Hudson River PCBs Superfund Site

TECHNICAL MEMORANDUM

EVALUATION OF 2016 EPA/GE AND 2017 NYSDEC SURFACE SEDIMENT DATA

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April 2019

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1.0 Introduction

As the Hudson River PCBs Superfund Site moves from active remediation to the long term monitored natural attenuation (MNA)[1] period anticipated in the 2002 Record of Decision (ROD), it is important to establish the post-remedy baseline conditions against which future conditions can be compared. To this end, EPA directed General Electric (GE) to undertake a sediment sampling survey in 2016 to characterize the PCB concentration in 0 to 2-inch surface sediments. In the survey, GE focused primarily on the areas outside the dredged areas (*i.e.,* non-dredged areas). Future work to characterize the baseline conditions inside the dredged areas (*i.e.,* the areas inside the certification units, or CUs) was postponed to a later date due to time constraints in 2016.[2] The 2016 EPA/GE investigation was based on an unbiased, randomized sampling design, with sufficient numbers of samples to detect a 5 percent rate of decline per year in non-dredged surface sediment concentrations of PCBs over a 10-year period. As part of the requirements for Operations, Maintenance and Monitoring (OM&M), surface sediments are to be sampled approximately every five years upon completion of dredging, while fish and water column monitoring is to be conducted annually.

The New York State Department of Environmental Conservation (NYSDEC), along with the federal trustees, indicated they were concerned that such a sampling program was insufficient for the following reasons:

- The EPA/GE sampling design required 10 years to reliably discern a rate of decline of 5 percent per year in surface sediment PCB concentrations. NYSDEC argued for a shorter time frame of approximately 5 years.
- The EPA/GE program was designed to provide information on the river section basis specified in the 2002 ROD, whereas NYSDEC in recent years has preferred a river reach basis. Reaches are discrete pools defined by run-of-the-river dams; finer segments of the river compared to the river sections, which, with the exception of River Section (RS) 1, are comprised of multiple reaches.

Given the above concerns, NYSDEC undertook a more intensive program in 2017, sampling both dredged and non-dredged areas. Other stakeholders also raised a concern that the 2016 EPA/GE sampling program was unlikely to place greater emphasis on areas proximal to dredged areas, where elevated sediment concentrations might be found. This additional concern is also addressed by NYSDEC's sampling program design, which simply covered a greater number of locations. The NYSDEC plan was based on an unbiased systematic grid, as opposed to the unbiased random

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1 The ROD was issued in 2002, prior to EPA's publication of its landmark 2005 *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* in which "Monitored Natural Recovery," or MNR, was established as the preferred term of art. For the purposes of this document, and the Hudson River PCBs Superfund Site generally, MNA and MNR are used interchangeably.

2 Sampling of sediments inside CUs by GE was accomplished in fall 2017; however, results are not yet available since certain questions regarding sample processing protocol are still being resolved. It is not anticipated that results of these 2017 samples collected by GE will change the evaluations in this memorandum.

design used by EPA/GE in 2016. To the extent possible, the NYSDEC design incorporated the EPA/GE locations in filling out its sampling grid (that is, NYSDEC did not sample a grid location if it had been previously sampled by EPA/GE).[3] Both designs were expected to yield similar results when examined on a river section basis. The discussion provided below describes EPA's analysis and interpretation of NYSDEC data, examined both against, and in combination with, the EPA/GE data to establish post-dredging baseline conditions.

1.1 Purpose of This Evaluation

This memorandum describes EPA's evaluation of surface sediment analytical data obtained by GE under EPA's oversight in 2016 and by NYSDEC in 2017 as it relates to OM&M activities for Operable Unit (OU)-2 of the Hudson River PCBs Superfund Site. The NYSDEC sampling activities were conducted from June 15 through September 19, 2017 by NYSDEC's contractor EA Engineering, P.C. and its affiliate EA Science and Technology (EA), and consisted of surface sediment sampling within the eight reaches of the Upper Hudson River. These eight reaches correspond to RS 1 through 3 in descending order, i.e., Reach 8 is coincident with RS 1 (Thompson Island Pool); Reaches 7 and 6 comprise RS 2, while Reaches 5 through 1 are encompassed by RS 3, as depicted in Figure 1.1-1 and shown in the table below.

River Section	Reach	Pool Name	Pool River Miles (RM)	Pool Description
RS 1	8	Thompson Island Pool	194.5-188.5	Former Fort Edward Dam to Thompson Island Dam
RS 2	7	Fort Miller Pool	188.5-186.1	Thompson Island Dam to Fort Miller Dam
	6	Northumberland Pool	186.1-182.4	Lock 6 in Fort Miller to Lock 5/ Northumberland Dam (Schuylerville, NY)
RS 3	5	Stillwater Pool	182.4-167.5	Lock 5 to Lock 4 (Stillwater, NY)
	4	Upper Mechanicville Pool	167.5-166	Lock 4 to Lock 3 (Mechanicville, NY)
	3	Lower Mechanicville Pool	166-163.5	Lock 3 to Lock 2 (Mechanicville, NY)
	2	Lock 1 Pool	163.5-159.4	Lock 2 to Lock 1 (Halfmoon, NY)
	1	Waterford (or Troy) Pool	159.4-154	Lock 1 to Federal Lock and Dam at Troy, NY

[3] Note that the consideration of EPA/GE sampling locations in the NYSDEC grid applies only to non-dredged areas. GE completed sampling of the dredged areas in late 2017, so that these locations were not available for NYSDEC to consider in their grid design.

EPA undertook this evaluation of surface sediment contaminant concentrations using the 2017 NYSDEC data, as well as the OM&M data collected by GE in 2016, with the following objectives:

- Assess the comparability of the two data sets for non-dredged areas and certain ongoing matters regarding PCB analytics;
- Determine if the remedial operations left behind substantive areas in excess of the ROD-specified criteria for each river section, based on the 0 to 2-inch sediment interval;[4]
- Characterize post-dredging surface sediment PCB concentrations by river reach and river section;
- Examine in more detail the pace of recovery of Upper Hudson River sediments immediately after dredging; and
- Identify if "hot spots" (areas of PCB concentrations substantially higher than surrounding areas and spatially extensive) remain in the Upper Hudson following the completion of dredging required by the 2002 ROD.

While the data obtained by NYSDEC were collected after the period covered by the Second Five-Year Review (FYR) Report, these evaluations are presented in concert with the revised version of that document (following consideration of public comment) to provide additional temporal understanding of the post-remedy conditions of the Upper Hudson River. Surface sediment samples were also collected within the boundaries of CUs by GE in fall 2017; however, results are not yet available since certain analytical protocols at the new laboratory are under review.

Contents of this memorandum are organized as follows:

- The remainder of **Section 1** briefly summarizes the 2016 EPA/GE and 2017 NYSDEC sampling program objectives and the data obtained by each entity.

- **Section 2** provides a summary of the two data sets as well as the procedures used to calculate Tri+ PCBs from the Method 8082 (M8082) results. Detailed discussion can be found in Attachment A.

- **Section 3** addresses the question: "What are the surface sediment concentrations in the Upper Hudson River after dredging?" using two sets of calculations to estimate the area-weighted average (mean) Total PCB and Tri+ PCB concentrations by river reach and river section. This analysis relies primarily on the Aroclor-based results. Further discussion of the relationship between Aroclor-based analysis (M8082) and congener-based analysis (M1668c) can be found in Attachment A to this memo, and the summary of the findings can be found in Section 2.

[4] The ROD specified 0-12 inches as surface sediment, but the 0 to 2-inch interval was selected for long term monitoring since it will respond more rapidly to changes in PCB conditions in the river.

- **Section 4** addresses the question: "What is the pace of recovery of the Upper Hudson River sediments after dredging?" by determining sediment recovery rates in non-dredged areas and comparing them with rates predicted in the 2002 ROD. These include rates calculated using available surface sediment data from 1976 through 2013 as well as rates calculated since the 2002 through 2005 GE's Design Support Sediment Sampling and Analysis Program (SSAP) through the present.
- **Section 5** addresses the question "Do 'hot spots' remain in the Upper Hudson River based on the combined 2016 EPA/GE and 2017 NYSDEC surface sediment data?" using various rigorous statistical methods to identify any remaining locations with PCB concentrations that are higher than the surrounding areas and spatially extensive.
- **Section 6** contains the summary and conclusions from this memorandum.

1.2 Purpose of OM&M Sediment Sampling

In general, the purpose of OM&M sediment sampling is to determine the post-dredging concentrations of PCBs in the sediment of the Upper Hudson River, to confirm that the remediation achieved its dredging goals, and to establish a baseline to compare against future measurements of sediment concentrations to document the rate of natural attenuation (or, in current terminology, natural recovery) over time. The next two subsections describe the details of the 2016 EPA/GE sampling program and the 2017 NYSDEC sampling program. Each subsection provides the objectives, the sample tallies and the analytical procedures used by each program.

1.2.1 2016 GE Sampling Program and Objectives

The data quality objectives (DQOs) of the overall long-term sediment OM&M program outlined in the 2010 Phase 2 OM&M Scope (USEPA, 2010) are as follows:

1. Determine post-remediation PCB levels in sediments in non-dredged areas of the Upper Hudson River.
2. Provide data on Select Areas[5] that exceeded the dredging criteria but were not targeted for dredging because they were buried by cleaner sediments, to assess whether the deposits have experienced erosion.
3. Determine sediment recovery rates in non-dredged areas of the Upper Hudson River.
4. Examine the changes to surface PCB concentrations in backfilled areas.

Of these DQOs, the 2016 sampling conducted by GE addressed the first. Objective 2 will be addressed by other future sampling while number 3 (establishing a rate) requires at least one additional survey to be conducted for the next FYR due in spring 2022. Thus, the initial (baseline) data needs for objective 3 were addressed, but more sampling events are needed. Objective 4 can be

[5] Select Areas were defined in the 2004 Resolution of GE Disputed Issues (USEPA, 2004) as locations where PCB inventory exceeded the dredging threshold, but the maximum PCB concentrations is below a depth of 24 in. and has 12 in. or more of relatively clean surface sediment (less than 5 mg/kg Total PCB). These areas did not require dredging under the selected remedy.

evaluated for the time period between backfill placement and 2017 once chemical analytical results are available. Future sampling will be required to further understand changes with time.

In designing the 2016 survey, the specific statistical objective for the EPA/GE's OM&M sampling program was to collect and analyze sufficient data to estimate the probability of detecting an approximate 5 percent annual change in PCB concentrations over a 10-year monitoring time period, *i.e.*, considering three time steps in the monitoring program, year 0 (baseline), year 5 and year 10. In order to meet this objective, it was determined in the 2010 OM&M Scope of Work (SOW) (USEPA, 2010) that approximately 350 sample locations from the non-dredged areas and a minimum of 50 locations from backfilled areas in each river section would have to be sampled by GE during each sampling event, totaling about 500 samples in all per event.

Following completion of the dredging activities in 2015, GE completed the first round of the OM&M benchmark sediment sampling in fall 2016. These data were collected to establish a baseline for future comparison of post-dredging PCB concentrations in non-dredged areas to facilitate sediment recovery rate estimates in such areas. Although the OM&M SOW called for 350 sample locations from the non-dredged areas, certain modifications were determined to be appropriate by EPA based on the variance of Tri+ PCB concentration in 2011-2013 surface sediment samples. Utilizing a randomized, unbiased sampling design, EPA proposed the collection of 226 primary surface sediment samples in non-dredged areas, with 226 secondary locations selected in the event any of the primary locations were inaccessible or could not otherwise be sampled. In addition, EPA has specified a total of 149 samples in the dredged areas. During field implementation of the sampling program, a total of 215 locations, 192 primary and 23 secondary, were sampled in the non-dredged areas between Rogers Island and the Federal Dam in Troy via a modified Van Veen sampler (equipped with a landing frame). Eleven of the 226 planned locations could not be sampled due to accessibility issues (via boat) or were abandoned due to the absence of appropriate sediment (*i.e.*, no sediment was present, or materials collected were too large in particle size to fit into the extraction apparatus for analysis of PCBs). Because of the onset of cold weather, additional sample locations were not selected to replace these abandoned locations.

Sediment samples from all 215 successful locations were analyzed for Aroclor PCBs via EPA M8082 and total organic carbon (TOC) via the Lloyd Kahn Method. EPA collected 25 split samples, including 2 field duplicates, and analyzed them for PCB congeners using EPA M1668c. Grain size distribution analysis was conducted by Alpha Analytical Inc. via ASTM Method D422-63 on all samples collected in fall 2016 regardless of whether the samples were analyzed for PCBs or not, for a total of 262 attempted locations during the 2016 sampling event.[6] Quality control (QC) samples were also collected for analysis. Automated electronic data verification and data validation (where necessary) were conducted upon sample collection and analysis.

Sampling inside the dredged areas was delayed due to the closure of the New York State Canal System locks for the winter season and weather-related safety concerns. This sampling resumed in

[6] Some sampling attempts resulted in retrieval of primarily coarser material with insufficient mass in particles smaller than 1 inch to be suitable for processing into sample jars for chemical analysis; however, the material was retained for grain size distribution analysis.

fall 2017; however, results are not yet available since certain laboratory sample processing protocols at the new laboratory are under review. It should be noted that EPA also required GE to collect an additional ~100 samples outside of the dredged areas in RS 3 based on variance observed in the data collected in 2016. These samples will also be analyzed once the sample processing protocol review is complete. These samples were added to meet EPA's sampling objective in the absence of the NYSDEC data. It is not anticipated that the results of these samples will change the evaluations in this memorandum.

1.2.2 2017 NYSDEC Sampling Program and Objectives

NYSDEC reviewed GE's EPA-approved 2016 Sediment Work Plan and asserted that the proposed sediment sampling plan was not sufficiently rigorous to determine whether the remedy was performing in a manner needed to reach the fish tissue concentration targets outlined in the ROD. NYSDEC recommended a more detailed approach, requiring on the order of 1,800 sample locations for each sampling event, to evaluate the remedy in the Upper Hudson River on a reach-by-reach basis. EPA's OM&M program was designed primarily to assess recovery rates in non-dredged areas at the level of the three river sections; thus, assessment on a reach-by-reach basis was not needed for this assessment, since GE's remedial design sampling rigorously pursued areas of elevated concentration. It was EPA's position that large areas of undiscovered contamination that would cause one reach to be markedly higher than others in the same river section would not have been missed by the remedial design sampling.

NYSDEC did not agree with EPA in this regard and chose instead to sample at a higher density, and in support of calculating reach-based averages. NYSDEC and its contractor, EA, prepared an OM&M Letter Work Plan for the supplemental OM&M activities in June 2017 (EA 2017) to complement the work required by EPA. The objectives of the NYSDEC supplemental sediment sampling activities were as follows:

- Conduct a survey of post-remedial surface sediment PCB concentrations to evaluate the performance of the remedy.
- Collect and analyze a sufficient number of samples to detect an 8 percent annual change in total PCBs in surface sediment in non-dredged areas over a 5-year timeframe with statistical power of 80 percent for each of eight river reaches.
- Establish baseline post-dredging concentrations of PCB in the Upper Hudson River to use as comparison points in determining estimated sediment recovery rates.

To meet these objectives, NYSDEC designed a sampling grid comprised of 1,673 locations, with approximately 200 sample points located in each reach. The grid was laid out with regular distances between points. The density of sampling (*e.g.,* samples per acre) varied by reach since the same number of points was used to characterize each reach but the reaches vary significantly in length. The use of a grid-based design provides an unbiased estimate of average surface concentrations consistent with the random design used by EPA. The main difference between the two programs is the spatial resolution. With a greater number of samples per reach and consistent spatial distribution, the NYSDEC data could potentially identify spatially extensive areas of elevated contamination.

Sediment sampling activities were carried out by EA from June 15 to August 31, 2017 utilizing three sampling vessels. Due to its focus on evaluating remedy effectiveness on a pool-by-pool basis, NYSDEC opted to structure its investigation approach according to the eight river reaches used historically to enumerate the pools formed above the various run-of-the-river dams spanning the Upper Hudson River. As described above, these reaches are encompassed by the three river sections used to structure the remedy determined by EPA (see Figure 1.1-1 and table in Section 1.1 above).

Samples were primarily collected using a modified Van Veen Sampler *(i.e.*, with a landing frame), as well as a ponar dredge sampler and an unmodified Van Veen sampler. A total of 1,687 locations (1,673 original proposed locations and 14 additional locations added based on field considerations) were proposed in dredged and non-dredged areas between Rogers Island and the Federal Dam in Troy. A total of 1,162 locations (1,089 main stem of the river, 59 in land cut areas, 9 in the Old Champlain Canal, and 5 in the Coveville inlet) were sampled, 472 locations were considered abandoned, and 53 locations were considered removed.[7] A total of 1,162 samples were analyzed for PCB Aroclors, TOC, grain size, and moisture content, while 10 percent of the samples were randomly selected for PCB congener analysis. QC samples were also collected. In an attempt to maintain comparability between the 2017 NYSDEC and the 2016 EPA/GE PCB results, NYSDEC contracted with the same analytical firm (Pace Analytical Services, LLC) used by GE to perform the PCB analyses by M8082 and M1668c.

Historically, GE has relied on another method (the modified Green Bay Method, or mGBM) to measure Tri+ PCBs directly and develop a conversion basis for the M8082 results. The mGBM analytical procedure was discontinued at the end of 2016 and is no longer available to the Hudson River project. In its place, NYSDEC had Pace Analytical Services analyze a subset of the samples (~10 percent) via EPA M1668c for the determination of Tri+ and Total PCBs. The analytical rigor of M1668c allows calibration to individual PCB congeners, while M8082 is calibrated to industrial mixtures of PCBs (*i.e.,* Aroclors) and thus approximates the PCB environmental mixtures.

The majority of post-ROD site data have been generated using M8082, in particular the SSAP data used for the design. When comparing data, consistency in analytical methods is important; thus, M8082 should be used for comparison to the pre-dredging benchmark created by the SSAP data. However, M1668c provides useful data in understanding the mixture of PCBs currently in the surface sediments and will be used to compare against future datasets which utilize M1668c.

In all of the following discussions except Section 3.3, the concentrations of Tri+ PCBs represent a value derived from the M8082 data, not a direct measurement of the Tri+ PCB congeners themselves. The Tri+ PCB value is calculated using the three Aroclors 1221, 1242 and 1254 that are primarily reported by the GE and NYSDEC laboratories. The formula to convert the Aroclor data to a Tri+ PCB estimate is:

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[7] The terms "abandoned" and "removed" in this context are further discussed in Section 2.

$$Tri + PCB = 0.13(Aroclor\ 1221) + 0.89(Aroclor 1242 + Aroclor\ 1254) \qquad \text{Eq. 1}$$

GE originally derived this formula as part of its remedial design sampling as a basis to convert M8082 Aroclor-based results to estimates of Tri+ PCB concentration consistent with mGBM, which was able to identify and quantify individual congeners. This basis for Tri+ PCB concentrations was the primary metric for the sediment criteria in the 2002 ROD. Throughout the design of the project the equation to convert to Tri+ PCBs was refined based on additional data collected. The equation presented above was finalized in 2011. Section A.3.1 of Attachment A reviews the most recent data available for M8082 and mGBM and confirms the relationship derived by GE. A revised basis to estimate Tri+ PCB concentrations from M8082 data was developed using the Method 1668c data obtained by NYSDEC in 2017. This analysis is described in Section A.3.2 of Attachment A.

2.0 Overview of Data Collected, Data Quality and Initial Observations

The EPA/GE and NYSDEC surface sediment sample data sets were evaluated, separately and as a combined data set, to determine the representativeness of the data, to establish the accuracy and precision of the data, and to assess whether the data met the established DQOs. Representativeness is a measure of how closely the data match the environmental conditions of the location at which the sample was collected. Accuracy measures agreement of the data with an accepted reference and is expressed as percent recovery. Errors in accuracy can be both field- and laboratory-related. Precision is expressed in relative percent difference (RPD) between duplicate measurements and is an estimate of reproducibility. This section describes the main conclusions regarding these matters. Additional detailed analyses regarding representativeness, accuracy and precision are provided in Attachment A, with the conclusions from those analyses included in this section.

2.1 Sampling Locations and Classifications

NYSDEC and EA utilized both the 2002-2005 SSAP data and the more recent 2016 EPA/GE OM&M data to develop a supplemental OM&M sampling plan. NYSDEC sample locations were chosen in a grid pattern in both dredged and non-dredged areas utilizing a randomized and unbiased sampling design. The proposed sampling locations shown in Figures 2.1-1a through 2.1-1t were chosen by NYSDEC according to a grid pattern and side-scan sonar (SSS) sediment type, and considered the locations previously sampled by EPA/GE in 2016; that is, the EPA/GE locations were not resampled by NYSDEC. The OM&M Letter Work Plan (EA, 2017) proposed a total of 1,673 surface sediment samples within River Reaches 1 through 8 in areas that were inside and outside dredged areas, including areas that have been backfilled and capped. During the field effort, an additional five sample locations were added in Reach 5 at Coveville, in an area previously thought to be non-navigable, and nine samples were added along the Old Champlain Canal for a total of 1,687 proposed locations. A gridded pattern was employed so that the simple arithmetic mean of the samples across a river reach (including data collected by GE) would yield an accurate approximation of the contamination level in the recoverable sediments. The grid pattern was generally complete through areas with cohesive sediment types like silt and sand. Areas with non-cohesive sediment types such as gravel had fewer collected samples, with the result that the grid is less complete in these areas, with gaps where samples could not be collected. Areas with an SSS classification of bedrock were generally not targeted for sampling.

Each location was classified by EA. However, to facilitate the calculation of area-weighted mean surface sediment concentrations, this classification approach was modified by Louis Berger to place each sample location in one of three categories: successful (also referred to as "recoverable sediments" throughout the document), abandoned, or removed. A location was classified as "successful" if there was sufficient sediment to recover, and a sample was collected, sent to the lab, and analyzed. Locations where access was limited (*e.g.*, areas exhibiting shallow water conditions that precluded sample collection or the presence of submerged aquatic vegetation [SAV], or debris), were classified together as "removed." If after 6 sampling attempts, a sample had insufficient sediment recovery or bedrock was encountered, the point was considered "abandoned." Figure 2.1-2 describes the successful, abandoned, and removed locations. Note that "abandoned" locations do not mean no data. These locations provide useful information on the nature of the river bottom and the likely level of the PCBs present. In particular, these locations are characterized by very coarse sediments (gravel or coarser) or bedrock. While the abandoned locations do not yield sediments than can be analyzed for PCBs, the information on sediment texture or the presence of bedrock informs us that the PCB concentrations are likely very low at these locations. This information is incorporated in the calculation of the area-weighted mean PCB concentration, which will be described in Section 3.2.

Based on EA's field notes from the sampling effort, descriptions of some locations were changed from abandoned to removed, or vice versa, for the purpose of this evaluation. These changes were also discussed with NYSDEC and EA in subsequent meetings and conference calls. Any unsuccessful sample location which had notes referencing the presence of SAV was classified as removed, while any sample referencing bedrock or no available substrate for sampling was classified as abandoned. Additionally, there were some locations with notes indicating the 100-feet (ft) sampling radius was probed and bedrock was encountered; these locations were classified as abandoned because sampling was unsuccessful due to the sediment type. Note that the "abandoned" locations are also referred to as "unrecoverable sediment" in this document.

As a result of these field conditions, 53 locations were classified as removed and 467 locations as abandoned within the eight river reaches, yielding a total of 1,089 successful surface sediment sample locations in the main stem of the river[8] (see Attachment A, Table A.1-1 for the summary of these location tallies). Figures 2.1-1a through 2.1-1t show the proposed, successful and abandoned sample locations, as well as Tri+ PCB concentrations across the eight reaches. Removed locations are displayed as "Proposed Location with No Attempts" in the figures.[9]

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[8] According to Table 4-1 Surface Weighted Average Concentrations by River Reach from the EA Data Summary Report (EA, 2018), there were a total of 1,368 samples collected from Reaches 1-8.

[9] The recoverable, removed and abandoned locations assignments from NYSDEC's gridded approach are very valuable to the OM&M going forward, because they allow for improved mapping of the river bottom. Improved mapping will allow for further refinement of future sampling locations and provide an opportunity to assess where the river bottom has changed since the SSAP sampling program.

There are 69 land cut and backwater data points, 5 of which were considered abandoned. The land cut and backwater sampling locations were not included in final sample counts used in the evaluation. Land cut areas are dug segments of the Champlain Canal outside of the mainstem of the river. These areas, as well as backwater areas, are not subject to the same hydrodynamic conditions as the mainstem of the river. Lacking the hydrodynamic conditions typical of the mainstem, they are unlikely to recover at the same rate as sediments in the main stem of the river, and so were excluded from the evaluation to avoid skewing assessment of time trends of the contamination in the main stem of the river. However, these areas still contribute to fish exposures and will be tracked and evaluated as part of the OM&M program. In addition to the land cut samples, a set of 9 samples along the Old Champlain Canal were likewise excluded from this analysis for the same reason. The Old Champlain Canal is located on the western bank of the Hudson River in Schuylerville near River Mile (RM) 181; while hydraulically connected (*i.e.*, there is water exchange), it is not hydrodynamically connected to the mainstem (*i.e.*, there is no direct relationship between water flow or velocities in the two water bodies).

Abandoned locations occurred in both dredged and non-dredged areas in each river reach but were more likely to occur in non-dredged areas. Locations with higher than average concentrations of PCBs were generally found in areas outside of the CUs. Less than 3 percent of locations within the CUs had higher than average concentrations of PCBs. Of that 3 percent, approximately 75 percent were in backfilled areas and 25 percent were in capped areas. A further examination of the sample locations, both successful and not, and the impact, if any, on the unbiased nature of the study, is included in Attachment A, Section A.1. Section A.1 describes how the 2017 NYSDEC sampling program was conducted and how the resulting data were categorized (removed, abandoned, or recovered). Categorization was based on whether sample collection was attempted or successful at each planned location while incorporating any additional information available from field notes taken during the sampling event. River Reaches 2 and 3 (in RS 3) have the highest proportion of abandoned locations to successful locations compared to the other six reaches, largely the result of their large areas of gravel and bedrock. The number of sample locations planned per river reach varied to reflect the anticipated variance of the data in each reach, based on previous data sets. Significantly fewer samples were planned and collected in River Reaches 6 and 7 (RS 2) compared to other reaches, based on the lower anticipated variance calculated for these reaches by NYSDEC.

EPA's classification and analysis of the various sampling locations results (recoverable sediment, abandoned and removed) is an important starting point in support of the subsequent analyses described in later sections of this report. While it will be important to track the concentrations of PCBs in recoverable sediments alone, the areas represented by abandoned and removed locations must be accounted for in calculating average fish exposures (area-weighted average PCB concentrations). It is essential that a consistent basis of comparison be established for analyses conducted in this report as well as in future evaluations of sediment data.

2.2 Analytical and Sampling Precision

Laboratory precision with respect to each of the PCB analytical methods (*i.e.*, Arocolor-based M8082 and congener-based M1668c) was assessed through a comparison of data from parent and field duplicate samples using statistical techniques. The assessments confirmed the precision of both analytical methods. A detailed discussion of the assessments and findings is presented in Attachment A, Section A.2. Section A.2 provides an analysis of the methodology and precision of the NYSDEC sampling program, including a comparison of the parent and duplicate sample pairs for the PCB Aroclors (M8082) and PCB Congeners (M1668c) analyses, as well as a comparison between the two methodologies. Total PCB concentrations were compared using RPD for each parent/field duplicate pair, based on the final (reportable) concentrations. The majority of sample pairs meet the targeted RPD threshold for M8082 analysis, yielding mean and median RPDs that are well below the State's criterion of 40 RPD. For M1668c data, 9 of the 14 pairs (i.e., 64 percent) show a precision of less than 40 RPD. The 14 sample pairs analyzed via PCB congener-based M1668c were also analyzed using Aroclor-based M8082; thus, a second metric is available for comparison, *i.e.,* RPD of matched pairs by both methods. RPD values were calculated using the M8082 results for Total PCB for the pairs with detections in all replicates of the sample. Results range from 5 to 86 RPD, with an average of 24 RPD. It appears that Method 8082 results for Total PCB are generally more precise than the M1668c results, although the median RPD values for samples analyzed by both methods met the target RPD criterion set by the State. Based on the observations made, EPA considers the data to be sufficiently precise to support the subsequent analyses performed in this memorandum.

2.3 Comparison of Sample Grain Size Distribution with SSS Texture

An analysis of SSS-based sediment texture and sample grain size distribution (particle size) data was performed for both the EPA/GE and NYSDEC surface sediment samples. The analysis examines the relationships between SSS sediment texture categories and 1) sample grain size results, 2) rates of abandoned sites, and 3) level of PCB contamination. A detailed discussion of the analysis can be found in Attachment A, Section A.4. The results in Section A.4 show that the NYSDEC samples in each SSS category contain a much higher frequency of coarse sand and a lower frequency of fine sand relative to the EPA/GE samples. Additionally, the SSS-based "Gravel" and "Bedrock" areas of RS 3 have a high number of abandoned locations. Across all three river sections, the "Silt" and "Silt and Sand" areas were sampled most successfully, with abandoned location rates less than 10 percent for both 2016 EPA/GE and 2017 NYSDEC sampling events. Lastly, variability of PCB levels within each sediment texture class was sufficiently large such that mean and median PCB levels agreed within uncertainty across textures in nearly all reaches. As a result, there was little correlation observed between sediment texture and PCB concentrations across sediment classifications. This is not surprising because although PCB concentration levels in sediment are known to be linked to sediment grain size, it is possible that any correlation between these variables has been affected by the removal of the highly contaminated fine-grained areas of the river bottom.

2.4 Assessment of TCMX Recovery on Sample Accuracy

During evaluation of the 2017 NYSDEC data, it was noted that 21 field samples and 2 duplicates had 2,4,5,6-Tetrachloro-Meta-Xylene (TCMX) surrogate recoveries in M8082 chromatography that were outside of the method control limits. Therefore, the PCB Aroclor results for those samples were qualified as estimated. Per the SW846 Method 8000 guideline, surrogate recovery data are used to evaluate and qualify the PCB Aroclor data, but not used directly to quantify PCB Aroclor concentrations. PCB Aroclor quantitation is accomplished by comparing the sample chromatogram to the most similar Aroclor standard to determine the pattern of peaks. However, in the 2017 NYSDEC dataset, there was an observed coincidence of TCMX recoveries and Aroclor 1221 detections when the TCMX recoveries were outside the control limits. TCMX is identified in the chromatogram with a retention time that occurs among the characteristic peaks used to quantify Aroclor 1221; however, the difference in retention time is wide enough to distinguish the TCMX surrogate peak from the Aroclor 1221 characteristic peaks. Therefore, it was concluded that the TCMX recoveries have no effect on the quantification of Aroclor 1221 and data from all 23 samples with the TCMX surrogate recovery nonconformance issue were used in the analyses presented in this memorandum. This is further explained in Attachment A, Section A.2.3.

2.5 Comparison of Aroclor and Congener-Based Analytical Results

As noted in Section 1.2.2, above, a means for conversion of PCB concentrations from an Aroclor basis to Total and Tri+ PCB concentrations was developed previously by GE using mGBM. Multiple conversion bases are required since estimates of both Tri+ PCBs and Total PCBs are needed from the Aroclor results. The development of the various conversions is described in Attachment A, Section A.3.1. While it had originally appeared that the conversion factors between GE's M8082 data and its mGBM data varied over time, further evaluation showed that the variation is due to the log-normal distribution of the data and the relatively small number of annual sample pairs. When the data are transformed into log-space, the conversion factors do not vary substantively by year. Moreover, a log-transform-based conversion incorporating all of the available matched pair data agreed closely with the results using GE's original conversion formula. Therefore, it is recommended that GE's original conversion formula continue to be used moving forward to estimate mGBM-based Tri+ PCB from M8082 (Aroclor-based) results.[10]

Since NYSDEC analyzed ten percent of the samples using both M8082 and M1668c, Total PCB measurements derived from both M8082 and M1668c were compared. Detailed analysis can be found in Attachment A, Section A.3.2. It was found that both Total PCB and Tri+ PCB concentrations derived from M1668c measurements were higher than those obtained by M8082. Based on the analyses, Total PCB by M1668c was approximately 55 percent higher than the sum of Aroclors based on M8082. Similarly, Tri+ PCBs by M1668c was approximately 35 percent higher than the sum of Aroclors 1242 and 1254 based on M8082.[11] Lastly, a conversion basis was needed to relate the M1668c results to the Tri+ PCB concentrations derived from M8082 (Aroclor-based) results using GE's original conversion formula. In this instance, Tri+ PCB concentrations by M1668c were approximately 44 percent higher than those estimated from M8082 by GE's original conversion formula.[12] M1668c provides a more robust basis than M8082 and mGBM to determine both Total PCB and Tri+ PCB concentrations. However, the long-term records of sediment and

[10] The mGBM-based estimates of Tri+ PCB were the basis for the removal criteria specified in the 2002 ROD.

[11] Aroclors 1242 and 1254 were taken to represent the Tri+ PCB component in a sample analysis by M8082. This is based on the congener distributions for these Aroclors and Aroclor 1221, which show that Aroclor 1221 contains very few Tri+ PCB congeners and represents little Tri+ PCB mass.

[12] Note that the estimates obtained by GE's original conversion formula represent most of the historical Tri+ PCB concentrations used in the ROD, remedial design and post-dredging sampling.

fish PCB levels are based on M8082. As a result, further evaluation and comparison of samples analyzed by both methods will be required during future sampling events.

3.0 What are the Hudson River surface sediment concentrations after dredging?

One of the major components of the selected remedy for the Upper Hudson River was to remove all PCB-contaminated sediments within areas targeted for remediation, with an anticipated residual of approximately 1 milligrams per kilogram (mg/kg) Tri+ PCBs (prior to backfilling) (USEPA, 2002). In 2017, questions regarding Upper Hudson River post-dredging PCB surface sediment concentrations were raised by NYSDEC, the federal natural resource trustees, and various other stakeholders through the public comment period for the FYR. According to NYSDEC, one of the primary motivations for NYSDEC's 2017 sampling effort was to evaluate the effectiveness of the remedy by determining PCB concentrations in surface sediments remaining after dredging. Thus, NYSDEC developed and implemented a sediment sampling plan designed to supplement and expand upon EPA-led sampling conducted in 2016 by GE. The resulting sediment data have been subjected to various statistical analyses to address the questions raised by these stakeholders.

Specifically, post-dredging surface sediment average (mean) Tri+ PCB and Total PCB concentrations within the Upper Hudson River were estimated for each river reach and river section using two sets of calculations. The first calculation method was a straightforward arithmetic mean of the recoverable surficial sediment sampling results by river reach and river section. The second calculation method applied was an area-weighted mean, which includes locations of bedrock and areas with unrecoverable sediment (*i.e.*, where sediment could not be obtained for analysis using the sampling approaches and devices available to the project). For most of the river reaches, the arithmetic mean concentrations for areas with recoverable sediment were less than 1.5 mg/kg of Tri+ PCBs. The area-weighted calculation, which provides a better approximation of concentrations across the entire bed of the river, yielded mean concentrations less than 1 mg/kg Tri+ PCBs for most of the reaches.

Before evaluating the data by the two different methods, it is helpful to review the PCB concentration for the individual surface sediment samples collected. Figures 3.0-1 and 3.0-2 show maps of the Upper Hudson River Tri+ and Total PCB concentrations, respectively. The Tri+ and Total PCB concentrations in Figures 3.0-1 and 3.0-2 were plotted with color gradation in half-log intervals. Each interval is approximately three times greater than the previous interval. In addition to the presentations in Figures 3.0-1 and 3.0-2, the data are also depicted relative to the ROD's long-term future MNA expectation of 0.25 mg/kg or less Tri+ PCB in the Thompson Island Pool (<0.25 mg/kg) and relative to the surface sediment dredging criteria (10 mg/kg Tri+ PCBs for RS 1 and 30 mg/kg Tri+ PCB for RS 2 and RS 3) in Figure 3.0-3. This figure is intended to facilitate the comparison of the PCB concentrations to the ROD-related thresholds. Note that the ROD's future MNA expectation was taken as < 0.25 mg/kg because the upstream load is expected to decline to a level of 0.0256 kg/day which yields a Tri+ PCB concentration on the suspended solids of about 0.25 mg/kg. This is described in the Responsiveness Summary to the Proposed Plan, White Paper 225353 - "Relationship Between PCB Concentrations in Surface Sediments and Upstream Sources"

(USEPA, 2002).[13] It is EPA expectation that the surface PCB concentration in RS 1 will not go far below the Tri+ PCB concentration on the solids entering the Thompson Island Pool.

A scatter plot was also created to evaluate how each of the individual samples are distributed with respect to the full data set. Figure 3.0-4 shows box and whiskers plots of the Tri+ PCB concentrations in the river (excluding the land cut areas and the Old Champlain Canal). Individual sample points were plotted in Figure 3.0-4 with blue and red dots indicating 2016 and 2017 samples, respectively. The surface sediment criteria for dredging are used to assess the effectiveness of the dredging. The plots include the dredging criteria (surface sediment Tri+ PCB thresholds) for RS 1 (10 mg/kg), RS 2 (30 mg/kg), and RS 3 (30 mg/kg). The number of points within each river reach is also indicated in the plot. With the exception of four locations found primarily in RS 1, concentrations found in most of the samples collected in 2016 and 2017 fall below the respective dredging criteria. This figure shows that the Tri+ PCB concentrations in the 0 to 2-inch layer lie below the dredging criteria for surface sediments in all river reaches.[14] In addition, over 99 percent of the surface sediment samples from Reaches 7 through 1 (*i.e.*, the reaches in RS 2 and RS 3) meet the more restrictive dredging criterion of 10 mg/kg, which was applicable only to RS 1. Figure 3.0-4 also shows that the EPA/GE and NYSDEC data appear to be equivalent in magnitude. The agreement between the data sets is further explored in the next section of this memorandum.

The distribution of individual PCB concentrations across the Upper Hudson was further explored in Figures 3.0-5 and 3.0-6. In Figure 3.0-5, the 2017 NYSDEC Tri+ PCB data for dredged areas were plotted against river mile and compared with the ROD's MNA expectation of less than 0.25 mg/kg Tri+ PCBs. With an overall median value of 0.26 mg/kg Tri+ PCBs, it can be concluded that nearly half of the dredged areas are below the ROD's MNA expectation. Also, this figure clearly illustrates the absence of substantive recontamination in the dredged areas, with an average Tri+ PCB concentration across all dredged areas of 0.75 mg/kg.

In Figure 3.0-6, the 2016 EPA/GE and 2017 NYDEC Tri+ PCB data for non-dredged areas are plotted against river mile. Like Figure 3.0-4, this presentation shows that in non-dredged areas in RS 1 and RS 2, only three and one locations, respectively, exceeded the river-section specific surface sediment removal criteria. The figure also shows that there are few exceedances of the RS 1 surface sediment criterion of 10 mg/kg Tri+ PCB in RS 2 and RS 3, indicating that the surface sediments in these river sections also meet the RS 1 criteria. Additionally, this figure shows the general declining trend of surface sediment Tri+ PCB concentrations with distance downstream. Lastly this figure shows that surface sediment concentrations decline downstream in a generally predictable fashion, with no river reach below Reach 7 appearing to be substantively elevated relative to its adjacent reaches.

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[13] The original text in the Responsiveness Summary White Paper referred to a Total PCB concentration of 0.25 mg/kg but should have been written as Tri+ PCB concentration.

[14] While the 0 to 2-inch samples collected by NYSDEC and GE largely fell below the surface sediment dredging criteria, the samples did not test the entire 0 to 12-inch interval that was the basis for the 2002 ROD.

3.1 Calculation of Surface Sediment Mean Concentrations of the Recoverable Sediments by River Reach and River Section

Post-dredging data show that the arithmetic means for locations with recoverable sediment for most of the river reaches are below 1.5 mg/kg Tri+ PCB. Average surface sediment concentrations were generated on a reach-by-reach basis and then combined to obtain the surface sediment average by river section. Initially, an arithmetic mean was calculated only for the successfully collected samples, ignoring any removed or abandoned locations. This calculation gives the mean concentration for areas with recoverable sediments. Tables 3.1-1 and 3.1-2 present the Total PCB and Tri+ PCB concentrations in recoverable surface sediment, respectively, and identify the number of samples collected in dredged areas (inside CUs[15]) and in non-dredged areas (outside the CUs), as well as the number of abandoned sample locations. These tables are organized by river section. Tables 3.1-3 and 3.1-4 present the same information, organized by river reach. The plots in Figures 3.1-1 and 3.1-2 show the mean Total PCB and mean Tri+ PCB concentrations, respectively, along with upper and lower confidence limits, as measured by M8082, for the recoverable sediment in non-dredged areas by river reach. These confidence limits are based solely on the variability of the individual sample results, representing plus or minus two standard errors on the mean value.

When the 2016 non-dredged areas data set is compared to the 2017 non-dredged areas data set, they are consistent with each other on a reach-by-reach basis, even though the range in the mean concentrations among reaches is substantial. For all reaches, the mean Total and Tri+ PCB concentrations of recoverable sediments for 2016 EPA/GE and 2017 NYSDEC data agree within statistical uncertainty, as shown by the overlapping error bars on the average concentrations for each reach in Figures 3.1-1 and 3.1-2. When examined on a river section basis, the average Tri+ PCB concentrations for recoverable sediments agree within statistical uncertainty in RS 1 and 3 but the NYSDEC average for RS 2, at 3.0 mg/kg Tri+ PCB is double that of the EPA/GE results (1.5 mg/kg Tri+ PCB). This difference was shown to be statistically significant and is largely due to the higher concentrations observed in Reach 7.

Unbiased sampling designs were achieved in different ways for the 2016 EPA/GE and 2017 NYSDEC sampling programs. The EPA/GE plan included 215 successful sample locations randomly spaced in 1-mile segments by river section. NYSDEC's plan included 1,687 planned gridded samples (1,089 successful sample locations) allotted among the eight reaches. Even though the two sampling program designs were very different, they still yielded the same result for mean recovered surface sediment, within uncertainty. Both sampling plans gave a representative unbiased sample set, notwithstanding the EPA/GE sampling program requiring fewer samples than NYSDEC's. The advantage to the NYSDEC sample set is that the larger number of samples generally yields less uncertainty in the final mean value. The agreement between the two data sets allows for the data to be combined for the subsequent analyses presented later in this memorandum.

The plots in Figures 3.1-3 and 3.1-4 show the mean Total PCB and mean Tri+ PCB concentrations, respectively, along with upper and lower confidence limits, as measured by M8082 for the

[15] CU refers to certification unit, one of the individual areas dredged by GE, each approximately 5 acres in size.

recoverable sediment in dredged areas only by river reach. Similar to Figure 3.0-2, these figures are based on NYSDEC data only, since the EPA/GE dredged area data from 2017 are not yet available. For additional reference, a line showing the ROD's MNA surface sediment expectation of less than 0.25 mg/kg Tri+ PCB is shown on Figure 3.1-4. It can be seen from this figure that the dredged areas in most reaches are close to this expectation.

In a similar manner, Figures 3.1-5 and 3.1-6 show the mean Total PCB and mean Tri+ PCB concentrations, respectively, for all compiled data from the 2016 EPA/GE and 2017 NYSDEC sampling events measured using M8082 by river reach from both dredged and non-dredged areas (inside and outside the CUs). These figures show that, in general, the overall concentrations of Tri+ PCB and Total PCB decrease from Reach 8 to Reach 1 (*i.e.*, from upstream to downstream) with a few exceptions. The peaks (in Reaches 3 and 7) are caused by a few isolated points with higher concentrations. In areas with recoverable sediment, the mean Tri+ PCB falls below 1.5 mg/kg for most of the river sections. This is above the post-dredging residual concentration of 1 mg/kg for Tri+ PCB, but it does not take into account the entire river bottom. The locations that were abandoned are more likely to have a lower concentration of Tri+ PCBs than the areas with recoverable sediment. Consideration of the abandoned locations in constructing area-weighted average concentrations is discussed in the next section of this memorandum.

