Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

Task 1: Literature Review and Data Search

Suffolk County Executive
Hon. Steven Bellone

Suffolk County Department of Economic Development and Planning
100 Veterans Memorial Highway
P.O. Box 6100
Hauppauge, NY 11788-0099

Joanne Minieri
Deputy County Executive and Commissioner

Division of Planning and Environment
Sarah Lansdale, AICP
Director

Prepared by:

Land Use Ecological Services, Inc.
570 Expressway Drive South, Ste. 2F
Medford, NY 11763
(T) 631-727-2400

H2M, Inc.
570 Broad Hollow Road
Melville, NY 11747
(T) 631-756-8000

Inter-Fluve, Inc.
301 S. Livingston Street, Suite 200
Madison, WI 53703
(T) 608-271-6355

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1 Introduction

This report provides an inventory of the available reports, information sources, and technical data pertinent to the restoration of aquatic habitats at Mud Creek County Park. The objectives of this report are to:

- Summarize the available technical data,
- Identify available data that can be used in the development and evaluation of restoration alternatives,
- Identify necessary data or information that must be obtained through field investigations.

2 Site History and Management Practices

The current conditions at Mud Creek County Park largely reflect duck farm management improvements implemented in the 1970s by Gallo Brothers in cooperation with the Suffolk County Soil and Water Conservation District. These practices were implemented to reduce the discharge of organic waste to Mud Creek by 1) minimizing duck access to the main stream channel, 2) providing capacity to store the farm's stormwater resulting from a 25-yr storm, and 3) treating duck waste through aeration, settling, and possibly chlorination (USACE, 2004). The 1977 Conservation Plan for the Gallo Brothers duck farm was obtained from Suffolk County Department of Economic Development and Planning and is shown in Figure 1.

Duck access to the main stream was minimized by 1) installing fences around duck feedlots and 2) creating duck swimwater areas that were largely separated from the main stream channel by earthen dikes. However, on the east side of Gazzola Drive, a duck swimwater area was maintained in the main stream channel and a portion of the stream's water was conveyed under Gazzola Drive by a 16" diameter steel pipe. On the west side of Gazzola Drive, the main stream channel now consists of three eutrophic ponds segmented by two earthen dikes with steel culverts to convey water through the dikes and, eventually, back into the Mud Creek at the southwestern corner of the former duck farm. On the west side of Gazzola Drive, two additional dikes were constructed parallel to the main stream channel on both the north and south sides. These dikes served to separate the duck swimwater areas from the main stream channel. The water for these duck swimwater areas was pumped from a groundwater supply well located on the east side of Gazzola Drive, then conveyed via concrete flumes and an 18" diameter steel pipe under Gazzola Drive and into the western swimwater areas. Water from the western swimwater areas was pumped into an aeration lagoon, where surface waters then spilled into a vertical drain, and then into three off-line settling pits before being discharged back into Mud Creek. Reports suggest the water in the settling pits may have been treated with chlorine prior to being discharged into Mud Creek, but this has not been confirmed (USACE, 2004).

The Gallo Brothers Conservation Plan provides a sufficient understanding of the altered hydrology of Mud Creek to identify potential duck waste deposition areas and to locate existing culverts and discharge pipes. The Conservation Plan indicates the locations of duck buildings, farm structures, and many feedlot fences, but the plan is not sufficient to locate all structures and debris that must be removed as part of site restoration. As described below, location and mapping of all structures, equipment, and debris within the site boundaries shall be included in the field research phase of the project (Tasks 4 and 7).

3 Site Conditions

3.1 Topography

Topographic data with sufficient horizontal and vertical accuracy to develop site and grading plans, stream channel restoration plans, cut and fill quantities, contract documents for construction and remediation work,

and proposed locations of nature trails and parking facilities do not exist for this site. We will complete a topographic survey that provides enough detail for designs, permitting, and construction and that shall include subsurface utility markouts, location of freshwater wetland boundaries, and site inventory features (as described below).

3.2 Existing Structures and Infrastructure

Nelson Pope and Voorhis (2007 and 2008) provide maps of under- and above-ground storage tank locations and a narrative inventory of existing structures, infrastructure, and debris. However, location maps identifying all existing structures, infrastructure, and debris suitable for the development of the demolition and clean-up plans necessary to ensure the creation of a safe, public park are not available for the study site. Therefore, the project team will identify and map the various structures and debris within the site boundaries and provide survey locations of existing structures and debris including, but not limited to, former duck house buildings, storage building and duck brooding houses, and a former duck processing structure (pickling house), a hay/feed storage barn, several pump houses, old trucks, boats, trailers, equipment, drums and containers, debris, and fences.

3.3 Utilities

The available reports do not provide sufficient information on the location of utility infrastructure including electric service lines, public water supply lines and private on-site water supply well, and stormwater catch basins, pipes, and outfalls on and adjacent to Mud Creek County Park. During the site topographical survey, sub-surface utility lines will be marked out and mapped.

Drainage plans for Gazzola Drive, Montauk Highway, and Patchogue-Yaphank Road shall be requested from the Town of Brookhaven Highway Department and/or Suffolk County Department of Public Works. If necessary, a Freedom of Information Law (FOIL) Request may be required to obtain this information. Suffolk County Department of Public Works is planning to construct a detention pond and bio-swale with rip-rap check dams to control stormwater discharge from Patchogue-Yaphank Road to the headwaters of the west branch of Mud Creek. This project is currently being reviewed by the NYSDEC for the issuance of a freshwater wetlands permit.

The existing water supply well will need to be officially closed and deemed 'abandoned' by the state. Abandoned wells will require a well completion report that references the registration number. We will review the existing maps and information for registered wells on file with NYSDEC in Stony Brook. If not registered, the well completion report will identify the well as unregistered. Additionally, for bidding purposes, the well depth will need to be determined during record search or through field investigations.

3.4 Historical, Cultural, and Archeological Resources

Little available information exists on the historical, cultural, and archeological resources of Mud Creek County Park. Nelson Pope and Voorhis (2007) indicated that the former Gallo duck farm property was located in a known archeological area. Mr. Richard Martin of the Suffolk County Department of Parks, Recreation, and Conservation has been contacted to assess the historical value of the existing structures at the former Gallo duck farm. New York State Office of Parks, Recreation, and Historic Preservation SPHINX database did not indicate any historical or cultural resources on the subject property. The New York State Office of Parks, Recreation, and Historic Preservation has been contacted in correspondence dated January 21, 2013 to provide confirmation of the presence or absence of significant historical, cultural, or archeological resources.

3.5 Freshwater Wetlands and Floodplains

Freshwater wetlands at Mud Creek County Park are regulated by the New York State Department of Environmental Conservation, under Article 15 (Protection of Waters) and Article 24 (Freshwater Wetlands) of the New York State Environmental Conservation Law, and by the United State Army Corps of Engineers, under Part 404 of the Clean Water Act. Accordingly, restoration activities at Mud Creek County Park will require environmental permits from both these regulatory agencies. The approximate location of the freshwater wetlands is shown on the New York State Freshwater Wetlands Map (Bellport Quadrangle) and the National Wetland Inventory maps (Figure 2). These maps do not have sufficient accuracy for the design of the restoration project or regulatory permitting. Therefore, a formal wetland delineation shall be conducted and the freshwater wetland boundary located with conventional survey methods. As shown in Figure 3, Mud Creek County Park is largely located in Flood Zone X, outside of the 500-year flood plain. Mud Creek and the immediate vicinity is located in Zone A indicating a 1% annual probability of flooding with no base flood elevation established.

