Upper 9-Mile Plan - A Proposal to Expedite Cleanup of the 17-Mile LPRSA
November 27, 2017

Executive Summary

The Lower Passaic River Cooperating Parties Group (CPG) has developed a plan to remediate the upstream portions (i.e., River Miles [RM] 8.3 to 14.7) of the Lower Passaic River Study Area (LPRSA)[1] and, in conjunction with the selected remedy for the lower 8.3 miles, to achieve risk-based goals for the Lower Passaic River. This plan is grounded in the understanding of the river and the behavior of the Chemicals of Potential Concern (COPCs) that have been derived from the Remedial Investigation field work and the development of hydrodynamic, sediment transport, contaminant fate and food web models. That understanding is documented in the draft Remedial Investigation report that will be delivered to the EPA in December 2017, and the preliminary chemical fate and transport and food web models that will be submitted in the 1st quarter 2018. The detailed evaluation of the plan will be submitted in a draft Feasibility Study (FS) at the end of the 3rd quarter 2018.

The proposed Upper 9-Mile Interim Remedy consists of a phased program that will be adaptively managed to assure that the goals for the remediation are met. Although the proposed plan focuses on actions in the Upper 9 miles, as required by the EPA, it will be evaluated on its benefits to the entire 17.4-mile LPRSA.

The proposed plan consists of five steps following EPA's issuance of a proposed plan and Record of Decision (ROD 1) based on the FS:

1) The pre-design phase will consist of a Pre-Design Investigation (PDI) to delineate the final remedial footprint and generate other detailed site information needed to support the final Remedial Design (RD), a baseline investigation to establish pre-remediation conditions for comparison with post-remediation conditions, and refined modeling to establish projected recovery trajectories;
2) The RD will develop the engineering plans and specifications for implementing the active remedy for the RM 8.3 to 14.7 reach;
3) Active remediation will remove and cap sediment that is acting as a source of risk to human and ecological receptors;
4) Performance Monitoring following active remediation will consist of sediment, fish tissue and water column sampling to confirm recovery or support the evaluation and design of additional remediation, if needed; and
5) A second Record of Decision (ROD 2) will codify final remediation goals, or define any additional remediation that must be performed.

[1] It is CPG's understanding that EPA has determined that the uppermost reaches of RM 14.7 to 17.4 will not be the subject of active remediation.

623529

Based on the current understanding of the river, the proposed cleanup plan will consist of:

1) PDI/RD – Cores will be collected from a high-density grid (e.g., 80 ft on-center) and dioxins and PCBs will be measured in samples from each core. The data will be used to delineate remediation areas within which concentrations meet or exceed 300 ng/kg for 2,3,7,8 TCDD or 1 mg/kg for total PCBs. The chemical fate and transport model and food web model will be calibrated using the PDI data, and the models will be used to project recovery trajectories for the river following completion of the Phase 1 Interim and Lower 8.3 Mile Remedies.
2) Phase 1 Interim Remedy – Sediment will be removed from the delineated remediation areas to allow for placement of an engineered cap and return of the river bottom to the pre-dredging elevations. Based on current understanding, the remediation footprint is likely to be approximately 80 acres.
3) Performance Monitoring –Fish tissue and water column sampling will be conducted and additional bathymetry measurements will be performed per the Performance Monitoring Plan developed in the RD. Sediment sampling will be performed to support diagnostic assessment of remedy performance, as needed. The data will be evaluated and compared to the projected recovery trajectories. Criteria and triggers for diagnostic assessment and/or additional action will be based on comparison of performance monitoring data with projected recovery rates.
4) If the performance monitoring data is consistent with the projected recovery trajectory then,

    ROD 2 will codify the final cleanup goals for the upper 9 miles of the LPRSA.

    Alternatively, if the performance monitoring data is not consistent with the projected recovery trajectories then, -

    Phase 2 Plan for additional remediation that will bring the river back on the projected recovery trajectory will be developed and implemented. Performance Monitoring will be continued and, as after Phase 1, evaluated to confirm that the recovery trajectories are being achieved.

At this time, it is expected that following completion of Phase 1 and about 10 years of recovery, sediment and fish tissue concentrations will decline to a point where human health and ecological risks for the full 17 miles of the LPRSA will meet EPA's acceptable risk levels[2]. The use of adaptive management as outlined in this proposal assures that, even if the remediation performed in Phase 1 does not meet the goals, additional work will ensure the river will meet the remedial goals.

[2] Based on EPA's modeling presentations from September 11, 2017

Upper 9-Mile Plan - A Proposal to Expedite Cleanup of the 17-mile LPRSA
November 27, 2017

Introduction and Summary

The Lower Passaic River Cooperating Parties Group (CPG) has been conducting the Remedial Investigation/Feasibility (RI/FS) for the 17-mile Lower Passaic River Study Area (LPRSA) under the oversight of USEPA Region 2 (EPA) since May 2007. In 2016, EPA issued a Record of Decision (ROD) which identified a remedy for the lower 8.3 miles of the LPRSA and stated that a remedy for the Upper 9 miles of the LPRSA would be identified upon the completion of the 17-mile RI/FS (Figures 1 & 2).

During a July 5, 2017 meeting with EPA, CPG representatives presented an approach to (1) accelerate the completion of the 17-mile LPRSA Remedial Investigation (RI) and Feasibility Study (FS); (2) refocus the FS on the Upper 9 miles, recognizing a ROD has been issued for the Lower 8 miles; and (3) accelerate the remediation of the Upper 9 miles using a phased approach and Adaptive Management. EPA and the CPG engaged in a series of meetings and exchanged information from August to November 2017 that focused on providing further details on the approach, evaluations of its likely effectiveness and the benefits of varying the Remedial Action Levels (RALs) around the values developed using the CPG's conceptual model using the existing data. Taking into account these discussions with EPA, the CPG updated and refined the proposed approach and this document outlines its technical basis, explains its components and describes a timetable for the Upper 9-Mile Plan.

In summary, the CPG proposes a phased approach to address the Upper 9-Miles using Adaptive Management and a Phase 1 Interim Remedy with the following components:

- RALs of 300 ng/kg 2,3,7,8-TCDD and 1 mg/kg of Total PCBs;
- Active remediation (dredging, capping and enhanced natural recovery) of approximately 80 acres from RM 8.3 to RM 14.7;
- A Phase 1 Pre-Design Investigation (PDI) to finalize the remedial footprint and assess the use of flexible RALs; and,
- Remedy performance criteria and thresholds, supported by a structured monitoring program, to determine whether additional actions are required or a final ROD can be issued

The implementation of a Phase 1 Interim Remedy coupled with natural recovery over a 10-year period is projected by EPA's current models to:

- Meet human health risk thresholds for fish consumption (Figure 3)
- Reduce ecological risk for avian and fish receptors by ~90% (Figure 4)

These risk reduction predictions will be refined during the remedial design phase and evaluated with the data acquired under a robust performance monitoring program over a period of several years following the implementation of the Phase 1 Interim Remedy. Monitoring results will be

assessed under a detailed Adaptive Management Plan, with defined performance criteria, thresholds, and triggers for further action, if needed.

The adoption of a Phase 1 Interim Remedy employing EPA's directives and principles related to Adaptive Management (Figure 5) provides certainty of meeting final risk goals, allows coordination with the Lower 8-mile Remedial Action and allows the entire 17 miles to be addressed years sooner, and potentially completes the clean-up in the mid-to-late 2020s.

This proposal provides the following:

- Conceptual Model for Developing RALs
- Technical Basis for RALs
- Phase 1 Interim Remedy for the Upper 9 Miles
- Approach for Completing the Upper 9-Mile Feasibility Study
- Outline and Time-Table of Work to Be Conducted Under the Upper 9-Mile Plan

Conceptual Model for Developing RALs

Chemicals of Potential Concern (COPC) concentrations in the Upper 9-mile sediments vary over an extremely wide range. This range reflects sediment type, erosion/deposition history and exposure to downstream contamination via upstream transport processes. In general, the highest concentrations are in fine sediment areas (Figure 6) that are no longer subject to the net deposition that is a principal agent of recovery. Areas that are subject to significant net deposition and areas that are subject to cyclic erosion and deposition have the potential for recovery. These areas have COPC concentrations that reflect the concentrations on recently deposited sediments originating from the water column. As stated by EPA in the 2014 Focused Feasibility Study (FFS) Remedial Investigation (RI) Report:

> *"As sediments deposit, they bring with them the particle-borne chemistry of the water column at the time of their deposition."* (FFS RI Report at page 2-4).

The concentrations on depositing particles are largely due to sediments whose concentration is significantly above the ambient water column condition. This idea is grounded in the basic principle that net COPC flux is directed from higher to lower concentration. Sediments are a net source to the water where they have concentrations greater than found on particles depositing from in the water column. That source can be the continual diffusive flux that is driven by the magnitude of the concentration gradient, intra-tidal resuspension or the episodic erosion that might occur during high flow events.

