January 29, 2018 Reference No.058502

Mr. Nate Nemani
RCRA Corrective Action Project Manager
Land and Chemicals Division
Remediation and Reuse Branch
U.S. EPA, Region 5
77W. Jackson Blvd
Chicago, Illinois 60604, Mail Code: LU-9J

Dear Mr. Nemani:

Re: Ecological Screening Assessment for Secondary Pond Under Future Use Scenarios Memorandum
RACER Nodular Industrial Land, Saginaw, Michigan
REPA5-3544-003

The following presents GHD's responses to Booz Allen Hamilton (BAH) technical review comments dated October 10, 2017 on the Ecological Screening Assessment for Secondary Pond Under Future Use Scenario's Memorandum (dated August 18, 2017) for the Revitalizing Auto Communities Response Trust's (RACER) Former Nodular Industrial Land (Site) in Saginaw, MI.

On December 4, 2017, RACER, GHD, U.S. EPA and BAH participated in a conference call to discuss BAH's October 10, 2017 comments. As part of the discussion, RACER/GHD also provided details on the proposed approach to obtaining closure of the Secondary Pond, which deviates from the standard approach of preparing detailed ecological risk assessments. Instead, the approach includes the preparation of a stream-lined risk assessment prepared with input and open dialogue with U.S. EPA. This streamlined approach is intended to minimize the reporting requirements and allow implementation of remedies more quickly. U.S. EPA concurred with the proposed approach to obtaining closure of the Secondary Pond.

In light of this discussion and concurrence on approach, BAH's comments are provided below in ***bold and italics*** followed by the response.

General Responses

There are two general responses to the comments. First, we want to clarify the intent of the analysis. Rather than a worst-case analysis that is typical of earliest stages of the Screening-Level Ecological Risk Assessment (SLERA), this analysis was intended to be more of an assessment that allowed some realism into the risk assessment. Second, the analysis was based on an assumption that an interim measure would be completed to reduce PCB concentrations by removal of all PCB concentrations above 50 milligrams per kilogram (mg/kg). This would reduce PCB concentrations by about 40 percent to a post-remedial surface weighted average concentration (SWAC) of about 2.4 mg/kg. This point is alluded to but somewhat unclear in the document. Along with the safety factors discussed below, this anticipated reduction in PCB concentrations should allay the reviewer's concerns about risks to mink, as it will significantly reduce the risks to even more negligible levels. We believe that the weight of evidence demonstrates no potential for unacceptable ecological risks at current PCB levels, but RACER believes there are other benefits to remove select PCB-impacted sediment.

The bulk of the reviewer's comments pertain to risks to mink. The August 2017 Ecological Screening Assessment analysis assumed that all the PCBs were Aroclor 1242, which in turn were assumed to all be trichlorobiphenyls. As pointed out by the reviewer, both halves were potentially non-conservative assumptions. However, consistent with the intent for a more realistic but still conservative analysis, the Ecological Screening Assessment also explicitly included several conservative assumptions that more than offset these non-conservative assumptions, including:

1) The conservative default assumption that mink eat only fish. In fact, mink eat a variety of aquatic and terrestrial prey and do not usually eat that much fish at all. In this habitat, the mink diet would likely be overwhelmingly terrestrial prey, such as small mammals and birds (USEPA 1993).

2) The assumption that any fish eaten by a mink will be taken from the pond, with none taken from the nearby aquatic systems. In reality, mink forage over large areas (100s of acres), so a realistic assumption is the mink would hunt in nearby aquatic systems as well as the pond.

3) The Biota Sediment Bioaccumulation Factor (BSAF) estimation also did not include any consideration of potential black carbon (BC). The bottom sediments are comprised of wastes associated with a foundry, which involves forming engine blocks from molten metal under very high heat (> 1000 F). The bottom sediments are also rich in organic carbon, which, like the metals and PCBs, is presumably associated with foundry processes. The combination of high organic carbon and very high heat suggests that pond sediments may contain appreciable amounts of black carbon, which would significantly reduce PCB bioavailability compared to that assumed in the original analysis. See references in original document

   To assess whether significant amounts of BC occur in the pond's sediments, an exploratory sampling event was conducted in late October 2017. The sampling event, the sampling results, and implications are described in Attachment 1 to these responses. As described in more detail there, more recent sampling showed both higher levels of total organic carbon than previously thought (9.9 percent rather than 5 percent) and also very high levels of BC (2.9 percent). Because BC was not estimated in the original samples, it was originally assumed to be 0 percent. Both results suggest that PCB bioavailability is much more limited than originally estimated. As estimated in Attachment 1, these sample results suggest that PCB bioavailability will be about 7.4 or more times lower than assumed in the original screening assessment. Reduction to risks would be similarly lower than estimated in the original screening assessment.

