US Army Corps of Engineers
Buffalo District

ERDC
Engineer Research and Development Center

Eighteenmile Creek Great Lakes Area of Concern (AOC)

Sediment Analysis and Assessment of Beneficial Use Impairments (BUIs)

Report to U.S. Environmental Protection Agency (USEPA)
Great Lakes National Program Office (GLNPO)

May 2020

Great Lakes RESTORATION

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EXECUTIVE SUMMARY

The Eighteenmile Creek Great Lakes Area of Concern (AOC) is situated along the south shore of Lake Ontario at the mouth of Eighteenmile Creek. The AOC boundary encompasses Olcott Harbor and the creek's main stem and its accompanying watershed, about two miles upstream to Burt Dam. The most downstream reach of the Eighteenmile Creek Superfund Site overlaps the main stem portion of the AOC. There are a total of five outstanding beneficial use impairments (BUIs) for the AOC: (1) Restrictions on Fish and Wildlife Consumption; (2) Degradation of Fish and Wildlife Populations; (3) Bird/Animal Deformities or Reproductive Problems; (4) Degradation of Benthos; and (5) Restrictions on Dredging Activities. The most frequently identified contaminants of concern (COCs) associated with these impairments include polychlorinated biphenyls (PCBs), dioxins/dibenzofurans, dichlorodiphenyltrichloroethane (DDT), dieldrin, copper, lead and mercury.

The U.S. Army Corps of Engineers (USACE), Buffalo District and U.S. Army Engineer Research and Development Center (USAERDC) were tasked by the U.S. Environmental Protection Agency (USEPA) with the following goals relative to Eighteenmile AOC BUIs:

1. Assess the need for sediment-related management actions necessary for delisting the AOC.
2. Assess the potential for COCs to inhibit BUI removal efforts for the AOC and provide associated recommendations.

This entailed a review of recent and ongoing sediment data collection under the AOC and Superfund programs, as well as a review of the criteria for BUI removal, data compilation, and associated data gap analysis. Based on the information contained in this review, we offer the following summary conclusions and recommendations specific to COCs and management actions and to address data gaps related to each BUI:

COC Conclusion
PCBs are the COC that appear to be driving BUI impairments in the AOC.

Sediment-Related Management Actions Conclusion
Management actions to remediate AOC sediments are not recommended based on this review. No COCs in sediment were indicated as contributing to AOC BUIs. Chemical and biological testing indicate no toxicity associated with the sediment. In addition, the surface weighted average concentration (SWAC) for total PCBs is at a relatively low level and within the range of remedial goals (RGs) developed for other Great Lakes AOCs, suggesting the bioaccumulation of PCBs from sediment is sufficiently low. Existing elevated concentrations of PCBs in fish appear to be the result of on-going high water column concentrations from upstream of Burt Dam.

BUI Data Gap-Related Recommendations

***Restrictions on Fish and Wildlife Consumption BUI*:**

(1) Administratively separate the fish consumption advisories (FCAs) for the AOC and Superfund Site source areas. Establish a FCA specific to the AOC and determine if it is different than the Superfund Site source area and Lake Ontario;
(2) Review existing USEPA, USACE and Niagara County Soil & Water Conservation District (NCSWCD) fish fillet data to assess whether they meet New York State Department of Health (NYSDOH) FCA quality control requirements;
(3) Conduct passive water sampling for PCBs across the AOC to further quantify freely dissolved concentrations of PCBs in the water column as a source for fish tissue bioaccumulation.

***Degradation of Fish and Wildlife Populations BUI*:**

(1) Conduct an acute toxicity risk assessment for PCBs in mink;
(2) Extend the dietary bioaccumulation model assessment for mink to include the Oak Orchard Creek regional reference site;
(3) Refine the dataset used for predicting dietary mink exposure by including the whole body fish tissue data previously collected by the USEPA, USACE and NCSWCD; and
(4) Conduct passive water sampling for PCBs to refine the dietary bioaccumulation model.

***Bird or Animal Deformities or Reproductive Problems BUI*:**

(1) Conduct a statistical analysis of the existing fish tissue data for the AOC and the Oak Orchard Creek and Lake Ontario regional reference sites to determine whether total PCB fish tissue concentrations within the AOC are statistically different from that of reference sites.
Recommendations 2, 3 and 4 are the same as those for the Degradation of Fish and Wildlife Populations BUI.

***Degradation of Benthos BUI*:**

(1) The current weight-of-the-evidence suggests that persistent sediment-associated contaminants are not substantially contributing to any benthic macroinvertebrate community-related impairments associated with AOC sediments. Therefore, no specific data gaps have been identified to inform the removal of this BUI.
(2) The additional chronic sublethal toxicity test results and sediment chemistry data on samples collected by E&E need to reviewed to confirm the assessment of benthos degradation. (Update note: Preliminary review of the

data presented in the draft report indicate no chronic toxicity associated with AOC sediments.)

(3) AOC stakeholders typically base BUI removal decision-making on data generated through standard sediment acute toxicity tests. The interpretation of data generated through chronic toxicity tests being completed in this case should take into consideration that elucidating whether the results are truly ecologically meaningful can be challenging and indeterminate.

(4) If any future benthic macroinvertebrate community sampling and analysis of sediments at emil-3 or any other site in the AOC is pursued, it should be accompanied with a full suite of paired chemistry and bioassay testing, as well as a complete characterization of physical parameters at the site. In addition, toxicity tests should follow existing testing and evaluation guidance, but include monitoring and mitigation for sediment porewater ammonia, as well as any necessary toxicity identification evaluation (TIE).

***Restriction on Dredging Activities BUI*:**

No recommendations.

Predominant PCB Source and Exposure in the AOC:

Fish tissue concentrations of total PCBs within the AOC remain elevated relative to FCA guidelines and regional reference conditions. This condition appears to be related to elevated water column concentrations of PCBs from upstream sources. Similarly, the mink dietary exposure model indicates that exposure to bioavailable PCBs in the water column may be the primary source of toxicity to mink in the AOC. Consequently, additional data and evaluation regarding the bioavailable fraction of PCBs in the water column would be beneficial toward the continuing assessment of the Restrictions on Fish and Wildlife Consumption, Degradation of Fish and Wildlife Populations, and Bird or Animal Deformities or Reproductive Problems BUIs. This recommendation is consistent with the findings of a previous evaluation regarding data needs necessary toward identifying remediation and restoration requirements for delisting the Eighteenmile Creek AOC.

This effort was undertaken per Focus Area 1 of the Great Lakes Restoration Initiative (GLRI) Action Plan III, "Toxic Substances and Areas of Concern." It was accomplished using funding from GLRI with substantial support from the New York State Department of Environmental Conservation (NYSDEC), USEPA Office of Superfund, the United States Geological Survey (USGS), and Ecology and Environment Inc. (E&E). This report was prepared by Scott W. Pickard[1], Kristen M. Buscaglia[2] and Andrew M. Lenox[3] of the USACE, Buffalo District, and Joseph P. Kreitinger[4] of the USAERDC.

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BACKGROUND

The Eighteenmile Creek Area of Concern (AOC) in the Town of Newfane, Niagara County, New York, is situated along the south shore of Lake Ontario at the mouth of Eighteenmile Creek, about 18 miles east of the mouth of the Niagara River. It is one of 43 Great Lakes AOCs designated by the International Joint Commission (IJC) under the 1987 Great Lakes Water Quality Agreement (IJC 1987). The AOC boundary encompasses the creek's outlet at Olcott Harbor and its main stem upstream approximately two miles to Burt Dam and its approximately 58,056-acre watershed (U.S. Environmental Protection Agency [USEPA 2019) (Figure 1).

The main stem of Eighteenmile Creek in the AOC upstream of the New York State (NYS) Route 18 Bridge is largely undisturbed and is located within a designated Significant Coastal Fish and Wildlife Habitat area (New York State Department of State [NYSDOS] 1987). Downstream of the dam, the creek flows north through a wooded, steeply-sloped gorge, and contains large beds of submergent and emergent aquatic vegetation. The creek channel is meandering and warmwater, offering low gradient, lower velocity pools with a mixture of mud and gravel-bottom substrates. These conditions collectively provide high quality habitat to a variety of fish and wildlife species. Downstream of the NYS Route 18 Bridge, the creek is largely developed for recreational purposes where marinas and Olcott Harbor are situated near the mouth. Olcott Harbor is a shallow draft federal navigation project maintained by the U.S. Army Corps of Engineers (USACE) and is a designated Harbor of Refuge. Land use within the AOC watershed is mostly agricultural in nature, with areas of rural residential and commercial development. The main stem portion of the AOC is used heavily for recreational and sport fishing, even more so in the fall during salmonid runs up the creek to Burt Dam.

The latest Remedial Action Plan (RAP) update for the AOC was completed in 2011 (Niagara County Soil & Water Conservation District [NCSWCD] 2011). There are a total of five outstanding beneficial use impairments (BUIs) for the AOC, including: (1) Restrictions on Fish and Wildlife Consumption; (2) Degradation of Fish and Wildlife Populations; (3) Bird or Animal Deformities or Reproductive Problems; (4) Degradation of Benthos; and (5) Restrictions on Dredging Activities. The most frequently identified contaminants of concern (COCs) associated with these impairments include polychlorinated biphenyls (PCBs), dioxins/dibenzofurans (dioxins/furans), dichlorodiphenyltrichloroethane (DDT), dieldrin, copper, lead and mercury (NCSWCD 2011). Sources of these contaminants include industrial and municipal wastewater discharges, inactive hazardous wastes sites, combined sewer overflows, sediments, pesticide use and the NYS Barge Canal (NCSWCD 2011; USEPA 2019). The main stem portion of the AOC also overlaps the most downstream reach of the Eighteenmile Creek Superfund Site Operable Unit 3 (OU3) , referred to as "Reach 1" (Ecology & Environment [E&E] 2017) (Figure 2).

The USACE Buffalo District and U.S. Army Engineer Research and Development Center (USAERDC) were tasked with assessing the potential for COCs to inhibit BUI removal efforts on the Eighteenmile Creek AOC and providing associated recommendations, including needs for management action. This entailed a review of the criteria for BUI removal and associated biological metrics, development of associated data quality objectives (DQOs), data compilation to fulfill the DQOs, and data gap analyses. Employing these DQOs, the overall objectives of this effort were to (1) document the status of each BUI with respect to removal; (2) review relevant information and identify any existing data gaps; and (3) recommend any additional data, information and/or evaluation that would be necessary to determine whether BUI removal could reliably occur.

This effort was undertaken consistent with the goals of Focus Area 1 of the Great Lakes Restoration Initiative (GLRI) Action Plan III, "Toxic Substances and Areas of Concern" (USEPA 2019). Focus Area 1 of the GLRI Action Plan III establishes a goal to remediate, restore, and delist AOCs through removal of all BUIs. To achieve this, a complete and approved list of all management actions necessary for delisting BUIs within an AOC is necessary. The GLRI Action Plan III is specific in its mention of Eighteenmile Creek AOC as one of 10 AOC's across the Great Lakes Basin where completion of management actions could conceivably be achieved in the next five years. Management actions are on-the-ground actions including, but not limited to, remediating contaminated sediment through public/private partnerships and restoring habitat (e.g., improving fish passage, restoring wetlands, and removing dams) that will ultimately lead to the removal of BUIs.

APPROACH

The methodology used in this effort involved a variety of interagency coordination and consultation and an evaluation of available data, most of which have not been published in the primary literature. The status of existing BUI removal criteria were also reviewed, from which DQOs were drafted to assess BUI removal. Using these DQOs, available information was researched, including some chemistry data compiled and managed in a Microsoft Access database. Available data were also assessed spatially and maps were created using ArcGIS 10.7 to review the spatial coverage of environmental data. For surface weighted average concentrations (SWACs), "total PCB" concentrations were determined through the summation of Aroclor measurements, or estimation through the summation of PCB congener measurements with the application of a multiplier. Specifically, total PCB values based on congener results were calculated by multiplying the sum of 22 congeners (PCB 8, 18, 28, 44, 49, 52, 66, 87, 101, 105, 118, 128, 138, 153, 170, 180, 183, 184, 187, 195, 206 and 209) by 2 (Committee on Remediation of PCB Contaminated Sediments *et al.* 2001). The Eighteenmile Creek AOC total PCB SWAC was calculated by generating thiessen polygons in ArcGIS 10.7. Using the area associated with each sample generated by the thiessen polygons, the SWAC was

calculated using the Spatstat package found in the statistical software R (Baddeley *et al.* 2015). Finally, screening modeling efforts were employed in some cases to support data evaluation. This entire process enabled the identification of data gaps, which formed the basis for determining needs for additional data, information and/or evaluation toward the removal of each BUI.

ASSESSMENT OF DATA RELATING TO BUI REMOVAL

Analysis of BUI Removal Criteria

Outstanding Eighteenmile Creek AOC BUIs and associated removal criteria, along with an up-to-date analysis, are detailed below. The IJC guidelines for delisting are provided upfront in reference to each BUI (IJC 2001). Note that some criteria are final and others are "working" or in the process of being revised.

Restrictions on Fish and Wildlife Consumption

IJC DELISTING CRITERIA
"When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines, and no public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed. Rationale: Accounts for jurisdictional; and federal standards; emphasizes local watershed sources."

The removal criteria for this Eighteenmile Creek AOC BUI include: *(1) There are no AOC-specific fish and wildlife consumption advisories issued by New York State; AND (2) Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed upstream of Burt Dam.*

It is expected that this BUI removal action will ultimately be driven by total PCB concentrations.

With respect to the first criterion, the NYS Department of Health (NYSDOH) will use fish tissue data collected from fillets to establish an AOC-specific fish consumption advisory (FCA), and then to assess whether the FCA is different than the advisory established for Lake Ontario and its tributaries. The current FCA for Eighteenmile Creek is the same between the AOC-reach of the creek and the reach above Burt Dam.

During the NYS AOC meeting on October 24, 2019, it was proposed that the second criterion be eliminated due to the technical challenge for determining the

source of PCBs that may be present in fish tissue. It is expected that this criterion will be proposed for removal to the Remedial Action Committee in 2020.

Degradation of Fish and Wildlife Populations

IJC DELISTING CRITERIA
"When environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical and biological habitat present. An effort must be made to insure that fish and wildlife objectives for Areas of Concern are consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals. Further, in the absence of community structure data, this use will be considered restored when fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants. Rationale: Emphasizes fish and wildlife management program goals; consistent with Agreement and Great Lakes Fishery Commission goals; accounts for toxicity bioassays."

The removal criteria for this Eighteenmile Creek AOC BUI include: *(1) Fish community metrics (e.g., diversity, abundance, biomass and condition) are similar to reference site(s); AND (2) Benthic macroinvertebrate community composition is within the range expected and similar to reference site conditions; AND (3) PCB concentrations in fish tissue and other prey are below thresholds likely to result in acute toxicity to fish or piscivorous wildlife (birds and mammals).*

These BUI removal criteria are final. The assessment of potential degradation to fish populations is being based on the measurement of fish diversity, abundance, biomass and condition of fish collected from the AOC and comparison to an Oak Orchard Creek regional reference location. The potential for degradation of *wildlife* populations within the AOC is being assessed using the potential for impacts to the mink population because of the sensitivity of mink to PCB-related toxicity. However, the mink population within the AOC is difficult to measure directly due to the limited extent of habitat suitable for mink and the low number of individuals present (though not prevalent, evidence of mink has been observed within the AOC (e.g., Haynes and Wellman 2019). Given the low population of mink, two surrogate measurement endpoints are being used in place of the direct measurement of the mink population. The benthic macroinvertebrate community composition is being used as the metric to evaluate the quality of the aquatic food web that can support mink while the PCB concentration in fish and other prey is being used to confirm that the mink diet within the AOC is not toxic to a degree that would impact the population. In addition, total PCB concentration data on fish tissue samples collected from the AOC (as well as Lake Ontario and Oak Orchard Creek regional reference locations) will be evaluated to assess the potential for acute toxicity to fish.

Bird or Animal Deformities or Reproductive Problems

IJC DELISTING CRITERIA
"When the incidence rates of deformities (e.g. crossbill syndrome) or reproductive problem s (e.g. eggshell thinning) in sentinel wildlife species do not exceed background levels in inland control populations. Rationale: Emphasizes confirmation through survey data; makes necessary control comparisons."

The removal criteria for this Eighteenmile Creek AOC BUI include: ***(1) PCB concentrations in fish tissue and prey from comparable functional feeding groups are similar to reference site(s); OR PCB concentrations in fish and other prey are below tissue concentrations known to cause deformities or reproductive impairment in piscivorous wildlife.***

These BUI removal criteria are final, and are specifically in reference to fish and prey consumed by mink which is a sentinel wildlife species. When comparing tissue PCB concentrations among functional groups of organisms or across trophic levels, it is important to consider lipid content and other factors. The PCB concentration data on fish tissue and prey samples collected from the AOC (as well as Lake Ontario and Oak Orchard Creek regional reference locations) will be required to evaluate BUI removal, including predicting the potential for deformities or reproductive impairment in mink. In addition, consensus is needed on tissue reference doses.

Degradation of Benthos

IJC DELISTING CRITERIA
"When the benthic macroinvertebrate community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when toxicity of sediment associated contaminants is not significantly higher than controls. Rationale: Accounts for community structure and composition; recognizes sediment toxicity; uses appropriate control sites."

