Recommendations to EPA for the "Five Year Review Report" for Hudson River PCBs Site

Executive Summary

The Hudson River is one of the highest priority natural resources for the Department of Environmental Conservation (DEC) in New York State. Since the 1970s, DEC has been at the forefront in requiring General Electric (GE) to address the PCB contamination of the Hudson River. With over forty years of effort involved in confronting this major environmental issue, DEC has a unique historical perspective to offer to the Environmental Protection Agency (EPA). DEC scientists and engineers have conducted an independent evaluation of the site history and current conditions, utilizing EPA's own guidance and criteria for performing five year remedy reviews. DEC also has a point of view different from EPA, in that the Hudson River is primarily a natural resource of the State; the people of the State will be making use of this precious resource long into the future. As a result, DEC is providing the State's positions on the upcoming 2017 Five-Year Review (FYR) for the Hudson River PCBs Site before EPA finalizes its report.

DEC's position has been informed by an independent evaluation of the information and data available for the site in an effort to provide EPA with an objective analysis regarding whether or not the remedy is protective of human health and the environment. When deciding on the remedy for the Hudson River, EPA considered that cancer and non-cancer health risks were well above the acceptable risk range for people who ate fish from both the upper Hudson River (between Hudson Falls and Troy) and the lower Hudson River (from Troy south to Manhattan). Risks to ecological receptors, particularly fish-eating animals, were also above EPA's acceptable range. The primary purpose of the remedy was to address this risk. In turn, the primary goal of the FYR is to ensure this risk has been adequately addressed by the remedy.

DEC also considered the rationale relied upon by EPA in the Record of Decision (ROD), which describes in detail why the implemented remedy was selected. EPA chose an active remedy, under which significant amounts of PCBs would be removed from the sediments of the upper Hudson by sediment dredging. EPA selected this remedy primarily based upon the time it would take to achieve targeted fish PCB concentrations after dredging. This was necessary, according to EPA, to protect the human and ecological receptors exposed to PCBs by eating fish. EPA understood the advisories for people to stop eating fish were not completely effective, and could never apply to ecological receptors, and thus the remedy selection needed to be based primarily upon the time to meet the targeted reductions in fish PCB concentrations. Specifically, EPA stated in the ROD that a delay of ten years in reaching target fish concentrations, of 0.4 mg/kg within 5 years of the completion of dredging and 0.2 mg/kg within 16 years of the completion of dredging, was unacceptable. This ten year delay was used as a basis for rejecting the Monitored Natural Attenuation (MNA) remedial alternative.

The most important point made in the rationale provided by EPA in the ROD for the selected remedy is that EPA concluded the dredging was needed to accelerate the time it would take to reach the remedial targets for fish flesh in order to quickly reduce human health and ecological risk compared to other alternatives that were evaluated. Additional delays of ten or more years to reach the target fish PCB concentrations were unacceptable to EPA. Otherwise, EPA would have selected the “MNA only” remedy. Institutional controls were understood to not be completely effective, and the acceleration of the time frame was necessary to protect people who eat fish as well as ecological receptors, both of which are subject to unacceptable levels of risk from consuming PCB-contaminated fish from the Hudson River. The State’s concurrence with the ROD was based on these very same principles and the understanding that delays to reach the target fish PCB concentrations were not acceptable.

EPA admitted in its first five year review that, based on the fact that portions of the upper Hudson River, particularly in River Section 2, are much more contaminated than previously thought, fish flesh PCB targets will not be met within the time frames anticipated in the ROD.

As the time to reach targeted fish PCB concentrations was the primary basis for the selected remedy, DEC has recommended that EPA perform the sampling work necessary to complete a detailed evaluation of the performance of the remedy, including increasing the sampling of sediment and fish tissue to the scale and frequency necessary to optimize the remedy through further remedial work as necessary to achieve the targeted fish PCB reductions identified in the ROD.

DEC also recommends that EPA expand the investigation of the site to include performance of a Remedial Investigation and Feasibility Study for the portion of the site between the Federal Dam at Troy and the Battery in New York City. This work is necessary to determine the nature and extent of PCB contamination in the sediments, water, and biota of the lower Hudson, and to evaluate remedial alternatives to address the currently uncontrolled unacceptable risks to human health and the environment. Until these recommendations are acted upon, EPA must not conclude that the remedy is protective of human health and the environment.

Taking into account these recommendations, EPA’s basis for selecting the remedy, and all data and information that has been gathered from implementation of the dredging project, DEC has determined the following:

1) that the dredging remedy is currently not protective of human health and the environment, as there are known exposures to both human and ecological receptors which have not been controlled and which remain in excess of EPA’s acceptable risk range; and

2) that an issue raised in the previous Five Year Review, the fact that sediment concentrations higher than anticipated will remain after dredging, indicates that the

targeted fish PCB concentrations will not be reached in the time frames identified in the ROD.

Therefore, EPA should carefully consider the Department's recommendations and incorporate them into the FYR, EPA should determine that the remedy is not protective of human health and the environment based on uncontrolled risks, and EPA should undertake all necessary actions to ensure that the remedy becomes fully protective to the benefit of the people of New York State.

Section 1 Purpose of Document

This document is intended to provide EPA, and the people of the State of New York, the position of DEC as it relates to the ongoing Five-Year Review for the Hudson River PCBs Site currently being conducted by EPA.

According to the EPA Guidance ("Comprehensive Five Year Review Guidance" OSWER No. 9355.7-03B-P, 2001) the purpose of an FYR is to:

> *"…evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. Protectiveness is generally defined in the National Contingency Plan (NCP) by the risk range and the Hazard Index (HI). Evaluation of the remedy should be based upon and sufficiently supported by data and evaluations."* (Section 1.1, page. 1-1)

While this document is not intended to replace or represent the EPA's Five-Year Review Report, the same format for report sections will be followed to allow for readers of both documents to understand the State's positions on the outcome of the process in a stepwise manner. This document tracks the FYR reporting process step-by-step, and concludes with the State's recommended protectiveness determinations, and recommendations for future action.

Section 2 Site Chronology

This section summarizes the Site Chronology to provide the reader with a basis to understand the history of PCB contamination in the Hudson River and the government's response. For more detail, please refer to the project documents, including the previous EPA Five Year Review Report site chronology.

1947-1977: Direct discharges of PCBs occur from two GE capacitor manufacturing facilities in Hudson Falls and Fort Edward

1983: Hudson River PCBs Site listed on the EPA National Priorities List

1984: EPA issues the first Record of Decision for the site, selecting Interim No Action for the PCB contaminated sediments in the upper Hudson.

1989: At the request of New York State, EPA begins Five Year Review of 1984 remedy

1990-91: Remnant Sites are capped as an Interim Remedial Measure by GE

1990: EPA starts the Reassessment of the 1984 remedy

2000: EPA issues Proposed Plan, identifying "Rem 3/10/Select", an active sediment removal remedy, as the preferred remedial alternative.

2002: EPA issues Record of Decision selecting "Rem 3/10/Select" as the remedy for the contaminated sediments of the upper Hudson between Fort Edward and Troy.

2003-09: GE, under a series of EPA administrative Orders, performs remedial design and baseline monitoring.

2006: EPA issues Remedial Action Consent Decree under which GE will perform the remedy.

2009: GE performs Phase 1, the first year of the dredging remedy.

2010: EPA performs a peer review of the remedy and issues modified scope of work for Phase 2

2011-2016: GE performs Phase 2, the remaining portion of the remedy.

2012: EPA issues first Five-Year Review Report

Section 3 Background

Section 3.1: Site Location, Physical Characteristics, Land and Resource Uses

(The following is taken largely from the 2012 EPA Five Year Review Report, and is included to give the reader the same perspective on these site characteristics.)

Site Location

The Site includes a nearly 200 river-mile stretch of the Hudson River in eastern New York State from the Village of Hudson Falls to the Battery in New York City. The Site is divided into the Upper Hudson River (the length of river between Hudson Falls and the Federal Dam at Troy, New York) and the Lower Hudson River (the length of river between the Federal Dam at Troy and the Battery). For purposes of the project, EPA further divided the Upper Hudson River area into three main sections known as River Section 1, River Section 2, and River Section 3. River Section 1 is the most upstream section, extending approximately 6 miles from Fort Edward to the Thompson Island Dam; River Section 2 extends from the Thompson Island Dam to the Northumberland Dam near Schuylerville, an extent of approximately 5 miles; and River Section 3 extends from below the Northumberland Dam to the Federal Dam at Troy, an extent of approximately 29 miles.

The Site also includes five Remnant Deposits located upriver from River Section 1. The Remnant Deposits are areas of PCB-contaminated sediments that became exposed after the river water level dropped following the removal of the Fort Edward Dam in 1973. Remnant Deposit 1 originally appeared as an island, but due to flooding in 1976 and 1983 most of the exposed sediment associated with this deposit site was scoured. Remnant Deposit 2 is approximately 3.5 acres and is located on the west bank of the Hudson River, in the town of Moreau. Remnant Deposit 3 is approximately 17 acres and is located on the east bank of the Hudson River, in the town of Fort Edward. Remnant Deposit 4 is approximately 24 acres and is located on the west bank of the Hudson River in the town of Moreau. Remnant Deposit 5 is approximately 3.5 acres and is located on the east bank of the Hudson River in the town of Fort Edward. The site has been broken up into “Operable Units” or “OUs” by EPA for administrative purposes. OU1 is the remedial work done under the 1984 ROD, including the work at the Remnant Sites. OU2 is the dredging remedy selected in the 2002 ROD. OU3 is a removal action taken on Rogers Island by EPA in 1999 to address soil contamination with PCBs and metals. OU4 is the floodplains, currently the subject of an ongoing remedial investigation.

