Naugatuck River Greenway
Waterbury, Connecticut

King's Mark
Environmental Review Team Report

King's Mark Resource Conservation and Development Area, Inc.

Naugatuck River Greenway
Waterbury, Connecticut

Naugatuck River Greenway
Waterbury, Connecticut

Environmental Review Team Report

Prepared by the

King's Mark
Environmental Review Team

Of the

King's Mark
Resource Conservation and Development Area, Inc.

For the

Mayor and
Inland Wetlands and Watercourses Agency
Waterbury, Connecticut

June 2006

Report #334

Acknowledgments

This report is an outgrowth of a request from the Waterbury Inland Wetlands and Watercourses Agency (IWWA) to the Southwest Conservation District (SWCD) and the King's Mark Resource Conservation and Development Area (RC&D) Council for their consideration and approval. The request was approved and the measure reviewed by the King's Mark Environmental Review Team (ERT).

The King's Mark 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, October 12, 2005, and Wednesday, October 19, 2005.

Nicholas Bellantoni	State Archaeologist UCONN – Office of State Archaeology (860) 486-5248
Robin Blum	Wildlife Technician DEP – Eastern District Headquarters (860) 295-9523
Christopher Donnelly	Forester DEP – Forestry Division (860) 424-3178
Samuel Gold	Regional Planner Council of Governments of the Central Naugatuck Valley (203) 757-0535
Joseph Hickey	Recreation Planner CT Greenways Council/DEP Retired (860) 529-4363
Alan Levere	Wetland Reviewer DEP – Office of the Chief of Staff (860) 424-3643
Leslie Lewis	Greenways Coordinator DEP – Greenway assistance Center (860) 424-3578
Dawn McKay	Biologist/Environmental Analyst 3 DEP - Environmental and Geographic Information Center (860) 424-3592

Donald Mysling	Senior Fisheries Biologist DEP – Inland Fisheries Division Habitat Conservation and Management Plan (860) 567-8998
Roman Mrozinksi	Executive Director Southwest Conservation District (860) 269-7509
David Poirier	Staff Archaeologist State Historic Preservation Office (860) 566-3005
Randolph Steinen	Geologist DEP – State Geological and Natural History Survey UCONN - Emeritus Professor, Geology Program (860) 486-1383

I would also like to thank Kathleen McNamera, chair, Waterbury IWWA, Dan Baroody, then Waterbury IWWA coordinator, Michael Jarjura, mayor, Sharon Okoye, Kurt Walton and Dave Balzer, CT DOT, Susan Peterson, DEP, Watershed Management, and all of the interested Waterbury agencies, boards and civic groups 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 study corridor, topographic and soils maps. During the field review Team members were given additional information and received color GIS maps base maps of property ownership along the study area. 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 city and landowners. 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 city. The results of this Team action are oriented toward the development of better environmental quality and the long term economics of land use.

The King's Mark RC&D Executive Council hopes you will find this report of value and assistance in the review of this proposed greenway.

If you require additional information please contact:

Elaine Sych, ERT Coordinator
CT ERT Program
P. O. Box 70
Haddam, CT 06438
Tel: (860) 345-3977 e-mail: ctert@comcast.net

Table of Contents

Introduction

The Waterbury Inland Wetlands and Watercourses Agency and the Mayor of Waterbury have requested assistance from the King's Mark Environmental Review Team (ERT) in conducting a natural resource inventory and opportunity assessment review for a proposal to create a greenway along the Naugatuck River through Waterbury.

The proposed project consists of the creation of a greenway corridor along the Waterbury reach of the Naugatuck River which is 7.1 miles in length. This greenway would consist of a recreation path, picnic areas, canoe landings, and observational decks, etc. It is thought that a greenway would stimulate various recreational activities and economic development along the river. It is envisioned that some day this greenway would connect with others being built and planned throughout the Naugatuck Valley north and south of Waterbury.

Objectives

The purpose of the ERT study is to provide a natural resource inventory, provide planners with information for the preparation of a concept plan for improving enjoyment and passive recreational use of the river. Specific areas of assessment and information requested include: soils, erosion and sediment control, water quality improvement, wetlands and river ecology, fisheries and wildlife habitat, and land use and recreational opportunities.

The ERT Process

Through the efforts of the Waterbury Inland Wetlands and Watercourses Agency and the Mayor's office, this environmental review and report was prepared for the City of Waterbury.

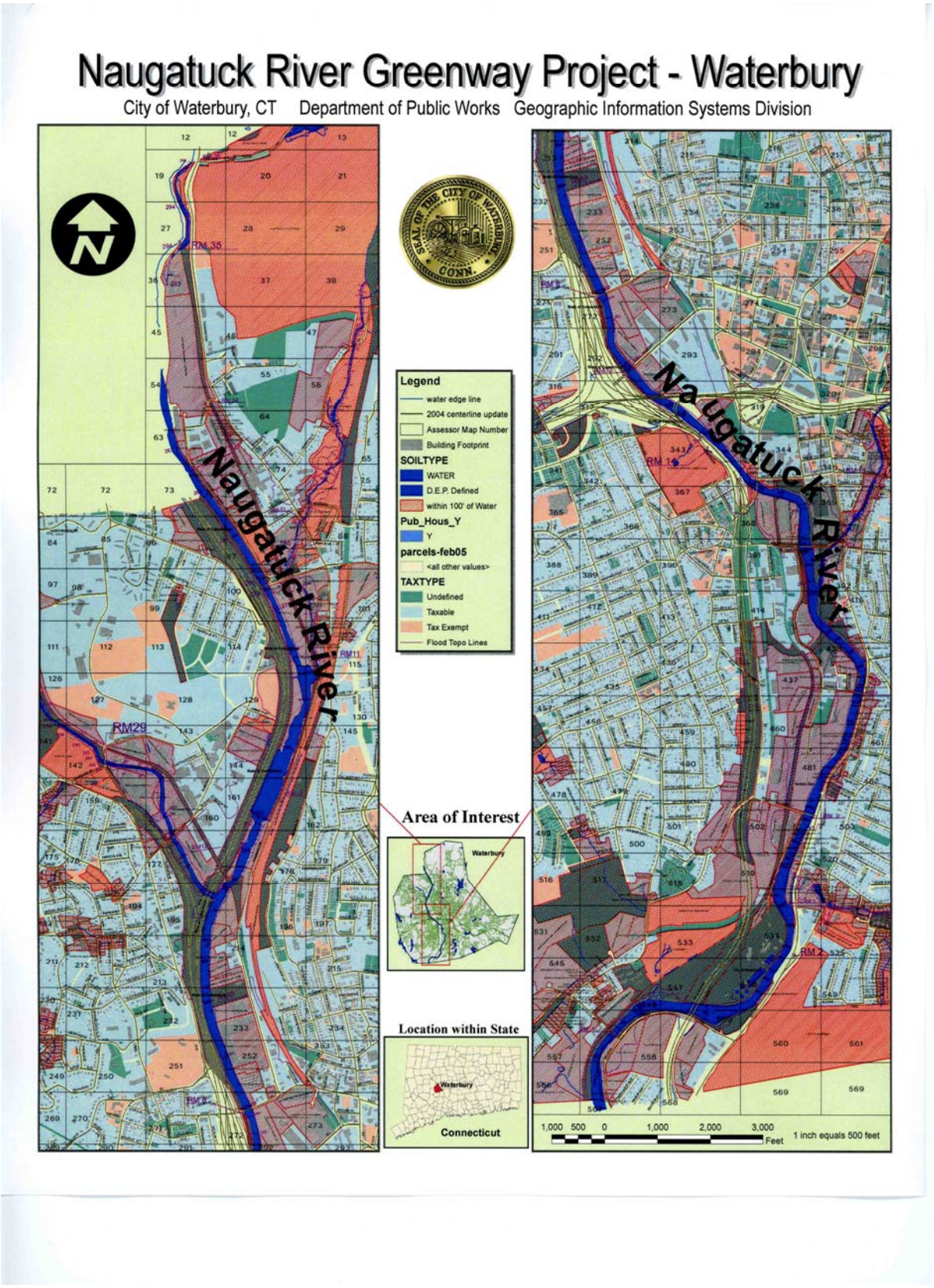
This report provides an information base and a series of recommendations and guidelines which cover the topics requested by the Waterbury IWWA. Team members were able to review maps, plans and supporting documentation provided by the applicant.

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, October 12 and Wednesday, October 19, 2005. 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. 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.


Naugatuck River Greenway Project - Waterbury
City of Waterbury, CT Department of Public Works Geographic Information Systems Division
Naugatuck River
Legend
water edge line
2004 centerline update
Assessor Map Number
Building Footprint
SOILTYPE
WATER
D.E.P. Defined
within 100' of Water
Pub_Hous_Y
Y
parcels-feb05
<all other values>
TAXTYPE
Undefined
Taxable
Tax Exempt
Flood Topo Lines
Area of Interest
Waterbury
Location within State
Waterbury
Connecticut
1,000 500 0 1,000 2,000 3,000
Feet
1 inch equals 500 feet

A Watershed Perspective

The Naugatuck River flows 44.7 miles from the Drakeville section of Torrington to its confluence with the Housatonic River in Derby. Above Drakeville, various streams including Jakes Brook, Hall Meadow Brook and Hart Brook drain the northern reaches of the watershed before coming together to form the West Branch of the Naugatuck. The river and its tributaries drain 311 square miles in parts of 27 municipalities. It is truly a shared resource.

Topography

There is a broad range of elevation within this drainage. At the farthest reaches of the northern end (top) of the watershed, on a ridge to the southwest of Dolphin Pond, the high point of 1,773 feet above Mean Sea Level (MSL) occurs. At the confluence with the Housatonic River, it has reached a low of 15 feet above MSL. Thus the basin is reduced in vertical elevation by one third of a mile. The basin measures about 45.6 miles north to south as the crow flies. That yields an average slope of about 1%. It is a very hilly watershed with some deeply incised valleys. In general, the basin has its highest elevations at the top or north end and lowest at the mouth or outlet. Also, it is high along the sides and shallower in the middle where the watercourse runs:

Water Quality

The quality of the water that flows in the Naugatuck River is the reflection of the quality of the land use in its watershed. Throughout the basin there are various types of land use which result in different classes of water quality. As in all watersheds, the land uses upstream can impact the water quality downstream. Thus, the water quality at the top, or beginning, of the watershed is generally the highest. In contrast, at the bottom of the watershed or the mouth, the water quality is at its worse. That is the case in the Naugatuck drainage.

The water quality maps at the DEP rate the classification of water on the following scale: AA being the best, A - the next best, B after that, then C, and finally D.

There are many reasons both historic and current for degraded water quality. Decades ago when the river was used a convenient sewer, the metal working industry left a legacy of heavy metals that remain with us today. Salt piles before they were covered leached into the ground water, as did petroleum leaks and spills which can take years to move through the subsurface soil and emerge in the waterways. In many ways we are paying the bill today for the lack of knowledge and caring of many years past.
(The DEP's Water Quality Classifications is available at: http://www.dep.state.ct.us/wtr/wq/wqs.pdf)

In the Naugatuck drainage, near the top of the watershed in Norfolk, of the three headwater streams of the West Branch, two bring with them a water quality of A and one AA. Once formed, the West Branch, as a class A stream, flows a little less than four miles, to the north end of Migeon Avenue in Torrington, where it degrades to class B.

In like fashion, the East Branch of the Naugatuck flows for nearly nine miles from its headwaters in Winchester. It has a water quality class of A. But at the point where it has its confluence with Troy Brook, also in Torrington, it degrades to B. The East Branch then flows south where it meets the West Branch and combines to form the Naugatuck main stem with a water quality of B.

The Naugatuck flows south below the confluence of the branches for 16.5 miles with the water quality of B. Then in Waterbury at the Anaconda American Brass facility, the water degrades to C. It carries that classification down stream and empties into the Housatonic River in Derby.

In the recent past the DEP has under taken many programs to improve the water quality by defining the pollution sources and remedying those situations. By elevating the water quality other results can follow. One key factor along the Naugatuck was improvement of the Sewage Treatment Plants that discharge into the river. Through upgrades to the plants and close monitoring of the outflow the best possible discharge may be obtained.

Two Sewage Treatment Facilities: The left hand image is in Harwinton near the top of the watershed and on the right is the facility in Ansonia near the bottom of the basin.

The study of macroinvertebrate populations is commonly used to determine the quality of water in river studies. Because these small creatures are not very mobile, the area in which they live is fairly constant. Though not as colorful or exciting as birds - for example - to most people, they populate areas where the water quality meets their tolerances. Thus, different species are dependant on different water qualities for the survival. And, as with birds, the better the habitat quality the more diverse the population. As the water travels downstream and becomes degraded, so to do the macroinvertebrate communities. Typically, bluebirds and goldfinches are not found in urban areas, but pigeons are. Conversely, pigeons are a rare sight in open space and undeveloped areas. In this analogy, the Naugatuck River has been the home to many pigeons for quite a long time.

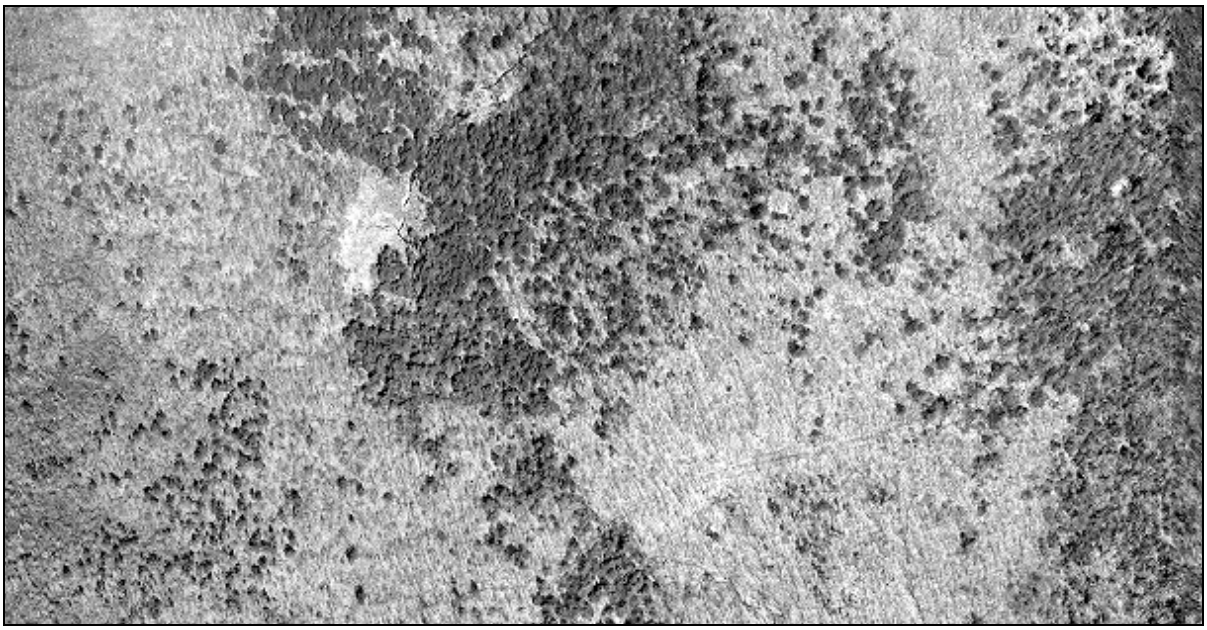
Degraded water quality ignites a chain reaction of change that has far reaching, negative impacts. The fishery aspect of the river can and has been, seriously affected. Everything good about a river disappears when it is used as a sewer. The industrial history of the Valley tells the story. Seventy years ago the river was intolerably toxic – a place to avoid. Today things are greatly changed. Eight municipal and two industrial waste treatment plants empty into the Naugatuck, versus historic often untreated flow. But just as Pollution is the spark for ecological degradation, so too can enhanced water quality trigger the healing of is river's ecology.

Land use - Four different and broad categories of land use dominate the Naugatuck River watershed: They are:

1.) Forest cover,
2.) Residential/commercial/pavement,
3.) Grass/turf/soil/farm, and
4.) wetlands/open water.

1.) Forest Cover

This the largest category of land use comprising 65%, or about 202 of the 311 square miles of the watershed. The Naugatuck watershed is fortunate to have in excess of 11,000 acres of state forest, parks and wildlife areas, and several hundreds of acres of municipal open space. (Although these actually account for less than ten percent of the forest cover.). Forest cover is excellent for water quality in that it filters precipitation, slows runoff to allow for year round stream flow levels, provides wildlife habitat, aids in recharging groundwater, and keeps the water cool for cold water fishes. The forest cover category is very likely the fastest shrinking land use in the drainage due to developmental pressures.



This forested area in Goshen is in the relatively undeveloped northern part of the Naugatuck River watershed. The dark areas are conifers while the gray areas show deciduous stands. This April 2004 image was taken after snow melt and before releafing occurred.