The removal criteria for the Eighteenmile Creek AOC BUI include: ***(1) Benthic macroinvertebrate communities are "non-impacted" or "slightly impacted" according to NYSDEC indices (Bode et al. 1996); OR (2) In the absence of NYSDEC data, riffle habitats require benthic macroinvertebrate communities with a species richness higher than 20, EPT (Ephemeroptera [mayflies], Plecoptera [stoneflies], Trichoptera***

[caddisflies]) richness greater than 6, a biotic index value greater than 4.51, and a percent model affinity greater than 50; OR (3) In the absence of benthic community data, this use will be considered restored when the level of toxic contaminants in sediments is not significantly higher than controls.

Discussions at the NYS AOC meeting on October 24, 2019 indicated that these BUI removal criteria are being revisited. The first is being retained unchanged, while the remaining two are being changed. The new second and third criteria are currently proposed as "Benthic macroinvertebrate community condition is similar to unimpacted control sites of comparable physical and chemical characteristics;" and "Toxicity of sediment-associated contaminants is similar to unimpacted control sites of comparable physical and chemical characteristics," respectively. The new criteria are expected to be finalized in 2020. Preliminarily, the second criterion may involve comparisons of benthic macroinvertebrate community metrics among the AOC and Oak Orchard Creek regional reference sediments (as a surrogate for an "unimpacted control site"). The third criterion may involve comparisons among toxicity data on AOC and Oak Orchard Creek regional reference sediments (as a surrogate for an "unimpacted control site"). Toxicity data relative to this third criterion would inform whether any impairments noted on benthic macroinvertebrate community composition (as evaluated through the second proposed removal criterion) are attributable to sediment toxicity.

Restrictions on Dredging Activities

IJC DELISTING CRITERION
"When contaminants in sediments do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities. Rationale: Accounts for jurisdictional and federal standards; emphasizes dredging and disposal activities."

The single removal criterion for the Eighteenmile Creek AOC BUI is: ***When contaminants in AOC sediments (located within the actual or potential dredging areas identified for the improvement of ship navigation) do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.***

This BUI removal criterion is final. At an October 15, 2019 interagency coordination meeting, it was clarified that "located within the actual or potential dredging areas identified for the improvement of ship navigation" meant the existing Olcott Harbor USACE (federal) navigation channel (a single entrance channel) and non-federal, inner harbor channels associated with marinas upstream to the NYS Route 18 Bridge. At the time of this writing, the latter specifically includes the Town of Newfane and Olcott Yacht Club marinas. For the purposes of this effort, this included bank-to-bank sediments in the harbor area upstream of the federal navigation channel. At this

meeting, NYSDEC indicated that the removal of this BUI would be predicated on any open-water or upland placement-related restrictions.

Review of Data Relating to BUI Removal

The sources of information and data used to inform this assessment of BUI removal are summarized in Tables A1 through A5 of Appendix A.

Restrictions on Fish and Wildlife Consumption

Table A1 summarizes the available sources of information used to evaluate this BUI removal.

> **CRITERIA: (1) There are no AOC-specific fish and wildlife consumption advisories issued by New York State; AND (2) Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed upstream of Burt Dam**

The NYSDOH FCA for Eighteenmile Creek is the driving restriction for this BUI. With respect to total PCBs, concentrations in fish fillets collected in the creek at times exceeded a fish consumption numerical guideline "Don't Eat" advisory of 2 mg/kg (NYSDOH 2019). Therefore, the current FCA for the creek (i.e., "Don't Eat") is the most stringent for all fish. There is no FCA(s) specific to the AOC because the existing FCA applies to reaches of the creek that are both downstream and upstream of Burt Dam. Therefore, there is an administrative need to develop a separate FCA for the AOC to monitor if differences in fish tissue PCB concentrations in fish collected upstream and downstream of the dam may result in difference advisories. For example, E&E (2017) noted overall that the highest concentrations of PCBs were observed in fish collected across three reaches upstream of Burt Dam, while the lowest concentrations were observed in fish collected in the reach downstream of the dam. Figure 3 illustrates total PCB concentrations in fish samples collected from the AOC according to existing FCAs, and in comparison to fish samples collected from Oak Orchard Creek and Lake Ontario regional reference sites.

The current FCA for Eighteenmile Creek is based on 1992 fish tissue data that showed elevated PCB concentrations in fish collected from upstream and downstream of the dam, while the current FCAs for Lake Ontario (ranging from "Up to 4 Meals/Month" to "Don't Eat") are based on more recent fish tissue data reported in 2014, and are linked to residues of PCBs, and dioxins/furans in specific fish species and size thresholds, and depend on the age and sex of consumers (NYSDEC 2014a). For any change to a less restrictive FCA, NYSDOH generally requires a minimum of two years' fish tissue data to demonstrate a downward trend in contaminant tissue concentrations.

At the NYS AOC meeting on October 24, 2019, the NYSDOH and NYSDEC indicated that the more recent data may be reviewed to determine if the AOC should have a FCA that is the same as the regional Lake Ontario and Oak Orchard Creek FCA. However, the requirements for relaxing advisories for waterbodies associated with a Superfund Site are more stringent than waterbodies that are not associated with a Superfund Site. The NYSDOH requires completion of all investigations, remedial activities and multiple years' worth of post-remediation fish tissue data showing lower and declining contaminant levels in fish. This is to help prevent premature relaxation of an advisory in response to a decreasing trend in fish contamination, when dredging, flooding or other disturbance of upstream contaminated sediments could resuspend COCs and contaminate fish downstream (an example of this occurred in the Hudson River). This policy also inherently allows the second criterion of this BUI (which is not measurable) to be removed since NYSDOH requires remedial work to be completed before relaxation of a FCA can occur.

A review of recently collected fish tissue data on the AOC shows that 51 whole body and 68 fillet samples have been analyzed for PCBs from 2009 through 2019. These fish tissue data were generated by NYSDEC, USEPA, USACE, NCSWCD and the State University of New York (SUNY) College at Brockport. The 2019 data, collected by NYSDEC, are not available as of the date of this report. The primary fish species collected in the AOC and analyzed for PCBs were bullhead (18), brown trout (10), chinook/king salmon (10), coho/silver salmon (10), largemouth bass (20), northern pike (5), pumpkinseed (15), rainbow trout (10) and rock bass (7). The U.S. Geological Survey (USGS) conducted a fish community survey for Eighteenmile Creek AOC and Oak Orchard Creek during 2019. Although the final report is still in preparation, this survey demonstrated that several fish species are prevalent within the creek for which tissue data have not been collected. The species potentially consumed by anglers, that are also prevalent and for which tissue data do not exist, include common carp and smallmouth bass. Although prevalent in Eighteenmile Creek, only one white sucker has been analyzed for PCBs. Upstream of Burt Dam in the Superfund Site source area, available fish tissue data include 86 whole body and 70 fillet samples that have been analyzed for PCBs from 2010 through 2018. These fish tissue data were generated by NYSDEC, USEPA, USACE and NCSWCD.

Based on this sampling, fish species composition is comparably different between the Superfund Site source area upstream of the dam and the AOC. Data for salmonid species (e.g., brown trout, chinook/king salmon, coho/silver salmon, and rainbow trout) are available exclusively for the AOC, while data for several non-salmonids (e.g., common carp, smallmouth bass, and walleye) exist exclusively for the Superfund Site source area. Since salmonids collected in the AOC spend most of their lifetime in Lake Ontario, it is important to consider whether PCBs observed in tissue reflect bioaccumulation from the lake or the AOC.

Fish tissue data on regional reference sites in Lake Ontario and a nearby similar creek are also available. A Lake Ontario regional reference dataset includes 58 fillet samples analyzed for PCBs. These samples were collected in 2014 by NYSDEC and used

by the NYSDOH to revise the Lake Ontario FCA to its current status (NYSDEC 2014a). The fish species collected include coho/silver salmon (20), smallmouth bass (15), white perch (10) and white sucker (5). An Oak Orchard Creek regional reference dataset includes 10 whole body and 20 fillet samples collected in 2018 and analyzed for PCBs (E&E 2019a). The fish species collected include bluegill (7), brown bullhead (1), common carp (4); largemouth bass (10); northern pike (3), pumpkinseed (3) and walleye (2).

Table 1 summarizes the available recent total PCB concentrations in fish tissue for Eighteenmile Creek upstream and downstream of Burt Dam, as well as for the regional reference sites in Oak Orchard Creek, the Lower Niagara River and Lake Ontario. Total PCB concentrations in about half of the sampled fish from the AOC, and the average concentration across fish species in the AOC, exceeded the total PCB "Don't Eat" criterion of 2 mg/kg. Average fish tissue concentrations in AOC fish fillets (2.1 mg/kg) are about an order of magnitude greater than those in the Oak Orchard Creek (0.16 mg/kg), Lower Niagara River (0.32 mg/kg) and Lake Ontario (0.14 mg/kg and 0.29 mg/kg) regional reference sites.

With regard to the salmonid species, all of the sampled fish within the AOC were below the 1 mg/kg guideline for a specific PCB advisory, with average concentrations across the four species ranging from 0.45 to 0.47 mg/kg (NYSDEC 2019a).

High water column concentrations of PCBs within the AOC appear to be a significant source of PCBs to fish tissue. Between 2004 and 2010, USEPA conducted biannual water quality monitoring of PCBs downstream of Burt Dam (USEPA 2011). This involved measurements of PCB congener concentrations in whole water samples collected from the AOC, as well as from the Oak Orchard Creek regional reference site. These data, in terms of total PCBs, are illustrated in Figure 4. On average during this period, the whole water concentration of total PCBs was 0.05 μg/L, about two orders of magnitude greater than the average concentration of 0.0005 μg/L for the Oak Orchard Creek regional reference site. This information, in tandem with average measured levels of dissolved organic carbon (DOC) and particulate organic carbon (POC) for Eighteenmile Creek of 3.4 mg/L (E&E 2019a) and 0.5 mg/L (NYSDEC 2009), respectively, a total PCB log K_{ow} of 6.589 (USEPA 1995) and average lipid content of 3.2%, were used to estimate the average total PCB concentration in fish tissue from water column exposure alone (bioconcentration). The resulting value of 1.5 mg/kg suggests that the majority of the average total PCB concentration measured in fish tissue (about 70%) can be explained through dissolved water column concentrations (Figure 5). Interestingly, this modeling also suggests that the much lower dissolved PCB water column concentrations at the Oak Orchard Creek reference site account for a proportionally smaller amount (about 10%) of the average tissue residues measured in fish.

Data Gaps and Recommendations

The above assessment has yielded the following data gaps and recommendations:

(1) Administratively separate the FCAs for the AOC and Superfund Site source area and establish a FCA specific to the AOC and determine if it is different than the Superfund Site source area and Lake Ontario.

(2) Review existing USEPA, USACE and NCSWCD fish fillet data to assess whether they meet NYSDOH FCA QC requirements.

(3) Conduct passive water sampling (e.g., via semipermeable membrane devices [SPMD]) for PCBs across the AOC to further quantify and evaluate freely dissolved concentrations of PCBs in the water column as a source for fish tissue bioaccumulation.

Degradation of Fish and Wildlife Populations

Table A2 summarizes the available sources of information used to evaluate this BUI removal.

CRITERION: (1) Fish community metrics (e.g., diversity, abundance, biomass and condition) are similar to reference site(s)

To assess the fish community, diversity, abundance, biomass and condition metrics, data were collected by the USGS in 2019 and by the NCSWCD in 2009. The 2019 data are not yet available. Based on discussion with the USGS during the NYS AOC meeting on October 24, 2019, it is expected that the 2019 sampling event will provide adequate data for developing the necessary fish community metrics. No additional data collection or assessment is recommended for assessment of the fish community.

AND

CRITERION: (2) Benthic macroinvertebrate community composition is within the range expected and similar to reference site conditions

For the benthic macroinvertebrate community assessment, E&E (2013b) conducted a baseline study to evaluate the current health of benthic macroinvertebrate communities in the Eighteenmile Creek AOC. In this assessment, benthic macroinvertebrates were sampled from two riffle and three pool habitats. The results indicated little to no benthic impairment within the AOC. A follow-up study was completed by USGS and NYSDEC (George *et al.* 2017) to confirm the results of E&E (2013b), as well as to address the lack of benthic macroinvertebrate community measurements from an appropriate reference site. Biological assessment profile (BAP) scores for the AOC and Oak Orchard Creek regional reference site were calculated to gauge the integrity of the benthic macroinvertebrate community using the methodologies in Smith *et al.* (2014). The results of George *et al.* (2017) suggest that the benthic macroinvertebrate communities in

the AOC and Oak Orchard Creek regional reference site are statistically similar. Despite this finding, the upstream-most AOC sample location scored lower, in terms of both BAPs and toxicity testing. A detailed discussion of these and other benthic macroinvertebrate data is provided in the *Degradation of Benthos* BUI section later in this report. Despite the potential for localized reduction in BAP scores that may be due to factors unrelated to persistent contaminants in sediments, there is no difference between the AOC and Oak Orchard Creek regional reference site BAP scores on a spatial scale that is relevant to the home range for mink. No additional data collection or assessment is recommended for the assessment of the benthic macroinvertebrate or wildlife community.

AND

> **CRITERION: (3) PCB concentrations in fish tissue and other prey are below thresholds likely to result in acute toxicity to fish or piscivorous wildlife (birds and mammals)**

The AOC mink population is being used again in this case as a surrogate for piscivorous wildlife due to its sensitivity to PCB-related toxicity. The potential for degradation of fish populations can be estimated by direct measurement of fish tissue concentrations and the prediction of potential for acute toxicity. Considerable data exist providing estimates for the concentrations of PCBs in fish. These data need to be compared to the tissue reference dose that is likely to result in acute toxicity to fish, kingfisher and mink.

Drs. James Haynes and Sara Wellman at SUNY College at Brockport are currently conducting an assessment of mink populations and the potential for bioaccumulation of PCBs in mink within the AOC. An interim report was prepared in July 2019 (Haynes and Wellman 2019). Due to the limited habitat for mink, the investigation has focused on collecting mink prey to establish the PCB exposure through the aquatic food web. Fish, crayfish and water samples have been collected and analyzed for PCBs during the fall of 2018, and the spring and summer of 2019. Crayfish were not collected during the spring of 2019 due to record high water levels on Lake Ontario that prevented wading in normally shallow water downstream of Burt Dam. Another attempt to collect an additional crayfish sample will occur during the spring 2020. Although attempts to collect amphibians were made during 2018 and 2019, none were seen during late September 2018 due to the time of year and none were collected during 2019 due to the high lake water levels. No samples have been collected from the Oak Orchard Creek regional reference site. Because there are fish tissue data for Oak Orchard Creek, a comparison of prey species collected from the AOC to the Oak Orchard Creek regional reference site could be made with the planned additional collection of crayfish in spring 2020.

Preliminary data derived from the fish and crayfish samples collected during the fall 2018 and spring 2019 by Drs. Haynes and Wellman indicate that none of the prey samples exceeded the dietary lowest observed adverse effect level (LOAEL) for

impaired reproduction deformities (precancerous jaw deformities in mink kits = 0.96 μg/g; Bursian *et al.* 2006a,b). However, an analysis needs to be performed for a dietary LOAEL specific for acute toxicity to adult mink since the BUI removal criterion is predicated on acute toxicity. It is interesting to note that although none of the prey samples exceeded the dietary LOAEL for jaw deformities, the dietary exposure model developed by Drs. Haynes and Wellman, which includes water ingestion, exceeded the dietary LOAEL of 0.96 μg/g for reproduction deformities. The dietary model predicts PCB exposure to be 35- to 64-times greater than the LOAEL, suggesting that PCB exposure through the water column is the primary source of toxicity to mink. Bioavailable PCBs in the water column were also identified as a potential significant source for PCB bioaccumulation in AOC fish in the Restrictions on Fish and Wildlife Consumption section above.

It is important to note that considerable uncertainty exists in the preliminary dietary model predictions developed by Drs. Haynes and Wellman, and that mink PCB bioaccumulation predictions are based on several assumptions. One assumption is that 100% of the PCBs and dioxins/furans measured in whole water samples result in uptake into mink tissues. This is highly unlikely to be the case. Contaminant concentrations were determined in whole water samples where the majority are typically sorbed to suspended solids. These suspended solids may include both biologically digestable organic matter and inert anthropogenic soot-like carbonaceous particulates. These soot-like particulates have been shown to have very slow desorption of PCBs. The high binding energies and slow desorption may potentially reduce the uptake of PCBs prior to elimination from the gut. Direct measurement of dissolved PCBs in AOC waters would reduce or eliminate this model uncertainty relating to the current whole water measurements. Additionally, the biomagnification factors for total PCBs in prey to mink tissue are assumed using simplifying assumptions regarding trophic level and an octanol-water partitioning coefficient (K_{ow}) for the sum of PCB congeners (i.e., total PCBs). Previous work by Drs. Wellman and Haynes has shown that these bioaccumulation model predictions can vary by an order of magnitude when compared to the direct measurement of total PCBs in livers of lakeshore mink. Given this uncertainty, the dietary model should be refined to include better estimates of the tropic transfer factor using site-specific trophic data and congener-specific K_{ow} values for PCBs.

