RESPONSIVENESS SUMMARY
HUDSON RIVER PCBs SITE RECORD OF DECISION

JANUARY 2002

For

U.S. Environmental Protection Agency
Region 2
and
U.S. Army Corps of Engineers
Kansas City District

BOOK 3 OF 3

FIGURES, TABLES & APPENDICES

TAMS Consultants, Inc.

Appendix A

HUDSON RIVER PCBs SUPERFUND SITE
NEW YORK
PRELIMINARY WETLANDS ASSESSMENT

APPENDIX A

HUDSON RIVER PCBs SUPERFUND SITE
NEW YORK
PRELIMINARY WETLANDS ASSESSMENT

The sediments and water in the Hudson River are contaminated with polychlorinated biphenyls (PCBs) from discharges originating from two General Electric Company (GE) capacitor manufacturing plants. The Hudson River PCBs Superfund Site extends nearly 200 river miles from Hudson Falls to the Battery in New York City. Many PCBs remain concentrated in *hot spots* in the sediments of the Upper Hudson River portion of the site, an approximately 40-mile reach of the river from Hudson Falls to Troy that traverses Washington, Saratoga, Albany, and Rensselaer Counties. The selected remedy involves sediment of the Upper Hudson River and this portion of the river is the focus of this assessment.

Both federal and state freshwater wetlands exist throughout the Upper Hudson region. Areas adjacent to the Upper Hudson River include forested shoreline wetlands, transitional uplands, and vegetated backwaters (emergent marsh and scrub-shrub wetlands). The National Wetlands Inventory (NWI) maps and the New York State Department of Environmental Conservation (NYSDEC) freshwater wetlands maps delimit the wetlands along the Upper Hudson River. Also, mapping prepared for GE depicts the locations of submerged aquatic vegetation (SAV) in the subject reach.

Description of the Selected Remedy

The remedial action objectives (RAOs) established for the Hudson River PCBs Superfund Site are to:

- Reduce the cancer risks and non-cancer health hazards for people eating fish from the Hudson River by reducing the concentration of PCBs in fish.
- Reduce the risks to ecological receptors by reducing the concentration of PCBs in fish.
- Reduce PCB levels in sediments to reduce concentrations in river (surface) water that are above applicable or relevant and appropriate requirements (ARARs).
- Reduce the inventory (mass) of PCBs in sediments that are or may be bioavailable.
- Minimize the long-term downstream transport of PCBs in the river.

Because certain wetlands and SAV communities along the Upper Hudson are contaminated by PCBs, they must be included in the areas to be dredged. There is no practicable alternative that exists other than remediation of those wetlands and SAV communities.

As documented in the Record of Decision for the Hudson River PCBs Superfund Site, the major components of the selected remedy comprise the following:

- Removal of sediments based primarily on a mass per unit area (MPA) standard of 3 g/m ^{2} Tri+ PCBs[1] or greater (approximately 1.56 million cubic yards of sediments) from River Section 1 (former Fort Edward Dam to Thompson Island Dam).
- Removal of sediments based primarily on an MPA of 10 g/m ^{2} Tri+ PCBs or greater (approximately 0.58 million cubic yards of sediments) from River Section 2 (below Thomson Island Dam to Northumberland Dam).
- Removal of selected sediments with high concentrations of PCBs and high erosional potential (NYSDEC *hot spots* 36, 37, and the southern portion of 39) (approximately 0.51 million cubic yards) from River Section 3 (below Northumberland Dam to Federal Dam at Troy).
- Dredging of the navigation channel, as necessary, to implement the remedy and to avoid hindering canal traffic during implementation. Approximately 341,000 cubic yards of sediments will be removed from the navigation channel (included in volume estimates in the preceding three components, above).
- Removal of all PCB-contaminated sediments within areas targeted for remediation, with an anticipated residual of approximately 1 mg/kg Tri+ PCBs (prior to backfilling).
- A phased approach whereby remedial dredging will occur at a reduced rate during the first year of dredging. This will allow comparison of operations with pre-established performance criteria and evaluation of necessary adjustments to dredging operations in the succeeding phase or to the criteria.
- Backfill of dredged areas with approximately one foot of clean material to isolate residual PCB contamination and to expedite habitat recovery, where appropriate.
- Use of rail or barge for transportation of clean backfill materials within the Upper Hudson River area.
- Monitored natural attenuation (MNA) of PCB contamination that remains in the dredging residual and in unremediated areas in the river.
- Use of environmental dredging techniques that will minimize and control resuspension of sediments during dredging.
- Transport of dredged sediments via barge or pipeline to sediment processing/transfer facility(ies) for dewatering and stabilization.
- Rail (or possibly barge) transport of dewatered, stabilized sediments to the appropriate licensed off-site landfill(s) for disposal. If a beneficial use of some portion of the dredged material is arranged, then an appropriate transportation method will be determined (rail, truck, or barge).
- Monitoring of fish, water, and sediment to determine when remediation goals are reached.
- Implementation (or modification) of appropriate institutional controls such as fish consumption advisories and fishing restrictions by the responsible authorities, until relevant remediation goals are met.

The selected remedy is expected to remove a total of 2.65 million cubic yards of contaminated sediment containing approximately 70,000 kg (about 150,000 lbs) of total PCBs from the Upper Hudson River. Remedial dredging will be conducted in two phases. The first phase will be

[1] "Tri+ PCBs" are PCB molecules with three or more chlorine atoms.

clearly and fully defined during the first year of design. The first phase will be the first construction season of remedial dredging. The dredging during that year will be implemented initially at less than full scale operation. It will include an extensive monitoring program of all operations, whereby monitoring data will be compared to performance criteria developed during the remedial design in consultation with the state, other natural resource trustees, and the public. Performance criteria will address (but may not be limited to) resuspension rates during dredging, production rates, residuals after dredging, or dredging with backfill as appropriate, and community impacts (*e.g.*, noise, air quality, odor, navigation).

The information and experience gained during the first phase of dredging will be used to evaluate and determine compliance with the performance criteria. Further, the data gathered will enable EPA to determine whether adjustments are needed to operations in the succeeding phase of dredging, or if performance criteria or the remedy as a whole needs to be reevaluated. EPA will make the data, as well as its final report evaluating the work with respect to the performance criteria, available to the public.

EPA has not yet determined the locations of sediment processing/transfer facility(ies) necessary to implement the selected remedy. For purposes of the Feasibility Study, example locations were identified from an initial list of candidate sites based on screening-level field observations that considered potential facility locations from an engineering perspective. In the Feasibility Study, it was necessary to assume the locations of sediment processing/transfer facility(ies) in order to develop conceptual engineering plans, analyze equipment requirements, and develop cost estimates for the remedial alternatives. For this purpose, two example locations were identified, one at the northern end of the project area in the vicinity of the Old Moreau Landfill, and one at the southern end of the project area near the Port of Albany. Each of these example locations meets many of the desired engineering characteristics for such a facility to support the remedial work and is representative of reasonable assumptions with regard to distance from the dredging work and cost. Other locations, both within the Upper Hudson River valley and farther downstream, are possible.

EPA will not determine the actual facility location(s) until after the Agency performs additional analyses, holds a public comment period on proposed locations, and considers public input in the final siting decision. Thus, all information provided in this preliminary wetlands assessment relative to potential impacts of the sediment processing/transfer facility(ies) on the environment should be considered representative and illustrative. Further specific assessment of and, as necessary, mitigation of, potential impacts will be addressed during design.

After construction is completed, the selected remedy relies on institutional controls such as fish consumption advisories and fishing restrictions (although perhaps in a modified form) and MNA for residual PCBs in dredged areas and the unremediated areas until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals (after remediation), as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

A separate source control action near its Hudson Falls plant is to be implemented by GE under an administrative order issued by NYSDEC, in order to address the continuing discharge of PCBs from that facility.

Effects of Selected Remedy on Wetlands

The selected remedy is protective of human health and the environment. Risk is reduced through removal of PCB-contaminated sediment in the river, followed by MNA. A principal benefit of EPA's selected remedy will be removal of a considerable sediment-bound contaminant mass from the river. PCB-contaminated sediments removed from the Upper Hudson River no longer will function as a source of contamination of Hudson River wetlands and SAV communities. As removal work proceeds, the mass of PCBs available for transport during flood events into wetlands bordering the river will diminish. In this context, the selected remedy will have a significant positive effect, especially during flood events when the potential for sediment resuspension is greatest. Further, removal of PCB-contaminated sediments from the river will greatly reduce the risk to ecological receptors resident in Hudson River wetlands and in SAV communities.

Based on analysis of NWI and NYSDEC wetlands mapping, approximately 1,460 acres of wetlands occur in or contiguous to the Upper Hudson River. Forested wetlands predominate, with emergent herbaceous wetlands, scrub-shrub wetlands, farmed wetlands, and mudflats also present. In addition, analysis of the GE SAV mapping indicates that an estimated 1,220 acres of SAV occur in or contiguous to the Upper Hudson River.

Excavation of sediments located in the Hudson River will occur with implementation of the selected remedy, potentially resulting in temporary, localized disturbance to the wetlands and SAV. Approximately 2.65 million cubic yards of PCB-contaminated sediment will be excavated. EPA proposes to place considerable fill in the river as a follow-up activity to dredging operations. On average, an estimated 3.5 feet of sediments will be removed from in-river dredging locations; only 1 foot of backfill will be placed in non-channel (shoal) areas. This will result in an average 2.5-foot net lowering of the river bottom elevation of in-river remediation areas, including existing SAV beds, after dredging and backfilling. Remediation areas comprising emergent wetlands will be backfilled to pre-remediation grades.

Comparison of the wetland locations to anticipated locations of dredging operations (the exact locations to be dredged will be determined during remedial design) indicates that no wetlands will be directly impacted by remediation activities, although the proposed operations will occur in locations contiguous to approximately 129 acres of wetlands. Such contiguous wetlands are situated adjacent to or near proposed dredging locations, but will not be dredged or backfilled under the selected remedy.

The approximately 129 acres of wetlands contiguous to proposed dredging locations comprise primarily forested (99 acres) and forested/scrub-shrub (25 acres) wetlands. An estimated 3 acres of scrub-shrub wetlands and 2 acres of emergent herbaceous wetlands also are located contiguous to proposed dredging locations.

These estimates are approximations of the anticipated wetland impacts only, as several inaccuracies are inherent in the impact assessment methodology used, specifically:

- NWI and NYSDEC wetlands maps show only the general configuration, location, and type of wetlands found within a given area of coverage. Because the maps are limited in precision by their scale and the identification method used, the boundaries of wetlands may need to be more precisely determined in the field.

- NYSDEC wetlands maps delimit only freshwater wetlands that are 12.4 acres in size or larger, and those smaller wetlands that are of unusual local importance (NYSDEC, 1986). Therefore, some Upper Hudson River wetlands that are smaller than 12.4 acres and are not of unusual local importance may not be mapped.

- Substantial differences in scale occur between NWI maps, NYSDEC freshwater wetlands maps, the remediation plans, and other sources of mapped data, resulting in inaccuracies in overlaying the various data sources.

- Mapped data was not field-verified for this analysis (although field delineation of habitats will be undertaken during remedial design).

To define the extent of wetlands in the remediation area and to enable the avoidance or minimization of impacts to contiguous wetlands, wetlands in and contiguous to the remediation area will be field-delineated during remedial design.

Based on comparison of the GE SAV maps and the proposed locations of dredging operations, an estimated 177 acres of SAV will be directly impacted by dredging. An additional 46 acres of SAV are contiguous to areas proposed for dredging.

River modification by dredging and backfilling will result in changes to the sediment supply and channel morphology, which in turn may lead to riverbed and riverbank erosion and sedimentation. The resulting instability could further impact wetlands and SAV. In addition, the resuspension of sediments during dredging and backfilling could indirectly impact SAV communities by reducing light penetration through the water column, thereby potentially impacting SAV growth and reproduction. However, if significant riverbed and river bank instability or sediment resuspension were to occur during or following remediation, such effects will be temporary and localized, although their actual duration and extent cannot be predicted accurately.

Another aspect of the selected remedy that potentially could impact wetlands is construction of sediment processing/transfer facility(ies), particularly a new wharf or dock to facilitate unloading sediment-laden barges. EPA would prefer to construct these operations at locations where wharf facilities already exist. However, in the event that is not possible, a wharf will need to be constructed at the river's edge to receive loaded barges. The discharge of water from the facility(ies) will comply with all substantive state and federal requirements.

Since the sediment processing/transfer facility(ies) site(s) have not been selected at this stage, it would be speculative to proceed further with assessing the impacts of their construction or operation on wetlands. Wetlands on the potential sites of the sediment processing/transfer facility(ies) will be assessed during remedial design and considered in the siting process.

Description of the Alternatives Considered and Their Effects on Wetlands and SAV

In addition to the selected remedy (designated REM 3/10/Select - Removal followed by MNA, with Upstream Source Control), the following four remedial alternatives were considered in the December 2000 Feasibility Study:

- **No Action (no Upstream Source Control) –** The No Action Alternative consists of refraining from the active application of any remediation technology to Upper Hudson River sediments and does not assume any source control action near the GE Hudson Falls plant, any administrative actions, nor any monitoring. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

- **Monitored Natural Attenuation (MNA) with Upstream Source Control –** The MNA Alternative relies on naturally occurring attenuation processes to reduce the concentrations of PCBs in the Upper Hudson River sediments and surface water, and assumes a separate source control action near the GE Hudson Falls plant. Long-term monitoring would be conducted in sediments, in the water column, and in fish to confirm that contaminant reduction is occurring and that the reduction is achieving RAOs. Institutional controls would be implemented as long-term control measures as part of the MNA Alternative. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.
- **CAP-3/10/Select - Capping, with Removal to Accommodate Cap, followed by MNA, with Upstream Source Control –** This alternative includes remediation by capping (after removal of more than 1.73 million cubic yards, in areas that either cannot be capped [navigation channels] or that require sediment removal to allow for placement of the cap) of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 1, sediments with an MPA of 10 g/m^2 PCBs or greater in River Section 2, and selected sediments within high concentration PCB target areas in River Section 3 (NYSDEC *hot spots* 36, 37, and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to allow for implementation of the remediation and allow normal boat traffic during remediation. This alternative assumes a separate source control action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. This alternative may also require restrictions on activities that could compromise the integrity of the cap. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

- **REM-0/0/3 - Removal followed by MNA with Upstream Source Control –** This alternative includes full section remediation by removal in River Sections 1 and 2, and removal of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 3. This alternative also includes sediment removal in the navigation channel as necessary to allow for the implementation of the remediation. The volume of sediments that would be removed under this alternative is estimated to be 3.82 million cubic yards, which is estimated to contain more than 84,000 kg (185,000 lbs) of total PCBs. This alternative assumes a separate source control action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

The No Action Alternative and the MNA Alternative do not entail excavation of contaminated sediments. The former does not include any physical remedial measures, and the latter relies on natural attenuation and a separate source control action only. Under both alternatives, contamination currently in the Upper Hudson River sediments would remain in place and remain a potential source for contamination of Hudson River wetland and SAV ecological communities. The No Action Alternative would not be protective of human health and the Hudson River environment. Although the MNA Alternative would include a separate source control action, it would not mitigate the ongoing negative effect the contaminated sediments are having on the wetland and SAV communities.

Implementation of the selected remedy, the CAP-3/10/Select Alternative, or the REM-0/0/3 Alternative would entail excavation of Upper Hudson River sediments, resulting in temporary disturbance to wetlands and SAV communities. Approximately 1.73 million and 3.82 million cubic yards of PCB-contaminated sediment would be excavated under the CAP-3/10/Select and REM-0/0/3 Alternatives, respectively. CAP-3/10/Select also would entail the capping of 207 acres of contaminated sediments. Like the selected remedy, the CAP-3/10/Select and REM-0/0/3 Alternatives, by removing PCB-contaminated sediments from the Upper Hudson River, would be protective of human health, the wetlands, and SAV communities.
EPA has determined that there is no practicable alternative that is protective of the environment that would not result in excavation of PCB-contaminated sediments. Implementation of the selected remedy will greatly reduce the levels of PCB contamination in Hudson River sediments, and will result in substantial reductions in human health and ecological risks at the site.

Measures to Mitigate Potential Harm to Wetlands and SAV if there is No Practicable Alternative to Locating in or Affecting Wetlands and SAV

The following mitigation measures will be undertaken to reduce potential impacts wetlands and SAV communities:

- EPA will employ measures to control resuspension and downstream migration of PCBs during remediation, including sediment barriers (*e.g.*, silt curtains) and operational controls, in order to minimize potential impacts to wetlands and SAV communities from resuspended PCB-laden sediments.

- At times when high winds or strong river currents impede maintenance of adequate control, in-river operations, particularly dredging, will be temporarily halted until the river returns to more typical discharge levels. Should it prove necessary to halt work because of high river flows, the dredges, barges, and other in-river equipment will be secured either at sediment processing/transfer facility(ies) or at mooring points constructed at suitable locations in the river.

- A habitat replacement program will be implemented in an adaptive management framework to replace SAV communities, wetlands, and riverbank habitat. The program will integrate implementation of habitat replacement actions, monitoring, and evaluation to ensure the effectiveness of the habitat replacement actions and the success of the overall program relative to specified replacement objectives. The replaced wetlands and SAV communities will be designed to provide several functions and values, specifically, wildlife habitat, flood control, and water quality improvement, at levels equivalent to those currently provided by the existing communities.

- A shoreline stabilization program will be implemented. The protection of the shoreline can be achieved using several techniques, depending on the potential for erosion at a particular location. Protecting the shore by restoring the vegetation is the preferred solution; however, bioengineering solutions or structural measures such as rip-rap may be required at selected locations to prevent further degradation of the shoreline.

- To define the extent of wetlands in the remediation area and to enable the avoidance or minimization of impacts to contiguous wetlands, wetlands in and contiguous to the remediation area will be field delineated during remedial design.

- During remedial design, EPA will consider in detail the need to minimize encroachments or impacts to wetlands in the vicinity of the sediment processing/transfer facility(ies). A wetlands delineation will be conducted to determine the extent of wetlands so that impacts can be avoided or minimized during the design of the sediment processing/transfer facility(ies).

- If it is determined that there will be wetland impacts resulting from the construction and operation of the sediment processing/transfer facility(ies) that cannot be avoided or further minimized, compensatory wetland mitigation will be implemented (as agreed upon by EPA, USACE, the federal trustees, and the NYSDEC). The goal of any compensatory mitigation will be to fully compensate for (replace) wetland acreage and all functions and benefits lost as a result of the construction and operation of the facility(ies).

Conclusion

The sediments in the Upper Hudson River reach are contaminated with PCBs at levels that are harmful to human health and ecological receptors. The selected remedy will result in excavation of these contaminated sediments using environmental dredging, backfilling of some of the dredged areas, and transportation of the excavated sediments to off-site, permitted disposal facilities outside the Hudson River valley. For some of the dredged sediments, a beneficial use may be arranged (*i.e.,* used for the manufacture of higher-value commercial products). Wetlands and SAV communities impacted by remediation operations will be replaced through implementation of a comprehensive habitat replacement program.

EPA has determined that:

- There is no practicable alternative to excavation of Upper Hudson River sediments and the resulting impacts to wetlands and SAV communities.
- Measures will be incorporated into the remedial design to reduce any temporary impacts to wetlands and SAV communities during implementation of the remedy.
- Long-term positive effects to the natural and beneficial value of wetlands and SAV communities will result from implementation of the selected remedy.

Reference

New York State Department of Environmental Conservation (NYSDEC). April 1986. New York State Freshwater Wetlands Mapping, Technical Methods Statement. Technical report, Division of Fish and Wildlife.

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Appendix B
HUDSON RIVER PCBs SUPERFUND SITE
NEW YORK
PRELIMINARY FLOODPLAINS ASSESSMENT

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HUDSON RIVER PCBs SUPERFUND SITE
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PRELIMINARY FLOODPLAINS ASSESSMENT

The sediments and water in the Hudson River are contaminated with polychlorinated biphenyls (PCBs) from discharges originating from two General Electric Company (GE) capacitor manufacturing plants. The Hudson River PCBs Superfund Site extends nearly 200 river miles from Hudson Falls to the Battery in New York City. Many PCBs remain concentrated in *hot spots* in the sediments of the Upper Hudson River portion of the site, an approximately 40-mile reach of the river in Washington, Saratoga, Albany, and Rensselaer Counties, from Hudson Falls to Troy. The selected remedy involves sediment of the Upper Hudson River and this portion of the river is the focus of this assessment.

The National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs) depict the 100-year floodplains for the Upper Hudson River and tributaries. The width of the 100-year floodplain ranges from approximately 400 feet to over 5,000 feet at places along the Upper Hudson River. The extent of the 500-year floodplain beyond the 100-year floodplain varies. Where the topography is flat, the 500-year floodplain can extend several hundred feet beyond the boundary of the 100-year floodplain, whereas in areas where the floodplain is topographically constrained, the boundaries of the 100-year and 500-year floodplains may coincide.

Description of the Selected Remedy

The remedial action objectives (RAOs) established for the Hudson River PCBs Superfund Site are to:

- Reduce the cancer risks and non-cancer health hazards for people eating fish from the Hudson River by reducing the concentration of PCBs in fish.
- Reduce the risks to ecological receptors by reducing the concentration of PCBs in fish.
- Reduce PCB levels in sediments to reduce concentrations in river (surface) water that are above applicable or relevant and appropriate requirements (ARARs).
- Reduce the inventory (mass) of PCBs in sediments that are or may be bioavailable.
- Minimize the long-term downstream transport of PCBs in the river.

As documented in the Record of Decision for the Hudson River PCBs Superfund Site, the major components of the selected remedy comprise the following:

- Removal of sediments based primarily on a mass per unit area (MPA) standard of 3 g/m^2 Tri+ PCBs[1] or greater (approximately 1.56 million cubic yards of

[1] "Tri+ PCBs" are PCB molecules with three or more chlorine atoms.

sediments) from River Section 1 (former Fort Edward Dam to Thompson Island Dam).

- Removal of sediments based primarily on an MPA of 10 g/m^2 Tri+ PCBs or greater (approximately 0.58 million cubic yards of sediments) from River Section 2 (below Thomson Island Dam to Northumberland Dam).
- Removal of selected sediments with high concentrations of PCBs and high erosional potential (New York State Department of Environmental Conservation [NYSDEC] *hot spots* 36, 37, and the southern portion of 39) (approximately 0.51 million cubic yards) from River Section 3 (below Northumberland Dam to Federal Dam at Troy).
- Dredging of the navigation channel, as necessary, to implement the remedy and to avoid hindering canal traffic during implementation. Approximately 341,000 cubic yards of sediments will be removed from the navigation channel (included in volume estimates in the preceding three components, above).
- Removal of all PCB-contaminated sediments within areas targeted for remediation, with an anticipated residual of approximately 1 mg/kg Tri+ PCBs (prior to backfilling).
- A phased approach whereby remedial dredging will occur at a reduced rate during the first year of dredging. This will allow comparison of operations with pre-established performance criteria and evaluation of necessary adjustments to dredging operations in the succeeding phase or to the criteria.
- Backfill of dredged areas with approximately one foot of clean material to isolate residual PCB contamination and to expedite habitat recovery, where appropriate.
- Use of rail or barge for transportation of clean backfill materials within the Upper Hudson River area.
- Monitored Natural Attenuation (MNA) of PCB contamination that remains in the dredging residual and in unremediated areas in the river.
- Use of environmental dredging techniques that will minimize and control resuspension of sediments during dredging.
- Transport of dredged sediments via barge or pipeline to sediment processing/transfer facility(ies) for dewatering and stabilization.
- Rail (or possibly barge) transport of dewatered, stabilized sediments to the appropriate licensed off-site landfill(s) for disposal. If a beneficial use of some portion of the dredged material is arranged, then an appropriate transportation method will be determined (rail, truck, or barge).
- Monitoring of fish, water, and sediment to determine when Remediation Goals are reached.
- Implementation (or modification) of appropriate institutional controls such as fish consumption advisories and fishing restrictions by the responsible authorities, until relevant remediation goals are met.

The selected remedy is expected to remove a total of 2.65 million cubic yards of contaminated sediment containing approximately 70,000 kg (about 150,000 lbs) of total PCBs from the Upper Hudson River. Remedial dredging will be conducted in two phases. The first phase will be the first construction season of remedial dredging. The dredging during that year will be implemented initially at less than full scale operation. It will include an extensive monitoring program of all operations, whereby the monitoring data will be compared to performance criteria developed during the remedial design in consultation with the state, other natural resource trustees, and the public. Performance criteria will address (but may not be limited to) resuspension rates during dredging, production rates, residuals after dredging or dredging with backfill as appropriate, and community impacts (*e.g.*, noise, air quality, odor, navigation).

The information and experience gained during the first phase of dredging will be used to evaluate and determine compliance with the performance criteria. Further, the data gathered will enable EPA to determine whether adjustments are needed to operations in the succeeding phase of dredging, or if performance criteria or the remedy as a whole need to be reevaluated. EPA will make the data, as well as its final report evaluating the work with respect to performance criteria, available to the public.

EPA has not yet determined the locations of sediment processing/transfer facility(ies) necessary to implement the selected remedy. For purposes of the Feasibility Study, example locations were identified from an initial list of candidate sites based on screening-level field observations which considered potential facility locations from an engineering perspective. In the Feasibility Study, it was necessary to assume the locations of sediment processing/transfer facility(ies) in order to develop conceptual engineering plans, analyze equipment requirements, and develop cost estimates for the remedial alternatives. For this purpose, two example locations were identified, one at the northern end of the project area in the vicinity of the Old Moreau Landfill and one at the southern end of the project area near the Port of Albany. Each of these example locations meets many of the desired engineering characteristics for such a facility to support the remedial work and is representative of reasonable assumptions with regard to distance from the dredging work and cost. Other locations, both within the Upper Hudson River valley and farther downstream, are possible.

EPA will not determine the actual facility location(s) until after the Agency performs additional analyses, holds a public comment period on proposed locations, and considers public input in the final siting decision. Thus, all information provided in this preliminary floodplain assessment relative to potential impacts of the sediment processing/transfer facility(ies) on the environment should be considered representative and illustrative. Further specific assessment of and, as necessary, mitigation of potential impacts will be addressed during design.

After construction is completed, the selected remedy relies on institutional controls, such as fish consumption advisories and fishing restrictions (although perhaps in a modified form), and MNA for residual PCBs in dredged areas and the unremediated areas until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals (after remediation), as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

A separate source control action near its Hudson Falls plant is to be implemented by GE under an administrative order issued by NYSDEC, in order to address the continuing discharge of PCBs from that facility.

Effects of Selected Remedy on Floodplains

The selected remedy is protective of human health and the Hudson River floodplain environment. Risk is reduced through removal of PCB-contaminated sediment, followed by MNA. A principal benefit of EPA's selected remedy will be removal of a considerable sediment-bound contaminant mass from the river. PCB-contaminated sediments removed from the Upper Hudson River no longer will function as a potential source of contamination of the Hudson River floodplain environment. As removal work proceeds, the mass of PCBs available to be transported during flood events into the floodplains will diminish. In this context, the selected remedy will have a significant positive effect, especially during flood events when the potential for sediment resuspension is greatest. Further, removal of PCB-contaminated sediments will greatly reduce the risk to ecological receptors resident in the Hudson River floodplain.

Excavation of sediments located in the Upper Hudson River will occur with implementation of the selected remedy, potentially resulting in temporary, localized disturbance to the floodplain. Approximately 2.65 million cubic yards of PCB-contaminated sediment will be excavated. EPA proposes to place considerable fill in the river as a follow-up activity to dredging operations. On average, an estimated 3.5 feet of sediments will be removed from in-river dredging locations, only 1 foot of backfill will be placed in non-channel (shoal) areas. This will result in an average 2.5-foot net lowering of the river bottom elevation of in-river remediation areas after dredging and backfilling.

Remediation areas comprising emergent wetlands will be backfilled to pre-remediation grades. The volume of fill material will only be a fraction of that removed by the dredging operations. Dredged areas between the shoreline and water depths of 12 feet, excluding emergent wetlands, will be partially backfilled with an estimated 0.8 million cubic yards of fill material, to limit the remobilization of residual PCB contaminants and to expedite habitat recovery. Thus, EPA will remove considerably more material from the river bottom than it will place as fill. Furthermore, in the context of the Hudson River being a series of impounded pools, backfilling, as proposed, will not utilize the river's active storage capacity. For both these reasons, it is not expected that backfilling will exacerbate conditions during flood events. No permanent impact (positive or negative) to the capacity of the floodplain to carry flood flows will result from implementation of the selected remedy.

River modification by dredging and backfilling will result in changes to the sediment supply and channel morphology, which in turn may lead to riverbed and riverbank erosion and sedimentation. If significant river bottom and bank instability were to occur during or following remediation, such effects will be temporary and localized, although their actual duration and extent cannot be predicted accurately.

An aspect of the selected remedy that potentially involves placement of fill in the river's floodplain is construction of sediment processing/transfer facility(ies), particularly a new wharf or dock to facilitate unloading sediment-laden barges. It is likely that the sediment processing/transfer facility(ies) required for the remedy will need to be located in the floodplain, given the need for the facility(ies) to have direct access to the river. EPA would prefer to construct these operations at locations where wharf facilities already exist. However, in the event that is not possible, a wharf will need to be constructed at the river's edge to receive loaded barges. One type of structure that may be used is a pile-supported deck, which would involve placement of little fill material. However, the final selection of wharf structure will depend on subsurface conditions at the transfer site as well as on the loads the structure will need to carry.

The sediment processing/transfer facility(ies) will be designed to treat the dredged material on a continuous basis. For the mechanical dredging option, a temporary staging area will be used to handle the stabilized (*i.e.*, mixed with Portland cement or other stabilizing agent) dredged material prior to transport of the stabilized material to a railcar loading area. For the hydraulic dredging option, a covered surge tank will be provided for flow and concentration equalization. The sediment processing/transfer facility(ies) will not have any short-term or long-term storage capability. The discharge of water from the sediment processing/transfer facility(ies) will comply with all substantive state and federal requirements.

Since the sediment processing/transfer facility site(s) have not been selected at this stage, it would be speculative to proceed further with assessing the impacts of their construction or operation on floodplains. EPA is aware of the need to minimize encroachments or impacts within floodplains and will consider the matter in detail during remedial design.

Description of the Alternatives Considered and their Effects on Floodplains

In addition to the selected remedy (designated REM 3/10/Select - Removal followed by MNA, with Upstream Source Control), the following four remedial alternatives were considered in the December 2000 Feasibility Study:

- **No Action (no Upstream Source Control) –** The No Action Alternative consists of refraining from the active application of any remediation technology to Upper Hudson River sediments and does not assume any source control action near the GE Hudson Falls plant, any administrative actions, nor any monitoring. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

- **Monitored Natural Attenuation (MNA) with Upstream Source Control –** The MNA Alternative relies on naturally occurring attenuation processes to reduce the concentrations of PCBs in the Upper Hudson River sediments and surface water, and assumes a separate source control action near the GE Hudson Falls plant. Long-term monitoring would be conducted in sediments, in the water column, and in fish to confirm that contaminant reduction is occurring and that the reduction is achieving RAOs. Institutional controls would be implemented as long-term control measures as part of the MNA Alternative. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

- **CAP-3/10/Select - Capping, with Removal to Accommodate Cap, followed by MNA, with Upstream Source Control –** This alternative includes remediation by capping (after removal of more than 1.73 million cubic yards, in areas that either cannot be capped [navigation channels] or that require sediment removal to allow for placement of the cap) of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 1, sediments with an MPA of 10 g/m^2 PCBs or greater in

River Section 2, and selected sediments within high concentration PCB target areas in River Section 3 (NYSDEC *hot spots* 36, 37, and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to allow for implementation of the remediation and allow normal boat traffic during remediation. This alternative assumes a separate source control action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. This alternative may also require restrictions on activities that could compromise the integrity of the cap. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

- **REM-0/0/3 - Removal followed by MNA, with Upstream Source Control –** This alternative includes full section remediation by removal in River Sections 1 and 2, and removal of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 3. This alternative also includes sediment removal in the navigation channel as necessary to allow for the implementation of the remediation. The volume of sediments that would be removed under this alternative is estimated to be 3.82 million cubic yards, which is estimated to contain more than 84,000 kg (185,000 lbs) of total PCBs. This alternative assumes a separate source control action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

The No Action Alternative and the MNA Alternative do not entail excavation of contaminated sediments. The former does not include any physical remedial measures, and the latter relies on natural attenuation and a separate source control action only. Under both alternatives, contamination currently in the Upper Hudson River sediments would remain in place and remain a potential source for contamination of Hudson River floodplain sediments and ecological communities. The No Action Alternative would not be protective of human health and the Hudson River environment. Although the MNA Alternative would include a separate source control action, it would not mitigate the ongoing negative effect the contaminated sediments are having on the floodplain environment.

Implementation of the selected remedy, the CAP-3/10/Select Alternative, or the REM-0/0/3 Alternative would entail excavation of Upper Hudson River sediments, resulting in temporary disturbance to the floodplain. Approximately 1.73 million and 3.82 million cubic yards of PCB-contaminated sediment would be excavated under the CAP-3/10/Select and REM-0/0/3 Alternatives, respectively. The CAP-3/10/Select also would entail the capping of 207 acres of contaminated sediments. Like the selected remedy, the CAP-3/10/Select and REM-0/0/3 Alternatives, by removing PCB-contaminated sediments from the Upper Hudson River, would be protective of human health and the floodplain environment.

EPA has determined that there is no practicable alternative that is protective of the environment that would not result in excavation of PCB-contaminated sediments. Implementation of the selected remedy will greatly reduce the levels of PCB contamination in Hudson River sediments, and will result in substantial reductions in human health and ecological risks at the site.

Measures to Mitigate Potential Harm to the Floodplain if there is No Practicable Alternative to Locating in or Affecting Floodplains

The selected remedy entails excavation of PCB-contaminated sediments within a 40-mile reach of the Upper Hudson River that have been determined to pose a threat to human health and ecological receptors. Rather than harming the floodplain, the implementation of the selected remedy will reduce the levels of PCB contamination in Hudson River floodplain sediments.