2.) Residential/Commercial/Pavement -

Residential/commercial/pavement is the second most dominant land use in the watershed. It comprises about 15.5% of the total area. The image below captures all three categories that make up this category. Dense residential, vast commercial areas and wide swaths of roadways all add to the impervious surfaces that cause rapid precipitation runoff, frequent discharges directly into waterways without treatment, thermal heating of runoff , and avoidance of groundwater recharging. This is the fastest growing class of land use as populations continue to expand bringing with them demands for homes, wider roads and commercial shopping strips.

This cross section view of downtown Waterbury and the highway captures the intensity of land use in the area.

3.) Grass/Turf/Soil/Farm

Grass/turf/soil/farm at 14.5% of the watershed, is a close second to the above category, but it likely will not see the growth rate that developed areas will see in the future. As the values of real estate continue to escalate, farmers frequently get squeezed out of the market. Their land gets sold at great gains for development, and becomes newly constructed various density residential areas.

While there is no agreed upon financial way (yet) to value the aesthetics of open space, it is clear that a given house lot does have added market value when it abuts permanent deeded open space. Thus, the work of the land trusts and open space commissions can reap rewards for the tax base.

This 2004 image of open farm fields in Litchfield with tree lined roads and acres of open field views may one day turn into an image of home sites and commercial shopping strips.

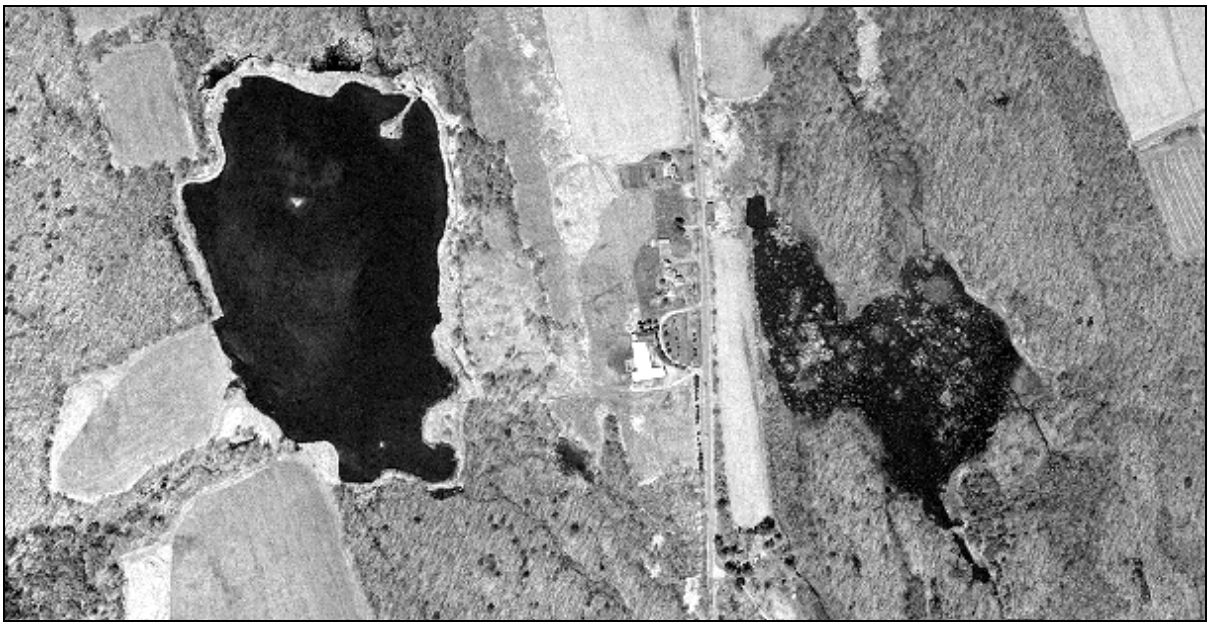
* * * * *

(**Notes:** The land use figures for the previous discussion are from 1995 data and are the most recent DEP offers. It can be said with certainty that the percentages cited above have changed in the past eleven years. The University of Connecticut's Project Clear has numbers from 2002, although they are arranged in slightly different categories than above. See them at:
http://clear.uconn.edu/projects/landscape/local/rbasin.asp?rbas=38&Go=Go

Building locations with various viewscapes as assets (Hedonic Values) enjoy increased values depending on the extent of the view. Ocean full view, superior partial views, and good partial views, all command different values as do lake front, lake view and mountain view. Add to that a greater value for locations bounded by forest preserves and other setting-dependant locations and a watershed wide review of these intangible assets could lead to profitable planning.)

4.) Wetlands/Open Water

This is the smallest of the categories at about five per cent of the land use. In many ways this small class is the most valuable. The wetlands' ability to improve water quality, provide habitat and refuge for wildlife, provide critical flood control and many other functions have been proven. Fortunately, there are laws to protect wetlands, although the laws are enforced with variably intensity throughout the watershed.



This 2004 image of Litchfield typifies open water and a partially treed shallow-water wetland.

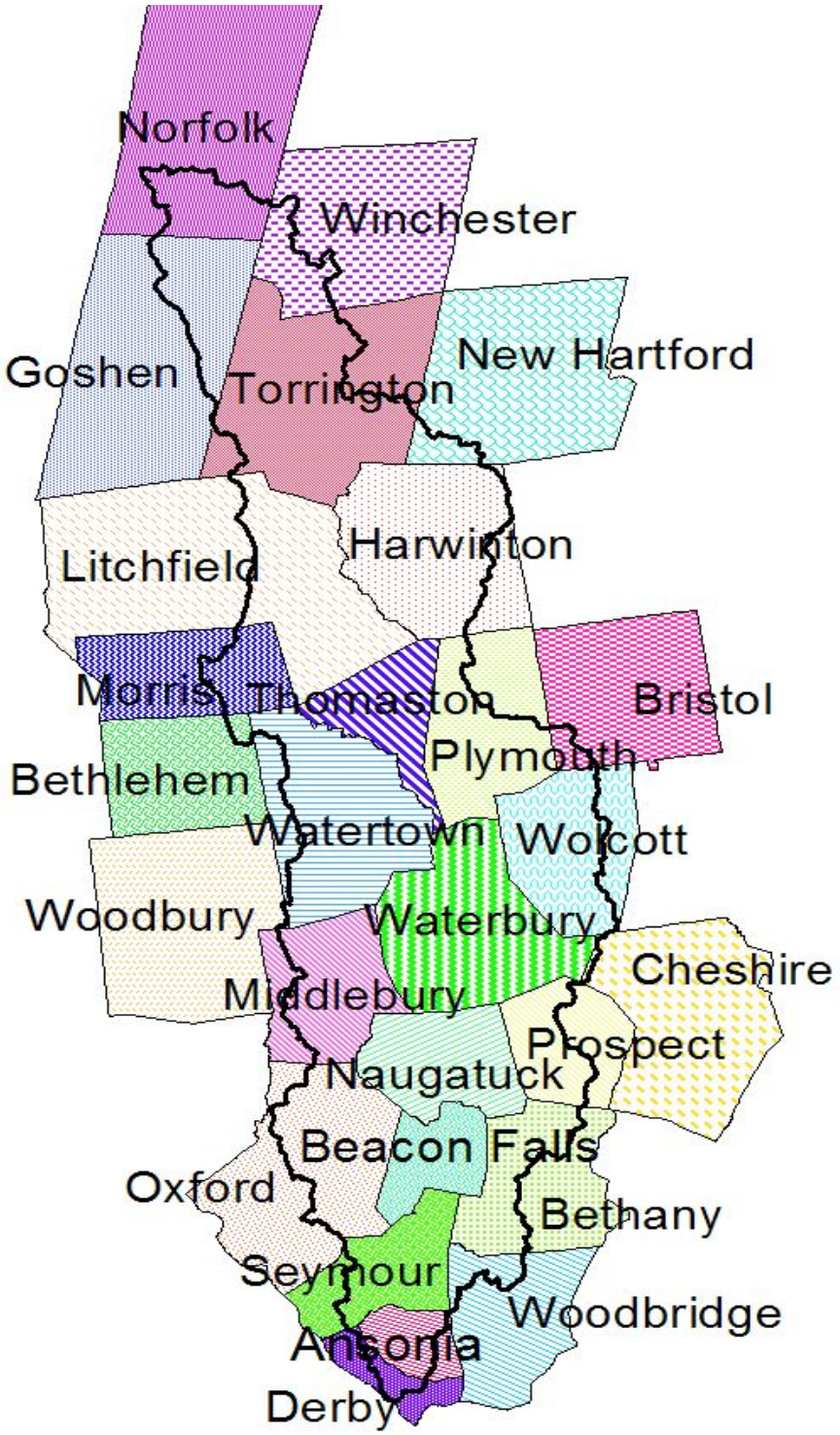
The Greenway Project

The Greenway Project is an ambitious one. One of the benefits of such a trailway is river advocacy. To have people making use of the river for birding, boating, fishing and paddling is to have eyes on it almost all year round. Spills of all sorts and abuses of water quality will get reported quickly. A river brings a sense of place and can be the focal point of land use in the watershed. Contributing tributaries will want to build on the effects of improved water quality in their neighborhood streams.

A greenway is, as much as any project, something the population can take pride in and call their own. The timing is right for the interest, since between 1992 and 2000 five of the larger sewage treatment plants upgraded their facilities to advanced wastewater, and a sixth facility's flow was redirected to the new Waterbury plant. This has resulted in the DEP Fisheries unit expanding its fish stocking program of trout and broodstock salmon on certain sections of the river.

The goal of bringing people to the river, in any format, will only continue to increase the health of the Naugatuck and make it more attractive for public use.

Naugatuck River Watershed



Topography and Geology
Naugatuck River Greenway, Waterbury Reach

The Naugatuck River enters Waterbury through a narrow, steep sided canyon that broadens southward to a less steep-sided valley. The ruggedness of the valley through which the river flows is controlled by the bedrock into which it has eroded.

Topography

The Naugatuck River flows southward through the city of Waterbury at a fairly steady gradient of 11-13 feet/mile. It enters Waterbury from the north in a narrow, steep-sided gorge that is 300-400 feet deep. The canyon at the border with Thomaston flows over the Straits Schist and is less than a quarter of a mile wide. It has little or no flood-plain at that point. It is practically a gorge.

A quarter of a mile to the south the canyon broadens somewhat and a flood plain of about 500-1000 feet in width is developed. South of the confluence of the Naugatuck River with Steele Brook the valley walls become less steep and the flood plain broadens to as wide as a half mile. The valley narrows south of town and becomes steep-sided as the river enters the Borough of Naugatuck. Interestingly, the Straits Schist is found south of Naugatuck where the river has also cut a gorge.

Partially dissected gravel terraces line the Waterbury reach over much of its length. Where the valley is narrower the terraces are less well developed and in some places absent. Where the valley is broader the terraces are well developed at approximately 50 feet above the river elevation. The terraces have been exploited for road and railroad beds especially in some of the narrower reaches. Sand and gravel have been mined from some terrace locations.

Maximum hilltop elevations in the State of Connecticut systematically decrease from north to south (Bell, 1985, p.77). In the Waterbury Quadrangle, for instance, hill top elevations range from 850-900 feet in the north (*e.g.* Bucks Hill area) to 750-800 feet in the south (*e.g.* East Mountain). In between, generally rolling hills of lesser elevation occur. This seems controlled by the fractured gneissic bedrock in the area that was more easily eroded by glacial action during the last Ice Age.

Bedrock Geology

The layers of rock in and surrounding Waterbury have been folded into a large up-warp of several miles width and resembles a giant inverted bowl that, in geologic jargon, is referred to as a dome. The center of the dome is actually in the eastern part of Middlebury as mapped by Gates and Martin (1967). The layers all tilt away from that center. The dome extends southward into Naugatuck. The rock formation nomenclature and correlations of Gates and Martin were altered by Rodgers (1985) for the State Map. Rodgers terminology is followed in this report.

In the center of and area of up-warp older rocks are pushed closer to the surface and hence the oldest rocks exposed are found in the middle of the Waterbury Dome. The rocks exposed in the central and southern sections of Waterbury, and over which the Naugatuck river flows south of its confluence with Steele Brook are thin- to thick-layered light- to dark-gray gneiss. It is fine- to medium-grained and contains muscovite, biotite, plagioclase feldspar, and quartz with minor amounts of garnet and kyanite. Layering in the gneiss is related to the abundance of mica: the more abundant mica is the better layered the rock is. This rock is referred to as the Waterbury Gneiss (**~~C~~wb**) by Rodgers (1985) who assigned a Cambrian (and possibly pre-Cambrian?) age to the rocks. The spectacular outcrops along I-84 on the northeast side of Pine Hill are composed of the Waterbury Gneiss.

The Taine Mountain Formation (**Ot**), Ordovician in age, overlies the Waterbury Gneiss. In the Waterbury area it has a well developed basal member. The basal member (**Otb**) consists of gray layered granofels, biotite-plagioclase-quartz gneiss and granulite. It is referred to as the Hitchcock Lake Member by Gates and Martin (1967). The main body of the Taine Mountain Formation (referred to as Unit I of the Hartland Formation by Gates and Martin, 1967) apparently is finer grained, lighter gray in color, and contains more muscovite mica than the basal member. It also contains layers of schist. The Taine Mountain Formation is well exposed in northern Waterbury and in the Watertown area as well as east of town. The formation thins, is missing, or becomes difficult to distinguish from the overlying Collinsville Formation south of town; Rodgers maps the two formations together in Naugatuck.

The Collinsville Formation (**Oc**), which overlies the Taine Mountain Formation, consists of grey and silvery-grey, medium- to coarse-grained schist with amphibolite and hornblende gneiss layers interbedded. It is Ordovician in age. Outcrops of the Collinsville Formation were not recognized during the ERT field trip.

The Straits Schist (**DSt**) is Silurian and Devonian in age. It consists of grey and silvery grey muscovite-quartz schist that contains garnite and locally kyanite or graphite. It is medium to coarse-grained.

Surficial Geology

In more recent geologic history large ice sheets formed numerous times covering portions of the northern hemisphere with glaciers during periods (cyclical) of global cooling. These ice sheets moved south-southeastward and as they did they eroded preexisting soil and bedrock over which they flowed. Thus abundant debris was available for transport and deposition. Some of the debris was deposited under the ice in the form of glacial till (lodgement-till). Some debris was deposited on the ground surface (melt-out till) when the glaciers melted and some was carried away by melt-water streams when the ice age ended approximately 16,500 years ago (date from Stone and others, 2005).

Till. Uplands surrounding the Naugatuck River canyon are blanketed by till. It is a non-sorted mixture of mud, sand and gravel and forms the rocky soil common to all of Connecticut. Till is generally about 20’ thick and is light olive gray in color. The composition of the till depends on the rock types over which the glacier flowed, but it generally is reflective of the local rock on which the till was deposited. Thus, where the bedrock is composed of schist, the till is compact, clayey, and micaceous but may contain non-schist rock fragments derived by erosion of other rocks over which the glacier flowed enroute; where the underlying rock is granite the till is loose, sandy and gravelly. Although till may cover the upper valley walls, it was not observed during the ERT field trip because much till may have been eroded by melt-water streams that flowed through the valley at the end of the last Ice Age.

Stratified sand and gravel. Melt-water streams transported large amounts of glacial debris derived either directly from the melting glacier or from erosion of till deposited by the glacier. The muddy portion of the debris was carried all the way to Long Island Sound and beyond but some of the sand and gravel was deposited on the valley floor as kames and kame terraces or as glacio-fluvial sand and gravel terraces. The sand and gravel deposits are stratified and may be 50 feet or more in thickness. They have been mined locally. Some of the roads utilize these terraces where the valley is narrow. The relatively level area of downtown Waterbury is built on one of the kame terraces.

Erosion of the Naugatuck River Valley was likely a function of several different agents during Quaternary time. Some of the erosion likely occurred during the most recent episode of deglaciation when sediment-laden meltwater-streams coursed through the valley. The presence of ice-contact sand and gravel deposits in and north of the area suggest, however, that ice occupied the valley during the last glaciation which in turn suggests that some valley erosion also occurred prior to the last glacial epoch.

Glacial erosion occurs by several mechanisms. One important mechanism is plucking which occurs because pressure melted water at the base of the glacier refreezes in cracks and wedges fragments of bedrock up and into the flow of the glacier base. Because of the way gneiss fractures, it is more susceptible to plucking. Schist on the other hand is not. Hence, areas underlain by the Straits schist formed slightly higher areas than those underlain by the Waterbury gneisses on which lower, more rolling hills were formed.

On the other hand, water erodes schist more easily than the gneiss. Hence, when the glaciers melted, the Naugatuck River quickly eroded a narrow canyon through the Straits Schist and filled in the broader valley where gneiss is present with sand and gravel deposits and modern alluvium.

References Cited

Bell, Michael, 1985, *The Face of Connecticut.* Connecticut Geol.and Nat. Hist. Survey, Bull 110, 196p.

Coleman, M.E., 2005, *The Geologic History of Connecticut's Bedrock.* State Geol. and Nat. Hist Survey of CT, Spec. Pub. #2, 30p.

Gates, R.M. and Martin, C.W., 1967, The Bedrock Geology of the Waterbury Quadrangle. State Geol. and Nat. Hist Survey of CT , Quad. Report 22, 36p.

