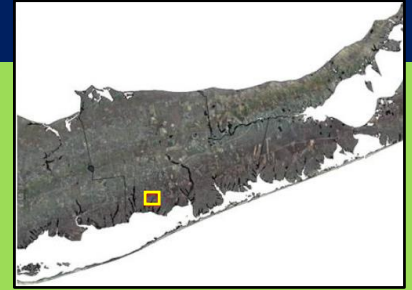




# Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

**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



Prepared for:



## Executive Summary

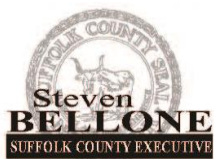
March 31, 2016

Prepared by:



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# Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study



Capital Project # 8710.110



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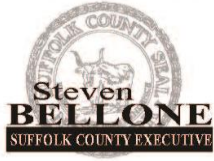
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# Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study



Capital Project # 8710.110



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## Acknowledgements

The successful completion of this shovel-ready, permitted plan to clean up and restore terrestrial and aquatic habitats in Mud Creek County Park is also due to the participation of others during the past three years. The Suffolk County Department of Economic Development and Planning would like to recognize the following individuals from Suffolk County and the Town of Brookhaven for their valued assistance:

### Suffolk County

Hon. Robert Calarco, Legislator, 7<sup>th</sup> District.

Department of Public Works  
Commissioner Gilbert Anderson, P.E., and staff –

William Hillman, P.E.  
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Kenneth Phalen, R.A.

### Town of Brookhaven

Hon. Edward P. Romaine, Supervisor

Hon. Daniel P. Losquadro, Superintendent of Highways

Veronica King, Stormwater Manager, Division of Stormwater.

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# **Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study**

## **Executive Summary March 31, 2016**

### **ERRATA**

Date prepared: July 7, 2016

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Page 11, the first paragraph, second sentence should read as follows:

The project provides for the installation of 29 drywells on Gazzola Drive to contain the runoff from a 1.2 inch rainfall event and construction of an overflow bio-swale vegetated with native plants to dissipate runoff from storm events producing greater rain volumes.

Page 13, the entry in the 3<sup>rd</sup> column, 10<sup>th</sup> row in the Cost Summary table, should read as follows:

**- Gazzola Drive Drainage Improvements:** Installation of 29 drywells on Gazzola Drive to minimize stormwater discharge to the restored stream





# Mud Creek Watershed Aquatic Ecosystem Restoration Feasibility Study

## Executive Summary

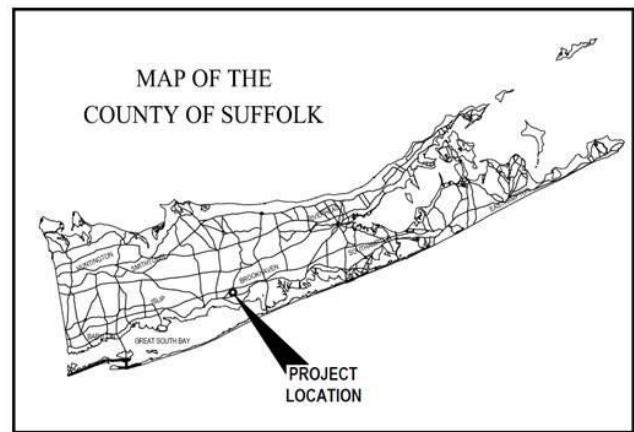
Suffolk County Department of Economic Development & Planning

*The streams generally start four or five miles from the ocean, sometimes bursting from a single fountain in pure and bright water, and ...flow over beds of clear white pebbles...The small streams, which... in the early course crawl sluggishly..., but in their progress become bright and sparkling brooks...These rivulets afford the choicest trout.*

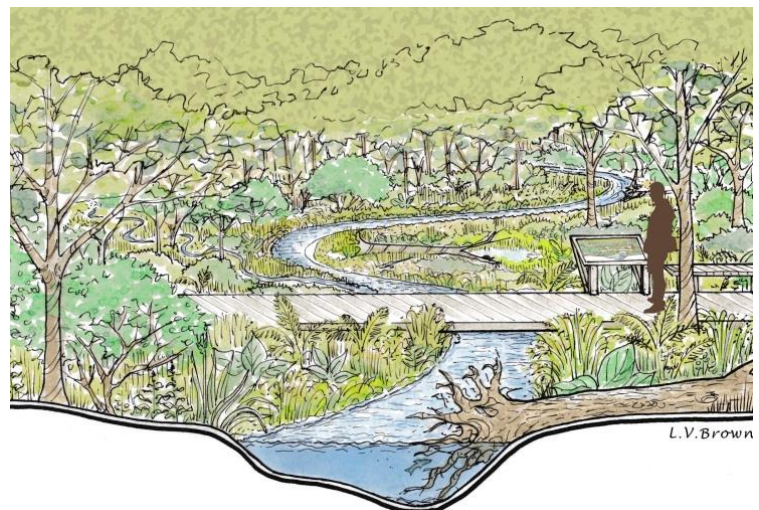
W. C. Watson's description of Long Island's streams published in 1860.

