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General Electric Company

Water Supply Options Analysis

Town of Halfmoon, New York

Town of Waterford, New York

Hudson River PCBs Superfund Site

April 2007

ARCADIS BBL

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Hudson River PCBs Superfund Site

Prepared for:

General Electric Company

Prepared by:

ARCADIS of New York, Inc.
6723 Towpath Road
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.449.0017

Our Ref.:

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Acronyms and Abbreviations

ADD	average daily water demand
AWWA	American Water Works Association
Colonie-Latham	Town of Colonie-Latham Water District
Consent Order	Order on Consent
CPE	Comprehensive Performance Evaluation
CPWA	Clifton Park Water Authority
DBPs	disinfection byproducts
DWSRF	Drinking Water State Revolving Fund
EBCT	empty bed contact time
ECL	Environmental Conservation Law
EDI	equal discharge increment
EPA	United States Environmental Protection Agency
EPS	Engineering Performance Standard
FOIL	Freedom of Information Law
GAC	granular activated carbon
GBM	Green Bay Method
GE	General Electric Company
HAA5	haloacetic acids
Halfmoon	Town of Halfmoon
IUP	Intended Use Plan
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant level
MDD	maximum daily water demand
Mechanicville	City of Mechanicville

NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYS DWSRF	New York State Drinking Water State Revolving Fund
OM&M	operation, maintenance and monitoring
PAC	powdered activated carbon
PCBs	polychlorinated biphenyls
Phase I FDR	Phase 1 Final Design Report Hudson River PCBs Superfund Site
PWSMP	Public Water Supply Monitoring Program
QEA	Quantitative Environmental Analysis, LLC
QoLPS	Quality of Life Performance Standards
RA CHASP	Remedial Action Community Health and Safety Plan
ROD	Record of Decision
Schaghticoke	Town of Schaghticoke
Schenectady	City of Schenectady
SCWP	Saratoga County Water Project
SPDES	State Pollutant Discharge Elimination System
Stage 1 DBPR	Stage 1 Disinfectants and Disinfection Byproducts Rule
Stage 2 DBPR	Stage 2 Disinfectants and Disinfection Byproducts Rule
TID	Thompson Island Dam
Troy	City of Troy
TSS	total suspended solids
TTHM	total trihalomethanes
USGS	United States Geological Survey
Waterford	Town of Waterford
WTP	Water Treatment Plant

Units of Measurement

cfs	cubic feet per second
cy	cubic yards
gpm	gallons per minute
hp	horsepower
µg/L	micrograms per liter
mg/L	milligrams per liter
MG	million gallons
MGD	million gallons per day
ng/L	nanograms per liter
psi	pounds per square inch

Executive Summary

The Purpose of This Report

This report evaluates contingency measures that could be implemented by the Town of Halfmoon (Halfmoon) and Town of Waterford (Waterford) public water supplies, beyond the protections that already exist, to ensure the protection of drinking water during Phase 1 of the Hudson River dredging project. During the development of this report, 20 options were evaluated. For each community, one contingency measure was recommended for further discussion and study.

GE developed this report at the direction of the U.S. Environmental Protection Agency (EPA). The analysis and recommendations are based on information provided to the General Electric Company (GE) by EPA, the New York State Department of Health (NYSDOH), the New York State Department of Environmental Conservation (NYSDEC), the Waterford and Halfmoon local governments and representatives of other municipalities. GE appreciates the assistance provided by these entities. Should additional information regarding the public water supply systems become available, GE may modify or add to the information contained in this report, as warranted.

GE developed this report to evaluate potential contingency measures that the Waterford and Halfmoon water suppliers could implement — including additional PCB treatment capabilities at the municipalities' existing water treatment plants and/or alternative water sources — should Phase 1 dredging cause PCB levels in water to exceed criteria established by EPA.

It is important to note that this evaluation was conducted in the midst of a broader, multi-year public discussion of the best ways to deliver public water services in many municipalities in Saratoga County. Recently, this discussion has intensified with the prospect of new industry and a regional water authority. While this report considers aspects of this regional discussion, its focus is on the far more specific question of what contingency measures, if any, could be implemented at the *existing* Waterford and Halfmoon public water treatment facilities should PCB levels in water exceed EPA's criteria.

It should also be noted that this report addresses only potential contingency measures that could be implemented during Phase 1; contingency measures that could be implemented during Phase 2 are not the subject of this report.

Phase 1 Project Designed to Protect Water Supplies

Throughout the development of the Phase 1 dredging project, the protection of public and private water supplies has been a priority for GE and EPA. As such, EPA has already imposed the following requirements on the dredging project:

- EPA has developed a Resuspension Performance Standard that contains detailed measures designed to control the releases of PCBs to the river during dredging. Should PCB levels in the water column exceed EPA's standard during dredging, EPA will require work activities to stop until EPA determines it is appropriate to continue. EPA has said this requirement will be protective of human health, the environment and the downstream public water supplies.

- EPA's Resuspension Performance Standard contains three action levels at which response actions will be taken. These response actions, which include additional monitoring or other contingency actions, were designed by EPA to control increasing levels of PCBs in the water column before those levels exceed EPA's standard.

- During dredging, the river will be extensively monitored for PCBs and other constituents at a series of stations located between Phase 1 dredging operations near Fort Edward and the Halfmoon and Waterford water supply intakes. Data collected from these monitoring stations will provide the information needed to determine if PCB transport to downstream areas is controlled.

GE has designed the Phase 1 dredging project to meet each of these requirements. Consequently, there appears little likelihood that water at the downstream public water supply intakes would be impacted by PCBs at levels that exceed EPA's standards or cause a public health concern. Nevertheless, EPA has required consideration of other contingency measures, and this report provides an analysis of measures that could be undertaken beyond the existing protections at the Waterford and Halfmoon public water supplies.

The Public Water Supply Systems

The Halfmoon and Waterford public water supply systems are located in Saratoga County at least 30 miles downstream of all Phase 1 dredge areas. Both water systems are currently equipped with facilities that can remove PCBs from the raw water they draw from the Hudson before distribution to end users.

The Water Commissioners of the Town of Waterford operate a water treatment plant (WTP) that serves the Town and Village of Waterford. The plant, located in the village, has a rated capacity of 2.2 million gallons per day (MGD) and obtains raw water from the Hudson River. When necessary, Waterford currently obtains water from the City of Troy. To meet New York State Department of Health requirements unrelated to the Hudson River dredging project, Waterford is reportedly considering options for future public water service, including construction of a new WTP, obtaining water from Troy on a long-term basis, or major improvements to its existing WTP.

The Halfmoon WTP was constructed in 2003, has a rated capacity of 2 MGD and is currently being outfitted with upgrades that will increase its rated capacity to 5 MGD. When necessary, Halfmoon has the ability to obtain water from existing groundwater supply wells and/or from Waterford.

Water Contingency Options Evaluated

Based on what is now known about the existing Waterford WTP and distribution system, seven contingency measures were evaluated that could be implemented if Phase 1 dredging activities cause PCB levels to exceed EPA’s Decision Criteria, including:

- Supplementing the plant’s existing powdered activated carbon treatment.
- Adding post-treatment granular activated carbon.
- Adding pre-treatment granular activated carbon.
- Adding post-treatment membrane technologies.
- Obtaining water from Troy.
- Obtaining water from Halfmoon.
- Obtaining water from new groundwater supply wells.

Based on what is known about the existing Halfmoon WTP and distribution system, 13 contingency measures were evaluated that could be implemented if Phase 1 dredging activities cause PCB levels to exceed EPA’s Decision Criteria, including:

- Supplementing the plant’s existing powdered activated carbon treatment.
- Adding post-treatment granular activated carbon.
- Adding pre-treatment granular activated carbon.
- Adding post-treatment membrane technologies.
- Obtaining water from Troy through Waterford.
- Obtaining water from Troy through Schaghticoke.
- Obtaining water from the Latham Water District.
- Obtaining water from the Clifton Park Water Authority.
- Obtaining water from Mechanicville.
- Obtaining water from the planned Saratoga County Water Project through Clifton Park.
- Obtaining water from existing groundwater supply wells.
- Obtaining water from new groundwater supply wells.
- Obtaining water from the Mohawk River.

Each of the measures was evaluated for its effectiveness in providing potable water of acceptable quality and quantity on a contingency basis. Also evaluated was the technical and administrative feasibility for implementing each alternative, including the many factors that influence the ability to design, permit, test, operate and maintain each option. For this report, these contingency options were evaluated only for temporary use in the unlikely event that PCB levels in water exceed EPA’s Decision Criteria; they were not evaluated for permanent use.

Recommended Options

Currently, both the Halfmoon and Waterford WTPs are permitted by NYSDOH to use powdered activated carbon (PAC) treatment, when needed, to improve the odor and taste of finished water. The use of activated carbon to remove PCBs from water is a well-proven, state-of-the-art technology that is widely used in water treatment plants and approved by regulatory agencies.

The Waterford WTP currently adds PAC into the raw water supply during treatment for odor and taste control. The WTP is reportedly effective at removing PCBs from the raw water. In 1983, the U.S. Geological Survey (USGS) determined that Waterford's existing WTP removed from the raw water almost 90 percent of PCBs. This was attributed mainly to coagulation and sedimentation which removed PCBs associated with suspended particulates and to the addition of PAC which removed PCBs in the dissolved state. (*Polychlorinated Biphenyl Concentrations in Hudson River Water and Treated Drinking Water at Waterford, New* York [USGS, 1983]).

In 1990, an engineering study of the Waterford WTP completed for NYSDEC determined that PCBs could be removed through the "conventional treatment process." Further, the study determined dissolved PCBs could be removed with the addition of PAC in the treatment process (*Waterford Drinking Water Supply Evaluation – Hudson River PCB Remnant* [Metcalf & Eddy, 1990]).

Similarly, the Halfmoon WTP has the ability to feed PAC into the raw water supply during treatment to control odor and taste. However, according to WTP personnel, the addition of PAC has not been necessary since construction of the WTP in 2003, and no PCBs have been detected in finished water.

The contingency option most suitable for both Halfmoon and Waterford may involve supplementing the plants' existing treatment methodologies with enough powdered activated carbon to not only control taste and odor, but to also effectively remove PCBs in water in the event the PCB criteria established by EPA are exceeded. To confirm the dosages of PAC that would be required for PCB removal, GE proposes in this report to undertake treatability studies, with the oversight of EPA and NYSDOH and the cooperation of the municipalities.

In addition, NYSDOH has said it will implement a Public Water Supply Monitoring Program (PWSMP), which will confirm the existing efficiency capabilities of both WTPs at removing PCBs. The data from this sampling effort will be used to determine the current (or pre-dredge) relationship between PCB levels at in-river monitoring stations and at the public water supply intakes.

This contingency warrants further study because it builds on the existing infrastructure in both water treatment plants, both of which are permitted by NYSDOH to use powdered activated carbon during treatment. Adoption of this approach would likely require minor modifications to each plant's treatment systems or trains, but it appears that such modifications could be made without interrupting current water service to the public.

Recommendation

With the approval and oversight of EPA and NYSDOH, GE would conduct a study to determine the level of powdered activated carbon necessary to further ensure the Waterford and Halfmoon water treatment plants produce finished water for the public that meets New York State regulatory standards even if PCBs during the first phase of dredging exceed EPA's decision criteria levels. The powdered activated carbon option was chosen for further study because both plants already are equipped and permitted to use powdered activated carbon as part of their respective water treatment regimen.

1. Introduction

1.1 Overview

As required by EPA's *Final Decision Regarding General Electric Company's (GE's) Disputes Regarding EPA's June 23, 2006 Comments on the Phase 1 Final Design Report* (Final Decision) issued on November 9, 2006 (EPA, 2006), this report identifies and evaluates various contingency measures that could be applied if dredging during Phase 1 of the Hudson River remedial project was to result in polychlorinated biphenyls (PCBs) in surface water at levels exceeding criteria set by the EPA upstream of, or at the Waterford and Halfmoon public water supply intakes. The contingency measures evaluated in this report include additional treatment of surface water before it is distributed to end users, and possible alternate water sources available to Waterford and Halfmoon.

This report only evaluates potential contingency measures that might be used during Phase 1 of the dredging project. No decisions have been made regarding potential contingency measures for Phase 2.

As explained in greater detail in the following sections, EPA established a two-step process for evaluating contingency measures for Phase 1 of the dredging project. As set out in the EPA's Final Decision, the first step in the process is for EPA to develop Decision Criteria. The Decision Criteria are standards for concentrations of PCBs in the water column that, if exceeded during Phase 1 dredging operations, would trigger the implementation of contingency measures. As described below, EPA issued Draft Decision Criteria on December 22, 2006.

Second, EPA's Final Decision directs GE to evaluate and recommend contingency measures to be implemented in the event that the Decision Criteria are exceeded during Phase 1 dredging. Currently, both Waterford and Halfmoon treat water from the Hudson River before distributing it to end users. The potential contingency measures evaluated in this report include providing additional treatment to remove PCBs from the water, and also consideration of alternate water sources that could provide water to Waterford and Halfmoon, if needed.

A summary of EPA's Final Decision is presented below, followed by a summary of EPA's Draft Decision Criteria. This section also summarizes the Phase 1 dredging project, with an emphasis on the monitoring that will take place during Phase 1. This section also contains an analysis of the PCB concentrations that would be expected to be detected at the Halfmoon and Waterford intakes in the event that monitoring of dredging in Phase 1 areas shows elevated concentrations of PCBs in the water column. The approach and information sources used to perform the options analysis are also presented below, as is a summary of Stage II Byproduct and LT2 Enhanced Surface Water Treatment rules that were considered as part of the options analysis.

1.2 Summary of EPA Final Decision

Pursuant to the *Administrative Order on Consent for Hudson River Remedial Design and Cost Recovery* (EPA, 2003), effective August 18, 2003 (Index No. CERCLA-02-2003-2027), the *Phase 1 Final Design Report Hudson River PCBs Superfund Site* (Phase 1 FDR; BBL, 2006) was prepared on behalf of GE and submitted to EPA on March 21, 2006. The Phase 1 FDR presented the Final Design for Phase 1 of the remedy selected by EPA to address PCBs in sediments of the Upper Hudson River.

On June 23, 2006, EPA provided GE with comments on the Phase 1 FDR, and GE subsequently disputed some of EPA's comments on the Phase 1 FDR. On November 9, 2006, EPA issued its Final Decision on the disputed items related to the Phase 1 FDR. EPA's Final Decision described the process to be used to evaluate additional water treatment and possible alternate water supplies. The Final Decision stated that EPA would develop Decision Criteria to be used to decide when it would be necessary to implement contingency measures for the Waterford and Halfmoon water supplies. In addition, the Final Decision required GE to prepare an evaluation of options for providing additional PCB treatment capabilities and/or alternative water sources in the event that Phase 1 dredging causes PCB levels to exceed the Decision Criteria. EPA directed GE to include the following in that analysis:

- Evaluate current water supply treatment processes and PCB removal capabilities for the Waterford and Halfmoon water supplies.
- Determine the amount of water and the sources of the water to be treated and/or distributed on a daily basis during the Phase 1 dredging season (May through November).
- Identify public water supply sources other than the Hudson River that currently exist or could reasonably be obtained prior to dredging, including an assessment of the amount of water that can be provided by the alternative water sources.
- Assess potential treatment options for further removal of PCBs at the Waterford and Halfmoon water supplies during the Phase 1 dredging project.

- Identify options for contingency measures to protect the Waterford and Halfmoon water supplies during the Phase 1 dredging project.

- Provide recommended contingency measure(s) to protect the Waterford and Halfmoon water supplies during the Phase 1 dredging project.

EPA's Final Decision also requires that after EPA approves or modifies the options analysis, GE will submit to EPA for review and approval an update to the Phase 1 Remedial Action Community Health and Safety Plan (RA CHASP) that identifies the EPA-approved contingency measures that would be implemented for the Waterford and Halfmoon public water supplies if the EPA-approved Decision Criteria are triggered. [1]

1.3 Summary of Draft EPA Decision Criteria

On December 22, 2006, EPA issued draft Phase 1 Public Water Supply Contingencies Criteria (Draft Decision Criteria). EPA's Draft Decision Criteria are as follows:

- Contingency Criteria: 0.6 micrograms per liter (µg/L) total PCB at the TID station or 0.5 µg/L total PCB at any other station (i.e., Schuylerville, Stillwater, or Waterford) or at a public water supply intake.

- An exceedance requires confirmation. Any combination of two results (either on the same day or consecutive days) exceeding either 0.6 µg/L total PCB at the Thompson Island Dam (TID) station or 0.5 µg/L total PCB at any other station or water supply intake will require the initiation of contingency measures (i.e., modifying existing treatment operations, additional treatment, and/or alternate water supply, etc.).

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[1] GE is submitting this options analysis in the interest of cooperating with EPA and to address the concerns expressed by the public water suppliers. Nonetheless, GE reserves all of its rights, including those set forth in the Consent Decree for the Hudson River PCBs Superfund Site, with respect to the Decision Criteria and implementing or funding alternate water supplies or additional treatment. The Consent Decree was approved by the Court on November 2, 2006, in *United States v. General Electric Co.*, No. 05-CV-1270 (N.D.N.Y.).

1.4 Summary of Phase 1 Hudson River Project Final Design

This subsection provides a brief description of the Final Design of Phase 1 of the Hudson River dredging project, focusing particularly on the monitoring of the water column that will be conducted during dredging, since that monitoring provides the information that would trigger the Decision Criteria. Additional details regarding the Phase 1 project can be found in the Phase 1 FDR (BBL, 2006).

In addition, this subsection describes the propagation of PCBs as they would move downstream from the area where Phase 1 dredging occurs. This analysis helps to put into perspective the levels that would be expected to occur at the Halfmoon and Waterford intakes in the event that monitoring near the dredge area showed an exceedance of the Decision Criteria.

1.4.1 Description of Phase 1 Project

The Superfund Record of Decision issued by EPA on February 1, 2002 (EPA, 2002) states that dredging will occur in two distinct phases. Phase 1 is defined as the first year of dredging and includes preparatory work such as the construction of a processing and transportation facility to support the project. During Phase 1, each component of the remedy, from dredging through sediment transportation and disposal, will be tested to determine the appropriateness and validity of the assumptions incorporated into the design. Equipment and systems will be operated and examined, production and processing rates will be assessed, and safety measures will be evaluated and enhanced. In addition, water, sediment, air, odor, noise and light will be monitored throughout the project, and the results will be compared to the Engineering Performance Standards (EPS) and Quality of Life Performance Standards (QoLPS) established by EPA.

Phase 1 of the project is designed for the dredging, dewatering, and disposal of 265,000 cubic yards (cy) of sediment from about 94 acres of the river bottom. Phase 1 dredging activities are planned to begin in mid-May of the Phase 1 dredging season – weather and river flow permitting – and continue into November**.** During dredging operations, targeted sediments will be removed from the river using environmental clamshell dredging equipment. Dredging will begin in the northern end of the project area and will generally proceed downstream in such a way as to maximize safety and efficiency while not unnecessarily hindering non-project navigation on the river. Dredging in one area further south, near Griffin Island, will begin early in the program to gather valuable information on sediment resuspension. The southernmost Phase 1 dredging area is located more than 30 river miles upstream of the Halfmoon and Waterford water supply intakes.

A map showing the approximate locations of the Phase 1 dredging areas in relation to the locations of the Halfmoon and Waterford intakes is shown on Figure 1. A more detailed view of the river in the vicinity of Halfmoon and Waterford is shown on Figure 2. [2]

Sediment dredged from the river will be placed into barges and transported through Lock 7 on the Champlain Canal to the land-based processing and transportation facility in the Town and Village of Fort Edward. Here, sediments will go through a multi-stage dewatering process before being loaded into railcars for transport to a permitted landfill outside New York State. After sediment removal, certain dredged areas will be backfilled or capped with approximately one foot of clean material, habitat replacement and reconstruction will be conducted, and disturbed shorelines will be reconstructed.

