Sediment Impact Investigation Report
Amber Brook/Hamilton Reservoir Confluence

Mashapaug Road
Holland, Massachusetts

MMI#3684-01

July 2008

Prepared for:
Northeast Concepts/Huguenot Farm
Holland, Massachusetts

Prepared by:
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 Introduction

Milone & MacBroom, Inc. (MMI) has been retained by Northeast Concepts/Huguenot Farm (NC/HF) of Holland, Massachusetts to assess historic and current sources of sediment deposition within the main channel of Amber Brook and Hamilton Reservoir near the confluence with Amber Brook. NC/HF owns and operates a forestry and farming operation on approximately 76 acres of land along Mashapaug Road in Holland, Massachusetts.

NC/HF was granted an approved Forest Cutting Plan (Department of Environmental Conservation (DEC) File no. 135-25997) on August 3, 2006. The Forest Cutting Plan expires on August 3, 2008, but may be extended by DEC if an extension request is submitted by NC/HF.

The NC/HF property is bisected by Mashapaug Road, which divides the property into two parcels. The smaller parcel, which is approximately 0.15 acres in size, is located east of Mashapaug Road and provides private shorefront access to Hamilton Reservoir. The larger parcel, which is approximately 75.8 acres in size, is located on the west side of Mashapaug Road and is actively being forested.

An access road is located on the larger tract of the NC/HF property serves as the main entrance. This existing road is located along the same alignment of an historic access road at this parcel, as documented in the 1915 book entitled "*The History of Holland*" by Reverend Martin Lovering. A reproduction of a map from that book is presented on the following page, showing the relative location of Hamilton Reservoir, Mashapaug Road, and Amber Brook. The labels have been added for clarification. Local tax maps and other site mapping also depict a former dirt cart road in this location.