4) The original risk assessment does not consider the pond's small size and potential ecological insignificance. The pond is simply too small to cause ecological risks to mink. Ecological risks pertain to populations, not individuals or small numbers of individuals. Average density of mink in good habitat is estimated to be about 0.015 per acre (USEPA 1993). Thus, the about 20-acre pond

represents potential exposure to less than 1/3 of a mink. Only half of that time would the exposed mink be a sensitive adult female. Thus, the pond represents potentially toxic exposure to about 1/6 of a susceptible mink. This safety factor alone is probably sufficient to dismiss ecological risks.

5) The assumed lipid levels in forage fish are higher than likely. For simplicity and conservativeness, the analysis assumed that fish would have the same lipid concentrations as organic carbon concentrations in sediments, which before additional sampling was assumed to be about 5 percent. However, this pond will likely be dominated by sunfishes, which have lipid levels of about 1.5 percent (USEPA 1995). Thus, a more likely estimate is that the forage fish would have a lipid concentration of about 2.5 percent, half of that assumed in the original screening risk assessment. This would represent another two-fold safety factor.

Nonetheless, to address concerns about the risk assessment to mink, more fine-grained calculations are provided in Tables 1 and 2, as requested in the comments. As suggested by the comments, Oliver and Niimi (1988) was used to estimate BSAF for the open water fish. However, the salmon data from that reference were not used as suggested. Salmon are top predators (trophic level 4 or 5) in the relatively long Lake Ontario food chain, whereas forage fish in small ponds would typically be lower on the food chain (trophic level 3). Rather than utilizing the salmon BSAF data, the BSAF for water column fish was estimated with the small smelt data from Oliver and Niimi. This is still a somewhat conservative methodology since Lake Ontario contains a predatory invertebrate, *Mysis relicta*. This mysid eats a lot of zooplankton, and, thus, functions in the food chain more like a small forage fish than the usual herbivorous zooplankton. Because PCBs biomagnify in food chains, the additional link in the food chain represented by mysids exaggerates likely bioaccumulation that would occur by zooplanktivorous forage fish in the pond's ecosystem. (For example, Rasmussen et al. (1990) found that small Canadian lakes with mysids tended to have significantly higher PCB concentrations in lake trout than PCB concentrations in lake trout from lakes without mysids.).

Notwithstanding this potentially conservative bias of Lake Ontario food chain, the Oliver and Niimi data were used to estimate BSAFs for each PCB homolog, for bottom feeding and open water forage fish. Oliver and Niimi have no data for monochlorobiphenyls, so the BSAF was assumed to be zero (Table 1). In addition, the Oliver and Niimi results for dichlorobiphenyls were less than detection, so the BSAF was assumed to be 0.1, 1/2 of the BSAF for trichlorobiphenyls.

As shown in the Table 1, there are not dramatic differences between BSAFs for bottom feeding fish and those for open-water feeding smelt. This somewhat surprising result is presumably due to the conservative effect of mysids and their effect on PCB biomagnification in the Lake Ontario water-column food chain. Once homolog specific bioaccumulation rates are estimated, these were then applied to homolog composition for Aroclors 1242, 1248, and 1254. As suggested in the comments, homolog compositions for the Aroclors are taken from ATSDR. Combining these factors allow estimation of Aroclor-specific BSAFs for forage fish, both benthic and water-column, and these are used to estimate fish concentrations based on current PCB concentrations in sediment. As shown in Table 2, the concentrations of PCBs in fish are somewhat higher than estimated in the original Ecological Screening Assessment.