The following mitigation measures will be undertaken to reduce potential impacts on the floodplain, as well as to reduce the potential that a low-frequency flood event could disable the remedy or cause contamination to spread during implementation of the remedy:

- EPA will employ measures to control resuspension and downstream migration of PCBs during remediation, including sediment barriers (*e.g.*, silt curtains) and operational controls, in order to minimize potential impacts to the floodplains from resuspended PCB-laden sediments.

- At times when high winds or strong river currents impede maintenance of adequate control, in-river operations, particularly dredging, will be temporarily halted until the river returns to more typical discharge levels. Should it prove necessary to halt work because of high river flows, the dredges, barges, and other in-river equipment will be secured either at sediment processing/transfer facility(ies) or at mooring points constructed at suitable locations in the river.
- A shoreline stabilization program will be implemented. The protection of the shoreline can be achieved using several techniques depending on the potential for erosion at a particular location. Protecting the shore by restoring the vegetation is the preferred solution; however, bioengineering solutions or structural measures such as rip-rap may be required at selected locations to prevent further degradation of the shoreline.

- A habitat replacement program will be implemented in an adaptive management framework to replace SAV communities, wetlands, and riverbank habitat. The program will integrate implementation of habitat replacement actions, monitoring, and evaluation to ensure the effectiveness of the habitat replacement actions and the success of the overall program relative to specified replacement objectives. The replaced wetlands and SAV communities will be designed to provide several functions and values; specifically, wildlife habitat, flood control, and water quality improvement at levels equivalent to those currently provided by the existing communities.

Conclusion

The sediments in the Upper Hudson River are contaminated with PCBs at levels that are harmful to human health and ecological receptors. The selected remedy will result in excavation of these contaminated sediments using environmental dredging, backfilling of some of the dredged areas, and transportation of the excavated sediments to off-site, permitted disposal facilities outside the Hudson River Valley. For some of the dredged sediments, a beneficial use may be arranged (*i.e.*, used for the manufacture of higher-value commercial products). No permanent impact to the capacity of the floodplain to carry flood flows will result from implementation of the selected remedy. As a result of remediation, the mass of PCBs available for transport into the floodplains during flood events will diminish.

EPA has determined that:

- There is no practicable alternative to excavation of Upper Hudson River sediments.
- Measures will be incorporated into the remedial design to reduce any temporary impacts to the floodplain during implementation of the remedy.
- Long-term positive effects to the natural and beneficial value of Hudson River floodplains will result from implementation of the selected remedy.

Appendix C

Stage 1A CULTURAL RESOURCES SURVEY

APPENDIX C

STAGE 1A CULTURAL RESOURCES SURVEY

ABSTRACT

The US Environmental Protection Agency (EPA) has prepared this *Stage IA Cultural Resources Survey* to meet the objective of initiating compliance with Section 106 of the National Historic Preservation Act (NHPA) (36 CFR Part 800) in conjunction with the Upper Hudson River PCBs Superfund Site remediation project. The report has six principal goals:

- Provide the regulatory framework and introduce the fundamental principals of both the Section 106 compliance process and National Register eligibility considerations;
- Outline the five alternatives devised to remediate the Upper Hudson River PCBs Superfund Site, including EPA's selected remedy;
- Provide background information on the environmental setting, prehistory, and history of the project area and region;
- Describe previous cultural resource studies and types of known resources in the Area of Potential Effect (APE) established for the project;
- Provide a preliminary discussion of the effects of the selected remedy on previously identified archaeological and architectural resources; and
- Outline future steps that may be taken by EPA as the Section 106 process progresses.

This *Stage IA Cultural Resources Survey* concluded that under 36 CFR Part 800, the selected remedy may potentially affect 14 previously identified archaeological sites and eight identified National Register-listed or eligible resources. EPA will try to avoid Adverse Effects during the remedial design phase while maintaining the effectiveness of the remediation. If avoidance through redesign of the dredging process in those areas is not feasible, alternative appropriate mitigative strategies would be implemented.

During the remedial design phase, EPA may conduct additional cultural resource surveys in compliance with Section 106. These surveys would be designed to identify as yet unmapped National Register-eligible resources; previously surveyed but unevaluated architectural resources and potential archaeological and architectural resources in areas that have not been previously surveyed, but that may be effected by the selected remedy. Effects to these resources and potential mitigation strategies would be explored as a future step in the Section 106 process, and would build upon the information presented in this baseline assessment of the Upper Hudson River APE.

This Stage IA Cultural Resources Survey was prepared by a team of architectural historians and archaeologists. The team was led by a registered professional archaeologist as defined by Federal Register, 36 CFR Part 61. See also 48 Fed Reg 44716-42 (September 29, 1983).

1. INTRODUCTION

EPA has selected a remedy for the remediation of the Upper Hudson River portion of the Hudson River PCBs Superfund Site. This remedy will involve dredging portions of the Upper Hudson River to remove sediments with elevated concentrations of PCBs. This *Stage IA Cultural Resources Survey* has been prepared to initiate compliance with Section 106 of the National Historic Preservation Act in conjunction with the Hudson River PCBs remediation project.

1.1 Site Description

The Hudson River flows in a generally southerly direction approximately 315 miles from its source at Lake Tear-of-the-Clouds on Mount Marcy in the Adirondack Mountains to the Battery in New York City. The Hudson River PCBs Superfund Site extends nearly 200 river miles from the Fenimore Bridge in Hudson Falls (River Mile [RM] 197.3) to the Battery in New York City. The Superfund Site is divided into the Upper and Lower Hudson Rivers, based on physical and chemical characteristics.

The Upper Hudson River portion of the Superfund Site is the subject of this report and extends from the Fenimore Bridge to the Federal Dam at Green Island in Troy, a distance of about 43 river miles (Figure C.1-1, Overview of Upper Hudson River Glen Falls to Federal Dam). Within the Superfund Site, the river is canalized and equipped with eight dams with locks that form a series of pools. The dams and locks are associated with the 60-mile-long Champlain Barge Canal that extends from Waterford (RM 158) to Whitehall at the southern end of Lake Champlain. Within the Upper Hudson, these dams, in addition to other environmental factors, control river flow.

The Upper Hudson is further divided into three sections to evaluate remedial alternatives (Figure C.1-1). River Section 1 contains the Thompson Island Pool and extends 6.3 miles from the former Fort Edward Dam (RM 194.8) to the Thompson Island Dam at RM 188.5. The 2.5 miles upstream of the former Fort Edward Dam extending to the Fenimore Bridge are not a major focus of the selected remedy because the area contains little sediment and the shoreline PCB contamination (*i.e.*, the remnant deposits) has largely been addressed.

River Section 2 extends about 5.1 river miles from the Thompson Island Dam to the Northumberland Dam, near Lock 5 of the Champlain Barge Canal at Schuylerville. River Section 3 extends about 29.5 river miles from below the Northumberland Dam to the Federal Dam at Troy.

The Hudson River between Fort Edward and Schuylerville (except for the region between the dams at Thompson Island and Fort Miller where the river is bypassed by a land cut) is part of the Champlain Canal that links the tidal Hudson River and the Erie Canal with Lake Champlain. This canal was dredged prior to about 1917 to provide a channel with a width of 200 feet and a depth of 12 feet. Dredging has continued in portions of the river to counteract sedimentation, including that associated with river floods in 1974 and 1976.

1.2 Site History

During World War II, General Electric Company (GE) established a plant in Fort Edward and, at the conclusion of the war, purchased and converted a paper mill in Hudson Falls for production of electrical components. From the 1940s until 1977, GE used PCBs in the manufacture of electrical capacitors at both facilities. Excess PCB oils were discharged both directly and indirectly into the Hudson River, especially at the Hudson Falls plant. Many of the PCBs discharged to the river adhered to sediments and accumulated as they settled in an impounded pool behind the Fort Edward Dam and other locations downstream. Because of its deteriorating condition, the dam was removed in 1973, and during spring floods, PCB-contaminated sediments were scoured and transported downstream.

In 1977, the manufacture and sale of PCBs within the US was generally prohibited under provisions of the Toxic Substances Control Act (TSCA). Although commercial uses of PCBs ceased that year, PCBs from GE's Fort Edward and Hudson Falls plants continued to contaminate the Hudson River due to erosion of remnant deposits, PCB discharges via bedrock fractures from the Hudson Falls plant, and erosion of contaminated deposits near the Fort Edward plant.

In 1984, the site was placed on the National Priorities List and that same year, the US Environmental Protection Agency (EPA) completed a Feasibility Study (FS) and Record of Decision (ROD) that recommended, among other things, an interim no action with regard to the PCB-contaminated sediments in the Upper Hudson. In 1989, EPA announced a reassessment of the interim No Action decision for the Upper Hudson River sediments in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (aka Superfund) regulations and New York State regulations, and to address other issues. Phase 1 of the Reassessment, consisting of a review of existing data, was completed in 1991. Phase 2, consisting of collection and analysis of new data, modeling studies, and human health and ecological risk assessments, was completed in November 2000. Phase 3, the FS, was completed in December 2000. This cultural resources document forms part of the Responsiveness Summary for the FS.

1.3 Goals of Remedial Action

The primary objective of the proposed action is to address the PCB-contaminated sediments in the Upper Hudson River. Removal of the sediments will reduce PCB concentrations in fish tissue, thereby significantly reducing future human health and ecological risks. In addition, the selected remedy assumes that a separate source control response action will be performed near GE's Hudson Falls plant to control a continuing source of PCBs to the water column, which contributes to PCB concentrations in fish tissue concentrations. This separate source control action currently is being addressed pursuant to a consent order between the New York State Department of Environmental Conservation (NYSDEC) and GE.

1.4 General Objectives and Organization of Document

EPA has prepared this *Phase IA Cultural Resources Assessment* to meet the objective of initiating substantive compliance with Section 106 of the National Historic Preservation Act in conjunction with the Hudson River PCBs remediation project. This appendix is organized as follows:

- Section 2 presents the regulatory framework for this effort and introduces the fundamental principles of both the Section 106 compliance process and National Register eligibility considerations.
- Section 3 outlines five alternatives considered as options for remediating the PCB-contaminated sediments, including EPA's selected remedy.
- Section 4 provides background information on the environmental setting of the region.
- Section 5 provides a prehistoric and historic context for the region.
- Section 6 details previous cultural resource studies and types of known resources in the area of potential effect established for the project.
- Section 7 provides a preliminary discussion of effects on previously identified archaeological and architectural resources.
- Section 8 discusses future steps that may be taken by EPA as the Natural Historic Preservation Act Section 106 process progresses. In addition, three supplemental sections at the end of this document contain tabulations of some of the data discussed in this report.

2.0 REGULATORY FRAMEWORK

EPA has prepared this Stage 1A Cultural Resources Survey for the Hudson River PCBs Responsiveness Summary (RS) in partial compliance with its historic preservation obligations related to the remediation of PCB-contaminated sediments in the Upper Hudson River portion of the Hudson River PCBs Superfund Site.

2.1 Applicable Statutes and Regulations

Several federal and state laws, executive orders, and regulations require that cultural resources either listed in the National Register of Historic Places or meeting the eligibility criteria for listing in the National Register be identified, evaluated, and considered during federally funded, licensed, permitted, or approved undertakings; and those undertakings pursuant to state or local regulations administered pursuant to delegation or approval by a federal agency. Federal and state statutes and regulations offering protection to cultural resources include:

- The National Historic Preservation Act (NHPA).
- Executive Order 11593, Protection and Enhancement of the Cultural Environment.
- The Archaeological Resources Protection Act (ARPA).
- The Native American Graves Protection and Repatriation Act (NAGPRA).
- The National Environmental Policy Act (NEPA).
- The New York State Environmental Quality Review Act (SEQRA).
- The New York State Historic Preservation Act (SHPA).

As the remediation of the Upper Hudson River PCBs site is an EPA action, the NHPA is presently the most relevant statute. However, as EPA's compliance process progresses, other statutes and regulations may be triggered.

Section 106 of NHPA of 1966, as amended (16 USC 470 et seq.), provides that federal agencies take into account the effects of their actions on any district, site, building, structure or object listed in or eligible for inclusion in, the National Register of Historic Places. Implementing regulations for Section 106, established by the Advisory Council on Historic Preservation (ACHP), are contained in 36 CFR Part 800, Protection of Historic Properties. These regulations provide specific criteria for assessing the effects of federally funded, licensed, permitted or approved undertakings on historic properties, or undertakings subject to state or local regulation administered pursuant to approval by a federal agency, and identifying adverse effects on historic properties.

The National Register of Historic Places establishes specific criteria for historic significance and integrity to govern listing and eligibility determinations. The tables entitled Criteria for Historic Significance and Integrity Aspects Defined summarize, respectively, eligibility criteria and the seven aspects of integrity that a resource must be evaluated for to be listed or eligible for listing in the National Register.

The effects of an undertaking on a cultural resource are predicted by evaluating the significant characteristics of the resource, and the design and anticipated consequences of the undertaking.

Effects to cultural resources listed in, or eligible for listing in, the National Register are evaluated with regard to the Criteria of Adverse Effect set forth in 36 CFR 800.9 and summarized in the table with that title, following the other two tables.

Criteria for Historic Significance

36 CFR 60.4, Part I
The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and: A. That are associated with events that have made a significant contribution to the broad patterns of our history; or B. That are associated with the lives of persons significant in our past; or C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or D. That have yielded, or may be likely to yield, information important in prehistory or history.
6 CFR 60.4, Part II
Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories: A. A religious property deriving primary significance from architectural or artistic distinction or historical importance; or B. A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or C. A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life; or D. A cemetery which derives its primary significance from graves or persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or E. A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or F. A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or G. A property achieving significance within the past 50 years if it is of exceptional importance.

Integrity Aspects Defined

Aspect of Integrity	Property Attributes
Location	Must not have been moved.
Design	Must retain historic elements that create the form, plan, space, structure, and style of the property.
Setting	Setting must retain its historic character.
Materials	Must retain the key exterior materials dating from the period of its historic significance.
Workmanship	Methods of construction from its time of significance must be evident.
Feeling	Physical features must convey its historic character.
Association	Must be the actual place where a historic event or activity occurred and must be sufficiently intact to convey that relationship to an observer.
Source: US Department of the Interior, 1991.	

Criteria of Adverse Effect

Criteria of Adverse Effect
"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative" (36 CFR 800.5[a][1]).
Examples of Adverse Effect
"Adverse effects on historic properties include, but are not limited to: 1. Physical destruction of or damage to all or part of the property; 2. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR Part 68) and applicable guidelines; 3. Removal of the property from its historic location; 4.Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; 5. Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features; 6. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; 7. Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance" (36 CFR 800.5[a][2]).

2.2 Survey Methods

As previously mentioned, this cultural resources survey has been prepared as a first step in the EPA's compliance with substantive requirements of Section 106 of the NHPA. For this project, the federal undertaking is considered remediation of PCB-contaminated sediments in the Upper Hudson River. As the initial step in this compliance process, the primary goals established for this assessment were to:

- Establish an area of potential effect (APE).
- Develop an environmental, prehistoric, and historic context for the APE and region.
- Conduct a baseline survey of previously identified cultural resources in the APE and relevant preservation planning and compliance documentation.
- Describe the selected remedy and alternatives to a sufficient degree to enable a preliminary assessment of effects and consider additional identification and evaluation efforts that EPA may conduct as the Section 106 process goes forward.

No fieldwork was conducted during the present survey and only a single information repository located within the project area was visited as described below. All site descriptions and interpretations are based on primary and secondary sources of information. The following subsections describe the methods involved with completion of this survey.

Area of Potential Effect

The Hudson River PCBs Superfund Site includes an approximate 40-mile portion of the Hudson River extending from the former Fort Edward Dam to the Federal Dam at Troy. Its width is defined as the shoreline when river water volume is at 8,471 cubic feet per second (cfs). In addition to dredging within this 40-mile portion of the river, alternatives developed for this action also considered two example locations for sediment processing/transfer facilities.

It is important to note that EPA has not yet determined the locations of sediment processing/transfer facilities necessary to implement the selected remedy. EPA will comply with substantive requirements of the NHPA in connection with the facility siting process. For purposes of the FS, example locations were identified from an initial list of candidate sites based on screening-level field observations which considered potential facility locations from an engineering perspective. In the FS, it was necessary to assume the locations of sediment processing and transfer facilities in order to develop conceptual engineering plans, analyze equipment requirements, and develop cost estimates for the remedial alternatives. For this purpose, two example locations were identified: one at the northern end of the project area in the vicinity of the Old Moreau Landfill, and one at the southern end of the project area near the Port of Albany. Each of these example locations fulfills many of the desired engineering characteristics for such a facility to support the remedial work and is representative of reasonable bounding assumptions with regard to distance from the dredging work and cost. Other locations, both within the Upper Hudson River valley and farther downstream, are possible.

The example facility locations presented in the FS have also been used in the Responsiveness Summary in order to clarify material presented in the FS and Proposed Plan, and in connection with additional noise, odor, and other analyses that were performed in order to respond to public comments. EPA will not determine the actual facility location(s) until after the Agency holds a public comment period on proposed locations and considers public input in the final siting decision. Thus, all information provided in the Responsiveness Summary relative to potential impacts of the sediment processing and transfer facilities on communities, residents, agriculture, the environment, and businesses should likewise be considered representative and illustrative. Further specific assessment of and, as necessary, mitigation of, potential impacts will be addressed during design once siting decisions have been finalized.

In consultation with the NY State Historic Preservation Office (Kuhn, pers. comm, August 7, 2001), EPA established an APE for the Stage 1A Cultural Resources Survey of the Upper Hudson River remediation area of adequate geographic area to encompass all reasonable direct or indirect potential alterations by the undertaking to the character or use of cultural resources and reflect the scale and nature of the undertaking. The Hudson River PCBs Superfund Site APE extends approximately 50 miles along the Hudson River from the southeastern edge of the City of Glens Falls, Warren County, through riverfront portions of Washington, Saratoga, and Rensselaer Counties, to the southern edge of the Port of Albany in the City of Albany, Albany County. The APE also includes a 2,000-foot-wide strip of land running along the east and west banks of the river for the entire 50 miles (Figure C.2-1, Upper Hudson River APE).

This APE envelops the entire portion of the river to be impacted by dredging and includes adjacent lands that could experience transportation-related effects and that could theoretically accommodate construction of a sediment processing/transfer facility.

Environmental, Prehistoric, and Historic Context

In compliance with Section 106, Chapters 4 and 5 of this document provide a description of the environmental setting and a prehistoric and historic context for the Upper Hudson River region, with special emphasis on communities along the Hudson River in the five-county region between the City of Albany north to the City of Glens Falls, including portions of Albany, Rensselaer, Saratoga, Washington, and Warren counties. To compile this context, secondary source research was conducted at the following repositories:

- New York Public Library, New York, NY.
- Columbia University, New York, NY.
- New York University, New York, NY.
- New York State Office of Parks, Recreation and Historic Preservation, Albany, NY.
- University of Maryland, College Park, MD.
- The office libraries of EPA's consultants.

The environmental setting presented in Section 4 focuses on the geological and environmental processes that have shaped the region and led to its being considered an attractive settlement location for thousands of years. The prehistoric and historic context focus on the settlement patterns, economic development, transportation, and major events of historic importance to the region from 10,000 years before present to present day, including highlights from the American Revolution, the War of 1812, the industrial revolution of the 19th century, World War II, and the post-World War II environment. The context provides a foundation to assist cultural resource specialists in understanding the archaeological potential and the historic built environment of the

Upper Hudson as it changed over time, and functions as a stepping stone for subsequent cultural resource studies that may be required as part of the Section 106 process.

Previously Identified Cultural Resources and Related Research

Data gathering was conducted at the New York Office of Parks, Recreation and Historic Preservation, also known as the New York State Historic Preservation Office (NYSHPO), to collect baseline information regarding previously identified cultural resources within the APE. The following categories of information were surveyed at the NYSHPO:

- National Register-listed resources.
- National Register-eligible resources.
- Previously identified but unevaluated resources.
- Compliance and preservation planning documentation.

Section 6 provides a discussion on and mapping of the location and nature of National Register-listed resources and previously identified but not evaluated archaeological sites within the APE. The section also provides information on the number of National Register-eligible architectural resources and surveyed but unevaluated architectural resources within the five counties flanking the Upper Hudson River.

The NYSHPO maintains an electronic database of all National Register-eligible and surveyed but unevaluated architectural resources that have been identified in the state. This database, known as SPHINX, is organized by municipal civil division (MCD) for each county. The SPHINX database was queried for each of the 23 MCDs located within the Hudson River PCBs APE, generating a list of numerous resources. In light of the many identified resources, the fact that the SPHINX database is not associated with a mapping system, and per the guidance of the Assistant Director of the NYSHPO (Kuhn, pers. comm., August 7, 2001), the location of each specific resource was not determined for the present survey.

Archaeological resources were identified through a review of the NYSHPO's site location maps. Locational information was manually transcribed onto US Geological Survey (USGS) quadrangle sheets and then digitized for entry into a geological information system (GIS). The site inventory form for each identified archaeological site was also reproduced.

The present survey only considered previously identified cultural resources on record at the NYSHPO. These resources consisted exclusively of archaeological sites and historic districts, buildings, structures, sites, and objects. However, according to the National Park Service, traditional cultural properties (TCPs) are also eligible for inclusion in the National Register if they are associated with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (NPS, 1990). The term culture refers here to the traditions, beliefs, practices, lifestyles, arts, crafts, and social institutions of a community. Although it was beyond the scope of this survey to evaluate the APE for the presence of TCPs, Section 6 does provide a brief discussion of the subject.

Section 6 also discusses the Hudson River itself as a significant historic resource in the Upper Hudson River APE. The river has been federally designated an American Heritage River, recognizing its unique place in American history and culture and rendering it eligible for technical assistance in achieving natural resource and environmental protection, economic revitalization, and historic and cultural preservation.

Description of Alternatives and Impacts of Selected Remedy

Also in compliance with Section 106, Section 3 of this cultural resources survey provides information on the five alternatives considered as options for remediating the PCB-contaminated sediments in the Upper Hudson River, including the selected remedy. In accordance with 36 CFR Part 800, Section 7 preliminarily assesses the effects of the selected remedy on known National Register-listed and National Register-eligible resources within the APE, and proposes preliminary recommendations to mitigate potential adverse effects. The effects discussion is an initial assessment based on the selected remedy and cultural resource data collected to date. During the remedial design process additional identification and evaluation efforts may be conducted in compliance with Section 106 to evaluate effects to all historically significant cultural resources within the APE.

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3.0 REMEDIAL ACTION ALTERNATIVES

3.1 Description of Alternatives

CERCLA mandates that remedial actions must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. The process used to develop and screen appropriate technologies and alternatives to address the PCB-contaminated sediments in the Upper Hudson River can be found in the FS. The technologies that were carried forward after the initial screening are:

- No Action (without upstream source control).
- Monitored natural attenuation (MNA) (assuming upstream source control).
- Capping (assuming upstream source control) followed by MNA.
- Removal (assuming upstream source control) followed by MNA.

Each of these alternatives is described in detail with supporting graphics in the December 2000 FS and is available at www.epa.gov-region02/superfund/hudson/fs000001.pdf. These alternatives are also described in the ROD. The following subsections provide summary information on each alternative.

No Action Alternative

The No Action alternative consists of refraining from the active application of any remediation technology to sediments in all three sections of the Upper Hudson River. The No Action alternative also excludes any upstream source control action at the GE Hudson Falls plant, any administrative actions, and any monitoring. As required by CERCLA, a review of site conditions would be conducted at five-year intervals to reassess the long-term appropriateness of continued No Action.

Under No Action, the release of PCBs from contaminated sediments into the surface water and subsequently to the air, as well as the transport of PCBs from the Upper Hudson River over the Federal Dam to the Lower Hudson River, will continue indefinitely and thereby degrade the environment.

Monitored Natural Attenuation

The MNA Alternative relies on naturally occurring attenuation processes to reduce the toxicity, mobility, and volume of the contaminants in the Upper Hudson River sediments and assumes a separate source control action near the GE Hudson Falls plant. Natural attenuation processes may include biodegradation, biotransformation, bioturbation, diffusion, dilution, absorption, volatilization, chemical reaction or destruction, resuspension, downstream transport, and burial by clean material. Long-term monitoring would be conducted in sediments, in the water column, and in fish to confirm that contamination reduction is occurring and that the reduction is achieving remedial action objectives (RAOs).

Institutional controls would be implemented as long-term control measures as part of the MNA Alternative, including continuation of fish consumption advisories and fishing restrictions that are currently in place. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

CAP 3/10/Select Alternative

This alternative includes remediation by capping (after removal of more than 1.73 million cubic yards, in areas that either cannot be capped [navigation channels] or that require sediment removal to allow for placement of the cap) of sediments with mass per unit area (MPA) of 3 g/m^2 PCBs or greater in River Section1, sediments with an MPA of 10 g/m^2 PCBs or greater in River Section 2, and selected sediments within high concentration PCB target areas in River Section 3 (NYSDEC *hot spots* 36, 37, and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to implement the remediation and allow normal boat traffic during remediation. The total area of sediments to be remediated is 493 acres, of which approximately 207 acres would be capped. It would take approximately 3 years to design and 6 years to implement this remedial alternative. This alternative assumes a separate source control action near the GE Hudson Falls plant and also relies on naturally occurring attenuation processes to reduce the toxicity, mobility, or volume of the remaining PCBs in the Upper Hudson River sediments after the construction is competed. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

Capping involves placement of an engineered low permeability cap on top of the PCB-contaminated sediment, including a top layer of fill. The low permeability cap material prevents or retards the movement of contaminated porewater into the water column and minimizes exposure of benthic organisms to the PCB-contaminated sediments. One containment option would consist of using AquaBlok^{tm} (or similar material), a manufactured product consisting of a composite of gravel particles encapsulated in bentonite. When the product comes into contact with water, the bentonite absorbs it and expands to form, with the sand and gravel, a continuous, impervious mat. In the case of the Hudson River remediation, the AquaBlok^{tm} would be placed underwater over the contaminated sediment to form an impervious cap, preventing further migration of the sediment to the environment.

After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. This alternative may also require restrictions on activities that could compromise the integrity of the cap. A long-term monitoring program would be required to verify the integrity of the cap and to assess the effectiveness of the cap and natural attenuation processes in achieving the RAOs. If any portion of the cap has been eroded, it would require replacement. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

REM-3/10/Select Alternative

This alternative includes remediation by removal of all sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 1, removal of all sediments with an MPA of 10 g/m^2 PCBs or greater in River Section 2, and removal of select sediments with high concentrations of PCBs in River Section 3 (NYSDEC *hot spots* 36, 37, and the southern portion of 39). This alternative also includes sediment removal in the navigation channel as necessary to implement the remediation. The total area of sediments targeted for removal is approximately 493 acres. The estimated volume of sediments to be removed is 2.65 million cubic yards, which is estimated to contain 70,000 kg (about 150,000 lbs) of PCBs. It would take approximately 3 years to design and 6 years to implement this remedy. This alternative assumes a separate source control response action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

REM 0/0/3 Alternative

This alternative includes full section remediation by removal in River Sections 1 and 2, and removal of sediments with an MPA of 3 g/m^2 PCBs or greater in River Section 3. This alternative also includes sediment removal in the navigation channel as necessary to implement the remedy. The total area of sediments targeted for removal is approximately 964 acres and the volume of sediments to be removed is estimated to be 3.82 million cubic yards. It would take approximately 3 years to design and 8 years to implement this alternative, which also assumes a separate source control action near the GE Hudson Falls plant. After construction is completed, this alternative relies on MNA and on institutional controls such as fish consumption advisories and fishing restrictions until the RAOs are achieved. A review of site conditions would be conducted at five-year intervals, as required by CERCLA.

3.2 General Removal Information

Removal by targeted dredging is the principal component of the two REM alternatives and a major component of the CAP alternative. The criteria for selection of targeted areas are based primarily on mass per unit area (*e.g.,* 3 g/m2, 10 g/m2) and PCB concentrations in surface sediment, as well as engineering considerations, such as minimum areas targeted (50,000 square feet for example).

As presented in Chapters 4 and 5 of the FS, both mechanical and hydraulic dredging technologies continue to be considered applicable to dredging Upper Hudson River PCB contaminated sediments. Dredging productivity, sediment in-river transport/conveyance, and sediment processing would vary between mechanical and hydraulic systems. Both methods have been considered in the development and evaluation of alternatives to preserve options in the remedial design.

The final selection of dredging equipment will occur during the project's design stage. Numerous factors will influence the selection, including data obtained for the pre-construction sediment sampling program, the results of more detailed engineering planning and analysis, and information obtained from potential contractors. It should be noted, however, that as described in the FS, River Section 3 (south of Lock 5) would be dredged using mechanical methods in any event, because there are practical limitations to the distance that a sediment slurry (discharged by a hydraulic dredge) can be pumped reliably.

Mechanical Dredging

With respect to mechanical dredging, auxiliary equipment that can be fitted to excavators include hydraulically actuated buckets with capacities compatible with project productivity requirements and in-river working constraints. An advantage of a hydraulically actuated machine is the positive action that allows for greater removal precision and permits handling of a wide range of sediment types and debris. It is expected that the mechanical dredges used on the Upper Hudson will be equipped with state-of-the-art components to limit sediment resuspension and to enable real-time assessment of equipment position and removal status.

Each excavator will be positioned on a floating platform (*e.g.*, deck barge or flexi-float) so that it can be towed to the actual work area and then maneuvered as necessary during removal operations. As removal operations proceed, sediments will be placed either in hopper barges or onto deck barges that have been configured for sediment handling. Barges will be filled to predetermined limits and towed to one of several transfer facilities where the sediment will be off-loaded.

Hydraulic Dredging

In general, the principal operating components of a cuttterhead suction dredge are the leading suction pipe with attached cutting head and an onboard slurry pump. The pump hydraulically entrains river sediments that have been loosened by action of the cutterhead and discharges the resultant slurry (water and sediment) into a length of trailing pipe.

Using a boom or ladder, the inlet or suction pipe and cutterhead can be extended sufficiently beyond the leading edge of the dredge to reach targeted materials. The slurry pump is sized to meet project productivity requirements and to convey slurried sediments to a processing facility. The entire assembly of suction piping and slurry pumps is mounted on a hull that allows the dredging system to be towed to and maneuvered within a particular work area. As in the case with mechanical systems, it is expected that the hydraulic dredging system will be fitted with state-of-the-art electronic positioning equipment so that the work is performed as efficiently and precisely as possible. In addition, it is expected that a number of innovations may be developed for this program to further control resuspension of river sediments and to improve the overall productivity of dredging operations.

Within the areas targeted for dredging, the goal is to remove all of the PCB-contaminated sediment, leaving a residual of approximately 1 mg/kg or less. Subsequent to removal, approximately one foot of backfill would be placed where appropriate (excluding the navigation channels) over the residual layer, which would further reduce the bioavailable PCB concentration at the surface and provide an appropriate substrate for biota. In addition, the backfill will help stabilize bank areas after dredging and minimize hydraulic changes to the river.

One suction dredge outfitted with a cutterhead can remove the targeted sediments in River Sections 1 and 2 in about four years. Hydraulic technology will probably not be utilized for dredging near-shore portions of the river. The near-shore area would be remediated using the mechanical system.

The slurry pipeline would be a 16-in high density polyethylene (HDPE) pipeline with a maximum length of 53,000 feet. Three types of pipes would be employed:

- Pontoon Line: Typically 2,000 feet long, a steel or HDPE pontoon line would be used behind the dredge and would provide flexibility for maneuvering the dredge along various dredge cuts.
- Submerged Line: Varying in length between a few hundred feet to about 50,000 feet long, the submerged line presents minimum interference with river traffic and would be expanded periodically as the dredge advances along the river.
- Shoreline Line: Short sections of shoreline pipe would be installed as necessary to carry the pipeline over land at locations such as Thompson Island and at Lock 6 near the Fort Miller Dam.

In addition to the pipeline, shore or barge-mounted booster pumps would be added as necessary to provide pumping power. Barge dimensions would be 45 feet x 30 feet x 5 feet with a 3-foot draft; barges would be placed 10,000 feet apart.

Given the limitations on slurry line length, it will also be necessary to employ several mechanical dredges for removal operations in River Section 3. It is expected that the required hydraulic dredge and mechanical dredges are either commercially available or can be fabricated for this project.

The dredged sediments would be transported to land-based sediment processing facilities. At these facilities the sediment would be dewatered to the extent practicable. Portland cement (or a similar stablizing agent) would be added to the solids portion to stabilize it before loading it onto rail cars. The sediments would be disposed of at an existing licensed TSCA or solid waste landfill outside of the Hudson Valley. Siting of a local landfill was screened out due to community objection. Another solids disposal option involves beneficial use of non-TSCA dredged material.

The water that is separated from the dredged material will undergo treatment to remove fine sediment particles and dissolved PCBs. Ultimately, the water will be discharged back into the Hudson River in compliance with substantive New York State Pollutant Discharge Elimination System requirements, which are applicable or relevant and appropriate requirements (ARARs) for this site.

Shoreline Stabilization

Since sediment removal and capping categories involve considerable sediment removal in proximity to the banks of the river, there will be a need to renew or stabilize shoreline areas so as to limit or control the potential for erosion. Locations requiring stabilization were not specifically delineated for purposes of the FS; however, a general concept has been developed. The approach is to assume that the stabilization program will be a function of depth of sediment removal within the river immediately adjacent to each shoreline segment. For river sections where near-shore removal operations are planned, backfilling will occur that which will entail placement of sand or gravel materials on the river bottom to isolate residual contamination and to re-establish ecological functions. It is expected that about one foot of material will be placed on the river bottom for these purposes and that this layer will also serve as an additional mechanism to control bank erosion. The actual length of shoreline that would require stabilization is specific to each alternative.

Sediment Processing/Transfer Facilities

With regard to sediment processing/transfer facilities, it is important to note that EPA has not yet determined the locations of sediment processing/transfer facilities necessary to implement the selected remedy. For purposes of the FS, example locations were identified from an initial list of candidate sites based on screening-level field observations which considered potential facility locations from an engineering perspective. It was also necessary to assume the locations of sediment processing/transfer facilities in order to develop conceptual engineering plans, analyze equipment requirements, and develop cost estimates for the remedial alternatives.