Rodgers, John, 1985, Bedrock Geologic Map of Connecticut. Connecticut State Geol. and Nat. Hist. Survey, Atlas Series: Bedrock Geologic Map.

Stone, J.R., Shafer, J.P., London, E.H. and Thompson, W.B., 1992, Surficial Materials Map of Connecticut. U.S. Geol. Surv. and Connecticut State Geol. and Nat. Hist. Survey, 2 sheets.

Stone, J.R., Lewis, R.S., and DiGiacomo-Cohen, M.L., 2005, The new Quaternary Geologic Map of Connecticut and Long Island Sound Basin, Part 1—Illustrated by a field trip along the coastline. In Skinner, B.J., and Philpotts, A.R., Guidebook for Field Trips in Connecticut, 97 Ann. Mtg. NEIGC; State. Geol. and Nat. Hist. Surv. of Connecticut Guidebook #8:39-53.

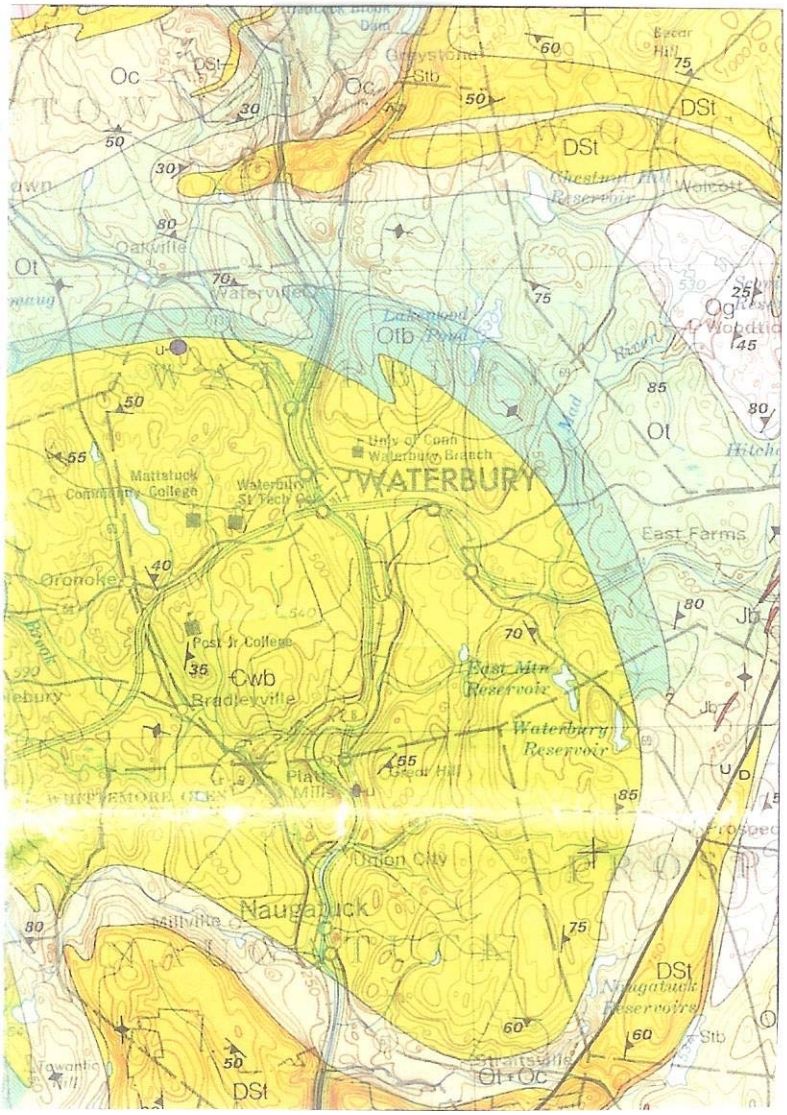


Figure 1. A portion of the Bedrock Geologic Map of Connecticut (Rodgers, 1985) showing Waterbury and adjacent areas and the eastern part of the Waterbury Gneiss Dome. Note that strike and dip symbols, which plot the orientation of the tilt of the rock layers, indicate the layers tilt away from the center of the dome, which is near the western edge of the map.

Strike and dip of foliation

Ot Taine Mountain Formation
DSt Straits Schist
Og Granite gneiss
Oc Collinsville Formation
Otb Taine Mt. Fm., basal member
Cwb Waterbury Geniss

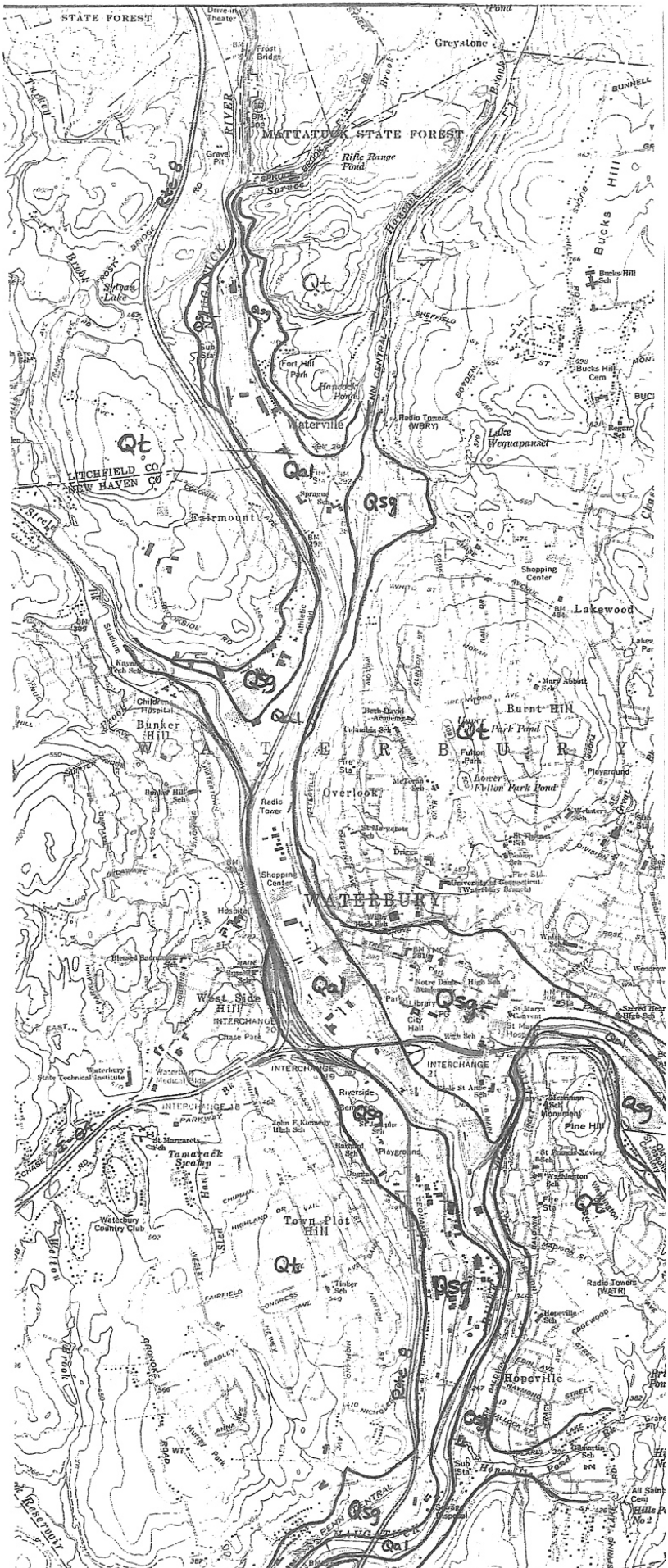


Figure 2. Surficial geologic map of the Naugatuck River valley bottom in Waterbury (after anonymous untitled map showing surficial geology of the Waterbury Quadrangle in Connecticut D.E.P. files).

Qal Recent (modern) river alluvium

Qsg Late Pleistocene may be either glacio-fluvial or ice contact deposits

Qt Glacial till

Conservation District Review

Soils Resources

This soils report applies to the +l,106 acre river corridor referred to as the Waterbury Greenway, coursing from Waterbury's northern border near Watertown trending south along the Naugatuck River to its southern border before entering the Borough of Naugatuck The information in this report is based on the historical soils series descriptions and the new digital mapping unit descriptions as presented in the Soil Survey of Connecticut, remote survey interpretations plus field observations. In an effort to inventory and assess the natural resources within this corridor, this report looks at three (3) separate areas and issues related to the soils, their physical attributes and their ability to affect water quality. Designated sections A1-A3 on Exhibit #1.

Exhibit *#2* (CT Soils Mapping)) are derived from the new digital survey (Soil Survey of Connecticut). The soil survey utilizes recent aerial photographic base with one soil legend, which employs the numbering convention used by the USD A. The historical reference for soils regarding this region can be found in sheet numbers 4, 5, 10 and 11 of the 1979 New Haven County Survey.

Mapping Units
Wetland Soils

1) **USD A Soil #13 - Map Unit Wa - Walpole sandy loam. Slopes 0 to 3 percent.**
   Walpole soils are very deep, nearly level, poorly drained soils that formed in depressions on broad glacial outwash terraces. Typically, they have a fine sandy loam or sandy loam surface layer and subsoil over a substratum of stratified loamy sand and gravel. Walpole soils have a watertable within 1 foot of the surface from late fall to late spring.

2) **USDA Soil # 100 - Map Unit Su - Suncook loamy fine sand. Slopes 0 to 3 percent.**
   These soils are very deep and excessively drained. They formed in sandy alluvial deposits. Subject to flooding, the saturated hydraulic conductivity is high or very high in the surface layer and underlying strata. Typically, these soils have fine sandy loam textures overlying stratified sand and gravel to a depth of 60 inches or more. These soils are subject to flooding and typically flood annually, usually in the spring snowmelt. Depths to the seasonally high watertable range from 3 to 6 feet during the period of January through April.

Concerns

2a) Streambank Stabilization - Increased, direct runoff discharges to tributaries and the river from development has increased velocities and volume, which entrain and transport solids and organic materials. Evidence of eroding banks have introduced sediments downstream, advances the aggrading of the stream.

2b) Commercial and Industrial Developments Threat to Water Quality - Sources of non-point source pollutants entrained in stormwater runoff discharges from commercial and industrial development need to be identified, ranked and prioritized regarding their affect on water quality. Direct discharge points to the Naugatuck River relative to the City's Stormwater Infrastructure mapping are potential retrofit opportunities that can renovate stormwater discharges that reduce the adverse affect of water quality.

2c) Marginal Land Use - The limitations imposed by the physical attributes associated with the upland soils should require a higher level of scrutiny by Waterbury's Inland Wetlands Commission, Health Dept. and the Planning & Zoning Commission. Thorough reviews of all plans of development are necessary to assess and evaluate potential threats to natural resources, minimize land disturbance, reduce further fragmentation of habitats and qualify suitable building lots that limit encroachment regarding these resources.

2d) Buffering of Watercourses and Wetlands - Most of the upland soils in close proximity to these watercourses and wetlands have ***moderate to severe erosion hazards*** that relate to their composition and their topographic relief. Establishing well defined limits of disturbance and preserving the majority of the natural landscape reduces the risk of erosion and siltation on and off-site.

Non-wetland Soils

3) USDA Soil # 29C - AfC - Agawam fine sandy loam, 8 to 15percent slopes.

This map unit consists of Agawam soils. These soils are very deep, well drained soils formed in loamy over sandy and gravelly glacial outwash deposits. Typically, they have a fine sandy loam surface layer and subsoil over a stratified sand and gravel substratum that extends to a depth of 60 inches or more.

This soil has **good potential for development.** Permeability is moderately rapid in the surface layer and subsoil and **rapid in the substratum.** Runoff is medium. Conservation measures are needed to prevent excessive runoff, erosion and siltation during construction.

Concern

- The rapid permeability in the substratum requires that caution be taken to prevent ground water contamination.
- These soils have been developed residentially, commercially and industrially.
- The aforementioned land uses employ a wide array of non-point source contaminants, which are introduced to the hydrologic regime of the area. The substratum can act as a conduit to the riverine environment and ultimately Long Island Sound.

4) USDA Soil # 34C - MyC - Merrimac sandy loam, 8 to 15 percent slopes.

Merrimac soils are very deep, somewhat excessively drained soils formed in glacial outwash deposits. Typically, Merrimac soils have fine sandy loam or sandy loam surface layer and subsoil over a stratified sand and gravel substratum that exceeds a depth of 60 inches or more.

5) USDA Soil # 60C - CfC - Charlton fine sandy loam, 8 to 15 percent slopes.
60D-CfD- " " " " ,15 to 25 percent slopes.

Located on the sides of hills and ridges and at the foot slopes of steep hills that have been influenced by underlying bedrock. This soil has a **poor potential for community development.** It is limited mainly by steepness of slopes. The steepness of slopes causes additional expense in building structures, roads and the installation of water and sewer lines. This soil is fairly easy to excavate, but it commonly contains stones and boulders.

This soil has a **severe erosion hazard.** Permeability is moderate to moderately rapid. Runoff is rapid. Intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during construction projects.

6) USDA Soil #62D -CnD - Charlton extremely stony fine sandy loam, 15 to 25 percent slopes.

This moderately steep-to-steep, well drained soil is on the sides of hills, ridges and steep valleys where the relief is affected by the underlying bedrock. This soil has moderate or moderately rapid permeability. Runoff is rapid. When disturbed, this soil has a **severe erosion hazard.** This soil has **poor potential for development** because of its steepness of slopes and stoniness.

This soil is limited by stoniness and steepness of slope. Permeability is moderate to moderately rapid. Runoff is medium to rapid. **The hazard of erosion is moderate to severe.** The steepness of slope attribute is significant during any proposed construction activity that is in such close proximity to wetlands and watercourses. Careful attention should be given in minimizing disturbances, employing enhanced erosion and sedimentation controls and maintaining adequate vegetated buffering of sensitive areas.

7) USDA Soil #73C - CrC - Charlton-Hollis soil 3 to 15 percent slopes.

This complex consists of well-drained soils located on uplands where the relief is affected by underlying bedrock. The Charlton component has moderate or moderately rapid permeability. Runoff is medium to rapid. The Hollis component has moderate to moderately rapid permeability above the bedrock.

This complex has **fair to poor potential** for community development. **The Charlton component has fair potential** for development and the **Hollis has poor potential** for development due to its shallowness to bedrock.

Intensive enhanced conservation measures such as temporary vegetation and siltation basins are frequently needed to prevent excessive runoff, erosion and siltation.

Concerns

The included Paxton and Hollis soils are even less suitable for development:

- Paxton soils have slow permeability in the substratum. A dense lense of Paxton soils within the Charlton soil can cause down slope seeps and affect the structural integrity of proposed service infrastructures and dwellings.
- Hollis soils are limited by their shallowness to bedrock, which is approx. 10 to 20 inches in depth.
- The fine participates of schist and gneiss associated with these soils stay in suspension for extended periods. This characteristic demands adequately sized temporary and permanent sedimentation basins to assure runoff pretreatment and minimize the potential for transport of solids and turbid water off-site.
- All of the aforementioned non-wetland soils (10-15) are easily suspended and transported by surface runoff. The minimization of land disturbance, avoiding or limiting exposure of steep slopes is important during all phases of construction.

8) USDA Soil #38A - Map Unit HkA - Hinckley gravelly sandy loam, 0 to 3 percent slopes. USDA Soil #38C - HkC - Hinckley gravelly sandy loam, 8 to 15 percent slopes.

These very deep excessively drained soils formed in sandy and gravelly glacial fluvial deposits derived mainly from granite, gneiss or schist. Typically, Hinckley soils have a gravelly sandy loam or gravelly fine sandy loam surface layer over a stratified gravelly to extremely gravelly loamy sand-to-sand subsoil and substratum. The substratum extends to a depth of 60 inches or more.

9) USDA Soil # 38E - Map Unit HME - Hinckley and Manchester 15 to 35 percent slopes.
This map unit consists of moderately steep to very steep, excessively drained soils on outwash terraces. The Hinckley and Manchester soils have rapid permeability in the surface layer and subsoil and very rapid permeability in the substratum. Runoff is rapid. Mainly the steep slopes limit soils. **Waste disposal systems, such as septic tank absorption fields, need very careful and often unusual design and installation to insure that effluent does not seep to the surface in areas downslope from the leaching system. Due to the very permeable substratum, particular attention to the systems design is required to prevent contamination of the groundwater.**

The hazard of erosion is severe. Intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during periods of construction.

10) USDA Soil #73E - HpE - Hollis-Charlton-Rock Outcrop complex, 15 to 35 percent slopes.
This complex has a **poor potential for development.** One soil is named Hollis. Hollis soils are shallow and well drained. They have fine sandy loam textures overlying consolidated bedrock at a depth of 10 - 20 inches. The other soil is named Charlton. Charlton soils are very deep well drained soils formed in loose glacial till. Typically, they have fine sandy loam textures to a depth of 60 inches or more.

