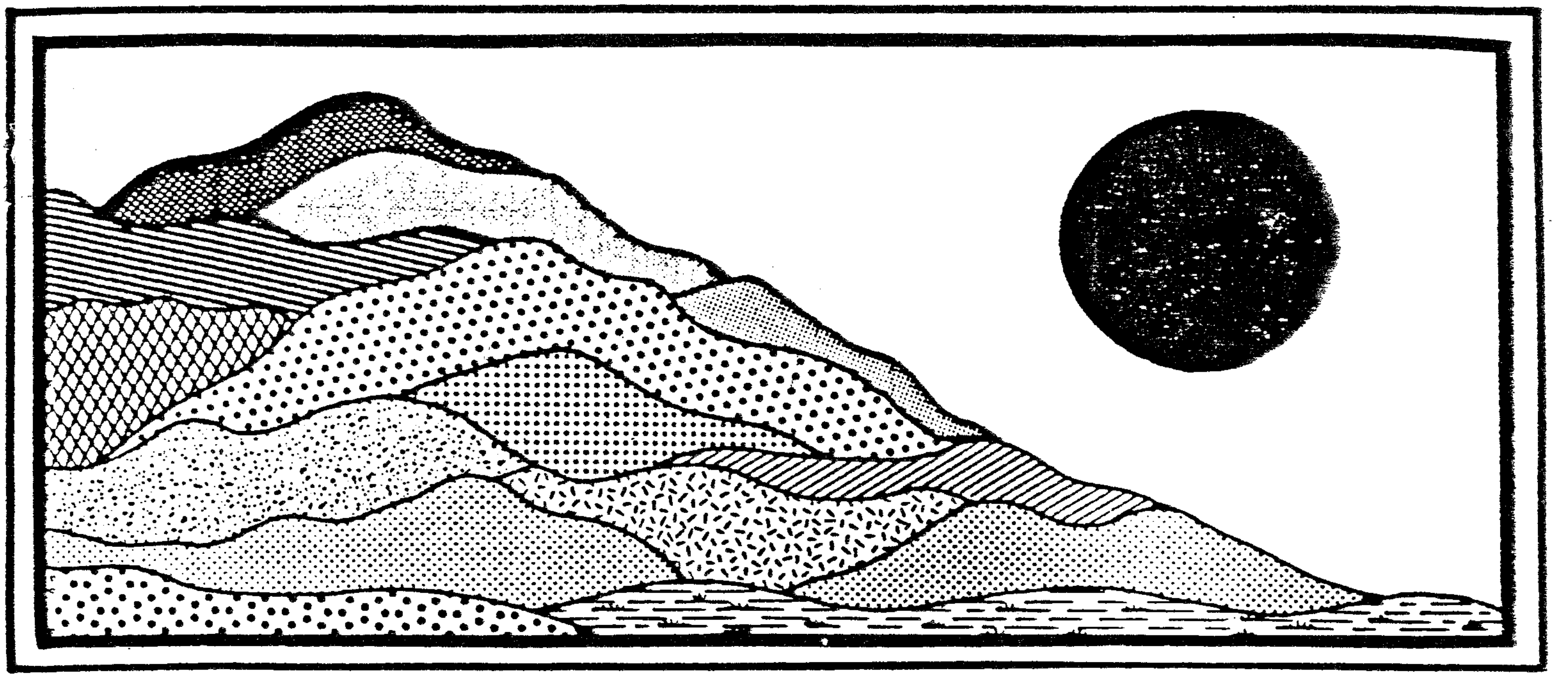
Fisher Meadows

Avon, Connecticut

October 1986



ENVIRONMENTAL

REVIEW TEAM

REPORT

EASTERN CONNECTICUT RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

Fisher Meadows

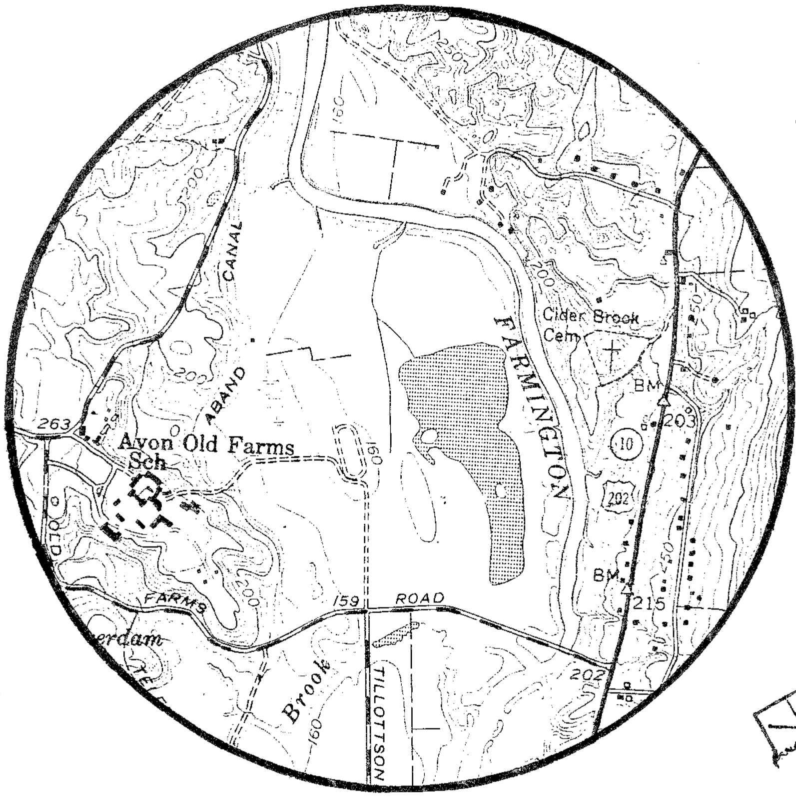
Avon, Connecticut

Review Date: JUNE 26, 1986

Report Date: OCTOBER 1986

RC&D

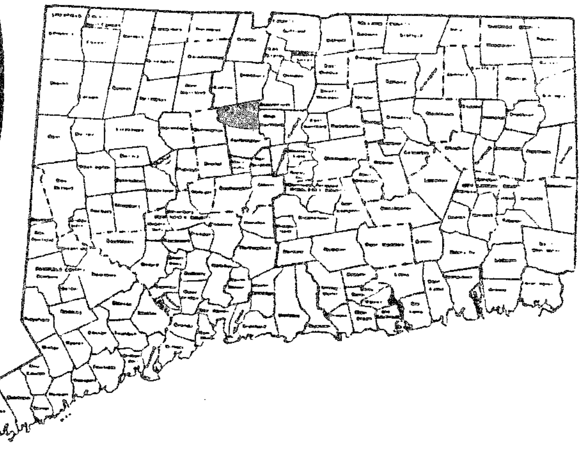
ENVIRONMENTAL REVIEW TEAM
PO BOX 198
BROOKLYN, CONNECTICUT 06234

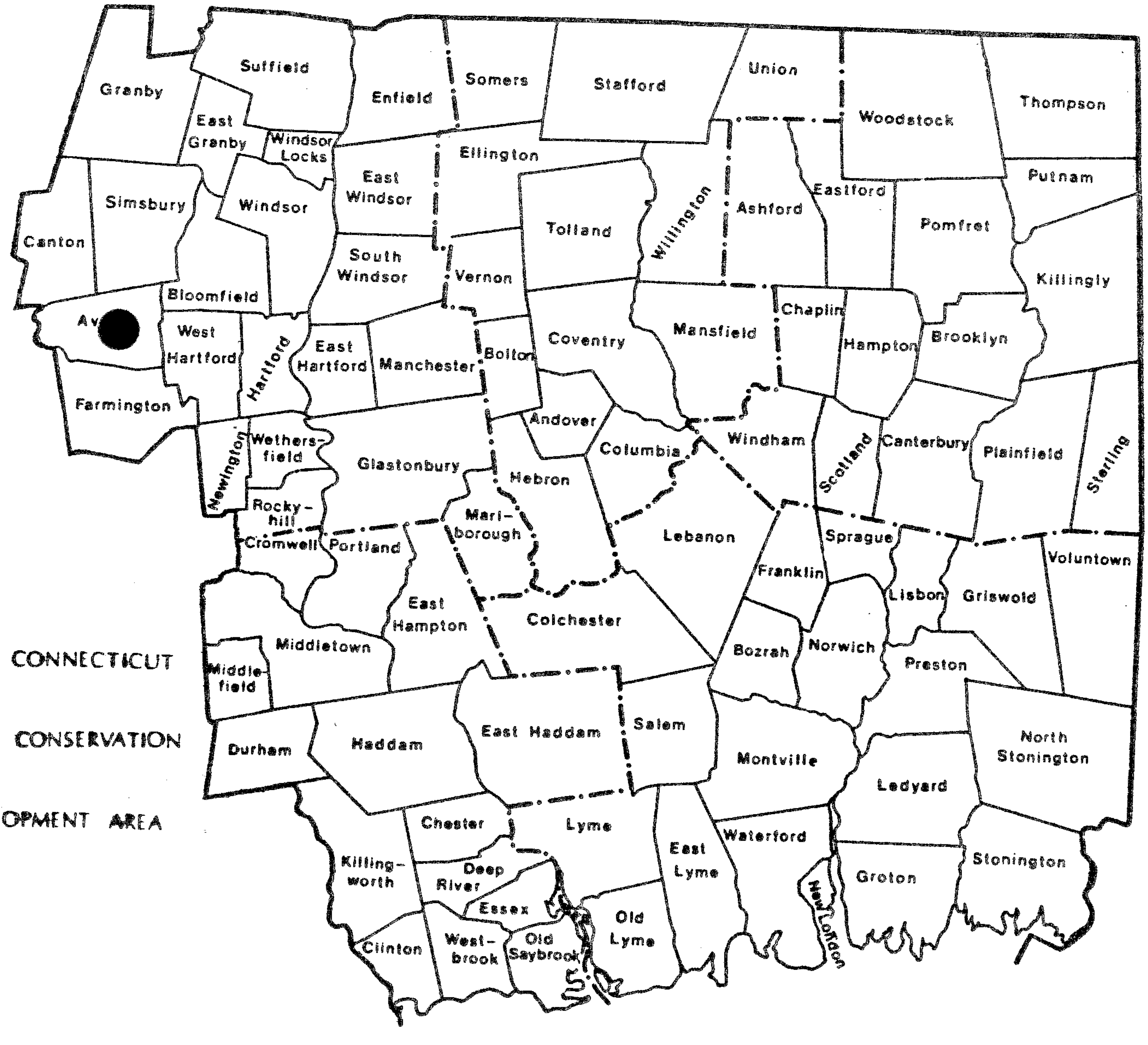


Site Location

FISHER MEADOWS

AVON, CONNECTICUT





EASTERN CONNECTICUT

RESOURCE CONSERVATION

& DEVELOPMENT AREA

ENVIRONMENTAL REVIEW TEAM REPORT ON FISHER MEADOWS RECREATION AREA

AVON, CONNECTICUT

This report is an outgrowth of a request from Avon Natural Resources Commission to the Hartford County Soil and Water Conservation District (S&WCD). The S&WCD referred this request to the Eastern Connecticut Resource Conservation and Development (RC&D) Area Executive Committee for their consideration and approval. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The ERT met and field checked the site on June 26, 1986, Thursday. Team members participating on this review included:

Tim Barry	--Fisheries Biologist - Department of Environmental Protection
Doug Cooper	--Principal Environmental Analyst - DEP, Water Resources Unit
Joe Hickey	--State Park Planner - DEP, Parks and Recreation
Kip Kolesinkas	--Soil Resource Specialist - U.S.D.A., Soil Conservation Service
Ken Metzler	--Senior Biologist - DEP, Natural Resources Center
Paul Rothbart	--Wildlife Biologist - Department of Environmental Protection
Larry Rousseau	--Forester - Department of Environmental Protection
Elaine Sych	--ERT Coordinator - Eastern Connecticut R C & D Area
Bill Warzecha	--Geologist - DEP, Natural Resources Center
Mike Wosniak	--Community Development Planner - Capitol Region Council of Governments

Prior to the review day, each Team member received a summary of the proposed project, a list of the Town's concerns, topography maps of the site and soils information. During the field review the Team members were given further information and maps. The Team met with, and were accompanied by the Town Planner, Recreation Planner, Town Manager and Town Engineer. 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 designs or detailed solutions to development problems. The Team does not recommend what final action should be taken on a proposed project -- all final decisions and conclusions rest with the Town and landowner. This report identifies the existing resource base and evaluates its significance to the proposed development, and also suggests considerations that should be of concern to the developer and the Town. The results of this Team action are oriented toward the development of better environmental quality and the long-term economics of land use.

The Eastern Connecticut R C & D Executive Committee hopes you will find this report of value and assistance in making your decisions on this Town owned recreation area.

If you require any additional information, please contact:

Elaine A. Sych
ERT Coordinator
Eastern Connectiuct R C & D Area
P. O. Box 198
Brooklyn, CT 06234
(203) 774-1253

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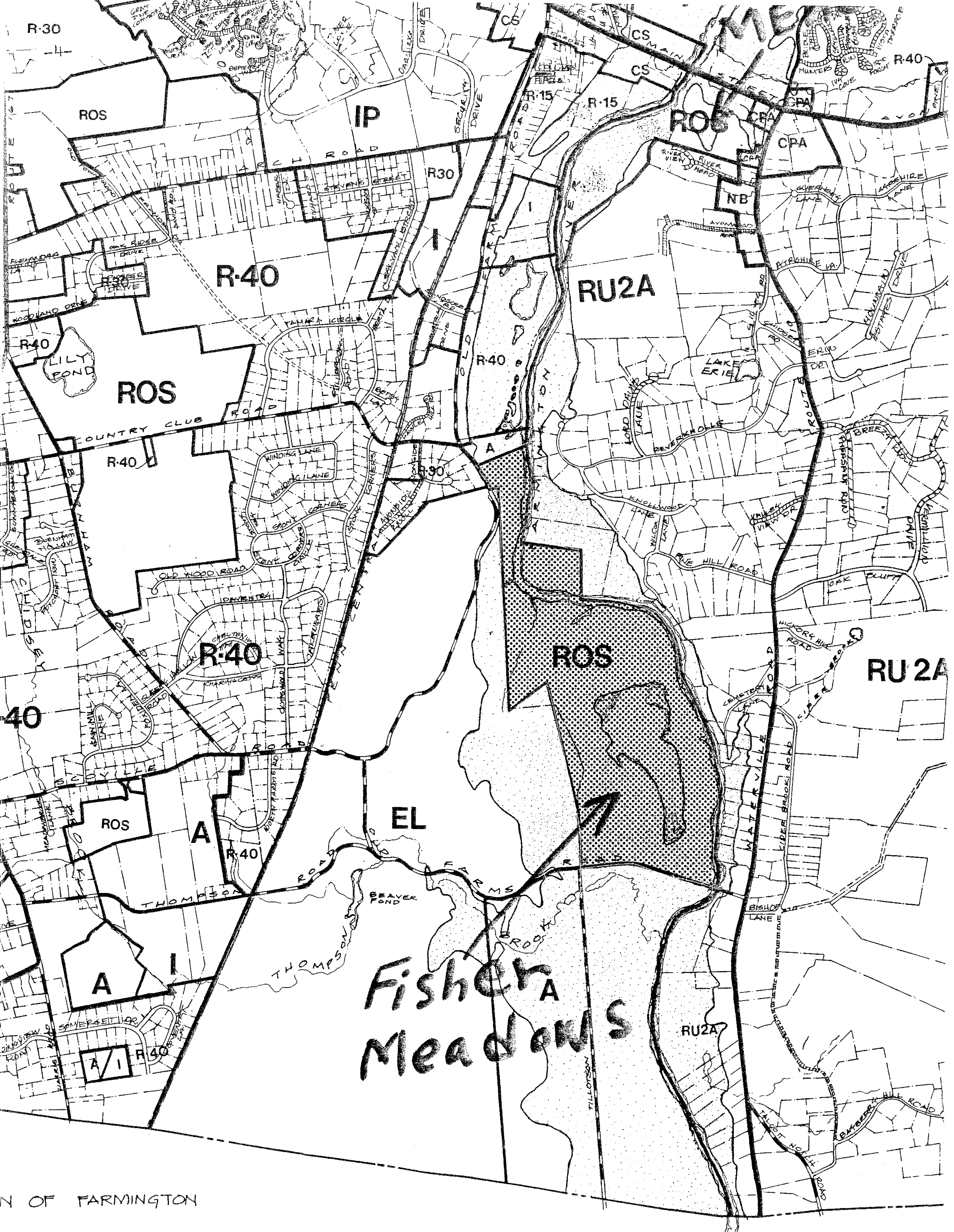
-4-
R-30
ROS
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CS
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R-15
ROS
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CPA
CPA
NB
R-40
R30
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RU2A
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ROS
LILY POND
R-40
A
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ROS
RU 2A
R-40
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EL
ROS
A
R-40
A
I
A/I
R-40
A
RU2A
ARCH ROAD
COUNTRY CLUB ROAD
MAIN STREET
OLD FARMS ROAD
THOMPSON ROAD
THOMPSON BROOK
BEAVER POND
TILLOTSON
WATERVILLE ROAD
ROUTE 10
BISHOP LANE
TALCOTT NOTCH ROAD
BARBERRY HILL ROAD
HICKORY HILL ROAD
PINE HILL ROAD
KNOLLWOOD LANE
BEVERLY KNOLLS
LAKE ERIE
WINDING LANE
STONY CORNERS
OLD WOOD ROAD
TAMARA CIRCLE
WOODLAND DRIVE
Fisher Meadows
N OF FARMINGTON

1. INTRODUCTION

The Eastern Connecticut Environmental Review Team was asked to prepare a natural resource inventory and evaluation of the Fisher Meadows Recreation Area in the Town of Avon.

The Town Manager and the Natural Resources Commission feel that this piece of town owned land offers a unique natural resource for the Town. Specifically, they are looking for information so that they can properly access and preserve it's value in the Town's open space/recreation network. The following sections identify the natural resource base of the site, provide management techniques and recommendations, and attempts to assess the parcel's recreational role for the town. A brief summary highlights the major concerns and recommendations.

2. TOPOGRAPHY AND SETTING

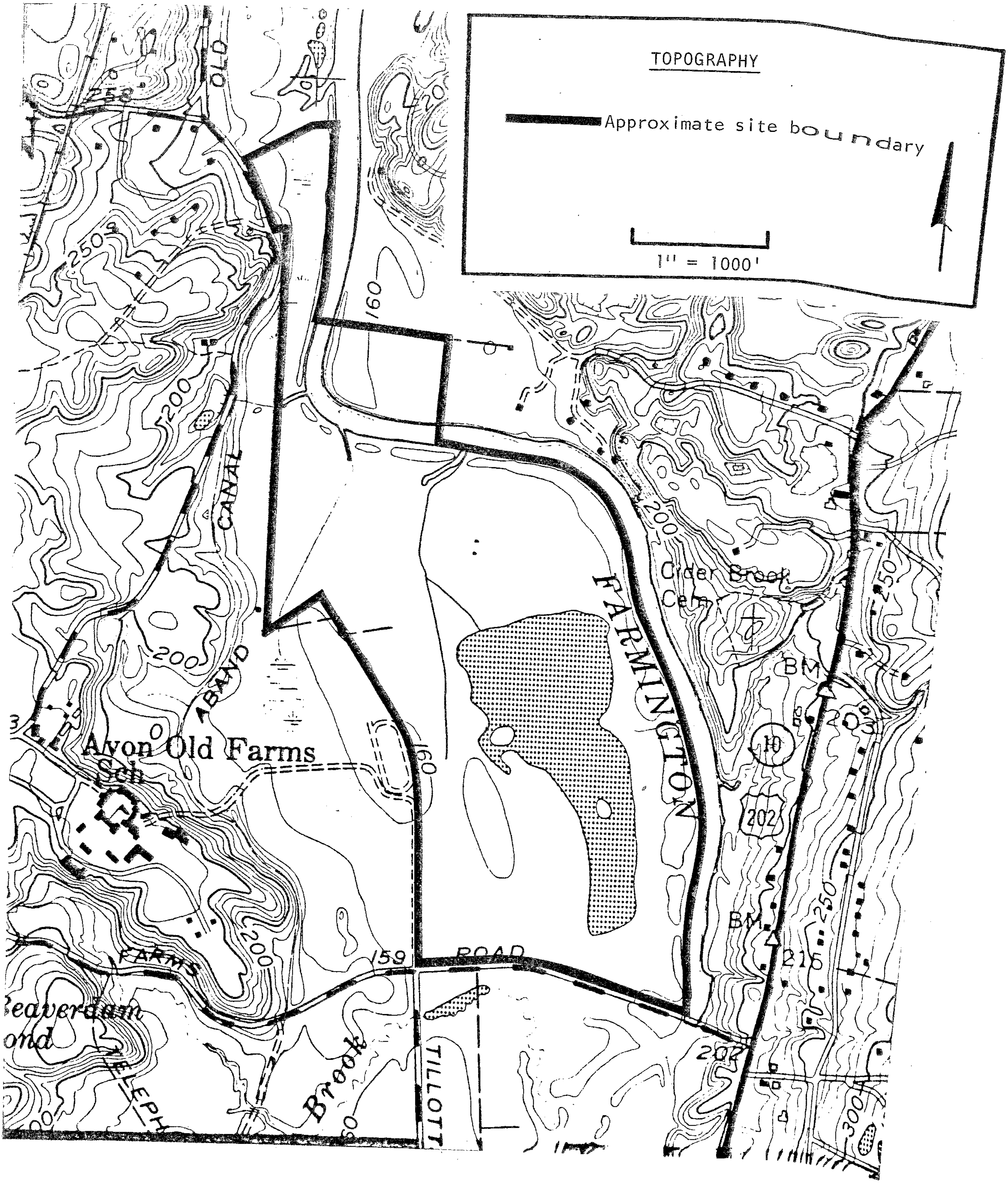
The Fisher Meadows parcel is about +265 acres in size and is located in the eastcentral part of Avon astride the Farmington River. Except for +15 acres on the eastside of the Farmington River, most of the parcel is located on the westside of the River. It is low-lying, mostly flat floodplain, where no development, other than passive and active recreational uses and agricultural uses have taken place. The land presently consists of active playing fields, i.e., soccer, softball, etc., a +30 acre man-made surface water body, open meadows, forest, an active turf farm and a few open watercourses. The +30 acre surface water body on the Fisher Meadows Property was created as a result of mining sand and gravel beneath the water table in the area. The mined material was used as a source of aggregate for construction purposes according to the local officials.

Access to the site is available from the north and south via Old Farms Road. The small piece of the parcel on the eastside of the river is accessible by Pine Hill Road.

3. GEOLOGY

Fisher Meadows is located entirely within the Avon topographic quadrangle. A surficial geologic map (Map GQ-147) and a bedrock geologic map (Map GQ-134) by R. W. Schnabel have been published for the quadrangle by the U. S. Geological Survey.

Except for a small area in the northern parts of the parcel along Old Farm Road, Fisher Meadows is covered by a material transported and deposited by the Farmington River during the last 10,000 years. This water deposited material is called alluvium. "Alluvium" deposited on the Fisher Meadows parcel consists of stratified sand, silt and gravels mixed with abundant organic debris in the upper few feet. The sand, silt and gravel were derived from older


TOPOGRAPHY
Approximate site boundary
1" = 1000'
OLD
250
200
CANAL
ABAND
Avon Old Farms
Sch
FARMS
ROAD
159
160
Beaverdam
Pond
Brook
TILLOTT
FARMINGTON
Order Brook
Cem
BM
203
10
202
BM
215
250
300

unconsolidated material deposited by glacier ice, which formerly covered Connecticut. These deposits typically have a brown or gray color to them which may be attributed to the abundant organic material present in the deposit. "Alluvium" is deposited mainly during flood stages, when the Farmington River breaks out of its channel. A well-developed terrace, whose surface elevation is about 160 feet above mean sea level, rises from the modern alluvial deposits mentioned earlier, to the eastern limits of the small piece of Fisher Meadows on the eastside of the Farmington River. This deposit which consists of stratified sediment ranging from silt to boulder size with organic material distributed in the upper few feet is separated from the modern alluvial desposits by an escarpment.

A glacial sediment called stratified drift covers a small area on Fisher Meadows along Old Farms Road in the northern parts. This elevated portion of the site is composed of sand, material overlain by sand and gravel. As mentioned earlier, stratified drift is a glacial sediment that was formed by the transportation and deposition of glacial rock debris by meltwater flowing from stagnant ice. The organic debris found in the alluvial deposits serves to distinguish these deposits from the glacial stratified drift deposits.

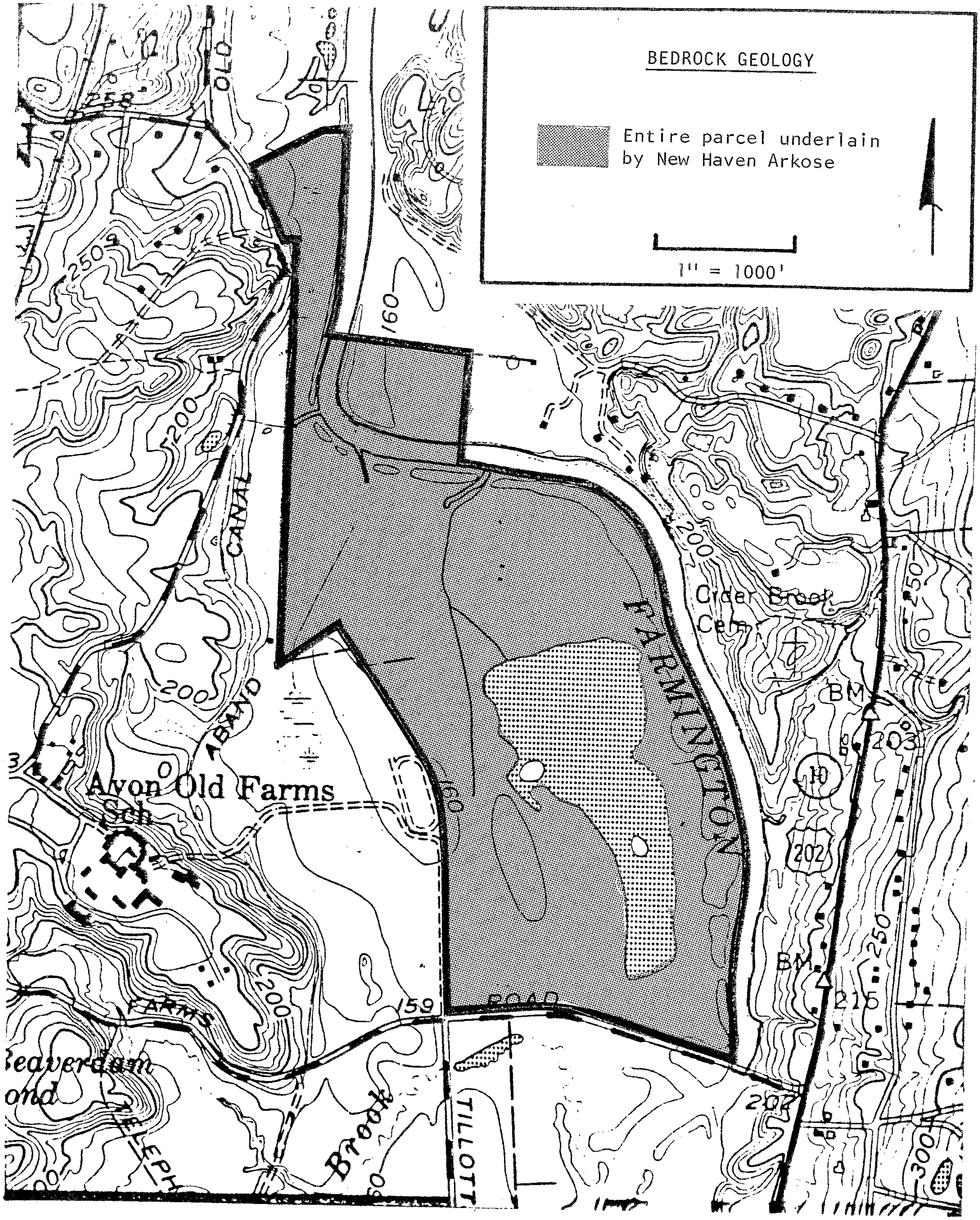
According to Connecticut Water Resources Bulletin Number 28 (Hydrogeologic Data for the Farmington River Basin), the thickness of unconsolidated materials covering Fisher Meadows ranges between 35 feet and 129 feet thick.

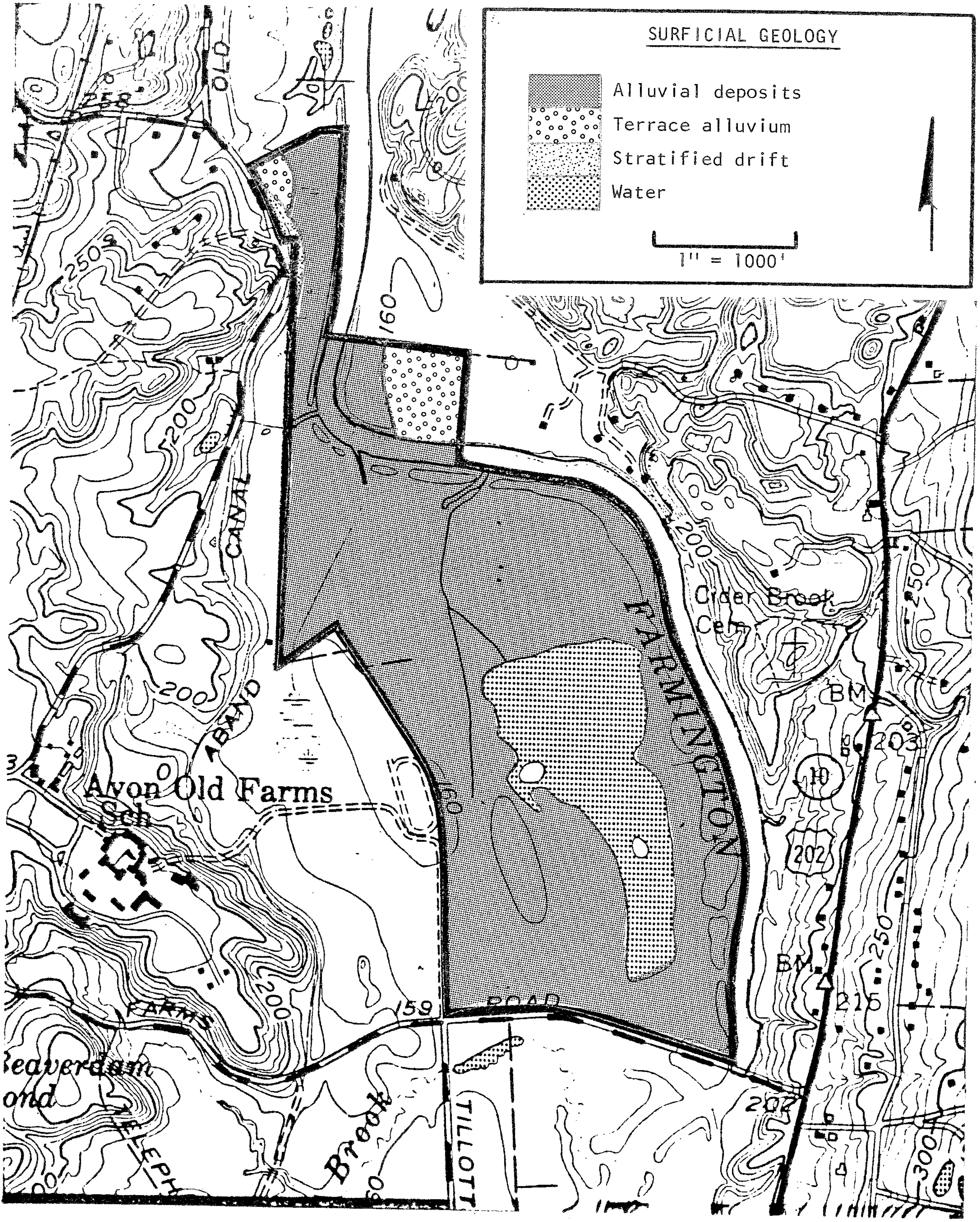
The greatest limitation of the alluvial soils, which comprise the bulk of the parcel, is that they are subject to inundation during flooding events.

Bedrock does not outcrop on the parcel. Schnabel identifies the bedrock underlying the parcel as part of the New Haven arkose. This unit consists of light to dark red arkose and arkosic siltstone. The term "arkose" refers to a medium to coarse grained, sandstone-like rock, which contains a high percentage of the minerals feldspar and quartz. It also contains rock fragments. The rock is locally known as brownstone. