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VIA OnBase Electronic Forms Upload

Attention: Lisa Strobridge, P.G.
Pennsylvania Department of Environmental Protection
2 East Main Street
Norristown, Pennsylvania 19401

Dear Ms. Strobridge,

Reference: Response to Public Comments
Ecological Risk Assessment: Areas of Interest 1 through 9,
Sitewide PADEP Facility ID No. 780190
Former Philadelphia Refinery
3144 Passyunk Avenue
City of Philadelphia
Philadelphia County

1.0 INTRODUCTION

On June 30, 2022, Evergreen submitted an Ecological Risk Assessment (ERA) for Areas of Interest (AOI) 1 through 9 at the former Philadelphia Refinery (facility). As outlined in Evergreen's 2019 Public Involvement Plan for the Act 2 Remediation Process at the former Sunoco Philadelphia Refinery, Evergreen accepted public comments for a 30-day period following the submission of the ERA. The purpose of this letter is to provide the comments received from the public and Evergreen's responses to these comments for Pennsylvania Department of Environmental Protection (PADEP) and US Environmental Protection Agency (EPA) consideration of the ERA. This response letter amends the previously submitted ERA and completes the submission. This response letter and attachments will be posted to Evergreen's website upon submission to the PADEP in the same location as the ERA.

2.0 RESPONSE TO PUBLIC COMMENTS

This section presents the comments received from the public via email (phillyrefinerycleanup@ghd.com) and the website (https://phillyrefinerycleanup.info/). Evergreen received submissions from three commenting groups for the ERA (**Attachment A**). Two sets of comments were technical in nature and sent directly via email, one from the Clean Air Council (CAC) and one from the Delaware Riverkeeper Network (DRN). One comment was submitted via the website submission form which is not related to the content of the ERA nor Evergreen's remediation program, but rather the future use of the property. A copy is included in **Attachment A** for completeness. As comments received relevant to the ERA were technical in nature when considered in full, the responses provided herein are also technical and not "plain language" so that the comments could adequately be addressed and evaluated by PADEP as part of the ERA review.

Note that previously published Evergreen documents referenced in this letter have not been included as attachments but can be found on the website (https://phillyrefinerycleanup.info/).

RESPONSES TO CAC COMMENTS

Comment 1

The Department should disapprove the report because it does not follow the requirements of 25 Pa. Code 250.311 or the Department's Technical Guidance Manual, which Evergreen attempts to avoid by erroneously asserting that relevant data are not available.

Response to Comment 1

As will be further detailed in the response to Comment 1a, the section of code referenced by the CAC, 25 Pa. Code 250.311 is in reference to a remediation standard that is not Evergreen's selected standard, and the Department's Technical Guidance Manual provides recommendations, not requirements. As is further detailed in the response to Comment 1c, Evergreen has used data that is available and relevant.

Comment 1a

The regulations and Technical Guidance Manual require an assessment of direct impacts to ecological receptors through several steps, which Evergreen does not follow.

Response to Comment 1a

The section of the 25 Pa. Code Chapter 250 referenced by CAC in this comment, §250.311, outlines requirements under the Statewide Health Standards (SHS). As has been noted in previous responses to CAC comments, Evergreen is remediating the former Philadelphia Refinery under the Site-Specific Standard (SSS) and while certain portions of the SSS regulations reference back to language under the SHS, it can be misleading to quote the SHS requirements without additional context. The "assessment" referenced in the quoted section of §250.311(a) is not necessarily an ecological risk assessment in accordance with EPA guidance, as is suggested in Comment 1a. An assessment of potential risk to ecological receptors under the SHS can take a different form, as is outlined in the remainder of §250.311.

The sections of the code that relate directly to the former Philadelphia Refinery ERA under the SSS are §250.402 and §250.409. It should be noted that §250.402(c) contains similar language to §250.311(a) and references this SHS section regarding the types of receptors that should be evaluated. As outlined in the ERA, Evergreen has followed this process to identify ecological receptors of concern. Evergreen used the guidance in §250.402(d)(1) under the SSS and performed "An ecological risk assessment to determine if an impact has occurred or will occur if the release of a regulated substance goes unabated". This section of the regulations, in reference to the baseline risk assessment, does not outline a requirement as to the methodology for the processes. The next section, §250.402(d)(2) with regard to development of remediation levels, does provide specific references, and indicates that the remediator should perform "An ecological risk assessment conducted in accordance with Department-approved EPA or ASTM guidance to establish acceptable remediation levels or alternative remedies based on current and future use that are protective of the ecological receptors." It is true that Evergreen's approach of reviewing multiple lines-of-evidence for each potential ecological receptor does not follow each step of the outlined approaches. However, this is not required by the regulations as Evergreen has not sought to "establish acceptable remediation levels or alternative remedies based on current and future use that are protective of the ecological receptors." Instead, Evergreen has shown that establishing such remediation levels or alternative remedies are not necessary because substantial impacts to ecological species of concern are not expected based on multiple lines-of-evidence.