### Introduction

The Suffolk County Department of Economic Development and Planning, in conjunction with the Suffolk County Department of Parks, Recreation, and Conservation, initiated a feasibility study in 2011 (CP# 8710.110) to evaluate environmental restoration opportunities at Mud Creek County Park in East Patchogue. Mud Creek and its adjacent wetlands and uplands were extensively impacted by duck farming throughout much of the 20<sup>th</sup> century. Comprehensive studies of the degraded ecological, hydrological, and physical conditions followed by feasibility assessment and public outreach have culminated in a “shovel-ready” project with construction drawings, specifications and regulatory permits for comprehensive restoration of degraded aquatic and terrestrial habitats at Mud Creek County Park.



Prior to intensive development, Long Island's south shore featured many sandy-bottomed streams fed by cool groundwater that meandered through white cedar swamps and oak-pine woods to tidal marshes and bays. The Mud Creek Watershed Aquatic Ecosystem Restoration Project aims to restore freshwater stream and floodplain forest habitat for fish (including brook trout) and wildlife, establish coastal oak forests, remove organic sediments and nutrients from the degraded floodplain, and reduce stormwater impacts. These restoration actions contribute to achieving the objectives of County Executive Bellone's “Reclaim Our Waters” initiative. The project will also create 1.3 miles of interpretive nature trails and boardwalks, and other recreational amenities.



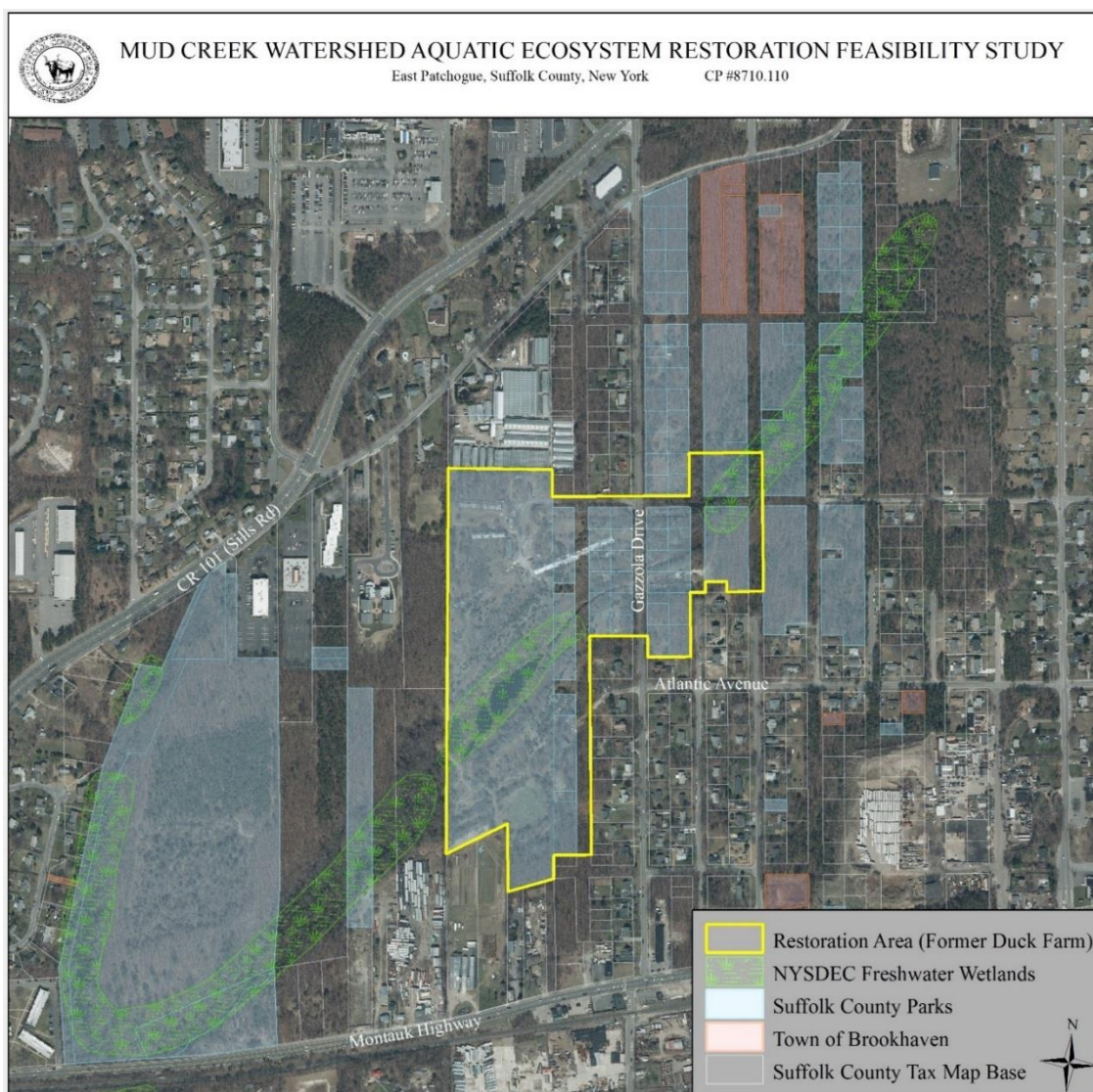
Conceptual Rendering of the Restored Stream and Floodplain  
at Mud Creek County Park.