Physical Characteristics

The Upper Hudson River is freshwater and non-tidal. Downstream of Fort Edward, the river is joined by several tributaries, the largest of which are the Mohawk River, Batten Kill, Fish Creek, and the Hoosic River. The flow in the Upper Hudson River is primarily controlled by several reservoirs above Glens Falls, including the Great Sacandaga

Lake. The Upper Hudson River has an average depth of less than 8 feet in the shoal areas and approximately 18 feet in the channel, with a maximum depth of more than 45 feet. The New York State Canal Corporation (NYSCC) navigation channel is generally identified as being a minimum of 12 feet deep by design in the project area.

The Champlain Canal is coincident with portions of the Hudson River, extending from Waterford on the Hudson to Whitehall at the southern end of Lake Champlain. Bedrock, cut away to form the Champlain Canal, is exposed in some areas of the river, while lacustrine silts and clays of glacial age are exposed in other areas. Coarser-grained sediments are often observed in the river channel, while finer-grained sediments are more common in shallow water. Areas adjacent to the Upper Hudson River include forested shoreline wetlands, transitional uplands, and vegetated backwater such as emergent marsh and scrub-shrub wetlands.

Land and Resource Use

In the Upper Hudson River, land use is primarily residential and agricultural with some commercial and industrial activities. Such uses of the river and lands surrounding the river are projected to remain the same. The Site passes through 14 different counties as the river flows to its final discharge point in New York Harbor. Four counties (Albany, Washington, Rensselaer and Saratoga) lie adjacent to the Upper Hudson River. Within these four counties, forest and farmlands surround urban centers and historic villages. In addition to the General Electric (GE) Hudson Falls and Fort Edwards plants, the area is home to other businesses including technology companies, oil service companies, and food companies.

The City of Poughkeepsie, the Dutchess County Water and Wastewater Authority, the Village of Rhinebeck, the Castle Point Medical Center, as well as the Highland and Port Ewen Water Districts obtain at least a portion of their potable water supplies directly from the Hudson River. The Towns of Waterford and Halfmoon also have intakes for obtaining Hudson River water, although both towns currently obtain their water from the City of Troy via an EPA-constructed water line. The river has been utilized for hydroelectric and thermal power generation, as well as for manufacturing processes, cooling and fire protection. The river is also used for irrigating agricultural lands and watering domestic lawns and gardens.

The river supports a variety of water-based recreational activities including sport fishing, waterfowl hunting, swimming and boating; however, at the current time, there is a New York State Department of Health “eat none” fish consumption advisory for the entire Upper Hudson River between the Corinth Dam and the Federal Dam at Troy.

Section 3.2 Initial Problem Identification and Responses

During an approximate 30-year period ending in 1977, GE used PCBs in its capacitor manufacturing operations at its Hudson Falls and Fort Edward, New York facilities. PCB

oils were discharged both directly and indirectly from these plants into the Hudson River.

In the early 1970's, in response to the discovery of PCBs in fish caught in the Hudson River, New York State began an enforcement action against General Electric. This enforcement action resulted first in an interim Order and Opinion in February 1976, and a final Agreement and Order in September 1976, under which GE implemented abatement actions to limit the direct discharges of PCBs from the capacitor plants in Hudson Falls and Fort Edward, NY. These actions included the limitation of direct PCB discharges from the capacitor plants, as well as construction and operation of a new wastewater treatment plant at the Fort Edward capacitor plant.

In 1973, the owner of the Fort Edward Dam removed the dam. As the dam was a short distance downstream of the GE Fort Edward capacitor plant (the Hudson Falls plant being located further upstream as well, above the Bakers Falls dam in the Village of Hudson Falls) some PCBs had contaminated the sediments in the pool impounded by the Fort Edward Dam. When the dam was removed, some of the PCBs still upstream of the dam were remobilized along with the sediments. These sediments were redeposited primarily in the vicinity of Rogers Island, a short distance downstream.

In August 1975, the New York State Department of Health issued the first advisories against consumption of fish from the Hudson River. These advisories exist, modified as appropriate, to the present day. NYSDOH continues to recommend that people eat none of the fish from the Upper Hudson River, that children under the age of 15 and that women of child-bearing age eat none of the fish from the river for the entire 200 mile length of the Superfund site, and that the general population limit their consumption of most species of fish caught south of the Federal Dam at Troy.

In February 1976, the New York State Department of Environmental Conservation implemented restrictions on fishing in the upper Hudson from Hudson Falls to the Federal Dam at Troy/Green Island. These restrictions were modified in 1995 to allow for catch and release fishing only in this reach of the upper Hudson.

Section 3.3 Superfund Listing and Initial Remedy Selection

The Site was proposed for inclusion on the National Priorities List (NPL) in September 1983 and formally listed in September 1984.

In 1984, EPA completed a Feasibility Study (FS) and issued a ROD for the Site. EPA identified PCB contamination in the Upper Hudson River sediments as a threat to human health and the environment, but selected an interim No Action remedy for the contaminated sediments because (as believed by EPA at the time) the reliability and effectiveness of remedial technologies available at that time were uncertain, and there were apparent downward trends of PCBs in fish, sediment, and water at the time (which did not continue after 1984).

The 1984 ROD included the following components:

• An interim No Action decision with regard to PCBs in the sediments of the Upper Hudson River;

• In-place capping, containment and monitoring of exposed Remnant Deposits (areas of former river bottom exposed by removal of the Fort Edward Dam), stabilization of the associated river banks and revegetation of the areas; and

• A detailed evaluation of the Waterford Water Works treatment facilities, including sampling and analysis of treatment operations to determine if modifications of the facilities were needed.

GE, as an Interim Remedial Measure under a 1990 Consent Decree with EPA, conducted the in-place capping of four Remnant Deposits located along the river banks upstream of the former Fort Edward Dam. The in place capping of these Remnant Deposits included grading, placement of a two-foot layer of soil and a manufactured geosynthetic clay liner, followed by revegetation to minimize erosion. This prevented direct contact with, and potential volatilization of, PCBs. The river banks were stabilized with rock to prevent scouring. Cap construction and the erection of gates to limit access were completed in 1991.

NYSDEC, with funding provided by EPA, conducted a treatability study at the Waterford Water Works. The study was released in 1990, and found that PCB concentrations were below current analytical detection limits after treatment and met current standards applicable to public water supplies.

Section 3.4 Reassessment and Remedy Selection Leading to the 2002 Record of Decision

In December 1989, EPA announced its decision to initiate a detailed Reassessment of the interim No Action decision for the Upper Hudson River sediments. This was prompted by the five-year review required by CERCLA, technical advances in sediment dredging and treatment / destruction technologies, as well as a request by NYSDEC for a re-examination of the 1984 decision.

EPA completed the Reassessment in December 2000, with the release of the Feasibility Study and Proposed Plan in late 2000. The Reassessement work is documented in several reports, including:

- Phase 1 Report (summary of existing conditions) – 1991
- Database Report – 1995
- Data Evaluation and Interpretation Report – 1997
- Low Resolution Sediment Coring Report – 1998
- Human Health Risk Assessment – Mid Hudson – 1999
- Revised Baseline Ecological Risk Assessment – 2000
- Revised Human Health Risk Assessment – 2000
- Revised Baseline Monitoring Report - 2000
- Feasibility Study Report - 2000

EPA issued the proposed plan in December 2000.

Following numerous public meetings and after extensive public comment, EPA issued a Record of Decision in February 2002.

The major components of the remedy in the 2002 ROD are:

- Upstream Source Control at the two GE capacitor plants in Hudson Falls and Fort Edward to achieve a target PCB surface water load at Rogers Island equal to an average surface water PCB concentration of 2 nanograms per liter.
- Targeted Environmental Dredging to remove PCB contaminated sediment from the Upper Hudson to meet specific removal criteria for PCB surface sediment concentration and PCB mass per unit area. This was done to achieve several objectives.
- Operation, Maintenance and Monitoring (OMM), including monitoring to evaluate the effectiveness of the remedy as well as to ensure that the remedy is protective of human health and the environment. Maintenance of any long term structures (such as caps) is also included.
- Monitored Natural Attenuation (now referred to as Monitored Natural Recovery, or MNR) , a reliance on natural processes after the dredging work to continue to result in a decrease in surface sediment PCB concentrations until the ultimate remedial goal is reached.
- Institutional Controls to reduce the potential for human consumption of fish from the Hudson River. These controls are the fish consumption advisories (FCAs), and the current catch and release fishery regulations in the upper Hudson.

(For a detailed listing of all remedy elements, see the 2002 ROD.)

Section 3.5 Summary of the Basis for the Need to Take Action

A good basic summary of the need to take action can be found on EPA's Hudson River web page (https://www3.epa.gov/hudson/cleanup.html#quest1). There EPA states:

Polychlorinated biphenyls, or PCBs, were widely used as a fire preventive and insulator in the manufacture of electrical devices, like transformers and capacitors, because of their ability to withstand exceptionally high temperatures. During a 30-year period ending in 1977, when EPA banned the production of PCBs, is estimated that approximately 1.3 million pounds of PCBs were discharged into the Hudson River from two General Electric (GE) capacitor manufacturing plants located in the towns of Fort Edward and Hudson Falls, New York. Once PCBs entered the river, they were deposited and mixed with the sediments at many locations on the river bottom and at some locations along the shoreline in the floodplain.

PCBs build up in the environment (bioaccumulate), increasing in concentration as you move up the food chain. The primary health risk associated with the site is the accumulation of PCBs in the human body through eating contaminated fish. Since 1976, high levels of PCBs in fish have led New York State to close various recreational and

commercial fisheries and to issue advisories restricting the consumption of fish caught in the Hudson River. PCBs are considered probable human carcinogens and are linked to other adverse health effects such as low birth weight, thyroid disease, and learning, memory, and immune system disorders. PCBs in the river sediment also affect fish and wildlife.

In 1984, 200 miles of river, between Hudson Falls and the Battery in New York City, was placed on EPA's National Priorities List of the country's most contaminated hazardous waste sites.
Today the Hudson River exists as one of the most extensively studied rivers in the country, having been monitored almost continuously for a period of more than 25 years. Ongoing evaluations of water quality, sediment, air quality, fish, and wildlife by the Federal Government and the State of New York demonstrated that the river was not cleaning itself and PCBs in the sediment posed a serious risk to human health and the environment. Studies conducted to evaluate the extent of the problem revealed that most of the contaminated sediments were in "hot spots" situated in a 40-mile stretch of the river between the town of Fort Edward and the Troy Dam.