The design for the Phase 1 dredging activities was developed using EPA's performance standards as a basis of the design, including EPA's Resuspension Performance Standard, which contains detailed measures to control the releases of PCBs and other compounds to the river during dredging. EPA's Resuspension Performance Standard is intended to be protective of public water supplies and the standard itself is consistent with the EPA's Maximum Contaminant Level (MCL) (0.5 µg/L), which is based on long-term exposure rather than the intermittent exposure that might occur during dredging. If the results of the surface water monitoring indicate that PCBs are detected in the water column at specific locations during dredging at concentrations exceeding EPA's Resuspension Performance Standard (i.e., 0.5 µg/L), dredging operations will stop until EPA determines it is appropriate to continue. The PCB level that spurs the stoppage of in-river activities, such as dredging, as part of the performance standards (0.5 µg/L) is lower than the Decision Criteria developed by EPA for considering the implementation of water supply contingencies (i.e., 0.6 µg/L at TID, the monitoring location closest to Phase 1 dredging).

At the end of Phase 1, the quantitative and qualitative information collected during the Phase 1 activities will be reviewed by EPA and GE, and before moving into Phase 2 (which includes all subsequent years of dredging), changes to the project, the design, or performance standards may be made.

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[2] In accordance with 6 CFR Part 29, water supply treatment, storage and distribution facilities are considered by the United States Department of Homeland Security to be critical infrastructure, and so maps showing the specific locations of those facilities are not included in this report.

1.4.2 Surface Water Monitoring During Dredging

This subsection summarizes the surface water monitoring program that will be in place throughout the dredging project. The monitoring program and the resuspension performance standard were developed to ensure "…that no public water supplies will be adversely impacted by the remediation regardless of a given water treatment plant's (WTPs) ability to treat PCB-bearing water." (EPA, 2004) To accomplish this goal, the resuspension performance standard was crafted to be conservative so that PCB levels in the raw water taken in by WTPs would be maintained below the MCL. As stated in Volume 2 of EPA's *Final Engineering Performance Standards* (EPA, 2004):

> Most of the WTPs potentially affected by the remediation have treatment systems that can reduce the concentration of PCBs in the finished water, although the current degree of reduction is unknown. For this reason, this standard will take the more conservative approach and not rely on this capability. Instead, this standard will be structured such that compliance with the standard achieves acceptable water column concentrations in the raw water. Based on this objective, PCB export must be sufficiently controlled so as to prevent exceedance of the 500 ng/L Total PCBs level at the water supply intakes at Waterford and Halfmoon, New York, the first public water supply intakes downstream of the remedial areas. While dilution and degradation can be expected to reduce PCB concentrations in the water column during transit from River Sections 1 and 2 to the public water intakes, these processes cannot be relied upon while dredging in River Section 3. Thus, dredging in River Section 3 requires that PCB export due to dredging not result in water column concentrations in excess of the federal MCL. As a conservative approach for the protection of the water supplies, this same concentration level (500 ng/L Total PCB) is applied at all far-field monitoring locations and is the standard for water column concentrations (*i.e.*, the Resuspension Standard threshold).

More details are provided in EPA's *Final Engineering Performance Standards* (EPA, 2004).

During dredging, the river will be continuously monitored for PCBs and other constituents at a series of stations (termed far-field stations) located between the Phase 1 dredging operations and the Halfmoon and Waterford water supply intakes. The data collected from these far-field stations will provide the information needed to determine that PCB transport to downstream areas is controlled such that PCB concentrations in the water column are at or below the federal drinking water MCL for PCBs of 0.5 µg/L.

As shown on Figure 1, far-field monitoring stations will be located near TID, Schuylerville at Lock 5, Stillwater, and Waterford. Additional stations will be located at Albany and Poughkeepsie. Sampling will also be performed at Cohoes to identify any PCB contributions from the Mohawk River to the lower river. The Upper Hudson River monitoring stations will be automated, and will be similar in configuration to the pilot automated sampling station that was constructed by GE at Lock 5 in Schuylerville in 2006. The automated stations will include a small building on shore, with a series of pipes (up to five) extending into the river from the building. The pipes will terminate in the river at pump intake structures that will be located in a manner that corresponds to an equal discharge increment, similar to the sampling points currently utilized for the Baseline Monitoring Program (QEA and ESI, 2004).

At each far-field station, continuous measurements of turbidity, temperature, pH, conductivity and dissolved oxygen will be collected and periodically transmitted to an electronic data management system. In addition, composite samples that represent the river cross section will be collected at each station. The composite samples will be formed from aliquots collected over 24-, 12-, 8-, or 6-hour periods, depending on the level of sampling (Routine, Evaluation, Control, or Standard as referenced in EPA's Final Engineering Performance Standards; EPA, 2004) being implemented and the location, as specified in the Resuspension Performance Standard. These composite samples will be submitted for PCB analysis. In order to provide timely information, the analytical laboratory will be required to provide PCB results from the water samples collected at TID and Schuylerville within 24 hours of the collection of the last sample aliquot at these stations, with a maximum time between collections (to the extent feasible) of four hours. Depending on the level of sampling required (Routine, Evaluation, Control, or Standard), PCB data from the remaining far-field stations may be required within 24 hours of the collection of the last sample aliquot at TID and Schuylerville. Otherwise, a 72-hour or greater laboratory turnaround time is permitted.

Data collected during routine monitoring will be evaluated as they become available. If this evaluation indicates that an applicable criterion under the Resuspension Standard or Substantive Water Quality Requirements has been exceeded, contingency monitoring will be implemented as follows:

- If PCB or total suspended solids (TSS) concentrations at TID exceed the Evaluation Level criteria during Phase 1, the sampling frequency will increase to two, 12-hour composite samples per day at TID and Schuylerville. Routine sampling will continue at the other stations.

- If PCB or TSS concentrations at TID exceed the Control Level criteria, the sampling frequency will increase to three, 8-hour composite samples per day at TID and Schuylerville. Sampling frequency at Albany and Poughkeepsie will increase to once per week and routine sampling will continue at Stillwater and Waterford. Laboratory turnaround time for PCB analysis from TID, Schuylerville, Stillwater, and Waterford will be 24 hours (when feasible).

- If the Standard Level for PCBs has been exceeded at TID or Schuylerville, the sample collection frequency at TID, Schuylerville, Stillwater, and Waterford will increase to four composite samples per day. Laboratory turnaround time will be 24 hours at these stations (when feasible).

As described above, if the results of surface water monitoring indicate that PCBs are detected in the water column at any of the fixed monitoring locations during dredging at concentrations exceeding EPA's Resuspension Performance Standard of 0.5 µg/L, dredging operations will stop until EPA determines it is appropriate to continue.

1.4.3 Downstream Propagation of PCB Release

EPA's Draft Decision Criteria set a threshold for implementing contingency measures when sampling results (including confirmation) show that water column concentrations exceed 0.6 µg/L total PCB at the TID station (located approximately 30 river miles from the water supply intakes for Halfmoon and Waterford) or 0.5 µg/L total PCB at any other station or at the Halfmoon or Waterford water supply intakes.

Apart from the Draft Decision Criteria, it should be noted that EPA's Resuspension Performance Standard for dredging operations requires that if Phase 1 dredging causes water column PCB levels at the TID station to exceed 0.5 µg/L, and the exceedance is confirmed with a second sample, dredging activities will be halted and not resumed until EPA determines it is appropriate to continue.

In order to better understand the relationship between the Draft Decision Criteria and the Resuspension Performance Standard, GE conducted an analysis of the PCB concentrations that would be expected to be detected at the Halfmoon and Waterford intakes in the event of an exceedance of the 0.5 µg/L Resuspension Performance Standard at TID. The analysis focused on the Halfmoon intake, since it is further upstream (closer to the dredge area) than the Waterford intake.

GE used its PCB Fate Model (QEA, 1999) to evaluate the amount of time it would take PCBs detected at TID to reach Halfmoon. It is important to note that this analysis assumed that PCBs would be present at the monitoring station at the assumed concentration for a period of 48 hours. The model provided estimates of the time lag between the first elevated PCB measurement at TID and the arrival of the peak PCB concentration at Halfmoon, including the reduction in concentration that naturally occurs between these points due to dilution and dispersion (i.e., spreading). The model results are conservative in that the modeling gave no consideration to the loss of PCBs due to settling or volatilization during downstream transit. The model considered what would occur during two conditions: typical summer river flow conditions, and higher flow conditions that might occasionally occur during the dredging season.

Under typical summer flow conditions of 2,000 to 4,000 cubic feet per second (cfs), the modeling results indicate the following:

- The peak concentration at Halfmoon would be about half that at TID (i.e., it would take a concentration of about 1.0 µg/L at TID to result in a peak concentration of 0.5 µg/L at Halfmoon).

- It takes two to three days for PCBs detected at TID to reach Stillwater. This provides adequate time to be able to collect additional samples in Stillwater as the PCBs move downstream from TID through that area of the river.

- It takes one additional day for the PCBs to travel from Stillwater to Halfmoon. Assuming accelerated PCB analysis time of 12 hours, there is adequate time for the Stillwater data to be used to determine the likelihood that PCB concentrations at the Halfmoon intake would exceed 0.5 µg/L.

Under higher flow conditions (greater than about 5,000 cfs), the following is estimated to occur based on modeling results:

- The peak concentration at Halfmoon would be about 60 to 65% of that at TID (i.e., a concentration of about 0.75 µg/L at TID would result in a peak concentration of 0.5 µg/L at Waterford).

- The time it would take for the PCBs to move from Stillwater to Halfmoon is much shorter (about 0.5 days or less). Therefore, it is not likely that Stillwater data could be used under these conditions to supplement the TID data for purposes of determining the estimated PCB concentrations at the Halfmoon intake.

This analysis shows that EPA's Draft Decision Criteria are highly conservative because, even without consideration of existing treatment capabilities at Halfmoon and Waterford, the criteria would require initiation of contingency measures when the criteria is exceeded at upstream monitoring stations even though the resultant concentrations at the Halfmoon and Waterford intakes may be below EPA's 0.5 µg/L MCL.

1.5 Activities Undertaken to Perform Options Analysis Evaluation

Technical background information regarding the Halfmoon and Waterford water supplies provided critical support in the preparation of this Water Supply Options Analysis. Background information was requested from the water suppliers in November 2006, and numerous meetings were held to expedite the retrieval and discussion of the information. Specifically, ARCADIS BBL and/or GE attended the following meetings to obtain information:

- November 29, 2006 meeting with representatives from Halfmoon and Waterford to discuss the Options Analysis and review information needed from the towns to complete the evaluation.

- December 5, 2006 meeting with representatives of the Waterford public water supplier to obtain information needed to conduct the Options Analysis, and to discuss Waterford's system capabilities, plans for expansion, and other pertinent issues.

- December 14, 2006 meeting with representatives of the Waterford public water supplier to obtain additional information needed to conduct the Options Analysis.

- December 14, 2006 meeting with representatives of the Halfmoon public water supplier to obtain information needed to conduct the Options Analysis, and to discuss Halfmoon's system capabilities, plans for expansion, and other pertinent issues.

- January 10, 2007 meeting with representatives of the City of Troy (Troy) public water supplier.

- January 16, 2007 meeting with representatives of NYSDEC.

- January 17, 2007 meeting with representatives of the Halfmoon public water supplier.
- January 18, 2007 meeting with representatives of NYSDOH.
- January 25, 2007 meeting with representatives of the Town of Colonie-Latham Water District (Colonie-Latham) public water supplier.
- January 30, 2007 meeting with representatives of the NYSDOH Glens Falls District Office.
- February 6, 2007 meeting with representatives of NYSDEC Region 4.
- February 13, 2007 meeting with a representative from Malcolm Pirnie, Inc. (consultant to EPA and Saratoga County).
- March 2, 2007 meeting with representatives of the City of Mechanicville (Mechanicville) public water supplier.

During the above-referenced meetings, information pertaining to the water suppliers for Halfmoon, Waterford, and/or neighboring water suppliers was reviewed and/or requested. In general, requested information was provided during or following the above-referenced meetings.[3] During preparation of this report, GE attempted to obtain current and reliable data, however, it is possible that the water suppliers or others may have additional information that could supplement the information presented herein.

[3] Under the New York State Freedom of Information Law (FOIL), information was also requested from NYSDOH and discussed in the meetings on January 18 and 30, 2007. GE received some of the information requested on March 6, 2007. However, additional requested information was not released to GE due to NYSDOH's determination that release would compromise confidentiality requirements and/or the information was restricted and not releasable under the FOIL process. GE disagrees with NYSDOH's determination, and reserves all of its rights to seek the withheld information in the future. Accordingly, this Options Analysis may be modified, revised, and/or supplemented based on further and continuing review of new documentation, as it becomes available.

1.6 Summary of Recently Promulgated Water Regulations

Recently promulgated regulations require public water suppliers to evaluate and potentially upgrade their water treatment, storage, and distribution systems within certain established timeframes. As such, the evaluation of potential alternate water sources included consideration of the potential impact of EPA's Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) and Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). These regulations were promulgated pursuant to EPA's authority under the Safe Drinking Water Act, and are generally applicable to public water suppliers.

The Stage 2 DBPR expands on the requirements of the Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR). In general, the purpose of the Stage 2 DBPR is to improve the monitoring and reduction of concentrations of the disinfection byproducts (DBPs), total trihalomethanes (TTHM), and haloacetic acids (HAA5) in water distribution systems. The Stage 2 DBPR generally requires a water system to complete an evaluation of its distribution system to characterize the existing levels of DBPs and to identify appropriate locations to monitor DBPs for compliance with the Stage 2 DBPR requirements. Compliance with the Stage 2 DBPR is based on running annual averages for each monitoring location, rather than a combined running annual average for all monitoring locations as required by the Stage 1 DBPR. The Stage 2 DBPR includes multiple requirements that must be completed (monitoring, report submission, etc.) at various interim milestone deadlines culminating with final compliance with the Stage 2 DBPR. The specific schedule for compliance with these interim and final deadlines varies by the size of the water system (i.e., population served); however, the critical deadlines generally fall between October 2006 and July 2014. It is anticipated that the deadline for final compliance with the Stage 2 DBPR for Waterford and Halfmoon will be July 2014, based on the sizes of their water systems.

In general, the purpose of the LT2ESWTR is to control microbial contaminants in water systems, principally Cryptosporidium, and to prevent a significant risk in microbial contamination that may be associated with implementation of the Stage 2 DBPR. The LT2ESWTR generally requires a water system to monitor its source water to determine the average Cryptosporidium concentration, and to use this information to evaluate the vulnerability of its source and additional treatment that may be required. The LT2ESWTR also requires water utilities to address uncovered finished water storage facilities by either installing a cover or providing additional treatment. The LT2ESWTR includes multiple requirements that must be completed (i.e., monitoring, report submission, etc.) at various interim milestone deadlines culminating with final compliance with the LT2ESWTR. Similar to the Stage 2 DBPR, the specific schedule for compliance with these interim and final deadlines varies by the size of the water system (i.e., population served); however, the critical deadlines generally fall between July 2006 and October 2016. It is anticipated that the deadline for final compliance with the LT2ESWTR for Waterford and Halfmoon will be October 2016, based on the sizes of their water systems.

The implementation of these rules may require monitoring not currently performed by the water suppliers. In addition, water suppliers may need to perform treatment system upgrades depending on the findings of the monitoring and revised compliance calculations (i.e., running annual averages for each monitoring location, rather than a combined running annual average). Based on the current schedule for implementation of the Phase 1 dredging project (i.e., May to November 2009), the compliance schedule for these rules and the assumption that alternate water sources or supplemental treatment will only be used if necessary as a short-term contingency measure, the evaluation of alternate water supply options presented in this report assumes that implementation of such contingency measures will not require compliance with these rules by Waterford or Halfmoon.

1.7 Report Organization

This Options Analysis Report has been prepared by ARCADIS BBL [formally known as Blasland, Bouck, and Lee, Inc. (BBL)] on behalf of GE with input from Quantitative Environmental Analysis, LLC (QEA) and GE. This Options Analysis Report is organized into the sections shown in Table 1.1, below.

Table 1.1 – Report Organization

Section	Description
Acronyms and Abbreviations	Provides definitions of acronyms used in this report.
1 Introduction	Provides background information and a description of the purpose and objectives of the options analysis.
2 Waterford – Summary of Water Supply and Treatment Capabilities	Provides a summary of information related to the water supply for Waterford.
3 Halfmoon – Summary of Water Supply and Treatment Capabilities	Provides a summary of information related to the water supply for Halfmoon.
4 Identification and Preliminary Screening of Potential Water Supply/Treatment Contingency Options	Summarizes the initial screening of potential contingency options for additional treatment capabilities and alternate water sources.

Section		Description
5	Evaluation of Potential Water Supply/Treatment Contingency Measures	Summarizes the evaluation of potential contingency measures for additional treatment capabilities and alternate water sources.
6	Recommended Contingency Measures	Identifies the recommended contingency measures to be implemented if necessary based on the results of monitoring at designated stations.
7	References	Provides references cited in this report.

2. Waterford – Summary of Water Supply and Treatment Capabilities

This section provides information about the water supply treatment and distribution system operated by the Water Commissioners of the Town of Waterford. This information was obtained from Waterford, NYSDEC, NYSDOH, and other sources (as referenced below).

2.1 Water Supply Source and System Description

The Water Commissioners of the Town of Waterford operate a WTP located in the Village of Waterford. The plant has a rated capacity of 2.2 MGD and obtains its raw water from the Hudson River. On a contingency basis (described below), Waterford obtains water from the City of Troy.

The Waterford WTP is the primary source of potable water for the Town and Village of Waterford. The WTP and distribution system regularly serve a population of approximately 9,800 through approximately 3,100 service connections (Delaware, 2005; NYSDOH, 2006). In addition, Waterford has a contract to provide a minimum of 0.3 MGD to Halfmoon, located to the north (Halfmoon, 2006c). Waterford provides water to Halfmoon through two 12-inch diameter pipes (Halfmoon, 2006c; Clough Harbour, 2006). Halfmoon is reportedly permitted to obtain up to a maximum of 1.0 MGD from Waterford through these interconnections (NYSDEC, 1996). The water supply contract between Waterford and Halfmoon is scheduled to expire at the end of 2021 (Waterford, 1981).

Waterford has a contract with Troy to purchase up to 7 MGD of water at the prevailing Troy rate plus 25% (Troy, 2006b). The connection to the Troy distribution system is through a 14-inch steel water main that is encased in insulation and an aluminum jacket and suspended below a bridge that crosses the Hudson River. This connection was constructed in 1972 and is metered (Standard, 1983). The source of water for the Troy supply is the Tomhannock Reservoir, which is a man-made reservoir located approximately 6.5 miles northeast of Troy (Troy, 2005). Currently, Waterford uses the connection with Troy to supplement or temporarily replace its supply from the Waterford WTP during periods of high demand or periods of high turbidity in the raw water taken from the Hudson River (Delaware, 2005; Waterford, 2006b). In June 2004, NYSDEC notified Waterford that a permit was required for this connection under the Public Water Supply Program, apparently since it was “routinely used for a period of years” and was no longer considered to be just for emergency use (NYSDEC, 2004b). A January 6, 2005 letter from NYSDEC to Waterford indicated that Waterford was scheduled to submit a permit application to NYSDEC by the end of October 2004; however, it was never received by NYSDEC and the use of this existing connection may represent an unpermitted water withdrawal from Troy (NYSDEC, 2005d). When the connection to Troy is opened, Waterford closes its connections with Halfmoon (Clough Harbour, 2006).

During the three-year period from 2003 to 2005, Waterford purchased three to 15 million gallons (MG) per year from (Waterford Water Commissioners, 2005; 2004; 2003). During September and October 2006, Waterford and NYSDOH performed a flow test of the 14-inch water main connecting the Troy and Waterford systems to evaluate water supply capacity and available pressures. The results of the flow test indicated that this connection maintained an average pressure ranging between approximately 98 pounds per square inch (psi) and 105 psi as measured by a gauge located at the connection, and 81 psi to 85 psi as measured by a gauge located at the Waterford WTP, while providing a flow ranging between approximately 4.2 MGD and 5.3 MGD (NYSDOH, 2006c; 2006d).

The Waterford distribution system is served by three steel above-ground storage tanks constructed in the 1950s (referred to as the Prospect Hill Tank, Northside Tank, and Swatling Tank). The Village of Waterford is served primarily by the Prospect Hill Tank, the northwest portion of Waterford is served by the Swatling Tank, and the “northside” section of Waterford in the vicinity of Valley View Avenue and Grace Street is served by the Northside Tank.