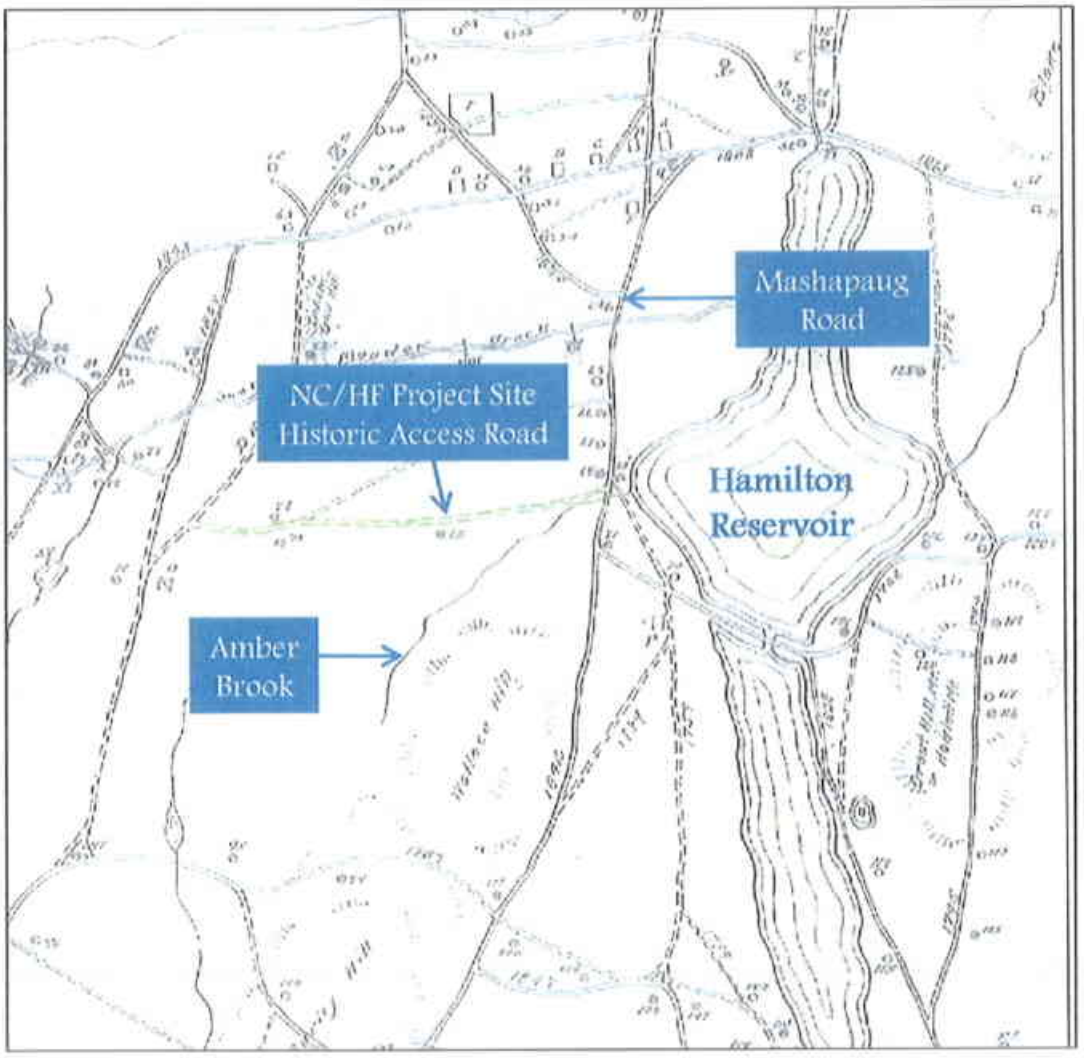
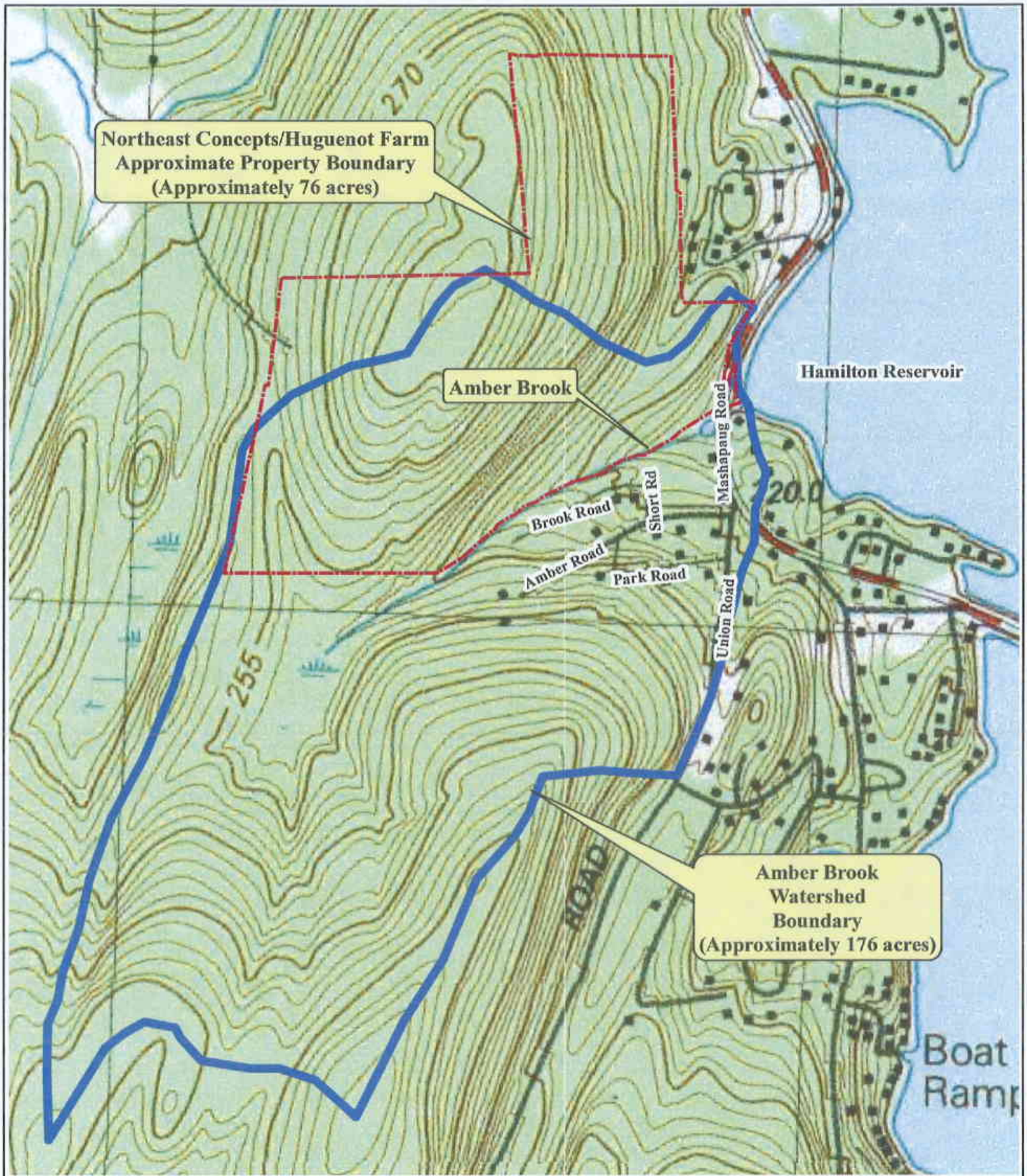