3.2 Calculation of Area-weighted Mean Concentrations Representing Fish Exposure by River Reach and River Section

The mean PCB concentration in the recoverable sediments alone can give an estimate of surface sediment contamination that is potentially misleading. This approach, taken alone, does not represent the full range of sediment exposure conditions, since un-sampled areas such as abandoned locations, areas not targeted for sampling due to safety concerns, expanses of bedrock and cobble, and SAV beds are not accounted for in the calculation. These un-sampled areas, especially expanses of bedrock and cobble, do not tend to have very high levels of PCBs. Therefore, the mean PCB concentration in the recoverable sediments represents an upper bound estimate. Although the PCB concentrations of the un-sampled areas are not known, these areas need to be accounted for in estimating the overall average concentration and therefore some inferences and assumptions are required. Calculations of the area-weighted mean concentrations for the sampled and un-sampled areas are presented in this section. While the recoverable sediments mean concentration represents an upper bound estimate, the area-weighted mean concentration most likely represents a lower bound estimate and the actual mean concentration probably lies somewhere in between. Similar to the calculations described in Section 3.1 for recoverable sediments alone, analyses in this section exclude data from the land cut areas and the Old Champlain Canal.

As defined in Section 2, abandoned locations were those that presented no sediment from which to collect samples. From the field notes prepared by EA, comments regarding many of the abandoned locations include notes about encountering bedrock or cobble, substrates that could not be sampled. Removed locations were those that were inaccessible due to occurrence of conditions such as dense beds of submerged aquatic vegetation or swift currents.

To estimate the area-weighted means of Tri+ PCB and Total PCB concentrations for each reach or river section, the river bottom was broken down into five separate sediment categories as follows:

1. Bedrock (areas determined using the information from GE's 2002/2003 SSS classifications).
2. Recoverable and removed locations in dredged sediment areas. Concentrations for removed locations were assumed to be equivalent to those found in successfully sampled sediment, and the areas were grouped together using the same estimated mean concentration.
3. Non-recoverable dredged sediment (abandoned locations).
4. Recoverable and removed locations in non-dredged sediment areas. Again, concentrations for removed locations in these areas were assumed to be equivalent to those found in successfully sampled sediment, and the areas were grouped together.
5. Non-recoverable non-dredged sediment (abandoned locations).

Before discussing the area-weighted mean concentration calculations, it is important to understand the various terms used in approaching the exercise. As stated above, some areas and PCB concentrations are unknown, and inferences and assumptions are required. The table below lists the various sediment categories, the area term used for each category in the area-weighted mean concentration calculation, whether the area is known or unknown, and how it is treated in the calculation.

<table>
<tr><th colspan="6">Sediment Category and Area Information</th></tr>
<tr><th>Sediment Category No.</th><th>Sediment Category</th><th>Area Term used in the Equation</th><th colspan="2">State of the Area in the Sediment Category</th><th>Source of Information</th></tr>
<tr><td>1</td><td>Bedrock</td><td>A1</td><td colspan="2">Known</td><td>Directly identified in the GE 2002/2003 SSS Survey</td></tr>
<tr><td>2</td><td>Recoverable Dredged Sediment</td><td>A2</td><td>Unknown</td><td rowspan="2">Sum of A2+A3 is known since this is the total area dredged by GE</td><td rowspan="2">Estimated from sample data based on proportion of abandoned locations to total locations in dredged areas</td></tr>
<tr><td>3</td><td>Non-Recoverable Dredged Sediment</td><td>A3</td><td>Unknown</td></tr>
<tr><td>4</td><td>Recoverable Non-Dredged Sediment</td><td>A4</td><td>Unknown</td><td rowspan="2">Sum of A4+A5 is known by difference, total river bottom area less bedrock and dredged areas</td><td rowspan="2">Estimated from sample data based on proportion of abandoned locations to total locations in in non-dredged areas</td></tr>
<tr><td>5</td><td>Non-Recoverable Non-Dredged Sediment</td><td>A5</td><td>Unknown</td></tr>
</table>

Similarly, some of PCB concentrations are unknown and inferences and assumptions need to be made. The table below lists the status of knowledge of PCB concentrations by sediment category and what inferences or assumptions were made to estimate the unknown terms.

Sediment Category and Concentration Information				
Sediment Category No.	**Sediment Category**	**Concentration Term used in the Equation**	**State of the Concentration in the Sediment Category**	**Source of Information**
1	Bedrock	C1	Unknown	Assigned 0.03 mg/kg, one-half the median reporting limit for non-detect samples
2	Recoverable Dredged Sediment	C2	Known	Estimated from recoverable sediment data in dredged areas
3	Non-Recoverable Dredged Sediment	C3	Unknown	Assigned 0.03 mg/kg, one-half the median reporting limit for non-detect samples
4	Recoverable Non-Dredged Sediment	C4	Known	Estimated from recoverable sediment data in non-dredged areas
5	Non-Recoverable Non-Dredged Sediment	C5	Unknown	Assigned 0.03 mg/kg, one-half the median reporting limit for non-detect samples

A detailed explanation of the equations and parameters used in calculating the area-weighted mean PCB concentrations can be found in Attachment A, Section A.5. Section A.5 also presents a summary of the calculations themselves. Figure 3.2-1 presents the area-weighted mean Total PCB and the area-weighted mean Tri+ PCB surface sediment concentrations by river section. Included in the plot is the area-weighted mean (red circle) with an error bar equal to plus or minus two times the standard error. The standard error estimates presented in these figures integrate the uncertainties associated with three sources: 1) uncertainty in the extent of recoverable sediments; 2) the variation in PCB concentrations; and 3) uncertainty in PCB concentrations in un-sampled areas. The development of these uncertainty estimates, including necessary assumptions is further described in Attachment A, Section A.5.

For Tri+ PCBs, there is a fourth source of uncertainty arising from the conversion of the M8082 Aroclor results to Tri+ PCB estimates. As discussed in Section 3.3 below, this uncertainty is not substantive and has not been included in the calculation of the error bars. The same uncertainty estimation procedures are used in all of the reach-based presentations described below.

Figure 3.2-2 presents the area-weighted mean Tri+ PCB surface sediment concentrations by river reach. Figure 3.2-3 contrasts the mean Tri+ PCB surface sediment concentrations for recoverable sediment (blue symbols) with the area-weighted mean Tri+ PCB surface sediment concentrations by river reach (red symbols). Note that the uncertainty on the mean recoverable sediment concentration reflects PCB concentration variation only, since surface area is not used in estimating the mean. In a parallel manner, Figures 3.2-4 and 3.2-5 show the results for Total PCB by river reach.

In all reaches for both Tri+ and Total PCB concentrations, the area-weighed mean is lower than the mean of the recoverable sediment data, as expected, due to the incorporation of the non-recoverable and bedrock areas. The figures in this section give an estimate of the overall average surface sediment concentration after completion of the dredging by river reach. The concentrations of Tri+ PCB and Total PCB generally decrease from Reach 8 to Reach 1 (from upstream to downstream), with Reach 7 showing the highest average surface concentrations. Most of the reaches have a mean Tri+ PCB concentration less than 1 mg/kg and are in line with the modeled trajectory in the analysis conducted for the ROD.

Tables 3.2-1 and 3.2-2 present by river section the area-weighted mean Tri+ PCB and the area-weighted mean Total PCB surface sediment concentrations, respectively, and the corresponding number of samples. Similarly, Tables 3.2-3 and 3.2-4 present by river reach the area-weighted mean Tri+ PCB and the area-weighted mean Total PCB surface sediment concentrations, respectively, and the corresponding number of samples.

As is evident in Figures 3.2-3 and 3.2-5, consideration of the abandoned locations and bedrock areas has served to reduce the estimated average surface sediment concentrations in all reaches. The reduction is most pronounced in Reaches 2, 3 and 7 (see Attachment A, Section A.5 for detailed discussion). Reaches 2 and 3 have the highest ratio of abandoned location area to total area, and they have more abandoned and removed locations than successfully sampled locations. Reach 7 also has a large difference between the area-weighted mean PCB concentration and the recoverable sediment mean PCB concentration. Reach 7 has the highest recoverable sediment mean concentration. Reach 7 does not have many abandoned points; however, it does have a very high ratio of bedrock to all other sediment categories. The bottom in Reach 7 is over 30 percent bedrock, while in most of the other reaches it is less than 20 percent. Since the area-weighted mean accounts for bedrock areas, their addition made the area-weighted mean lower, roughly in proportion to the fraction of area identified as bedrock.[16] It is EPA's intention to track future sediment PCB concentrations on both a recoverable sediment average and an area-weighted average basis.

[16] Note that these area-weighted means integrate across all river bottom surfaces and form the basis for long-term monitoring of surface sediment concentrations under MNR. These area-weighted means are not directly comparable to those derived for the ROD since bedrock areas were not included in the sediment trajectories for RS 1 and RS 2, and no data were available to identify bedrock areas in RS 3 at the time of the ROD.

Based on analyses presented above, the current mean Tri+ PCB surface sediment concentrations in the Upper Hudson River is 0.75 mg/kg in the dredged areas for the recoverable sediments. This value represents a significant reduction in mean Tri+ PCB surface sediment concentration throughout the Upper Hudson River when compared with pre-dredging Tri+ PCB surface sediment concentration and is lower than previous estimates of the area-weighted surface sediment concentrations anticipated immediately following the completion of dredging and backfill (or capping). Estimates of surface sediment concentrations anticipated immediately following the completion of dredging and backfill (or capping) were presented in the 2012 FYR and Appendix 4 of the FYR Report (USEPA, 2012; 2019).

Immediately following dredging and backfill (or capping), it was estimated that the surface sediment concentrations in dredged and backfilled areas would average 0.25 mg/kg Tri+ PCB. Due to the hydrodynamics of the Upper Hudson River, it was anticipated that the transport and redistribution of sediment would act to both transport clean backfill material to areas that were not dredged, but also transport some sediment from areas not dredged to areas that were dredged. Thus, calculation of estimated and actual post-dredging pool-wide surface sediment concentrations were based on area-weighted averages that included both dredged and non-dredged areas.

In the 2012 FYR, post-dredging surface sediment concentrations were estimated using the SSAP surface sediment results for non-dredged areas, and were assumed to be 0.25 mg/kg Tri+ PCB surface sediment concentrations in dredged areas.[17] The resulting calculated area-weighted average Tri+ PCB surface sediment concentrations were 1.9 mg/kg, 7.1 mg/kg and 3.1 mg/kg in RS 1, 2 and 3, respectively (Table 1 of Appendix A in the 2012 FYR Report). Following completion of dredging activities, the 2016 OM&M sediment sampling survey conducted by EPA/GE was used to update these estimates, yielding area-weighted average surface sediment concentration that are lower than anticipated (0.77 mg/kg, 1.34 mg/kg and 0.83 mg/kg in RS 1, 2 and 3, respectively; see Table A4-5 of Appendix 4 in this FYR). The more exhaustive post-dredging surface sediment survey conducted by NYSDEC found comparable low area-weighted concentrations for Tri+ PCB surface sediment concentration (0.95 mg/kg, 1.3 mg/kg and 0.53 mg/kg in RS 1, 2 and 3, respectively (Table 3.2-1), supporting the results of the 2016 EPA/GE OM&M survey.

These results indicated that even with the anticipated redistribution of sediments in the Upper Hudson River during and after dredging, current Tri+ PCB surface sediment concentrations are substantially below the calculated post-dredging area weighted surface sediment concentrations (from the 2012 FYR Report) which was estimated with data collected prior to dredging and did not account for continued natural recovery. The new data highlights the effectiveness of the remedy. It should be noted that following PCB source controls implemented at the former GE facilities, Tri+ PCB concentrations in suspended sediment entering the Upper Hudson River from upstream were estimated to be approximately 0.25 mg/kg as discussed in Section 3.0. Given that this value is lower than current surface sediment concentrations, and the water column concentrations entering the site are below those anticipated at the time of the ROD, it is expected that over time surface sediment

[17] Concentrations in dredged areas were assumed to be 0.25 mg/kg because dredging was still ongoing when the 2012 FYR Report was published.

concentrations will continue to decline as a result of introduction of relatively cleaner sediments transported through the surface water from the upstream boundary above Rogers Island.

3.3 Estimating Uncertainty in Area-weighted Mean Tri+ PCB Concentrations

As noted in the Introduction and in Section 2.5 above, the Tri+ PCB concentrations employed throughout the Remedial Design were obtained from the M8082 results using the conversion formula developed by GE during the Remedial Action phase of the project (Eq. 1, repeated below).

$$Tri + PCB = 0.13(Aroclor\ 1221) + 0.89(Aroclor 1242 + Aroclor\ 1254) \qquad \text{Eq. 1}$$

In calculating the Tri+ PCB average values for recoverable sediments and for the area-weighted average, this formula (Eq. 1) was applied to each individual sample. The estimated Tri+ PCB values were subsequently treated as if they were direct measures of Tri+ PCBs. Generally speaking, uncertainty in the conversion equation is expected to increase uncertainty in estimates of mean Tri+ PCB relative to what would be expected if actual measurements were available. To understand the relative importance of uncertainty in the conversion equation in comparison to other sources of uncertainty, an estimate of, sampling variance explicitly including this variance component was developed, and the proportion of variance due to the regression components was estimated.

The estimating equation for Tri+ PCB representative of areas where sampling was attempted is composed of sums and products of terms representing three components: 1) Aroclor 1221 and the sum of Aroclor 1242 and Aroclor 1254 concentrations; 2) the proportion of surface area where sediments were recoverable; and 3) the regression coefficients converting Aroclors to Tri+ PCB concentrations:

$$\overline{Tri+\ PCB} = \hat{P} \times avg\left(\hat{\beta}_1 \times (Aroclor\ 1221) + \hat{\beta}_2 \times (Aroclor\ 1242 + Aroclor\ 1254)\right) + \left(1 - \hat{P}\right) \times (Tri + PCB_{No\ Sediment}) \qquad \text{Eq. 2}$$

Where: $\hat{P}$ is the proportion of river bottom surface area with recoverable sediment,
$\hat{\beta}_1$ and $\hat{\beta}_2$ are the regression coefficients used in converting from Aroclors to Tri+ PCB,
Aroclor 1221, and Aroclor 1242 +Aroclor 1254 are the reported individual concentrations,
$Tri + PCB_{No\ Sediment}$ is the concentration assigned to areas with no recoverable sediment,
"avg( )" indicates the arithmetic average of the term in parentheses.

The equation can be implemented by first averaging the individual Aroclor data on a river section or river reach basis (*e.g.*, average Aroclor 1242+Aroclor 1254 for RS 1) and then converting these averages to Tri+ PCB, or by converting each individual sample measurement to Tri+ PCB and then averaging by river section or river reach. Either approach results in identical estimates of mean Tri+ PCB, each with the same sampling variance. Although the sampling variance is identical regardless of the order of operations, there may be reasons unrelated to statistics to prefer one order of operations over the other. In each case, the sampling variance is identical, but as with the estimated mean itself, it is also possible to estimate the sampling variance in more than one way, usually with the same order of operations used to estimate the mean itself.

To investigate the relative importance of the variance components, a statistical method based on a Taylor expansion (Casella and Berger, 1990, p. 328) was used to construct the variance estimator and it was found that the variance is composed of a sum of three independent terms, the first involving covariance of the Eq. 1 regression coefficients; the second involving covariance of the Aroclor concentrations and the third involving the variance of $\hat{P}$. The formulas are somewhat complicated, so the potential to simplify them was investigated. It was found that with over 440 pairs of samples supporting the regression equation (Eq. 1) the variance associated with the regression coefficients was less than 1 percent of the total variance. Because the standard error varies with the square root of the variance, the contribution to the standard error would be less than 0.5 percent of the error estimate. This very minor contribution to the variance and standard error allows the regression coefficients to be treated as known constants in the variance estimate for Tri+ PCBs. This simplification substantively reduced the level of effort to develop spreadsheet calculations of means and variances needed for the multiple sets of confidence intervals provided within this report and discussed further in Attachment A.

With this simplifying assumption and noting that the Aroclors can be converted to Tri+ PCB at the sample level or after averaging them, the estimating equation can be expressed in simplified form:

$$\overline{Tri+\ PCB} = \hat{P} \times \overline{Tri + PCB}_{Recoverable\ Sediment} + \left(1 - \hat{P}\right) \times \left(\overline{Tri + PCB}_{No\ Sediment}\right)$$

Eq. 3

and known formulas for variances of sums and products of random variables (Goodman, 1960) are used to calculate the variance and subsequently confidence limits (Attachment A). This approach is the basis for the error bars presented for area-weighted average concentrations presented in Figures 3.2-1 to 3.2-5.

3.4 Summary of Post-Dredging Surface Sediment Concentrations

For most reaches, Tri+ PCB surface sediment concentrations are well below the ROD dredging criteria. In a scatter plot comparison of individual samples across all 8 river reaches, greater than 99 percent of the locations fall below the surface sediment dredging criteria prescribed for the various river sections; and most locations meet the more restrictive dredging criterion of 10 mg/kg, which was applicable only to RS 1. Both the arithmetic averages of the recoverable sediment locations and the area-weighted averages for each reach, indicate that the concentration of Total PCB and Tri+ PCB generally decline from Reach 8 to Reach 1 (from upstream to downstream), with Reach 7 showing a local maximum. The arithmetic mean of recoverable sediment locations shows that most of the reaches have a mean Tri+ PCB concentration less than 2 mg/kg. The area-weighted mean gives a better picture of the contamination levels for the entire river including bedrock areas and areas with non-recoverable sediment. Most of the reaches have a Tri+ PCB concentration less than 1 mg/kg and are at or approaching the ROD's MNA expectation of 0.25 mg/kg Tri+ PCB or less in the downstream-most reaches.

4.0 What is the Pace of Recovery of the Upper Hudson River Sediments after Dredging?

In public comments regarding the FYR Report, federal trustees and various other interested stakeholders raised concerns regarding the pace of recovery of the Upper Hudson River sediments after dredging. There have been questions as to whether the active dredging required by the remedy was sufficient to allow the post-dredging pace of recovery to meet the rates predicted in the 2002 ROD. The post-dredging sediment sampling data collected by NYSDEC have been assessed, in combination with the 2016 EPA/GE OM&M sediment data, to improve the understanding of the system, as well as to further evaluate the effectiveness of the remedy.

As stated in Section 1 of this report, one of the objectives of the overall long-term OM&M program is to determine sediment recovery rates in the non-dredged areas of the Upper Hudson River. The focus in the OM&M program is on the non-dredged areas because surfaces inside the dredged areas (i.e., CUs) were backfilled or capped, and therefore are close to or at the ROD's MNA expectation of 0.25 mg/kg or less Tri+ PCBs. Although, under the OM&M program, the sediment recovery rates are not required to be calculated from the dredged areas, the OM&M SOW requires examination of the changes to surface PCB concentrations in backfilled and capped areas. At the time of the ROD, sediment recovery rates were predicted to be on the order of 8 percent per year. To date, the 2016 EPA/GE and 2017 NYSDEC sediment data are available, and it is useful to evaluate the pace of recovery based on the new data.

Given differences over time in sampling program design,[18] chemical analytical methods and sample collection methods (cores vs. surface grab samples), the sediment recovery rates are presented for two overlapping time periods ending in 2017: (1) examination of the sediment recovery rate starting with data from the SSAP program (2002-2005) through data collected under the Downstream Deposition Study (DDS) program in 2011/2013, and (2) development of a simple recovery rate using the entire available surface sediment data record from 1976 to 2013. The recovery rate was examined two ways because depending on which sediment sampling events were used, a wide range of annual rates of change was obtained as discussed in Appendix 4 of the FYR Report. As described in Appendix 4, these rates can vary from a decline of more than 18 percent per year to an increase of more than 9 percent per year. As a result, the first approach focuses on the two most recent and spatially extensive surveys (the 2002 to 2005 SSAP data and the 2016/2017 OM&M data). However, recognizing that survey selection can strongly affect the rate of decline estimate, the second approach (*i.e.,* simple trend analysis using the entire set of available surface sediment data from 1976 to 2013) was developed. As part of this approach, the 2016/2017 post-dredging average surface sediment concentrations are compared to the surface sediment trajectory based on the 1976 to 2013 empirical time trend.

[18] Different sampling program designs have been developed over the history of site investigations, resulting in differing DQOs for the resulting data sets, and posing challenges when comparing one data set to another.

4.1 Examination of Sediment Trend through Time since the SSAP Program (2002-2005)

Analysis of temporal trends in surface sediment from sediment survey sample pairs is presented in Appendix 4 of the FYR Report. As stated in Appendix 4, the calculated sediment recovery rates vary depending on the sediment sample pairs used, due to limitations in comparability among the data sets. Each data set has unique features, such as variability in methods of sample collection, chemical analysis, and handling that make direct comparisons potentially uncertain. Detailed description of each data set can be found in the aforementioned Appendix 4, Section 2. Figure 4.1-1 presents the estimated mean Tri+ PCB concentration for sediments in RS 1 from six different surveys. Mean Tri+ PCB concentrations for both dredged (filled circle symbol) and non-dredged (open circle symbol) areas, as well as area-weighted (filled diamond symbol) are plotted in Figure 4.1-1.

In preparing the data for this figure, the various data sets were assembled to create the equivalent of area-weighted averages of the surface sediments in RS 1 to the extent possible. This approach was taken to maximize the comparability of the historical data with the recent (2016 and 2017) data sets. That is, the most recent studies were specifically designed to estimate average surface sediment concentrations on a river wide basis, integrating dredged areas, non-dredged areas and bedrock. To assess changes over time to the present, the historical data sets were compiled to estimate sediment concentrations in these same domains, and area-weighted when appropriate, to yield similarly constructed river-wide averages. Figure 4.1-1 presents the results for RS 1, the area of the river with the most extensive and longest series of sediment surveys. This approach reflects a refinement of previous presentations of RS 1 data (*e.g.,* the FYR Report), which included medians or simple arithmetic averages of the data or attempted to track PCB levels in a single sediment type (*e.g.,* fine-grained sediments) over time.

To this end, the 1991 and 1998 GE survey data were compiled as arithmetic averages of surface sediment composite sample concentrations for the respective years, reflecting the fact that these data cannot be separated into dredged and non-dredged areas. These data are represented by squares and do not use the circle symbols described above. The SSAP data are represented by the filled and open symbols as well as by a diamond. In this instance the diamond represents an area-weighted average of the data from dredged and non-dredged areas, also integrating the contribution from bedrock. Bedrock was assumed to have an average surface concentration of less than 0.03 mg/kg Tri+ PCB for this calculation (based on the analysis done for this memorandum), although the area-weighted average is not very sensitive to this assumption since the bedrock constitutes a small percentage of the overall area of RS 1. The 2016-2017 data were also combined as an area-weighted average incorporating bedrock as well. This average is also represented as a diamond, plotted midway between 2016 and 2017 on the horizontal axis. Notably, this area-weighted average incorporates the large decline in the dredged area surface concentrations due to the remedy.[19]

[19] An area-weighted average could not be constructed for the 2011 DDS data due to their limited spatial coverage. They are shown in Figure 4.1-1 for completeness.

Based on the data, non-dredged areas decreased by slightly more than 50 percent since the SSAP program. The Tri+ PCB concentrations in the dredged areas have decreased markedly (more than 90 percent) as a result of dredging, with a mean surface sediment concentration under 1 mg/kg Tri+ PCB. The weighted average Tri+ PCB concentrations for RS 1 (accounting for dredged, non-dredged and bedrock areas) have also decreased more than 90 percent.

4.2 Simple Sediment Trend Analysis

Appendix 4 of the FYR Report presented a simple sediment trend analysis for surface sediment data covering the 40-year period from 1976 to 2016. This simple trend analysis was performed to overcome the apparent limitations of temporal analysis of multiple rounds of sediment data collection, as described in Appendix 4, Section 3. In the evaluation for this memorandum, the 2017 NYSDEC surface sediment data were added to the simple trend plots presented in Appendix 4 (see Figure 4.2-1). The 1976 to 2013 trends were compared with recently collected data (2016 and 2017), for an assessment of current surface PCB concentrations relative to what might have been expected from the trend line obtained from data in the absence of the remedy (1976 to 2013 data). For cohesive sediments, Tri+ PCBs declined on average by 5, 7, and 7 percent per year in RS 1, RS 2 and RS 3, respectively, through 2013. Confidence bounds were markedly similar for each river section, with upper confidence limits of about 10 percent and lower confidence limits of about 3 percent (see Appendix 4, Table A4-4). These rates are generally consistent with the approximately 8 percent decay rate simulated by EPA's HUDTOX model for the pre-dredging period at the time of development of the ROD.

The estimated means and confidence limits for data collected in 2016 (non-dredged areas only) and 2017 (both dredged and non-dredged areas) were overlain on the plots to compare them with what might have been expected based on the empirical trends. Note that in RS 1, almost all sediment in the area classified as cohesive was dredged. Therefore, it is expected that the mean Tri+ PCB concentrations of the 2017 data fall below the empirical trend line 95% confidence bands. Since the 2016 samples were collected in the non-dredged areas and only 6 samples fall in the cohesive area, the 2016 data are not plotted in Figure 4.2-1a. For RS 2, the 2016 and 2017 data also plotted below the empirical trend line 95% confidence bands, suggesting that negative effects of resuspension and redeposition on surface sediment concentrations were not in evidence and may have been minimal (Figures 4.2-1c and d). For RS 3, the 2016 and 2017 data plotted within the empirical trend line 95% confidence limit as expected, since this section had only minor dredging (Figures 4.2-1e and f).

In summary, both approaches to estimate the recovery rates produce results that show the sensitivity of estimates of temporal change to variability in methods of sample collection, analysis, and handling, which are unavoidable. This is evidenced by the wide range of recovery rate estimates, depending on which sediment survey pair is considered. However, based on measured Tri+ PCB concentrations by both EPA/GE and NYSDEC in 2016 and 2017, as well as the series of surface sediment measurements extending back to 1976, there is evidence of natural recovery occurring in surface sediments in all three sections of the Upper Hudson River. Furthermore, Tri+ PCB concentrations measured in 2016 and 2017 appear to be at or below levels that would be predicted by these empirical recovery time trends. Despite the larger number of samples collected by

NYSDEC in 2017 compared to the samples collected by EPA/GE in 2016, the calculated mean concentrations are comparable and yield a similar rate of recovery.

5.0 Do "Hot Spots" Remain in the Upper Hudson River Based on the Available Surface Sediment Data?

Hot spots were initially defined as areas with a Total PCB concentration exceeding 50 mg/kg (Tofflemire and Quinn, 1979 and USEPA, 2002). The remedy selected for the Upper Hudson River targeted sediments for dredging based primarily on a mass per unit area (MPA) of 3 g/m^2 Tri+ PCBs or greater for RS 1, MPA of 10 g/m^2 for RS 2 and high concentrations of PCBs and high erosional potential (NYSDEC Hot Spots 36, 37, and the southern portion of 39) from RS 3. In the transition from the remedial action to OM&M, a contemporaneous measure of remedy effectiveness is to consider whether surface sediments with elevated and bioavailable PCBs remain in the Upper Hudson River. For the purpose of this discussion, the possible presence of hot spots is evaluated by three different approaches. First, the EPA examined the distribution of locations in excess of the surface sediment dredging criteria specified in the ROD (*i.e.*, 10 mg/kg Tri+ PCB for RS 1 and 30 mg/kg Tri+ PCB for RS 2 and RS 3). Second, the EPA examined the number and distributions of locations in excess of the original hot spot definition of 50 mg/kg Total PCB concentration. Third, the EPA examined the spatial distribution of the Tri+ PCB concentrations using statistical tools to identify areas that were substantively higher than the average levels of Tri+ PCBs in the river and assess whether these areas could be construed as "hot spots." In order to make this assessment, the combined 2016 and 2017 surface sediment data were evaluated using statistical and geostatistical tools. The results from each of these approaches are discussed below. Notably, the results indicate no substantive exceedances of the ROD or "hot spot" criteria, and only two areas with locally elevated concentrations that may need further assessment.

5.1 Are There Sediments Remaining that Exceed the Dredging Criteria for Their Respective River Sections?

To assess areas or locations that might exceed dredging criteria, the Tri+ PCB concentration for each river reach along with the surface sediment concentration dredging criteria (black line) were plotted (Figures 3.0-43.0-5 and 3.0-6). Since these surface concentrations, along with the MPA values for specific river sections, were used to determine whether an area needed to be dredged or not, exceedance of these values can be explored for evidence of potential hot spots. These figures indicate that there are only four samples (three from the 2017 dataset and one from 2016 dataset) that exceed river section-specific surface sediment dredging criteria. Table 5.1-1 summarizes the samples with elevated PCB concentration, along with the areas of interest based on the "hot spot" analysis which will be discussed later in Section 5.3.

There are two 2017 samples and one 2016 sample that exceed the 10 mg/kg Tri+ PCB criterion in RS 1. The samples are all located within non-dredged areas near the norther end of RS 1 (Figures 5.1-1 and 5.1-2). None of these locations exhibited concentrations more than twice the dredging threshold (maximum was 17.2 mg/kg Tri+ PCB) and two of the three are within measurement error of the threshold (values of 10.6 and 10.5 mg/kg Tri+ PCB) (Table 5.1-1). In each instance, the location with the elevated values is surrounded by measurements at much lower concentrations. An isolated sample with a higher concentration does not, by itself, denote a hot spot; it must be kept in mind that there were known areas of higher concentration along the shoreline, adjacent to structures, and isolated from significant PCB deposits that were excluded from targeting for dredging. All offsets, including those for engineering, safety and cultural resources purposes, were reviewed and approved by EPA in consultation with NYSDEC.

A fourth sample (HR17-OU2-R7-050) representing a similar exceedance is located in RS 2/Reach 7 along the north shore of Galusha Island, a small island near RM 187 (Figure 5.1-3). The result for this sample just marginally exceeds the 30 mg/kg threshold with a Tri+ PCB concentration of 31.1 mg/kg. In addition to exceeding the Tri+ PCB dredging thresholds, the result for this sample (HR17-OU2-R7-050) exceeded the NYSDEC Total PCB 50 mg/kg threshold for a "hot spot," at 58.8 mg/kg Total PCB (Table 5.1-1). The area surrounding this sample location was previously identified as one of the 40 NYSDEC-identified hot spots (*i.e.*, Hot Spot 25). It is possible that this location may have simply been "missed" as it only lies about 6 ft outside targeted dredging area CU-63. This could be a rare case where the CU boundary should have extended a bit farther. However, a review of data collected during dredging suggests that this location was previously indicated as falling on land (*i.e.*, on Galusha Island). Thus, it is possible that this area was originally not targeted for dredging due to the location of this island's shoreline and its role in defining the limits of work required under the remedial action. It is also possible that in the years since dredging the upstream side of the island's shoreline shifted such that this point was no longer on land, or that conditions were sufficiently different during data collection to allow the 2017 NYSDEC sampling vessel to access an area that was previously inaccessible. Note that sample HR17-OU2-R7-041 is noted in Figure 5.1-3 as exceeding a threshold; while the Tri+ PCB concentration of 21.6 mg/kg did not exceed the 30 mg/kg dredging criterion, the Total PCB concentration of this sample is 60.9 mg/kg, which is greater than 50 mg/kg (see also Table 5.1-1 and below for further discussion). This location is more than 500 ft distance from the other elevated location in this area, and both locations are surrounded by low level sediment Tri+ PCB concentrations that fall below both the RS 2 and the RS 1 removal criteria. sampling locations. Thus, neither location can be construed as a hot spot based on the removal criteria.

When this Total PCB-based definition was also applied to the entire data set, a total of four samples with Total PCB concentration exceeding 50 mg/kg were identified. In addition to the two exceedances previously identified near Galusha Island (HR17-OU2-R7-050 at 58.8 mg/kg Total PCB and HR17-OU2-R7-041 at 60.9 mg/kg Total PCB), two other samples in RS 3, Reaches 4 and 3 (HR17-OU2-R4-060, and OCU-RS3-8079-202), were identified with Total PCB concentrations of 67.1, and 57 [20] mg/kg, respectively (Table 5.1-1).

The first of these, HR17-OU2-R4-060, exhibits the highest Total PCB concentration in the 2017 NYSDEC dataset (Total PCB=67.1 mg/kg) (left panel of Figure 5.1-4). This sample was collected north of the Upper Mechanicville Dam in RS 3/Reach 4 but was spatially isolated from other

[20] Note that the electronic data deliverables (EDDs) for NYSDEC's and GE's sample results report different levels of precision; in this case, GE reports this value as a whole number.

samples with elevated concentrations. Most importantly, the Tri+ PCB concentration (24.2 mg/kg) is below the RS 3 dredging threshold; thus, the location only exceeded the Total PCB threshold, and would not have been specifically targeted for removal under the ROD. Again, since this is an isolated sample, it does not qualify as a hot spot. In fact, all the surrounding concentrations from nearby 2017 NYSDEC and 2016 GE sediment samples are less than 10 mg/kg Tri+ PCB (right panel of Figure 5.1-4). Without a cluster of samples with elevated PCB concentrations, a location cannot be deemed a hot spot.

The remaining location in excess of 50 mg/kg Total PCB is a 2016 sample (OCU-RS3-8079-202), located in RS 3/Reach 5 near RM 179, that showed a Total PCB concentration of 57 mg/kg (left panel of Figure 5.1-5). Its Tri+ PCB concentration is 23.4 mg/kg, which does not exceed the Tri+ PCB dredging criterion (right panel of Figure 5.1-5 and Table 5.1-1). The surrounding samples in this area all yielded Total PCB concentrations less than 3 mg/kg and Tri+ PCB concentrations less than 1 mg/kg.

Based on these analyses, it is evident that the remedial dredging program was successful in removing nearly all areas of elevated surface sediments PCB levels based on the ROD criteria. The four locations found to exceed these criteria were generally isolated and did not greatly exceed the criteria. These represent 4 out of 1,818 occupied main stem locations,[21] about 0.2 percent of the locations, indicating that 99.8 percent of all occupied locations either fell below the dredging criteria or had no recoverable sediment. Notably, only 11 of the 1,818 locations exceeded the RS 1 criterion of 10 mg/kg Tri+ PCB, indicating that 99.4 percent of all locations were below the dredging criteria or had no recoverable sediment. For RS 2 and RS 3, only 8 of the 1,570 locations exceeded the RS 1 criterion of 10 mg/kg Tri+ PCB, indicating that 99.5 percent of all locations were below the RS 1 surface sediment dredging criterion. The application of the original NYSDEC "hot spot" criterion of 50 mg/kg Total PCB also indicated the success of the removal effort, with only 4 locations identified above this criterion, out of 1,818 main stem locations, and most of these still fell below the ROD's surface sediment Tri+ PCB dredging criterion applicable to the respective river section.

5.2 Identification of Areas That are Statistically Significantly Higher in Concentrations than the Average

A geostatistical "Optimized Hot Spot Analysis" tool in ArcGIS was used to identify statistically significant spatial clusters of high Tri+ PCB concentrations higher than the average for the combined 2016 and 2017 surface sediment data for a specified search radius. This tool works by examining each sample within the context of neighboring samples. A sample with a high value may be noteworthy but may not indicate a statistically significant hot spot; such classification requires that a high Tri+ PCB concentration be affirmed by the presence of similarly elevated, or at least somewhat elevated samples in its neighborhood. The local mean for a sample and its neighbors is compared to the mean of all samples; when the local mean is very different from the expected local

[21] An occupied location is defined as either a recoverable sediment sampling location or an abandoned sampling location, based on the definitions of these terms given in Section 2. Removed locations are not included in the total of occupied locations.

mean, and when that difference is too large to be the result of random chance, a statistically significant z-score[22] results (ArcGIS, 2018). Areas exhibiting statistically significant z-scores using this approach are referred to as hot spots by the ArcGIS tool. However, since ArcGIS results do not have specific thresholds and reported relative values, these areas are referred to as "areas of interest" in this document. A search radius of 250 ft was used in this analysis.[23]

Figure 5.2-1 presents the results of the ArcView analysis. Each location was tagged by the ArcView tool, identifying it as statistically significantly different from the surrounding locations or not (within a 95% confidence interval). The results are shown by the small symbol at the center of each locations. The Tri+ PCB concentrations were also plotted in the figure as larger circles for 2017 data and as squares for the 2016 data. Samples that are statistically significantly higher than the surrounding area are indicated with a red dot at the center and the ones that are statistically significantly lower are indicated with a blue dot inside the larger circles or squares. Note that the hot spot analysis tool may also identify "cold spots", or clusters of points with statistically significantly lower concentrations than their neighbors, but none were observed based on the combined 2016 and 2017 surface sediment data. Samples that are not statistically significantly different than their neighbors are identified with a yellow center dot. It can be seen from Figure 5.2-1 that most areas fit this latter description, with the occasional individual "hot" point. Three areas of interest (with statistically elevated PCB concentrations) were identified by the tool as follows:

1. near Galusha Island between RM 188 and 187 in RS 2/Reach 7 (Figure 5.2-1 – Sheet 4)
2. near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4 (Figure 5.2-1 – Sheet 14)
3. near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3 (Figure 5.2-1 – Sheet 15)

These areas are discussed in detail in Section 5.3 below.

5.3 Examination of the Areas of Interest

The first area of interest is near Galusha Island, in RS 2/Reach 7 between RM 188 and 187 (Figure 5.2-1 – Sheet 4 and Table 5.1-1). This location is consistent with the previous observation discussed in Section 5.1, where there are two samples with either Tri+ PCB or Total PCB threshold exceedances (HR17-OU2-R7-050 and HR17-OU2-R7-041). Only one of these samples showed a Tri+ PCB concentration greater than 30 mg/kg (HR17-OU2-R7-050, Tri+ PCB of 31.1 mg/kg). The other sample, HR17-OU2-R7-041, showed a Tri+ PCB concentration of 21.6 mg/kg. In addition to these two relatively higher PCB concentrations, the surrounding samples had Tri+ PCB concentrations in the range of 3 to 10 mg/kg (large yellow circles), indicating the area has generally higher sediment Tri+ PCB levels compared to most other areas of RS 2 but still well below the removal criteria for RS 2, with the exception of one location. As noted before all but two locations

[22] A z-score is the difference between a local mean and the population mean divided by the standard deviation of the population; thus, it is the number of standard deviations below or above the population mean.

[23] Two different search radii were attempted, 250 ft and 1,000 ft. The 250-ft radius confirmed many of the locations that were identified in Section 5.1. The 1,000-ft radius did not yield useful results, identifying areas with average concentrations as low as 1 mg/kg Tri+ PCB.

in this area fall below the RS 1 criterion of 10 mg/kg Tri+ PCB. Note that only one sample (HR17-OU2-R7-050) exceeded both the Tri+ PCB dredging and Total PCB 50 mg/kg thresholds.

The second area of interest is near the Upper Mechanicville Dam in RS 3/Reach 4 (Figure 5.2-1 – Sheet 14). The ArcGIS "Optimized Hot Spot Analysis" tool identified a cluster of six data points, but upon closer examination it is apparent the cluster is influenced by just one point (HR17-OU2-R4-060) that exhibited the highest concentration in the 2017 NYSDEC dataset (Total PCB=67.1 mg/kg, Tri+ PCB =24.2 mg/kg) inside an area that was dredged. Although this exceeds the Total PCB 50 mg/kg threshold, it does not exceed the surface sediment dredging threshold of 30 mg/kg Tri+ PCB. The other five samples identified in this cluster have concentrations below 3 mg/kg Tri+ PCB and the single higher-concentration sample in this area is not considered to constitute a hot spot.

About 600 ft north of the Lower Mechanicville Dam in RS 3/Reach 3 is the remaining area of interest in the Upper Hudson River (Figure 5.2-1 – Sheet 15). The cluster identified by the ArcGIS "Optimized Hot Spot Analysis" tool consists of seven samples that mostly fall within CU-96. Two samples fall outside the CU in an area characterized as silt, and exhibit the highest concentrations found in the area: HR17-OU2-R3-020 (Total PCB=39.8 mg/kg, Tri+ PCB=21.2 mg/kg) and HR17-OU2-R3-014 (Total PCB=33.2 mg/kg, Tri+ PCB=17.6 mg/kg). Unlike the second area near the Upper Mechanicville Dam described above, the proximity of the two samples to one another suggests it may be appropriate to examine this location further. In particular, further study may be warranted to refine the area with concentrations between 10 and 30 mg/kg Tri+ PCB and to track its change over time. However, all samples in the area are below the RS 3 criterion of 30 mg/kg Tri+ PCB and all but two are below the RS 1 criterion of 10 mg/kg Tri+ PCB.

5.4 What Actions or Responses are Appropriate Based on These Results

Based on these results, the remedy was effective at removing the target areas as defined in the 2002 ROD and most areas of elevated PCB concentrations. The percentage of sample locations with surface sediment concentrations below the removal criteria are greater than 99 percent by all measures. Overall, these analyses have not identified any specific areas that would qualify as "hot spots" requiring additional active remediation beyond natural attenuation and ongoing monitoring. There are three areas of interest that may warrant further consideration and additional attention during future sampling rounds under the OM&M program: the Galusha Island Area and the areas near the Upper and Lower Mechanicville Dams. More closely-spaced surface sediment sampling may be helpful to further investigate these three areas during the next OM&M sampling cycle prior to the next FYR. It should be noted that surface sediment results alone would not provide sufficient data related to any potential remediation. Deeper sediment samples may be needed to answer questions regarding the potential for buried inventory that could be disturbed in the future or otherwise disrupt recovery. Additionally, bathymetric survey and beryllium-7 testing (an indicator of recent sediment deposition) may be helpful in further evaluating sediment accumulation in these areas.

The combined 2016 EPA/GE and 2017 NYSDEC data sets will be used to determine any necessary modifications to the scope of work for the next surface sediment sampling round to support the next five-year review. It should be noted that the areas that do not have hydrodynamic conditions similar to the main stem of the river, such as the land cuts and Coveville backwater area, will be tracked separately under the OM&M program.

Although the 2016 EPA/GE sampling program resulted in samples collected in every reach, the combined 2016 and 2017 data sets provide better resolution of current surface sediment conditions on a reach-by-reach basis than would be possible with just the 2016 data alone. As additional years of fish data are collected, the combined data may allow for better resolution to local conditions. In spring 2019, GE will be collecting sport fish samples in Reaches 1-4, which have not previously been sampled.

6.0 Summary and Conclusions

This memorandum comprises an extensive series of analyses that examine the recent surface sediment sampling efforts conducted by NYSDEC in 2017 and by EPA/GE in 2016. These data sets provide a detailed look at surface concentrations and provide a robust basis to assess the success of the dredging remedy regarding the surface sediment removal criteria. Note that the discussions focus on Tri+ PCBs since this metric was the basis for the remedy criteria developed for the ROD due to the preferential uptake of Tri+ PCBs by fish relative to monochloro- and dichloro-homologues, which contribute to Total PCBs but not appreciably to fish body burdens. The following discussion summarizes the major conclusions of these analyses, including those presented in greater detail in Attachment A.

Overview of Data Collection, Data Quality and Initial Observations

<u>Data Quality and Comparability:</u> Both the EPA/GE and NYSDEC analytical programs met their data quality objectives for the majority of the data. NYSDEC pointedly used the same laboratory and analytical procedures to ensure comparability between the EPA/GE and NYDSDEC results. Comparison of the two data sets shows good agreement in most river reaches, indicating that it is acceptable to combine the two data sets for analysis of average surface sediment conditions and for tracking the long-term recovery of the sediments as part of the OM&M monitoring. An analytical issue in the NYSDEC data related to surrogate recovery was not found to impact the NYSDEC data usability or reported values.

<u>2016 EPA/GE OM&M Activities:</u> The 2016 EPA/GE survey yielded 215 unique environmental samples from across the three river sections, obtained from non-dredged areas only. The EPA/GE sampling program was based on an un-biased random sampling design by river mile, so data were collected in each river reach. These samples were all analyzed for PCBs using Aroclor-based M8082. Total PCB concentrations found range from non-detect to 57 mg/kg. The estimates of Tri+ PCBs ranged from non-detect to 23 mg/kg. Sediment analytical summary statistics are provided in Table 6.0-1 for Total PCBs and Table 6.0-2 for Tri+ PCBs. The left side of these tables provides a summary of the EPA/GE data for the non-dredged areas. These results are based on the 215 locations which yielded recoverable sediments. Note that for the purpose of this discussion,

"recoverable sediments" refers to a location where there was sufficient sediment to recover for laboratory analysis, and a sample was collected, sent to the lab, and analyzed. These results show that surface concentrations of Tri+ PCBs in non-dredged areas all averaged 1.7 mg/kg or less, depending on river section. There were no observed exceedances of the Tri+ PCB surface sediment dredging criteria specified in the ROD (10 mg/kg Tri+ PCB in RS 1 and 30 mg/kg Tri+ PCB in RS 2 and RS 3) in the EPA/GE data.