In turn, these estimated fish concentrations are compared to Aroclor specific No Observed Effect Concentrations (NOECs). The NOEC for Aroclor 1242 was based on feeding experiments conducted by Aulerich et al. (1977) in which no effects on mink reproduction were seen at 2 mg/kg, ww, in food. This NOEC is bolstered by the feeding studies of Käkelä et al. (2002), in which there was about a 40 percent suppression of mink reproduction at 3 mg/kg, ww, Aroclor 1242. In turn, complete suppression of reproduction was also found at 5 mg/kg, ww, Aroclor 1242 (Bleavins et al. 1980). The toxicities of Aroclors 1248 and 1254 were based on Chapman's memo, which estimated a NOEC of 0.5 mg/kg and a Limited Observed Effect Concentrations (LOEC) of 0.6 mg/kg for both Aroclors.

The estimated fish concentrations for each Aroclor were then compared to the Aroclor-specific NOEC values, and summed for all the Aroclors. As shown in Table 2, estimated exposures are about 1.5 to 1.7 times the NOEC exposures. However, these only moderately elevated quotients would be reduced to *de minimis* levels with relaxation of any one of the multiple safety factors included in these calculations. For example, quotients would decline another 50 percent assuming, more realistically, that the mink diet was only 1/2 fish. Similarly, the reality that that the pond is habitat for about 1/6th of a female mink, on average, reduces the quotient by another factor of 6. Also, reasonably assuming that the pond would be dominated by sunfishes would reduce the quotient by another factor of 2 or so. These safety factors are not redundant, so they could be multiplied to produce a total safety factor of about 24-fold. There is also a 5 to 10 fold safety factor due to the ample black carbon found in the sediments.

Remember also that PCB concentrations and quotients presented in Table 2 will decline by another 40 percent after elevated concentrations of PCBs are removed in the anticipated interim measure. This anticipated safety-factor is also sufficient to reduce risks to negligible levels.

Section 4.1.1 Risks to Consumers of Aquatic Life in Secondary Pond

Comment 1:

The Eco Screening Assessment assumes that the mink consumes benthivorous fish from the ponds. However, as the assessment points out, mink will likely consume a mix of trophic level fish, including fish from the water column. The Oliver and Niimi (1988) paper from which the Eco Screening Assessment developed a biota-sediment accumulation factor (BSAF) for benthivorous fish, also presents data that can be used to develop BSAF values for salmonids. The Eco Screening Assessment should use those data to develop a BSAF that represents the mix of water column fish and benthivorous fish. The data presented in Oliver and Niimi (1988) for polychlorinated biphenyls (PCBs) in salmonids will result in a BSAF that is higher than the BSAF developed in the Eco Screening Assessment for sculpin.

Oliver, B.G. and Niimi, A.J. 1988. Trophodynamic Analysis of Polychlorinated Biphenyl Congeners and Other Chlorinated Hydrocarbons in the Lake Ontario Ecosystem. Environ. Sci. Technol. 22(4):388-397

GHD Response:

This comment is addressed in the general responses.

Comment 2:

The Eco Screening Assessment is based on an assumption that the PCBs in the sediments consist of Aroclor 1242, and further that Aroclor 1242 consists primarily of trichlorophenyls. The BSAF that was developed from the Oliver and Niimi (1988) paper uses data only for trichlorophenlys. However, Aroclor 1242 does not consist primarily of trichlorophenyls, but is approximately 15% dichlorophenyls, 45% trichlorophenyls, 20% tetrachlorophenyls, and 19% pentachlorophenyls, according to Table 4-4 of the Agency for Toxic Substances and Disease Registry (ATSDR) (2000) toxicological profile for PCBs. An appropriate BSAF for Aroclor 1242 should more appropriately be based on the representative mix of chlorophenyls. More critically, though, the data in Appendix A of the Eco Screening Assessment shows that the sediment PCBs consist of a mix of Aroclor 1242, Aroclor 1248, and Aroclor 1254, not just Aroclor 1242. Aroclor 1248 consists primarily of tetrachlorophenyls and pentachlorophenyls, whereas Aroclor 1254 consists primarily of pentachlorophenyls and hexachlorophenyls. A more appropriate BSAF should be developed from the Oliver and Niimi (1988) paper, for a mix of sculpin and salmonids, that represents the mix of tri-, tetra-, penta-, and hexachlorophenyls that are present in the Secondary Pond sediments, as based on the detected levels of Aroclor 1242, Aroclor 1248, and Aroclor 1254.

ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). November.

GHD Response:

This more refined calculation is presented in the general responses.