## Summary of Proposed Restoration Actions

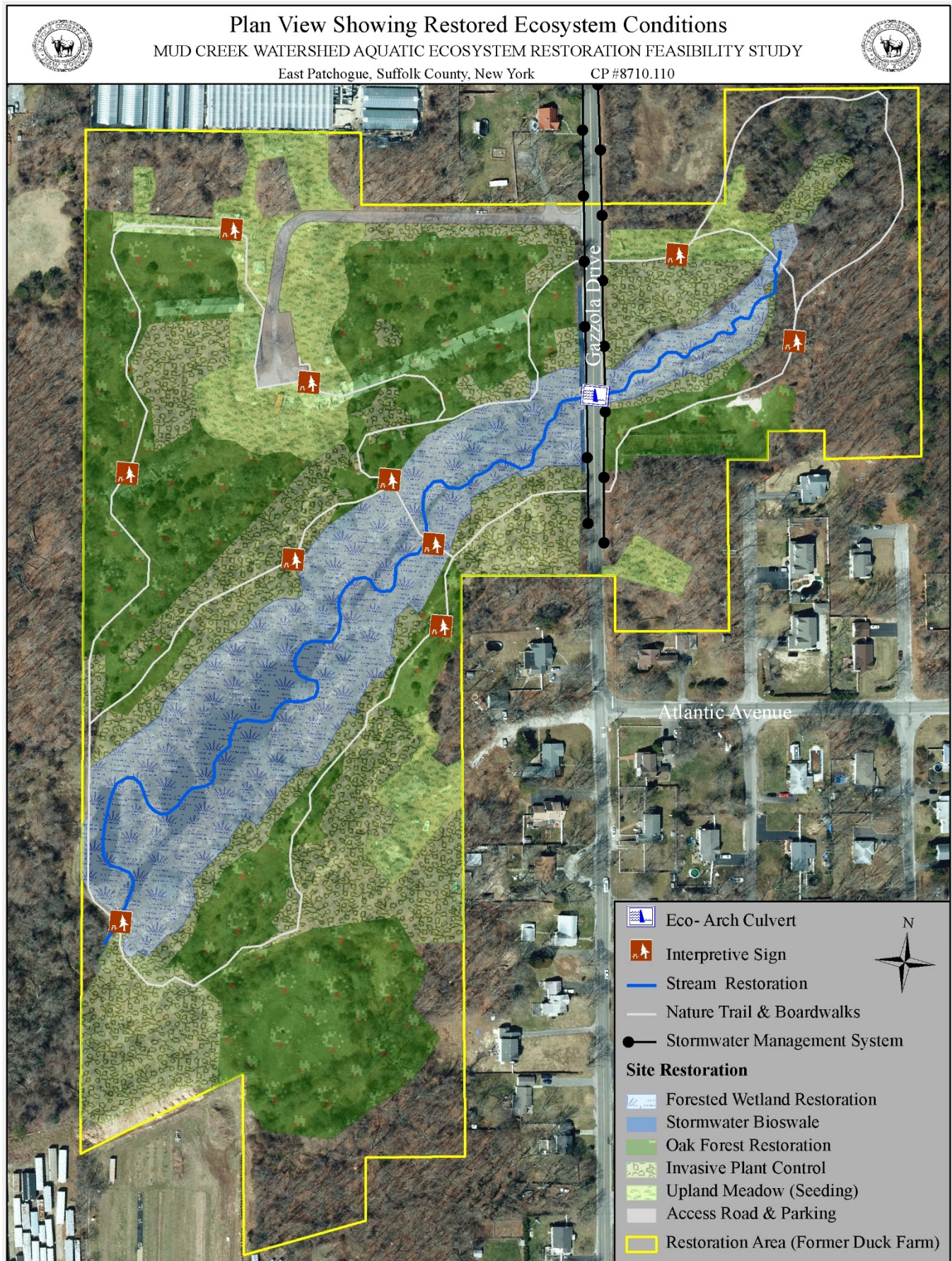
- Removal of all dilapidated buildings, debris, and abandoned equipment;
- Removal of 16,000 cubic yards (cy) of accumulated organic sediments and invasive plant rhizomes;
- Creation of 2,300 linear feet (lf) of new coastal plain stream;
- Restoration of 6.4 acres of floodplain with forested wetlands and 14.4 acres of oak forests and meadows;
- Installation of stormwater management structures at Gazzola Drive and Montauk Highway;
- Installation of an ecologically-friendly culvert at Gazzola Drive;
- Construction of new driveway, parking facility, and 650 lf of ADA compliant trail and timber boardwalk;
- Construction of 1.3 miles of nature trail, elevated timber boardwalks, interpretive signage, and benches.

Approximately 2,100 acres and nearly 20 miles of shoreline were utilized for duck production in Suffolk County during the 20<sup>th</sup> century, causing significant environmental impacts both on the farms and to the adjacent wetlands, streams, and bays. Many former duck farms are now publically owned with Suffolk County alone owning five former duck farms (total of 425 acres) and sharing ownership of three others (total of 67 acres).

Ecological restoration at Mud Creek can serve as a model for the conversion of these abandoned and under-utilized duck farms into amenities that provide recreational, aesthetic, and environmental benefits to the surrounding communities and the residents of Suffolk County.









## Mud Creek's Duck Farming History

Mud Creek County Park's lands and waters were used by the privately owned Gallo Duck Farm from 1922 to the mid-1980s. Prior to duck farming, the area contained "streams, swamps, and woods" with the East Branch of Mud Creek flowing through the duck farm property. Duck farming caused many physical alterations to Mud Creek and its adjoining wetlands and uplands including excavation and straightening of the stream channel; the construction of earthen dams and berms within the stream and its floodplain; clearing of forests to create feedlots for ducks; and construction of barns and other farm structures.