CAC points out some specific steps from the PADEP Technical Guidance Manual (TGM) section on ecological risk assessment under the SSS that were not expressly conducted in the ERA. The TGM is a reference document that provides remediators with assistance and recommendations for meeting the requirements of Act 2 and the 25 Pa. Code Chapter 250 as is outlined in the first section of the TGM in Section I (A)(2) "The Department has developed this manual to assist remediators in satisfying the requirements of the Land Recycling and Environmental Remediation Standards Act (35 P.S. §§ 6026.101-6026.908), commonly known as Act 2, and the regulations at 25 Pa. Code Chapter 250 (regulations). The manual provides suggestions and examples for the best approach to site characterization and remediation." The recommendations presented in the TGM are not requirements of Act 2 or the regulations. Act 2 allows remediators discretion while requiring them to adhere to the Act and the regulations. Evergreen uses many of the assessment tools and considerations referenced in the TGM to support the lines-of-evidence based approach; the CAC points out the deviations.

Comment 1b

In place of the steps contemplated by the Technical Guidance Manual, Evergreen uses conclusory, qualitative, and vague arguments, extending to its analysis of the Schuylkill river water and sediment and Mingo Creek.

Response to Comment 1b

In the details of this comment, CAC repeatedly refers to the SHS regulations. As previously discussed, these references can be misleading. The directly applicable sections of the regulations are §250.402 and §250.409.

As is outlined in Section 1.0 of the ERA, Evergreen does not dispute that it has taken an approach to the ecological risk assessment that makes modifications to the suggestions that are recommended in the TGM. There are several reasons that the weight-of-evidence approach is appropriate for the ERA at the former Philadelphia Refinery and many of these reasons apply to specific receptors and/or specific pathways, some of which will be discussed in further detail in the response that follows.

To conduct a qualitative risk assessment, both representative samples (or an appropriate substitute) and relevant toxicity reference values (TRVs) must be available. Two of the primary media of concern for the identified ecological receptors are surface water and sediment. These are also two media that are highly susceptible to background contamination and cross-contamination, particularly for tidally influenced rivers in areas with a long history of industry, such as the Schuylkill River. There is a strong case that potential samples collected would be influenced by other sources. However, Evergreen did use available sediment and surface water data as a consideration in the ERA. In addition, an alternative method was used to predict the contaminant contribution from the former Philadelphia Refinery to surface water of both Mingo Basin and the Schuylkill River. As outlined in the June 2022 Sitewide Fate and Transport Remedial Investigation Report (RIR), this was a detailed and conservative evaluation that used site-specific data, including many years of groundwater analytical data and an intensive review of site geology. The results of this analysis were incorporated into the ERA for both the Mingo Basin and the Schuylkill River which have applicability to fish species, certain avian species, and reptile species. It should also be noted that the calculations for the Mingo Basin are particularly conservative as they do not rely on dispersion within the surface water body.

With respect to the TRVs, as will be detailed further in the response to Comment 1e, Evergreen did not claim that there are no TRV values available for any of the species of concern. However, as stated in Section 4.0 of the ERA, the supporting data are not available for reptiles. Therefore, other lines of evidence are considered for the Eastern redbelly turtle. For the other species of concern, available data are considered and environmental fate and transport, uptake and bioaccumulation potential, and ecological toxicity of the Evergreen constituents of potential ecological concern (COPECs) are discussed and evaluated.

An additional consideration with respect to quantitative risk assessment for ecological receptors, particularly ones with near shore and on-shore habitats, is the uncertainty surrounding what changes to that habitat may be completed during upcoming development activities. Hilco Redevelopment Partners (HRP) is still in the planning stages of the project, but will likely fill in current onsite ponds, rendering moot data collected and evaluated during an ERA.

CAC also criticizes the manner in which Evergreen considers an additional set of screening values for sediment from the Ontario Ministry of the Environment. As is further detailed in the response to Comment 1d, these screening values were included as an alternative that suitably reflects site conditions.

Comment 1c

Evergreen erroneously asserts that proper analysis cannot be carried out because of lack of site and habitat characterization data.

Response to Comment 1c

In this comment, CAC points out soil and groundwater data that Evergreen has in general proximity to surface water bodies identified as habitats for ecological receptors. Evergreen does have a significant quantity of soil and groundwater data. The groundwater concentration data is not directly applicable to ecological receptors and was not used expressly as groundwater concentration data. However, it was used as the defining basis for the previously mentioned Sitewide Fate and Transport RIR to predict surface water concentrations in the Mingo Basin and the Schuylkill River. This is an appropriate method for evaluating surface water concentrations of COPECs in a scenario when surface water samples can be influenced by many other sources. The responses to Comments 4c, 5b, and 5c discuss the reasons that surface soil was not evaluated in detail. As previously discussed, even though sediment samples are highly susceptible to background contamination and cross-contamination available data were used.