In EPA's 2002 ROD, there is also a good summary of the human health and environmental risks posed by the disposal of PCB in the Hudson River by GE. In the "Risk Characterization section of the ROD, on page 38, EPA describes the cancer risk for a reasonably maximum exposed human fish consumer (one fish meal per week) of fish from the upper Hudson as one in a thousand. The hazard index (HI) a way of describing how much greater of an exposure is present as compared to an exposure which is not expected to cause non-cancer health impacts. The HI for adults consuming one fish meal per week from the upper Hudson, according to EPA, was 65; for adolescents, 71; for children, 104.

In the mid-Hudson area, EPA calculated the cancer risk to adult fish consumers at four in ten thousand, and one in ten thousand for children. The Hazard Index for adult fish consumers was 30; for children, 10.

EPA also calculated ecological risks posed by the PCBs disposed in the river. EPA's summary of the ecological risks included:

- Birds and mammals that eat PCB-contaminated fish from the Hudson River, such as the bald eagle, belted kingfisher, great blue heron, mink and river otter are at risk at the population level. PCBs may adversely affect the survival, growth, and reproduction of these species.
- Piscivorous (fish eating) mammals, represented by the river otter, are at the greatest risk due to their feeding patterns.
- Fragile populations of threatened and endangered species, represented by the bald eagle, are particularly susceptible to adverse effects from PCB exposure.
- Piscivorous fish (e.g., largemouth bass and striped bass) and omnivorous fish (e.g., brown bullhead and shortnose sturgeon) in the Hudson River may be

adversely affected (i.e., reduced survival, growth and/or reproduction) from exposure to PCBs.

- Omnivorous animals, such as the raccoon, that derive a large portion of their food from the Hudson River may be adversely affected (i.e., reduced survival, growth, and/or reproduction) from exposure to PCBs.
- Birds and mammals that feed on insects with an aquatic stage spent in the Hudson River, such as the tree swallow and little brown bat, may be adversely affected (i.e., reduced survival, growth and/or reproduction), particularly insectivorous mammals living in the Thompson Island Pool area.

Overall, EPA stated in the ROD (p. 49) that:

> "Basis for Action: The excess cancer risk and non-cancer health hazards associated with human ingestion of fish, as well as the ecological risks associated with ingestion of fish by birds, fish and mammals, are above acceptable levels under baseline conditions. The response action selected in this ROD is necessary to protect the public health or welfare and the environment from actual releases of hazardous substances into the environment."

Section 4 Remedial Actions

Section 4.1 Remedy Selection

EPA evaluated five final remedial alternatives in the Feasibility Study. Those five alternative can be grouped into two types of alternatives – those which involve active remediation of the PCB contaminated sediments of the upper Hudson River (capping and/or dredging), and those which do not (No Action and Monitored Natural Attenuation. The five alternatives in the Proposed Plan and ROD were:

- No Action;
- Monitored Natural Attenuation – reliance on source control and natural recovery processes only;
- Cap "3/10/Select" – capping of targeted areas of river bottom, with different criteria by River Section, along with source control and natural recovery processes;
- Removal "3/10/Select" – environmental dredging of contaminated sediments from targeted areas of river bottom, with different criteria by River Section, along with source control and natural recovery processes;
- Removal "0/0/3" - capping of targeted areas of river bottom utilizing a more stringent set of criteria by River Section, along with source control and natural recovery processes.

In the ROD, EPA weighed the alternatives according to the remedy selection criteria in the National Contingency Plan, and made several determinations, resulting in the selection of the "Removal 3/10/Select" remedy for Operable Unit 2 of the site. The rationale is articulated in section 13.4 of the ROD, "Rationale for Selection of the Selected Remedy", on pages 102-105.

A summary of the determinations by EPA in this section of the ROD are as follows:

1) An active remedial approach is necessary, because the unacceptable risks to human health and the environment would persist throughout the Hudson River for an unacceptable period of time.
    - There is an unacceptable risk to human health and the environment from the consumption of fish from the Hudson River.
    - The unacceptable risk will continue for many decades without active remediation of the PCB-contaminated sediments and control of the upstream sources.
    - The No Action alternative is not protective of human health and the environment and therefore could not be selected for the Site.
2) A delay of twenty years in reaching target fish concentrations is unacceptable.
    - The Monitored Natural Attenuation (MNA) alternative, which does not include any active remediation of the sediments but does account for future upstream source control, will reduce risks from consumption of fish,

but it is predicted to take at least twenty years longer than the selected remedy to reach target levels in fish tissue in River Sections 1 and 2.

3) The selected remedy is protective because it results in significant reductions in risk, and is cost effective.
    - All of the three active remediation alternatives, REM- 3/10/Select, CAP-3/10/Select, and REM-0/0/3, would be protective of human health and the environment as they permanently remove large volumes of PCBs from the river, which will result in significant reductions in risk from consumption of fish from the Hudson.
    - The lesser cost, and similar reduction in risk, associated with REM-3/10/Select makes REM-3/10/Select more cost effective.
4) A delay of ten years or more in reaching targets is unacceptable.
    - EPA projected that that the target concentration of 0.4 mg/kg PCB in fish fillet (wet weight), which is protective of the average adult who consumes one fish meal from the Upper Hudson every two months, will be attained within 5 years of completion of dredging for the three active remediation alternatives.
    - The target of 0.2 mg/kg PCB, protective of an adult who consumes one fish meal from the Upper Hudson per month, is projected to be attained within 16 years of completion of dredging for the three active remediation alternatives.
    - It is projected to take at least 10 additional years for MNA to reach the 0.2 mg/kg and 0.4 mg/kg PCB target levels, and up to decades longer compared to the active remediation alternatives.
5) The time to reach the ultimate remedial goal of 0.05 ppm PCB in fish was not a factor in remedy selection.
    - The Remediation Goal of 0.05 mg/kg PCB for human consumption of fish, which is protective of an adult who consumes one fish meal from the Upper Hudson per week, will not be attained by any of the alternatives within the modeling time frame (67 years after dredging) in the Upper Hudson River as a whole.
6) The remedy is expected to result in meeting the ultimate remedial goal in the lower river.
    - The Remediation Goal of 0.05 mg/kg also is expected to be attained in the majority of the Lower Hudson River.
7) Institutional controls are an element of the remedy, and represent the sole controls on human health risk after dredging.
    - The selected remedy relies on institutional controls (fish consumption advisories and fishing restrictions) to protect human health until target PCB concentrations in fish are achieved.
    - Institutional controls do not protect ecological receptors.

8) The institutional controls are not completely effective, and the shorter time to reach target fish PCB concentrations to protect fish consumers is a basis for the selected remedy.
    - Human health risk reduction relies on knowledge of and voluntary compliance with the consumption advisories and fishing restrictions.
    - The active remedial alternatives are substantially more protective of people who do not follow the fish consumption advisories, because of the residual risk in consuming fish and the shorter time required to reach fish PCB target levels under those alternatives.

The most important point made in the rationale provided by EPA in the ROD for the selected remedy is that EPA concluded the dredging was needed to accelerate the time it would take to reach the remedial targets for fish flesh in order to quickly reduce human health and ecological risk compared to other alternatives that were evaluated. The targets to protect human health, 0.4 ppm and 0.2 ppm PCB in river-reach and species averaged fish in the upper Hudson, were to be met five and sixteen years, respectively, after the completion of dredging. Additional delays of ten or more years to reach the target fish PCB concentrations were deemed to be not acceptable, or EPA would have selected the “MNA only” remedy. Institutional controls were understood to not be completely effective; the acceleration of the time frame was necessary to protect people who eat fish as well as ecological receptors, both of which are subject to unacceptable levels of risk from consuming PCB contaminated fish from the Hudson River.

Section 4.2 Remedy Implementation after the 2002 ROD

After the ROD was issued in 2002, EPA issued Orders on Consent to GE for the design of the remedy selected in the ROD. These agreements also called for the gathering of baseline water quality and fish data before the start of dredging.

In October 2005, GE and EPA executed an agreement under which GE agreed to perform the first year of dredging work. This agreement also called for a peer review of the results of the first year of work, an opportunity for EPA to revise the scope of work and performance standards set for the work, and provisions for GE to agree to perform the remaining remedial work.

During project design, there was also efforts to protect downstream water supplies from potential impact during the dredging work. There was a Public Water Supply Monitoring Program undertaken by the New York State Department of Health, and construction of a new water transmission pipeline from the City of Troy to serve the Towns of Waterford and Halfmoon.

GE completed construction of the site dewatering facility in Fort Edward between 2007 and 2009. The first year of dredging work (“Phase 1”) was performed in 2009.

During Phase 1, approximately 286,000 cubic yards of contaminated sediment was removed from approximately 48 acres of river bottom, dewatered and rail transported to permitted offsite disposal facilities. Initial plans were for 265,000 cubic yards to be removed from 90 acres of river bottom, but it was found that the PCB contamination in several Phase 1 areas extended deeper than anticipated, as a result of a sampling technique applied during design, which resulted in the depth of contamination being underestimated. As a result the volume dredged increased.

EPA performed the Peer Review in 2010, and issued modifications to the scope of work and performance standards. GE agreed in late 2010 to perform the remaining portion of the remedy based on these modifications.

Between 2011 and 2015, GE removed approximately an additional 2.4 million cubic yards of contaminated sediment, which was dewatered and rail transported to permitted offsite disposal facilities. In the areas dredged each year, the replanting of wetland and aquatic vegetation was completed the following year. The last work required as part of project construction scope, habitat planting in the final dredge areas, was completed in 2016. DEC has concerns that the habitat reconstruction work has not been sufficient to address the ecological impacts of the dredging work and that the habitat construction is likely to fail. DEC will continue to work with EPA to seek the needed additional habitat reconstruction.