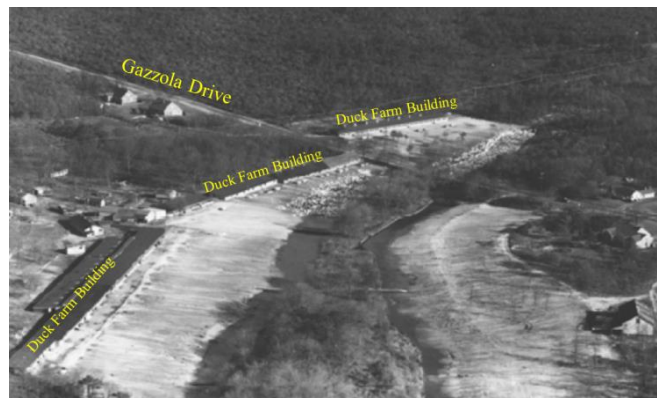
An aerial photo of the duck farm, as it existed in 1951, shows that Mud Creek was dredged to create two artificially wide and straight channels, cleared of forests adjacent to the stream and graded to create feedlots for ducks. Ducks are visible in the feedlots and in the stream in the upper portion of the image. In the early 1970s, the duck farm's nearly 12 acres of feedlots typically contained 70,000 ducks and produced approximately 350,000 ducks annually.

Prior to environmental regulations enacted in the 1970s, the ducks at Long Island's more than 70 commercial duck farms swam in pens within creeks and discharged their wastes directly into the streams that eventually flowed into the bays. Duck waste contributed suspended solids, nutrients, and coliform bacteria into the Peconic and South Shore estuaries and dramatically impacted water quality, phytoplankton assemblages, and shellfish and benthic communities.

The 45.8 acre duck farm along the East Branch of Mud Creek was acquired by Suffolk County through tax lien procedures and transferred to the Suffolk County Department of Parks, Recreation, and Conservation in 2001. Other County land acquisitions along the West and East Branches of Mud Creek

total 100.3 acres and comprise the majority of the headwaters of Mud Creek north of Montauk Highway, allowing for the preservation and long-term management of Mud Creek's riparian corridor at the landscape-level for the benefit of both wildlife and fisheries, water quality improvements, and recreational opportunities for County residents.

Since the late 1960s, Suffolk County has undertaken extensive actions to remediate and restore former duck farm properties and their impacts to the County's bays and estuaries by 1) dredging organic duck sludge from Moriches Bay, Flanders Bay, and their tributaries and 2) acquiring former duck farms and converting them to parklands (such as Indian Island Golf Course). Ecological restoration at Mud Creek County Park is the latest of Suffolk County's continuing efforts to rehabilitate wetlands, uplands, and shorelines destroyed by duck farming and provide the County's residents with the opportunity to access wetlands and waterways for recreational and educational purposes.



Aerial view of Gallo Duck Farm in 1951  
(Photo provided by M.L. Varney).



Gallo Duck Farm (Photo provided by M.L. Varney).



## Brook Trout

Mud Creek supports a unique, 'heritage' population of brook trout (*Salvelinus fontinalis*) – a naturally reproducing population that is not known to have been genetically altered through artificial stocking of fish. Conservation of heritage populations is a high priority throughout New York to maintain the genetic diversity of this species, listed as a NYS Species of Greatest Conservation Need. Periodic fish surveys (most recently in 2013) indicate that Mud Creek's small brook trout population has persisted in a narrow length of suitable habitat in the lower East and West Branches to the headwaters of Robinson Pond, despite both historical and current impacts, such as discharge of duck farm waste, habitat degradation and stream channel manipulation, and urban stormwater runoff. Given the designation of the brook trout as New York's official state fish, and the unique status of the Mud Creek trout population, an important benefit of ecological restoration at Mud Creek is creation of new habitat for this species and improving habitat and water quality in impaired reaches of the lower East Branch.



Brook Trout (*Salvelinus fontinalis*), New York's official state fish, has inhabited Mud Creek prior to duck farming and its impacts. (Photo provided by S. DeSimone).

## Site Investigation and Analysis to Support Ecological Restoration Plans

Extensive field investigations, surveys, and analyses were undertaken to identify the opportunities and challenges associated with restoration at Mud Creek County Park; develop and evaluate alternatives for ecological restoration; and prepare construction drawings and specifications for comprehensive restoration of aquatic, wetland, and upland habitats. Specific investigations conducted between May 2013 and May 2015 included:

- Stream, Floodplain, and Upland Topographic Survey
- Inventory and Survey of Stream Impoundments and Culverts
- Cores for Sediment Characterization and Contaminant Analysis
- *In Situ* Measurements of Stream Velocity and Discharge Volume
- Long-term Water Level Monitoring in East and West Branches
- Modelling of Hydraulic Characteristics (HEC-RAS model)
- Long-term Stream Temperature Monitoring in the East and West Branches
- *In Situ* Measurements of Stream Dissolved Oxygen Concentration
- Fish Survey and Aquatic Macroinvertebrate Sampling
- Ecological Communities Mapping and Invasive Species Mapping
- Botanical Inventory and Tree Survey (all trees > 4 inches diameter)
- Freshwater Wetland Delineation
- Dilapidated Structure, Debris, Equipment, and Stockpile Inventory
- Assessment of Subsurface Disposal Systems and Underground Heating Oil Tank Locations
- Subsurface Soil Sampling
- Asbestos Survey
- Hazardous Material Survey