Comment 1d

Evergreen erroneously concludes that there is no expected risk to species of concern based on water modeling for the Schuylkill River and Mingo Creek, and on sediment testing and analysis for the Schuylkill River.

Response to Comment 1d

Regarding surface water, fate and transport modeling supports the conclusion that potential risks from exposure to site-related constituents of concern (COCs) that were modeled in surface water in the Schuylkill River and Mingo Creek are negligible. It is true that the surface water modeling was performed for five of the Evergreen COCs as indicator parameters. As described in the Sitewide Fate and Transport RIR, the selection of these compounds (benzene, naphthalene, methyl tertiary-butyl ether, benzo(a)pyrene, and lead) was based on several criteria: prevalence, toxicity, mobility, and solubility. The details are found in Sections 2.2 and 2.3 of the Sitewide Fate and Transport RIR.

Groundwater concentrations of COPECs that are greater than Medium-Specific Concentrations (MSC) do not imply risks to aquatic ecological receptors as MSCs are based on potential human health impacts and do not take into account mixing and dilution in surface water.

Regarding sediment, CAC implies that Evergreen disregards USEPA BTAG screening values. Available sediment analytical results are screened to BTAG values; however, explanation is provided as to why it is appropriate to consider other values. The reasons will be expounded upon here. Bulk sediment concentrations of PAHs are known to be unreliable indicators of potential adverse effects to ecological receptors (USEPA, 2003; *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures*). Pursuant to USEPA (2003) guidance, organic carbon-normalized concentrations are better predictors of the bioavailable fraction of the individual PAH compounds and thus of the potentially toxic fraction. Although several of the Region 3 BTAG screening levels take into account screening levels that have been derived using equilibrium partitioning (e.g., fluorene, naphthalene, phenanthrene), many Region 3 BTAG screening levels do not account for equilibrium partitioning (e.g., anthracene, benzo(a)anthracene, benzo(a)pyrene [BAP], chrysene, pyrene). Furthermore, as stated in the ERA, the Region 3 BTAG screening levels that use equilibrium partitioning in their derivation assume an organic carbon content of one percent. An organic carbon content of one percent is not representative of the sediment in the Schuylkill River in the near vicinity of the site, as measured organic carbon content averages 12.28 percent in this area. Since PAH bioavailability and toxicity are known to be highly correlated with organic carbon (USEPA, 2003) it is reasonable to account for the elevated organic carbon content of the Schuylkill River sediment when identifying appropriate sediment screening levels and the Ontario Ministry of the Environment screening values were additionally considered.

Comment 1e

Evergreen erroneously claims that following the required risk assessment is not possible due to lack of data regarding Toxicity Reference Value (TRV) for the species of concern.

Response to Comment 1e

The statement in the ERA "However, certain site characterization data are limited for the habitats that are the subject of this ERA and TRVs are not available for all species of concern" is accurate. TRVs are not available for reptiles, and the redbelly turtle is a reptile. Extrapolation of toxicity values derived for avian or mammalian receptors to reptilian receptors is not an acceptable practice due to the differences in physiology and metabolism.

The ERA used a weight-of-evidence approach that is consistent with the PADEP TGM and USEPA guidance (1997; *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*).

Screening levels and TRVs for constituents in soil are not applicable to the ecological receptors evaluated in the ERA, which are mainly aquatic and/or riparian. Soil exposures for these receptors are minimal. The marsh wren and least bittern are not significantly exposed to soil as they are mostly aquatic/riparian feeders. As such, ecological soil screening levels are not applicable to these species. Peregrine falcons are not likely to be directly exposed to surface soil either.

Comment 2

Evergreen does not consider the additive effect of contaminants on species of concern, and does not provide a quantitative assessment of the cumulative impacts of contaminants.

Response to Comment 2

Although current human health risk assessment guidance (USEPA, 1989; *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual*) provides methods for assessing the potentially cumulative cancer and non-cancer effects of multiple contaminants on humans, current ecological risk assessment guidance (USEPA, 1997) does not provide similar methodology for assessing cumulative effects from multiple contaminants.

The Agency for Toxic Substances and Disease Registry (ATSDR) recommendation of “A hazard index approach that assumes additive joint action and uses ATSDR Minimal Risk Levels” refers to human health evaluations and is not applicable to ecological receptors using current ecological risk assessment guidance. Pursuant to ATSDR, a Minimal Risk Level “is an estimate of the amount of a chemical a **<u>person</u>** [emphasis added] can eat, drink, or breathe each day without a detectable risk to health.” A Minimal Risk Level is not applicable to ecological receptors.