3.6 Endangered, Threatened, or Rare Plants and Wildlife

Available information on Mud Creek County Park indicates no known records of endangered, threatened, or rare plants, wildlife, or ecological communities at or in the vicinity of Mud Creek County Park. A review of the New York State Environmental Resource Mapper (http://www.dec.ny.gov/imsmaps/ERM/viewer.htm) and its on-line database of endangered, threatened, and rare species indicated no historical or currents records of endangered, threatened, or rare natural resources. A written information request was submitted to the New York Natural Heritage Program (dated January 18, 2013) to provide formal confirmation of the absence of protected natural resources on the subject property.

3.7 Soils

The Suffolk County Soil Survey for Mud Creek County Park is provided in Figure 4 (obtained from the USDA-NRCS Web Soil Survey, websoilsurvey.nrcs.usda.gov). The County soil survey indicates that the freshwater wetlands in Mud Creek County Park are located on poorly drained, acidic, sandy soils belonging to the Atison (At) series. The soil survey characterizes the disturbed soils on the former Gallo Brothers duck farm as *Cut and Fill Land (CuC)*. The upland soils adjacent to Mud Creek are either sands belonging to the Carver and/or Plymouth (Cp) series or sandy loams belonging to the Riverhead (Rd) series. The County soil survey provides useful general guidance on the typical depth of organic matter, soil texture or grain size, and soil pH of native soils at the study site. The County soil survey does not provide sufficient data on the existing soil conditions on the subject property to guide the design of aquatic or terrestrial habitats. Therefore, soil investigations and testing will need to be conducted in potential wetland and upland restoration areas to determine if nutrient concentrations, pH, grain size, and % organic matter are adequate for the establishment of native wetland or upland communities. These investigations will need to sample soils to a depth of 2-4 feet depending on the depth of historical fill, grading, or ground disturbance. Deeper soil/sediment sampling may be necessary in swimwater areas or impounded waters where large accumulations of organic matter may be present.

3.8 Existing Development Outside of Project Area

Existing development and impacts outside of the County parklands, including stormwater discharge from adjacent roadways, ATV access, and sewage treatment plants (STPs), may have adverse effects on the

success of on-site restoration actions. Accordingly, available information on these potential impacts was reviewed.

Insufficient existing information is available on the stormwater infrastructure for Patchogue-Yaphank Road, Gazzola Drive, and Montauk Highway and the impacts of this infrastructure to Mud Creek. A FOIL request has been sent to the NYSDEC to obtain site plans and supporting information for "stormwater remediation" of Mud Creek at Patchogue-Yaphank Road. A NYSDEC permit was not issued for this project (NYSDEC Application ID# 1-4722-05798/00001). It is expected that these permit application materials will provide information of the existing stormwater infrastructure at the headwater of the west branch of Mud Creek. Due to the absence of survey information on the location and type of stormwater infrastructure impacting the east branch of Mud Creek, supplemental ground topographic data and mapping of existing drainage structures will be conducted during the field reconnaissance phase of the project along portions of Gazzola Drive and Montauk Highway which may discharge into the East Branch. The northern headwaters of the west branch of Mud Creek will be visually inspected for stormwater impacts. No additional surveying or location of existing drainage structures on Patchogue-Yaphank Road is expected to be necessary.

Illegal use of ATVs is a persistent management problem for public parklands in Suffolk County. No existing information is available on the existing use of ATVs at Mud Creek County Park. Accordingly, during mapping of the ecological communities, ATV access points and trails will be located so that the restoration design can attempt to minimize site access points. There is a dirt bike course located in the woodlands on SCTM# 200-975.71-1-1 (9.5 acre TDR Donation in Progress Lot). During mapping of the ecological communities, potential access points from this dirt bike course to potential restoration areas shall be identified.

The Patchogue Senior Apartments (i.e. Conifer Village) has a private sewage treatment plant that is located within 0.5 miles of the east branch of Mud Creek. This STP is authorized under NY SPDES Permit # NY 0253316, which regulates the allowed pH and nitrogen for the plant's discharge to groundwater. A FOIL request has been submitted to the NYSDEC requesting a copy of the site's SPDES permit so the potential contribution of nutrients to nearby groundwater can be evaluated during the design and evaluation of restoration alternatives.

4 Environmental Assessment

4.1 Environmental Site Assessments for Duck Farm Buildings and Feedlots

A Phase I Environmental Site Assessment (ESA) was prepared by Nelson Pope and Voorhis, LLC (Melville, NY) and dated December 20, 2007 (Nelson Pope and Voorhis, 2007). The Phase I ESA indicates that after the cessation of duck farming activities in the mid 1980s, the property was utilized as a trucking company storage yard and workshop and then abandoned in 1994. The Phase I provides a thorough inventory of the structures, features, and debris located at the former duck farm property including the following:

- A former duck house building. After the 1980s, the western portion of the building was utilized as a trucking company workshop. The single bay workshop contained a dirt floor. Ten, 5-gallon containers of hydraulic fluid, motor oil and waste oil were stored in the building. "Minor staining"

was observed on the dirt floor. A front-end loader was located on a concrete pad. Staining was observed on the concrete pad, underneath the front-end loader.

- A former brooding house
- A storage building
- A former duck house building. A street sweeper was located in this building and staining was observed beneath the street sweeper.
- Two houses
- A woodshop
- An office
- Former duck processing building (picking house) that was connected to an on-site sanitary system
- A hay / feed storage barn
- Two, 500-gallon gasoline underground storage tanks (UST)
- Three, 1,500-gallon fuel oil USTs
- One 550-gallon fuel oil UST
- Two, 250-gallon diesel fuel aboveground storage tanks (AST)
- One, empty 275-gallon AST (inside a former recharge / settling basin)
- One, 1,000-gallon storage tank (cut open)
- Five pole-mounted transformers
- A private water supply well with an electric pump at the ground surface.
- Compressor (located beneath a makeshift shelter)
- Steel storage bin and miscellaneous steel bins inside a former recharge/settling basin
- Several partially full 55-gallon drums and five, full 5-gallon pails
- Thirteen truck batteries
- Stained soils were observed west of the workshop
- A stockpile of soil and a stockpile of wood chips
- Several abandoned trucks, boats, trailers, and equipment
- An abandoned car
- Stockpile of debris and remnants of a house destroyed by a fire
- Several pump houses. The pump house in the southern portion of the site pumped water from the swimwater area to a recharge/settling basin where the wastewater was aerated. The water was then pumped into one of four recharge basins where chlorine was added.
- Two, 4-inch polyvinyl chloride (PVC) pipes to drain standing water downstream
- Remnants of three buildings of unspecified use.

Seven one- and two-story wood framed structures with interior walls and ceilings constructed of bare wood were located along with several collapsed or remnants of former structures. The floors consisted of “dirt” or wood. Building exteriors consisted of wood clapboard siding, wood shingles, plywood, or transite board. The roofs consisted of asphalt shingles and corrugated steel sheathing. The buildings were connected to on-site sanitary systems. The former duck processing building, the former brooding house, residence/house, and the two former duck houses were heated by oil-fired boilers. The oil-fired boiler in the former duck processing building was in poor condition. The condition of the remaining boilers was not observed.

Suspected asbestos-containing material (ACM) was not identified within the buildings during site inspection for the Phase I ESA. Solid waste generated at the subject property was containerized in dumpsters. No solvent or hazardous substance odors, floor drains, subsurface stormwater leaching pools, surface water, or groundwater monitoring wells were identified at the subject property during the Phase I ESA. The subject property was not identified in the federal, state and local databases regarding spills or environmental contamination.