## Environmental Stressors and Impaired Ecological Function at Mud Creek

Due to extensive manipulation during the decades of duck farming, the meandering groundwater stream, riparian forested wetlands, and upland oak forests that predated European colonization along Mud Creek are no longer present. Duck farming operations ceased in the mid-1980s; however, many of the environmental impacts and stressors of the duck farm persist to the present. While significant re-growth of vegetation has occurred on the former duck farm, the aquatic and terrestrial habitats are still poor quality, dominated by invasive species, and exhibit only limited indications of natural succession toward the high quality ecosystems of the past.

### *Disrupted Stream and Floodplain*

The East Branch and its floodplain have been completely altered by straightening of the stream channel, excavation of feedlots and swim ponds for ducks, installation of earthen berms and flow barriers, and the construction of Gazzola Drive. These physical alterations have homogenized the stream and its floodplain and destroyed the quality and diversity of Mud Creek's aquatic habitat. The numerous stream barriers prevent or restrict the movement of fish and aquatic organisms, disrupt stream hydrology, and have caused the accumulation of thick deposits of fine sediments and organic matter that degrade water quality. The earthen berms constructed parallel to the stream channel disconnect Mud Creek from its natural floodplain.



Artificially straightened stream channel on the former duck farm at Mud Creek County Park.

These organic sediment deposits contain concentrated nutrients and contaminants that contribute to the degradation of water quality. As a result, aquatic invertebrates found in the East Branch are typically species tolerant of pollution and poor water quality, such as chironomid larvae and scud amphipods. The stream barriers also create shallow ponds with stagnant and warm water not suitable for brook trout. Water temperatures in the shallow, sunlit ponds at Mud Creek are frequently lethal to brook trout and the warming of the stream on the former duck farm makes the downstream reaches of Mud Creek less habitable for brook trout. The culverts at Gazzola Drive are undersized and clogged, limiting the flow of water during both normal and high flow conditions, trapping sediments upstream of the road, and disrupting movement of aquatic organisms and wildlife.



Left: Multiple stream barriers disrupt stream hydraulics, sediment transport, and the movement of aquatic life.

Right: The site's ponds are nutrient rich with warm temperatures and low oxygen content not suitable to brook trout.



### *Invasive Aquatic and Terrestrial Plants*

Despite the nearly thirty years that have passed since cessation of duck farming, large areas of Mud Creek County Park (approximately 15.2 acres) continue to be dominated by invasive plants. Common Reed (*Phragmites australis*) dominates the degraded stream, its floodplain, and the margins of the site's shallow ponds. Mugwort (*Artemisia vulgaris*) forms dense stands in the former duck feedlots. These invasive plants flourished in the nutrient-rich and disturbed conditions at the abandoned duck farm. Both *Phragmites* and mugwort infestations result in significantly degraded ecological conditions, as these plants exclude nearly all other plant species (including most other invasive plants) and provide poor habitat for many wildlife species. Few seedlings or saplings of native trees are interspersed within the site's *Phragmites* or mugwort stands. Without young trees to eventually out-compete and shade-out these species, large areas of Mud Creek County Park will remain ecologically compromised for many years to come. Restoration actions to remove these invasive species and establish native trees are necessary to restore species and structural diversity to these areas and enhance wildlife habitat. Therefore, *Phragmites* and mugwort at Mud Creek County Park shall be controlled through a combination of mechanical methods (i.e., excavation or grubbing) and herbicide applications over multiple growing seasons.



Left: *Phragmites australis* has colonized much of the floodplain of Mud Creek on the former duck farm.



Right: The former duck feedlots are often dominated by invasive mugwort (*Artemisia vulgaris*).

### *Stormwater Discharges*

Stormwater contains many potential pollutants including sediment, nutrients and pesticides from lawn care products, floatable debris and trash, coliform bacteria, metals, and petroleum products. Stormwater from roadways, paved surfaces, commercial areas, and residential neighborhoods discharges to the East Branch of Mud Creek at Gazzola Drive and Montauk Highway, and contributes to the degraded water quality conditions observed on the former duck farm and in the lower East Branch.



A section of Gazzola Drive about 0.5 miles in length drains directly into the East Branch of Mud Creek.

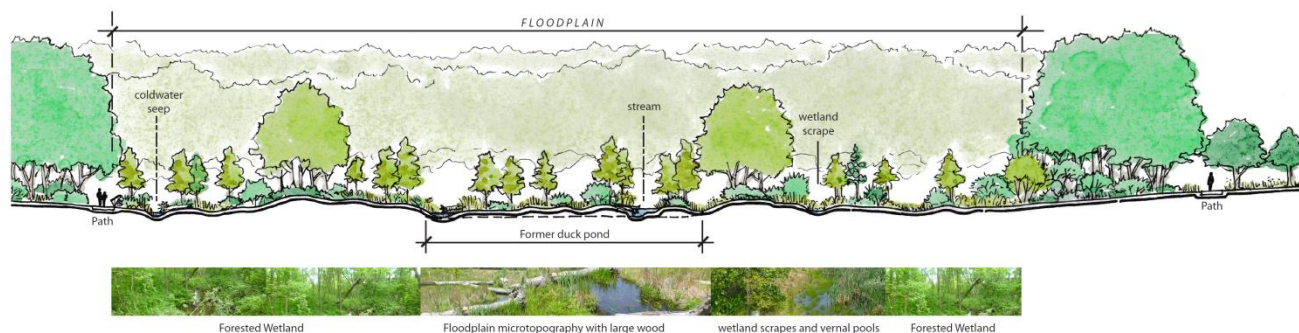
## Mud Creek Restoration Actions and Project Benefits