When total toxic equivalents (TEQs) of coplanar PCBs plus dioxins/furans were used to estimate potential toxicity, upper trophic level fish caught in the AOC exceeded the LOAEL for mink reproductive deformities. Crayfish and lower trophic level fish did not. The aquatic dietary exposure model predicted 2.8 to 5.1-fold exceedances of the total TEQ LOAEL for jaw deformities in kit mink when both PCB and dioxin/furan congeners were used to calculate Total TEQ. The calculation of Total TEQ using only PCB congeners resulted in a value of 7.8 ng/kg that translates into a dietary hazard quotient of 0.85. When a dietary bioaccumulation model was evaluated that included direct measurement of PCB in whole water samples, nearly all of the potential toxicity to mink resulted from PCBs present in the water samples. This is important because the

primary source of toxicity to mink based on this analysis appear to be exposure to background levels of PCBs from continuing sources from upstream of Burt Dam.[5]

Data Gaps and Recommendations

The above assessment has yielded the following data gaps and recommendations:

(1) Conduct a risk assessment to estimate the potential for acute toxicity to mink from PCBs. The preliminary investigation by Drs. Haynes and Wellman was conducted for the chronic mink toxicity endpoint of jaw deformities only.

(2) Extend the dietary bioaccumulation model assessment for mink to include the Oak Orchard Creek regional reference site. Existing fish tissue data may be used. However, the collection and tissue residue analysis of crayfish from the Oak Orchard Creek regional reference site would be required, and is recommended to be integrated into the planned 2020 crayfish data collection effort in the AOC.

(3) Refine the dataset used for predicting dietary mink exposure by including the whole body fish tissue data previously collected by the USEPA, USACE and NCSWCD.

(4) Conduct passive water sampling for PCBs to refine the dietary bioaccumulation model. Sampling at these locations will provide bounds for the water exposure to mink which appears to be driving the risk associated with the mink diet exposure model. This can be accomplished via using passive sampling devices (e.g., SPMD).

Bird or Animal Deformities or Reproductive Problems

Table A3 summarizes the available sources of information used to evaluate this BUI removal.

CRITERION: (1) PCB concentrations in fish tissue from comparable functional feeding groups are similar to reference site(s)

As previously described under the Restrictions on Fish and Wildlife Consumption section above, a review of recently collected fish tissue data for the AOC shows that 51 whole body and 68 fillet samples have been analyzed for PCBs from 2009 through 2019.

[5] Dioxins/furans have been identified as critical in the lake-wide management plan for Lake Ontario. However, within Eighteenmile Creek, the presence of low levels of pesticides and dioxins/furans are not considered related to past industrial and/or commercial activities in OU2 and, therefore, are not being assessed in the Screening Level Ecological Risk Assessment (SLERA) and BERA for OU3.

The 2019 data collected by NYSDEC are not available as of the date of this report. Fish tissue data for regional reference sites, which include Lake Ontario and Oak Orchard Creek, are also available. A Lake Ontario regional reference dataset includes 58 fillet samples analyzed for PCBs collected in 2014 by NYSDEC (NYSDEC 2014a). An Oak Orchard Creek regional reference dataset includes 10 whole body and 20 fillet samples collected in 2018 and analyzed for PCBs (E&E 2019a). Although crayfish in the AOC were not collected during the spring of 2019 due to record high water levels on Lake Ontario, an attempt to collect additional crayfish samples is currently planned for spring 2020. However, no crayfish samples have been collected from the Oak Orchard Creek regional reference site. Table 1 summarizes the available recent total PCB concentrations in fish tissue for Eighteenmile Creek upstream and downstream of Burt Dam, as well as for the regional reference sites in Oak Orchard Creek, the Lower Niagara River and Lake Ontario.

CRITERION: (2) PCB concentrations in fish and other prey are below tissue concentrations known to cause deformities or reproductive impairment in piscivorous wildlife

As previously described under Degradation of Fish and Wildlife Populations section above, Drs. Haynes and Wellman are currently conducting an assessment of mink populations and the potential for bioaccumulation of PCBs in mink within the AOC. An interim report was prepared in July 2019 (Haynes and Wellman 2019).

Preliminary data derived from the fish and crayfish samples collected during the fall 2018 and spring 2019 by Drs. Haynes and Wellman indicate that none of the prey samples exceeded the dietary LOAEL for impaired reproduction deformities. However, Drs. Haynes and Wellman's model, which includes water ingestion, exceeded the dietary LOAEL for reproduction deformities. The dietary model predicts PCB exposure to be 35- to 64-times greater than the LOAEL, suggesting that PCB exposure through the water column is the primary source of toxicity to mink. The preliminary report needs to be finalized with the addition of the complete set of fish tissue data for the AOC, the final crayfish tissue samples, refining the dietary exposure model to include better estimates of exposure through direct measurements of dissolved PCBs in water, and refinement of the tropic transfer factor using site-specific trophic data and K_{ow} values.

<u>Data Gaps and Recommendations</u>

The above assessment has yielded the following data gaps and recommendations:

(1) A statistical analysis of the existing fish tissue data for the AOC and the Oak Orchard Creek and Lake Ontario regional reference sites should be conducted to determine whether total PCB fish tissue concentrations within the AOC are statistically different from that of reference sites.

(2) Extend the dietary bioaccumulation model assessment for mink to include the Oak Orchard Creek regional reference site. Existing fish tissue data may be used. However, the collection and tissue residue analysis of crayfish from the Oak Orchard Creek regional reference site would be required and is recommended to be integrated into the planned 2020 crayfish data collection effort in the AOC. This data gap and recommendation is the same as for the Degradation of Fish and Wildlife Populations BUI removal.

(3) Refine the dataset used for predicting dietary mink exposure by including the whole body fish tissue data previously collected by the USEPA, USACE and NCSWCD. This data gap and recommendation is the same as for the Degradation of Fish and Wildlife Populations BUI removal.

(4) Conduct passive water sampling for PCBs to refine the dietary bioaccumulation model. Sampling at these locations will provide bounds for the water exposure to mink which appears to be driving the risk associated with the mink diet exposure model. This can be accomplished via using passive sampling devices. This data gap and recommendation is the same as for the Degradation of Fish and Wildlife Populations BUI removal.

Degradation of Benthos

Table A4 summarizes the available sources of information used to evaluate this BUI removal. Evaluation of this BUI removal relies heavily on the 2014 benthic datasets in George *et al.* (2017) since they are the most recent and included a comparison to the Oak Orchard Creek reference site. In addition, five samples were collected from the AOC in 2012, with none being collected from the Oak Orchard Creek regional reference site (E&E 2013b). Figure 6 shows the location of each of these sample sites in the AOC. Based on the recent survey of George *et al.* (2017), both the macroinvertebrate communities and laboratory toxicity tests indicate that the overall quality of bed sediment in the AOC are is not significantly different than that of the Oak Orchard Creek reference site. This finding was supported by the results of four endpoints from two toxicity tests and by the NYSDEC multi-metric index of macroinvertebrate community integrity conducted using AOC sediments and reference site sediments. However, considerable variability exists in the macroinvertebrate community data with one AOC sample (emil-3) near the mid-point of the creek showing a moderately impacted community. An additional sediment sample was recently collected in the vicinity of emil-3 and analyzed for chemistry and benthic chronic toxicity. These data are not yet available. The characterization of sediment toxicity at the emil-3 site may provide additional evidence whether the benthos within the AOC is considered degraded. A comprehensive discussion of the existing data used for assessing this BUI is provided for each criterion below.

CRITERION: Benthic macroinvertebrate communities are "non-impacted" or "slightly impacted" according to NYSDEC indices (Bode *et al.* 1996)

The benthic macroinvertebrate community information and data considered in this assessment from E&E (2013b) and George *et al.* (2017) are compiled in Table 2. One of the three 2014 benthic macroinvertebrate community samples evaluated by George *et al.* (2017) was classified as "moderately impacted" under NYSDEC criteria and thus failed to meet the BUI removal criterion. A 2012 benthic macroinvertebrate community survey of the AOC showed that one out of five samples collected failed to meet the BUI removal criterion because it was classified as "moderately impacted." These investigations are detailed below.

George *et al.* (2016, 2017) collected bed sediment samples from three sites in the AOC (i.e., emil-3, emil-4 and emil-5) and from three sites at the Oak Orchard Creek reference site downstream of Waterport Dam (i.e., orch-3, orch-4 and orch-5). Five replicate grab samples were collected from each site, with the macroinvertebrates being identified to the lowest possible taxonomic resolution (usually genus or species) and counted. BAP scores were then calculated to assess the condition of macroinvertebrate community. The BAP is calculated based on five component metrics: species richness, Hilsenhoff biotic index (Hilsenhoff 1987), dominant-3, percent model affinity (Novak and Bode 1992) and Shannon-Weiner diversity. The BAP score was then assessed using the NYSDEC four-tiered scale of water quality impact (severe: 0–2.5; moderate: 2.5–5.0; slight: 5.0–7.5; or non-impacted: 7.5–10.0). In this system, moderate and severe scores are indicative of impaired conditions (Smith *et al.* 2014).

The aggregate BAP scores at AOC sites emil-3, emil-4 and emil-5 were calculated to be 3.9, 6.4 and 7.5, respectively, with emil-3 (3.9) being classified as "moderately impacted" and failing to meet the BUI removal criterion. The remaining emil-4 and emil-5 sites were classified as "slightly impacted" (6.4) and "non-impacted" (7.5), respectively, passing the BUI removal criterion. The BAP score for emil-3 was determined to be significantly lower than the other BAP scores within the AOC and the reference site. However, a single low BAP score should not be considered unusual where there are many environmental factors, unrelated to the presence of persistent contaminants in sediment, that can influence macroinvertebrate community structure (e.g., water depth, eutrophication, sedimentation, etc. [Angradi *et al.* 2017]). It is important to note that low relative abundance of benthic macroinvertebrates was found for both the AOC and Oak Orchard reference sites, indicating that regional factors other than persistent contaminants in AOC sediments in are impacting the BAP scores (George *et al.* 2017).

George *et al.* (2017) provided an additional line of evidence suggesting that conditions at emil-3 may be impaired. It was determined that four macroinvertebrate taxa contributed to various dissimilarities between the communities at emil-3 and Oak Orchard Creek regional reference sites. Major differences at emil-3 included that *Chironomus* sp. and *Microchironomus* sp. (both chironomids) were absent, and that *Procladius* sp., a pollution tolerant chironomid, usually dominated in the sample

replicates. In addition, *Limnodrilus hoffmeisteri* (an oligochaete) showed a comparably low abundance.

A previous investigation on the macroinvertebrate community structure in the AOC demonstrated considerable spatial variability in BAP scores (E&E 2013b), both within the study and in tandem with the results of George *et al.* (2017). Two sites flanking emil-4 (BP1 and BP3) yielded "non-impacted"-classified BAP scores (7.4 and 7.1, respectively). Further, E&E (2013) yielded a "moderately impacted" classification (BAP of 4.5) at an upstream riffle habitat site (BR2) and "non-impacted" classification (BAP of 6.7) at a pool habitat site (BP2) downstream of emil-3. Ecology & Environment, Inc. (2013b) also found pollution tolerant taxa to account for over 95% of the invertebrates identified at pool habitat sites BP1, BP2 and BP3, with the dominant taxa being *Procladius* sp., the Chironomini tribe and aquatic worms within the Naididae family. As previously indicated, all three of these sites were nevertheless classified as "non-impacted" through BAP scoring.

Organic enrichment of sediments in the AOC, and possibly other non-persistent contaminant related factors, may play some role in the assessment of benthic macroinvertebrate communities and impairment of the benthos. Further discussion on this is included below.

OR

CRITERION: Benthic macroinvertebrate community condition is similar to unimpacted control sites of comparable physical and chemical characteristics

Analyses of benthic macroinvertebrate community condition, as described using BAP scoring, demonstrated that the status of this condition within the AOC was not significantly worse when compared to the Oak Orchard Creek reference site (George *et al.* 2017). This criterion for BUI removal has been satisfied. Variation in the BAP scores were observed for both creeks with one sample in the AOC (i.e., emil-3) having the lowest score. The BAP scores for the AOC and Oak Orchard Creek reference site ranged from 3.9 to 7.5 and 6.0 to 7.1, respectively. The Oak Orchard Creek reference sites were consistently classified as "slightly impacted."

Sediment chemistry was not included with the benthic macroinvertebrate assessment completed by George *et al.* (2017). To gain a better understanding of sediment contamination in the AOC, a screening of sediment metal concentrations in surficial AOC sediments was performed based on existing data. Figures 7 and 8 illustrate sites where concentrations exceeded the consensus probable effect concentration (PEC) (MacDonald *et al.* 2000) and PECx2, respectively (note that sediment concentrations of both dieldrin and ∑DDT were also examined, but did not exceed PECs and therefore were not included in a figure). These two figures also include designating which site sediment samples were subjected to chemical analysis (dots) and/or toxicity tests (stars).

These two figures fail to suggest any remarkable concentrations of metals that would contribute to impairment of the benthic macroinvertebrate community in the vicinity of emil-3. Furthermore, acid volatile sulfide/simultaneously extracted metal (AVS/SEM) data and toxicity test results from E&E (2013b) indicate that although metal concentrations in AOC sediments may exceed various sediment quality guidelines (e.g., PECs), they showed low potential for bioavailability. While the highest concentrations of PCBs (range 0.42 to 2.0 mg/kg; localized average 1.1 mg/kg) in the AOC do occur at two sites in the vicinity of emil-3, it is unlikely that such concentrations of PCBs alone in sediment would manifest acute toxicity in the bioassays applied (e.g., USACE 2011a,b). Given the somewhat differing hydrologic (e.g., depths, current velocities, water quality) and physical (e.g., sediment grain size distribution, total organic carbon [TOC] content) conditions in the AOC in comparison to Oak Orchard Creek, it is likely that factors unrelated to persistent contaminants play some role in the differing benthic community assemblage at emil-3. For example, Reinhold-Dudok and den Besten (1999) concluded that the presence of solid substrates, depth, current velocity, particle size distribution and content of organic matter in sediment were the most important factors contributing to the variability in the benthic macroinvertebrate community assemblages in a Netherlands river delta.

It is worth noting that some of the indexes used to calculate the BAP score in this case (e.g., HBI [Hilsenhoff 1987], percent model affinity [PMA] index [Novak and Bode 1992]) solely or partially assess organic and nutrient pollution. Consequently, the scoring applied is not limited to persistent contaminant-related effects to benthic macroinvertebrates, and such effects may not be AOC-specific and more regional in scope. For example, data from George *et al.* (2017) shows that the average TOC content in AOC sediments (3.4%) is double that of Oak Orchard Creek downstream regional reference sediment (1.7%), indicating some organic enrichment in AOC sediments.

Nevertheless, in comparison to the HBI, Novak and Bode (1992) suggested that the PMA can better reflect adverse impacts relating to non-organic pollution. There may be one or several non-persistent contaminant-related factors shaping the lower BAP score at emil-3. First, PMA is one of the drivers of the BAP score on the emil-3 sediment, but it should be noted that the index was developed for riffle habitats and emil-3 is not located in riffle habitat (Novak and Bode 1991). Since all samples were collected in late August, Eighteenmile Creek was likely undergoing seasonal eutrophication and related conditions may have been comparatively more severe at emil-3. Pollution from agricultural runoff may also have played a role. In an Ohio River basin, Rae (1989) found *Procladius* to be indicative of "high agricultural runoff" characterized by high turbidity and the release of nitrate from fertilizers. The abundance of *Procladius*, along with the presence of *L. hoffmeisteri* at emil-3, also influenced the other two very low index values (measuring species richness and diversity) contributing to the BAP score. Finally, aquatic habitat at emil-3 appears to differ from the other AOC sites in George *et al.* (2017). The emil-3 site is located closer to the shoreline within an inside bend, opposite a large shoreline marsh, just before where the creek undergoes a notable constriction.

AND

CRITERION: Toxicity of sediment-associated contaminants is similar to unimpacted control sites of comparable physical and chemical characteristics

The toxicity test data considered in this assessment from E&E (2013b), EnviroSystems, Inc. (2013a,b) and George *et al.* (2017) are compiled in Table 3. The most recent results from sediment toxicity testing by George *et al.* (2017) supported the conclusion that the quality of bed sediments in the AOC are not significantly worse than that of the downstream reference sites in Oak Orchard Creek. This finding is supported by the results from measuring four biological measurement endpoints from two toxicity tests. Based on this evaluation as detailed below, the criterion for removal of this BUI is satisfied.

George *et al.* (2016, 2017) subjected sediment samples discussed previously to standard 10-day toxicity testing employing the test species *Hyalella azteca* (amphipod) and *Chironomus dilutus* (midge), using survival and growth as biological measurement endpoints (USEPA 2000). Similar to the benthic macroinvertebrate community data, George *et al.* (2017) noted that the survival and growth of these test organisms exposed to the AOC sediments was not statistically different when compared to Oak Orchard Creek reference sediments. However, significantly lower survival of *C. dilutus* was observed specifically for the emil-3 sediment sample (mean 76%) compared to the Oak Orchard reference sediment samples (mean 93%). While not significantly different, *C. dilutus* exposed to the emil-3 sediment sample exhibited the lowest growth (mean 0.89 mg). The *H. azteca* results showed a similar pattern, with the lowest survival being observed (although not significantly different) relative to the emil-3 sediment sample (mean 86%), and growth (mean 0.11 mg) being significantly less than the Oak Orchard Creek sediment samples (mean 0.14 mg). Based on these data, George *et al.* (2017) concluded that the emil-3 sediments "consistently scored poorly" and inferred that the toxicity test results coupled with those of Pickard (2006) may identify the emil-3 sediment and upper 2 km of the AOC as a potentially adversely impacted reach that could be targeted for more intensive sampling or future remedial efforts.

Several lines of evidence suggest that the emil-3 site sediment are not toxic due to the presence of persistent sediment contaminants even though the site consistently yielded the lowest growth and survival measurements in the samples tested. These lines of evidence include the absolute measurements of survival and growth, and the differences in growth and survival relative to the Oak Orchard Creek reference sediments. This assessment of the data is detailed below and summarized in Table 4.

