Mukluk Preserve Property
Sprague, Connecticut

Eastern Connecticut Environmental Review Team Report

Eastern Connecticut
Resource Conservation and Development Area Inc.

Mukluk Preserve Property
Sprague, Connecticut

Environmental Review Team Report

Prepared by the
Eastern Connecticut Environmental Review Team

Of the
Eastern Connecticut
Resource Conservation and Development Area, Inc.

For the
Conservation Commission
Sprague, Connecticut

January 2008

Report # 615

Acknowledgments

This report is an outgrowth of a request from the Sprague Conservation Commission to the Eastern Connecticut Conservation District (ECCD) and the Eastern Connecticut Resource Conservation and Development Area (RC&D) Council for their consideration and approval. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The Eastern Connecticut Environmental Review Team Coordinator, Elaine Sych, would like to thank and gratefully acknowledge the following Team members whose professionalism and expertise were invaluable to the completion of this report.

The field review took place on Wednesday, August 1, 2007.

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**Report expected, but not yet received.*

I would also like to thank Donald Boushee, chair, conservation commission, Dennison Allen, first selectman, Gerald Stefon, Kathleen Boushee and Joe Osonski, planning and zoning commission, Penny Newberry, grant writer and Paul Burgess, consultant for their cooperation and assistance during this environmental review.

Prior to the review day, each Team member received a summary of the proposed project with various maps and other reports were available for review: 1) Open Space and Watershed Land Grant Acquisition program Application/Engineering Report (2004), 2) Phase I and Phase II Environmental Site Assessment (2004), 3) EPA Phase II Report (2006) and 4) Mukluk Appraisal (2004). During the field review Team members were given additional information. Some Team members conducted a map review only. Following the review, reports from each Team member were submitted to the ERT coordinator for compilation and editing into this final report.

This report represents the Team's findings. It is not meant to compete with private consultants by providing site plans or detailed solutions to development problems. The Team does not recommend what final action should be taken on a proposed project - all final decisions rest with the town. This report identifies the existing resource base and evaluates its significance to the proposed use, and also suggests considerations that should be of concern to the town. The results of this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in the review of this town owned property.

If you require additional information please contact:

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*Pre-walk meeting at the town hall***.**

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Introduction

The Sprague Conservation Commission has requested assistance from the Eastern Connecticut Environmental Review Team (ERT) in conducting a natural resource inventory and review of the town owned Mukluk Preserve property.

The Mukluk Preserve is a 270+ acres former private skeet shooting and hunting preserve located in the northwest corner of town, with a small portion in Franklin and Scotland. It borders the Ayer's Mountain Preserve in Franklin, has one mile of frontage on the Shetucket River, and lies directly across from the Mohegan State Forest. It is an integral part of the Shetucket Heritage Corridor and the Last Green Valley.

The property has been used for many things since the early 1700's so it is a wealth of historic and cultural artifacts, including stage coach roads, tavern and barn foundations, ice ponds, etc. It is a very large site with wildly varying topography and plant and animal species. The property, being privately owned for over 50 years, has not been accessible to the public. In 2004-2005 O&G Gravel proposed purchasing the property; the foreseen consequences of this operation resulted in the community's voting overwhelmingly to purchase the property, with the scarce resources they had, and preserve it for "open space and other municipal purposes." There is a network of well-used hiking trails and dirt roads on the site and along the river that indicates activities like fishing, hiking, birding and bicycling are common uses of the site.

The Mukluk Preserve was purchased by the Town in 2004/2005 for a purchase price of 1.3 million dollars. The town applied for an Open Space and Watershed Land Acquisition Grant from the state and received $500,000 in grant funds to offset the cost of purchase. The Town will have to vote on the acceptance of the grant in the future. The conditions of acceptance are the placement of a conservation easement on all but 16 acres of lead-contaminated land, which is in the process of being remediated. Some citizens would prefer to see economic rather than social or ecological gain derived from the property.

Objectives

The fledgling Sprague Conservation Commission (SCC) can say, but cannot prove, that the property possesses so many natural resources that it is indeed economically prudent to advocate for its preservation. The SCC needs the ERT's assistance to produce a detailed and thorough inventory of the property's natural resources. Its river frontage and integral wetlands, with its varying plant and animal species, need to be catalogued. It is important that a thorough inventory be completed in order for citizens to understand as much as about this important resource as possible in order to make an informed choice about the conservation easement. Although well-used over the years, no attention was ever paid at this site to the interaction of the species existing there. People who have visited Mukluk are amazed by its beauty and diversity. The goal

of the town is to provide as much access to as many people as possible; so that this property's intrinsic value will never be questioned.

Information and concerns expressed by the town include:

- Soils – limitations and opportunities
- Topography/Geology - possible gravel deposits
- Erosion and Sediment Control - protection of wetlands and watercourses
- Wetlands – significance and protection of wetlands
- Ponds – information and guidance on remediation efforts
- River Ecology – protection of the river
- Fisheries – aquatic resources
- Wildlife – wildlife resources and habitats
- Vegetation – general descriptions and guidelines
- Archaeological and Historic Significance
- Recreational Use
- Land Use – limitations and opportunities, consistency with state, local and regional plans
- Traffic/Access

The ERT Process

Through the efforts of the Sprague Conservation Commission this environmental review and report was prepared for the Town of Sprague.

This report provides a natural resource inventory and a series of recommendations and guidelines which cover the topics requested by the Commission. Team members were able to review maps, plans and supporting documentation provided by the town.

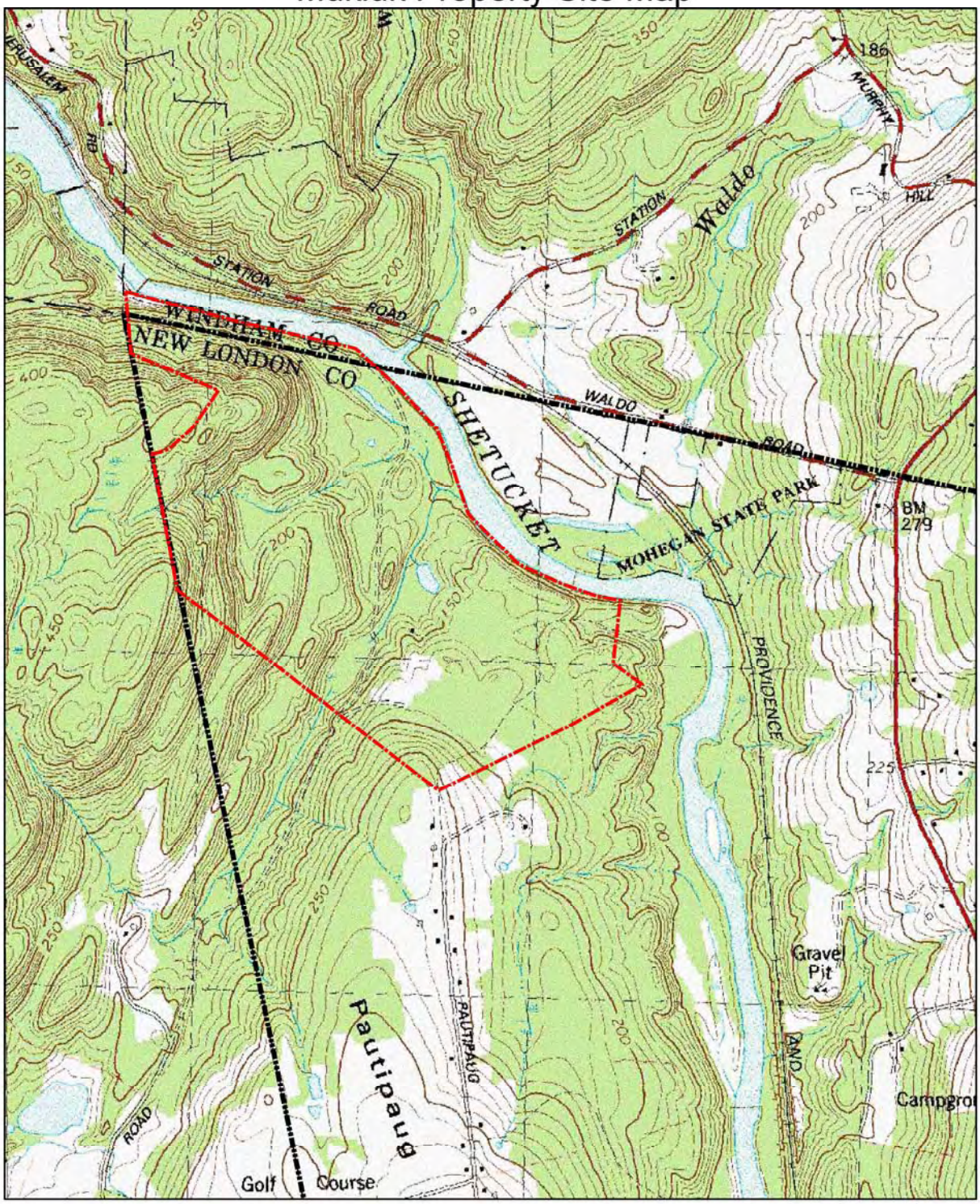
The review process consisted of four phases:

1. Inventory of the site's natural resources;
2. Assessment of these resources;
3. Identification of resource areas and review of plans; and
4. Presentation of education, management and land use guidelines.

The data collection phase involved both literature and field research. The field review was conducted on Wednesday, August 1, 2007. The emphasis of the field review was on the exchange of ideas, concerns and recommendations. Some Team members made separate and/or additional site visits while others conducted a map review only. The field review allowed Team members to verify information and to identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. Individual Team members then prepared and submitted their reports to the ERT coordinator for compilation into this final ERT report.

Mukluk Property Site Map



The Connecticut Environmental Review Team

This map was prepared by Amanda Fargo-Johnson for the Connecticut Environmental Review Team. This map is for educational use only. It contains no authoritative data. July 2007.

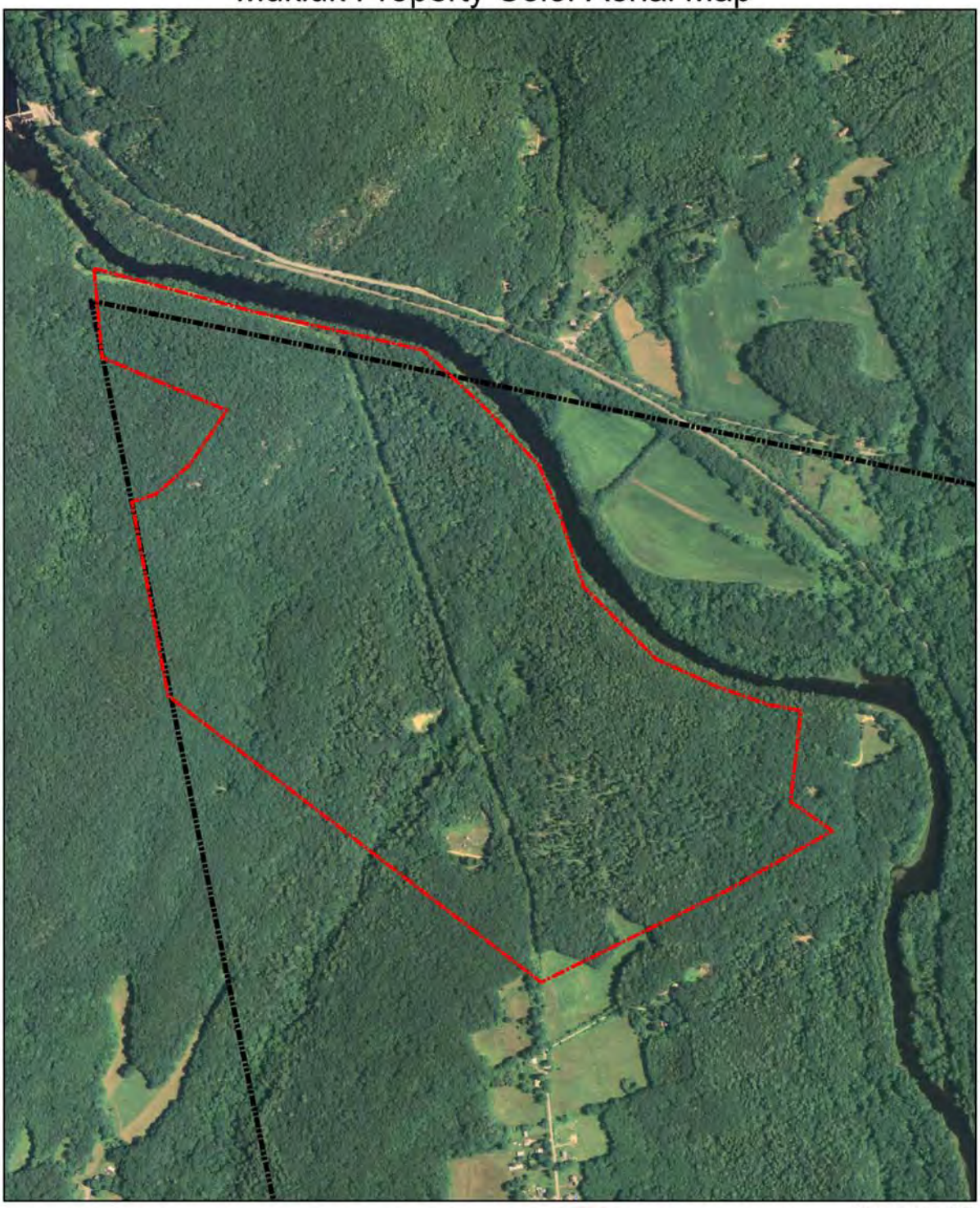
ERT Review Area

Sprague, CT

N

0 0.050.1 0.2 0.3 Miles

Mukluk Property Color Aerial Map



The Connecticut Environmental Review Team

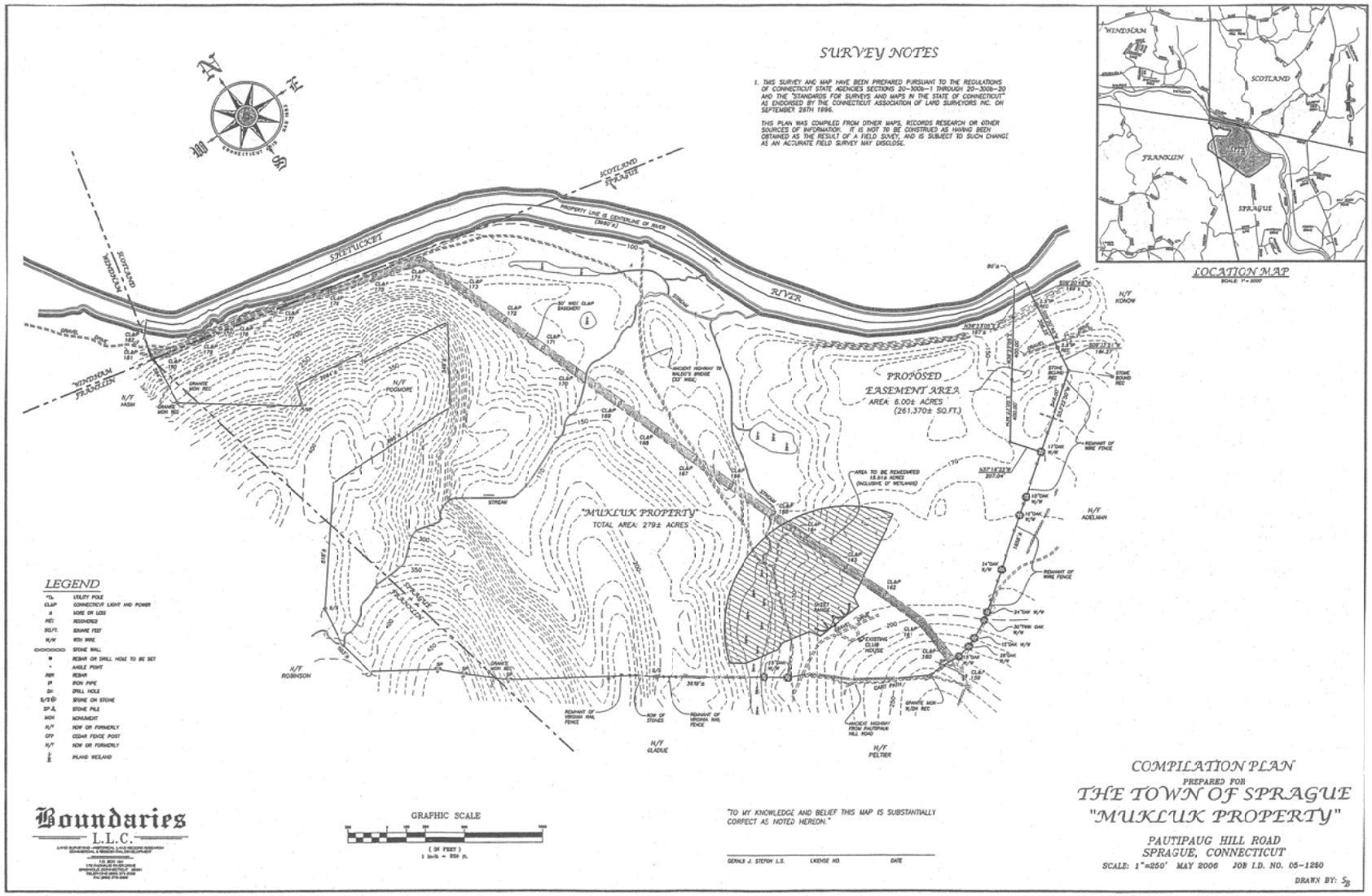
This map was prepared by Amanda Fargo-Johnson for the Connecticut Environmental Review Team.
This map is for educational use only.
It contains no authoritative data.
August 2007.

ERT Review Area

0 0.040.08 0.16 0.24
Miles

Sprague, CT

N


SURVEY NOTES
1. THIS SURVEY AND MAP HAVE BEEN PREPARED PURSUANT TO THE REGULATIONS OF CONNECTICUT STATE AGENCIES SECTIONS 20-300b-1 THROUGH 20-300b-20 AND THE "STANDARDS FOR SURVEYS AND MAPS IN THE STATE OF CONNECTICUT" AS ENDORSED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS INC. ON SEPTEMBER 26TH 1996.
THIS PLAN WAS COMPILED FROM OTHER MAPS, RECORDS RESEARCH OR OTHER SOURCES OF INFORMATION. IT IS NOT TO BE CONSTRUED AS HAVING BEEN OBTAINED AS THE RESULT OF A FIELD SURVEY, AND IS SUBJECT TO SUCH CHANGE AS AN ACCURATE FIELD SURVEY MAY DISCLOSE.
LOCATION MAP
SCALE 1" = 2000'
WINDSOR
SCOTLAND
FRANKLIN
SPRAGUE
SHETUCKET
RIVER
PROPERTY LINE IS CENTERLINE OF RIVER (N90°E)
PROPOSED EASEMENT AREA
AREA: 6.00± ACRES
(261,370± SQ.FT.)
"MUKLUK PROPERTY
TOTAL AREA: 279± ACRES
AREA TO BE REMEDIATED 18.51± ACRES (INCLUSIVE OF WETLANDS)
EXISTING CLUB HOUSE
ANCIENT HIGHWAY TO WILDO'S BRIDGE (33' WIDE)
ANCIENT HIGHWAY FROM PAUTIPAUG HILL ROAD
CART PATH
STREAM
LEGEND
UTILITY POLE
CLAP CONNECTICUT LIGHT AND POWER
M&L MORE OR LESS
REC RECORDED
SQ./FT. SQUARE FEET
W/W WIRE WIRE
STONE WALL
REBAR OR DRILL HOLE TO BE SET
ANGLE POINT
RBR REBAR
IP IRON PIPE
DH DRILL HOLE
S/S SPIKE ON STONE
SP PILE STONE PILE
MON MONUMENT
N/F NOW OR FORMERLY
CFP CEDAR FENCE POST
N/F NOW OR FORMERLY
WETLAND
Boundaries
L.L.C.
GRAPHIC SCALE
(IN FEET)
1 inch = 200 ft.
"TO MY KNOWLEDGE AND BELIEF THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON."
GERALD J. STETON L.S. LICENSE NO. DATE
COMPILATION PLAN
PREPARED FOR
THE TOWN OF SPRAGUE
"MUKLUK PROPERTY"
PAUTIPAUG HILL ROAD
SPRAGUE, CONNECTICUT
SCALE: 1"=250' MAY 2006 JOB I.D. NO. 05-1260
DRAWN BY: SB

Geology

Topography

Topography of the Mukluk Preserve is easily separated into two areas: an upland area to the west and a hummocky lowland area to the east. Geology is responsible for the bipartite nature of the topography. Upland areas are underlain by bedrock. The lowlands are underlain by sand and gravel deposited by glacial melt-water streams (See Fig. 1 and 2).