The Phase I ESA (Nelson Pope and Voorhis, 2007) identified the following recognized environmental conditions (REC) at the site and recommended the following:

- The underground storage tanks should be registered with the Suffolk County Department of Health Services (SCDHS) and 1) removed in the presence of SCDHS personnel or 2) determine if the contents had leaked previously by sampling the soil surrounding the storage tanks and analyzing the samples for semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs).
- Report a spill to the New York State Department of Environmental Conservation (NYSDEC) based on the areas of staining observed at the Site.
- If the buildings are to be demolished, conduct an asbestos survey.
- The soil within the recharge / settling basins and the former duck houses should be sampled and analyzed for *Histoplasma capsulatum*.
- The soil from the stockpile should be sampled and analyzed for metals, SVOCs and VOCs.
- If no longer in use, abandon the on-site supply well.
- The ASTs, abandoned car, trucks and boats, truck batteries, drums, pails should be removed and properly disposed off-site. If staining is observed under the item removed, the soil should be tested or the stained soil should be removed and properly disposed off-site.
- The buildings in “deteriorated condition” should be razed and removed from the site.
- All cesspools and subsurface drywells should be located and backfilled.

Based on the findings and recommendations in Nelson Pope and Voorhis (2007), a Limited Phase II Environmental Site Assessment was conducted by Nelson Pope and Voorhis (dated May 12, 2008) to address the identified recognized environmental conditions (Nelson Pope and Voorhis, 2008). Important findings of this Limited Phase II ESA include the following:

Underground Storage Tank (UST) Investigations

An underground storage tank investigation was conducted for the USTs associated with the two duck processing houses, the USTs associated with the brooding house and processing house, and the two gasoline USTs. A remote sensing ground penetrating radar (GPR) survey was performed on portions of the site to determine the orientation of the USTs and the location of 3-4 soil probes around each UST. Discrete soil samples were collected from various depths up to 16 feet below ground surface around each UST. The total organic vapor concentration in each discrete sample headspace was analyzed with a portable Photo Ionization Detector (PID). Soil samples collected from around the fuel oil USTs were analyzed for SVOCs and VOCs. SVOCs were not detected at concentrations greater than the laboratory method detection limit (MDL). No SVOCs or VOCs were detected at a concentration greater than their respective soli clean-up objectives (SCOs) for Restricted-Residential Use (RRU) under NYSDEC 6 NYCRR Part 375. VOCs concentrations in soil from depths of 12 to 16 feet below ground surface surrounding the eastern gasoline storage tank were greater than their respective recommended soil cleanup objectives (RSCOs), in the

NYSDEC Technical and Administrative Guidance (TAGM) #4046, and their respective soil cleanup levels (SCL) for gasoline and fuel oil contaminated soils, as presented in the NYSDEC Commissioner Policy (CP)-15 / Soil Cleanup Guidance. It should be noted that the laboratory MDL for several VOCs were greater than their respective SCLs.

Shallow Soil and Stockpile Investigation

Surface soil samples were collected by hand auger from the dirt floors of the former duck housing buildings (total of five samples), from the former water retention basins (total of five samples) and from the soil stockpiles (total of four samples) at the site. Soil samples collected from the former duck house buildings and the former water retention basins were obtained from the upper six inches of the ground surface and soil samples collected from the stockpiles were obtained from the upper six inches to two feet of the stockpiles. Soil samples collected from the former duck house buildings and the former retention basins were analyzed for *Histoplasma capsulatum* (a bacterium commonly found in fowl fecal matter). Soil samples collected from the stockpiles were analyzed for metals, mercury, SVOCs, and VOCs.

Histoplasma capsulatum was not detected in the soil samples collected from the former duck house buildings and the former water retention basins. Metals were not detected at concentrations greater than their respective soil cleanup objectives (SCOs). SVOCs were detected at concentrations greater than their respective SCOs in stockpile samples collected from “the east central portion of the soil pile” and “the west central portion of the soil pile”.

Based on the analytical results, a spill was reported to the NYSDEC. For the purposes of this Environmental Document and Data Summary, the NYSDEC Online Spill Incidents Database was searched regarding the spill. Based on the online database details, a spill was reported to the NYSDEC on May 1, 2008 when an unknown amount of an unknown petroleum product was spilled, affecting the soil. NYSDEC assigned Spill Number 0801293 to the Site and closed the spill on January 5, 2009.

Based on the findings of the Phase II ESA, the following actions were recommended (Nelson Pope and Voorhis, 2008):

- The UST identified as GT-2 should be removed and all impacted soils should be excavated and disposed of at an appropriate facility.
- The USTs at the Site should be removed.
- The two soil stockpiles should be removed from the Site and disposed of at an appropriate facility.
- No further action (with regards to potential impacts from *Histoplasma capsulatum*) was recommended for the soil within the former duck house buildings and former water retention basins.

Based on the recommendations of Nelson Pope and Voorhis (2008), Fenley and Nicol removed approximately 55-gallons of tank liquid and sludge from two USTs at the Site using a vacuum truck and drum vacuum and excavated two, inactive, single wall, steel, 550-gallon gasoline USTs with a backhoe (Fenley and Nicol, 2008). These USTs (T-1 and T-2) were located in an open area near a former maintenance garage and generator building. UST removal was conducted in the presence of Mr. Walter Petrule of the SCDHS and Ms. Jennifer Pitkewicz of the NYSDEC on September 19, 2008. Soil confirmation samples were collected and analyzed and the surrounding soil was inspected for visual and olfactory evidence of impacts. The USTs, UST contents, and surrounding impacted soil were disposed of off-site at an approved waste disposal facility (Fenley and Nicol, 2008).

Confirmation soil sample analysis detected no VOCs or fuel oxygenates at concentrations greater than their respective SCOs or SSCLs for RRU "NYSDEC guidance values" and/or the laboratory MDL. Based on the findings, no further action was recommended with regards to the two USTs (Fenley and Nicol, 2008). This recommendation is confirmed by the closure of NYSDEC Spill Number 08-01293. In a letter from the NYSDEC to the Suffolk County Department of Public Works (SCDPW) dated January 9, 2009, the NYSDEC stated that the "necessary cleanup and removal actions" were completed and "no further remedial activities", as related to NYSDEC Spill Number 0801293.

It should be noted that the tank content disposal manifest was illegible and the UST disposal manifests were not available for review. Although a site plan was provided in Fenley and Nichol (2008), the location of the two USTs was indeterminable.

Based on the recommendations of Nelson Pope and Voorhis (2008), Fenley and Nicol (2009) removed the following:

- One, single wall, steel, 550-gallon, heating oil UST (SCDHS Tank ID 5) located on the east side of the slaughterhouse on the southern portion of the Site;
- One, single wall, steel, 275-gallon, heating oil AST (SCDHS Tank ID 6) located on the west side of a barn / maintenance building;
- One, single wall, steel, 550-gallon, heating oil UST (SCDHS Tank ID 7) located east of a foundation to the former duck building;
- One, single wall, steel, 1,000-gallon, heating oil UST (SCDHS Tank ID 8) located north of a foundation to the former duck building; and
- One, single wall, steel, 1,000-gallon, heating oil UST (SCDHS Tank ID 9) located on the north side of the former duck building.
- Approximately 765-gallons of tank liquid and sludge from the AST and USTs using a vacuum truck

These USTs and ASTs were removed between February 5 and 10, 2009, in the presence of Mr. Walter Petrule of the SCDHS. Based on a Fenley and Nicol Affidavit dated April 8, 2009, the AST and USTs were legally disposed.

Confirmation soil sample analytical results detected no SVOCs and VOCs concentrations greater than their respective SCOs or SSCLs for RRU and/or laboratory MDL. Based on these findings, Fenley and Nichol (2009) recommended no further action with regards to the AST and USTs. It should be noted that the Site Plan was illegible and the location of the storage tanks was indeterminable.

The information provided by Nelson Pope and Voorhis (2007 and 2008) and Fenley & Nicol (2008 and 2009) provides location of storage tanks, stockpiles, previous sample collection points and is largely sufficient for the project team to develop an investigation work plan for Mud Creek County Park. As noted, the site plans from the Fenley and Nicol reports were illegible and the location of the storage tanks was indeterminable; however, Nelson Pope and Voorhis (2008) provides locations for the six storage tanks. The investigation work plan shall include an asbestos survey of existing buildings and structures, surface and subsurface soil sampling, and inventorying and sampling of debris and drums/containers of unknown contents.