A working hypothesis emerging from this principle is that remediating sediments having COPC concentrations higher than on the particles that deposit on the sediment will significantly reduce concentrations on those particles and accelerate concentration reductions in the remaining sediments.

Therefore, the RALs developed for the Phase 1 Interim Remedy in the Upper 9 miles aim to address sediment with the highest concentrations of 2,3,7,8-TCDD and PCBs (and all other co-located COPCs) and remove the sediment that is most responsible for driving risk and inhibiting recovery (i.e., those sediments with concentrations substantially greater than found on particles depositing from the water column).

Technical Basis for RALs

Two lines of evidence were evaluated in developing the RALs proposed for the Phase 1 Interim Remedy: 1) 2,3,7,8-TCDD and Total PCB concentrations on sediment recently deposited in the upper 9 miles of the LPR; and 2) 2,3,7,8-TCDD and Total PCB concentrations in the water column. As discussed below, both lines of evidence provide insight into the most appropriate RALs to select, but the data from the recently deposited sediment are considered the most reliable because they represent the levels of contaminants that have actually accumulated on the river bottom.

Recently Deposited Sediment Concentrations

The role of deposition as an agent of recovery is illustrated by the changes in 0-0.5 ft (surface) sediment 2,3,7,8-TCDD concentration in RM 1 to RM 7 areas that experienced significant net deposition between 1995 and 2011 (as estimated from bathymetric changes). Those changes are shown in Figure 7 for areas with 0.5 to 1 ft of net deposition and areas with greater than 1 ft of net deposition between 1995 and 2011. In both categories, levels declined to somewhere between 200-300 ng/kg. Thus, even modest deposition of between 0.03 and 0.06 ft/yr (0.95 to 1.9 cm/yr) is sufficient to support recovery. This recovery has been limited by sediment-based contaminant sources that keep depositing particles at relatively high concentrations. Had those concentrations been significantly lower, the recovery would have proceeded much more quickly. The deposition that has occurred will likely continue as the river evolves and responds to changing sea level, which rose about 0.3 cm/yr over the 1995 to 2010 period and is projected to rise more quickly in the future. Sea level rise can facilitate deposition through general deepening and the enhanced upstream transport of sediment resulting from further upstream propagation of the salt wedge. Ongoing deposition, coupled with the cyclic erosion and deposition at other locations, will allow recovery once the contaminant concentrations on water column particles are reduced through active remediation.

The levels found in the areas that experienced net deposition between 1995 and 2011 match the levels measured by EPA in a 2007-2008 study of COPC concentrations on recently-deposited sediment (i.e., sediments deposited from the water column no earlier than 6 months prior to the sampling). As seen on Figures 4-3 of the FFS RI Report (included here as Figure 8), the 2,3,7,8-TCDD concentrations in recently deposited sediment in the Lower 8-miles fall between 200 and 300 ng/kg, while the 2 samples collected between about RM 8 and RM 12 have concentrations of 460 and 540 ng/kg.

EPA's 2007-2008 study also provides information on the PCB levels in recently deposited sediment. Figure 9, which is from the FFS RI Report Figure 4-12, shows levels of about 1 mg/kg Total PCBs in the RM 1 to RM 7 reach and, consistent with the findings for 2,3,7,8-TCDD, somewhat higher concentrations in the RM 8 to RM 12 reach of 1.4 and 1.6 mg/kg.

Additional perspective on COPC levels expected in areas subject to net deposition is provided by the sampling of surface sediment that has deposited on the cap in the RM 10.9 Removal Area since the remedial action. These samples were analyzed for 2,3,7,8-TCDD, PCBs and phenanthrene. Most of the results for 2,3,7,8-TCDD are tightly grouped with an average of 211 ng/kg (excepting 3 samples collected at the edge or on hardpan, the other 8 results range from 195 to 232 ng/kg). Similarly, these 8 samples have tightly grouped Total PCB concentrations that average 0.8 mg/kg (range from 0.4 mg/kg to 0.9 mg/kg).

Water Column Particulate Concentrations

The levels on water column particulates were measured in two rounds of high volume sampling conducted by the CPG in 2011. Within the LPR, stations were located at RM 4.2 and RM 10.2. The utility of these data in establishing RALs is limited by the variability in the results of the two rounds, coupled with the fact that they reflect a combination of particles that were sourced from the river bed and from the watershed that may deposit on the river bottom or not settle and be transported through the system. Nevertheless, they provide some perspective on what might be the average condition.

At RM 4.2, the results of rounds 1 and 2 were 590 ng/kg and 180 ng/kg. At RM 10.2, they were 180 ng/kg and 340 ng/kg. The companion results for Total PCBs are 1.3 mg/kg and 0.4 mg/kg at RM 4.2 and 0.7 mg/kg and 0.9 mg/kg at RM 10.2.

Summary

The available data for the upper 9 miles suggest that sediments with surface sediment 2,3,7,8-TCDD concentrations in the range of 200 to 400 ng/kg and Total PCB concentrations in the range of 0.7 to 1.6 mg/kg are likely to be reflective of recent deposition and likely to have good recovery potential if the concentrations on depositing particles are significantly reduced.

That potential is evidenced in the vertical profiles of contamination in sediment cores with surface sediment 2,3,7,8-TCDD concentrations in the range of 200 to 300 ng/kg. Twelve such cores exist in the Upper 9 miles within areas for which bathymetric changes between 2007 and 2012 can be assessed using multibeam bathymetry measurements. Ten of those cores indicate likely good recovery potential: seven have profiles in which one or more subsurface layers are in the concentration range of depositing particles, indicating the likelihood of ongoing deposition; two have higher concentration in the subsurface but no indication of erosion; and one has essentially no contamination below the surface layer, suggesting a location of temporary deposition. The other two show evidence of erosion. Locations showing evidence

of erosion and relatively high subsurface concentrations would be targeted for removal during the Phase 1 Interim Remedy.

In the nearshore shallow region lacking multibeam bathymetry data, there are seven cores with surface sediment 2,3,7,8-TCDD concentrations in the range of 200 to 300 ng/kg. Five of these cores have profiles indicating a potential for contemporary deposition: two have subsurface concentrations in the range of depositing particles and three others have subsurface concentrations just above that range. The last two have relatively high concentrations below the surface segment indicating a lack of significant contemporary deposition. Locations exhibiting these characteristics would be targeted for removal during the Phase 1 Interim Remedy.

Locations with surface segment 2,3,7,8-TCDD concentrations below 200 ng/kg are generally composed of coarse sediments (Figure 6) within which there is a component of finer sediments that likely is subject to alternating erosion and deposition. At these locations, the finer sediment component can be examined using carbon-normalized concentrations. These concentrations are similar among the locations with dry weight concentrations in the range of 100 ng/kg to 200 ng/kg at an average of about 5,000 ng/kg OC. This average is similar to the carbon-based concentrations of water column particles (which average about 3,000 ng/kg OC) supporting the idea of close communication between the water column and sediment through alternating erosion and deposition.

Conclusions

Using the conceptual model outlined here, an effective remedial approach would target sediments having COPC concentrations clearly above the levels indicative of depositing water column particulates. This has the benefit of reducing the major sources of water column contamination and accelerating recovery in the sediments having natural recovery potential. Being clearly above the concentration levels indicative of recent deposition means being clearly above the ranges cited above (200 to 400 ng/kg of 2,3,7,8-TCDD and 0.7 to 1.6 mg/kg of Total PCBs). Thus, this category includes sediments above 400 ng/kg of 2,3,7,8-TCDD and 1.6 mg/kg of PCBs. In the interest of being somewhat conservative in identifying such sediments, while not unduly targeting sediments with good recovery potential, it is proposed to set RALs of 300 ng/kg for 2,3,7,8-TCDD and 1 mg/kg for Total PCBs.

While the existing uncertainty precludes an accurate delineation of the areas exceeding the RALs, the analysis of the data suggests that more than 30% of the area in the region between RM 8 and RM 14.7 would be targeted. A simple way to look at the proposed RALs is by the raw statistics of the sediment data for the RM 8 to RM 14.7 reach. The “2010” data set includes 264 samples of the top 6 inches. Of these, 116 have 2,3,7,8-TCDD concentration of 300 ng/kg or greater and 148 have less than 300 ng/kg. The average concentration of the samples in the first category is 4,560 ng/kg. Those in the second category average 90 ng/kg. Thus, remediation based on the proposed RALs will achieve a substantial reduction in concentration assuming the

sediments in the two categories can be accurately identified through pre-design sampling. In addition to greatly and rapidly reducing risk, the substantial reduction in concentration achieved by Phase 1 of this adaptively managed remedy should accelerate recovery of the remaining sediments because the sediments that inhibit recovery will have been actively remediated.

Because this is an interim remedy, no preliminary remediation goals (PRGs) are required at this time. Based on the refined understanding of the river that will be achieved by monitoring the impact of Phase 1, a second ROD can be developed that will set PRGs and determine what, if any, additional work is need to complete the remediation of the Upper 9 miles.