***C. dilutus* toxicity assessment**

With respect to the survival measurement endpoint, the difference between mean survival of 76% for *C. dilutus* exposed to the emil-3 sediment sample and the combined

mean survival for the Oak Orchard Creek reference sediments (94%) is less than 20%, a criterion used to assess whether the survival of *C. dilutus* observed in laboratory toxicity tests may be biologically meaningful when extrapolated to the field (USEPA/USACE 1998b). Moreover, the difference between the combined mean survival for the AOC (86%) and that for the Oak Orchard Creek reference sediments is less than 20%. It is interesting to note that the mean survival of *C. dilutus* exposed to the sediment samples collected from the Eighteenmile Creek Superfund Site source area (88% and 90%), which would generally be expected to be among the lowest, were greater than those observed for the emil-3 sediment in the AOC.

With respect to the growth measurement endpoint, the *C. dilutus* growth of 0.89 mg observed for the emil-3 sediment sample exceeded the minimum growth criterion of 0.6 mg considered acceptable for this laboratory toxicity test (USEPA/USACE 1998a,b). In addition, this value was within the range measured for the Oak Orchard Creek reference sediment (mean range 0.77 to 0.99 mg; George *et al.* 2016). Collectively, the *C. dilutus* survival and growth data for the emil-3 sediment do not suggest any significant acute or sublethal toxicity.

***H. azteca* toxicity assessment**

With respect to the survival measurement endpoint, the *H. azteca* mean survival of 86% for the emil-3 sediment sample is similar to that for the orch-5 reference sediment sample in Oak Orchard Creek (89%). In addition, the difference between mean survival for the emil-3 sediment sample and the combined mean across the Oak Orchard Creek reference sediments (94%) (based on data from George *et al.* 2016) is less than 10% (USEPA/USACE 1998a,b), suggesting a difference that is not biologically meaningful. Finally, the combined mean survival for the AOC (93%) is similar to that of the reference sediments.

Regarding the growth measurement endpoint, there is no published guidance pertaining to ecologically meaningful thresholds for the minimum growth of *H. azteca*. The lowest mean growth of 0.11 mg yielded at emil-3 was similar to that of the orch-3 reference sediment sample (0.12 mg), and the combined AOC mean growth (0.13 mg) is similar to that of the combined Oak Orchard Creek regional reference sediment. Furthermore, the mean growth values for the Superfund Site source area sediments (0.15 and 0.13 mg), which would generally expected to be lower, were higher than the mean growth associated with emil-3 sediment. Additional discussion concerning the emil-3 growth result in comparison to other *H. azteca* growth data generated through other investigations is presented below.

E&E (2013b) and EnviroSystems, Inc. (2013a,b) standard laboratory toxicity tests

E&E (2013b) applied standard 10-day *H. azteca* and *C. dilutus* toxicity tests to surface grab sediment samples collected from three pool habitat sites downstream from Burt Dam, using both survival and growth as measurement endpoints (USEPA 2000). While

they did not test any reference site sediments, the laboratory control sediment sample (for determining laboratory test quality and acceptability) was used for evaluating AOC sediment toxicity.

With respect to the survival measurement endpoints, mean survivals for both test species observed for the AOC sediment samples were high (range 90 to 96%), and there were no statistically significant differences in comparison to the control sediment sample.

Regarding the growth measurement endpoints, the results for both test species yielded no statistically significant differences between the AOC and control sediment samples. The *H. azteca* mean growth observed by George *et al.* (2017) (0.11 mg) was very similar to growth data for the AOC pool habitat sediment samples measured by E&E (2013b) (range 0.10 to 0.11 mg) which include the two sites flanking emil-3 (BP1 and BP3). The mean growth for the emil-3 sample was also higher than the mean growth values associated with Olcott Harbor sediment (range 0.05 to 0.07 mg), lake reference site sediment (0.05 mg) and the test control sample (0.06 mg) (EnviroSystems, Inc. 2013a,b). Figure 9 illustrates the combined *H. azteca* growth data generated on AOC, Superfund Site source area, reference and control sediments from E&E (2013b), EnviroSystems, Inc. (2013a,b) and George *et al.* (2017).

E&E (2013b) concluded that their bioassay results suggest that that although many of the contaminant (e.g., metals, PCBs, pesticides) concentrations in AOC sediments exceeded screening levels, the contaminants did not result in toxicity to benthic invertebrates. These data were consistent with the (AVS/SEM data showing divalent metals to not be bioavailable (E&E 2013b).

Toxicity summary

It is concluded that the *C. dilutus* and *H. azteca* toxicity test data from George *et al.* (2017) indicate that the sediments sampled from the AOC and Oak Orchard Creek reference sites are toxicologically similar. The USEPA Office of Superfund is currently performing (under contract) additional chronic toxicity tests on a sediment sample collected from site emil-3. Note, however, that there is no published guidance on the interpretation of chronic toxicity test endpoints, and there are complexities in extrapolating observed laboratory-based results to ecological effects in the field.

Data Gaps and Recommendations

The above assessment has yielded the following data gaps and recommendations:

(1) The current weight-of-the-evidence suggests that persistent sediment-associated contaminants are not substantially contributing to any benthic macroinvertebrate community-related impairments associated with AOC sediments. Therefore, no specific data gaps have been identified to inform the removal of this BUI.

(2) The additional chronic toxicity test results and sediment chemistry data on samples collected by E&E need to reviewed to confirm the assessment of benthos degradation. (Update note: Preliminary review of the data presented in the draft report indicate no chronic toxicity associated with AOC sediments. All measurement endpoint results on AOC sediment samples were not statistically different in comparison to the reference or control sediment samples.)

(3) AOC stakeholders typically base BUI removal decision-making on data generated through standard sediment acute toxicity tests. The interpretation of data generated through chronic toxicity tests being completed in this case should take into consideration that elucidating whether the results are truly ecologically meaningful can be challenging and indeterminate.

(4) If any future benthic macroinvertebrate community sampling and analysis of sediments at emil-3 or any other site in the AOC is pursued, it should be accompanied with a full suite of paired chemistry and bioassay testing, as well as a complete characterization of physical parameters at the site. In addition, toxicity tests should follow either USEPA/USACE (1998a,b) and/or USEPA (2000), but include monitoring and mitigation for sediment porewater ammonia, as well as any necessary toxicity identification evaluation (TIE).

Restrictions on Dredging Activities

CRITERION: When contaminants in AOC sediments (located within the actual or potential dredging areas identified for the improvement of ship navigation) do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities

Current dredging and the management (disposal) of dredged sediments from both the federal and non-federal channels in the AOC are not restricted because they have been determined to be suitable for either open-water or upland placement based on existing bulk sediment and bioassay data relative to pertinent standards, and applicable criteria or guidelines at the federal and/or state levels. In practice, sediments dredged from these areas are either placed at an authorized one quarter square mile open-water placement site in Lake Ontario, located 1.5 miles due north of the Olcott Harbor Light at an azimuth of 0°00'(USACE 1991), or at a number of upland sites. Dredged sediment that is discharged at the open-water site is subject to specification by the USACE under the Clean Water Act and must comply with the Clean Water Act Section 404(b)(1) Guidelines (USEPA 1980), and be issued a Section 401 water quality certification (WQC) from NYS. The dredging must also comply with the NYS Coastal Management

Program, including the issuance of a consistency concurrence. Dredged sediment placed at upland sites would be subject to NYS Solid Waste regulations regarding beneficial use.

Table A5 summarizes the available sources of information used to evaluate this BUI removal. There appear to be sufficient data and information to inform and support the removal of this BUI. Accordingly, NYSDEC is currently in the process of drafting the removal recommendation for this BUI.

In reference to the Olcott Harbor Entrance Channel, historic data provide that between about 5,000 and 10,000 cubic yards of sediment are maintenance-dredged from the entrance channel and open-water placed on a frequency of about every 10 to 20 years. This sediment dredged from this channel is usually predominantly sands. Bulk contaminant and toxicity test data, and standard elutriate test data have shown that placement of the dredged sediments at the specified open-water site would not result in unacceptable adverse effects on the aquatic ecosystem according to Clean Water Act Section 404(b)(1) Guidelines (USACE 1991, 2013). No COCs identified in the dredged sediment, and insignificant acute and sublethal toxicity was demonstrated through standard *H. azteca* and *C. dilutus* toxicity test data (USACE 2013). The NYSDEC previously issued WQC for the discharge of this dredged sediment at the specified open-water site (NYSDEC 2014b), and the NYS Department of State previously issued consistency concurrence for the dredging.

Records on the dredging of non-federal areas in the harbor show that between about 100 and 15,000 cubic yards of sediments are dredged from marinas at a frequency of about every 10 to 25 years. These dredged sediments have been placed at both the specified open-water placement site and upland sites. The NYSDEC has generally classified sediments in the marina areas as on the lower end of "Class B" according to screening criteria, indicating that they are "slightly to moderately contaminated" (NYSDEC 2004). Absent additional bioassay data, such sediments are generally discouraged from being place in the open-water. Standard *H. azteca* and *C. dilutus* toxicity test data from George *et al.* (2017) (emil-5) suggest insignificant acute and sublethal toxicity associated with sediments in the general vicinity of the marinas. Past reviews by NYSDEC have shown the dredged sediments to be suitable for upland beneficial use.

In summary, relatively low contaminant concentrations in sediments dredged downstream of the Route 18 Bridge have led to imposing no restrictions on past dredging activities in the AOC with respect to this BUI removal criterion. Since known contaminant sources within the AOC continue to be addressed, the quality of these sediments is expected to improve until sometime in the future. Therefore, administrative work toward the removal of this BUI is currently underway. Note, however, that the USEPA Office of Superfund has cited some concerns regarding the public messaging of this BUI removal (e.g., a possible resulting misperception that sediments in the Eighteenmile Creek Superfund Site would no longer be considered a risk to human health and the environment).

Review of Sediment Remediation Needs in the AOC

This assessment addresses the AOC COCs (i.e., PCBs, dioxins/furans, DDT, dieldrin, copper, lead and mercury) with respect to sediment conditions.

Sediment concentrations of DDT and dieldrin do not exceed PEC criteria within the AOC and thus are not suspected of significantly contributing to BUIs. Concentrations of metals, including copper, lead and mercury, do exceed PEC criteria in certain areas, indicating the potential for toxicological impacts. However site-specific sediment toxicity testing and AVS/SEM analysis of these sediments indicate that sediment-associated metals are not bioavailable. Thus, sediment-associated copper, lead and mercury within the AOC are not suspected of significantly contributing to BUIs. Concentrations of dioxins/furans within the AOC range from 0.12 pg/g to 16.2 pg/g TEQ with an average of 4.7 pg/g TEQ (Pickard 2006). Such sediment concentrations are not inconsistent with PCDD/F TEQs for sediment at areas of Lake Ontario offshore of Olcott, Rochester and Oswego, where PCDD/F concentrations range from 32 pg/g to 120 pg/g TEQ (Pickard and Clarke 2008). Thus, sediment-associated dioxins/furans within the AOC are also not suspected of significantly contributing to BUIs.

Total PCB concentrations were measured in a total of 42 surficial sediment samples collected from throughout the AOC at a density of about one sample every 2.1 acres (Figure 10). Concentrations ranged from non-detectable to 2 mg/kg (the maximum concentration was from a split sample analyzed for both Aroclor and PCB congeners, the actual average concentration of which was 1.4 mg/kg). The data distribution was approximately normal, with a calculated SWAC of 0.35 mg/kg, median of 0.28 mg/kg, arithmetic mean of 0.35 mg/kg and 95% upper confidence limit (UCL_{95}) of 0.42 mg/kg (Table 5). The spatially explicit SWAC can be conceptualized as a concentration that roaming fish or other mobile aquatic organisms are exposed to in their activities associated with sediment. All of these values are within the range or similar to remedial goals (RGs) used for PCB-contaminated sediments at other AOCs (e.g., Ashtabula River AOC [RGs 0.3 to 1.0 mg/kg] [Ashtabula River Partnership (ARP) 2001]) and Buffalo River AOC [RGs 0.18 to 0.44 mg/kg] [Environ 2011]) (Figure 11). Such concentrations also fall on the lower end of "Class B" sediments (i.e., 0.1 to 1.0 mg/kg) using NYSDEC screening criteria (NYSDEC 2004). This information, in tandem with the fact that the predominant source of PCB bioaccumulation in the AOC appears to be high water column concentrations from sources upstream of Burt Dam, collectively suggests that it would be difficult to justify any management actions for AOC sediments.

PCB bioaccumulation risk associated with Eighteenmile Creek AOC sediments is predicted to be low. The main exposure pathways of PCBs in sediment to aquatic organisms include (1) bioaccumulation via consumption of benthos, and (2) release of PCBs to the water column via flux from sediment porewater (e.g., through sediment resuspension and passive diffusion); these transfers to the water column may then be bioaccumulated via consumption of pelagic organisms and direct uptake

(bioconcentration). For the first pathway, the theoretical bioaccumulation potential (TBP) model (McFarland 1984; McFarland and Clarke 1987) was employed to predict PCB bioaccumulation specific to sediment using the SWAC. Conservatively using an aquatic oligochaete worm as a surrogate species for benthic macroinvertebrates and a biota-sediment accumulation factor (BSAF) of 2.5 from Pickard (2008), the model predicts that bioaccumulation of total PCBs from sediments across the AOC would be on the order of 0.35 mg/kg (this estimate is for benthic macroinvertebrate bioaccumulation only and should not be directly extrapolated to bioaccumulation in fish). This model result is about two times higher than the measured mean total PCB residue of 0.14 mg/kg in the oligochaete *Lumbriculus variegatus* exposed in the laboratory to composited discrete sediment samples from across the AOC (with a mean total PCB sediment concentration of 0.22 mg/kg) (Pickard 2008). These modeled and measured results combined suggest that the contribution of PCBs to the aquatic organisms via bioaccumulation from sediment is limited and approaching lake background levels predicted through the TBP model to be on the order of 0.1 mg/kg.

With respect to the second set of more indirect pathways involving the potential release of dissolved PCBs to the water column through sediment flux, equilibrium partitioning (EqP) modeling (Di Toro *et al.* 1991) estimates an average freely dissolved sediment porewater concentration on the order of 0.003 μg/L. This result is less than the estimated freely dissolved water column concentration of 0.0125 μg/L, suggesting that the flux of PCBs within the AOC would be from water to sediment (Figure 12). Therefore, these particular pathways are not expected to affect bioaccumulation from AOC sediments. The estimated porewater concentration is also predicted to result in a tissue concentration of 0.12 mg/kg in oligochaetes, which is similar to the average measured concentration in *L. variegatus* exposed to AOC sediments and predicted bioaccumulation from Lake Ontario sediments. This provides an additional line of evidence indicating that the bioaccumulation of PCBs from AOC sediments is relatively low.

Pickard (2008) concluded that surficial sediments in the AOC contain levels of contaminants that should be of toxicological concern. It should be noted, however, that the investigation applied sediment screening criteria and did not apply any toxicity or AVS/SEM testing to specifically evaluate sediment-associated contaminant bioavailability. In addition, the investigation did not address water column-based PCB contamination in the AOC. In terms of BSAFs, the higher bioavailability of neutral organic compounds, including PCBs, in surficial AOC sediments evidenced in Pickard (2008) can only be hypothesized to be related to the on-going deposition of PCBs from the water column. To this point, the highest mean BSAF of 4.4 observed in the AOC was located in the upstream-most location. This is consistent with the BSAF being confounded by the influence of highly bioavailable dissolved PCBs from the water column arising from upstream of Burt Dam.

CONCLUSIONS

This effort was undertaken to assess the status of BUI removal efforts on the Eighteenmile Creek AOC and to determine the need for any further sampling, analysis and/or related management actions. The results identify data gaps and provide recommendations to evaluate or facilitate BUI removal.

Two out of the five AOC BUIs are either in the process of being removed or are close to initiating that process. The Restriction on Dredging Activities BUI is in the beginning stages of the administrative removal process, and the Degradation of Benthos BUI appears to be approaching a stage where action on this process can commence. Due to continuing elevated PCB residues in fish tissue, it appears that any action to remove the Restrictions on Fish and Wildlife Consumption BUI will not likely commence for a number of years, pending additional evaluation. Existing PCB residues in AOC fish may largely be a consequence of water column concentrations of PCBs originating from the upstream source area. Some additional data collection and analysis is also recommended for the Degradation of Fish and Wildlife Population and Animal Deformities or Reproductive Problem BUIs to better enable their evaluation for BUI removal.

Based on the information contained in this review, we offer the following summary conclusions and recommendations specific to COCs and management actions and to address data gaps related to each BUI:

COC Conclusion
PCBs are the COC that appear to be driving BUI impairments in the AOC.

Sediment-Related Management Actions Conclusion
Management actions to remediate AOC sediments are not recommended based on this review. No COCs in sediment were indicated as contributing to AOC BUIs. Chemical and biological testing indicate no toxicity associated with the sediment. In addition, the surface weighted average concentration (SWAC) for total PCBs is at a relatively low level and within the range of remedial goals (RGs) developed for other Great Lakes AOCs, suggesting the bioaccumulation of PCBs from sediment is sufficiently low. Existing elevated concentrations of PCBs in fish appear to be the result of on-going high water column concentrations from upstream of Burt Dam Based on the information contained in this review, a series of recommendations addressing sediment-related management actions and BUI removal data gaps were developed. These are summarized below.