4.2 Hazardous, Toxic and Radioactive Waste Sampling for Sediments

Suffolk County Planning Department and United States Army Corps of Engineers (USACE) collected sub-surface soil and sediment samples from the former Gallo Duck Farm property between December 12 and 19, 2006. Sampling included nine sediment cores (to a depth of 4-6 feet below the ground surface), two sediment samples from the pond, and one surface composite grab from the settling basin. A location map of the sediment cores and samples is provided in Figure 5. Samples were analyzed for volatile organic compounds, semi-volatile organic compounds, pesticides, polychlorinated biphenyls (PCBs), priority pollutant metals, *Escherichia coli*, Kjeldahl nitrogen, total phosphorus, total organic carbon, and total solids. Environmental testing was performed by the USACE Fort Monmouth Environmental Laboratory. The findings of this sediment and soil sampling are presented in USACE (2009).

Elevated cadmium concentration (4.94 ppm) was observed in sediment at the upstream end of the large pond to the west of Gazzola Drive. This sediment would be considered Class B under NYSDEC Technical & Operational Guidance Series (TOGS) 5.1.9 and is considered to have chronic toxicity to aquatic life (NYSDEC, 2004). This sediment is not an adequate substrate for aquatic life and would need to be removed from any proposed aquatic habitats or capped with clean material. Elevated chromium concentrations (11.4 and 11.6 ppm) were observed in upland locations (Sites 6052702 and 6052706, respectively) on the east and west sides of Gazzola Drive. If excavated, these sediments should not be re-used in aquatic habitats.

This report indicates that no detectable levels of PCBs or pesticides were observed. However, the report did not indicate the minimum detection limits of the analytical tests. The specific pesticides tested for are not included in the report. The US ACE Fort Monmouth Laboratory will be contacted to attempt to obtain the original lab reports for these analyses.

The report indicates that 48 VOCs were tested for, but does not indicate which VOCs were tested for or the minimum detectable limits for the analytical tests. Therefore, it is not possible to determine if the sediments meet NYSDEC standards. The report indicates that elevated levels of acetone were observed. In the absence of industrial history consistent with the on-site use of acetone, it is typically assumed that the elevated acetone levels were introduced during the lab analysis of the sediment samples.

The report indicates that 70 SVOCs were tested for, but does not indicate which SVOCs were tested for or the minimum detectable limits for the analytical tests. Therefore, it is not possible to determine if the sediments meet NYSDEC standards. The report indicates that elevated levels of several phthalates were observed. The report indicated that these phthalates were introduced during sampling due to the use of plastic sampling gloves. The report indicated pyrene concentrations of 0.27 ppm, which would not restrict use or placement of these soils based on NYSDEC SCOs.

The available sediment testing data provides useful information on expected hazardous or toxic contaminants at Mud Creek County Park; however, the existing data will likely not be sufficient to obtain NYSDEC approval with respect to its freshwater wetlands and solid and hazardous materials regulations. The available sediment testing data is not adequate for obtaining NYSDEC approval for excavation aspects of site restoration as 1) available sediment sampling data will not likely correspond to proposed excavation areas, 2) available sediment sampling data does not provide contaminant concentrations for both sediments to be excavated/dredged and sediments that will be exposed as the new benthic substrate, and 3) the minimum detection limits of previous analyses may not have sufficient accuracy for comparison with NYSDEC standards.

Restoration of aquatic habitats on the former Gallo property will likely require substantial excavation and grading. Additional sediment sampling and testing will likely be required within the boundaries of proposed excavation/cut areas, particularly those excavation areas containing duck sludge or impacted by stormwater runoff. This testing will be necessary to determine 1) are existing sediments (or underlying sediments) suitable for establishment of healthy aquatic and benthic invertebrate communities, 2) can sediments be safely re-used or disposed of on-site, and 3) what is an appropriate disposal facility for any sediments that must be taken off-site. Additional sampling and testing will need to be conducted during the field data collection phase of the project and prior to evaluation of restoration alternatives and environmental permitting. It is prudent to conduct additional sediment testing prior to the design and evaluation of restoration alternatives, so that potential constraints imposed by contaminated sediments and their placement or disposal can be evaluated.

5 Freshwater Fisheries and Stream Channel Morphology

Mud Creek contains a heritage strain of brook trout (*Salvelinus fontinalis*)--a population that has sustained itself by natural reproduction and is not known to have been genetically altered by the introduction of stocked fish. The genetic makeup of this strain was analyzed in a 1985 statewide study aimed at identifying different strains of inland brook trout. The report summarizing those findings, (Perkins et al., 1985), recommended that the protection of the genetic diversity found among New York's heritage strain brook trout should be a high priority for all State fishery managers in order to maintain this substantial and irreplaceable portion of the total diversity within the species complex. Given the designation of the brook trout as New York's official state fish, and the unique status of the Mud Creek strain, a principal goal of the Mud Creek restoration project should be creating new habitat for brook trout at Mud Creek County Park and improving habitat quality in impaired reaches of the east branch.

The New York State Department of Environmental Conservation and its predecessors conducted stream surveys in Mud Creek in 1938, 1985, 1993, and 2001 (Kozlowski, 2001). These early surveys were for purposes other than quantifying the population such as genetic testing, transfer of fish to other streams, and display at an aquarium. These data collections showed presence and absence of brook trout and numbers caught, but not enough detail to make meaningful comparisons between years or between stream segments. In 2005, a quantitative survey was conducted by the USACE and NYSDEC with all fish species measured and weighed, and the surveyed stream distances recorded (USACE, 2005). These records show that Mud Creek brook trout have persisted through the 20th century and are still present today.

The 2005 USACE survey provides field data sheets, but limited analysis of data. These data sheets indicate that populations of brook trout, eastern mudminnow (*Umbra pygmaea*), and American eel (*Anguilla rostrata*) are larger in the west branch of Mud Creek compared to the east branch. With further analysis, the 2005 USACE fisheries survey data will be useful for comparisons between the two branches of Mud Creek, informing project design, and serving as a benchmark for long-term monitoring. Field notes from this fisheries survey present a good overall picture of the riparian corridor including generalized bottom types, floodplain description, vegetation types present, and invasive species. These descriptions indicate that the stream channel has been altered and is subject to other anthropogenic influences.

While the 2005 USACE fisheries survey noted stream bottom types in the surveyed reaches, no quantitative information is available to assess the condition of the channel. Therefore, fundamental habitat components, such as undercut banks, deep pools and snags, will need to be identified and quantified during the field data collection phase of the project.

Stream temperature measurements for both branches of Mud Creek are also sparse. Stream temperature is the primary physical factor that determines a stream's suitability to support brook trout. While the long-term presence of brook trout in Mud Creek is the most reliable test of suitability, long term stream temperature measurements throughout the study area will be useful to determine which stream segments serve as refugia during heat waves and where groundwater discharges to the stream channel. Brook trout build their nests (redds) in moving, well oxygenated water, often where groundwater upwelling occurs. Within-stream temperature gradients are important to determine which stream segments have the best potential to harbor cold water species and can serve as refuge during hot weather. Stream temperature profiles need to be developed using continuous reading data loggers to aid in the restoration design. Temperature differences along the channel profile can reveal points of groundwater discharge. It is recommended that 10 temperature sensors are deployed as soon as possible to develop a long-term record of stream temperature in both branches of Mud Creek. Sensors will need to remain in place for at least one season of hot temperatures subsequent to construction to ensure that the project's impact on water temperatures is monitored. In addition to the continuous recording sensors, a survey of sub-bed temperatures is needed in the east branch to help identify groundwater discharge points.

