastewater might be anticipated, MDE may require the permittee to conduct a new set of tests.

15. The biomonitoring program study plan, WET test results and related materials shall be submitted electronically to the Department if the permittee has already been approved for the NetDMR tool. The material shall be attached as separate single files and labeled as "Biomonitoring Program Study Plan" and "WET Test Results" in the NetDMR tool. Otherwise, the permittee shall submit all pertinent physical documents to:

Attention: Whole Effluent Toxicity Coordinator
Compliance Program
Water and Science Administration
Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 420
Baltimore, MD 21230-1708

The permittee shall notify the Department at the above address or via email at mde.biomonitoring@maryland.gov immediately upon electronic submission of the biomonitoring program study plan, WET test results and associated material through NetDMR tool.

*omit for industrial facilities

Appendix B

BIOMONITORING PROGRAM (Significant concern and effluent flow is less than 10% of the receiving water low flow)

1. Within three months of the effective date of the permit, the permittee shall submit to the Department for approval a study plan to evaluate wastewater toxicity at Outfall by using biomonitoring. The study plan should include a discussion of:

    a. wastewater and production variability
    b. sampling & sample handling
    c. source & age of test organisms
    d. source of dilution water
    e. testing procedures/experimental design
    f. data analysis
    g. quality control/quality assurance
    h. report preparation
    i. testing schedule

2. For industrial facilities:
   The testing program shall consist of definitive quarterly testing for one year. Three of the quarters shall have acute testing and one of the quarters shall have chronic testing. This testing shall be initiated no later than three months following the Department's acceptance of the study plan.

   For municipal facilities:

The testing program shall consist of definitive testing for four annual testing events. Three of the events shall have acute testing and one of the events shall have chronic testing. The testing events shall be conducted annually during January or February of each of the first four years after approval of the study plan. One of these first two testing events shall include the chronic tests. This testing shall be initiated no later than January or February following the Department's acceptance of the study plan. If results from any of the required annual tests show toxicity in the effluent, the permittee shall repeat the required test within 30 days as a follow-up test. If toxicity is observed from the results of the follow-up test, the permittee shall be subject to the requirements specified in Special Condition II (D)10.

For Freshwater Receiving Stream

a. The acute testing shall consist of 48-hour static renewal tests using fathead minnow and the 48-hour static renewal tests using a daphnid.

b. The chronic testing shall include the Ceriodaphnia survival and reproduction test and the fathead minnow larval survival and growth test.

c. Acute test results shall be expressed as LC_{50}. Chronic test results shall be expressed as NOEC, LOEC, ChV, and IC_{25}.

For Estuarine Receiving Stream

a. The acute testing shall consist of 48-hour static renewal tests using either sheepshead minnows (*Cyprinodon* variegatus), silversides (*Menidia beryllina* , *Menidia menidia* , *Menidia peninsulae*) and mysid shrimp (*Americamysis bahia* A.K.A. *Mysidopsis bahia*). Testing must include one vertebrate species and one invertebrate species

b. The chronic testing shall include the sheepshead minnow (*Cyprinodon* variegatus) or inland silverside (*Menidia beryllina*) larval survival and growth tests and mysid shrimp (*Americamysis bahia* AKA *Mysidopsis bahia*) survival, growth, and fecundity tests. Testing must include one vertebrate species and one invertebrate species

c. Acute test results shall be expressed as LC_{50}. Chronic test results shall be expressed as NOEC, LOEC, ChV, and IC_{25}.

3. The samples used for biomonitoring shall be collected at the same time and location as the samples analyzed for the effluent limitations and monitoring requirements for this outfall. For chlorinated effluents, samples shall be collected after dechlorination. The permittee shall collect 24-hour flow–proportioned composite samples unless the Department has given prior approval of an alternative sampling type.