Phase 1 Interim Remedy for the Upper 9-Miles

The CPG proposes an Upper 9-Mile FS that evaluates remedial alternatives based on RALs of 300 ng/kg of 2,3,7,8-TCDD and 1 mg/kg Total PCBs. Initial estimates suggest that this would result in a remedial footprint of approximately 80 acres between RM 8.3 and RM 14.7 for the Phase 1 Interim Remedy. Preliminary estimates suggest that the sediment SWAC would be reduced by approximately 90%. Based on preliminary EPA modeling, natural recovery processes would further reduce the fish consumption risk to acceptable levels ($< 1x10^{-4}$) for a mixed fish diet (including carp) by 2038 (Figure 3) and hazard quotients for ecological receptors (fish and avian species) would be reduced by 90% (Figure 4). The risk reductions would be confirmed by updated chemical fate and transport and bioaccumulations models that would be refined and updated following the Phase 1 PDI.

The Phase I PDI would consist of collecting cores from a high-density grid (e.g., 80 ft on-center) and analyzing for dioxins and PCBs to confirm and finalize the remedial footprint for the RD. The use of a variable RAL for 2,3,7,8-TCDD (i.e., different RALs for geomorphic or habitat areas) was assessed with the existing data and found to produce only small changes in remedy effectiveness. The use of variable RALs would be reexamined as part of the Remedial Design and could be implemented if found to demonstrably improve the effectiveness of the Phase 1 Interim Remedy.

Upper 9-Mile Feasibility Study

The FS will evaluate remedial alternatives in the Upper 9 miles of the LPRSA in conjunction with the ROD remedy for the lower 8 miles. The considered alternatives will be developed using the RALs discussed above, and will include active remediation of sediments at or above the RALs and sediments below the RALs at risk for exposure of high subsurface concentrations due to erosion. Included will be considerations of variations in dredging depths, capping technologies, ENR, and possible sequencing options in relation to the Lower 8-mile remedy. The FS will evaluate and compare the alternatives, including risk reduction, estimated timeframe to achieve protectiveness, and cost. Remedy protectiveness will be evaluated over the full 17-mile LPRSA.

The FS evaluations will be performed in close coordination with EPA to focus and expedite the completion of the FS. It is anticipated that frequent meetings between EPA and the CPG will be convened to discuss and agree on key FS issues. The CPG proposes that CSTAG/NRRB be briefed regularly during the FS, so that review comments and concerns can be addressed as the FS is being completed.

Adaptive Management Approach for the Upper 9 Miles

Phase 1 of the Upper 9-mile remedy is expected to achieve acceptable risk reduction, based on the best available data and evaluations. Attainment of remedial objectives and/or performance goals will be tracked through post- construction, performance monitoring and associated monitoring metrics (Figure 10). Triggers for diagnostic assessment and consideration of additional remediation will be finalized during the Remedial Design (Figures 11 & 12). If the remedy performance is not achieving expectations (based on the defined triggers), a diagnostic assessment, including additional monitoring and/or evaluations, will be performed to understand why the remedy did not perform as anticipated and to determine whether additional active remediation, or other steps, are necessary.

Performance Monitoring for the Upper 9- Miles

The performance monitoring program, which will be finalized during the Remedial Design, will be developed to address the data needs specified in the Adaptive Management Plan (i.e., the data needed to measure against performance triggers). Monitoring will occur with sufficient spatial and temporal coverage to evaluate remedy performance in a timely manner. The monitoring plan will include primary monitoring components, based on the metrics and triggers specified in the Adaptive Management Plan, and secondary components, which may be performed to support a diagnostic assessment (Figure 13). Ideally, the performance monitoring program will be coordinated with the Lower 8-mile monitoring program to provide the most comprehensive understanding of response to remedial actions.

Subsequent Actions

If the results of the performance monitoring and diagnostic assessment show that the remedy is not performing as expected and will not achieve the anticipated risk reduction, a focused feasibility study or appropriate evaluation will be performed to identify and evaluate additional actions to attain protectiveness. If the Interim Remedy is found to be protective, then a final ROD with remedial goals will be issued.

Outline and Timetable of Work to Be Conducted Under the Upper 9-Mile Plan

I. 17-mile Remedial Investigation (RI) Report – July 2017 to January 2018[1],[2]

A. Complete the reach-by-reach analysis.

B. Calibrate the Chemical Fate and Transport (CFT) model for 2,3,7,8-TCDD and Tetra-PCB.

C. Revise RI Report Appendix J (Conditional Simulation and COPC Mapping) in response to EPA comments.

D. Complete mapping of Total PCBs and 2,3,7,8-TCDD in sediment using conditional simulation.

E. Identify uncertainties (e.g., contaminant fate and transport, sediment stability etc.) that will be evaluated as part of the Performance Monitoring Program (see Section VI).

F. Approved Final BHHRA (July 2017)

G. Submit Revised RI Report to EPA (November 2017 to January 2018)

H. Working Assumptions

1. EPA will approve use of the calibrated model to evaluate FS remedial options.

2. EPA will approve RI Report in a timely manner.

I. Deferred RI Work

1. EPA-requested additional detail on fate and transport for RI Report Chapter 6

2. Modeling of the other 7 COPCs[3]

3. Resolving differences on the stability of sediments for which the bathymetric differencing shows no evidence of erosion

II. Upper 9-mile (ROD 1) Feasibility Study (FS) – 2017 to 2019

A. ROD 1 FS DELIVERABLES

1. TECHNICAL MEMORANDA

To achieve an efficient and streamlined approach to completing the FS, a series of collaboration meetings will be convened with EPA and the CPG to identify, discuss, evaluate, and agree on key FS elements. The results of the collaboration meetings will be memorialized in summary memoranda, which will be submitted

[1] Sections I and II would be performed pursuant to the May 2007 Administrative Order on Consent for completing the 17-mile RI/FS. The remaining sections are intended to describe how the RI/FS, Remedial Design and Remedial Action would fit together and would be the subject of future order(s) between EPA and a new group of responsible parties.

[2] A flowchart/timeline for completing the RI/FS and the ROD 1 activities are included as Figure 14.

[3] The 7 additional COPCs for calibration are 12378-PeCDD, 23478-PeCDF, 1234678-HpCDF, PCB-126, PCB-167, DDX and Hg were proposed by the CPG in December 2016 and approved by EPA on March 19, 2017.

to EPA for comment and approval. The following topics for the Upper 9-mile FS will be discussed in the collaboration meetings and documented in memoranda:

a) *RAOs*
b) *Remedial technology screening*
c) *Remedial alternatives*
d) *Engineering assumptions*
e) *Evaluation metrics*
f) *Baseline and long-term performance monitoring framework*

2. Draft ROD 1 FS

a) *Incorporates outcomes of collaboration meetings*
b) *Includes evaluation of RM 10.9 Removal Action as a final action*
c) *Includes an Adaptive Management framework as an appendix to the FS and will include proposed performance metrics and potential thresholds for evaluating the need to undertake further action in ROD 2, if needed*

3. Final ROD 1 FS

Collaboration meetings will be convened with EPA and the CPG, if needed, to discuss and resolve comments on the draft FS prior to submission of the final FS.

B. RAOs and PRGs

1. RAOs for the ROD 1 remedy would be those Region 2 provided to the CPG on 7/3/17, with the suggested incorporation of the surface water RAO into the ecological RAO, as follows:

a) *Human Health - Fish and Crab Consumption:* Reduce cancer risks and noncancer health hazards for people eating fish and crab by reducing the concentrations of COCs in the sediments and surface water of the Lower Passaic River.
b) *Human Health - Direct Contact:* Reduce cancer risks and noncancer health hazards to people who come into direct contact with sediment by reducing concentrations of COCs in the sediments of the Lower Passaic River.
c) *Ecological:* Reduce the risks to ecological receptors by reducing the concentrations of COCs in the sediments and surface water of the Lower Passaic River.
d) *Contaminant Migration:* Reduce the migration of COC-contaminated sediments from the Upper 9 miles of the Lower Passaic River to the Lower 8 miles, Newark Bay and the New York-New Jersey Harbor Estuary.

2. Numeric PRGs will not be established for the Phase 1 ROD. Development of final numeric remedial goals would be deferred to a subsequent ROD.

a) Phase 1 ROD remedy performance would be evaluated through baseline and long-term performance monitoring, comparing post-remedy recovery trajectories using the CFT and bioaccumulation models to pre-remedy baseline data. The Phase 1 ROD remedy performance data would also be considered in developing final numeric goals/PRGs under a subsequent ROD.