For this purpose, two example locations were identified: one at the northern end of the project area in the vicinity of the Old Moreau Landfill (NTF), and one at the southern end of the project area near the Port of Albany (STF). At each example site, mechanical dredging and hydraulic dredging would require different layouts. The example NTF mechanical dredging facility would consist of administration buildings and waterside unloading docks and hoppers, in addition to a link road between the railcar loading area and a temporary staging area. The example NTF hydraulic facility would be equipped with a similar layout, including pipes to pump dredge materials to the screening, tank, press and storage facilities, in addition to a railcar loading area. The example STF mechanical dredging facility would be equipped with barge unloading docks, a pug mill, silos, administration buildings, access roads and railcar loading areas. The example STF hydraulic dredging facility would be equipped with a similar layout, including pipes to pump dredged materials to railcars.

Both example locations fulfill many of the desired engineering characteristics for such a facility to support the remedial work, and is representative of reasonable bounding assumptions with regard to distance from the dredging work and cost. Other locations, both within the Upper Hudson River valley and farther downstream, are possible.

EPA will not determine the actual facility location(s) until after the Agency performs additional analyses, holds a public comment period on proposed locations, and considers public input in the final siting decision. Thus, all information provided in this report relative to potential impacts of the sediment processing/transfer facilities on communities, residents, agriculture, the environment and businesses should likewise be considered representative and illustrative. Further specific assessment of and, as necessary, mitigation of, potential impacts will be addressed during design once siting decisions have been finalized.

3.3 Selected Remedy

The selected remedy is the removal (targeted dredging) alternative REM-3/10/Select. The specific components of this alternative are summarized in the foregoing text of this appendix and explained in further detail in the body of the Feasibility Study and in the Record of Decision. Figure C.3-1 A & B to Figure C.3-1 K & L, Alternative REM-3/10/Select Removal Areas and

Depths, provides a variety of information concerning this alternative. It depicts each of the sediment removal target areas located within the project area, the approximate area and depth of removal of sediments to be dredged under this remedy, limited information regarding rocky portions of the river bottom, and other information such as locations for navigational dredging. The roughly 41 river miles of the Hudson River PCBs remediation area are presented in this figure in 12 sections (presented as seven separate figures), in order to provide sufficient detail.

For the purposes of this cultural resources survey, effects of the selected remedy on known archaeological and architectural resources and potential archaeological and architectural resources are discussed in Section 7 of this document.

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4.0 ENVIRONMENTAL SETTING

The Hudson River flows in a generally southerly direction approximately 315 miles from its source at Lake Tear-of-the-Clouds on Mount Marcy in the Adirondack Mountains to New York Harbor. The geomorphology of the Hudson River Valley reflects the influence of major Paleozoic tectonic events and more recent glacial-interglacial modifications to the landscape (Goldthwait, 1992; Dineen, 1992). Since the Holocene (ca. 10,000 years before present [BP]), landscapes in the region have been increasingly fashioned by post-glacial hydrographic modifications that have resulted in the contemporary flow, discharge, and sedimentation regimes of the present Hudson drainage net. However, the impacts of Euroamerican and modern landscaping over the past 200 years are responsible for more large-scale erosion and sedimentation than the combined effects of climatic forcing since the melting of the glaciers.

4.1 Physiology

The project region is contained in a narrowly confined portion of the northern Valley and Ridge physiographic province. Bounded by the Adirondack Mountains to the north, the Catskills to the west, and the Taconic Mountains to the east, the Hudson Valley is a north-south trending valley formed in a Paleozoic basement and shaped by the movement of recent continental ice sheets (Fisher et al., 1973; Isachsen et al., 2000) (Figure C.4-1, Land Regions for New York State). Together with the nearby Lake George Trough and Lake Champlain basin to the east, the region forms the Hudson-Champlain Lowland, also known as the Hudson Valley Section of the Valley and Ridge Province (Funk, 1976; NYSGS, 1997). This section is the northernmost portion of the 900-mile-long belt of alternating Paleozoic rocks that forms the Appalachian Valley and Ridge, and is part of the Appalachian Geosyncline structural province (Bick, 1993).

The Appalachian Valley and Ridge is a physiographic province characterized by parallel structures of hard and soft lithologies, forming differentially eroded high and low topographic features. In the vicinity of the Hudson River, the province is formed in folded and thrust-faulted sandstones, shales, and carbonates, primarily of Cambrian through Devonian age (570-345 million years ago [mya]) (Bick, 1993; Cooper et al., 1990; Fisher et al., 1973; NYSGS, 1997). This lithology is similar for the neighboring regions of the St. Lawrence Valley to the north, the Central Lowland to the west, and the Appalachian Plateaus in south-central New York State (Olcott, 1995). Underlying formations include the Wappinger group clastics and carbonates, Normanskill Group greywacke, Trenton Group clastics, Helderberg Group carbonates, Onondaga carbonates, and Hamilton Group marine and non-marine clastics (NYSGS, 1997).

Tectonically, this region has been greatly influenced by several mountain-building events, including early Phanerozoic era Taconic, Acadian, and Alleghenian Orogenies, causing severe deformation of the lithology underlying the general project area (Bick, 1993; Moore and Maillet, n.d.). Topographic high points range between 200 and 800 feet above sea level. Major fault lines trend northeastward, reflecting the impact of Paleozoic continental collisions; the vertical displacement in some areas is substantial. A number of fault lines extend from the Adirondack region into the Hudson Valley, and the area is considered tectonically active (Olcott, 1995; Van Diver, 1997).

Portions of the project area fall outside the Ridge and Valley Province, and are properly assigned to the Appalachian Plateau (to the west) and the New England Province (to the east) (Fisher et al., 1973). The plateau is a moderately deformed region of Cambrian through Permian (570-245 mya) sedimentary rocks, nearly horizontal in aspect. The New England Upland, also called the Piedmont, is a complex, highly deformed series of meta-sedimentary and igneous rock originating in the Precambrian (Bick, 1993; Cooper et al., 1990). The northernmost county in the project area, Warren County, rests entirely in the Adirondack Province. Occupying 10,000 square miles, this province is a domed uplift of Precambrian metamorphic and igneous rocks, pushed through and above the younger, flanking sedimentary beds (Vigil et al., 2001). The resulting topography is a rugged hill country with numerous waterfalls, and marked by a few high peaks of granite and anorthsite (Figure C.4-2, Land Form Categories for New York State).

Within the general project area, local rock promontories and dramatic cliffs offset major valley breaks and margins. The Devonian Helderberg escarpment is a limestone feature on the northeast side of the Catskills near Albany, and part of the Appalachian Plateau. This outcropping is known for its fossil-rich sequences (Van Diver, 1997). The Pine Barrens (or Pine Bush) are the late Holocene remnants of a large sand delta deposited by the ancient Mohawk River into glacial Lake Albany (Isachsen et al., 2000:171). Upon retreat of the lakeshore at the end of the Pleistocene (ca. 12,500 BP), the delta and lakebed were exposed to winds coming from the northwest, and a 40-sq-mi dune field developed, subsequently stabilized by vegetation (Dinerstein et al., 1999).

Other features breaking up the terrain include Cohoes Falls and Howe Caverns in Albany County, the Saratoga Geyser, and a Pliocene pillow basalt formation called Stark's Knob, also in Saratoga County (Van Diver, 1997). These features underscore the variability of the regional geomorphology. However, a key element in reconstructing the geomorphology remains the chronology of the Hudson Valley terraces, the time-stratigraphic relationships between local bedrock promontories and the terrace sequences, and the dating of late Quaternary glacial features including peninsulas, islands, kettle lakes, eskers, and kames.

4.2 Glacial History

Unlike portions of the Valley and Ridge Province outside of New York State, the Hudson River valley area does not demonstrate the characteristic folded and faulted mountains of Pennsylvania or the southern states. In part, this is a reflection of the unique orogeny of the Adirondack system. Accordingly, the surface terrain has a considerably more prominent glacial signature. A convenient starting point for major events still expressed in the landscape is 1.6 million years ago at the beginning of the Pleistocene Epoch (Cooper et al., 1990; Muller, 1965; Oldale and Colman, 1992; Van Diver, 1997). At this time, a continental glacier known as the Laurentide Ice Sheet developed in the Laurentian Mountains of eastern Quebec, tying up atmospheric and surface water, and causing a drop of more than 330 feet in global sea level (Isachsen et al., 2000). The Laurentide glacier made four major advances during the Pleistocene, retreating into Canada during warm interglacial periods.

The present character of the Hudson River was dramatically shaped by the Pleistocene glaciation of New England, and the subsequent retreat and melting of those ice sheets into Canada. The ancient Hudson Valley was the site of a series of glacial lakes during the closing phases of the Pleistocene. Reconstructions of the advance and retreat of the terminal ice sheets in the area indicate that glacial Lake Albany, which occupied the region between Glens Falls and New York City, was extant between 14,000-12,000 BP. At its maximum, glacial Lake Albany was 31 miles wide, 200 miles long, and nearly 400 feet deep (Isachsen et al., 2000). Accordingly, the central and upper portions of the Hudson valley were submerged or occupied by ice in the years generally associated with arrivals of human populations in the Northeast.

Following deglaciation, new hydrographic regimes were created in the Hudson Valley. Expectedly, terminal Pleistocene strata record laminated clays and silts in the few pro-glacial basins and depressions investigated. Most significant are the post-Pleistocene records that document paleoenvironmental events that are contemporaneous with the earliest Holocene occupations. For example, Great Bear Swamp registers fibrous peaty deposits at a depth of 8 feet that are aged to at least 7,000 BP. To the west of the project area, Meadowdale Bog on the ice-proximal slope of the Meadowdale moraine features similar fibrous peats at a depth of 18 feet that are less than 9,000 years old. While neither of these sites provides archaeological materials, collectively they preview the organic composition and depths of Holocene deposits in the glacial terrain adjacent to the Hudson Valley (Schuldenrein, 1996).

Within the Hudson valley proper, evidence of major fluvial and torrential drainage associated with the emptying of glacial Lake Albany is aged to 12,500 BP. Estuarine developments – effectively ongoing encroachment of the post-glacial sea level transgression – were initiated immediately thereafter, although more detailed confirmation of this landscape model is required in the project area (Schuldenrein, 1996).

New York State preserves only the remains of the last Laurentide advance and retreat. From the north and west, the Wisconsin glaciation (20,000 BP and 12,000 BP) advanced across all of upstate New York, blanketed the area of what is now New York City, and extended into most of Long Island (Isachsen et al., 2000; Schuldenrein, 1995; Woodworth, 1905). This most recent ice surge sculpted the topography of the uplands, carved valleys deep into basement rock, and shifted or reversed major stream systems (Muller, 1965). The extent of glacial penetration by the ice sheets is marked by several major terminal moraines, including the Valley Heads Moraine across western New York, and Ronkonkoma and Harbor Hill Moraines of Long Island (Isachsen et al., 2000; Muller, 1965; Van Diver, 1997).

In addition to the ice sheets, glacial melt water generated huge volumes of sand, silt, and clay that variously dammed streams and created large temporary lakes in the Hudson and Mohawk River valleys (Muller, 1965; Schuldenrein, 1995). Lake Iroquois, to the east of Albany along the Mohawk River, and Lake Albany, within the mid-Hudson valley, were among the largest glacial lakes in the region, and were fed by the retreating Wisconsin glacier between 20,000 and 13,000 BP. Glacial outwash terraces, stagnation and terminal moraines, kettles, and eskers are among the characteristic landforms preserved in the path of the continental glaciers across the present Hudson valley landscape.

4.3 Hydrology

The river originates in small postglacial lakes in the Adirondack Mountains and flows southward more than 315milesto the Atlantic Ocean at New York City. The stream has a meandering pattern, with a gradient of more than 50 feet from its Adirondack headwaters at Lake Tear of the Clouds and the Opalescent River on Mount Marcy in Essex County, to Glens Falls, Warren County. The river drains approximately 13,370 square miles, gradually becoming less steeply graded as it flows southward (Funk, 1976) (Figure C.4-3, Hydrography on Upper Hudson River). The elevation at the top of the floodplain ranges from 110 feet above sea level (ASL) at Schuylerville, 30 feet ASL at Waterford-Troy, 10 feet ASL at Hudson, and sea level at Newburgh (Dineen, 1992). Currently, within the project area, mean annual precipitation rates vary between 40 and 50 inches (in), supplying 20 to 30 in of runoff to the surface drainage system and aquifers (Olcott, 1995). At Fort Edward in Washington County, USGS Stream Flow Site 03127750 recorded peak stream flows between 14,000 and 31,000 cubic feet per second (cfs) for the most recent ten years (USGS, 2001).

Like the Hudson Valley physiographic province, the Hudson River itself has a history and character derived from its geologic foundation. The course of the stream itself is structurally controlled by a contact between Precambrian and Triassic bedrock, restricting the valley to a narrow passage between the Adirondacks and Taconic Ranges (Muller, 1965; Schuldenrein, 1995). North of Troy, the stream channel is narrow, non-tidal in nature, but flooding seasonally. Here, the Upper Hudson River ranges from 600 to 700 feet wide, and is characterized as slightly sinuous, with a sinuosity value of 1.01. In places, the channel cuts into bedrock to a maximum depth of 125 feet. The stream is freshwater above Troy and the valley floor opens at this point, creating broad alluvial flats and low terraces or uplands as it meanders across a floodplain 2,000 feet wide (Funk, 1976; U.S. Fish and Wildlife, 1997).

Deeply cut into bedrock north of Schaghticoke, the Hoosic River debouches at the Hudson and is the only major tributary on the eastern flank of the project area (Woodworth, 1905). At the city of Cohoes, the Hudson is joined by its principal tributary, the Mohawk River, widening to become a tidal river and estuary system south of Troy (US Fish and Wildlife, 1997). The Mohawk River drained Glacial Lake Iroquois during the Pleistocene, and provided a natural lowland passage to Lake Ontario and other regions to the north and west of the project area. Other minor tributaries include Batten Kill, Moses Kill, Dead Creek, and the Champlain Canal on the east bank. Fish Kill and Snook Kill tributaries are located on the west bank of the stream.

South of Troy, the river widens to a tidal estuary, punctuated by numerous islands, inlets, and low terraces. To the south at New York City, the valley is again constrained by steep bluffs, the Palisades to the west and the Hudson Highlands to the east (Schuldenrein, 1995). At this point, the stream renews its incision into bedrock, creating a drowned river valley. In fact, this stream trench continues beyond the Upper New York Bay and into a deep submarine canyon for more than 200milesbeyond the Atlantic coastline.

4.4 Sediments

As a result of this recent glacial activity, sediments in the Hudson valley are relatively young, massive to compacted deposits of unmodified or reworked glacial tills. Fullerton (1992) describes a variety of sediment types and landform complexes within the valley, including Holocene dune sands; lacustrine or lake delta sands and gravels; kame delta deposits; loamy tills; and lake, ice contact or outwash sediments dating from the Late Wisconsin (Figure C.4-4, Underlying Rock Formation for New York State).

The thickness of the alluvial deposits increases downstream, with approximately 15 feet of alluvium recorded at Fort Edward, 20 feet at Schuylerville, 40 feet at Albany, 60 feet at Hudson, and 70 feet at Kingston (Dineen, 1992). Accumulations reach 100 to 200 feet in the Lower Hudson valley channel sequences (Schuldenrein, 1995). The thickening of downstream alluvial sediments is a reinforcement of traditional fluvial geomorphic models (Schumm, 1977).

Quaternary glacial deposits on Long Island exceed 600 feet in depth (Olcott, 1995). Within the project area, sediments consist of fining upward sequences, ranging from coarse sands, gravel, and cobbles at the base, to sands and silts, with organic rich silts dominating the uppermost levels. Soils, organic mats, and lenses of finer particles are discontinuous throughout the floodplain (Dineen, 1992). South of Troy, the sediment packages are dominated by riverine and estuarine deposits, and consist mostly of finer grade sands, silts, clays, and intermittent organics. Dineen (1992) notes that deltas are formed in several locations where tributaries join the trunk stream, including the confluence of the Hudson with the Mohawk and Hoosic Rivers. Soils, furthermore, tend to be spodosols, typical of cool, moist environments with coniferous vegetation, underlain by sandy parent materials (Birkeland, 1999; Holliday, 1992). These tend to be of middle to late Pleistocene or younger age (Muller, 1965).

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5.0 PREHISTORIC AND HISTORIC BACKGROUND

This overview of the prehistoric and historic background of the Hudson River Valley provides a baseline contextual framework against which to consider the cultural resources of the Hudson River PCBs Superfund Site in particular. The period of prehistory represented in this region extends for over 10,000 years and is presented below as a series of major cultural periods describing specific adaptations to a changing environment and other factors. Although the historic era is far briefer, beginning in the 17th century, it is a period marked by dramatic change, conflict, development, and ever-increasing social complexity. The historic context is generally presented chronologically by century. However, subsections have been included to describe significant historical events such as military conflicts and broad trends that are significant such as the development of New York State's transportation system.

5.1 Prehistoric Period

The Upper Hudson River valley has been the subject of considerable professional and avocational prehistoric research, but it has not figured prominently in discussions of New York State prehistory. Extensive cultural resource management work has been conducted (*e.g.,* Huey, 1997) but the results have not been widely disseminated. The early discussions of prehistory by Ritchie (1958), Ritchie and Funk (1973), and Funk (1976, 1978) mention numerous sites in the area of Warren, Washington, Saratoga, Rensselaer, and Albany Counties, but most of these are known only from surface collections.

Curtin and Bender (1990) provide an important survey of the development of prehistoric archaeology and settlement patterns in the Upper Hudson River region. Their work is based on publications and unpublished data in the files of the New York State Museum and State Historic Preservation Office. Their study identifies 735 prehistoric sites along the Upper Hudson River and adjacent environs; however, few specifics are provided about individual sites. They point out that the lack of systematic goals and methods employed during the 20th century produced a vast but uneven database, which frequently lacks basic information such as geographic coordinates. They also note that syntheses such as those of Ritchie and Funk are based on only a small number of known sites. In the case of the latter's seminal (1976) work, 160 sites are mentioned, only 20 of which are regarded as 'key' (Bender and Curtin, 1990). Their research was therefore oriented toward broader, but still problematic, questions of settlement density and land use.

More comprehensive data analysis on the basis of excavated materials has been done for the Middle Hudson (Eisenberg, 1978; Diamond, 1996), and on the basis of professional and avocational surface collections from the Mohawk River to the west of the present study area (Snow, 1995a; 1995b). Interest in the Middle and Lower Hudson stems from its proximity to other major well-studied drainages, such as the Delaware and Susquehanna (*e.g.,* Funk, 1977), and to Colonial and American population centers. Interest in the Mohawk River has been generated in part by the fact that it is the heartland of the Mohawk nation, and toward the eastern range of the 'League of the Iroquois' (Snow, 1994; Kuhn and Sempowski, 2001).

Recent syntheses have been produced for areas to the north, the St. Lawrence headwaters region, (Abel and Fuerst, 1999) and southern Ontario (Warrick, 2000). To the south of the study area Lindner and his students have undertaken a series of projects at Tivoli Bays in Dutchess County

(Lindner, 2001; Waterman, 1992; Funk, 1992), following up on earlier work by Ritchie and Butler (Chilton, 1992). Other important work has been conducted at quarry sites in Washington and Rensselaer Counties (Holland, 1999; Brumbach, 1987). Overall, the archaeology of the Upper Hudson River valley remains lesser known than most areas of New York State.

Cultural Sequence and Chronology

The basic cultural sequence and chronology for New York State is still based on Ritchie (1994 [originally published 1965, revised 1969, 1980]), modified by Funk (1976), Snow (1995b), and others. It follows generally the overall sequence for eastern North America:

Cultural Sequence and Chronology

Cultural Period	Time Period	Geological Age
Paleo-Indian	9,000-7,000 BC	Late Pleistocene
Early Archaic	7,000-5,000 BC	Early Holocene
Middle Archaic	5,000-3,000 BC	
Early Woodland	3,000-1,000 BC	
Middle Woodland	1,000-0 BC	
Late Woodland	AD 1-AD 1,000	
Contact	AD 1525	

A number of researchers have commented on the problem of applying cultural sequences and typologies generated primarily for western and southern New York to northern and eastern parts of the state (Chilton, 1992; Abel and Fuerst, 1999). Given the paucity of excavated data from the Upper Hudson River valley at present, the generalized sequence and chronology must suffice.

Late Pleistocene, Paleo-Indian Hunters

In upper New York State, the retreat of the Laurentide ice sheet at the end of the Wisconsin glaciation produced significant landscape modification, and meltwaters created a number of proglacial lakes. These included Lake Hudson, which filled the valley south of the Hudson Highlands ca. 15,000 BP, and Lake Albany, which occupied the valley north of the highlands to the area of Troy by ca. 13,000 BP. By ca. 12,000 BP the natural dams retaining these lakes were breached, allowing the lakes to drain and permitting rebound of the land mass and the rise of sea levels (Salwen, 1975; Schuldenrein, 1995). The complex Holocene topography and resource base emphasized by Bender and Curtin (1990) as the settings for human occupation of the Upper Hudson River Valley are primarily glacial in origin (Dineen, 1992).

Uncertainty remains about the timing and route of Paleo-Indian colonization of North America in general (Anderson and Gilliam, 2000), and the first human occupation of New York State is equally problematic. Humans entered upstate New York and the Upper Hudson River valley for the first time ca. 10,000-9,000 BC. Ritchie (1980) reports isolated finds of fluted points characteristic of the Clovis tradition in the Albany area, but offered few details. Levine's (1986) publication of Paleo-Indian fluted points from surface collections in the Upper Hudson River valley is similarly vague regarding the nature of find spots and their environmental settings.

Most appear to have been collected from plow zones and indicate an extremely ephemeral occupation, such as hunting camps.

Relatively few Paleo-Indians sites have been excavated in New York State. These include the West Athens Hill and Kings Road sites in Greene County (Funk and Ritchie, 1973; Weinman and Weinman, 1969), the Davis site in Essex County (Ritchie, 1980), and the Dutchess Quarry Cave in Orange County (Funk et al., 1969). Excavated sites are consistently small and indicative of extremely short-term utilization. Bender and Curtin's collation of sites contained only eleven Paleo-Indian occurrences in the Upper Hudson River valley (1990:88). The material culture of the Paleo-Indian period consists largely of projectile points, with smaller numbers of knives, scrapers, flakes, choppers, and pounding tools. Eisenberg (1978) provides a formal analysis of Paleo-Indian lithics. These assemblages indicate heavy dependence on hunting, probably of large game, and possibly exploitation of flint resources. The rare occurrence of Hudson River flints such as Normanskill chert at the southeastern Pennsylvania Paleo-Indian Shoop site (Witthoft, 1952) lends further support to this view.

The small numbers of artifacts reported for New York State as a whole in recent studies of North American fluted points support the reconstruction of only sporadic Paleo-Indian movement through the Upper Hudson River valley (Anderson and Faught, 1998; Morrow and Morrow, 1999). Funk and Wellman (1984) suggested that ecological factors, namely the predominance of post-glacial coniferous forests with relatively scarce resources, account for the scarcity of Paleo-Indian and Early-Middle Archaic sites in New York State. This view is increasingly challenged by new evidence from throughout the Northeast. It is clear, however, that Early Paleo-Indian occupation of the Upper Hudson River valley is characterized by extremely low population density. Given the paucity of excavated sites and faunal assemblages, it remains unclear whether Paleo-Indian groups were generalized hunter-gatherers or specialized hunters pursuing species such as caribou (cf. Abel and Fuerst, 1999). Evidence from Paleo-Indian sites in Connecticut, however, suggests that the margins of paleo-lakes would have been especially productive areas for hunters (Curran and Dincauze, 1977), but riverbank sites would tend to have been severely eroded and the ad hoc tool components washed downstream where they are unrecognized. The collection emphasis on projectile points also skews discussions of subsistence toward fauna and away from floral resources (Moeller, n.d.).

Holocene, Archaic Hunter Gatherers

The Early and Middle Archaic periods had long been interpreted as representing a low point in human occupation in the northeast, but as with the Paleo-Indian period, surface collections have begun to fill in the gap (Levine 1986). Part of the explanation for the increasing density of human occupation of upper New York State may involve the gradual transition from coniferous to hardwood forests during the course of the period (Salwen, 1975). Earlier Archaic sites such as Lamoka Lake (Ritchie, 1980) and the Sylvan Lake Rockshelter (Funk, 1976) are situated along more southern latitudes than the Upper Hudson River valley, possibly suggesting a gradual increase in semi-sedentary occupation in synch with changing environmental conditions. By the Late Archaic, human occupation is widespread through New York State. Bender and Curtin suggest that the seemingly dramatic increase in the density of Late Archaic sites may be a manifestation of a fully developed strategic exploitation system (1990). Conversely, they suggest that the continuation of Late Archaic material culture in the Early Woodland may be overemphasizing the earlier period at the expense of the latter (1990).

Generalized hunter-gatherers characterize the Archaic period, exploiting not only large game but also a wide variety of fauna such as small mammals and birds and riverine resources. A number of shell mounds on the Lower Hudson indicate systematic exploitation of oysters at least as far north as Croton (Schaper, 1989; 1993), and oysters have been found in Archaic levels at Cruger's Island in northern Dutchess County (Ritchie, 1958). Fishing equipment such as netsinkers are common, but the extensive presence of knives and other butchering tools at sites such as the Datum (Eisenberg, 1982) indicate the continued importance of hunting.

Excavated Archaic sites in the Upper Hudson River valley include River, Fish Club Cave, and Snook Hill (Ritchie, 1958; Funk, 1976). More recently, excavations have been undertaken at the Becker Property in Rensselaer County (Cesarski, 1999). The settlement pattern is of an increasingly complex series of sites, including base camps such as Lamoka Lake and the Bent site on the Mohawk River (Ritchie and Funk, 1973), up to five acres in size; seasonal rock shelters such as Sylvan Lake and Zimmerman, in Greene County (Funk, 1976); and smaller hunting and fishing camps. The complexity of settlement is matched by the increasing diversity of projectile point styles, suggesting that New York State was occupied by a variety of groups with different subsistence strategies and social identities (Salwen, 1975). The presence of quarrying and chipped tool production sites such as Pleasantdale in Rensselaer County (Brumbach, 1987) may also reflect greater site specialization and increased economic interaction between groups.

Archaic groups did not possess domesticated plants, but the size and depth of deposit in many sites suggest that occupation was either year-round or repeated. The increasing familiarity with microenvironments and technological innovations, in particular the emergence of stone bowls, evidently of Southeastern derivation, were important pre-adaptive features for the development of agriculture during the Woodland period.

Middle Holocene, Woodland Horticulturists

The Woodland period saw the establishment of horticulture and the development of larger social units, including matriarchal and matrilocal clans, sedentary villages, and tribes immediately ancestral to the historically known groups of upstate New York. Pottery was gradually introduced, and a much wider variety of material culture came into use. While minor climate fluctuations took place during this period, the overall environment was very similar to that of today. In general much more information is available for the Middle rather than the Upper Hudson River valley (Diamond, 1996).

Early Woodland sites are similar to those of the Late Archaic. They are typically small, and projectile points, scrapers, and bone tools provide evidence of hunting, fishing, and limited cultivation (Funk, 1976). The Church and Coffin sites, located on the Hudson River flood plain in Washington County (Funk and Lord, 1972) are good examples of a multi-purpose and hunting camp, respectively, but relatively few sites are known from the Upper Hudson River valley. Pottery is found on an increasing number of sites, typically stamped and impressed cooking pots tempered with crushed shell. The wide variety of types, however, points to low levels of interaction between groups. Another new feature of the early Woodland period are burials with elaborate grave goods, including flints and bone tools, shell and copper beads, and stone pendants (Ritchie, 1980). These symbolic and religious developments are related in part to the emergence of a broad variety of religious practices in Eastern North America (Brown, 1997).

By the Middle and Late Woodland, the size and complexity of sites increases tremendously. The key to later developments was the introduction of horticulture and the triad of cultigens, maize (*Zea mays*), beans (*Phaseolus vulgaris*), and squash (*Cucurbita pepo*). Their processing was facilitated by the use of cooking pots and storage pits. Villages were occupied year-round and by the end of the period were often comprised of multiple longhouses positioned on defensible hills with palisades. Smaller hunting, fishing, and farming settlements developed as offshoots. The Weinman site in Warren County (Funk, 1976) is a small camp, but it contained cooking hearth, storage pits (possibly for nuts), a chipped stone workshop, and a pottery dump. The Dennis site in Albany County (Funk, 1976) is located on a series of alluvial flats on a Hudson River tributary. Sturgeon plates, deer bones, fresh water shells, and corn and beans were found in hearth and storage pits, indicating the range of subsistence activities. One of the largest Late Woodland sites is Garoga in Fulton County. It reached some two and a half acres in size and was comprised of at least seven longhouses, each between 150 and 200 feet in length, with hundreds of storage pits (Ritchie and Funk, 1973).

The Middle and Late Woodland periods see the emergence of distinctive Iroquoian sites, particularly in the Mohawk River Valley and central New York (Snow, 1994). The origins of the Mohawk and other Iroquoian groups, however, remain controversial. From the Mohawk River valley it appears that villages of 100 to 200 individuals prevailed until ca. 1450, and were followed by larger villages of 600 to 800 people on defensible hilltop positions. Snow suggests that the League of the Iroquois developed during this period and produced more secure conditions (Snow, 1995b). A distinction between Mohawks and Algonquin-speaking Mahicans also became evident by this time, and by the 16th century the groups were bitter rivals.

The Upper Hudson River valley figures centrally in these ethnic developments. A number of recently excavated Late Woodland sites, including Winney's Rift in Saratoga County (Brumbach and Bender, 1986b) and the Goldkrest Site in Rensselaer County (Lavin et al., 1996), were only small camps, comprised of a few hearths. A variety of ceramic types are present at both sites, including some indicative of coastal and Delaware valley connections, raising the question of whether these were Mohawk or Mahican sites. The Fish Kill site in Saratoga County has both Mahican and Mohawk ceramics, pointing to the complexity of ethnic relations during this period (Brumbach, 1975). The evidence suggests that the entire Hudson River valley was a contact zone between various groups and that inter-group relations were highly dynamic (Diamond, 1996). Figures C.5-1 (New Netherland and New England, 1635) and C.5-2 (New Netherland, 1621), clearly depict the mosaic of identified native tribal groups during this period of time.

Contact Period

The Contact period in the Upper Hudson Valley begins ca. 1525 as Europeans started moving north from the Middle Hudson and Susquehanna River valleys and south from the St. Lawrence. From 1525, European trade goods begin appearing at native sites, including rolled copper tubes, iron spikes and adzes, and from 1580, glass objects are evident (Snow, 1995b). The Spanish explorer Giovanni de Verrazzano reached New York Harbor on April 17, 1524, and a few historical references suggest that other Spaniards may have established a fort in the area of Albany during the 16^{th} century, but as yet there is no corroborating archaeological evidence. Similar claims that the French had established a fort at Albany by 1540 are uncorroborated (Kraft, 1991). The Dutch explorer Henry Hudson's voyage in search of the Northeast Passage to the Orient took place in 1609, whereupon he discovered instead the river that now bears his name. Hudson was initially able to trade peacefully with native groups, despite hostility created by the earlier appearance of European slavers. Almost immediately thereafter Dutch traders in great numbers began flooding into the area in search of furs and other materials. The English and then the French also quickly sought to displace the Dutch by force, sending expeditionary forces in 1613 and later (Kraft, 1991). These efforts were unsuccessful.

In 1614 the Dutch established Fort Nassau on the west bank of the Hudson River at what is now Albany. This was a small fort surrounded by an 18-foot-wide moat and manned by only 10 or 12 men. The location was said to be in Mohawk territory (Kraft, 1991), and the Dutch quickly took advantage of the complex rivalries between native groups. Also in 1614, Champlain led Huron and other groups against the Iroquois, beginning a series of displacements that would change native geography and demography. How this affected the Upper Hudson River valley is uncertain. There is ethnohistoric evidence suggesting that Mahican groups lived both in 'castles,' that is, stockaded villages, as well as in 'villages,' possibly seasonal camps (Brasser 1974; Bender and Curtin 1990:4-7). Images of such structures appear on period maps as William Bleaeu's 1635 map of the northeast coast of America (Figure C.5-1, New Netherlands and New England, 1635). While significant changes in native settlement systems are likely to have occurred in the Hudson Valley, they cannot be documented archaeologically at this time, in the manner of better-known Mohawk settlements to the west (Snow 1995b). Indeed, the few Late Woodland/Contact period sites excavated in the Upper Hudson River valley area are exclusively small settlements (Diamond, 1996).

Iroquois populations of upstate New York appear to increase dramatically ca. 1614-1634, in part as a result of refugees entering from the St Lawrence area, and then drop precipitously as a result of smallpox (Snow, 1995d). Approximately 75 percent of the Iroquois died in the years immediately following 1634. Contemporary settlement and demographic trends in the Upper Hudson River valley, however, remain unclear. Whether Mahicans responded to European colonization and disease with nucleated settlements or dispersal is unknown (Diamond, 1996).

Research Problems

Archaeological research in the Upper Hudson River valley has identified a number of unresolved questions, or research problems. Curtin and Bender (1990) identify a number of specific issues that future field efforts could help address. Following are four more general research problems for this region.

Culture History

As mentioned earlier, the Upper Hudson River's material culture, change, and cultural history is invariably characterized through application of systems developed for other regions (such as the Lower Hudson, the Mohawk River valley, the Susquehanna River valley, or Central New York).

An outstanding research problem for the Upper Hudson is to generate locally derived cultural sequences and typologies, rather than applying these other systems.

Settlement Models

Ritchie and Funk have suggested a preference among prehistoric populations for site placement along major and minor stream drainages, or on uplands that afford strategic vantage points (Funk 1976, 1993; Ritchie and Funk 1973). Funk's 1976 study of the Hudson River valley from Lake George to New York City analyzed more than 160 sites along first, second, and third order streams and adjacent uplands (1976). Open campsites on the floodplain or islands, rockshelters, or upland promontories were noted within the study. Funk has proposed two generalized models for prehistoric settlement. The first emphasizes upland-lowland contrasts (1976, 1992), while the second, generated by his work on Susquehannan prehistory, emphasizes the exploitation of more topographically complex microenvironments (1977, 1992). Given the size and complexity of the Upper Hudson River valley, it is difficult to suggest which model is more likely to have explanatory value, although the settlement pattern study by Bender and Curtin (1990) usefully emphasizes complexity and microenvironments.