<u>2017 NYSDEC Supplemental OM&M Activities</u>**:** NYSDEC's 2017 survey yielded 1,089 unique environmental samples from across the three river sections, obtained from dredged and non-dredged areas. The NYSDEC sampling program was based on a gridded (and therefore similarly un-biased) sampling design in all river reaches. Overall, the results obtained by the more extensive NYSDEC survey are similar to those obtained by EPA/GE. These results are summarized on the right sides of Tables 6.0-1 and 6.0-2. These tables permit the direct comparison of NYSDEC and EPA/GE analytical data for non-dredged areas on a river section and reach basis. In particular, average Tri+ PCB concentrations for recoverable sediments in non-dredged areas agreed well (within ±15 percent or less) in RS 1 and RS 3. Only in RS 2 do the EPA/GE and NYSDEC results differ substantively, with the NYSDEC average about twice that of the EPA/GE result. This difference was found to be statistically significant. This disagreement is attributed to the generally higher levels observed by NYSDEC in Reach 7. When examined on a reach basis, the average Tri+ PCB concentrations ranged from 0.34 mg/kg (Reach 2) to 3.8 mg/kg (Reach 7).

<u>PCB Analytical Methods Comparison:</u> The conversion basis developed by GE as part of the SSAP program for M8082 and Tri+ PCB as measured by the mGBM was shown to consistently estimate Tri+ PCB concentrations over time, with no measurable variation in the relationship over time. The data for this relationship was obtain by GE over several periods, from 2002-2006, 2009 and 2011. This equation was originally finalized by GE in 2011, but was reviewed here given the end of the mGBM capacity at Pace Analytical Services in late 2016, and the introduction of the M8082/M1668c matched pair data by the State. It is recommended that the GE formulation continue to be applied for any future analyses of sediments by M8082 to estimate Tri+ PCB concentrations on a basis consistent with those of the ROD and the remedial design. The analysis of matched pairs of sediment samples by M8082 and M1668c shows that M8082 reports a lower Total PCB concentration and yields a lower Tri+ PCB estimate. The relationship between the two methods also has a high degree of variability. These observations will need to be further evaluated and considered in OM&M requirements for GE's sampling program and in subsequent FYR reports.

<u>PCBs and Sediment Texture:</u> PCBs were not found to be well correlated with surface sediment texture. While the reason for this is unknown, it is likely that the lack of correlation is largely a direct effect of the remedy itself, which tended to remove sediments with higher PCB levels, sediments that also tended to be fine-grained in nature. While sediment texture did not correlate with sediment texture, it did correlate with sampling success. The rate of sample location abandonment was much lower for areas classified as silts and sands relative to those classified as gravels and bedrock, based on side-scan sonar.

What are the Hudson River Surface Sediment Concentrations after Dredging?

Integrating EPA/GE and NYSDEC Results as Area-Weighted Average Concentrations: Analysis of the 2016 EPA/GE and 2017 NYSDEC data sets shows that even though the two sampling program designs were different, they still yield similar results for mean recoverable surface sediment in nearly all reaches, which allowed them to be combined for further analyses. Both sampling plans gave a representative unbiased sample set, even though EPA/GE's sampling program consisted of significantly fewer samples than NYSDEC's.

To create average PCB concentrations that represent the entire area in each river section or reach (and not just those that were successfully sampled), it is important to integrate across all river bottom areas, that is, across non-dredged areas, dredged areas, limited access areas and very coarse-grained areas (typically areas of sample refusal). EPA used the NYSDEC and GE data on recoverable sediments along with the information on abandoned sampling locations, on inaccessible sampling locations and information from the GE 2002/2003 SSS sediment maps to create an area-weighted average concentration of Total PCB and Tri+ PCB for each river reach and river section. These results are given in Tables 6.0-3 and 6.0-4, respectively. Notably, Table 6.0-4 shows that Reaches 1 and 2 are near or below the ROD's MNA expectation of less than 0.25 mg/kg Tri+ PCBs. EPA notes that further reduction of the surface sediment concentration may be necessary to reach the final fish tissue concentration goal of 0.05 mg/kg Tri+ PCBs. Specific model estimates for surface sediment PCB concentrations were developed for each portion of the river. Section 3 describes the derivation of the data in these tables in greater detail.

As shown in Table 6.0-4, except for Reach 7 and RS 2, all river sections and reaches have an area-weighted average Tri+ PCB concentration less than 1 mg/kg. Reach 7 has the highest Tri+ PCB area-weighted average of any river section or reach at 1.7 mg/kg, and this reach is the reason for the elevated average Tri+ PCB concentration in RS 2 at 1.3 mg/kg. Total PCB concentrations follow a similar pattern to those of Tri+ PCB. While the results presented in Tables 6.0-3 and 6.0-4 are considered most representative of the actual area-weighted mean concentration, simple arithmetic means of the recoverable sediment data for each river section and reach yield similar relationships across areas, although at somewhat higher concentrations.

Identification of Locations above the ROD Dredging Criteria: The information in Tables 6.0-3 and 6.0-4 clearly show that average surface sediment concentrations are well below any of the ROD-specified dredging criteria. However, this does not address the individual locations. When individual sample results are compared to their respective dredging thresholds for surface sediment (10 mg/kg Tri+ PCB in RS 1 and 30 mg/kg Tri+ PCBs in RS 2 and RS 3), only four samples out of the combined total of 1,304 mainstem Hudson samples obtained by NYSDEC and EPA/GE exceed the thresholds (Table 6.0-5). This is 0.3 percent of the locations with recoverable sediment (see Section 3 for further discussion). More to the point, these results indicate that 99.7 percent of all locations with recoverable sediments fell below the ROD dredging criteria for surface sediments. To further emphasize this point, when abandoned locations are included in the tally, this percentage rises to 99.8 percent, since abandoned locations are not considered to contain Tri+ PCB levels in excess of ROD dredging criteria.

These four locations with surface sediments in excess of the ROD criteria were detected in isolated locations in non-dredged areas, generally surrounded by locations with substantially lower concentrations. This very small number of excursions is not unexpected since the remedial design left some isolated locations exceeding dredging thresholds untargeted. Given the very small number of PCB concentration dredging criteria exceedances (four in all), their isolated locations, and their very limited impact on average concentrations, in general the overall dredging goals are considered to have been achieved for surface sediments for the three river reaches.

A closer review of the individual sample locations shows that not only are there few locations in excess of the river section-specific dredging criteria, but additionally, there are few locations, only eight in all in RS 2 and RS 3, that exceed the more stringent RS 1 dredging criterion of 10 mg/kg Tri+ PCBs. This observation indicates that there are few areas that would exceed the RS 1 surface sediment dredging criterion, if it were to be applied to RS 2 and RS 3 (see bottom portion of Table 6.0-5). The corollary to this is that 99.5 percent of all occupied locations in RS 2 and RS 3 fall below the RS 1 dredging criterion for surface sediments. The level of surface sediment contamination in these river sections was a significant concern of the trustees, *i.e.,* that there were significant portions of RS 2 and RS 3 sediments that would continue to pose elevated exposures in excess of the RS 1 dredging criterion. In general, the current data do not show this to be a substantive issue.

<u>PCB Levels in Dredged Areas:</u> PCB levels in dredged areas continue to remain low, with some areas now 7 years post-dredging. With an overall median value of 0.26 mg/kg Tri+ PCBs, it can be concluded that nearly half of the dredged areas are below the ROD's MNA expectation of less than 0.25 mg/kg. The data obtained by NYSDEC illustrate the absence of substantive recontamination in the dredged areas, with an average Tri+ PCB concentration across all dredged areas of 0.75 mg/kg. There are a limited number of high value locations within the dredged areas, but they are not characteristic of the dredged areas in general. The mean and median listed above incorporate these outlier values and still yield acceptable values for Tri+ PCB concentrations.

<u>What is the Pace of Recovery of the Upper Hudson River Sediments after Dredging?</u>

Post-dredging sediment sampling data collected by EPA/GE and NYSDEC were analyzed to evaluate the pace of recovery of Upper Hudson River sediments. At the time of the 2002 ROD, recovery rates were predicted to be on the order of 8 percent per year. Analysis of the recent data from non-dredged areas in RS 1 showed that declines are consistent with ROD model forecasts, with a best estimate rate of 6 percent per year. The uncertainty on this rate of decline is sufficiently large that it agrees within error with the ROD estimate. Although the recovery rate cannot be calculated in the dredged areas, an observation can be made that the Tri+ PCB concentrations have decreased extensively after dredging, with the mean of recently deposited sediments, as found on top of backfilled areas, under 1 mg/kg Tri+ PCB.

The RS 1 estimate for non-dredged areas is further supported by the estimated rates of decline for cohesive and non-cohesive sediments in all river sections. For both sediment classes (as originally defined in the ROD and estimated from the subsequent data sets) in all three river sections, surface sediment (0-2 inches) have been declining at rates consistent with the 8 percent rate of decline. Specifically, the 95 percent confidence intervals on the rates of decline for each sediment class and river section typically range between 2 and 10 percent per year (see the 95 percent confidence interval given in Figures 4.2-1a through f), so that all estimates are consistent with the ROD-based estimate of 8 percent per year, given the uncertainty in the estimates.

Based on measured Tri+ PCB concentrations, there is evidence of natural recovery occurring in surface sediments in all three sections of the Upper Hudson River. Furthermore, Tri+ PCB concentrations measured in 2016 and 2017 in non-dredged areas appear to be at or below levels that would be predicted by the empirical recovery time trends using the historical data.

Do "Hot Spots" Remain in the Upper Hudson River Based on the Available Surface Sediment Data?

The 2016 and 2017 surface sediment data were assessed for the possible presence of post-dredging hot spots in the Upper Hudson River. The data were compared to the respective dredging thresholds for each river section, as well as the original hot spot definition of a PCB concentration of 50 mg/kg Total PCBs (Tofflemire and Quinn, 1979). In all 1,304 recoverable sediment samples, there are only four individual isolated locations that exceed 50 mg/kg Total PCBs, indicating that based on 0 to 2-inch surface samples, there is no evidence for "hot spots" as originally defined by Tofflemire and Quinn. As shown by the analyses in Section 3 and Section 5 of this memo, there are few locations (4) in excess of the dredging criteria as specified by the ROD for each river section. Additionally, there are few exceedances of the most stringent surface sediment criterion as specified for RS 1, even when applied across the entire Upper Hudson (3 in RS 1, and 8 in RS 2 and RS 3 combined). These results also provide no significant evidence for "hot spots," and represent just a few isolated locations with higher concentrations.

A geostatistical analysis was also undertaken to statistically identify local areas of higher average concentrations. This analysis identified three areas where sediment concentrations were elevated with respect to the surrounding sample locations. All but one sample from these three areas were below the applicable ROD dredging criteria. The three areas identified are:

- Galusha Island Area (RS 2/Reach 7): Includes 20 sample locations; two locations exceed the RS 1 criterion of 10 mg/kg Tri+ PCBs, one of which exceeds the RS 2 surface sediment criterion of 30 mg/kg Tri+ PCBs, at 31 mg/kg.
- Upper Mechanicville Dam Area (RS 3/Reach 4): Includes 6 sample locations; this cluster is influenced by just one point with a concentration of 24 mg/kg Tri + PCBs. No locations exceeded the RS 3 criterion of 30 mg/kg Tri+ PCBs. Because this area contains a single elevated value, it is not considered of true statistical significance.
- Lower Mechanicville Dam Area (RS 3/ Reach 3): Includes 7 sample locations; this cluster includes two values over the RS 1 criterion of 10 mg/kg Tri+ PCBs. No locations in the Lower Mechanicville Dam area exceeded the RS 3 criterion of 30 mg/kg Tri+ PCBs for surface sediments

Additionally, it should be noted that the number of identified elevated locations in these areas was limited. Thus, based on the extensive data set from the combined NYSDEC and EPA/GE sampling programs, the Galusha Island Area and the areas near Upper and Lower Mechanicville Dam are the only three areas that may warrant consideration of additional attention during future sampling rounds under the OM&M program. None of these areas could be construed as a "hot spot" based on either the NYSDEC or the ROD surface sediment criteria.

Improvements to the System Understanding

These analyses support and expand EPA's system understanding of the Upper Hudson River. In particular, the data show that the dredging effort was successful and minimal evidence exists for elevated surface concentrations, or unexpected recontamination of remediated areas. Thus, the remedial design correctly identified sediments for dredging and these areas were successfully addressed. Additionally, despite the application of a higher dredging threshold in RS 2 and RS 3, the combined 2016 EPA/GE and 2017 NYSDEC data indicate that there is little evidence for large areas of surface sediment contamination that currently fall between the RS 1 criterion (10 mg/kg Tri+ PCB) and the RS 2 and RS 3 criterion (30 mg/kg Tri+ PCB) in the non-dredged areas. In dredged areas, concentrations are generally low and nearly half meet the ROD's MNA expectation of less than 0.25 mg/kg Tri+ PCB,[24] although there are a few locations with notably higher concentrations that are not explained with the available information. However, these are a limited subset of the dredged area data (about 5 percent of samples). GE collected nearly 150 additional samples in dredged areas in 2017 and, once analytical results are available, they will be used to confirm the observations from the NYSDEC data.

Bathymetric surveys, side-scan sonar, beryllium-7 (an indicator of recent sediment deposition) data and additional surface sediment samples may be helpful to evaluate recent deposition as part of future OM&M sampling. EPA has identified 3 areas where this additional data collection may be particularly useful. These areas are found primarily in Reaches 3, 4 and 7. The analysis of these elevated locations is presented in Section A.1.3 of Attachment A.

The collection of new surface sediment measurements continues to support the rate of decline for surface sediment Tri+ PCB levels estimated by the ROD (8 percent per year). The most recent data (*i.e.,* the 2016 and 2017 samples) in non-dredged areas are at or below concentrations forecast by the empirical trends derived from historical data.

The greater resolution provided by the NYSDEC data identifies Reach 7 as elevated compared to most other reaches. As a result, Reach 7 may require more detailed long-term monitoring. Additionally, analytical chemistry challenges regarding M8082 and M1668c reporting and estimation of Tri+ PCB concentrations need to be further considered to ensure accurate long-term monitoring of sediment and fish PCB levels and their changes through time.

[24] As noted earlier, further reduction of the surface sediment concentration may be necessary to reach the final fish tissue concentration goal of 0.05 mg/kg Tri+ PCBs. Specific model estimates for surface sediment PCB concentrations were developed for each portion of the river.

7.0 References

ArcGIS, 2018. How Hot Spot Analysis (Getis-Ord Gi*) Works. http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-statistics-toolbox/h-how-hot-spot-analysis-getis-ord-gi-spatial-stati.htm. Last accessed July 10, 2018.

EA Engineering, P.C. and Its Affiliate (EA), 2017. Operation, Maintenance, and Monitoring Letter Work Plan, Contract/Work Assignment No. D007624-36, Site/Spill No./Pin: Hudson River PCB Sediments OU-2 (546031). 23 June 2017.

EA, 2018. Data Summary Report, Hudson River PCB Sediments OU-2 (546031), Upper Hudson River, New York, Work Assignment No. D007624-36. DRAFT. March 2018

General Electric, 2005. Phase 1 Dredge Area Delineation Report. Prepared for: General Electric Company, Albany, NY. Prepared by: Quantitative Environmental Analysis, LLC, Montvale, NJ. February 28, 2005.

Goodman, L.A., 1960. On the exact variance of products. *Journal of the American Statistical Association,* Vol. 55, No. 292 pp 708-713.

Casella, G., and R.L. Berger. 1990. *Statistical Inference.* Duxbury Press, Belmont, CA.

Tofflemire, T.J. and S.O. Quinn, 1979. Technical Paper No. 56, PCB in the Upper Hudson River: Mapping and Sediment Relationship. April 1979.

USEPA, 2000. Phase 2 Report, Further Site Characterization and Analysis. Volume 2D - Revised Baseline Modeling Report (RBMR), Hudson River PCBs Reassessment RI/FS. Prepared for USEPA Region 2 and USACE, Kansas City District by TAMS Consultants, Inc., Limno-Tech, Inc., Menzie-Cura & Associates, and Tetra Tech, Inc., January.

USEPA, 2002. Hudson River PCBs Site, New York, Record of Decision.

USEPA, 2004. Resolution of GE Disputed Issues since GE's May 21, 2004 Presentation to the Regional Administrator. July 22, 2004.

USEPA, 2010. Operations, Maintenance, and Monitoring for Phase 2 of the Remedial Action, Attachment E to the Statement of Work, Hudson River PCBs Site. December 2010.

USEPA, 2012. First Five-Year Review Report for the Hudson River PCBs Superfund Site. Prepared by USEPA Region 2, New York, NY. June 1, 2012.

USEPA, 2019. Second Five-Year Review Report for the Hudson River PCBs Superfund Site. Prepared by USEPA Region 2, New York, NY. April 2019.

TABLES

Table 3.1-1
Total PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Section

Area	River Section	2016 EPA/GE			2017 NYSDEC		
		Recoverable Sediment Data		Abandoned Points	Recoverable Sediment Data		Abandoned Points
		N	Mean		N	Mean	
Dredged Areas	1				143	0.96	5
	2				58	1.2	4
	3				48	2.5	2
	Total				249	1.3	11
Non-Dredged Areas	1	33	4.1	9	50	3.1	8
	2	70	3.1	7	99	5.2	20
	3	112	1.6	31	691	1.2	428
	Total	215	2.5	47	840	1.8	456
All Areas Total		215	2.5	47	1089	1.7	467

Table 3.1-2
Tri+ PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Section

Area	River Section	2016 EPA/GE			2017 NYSDEC		
		Recoverable Sediment Data		Abandoned Points	Recoverable Sediment Data		Abandoned Points
		N	Mean		N	Mean	
Dredged Areas	1				143	0.62	5
	2				58	0.74	4
	3				48	1.2	2
	Total				249	0.75	11
Non-Dredged Areas	1	33	1.7	9	50	2.0	8
	2	70	1.5	7	99	3.0	20
	3	112	0.79	31	691	0.76	428
	Total	215	1.2	47	840	1.1	456
All Areas Total		215	1.2	47	1089	1.0	467

Table 3.1-3
Total PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data
by River Reach

Area	River Reach	2016 EPA/GE			2017 NYSDEC		
		Recoverable Sediment Data		Abandoned Points	Recoverable Sediment Data		Abandoned Points
		N	Mean		N	Mean	
Dredged Areas	8				143	0.96	5
	7				28	1.1	1
	6				30	1.3	3
	5				20	0.72	0
	4				11	8.0	1
	3				12	1.4	1
	2				3	0.21	0
	1				2	0.21	0
	Total				249	1.3	11
Non-Dredged Areas	8	33	4.1	9	50	3.1	8
	7	27	4.2	2	62	6.6	4
	6	43	2.5	5	37	2.9	16
	5	63	2.2	1	203	1.3	22
	4	6	2.3	0	212	1.1	72
	3	7	1.8	10	96	2.2	106
	2	11	0.36	16	66	0.47	166
	1	25	0.56	4	114	0.71	62
	Total	215	2.5	47	840	1.8	456
All Areas Total		215	2.5	47	1089	1.7	467

Table 3.1-4
Tri+ PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Reach

Area	River Reach	2016 EPA/GE			2017 NYSDEC		
		Recoverable Sediment Data		Abandoned Points	Recoverable Sediment Data		Abandoned Points
		N	Mean		N	Mean	
Dredged Areas	8				143	0.62	5
	7				28	0.72	1
	6				30	0.75	3
	5				20	0.45	0
	4				11	3.2	1
	3				12	0.97	1
	2				3	0.17	0
	1				2	0.15	0
	Total				249	0.75	11
Non-Dredged Areas	8	33	1.7	9	50	1.9	8
	7	27	2.1	2	62	3.8	4
	6	43	1.2	5	37	1.7	16
	5	63	1.0	1	203	0.87	22
	4	6	1.1	0	212	0.68	72
	3	7	0.93	10	96	1.3	106
	2	11	0.22	16	66	0.34	166
	1	25	0.33	4	114	0.49	62
	Total	215	1.17	47	840	1.1	456
All Areas Total		215	1.17	47	1089	1.0	467

Table 3.2-1
Tri+ PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Section

River Section	2017 NYSDEC+ 2016 EPA/GE Area Weighted Sediment Data	
	N	Mean
1	252	0.95
2	258	1.3
3	1361	0.53
Total	1871	Note 1

Direction of Flow

Table 3.2-2
Total PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Section

River Section	2017 NYSDEC+ 2016 EPA/GE Area Weighted Sediment Data	
	N	Mean
1	252	1.6
2	258	2.6
3	1361	0.89
Total	1871	Note 1

Table 3.2-3
Tri+ PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Reach

River Reach	2017 NYSDEC+ 2016 EPA/GE Area Weighted Sediment Data	
	N	Mean
8	252	0.95
7	124	1.7
6	134	0.98
5	316	0.79
4	313	0.57
3	257	0.55
2	266	0.10
1	209	0.28
Total	1871	Note 1

Direction of Flow

Table 3.2-4
Total PCB Concentrations in Surface Sediment (0-2 inch) 2016-2017 Data by River Reach

River Reach	2017 NYSDEC+ 2016 EPA/GE Area Weighted Sediment Data	
	N	Mean
8	252	1.7
7	124	3.0
6	134	1.8
5	316	1.3
4	313	1.0
3	257	0.91
2	266	0.14
1	209	0.40
Total	1871	Note 1

Note:
1. Area-weighted mean was not calculated on a river wide basis

Table 5.1-1. Samples with Elevated PCB Concentrations and Areas of Interest Based on Hot Spot Analysis

River Reach	Area	River Section 1 Criteria Tri+ PCB >10ppm	River Section 2 & 3 Criteria Tri+ PCB >30 ppm	Total PCB > 50ppm	Geostatiscal Locations (include all other samples)	Sample ID	Tri+ PCB Exceedance	Total PCB Exceedance	Notes	Figure
8	Rogers Island	X			--	HR17-OU2-R8-182	17.2		Isolated Elevated Sample	5.2-1 Sheet 1
		X			--	HR17-OU2-R8-191	10.6			
	North of Route 4 Staging Area	X			--	OCU-RS1-9392-010	10.5		Isolated Elevated Sample	5.2-1 Sheet 2
7	Galusha Island	X	X	X	20	HR17-OU2-R7-050	31.1	58.8	Possibly area with relatively higher concentrations compared to the entire surface sediment data set. Other geostatistically-identified samples range between 3 and 10 ppm Tri+ PCBs.	5.2-1 Sheet 4
		X		X		HR17-OU2-R7-041	21.6	60.9		
6	None									
5	River Mile 179	X		X	--	OCU-RS3-8079-202	23.4	57	Isolated Elevated Sample	5.2-1 Sheet 8
4	Upper Mechanicville Dam	X		X	6	HR17-OU2-R4-060	24.2	67.1	Hot Spot driven by one sample inside dredge area, other samples near-by are less than 3ppm Tri+ PCB. Other geostatistically-identified samples range between 0.3 and 10 ppm Tri+ PCBs.	5.2-1 Sheet 14
3	North of Quack Island	X			--	HR17-OU2-R3-113	14		Isolated Elevated Sample	5.2-1 Sheet 15
	Lower Mechanicville Dam	X			7	HR17-OU2-R3-020	21.2		Possible area with relatively higher concentrations compared to the entire surface sediment data set. Other geostatistically-identified samples range between 0 and 10 ppm Tri+ PCBs.	5.2-1 Sheet 15
		X			--	HR17-OU2-R3-014	17.6			
2	None									
1	North of Kelts Grove	X			--	HR17-OU2-R1-135	10.7		Isolated Elevated Sample	5.2-1 Sheet 18
	Count Total	11	1	4	33					

Note:

X	Exceedance of ROD Criteria

Table 6.0-1
Mean Total PCB Concentration for Non-Dredged Areas
Comparison of EPA/GE and NYSDEC Results

Recoverable Sediment Locations Only

2016 EPA/GE Non-Dredged Areas				2017 NYSDEC Non-Dredged Areas				
Section	Mean	Min	Max	Section Mean	Reach Mean	Min	Max	Reach
1	4.1	0.041 U	31	3.1	3.1	0.069 U	24	8
2	3.1	0.18	17	5.2	6.6	0.13	61	7
					2.9	0.16	18	6
3	1.6	0.017 U	57	1.2	1.3	0.037	12	5
					1.1	0.022	16	4
					2.2	0.038	40	3
					0.47	0.029	2.4	2
					0.71	0.022	15	1

Notes:
1. Results for locations with recoverable sediments only. No corrections were made for abandoned locations. See text for discussion.
2. EPA/GE results based on 215 samples.
3. NYSDEC results based on 840 samples, landcut samples excluded
4. U= Nondetect Value
5. Table excludes NYSDEC dredged area samples

Table 6.0-2
Mean Tri+ PCB Concentration for Non-Dredged Areas
Comparison of EPA/GE and NYSDEC Results

Recoverable Sediment Locations Only

2016 EPA/GE Non-Dredged Areas				2017 NYSDEC Non-Dredged Areas				
Section	Mean	Min	Max	Section Mean	Reach Mean	Min	Max	Reach
1	1.7	0.006	11	2.0	2.0	0.060	17	8
2	1.5	0.082	7.6	3.0	3.8	0.075	31	7
					1.7	0.10	9.9	6
3	0.79	0.005	23	0.76	0.87	0.033	7.8	5
					0.68	0.019	7.1	4
					1.3	0.034	21	3
					0.34	0.004	1.7	2
					0.49	0.019	11	1

Notes:
1. Results for locations with recoverable sediments only. No corrections were made for abandoned locations. See text for discussion.
2. EPA/GE results based on 215 samples.
3. NYSDEC results based on 840 samples, landcut samples excluded
4. Tri+ PCB values caluclated using GE's standard conversion formula:

$$Tri + PCB = 0.13\ Aroclor\ 1221 + 0.89(Aroclor1242 + Aroclor\ 1254)$$

5. U= Nondetect Value
5. Table excludes NYSDEC dredged area samples

Table 6.0-3
Area-Weighted Average Total PCB Concentration

Combined Results Section or Reach Wide							
Section	Mean	Min	Max	Reach Mean	Min	Max	Reach
1	1.7	0.019	31	1.7	0.019	31	8
2	2.6	0.030	61	3.0	0.030	61	7
				1.8	0.062 U	18	6
3	0.88	0.007	67	1.3	0.007	57	5
				1.0	0.022	67	4
				0.91	0.038	40	3
				0.14	0.029	2.4	2
				0.40	0.022	15	1

Notes:

1. Mean values represent an area-weighted average concentration, accounting for all area types, integrating recoverable sediment locations, abandoned locations and inaccessible areas. Minimum and Maximum values are based on recoverable locations only. See text for discussion.
2. Results incorporate both EPA/GE and NYSDEC results.
3. Landcut samples excluded
4. U= Nondetect Value

Table 6.0-4
Area-Weighted Average Tri+ PCB Concentration

Combined Results Section or Reach Wide							
Section	Mean	Min	Max	Reach Mean	Min	Max	Reach
1	0.95	0.006	17	0.95	0.006	17	8
2	1.3	0.026	31	1.7	0.026	31	7
				0.98	0.055 U	9.9	6
3	0.53	0.004	24	0.79	0.005	23	5
				0.57	0.019	24	4
				0.55	0.034	21	3
				0.10	0.004	1.7	2
				0.28	0.019	11	1

Notes:

1. Mean values represent an area-weighted average concentration, accounting for all area types, integrating recoverable sediment locations, abandoned locations and inaccessible areas. Minimum and Maximum values are based on recoverable locations only. See text for discussion.
2. Results incorporate both EPA/GE and NYSDEC results.
3. Tri+ PCB values caluclated using GE's standard conversion formula:

$$Tri + PCB = 0.13\ Aroclor\ 1221 + 0.89(Aroclor1242 + Aroclor\ 1254)$$

4. Landcut samples excluded
5. U= Nondetect Value

Table 6.0-5
ROD Criteria Exceedances (0-2 in samples)

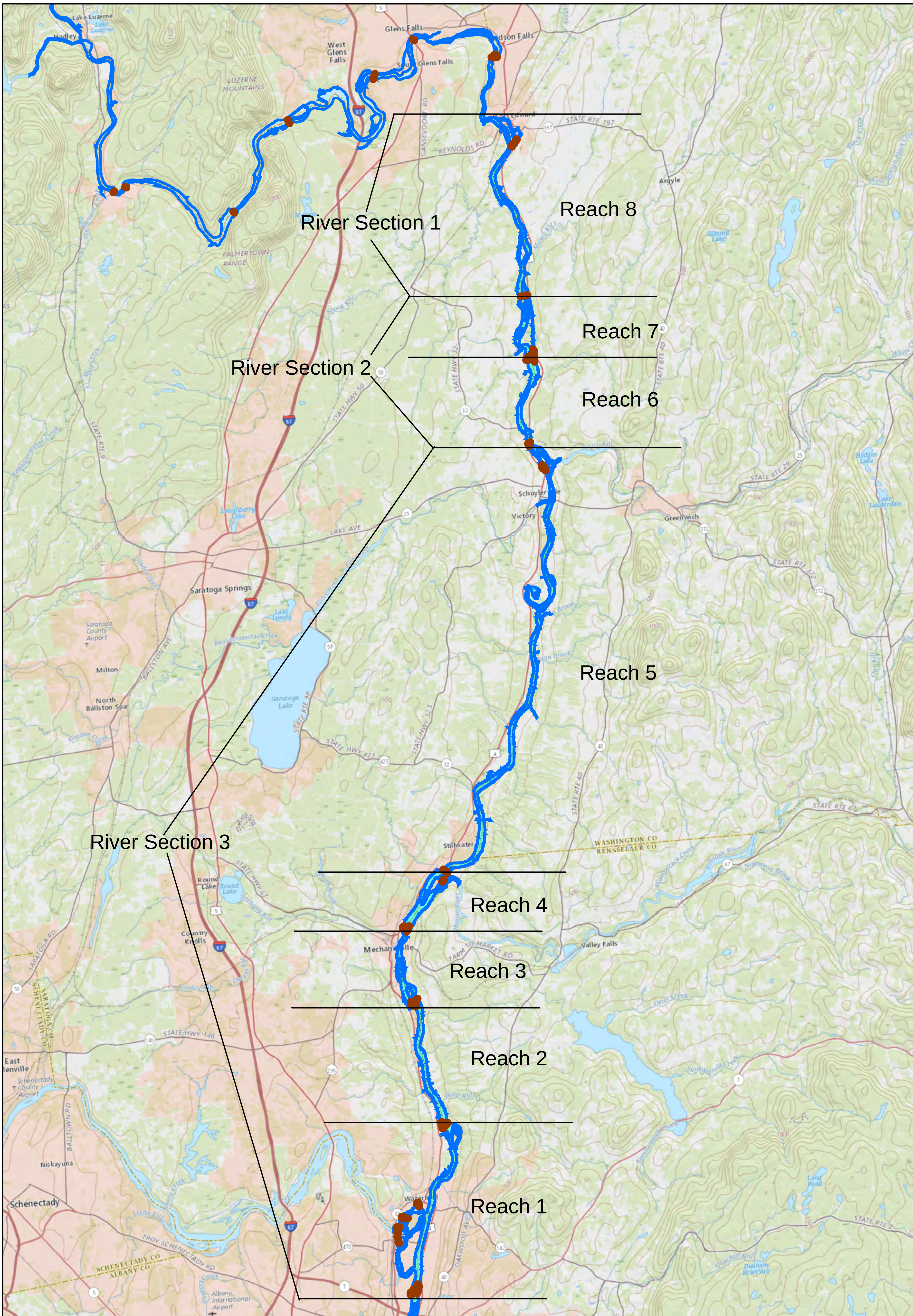
River Section	Tri+ PCB Criteria (ppm)	Number of Exceedances	Recoverable Sediment Locations		Abandoned Locations	Total Occupied Locations	Exceedances as a Percentage of Total Occupied
			Total	Exceedances as a Percentage of Total			
1	10	3	226	1.3%	22	248	1.2%
2	30	1	227	0.44%	31	258	0.39%
3	30	0	851	0%	461	1312	0.0%
Total		4	1,304	0.31%	514	1,818	0.22%

Applying RS 1 Dredging Threshold (10 mg/kg)

River Section	Tri+ PCB Criteria (ppm)	Number of Exceedances	Recoverable Sediment Locations		Abandoned Locations	Total Occupied Locations	Exceedances as a Percentage of Total Occupied
			Total	Exceedances as a Percentage of Total			
2	10	2	227	0.88%	31	258	0.78%
3	10	6	851	0.71%	461	1312	0.46%
Total		8	1,078	0.74%	492	1,570	0.51%

1. Results incorporate both 2016 EPA/GE and 2017 NYSDEC data.
2. Landcut samples excluded
3. Total Occupied Locations include Recovered and Abandoned Locations

FIGURES



Legend

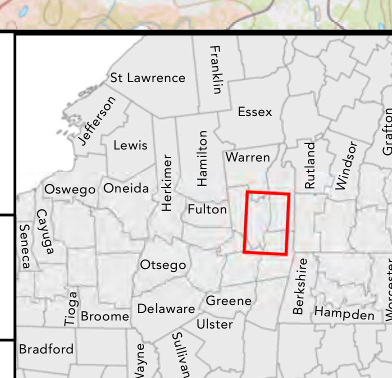
Shoreline

Dam and Lock Locations

Sources: USGS Quadrangle 2016

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019



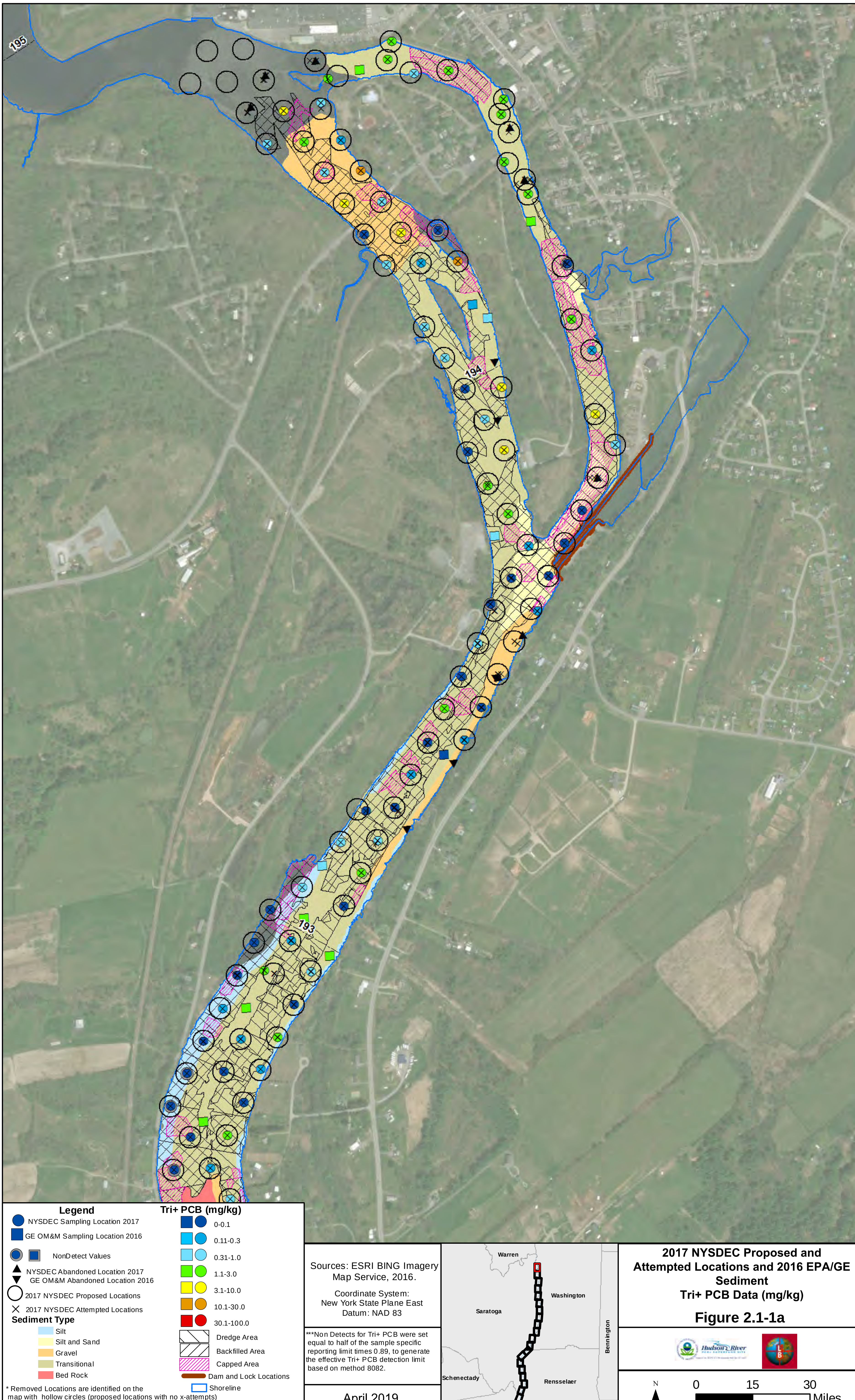
Overview Map
River Reaches and
River Sections

Figure 1-1.1

Louis Berger

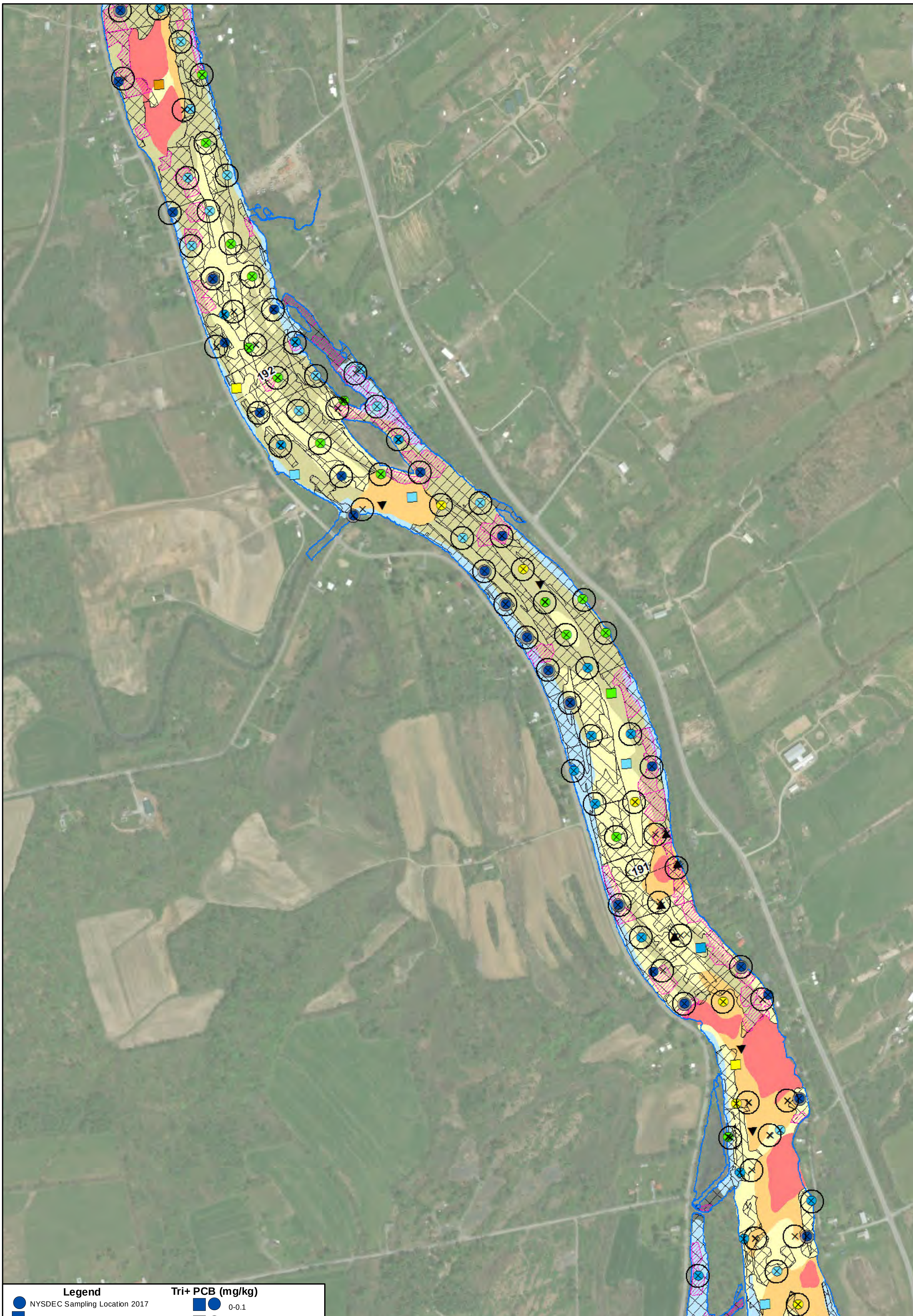
N

0 90 180
Miles



2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1a



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

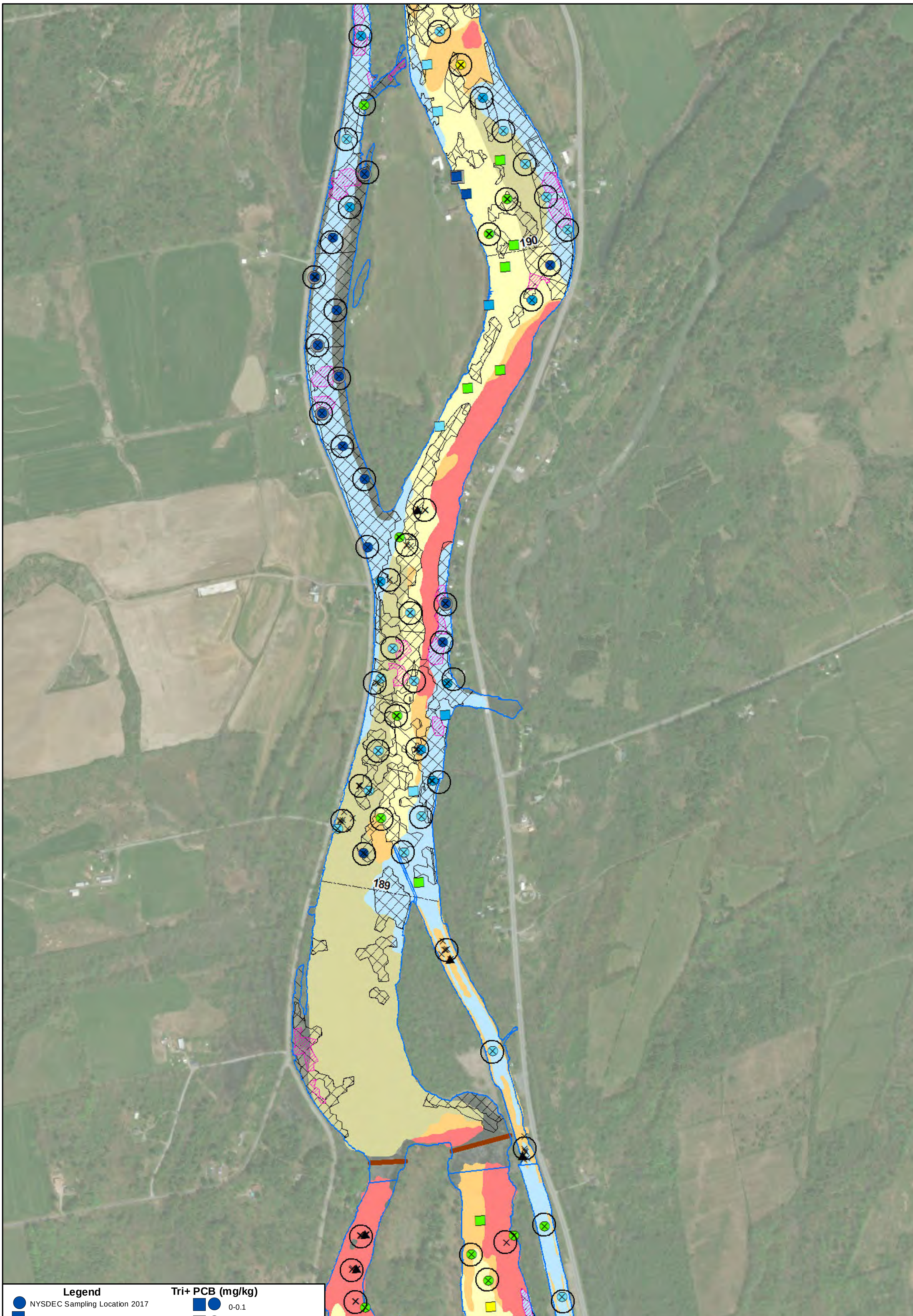
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1b