EPA is currently in the process of finalizing the plans for the monitoring programs to be undertaken as part of the Operation, Maintenance and Monitoring element of the remedy. Initial sediment sampling work was performed in the fall of 2016, but the data are not expected to be available for the FYR; plans for water and fish monitoring have yet to be finalized. This monitoring work out into the future is critical in understanding the performance of the remedy and identifying any potential need for future action to meet the remedial goals. However, monitoring alone is not a substitute for ensuring that the remedy is protective of human health and the environment.

Section 4.3 Operation, Maintenance and Monitoring

EPA has not yet approved work plans for long term monitoring for water quality or fish tissue; currently, the work specified for off season monitoring as part of the Remedial Action Monitoring Plan is being performed by GE. This work includes annual spring sport fish and fall forage fish sampling, and water sampling at Bakers Falls, Rogers Island, Thompson Island, Schuylerville, Waterford, Albany, and Poughkeepsie.

At the time of the preparation of this document, no post remedial fish data for 2016 were available.

No post remedial sediment data are yet available; however, EPA directed GE to begin performing surface sediment sampling in late October 2016, and such data may become available to EPA prior to the writing of the FYR report. Such data may modify the conclusions of this document. The Department has already identified, in a letter to

EPA on November 12, 2016, the need for substantially more sediment data in order to understand the performance of the remedy on both a more highly resolved spatial scale and in a time frame commensurate with the times to reach remedial goals identified in the ROD. There is water data available for 2016. It appears that the water column concentrations and loads are lower in 2016 than in the years before dredging. The decrease is most significant upstream, with the most improvement at Thompson Island. The degree of improvement declines with distance downstream, with lesser improvement at Schuylerville than at Thompson Island, and even less improvement at Waterford. As there are significant year to year variations in flows, and these flow variations can impact both concentration and mass loading of PCBs in water, it is difficult to draw detailed conclusions from the available data other than what is described above.

Section 5 Progress Since Last Review

In this Section, the protectiveness statements from the previous Five-Year Review in 2012 will be reviewed. The status of any recommendations and follow up actions will be provided, along with the results of any implemented actions. The status of any prior issues from the previous Five Year Review will also be provided.

Section 5.1 Protectiveness Determinations in 2012 Five-Year Review Report

The following protectiveness determinations were made by EPA in the previous Five-Year Review report issued in 2012.

Section 5.1.1 Protectiveness Determination for Operable Unit 1

In the 2012 Five Year Review Report, EPA identified that the appropriate protectiveness determination for the Remnant Site remedy, completed as an Interim Remedial Measure in the early 1990s, was “Short Term Protective”, stating that:

> “The remedy at the formerly exposed Remnant Deposits at the Hudson River PCBs Superfund Site currently protects human health and the environment as the in-place containment and cap system prevents human exposure, and as perimeter fencing and signage continue to be maintained. However, in order for the remedy to be protective in the long-term, an institutional control needs be implemented to ensure that future use of the Remnant Deposits does not compromise the integrity of the cap system or result in unsafe exposures.”

Section 5.1.2 Protectiveness Determination for Operable Unit 2

In the 2012 Five Year Review report, the protectiveness determination for Operable Unit 2 was “Will Be Protective”, stating that

> “Based on data collected and reviewed to date, EPA expects that the remedy at OU2 will be protective of human health and the environment upon completion. In the interim, human exposure pathways that could result in unacceptable risks are being controlled.”

However, this determination may not have been in compliance with EPA guidance. According to EPA’s guidance clarifying the use of protectiveness determinations for Five Year Reviews (OSWER 9200.2-111), “Will Be Protective” is intended for remedies where sufficient data and documentation exists to conclude that human and ecological risks are under control, and no unacceptable risks are occurring in those areas. In addition, the guidance states that to make the “Will Be Protective” determination, the available information must also indicate that the remedy under construction is anticipated to be protective upon completion, and no remedy implementation or performance issues have been identified.

EPA identified in the 2012 Five Year Review report (on page 33) that there would likely be a delay in reaching the ROD targets for reductions in fish PCB concentrations due to

the remedy leaving behind more PCBs, primarily in River Section 2, than anticipated during remedy selection:

> "The notable difference between the ROD-anticipated reduction based on the HUDTOX modeling conducted at the time of the ROD and that predicted from the remedial design Sediment Sampling and Analysis Plan (SSAP) core data occurs in River Section 2. The reduction anticipated by the ROD modeling (64 percent) is about twice as much of an improvement for River Section 2 as predicted from the remedial design (36 percent). This indicates that it will likely take River Section 2 longer to reach its ultimate remedial goals than the original forecast in the ROD."

EPA also stated, on page 33, that:

> "Nevertheless, EPA believes that the remedial goals could be achieved more quickly, and with a reduced time and extent of injury to ecological receptors, if additional dredging (beyond the ROD requirements) were to be carried out, particularly in River Section 2."

It is also pertinent to note that nowhere in the 2012 Five Year Review Report, or elsewhere in the available record, does EPA conclude that the remedy will be protective upon completion of construction. Rather, EPA stated that only after some period of MNA will the remedy be protective.

Section 5.1.3 Site-wide Protectiveness Determination

For the entire site, EPA also determined that the remedy "Will Be Protective", stating that

> "EPA anticipates that once the institutional control has been implemented at OU1 and the dredging and MNA remedy have been completed at OU2, the remedies at the Hudson River PCBs Superfund Site will be protective of human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled."

EPA relied upon the eventual reaching of the RAOs, at some future date, due to MNA as a basis for stating that the remedy "Will Be Protective"; however, this is also inappropriate, as the remedy would only be protective at the end of the MNA period, several decades into the future, and contradicts the basis upon which EPA selected the remedy, that a delay in abating the uncontrolled ecological and human health exposures was not acceptable.

It is inappropriate under EPA guidance for EPA to state that the remedy "Will Be Protective" in the 2012 Five Year Review, as the exposures at the time were (which remain to the present day) result in human health and environmental risks above the acceptable risk ranges. Also the institutional controls are known to be, as were expected in the ROD, not completely effective controls on the risks.

Construction is now complete for this site. For remedies where construction is complete, EPA classifies them as “Operating Remedial Actions”:

> “Operating remedial actions are those actions that are ongoing, but where cleanup levels have not yet been achieved. Such actions typically have remedial components requiring several years to reach cleanup levels (e.g., groundwater and surface water restoration, monitored natural attenuation, soil vapor extraction, and bioremediation)”. (“Comprehensive Five Year Review Guidance”, OSWER 9355.7-03B-P, page 4-2)

Clearly, Operable Unit 2 of the Hudson River site is now an “Operating Remedial Action”, and “Will Be Protective” no longer applies.

Section 6 Five Year Review Process

In undertaking this evaluation, DEC has considered and followed the applicable EPA Guidance on performing Five Year Reviews, including:

- OSWER 9355.7-03B-P: “Comprehensive Five Year Review Guidance” (July 2001)
- OSWER 9200.2-111: “Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews” (September 2012)
- OSWER 9355.7-18: “Recommended Evaluation of Institutional Controls: Supplement to the ‘Comprehensive Five-Year Review Guidance’” (September 2011)

DEC has also reviewed the environmental quality data for the site available through the date of this report, including:

- The data presented in the Reassessment RI/FS leading to the Record of Decision in 2002;
- The data contained in the DEC fish PCB database;
- The data generated during project design after 2002;
- The data generated in the Baseline Monitoring Program before dredging began;
- The data generated in the Remedial Action Monitoring Plan since the start of dredging.

Section 7 Technical Assessment

In the evaluation of the remedial action undertaken by GE in the upper Hudson between 2007 and 2015, the first question to be answered (in accordance with EPA guidance) is Question A:

Section 7.1 First Question in Five-Year Review guidance

Question A: Is the remedy functioning as intended by the decision documents?

Section 7.1.1 Intended Function of the Remedy in the Record of Decision

To answer this question, it is important to first clearly lay out what the decision documents portrayed as the intent of the remedy. The primary decision document is the Record of Decision text, supported by the responsiveness summary and the Feasibility Study.

- The ROD clearly selected a remedy for only the "upper Hudson River" portion of the Hudson River PCBs Site. The Hudson River NPL site extends from Bakers Falls to the Battery in New York City. The "Lower Hudson River" specifically did not have any remedial actions evaluated or identified. However, EPA stated that the remedial actions to be undertaken in the upper Hudson would result in reduced PCB concentrations in the lower Hudson.
- The remediation of the two GE capacitor plants, in Fort Edward and Hudson Falls, was an important element of the overall remedy, but was not part of the EPA lead dredging project. EPA relied upon the State of New York to achieve control over these two historic sources of PCBs to the river.
- The specific expectation in the ROD for the upstream "source control" efforts was that the surface water PCB mass loading at Roger Island, downstream of the plant sites but upstream of the area to be dredged, would decrease to a loading equivalent to an annual average surface water concentration of 2 ng/l of Tri+ PCB.
- The ROD stated that the selected remedy will greatly reduce the mass of PCBs in sediments and lower the average surface sediment PCB concentration, which will in turn reduce PCB levels in the surface water and fish tissue, thereby reducing the level of risk to human and ecological receptors.
- The expectation in the ROD for the decrease in fish PCB concentrations was that the remedy would result in large, rapid declines in fish PCB concentrations in the upper Hudson, such that the reach and species weighted average fish PCB concentration would reach 0.4 parts per million (ppm) five years after dredging was completed. EPA also anticipated that a second target concentration of 0.2 ppm would be reached sixteen years after dredging.
- EPA did not expect to reach the ultimate remedial goal of 0.05 ppm in the average fish PCB concentration in the upper Hudson, but did expect that the remedial work in the upper Hudson to have an impact on the lower Hudson such

that the ultimate remedial goal of 0.05 ppm in average fish PCB concentration would be achieved in the lower Hudson River.