Comment 3:

As mentioned above, the data in Appendix A shows that the PCBs in the Secondary Pond sediment consist of a mix of Aroclor 1242, Aroclor 1248, and Aroclor 1254. The mink toxicity value (no observed adverse effect concentration) used in the Eco Screening Assessment was developed for Aroclor 1242, which is generally less toxic to mink than other Aroclors. Reviews that focused on compilations of PCB toxicity reference data (e.g., Blankenship et al. 2008, USEPA 1995) provides toxicity values for Aroclors found in the Secondary Pond sediment. The Eco Screening Assessment should use a toxicity reference value for Aroclor 1248 or Aroclor 1254, rather than the value for Aroclor 1242, in order to be adequately protective of mink that may consume fish from the pond. For example, Aulerich et al. (1985) identified a lowest observed adverse effect level (LOAEL) for survival and for reproductive effects of 0.1 milligrams per kilogram (mg/kg) for Aroclor 1254. USEPA (1995) identified a LOAEL of 2 mg/kg from the Aulerich and Ringer (1977) study, and applied a 10-fold uncertainty factor since a no observed adverse effect level was not available from the data, which would result in a dietary toxicity reference value of 0.2 mg/kg. Use

of this value would result in hazard quotients for mink exposure to fish from the Secondary Pond that are several-fold higher than those reported in the Eco Screening Assessment.

Blankenship, A.L., D.P. Kay , M.J. Zwiernik , R.R. Holem , J.L. Newsted , M. Hecker, and J.P. Giesy. 2008. Toxicity reference values for mink exposed to 2,3,7,8-tetrachlodibenzo-p-dioxin (TCDD) equivalents (TEQs). Ecotoxicology and Environmental Safety 69:325–349.

USEPA 1995. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife: DDT, Mercury, 2,3,7,8-TCDD, PCBs. EPA/820/B-95/008. Washington, DC. March.

GHD Response:

This comment is addressed in the general responses.

Comment 4:

Based on the above comments, the use of a BSAF that represents a mix of salmonids and sculpin as prey for mink, and that reflect a mix of tri-, tetra-, penta-, and hexachlorophenyls in Secondary Pond sediments, and the use of a more appropriate toxicity reference value, would result in hazard quotients for mink that are several-fold higher than those presented in the Eco Screening Assessment. Hazard quotients need to be recalculated to reflect the likely prey species and the mix of chlorophenyl compounds that are present in the Secondary Pond sediments.

GHD Response:

This comment is addressed in the general responses.

Page 10, Section 4.1.3 Risks to Aquatic Benthos, First Paragraph

Comment 5:

Although the Eco Screening Assessment describes the acid-volatile sulfide/ simultaneously extracted metals (AVS/SEM) method as more reliable than other sediment screening criteria, note that the following recently published studies have identified problems associated with the reproducibility of both AVS and SEM measurements. Uncertainties with the AVS/SEM method should be mentioned.

Hammerschmidt, C.R. and G.A. Burton. 2010. Measurements of acid volatile sulfide and simultaneously extracted metals are irreproducible among laboratories. Environmental Toxicology and Chemistry 29:1453-1456.

Brumbaugh, W.G., C.R. Hammerschmidt, L. Zanella, E. Rogevich, G. Salata, and R. Bolek. 2011. Interlaboratory comparison of measurements of acid-volatile sulfide and simultaneously extracted nicked in spiked sediments. Environmental Toxicology and Chemistry 30:1306-1309.

GHD Response:

The issues with AVS/SEM analyses are acknowledged. However, a plan is currently being devleoped to conduct sediment pore water analyses, which will greatly reduce uncertainties about AVS/SEM and potential toxicity.

Page 10, Section 4.1.3 Risks to Aquatic Benthos, Third Paragraph

The text indicates that PCBs are not very toxic to benthic invertebrates because they lack the aryl hydrocarbon (Ah) receptor. However, the concentrations of PCBs in sediments exceed toxicity-based criteria, indicating that they do pose a risk of toxicity to the sediment benthos, regardless of mechanism. The assessment should be edited to reflect the estimated risk, including summary conclusions.

GHD Response:

PCBs do exceed so called co-incidence based sediment quality benchmarks (Co-SQBs), but those Co-SQBs are not toxicity-based, at least with respect to the toxicity of PCBs (e.g., see National Academy of Sciences 2001), or, more likely, toxicity of any compound. Instead, the Co-SQBs appear to be nothing more than indexes of background concentrations (see Smith 2007, Smith and Jones 2006, 2012). Thus, Co-SQBs for PCBs are relatively low because PCBs are relatively rare in sediments, not because PCBs in sediments are very toxic to benthic invertebrates.