Stream geomorphic measurements have not been taken on any reaches of Mud Creek. These measurements are essential to designing stable, long-lasting and healthy stream channels. In addition, no hydrology data is available to determine flow frequencies. Due to this lack of quantitative and reproducible data for Mud Creek, measuring success of the stream restoration would be difficult, if not inconclusive, without gathering additional information. While the 2005 USACE study can provide some useful and reliable statistics (fish biomass, catch per unit effort, length frequency), it will not be a very good indicator of pre-project conditions due to the amount of time that has passed since the survey.

A quantitative fish habitat assessment is recommended as the primary monitoring tool for stream health in Mud Creek. Physical conditions measured in habitat assessments do not change substantially from year to year whereas biological measurements are subject to many variables such as weather, reproductive success, angler harvest, and predation. This approach does not require specialized equipment, so it is less costly than fish sampling and allows investigators to assess more sites. It is recommended that fish habitat assessments are implemented in both the east and west branch (control) of Mud Creek and before and after restoration in the east branch. Fish habitat assessment should evaluate habitat suitability for both brook trout and American eel. Stream walks during the autumn should also be conducted to identify brook trout spawning sites.

It is also recommended that fisheries surveys be conducted in both the east and west branch (control) of Mud Creek and before and after restoration in the east branch. While the 2005 USACE study provides valuable information, physical conditions and populations may have changed since this study was completed. Therefore, we recommend that a replicate of the 2005 fishery survey be included in the project work plan to provide up-to-date information.

Due to the absence of hydrological data on Mud Creek, contemporary hydrologic models will be employed to determine flow frequency of both branches of Mud Creek. Data generated by these models are needed to calculate water levels during varying flow conditions and will, in turn, lead to the channel design. Watershed characteristics that go into flow frequency calculations include geology, size, slope, extent of development and soil properties. These factors are combined with precipitation records to calculate 1, 2, 5, 10, 25, 50, and 100-year flow frequencies. Another method is gauge transfer that uses flow frequency data from a similar gaged watershed and applies that data to the project site based on the drainage area.

Family level macroinvertebrate sampling and analysis in both branches of Mud Creek is needed to assess water quality trends through the project's lifetime. Sampling methods could include kick samples if riffle substrate is present and dip nets or artificial substrate samplers, such as Hester-Dendy sampler, if organic or soft substrates are present. It is recommended that macroinvertebrate sampling is implemented in both the east and west branch (control) of Mud Creek and before and after restoration in the east branch.

Stream geomorphic measurements are critical to the design of a stable channel that can carry its sediment load without aggrading or degrading and be resilient enough to adjust to variations in hydrologic conditions. No existing data on stream and floodplain geomorphology is available; therefore, the field research phase of this project shall include data collection on the following geomorphic parameters:

- Location of existing stream channel and any side channels
- Water surface and streambed profiles and cross sections for development of the hydraulic model
- Channel profiles and cross sections for reference stream reaches
- Flow measurements on main stream channel
- Pebble counts or, in the absence of coarse material, maps of sediment types on the channel bed
- Qualitative observations of channel bedforms, bank heights, deposition or incision features, flood elevations, and locations of groundwater upwelling
- Topographic survey of all relic and contemporary hydraulic control structures such as berms, culverts, sluiceways, ditches, and pipe networks, etc.
- Existing stormwater input locations
- Soil cores across the stream's floodplain to establish where the pre-disturbance channel was located, to determine limits of fill and if removal of fill is feasible, and to evaluate whether post-settlement alluvium (legacy sediment) is present and if it is impacting floodplain health
- An evaluation of culverts for hydraulic constraints and fish passage

6 Natural Resources

Some qualitative information is available on the existing plant communities and natural resources of Mud Creek County Park. Aerial imagery from 1928, 1938, 1947, 1957, 1966, 1976, 1980, and 1994 from Suffolk County Planning and Nelson Pope and Voorhis (2007) provides useful information on the land use history on and adjacent to Mud Creek County Park and approximate dates of forest stand initiation. In addition, field notes from the USACE 2005 fisheries survey (USACE, 2005) indicate that the east branch of Mud Creek downstream of the former duck farm property had no aquatic vegetation and the adjacent stream banks were vegetated by sweet pepperbush (*Clethra alnifolia*), porcelianberry (*Ampelopsis brevipedunculata*), red maple (*Acer rubrum*), and pitch pine (*Pinus rigida*). The west branch of Mud Creek had aquatic vegetation consisting of smartweed (*Polygonum sp.*), starwort (*Callitriche sp.*), and duckweed (*Lemna sp.*). The tree canopy above the west branch was dominated by red maple, black gum (*Nyssa sylvatica*), and pitch pine. The west branch's shrub layer was diverse consisting of sweet pepperbush, elderberry (*Sambucus canadensis*), red chokeberry (*Photinia pyrifolia*), swamp azalea (*Rhododendron viscosum*), fetterbush (*Lyonia lucida*), sheep laurel (*Kalmia angustifolia*), greenbriar (*Smilax rotundifolia*), and highbush blueberry (*Vaccinum corybosum*). Herbaceous plants in the freshwater wetlands of the west branch included cinnamon fern (*Osmunda cinnamomea*), jewelweed (*Impatiens capensis*), Massachuesetts fern (*Thelypteri simulata*), beggars tick (*Bidens tripartita*), sensitive fern (*Onoclea sensibilis*), and sphagnum moss (*Sphagnum sp.*).

These cursory field notes do not provide sufficient data quality to develop wetland and stream restoration plans that ensure continuity with natural conditions. Field data necessary for the evaluation of restoration alternatives and development of final restoration designs shall include the following:

- Mapping of existing ecological community types within focus area according to Edinger et al (2002). The boundaries of identified ecological communities shall be mapped using sub-meter accuracy, handheld GPS receivers.
- Location and mapping of trees and shrubs on former Gallo property. All trees (greater than 3" in caliper) and stands of shrubs, including both native and invasive species, shall be identified and located. During conceptual and final plan development, determinations will be made regarding which trees/shrubs will be preserved and which trees/shrubs will be removed.
- Vegetation inventory and analysis of riparian, wetland, and upland habitats in the West Branch of Mud Creek and upstream of the East Branch of Mud Creek:
    - Riparian and upland habitat on the west branch of Mud Creek and upstream reaches of the east branch shall be used as reference sites for the proposed restoration site. Approximately ten reference locations shall be established along the west branch, the lower east branch (downstream of the former Gallo property), and the upper east branch (upstream of the former Gallo property). Vegetation data collected at these reference sites shall include plant inventory data and measures of relative abundance of plant species.
- Location and mapping of existing stands of invasive plants.
- Rhizome depth of existing *Phragmites* stands to evaluate potential efficacy of *Phragmites* removal methods.
- Identification of areas with existing coverage of native and invasive herbaceous plant cover and without significant existing native trees suitable for establishment of grassland areas.

7 Surface Waters and Groundwater

7.1 Surface Water Quality

Long-term water quality monitoring data is available for the lower reaches of Mud Creek (just south of Montauk Highway and at the downstream end of Robinson Pond) from 1970 to the present. Only limited water quality data is available from the former Gallo duck farm property; this data was collected in 2006 by the Suffolk County Department of Health Services. The results of these water monitoring projects are provided in Suffolk County Department of Health Services (2008). The Suffolk County Department of Health Services (2008) report was prepared at the request of the Suffolk County Planning Department to assess water quality of streams formerly impacted by duck farms in the Peconic and South Shore estuaries. This report (Suffolk County Department of Health Services, 2008), provides data regarding nitrogen (total nitrogen, total inorganic nitrogen, ammonia, nitrate/nitrite), phosphorus (ortho-phosphate), coliform bacteria (total and fecal coliform), and dissolved oxygen concentrations. Data was collected by the Suffolk County Department of Health Services- Office of Water Resources between 1970 and 1999 and the Suffolk County Department of Health Services- Office of Ecology between 1976 and 2006. Mr. Michael Jensen of the Office of Ecology indicated that no further water quality monitoring of Mud Creek has been conducted by the Office of Ecology since 2006. Mr. Andrew Rapeijko of the Office of Water Resources has indicated that additional surface water quality monitoring of the locations downstream of Montauk Highway was conducted in 2010. This data will be sent to the project team for review.