Illustration from "The History of Holland" by Reverend Martin Lovering, 1915

Amber Brook flows in a northeasterly direction along the southern border of the larger parcel and flows beneath Mashapaug Road into Hamilton Reservoir. Approximately half of the site is located within the Amber Brook watershed. The NC/HF site and the Amber Brook watershed are depicted on Figure 1.

The subject report summarizes the on-site and off-site investigations completed by Milone & MacBroom, Inc. and presents historical and current sources of sediment deposition at the Amber Brook/Hamilton Reservoir confluence.



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Northeast Concepts/ Huguenot Farm

LOCATION: Holland, MA

MMI#: 3684-01-1
MXD: H:\Quad Map.mxd
SOURCE: DEP Bulletin No.40

N

USGS Quadrangle Map

DATE: June 2008
SCALE: 1" = 600'

SHEET: Figure 1

2.0 Amber Brook Watershed and Watercourse Description

The Amber Brook watershed has a contributing land area of approximately 176 acres. Land use within the watershed is predominantly forested with a mix of single family residential lots. The upland soils within the watershed are classified as moderately well to well drained sandy loams. This watershed has the Brookfield series, Hinckley series, Paxton and Montauk series, and Woodbridge soil series. Patches of very poorly and poorly drained soils are also found within this watershed and include soil series such as the Freetown series and Ridgebury series.

The headwaters of Amber Brook begin at a depressional palustrine forested wetland located along the western portion of the watershed. Amber Brook flows northeasterly into a manmade pond located on the west side of Mashapaug Road and then discharges into Hamilton Reservoir. Amber Brook has a step riffle pool geomorphology with a substrate consisting of coarse sand, pebbles, cobbles, and stones. The width of the watercourse varies from three to four feet. There is no evidence of channel or bank erosion within the brook. The watercourse has a dense forested riparian zone consisting of eastern hemlock, red oak, yellow birch, black birch, red maple, spicebush, cinnamon fern, Christmas fern, and Canada mayflower. The understory is of low density because of the dense tree canopy.

3.0 Site Investigations

Two site investigations were conducted at the NC/HF site and within the Amber Brook watershed. The first occurred on June 20, 2008 during dry weather conditions. The second occurred on June 23, 2008 following an intense rain event.