The rock outcrop consists of exposures of crystalline bedrock located on knobs and ledges. The Hollis soil dominates the area, followed by the Charlton and rock outcrop components. **Runoff is rapid** in both the Hollis and Charlton type soils. Both are limited by steepness of slopes and shallowness to bedrock, rock outcrops and stoniness. **There is a hazard of effluent seeping into cracks in the bedrock and polluting groundwater.**

These highly erodable slopes must employ intensive conservation measures such as the use of diversions, vegetative cover, mulching and siltation basins, which are needed to prevent excessive runoff, erosion and siltation.

11) USDA Soil # 75C - Map Unit HrC - Hollis-Rock outcrop complex, 3 to 15 percent slopes.
Hollis soils are shallow and somewhat to well drained soils. Typically, they have fine sandy loam textures overlying consolidated bedrock at a depth of 10 to 20 inches. These soils do not have a watertable within their 20-inch depth.

12) USDA Soil # 75E - Map Unit HSE - Hollis-Rock outcrop complex, 15 to 25percent slopes.
The map unit is limited mainly by steep-to-steep slopes, shallowness to bedrock and rock outcrops. This map unit has poor potential for development. **Onsite waste disposal systems will require very unusual design and installation. There is a hazard of system failure or that effluent may seep into the cracks in the bedrock and pollute the groundwater.**

Erosion hazard is severe. If these soils are disturbed for construction, intensive conservation measures, such as mulching, re-establish vegetative cover and siltation basins are needed to diffuse surface runoff to control excessive runoff, erosion and siltation.

13) USDA Soil #76E - RPE Rock, Outcrop - Hollis complex, 3 to 45 percent slopes.

The RPE map unit is composed dominantly of Rock outcrop and Hollis soils. These two components are so intermingled on the ground that they could not be separated on the map. The Hollis soils are shallow and somewhat excessively drained. Typically, they have a fine sandy loam texture overlying consolidated bedrock at a depth of 10 to 20 inches. The Rock outcrop consists of consolidated bedrock.

14) USDA Soil # 84C - Map Unit PbC - Paxton fine sandy loam, 8-15 percent slopes. USDA Soil # 84D - Map Unit PbD - Paxton fine sandy loam, 15-25 percent slopes.

This PbC map unit consists primarily of Paxton soils that are very deep, well drained soils formed in compact glacial till, derived mainly from gneiss and schist. Typically, they have a friable fine sandy loam or loam surface layer and subsoil over a firm fine sandy loam or sandy loam dense till substratum. Commonly referred to as hardpan.

This soil has **fair potential** for community development. Permeability is moderate in the surface layer and subsoil and slow in the substratum. It is limited mainly by the slowly permeable substratum and the steepness of slopes. **Runoff is rapid. Erosion hazard is severe** and fairly intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during periods of construction.

"D" Slope Designations

- The steeper slope designations have a moderate to severe erosion hazard and waste disposal systems have the potential of effluent breakouts at mid-slope.

- These soils have a poor potential for development as steeper slopes increase the erosion hazard and dense subsoil layers perch watertables that form mid-slope seeps and may give rise to effluent breakouts from waste disposal systems.

- Careful design and installation of footing drains are needed to insure the integrity of the structures basement and utilities.

- The majority of these soils occur in the southern portion of this region, which has a majority of low to medium density residential land use.

15) USDA Soil # 238C - HmC - Hinckley-Urban Land complex, 3 to 15 percent slopes.

These mapping units are areas covered by buildings, roads and other impervious surfaces, which are sited on the parent material of a Hinckley soil type. Hinckley soils are very deep excessively drained soils formed in sandy and gravelly glacial fluvial deposits derived mainly from granite, gneiss or schist. Typically, Hinckley soils have a gravelly sandy loam or gravelly fine sandy loam surface layer over a stratified gravelly to extremely gravelly loamy sand-to-sand subsoil and substratum. The substratum extends to a depth of 60 inches or more.

16) USDA Soil # 260B - Charlton-Urban Land complex, 3 to 8 percent.

These mapping units are areas covered by buildings, roads and other impervious surfaces, which are sited on the parent material of a Charlton soil type.

Located on the sides of hills and ridges and at the foot slopes of steep hills that have been influenced by underlying bedrock. This soil has a **fair potential for community development.** It is limited mainly by steepness of slopes. The steepness of slopes causes additional expense in building structures, roads and the installation of water and sewer lines. This soil is fairly easy to excavate, but it commonly contains stones and boulders.

This soil has a moderate **erosion hazard.** Permeability is moderate to moderately rapid. Runoff is rapid. Intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during construction projects.

17) USDA Soil # 260C - with 8 to 15 percent slopes.

18) USDA Soil # 260D - with 15 to 25 percent slopes.

These mapping units are areas covered by buildings, roads and other impervious surfaces, which are sited on the parent material of a Charlton soil type.

Located on the sides of hills and ridges and at the foot slopes of steep hills that have been influenced by underlying bedrock. This soil has a **poor potential for community development.** It is limited mainly by steepness of slopes. The steepness of slopes causes additional expense in building structures, roads and the installation of water and sewer lines.
This soil is fairly easy to excavate, but it commonly contains stones and boulders.

This soil has a **severe erosion hazard.** Permeability is moderate to moderately rapid. Runoff is rapid. Intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during construction projects.

19) USDA Soil # 273E - Charlton-Chatfield-Urban Land complex, 15 to 45 percent slopes.

These mapping units are areas which have been highly modified and covered by buildings, roads and other impervious surfaces, which are sited on intermingled parent material of a Charlton-Chatfield soil types. .

20) USDA Soil # 284C - Paxton-Urban Land complex, 8 to 15 percent slopes.

These mapping units are areas covered by buildings, roads and other impervious surfaces, which are sited on the parent material of a Paxton soil type.

This PbC map unit consists primarily of Paxton soils that are very deep, well drained soils formed in compact glacial till, derived mainly from gneiss and schist. Typically, they have a friable fine sandy loam or loam surface layer and subsoil over a firm fine sandy loam or sandy loam dense till substratum, commonly referred to as hardpan.

This soil has **fair potential** for community development. Permeability is moderate in the surface layer and subsoil and slow in the substratum. It is limited mainly by the slowly permeable substratum and the steepness of slopes. **Runoff is rapid. Erosion hazard is severe**
and fairly intensive conservation measures are needed to prevent excessive runoff, erosion and siltation during periods of construction.

21) USDA Soil # 303 - Qu - Pits and Quarries

These are areas along higher hills and ridges where bedrock has been excavated. Quarries are nearly barren of vegetation. Generally, once the natural resource has been exhausted these areas are abandoned and pioneer species sparsely dot the landscape. Quarries require on-site investigation and evaluation if they are to be considered for other land uses.

22) USDA Soil # 306 - UD - Udorthents Urban Land complex

This mapping unit is comprised of cut and borrows areas where the surface layer and subsoil has been modified or removed. In many places, the landscape has been smoothed, and the cut and fill areas occur in a complex pattern.

23) USDA Soil # 307 - Ur - Urban Land

These mapping units are areas covered by buildings, roads and other impervious surfaces. Most of these areas are in larger cities and the larger industrial and office complexes in our county. This miscellaneous area requires on-site investigation and evaluation if they are to be considered for other land uses.

24) USDA Soil # 308 - Udorthents smoothed

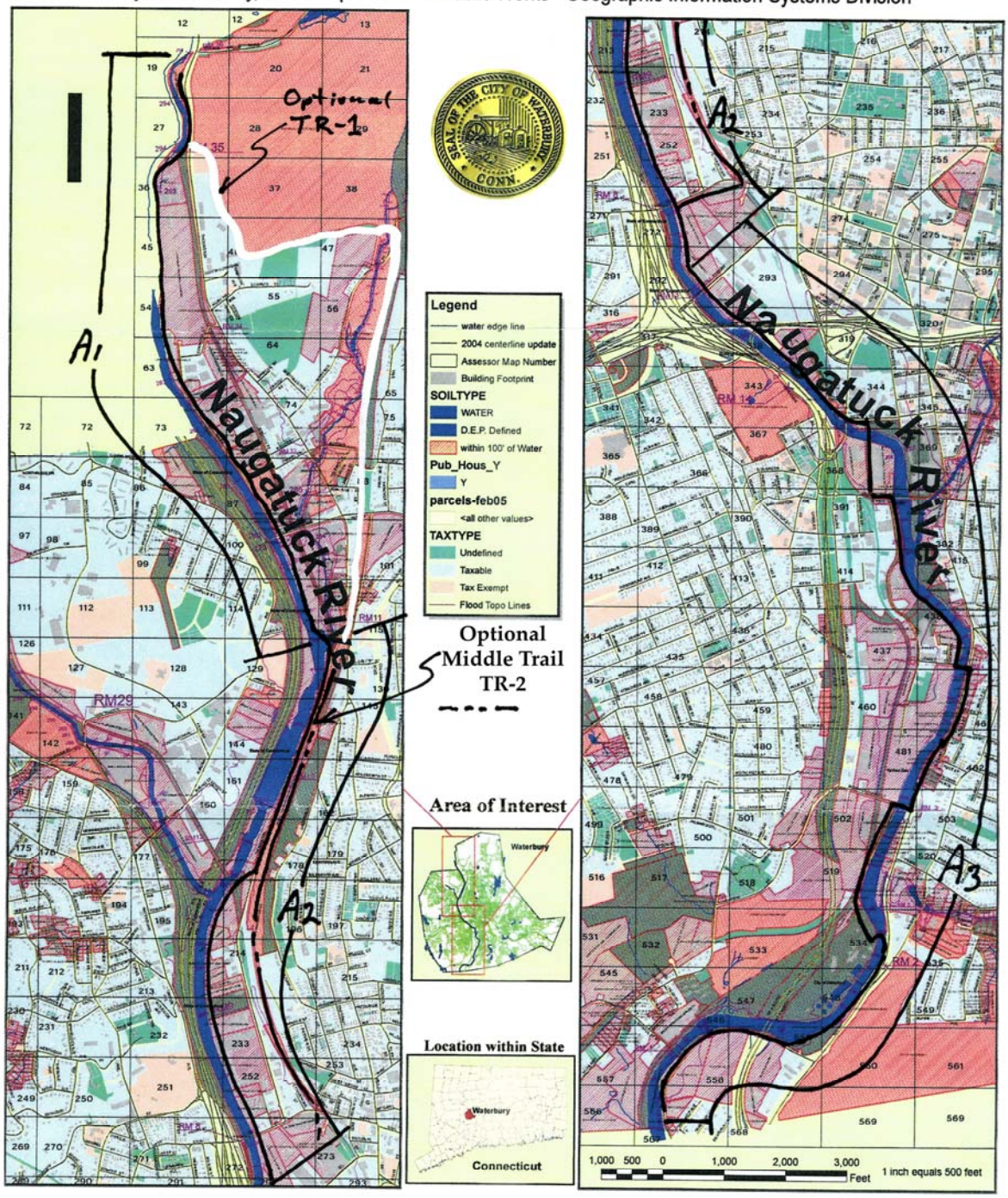
This map unit consists of a well drained to excessively drained soil. This mapping unit is comprised of cut and borrows areas where the surface layer and subsoil has been modified or removed. Slopes are generally less than 15 percent; there are steep escarpments at the edges of some borrow areas and in a few urban developments. In many places, the landscape has been smoothed and the cut and fill areas occur in an intricate and complex pattern

The soil in this unit has a wide range of characteristics. Texture ranges mainly from sandy loam to silt loam or the gravelly analogs. Consistence ranges from loose to very firm. Permeability ranges from very rapid to slow.

Exhibit #1

Naugatuck River Greenway Project - Waterbury

City of Waterbury, CT Department of Public Works Geographic Information Systems Division



Exhibit#2

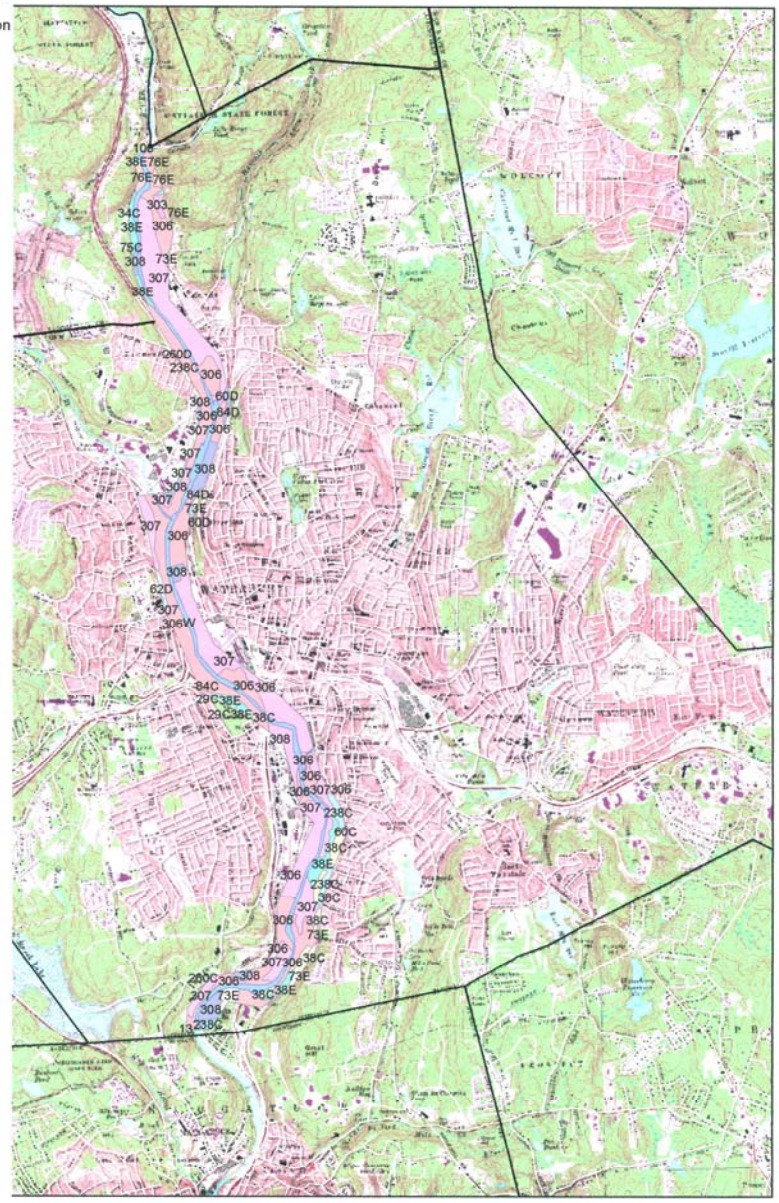
Naugatuck River Greenway Project - Waterbury

Legend

- practice_instance_point
- practice_instance_polyline
- practice_instance_polygon
- land_unit
- County
- Town
- Roads

MUSYM

- 100
- 13
- 238C
- 260B
- 260C
- 260D
- 273E
- 284C
- 29C
- 303
- 306
- 307
- 308
- 34C
- 38A
- 38C
- 38E
- 60C
- 60D
- 62D
- 73C
- 73E
- 75C
- 75E
- 76E
- 84C
- 84D
- W



3,700 0 3,700 7,400 11,100 14,800 Feet

N

Image: Topogography

Exhibit #2 Full Size (Included with hard copy only)

Naugatuck River Greenway Project

The siting of potential trails and observation points in this highly urbanized setting is a challenge. Balancing viable river access opportunities while preserving and protecting the limited natural resources along the river corridor requires consideration of the following;

- minimizing the disturbance of existing riverine environments and riparian buffers.
- preserve and protect recovering up-slope environments.
- avoid highly erodible soil types with steep slopes.
- utilize existing and abandoned structures, (such as railroad beds, fire roads and former utility properties, which can provide a base in routing the greenway.

Al - Upper Greenway Corridor (Black Trail)

This upper section of the Naugatuck River corridor has significant constraints imposed by the areas topographic relief (Soils # 38E & 76E) and anthropogenic influences from state and local roadways to commercial and industrial development. The riverine environments are subject to a wide array of nonpoint threats to water quality from the regions stormwater runoff, which is associated with the aforementioned land uses.

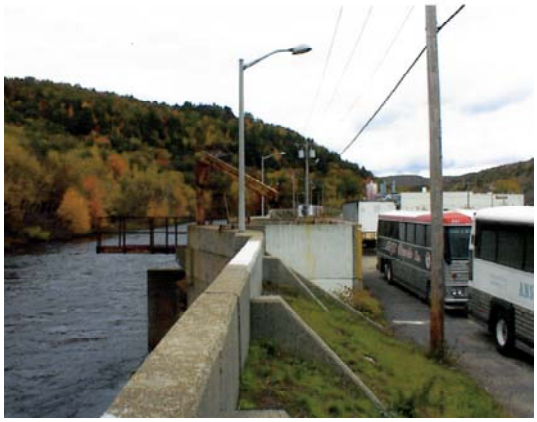
The northern reaches of the greenway can take advantage of a limited use railroad spur on the west side of the river or accommodate a trail on the east bank that would parallel Thomaston Ave. (P1) to the area of the trestle. The western bank and buffer should not be disturbed due to its steep topographic relief and shallowness to bedrock. (Soils #38E & 76E)

The eastern bank of the river is quite well stabilized and developed with industrial and commercial uses. This side of the river lends itself to easier construction and a reuse of an already developed area. (Soils #306 & 307) Developing a catwalk along its length with observation points trending south to Huntington Ave crossing would be less intrusive to the environment and provide a higher vantage point along

the river. (P2 & P3) It's granted that this section may be less than desirable to walk through these highly developed areas, but the disturbance of the west bank leads to the following concerns:

- Steep slopes would lead to loss of habitat.
- Safety issues and emergency response.
- Disturbance of highly erodable soils and increase the risk of adversely affecting water quality in the Naugatuck River.
- Damage caused by flooding to trail along bank.

P2- Looking South



P3 – Looking North

Note:

A footbridge in this area provides access to the west bank (P4). This area has the potential as an observation point, fishing area and limited boat launch for canoes and kayaks.

Huntingdon Ave. Bridge (P5). South of Huntingdon Ave; the eastern bank provides a higher vantage point, which is out of the floodway, which intersects with a very limited use railroad bed that parallels the river and Thomaston Ave. The soils in this area consist of various soil textures that have been previously disturbed or filled. (Soils # 306 & 60D)

P4 - Footbridge area and restored site.

P5 – Huntingdon Avenue Bridge East bank.

Optional Northern Trail Loop (TR-1)

Optional connecting trail loop for the Upper Greenway could follow the railbed north from the railroad bridge towards Hancock Pond. The rail spur follows Hancock Brook to the end of Sheffield St. The potential trail would run west along the southern and western border of Mattatuck State Forest where it ultimately completes the Upper Greenway Loop at the Thomaston Ave. trailhead. (TR-1 in White)

A2 - Middle Greenway Corridor

The middle section courses through higher use areas with greater densities in impervious surfaces. The difficulties in routing the trail are related to gaining limited access to commercial and industrial properties along the river corridor.

Trending south from the railroad bridge and confluence of Hancock Brook and the Naugatuck, the trail could follow the rail-bed along the river. (P6) Generally these soils are Udorthents and Urban Lands - # 306,307 & 308.

P6 – Railroad bed paralleling Thomaston Avenue

Optional Middle Trail Route (TR-2)

This optional route parallels the west side of Thomaston Ave trending south at a higher elevation some 200 feet from the river. A berm at the top of slope next to the rail spur may provide an adequate base for any trail. The soils range from Udorthents - #308, Charlton - #60D, Charlton Hollis - #73E and Paxton - #84D.

Note:

The aforementioned soil descriptors indicate that enhanced erosion and sedimentation controls need to be employed if these soils are disturbed. This is because of their soil attributes and radical topographic relief, which have a severe erosion hazard and very steep slopes.

Both trails could end the middle trail at either West Main St. or Freight Street depending on the ability to gain access to the riverfront.

A3 - Lower Greenway Corridor

The lower section of the greenway could begin in the area of West Main or Freight St. along the rail spurs or along the eastern bank of the river. Trending south, the railroad bridge (P7) over the Naugatuck provides a crossing within the more developed region of the city. The trail would follow an abandoned rail-bed situated between an industrial complex. While a temporary departure from the river corridor, the trail could trend east onto Washington Ave., then trend south onto Railroad Hill St., which would follow the west bank of the river to Eagle Street where it would cross to the eastern bank of the river and continue south along South Main St. to Leonard St. Generally these soils are Udorthents and Urban Lands - # 306,307 & 308.

The Leonard Street crossing would bring the trail back to the west side of the river, which would follow Municipal Road south (P8). The proposed trail could utilize the Water Treatment Facility properties or elect to cross the river at its narrowest point with an arched footbridge that spans the river and reconnects to the east bank. The trail could then parallel South Main St. or the riverbank to the trails terminus at a selected area along Platts Mill Rd. (P9 - Pll)

P9 – P11

Concerns

The soils along this section of the river vary greatly depending on which side of the river is utilized for the trail. Constraints to developing the trail in this section revolve around the steepness of slope, proximity to the river, maintaining the stability of the riverbank and the safety of the public regarding the busy thoroughfare.

Note:

(An example of an installed arched footbridge is located in the Town of Wallingford on the first segment of the Quinnipiac River Linear Trail.)

Wetland Resources

The initial visit to this site was on October 12, 2005. Due to heavy rain the field walk was completed the following week on October 19, 2005. The goal was to assess the wetland impacts of a proposed greenway trail that would parallel the watercourse along its length through the City. The ERT study hopes to provide planners with the information needed in the consideration of this greenway. The ERT will provide Waterbury with an analysis of its largest natural resource, assist the City with efforts to develop a greenway strategy that will protect the natural beauty and well being of the River; preserve areas of open space; develop the River's recreational potential; and, promote economic development that would make use of this vast resource

Description

The project site is extensive. The length of the Naugatuck River as it passes through Waterbury is 7.6 miles. It is crossed by 16 bridges including roadways, footbridges and railroad tracks.

Six tributaries flow into it along this reach. From the north they are Spruce Brook, Hancock Brook, Steele Brook, the Mad River, Hopeville Pond Brook, and an unnamed tributary that passes under Highland Avenue before its confluence.

There are one falls and 8 riffle areas along this stretch of river. At the north end of the city the elevation of the river is ±300 feet above mean sea level (MSL). To the south where the Naugatuck leaves the city it is at ±220 feet above MSL. Thus, it drops 80 feet over the run of 40,650 feet yielding a very slight stream gradient of two tenths of one percent (0.002).

As with many urban river systems, it has sections of beauty and inaccessibility and sections where it is bermed, channeled, constricted, littered, dammed, impounded and dumped upon. The Naugatuck River and its floodplain have all of this diversity. Additionally, the river corridor is in the hands of many and diverse property owners.

Despite these things, and in many cases because of them, the river and its floodplain in combination are often a refuge for urban wildlife. The thick growths of riverine and invasive plants thrive in the isolated environment of the river which had been effectively cut off from access by major roadways.

For descriptive purposes this reviewer has broken the study are into seven separate reaches. These are:

A. Spruce Brook Road to Flood Control 0.3 miles
B. Flood Control to Huntington Ave 0.14 miles
C. Huntington Ave to the Steele Brook 1.2 miles
D. Steele Brook to Mixmaster 1.3 miles
E. Mixmaster to Washington Street 0.8 miles
F. Washington Street to South Leonard Street 1.1 miles
G. South Leonard to Naugatuck town line 1.6 miles

A. Spruce Brook Road to Flood Control

This reach is the northernmost in the study area. The Team viewed the river from the east shore more or less opposite where Spruce Brook Road approaches the Thomaston Avenue from the northeast. This is a beautiful expanse of the river.

2004 aerial image

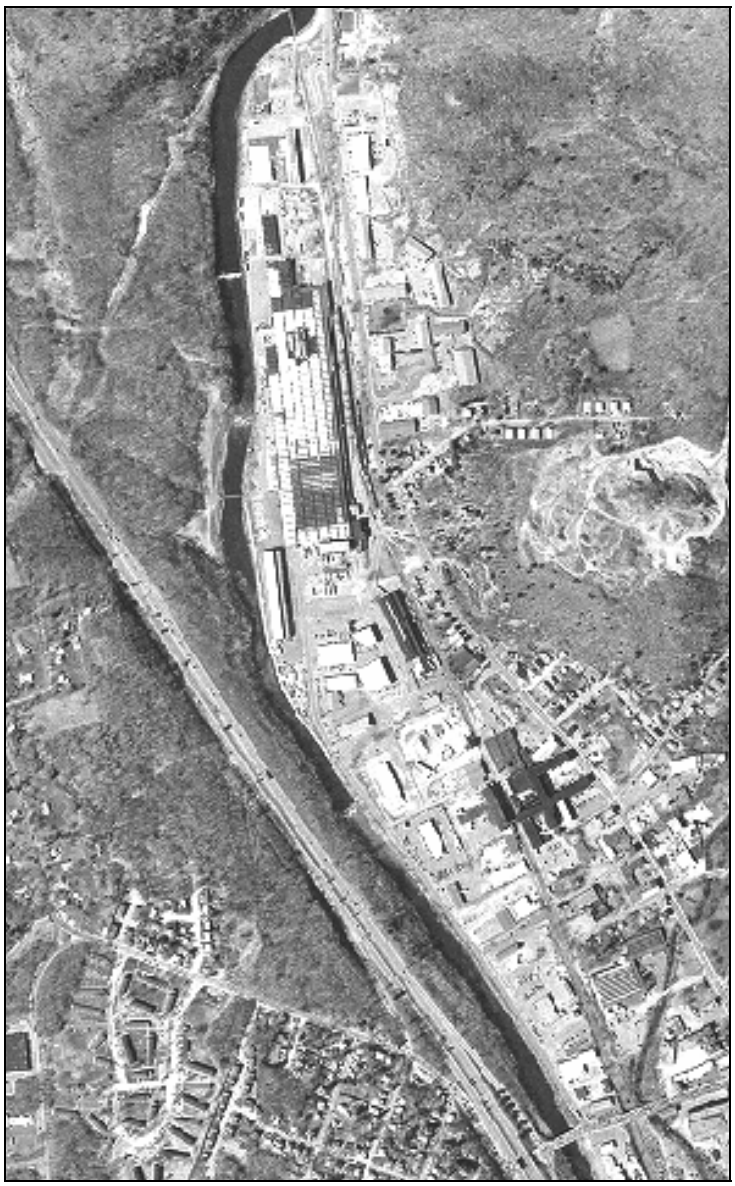
The trees and hills combine with the flowing water to provide a wonderful bit of scenery.

The Team observed an old roadway on the landscape at the time of our visit. In the 1934 aerial photograph below it is easy to see the white ribbon of the trolley line between the dark river and the wider, white road.

1934 aerial image

For the length of this reach the slope from the road down to the water is precipitous, rocky and wooded. There is no floodplain to speak of and the steep slopes are well vegetated thereby keeping erosive forces in check. This reach is crossed by one bridge.

B. Flood Control to Huntingdon Avenue

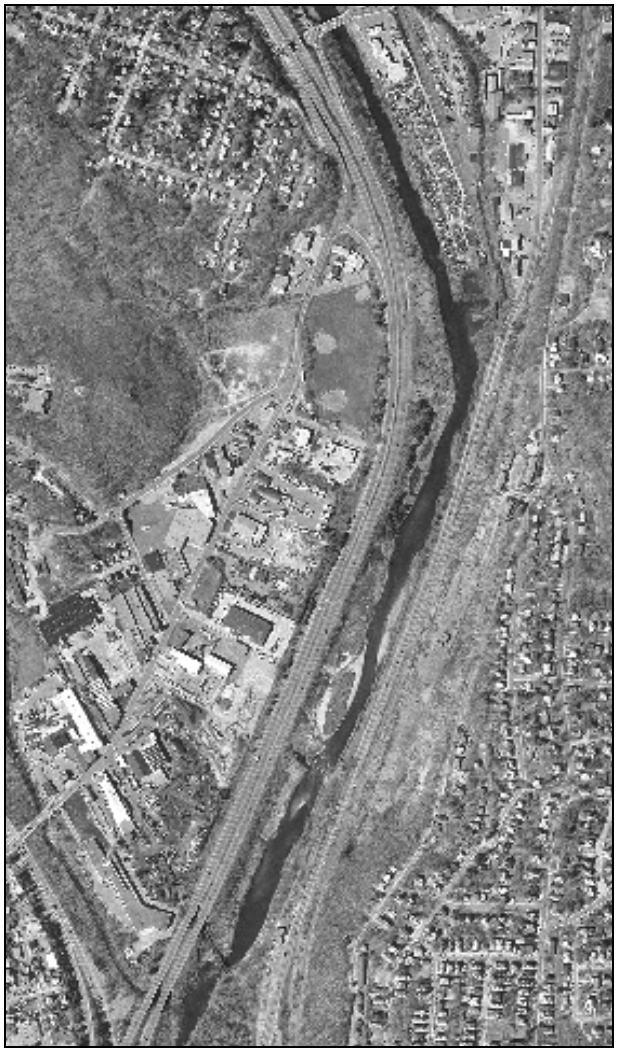


This reach is the second most northern in the study area. From the flood control structure at the top of the left hand image to the Huntingdon Avenue bridge at the bottom, this reach is almost totally isolated from use on its east shore because of a flood wall.

The team stood at the flood wall and looked across the river to the wooded hills in Watertown.

The elevation of the Watertown hills undoubtedly forced flood waters onto the Waterbury side of the river. At some point the city chose to wall off the floodplain and channel the flow. The long term result has been a total isolation of the river for the entire 1.4 mile length of this reach. The foot bridge over the river in the distance in the above photo provides access to the opposite shore, but that is in Watertown. The footbridge is one of two bridges in this reach. There is also an area that appears to have been a low level dam across the river. It shows up as a white line about a quarter of the way down in the above image. As in the reach above, there is no floodplain to deal with here since the floodwall poses a vertical barrier for the entire 1.4 miles.

C. Huntingdon Avenue to Steele Brook



This reach is the third most northern in the study area. The length of 1.25 miles runs form the Huntingdon Avenue bridge to the confluence with Steele Brook which enters from the west.

The first three tenths of a mile are dominated by commercial industrial and an automobile junk yard. Any hope of access to this side of the river could only be realized in the distant future, and the potential for petroleum product pollution on site could be quite high due to its current use. At first sight it would seem that the west side would be favorable for access, but the width of the highway right-of-way comes into play. The steepness of slope would be an additional factor. In this area, a 20 per cent slope to the river would preclude most activities.

As it moves further south the river becomes more intensely isolated between the two highway corridors. Only at the confluence with Steele Brook does the area open up slightly.

The Team stopped to inspect the confluence of Hancock Brook and the Naugatuck. The brook passes under the railroad bridge, and it was an easy walk on the floodplain down to the Naugatuck shore. The view from the shoreline is surprising in that such beautiful vistas associated with an urban river are just not expected. But local residents are attracted to the river. Someone is maintaining bird boxes along the shore. There was beaver sign along the low portions of tree trunks.

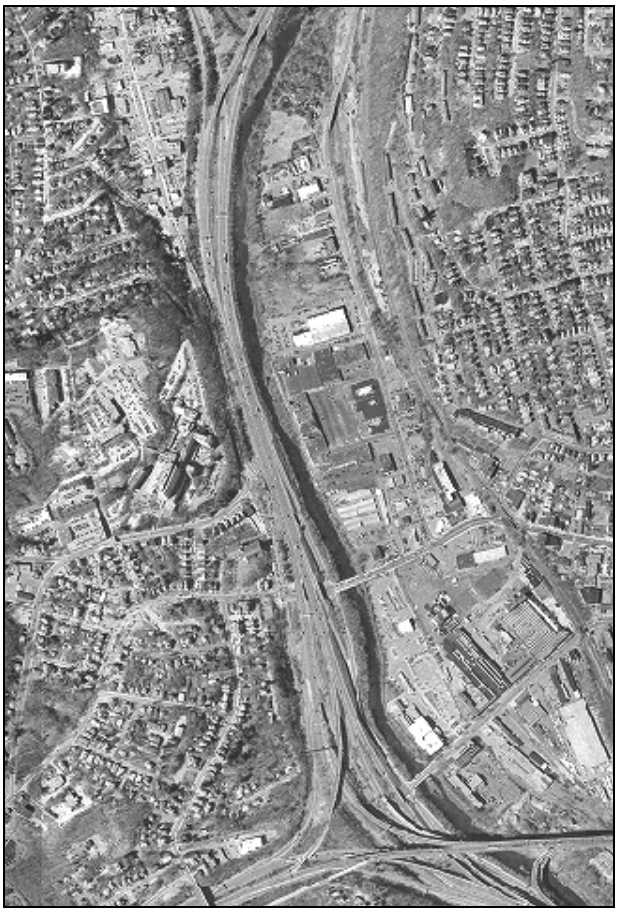
The Team also stopped to inspect a small roadside area abutting Steele Brook along its south bank. This location was 10 yards in from the Naugatuck River and almost right below the elevated highway. It is an isolated area where few visit. There is solitude despite the din of the traffic. Steele Brook flows along placidly. It enjoys a wide riparian area relative to its width.

The left hand image is the view upstream along the Naugatuck from the confluence of Hancock Brook. This view provided a pleasant aesthetic surprise toTeam members. On the right is Steele Brook about 30 yards upstream from the Naugatuck.

Two bridges cross this reach of the river. As can be seen in the photo the river has some room to meander within its floodplain.

D. Steele Brook to the Mixmaster

In this section the river is confined very tightly by various land uses. This area is characterized by the highway abutting the river corridor on the west for the entire distance.



To the east for the first .45 miles the steep hills climb away from the river. Nearly the entire balance of the reach on the east side, about 0.6 mile, is paralleled with a floodwall. The slope and the floodwall, in combination with the abutting highway to the west, serve to channel the river. There is no floodplain.

The river is at one of its narrowest points here measuring about 55 feet in width. Because of its isolation due to the highway to the west, and the combination of steep slopes and floodwall to the east, a riparian corridor exists, although it is quite narrow.

E. Mixmaster to Washington Avenue

In the short distance from the mixmaster to Washington Avenue (0.8 mile), the river passes under four bridges and changes direction from flowing southeasterly to almost due south. As is typical upstream, the river is constricted by private property and slopey terrain on the east. For half of its length in this reach, it abuts the highway to the west.

It is in this reach that the river finally breaks away from the abutting highway where it has been in kinship for the previous 3.5 miles. As it bends to the southeast it leaves that roadway and begins its passage through the south end of the city with its local streets and small manufacturing.

The Team made a stop along the east shore under the mixmaster. Two things of note were obvious there as seen in the photographs below. First, these isolated areas can often be quite attractive.

As happens upstream, the very limited access provides a solitary sense of place. But the opposite is also true. In the second picture of the failing erosion control, infractions that do occur can go unnoticed for lengthy periods of time.

Just above the Washington Avenue bridge on the east side of the river, the various properties are lined with nearly 500 feet of floodwall. On the west side just above the bridge is an industrial building with what appears to be its own sewage treatment facility.

This view under the mixmaster shows lush vegetation and the isolated nature of the river. The view to the right shows the dramatic failure of the erosion control allowing a fan of soil to move downslope to the river. This occurrence is just below the materials recycling operation.

F. Washington Street to South Leonard Street

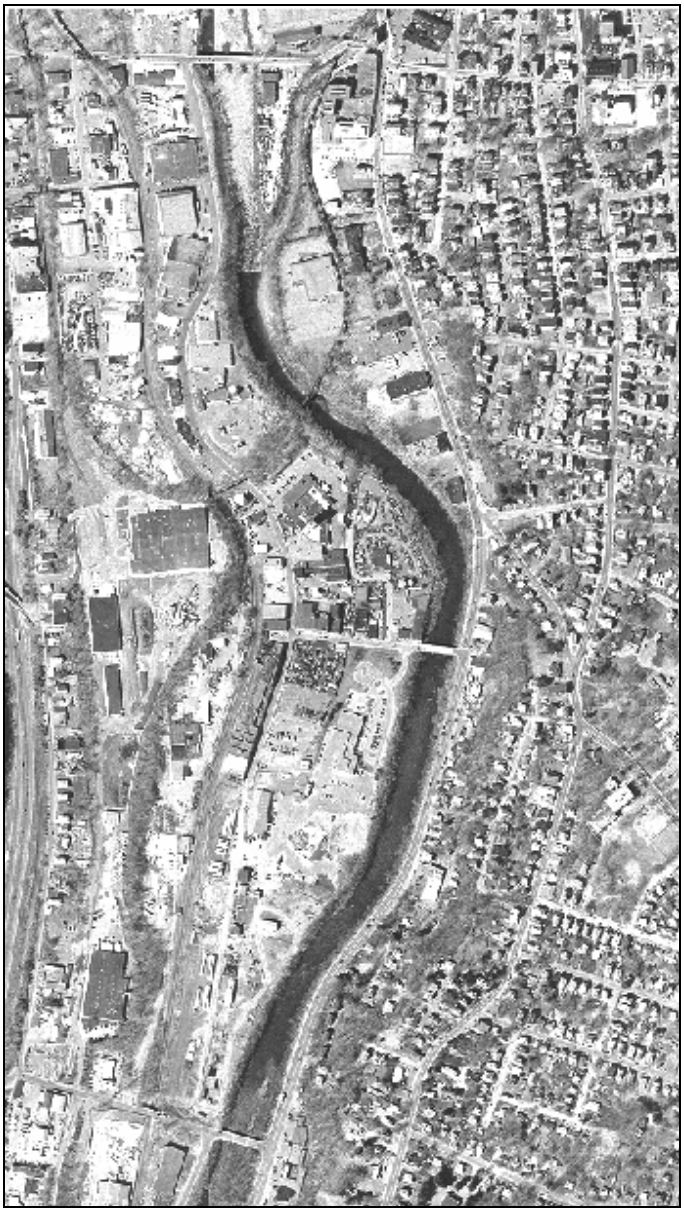
Along this run the river begins to move out from the high density land use of the city. This run is crossed by two bridges and varies in width from 60 to 260 feet. Above Eagle Street there is more room laterally for the river, as it is not held quite as tightly by the landscape. The result is viewsheds that offer picturesque glimpses of the river.

These images were taken from the Washington Street bridge and show the Naugatuck River looking north on the left, and looking to the south on the right. Both views, as much as any views theTeam had of the river, show the inviting nature of this sometimes beautiful waterway.

Below Eagle Street, the channel way tightens up once again, held tightly by South Main Street to the east and fairly steep-sloping private property to the west.

One of the major challenges to the linear pathway will be the Yankee Gas property on the west bank just north of South Leonard Street. Their property borders the river for approximately 1,750 feet or one third of a mile. Issues of security were brought to bear here. The property is separated from the river by a chain link fence. The location of the fence is at the narrow top-of-the-slope, up from the river level. There is very little width for the possibility of a formal trail or pathway.

The above photo shows the staked haybale/ silt fence, the chin link fence with barbed wire and a narrow width of surface before the land drops off to the river level. On the right, the Washington Street Bridge is the northern most with the Eagle Street bridge in the center.



G. South Leonard Street to Naugatuck Town Line

In this final run, the topography evens out and the river meanders on the level of its floodplain. Two bridges cross the river and it features two riffly areas and a “rapids” where there seems to have been a structure spanning the width of the river. The appearance of openness exists as the density of land use has decreased greatly since the center of the city. Though the land use is constant along the river, development does not occur right up to the water’s edge. The sewage treatment plant is a good example of a dedicated land with but far less impervious surface than upstream land uses.

Here the river widens and is free enough to meander through its own channels creating a few islands. We did not see that upstream in the study area as there was literally no lateral space to widen that much, and the confines of the neighboring land use channels the river for much of its run through the City. Previous islands in the river occur about 2.5 miles above the start of the study area.

The left hand figure shows the Naugatuck as it passes by a concrete obstruction ~200 yards north of the Bristol Street bridge. On the right is a view of the Naugatuck looking north along its shore at our final stop.

Access

It seemed at the time of the visit that the Team had obtained a fairly comprehensive overview of the Naugatuck River corridor. The many stops exposed us to a variety of land uses and varied physical settings. But just the opposite was true.

Upon closer inspection of each reach, the objective observer had to realize that, although the Team experienced a lot, we had only a limited view of the river corridor. A more thorough investigation of mapping and aerial photography shows a history of land-use that has cut the river off from public access, recreation and enjoyment.

Limited access is the result of at least two different factors. First, almost no publicly held land borders the river. This results in there being little to no public access to the river. The mapping that the DEP has access to shows that no municipal or DEP property abuts the river. There may be other state agencies that do abut it, and the City would have access to that information. But for over 99 per cent of the length of this reach, (15.2 miles, including both sides of the river over a study length of 7.6 miles) the abutting land is owned privately. Secondly, for great lengths of the study area, the river corridor is closely paralleled by highway rights-of-way. The hilly terrain of the Naugatuck River Valley forces these travel corridors to dominate the low-lying areas along the river making access in many places all but impossible. The river itself has become just an aquatic pathway below-the-road as seen at 65 miles per hour.

Water Quality

The water Quality maps at the DEP show the Naugatuck River as it passes through Waterbury as having a water quality of “C/B”. That is on the scale of AA being the best, A - the next best, B after that, then C, and finally D. In Waterbury’s classification, there are two letters separated by a slash. This indicates a current water quality of C but with the goal of upgrading the water quality to B.

There are many reasons both historic and current for degraded water quality. In the days when the river was used a handy sewer, the metal working industry left a legacy of heavy metals that remain with us today. Petroleum leaks and spills can take years to move through the subsurface soil and emerge in the waterways.

(The DEP’s Water Quality Classifications is available at: http://www.dep.state.ct.us/wtr/wq/wqs.pdf)

Today, the river is neighbored by hundreds of acres of impervious surface. Much of the runoff from this likely drains directly to the Naugatuck adding road salts and sands, automobile gas and oil leaks, general trash, litter and debris along with untold fertilizers, pesticides and all else that flows downhill. In addition, there is a warming of runoff from asphalt surfaces (versus runoff from natural conditions) with a result known as thermal pollution. An example of this is the 4,000 feet reach upstream of where I-84 crosses the Naugatuck River. On the east side of the river for a distance of 600 feet inland, this 4,000 foot reach is entirely impervious, roofs and parking lots prevail. This equates to 55 acres. Moving inland another 100 yards, the situation is the same, only now the total impervious surface is 82.5 acres.

Maybe for just that reason the attraction to the river is strong. In contrast to concrete and asphalt, the river corridor is the softest, most colorful entity on the landscape. Because of its isolation, the river has been able to maintain a narrow but well vegetated riparian corridor along, in many cases, both its east and west shoreline. This provides viewsheds that, from almost every location, make the river very attractive to the eye. In contrast to the manufacturing areas that border it, the river is beautiful. And that makes it inviting.

In many ways, the river's isolation, which could scuttle the linear trail project, is the very thing that makes an alternate use worth considering.

Trails on Land

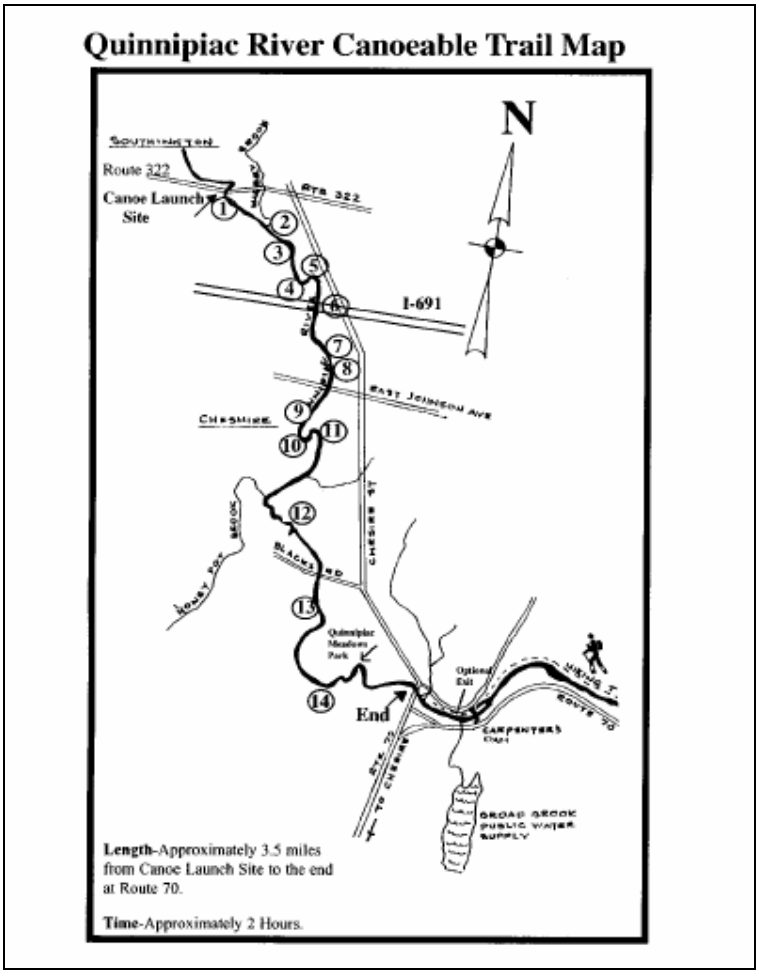
Very often in Connecticut, and in the nation, the trails that have become heavily used and immensely popular are those along old railroad beds. In such cases, the right-of-way already existed. Municipal or state acquisition of the proposed trail was with one property owner – the former railroad. It is difficult to find an example of a trail that was built from "scratch", that is, a whole new entity where none existed before.

The goal of this ERT was to assess the impacts of a linear river trail along the watercourse. The acquisition or leasing of the necessary abutting private property for a walking or biking trail may be a difficult hurdle. Construction of some portions of the tail would demand erosion and sediment controls that might prove to be quite costly. But that is not to say a trail cannot be built. Where needed, trail sections away from immediate riverside may be a workable alternative. In the sequence of attracting people to the river, this reviewer finds it easier to envision the trail coming to fruition after access, and thus increased public use, is available to the public by other means.

The project is ambitious, but access to the river is possible. It became evident during this reviewer's study that the river as a resource is underutilized, and that there are multiple ways of connecting the public to it.

Trails on Water

In many areas of the state the watercourse itself is the trail. Eight and a half miles due east of the Naugatuck River, the Quinnipiac River Watershed Association (QRWA) has designated a 3.5 mile stretch of the river as a Canoeable Trail. They provide a trail guide on the internet to interpret the 14 marked stops along the way.



8.5 miles due east of the Naugatuck, the Quinnipiac River attracts river enthusiasts with a paddleable trail guide.

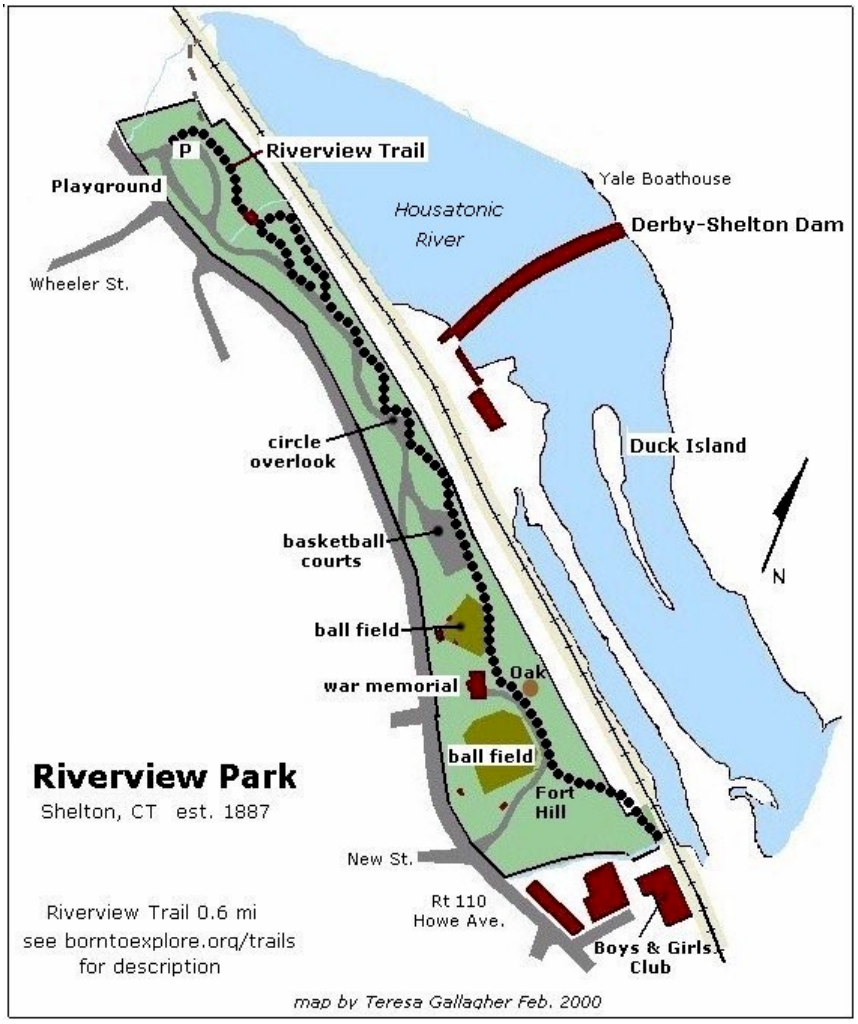
The River trail concept does at least two things well. First, it gets people on the river. There is little better to advocate for the river's health than the river users themselves. These individuals are intimate with the river and can report on degradation in real time.

Second, a river trail forces the issue of accessibility for paddler's launches and often for fishing access. Waterbury would do well to gain access to the river in the form of pocket parks and cartop boat launches.

To maintain interest in the river, the QRWA also has annual cleanup events and canoe/kayak races along the river. These water uses could be easily adopted to the Naugatuck, provided the City is able to strategically locate access points.

(The QRWA guide can be found on their homepage at http://www.qrwa.org/ follow the link to Publications. Their *Canoe and Natural Resource Guide to the Quinnipiac River* is even more descriptive and thorough covering a length of over 35 miles.)

Some towns realize the constraints of complete linear connection and provide access to the river where it is feasible. In Shelton, along the Housatonic River, the town parks take advantage of river access with a series of small but inviting locations. Their Riverview Park has a trail length of only six tenths of a mile, or about 3,000 feet.



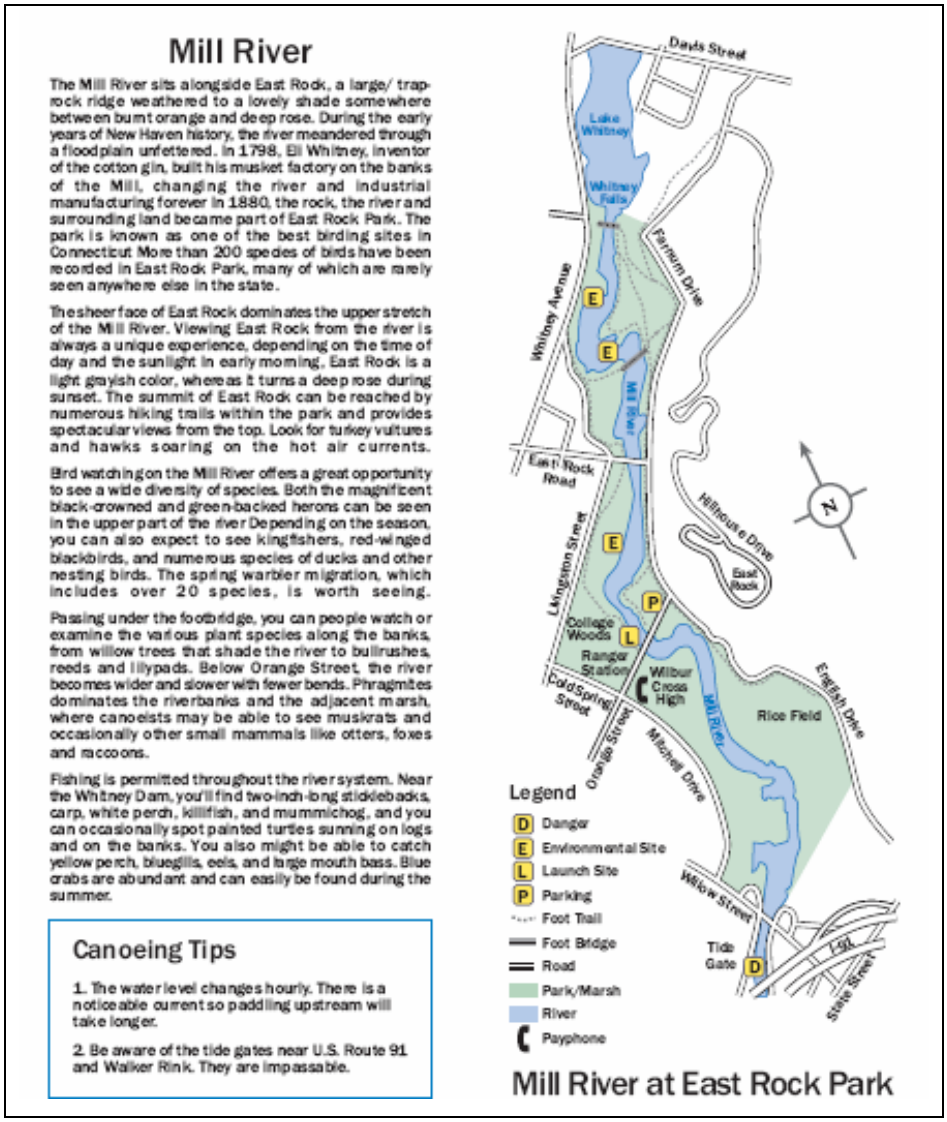
In addition, the Shelton River Walk trail is only three tenths of a mile in length. They have found that building what can reasonably be built generates interest in the river and gets support for the completion of longer term plans.

River Walk looking south.

River Walk looking north.

Canal Street sidewalk is used to make a loop.

Finally, the City of New Haven provides paddler's guides for four of its rivers. Like the Naugatuck, it was not feasible to construct an entire greenway yet they chose to make use of the urban river setting nonetheless. The paddler's guides are downloadable from the internet at: http://www.cityofnewhaven.com/Parks/outdooradventure/media/CanoeGuide-MillRiver.pdf



Mill River

The Mill River sits alongside East Rock, a large/ trap-rock ridge weathered to a lovely shade somewhere between burnt orange and deep rose. During the early years of New Haven history, the river meandered through a floodplain unfettered. In 1798, Eli Whitney, inventor of the cotton gin, built his musket factory on the banks of the Mill, changing the river and industrial manufacturing forever. In 1880, the rock, the river and surrounding land became part of East Rock Park. The park is known as one of the best birding sites in Connecticut. More than 200 species of birds have been recorded in East Rock Park, many of which are rarely seen anywhere else in the state.

The sheer face of East Rock dominates the upper stretch of the Mill River. Viewing East Rock from the river is always a unique experience, depending on the time of day and the sunlight in early morning, East Rock is a light grayish color, whereas it turns a deep rose during sunset. The summit of East Rock can be reached by numerous hiking trails within the park and provides spectacular views from the top. Look for turkey vultures and hawks soaring on the hot air currents.

Bird watching on the Mill River offers a great opportunity to see a wide diversity of species. Both the magnificent black-crowned and green-backed herons can be seen in the upper part of the river. Depending on the season, you can also expect to see kingfishers, red-winged blackbirds, and numerous species of ducks and other nesting birds. The spring warbler migration, which includes over 20 species, is worth seeing.

Passing under the footbridge, you can people watch or examine the various plant species along the banks, from willow trees that shade the river to bullrushes, reeds and lilypads. Below Orange Street, the river becomes wider and slower with fewer bends. Phragmites dominates the riverbanks and the adjacent marsh, where canoeists may be able to see muskrats and occasionally other small mammals like otters, foxes and raccoons.

Fishing is permitted throughout the river system. Near the Whitney Dam, you'll find two-inch-long stickleba cks, carp, white perch, killifish, and mummichog, and you can occasionally spot painted turtles sunning on logs and on the banks. You also might be able to catch yellow perch, bluegills, eels, and large mouth bass. Blue crabs are abundant and can easily be found during the summer.

Canoeing Tips

1. The water level changes hourly. There is a noticeable current so paddling upstream will take longer.

2. Be aware of the tide gates near U.S. Route 91 and Walker Rink. They are impassable.

This is and example of one of New Haven's four Canoe/Kayak Trail Guides

Other municipalities that are not in the position to create river walks and/or trails along their waterways have taken full advantage of the recreational opportunities which abound for paddlers. They have invited the growing number of kayakers and canoers to come and recreate on their rivers, they provide access points and printed guides, and they ensure that rivers, which otherwise would be held in isolation, are used by the public and realize their potential as assets to the city.

Aquatic Resources

Site Description

The Waterbury Greenway Project encompasses the Naugatuck River reach through Waterbury from the Spruce Brook confluence on the Thomaston downstream (south) to the Naugatuck town line. Approximately 7.1 miles of river are within the bounds of the Waterbury Greenway Project.

Nearly the entire length of the Naugatuck River through Waterbury has long been impacted by man-made alteration. Beginning in the 1700's, the Naugatuck River through Waterbury (as elsewhere in the Naugatuck River Valley) attracted industrial development as the steep gradient of the river made favorable sites to construct dams and provide waterpower for early mills. Industrial development along the river banks and use of the river as a receptacle for municipal sewage and a wide variety of industrial discharges subsequently followed the development of water-power. Following a devastating flood of August 1955, lengthy segments of the Naugatuck River were channelized and rip-rap lined by the U.S. Army Corps of Engineers in 1960-61. The project was funded through Section 205 of the Corp's Continuing Authorities Program.

Throughout a lengthy period of economic development, large quantities of untreated industrial wastes and sewage were discharged into the Naugatuck River. By 1899, the State Sewage Commission reported that the Naugatuck River had reached the limit of permissible pollution. A subsequent report by the State Board of Health in 1915 described the river as badly polluted throughout is length, a condition that remained essentially unchanged until the early 1970's. Federal and State mandated wastewater treatment improvements during the 1970's, combined with the general decline in industry and the closure of other businesses, led to dramatic improvements in the water quality and aesthetics of the Naugatuck River. Further improvements were made from the mid-1980's to the year 2000 with advanced wastewater treatment at a number of municipal wastewater treatment plants along the Naugatuck River that included reconstruction of the Waterbury Waste Water Treatment Plant.

The Department of Environmental Protection classifies the Naugatuck River reach through Waterbury as *Class C/B* surface water. Surface water of this classification is presently not meeting water quality criteria or one or more designated uses (i.e. recreational use, fish and wildlife habitat, agricultural and industrial supply and other legitimate uses including navigation) due to pollution. The goal for such waters may be *Class A* or *Class B* depending upon the specific uses designated for a watercourse.

Despite improvements to water quality, instream and riparian habitat of the Naugatuck River through Waterbury remain impaired. As the result of commercial, industrial and urban development along with flood control modifications, the river is notably lacking in instream cover (e.g. large boulders, accumulations of woody debris and has an extremely limited, non-contiguous vegetated riparian floodplain).

The Naugatuck River had been segmented by several dams in Waterbury. An initiative to remove the dams and restore continuity to riverine habitat began with the reconstruction of the Waterbury Waste Water Treatment Plant that occurred over the three-year period of 1997-2000. In conjunction with the treatment plant reconstruction, the Anaconda Dam and Freight Street Dam were removed in 1999; the Chase Brass Dam was later removed in 2004.

Aquatic Resources

Prior to the alterations associated with industrial and urban development, the Naugatuck River through Waterbury likely provided habitat for a cold water riverine fish assemblage. Construction of dams, channelization, and destruction of riparian habitat have dramatically altered the Naugatuck River's physical characteristics and are theorized to have subsequently reduced the river's ability to support a diverse fish community and in particular have a reduced support for cold water species. Inland Fisheries Division fish population surveys of the Naugatuck River have confirmed that, despite water quality improvements, physical habitat impairment remains a significant factor limiting fish species support.

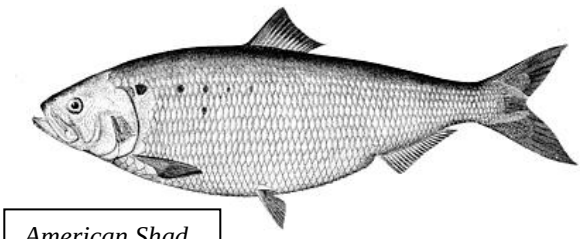
The Division has conducted annual fish surveys in the Naugatuck River through Waterbury beginning in late 1990's. The surveys are conducted at several sites in the river proximate the Mad River confluence downstream to the former Platt's Mill Dam. Two surveys were conducted at the former Anaconda Dam site. The surveys revealed a fish community of the

following species: blacknose dace, longnose dace, spottail shiner, creek chub, fallfish, common shiner, banded killifish, tessellated darter, rock bass, smallmouth bass, redbreast sunfish, white sucker and American eel. These riverine species are commonly associated with either cool- or cold water riverine systems and can tolerate watercourses with degraded physical habitat.

Also collected in the surveys were largemouth bass, bluegill, pumpkinseed, golden shiner, yellow perch and brown bullhead. These species inhabit warmwater lakes and ponds and large, slow moving rivers; they are considered a transient species in rivers such as the Naugatuck River.

Within the past five years, the Division has stocked hatchery-reared trout in the Naugatuck River through the Waterbury area. Approximately 3,100 adult-aged brook, brown and rainbow trout are allocated for the Naugatuck River through Waterbury. Beginning in 2002, the Division has designated the Naugatuck River from Torrington to Seymour (including the segment through Waterbury) as a *Trophy Trout Stream*. This designation limits the daily creel limit of trout to two fish.

In addition to resident cold water fish species, the Naugatuck River fishery population once included American shad, alewife, and blueback herring. These species are anadromous meaning that they spend most of their lives in estuary and ocean waters and return to fresh water to spawn. The young develop to a juvenile age then migrate back to the marine environment. The Division has developed a plan to restore these species to the Naugatuck River. The anadromous fish restoration plan initiated with removal of dams and/or installation of fish passage facilities.



American Shad

Angling is allowed through intermittent segments of the West Branch Naugatuck River from Stillwater Pond to Route 4. Approximately 350 adult hatchery reared brook, brown and rainbow trout are stocked to satisfy angler demand.

Habitat Enhancement Recommendations

As previously mentioned, physical habitat impairment is likely to be the primary factor limiting complete support of a coldwater and anadromous fish assemblage in the Naugatuck River. The following are recommendations for the restoration and/or enhancement of impaired habitat within and along the Naugatuck River that can be incorporated into the Waterbury Greenway Project.

- **Restoration of riparian habitat**. Nearly the complete length of the Naugatuck River channel is contained within retaining walls resulting from industrial, commercial and residential development in the Waterbury area. The retaining walls have eliminated or dramatically reduced the once vegetated riparian area associated with the river. Naturally vegetated riparian ecosystems perform a variety of unique functions essential to a healthy instream aquatic environment. 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 fish;
  - stabilize streambanks 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 fish;
  - serve as a reservoir, storing surplus runoff for gradual release into streams during summer and early fall base flow periods.

- **Restoration of instream habitat**. Development within and along the Naugatuck River through Waterbury has dramatically altered instream habitat and has functionally channelized the river. Channelization converts rivers into straighter, wider, and shallower channels virtually eliminating all productive instream habitat. Division fish surveys indicate the river supports a wide variety of fish species however; most individuals of each species are small length, juvenile aged fish. The most apparent factor limiting support of

larger sized fish is the nearly complete lack of large cover features. Large cover features provide overhead and lateral cover for fish; cause the breakup of a uniform current and therefore dislodge and relocate fine sediments; and increase feeding lies for fish by creating resting stations in locations of abundant food drift.

The most commonly used means to provide large cover in channelized streams of similar size and gradient as the Naugatuck River is by the installation of random boulders, boulder clusters, or rock vanes. The use of rock assures long-term permanence however, the rock needs to be of a suitable size to provide stability. This requires machinery for installation. The Division can provide design details for these cover features and the most suitable sites for their installation.

The Waterbury Greenway Project should also consider the following:

- **Create formal pedestrian access points to the river.**

- **Signage should be erected along the Naugatuck River** at select, readily accessible vantage points atop the river banks to describe the function of key features of a stream such as pools, riffles, riparian area, and the consequence of stormwater discharges. Suggested verbiage for such signage includes:

  Stream habitat overview. A key characteristic of any productive in-stream habitat is diversity. It is imperative that the proper blend of water depths, water velocities, and substrate types be present together to form the necessary food production, spawning-incubation, and cover areas that combine to form a complete stream habitat.

  Pools. Loosely defined, a pool is a region of deeper, slower moving water with fine bed materials. With overhanging banks and vegetation, pools provide cover, shelter, and resting areas primarily for larger finfish. During low flows pools can become isolated pockets of water which allow survival of finfish and other aquatic organisms.

  Riffles. Areas of shallower, faster moving water with coarser bed materials. Riffles are most often associated with “white water,” a turbulence which adds oxygen to water. Riffles tend to support higher densities of aquatic insects and are thus important areas of finfish

food production. Riffles also serve as a spawning site for most stream finfish. Due to competition and predation, juvenile and small sized finfish tend to inhabit riffles.

Riparian area. The riparian area is that section of land which adjoins the river channel. A well vegetated riparian area is critical to the health of the river ecosystem. Roots of trees, shrubs, and grasses bind the river bank soils and provide a resistance to the erosive forces of flowing water. Stems and leaves of river bank vegetation provide shade which prevents high water temperatures. Leaves, stems, and other plant parts that fall into the river provide food for aquatic insects. Large woody debris that fall into the river enhance physical habitat. Abundant riparian vegetation softens rainfall and enables the riparian area to serve as a reservoir storing surplus runoff for a gradual release to the river during low flow periods of summer and early fall. The riparian area is a natural filter that removes nutrients, sediments, and other non-point source pollutants from overland runoff.

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 no known extant populations of Federal or State Endangered, Threatened or Special Concern Species that occur at the site in question.

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 Natural Resources 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 substitutes 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.

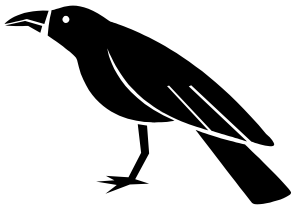
Please be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for the proposed project.

Wildlife Resources

The proposed greenway area follows the Naugatuck River in Waterbury; proposals include recreation paths, picnic areas, canoe landings, observation decks, etc. in order to stimulate recreational activities and economic development along the river. The majority of the proposed greenway site consists of urban areas that are highly developed with manufacturing and other businesses, as well as extensive roadways and rail system.

Wildlife Habitats

The bulk of wildlife habitat found in the proposed greenway area consists of narrow strips of vegetation on steep dikes between the river and roadways or buildings (businesses and factories). Species likely to be making use of these areas include those that are well adapted to living in urban environments such as gray squirrels, raccoons, blue jays, and crows. There is a significant amount of non-native invasive species, particularly Japanese knotweed, with low wildlife value. Due to the current habitat fragmentation in the bulk of the proposed greenway area, development of a greenway path should not be expected to have a significant impact on wildlife. In those areas with more significant amounts of wildlife habitat and native vegetation, impacts of a greenway will include further fragmentation of already dwindling habitat and higher levels of disturbance from human use.



While the Naugatuck River itself is not to be directly impacted or altered, trail construction along the riverside will certainly have indirect impacts on this important waterway. In many sections, the vegetated area between the river and major roadway consists of a narrow steep dike. Reducing the amount of vegetation on these already small areas may result in bank erosion that can negatively impact the water quality in the river.