Comment 3

Evergreen cannot cure the deficiencies in its assessment of impacts to avian species by referring to a letter from the Pennsylvania Game Commission (PGC), because that letter is only as reliable as the deficient information that was provided to it.

Response to Comment 3

The ERA used multiple lines-of-evidence in accordance with PADEP TGM and USEPA (1997) guidance and did not rely on the results of the Pennsylvania Natural Diversity Index (PNDI) search to draw conclusions regarding potential ecological risk. One of the main purposes of the PNDI search and follow-up agency correspondence is to aid in properly identifying the species of concern that should be included in the ecological risk assessment process. However, the Pennsylvania Game Commission did in fact respond to the PNDI search with the conclusion that “no impact is likely” for the avian species (marsh wren, least bittern, and peregrine falcon) identified in the original PNDI search. The information provided to the Pennsylvania Game Commission as part of the PNDI search was consistent with typical letters provided to the agencies that are a part of the PNDI process and was not deficient.

Comment 4

For the Eastern Redbelly turtle, Evergreen fails to provide an adequate risk assessment.

Response to Comment 4

The ecological risk assessment uses methods suggested in USEPA (1997) guidance. Quantitative population studies (particularly for upper trophic level receptors) are extremely problematic and often yield inconclusive or erroneous results.

Comment 4a

Evergreen erroneously determines habitat suitability by the presence or absence of redbelly turtles, rather than by determining risk according to the regulations and the Technical Guidance Manual.

Response to Comment 4a

A site-specific *Eastern Redbelly Turtle (Pseudemys rubriventris) Habitat Evaluation* (ERC, 2018, ERA Appendix E) was conducted by a qualified redbelly turtle (RBT) biologist/surveyor as recognized by the Pennsylvania Fish and Boat Commission and the U.S. Fish and Wildlife Service. The RBT habitat evaluation incorporated the assessment of hydrology, freshwater wetlands, soil composition, vegetation assemblages, ecotone areas, and surrounding land uses in relation to the habitat requirements of the RBT and determined that certain water bodies did not provide suitable habitat to support RBT populations. Subsequent to the habitat evaluation, a *Phase II Eastern Redbelly Turtle (Pseudemys rubriventris) Presence/Absence Survey* (ERC, 2019, ERA Appendix F) was conducted to determine if RBT were present in the onsite water bodies. As presented in the RBT presence/absence survey, there are few natural basking areas within Waterbody G; therefore, four (4) basking boards were deployed to provide basking substrate for turtles. In addition to the basking survey, The RBT biologist/surveyor also visually scanned and transected the shoreline of Waterbody G in an attempt to locate any old turtle nests or turtle shells. Searches for exposed soil, scrapes, and egg shells were made. While traversing the waterbody's edge, searches were also made for shells of deceased turtles. Based on the results of these observations, Waterbody G was determined to provide sub-optimal habitat and due to the sub-optimal habitat, it was determined that RBT were not inhabiting Waterbody G.

The RBT surveys were not specifically used to determine risks; however, if a receptor is not present in a given habitat (i.e., turtles are not present in a particular waterbody) then potential exposure pathways for that receptor are considered incomplete in relation to that waterbody and, by definition, there are no risks.

Comparisons of terrestrial soil concentrations of lead to screening levels for plants, birds, or mammals are not appropriate for the assessment of exposures to aquatic reptiles (e.g., RBT) as detailed in the response to Comment 4c.

Comment 4b

The Department should reject as vague and conclusory Evergreen's assertions that several potential exposure routes of contaminants to the redbelly turtles pose little or no risk.

Response to Comment 4b

Bulk sediment concentrations of COPECs provide little information regarding potential hazards to RBT as the USEPA Region 3 BTAG screening values and Ontario Ministry of the Environment Lowest Effect Level (LEL) and Severe Effect Level (SEL) levels are based on potential adverse effects to benthic invertebrate communities and not based on potential effects to upper trophic level receptors such as RBT.

The references provided by CAC are either misleading or do not support their assertions. For example, regarding CAC's assertion that Evergreen discounted potential exposure routes and toxicity to turtles, Meador (2008) states "Very few studies have been conducted on the responses of reptiles to PAH exposure," and "These studies generally describe the direct effects of oil on these species." Since oil is a complex mixture of constituents, it is not appropriate to attribute adverse effects observed in an exposed species to any single constituent. The causative agent of the observed effects is impossible to discern with any level of certainty. "Only after significant progress is made in understanding how individual PAHs act on myriad biological systems can we begin to tackle the problem of complex mixtures containing PAHs and other toxicants." (Meador, 2008). Although biotransformation rates in reptiles may be somewhat lower than those measured in mammals (which have been shown to be rapid), reptiles do metabolize and eliminate PAH metabolites. Furthermore, bioaccumulation in certain tissues does not directly equate to toxicity.