Later analyses of the valley further suggest that prehistoric occupations not only exploited the resources of the tributaries and uplands, but moved into more diverse microenvironments associated with marshes, tidal flats, beaches, point bars, alluvial fans, promontories, and other features (Brumbach and Bender, 2000; Cesarski, 1996; Claassen, 1996; Dineen, 1992; Funk, 1993; Schuldenrein, 1995).

Similarly, the larger question as to whether the Hudson River valley acted as a 'container' or a 'constrainer,' interpretations which contrast the interconnectedness or isolation of the region, or which emphasize upriver-downriver dichotomies (Snow, 1980), cannot be evaluated at present. Chilton's work on the Middle Hudson River site of Goat Island (1992) led her to suggest previously unrecognized connections with the Delaware valley and coastal Connecticut. Research in the Upper Hudson Valley will permit new links to be made with the archaeologically better understood regions of the Green Mountains and Berkshire Hills to the east, the Mohawk River valley to the west, and the Middle and Lower Hudson River valley.

Spread of Farming

A third problem is the spread of farming and domesticates to upstate New York and New England. Maize appears in the Eastern Woodlands ca. AD 175 (Smith, 1992) and reaches New York State as part of a triad along with beans and squash. The dating of this triad has been suggested to be ca AD 1000 to 1100, but this has been recently questioned and a date after AD 1300 proposed for the full adoption of domesticates (Hart and Scarry, 1999). Indeed, Bender and Curtin's work indicates that over 50 percent of Late Woodland sites are located on soils that do not support corn agriculture (1990).

The problem of maize also impinges directly on the question of the development of ethno-historically attested groups in New York. The spread of farming and the origins of the Northern Iroquois have been associated by Snow (1995c; cf. Hart, 2001) with the migration of groups from the Clemson's Island culture of Central Pennsylvania, ca. AD 900. This model contrasts with the scenario of *in situ* development of the Northern Iroquois from Owasco tradition, derived from the Point Peninsula culture, and the subsequent diffusion of maize agriculture (Ritchie, 1994 [1980]). New archaeological research in the Upper Hudson valley will help fill in critical gaps in Northeastern prehistory as a whole.

Origins of Historically Attested Groups

Finally, as noted above, the Upper Hudson valley lies at the eastern edge of the territory of the Mohawk and the five nations' 'League of the Iroquois.' It is generally held, following early Dutch observations, that the Mohawk occupied the west side of the Hudson valley, while their bitter rivals, the Algonquin-speaking Mahican, occupied the east (Figures C.5-1 and C.5-2). The opportunity to examine archaeological sites in this contact zone will permit a far more refined assessment of ethnic development and interaction, expanding the results obtained from Winney's Rift in Saratoga County (Brumbach and Bender, 1986b) and the Goldkrest Site in Rensselaer County (Lavin et al., 1996). The incorporation of new groups and refugees by the Mohawk is well documented, and the process is also manifested in Connecticut, part of the aftermath of the Pequot War of 1637. How Mohawk and Mahican interacted in the context of European colonization, warfare, and indigenous demographic collapse is an important question. The presence of the 16th century Dutch trading colony at Fort Orange (Huey, 1988), which is modern Albany, also permits interaction with indigenous groups to be assessed in greater detail, including the archaeological correlates of economic relationships, cultural change, and the catastrophic epidemiological and demographic consequences of contact (Snow, 1995d).

5.2 Pre-Industrial Era, ca. 1609 - 1815

The Dutch Period

European Discovery

In 1609, Henry Hudson, who was traveling in search of the Northwest Passage for the Dutch East India Company, sailed on the Half Moon up the river that was to bear his name as far as modern day Albany. On his way, the explorer - the first European to navigate the Hudson - met natives clothed in "*divers sort of good furres*," from whom he acquired valuable beaver and otter pelts. The Dutch traditionally imported their furs from Russia, but the czars charged heavy export duties. Thus, the discovery of a new, duty-free source of fur was welcome by Dutch merchants, and Hudson soon had many followers. In 1614, a fortified trading post, Fort Nassau, was built on an island near modern day Albany. The site turned out to be badly chosen, as it flooded almost every year. So, in 1624, it was abandoned and replaced by a new post, Fort Orange, located by the west bank of the river (Burke, 1991).

Establishment of the Beaver Trade

In 1621 the Dutch West India Company was chartered and given exclusive trading rights in New Netherland for a period of twenty-four years. The Dutch established Fort Orange in 1624 as the successor to Fort Nassau (Huey, 1988). As part of their charter, the West India Company began offering free transportation and farmland to settlers, who began to populate areas along the Delaware and Hudson Rivers (Kraft, 1991). The company claimed a monopoly on trade in the

New World and the west coast of Africa below the Tropic of Cancer (Ellis, 1957; Morris, 1976). Although settlers needed to work the land to feed themselves, the fur trade remained the true business of New Netherland. At first the Dutch West India Company tried to maintain its monopoly on the trade, but in 1636, facing uncontrollable smuggling by both its agents and settlers, the company finally opened it to individuals in exchange for the imposition of an import-export duty. Private traders settled in growing number in the village of Beverwyck near Fort Orange, which the English would eventually rename Albany (Burke, 1991). Indians sold the pelts to the merchants of Beverwyck, who in turn sent them down the Hudson to New Amsterdam. Business was brisk: in 1656 and again in 1657, Beverwyck shipped as many as 40,000 beaver and otter skins to New Amsterdam. A specific type of sailboat, the sloop, was evolved for navigation on the lower Hudson River, so successful that it carried both freight and passengers between the Ocean and Beverwyk/Albany (and, later, Troy) from the Dutch period through the late 19th century.

Early Settlement

In 1624, the Dutch West India Company dispatched to its new foothold in North America 30 families, about 18 of which ended up in Fort Orange (Morris, 1976). The following year, another group of emigrants under the leadership of Peter Minuit (ca.1580-1638) settled on Manhattan Island, which Minuit famously bought from the natives for 60 guilders. The new settlement was baptized New Amsterdam (Morris, 1976). The Lower Hudson, between New Amsterdam and Fort Orange, formed the central axis of the new colony that was known as New Netherland (Figure C.5-2, New Netherland, 1621). In 1626, the first news from the new territory arrived in Amsterdam: "*our people are in good heart and live in peace there; the women also have borne some children there…. They had all their grain sowed by the middle of May and reaped by the middle of August*" (cited in Thompson, 1966).

Overall, the early settlement of New Netherland by the Dutch proved both more and less successful than that of Virginia and New England by the English. It was more successful because there appear to have been no "famine years" due to milder natural conditions and the Dutch settlers who arrived better prepared to work the land than their English counterparts (Thompson, 1966). On the other hand, in spite of that relatively smooth start, the Dutch population remained sparse and settlements in New Netherland were few. Reasons for this low initial population growth include the religious tolerance and relative prosperity characteristic of the Netherlands at the time, which provided few incentives to pack up and start a new life overseas, and the relatively unattractive colonization scheme put in place under the auspices of the company, the best-known aspect of which is the patroon system.

Under the patroon system, initiated in 1629, tracts of land in the Hudson River valley were granted to individuals that undertook to settle at least 50 adults within four years. Each grant included either 16 miles of river frontage on one side or 8 miles on either side. Grantees (patroons) were given administrative and judicial authority over their settlers (except in cases involving a capital offense or more than 50 guilders [Kim, 1978]), as well as tax exemptions (Thompson, 1966; Morris, 1966). Generally, laboring under the control of a patroon held little appeal for prospective tenants, who could find better deals elsewhere, and overall, the experiment was a failure. The only patroonship that succeeded was the one granted to Kiliaen van Rensselaer (1595-1644), a Dutch jeweler, on both sides of the river near Fort Orange.

Rensselaerwyck, as it was known, extended 11 miles below Fort Orange, and 9 miles above it, almost reaching the Mohawk River (Carmer, 1939) (Figure C.5-3, Major Land Grants and Patents of Colonial New York).

In 1638, in an effort to counter the expansion of the neighboring English settlements, potentially more attractive schemes were developed that involved smaller grants to individual farmers, but with limited results (Thompson, 1966). Finally, periodic and destructive wars with the Indians also took their toll (Kim, 1978). Consequently, for most of its short history, New Netherland remained centered at the mouth and in the lower reaches of the Hudson River, with virtually no substantial establishments between Manhattan and Rensselaerwyck (Thompson, 1966). It is only in 1661 that Esopus (modern Kingston) was founded. Also in 1661, Schenectady was established on the Mohawk, west of Fort Orange, on the spot where Indian traders had to unload their canoes before continuing on land toward Beverwyck (Burke, 1991; Armour, 1986). But by then, the days of New Netherland were numbered.

The English Period

Continuity

The colony became the property of the duke of York (King James II after 1685) in 1664. The takeover of the colony by the English did not significantly alter existing patterns and methods of settlement. In spite of some initial hesitations and experiments, the granting of large tracts of land and the constitution of feudal-like estates, known as manors, more or less continued the patroon system, except that settlement requirements faded and the grants became more a means of speculation than of colonization (Thompson, 1966; Kim, 1978). Governors varied in the abandon and extravagance with which they granted manorial and non-manorial land patents - some of them immense, many of them so vaguely defined as to be derisively described as “ambulatory grants” - but overall the process of privatization went on uninterrupted into the following century. By 1714, most of the Hudson River valley from Saratoga to the sea was in private hands. The land distribution process resulted in the concentration of large amounts of land in relatively few hands, the subsequent constitution of a landed aristocracy eager to emulate the English nobility, and a general lack of attractiveness for potential settlers (Thompson, 1966). However, in spite of the higher visibility of the large estates, small farms (100 to 200 acres) remained numerous and the area sustained a slow but steady economic and demographic growth, fed by both agriculture and trading.

Demographic and Economic Growth

In 1698, New York counted 18,067 inhabitants, about twice as many as were there when the English took over 34 years earlier. Of the ten counties constituted in 1683 (from north to south and west to east: Albany, Ulster, Dutchess, Orange, Westchester, New York, Queens, Suffolk, Kings, and Richmond, Figure C.5-4, New York Counties, Colonial Era, 1776), the five southernmost ones comprised 68 percent of the total population, with only 3,000 people living north of Westchester. The Hudson River valley remained sparsely populated, even south of Albany. Albany itself, incorporated in 1686, was still little more than a small trading outpost with a predominantly Dutch population. In 1698, only 1,476 people lived in all of Albany County. Growth accelerated in the first half of the 18^{th} century and the population became more evenly distributed. By 1749, New York counted 73,350 inhabitants, only half of whom lived in the southernmost counties. The county of Albany now had 10,630 residents. Diversity was a hallmark of the colony's non-Indian population. The Dutch elements remained strong: Albany kept a marked Dutch identity at least until the French and Indian War. In the first decade of the 18th century, Germans from the Palatinate settled along the Schoharie and the Mohawk. Along with England, Ireland, and Scotland, New England was a major source of English speaking New Yorkers (Ellis, 1957). Finally, the city of New York had a very active slave market and people of African descent were also present throughout the valley. In 1723, Albany and Westchester Counties had slave populations of 808 and 448, respectively. By 1771, these figures had become 3,877 and 3,430. Throughout the 18th century, between 12 and 15 percent of all New York residents were black (Williams-Myers, 1994; Thompson, 1966).

Economically, agriculture gained in importance as the fur trade, although still dominant, ran into difficulties. Indeed, the nearest hunting grounds had quickly been exhausted and pelts had to be brought from farther and farther west, in competition with the French, settled in Canada since the early 17th century and eager to control the fur producing regions around the Great lakes. That the French did not appreciate the competition was clearly demonstrated when in 1690, along with their native allies, they laid waste to the small English trading post of Schenectady. Nonetheless, economic need and demographic growth fed a general English push westward, of which the establishment of Fort Oswego on Lake Ontario in 1727 was an important stage (Thompson, 1966).

"The Great Warpath"

The Upper Hudson valley benefited little from the expansion that marked the first half of the 18th century, although land patents were granted north of Albany. Examples are the Kayaderosseras Patent, which covered between 333,000 and 500,000 acres (Ellis 1979), and the Saratoga Patent, a non-manorial patent for about 150,000 acres of land north of Albany granted in 1684 to Dr. Cornelis Van Dyke and six others merchants from Albany, including Peter Philips Schuyler and David Schuyler (Kim, 1978) (Figure C.5-3). Nonetheless, the upper reaches of the Hudson remained very much a wilderness through the pre-Revolutionary decades. There were several reasons for this slow development. First, as Henry Hudson himself had stated, Albany was more or less the point where the river was "*at an end for shipping to goe in*" (cited in Thompson, 1966), making movements of people and goods further north more difficult, and prompting settlers to move westward along the Mohawk River instead. Second, the Upper Hudson River valley lay more or less halfway down the natural passageway between the regions settled by the French around Lake Champlain and the St. Lawrence River, and those settled by the English around the Lower Hudson and the Connecticut River. For this reason, it remained a sort of no man's land between the two rival empires, an area of forts and military settlements rather than farms or trading posts, the southern end of what a scholar recently dubbed "the Great Warpath" (Starbuck, 1999).

Several wars were fought in the late 17th and the 18th centuries among the English, the French, and their respective Indian allies, in general in connection with European wars: King William's War (War of the League of Augsburg) in 1689-1697; Queen Anne's War (War of Spanish Succession) in 1701-1713; King George's War (War of Austrian Succession) in 1740-1748; and French and Indian War (Seven Years' War) in 1754-1763. These wars, especially the later ones, took their toll on the Upper Hudson. In 1745, during King George's War, the fort and small village of Saratoga was laid waste by a French and Indian raiding party in retaliation for the English's bringing the Iroquois into the war. Saratoga was at that date the northernmost English settlement on the Hudson. There, between 1720 and 1745, Johannes Schuyler and his son Philip had built about 20 houses, mostly south of Fish Creek, about three-quarters of a mile north of Fort Saratoga. About 200 people lived on the estate (Starbuck, 1999). After the disaster of 1745, the Schuyler grounds remained empty until 1763, though between 1757 and 1763 the nearby mouth of Fish Creek was the site of Fort Hardy, a small post abandoned after the Treaty of Paris ended the French and Indian War (Starbuck, 1999).

It is mostly just before and during the last and most momentous Franco-English confrontation that the "Great Warpath" really came into its own. Indeed, the Hudson River/Lake George/Lake Champlain nexus was destined to play an essential role in the ultimate struggle for hegemony in North America (Starbuck, 1999). During the first half of the 18th century, in an effort to block English expansion westward and away from the coast, the French established a remarkable series of forts in the trans-Appalachian regions (Leach, 1966). An important element of this network was Fort Frederic, built in 1734-1737 at Crown Point, on the western shore of Lake Champlain, "like the tip of a warning finger pointing toward the backcountry of New England and the Upper Hudson Valley" (Leach, 1966). Indeed, Fort Frederic did have the potential to allow the French to control trade throughout the Champlain valley (Starbuck, 1999).

At the beginning of the war the British attempted to oust the French from Crown Point. On September 8, 1754, an expedition led by William Johnson defeated the French and Indian troops of Baron Dieskau in the Battle of Lake George, but was unable to push on to Crown Point (Ellis, 1957). In September 1755, British forces that had come up the Hudson started construction of Fort William Henry at the southern end of Lake George. The new fort was intended to check any French southward push and to guard the portage between the lake and the Hudson (Starbuck, 1999). On their side, the French established yet another new fort south of Crown Point, which they called Fort Carillon, better known in history as Fort Ticonderoga (Ellis, 1957). On August 9, 1757, French leader Montcalm attacked Fort William Henry. The defenders surrendered but fell victim to an Indian attack, an event that was later to inspire James Fenimore Cooper. The fort was burnt to the ground. The 1,400 survivors of the massacre took refuge at Fort Edward, south of Lake George, by the Hudson River.

In the 1750s, Fort Edward, on the east bank of the river, and nearby Rogers Island were home to one of the largest British military installations in North America (Starbuck, 1999). Beside regular British troops, provincial companies from several colonies were garrisoned there, and the island served as a base for the irregular soldiers (or Rangers) of Robert Rogers, whose name was given to the island some time between 1757 and 1759. Fort Edward, built at the same time as Fort William Henry, was a log fort surrounded by a ditch. The dirt from the ditch had been used to erect embankments on top of which pickets rose up about 12 feet. By the standards of British military installations in North America, it was designed for the long term (that is, the few years the British expected to need to win the war). Most troops and supplies sent north from Albany went through Fort Edward, whence they were portaged to Lake George.

Both General Abercromby's failed expedition against Fort Ticonderoga in 1758 and General Amherst's successful expedition against the same fort in 1759 went through Fort Edward on their way north. In fact, passing armies of British and Provincial troops regularly, if temporarily, made Fort Edward the largest city in the North American colonies (Starbuck, 1999). But the site was more than a mere transit point. It was also home to a large number of military hospitals. Sick or injured soldiers were sent there from other camps. After the destruction of Fort William Henry, Fort Edward became the northernmost British fort in the Hudson River/Lake George complex. It lost much of its importance after the victory over Fort Ticonderoga but was still active during the early stages of the Revolutionary War, when it saw the likes of Benedict Arnold and John Burgoyne. It was probably completely abandoned in late 1777 or soon after (Starbuck, 1999).

Lesser forts also punctuated the Upper Hudson valley between Albany and Fort Edward: Fort Hardy, which has already been mentioned; and further north, seven miles south of Fort Edward, Fort Miller (Lossing, 1972). Once the French menace disappeared and the French's modest role played itself out, these forts went into decline. However, many, like Fort Edward, did regain some importance during the Revolutionary War. In July 1777, for example about 2,000 American fighters driven out of Fort Ticonderoga by Burgoyne arrived at Fort Miller.

Pre-Revolutionary Expansion

The French and Indian War ended in 1763 with the Treaty of Paris and the loss of Canada by the French. What had been the main obstacle to the settlement of the Upper Hudson River valley and of the regions that now constitute the northern portion of New York State was removed. These areas fully benefited from the general economic and demographic growth that characterized the pre-Revolutionary decades. Significantly, it is starting in 1763 that the old Schuyler property, which had been destroyed in the 1745 and left more or less fallow after that, was resettled by Philip Schuyler, the nephew and heir of the former landlord. Schuyler built two sawmills, a flax mill, and a new home for himself. By 1767, 1,200 people lived on the Schuyler estate. Most of them were engaged in the production of timber, which was sent down to New York City via Albany (Starbuck, 1999).

Demographic and economic growth, already clearly perceptible in the first half of the 18th century, accelerated after 1750. In 1771, New York counted over 163,000 residents, as against 73,000 in 1749 (Thompson, 1966). Although the city of New York and surrounding counties continued to be home to a significant proportion of the colony's inhabitants, growth was spread over the entire territory. The five southernmost counties now accounted for only 37 percent of the total population and even the Upper Hudson country benefited, as adventurous Yankees moved west and north toward, among other destinations, Lake George and Lake Champlain. The Population of Albany County quadrupled between 1749 and 1771, and new counties were created to the northwest (Tryon County) and north (Charlotte) of Albany.

However, truly substantial population centers remained few. Albany was still the only incorporated community outside of New York City, which retained its overwhelming economic and commercial importance. Up river, only Schenectady and Kingston had claims to being more than villages. The prosperity of New York rested mostly on trade with the other North American colonies, the West Indies, and the mother country. The colony exported agricultural and natural produce (wheat, Indian corn, rye, livestock, beeswax, timber, furs and skins, etc.) as well as manufactured products made from locally produced or imported raw materials (pig and bar iron, soap and candles, cordage, refined sugar, chocolate, etc.). From Europe and the rest of America, New York imported the goods it needed and did not produce them locally. From Africa, it imported substantial numbers of slaves: in 1771, almost 20,000 New York residents were black (Thompson, 1999).

In 1772, New York had 709 vessels engaged in the sea trade (as against 157 in 1749). Although no statistics exist for the river trade at this date, it must have grown apace, as the Hudson and the Mohawk Rivers linked the interior of the colony to its port and to the outside world, and carried ever more numerous and larger sloops. Most of the traffic on the Hudson, however, took place south of Albany. The Upper Hudson remained relatively isolated and its full exploitation still mostly a potentiality. On the eve of the Revolution, Governor Tyron recognized this potential. In 1772, he stated "it seems practicable to open a passage [north of Fort Edward] by Locks & c. to the waters of Lake Champlain which communicate with the River St. Lawrence." Tyron also noted that, although too expensive to be yet realized, "*when effected* [it] *would open a most effective inland navigation, equal perhaps to any as yet known*" (cited in Thompson, 1966). Tryon's vision, however, would have to wait to be implemented. Indeed, at the time he was writing these lines, the Upper Hudson River valley was on the eve of reverting to its role as the "Great Warpath."

The Revolutionary Era, 1776-1783

The "Great War Path" Revived

If nothing else, geography guaranteed that New York State (which declared its independence on July 9, 1776) and the Hudson River valley would play a major role in the confrontation that began in Lexington in April 1775. Indeed, occupying the region that extended from Quebec down to New York City would have allowed the British to cut New England off from the rest of the continent and to isolate, then crush, what they saw as the cradle of, and main force behind, the revolt (Ellis, 1957).

In Spring 1777, Lt. General John Burgoyne, at the head of a force of 7000 to 8000 English, German, and Canadian troops, left Canada en route for Albany, where he expected to be met by the army of Lt. Colonel Barry St. Leger, who was to advance from Oswego along the Mohawk valley, and by the forces of General Howe, who, after the conquest of New York City in September 1776, was assumed to be willing and ready to push north. No such meeting, however, took place. Instead, Howe and most of his troops sailed off to attack Philadelphia. As for St. Leger, he was defeated and stopped at the battle of Oriskany (near modern Rome) on August 6 (Ellis, 1957).

The Battle of Saratoga

In the meantime, Burgoyne had been pushing south (Figure C.5-5, Northern Campaigns of the Revolutionary War). On July 5, he forced the evacuation of Fort Ticonderoga (Figure C.5-5). This, however, proved to be the high point of the campaign. Having to lead a large, heavily equipped army through rough territory made rougher by the obstructions planted on the way to the Hudson valley by General Philip Schuyler, Burgoyne moved slowly. He did not reach the river until July 30. Food was in short supply. A party sent to capture American supplies was defeated at Bennington on August 13, revealing and increasing the vulnerability of the English, and encouraging American troops, under the command of General Gates since August 2 (Ellis, 1957). Gates had the time to erect defensive earthworks at Bemis Heights on the right bank of the Hudson, just north of the small village of Stillwater and near a tavern belonging to John Bemis, in a landscape of woods and fields (Starbuck, 1999). Burgoyne marched on south along the left bank of the Hudson, roughly where Route 4 now runs (Starbuck, 1999). On September 15, at old Saratoga (now Schuylerville), he crossed over to the right bank, about 8 miles north of where Gates, now assisted by Benedict Arnold and Daniel Morgan, was waiting for him.

A first clash occurred on September 19 (Battle of Freeman's Farm) near the American lines. As no clear victor emerged, the British retired and started building their own earthworks, consisting of *"several large redoubts joined by long earthen and timber barriers that snaked across the landscape"* (Starbuck, 1999). The British remained on their positions for three weeks, unrealistically hoping for reinforcement from New York City and from loyalist sympathizers. In the meantime, the American forces were able to rally and increase their numbers as militia units arrived from the rest of New York State and from New England (Starbuck, 1999). Finally, on October 7, a force of about 1,700 hundred British troops sent out to probe the enemy positions encountered about four times as many Americans and were forced to retreat. Burgoyne's situation had now become untenable. Sickness and wounds left him with about 5,000 men fit for combat against Gates' 17,000. It had become clear that reinforcements would not materialize, and on October 17, 1777, Burgoyne formally surrendered to Gates in Old Saratoga (Schuylerville), ending what has become known in history as the battle of Saratoga. After news of the defeat was received in England, Lord North put out feelers for a potential settlement. The Americans proved unwilling to settle for anything less than full independence, but the move did manage to worry the French into officially recognizing the independence of the colonies (Morris, 1976). The battle of Saratoga kept the British from lethally dividing the colonies; by prompting France to actively enter the conflict, that success virtually guaranteed the eventual victory and independence of the States. For these reasons, it has generally been considered an event of world-historical importance.

After 1777, while the primary theater of war moved south, upstate New York State remained the site of an active and bloody frontier war, waged mostly between local independents and loyalists supported by the Iroquois allies, who went down in defeat with the side they had embraced (Ellis, 1957; Thompson, 1966).

New Beginnings

Recovery

The Revolutionary War took a heavy toll on New York State in general and on the Hudson valley in particular. Destruction was widespread, as exemplified by the ruin of the recently reconstituted Schuyler estate in Saratoga, burned down in October 1777 on Burgoyne's order. Schuyler himself reported that only one building - one of the two saw mills mentioned above - was left standing. The main house, the second one in less than 50 years, possibly a sprawling Georgian affair with formal gardens extending towards the Hudson, was gone in smoke, but the same year a third one, still in existence, was built with great speed (between 17 and 30 days) at some distance of the original site, then expanded over the following years. In 1783, the area received a boost from the opening of a road to modern Saratoga Springs. The settlement at the north of Fish Creek grew, and in 1820, it took the name of Schuylerville. The Schuyler property remained in the hands of the founding family until 1839, when it was sold to George Straver, whose heirs kept it until 1946. It became public property in 1950 (Starbuck, 1999).

The destruction and rapid recovery of the Schuyler estate neatly echoes the fate of post-Independence New York. While war-related destruction was extensive, especially on the frontier, recovery was quick, and the 1790s saw the beginning of a remarkable period of growth, with the total population of the state going from about 340,000 in 1790 to almost 1.4 million in 1830. Most significantly, people now spread all over the state. If in 1785 three quarters of all New Yorkers still lived within ten miles of tidal waters, by 1820 the same proportion lived well away from both the ocean and the Hudson River (Ellis, 1979). Nonetheless, the Hudson Valley did get its share of growth as new towns - among them Troy, founded in 1787 and soon in control of trade with the Upper Hudson and western Vermont, and Lansingburgh - multiplied. The opening of large new tracts of land to farming and agricultural improvements turned Albany into a granary, and cattle and sheep from the interior counties were also led there to be slaughtered by the hundreds. Produce was then loaded on sloops and sent down to New York City for consumption or redistribution. Between 1790 and 1810, the population of Albany tripled (Ellis, 1979). New counties soon had to be carved out of the old Albany and Charlotte Counties: Washington in 1784, and Saratoga and Rensselaer in 1791 (Figure C.5-4). The importance of the Upper Hudson to New York was solidified in 1808 when construction commenced on the state capitol complex in Albany, ensuring the city's prominent position in the growing state.

The War of 1812 and the Birth of Uncle Sam

With the victory of the colonies over England, the “Great Warpath” lost most of its strategic importance. From then on, conflicts would take place well away from the Hudson. The river and its valley would now play a more indirect, if no less essential, role. Rather than its geography, the many recruits the area provided for US armies and the agricultural and industrial production of its farms and towns would now become the Hudson valley's contribution to the military efforts of the nation. The story of the “birth” of Uncle Sam in Troy during the War of 1812, assuming there is any truth to it, neatly encapsulates this fact, since apparently the “real” Uncle Sam was a meat supplier to the troops preparing to fight the English up north in Canada.

Although New York, a big exporter state that had more to lose than to win in a confrontation with England, had shown little enthusiasm about the war, it was from the very beginning an important theater of operations. In 1812 the US launched a somewhat improvised three-pronged attack on Canada. William Hull, governor of the Michigan Territory, was to invade Upper Canada from Detroit, Major General Stephen van Rensselaer was to attack Niagara, and Major General Henry Dearborn was to push north toward Montreal from Plattsburgh, on Lake Champlain. The plan proved unsuccessful and fighting continued on the northern frontier of New York throughout the war, without, however, ever reaching the Hudson valley. This is not to say that the idea did not occur to the English to revive the old Burgoyne strategy and to march down the Lake Champlain/Lake George/Hudson valley corridor in order to cut off New England from the rest of the country. The Battle of Plattsburgh Bay on September 11, 1814, however, which gave the Americans undisputed control over Lake Champlain and forced the British to retreat to Canada, guaranteed that this would never happen (Ellis, 1957; Morris, 1976).

Thus for the first time in the military history of New York and the United States, the Hudson valley served as the rear line rather than the front. Camps and barracks were set up for passing troops and local recruits. For instance, an old unoccupied building on the northwest corner of Hoosick Street in Lansingburgh was turned into a barracks, and a large encampment was built in Greenbush, on the east side of the Hudson. Rifle practice pits were still visible there in 1942 (Kimball, 1942). Greenbush, like other similar camps, had to be supplied. That's where Uncle Sam comes in.

Samuel “Uncle Sam” Wilson was a successful meat packer who had moved to Troy from New Hampshire in 1789, one in a wave of post-Independence Yankee immigration to upstate New York. On October 1, 1812, a certain Elbert Anderson, a contractor for the Army of the North, advertised in newspapers in Troy and Albany for the provision of two thousand barrels of prime pork and three hundred barrels of prime beef to be delivered at Waterford, Troy, Albany, and New York City early the following year. Samuel Wilson and his brother Ebenezer, who between them slaughtered much of the meat sold in Troy, contracted to provide beef, which they sometimes delivered directly to the recruits encamped at Greenbush. Local soldiers commonly referred to the supplier by his nickname of "Uncle Sam," a moniker that those less familiar with local society mistakenly assumed referred to the letters US stamped on each barrel by government inspectors. This, the traditional story goes, is how Uncle Sam inadvertently came to stand for the United States. Exactly 150 years later, in 1962, the US Congress officially recognized Troy as the birth place of Uncle Sam, who had in the meantime achieved world fame by donning top hat and whiskers and forcefully bidding young Americans to join the US Army (Rensselaer County Website).

5.3 19th Century, ca. 1820-1900

The 19th century was a period of great social and economic transformation in the United States. From a predominantly rural and agrarian society, the US became the highly urbanized and industrial power that would dominate the international politics and economy of the 20th century. A key region in one of the wealthiest and most populous states of the Union, the Hudson Valley was deeply transformed during those decades. Some of the earliest manifestations of the transportation revolution that made possible the continent-wide expansion of the nation took place there. The new steam technology was quickly applied to the boats that traveled up and down the river, which made travel between New York City and Albany faster and easier, and linked the upper reaches of the valley more tightly to the great port that lies at its southern end. Other innovations in transportation, including the construction of the Erie and Champlain canals, had a great impact on residential, industrial, and commercial development along the Hudson. Figure C.5-6, Confluence of Hudson and Mohawk Valleys, 1843, depicts this new intensity of development and the varied transportation systems in place in the Upper Hudson. However, transportation system expansions and improvements during this time period also extended across the rest of New York State (Figure C.5-7, Canals of New York in 1855).

Although agriculture continued to play an important role in the region’s economy during the first half of the century, more and more mills were established north of Albany in the vicinity of the Hudson to take advantage of the river as a source of energy for lumber, grain, and textile processing and production. During the second half of the 19th century, the Upper Hudson region continued its transformation. Although railroad construction began in the early 19th century, it is in its second half that the lines were expanded and solidified so as to facilitate travel from all points. Industrialization spread further and deeper as large factories were established in favorable spots along the river. All these developments left their mark along the valley. But the modernization processes at work there and all over the northern United States were not as successful everywhere. The southern states remained faithful to economic and social structures inherited from the past, and conflict between the old and the New World erupted in 1860. Although it was fought far from its banks, the Civil War left many memories along the Hudson.

The Transportation Revolution

Technological advances in transportation encouraged rapid growth along the Upper Hudson River (Figure C.5-8, Upper Hudson River & Surrounding Region, 1880). Both land and water-based transportation methods such as turnpikes, boats, canals, and railroads improved and developed, ushering in an era of rapid economic development. Waterways, however, remained essential. In fact, the chief function of the turnpikes, canals, and railroads in the Hudson region before 1850 was to connect navigable bodies of water, such as the Hudson River, with each other.

Turnpikes and Plank Roads

The turnpike movement leaped into prominence in the early years of the 19th century. The first turnpike was chartered in 1797 to link Albany and Schenectady. The road was completed in 1805, by which time construction of many other turnpikes was under way in the state. In those same years, a scheduled stage coach and mail service was instituted across the state, requiring that the main thoroughfare between Massachusetts, Albany, and the western regions be improved. By 1820, 278 companies had been chartered for construction or improvement and operation of more than 6,000 miles of toll road, of which about two thirds had actually been built (Thompson, 1966; Ellis, 1967).

Communities along the Hudson, particularly between New York City and Albany, entered an era of intense competition for the western trade. The cities of Hudson, Kingston, and Newburgh south of Albany promoted themselves as offering the shortest route to the Catskill Mountains, with connections eastward to the New England turnpike system. While Albany functioned as gateway to the west by dominating the western Mohawk corridor, turnpikes were also built north of it, along the Upper Hudson. These turnpikes extended east and west of the river between the Albany/Troy area and Glens Falls and the Lake George region (Thompson, 1966).

The turnpike era witnessed a steadily growing interest in the larger question of interregional trade between the Atlantic seaboard and the Ohio country. The development of the Ohio River valley was rapid, and its orientation down river to New Orleans, coupled with the industrial rise of Pittsburgh between Ohio and New York, threatened the prominence of New York in the competition for east-west traffic. New York could only hope to compete by making the maximum use of its land and water connections. Hence the building of canals, described below (Thompson, 1966).

Road building in the 19^{th} century also included wood plank roads or plank roads. Shortly before 1850, the first plank road was laid out between Syracuse and Oneida, and by the early 1850s, over 182 companies had secured charters for plank roads in the state. Because of the ample upstate lumber supply, such roads could easily be built in that region. Financed by local businessmen hoping to promote their cities and towns, plank roads had waned in popularity by the 1860s, as they were subject to rapid deterioration and proved dangerous for horses (Ellis, 1967; Thompson, 1966).