Reducing Impacts

Although steps that can be recommended to reduce impacts to wildlife will vary with the specific conditions along the proposed greenway, some general guidelines can be provided.

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 stream bank erosion at heavily used sites. The overall level of disturbance to vegetation/habitat and wildlife can be significantly reduced by establishing one or two multiple-use trails rather than several single/exclusive-use trails.

Some general 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 as it can impede migration for amphibians. 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. 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);

Other considerations should include any unique or special habitat features; these should not be crossed by trails, doing so can lead not only to habitat fragmentation, but further degradation by increased human traffic. Finally, trail design should be carefully considered in those areas where only narrow strips of vegetation separate the river from roads and/or buildings. Any loss of vegetation, particularly where the riverside slope is steep, may result in streamside erosion and loss of what may be the small amount of remaining usable wildlife habitat. In these locations, trails should be placed outside of the dike/vegetated area.

Please note that this report is being provided as a very general guideline regarding issues to consider in developing a greenway. More specific information can only be provided by as site-specific determination of the quality and quantity of habitats present along the entire length of the proposed greenway, the requirements of the wildlife species found in those habitats, and using this data to minimize trail impact.

Forestry / Woody Vegetation Resources

If the Naugatuck River Greenway Project were to go forward, there are several good opportunities to take advantage of the existing trees and woody vegetation along the river. The trees along with the Greenway would be welcome as attributes of the trail, in terms of the shade that they would provide, what they would add to the aesthetic experience, the sense of connection to the natural world that they would offer, and the important temporal connections trees provide, both to the past and to the future. As trees grow, they tend to increase in appeal and the benefits they provide also tend to increase in an accelerating manner over time.

The narrow, linear forest that currently exists along the length of the proposed greenway is young, diverse, and, for the most part, in reasonably good health. It is, however, largely discontinuous, with large sections along the river not in forest. The sections not in forest are variously paved, cleared and subsequently given over to monocultures of such weedy species as Japanese knotweed, under active use as highway right-of-way, industrial property or in residential use, and so on. These areas are not a part of this discussion.

Japanese Knotweed

Black Birch

The forested sections along the river were largely initiated following the major flood of 1955 and the subsequent civil engineering projects undertaken to prevent future such floods. As a part of this examination of the forest, various trees along the river's length were assessed as to age through the use of an increment borer. The results of these counts of the tree's growth rings are included in Table 1. As can be seen from this table, only one tree was found to be over 50 years old. This is believed to be reflective of the situation in the field.

Table 1

Species	Site	dbh	Age
Hickory	**#1**	**10”**	**>28**
Red Maple	**#1**	**8”**	**18**
Red Oak	**#1**	**12”**	**>20**
White Ash	**#1**	**10”**	**30**
Yellow Birch	**#2**	**8”**	**22**
Black Birch	**#2**	**10”**	**54**
Norway Maple	**#3**	**6”**	**28**
White Birch	**#4**	**8”**	**35**

Site #1 – Along Thomaston Avenue, south of intersection with Route 262
Site #2 – Adjacent to National Rent a Fence, where Hancock Brook flows into Naugatuck
Site #3 – Railroad Hill Road, near Washington Avenue
Site #4 – Along Platts Mill Road

Over the course of the past 3-4 decades, it does not appear that there was any serious effort made to influence the structure or make-up of this forest in its various parts, other than the removal of vegetation where the land was needed for other purposes. Trees and shrubs grew up along particular stretches of the river largely based on such factors as availability of seed source and appropriateness of the site to individual species. Early practices and events (e.g. – mowing, grass fires), where they occurred, would likely have also influenced species composition. Since these trees have become established, however, there is little sign of widespread disturbance, at least until recently. Over the past few years, it is obvious that a beaver population of considerable size has developed in the Naugatuck River, and that these animals are removing trees. Other than that, the original “catch” of trees continues to sort itself out, with the various individual trees and tree species taking advantage of the opportunities each site presents it.

This has led to significant diversity in the forest’s make-up along the length of the river. For example, at the north end of the inspection tour, near to the Waterbury-Watertown municipal line, a fairly heterogeneous mix of native trees, including various species of oaks, maples, hickory and birch, is developing, with openings in the crown favoring the development of a significant shrub layer. Further down the river, near to where the Hancock Brook flows into the Naugatuck, the species composition is largely all birches. Further still down the Naugatuck River, along Railroad Hill Road, the species mix includes more sycamores, elms and Norway maples. This particular mix of trees species creates a relatively dense crown that is shading out much of the understory.

This diversity of woody vegetation along the Greenway's length would likely increase the interest and appeal of the trail for those who would use it. Citing the trail to take advantage of this diversity of woody vegetation is, as a general principle, both desirable and practical, in so far as it is practical to locate a pedestrian or bicycle trail anywhere along the river.

One note of caution must be given with respect to the wooded sections along the river. If construction of the trail leads to openings in the canopy in those sections, it must be anticipated that undesirable invasive species will take advantage of these openings. In the 2-4 decades since most of the woody vegetations has become established, the relative presence of invasive species in the surrounding landscape has increased. As previously mentioned, Norway maple already has had some success in establishing itself at points along the river. Its success is likely due to having been present in a seed source when these sites were first being established. Other invasive plants, given a second opportunity to become established by incursions into the existing woody growth, will likely have greater success this time.

One other note – the forest along the river also provides a very attractive backdrop, even when viewed from across the river or from a distance. Thus, many of the aesthetic values of the forest are gained even if the trail does not run through these wooded sections. And, of course, the benefits provided by these trees to the river and to the city extend well beyond the simply aesthetic, and include such contributions as protection of stream water quality, improvement of air quality, noise buffering of the adjacent roads and highways, and the cooling of the river and of the streets adjacent to the river.

Archaeological and Historical Review

The Office of State Archaeology and the State Historic Preservation Office recommend an archaeological assessment survey for the project area, including field inspection, as a pertinent approach for the identification of archaeologically sensitive areas which could be then avoided during the construction of trail-related amenities (i.e., parking, picnic areas, observational decks, etc.). An assessment survey would also provide the City of Waterbury with a historic context for understanding Native American, Colonial and subsequent industrial uses of the Naugatuck River. This historic and archaeological overview could provide important information for public education and/or interpretive signs along the greenway.

The recommended assessment survey should be conducted in accordance with the State Historic Preservation Office's *Environmental Review Primer for Connecticut's Archaeological Resources*. Funding may be available in the near future from the state of Connecticut to conduct the recommended survey,

The Office of State Archaeology and the State Historic Preservation Office are prepared to offer technical assistance in conducting the archaeological survey and they look forward to working with the City of Waterbury in the conservation and preservation of its cultural resources.

DEP Trails and Greenways Comments

The Naugatuck River has been designated as an official State greenway. Since many of the other communities up and down the river are engaged in building or planning greenways, it is satisfying to know that officials in Waterbury are trying to connect their section as well.

The site as walked presents many challenges as far as the physical terrain is concerned. Banks are narrow and taking the trail into the floodplain may result in negative impacts to riparian resources. One suggestion may be to utilize existing sidewalk/road systems farther away from the river, with spur routes leading back to the water for viewing/access. While not as scenic as a path along the Naugatuck, it may be more feasible. The possibility exists down the road for TEA or other earmark monies for this type of project.

Although developing a long term vision for a trail is a valuable exercise, it is imperative for communities to remain as flexible as possible and to be realistic in identifying what is doable in terms of trail development, especially in the short-term. Waterbury should concentrate limited resources on portions of the trail that are more achievable and physically possible, so that momentum and excitement for extending and continuing the trail project can be generated and maintained.

Recreation Planner Review

The purpose of this ERT review is to explore the potential for a greenway, preferably involving a trail, along the Naugatuck River in Waterbury. This river corridor has experienced the uses and abuses of the industrial revolution and urbanization followed by de-industrialization and urban decay. Therefore, a renewal rather than a preservation strategy is required. To comprehensively address such issues as availability of privately owned property, brownfields, and unused and/or underused factory buildings and riverside properties and their impact on a possible greenway, as well as on related urban redevelopment, a detailed planning and engineering study is needed. Thus, the following ERT comments by river stretch should be considered a preliminary assessment containing some suggestions which may in the course of a follow-up study prove to be feasible options.

1. **North of Huntingdon Ave.**
   a. **West Bank-** The hilly, wooded land between Route 8 and the River is largely in DOT, CL&P and Waterbury Industrial Commons ownership and could support a hiking trail, connecting to the existing Jericho Trail and thus to the Mattituck Trail.

   b. **East Bank-** A bike trail is suggested along Thomaston Ave. from at least Frost Bridge Rd. south to Commons Rd. and thence along Commons and Chase River Roads to Huntingdon Ave., as generally enough width exists for a safe bike lane on all three streets. Also, landscaping along the riverside stretch of Chase River Rd. is recommended.

2. **Huntingdon Ave- West Main St.**
   a. **West Bank-** A riverside trail is suggested, with detailed engineering required to determine the feasibility of a bike trail in several tight stretches, plus needed access under the Steele Brook rail spur, and also a pedestrian bridge over Steele Brook would be needed. In addition, the status of the unused portion of the Steele Brook rail right-of-way and the potential for linking a trail on this right-of-way to a future Naugatuck River trail should be investigated.

   b. **East Bank-** There is little potential for a greenway or trail in this stretch because of a combination of existing development, lack of width on Thomaston Ave., and the immediate proximity of the railroad to the River. This reviewers suggestion is to relocate the Hychko Junkyard and to transform this visually prominent site into a riverside park.

3. **West Main St- Freight St.**
   a. **West Bank-** DOT owned, but seemingly too narrow to support a trail.
   b. **East Bank-** Totally CL&P owned, with a riverside bike trail feasible, with appropriate security fencing to protect CL&P property, within the roughly 30 foot space between CL&P office and the riverbank.

4. **Freight St.- Bank St.**
   a. **West Bank-** Largely DOT owned, but seemingly too narrow to contain a trail.
   b. **East Bank-** The MacDermid Company previously expressed a willingness to provide a trail across its property. Then utilizing N/F Consalt Inc., DOT, Yankee Gas, and Laidlaw Transit Properties, a trail and park area could be built on unused /underused land to Jackson St. near the junction of Bank St.

5. **Bank St.-Washington St.**
   An abandoned rail spur can provide access from West Liberty St. across the river to Washington St. and will require new decking on the existing bridge.

6. **Washington St.-Eagle St.**
   a. West Bank- A bike path should follow Railroad St. to Eagle St. with landscaping suggested along the city-owned stretch of riverbank.
   b. East Bank- Several reported brownfield sites should be reclaimed as riverfront park areas, especially the N/F Calabrese Site at the Mad River confluence. Also the N/F Mancinone site is a reuse possibility. What is the status and reuse potential of the former Mad River Rail Branch Bridge?

7. **Eagle St. – South Leonard St.**
   a. West Bank- Totally Yankee Gas owned as a liquid natural gas storage site and thus a major security issue. Theoretically a riverside trail could be built, if security concerns would permit and if a bank cut routing could be designed around the valves/piping near the southwest corner of the property.
   b. East Bank- Lack of road width along South Main St. limits safe trail use, but several city owned riverbank stretches could be landscaped.

8. **South Leonard St.- Bristol St.**
   a. West Bank- Municipal Rd. offers a trail routing to the upgraded sewer plant which not only has cleansed the river dramatically, but also offers a landscaped riverside stretch to the Rte. 8 Bridge. Further investigation is needed to determine the feasibility of a foot trail at least around the sewer plant complex and along the river on City and DOT rail right-of-way land to Bristol St. Similarly a potential linkage with DEP's Larkin Bridle Trail should be investigated easterly of Bristol St.

   b. East Bank- Again development and lack of road width on South Main St. limits trail potential, but several extensive city-owned riverside stretches can be landscaped, or maintained as is along Platts Mill Rd. In addition, the N/F Camp tract at South Main St. and Platt's Mill Rd. should be acquired as additional city-owned park.

9. <u>Bristol St.-Naugatuck Town Line</u>

a. <u>West Bank-</u> DOT-owned rail right-of-way, but probably too narrow for a trail.

b. <u>East Bank-</u> Privately owned, but a public fishing access point exists.

In closing, this reviewer hopes that these suggestions will spark further discussion, leading to action.

Planning Considerations

Planning

The Waterbury section of the Naugatuck River Greenway is right at the halfway point of a trail that will extend over 41 miles from Torrington to Derby. The Greenway obtained state recognition in 2001 and is currently listed as being a trail of "Statewide Significance" by DEP's Draft State Recreational Trails Plan. The creation of the Naugatuck River Greenway is a major recommendation of the Central Naugatuck Valley Region's Regional Plan of Conservation and Development. It is also part of the City of Waterbury's new Plan of Conservation and Development. The State Plan of Conservation and Development strongly supports the creation of greenways.

Political Support / Funding

Politicians on the local, state, and federal levels have expressed support for a greenway trail along the Naugatuck River. Mayor Jarjura endorsed it as part of his re-election campaign in 2005. Interest in funding the trail has been expressed by state legislators and members of the region's Congressional delegation. Funding for this trail will most likely be received though the Federal Surface Transportation Enhancement Program (STP-Enhancement). The National Recreational Trails Program, administered by DEP for the Federal Highway Administration, could fund small construction of incremental portions of the Naugatuck River Greenway.

Land Use

The City of Waterbury contained the longest industrialized stretch of the Naugatuck River. The river was long exploited for industry through damming and dumping. Some functioning industrial uses are still located alongside the river, although these industries are no longer directly discharging untreated effluent into the river. The dams that once blocked the river in Waterbury have been breached. Several industrial owners have expressed willingness to provide easements alongside the eastern bank of the Naugatuck River for a pedestrian trail. Route 8 runs along the western bank of the river. The highway generally prevents public access to the western bank of the river. Creating a recreational amenity adjacent to unused industrial / brownfield sites may encourage their redevelopment.

Transportation

The Waterbury portion of a Naugatuck River Greenway would be easily accessible to people within the city, region and state. The halfway point of the greenway trail is at the interchange of Interstate 84 and Route 8. These two major expressways would facilitate access to a greenway from across the state. The design for the upgrade of the Interstate 84 / Route 8 interchange will include the construction of a portion of the greenway trail. The Waterbury portion of a Naugatuck River Greenway is within a half mile of 41,000 people. The Waterbury Metro North station is only a quarter of a mile from the proposed route of the greenway on the eastern bank of the Naugatuck River. This proximity could promote use of the Greenway trail by day trippers from New York. Currently the MTA promotes bicycling excursions on the Harlem Valley Rail Trail located in Wassaic, NY located at the end of the Harlem River Metro North line. The travel time to this station is approximately the same as a trip to Waterbury from Grand Central Station.

Project Progress Outside Waterbury

Only two small parts of a future Naugatuck River Greenway have been built in the Central Naugatuck Valley Region. In Naugatuck a short walking path has be built along the river at Linden Park. In Beacon Falls two riverfront parks connected by a sidewalk have been built. Both towns have plans in the works for expanded downtown riverwalks which will be incorporated into a future greenway. The Borough of Naugatuck has secured STP-Enhancement funding for its riverwalk and has scheduled construction. The City of Derby in the Lower Naugatuck Valley has begun building a trail along the Naugatuck River. This trail has experienced heavy use despite the fact that it has yet to be completed. In the Litchfield Hills region two ERTs have been conducted to help assess the feasibility and routing of a Greenway Trail from Torrington to the Thomaston Dam.

About the Team

The King's Mark Environmental Review Team (ERT) is a group of environmental professionals drawn together from a variety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, soil scientists, foresters, climatologists and landscape architects, recreational specialists, engineers and planners. The ERT operates with state funding under the aegis of the King's Mark Resource Conservation and Development (RC&D) Area - an 83 town area serving western Connecticut.

As a public service activity, the Team is available to serve towns within the King's Mark RC&D Area - *free of charge.*

Purpose of the Environmental Review Team

The Environmental Review Team is available to assist towns in the review of sites proposed for major land use activities or natural resource inventories for critical areas. For example, the ERT has been involved in the review of a wide range of significant land use activities including subdivisions, sanitary landfills, commercial and industrial developments and recreation/open space projects.

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 site and highlighting opportunities and limitations for the proposed land use.

Requesting an Environmental Review

Environmental reviews may be requested by the chief elected official of a municipality or the chairman of an administrative agency such as planning and zoning, conservation or inland wetlands. Environmental Review Request Forms are available at your local Conservation District and through the King's Mark ERT Coordinator. This request form must include a summary of the proposed project, a location map of the project site, written permission from the landowner / developer allowing the Team to enter the property for the purposes of a review and a statement identifying the specific areas of concern the Team members should investigate. When this request is reviewed by the local Conservation District and approved by the King's Mark RC&D Executive Council, the Team will undertake the review. At present, the ERT can undertake approximately two reviews per month depending on scheduling and Team member availability.

For additional information regarding the Environmental Review Team, please contact the King's Mark ERT Coordinator, Connecticut Environmental Review Team, P.O. Box 70, Haddam, CT 06438. The telephone number is 860-345-3977.