4. The following EPA documents discuss the appropriate methods:

For Freshwater Receiving Stream

a. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

b. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms Fourth Edition, EPA-821-R-02-013, October, 2002

For Estuarine Receiving Stream

a. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

b. Short-term Methods for Estimating the Chronic Toxicity of Effluents and

Receiving Waters to Marine and Estuarine Organisms Third Edition, EPA-821-R-02-014, October 2002

5. Test results shall be submitted to the Department within one month of completion of each set of tests.

6. Test results shall be reported in accordance with MDE/WMA "Reporting Requirements for Effluent Biomonitoring Data," revised 11/2/2018.

7. As a minimum, the reported chronic results shall be expressed as NOEC, LOEC, ChV, and IC_{25}.

8. The 48-hour LC_{50} shall be calculated and reported along with the chronic results.

9. If testing is not performed in accordance with MDE-approved study plan, additional testing may be required by the Department.

10. If the test results of any two consecutive valid toxicity tests show acute or chronic toxicity (LC_{50} equal to or less than 100% for acute tests and an IC_{25} equal to or less than the in-stream waste concentration for chronic tests), the permittee shall repeat the test within 30 days to confirm the findings of acute or chronic toxicity. Intermittent toxicity or other concerns may require additional testing or limits. If acute and/or chronic toxicity is confirmed, the permittee shall:

    a. Eliminate the source of toxicity through operational changes as soon as possible but in any case not longer than within three months, or

    b. Perform a TRE. If the permittee repeats the toxicity testing as stated above and the results of the repeat test do not confirm the acute or chronic toxicity, the Department will require the permittee to repeat the toxicity testing as stated above to reconfirm a finding of no acute or chronic toxicity. After reconfirmation, the permittee shall complete any remaining quarterly testing required.

11. If the permittee completes a TRE in accordance with II.E.10.b and unacceptable toxicity is confirmed, a Whole Effluent Toxicity (WET) permit limit and a compliance schedule will be required.

12. To address federal NPDES requirements for WET testing and limits, MDE shall implement permit limits in a new or renewal permit when a WET test result shows reasonable potential for toxicity unless it can be demonstrated that the source of toxicity has been eliminated, inappropriate test procedures were utilized, or the source has been controlled via a chemical specific permit limitation. Where reasonable potential has been assumed based on one test result, the permit shall include a WET limit effective within three years unless the effluent shows no toxicity in six follow-up quarterly tests. The

permit may be modified to remove the WET limit if the six follow-up quarterly tests show no toxicity.

13. If plant processes or operations change so that there is a significant change in the nature of the wastewater, the Department may require the permittee to conduct a new set of tests.

*14. If a significant industrial user locates within the service area so that significant change in the nature of the wastewater might be anticipated, MDE may require the permittee to conduct a new set of tests.

15. The biomonitoring program study plan, WET test results and related materials shall be submitted electronically to the Department if the permittee has already been approved for the NetDMR tool. The material shall be attached as separate single files and labeled as "Biomonitoring Program Study Plan" and "WET Test Results" in the NetDMR tool. Otherwise, the permittee shall submit all pertinent physical documents to:

Attention: Whole Effluent Toxicity Coordinator
Compliance Program
Water and Science Administration
Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 420
Baltimore, MD 21230-1708

The permittee shall notify the Department at the above address or via email at mde.biomonitoring@maryland.gov immediately upon electronic submission of the biomonitoring program study plan, WET test results and associated material through NetDMR tool.

*omit for industrial facilities

Appendix C

BIOMONITORING PROGRAM (Lower concern and effluent flow is greater than 10% of the receiving water low flow)

1. Within three months of the effective date of the permit, the permittee shall submit to the Department for approval a study plan to evaluate wastewater toxicity at Outfall by using biomonitoring. The study plan should include a discussion of:

   a. wastewater and production variability
   b. sampling & sample handling
   c. source & age of test organisms
   d. source of dilution water
   e. testing procedures/experimental design
   f. data analysis
   g. quality control/quality assurance
   h. report preparation
   i. testing schedule

2. The testing program shall consist of two definitive acute testing events, three months apart. This testing shall be initiated no later than three months following the Department's acceptance of the study plan.

   For Freshwater Receiving Stream

   Each of the two testing events shall include a 48-hour static renewal test using fathead minnow and a 48-hour static renewal test using a daphnid species.

   For Estuarine Receiving Stream

   a. The testing shall consist of 48-hour static renewal tests using either sheepshead minnows (*Cyprinodon* variegatus), silversides (*Menidia beryllina* , *Menidia menidia* , *Menidia peninsulae*) and mysid shrimp (*Americamysis bahia* A.K.A. *Mysidopsis bahia*). Testing must include one vertebrate species and one invertebrate species

   b. Test results shall be expressed as LC_{50}.

3. The samples used for biomonitoring shall be collected at the same time and location as the samples analyzed for the effluent limitations and monitoring requirements for this outfall. For chlorinated effluents, samples shall be collected after dechlorination. The permittee shall collect 24-hour flow–proportioned composite samples unless the Department has given prior approval of an alternative sampling type.

4. Testing shall be conducted in accordance with the procedures described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and

Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

5. Test results shall be submitted to the Department within one month of completion of each set of tests.

6. Test results shall be reported in accordance with MDE/WMA "Reporting Requirements for Effluent Biomonitoring Data," revised 11/2/2018.

7. If testing is not performed in accordance with MDE-approved study plan, additional testing may be required by the Department.

8. If the test results of any two consecutive valid toxicity tests conducted within any 12-month period show acute toxicity (LC_{50} equal to or less than 100%) the permittee shall repeat the test within 30 days to confirm the findings of acute toxicity. If acute toxicity is confirmed, the permittee shall:

    a. Eliminate the source of toxicity through operational changes as soon as possible but in any case not longer than within three months, or

    b. Perform a TRE. If the permittee repeats the toxicity testing as stated above and the results of the repeat test do not confirm the acute toxicity, the Department will require the permittee to repeat the toxicity testing as stated above to reconfirm a finding of no acute toxicity. After reconfirmation, the permittee shall complete any remaining quarterly testing required.

    .

9. If the permittee completes a TRE in accordance with II.E.8.b and unacceptable toxicity is confirmed, a Whole Effluent Toxicity (WET) permit limit and a compliance schedule will be required.

10. To address federal NPDES requirements for WET testing and limits, MDE shall implement permit limits in a new or renewal permit when a WET test result shows reasonable potential for toxicity unless it can be demonstrated that the source of toxicity has been eliminated, inappropriate test procedures were utilized, or the source has been controlled via a chemical specific permit limitation. Where reasonable potential has been assumed based on one test result, the permit shall include a WET limit effective within three years unless the effluent shows no toxicity in six follow-up quarterly tests. The permit may be modified to remove the WET limit if the six follow-up quarterly tests show no toxicity.

11. If plant processes or operations change so that there is a significant change in the nature of the wastewater, the Department may require the permittee to conduct a new set of tests.

*12. If a significant industrial user locates within the service area so that significant change in

the nature of the wastewater might be anticipated, MDE may require the permittee to conduct a new set of tests.

13. The biomonitoring program study plan, WET test results and related materials shall be submitted electronically to the Department if the permittee has already been approved for the NetDMR tool. The material shall be attached as separate single files and labeled as "Biomonitoring Program Study Plan" and "WET Test Results" in the NetDMR tool. Otherwise, the permittee shall submit all pertinent physical documents to:

Attention: Whole Effluent Toxicity Coordinator
Compliance Program
Water and Science Administration
Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 420
Baltimore, MD 21230-1708

The permittee shall notify the Department at the above address or via email at mde.biomonitoring@maryland.gov immediately upon electronic submission of the biomonitoring program study plan, WET test results and associated material through NetDMR tool.