### *Restored Groundwater Stream and 6.4 acre Forested Floodplain*

The project shall construct 2,300 feet of new stream channel within a forested wetland to restore high quality habitat for fish and wildlife, including brook trout. The topography of the restored floodplain will be textured to create spring pools and tributary channels, vernal pools, and floodplain scrapes and mounds. These features promote plant and wildlife diversity, improve aquatic and terrestrial habitat complexity, and provide storage of flood waters during high-water events. The constructed stream channel (approximately 6-12 feet in width) would be well-connected to both groundwater and its vegetated floodplain. Downed trees shall be anchored within the restored stream channel to enhance habitat complexity, create overhead cover for aquatic organisms, maintain scour pools for adult fish and shallow water habitat for juveniles, and provide flow refugia. The existing *Phragmites* marsh shall be replaced by dense planting of more than 2,500 native trees and shrubs and a native wetland grass and wildflower seed mix (comprised of more than 25 species) to promote the development of a densely forested floodplain. The forested wetland in Mud Creek's restored floodplain will provide habitat for a diverse variety of aquatic invertebrates, amphibians and reptiles, waterfowl and songbirds, and small mammals.



**Left:** Restored stream and wet meadow floodplain with large wood as in-stream habitat in Eel River, MA.  
**Right:** Mature forested floodplain with stream channel on the West Branch of Mud Creek.



**Conceptual Rendering of the Restored Stream and Floodplain at Mud Creek County Park.**



### *Removal of In-stream Barriers and Floodplain Berms*

The in-stream barriers (earthen berms and culverts) that disrupt the hydraulic and ecological function of the East Branch of Mud Creek will be removed within the project area. The removal of earthen berms will enable the daily and seasonal movements of fish and aquatic organisms and increase access to optimal feeding and spawning habitat throughout the connected reaches of Mud Creek. The clogged and undersized culvert at Gazzola Drive will be removed and replaced with an eco-friendly arch culvert to provide 1) increased flow capacity during flood events, 2) movement of groundwater flow during average flow periods, and 3) passage for aquatic organisms and wildlife.



**Left:** Existing non-functional stream culvert on East Branch of Mud Creek at Gazzola Drive.  
**Right:** Constructed eco-friendly box culvert and stream channel under Long Pond Road, Eel River (MA).

### *Organic Sediment Removal*

Earthen berms constructed during duck farm operation have caused the accumulation of thick deposits of fine sediments and organic matter (between 2 and 7 feet in depth). The project shall excavate approximately 3,700 cubic yards of fine sediments from the shallow ponds on the former duck farm and 12,300 cubic yards of organic matter and *Phragmites* rhizomes in the degraded floodplain. The organic matter and nutrients contained within these accumulated sediments contribute to algal growth and low dissolved oxygen concentrations on the former duck farm and in downstream reaches of the East Branch of Mud Creek and Robinson Pond. Therefore, removal of these sediments will improve water quality and aquatic habitat for fish (particularly brook trout), amphibians, and invertebrates within the East Branch of Mud Creek and potentially Robinson Pond.

### *Oak Forest Restoration*

The project shall establish 11 acres of young oak forests on the degraded former duck feedlots at Mud Creek County Park. Restoration actions will include eradication of invasive plants through mowing, grubbing, and repeated herbicide applications; soil improvements through use of cover crops and amendments; planting more than 3,850 native trees and shrubs; seeding native warm season grasses and wildflowers to stabilize and improve soils; and protection of young trees and shrubs with tree shelters. Existing stands of native trees on the site have been identified and incorporated into the restoration plan to increase the ecological and structural diversity of the restored habitats and serve as source of native tree seeds. Large stands of Eastern red cedar, totaling 1.6 acres, and oak-dominated stands (1.3 acres) with large white and black oak trees up to 45 inches in diameter will be preserved and incorporated into the restored habitats of Mud Creek County Park.

Restoration of oak forests has many ecological benefits. The acorns produced by oak trees are an important food source for many species of birds and wildlife including white-tailed deer, wild turkey, and wood ducks. Mature oak forests provide den sites and cavities that are used by many species and support a diversity of butterflies, moths, and other pollinators. The shaded forest understory created is also less likely to be re-colonized by mugwort and other invasive herbaceous plants. The establishment of oak forests on the former duck farm will connect the

oak forests located downstream and upstream, thereby creating a contiguous patch of habitat for wildlife more than 150 acres in size.



**Left:** Coastal oak forest to northeast of Mud Creek County Park. This forest type is the restoration target for the former duck feedlots dominated by invasive plants. **Right:** Immature oak forest with grass-dominated understory. This condition may persist well into development of the forest as trees mature.