On June 20, 2008, Jeanine Armstrong Bonin, P.E. of Milone & MacBroom, Inc. conducted a site reconnaissance at the NC/HF property, along the Amber Brook corridor adjacent to

the site, and in the Amber Brook watershed. Appendix A contains a photo log of the site visit. As can be seen in photos 1A through 4A, while water clarity was good on the day of field investigations, Hamilton Reservoir in the area of Amber Brook has been notably impaired with previously deposited sediment. The NC/HF shoreline parcel appeared stable, with no indication of active erosion into Amber Brook or Hamilton Reservoir.

An access road to the NC/HF parcel off Mashapaug Road runs parallel with Amber Brook, with an approximate 100-foot width vegetative strip between the access road and the brook. On the northern (upslope) side of the access road, several interim sediment basins have been constructed to provide pre-treatment via detention of runoff from the north and east. The access road is unpaved, with silt fence and haybales along the southern edge of the road, as can be seen in Figures 5A and 6A. On the day of inspection, the vegetative strip between the access road and Amber Brook was free of sediment deposition, as was the brook through this reach. This area is depicted on Figures 7A and 8A.

Silt fencing along portions of the access road (shown in Figures 9A and 10A) had clearly contained a significant amount of sediment and while there was no evidence of failure, some areas were in need of maintenance where sediment accumulations were approaching the top of the fence. There was no evidence that sediment had migrated through the vegetative buffer or into Amber Brook.

A reconnaissance of the Amber Brook watershed was also conducted on June 20, 2008. As can be seen in Figure 1, the watershed is very steep, with the exception of the headwater wetlands to Amber Brook. Many of the roads and driveways in the watershed are unpaved, with apparent ruts and rills from prior erosion. Catch basins did not appear to have sumps and no watershed detention basins were evident.

On June 23, 2008, Matthew Sanford, an environmental scientist and professional wetland scientist with Milone & MacBroom, Inc. conducted a site investigation at NC/HF site and the Amber Brook watershed. An intense rain storm occurred at the subject site between the hours of 9:00 a.m. and 11:30 a.m. By the time, MMI arrived on site, the rain had stopped and stormwater runoff was negligible.

The closest known rain gauge to the subject site is located approximately 27 miles northeast in Worcester, Massachusetts. According to the Worcester rain gauge, the June 23, 2008 rain event produced approximately 2.8 inches of rain fall within a 24 hour period, with a majority of the rain occurring between the hours of 9:00 a.m. and 11:00 a.m.

MMI investigated three primary areas including:

- NC/HF Private Shoreline Property
- NC/HF Private Forestry and Farming Property
- Amber Brook Watershed

NC/HF Private Shoreline Property

The NC/HF private shoreline property is located along the east side of Mashapaug Road. Several rills and large sandy sediment deposits were observed on the surface of native soil. Several small diameter tree sapling stumps were found intact beneath the recent sediment deposition. A photo log of the June 23, 2008 site visit is included herein as Appendix B. Based on photographs taken by NC/HF on June 23, 2008, it is evident that the sediment on the private beach was coming from Town owned gravel/sandy roads and private driveways (see photos 1B through 4B). Town-owned roads include Amber Road, Park Road, and Union Road. These travelways are not paved and have relatively steep grades (see photos 5B through 10B). There was no evidence that the recently deposited sediments found on the shorefront property were coming from the NC/HF access road or elsewhere on the site located across Mashapaug Road.

NC/HF Private Forestry and Farming Property

The NC/HF private forestry and farming parcel is located along the west side of Mashapaug Road. The main entrance to the site runs parallel to Amber Brook and is a sand and gravel roadway. Interim sediment basins were actively catching runoff upgradient of the access road (see photo 16B) and upgradient of the silt fence. These sediment basins are located approximately 160 linear feet west of Mashapaug Road. They were constructed to help capture coarse grained material coming from exposed soil areas on site. Stormwater from these sediment basins is discharged across the existing access drive and is directed into a swale that flows east along the silt fence. Stormwater from within the swale is directed into an existing (historic) sediment basin located on the east side of Mashapaug Road.