*omit for industrial facilities

Appendix D

BIOMONITORING PROGRAM (Lower concern and effluent flow is less than 10% of the receiving water low flow)

1. Within three months of the effective date of the permit, the permittee shall submit to the Department for approval a study plan to evaluate wastewater toxicity at Outfall by using biomonitoring. The study plan should include a discussion of:

   a. wastewater and production variability
   b. sampling & sample handling
   c. source & age of test organisms
   d. source of dilution water
   e. testing procedures/experimental design
   f. data analysis
   g. quality control/quality assurance
   h. report preparation
   i. testing schedule

2. The testing program shall consist of two definitive acute testing events, three months apart. This testing shall be initiated no later than three months following the Department's acceptance of the study plan.

   For Freshwater Receiving Stream

   Each of the two testing events shall include a 48-hour static renewal test using fathead minnow and a 48-hour static renewal test using a daphnid species.

   For Estuarine Receiving Stream

   a. Each of the two testing events shall include a 48-hour static renewal test using fathead minnow and a 48-hour static renewal test using a daphnid species.

   b. The permittee may substitute 48-hour static renewal tests using either sheepshead minnows (*Cyprinodon* variegatus), silversides (*Menidia beryllina* , *Menidia menidia* , *Menidia peninsulae*) and mysid shrimp (*Americamysis bahia* A.K.A. *Mysidopsis bahia*) for the above tests. Testing must include one vertebrate species and one invertebrate species

   c. Test results shall be expressed as LC_{50}

3. The samples used for biomonitoring shall be collected at the same time and location as the samples analyzed for the effluent limitations and monitoring requirements for this outfall. For chlorinated effluents, samples shall be collected after dechlorination. The permittee shall collect 24-hour flow–proportioned composite samples unless the Department has given prior approval of an alternative sampling type.

4. Testing shall be conducted in accordance with the procedures described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

5. Test results shall be submitted to the Department within one month of completion of each set of tests.

6. Test results shall be reported in accordance with MDE/WMA "Reporting Requirements for Effluent Biomonitoring Data," revised 11/2/2018.

7. If testing is not performed in accordance with MDE-approved study plan, additional testing may be required by the Department.

8. If the test results of any two consecutive valid toxicity tests conducted within any 12-month period show acute toxicity (LC_{50} equal to or less than 100%), the permittee shall repeat the test within 30 days to confirm the findings of acute toxicity. If acute toxicity is confirmed, the permittee shall:

    a. Eliminate the source of toxicity through operational changes as soon as possible but in any case not longer than within three months, or

    b. Perform a TRE. If the permittee repeats the toxicity testing as stated above and the results of the repeat test do not confirm the acute toxicity, the Department will require the permittee to repeat the toxicity testing as stated above to reconfirm a finding of no acute toxicity. After reconfirmation, the permittee shall complete any remaining quarterly testing required.

9. If the permittee completes a TRE in accordance with II.E.8.b and unacceptable toxicity is confirmed, a Whole Effluent Toxicity (WET) permit limit and a compliance schedule will be required.

10. To address federal NPDES requirements for WET testing and limits, MDE shall implement permit limits in a new or renewal permit when a WET test result shows reasonable potential for toxicity unless it can be demonstrated that the source of toxicity has been eliminated, inappropriate test procedures were utilized, or the source has been controlled via a chemical specific permit limitation. Where reasonable potential has been assumed based on one test result, the permit shall include a WET limit effective within three years unless the effluent shows no toxicity in six follow-up quarterly tests. The permit may be modified to remove the WET limit if the six follow-up quarterly tests show no toxicity.

11. If plant processes or operations change so that there is a significant change in the nature of the wastewater, the Department may require the permittee to conduct a new set of

tests.

*12 If a significant industrial user locates within the service area so that significant change in the nature of the wastewater might be anticipated, MDE may require the permittee to conduct a new set of tests.