Steamboats

Since colonial times, the Hudson River had been one of America's major trade arteries. In the year 1827 alone, 200 vessels traveled between Albany and New York City. In the early decades of the 19^{th} century, the Hudson's already flourishing water-based transportation sector was revolutionized by the application of steam technology to navigation. In 1807, Robert Fulton, with the backing of Robert Livingston of Clermont, heir to the prominent Livingston family of Livingston Manor, successfully traveled 100 miles in 24 hours from the west side of Manhattan to Livingston Manor on the steamboat Clermont. The following day, Fulton traveled 150 more miles north to Albany, completing the entire trip in 36 hours. The steamboat, powered by a coal-burning steam engine, provided fast, efficient transportation for freight and passengers who previously had to rely on nature-dependent boats, including Dutch sloops, arks, river boats, and rafts (Thompson, 1966). Fulton's successful steamboat journey from Manhattan to Albany promised that soon passengers and cargo would no longer be held captive by the Hudson's capricious winds and tides (Stanne, 1996).

From 1807 to the mid-1820s, Fulton and Livingston attempted to protect the steamboat from competition by creating a monopoly along the Hudson. In 1824, the US Supreme Court brought their effort to naught by finding the grants of such monopolies by the states unconstitutional under the interstate commerce clause (Gibbons v. Ogden). This decision made increased competition possible, thus benefiting both passengers and freight. By 1850, over a hundred steamboats were reliably carrying more than a million passengers. The Hudson River Day Line, a prominent firm that operated from the mid to late 19^{th} century, offered regularly scheduled steamboat service between New York City and Albany, with railroad connections along the route to pastoral destinations such as the Catskill Mountain resorts (Stanne, 1996).

Despite all their advantages, steamboats still had to accommodate nature. As the river froze during winter months, navigation was curtailed and the movement of both goods and people along the waterway came to a standstill. But there were ways to work around the vagaries of nature and the limitations they imposed on trade. The same years that saw the rise of the steamboat also witnessed the construction of canals linking the Upper Hudson to other waterways, further facilitating efficient shipment of cargo from and to New York (Stanne, 1996).

Canals

The Erie Canal

As the United States acquired vast tracts of land west of the Appalachians, it became imperative that an adequate transportation system be created to link the interior with the Atlantic seaboard without relying upon poor roads or the existing water route from the Great Lakes to the St.

Lawrence River. In 1810, New York legislator DeWitt Clinton created a study commission to recommend a route that would connect the Great Lakes region with the Hudson River. Over the next seven years, the commission studied various possibilities. By 1815, it had drawn up a proposal for a waterway - the Erie Canal - that would extend 363 miles between Buffalo and the eastern tip of Lake Erie to Albany on the Hudson River (Adams, 1996).

In 1817, the state legislature passed a bill authorizing construction of the Erie Canal, which began that same year. The route followed the west bank of the Hudson to Cohoes, cut across and around Cohoes Falls to the Mohawk Valley at Crescent, followed the Mohawk River valley to Rome, and cut south to Syracuse. From there the canal went west to Rochester, Lockport, Tonawanda on the Niagara River, and then ran ten more miles north to the Erie Basin in Buffalo. Completed in 1825, the new canal was 4 feet deep, 28 feet wide at the bottom, and 40 feet wide at water level. It included 83 stone locks with 90-foot by 50-foot chambers that could accommodate boats weighing more than 100 tons (Adams, 1996).

The new canal was an immediate success. Indeed, it cut the transportation cost of goods and passengers from the Midwest to the east to a fraction of the pre-construction costs. Freight costs between Albany and Buffalo, for instance, were slashed 90 percent (Ellis, 1967). Wool, wheat, pork, whiskey, and other items could now be shipped eastward at prices that northeastern farmers could not match. Prior to the construction of the Erie Canal, New York could boast to be the breadbasket of the nation. The success of the new waterway deprived the state of this claim by allowing the Midwest to become the leading producer of wheat in the United States. On the other hand, the canal fostered the growth of cities along its course, western cities like Rochester or Buffalo, but also eastern ones, such as Albany and New York City. The latter, in particular, partly owes to the canal its rise as the prominent financial center for banking, shipping, and insurance that it has remained ever since (Thompson, 1966).

The Champlain Canal

The Erie Canal did not exist in isolation. It was only the main trunk of a larger network of natural and artificial waterways that connected the different sections of the state to each other and, via the Hudson River, to New York City. Prominent among these feeder waterways was the Champlain Canal, which ran along the Upper Hudson, between Troy and Whitehall, largely within the project area (Figure C.5-7).

Work on the Champlain and the Erie canals began at about the same time (Adams, 1996). The main purpose of the Champlain Canal was to finally perform long-needed and long-contemplated improvements along the Upper Hudson between Troy and Fort Edward, a stretch of the river characterized by multiple falls ranging in heights from 5 feet to 20 feet, and up to 100 feet between Fort Edward and Hadley. In fact, the Hudson River from the city of Hudson (located south of Albany) northward was a “navigational nightmare of shifting shoals, mud flats, sandbars and islets” (Harris & Pickman, 1996; www.members.aol.com/cragscons/acsci.html). As mentioned above, Henry Hudson has ended his voyage where Albany now stands because there the river was “at an end for shipping to goe in.” By improving the navigability of the Hudson north of Albany, the canal would make it possible to divert the export traffic of the Champlain region from Quebec to the Hudson (Thompson, 1966). It would also carry great quantities of lumber produced in the southern Adirondacks, which would then be processed at saw mills along the canal route, Lake Champlain, and other water tributaries (Greene, 1930).

Completed in 1822, the 81-mile-long, 4-foot-deep canal began at Watervleit, shared a junction with the Erie Canal at Waterford, crossed the Mohawk River via Cohoes on an aqueduct, and followed the west shore of the Hudson past Mechanicville, Stillwater, Bemis Heights, Coveville, and Schuylerville. Thereafter the canal followed the east shore of the Hudson through Thomson, Fort Miller, and Fort Edward, where it branched off the Hudson to follow Wood Creek to Whitehall at the head of Lake Champlain. The original Champlain Canal had 12 locks and multiple fixed bridges. Later in the century, the Glen Falls Feeder Canal was built along the Upper Hudson to provide a link between the lumbering center of Glens Falls and Fort Edward on the Champlain Canal (Adams, 1996). Another related improvement was the Troy State Dam and Sloop Lock. The dam facilitated the establishment of multiple industries above it because it provided a cheap, plentiful energy source (R. Bliven, ca. 1987).

The Erie and Champlain Canals continued to be worked on through the 19th century. In 1862, they were deepened, widened, straightened, and improved through the construction of fewer and larger locks (Thompson, 1966). Eventually, the Champlain Canal reached a depth of 6 feet with 32 locks.

Railroads

Developed first a mere adjunct to waterways, the railroad eventually became their main and ultimately victorious competitor for the cheap transportation of people and freight. Unlike what had happened with the canal system, which had developed more or less systematically around a main trunk, railroads grew piecemeal and were only progressively organized into a coherent network. The first railroad in New York was the Albany & Schenectady Railroad, inaugurated in 1831. By 1833, a line had been built to Saratoga and two trains left Albany each day for Schenectady, with connection to Saratoga (Ellis, 1957). Growth was rapid. By 1842, it was possible to travel by rail from Albany to Buffalo on the tracks of seven different companies (Thompson, 1966). By then, rail had captured most of the Erie Canal's passenger market. Competition over freight began in earnest when the legislature allowed railroads to carry freight in 1847.

Hudson River Railroad

The first railroads connecting Albany to New York City along the Hudson were built in the mid-19th century, delayed by the widespread notion that trains could never compete with the river. The Hudson River Railroad was completed along the east bank of the river between New York City and Rensselaer (formerly Greenbush) in 1851. The establishment of the route required much rock blasting and tunneling, and Spuyten Duyvil and other creeks had to be bridged at their mouths. The large, 1,500-foot-long Cortlandt Bridge was built across Annsville Creek at Peekskill, and other major bridges were built across the Croton River and Wappingers Creek, south of Albany. William Redfield, steamboat operator and principal backer of the Hudson River Railroad, viewed the line as a good investment because it offered an alternative to steamboat travel, which ceased during the annual freeze-up of the Hudson (Adams, 1996).

By 1864, Hudson River Railroad had been absorbed into Cornelius Vanderbilt's railroad empire. Vanderbilt's shift of focus from steamboat - the empire's original business - to railroad may be regarded as a sure sign that the latter had finally arrived. By 1867, Vanderbilt had acquired all the lines between Albany and New York City. In 1867, he also gained control of the New York Central Railroad, originally founded in 1853 by an Albany merchant. The year before, New York Central had finally completed construction of a bridge over the Hudson in Albany, long delayed by rivalry with Troy. By 1869, New York Central and Hudson River railroads had merged and controlled the majority of rail traffic between Albany and Buffalo and between Albany and New York City (Adams, 1996).

West Shore Railroad

In the 1870s, railroads were built along the west shore of the Hudson between New York City and Albany, in direct competition with Vanderbilt's New York Central line. Prior to this, the west bank had been completely dependent on steamboats and ferry connections to the Hudson River Railroad, and during the winter, was often cut off from the rail line on account of the river freeze. During the same period, the Jersey City & Albany Railroad was constructed between Jersey City and Congers, New York. In the 1880s, the New York, West Shore & Buffalo took over the Jersey City & Albany Railroad, and completed the line between Congers and a point just south of Albany. The line merged with the New York, West Shore & Chicago to provide service from Albany to Buffalo. By 1884, trains were operating on the lines between Weehawken (Jersey City area) and Buffalo. The New York, West Shore & Buffalo was built to the highest engineering standards and had lower grades than the Hudson River Railroad (Adams, 1996).

In 1885, the New York, West Shore & Buffalo was taken over by Vanderbilt's New York Central, and became known as the West Shore Railroad, which provided service from New York City to Albany then west to Buffalo and beyond. It also provided service east from Albany to Boston via the Boston & Maine line, and provided feeder service to the Catskill Mountain resorts (Adams, 1996) (Figure C.5-9, West Shore Railroad and New York Central Railroad).

Delaware & Hudson Railroad

Railroads were also built north of Albany along the Hudson during the 19^{th} century. Many were associated with the Delaware & Hudson (D&H) enterprise. The D&H was chartered in 1823 to build a canal from the northeast Pennsylvania coalfields to the Hudson River at Kingston, south of Albany. The canal ran from Honesdale, Pennsylvania, to Rondout, New York. It was completed in 1828 and operated until 1899, when the company divested itself of it and expanded its railroad activities. The company changed its name to the D&H Railroad in 1904 (Adams, 1996).

In the 1870s, the D&H acquired a small empire of short lines in the Upper Hudson, building upon its acquisition of the Albany & Susquehanna between Albany and Binghamton in 1869. These lines included the Saratoga & Schenectady, linking Saratoga Springs and Ballston Spa with Schenectady and Albany; and the Rensselaer & Saratoga, linking Troy via the first railroad bridge across the Hudson River with Saratoga and points west. The bridge spanned the river between Troy and Green Island and carried the line north to various islands at the confluence of the Mohawk and Hudson Rivers (Adams, 1996). The D&H also acquired the Saratoga & Washington Railroad, originally built in 1848. The line extended north from Saratoga Springs to Whitehall at the southern tip of Lake Champlain, and crossed the Hudson at Fort Edward. In addition, the D&H acquired the 1869 Glens Falls Railroad that connected Fort Edward to Glens Falls, with connections to Lake George, where steamboats served lakeside resorts. Other railroads that were added to the D&H portfolio included the Albany Northern Railroad. This railroad was an 1853 line that ran north from Albany along the west bank of the Hudson to Cohoes; across the Mohawk River to Waterford Junction; and across the Hudson again to Eagle Bridge, New York. Connections were made there to Vermont (Adams, 1996) (Figure C.5-10, Delaware and Hudson Railroad).

Other railroads along the Hudson north of Albany included the Boston & Maine Railroad. The line, established in 1879, currently carries freight traffic across the Hudson to Mechanicville on a railroad bridge where it connects with the D&H at a major freight interchange in Riverside (Adams, 1996).

Agriculture

In the 19th century, agriculture continued to play an important role in the economy of the Upper Hudson region. The post-Revolutionary spurt of growth in cities and trade along the Atlantic coast prompted increasing emphasis on commercial agricultural production. Wheat was the principal crop at the confluence of the Hudson and Mohawk Rivers and the area became known as one of the granaries of the nation. Cattle, sheep, and poultry and the food and clothing items they yielded became regular items of exchange (Thompson, 1966).

The completion of the Erie Canal had an important impact on the Hudson River valley, as it enabled a "wheat belt" to emerge between Onondaga and Lake Erie. In the end, the Hudson valley was supplanted as grain producer since it could not compete with western New York wheat, especially following the damage inflicted by the Hessian fly and midge infestation in the first half of the century (Thompson, 1966).

In response to these factors, rye, corn, oats, and barley began to be cultivated along the Mohawk and Hudson River valleys. Cattle were driven to metropolitan markets such as Albany. In reaction to competition from the west, eastern New York farmers, including Hudson Valley yeomen, turned increasingly to dairy farming, fodder crops, orchards, and flax. New York State remained an important producer of agricultural products (such as oats, barley, buckwheat, butter, cheese, orchard and garden produce, potatoes, poultry, and cattle). The rapid growth of the Midwestern states, however, allowed them to progressively supplant western New York, in particular because Midwestern wheat could now easily be shipped eastward via the Erie Canal. New York dropped from almost first in wheat production rank in 1850 to 17th in 1890 (Thompson, 1966).

At the end of the 19th century, though, New York was still the leader in dairy production, oats, corn, and hay acreage. The ongoing success of commercial dairying and horticulture was made possible by the advent of the railroad, which linked previously separated markets. Improvements in agricultural technology at the end of the century prepared the state for a new phase of agricultural development in the 20th century, despite the overall decline in farmland in the 1880s and 1890s (Thompson, 1966).

Industries

During the 19th century, the Upper Hudson region hosted a variety of industries linked to local natural and manmade resources. Many factories were established following the completion of the Champlain Canal in 1822, which facilitated transportation of both freight and passengers over a previously non-navigable section of the river. A sampling of industries located in Albany, Rensselaer, Saratoga, and Washington Counties follows. They span the entire century, from its early decades, characterized by local production, to its late ones, characterized by regional production and distribution.

Albany County

Major riverside settlements in Albany County include the city of Albany, Watervliet, and Cohoes. With the opening of the Erie Canal in 1825, the city of Albany became a gateway to the west. Located at the eastern terminus of the canal, Albany turned into a major shipping point for westbound freight. As the century wore on, the city's role as a major shipping center increased, due to the numerous railroad lines that passed through it.

In addition, Albany also became a great lumber center. Lumber from the southern Adirondacks region was rafted down the Hudson from Glens Falls in southern Warren County (Thompson, 1966). Upon arrival in Albany, it was processed in the region's many sawmills and then shipped west via the Erie Canal or to points south along the Hudson, with New York City as a major destination. Albany retained its prominence as a lumbering center until the 1890s, when lumber supplies originating in the southern Adirondacks became depleted. The higher, isolated sections of the Adirondacks, on the other hand, remained untouched.

Watervliet, located north of Albany, was also an important industrial center. In 1813, the Watervliet Arsenal was established along the west bank of the Hudson River. The arsenal was founded to produce munitions for the War of 1812, and was eventually equipped with its own railroad sidings for easier shipping. In the 1880s, the arsenal became the "cannon factory" of the United States. Today, it continues to produce weapons and other high tech armaments (www.wva.army.mil).

Cohoes was another major settlement. Located north of Albany and Watervliet, it sits at the confluence of the Hudson and Mohawk Rivers, near the 70-foot Cohoes Falls (Figure C.5-6). As early as 1811, manufacturing concerns in Cohoes were turning out cotton, wool, linen, and iron products. With the completion of the Erie Canal in 1825 and the construction of a massive dam for waterpower in 1865, Cohoes was poised for future growth. Manufacturing enterprises benefited from the availability of waterpower, enabling the city to become an important textile manufacturing center. Chief among these knitting mills was the Harmony Manufacturing Company, established in the 1830s (Greene, 1930; www.brittanica.com).

Rensselaer County

In the early 19th century, 80 percent of the Rensselaer County population was engaged in agriculture- and forest-related pursuits. Local agriculture-related industries benefited from the power produced by the county's ample streams and waterfalls, and included gristmills and flouring mills, cheese factories, tanneries, and saw mills, all sustained by the abundant lumber supply of the Upper Hudson region. The food processing sector was also well represented, with many malt factories, breweries, and cider mills (R. Bliven, ca. 1987).

By the middle of the century, a wider variety of industries could be found in the county, centered on iron, textiles, building materials, food, pottery, and brushes. Iron production included horseshoes, cast iron stoves, and storefronts. Clothing, men's collars, and twine represented the area's textile-related production. Building and construction materials, such as roofing, brick, sheet steel, and oilcloth were also manufactured in the county, as well as leather and paper. Food and drink production focused on potatoes, milk, whiskey, and beer (Vanderwerker, 1994).

Major industrial settlements in the project area included the cities of Rensselaer (known as Greenbush until 1897), Troy, and Lansingburgh, on the east bank of the Hudson River. Rensselaer, located across the Hudson from Albany, was the terminal point for the Hudson River Railroad, which originated in New York City. The advent of the railroad caused Rensselaer to become a major rail junction, as travelers and freight arriving from the south would disembark in the city and be ferried across the Hudson to Albany for travel to points west.

The city of Troy, Rensselaer County's seat, located north of the city of Rensselaer, was home to many industries. In the early 1800s, it was an important manufacturing center for cotton, wool, and rolling paper. Numerous grist, saw, and pulling mills were also found there, along with carding machines and distilleries. Factories were established for the production of metal shovels, nails, and spades. Indeed, Troy was an early seat of the US iron and steel industry (Greene, 1930). In 1822, Troy benefited from the completion of the Champlain Canal, which opened the Upper Hudson to navigation and made the Lake Champlain region accessible. Troy was also linked to the Great Lakes region via the Erie Canal (Greene, 1930). As part of the Champlain canal, a dam was built above Troy that provided local industries, including a paint manufacturing company, with power (R. Bliven, ca. 1987). Finally, steamboats plied the Hudson between Troy and New York City, making Troy a major transportation center for both passengers and freight (Greene, 1930). The city's renowned clothing industry supposedly originated with the invention of the detachable collar by a Troy housewife in the early 1800s. In 1834, Troy's first collar and shirt factory opened, and clothing dominated the city's economy after the introduction of the sewing machine in 1852. Clothing would remain a primary item produced in Troy well into the 20th century (www.brittannica.com).

Located on the northern edge of Troy, Lansingburgh was also an important industrial settlement during the 19th century. Early in the century, it had become a shipbuilding center where sloops, schooners, scows, and other vessels were built. By 1818, the city became known as a brush manufacturing center, and by the late 1800s, it counted no less than 35 brush making factories (Vanderwerker, 1994).

Saratoga County

Many industries were also established in eastern Saratoga County during the 19th century. The majority of these industries were located in Waterford, Mechanicville, Stillwater, and Northumberland.

In Waterford, founded in 1816 north of Albany, the Erie and Champlain Canals met. This made the town and village a gateway to both the Upper Hudson, along the Champlain Canal, and to points west, along the Erie Canal (Greene, 1930; www.canals.state.ny.us). The original Champlain Canal waterway was built through central Waterford, ushering in an era of heavy maritime traffic. In addition to the Champlain Canal, the Waterford Sidecut was also constructed through the town and village. It consisted of a system of locks used to bypass a weighlock on the Erie Canal. Because of special position, many canal-related industries were located in Waterford during the 19th century (www. canals.state.ny.us).

Mechanicville, located north of Waterford, was also a center of industrial activities. Around 1800, wool and flour mills were established at the confluence of the Tenendeho Creek and the Hudson River. With the opening of the Champlain Canal in 1822 and the advent of the Saratoga and Rensselaer Railroad in 1835, the village became an important interchange for commerce. From the 1850s to the 1870s, textile mills, sash and blind factories, and a linen thread company settled in the area. In 1878, the Boston, Hoosic Tunnel and Western railroad reached Mechanicville, and by the 1880s, the Hudson River Water Power and Paper Company began to construct the largest dam to date on the Hudson River. During this period, a vehicular toll bridge was built across the Hudson to Hemstreet Park in Rensselaer County, facilitating access to other areas of the Upper Hudson region (www.mechanicville.com).

Stillwater, so named because of the leisurely pace of this part of the Hudson as it flows past the town, lies north of Mechanicville, and like Mechanicville, it was an important industrial center in the 19th century. Incorporated in 1816, Stillwater grew with the arrival of the Champlain Canal along its western edge. Knitting mills, wallpaper mills, and strawboard mills were established during this period, along with residential and commercial developments. Saw mills and brick kilns were also set up, with the latter using clay discarded from construction of the canal (Sylvester, 1893).

Other major settlements along the west bank of the Hudson included Northumberland. During the 19th century, agriculture was the principal occupation of Northumberland residents. The town stood on fertile land and produced abundant crops of rye, oats, and corn. Potatoes were also produced. Following the completion of the Champlain Canal, they were loaded onto canal boats at three docks in Northumberland. Canal-related resources in Northumberland included a wood dam, rebuilt in stone in the 1860s. The dam regulated water supply for the canal from Northumberland to Stillwater (Vanderwerker, 1994). Paper-making industries, such as wallpaper mills, were also prominent, in addition to waterfront warehouses that stored ice and brick for eventual shipping via the Hudson to New York City (Vanderwerker, 1994).

Washington County

During the 19th century, many industries were established in western Washington County along the west banks of the Hudson River, in Thomson, Fort Miller, Fort Edward, and Hudson Falls. Thomson, originally called Pittstown, was settled in 1822, a direct result of the opening of the Champlain Canal. Early industries there included saw mills and paper mills. On one occasion, stones from a dead volcano at Stark's Knob, southwest of Thomson on the west bank of the river, were blasted for use in the construction of a saw mill dam. By the 1880s, the Thomson Pulp & Paper Company had built a large mill in the village to take advantage of the region's ready supply of lumber (Vanderwerker, 1994).

Fort Miller, located north of Thomson, had a cobbler, millinery, tin and wagon shop, blacksmith shops, and grocery stores during the 19th century. Like in Thomson, lumbering and papermaking became prominent activities following the arrival of the Champlain Canal (www.fortedwardnewyork.net).

Fort Edward, north of Fort Miller, had a clothing mill that was transformed to produce coarse paper over the course of the 19th century. A blast furnace, with ore provided by Fort Ann and Crown Point to the north, was established there in 1854, along with sawmills and factories that produced stoneware and pottery (www.fortedwardnewyork.net).

Hudson Falls, known as Sandy Hill during the early 19th century, was a great lumbering center. Numerous sawmills were located in Hudson Falls, which rivaled Glens Falls and Albany in lumber production.

Warren County

The major industrial settlement in Warren County was Glens Falls, located on the north bank of the Upper Hudson as the river curves west. Established in the 18th century as a milling center, the city grew rapidly following the construction in 1832 of the Glens Falls Feeder Canal. This 12-mile canal functioned by diverting water from the Hudson at Glens Falls and delivering it to summit level near Fort Edward. The feeder canal merged with the Champlain Canal and provided a conduit to transport lumber and other products to markets in Albany, New York City, and other commercial centers. In the late 19th century, Glens Falls' industrial base grew to include several lumber companies, lime companies that exploited local limestone quarries, and a clothing industry, among other operations (Smith, 1984).

The Legacy of Slavery and the Civil War

With the end of the Revolutionary War, the Hudson River valley ceased forever to be a battlefield. Wars, however, continued to affect the region and to draw on its resources. Although the battles of the Civil War took place far from the state, the industrial resources of New York, by then the most populous and wealthiest state, were essential to the success of the Union. Of these resources, the Hudson River valley provided its fair share. For instance, Rensselaer County provided the Union with machine made horseshoes, manufactured at the Burden Iron Works, powered by the largest waterwheel in the world (Rensselaer County Website). Furthermore, the

Watervliet Arsenal located on the west bank of the Hudson, north of Albany in Albany County, provided artillery for the war effort.

New York had been a free state since July 4, 1827, a day that saw the completion of a progressive emancipation process started in 1799. African slaves made up an important minority of the population of pre-colonial New York. In 1771 about 17,500 New Yorkers were of African descent, a third or so of whom lived and toiled in the Hudson valley. By 1799, there were about 15,000 slaves in the valley (Williams-Myers, 1994). Black soldiers fought in the colonial wars and the Revolutionary War, on either side. To them, post-Independence developments brought civil but not necessarily economic or political freedom, or social acceptance, and poverty, although not universal, was widespread. Thus, 1827 was more a beginning than an end.

By the middle decades of the century, an active black leadership had evolved that put its political hope in Republican politics, as New York Democrats did not particularly favor racial progress. New York blacks became involved in the fight against southern slavery. Always an important communication corridor, the valley of the Hudson had become a branch of the Underground Railroad, which divided in Albany into three routes. One ran northwards along the upper valley, toward Canada. Those escapees taking the northern route gathered at Troy, where they hooked up with conductors and received supplies and money before moving on to Canada via either Niagara or Lake Champlain. The Israel African Methodist Episcopal Church and the First Liberty Presbyterian Church in Albany and Troy were stops on the Underground (Williams-Myers, 1994). There must have been other stops along the Upper Hudson valley, such as the McCrea Homestead, which, as the existence of a small hidden room in the cellar suggests, may have been used to hide fugitives (Vanderwerker, 1994).

The law did not look kindly on fugitive slaves but the law could be resisted. When in April 1860, a federal marshall apprehended Charles Nalle, an escaped slave from Virginia who had been living in Troy, a large crowd, led by Harriet Tubman, formed and helped Nalle to escape again. He returned to Troy after benefactors bought his freedom. A plaque on State Street commemorates the spot where he was arrested (Williams-Myers, 1994). The period of the Civil War was overall a difficult one for African-Americans, as many opponents to the war took their anger out on those on whose behalf they believed it was being fought. The adoption of the military draft in March 1863 encountered strong resistance and led to rioting and attacks against blacks not only in New York City but in several other places as well, including Troy (Williams-Myers, 1994). On July 15, a mob of men formed and marched from the nail factory in South Troy into the city, as far as Mount Olympus, before moving on to the offices of the Troy Times, which had advocated enforcement of the draft, and wrecking the place (they did spare the presses, though, and the paper was able to resume publication within a week) (Sylvester, 1893).

Nonetheless, both white and black troops from New York State and the Hudson valley fought with distinction for the Union. From Saratoga County came most of the 77th Regiment of New York Volunteers (the Bemis Heights Battalion), organized in Summer-Fall 1861. Recruits first gathered and trained at a fair field, baptized Camp Schuyler, east of Saratoga Springs. They left for Washington, DC on November 28, 1861 and saw fire for the first time on April 4, 1862, near Williamsburg, Virginia (Sylvester, 1878). The 125th and 169th Regiments came from Rensselaer County. These troops, first organized in Troy, used a building of the County Agricultural Society just north of the town as a training camp. They first saw fire on August 30, 1862 (Sylvester, Rens. County). Black men from the valley also fought, some in New York's three regiments of US Colored Troops - the 20th, 26th, and 31st - and many in the predominantly Black regiments organized in other states, such as the 54th Massachusetts Infantry (Williams-Myers, 1994).

5.4 20th Century ca. 1900-1945

During the first half of the 20th century, the Upper Hudson region continued to develop as a commercial and industrial center. The advent of electricity and recognition of the Hudson as a prime source of hydroelectricity fostered further industrial development along the river. Likewise, the improvement of roads, canals, and the creation of the Port of Albany early in the century spurred industrial growth along the Upper Hudson corridor. Last but not least, World War I and World War II also affected both industries and people of the Upper Hudson. What follows is an outline of the economic transformations that impacted the Upper Hudson during the first half of the 20th century.

Transportation System

Road Network

It is in the early decades of the 20th century that the automobile industry, whose roots went back to the 1880s, came into its own. Major improvements were made in materials, construction, suspension, chassis design, tire construction, steering, and electrical equipment. At the same time, new methods of production turned what had started as a toy for the rich into a mass produced commodity. More and more people were able to purchase and own automobiles. In 1915, about 225,000 autos were registered in New York. By 1930 this number had reached 1,330,000 (Ellis, 1967).

The demand for better roads increased with automobile ownership in New York and across the nation. In 1916, the first federal highway construction program was launched, and by 1926, New York and the Upper Hudson region had a comprehensive network of paved roads, including roads flanking the banks of the Hudson between New York City and Albany, and Albany and the southern Adirondacks region (Ellis, 1967) (Figure C.5-11, Upper Hudson River, 1921).

Barge Canal System

Aging and obliged to compete with railroads, New York's canals needed improvement if they were to continue to play a role in 20th America. In 1903, the New York State Barge Canal system was implemented to overhaul and reconstruct the Erie and Champlain Canals and associated features. In the 19th century, canals were made of cut stone. In the 20th, concrete, which provides a smoother, stronger, more modern type of canal, was used as the main construction materiel (McFee, 1998).

Construction of the Barge Canal system began in 1905 and resulted in an over 400-mile-long network of 12-foot-deep waterways, 70 percent of which were located in riverbeds and lake channels (Figure C.5-12, New York Barge Canal System, 1925). As a result, some 19th century portions of the canals were abandoned, including the portion of the Champlain Canal along the west shore of the Hudson between Waterford and a point north of Stillwater. A canalized portion of the Hudson River replaced this abandoned section. In addition, the 19th century Glens Falls Feeder Canal was improved and used to provide water for the summit of the Champlain Canal at Fort Edward (McFee, 1998).

Upon completion of the project in 1918, the modernized Champlain Canal measured 61.5 miles and was equipped with ten concrete locks located as follows:

- Waterford (Lock 1).
- Between Waterford and Mechanicville (Lock 2).
- Mechanicville (Lock 3).
- Stillwater (Lock 4).
- Schuylerville (Lock 5).
- North of Schuylerville (Lock 6).
- Fort Edward (Lock 7).
- North of Fort Edward (Lock 8).
- South of Fort Ann (Lock 9).
- South of Whitehall (Lock 11).

Lock 10 was never built. The locks were typically 45 feet wide, and measured 338 to 343 feet between the gates, with 300- to 310-foot lock chambers (Greene, 1930). Junction locks connecting to the 19th century Champlain Canal structure were also installed along the barge canal. These locks had concrete walls and wood gates, and were located north of Lock 5 and in the Village of Fort Edward, north of Route 197 (Raber Associates, 1989). The gates and valves of the ten concrete locks were originally powered by hydroelectricity via units housed in powerhouses adjacent to the locks. Over time, the hydroelectric units were replaced with conventional electric motors, except for Lock 5 (as of 1998) (McFee, 1998).

Other features of the Barge Canal System included fixed and movable dams. Approximately 12 dams were built along the Champlain Barge Canal, five of which, in addition to the sixth dam at Troy, are located in the Hudson River PCBs Superfund Site project area, including the Stillwater Dam, Northumberland Dam, Fort Miller Dam, Thompson Island Dam, and the Fort Edward Dam (Raber Associates, 1989). Most of the dams were fixed crest, concrete structures. The majority were equipped with taintor gates and pivoting gates 50 feet wide, could be raised above water level, and had heavy counterbalances to facilitate one-man operations.

During construction of the Barge Canal System, the US Army Corps of Engineers (USACE) replaced the Troy State Dam and Sloop Lock with a larger structure, known as the Federal Dam (www.Albany.net). The new dam consisted of a 45-foot by 520-foot concrete lock that eased travel along the waterway (Greene, 1930).

Bridges and guard gates were also built along the canal route. Bridges carried vehicular and railroad traffic over the canals. The bridges along the Champlain Canal were fixed in place with a 15-foot clearance (Adams, 1996). Guard gates were steel gates that could be lowered in the event of a break in the canal to stop water from draining out (McFee, 1998). There was little need for guard gates on the Champlain Barge Canal because it had no lengthy sections of land lines at elevations above the surrounding terrain (Raber Associates, 1989).

In addition to these features, terminal and docking facilities were also provided. These were located at Mechanicville, Thomson, and Fort Edward, within the current Hudson River PCBs Superfund Site project area. The terminals were generally simple structures, consisting of dock walls, frame warehouses, and loading equipment. Locktender houses, storehouses, and shop buildings were also constructed along the canal route (Raber Associates, 1989).

Other sections of the Barge Canal System included Erie (323 miles), Oneida Lake (19 miles); Oswego (22.8 miles), Cayuga & Seneca (27.3 miles), and spurs to Syracuse, Rochester, and Erie (10 miles). The width of the barge canal was 200 feet, with a minimum bottom width of 75 feet (Greene, 1930).

The Champlain portion of the barge canal carried a variety of goods, including lumber and paper products from Canada and points south, iron ore from the Adirondacks, and petroleum, which was stored in tanks in the ports of Albany and New York for distribution in northern and western New York (McFee, 1998).

Port of Albany

In 1925, less than a decade after the completion of the New York State Barge Canal, the Albany Port District Commission was formed by the cities of Albany and Rensselaer to create a deep-water port for ocean shipping that would link the cities of Albany, Rensselaer, Troy, Cohoes, Watervliet, and Schenectady (Hudson-Mohawk municipal district) to the Atlantic. Although steamships continued to travel between New York City and Albany during the early 20th century, sea-faring ships had a larger freight capacity and were more useful to industry and commerce than smaller river vessels. To bring ocean freighters to Albany, the Hudson River ship channel between Albany and New York City had to be deepened (Greene, 1930).

The federally funded Deeper Hudson project consisted of two phases:

- Creation of a 27-foot-deep channel between the city of Albany and the city of Hudson, located 30 miles south of Albany. The river was also to be dredged between Albany and the Federal Dam at Troy. The deeper channel joined with the existing channel south of Hudson to convey ship traffic between New York City and the Albany region.
- Construction of an extensive port facility along the Hudson between the cities of Albany and Rensselaer that would be free from bridge obstruction and well situated for ship, rail and truck traffic for industry and commerce (Greene, 1930).

Port construction and river dredging began in 1926 and were completed in 1930, at a cost of $11,200,000. In Albany, the port encompassed 201 acres of level land with 5,300 feet of dock frontage. In Rensselaer, the port encompassed 110 acres with 2,600 feet of dock frontage. The port was filled and graded to 18 feet above the mean level of the Hudson River. The docks were made of concrete block on pile substructures. Additional land was set aside south of the port for future expansion (Greene, 1930).