Silt fence has been installed along the southern edge of the access road and runs west along the "no cut/clear zone" as approved on the Forest Cutting Plan (see photo 15B). Down gradient of the filter fence, the historic sediment basin is located at the southeast corner of this property (see photo 13B). This basin was likely installed by a previous owner of the site, which at one time was known and operated as the Blodgette Farm. Remnants of other physical features, such as walls, swales, and berms are also evident throughout the site, indicative of previous activity on the land. The sediment basin receives stormwater runoff from Mashapaug Road as well as the NC/HF site. Stormwater that enters this sediment basin flows into Amber Brook via an overflow berm and then discharges through a pipe under Mashapaug Road.

As can be seen in photos 14B and 15B, the silt fence along the access road was undermined at several locations. Exposed soils were found on the downgradient side of the silt fence and small rills were evident. These rills were also being directed to the sediment basin as previously described. There was no evidence that existing exposed soils were eroding directly into Amber Brook.

MMI walked the entire length of silt fence and Amber Brook channel on the NC/HF property, looking for evidence of sediment entering Amber Brook from the subject property, but found no evidence of rills, gullies, or sediment deposits within the forested riparian zone on the NC/HF property.

Amber Brook Watershed

The watershed is predominantly forested and has a mix of single family homes, most of which are serviced by sand and gravel roads and driveways. Many of the roads and driveways have steep slopes (see photos 6B and 8B). The combination of steep slopes and highly erodible soils on these roads makes them susceptible to significant erosion, as was documented by MMI on June 23, 2008. Photos 1B, 2B, and 9B through 12B document the erosion that occurred in the watershed. Rills and suspended sediments were observed flowing into the historic sediment basin at the corner of Mashapaug Road and the NC/HF access drive.

On the right (east) bank of Amber Brook and opposite of the NC/HF property, MMI observed several rills that had recent alluvium and sediment deposits within them and all were discharging directly into Amber Brook (see photo 7). The source of these rills and sediment deposits were traced back to the Town owned roads known as Short Road and Brook Road (see photos 5B and 6B). The surface water within the neighboring private pond had turbid water. This pond is acting as a sediment basin for Amber Brook. In fact, the pond has likely been made shallower by the continual deposition of sediment from Town owned road stormwater runoff.

4.0 Historical Aerial Photograph Inventory and Analysis

MMI reviewed historical aerial photographs to help determine the primary sources of the existing sediment delta at the Amber Brook/Hamilton Reservoir confluence. The aerial photographs reviewed include the years 1999, 2003, and 2005. These aerials are represented by Figures 2 through 4 herein.

In all three aerial photographs, the sediment delta is large and visible. In addition, the aerial photographs show that the existing subject property is entirely forested. The current owners of the NC/HF property did not purchase this property until 2006 and forestry operations did not commence until late summer, well after the formation of the sediment delta.

Based on the review of the historic aerial photographs it is evident that the sediment delta was present well before NC/HF began their forestry operations and that the most likely cause of the sediment delta is the uncontrolled erosion within the watershed and along Town owned roads located within the Amber Brook watershed. The delta continues to grow because the roads and driveways consistently erode each year. All drainage ditches and catch basins from Amber Road and Union Road, which are full of sediment, are directed into a 15-inch SLCPP (smooth lined corrugated plastic pipe) (see photo 12B) and are discharged directly into Amber Brook on the west side of Mashapaug Road.

In addition to the direct point discharge sources, overland surface runoff from Short Road and Brook Road are directed into concentrated rills, which discharge directly into Amber Brook. These rills, which are not located on the NC/HF property, are also contributing significant amounts of sediment to Amber Brook.

