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September 5, 2019

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629 East Main Street
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2018 Annual Short-term Monitoring Report
Former DuPont Waynesboro Site – Area of Concern 4
Waynesboro, Virginia
VAD003114832

Dear Mr. Jordan:

On behalf of E.I. DuPont de Nemours and Company (a wholly-owned subsidiary of Corteva Agriscience™), AECOM is pleased to provide you with the 2018 Annual Short-Term Monitoring (STM) Report for the Former DuPont Waynesboro Site Area of Concern (AOC 4). This report describes post-remediation conditions at the Constitution Park and City Shops Bank Management Areas (BMAs). This report also describes baseline conditions at other Phase 1 BMAs that are currently in the design/construction process.

As always, please contact me at 610-832-3585 or Mike Liberati at 302-598-9936 with any questions or comments regarding the enclosed document.

Sincerely,
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AECOM

2018 Short-Term Monitoring Report

Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

Submitted on behalf of:
E.I. DuPont de Nemours and Company,
A wholly-owned subsidiary of Corteva Agriscience™

Submitted by:
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Project Number: 60594243
Date: September 2019

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Acronym List

Acronym	Explanation
µg/kg	Micrograms per kilogram
ADQM	Analytical Data Quality Management
AOC	Area of Concern
BMA	Bank Management Area
Corteva	Corteva Agriscience™
DuPont	E.I. DuPont de Nemours and Company
DVM	Data Verification Module
EDD	Electronic Data Deliverable
EIM	Environmental Information Management (Locus Technologies)
EPA	U.S. Environmental Protection Agency
EPW	Evaluation of Planned Wetlands
FIHg	Filtered inorganic mercury
Hg	Mercury
IHg	Inorganic mercury
IM	Interim Measure
IRM	Interim Remedial Measure
kg/year	Kilograms per year
LiDAR	Light detection and ranging
LTM	Long-Term monitoring
LWD	Large Woody Debris
MeHg	Methylmercury
mg/kg	Milligrams per kilogram
ng/L	Nanograms per liter
NRDC	Natural Resources Defense Council
QA/QC	Quality Assurance/ Quality Control
RBP	Rapid Bioassessment Protocols
RCRA	Resource Conservation and Recovery Act
RRM	Relative river mile
SRST	South River Science Team
STM	Short-Term Monitoring
THg	Total mercury
USGS	United States Geological Survey
USM	Unified stream methodology
VDEQ	Virginia Department of Environmental Quality

Executive Summary

Interim measures (IM) are being implemented by E.I. DuPont de Nemours and Company, a wholly-owned subsidiary of Corteva Agriscience™ (Corteva) in accordance with the United States Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. VAD003114832, to address mercury (Hg) contamination historically released to the South River from the former DuPont facility in Waynesboro, Virginia (site). Riverbank soils impacted by these historical releases are currently the primary source of Hg loading to the South River and as such, are the focus of current and planned interim measures (URS, 2012; Anchor QEA et al., 2015).

Short-term monitoring (STM) is being conducted in an adaptive management framework to evaluate the performance of the interim measures and proposed remedial approach. STM evaluates the approach over a short period ranging from two to 10 years and is limited in spatial extent immediately adjacent to a specific remediation reach called a bank management area (BMA). Biotic and abiotic measurement endpoints included in the STM program are categorized into the following performance metrics: Bank Stability, Mercury Loading/Exposure, and Riparian/Aquatic Habitat.

Although bank erosion is the primary Hg transport pathway from riverbanks, other transport and exposure pathways are also possible. The ability to differentiate between local sources of Hg (e.g., bank soils) and Hg loading from upriver is essential in the assessment of remedy effectiveness. STM includes the measurements of total mercury (THg) and methylmercury (MeHg) in biotic and abiotic media in both near-bank and mid-channel environments to support the differentiation of local (i.e., bank) sources and sources from upriver. Following remedy implementation, STM data, in context with the long-term monitoring (LTM) program data, will provide input to potential source identification (i.e., local bank vs. upriver).

Results of the 2018 STM efforts indicate that riverbanks at each STM station are generally stable with isolated areas of erosion, which is consistent with previous estimates (Anchor QEA et al., 2015). Riparian and aquatic habitat values at the STM stations evaluated in 2018 were generally good, with the exception of impacts associated with invasive species and increased substrate embeddedness. Invasive plant species are present at most STM stations, and in some instances, they are the dominant species within the BMA.

Post-remediation data collected at the Constitution Park and City Shops BMAs show declining concentrations in several abiotic and biotic media. The following preliminary success criteria were achieved based on 2018 STM near-bank sediment data:

- Constitution Park BMA: Greater than 80% reduction in inorganic mercury (IHg) and MeHg; and
- City Shops BMA: Greater than 80% reduction in IHg.

In addition, pore water Hg concentrations are decreasing at both BMAs following an initial increase immediately after construction. Biotic media concentrations typically respond to changes in abiotic media, so while concentrations in biotic media at the BMAs monitored are generally more variable, limited reductions in pereiphyton IHg and MeHg concentrations were observed at some locations.

The Hg concentrations in biotic and abiotic media at non-remediated BMAs generally followed spatial and temporal trends documented in baseline data associated with

previous investigations, including the Ecological Study of the South River and a Segment of the South Fork Shenandoah River (URS, 2012), the Bank Stabilization Pilot Study (URS, 2014), the 2015 and 2016 pre-remediation STM reports (AECOM, 2016 and 2017) and the 2017 STM report (AECOM, 2018a). Those studies documented Hg concentrations in most media generally increasing with distance downriver; concentrations in media from near-bank environments are generally higher than those measured in mid-channel environments. While IHg and MeHg concentrations in bulk sediment, pore water, periphyton, and transplanted *Corbicula* were somewhat variable, they continue to be locally influenced by areas of elevated THg in bank soils; this finding is consistent with previous data collected as part of the Pilot Study (URS, 2014).

In addition to their relationship with primary RCRA remedial goals, monitoring activities include components related to conclusions from the multi-year study (Ecological Study) conducted as part of a consent decree with the Natural Resources Defense Council (NRDC) and Virginia Chapter of the Sierra Club, and the Remediation Proposal, which was part of the final settlement agreement between DuPont and NRDC in 2013 (URS, 2012; Anchor QEA and URS, 2013). As noted in the Ecological Study and the Remediation Proposal, some aspects of the STM may change depending on whether the results have material impact on current or future remedial decisions. In the future, Corteva will continue to undertake interim remedial measures (IRMs) and monitoring with technical collaboration of the Virginia Department of Environmental Quality (VDEQ) and the South River Science Team (SRST).

1.0 Introduction

1.1 Background

Interim measures (IMs) are being implemented by E.I. DuPont de Nemours and Company (DuPont), a wholly-owned subsidiary of Corteva Agriscience™ (Corteva) in accordance with the United States Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. VAD003114832, to address mercury (Hg) contamination historically released to the South River from the former DuPont facility in Waynesboro, Virginia (site). The site used compounds such as mercuric sulfate, to produce acetate flake and yarn from 1929 to 1950. The majority of the Hg from the process wastes was recovered at an on-site retort facility. Inadvertent Hg releases during that period were remediated in accordance with applicable waste management practices of the time. Riverbank soils impacted by these historical releases are currently the primary source of Hg loading to the South River and as such, are the focus of the current and planned IMs for the river (URS, 2012; Anchor QEA et al., 2015).

Phase 1 IMs are focused on bank stabilization, which are being implemented at Bank Management Areas (BMAs) within the first two relative river miles (RRM), below the site (i.e., RRM 0 - RRM 2) (see Figure 1). A combination of source area removal (for Primary BMAs) and structural and vegetative stabilization (for Secondary BMAs) is being used to reduce Hg transport into the river from eroding banks. Primary BMAs consist of banks that contribute disproportionately higher total mercury (THg) of approximately 40% of the load between RRM 0 and RRM 2. THg loading from Secondary Stabilization BMAs is substantial, but less than loading from the Primary Removal BMAs.

Prior to implementation of the IMs, Corteva voluntarily undertook a Bank Stabilization Pilot Study to test the hypothesis that stabilization of Hg contaminated riverbanks would reduce Hg transport and exposure in near-bank environments. The Pilot Study was implemented in 2009 near RRM 0.1, just downstream from the former DuPont Waynesboro facility. The primary objective of the Pilot Study was to reduce riverbank erosion rates and particle-associated Hg loading to the river through bank stabilization. Annual post-stabilization monitoring of the Pilot Study indicates that Hg concentrations in near-bank sediment, pore water, and transplanted *Corbicula fluminea (Corbicula)* tissue are decreasing as a result of bank stabilization (Anchor QEA and URS, 2013). Most notably, post-stabilization mean inorganic mercury (IHg) pore water concentrations at the Pilot Study are significantly lower ($p < 0.001$) than pre-stabilization concentrations. These are critical findings that form the basis of pre- and post-remediation data assessment for the Constitution Park BMA.

1.2 Purpose and Objectives

Short-term monitoring (STM) and long-term monitoring (LTM) are being conducted to evaluate the performance of the IMs and proposed remedial approach. STM data presented in this annual report are intended to provide input to assessment of the remedial approach over a short period ranging from two to 10 years and are limited to a specific spatial extent, immediately adjacent to a particular BMA.

The STM and LTM reporting schedules vary based on the objectives of each program. STM reporting will occur annually. LTM reporting will occur every three years and is intended to provide input to a system-wide assessment of the remedial approach over a longer timeframe (10+ years).

The purpose of this report is to use data collected to date to assess the effectiveness of the remediation at Constitution Park BMA (STM-01) and City Shops BMA (STM-07) and to continue documentation of pre-remediation baseline conditions at other BMAs. The Allied Ready Mix BMA (STM-08) was not sampled in 2018 due to ongoing construction associated with remediation at the BMA. As more data are collected in the future, the assessment of the efficacy of remediation will rely on robust statistical data analyses. The table below summarizes the baseline datasets and remediation status for Phase 1 IMs for each BMA.

BMA	Station	Baseline Dataset	Remediation Complete
Bank Stabilization Pilot Study	--	2008	November 2009
Constitution Park	STM-01	2015-2016	February 2017
City Shops	STM-07	2015-2016	February 2018
Allied Ready Mix	STM-08	2016-2017	November 2018
Shiloh Baptist Church	STM-03	2017	August 2019
North Park	STM-05	2015-2018	TBD

Three primary objectives of the data evaluation are as follows:

- **Post-remediation BMAs:** Compare baseline and post-remediation data to evaluate the achievement of preliminary success criteria (see Table 1).
- **Baseline BMAs:**
  - Evaluate baseline data at non-remediated BMAs for consistency with historical data, as well as a point of reference for evaluating the potential for changes associated with the regional climatic conditions or other non-remediation related events.
  - Evaluate possible relationships among sampling matrices or elements to identify potential sampling redundancies or data that may not be responsive to remedial action.

1.3 Scope

This report summarizes the sampling methodology and data collected from each of the 2018 STM stations (see Figure 2). A comparison of pre- and post-remediation data for both Constitution Park and City Shops is provided; results will be evaluated in the context of all of the data collected to date, and the findings of the Pilot Study when evaluating the influence of the load reduction associated with the two completed BMAs.

1.4 Report Organization

This STM Report includes the following sections:

- Section 2 briefly describes the methods implemented during STM.
- Section 3 summarizes results and provides a discussion of the 2018 STM effort.
- Section 4 provides a review of the data quality assessment.
- Section 5 provides the findings of the 2018 STM data evaluation.
- Section 6 lists the references cited in this report.

2.0 Methods

The IMs and monitoring strategy were developed largely from conclusions drawn from data collected as part of the multi-year Ecological Study conducted in collaboration with the Natural Resources Defense Council (NRDC) and Virginia Chapter of the Sierra Club, and the Remediation Proposal, which was part of the final settlement agreement between DuPont and NRDC in 2013 (URS, 2012; Anchor QEA and URS, 2013). The 2018 STM effort was conducted consistent with the Final Area of Concern (AOC) 4 STM Plan that provides a detailed sampling schedule (URS, 2015); each annual effort includes a spring/summer event and a fall event, spread over several weeks. This section summarizes the methods including station locations, metrics, and data evaluation strategy. Table 1 provides an overview of the STM monitoring plan design, including performance objectives, metrics, success criteria, and potential adaptive management outcomes. A complete summary of methods is provided in Appendix A.

2.1 Station Locations

The STM sampling strategy includes a near field station for each BMA. The 2018 STM sampling effort included only those stations that are located adjacent to the following:

- Constitution Park BMA (STM-01), which was completed in February 2017
- City Shops BMA (STM-07), which was completed in February 2018
- Shiloh Baptist Church and North Park BMAs, which are anticipated to be completed in 2019 and 2020, respectively

The latter are still being sampled for baseline data. The Allied Ready Mix (STM-08) was not sampled in 2018 due to ongoing construction. The 2018 STM program includes the following stations, as shown in Figures 1 and 2. A photographic log of key bank features is provided in Appendix B.

2.2 STM Monitoring Metrics

Measurable metrics and success criteria have been included in the STM effort to document bank stability and its relationship with Hg loading to the South River in response to construction of IMs. These metrics and success criteria were partially selected for inclusion in the STM based on the preliminary success of the Pilot Study (URS, 2014).

STM metrics and data were specifically selected to evaluate the following:

- Bank stability
- THg and methylmercury (MeHg) concentrations in:
  - Sediment
  - Pore water
  - Periphyton
  - Transplanted *Corbicula*
  - Riparian and aquatic habitat

Each of the target datasets is focused on a specific performance goal directed at bank stability, Hg loading, and/or Hg exposure. Additional ancillary datasets primarily focused

on riparian and aquatic habitat features were also collected to address stakeholder concerns (see Section 2.3). Biotic and abiotic media samples collected during the 2018 STM effort were analyzed for THg and MeHg; IHg was calculated as the difference between THg and MeHg.

Some aspects of the STM may change depending on whether or not the data are found to provide unique input to remedial decision-making. Potential modification to data collection and assessment of remedy effectiveness is consistent with Corteva's plan to perform the program in an enhanced adaptive management framework with the technical collaboration of the Virginia Department of Environmental Quality (VDEQ) and the South River Science Team (SRST). The SRST is composed of members from state and federal government, the academic community, local environmental groups, and Corteva. The role of the SRST is to provide stakeholder and technical input to the AOC 4 program.

2.3 Ancillary STM Habitat Metrics

Ancillary STM habitat metrics were included as part of the 2018 pre- and post-remedy monitoring effort to address stakeholder concerns regarding preserving riparian ecological habitats within the City of Waynesboro but are not part of the RCRA STM program. The methods used to collect ancillary data included evaluation of planned wetlands (EPW), unified stream methodology (USM), and benthic community analyses. The ancillary STM habitat metrics are summarized in Appendix C.

2.4 Data Evaluation

For the purposes of this report, data evaluation includes two broad categories;

- Constitution Park and City Shops BMAs: Pre- versus post-remediation data
- Shiloh Baptist Church and North Park BMAs: Baseline characterization

The following paragraphs describe how the data are considered in each of these categories, along with the consideration for future data evaluation.

2.4.1 Post-Remediation

Post-remediation monitoring of the Pilot Study site provides a framework for the evaluation of the Constitution Park and City Shops BMAs post-remediation data. The Pilot Study found that Hg concentrations in near-bank sediment, pore water, and transplanted *Corbicula* tissue are decreasing as a result of bank stabilization (URS, 2014).

Since 2018 is the second year of post-remediation data for Constitution Park and the first year of post remediation data for City Shops, data are insufficient for statistical comparisons. Future annual STM reporting will include statistical evaluation of abiotic and biotic monitoring data, as sufficient quality and quantity data become available. Potential relationships between monitoring media data that may be demonstrated will be used to understand the potential mobilization of Hg from bank soils to the adjacent aquatic system, and to identify potential data redundancies. Future data evaluation will continue to be integrated with the findings from the Pilot Study and subsequent years' data to help inform the remedial design and STM approach (URS, 2014). In addition, monitoring data are included in the data evaluation process to determine the final remedy for design and construction of subsequent BMAs. For example, limits of

excavation and/or stabilization are adjusted based upon bank soil delineation data and sediment monitoring data.

2.4.2 Pre-Remediation/Baseline

Evaluation of data for baseline characterization of BMAs that have not undergone remediation will be limited to simple statistics such as concentration range and mean concentrations by station. For the purposes of this evaluation and consistent with the STM Plan goal of monitoring near field, short-term changes, baseline data collected are being evaluated based on individual location and not pooled.

2.4.3 Future Evaluation

Although riverbank erosion is the primary Hg transport pathway, other pathways are also possible. The measurement of THg and MeHg in near-bank sediments, pore water, and periphyton alone may not be sufficient to differentiate between local bank and upstream sources. As more data are collected in the future, the STM dataset will be evaluated in context with the LTM program, which encompasses a broader distribution of sampling locations, upstream and downstream of the BMAs. LTM data to be considered as part of the STM data evaluation may include surface water, interstitial sediment, and transplanted *Corbicula*.

3.0 Results and Discussion

This section summarizes the results of the 2018 STM effort. Section 3.1 provides pre- and post-construction conditions for Constitution Park BMA (STM-01), including bank stability, post-remediation conditions, and a discussion of riparian and aquatic habitats. The results and discussion for City Shops BMA (STM-07) is provided in Section 3.2. Section 3.3 describes baseline conditions for remaining stations (STM-03 and STM-05) associated with BMAs that have not been stabilized yet.

The spring STM sampling was conducted during the weeks of June 18, 2018; the fall STM sampling was conducted during the weeks of October 8 and 22, 2018.

Climate plays a key role in influencing annual hydrological conditions of South River. Regional climatic conditions in 2018 differed from long-term trends for much of the year based on the South River stream discharge at the United States Geological Survey (USGS) gage located at Harriston, Virginia (see Figure 3). Stream discharge was lower than the 65-year median daily statistic for much of the period between January and late April 2018. Stream discharge for the rest of the year (May to December 2018) was substantially higher than the 65-year median daily statistic due to a number of high flow events including a 5-year (11.92-foot stage height, 9,080 cubic feet per second) storm event, which occurred on September 17, 2018. The high stream discharge during the typical April to June peak methylation period is hypothesized to contribute to decreased MeHg concentrations in surface water through dilution; cooler water temperatures associated with high flows may also inhibit methylation. Additionally, high discharge events can increase bank erosion and mobilize stream sediments, which could impact Hg concentrations throughout the South River.

The sections below present the results of the 2018 STM effort and a discussion of the results in the context of the remedial construction status for each BMA. Constitution Park BMA (STM-01) and City Shops BMA (STM-07) include representative pre- and post-remediation data; all other BMA STM data represent baseline conditions.

3.1 Constitution Park BMA

3.1.1 Bank Stability

The baseline assessment of bank stability for all BMAs was conducted as part of the remedial design process for the Phase 1 IMs. The March 2014 light detection and ranging (LiDAR) survey described existing, pre-remediation bank conditions with average bank heights of 9.5 feet and bank angles ranging from 15 to 20 degrees. Hg loading to the South River from this BMA was calculated at 2.1 kilograms per year (kg/year), which represents approximately 14% of the total Hg loading from banks in RRM 0 to 2. Complete details of pre-remediation bank conditions are presented in Section 4.3 and Appendix A of the *Final Interim Measures Design, Implementation and Monitoring Work Plan* (Anchor QEA et al., 2015).

The as-built angle of the riverbank provides a good indicator of post-remediation bank stability at the Constitution Park BMA. Consistent bank angles were documented throughout the BMA; limited areas of localized scour were observed. Detailed summaries of post-remediation bank stability at the Constitution Park BMA are provided in the 2018 Constitution Park BMA maintenance inspections (AECOM, 2018b and 2019a). A photographic log of key bank features documented at Constitution Park is provided in Appendix B.

3.1.2 Post-Remediation Data

Bank erosion is the primary Hg transport pathway from riverbanks to the South River. The findings of the Pilot Study indicate that as this pathway is eliminated, subsequent Hg reductions in near-bank biotic and abiotic media are likely to occur. The IM success criteria were selected based upon these findings and form the basis of the evaluation (Anchor QEA and URS, 2013).

Sediment

Post-remediation, near-bank sediment Hg concentrations observed in 2018 at the Constitution Park BMA were lower compared to 2017 post-remediation data and pre-remediation concentrations (see Table 2 and Figure 4). Both the spring and fall 2018 post-remediation sampling events had mean THg concentrations between 0.47 milligrams per kilogram (mg/kg) and 0.55 mg/kg; an order of magnitude lower than the mean 2017 post-remediation THg concentration of 13.5 mg/kg and the baseline mean concentration of 8.64 mg/kg (see Table 2).

Both the spring and fall 2018 Post-IM sediment Hg concentrations for the Constitution Park BMA (STM-01) are the lowest documented in the study compared to previous years' data at Constitution Park and other BMAs (see Table 2). The most notable reductions in THg and IHg concentrations in both the spring and fall 2018 sampling events were at Transect D (see Figure 4). The mean 2018 post-remediation IHg concentrations of 0.51 mg/kg at the Constitution Park BMA were 94% lower than the baseline mean of 8.6 mg/kg. Likewise, MeHg concentrations also decreased 83%, from a baseline of 9.86 micrograms per kilogram (µg/kg) to 1.7 µg/kg observed in 2018.

These substantial decreases in bulk sediment Hg concentrations adjacent to the Constitution Park BMA are likely due to high flow events in combination with the bank stabilization remedy. Several high flow events that occurred before the 2018 sampling events likely transported high concentration sediments documented in previous events downstream. As these high concentration sediments were transported downstream, the bank stabilization remedy prevents erosion of additional soils and associated Hg from the Constitution Park BMA into river (see Figure 5). The elimination of this migration pathway allows for replacement of the Hg rich bank soils and sediments, by clean sediment and soils transported from areas upstream of the original source. This finding is consistent with those of the Pilot Study, which predicted that over time, remediation of bank soil, along with deposition of cleaner sediments from upstream, would reduce and/or eliminate Hg transport in the system. The elimination of exposure pathways, by eliminating the source material, is intended to result in an overall reduction of Hg concentrations in biotic and abiotic aquatic media.

Pore Water

Pore water Hg concentrations continue to decline at Constitution Park two years following remediation. The mean post-remediation filtered inorganic mercury (FIHg) concentration of 11.3 nanograms per liter (ng/L) collected in 2018 at Constitution Park was 42% below the baseline mean concentration of 19.5 ng/L. Pre- and post-remediation annual mean filtered MeHg concentrations continue to be generally similar at 3.4 ng/L and 3.9 ng/L, respectively (see Figure 6). Additionally, filtered MeHg and IHg concentrations in pore water displayed consistent seasonal patterns, with spring concentrations elevated relative to the fall (see Table 3).

Declining pore water concentrations reflect similar concentration reductions in nearby sediments (see Figure 5), which is consistent with monitoring data collected at the Pilot

Study. While data are insufficient to predict long-term trends, it is anticipated that Hg concentrations will continue to show incremental decrease over time, similar to the findings at the Pilot Study.

Periphyton

Hg accumulation in periphyton is an indicator of changes to localized surface water loads in the South River (Brent, 2010). It is anticipated that as construction of IMs progresses and as IHg and MeHg concentrations in near-bank sediment and pore water decline, Hg concentrations in epilithic periphyton will also decline. The 2018 post-remediation Hg concentrations at the Constitution Park BMA generally remain within the range of baseline concentrations (see Table 4 and Figure 7). IHg concentrations of both near-bank and mid-channel periphyton remained unchanged two years after remedy implementation and were within the background/pre-remediation concentration range. These results indicate that periphyton may not be as responsive to the IMs as other datasets. As additional post-remediation data become available for the Constitution Park and other BMAs, the relationship between sediment, pore water, and periphyton concentrations will be examined to determine if modifications to the periphyton monitoring program are warranted.

Clam

Post-remediation *Corbicula* data are provided in Table 5. The location (*mid-channel* or *near-bank*) and type of exposure (*seeded* or *caged clams*) influence the relative MeHg concentrations observed in transplanted *Corbicula*. In general, seeded *Corbicula* tend to have higher MeHg uptake than caged clams as they are able to filter and pedal-feed and have a greater exposure to sediment and sediment porewater than caged clams. Caged clams are suspended off the substrate and represent more of an aqueous exposure as they do not have contact with sediment and are more limited to filter feeding only, which has been demonstrated to result in less MeHg uptake (URS, 2012, 2014, and 2015; AECOM, 2016 and 2017). Additionally, clams transplanted in near-bank environments tend to have higher MeHg uptake then those placed in mid-channel environments, likely due to the influence of elevated bank soils on near-bank sediment Hg concentrations (URS, 2012). STM data collected in 2018 (see Table 5) demonstrated consistent spatial and temporal data patterns to those described above, specifically:

- Concentrations of MeHg in near-bank, seeded *Corbicula* were generally higher than near-bank, caged *Corbicula*.
- Concentrations of MeHg in near-bank, caged *Corbicula* were also generally higher than spring mid-channel caged clams.
- Mean MeHg concentrations in near-bank, *Corbicula* were similar in the spring and fall.

Post-remediation IHg and MeHg concentrations in *transplanted Corbicula* were within the range of concentrations observed in the baseline data. The findings of the Pilot Study showed a consistent decline in Hg concentrations in *transplanted Corbicula* following remediation. It is anticipated that current reductions in near-bank sediment and pore water concentrations may lead to declines in IHg and MeHg concentrations in *near-bank, transplanted Corbicula* in the future.

Comparison of seasonal MeHg data between years is complicated by annual variation in physical factors such as precipitation and temperature. LTM and STM MeHg concentrations in several biotic media collected in 2018 were lower than in previous

years, likely due to regional climatic conditions (e.g., elevated river discharge) during most of 2018. Cooler water temperatures associated with these flows may also inhibit methylation, which may explain the less pronounced seasonal difference in MeHg concentrations between spring and fall observed in 2018. A summary of post-remediation *Corbicula* data is provided in Table 5 and Figure 8.

The 2018 post-remediation data collected at the Constitution Park BMA are encouraging as Hg concentrations in near-bank abiotic media have decreased compared to baseline conditions. The key findings from the 2018 STM monitoring at the Constitution Park BMA are provided as follows:

- Mean Hg concentrations in near-bank sediment achieved preliminary success criteria in 2018 with reductions of IHg (94%) and MeHg (83%) greater than 80% compared to baseline data.
- Pore water data has declined following the initial post-remediation increase observed in 2017.
- Biological media including transplanted *Corbicula* and periphyton data appear to be less responsive to the interim measure than abiotic media.

Although preliminary success criteria have been achieved for some media, the evaluation of future datasets will be necessary to determine if a statistically significant declining trend is occurring.

3.1.3 Riparian and Aquatic Habitat

Riparian Vegetation

Post-remediation riparian vegetation communities were surveyed in 2018 at the Constitution Park BMA. Results of the survey are provided in Table 6 and summarized below:

- **Tree stratum**: Pre-existing black locust (*Robinia pseudoacacia*) trees present in the secondary BMAs were the only trees documented at either of the two vegetation plots; however, other pre-existing trees are present throughout the BMA.
- **Sapling/shrub stratum:** Red maple (*Acer rubrum*), American sycamore (*Platanus occidentalis*), and Atlantic ninebark (*Physocarpus opulifolius*) were present in the sapling/shrub stratum from 0 to 15% percent cover. While silky dogwood (*Cornus amomum*), speckled alder *(Alnus incana),* and multiflora rose *(Rosa multiflora)* had a percent cover of ≤10%.
- **Herbaceous plant stratum:** Japanese knotweed (*Fallopia japonica*), is a non-native, invasive plant that represented a substantial portion of the herbaceous plant community (35% to 40% cover). Other herbaceous plant species observed were present at low <5% cover.

Although Japanese knotweed dominates the herbaceous layer throughout much of the BMA (35% to 40%), it is almost half of its 2017 coverage (40% to 85%). This decrease in the invasive Japanese knotweed coverage at the Constitution Park BMA indicates that herbicide applications have been effective at reducing Japanese knotweed within the BMA. The Japanese knotweed treatment program will continue into 2019, and the BMA will be replanted as necessary to achieve remedial action objectives.

Aquatic Habitat

Rapid bioassessment protocol (RBP) scores remain similar to previous years and reflect the influence of adjacent land use at Constitution Park. Most instream RBP habitat parameters for the Constitution Park BMA were within the “suboptimal” range with the exception of sediment deposition which increased from “suboptimal” to “optimal.” This increase can be attributed to several storm events prior to the fall field event which reduced the amount of sediment deposition along the Constitution Park BMA by transport of fine sediments. Consistent with previous years, the terrestrial metric scores “marginal” for vegetation protection and riparian vegetation zone due to continued cover of the invasive Japanese knotweed and anthropogenic influences associated with the park. It is anticipated that the habitat and associated RBP scores will improve with ongoing invasive vegetative management and as the vegetative community matures.

3.2 City Shops BMA

3.2.1 Bank Stability

The March 2014 LiDAR survey described existing, pre-remediation bank conditions with average bank heights of 6 to 18 feet and with approximately 70% of banks exceeding a slope of 60 degrees. Hg loading to the South River from this BMA was calculated at 1.3 kg/year, which represents approximately 10% of the total Hg loading from banks in RRM 0 to 2. Complete details of pre-remediation bank conditions are presented in Section 4.3 and Appendix A of the *Final Interim Measures Design, Implementation and Monitoring Work Plan* (Anchor QEA et al., 2015).

Consistent bank angles were documented throughout the BMA in the 2018 survey indicating continued good stability; no areas of localized scour, settling or undercutting were observed. Detailed summaries of post-remediation bank stability at the City Shops BMA are provided in the 2018 City Shops BMA maintenance inspections (AECOM, 2018c and 2019b). A photographic log of key bank features documented at City Shops is provided in Appendix B.

3.2.2 Post-Remediation Data

STM-07 transects F through K (see Figure 1) represent post-remediation monitoring data for the City Shops BMA; transects A through E are located adjacent to the North Park BMA and as such have been excluded from the results discussed below.