13. The biomonitoring program study plan, WET test results and related materials shall be submitted electronically to the Department if the permittee has already been approved for the NetDMR tool. The material shall be attached as separate single files and labeled as "Biomonitoring Program Study Plan" and "WET Test Results" in the NetDMR tool. Otherwise, the permittee shall submit all pertinent physical documents to:

Attention: Whole Effluent Toxicity Coordinator
Compliance Program
Water and Science Administration
Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 420
Baltimore, MD 21230-1708

The permittee shall notify the Department at the above address or via email at mde.biomonitoring@maryland.gov immediately upon electronic submission of the biomonitoring program study plan, WET test results and associated material through NetDMR tool.

*omit for industrial facilities

Appendix E
SAMPLING AND REPORTING REQUIREMENTS FOR EFFLUENT BIOMONITORING DATA

BIOMONITORING SAMPLING REQUIREMENTS

Samples for all WET testing should be planed and collected during periods that best represent the facility's routine operations, that is, times when the effluent sample matrix is representative of the operational waste streams associated with the facility.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

BACKGROUND

The Maryland Department of the Environment has compiled the following guidelines for reporting toxicity data from biomonitoring tests. These guidelines were formulated in an effort to standardize evaluations of toxicity data submitted to the Department.

BIOMONITORING REPORTING REQUIREMENTS

The results from biomonitoring toxicity tests shall be reported in a concise, easily understood manner. Each test report, in addition to an overall summary of the results, shall include the following documentation.

1. Chain of Custody Forms: A chain of custody form should accompany each individual sample collected. Each form shall include the following information.

    - Facility name
    - Sample collection date, time, and location (start and finish)
    - Sampling Method (grab or composite)
    - Volume of sample
    - Type of test (Acute or Chronic)
    - Sampler's signature and date
    - Description of sample storage during transportation
    - The signatures of all persons receiving custody of sample prior to use in testing, dates and times of receipt
    - Comments (as appropriate)

2. Effluent Quality Measurements: These data shall be reported for each effluent sample either at the time of collection or upon receipt by the toxicity testing laboratory.

Date and time of measurements	Conductivity and Salinity
Temperature	Hardness
pH	Alkalinity
Dissolved Oxygen	Visual Description
Total Residual Chlorine*(TRC)	Comments (as appropriate)

- *If the TRC exceeds 0.02 mg/l, the samples are dechlorinated in the laboratory, prior to heir use in toxicity tests.*

3. Toxicity Test Data:

A. Dilution Water.
   (1) Source of the dilution water
   (2) Manipulation steps (if any)

B. Test Organisms.
   (1) Source of the test organisms
   (2) Age of test organisms
   (3) Any acclimation steps
   (4) Disease treatment (if applicable)
   (5) Reference toxicant test data*
      (a) Reference toxicant identity
      (b) Test date(s)
      (c) A complete copy of the monthly in-house SRT test report associated with the WET test including bench sheets notes and all statistical data.
      (d) Summary of test results (48-hr LC_{50} with 95% confidence limits for acute tests; NOEC, LOEC, ChV. PMSD & IC_{25} for chronic tests)**
      (e) Plotted control charts along with the applicable upper and lower control limits should be submitted for each test species for each report. Only the last 20 data points can be used to determine QA acceptance criteria.

**When in-house organisms are used, monthly test data from the previous 5 months shall be reported. When organisms from an outside source are used, reference toxicant data from a test performed concurrently with the effluent test shall be reported, unless the test organism supplier provides control chart data from at least the last five monthly toxicity tests. Regardless of the source of test organisms (in-house cultures or purchased from external suppliers), the testing laboratory must perform at least one acceptable reference toxicant test per month for each toxicity test method conducted in that month. If a test method is conducted only monthly, or less frequently, a reference toxicant test must be performed concurrently with each effluent toxicity test.*

***Tests with values that are not within the control limits must be investigated by the laboratory's QA manager and documented. Repeat testing should be conducted based on the outcome of the laboratory's investigation*

C. Effluent Toxicity Tests. The organisms utilized shall be clearly identified in the reporting of the following information for each effluent toxicity test.

(1) Test results.

(a) For both acute and chronic tests, the LC_{50} value, with 95% confidence limits, from the first 48 hours of the test.