Using information on the toxicity of PCBs to invertebrates, Fuchsman et al. (2006) developed a final chronic value (FCV) of 5.4 micrograms per liter (µg/L) for Arochlor-1254. Using equilibrium partitioning, they identified an equilibrium partitioning sediment benchmark (ESB) of 1,500 micrograms per gram (µg/g) organic carbon. Based on the Site-specific fraction of organic carbon (foc) of 5 percent, the ESB for protection of benthic organisms is 75 mg/kg.

Nonetheless, this comment had no real bearing on the risk assessment, since potential risks to benthos are acknowledged to potentially occur, due to the metals. Furthermore, high concentrations of PCBs will be removed during the interim measure.

Page 13, Section 4.1.5 Summary of Risks to the Pond as Pond in the Future

Comment 2:

The conclusions presented on the lack of risks to mammalian consumers of fish from the pond need to be restated given the recalculation of hazard quotients based on the above comments regarding mink consumption of fish from the pond.

GHD Response:

Comment addressed. More refined analyses show no change in the assessment of no potential for risk, and this general conclusion is bolstered when reductions in PCB concentrations, associated with interim clean-up measure, are considered.

Page 14, Section 4.3 EcoRisk of Pond as Terrestrial Ecosystem

Comment 3:

The potential for risks to terrestrial receptors is appropriately described as high, given the greater than 10-fold and up to 100-fold exceedances of Ecological Soil Screening Levels (EcoSSLs) and other criteria. The text should note that EcoSSLs are not the lowest of possible toxicity-based criteria but are based on assumptions of acceptable impacts to a percentage of receptors, and hence are not necessarily as conservative as declared in the Eco Screening Assessment.

GHD Response:

This comment conflicts with the understanding of GHD's scientists concerning the Ecological Soil Screening Levels (EcoSSLs). However, to allay reviewer's concerns, the discussion of the conservatism of EcoSSL's will be softened.

Should you have any questions on the above, please do not hesitate to contact us.

Sincerely,

GHD

Daniel Smith

JEP/kf/40

Encl.

cc: Dave Favero (RACER)
John-Eric Pardys (GHD)

References

Aulerich, R. and R. Ringer. 1977. Current status of PCB toxicity to mink, and effect on their reproduction. Arch Environ Contam Toxicol 6: 279-292.

ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Agency for Toxic Substances and Disease Registry. November, 2000.

Chapman, J. 2003. Memo from James Chapman, EPA Region 5, to Shari Kolak, on-line at www.michigan.gov/documents/deq/deq-rrd-KzooRiv-BERA-102003zAppendixD_312426_7.pdf

Bleavins, M., R. Aulerich, and R. Ringer. 1980. Polychlorinated biphenyls (Aroclors 1016 and 1242): Effects on survival and reproduction in mink and ferrets. Arch Environ Contam Toxicol 9: 627-635.

Fuchsman, P., T. Barber, J. Lyndall, and K. Leigh. 2006. An evaluation of cause-effect relationships between polychlorinated biphenyl concentrations and sediment toxicity to benthic invertebrates. Environmental Toxicol. Chem. 25. 2601-12. 10.1897/05-614R.1.

Käkelä, A., R. Käkelä, H. Hyvärinen, and J. Asikainen. 2002. Vitamins A1 and A2 in hepatic tissue and subcellular fractions in mink feeding on fish-based diets and exposed to Aroclor 1242. Environ Toxicol Chem 21: 397-403.

National Academy of Sciences Board. 2001. A Risk-Management Strategy for PCB-Contaminated Sediments. Committee on Remediation of PCB-Contaminated Sediments. National Academy of Sciences Board on Environmental Studies and Toxicology. National Research Council. National Academy Press, Washington, D.C. 432 pp.

Rasmussen, J.B., D.J. Rowan, D.R.S. Lean, and J.H. Carey. 1990. Food chain structure in Ontario lakes determines PCB levels in lake trout and other pelagic fish. Can. J. Fish. Aquat. Sci. 47:2030−2038.

Smith, D.W., and Jones, S.M. 2006. It's time to abandon co-occurrence sediment quality benchmarks (SQBs). Learned Discourse, Society of Environmental Toxicology and Chemistry. March 2006.

Smith, D.W. 2007. It’s time to formally abandon co-occurrence sediment quality benchmarks (SQBs): Part 2. Proceedings of the 9th International Symposium on In-Situ and On-Site Bioremediation, Baltimore, MD, May 2007.

Smith, D.W., and Jones, S.M. 2012. Ecological risk assessment and natural resource injury assessment: when policy masquerades as science. Environmental Litigation, Winter, 2012. http://apps.americanbar.org/litigation/committees/environmental/email/winter2012/winter2012-eras-nrdas-when-policy-masquerades-science.html

USEPA. 1993e. Wildlife Exposure Factors Handbook, Volumes I and II, U. S. Environmental Protection Agency, USEPA/600/R-93/187a and 187b,December 1993.

USEPA. 1995. Great Lakes Water Quality Initiative Technical Support Document for the Procedure to Determine Bioaccumulation Factors. Office of Water EPA-820-B-95-005 March 1995

Table 1

Response to EPA Comments on Pond Ecorisk
PCB Homolog Concentrations in Lake Ontario Sediments and Biota and Estimated BSAF Values
Nodular Site
Saginaw, Michigan

	PCB Concentrations (µg/kg)			**BSAF, lipid and carbon normalized**	
	Sediment	**Sculpin**	**Small Smelt**	**Sculpin**	**Small Smelt**
MonochloroBP	NE	NE	NE	NC	NC
DichloroBP	ND	ND	ND	NC	NC
TrichloroBP	22	13	6.3	0.20	0.19
TetrachloroBP	200	190	110	0.32	0.37
PentachloroBP	180	580	230	1.09	0.86
HexachloroBP	93	500	170	1.81	1.23
HeptachloroBP	48	280	86	1.97	1.21
OctachloroBP	22	75	16	1.15	0.49
NonachloroBP	5.8	7	ND	0.41	0.00
DecachloroBP	9.4	4.6	ND	0.17	0.00
% Carbon, Lipid	2.70%	8%	4%	NA	NA

Notes:

Data from Oliver and Niimi (1988)
NE = Not Estimated
NC = Not Calculated
ND = Not Detected
NA = Not Applicable

Table 2

Homolog and Aroclor-Specific BSAFs, Estimated Concentrations of Aroclors, and Screening Quotients (SQ)
RACER Saginaw Nodular Industrial Land
Saginaw, Michigan

Homolog	Sculpin BSAF	Composition from ATSDR (2000)			Total
		Aroclor 1242	Aroclor 1248	Aroclor 1254	
MonochloroBP	0.00	0.8%	0.1%	0.0%	-
DichloroBP	0.10	15.0%	1.6%	0.2%	-
TrichloroBP	0.20	44.9%	21.3%	0.8%	-
TetrachloroBP	0.32	20.2%	32.8%	7.6%	-
PentachloroBP	1.09	18.9%	42.9%	65.3%	-
HexachloroBP	1.81	0.3%	1.6%	24.4%	-
HeptachloroBP	1.97	0.0%	0.0%	2.0%	-
OctachloroBP	1.15	0.0%	0.0%	0.0%	-
NonachloroBP	0.41	0.0%	0.0%	0.0%	-
Aroclor-Specific BSAF*		0.38	0.65	1.22	-
Sediment Concentration (mg/kg)		2.94	0.66	0.14	3.74
Estimated Fish Concentration (mg/kg)		1.12	0.43	0.17	1.71
NOEC, ww, from Text		2.00	0.50	0.50	-
NOEC SQ, Conc./NOEC		0.56	0.85	0.34	1.75

Homolog	Small Smelt BSAF	Composition from ATSDR (2000)			Total
		Aroclor 1242	Aroclor 1248	Aroclor 1254	
MonochloroBP	0.00	0.8%	0.1%	0.0%	-
DichloroBP	0.10	15.0%	1.6%	0.2%	-
TrichloroBP	0.19	44.9%	21.3%	0.8%	-
TetrachloroBP	0.37	20.2%	32.8%	7.6%	-
PentachloroBP	0.86	18.9%	42.9%	65.3%	-
HexachloroBP	1.23	0.3%	1.6%	24.4%	-
HeptachloroBP	1.21	0.0%	0.0%	2.0%	-
OctachloroBP	0.49	0.0%	0.0%	0.0%	-
NonachloroBP	0.00	0.0%	0.0%	0.0%	-
Aroclor-Specific BSAF*		0.34	0.55	0.92	-
Sediment Concentration (mg/kg)		2.94	0.66	0.14	3.75
Estimated Fish Concentration (mg/kg)		1.01	0.37	0.13	1.51
NOEC, ww, from Text		2.00	0.50	0.50	-
NOEC SQ, Conc./NOEC		0.50	0.74	0.26	1.50