The Shetucket River forms the northern boundary of the Preserve and the lowest elevation in the Preserve (just lower than 90 feet above sea level) is along the river's downstream banks. It flows southeasterly at a gradient of about 10 feet/mile. It passes through a shallow bedrock-gorge (about 300 feet deep) along the northwestern part of the parcel. Thereafter the river flows beside forested sand and gravel banks that form riverside bluffs, up to 90 feet high, near the eastern part of the preserve (Fig. 3). The river frontage in the central part of the Preserve is an older river terrace that stands about 10 feet above modern river elevation. The older terrace has a natural levee (Fig. 4A) that has been breached by local modern streams (Fig.4B).

Figure 1A. Bedrock geology of the Mukluk Preserve and surrounding area. DSs = Scotland Schist; Soh = Hebron Gneiss; Dc = Canterbury Gneiss (not exposed on Preserve). Map from DEP, Environmental Conditions Online which is taken from Rodgers, 1985.

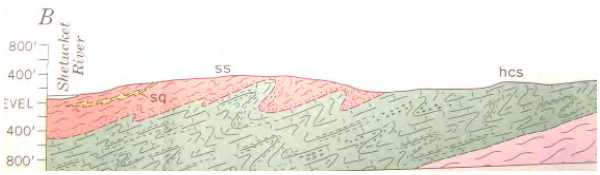


Figure 1B. Cross section illustrating the complex folding. The location of the cross section is just northeast of the parcel and it is oriented at right angles to the trend of the ridge. ss = Scotland Schist, hcs = Hebron Gneiss. Copied from BB' of Dixon and Shaw, 1965.

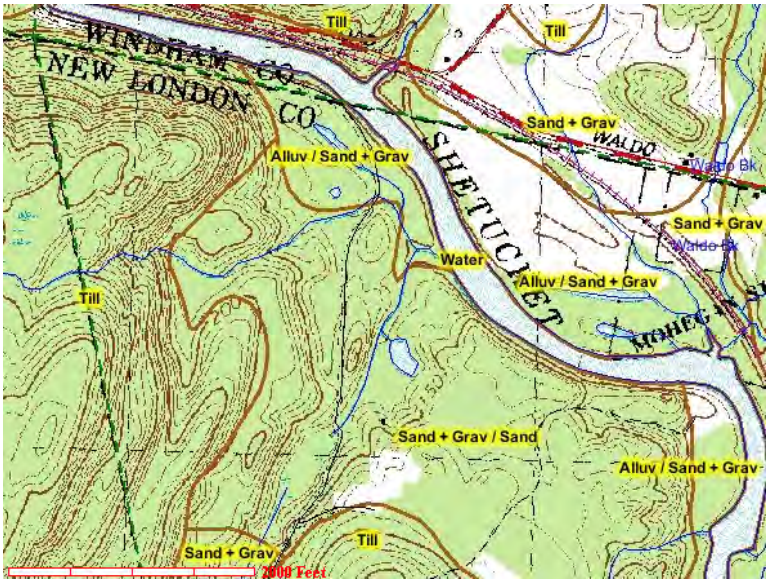


Figure 2. Surficial geologic map of the Mukluk Preserve and surrounding area. This map shows, for any given area, what type of unconsolidated material can be found overlying the bedrock. Unfortunately it does not show the location of outcrops. Map from DEP, Environmental Conditions Online which is taken from Stone and others, 1992.

Figure 3. Shetucket River, looking downstream. Steep forested bluffs seen on the riverside downstream are underlain by sand and gravel. The bluff top elevation is about 80 feet above the river. The Shetucket River does not have a well developed flood plain at this location. Modern floodplain elevation may be seen in the small tributaries that empty into the Shetucket (see Fig.8).

A. B.

Figure 4. A. Terrace along the Shetucket River (on right side of image) and natural levee associated with the terrace rather than with the modern river floodplain. Terrace stands 8-10 feet above the river level and the natural levee top stands 10-15 feet above the modern river elevation. The river may be seen on left side of image. This was mapped as modern alluvium (and therefore a modern levee) by Shaw (Dixon and Shaw, 1965). B. Breach in terrace and levee by modern stream.

The uplands are mostly covered by a thin veneer of glacial till and significant rock exposure can be found. The bedrock ridge along the western part of the Preserve contains the highest elevations, a maximum of just higher than 460 feet, and the most rugged topography. Here local cliffs are formed by glacial erosion along joint sets (aligned fractures). Where an intermittent stream crosses the steep topography two waterfalls are formed (Fig. 5A and 5B). The rock structure (foliation), oriented northeast-southwest, controls the topographic expression of the bedrock ridges. The important joints strike northeast-southwest also.

The lowland area has a rather hummocky topography. Some small (area-wise) depressions, referred to as kettles, are filled with shallow bodies of standing water. Most of the lowland topography is the result of processes that occurred during and immediately after deposition of the sand and gravel from glacial melt-water streams. Modern day erosion has been minor.
.

A.

B.

Figure 5. A. Lower waterfall (dry in August, 2007) cascades over an outcrop of Hebron Gneiss. Image by A. Johnson. B. Stepped cliff over which water cascades when intermittent stream is flowing. This is the upper falls; it is greatly concealed by leaves during the spring and summer. The cascade falls over Scotland Schist.

Bedrock Geology

The Mukluk Preserve is underlain by two geologic formations: the Scotland Schist and the Hebron Gneiss (Figure 6A and 6B). The Hebron Gneiss is poorly exposed; most of the bedrock outcrops on the Preserve consist of the Scotland Schist. The foliation strikes northeast-southwest and dips (is tilted) toward the southwest.

A.

B.

Figure 6. A. Fragments of Scotland Schist. B. Outcrop of Hebron Gneiss. This is a calc-silicate gneiss. The major foliation and bedding coincide. Beds are several centimeters thick (1-2 inches) and are defined by thin micaceous seams (recessive weathering).

The Scotland Schist is the younger of the two formations. It consists of gray to silvery, medium grained quartz-muscovite schist. Locally, small crystals of garnet and staurolite are found. It is well foliated and in many areas deformed with small amplitude near isoclinal folds. It is not well fractured and for that reason it is more difficult for glaciers to erode. Hence, schist underlies the uplands. Where a good joint set is formed, the Scotland Schist supports cliffs and one of the

waterfalls mentioned above. The Scotland Schist is Siluro-Devonian in age (Rodgers, 1985) and overlies the Hebron Gneiss, which is Siluro-Ordovician in age.

The Hebron Gneiss consists of interlayered dark gray schist and greenish gray, fine to medium grained calc-silicate gneiss. It fractures better than the Scotland Formation and was eroded to a lower elevation by the Ice Age glaciers. It is exposed in the lower of two waterfalls on the Preserve (an outcrop that was missed by the Dixon and Shaw, 1965).

The geologic structure of the area is complex (Figure 1B). Generally, however, the foliation of these rocks dip toward the southwest. The major foliation and compositional layering of the rocks coincide. The rocks are folded, possibly isoclinally folded. Small scale folding is evident in the schistose rocks. Large-scale folding is made apparent by geologic mapping (Dixon and Shaw, 1965).

A prominent cross-fault was mapped by Dixon. It is located in the gorge cut by the Shetucket River. It is likely that the river exploited the weakness in the rocks caused by the fault to erode the gorge.

Surficial Geology

A deposit of sand and gravel covers the eastern two-thirds of the Preserve. It may be as much as 100 feet or more in thickness. Glacial melt-water streams at the end of the last Ice Age deposited the sand and gravel. Small amounts of left over glacial ice remained in the valley and the melt-water streams flowed over and around the ice. Sand and gravel were deposited against and upon the left over ice. The streams likely formed a fairly broad alluvial plain over the ice. When the leftover ice melted, the surface of the sand and gravel alluvial plain deposit settled or collapsed into the space the ice occupied before melting. This process created the hummocky topography (Figure 7A).

A. B.

Figure 7. A. Hummock topography is characteristic of sand and gravel deposited against and upon left over glacial ice. When the left over ice melts the sand surface subsides into the space formerly occupied by the ice. This results in the uneven topography. The low area on the left of the image is where the left over ice was thicker. B. Ridge of sand and gravel must have been formed where ice was thin, possibly in a crack or channel. Space for thicker sand to accumulate

was created by the absence of left over ice. Sand on all sides of the ridge collapsed into the space created when the ice melted.

Thicker deposits of sand formed in the hollows or thin areas of the left over ice and today, with the ice gone, they form the high areas of the deposit. For instance, sand deposited in a crack or crevasse in the ice would appear as a ridge today (Figure 7B). Sand deposited around a large chunk of left over ice would today appear as a low spot, referred to as a kettle.

A floodplain and modern alluvium can be found on the opposite side of the Shetucket River abutting the Preserve and in local areas where tributary streams breach the terrace levee (Figure 8A and B). The modern flood plain lies 4-7 feet lower than the terrace levee and 2-4 feet lower than the terrace elevation. It lies approximately at the flood elevation (see FEMA Flood Maps). The flood plain is only identifiable on the parcel at the confluence of two tributary streams with the Shetucket.

A.

B.

Figure 8. Modern flood elevation indicated by flood plain on tributary stream just inboard from its confluence with the Shetucket River, which can just barely be seen on the right side of Figure 8B. Note terrace levee on the right of both images. An erosional scarp made by tributary stream can be seen in levee.

References

Dixon, H.R., and Shaw, C.E., Jr., 1965, Geologic map of the Scotland Quadrangle, Connecticut. U.S. Geol. Surv. Map GQ-392.

Rodgers, John, 1985, Bedrock Geological Map of Connecticut. State Geological and Natural History Survey of Connecticut, Nat'l. Resource Atlas Series, 1:125,000, 2 sheets.

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Conservation District Review

Introduction

The Mukluk Preserve is a 270 acre parcel tucked into the northwest corner of the town of Sprague. Several years ago the citizens of Sprague purchased the property for the purpose of preserving it as open space and other possible municipal uses.

Flowing along the northeastern property line is the Shetucket River. The property boasts of about 1 mile of river frontage. The Shetucket River is part of the Quinebaug-Shetucket Rivers Valley National Heritage Corridor as designated by Congress in 1994. Sprague is one of 35 towns in the designated corridor.

Due to a previous use as a Skeet Club, a portion of the site was determined to have lead contamination and is therefore undergoing review for site remediation. The contaminated area is presently well defined in the field with safety netting, a portion of which contains wooded wetlands, a small pond, and an associated intermittent watercourse.

In the middle of site a small gravel excavation operation was noted. Slopes are still exposed, with some colonies of invasive species. Old material stockpiles and a screener are still present.

Access to the property is via a long, one lane, dirt drive, off of Holton Road in the Town of Franklin. Pautipaug Road in Sprague gets close to the parcel but does appear to provide direct frontage.

Resources and Recommendations

Included in this report is an overview of site resources for water, soils, and vegetation and associated recommendations. Also addressed is open space and general planning considerations relating to future uses for the property.

Water Resources

One of the key water resources on site is the Shetucket River. The Shetucket River is a 25 mile tributary of the Thames River. Bottom substrate consists of cobbles interspersed with boulders.

There are riffle and pool sections combined with deeper water pools. A few quick stone turnovers revealed numerous stonefly larvae, a desirable macroinvertebrate. Offering riverine habitat, fishing and other recreational opportunities and aesthetically beautiful, the river is a valuable resource.

Several intermittent watercourses flow through the site, discharging to the Shetucket River along its western bank. In the northwestern part of the property, the watercourse flows over significant elevation drops of over 150 feet in a distance of 750 feet, creating spectacular waterfalls where the slopes near a vertical angle. Wooded wetlands, as well as a beaver pond, are additional water resources associated with the watercourses.

Surface water quality ratings are listed as B (suitable for uses such as fishing and swimming) for the Shetucket River, and A or AA (indicating good to excellent natural quality) for the tributaries on site. This is referencing the CT-DEP Standards and Classifications Map, published by CT-DEP.

Portions of the site along the river are designated as having deposits of coarse grained stratified drift (sand/sand and gravel), with a water saturated thickness of 10 feet or greater, according to the map entitled, Groundwater Availability in Connecticut, by Daniel Meade, 1978. Groundwater throughout the site is classified as GA and GAA (indicating natural quality or suitable for drinking) based on CT-DEP Connecticut Water Quality Standards and Classifications.

Recommendations

- If any land development is considered for this property, substantial “no disturbance zones” should be established adjacent to the Shetucket River. While the steep slopes adjacent to the river appear stable at this point, any loss of vegetation or flooding could contribute to slope undercutting or slumping. Maintaining large buffers, allows area for natural slope erosion while minimizing impact of man induced activities. “No disturbance zones” should be on the order of several hundred feet. Activities such as trails, plantings, and river access, could be conducted provided the appropriate steps to minimize erosion are taken.
- As the intermittent watercourses feed directly to the river, areas adjacent to these resources should also be protected. All steep slopes immediately adjacent to water resources should be included in a “no disturbance zone”.

- Any plans for development of the property should carefully consider stormwater impacts. Pollutants associated with stormwater runoff are a leading factor in water quality decline. Additionally, large flushes of hot water, which can increase river water temperature, should be avoided.

- Any change in land-use should also be reviewed in light of potential impacts to groundwater quality, which can impact the river and possible future water supplies.

- While the final determination of the lead contamination clean-up will be under the direction of the DEP, careful consideration should be given to potential impact on water resources as well. Timing of clean-up, erosion controls, dewatering practices and habitat restoration measures should all be a part of a comprehensive remediation plan.

Soils and Topography

The majority of the site has moderately sloping to very steep topography, with almost vertical slopes adjacent to the river in the eastern portion of the site. The western part of the property encompasses a portion of land formation known as Pleasure Hill. Heading northwest to northeast, the river is flanked by steep banks which become gentle to moderately sloping then develop to almost vertical slopes along the most easterly border. Surprisingly, the banks are relatively stable even along the steepest part, as a result of the forested cover. Removal of anything more than a few trees along the bank area would expose the river to moderate to severe erosion potential.

There are several areas of gently sloping land on the parcel. However the only sizable portion which is not encumbered by wetlands or watercourses is in the southeastern part of the site.

General soils mapping for the site based on the NRCS website is included at the end of this section. In addition, ECCD has supplied a site restriction table that corresponds to the soil types. Included in the table are restrictions for construction materials (gravel source), shallow excavations and soil potential ratings for sanitary sewage disposal systems. The corresponding ratings are based on a 0.01-1.00 numerical scale. A soil feature with a 0.00 rating is not considered a limitation while a rating of 1.00 relates to the greatest negative impact. There are several soil types listed with fair to good potential for gravel sources. However these same soils are also rated as very limited with shallow excavations (5-6 feet), due to caving of cut banks, slope and depth to bedrock. Additionally the majority of these soils appear to be located either immediately adjacent to the river, other water resources, or the contamination site.

Recommendations

- Every effort should be made to preserve steep slope areas that are currently stabilized, due in a large part by the existing vegetation. This will minimize erosion potential and downstream impacts. This is especially critical along the river bank as well as the wetland and watercourse resources.

- The majority of the soils on site are associated with limited potential for septic installation due to issues with seepage of improperly treated effluent. On-site septic may be very limited on this site and should be reviewed carefully if future plans call for leaching systems.

- While a sieve analysis would answer the question on sand and gravel quality, the bigger question is the suitability of the site for a gravel excavation operation. Gravel excavation sites can have several detrimental impacts, including;
    - alteration of surface hydrology,
    - reduced cover material over groundwater sources,
    - removal of valuable farmland soils,
    - introduction of widespread invasive species,
    - noise pollution,
    - air pollution,
    - increased erosion issues and
    - negative water quality impacts associated with sedimentation and commercial vehicle pollutants.

    Careful consideration of all those potential impacts should be a part of any decisions on future use of the property.

Vegetation

The site contains a diverse array of vegetative communities, including, coniferous forests, mixed deciduous forests, wooded wetlands and the power line shrub/field habitats. Following is a brief overview of significant vegetative communities on site.

Coniferous Forests

In the eastern and southern portions of the site and along some of the riverbank are coniferous forests dominated by white pine and eastern hemlock stands. Where white pine is dominant, the canopy also includes to a lesser degree some hemlock, red maple, hickory, black birch and white oak. Maple-leaved viburnum, lowbush blueberry, beech, black cherry and huckleberry form the lower understory communities. Where present, herb layers consist of ground pine, May flower, ferns, sorrel and wild lettuce among other species. Species such as poison ivy, multiflora rose, blackberry and bittersweet are found along trail and power line edges.

Fallen trunks and some tree removal have created small openings in the canopy where herbaceous vegetation thrives. Branches and trunks on the ground provide microhabitats for smaller animals, including amphibians, small mammals and insects, which in turn provide rich food sources for other species

The hemlock stands consist primarily of a monoculture with little to no understory. On the steep river bluffs, hemlocks are providing the main source of bank stabilization.

Deciduous Forests

The majority of the western part of the site is dominated by deciduous forest species. Included in the canopy are oak, hickory, red maple, sugar maple, birch, with some hemlock and white pine. The shrub layer is dominated by blueberry, mountain laurel, bayberry and huckleberry with species including goldenrod, partridgeberry, ground pine, club moss, ferns and various grasses forming the herb layer.

Wooded Wetlands

The wooded wetlands on site are located in various areas, and in general include species such as red maple, birch, hickory and musclewood in the overstory, blueberry, winterberry, witch hazel, sweet pepperbush, spice bush, sassafras, mountain laurel in the understory with, cinnamon fern,

royal fern, New York fern, lady fern, skunk cabbage, trillium, ground pine, sphagnum moss, sedges, grasses, and wild grape as the herbaceous layer.

The small pond, in addition to species found in the wooded wetlands also has species including speckled alder, joe-pye-weed, blue iris, monkey flower, smartweed, sensitive fern, touch me not, alder, bur-reed, sedges, and rushes.

Power Line ROW

Bisecting the property north to south is a power line right of way. Due to the nature of power lines, vegetation is kept at a shrub layer and below and therefore supports a larger diversity of herbaceous plants. The shrub layer is dominated by blueberry, mountain laurel, witch hazel, blackberry, winter berry, some barberry and small white pine seedlings. Bracken fern, sweet fern, hay-scented fern, goldenrod, day flower, smartweed, calico aster, dewberry, sedges, club moss, grasses, groundnut, heal-all, and common plantain are present in the herb layer.

Power lines, or any other cleared area, can have both a positive and negative impact on forest habitat. On the one hand they break up large continuous tracts of forests and fragment the landscaped environment. They do however provide an edge effect which allows for a wider variety of plant species and thus food sources, which are important to some species.

Invasive Species

Invasive species were noted at several locations, and are usually associated with land disturbances. The small gravel excavation site contained small colonies of both phragmites as well as autumn olive. Also noted at various points on site were bittersweet, and barberry.

Species of Concern

Several listings for Connecticut Species of Concerns were noted along the river corridor according to the CT DEP Natural Diversity Data Base mapping. Further information on specific species can be obtained from that department.

Recommendations

- One of the main items requested was an inventory of fauna and flora species. While we have included general plant communities in this report, it does not substitute for an in-depth cataloging of species, if that is what has been deemed necessary for future decision-making. There are several options to obtaining more information which include:
    - hiring of private firms who specialize in flora and fauna identification,
    - coordinating with local college or universities for a similar service or
    - organizing a Bioblitz, which is 24 hour inventory of site species conducted by scientists and hosted by the Center for Conservation and Biodiversity and the Connecticut Museum of Natural History.