- EPA expected that natural recovery processes after dredging would result in continuing reductions in fish, water, and sediment PCB concentrations, and that these processes would be monitored and the results compared to the anticipated conditions at the time of remedy selection.
- EPA expected that the Institutional Controls (Fish Consumption Advisories and Fishing Regulations) would be maintained and/or modified until the ultimate remedial goal is met.

Section 7.1.2 Elements of the Selected Remedy

EPA, on pages 94-96 of the ROD, articulated the specific elements of the remedy. The primary elements of the remedy are summarized as follows:

- Upstream Source Control at the two GE capacitor plants in Hudson Falls and Fort Edward to achieve a target PCB surface water load at Rogers Island equal to an average surface water PCB concentration of 2 nanograms per liter.
- Targeted Environmental Dredging to remove PCB contaminated sediment from the Upper Hudson to meet specific removal criteria for PCB surface sediment concentration and PCB mass per unit area. This was required to achieve several objectives, including reductions in PCB mass and surface sediment PCB concentrations, targeted reductions in fish PCB concentrations in the time frame identified in the ROD, and reductions in PCB mass transport from the upper Hudson to the lower Hudson.
- Operation, Maintenance and Monitoring (OMM), including monitoring to evaluate the effectiveness of the remedy as well as to ensure that the remedy is protective of human health and the environment. Maintenance of any long term structures (such as caps) is also included.
- Monitored Natural Attenuation (now referred to as Monitored Natural Recovery, or MNR), a reliance on natural processes after the dredging work to continue to result in a decrease in surface sediment PCB concentrations until the ultimate remedial goal is reached.
- Institutional Controls to reduce the potential for human consumption of fish from the Hudson River. These controls are the fish consumption advisories (FCAs), and the current catch and release fishery regulations in the upper Hudson.

Section 7.1.3 Assessment of the Current Status vs. Remedy Intent

The table below lists the remedy elements described above, the intent expressed in the ROD for how the remedy element was to perform, and DEC's evaluation of current conditions and an assessment of whether the remedy is performing as intended.

Table 1: Performance of Remedy Elements as compared to Stated Intent in the Record of Decision (Page 1 of 4)

Remedy Element	ROD Intent	Current Status	Performance as intended by ROD?
Upstream Source Control (Reduction in PCB Mass Load from upstream sources, including the two GE Capacitor plants in Hudson Falls and Fort Edward)	Source control at the GE Hudson Falls plant was projected to decrease the current concentration of PCBs in the water - column of approximately 13 ng/L Tri+ PCB to 2 ng/L Tri+ PCB, by January 1, 2005.	Several years of monitoring data are available for the period after completion of the primary source control measures at the two GE plant sites. The data indicate that the load from the upstream source areas (above Rogers Island) meet or exceed the reductions projected in the ROD.	Yes, performing as intended.
Targeted Removal of Contaminated Sediment in the Upper Hudson (Reduction in PCB Mass Load over the Federal Dam to the Lower Hudson due to sediment removal in the Upper Hudson)	The reduced PCB load over the Federal Dam projected by the selected remedy will ultimately result in reduced concentrations of PCBs in fish, sediment and water. This in turn will result in reduced risks to humans and ecological receptors living in and near the Lower Hudson River from PCB contamination originating in the Upper Hudson River.	Less than one year of post dredging monitoring data available; limited available data suggests that there has been a reduction in PCB load over the Federal Dam as compared to baseline monitoring.	Unknown. Insufficient water, sediment, and/or fish data is available to document any significant trends.; Further monitoring is required to determine if the remedy is performing as intended in reducing PCB loading, resulting in a reduction in sediment, water and fish PCB concentrations in the lower Hudson.

Table 1 (p. 2 of 4)

Remedy Element	ROD Expectation	Current Status	Performing as intended by ROD?
Targeted Removal of Contaminated Sediment in the Upper Hudson (Reduction in PCB Mass and average Surface Sediment PCB Concentrations	Implementation of the selected remedy will greatly reduce the mass of PCBs in the sediments in the Upper Hudson and lower the average PCB concentration in surface sediments, which in turn will reduce PCB levels in the water column and fish and other biota, thereby reducing the level of risk to human and ecological receptors.	EPA and GE are currently engaged in a process of measuring surface sediment PCB concentrations. DEC has demanded a more rigorous sampling program than currently planned. Estimate of average surface sediment PCB concentrations to be left behind after dredging, made in the previous Five Year Review, indicates that higher PCB concentrations in surface sediment were to be left behind than anticipated at the time of the ROD.	Unknown and unlikely. Insufficient surface sediment PCB data is available. It is unlikely the remedy will achieve the reduction in surface sediment PCB concentrations in River Section 2 intended by the remedy at the end of dredging.
Targeted Removal of Contaminated Sediment in the Upper Hudson (Reduction in Fish PCB concentrations in upper Hudson fish in the specified time frames)	The target concentration of 0.4 mg/kg PCB in fish fillet (wet weight), which is protective of the average adult who consumes one fish meal from the Upper Hudson every two months, will be attained within 5 years of completion of the dredging (before or by 2013) for the three active remediation alternatives. The target of 0.2 mg/kg PCB, protective of an adult who consumes one fish meal from the Upper Hudson per month, is projected to be attained within 16 years of completion of dredging	There is not sufficient post dredging fish PCB sampling results from the upper Hudson to compare to the target concentrations to be met in five and sixteen years, respectively. Currently available fish PCB concentrations are well above the targets, but these do not represent post remedial conditions in the upper Hudson.	Unknown. Insufficient data are available in the upper Hudson to quantify the magnitude of the delay in reaching the target concentrations. Currently available fish PCB concentrations indicate ongoing exposures which present unacceptable human health and ecological risks. The elevated average surface sediment PCB concentrations remaining after dredging will delay the time to reach the ROD-specified targets for fish PCB concentrations to be met five and sixteen years after dredging.

Table 1 (Page 3 of 4)

Remedy Element	ROD Expectation	Current Status	Performing as intended by ROD?
Targeted Removal of Contaminated Sediment in the Upper Hudson Reduction in Fish PCB concentrations in Lower Hudson fish as a result of the remedy	The Remediation Goal of 0.05 mg/kg also is expected to be attained in the majority of the Lower Hudson River	There is not sufficient post dredging fish PCB sampling results from the Lower Hudson to compare to the Remediation Goal of 0.05 ppm in fish PCB. Currently available fish PCB concentrations are well above the targets, but these do not represent post remedial conditions in the lower Hudson. PCB concentrations in the Lower Hudson (particularly fish PCB concentrations in the area below Albany) did not change in response to increased PCB load during dredging.	Unknown. Insufficient data are available in the lower Hudson to answer the question as to the magnitude of the delay in reaching the Remediation Goal of 0.05 ppm PCB in fish. However, given the limited impact of the remedy to date on fish in the Lower Hudson below Albany it is not anticipated that there will be further improvements in fish PCB in this area as a result of the dredging. Currently available fish PCB concentrations indicate ongoing exposures present unacceptable human health and ecological risk.
Monitored Natural Recovery (MNR, previously referred to as MNA) and **Operation, Maintenance and Monitoring**	Long-term monitoring would be conducted in sediments, in the water column, and in fish to confirm that contaminant reduction is occurring and that the reduction is achieving Remedial Action Objectives. The monitoring data would also be used as input parameters in the mathematical models to evaluate progress of the natural attenuation processes against the original predictions. (ROD, p. 61)	EPA and GE have not yet finalized the OMM monitoring program to gather the sediment, fish and water data. Initial surface sediment data gathering is ongoing. To date, EPA has not yet begun updating the mathematical models or inputting new data to compare to original predictions.	Unknown. No comparisons of post dredging recovery rates are possible as very limited post remedial data is available.

Remedy Element	ROD Expectation	Current Status	Performing as intended by ROD?
Institutional Controls	The selected remedy relies on institutional controls (fish consumption advisories and fishing restrictions) to protect human health until target PCB concentrations in fish are achieved.	The institutional controls are in place as envisioned in the ROD. DOH provides annual updates to the "Health Advice on Eating Sportfish and Game" which pertain to the entire site (both Lower and Upper Hudson), and perform outreach activities in accordance with the established plan, and level of funding set in the Remedial Action Consent Decree.	Unknown and Unlikely. The ROD does not establish a quantitative target, only an expectation that the controls will not be completely effective. Available information indicates that people continue to eat fish despite the institutional controls, and that these exposures represent human health risk beyond the EPA acceptable risk range.

Summary of Evaluation – Question A

It does not appear that the data is available to quantify the degree to which the remedy is or is not performing as intended by the ROD. The currently available fish PCB concentrations throughout the entire site are well above the target concentrations, the first of which is to be met five years after remediation. These current fish PCB concentrations also continue to result in exposures to both human and ecological receptors which are above EPA's acceptable risk range, and the institutional controls are understood to not be completely effective.

The degree to which the remedy has achieved the intended reductions in surface sediment PCB concentrations is unclear, as the data gathering necessary to answer that question has not yet been completed and is insufficient in scope. A more rigorous sampling program than currently planned is necessary, as identified by DEC, in order to provide the data necessary to determine if the current surface sediment PCB concentrations are capable of meeting the intent of the ROD; the current EPA approved sampling plan is not designed to answer that question with the appropriate degree of statistical certainty. For example, the analysis of surface sediment data in the previous Five Year Review report indicated that the intended reductions in surface sediment PCB concentrations were not achieved in River Section 2.

As a result, the remedy will not have achieved the anticipated surface sediment PCB concentrations, making it equally unlikely that the fish PCB concentrations will achieve EPA's ROD targets in the time frames identified in the ROD, within five and sixteen years of remedy completion.

It also appears that the anticipated reductions in fish PCB concentrations in the lower Hudson, as a result of the remedial work in the upper Hudson, will likely not occur as anticipated in the ROD.