Attachment 1

Attachment 1: Black Carbon Sampling of Nodular Pond

As described in the original screening analysis (GHD 2017), the previously collected data suggested that there might be considerable amounts of black carbon (BC) in the pond. Notably, total organic carbon (OC) concentrations in sediments were elevated for a natural pond – an average of about 5 percent -- suggesting that this OC was due to industrial processes, rather than in-pond photosynthesis. In turn, the Site's industrial processes (metal casting) are known to occur at very high temperatures, up to about 1000°F, which could produce BC.

To explore the potential for elevated concentrations of BC in pond sediments, GHD took exploratory samples of pond sediments from 10 locations around the edge of the partially drained pond. Pond sediments are too watery to support wading, and launching a boat was beyond the scope of this sampling. Therefore, sediment samples were taken right at the shoreline where they could be safely and easily collected. Some sediment samples were taken above the water line, in now dried and exposed sediments, and some were taken as grabs from shore, below the water line, in still inundated sediments. Because the pond had been partially drained since fall of 2016, these shoreline samples represent the sediments from a depth below water of approximately 4 feet (ft) to 6 ft when the pond was full. To compensate for the fact that the pond's underwater sediments are almost entirely water, samples taken in nearshore now-dried sediments, were taken from the top 1-inch of sediment. Those samples taken in the still wet sediments, under the water line, were taken from the top 6-inches of sediments[1].

The sampling results indicate two important phenomena (Table A1). First, these sediment samples had about double the total OC as previously collected in the screening analysis (9.9 percent total OC versus about 5 percent total OC). A likely explanation for this difference is that the top layers of sediments assessed in the 2017 samples are richer in total OC than the bottom layers of sediments. Previous sediment samples were often core samples that sometimes went down deep, a foot or more, into the sediments. Since the risk screening analysis assumed total OC concentrations of 5 percent, the approximate net effect of doubling TOC concentration would be a halving of risks from PCBs.

The second significant result is that the sediments contained very high concentrations of BC (approximately 2.9 percent). As discussed in the original screening analyses and elsewhere, BC binds much more readily to hydrophobic substances than typical OC. Empirical data suggest that BC binds 5 to 100 times more tightly (e.g., see Lohman et al. 2005, Werner et al. 2010, USEPA 2012), which would reduce bioavailability and PCB risks accordingly[2]. Although calculation of the effect is quite complicated (USEPA 2012), the effect on PCB risks can be roughly estimated as follows. Conservatively assume that BC binds PCBs ten times more aggressively than regular OC binds PCBs. The net effect of total OC that

---

1 The ponds sediments were very watery, so the top 1 inch of dried sediments was assumed to represent the biological exposure zone for aquatic benthos. For those sediments, which were still under water when sampling occurred, a more typical 6-inch biological exposure zone was assumed.

2 For example, Xia (1998) estimated the binding of regular organic carbon, Koc, for PCBs. as log *K*oc (PCBs) = 0.97 log *K*ow - 0.50, while the partition coefficient for black carbon, Kbc, has been estimated as 0.54 * log Kow + 3.41 (USEPA 2012). Thus, the log difference between Kbc and Koc is equal to -0.43 * Log Kow + 3.91. (Taking the antilog of the log difference yields the ratio of Kbc to Koc.) Aroclor 1242 and Aroclor 1254 have log Kow values of 5.6 and 6.5, respectively (ATSDR 2000). Plugging these values into the equation above and taking the antilog suggest that the Kbc for these two Aroclors are about 32 and 13 times, respectively, the Koc values. Similarly, Werner et al. (2010) found the best fit to PCB data when Koc and Kbc were calculated with the following equations: log *K*oc = 0.74 * log *Kow* + 0.15, and log *K*bc = 0.912 * log *Kow* + 1.370. Again, the log difference is equal to 0.172 Log Kow + 1.22. Plugging the Kow values for Aroclors 1242 and 1254 and taking the antilog would estimate that Kbcs for PCBs are >100 fold the Kocs for typical organic carbon

is 30 percent BC would be to increase PCB binding, and decrease PCB bioavailability by about 3.7 fold. This is the weighted average of 70 percent of the total OC at usual binding affinity and 30 percent of the total OC at 10 times the usual binding affinity. Note that the additional binding due to BC is independent of extra binding due to more TOC than originally assumed.