Sediment-Related Management Actions Conclusion

Management actions to remediate AOC sediments are not recommended based on this review. No COCs in sediment were indicated as contributing to AOC BUIs. Chemical

and biological testing indicate no toxicity associated with the sediment. In addition, the SWAC for total PCBs is at a relatively low level and within the range of RGs developed for other Great Lakes AOCs, suggesting the bioaccumulation of PCBs from sediment is sufficiently low. Existing elevated concentrations of PCBs in fish appear to be the result of on-going high water column concentrations from upstream of Burt Dam.

BUI Data Gap-Related Recommendations

***Restrictions on Fish and Wildlife Consumption*:**

(1) Administratively separate the FCAs for the AOC and Superfund Site source area, and establish a FCA specific to the AOC and determine if it is different than the Superfund Site source area and Lake Ontario;
(2) Review existing USEPA, USACE and NCSWCD fish fillet data to assess whether they meet NYSDOH FCA QC requirements;
(3) Conduct passive water sampling for PCBs across the AOC to further quantify freely dissolved concentrations of PCBs in the water column as a source for fish tissue bioaccumulation.

***Degradation of Fish and Wildlife Populations*:**

(1) Conduct an acute toxicity risk assessment for PCBs in mink;
(2) Extend the dietary bioaccumulation model assessment for mink to include the Oak Orchard Creek regional reference site
(3) Refine the dataset used for predicting dietary mink exposure by including the whole body fish tissue data previously collected by the USEPA, USACE and NCSWCD; and
(4) Conduct passive water sampling for PCBs to refine the dietary bioaccumulation model.

***Bird or Animal Deformities or Reproductive Problems*:**

(1) Conduct a statistical analysis of the existing fish tissue data for the AOC and the Oak Orchard Creek and Lake Ontario regional reference sites to determine whether total PCB fish tissue concentrations within the AOC are statistically different from that of reference sites.
Recommendations 2, 3 and 4 are the same as those for the Degradation of Fish and Wildlife Populations BUI.

***Degradation of Benthos*:**

(1) The current weight-of-the-evidence suggests that persistent sediment-associated contaminants are not substantially contributing to any benthic macroinvertebrate community-related impairments associated with AOC sediments. Therefore, no specific data gaps have been identified to inform the removal of this BUI.

(2) The additional chronic toxicity test results and sediment chemistry data on samples collected by E&E need to reviewed to confirm the assessment of benthos degradation. (Update note: Preliminary review of the data presented in the draft report indicate no chronic toxicity associated with AOC sediments.)
(3) AOC stakeholders typically base BUI removal decision-making on data generated through standard sediment acute toxicity tests. The interpretation of data generated through chronic toxicity tests being completed in this case should take into consideration that elucidating whether the results are truly ecologically meaningful can be challenging and indeterminate.
(4) If any future benthic macroinvertebrate community sampling and analysis of sediments at emil-3 or any other site in the AOC is pursued, it should be accompanied with a full suite of paired chemistry and bioassay testing, as well as a complete characterization of physical parameters at the site. In addition, toxicity tests should follow either USEPA/USACE (1998a,b) and/or USEPA (2000), but include monitoring and mitigation for sediment porewater ammonia, as well as any necessary toxicity identification evaluation (TIE).

***Restriction on Dredging Activities*:**
No data gaps/recommendations.

***Predominant PCB Source and Exposure in the AOC*:**
Fish tissue concentrations of total PCBs within the AOC remain elevated relative to fish consumption advisory guidelines and regional reference conditions. This condition appears to be related to high water column concentrations of PCBs from upstream sources. Similarly, the mink dietary exposure model indicates that exposure to bioavailable PCBs in the water column may be the primary source of toxicity to mink in the AOC. Consequently, additional data and evaluation regarding the bioavailable fraction of PCBs in the water column would be beneficial toward the continuing assessment of the Restrictions on Fish and Wildlife Consumption, Degradation of Fish and Wildlife Populations, and Bird or Animal Deformities or Reproductive Problems BUIs. This recommendation is consistent with that of E&E (2009), which identified the need for further evaluation of the sources, transport and fate of PCBs within the Eighteenmile Creek watershed with regard to identifying remediation and restoration needs toward delisting the Eighteenmile Creek AOC.

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FIGURES

TABLES

APPENDIX

Document Path: K:\GLRI\Eighteen Mile Creek\Data Gap Analysis\GIS\ArcMap\20191101_AOC_SiteMap.mxd

Legend

- Burt Dam
- Federal Navigation Channel
- Eighteen Mile Creek AOC Boundary
- Eighteen Mile Creek Source AOC Boundary

0 500 1,000 Feet

US Army Corps of Engineers® Buffalo District

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EIGHTEENMILE CREEK AREA OF CONCERN (AOC) SITE MAP

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EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 1

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N

LAKE ONTARIO

FEDERAL NAVIGATION CHANNEL

OLCOTT REC HARBOR

REACH 1/ AOC BOUNDARY

BURT DAM

REACH 2 & 3

NEWFANE DAM

REACH 4

REACH 5

REACH 6

REACH 7

REACH 8

OU1 & OU2

OU3

Olcott
E Lake Rd
Keg Creek
Krull Park
Lake Rd
Lockport Olcott Rd
Jockey Rd
Phillips Rd
Swigert Rd
N Beebe Rd
Burt
Wilson Burt Rd
W Creek Rd
TRANSIT Rd
Fuller Rd
Drake Settlement Rd
McClew Rd
Newfane
Hess
Gow Rd
Checker Tavern Rd
Ide Rd
Charlotteville Rd
Hosmer Rd
Coomer Rd
Hopkins Creek
McKee Rd
Shadigee Rd
Dale Rd
Brown Rd
Bishop Rd
Beebe Rd
Hatter Rd
Nelson Rd
366 ft
Jacques Rd
Ewings Rd
Lockport Olcott Rd
405 ft
North Rd
Murphy Rd
Chestnut Rd
Ellicott Rd
104
Checkered Tavern Rd
Wheeler Rd
Humphrey Rd
Ridge Rd
93
Wicks Rd
Willowbrook Golf Course
Oak Run Golf Club
Dale Rd
Slayton Settlement
Stone Rd
Purdy Rd
Lake Ave
Day Rd
500 ft
78
Plank Rd
Budd Rd
Shunpike Rd
Town Line Rd
Leete Rd
Sunset Dr
Old Niagara Rd
N Canal Rd
S Canal Rd
Eighteenmile Creek
W Jackson St
Gulf Wilderness Park
Glenwood Cemetery
Outwater Memorial Park
Mill St
Clinton St
Market St
Lockport Town and Country Club
East Ave
Walnut St
Niagara County Golf Course
Lockport
Niagara St
Upper Mountain Rd
Thrall Rd
Mud Creek
Gasport
Appleton
Barker
Wilson
Newfane
Twelvemile Creek
Johnson Cr
0
4
Miles

Legend

- Dam Locations
- Operable Unit 1 (OU1) and Operable Unit 2 (OU2)
- Operable Unit 3 (OU3)
- Federal Navigation Channel
- Eighteen Mile Creek Source AOC Boundary

0 2,500 5,000 Feet

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EIGHTEENMILE CREEK OPERABLE UNIT 3 (OU3) SITE MAP

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EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 2

FIGURE 3. Mean concentrations of total PCBs in fillets of fish collected from the AOC and reference sites, and associated fish consumtion advisories (FCAs).

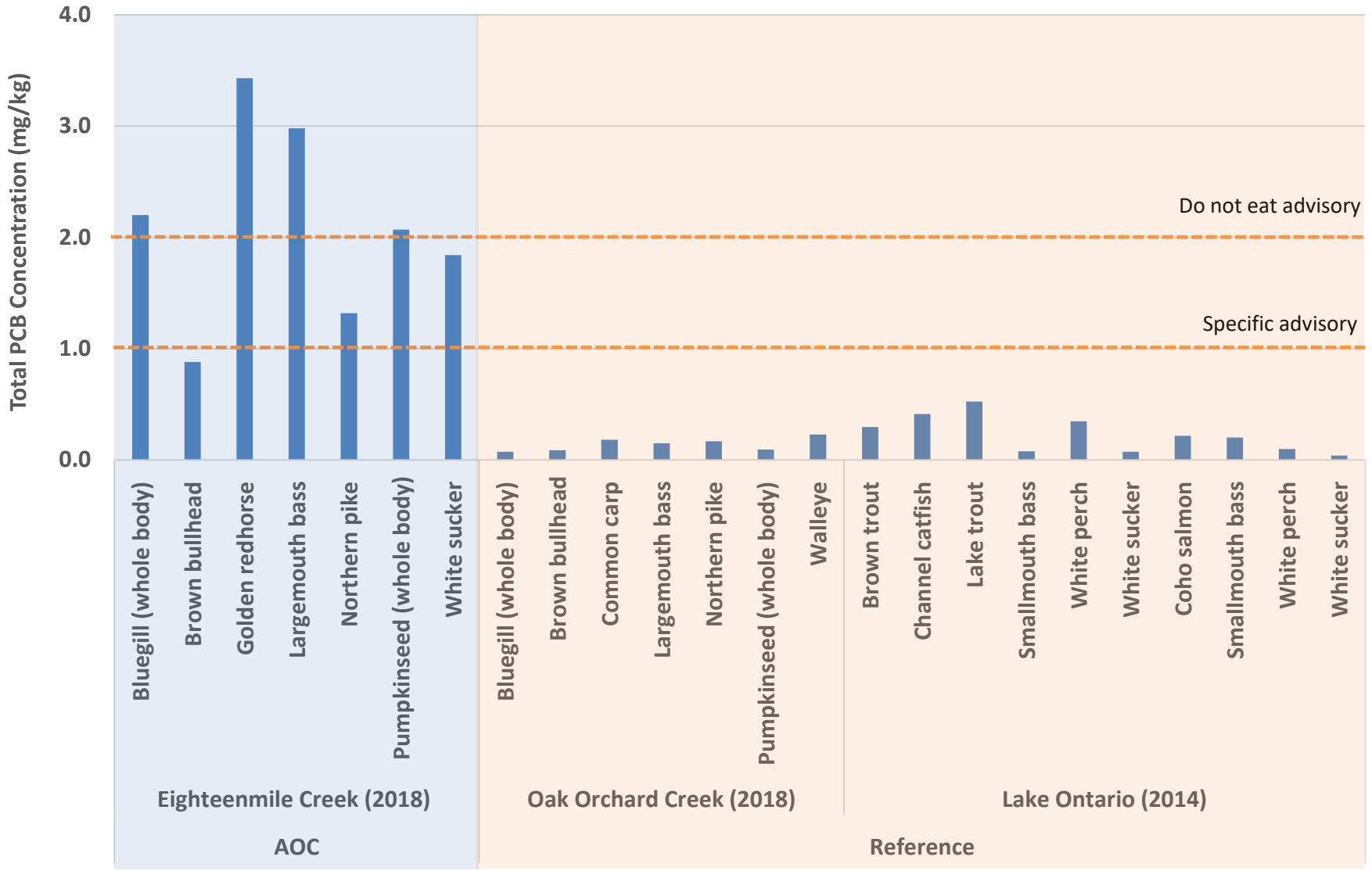


FIGURE 4. Concentrations of total PCBs in whole water samples from the AOC and Oak Orchard Creek reference site.

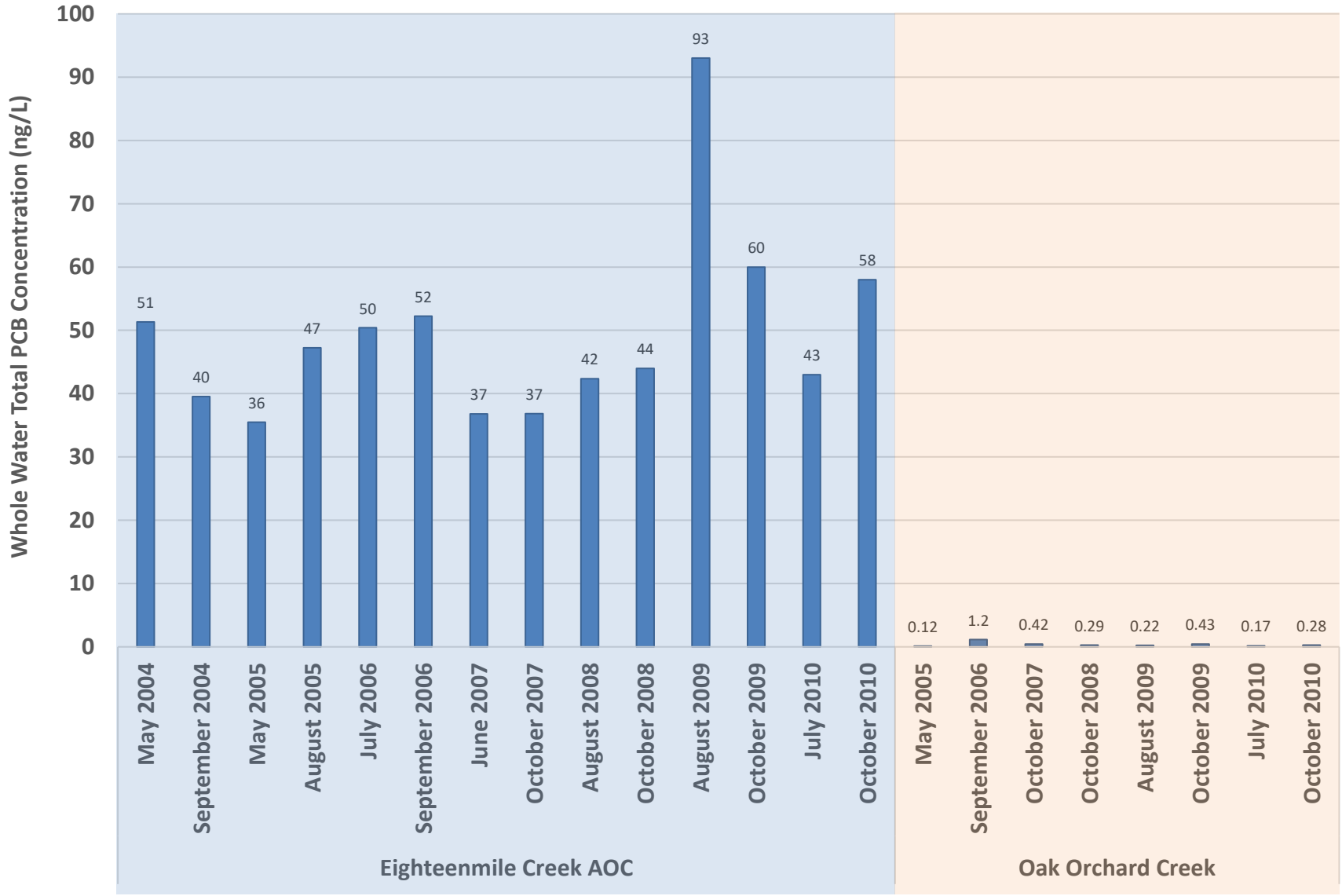
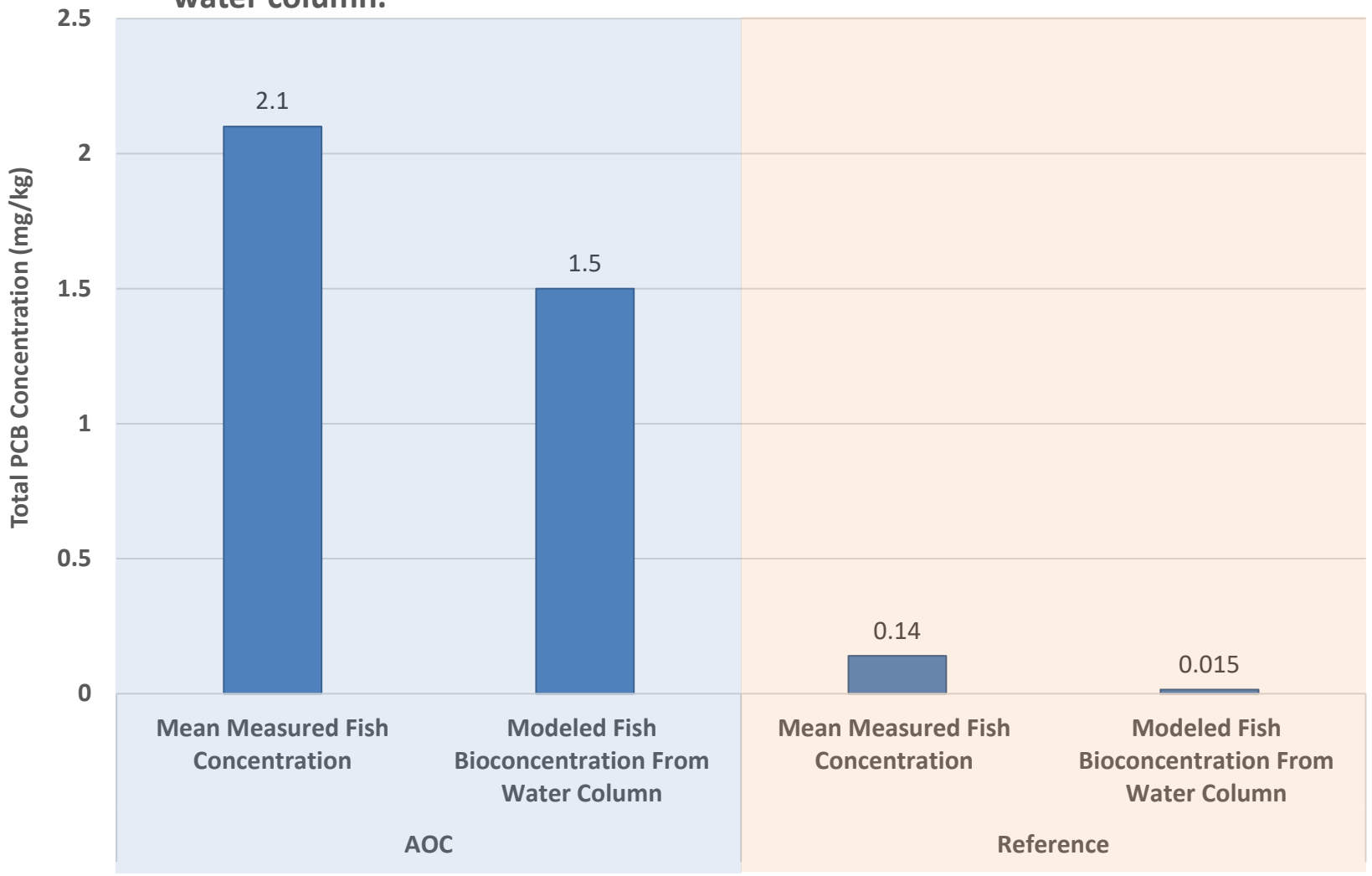


FIGURE 5. Mean measured total PCB concentrations in fish collected from the AOC and a reference site, in comparision to modeled bioaccumulation from the water column.