Guidance documents published by the USEPA provide ambient water quality recommendations for rivers and streams. The USEPA has recommended that total phosphorus concentrations below 0.10 mg/L and total nitrogen concentrations below 0.38 mg/L be maintained to avoid the adverse effects of eutrophication (US EPA, 2001).

New York State has narrative water quality standards for nitrogen and phosphorus indicating that the maximum limits are "none in amounts that will result in growths of algae, weeds, and slimes that will impair the waters for their best usages" (NYSDEC, 2008). The NYSDEC has also provided a water quality guidance value of 20 µg/L (or .02 mg/L) for phosphorus (total phosphorus) for class AA, A, and B surface waters (NYSDEC, 2011a). NYSDEC has an existing water quality guidance value of 10 mg/L for nitrate-nitrogen for groundwater and Class A surface waters and "none that will result in growths of algae, weeds, and slime that will impair use" for Class B, C, and D waters. Mud Creek is classified as a Class C(TS) surface water upstream of Robinson Pond. This designation indicates that the surface waters of Mud Creek support fisheries, are suitable for non-contact recreation, and support trout spawning (NYSDEC, 2011b). The NYSDEC Atlantic Ocean/Long Island Sound Basin Waterbody Inventory and Priority Waterbodies List (NYSDEC, 2011b) indicates that aquatic life in Mud Creek is stressed due to nutrient pollution and low dissolved oxygen due to urban stormwater runoff.

Dissolved ortho-phosphate concentrations at the downstream end of the pond on the former Gallo duck farm property (Sampling Location #4) averaged 0.35 mg/L in 2006. Dissolved ortho-phosphate concentrations upstream of Gazzola Drive (Sampling Location #5) were reported as "< 0.20 mg/L" in 2006. The locations of these water sampling locations are shown in Figure 6. The water quality data from upstream of Gazzola Drive cannot be reliably interpreted, as specific numeric nutrient concentrations were not presented in Suffolk County Department of Health Services (2008). However, ortho-phosphate concentrations from the pond on the former Gallo farm are indicative of highly eutrophic conditions. Nitrate/nitrite concentrations at the downstream end of the pond on the Gallo farm property and upstream of Gazzola Drive (Sampling Locations #4 and #5) averaged 0.27-0.42 mg/L, exceeding the NYSDEC for Class A surface waters. Total nitrogen concentrations were 0.40-0.86 mg/L exceeding US EPA recommendations and indicating that eutrophic conditions are present in the surface waters on the former Gallo property. Surface water dissolved oxygen concentrations ranged between 0.4 and 7.2 mg/L with average values of 2.7 mg/L and 3.7 mg/L at Sampling Locations #4 and #5, respectively. These dissolved oxygen values are well below the NYSDEC standard of 5.0 mg/L. In summary, the nutrient and dissolved oxygen concentrations observed in the surface waters of the east branch of Mud Creek are consistent with substantial impairment by historic duck farming activities and eutrophic conditions in the site's existing surface waters. The limited water quality data available for the former Gallo duck farm property and Mud Creek County Park are not suitable for baseline monitoring. Our project team does not intend to monitor nutrient and dissolved oxygen concentrations in restored reaches of the east branch of Mud Creek and, instead, shall focus on monitoring of macroinvertebrate assemblages and fish habitat assessments as more reliable and integrated predictors of habitat quality.

Despite a general decline in total and fecal coliform concentration in Mud Creek between the 1970s and 1990s (Suffolk County Department of Health Services, 2008), more recent sampling in 2006 indicated elevated coliform levels in Mud Creek (2,400 to 16,000/ 100 ml), particularly after rain events. The New York State Standard for total and fecal coliform concentration in surface waters is 100/ 100 ml). Suffolk County concluded that these results indicate stormwater discharge into both the east and west branches of Mud Creek. Due to the limited number of samples collected (7 samples in 24 years), this data is not suitable for baseline monitoring. Our project team does not intend to monitor coliform concentrations in restored reaches of the east branch of Mud Creek and, instead, shall prescribe and/or recommended management practices to minimize the potential for stormwater flows to the stream.

7. 2 Groundwater

Limited data on groundwater elevations exists for the former Gallo Brothers duck farm or Mud Creek County Park. According to Long Island groundwater contour maps (USGS, 2002), the elevation of groundwater in the vicinity of the project site is 5-20 feet above mean sea level, depending on meteorological conditions and water table variability, and the depth to groundwater on the subject property is approximately 0 to 17 feet (Nelson Pope and Voorhis, 2007). These contour maps were based on groundwater data collected from wells within 0.5-1.2 miles of the subject site (Nelson Pope and Voorhis, 2007). Mr. Andrew Rapeijko of the Suffolk County Department Health Services indicated that Suffolk County maintained a groundwater level monitoring well at Brookhaven Hospital (0.5 miles from Mud Creek) with sporadic measurements between the 1970s and 1986. A USGS groundwater monitoring well (ID # S47752.1) is located 1.2 miles west of Mud Creek near Phyllis Drive and has approximately 75 groundwater level measurements between 1974 and 2011. The limited available groundwater elevation data from Suffolk County and USGS will be reviewed. However, it is likely that this data is insufficient and, accordingly, piezometers will need to be installed on site to support the design and restoration of aquatic habitats.

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Figure 1. GALLO BROTHERS DUCK FARM CONSERVATION PLAN (1977)

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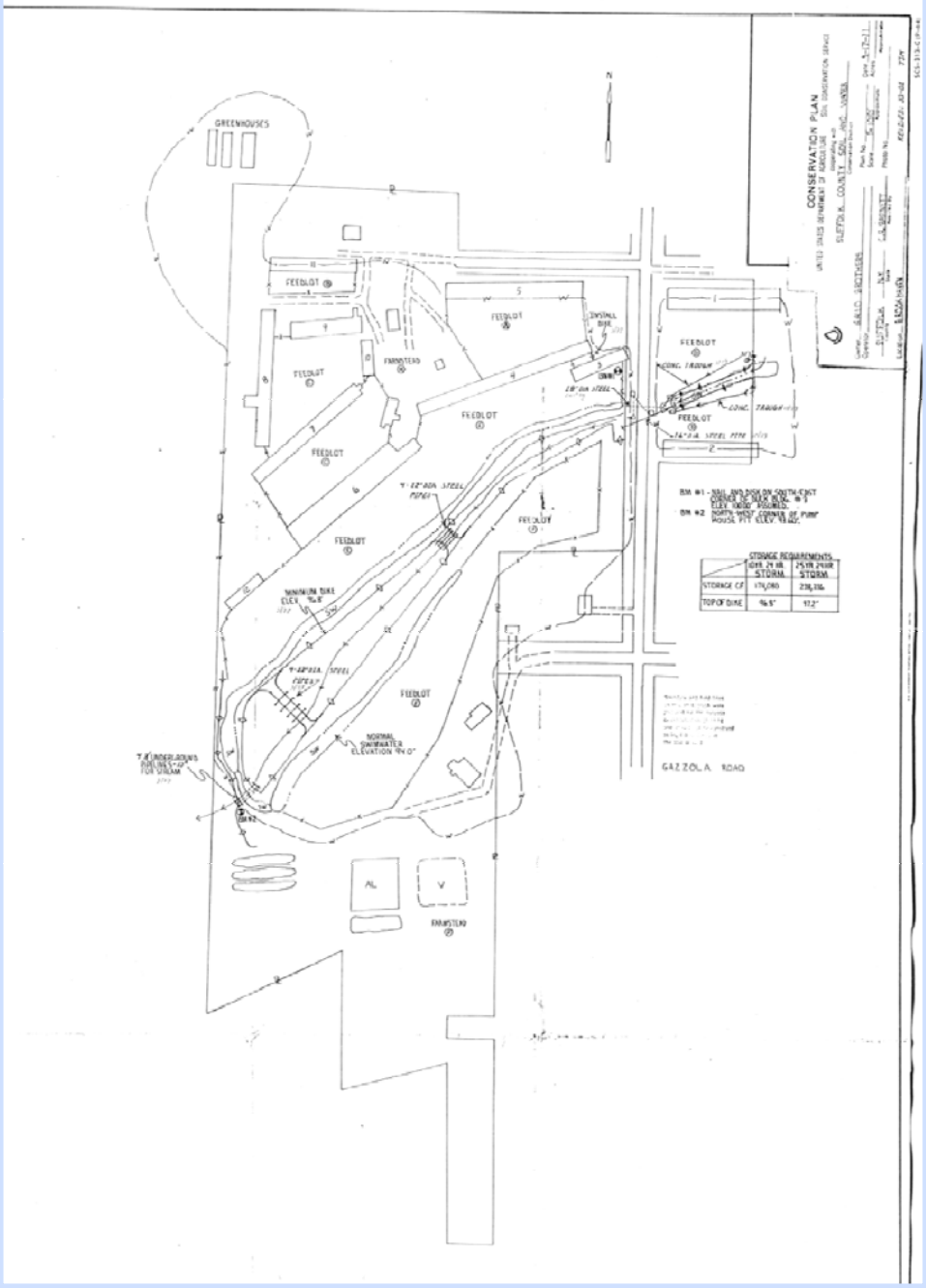


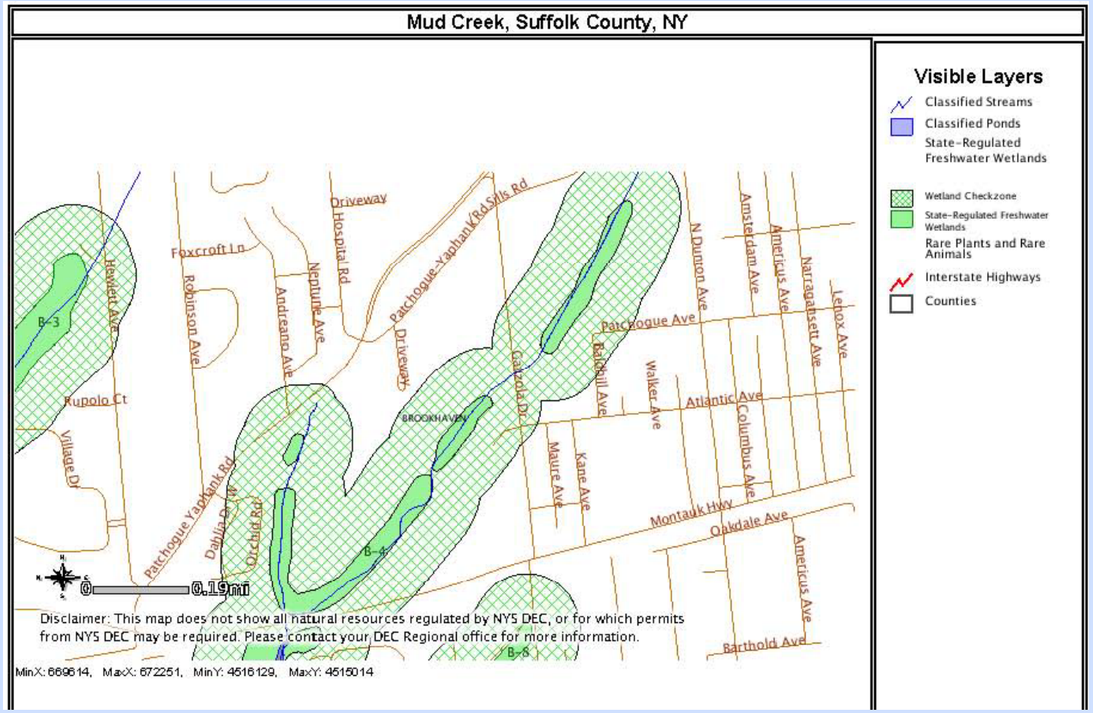
NOTES:

1. This publication is funded by the County of Suffolk under CP# 8710.110 .
2. United States Department of Agriculture- Soil Conservation Services (1977), Suffolk County Department of Economic Development and Planning

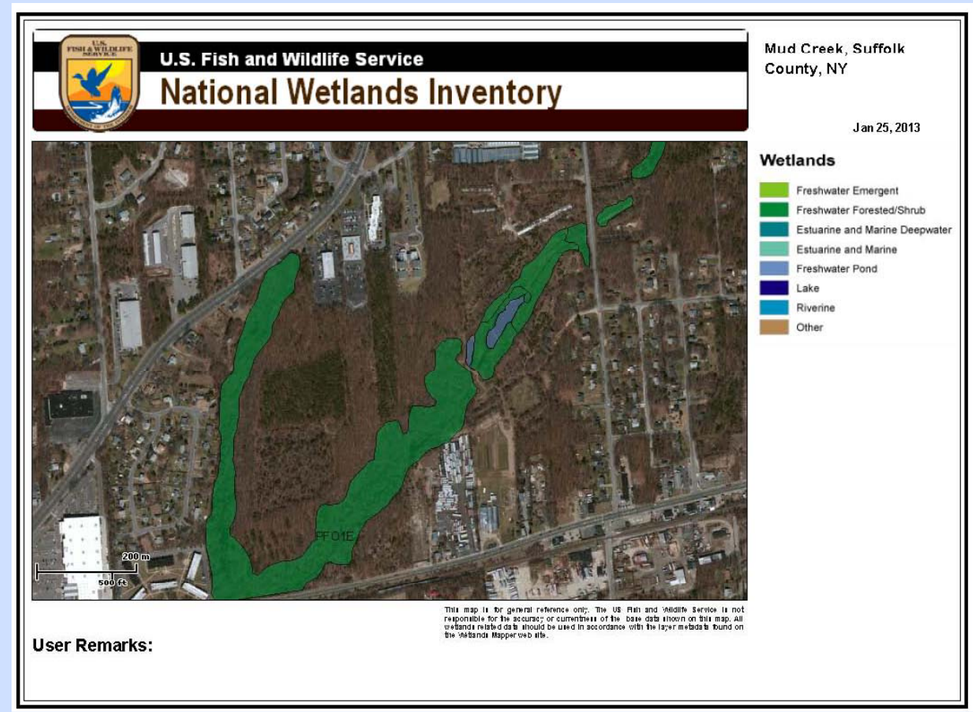
Figure 2. NEW YORK STATE FRESHWATER WETLAND MAP AND NATIONAL WETLAND INVENTORY MAP

Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

NEW YORK STATE FRESHWATER WETLAND MAP



NATIONAL WETLAND INVENTORY MAP



NOTES:

1. This publication is funded by the County of Suffolk under CP #8710.110.
2. NYS Freshwater Wetland Map obtained from online Environmental Resource Mapper (http://www.dec.ny.gov/imsmaps/ERM/viewer.htm).
3. National Wetland Inventory Map obtained from online Wetlands Mapper (http://www.fws.gov/wetlands/Data/Mapper.html).