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016
2017 NYSDEC Proposed Locations
2017 NYSDEC Attempted Locations

Sediment Type

Silt
Silt and Sand
Gravel
Transitional
Bed Rock

Tri+ PCB (mg/kg)

0-0.1
0.11-0.3
0.31-1.0
1.1-3.0
3.1-10.0
10.1-30.0
30.1-100.0
Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

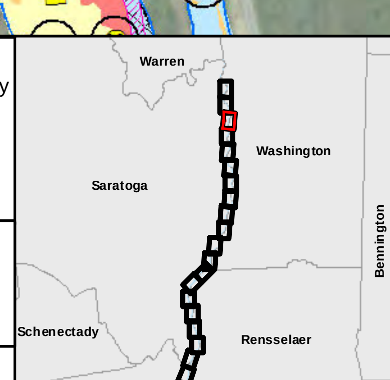
* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

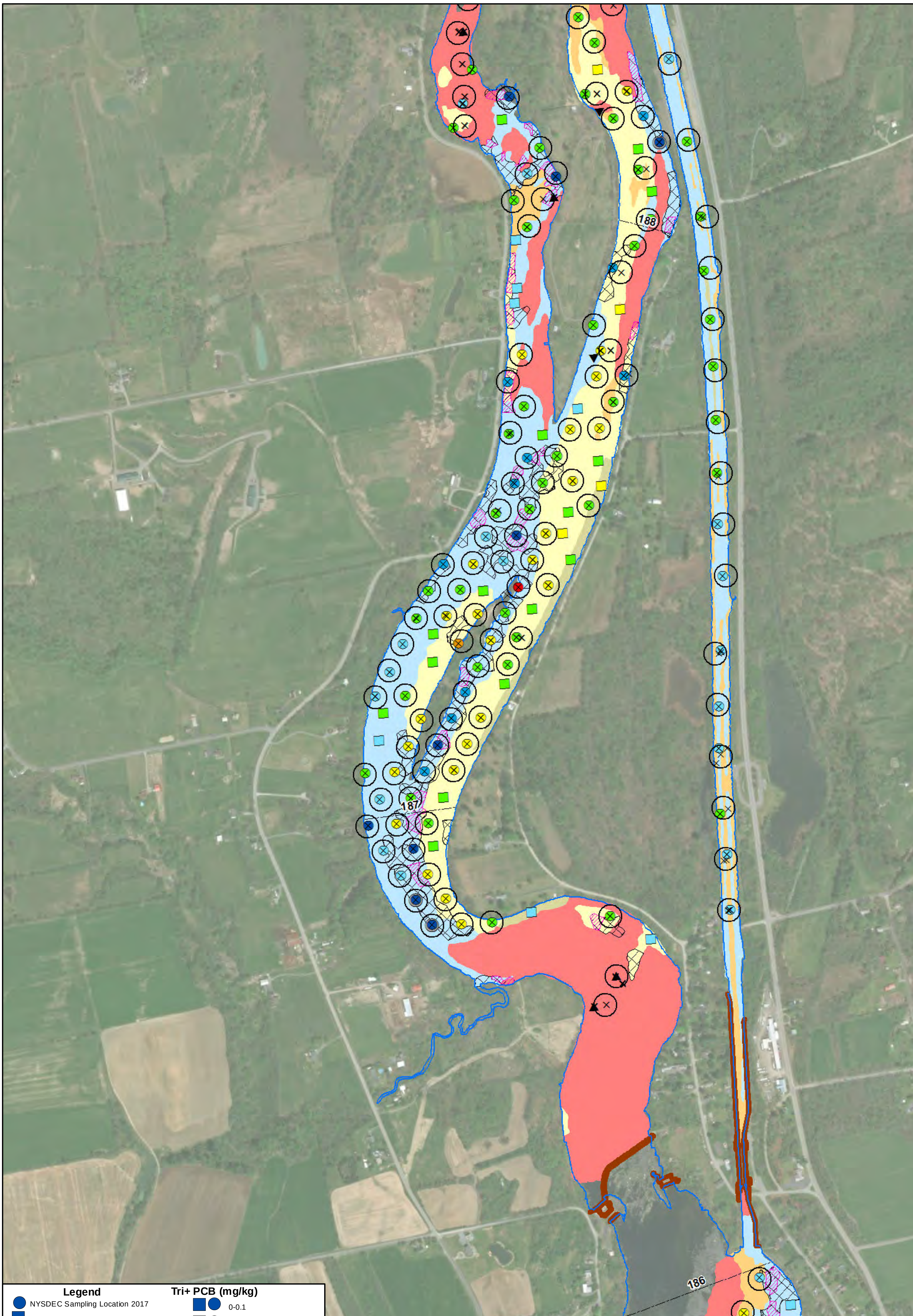
April 2019



2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1c

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

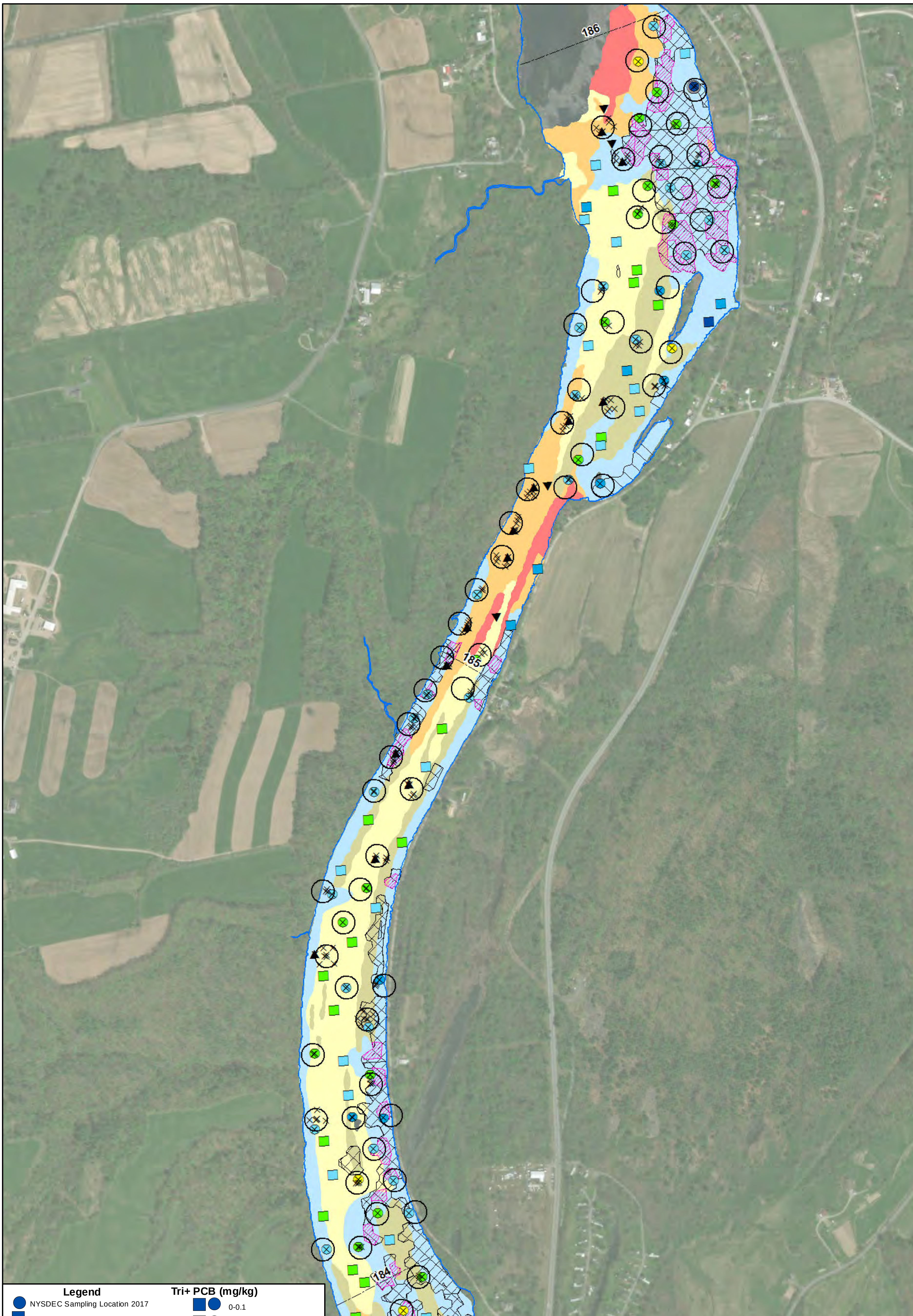
April 2019

2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1d

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

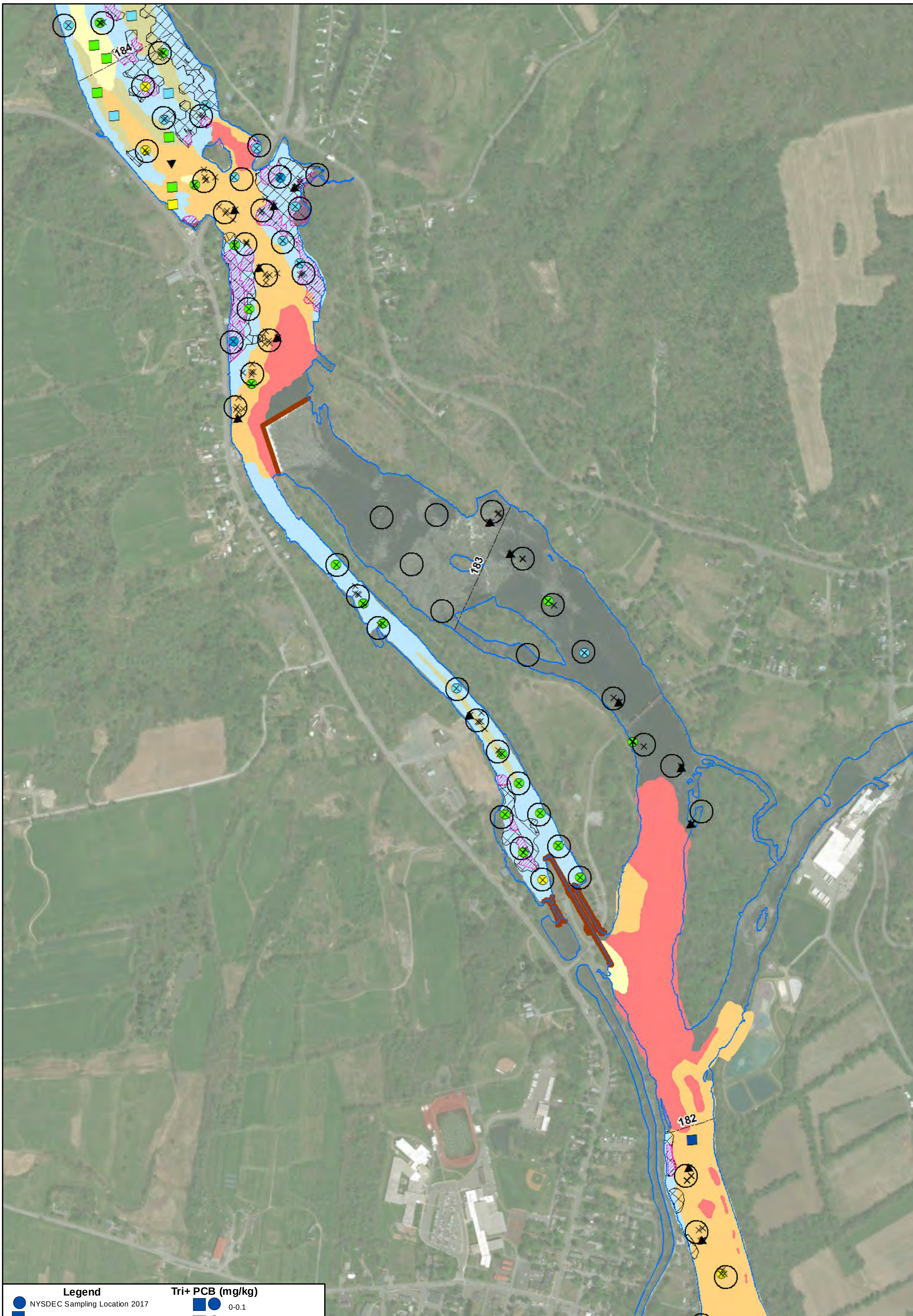
April 2019

2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1e

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

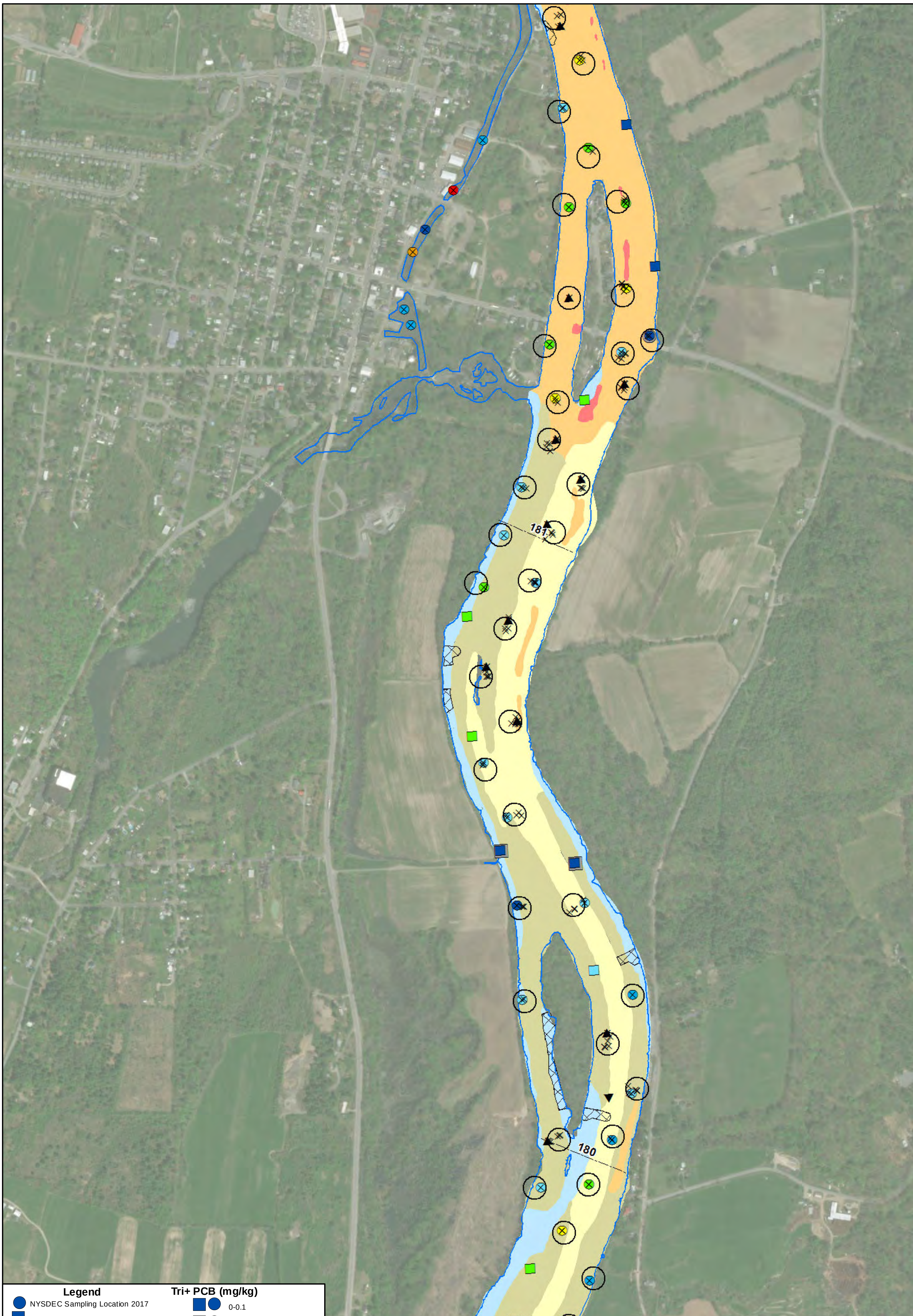
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1f

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)

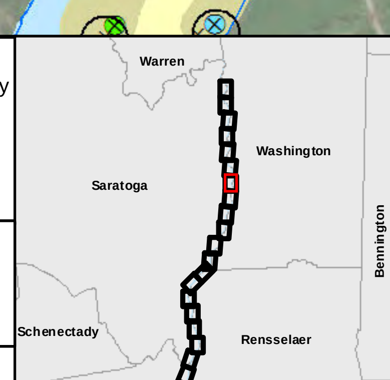
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

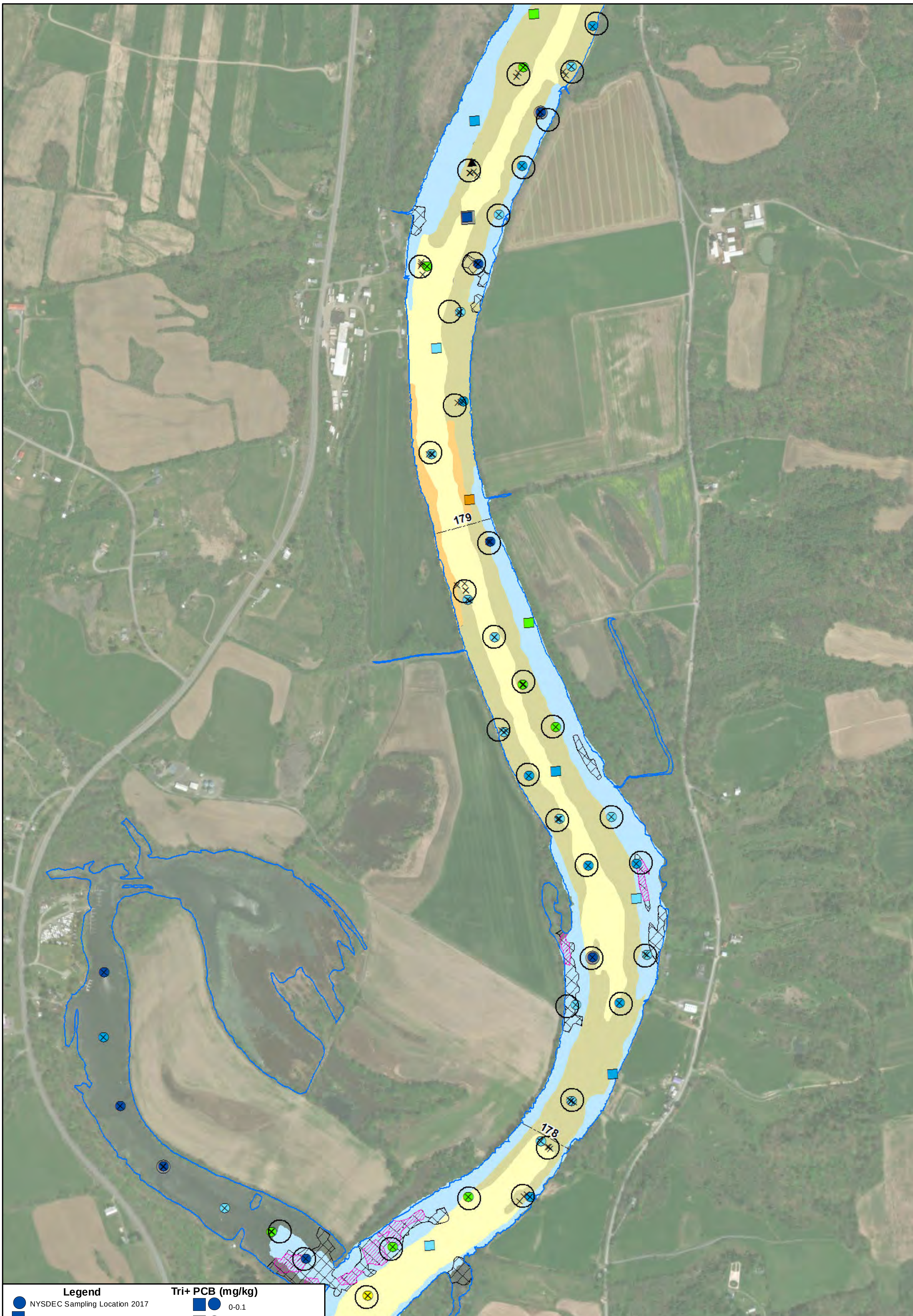


2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1g

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

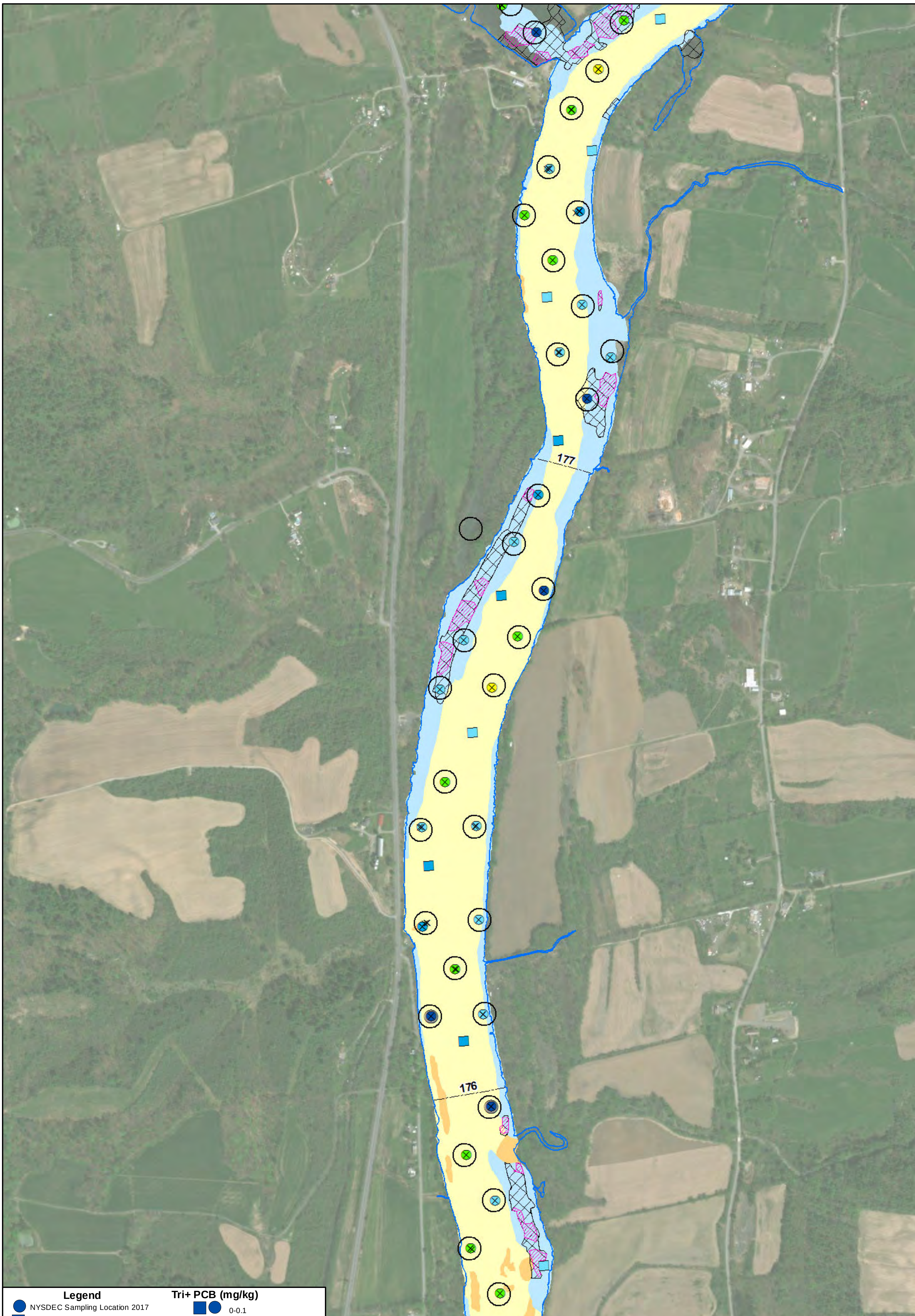
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1h

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

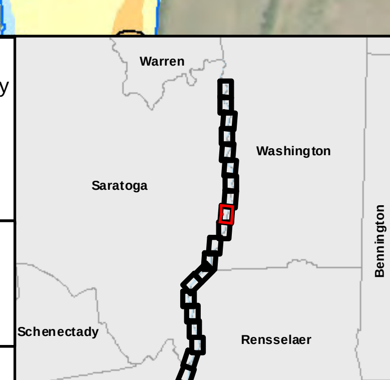
* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019



2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1i

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd

Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

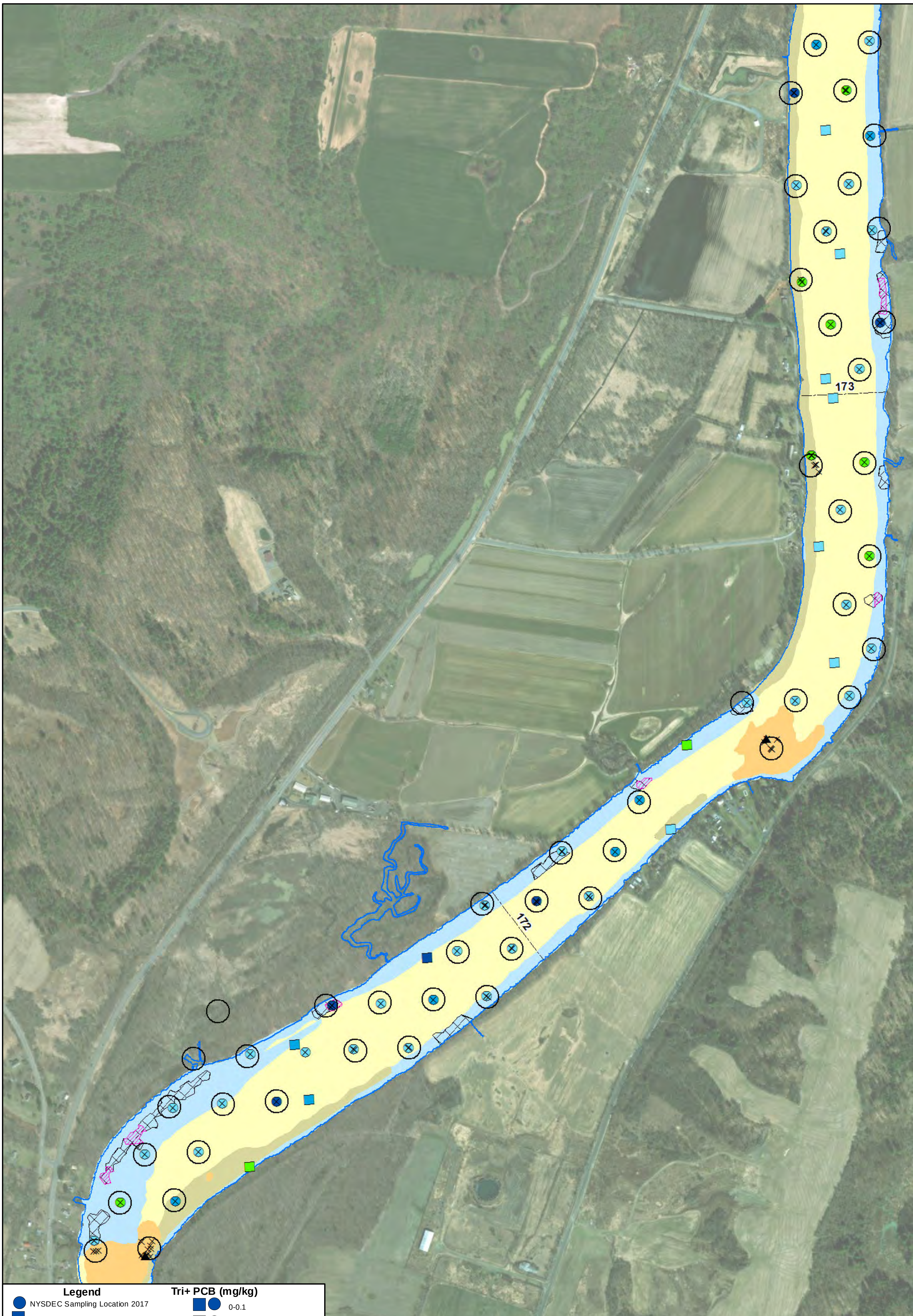
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1j

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

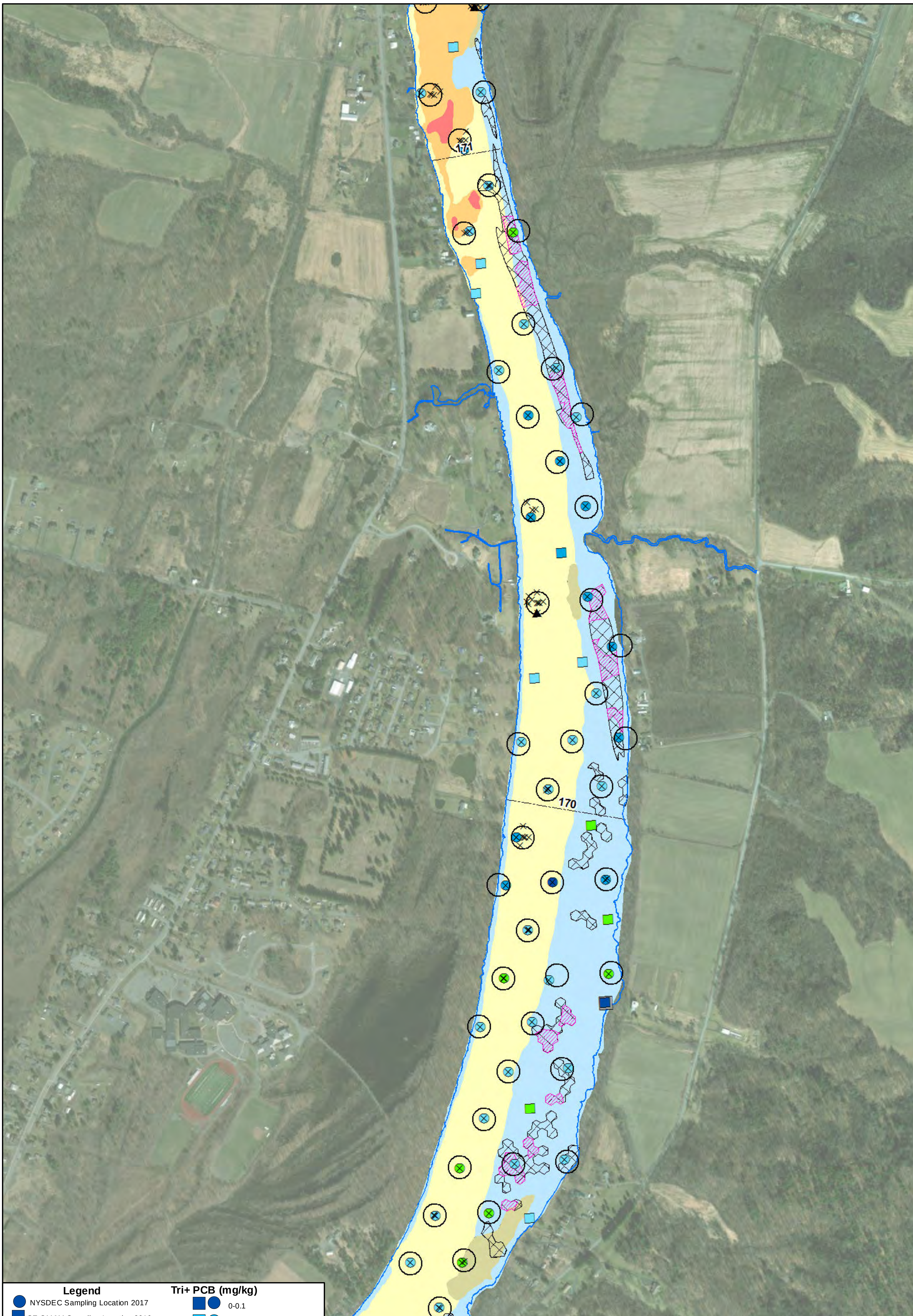
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1k

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016
2017 NYSDEC Proposed Locations
2017 NYSDEC Attempted Locations

Sediment Type

Silt
Silt and Sand
Gravel
Transitional
Bed Rock

Tri+ PCB (mg/kg)

0-0.1
0.11-0.3
0.31-1.0
1.1-3.0
3.1-10.0
10.1-30.0
30.1-100.0
Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

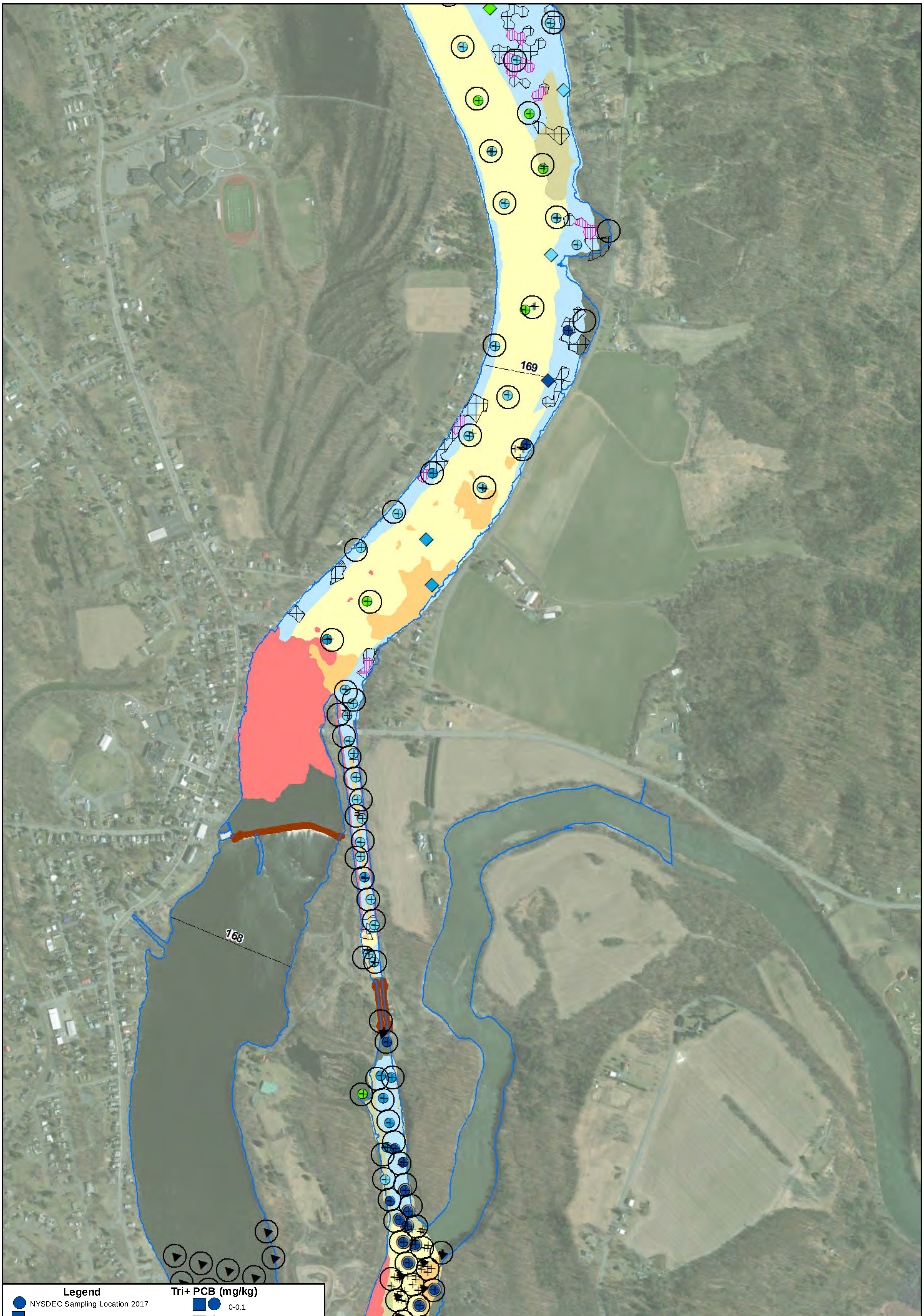
***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1l

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1m

N

0 15 30 Miles

Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- X 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

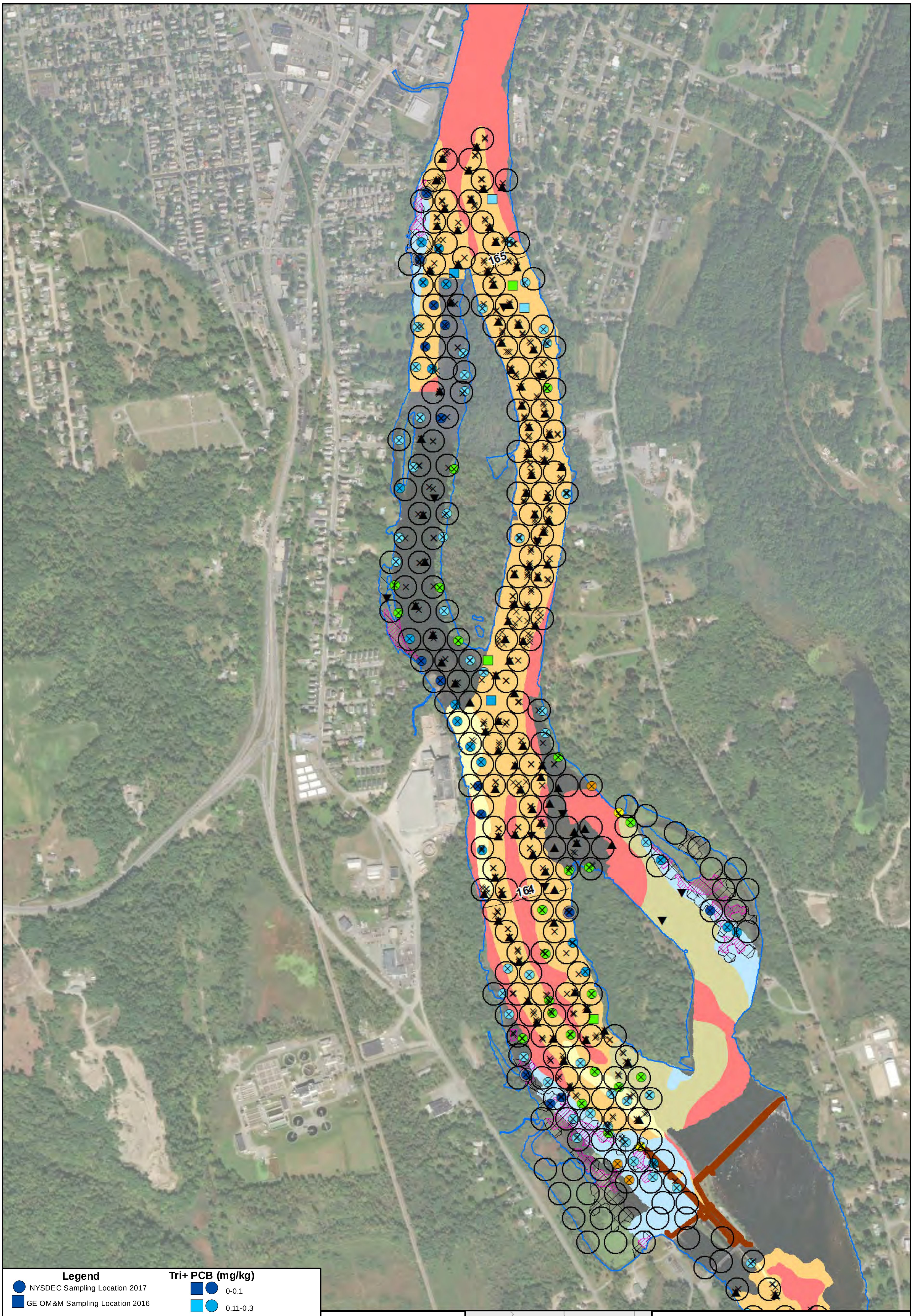
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1n

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

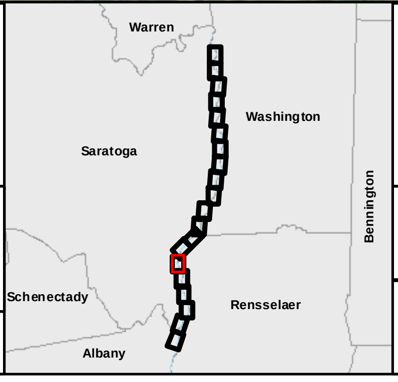
* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

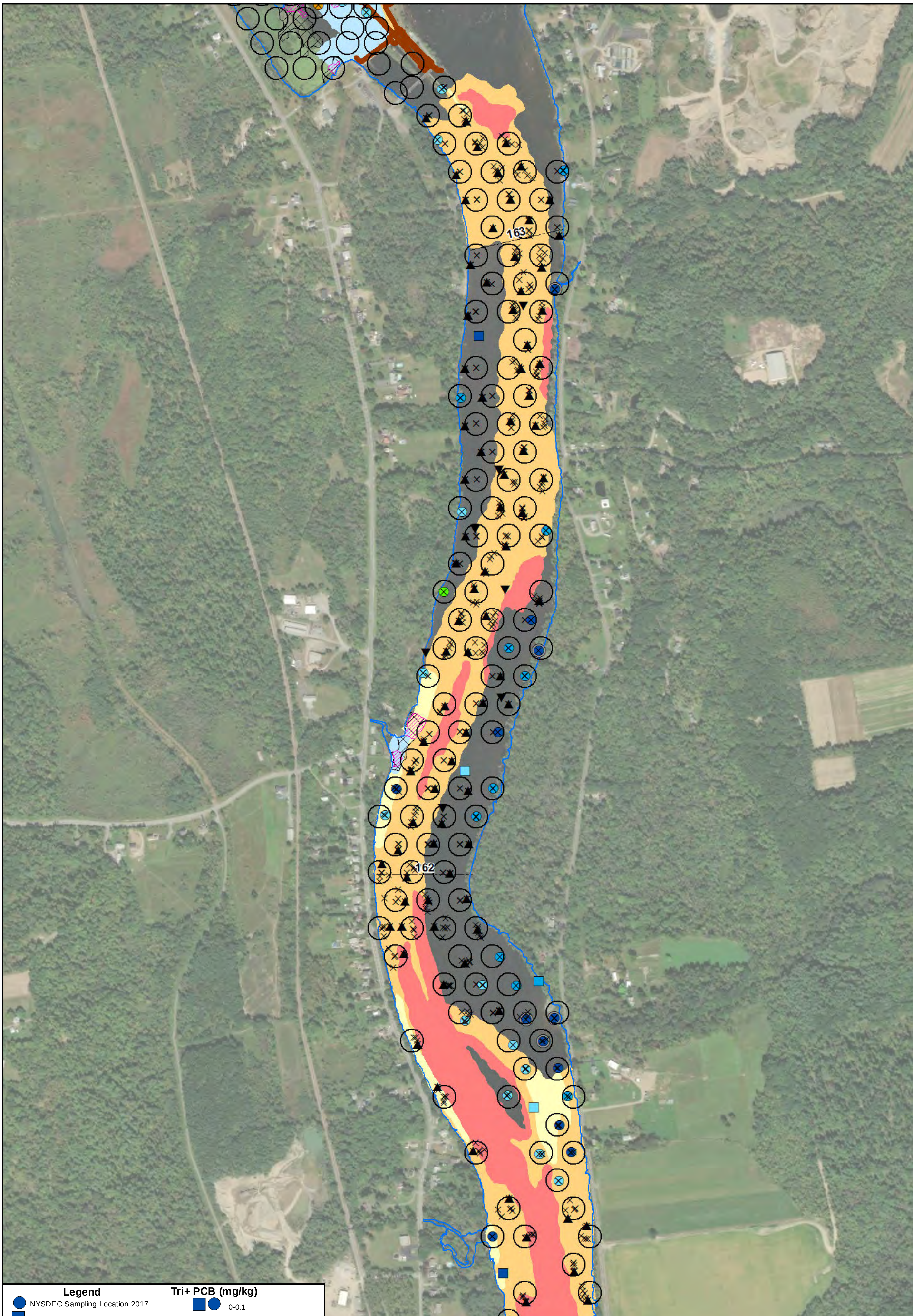


2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1o

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

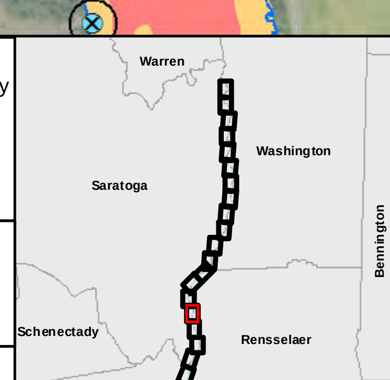
* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