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Northeast Concepts/ Huguenot Farm		**LOCATION:** Holland, MA	
MMI#: 3684-01-1 MXD: H:\1999 Aerial.mxd SOURCE: DEP Bulletin No.40	N **1999 Aerial Photograph**	DATE: June 2008 SCALE: 1:2,400	SHEET: Figure 2

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Northeast Concepts/ Huguenot Farm

LOCATION: Holland, MA

MMI#: 3684-01-1
MXD: H:2003 Aerial.mxd
SOURCE: DEP Bulletin No.40

N

2003 Aerial Photograph

DATE: June 2008
SCALE: 1:2,400

SHEET: Figure 3

Engineering, Landscape Architecture and Environmental Science MILONE & MACBROOM® 99 Realty Drive Cheshire, Connecticut 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com	**Northeast Concepts/ Huguenot Farm**		**LOCATION:** **Holland, MA**	
MMI#: 3684-01-1 MXD: H:2005 Aerial.mxd SOURCE: DEP Bulletin No.40	N	**2005 Aerial Photograph**	DATE: June 2008 SCALE: 1:2,400	SHEET: Figure 4

5.0 Conclusions and Recommendations

The field investigations of June 20 and June 23, 2008 and a review of historic aerial photographs suggest that the primary contribution of suspended sediments to Amber Brook and the delta in Hamilton Reservoir are from the town owned roads and private driveways located south of Amber Brook. Photo documentation of the runoff within the watershed demonstrates the effects of unpaved roads and driveways on steep slopes in a watershed that lacks stormwater management controls. Additionally, historic aerial photographs clearly show that the sediment delta in Hamilton Reservoir predates the ownership and forest cutting operations at the NC/HF property.

It is apparent that the Town of Holland needs to develop a sediment management plan for the Amber Brook watershed. The following specific management measures are recommended:

- Stabilize steep roads within the watershed;
- Stabilize private driveways within the watershed;
- Design and install sediment collection devices such as formal sediment basins, catch basins with deep sumps, and/or Vortechnics units;
- Dredge the existing manmade pond located on west side of Mashapaug Road;
- Construct more formal sediment basins near Mashapaug Road;
- Construct a sediment forebay within Hamilton Reservoir at the outlet of Amber Brook that can be accessed by Town crews for routine sediment removal;
- Conduct annual street sweeping and cleanout of all stormwater structures; and
- Educate residents within the watershed of the importance of removing road sands from driveways each spring.

If the Town of Holland does not incorporate new stabilization and stormwater measures within the watershed, the existing sediment delta will continue to expand.

Stormwater runoff from the NC/HF site must also be managed. Currently, runoff is captured in intermediate sediment basins on the upgradient (north) side of the access road. Stormwater from these sediment basins is discharged across the access drive and is directed into a swale that flows east along silt fence. Stormwater from within the swale is directed into an existing (historic) sediment basin, which also accepts runoff directly from Mashapaug Road. The measures in place at the NC/HF site provide multiple levels of protection prior to discharging to Amber Brook; however, they must be maintained to be effective.

Subsequent to the June 23, 2008 event and under the direction of Milone & MacBroom, Inc., the following improvements were made at the NC/HF site:

- New hay bales were placed on the upslope side of the silt fence.
- Two small breeches in the silt fence were reinforced.
- The area on the eastern side of the silt fence was stabilized. Large woody debris was removed by hand; a metal rake was used to stabilize the area; and the area was seeded and covered with straw mulch.
- Three-inch crushed rock was installed in the drainage swale to help slow the water and stabilize the swale.
- Two berms were constructed on the access road to slow down runoff.
- The straw barrier at the outlet side of the sediment basin (upstream of the Mashapaug Road culvert) was reinforced to help filter runoff before discharging into Amber Brook.
- A small berm was placed along the shoreline site to help prevent sediment laden runoff along Mashapaug Road from depositing on the site.

Appendix C is a photo log of the site following completion of the above improvements.