The results of the study conducted on snapping turtles including those at the John Heinz National Wildlife Refuge (JHNWR) by Van Meter, et al. (2006) were inconclusive, with no direct evidence that exposure to PAHs resulted in adverse effects in snapping turtles:

- "Embryos from John Heinz National Wildlife Refuge exposed to crude oil did not show a linear association between severity of deformities and level of crude oil exposure. There was no clear trend among these embryos as even control embryos had a lethal deformity rate of 50%. This was the highest rate of lethal deformities of all treatment groups."
- "Exposure to BaP did not have a significant effect on survival rates among JHNWR, Algonquin Provincial Park, or Michigan embryos."
- "Chemical treatment did not have a significant effect on righting response time. Righting response times of control hatchlings were variable and often hatchlings treated with crude oil or BaP were able to right themselves faster than control turtles."

These studies elucidate the fact that the potential effects on turtles exposed to contaminants in surface water and sediment are not well understood at this time and that linkage of constituent concentrations in abiotic media (e.g., soil, surface water, sediment) to adverse effects is inconclusive and potentially misleading.

Comment 4c

Evergreen ignores potential exposure to redbelly turtle eggs from surface soil contamination, which can affect their viability.

Response to Comment 4c

Current practice in ecological risk assessment of upper trophic level feeding guilds is to estimate total exposures of receptors via the ingestion pathway. Other pathways (e.g., inhalation, dermal absorption) are considered insignificant compared to ingestion and are not quantitatively assessed. The potential effects of lead in soil on turtle eggs has not been studied thoroughly. The study conducted by Burger (1998) exposed turtle hatchlings via injection, which is not analogous to eggs that may or may not absorb lead from soil through the shell. Dosing hatchling turtles via injection cannot be correlated to absorption through the egg shell and potentially incorporated into a turtle embryo. These exposures are entirely different. Furthermore, "Hatchlings from 1995 showed no significant differences in growth, survival, or behavior between control and lead-injected animals at a dose of 0.05 and 0.1 mg/g." (Burger, 1998).

Ozdilek and Ozdilek (2007) studied sea turtles from a beach in an area that receives "untreated domestic wastewater" and "all types of untreated domestic and industrial wastewaters" and attempted to correlate observed adverse effects to concentrations of metals found in the egg shells (not the embryos). Contaminants other than metals, that were likely present in the domestic and industrial wastewaters, were not considered when trying to correlate observed effects to constituent concentrations in egg shells. Furthermore, it is not possible to assign adverse effect causation to any specific constituent detected in egg shells when numerous metals were detected in the tested egg shells and none of the other chemicals found in domestic and industrial wastewater were analyzed.

It is not clear why CAC references a Region 3 BTAG marine sediment screening benchmark when the waterbodies at the Site are freshwater. The USEPA Region 3 BTAG marine sediment screening level for lead is based on potential adverse effects to marine benthic invertebrate communities and is not applicable to potential effects in turtles. Similarly, the USEPA Eco-Soil Screening Levels for lead in soil for avian and mammalian wildlife are not applicable to turtles and are not relevant for the assessment of turtles or other reptiles.

Since the potential effects of constituents in soil to turtle eggs is not well understood, a meaningful quantitative evaluation of the potential effects of site-related contamination on redbelly turtle eggs is not possible.

Comment 4d

The presence/absence survey for the redbelly turtles does not comply with the Technical Guidance Manual, and it does not support the claim that they are not adversely impacted by exposure to contaminants on the site.

Response to Comment 4d

The Eastern Redbelly Turtle (*Pseudemys rubriventris*) Habitat Evaluation (ERC, 2018, ERA Appendix E) and the Phase II Eastern Redbelly Turtle (*Pseudemys rubriventris*) Presence/Absence Survey (ERC, 2019, ERA Appendix F) support the USEPA (1997) concept that if receptors are not present in a certain area/habitat, then exposures are incomplete and therefore, potential risks are not possible.

USEPA ecological risk assessment guidance (1997) states "For an exposure pathway to be complete, a contaminant must be able to travel from the source to ecological receptors and to be taken up by the receptors via one or more exposure routes." USEPA ecological risk assessment guidance (1997) further states "If an exposure pathway is not complete for a specific contaminant (i.e., ecological receptors cannot be exposed to the contaminant), that exposure pathway does not need to be evaluated further." Consistent with this USEPA ecological risk assessment guidance, since several water bodies onsite do not provide suitable RBT habitat and site-specific surveys of these waterbodies determined that RBT were not present, , it was concluded that risks to RBT at these locations were negligible.

A quantitative comparison of RBT populations at the site to a reference area would not yield any relevant information. As referenced by CAC, J.E. Stone (2010) studied turtle distribution with respect to human "impact". Human impact was qualitatively classified with respect to potential human intervention with no consideration given to potential chemical "contamination". Stone (2010) concluded that human activity alone had an adverse effect on turtle populations. If this conclusion is accurate, then it would not be possible to distinguish between effects caused by human activity and effects caused by chemical contaminants, or both. This master's thesis does not provide any information regarding the potential impacts to turtles from chemical contamination and is not relevant to this ecological risk assessment.