Document Path: K:\GLRI\Eighteen Mile Creek\Data Gap Analysis\GIS\ArcMap\20191119_Tox_Invert_Samps.mxd

Legend

- E & E (2013b) Benthic Community Sample Locations
- George et al. (2017) Sediment Toxicity Sample Locations
- Burt Dam
- Federal Navigation Channel
- Eighteen Mile Creek AOC Boundary
- Eighteen Mile Creek Source AOC Boundary

0 500 1,000 Feet

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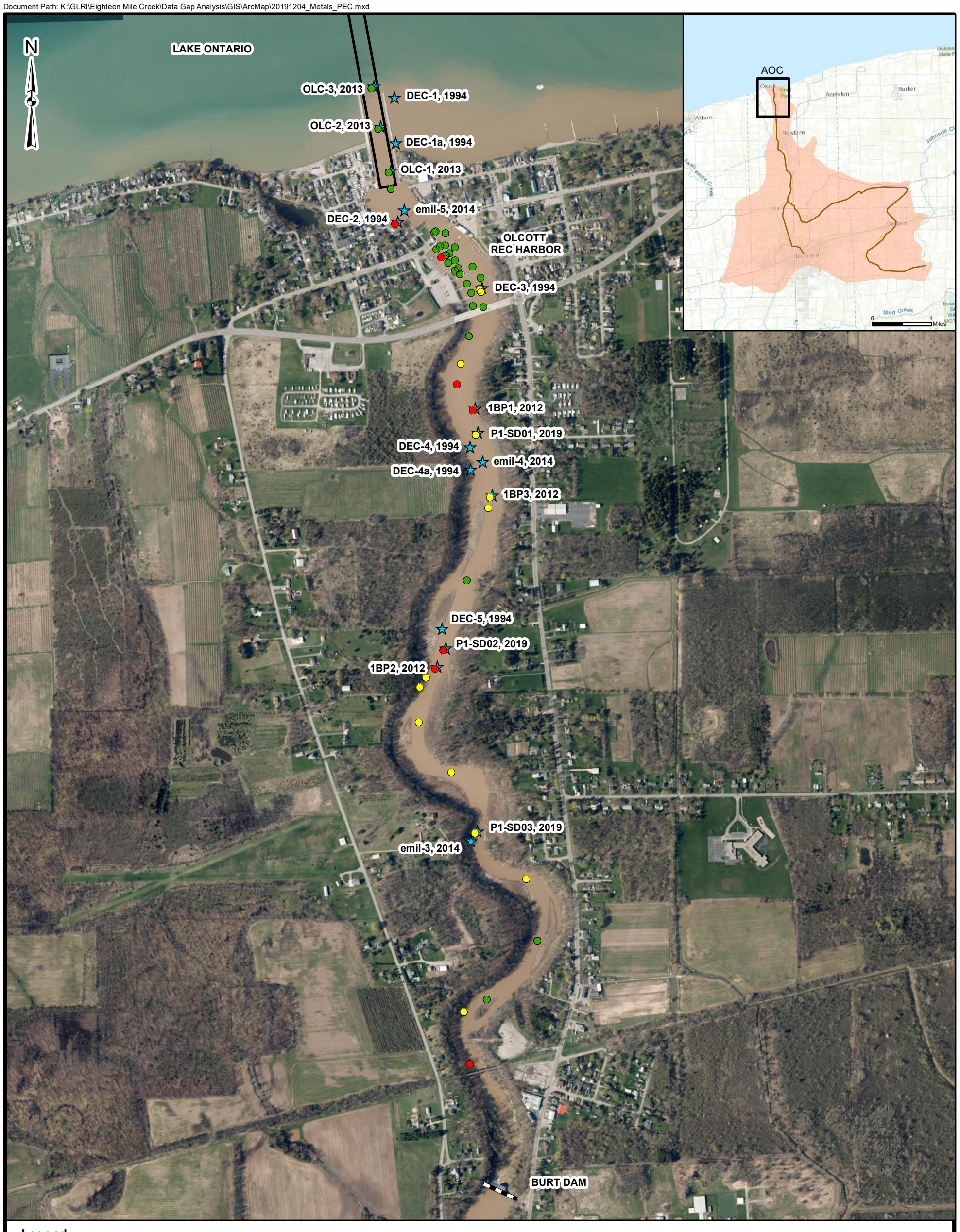
EIGHTEENMILE CREEK AREA OF CONCERN (AOC)
BENTHIC COMMUNITY AND SEDIMENT TOXICITY SAMPLE LOCATIONS

Document Name: 20191119_Tox_Invert_Samps.mxd
Drawn By: h5tdekmh
Date Saved: 16 Dec 2019
Time Saved: 10:18:06 AM

EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 6

Document Path: K:\GLRI\Eighteen Mile Creek\Data Gap Analysis\GIS\ArcMap\20191204_Metals_PEC.mxd



Legend

- Conc ≤ PEC (mg/kg)
- Conc Range PEC to 2x PEC (mg/kg)
- Conc ≥ 2x PEC (mg/kg)
- Sediment Toxicity Sample Locations
- Burt Dam
- Federal Navigation Channel

*Note: Labels indicate sediment toxicity sample locations. The metals included in this figure are as followed: Arsenic (PEC = 33 mg/kg), Cadmium (PEC = 4.98 mg/kg), Chromium (PEC = 111 mg/kg), Copper (PEC = 149 mg/kg), Lead (PEC = 128 mg/kg), Mercury (PEC = 1.06 mg/kg), Nickel (PEC = 48.6 mg/kg), Zinc (PEC = 459 mg/kg).

0 500 1,000 Feet

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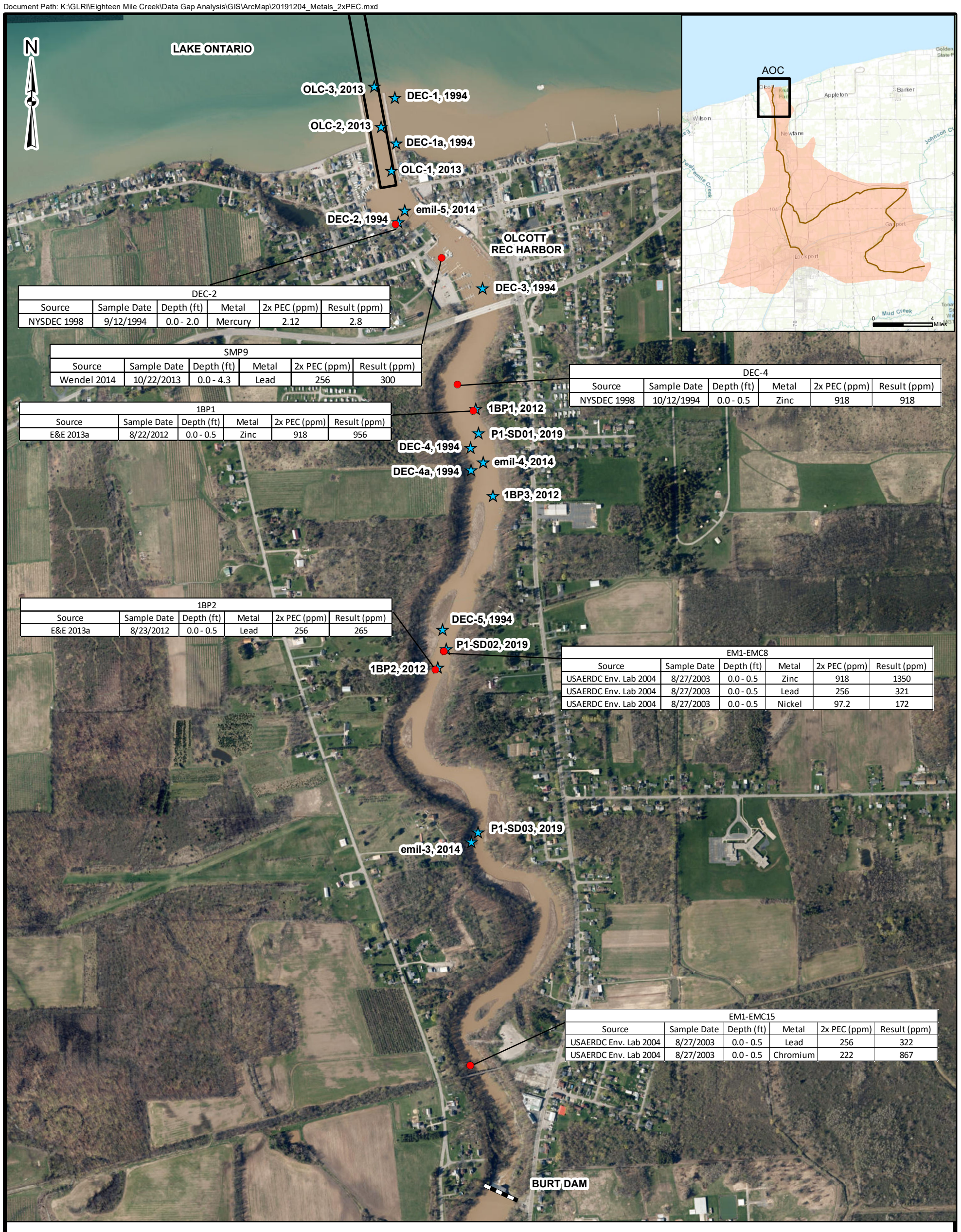
EIGHTEENMILE CREEK AREA OF CONCERN (AOC)
CONCENTRATION OF METALS IN SURFACE SEDIMENT & SEDIMENT TOXICITY SAMPLE LOCATIONS

Document Name: 20191204_Metals_PEC.mxd
Drawn By: h5tdekmh
Date Saved: 16 Dec 2019
Time Saved: 12:04:17 PM

EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 7

Document Path: K:\GLRI\Eighteen Mile Creek\Data Gap Analysis\GIS\ArcMap\20191204_Metals_2xPEC.mxd



DEC-2					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
NYSDEC 1998	9/12/1994	0.0 - 2.0	Mercury	2.12	2.8

SMP9					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
Wendel 2014	10/22/2013	0.0 - 4.3	Lead	256	300

1BP1					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
E&E 2013a	8/22/2012	0.0 - 0.5	Zinc	918	956

DEC-4					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
NYSDEC 1998	10/12/1994	0.0 - 0.5	Zinc	918	918

1BP2					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
E&E 2013a	8/23/2012	0.0 - 0.5	Lead	256	265

EM1-EMC8					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
USAERDC Env. Lab 2004	8/27/2003	0.0 - 0.5	Zinc	918	1350
USAERDC Env. Lab 2004	8/27/2003	0.0 - 0.5	Lead	256	321
USAERDC Env. Lab 2004	8/27/2003	0.0 - 0.5	Nickel	97.2	172

EM1-EMC15					
Source	Sample Date	Depth (ft)	Metal	2x PEC (ppm)	Result (ppm)
USAERDC Env. Lab 2004	8/27/2003	0.0 - 0.5	Lead	256	322
USAERDC Env. Lab 2004	8/27/2003	0.0 - 0.5	Chromium	222	867

Legend

Surface Sediment Concentration

- Conc ≥ 2x PEC (mg/kg)
- Sediment Toxicity Sample Locations
- Burt Dam
- Federal Navigation Channel
- Eighteen Mile Creek Source AOC Boundary

*Note: Labels indicate sediment toxicity sample locations and call out boxes indicate samples where surface sediment concentrations exceed 2x Probable Effect Concentrations (PEC).

0 500 1,000 Feet

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EIGHTEENMILE CREEK AREA OF CONCERN (AOC)
CONCENTRATION OF METALS IN SURFACE SEDIMENT & SEDIMENT TOXICITY SAMPLE LOCATIONS

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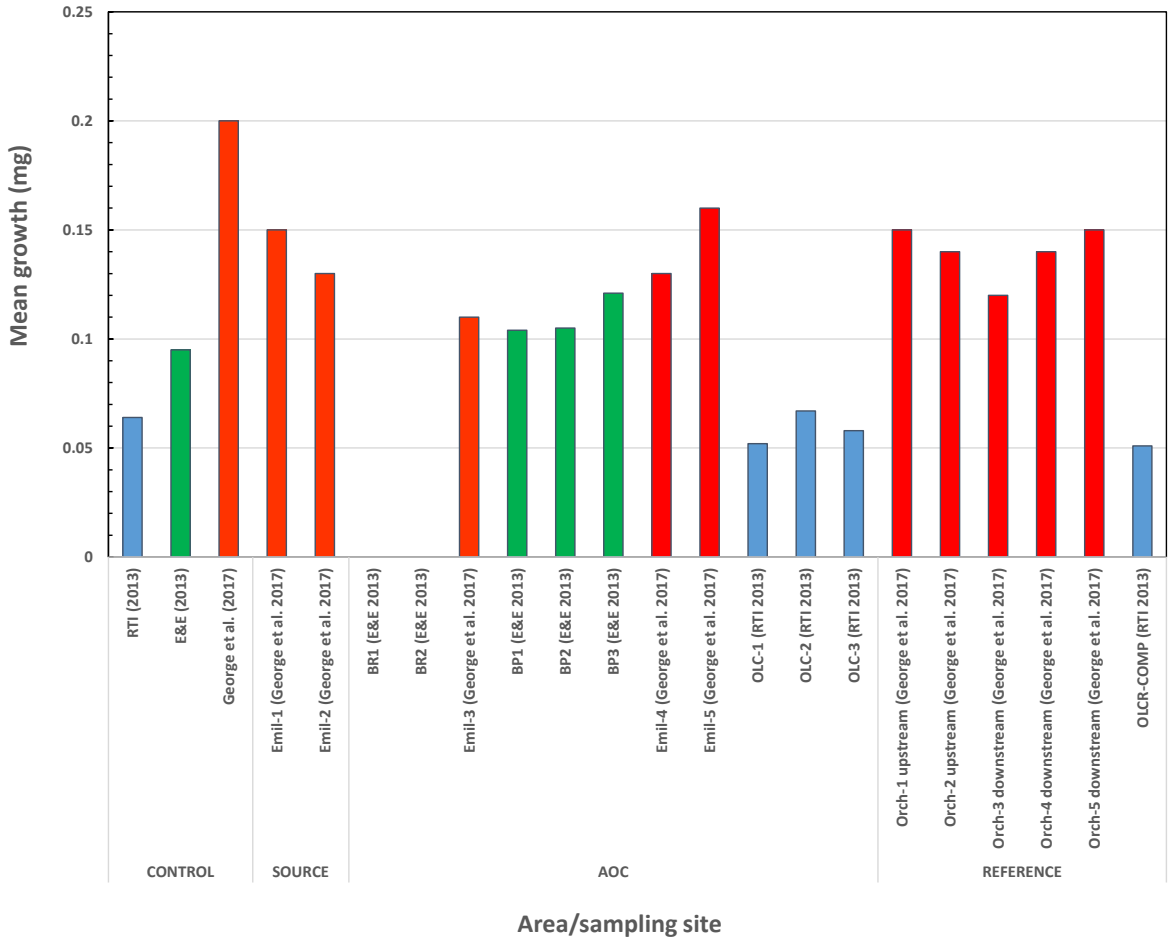
EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 8

FIGURE 9. Results of 10-day *H. azteca* growth toxicity tests on sediment samples from the Eighteenmile Creek AOC, source area, various reference sites and controls (E&E 2013 [green bars]; RTI 2013 [blue bars]; George *et al.* 2017 [red bars]).



Document Path: K:\GLRI\Eighteen Mile Creek\Data Gap Analysis\GIS\ArcMap\20200514_SWAC_Figure.mxd

Legend

- Surface Sediment Sample Locations
- Surface Sediment Sample Areas for SWAC
- Burt Dam

0 250 500 1,000
Feet

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TOTAL PCB SURFACE SEDIMENT SAMPLE LOCATIONS AND AREAS FOR CALCULATION OF SURFACE WEIGHTED AVERAGE CONCENTRATION (SWAC)

Document Name: 20200514_SWAC_Figure.mxd
Drawn By: h5tdekmh
Date Saved: 15 May 2020
Time Saved: 1:34:27 PM

EIGHTEENMILE CREEK, NEW YORK
EIGHTEENMILE AOC DATA GAP ASSESSMENT (482889)

FIGURE 10

FIGURE 11. Total PCB SWAC for Eighteenmile Creek AOC in comparison to Remedial Goals (RGs) at other Great Lakes AOCs.