- If not provided in the ERT report, further information on the presence of species of concern on the Mukluk property should be obtained from the DEP Natural Diversity Data Base. Knowing the specific species involved and their associated habitat will help determine the likelihood of their presence on this parcel.

- Simple wildlife management techniques such as maintaining some dead trees, fallen logs, brush piles and using native species if supplemental planting is anticipated will continue to maintain or improve habitat.

- While much of the site is free of invasive species, those areas that have been disturbed, such as the small gravel pit or power lines are most susceptible to colonization by undesirable species. Future plans should consider the possible negative impact of opening up new areas on site to invasive species.

- Periodic removal of small colonies of invasive plants will assist in minimizing the spread.

Open Space and Planning Considerations

Of primary importance for the citizens of Sprague is to decide what the long term best use of the property is.

This property has increased value not only from its size of 270 acres, but from surrounding open space areas as well. Over 3,500 acres of relatively undeveloped land exists in this vicinity. New England is noted for its habitat fragmentation due to development, which has spanned several hundred years. While some animal species adjust to suburban or even urban development, many species require large tracts of undisturbed land. Although some of the acreage is owned privately and may come under development pressure in the future, there are several other large designated open space parcels, either linked or within close proximity to this parcel

Should the town opt to move forward with any development plans, the following should be considered very carefully.

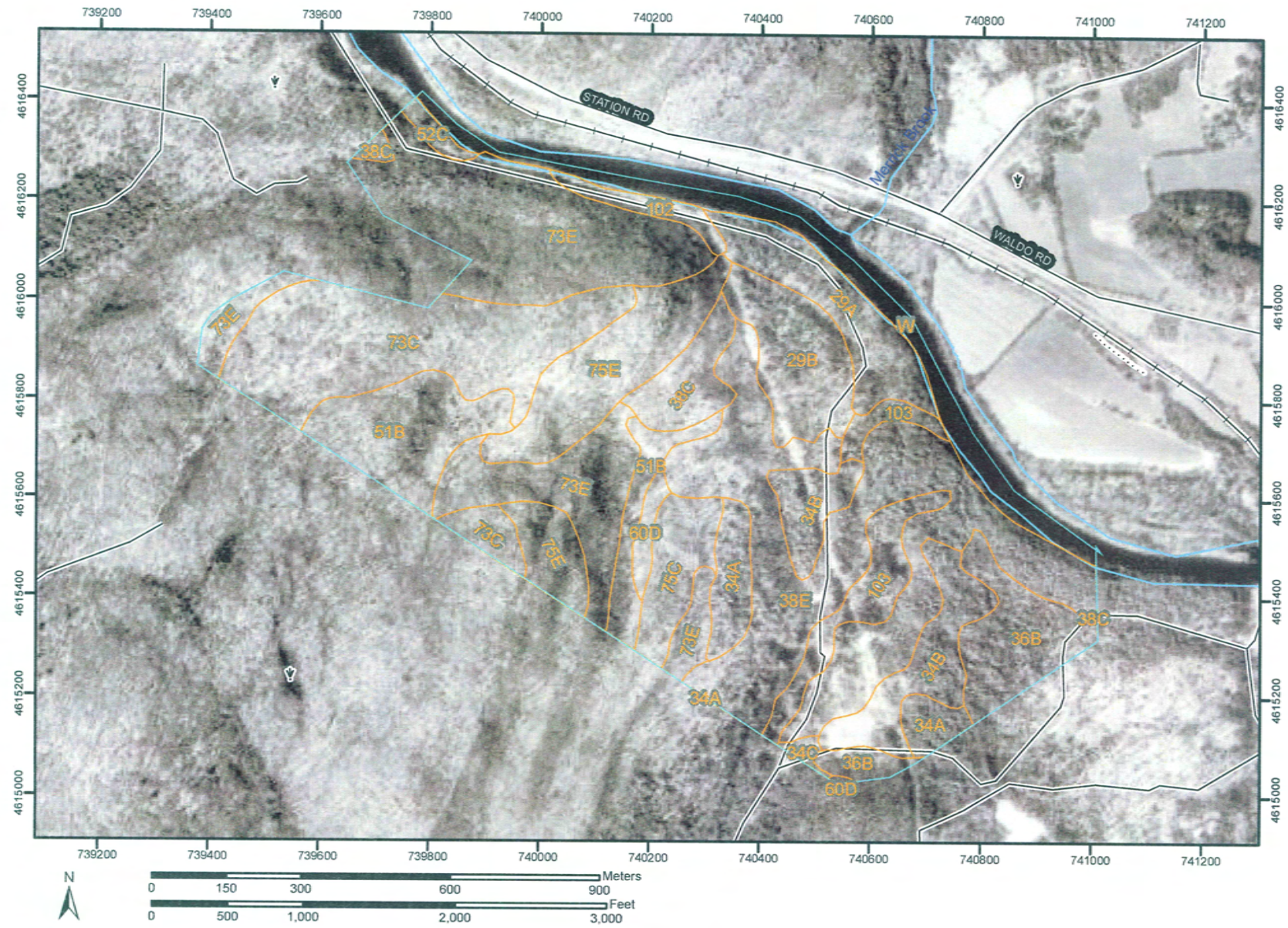
Recommendations

- Due to the nature of the site; being situated adjacent to the Shetucket River, an integral part of the river corridor, the presence of adjacent species of concern, terrain of moderate to steep topography, and diversity of habitats present, it is ECCD's opinion that the majority of the property should be maintained as open space. That being said, there are many opportunities to use the property for passive recreation including, fishing, hiking, cross country skiing and photography. Other potential uses include environmental education, timber management, research, or a place for community gatherings. However, should the town consider more intensive use of the property, including activities such as land clearing, grading, etc., ECCD strongly recommends that it be confined to the southeast corner, because that portion of the property is restricted the least by natural resource concerns. It is further recommended that any such use of the property not exceed 20% of the total acreage.

- If the town has not already designated a river corridor protection zone on its Plan of Conservation and Development, it would be prudent to implement such a tool at this time. This will highlight the importance of the resource and aid it in its preservation.

- If site development is proposed, access to the property would likely need to be substantially upgraded, including town road(s). Careful consideration of the detrimental impacts to natural resources and neighborhood characteristics should be weighed

Soil Map–State of Connecticut
(Mukluk Preserve)



USDA Natural Resources Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 6, Mar 22, 2007

Date(s) aerial images were photographed: 4/12/1991

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

State of Connecticut (CT600)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
29A	Agawam fine sandy loam, 0 to 3 percent slopes	13.9	4.4%
29B	Agawam fine sandy loam, 3 to 8 percent slopes	14.0	4.4%
34A	Merrimac sandy loam, 0 to 3 percent slopes	8.4	2.7%
34B	Merrimac sandy loam, 3 to 8 percent slopes	17.4	5.5%
34C	Merrimac sandy loam, 8 to 15 percent slopes	0.8	0.3%
36B	Windsor loamy sand, 3 to 8 percent slopes	15.0	4.8%
38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	8.2	2.6%
38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	57.9	18.4%
51B	Sutton fine sandy loam, 2 to 8 percent slopes, very stony	21.9	6.9%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	1.5	0.5%
60D	Canton and Charlton soils, 15 to 25 percent slopes	2.2	0.7%
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	38.0	12.1%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	55.8	17.7%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	8.4	2.7%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	23.5	7.4%
102	Pootatuck fine sandy loam	3.3	1.0%
103	Rippowam fine sandy loam	11.2	3.6%
W	Water	14.2	4.5%
Totals for Area of Interest (AOI)		315.5	100.0%

Selected Soil Interpretations

This report allows the customer to produce a report showing the results of the soil interpretation(s) of his or her choice. It is useful when a standard report that displays the results of the selected interpretation(s) is not available.

When customers select this report, they are presented with a list of interpretations with results for the selected map units. The customer may select up to three interpretations to be presented in table format.

For a description of the particular interpretations and their criteria, use the "Selected Survey Area Interpretation Descriptions" report.

Report—Selected Soil Interpretations

Selected Soil Interpretations– State of Connecticut							
Map symbol and soil name	Pct. of map unit	Eng - construction materials; gravel source (ct)		Eng - shallow excavations		Eng - soil potential ratings of ssds (ct)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
29A—Agawam fine sandy loam, 0 to 3 percent slopes							
Agawam	80	Poor		Very limited		High potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.00				
29B—Agawam fine sandy loam, 3 to 8 percent slopes							
Agawam	80	Poor		Very limited		High potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.00				
34A—Merrimac sandy loam, 0 to 3 percent slopes							
Merrimac	80	Fair		Very limited		High potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.29				
34B—Merrimac sandy loam, 3 to 8 percent slopes							
Merrimac	80	Fair		Very limited		High potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.29				

Selected Soil Interpretations– State of Connecticut							
Map symbol and soil name	Pct. of map unit	Eng - construction materials; gravel source (ct)		Eng - shallow excavations		Eng - soil potential ratings of ssds (ct)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
34C—Merrimac sandy loam, 8 to 15 percent slopes							
Merrimac	80	Fair		Very limited		High potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.29	Slope	0.63		
36B—Windsor loamy sand, 3 to 8 percent slopes							
Windsor	80	Poor		Very limited		Low potential	
		Bottom layer	0.00	Cutbanks cave	1.00		
		Thickest layer	0.00				
38C—Hinckley gravelly sandy loam, 3 to 15 percent slopes							
Hinckley	80	Good		Very limited		Low potential	
		Thickest layer	0.21	Cutbanks cave	1.00		
		Bottom layer	0.64	Slope	0.04		
38E—Hinckley gravelly sandy loam, 15 to 45 percent slopes							
Hinckley	80	Good		Very limited		Low potential	
		Thickest layer	0.21	Slope	1.00		
		Bottom layer	0.64	Cutbanks cave	1.00		
51B—Sutton fine sandy loam, 2 to 8 percent slopes, very stony							
Sutton	80	Poor		Very limited		Low potential	
		Bottom layer	0.07	Depth to saturated zone	1.00		
		Thickest layer	0.07	Cutbanks cave	1.00		
52C—Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony							
Sutton	80	Poor		Very limited		Low potential	
		Bottom layer	0.07	Depth to saturated zone	1.00		
		Thickest layer	0.07	Cutbanks cave	1.00		
				Slope	0.04		

Selected Soil Interpretations– State of Connecticut							
Map symbol and soil name	Pct. of map unit	Eng - construction materials; gravel source (ct)		Eng - shallow excavations		Eng - soil potential ratings of ssds (ct)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
60D—Canton and Charlton soils, 15 to 25 percent slopes							
Canton	45	Fair		Very limited		High potential	
		Thickest layer	0.00	Slope	1.00		
		Bottom layer	0.36	Cutbanks cave	1.00		
Charlton	35	Fair		Very limited		High potential	
		Thickest layer	0.00	Slope	1.00		
		Bottom layer	0.14	Cutbanks cave	1.00		
73C—Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky							
Charlton	45	Fair		Very limited		Low potential	
		Thickest layer	0.00	Cutbanks cave	1.00		
		Bottom layer	0.14	Slope	0.04		
Chatfield	30	Fair		Very limited		Low potential	
		Thickest layer	0.09	Depth to hard bedrock	1.00		
		Bottom layer	0.29	Cutbanks cave	1.00		
				Slope	0.04		
73E—Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky							
Charlton	45	Fair		Very limited		Low potential	
		Thickest layer	0.00	Slope	1.00		
		Bottom layer	0.14	Cutbanks cave	1.00		
Chatfield	30	Fair		Very limited		Low potential	
		Thickest layer	0.09	Depth to hard bedrock	1.00		
		Bottom layer	0.29	Slope	1.00		
				Cutbanks cave	1.00		

Selected Soil Interpretations– State of Connecticut							
Map symbol and soil name	Pct. of map unit	Eng - construction materials; gravel source (ct)		Eng - shallow excavations		Eng - soil potential ratings of ssds (ct)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
75C—Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes							
Hollis	35	Poor		Very limited		Very low potential	
		Thickest layer	0.00	Depth to hard bedrock	1.00		
		Bottom layer	0.00	Slope	0.04		
Chatfield	30	Fair		Very limited		Very low potential	
		Thickest layer	0.09	Depth to hard bedrock	1.00		
		Bottom layer	0.29	Cutbanks cave	1.00		
				Slope	0.04		
Rock outcrop	15	Not rated		Not rated		Very low potential	
75E—Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes							
Hollis	35	Poor		Very limited		Very low potential	
		Thickest layer	0.00	Depth to hard bedrock	1.00		
		Bottom layer	0.00	Slope	1.00		
Chatfield	30	Fair		Very limited		Very low potential	
		Thickest layer	0.09	Depth to hard bedrock	1.00		
		Bottom layer	0.29	Slope	1.00		
				Cutbanks cave	1.00		
Rock outcrop	15	Not rated		Not rated		Very low potential	
102—Pootatuck fine sandy loam							
Pootatuck	80	Poor		Very limited		Extremely low potential	
		Thickest layer	0.00	Depth to saturated zone	1.00		
		Bottom layer	0.00	Cutbanks cave	1.00		
				Flooding	0.80		
103—Rippowam fine sandy loam							
Rippowam	80	Poor		Very limited		Not rated	
		Thickest layer	0.00	Depth to saturated zone	1.00		
		Bottom layer	0.00	Cutbanks cave	1.00		
				Flooding	0.80		
W—Water							
Water	100	Not rated		Not rated		Not rated	

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 6, Mar 22, 2007

Wetland Resources

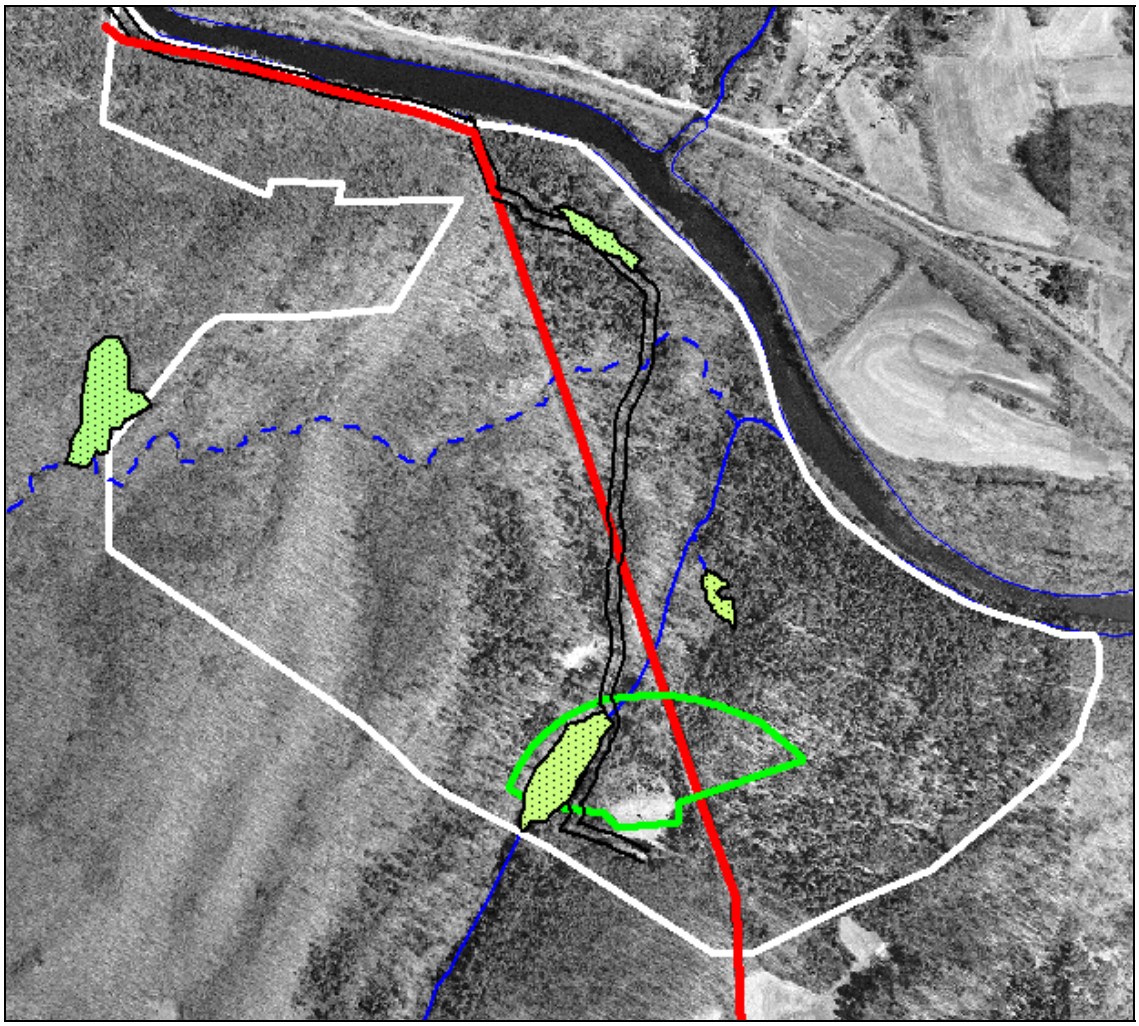
The Team found the Mukluk Preserve to be a diverse landscape ranging in elevation from the high of 465 feet above mean sea level (msl) along the western jog of the parcel and a low of ~95 feet bordering the Shetucket River. There are areas of steep slopes, some as much as 35 per cent and other areas of relatively level ground. For the most part, the steep slope areas are west of the woods road and the flat areas are to the east of the roadway. In effect, the entire parcel is tilted downward toward the river. This has the effect of draining the entire parcel directly into the Shetucket River. The entire parcel is wholly in the Shetucket watershed.

The property has a mixture of woodlands. Conifers dominate the areas both around and east of the woods road while deciduous trees dominate the western 40 per cent of the parcel. Also notable on the property is a power line right-of-way that divides the parcel nearly half and half, east and west.

Only one stream was flowing at the time of the visit. That is the stream which flows northeast out of the wetland and remediation area. An intermittent stream flows west-to-east out of a wetland located just west of the property. This stream was dry at the time of the visit. Another smaller wetland is located north-northeast of the remediation area. It has intermittent, probably seasonal, outflow during wet periods of the year.

It is to be noted that while the Team visited many highlighted spots on its walk, not every inch of the parcel was observed. Therefore there may be additional, small wetlands that are not commented on here. Any of those known should be mapped and documented before a plan of use is drawn up.

Dominant on any current map is the 15 acre umbrella-shaped area delineating the acreage that is to be remediated from years of accumulated lead shot. Included in this area is a wetland of approximately 2.5 acres, roughly 2.25 acres of which (90%) is in the remediation area.



In the 2004 aerial photograph above many of the features the Team observed are depicted and delineated. The overall property boundary is the white line. The 'umbrella' of lead shot is green, the stippled pattern depicts four wetland areas, the power line right-of-way (ROW) is the red line, and the parallel black lines depict the old woods road. Note that the road, when running south to north crosses the stream as it outlets from the remediation wetland, passes across the power line ROW, and crosses over the intermittent stream course before bending northwest along the river. (All lines are placed for approximate reference.)

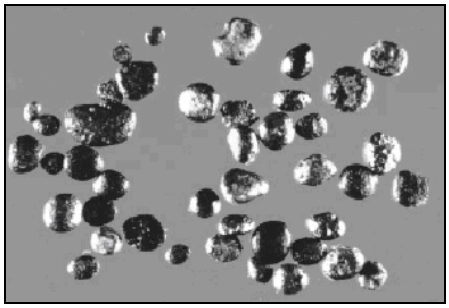
Notes from the Site Walk

Remediation Wetland: Two problems aggravate the health of this largest wetland on the property. First is the issue of lead accumulated from shotgun shells. The wetland itself is ± 300 feet from the firing area. But as can be seen from the 'umbrella' coverage, the wide distribution of

lead contaminates the wetland and beyond. The question arises about the removal of lead from the wetland by way of draining the impoundment, removing the pellets and likely some bottom material, then refilling to pre-work levels.

In the aerobic environment, that is, where the lead shot is exposed to air, the process of lead breakdown can begin. But the breakdown of a single pellet is glacially slow. One study estimated 10,000 years for the complete breakdown of a single pellet in temperate climates[1]. For the most part the lead binds to the top few inches of soil and does not become active in the ground water movement.

There is a difference when the lead is in an anaerobic environment, as in water. Here, with no exposure to air, the breakdown is nearly non-existent. Thus, the water is not contaminated and bottom soils may not be either. The single largest problem with lead in impounded water is that ducks may ingest it. Since ducks have no teeth and swallow their food whole, their gizzard does the grinding. The muscled gizzard squeezes together to break down the food. Ducks aid their gizzards by regularly swallowing grit to help with the breakdown. The 'grit' becomes a health problem for the duck when it contains lead pellets. The lead is broken down by digestive acids and impacts the liver, nerves, heart, and blood. Lead toxicity to waterfowl in shallow water feeding environments can be high enough to significantly effect local populations under certain conditions[2].



This photograph clearly shows the degradation of round lead shot in the gizzard. Each pellet was originally the same size. The lead that has eroded entered the vital systems of the duck most likely causing lead poisoning. Courtesy: Waterfowl Management Handbook, *U.S. Fish and Wildlife Service, Leaflet 13.2.6; 1989*

If it is possible to remediate the entire wetland and impoundment then the work should be done. That the work would have a huge ecological impact for its duration, there is no doubt.

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1. Dr Corinne Rooney Soil, Plant and Ecological Sciences Division, Lincoln University, Canterbury, New Zealand **http://www.lead.org.au/fs/shootingranges.pdf**
2. http://www.npwrc.usgs.gov/resource/birds/pbpoison/mortalit.htm

However, the work is finite and recovery will come about. Conversely, without remediation, the potential for lead toxicity to the waterfowl will continue indefinitely. The goal should be to rebuild the pond to current conditions after the remediation is completed. In order to restore the environment to its pre-work status an inventory of species should be taken prior to work.

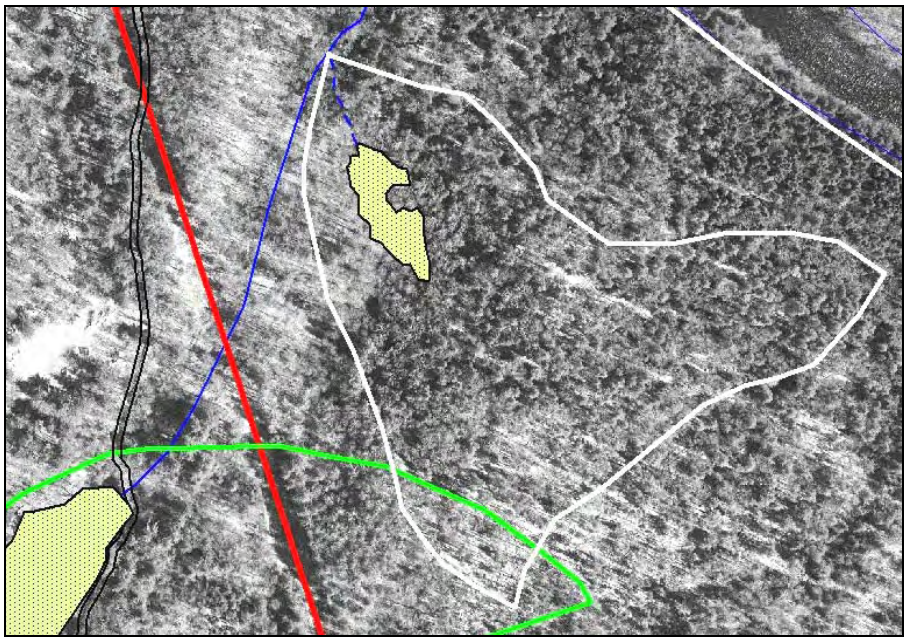
Regarding the remediated wetland, the work could also open the door to invasive species. As part of the remediation plan a two to three year observation period would be needed after the work to guard against an influx of invasive plants.

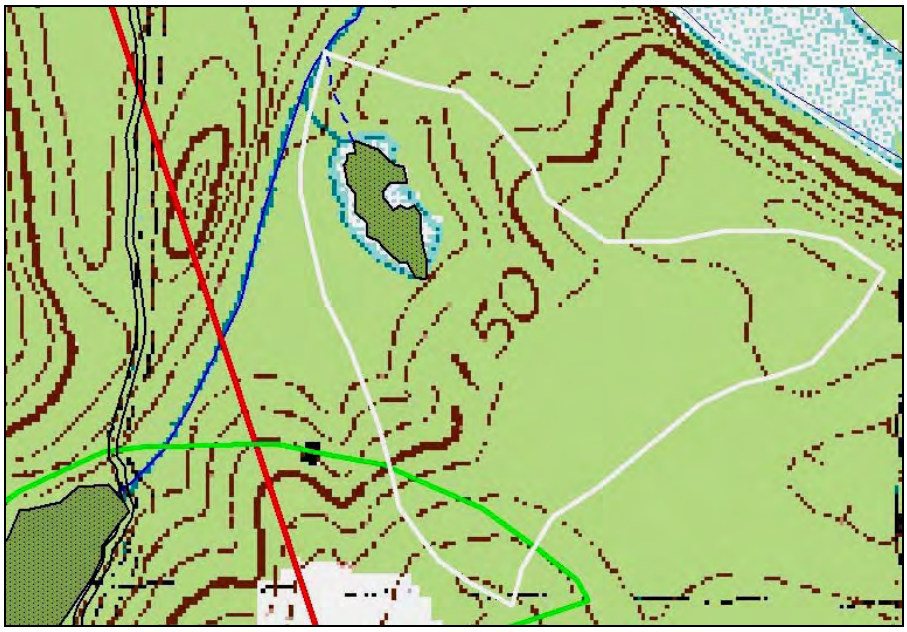
Secondly, and far more simply, the open water in the wetland has much fine-particle sediment in suspension. The walk the Team took brought us along the road immediately to the east of the wetland pond. The gravel road is the apparent source of sedimentation and erosion problems.

In this photograph, the gravel road immediately to the east of the to-be-mitigated wetland runs parallel with the orange fence. This washout is perpendicular to the fence and thus is headed directly downhill into the pond. It brings with it substantial sediments. This location is underlain by sand and gravel so that any surface disturbance will easily transform into sediment laden runoff, the results of which were readily apparent in the pond.

The second largest wetland the Team visited is immediately northeast of the area to be remediated. On the Boundaries, LLC map of May, 2006 this wetland is represented by three

wetland symbols. It is marsh-like in its hydraulic and vegetative makeup with highly organic soil thickly covered with grasses and ferns. It is increasingly saturated as the middle is approached, and at which point there is enough critical moisture mass to form the small rivulet which passes through the stems.



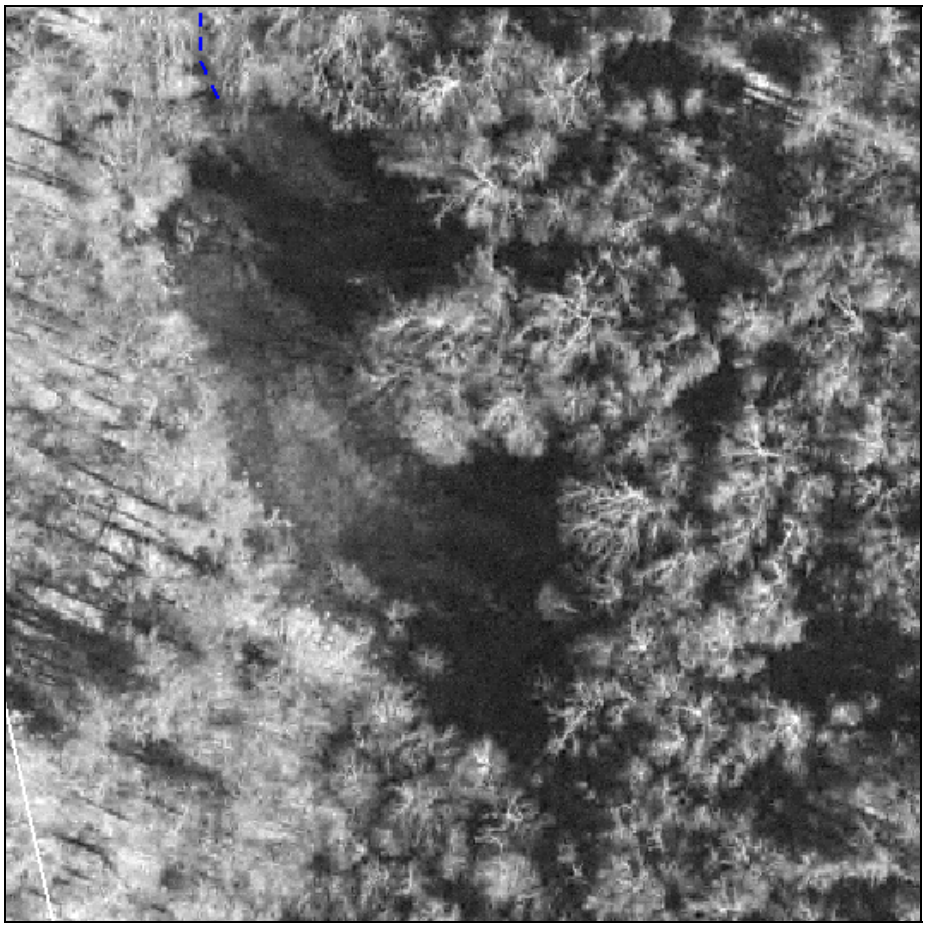


This second largest wetland on the site has a watershed of about 14± acres. The wetland has its intermittent outlet to the northwest. The drainage basin is quite level in the southeast half with an elevation of 165-170 feet above sea level. The land drops off ~50 feet as it drains northwest and down hill to the wetland, incurring slopes of 14 to 20 per cent. This wetland and its individual drainage demands more study to under-stand the hydrology that makes it work.

The two views above show the 2004 aerial photograph of this second largest wetland and the USGS topographic map. The drop off of the landscape is readily apparent.

	Team members passed through the wetland north of the remediation site. In the absence of trees and shrubs the herb layer dominates with a thick, healthy organic cover.
The lowest point of this wetland was toward the center, it being wet underfoot until that point. Though indiscernible in the photo to the right, a small streamlet was actively flowing at the base of these thick grasses.	
	The team found no outlet at the time of the visit. However, the area that appears to be the main outflow, geographically to the northwest of the wetland, has been barricaded or dammed with small boulders, dirt and vegetative debris. No one was clear about the origin or use of this ‘construction.’

This wetland, at over half and acre might be of interest for educational value. Its varied water depths and odd kidney shape should be understood before any impact to it and its drainage is intended. The Team only briefly inspected the top half of the “kidney” shape and the area near the outlet. In addition, the watershed is completely contained on the property so that the town has a valuable, compact ecological study area at its disposal.



This close-up 2004 aerial photograph of the second largest wet-land shows its outline and its placement among the leafless (in this early spring photograph) deciduous trees.

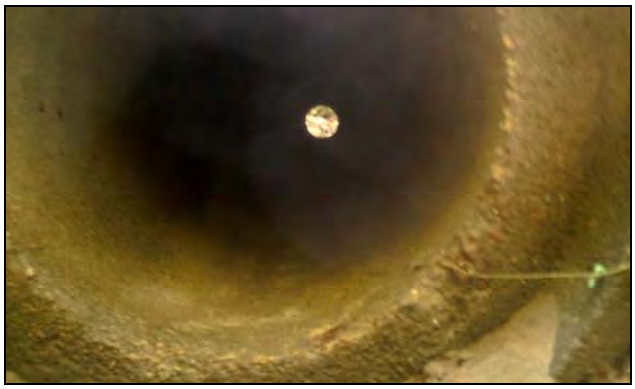
The third wetland (below) visited was small, elongate, and quite close to the Shetucket River. It is depicted by two wetland symbols on the Boundaries, LLC map of May, 2006.

There was some conjecture that this wetland was at one time a cranberry bog. However, soil sampling into the bottom of this open area revealed an organic layer of about 5-6 inches overlying mineral soils.

Its overall position on the landscape, being in so flat an area, did not lend itself to being capable of impounding standing water, but rather just a low point or drainage on the landscape where moisture is carried in the wettest times of the year. At the time of the visit the area was dry and dominated by the herb layer with a complete absence of the shrub and tree layer, except at subtle elevation changes.

The intermittent stream that passes across the parcel in a generally west-to-east pattern was dry at the time of the team visit. It issues from the mitten-shaped wetland immediately west of the property. The stream loses 290 feet of elevation in its flow path, from ~395 feet above msl down to 105 feet. Much of this loss is by way of two waterfalls or cascades.

In this series of photos the west-to-east, well defined, intermittent stream course passes under the old road via twin concrete pipe culverts. Actually, the pipe on the left (north) is clear for passing water but the pipe on the right (as seen below) is clogged. This clog forces all the flow to the pipe on the left and most likely passes it with increased velocity. That could have downstream impacts of sediment in the watercourses.



Comments

The ERT Team visited in a dry portion of the year and the wetlands and watercourses were not alive with standing water. Still the ERT reviewed three major on-site wetlands, the intermittent watercourse, and several of the small tributaries close to the shore of the Shetucket River. There was little visual impact to the wetlands except for the suspended sediments in the pond. Most are shaded for much of the day by the mature status of the riparian woodlands.

In all, this parcel encompasses 270 acres. But it is not self-contained. Many of the streams, both intermittent and perennial, have their headwaters off the property. In the graphic to the left the property boundary is in black, the watercourses in blue (dashed lines for intermittent), and the generalized drainage basin delineations are in dark green. Thus, the management of the future water quality extends beyond the parcel boundary. The topography dictates the where water flows.

Conclusion

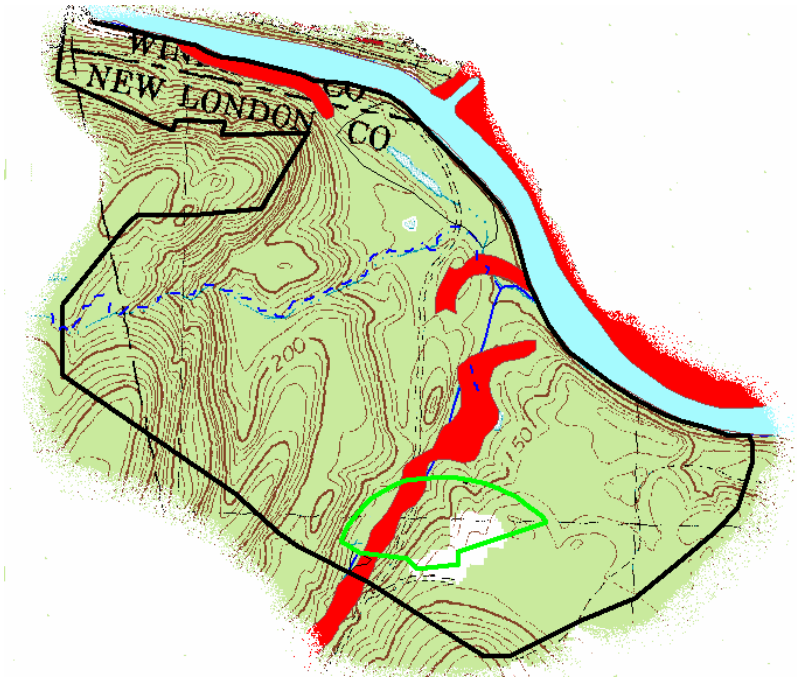
For whatever reasons this particular parcel has been free of impact for most of its recent existence. Aside from the lead and suspended sediment problems, the wetlands are in good health. With water flowing, the area must be even more aesthetically pleasing. To maintain the current

ecological integrity, the geographic area that contributes to these wetland systems should be understood before they are impacted. For that purpose it is suggested that those concerned:

1.) Delineate as closely as possible all contributing areas (watersheds) to the stream courses that flow across the parcel.

2.) Inventory and map all the wetlands on the property. The generally available GIS soils mapping outlines wetland areas that the Team did not visit. Additionally, the soil mapping identifies mapped soil units of only three acres or greater. Knowing that, there is good likelihood that there are many 1 to 2 acre wetland soil areas yet to be documented.

On the right the wetland soil mapping is layered over the USGS Scotland topographic map. The red color shows a great amount of wetland area, far more than the Team visited. There may well be other wetland inclusions on the parcel as this soils mapping does not note any soil unit of less than three acres.



3.) Repair erosion on the main woods road in both locations. It is clear that the washout on the road abutting the pond, and where the road crosses the intermittent stream are causing and/or will continue to cause on site sedimentation problems until the concerns are corrected.

Remediation Status for the Mukluk Property

Introduction

The 270 acre Mukluk property was purchased by the Town of Sprague to be retained as open space. A portion of the funding was obtained via an open space/ land acquisition grant from the Connecticut DEP. It consists of mixed hardwood forest abutting the Shetucket River. In general, the site has been used for hunting, fishing and other passive recreation. At some point the site was subjected to limited quarrying. The Mukluk Sportsmen's Club began leasing this property in 1955 and a portion of this property was used as a skeet range shooting and a rifle range for the Mukluk Sportsmen's Club since 1966.

Due to its use as a skeet range, a portion of the site has been contaminated with lead from the shot and polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPH) from the clay targets. The Town entered into the 133x program for voluntary remediation for this portion of the site. A Phase I and II Environmental Site Assessment was completed on June 3, 2004. The Phase II report concluded that although PAHs were present in soils, the levels were below the values listed in the Remediation Standards Regulation and therefore was not the primary contaminant of concern. The analytical results did indicate that lead concentration in the soil were consistently above Remediation Standard Direct Exposure Criteria (DEC) and pollution mobility criteria (PMC). Lead concentrations also exceed the hazardous waste levels in some areas. A draft Phase III Field Investigation and Remedial action plan was submitted in December 2004. A site visit was made on August 21, 2007 with the Connecticut Environmental Review Team.

Areas of Concern

The primary area of concern that will require remediation is the skeet range which includes the shooting area and the shot fall zone. The shot fall zone consists of the wetland/pond and upland adjacent to it. This is the area that had received shot and broken skeet targets. The total area contaminated by lead shot is approximately 12-14 acres.

The area of high lead contamination is currently bounded by either a 4-foot or 5-foot fence. The enclosed area includes the shot fall zone and a cleared shooting area. The shooting area itself is approximately 300 by 200 feet. The entire area contaminated by lead shot is similar in shape to a baseball field. The length of the immediate skeet field is approximately 500 feet in an east-west direction and then it fans out from this area approximately 600 feet west-northwest and 400 feet east northeast and 700 feet north. A clubhouse is located adjacent to the shooting area but is outside of the contaminated area.

The Wetland

The wetland on the site is approximately 600 feet by 225 feet and is estimated to encompass 2.3 acres. Samples collected at the site indicated high levels of lead. Three samples of sediment were collected in the wetland itself. Concentrations of lead ranged from 14230 ppm (1.4%) to 20800 ppm (2.1%) These levels of lead in the wetland pond sediment are five times higher than the direct exposure criteria and approximately twenty times high than the Severe Effect Level (SEL). The high concentration of lead in the sediment has resulted in a high level of lead in the pore water. The concentration in the pore water was measured at 0.83 mg/l, which exceeds the acute criteria for lead by a factor of 24.

The concentration in the surface water in the wetland is 0.022 mg/l and exceeds the chronic criteria for lead by a factor of 16. The concentration of lead in the brook leaving the wetland is similar at 0.018 mg/l. These concentrations of lead will most likely result in impact to growth and reproduction in the organisms that dwell or should dwell in the wetland and stream. Although some ripples were observed on the pond during our site visit, no organisms were spotted.