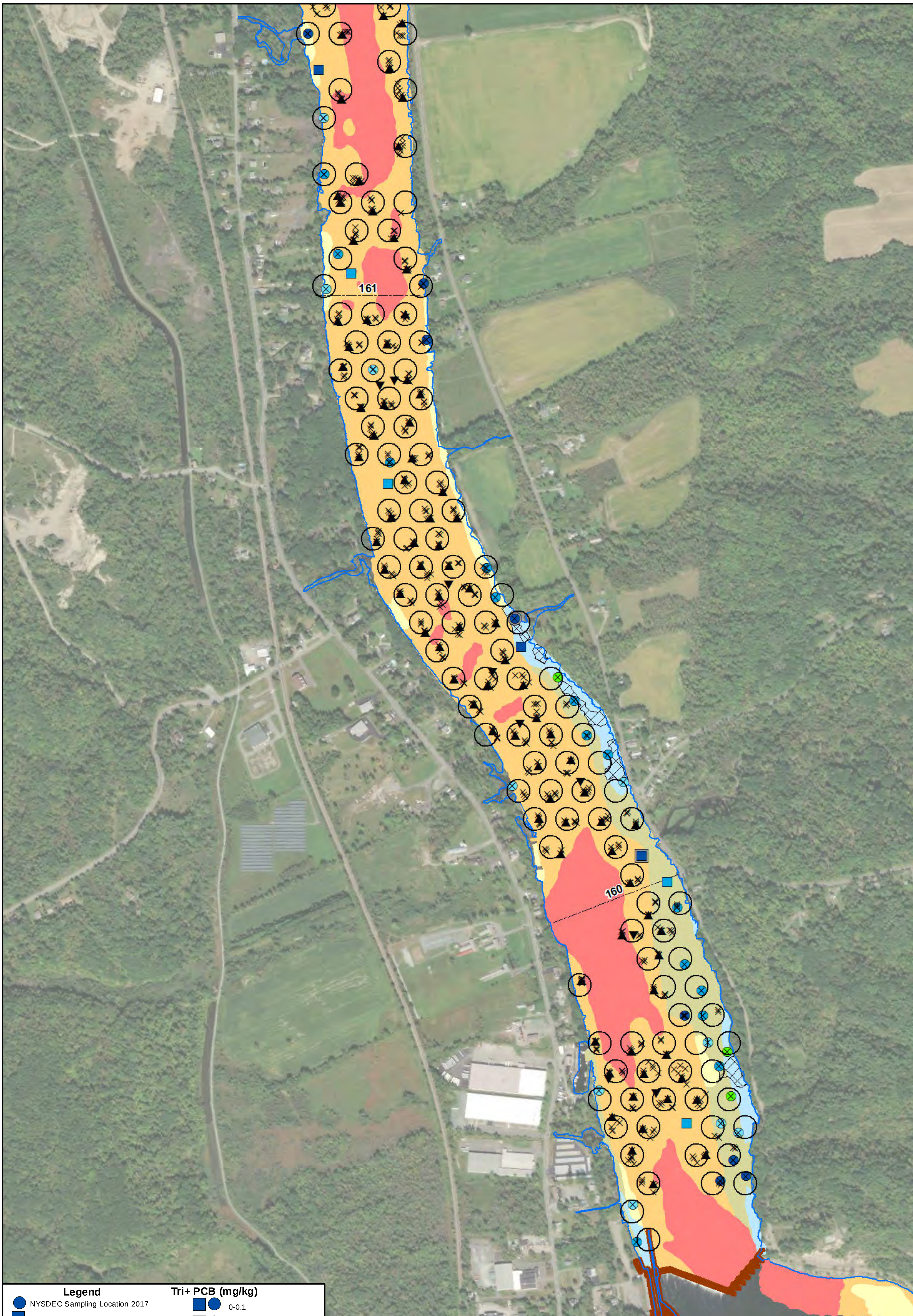


2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1p

N
0 15 30
Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

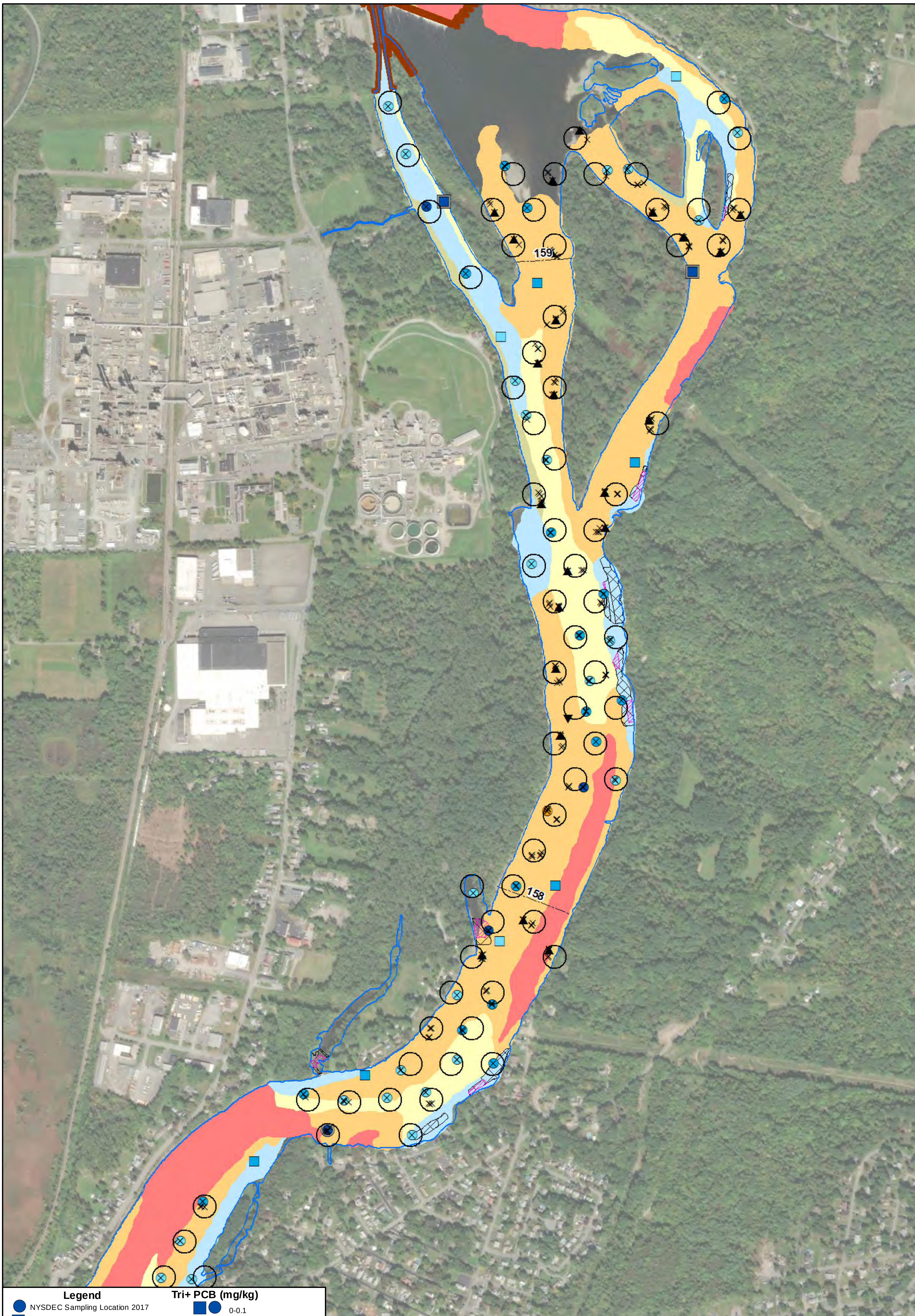
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1q

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

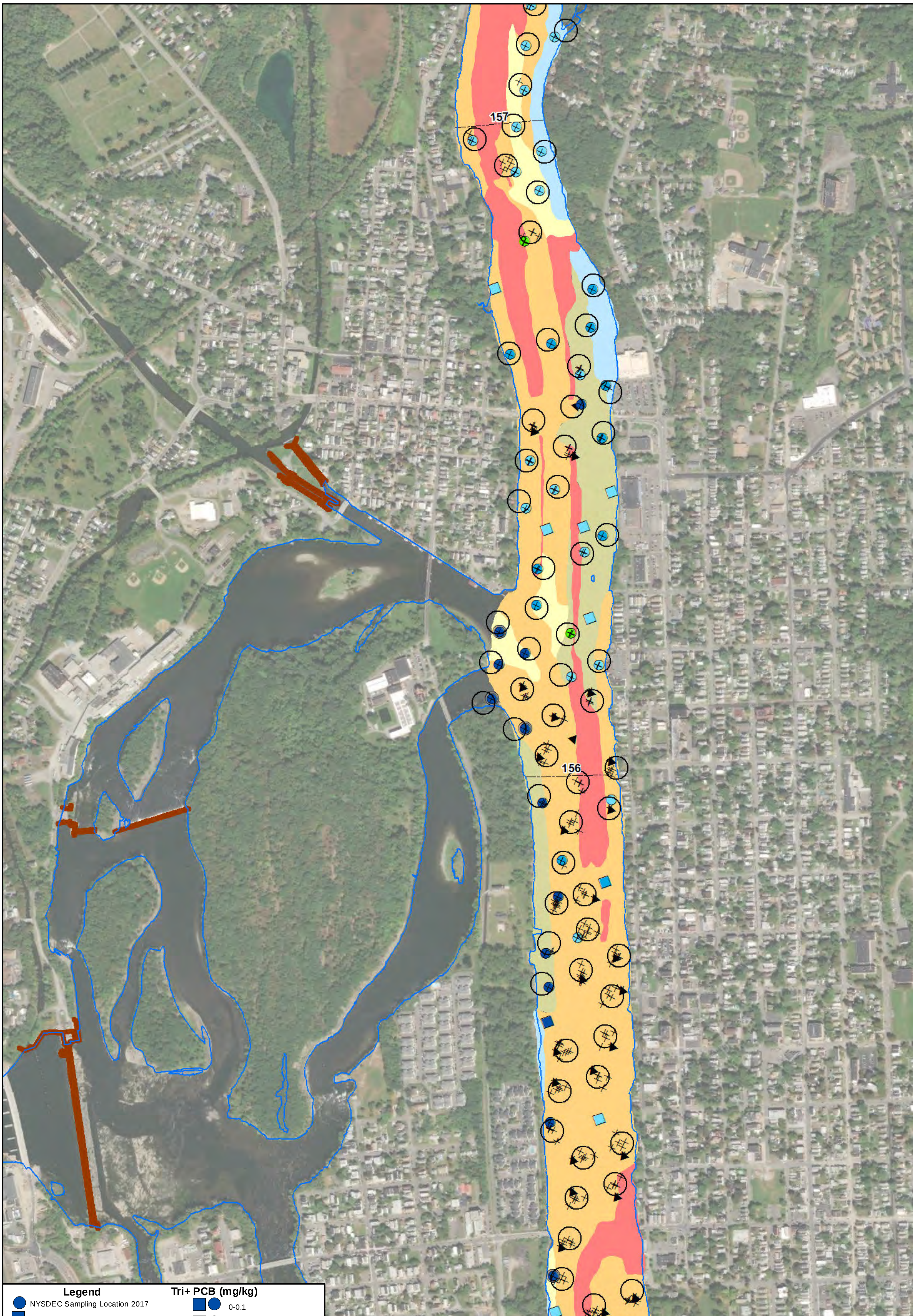
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1r

N

0 15 30 Miles

Document Path: M:\02859919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

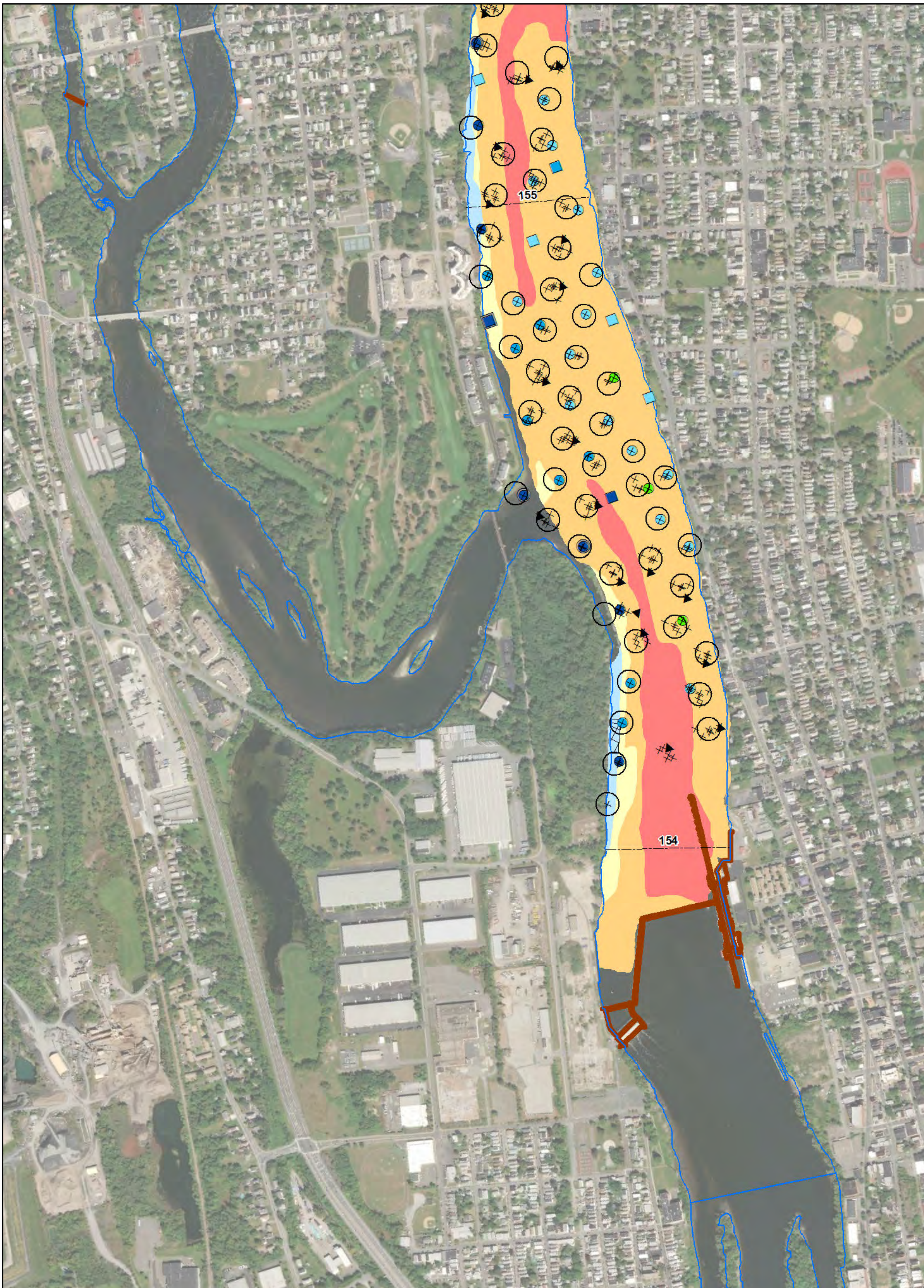
2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1s

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016
- 2017 NYSDEC Proposed Locations
- 2017 NYSDEC Attempted Locations

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

* Removed Locations are identified on the map with hollow circles (proposed locations with no x-attempts)
**Landcut Points are included on this map

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

***Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

April 2019

2017 NYSDEC Proposed and Attempted Locations and 2016 EPA/GE Sediment Tri+ PCB Data (mg/kg)

Figure 2.1-1t

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\2.1-1 Tri+PCB Proposed and Attempted.mxd

Successful Locations
(Recoverable Sediment)

Sample Attempted → Collection Successful

Potential Data from Location

Gross Physical Observations	Detailed Physical Observations	Chemical Analytical Results
• Side Scan Sonar • Observed Sediment Texture Category • Water Depth • Vegetation	• Soil Classification • Grain Size Analysis (if material available)	• PCB via M8082 [Aroclors] • PCB via 1668c [Congeners]

Abandoned Locations
(No Recoverable Sediment)

Sample Attempted → Collection Unsuccessful

Potential Data from Location

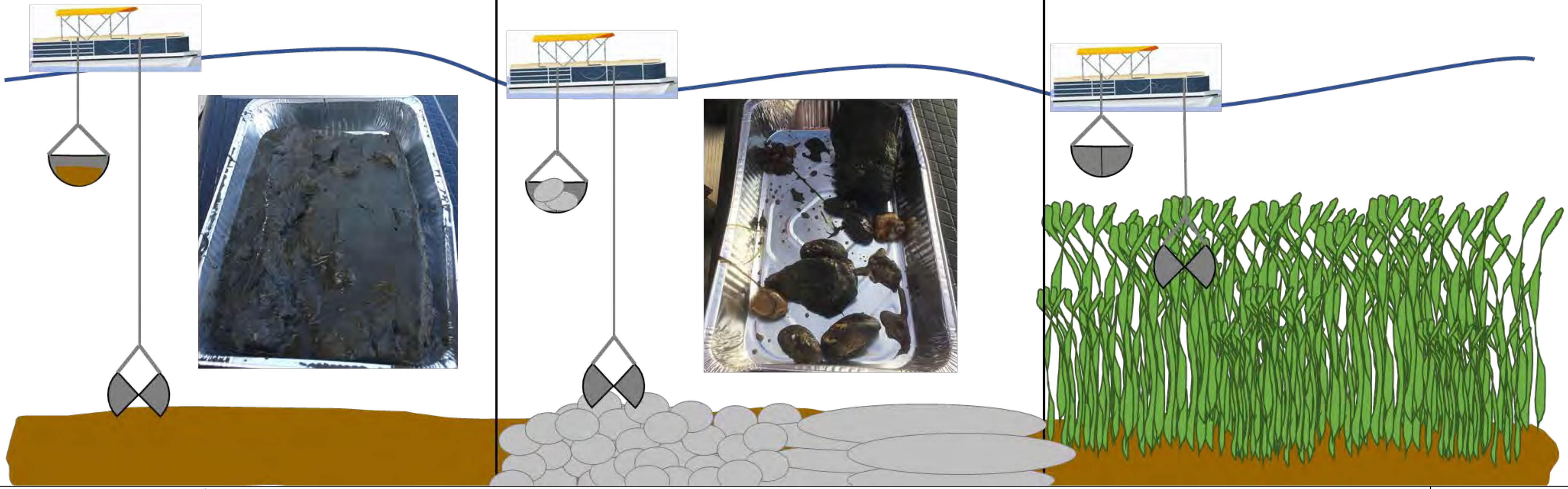
Gross Physical Observations	Detailed Physical Observations	Chemical Analytical Results
• Side Scan Sonar • Observed Sediment Texture Category • Water Depth • Vegetation	• Soil Classification • Grain Size Analysis (if material available)	• None

Removed Locations
(No Available Access to Sediment)

Sediment was not accessible due to vegetation or river conditions

Potential Data from Location

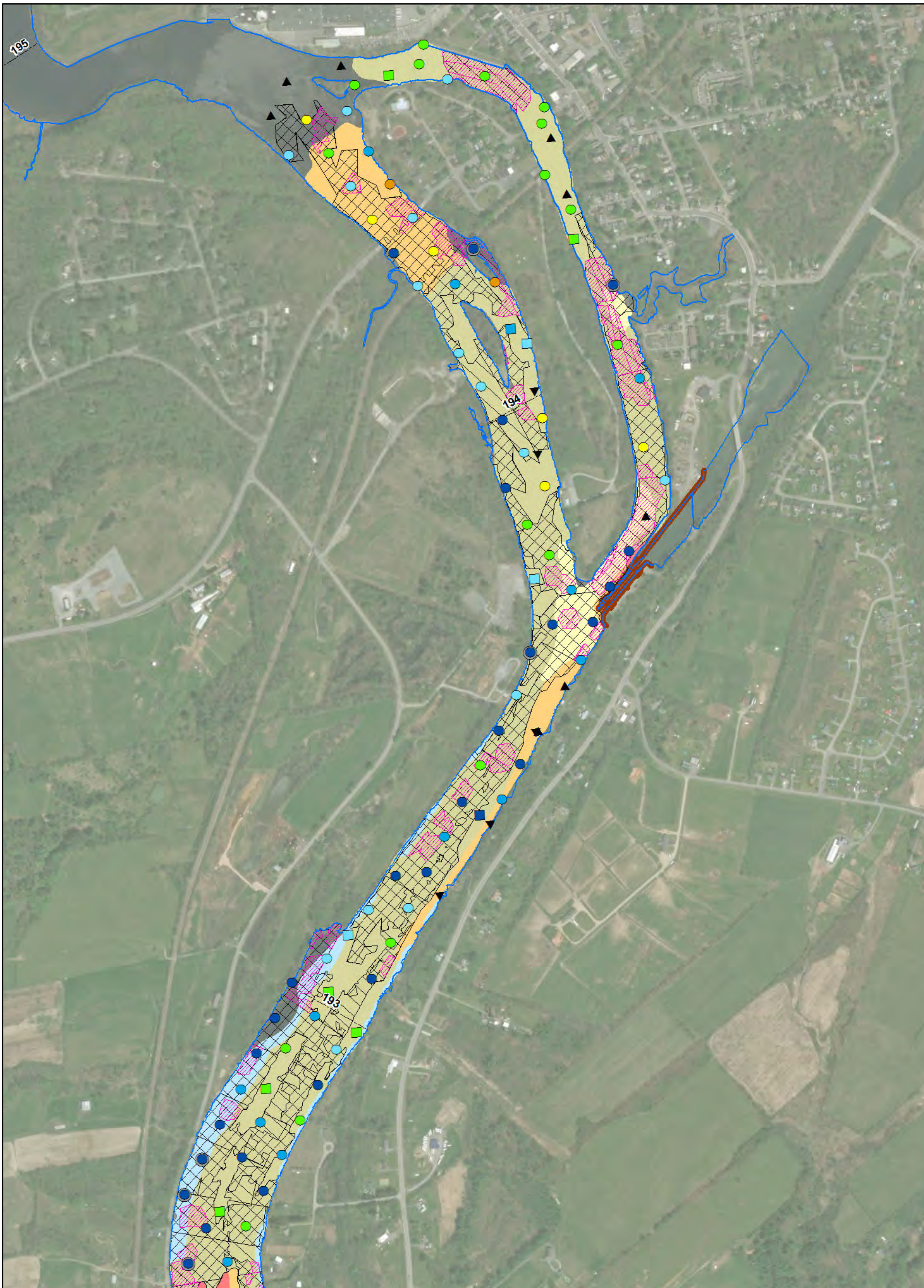
Gross Physical Observations	Detailed Physical Observations	Chemical Analytical Results
• Side Scan Sonar • Observed Sediment Texture Category • Water Depth • Vegetation	• None	• None



Sample Location Types – Successful, Abandoned and Removed

Figure 2.1-2

April 2019



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East Datum: NAD 83

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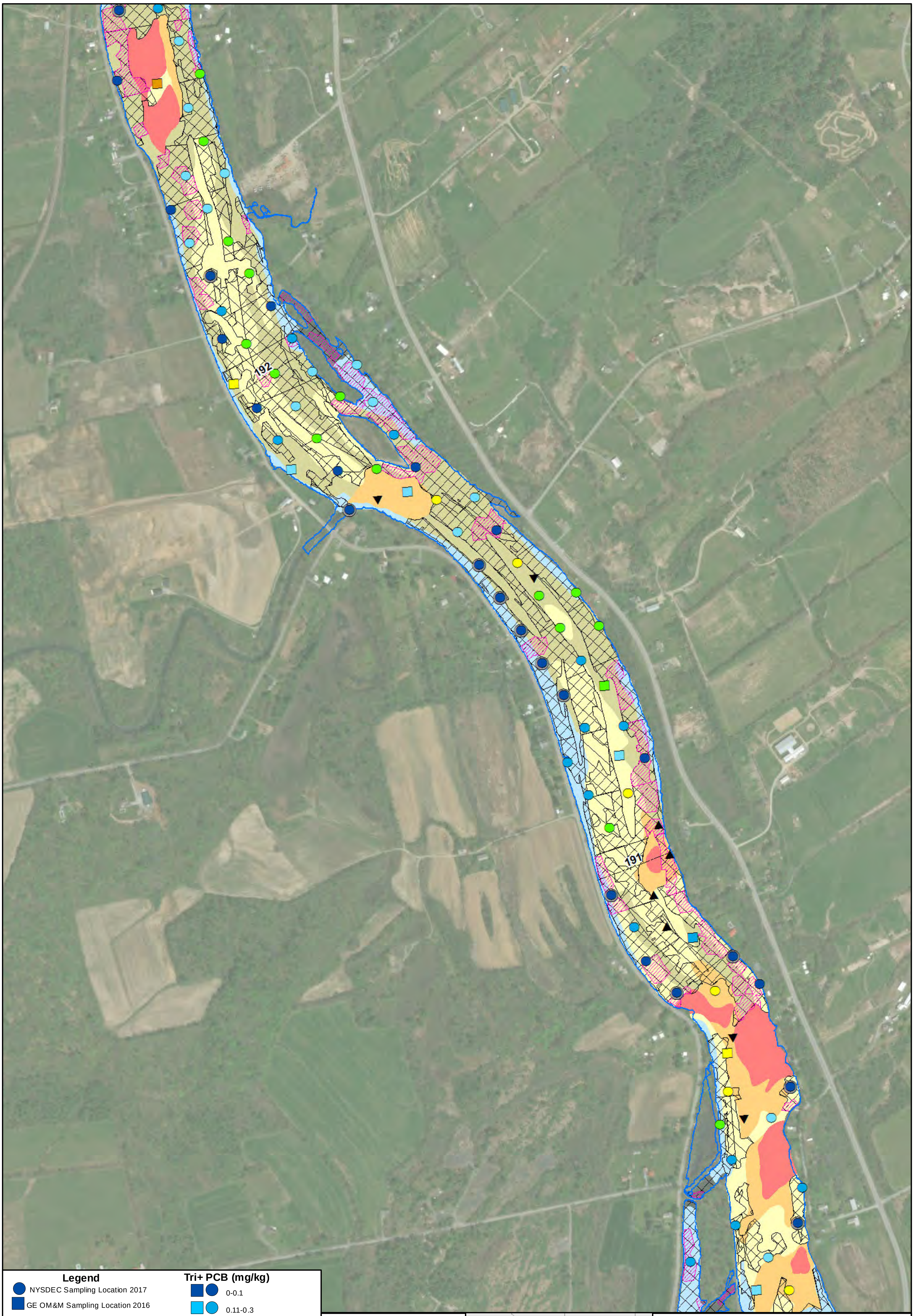
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1a

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\3.0-1 Tri+PCB.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
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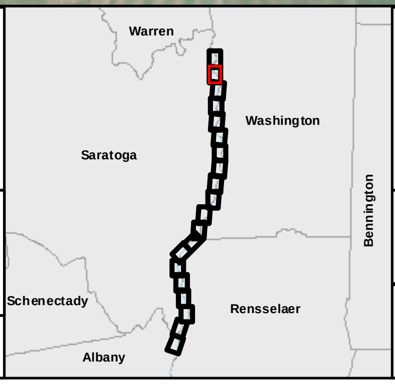


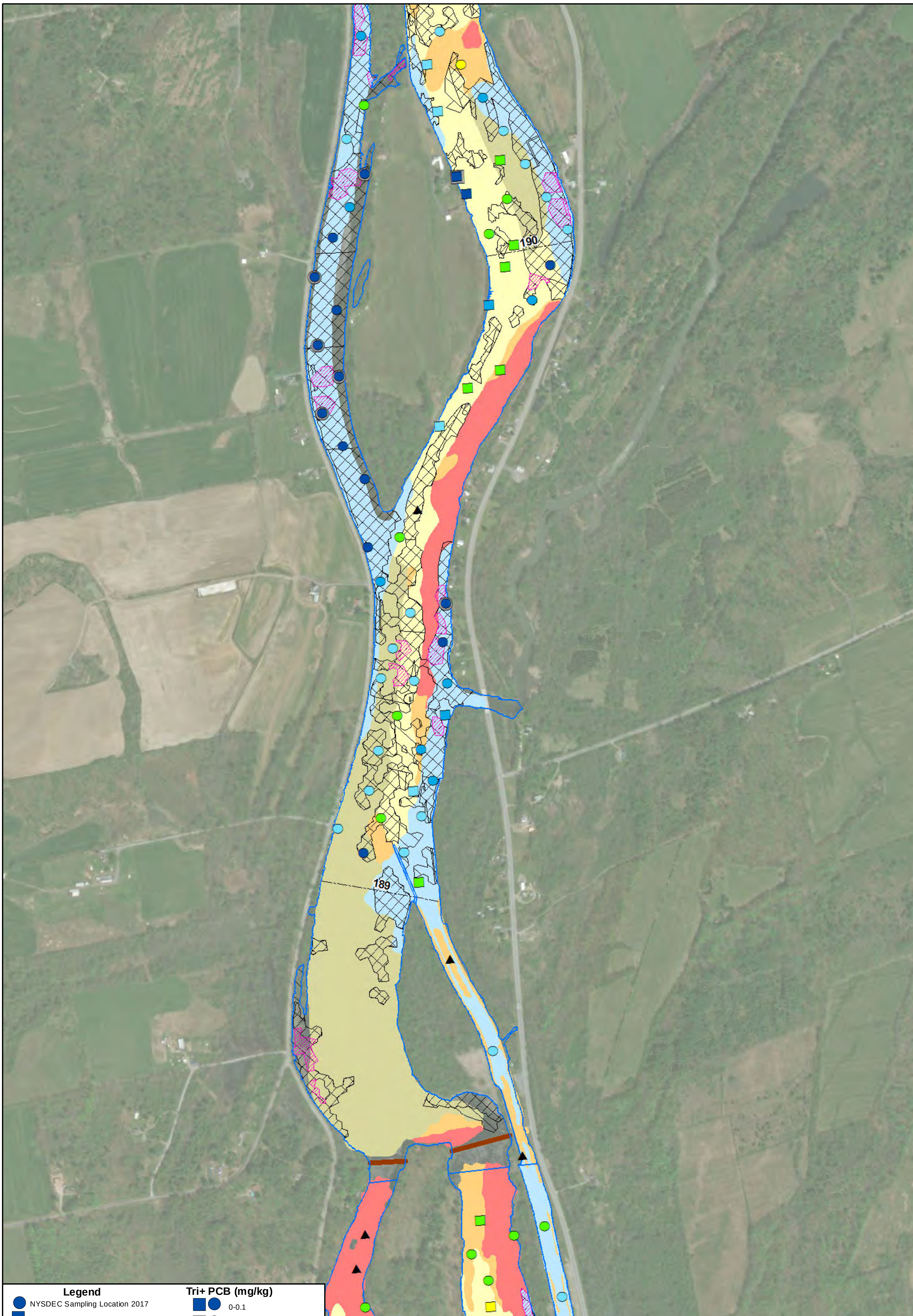
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1b

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

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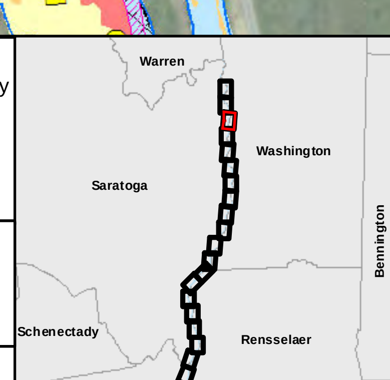
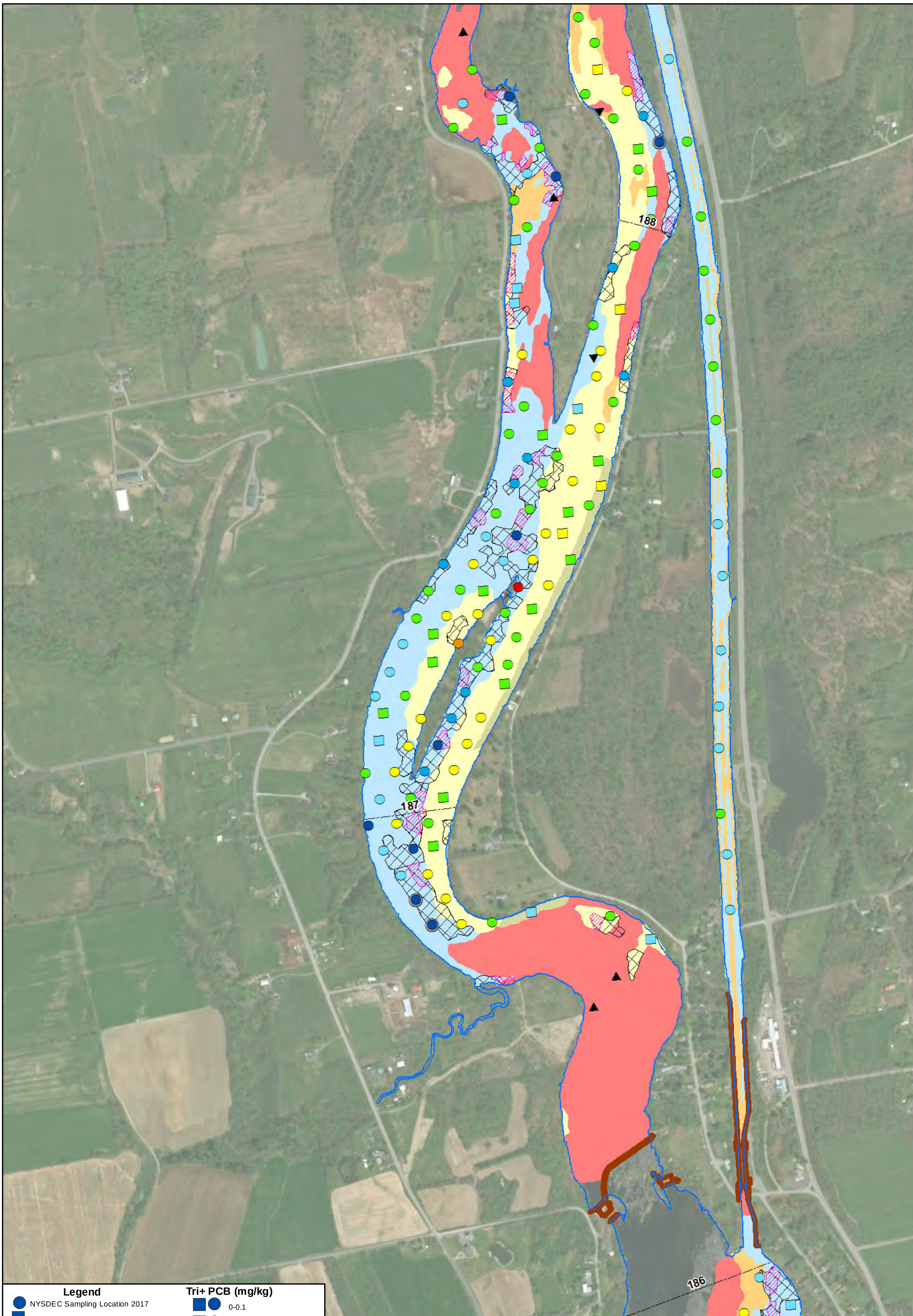


2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1c

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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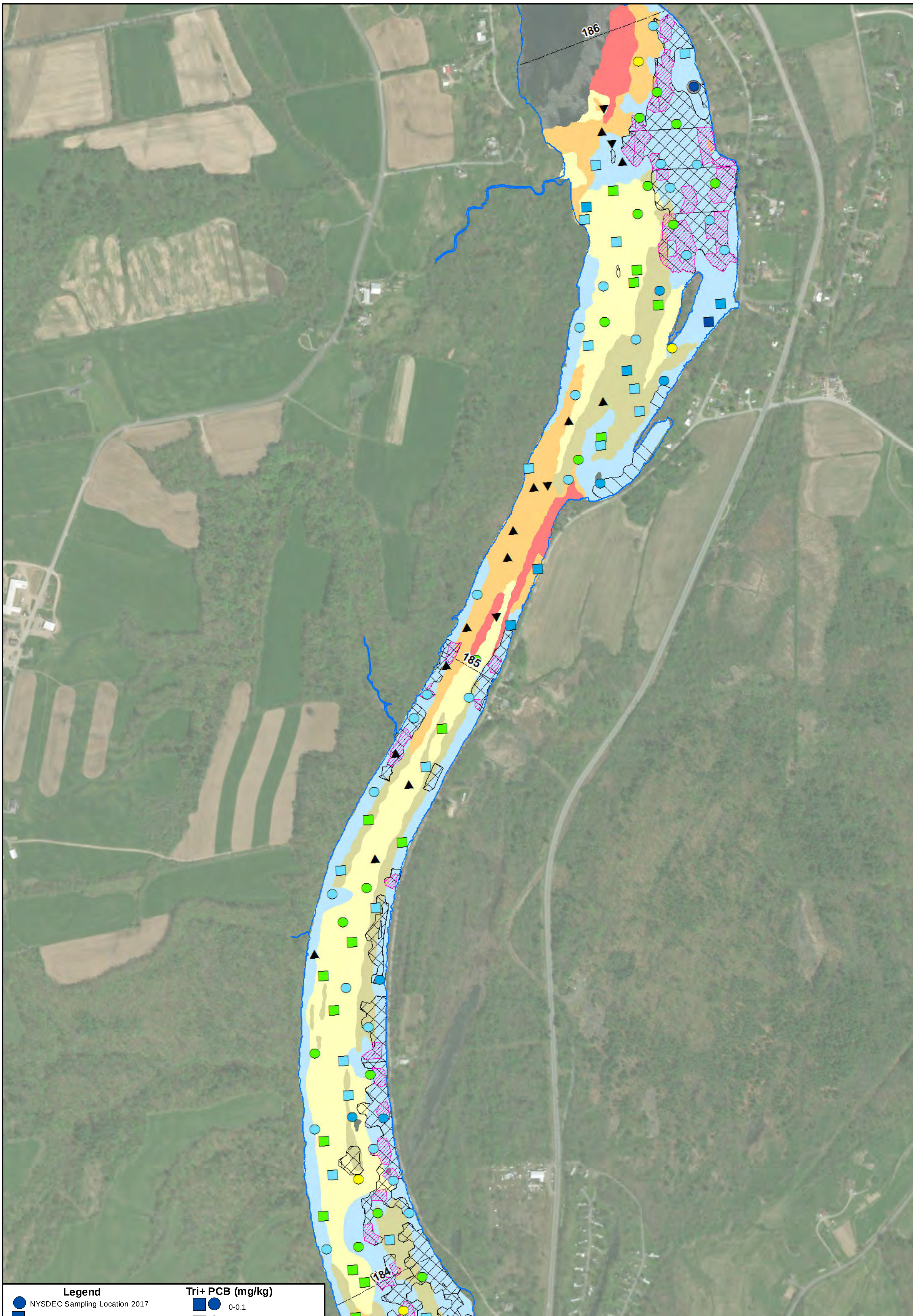
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1d

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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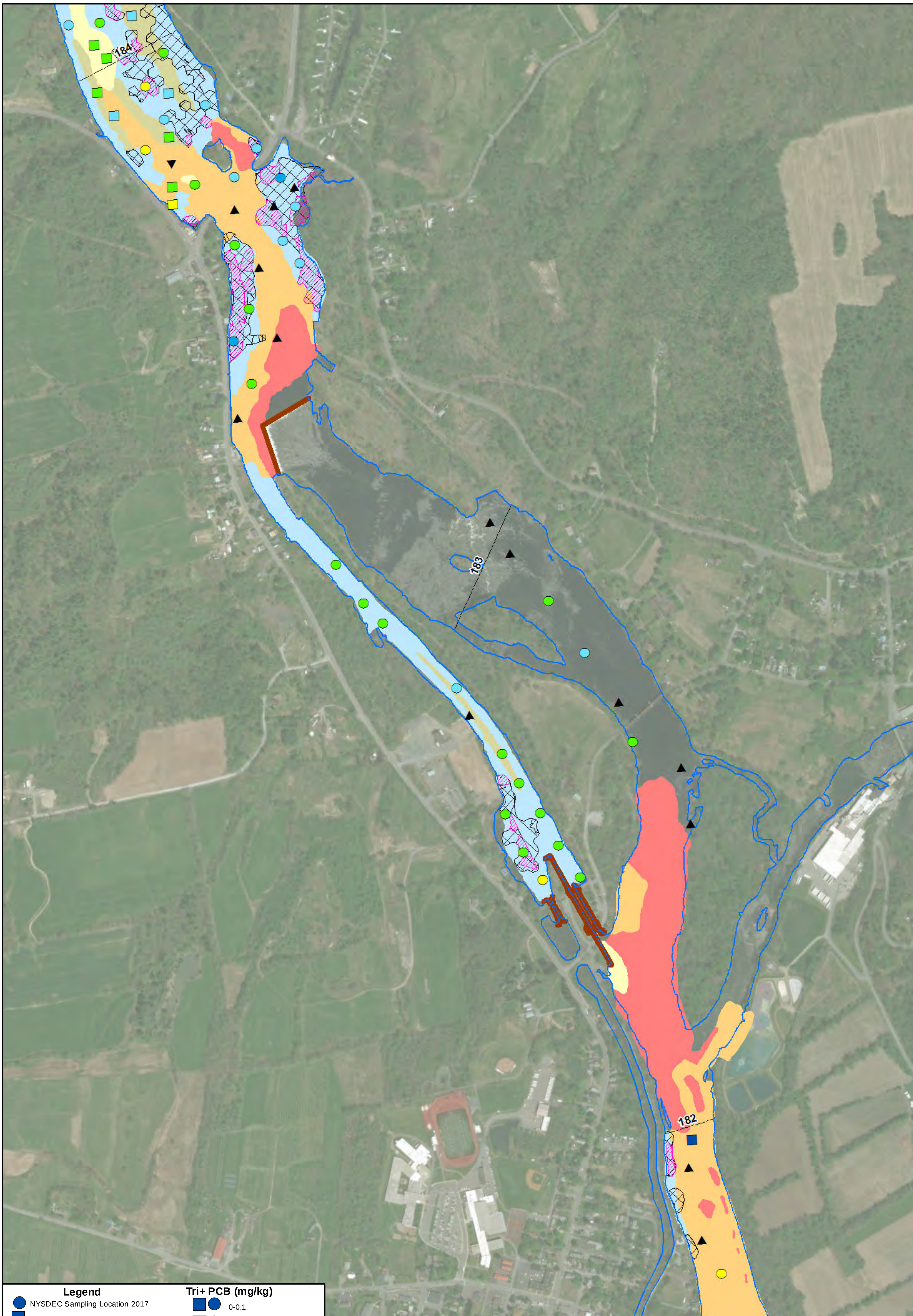
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1e