Table 2.1 – Waterford Distribution System Storage Tank Information

Tank Name	Total Storage Volume (MG)	Type of Storage Tank
Prospect Hill	0.33	Ground
Northside	0.33	Standpipe
Swatling	0.50	Standpipe
Total	**1.16**	**-**

Note:

1. Waterford, 1992; Delaware, 2005;; Standard, 1990.

As presented in Table 2.1, the three storage tanks have a total volume of 1.16 MG. The available storage volume, defined as the storage volume in excess of the volume required to maintain a minimum system pressure of 20 psi, is reported to be 0.54 MG (approximately 47% of total storage volume) (Standard, 1990). The remaining 0.62 MG (approximately 53% of the total storage volume) is considered to be unavailable and serves the purpose of maintaining a minimum system pressure of 20 psi (Waterford, 1992; Standard, 1990).

The Waterford distribution system contains approximately 35.4 miles of water mains between four and 14 inches in diameter (19.1% are 6-inch diameter and smaller, 45.7% are 8-inch diameter, and 35.2% are 10-inch diameter or larger) (Standard, 1990).

Waterford has booster pump stations in the distribution system located near the Northside Tank (Northside Pump Station) and the Prospect Hill Tank (Prospect Hill Pump Station). These pump stations do not have emergency backup generators. In accordance with Waterford's Emergency Response Plan, in the event of an extended power outage, the connection with Troy is opened and portable electrical power generators are rented to operate the pump stations (Delaware, 2005; Waterford, 2006b).

2.2 Water Treatment Processes and Capacities

The Waterford WTP is located along the west side of the Hudson River, north of the river's confluence with the Mohawk River. The Waterford WTP has been in operation since 1913 and underwent a major upgrade in 1957. According to information included in NYSDOH's *Comprehensive Performance Evaluation (CPE) Report* (NYSDOH, 1997), Waterford's WTP includes the following components and processes:

- An 18-inch diameter intake pipe that extends into the Hudson River and draws water from a location above the river bottom.

- Two 30-horsepower (hp) vacuum-primed low-lift pumps that draw raw water from the river through a gate-type duplex strainer with two ¼-inch screens and discharge to the head of the aeration chambers.

- A three-stage aeration/rapid mix/coagulation basin that incorporates diffused air, alum, sodium aluminate and sodium silicate. Diffused air from two rotary blowers is used to control iron and manganese.

- A dual-train flocculation system, with each train consisting of four sequential flocculation basins with variable speed wire screen paddle mixers.

- A powdered activated carbon (PAC) feed system consisting of a hopper, mixing tank, and feed pump. The PAC is used for taste and odor control, and is added into the third flocculation basin of each train.

- A two-stage sedimentation process. Each stage consists of a set of two parallel sedimentation basins, one set located directly under the flocculators (stage 1) and one set located immediately prior to the filters (stage 2). No mechanical sludge removal facilities are provided in the sedimentation basins. Cleaning of the basins is accomplished by draining the basins and washing them down, with the washwater draining to an on-site drain.

- A gas chlorination system utilizing 150-pound cylinders, chlorine regulators, valves, piping, and appurtenances to provide disinfection. Chlorine is added prior to the stage 2 sedimentation basins (i.e., pre-filtration disinfection) and into the clearwell (i.e., post-filtration disinfection).

- Four dual-media filters consisting of anthracite and sand, over support gravel and transite underdrains.

- A 67,000-gallon clearwell located directly below the filters. Soda ash, fluoride, and chlorine are fed into the clearwell. Chlorine is added to provide post-filtration disinfection, soda ash is added for pH adjustment, and fluoride is added to provide protection against dental caries.

- Three high-lift pumps that supply finished water to the distribution system.

Currently, untreated backwash water is discharged from the WTP to the Hudson River via a connection to the on-site storm sewer system. On November 17, 2005, NYSDEC executed an Order on Consent (Consent Order) with the Water Commissioners of the Town of Waterford to address violation of the NYS Environmental Conservation Law (ECL). NYSDEC determined that the Waterford WTP routinely discharges untreated settling basin sludge and filter backwash to the Hudson River without a State Pollutant Discharge Elimination System (SPDES) permit (NYSDEC, 2005c). The Consent Order identifies the following significant milestone dates for submittals and compliance for Waterford's WTP:

- On or before May 1, 2006, provide a report and schedule of interim measures, pending upgrades to the Waterford WTP or connection to the Town of Waterford Sewer District sewer system.

- On or before March 1, 2007, connect discharges to Town of Waterford Sewer District sewer system.

- On or before June 1, 2007, if not able to connect to Town of Waterford Sewer District sewer system, submit final design and construction documents for a wastewater collection and treatment system with a complete SPDES permit for approval.

- On or before December 31, 2008, complete construction of the approved wastewater collection and treatment system.

- On or before March 1, 2009, achieve compliance with the final effluent limits contained in the approved SPDES permit.

- On or before March 1, 2009, cease illegal discharge from the Waterford WTP.

A January 6, 2005 letter from NYSDEC to Waterford acknowledged receipt of a preliminary engineering study for construction of a new WTP to serve Waterford as the proposed method to resolve the sludge discharge compliance issues (note: a copy of this study was not provided to GE during this options analysis). Although Waterford is apparently considering construction of a new WTP to address the Consent Order as indicated above (NYSDEC, 2005c), the actual proposed course of action (and associated schedule) that will be implemented by Waterford to address the Consent Order has not been confirmed.

2.3 Current and Projected Water Demand and Rates

Waterford's average daily water demand (ADD) and maximum daily water demand (MDD) for 2003, 2004, and 2005 are listed in Table 2.2 below (Waterford Water Commissioners, 2003; 2004; 2005). The overall ADD for this period was approximately 1.7 MGD.

Table 2.2 – Waterford Water Demand – 2003 to 2005

Year	ADD (MG)	MDD (MG)
2003	1.8	2.6
2004	1.7	1.9
2005	1.6	2.5

Note:

1. Waterford, 2003; 2004; 2005.

Long-term projections of Waterford's water demand have not been provided by Waterford. However, a *Preliminary Engineering Report* (Delaware, 2005) estimated that water demand could increase by 0.72 MGD over the next 10 years (or annually by 4%). This projection assumed the development of two large tracts of undeveloped residential land in Waterford, totaling approximately 700 acres. On the basis of this projection, the report recommended that the existing WTP be replaced by a new WTP having a capacity of 2.88 MGD or 2,000 gallons per minute (gpm) with one filter out of service, and 3.6 MGD with all filters operating.

Based on assumptions included in the *Preliminary Engineering Report* (Delaware, 2005), the ADD is projected to be approximately 2 MGD in 2009 when the Phase 1 dredging activities are scheduled. Applying the existing MDD-to-ADD ratio of 1.5, the estimated MDD for 2009 is 3 MGD.

Finished water production information presented in the daily logs of the Waterford WTP from 2004 through 2006 was reviewed to determine the ratio of the ADD for the period from May through November (i.e., anticipated months of Phase 1 dredging activities) to the ADD for the full 12-month period for January through December (Waterford, 2006c). In 2004, this ratio was estimated to be 1.04, and increased by an estimated 5% annually for an estimated value of 1.14 in 2006. Conservatively, assuming this trend continues, this ratio is estimated to be 1.3 in 2009. Applying this ratio to the projected 2009 ADD of 2 MGD, the estimated ADD for May through November 2009 is approximately 2.6 MGD.

Waterford’s 2006 water rate for residential and industrial customers was $2.37 per thousand gallons (Waterford, 2006a). In 2005, Waterford charged Halfmoon $2.82 per thousand gallons for the first 27 million gallons per quarter and $2.51 per thousand gallons above 27 million gallons per quarter. In 2005, Waterford reportedly paid $4.87 per thousand gallons for water purchased from Troy (Waterford, 2005). As presented in Section 2.1, however, information from Troy indicates that they sell water to Waterford at a rate equal to the prevailing Troy rate plus 25% (Troy, 2006b). Applying this formula for 2005, the rate would have been $3.79 per thousand gallons (Troy, 2006a), which is $1.08 less than the rate reported by Waterford (Waterford, 2005). The reason for this discrepancy is not known.

2.4 Assessment of Existing PCB Treatment Capabilities

This subsection provides information regarding the existing PCB removal capabilities of the Waterford WTP and studies that have been performed to evaluate its PCB treatment capability.

2.4.1 USGS Evaluation of PCBs in Hudson River Water and Treated Drinking Water at Waterford

In 1983, the USGS, in cooperation with Waterford and NYSDEC, performed a study that was reported in *Polychlorinated Biphenyl Concentrations in Hudson River Water and Treated Drinking Water at Waterford, New* York (USGS, 1983). This study evaluated the removal efficiency of PCBs at the Waterford WTP based on PCB concentration data for the period between 1975 and 1981. PCB concentrations in untreated raw water were compared to concentrations in treated drinking water to determine average removal efficiency. Removal efficiencies were determined for periods of high and low flow in the Hudson River. The results of this study indicated that at the Waterford WTP "the processes used to purify water removed almost 90 percent of PCBs. During high flows, the concentration-weighted average removal efficiency was 87 percent. Coagulation and sedimentation are probably the most important phases for PCB removal during high flows, when PCBs are associated with suspended particulates. At lesser flows, when PCBs are mostly in the dissolved state, the removal efficiency since 1976 was 88 percent. The removal of PCBs during these lesser flows is attributed to the addition of powder activated carbon." (USGS, 1983).

2.4.2 1990 Water Supply Evaluation

In 1990, Metcalf & Eddy performed a study for NYSDEC titled *Waterford Drinking Water Supply Evaluation – Hudson River PCB Remnant* (Metcalf & Eddy, 1990). The study evaluated PCB concentration data from 1976 through 1989. The scope of the study included data review and summary, evaluation of the Waterford WTP, and a public health risk assessment. The study stated that PCBs can be removed with the particulate matter through the "conventional treatment process," which includes coagulation, flocculation, and media filtration. The study indicated that dissolved PCBs can be removed by the addition of PAC. Additional conclusions from the study are summarized below (Metcalf & Eddy, 1990):

- According to NYSDOH and Waterford data, "historical Hudson River water quality at Waterford indicates that the maximum PCB concentrations have decreased since sampling was initiated in 1976 from 1.4 µg/L to below the detection limit (0.01 µg/L) in 1985."

- USGS data indicated that the PCB concentration in Hudson River water at the time of the study was between the 0.1 µg/L detection limit (generally used by the Waterford WTP and NYSDOH) and zero. NYSDOH data indicated that the treated water from the Waterford WTP "has not exceeded the step II action level (0.1 µg/L) since 1976."

- The WTP process at Waterford has historically removed a minimum of 67 percent of the total PCB concentrations during treatment. Sixty-seven percent was the lowest removal efficiency observed during sampling, which occurred from January 1976 to September 1982.

- "Many of the unit processes at the water treatment plant do not meet current standards as outlined in NYCRR Title 10 Part 5-1.22(b) Bulletin 42, Recommended Standards For

Water Works, 1987 Edition. These shortcomings are expected to decrease the PCB contaminant removal efficiency of the plant."

- Though "outdated and strained," the Waterford WTP is providing a "safe supply of drinking water that meets state and federal standards with respect to PCBs."

- Measured PCB concentrations in treated water from the Waterford WTP were below the federal drinking water standard of 0.5 µg/L (the MCL) and the NYSDOH action level of 0.1 µg/L.

Based on these conclusions, the study included the following recommendations for design of a new WTP in Waterford (Metcalf & Eddy, 1990):

- "When a new treatment facility is implemented, it should be designed for removal of organics in particulate and solution form to address the variations in Hudson River quality."

- "Specifically, the addition of post-filtration granular activated carbon (GAC) contactors or utilization of GAC medium filters for the dual purpose of particulate removal and removal of organics in solution is recommended."

- "Intake facility modifications should also be considered to maximize the quality of Hudson River water entering the plant by minimizing particulate matter and turbidity in the influent water."

- "Until a new treatment plant is built, the existing facilities could be upgraded by the addition of GAC polishing filters. This would ensure a continuous supply of safe water."

- Another recommendation to Waterford was to perform a PCB water quality analysis to provide information useful in designing a new WTP.

2.4.3 Water Supply Sampling Data – 2002 through 2006

Based on information provided by Waterford, between 2002 and 2006, PCB concentrations in both raw water and finished water analyzed using EPA Method 508 were less than laboratory detection limits and the MCL drinking water limit of 0.5 µg/L (JH Consulting, 2006).

2.4.4 NYSDOH Public Water Supply Monitoring Program

Prior to and during Phase 1 dredging, NYSDOH, in consultation with EPA and NYSDEC, intends to implement a Public Water Supply Monitoring Program (PWSMP) to monitor public water supplies that draw water from the Hudson River and provide sufficient data to confirm that, during dredging, public water supplies comply with the EPA's MCL of 0.5 µg/L for PCBs (NYSDOH, 2006a). The PWSMP includes monitoring in the upper river at the Halfmoon and Waterford WTPs, and in the lower river at the Rhinebeck and Poughkeepsie WTPs. The PWSMP will include baseline monitoring prior to dredging and monitoring during dredging. The PWSMP will include monitoring of raw water and finished water to supplement in-river surface water monitoring conducted as part of the Phase 1 dredging project. Samples will be analyzed for PCBs using the same congener-specific method (Green Bay Method) used for in-river surface water monitoring. Finished water samples will also be analyzed for PCBs using an Aroclor-based method (EPA Method 508), which is a required analytical method for public water suppliers.

Baseline monitoring is expected to begin at the Waterford and Halfmoon WTPs during the summer of 2007 and end in the fall of 2007. The data from this sampling effort will be used to determine the current (or pre-dredge) relationship between PCB levels at in-river monitoring stations and at public water supply intakes.

2.5 Previously Recommended Upgrades and Estimated Costs

Previous reports have presented evaluations of the Waterford WTP and distribution/storage system. Many of these reports included recommendations for improvements to the water system infrastructure, including the WTP, distribution system, and storage tanks. The following list summarizes the recommended improvements and their estimated costs (where applicable or available):

- In response to a 1983 failure of the 14-inch Waterford-Troy water main, Waterford conducted a study of this inter-system connection. The study reviewed the failure and presented four options for improvement of the water main. Estimated costs for the proposed options ranged from approximately $45,000 to $170,000 (1983 dollars) (Standard, 1983). It is not known which, if any, of these options was implemented, or if the water main was replaced or modified. However, it is understood that this water main is currently functional and is used as a supplemental/contingent water supply for Waterford. The study is documented in a *Report on 14" Waterford–Troy Water Main* (Standard, 1983).

- In 1989, the condition of a 12-inch unlined cast iron water main on Middletown Road was evaluated (Standard, 1989). The investigation concluded that a section of the water main, which was installed in 1958, should be cleaned or replaced; the report did not include estimated costs. It is not known if all or portions of this water main were cleaned or replaced. Details of this study are included in a report titled *Investigation of 12-inch Water Main on Middletown Road, Town of* W*aterford, New York* (Standard, 1989).

- In 1990, the Waterford distribution and storage systems were studied to evaluate their condition. The evaluation concluded that many repairs were needed, including construction of two new storage tanks and water main replacements. The estimated costs for the improvements were $5,519,550 (1990 dollars). Details regarding this evaluation were provided in a report titled *Distribution System Analysis Town and Village of Waterford, Saratoga County, New* York (Standard, 1990).

- In 1992, the general manager of the Waterford Water Works prepared a memorandum (Waterford, 1992) that examined the conclusions and recommendations included in Standard Engineering's 1990 Study (Standard Engineering, 1990). The memorandum indicated that supplemental storage had been ruled out due to space limitations and the aesthetics of having two water tanks side-by-side (Waterford, 1992).

- In 1992, three options were presented to upgrade the WTP to 3.0 MGD. Each option included a GAC system for polishing water after the filtration process. The estimated costs for these options were $5,722,500 for a new conventional WTP, $5,018,300 for a new packaged WTP, and $4,415,000 for rehabilitation of the existing WTP (1992 dollars). Details regarding this evaluation are included in a report titled *Water Commissioners of the Town of Waterford – Water Plant Evaluation and Treatment Alternatives* (Standard, 1992).

- In 1996, a study was conducted to determine the potential for transporting water from Troy through Waterford to Halfmoon while maintaining safe working pressures within the distribution systems. This study involved modeling water flow through the distribution systems using a computer modeling software package known as "EPANET." The software runs a hydraulic model known as Extended Period Simulation (Dillon, 1996). Details and conclusions of this analysis were included in a report titled *Distribution System Analysis Troy-Waterford-Halfmoon Water Transportation* (Dillon, 1996). One of the conclusions presented in the report indicated that Halfmoon could obtain approximately 2 MG over a 24-hour period at varying flow rates from a connection to the Waterford system in the vicinity of the intersection of Brookwood Road and Hudson River Road.

- In 1997, NYSDOH performed a Comprehensive Performance Evaluation (CPE) of the Waterford WTP to evaluate major unit processes, assess WTP performance and evaluate operation and maintenance of the facility. The CPE report summarized the findings of the evaluation and presented recommendations from NYSDOH for improvements including operation/maintenance items, backflow protection, operator safety, and other miscellaneous items (NYSDOH, 1997). Details regarding this evaluation are summarized in a report titled *Results of the Comprehensive Performance Evaluation of the Waterford Water Filtration Plant* (NYSDOH, 1997).

- In 2001, three pilot studies of alternate water treatment processes were performed to evaluate potential replacement processes for the existing Waterford WTP. The pilot studies evaluated USFilter Actiflоc™, WesTech ClariCell™, and DualSand™ Filtration System as potential replacement processes for the existing WTP. The pilot studies were performed to demonstrate whether the processes would meet NYSDOH requirements for turbidity and particle removal. The findings of the pilot studies indicated that each of these processes successfully removed turbidity and particles at or exceeding NYSDOH requirements. Details related to these studies are included in reports titled *Pilot Study Report, Actiflоc™ Water Treatment System and Waterford, New York* (USFilter, 2001), *WesTech ClariCell™ Demonstration Pilot Plant Report* (WesTech Engineering, Inc, 2001), and *Waterford Waterworks Drinking Water System Pilot Plant Test Report* (DSS Environmental, 2001).

- In 2005, the Waterford water treatment, storage, and distribution systems were evaluated. Details for this evaluation are included in a *Preliminary Engineering Report, Water Commissioners, Town of Waterford Water System Improvement Project, Waterford, Saratoga County, New York* (Delaware, 2005). Numerous recommended improvements were presented in the report, including: improvements to the raw water intake; replacement of one storage tank and refurbishment of the other two storage tanks; replacement of existing pumping facilities; replacement of existing sections of water mains; installation of new water mains; and replacement of the existing Waterford WTP with a new WTP. The total estimated cost presented for the distribution storage system improvements was $3,770,756 (2005 dollars) and the total estimated cost for replacement of the existing WTP was $6,384,000 (2005 dollars) (Delaware, 2005).

- In 2006, a tentative plan for long-term water service from Troy was developed to address the possibility that the Hudson River source might not be available during dredging. The plan recommended improvements to the Waterford system in the event that Troy becomes the primary water supply source for Waterford on a long-term basis. The recommended improvements included storage tank replacements/refurbishments and water main replacements for a total estimated cost of $8,500,000 (2006 dollars) (Delaware, 2006).

In addition, improvements to the Waterford system were recommended to support an option to provide Halfmoon with up to 5 MGD from Troy through the Waterford distribution system. The recommended improvements included installation of a 20-inch diameter connection to the Troy system via directional drill under the Hudson River and numerous water main improvements within Waterford and north to the Halfmoon Town Line for an estimated cost of $14,125,000 (2006 dollars) (Delaware, 2006). Details regarding this evaluation are summarized in a report titled the *Water Commissioners of the Town of Waterford – Hydraulic Study and Tentative Plan Requirements for Long Term Water Service from the Troy Interconnect* (Delaware, 2006).