Current concentrations of lead in the wetland would also pose risk to dabbling ducks, herons and other terrestrial organisms which would feed off the invertebrates, fish and frogs that should dwell in the wetlands. Not only would these organisms assume toxic doses from their food but they would also ingest a certain amount of sediment. Any final remediation plan would have to take into account the level of lead which is safe for human health, aquatic life and terrestrial organisms via the food chain.

At this time it appears that the sediment is not migrating out of the pond because these high levels of lead are not found in the stream. Therefore, it may be advisable to implement an alternative interim solution that would prevent the

contaminated lead sediment from migrating downstream and interacting with the surface water. Isolation of this sediment via either a clay cap or an impervious "geofabric" should also reduce concentrations of lead in the surface water in both the pond and stream below the chronic criteria. Such a cap either clay or "geofabric" may prove beneficial in the short run to prevent lead contaminated sediment from influencing the concentration of lead in surface water or migrating off site until funds become available for a more permanent solution.

Ultimately dredging of the pond/wetland area and removal of contaminated lead sediment is the preferred treatment. The Pond/wetland area will need to be diverted and dredged as outlined in their Phase III. The surface water should be diverted around the area of wetland being excavated. It was suggested that the dredged sediment be transported to the former shooting area prior to shipping off site as either waste or reclamation. The pore water or dewatering wastewaters from this sediment must be collected and treated prior to discharge. This discharge needs to be covered under the Groundwater Remediation Wastewater Directly to Surface General Permit.

After remediation of the contaminated sediment, the surface water must be monitored to determine if lead concentration in the ponded/wetland area and the downstream site are consistent with water quality criteria for lead.

Upland Site

Prior to the August 21, 2007 site visit the solid waste debris from clay targets and shot gun shells was removed from the shooting area in the immediate vicinity of the clubhouse. According to the final disposal report, 17 tons of building material, 8 tons of solid waste and 300 tons of target and shell debris were removed.

Upland soils also exceed the direct exposure and pollutant mobility criteria for lead established in the Remediation Standard Regulations. Concentrations of lead in the upland soil are particularly high on the western bank of the wetland. These values are approximately 1.7% lead for the first two inches for the northwestern locations. The other sample of soil taken from the southwestern portion of the wetland showed much higher lead in the 2-4 inch layer (1.1%) as opposed to the surface layer (0-2”)(0.1%). It should also be noted that the concentration of lead in the 2-4" layer is above permissible levels and that depth of contaminated soil in this area has not been defined. This area should be remediated with the wetland.

A pilot project is proposed for a small portion of this site. The pilot project includes removal of surficial lead contamination by vacuuming up the leaf litter and loose soils in preparation for phyto-remediation. The following spring vegetation would be planted which would uptake the lead. The understory would then be removed following the growing season to determine the effectiveness of using plants to remove and reduce the concentration of lead in the soil. If this pilot study was effective it may be possible to apply this technique to the remaining contaminated site. The advantage of this technique would be that the many trees and canopy would be preserved, reducing the amount of runoff and potential erosion from this site. Due to the high concentration of lead present in the top few inches of leaf litter or soil, disposal options would need to be determined. The leaf litter/soil would have to be disposed of as either solid/hazardous waste or offered for reclamation depending on the concentration and condition of the lead found.

Soil on this site was only analyzed to a depth of 4 inches, in some areas additional soil may need to be remediated because the depth of the lead contamination in the soil has not been determined. Additionally the final concentration of lead acceptable at this site to protect both human health and the environment has not been established.

Fisheries Resources

Unnamed Tributary to Shetucket River

This unnamed stream was sampled by the DEP Inland Fisheries Division stream survey team in 1993. Results of that survey documented that this watercourse supports a very robust native brook trout population. Brook trout typically spawn in Connecticut during the month of October. Eggs incubate within gravel over the fall and winter periods with eggs hatching in late February or early March. Fry remain in the gravel until their yolk sacs are absorbed at which time the fry emerge from underneath the gravel and move into preferred stream microhabitats. Realizing the importance of brook trout and their habitats, a unique partnership is now underway between state, federal, local agencies, as well as non-profit government organizations and private citizens called the Eastern Brook Trout Joint Venture (EBJTV). As part of the National Fish Habitat Initiative, this venture is a geographically focused, locally driven scientifically based effort with goals to protect, restore, and enhance aquatic habitat throughout the eastern range of brook trout. More can be learned about these efforts at www.fishhabitat.org.

Shetucket River

The Shetucket River supports a highly diverse fish community (23 species, 15 native) due to the presence of inland, diadromous (fishes that spend part of their lives in both fresh and salt waters) and marine species. The entire Shetucket River is managed as a Trophy Trout stream with a daily creel limit of 2 fish and an open season from the 3rd Saturday in April to the last day in February. It is annually stocked by the Inland Fisheries Division (IFD) with adult brown and rainbow trout. For example in 2006, it was stocked with 3,650 brown trout (9-12 inches in length), 2,135 brown trout greater than 12 inches, 3,265 rainbow trout greater than 12 inches and 170 surplus broodstock (rainbow and brown) ranging from 1 to 10 pounds in size. Many tributary streams to the Shetucket River provide important thermal refuges for trout; in particular, downstream of the Scotland Dam are Merrick Brook, Scotland and Beaver Brook, Baltic. Areas within 100 feet of the mouths of these tributaries are closed to all fishing from June 1 to August 31. Occasionally, wild brown trout and native book trout can be found in the Shetucket River that have moved into the river from coldwater tributary streams. In addition to a trout fishery, the Shetucket River supports an abundant smallmouth bass fish population. Smallmouth bass are generally small (less than 12 inches in length); however, some individuals can reach 12 inches in size. IFD electrofishing surveys of the Shetucket River have documented a diverse community of fluvial dependent/specialist fish species, which include blacknose dace, fallfish, tessellated darter and white sucker (Table 1). The Shetucket River is also managed as an Atlantic salmon broodstock fishery from the Scotland Dam, (Scotland) downstream to the Occum Dam (Norwich). A total of 752 Atlantic salmon broodstock were stocked in this area of the river during 2006. Surplus broodstock are between two to four years old and weigh between 2 and 12 pounds. Please refer to the 2007 Connecticut Angler Guide for Atlantic salmon broodstock seasons, creel limits and legal fishing methods.

Table 1. List of fish species found in the Shetucket River upstream and downstream of the Scotland Dam.

Common Name	Scientific Name
American eel	*Anguilla rostrata*
Atlantic salmon	*Salmo salar*
Banded killifish	*Fundulus diaphanus*
Blacknose dace	*Rhinichthys atratulus*
Bluegill	*Lepomis macrochirus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameiurus nebulosus*
Brown trout	*Salmo trutta*
Common carp	*Cyprinus carpio*
Chain pickerel	*Esox niger*
Fallfish	*Semotilus corporalis*
Golden shiner	*Notemigonus crysoleucas*
Green sunfish	*Lepomis cyanellus*
Largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
Rainbow trout	*Oncorhynchus mykiss*
Redbreast sunfish	*Lepomis auritus*
Rock bass	*Ambloplites rupestris*
Smallmouth bass	*Micropterus dolomieui*
Spottail shiner	*Notropis hudsonius*
Tessellated darter	*Etheostoma olmstedi*
White sucker	*Catastomus commersoni*
Yellow perch	*Perca flavescens*

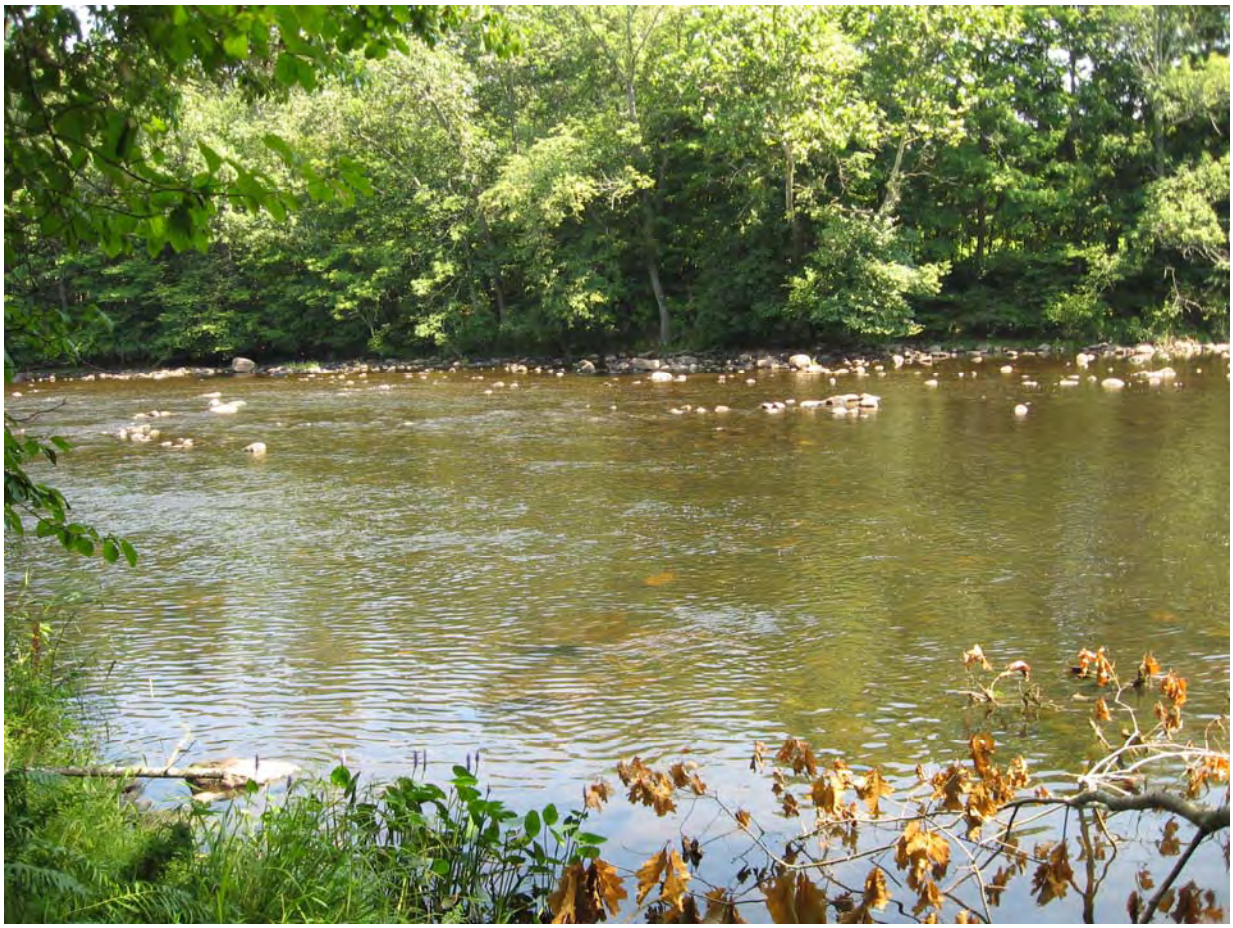
Recommendation/Comments

1. It is the policy of the CTDEP Inland Fisheries Division (IFD) that riparian corridors be protected with a 100 ft. wide undisturbed riparian buffer zone. A riparian wetland buffer is one of the most natural mitigation measures to protect the water quality and fisheries resources of watercourses. Future management of this property should consider the use of this standard buffer along the Shetucket River and unnamed tributary to protect onsite natural resources. Copies of the IFD policy and position statements are available in the Appendix

2. During the last decade, the Inland Fisheries Division has been actively adding Large Woody Debris (LWD) to river systems as a component of individual stream restoration projects, particularly in streams that are LWD deficient. LWD is typically defined by biologists as logs with a minimum diameter of 4 inches and a minimum length of 6 feet that protrude or lay within a

stream channel. LWD provides a multitude of aquatic resource benefits including, creation and enhancement of instream fish habitats, stream channel stabilization and trapping organic materials such as leaves, providing a food source for aquatic insects. In essence, LWD is a very important component of a river's biological diversity and health. A copy of the DEP Inland Fisheries Division Large Woody Debris Fact sheet is available in the Appendix.

The Shetucket River is LWD deficient and as such would greatly benefit from the introduction of LWD as part of river management and restoration efforts. The Inland Fisheries Division has targeted the Shetucket River for the introduction of LWD and as such would be willing to partner with the Town of Sprague to restore LWD in the Shetucket River along the Mukluk property. The team's fisheries biologist can be contacted at 860-295-9523 for further technical guidance and information.



Wildlife Resources

A site inspection was conducted on August 1, 2007 to evaluate existing wildlife habitat on the property. The property is located in the northwest corner of town and is south of Talbot Wildlife Area, west of Mohegan State Forest, and includes a portion of the Shetucket River on the northern and eastern borders (approximately 1 mile of river frontage). It is approximately 270 acres in size and was formerly a private skeet shooting and hunting preserve. The town purchased the property in 2004/2005 and needs to decide if a state Open Space and Watershed Land Acquisition Grant requiring a conservation easement (for all but 16 acres of lead-contaminated land) should be accepted. The site is comprised of a myriad of habitat types including riparian zone, mature coniferous, deciduous and mixed forested areas, and forested rocky ledges found along the steep slopes of the western portion of the property. Wetlands include the Shetucket River, ponds (one is lead-contaminated) and intermittent streams.

Existing Wildlife Habitats

The northern portion of the property includes the Shetucket River and its forested riparian (riverside) zone. Portions of the Shetucket are considered large river habitat. Large rivers and associated riparian zones support a diverse assemblage of species. Deep freshwater habitats provide adult holding areas, migration staging areas, and foraging and spawning areas for many fish. The associated riparian zone, including rocky and gravelly riverbanks and riverside outcrops are critical for species such as the eastern small-footed bat, and long-tail and short-tail weasels. Areas such as this are also important for species such as bald eagles, which utilize forested areas near large bodies of water for breeding, and may winter along large rivers.

The western portion of the property contains mostly mature hardwood forest, with areas of steep slopes and rocky outcrops. The understory includes species such as mountain laurel and other typical ledge species such as highbush blueberry, lowbush blueberry, and Christmas fern.

Forested areas are valuable to wildlife, providing cover, food, nesting and roosting places and denning sites. Mast or acorns produced by oaks provides excellent forage for a wide variety of mammals and birds including white-tailed deer, gray squirrel, southern flying squirrel, eastern chipmunk, white-footed mouse, eastern wild turkey and blue jay. Trees, both living and dead, also serve as a home for a variety of insects, which, in turn, are eaten by many species of birds, including woodpeckers, warblers and nuthatches. Other wildlife species found in this habitat type include white-breasted nuthatch, American redstart, barred owl, broad-winged hawk, redback salamander and northern ringneck snake.

The southern portion of the property contains a lead-contaminated wetland and field (site of the old skeet range). The area also contains other ponds and intermittent streams. Wildlife likely utilizing wetland habitat for food and cover are raccoons, star-nosed moles, pickerel frogs, spring peepers and eastern garter snakes.

Value of Property as Wildlife Habitat

The value of the Mukluk Preserve is found in both its size and its location within the surrounding landscape. Large, unfragmented parcels of mature forest containing multiple habitat types are increasingly rare in Connecticut, as development creates small, isolated patches of habitat in the landscape. For wildlife, large blocks of habitat are always better, as they can provide a greater variety of food (different types of acorns, catkins, a variety of fruits, etc.), more nesting and roosting sites, and areas for cover.

The Shetucket River and its riparian zone contribute significantly to the value of this area, providing a large area with multiple resources (food, cover, shelter) for species that may be using the river as a migratory route. Connecticut contains a few large rivers, most of which have had habitats altered due to dam construction, navigational dredging, and consumptive water use. Large Rivers and Streams and their Associated Riparian Zones are considered one of the 13 most imperiled habitats in Connecticut (Metzler and Wagner 1998). Riverside development, water diversion, and discharges are the major threats to this type of ecosystem.

The property's location; south of Talbot Wildlife Management Area (approximately 450 acres) and west of Mohegan State Forest (approximately 400 acres), provides undeveloped habitat south of the Shetucket River in addition to these already-protected areas on the north side of the river and thus increasing its value as wildlife habitat.

Habitat Management Recommendations

The most important recommendation for managing this area is to limit its use to the types of recreation compatible with wildlife. In general, low-disturbance recreational activities (walking, biking, etc.) should be limited to use of the established trails. If new trails are to be established, guidelines for protecting wildlife resources should be followed (see General Guidelines for Protecting Wildlife in the Appendix) and dogs should be leashed at all times in order to prevent disturbance to wildlife.

There is some opportunity to manage the forested habitat to benefit wildlife. Forestry management techniques could be considered for portions of this site. Creating a variety of age-classes within a forested area is often beneficial to a wide variety of wildlife species. The location of any vernal pools or other wetlands should be carefully considered when planning any cutting. Forestry management should only be undertaken under the advisement of a certified professional forester.

If cutting in the forested areas, standing dead trees (snags) as well as any trees with unusual structure should be left standing. Snags provide both nesting sites and foraging opportunities for cavity-nesting species and insect-eating birds.

Summary

The Mukluk property provides high-value habitat for wildlife because of its size, the habitats of which it is comprised, and its proximity to the Shetucket River. Stewardship of this area will conserve the inherent wildlife values and protection through conservation easement will enhance the value of the entire area by providing a buffer from development and maintaining a large acreage of undeveloped land.

References

Connecticut's Comprehensive Wildlife Conservation Strategy. Connecticut Department of Environmental Protection. 2006.

Metzler, K.J. and D.L.Wagner. Thirteen of Connecticut's most imperiled ecosystems. Draft: 16 April 1998.

The Natural Diversity Data Base

The Natural Diversity Data Base maps and files regarding the project area have been reviewed. According to our information there are records for State Special Concern *Clemmys insculpta* (wood turtle) from the vicinity of this project site,

Wood turtles require riparian habitats bordered by flood plains, woodlands or meadows. Their summer habitat includes pastures, old fields, woodlands, power line cuts and railroad beds bordering or adjacent to streams and rivers. They hibernate submerged in tangled tree roots along the river banks or in deep pools from November 1 to April 1. These species have recently been negatively impacted by the loss of suitable habitat.

If, in the future, any work will be conducted in the habitat described above, the Wildlife Division recommends that a herpetologist familiar with the habitat requirements of this species conduct surveys. A report summarizing the results of such surveys should include habitat descriptions, species list and a statement/resume giving the herpetologist' qualifications. The DEP doesn't maintain a list of qualified herpetologists. A DEP Wildlife Division permit may be required by the herpetologist to conduct survey work; you should ask if your herpetologist has one. The results of this investigation can be forwarded to the Wildlife Division and, after evaluation, recommendations for additional surveys, if any, will be made.

Standard protocols for protection of wetlands should be followed and maintained during the course of any construction. Additionally, all silt fencing should be removed after soils are stable so that reptile and amphibian movement between uplands and wetlands is not restricted. Please be advised that should state permits be required or should sate involvement occur in some other fashion, specific restrictions or conditions relating to the species discussed above may apply. In this situation, additional evaluation of the proposal by the DEP Wildlife Division should be requested. Please be advised that this unit of the Wildlife Division has not made a field inspection of the project site. Consultation with the Wildlife Division should not be substituted for site-specific surveys that may be required for environmental assessments. If you have nay additional questions please contact Julie.Victoria@po.state.ct.us during the field season (April – August) and please reference the NDDB #15563 when you e-mail.

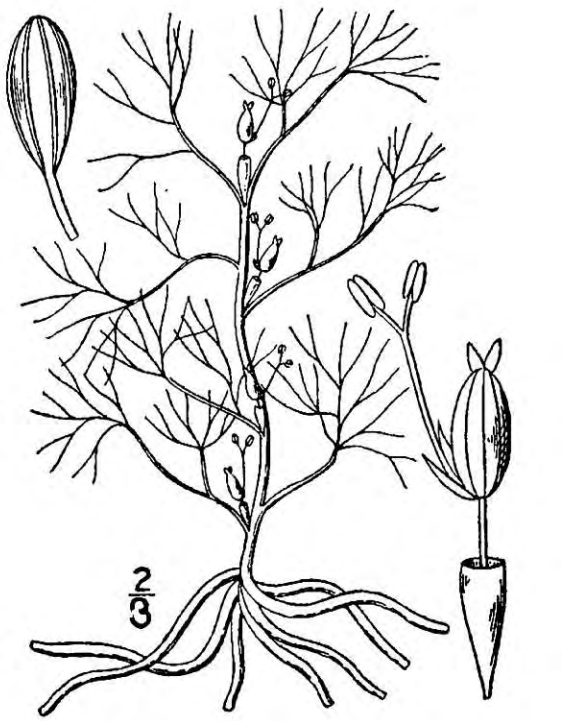
In addition, we have extant records for State Threatened *Asplenium montanum* (mountain spleenwort) and State Special Concern *Podostemum ceratophyllum* (threadfoot) from an area in very close proximity to this property. The topography and riverine habitat on the site make it very likely that one or both species could occur here. A site survey by a botanist should be done to determine if the species is present in the area in question. The NDDB requests that a report summarizing the results of such survey should include habitat descriptions, vascular plant species with special notes on the presence or absence of the species in question and a statement/resume giving the botanist's qualifications. The report should be sent to our program botanist, Ms. Nancy Murray (DEP-Wildlife Division; 860-424-3589) at 79 Elm Street, 6th Floor, Hartford, CT 06106. Please direct any questions concerning these plants to Ms. Murray.

Natural Diversity Data Base information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the years by the Environmental and Geographic Information Center's Geological and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substituted for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available.

Please be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for the proposed site.

Mountain Spleenwort

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 29.



Threadfoot

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 2: 205.

Connecticut Department of Environmental Protection

Wood Turtle

(Clemmys insculpta)

IDENTIFICATION: A medium-sized turtle, readily distinguished by its sculptured, rough, moderately-domed carapace, black head, orange-red wash on its under limbs, and a yellow plastron with black squares along the edges. Adults 150-200 mm carapace length.

In contrast to Connecticut's other turtle species, the wood turtle is an animal of the northern forest biome, from the Great Lakes eastward through New England and northeastern Canada. Its southern range limit lies near Washington, DC. In Connecticut, the strongholds of wood turtle distribution are the eastern and western uplands. Although once quite common in the Central Connecticut Lowland, many populations have been reduced or even eliminated by habitat fragmentation. This species was never common in the coastal zone of the state. Wood turtles have extensive landscape-scale habitat requirements, requiring clean rivers and large streams with deeply undercut banks for hibernation, as well as extensive areas of floodplain, forest, and fields for summer foraging. Because of their extensive overland movements, they are very susceptible to road mortality. They take over a decade to reach sexual maturity, and have a low egg output, and limited juvenile survivorship. Loss of adults from breeding populations, whether from increased road mortality or by collection for the wildlife trade, is a major problem affecting the sustainability of wood turtle populations in Connecticut. Possession of any wood turtle is prohibited (Conn. Code Sec. 26-55-3-C) in Connecticut without regard to its origin, and collection within Connecticut is prohibited (Conn. Code Sec. 26-66-14-A). The wood turtle is a "Special Concern" species in Connecticut. International commerce in wood turtles posed such a threat that in 1992 this species was placed under international trade regulatory protection administered by CITES (Convention on International Trade in Endangered Species of Flora and Fauna). The wood turtle is of conservation concern throughout most of its range. Most states and provinces where it occurs afford it special status and/or some form of statutory protection.

Archaeological and Historical Review

The Mukluk Property has the potential for many significant archaeological resources, including campsites associated with Native Americans occupations as well as Colonial land use.

The project area contains over a mile of frontage on the Shetucket River, including high terraces which the state site files have listed as being associated with pre-Contact campsites. Three areas of sensitivity for Native American sites are especially noteworthy, the elevated and relatively flat terrain of the southeast portion of the site, the eastern portion where feeder brooks confluence with the Shetucket River, and the area surrounding the waterfall. In addition, the various wetlands within the project area suggest sites upslope from the river.

Colonial archaeological sites are represented by numerous stone foundations and walls that are dispersed throughout the project area, including remnants of houses, barns, and other buildings associated with a historic stagecoach road and farming activities.

The Preserve contains +270 acres of historic property that has remained relatively undeveloped and as a result has the potential for archaeological sites with high integrity, that is, they can still yield important information about the Town of Sprague's historic past. The Office of State Archaeology (OSA) and the State Historic Preservation Office (SHPO) recommend that the property be used for passive recreation and the archaeological sites located at Mukluk should be considered as educational opportunities for students and the general public.

The Office of State Archaeology and the State Historic Preservation Office **strongly** recommend that any proposals to develop this property must have a complete archaeological reconnaissance survey. This survey should be conducted in accordance with the State Historic Preservation Office's *Environmental Review Primer for Connecticut's Archaeological Resources.* The OSA and SHPO are prepared to assist the Town of Sprague in complying with the recommended survey should this be necessary.

Recreation Planner Comments

Introduction/Setting

The Mukluk Property is a 270+ acre tract containing over a mile of frontage on the Shetucket River. It basically consists of high, dry upland ranging from rough, rocky land in the west to glacio-fluvial soils in the center and along the river to gently rolling till soils in the east. Several unnamed brooks with small associated wetlands drain the bulk of this heavily wooded property.

It is a key element in a largely pristine river corridor reaching from South Windham to Baltic Village and protected to date by a state-owned rail ROW on the north and hilly topography on the south. This natural character is particularly true of the stretch downstream of the Scotland dam, which is a recognized prime fishery resource.

Significant portions of this corridor and surrounding lands already are in protected ownership including the previously mentioned CONNDOT rail corridor; DEP's Mohegan State Park, Salt Rock Campground, and Merrick Brook Wildlife Management Area; the Nature Conservancy's Ayers Mountain Preserve; and the Town of Sprague's Baltic Mill Property which includes development-controlling flowage rights ownership up to the Scotland Dam (per discussion with First Selectman Dennison Allen).

Management Issues/Potential Uses

1. **Water Supply** – Per First Selectman Allen, a number of town wells are contaminated. The fiscally best option may well be to install improved filtration at the existing town reservoir north of Baltic Village. However, the Mukluk Property could provide an additional future potential well site location unless pipeline costs would rule out this option.
2. **Site Contamination** – The firing range at the former game club has resulted in approximately 15 acres of lead contamination including the range proper and an adjoining wetland down range. A site cleanup is underway and will require additional work as well as prohibition of public use in the affected area.
3. **Possible gravel mining** – presumably the main potential consists of the areas of Hinckley soil found throughout the center of the property and along the Shetucket River downstream of its confluence with the brook draining most of the property. The extent and potential value of this resource is unknown to this reviewer, but it is very clear that such mining would destroy the scenic character of the river corridor and of the property itself and likely negatively impact the Shetucket River through siltation.

Management Recommendations

The Mukluk Property is a key element in a high priority streambelt corridor of regional significance. This was recognized in the Quinebaug and Shetucket National Heritage Corridor's 1997 "Vision to Reality: A Management Plan" which recommended "selective acquisition to protect scenic areas where public access is appropriate." Furthermore, it placed "primary emphasis on the two major streams in the region – the Quinebaug and the Shetucket Rivers." Because of its special character, it is recommended that it should be managed as low use intensity open space. Specific uses could include active silvaculture to produce some revenue to the town, non-motorized trail uses, fishing, and casual picnicking, perhaps a youth group camping area, and a possible well location as state above. Although the former range area, once decontaminated, is physically suitable for ballfields, its remote location and difficulty of ready access seems to rule out such development.

Recreational Trail and Greenways Potential

Potential for Recreational Trail Development

There are no opportunities to link into an existing statewide significant trail system in the area of this property; however, regional and local opportunities may be worth exploring. As noted in the review materials provided, gravel paths and roads exist and are being utilized on the site. In particular, the map entitled "The Town of Sprague Mukluk Property" shows a gravel road that parallels the Shetucket River for over 2000 feet and heads south, finally exiting the property. This trail may have potential to provide access for fishing and use as a multi-use, universal access trail. There also appear to be opportunities to take the trail west along the unnamed stream on the property guiding them to points of ecologic or geologic interest.

Officially establishing a trial system and designating recreational uses may help keep current users from unknowingly abusing any identified sensitive resources. If they are interested in pursuing trail development, the Conservation Commission is encouraged to work with their parks department to determine what type of recreational uses are occurring now on the site, what are the needs of the town, and then how such a trail(s) could bring recreational assets to the area (potential collaboration with border towns) and the town while protecting any identified sensitive natural resources.

Greenways Potential

As discussed in the review materials, the property provides a large protected open space. Existing state parks, forests and wildlife management areas to the north, east and south of the property contribute to a developing regional greenway. The Conservation Commission may wish to work with the Windham Council of Governments and the Quinebaug-Shetucket National Heritage Corridor to help the town understand how the property fits in regionally.

Planning Considerations

Site Description and Overview

At the request of the Sprague Conservation Commission, a review was performed of the Mukluk Property located at 239 Pautipaug Hill Road predominately located in the Town of Sprague. The Sprague Tax Assessor designates the site as Map 6, Block 1, Lots 3 & 4.

Although small portions of the southwestern and northwestern portions of the property are located in the towns of Franklin and Scotland respectively, the task of this review is to provide a thorough inventory of the natural resources, and address specific concerns associated with the portion of the property located in Sprague.

The 280 acre area is predominately wooded and undeveloped with varying topography and several water features that include one mile of frontage along the Shetucket River, wetlands, ponds, waterfalls and several smaller streams. The southeastern portion of the property is developed with a clubhouse structure and a skeet range, both of which are non-operational. The clubhouse is serviced by an onsite private well and septic system. Neither Franklin nor Sprague provides sewer service, and there are no public water supply wells located on the property.

There is no evidence of any prior industrial use of the site despite ownership by the Baltic Mills Company and Ponemah Mills prior to 1955. Most prior use of the property was thought to be agricultural.

The property is located in the middle of a 3,500 acre, roadless tract of land. Access to the site is limited to a 10' wide gravel road extending from the easterly terminus of Holton Road in Franklin to the southwesterly corner of the property, and a dirt road that extends from Pautipaug Road in the southern portion of the site. Two discontinued highways once served the site. A graded, gravel road extends from the site access road to the northern portion of the site. A network of hiking trails and dirt roads exist throughout the property and along the river.

Adjacent Land Use

The land use surrounding the Mukluk property is sparsely developed residential land to the east across the Shetucket River, to west beyond the undeveloped woodland, and to the south

along Pautipaug Hill Road. Other nearby land use includes seasonal cabins/recreational use immediately to the east, agricultural land, a golf course, undeveloped and wooded land, and the Shetucket River along the eastern and northern boundaries of the property.

One property immediately adjacent to the site to the south is privately owned and, although not presently used as such, could someday be used for sand and gravel mining operations.

Current Land Use and Zoning

The Mukluk property is currently zoned as R-80 Rural Zone through most of the site, with an area of R-120 Natural Resource Protection Zone that encompasses the land along the Shetucket River from the southeast edge of the property to the northern and northwestern property boundaries. The proposed future uses such as passive recreation, excavation, recreational facilities, and forestry and conservation activities, are either permitted as of right or by special permit by the existing zoning regulations. The portion of the property located in Franklin is also zoned R-120.

Site Access

The site has been privately owned for over 50 years with no access to the public. With all former highways and bridges discontinued, access to the site is extremely limited. The

highway that once traversed the site, connecting with the former Waldo Bridge and thereby providing access into Scotland, CT was discontinued in 1880. Access for any future intensive use would only be possible, at this time, via Pautipaug Road, a small local road that passes through a low-density residential area, and ending 600 feet south of the site. Without significant improvements, the current available access presents severe constraints to any future intensive use of this property. Additionally, there are many legal and environmental issues with regard to reactivating a discontinued highway.

Recreational Opportunities and Open Space Priorities

The site, located primarily in the northwest corner of Sprague, has been used as a private skeet shooting and hunting preserve. The property is considered an integral part of the Quinebaug-Shetucket Heritage Corridor and the Last green Valley. Because of its location near Ayers Mountain Preserve and Mohegan State Forest, its network of existing trails through the wooded and marsh areas, and its direct, unspoiled, scenic frontage along the Shetucket River, the property offers many passive recreational opportunities, such as, but not limited to, hiking, biking, horseback riding, bird watching, fishing and boating.

While the Conservation Commission recommends that the site remain as open space and be used for passive recreation, the Economic Development Commission has recommended the following three possible income generating future uses: gravel mining operations; wind power generation; and a pavilion to be used for corporate retreats.

Development Opportunities and Constraints

Opportunities:

Projects that enhance the existing natural resource features of an area will serve to attract more visitors to the town, increase property values, and ensure compliance with state, regional and local conservation and development goals.

In terms of slopes and soil conditions, the areas within the property that are not considered to be constrained are limited to the existing clubhouse and skeet range area in the southeastern portion of the property (not considering the limitations posed by the existing area of contamination briefly described below, that makes this area not currently suitable for any future use) as well as some small areas scattered throughout the central portion of the site.

(Full page views of these maps may be found in the Appendix.)

Constraints:

Approximately 3/4 of the property is considered to contain significant constraints to development, such as areas within the 100-Year Flood Zone, wetlands areas; and DEP identified Natural Diversity Areas, as shown on the maps below. Additionally, much of the property is underlain with coarse-grained stratified drift deposits, which are indicators of potential aquifers.

Furthermore, any future demand for access to the site is limited by surrounding private property, steep slopes, the Shetucket River, and lack of any truly viable road system in close proximity. As stated earlier, the site lacks public water and sewer. Any intensive development would be served by on site, private wells and individual septic systems.

The 17-acre area that includes the former skeet range and a nearby pond is heavily contaminated with lead. Gerry Stefon, vice chairman of Sprague's Planning and Zoning Commission estimates that remediation efforts could cost over $4 million, which would impose a significant financial constraint on future use of this area. Although contaminated, and no public access permitted, this portion of land is still considered to be public land and it must therefore be remediated. According to Dave Stygar of the DEP, this contaminated area would not be included in the potential conservation easement area to be designated in exchange for a $500,000 grant offered by the DEP to off-set the purchase price paid by the Town of Sprague. The conditions of this grant include the provision that a conservation easement to be placed on the entire site (minus the contaminated area) restricting potential future uses to passive recreational and open space uses only. This exclusion would allow the town more time to procure sufficient funds for environmental remediation as only $240,000 in federal grant money has been secured to off-set the cost of remediation thus far.

Consistency with State, Local and Regional Plans of Conservation and Development

State Plan: The property is located in a portion of Sprague identified as Rural, Conservation and Preservation areas on the 2004-2009 *Connecticut Conservation and Development Policies Plan* Locational Guide Map.

Regional Plan: The property is identified as Existing and Proposed Recreational and Open Space Use with an area of Proposed Conservation Area along the river. In keeping with the goals and objectives with regard to natural resource protection and open space preservation identified in the 2007 *Draft Regional Plan of Conservation and Development*, development should be concentrated where the fewest natural resource limitations exist in order to

preserve the region's natural resource base. Intensive development of the Mukluk property would not be consistent with this goal.

Town Plan: The property is identified as Future Open Space with a Water Focus Area identified along the Shetucket River. In keeping with the Town's natural resource protection and open space enhancement goals, development along waterways should be regulated to ensure the protection of groundwater and surface water resources. Future open space areas are areas thought to contribute positively to the Town's open space network and resources as well as well as contribute to the overall economic well-being of the Town and quality of life for its residents. Furthermore, the 2007 *Plan of Conservation and Development* identifies goals and objectives that support actions to protect the prime features and pastoral characteristics of Sprague's natural landscape.

Summary

While preservation of the Mukluk property as open space is consistent with state, regional and town future land use plans, other options for future development do exist in the southeastern portion of the property. These include confining future development to the 17-acre tract associated with the former Mukluk Skeet Club and/or possibly extending this 17-acre tract to encompass the 30-acre southeastern corner of the property to potentially allow more intensive use with the intent of generating tax revenues for the town. It should be noted however that because the 17 acres that encompass the former skeet range are contaminated, no development for economic gain can take place until full and costly environmental remediation has been completed. Additionally, this consideration of additional acreage (in addition to the 17-acre tract) for potential development or any plans for future use other than passive recreation or preservation as open space, would result in the partial or total forfeit of the $500,000 DEP grant that has been offered to off-set the purchase price of the property. However, aside from these above considerations, the fact remains that the constraining site conditions such as steep slopes, wetland areas and flood zones, as well as the notable lack of site access and existing infrastructure, would considerably constrain any future intensive land use on this or any other portion of the property.

A Watershed Perspective

*This section will be completed and added as soon as it is available.

Appendix

DEP - Inland Fisheries Division Policy Statement – Riparian Corridor Protection
DEP - Inland Fisheries Division Position Statement – Utilization of 100 Foot Buffer Zones to Protect Riparian Areas in Connecticut
DEP Inland Fisheries Division - Large Woody Debris Fact Sheet

DEP - General Guidelines for Protecting Wildlife

Planning Considerations Section Maps

DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND FISHERIES DIVISION

POLICY STATEMENT
RIPARIAN CORRIDOR PROTECTION

I. INTRODUCTION, GOALS, AND OBJECTIVE

Alteration and exploitation of riparian corridors in Connecticut is a common event that significantly degrades stream water quality and quantity. Inasmuch as riparian ecosystems play a critical role in maintaining aquatic resource productivity and diversity, the Inland Fisheries Division (Division) recognizes that rigorous efforts are required to preserve, protect, and restore these valuable resources. Consequently, a riparian corridor protection policy has been developed to achieve the following goals and objective:

Goals

Maintain Biologically Diverse Stream and Riparian Ecosystems, and

Maintain and Improve Stream Water Quality and Water Quantity.

Objective

Establish Uniform Riparian Corridor Buffer Zone Guidelines.

II. DEFINITIONS

For the purpose of implementing a statewide riparian corridor protection policy, the following definitions are established:

Riparian Corridor: A land area contiguous with and parallel to an intermittent or perennial stream.

Buffer Zone: An undisturbed, naturally vegetated area adjacent to or contained within a riparian corridor that serves to attenuate the effects of development.

Perennial Stream: A stream that maintains a constant perceptible flow of water within its channel throughout the year.

Intermittent Stream: A stream that flows only in direct response to precipitation or which is seasonally dry.

III. RIPARIAN FUNCTION

Naturally vegetated riparian ecosystems perform a variety of unique functions essential to a healthy instream aquatic environment. The delineation and importance of riparian functions are herein described. Vegetated riparian ecosystems:

* Naturally filter sediments, nutrients, fertilizers, and other nonpoint source pollutants from overland runoff.

* Maintain stream water temperatures suitable for spawning, egg and fry incubation, and rearing of resident finfish.

* Stabilize stream banks and stream channels thereby reducing instream erosion and aquatic habitat degradation.

* Supply large woody debris to streams providing critical instream habitat features for aquatic organisms.

* Provide a substantial food source for aquatic insects which represent a significant proportion of food for resident finfish.

* Serve as a reservoir, storing surplus runoff for gradual release into streams during summer and early fall base flow periods.

IV. RIPARIAN CORRIDOR BUFFER ZONE GUIDELINES

Recognizing the critical roles of riparian corridors, the Division provides buffer zone guidelines that are designed to bring uniformity and consistency to environmental review. The guidelines are simple, effective, and easy to administer. The following standard setting procedure should be used to calculate buffer zone widths.

Perennial Stream: A buffer zone 100 feet in width should be maintained along each side.

Intermittent Stream: A buffer zone 50 feet in width should be maintained along each side.

Buffer zone boundaries should be measured from either, (1) edge of riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or (2) in the absence of a riparian wetland, the edge of the stream bank based on bank–full flow conditions.

The riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition. All activities that pose a significant pollution threat to the stream ecosystem should be prohibited.

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths and allowable development uses within these areas, local authorities should be encouraged to adopt the more restrictive regulations and policies.