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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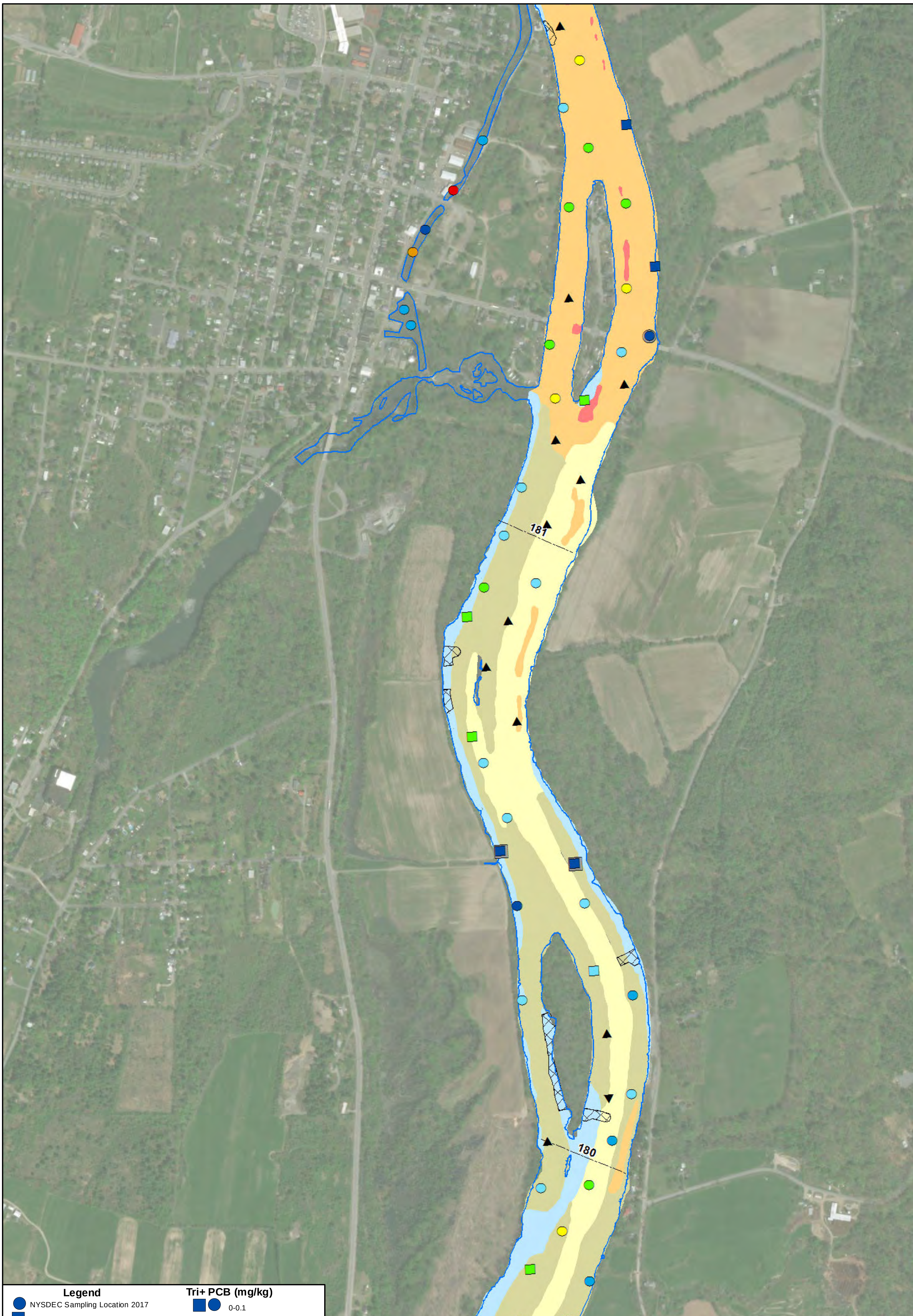
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1f

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type

Silt
Silt and Sand
Gravel
Transitional
Bed Rock

Tri+ PCB (mg/kg)

0-0.1
0.11-0.3
0.31-1.0
1.1-3.0
3.1-10.0
10.1-30.0
30.1-100.0

Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

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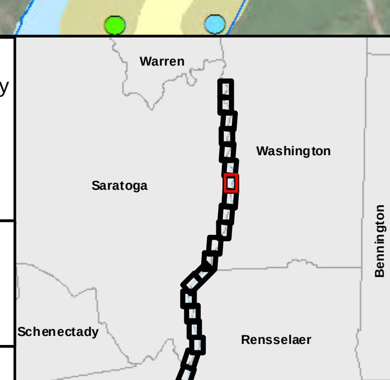
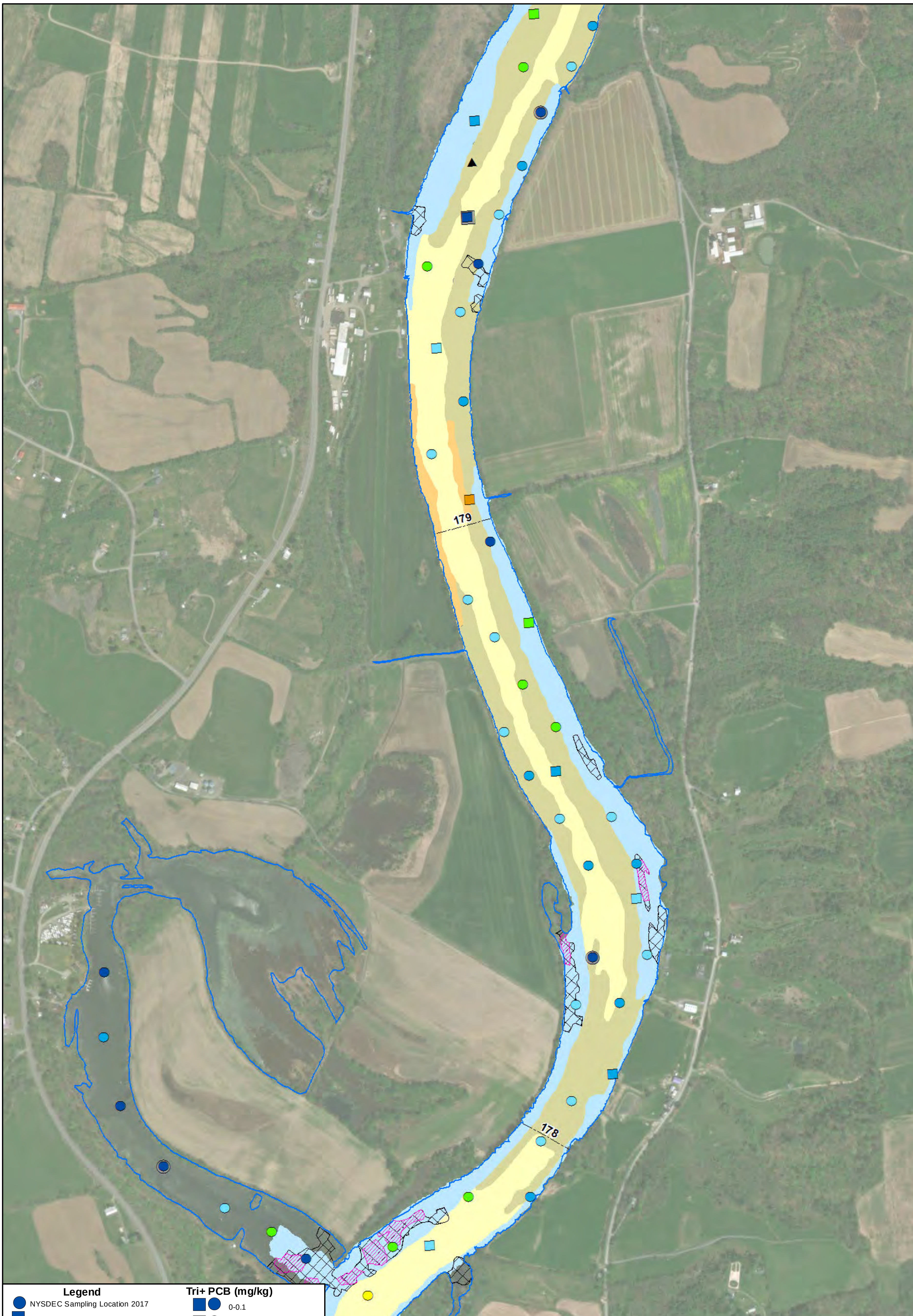


2017 NYSDEC and 2016 EPA/GE
Sediment Data
Tri+ PCB Data (mg/kg)

Figure 3.0-1g

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
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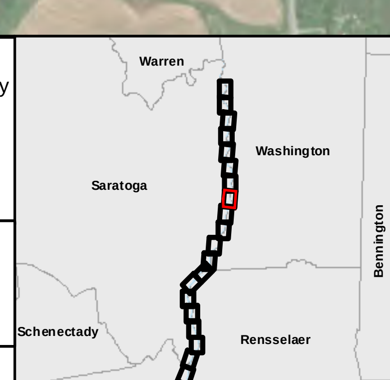
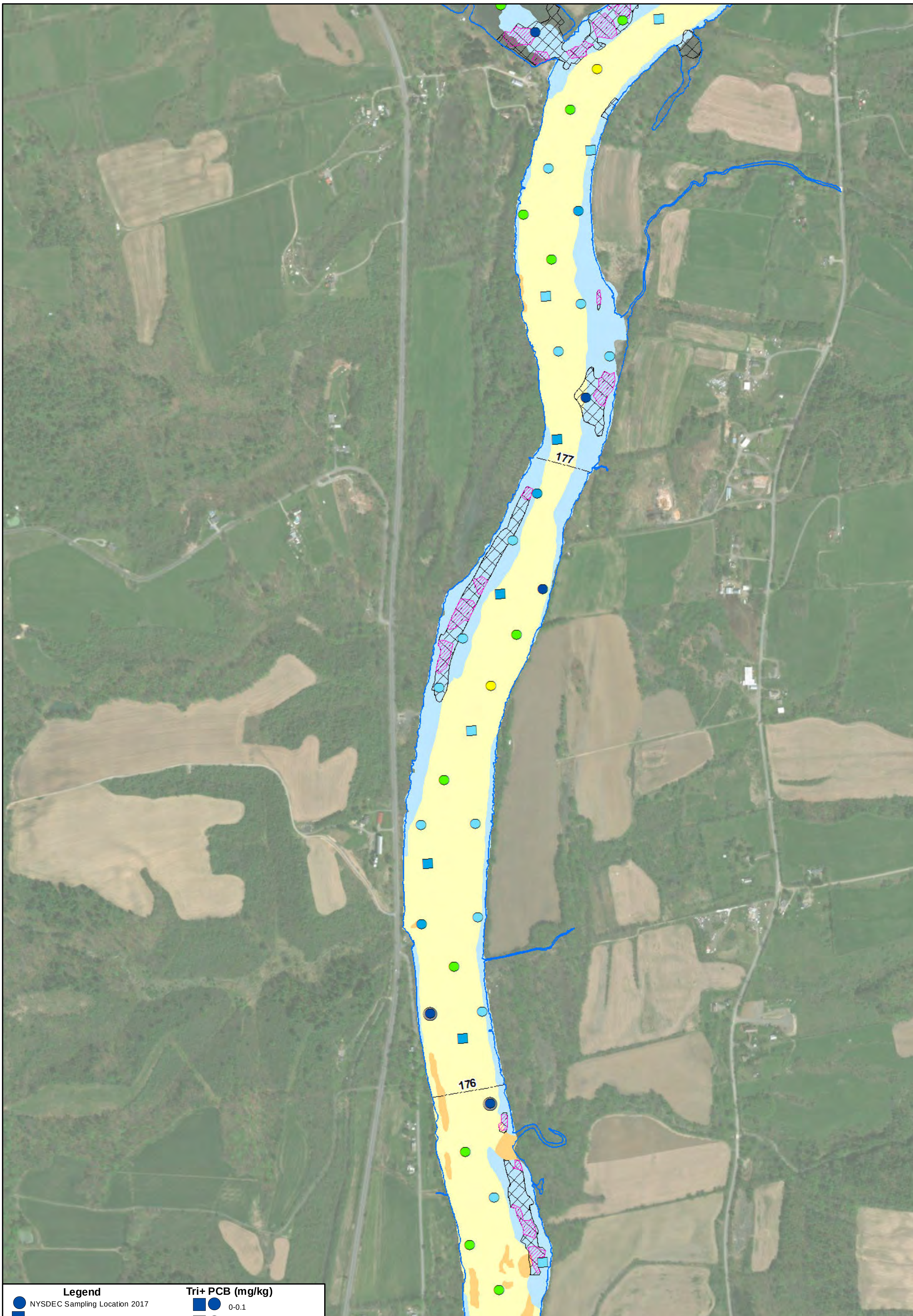


2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1h

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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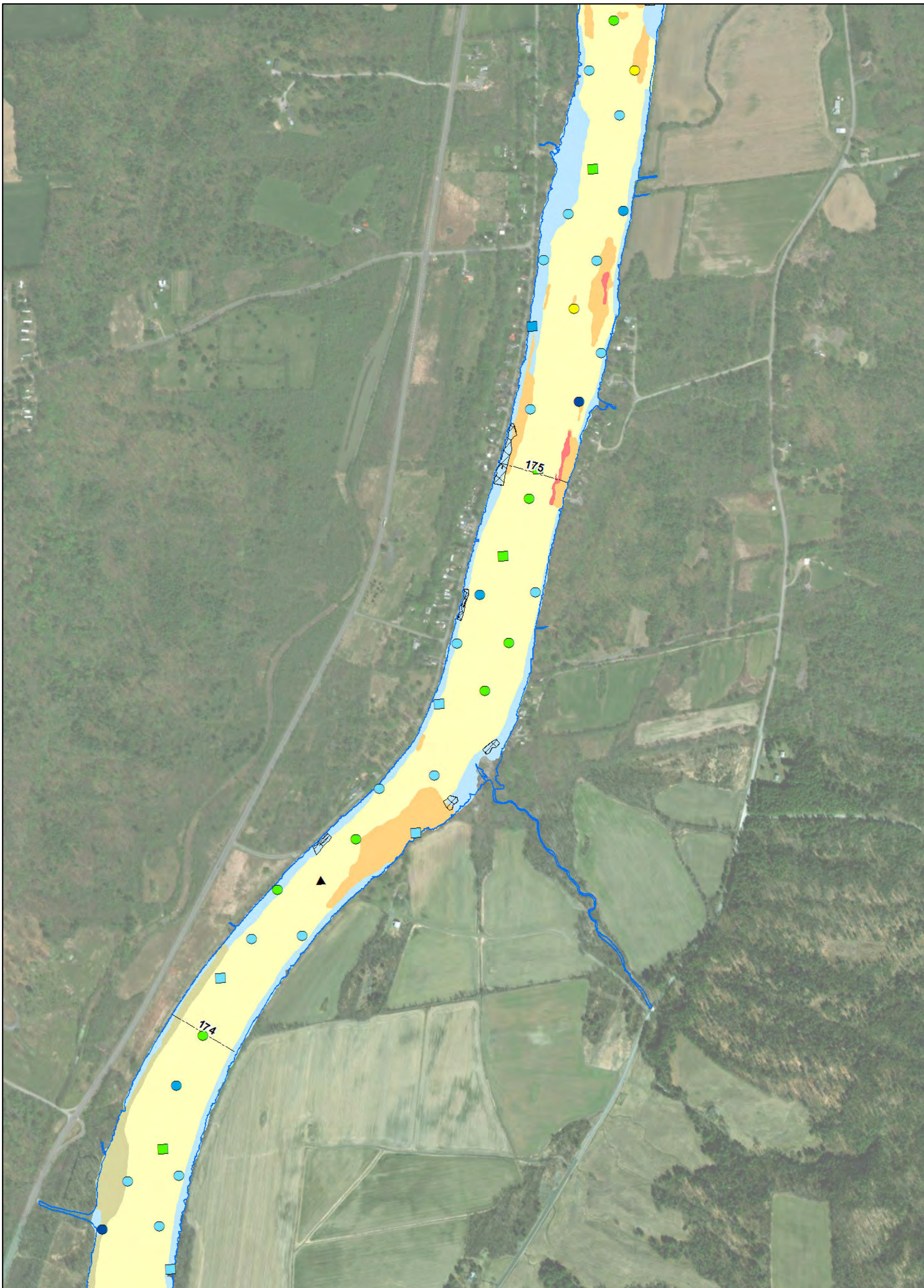
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1i

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

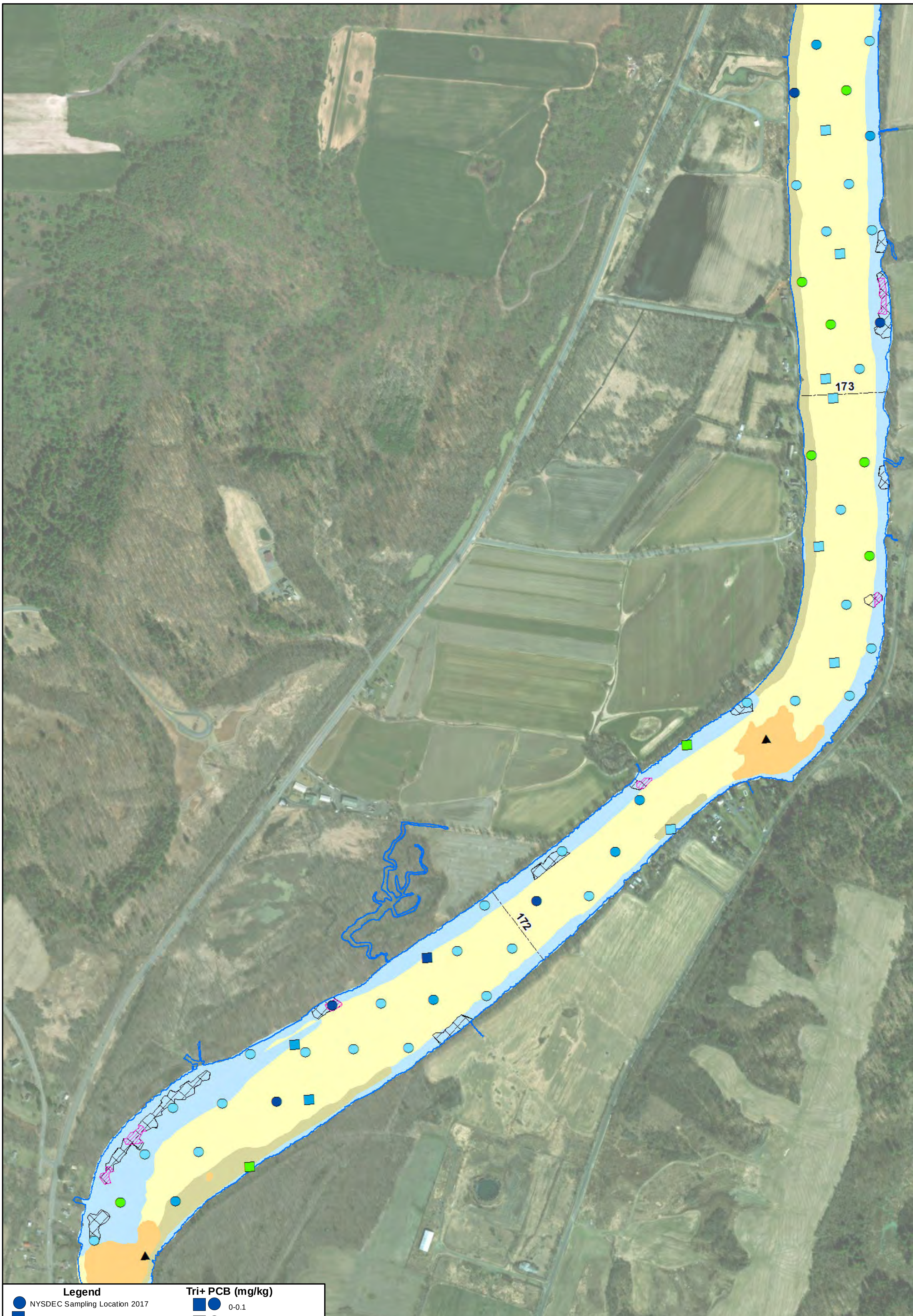
Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1j

N
0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- ▲ NYSDEC Abandoned Location 2017
- ▼ GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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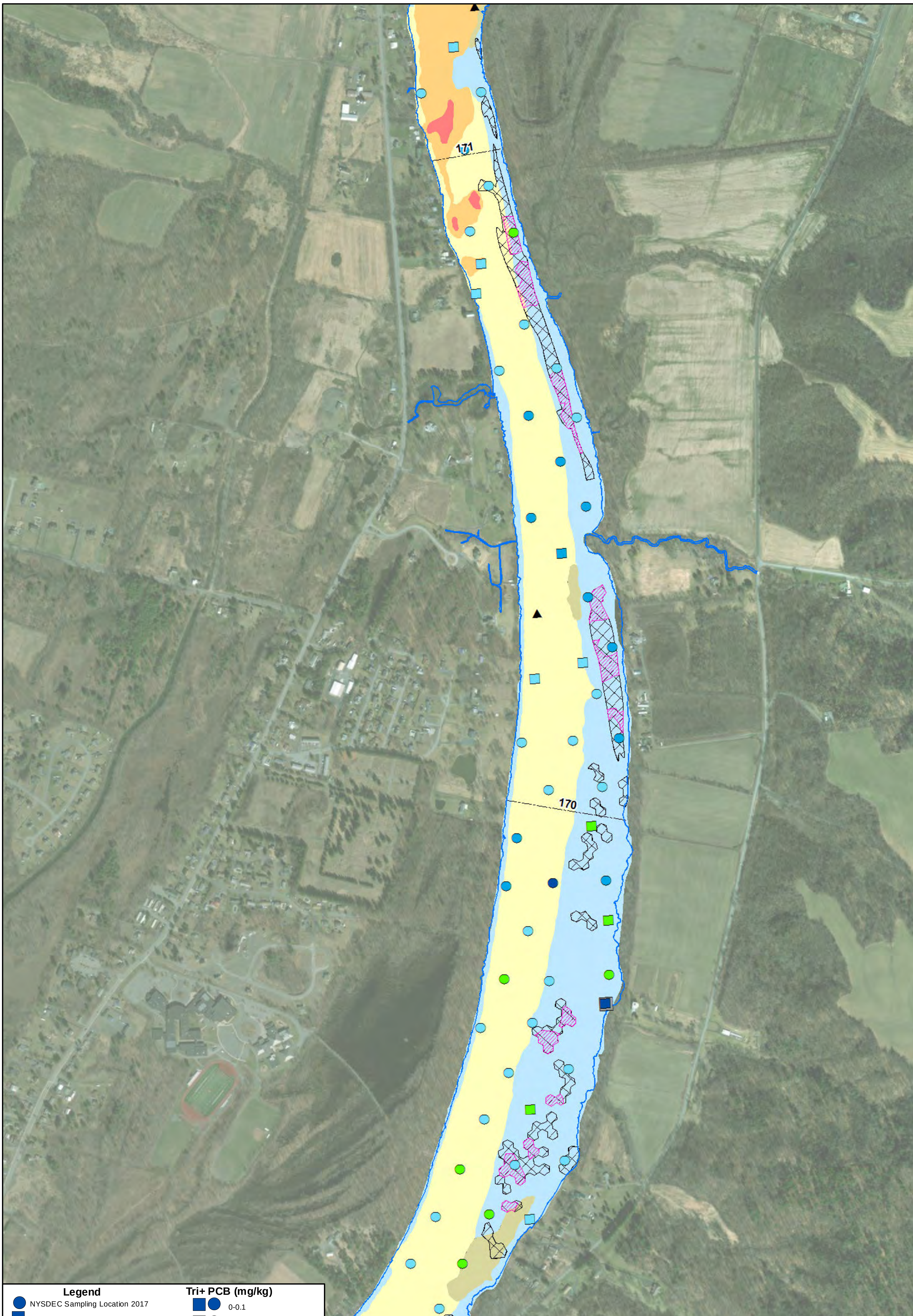
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1k

N 0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

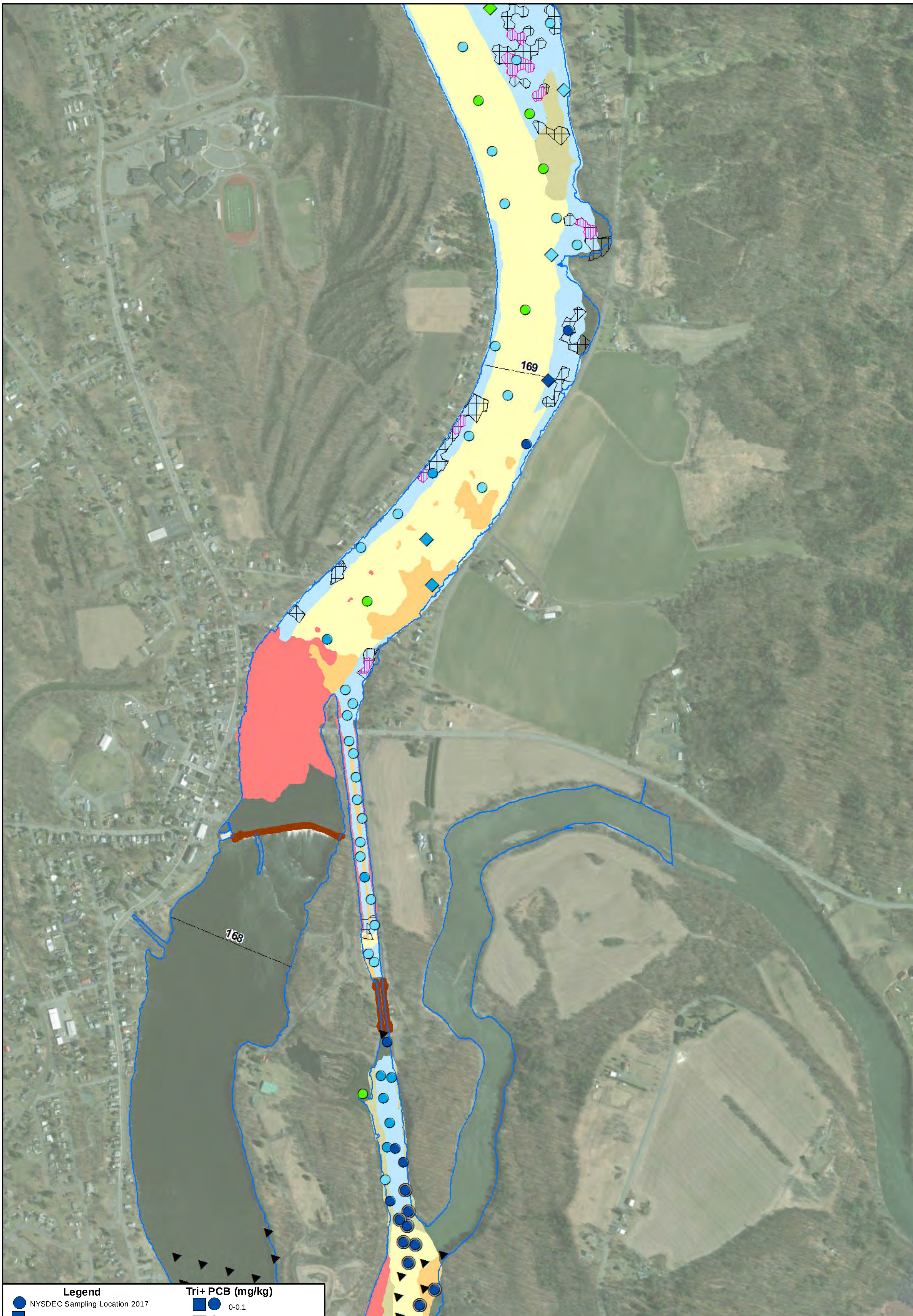
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1l

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

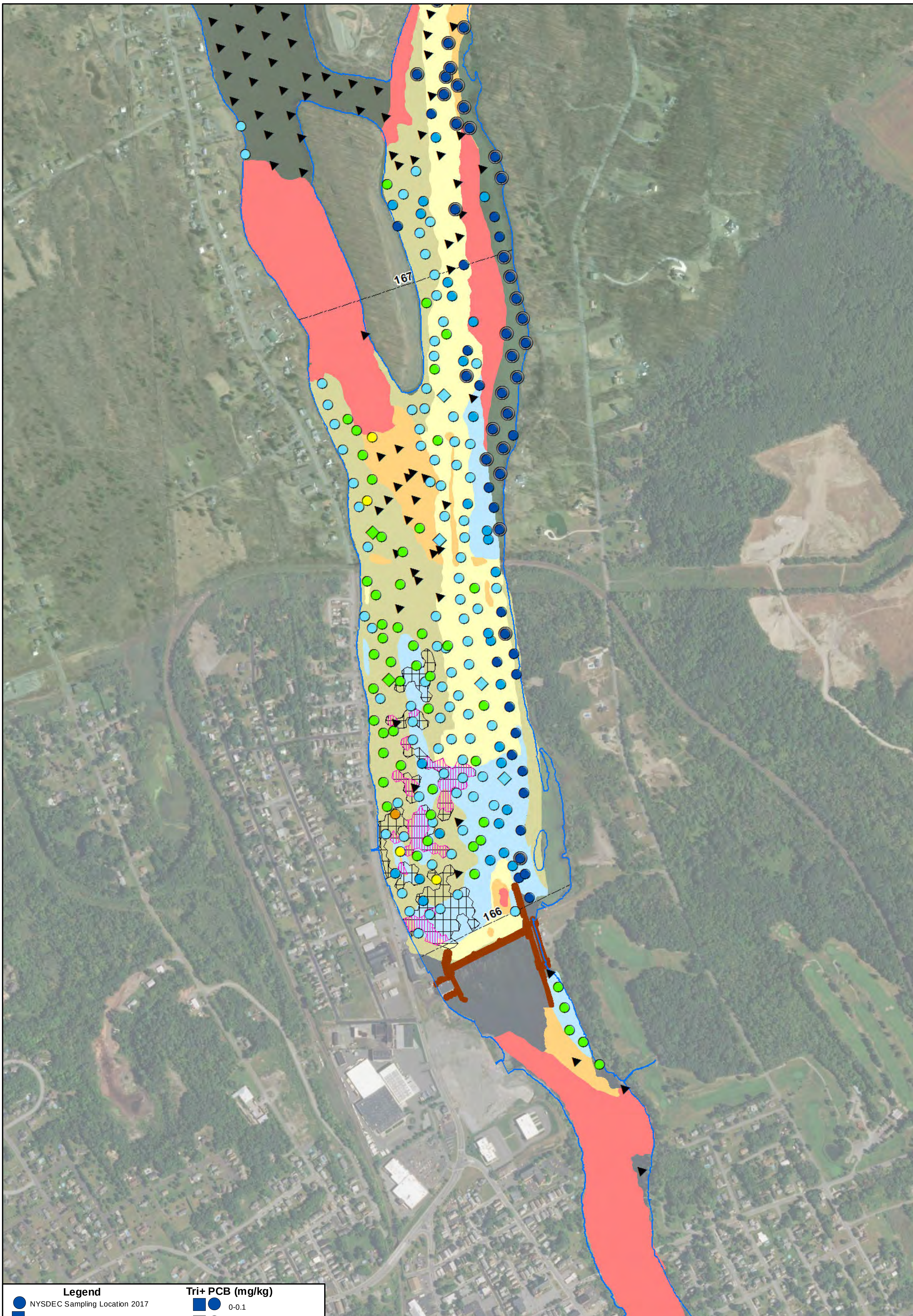
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1m

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

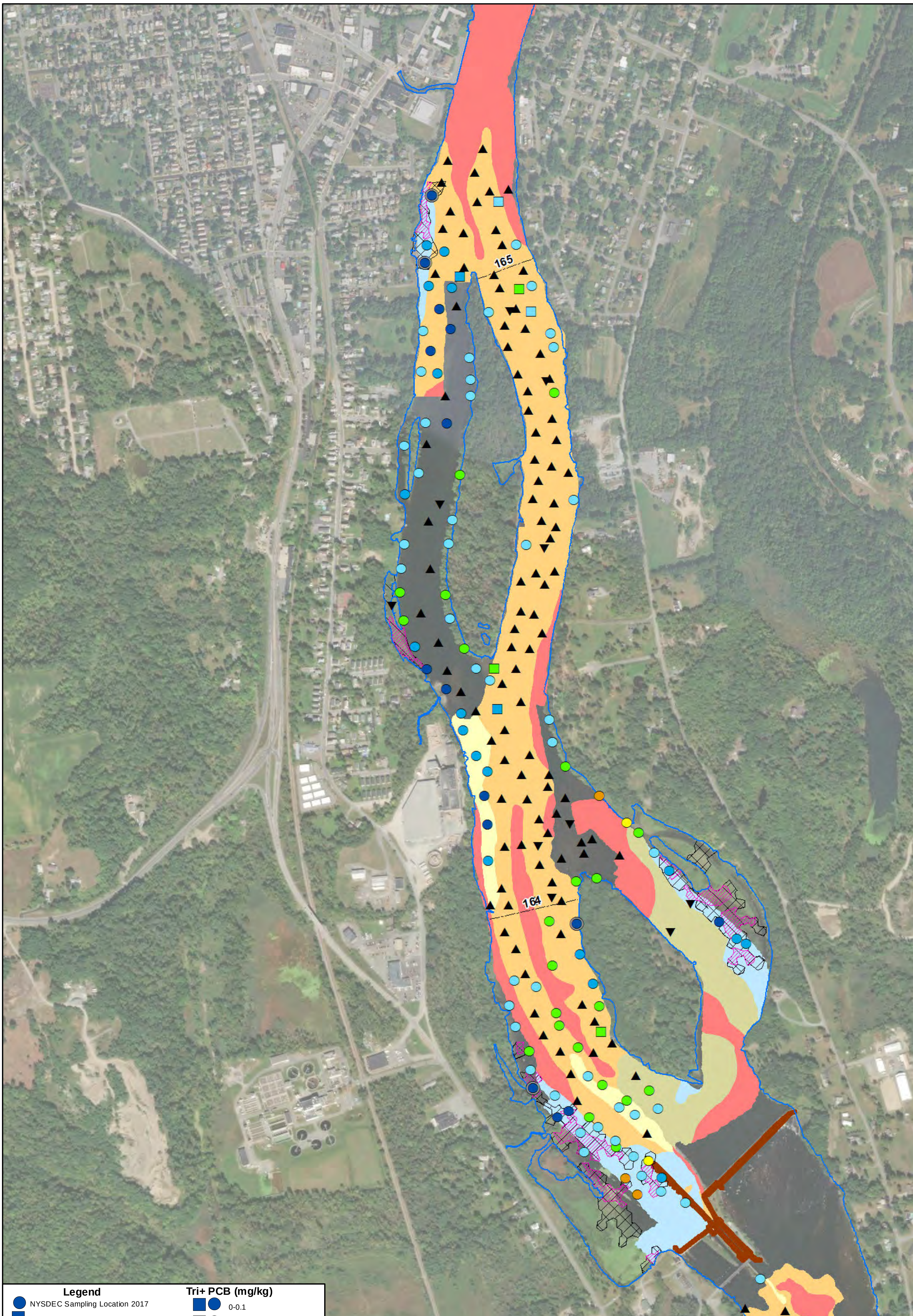
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1n

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

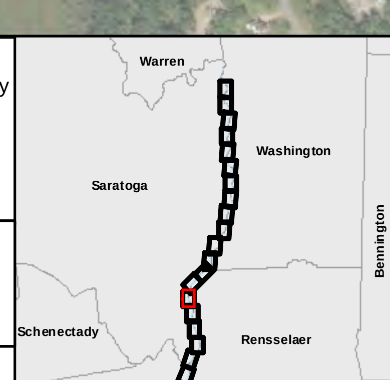
- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

April 2019

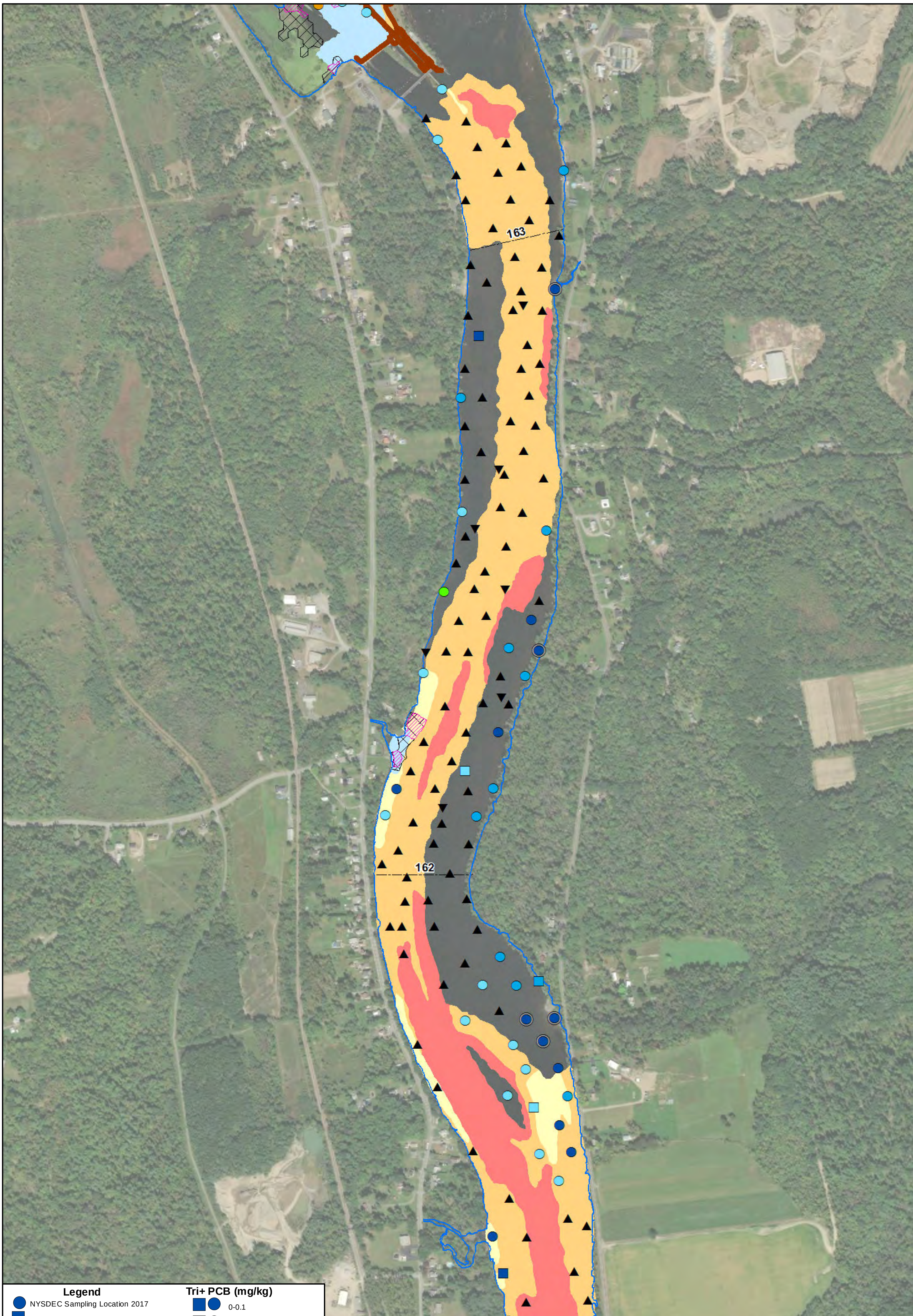


2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1o

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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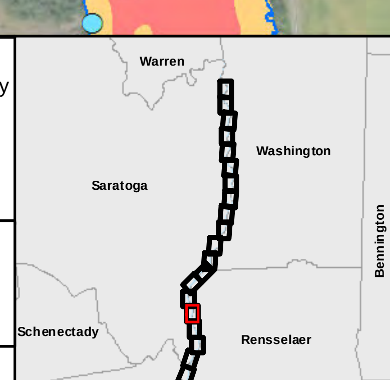


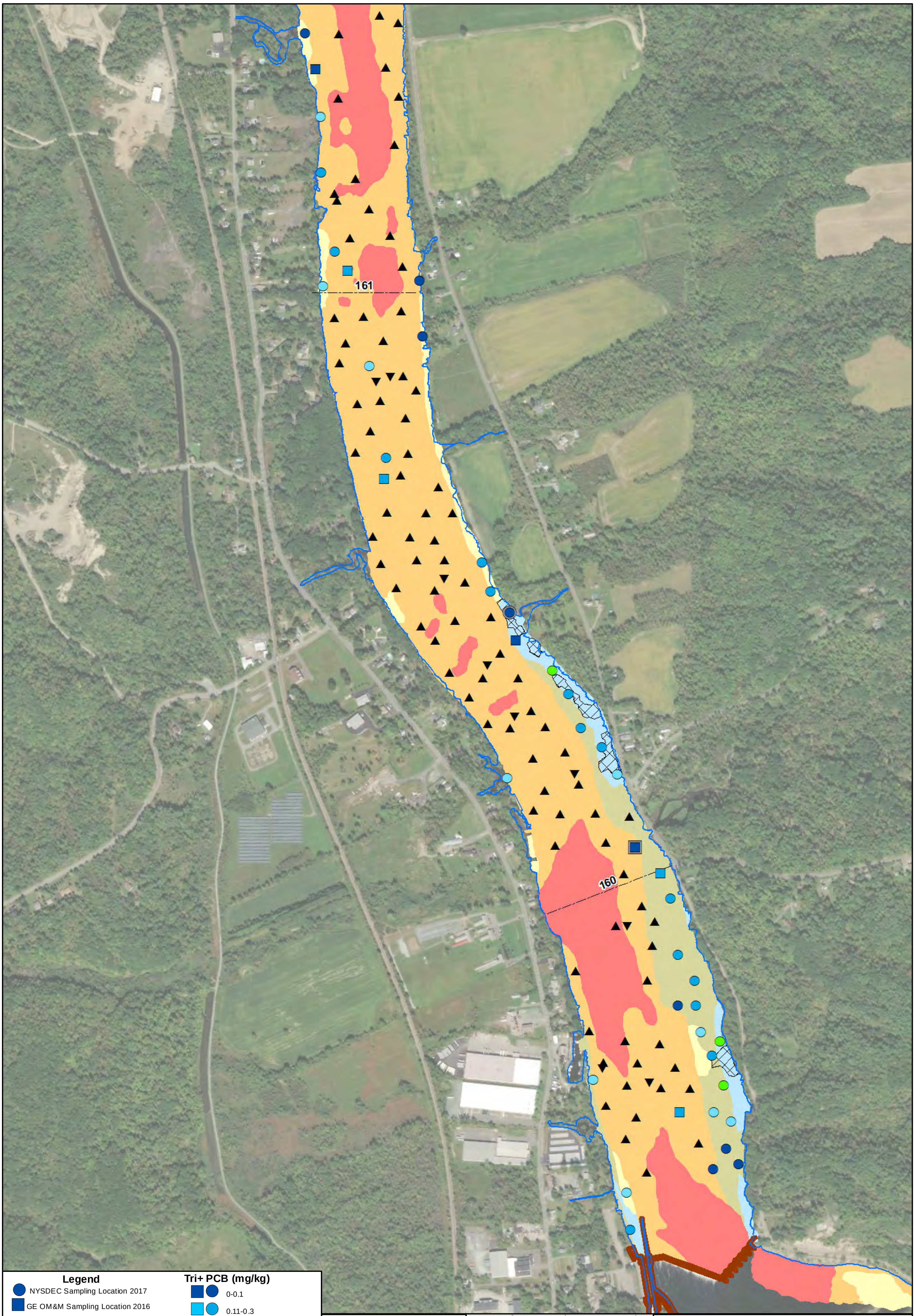
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1p

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type

Silt
Silt and Sand
Gravel
Transitional
Bed Rock

Tri+ PCB (mg/kg)