Several of the improvements to the Waterford system recommended to support a long-term water supply from Troy to Waterford and from Troy to Halfmoon (transported through Waterford) have been previously identified, but have not been implemented. It appears that many of these improvements will be required to upgrade Waterford's existing system, regardless of whether water is ultimately obtained from Troy for Waterford and/or Halfmoon.

- Waterford is seeking funding from the New York State Drinking Water State Revolving Fund (NYS DWSRF) for two separate projects. The projects in order of highest point score (as listed in the 2007 Intended Use Plan) are a New Water Treatment Plant (funds requested are $4,635,000) and New Storage, Upgrade Distribution System (funds requested are $6,706,875). Details related to these proposed projects are presented in the *NYS Drinking Water State Revolving Fund Final Intended Use Plan, Funding Period October 1, 2006 to September 30, 2007* (NYSDOH, 2006). This reference suggests that Waterford has submitted reports to NYSDOH indicating that there is need for such improvements.

In summary, to meet NYSDOH requirements and maintain system reliability unrelated to the Hudson River dredging project, Waterford is reportedly considering options for public water service, including construction of a new WTP, obtaining water from Troy on a long-term basis, or major improvements to its existing WTP. Over the past 25 years, multiple evaluations and studies have been performed of the Waterford WTP and/or distribution and storage system and have recommended various improvements. Major recommended upgrades (e.g., replacement of the existing WTP) have not been implemented. Based on the information obtained and reviewed in conjunction with performance of this options analysis, it is unclear which, if any, additional improvements have been implemented. Although not available during the preparation of this report, additional information may be available from Waterford and/or NYSDOH to confirm what improvements have been implemented.

3. Halfmoon – Summary of Water Supply and Treatment Capabilities

This section provides information about the water supply treatment and distribution system operated by the Town of Halfmoon Consolidated Water District.[4] This information was obtained from Halfmoon, NYSDEC, NYSDOH, and other sources (as referenced below).

3.1 Water Supply Source

The Halfmoon WTP was constructed in 2003 and uses the Hudson River as its water supply source. The Hudson River was recommended as the source of supply in 1999 based on a water source study that was conducted on behalf of Halfmoon (Clough Harbour, 2000a). The study evaluated many surface water source alternatives including the Mohawk River, Tomhannock Reservoir, Mechanicville Reservoir, and the Hudson River. Groundwater supplies within Halfmoon and Clifton Park were also considered. Ultimately, the Hudson River was selected as the most cost effective and reliable source for water supply. The Halfmoon WTP and distribution system serve a population of approximately 12,000 through approximately 4,500 service connections within the Town of Halfmoon (Halfmoon, 2005). The Halfmoon WTP has an operating capacity of 2 MGD (Halfmoon, 2005; Clough Harbour, 2005). Halfmoon is implementing upgrades to the WTP that will reportedly be completed in the first half of 2007. These upgrades, which are part of Halfmoon's Phase 2 Water Source Improvement Project, will increase the rated capacity of the WTP to 5 MGD (Clough Harbour, 2005).

Prior to completion of the Halfmoon WTP in August 2003, the primary sources of supply for Halfmoon were a series of groundwater supply wells known as the "Hoffman Wells," other groundwater supply wells, and water purchased from Waterford (described below) (Halfmoon 2002; 2003). The Hoffman Wells consist of five groundwater wells and a pump station that are located in the northern portion of the town and are still functioning. These wells are permitted for a total maximum capacity of 1.4 MGD (NYSDEC, 1994; Halfmoon, 2005). However, available documentation indicates that the actual capacity of the Hoffman

[4] A section of Halfmoon, referred to as Halfmoon Water District No. 1, is currently isolated from the Halfmoon Consolidated Water District and is not supplied by the Halfmoon WTP. Halfmoon Water District No. 1 is supplied by the City of Mechanicville, which does not utilize the Hudson River as its water supply source. Accordingly, the water demand values reported by Halfmoon and summarized in this report do not include the water demand for Halfmoon Water District No. 1, nor is District No. 1 included in the evaluation of water supply contingency options.

Wells is less than the permitted source capacity. During a recent meeting, representatives from Halfmoon indicated that the Hoffman Wells are capable of supplying approximately 0.6 MGD for short durations (Halfmoon, 2006c). In 2005, the Hoffman Wells were used only to supplement the WTP supply during maximum demand periods. The other groundwater supply wells have reportedly been abandoned due to unreliable water quality (Halfmoon, 2005) and Halfmoon has also indicated a desire to remove the Hoffman Wells from service upon completion of the Phase 2 improvements to the WTP.

As described in Section 2.1, Halfmoon has an existing contract with Waterford for Halfmoon to purchase a minimum of 0.3 MGD, and reportedly is permitted to obtain a maximum of 1.0 MGD from Waterford (NYSDEC, 1996). This water supply is delivered to Halfmoon through two 12-inch diameter metered connections from Waterford (Clough Harbour, 2006; Halfmoon, 2006c), one of which has a booster pump station. The contract agreement extends until December 31, 2021 (Waterford, 1981). As presented in Section 2.1, however, when Waterford obtains water from Troy (i.e., during periods of high demand or high turbidity), the connections between Halfmoon and Waterford are closed (Clough Harbour, 2006). It is not known how this specific condition is incorporated into the terms of the existing contract.

Halfmoon also has a connection with the Clifton Park Water Authority (CPWA) water distribution system (Clough Harbour, 2006). According to Halfmoon, however, the hydraulic head of the Halfmoon system is higher than that of the CPWA system at this connection. Consequently, this connection typically cannot be used to supply water from the CPWA system to Halfmoon. Halfmoon indicated that booster pumping facilities would be required to enable water to flow from the CPWA system to Halfmoon (Clough Harbour, 2006).

The Halfmoon distribution system contains approximately 100 miles of water main (Halfmoon, 2006b). The system is served by four above-ground water storage tanks that provide a total storage volume of 2.95 MG. Specific information for each of the tanks is provided in Table 3.1 below (Halfmoon, 2005).

Table 3.1 – Halfmoon Distribution System Storage Tank Information

Tank Name	Total Storage Volume (MG)	Type of Storage Tank (type)
Angle Lane	0.40	Elevated
Werner Road #1	0.75	Elevated
Werner Road #2	1.00	Elevated
Brookwood	0.80	Stand Pipe
Total	**2.95**	**---**

Note:

1. Halfmoon, 2005.

3.2 Water Treatment Processes and Capacities

Upon completion of the Phase 2 improvements (anticipated in first half of 2007), Halfmoon's WTP will include the following components and processes (Clough Harbour, 2000b; 2005), and will be permitted for up to 7 MGD withdrawal from the Hudson River (NYSDEC, 2005a; 2005b):

- A 12 MGD raw water intake structure consisting of several chambers that act as a sediment settling area and wet well for raw water pumps.

- Four 75-hp, 2-MGD raw water pumps that feed a 16-inch-diameter force main to the WTP.

- Coagulant (alum) that is added to the raw water via feed pumps prior to static mixing and the Actifloc™ treatment units (described below).

- A PAC feed system for taste and odor control, located after static mixing and prior to the treatment units. Based on information provided by Halfmoon, the PAC system has not been used since startup of the WTP (Halfmoon, 2006a).

- Three 1-MGD USFilter Actifloc™ treatment units and two 2-MGD USFilter Actifloc™ treatment units with a total plant capacity of 7.0 MGD. If the largest process train is out of service or in backwash cycle, the rated capacity of the WTP will be 5.0 MGD. Each treatment unit consists of two complete process trains, which include two-stage flocculators with variable speed adjustment, a settling compartment with horizontal tube settlers, and a mixed media filter compartment with an underdrain system.

- One 202,000-gallon chlorine contact tank and one 252,000-gallon chlorine contact tank for dissolution of sodium hypochlorite. The chlorine is added to the filtered water lines just prior to the contact tanks. Also, provisions have been made for prechlorination of the raw water line prior to the treatment units.

- Clearwells, located adjacent to the chlorine contact tanks and sized at 100,000 gallons and 202,000 gallons.

- Two 250-hp, 2.0 MGD finish water pumps and two 500-hp, 4.0 MGD finish water pumps that provide finished water to the distribution system.

Also, as part of the Phase 2 improvements, Halfmoon is constructing the following improvements to the distribution system (Clough Harbour, 2005):

- Approximately 23,000 linear feet of 24-inch diameter transmission main and appurtenances will be constructed from the WTP.

- Approximately 5,700 LF of 16-inch diameter main will be constructed.

- Additional 12-inch and 8-inch mains will be installed to provide loops in the distribution system.

3.3 Current and Projected Water Demand and Rates

The ADD for Halfmoon was approximately 1.6 MGD between 2003 and 2005, based on annual drinking water quality reports published by Halfmoon. The ADD and MDD for 2003, 2004, and 2005 are summarized in Table 3.2 below.

Table 3.2 – Halfmoon Water Demand – 2003 to 2005

Year	ADD (MG)	MDD (MG)
2003	1.5	2.6
2004	1.6	2.6
2005	1.8	2.9

Note:

1. Halfmoon, 2003; 2004; 2005.

During completion of the Water Source Study, Halfmoon's engineer developed projected future water demands for the town (Clough Harbour, 2000a). The projections were based on the rate at which users were added to the Halfmoon water system over the period between 1992 and 1998. An annual increase in average water supply of approximately 0.09 MGD per year was identified as the rate of increase during this period. Based on this rate of increase, the ADD was projected to be 3.05 MGD by 2018. The 2018 MDD was projected to be 6.10 MGD, based on the annual ratio of MDD-to-ADD of 2.0 for 1996, 1997, and 1998 (Clough Harbour, 2000a; 2000b; 2005).

Subsequent to the development of the demand projections presented in the Water Source Study (Clough Harbour, 2000a) in 1999, the ADD and MDD have risen slower than these projections forecast. The demand trends were presented by Halfmoon's engineer in the basis of design for the *Phase II Source Water Improvement Project Report* (Clough Harbour, 2005), which included water demand data through 2005. The revised water supply demand projections presented in the Phase II Report (Clough Harbour, 2005) estimated an ADD of 2.25 MGD and an MDD of 4 MGD for 2009 and an ADD of 3 MGD and an MDD of 5.25 MGD for 2018.

Monthly finished water production information provided by Halfmoon for 2004 through 2006 (Halfmoon, 2006c) (i.e., for the WTP, the Hoffman Wells, and an assumed 0.3 MGD from Waterford) was reviewed to determine the ratio of the ADD for the period between May through November (i.e., anticipated months for the Phase 1 dredging activities) to the ADD for the full 12-month period between January through December (Halfmoon, 2006c). In 2004, this ratio was estimated to be 1.12, and increased by an estimated 3.5% annually for an estimated value of 1.19 in 2006. Conservatively, assuming this trend continues, this ratio is estimated to be 1.3 in 2009. Applying this ratio to the projected 2009 ADD of 2.25 MGD, the estimated ADD for the period between May and November 2009 is approximately 3 MGD.

Halfmoon Consolidated Water District's 2006 water rate for residential and industrial customers within the District was $2.95 per thousand gallons for the first 30,000 gallons per quarter, $4.43 per thousand gallons for 31,000 to 50,000 gallons per quarter, and $5.90 per thousand gallons above 50,000 gallons per quarter (Halfmoon, 2006c). Pursuant to the agreement with Waterford in 2006, Halfmoon purchased water from Waterford at a cost of $2.82 per thousand gallons for the first 27 MG per quarter and $2.51 per thousand gallons above 27 MG per quarter (Halfmoon, 2006c). Halfmoon also reported a 2006 water rate of $4.73 per thousand gallons for purchase of water from Troy (presumably through Waterford's system), and a 2006 water rate of $3.57 per thousand gallons for purchase of water from CPWA (Halfmoon, 2006c). However, none of the information obtained and reviewed for this Options Analysis indicated that Halfmoon purchased any water from Troy or CPWA within the last four years.

3.4 Assessment of Existing PCB Treatment Capabilities

The water source study that was conducted on behalf of Halfmoon in 1999 also assessed existing PCB concentrations in the Hudson River and considered previous treatability studies performed for Waterford (Clough Harbour, 2000a).

3.4.1 Halfmoon Source Water Study

The 1999 source water study considered the 1990 study performed by Metcalf & Eddy presented in the *Waterford Drinking Water Supply Evaluation, Hudson River PCB Remnant Site Project-Task 3* (Metcalf & Eddy, 1990). A summary of conclusions provided in the 1990 report is presented in Section 2.4.2 of this Options Analysis report.

In addition, the 1999 water source study evaluated PCBs in the Hudson River when selecting a location for the raw water intake structure. Specifically, locations of PCB "hot spots" as determined by EPA were considered (Clough Harbour, 2000b). The water source study also drew upon an evaluation performed in 1984 by NYSDOH, which recommended including post-filtration GAC contactors as a finishing process to capture PCBs in a dissolved state (Clough Harbour, 2000b). The addition of PAC into the treatment process "may also be contributing to the adsorption of any PCBs that may be present in the water due to the adsorption of organic material" (Clough Harbour, 2000b).

The Halfmoon WTP has the ability to feed PAC into the raw water supply to the WTP; however, as described in Section 3.2, WTP personnel indicated that this system has not been utilized since startup of the WTP in 2003 (Halfmoon, 2006a).

3.4.2 Water Supply Sampling Data – 2004 through 2006

Based on information provided by Halfmoon, raw and finished water quality monitoring data for the Halfmoon WTP between 2004 and 2006 indicate that PCB concentrations in both raw water and finished water analyzed using EPA Method 508 were less than laboratory detection limits and the MCL drinking water limit of 0.5 µg/L (JH Consulting, 2006).

3.4.3 NYSDOH Public Water Supply Monitoring Program

NYSDOH will conduct a PWSMP consisting of monitoring of public water supplies prior to and during Phase 1 dredging. Additional information related to the PWSMP is included in Section 2.4.4.

3.5 Previously Recommended Upgrades and Estimated Costs

As described in Section 3.2, Halfmoon is in the process of implementing a phased plan for upgrading its WTP and distribution/storage system. The first phase of this plan included the major system component replacements and upgrades completed in 2003. The second phase is scheduled to be completed in the first half of 2007.

In 2006, Halfmoon's engineering consultant evaluated improvements to Halfmoon's distribution system that would be required to transmit an adequate volume of water from Troy to Halfmoon (delivered through Waterford's system). The recommended improvements consisted of installation of a new section of 16-inch diameter water main along Hudson River Road from the Halfmoon-Waterford town line to the Halfmoon WTP clearwell, for an estimated project cost of $2,200.000 (2006 dollars) (Halfmoon, 2006a). This new water main was recommended to be installed in conjunction with the improvements to the Waterford system for long-term supply from Troy to Halfmoon, as presented in Section 2.5.

According to the 2007 *Final Intended Use Plan* (IUP) for the NYS DWSRF (NYSDOH, 2006), Halfmoon is seeking funds for two separate projects. The projects in order of highest point score (as listed in the 2007 IUP) are New Storage and Pump Station Upgrades ($2,074,163 requested) and Upgrades to Distribution System ($726,993 requested). The NYS DWSRF reference (NYSDOH, 2006) suggests that Halfmoon has submitted reports to NYSDOH indicating that there is need for such improvements.

4. Identification and Preliminary Screening of Potential Water Supply/Treatment Contingency Options

This section presents the array of potential water supply and treatment options identified for evaluation in this water supply options analysis. This section also summarizes the preliminary screening of the options based on their potential effectiveness and implementability in meeting the objective of supplying sufficient water or providing reliable treatment contingencies during Phase 1 dredging operations. The options retained after this preliminary screening step are then evaluated in further detail in Section 5.

4.1 Identification of Potential Water Supply and Treatment Contingency Options

Based on a detailed review of technical documents provided or prepared by Waterford, Halfmoon and neighboring towns, cities, and water districts (see references in Section 7), and based on several meetings with Waterford, Halfmoon, neighboring towns/cities, agencies, and others (see Section 1.5), the following contingency options were identified for preliminary screening. These options were also identified based on the underlying effectiveness and implementability of each technology as industry standards, as evidenced by the application of these types of technologies and approaches in other water supply systems in New York State and across the country.

4.1.1 Potential Water Supply Contingency Options

- Waterford Water Supply from Troy through Existing Interconnection.
- Waterford Water Supply from Troy through Existing Interconnection and Storage and Distribution System Improvements.
- Waterford Water Supply from Halfmoon.
- Halfmoon Water Supply from Troy (through Waterford from Existing and New Interconnections).
- Halfmoon Water Supply from Troy through a New Interconnection at Schaghticoke.
- Halfmoon Water Supply from New Interconnection with Town of Colonie-Latham Water District.
- Halfmoon Water Supply from the Clifton Park Water Authority.

- Halfmoon Water Supply from New Interconnection with Town of Mechanicville.

- Halfmoon Water Supply from New Interconnection with Saratoga County Water Project Wheeled Through Clifton Park Water Authority.

- Halfmoon Water Supply from Existing Halfmoon Water Supply Wells.

- Halfmoon and/or Waterford Supply from New Water Supply Wells.

- Halfmoon Water Supply from New Mohawk River Intake.

4.1.2 Potential Water Treatment Contingency Options.

- Existing Powdered Activated Carbon Treatment at Existing Plants.

- Providing Post-Treatment Granular Activated Carbon to Existing Plants.

- Addition of Pre-Treatment Granular Activated Carbon to Existing Plants.

- Addition of Post-Treatment Membrane Technologies to Existing Plants.

4.2 Summary of Screening Criteria

As discussed in Section 1.2, EPA's Final Decision requires GE to evaluate options for alternative water supplies and/or additional treatment in the event that Phase 1 dredging causes PCB levels to exceed the Decision Criteria. Therefore, the options identified above were evaluated as contingency measures to be implemented only when required by EPA's Decision Criteria, and not as permanent facilities to serve Halfmoon or Waterford. Each of the options was screened based on an evaluation of its effectiveness and implementability, as described below.

4.2.1 Effectiveness

This criterion considers the extent to which each option is capable of providing potable water of acceptable quality and quantity for Waterford and Halfmoon on a contingency basis, if monitoring indicates that the Phase 1 activities exceed EPA's Decision Criteria.

4.2.2 Implementability

This criterion considers the technical and administrative feasibility for implementing each alternative, including the following factors that influence the ability to design, permit, test, operate, and maintain each option:

- Ability to be constructed or implemented before Phase 1 dredging activities begin.
- Ability to obtain federal, state, and local permits and approvals, to the extent applicable.
- Ability to comply with statutory and regulatory requirements.
- Ability to achieve and maintain system storage and pressure, including during fire flows or system repairs, that are equivalent to the existing system storage and pressure.
- Availability and capacity of treatment, storage, and disposal facilities.
- Feasibility and constructability of temporary facilities.
- Operation, maintenance and monitoring (OM&M) requirements, including reliability of operation.
- Availability of specific equipment and technical specialists to operate process units.

Although each of the above factors was considered during the evaluation, the focus of the following sections is on those factors that might have a negative impact on implementability, and therefore might lead to screening out an alternative.

4.3 Potential Water Supply Contingency Options

The options presented below are alternatives that have been evaluated for their potential to provide contingent potable water supplies from alternate water sources (i.e., not utilizing the Hudson River as the source) to Waterford and Halfmoon, if necessary, if EPA's Decision Criteria are exceeded during Phase 1 dredging activities.

4.3.1 Waterford Water Supply from Troy through Existing Interconnection

General Description: Under this option, Waterford would be supplied with water from Troy through the existing connection between the two systems.

Effectiveness: The source of water for Troy's water system is the Tomhannock Reservoir. This option would provide an effective contingency for Waterford by utilizing an alternate existing source of water.

Implementability: There is an existing 14-inch diameter water main connection between the Troy and Waterford water distribution systems. As described in Section 2, Waterford currently receives water from Troy on an emergency/contingency basis through this connection. Troy has reported that it has adequate excess capacity to provide short-term or long-term primary supply for Waterford. When it is necessary to activate the emergency/contingency water supply from Troy, Waterford notifies Troy and representatives of the two water suppliers manually open the connection (typically within two hours). As described in Section 2.1, NYSDEC indicated that, as of January 2005, Waterford had not submitted appropriate permit applications to NYSDEC for use of the existing connection with Troy. As such, the use of this existing connection may represent an unpermitted water withdrawal from Troy (NYSDEC, 2005d). This potential option would be administratively and technically feasible to implement.