12/13/91
Date

James C. Moulton
Acting Director

POSITION STATEMENT
UTILIZATION OF 100 FOOT BUFFER ZONES TO PROTECT RIPARIAN AREAS IN CONNECTICUT

BY
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I. INTRODUCTION

One tenet of the Inland Fisheries Division Policy on Riparian Corridor Protection is the utilization of a 100 foot buffer zone as a minimum setback along perennial streams. The adoption of such a policy is sure to be controversial. Laymen, developers and natural resource professionals alike will ask questions such as: Why was a standard setting method adopted? What's magical about 100 feet? Will 100 feet be sufficiently protective, or will it be overly protective? In response, this paper outlines the ramifications of adopting a riparian corridor policy including the use of a 100 foot buffer zone.

II. STANDARD SETTING VERSUS SITE SPECIFIC BUFFER ZONES

There are two approaches for determining buffer zone width; standard setting and site specific. Standard setting methods define an area extending from the streambank edge or highwater mark to some landward fixed point boundary. Site specific methods utilize formulas that incorporate and consider special site specific land characteristics, hence, the calculation of a variable width buffer zone. In both case, buffers are employed to define an area in which development is prohibited or limited.

A major advantage of standard setting methods is that they are easy to delineate and administer, thereby improving the consistency and quality of environmental assessments. Furthermore, valuable staff time would not be required to determine site specific buffer zones along each and every watercourse of concern.

The exact width of a buffer zone required for riparian corridor protection is widely disputed (Bottom et al. 1985 and Brinson et al. 1981). Buffer width recommendations found in the literature vary from as little as 25 feet to as great as 300 feet (Palfrey et al. 1982). The 100 foot buffer is widely accepted in Connecticut having been adopted by numerous inland wetland and conservation commissions as an appropriate minimum setback regulation for streambelts. In addition, Division staff have been recommending the utilization of the 100 foot buffer zone to protect streambelts since the early 1980's. Scientific research has not been generated to dispute the adequacy of utilizing 100 foot buffer zones to protect Connecticut's riparian corridors. In fact, to ensure that riparian functions are not significantly altered, recent scientific information points towards maintaining buffer zones that would be at a minimum, 100 feet in width (see section III).

Site specific methods define buffer widths according to the character and sensitivity of adjacent streamside lands. These buffer widths, also referred to as "floating buffers," consider physical site characteristics such as slope, soil type, and vegetative cover. The advantage of site specific methods is that buffer widths are designed using site characteristics and not an arbitrary predetermined width. Unfortunately, there is no "one" universally accepted formula or model and none have been developed for use in Connecticut. Most formulas are based on the degree to which sediment can be removed or filtered by natural vegetation, thus, the primary useage is sediment control. Other weaknesses of site specific techniques are (1) all areas must be evaluated on a case-by case basis and, (2) the subjectivity of different techniques (i.e. if the evaluation technique is inadequate, the buffer width will also be inadequate).

Additionally, these formulas only concentrate on one specific riparian function at a time and do not take into account multiple riparian functions, especially those of inland fisheries values as discussed in Section III. Consequently, site specific formulas approach riparian function on a single dimension rather than taking a more realistic, holistic approach.

In the absence of a scientific model to determine buffer widths suitable to protect Connecticut's riparian corridors, the utilization of a standard setting method is environmentally and politically prudent.

III. RIPARIAN FUNCTION

To assess the efficacy of a 100 foot buffer zone, the literature was searched to identify studies which have applied a quantitative approach to buffer width determination. Literature was searched for studies which both support and dispute the 100 foot zone. The following is a summary "by riparian function" of quantitative studies which assess buffer widths.

Sediment Control

Width, slope and vegetation have been cited as important factors in determining effectiveness of buffer zones as sediment filters (Karr and Schlosser 1977). Wong and McCuen (1981), who developed and applied a mathematical model to a 47 acre watershed, found that a 150 foot zone along a 3% slope reduced sediment transport to streams by 90%. Mannering and Johnson (1974) passed sediment laden water through a 49.2 foot strip of bluegrass and found that 54% of sediment was removed from the water. Trimble and Sartz (1957) developed recommendations as to width of buffer areas between logging roads and streams to reduce sediment load. They determined a minimum strip of 50 feet was required on level land with the width increasing 4 feet for each 1% slope increase. Buffer widths as determined by Trimble and Sartz (1957) have been characterized as evaluated guesses rather than empirically defined widths (Karr and Schlosser 1977). Rodgers et al. (1976) state that slopes greater than 10% are too steep to allow any significant detention of runoff and sediment regardless of buffer width. After a critical review of the literature, Karr and Schlosser (1977) determined that the size and type of vegetative buffer strip needed to remove a given fraction of the overland sediment load cannot be universally quantified. Existing literature does suggest that 100 foot riparian buffers will assist with sediment entrapment, although efficacy will vary according to site conditions.

Temperature Control

Brown and Brazier (1973) evaluated the efficacy of buffer widths required to ameliorate stream water temperature change. They concluded that angular canopy density (ACD), a measure of the ability of vegetation to provide shading, is the only buffer area parameter correlated with temperature control. Results show that maximum angular canopy density or maximum shading ability is reached within a width of 80 feet. Study sites were 9 small mountain streams in Oregon that contained a conifer riparian vegetative complex. Whether or not maximum angular canopy density is reached within 80 feet in a typical Connecticut deciduous forest riparian zone is doubtful. Tree height in Connecticut riparian zones is smaller than in Oregon (Scarpino, personal communication), therefore buffers greater than 80 feet in width would be required for temperature maintenance in Connecticut.

Nutrient Removal

Nutrient enrichment is caused by phosphorous and nitrogen transport from, among other things, fertilized lands and underground septic systems. Most research on nutrient enrichment has focused on overland surface flow. Karr and Schlosser (1977) report that 88% of all nitrogen and 96% of all phosphorous reaching watercourses in "agricultural watersheds" were found to be attached to sediment particles; thus, successful nutrient removal can be accomplished through successful sediment removal. There are conflicting reports on the ability of buffer widths to remove nutrients with most research being tested on grass plots. Butler et al. (1974) as cited by Karr and Schlosser (1977) found that a 150 foot buffer width of reed canary grass with a 6% slope caused reductions in phosphate and nitrate concentrations of between 0–20%. Wilson and Lehman (1966) as cited by Karr and Schlosser (1977) in a

study of effluent applied to 300 m grass plots found that nitrogen and phosphorous concentrations were reduced 4 and 6%, respectively. Studies on subsurface runoff as cited in Clark (1977) found high concentrations of nitrates at 100 feet from septic systems with unacceptable levels at 150 feet. Clark (1977) recommended that a 300 foot setback be used whenever possible, with a 150 setback considered adequate to avoid nitrate pollution. Environmental Perspective Newsletter (1991) states that experts who commonly work with the 100 foot buffer zone set by the Massachusetts Wetlands Protection Act are increasingly finding that it is insufficient since many pollutants routinely travel distances far greater than 100 feet with nitrate–nitrogen derived from septic systems moving distances of greater than 1000 feet. Research indicates that the adoption of 100 foot buffer widths for Connecticut riparian zones will assist with the nutrient assimilation; albeit, complete removal of all nutrients may not be achieved.

Large Woody Debris

The input of large woody debris (LWD) to streams from riparian zones, defined as fallen trees greater than 3 m in length and 10 cm in diameter has been recently heralded as extremely critical to stream habitat diversity as well as stream channel maintenance. Research on large woody debris input has mainly been accomplished in the Pacific Northwest in relation to timber harvests. Murphy and Koski (1989) in a study of seven Alaskan watersheds determined that almost all (99%) identified sources of LWD were within 100 feet of the streambank. Bottom et al. 1983 as cited by Budd et al. (1987) confirm that in Oregon most woody structure in streams is derived from within 100 feet of the bank. Based on research done within old–growth forests, the Alaska region of the National Marine Fisheries Service, recognizing the importance of LWD to salmonid habitat, issued a policy statement in 1988 advocating the protection of riparian habitat through the retention of buffer strips not less than 100 feet in width (Murphy and Koski 1989). All research findings support the use of a 100 foot buffer zone in Connecticut for large woody debris input.

Food Supply

Erman et al. (1977) conducted an evaluation of logging impacts and subsequent sediment input to 62 streams in California. Benthic invertebrate populations (the primary food source of stream fishes) in streams with no riparian buffer strips were compared to populations in streams with buffer widths of up to 100 feet. Results showed that buffer strips less than 100 feet in width were ineffective as protective measures for invertebrate populations since sediment input reduced overall diversity of benthic invertebrates. Buffer strips greater than 100 feet in width afforded protection equivalent to conditions observed in unlogged streams. The ultimate significance of these findings is that fish growth and survival may be directly impacted along streams with inadequate sized riparian buffer zones. All research supports the feasibility of implementing a 100 foot buffer zone in Connecticut to maintain aquatic food supplies.

Streamflow Maintenance

The importance of riparian ecosystems in terms of streamflow maintenance has been widely recognized (Bottom et al. 1985). In Connecticut, riparian zones comprised of wetlands are of major importance in the hydrologic regime. Riparian wetlands store surplus flood waters thus dampening stream discharge fluctuations. Peak flood flows are then gradually released reducing the severity of downstream flooding. Some riparian wetlands also act as important groundwater discharge or recharge areas. Groundwater discharge to streams during drier seasonal conditions is termed low flow augmentation. The survival of fish communities, especially coldwater salmonid populations is highly dependent upon low flow augmentation (Bottom et al. 1985). Research, although documenting the importance of riparian zones as areas critical to streamflow maintenance, has not investigated specific riparian buffer widths required to provide the most effective storage and release of stream flows.

IV. OTHER POLICY CONSIDERATIONS

Measurement Determination

The proposed policy states that buffer zone boundaries should be measured from either the edge of the riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or in the absence of a riparian wetland, the edge of the streambank based on bank-full flow conditions. This boundary demarcation is absolutely necessary to ensure that all riparian wetlands are protected. For example, if all measurements were to start from the perennial stream edge and extend landward for a distance of 100 feet, many riparian zones that contain expansive wetlands greater than 100 feet in width would be left unprotected.

Also, since boundary demarcation includes wetland delineation, the ultimate width of the buffer will vary according to site specific features. Consequently, buffer width determination as stated by Division policy is a "hybridization" of both standard setting and site specific methods. This hybridization of methods is advantageous since it acknowledges the sensitivity of streamside wetlands.

Home Rule

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths, local authorities would be encouraged to adopt the more restrictive regulations and policies. This feature incorporates flexibility to acknowledge the importance of local "home rule" regulations or policies already in accepted practice. Conversely, towns and cities without accepted policies and regulations could choose to enact the Division policy.

Allowable Uses in Buffer Zones

The Division policy states that "the riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition and that all activities that pose a significant pollution threat to the stream ecosystem should be prohibited." In essence, the buffer zone becomes an area where no development should be allowed. For this policy to be effective, there should be no exceptions, a blanket restriction of all uses would be recommended. Further clarification and more precise definitions of allowable uses will, however, be required in the future if the policy evolves into a departmental regulation.

Recently, the Connecticut Supreme Court has ruled that local agencies can prohibit specific development within buffer zones. The *Lizotte v. Conservation Commission of the Town of Somers, 216 Conn.320 (1990)* decision ruled that the construction or maintenance of any septic system, tank, leach field, dry well, chemical waste disposal system, manure storage area or other pollution source within 150 feet of the nearest edge of a watercourse or inland wetland's seasonal high water level can be prohibited (Wetlands Watch 1990). If this decision is a precursor of the future, Connecticut courts will continue to the support the use of buffers, especially those which restrict or prohibit detrimental activities.

V. CONCLUSIONS

The following actions are required to preserve, protect, and restore Connecticut's riparian corridors:

1. The Inland Fisheries Division needs to adopt and implement the proposed policy so that staff can use it as a guideline to assist cities, towns, developers and private landowners with making sound land use decisions. This policy will act to solidify a collective position concerning riparian corridor protection.

2. While the proposed policy in its "current form," represents a recommendation from the CTDEP Inland Fisheries Division, the ultimate goal of the Division should be to progressively implement this policy as either a CTDEP regulation or State of Connecticut statute.

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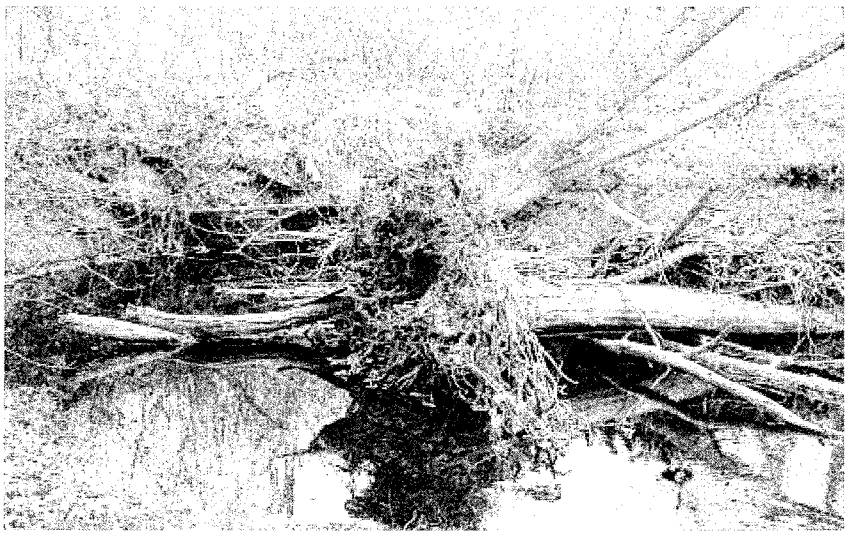
Inland Fisheries Division
Habitat Conservation and Enhancement Program

Large Woody Debris Fact Sheet

I. Introduction

Trees that grow along a streamside can often fall into a watercourse due to floods, erosion, windthrow, disease, beaver activity or natural mortality. These materials, often referred to as Large Woody Debris (LWD) can include whole trees with a rootwad and limbs attached or portions of trees with or without rootwads or limbs. LWD is typically defined by biologists as logs with a minimum diameter of 4 inches and a minimum length of 6 feet that protrude or lay within a stream channel. Environmental and recreational groups have often removed LWD as part of river cleanup or river improvement projects. Although these groups have good intentions, LWD removal can be "very detrimental" to stream health and well being. In fact, during the last decade, the Inland Fisheries Division has been actively adding LWD to river systems as a component of individual stream restoration projects, particularly in streams that are LWD deficient. This fact sheet describes the vital importance of LWD to river ecosystems and provides guidance for its beneficial management.



Example of various types of large woody debris in the Moosup River, Plainfield.

II. Ecological Benefits of Large Woody Debris

Research studies have shown that LWD is a vital and naturally occurring component of healthy stream ecosystems. Ecological benefits of LWD are described below.

- ***Fish Habitat***

LWD that falls completely across a stream causes water to be slightly impounded resulting in the formation of an upstream pool and a downstream plunge pool as water flows under and over the wood. Pools are deeper water habitats that provide critical hiding and resting areas for fish and are especially important fish habitats during periods of low streamflow. Water flowing over and under LWD during high flow events can result in localized scour pockets or holes, providing excellent cover habitats for fish. LWD can also create velocity shelters for fish, especially behind large rootwads. Fish often rest within these velocity shelters, where water velocities are slower. In large streams and rivers, LWD can trap and accumulate smaller wood, branches, leaves and other organic materials that add to the complexity and diversity of instream fish habitats.

- ***Stream Channel and Streambank Stability***

LWD in low gradient, meandering and sandy streambed systems such as the Scantic River in north central Connecticut serve a critical function in controlling the grade of the stream channel by holding back or stabilizing the movement of these fine streambed materials. Conversely, LWD can also facilitate the transport of fine sediments where wood accumulation narrows a stream channel thereby increasing water velocities. In these situations, LWD assists with flood management by ensuring that the streambed elevation does not increase. In addition, LWD that has accumulated along streambanks can often absorb and redirect the highly erosive forces of large streamflow events protecting streambanks from erosion. Research has documented many examples where LWD was removed from entire river sections, resulting in major erosion of the stream channel, streambanks and ultimately degradation of instream fish habitats.

- ***Biological Diversity***

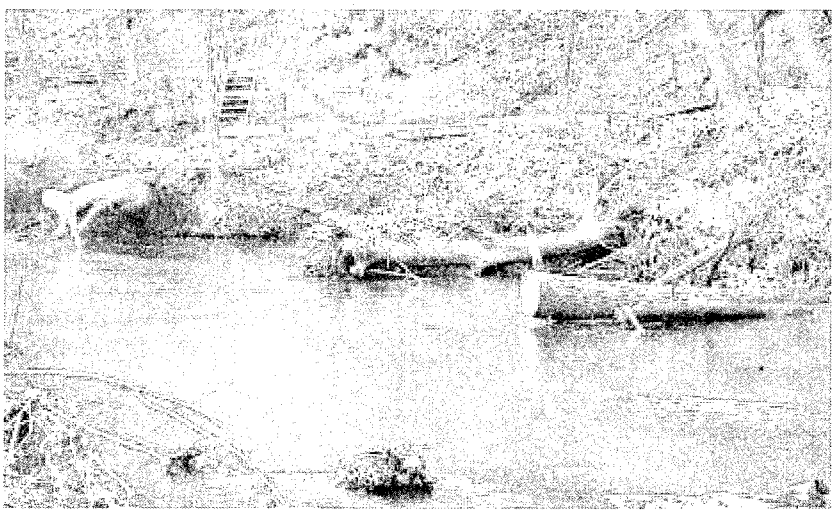
Microscopic algae, called periphyton can attach to LWD and provide food for aquatic insects and other invertebrates, which also colonize and attach themselves to woody debris. In addition, LWD tends to trap and collect other organic materials such as leaves, providing a food source for many aquatic insects, which shred and consume leaf materials. These same aquatic insects comprise a major component within fish diets. In a very real sense, LWD effectively creates a "mini-ecosystem" which significantly adds to a stream's biological diversity and health.

III. Large Woody Debris Management

Considering the multiple environmental benefits provided by large woody debris, it is understandable why biologists are extremely concerned about river cleanup projects that involve extensive LWD removal. Therefore, it is the intent of this fact sheet to provide common sense guidelines for large woody debris management that will address the concerns of property owners and river users while retaining the natural ecological benefits of LWD in Connecticut streams.

➢ **General Guidelines**

LWD removal should only be considered when there is compelling evidence that it is causing flooding of private/public infrastructure, significant streambank erosion, or is a navigational hazard. When cutting streamside trees and LWD, first determine property ownership in the specific area where the work is to be done. You must always obtain permission from the property owner to legally gain access and perform the work. Property boundaries in Connecticut often run through the centerline of the stream channel so you may have to contact property owners on both sides of a stream channel for permission. Secondly, **always contact your municipal Inland Wetland Agency** to determine if the proposed work will require any local regulatory permits. Lastly, although any large-scale riverwide LWD removal projects would be discouraged, such projects may require permits from the Connecticut Department of Environmental Protection. Please contact the DEP Inland Water Resources Division for regulatory guidance and permit determination prior to initiating any projects. Fisheries Biologists from the DEP Inland Fisheries Division, Habitat Conservation and Enhancement Program can also be contacted for specific onsite guidance regarding LWD removal. DEP Watershed Management and Coordination staff may be contacted for further assistance regarding watershed management issues.



Example of large woody debris cut and removed from the Hockanum River, Manchester. While some wood was left in place, some of the cut wood could have been repositioned and anchored to the streambank to help retain LWD ecological benefits.

Where LWD absolutely has to be cut, wood can be floated, repositioned and anchored to the shoreline, so its ecological benefits are not lost. For example, LWD that lies perpendicular to streamflow can be repositioned so it is aligned in a downstream orientation at an angle ranging from **20 to 40 degrees** to the streambank (see diagram).