Sediment

The 2018 dataset represents the first post-remediation data for the City Shops BMA. Near-bank sediment Hg concentrations were lower in 2018 compared to pre-remediation concentrations (see Table 7 and Figure 9). Like Constitution Park, reduced mean THg and IHg sediment concentrations observed in the spring and fall of 2018 are likely the result of decreased concentrations observed at several transects, particularly Transects G and K (see Figure 10). Sediment THg concentrations at these transects are now among the lowest observed, among all BMAs sampled. The mean 2018 post-remediation THg concentration of 1.46 mg/kg at the City Shops BMA was 81% lower than the baseline THg and IHg mean of 7.8 mg/kg.. The mean MeHg concentration also decreased 40.9% from a baseline mean concentration of 11 µg/kg, to 6.50 µg/kg, with data from the 2018 fall sampling event being lower than the spring.

The extensive use of a launchable stone toe at both the Pilot Study and City Shops BMA resulted in an immediate reduction in near-bank sediment Hg concentrations. The Pilot Study bank stabilization involved building out the bank into the channel to restore historical stream channel dimensions and ultimately capping elevated sediment deposits. The same approach was used for the City Shops BMA; near-bank sediment deposits adjacent to the City Shops BMA were removed and/or capped by the launchable toe included in the remedy design. It is anticipated that near-bank sediment Hg concentrations will continue to decline over time, with isolation and removal of elevated bank soils. Until the banks were stabilized, these soils served as an ongoing source of legacy Hg-impacted solids to the near-bank environment.

Pore Water

Pore water Hg concentrations at City Shops generally increased in the first year following remedy implementation, similar to findings from the Constitution Park BMA (see Table 8 and Figure 11). The mean, post-remediation, FIHg concentration of 20.4 ng/L documented in the spring of 2018 was higher than the average pre-remediation IHg concentrations of 9.8 ng/L. In the fall, average IHg concentrations (5.5 ng/L) decreased back to near baseline conditions.

Similar to Constitution Park, immediately following construction, the spring 2018 post-remediation, mean filtered MeHg concentration of 6.57 ng/L was higher than baseline. Despite a decrease in the fall of 2018 relative to the spring, concentrations were still elevated above average baseline MeHg conditions (see Figure 11).

Although pore water concentrations were elevated one year post remediation, particularly in the spring, it is likely that reductions observed in sediment concentrations will lead to decreases in pore water concentrations in the future as observed at the Constitution Park BMA. While it is premature to identify long-term data trends, it is anticipated that Hg concentrations will continue to show incremental decrease over time, similar to the Pilot Study findings.

Periphyton

In 2018, post-remediation, near-bank and mid-channel periphyton THg and IHg concentrations at the City Shops BMA were less than baseline concentrations one year after bank stabilization (see Table 9 and Figure 12). Key results are as follows:

- Mean spring periphyton IHg concentrations in mid-channel (151 µg/kg) environments as well as mean annual near-bank IHg concentrations (847.2 µg/kg) were less than baseline data (631.5 µg/kg and 1981.3 µg/kg respectively).
- Mean 2018 spring mid-channel periphyton IHg concentrations (151 µg/kg) were also lower than spring 2018 near-bank periphyton concentrations (574.5 µg/kg).
- 2018 MeHg concentrations in periphyton were similar to baseline levels observed prior to the start of remediation.

Although there was a decrease in 2018 IHg concentrations at the City Shops BMA, Hg concentrations in periphyton tend to be highly variable and dependent upon other watershed level variables such as temperature and discharge. As more IMs are implemented at upstream BMAs to reduce overall Hg loading to the river, periphyton data may show a more consistent and reliable response in relation to near-bank sediment and pore water data. As additional post-remediation data become available for the City Shops BMA, the relationship between sediment, pore water, and periphyton will

be examined to determine if modifications to the periphyton monitoring program are warranted.

Clam

Similar to the Constitution Park data, *Corbicula* concentrations at the City Shops BMA display consistent trends on the South River as outlined in Section 3.1.2 above. (URS, 2012, 2014, and 2015; AECOM, 2016 and 2017). Key data observations are as follows:

- Mean MeHg and IHg concentrations in near-bank caged *Corbicula* were higher in the spring than the fall.
- Mean concentrations of near-bank seeded and caged *Corbicula* were similar in the spring.
- A high discharge event that occurred during the fall 2018 deployment resulted in a loss of near-bank seeded clams; therefore, no data were able to be obtained.

A complete summary of *Corbicula* data is presented in Table 10 and Figure 13.

Post-remediation IHg and MeHg concentrations in transplanted *Corbicula* were slightly lower or within the range of concentrations observed in the baseline data during the Spring sampling event; however, given the limited sample size, trends and statistical significance were not performed (see Table 10 and Figure 13). Based on the findings of the Pilot Study where Hg concentrations in transplanted *Corbicula* declined following remediation, it is anticipated that current and future reductions in near-bank sediment and pore water may lead to declines in IHg and MeHg concentrations in near-bank transplanted *Corbicula* in the future.

3.2.3 Riparian and Aquatic Habitat

Riparian Vegetation

Post-remediation riparian vegetation communities were surveyed in 2018 at the City Shops BMA. Half of the survey plots were within the remediated section of the BMA and had been recently planted with small trees and shrubs. Results of the survey are provided in Table 11 and summarized below:

- **Tree stratum**: Pre-existing black walnut (*Juglans nigra*) and boxelder (*Acer negundo*) trees in the secondary BMAs were the only trees documented at either of the two vegetation plots; however, other pre-existing trees are present throughout the upper portion of the BMA that was not remediated. Trees planted following remediation are categorized as saplings but over time will provide increased canopy cover over the bank and river.
- **Sapling/shrub stratum:** With a percent cover ranging from 0 to 70%, Tartarian honeysuckle was the dominant species in the sapling/shrub stratum, particularly in the un-remediated portion of the BMA. Along the remediated section, planted Atlantic ninebark (*Physocarpus opulifolius*), river birch (*Betula nigra*), and staghorn sumac (*Rhus typhina*) comprised 0 to 5% of the sapling/shrub stratum cover.
- **Herbaceous plant stratum:** In the remediated section of the BMA, planted riverbank wildrye (*Elymus riparius*) was the dominant herbaceous plant species present in the spring (60% to 98% coverage) with dense colonies of wild senna (*Senna hebecarpa*) also present in the fall (70% coverage). The herbaceous plant community in the un-remediated section of the BMA consisted of a low

percent cover of tartarian honeysuckle (10% to 30%), invasive Japanese knotweed (20%), and other herbaceous plant species were present at <5% cover.

The invasive species management plan has been effective in controlling the spread of Japanese knotweed. The extent of Japanese knotweed in 2018 was well controlled throughout much of the BMA with a similar average coverage of 10% in 2017 and 2018. The riparian vegetation data suggests that plantings along the BMA have so far been successful but ongoing monitoring in 2019 will continue to monitor the overall plant community at the City Shops BMA.

Aquatic Habitat

RBP scores were higher than pre-remediation, indicating an overall increase in habitat quality associated with the remediation. Most instream RBP habitat parameters for the City Shops Park BMA increased and were within the “optimal” range. This increase in habitat quality can be attributed to the stabilization of the banks associated with the remediation, increased habitat from installed large woody debris (LWD), and reduction in the amount of sediment deposition from stabilized banks. In addition, several storm events prior to the fall field event transported many of the fine sediments away from the BMA.

The habitat metric scores for vegetative protection and riparian vegetative zone both decreased from “optimal” to “suboptimal/marginal” and “suboptimal” to “marginal,” respectively, after remediation. This decrease in vegetation habitat quality is linked the removal of vegetation and the decrease in overall vegetation abundance due to recently completed remediation at City Shops (left bank) and Allied Ready Mix (right bank) BMAs. Overtime, as the samplings and shrubs mature, it is expected that vegetative habitat conditions and quality will return to or exceed, pre-remediation levels.

3.3 Baseline Characterization BMAs

This section presents the results of the ongoing baseline characterization efforts at the following BMAs and their associated stations, and bank orientation on South River looking downstream:

- Shiloh Baptist Church (STM-03) – left bank
- North Park (STM-05) – left bank

The Allied Ready Mix BMA (STM-08) was not sampled in 2018 due to ongoing construction associated with remediation.

3.3.1 Bank Stability

As discussed in Section 3.1.1 above, complete details of pre-remediation bank conditions are presented in Section 4.3 and Appendix A of the *Final Interim Measures Design, Implementation and Monitoring Work Plan* (Anchor QEA et al., 2015).

The March 2014 LiDAR survey described existing, pre-remediation bank conditions with average bank heights ranging from 6 feet at the Allied Ready Mix BMA to 20 feet at the Shiloh Baptist Church BMA. Bank angles ranged from 16 to 80 degrees, with areas of undercutting documented at the toe of slope in a number of areas. Mercury loading to the South River from these BMAs ranged from 0.9 kg/year to 4.9 kg/year.

Visual reconnaissance performed in 2018 confirmed the results of the baseline LiDAR survey conducted in 2014. Improvised foot paths to the river have been created by recreational users of the river at a number of locations throughout the monitoring area (see Appendix C and Figure C-1); these paths were generally present near areas of active public use such as along the greenway and North Park.

3.3.2 Baseline Data for Environmental Media

Environmental monitoring media include the abiotic media of sediment and pore water, and the biotic media of *Corbicula* and periphyton. A robust baseline dataset of these media is critical to assess the performance of the IMs at each BMA. Data presented below will form the basis of comparison of post-remediation conditions at each BMA as construction proceeds.

Sediment

A summary of 2018 sediment data is provided in Table 12. Figure 14 provides a summary of sediment data collected in 2015, 2016, 2017, and 2018.

Pre-remediation, baseline sediment Hg concentrations were generally similar for 2015, 2016, 2017, and 2018. Spatial and temporal data distribution were also similar for all three baseline years (see Figure 14). Although the majority of near-bank sediment data collected in the STM program reflects larger reach-scale Hg concentrations documented in previous investigations (URS, 2012), localized near-bank deposits with elevated THg concentrations were documented at each monitoring station. These deposits were typically located adjacent or just downstream of riverbanks with elevated bank soil THg (see Figures 15 through 17).

Reach-specific characteristics such as water depth, channel gradient, flow, and surface water velocity can influence the distribution and similarity between elevated THg in bank soils and near-bank sediment deposits. For example, in more quiescent reaches of the South River, near-bank sediment deposits with elevated THg concentrations tend to be closer to banks with elevated bank soils compared to those in higher energy environments.

Pore Water

A summary of pore water data collected as part of the baseline characterization is provided in Table 13. Baseline filtered pore water IHg and MeHg concentrations were generally similar between 2015, 2016, 2017, and 2018; spatial and temporal data distribution was also similar for all four baseline years (see Figure 18). Pore water data continue to reflect spatial and temporal distribution of nearby sediment concentrations, where the highest filtered THg pore water concentrations were typically co-located at the transects with the highest THg sediment (see Figures 15 through 17). Both IHg and MeHg displayed variable seasonal patterns and generally had higher concentrations in the fall than the spring, potentially due to large discharge events before sampling in 2018 (see Table 13 and Figure 18).

Periphyton

Table 14 and Figure 19 present STM baseline periphyton data for 2015, 2016, 2017, and 2018. Baseline Hg data collected in 2018 were within the range of baseline data collected in 2015, 2016, and 2017 (see Table 14). It is anticipated that as IMs progress and reduce IHg and MeHg in near-bank sediment and pore water, Hg concentrations in epilithic periphyton will also decline.

Clam

Table 15 and Figure 20 present STM baseline data for transplanted and seeded *Corbicula* for 2015, 2016, 2017, and 2018. IHg and MeHg concentrations in transplanted and seeded *Corbicula* treatments were consistent between the 2015, 2016, 2017, and 2018 data (see Figure 20).

- MeHg concentrations in *Corbicula* tissue were generally higher in the spring compared to the fall (see Table 15), likely attributable to seasonally-influenced, in-stream methylation rates.
- MeHg tissue concentrations were generally higher in near-bank environments compared to mid-channel environments (see Table 15).
- MeHg tissue concentrations were generally higher in seeded than in caged *Corbicula* (see Table 15); high discharge events in the South River in 2018 prevented recovery of all fall near-bank seeded samples at STM-03 and in all but one replicate sample in the fall at STM-05.

3.3.3 Riparian and Aquatic Habitat

Riparian Vegetation

Riparian vegetation communities were surveyed in 2018 at the two baseline characterization BMAs (e.g., City Shops and North Park). Riparian vegetation conditions documented in the survey plots were generally similar between years, and the spring and the fall at each station. Non-native, invasive plant species were present at all stations, in the spring and in the fall.

The riparian vegetative survey results are provided in Table 16 and summarized below:

- **Tree stratum:** Collectively, black locust (*Robinia pseudoacacia*), black walnut (*Juglans nigra*), silver maple (*Acer saccharinum*), and American sycamore (*Platanus occidentalis*), were the dominant tree species with the highest percent cover at each of the monitoring stations.
- **Sapling/shrub stratum:** Tartarian honeysuckle (*Lonicera tatarica*) had the highest percent cover for each BMA. Non-native species found at each BMA include tree of heaven (*Ailanthus altissima*) and multiflora rose (*Rosa multiflora*) ranging from 0 to 30% cover.
- **Herbaceous plant stratum:** Japanese knotweed dominated the herbaceous plant stratum at Shiloh Baptist Church BMA (0 to 80% cover); several species of ivy (ground, common, and poison ivy) were also present in low percent covers. The density of herbaceous species observed in the survey plots at the North Park BMA was low and included autumn olive (*Elaeagnus umbellate*) and ground ivy (*Glechoma hederacea*) (0 to 10%) with all other species representing <5% cover.

Post-remediation monitoring at the Allied Ready Mix BMA STM-08 will begin in the spring of 2019.

Aquatic Habitat

RBP scores remained very similar to previous years, and generally reflect the influence of adjacent land use. A summary of key RBP metric scores is provided below for each BMA:

- Shiloh Baptist Church BMA (STM-03): RBP scores were “suboptimal” for most habitat parameters with one marginal score for sediment deposition. Both banks had similar scores for bank stability, vegetative protection, and riparian vegetative zone.
- North Park BMA (STM-05): RBP scores were generally “suboptimal”. However, embeddedness was scored as “marginal” due to numerous stretches of bedrock, and a large fine-grained sediment deposit. An improvement in sediment deposition and pool substrate characterization was documented from the previous year, potentially due to high discharge events, which transported sediments in some areas, and deposited it in others.

3.4 Ancillary STM Habitat Metrics

Ancillary STM habitat metrics are summarized in Appendix C.

4.0 Data Quality Assessment

The 2018 STM analytical data were reviewed in accordance with the Corteva Data Verification Module (DVM) process to determine data usability. The DVM is an internal review process used by the Corteva Analytical Data Quality Management Group (ADQM) to assist with the determination of data quality. The electronic data deliverables received from the laboratory were loaded into the Locus Environmental Information Management (EIM™) database and processed through a series of data quality checks, which are a combination of software (Locus EIM™ database DVM) and manual reviewer evaluations. The review process included comparing available laboratory data deliverables [hardcopy and electronic data deliverable (EDD)] versus the original project specifications, examining the completed chain of custody, and using the automated DVM during the data evaluation.

4.1 Findings

Based on the analytical data quality assurance/ quality control (QA/QC) review, all 2018 STM data are considered usable. No data evaluation qualifiers were applied to the analytical data. Additional findings of the data quality assessment include the following:

- Active remediation at the Allied Ready Mix BMA (STM-08) prevented collection of STM data at that location during the fall and spring of 2018.
- Several deployments of transplanted clams were lost during the fall monitoring effort due to high flows associated with storms.

No other deviations from the sampling plan occurred.

5.0 Findings

The 2018 STM effort documented post-remediation conditions at the Constitution Park BMA and at the City Shops BMA. Pre-remediation conditions at the Shiloh Baptist Church BMA (STM-03) and the North Park BMA (STM-05) were also documented, in accordance with the Final AOC 4 STM Plan (URS, 2015):

Future data collected at these and other STM stations will be compared to baseline conditions to evaluate the IM effectiveness. The assessment will be based on metrics and success criteria that have been established for the STM program (URS, 2015). Results of the Pilot Study will continue to serve as a framework for the interpretation of results of the STM program (Anchor QEA and URS, 2013).

Findings based on a review of the 2018 STM data are provided below:

- **Bank Stability:**
  - Riverbanks are generally stable; isolated areas of erosion, including undercut banks and steep bank slopes with limited vegetation, are present at each monitoring station.
  - Improvised access paths were present at each location, contributing to localized bank erosion and deposition in South River.
  - The remediation completed at Constitution Park and City Shops increased bank stability, eliminating or reducing erosion of bank soils, and Hg loading into the river.
- **Environmental Media:**
  - Constitution Park BMA
    - Preliminary success criteria have been met for IHg and MeHg in near-bank sediments collected at the Constitution Park BMA in 2018.
    - Constitution Park BMA post-remediation abiotic media Hg concentrations continue to decline in 2018, likely in response to bank stabilization and other environmental conditions. The Hg concentrations in biotic media were variable but were within the range of baseline concentrations. It is anticipated that current and future reductions in near-bank sediment and pore water may lead to declines in Hg concentrations in biotic media in the future.
  - City Shops BMA
    - Preliminary success criteria have been met for IHg concentrations in near-bank sediment collected in 2018 at the City Shops BMA. Future data collections will continue to evaluate if consistent downward trends are occurring in sediment data.
    - City Shops BMA post-remediation sediment Hg concentrations decreased in 2018 relative to baseline, but pore water Hg concentrations were observed to increase, particularly in the spring. The increase in pore water concentrations is likely in response to disturbance to the system associated with construction; this response was also observed after the Constitution Park BMA bank stabilization. Similar to Constitution Park, Hg concentrations in biotic media remained consistent with pre-remediation conditions.

- Baseline BMAs
  - Hg concentrations generally follow spatial and temporal trends documented in previous investigations with concentrations typically higher in near-bank environments and decreasing with increased distance from the former plant site.
  - THg concentrations in near-bank bulk sediment and filtered pore water continue to be higher adjacent to, or downstream from un-remediated Primary BMA riverbanks with elevated THg concentrations in bank soils.
  - THg concentrations in near-bank sediment and pore water generally reflect broader THg concentrations in RRM 0-2 associated with multiple diffuse sources. It is anticipated that sediment THg concentrations will continue to reflect THg concentrations on particles suspended in the water column, as documented in the Pilot Study.

- **Riparian and Aquatic Habitat:**
  - Invasive plant species were present at most monitoring stations, particularly at the remediated Constitution Park BMA (STM-01). A recently implemented invasive species management program has helped reduced the amount of Japanese knotweed by nearly 50% and will be continued in 2019.
  - At the City Shops BMA riparian vegetation data suggest that plantings along the BMA have been successful; ongoing 2019 monitoring will provide data to assess the overall plant community.
  - EPA RBP scores rated most habitats “sub-optimal” to “optimal”; however, a few lower “marginal” scores were documented; no significant negative changes were documented due to the remediation.

With the completion of IMs at the Constitution Park BMA in February 2017, and the City Shops BMA in February 2018, the 2018 monitoring was the second and first post-remediation dataset collected at each BMA respectively. As such, limited statistical comparisons are possible; trend analyses will be performed to evaluate long-term trends as the post-remediation dataset grows. Monitoring results will be evaluated in the context of the established success criteria, as well as the framework of the Pilot Study (Anchor QEA and URS, 2013).

IMs at the Allied Ready Mix BMA were completed in November 2018. The 2019 STM effort and data evaluation will incorporate the first post-remediation dataset for this BMA. Additionally, IMs at the Shiloh Baptist Church BMA are anticipated to be completed in 2019 and will be incorporated into the post-remediation dataset when complete. With the exception of North Park, STM data collected in 2019 at other stations will be considered post-remediation monitoring data.

Consistent with adaptive management principles for AOC 4, the STM approach may be revised based on documented progress towards the achievement of success criteria, contingency actions, and emerging decision analysis options. More specifically, monitoring data that do not provide useful information for the remedial decision process may be reduced or eliminated from the STM program with the concurrence of the VDEQ, which is consistent with the revisions to the LTM program implemented in 2018.

6.0 References

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Tables

Table 1
AOC 4 Short-Term Monitoring Plan Summary
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Short-Term Remedial Action Objectives				Monitoring Plan Designs			Adaptive Management Outcomes	
General Objective	**Performance Objective**	**Measurable Metric**	**Preliminary Success Criteria**	**General Station Locations**	**Monitoring Frequency (post construction)**	**Analytical Parameters**	**Contingency Actions**	**Decision Analysis**
Reduce Mercury Transport and Exposure	Increase in Bank Stability	Topography	Maintenance of Post-Construction Bank Condition	BMA Evaluated Holistically	Twice Annually for First 3 Years; Post-storm	Continuous Bank Angle / Grade	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
		Vegetation	>80% Cover; <10% Invasives	Vegetation Plots at Each BMA	Twice Annually for First 3 Years; Post-storm	Cover and Species Composition	Additional Vegetation Enhancement	Refine Effectiveness Estimates
		Design and Implementation	Landowner Approvals and Permits	BMA Properties	NA	NA	NA	Refine Implementation Estimates
	Reduce Mercury Loading from Bank	Surface Sediment	>75% Mercury Concentration Reduction	Transects Spaced ~100-200' at each BMA	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Pore Water	>75% Mercury Concentration Reduction	Transects Spaced ~100-200' at each BMA	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Periphyton	>75% Mercury Concentration Reduction	Downstream of Representative BMAs (Near-shore)	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Asiatic Clam Sampling	>75% Mercury Concentration Reduction	Downstream of Representative BMAs (Near-shore)	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
	Reduce In-Channel Mercury Exposure	Periphyton	>50% Mercury Concentration Reduction	Downstream of Representative BMAs (Channel)	Annually for First 10 Years	IHg and MeHg Concentrations	NA	Refine CSM
		Asiatic Clam Sampling	>50% Mercury Concentration Reduction	Downstream of Representative BMAs (Channel)	Annually for First 10 Years	IHg and MeHg Concentrations	NA	Refine CSM
Maintain or Improve Riparian and Aquatic Habitat	Improve Bank Vegetation	Vegetation	>80% Cover; <10% Invasives	Vegetation Plots at Each BMA	Twice Annually for First 3 Years	Cover and Species Composition	Additional Vegetation Enhancement	Refine Effectiveness Estimates
	Improve In-Stream Habitat	Rapid Bioassessment Protocols	Visual Stream Classification	Each BMA Assessed Independently	Quarterly for the First Year and Semi Annually (Q1/Q3) for years 2-10[1]	Rapid Bioassessment Protocol Scores	NA	Refine Effectiveness Estimates
	Maintain Detrital Input/Stream Shading	Canopy Cover	Achievement of Baseline Canopy Coverage	Transects Spaced ~ 100-200' at each BMA	Annually for First 3 Years	Percent Canopy Coverage (Spherical Densiometer)	Additional Vegetation Enhancement	Refine Effectiveness Estimates
	Maintain Stream Substrate Condition	Wolman Pebble Counts	Maintenance / Improvement of Baseline Conditions	Transects Spaced ~100-200' at each BMA	Annually for First 3 Years	Particle Size Analysis	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
	Maintain In-stream Habitat Features	# of In-stream Habitat Features	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Twice Annually for First 3 Years	# of In-stream Habitat Features	Structural Stabilization	Refine Effectiveness Estimates
	Habitat Function and Ecological Value	EPW & USM	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Annually for first 3 Years	USM Methodology & EPW Non-tidal Stream - Fish FCI	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
Maintain or Improve Benthic Community	Maintenance of Benthic Community	Benthic Invertebrate Metrics	Maintenance / Improvement of Baseline Conditions	Four Locations Within the Interim Measures Area (RRM 0.5, RRM 1.0, RRM 1.5, RRM 2.0)	Twice Annually for First 3 Years	300 Organism Sub-count	NA	Refine Effectiveness Estimates
River Access / Aesthetics	Provide Stable River Access Points	Stable Access Points	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Twice Annually for First 3 Years	# of Stable and Improvised Access Points	Structural Stabilization	Refine Effectiveness Estimates

Notes:
EPW, Evaluation for Planned Wetlands
FCI, Functional Capacity Index
USM, Unified Stream Methodology
RRM, Relative River Mile
NA, Not applicable
IHg, Inorganic mercury
MeHg, Methylmercury
CSM, Conceptual Site Model
BMA, Bank Management Area
Ancillary habitat/ public access metrics
1, baseline (pre-construction) monitoring will occur semi annually

Table 2
Constitution Park BMA Sediment Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Replicate[1]	Sediment Type	THg (mg/kg, dw)					IHg (mg/kg, dw)					MeHg (µg/kg, dw)				
		Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD
A	Bulk	8.64 ± 19.7	0.04	0.14	0.5 ± 0.7	7.0 ± 20.8	8.63 ± 19.7	0.04	0.14	0.5 ± 0.7	7.0 ± 20.8	9.86 ± 19.7	0.74	1.16	1.7 ± 1.8	6.4 ± 1.8
B			0.19	0.04				0.19	0.04				1.09	0.12		
C			0.33	0.25				0.33	0.25				1.77	0.64		
D			1.81	1.80				1.81	1.80				5.17	4.76		
E			0.36	0.12				0.36	0.12				0.73	1.13		
Mean			0.55	0.47				0.55	0.47				1.90	1.56		

Notes:
1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Baseline samples collected 2015-2016
3, Post IM samples collected 2017-2018
IHg, Inorganic mercury
MeHg, Methylmercury
dw, Dry weight
-- Data not collected/included in STM Program

Table 3
Constitution Park BMA Filtered Pore Water Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Replicate[1]	FTHg (ng/L)					FIHg (ng/L)					FMeHg (ng/L)				
	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD
A	22.9 ± 39.5	6.29	1.89	15.3 ± 11.8	21.7 ± 23.2	19.5 ± 32.6	3.41	1.30	11.3 ± 10.4	17.6 ± 20.0	3.4 ± 7.5	2.88	0.59	3.9 ± 6.1	4.1 ± 6.5
B		36.32	18.06				36.17	9.04				0.15	9.03		
C		32.14	4.65				12.51	3.34				19.63	1.31		
D		16.16	20.73				14.74	18.80				1.42	1.93		
E		10.68	5.63				10.57	3.54				0.11	2.09		
Mean		20.32	10.19				15.48	7.20				4.84	2.99		

Notes:
1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Baseline samples collected 2015-2016
3, Post IM samples collected 2017-2018
FIHg, Inorganic mercury (filtered fraction)
FMeHg, Methylmercury (filtered fraction)
-- Data not collected/included in STM Program

Table 4
Constitution Park BMA Periphyton Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Environment	IHg (µg/kg, ww)						MeHg (µg/kg, ww)					
	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD			Concentration Range	Mean ± SD	Concentration Range	Mean ± SD	
Mid-Channel	177.6 ± 79.1	85.1 - 514.2	241.9 ± 236.7	--	--	159.5 ± 175.1	0.64 ± 0.35	2.16 - 2.31	2.22 ± 0.08	--	--	1.4 ± 0.9
Near Bank	301.5 ± 265.9	90.6 - 94.0	92.4 ± 1.7	141.1 - 285.8	213.2 ± 72.4	231.6 ± 126.8	0.98 ± 1.00	1.25 - 1.41	1.32 ± 0.08	1.66 - 2.25	1.88 ± 0.32	1.2 ± 0.5

Notes:
1, Baseline samples collected 2015-2016
2, Post IM samples collected 2017-2018
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 5
Constitution Park BMA *Corbicula* Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Environment	IHg (µg/kg, ww)					MeHg (µg/kg, ww)				
	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD			Concentration Range	Mean ± SD	Concentration Range	Mean ± SD	
Near-Bank Seeded	21.6 ± 11.4	15.6 - 19.3	17.3 ± 1.9	17.5 - 20.4	19.3 ± 1.6	18.8 ± 1.7	21.2 ± 16.2	13.4 - 13.8	13.7 ± 0.2	15.3 - 18.4	16.8 ± 1.6	17.6 ± 8.9
Near-Bank Caged	17.4 ± 5.5	12.3 - 53.1	26.1 ± 23.3	12.8 - 15.9	14.3 ± 1.5	17.7 ± 11.8	11.3 ± 4.2	8.8 - 52.4	23.4 ± 25.1	6.9 - 9.0	7.8 ± 1.0	12.7 ± 12.7
Mid-Channel Caged	20.6 ± 9.9	13.8 - 17.1	15.4 ± 1.6	--	--	16.0 ± 1.3	7.5 ± 2.8	5.6 - 7.9	6.4 ± 1.3	--	--	7.6 ± 1.7

Notes:
1, Baseline samples collected 2015-2016
2, Post IM samples collected 2017-2018
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 6
Constitution Park BMA Riparian Vegetation Plot Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Vegetative Species		Absolute % Cover[1]	
Scientific Name	**Common Name**	**Spring 2018**	**Fall 2018**
Constitution Park BMA (STM-01)			
Tree/Vine Stratum			
Robinia pseudoacacia	Black Locust	0-30	0-30
Convolvulus arvensis	Field Bindweed	0-2	0-2
Sapling/Shrub Stratum			
Acer rubrum	Red Maple	10-15	10-15
Cornus amomum	Silky Dogwood	0-5	0-5
Platanus occidentalis	Sycamore	0-15	0-15
Alnus incana	Speckled Alder	0-5	0-5
Physocarpus opulifolius	Atlantic Ninebark	5	5-10
Rosa multiflora	Multiflora Rose	0	0-2
Herbaceous Stratum			
Fallopia japonica	Japanese Knotweed	35-40	15-25
Cyperus esculentus	Yellow Nutsedge	2	2
Elymus riparius	Riverbank Wildrye	0-2	0-5
Tridens flavus	Purple top grass	0	0-5
Daucus carota	Queen Anne's Lace	0-2	0
Plantago major	Common plantain	0-1	0
Festuca rubra	Red fescue	0	0-2

Notes:
1, Represents the range observed between two riparian vegetative survey plots per Short-Term Monitoring
NA, Not applicable

Table 7
City Shops BMA Sediment Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Replicate[1]	Sediment Type	THg (mg/kg, dw)					IHg (mg/kg, dw)					MeHg (µg/kg, dw)				
		Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD
F	Bulk	7.8 ± 8.1	1.36	3.90	1.5 ± 0.9	1.5 ± 0.9	7.82 ± 8.1	1.36	3.88	1.5 ± 0.9	1.5 ± 0.9	11.0 ± 10.2	1.84	16.05	6.5 ± 5.5	6.5 ± 5.5
G			2.04	0.68				2.03	0.68				6.70	2.34		
H			2.13	1.01				2.11	1.00				13.08	3.64		
I			1.48	0.69				1.46	0.69				16.57	2.45		
J			1.31	1.31				1.30	1.31				4.17	4.29		
K			0.35	1.30				0.35	1.30				1.26	5.62		
Mean			1.44	1.48				1.44	1.48				7.27	5.73		

Notes:
1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Baseline samples collected 2015-2017
3, Post IM samples collected 2018
IHg, Inorganic mercury
MeHg, Methylmercury
dw, Dry weight
-- Data not collected/included in STM Program

Table 8
City Shops BMA Filtered Pore Water Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Replicate[1]	FTHg (ng/L)					FIHg (ng/L)					FMeHg (ng/L)				
	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD	Baseline[2] Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Post IM[3] Mean ± SD
F		16.31	14.09				11.73	5.40				4.58	8.69		
G		25.94	17.70				24.15	12.77				1.79	4.93		
H		12.74	8.90				10.35	6.46				2.39	2.44		
I	11.1 ± 15.1	33.35	8.35	18.8 ± 18.9	18.8 ± 18.9	9.8 ± 14.8	13.77	3.01	13.0 ± 16.6	13.0 ± 16.6	1.3 ± 1.45	19.58	5.34	5.8 ± 5.3	5.8 ± 5.3
J		1.81	3.41				1.16	1.50				0.66	1.91		
K		71.72	10.96				61.28	3.87				10.44	7.10		
Mean		26.98	10.57				20.40	5.50				6.57	5.07		

Notes:

1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Baseline samples collected 2015-2017
3, Post IM samples collected 2018
FIHg, Inorganic mercury (filtered fraction)
FMeHg, Methylmercury (filtered fraction)
-- Data not collected/included in STM Program

Table 9
City Shops BMA Periphyton Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Environment	IHg (µg/kg, ww)						MeHg (µg/kg, ww)					
	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD	Baseline[1] Mean ± SD	2018 June		2018 October		Post IM[2] Mean ± SD
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD			Concentration Range	Mean ± SD	Concentration Range	Mean ± SD	
Mid-Channel	631.5 ± 380.0	100.7 - 216.0	151.0 ± 59.0	--	--	151.0 ± 59.0	1.2 ± 0.5	2.1 - 2.5	2.3 ± 0.2	--	--	2.3 ± 0.2
Near Bank	1981.3 ± 884.5	349.8 - 1011.4	574.5 ± 378.4	814.7 - 1425.4	1119.9 ± 305.3	847.2 ± 428.8	2.7 ± 1.9	3.9 - 4.3	4.1 ± 0.2	3.2 - 3.9	3.6 ± 0.3	3.9 ± 0.4

Notes:
1, Baseline samples collected 2015-2017
2, Post IM samples collected 2018
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 10
City Shops BMA *Corbicula* Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Environment	IHg (µg/kg, ww)						MeHg (µg/kg, ww)					
	Baseline[1] Mean ± SD	2018 June		2018 October[3]		Post IM[2] Mean ± SD	Baseline[1] Mean ± SD	2018 June		2018 October[3]		Post IM[2] Mean ± SD
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD			Concentration Range	Mean ± SD	Concentration Range	Mean ± SD	
Near-Bank Seeded	36.9 ± 18.0	21.3 - 24.3	22.4 ± 1.6	--	--	22.4 ± 1.6	25.3 ± 11.6	19.6 - 24.5	22.1 ± 2.4	--	--	22.1 ± 2.4
Near-Bank Caged	29.0 ± 12.3	22.0 - 32.9	26.0 ± 6.0	14.5 - 17.0	15.7 ± 1.3	20.8 ± 6.9	13.6 ± 5.5	13.1 - 19.1	15.3 ± 3.3	3.6 - 5.5	4.6 ± 1.0	10.0 ± 6.3
Mid-Channel Caged	24.3 ± 5.9	13.2 - 16.8	15.5 ± 2.0	--	--	15.5 ± 2.0	9.1 ± 2.2	6.2 - 6.8	6.5 ± 0.3	--	--	6.5 ± 0.3

Notes:
1, Baseline samples collected 2015-2017
2, Post IM samples collected 2018
3, Near-Bank Seeded *Corbicula* lost during deployment due to storms
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 11
City Shops BMA Riparian Vegetation Plot Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Vegetative Species		Absolute % Cover[1]	
Scientific Name	**Common Name**	**Spring 2018**	**Fall 2018**
City Shops BMA (STM-07)			
Tree/Vine Stratum			
Juglans nigra	Black Walnut	0-10	0-5
Acer negundo	Box Elder Maple	0-75	0-60
Vitis vulpina	Grape Vine	0	0-10
Menispermum canadense	Moonseed	0-10	0
Lonicera japonica	Japanese Honeysuckle	0-10	0
Toxicodendron radicans	Poison Ivy	0	0-5
Ampelopsis brevipedunculata	Porcelain berry	0-5	0
Celastrus orbiculatus	Oriental Bittersweet	0-55	0-55
Sapling/Shrub Stratum			
Lonicera tatarica	Tartarian Honeysuckle	0-40	0-70
Elaeagnus umbellata	Autumn Olive	0	0-2
Betula nigra	River birch	0-2	0
Fothergilla gardenii	Dwarf Fothergilla	0-1	0-10
Physocarpus opulifolius	Atlantic Ninebark	0-5	0-5
Rhus typhina	Staghorn Sumac	0-2	0-5
Herbaceous Stratum			
Fallopia japonica	Japanese Knotweed	0-20	0-20
Agrostis perennans	Upland Bentgrass	0	0-25
Andropogon gerardi	Big Bluestem	0	0-5
Cyperus esculentus	Yellow Nutsedge	0	0-5
Senna hebecarpa	Wild Senna	0	0-70
Lonicera tatarica	Tartarian Honeysuckle	0-10	0-30
Elymus riparius	Riverbank Wildrye	0-98	0-60
oats sp.	NA	0	0-2

Notes:

1, Represents the range observed between two riparian vegetative survey plots per Short-Term Monitoring station.

NA, Not applicable

--, Not sampled

Table 12
Baseline Sediment Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Site	Sample Replicate[1]	Sediment Type	THg (mg/kg, dw)				IHg (mg/kg, dw)				MeHg (µg/kg, dw)			
			Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD
Shiloh Baptist Church BMA (STM-03)[2]														
STM-03	A	Bulk	7.1 ± 9.1	0.2	0.5	8.3 ± 10.6	7.1 ± 9.1	0.2	0.5	8.3 ± 10.6	9.1 ± 9.4	2.1	1.5	9.7 ± 10.6
	B			1.2	0.8			1.2	0.8			7.6	1.4	
	C			11.3	12.3			11.3	12.3			11.7	13.9	
	D			1.2	1.4			1.2	1.4			2.3	1.1	
	E			16.6	7.3			16.6	7.3			7.5	6.1	
	F			25.9	2.4			25.9	2.3			26.7	8.8	
	G			10.6	1.4			10.6	1.4			14.7	3.5	
	H			43.4	6.8			43.3	6.8			46.7	3.7	
	I			5.0	4.2			5.0	4.2			9.4	5.5	
	J			2.7	11.0			2.7	11.0			9.0	11.5	
	Mean			**11.8**	**4.8**			**11.8**	**4.8**			**13.8**	**5.7**	
North Park BMA (STM-05 & STM-07A-E)[3]														
STM-05	A	Bulk	34.4 ± 81.3	6.9	7.9	39.0 ± 49.2	34.4 ± 81.3	6.9	7.9	39.0 ± 49.2	19.5 ± 21.9	8.8	8.0	25.6 ± 31.6
	B			1.7	27.2			1.7	27.2			3.2	11.0	
	C			24.7	17.6			24.7	17.6			31.9	11.4	
	D			2.1	5.7			2.1	5.7			5.9	12.1	
	E			19.3	94.4			19.3	94.4			79.3	33.7	
	F			78.2	141.6			78.1	141.6			57.5	40.3	
	G			155.8	186.8			155.6	186.7			146.8	90.2	
	H			19.7	46.6			19.7	46.6			13.8	18.7	
	I			56.0	6.4			55.9	6.4			27.3	4.8	
	J			89.4	27.0			89.4	27.0			31.4	7.6	
STM-07	A			2.6	59.0			2.6	59.0			2.6	15.8	
	B			13.4	9.5			13.4	9.5			19.9	7.1	
	C			10.8	10.2			10.8	10.2			8.4	2.7	
	D			27.2	16.4			27.2	16.3			40.8	8.9	
	E			3.9	1.9			3.9	1.9			10.4	7.6	
	Mean			**34.1**	**43.9**			**34.1**	**43.9**			**32.5**	**18.6**	
Allied Ready Mix BMA (STM-08)[4]														
STM-08	A	Bulk	13.6 ± 30.5	--	--	-- ± --	13.5 ± 30.4	--	--	-- ± --	11.8 ± 12.8	--	--	-- --
	B			--	--			--	--			--	--	
	C			--	--			--	--			--	--	
	D			--	--			--	--			--	--	
	E			--	--			--	--			--	--	
	F			--	--			--	--			--	--	
	G			--	--			--	--			--	--	
	H			--	--			--	--			--	--	
	I			--	--			--	--			--	--	
	J			--	--			--	--			--	--	
	Mean			--	--			--	--			--	--	

Notes:
1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Shiloh Baptist Church BMA (STM-03), baseline samples collected 2017-2018
3, North Park BMA (STM-05), baseline samples collected 2015-2018
4, Allied Ready Mix BMA (STM-08), baseline samples collected 2017
IHg, Inorganic mercury
MeHg, Methylmercury
dw, Dry weight
-- Data not collected/included in STM Program

Table 13
Baseline Filtered Pore Water Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Site	Sample Replicate[1]	FTHg (ng/L)				FIHg (ng/L)				FMeHg (ng/L)			
		Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD	Baseline Mean ± SD	June 2018 Sampling Event	October 2018 Sampling Event	2018 Mean ± SD
Shiloh Baptist Church BMA (STM-03)[2]													
STM-03	A	11.1 ± 12.1	3.3	3.2	13.5 ± 14.1	9.8 ± 12.0	2.5	2.6	12.2 ± 14.0	1.2 ± 1.4	0.8	0.5	1.3 ± 1.5
	B		3.0	2.3			2.5	2.1			0.5	0.2	
	C		13.8	6.0			9.6	3.9			4.3	2.0	
	D		6.8	5.9			6.0	5.4			0.8	0.5	
	E		5.9	6.3			5.6	6.1			0.3	0.2	
	F		27.7	10.7			24.9	10.1			2.8	0.6	
	G		10.9	1.5			9.4	1.3			1.5	0.2	
	H		36.7	22.0			35.3	21.4			1.4	0.6	
	I		19.1	18.7			13.3	18.3			5.8	0.4	
	J		7.3	58.4			4.6	58.1			2.6	0.3	
	Mean		**13.5**	**13.5**			**11.4**	**12.9**			**2.1**	**0.6**	
North Park BMA (STM-05 & STM-07A-E)[3]													
STM-05	A	24.7 54.2	7.2	270.9	28.0 ± 49.2	21.4 ± 49.9	6.7	166.7	21.3 ± 31.6	3.2 ± 10.5	0.5	104.2	6.8 ± 19.2
	B		8.1	2.4			6.1	1.9			2.0	0.5	
	C		8.4	9.3			7.2	7.7			1.1	1.6	
	D		2.8	3.5			2.5	3.1			0.3	0.4	
	E		11.7	53.1			10.1	36.1			1.6	17.0	
	F		31.8	52.3			27.9	43.4			3.9	8.8	
	G		33.9	13.0			32.8	12.5			1.1	0.5	
	H		4.9	33.3			4.5	14.0			0.4	19.3	
	I		32.0	62.8			29.1	62.6			2.9	0.2	
	J		21.6	51.7			21.1	42.2			0.5	9.5	
STM-07	A		7.6	38.7			7.3	37.8			0.3	0.9	
	B		8.8	4.9			6.8	4.6			2.0	0.4	
	C		4.8	13.0			4.7	10.8			0.0	2.2	
	D		3.9	2.2			3.8	2.2			0.1	0.0	
	E		16.0	26.2			14.5	7.2			1.5	19.1	
	Mean		**13.6**	**42.5**			**12.3**	**30.2**			**1.2**	**12.3**	
Allied Ready Mix BMA (STM-08)[4]													
STM-08	A	5.4 ± 2.8	--	--	-- ± --	4.7 ± 2.5	--	--	-- ± --	0.7 ± 1.2	--	--	-- ± --
	B		--	--			--	--			--	--	
	C		--	--			--	--			--	--	
	D		--	--			--	--			--	--	
	E		--	--			--	--			--	--	
	F		--	--			--	--			--	--	
	G		--	--			--	--			--	--	
	H		--	--			--	--			--	--	
	I		--	--			--	--			--	--	
	J		--	--			--	--			--	--	
	Mean		--	--			--	--			--	--	

Notes:
1, Per STM station, sample replicates increase alphabetically with distance downstream
2, Shiloh Baptist Church BMA (STM-03), baseline samples collected 2017-2018
3, North Park BMA (STM-05), baseline samples collected 2015-2018
4, Allied Ready Mix BMA (STM-08), baseline samples collected 2017
FIHg, Inorganic mercury (filtered fraction)
FMeHg, Methylmercury (filtered fraction)
-- Data not collected/included in STM Program

Table 14
Baseline Periphyton Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Sample Environment	IHg (µg/kg, ww)					MeHg (µg/kg, ww)				
	Baseline Mean ± SD	2018 June		2018 October		Baseline[1] Mean ± SD	2018 June		2018 October	
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD
Shiloh Baptist Church BMA (STM-03) [1]										
Mid-Channel	35.9 ± 9.7	24.8 - 42.6	35.9 ± 9.7	--	--	1.3 ± 0.2	1.1 - 1.6	1.3 ± 0.2	--	--
Near Bank	391.349 ± 326.42	190.5 - 337.9	276.1 ± 76.5	480.4 - 1146.3	747.0 ± 352.2	1.7 ± 0.6	1.8 - 3.1	2.3 ± 0.7	1.6 - 1.8	1.7 ± 0.1
North Park BMA (STM-05) [2]										
Mid-Channel	433.089 ± 587.83	65.3 - 83.7	72.2 ± 10.0	--	--	1.0 ± 0.7	0.9 - 1.2	1.1 ± 0.2	--	--
Near Bank	1232.5 ± 793.2	201.9 - 563.0	341.9 ± 193.8	1119.3 - 1346.1	1195.9 ± 130.1	2.1 ± 1.5	2.0 - 2.4	2.2 ± 0.2	2.4 - 2.9	2.7 ± 0.3
Allied Ready Mix BMA (STM-08) [3]										
Mid-Channel	483.444 ± 83.1	--	--	--	--	1.0 ± 0.05	--	--	--	--
Near Bank	492.079 ± 439.0	--	--	--	--	1.8 ± 0.7	--	--	--	--

Notes:
1, Shiloh Baptist Church BMA (STM-03), baseline samples collected 2017-2018
2, North Park BMA (STM-05), baseline samples collected 2015-2018
3, Allied Ready Mix BMA (STM-08), baseline samples collected 2017
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 15
Baseline *Corbicula* Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

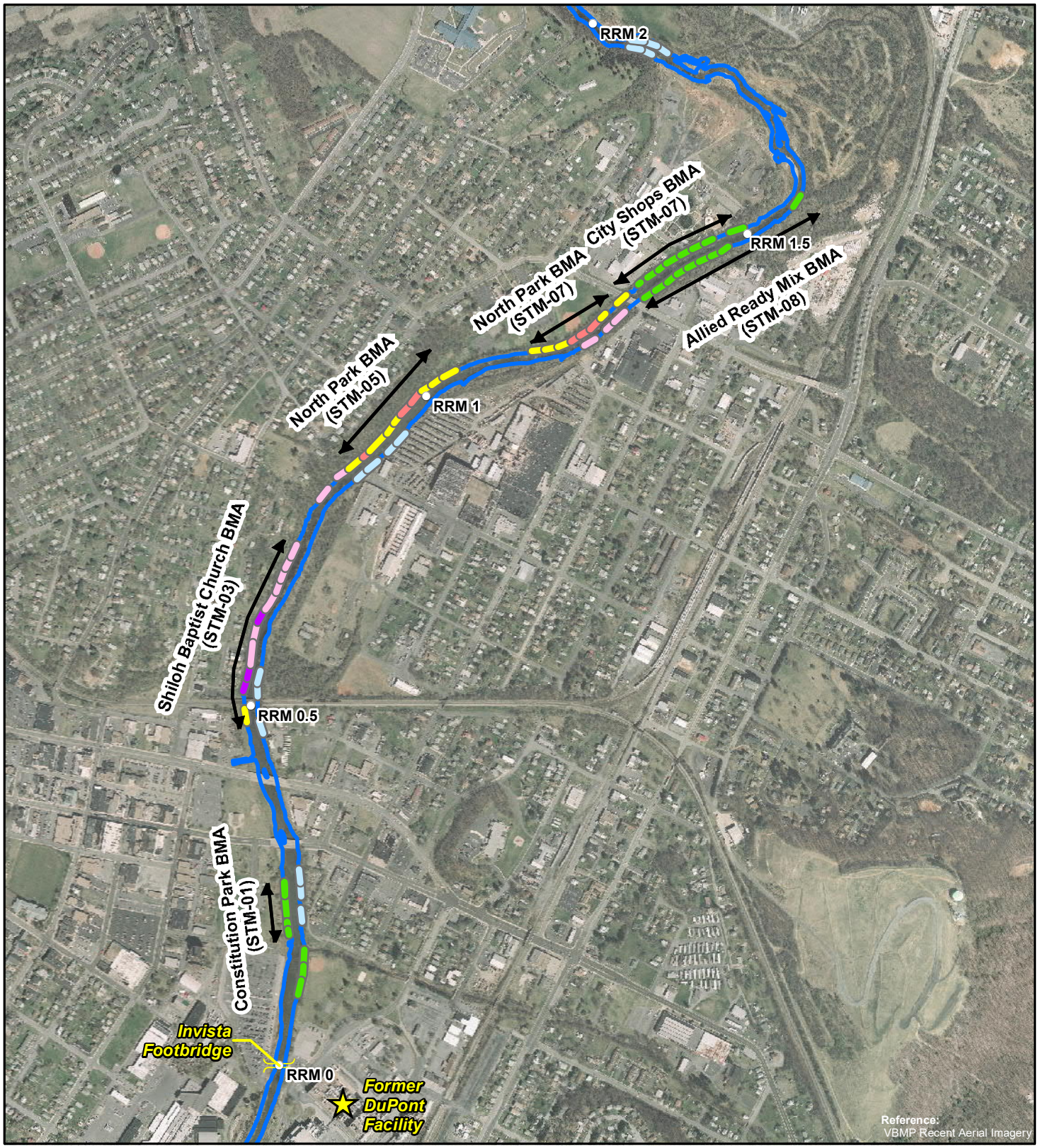
Sample Environment	IHg (µg/kg, ww)					MeHg (µg/kg, ww)				
	Baseline Mean ± SD	2018 June		2018 October		Baseline Mean ± SD	2018 June		2018 October	
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD
Shiloh Baptist Church BMA (STM-03) [1]										
Near-Bank Seeded	23.5 ± 3.7	25.1 - 27.7	26.6 ± 1.4	--	--	19.6 ± 3.6	19.9 - 24.2	22.5 ± 2.3	--	--
Near-Bank Caged	18.0 ± 2.6	17.9 - 21.8	19.8 ± 2.0	15.3 - 16.8	16.3 ± 0.9	8.1 ± 2.5	7.3 - 9.7	8.5 ± 1.2	5.0 - 5.3	5.2 ± 0.2
Mid-Channel Caged	11.2 ± 1.0	10.3 - 12.3	11.2 ± 1.0	--	--	4.5 ± 0.8	4.1 - 5.5	4.5 ± 0.8	--	--
North Park BMA (STM-05) [2]										
Near-Bank Seeded	32.5 ± 13.2	--	--	36.6 - 36.6	36.6 ± --	23.0 ± 15.8	--	--	12.0 - 12.0	12.0 ± --
Near-Bank Caged	26.6 ± 11.7	20.7 - 24.1	22.2 ± 1.7	17.7 - 21.0	19.0 ± 1.7	15.1 ± 10.0	13.1 - 16.0	15.0 ± 1.7	5.0 - 6.0	5.6 ± 0.6
Mid-Channel Caged	19.9 ± 7.6	10.6 - 18.0	13.5 ± 3.9	--	--	6.9 ± 2.1	4.5 - 5.1	4.8 ± 0.3	--	--
Allied Ready Mix BMA (STM-08) [3]										
Near-Bank Seeded	22.4 ± 1.5	--	--	--	--	11.8 ± 3.7	--	--	--	--
Near-Bank Caged	19.5 ± 3.3	--	--	--	--	8.2 ± 3.2	--	--	--	--
Mid-Channel Caged	20.7 ± 1.0	--	--	--	--	11.8 ± 0.8	--	--	--	--

Notes:
1, Shiloh Baptist Church BMA (STM-03), baseline samples collected 2017-2018
2, North Park BMA (STM-05), baseline samples collected 2015-2018
3, Allied Ready Mix BMA (STM-08), baseline samples collected 2017
IHg, Inorganic mercury
MeHg, Methylmercury
ww, Wet weight
-- Data not collected/included in STM Program

Table 16
Baseline Riparian Vegetation Plot Data
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Vegetative Species		Absolute % Cover[1]	
Scientific Name	**Common Name**	**Spring 2018**	**Fall 2018**
Shiloh Baptist Church BMA (STM-03)			
Tree/Vine Stratum			
Juglans nigra	Black Walnut	0-60	0-60
Acer saccharinum	Silver Maple	0-65	0-65
Acer negundo	Box Elder	0-25	0-25
Lonicera japonica	Japanese Honeysuckle	5-10	5-10
Platanus occidentalis	American Sycamore	0	0-10
Clematis terniflora	Sweet Autumn Virginsbower	5-20	5-20
Vitis sp.	Grape Vine	0-15	0-10
Toxicodendron radicans	Poison Ivy	0-15	0-15
Sapling/Shrub Stratum			
Lonicera tatarica	Tartarian Honeysuckle	10-50	10-70
Ailanthus altissima	Tree of Heaven	0-30	0-30
Acer negundo	Box Elder Maple	0-10	0-10
Herbaceous Stratum			
Fallopia japonica	Japanese Knotweed	0-80	0-80
Glechoma hederacea	Ground Ivy	5-10	5-10
Hedera helix	Common Ivy	0-40	0-25
Toxicodendron radicans	Poison Ivy	0-5	0-5
Phytolacca americana	Pokeweed	0-2	0
Smilax sp.	Green Briar	0-30	0
Rosa multiflora	Multiflora Rose	0-15	0-15
North Park BMA (STM-05)			
Tree/Vine Stratum			
Juglans nigra	Black Walnut	60-70	25-60
Robinia pseudoacacia	Black Locust	0-10	0-30
Platanus occidentalis	American Sycamore	0-20	0-15
Quercus montana	Chestnut Oak	0	0-10
Catalpa speciosa	Northern Catalpa	0-10	0-20
Vitis vulpina	Grape Vine	5-10	5-10
Parthenocissus quinquefolia	Virginia Creeper	0-1	0-10
Ampelopsis brevipedunculata	Porcelain berry	0	0-5
Toxicodendron radicans	Poison Ivy	0-35	0-35
Clematis terniflora	Sweet Autumn Virginsbower	0-10	0-10
Sapling/Shrub Stratum			
Lonicera tatarica	Tartarian Honeysuckle	70-90	70-90
Rosa multiflora	Multiflora Rose	15	10-15
Albizia julibrissin	Persian Silk Tree	0-2	0-2
Juglans nigra	Black Walnut	0-30	0-25
Lindera benzoin	Northern Spicebush	0	0-10
Ailanthus altissima	Tree of Heaven	0	0-2
Herbaceous Stratum			
Acer rubrum	Red Maple	0-2	0
Elaeagnus umbellata	Autumn Olive	0	0-20
Lindera benzoin	Northern Spicebush	0-4	0
Albizia julibrissin	Persian Silk Tree	0	0-1
Glechoma hederacea	Ground Ivy	0-10	0-10
Toxicodendron radicans	Poison Ivy	0-5	0-5
Rubus idaeus	Red Raspberry	5	5
Lonicera tatarica	Tartarian Honeysuckle	0-3	0-3

Figures



Legend

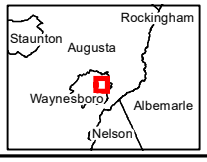
- Extent of Short-term Monitoring Location
- Shoreline
- Relative River Mile (RRM)

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

0 375 750 1,500 Feet

N



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Date: 8/29/2019	

Figure 1
Short-Term Monitoring Area Overview Map
2018 Short-Term Monitoring Report

Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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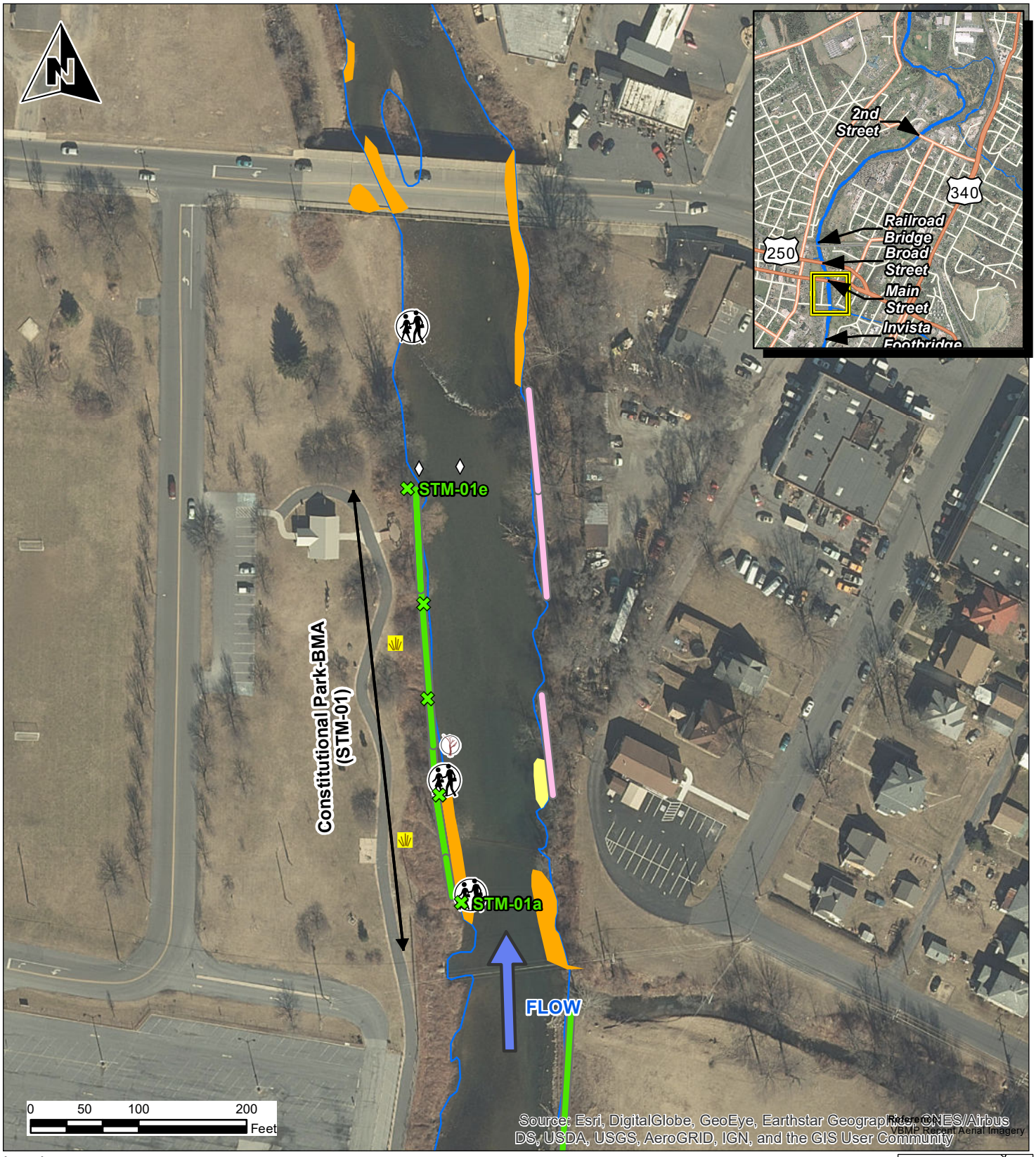