(b) For chronic tests, the values for NOEC, LOEC, ChV and IC_{25} (based on biomass with 95% confidence limits). The PMSD results for reproduction, growth and if applicable, fecundity*** must be reported with the summary of the endpoints. A test with a PMSD that exceeds the upper bounds specified by the method manual is not acceptable and must be repeated unless the effluent is identified as being toxic.

****The fecundity endpoint is an optional but required endpoint. It is in many cases the most sensitive measure of toxicity. Laboratories should optimize temperature, feeding and organism densities during pre-test holding and testing periods to ensure achieving the criteria (egg production by 50 % or more of the control females) necessary to determine the fecundity endpoint. If the test organisms are purchased, the WET testing laboratory should make the necessary arrangements with the supplier to ensure that pre-test holding conditions are optimized to successfully achieve the fecundity endpoint. See Section 14.6.13.2.11 in Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms Third Edition, October 2002.*

(2) Water quality measurements.

(a) Daily measurements (before and after renewal) of temperature, DO****, and pH for all dilutions.

(b) Daily measurements of conductivity, alkalinity, and hardness for 100% and 0% dilutions.

(c) A summary (mean and range) of the data described in (a) and (b) above.

*****If DO is below 40% saturation (3.3 mg/l at 25°C), samples are to be aerated gently before toxicity testing. The report shall indicate if aeration is necessary.*

(3) Initial test measurements and set up.

(a) Number of replicates.

(b) Number of organisms in each replicate.

(c) Volume of solution and the size of test chambers.

(d) Daily diet or lack of feeding.

(e) Randomization performed and documented.
(f) *Ceriodaphnia dubia* blocking procedures performed and documented.

(4) Daily mortality data, and for chronic reproduction tests, daily brood production.
(5) For chronic growth tests, final weight data for all organisms remaining at test conclusion.
(6) Summarized mortality, and for chronic tests, growth and reproduction data.
(7) Statistical calculations, including tests on assumptions (e.g., normality, homogeneity of variance). The statistical method and data used shall be clearly identified.
(8) Any test method deviations.
(9) Relevant observations on test organisms or conditions.
(10) Randomization template records or documentation that randomization procedures were properly followed for both test species.
(11) Documentation of *Ceriodaphnia dubia* blocking procedures for each testing event
(12) Sample manipulation steps (if any) shall be reported.
(13) A complete copy of the monthly in-house SRT test report associated with the WET test including bench sheets, notes and statistical data.

EFFLUENT TOXICITY TEST PROCEDURES GUIDANCE

On October 16, 1995, the EPA published its final rule in the Federal Register establishing whole effluent toxicity test methods at 40 CFR Part 136. These test methods are described in the following manuals. All WET testing required to be conducted for discharge permits issued under the National Pollutant Discharge Elimination System must conform to these methods.

EPA Effluent Toxicity Test Manuals:

Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms Fourth Edition, EPA-821-R-02-013, October, 2002

Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms Third Edition, EPA-821-R-02-014, October 2002

Appendix F – Whole Effluent Toxicity Tests to be Employed by Permittees

Test methods utilized by permittees for whole effluent toxicity testing must conform to the test methods found in *Table IA—List of Approved Biological Methods for Wastewater and Sewage Sludge* found in the latest edition of 40 CFR Part 136

freshwater

acute - 48 hour or 96 hour static renewal assays for lethality or immobility utilizing:

fathead minnow (*Pimephales promelas*), Bannerfin *shiner* (*Cyprinella leedsi*), Rainbow Trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*)
and *Daphnia magna, Daphnia pulex,* or *Ceriodaphnia dubia*

chronic - *Ceriodaphnia dubia* survival & reproduction
larval fathead minnows (*Pimephales promelas*) survival & growth

estuarine/marine

acute - 48-hour or 96 hour static renewal assays for lethality or immobility utilizing:

sheepshead minnows (*Cyprinodon variegatus*), inland silversides (*Menidia beryllina*), Atlantic silverside (*Menidia menidia*), tidewater silverside (*Menidia peninsulae*) mysid shrimp (*Americamysis bahia*, *f*ormerly Mysidopsis *bahia*

chronic - sheepshead minnows (*Cyprinodon variegatus*) larval survival & growth
inland silversides (*Menidia beryllina*) larval survival & growth
mysid shrimp (*Americamysis bahia, formerly Mysidopsis bahia*) survival, growth & fecundity