The available 2016 surface water PCB data provides an early indication of the performance of the remedy. Surface water PCB concentrations at Rogers Island indicate that in 2016 the goal for upstream source control has been exceeded; concentrations have typically been lower than 2 nanograms per liter. Surface water concentrations at Thompson Island, Schuylerville, and Waterford are lower than those measured during the Baseline Monitoring Program before dredging; however, the degree of improvement appears to decline with distance downstream. The cleanup criteria in the ROD for dredging in River Sections 2 and 3 were approximately 3 times less stringent than River Section 1. The greatest improvement is at Thompson Island, downstream of River Section 1 where the most stringent cleanup criteria were used for dredging. At Schuylerville, downstream of River Section 2, the improvement appears to be more modest; and at Waterford, the downstream end of River Section 3, the improvements are minimal.

It appears, based upon the limited amount of available data, that the degree of improvement in water PCB concentrations diminishes with distance downstream, likely

the result of the less stringent sediment cleanup standards applied below the Thompson Island Dam. It is unclear, due to limited data, if the ROD targets for PCB mass transport reductions will be achieved.

Section 7.2 Second Question in Five-Year Review guidance

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The exposure assumptions and toxicity data are summarized in Section 8 of the ROD, "Summary of Site Risks", starting on p. 31. According to the EPA's Five Year Review guidance, to answer Question B, the following should be considered:

- Standards and TBCs ("to be considered")
- Cleanup levels, including the basis for the cleanup levels (risk based or Applicable or Relevant and Appropriate Requirements (ARARs))
- Exposure Pathways, including new routes of exposure or new receptor populations
- Toxicity and other contaminant characteristics

Section 7.2.1 Standards and TBCs

It does not appear that any new ARARs, either standards or TBCs, have been identified since the ROD was issued which would impact the understanding of how the remedy is performing.

Section 7.2.2 Cleanup Levels

The cleanup levels set in the ROD for the sediment dredging element of the remedy were risk based; that is, EPA established a cleanup level based upon the anticipated risk reduction associated with the selected remedy. For this site, the reductions in risk to be achieved in the specified time frames through application of the sediment cleanup levels were a function of the anticipated reductions in fish PCB concentrations to be achieved as a direct result of the sediment removal, followed by natural recovery.

For River Section 1, the cleanup level was a Tri Plus PCB mass per unit area (MPA) of 3 grams per square meter, and a surface Tri Plus PCB concentration of ten parts per million. For River Sections 2 and 3, the cleanup level was a Tri Plus PCB MPA of 10 grams per square meter, and a surface sediment concentration of 30 parts per million Tri Plus PCB, a threefold increase over Section 1.

EPA anticipated that the use of these cleanup criteria for sediment would achieve the reductions in fish PCBs in the time frames defined to achieve the risk reduction goals. It is not possible, however, to determine at this time if the basis used to establish these cleanup levels (the understanding of the relationship between sediment, water, and fish PCBs at the time of remedy selection) is still valid today. Only through the interpretation of the sediment, water, and fish PCB concentrations to come out of the post-remedial

monitoring can this understanding be confirmed, or the need to modify this understanding be identified.

At the present time, the available sediment data can be used to extrapolate fish PCB concentrations based upon the existing understanding. In the previous five year review, EPA identified that the surface sediment PCB concentrations remaining in River Section 2 after remediation would be higher than anticipated at the time of the ROD. If the understanding of the relationship between sediment and fish PCB at the time of the ROD is applied, then the expected result is that the reductions in fish PCB concentrations in River Section 2 would be less than anticipated in the ROD, likely resulting in a greater time to achieve the ROD specified fish tissue concentrations. The impact of this on the expected rates of decline associated with natural recovery is unknown.

Summary – Cleanup Levels

It appears that the data are not yet available to quantify the degree to which the sediment cleanup levels may need to be modified to achieve the targeted reductions in fish PCB concentrations in the time frames identified in the ROD. . A review of the surface sediment data from the previous Five Year Review report indicates that the cleanup levels would not reach the post remedial risk reduction goals in the specified time frame for River Section 2. Post remedial monitoring is required in water, sediment, and fish to confirm or refute the goal set forth in the ROD that the specified sediment cleanup levels would achieve the intended reductions in water, sediment, and fish concentrations such that the risk reduction targets would be met in the intended time frames. As stated in the ROD on page 66, “The time to reach target PCB concentrations in fish was a primary factor in comparing remedial alternatives.”

Section 7.2.3 Exposure Pathways, including new routes of exposure or new receptor populations

Air - The most significant route of exposure is still the consumption of fish and other wildlife from the Hudson River. However, some published research suggests the possibility that the air route of exposure may be a significant one. DEC has evaluated the available data from the baseline study completed in the upper Hudson by DEC before the dredging project, from the dredging project air monitoring program, and from published research from the lower Hudson. It appears that the exposure point concentrations are within the DEC standards; however, EPA should verify this hypothesis and gather representative air data to confirm that the air route of exposure is not a significant route of exposure requiring remedial action, particularly in the Lower Hudson.

Walleye – Since the risk assessment work was completed in the mid to late 1990s, it appears that there has been a change in the species mix among sport fish in the Hudson River. Walleye are now much more prevalent than during the 1990s and are now commonly found throughout the Lower Hudson and in the southern portion of the

Upper Hudson. As a sought-after food fish, walleye may represent a significant portion of the overall take of fish for human consumption, particularly in the Lower Hudson. Available data indicate that the PCB concentrations in walleye are 1.5 to 2 times higher than in bass, another commonly sought after game fish, which was the species used in EPA's risk assessment. EPA needs to update the current understanding of risks posed by fish consumption given the change in fish species available for consumption. Surveys of people taking fish from the Hudson would help inform this issue.

Differing Receptor Populations – During the process of implementing the Fish Consumption Advisories, the Department of Health (DOH) has been conducting outreach efforts in both the Upper and Lower Hudson. As a part of these efforts, DOH has been working to identify and reach out to the various ethnic groups, often immigrant, who live in the communities along the Hudson River. Since the risk assessment work was done in the late 1990s, different ethnic groups have moved into the area and have potentially different rates of fish consumption, different preferences for fish species to eat, and different preparation methods. A change in these parameters could result in a different set of assumptions which should be incorporated in the risk assessment process.

Summary - Exposure Pathways

The data may not be available to evaluate whether or not the assumptions made for exposure pathways are still valid.

Two issues related to routes of exposure should be evaluated by EPA; the hypothesis that the exposures via the air route are acceptable and do not require further remediation should be evaluated through the gathering of representative air data. EPA should also evaluate the degree to which the risk assessment assumptions would be modified by the inclusion of walleye as a species available for consumption, particularly in the lower Hudson and the southern portion of the upper Hudson.

Section 7.2.4 Toxicity and other contaminant characteristics

In the 2012 Five Year Review report, EPA stated that:

> "However, the Integrated Risk Information System, or IRIS, EPA's consensus database, is currently re-evaluating the non-cancer toxicity value for PCBs and this value will need to be reassessed at the time of the next five-year review."

The State's understanding of this statement is that the IRIS update had not yet been completed at the time; as a result, EPA was not able to use the updated information on PCB non-cancer toxicity for this review. The State encourages EPA to complete the IRIS evaluation and update as soon as possible, so that the necessary evaluations can be made about the protectiveness of the remedy utilizing the most up to date understanding of PCB toxicity, if possible in this review.

Table 2: Current Validity of Standards, Cleanup Levels, Exposure Pathways, and Toxicity used in Remedy Selection

Question B Element	Still Valid?	Discussion
Standards and TBCs	Yes	No New ARARs Identified
Cleanup Levels, including basis	Unknown	Data are not available to evaluate if the cleanup levels in sediment will achieve the needed reductions in fish PCB concentrations and thus human health and environmental risk.
Exposure Pathways	Unknown	Data are not available to determine if the changes in species availability, and changes in demographics, result in a significant change to the risk assessment inputs and results.
Toxicity and other Contaminant Characteristics	Unknown	EPA has not yet completed the Agency's update to the IRIS database.
Overall	Unknown	

Section 7.3 Third Question in Five-Year Review guidance

Question 3: Has any other information come to light which could call into question the protectiveness of the remedy?

In answering Question 3, DEC has evaluated the available data and site conditions, and has identified two areas where information has come to light which could call into question the protectiveness of the remedy: (1) the Sediment Sampling and Analysis Plan sediment data, which informed EPA that the selected remedy as implemented would result in greater surface sediment PCB concentrations than anticipated in the FS and ROD, and (2) the water and fish monitoring completed during dredging, which showed that the downstream PCB mass flux was not a significant factor in downstream fish PCB concentrations, indicating that the local sediment PCB concentrations were a much more important factor in controlling fish PCB concentrations than thought at the time of remedy selection.

Section 7.3.1 Sediment Sampling and Analysis Plan (SSAP) Data

After the ROD was issued in 2002, EPA issued an administrative Order on Consent to GE, under which GE performed a significant sediment sampling program, the intent of which was to closely define the distribution of PCB concentrations both laterally and with depth. This sediment sampling program included thousands of sampling locations throughout the upper Hudson, and provided the data to allow for an updating of the understanding of the average surface sediment PCB concentrations.

In the 2012 Five Year Review Report, EPA presented a table which summarized the difference in the area-weighted surface sediment PCB concentrations in the upper Hudson between those used in remedy selection, and an updated average taking into account the data gathered in the SSAP after the ROD was issued. This also allows estimates to be made of both the pre-remedial average, and post-remedial average, surface sediment PCB concentrations.

At the time of remedy selection, EPA estimated the average surface sediment concentrations (in parts per million, or ppm) before and after remediation as follows:

Table 3: EPA estimated surface sediment concentrations from 2012 Five Year Review Report

River Section (RS)	ROD Estimate Before Remedy	ROD Estimate After Dredging	ROD Estimated Percent Reduction	SSAP Revised Estimate Before Dredging	SSAP Revised Estimate After Dredging	SSAP Revised Estimated Percent Reduction
RS 1	4.6	0.96	79%	14.2	1.5	87%
RS 2	2.26	0.8	64%	11	7.1	36%
RS 3	0.53	0.51	4.4%	3.3	3.1	4.9%

After the SSAP data is taken into account, it became apparent that the surface sediment PCB concentrations in the upper Hudson were higher than anticipated; a factor of 3.1X in River Section 1, 4.9X in River Section 2, and 6.2X in River Section 3. The remedial approach, to take out PCB contaminated sediment based upon a removal criteria based primarily upon Mass Per Unit Area, did not change. As a result, the average surface sediment PCB concentration after dredging was quite different than anticipated in the ROD, particularly for River Sections 2 and 3.