C. REMEDIAL ALTERNATIVES

1. A limited set of remedial alternatives would be developed and evaluated for the ROD 1 remedy. At a minimum, the set of alternatives would include:

a) No action upriver

b) Targeted removal upriver

Remedial alternatives may include a range of removal depths and/or capping technologies and/or alternative sequencing of the upper and lower actions

2. Remedial Action Levels (RALs) for 2,3,7,8-TCDD and Total PCBs will be 300 ng/kg for 2,3,7,8-TCDD and 1 mg/kg for Total PCBs

D. REMEDIAL ALTERNATIVES EVALUATION

1. CFT and bioaccumulation model projections will be performed for the ROD 1 remedial alternatives to compare risk reduction and remedy benefit.

2. Model projections of remedy benefit will be based on 2,3,7,8-TCDD and PCBs; other COCs will be evaluated based on initial SWAC reductions and/or correlations.

E. ADAPTIVE MANAGEMENT FRAMEWORK

1. A framework for Adaptive Management, including triggers, metrics, and monitoring approach will be submitted as an appendix to the FS. (See below for additional detail on approach.)

F. CSTAG/NRRB REVIEW

1. FS review by CSTAG and NRRB would ideally be initiated early in the FS process, so comments can be incorporated into the draft and final FS, to expedite the review process.

III. EPA to issue Proposed Plan/ROD 1/AOC – 2019-2020

IV. ROD 1 Pre-Design Investigation and Remedial Design – 2021 to 2024

A. A pre-design investigation (PDI) would address the following:

1. Delineation of remedial area boundaries including the use of variable RALS

2. Evaluation of the treatability of targeted sediments
3. Establishment of baseline contaminant levels in fish and the water column
4. Additional characterization of sediment stability

B. Remedial design would ideally be coordinated with Lower 8-mile design to optimize treatment and disposal during the remedial action, including:

1. Treatment facilities
2. Off-site transportation
3. Customized equipment

C. Baseline Monitoring will be performed as part of the PDI to characterize current conditions in the upper 9 miles, and will include:

1. Bathymetry
   a) Bathymetry - updated bathymetry, including multibeam and single beam, to characterize shallow areas
   b) Side-scan sonar – updated and refined surficial sediment texture map
2. Fish tissue data
   a) Characterization of fish and crab tissue concentrations
   b) Initiation of temporal trend analysis
3. Water column monitoring
   a) Characterization of solids and COC fluxes within and into/out of the Upper 9-mile reach
4. Sediment chemistry data
   a) Delineation of remedial areas
   b) Support of pre-design geotechnical/engineering

D. Finalize Model Projections of Expected Remedy Long-term Performance

1. Refine and finalize CFT and FWM using the data generated in the PDI and baseline investigations and the finalized remedy footprint
2. Update projection runs to support establishment of PRGs

E. Adaptive Management Approach

1. A detailed Adaptive Management Plan will be finalized during remedial design, including specification of criteria values (i.e., concentrations and timeframes) that might trigger the need for additional action or further investigation
2. Proposed primary monitoring metrics are baseline and long-term tissue and water column monitoring and baseline and post-storm bathymetric surveys
3. Primary long-term monitoring will include:
   - Bathymetry (following high flow events)
   - Water column
   - Biota
4. Criteria and triggers for diagnostic assessment and/or additional action will be based on comparison of performance monitoring data with projected recovery rates
5. Potential triggers are tissue and/or water column recovery rates that are slower than expected and/or indications of re-exposure of buried contamination
6. A diagnostic assessment could include:
   - Increased monitoring frequency to confirm conditions of concern
   - Focused sampling to isolate area(s) of concern
   - Bathymetric evaluation
   - Model recalibration
   - CSM refinement
   - Source identification
7. If recovery is not proceeding as anticipated, then diagnostic assessment will be implemented to determine if additional actions are necessary, and if so, to support an evaluation of potential additional actions
8. Additional remedial actions will be performed if deemed necessary

V. Remedial Action – 2024 to 2027

VI. Performance Monitoring Program (PMP) – 2027 to 2035

A. Objectives that may be identified and addressed within the scope of the PMP:

1. Achievement of RAOs and performance standards:

a) Reduced tissue concentrations in fish and crab

b) Reduced COC concentrations on water column solids depositing in the Upper 9 miles

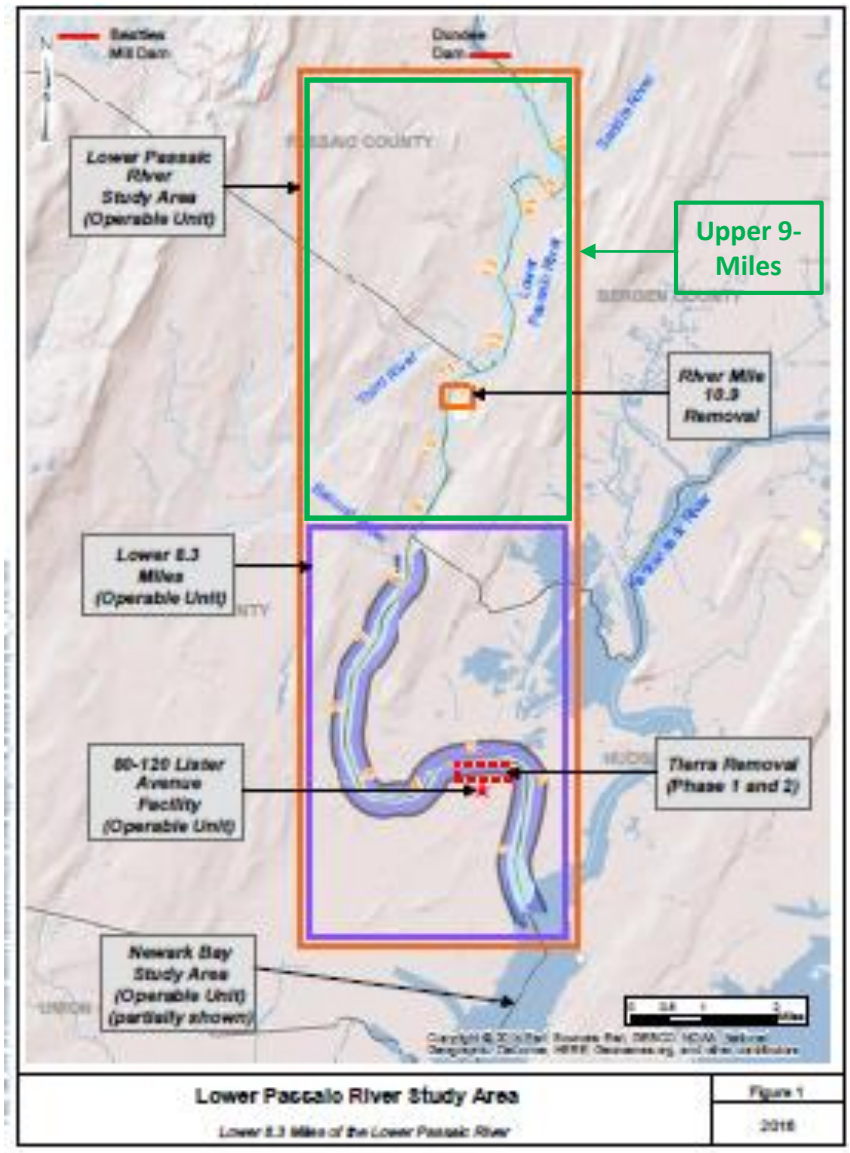
c) Prevention of re-exposure of subsurface sediment with COC concentrations much greater than the RALs in uncapped areas