Conclusion: This option is feasible and will be retained for further evaluation in Section 5.

4.3.2 Waterford Water Supply from Troy through Existing Interconnection and Storage and Distribution System Improvements

General Description: Under this option, Waterford would be supplied with water from Troy through the existing connection between the two systems. This option also includes improvements to Waterford's existing distribution and storage system based on recommendations prepared on behalf of Waterford to evaluate long-term water supply from Troy for Waterford if the Hudson River was not available as a water source for Waterford (Delaware, 2006).

Effectiveness: The source of water for Troy's water system is the Tomhannock Reservoir. This option would be an effective contingency for Waterford by utilizing an alternate existing source of water.

Implementability: This potential option could be administratively and technically feasible to implement (see Section 4.3.1). However, in the course of evaluating potential long-term water supply options not related to the Hudson River dredging project, certain improvements for the Waterford distribution and storage system have been recommended (as outlined in Section 2.5 of this report). Documentation was not made available by Waterford or others during preparation of this options analysis report demonstrating that inadequate system capacity or pressures exist during periods of emergency/contingent supply from Troy. (As presented in Section 2.1, flow testing indicated that the existing 14-inch diameter interconnection can supply approximately 4.2 to 5.3 MGD to Waterford). Such documentation would be needed to justify making improvements to the existing distribution and storage system for the purpose of implementing a contingent water supply. Based on the extent of infrastructure improvements included under this option, it is uncertain whether this option could be completed prior to the start of the Phase 1 dredging activities.

Conclusion: The proposed storage and distribution improvements for Waterford under this option have not been justified as being necessary to transmit an adequate supply of water from Troy to Waterford on a short-term contingency basis during Phase 1 dredging activities. Therefore, this potential option will not be evaluated further.

4.3.3 Waterford Water Supply from Halfmoon

General Description: Under this option, Halfmoon would supply Waterford with water.

Effectiveness: The source of supply for Halfmoon's water system is the Hudson River. Therefore, this option would not be an effective contingency unless supplemental treatment measures are utilized at the Halfmoon WTP (see Section 4.4).

Implementability: There are two existing connections between the Halfmoon and Waterford water distribution systems. The rated capacity of the Halfmoon WTP will reportedly be 5 MGD following completion of current upgrades (as summarized in Section 3). As summarized in Sections 2 and 3, the projected 2009 combined MDD for Waterford and Halfmoon is 7 MGD (MDD of 3 MGD and 4 MGD, respectively), which will exceed the rated capacity of the Halfmoon WTP. Therefore, this potential option would not be technically feasible to implement.

Conclusion: This option is not effective or feasible as a contingency measure, and therefore will not be evaluated further.

4.3.4 Halfmoon Water Supply from Troy (through Waterford from Existing and New Interconnections)

General Description: Under this option, Troy would supply water to Halfmoon utilizing the existing 14-inch diameter connection between the Troy and Waterford distribution systems. The water would then be wheeled (i.e., conveyed) through Waterford's system to Halfmoon's distribution system.

Effectiveness: The source of water for Troy's water system is the Tomhannock Reservoir. Therefore, this option would be an effective contingency for Halfmoon by utilizing an alternate existing water source.

Implementability: As described in Section 2.1, the existing interconnection between Troy and Waterford can convey approximately 4.2 to 5.3 MGD to Waterford, which is adequate to meet Halfmoon's projected 2009 MDD of 4 MGD. However, this existing interconnection does not have the necessary capacity to convey the volume of water needed to adequately meet Waterford's and Halfmoon's combined projected 2009 MDD of 7 MGD (MDD of 3 MGD and 4 MGD, respectively). Based on an evaluation performed by Waterford's engineer (Delaware, 2006), to meet the towns' combined projected 2009 MDD, a new interconnection between the Troy and Waterford distribution systems would be required to supplement the existing 14-inch diameter interconnection.

As described in Section 2, there are two existing connections between the Halfmoon and Waterford distribution systems. Halfmoon currently receives a portion of its water from Waterford through these connections. However, evaluations performed by the towns' engineers (Delaware, 2006; Halfmoon, 2006a) indicate that these existing interconnections cannot adequately convey enough water to meet Halfmoon's projected 2009 MDD, nor can the existing interconnections supply water at an adequate system pressure. If this option were to be implemented, a detailed engineering and hydraulic evaluation would be required to evaluate whether the existing system could provide water at the necessary volume and pressure without construction of a new interconnection between the two towns.

This option would be administratively and technically feasible to implement. However, based on the extent of potential infrastructure improvements, it is uncertain whether this option could be completed prior to the start of the Phase 1 dredging activities.

Conclusion: This option would be an effective and feasible contingency, and will therefore be retained for further evaluation in Section 5.

4.3.5 Halfmoon Water Supply from Troy through a New Interconnection at Schaghticoke

General Description: Under this option, Troy would supply Halfmoon with water, wheeled through the Town of Schaghticoke (Schaghticoke).

Effectiveness: The source of water for Troy's water system is the Tomhannock Reservoir. Therefore, this option would be an effective contingency for Halfmoon by utilizing an alternate existing source of water.

Implementability: There is an existing interconnection between Troy and Schaghticoke. However, there is no existing interconnection between the Schaghticoke and Halfmoon water distribution systems; therefore, construction of a new interconnection would be required across the Hudson River. Design, permitting and construction of such an interconnection would take time to implement. In addition, infrastructure improvements could be required to upgrade water mains within Schaghticoke to accommodate the volume of water necessary to meet Halfmoon's projected 2009 MDD of 4 MGD. It is not known whether Schaghticoke would be willing to proceed with a new interconnection across the Hudson and/or temporary supply to Halfmoon. There are no known hydraulic analyses or engineering evaluations available that evaluate the required capacity or feasibility of this potential interconnection. Based on preliminary information received during preparation of this options analysis report, the extent of infrastructure improvements that are likely needed for this option would be extensive and the feasibility is uncertain. For this reason, it is uncertain that this option could be completed prior to the start of Phase 1 dredging activities.

Conclusion: Although this option could be an effective contingency measure, the feasibility of implementing the option is uncertain. Therefore, this option will not be retained for further evaluation.

4.3.6 Halfmoon Water Supply from New Interconnection with Town of Colonie-Latham Water District

General Description: Under this option, the Colonie-Latham would supply Halfmoon with water.

Effectiveness: The primary source of water for the Colonie-Latham is the Mohawk River (Colonie, 2005). Other sources of water that are utilized by Colonie-Latham include the Stony Creek Reservoir (which is a surface water reservoir located in the Town of Clifton Park) and groundwater wells (i.e., Mohawk View Well Complex) located on the site of Colonie-Latham's WTP (Colonie, 2005). The Stony Creek Reservoir is reportedly used infrequently, but the groundwater wells are reportedly used year-round (Colonie, 2005). Therefore, this potential option would be an effective contingency for Halfmoon by utilizing an alternate existing source of water.

Implementability: There is no existing interconnection between the Colonie-Latham and Halfmoon water distribution systems. To facilitate this option, an interconnection would have to be designed and constructed and improvements to the infrastructure of the Colonie-Latham and Halfmoon water distribution systems would likely be required, which could include new water mains, pumping facilities, and/or storage tanks. Colonie-Latham has reported that it has adequate excess capacity to supply water to Halfmoon; however, no engineering studies have been performed to date to evaluate the feasibility and identify the infrastructure and any necessary permitting that would be required. Based on preliminary information received during preparation of this options analysis report, the extent of infrastructure improvements that are likely needed for this option would be extensive and the feasibility is uncertain. For this reason, it is uncertain that this option could be completed prior to the start of Phase 1 dredging activities.

Conclusion: Although this option could be an effective contingency measure, the feasibility of implementing the option is uncertain. Therefore, this option will not be retained for further evaluation.

4.3.7 Halfmoon Water Supply from the Clifton Park Water Authority

General Description: Under this option, Halfmoon would be supplied with water from the CPWA.

Effectiveness: The primary source of water for CPWA is groundwater from wells installed in a local aquifer (CPWA, 2006). Therefore, this potential option would be an effective contingency for Halfmoon by utilizing an alternate existing source of water.

Implementability: There is an existing interconnection between the CPWA and Halfmoon water distribution systems. However, as summarized in Section 3.1, the existing hydraulic grade of the Halfmoon system is higher that the CPWA system at this interconnection. To implement this option, new booster pumping facilities would be required to provide water flow from the CPWA system to Halfmoon (Halfmoon, 2006a). The CPWA has a reported MDD of approximately 6 MGD (CPWA, 2006). The source study performed previously for Halfmoon (Clough Harbour, 2000a) indicated that the CPWA system was permitted to pump a maximum of 9.3 MGD from its wells; however, due to water quality deficiencies, the CPWA system had a lower “practical” operating capacity of approximately 7.67 MGD

(Clough Harbour, 2000a). The projected 2009 MDD of both Clifton Park and Halfmoon is 10 MGD (6 MGD and 4 MGD, respectively). Since completion of the source study in 2000, CPWA has increased its permitted capacity from 9.3 MGD to approximately 11.1 MGD (NYSDEC, 2004a). However, no engineering studies of the CPWA system were provided for this evaluation and the actual operating capacity of the existing CPWA system is not known. Based on discussions with Halfmoon (Halfmoon, 2006a), CPWA reportedly does not have adequate excess capacity to provide primary water supply for Halfmoon. Therefore, this option would not be technically feasible to implement.

The CPWA has reportedly held preliminary discussions to consider obtaining water from the City of Schenectady (Schenectady) through a new interconnection. If constructed, a new interconnection between CPWA and Schenectady would increase the available water supply for potential transport to Halfmoon as a contingency measure. However, there is uncertainty regarding implementation and/or schedule for a potential interconnection between the CPWA and Schenectady.

Conclusion: Although this option could be an effective contingency measure, the feasibility of implementing the option is uncertain and it is unknown if sufficient excess capacity is available from CPWA. Therefore, this option will not be retained for further evaluation.

4.3.8 Halfmoon Water Supply from New Interconnection with Town of Mechanicville

General Description: Under this option, Halfmoon would be supplied with water from the City of Mechanicville.

Effectiveness: The primary source of water for Mechanicville is the Mechanicville Reservoir. Mechanicville also utilizes the Terminal Reservoir as a secondary source of water. This potential option would be an effective contingency measure by utilizing alternate existing sources of water for Halfmoon.

Implementability: As described in Section 3.1, there is an existing interconnection between the Mechanicville and Halfmoon water distribution systems that supplies water to Halfmoon's Water District No. 1. There is currently no existing interconnection between Mechanicville and the remaining portion of the Halfmoon distribution system. Mechanicville has reported that it does not have adequate excess capacity to be the primary supply for Halfmoon. Therefore, this potential option would not be technically feasible to implement.

Conclusion: Although this option could be an effective contingency measure, the option is not feasible based on insufficient excess water capacity available from Mechanicville. Therefore, this option will not be retained for further evaluation.

4.3.9 Halfmoon Water Supply from New Interconnection with Saratoga County Water Project Wheeled Through Clifton Park Water Authority

General Description: Under this option, Halfmoon would be supplied with water from a new interconnection with the Saratoga County Water Project (SCWP), wheeled through the CPWA system.

Effectiveness: Saratoga County developed the SCWP to construct a regional public water supply system to provide wholesale water to municipal customers within Saratoga County. The SCWP has not been built yet and is not currently supplying water to any municipality. The plan for the SCWP includes construction of a new WTP in the Town of Moreau, which will utilize the Hudson River as the primary source of supply. The proposed intake for the new WTP will be located upstream of Phase 1 dredging activities. The plan for the SCWP also includes installation of a new transmission main from the WTP south through Saratoga County, terminating in the Town of Malta. The CPWA may construct a new transmission main to connect with the SCWP. Provided that the SCWP is constructed as planned and infrastructure improvements are made at various locations within Saratoga County north of Halfmoon, this potential option would be an effective contingency because it would utilize a source of Hudson River water upstream of Phase 1 dredging activities.

Implementability: There is an existing interconnection between the CPWA and Halfmoon water distribution systems. However, as described in Section 3.1, the existing hydraulic grade of the Halfmoon system is higher that the CPWA system at this interconnection; therefore, new booster pumping facilities would be required to enable water flow from the CPWA system to Halfmoon. The SCWP has reported that it will have adequate excess capacity to supply Halfmoon’s projected water demand. However, the scope and extent of supply of the SCWP is still being developed. There are no existing engineering studies available to evaluate the feasibility and identify necessary regulatory approvals and infrastructure improvements required for the CPWA system to wheel water to Halfmoon from the SCWP. There appears to be uncertainty regarding the current planning and construction schedule for completion of the SCWP (including whether a new CPWA transmission main will be incorporated into the plan) and whether this project would be completed prior to commencing Phase 1 dredging activities. Based on uncertainty regarding the schedule and scope of the SCWP, this potential option does not appear to be administratively or technically feasible for the Phase 1 dredging project.

<u>Conclusion:</u> Although this option could be an effective contingency measure, the feasibility of implementing the option is uncertain and it is unknown if sufficient capacity and infrastructure will be available before Phase 1 dredging activities begin. Therefore, this option will not be retained for further evaluation. However, this option will be monitored and may be considered in the future as the SCWP progresses and the schedule and scope of the SCWP are more clearly defined.

4.3.10 Halfmoon Water Supply from Existing Halfmoon Water Supply Wells

<u>General Description:</u> Under this option, Halfmoon would be supplied with water from its existing groundwater wells.

<u>Effectiveness:</u> This potential option would be an effective contingency measure for Halfmoon by utilizing an existing non-Hudson River source of water.

<u>Implementability:</u> Halfmoon currently utilizes existing groundwater wells installed in a local aquifer to supplement supply to its existing system. The capacity of the groundwater wells is reported to be approximately 0.6 MGD, which can only be provided on a short-term basis. The existing groundwater wells do not have adequate capacity to be the primary source of supply for Halfmoon. Therefore, this option would not be technically feasible to implement as a stand-alone option.

<u>Conclusion:</u> This option will not be evaluated further as a stand-alone option. It may have some applicability as a supplemental supply along with another option described herein.

4.3.11 Halfmoon and/or Waterford Supply from New Water Supply Wells

<u>General Description:</u> Under this option, Halfmoon and Waterford would draw water from new groundwater supply wells.

<u>Effectiveness:</u> This potential option would be an effective contingency measure for Halfmoon and Waterford by utilizing an alternate source of water.

<u>Implementability:</u> Halfmoon currently utilizes existing groundwater wells installed in a local aquifer. These wells have a limited capacity. The CPWA uses additional groundwater wells installed in the same aquifer for its supply. It has been reported that operation of the Halfmoon wells can impact the capacity of the CPWA wells (Halfmoon, 2006a). Therefore, it is not reasonable to expect that new wells constructed within the existing aquifer would provide adequate capacity to meet Halfmoon’s projected water demand. Furthermore, it is

not expected that a new aquifer could be identified and new wells developed (including necessary infrastructure and regulatory approvals) prior to the start of Phase 1 dredging activities. Therefore, this potential option would not be administratively or technically feasible for Halfmoon.

Waterford does not currently utilize groundwater wells. It is not expected that a new aquifer could be identified and new wells developed (including necessary infrastructure and regulatory approvals) prior to the start of Phase 1 dredging activities. Therefore, this potential option would not be administratively or technically feasible for Waterford.

Conclusion: Although this option could be an effective contingency measure, it is not feasible to implement on a scale or schedule sufficient to meet objectives. Therefore, this option will not be retained for further evaluation.

4.3.12 Halfmoon Water Supply from New Mohawk River Intake

General Description: Under this option, the Halfmoon WTP would be supplied with a new raw water intake from the Mohawk River.

Effectiveness: This potential option would be an effective contingency measure by utilizing an alternate source of water for Halfmoon.

Implementability: Use of the Mohawk River as the primary source of water for the Halfmoon WTP was evaluated during the water source study for Halfmoon (Clough Harbour, 2000a). The study concluded that use of the Mohawk River was not feasible due to constraints related to the availability of land for an intake and raw water pump station. Therefore, this potential option would not be technically feasible to implement.

Conclusion: Although this option could be an effective contingency measure, it is not feasible to implement. Therefore, this option will not be retained for further evaluation.

4.4 Potential Water Treatment Contingency Options

This section describes potential PCB treatment options that could be utilized on a contingency basis to remove PCBs from the Hudson River supply water at Waterford and Halfmoon, if EPA's Decision Criteria are exceeded during Phase 1 dredging activities.

4.4.1 Existing Powdered Activated Carbon Treatment at Existing Plants

General Description: Both the Waterford and Halfmoon WTPs are currently permitted by NYSDOH to use powdered activated carbon treatment, when needed, to improve the odor and taste of finished water. Under this option, supplemental doses of PAC would be fed through the plants' existing PAC feed systems to address the potential presence of PCBs in raw water. The anticipated method of implementation would be to increase and/or adjust the rate of PAC addition at the WTPs (using the existing delivery systems at both plants) for treatment of dissolved PCBs, based on the adsorptive capacity of PAC.

Effectiveness: Activated carbon (PAC and GAC) is a state-of-the-art technology that is widely used in the water treatment industry to remove PCBs from water. Therefore, this option could be an effective contingency measure. Treatability testing would be required to confirm the effectiveness of PAC and determine required PAC dosages and adsorption rates based on potential water quality during Phase 1 dredging activities.

Implementability: This option is implementable because PAC feed systems already exist at both WTPs. The existing infrastructure appears acceptable to provide PAC dosage that may be needed to remove PCBs; minor improvements to the existing PAC storage, feed, and/or sludge removal infrastructure may be required to accommodate the actual PAC dosage required, as determined by treatability testing.

Conclusion: This option would be effective and feasible and will be retained for further evaluation in Section 5.

4.4.2 Providing Post-Treatment Granular Activated Carbon to Existing Plants

General Description: Under this option, mobile GAC units would be used by the WTPs as a polishing step at the end of existing treatment processes. The GAC units would be used specifically to remove residual PCBs, as needed, if the EPA's Decision Criteria are exceeded during Phase 1 dredging activities. The anticipated method of implementation for this option would be to connect the mobile GAC units at (or near) the end of the existing treatment train via temporary piping connections and fittings/valves as necessary to provide the ability to put the GAC units on-line quickly when required.

Effectiveness: This option would be an effective contingency, based on the known ability of GAC to remove PCBs from water, the results of treatability testing previously performed by GE confirming the ability of GAC to remove PCBs from Hudson River water, and the results of previous studies related to PCBs present in the Hudson River (Metcalf & Eddy, 1990).

Implementability: This option can be implemented, but would require piping modifications at each WTP to install temporary connections to the GAC units. In addition, an adequate amount of space would be required to install multiple temporary GAC trailers (each approximately 8-feet-wide by 53-feet-long) and associated temporary storage tanks, pumping equipment, piping, and appurtenances near the existing treatment system at each WTP.

Conclusion: This option is effective and feasible as a contingency measure, and will be retained for further evaluation in Section 5.

4.4.3 Addition of Pre-Treatment Granular Activated Carbon to Existing Plants

General Description: Under this option, mobile GAC units would be used by the WTPs as a pretreatment step (i.e., before existing treatment processes). The GAC units would be used specifically to remove residual PCBs, as needed, if EPA's Decision Criteria are exceeded during Phase 1 dredging activities. The anticipated method of implementation for this option would be to connect mobile GAC trailers and any associated pretreatment equipment needed to protect the GAC units from fouling (e.g., filtration, chemical precipitation, etc.), at the appropriate point in the influent WTP piping before any existing treatment components. GAC adsorption is typically considered a polishing step and solids and any other materials that could foul the carbon would need to be removed prior to the GAC units in order to be effective. Temporary piping connections and fittings/valves would be installed as necessary to provide the ability to put the GAC units and associated pretreatment systems on-line quickly when required.

Effectiveness: Based on the known ability of GAC to remove PCBs from water, the results of treatability testing previously performed by GE confirming the ability of GAC to remove PCBs from Hudson River water, and the results of previous studies related to PCBs present in the Hudson River (Metcalf & Eddy, 1990), this option would be an effective contingency measure (as long as associated pretreatment equipment needed to protect the GAC units from fouling is utilized).