Comment 5a

Evergreen fails to provide data regarding avian species onsite, and erroneously relies on generalities that do not properly account for the site.

Response to Comment 5a

The facility is currently undergoing significant alteration due to the demolition of the former refinery operations at the site and redevelopment. As such, ecological habitat at the site is anticipated to undergo significant changes. At the current stage of redevelopment, it would be impossible to distinguish between changes in avian populations at the site due to human intervention (I.e., site redevelopment) and potential chemical contamination.

Contrary to the assertion made by CAC regarding the rapid metabolism of PAHs by birds, the study by Custer, et al. (2001) conducted on a refinery site in Casper, Wyoming determined "the main route of exposure of PAHs to tree swallow and house wren chicks was probably through the diet. All five of the PAHs found in swallow and wren carcasses at the refinery site were present at high concentrations in the dietary samples. Additionally, the total PAHs in dietary samples at the refinery site were 28 and 38 times higher than found in swallow and wren carcasses. The high ratio of diet to carcass PAHs was expected because of the rapid rate of metabolism of these compounds by birds."

Further validation that birds rapidly metabolize PAHs is provided by Dhananjayan and Muralidharan (2013) who reported that "Levels of contaminants measured in the tissues of vultures are comparable with the levels documented in a number of avian species and are lower than those reported to have caused deleterious effects". Dhananjayan and Muralidharan (2013) also state that "PAHs are rapidly metabolized in birds", which corroborates similar statements presented in the ERA. Dhananjayan and Muralidharan (2013) did not determine any correlation between residual levels of PAHs in tissues of white-backed vultures and corresponding environmental media concentrations or potential adverse effects. This study simply presents data that suggests PAHs were detected in vulture tissues and no conclusions were drawn about their origin or effects.

Evergreen has the following comments regarding the additional studies referenced by CAC in Comment 5a:

- The study by Gonzalez-Gomez, et al. (2020) illustrates how birds exposed to PAHs metabolize and sequester PAHs in external tissues (e.g., feathers) thereby mitigating exposure and potential hazards. This study substantiates statements in the ERA that "PAHs are readily metabolized and excreted" by birds.
- According to Perez, et al. (2007), vertebrates are not good models to assess oil contamination because of their great ability to metabolize PAHs. In common with all vertebrates, birds have well-developed mixed function oxygenase (MFO) systems that can rapidly metabolize parent PAHs into hydrophilic products that are more easily excreted. In a study conducted with yellow-legged gulls in an area of a marine oil spill, total PAH concentrations in the blood of gulls decreased 3-fold in just one year, down to the values from unoiled colonies (Perez, et al., 2007). These results suggest that "PAHs are readily metabolized and excreted" by birds.
- The study by Provencher, et al. (2020) did not directly address PAH metabolism and elimination by birds.
- Waszak, et al. (2020) report that "Birds, like other vertebrates, generally display high oxidative P-450 enzyme activity and can quickly metabolize and easily excrete most of consumed PAHs". Waszak, et al. (2020) further state "All birds are equipped with a well-developed mixed-function oxidase (MFO) system that facilitates biotransformation and detoxification of exogenous chemicals, including PAHs".
- As presented in Eisler, 1987, "PAH levels in fish are usually low because this group rapidly metabolizes PAHs; furthermore, higher molecular weight PAHs, do not seem to accumulate in fish."
- The study by Olayinka, et al. (2019) was not designed to assess the accumulation or metabolism of PAHs in fish, the favored prey item of least bittern, and as such this study does not provide information that is useful in the ERA.
- The study by Dhananjayan and Muralidharan (2013) was not designed to assess the accumulation or metabolism of PAHs in fish. However, the authors did state that "The absence or rather low detection of certain PAHs in the fish samples may be attributed to their rapid depuration or biotransformation. The accumulation and depuration of PAHs in fish can be influenced by various factors including route and duration of exposure, lipid content of tissues, environmental factors, differences in species, age, and sex, and exposure to other xenobiotics."

Comment 5b

The report discounts and fails to properly account for potential exposure routes, in particular to lead, that can affect the risk assessment of the marsh wren (*Cistothorus palustris*).

Response to Comment 5b

Terrestrial soil does not represent a significant exposure medium for marsh wrens. Ingestion of insects with an aquatic life stage is the most significant exposure pathway for marsh wrens, and current methodologies for estimating exposures in ecological risk assessment only account for ingestion pathways. Ecological risk assessment methods do not exist for estimating exposures via non-ingestion pathways (e.g., inhalation, dermal absorption).

The New Jersey Audubon Society (2009) report suggests several possible pathways of exposure to contaminants in the New Jersey Meadowlands for birds, but the report does not provide any data regarding dietary or other sources of contaminants in birds.