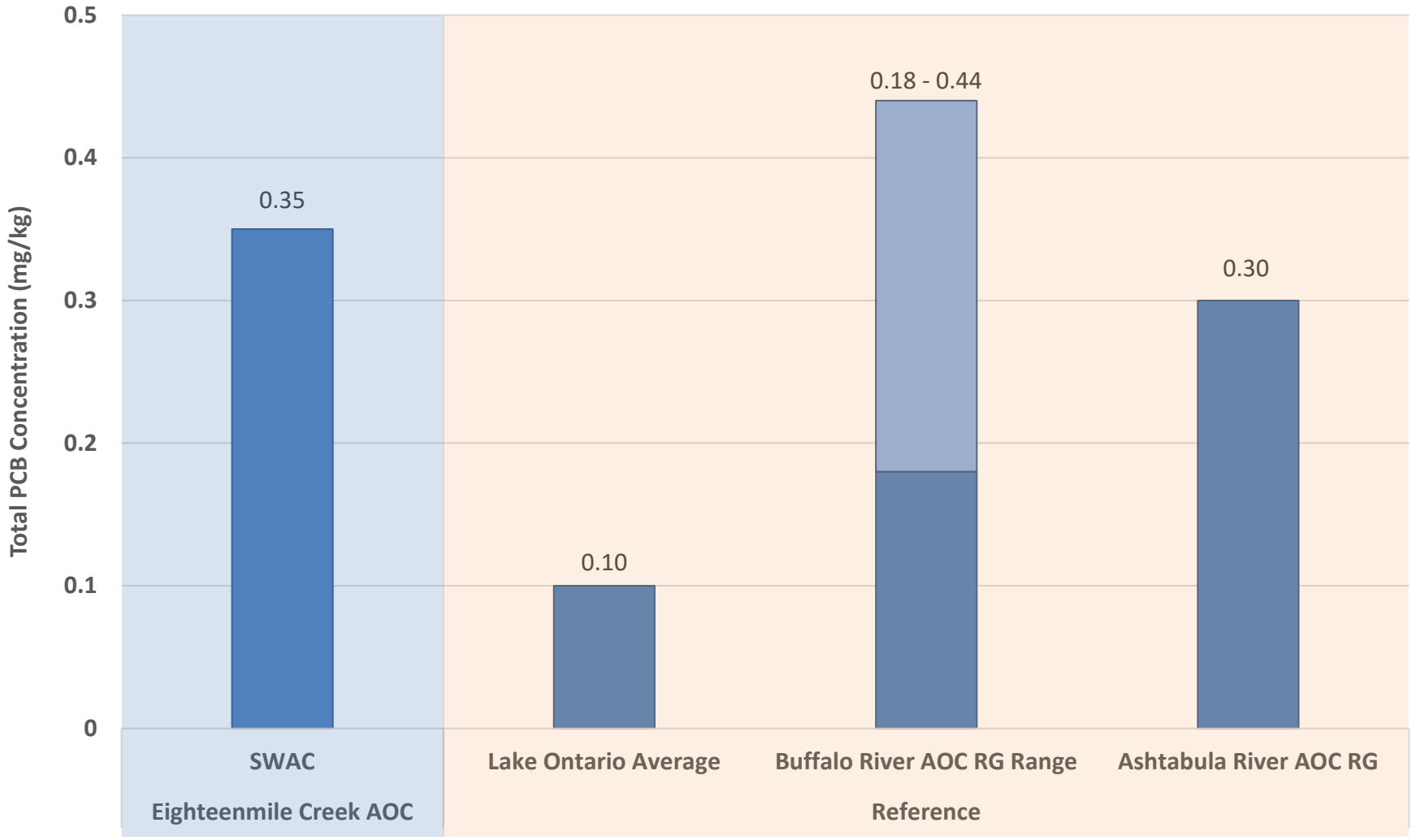

FIGURE 12. Average total PCB concentration in AOC whole water, with associated predictions of dissolved fraction in the water column and sediment pore water.

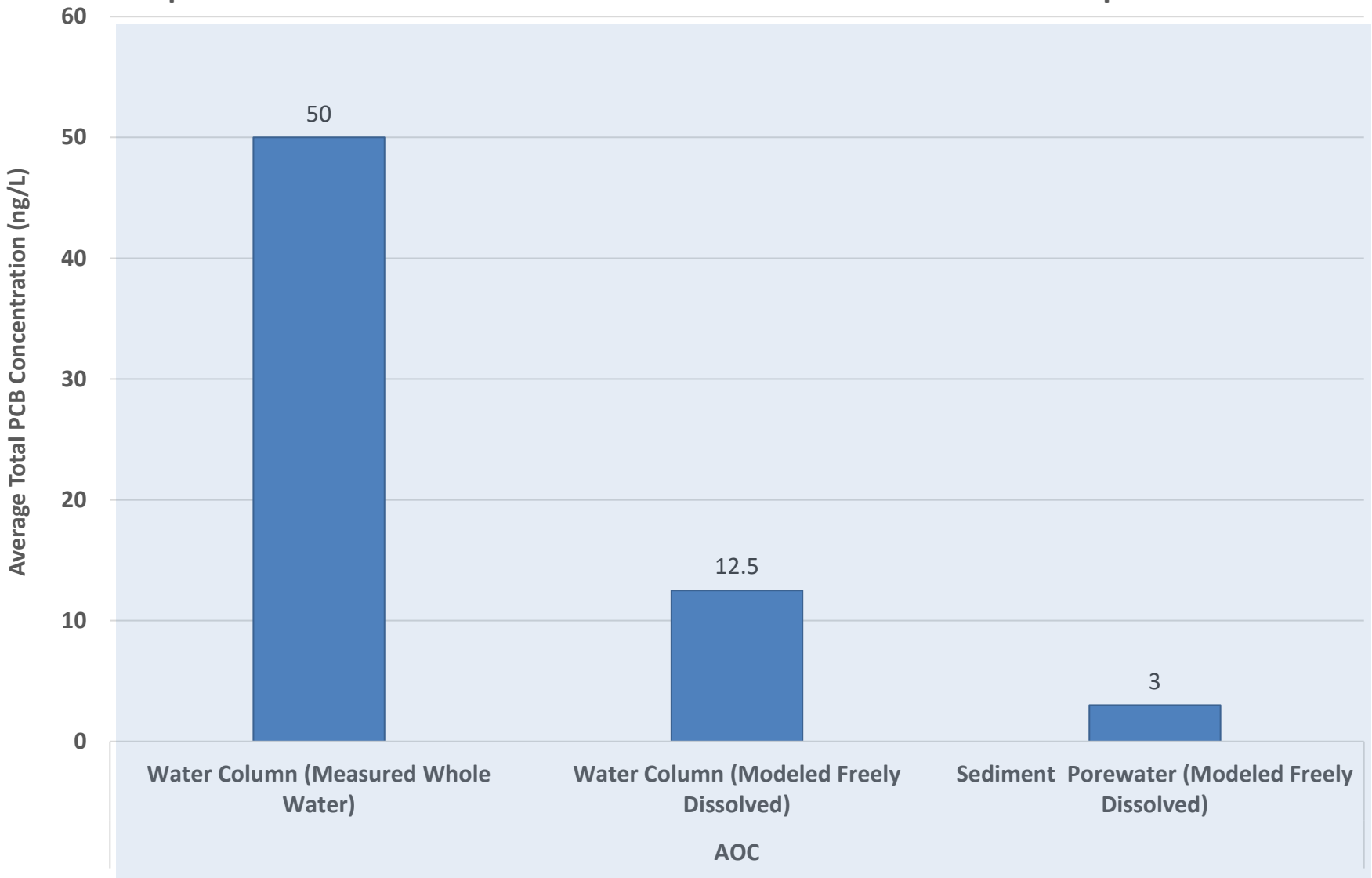

Table 1. Fish Tissue Concentrations of Total PCBs

Location	Fish	Mean Tissue Concentration	
		Total PCB (mg/kg)	Lipid (%)
Eighteenmile Creek AOC (2018)	bluegill (whole body) (n=4)	2.20	3.4
	brown bullhead (fillet) (n=2)	0.88	4.2
	golden redhorse (fillet) (n=2)	3.43	2.5
	largemouth bass (fillet) (n=10)	2.98	2.8
	northern pike (fillet) (n=5)	1.32	1.5
	pumpkinseed (whole body) (n=6)	2.07	2.9
	white sucker (fillet) (n=1)	1.84	4.8
	Average	**2.10**	**3.2**
Upstream of Eighteenmile Creek AOC (2018)	bluegill (whole body) (n=6)	2.61	2.3
	channel catfish (fillet) (n=1)	4.49	1.5
	common carp (fillet) (n=10)	17.9	12.4
	common shiner (whole body) (n=2)	1.90	4.6
	green sunfish (whole body) (n=1)	4.54	2.8
	largemouth bass (fillet) (n=16)	3.07	1.4
	northern pike (fillet) (n=7)	3.29	0.87
	northern hogsucker (whole body) (n=1)	8.46	2.6
	pumpkinseed (whole body) (n=9)	3.48	2.2
	rock bass (whole body) (n=1)	4.09	1.7
	smallmouth bass (fillet) (n=4)	9.76	2.9
	walleye (fillet) (n=2)	2.21	1.2
	Average	**5.48**	**3.0**
Oak Orchard Creek Regional Reference Area (2018)	bluegill (whole body) (n=7)	0.074	3.2
	brown bullhead (fillet) (n=1)	0.086	1.8
	common carp (fillet) (n=4)	0.182	5.0
	largemouth bass (fillet) (n=10)	0.149	2.7
	northern pike (fillet) (n=3)	0.168	1.8
	pumpkinseed (whole body) (n=3)	0.093	2.3
	walleye (fillet) (n=2)	0.229	2.0
	Average	**0.140**	**2.7**
Lower Niagara River (2014)	carp (fillet) (n=15)	0.571	8.4
	freshwater drum (fillet) (n=17)	0.455	6.2
	rock bass (fillet) (n=7)	0.159	1.2
	smallmouth bass (fillet) (n=15)	0.291	2.0
	yellow perch (fillet) (n=18)	0.122	1.0
	Average	**0.320**	**3.8**
Lake Ontario West (2014)	coho salmon (fillet) (n=28)	0.218	6.6
	smallmouth bass (fillet) (n=15)	0.202	4.4
	white perch (fillet) (n=10)	0.097	3.8
	white sucker (fillet) (n=5)	0.039	1.9
	Average	**0.139**	**4.2**
Lake Ontario East (2014)	brown trout (fillet) (n=10)	0.295	15.1
	channel catfish (fillet) (n=11)	0.413	5.8
	lake trout (fillet) (n=98)	0.525	13.9
	smallmouth bass (fillet) (n=10)	0.077	1.7
	white perch (fillet) (n=25)	0.348	3.5
	white sucker (fillet) (n=10)	0.073	1.2
	Average	**0.289**	**6.9**

TABLE 2. Summary of benthic macroinvertbrate community index and biological assessment profile (BAP) data on sediment samples collected from the source area, Eighteenmile Creek AOC and Oak Orchard Creek reference areas (data compiled from E&E [2013b] and and George *et al.* [2017]).

Investigation/source	Area/sample	Sampling site	Index					10-scaled BAP score	BAP classification	Aggregrate BAP score	Aggregate BAP classification
			Species richness	Hilsenhoff biotic index (HBI)	Shannon-Weiner index	Percent model affinity (PMA)	Dominant-3				
George *et al.* (2017)	Source area	emil-1	11.0	8.6	2.7	60.5	68.4	4.9	Moderately impacted	5.2	Slightly impacted
		emil-2	6.6	9.0	1.9	46.3	83.6	2.4	Severely impacted	4.9	Moderately impacted
	AOC	emil-3	5.4	8.6	1.8	24.6	82.0	2.1	Severely impacted	3.9	Moderately impacted
		emil-4	9.4	8.7	2.6	42.4	68.6	3.9	Moderately impacted	6.4	Slightly impacted
		emil-5	10.6	8.0	3.1	42.3	51.7	5.4	Slightly impacted	7.5	Non-impacted
	Oak Orchard Creek regional upstream reference	orch-1	12.6	8.0	3.2	37.6	52.4	5.4	Slightly impacted	7.2	Slightly impacted
		orch-2	15.2	8.4	3.2	48.6	55.3	5.9	Slightly impacted	6.6	Slightly impacted
	Oak Orchard Creek regional downstream reference	orch-3	10.4	8.2	3.0	34.7	56.8	4.8	Moderately impacted	6.1	Slightly impacted
		orch-4	11.4	8.5	3.0	36.2	56.3	4.8	Moderately impacted	7.1	Slightly impacted
		orch-5	9.4	8.8	2.6	48.8	64.2	4.3	Moderately impacted	6.0	Slightly impacted
E&E (2013b)	AOC	BR1	24.0	6.2	3.1	48.4	65.4	5.7	Slightly impacted		
		BR2	23.0	5.1	1.7	26.6	91.3	4.5	Moderately impacted		
		BP1	23.0	7.6	3.3	58.1	58.7	7.4	non-impacted		
		BP2	19.0	7.7	3.3	53.7	61.1	6.7	non-impacted		
		BP3	21.0	7.9	3.6	49.5	52.4	7.1	non-impacted		

TABLE 3. Acute and sublethal toxicity test data on Eighteenmile Creek AOC, reference and control sediment samples (data compiled from E&E [2013b], EnviroSystems, Inc. [2013a,b] and George *et al.* [2017]).

Investigation/source	Area/sample	Sampling site	Toxicity test			
			Hyalella azteca		*Chironomus dilutus*	
			Mean survival (%)	Mean growth (mg)	Mean survival (%)	Mean growth (mg)
George *et al.* (2017)	Source area	emil-1	82.5	0.15	90.0	1.05
		emil-2	93.8	0.13	87.5	0.98
	AOC	emil-3	86.3	0.11	76.3	0.89
		emil-4	98.8	0.13	93.8	0.98
		emil-5	95.0	0.16	88.8	1.19
	Oak Orchard Creek regional upstream reference	orch-1	97.5	0.15	91.3	0.92
		orch-2	92.5	0.14	93.8	1.09
	Oak Orchard Creek regional downstream reference	orch-3	95.0	0.12	91.3	0.77
		orch-4	97.5	0.14	95.0	0.90
		orch-5	88.8	0.15	93.8	0.97
	Laboratory control sample	Control-1	97.5	0.20	97.5	1.15
E&E (2013b)	AOC	BP2	94.0	0.11	96.0	1.67
		BP3	91.0	0.12	90.0	1.79
		BP1	95.0	0.10	93.0	1.73
	Laboratory control sample	Control	88.0	0.10	95.0	1.65
EnviroSystems, Inc. [2013a,b]	AOC	OLC-1	91.3	0.05	88.8	1.52
		OLC-2	90.0	0.06	97.5	1.10
		OLC-3	91.3	0.07	93.8	1.40
	Lake regional reference	OLCR-COMP	47.5	0.05	95.0	1.26
	Laboratory control sample	Unnamed	80.0	0.06	93.8	1.70

TABLE 4. Suggested compliance of toxicity test measurement endpoint results on AOC sediments with BUI removal criteria, using the data on sample emil-3 as an example.

Toxicity test measurement endpoint	Discrete emil-3 result (±SD)	Should the result meet the BUI removal criterion? Why?
Hyalella azteca **survival (mean, %)**	86.3±12	**YES**. The survival is similar to the result on one of the three reference sediment samples (89%). In addition, the difference between the survival associated with this discrete sample in comparison to the combined mean across the reference sediment samples is less than an established criterion of 10%, suggesting a negligible difference. Finally, the combined AOC sediment mean survival is comparable to the combined mean reference sediment survival.
H. azteca **growth (mean, mg)**	0.11 ±0.02	**YES**. Note that there is no published guidance on interpreting these bioassay data. This growth value was comparable to the result on one of the three reference sediment samples (0.12 mg). In addition, the combined AOC sediment mean growth is comparable to the combined reference sediment mean growth. Finally, other recent investigations have yielded generally consistent growth values on the order of 0.05 to 0.10 mg across various AOC, lake reference and control sediment samples, suggesting that the growth associated with this discrete sediment sample is acceptable.
Chironomus dilutus **survival (mean, %)**	76.3±16	**YES**. The between difference the survival associated with this discrete sample in comparison to the combined mean across the reference sediment samples is less than an established criterion of 20%, suggesting a negligible difference. Moreover, the difference between the combined mean survivals across the AOC and reference sediment samples is less than 20%.
C. dilutus **growth (mean, mg)**	0.89±0.15	**YES**. The growth was within the range measured for the reference sediment samples (0.77 to 0.99 mg). A supporting line of evidence is that growth exceeded an established criterion of 0.6 mg.

Table 5. Summary of Total PCB data and Surface Weighted Average Concentration (SWAC) values for the Eighteenmile Creek AOC and Oak Orchard Creek regional reference area.

Total PCB (mg/kg)								
Data Set	**N**	**Min**	**Median**	**Max**	**Mean**	**UCL_{95}**	**$ProUCL_{95}$ Recommended Data Distribution**	**SWAC**
Eighteenmile Creek AOC								
- Total PCB Aroclor & Congeners[1]	42	ND	0.28	1.4	0.35	0.42	Approximate Normal	0.35
Oak Orchard Creek Regional Reference								
- Total PCB Aroclors[2]	11	ND	ND	ND	ND	ND	-	-

[1]Total PCB Aroclor and Total PCB Congener results for split samples were averaged.
[2]Oak Orchard Creek results were all non-detect (ND). The maximum MDL value for Oak Orchard Creek was 0.008 mg/kg.