Figure 3. FEMA Flood Insurance Rate Map Designations

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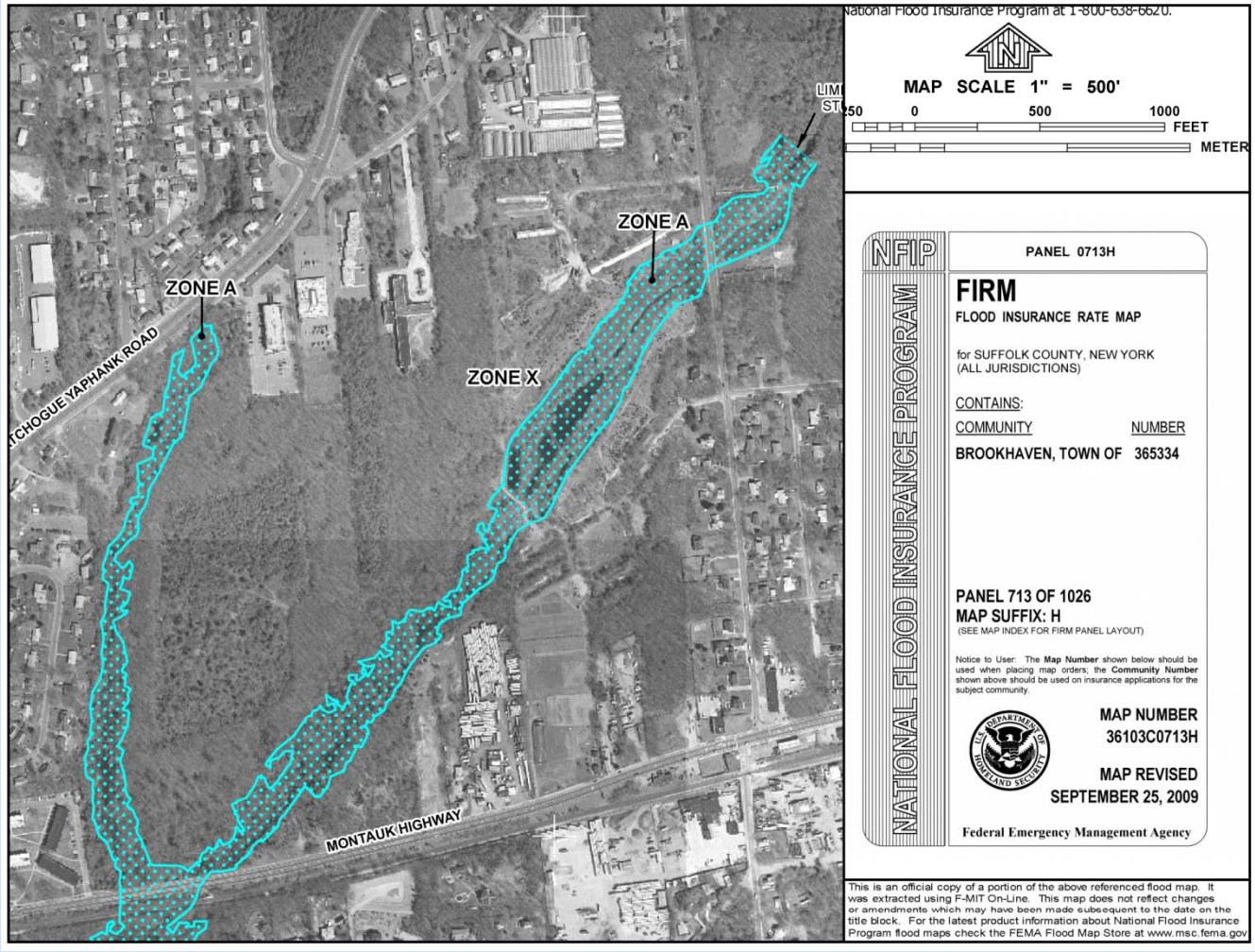

NOTES:

1. This publication is funded by the County of Suffolk under CP #8710.110.
2. FIRM obtained from FEMA Map Service Center (https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1)

Figure 4. SOIL MAP FOR MUD CREEK COUNTY PARK

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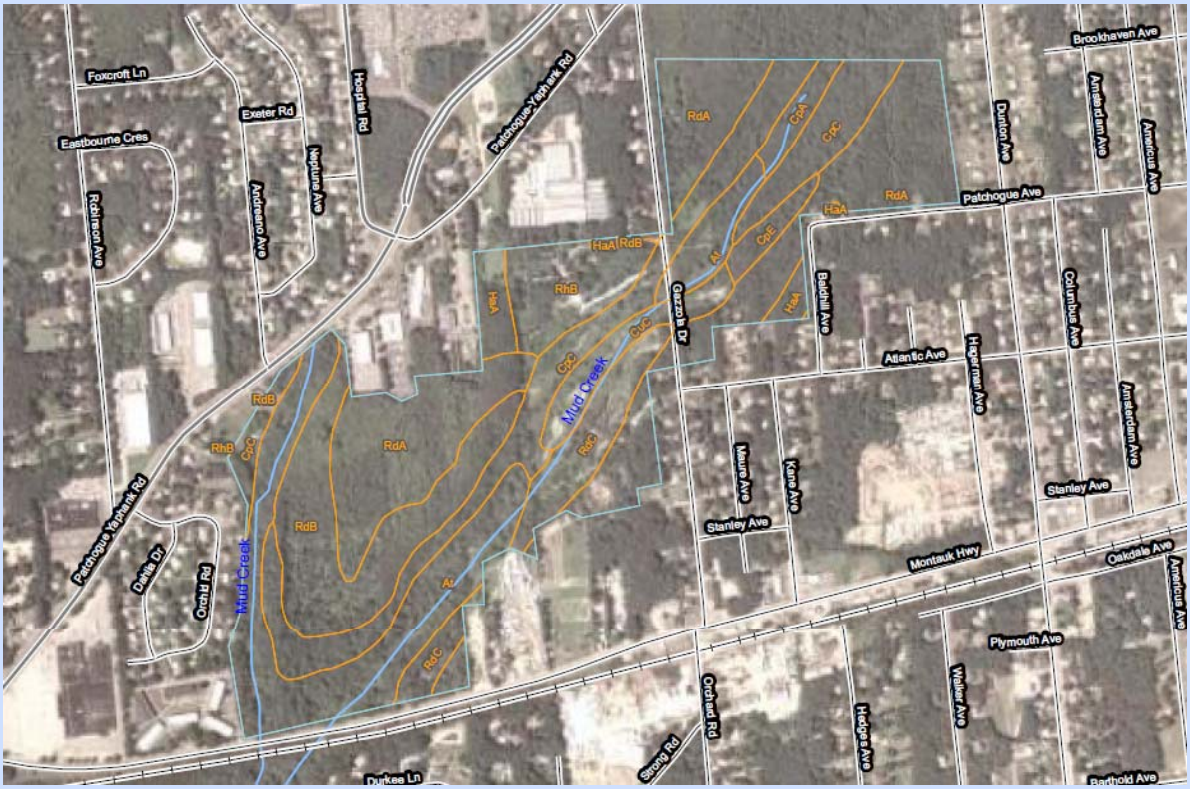

NOTES:

1. This publication is by the County of Suffolk under CP #8710.110 .
2. US Department of Agriculture- Soil Conservation Services (Web Soil Survey)
   Soil Survey of Suffolk County, New York (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx)

Figure 5. LOCATIONS OF PREVIOUS SEDIMENT INVESTIGATIONS

Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

NOTES:
1. This publication is funded by the County of Suffolk under CP #8710.110.
2. US Army Corps of Engineers (2009). Long Island Duck Farm History and Ecosystem Restoration Opportunities- Appendix C.

Figure 6. LOCATIONS OF PREVIOUS SURFACE WATER QUALITY MONITORING FOR MUD CREEK

Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

NOTES:

1. This publication is funded by the County of Suffolk under CP #8710.110.
2. Suffolk County Department of Health Services (2008) - Water Quality Trends at Selected Streams Impacted by Duck Farm Operations (Figure 17)