The marsh wren is not an avian ground insectivore. Avian ground insectivores (e.g. Northern flicker) feed preferentially on invertebrates that live in terrestrial soil (e.g., earthworms). Marsh wrens consume mostly insects but also aquatic invertebrates and spiders, which they glean from the water surface, on stems and leaves of emergent vegetation, and the marsh floor (Kale, 1965; Welter, 1935). They sometimes also feed by flycatching (Welter, 1935). Organisms that are aquatic for all or part of their lives are an important component of the diet of marsh wren adults and nestlings. As presented in the ERA, terrestrial soil is not a significant exposure medium for marsh wrens. Since marsh wrens and avian ground insectivores have different feeding strategies, a screening level of 11 milligrams per kilogram lead in soil is not directly applicable to marsh wrens.

Comment 5c

The report improperly discounts and fails to properly account for potential exposure routes, in particular to lead, that can affect the risk assessment of the Least bittern (*Ixobrychus exilis*).

Response to Comment 5c

The potential exposure routes described in the ERA are the most significant exposure routes for least bittern. Nests are usually built in areas of tall cattails, reeds, or rushes and they feed mainly on small fish such as minnows, sunfishes, and perches. Based on their preference for building nests in aquatic vegetation and their preferred prey being aquatic (i.e., fish), exposure to terrestrial soil is minimal. Other exposure routes are possible but would only contribute a minor portion of the overall exposures potentially experienced by least bittern. Food ingestion is the most significant exposure pathway in ecological risk assessment and least bitterns' dietary preference is small fish. As such, the most significant exposure pathway for least bitterns is through ingestion of fish.

RESPONSES TO DRN COMMENTS

Note: Responses to the DRN comments were prepared by Harold M. Brundage III of Environmental Research and Consulting, Inc. (ERC). Mr. Brundage authored the "Ecological Risk Assessment for Hickory Shad, Shortnose Sturgeon, and Atlantic Sturgeon in the Schuylkill River Adjacent to the PES Philadelphia Refining Complex, Areas of Interest 1 through 9", dated May 1, 2020 (ERC, 2020) (Assessment), which was provided as Appendix G of the overall ecological risk assessment for the facility prepared by Stantec (2022).

DRN Comment 1

DRN is concerned that the Ecological Risk Assessment fails to account for the full panoply of risks posed to the endangered Atlantic sturgeon and shortnose sturgeon. In particular, the genetically unique population of Atlantic sturgeon in the Delaware River is at a precariously low level, with the most recent estimate of the breeding population size being merely 125–250 adults.[1] Given the dire status of this species, Evergreen must rigorously investigate any potential risk caused by contamination from the Site, and the Pennsylvania

Department of Environmental Protection ("PADEP") and United States Environmental Protection Agency ("USEPA") must ensure that cleanup at the site is protective of endangered species.

The Assessment relies primarily on the assumption that because sturgeon seldom travel up the Schuylkill River, they will not be exposed to contaminants from the Site. However, the Site is immediately upstream from the Schuylkill's confluence with the tidal Delaware River, which is federally-designated critical habitat for the Atlantic sturgeon. As explained in USEPA's Ecological Risk Assessment Guidance for Superfund document, additional sampling further downstream from a site may be necessary in circumstances where contaminants of concern extend beyond initial sampling areas.[2]

Response to DRN Comment 1

We are aware of the recent estimates of the size of the breeding population (N_s) of Atlantic sturgeon in the Delaware River. N_s is the number of adults that produce at least one offspring during a single breeding season, which sets a lower bound on the size of the spawning run and should not be conflated with the number of fish on the spawning grounds or the census population size. Please note that Mr. Brundage, who prepared the subject risk Assessment (ERC, 2020, ERA Appendix G), as well as these responses, was a co-author of the Ecological Applications paper[1] cited by DRN.

While it is correct that the use of the Schuylkill River by sturgeons appears to be limited, it is inaccurate to say that the Assessment relied primarily on this minimal occurrence when assessing risk. Although the occurrence and abundance of the species of concern was considered, as this relates to exposure probability (i.e., no occurrence = no exposure), the Assessment was based primarily on comparison of best available data on sediment and water quality in the Schuylkill River adjacent to the site (see ERC, 2020, ERA Appendix G Section 4.3.2) to various ecological screening benchmarks and effect concentrations for the COCs obtained from the literature (see ERC, 2020, ERA Appendix G Section 4.4).