2. Continued evaluation of uncertainties in the RI report, including sediment stability

VII. Possible ROD 2 Follow-on Actions – 2034-2036 (Estimated Timeframe)

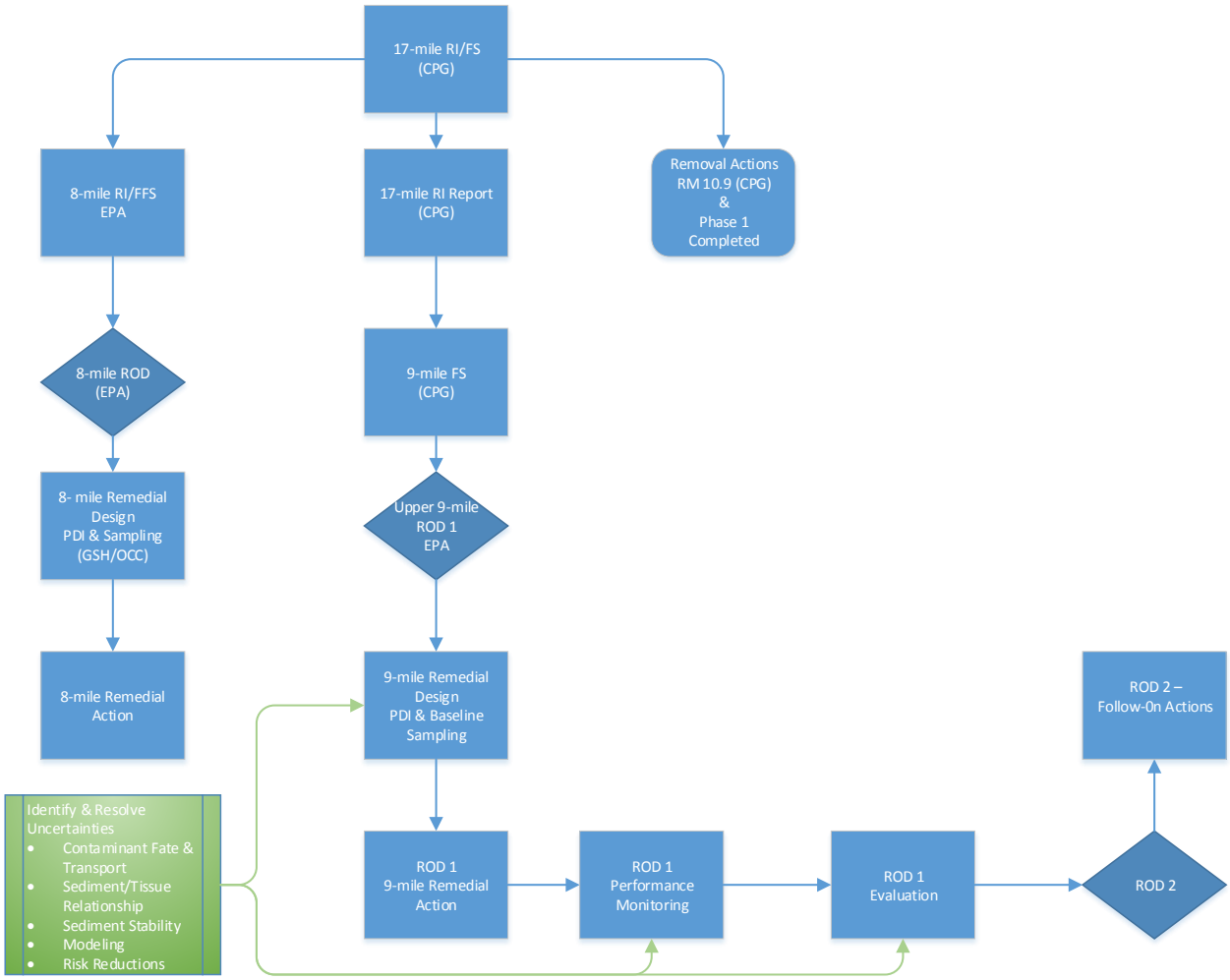
Figures

Figure 1- Diamond Alkali Superfund Site



- OU1 – 80-120 Lister Avenue Facility
  - Addressed by the 1987 ROD; completed in 2004
  - Interim containment remedy, which consists of capping, subsurface slurry wall and flood wall, and a groundwater collection and treatment system
- OU2 - Lower 8.3 miles of the Lower Passaic River Study Area
  - March 2016 ROD selected a remedy to address the sediments of the lower 8.3 miles
  - Most contaminated segment of the river and a primary ongoing contaminant source to the rest of the LPR and Newark Bay.
- OU3 – Upper 17-miles of the Lower Passaic River Study Area
  - Upper 9-mile Plan proposes a remedy to rapidly address through a interim remedy that relies on adaptive management
  - Includes completing the 17-mile RI Report and refocusing FS on the Upper 9-miles.
- OU4 – Newark Bay Study Area RI/FS

Figure 2 - How the Upper 9-Mile Plan Completes the 17-Mile LPRSA Remedial Actions



- 17-Mile RI/FS has generated a series of remedial actions
  - Removal Actions including RM 10.9 & Tierra Phase 1
  - 8.3 Mile ROD addresses ~90% of the contaminated sediment in the LPRSA
- Upper 9-Mile Plan proposes to rapidly address remaining sediment with a Phased Adaptive Approach

Figure 3 - Cancer Risk Reductions – Adult & Child Angler

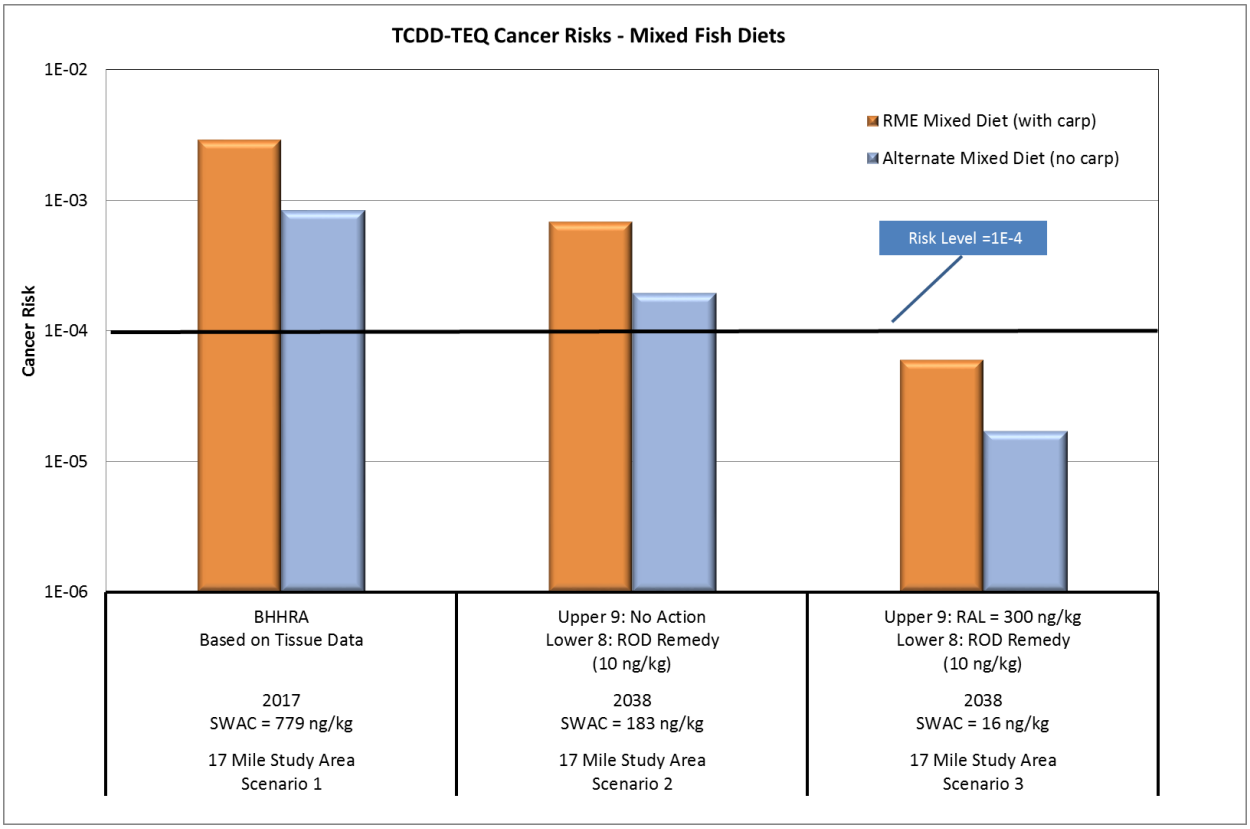


Figure 4 - Ecological Risk Reductions – White perch (tissue). carp (tissue) & sandpiper (diet)

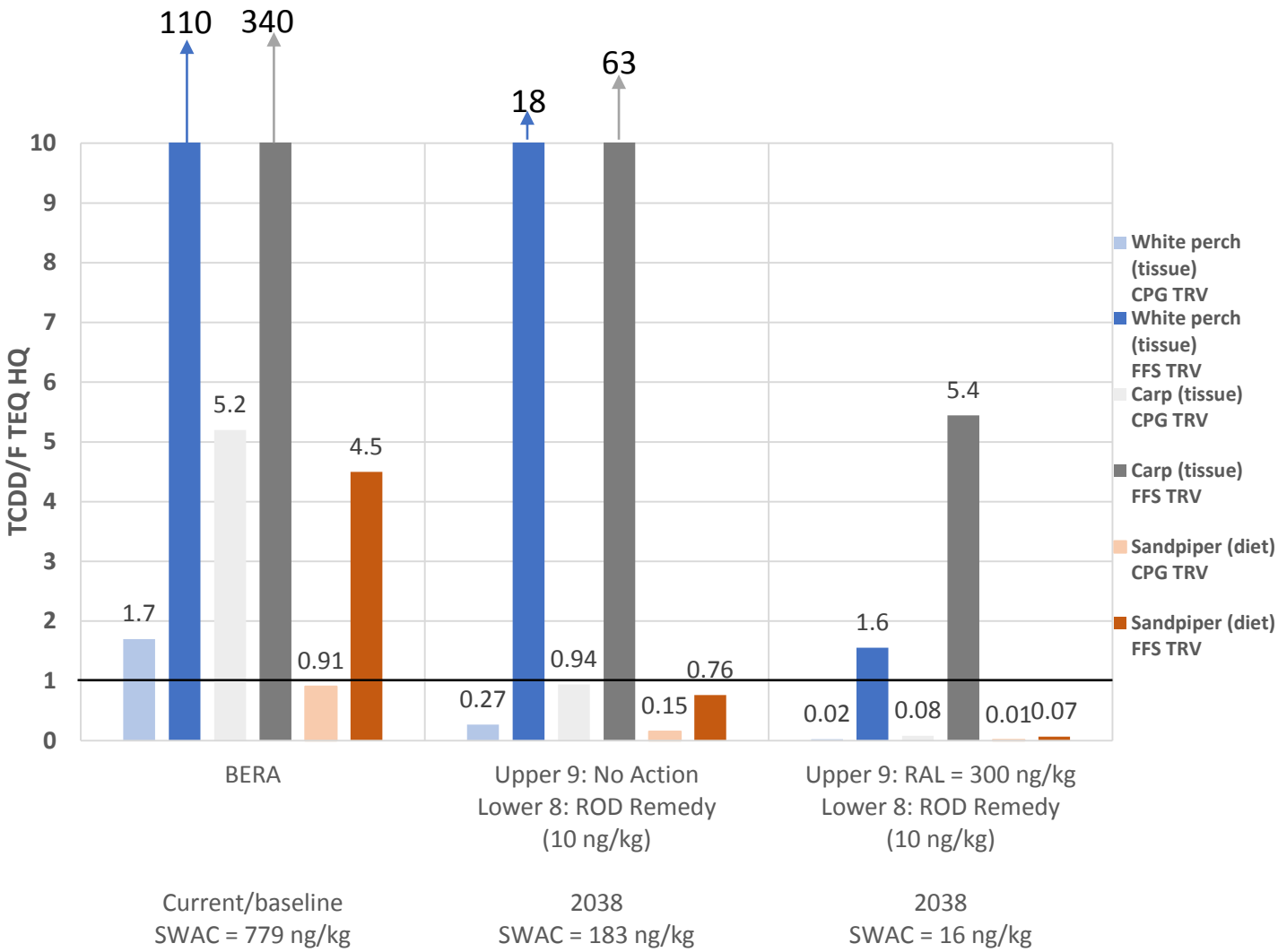


Figure 5 – The Interim Remedy is Completely Consistent with EPA Guidance

2005 Sediment Guidance

- Take other early or interim actions, followed by monitoring before deciding on a final remedy
- Use adaptive management at complex sediment sites…test hypotheses, reevaluating assumptions as new information is gathered
- Phase in remedy selection where F&T is not well understood or there are significant implementation issues
- Consider separating management of source area from other areas

2017 OLEM Directive

- Consider early actions during RI/FS
- Develop achievable risk reduction expectations
- Consider the limitations of models
- Consider a structured adaptive management approach
- Use monitoring data to evaluate remedial effectiveness

2017 Superfund Task Force Recommendations

- Strategy 2: Promote the application of adaptive management at complex sites and expedite cleanup through use of early/interim rods and removal actions
- Recommendation 3: Broaden the use of adaptive management (AM) at Superfund Sites

Figure 6 - Spatial pattern of surface sediment 2,3,7,8-TCDD concentrations showing fine sediment content of each sample

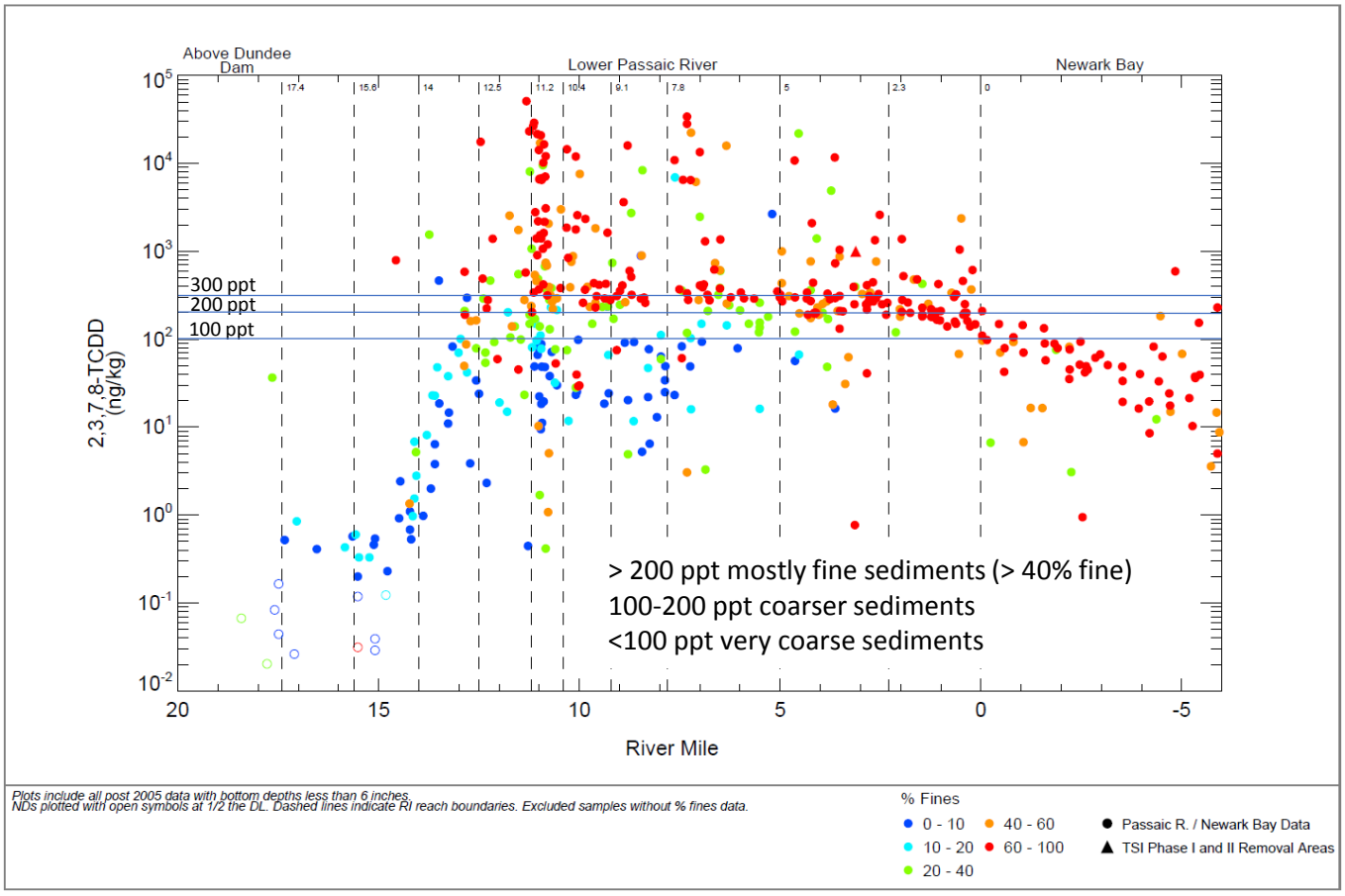
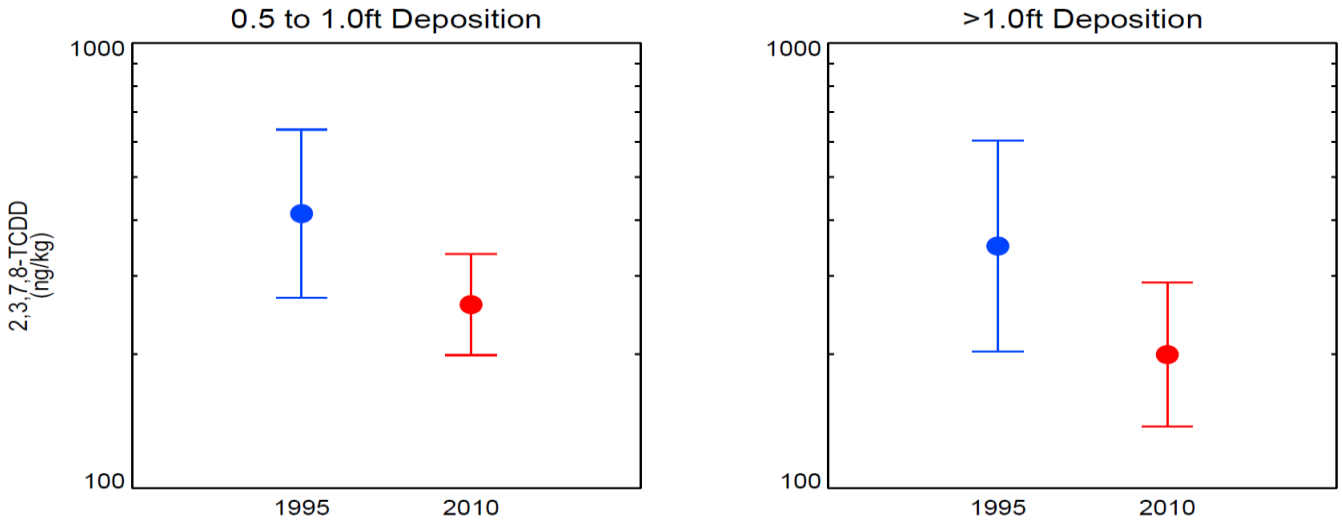
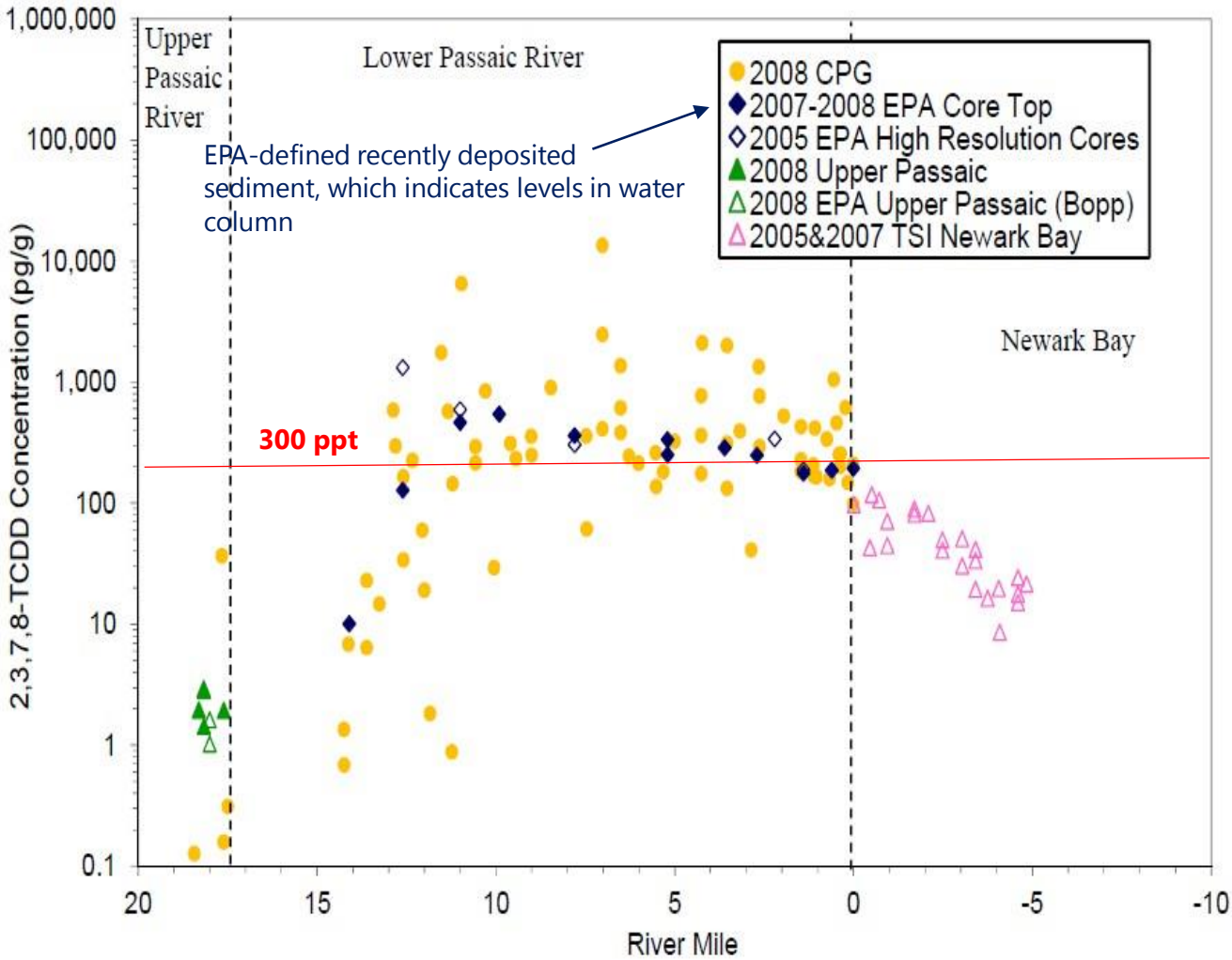


Figure 7 - Change in Average Surface Sediment 2,3,7,8-TCDD Concentration in Areas Between RM 1 and RM 7 That Experienced Net Deposition Between 1995 & 2011



Plot shows the arithmetic average calculated in natural log space with +/- two standard errors for data collected between RM 1 and RM 7. The 1995 dataset includes data collected between 1995 – 1999 and the 2010 dataset includes data collected between 2005 – 2013. Differences between 1995 and 2011 bathymetry surveys were used where available. Outside the coverage of the 2011 bathymetry data, differences between 1995 and 2007 bathymetry surveys were used.

Figure 8 - 2,3,7,8-TCDD Concentration in Recently-Deposited Sediments in the Lower Passaic River, Newark Bay and the Upper Passaic River (Extracted from FFS RI Report Figure 4-3)



"…2,3,7,8-TCDD concentration in recently-deposited sediments vary less than a factor of 3 from RM 2 to RM 12 (note in blue diamonds on the upper diagram in Figure 4-3)." – FFS RI Report at Page 4-3.

Figure 9 -Total PCBs in Recently-Deposited Sediments in the Lower Passaic River, Newark Bay and the Upper Passaic River (Extracted from FFS RI Report Figure 4-12)

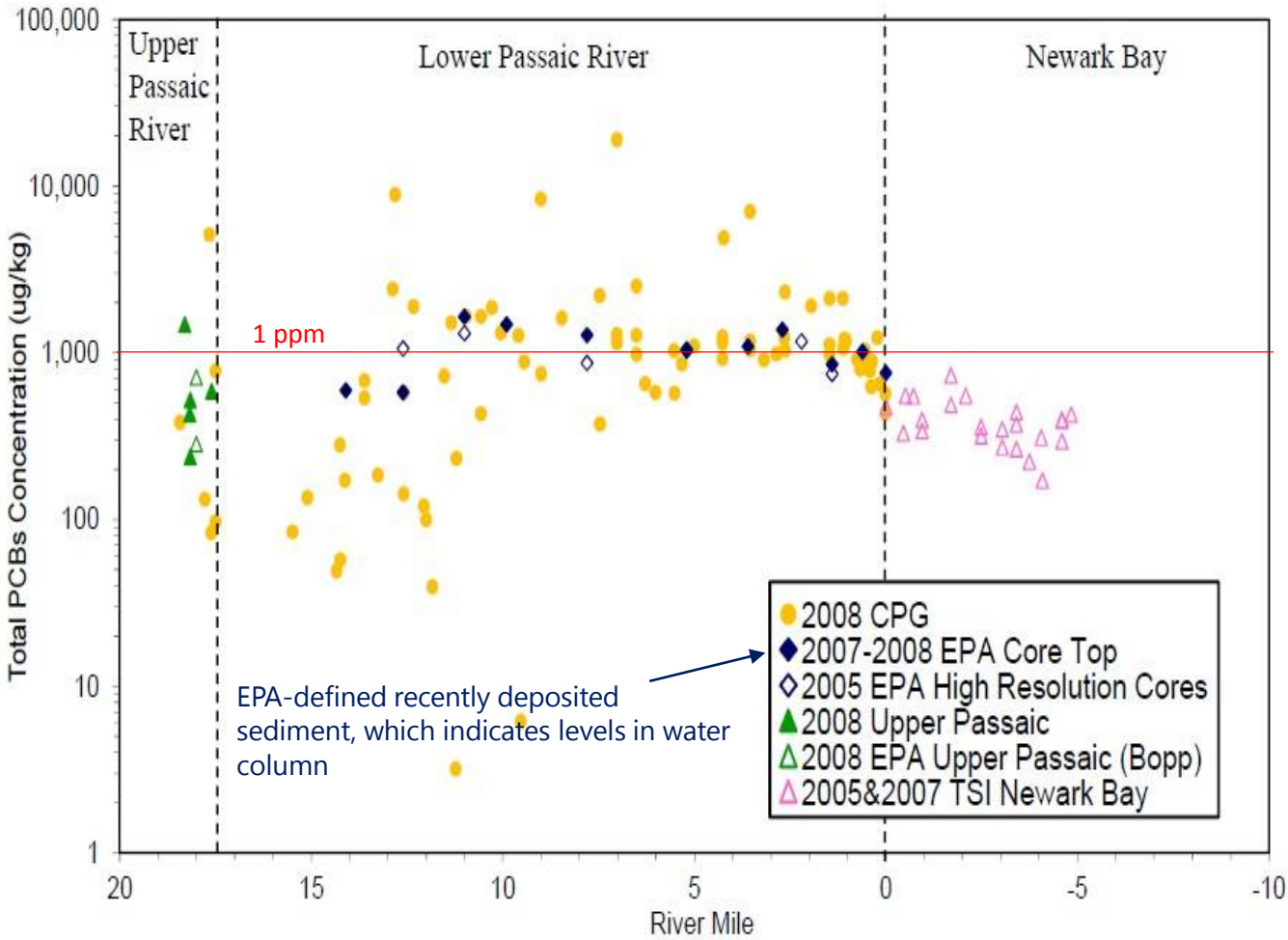
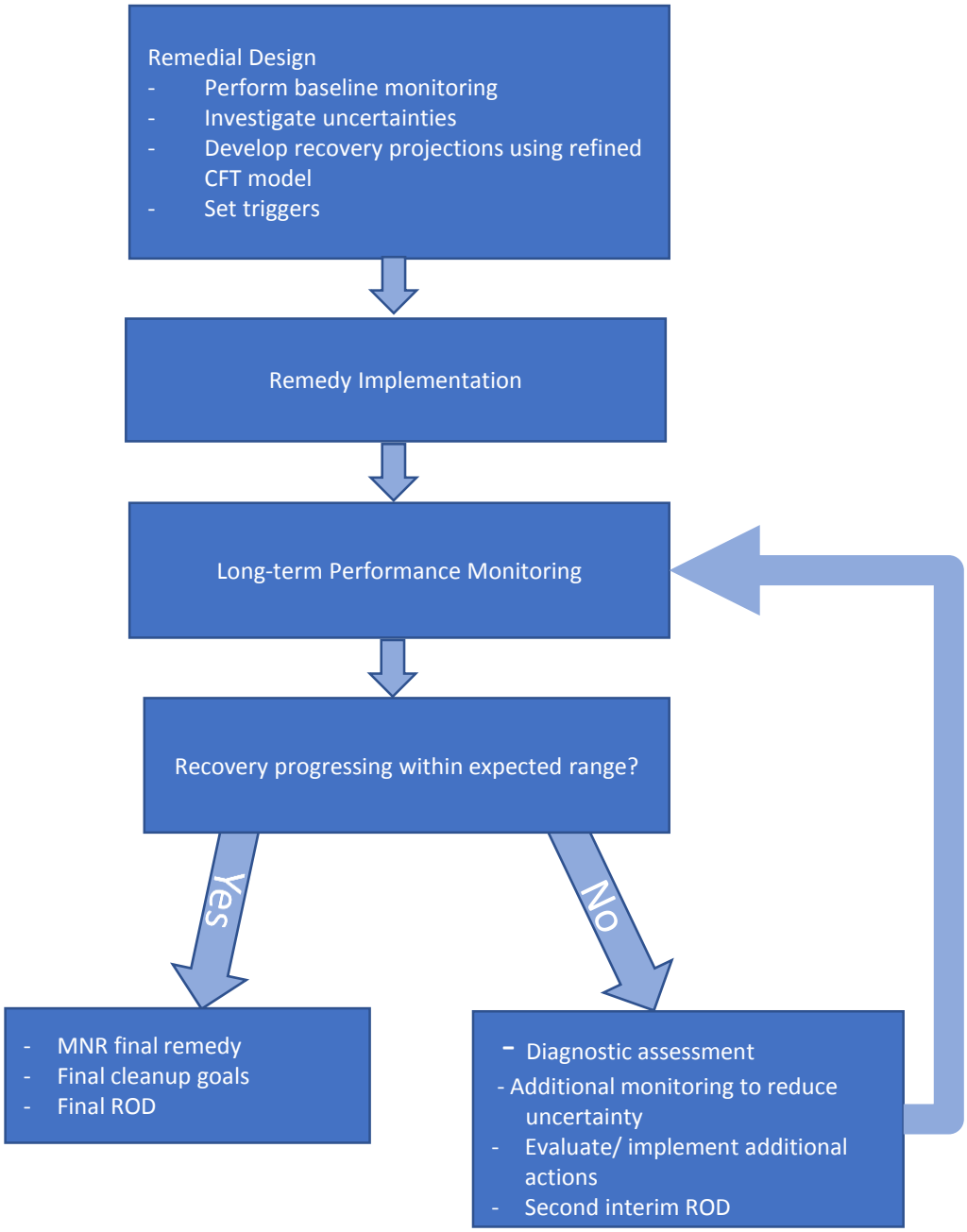


Figure 10 - Upper 9-mile Adaptive Management Process



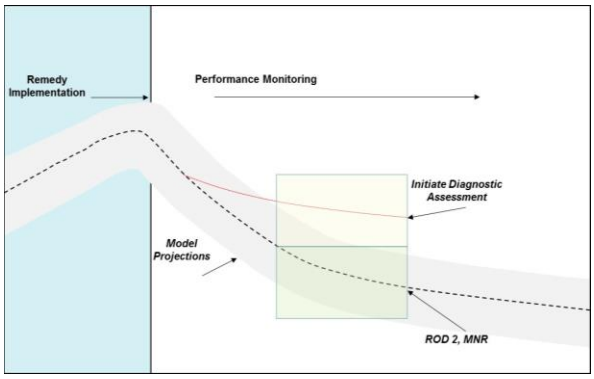


Figure 11 - Adaptive Management - Preliminary Metrics, Triggers, and Responses

Remedy Objective/ Performance Standard	Primary Monitoring Metrics	Potential Triggers	Possible Response Actions
Reduce tissue concentrations in fish and crab	• Baseline and long-term tissue monitoring	• Tissue recovery rates are slower than the projected range • Tissue concentrations reach a plateau that will not achieve adequate risk reduction	• Confirmatory tissue sampling • Diagnostic sediment and water column monitoring • Source investigation • CFT/FWM model recalibration • Evaluation/selection of additional source control or in-water actions
Reduce COC concentrations on water column solids depositing in the upper 9 miles	• Baseline and long-term water column monitoring	• Water column solids COC concentration recoveries are less than the projected range	• Focused water column monitoring to identify areas of concern • HST/CFT model recalibration • Evaluation/selection of additional source control or in-water actions
Prevent re-exposure of subsurface sediment with COC concentrations >> RALs in uncapped areas	• Baseline and post-construction bathymetry • Future bathymetric surveys in response to high-flow events	• Bathymetry data indicate erosion and re-exposure of buried contamination	• Sediment sampling in potentially eroded/exposed areas • Evaluation/selection of additional actions

Figure 12 - Adaptive Management Approach

- Criteria and triggers for diagnostic assessment and/or additional action will be based on comparison of performance monitoring data with projected recovery rates
- If the diagnostic assessment identifies:
  - Lack of recovery due to identifiable factors – additional remedial actions will be evaluated/selected
  - Slower than projected but ongoing recovery – revisit CSM and/or model projections, re-evaluate risk reduction timeframes, continue monitoring and/or consider additional actions

Diagnostic measures could include:

- Increased monitoring frequency to confirm conditions of concern
- Focused sampling to isolate area(s) of concern
- Bathymetric evaluation
- Model recalibration
- CSM refinement
- Source identification

Figure 13 - Potential Monitoring in the Upper 9 Miles

		Bathymetry	Water Column	Biota	Sediment (Recovery Indicator Areas)
Baseline		√	√	√	√**
Remedy Implementation			√	√	
Year 0 Post Construction		√	√	√	√
Long-term	Primary*	√	√	√	
	Diagnostic		√	√	√

*Primary components are those identified as triggering metrics
**Sediment sampling will be performed in PDI

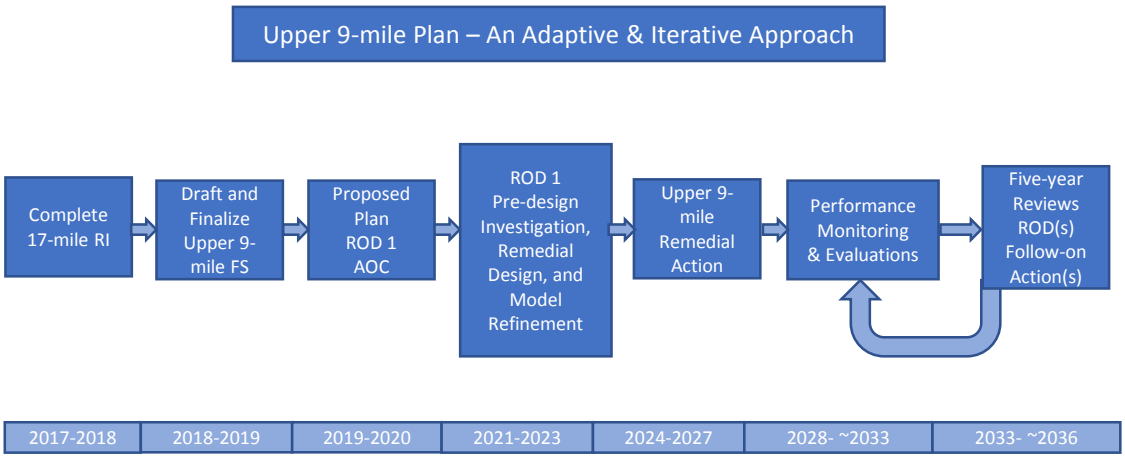



Figure 14 – Upper 9-Mile Timeline