Implementability: As stated above, implementation of this option would require additional pretreatment steps to remove solids and minimize fouling of the GAC units. Adding a complete GAC pretreatment system would essentially duplicate the existing WTP system and would be redundant.

Conclusion: This option would not provide appreciably greater effectiveness than post-treatment carbon, but would add significant additional redundant (and unnecessary) treatment. As such, this option will not be evaluated further.

4.4.4 Addition of Post-Treatment Membrane Technologies to Existing Plants

General Description: Under this option, mobile membrane filtration/separation units (e.g., microfiltration, ultrafiltration, nanofiltration, reverse osmosis) would be added to the WTPs as a polishing step at the end of existing treatment processes. The membrane filtration units would be used to remove dissolved PCBs and very fine solids and colloidal material that may contain residual PCBs. The system would be employed, as needed, if EPA's Decision Criteria are exceeded during Phase 1 dredging activities. The anticipated method of implementation for this option would be to connect the mobile membrane filtration trailers at (or near) the end of the existing treatment train via temporary piping connections and fittings/valves to provide the ability to put the membrane filtration units on-line quickly when required.

Effectiveness: According to treatment system vendors, membrane filtration processes are typically capable of removing between 50 to 90 percent of PCBs from water. Therefore, this option would have only limited effectiveness to treat water for PCBs.

Implementability: The membrane systems are more difficult to implement than GAC systems due to the need to handle an additional waste concentrate stream and the potential need for additional pretreatment.

Conclusion: Membrane filtration processes have only limited efficiency and effectiveness to treat water for PCBs relative to other treatment technologies that are more readily available and commonly used for PCB treatment. This option will not be evaluated further.

5. Evaluation of Potential Water Supply/Treatment Contingency Measures

For each town, one alternative water supply option and two treatment technologies were retained from the screening-level analysis of effectiveness and implementability presented in Section 4. This section provides a more in-depth analysis of the six retained options:

- Waterford Option No. 1: Water Supply from Troy through Existing Interconnection.
- Waterford Option No. 2: Existing Powdered Activated Carbon Treatment at WTP.
- Waterford Option No. 3: Post-Treatment Granular Activated Carbon Treatment at WTP.
- Halfmoon Option No. 1: Water Supply from Troy (through Waterford from Existing and New Interconnections).
- Halfmoon Option No. 2: Existing Powdered Activated Carbon Treatment at WTP.
- Halfmoon Option No. 3: Post-Treatment Granular Activated Carbon Treatment at WTP.

The components of the extended evaluation presented in the remainder of this section include:

- A description of the option.
- Major advantages and disadvantages of the option.
- Effectiveness and implementability relative to other options considered (and based on the factors described in Section 4.1).
- A summary of preliminary estimated costs to implement the option.

As discussed in Section 4.1, the water supply and treatment options considered in this section were evaluated under the assumption that contingency measures will be implemented only when required by EPA's Decision Criteria, not as permanent facilities.

For each option, estimates are provided both for capital costs (i.e., upfront construction/installation/system rental), and for OM&M costs. The estimated OM&M costs assume that implementation of the contingency measure, if necessary, would be required for a duration of up to seven days (the actual duration of each contingency event will be dependent on the results of monitoring activities compared against EPA's Decision Criteria). Accordingly, the estimated OM&M costs presented herein were developed on a unit basis of a one-week operating period.

5.1 Waterford Option No. 1: Water Supply from Troy through Existing Interconnection

As summarized in Section 4.2.1, this contingency measure involves activating a temporary supply of water to Waterford from Troy's distribution system by utilizing the existing 14-inch diameter interconnection between the two systems. As summarized in Section 2.1, this interconnection is already used periodically by Waterford as a contingency water supply and reportedly can provide approximately 4.2 to 5.3 MGD to Waterford (NYSDOH, 2006c; 2006d), enough to supply Waterford's projected 2009 MDD of 3 MGD (summarized in Section 2).

Under current operating procedures, in the event of a contingency situation (e.g., during periods of high turbidity in the Hudson River or during certain maintenance activities), Waterford temporarily suspends operation of its WTP and activates the existing interconnection with Troy by manually opening existing system valves. Implementation of this option as a contingency measure during Phase 1 dredging activities would follow the same procedures, if monitoring results indicate that EPA's Decision Criteria are exceeded.

As summarized in Section 2.5, Waterford's engineering consultant indicated that numerous improvements to the Waterford water system infrastructure would be necessary for Troy to provide a long-term supply to Waterford (Delaware, 2006). These improvements included replacement of the Prospect Hill water storage tank and booster pump station, refurbishment of the Northside and Swatling water storage tanks, and installation of new sections of water main (Delaware, 2006). However, these improvements were recommended to address existing deficiencies in Waterford's system (Delaware, 2005), and are therefore unrelated to the potential use of water supply from Troy as a contingency option during Phase 1. Because the existing interconnection (and existing system infrastructure) is currently used as a contingency supply and can reportedly supply an adequate amount of water on a short-term basis, it is assumed that improvements to Waterford's existing water system infrastructure are not required to implement this option as a contingency measure in response to Phase 1 dredging activities.

Because this option utilizes an alternative source of water supply (i.e., Tomhannock reservoir via interconnection with Troy's system), it is considered to have a relatively high level of effectiveness. Another advantage associated with implementation of this option is the utilization of existing infrastructure and procedures that have been proven reliable by Waterford, thereby eliminating the need for new infrastructure or implementation of new procedures. For this reason, this option is considered to have a relatively high level of feasibility and implementability.

While it is assumed there would be no capital cost associated with implementation of this option, the OM&M includes additional estimated costs incurred by Waterford to purchase water from Troy at a higher rate than what Waterford charges customers for water supplied from its WTP. Projected rates for 2009 were estimated based on historic rate information provided by Waterford and Troy, plus a projected annual percentage increase for each rate. The estimated weekly OM&M costs to purchase water from Troy were thereby determined by applying the difference in the projected 2009 rates (i.e., the rate to purchase water minus the rate charged to Waterford customers) multiplied by the total weekly volume of water that would be purchased by Waterford from Troy at the projected 2009 ADD for the period May through November of 2.6 MGD. No other OM&M costs are assumed to be necessary to implement this option. The estimated capital and OM&M costs associated with this option are presented in Table 5.1. The total cost for this option is relatively low compared to other options. However, OM&M costs for this option are relatively high if the temporary supply is required for a prolonged period during Phase 1.

Troy recently proposed a lower rate to supply water to Waterford “for an extended period of a year or more” during dredging activities (Troy, 2006b). However, since it is assumed that the contingency measure will be implemented only when required by EPA’s Decision Criteria, this proposed lower rate for long-term supply would not be applicable and was not used to develop the estimated costs for this option.

5.2 Waterford Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant

As summarized in Section 4.4.1, this contingency measure involves utilizing the existing PAC feed system at the Waterford WTP to provide supplemental treatment of the raw water for removal of PCBs during contingency periods triggered by EPA’s Decision Criteria. As summarized in Section 2.2, Waterford currently utilizes a PAC feed system at the Waterford WTP for taste and odor control. Average PAC usage in 2006 was reported to be approximately 60 pounds per day, for a total weekly usage of approximately 420 pounds (Waterford, 2006c). At the current ADD of 1.7 MGD, this equates to an approximate dose of 4 mg/L PAC.

The same technology currently being used for taste and odor control is capable of removing PCBs from water. Under this option, the existing PAC system would be utilized to feed an estimated additional 315 pounds of PAC per week into the raw water as a contingency measure. The estimated weekly additional amount of PAC required is based on a projected 2009 ADD for the period from May through November of 2.6 MGD with an assumed raw water PCB concentration of 1 µg/L and an adsorption rate of 1 milligram of PCBs removed per 1 gram PAC. This equates to an approximate additional required dose of 2 mg/L PAC. For the purpose of preparing a conservative estimate under this evaluation, the estimated additional PAC required to remove PCBs under this contingency measure does not account for potential removal of PCBs by the PAC that is currently applied at the Waterford WTP (i.e., approximately 60 pounds per day). For the purpose of this evaluation, it is assumed that one additional metering pump and associated appurtenances would be required at the Waterford WTP to supplement the existing PAC feed system.

Advantages associated with implementation of this option include utilizing existing facilities and procedures that Waterford currently has in place, and the relatively minimal amount of new infrastructure that would be required (i.e., additional metering pump and appurtenances). Since the Waterford WTP is currently permitted by NYSDOH to operate using the existing PAC system, it is assumed that the use of the PAC system as a contingency measure would be approved by NYSDOH. However, the need to obtain applicable regulatory approvals, if any, would have to be explored. This option is considered to have a high level of administrative and technical feasibility and implementability.

Treatability testing would be necessary prior to implementation of this option to confirm its effectiveness and determine actual operating requirements, including additional PAC dosage that would be required.

The estimated capital costs associated with implementation of this option include treatability testing and installation of one additional metering pump and appurtenances for the existing PAC feed system at the Waterford WTP. The estimated OM&M costs associated with this option include costs for: additional PAC material required; additional labor for PAC handling; additional labor and disposal costs for the sludge generated; and additional water sampling and analysis. The estimated capital and OM&M costs associated with this option are presented in Table 5.2. The costs for this option are relatively low even if the PAC system is required for a prolonged period during Phase 1 dredging activities.

5.3 Waterford Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant

As summarized in Section 4.4.2, this contingency measure involves utilizing mobile GAC units at the Waterford WTP to provide supplemental treatment of the post-filtration effluent for removal of residual PCBs during contingency periods triggered by EPA's Decision Criteria. The mobile GAC treatment units would be staged at the Waterford WTP along with the necessary piping, valves, storage tanks, pumping units, electrical and control facilities, and appurtenances. The GAC units would be piped into the existing treatment process train between the filters and clearwell to provide treatment of the post-filtration effluent. Temporary piping connections to the existing filter effluent piping and clearwell influent would be necessary to direct water to and from the GAC treatment units.

Based on previous treatability studies performed by GE for the Hudson River project (BBL, 2006), it is assumed that an empty bed contact time (EBCT) of 20 minutes would be adequate for PCB removal. Sizing of available GAC treatment units results in vessels that would be capable of treating a maximum flow of 250 gpm (i.e., 0.36 MGD). Nine GAC units would therefore be required to accommodate the projected 2009 MDD of 3 MGD.

As described in Section 2.2, chlorine is currently added prior to the stage 2 settling basins (i.e., pre-filtration disinfection) and into the clearwell (i.e., post-filtration disinfection). The existing clearwell has a relatively short detention time and the treatment process reportedly achieves the majority of its required disinfection contact time in the stage 2 settling basins from the pre-filtration disinfection (NYSDOH, 1997). Since chlorine compounds would be adsorbed by the GAC units and decrease their capacity for adsorbing PCBs, a temporary chemical feed system would be required to feed a dechlorination chemical such as sodium metabisulfite (in accordance with American Water Works Association; AWWA, B601) into the influent to the GAC units. Based on a review of the existing Waterford WTP site, it is assumed that there is adequate space available to accommodate the staging of the multiple GAC units and dechlorination system required for this contingency measure.

The primary advantage associated with implementation of this option is that GAC treatment is a proven and effective technology for removal of PCBs from water. As such, this option is considered to have a high level of effectiveness.

The primary disadvantage associated with this option is the amount of temporary treatment facilities and appurtenances that would be required at the Waterford WTP and the temporary changes in operating procedures that would be required. It is assumed that the use of the post-filtration GAC treatment system could be approved by NYSDOH, although the need to obtain applicable regulatory approvals, if any, would have to be explored. Considering these factors, this option is considered to have a relatively high level of administrative feasibility and a relatively moderate level of technical feasibility and implementability.

The estimated capital costs associated with implementation of this option include the mobilization and installation of the temporary GAC units, piping, valves, storage tanks, pumping units, electrical and control facilities, and appurtenances described above. The estimated OM&M costs associated with this option include estimated costs for additional power and miscellaneous facilities required to implement this option, as well as disposal of carbon at the end of Phase 1. The estimated capital and OM&M costs associated with this option are presented in Table 5.3. The costs for this option are moderate compared to the other contingency measures evaluated in this section.

5.4 Halfmoon Option No. 1: Water Supply from Troy (through Waterford from Existing and New Interconnections)

As summarized in Section 4.3.4, this contingency measure involves activating a temporary supply of water to Halfmoon from Troy's water system by wheeling water through Waterford's water distribution system. Implementation of this option would include utilizing the existing 14-inch diameter interconnection between Waterford and Troy and the two existing 12-inch diameter interconnections between Waterford and Halfmoon.

This option would also include improvements to the infrastructure of both the Waterford and Halfmoon water systems to accommodate the volume of water needed to meet Halfmoon's projected demand for 2009. Based on the results of field flow testing performed by Waterford and NYSDOH (NYSDOH, 2006c; 2006d) and other information summarized in Sections 2 and 3, the existing Waterford and Halfmoon water systems reportedly cannot transmit sufficient water from the Troy system to adequately serve the *combined* Waterford and Halfmoon projected 2009 MDD of 7 MGD.

As summarized in Section 2.5, Waterford's engineering consultant indicated that construction of numerous improvements to the Waterford water system infrastructure would be necessary to provide a long-term supply from Troy to Halfmoon through Waterford's system to meet projected water demand. The recommended improvements to Waterford's system are summarized in Section 2.5 and include construction of a new 20-inch diameter interconnection between Troy and Waterford by crossing under the Hudson River via directional boring, and installation of various sections of new 20-inch diameter and 16-inch diameter water mains to replace existing smaller water mains. Waterford's engineering consultant also indicated that replacement of the Prospect Hill water storage tank and booster pump station, and refurbishment of the Northside and Swatling water storage tanks, would be required. Limited information was available during preparation of this report to provide justification for the recommendations and/or to independently evaluate the need for the improvements. However, as summarized in Section 2.5, these specific storage tank and booster pump station improvements were recommended to address existing deficiencies in Waterford's system (Delaware, 2005), which are unrelated to the potential use of water from Troy as a short-term contingency measure. As such, it is assumed that the specific storage tank and booster pump station improvements are not required for the purpose of wheeling water to Halfmoon.

As summarized in Section 3.5, Halfmoon indicated that installation of a new section of 16-inch diameter water main from the Waterford-Halfmoon town boundary to the Halfmoon WTP clearwell would be required to accommodate the volume of water from Troy wheeled through Waterford's system, based on the projected 2009 water demand (Halfmoon, 2006a).

Because this option utilizes an alternative source of water supply (i.e., Tomhannock reservoir via existing and new interconnections with Troy), it is considered to have a relatively high level of effectiveness.

The primary disadvantage associated with implementation of this option is the amount of infrastructure improvements that would be required for the Waterford and Halfmoon water systems to assure combined system demands can be met during contingency periods triggered by EPA's Decision Criteria. It is assumed that construction of these improvements would require a significant amount of time in order to complete the required planning, any necessary regulatory approvals, design, and construction. The need for land and/or easement acquisition to complete construction was not identified by Waterford or Halfmoon; however, if required, this will likely increase the overall amount of time required to complete the project. It is anticipated that a significant administrative and technical effort would be required to complete this work prior to initiation of Phase 1 dredging activities. For these reasons, this option is considered to have a relatively low level of administrative and technical feasibility and implementability.

The estimated capital costs associated with implementation of this option include the infrastructure improvements described above, and are based on cost estimates developed by Waterford's and Halfmoon's engineering consultants. The estimated OM&M costs for this option include the additional costs that would be incurred by Halfmoon to purchase water from Troy. Projected rates for 2009 were estimated based on historic rate information provided by Halfmoon and Troy, and a projected annual percentage increase for each rate. The estimated weekly OM&M costs to purchase water from Troy were determined by applying the difference in the projected 2009 rates (i.e., the rate to purchase water minus the rate charged to Halfmoon customers) multiplied by the total weekly volume of water that would be purchased by Halfmoon from Troy at Halfmoon's projected 2009 ADD for the period from May through November of 3 MGD. No other OM&M costs are assumed to be necessary to implement this option. The estimated capital and OM&M costs associated with this option are presented in Table 5.4. This option is the most expensive option evaluated in this section.

5.5 Halfmoon Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant

As summarized in Section 4.4.1, this contingency measure involves utilizing the existing PAC feed system at the Halfmoon WTP to provide supplemental treatment of the raw water for removal of PCBs during contingency periods triggered by EPA's Decision Criteria. As summarized in Section 3.2, there is an existing PAC feed system located at the Halfmoon WTP that is designed for taste and odor control with a designed maximum PAC feed dosage of 40 mg/L (Clough Harbour, 2000b). Based on information provided by Halfmoon, the PAC system reportedly has not been used since startup of the facility in 2003 (Halfmoon, 2006a).

Under this option, the existing system would be utilized to feed an estimated 350 pounds of PAC per week into the raw water as a contingency measure. The estimated weekly amount of PAC required is based on a projected 2009 ADD for the period from May through November of 3 MGD, with an assumed raw water PCB concentration of 1 µg/L and an adsorption rate of 1 milligram of PCBs removed per 1 gram of PAC. This equates to an approximate required dose of 2 mg/L PAC, which is within the design capacity of the existing PAC feed system. Treatability testing would have to be performed to evaluate actual PAC dosage requirements, including estimated non-PCB organic compounds that may be adsorbed by the PAC. It is assumed that additional facilities or improvements to the existing PAC feed system are not required.

The primary advantage of this option is the utilization of existing facilities that are already in place at the Halfmoon WTP. However, since the system reportedly has not been used since the plant started up, the operators may need some additional training before the system could be used during Phase 1 dredging operations. Since the Halfmoon WTP is currently permitted by NYSDOH to operate using the existing PAC system, it is assumed that the use of the PAC system as a contingency measure would be approved by NYSDOH. However, the need to obtain applicable regulatory approvals, if any, would have to be explored. This option is considered to have a relatively high level of administrative feasibility and implementability.

Treatability testing would be necessary prior to implementation of this option to confirm its effectiveness and determine actual operating requirements, including additional PAC dosage that would be required.

The estimated capital costs associated with implementation of this option include treatability testing. However, no infrastructure improvements are assumed. The estimated OM&M costs associated with this option include estimated costs for: PAC material required; labor for PAC handling; additional labor and disposal costs for the sludge generated; and additional water sampling and analysis. The estimated capital and OM&M costs associated with this option are presented in Table 5.5. The costs for this option are relatively low even if the PAC system is required for a prolonged period during Phase 1 dredging activities.

5.6 Halfmoon Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant

As summarized in Section 4.4.2, this contingency measure involves utilizing mobile GAC units at the Halfmoon WTP to provide supplemental treatment of the post-filtration effluent for removal of residual PCBs during contingency periods triggered by EPA’s Decision Criteria. Implementation of this option includes mobile GAC treatment units that would be staged at the Halfmoon WTP along with the required piping, valves, storage tanks, pumping units, electrical and control facilities, and appurtenances. The GAC units would be piped into the existing treatment process train between the filters and chlorine contact tanks to provide treatment of the post-filtration effluent. Temporary piping connections to the existing filter effluent piping and chlorine contact tanks would be necessary to direct water to and from the GAC treatment units.

Based on previous treatability studies performed by GE for the Hudson River project (BBL, 2006), it is assumed that an EBCT of 20 minutes would be adequate for PCB removal. Sizing of available GAC treatment units results in vessels that would be capable of treating a maximum flow of 250 gpm (i.e., 0.36 MGD). Twelve GAC units would be required to accommodate the projected 2009 MDD of 4 MGD.

As described in Section 3.2, chlorine is currently added to the filter effluent prior to the chlorine contact tanks (i.e., post-filtration disinfection). The treatment process reportedly achieves the required disinfection contact time in the chlorine contact tanks. Since chlorine compounds would be adsorbed by the GAC units and decrease their capacity for adsorbing PCBs, it would be necessary to temporarily relocate the existing chlorine feed point from the filter effluent piping to the GAC effluent piping, prior to its connection to the chlorine contact tanks. Based on a review of the existing Halfmoon WTP site, it is assumed that there is adequate space available to accommodate the staging of equipment and piping required for the GAC treatment system under this contingency measure.

The primary advantage associated with implementation of this option is that GAC adsorption is a proven and effective technology for removal of PCBs from water. As such, this option is considered to have a high level of effectiveness.