The port was equipped with extensive rail access. The West Shore and Delaware & Hudson railroads were located on the Albany side, while the New York Central and Boston & Albany railroads were located on the Rensselaer side. Both sides were also equipped with switching tracks, dock-front loading tracks, and car float ferries to transport rail cars across the Hudson. Railroad transit sheds were also built at the port, along with extensive rail classification yards, grain elevators, warehouses, cold storage, open storage, lumber terminals, railroad yards, loading devices, cranes, mechanical stalls, turning basins, switching engines, fire protection, streets, sewers, and water access. While the grain elevators most likely stored grain that was transported to Albany via the Erie Canal, the lumber terminals probably stored lumber shipments transported via the Champlain Canal (Greene, 1930).

The Port of Albany succeeded in reinforcing Albany's position as one of the largest freight transfer points in the United States. By 1930, the port and city could accommodate 20,000 rail cars daily, and were able to provide complete rail distribution services for the United States and Canada. In addition, the port offered good highway access for trucks, and benefited from its location just south of the Barge Canal System (Greene, 1930).

Advent of Electric Railways

Among the most momentous technological innovations of the late 19^{th} century was the discovery and domestication of electrical power. The newly developed electric motor was soon applied to the railroads, resulting by the turn of the century in an explosion of streetcar lines throughout the state (Thompson, 1966). To meet the competition, conventional steam- and coal-powered railroads resorted to fare reductions, economies (elimination of unused cars, fewer passenger trains), improved service, and, sometimes, acquisition of electric lines. However, the competitive threat of the electric lines to conventional lines turned out to be temporary (Ellis, 1967).

By 1910, most of the towns in the more densely settled regions of the state were connected to over 4,000 miles of newly constructed electric railways, including Albany, Troy, Mechanicville, Saratoga Springs, Glens Falls, and points in between in the Upper Hudson region (Figure C.5-13, Hudson River Valley Electric Railway, 1906). But by the time World War I began, electric railways were in decline, hurt by labor demands, high cost of raw materials, inability to secure capital at reasonable rates, government regulation, owner manipulation and, above all, the advent of automobiles and trucks, which became popular in New York and the United State during the two decades following 1900 (Ellis, 1967).

Agriculture

The shift from animal to mechanical power in the 1920s, coupled with the improvement of rural roads, the advent of trucks and automobiles, and the spread of electricity deeply transformed rural life in the state and Upper Hudson region in the early 20^{th} century. New York's agricultural output continued to decline, while manufacturing production and employment continue to grow (Thompson, 1966).

Industries

By the close of the 19^{th} century, industrial development along the Upper Hudson had moved away from limited, localized businesses and toward regional enterprises whose horizon extended well beyond the Upper Hudson region. This shift was made possible by rapid technological developments in transportation and mechanized production, which allowed factories and utilities to produce goods and services that could be quickly transported or transmitted to distant markets. More efficient production and delivery systems led to a consolidation of industries along the Upper Hudson during the early 20th century. Some of these enterprises are described below, grouped according to industry rather than location because of the widening of horizons characteristic of the period under consideration.

Hydroelectric Industry

The burgeoning electric industry soon recognized the potential of the Upper Hudson to produce electricity. Between 1900 and 1930, power companies and factories built a number of hydroelectric plants along the Upper Hudson. Many were the work of the New York Power & Light Company, established in 1927 to serve the power needs of Upstate New York, including portions of the Upper Hudson region (Greene, 1930).

New York Power & Light constructed the first real hydroelectric development on the river in Mechanicville in eastern Saratoga County in the 1890s (Hay, 1987). In the 1930s, the plant still delivered 3,000 horse-power of electrical energy into the general power system, although it was by then considered obsolete in design (Greene, 1930). In 1929, New York Power & Light became a subsidiary of Niagara Hudson, which brought together numerous steam and hydroelectric plants in the Mohawk, Hudson and Niagara Falls region. Other hydroelectric plants built along the Upper Hudson in the early 20th century include facilities at Moreau (1908), Lock 5 in Schuylerville (1916), Schuylerville at Fish Creek (1919), and Victory Mills (1917), and on Green Island (Hay, 1987).

Paper Mills

During the early 20th century, paper mills became very common in the Upper Hudson valley, where they could take advantage of the ready lumber supply and of the power generated by the river. By 1930, there were paper plants near or in Mechanicville, Thomson, Fort Miller, Fort Edward, Hudson Falls, and Glens Falls. For instance, the West Virginia Pulp and Paper Company built a large plant north of the New York Power & Light Co. plant at Mechanicville. The Stillwater Dam of the Champlain Canal helped powering the plant. The dam created a pond more than 15 miles long that smoothed out irregularities in stream flow for the downstream plant. Canal-related dams at Thomson and Fort Miller also contributed to the development of the paper industry in the region (Greene, 1930).

The area north of the Fort Edward Dam possessed excellent hydroelectric potential because of a series of falls. Therefore, major paper mills were also established in this section of the river. These included the International Paper Company Plant at Fort Edward, which was equipped with a hydroelectric system that also supplied the New York Power & Light Company's general power system (Greene, 1930).

Hudson Falls, north of Fort Edward, also was dominated by a paper plant. The Union Bag and Paper Power Corporation had established a paper plant at Bakers Falls with a 10,000 horse-power hydroelectric plant, with a potential 100,000 horse-power output. The paper plant was operated as a subsidiary of Niagara Hudson Power Corporation. Glens Falls, located north of

Hudson Falls, also had a large paper plant. The plant was co-owned by International Paper and Finch, Pruyn & Company, the latter of which first established operations in Glens Falls in the 1860s (Greene, 1930; www.finchpaper.com).

Other Industries

Other early 20th-century industries in the Upper Hudson region included concrete, munitions, automobile parts, and textile plants, among many others. The concrete industry flourished in conjunction with road improvement projects and the construction of the New York State Barge Canal. For example, the Champlain Stone and Sand Company of Hudson Falls was established in 1905 to crush stone from Stark's Knob, a dead volcano in eastern Saratoga County. The cement was used for state roads and canal locks along the Champlain division of the New York State Barge Canal (Vanderwerker, 1994). Other cement plants were also established along the Upper Hudson during this period in response to demand generated by the construction of the canal and other facilities.

The automotive industry also recognized the industrial potential of the Upper Hudson during the early 20th century. In 1922, Henry Ford vacationed on the newly completed New York State Barge Canal. This trip stimulated his interest in the potential of the canal for shipping car parts and as a result, in the late 1920s and early 1930s, Ford built four plants on navigable waterways in the east, including Chester, Pennsylvania; Edgewater, New Jersey; Norfolk, Virginia; and Green Island, New York. Green Island is located on the Hudson between Troy and Watervliet. Green Island, like the other plants, produced axles, springs, radiators, and other finished auto parts that were transported by barge to Ford's River Rouge plant in Dearborn, Michigan, via the Erie Canal. In addition to these plants, Ford also built four motorships named after the eastern plants. The welded-steel ships had a 3,000-ton capacity and were the largest ships of their kind in the 1930s. When the US entered World War II, the government seized the ships for the war effort. The *Green Island* was later sunk by a German submarine (McFee, 1998).

Munitions were produced at the Watervliet Arsenal. In the early years of the century, the arsenal also produced cannons that were used during World War I. Paint pigment also was manufactured along the Upper Hudson, in Northumberland. In addition to these products, textiles, including knit goods and shirt collars, continued to be produced in Cohoes and Troy, respectively.

World War II

By the time World War II broke out, the Upper Hudson River region, with its superb transportation network and numerous industries, had become an industrial powerhouse. As such, it made an important contribution to the war effort. During the war, the New York State Barge Canal, including the Champlain division, played a key role. Safe from the German submarines thought to be tracking US movements along the Atlantic coast, it carried more petroleum barges and more oil than ever before. The majority of the petroleum shipped on barges was transported westward from New York and Albany along the Erie Canal, but some was also shipped east from the Great Lakes region to meet wartime demands. In addition to the canals, the extensive railroad system and Port of Albany assisted in the transport of goods and troops to and from the Upper Hudson region (McFee, 1998).

The region's industrial development continued during the war, ushering in a new type of industrial activity that would dominate its economy in the post-World War II era. In 1942, the US government contracted with GE to establish a government-owned, contractor-operated (GOCO) facility for the production of selsyn motors for the US military. GE, founded in 1892 in Schenectady, New York, on the other side of the river from Fort Edward, established many plants throughout New York and the US before and during the war (Bicentennial Committee, 1984).

5.5 20th Century: 1945-Present

As World War II veterans returned home from the war to a robust economy, the Upper Hudson experienced rapid industrial, residential and commercial growth. The region continued to grow as a major industrial and agricultural area along the lines set in the first half to of the 20th century. To accommodate that growth, improvements were made to the transportation infrastructure.

Transportation System

Road Network

The rapid increase in automobile ownership characteristic of the postwar boom - between 1940 and 1950, ownership rose from 2,775,000 to 3,735,000 - exposed the inadequacy of New York's road system. In 1942, under Governor Herbert Lehman, work had begun on the New York State Thruway, a limited access superhighway that would rapidly move traffic between New York City, Buffalo, and other points. The outbreak of World War II, however, prevented its completion. Because of the sharp rise in construction costs during the post-war period, the thruway was turned into a toll road in 1950, and the legislature set up a separate agency, the New York State Thruway Authority, to oversee its construction and toll collection. By 1955, the route between New York City, Albany, and Buffalo was completed, mirroring the location of the Erie Canal constructed over a century earlier. Later thruway spurs were completed to connect the thruway to the Massachusetts Turnpike, New Jersey Turnpike, the Pennsylvania state line, and Niagara Falls. The thruway, later renamed the Thomas E. Dewey Thruway, served the most densely populated portion of the state. Its success served as a catalyst for highway construction in other parts of New York, resulting in, among others, in the construction of the toll-free Adirondack Northway, which extended north from Albany, west of the Hudson River, to the Canadian border near Rouses Point. The Northway, located west of the project area, spurred additional industrial, residential, and commercial growth in the Upper Hudson region (Ellis, 1967).

Indeed, prime industrial sites were developed along the thruway system and close to interchanges, particularly in areas close to Hudson River bridge crossings or at places that linked access routes to nearby urban centers. The thruway system quickly began to outclass both the Hudson River and the railroad system as a determinant for industrial location (Boyle, 1989).

Overall, highway construction in the 1950s and 1960s ushered in a burst of commercial and suburban housing development. City populations along the Upper Hudson dwindled as the basic needs of the population were satisfied at outlying sites. The new suburbs covered large areas in comparison to the dense waterfront settlements. As a result, broad, winding highways had to be developed to link together home, work, and shopping and recreational areas (Boyle, 1989).

Barge Canal System

After World War II, the Champlain division of the New York State Barge Canal System continued to be actively used as a freight shipping facility. By the late 1940s, oil was the main product carried by the canal system, including the Champlain division. Shipments of grain steadily declined, in part because of lower railroad shipping rates. In 1951, 4 million tons of oil were shipped along the canal, as opposed to 665,339 tons of grain (McFee, 1998).

The majority of oil shipments originated from ocean tankers that traveled from New York harbor to the Port of Albany, where the oil was transferred to canal barges before being distributed to terminals along the Champlain and Erie divisions. In the 1960s and 1970s, petroleum barges accounted for most of the traffic on the Champlain division. The majority of shipments were bound for the US Air Force Base in Plattsburgh, New York, and the city of Burlington, Vermont. By 1971, freight tonnage on the Champlain division accounted for half the freight tonnage carried by the entire New York State Barge Canal system (McFee, 1998).

Other products shipped on the Champlain division during the second half of the 20th century included iron ore, bulk cement, and paper products. The paper processing industry, established along the Upper Hudson during the 19th century, continued to ship paper products via the canal, including newsprint from Canadian mills on the St. Lawrence River, and pulpwood processed at mills in the Upper Hudson and surrounding region (McFee, 1998).

However, in the 1960s, freight traffic on the New York State Barge Canal declined. There were many reasons for this, including the construction of underground oil pipelines that pumped oil from tank farms in Pennsylvania to Rochester, Syracuse, Buffalo, and other locations. Because pipelines are not impacted by the weather, as canals are, and can operate year-round, the need for storage facilities was eliminated, and, as a result, oil shipments via canal barges declined (McFee, 1998).

By the close of the 20th century, the New York State Barge Canal was used mostly for recreational purposes. In 1992, the New York State Canal Corporation was formed to oversee operation of the canal, and in 1995, it published a plan that envisioned the canal system as a recreational facility. Portions of the plan have been implemented and pleasure craft now ply the waters of the Champlain division, where freight-laden ships once traveled (McFee, 1998).

Railroads

In the post-World War II era, railroads continued to be an essential element of the region's transportation infrastructure. However, by the 1950s, the New York Central empire (including the original Hudson River Railroad and West Shore Railroad rights-of-way) began to experience financial difficulties as freight traffic shifted to trucks on the new federally-subsidized highways. Passenger traffic also shifted to the highways and later to airlines. Over the course of the 1950s and 1960s, maintenance on the New York Central lines deteriorated to the point of causing frequent breakdowns, thereby impairing the railroads' ability to offer acceptable service. In 1968, the New York Central merged with its great rival, the Pennsylvania Railroad, to form the Penn-Central Railroad, which later became the Penn-Central Corporation, a name indicative of the company's desire to play down its image as a railroad enterprise. Under Penn-Central, the railroad infrastructure continued to deteriorate. Eventually, the corporation declared bankruptcy in 1970. In 1976, the defunct Penn-Central, along with other bankrupt railroads in the northeast, was incorporated into the Conrail Corporation specializing in freight service. In 1971, bankrupt passenger lines were incorporated into the National Railroad Passenger Corporation, or Amtrak (Adams, 1996).

Within the Upper Hudson region, Conrail assumed control of the former New York Central lines along the east and west banks of the Hudson, including the substantial freight yards at the Port of Albany. In addition, the D&H Railroad maintained control of a large portion of the lines running along the west bank of the Hudson, originating west of Lower Patroon Island near Albany, and the east bank of the Hudson via the Rogers Island crossing at Fort Edward. The D&H Railroad continued to provide service in competition with Conrail. Other rail lines along the Upper Hudson included the freight-only Boston & Maine Railroad, which spanned the Hudson between the town of Schaghticoke east of the Hudson River and Riverside, north of Mechanicville on the west bank (Adams, 1996).

Industries

The post-World War II-era was characterized by ongoing industrial development in the Upper Hudson region. Heavy manufacturing associated with textile mills, papermaking, and the electric industry dominated the economy. The hydroelectric industry also played an important role. Toward the close of the 20th century, heavy manufacturing declined, mirroring general trends in New York State and the United States.

Hydroelectric Industry

The hydroelectric power of the Hudson near Mechanicville continued to be exploited by the power and paper industries. While many hydro plants closed, including those at Bakers Falls (1982), Fort Edward (1973), and Victory Mills (1970), many others remained open as of 1987, including Green Island; Lock 5 in Schuylerville; Schuylerville at Fish Creek; and Moreau.

In 1983, New York State Electric & Gas Company (NYSEG) built a 16.8-megawatt hydroelectric station in Mechanicville, which came on line in 1983. At the time of construction, the Mechanicville plant was one of the largest in the state. It was one of nine large-scale hydroelectric plants in the state operated by NYSEG (Ellis, 1988).

Paper Mills

The paper industry continued to flourish in the second half of the 20th century. Large lumber mills remained active in the Glens Falls vicinity. Specifically, Finch, Pruyn & Company continued to manufacture paper at its mills in Glens Falls, where it has been since 1865 (www.finchpaper.com). In the last decades of the century, however, extractive industries dependent on lumber supply began to decrease along the Upper Hudson. Canadian paper mills supplanted those in upstate New York, which were too reliant on dwindling lumber supplies from the Adirondack Forest. Furthermore, New York mills utilizing Canadian lumber were also subject to high tariffs, increasing the cost of operating paper mills in the state (Thompson, 1966).

Electric Industry

During the post-World War II period, the electric industry grew to dominate the economy of the Upper Hudson region. Following the war, GE purchased the Fort Edward plant from the US government and phased out selsyn motor production. In its place, GE produced small capacitors, which had previously been a part of the transformer business headquartered at GE's plants in Pittsfield, Massachusetts (Bicentennial Committee, 1984). Capacitors are electric devices that store energy and provide improved efficiency for electrical systems containing transformers, motors, and transmission lines.

GE's capacitor business grew rapidly and in 1950, the firm purchased the Union Bag & Paper Corporation plant in Hudson Falls. In 1951, GE permanently transferred the production of power capacitors to Hudson Falls from Pittsfield. In 1952, the Hudson Falls plant was augmented by the permanent relocation there of all business functions, including finance, marketing, engineering and personnel, as well as manufacturing operations, from the Pittsfield plant (Bicentennial Committee, 1984).

By 1957, the GE Fort Edward and Hudson Falls plants employed 1,800 people and the need for more plant capacity was evident. As a result, a new plant was built in South Carolina to produce electrolytic and tantalum capacitors, which were originally developed at the Hudson Falls plant laboratory. Nickel-cadmium batteries, also developed in Hudson Falls, required the construction of a GE plant in Florida (Bicentennial Committee, 1984).

By 1961, the Fort Edward plant doubled in size to accommodate increased production of small capacitors used in lighting and air conditioning systems. In addition, a foil rolling mill was built to produce the ultra-thin aluminum foil used for capacitors. In 1967, GE patented a method, most likely developed in Hudson Falls, that used polypropylene plastic film in high voltage capacitors. This innovation had a profound impact on capacitor design and use throughout the world. Licensing of the technology spurred great interest in the Hudson Falls plant, which hosted many international visitors during this period (Bicentennial Committee, 1984).

In 1969, employment at the Fort Edward and Hudson Falls plants peaked at 1,900. GE was then the largest employer in the capital region, while the electrical industry in general ranked among the top employers in New York State (Ellis, 1967). In 1973, the oil embargo caused a general slowdown in plant output, but production continued until the mid-1970s (EPA, 2000).

The Conservation Movement

In the 1960s, the emerging conservation movement, drawing upon the relatively new science of ecology with its concern for human impact on the natural environment, began to focus its efforts on the effect of industrial processes on natural resources such as the Hudson River. When Consolidated Edison (Con Ed), searching for new sources of power to satisfy New York City's electrical power needs, announced a proposal to construct a pumped storage generating plant at

Storm King Mountain, in the mid-Hudson area, a major environmental battle began. The controversy contributed to a rebirth of interest in the Hudson, also fueled by the debate over the federal National Environmental Policy Act (NEPA). Although Con Ed was initially granted a license to built the plant, legal challenges to the licensing process resulted in a precedent-setting ruling that recognized that aesthetic and environmental impacts should be considered during licensing procedures (Stanne, 1996).

During the same period, government agencies in charge of environmental protection became increasingly concerned about the quality of the water of the Hudson, where an increasing number of fish kills were occurring. In particular, concerns were raised about the discharging, both direct and indirect, of PCBs into the river by the GE plants at Fort Edward and Hudson Falls. PCBs are considered by EPA to be probable human carcinogens. GE's PCBs adhered to river sediments and accumulated with the sediments as these settled in an impounded pool behind the Fort Edward Dam of the Champlain Barge Canal. In 1973, the dam was removed, and by the mid-1970s, NYSDEC had identified 40 PCB hot spots between Rogers Island and Lock 2 of the Champlain Barge Canal along the Upper Hudson (EPA, 2000).

Legal action brought against GE by NYSDEC in 1975 resulted in a $7 million program for the investigation of PCBs and the development of methods to reduce or remove the threat of PCB contamination. In 1976, NYSDEC issued a ban on fishing in the Upper Hudson River from Hudson Falls to the Federal Dam at Troy due to potential risks associated with consumption of PCB-contaminated fish. In 1977, the manufacture and sale of PCBs in the United States were generally prohibited under provisions of the Toxic Substances Control Act (TSCA). Commercial uses of PCBs ceased in 1977, but erosion from PCB deposits, and discharges via bedrock fractures from the GE Hudson Falls plant and contaminated deposits above the water line near the Fort Edward plant continued to impact the water quality of the Hudson River (EPA, 2000). Today, the GE Hudson Falls plant has ceased operations. The GE Fort Edward plant, however, remains active.

In 1984, the Hudson River, between the Fenimore Bridge in Hudson Falls and New York City, was designated a Superfund site, and the same year the EPA completed an FS focusing on methods to clean the Hudson River. The study recommended, among other things, an interim No Action decision with regard to PCBs in the sediments of the Upper Hudson. In 1989, the EPA announced its intention to reassess the 1984 decision. The selected remedy resulted from EPA's reassessment of the 1984 interim No Action decision.

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6.0 RESULTS OF SURVEY

As described in Section 2, EPA conducted data gathering at the NY State Historic Preservation Office (NYSHPO) to collect baseline information regarding previously identified cultural resources within the Hudson River PCBs Superfund Site APE. The following categories of information were surveyed at the NYSHPO:

- National Register-listed resources;
- National Register-eligible resources;
- Previously identified but unevaluated resources; and
- Previous studies including relevant compliance and preservation planning documentation and geophysical surveys conducted in the project area.

The results of this research are presented in the following subsections with supporting tables included as appendices.

6.1 National Register-Listed Resources

A review of the files of the NYSHPO identified 89 National Register-listed resources within the Hudson River PCBs Superfund Site APE. Two of the 89 resources are linear historic districts (Old Champlain Canal in Saratoga and Washington Counties; Glen Falls Feeder Canal in Washington and Warren Counties) that are counted as historic districts in each county that the resource passes through. Eighty-seven of the 89 resources occur in only one county. As shown in Figure C.6-1A to Figure C.6-1D, Architectural and Archaeological Resources in Upper Hudson River APE, and listed in the table below entitled National Register-listed Resources by County, the majority of these resources, 32 and 37, are located in the urbanized areas of Albany and Rensselaer Counties, respectively. The most prevalent resources in the APE are individually listed buildings: 57 buildings represent 64 percent of the total resources identified in the APE. However, the 26 historic districts, representing 28 percent of the total resources identified in the APE, comprise the largest area and include hundreds of individual buildings and other resources, although this number was not quantified in the present survey. These resources are mapped on Figure C.6-1A to Figure C.6-1D, and keyed to the five-part five table, Table C-1 (1a through 1e) appended to this document. Table C-1 provides information on each of these 89 resources, organized by county.

Only two of these resources explicitly identify archaeological resources as contributing elements, Peebles Island (Saratoga County) and Rogers Island (Washington County). This does not necessarily indicate that archaeological sites are not present in other resources, simply that they were not identified or evaluated.

National Register-listed Resources by County

Resource Type	County					Totals
	Albany	Rensselear	Saratoga	Warren	Washington	
Historic Districts	11	7	4*	1**	3*/**	26
Historic Buildings	19	29	3	N/A	6	57
Historic Structures	2	N/A	1	N/A		4
Historic Sites	N/A	1	N/A	N/A	1	2
Historic Objects	N/A	N/A	N/A	N/A	N/A	N/A
Totals	32	37	8	1	10	89

*Old Champlain Canal, a linear historic district, is counted as a district in Saratoga and Washington counties.
**Glen Falls Feeder Canal, a linear historic district, is counted as a district in Washington and Warren Counties.

6.2 National Register-Eligible Resources

The NYSHPO maintains an electronic database of all National Register-eligible architectural resources that have been identified in the state, as described in Section 2. This database, known as SPHINX, is organized by municipal civil division (MCD) for each county. The SPHINX database was queried for each of the 23 MCDs located within the Hudson River PCBs APE, generating a list of 693 previously identified architectural resources, of which 616 were determined National Register-eligible as either individual resources or contributing resources to historic districts. In light of the many identified resources, the fact that the SPHINX database is not associated with a mapping system, and per the guidance of the Assistant Director of the NYSHPO (Kuhn, pers. comm., August 7, 2001), the location of each specific resource was not determined for the present survey. The table below entitled National Register-Eligible Resources by Municipal Civil Division by County provides information on the total number of surveyed and eligible individual resources and historic districts in each MCD, organized by county.

That table reveals that the city of Troy contains the greatest number of surveyed resources, at 302 (over 40 percent of all surveyed resources), and 280 determined to be eligible as individual resources or part of a historic district. The city of Albany contains 110 surveyed resources (15 percent of all surveyed resources), and 104 are determined eligible as individual resources or part of a historic district. Warren County contains only six eligible resources, the fewest of all of the counties.

One particularly significant National Register-eligible resource, the Champlain Barge Canal, is present within the study area. Surveyed in 1989, the canal was recommended for National Register eligibility, including the barge canal channel, locks, dams, siphon spillways, guard gates, bridges, and other features such as culverts, sluice gates, terminals, locktender houses, storehouses, shop buildings, and other associated features (Raber Associates, 1989).

National Register-Eligible Resources by Municipal Civil Division by County

County/Municipal Civil Division (MCD)	Individually National Register-Eligible Resource	Determined Eligible as Part of a Historic District	Surveyed and Undetermined to Date	Total
Albany County				
City of Albany	37	67	6	110
City of Watervliet	N/A	N/A	1	1
Village of Green Island	1	N/A	N/A	1
City of Cohoes	1	N/A	N/A	1
Total for Albany County	39	67	7	113
Saratoga County				
Village of Waterford	2	N/A	N/A	2
Town of Halfmoon	9	N/A	2	11
City of Mechanicville	3	N/A	1	4
Town of Stillwater	2	N/A	2	4
Village of Stillwater	5	N/A	N/A	5
Town of Saratoga	2	N/A	N/A	2
Village of Schuylerville	2	N/A	N/A	2
Town of Northumberland	4	N/A	1	5
Town of Moreau	4	N/A	4	8
Total for Saratoga County	33	N/A	10	43
Rensselaer County				
Town of Schaghticoke	5	N/A	2	7
City of Troy	35	245	22	302
City of Rensselaer	65	N/A	N/A	65
Town of East Greenbush	6	N/A	20	26
Total for Rensselaer County	111	245	44	400
Warren County				
City of Glens Falls	6	N/A	1	7
Total for Warren County	6	N/A	1	7
Washington County				
Village of Hudson Falls	16	24	3	43
Village of Fort Edward	11	44	7	62
Town of Fort Edward	5	N/A	3	8
Town of Greenwich	8	1	2	11
Town of Easton	1	5	N/A	6
Total for Washington County	41	74	15	130
County Totals				
Total Number of Resources	230	386	77	693
Source: SPHINX Database, New York SHPO, Albany, New York				

6.3 Unevaluated Resources

A number of previously identified but unevaluated archaeological and architectural resources were identified in the Hudson River PCBs Superfund Site APE as described below. At this time, the National Register eligibility status of these resources has not been determined by the NYSHPO.

Archaeological Resources

The site location maps of the NYSHPO depict a total of 329 archaeological resources within the Hudson River PCBs Superfund Site APE (96 of these sites are in Albany County, 56 in Rensselaer County, 119 in Saratoga County, 1 in Warren County, and 58 in Washington County). This information was manually transcribed onto USGS quad sheets and then digitized onto the Hudson River PCBs GIS. The general location of these sites is presented on Figure C.6-1A to Figure C.6-1D, which is keyed to a listing of site identifiers and summary information provided in Table C-2. The National Register eligibility status of these sites is unknown, but it is likely that the overwhelming majority have not been evaluated.

The site inventory forms for each of these sites was examined for information concerning cultural affiliation. The sites were described as follows:

- 145 sites (44 percent), the majority of those inventoried, contained exclusively historic resources.
- A total of 133 of these sites (40 percent) contained exclusively prehistoric resources.
- 35 sites (11 percent) had an unknown cultural affiliation.
- 13 sites contained both a prehistoric and a historic component.
- 3 sites had both components and Contact-era remains (3).

The table below entitled Unevaluated Archaeological Resources by County and Cultural Affiliation provides a further breakdown of this information by county and the distance of a boundary of the resource from the Hudson River.

Although roughly equivalent numbers of sites have been identified that contain exclusively prehistoric materials or contain exclusively prehistoric materials, 133 and 145 respectively, significant variation is present in the distribution of these sites by county. Almost 50 percent of the 145 identified historic sites are located in Albany County while about 43 percent of the identified prehistoric sites are located in Saratoga County. These differences are likely a result of both the degree of historic settlement in a county and the level of subsequent urbanization.

This table also reveals apparent patterning in the distribution of archaeological sites within the Hudson River PCBs Superfund Site APE by cultural affiliation in relation to their distance from the river. Just under half of the 133 identified prehistoric sites have a boundary located within 250 feet of the Hudson River's coastline, an area that consists of only just over 12 percent of the APE itself. This suggests a correlation between prehistoric site location and distance to the river. A similar but weaker pattern is evident for the historic sites as well.

Some of the site inventory forms contain more specific information regarding cultural affiliation (Table C-2 following the body of this document). Of those forms for previously identified prehistoric sites that indicate a specific cultural affiliation, about half are associated with the Archaic period and half are associated with the Woodland. No Paleo-Indian sites are represented and only a small number of sites with a Contact period component.

Unevaluated Archaeological Resources by County and Cultural Affiliation

County	Cultural Affiliation									Totals
	Prehistoric			Historic			Both	Contact	N/A	
	<250 ft	>250 ft	Total	<250 ft	>250 ft	Total				
Albany	5	9	14	5	66	71	3	1	7	96
Rensselaer	19	24	43	3	8	11	0	0	2	56
Saratoga	31	26	57	16	16	32	4	1	24	119
Warren	0	0	0	1	0	1	0	0	0	1
Washington	11	8	19	19	11	30	6	1	2	58
Totals	66	67	133	44	101	145	13	3	35	329

Sites were counted by the location of their center point.
<250 ft refers to sites with a boundary within 250 ft of the coastline.
>250 ft refers to sites with no boundary closer than 250 ft of the coastline.
All three Contact sites reported prehistoric and historic remains as well.

Architectural Resources

The table entitled National Register-Eligible Resources by Municipal Civil Division by County in the foregoing Subsection 6-2 provides information on the number of unevaluated resources in the 23 MCDs that comprise the Hudson River PCBs Superfund Site APE according to the SPHINX database. Because the database is not associated with a mapping system, the location of each specific resource was not determined for the present survey, as per the guidance of the Assistant Director of the NYSHPO (Kuhn, pers. comm., August 7, 2001). Therefore, many of these resources may be located outside the Hudson River PCBs Superfund Site APE. Currently, the greatest number of identified but unevaluated resources - 44 such resources, or over 50 percent of the total - are located in Rensselaer County. Albany County has far fewer, with only seven unevaluated resources. Warren County has only one unevaluated resource.

6.4 Previous Studies

Archaeological Compliance Surveys

The NYSHPO maintains a series of maps, organized by county, that depict the approximate survey or testing area of archaeological compliance documentation. A review of these maps for the counties overlapping the Hudson River PCBs Superfund Site APE identified 83 separate reports, 29 that were conducted within Albany County, 15 in Rensselaer County, 25 in Saratoga County, 2 in Warren County, and 12 that were conducted in Washington County.

An abstract of these reports is provided in the NYSHPO's biblio-files. The entry for each of these 83 reports was reproduced and reviewed for summary information. Table C - 3 at the end of this appendix contains a listing of these reports. The biblio-file review revealed that these 83 surveys identified a total of 185 archaeological sites; however, no information was provided regarding the eligibility status of these sites. It should be noted that the site file review previously discussed (Subsection 6.3) identified a total of 329 sites in the Hudson River PCBs Superfund Site APE. It is unclear why the number of sites listed in the survey report abstracts is so much lower than the 329 total previously discussed, but it is likely that this is partly due to the fact that not all listed sites are identified through formal compliance surveys.

The following table, Sites Identified by Prior Archaeological Surveys in APE by County, provides summary information on the 185 archaeological sites identified by the surveys, organized by type by county.

Sites Identified by Prior Archaeological Surveys in APE by County

County	Number of Identified Sites by Type					Acreage of Survey Area*
	Prehistoric	Historic	Both	N/A	Total	
Albany	2	42	1	0	45	81
Rensselaer	21	6	3	43	73	209
Saratoga	25	17	0	1	43	599
Washington	3	20	1	0	24	62
Warren**	0	0	0	0	0	Not provided
Totals	51	85	5	44	185	951

* Acreage of survey area was not reported for many surveys.
** The Warren surveys did not identify any sites.

Geoarcheology of the Hudson River Valley

Six studies within the Hudson Valley and neighboring areas provide a broad outline for the potential of geoarcheological evidence and interpretation in the project area. An analysis of the Hoosic River drainage within the project area, an analysis of glacial lake settlement patterns to the northwest of the project area, and four studies concerning the Central and Lower Hudson valley, offer a framework for reconstruction of the human-landscape interactions for the project area.

Hoosic River Drainage, Rensselaer, and Washington Counties

A study from the Hoosic River drainage concerns numerous Paleo-Indian through Late Woodlands sites within Rensselaer and Washington Counties (Cesarski, 1996). Ms. Cesarski's research surveys the land use patterns around Glacial Lake Albany (at the Hoosic-Hudson confluence) and Glacial Lake Bascom (occupying the Hoosic Drainage in eastern New York, Vermont, and Massachusetts). Cesarski argues that the glacial lakes created "wetland mosaics" (1996), providing diverse subsistence, settlement, and raw material resources for prehistoric populations in the central Hudson Valley. She suggests that these glacial lake margins and inter-lake basin areas are core and secondary centers, respectively, for the immediate post-glacial period (12,000-7,000 BP). This pattern changes as the lakes disappear during the gradual climatic amelioration of the Hypsothermal episode (9,000-6,000 BP), causing a shift toward the stream drainages as core resource and settlement areas for later prehistoric periods.

Based on a group of more than 110 sites from the Hoosic drainage, Cesarski reconstructs land use patterns by examining artifact assemblages from residential and special use sites (1996). Analysis of lithic artifact density, distribution, and type suggests early exploitation of wetlands in the glacial lake basins of the Hudson Valley, with occupations occurring along the highland margins of the lakeshore. These areas became secondary in the ensuing periods, as the lakes receded and prehistoric populations emphasized the major and minor stream valleys for both settlement and economic resources (Cesarski, 1996; Nicholas, 1991).