0-0.1
0.11-0.3
0.31-1.0
1.1-3.0
3.1-10.0
10.1-30.0
30.1-100.0
Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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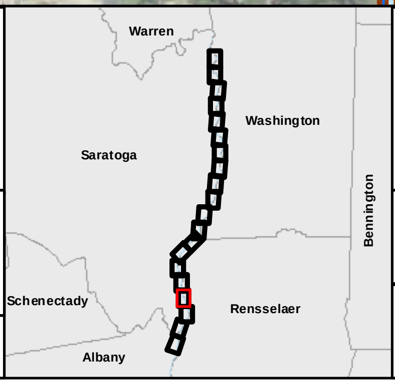
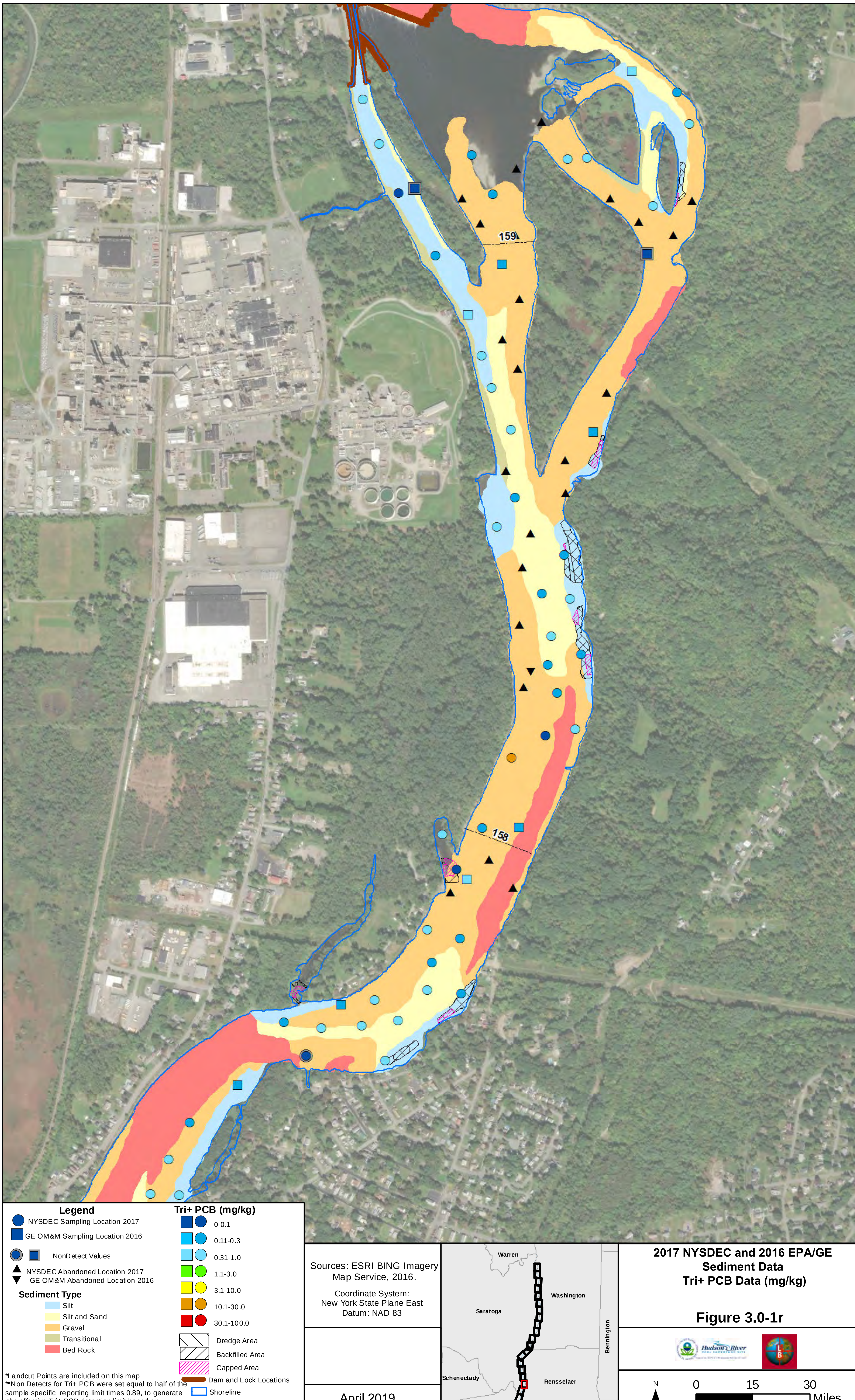


2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

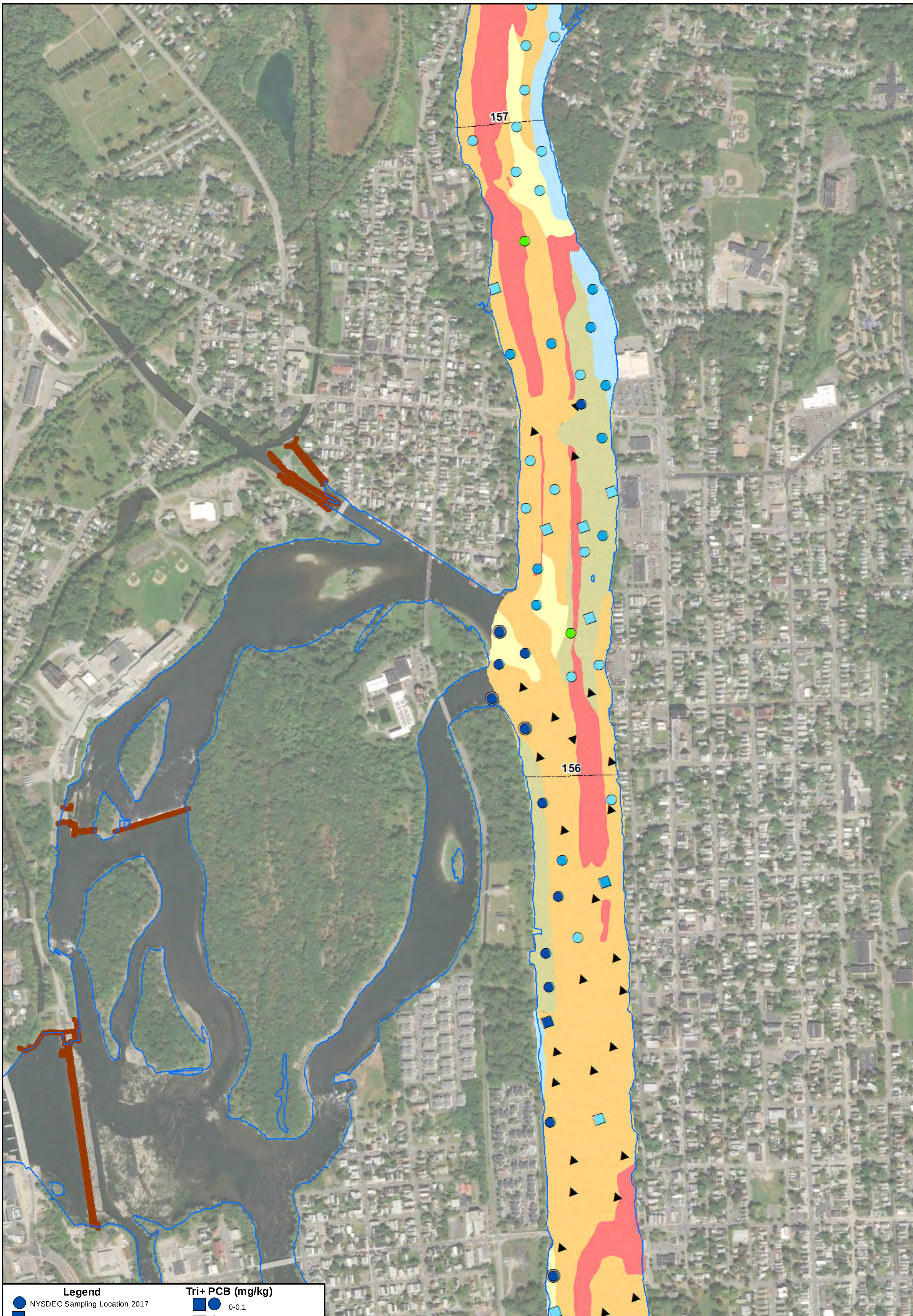
Figure 3.0-1q

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\3.0-1 Tri+PCB.mxd



Document Path: M:\02859191\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

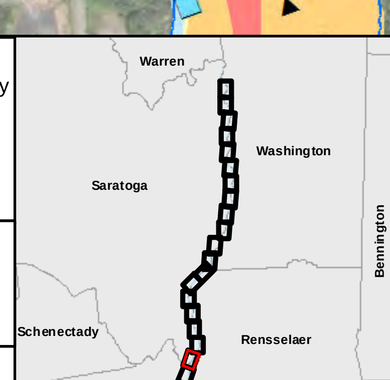
- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

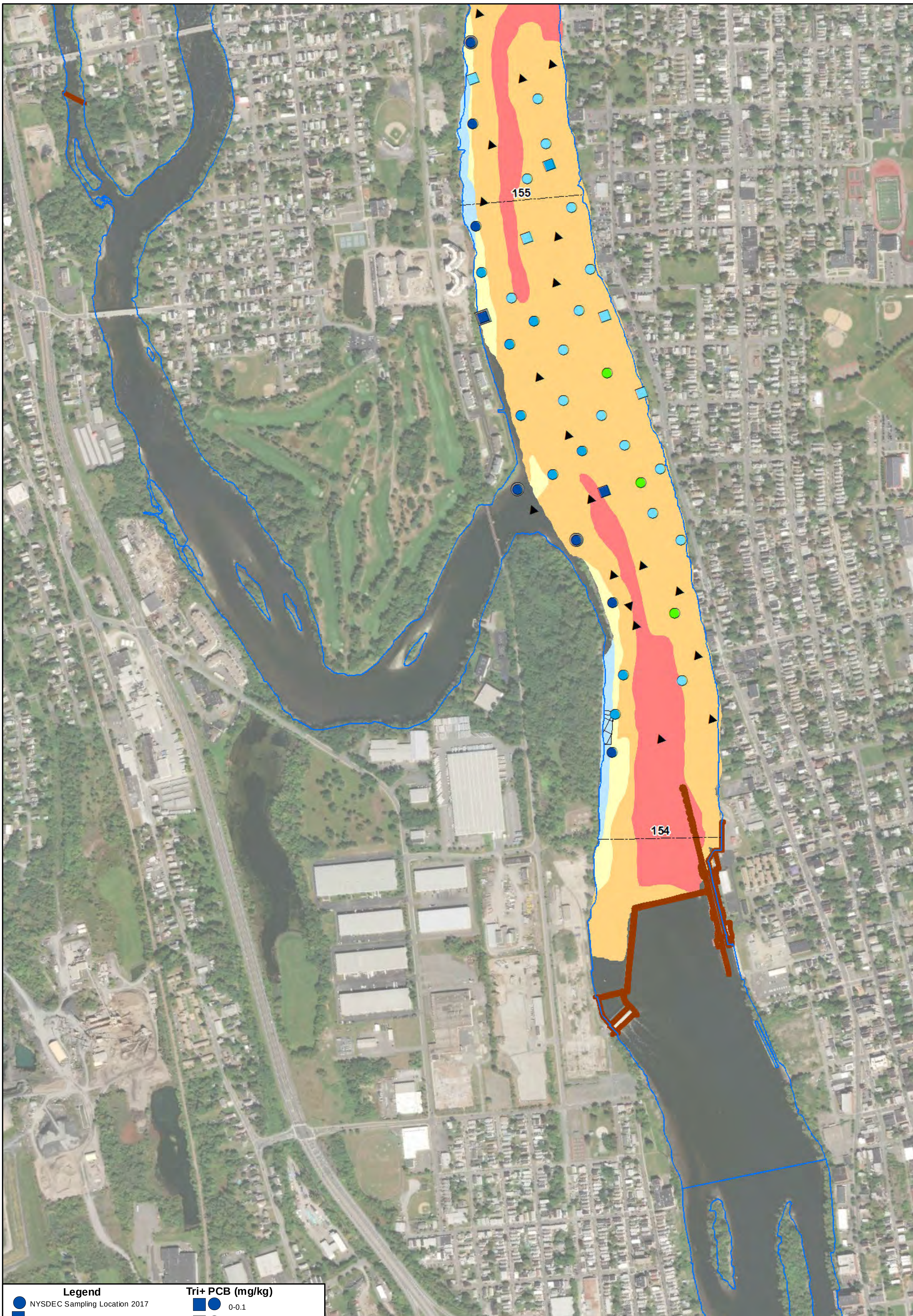


2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1s

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Tri+ PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Tri+ PCB were set equal to half of the sample specific reporting limit times 0.89, to generate the effective Tri+ PCB detection limit based on method 8082.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

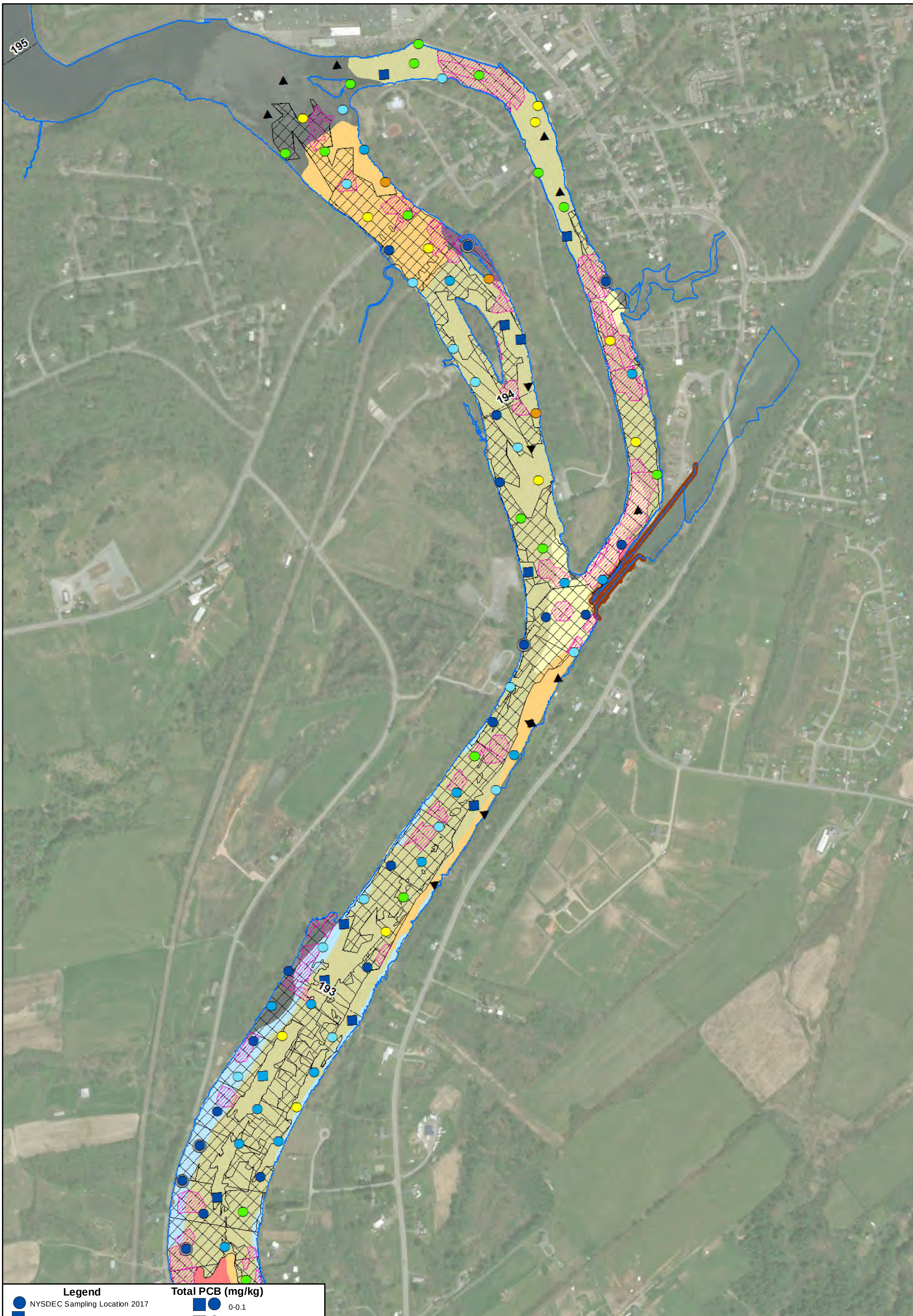
2017 NYSDEC and 2016 EPA/GE Sediment Data Tri+ PCB Data (mg/kg)

Figure 3.0-1t

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-1 Tri+PCB.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

April 2019

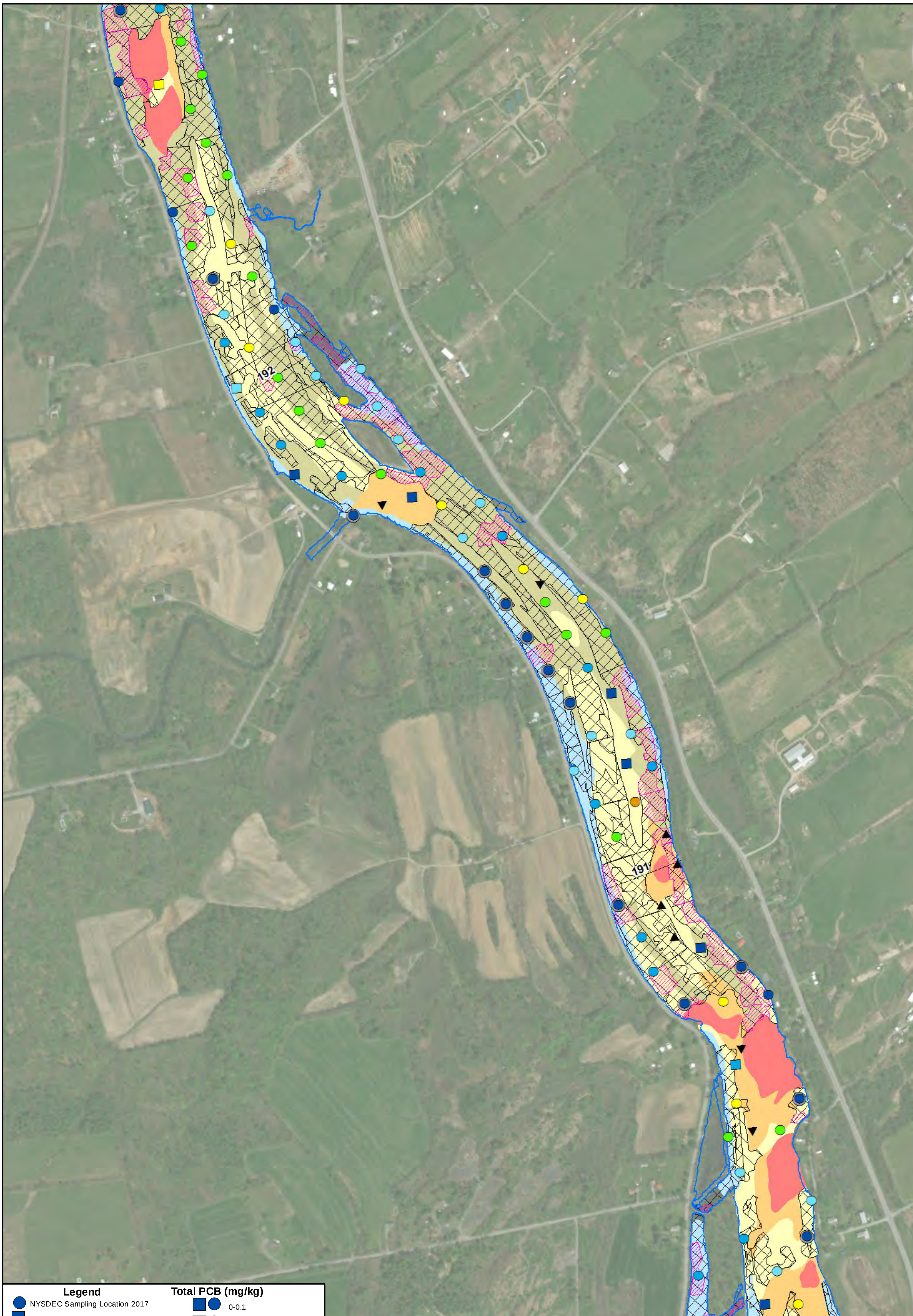
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2a

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

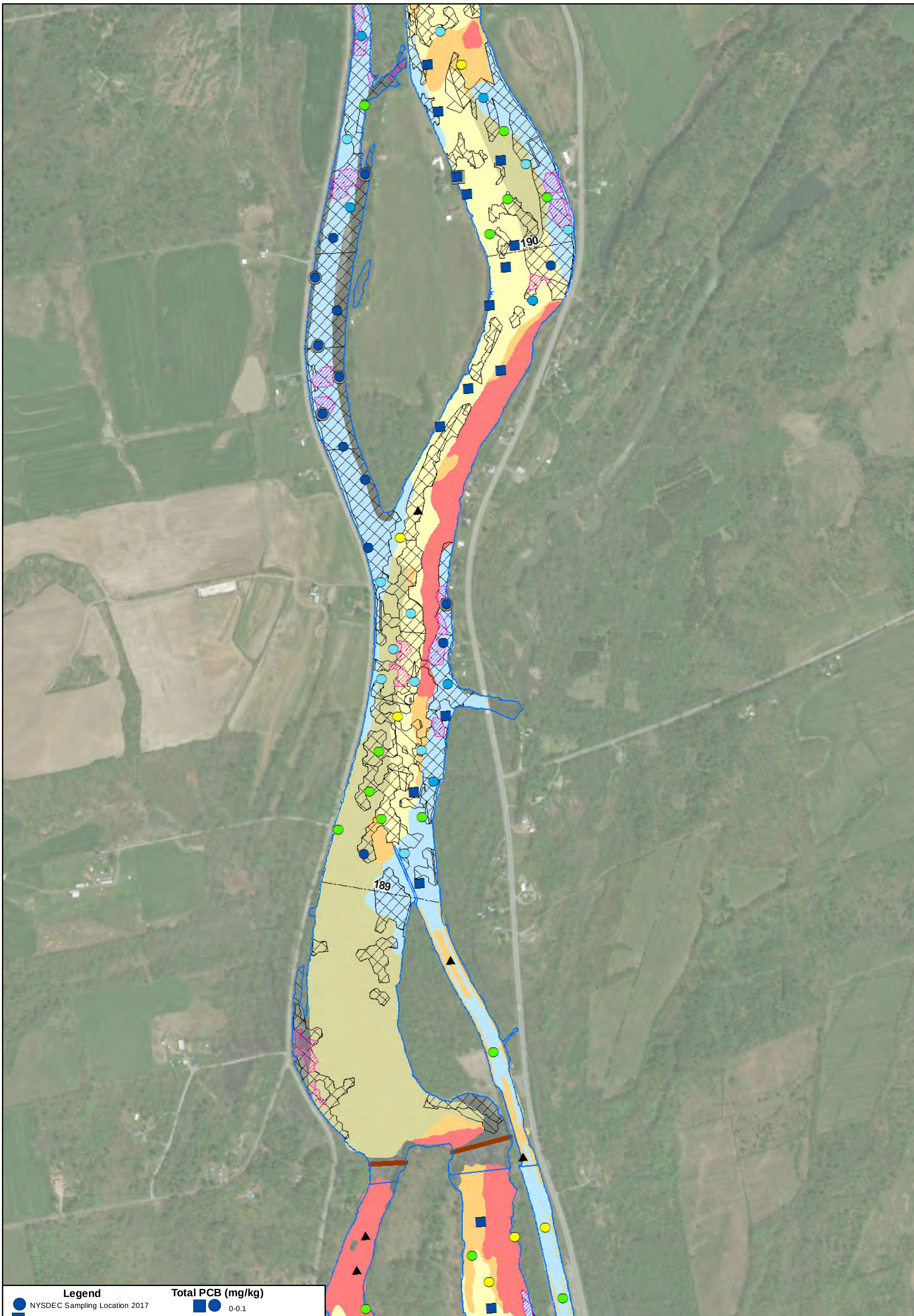
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2b

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

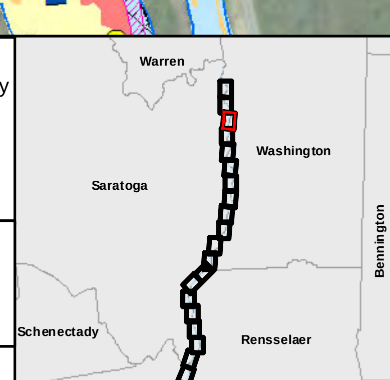
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019



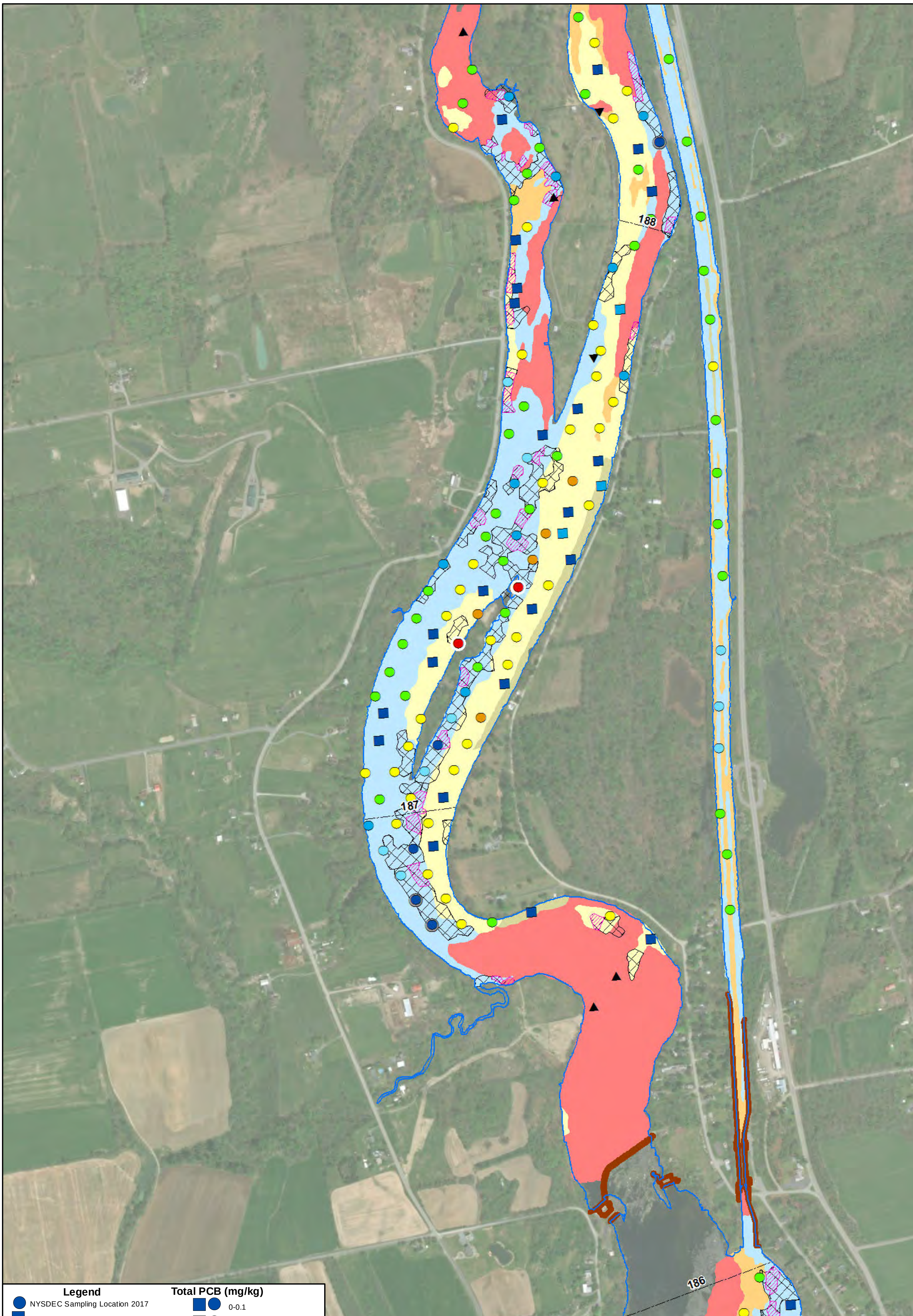
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2c

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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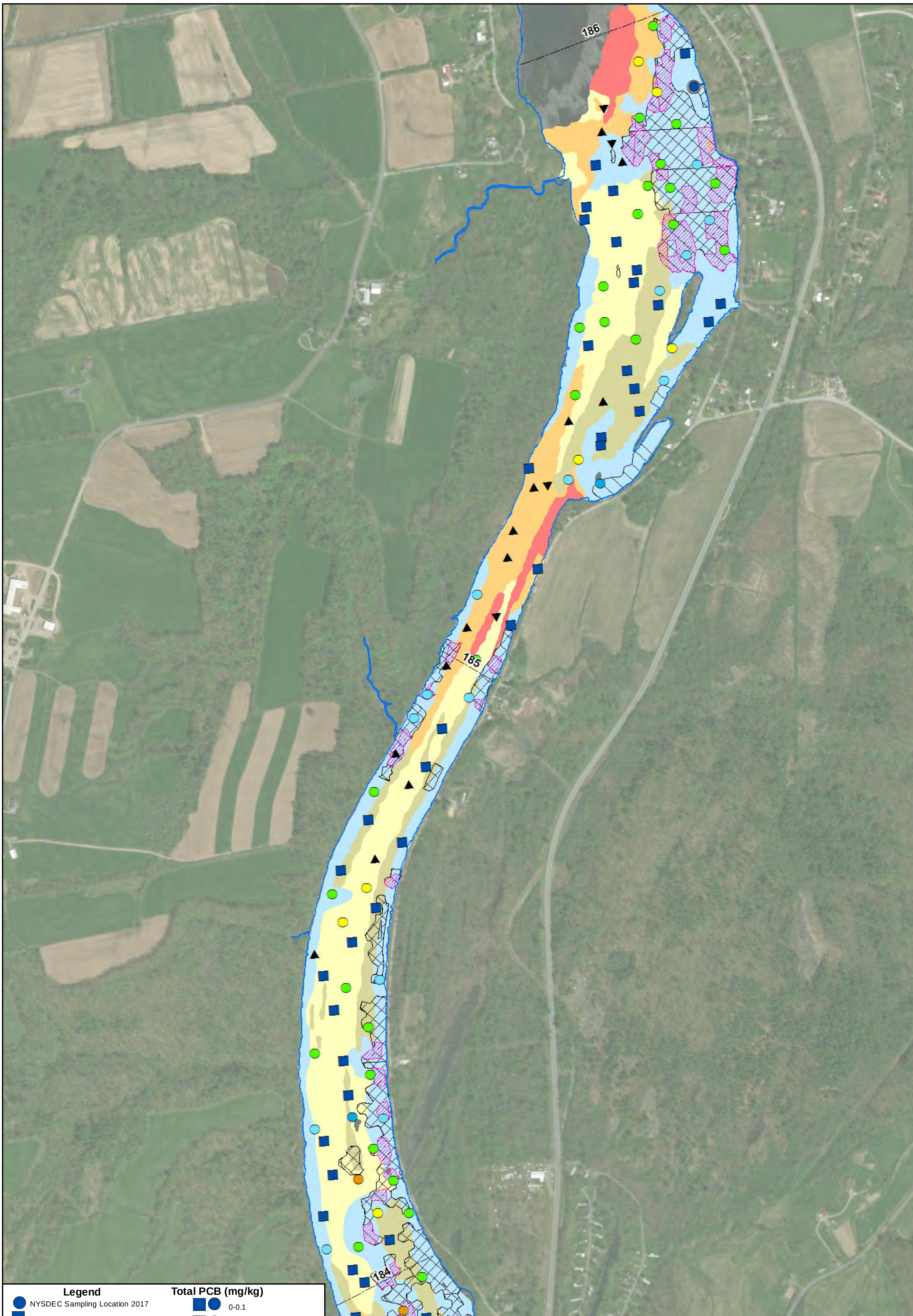
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2d

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type
- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)
- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

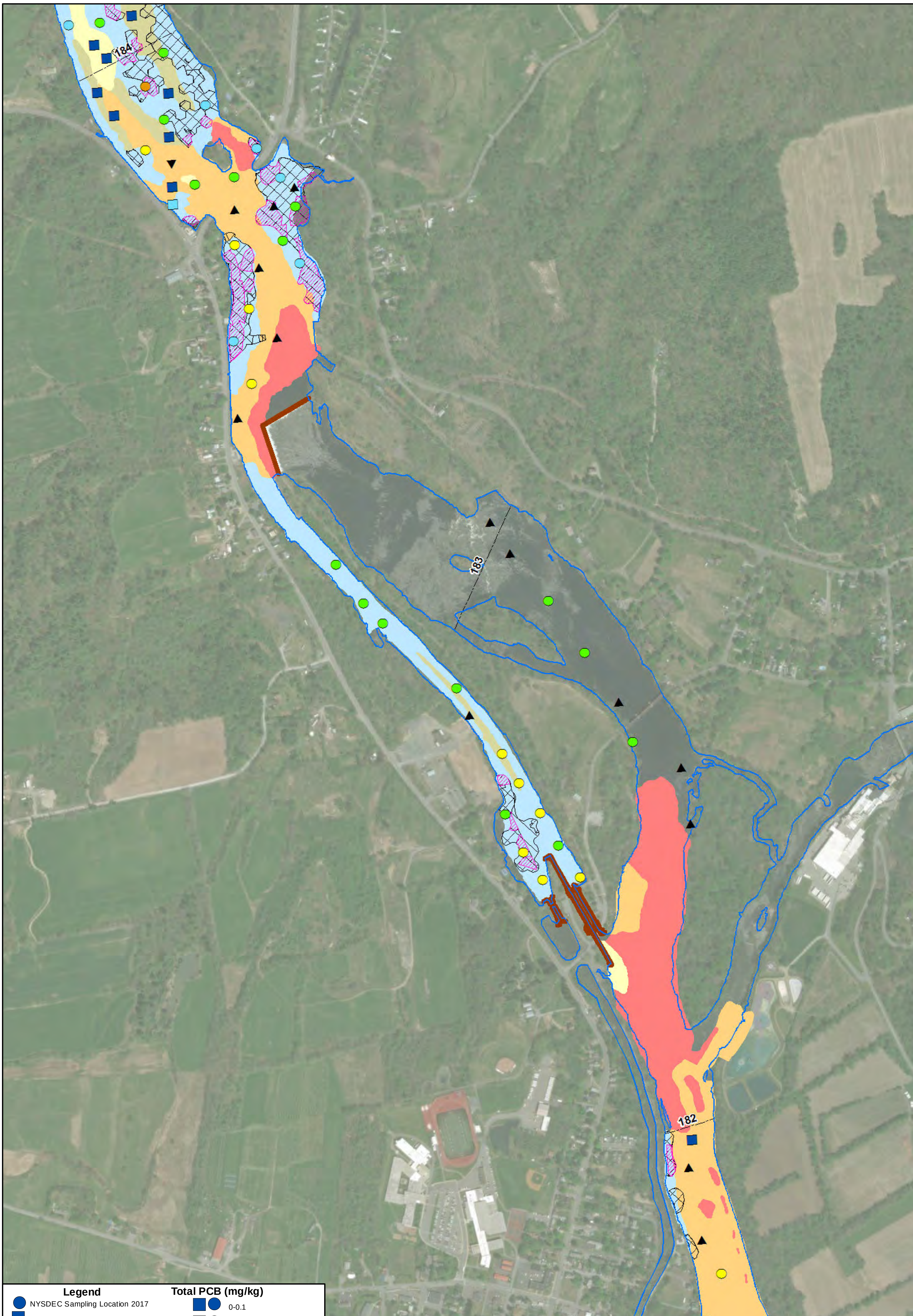
April 2019

2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2e

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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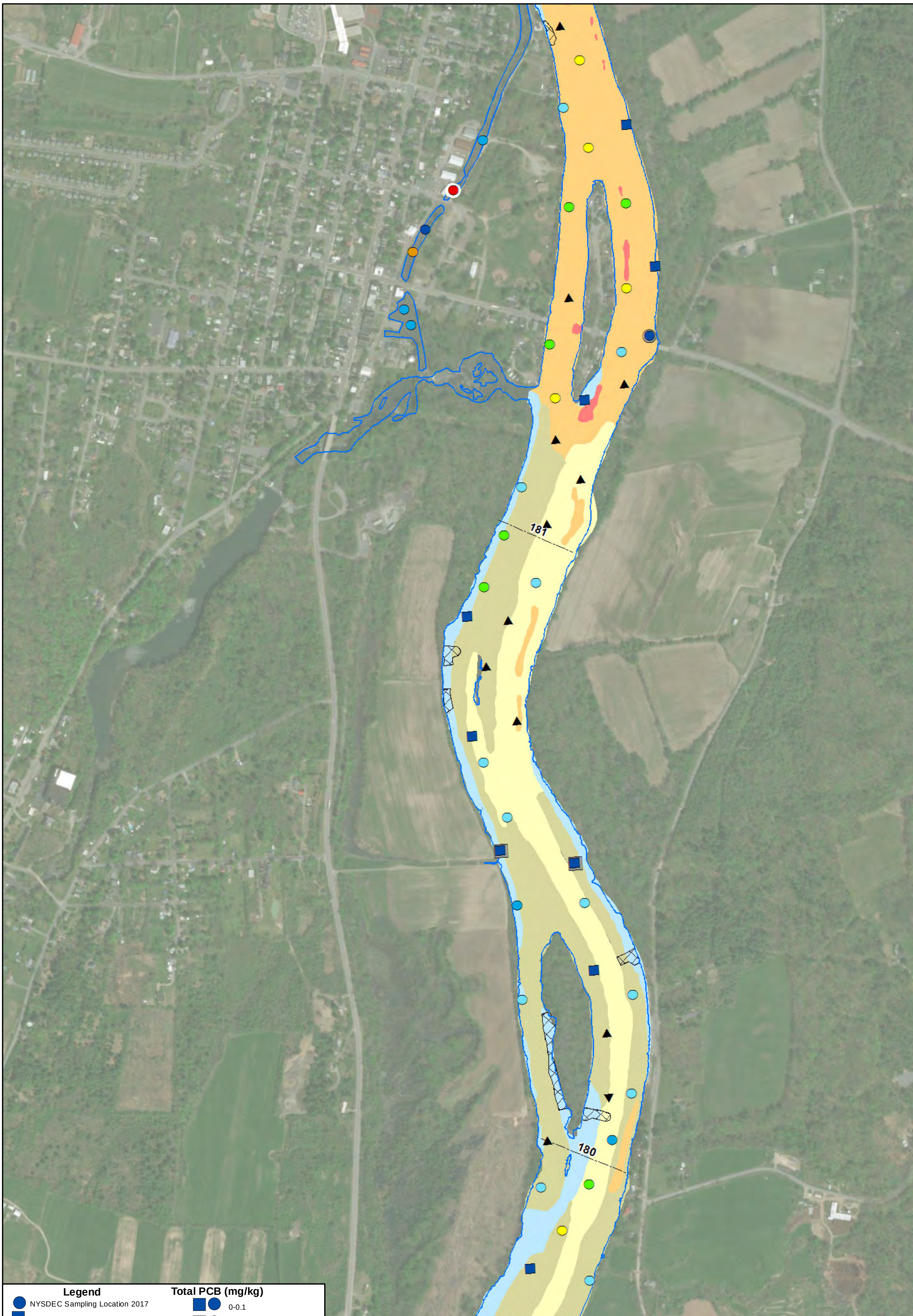
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2f

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

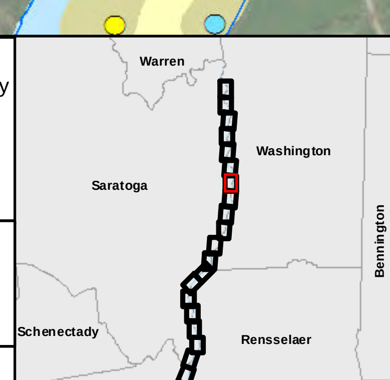
- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019



2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2g

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd

Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- ▲ NYSDEC Abandoned Location 2017
- ▼ GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0

- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

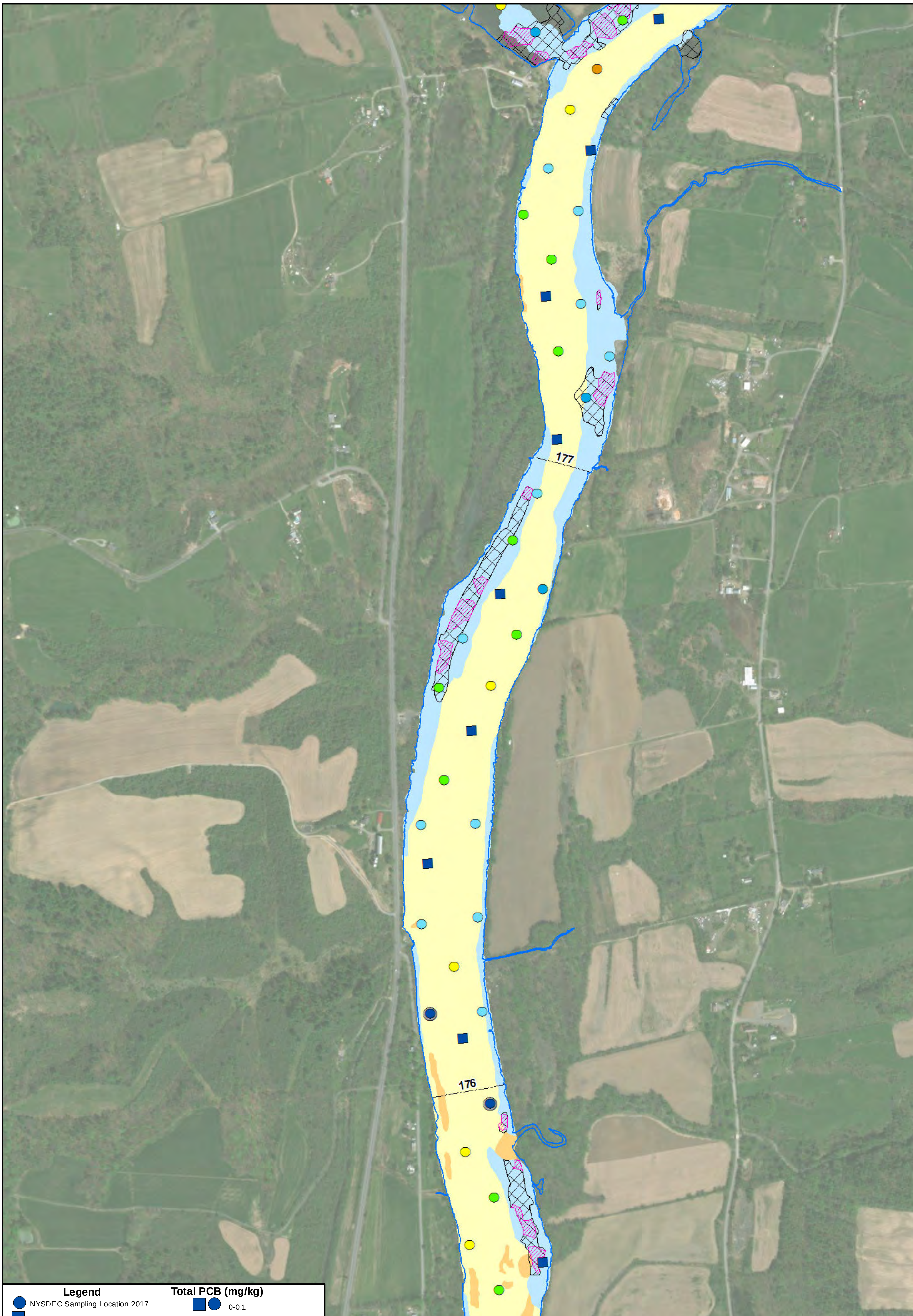
April 2019

2017 NYSDEC and 2016 EPA/GE
Sediment Data
Total PCB Data (mg/kg)

Figure 3.0-2h

N
0 15 30
Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

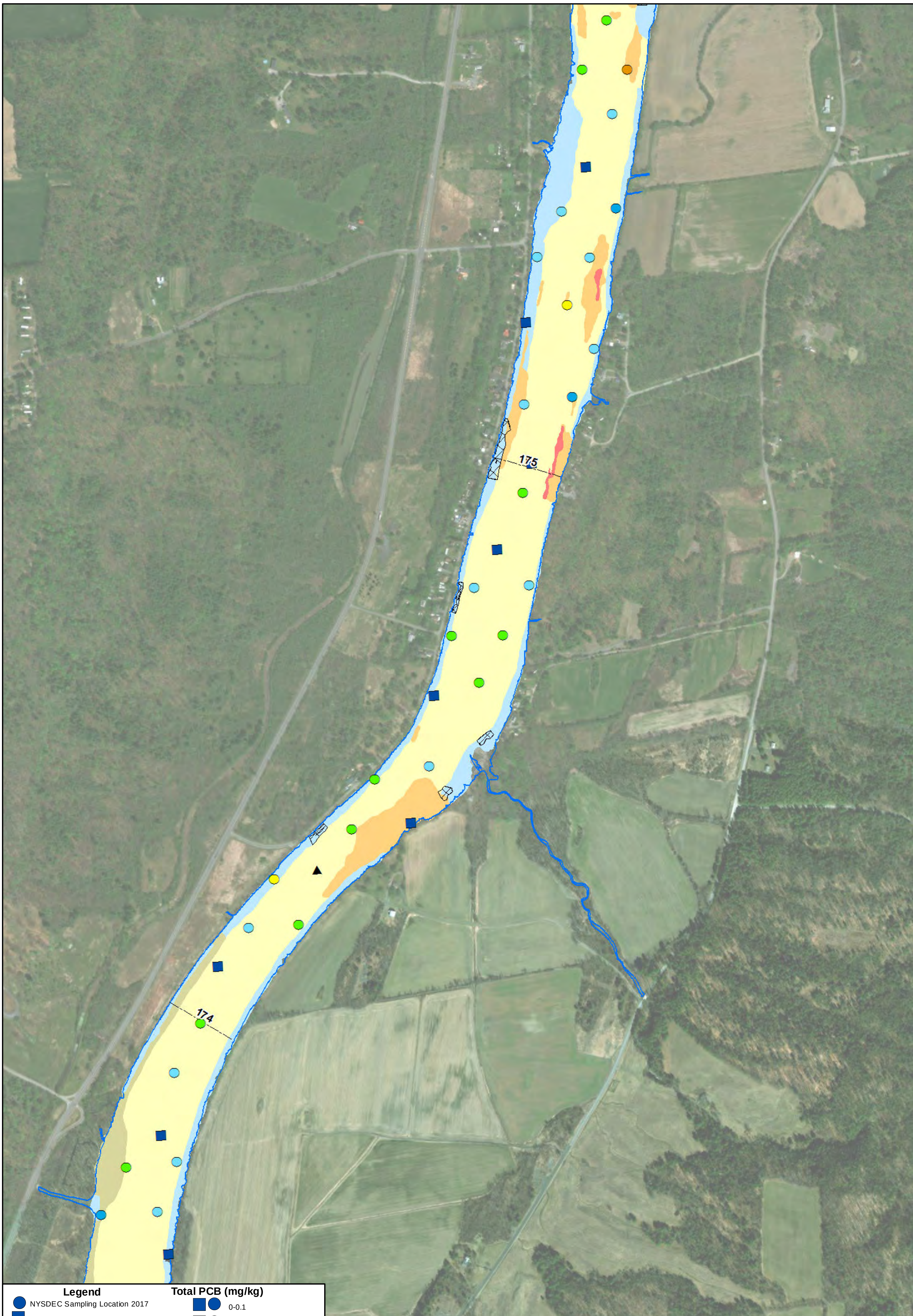
Coordinate System:
New York State Plane East
Datum: NAD 83