NC/HF should continue to adhere to the Forest Cutting Plan issued by DEC in August of 2006 and continue to maintain sediment and erosion controls at the site. Sediment filter fence, haybales, and interim sediment basins should be inspected on a regular basis, particularly following significant rain events, and these protection measures should be maintained as necessary to ensure that they are not compromised during storm events.

Sediment Impact Investigation Report.doc

APPENDIX A

JUNE 20, 2008 PHOTO LOG

Appendix A
Sediment Investigation Study
Amber Brook/Hamilton Reservoir
Photo Log of June 20, 2008

Photo 1A
Hamilton Reservoir near Mashapaug Road.

Photo 2A
Hamilton Reservoir near sediment delta downstream of Amber Brook outlet.

Photo 3A
Amber Brook at outlet to Hamilton Reservoir.

Photo 4A
Amber Brook flowing beneath Mashapaug Road to Hamilton Reservoir.

Photo 5A
View of entrance to NC/HF property across Mashapaug Road.

Photo 6A
NC/HF Access Road. Amber Brook is to the left beyond the silt fence.

Photo 7A
Amber Brook adjacent to NC/HF property.

Photo 8A
Vegetative buffer strip between NC/HF access road and Amber Brook.

Photo 9A
Silt fence adjacent to (south of) NC/HF access road near Amber Brook.

Photo 10A
Original haybales and silt fence placed adjacent to (south of) NC/HF access road.

APPENDIX B

JUNE 23, 2008 PHOTO LOG

Appendix B
Sediment Investigation Study
Amber Brook/Hamilton Reservoir
Photo Log of June 23, 2008

Photo 1B
Sediment laden runoff coming from Park Road.

Photo 2B
Roadway runoff from Mashapaug Road and Union Road
flowing onto Northeast Concepts' shorefront property.

Photo 3B
Runoff from Mashapaug Road and Union Road
flowing onto Northeast Concepts' shorefront property.

Photo 4B
Sediment deposits from June 23, 2008 rain storm atop native soil and at Northeast
Concept shoreline property off Mashapaug Road.

Photo 5B
Rills formed on Short Road as a result of June 23, 2008 storm event.
Suspended solids being transported directly into Amber Brook.

Photo 6B
Rills observed on Short Road and Brook Road following rain event on June 23, 2008.

Photo 7B
Sediment deposits found within Amber Brook riparian forest zone downgradient from Short Road. Sediment discharges directly into Amber Brook.

Photo 8B
Large rills on Amber Road.

Photo 9B
Sediment deposits on Amber Road that are flowing towards Amber Brook.

Photo 10B
Manmade swale along north edge of Amber Road that drains to a Town catch basin located at the corner of Amber Road and Union Road. Large quantities of sediment within the swale dumps directly into catch basin, which is piped directly into Amber Brook.

Photo 11B
Catch basin located at corner of Amber Road and Union Road that is collecting sediment from Amber Road and discharging sediment directly into Amber Brook.

Photo 12B
Town owned SLCPP (smooth lined corrugated plastic pipe) outfall discharging sediment laden runoff directly into Amber Brook. Runoff within pipe is being collected from Amber Road.

Photo 13B
Historic sediment basin located at the corner of
Mashapaug Road and NC/HF access drive.

Photo 14 B
Silt fence undermining on NC/HF access drive.

Photo 15B
Silt fence along NC/HF access drive protecting Amber Brook.

Photo 16B
Interim sediment basin traps constructed on NC/HF property.

APPENDIX C

JULY 2008 PHOTO LOG

Appendix C
Sediment Investigation Study
Amber Brook/Hamilton Reservoir
Photo Log of July 2008

Photo 1C
Newly planted area and refurbished silt fence and haybales along entrance drive.

Photo 2C
View of entrance drive from Mashapaug Road.

Photo 3C
Maintained interim sediment basin traps on NC/HF property.
View looking to the east.

Photo 4C
Maintained interim sediment basin traps on NC/HF property.
View looking to the west.

Photo 5C
Maintained interim sediment basin traps on NC/HF property.
View looking to the north.