Appendix A1

Restrictions on Fish and Wildlife Consumption: Number of fish tissue samples collected for PCB measurement. Lipid data are available for all fish tissue samples.

1. There are no AOC-specific fish and wildlife consumption advisories issues by New York State;

AND

2. Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed upstream of Burt Dam. ****(This criterion is expected to be removed due to an inability to measure it.)***

Species	Eighteenmile Creek AOC : Below Burt Dam			Eighteenmile Creek : Above Burt Dam			Oak Orchard Creek Regional Reference			Western Lake Ontario Regional Reference		
	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source
Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-
Bluegill	4	-	E&E 2019a	6	-	E&E 2019a	7	-	E&E 2019a	-	-	-
Bluegill/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Bullhead	13	5	E Risk Sciences, USAERDC 2012, E&E 2009 & 2013a	14	10	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Brown Bullhead	-	2	E&E 2019a	-	-	-	-	1	E&E 2019a	-	-	-
Brown Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Chinook/King Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Coho/Silver Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	28	NYSDEC 2014a
Common Carp	-	-	-	-	11	E&E 2019a	-	4	E&E 2019a	-	-	-
Common Shiner	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Forage	12	-	E Risk Sciences, USAERDC 2012, E&E 2013a	24	-	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Gizzard Shad	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Golden Redhorse	-	2	E&E 2019a	-	1	E&E 2019a	-	-	-	-	-	-
Green Sunfish/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Lake Trout	-	-	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	7	13	E Risk Sciences, USAERDC 2012, E&E 2019a, NYSDEC 2019b	18	17	E Risk Sciences, USAERDC 2012, E&E 2013a, E&E 2019a	-	10	E&E 2019a	-	-	-
Northern Hogsucker	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Northern Pike	-	5	E&E 2019a	-	8	E&E 2019a	-	3	E&E 2019a	-	-	-
Pumpkinseed	15	-	E&E 2019a, NYSDEC 2019b	12	-	E&E 2019a	3	-	E&E 2019a	-	-	-
Rainbow Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Rock Bass	-	-	-	4	-	E&E 2019a	-	-	-	-	-	-
Silver Redhorse	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	13	E&E 2019a	-	-	-	-	15	NYSDEC 2014a
Walleye	-	-	-	-	7	E&E 2019a	-	2	E&E 2019a	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	10	NYSDEC 2014a
White Sucker	-	1	E&E 2019a	-	1	E&E 2019a	-	-	-	-	5	NYSDEC 2014a
Total	51	68	-	86	70	-	10	20	-	-	58	-

Restrictions on Fish and Wildlife Consumption: Number of fish tissue samples collected for dioxin and furan measurement. Lipid data are available for all fish tissue samples.

Species	Eighteenmile Creek AOC : Below Burt Dam			Eighteenmile Creek : Above Burt Dam			Oak Orchard Creek Regional Reference			Western Lake Ontario Regional Reference		
	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source
Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	-	-	-	-	-	-
Bullhead	2	-	E&E 2009	-	-	-	-	-	-	-	-	-
Chinook/King Salmon	-	-	-	-	-	-	-	-	-	-	-	-
Coho/Silver Salmon	-	-	-	-	-	-	-	-	-	-	3	NYSDEC 2014a
Lake Trout	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	-	-	-	-	-	-	3	NYSDEC 2014a
White Perch	-	-	-	-	-	-	-	-	-	-	3	NYSDEC 2014a
Total	2	-	-	-	-	-	-	-	-	-	9	-

Restrictions on Fish and Wildlife Consumption: Number of fish tissue samples collected for mercury measurement. Lipid data are available for all fish tissue samples.

Species	Eighteenmile Creek AOC : Below Burt Dam			Eighteenmile Creek : Above Burt Dam			Oak Orchard Creek Regional Reference			Western Lake Ontario Regional Reference		
	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source	Whole Body	Fillet	Source
Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-
Bluegill	4	-	E&E 2019a	6	-	E&E 2019a	7	-	E&E 2019a	-	-	-
Bluegill/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Brown Bullhead	-	2	E&E 2019a	-	-	-	-	1	E&E 2019a	-	-	-
Brown Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Chinook/King Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Coho/Silver Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	28	NYSDEC 2014a
Common Carp	-	-	-	-	11	E&E 2019a	-	4	E&E 2019a	-	-	-
Common Shiner	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Gizzard Shad	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Golden Redhorse	-	2	E&E 2019a	-	1	E&E 2019a	-	-	-	-	-	-
Green Sunfish/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Lake Trout	-	-	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	13	E&E 2019a, NYSDEC 2019b		17	E&E 2019a	-	10	E&E 2019a	-	-	-
Northern Hogsucker	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Northern Pike	-	5	E&E 2019a	-	8	E&E 2019a	-	3	E&E 2019a	-	-	-
Pumpkinseed	15	-	E&E 2019a, NYSDEC 2019b	12	-	E&E 2019a	3	-	E&E 2019a	-	-	-
Rainbow Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Rock Bass	-	-	-	4	-	E&E 2019a	-	-	-	-	-	-
Silver Redhorse	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	13	E&E 2019a	-	-	-	-	15	NYSDEC 2014a
Walleye	-	-	-	-	7	E&E 2019a	-	2	E&E 2019a	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	10	NYSDEC 2014a
White Sucker	-	1	E&E 2019a	-	1	E&E 2019a	-	-	-	-	5	NYSDEC 2014a
Total	19	63	-	30	60	-	10	20	-	-	58	-

Appendix A2

Degradation of Fish and Wildlife Populations

1. Fish Community metrics (e.g., diversity, abundance, biomass, and condition) are similar to reference site(s);

Source	Eighteenmile Creek AOC	Oak Orchard Creek Regional Reference
	Number of Stations	Number of Stations
E&E 2009	3	3
USGS 2019 (data not yet	5	5

AND

2. Benthic macroinvertebrate community composition is within the range expected and similar to reference site condition;

Source[1]	Eighteenmile Creek AOC	Oak Orchard Creek Regional Reference
	Number of Stations	Number of Stations
NYSDEC 1998	5	-
E&E 2013b	5	-
George et al. 2017	3	5
E&E 2019b (Phase II data not yet available)	3	2

[1]Some studies are older than 10 years and do not represent current conditions.

AND

3. PCB concentration in fish tissue and other prey are below thresholds likely to result in acute toxicity to fish or piscivorous wildlife (birds and mammals).

Number of fish tissue samples collected for PCB measurement. Lipid data are available for all fish tissue samples.

Species	Eighteenmile Creek AOC : Below Burt Dam			Eighteenmile Creek : Above Burt Dam			Oak Orchard Creek Regional Reference			Western Lake Ontario Regional Reference		
Fish	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source
Alewife	3	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-
Bluegill	7	-	E&E 2019a, NYSDEC 2019c	7	-	E&E 2019a, NYSDEC 2019c	7	-	E&E 2019a	-	-	-
Bluegill/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Bluntnose Minnow	-	-	-	1	-	NYSDEC 2019c	-	-	-	-	-	-
Bullhead	13	5	E Risk Sciences, USAERDC 2012, E&E 2009 & 2013a	14	10	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Brown Bullhead	-	2	E&E 2019a	-	-	-	-	1	E&E 2019a	-	-	-
Brown Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Chinook/King Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Coho/Silver Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	28	NYSDEC 2014a
Common Carp	-	-	-	-	11	E&E 2019a	-	4	E&E 2019a	-	-	-
Common Shiner	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Emerald Shiner	8	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Forage	12	-	E Risk Sciences, USAERDC 2012, E&E 2013a	24	-	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Gizzard Shad	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Golden Redhorse	-	2	E&E 2019a	-	1	E&E 2019a	-	-	-	-	-	-
Green Sunfish/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Lake Trout	-	-	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	7	13	E Risk Sciences, USAERDC 2012, E&E 2019a, NYSDEC 2019b	18	17	E Risk Sciences, USAERDC 2012, E&E 2013a, E&E 2019a	-	10	E&E 2019a	-	-	-
Northern Hogsucker	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Northern Pike	-	5	E&E 2019a	-	8	E&E 2019a	-	3	E&E 2019a	-	-	-
Pumpkinseed	15	-	E&E 2019a, NYSDEC 2019b	12	-	E&E 2019a	3	-	E&E 2019a	-	-	-
Rainbow Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Rock Bass	7	-	NYSDEC 2019c	4	-	E&E 2019a	-	-	-	-	-	-
Round Goby	3	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Silver Redhorse	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	13	E&E 2019a	-	-	-	-	15	NYSDEC 2014a
Striper Shiner	-	-	-	7	-	NYSDEC 2019c	-	-	-	-	-	-
Walleye	-	-	-	-	7	E&E 2019a	-	2	E&E 2019a	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	10	NYSDEC 2014a
White Sucker	-	1	E&E 2019a	-	1	E&E 2019a	-	-	-	-	5	NYSDEC 2014a
Other Prey[2]												
Crayfish	7	-	E&E 2013a, Hayes and Wellman 2019	9	-	E&E 2013a, Hayes and Wellman 2019	-	-	-	-	-	-
Lower Trophic Level Fish	4	-	Hayes and Wellman 2019	-	-	-	-	-	-	-	-	-
Upper Trophic Level Fish	4	-	Hayes and Wellman 2019	-	-	-	-	-	-	-	-	-
Total	90	68	-	104	70	-	10	20	-	-	58	-

[1]Data are available to extrapolate from fillet to whole-body.

[2]Awaiting the report from the 2019 data collection from SUNY Brockport.

Appendix A3

Bird/Animal Deformities or Reproductive Problems: Number of fish tissue samples collected for PCB measurement. Lipid data are available for all fish tissue samples.

1. PCB concentrations in fish tissue from comparable functional feeding groups are similar to reference site(s);

OR

2. PCB concentrations in fish and other prey are below tissue concentrations known to cause deformities or reproductive impairment in piscivorous wildlife.

Species	Eighteenmile Creek AOC : Below Burt Dam			Eighteenmile Creek : Above Burt Dam			Oak Orchard Creek Regional Reference			Western Lake Ontario Regional Reference		
Fish	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source	Whole Body	Fillet[1]	Source
Alewife	3	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-
Bluegill	7	-	E&E 2019a, NYSDEC 2019c	7	-	E&E 2019a, NYSDEC 2019c	7	-	E&E 2019a	-	-	-
Bluegill/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Bluntnose Minnow	-	-	-	1	-	NYSDEC 2019c	-	-	-	-	-	-
Bullhead	13	5	E Risk Sciences, USAERDC 2012, E&E 2009 & 2013a	14	10	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Brown Bullhead	-	2	E&E 2019a	-	-	-	-	1	E&E 2019a	-	-	-
Brown Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Chinook/King Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Coho/Silver Salmon	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	28	NYSDEC 2014a
Common Carp	-	-	-	-	11	E&E 2019a	-	4	E&E 2019a	-	-	-
Common Shiner	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Emerald Shiner	8	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Forage	12	-	E Risk Sciences, USAERDC 2012, E&E 2013a	24	-	E Risk Sciences, USAERDC 2012, E&E 2013a	-	-	-	-	-	-
Gizzard Shad	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Golden Redhorse	-	2	E&E 2019a	-	1	E&E 2019a	-	-	-	-	-	-
Green Sunfish/Pumpkinseed	-	-	-	1	-	E&E 2019a	-	-	-	-	-	-
Lake Trout	-	-	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	7	13	E Risk Sciences, USAERDC 2012, E&E 2019a, NYSDEC 2019b	18	17	E Risk Sciences, USAERDC 2012, E&E 2013a, E&E 2019a	-	10	E&E 2019a	-	-	-
Northern Hogsucker	-	-	-	2	-	E&E 2019a	-	-	-	-	-	-
Northern Pike	-	5	E&E 2019a	-	8	E&E 2019a	-	3	E&E 2019a	-	-	-
Pumpkinseed	15	-	E&E 2019a, NYSDEC 2019b	12	-	E&E 2019a	3	-	E&E 2019a	-	-	-
Rainbow Trout	-	10	NYSDEC 2019b	-	-	-	-	-	-	-	-	-
Rock Bass	7	-	NYSDEC 2019c	4	-	E&E 2019a	-	-	-	-	-	-
Round Goby	3	-	NYSDEC 2019c	-	-	-	-	-	-	-	-	-
Silver Redhorse	-	-	-	-	1	E&E 2019a	-	-	-	-	-	-
Smallmouth Bass	-	-	-	-	13	E&E 2019a	-	-	-	-	15	NYSDEC 2014a
Striper Shiner	-	-	-	7	-	NYSDEC 2019c	-	-	-	-	-	-
Walleye	-	-	-	-	7	E&E 2019a	-	2	E&E 2019a	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	10	NYSDEC 2014a
White Sucker	-	1	E&E 2019a	-	1	E&E 2019a	-	-	-	-	5	NYSDEC 2014a
Other Prey[2]												
Crayfish	7	-	E&E 2013a, Hayes and Wellman 2019	9	-	E&E 2013a, Hayes and Wellman 2019	-	-	-	-	-	-
Lower Trophic Level Fish	4	-	Hayes and Wellman 2019	-	-	-	-	-	-	-	-	-
Upper Trophic Level Fish	4	-	Hayes and Wellman 2019	-	-	-	-	-	-	-	-	-
Total	90	68	-	104	70	-	10	20	-	-	58	-

[1]Data are available to extrapolate from fillet to whole-body.

[2]Awaiting the report from the 2019 data collection from SUNY Brockport (Hayes and Wellman).

Appendix A4

Degradation of Benthos: Number of stations sampled for macroinvertebrates in the Eighteemile Creek AOC and background sites for calculation of "Bode" Index

1. Benthic macroinvertebrate communities are "non-impacted" or "slightly impacted" according to NYSDEC indeces (Bode et al. 1996);

AND

2. Benthic macroinvertebrate community condition is similar to unimpacted control sites of comparable physical and chemical characteristics;

Source[1]	Eighteenmile Creek AOC	Oak Orchard Creek Regional Reference
NYSDEC 1998	5	-
E&E 2013b	5	-
George et al. 2017	3	5
E&E 2019b (Phase II data not yet available)	3	2

[1]Some studies are older than 10 years and do not represent current conditions.

AND

3. Toxicity of sediment-associated contaminants is similar to unimpacted control sites of comparable physical and chemical characteristics.

**(BUI criteria reflects pending updates discussed at the NYS AOC meeting on 10/24/19).*

Degradation of Benthos: Number of toxicity tests on sediment collected from the Eighteenmile Creek AOC and background sites.

Source[1]	Species	Eighteenmile Creek AOC		Oak Orchard Creek Regional Reference	
		Number of Tests	Number of Replicates	Number of Tests	Number of Replicates
Acute Toxicity Tests[2]					
NYSDEC 1998	*Chironomus tentans*	5	4 per sample	-	-
	Hyalella azteca	5	4 per sample	-	-
E&E 2013b	*C. dilutus*	3	-	-	-
	H. azteca	3	-	-	-
USACE 2013, EnviroSystems, Inc. 2013a & 2013b	*C. dilutus*	3	5 per sample	-	-
	H. azteca	3	5 per sample	-	-
George et al. 2017	*C. dilutus*	3	8 per sample	5	8 per sample
	H. azteca	3	8 per sample	5	8 per sample
Chronic Toxicity Tests[3]					
E&E 2019b (Phase II data not yet available)	*C. dilutus*	9	8 per sample	2	8 per sample
	H. azteca	9	8 per sample	2	8 per sample

[1]Some studies are older than 10 years and do not represent current conditions.

[2]Survival and growth of test species were measured after 10-day sediment exposures.

[3]Survival and growth of test species were measured after 28-day sediment exposures.

Appendix A5

Restrictions on Dredging: Number of sediment chemistry and toxicity test samples collected in and out of the federal navigation channel downstream of Route 18 Bridge.

1. When contaminants in AOC sediments (located within the actual or potential dredging areas identified for the improvement of ship navigation) do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.

Area	Data Type[1]	Number of Samples	Number of Replicates	Source[2]
Federal Navigation Channel	Sediment Chemistry	4	-	E Risk Sciences, USAERDC 2012, USACE 2013
	Chironomus dilutus	3	5 per sample	USACE 2013, EnviroSystems, Inc. 2013a & 2013b
	Hyalella azteca	3	5 per sample	USACE 2013, EnviroSystems, Inc. 2013a & 2013b
Non-Federal Navigation Channel	Chemistry	29	-	NYSDEC 1998, USAERDC Environmental Laboratory 2004, E Risk Sciences, USAERDC 2012, Wendel 2014
	C. dilutus	3	8 per sample	NYSDEC 1998, George et al. 2017
	H. azteca	3	8 per sample	NYSDEC 1998, George et al. 2017
Total		45	78	-
Lake Ontario Disposal and Reference Areas	Chemistry	4	-	USACE 2013, EnviroSystems, Inc. 2013a & 2013b
	C. dilutus	2	5 per sample	USACE 2013, EnviroSystems, Inc. 2013a & 2013b
	C. tentans	2	4 per sample	NYSDEC 1998
	H. azteca	4	4 per sample	NYSDEC 1998
Total		12	34	-

[1]Survival and growth of test species were measured after 10-day sediment exposures.

[2]Some studies are older than 10 years and do not represent current conditions.