The primary disadvantage associated with this option is the amount of temporary treatment facilities and appurtenances that would be required at the Halfmoon WTP and the temporary changes in operating procedures that would be required. It is assumed that the use of the GAC treatment system would be approved by NYSDOH, although the need to obtain applicable regulatory approvals, if any, would have to be explored. Considering these factors, this option is considered to have a high level of administrative feasibility and a moderate level of technical feasibility and implementability.

The estimated capital costs associated with implementation of this option include the procurement and installation of the GAC units, piping, valves, storage tanks, pumping units, electrical and control facilities, and appurtenances described above. The estimated OM&M costs associated with this contingency measure include estimated costs for additional power and miscellaneous facilities that would be required to implement this option. The estimated capital and OM&M costs associated with this option are presented in Table 5.6. The costs for this option are moderate compared to the other contingency measures evaluated in this section.

5.7 Summary of Detailed Evaluation

Table 5.7 provides a summary overview of the relative effectiveness, administrative feasibility/implementability, technical feasibility/implementability, capital costs, and OM&M costs for each of the six contingency measures discussed in this section. Based on this extended evaluation, Section 6 describes which options are selected as the recommended contingency measures for the Waterford and Halfmoon systems.

6. Recommended Contingency Measures

EPA has developed a Resuspension Performance Standard that contains detailed measures designed to control the releases of PCBs to the river during dredging. The EPA's Resuspension Performance Standard is intended to be protective of public water supplies. Should PCB levels in the water column exceed EPA's standard during dredging, dredging activities will cease until EPA determines it is appropriate to continue. The PCB level that spurs the stoppage of in-river activities, such as dredging, as part of the performance standards (0.5 µg/L) is lower than the Decision Criteria developed by EPA for considering the implementation of water supply contingencies (i.e., 0.6 µg/L at TID, the monitoring location closest to Phase 1 dredging).

In the event PCB levels in the river exceed EPA's Decision Criteria, the following contingency measures are recommended for the Halfmoon and Waterford water supplies based on the detailed evaluation of the contingency measures presented in Sections 4 and 5. This section identifies the recommended contingency measures for each town, presents the primary basis for the selection, and identifies activities needed to implement the recommended options prior to Phase 1 dredging operations.

6.1 Recommended Contingency Measure for Waterford

For Waterford, the recommended contingency measure is Waterford Option No. 2, Existing Powdered Activated Carbon Treatment at Water Treatment Plant. This contingency measure would include utilizing the existing PAC feed system at the Waterford WTP to provide supplemental treatment of the raw water for removal of PCBs in the event that EPA's Decision Criteria are triggered.

This contingency measure was selected based on its relatively high level of feasibility (both administrative and technical) and overall implementability. This option involves the use of existing facilities with relatively minimal new infrastructure improvements needed to implement this contingency measure (i.e., assumes additional metering pump and appurtenances may be required). Treatability testing would be necessary prior to implementation of this option to confirm its effectiveness and establish appropriate operational requirements (e.g., PAC dosage, equipment sizing, etc). As summarized in Table 5.7, the estimated costs to implement this option for Waterford are approximately $64,000 (capital, including treatability testing) and $11,000 per week (OM&M). Thus, this alternative is cost-effective compared to the other contingency options for Waterford.

When fully implemented, this technology will be protective of the Waterford public water supply during contingency periods by reliably and effectively removing PCBs that may be above criteria for raw water coming into the WTP. Treatability testing and operational testing will be implemented to verify that after PAC treatment, PCBs will not be detectable above applicable water quality standards, MCLs, or EPA’s Decision Criteria.

6.2 Recommended Contingency Measure for Halfmoon

Similar to Waterford, the recommended contingency measure for Halfmoon is Halfmoon Option No. 5, Existing Powdered Activated Carbon Treatment at Water Treatment Plant. This contingency measure involves utilizing the existing PAC feed system at the Halfmoon WTP to provide supplemental treatment of the raw water for removal of PCBs in the event that EPA’s Decision Criteria are triggered.

This contingency measure was selected based on its relatively high level of feasibility (both administrative and technical) and overall implementability. This contingency measure can be readily implemented because it will utilize existing infrastructure (i.e., existing PAC feed system), thereby eliminating the need for new infrastructure. However, the plant operators may need additional training before the system can be utilized. Treatability testing would be necessary prior to implementation of this option to confirm its effectiveness and establish appropriate operational requirements (e.g., PAC dosage, equipment sizing, etc). As summarized on Table 5.7, the estimated costs to implement Option No. 5 for Halfmoon are approximately $55,000 (capital, including treatability testing) and $7,000 per week (OM&M). Thus, this alternative is cost-effective compared to the other contingency options for Halfmoon.

When fully implemented, this technology will be protective of the Halfmoon public water supply during contingency periods by reliably and effectively removing PCBs that may be above criteria for raw water coming into the WTP. Treatability testing and operational testing will be implemented to verify that after PAC treatment, PCBs will not be detectable above applicable water quality standards, MCLs, or EPA’s Decision Criteria.

6.3 Tasks Required to Implement Recommended Contingency Measures

Several administrative and technical tasks must be completed prior to the start of Phase 1 dredging activities in order to implement the recommended contingency measures. The tasks required to implement the recommended contingency measures are similar for both towns and are summarized below.

6.3.1 Development of Notification and Implementation Procedures

Implementation of the contingency measures will require coordination with several entities, including GE, EPA, NYSDOH, NYSDEC, Waterford, and Halfmoon.

In accordance with the CHASP, GE will promptly notify EPA, NYSDOH, NYSDEC, and the water suppliers if monitoring results indicate that EPA's Decision Criteria are exceeded during the Phase 1 dredging project and that initiation of contingency measures is required. Procedures for communicating surface water monitoring results and notifying the towns to initiate implementation of contingency measures would need to be established. In addition, procedures would be needed to notify the towns when contingency measures are no longer needed based on the results of surface water monitoring. Development of the detailed notification procedures would be completed jointly by representatives from GE, EPA, NYSDOH, Waterford, and Halfmoon.

6.3.2 Treatability Studies

Prior to implementation of the PAC systems as contingency measures for Waterford and Halfmoon, treatability studies will need to be implemented to confirm the effectiveness of this option and to establish necessary operating requirements. Treatability studies may include bench-scale treatability studies and/or pilot-scale treatability studies using PAC feed systems representative of the existing PAC systems at the Halfmoon and Waterford WTPs. The specific requirements and scope for performing the treatability studies would be developed in coordination with EPA, NYSDOH, Waterford, and Halfmoon.

In addition, data generated as part of NYSDOH's planned PWSMP could be used to evaluate the effectiveness of the existing PAC systems at Waterford and Halfmoon in conjunction with treatability studies. Some modification of NYSDOH's proposed monitoring approach may be required to evaluate the effectiveness of the PAC systems (e.g., modifying the monitoring locations and/or procedures, adjusting system operating procedures, modifying and/or ceasing application of PAC during the monitoring program).

6.3.3 System Improvements

Following treatability testing, the existing PAC systems at Waterford and Halfmoon would be reviewed to determine if modifications to the existing systems are necessary to meet the operational requirements established by the treatability testing. If needed, design documents detailing modifications to the WTP would be prepared for NYSDOH approval. Based on a preliminary review of the existing facilities and estimates of the additional PAC dosage required, it appears that minimal modifications to the existing systems will be required to implement these contingency options.

6.3.4 Permitting

Permits and/or approvals may be required from NYSDOH for use of the PAC systems at Waterford and Halfmoon as contingency measures. Potentially applicable regulatory approvals are not known at this time. Since both WTPs are currently permitted by NYSDOH to operate using the existing PAC systems, it is assumed that the use of the PAC systems as contingency measures would be approved by NYSDOH. However, use of PAC as contingency measures may require adjustments to the PAC feed rates and/or other adjustments to the operating conditions that would need to be reviewed with NYSDOH.

6.3.5 Training

Since the PAC system is currently used at the Waterford WTP, minimal additional training (if any) would be required to operate the PAC system as a contingency measure during the Phase 1 dredging project. However, the existing PAC feed system at the Halfmoon WTP reportedly has not been used since Halfmoon's new WTP was constructed in 2003. It is not known whether standard operating procedures for the PAC system have been developed previously by Halfmoon, or if the Halfmoon plant operators have been trained to operate the system. Therefore, operating procedures may need to be developed or revised to describe specific requirements for operating the PAC feed system. The specific OM&M requirements would be based on the results of treatability testing and any specific requirements defined by NYSDOH. Following development of new or revised OM&M procedures, additional training may be required for the Halfmoon plant operators prior to use of the system.

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Tables

Table 5.1 - Cost Estimate
Waterford Option No. 1: Water Supply from Troy through Existing Interconnection

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 [8]
No Additional Infrastructure Required [1]	-		$ -	$ -	$ -
			Subtotal	$ -	$ -
			Mobilization/Demobilization (5%)	$ -	$ -
			Construction Contingency (25%)	$ -	$ -
Engineering News Record Construction Cost Index			Total Construction Cost	$ -	$ -
March 2007 ENRCCI = 7856			Engineering (20%)	$ -	$ -
August 2009 ENRCCI = 8630 [8]			Administration (3%)	$ -	$ -
			Total Project Cost [2]	$ -	$ -

Weekly Operation and Maintenance Costs

Item Description	Quantity [3]	Units	Unit Price [4][5][6]	Total Cost March 2007	Total Adj. Cost August 2009 [8][9]
Purchase Water from Troy [7]	18,200	1k GAL	$ 5.50	N/A	$ 100,100
Subtract Cost at Waterford Billing Rate	18,200	1k GAL	$ (2.60)	N/A	$ (47,320)
			Subtotal	N/A	$ 52,780
			Contingency (25%)	N/A	$ 13,195
			Total Weekly O&M Cost [2]	N/A	$ 66,000

Notes/Assumptions:

1. This cost estimate assumes existing interconnection can adequately supply the projected 2009 Waterford maximum day demand of 3 MGD, based on review of information provided by Waterford and NYSDOH. (NYSDOH, 2006c; 2006d). In addition, the existing interconnection is currently used on a contingency basis to supplement or completely replace Waterford's water supply during periods of high demand, high turbidit from the Hudson River, or other emergency condition. Since the existing interconnection (and existing system infrastructure) is currently used without modification as a contingency supply and can reportedly supply an adequate amount of water on a contingent basis, it is assumed that improvements to Waterford's existing water system infrastructure are not required to implement this option as a contingency measure.
2. Costs are rounded up to nearest $1,000.
3. Based on a projected 2009 average daily demand of 2.6 MGD for Waterford for the period May through November (i.e., Phase 1 dredging seaso
4. Unit price rates per 1,000 gallons projected for 2009 from current rate information provided by Waterford (Waterford, 2005; Waterford, 2006a) at an assumed 3% annual increase, based on historical trend of the CPI from the last 2 years rounded up to the nearest $0.05.
5. There is a discrepancy between the rates reported by Waterford and Troy for purchase of water from Troy. Waterford's reported 2005 rate for purchase of water from Troy was $4.87 per 1,000 gallons (Waterford, 2005) and Troy's reported 2005 rate for sale of water to Waterford was $3.79 per 1,000 gallons (Troy, 2006b). For the purpose of developing this cost estimate, the higher (i.e., more conservative) rate reported by Waterford (i.e., $4.87 per 1,000 gallons) was utilized to determine the projected 2009 rate.
6. Troy proposed to charge a lower rate to supply water to Waterford "for an extended period of a year or more" during the dredging activities (Troy, 2006b). Since it is assumed that the contingency measures will be implemented only when required by EPA's Decision Criteria, this proposed lower rate for long-term supply would not be applicable and was not used to develop this cost estimate.
7. Troy has an existing contract with Waterford to supply up to 7 MGD to Waterford at a purchase rate equal to Troy's City Rate plus 25% (Troy, 2006b). The terms of any future contract are not known; however, it is assumed that the existing contract terms will apply during the Phase 1 dredging activities.
8. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
9. Projected increase of construction costs per projected August 2009 ENRCCI not applicable.
10. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.2 - Cost Estimate
Waterford Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
New Metering Pump and Appurtenances	1	LS	$ 5,000	$ 5,000	$ 5,493
			Subtotal	$ 5,000	$ 5,493
			Mobilization/Demobilization (5%)	N/A	N/A
			Construction Contingency (25%)	$ 1,250	$ 1,373
Engineering News Record Construction Cost Index			Total Construction Cost	$ 6,250	$ 6,866
March 2007 ENRCCI = 7856			Engineering (20%)	$ 1,250	$ 1,373
August 2009 ENRCCI = 8630 (7)			Treatability Studies (6)	$ 50,000	$ 54,926
			Administration (3%)	$ 188	$ 206
			Total Project Cost (5)	$ 58,000	$ 64,000

Weekly Operation and Maintenance Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
Additional PAC Material (1)	315	LB	$ 2	$ 630	$ 692
Additional PAC Handling Labor (2)	7	HR	$ 60	$ 420	$ 461
Additional Sampling Costs (3)	14	EA	$ 150	$ 2,100	$ 2,307
Additional Sludge Disposal	4	TON	$ 225	$ 900	$ 989
Additional Sludge Handling Labor (4)	64	HR	$ 60	$ 3,840	$ 4,218
			Subtotal	$ 7,890	$ 8,667
			Contingency (25%)	$ 1,973	$ 2,167
			Total Weekly O&M Cost (5)	$ 10,000	$ 11,000

Notes/Assumptions:

1. Waterford utilized approximately 60 pounds per day of powdered activated carbon (PAC) during routine operation of the water treatment plant for taste and odor control during the period May through November 2006 (Waterford, 2006c). The additional weekly quantity is based on an average additional daily PAC feed rate of 45 pounds per day. This is calculated by assuming a raw water PCB concentration of 1,000 nanograms per liter and PAC adsorption rate of 1 milligram PCBs removed per 1 gram of PAC for the projected 2009 average daily demand of 2.6 MGD at Waterford for the period May through November (i.e., Phase 1 dredging activities)
2. Based on one additional hour per day.
3. Based on analysis of two additional PCB samples per day (raw and finished water).
4. Based on two people for 8 hours per sedimentation basin, for four sedimentation basins.
5. Costs are rounded up to nearest $1,000.
6. Treatability studies costs are based on bench-scale studies.
7. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
8. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.3 - Cost Estimate
Waterford Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
Site Preparation (1)	1	LS	$ 20,000	$ 20,000	$ 21,970
Temporary Equalization Tank Rental (21,000 gal each) (2)	3	EA	$ 14,000	$ 42,000	$ 46,138
Temporary Booster Pump Rental (2)	6	EA	$ 16,000	$ 96,000	$ 105,458
GAC Trailer Delivery/Pickup (3)	10	EA	$ 2,000	$ 20,000	$ 21,970
GAC System Trailer Rental (2)(3)	10	EA	$ 80,000	$ 800,000	$ 878,819
GAC System Trailer Initial Carbon Loading (3)	10	EA	$ 20,000	$ 200,000	$ 219,705
Dechlorination Feed System (Sodium Metabisulfite)	1	LS	$ 35,000	$ 35,000	$ 38,448
Pipes, Fittings and Valves (4)	1	LS	$ 200,000	$ 200,000	$ 219,705
Temporary Enclosures for Pumping Equipment	2	EA	$ 10,000	$ 20,000	$ 21,970
Pavement Restoration	2,500	SF	$ 3	$ 7,500	$ 8,239
General Restoration	10,000	SF	$ 0.50	$ 5,000	$ 5,493
			Subtotal	$ 1,445,500	$ 1,587,916
			Mobilization/Demobilization (5%)	$ 72,275	$ 79,396
			Construction Contingency (25%)	$ 361,375	$ 396,979
Engineering News Record Construction Cost Index			Total Construction Cost	$ 1,879,150	$ 2,064,290
March 2007 ENRCCI = 7856			Engineering (20%)	$ 375,830	$ 412,858
August 2009 ENRCCI = 8630 (6)			Administration (3%)	$ 56,375	$ 61,929
			Total Project Cost (5)	$ 2,312,000	$ 2,540,000

Weekly Operation and Maintenance Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
Additional Power	1	LS	$ 1,000	$ 1,000	$ 1,099
Additional Operator Labor (7)	7	HR	$ 60	$ 420	$ 461
Miscellaneous (8)	1	LS	$ 1,000	$ 1,000	$ 1,099
			Subtotal	$ 2,420	$ 2,658
			Contingency (25%)	$ 605	$ 665
			Total Weekly O&M Cost (5)	$ 4,000	$ 4,000

Notes/Assumptions:

1. Includes site clearing and grading, temporary electrical service, and other site preparation activities.
2. Based on 8-month rental period during Phase 1 dredging activities.
3. Based on a capacity of 250 GPM per unit with 20-minute empty bed contact time (EBCT), for a projected 2009 maximum daily demand of 3 MGD at Waterford. Unit prices provided by GE Water and Process Technologies.
4. Includes interior, exterior, and buried piping; excavation and backfill; and appurtenances.
5. Costs are rounded up to nearest $1,000.
6. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
7. Based on one additional hour per day.
8. Includes chemical costs for sodium metabisulfite and additional chlorine.
9. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.4 - Cost Estimate
Halfmoon Option No. 1: Water Supply from Troy (through Waterford from Existing and New Interconnections)

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

Item Description [1]	Quantity [2]	Units [2]	Unit Price [2]	Total Cost March 2007	Total Adj. Cost August 2009 [8]
20-inch Interconnection under Hudson River at 123rd Street [2][3][4]	1,400	LF	$ 675	$ 945,000	$ 1,038,105
Flow Meter/Controls at New Interconnection [2][4]	1	LS	$ 75,000	$ 75,000	$ 82,389
20-inch Main, Middle Street, Fifth Street [2]	2,700	LF	$ 250	$ 675,000	$ 741,503
20-inch Main, Canal between Broad and Division [2]	400	LF	$ 300	$ 120,000	$ 131,823
16-inch Main, Division to Washington [2]	1,400	LF	$ 250	$ 350,000	$ 384,483
16-inch Main, Fonda to Pump Station [2]	3,000	LF	$ 200	$ 600,000	$ 659,114
12-inch & 16-inch Main, Fonda to Middletown Interconnection [2]	4,000	LF	$ 100	$ 400,000	$ 439,409
16-inch Main, Middletown to Crossline [2]	3,400	LF	$ 200	$ 680,000	$ 746,996
16-inch Main, Bells Lane to Route 4 [2]	1,800	LF	$ 200	$ 360,000	$ 395,468
16-inch Main, Route 4 [2]	3,600	LF	$ 200	$ 720,000	$ 790,937
			Subtotal	$ 4,925,000	$ 5,410,228
			Mobilization/Demobilization (5%)	$ 246,250	$ 270,511
			Construction Contingency (25%)	$ 1,231,250	$ 1,352,557
Engineering News Record Construction Cost Index			Total Construction Cost	$ 6,402,500	$ 7,033,296
March 2007 ENRCCI = 7856			Engineering (20%)	$ 1,280,500	$ 1,406,659
August 2009 ENRCCI = 8630 [8]			Administration (3%)	$ 192,075	$ 210,999
			Subtotal	$ 7,875,075	$ 8,650,954
			16-inch Main from Town Line to Clearwell [6]	$ 2,200,000	$ 2,416,752
			Total Project Cost [4][7]	$ 10,076,000	$ 11,068,000

Weekly Operation and Maintenance Costs

Item Description	Quantity [10]	Units	Unit Price [11]	Total Cost March 2007	Total Adj. Cost August 2009 [8][9]
Purchase Water from Troy through Waterford [12]	21,000	1k GAL	$ 5.50	N/A	$ 115,500
Subtract Cost at Halfmoon Billing Rate	21,000	1k GAL	$ (3.25)	N/A	$ (68,250)
				N/A	
			Subtotal	N/A	$ 47,250
			Contingency (25%)	N/A	$ 11,813
			Total Weekly O&M Cost [7]	N/A	$ 60,000

Notes/Assumptions:

1. Improvements to Waterford's distribution system infrastructure include only those that appear to be necessary to supply water to Halfmoon from Troy through Waterford's system, based on recommendations by Waterford's engineering consultant, Delaware Engineering, P.C. (Delaware). (Delaware. 2006.) Other infrastructure improvements recommended by Delaware (Delaware, 2006), including storage tank improvements, pump station replacement, pressure-reducing valve replacement, Troy interconnect vault improvements, unidentified valve replacements, and water main improvements on Middletown Road to Swatling Tank and on Broad Street, do not appear to be necessary to implement this contingency measure and are not included in this cost estimate.
2. Improvement to Waterford's distribution system infrastructure recommended by Delaware to provide water supply to Halfmoon from Troy through Waterford's distribution system. Estimated quantities and unit prices provided by Delaware. Unit prices represent construction only and do not include engineering, surveying, geotechnical, contingency, or other similar non-construction costs (Delaware, 2006).
3. Based on installation by directional drilling (Delaware, 2006).
4. It is assumed that Waterford Option No. 1 - Water Supply from Troy through Existing Interconnection and Halfmoon Option No. 1 - Water Supply from Troy (through Waterford from Existing and New Interconnections) would be implemented simultaneously. If a contingency measure other thar Waterford Option No. 1 is implemented, then the new 20-inch interconnection with Troy and associated flow meter/controls would not be required to implement Halfmoon Option No. 1, because the existing interconnection can supply an adequate amount of water to the Waterford system to meet Halfmoon's projected 2009 maximum day demand of 4 MGD. Eliminating these two items would reduce the total project cost by approximately $1,631,000 (March 2007 dollars) or $1,791,000 (August 2009 dollars).
5. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
6. Cost estimate for water system improvements in Halfmoon is from verbal information provided by Halfmoon and includes project cost. Estimated quantities and unit price information not provided. A breakdown of the project cost information (i.e., construction cost, contingency, engineering, etc...) was also not provided (Halfmoon, 2006a).
7. Costs are rounded up to nearest $1,000.
8. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
9. Projected increase of construction costs per projected August 2009 ENRCCI not applicable.
10. Based on a projected 2009 average daily demand of 3 MGD for Halfmoon for the period May through November (i.e., Phase 1 dredging season).