April 2019

2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2i

N
0 15 30 Miles



Legend

NYSDEC Sampling Location 2017
GE OM&M Sampling Location 2016
NonDetect Values
NYSDEC Abandoned Location 2017
GE OM&M Abandoned Location 2016

Sediment Type

Silt
Silt and Sand
Gravel
Transitional
Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

0-0.1
0.11-0.3
0.31-1.0
1.1-3.0
3.1-10.0
10.1-30.0
30.1-100.0

Dredge Area
Backfilled Area
Capped Area
Dam and Lock Locations
Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

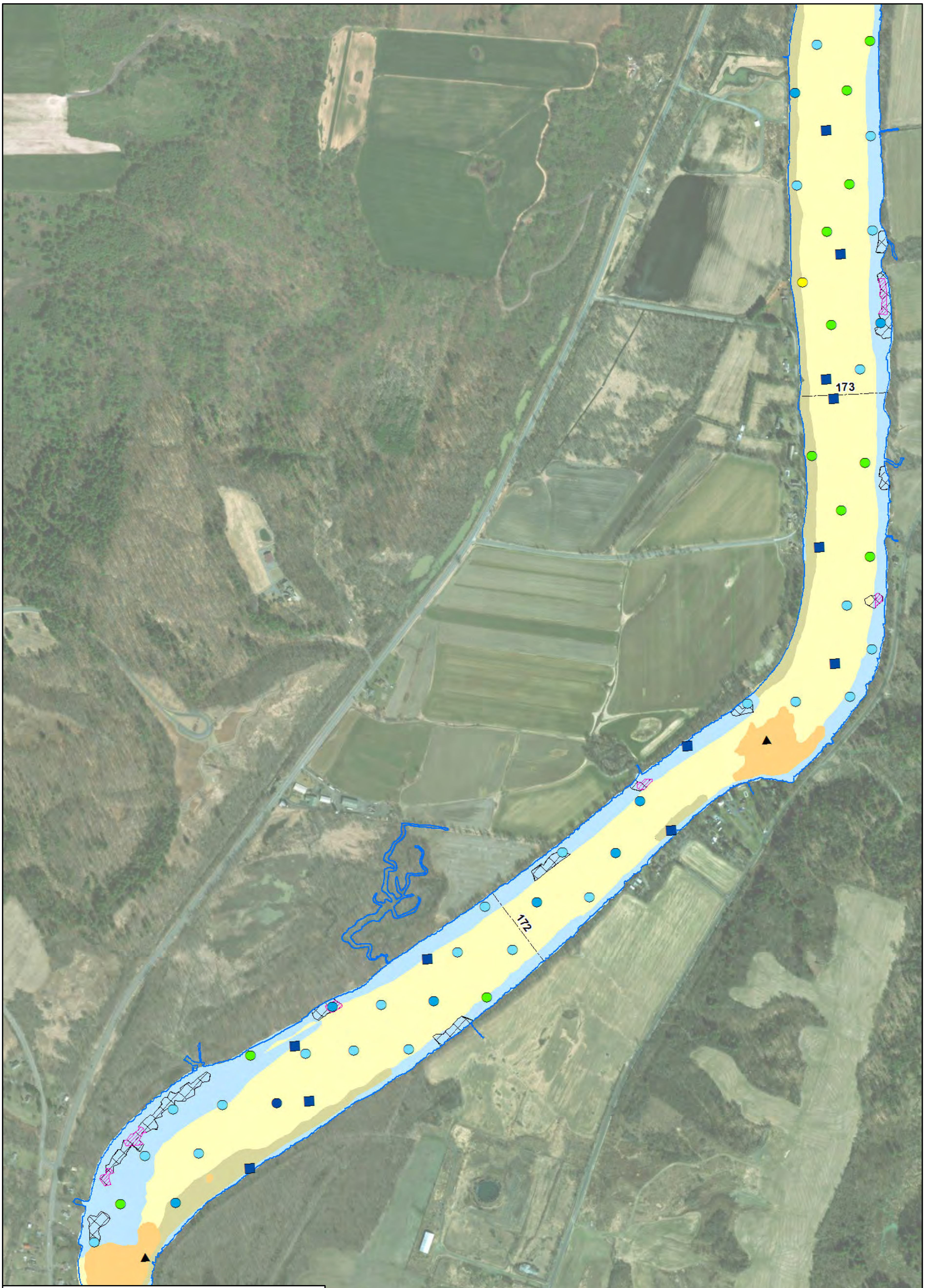
April 2019

2017 NYSDEC and 2016 EPA/GE
Sediment Data
Total PCB Data (mg/kg)

Figure 3.0-2j

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

April 2019

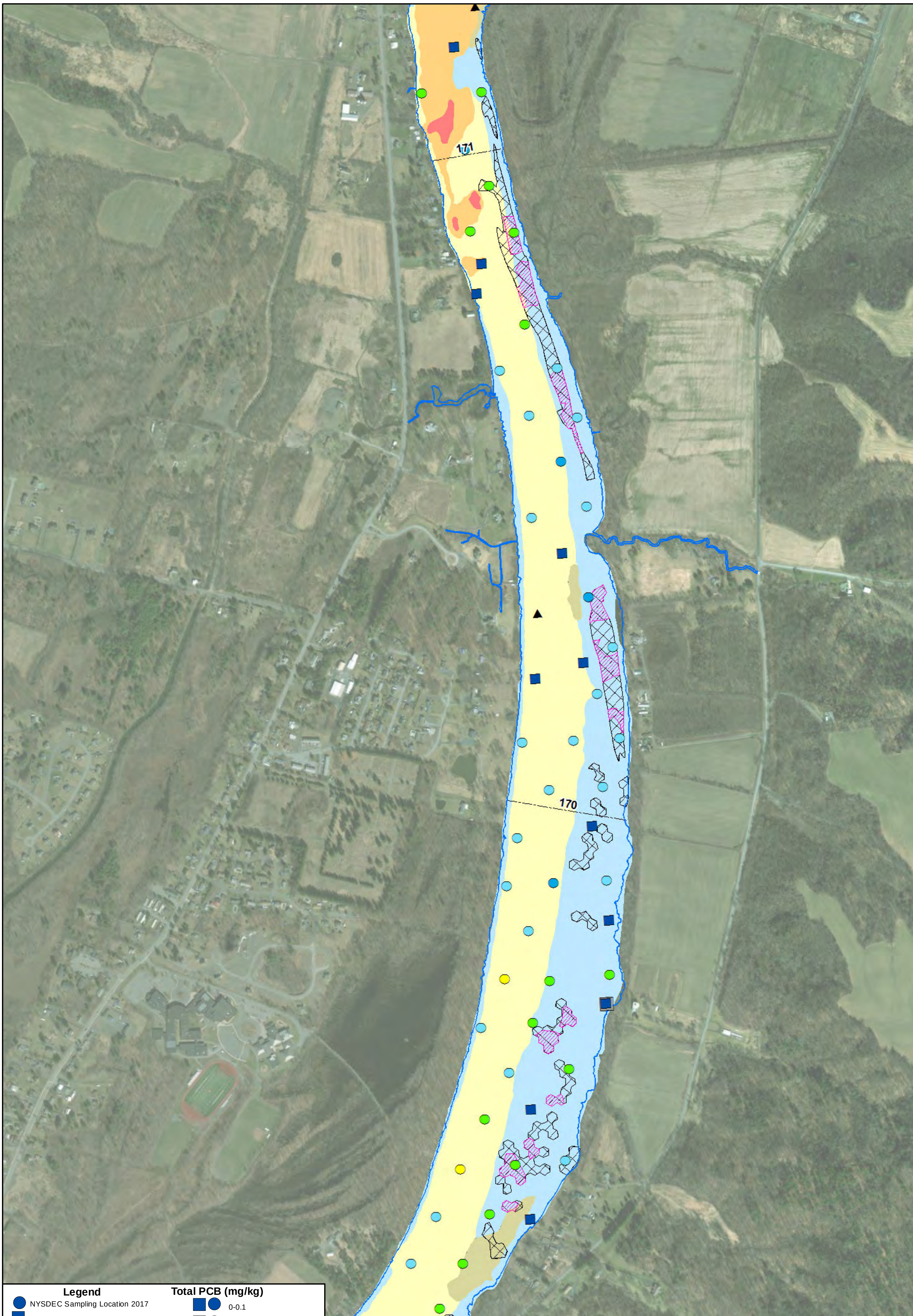
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2k

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

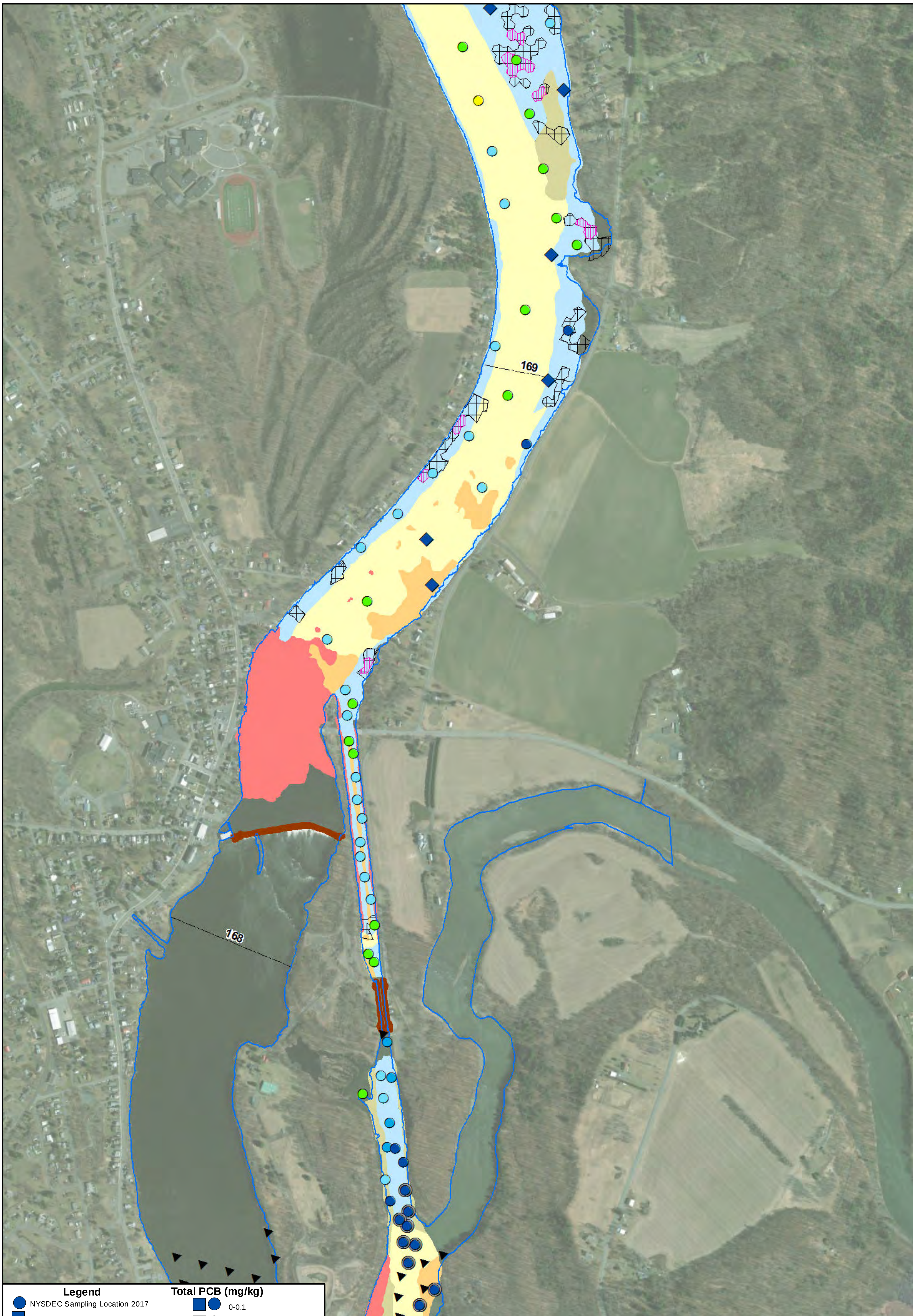
April 2019

2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2l

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

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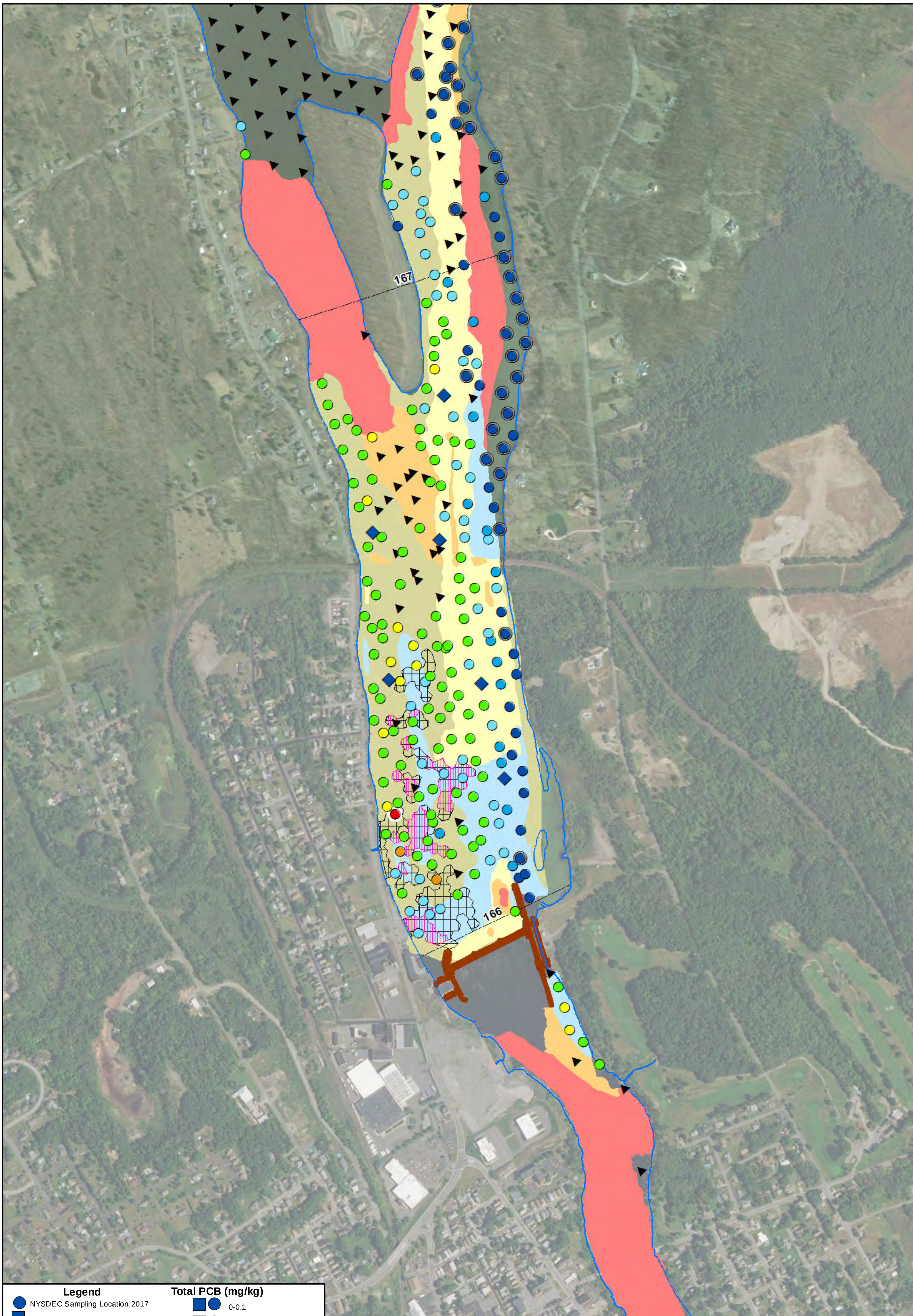
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2m

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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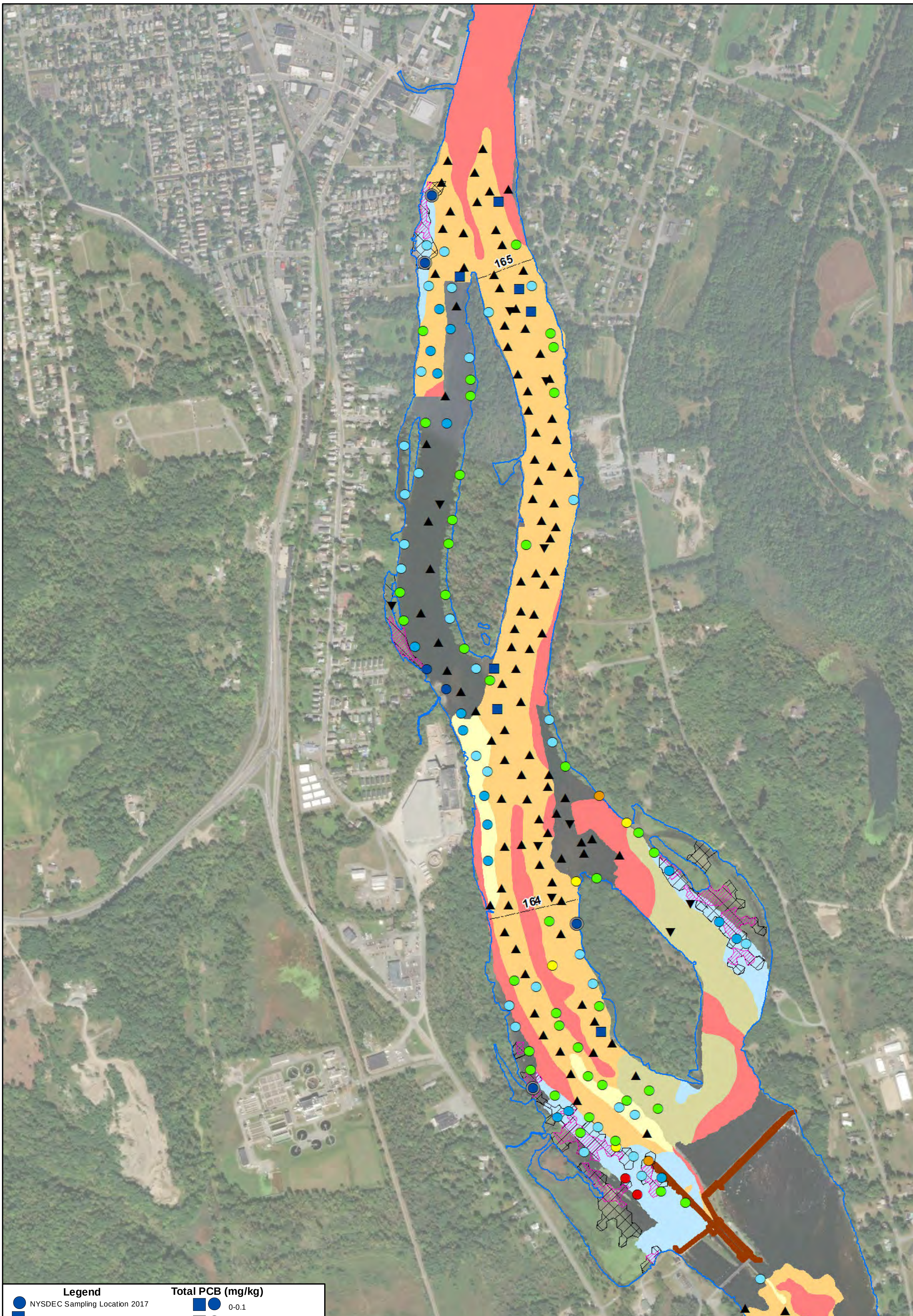
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2n

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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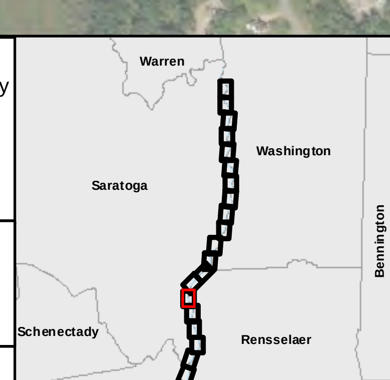
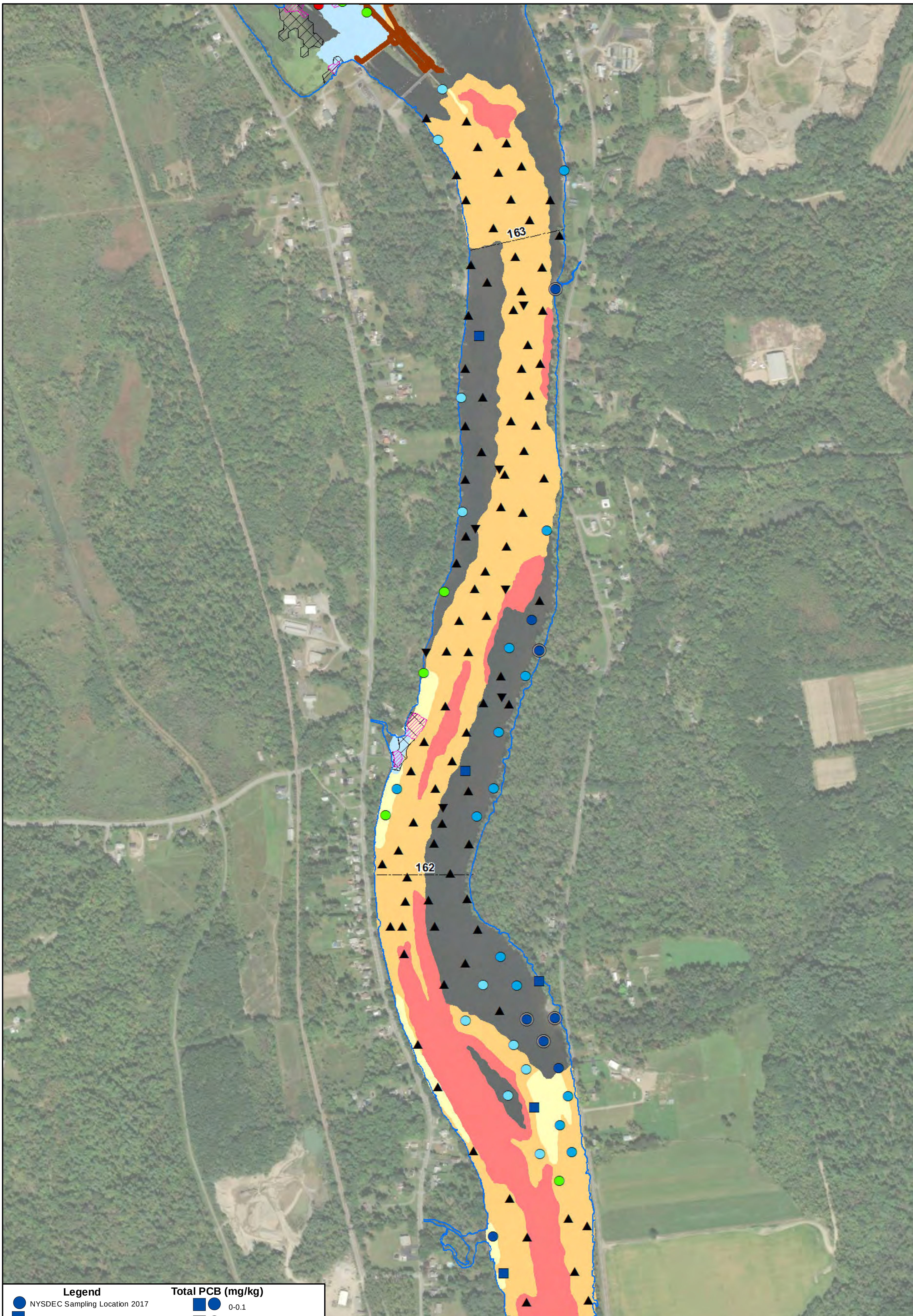


2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2o

N

0 15 30 Miles



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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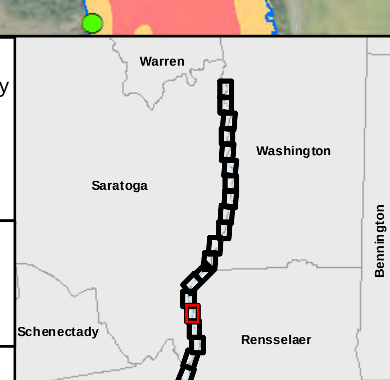


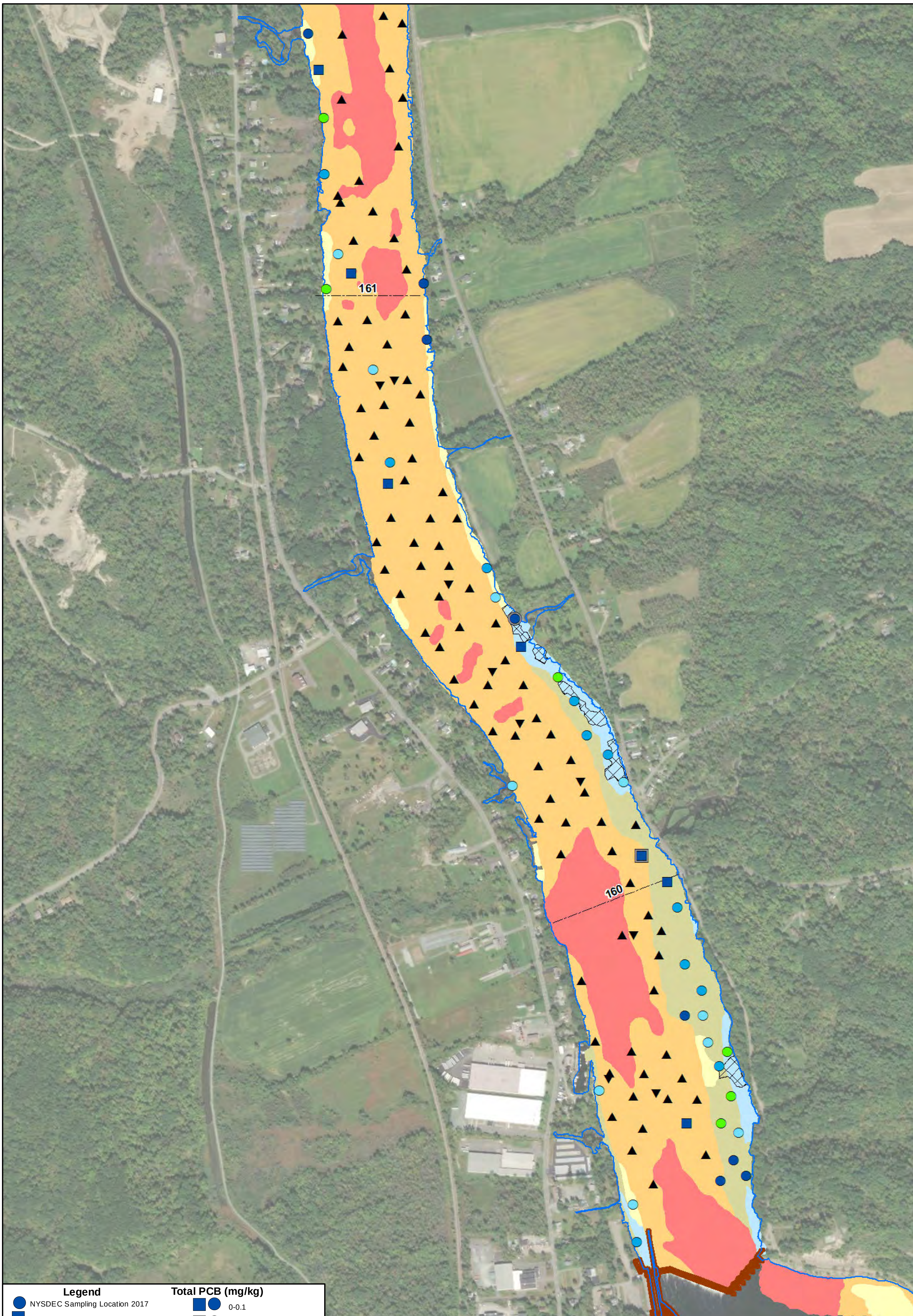
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2p

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M\3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

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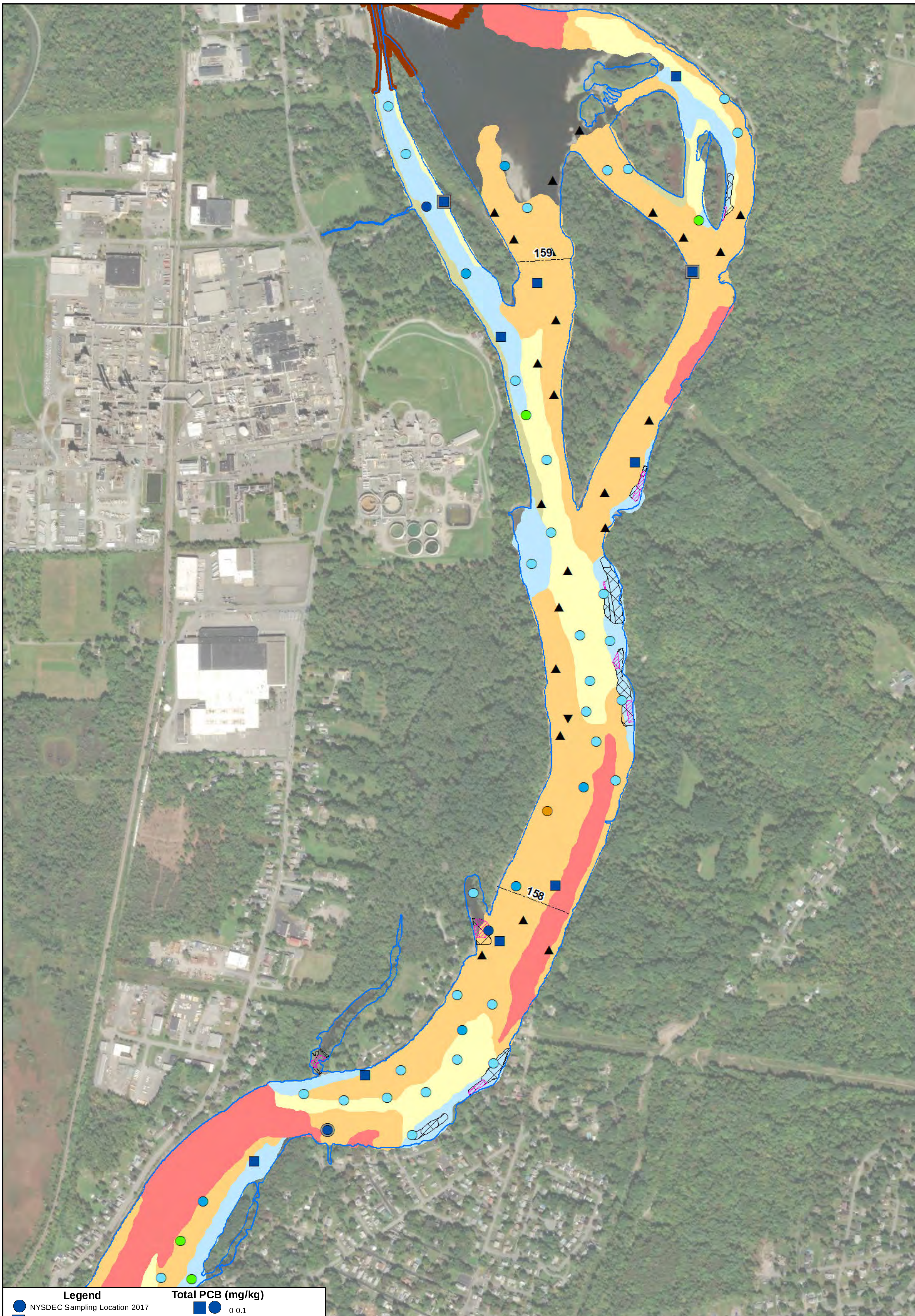
2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2q

N

0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System: New York State Plane East
Datum: NAD 83

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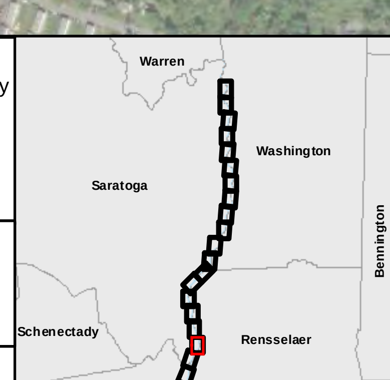
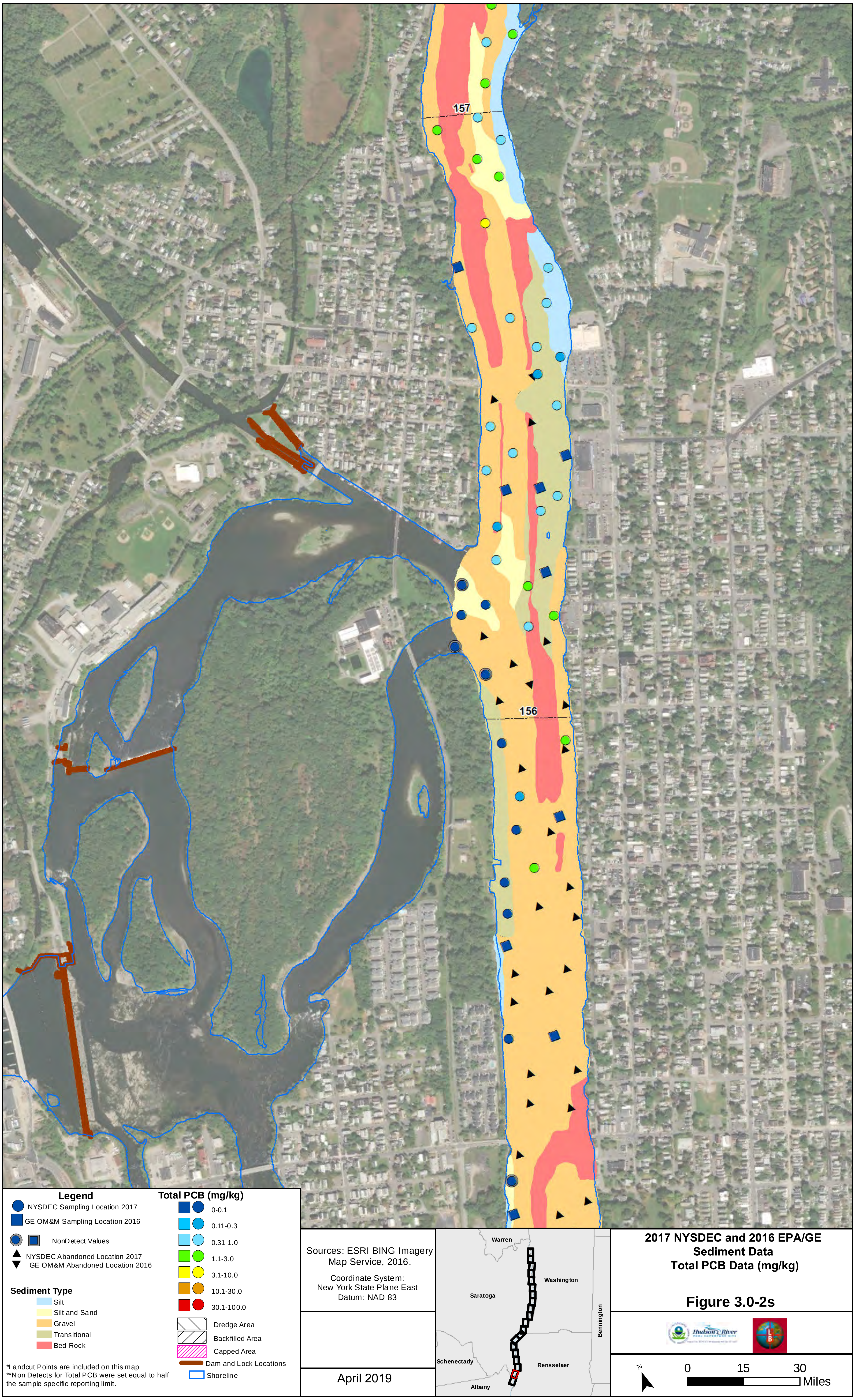


2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

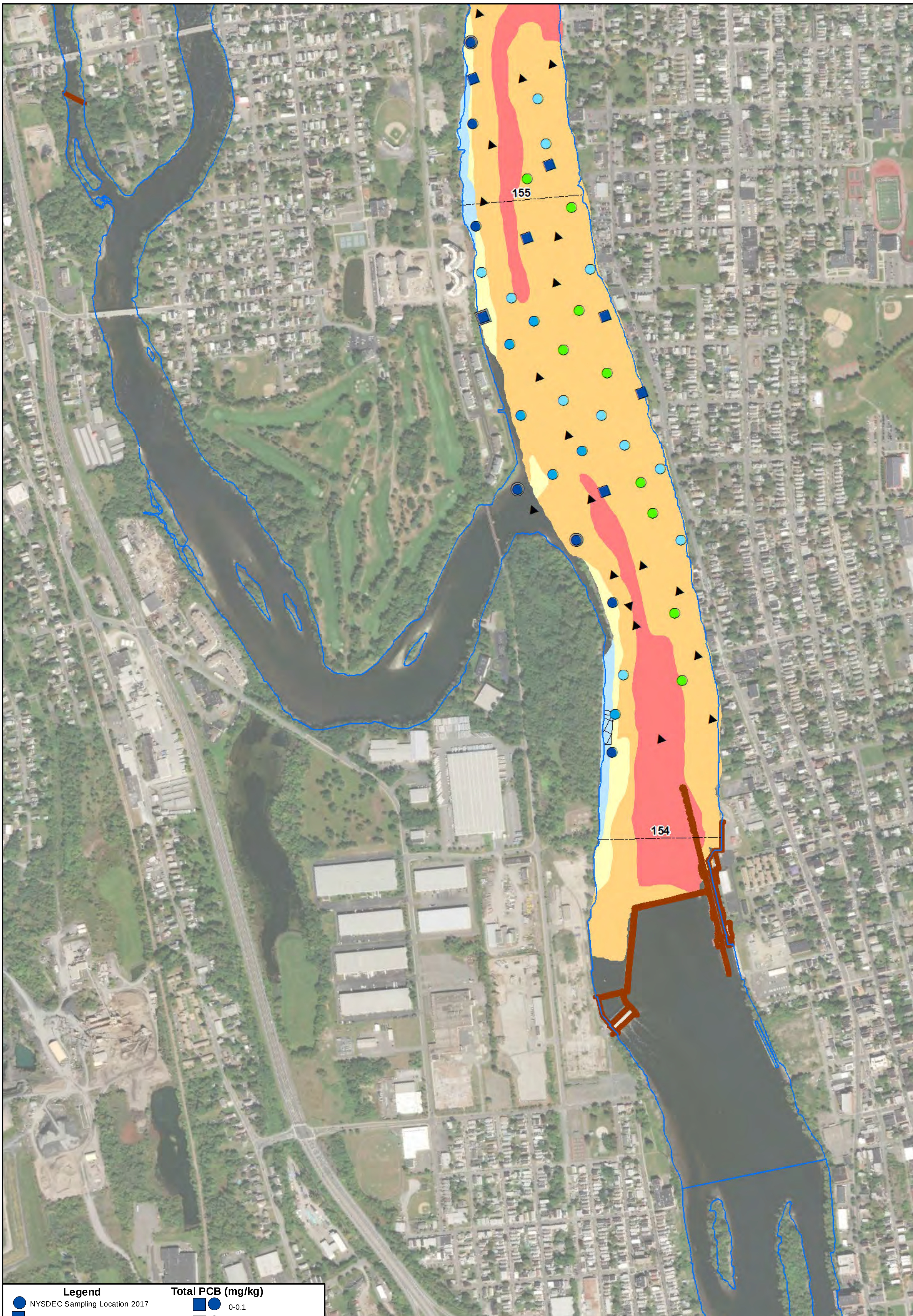
Figure 3.0-2r

N
0 15 30 Miles

Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Document Path: M:\0285919\GIS\OM_M3.0-2 Total PCB Proposed and Attempted.mxd



Legend

- NYSDEC Sampling Location 2017
- GE OM&M Sampling Location 2016
- NonDetect Values
- NYSDEC Abandoned Location 2017
- GE OM&M Abandoned Location 2016

Total PCB (mg/kg)

- 0-0.1
- 0.11-0.3
- 0.31-1.0
- 1.1-3.0
- 3.1-10.0
- 10.1-30.0
- 30.1-100.0
- Dredge Area
- Backfilled Area
- Capped Area
- Dam and Lock Locations
- Shoreline

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

*Landcut Points are included on this map
**Non Detects for Total PCB were set equal to half the sample specific reporting limit.

Sources: ESRI BING Imagery Map Service, 2016.

Coordinate System:
New York State Plane East
Datum: NAD 83

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2017 NYSDEC and 2016 EPA/GE Sediment Data Total PCB Data (mg/kg)

Figure 3.0-2t

N

0 15 30 Miles