**Eastern red cedar (left) and large oak trees (right) located on the former duck farm will be incorporated into the restored habitats to enhance wildlife habitat, increase structural complexity, and serve as seed sources.**

Collectively, the project will restore 18.8 acres of upland and wetland forests at Mud Creek County Park. Forests provide a number of important ecosystem services including:

- Stabilization of soils and prevention of erosion and sediment transport;
- Maintenance of soil quality by adding organic matter and nutrients through litterfall;
- Regulation of hydrological cycles by absorbing and storing water when precipitation is abundant and releasing water to streams during droughts;
- Water quality improvement by filtering and removal of pollutants by plants and soil microorganisms;
- Providing fish and wildlife habitat, including recreationally important species;
- Increase in abundance and diversity of insect pollinators to the benefit of both native plants and crops;
- Absorption of airborne particulates and pollutants;
- Moderation of climate by trapping moisture and cooling ground surfaces;
- Uptake of carbon dioxide from the atmosphere;
- Providing aesthetic benefits to neighboring communities; and
- Providing opportunities for recreation and nature appreciation.



### *Stormwater Management*

Large pulses of warm, pollutant-laden runoff from paved surfaces discharge to the East Branch of Mud Creek from Gazzola Drive and Montauk Highway during precipitation events. The project provides for the installation of twenty drywells on Gazzola Drive to contain the runoff from a 1.2 inch rainfall event and construction of an overflow bio-swale vegetated with native plants to dissipate runoff from storm events producing greater rain volumes. A hydrodynamic separator shall be installed on Montauk Highway to remove debris, sediments, and oils from stormwater prior to discharge to Mud Creek. These infrastructure improvements will reduce the impacts of urban stormwater runoff on Mud Creek by infiltrating stormwater to the ground and the floodplain wetlands rather than direct discharges of stormwater into the stream channel.

### *Demolition of Dilapidated Buildings and Removal of Debris and Abandoned Equipment*

Investigations of the site during the restoration planning and design identified 16 dilapidated duck farm buildings and structures, several out-of-service cesspools, out-of-service utility poles and wires, and hundreds of pieces of debris and abandoned equipment. Restoration of the site will include the razing, under controlled demolition, of dilapidated buildings in accordance with New York State regulations and removal of all abandoned equipment, debris, and soil stockpiles, with disposal at a licensed waste disposal facility.



**Dilapidated duck farm buildings and abandoned equipment will be razed and removed.**

### *Visitor Amenities*

Visitors to Mud Creek County Park will be able to experience and enjoy the restored wetlands and forests, and to learn about Suffolk County's natural resources and duck farming history. Park amenities will include 1.3 miles of nature trails for passive recreation, elevated timber boardwalks over restored wetland areas and proposed stream/wetland overlook platforms, 650 linear feet of ADA compliant asphalt path and timber boardwalk, interpretive signage located along the nature trails and boardwalks, an informational kiosk at the parking area, and resting benches. A new driveway access and parking area will accommodate 10 passenger cars and two school buses.



Visitor amenities at Mud Creek County Park will include nature trails (far left), timber boardwalks in wetlands (left center), interpretive kiosk for park maps and information (right center), and interpretive signage (far right). Typical photos provided for proposed Mud Creek visitor amenities.

## Economic and Health Benefits Provided by Ecosystem/Watershed Restoration

The restoration of Mud Creek County Park will provide a wide range of economic and environmental benefits to the East Patchogue and North Bellport communities and all residents of Suffolk County. These benefits include:

*Economic Benefits of Parks and Protected Open Space (Increased Property Values):* Ecological restoration and creation of an accessible public park has the potential to increase property values and quality of life for these nearby communities. Parks and protected open space increase the value of nearby residential properties because people like living close to parks and protected open spaces. For Long Island as a whole, parks and protected open space raised the value of nearby residential properties by an estimated \$5.18 billion (2009) and increased property tax revenues by \$58.2 million annually.

*Economic Benefits of Parks and Protected Open Space (Visitation and Tourism):* Approximately 28 percent of visitors (i.e., nonresidents) to Long Island—5.1 million per year—come for the purpose of visiting parks, such as beaches, heritage sites, and so on. These visitors spend \$615 million annually in the local economy and generate \$27.3 million in sales tax. Residents also enjoy Long Island's parks and protected open space. Residents are willing to pay \$1.48 billion per year for the recreational activities they enjoy in park facilities.

*Educational Benefits of Parks and Protected Open Spaces:* The restoration of Mud Creek County Park will provide recreational and educational opportunities to residents including an informational kiosk and interpretive signage along the nature trail, 1.3 miles of nature trails for passive recreation, and boardwalk and overlook areas to view the restored ecological communities. Science faculty at South Country School District, which serves the project area, have expressed support for this project as a way to enhance science education.

*Health Benefits of Parks and Protected Open Space:* The restoration plan provides 1.3 miles of nature trails for passive recreation. Independent research shows that park use translates into increased physical activity, resulting in medical costs savings. Approximately 611,000 Long Islanders engage in physical activity at a level sufficient to generate measurable health benefits, yielding annual savings in medical costs of \$164 million.

## Construction Plans, SEQRA Review, and Environmental Permits

The feasibility study initiated by the Suffolk County Department of Economic Development and Planning culminated in the development of final construction drawings and specifications dated March 2016. Suffolk County review of the restoration of aquatic and terrestrial habitats at Mud Creek County Park under the State Environmental Quality Review Act resulted in the issuance of a Negative Declaration on September 16, 2015. Regulatory approvals for construction have been obtained from the New York State Department of Environmental Conservation and the United States Army Corps of Engineers.