As can be seen in Table 3 above, the average surface sediment PCB concentration after dredging was anticipated by EPA in 2012 to be about 50% higher in River Section 1 compared to the ROD estimate, a factor of about 9X higher in River Section 2 compared to the ROD estimate, and a factor of about 6X higher in River Section 3 compared to the ROD estimate.

It is also informative to look at the data in terms of the anticipated percent reduction in surface sediment PCB concentrations. In general, the expected reduction in fish PCB concentrations should be proportional to the reduction in surface sediment PCB concentrations. In the table above, one can see that the ROD anticipated percent reduction for River Sections 1 and 3 are similar to the updated anticipated percent reduction using the SSAP data. However, the updated anticipated percent reduction in River Section 2 is little more than half (36% vs. 64%) what was anticipated in the ROD.

It is EPA's expectation, based on standard geochemical and biochemical theory, that the rates of decay in Tri+ PCB concentrations in water column and fish tissue should

parallel the rate of decay in surface sediment concentrations. This means that the lesser degree of improvement in sediment PCB concentrations should be reflected in a lesser degree of improvement in fish PCB concentrations. However, the data needs to be gathered to determine if this is the case. It is also pertinent to point out that if EPA's expectation above is demonstrated by data, then the fish in River Section 3 should only immediately improve ~ 4% as a direct result of the dredging, and the fish in the lower River, where no sediment remediation was done, should show little additional improvement as a result of the remedy.

Summary – Post ROD SSAP Surface Sediment Data

DEC has reviewed the sediment data made available since the ROD was issued. Two hypotheses are available; the post remedial fish PCB concentrations should be expected to be higher than anticipated at the time of remedy selection, but will the amount of increase be driven by the increase in the absolute concentration, or by the decrease in the amount of improvement from before to after remediation? It is clear that there will be more PCB in fish tissue than what was expected at the time of remedy selection. However the data is not currently available to allow for a quantitative conclusion to be drawn at this time, as to how much higher the fish PCB concentrations will be than reflected in the ROD, nor how much the increased PCB concentrations in sediments, compared to the post dredging conditions assumed in the ROD, will impact the post remedial declines in sediment, water and fish PCB concentrations now that the project is in the Monitored Natural Recovery phase.

Section 7.3.2 Remedial Action Monitoring Plan (RAMP) Fish and Water data

After the ROD was issued, EPA issued a several Orders on Consent to GE to implement various activities, including water, sediment, and fish sampling programs. The water and fish monitoring programs were modified and continued through the period when the dredging work was done. These monitoring programs, which continue to the present time, allow for an understanding of the relationship between water, sediment, and fish PCB concentrations over time. In particular, one can evaluate the relationship between the water column PCB concentrations and mass load (the mass of PCB carried by the river on a temporal, typically daily, basis) and the fish PCB concentrations. In the 2016 White Paper put out by EPA in response to a NOAA publication, EPA stated that fish tissue concentrations south of Albany did not increase during the dredging period when loads from the Upper Hudson increased temporarily, and that these observations suggest that Lower Hudson fish tissue levels may be additionally influenced by local factors that are unrelated to current Upper Hudson conditions such as local PCB sources and inventory of PCB in sediments from past releases.

An evaluation of PCB concentrations in fish in the upper Hudson during dredging also shows a similar pattern. In the vicinity of dredging, the PCB concentrations in fish typically increased in response to the exposures from the work; however, farther

downstream, there was much less or no response, even though the increased PCB concentrations and load from the dredging were noted throughout the upper Hudson and into the lower Hudson. This contrasts with the previously understood conceptual site model, under which the fish PCB concentrations downstream of the dredging should have increased by an amount commensurate with the increase in water column PCB concentrations. This was not observed; rather, as described above, fish PCB concentrations away from the vicinity of the dredging work and immediately downstream had little or no significant reaction to the water column PCBs concentrations during dredging. This indicates to DEC that the exposures to local sediment PCBs were much more relevant to fish PCB concentrations than water column exposures.

The available RAMP fish and water data indicate to DEC that the understanding of relative importance between exposure to PCBs from local sediments, and exposure to PCBs in the water column, should be updated for this ecosystem. In the modeling and assessment work done in the late 1990s to support remedy selection by EPA, a set of estimates were developed to define this relationship. At the time of remedy selection, DEC informed EPA that the modelling and assessment work may have underestimated the relative importance of the sediments; it appears, based upon the fish and water data gathered during dredging, that there is further reason to believe that local sediments play a larger factor in influencing fish PCB concentrations. As a result, the estimates of the relationships between fish, water, and sediment need to be updated.

Summary – RAMP Fish and Water Data

The water and fish data gathered during remediation indicate that the local sediments play a larger role in influencing fish PCB concentrations than thought at the time of remedy selection. In the context of the Five Year Review, this means that EPA needs to re-evaluate and re-quantify the relationships between media (sediment, water and fish) which formed the basis upon which cleanup level was determined. Once this is done, EPA can evaluate whether further remedial work is necessary to reach the ROD goals for time to achieve the targeted reductions in fish PCB concentrations.

This means that the scale upon which the remedial program is managed should be modified from a solely River Section based approach to one which more closely reflects the exposures which now are understood to much more important in controlling fish PCB concentrations. As the fish do not travel between pools to any extent due to the locks and dams between pools, fish can only be exposed to the sediments in the pool where they live. Averaging sediment PCB concentration from multiple pools, and comparing these averages with fish PCB concentrations averaged across multiple pools, will dilute out any relationships between the sediment and fish PCB concentrations. It will be very difficult if not impossible to understand if the sediment remedy is functioning as intended in the ROD.

Section 8 Issues

In this portion of the document, DEC will list the issues identified in the assessments above, and how these issues may impact the protectiveness of the remedy.

Section 8.1 Issues related to Question #1

DEC finds that, with one exception, the data are not yet available to determine if the remedy is functioning as intended by the decision documents. It appears that the upstream source control goal is being met, but further surface water data is needed to confirm that the goal is met over the long term. For the remaining remedy elements, additional post remedial monitoring data needs to be gathered, as recommended by the State earlier this year, to compare against the intended function of the remedy as expressed in the ROD and identified above. However, it is clear that under current conditions, the remedy is not protective, as there are ongoing uncontrolled exposures, to both human and ecological receptors, in both the upper and lower Hudson, which are in excess of the EPA acceptable risk range. It is also clear, as EPA stated in the previous Five Year Review report, that the remaining PCB concentrations in sediment, particularly in River Section 2, will result in a delay in reaching the targeted reductions in fish PCB concentrations identified in the ROD. The current lack of data makes it difficult to know how much the delay will be, and to know the degree to which further remediation is needed to achieve the ROD goals.

Section 8.2 Issues related to Question #2

DEC also finds that, with one exception, the data are not yet available to determine if the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection are still valid. It appears that no new ARARs or TBCs have been identified to take into account in the remedial program for this site. However, DEC finds that there is not sufficient data available to evaluate if the cleanup levels in the ROD are still valid; to determine if the exposure pathways used in the risk assessments are still valid (due to changes in fish species distribution, and in population demographics among human fish consumers); and to determine if the toxicity assumptions are still valid, as EPA has not yet completed the anticipated update to the IRIS database for PCBs.

Section 8.3 Issues related to Question #3

DEC finds that two important data sets have become available since remedy selection which call into question the protectiveness of the remedy.

First, the SSAP data gathered during project design indicates that higher surface sediment PCB concentrations were left behind after dredging than anticipated during remedy selection. The degree to which this will impact the remedy is unknown without further data gathering; however, it is clear that fish PCB concentrations will be higher than anticipated after dredging, and the rate of decline after dredging may also be impacted as well.

Second, the fish and water data gathered during the dredging work indicate that the degree to which local sediments influence fish PCB concentrations is greater than thought at the time of remedy selection. As a result, there will be little additional improvement in fish PCB concentrations in the lower Hudson, particularly south of Albany, as a result of the dredging. The degree to which there will be improvements in upper Hudson fish will also be impacted; however, this impact is unclear and will require further monitoring, at a spatial scale representative of the exposures from sediments to fish.

Table 4: Issues which prevent the remedy from being protective or may do so in the future (p. 1 of 2)

Issues	Affects Protectiveness (Y/N)	
	Current	Future
Insufficient data are available to determine if the targeted sediment removals have resulted in the anticipated reductions in surface water total PCB load to the Lower Hudson.	Y	Y
Insufficient data are available to determine if the targeted sediment removals have lowered the surface sediment PCB concentrations sufficiently to achieve the risk reduction goals by reducing fish PCB concentrations.	Y	Y
Insufficient data are available to determine if the targeted sediment removals will result in meeting the target average fish PCB concentrations in the upper Hudson in five and sixteen years after dredging.	N	Y
Insufficient data are available to determine if the targeted sediment removals will result in meeting the remediation goal of 0.05 ppm PCB in fish in the majority of the lower Hudson River.	N	Y
Insufficient data are available to determine the rates of post-remedial decline in water, sediment, and fish PCB concentrations due to Monitored Natural Recovery are occurring at the rates anticipated in the ROD. EPA has not yet begun to update the mathematical models or inputting new data to compare to original predictions.	N	Y
Available information indicates that, while the Institutional Controls are in place and performing as intended by the ROD, some people continue to eat fish, and these exposures represent human health risk beyond the EPA acceptable risk range.	Y	Y
Insufficient data are available to determine if the cleanup levels are still valid.	Y	Y
Insufficient data are available to determine if the exposure pathway assumptions are still valid.	N	Y
EPA has yet to complete the IRIS update for PCBs	N	Y
SSAP data, available after remedy selection, indicates that higher surface sediment PCB concentrations will be left behind after dredging, leading to higher fish PCB concentrations than anticipated.	Y	Y
RAMP data, gathered during the dredging work, indicates that local sediments are more important than thought at the time of remedy selection, indicating that there will be little improvement in fish PCB concentrations south of Albany, and the monitoring program needs to account for finer spatial resolution which more closely reflects actual fish exposures to sediments.	N	Y