Appendix G TOXICITY REDUCTION EVALUATION

The permittee shall conduct a Toxicity Reduction Evaluation (TRE) when a review of toxicity test data by the Department indicates unacceptable acute or chronic effluent toxicity. A TRE is an investigation conducted to identify the causative agents of effluent toxicity, isolate the source(s), determine the effectiveness of control options, implement the necessary control measures and then confirm the reduction in toxicity.

1. Within 90 days of notification by the Department that a TRE is required, the permittee shall submit for approval by the Department a plan of study, schedule and completion date for conducting a TRE. The permittee shall conduct the TRE study consistent with the submitted plan and schedule.

for industrials: 2. This plan should follow the framework presented in Generalized Methods for Conducting Industrial Toxicity Reduction Evaluations (EPA/600/2-88/070) March 1989.

for municipals: 2. This plan should follow the framework presented in Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants (EPA/833B-99/002) August 1999.

Additional Guidance documents on the TRE process are shown below:

Methods for Aquatic Toxicity Identification Evaluations Phase I Toxicity Characterization Procedures Second Edition United States Environmental Protection Agency Office of Research and Development Washington, DC 20460
EPA/600/6-9 l/003 February 1991

Methods for Aquatic Toxicity Identification Evaluations Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity, United States Environmental Protection Agency Office of Research and Development EPA/600/R-92/080 September 1993 Washington DC 20460

Methods for Aquatic Toxicity Identification Evaluations Phase Ill Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity, United States Environmental Protection Agency Office of Research and Development Washington DC 20460 EPA /600/R-92/08 1 September 1993

Clarifications Regarding Toxicity Reduction and Identification Evaluations in the National Pollutant Discharge Elimination System Program, March 27, 2001, U.S. Environmental Protection Agency, Office of Wastewater Management , Office of Regulatory Enforcement, Washington, DC 20460

3. Beginning 60 days from the date of the Department's acceptance of the TRE study plan and every 60 days thereafter, the permittee shall submit progress reports including all

relevant test data to the Department. This shall continue until completion of the toxicity reduction confirmation.

4. Within 60 days of completion of the toxicity identification or the source identification phase of the TRE, the permittee shall submit to the Department a plan, schedule and completion date for implementing those measures necessary to eliminate acute toxicity, an LC_{50} greater than 100%, and/or eliminate chronic toxicity, an IC_{25} greater than the in-stream waste concentration (IWC). The implementation of these measures shall begin immediately upon submission of this plan.

5. Within 60 days of completing the implementation of the control measures to eliminate or reduce toxicity, the permittee shall submit to the Department for approval a study plan to confirm the elimination or reduction of toxicity by using biomonitoring.

6. If, for any reason, the implemented measures do not result in compliance with the Department's toxicity limitations, the permittee shall continue the TRE and a Whole Effluent Toxicity (WET) permit limit and a compliance schedule will be required.

7. All TRE-related materials shall be submitted electronically to the Department if the permittee has already been approved for the NetDMR tool. The material shall be attached as a separate single file with the file name "TRE" in the NetDMR tool. Otherwise, the permittee shall submit all pertinent physical documents to:

Attention: Whole Effluent Toxicity Coordinator
Compliance Program
Water and Science Administration
Maryland Department of the Environment
Montgomery Park Business Center
1800 Washington Boulevard, Suite 420
Baltimore, MD 21230-1708

The permittee shall notify the Department at the above address or via email at mde.biomonitoring@maryland.gov immediately upon electronic submission of TRE material through the NetDMR tool