## Project Construction Cost Estimates

Construction costs for comprehensive ecological restoration of the former duck farm at Mud Creek County Park range between \$4.2 and 5.1 Million based on engineer's estimates.

**Cost Summary for Ecosystem Restoration and Park Construction at Mud Creek County Park (Costs in 2016 Dollars)**

Restoration Action	Construction Cost	Description and Notes
Coastal Plain Stream and Floodplain Restoration	\$1,058,866	- <b>6.4-acre Floodplain Restoration with Stream:</b> Excavation of floodplain to a depth of 1.5 feet to remove 16,000 cy of organic sediments and <i>Phragmites</i> rhizomes; removal of duck farm berms and structures; on-site dewatering and management of sediments, placement of 17,600 cy of clean fill to attain grade for forested wetland, and creation of 2,300 lf of stream channel
	\$317,900	- <b>Stream Channel Construction, Bioengineering, and Habitat Enhancement:</b> Construct bioengineered stream banks, side channels, vernal pools, and install woody debris
	\$204,160	- <b>Forested Wetland Restoration:</b> Planting of 2,560 native trees and shrubs and installation of native grass and wildflower seed mix throughout restored floodplain
	\$52,800	- <b>Herbicide Applications to Control Invasive <i>Phragmites</i>:</b> <i>Phragmites</i> management for five years to establish native forested wetlands
Oak Forest Restoration	\$352,400	- <b>Oak Forest Restoration:</b> Planting of 3,850 native trees and shrubs and seeding of native grass and wildflower meadows in the site's weedy fields and building footprints
	\$221,040	- <b>Site Preparation for Oak Forest Restoration:</b> Clearing, invasive plant management, and soil preparation for oak forest and meadow restoration
	\$55,440	- <b>Herbicide Applications to Control Invasive Mugwort:</b> Mugwort management for five years to establish native trees
	\$44,600	- <b>Forest Enhancement:</b> Invasive tree, shrub, and vine control and removal of debris in existing forests and woodlands at Mud Creek County Park
Stormwater Management and Gazzola Drive Culvert	\$334,800	- <b>Gazzola Drive Drainage Improvements:</b> Installation of 20 drywells on Gazzola Drive to minimize stormwater discharge to the restored stream
	\$92,000	- <b>Eco-Friendly Culvert:</b> Installation of open arch culvert under Gazzola Drive to increase stream connectivity and associated water management
	\$66,840	- <b>Montauk Highway Drainage Improvements:</b> Installation of hydrodynamic separator to reduce pollutant discharge
Park Construction	\$745,000	- <b>Removal of Dilapidated Buildings/Structures:</b> 8 w/o asbestos and 8 w/ asbestos
	\$40,000	- <b>Removal of Non-Hazardous Debris and Abandoned Equipment</b>
	\$63,700	- <b>Construction of New Driveway and Parking Lot</b>
	\$217,000	- <b>Construction of Recreational Amenities:</b> 6,830 lf of bare earth nature trail, 280 lf of elevated timber boardwalk and overlooks, 650 lf of ADA compliant trail, 10 interpretive signs, entrance kiosk, benches, and litter receptacles
Long-Term Monitoring	\$202,670	- <b>Long-Term Ecological Monitoring:</b> Collection of monitoring data to evaluate success in attaining ecological goals and manage restored habitats. Monitoring includes data collection on water chemistry, macroinvertebrate and fish community diversity and abundance, native plant diversity, invasive species abundance, and photo monitoring for 3-15 years (based on monitoring parameter) after construction.
Construction Expenses	\$110,000	- <b>Mobilization, Testing Allowance, and Temporary Haul Roads</b>
Off-Site Disposal Option	\$869,864	- <b>Off-Site Sediment Transport and Disposal at Landfill</b>
<b>Estimated Total Cost</b>	<b>\$4,179,216 Restoration Costs with ON-SITE Disposal</b>	
	<b>\$5,049,080 Restoration Costs with OFF-SITE Disposal (Includes Off-Site Disposal Option)</b>	

*Construction Phasing*

Implementation of ecological restoration and construction of park amenities may be phased if required by budgetary constraints. Phased implementation could target demolition of dilapidated buildings, installation of stormwater and culvert improvements, or restoration actions located east of Gazzola Drive initially, depending on funding, with restoration actions west of Gazzola Drive occurring subsequently when funding allows.

**A Transferrable Experience**

The Mud Creek Watershed Aquatic Ecosystem Restoration project will have important ecological and water quality benefits for Mud Creek. Equally important is the precedent and experience gained regarding conversion of underused and blighted former duck farms into amenities for their surrounding communities. Approximately 2,100 acres and nearly 20 miles of shoreline were utilized for duck production in Suffolk County during the 20<sup>th</sup> century. Suffolk County owns five former duck farms (total of 425 acres), shares ownership of three others (total of 67 acres), and has proposed seven additional former duck farm sites for open space acquisition. The restoration of these former duck farms represents an important opportunity to 1) remove dilapidated, blighted structures that are a liability to the County, 2) improve aesthetic and environmental conditions for nearby neighborhoods, and 3) restore miles of critical shoreline and wetland habitats and provide County residents with the opportunity to access these waterways for recreational and educational purposes.



Suffolk County Executive  
Hon. Steven Bellone