DRN Comment 2

The Assessment does not address the degree to which contaminated sediment from the Schuylkill River deposits in the Delaware River.[3] The Assessment also does not address the movement of benthic invertebrates (either by their own volition or by current) from the areas of contaminated sediment in the Schuylkill River to the Delaware River. Additionally, the Assessment fails to differentiate between early-life-stage and adult Atlantic and shortnose sturgeon in evaluating sensitivity to contaminants, particularly via consumption of sediment and benthic invertebrates.[4]

In order to best inform remedial action at the site, the responsible parties and all government entities with oversight responsibilities must consider the effect of contaminants on all life stages of endangered sturgeon species in the Delaware River. To do so, the Assessment must be revised to evaluate the pathways of exposure in the Delaware River.

Response to DRN Comment 2

The Partnership for the Delaware Estuary report[3] cited by DRN discusses the amount of sediment transported from the *non-tidal* portions of the Delaware River and various tributaries to the *tidal* Delaware River. This should not be confused with sediment transport from the *tidal* Schuylkill River, where flow dynamics are very different from those in the non-tidal river. Nonetheless, inclusion of exposure pathways in the Delaware River in the Assessment would not be helpful because it is virtually impossible to link contamination in the Delaware River directly with the subject site. Contamination in the Delaware River cannot be attributed to any particular source, as previously mentioned, given the long pollution history of this part of the river, and the mixing and weathering of contaminants from numerous sources (both historical and more recent), exacerbated by the tidal nature of the river, which results in contaminants being transported upriver as well as down. It should be noted that the Pollutant Dispersal model developed by Baird (Sitewide Fate and Transport RIR, Appendix L) for the site, although considering aqueous phase contaminants, not sediment, indicated that the transport of dissolved contaminants from the site to the Delaware River was not significant.

Although the movement of benthic organisms was not specifically addressed, the main text of the ERA considered the ingestion of benthic invertebrates, as well as ingestion of water and sediment, and concluded that ingestion did not pose significant risk to the species of concern (Sections 6.4. 6.5, and 6.6).

DRN criticizes the Assessment for failing to “differentiate between early-life-stage and adult Atlantic and shortnose sturgeon in evaluating sensitivity to contaminants”. That is because there is no ecotoxicological information for the site COCs specific to any life stage of shortnose or Atlantic sturgeon (see Section 4.4 of ERC, 2020 in ERA Appendix G). A literature review was conducted as part of the Assessment to identify ecotoxicological data for the COCs with the following hierarchy of relevancy: 1) effects on shortnose and Atlantic sturgeon (no literature found), 2) effects on other sturgeon species (one publication found on effects of lead in sediment on white sturgeon fry), and 3) effects on non-sturgeon fish species (several publications found for lead and PAHs, including effects of dissolved PAHs on fish embryos). Comparison of COC concentrations adjacent to the site to the ecotoxicological concentrations from the literature indicated that adverse effects were unlikely (see Section 4.4 of ERC, 2020, in ERA Appendix G for details of this assessment).

Moreover, it was not necessary to explicitly consider sturgeon early life stages in the Assessment because these life stages do not occur at or near the site nor in the proximal reach of the Delaware River. Shortnose sturgeon spawn in the non-tidal Delaware River some 65-89 kilometers (km) upriver, and eggs and larvae do not occur anywhere near the site. Atlantic sturgeon spawn at least 19 km downriver of the Schuylkill River confluence, eggs and early (yolk-sac) larvae remain at or near the spawning site, and older (post yolk-sac) larvae are unlikely to move upriver towards the site (see Section 3.4.2 of ERC, 2020 in ERA Appendix G).

[1] White, Shannon L., Nicholas M. Sard, Harold M. Brundage III, Robin L. Johnson, Barbara A. Lubinski, Michael S. Eackles, Ian A. Park, Dewayne A. Fox, and David C. Kazyak. 2022. “Evaluating Sources of Bias in Pedigree-Based Estimates of Breeding Population Size.” Ecological Applications e2602. https://doi.org/10.1002/eap.2602
[2] U.S. Envtl. Prot. Agency, Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Risk Assessments – Interim Final at 6-2 (1997), available at http://semspub.epa.gov/src/document/HQ/157941
[3] Gebret, J.A., R. Searfoss. “Chapter 4—Sediments” in the Technical Report for the Delaware Estuary & Basin. Partnership for the Delaware Estuary. PDE Report No. 12-01. June 2012. pp. 108 (estimating the mean annual sediment discharge from the non-tidal Delaware, the Schuylkill, and the Brandywin, to be 1.28 million metric tons).
[4] R. Christopher Chambrs, Dawn D. Davis, Ehrn A. Habeck, Nirmal K. Roy, & Isaac Wirgin, “Toxic Effects of PCB126 and TCDD on Shortnose Sturgeon and Atlantic Sturgeon.” 31 Envtl. Toxicololgy & Chemistry 2324–37 (2012) (evaluating effects of chemical contaminants on early-life-stage sturgeon).

Reference: Response to Public Comments Sitewide Remedial Investigation Report Addendum, Former Philadelphia Refinery

Regards,

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Enclosure: Attachment A – Public Comments
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