Table 5.4 - Cost Estimate
Halfmoon Option No. 1: Water Supply from Troy (through Waterford from Existing and New Interconnections)

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

11. Halfmoon's reported 2006 rate for purchase of water from Troy was $4.73 per 1,000 gallons (Halfmoon, 2006c), which is projected to be approximately $5.20 per 1,000 gallons for 2009 at an assumed 3% annual increase, based on historic trend of the CPI from the last 2 years, rounded up to the nearest $0.05. This is less than the projected 2009 rate of $5.50 per 1,000 gallons for Waterford to purchase water from Troy (see Table 5.1). For the purpose of developing this cost estimate, it was assumed that Halfmoon would be charged the same rate as Waterford to purchase water from Troy, and the higher (i.e., more conservative) rate of $5.50 was utilized in this cost estimate. The unit price Halfmoon billing rate per 1,000 gallons projected for 2009 from current rate information provided by Halfmoon (Halfmoon, 2006c) at an assumed 3% annual increase, based on historical trend of the CPI from the last 2 years, rounded up to the nearest $0.05. The unit prices do not include any additional fee for wheeling water through Waterford's distribution system.
12. The terms of any future contract are not known; however, it is assumed that contract terms adequate to supply Halfmoon's projected 2009 maximum day demand of 4 MGD using a rate structure similar to the existing will apply during the Phase 1 dredging activities.
13. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.5 - Cost Estimate
Halfmoon Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (7)
No Additional Infrastructure Required (1)	-		$ -	$ -	$ -
			Subtotal	$ -	$ -
			Mobilization/Demobilization (5%)	$ -	$ -
			Construction Contingency (25%)	$ -	$ -
Engineering News Record Construction Cost Index			Total Construction Cost	$ -	$ -
March 2007 ENRCCI = 7856			Engineering (20%)	$ -	$ -
August 2009 ENRCCI = 8630 (8)			Treatability Studies (7)	$ 50,000	$ 54,926
			Administration (3%)	$ -	$ -
			Total Project Cost (6)	$ 50,000	$ 55,000

Weekly Operation and Maintenance Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (7)
Additional PAC Material (2)	350	LB	$ 2	$ 700	$ 769
Additional PAC Handling Labor (3)	7	HR	$ 60	$ 420	$ 461
Additional Sampling Costs (4)	14	EA	$ 150	$ 2,100	$ 2,307
Additional Sludge Disposal	4	TON	$ 225	$ 900	$ 989
Additional Sludge Handling Labor (5)	8	HR	$ 60	$ 480	$ 527
			Subtotal	$ 4,600	$ 5,053
			Contingency (25%)	$ 1,150	$ 1,263
			Total Weekly O&M Cost (6)	$ 6,000	$ 7,000

Notes/Assumptions:

1. Assumes capacity of existing pwdered activated carbon (PAC) feed system, reported by Halfmoon to be 40 milligrams per liter feed rate (Clough Harbour, 2000b), is adequate to feed the estimated additional PAC feed rate.
2. Halfmoon currently does not utilize PAC during routine operation of the water treatment plant for taste and odor control (Halfmoon, 2006a). The additional weekly quantity is based on an average additional daily PAC feed rate of 50 pounds per day. This is calculated by assuming a raw water PCB concentration of 1,000 nanograms per liter and PAC adsorption rate of 1 milligram PCBs removed per 1 gram of PAC for the projected 2009 average daily demand of 3 MGD at Halfmoon for the period May through November (i.e., Phase 1 dredging season).
3. Based on one additional hour per day.
4. Based on analysis of two additional PCB samples per day (raw and finished water).
5. Based on two people for 4 hours per week.
6. Costs are rounded up to nearest $1,000.
7. Treatability studies costs are based on bench-scale studies.
8. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
9. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.6 - Cost Estimate
Halfmoon Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company - Albany, New York

Capital Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
Site Preparation (1)	1	LS	$ 40,000	$ 40,000	$ 43,941
Temporary Equalization Tank Rental (21,000 gal each) (2)	3	EA	$ 14,000	$ 42,000	$ 46,138
Temporary Booster Pump Rental (2)	6	EA	$ 16,000	$ 96,000	$ 105,458
GAC Trailer Delivery/Pickup (3)	14	EA	$ 2,000	$ 28,000	$ 30,759
GAC System Trailer Rental (2)(3)	14	EA	$ 80,000	$ 1,120,000	$ 1,230,346
GAC System Trailer Initial Carbon Loading (3)	14	EA	$ 20,000	$ 280,000	$ 307,587
Pipes, Fittings and Valves (4)	1	LS	$ 250,000	$ 250,000	$ 274,631
Temporary Enclosures for Pumping Equipment	2	EA	$ 10,000	$ 20,000	$ 21,970
Pavement Restoration	5,000	SF	$ 3	$ 15,000	$ 16,478
General Restoration	20,000	SF	$ 0.50	$ 10,000	$ 10,985
			Subtotal	$ 1,901,000	$ 2,088,293
			Mobilization/Demobilization (5%)	$ 95,050	$ 104,415
			Construction Contingency (25%)	$ 475,250	$ 522,073
Engineering News Record Construction Cost Index			Total Construction Cost	$ 2,471,300	$ 2,714,781
March 2007 ENRCCI = 7856			Engineering (20%)	$ 494,260	$ 542,956
August 2009 ENRCCI = 8630 (6)			Administration (3%)	$ 74,139	$ 81,443
			Total Project Cost (5)	$ 3,040,000	$ 3,340,000

Weekly Operation and Maintenance Costs

Item Description	Quantity	Units	Unit Price	Total Cost March 2007	Total Adj. Cost August 2009 (6)
Additional Power	1	LS	$ 1,000	$ 1,000	$ 1,099
Additional Operator Labor (7)	7	HR	$ 60	$ 420	$ 461
Miscellaneous	1	LS	$ 1,000	$ 1,000	$ 1,099
			Subtotal	$ 2,420	$ 2,658
			Contingency (25%)	$ 605	$ 665
			Total Weekly O&M Cost (5)	$ 4,000	$ 4,000

Notes/Assumptions:

1. Includes site clearing and grading, temporary electrical service, and other site preparation activities.
2. Based on 8 month rental period during Phase 1 dredging activities.
3. Based on a capacity of 250 GPM per unit with 20-minute empty bed contact time (EBCT), for a projected 2009 maximum daily demand of 4 MGD for Halfmoon. Unit prices provided by GE Water and Process Technologies.
4. Includes interior, exterior, and buried piping; excavation and backfill; and appurtenances.
5. Costs are rounded up to nearest $1,000.
6. Projected ENRCCI for anticipated mid-point of Phase 1 dredging activities in August 2009 = 8630; based on historical trend from last 2 years.
7. Based on one additional hour per day.
8. This estimate has been prepared for the purposes of comparing potential water supply alternatives. The information in this cost estimate is based on the available site information and the anticipated scope of the alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS of New York, Inc. is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability reserves.

Table 5.7 - Comparative Summary of Waterford Options Evaluation

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company – Albany, New York

Option	Relative Effectiveness	Relative Feasibility and Implementability	Pros	Cons	Estimated Capital Cost (1)	Estimated Weekly OM&M Cost (1)
Option No. 1: Temporary Supply from Troy Through Existing Interconnection	High	High	• No capital improvements required. • Utilizes existing infrastructure and procedures currently utilized by Waterford. • Highly effective since it utilizes an alternate source of water.	• Water supply from Troy not permitted by NYSDEC.	$0	$66,000
Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant	High (2)	High	• Minimal capital improvements anticipated to be required. • Utilizes existing facilities and procedures currently utilized at the WTP.	• Treatability study required to demonstrate level of effectiveness.	$64,000	$11,000
Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant	High	Moderate	• Highly effective since it utilizes proven technology for removal of PCBs from water.	• Significant amount of temporary capital improvements required. • Complex connection to existing WTP piping and facilities required. • Temporary changes in WTP operating procedures.	$2,540,000	$4,000

Notes:
1. Refer to Tables 5.1 through 5.3.
2. This option is anticipated to be effective; however, treatability testing would be performed to confirm its effectiveness.

Table 5.8 - Comparative Summary of Halfmoon Options Evaluation

Water Supply Options Analysis
Hudson River PCBs Superfund Site
General Electric Company – Albany, New York

Option	Relative Effectiveness	Relative Feasibility and Implementability	Pros	Cons	Estimated Capital Cost (1)	Estimated Weekly OM&M Cost (1)
Option No. 1: Water Supply from Troy (Through Waterford from Existing and New Interconnections)	High	Low	• Highly effective since it utilizes an alternate source of water.	• Significant capital improvements required. • Planning, design, permitting, and construction of required capital improvements difficult to complete before start of Phase 1 dredging activities.	$11,068,000	$60,000
Option No. 2: Existing Powdered Activated Carbon Treatment at Water Treatment Plant	High (2)	High	• No capital improvements anticipated to be required. • Utilizes existing facilities at the WTP.	• Treatability study required to demonstrate level of effectiveness.	$55,000	$7,000
Option No. 3: Post-Treatment Granular Activated Carbon Treatment at Water Treatment Plant	High	Moderate	• Highly effective since it utilizes proven technology for removal of PCBs from water.	• Significant amount of temporary capital improvements required to implement. • Complex connection to existing WTP piping/facilities required. • Temporary changes in WTP operating procedures.	$3,340,000	$4,000

Notes:
1. Refer to Tables 5.4 through 5.6
2. This option is anticipated to be effective; however, treatability testing would be performed to confirm its effectiveness.

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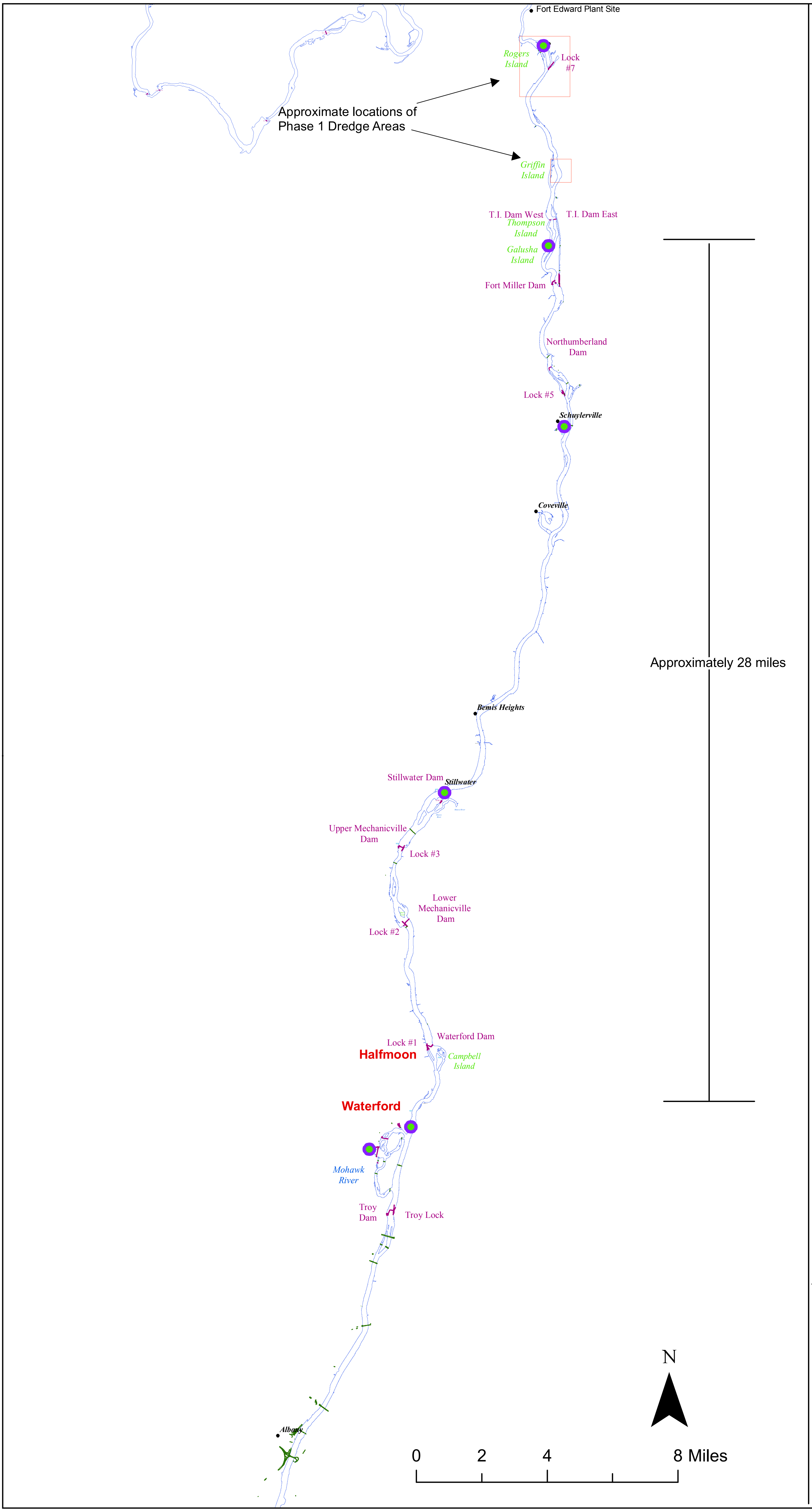
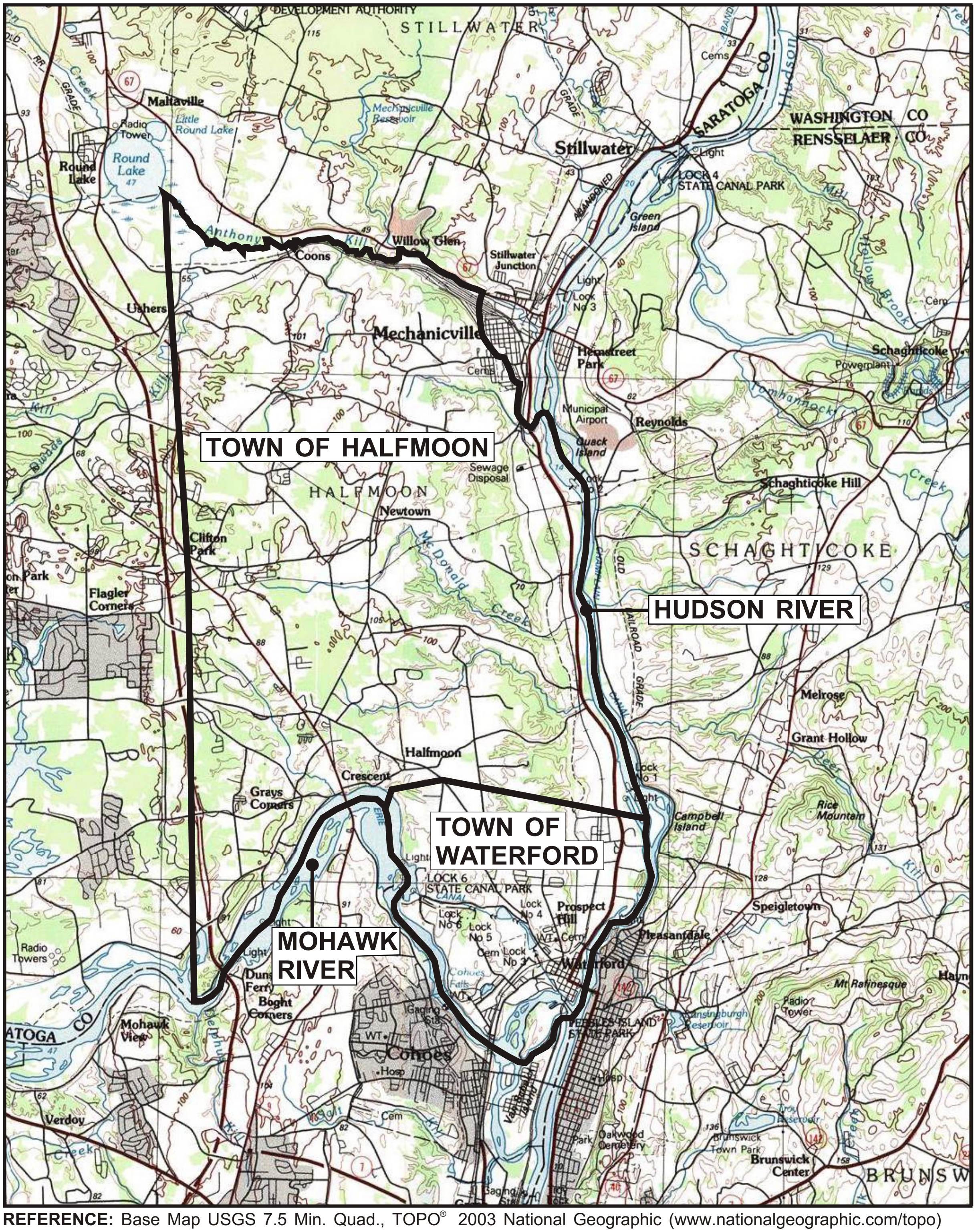
Figures



General Electric Company
Hudson River Project

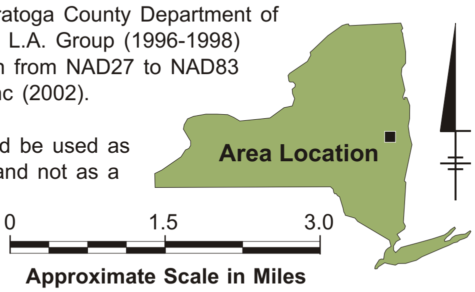
Figure 1.

Approximate locations of Phase 1 Dredge Areas and Surface Water Monitoring Stations



REFERENCE: Base Map USGS 7.5 Min. Quad., TOPO® 2003 National Geographic (www.nationalgeographic.com/topo)

MUNICIPAL BOUNDARIES
Authored by: Derived from tax map conversion digital files prepared for Saratoga County Department of Real Property Tax by L.A. Group (1996-1998) and digital conversion from NAD27 to NAD83 by Weiler Mapping Inc (2002).
Limitations:
This data layer should be used as a general reference and not as a definitive source.



GENERAL ELECTRIC COMPANY
WATER SUPPLY OPTIONS ANALYSIS

AREA LOCATION MAP

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FIGURE
2

04/05/07 SYR-D85-DJH
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