Thus, the new sediment sample data suggest that the bioavailability of and risk posed by PCBs are considerably lower than assumed in the original screening. If TOC concentrations in surface sediments are actually 9.9 percent, rather than 5 percent, the PCB risks decline about two fold. The high BC concentrations would also significantly reduce PCB bioavailability, and risks, even more so, by a factor of about 3.7 or more. Considering both effects together would suggest that PCBs risks were about 7.4 times or more lower than calculated in the original screening. These additional data should further allay concerns about risks from PCBs.

References

ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Agency for Toxic Substances and Disease Registry. November, 2000.

GHD. 2017. Ecological Screening Assessment for Secondary Pond under Future Use Scenarios" Memorandum to Nate Nemani, USEPA, from Daniel Smith, GHD. August 2017.

Lohmann, R., J.K. MacFarlane, and P.M. Gschwend. 2005. Importance of black carbon to sorption of native PAHs, PCBs, and PCDDs in Boston and New York, Harbor sediments. *Environ. Sci.*

Technol. 39: 141–148.

Werner D, S.E. Hale, U. Ghosh, and R.G. Luthy. 2010. Polychlorinated Biphenyl Sorption and Availability in Field-Contaminated Sediments. Environmental Science & Technology. 44:2809–2815.

USEPA. 2012. Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Procedures for the Determination of the Freely Dissolved Interstitial Water Concentrations of Nonionic Organics. EPA/600/R-02/012 | December 2012

National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division

Xia, G. S. 1998, Sorption behaviour of nonpolar organic chemicals on natural sorbents. Ph.D. Thesis, The Johns Hopkins University, Baltimore, MD, 1998.

Table 1.A

Sample Results for Total Organic Carbon and Black Carbon in Secondary Pond Sediments
RACER Saginaw Nodular Industrial Land
Saginaw, Michigan

Sample Location:	**BC01-17**	**BC02-17**	**BC03-17**	**BC04-17**	**BC05-17**	**BC06-17**	**BC07-17**
Sample Date:	**10/30/2017**	**10/30/2017**	**10/30/2017**	**10/30/2017**	**10/30/2017**	**10/30/2017**	**10/30/2017**
Sample Depth:	**(0-1) in BGS**	**(0-1) in BGS**	**(0-6) in BGS**	**(0-1) in BGS**	**(0-6) in BGS**	**(0-1) in BGS**	**(0-1) in BGS**
Medium	**Dried Sediments**	**Dried Sediments**	**Wet Sediments**	**Dried Sediments**	**Wet Sediments**	**Dried Sediments**	**Dried Sediments**
Parameters							
% Black carbon	2.5%	2.8%	3.3%	2.8%	3.4%	2.7%	2.7%
% Total organic carbon (TOC)	11.0%	10.0%	9.5%	7.2%	12.0%	10.0%	11.0%
% Black Carbon of TOC	23%	28%	35%	39%	28%	27%	25%

Table 1.A

Sample Results for Total Organic Carbon and Black Carbon in Secondary Pond Sediments
RACER Saginaw Nodular Industrial Land
Saginaw, Michigan

Sample Location:	**BC08-17**	**BC09-17**	**BC10-17**	**BC10-17**	**Mean**
Sample Date:	**10/30/2017**	**10/30/2017**	**10/30/2017**	**10/30/2017**	**Dups Averaged**
Sample Depth:	**(0-6) in BGS**	**(0-1) in BGS**	**(0-1) in BGS**	**(0-1) in BGS**	
Medium	**Wet Sediments**	**Dried Sediments**	**Dried Sediments**	**(Duplicate)**	
Parameters					
% Black carbon	3.7%	3.4%	1.4%	1.9%	2.9%
% Total organic carbon (TOC)	14.0%	10.0%	3.8%	4.9%	9.9%
% Black Carbon of TOC	26%	34%	37%	39%	30.3%