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

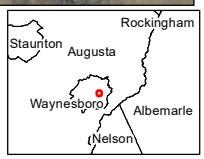

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Figure 2: Sheet 1 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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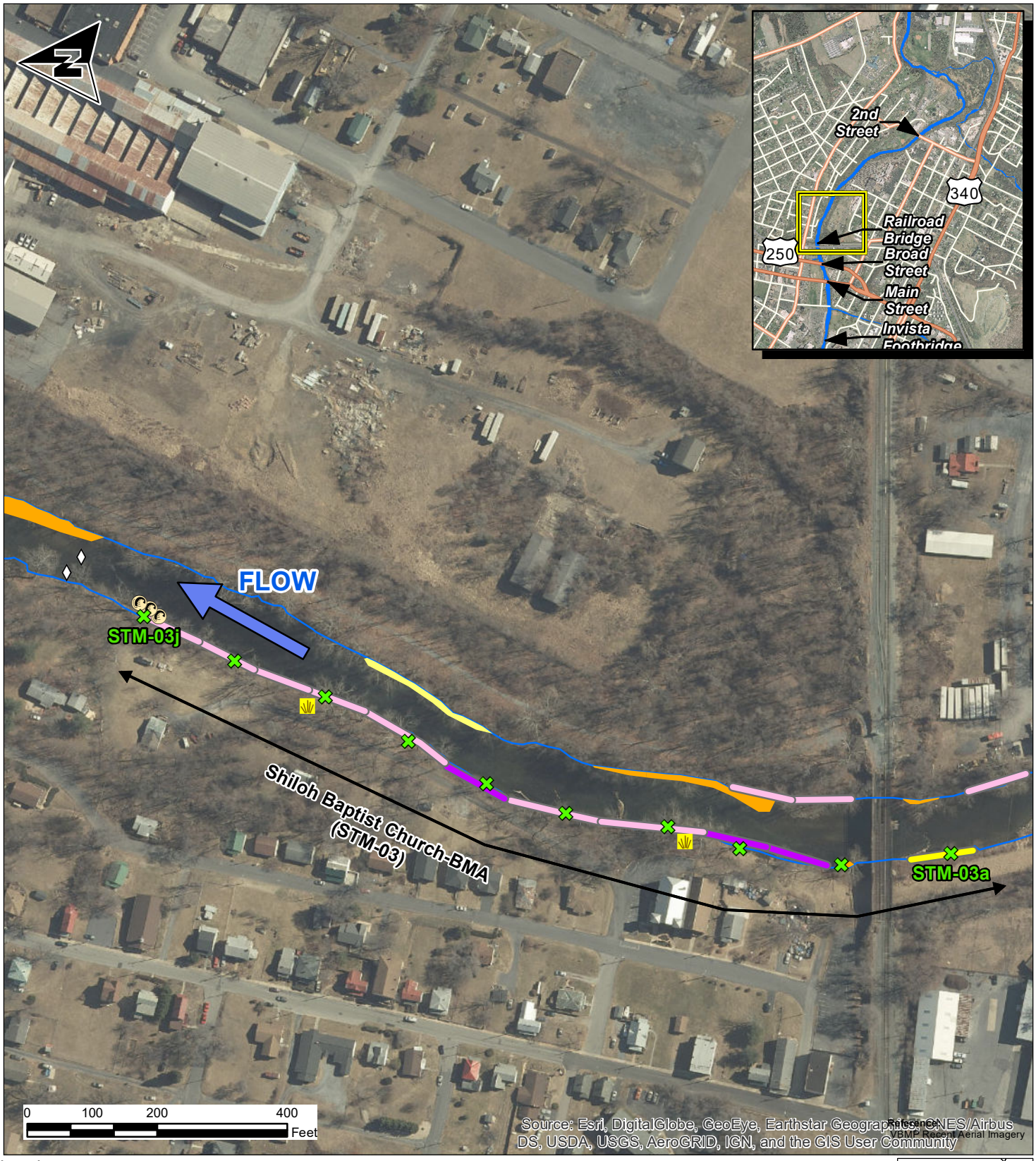

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

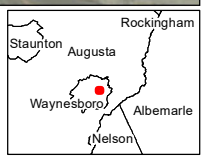

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Figure 2: Sheet 2 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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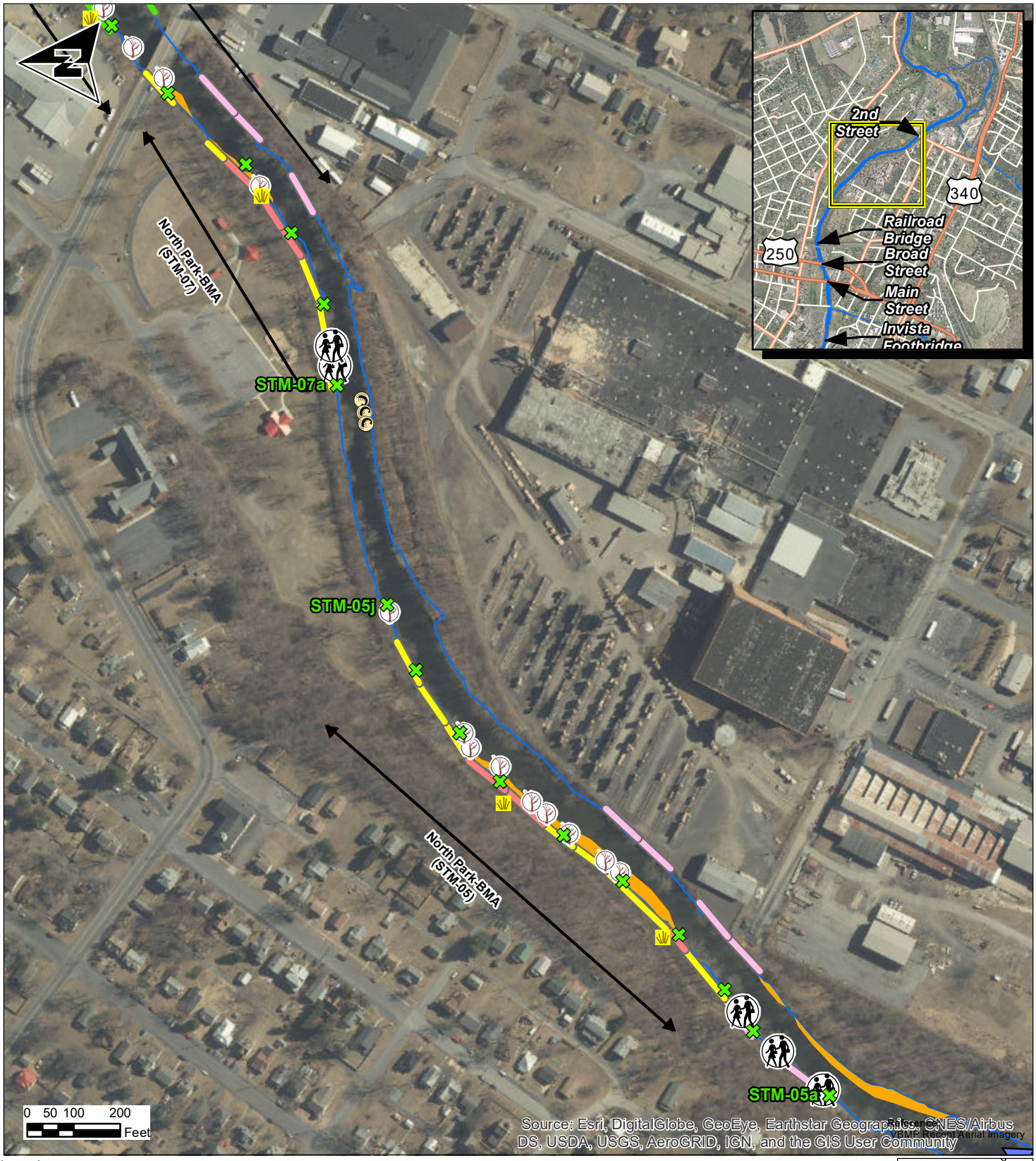

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

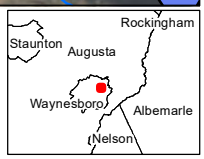

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Figure 2: Sheet 3 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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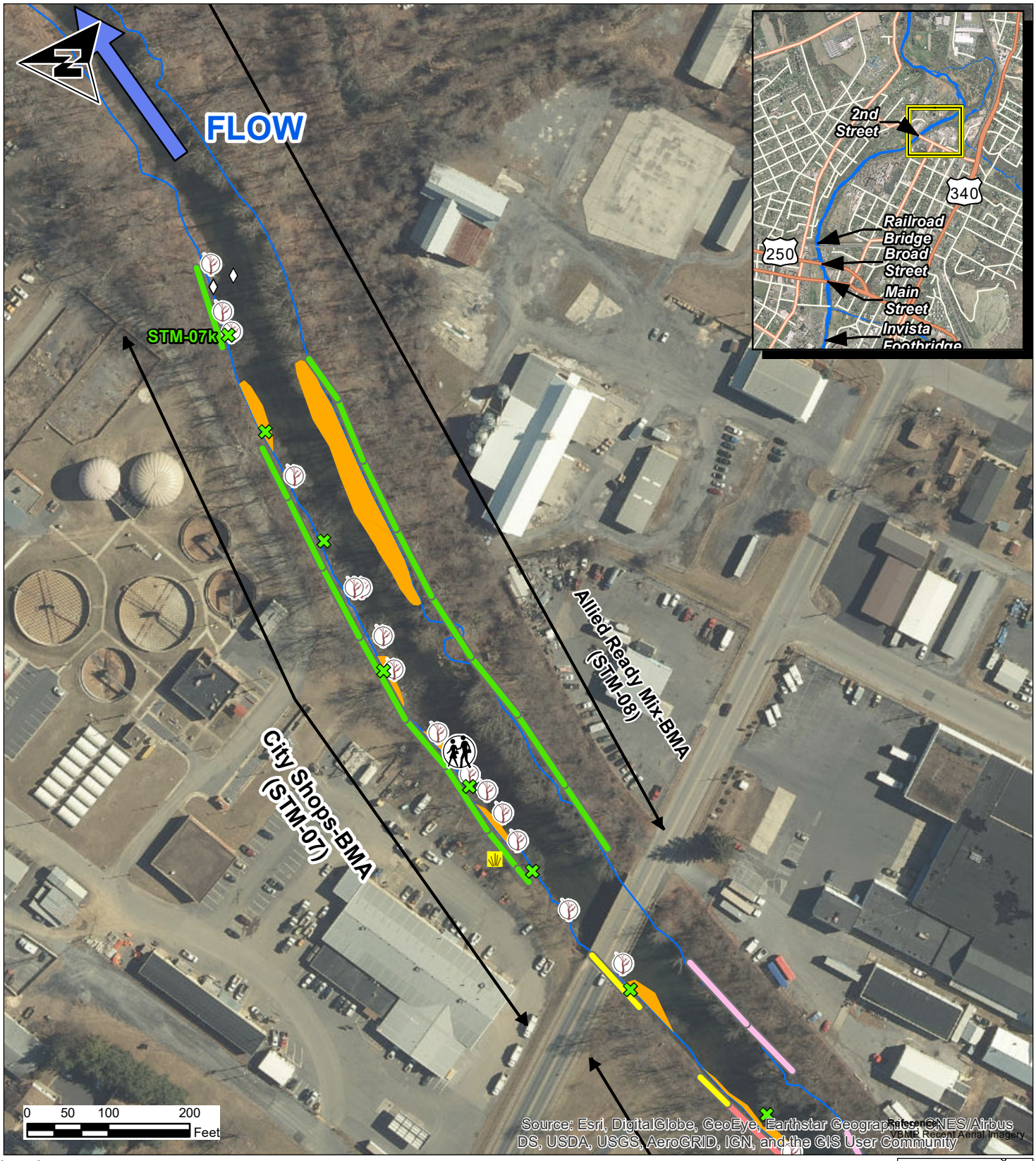

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

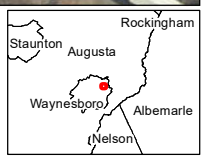

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Figure 2: Sheet 4 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
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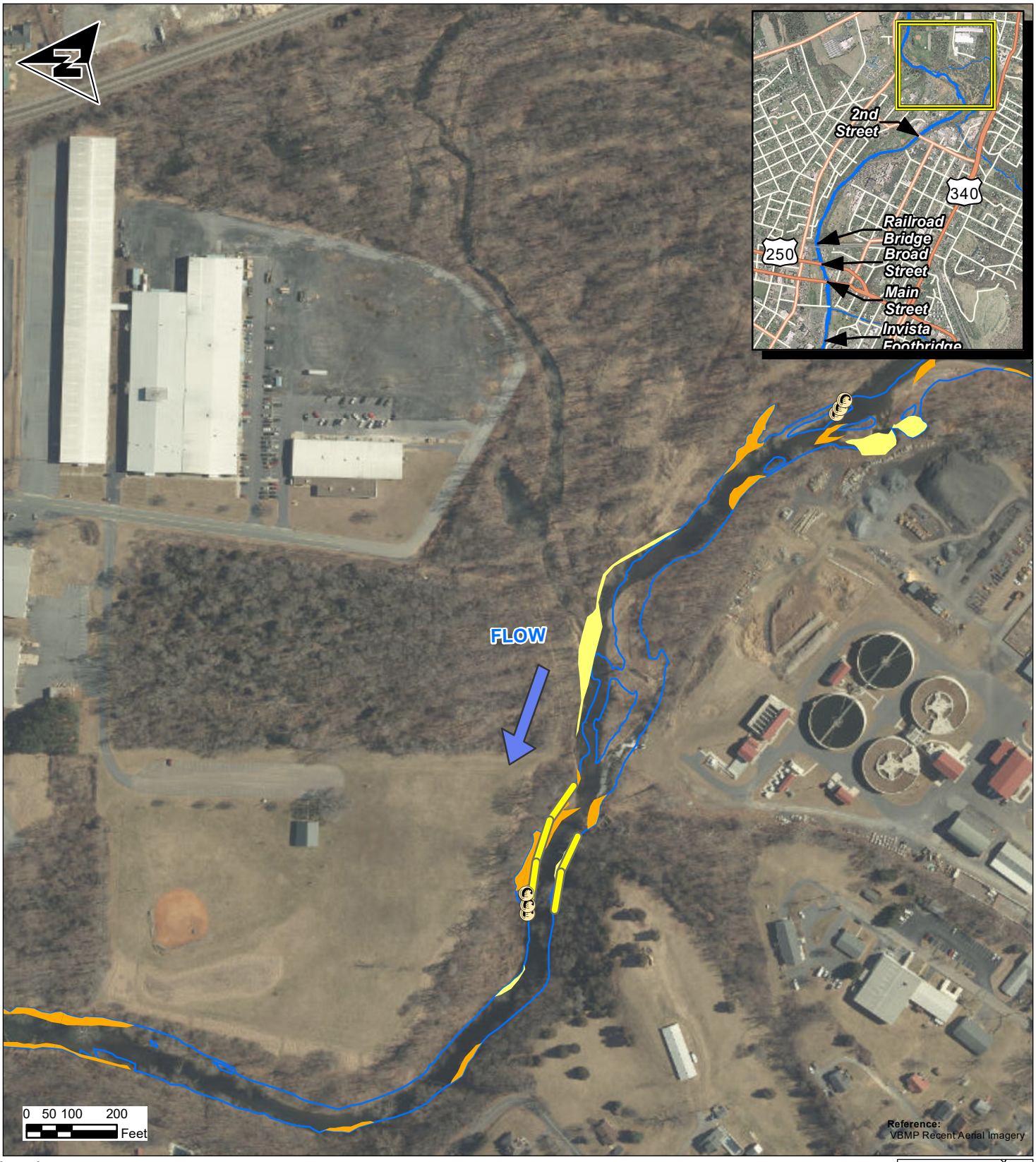

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

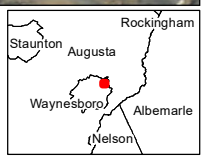

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Figure 2: Sheet 5 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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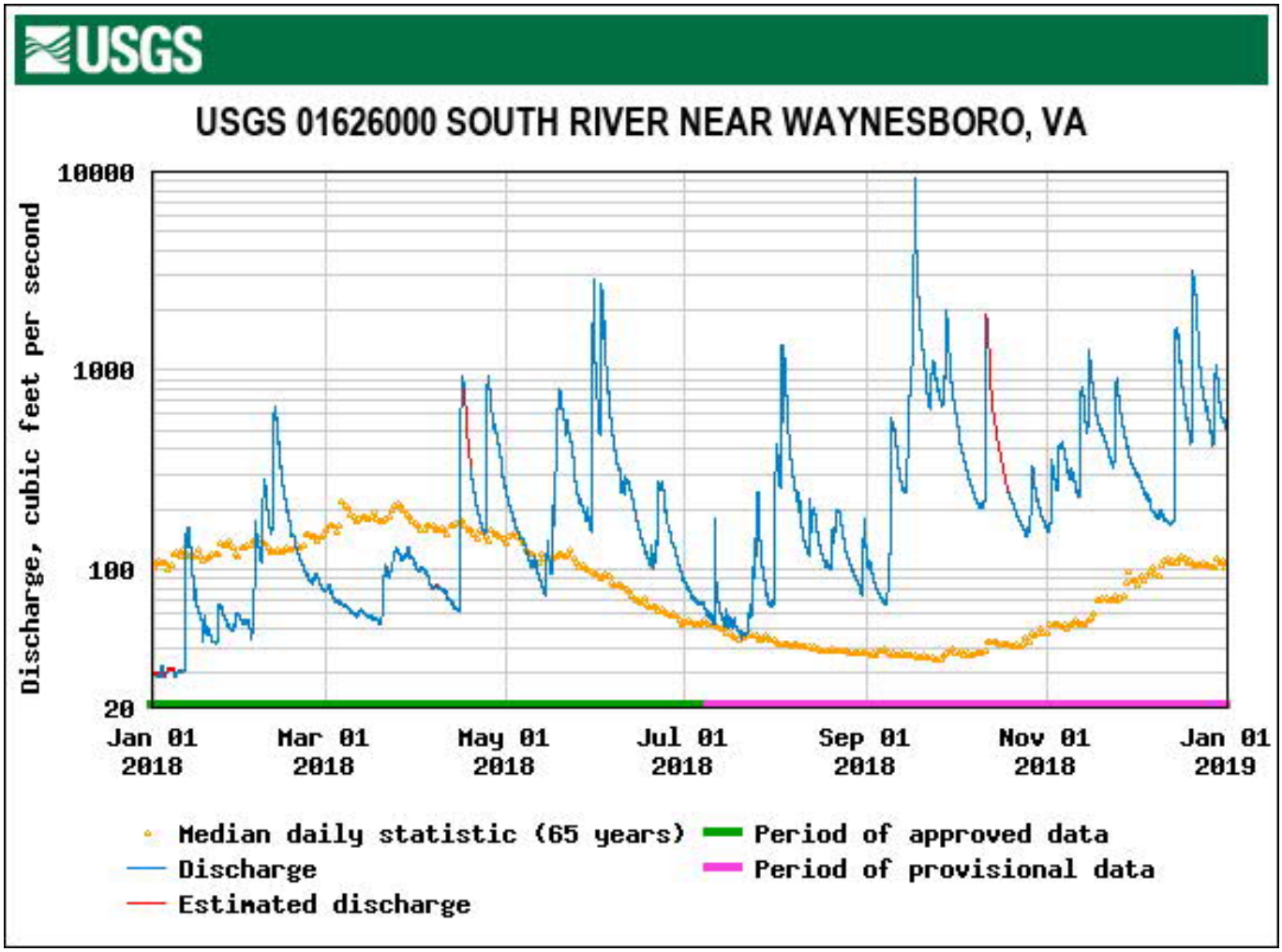
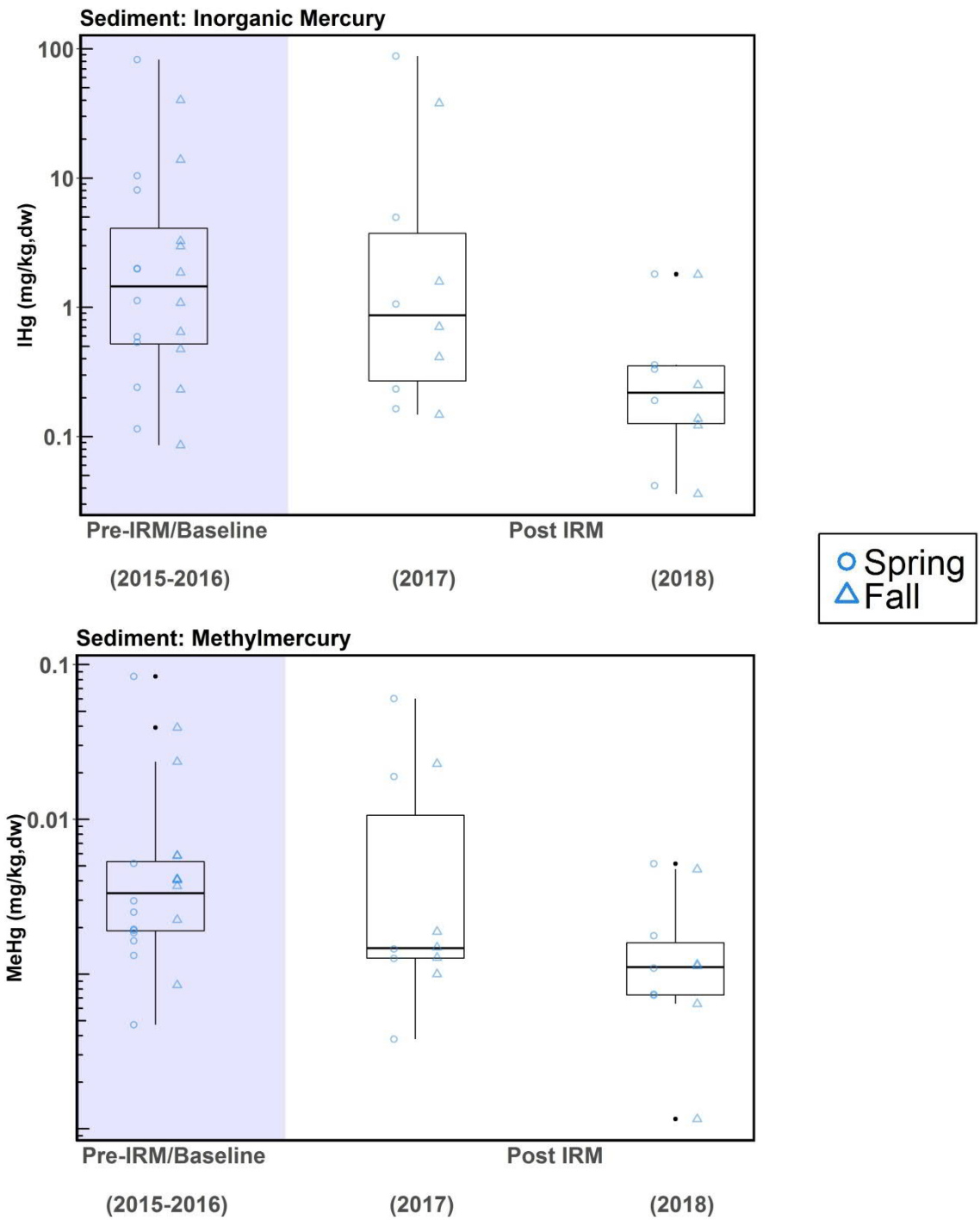
Figure 3
2018 Discharge Data at USGS Station # 01626000
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Source:
https://nwis.waterdata.usgs.gov/usa/nwis/uv/?cb_00060=on&cb_00065=on&format=gif_stats&site_no=01626000&period=&begin_date=2017-01-01&end_date=2018-01-1 (Accessed on 1/9/2019)

Figure 4
Mercury Concentrations in Sediment – Constitution Park BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
mg/Kg, Milligrams per kilogram
dw, Dry weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2016)

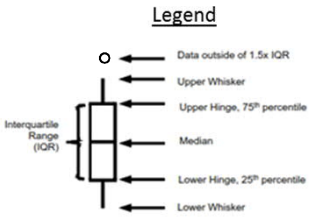
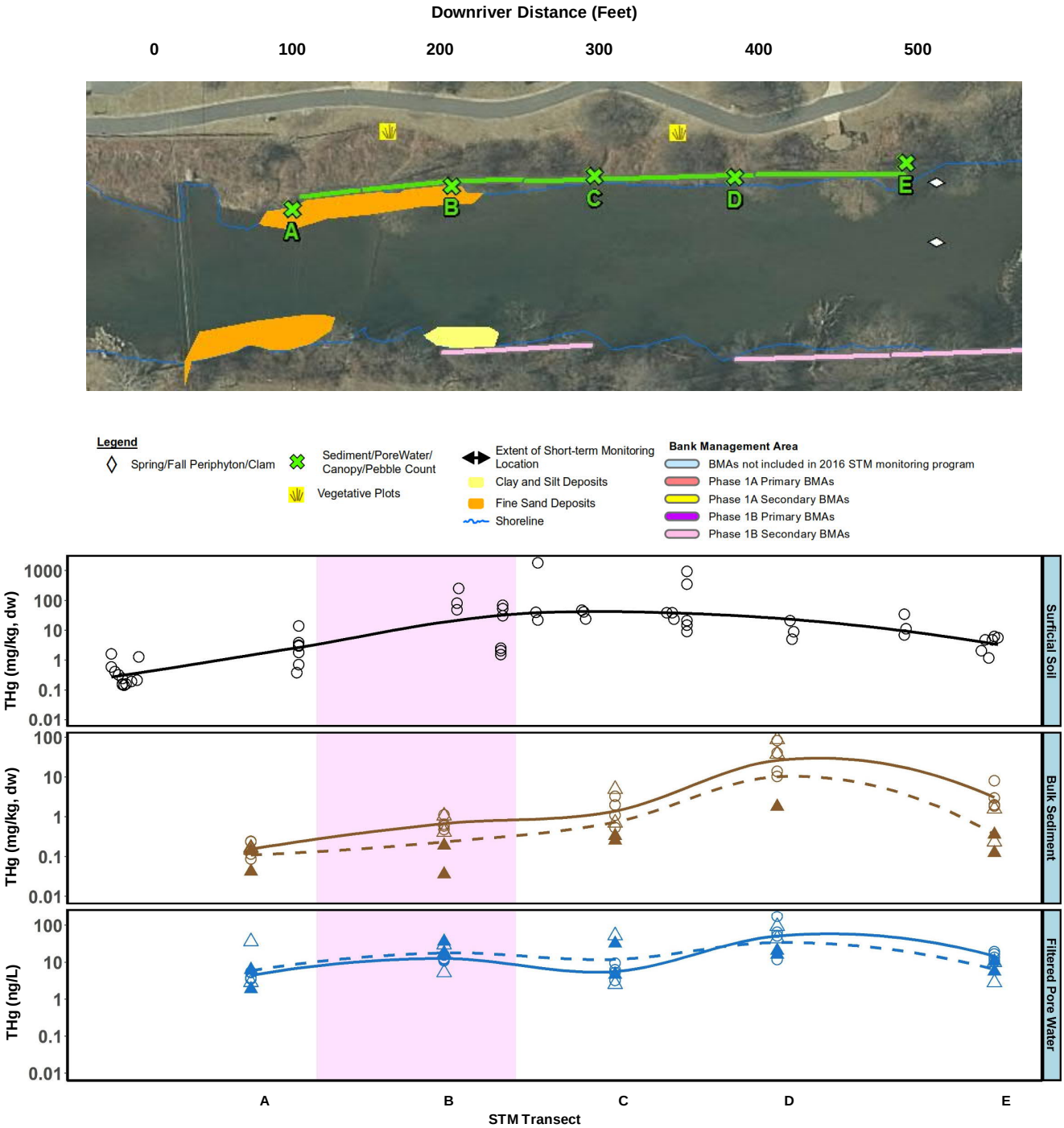
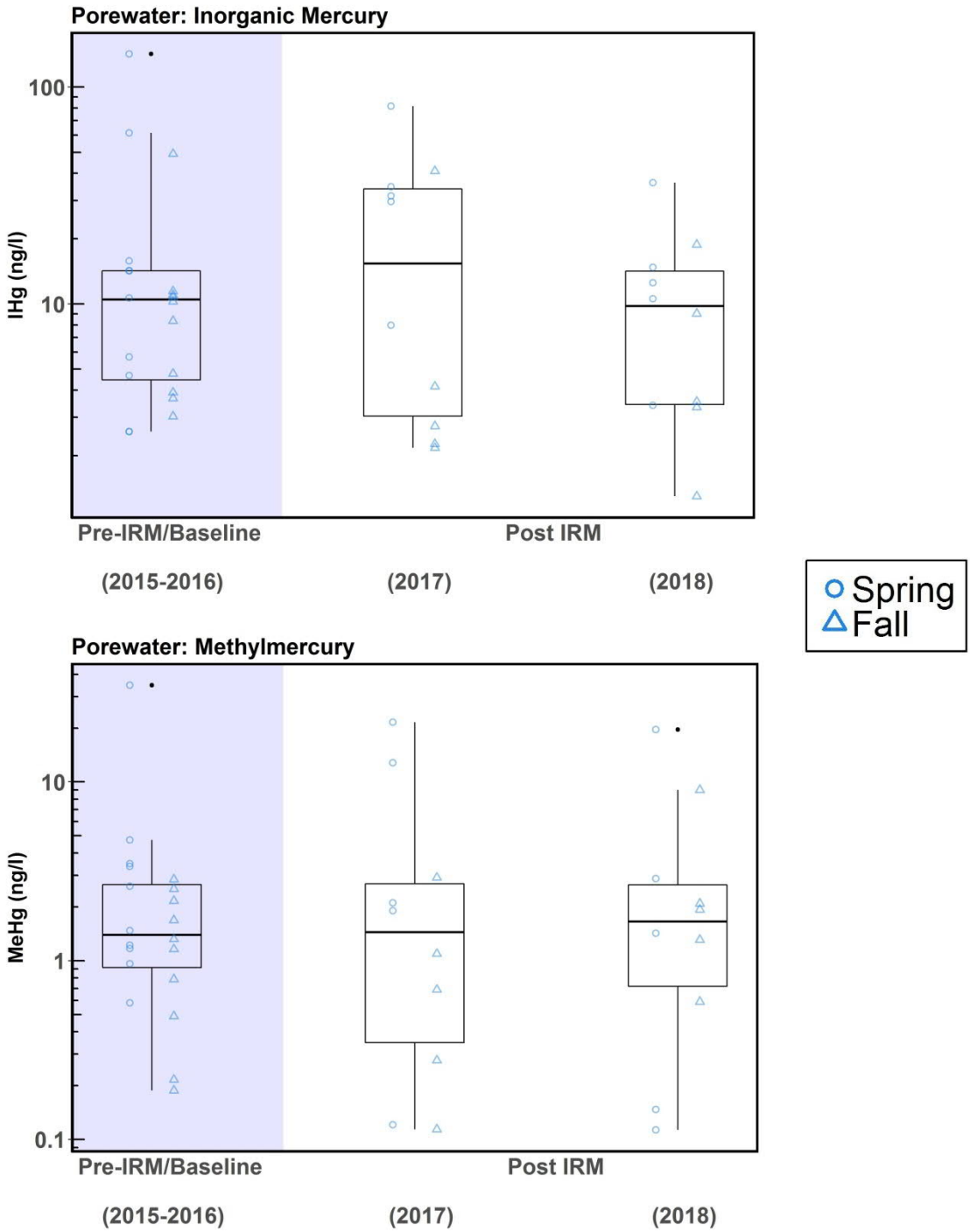


Figure 5
Total Mercury Concentrations in Surficial Bank Soil, Sediment, and Filtered Pore Water- Constitution Park BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
Data shown are total mercury (THg) concentrations on surficial bank soil [miligrams per kilogram (mg/kg), dry weight (dw)], near-bank sediment (mg/kg dw), and near-bank filtered pore water [nanograms per liter (ng/L)]; sediment and pore water data were collected as part of the spring and fall STM events conducted in 2015, 2016, 2017, and 2018. Data are fit with loess curves to show spatial relationships of THg among the sample media. Solid lines represent average baseline conditions while dashed lines represent average post remediation conditions. Pink shaded areas represent bank segments where removal of mercury-impacted soils are anticipated.