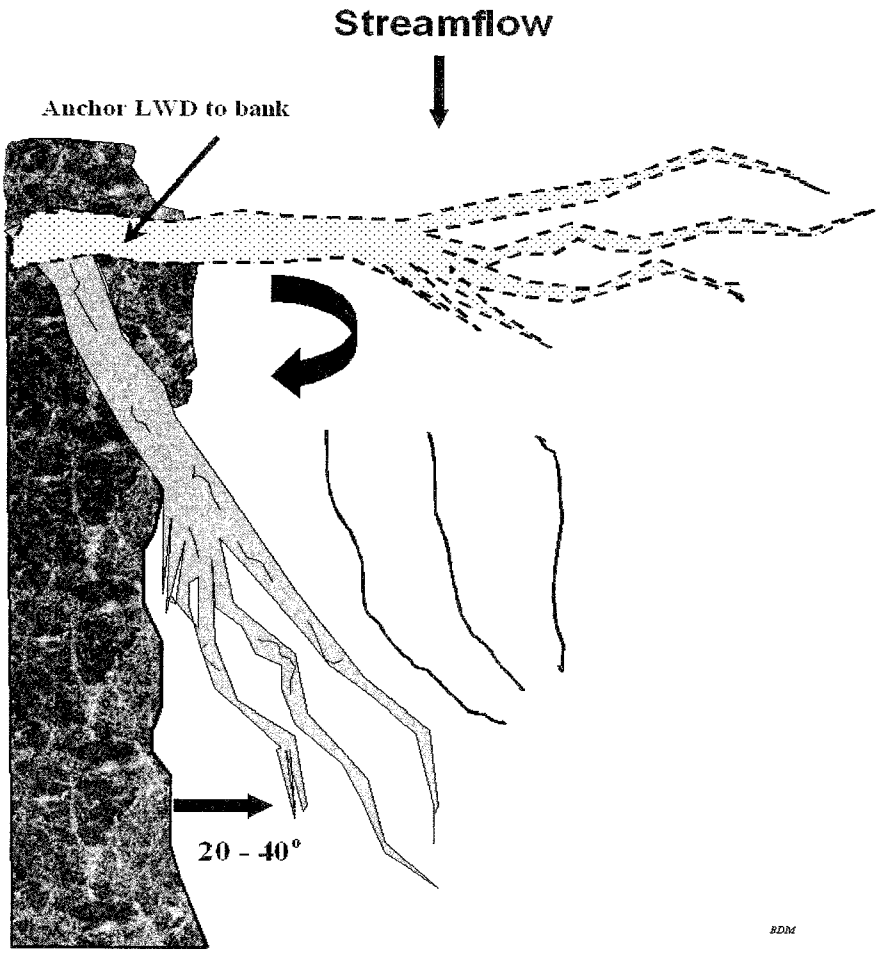


Diagram demonstrating LWD lying perpendicular to streamflow that was cut and realigned in a downstream orientation at the preferred angle ranging from 20 to 40 degrees to the streambank. LWD is secured to the streambank with an appropriate anchoring system.

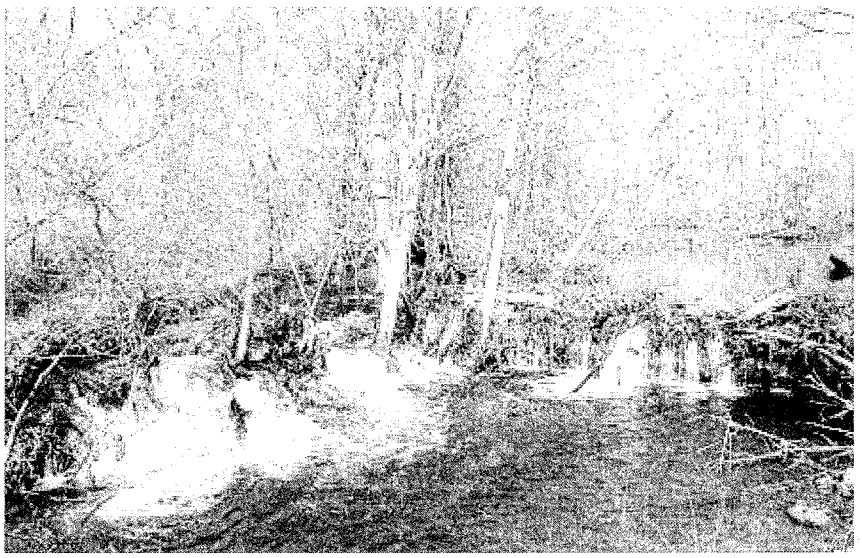
This orientation will ensure that the repositioned LWD does not deflect river flows into the streambank and cause erosion. LWD can be anchored to the streambank with the use of wire cable and gripple fastening systems. Contact Inland Fisheries Division biologists for more specific information related to anchoring systems. Under no circumstances should LWD be cut and either allowed to float downstream or moved to streambanks and left within the floodplain where subsequent storm events can transport it back into the watercourse. The concern is that this wood could collect at a downstream bridge or culvert crossing and impair the conveyance of water through that roadway crossing infrastructure.

➢ **Navigation**

LWD has been removed from several streams in Connecticut to provide more favorable navigation conditions for canoes and kayaks during springtime canoe races. The removal of LWD for a one-day event can have long lasting impacts to a stream's ecosystem for decades to come. If LWD has to be removed to enhance navigation, it is recommended that partial removal be evaluated to allow for navigation through the area. Where feasible, only the minimum necessary amount of LWD should be removed to enhance passage and be replaced downstream where it will not pose a navigational hazard. Portage of canoes may be necessary in some areas to minimize LWD removal. As previously mentioned, when LWD absolutely has to be cut, wood can be floated, repositioned and anchored to the shoreline.

➢ **Logjams**

Logjams are natural accumulations of LWD that may span an entire width of stream channel and create a partial obstruction to streamflows. Logjams usually do not block upstream fish passage. In some circumstances where streams are completely blocked, logjams can create a backwater condition and flood riparian lands providing beneficial nutrient enrichment to riparian soils. Logjams provide many of the same benefits of LWD that have been described elsewhere in this fact sheet; however, another important function is that logjams may redirect streamflows resulting in the formation of a new stream channel or perhaps even redirect flow into an abandoned channel. These channel shifts are normal occurrences and function to effectively move water and sediment loads throughout a stream system.



Example of a newly formed logjam in the Fenton River, Mansfield.

LWD may have to be removed where logjams collect in front of roadway culverts and bridges if it has been determined that they impede water conveyance and create a flood hazard. However, it may be possible to remove the logjam and re-introduce portions of LWD downstream of the roadway crossing where it does not present any hazard. Logjams that do not present a flood hazard should not be removed. Often times, logjams are temporary and will break apart during subsequent flood events so they may not present an immediate cause for concern. Beaver may also build dams along logjams that can result in flooding. Please contact the DEP Wildlife Division for problems associated with beaver activity.

In summary, due to the important ecological functions and benefits of LWD in Connecticut streams, careful consideration should be given before it is removed from any river or stream. Prior to initiating LWD removal, one should refer to the guidance provided in this fact sheet and contact local and state agencies to obtain any necessary authorization.

Contact Information

Bureau of Natural Resources

Inland Fisheries Division
Hartford Office:860-424-3474
Eastern Connecticut:860-295-9523
Western Connecticut:860-567-8998

Wildlife Division

Eastern Connecticut:860-295-9523
Western Connecticut: 860-675-8130

Bureau of Water Protection and Land Reuse

Inland Water Resources Division
860-424-3019

Planning and Standards Division
Watershed Management and Coordination Program
860-424-3020

Suggested References

Gregory, S.V., K.L. Boyer and A.M. Gurnell, editors. 2003. The ecology and management of wood in world rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland.

Rutherfurd, I., Marsh, N., Price, P. and S. Lovett. 2002. Managing woody debris in rivers, Fact Sheet 7, Land and Water, Australia, Canberra.

General Guidelines for Protecting Wildlife Resources When Developing Trails

Some properties may lend themselves to providing a variety of recreational opportunities (e.g., hiking, hunting, fishing, nature study and photography, horseback riding, mountain biking.) Properly designed trails can provide excellent opportunities to increase public appreciation for wildlife and the ecological values of various habitats. Trails should be designed to enhance the learning and aesthetic aspects of outdoor recreation while minimizing damage to the landscape. They should be laid out to pass by or through the various cover types and other special features represented on the property while avoiding those areas prone to erosion or that contain plants or animals that may be impacted by human disturbance. Uses that are generally considered "compatible" could impact sensitive resources depending on the location, timing and frequency of their occurrence. For example, while regulated fishing is considered an accepted form of outdoor recreation, there could be impacts associated with it, such as streambank erosion at heavily used sites. The overall level of disturbance to vegetation/habitat and wildlife can be significantly reduced by establishing one or two (will depend on property size and degree of importance to natural resources) multiple-use trails rather than several single/exclusive-use trails.

Some guidelines to follow when developing a trail system include:

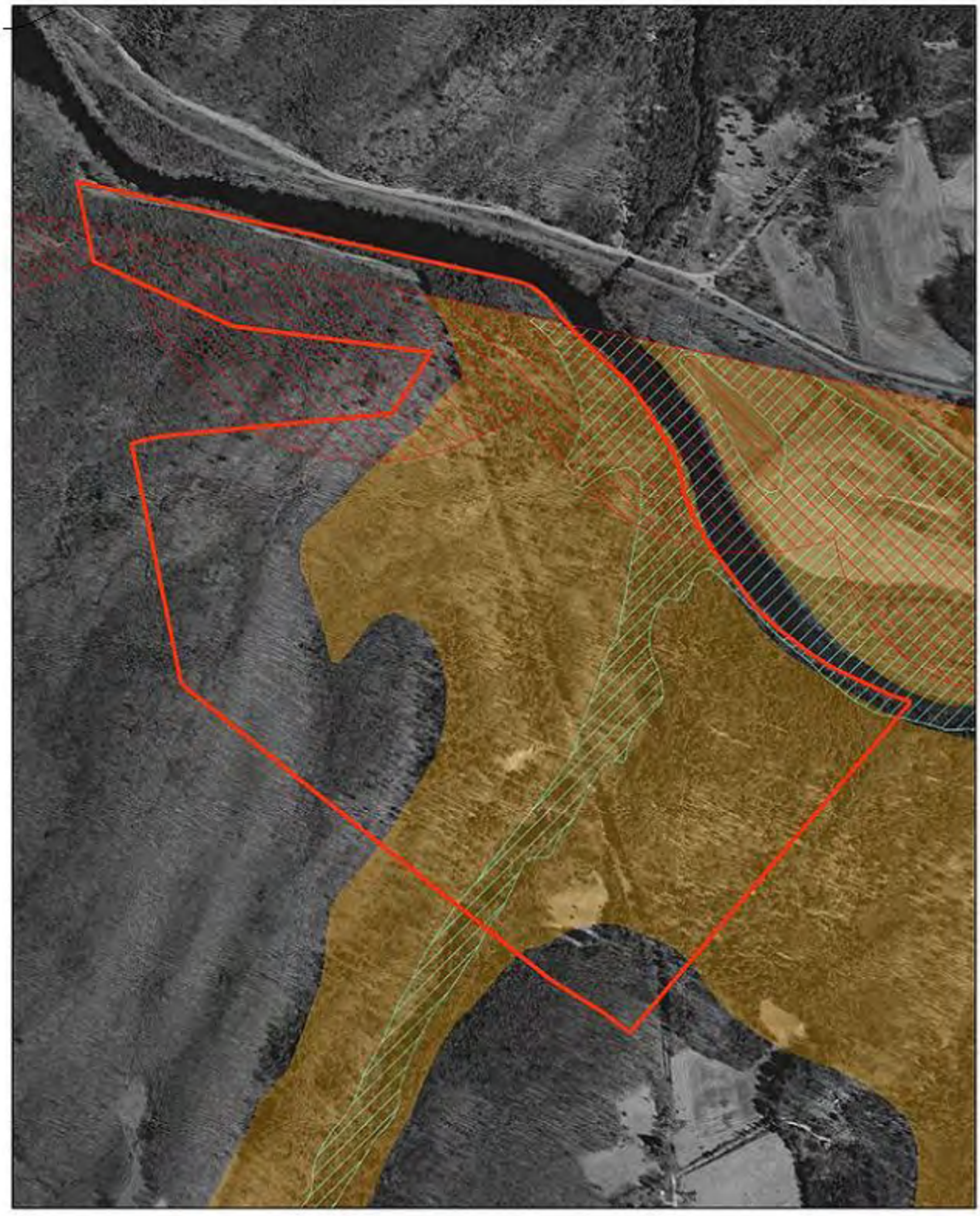
- Narrow, passive-use recreation trails with natural substrate that would require minimal vegetation removal, maintain forest canopy closure, prohibit the use of motorized vehicles, and require dog owners to keep their dogs under control, are preferred to reduce environmental impacts and disturbance to wildlife. Abandoned roadways (e.g., farm/logging roads) should be incorporated into the trail system whenever possible and appropriate to minimize cutting activity/vegetation removal;
- If a paved, multi-purpose trail is established, avoid the use of curbing. If it is necessary, Cape Cod style curbing (curbing at 45 degree angle) is recommended;
- Know the characteristics of the property and plan the layout so that the trail passes by or through a variety of habitat types;
- Make the trail as exciting and safe as possible and follow a closed loop design. Avoid long straight stretches of >100'; trails with curves and bends add an element of surprise and anticipation and appear more "natural";
- Traversing wetlands and steep slopes should be avoided whenever possible to minimize erosion and sedimentation problems; where wetlands must be crossed, a boardwalk system should be used;
- The property boundaries and trail should be well marked. It is best to provide a map/informational leaflet describing the wildlife values associated with the property (e.g., value of wetlands, various habitat types/stages of succession, habitat management practices) and guidelines for responsible trail use;

- Potential impacts of trails on private property owners should be identified. Where trails bisect private property, the access should be of adequate width and the trail well-marked to help avoid potential conflicts (e.g., trespass by trail users);
- For more specific guidance on trail design and construction contact the Connecticut Forest & Park Association (860-346-2372 or www.ctwoodlands.org) or Appalachian Mountain Club (www.outdoors.org);
- For an extensive literature review about the effects of different types of recreation activities on wildlife, visit web site www.Montanatws.org – 307 page document published in 1999 entitled, "Effects of recreation on Rocky Mountain wildlife: A review for Montana."

Prepared by the CT DEP Wildlife Division for the Partners In Stewardship Program (June 2002)

Questions? Contact CT DEP Wildlife Division at 860-295-9523 (Eastern CT) or 860-675-8130 (Western CT)

Mukluk Property, Town of Sprague, CT



Source:
State of Connecticut DEP
FEMA, and CT DOT

Prepared by:
SCCOG Southeastern Connecticut Council of Governments Geographic Information System

N
W E
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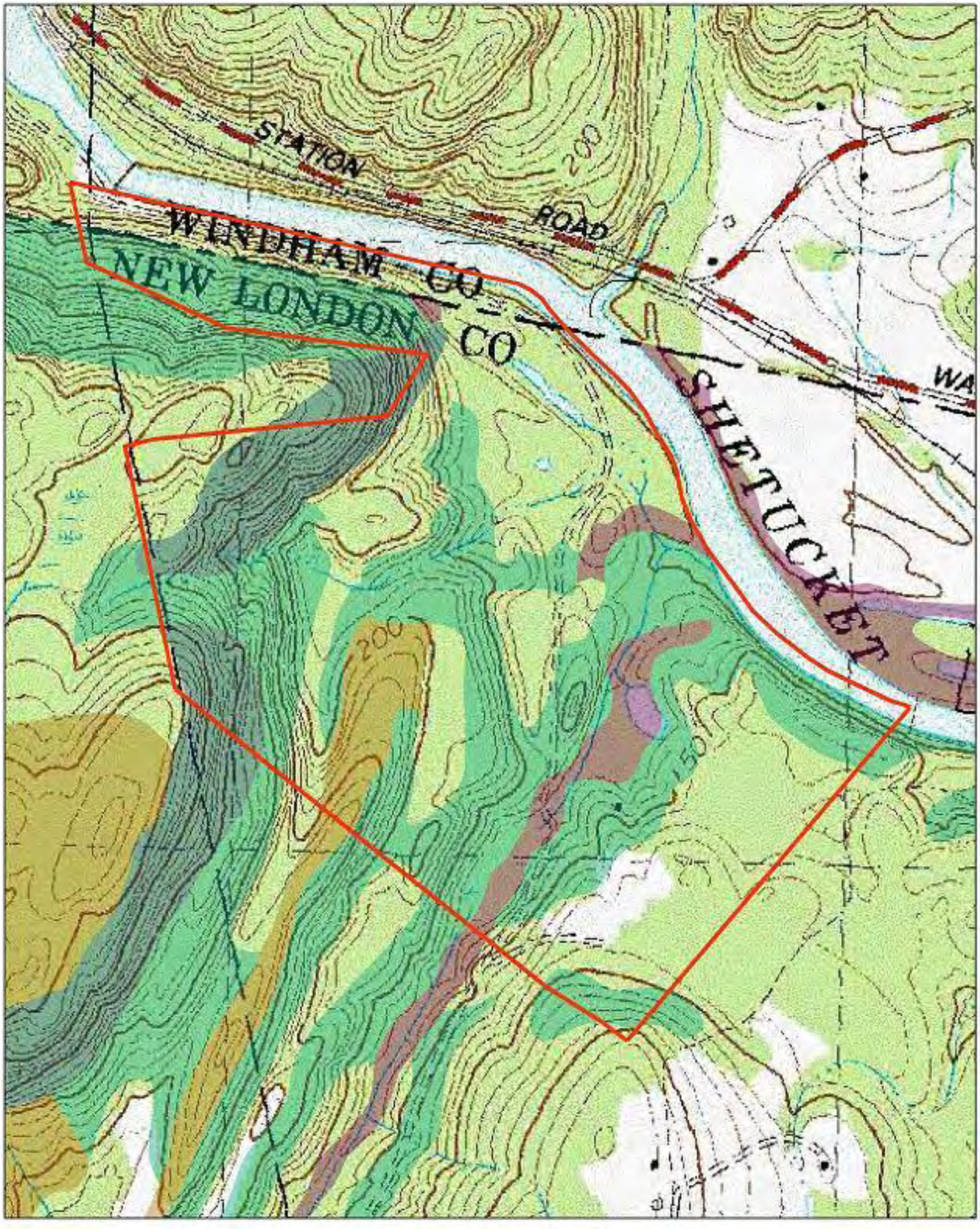
1 inch equals 500 feet

Legend

- Natural Diversity Databse Location
- A - 100 Year Flood Zone
- Coarse-Grained Stratified Deposits

Mukluk Property, Town of Sprague, CT



Source: USGS Topographic map, and Natural Resources Conservation Service (NRCS) SSURGO Soils Database

Prepared by:

SCCOG Southeastern Connecticut Council of Governments Geographic Information System

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1 inch equals 500 feet

Legend

- Alluvial and floodplain soils
- Soils less than 20" deep with Slopes under 15%
- Soils with Slope over 15% and Depth Greater than 20"
- Soils less than 20" deep with Slope over 15%

About the Team

The Eastern Connecticut Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a variety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, foresters, soil specialists, engineers and planners. The ERT operates with state funding under the supervision of the Eastern Connecticut Resource Conservation and Development (RC&D) Area — an 86 town region.

The services of the Team are available as a public service at no cost to Connecticut towns.

Purpose of the Team

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in reviewing a wide range of projects including subdivisions, landfills, commercial and industrial developments, sand and gravel excavations, active adult, recreation/open space projects, watershed studies and resource inventories.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

Requesting a Review

Environmental reviews may be requested by the chief elected official of a municipality and/or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the chairman of your local Conservation District and the ERT Coordinator. A request form should be completely filled out and should include the required materials. When this request is reviewed by the local Conservation District and approved by the ERT Subcommittee, the Team will undertake the review on a priority basis.

For additional information and request forms regarding the Environmental Review Team please contact the ERT Coordinator: 860-345-3977, Eastern Connecticut RC&D Area, P.O. Box 70, Haddam, Connecticut 06438, e-mail: ctert@comcast.net