Section 9 Recommendations and Follow-up Actions

Section 9.1 Recommendation 1 - Conduct additional studies / improve OMM activities

As described above, DEC finds that there are insufficient post remedial data available to evaluate if the remedy is functioning as intended by the decision documents. Several questions need to be answered now, and in the future, including:

- To what degree have the targeted sediment removals achieved or not achieved the intended reduction in surface water PCB load to the lower Hudson?
- To what degree have the targeted sediment removals achieved or not achieved the intended reductions in surface sediment PCBs?
- Will the targeted sediment removals done during the dredging program result in achieving the targeted average fish PCB concentrations in the time frame identified in the ROD (0.4 ppm in five years after dredging, 0.2 ppm in sixteen years after dredging)? If not, what further removals are necessary to reach these goals?
- When will the targeted sediment removals result in achieving the Remediation Goal of 0.05 ppm PCB in fish in the majority of the Lower Hudson?
- Are the post-remedial declines in sediment, water, and fish PCB concentrations due to MNR occurring at the rates anticipated in the ROD? How do the predictions from updated models, using new data, compare to original predictions?
- Do the exposures, to both human and ecological receptors, continue to result in risks beyond EPA's acceptable risk range?
- Given the post remedial PCB distribution in sediment, how long will it take to reach the targeted reductions in fish PCB concentrations? Should EPA continue to expect that the targeted sediment removals implemented under the ROD will achieve the expected reductions in risk in the time frames expressed in the ROD?
- Are the assumptions used for the exposure pathways still valid? Are the assumptions for fish species availability, and human demographics and behaviors, still representative?
- Is the current understanding of PCB toxicity up to date?
- What will the overall impact be on the remedy of the finding after remedy selection that higher PCB concentrations in surface sediment will be left behind after remediation?
- What will the impact be on the remedy of the finding after remedy selection that local sediments appear to have a higher influence on fish PCB concentrations? How does this affect the overall conceptual site model?

These questions should form the basis for the Data Quality Objectives to guide the needed additional studies. In many cases, the questions can be answered by monitoring to be done under the "Operation, Maintenance, and Monitoring" or OMM

element of the remedy. However, EPA will need to supplement the work to be done as currently envisioned in the OMM Scope attached to the Remedial Action Consent Decree to accomplish this. The detailed recommendations previously provided by DEC on the scope of OMM data gathering will inform EPA on DEC's position on the needed monitoring.

A fundamental change in conceptual site model needs to be accounted for in managing the remedial program for this site, now in the Monitored Natural Recovery (previously called by EPA "MNA") phase. The appropriate spatial scale (i.e. pool by pool, rather than averaged over multiple pools) should be used in the design of sediment, water, and fish sampling to be undertaken to understand the performance of the remedy.

EPA should also conduct a scientific, broad based survey of people who fish in the Hudson River or who eat fish from the river, in order to inform the risk assessors as to whether or not the assumptions made during the risk assessment in the 1990s are still valid today. If they are not, then EPA should also review the risk assessment calculations to determine if the understanding of site risks need to be updated.

Section 9.2 Recommendation 2 - Prepare to Optimize Remedy

As the monitoring program and additional studies to be performed under Recommendation 1 above move forward, EPA should be considering the additional response actions that are likely necessary to accomplish the goals in the ROD for achieving the targeted reductions in fish PCB concentrations in the time frames set forth in the ROD. In order to do this, EPA will need to update the conceptual site model, including updating the understanding of the relationships between sediment, water, and fish PCB concentrations, to inform evaluations of potential future response actions. This updating of the conceptual site model, and gathering of data to understand the relationships between media, also should be completed on a time frame commensurate with the time frames in the ROD for reaching the targeted reductions in average fish PCB concentrations; that is, in five to sixteen years. The data gathering needs be done on a spatial scale commensurate with the understanding of the degree to which local sediments control fish PCB concentrations, and be designed to answer the questions in time to allow for further response actions in time frames commensurate with meeting goals of the ROD.

Section 9.3 Recommendation 3 – Expand Site Investigation to the Lower River

As described above, the fish and water data gathered during the dredging work indicate that the degree to which local sediments influence fish PCB concentrations is greater than thought at the time of remedy selection. As a result, there will be little additional improvement in fish PCB concentrations in the lower Hudson, particularly south of Albany, as a result of the dredging. In order to complete the site conceptual model and evaluate the need for remedial action for the Lower Hudson, it will be necessary for EPA to perform a Remedial Investigation / Feasibility Study for the portion of the site between the Federal Dam at Troy and the Battery in New York City.

Section 10 Protectiveness Statements

Section 10.1 Basis for protectiveness statements by Operable Unit

In evaluating the appropriate protectiveness statements for this site, DEC has considered the guidance set forth by EPA for determining protectiveness. Three guidance documents are particularly informative; the EPA “Comprehensive Five-Year Review Guidance” (OSWER 9355.7-03B-P), and “Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews” (OSWER 9200.2-111). DEC also consulted OSWER Directive 9355.7-18, “Recommended Evaluation of Institutional Controls: Supplement to the ‘Comprehensive Five-Year Review Guidance’”.

The Hudson River PCBs Site has been divided up into several Operable Units by EPA. DEC has focused upon Operable Unit 2 (the sediment remedy for the upper Hudson selected in the 2002 ROD), and the lower Hudson, in this document, as EPA has not performed any additional response actions for Operable Unit 1 since the last Five-Year Review in 2012.

Section 10.2 Operable Unit 1 (Remnant Site Capping IRM)

For Operable Unit 1, DEC finds that the appropriate statement continues to be “Short Term Protective”.

As the site conditions for Operable Unit 1 have not changed since the last review, the protectiveness determination should remain the same.

Section 10.3 Operable Unit 2 (Dredging Remedy for the upper Hudson River)

For Operable Unit 2, DEC finds that the appropriate statement is “Not Protective”.

DEC evaluated the protectiveness of the remedial action for Operable Unit 2 as a remedy for which construction has been completed. The dredging element of the remedy was completed in 2015; habitat reconstruction efforts were completed in mid-2016. No further construction is to be done in the river as part of this remedy.

This finding of “Not Protective” is based primarily upon the current conditions. There are known exposures to human and ecological receptors which result in risks beyond EPA’s acceptable risk range. DEC considered the finding of “Protectiveness Deferred”; this determination would have been appropriate if conditions were such that the available information did not provide sufficient data and documentation that all human and ecological risks are currently under control, and no unacceptable exposures were occurring. While this may be true for Operable Unit 2 for future risks, there is considerable uncertainty and skepticism, due to lack of data and to the current understanding of site conditions as described above, that the fish PCB targets in the ROD will be met in the intended time frame. As a result at the present time, DEC

considers the determination of “Not Protective” to be the sole appropriate finding under EPA guidance for Operable Unit 2.

Section 10.3 Lower Hudson River (From the Federal Dam at Troy south to New York City)

For the lower Hudson, DEC finds that the appropriate statement is “Not Protective”.

Although not required by EPA guidance, DEC has evaluated the site conditions in the portion of the site which has not undergone investigation and remedy selection. As such, one may not answer Question A (Is the remedy functioning as intended by the decision documents?). However, following the same logic as for Operable Unit 2, DEC finds that the appropriate statement for this portion of the site, where there are known exposures to human and ecological receptors which result in risks beyond EPA’s acceptable risk range, to be the same as for Operable Unit 2 – Not Protective.

Section 11 Next Review

The next formal “Five Year Review” should be completed once five years have passed since the completion of the current review. However, as this remedy is now entering the MNR phase, EPA should engage in a process which regularly updates the conceptual site model to take into account new data as it comes in, and continually updates EPA’s understanding of remedy performance. This understanding should include an update and recalibration of the site mathematical models to take into account the updated site conceptual model as well as the data available since remedy selection. EPA should be prepared to optimize the remedy, including evaluations of the need for further active remediation in the form of additional dredging, as needed to achieve the target fish PCB concentrations in the ROD in a time frame commensurate with the selected remedy.

Section 12 Summary and Conclusions

In evaluating the protectiveness of the dredging remedy for the Hudson River PCBs site, DEC has evaluated the current conditions following EPA's guidance for conducting Five Year Reviews. It is clear that the appropriate determination for the dredging remedy, and for the entire site, is "Not Protective".

This determination is based upon the finding that, despite the substantial remedial work done in constructing the dredging remedy between 2009 and 2015, the risks to human health and the environment are well above the EPA acceptable risk range, and due to the understood incomplete effectiveness of the institutional controls, unacceptable exposures are still occurring. The following actions need to be taken to ensure protectiveness:

- Monitoring at the appropriate spatial and temporal scale, in accordance with the recommendations provided by the State to EPA, to evaluate the performance of the remedy, to determine if the remedy will result in meeting the targeted fish PCB concentrations in the ROD in the time frames specified.
- Prepare to optimize the remedy, as needed determined by the monitoring data. The site conceptual model needs to be updated to take into account the data gathered during since the ROD was issued that showed that higher surface sediment PCB concentrations would be left behind than anticipated, and to take into account the finding based upon the data gathered during the remedial action, that the local sediments appear to be much more important in governing fish PCB concentrations than was thought during remedy selection. This should also include the redevelopment and recalibration of the site mathematical models, to help in understanding remedy performance.
- Expand the investigation of the site to include performing a Remedial Investigation / Feasibility Study for the portion of the site between the Federal Dam at Troy and the Battery in New York City. This work is necessary to determine the nature and extent of PCB contamination in the sediments, water, and biota of the Lower Hudson, and evaluate remedial alternatives to address the currently uncontrolled unacceptable risks to human health and the environment.