Figure 6
Mercury Concentrations in Pore Water – Constitution Park BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury (filtered fraction)
MeHg, Methylmercury (filtered fraction)
ng/L, nanograms per liter
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2016)

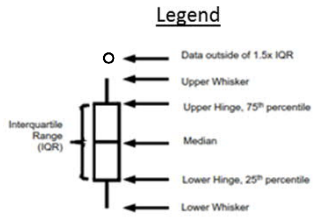
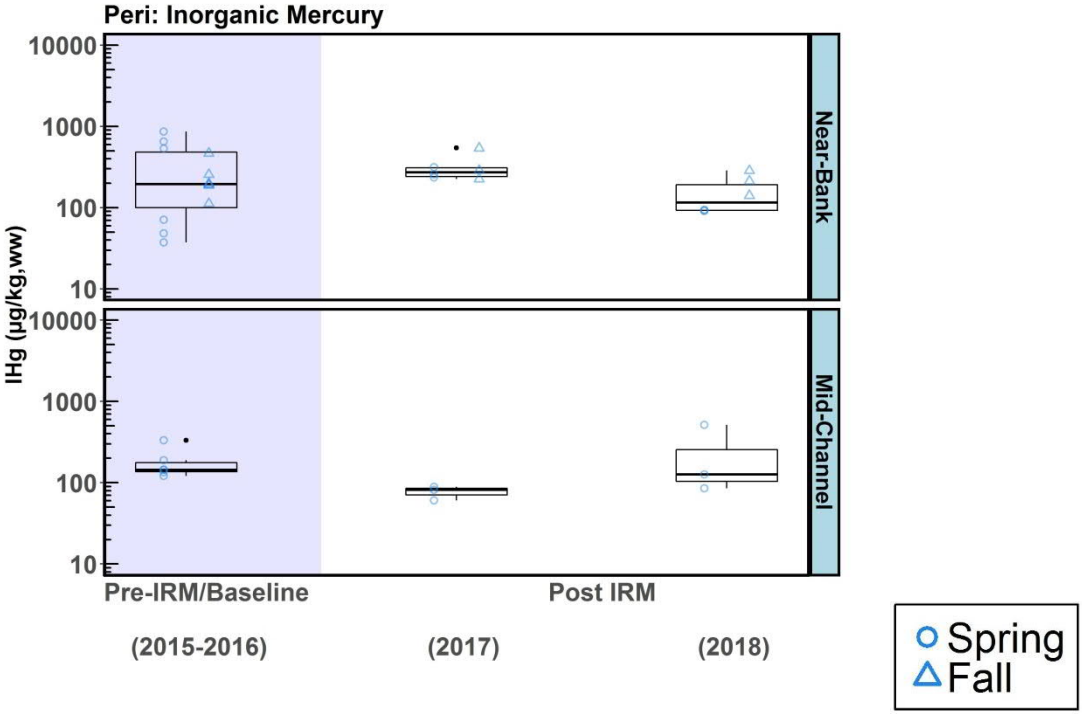
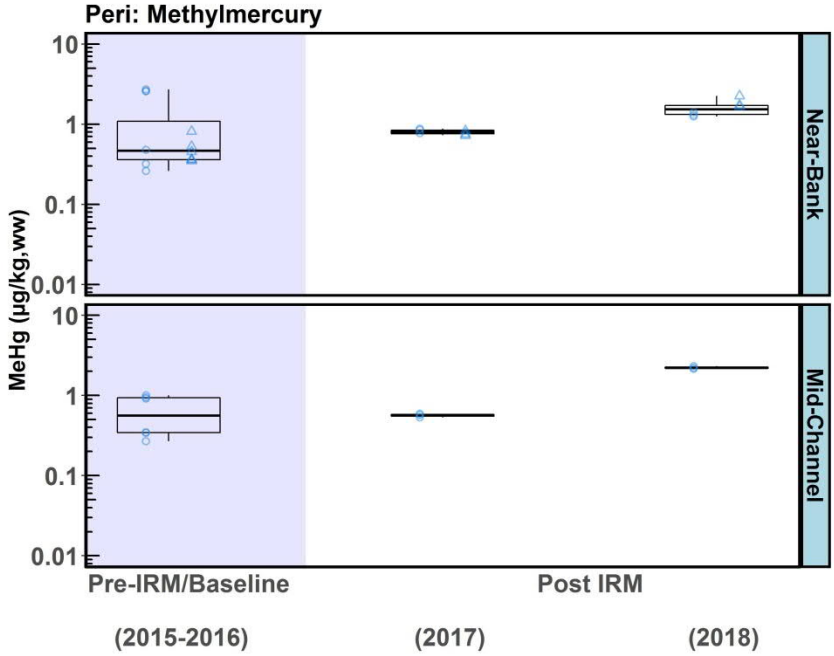


Figure 7
Mercury Concentrations in Periphyton – Constitution Park BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4





Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2016)

Legend

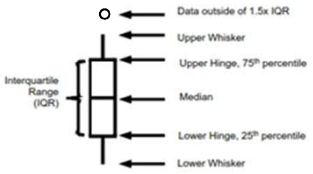
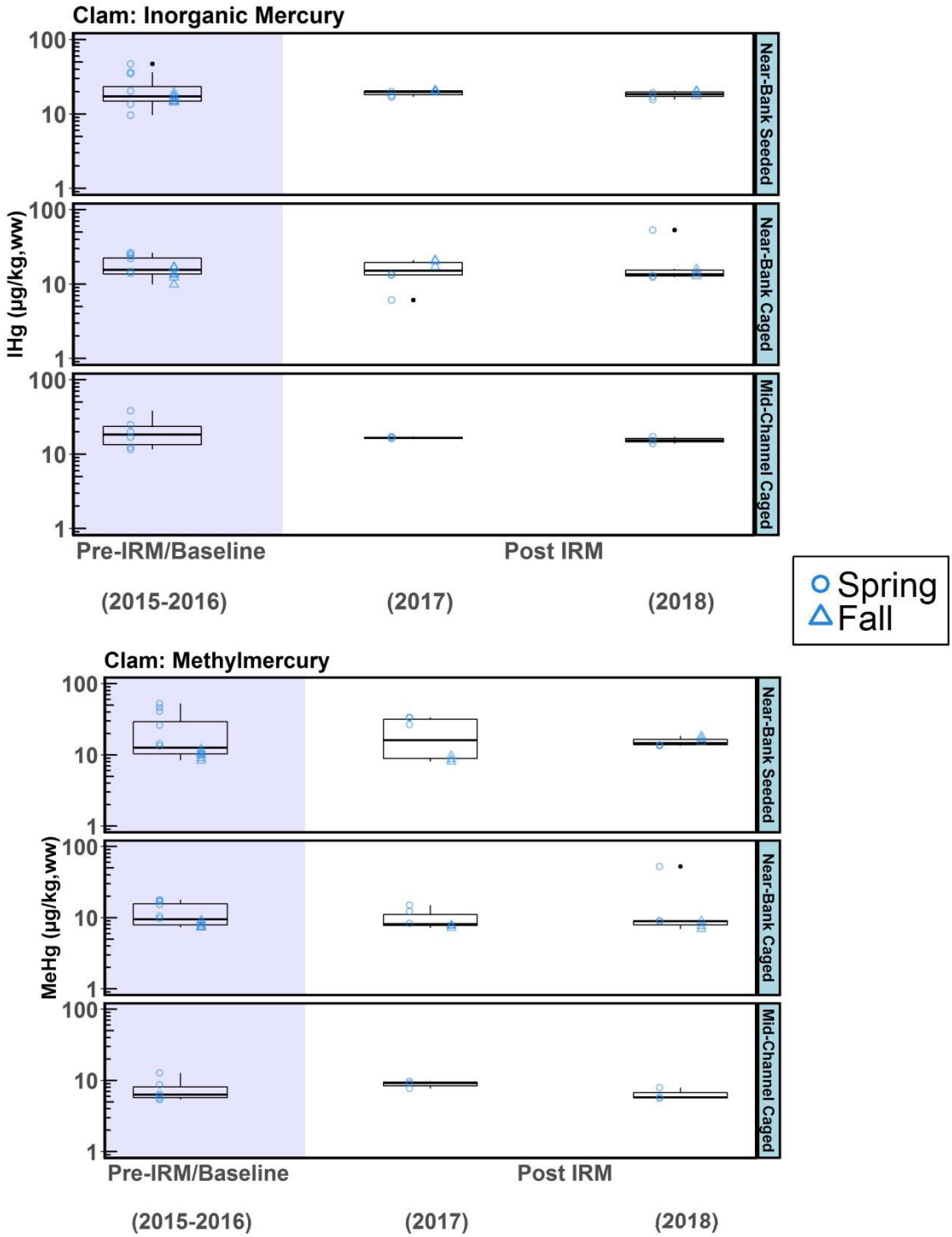


Figure 8
Mercury Concentrations in *Corbicula* – Constitution Park BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2016)

Legend

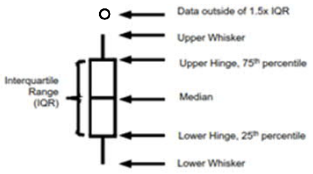
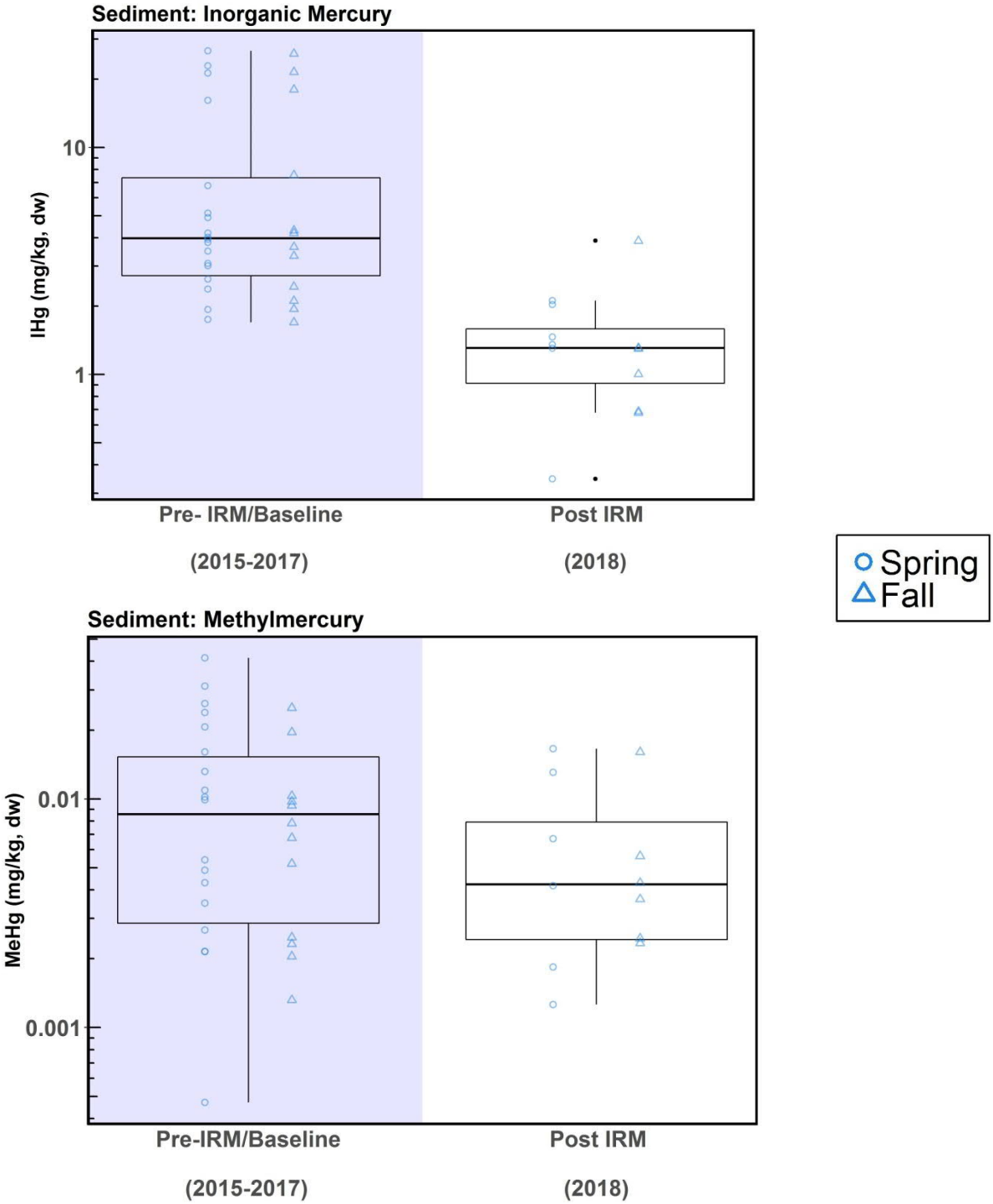


Figure 9
Mercury Concentrations in Sediment – City Shops BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
mg/Kg, Milligrams per kilogram
dw, Dry weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2017)

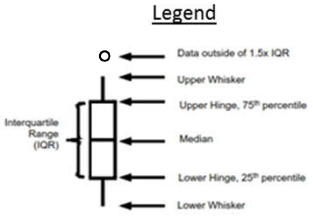
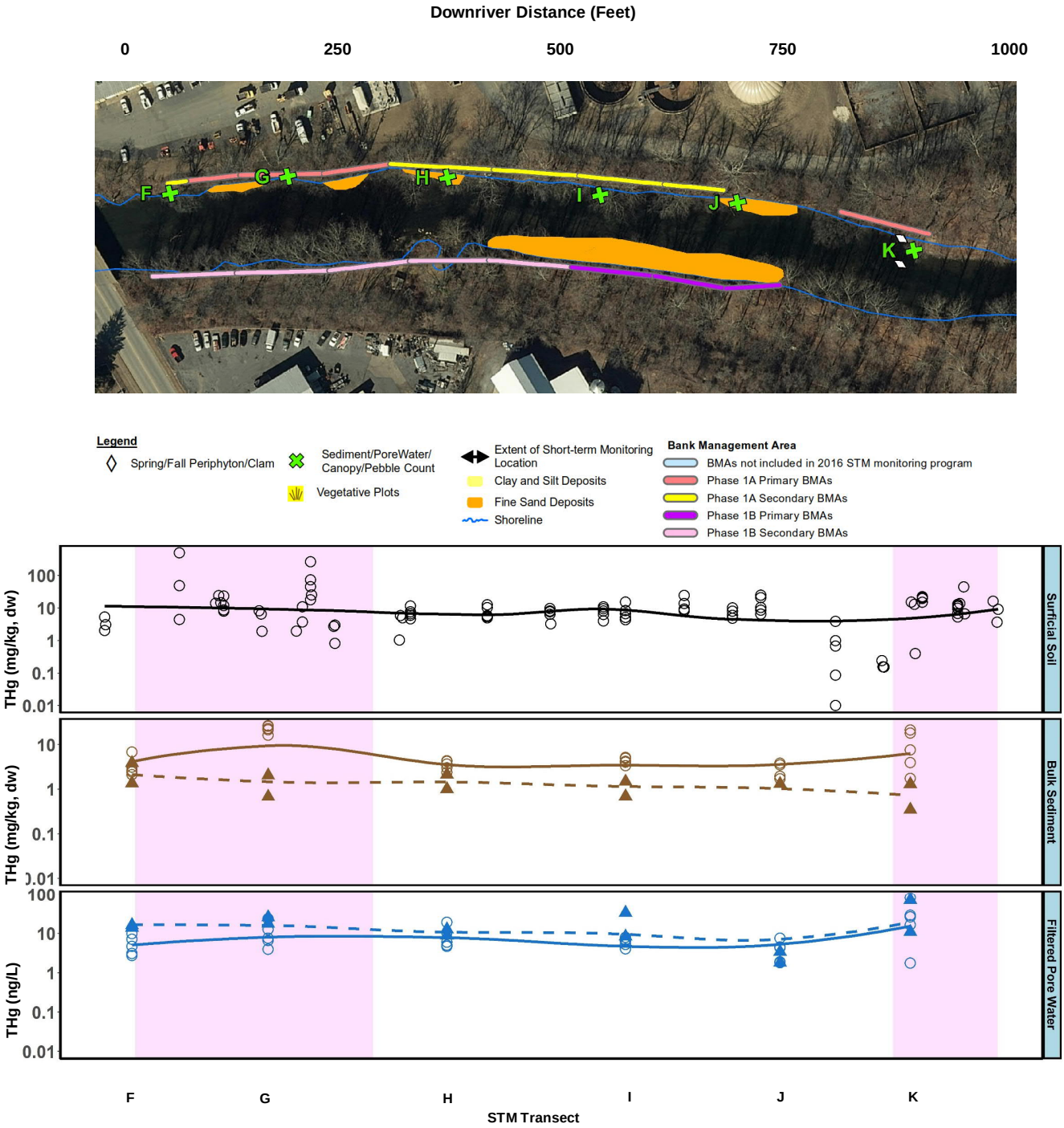


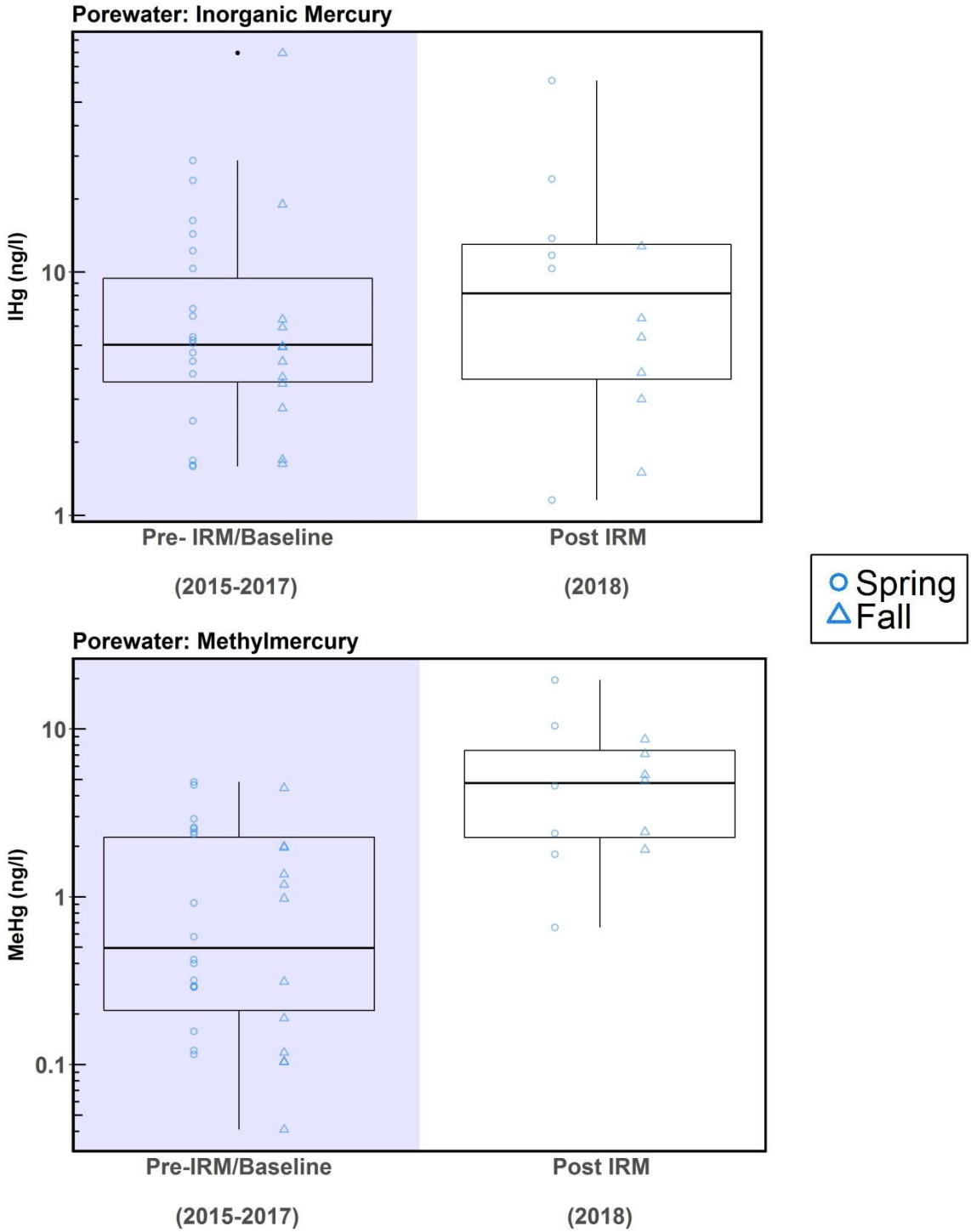
Figure 10
Total Mercury Concentrations in Surficial Bank Soil, Sediment, and Filtered Pore Water – City Shops BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
Data shown are total mercury (THg) concentrations on surficial bank soil [miligrams per kilogram (mg/kg), dry weight (dw)], near-bank sediment (mg/kg dw), and near-bank filtered pore water [nanograms per liter (ng/L)]; sediment and pore water data were collected as part of the spring and fall STM events conducted in 2015, 2016, 2017, and 2018. Data are fit with loess curves to show spatial relationships of THg among the sample media. Solid lines represent average baseline conditions while dashed lines represent average post remediation conditions. Pink shaded areas represent bank segments where removal of mercury-impacted soils are anticipated.

Baseline (2015-2017)
Remediated 2018

Figure 11
Mercury Concentrations in Pore Water – City Shops BMA
2018 Short-Term Monitoring Report
Former DuPont Wavnesboro Site. Area of Concern 4



Notes:
IHg, Inorganic mercury (filtered fraction)
MeHg, Methylmercury (filtered fraction)
ng/L, nanograms per liter
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2017)

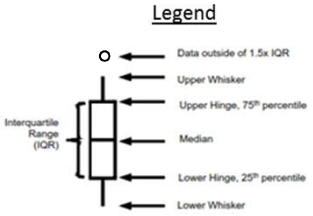
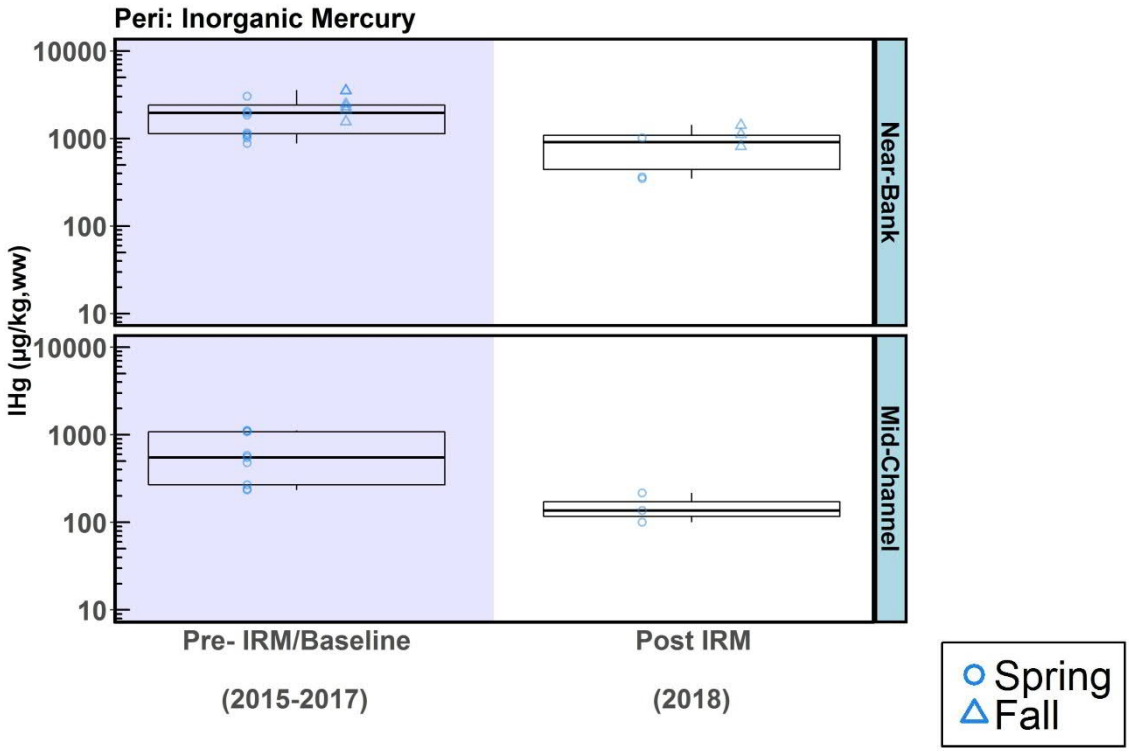
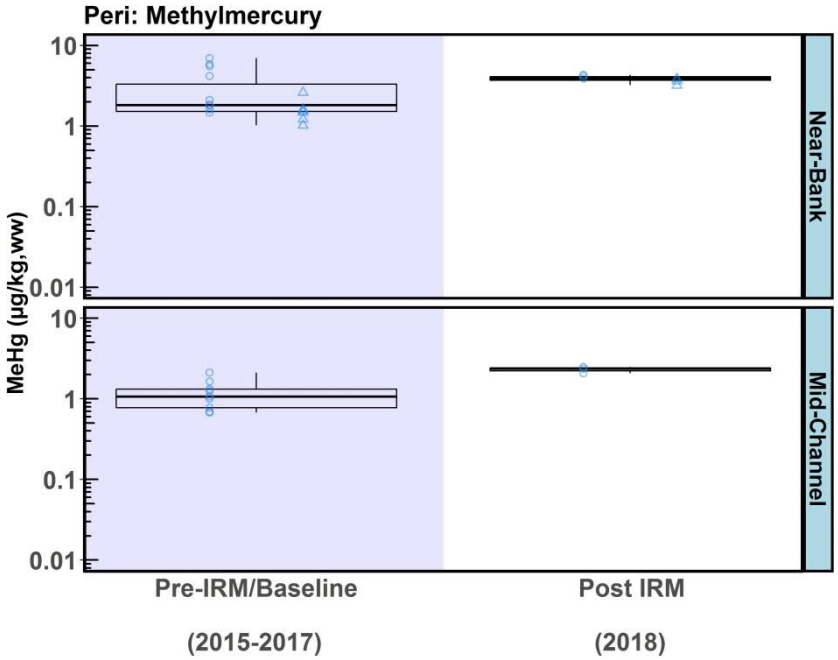


Figure 12
Mercury Concentrations in Periphyton – City Shops BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4





Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2017)

Legend

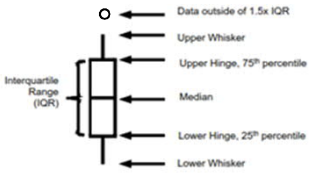
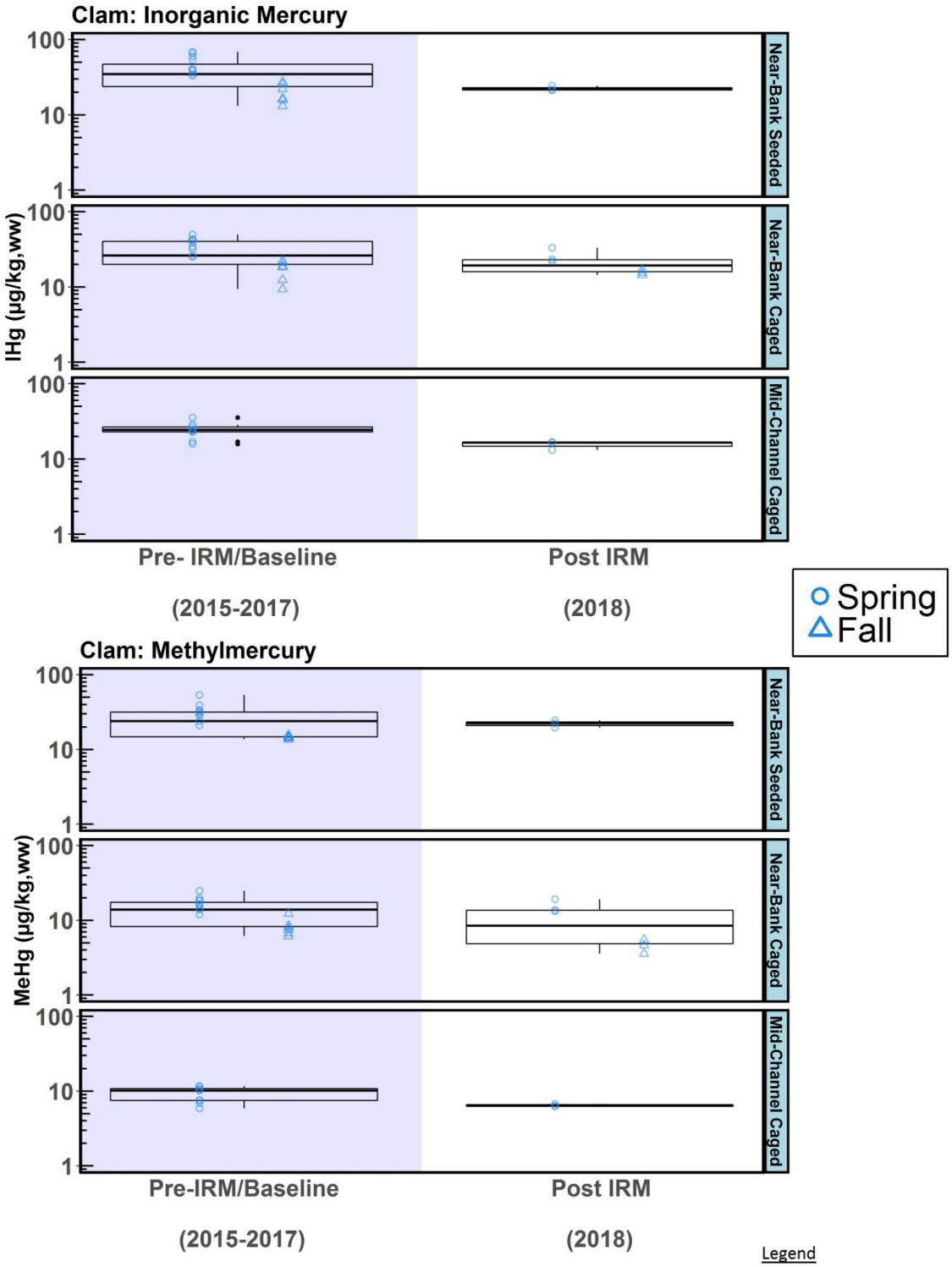


Figure 13
Mercury Concentrations in *Corbicula* – City Shops BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight
Blue shading, indicates baseline condition prior to the start of remedial actions (2015-2017)

Legend

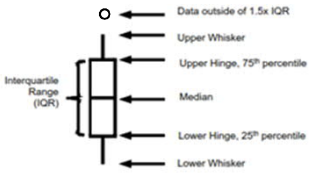
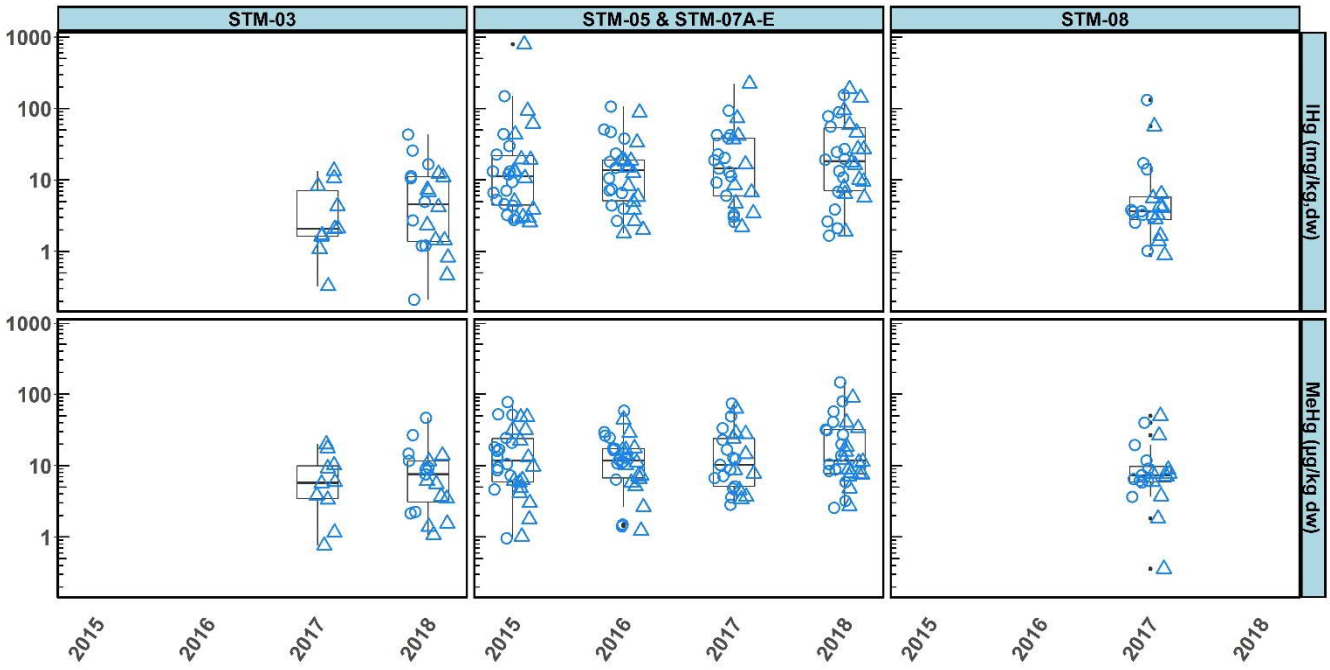


Figure 14
Baseline Characterization of Mercury Concentrations in Sediment
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
mg/Kg, Milligrams per kilogram
µg/kg, Micrograms per kilogram
dw, Dry weight

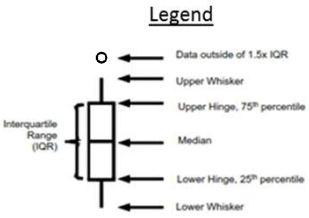
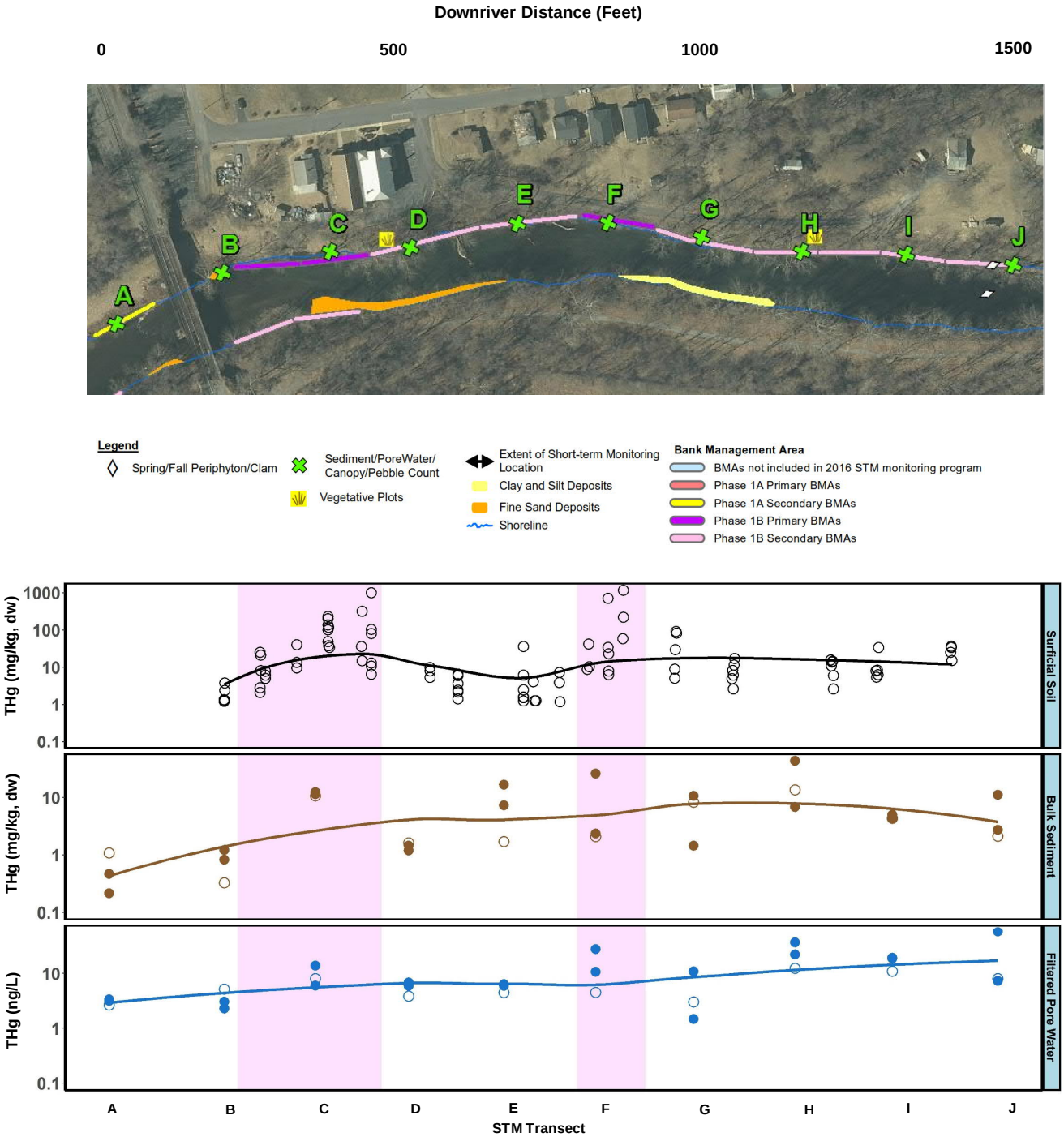
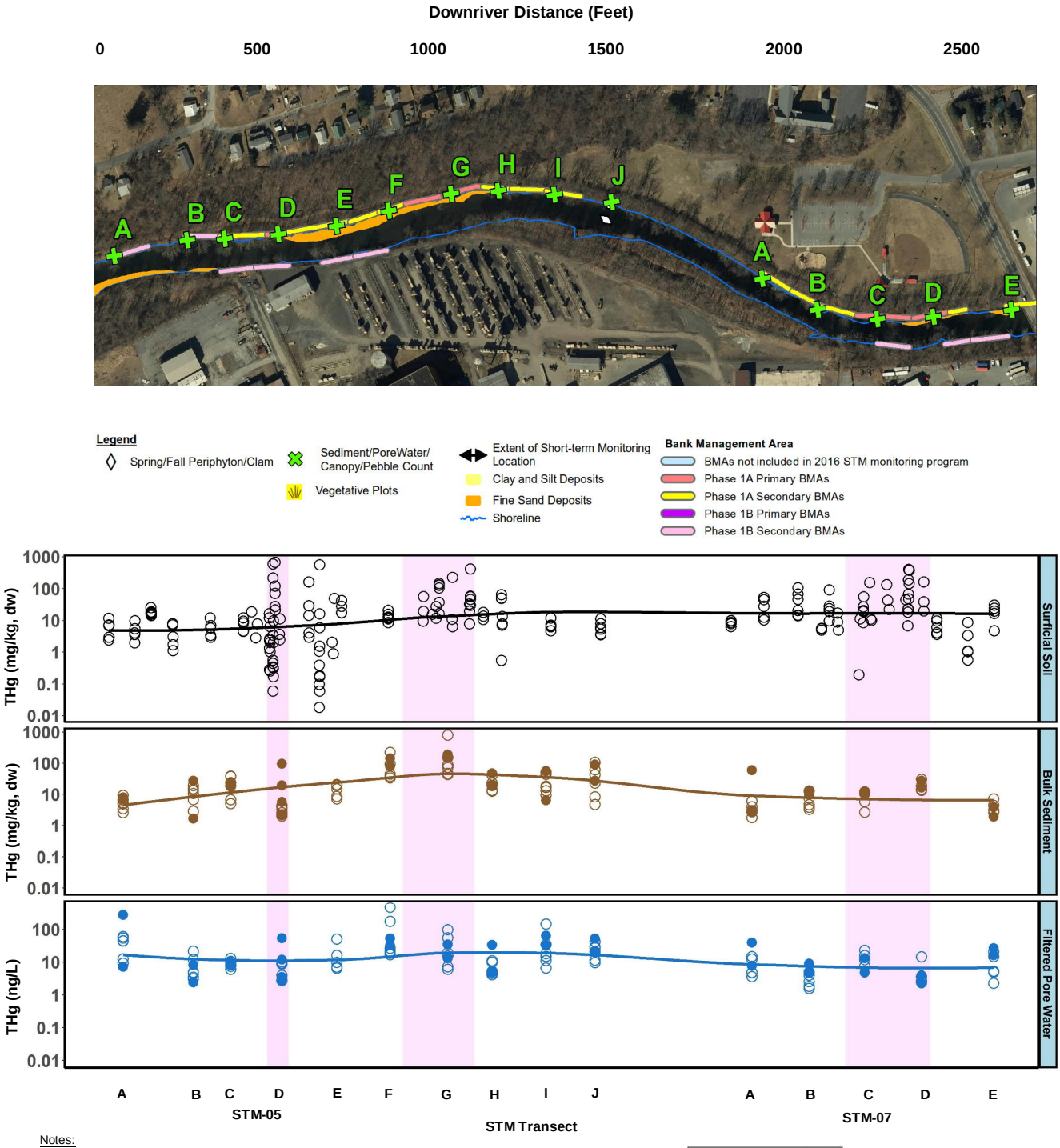


Figure 15
Total Mercury Concentrations in Surficial Bank Soil, Sediment, and Filtered Pore Water- Shiloh Baptist Church BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



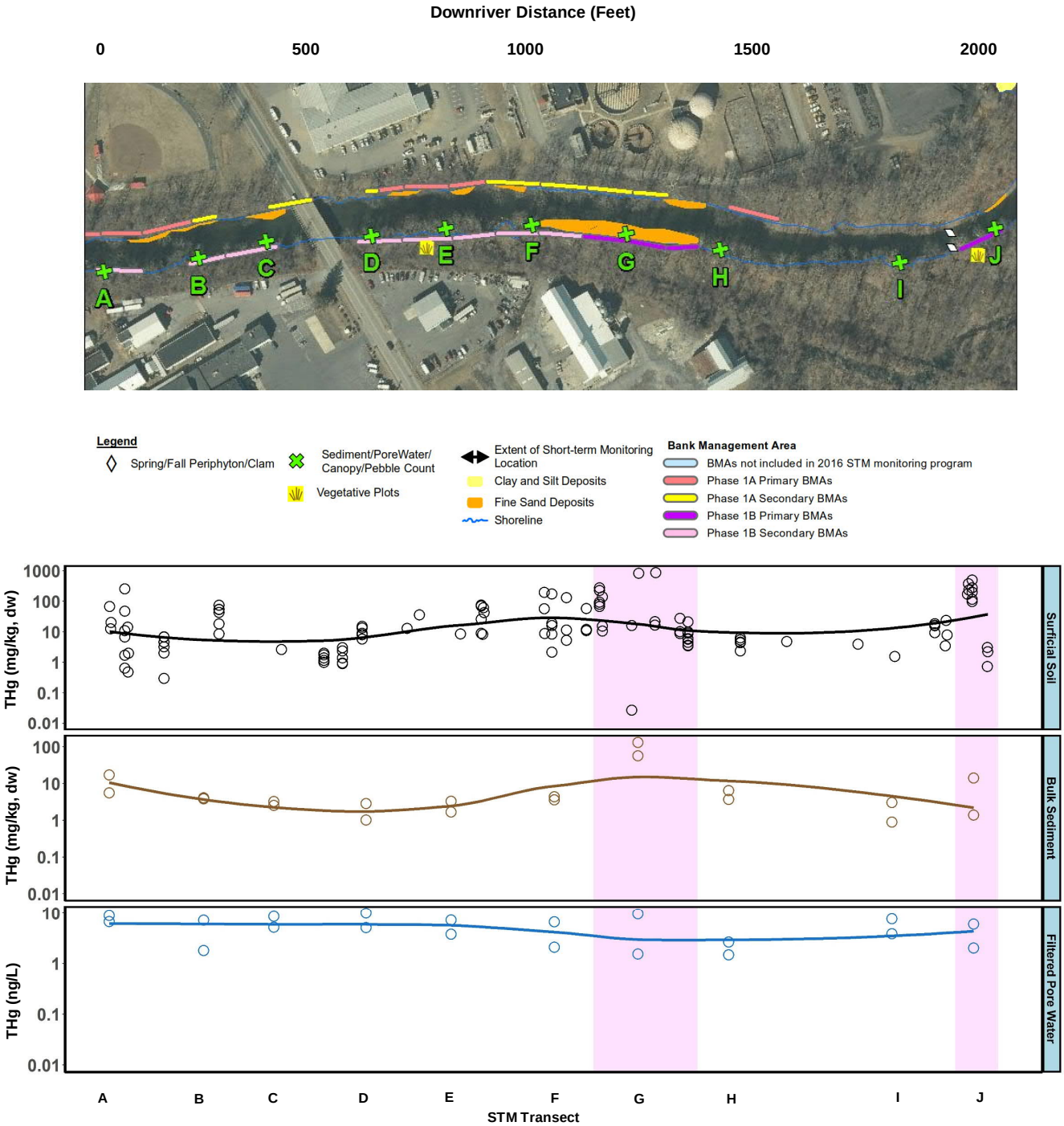
Notes:
Data shown are total mercury (THg) concentrations on surficial bank soil [miligrams per kilogram (mg/kg), dry weight (dw)], near-bank sediment (mg/kg dw), and near-bank filtered pore water [nanograms per liter (ng/L)]; sediment and pore water data were collected as part of the spring and fall STM events conducted in 2017 and 2018. Data are fit with loess curves to show spatial relationships of THg among the sample media. Solid lines represent average baseline conditions while dashed lines represent average post remediation conditions. Pink shaded areas represent bank segments where removal of mercury-impacted soils are anticipated.

Figure 16
Total Mercury Concentrations in Surficial Bank Soil, Sediment, and Filtered Pore Water- North Park BMAs
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
Data shown are total mercury (THg) concentrations on surficial bank soil [miligrams per kilogram (mg/kg), dry weight (dw)], near-bank sediment (mg/kg dw), and near-bank filtered pore water [nanograms per liter (ng/L)]; sediment and pore water data were collected as part of the spring and fall STM events conducted in 2015, 2016, 2017, and 2018. Data are fit with loess curves to show spatial relationships of THg among the sample media. Solid lines represent average baseline conditions while dashed lines represent average post remediation conditions. Pink shaded areas represent bank segments where removal of mercury-impacted soils are anticipated.

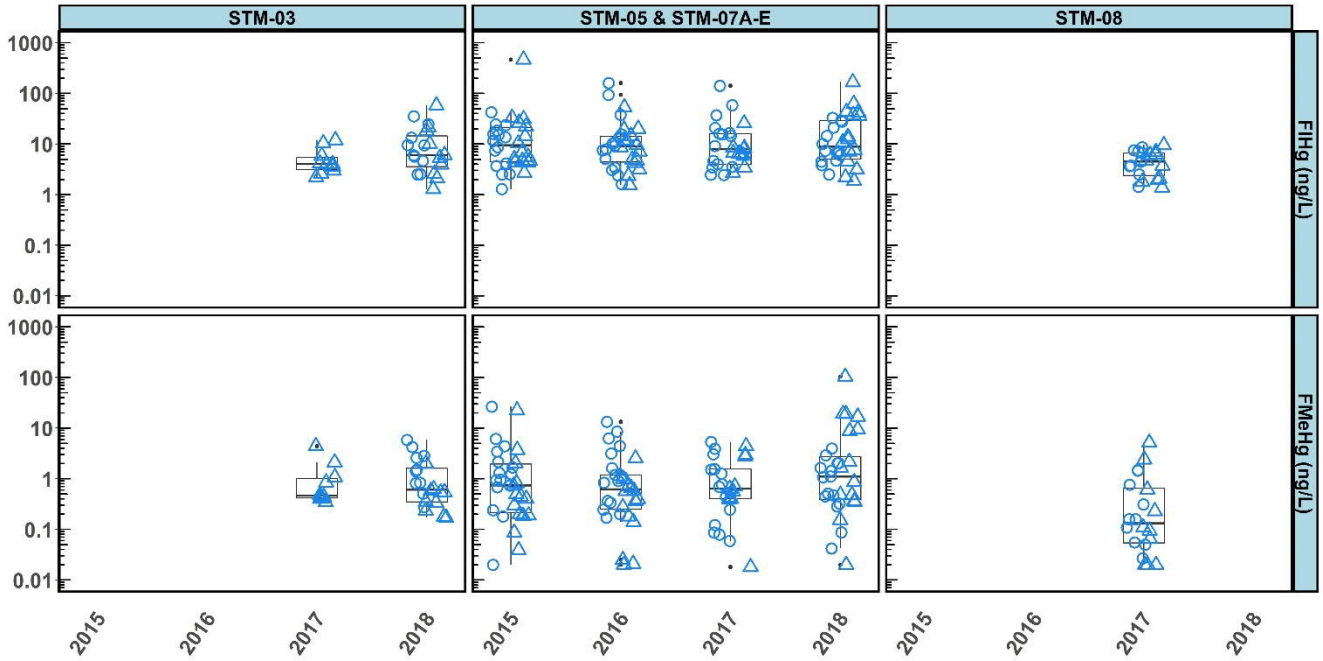
Figure 17
Total Mercury Concentrations in Surficial Bank Soil, Sediment, and Filtered Pore Water- Allied Ready Mix BMA
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
Data shown are total mercury (THg) concentrations on surficial bank soil [miligrams per kilogram (mg/kg), dry weight (dw)], near-bank sediment (mg/kg dw), and near-bank filtered pore water [nanograms per liter (ng/L)]; sediment and pore water data were collected as part of the spring and fall STM events conducted in 2017. Data are fit with loess curves to show spatial relationships of THg among the sample media. Solid lines represent average baseline conditions while dashed lines represent average post remediation conditions. Pink shaded areas represent bank segments where removal of mercury-impacted soils are anticipated.

Baseline (2017)

Figure 18
Baseline Characterization of Mercury Concentrations in Filtered Pore Water
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4



Notes:
FIHg, Inorganic mercury (filtered fraction)
FMeHg, Methylmercury (filtered fraction)
ng/L, nanograms per liter

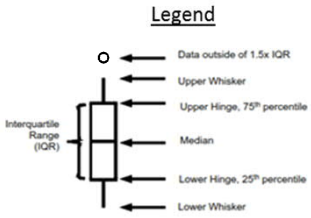
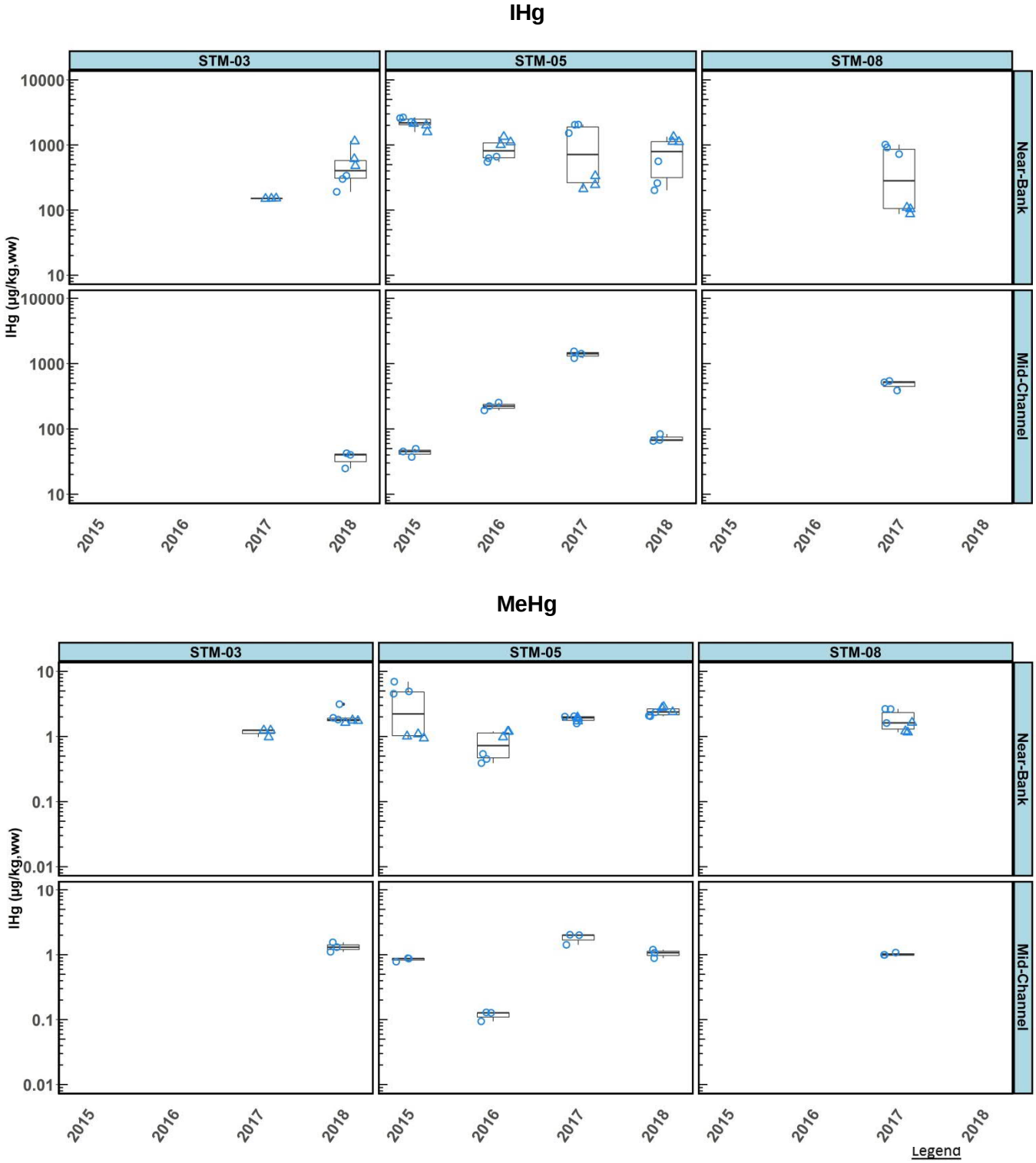
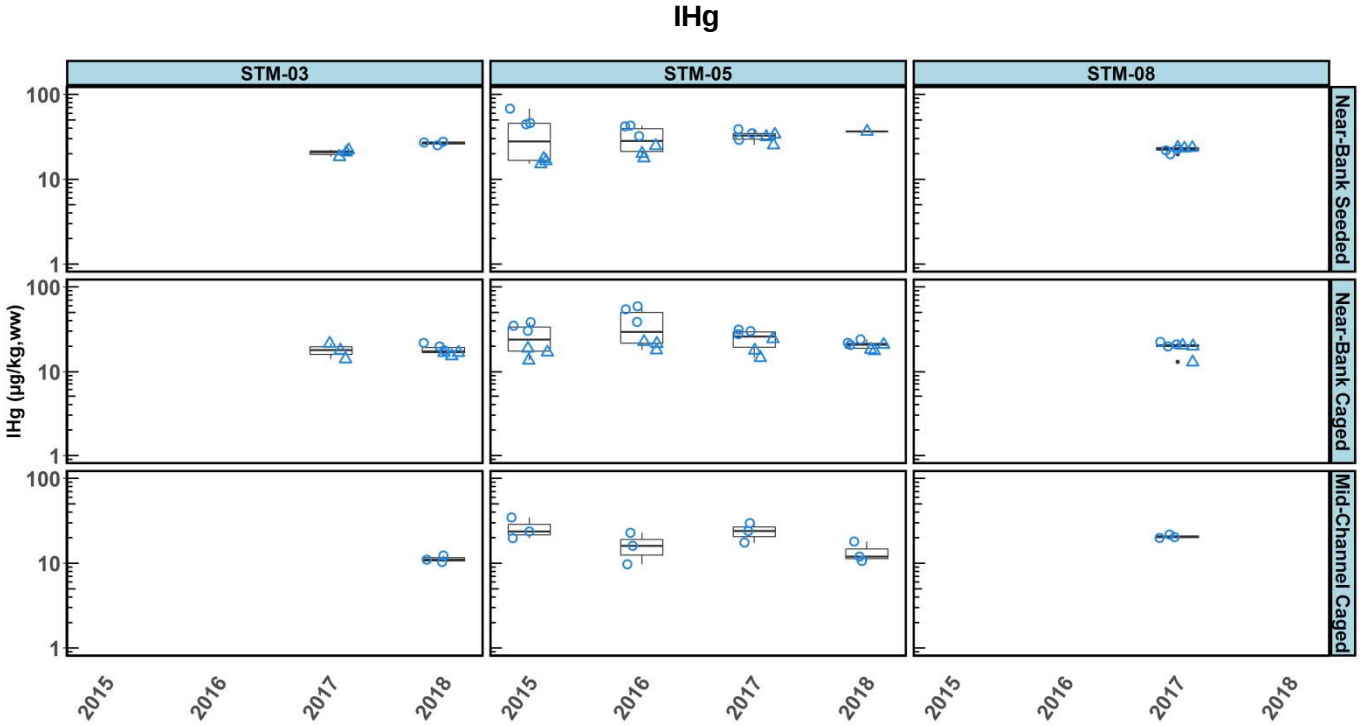


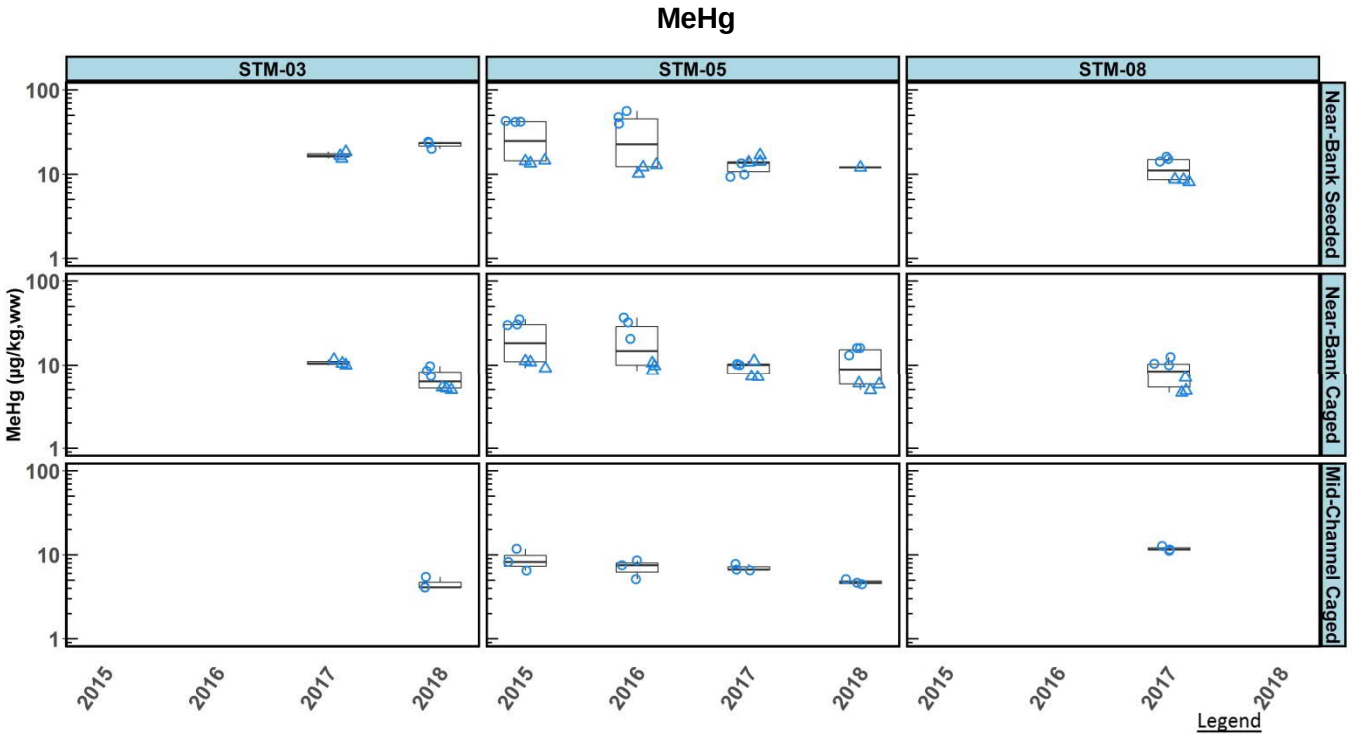
Figure 19
Baseline Characterization of Mercury Concentrations in Periphyton
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

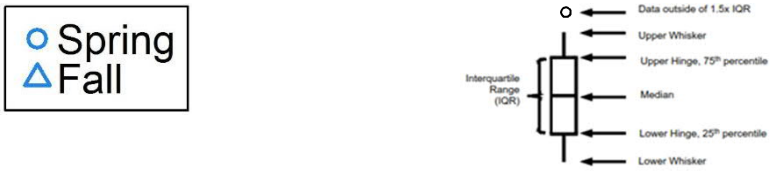


Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight

Figure 20
Baseline Characterization of Mercury Concentrations in Transplanted Asiatic Clams (*Corbicula*)
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4







Notes:
IHg, Inorganic mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight

Appendices

Appendix A

Sampling Methodology

Appendix A
Short-Term Monitoring Methodology
AOC 4 2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Virginia

This appendix summarizes the methodology used during Short-Term Monitoring (STM) events conducted in 2018. These methods are consistent with the approved STM Plan (URS, 2015) and have been presented in previous reports and have been moved to an appendix to streamline the Annual Report. This appendix is presented for completeness; however, the methodology is the same as presented in the STM Plan (URS, 2015).

Bank Stability

Bank erosion is an important mechanism of total mercury (THg) loading to the South River. Bank areas with elevated mercury (Hg) concentrations that are also erosive will result in higher system loading. Bank stabilization, to reduce erosion in areas of high loading, is the focus of the Phase 1 interim measure. Baseline Bank Management Area (BMA) bank stability data will be used as a reference for post-remediation stabilized banks.

As described in the Final Interim Measures Design, Implementation and Monitoring Work Plan (Anchor QEA et al., 2015), baseline bank topography for the first two river miles was documented in March 2014 by conducting a shore-based light detection and ranging (LiDAR) survey. To further document pre-remediation (STM-03 and STM-05) and post-remediation (STM-01 and STM-07) bank stability, conditions were visually evaluated during the June and October 2018 STM events. A photographic log of key bank features documented at STM-01, STM-03, STM-05, and STM-07 is provided in Appendix B of the 2018 STM Report. Active remediation at the Allied Ready Mix BMA (STM-08) precluded sampling at this station in 2018. Post-remediation monitoring will begin at this station in the spring of 2019.

Mercury Loading and Exposure

Monitoring metrics that represent good indicators of Hg loading include abiotic media such as sediment, that can serve as a transport or exposure medium. Biotic media, at the lowest trophic level such as periphyton, are also sensitive indicators of loading and exposure. Methods to measure these metrics are provided in this section.

Sediment

Near-bank sediment THg and methylmercury (MeHg) concentrations can be influenced by localized bank erosion and depositional processes and provide a direct measurement of Hg loading to the system. Deposition can occur in areas of relatively slower flow, including quiescent areas near the banks, and downstream of large woody debris (LWD) and near-bank obstructions (URS, 2012). Sediment data collected as part of the 2018 efforts at STM 03 and STM-05 will be used to characterize pre-remedial, near-bank sediment Hg concentrations, as a basis for comparison with post-remedy conditions. Sediment data collected at STM-01 and STM-07 will be used to assess post-remediation conditions.

Sediment samples were collected in 2018 following standard operating procedure SRSE-2 (URS, 2015). Bulk sediment samples were collected at transects spaced approximately 100 to 200 feet apart, from near-bank environments at STM-01, STM-03, STM-05, and STM-07 (as shown in Figure 2 of the 2018 STM Report). The samples were collected by direct pushing

dedicated 2-inch acetate cores to a depth of 15 centimeters (cm) at each individual transect. The sediment samples collected at each individual transect were characterized, then thoroughly homogenized in a stainless-steel bowl prior to being transferred to laboratory-supplied bottleware, and preserved on dry ice. Samples were submitted to Brooks Applied Laboratories (Bothell, Washington) under proper chain-of-custody (COC) procedures.

Filtered Pore Water

Pore water refers to the aqueous phase occupying sediment interstitial spaces. It is an important medium for Hg transfer between the solid (sediment) and aqueous phases. Conditions in the interstitial spaces can also be conducive to Hg methylation.

Pore water samples were collected in 2018 following procedures outlined in SOP SRPW-1 (URS, 2015). Pore water samples were co-located with bulk sediment samples (i.e., collected at transects along STM-01, STM-03, STM-05, and STM-07, spaced approximately 100 to 200 feet apart). The samples were collected from near-bank, undisturbed, shallow sediments, 5 to 10 cm below the sediment surface, with a decontaminated push-point sampler (i.e., Henry Probe). They were field-filtered using 0.45-micrometer (µm) syringe-tip filters.

In situ water quality parameters for the unfiltered pore water and the overlying ambient surface water were monitored and compared to validate the collection of representative pore water samples. A Myron 6P meter was used to document water quality parameters, including temperature, specific conductivity (SC), oxidation-reduction potential (ORP) and pH. Samples were preserved at 4 degrees Celsius (°C), and submitted to Brooks Applied Laboratories (Bothell, Washington) for analysis.

Periphyton

Epilithic periphyton (i.e., algae and suspended solids associated with streambed substrates) plays an important role in the trophic transfer of MeHg in the South River (URS, 2012). Mercury concentrations in periphyton are expected to respond to the effects of the bank stabilization by declining along with a decrease in sediment concentrations.

Periphyton sampling was conducted in accordance with SOP SRTI-1 (URS, 2015). Three composite samples were collected from near-bank environments at the downstream extent of each STM during the 2018 sampling events; three composite samples were also collected from mid-channel environments for comparison with long-term monitoring (LTM) data. Samples were collected from similar surface water depths and flow regimes at each STM, within each environment (i.e., near-bank and mid-channel).

Samples were collected using a decontaminated plastic spatula to scrape periphyton off streambed cobbles until a suitable sample mass was obtained; descriptions (i.e., texture, color, general abundance, etc.) of all periphyton samples were documented upon collection. Each sample was gently rinsed with site water to remove coarse substrates (i.e., fine-medium sands and gravel). Upon inspection, any invertebrates found in the sample were removed prior to placing the sample in laboratory-supplied bottleware and preserving on dry ice. Samples were submitted to Brooks Applied Laboratories (Bothell, Washington) for analysis.

Asiatic Clam

Corbicula were included as a monitoring element in the STM program because of its important role in the South River aquatic and terrestrial food webs, and its sedentary nature. *Corbicula* were collected from a reference location in Middle River and deployed at the 2018 STM stations for a five-week exposure period to measure Hg uptake. *Corbicula* were deployed at the

downstream extent of each STM station in order to capture the cumulative influence of the associated BMAs. Two deployment types were used to evaluate potential differences in Hg exposure to *Corbicula*:

- Epifauna (caged): *Corbicula* were contained in porous sleeves and suspended in the water column, off of the substrate, via frame-cages.
- Infauna (seeded): *Corbicula* were tagged and seeded directly into the sediment.

Similar to the periphyton sampling strategy, two environments were sampled at each 2018 STM station in June (i.e., near-bank and mid-channel); only near-channel clams were deployed in October 2018, in accordance with the STM Plan (URS, 2015). Three composite transplanted *Corbicula* samples were collected per deployment type (i.e., seeded and caged) from near-bank environments at the downstream extent of each STM. Additionally, three composite transplanted *Corbicula* samples (caged only) were collected from mid-channel environments at the downstream extent of each STM (June only). *Corbicula* were depurated for 24 hours in aquaria filled with distilled water, processed, frozen, and submitted to a Brooks Applied Laboratories (Bothell, Washington) for analysis.

Riparian and Aquatic Habitat

Bank stabilization can provide a positive effect on the function of the existing riparian and associated aquatic habitats. This section describes the methods used to evaluate the ecological attributes of these habitats.

Riparian Vegetation

Riparian vegetation plays an important role in bank stability and habitat quality for ecological receptors. It also provides value to stakeholders and the public at large in terms of the way the banks are viewed. Riparian vegetative communities for the following strata were assessed at two plots per station during each of the 2018 STM field events:

- Herbaceous: 1-meter diameter around the center of the plot
- Shrub/sapling: 3-meter diameter around the center of the plot
- Tree/vine: 10-meter diameter around the center of the plot

The dominant vascular plant species were identified to the lowest practical taxon, and the percent areal cover was quantified for each stratum.

Rapid Bioassessment Protocol

The pre-remedy quality of the substrate, channel morphology, bank structure, and riparian vegetation was evaluated at each STM station in the spring and fall of 2018 using modified Rapid Bioassessment Protocols (RBPs) (Barbour et al., 1999). Specific metrics assessed included the following:

- Epifaunal substrate/available cover
- Embeddedness
- Pool substrate characterization
- Sediment deposition
- Bank stability (subject bank only)
- Vegetative protection

- Riparian vegetative zone width

The RBP scoring system assigns a numerical score that fits into one of four condition categories: optimal, suboptimal, marginal, or poor.

Ancillary STM Habitat Metrics

Ancillary STM habitat metrics were included as part of the 2018 pre and post-remedy monitoring effort to address stakeholder concerns regarding preserving high-quality ecological habitats within the City of Waynesboro but are not part of the RCRA STM program. The methods used to collect these ancillary data included evaluation of planned wetlands (EPW), unified stream methodology (USM), and benthic community evaluations. The ancillary STM habitat metrics are summarized in Appendix C of the 2018 STM Report.

References

Anchor QEA, URS, and E.I. du Pont de Nemours and Company. 2015. *Final Interim Measures Design, Implementation and Monitoring Work Plan. Phase I – South River Area of Concern 4*. 471 pp.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish*. Second Edition. EPA 841-B-99-002. USEPA Office of Water, Washington, D.C.

URS. 2015. *Final AOC 4 Short-Term Monitoring Plan – Relative River Mile 0-2 of the South River, Virginia*. Prepared by URS Corporation. February 2015.

URS. 2012. *Final Report: Ecological Study of the South River and a Segment of the South Fork Shenandoah River, Virginia*. Fort Washington, Pennsylvania. Final report prepared by URS Corporation. September 2012.

Appendix B

Photographic Log of Short-Term Monitoring Stations

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
1	06/26/2018

Direction Photo Taken:

North

Description:

Constitution Park BMA STM-01, looking downstream, with installed rock toe and large woody debris along the bank.

Photo No.	**Date:**
2	10/08/2018

Direction Photo Taken:

West

Description:

Constitution Park BMA STM-01 proximal to Transect C with limited areas of Japanese Knotweed (*Fallopia japonica*) on riverbank.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
3	06/19/2018

Direction Photo Taken:

North

Description:

Unofficial footpath along the river, proximal to Constitution Park BMA STM-01, Transect A.

Photo No.	**Date:**
4	10/09/2018

Direction Photo Taken:

North

Description:

Constitution Park BMA STM-01, looking downstream near Transect D, with installed geocell and erosion control fabric with minimal vegetation cover and visible along bank;

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
5	10/09/2018

Direction Photo Taken:

South

Description:

Japanese Knotweed (*Fallopia japonica*) at Transect A of Shiloh Baptist Church BMA STM-03, with unofficial footpath to the river visible in the background.

Photo No.	**Date:**
6	10/09/2018

Direction Photo Taken:

South

Description:

Unofficial footpath to the river above Transect B of Shiloh Baptist Church BMA STM-03, adjacent to the railroad bridge.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
7	10/09/2018

Direction Photo Taken:

East

Description:

Shiloh Baptist Church BMA STM-03, looking upstream under the rail road bridge near Transect D.

Photo No.	**Date:**
8	10/09/2018

Direction Photo Taken:

South

Description:

Natural large woody debris at Shiloh Baptist Church BMA STM-03.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
9	06/19/2018

Direction Photo Taken:

Northwest

Description:

Shiloh Baptist Church BMA STM 03, near Transect C, looking downstream, with bedrock outcrop on the left bank.

Photo No.	**Date:**
10	06/19/2018

Direction Photo Taken:

South

Description:

Shiloh Baptist Church BMA STM-03, near Transect E, showing unplanned footpath to river and natural woody debris.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
11	10/09/2018

Direction Photo Taken:

Northwest

Description:

Downstream view of Shiloh Baptist Church BMA STM-03, with cobble bar exposed above Transect J.

Photo No.	**Date:**
12	11/01/2018

Direction Photo Taken:

Southwest

Description:

North Park BMA STM-05 showing unplanned footpath to river.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
13	11/01/2018

Direction Photo Taken:

Southwest

Description:

North Park BMA STM-05, showing natural large woody debris along left bank.

Photo No.	**Date:**
14	11/01/2018

Direction Photo Taken:

Southwest

Description:

North Park STM-05 showing overhanging vegetation with undercut banks; large woody debris present along the bank.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
15	6/20/2018

Direction Photo Taken:

North

Description:

Downstream view of North Park BMA STM-05, with overhanging vegetation along Transect D.

Photo No.	**Date:**
16	11/01/2018

Direction Photo Taken:

North

Description:

City Shops BMA STM-07 cobble riffle at the upstream extent of BMA.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
17	10/10/2018

Direction Photo Taken:

North

Description:

Large woody debris under bridge at the City Shops BMA STM-07.

Photo No.	**Date:**
18	10/10/2018

Direction Photo Taken:

West

Description:

City Shops STM-07, near Transect F, showing exposed roots on the left bank.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
19	6/21/2018

Direction Photo Taken:

Southeast

Description:

Upstream view of City Shops BMA STM-07, proximal to Transect H; showing installed rock toe and large woody debris along bank.

Photo No.	**Date:**
20	10/10/2018

Direction Photo Taken:

West

Description:

City Shops BMA STM-07, near Transect H showing the root ball side of one of the installed large woody debris (LWD) has pivoted downstream from its original position and is now parallel to another LWD downstream.

Client Name:	**Site Location:**	**Project No.**
Corteva	South River – Short-Term Monitoring	60594243

Photo No.	**Date:**
21	6/21/2018

Direction Photo Taken:

West

Description:

City Shops BMA STM-07 showing exposed roots and undercut banks near Transect J.

Photo No.	**Date:**
22	10/10/2018

Direction Photo Taken:

West

Description:

City Shops BMA STM-07, near Transect K; LWD moved from its installed position. The root ball side of the installed LWD has pivoted downstream from its original position and is now angled into the river.

Appendix C

Ancillary Short-Term Monitoring Metrics

Appendix C
Ancillary Short-Term Monitoring Habitat Metrics
AOC 4 2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Virginia

This appendix summarizes the ancillary habitat-specific metrics conducted during the 2018 Short-Term Monitoring (STM) events. These ancillary parameters are being evaluated to address stakeholder concerns regarding preservation of existing ecological habitats during the implementation of the Phase I interim measures and are not part of the Virginia Department of Environmental Quality (VDEQ) approved STM Plan under the Resource Conservation and Recovery Act (RCRA).

Canopy Cover

Canopy cover was assessed using a spherical densiometer to quantify the percent canopy cover at each STM station in the spring of 2018. The spherical densiometer is a concave mirror that is divided into 96 cells. The number of cells with open sky (four out of 96 available) was recorded. These four densiometer readings were collected from the middle of the river (one facing each compass direction), co-located with each sediment and pore water sampling transect. The arithmetic mean was calculated for the four readings collected at each transect, which was then used to determine the overall arithmetic mean percent (%) open sky and % canopy cover for each STM station. Overall, mean percent canopy cover was relatively low (16% to 46%) and increased with distance downstream of Constitution Park (see Table C-1). Canopy cover remained similar between years for all STM stations including at the Constitution Park BMA (STM-01) with interim measures completed in February 2017 and at the City Shops BMA (STM-07) with interim measures completed in February 2018.

Aquatic/Riparian Habitat

Additional assessments of aquatic and riparian habitat, similar to the EPA Rapid Bioassessment Protocols (RBPs), were conducted [i.e., Evaluation of Planned Wetlands (EPW), and Unified Stream Methodology (USM)] with the goal of documenting baseline (STM-03, STM-05, and STM-08) and post-remediation (STM-01 and STM-07) habitat quality and ecological function.

Evaluation for Planned Wetlands

The Evaluation for Planned Wetlands (Bartoldus et al., 1994) is an assessment methodology that can be used to evaluate pre- and post-restoration/creation ecological function and value of an ecosystem, typically a wetland. For this assessment, only the Non-Tidal Fish assessment (EPW Fish) was conducted as other elements of the EPW are redundant with the RBP metrics already conducted as part of the Area of Concern (AOC) 4 STM Plan. The EPW Fish Functional Capacity Index (FCI) is composed of 20 monitoring elements that are separated into the following four categories: limiting factors, food/cover, reproduction, and water quality. Individual scores for each element were averaged within the four categories to determine the overall FCI, which ranges from zero to one, with 0 being a limited ecological value and 1 representing a high ecological value. The EPW assessment was conducted in the fall of 2018; the EPW Fish scores for STM-01, STM-03, STM-05, and STM-07 were 0.60, 0.62, 0.64, and 0.62, respectively. STM-08 was not assessed due to ongoing construction. Scores for all BMAs either remained similar or increased slightly over previous years, indicating moderate functional capacity for fish populations (AECOM, 2017 and 2018).

Unified Stream Methodology

The USM was completed in accordance with *Unified Stream Methodology for Use in Virginia* [U.S. Army Corps of Engineers (USACE) and VDEQ, 2007]. This approach was used to evaluate potential impacts to the South River by assigning a Reach Condition Index (RCI) for each STM station. The RCI is based on the condition of the channel, riparian corridor, and instream habitat, as well as the extent of channel alteration. The RCI ranges from 0.5 to 1.5, with streams in poorer condition scoring lower. The USM assessment was conducted in the fall of 2018; RCIs for STM-01, STM-03, STM-05, and STM-07 were 1.13, 1.26, 1.16, and 1.06, respectively. At the recently completed Constitution Park and City Shops BMAs (STM-01 and STM-07), USM remained similar between baseline and post-construction data indicating no negative impacts to the USM from interim measures (AECOM, 2017 and 2018).

In addition to overall habitat quality, the location, quantity, and approximate size of in-stream habitat features [i.e., large woody debris (LWD)], adjacent to each STM station, were characterized and located using a hand-held Global Positioning System (GPS) (see Figure C-1). Presence of in-stream LWD features was monitored twice in 2018 for STM-01, STM-03, STM-05, and STM-07, once in the spring and once in the fall. LWD features documented at STM locations ranged from one to 15, with the highest densities observed adjacent to the recently completed City Shops BMA (STM-07).

Access paths to the river were surveyed twice in 2018 for each monitoring location. All paths were located using GPS (see Figure C-1). Nine river access paths, of varying degrees of apparent use, were documented (see Figure C-1).

Benthic Community

Benthic communities were sampled in accordance with EPA RBP methodologies (Barbour et al., 1999) at four locations. Of note, these locations do not directly correspond to STM stations; rather, they are spaced approximately 0.5 relative river miles (RRMs) between RRM 0 and RRM 2. At each location, three replicate samples were collected along a gradient of transitional/riffle habitats; each replicate sample was a composite of samples collected at the left, middle, and right points of the wetted stream channel using a standard Surber sampler (see Figure C-1).

Benthic community samples were collected twice in 2018, once in the spring and once in the fall. Preserved benthic community samples were submitted to a laboratory for taxonomic analysis. Results from the benthic community assessment will be compared to post-remediation results as an additional evaluation of overall habitat quality as interim measures continue to be completed. Descriptive statistics (arithmetic mean ± standard deviation) of select metrics are provided in Table C-2.

Benthic invertebrate communities are relatively diverse and generally comparable among sampling locations and sampling events (see Table C-2). However, among all sampling locations, % Ephemeroptera, plecoptera, and trichoptera (% EPT) increased while %Diptera/Oligochaeta decreased in October compared to June, likely attributable to a decrease in the overall number of taxa observed and total abundance between June and October.

Substrate Characterization

Pebble counts are used to assess substrate distribution. Wolman pebble counts (Wolman, 1954) were conducted at each STM sampling transect during the October 2018 monitoring event; 20 data points were collected along each transect, equally spaced, spanning from left bank to right bank.

Substrate sizes were generally evenly distributed throughout all STMs. Sand/fines were observed at a high ratio throughout STM-01 and STM-05, whereas bedrock was more frequently observed at STM-03 and STM-07 (see Figure C-2). Of note, although a large amount of Class 1 substrates (i.e., sand/fines) were documented at STM-01 and STM-05, this does not necessarily represent the presence of large fine-grained deposits, but rather fine-grained substrates that have become embedded around larger substrates in the riverbed (i.e., embeddedness). The D_{50} (median) substrate size classes for STM-01, STM-03, STM-05, and STM-07 were 45 millimeters (mm) (very coarse gravel), 90 mm (medium cobble), 45 mm (very coarse gravel), and 64 mm (small cobble), respectively. Grain size generally increased between 2017 and 2018 sampling events, likely attributed to high flow events in the summer of 2018 which may have scoured out smaller substrate types (AECOM, 2018). When comparing STM-01 to baseline data, there is a decrease in sands/fines and a higher percentage of very course gravel due to the remediation of the STM-01 reach (AECOM, 2017). When comparing STM-07 to baseline data, there is an increase in overall substrate size but a higher percentage of sands/fines due to the remediation of the STM-07 reach (AECOM, 2017).

Summary

Additional habitat/ecological function metrics were evaluated to document conditions both pre- and post- implementation of the Phase 1 Interim Measures for AOC 4. The data collected in 2018 and summarized above were similar to the baseline dataset for which post-remediation datasets will be compared as additional interim measures are completed. Post remediation conditions at the Constitution Park and City Shops BMA were overall similar to pre-remediation conditions indicating that the completed interim measure did not negatively impact habitat and ecological function at the BMA. Overall, habitat and ecological function at the areas evaluated can be generally described as moderate to optimal, which is consistent with the findings of the EPA RBPs conducted as part of the AOC 4 STM program. Canopy cover was low to moderate (e.g., < 50%) at each STM station. Channel substrates were moderately embedded; however, relatively diverse benthic invertebrate communities were documented throughout the RRM 0-2 reach.

Consistent with adaptive management principles for AOC 4, the STM approach may be revised based on documented progress towards the achievement of success criteria, contingency actions, and emerging decision analysis options (URS, 2015). Specifically, monitoring data that do not materially impact the remedial decision process may be reduced or eliminated from the STM program.

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Tables

Table C-1
Canopy Cover Data Summary
Appendix C Ancillary Short-Term Monitoring Metrics
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Transect ID	Mean Densiometer Reading[1]	Mean Open Sky (%)	Overall Mean Open Sky (%)	Overall Mean Canopy Cover (%)
Constitution Park BMA (STM-01)				
A	94	97.4	84	16
B	71	73.4		
C	79	82.3		
D	87	90.4		
E	71	74.2		
Shiloh Baptist Church BMA (STM-03)				
A	74	76.6	60	40
B	75	77.9		
C	76	79.4		
D	31	31.8		
E	79	82.3		
F	62	64.6		
G	43	44.3		
H	37	38.5		
I	68	70.6		
J	36	37.0		
North Park BMA (STM-05)				
A	45	46.9	55	45
B	29	29.9		
C	54	56.3		
D	45	46.6		
E	59	61.7		
F	81	84.4		
G	63	65.4		
H	48	50.0		
I	51	52.6		
J	52	53.9		
City Shops BMA (STM-07)				
A	41	42.2	54	46
B	30	31		
C	43	44		
D	24	24.5		
E	61	63.8		
F	96	100.0		
G	96	100.0		
H	38	39.3		
I	37	38.0		
J	50	51.8		
K	52	54.2		
Allied Ready Mix BMA (STM-08)[2]				
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Notes:

1, Canopy cover is only sampled in the spring.

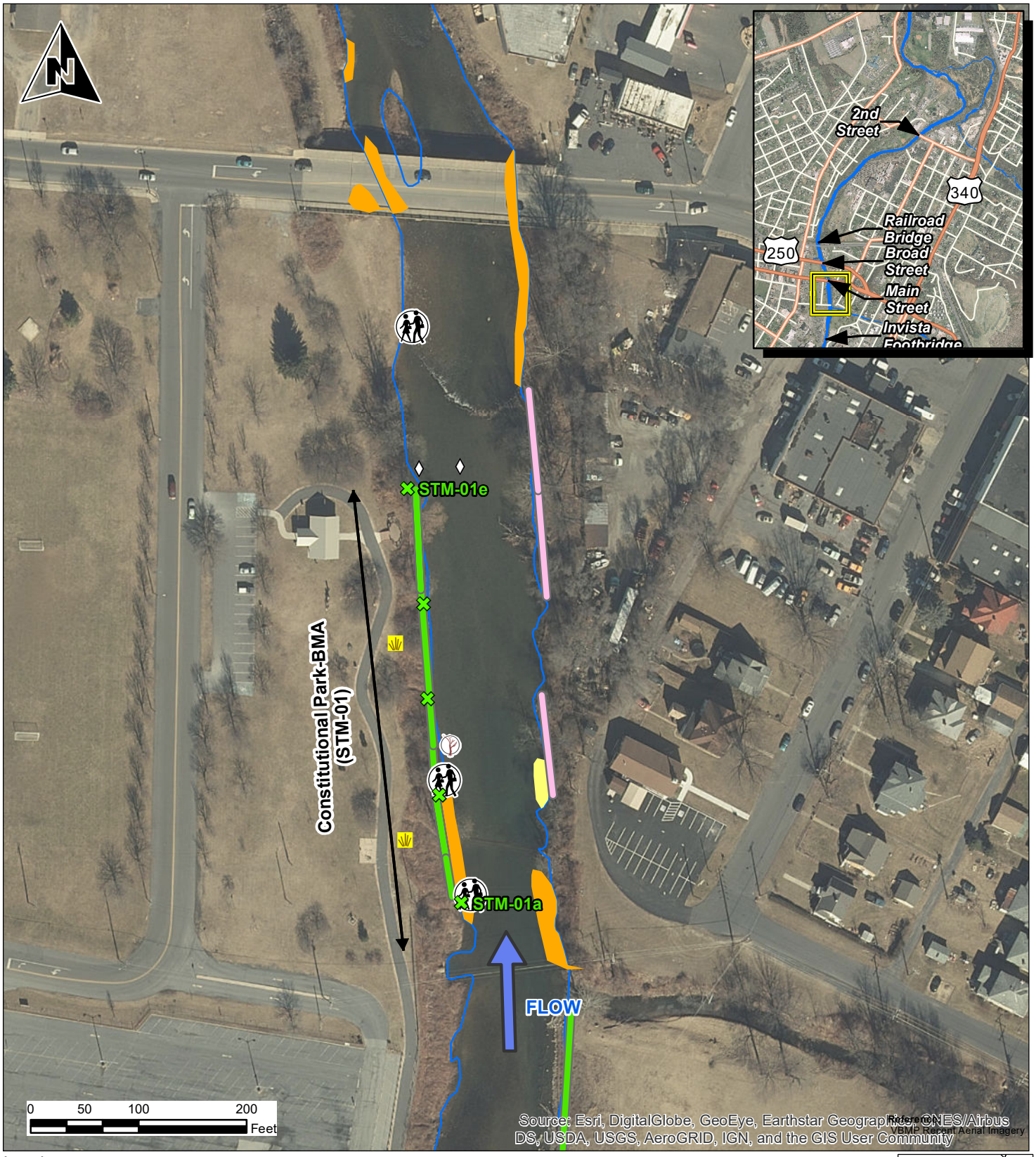
2, STM-08 was not sampled in the spring of 2018 due to ongoing construction.

Table C-2
Benthic Community Assessment Metrics
Appendix C Ancillary Short-Term Monitoring Metrics
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4

Metric	Sampling Station / Mean ± SD				
	RRM 0.5		RRM 1.0	RRM 1.5	RRM 2.0
June 2018					
Corrected Abundance (n)	848	± 918	413 ± 145	410 ± 302	256 ± 55
Taxa Richness	30.7	± 6.1	28.3 ± 5.5	31.3 ± 4.9	36.7 ± 2.1
% EPT	34.8	± 12.2	31.8 ± 11.9	30.9 ± 10.2	26.8 ± 2.0
% Diptera/Oligochaeta	15.2	± 5.6	15.7 ± 10.9	21.6 ± 6.9	13.9 ± 4.8
Shannon's H	0.99	± 0.26	0.93 ± 0.18	1.04 ± 0.24	1.07 ± 0.13
Pielou's J	0.66	± 0.14	0.64 ± 0.10	0.69 ± 0.14	0.69 ± 0.08
VA Non-coastal SCI	66.8	± 1.33	68.7 ± 1.48	67.2 ± 1.05	70.6 ± 2.35
October 2018					
Corrected Abundance (n)	377	± 207	318 ± 212	167 ± 68	149 ± 103
Taxa Richness	31.3	± 6.0	23.7 ± 4.7	25.7 ± 4.7	22.0 ± 7.0
% EPT	58.5	± 1.8	63.7 ± 13.4	47.6 ± 1.7	53.1 ± 13.3
% Diptera/Oligochaeta	2.9	± 1.9	3.1 ± 2.2	42.0 ± 2.6	3.7 ± 2.7
Shannon's H	1.07	± 0.01	1.00 ± 0.03	1.04 ± 0.14	1.04 ± 0.07
Pielou's J	0.72	± 0.05	0.73 ± 0.06	0.74 ± 0.08	0.78 ± 0.08
VA Non-coastal SCI	75.8	± 2.92	73.4 ± 1.67	60.7 ± 6.14	72.6 ± 5.56

Notes:
Mean ± SD, Arithmetic mean ± standard deviation
EPT, Ephemeroptera, plecoptera, and trichoptera
SCI, stream condition index

Figures



Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

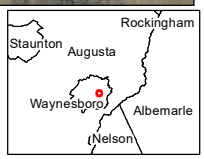


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Figure C-1: Sheet 1 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia

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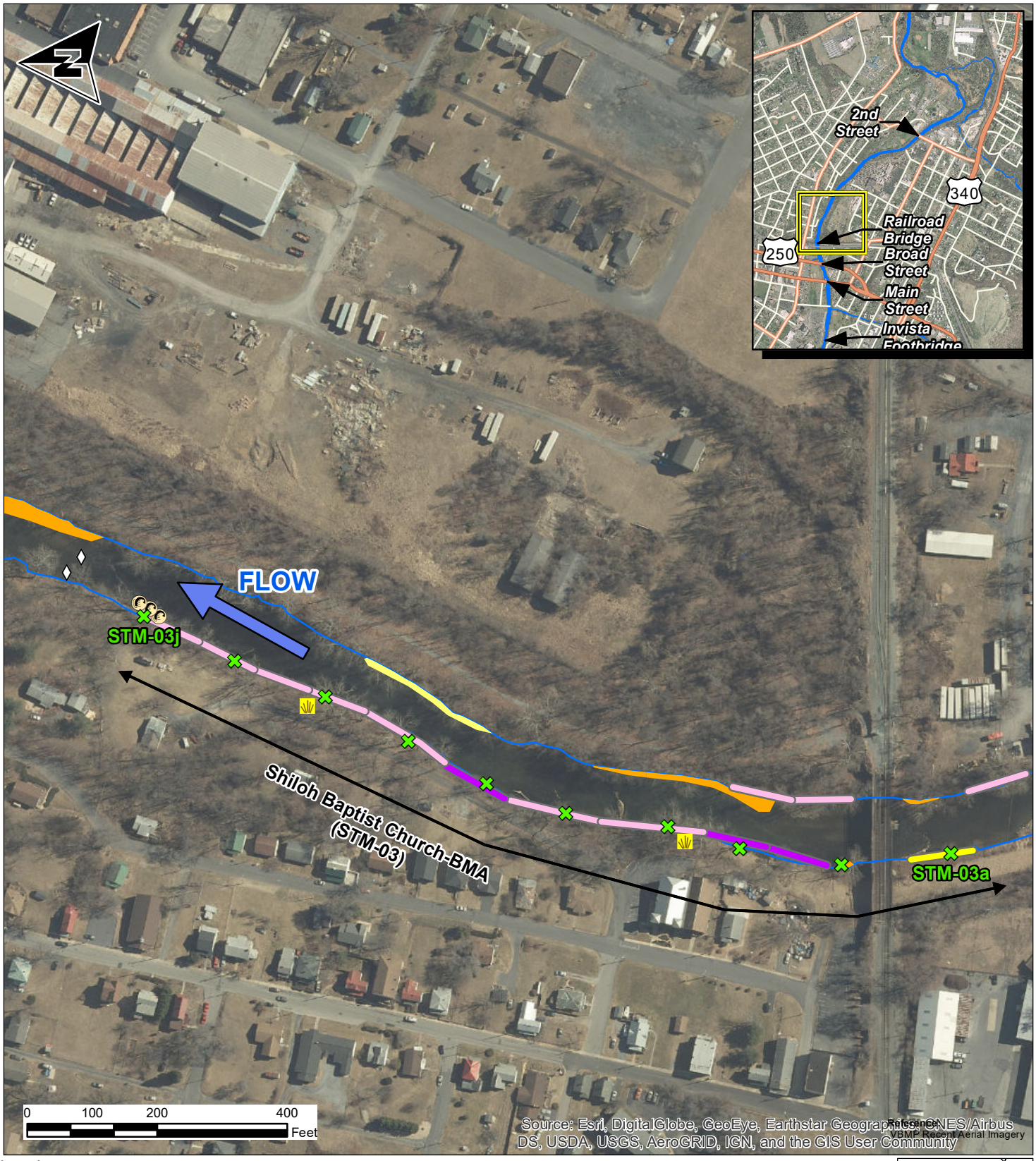

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

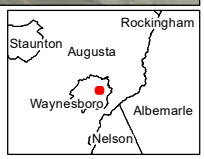

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Figure C-1: Sheet 2 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
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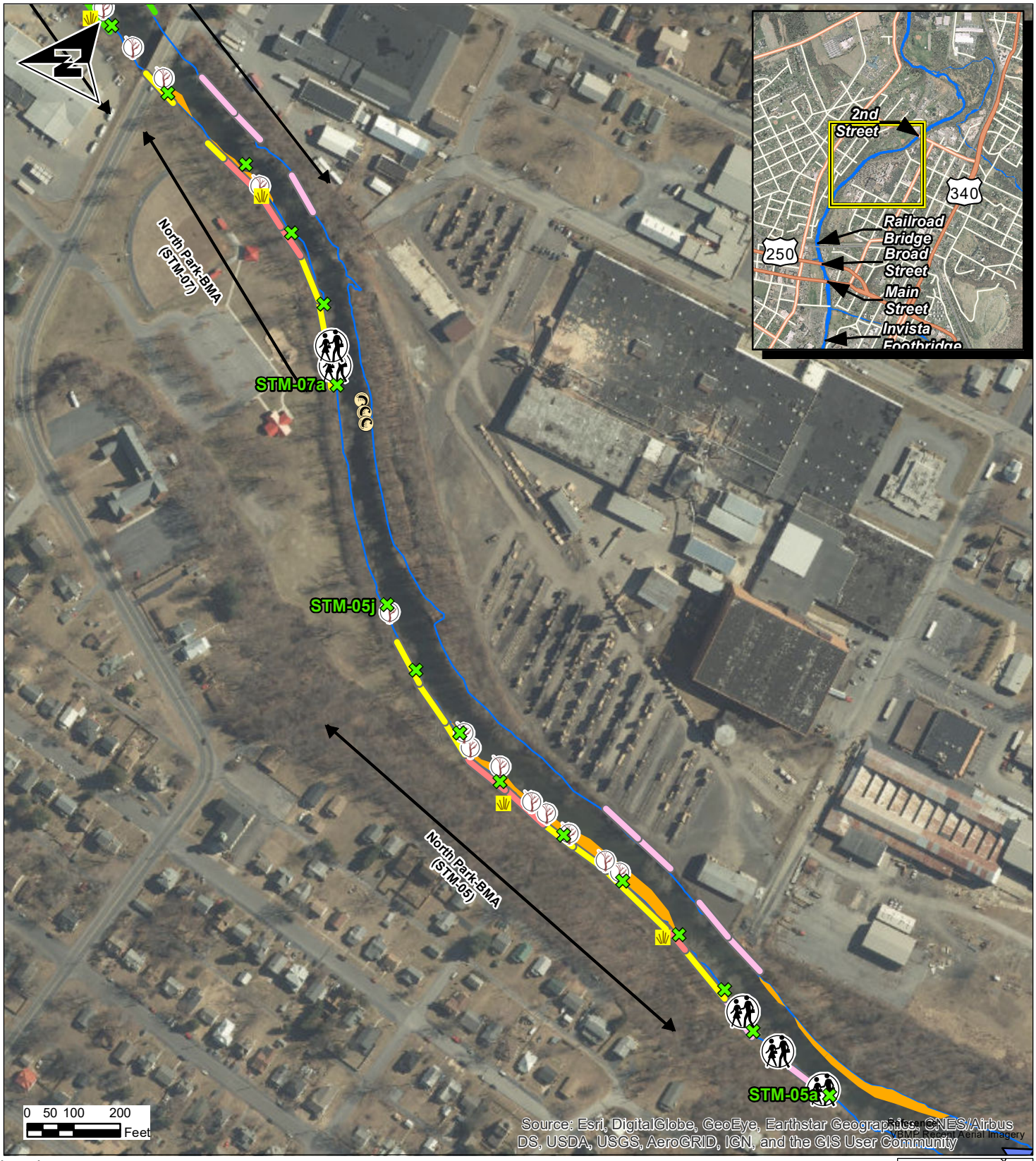

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

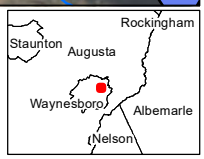

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Figure C-1: Sheet 3 of 5
Short-Term Monitoring Stations Overview Map
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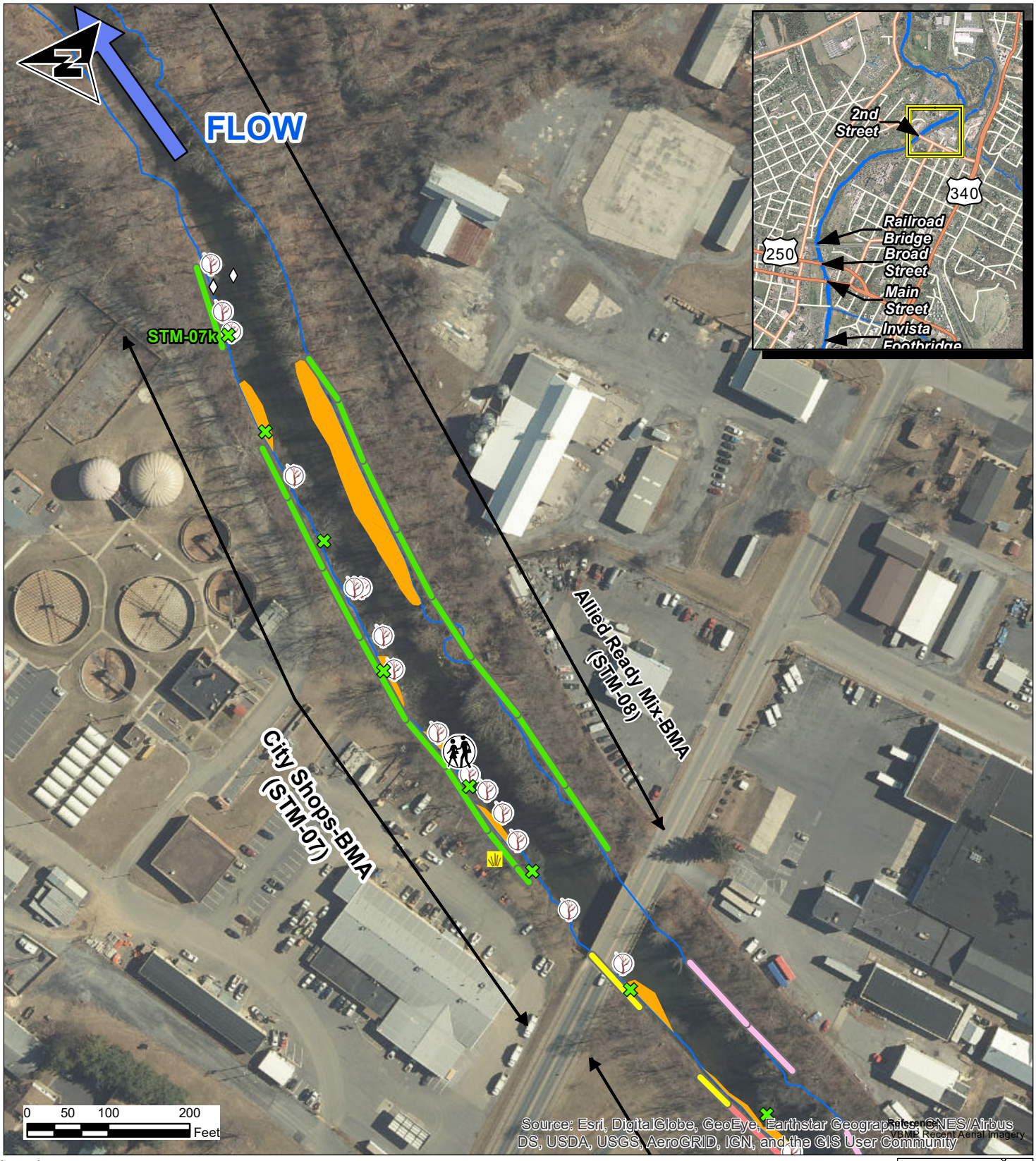

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

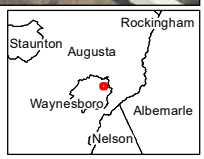

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Figure C-1: Sheet 4 of 5
Short-Term Monitoring Stations Overview Map
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
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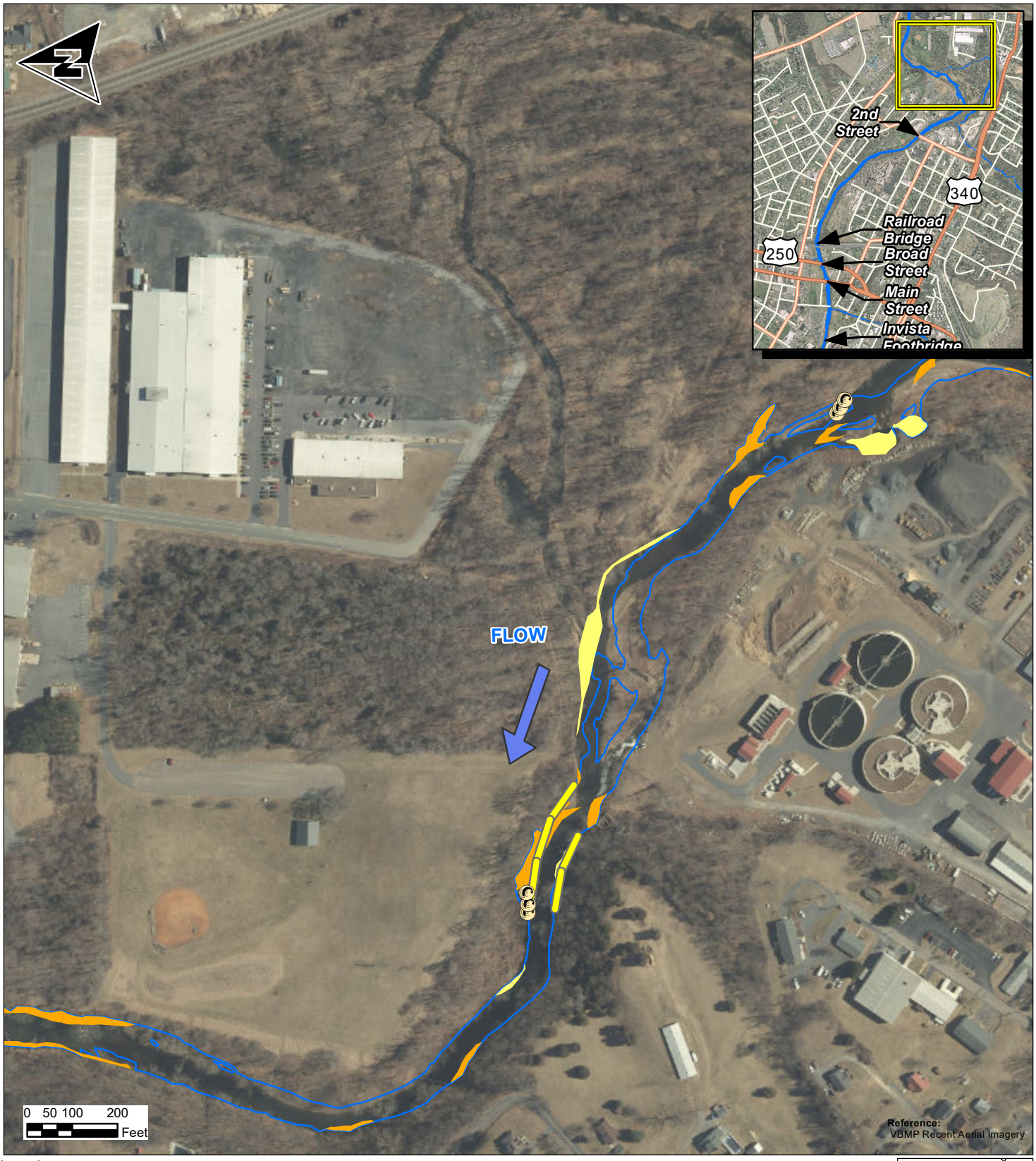

Legend

- Periphyton/Clam
- Benthic Community
- Vegetative Plots
- Sediment/PoreWater/ Canopy/Pebble Count
- Large Woody Debris
- River Access
- Extent of Short-term Monitoring Location
- Clay and Silt Deposits
- Fine Sand Deposits
- Shoreline

Bank Management Areas

- Interim Measures Complete
- BMAs Not Included in STM Program
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs

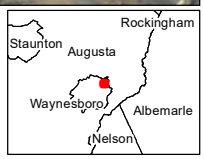

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Figure C-1: Sheet 5 of 5
Short-Term Monitoring Stations Overview Map
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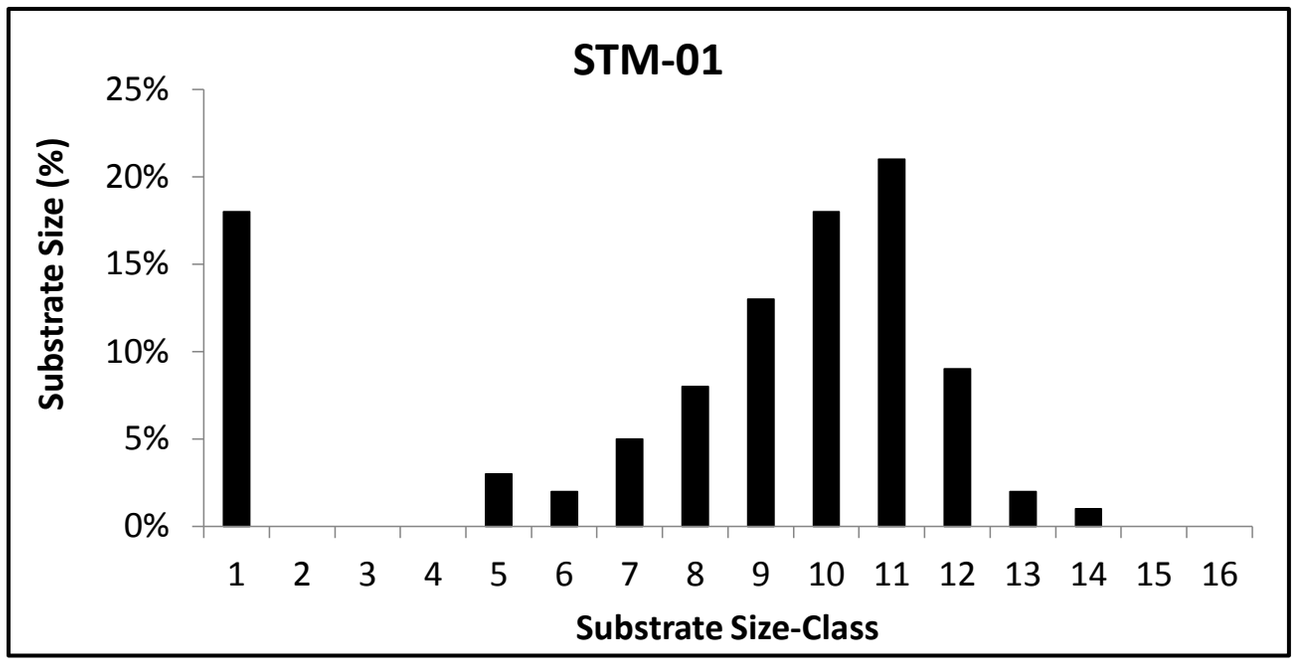
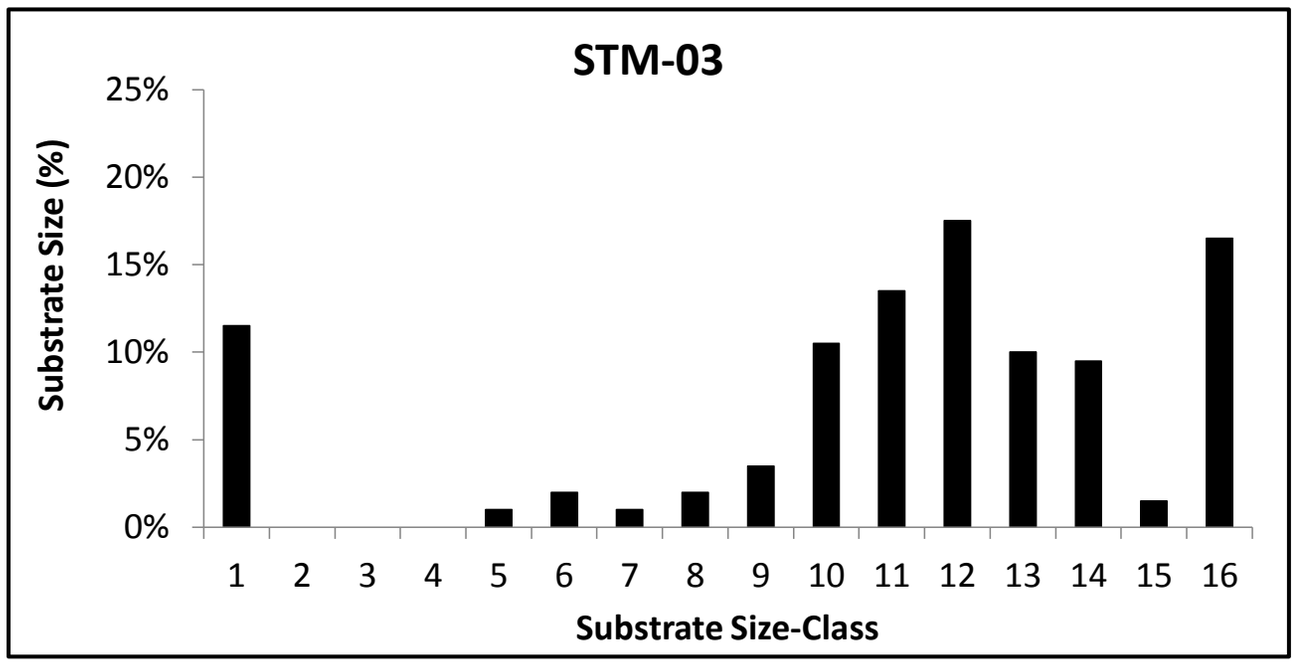
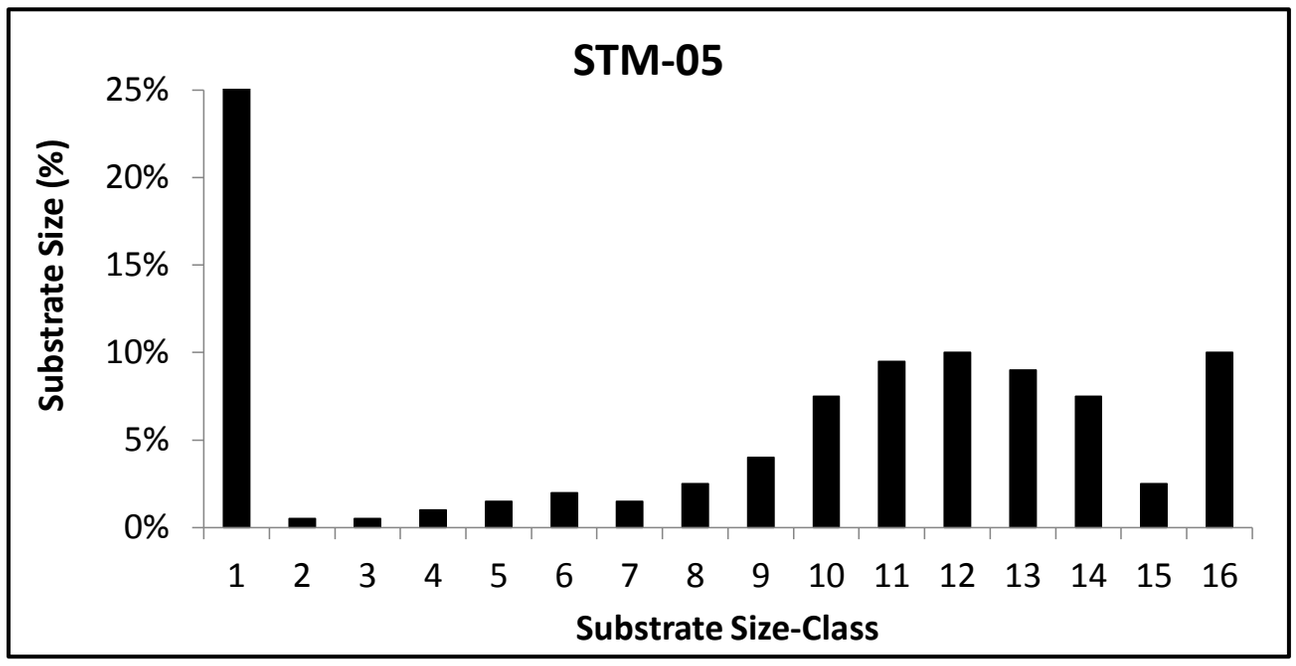
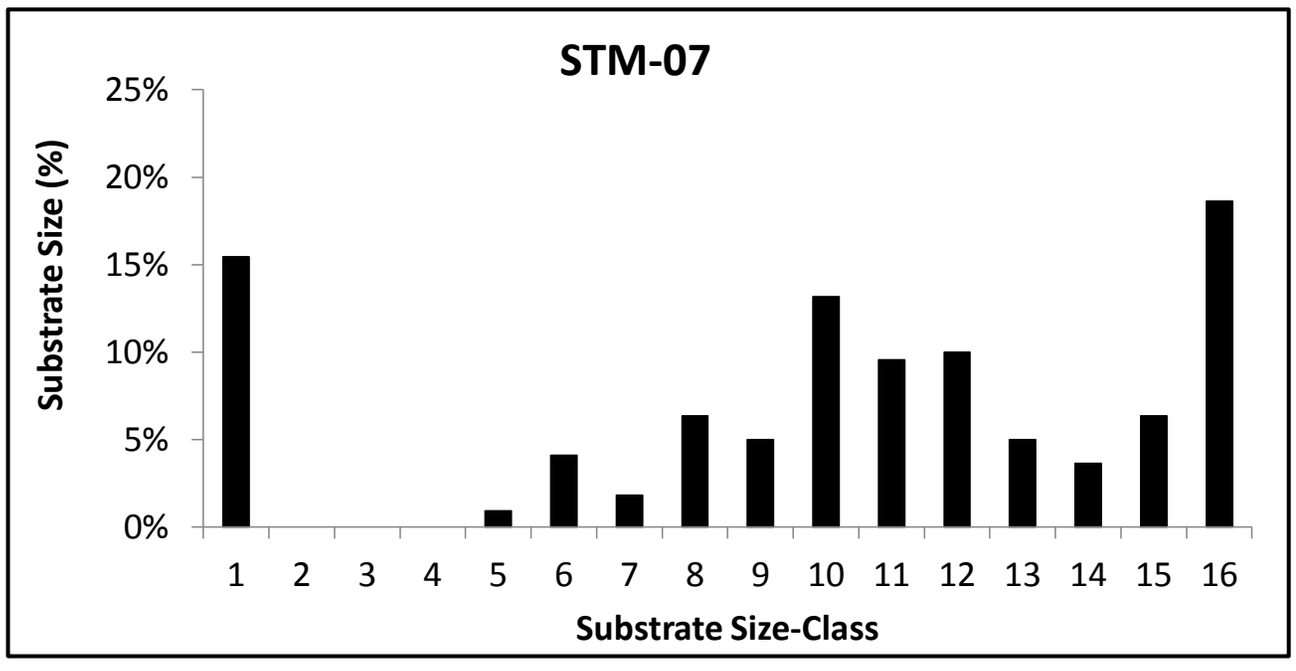
Figure C-2
Sediment Grain Size Distribution
2018 Short-Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4









Substrate Size Class Descriptions		
Substrate Size-Class	Size Range (mm)	Description
1	0 - 2.0	Sand/Fines
2	2.0 - 2.8	Very Fine Gravel
3	2.8 - 4.0	Very Fine Gravel
4	4 - 5.6	Fine Gravel
5	5.6 - 8.0	Fine Gravel
6	8 - 11.0	Medium Gravel
7	11 - 16	Medium Gravel
8	16 - 22.6	Coarse Gravel
9	22.6 - 32	Coarse Gravel
10	32 - 45	Very Coarse Gravel
11	45 - 64	Very Coarse Gravel
12	64 - 90	Small Cobble
13	90 - 128	Medium Cobble
14	128 - 180	Large Cobble
15	180 - 300	Very Large Cobble
16	>300	Boulder/Bedrock