Fort Drum, Jefferson, and Lewis Counties

Paleoenvironmental investigations on glacial Lake Iroquois near Fort Drum, New York, provide rich detail of the lakeshore settlement patterning for early Holocene populations. GIS modeling of present topography and known sites generated a predictive tool for the identification of potential archaeological resources along the reconstructed shorelines of remnant lakes (Rush *et al*., 2000). Rush and colleagues were able to identify Frontenac phase shorelines of Lake Iroquois and surveyed new upland areas for archaeological potential. Further, the researchers were able to document fossil islands, shore margins, wetlands, and dune deposits that would have been accessible microenvironments for Paleoindian and Archaic peoples. Surprisingly, settlement through time seemed to follow the receding shoreline of Lake Iroquois in some parts of the study area. Although Rush et al. (2000) noted problems with later Holocene aeolian deflation of the shoreline, the demonstration of successive occupations encircling a glacial lake has potential for expanding understanding of early settlements along other lacustrine systems, including glacial Lake Albany in the Hudson River valley.

Central and Lower Hudson Valley, Washington, Albany, Rensselaer, Columbia, Ulster, Dutchess, and Orange Counties

Dineen (1992) discusses the post-Pleistocene geology of the Central and Lower Hudson valley floodplain and estuary system. Noting the increasing depth of alluvial deposits as the stream flows southward, Dineen chronicles the development of terraces and alluvial fans along the present valley margins and the pre-Pleistocene trunk streams. Significant changes in sea level contribute to the development of these landforms, as the stream responds to new climatic and environmental conditions.

This model indicates that within the river channel a basal gravel, laid down by the emptying of Lake Fort Ann, a late glacial lake in the Hudson valley, rests at the lowest level of the Hudson Gorge from Comstock, Washington County, to the New York Bay, and is dated to approximately 10,600 BP. (Dineen, 1992). This gravel indicates that an ancient Hudson River flowed slightly east of the present stream course, prior to glacial modification of the valley. While the gravels were deposited in the upper portions of the river, course sands and gravels occupied the mid-valley channel and were part of the Hudson River Delta, extending from Troy to Newburgh. Landforms notable within the delta include a remnant floodplain, smaller tidal tributary deltas, and a submerged tidal tributary area (Dineen 1992:60-63). Dineen notes that while parts of this delta are underwater, other deltas in the southern portion of the valley are exposed, due to the delivery of sediment to the tributary mouth in excess of alluvial erosion or tidal changes by the trunk channel. While these coarse deposits filled the Upper and Mid-Hudson valley channel, finer organic silts and clays were accumulating in the lower estuaries of the valley at approximately the same time period or slightly later (Dineen, 1992).

Dineen documents a variety of landforms, deposits, and processes contributing to the present character of the Hudson valley project area. The model highlights the interaction between rising sea levels, stream erosion, and sediment deposition through the Holocene, providing the most comprehensive outline of Hudson valley landscape development during prehistoric occupation.

Dogan Point, Westchester County

Another example of geoarchaeological investigations within the greater Hudson Valley region is the work at Dogan Point conducted by Geoarcheology Research Associates. The site of Dogan Point, near Montrose, New York, is a Middle to Late Archaic (5,500-2,500 BP) oyster shell midden on the east bank of the Lower Hudson River (Claassen, 1995, 1996; Schuldenrein, 1995). Occupying a bedrock promontory nine to 13 feet above mean sea level, the site is preserved within the widening estuarine reach of the valley, and its cultural materials reflect exploitation of the available brackish water resources during the mid to later Holocene.

Schuldenrein reconstructs several phases of cultural activity at Dogan Point, and relates them to evolution of the landscape in the study area. Paleoclimatic reconstructions for the mid to late Holocene indicate shifting temperature and moisture regimes, affecting the extent of glaciation, fluctuation of salt and freshwater conditions in the estuary, and the dependent ecosystems in the valley (Claassen, 1996).

Observed environmental shifts, as seen in zooarchaeological evidence, are supported by the landscape reconstruction of an early estuary giving way to a later tributary drainage system in the valley. This landscape model also proposes the development of microenvironments in both the early and later periods of the Dogan Point occupation. Beaches, coves, and tidal flats associated with the estuary become ridges and swales, deltas, and point bars associated with a dendritic stream pattern (Schuldenrein 1995:46).

Goldkrest Site, Rensselaer County

The Goldkrest site is a Middle to Late Woodland period site located on Kuypers Island, near East Greenbush, New York, that revealed good evidence of landscape development along the Hudson River drainage since the terminal Pleistocene. The Quaternary map of the Hudson Valley classes surface sediments in the vicinity of Goldkrest as "al," or Holocene alluvium (Fullerton, 1992). This Holocene alluvium has a very limited distribution along this segment of the Hudson Valley and is confined to a 62.5-mile linear band centered at the confluence of the Mohawk and Hudson Rivers. Identification of such Holocene alluvial "packages" such as this is critical because they effectively suggest the potential for encountering preserved archaeological sediments in the area.
Stratigraphic and sedimentary analyses traced the changing stream path and site formation processes. The channel was probably braided in early phases, later developing a meandering pattern. The overall landscape would have included backswamps, islands, and slackwater channels. Since there is no evidence at the Goldkrest site for occupation at this time, it is suggested that the dynamic and erosive character of the stream may have removed any possible sites from the area (Schuldenrein 1996:11).

Significantly, this landscape model indicates that the Middle to Late Woodland components, as preserved in the paleosol, were developed under more stable (minimal deposition, minimal erosion) landscape conditions. Furthermore, it indicates a moist, temperate paleoclimate between 1,500-600 BP for the Hudson River valley.

Preservation in "Channel Dredge" Settings: An Example from the Port of New York, Lower Hudson Valley

Development of a site sensitivity model for the Upper and Lower Bay of the Lower Hudson River valley in the Port of New York is a final relevant study of archeological site settings and preservation contexts. GRA (2000) conducted this effort as part of a USACE, New York District, plan for widening and deepening the existing navigation channels.

Analysis involved excavation and analysis of a series of sub-aqueous sediment borings. Samples were studied stratigraphically and sedimentologically and then subjected to a variety of specialist analyses, including radiocarbon dating; foram analysis; pollen analysis; and macrobotanic identifications. Limited paleoenvironmental reconstructions were produced that helped to determine the landscape implications of the stratigraphic columns that were retrieved. The results were used to develop a working model of cultural resource sensitivity that ranked the channels and various segments according to likelihood for site preservation both within the navigation channels and the terrain flanking the channel.

In general, it was concluded that the navigation channels had moderate to high potential for preserving intact deposits pre-dating 6000 BP. Sites post-dating the Late Archaic, while generally better known outside the project area in terrestrial environments, are less likely to be preserved in the channel environments because they are higher in elevation and thus more exposed to the destructive long-term effects of dredging and shipping activities. Specific channels were sampled to test the hypotheses.

This type of study should serve as a baseline study for systematizing observations about the cultural resource distributions buried along the channel environments. The example of New York Harbor can be extrapolated to upstream locations where analogous estuarine settings are dominant. The model is based on a sensitivity model that was largely constructed from limited fieldwork and from an uneven archeological database. As such the methodology provides guidelines for follow up testing based on the sensitivity zonations identified for the channel alignments.

Geophysical Surveys

A number of geophysical surveying techniques have been used on the Upper Hudson River since the early 1980s. These surveys were designed to characterize riverbed morphology and sediment distribution patterns in association with the Hudson River PCBs Reassessment Remedial Investigation/Feasibility Study (RI/FS). Most significantly, Roger D. Flood, Ph.D., of the Marine Sciences Research Center of SUNY Stony Brook, implemented several survey techniques including the following:

- Side-scan sonar.
- High frequency echo sounding.
- Low frequency acoustic sub-bottom profiling.
- Confirmational sediment sampling (Flood, 1993).

Side-scan sonar information, when combined with bathymetric data, sediment sampling, and subbottom profiling, provides sediment information about the river bottom morphology, the distribution of sediments within the river, and the processes responsible for those distribution patterns. As such information is also of archaeological relevance, and can contribute to the modeling of the archaeological sensitivity of the river bottom sediments, Dr. Flood's results are selectively summarized below.

Side-Scan Sonar

Side-scan sonar provides information that is somewhat equivalent to an aerial photograph but yields sediment images based on the reflectivity of sound as opposed to light. A range of environmental factors effected the sonar character in the Upper Hudson survey area. These effects included:

- Bottom type (sediment, rock outcrop, or vegetation).
- Sediment size (gravel, sand, silt, or clay).
- Small-scale roughness (ripples, lineations, or rock layering or fracture pattern).
- Sediment layering (buried but near-surface sand or gravel layers).
- Large discrete features (trees, large chunks of sawn wood, docks, and even shadows cast by such features).
- Bottom slope.
- Shoreline.

While the effect of some of these factors was easily established, others required more careful evaluation and the calibration of the sonar data (Flood, 1993).

The 1993 survey evaluated two different sonar frequencies for their suitability to the specific environmental and sedimentological attributes of the Upper Hudson, 100 kHz and 500 kHz. The combined analysis of sonar data and sediment data suggested that readings from the 500 kHz information was related to mean sediment size, with coarser sediments being more reflective than finer ones. Alternatively, the 100kHz demonstrated a poor correlation to grain size parameters and was therefore determined to be of only marginal utility.

High Frequency Echo Sounding

High frequency echo sounding was utilized in conjunction with the sub-bottom profiling to clearly establish the depth and bathymetry of the river bottom. Through echo sounding, it was possible to ensure that layering within the upper few feet of the sub-bottom would be observed if present.

Low Frequency Acoustic Sub-bottom Profiling

The 1993 survey utilized a seven kHz sub-bottom profiler to identify layering within the river bottom, sediment characteristics, and sediment thickness. Although sub-bottom layers were observed in specific portions of the river, the survey was generally unable to identify such layers. Apparently, four factors made the identification of sub-bottom stratigraphy difficult, as follows:

- Sediment size – Much of the river bed consists of coarse sand, gravels, and weathered rocks, which scatter and attenuate sound signals.
- Presence of sawn wood fragments – Wood fragments in the upper one to two feet effectively stop sound penetration due to their size, the irregular shape of their depositional layer, and gas inclusions.
- Presence of gas – Gas may be present in rapidly deposited fine-grained sediments and dramatically increases sound attenuation.
- Shallow water – No river bottom was recognized in water with a depth of less than about four feet; probably because the profiler settings were optimized for deeper water (Flood, 1993).

Through analysis of the low frequency acoustic sub-bottom profile data, eight *categories* of information concerning the stratigraphy of the river bottom were identified, as summarized in the following table, Categories of Sub-bottom Stratigraphic Information.

Categories of Sub-bottom Stratigraphic Information

Category	Description
1	Distinctive layering consisting of up to 30 ft of parallel-laminated sediment (glacial-era varved silts and clays).
2	Glacial-era varved silts and clays overlaying an older deposit (either older sediment, bedrock, or poorly resolved laminated sediments).
3	One clearly-defined sub-bottom layer; it is unknown whether it pre- or post-dates canal construction. Portions may consist of poorly resolved laminated sediments.
4	One clearly-defined sub-bottom layer overlaying laminated sediments.
5	One clearly-defined sub-bottom layer overlaying additional layers that do not resemble laminated sediments.
6	No clear sub-bottom echo was observed; this was the most common echo type.
7	A record too poor to interpret due to shallow water.
8	One sub-bottom layer observed, but it was likely an echo from the adjacent steep channel wall.

Categories 1, 2, and 4 describe parallel-laminated sediment, soils that were identified through coring as "*glacially-deposited varved silts and clays*" (Flood, 1993). This sediment was observed in several areas of the river but most often in the deepest portions. These deposits were identified as "*sticky gray* clay" during an earlier sampling effort (Gahagan and Bryant Associates, 1982). It is further suggested that once exposed, this sediment is susceptible to erosion.

Categories 3, 5, and 6 reflect the presence of discrete sub-bottoms and were observed in many portions of the river. However, these layers could only be followed laterally for relatively short distances and may at times reflect deposits of recent origin (Flood, 1993). The most extensive regions of relatively deep discrete sub-bottom horizons were identified between the Thompson Island Dam and the Fort Miller Dam. Flood suggests that such layers may be common in this portion of the river since it has never been dredged (1993).

Sediment Sampling

Approximately 300 confirmational sediment samples were taken and analyzed to evaluate and calibrate the remote sensing information. Sediment grain sizes were determined for surficial deposits and some deeper samples.

Conclusion

Geophysical surveying has determined portions of the Upper Hudson River bottom contain sediments that post-date the glacially deposited varved silts and clays. These silts and clays are associated with former Lake Hudson. Shallower and more recent sediments have the potential to contain archaeological resources.

Architectural Surveys

Numerous previous historic architectural surveys have been conducted within Albany, Rensselaer, Saratoga, Washington, and Warren Counties. These include both state and federal compliance surveys and general surveys undertaken for historic preservation planning purposes.

Compliance Surveys

According to the table entitled National Register-Eligible Resources by Municipal Civil Division by County in Subsection 6.2, 693 architectural resources have been surveyed in the five counties, and 616 of these have been determined to be eligible for listing in the National Register. Many of the surveys that identified these resources were conducted in compliance with Section 106 of the National Historic Preservation Act and/or Section 428 of the New York State Historic Preservation Act.

Specific background research indicates that a Section 106 compliance survey undertaken for Niagara Mohawk Power Corporation was prepared in 1980 to examine the National Register eligibility of four hydroelectric plants in the Glens Falls vicinity. The report, *Cultural Resources Survey of Four Hudson River Hydroelectric Plants New York* (Clune & Johnson, 1980), concluded that the National Register-listed Mechanicville plant in the Hudson River PCBs Superfund Site APE provides an excellent foil against which to measure the eligibility of the four Glen Falls plants. The report concluded that none of the four plants appeared to be National Register-eligible.

Other Surveys

Other architectural surveys within the Hudson River PCBs Superfund Site APE include general historic architectural contexts and historic preservation planning surveys funded through private and/or government grants. These surveys often have geographic scopes (village, town, city or county-wide) or thematic scopes (bridges, canals, power plants, etc.). Within the Hudson River PCBs Superfund Site APE, various thematic surveys have been conducted, including:

National/Statewide Surveys

According to available documentation at the NYSHPO, a survey documenting hydroelectric development in the US was conducted in 1987. The survey, *Hydroelectric Development in the United States, 1880-1940* (Duncan Hay; New York State Museum, 1987), has a section devoted to the history of hydroelectric development in New York, including the Upper Hudson River region. The survey describes numerous hydroelectric developments in the project APE, including those associated with the electric, paper, canal and other industries. Of specific interest to the Upper Hudson River are the National Register-listed Mechanicville hydroelectric plant, the modern Upper Mechanicville hydroelectric plant, the Lock C-5 facility in Schuylerville along the Champlain Barge Canal, and the Niagara-Mohawk facility at Moreau (Fenimore), among others.

Regional Surveys

According to available information at the NYSHPO, useful architectural surveys have also been prepared on resources within the project APE. One report, entitled *Reconnaissance Study of Historic Resources in the Champlain Canal Corridor, Albany, Saratoga, Washington, and Warren Counties, New York* (Raber Associates, 1989), provides valuable information on the history of the 20th century Champlain Barge Canal and associated features, and recommended the canal as eligible for listing in the National Register.

Town, Village, City or Neighborhood Surveys

Multiple municipalities within the Hudson River PCBs Superfund Site APE have undertaken historic architectural surveys. These include:

- Albany County, City of Albany, Downtown areas (1976).
- Albany County, Town of Colonie (1981).
- Warren County, City of Glens Falls (1980-81).

These surveys have resulted in the National Register listing of numerous resources located in Albany and Warren Counties, featured in Table C - 1.

6.5 Other Resources

American Heritage Rivers

In 1998, the Hudson River was designated an American Heritage River under the authority of President Clinton's Executive Order 13061, enacted in 1997. As an American Heritage River, the Hudson's unique place in American history and culture has been officially recognized, and, as a result, is entitled to technical assistance in achieving natural resource and environmental protection, economic revitalization, and historic and cultural preservation.

To implement these programs and to devise plans to benefit the river and surrounding communities, a River Navigator has been appointed. The role of the River Navigator is to facilitate the application of existing federal programs and resources to the needs of the river.

Key stakeholders and partners of the Hudson River American Heritage River initiative are represented by the Hudson River Community Forum, and include local, state, and federal agencies pursuing programs and interests that impact the Hudson Valley communities. Key federal partners include:

- USACE.
- USEPA.
- Federal Emergency Management Agency (FEMA).
- Federal Highway Administration (FHWA).
- US Department of the Interior.
- US Department of Commerce.
- US Department of Agriculture.

Although the Hudson River is not a designated National Register-listed historic site, the American Heritage River program acknowledges the important role that the river has played in the development of New York and the nation. This designation will be taken into account when analyzing effects of the selected remedy on the river.

Traditional Cultural Properties

Section 106 directs federal agencies to consider the effects of their undertakings upon TCPs (as described in Section 2), in addition to the effects to other cultural resources. Such properties are often identified only through interviews "with knowledgeable users of the area, or through other forms of ethnographic research" (NPS, 1990).

There are no previously identified TCPs in the Hudson River PCBs Superfund Site APE, and, as stated in Section 2, the present survey did not include an evaluation of the presence of such properties, nor any type of field reconnaissance in the project area. However, a cursory survey of comments and responses to EPA's FS received from both individuals and local organizations suggest strong cultural identification with certain traditional river-based lifestyles and activities. This is reflected in the number of comments that express disappointment over loss of the Hudson River fishery and the loss of fishing and other recreational opportunities in general in the Upper Hudson. For many area residents along the Upper Hudson, hiking, swimming, wading, boating, and catch and release fishing are integral components of their relationship to the river, and some have offered the opinion that these activities would be threatened by implementation of the selected remedy. Discussions of the effects of the selected remedy upon river ecology and regional socioeconomics are provided in the Feasibility Study, the Responsiveness Summary, and numerous white papers prepared for the Responsiveness Summary that address individual areas of concern.

In addition, there are many parks along the Upper Hudson that host festivals attended by the local and regional population. A substantive discussion regarding TCPs in the APE would involve additional data collection. Such data collection may take the form of local informant interviews during the remedial design process.

7.0 POTENTIAL EFFECTS OF SELECTED REMEDY

Through a survey of the files of the NYSHPO, EPA has determined that a number of cultural resources are located within approximately 2,000 feet of the Hudson River coastline between Hudson Falls and the Port of Albany, the Hudson River PCBs Superfund Site APE. These resources include over 85 buildings, structures, sites, or historic districts that are listed on the National Register of Historic Places (primarily buildings and districts, although two listed resources include archaeological sites), approximately 300 identified but unevaluated archaeological sites, and an undetermined number of National Register-eligible resources. In addition, through preliminary analysis of the project area, there is the high potential for additional historic architectural resources and archaeological sites to be present both within the Hudson River PCBs Superfund Site APE, in the immediate vicinity of the remediation area, and buried within the river sediments.

Based on preliminary Criteria of Effect (36 CFR Part 800) analyses of the potential effect of the selected remedy on National Register-listed and eligible resources (and identified but unevaluated archaeological sites), it appears that the remedy would have No Effect on the majority of these resources because most are far removed from the remediation area. The effects of the selected remedy upon nearby cultural resources were considered for two general types of effects:

- Permanent effects such as dredging portions of the river bottom and stabilizing the shoreline.
- Temporary effects such as use of the rail and canal systems to move dredged materials within and from the river, the use of local roads to transport workers, construction equipment, maintenance equipment, and project supplies, the temporary use of pipelines, booster pumps, and associated apparatus (in the case of hydraulic dredging), and the temporary view shed effects of the dredging process.

Construction of sediment processing/transfer facilities may also result in both permanent and temporary effects to cultural resources in the project area. However, it is important to note that EPA has not yet determined the locations of such sediment processing/transfer facilities necessary to implement the selected remedy. EPA will comply with substantive requirements of the NHPA in connection with the facility siting process. For purposes of the FS, example locations were identified from an initial list of candidate sites based on screening-level field observations which considered potential facility locations from an engineering perspective. In the FS, it was necessary to assume the locations of sediment processing and transfer facilities in order to develop conceptual engineering plans, analyze equipment requirements, and develop cost estimates for the remedial alternatives. For this purpose, two example locations were identified: one at the northern end of the project area in the vicinity of the Old Moreau Landfill, and one at the southern end of the project area near the Port of Albany. Each of these example locations fulfills many of the desired engineering characteristics for such a facility to support the remedial work, and is representative of reasonable bounding assumptions with regard to distance from the dredging work and cost. Other locations, both within the Upper Hudson River valley and farther downstream, are possible. USEPA, however, will not determine the actual facility location(s) until after the agency holds a public comment period on proposed locations, and considers public input in the final dredging decision.

EPA does not anticipate any Adverse Effects under 36 CFR Part 800 to listed or eligible resources due to a decline in tourism since the agency believes that the selected remedy will result in an expansion, rather than a decline, in tourism in the Hudson River valley (White Paper – Socioeconomics). Visual effects in the project area will be temporary. When the project is complete, the river will look very much as it does today. There should be no permanent visual effects to historic areas.

The following is a summary of the primary components of the selected remedy as they relate to this discussion of effects on cultural resources.

Dredging

The goal of the selected remedy is to remove PCBs from the Upper Hudson River that have been deposited in the waterway since the 1940s. Dredging itself is an action long-associated with the Upper Hudson River and probably dates back to the early 19th century. However, dredging associated with the selected remedy would have a direct effect upon river bottom sediments that have not been previously dredged and will likely result in secondary effects to portions of the coastline. The remedy does not call for any removal of material above the 3,000 cubic feet per second (cfs) waterline. Dredging, however, may change the near-shore slope of the river bottom and so destabilize banks in some areas. Stabilization measures may be required to address this issue.

The selected remedy would involve either mechanical or hydraulic dredging or a combination of the two. Figure C.3-2 depicts the areas targeted for dredging, although these boundaries will be refined during the remedial design process. Mechanical dredging consists of excavators positioned on a floating platform. Hydraulic dredging would likely consist of a suction dredge with a cutterhead to remove targeted sediments. Temporary slurry pipelines (pontoon, submerged, and shoreline) would convey hydraulically dredged material to transfer facilities. Temporary shore or barge-mounted booster pumps would provide pumping power along the length of the dredge route. Backfilling would be conducted in certain areas to isolate residual contaminants that remain after dredging and to meet habitat replacement objectives.

The selected remedy also includes navigational dredging in River Sections 2 and 3. Navigational dredging would most likely be mechanical, subject to final plans. Backfilling and shoreline stabilization would not occur after navigational dredging.

Transportation

The existing rail and canal system will be used to transport dredged sediments to and from processing facilities and landfills as dredging proceeds. The existing rail and canal system will also be used to transport backfill material to the Upper Hudson River area. Roads will be used to transport workers, construction equipment, maintenance equipment, and project supplies (*e.g.*, stabilization agent), among other things. It is anticipated that the existing transportation network is adequate for these tasks and no major improvements would be required.

Processing

As discussed above, PCB-laden sediments will be brought to transfer sites within the Upper Hudson River project APE. The example NTF in River Section 1 and example STF south of River Section 3 near Albany, are described above and in Section 3. Such facilities would require wharves, adequate land area to construct facilities needed to process incoming sediments, and access to operating rail lines for off-site transfer of processed sediments.

7.1 Effects to Known National Register-Listed and Eligible Resources

Eighty-nine National Register-listed resources and multiple National Register-eligible resources are located in the Hudson River PCBs Superfund Site APE. Based on the review of preliminary plans, it appears that the selected remedy would have No Effect on the majority of the listed properties. However, preliminary analyses indicate that seven National Register-listed and one known National Register-eligible resource may be temporarily affected by the selected remedy as described in the Record of Decision and summarized in Section 3 of this Cultural Resources Assessment. These resources, which are illustrated in Figures C.6-1A to C.6-1D, and listed in Table C - 1 (a through e) appended to this report, are reflected in the table below, Known National Register-Listed and Eligible Resources Temporarily Affected by Selected Remedy:

Known National Register-Listed and Eligible Resources Temporarily Affected by Selected Remedy

Resource Name	Municipal Civil Division (MCD)	County
Rogers Island	Town of Fort Edward	Washington
Mechanicville Hydroelectric Plant	City of Mechanicville	Saratoga
Champlain Barge Canal (National Register-Eligible	Multiple MCDs	Albany, Rensselaer, Saratoga, Washington and Warren
Old Champlain Canal	Multiple MCDs	Saratoga and Washington
St. James Episcopal Church	Town of Fort Edward	Washington
Old Fort House	Town of Fort Edward	Washington
Fort Miller Reformed Church	Town of Fort Miller	Washington
Saratoga National Historical Park	Vicinity of Stillwater	Saratoga

As further discussed below, for two of the listed resources (Rogers Island and the Mechanicville hydroelectric plant), this temporary effect could potentially be adverse. The selected remedy would have no adverse effect on the remaining five listed and single eligible resources. EPA will mitigate all identified unavoidable effects that are identified.

Potential effects to these primarily architectural resources were evaluated with regard to the Criteria of Adverse Effect set forth in 36 CFR 800.9 (and listed in the table entitled Criteria of Adverse Effect in Subsection 2.2). The discussion presented below is based upon a review of the selected remedy and the limited available information on identified resources. Fieldwork would be necessary to fully assess these effects in accordance with 36 CFR Part 800.9. It is important to note that EPA will minimize identified effects during remedial design through either suitable redesign of the remedy or, if effects are determined to be unavoidable, through appropriate mitigative strategies to be identified in the future.

Potential Adverse Effects

The selected remedy may result in potential Adverse Effect to portions of two National Register-listed resources in the Hudson River project APE. These resources are Rogers Island in Washington County and the Mechanicville hydroelectric plant in Saratoga County. Potential methods to mitigate these effects are suggested below and would be subject to review by the EPA, NYSHPO, ACHP, and other consulting parties, pending field visits to be conducted during remedial design.

Rogers Island

Under the selected remedy, portions of the Hudson River to the west and east of Rogers Island may be mechanically or hydraulically dredged. Rogers Island possesses a high potential to yield prehistoric and historic archaeological sites, and the boundaries of these resources may extend into the river itself. Although it is post-World War II sediments that contain targeted PCBs, either mechanical or hydraulic dredging along the channel adjacent to Rogers Island has the potential to disturb older sediments that may have some prehistoric and historic archaeological sensitivity.

Given the potential for adverse effects, if sites associated with Rogers Island are determined to extend into areas targeted for dredging or shoreline stabilization, EPA will try to avoid such impacts during remedial design while maintaining the effectiveness of the remediation. If avoidance through design of the dredging process in those areas is not feasible, alternative appropriate mitigative strategies would be implemented.

Mechanicville Hydroelectric Plant

Under the selected remedy, the Mechanicville hydroelectric plant may be temporarily adversely affected by mechanical or hydraulic dredging because preliminary plans appear to indicate that material may be removed from land within the National Register boundary of the resource. No damage to the building is anticipated as part of this project. However, dredging near the plant may result in temporary visual affects to the historic plant. Potential, preliminary mitigation measures include designing a dredging scheme that would preserve the historic integrity of the plant's contributing features.

No Adverse Effect

The selected remedy may also temporarily result in No Adverse Effect with conditions to one National Register-eligible resource and five National Register-listed resources in the Hudson River PCBs Superfund Site APE. These resources include the:

- National Register-eligible Champlain Barge Canal in Albany, Rensselaer, Saratoga, and Washington Counties.
- National Register-listed Old Champlain Canal in Washington and Saratoga Counties.
- National Register-listed St. James Episcopal Church in Washington County.
- National Register-listed Old Fort House in Washington County.
- National Register-listed Fort Miller Reformed Church Complex in Washington County.
- National Register-listed Saratoga National Historical Park in Saratoga County.

Champlain Barge Canal

The Champlain Barge Canal route follows the channel of the Upper Hudson for most of its length, beginning at the Federal Dam in Troy, except for a land cut between the Fort Miller Dam and the Thompson Island Dam. Under the selected remedy, mechanical or hydraulic dredging of *hot spots* and general navigational dredging could temporarily affect the historic character and setting of the canal route. In addition, booster pumps and pipelines associated with hydraulic dredging may also result in a temporary visual effect to the canal by temporarily altering the historic setting, character and feeling of the resource. It is anticipated that contributing locks and dams would remain intact and not be affected by dredging.

Dredging, coupled with the restoration of barge and towboat service within the canal right-of-way, is consistent with the barge canal's historic use. Therefore, it is anticipated that the selected remedy would result in No Adverse Effect to the Champlain Barge Canal because small-craft usage and dredging are consistent with the canal's historic use, and the dredging scheme would be designed to avoid or minimize permanently affecting contributing features of the barge canal. Furthermore, the visual effect of temporary booster pumps and pipelines associated with hydraulic dredging on the canal would be evaluated pending final design.

Old Champlain Canal

Under the selected remedy, mechanical or hydraulic dredging may temporarily disturb portions of the 19^{th}-century Old Champlain Canal primarily in River Section 1, and small areas in River Section 2. Dredged areas would be backfilled, as appropriate. In addition, booster pumps and pipelines associated with hydraulic dredging may also result in a temporary visual effect to the canal by temporarily altering the historic setting, character and feeling of the resource. It is anticipated that contributing stone features, locks and dams would remain intact and not be affected by the dredging.

As described above, dredging has historically occurred within the canal route over time. Therefore, it is anticipated that the selected remedy would result in No Adverse Effect to the Old Champlain Canal because dredging is consistent with the historic use of the canal and the dredging scheme would be designed to avoid or minimize permanently affecting contributing features within the canal right-of-way. Furthermore, the visual effect of temporary booster pumps and pipelines associated with hydraulic dredging on the canal would be evaluated pending final design.

St. James Episcopal Church

Under the selected remedy, dredging would likely occur south of the church along Rogers Island and south of the church along the channel between Rogers Island and the east bank of the Hudson. No sediment removal would occur on the church property within the National Register boundary. If hydraulic dredging is used, booster pumps and pipelines may temporarily be located in the vicinity of the church, so hydraulic dredging may have a short-term visual effect on the church because temporary pipelines and booster pumps may be located near the church property. It is anticipated that the selected remedy would result in No Adverse Effect to the church because the temporary apparatus would not permanently alter the historic character and setting of the church.

Old Fort House

Under the selected remedy, dredging is expected to occur west of the Old Fort House along the channel between Rogers Island and the east bank of the Hudson. No excavations would occur on the house property. However, like St. James Church, temporary booster pumps and pipelines may be located in the vicinity of the house if hydraulic dredging is used. Therefore, hydraulic dredging may have a short-term visual effect on the house because pipelines and booster pumps may be located near it for a period of time. However, this action would result in No Adverse Effect to the house because the temporary apparatus would not permanently alter the historic character and setting of the Old Fort House.

Fort Miller Reformed Church

Under the selected remedy, dredging would occur south of the church, well removed from the property boundary. Sediments would be dredged directly north and south of the church. If hydraulic dredging is performed in this location, temporary booster pumps and pipelines may be installed near the church.

Dredging would have short-term, visual effects on the church since it would occur north and south of the building. Hydraulic dredging may also have an additional, temporary, short-term visual effect on the church because pipelines and booster pumps may be located near the church. However, these actions would result in No Adverse Effect because the dredging schemes would be designed to minimize effect to the historic character, setting and feeling of the church and not result in permanent alterations to the historic integrity of the church.

Saratoga National Historical Park

Under the selected remedy, navigational dredging would likely occur east of the southeast section of Saratoga National Historical Park. The dredging method will most likely be mechanical, subject to final plans. This action may result in a temporary visual effect on the park because it would occur along the Hudson, directly east of the park property. However, these actions would result in No Adverse Effect because navigational dredging would avoid direct contact with the park property.

7.2 Effects to Archaeological Resources

Research conducted at the NYSHPO identified 329 archaeological sites in the project APE (see Section 6). The National Register eligibility of these resources is not known and most, if not all, have not been evaluated. Furthermore, most of these sites are far-removed from the areas to be dredged and will therefore be unaffected by the selected remedy. However, given the inherent inaccuracies of available locational information for these sites, and the fact that site boundaries are often unknown, EPA has conservatively identified 14 of these sites as potentially being affected by the selected remedy. Available mapping indicates that these 14 sites are located within 150 feet of areas targeted for dredging and five of these sites (42, 43, 85, 185, and 212) extend to the river's edge or beyond (possibly into the river), although their exact location is not currently known. The table below, Archaeological Resources Near the Selected Remedy, provides a list of these sites and a summary of the limited information collected on them during the course of the present study. The site identifier provided in the first column is also shown on Figure C.6-1 and the archaeological site listing provided in Table C - 2, appended to this document.

Archaeological Resources Near the Selected Remedy

Site ID	NYSHPO Designation	Available Cultural Affiliation Information	County
37	A115-42-0003	Both prehistoric and historic	Washington
42	A091-13-0002	19th century historic	Saratoga
43	A115-06-0009	18th century historic	Washington
45	A115-06-0018	18th century historic	Washington
46	A115-06-0017	Early 20th century historic	Washington
47	A115-06-0016	Prehistoric	Washington
48	A115-06-0019	Late Archaic prehistoric	Washington
49	A115-06-0020	19th century historic	Washington
56	A115-08-000570	Archaic prehistoric and 19th century historic	Washington
57	A091-14-0021	19th century historic	Saratoga
85	A091-17-0009	Historic	Saratoga
185	7413	Traces of prehistoric occupation	Washington
211	7808	Prehistoric projectile points were recovered	Saratoga
212	6483	Traces of prehistoric occupation	Saratoga

Site ID numbers 185, 211, and 212 represent very large tracts of land surveyed in 1922 by former New York State Archaeologist Parker. Site ID number 185 extends south from the Fort Edward Dam to the Northumberland Dam. Site ID number 211 runs fom north of Stillwater to Mechanicville. Site ID number 212 extends from Stillwater to south of Mechanicville. Little information remains about these sites; however, the areas represent regions where traces of occupation were found scattered throughout.

If, during future identification and evaluation efforts, any of these sites are determined to extend into areas targeted for dredging or shoreline stabilization, and are determined to be National

Register eligible, the EPA may determine that the selected remedy poses a potentially adverse effect. EPA will try to avoid such effects during remedial design while maintaining the effectiveness of the remediation. If avoidance through redesign of the dredging process in those areas is not feasible, alternative appropriate mitigative strategies would be implemented.

7.3 Effects to Other Resources

The selected remedy may also result in effects to unmapped National Register-eligible resources; previously surveyed and unevaluated resources and yet-to-be-identified resources. Effects to these resources would be explored as a future step, as described in Section 8.

8.0 FUTURE STEPS

Section 106 of the NHPA requires federal agencies to take into consideration the effect of their actions upon cultural resources listed in or eligible for listing in the National Register of Historic Places, as discussed in Section 2 of this document. EPA has identified a number of previously surveyed cultural resources that are either National Register listed or have been previously determined to be National Register eligible within 2,000 feet of the banks of the Upper Hudson River, the APE. EPA also identified cultural resources within this area that have been previously identified but not yet evaluated for eligibility. In addition, through preliminary analysis of the project area, EPA has determined there is the high potential for additional cultural resources (both historic architectural resources and archaeological sites) to be present within the APE, both in the immediate vicinity of the proposed remediation area, and buried within the river sediments. These potential additional resources have not been either surveyed or evaluated. As discussed in Section 7, the selected remedy may affect a small number of these previously identified cultural resources and these additional potential resources.

The EPA's Section 106 compliance process will involve additional identification and evaluation efforts during the remedial design phase to determine the extent of potential effects to National Register listed or eligible resources. Once EPA has completed its identification and evaluation efforts, it will then determine if and to what extent National Register-listed or eligible resources will be adversely effected by the selected remedy and will identify appropriate methods to mitigate those effects. Mitigation, if necessary, could take place either during the remedial design phase or during the remedial action itself. The following discussion provides an overview of these efforts.

8.1 Identification and Evaluation Efforts

EPA will conduct both identification and evaluation efforts in areas that will be impacted by the selected remedy. EPA will also comply with substantive requirements of the NHPA in connection with the transfer facility siting process.

Archaeological Resources

The identification and evaluation of archaeological resources that may be affected by the selected remedy will proceed in stages. Initial steps will include visually assessing those portions of the Upper Hudson River that will be affected by the remedial action, examining previously identified sites in the area (Section 6), conducting interviews with local informants regarding past land use and evidence of archaeological resources, and collecting supplemental background data including past ground surface disturbances and landforms associated with previously identified sites. Collected information will be used to develop an archaeological sensitivity model for the remediation area.

Subsequent identification efforts may include archaeological subsurface testing along portions of the coastline determined to be sensitive and geoarchaeological soil borings within the river itself. Geoarchaeological soil borings would be conducted to gather radiocarbon samples and sedimentological data to assess, from a cultural resources perspective, the data already collected during the geophysical surveys discussed in Section 6. These subsequent identification efforts would be designed to determine the presence or absence of cultural resources in areas that will be affected by the selected remedy. The results of these efforts would be used to refine the archaeological sensitivity model discussed above.

If archaeological resources are identified in areas that will be affected by the selected remedy, EPA may conduct additional fieldwork to determine their horizontal and vertical extent, temporal affiliation, and degree of integrity in conjunction with a determination of their National Register eligibility.

Architectural Resources

A survey of individual buildings and structures in portions of the Hudson River PCBs Superfund Site APE will be conducted to identify and evaluate architectural resources that may be affected by the selected remedy. The building and structure survey will determine the exact location of previously surveyed National Register-eligible resources and previously surveyed, unevaluated resources featured in Table C-2.

In addition, this survey will identify National Register-eligible resources within the APE that have not been documented by the NYSHPO. The survey will be most intensive along River Section 1 in Moreau in Saratoga County and Fort Edward in Washington County. In River Section 2, additional intensive-level survey would occur in Northumberland in Saratoga County and Fort Miller in Washington County. In River Section 3, survey efforts would focus on Easton in Saratoga County, coastal Mechanicville and associated islands in Saratoga County, and coastal Waterford in Saratoga County.

Surveying would also occur in other areas of the Hudson River project APE that are identified through the transfer facility siting process.

Traditional Cultural Properties (TCPs)

Section 106 compliance may also involve investigation of the Upper Hudson River region as a potential location of National Register-eligible TCPs. This task would involve ethnographic research and local informant interviews to identify and evaluate whether the Upper Hudson River APE possesses National Register-eligible TCPs. If aspects of the Upper Hudson River are determined to be National Register-eligible TCPs, the effect of the selected remedy on the river would have be assessed according to 36 CFR Part 800.

8.2 Mitigation of Adverse Effects

Following the identification and evaluation of all National Register-eligible resources that will be affected by the selected remedy, an expanded criteria of effects analyses under 36 CFR Part 800 would be performed and measures would be developed to mitigate Adverse Effects. These measures would be developed in consultation with the NYSHPO, ACHP, and other consulting parties.

8.3 Coordination

EPA will coordinate and consult with local, state, and federal agencies, as well as other identified consulting parties during the Section 106 process. If adverse effects are identified, EPA will consult with the NYSHPO on ways to avoid or mitigate such effects, or discuss conditions under which a determination of no adverse effect could be made.

As described in Section 6, the Hudson River is a federally designated American Heritage River and engaged in the planning process to achieve, among other goals, historic and cultural preservation. Therefore, Section 106 consultation would likely include the designated River Navigator who facilitates the application of existing federal programs and resources to the needs of the river. The River Navigator may be aware of ongoing historic preservation efforts along the Upper Hudson River, and these efforts would be documented and assessed in subsequent Section 106 surveys.

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BIBLIOGRAPHY

Archival Materials

Bedient, Kathryn Demoss, Beth J. Feingold, Kirsten M. Menking, Jill S. Schneiderman, Warren D. Allmon, Peter Nester. Post-Glacial Environmental History of Hyde Park Mastodon Site, Duchess County, NY. A paper presented to the Geological Society of America Northeastern Section, 36th Annual Meeting, March 12-14, 2001. Burlington, Vermont. 2001.

Bick, Kenneth F. "Geology of the United States". Unpublished manuscript. On file at Department of Geology, College of William and Mary, Williamsburg, VA. 1993.

Brumback, Hetty Jo and Susan Bender. "Foraging, Fishing, and Farming (?) in the Upper Hudson River Valley: In the Land of the Mohican". A paper presented to the New York Natural History Conference VI, April 26-29, 2000. New York State Museum, Albany, NY.

Creemens, David L. and John P. Hart. "Current Topics in Northeast Geoarchaeology: Glaciated Landscapes". A paper presented to the New York Natural History Conference VI, April 26-29, 2000. New York State Museum, Albany, NY.

Cadwell, Donald H., Ernest H. Muller, and P. Jay Fleisher. "Geomorphic History of New York State". A paper presented to the New York Natural History Conference VI, April 26-29, 2000. New York State Museum, Albany.

Huey, Paul R. "Aspects of Continuity and Change in Colonial Dutch Material Culture at Fort Orange, 1624-1664". Unpublished Ph.D. dissertation. Philadelphia: University of Pennsylvania. 1988.

Knapp, Timothy D. "Variation in Upper Susquehanna Valley Early Late Woodland Subsistence and Settlement: A Comparison from the Chemung and Chenango Valleys of South Central New York." Paper presented to the New York Natural History Conference VI, April 26-29, 2000. New York State Museum, Albany, NY.

Lutins, Allen. "Prehistoric Fishweirs in Eastern North America." Unpublished M.A. thesis. Department of Anthropology. State University of New York at Binghamton. 1992.

Rush, Laurie W., Steve Ahr, James Rapant, Carol Caddy, Randy Amici, and Richard LeClerc. "Glacial Geology and Prehistoric Sensitivity Modeling, Fort Drum, New York." A paper presented to the New York Natural History Conference VI, April 26-29, 2000. New York State Museum, Albany.

Articles

Abel, Timothy J. and David N. Fuerst. "Prehistory of the St. Lawrence River Headwaters Region". *Archaeology of Eastern North America*. 27: 1-53. 1999.

Anderson, David G. and Michael K. Faught. "The Distribution of Fluted Paleoindian Projectile Points: Update 1998." *Archaeology of Eastern North America* 26: 163-87. 1998.

Anderson, David G. and J. Christopher Gillam. “Paleoindian Colonization of the Americas: Implications from an Examination of Physiography, Demography, and Artifact Distribution.” *American Antiquity.* 65, no. 1: 43-66. 2000.

Brown, James A. “The Archaeology of Ancient Religion in the Eastern Woodlands.” *Annual Review of Anthropology*. 26: 465-85. 1997.

Brumbach, Hetty Jo and Bender Susan J. “Winney's Rift: A Late Woodland Village Site in the Upper Hudson River Valley.” *Bulletin and Journal of Archaeology for New York State.* 92: 1-8. 1986.

Brumbach, Hetty Jo and Bender Susan J. “"Iroquoian" Ceramics in "Algonkian" Territory.” *Man in the Northeast*. 10: 17-28. 1975.

Brumbach, Hetty Jo and Bender Susan J. “Anadromous Fish and Fishing: A Synthesis of Data from the Hudson River Drainage.” *Man in the Northeast*. 32: 35-66. 1986.

Brumbach, Hetty Jo and Bender Susan J. “A Quarry/Workshop and Processing Station on the Hudson River in Pleasantdale, New York.” *Archaeology of Eastern North America*. 15: 59-83. 1987

Brumbach, Hetty Jo and Bender Susan J. “A Quarry/Workshop and Processing Station on the Hudson River in Pleasantdale, New York.” *Archaeology of Eastern North America*. 15: 59-83. 1987.

Carbone, Victor A. “Environment and Society in Archaic and Woodland Times.” *Practicing Environmental Archaeology: Methods and Interpretation*, pp.39-52. Edited by R.W. Moeller. Occasional Paper Number 3. Washington, CT: American Indian Archaeological Institute. 1982.

Cesarski, Ellen. “Archaeological Survey of the Becker Property, Rensselaer County, New York.” *Bulletin, Journal of the New York State Archaeological Association* 115: 17-25. 1999.

Cesarski, Ellen. “Prehistoric Land Use in the Hoosic River Drainage: An Analysis of Extant Collections from Two Glacial Lake Basins”. *A Golden Chronograph for Robert E. Funk*, pp. 85-97. Edited by C. Lindner and E.V. Curtin. Occasional Publications in Northeastern Anthropology. No. 15. 1996.

Chilton, Elizabeth S. “Archaeological Investigations at Goat Island Rockshelter: New Light from Old Legacies.” *Hudson Valley Regional Review* 9: 47-76. 1992.

Clark, Peter U. “The Last Interglacial-Glacial Transition in North America: Introduction.” *The Last Interglacial-Glacial Transition in North America*, pp. 1-12. Eds. P.U. Clark and P.D. Lea. Special Paper 270. Boulder, CO: Geological Society of America. 1992.

Diamond, Joseph E. “Terminal Late Woodland/Early Contact Period Settlement Patterns in the Mid-Hudson Valley.” *Journal of Middle Atlantic Archaeology*. 12: 95-111. 1996.

Dincauze, Dena F. “Paleoenvironmental Reconstructions in the Northeast: The Art of Multidisciplinary Science.” *Foundations of Northeast Archaeology*, pp. 51-96. Ed. D. Snow. New York: Academic Press. 1981.

Dineen, Robert J. “Postglacial Terrace Formation, Lateral River Migration, and Prehistoric Settlement Patterns.” *Archaeological Investigations in the Upper Susquehanna Valley, New York State.* Vol. 1. Ed. R.E. Funk, pp. 100-114. Buffalo, NY: Persimmon Press. 1992.

Eisenberg, Leonard. “A Preliminary Analysis of the Datum: A Multicomponent Site Near the Hudson River, Ulster County, New York.” *Man in the Northeast*. 24: 1-36. 1982.

Eisenberg, Leonard. “Paleo-Indian Settlement Pattern in the Hudson and Delaware River Drainages.” *Occasional Publications in Northeastern Anthropology*. No. 4. Rindge, NH: Dept. of Anthropology, Franklin Pierce College. 1978.

Eisenberg, Leonard. “Holocene Environments in the Hudson Valley.” *A Golden Chronograph for Robert E. Funk*, pp. 57-72. Ed. C. Lindner and E.V. Curtin. *Occasional Publications in Northeastern Anthropology,* No. 15. Bethlehem, CT: Archaeological Services. 1992.

Funk, Robert E. “Hudson Valley Prehistory: Current Status and Prospects.” *Canadian Ethnology Service* 39: 1-87. 1978.

Funk, Robert E. “The Tivoli Bays as a Middle-Scale Setting for Cultural-Ecological Research.” *Hudson Valley Regional Review* 9: 1-24. 1992.

Funk, Robert E. et al. “The Archaeology of Dutchess Quarry Cave, Orange County, New York.” *Pennsylvania Archaeologist*. 39, no. 1-4: 7-22. 1969.

Funk, Robert E. and Philip Jr. Lord. “Two Stratified Alluvial Sites in the Upper Hudson Valley.” *Pennsylvania Archaeologist*. 42, no. 1-2: 27-61. 1972.

Funk, Robert E. and Beth Wellman. “Evidence for Early Holocene Occupations in the Upper Susquehanna Valley, New York.” *Archaeology of Eastern North America*. 12: 81-109. 1984.

Goldthwait, Richard P. “Historical Overview of Early Wisconsin Glaciation.” *The Last Interglacial-Glacial Transition in North America,* pp. 13-18. Edited by P.U. Clark and P.D. Lea. Special Paper 270. Boulder, CO: Geological Society of America. 1992.

Hart, John P. “Maize, Matrilocality, Migration and Northern Iroquian Evolution.” *Journal of Archaeological Method and Theory*. Vol. 8, No. 2: 151-82. 2001.

Hart, John P. and Scarry C. Margaret. “The Age of Common Beans (*Phaseolus vulgaris*) in the Northeastern United States.” *American Antiquity.* 64, no. 4: 653-8. 1999.

Holland, John D., and Roger L. Ashton. “The Flately Brook Quarry: a Source of Normanskill Chert in Washington County, New York.” *Bulletin, Journal of the New York State Archaeological Association*. 115: 13-16. 1999.

Harris, Wendy and Arnold Pickman. Landscape, Landuse and the Iconography of Space in the Hudson River Valley: The Nineteenth and Early Twentieth Century. Paper presented at the New York Academy of Sciences. 1996.

Joyce, A.A. “Early/Middle Holocene Environments in the Middle Atlantic Region: A Revised Reconstruction”. *Holocene Human Ecology in Northeastern North America*, pp. 185-214. Ed. G. P. Nicholas. New York: Plenum Press. 1988.

Juet, Robert. “The Voyage of the Half Moon from April 4 to 7 November 1609.” New Jersey Historical Society, Newark. 1959.

Kuhn, Robert D. and Martha L. Sempowski. “A New Approach to Dating the League of the Iroquois.” *American Antiquity* 66, no. 2: 301-14. 2001.

Lavin, Lucianne et al. “The Goldkrest Site: An Undisturbed, Multi-component Woodland Site in the Heart of Mahican Territory. “ *Journal of Middle Atlantic Archaeology* 12: 113-29. 1996.

Levine, Mary Ann. “New Evidence for Postglacial Occupations in the Upper Hudson Valley.” *Bulletin, Journal of the New York State Archaeological Association* 98: 5-12. 1989.

Lindner, Christopher. “Hudson Valley Prehistory: Artifacts and Ecofacts.” *News From Hudsonia* 16, no. 1. 2001.

Meltzer, David J. “Late Pleistocene Human Adaptation in Eastern North America.” *Journal of World Prehistory* 2(1): 1-52. 1988.

Morrow, Juliet E. and Toby A Morrow. “Geographic Variation in Fluted Projectile Points: A Hemispheric Perspective.” *American Antiquity* 64, no. 2: 215-30. 1999.

Muller, Ernest H. “Quaternary Geology of New York.” The Quaternary of the United States: A Review Volume for the VII Congress of the International Association for Quaternary Research, pp. 99-112. Ed. by H.E. Wright, Jr. and D.G. Frey. Princeton, NJ: Princeton University Press. 1965.

The New York Archaeological Council. Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State. New York State Office of Parks, Recreation and Historic Preservation. 1994.

Oldale, R.N. and S.M. Colman. “On the Age of Penultimate Full Glaciation of New England.” In *The Last Interglacial-Glacial Transition in North America*, pp. 163-170. Edited by P.U. Clark and P.D. Lea. Special Paper 270. Boulder, CO: Geological Society of America. 1992.

Ritchie, William A. and Robert E. Funk. “Aboriginal Settlement Patterns in the Northeast.” *New York State Museum Memoir 20*. Albany, NY: State University of New York. 1973.

Roberts IV, William I., Nancy Stehling, Gerald Bigelow, et. al., and Greenhouse Consultants Inc., prep. The Stage IB/II Cultural Resource Report for the Fort Edward PCB Containment

Facility in Washington County, New York. Malcolm Pirnie Inc. and The New York State Dept. of Environmental Conservation.1986.

Salwen, Bert. "Post-glacial Environments and Cultural Change in the Hudson River Basin. *Man in the Northeast* 10: 43-70. 1975.

Schaper, Hans F. "Shell Middens in the Lower Hudson Valley." *Bulletin, Journal of the New York State Archaeological Association* 98: 13-24. 1989.

Schaper, Hans F. "Oysters and Settlement in the Lower Hudson Valley. *Bulletin, Journal of the New York State Archaeological Association* 106: 24-36. 1993.

Schaper, Hans F. "Prehistoric Fishing in the Lower Hudson Valley: In Search of Evidence." *Bulletin, Journal of the New York State Archaeological Association* 116: 12-24. 2000.

Schuldenrein, Joseph. "Prehistory and the Changing Holocene Geography of Dogan Point." *Dogan Point: A Shell Matrix Site in the Lower Hudson Valley*, pp. 39-63. Edited by C. Claassen. *Occasional Papers in Northeastern Anthropology*, 14. Bethlehem, CT: Archaeological Services. 1995.

Shallat. Todd. "Building Waterways, 1802-1861: Science and the United States Army in Early Public Works." *Technology and Culture* 31, No. 1. pp. 18-50. 1990.

Smith, Bruce D. "Prehistoric Plant Husbandry in Eastern North America." *The Origins of Agriculture, An International Perspective*, eds. C. W. Cowan and P. J. Watson, pp. 101-19. Washington, D.C.: Smithsonian Institution Press. 1992.

Snow, Dean R. "Migration in Prehistory: The Northern Iroquoian Case." *American Antiquity* 60: 59-79. 1995c.

Snow, Dean R. "Microchronology and Demographic Evidence Relating to the Size of Pre-Columbian North American Indian Populations." *Science* 268: 1601-1604. 1995d.

Warrick, Gary. "The Precontact Iroquoian Occupation of Southern Ontario." *Journal of World Prehistory*. 14: 415-66. 2000.

Waterman, Bethia. "Searching for Clues to Prehistoric Human Interaction with the Environment at Tivoli Bays." *Hudson Valley Regional Review* 9, No. 1: 77-92. 1992.

Weinman, Paul. L. and T. P. Weinman. "The Kings Road Site: A Recently Discovered Paleo-Indian Manifestation in Greene County, New York." *New York State Archaeological Association Bulletin* 45: 1-23. 1969.

Witthoft, John. "A Paleo-Indian Site in Eastern Pennsylvania: An Early Hunting Culture." *Proceedings of the American Philosophical Society* 96, No. 4: 464-95. 1952.

Books

Adams, Arthur G. *The Hudson River Through the Years*. New York: Fordham University Press. 1996.

Bascom, Robert O. The Fort Edward Book, Containing Some Historical Sketches, with Illustrations, and Family Records. Fort Edward, NY: J.D. Keating. 1903.

Bicentennial Committee of the Town of Kingsbury and the Village of Hudson Falls. *Warpaths, Wildcats and Waterfalls: A View of Early Times in the Village of Sandy Hill and the Township of Kingsbury*. Glens Falls, NY: Rist-Frost Associates. 1984.

Birkeland, Peter W. *Soils and Geomorphology*. New York: Oxford University Press. 1999.

Bliven, Bruce. *New York, a Bicentennial History*. New York: WW Norton & Co. for American Association for State and Local History, Nashville, TN. c 1981.

Bliven, Rachel D., et al. A Resourceful People: A Pictorial History of Rensselaer County, New York. Norfolk, VA: Donning Company. ca. 1987.

Boyle, Robert H. *The Hudson River; A Natural and Unnatural History*. New York: WW Norton; & Co. for George McLeod Limited, Toronto, Canada. 1969.

Bruce, Wallace. *The Hudson*. New York: Bryant Union. [c 1894?].

The City if Cohoes: Its Past and Present History, and Future Prospects, its Great Manufactories. Cohoes, NY. 1873.

Clark, Peter U. and Peter D. Lea, eds. *The Last Interglacial-Glacial Transition in North America*. Special Paper 270. Boulder, CO: Geological Society of America. 1992.

Cooper, John D., Richard H. Miller, and Jacqueline Patterson. *A Trip through Time: Principles of Historical Geology*. Columbus, OH: Merrill Publishing. 1990.

Dincauze, Dena F . *Environmental Archaeology: Principles and Practice*. New York: Cambridge University Press. 2000.

Eldridge, Paul. *Crown of Empire, The Story of New York State*. New York: T. Yoseloff. 1957.

Ellis, David Maldywn, et al. *A History of New York State*. Ithaca, New York: Cornell University Press. 1967.

Ellis, David Maldywn, et al. *New York State: Gateway to America*. Northridge, California: Windsor Publications. 1988.

Fisher, Donald W., Yngvar W. Isachsen, and Lawrence V. Rickard, eds. *Landforms and Bedrock Geology of New York State*. Baltimore: A. Hoen and Company, Inc. 1973

Fitch, Asa. *Their Own Voices: Oral Accounts of Early Settlers in Washington County, New York*. Ed. Winston Adler. Interlaken, NY: Heart if the Lakes Publishers. 1983.

Fort Edward Historical Association. *Guide to Historic Fort Edward*. 1930.

Funk, Robert E. *Recent Contributions to Hudson Valley Prehistory*. Memoir 22. Albany, NY: New York State Museum. 1976.

Funk, Robert E. Archaeological Investigations in the Upper Susquehanna Valley, New York State. Vol. 1. Buffalo, NY: Persimmon Press. 1993.

Funk, Robert E. *Recent Contributions to Hudson Valley Prehistory*. Albany, NY: State University of New York, State Education Department. 1976.

Funk, Robert E. Adaptation, Continuity and Change in Upper Susquehanna Prehistory. George's Mill, NH. 1977.

Greene, Nelson, ed. History of the Valley of the Hudson, River of Destiny, 1600-1930. 5 Vols. Chicago: S.J. Clarke. 1930.

Hill, William H. Old Fort Edward Before 1800; An Account of the Historic Ground Now Occupied by the Village of Fort Edward, New York. Fort Edward, NY: Privately printed, 1929.

Holliday, Vance T., ed. *Soils in Archaeology: Landscape Evolution and Human Occupation*. Washington, D.C.: Smithsonian Institution Press. 1992.

Isachsen, Y.W., E. Landing, J.M. Lauber, L.V. Rickard, W.B. Rogers eds. *Geology of New York: A Simplified Account*. Albany, NY: New York State Museum Geology Survey. 2000.

Kimball, Francis Paton. *The Capital Region of New York State, Crossroads of Rmpire*. Vol. 2. New York: Lewis Historical Publishing Company, Inc. 1942.

Manello, George, and Robert A. Davison. *Life in New York*. New York: Holt, Rinehart & Winston, 1962.

Maude, John. Visit to the Falls of Niagara in 1800. London. 1826.

McFee, Michele Ann. *A Long Haul: The Story of New York State Barge Canal*. Fleischmanns, NY: Purple Mountain Press, c 1998.

Miller, John A. Men and Volts at War; The Story of General Electric in World War II. New York: Whittlesey House, 1947.

Munsell, Joel. *The Annals of Albany*. Vol. II. Albany, NY: Munsell. 1870.

Mylod, John. *Biography of a River; The People and Legends of the Hudson Valley*. Ed. by Alec Thomas. New York: Hawthorn Books, 1969.

Nicholas, George P. Ed. Holocene Human Ecology in Northeastern North America. New York: Plenum Press. 1988.

Redway, Jacques W. *The Making of the Empire State.* New York: Silver, Burdett, 1904.

Ritchie, William A. *An Introduction to Hudson Valley Prehistory*. Science Service Bulletin 367. Albany, NY: New York State Museum. 1958.

Ritchie, William A. *The Archaeology of New York State.* Fleischmanns, NY: Purple Mountain Press. 1994.

Saratoga County Bicentennial Commission. *Enjoy Saratoga County: A Self Guiding Glimpse of History*. Ballston Spa, NY: Saratoga County Bicentennial Commission. 1974.

Sawyer, Willoughby. *Some Facts Concerning Our Local History*. Hudson Falls, NY: Swigert Press, ca. 1930.

Schumm, Stanley A. *The Fluvial System*. New York: John Wiley & Sons. 1977.

Snow, Dean R. *The Iroquois*. Oxford: Blackwell. 1994.

Snow, Dean R. *Mohawk Valley Archaeology: the Collections*. University Park, PA.: Matson Museum of Anthropology, Pennsylvania State University. 1995a.

Snow, Dean R. *Mohawk Valley Archaeology: the Sites*. University Park, PA: Matson Museum of Anthropology, Pennsylvania State University. 1995b.

Spann, Edward K. *The New Metropolis, New York City, 1840-1857*. New York: Columbia University Press. 1979.

Stanne, Stephen P., Roger G. Panetta and Brian E. Florist. *The Hudson: An Illustrated Guide to the Living River*. New Brunswick, NJ: Rutgers University Press. 1996.

Sullivan, James. *History of New York State, 1523-1927*. 6 Vols. Ed by James Sullivan; E. Melvin Williams, Edwin P. Conklin, Benedict Fitzpatrick. New York: Historical Publishing Company, c 1927.

Sylvester, Nathaniel Bartlett. *History of Rensselaer County, New York*. Philadelphia, PA: Everts & Peck, 1880.

Sylvester, Nathaniel Bartlett. History of Saratoga County, New York With Historical Notes on its Various Towns. Chicago: Gersham, 1893.

USEPA. 1997. Phase 2 Report, Further Site Characterization and Analysis. Volume 2C – Data Evaluation and Interpretation Report (DEIR), Hudson River PCBs Reassessment RI/FS. Prepared for USEPA Region 2 and USACE, Kansas City District by TAMS Consultants, Inc., The Cadmus Group, Inc. and Gradient Corporation. February.

USEPA. 1999. Phase 2 Report, Further Site Characterization and Analysis. Volume 2E- Baseline Ecological Risk Assessment, Hudson River PCBs Reassessment RI/FS. Prepared for USEPA Region 2 and the USACE, Kansas City District by TAMS/MCA. August.

VanDerwerker, Grace. *Early Days in Saratoga County.* Interlaken, NY: Empire State Books, 1994.

Van Diver, Bradford B. *Roadside Geology of New York.* Missoula, MT: Mountain Press Publishing Company. 1997.

Wachsmann, Shelley. The Sea of Galilee Boat, An Extraordinary 2000 Year Old Discovery. New York: Plenum Press. 1995.

Interviews

Kuhn, Robert, Assistant Director, New York State Historic Preservation Office, to Allison Rachleff and Michael Pappalardo of TAMS Consultants, Inc., August 7. 2001.

Maps

New York Auto Road Map: Chicago, IL: Rand McNally and Company. 1929.

Capital District Atlas: A Book of Detailed Road Maps for Albany, Rensselaer, Saratoga, and Schenectady Counties. 16th ed. Clifton Park, NY: Jimapco. ca. 1994.

Fullerton, David S.,ed. *Quaternary Map of the Hudson 4° x 6° Quadrangle, United States and Canada*. Map I-1420 (NK-18). Miscellaneous Investigation Series. Reston, VA: U.S. Geological Survey. 1992.

New York State Thruway. Albany, NY: Rand McNally and Company. 1968.

Talcott, R.H. Map of the Hudson River Between Troy and New Baltimore, Surveyed and Drawn in 1867-8 Under the Direction of Bvt. Major General John Newton. On file at US Army Corps of Engineers, Troy, NY.

Reports

Classen. (1996). Summary Geoarcheological Observations at the Goldkrest Site, CNG TL-470, East Greenbush, New York. Prepared for CNG Transmission Corporation, Clarksburg, West Virginia. 1996.

Clune & Johnson. *Cultural Resources Survey of Four Hudson River Hydroelectric Plants, New York*. 1980. Prepared for Niagara Mohawk Power Corporation, Syracuse, NY.

Curtin, Edward V. and Susan J. Bender. *A Prehistoric Context for the Upper Hudson Valley: Report of the Survey and Planning Project*. 1990. Prepared for New York State Office of Parks, Recreation, and Historic Preservation, Albany, NY.

General Electric Corporation. Comments of the General Electric Company on EPA's Hudson River PCB Feasibility Study and Proposed Remedial Action Plan. Vol. 3: Appendix C. April 17, 2001.

Harris, Wendy E. and Arnold Pickman. Cultural Resources Investigation, Hudson River Habitat Restoration Study, Mill Creek Marsh, Town of Stuyvesant, Columbia County, New York, Schodack-Houghtaling Island, Town of New Baltimore, Greene County, New York. 2000. Prepared for US Army Corps of Engineers, New York District, New York, New York.

Harris, Wendy and Arnold Pickman. Landscape, Landuse and the Iconography of Space in the Hudson River Valley: The Nineteenth and Early Twentieth Century. Paper presented at the New York Academy of Sciences. 1996.

Hay, Duncan. *Hydroelectric Development in the United States, 1880-1940*. 1987. Prepared for Edison Electric Institute, Washington, DC. On file at New York State Office of Parks, Recreation and Historic Preservation, Albany, NY.

Huey, Paul R. Historical and Archeological Resources of Castleton Island State Park, Towns of Stuyvesant, Columbia County, New Baltimore, Greene County, and Schodack, Rensselaer County, New York: A Preliminary Phase I Cultural Resources Assessment. 1997. Prepared for New York State Office of Parks, Recreation and Historic Preservation, Albany, NY.

Hughes, G.W. "Report of Colonel of Corps of Topographical Engineers Relative to the Examination and Survey of the Hudson River." *Annual Report of the Chief of Engineers, US Army*. 1844. On file at the US Army Corps of Engineers, New York District, Troy, NY.

National Park Service (NPS). National Register Bulletin: How to Apply the National Register Criteria for Evaluation. Washington, DC: US Department of the Interior. 1990.

New York Archaeological Council. Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State. New York State Office of Parks, Recreation and Historic Preservation. 1994.

New York Hudson River Commission. *The Hudson Report*. 1966.

Raber Associates. Final Report: Reconaissance Study of Historic Resources in the Champlain Canal Corridor, Albany, Saratoga, Washington and Warren Counties, New York. 1989. Prepared for New York State Office of Parks, Recreation and Historic Preservation, Albany, NY.

Raber Associates. *Preliminary Cultural Resources Assessment, New York State Barge Canal Study*. 1982. Prepared for US Army Corps of Engineers, New York District.

Roberts IV, William I., Nancy Stehling, Gerald Bigelow, et. al., and Greenhouse Consultants Inc., prep. The Stage IB/II Cultural Resource Report for the Fort Edward PCB Containment Facility in Washington County, New York. Malcolm Pirnie Inc. and The New York State Dept. of Environmental Conservation.1986.

US Army Corps of Engineers. *Improvement of the Hudson River*. Prepared by DeWitt Clinton for the War Department. Twenty-second Congress, First Session, Document No. 189. House of Representatives. On file at US Army Corps or Engineers, Troy, NY.

EPA. *Hudson River PCBs Reassessment RI/FS, Phase 3 Report: Feasibility Study*. December 2000. Prepared by TAMS Consultants Inc. for EPA Region 2 and US Army Corps of Engineers, Kansas City District.

Web Sites

Dinerstein, E., S. Buttrick, M. Davis, B. Eichbaum. "Atlantic Coastal Pine Barrens (NA0504)." In *Terrestrial Ecoregions of North America: A Conservation Assessment*. Edited by T.H. Ricketts and E. Dinerstein. Washington, DC: Island Press. 1999. Available at www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0504_full.html.

Harris, Wendy and Arnold Pickman. "Landscape, Landuse and the Iconography of Space in the Hudson River Valley: The Nineteenth and Early Twentieth Century. Paper presented at the New York Academy of Sciences, December 9, 1996. Available at http://members.aol.com/cragscons/acsci.html.

Moore, Alexandra and Andrew Maillet. (n.d.). Stratigraphy from Oneonta to the Hudson River. In *A Virtual Field Trip: Oneonta to the Hudson River*. Department of Geological and Environmental Sciences, Hartwick College, Oneonta, New York. Available at www.hartwick.edu/geology/work/VFT-so-far/VFT.html.

New York State Geological Survey. *Bedrock Geology of Albany County, New York*. New York State Museum, Albany. 1997. Available at www.albany.net/~go/newyorker/albany.html.

Olcott, Perry G. (1995). *Groundwater Atlas of the United States: Connecticut, Maine, Massachusetts, New York, Rhode Island, and Vermont*. Document HA-730 M. U.S. Department of Interior, U.S. Geological Survey, Reston, VA. Available at http://capp.water.usgs.gov/gwa/ch_m/M-text.html.

Ritchie, William A. *An Introduction to Hudson Valley Prehistory*. Bulletin 367. New York State Museum and Science Service, Albany. 1958.Available at www.ulster.net/~hrmm/tivolibays/ritchie/cruger.htm.

United States Fish and Wildlife Service. "Upper Hudson River Estuary Complex #33." *Significant Habitats and Habitat Complexes of the New York Bight Watershed*. Southern New England/New York Bight Coastal Ecosystems Program, Charlestown, Rhode Island. 1997. Available at http://training.fws.gov/library/pub5/web link/text/upp hud.htm.

United States Geological Survey. "Surface-Water Data for USA. Annual Peak Stream Flow for New York State at Site 03127750." U.S. Department of the Interior. 2001. Available at http://water.usgs.gov/nwis/peak/?site_no=01327750.

Woodworth, Jay Backus. *Ancient Water Levels of the Champlain and Hudson Valleys*. Bulletin 84, Geology 8 of the New York State Museum. New York State Education Department, Albany, New York. 1905. Available at www.columbia.edu/dlc/nysmb/mb84/mb84c063/b84p063t/html.

Vigil, Joseph, David G. Howell, Richard Pike, Eleanor Jewel, and Naomi Kalman. *A Tapestry of Time and Terrain: The Union of Two Maps – Geology and Topography*. Geologic Investigation Series I-2720. U.S. Department of Interior, U.S. Geological Survey, USGS Information Services, Denver. 2001. Available at http://tapestry.usgs.gov.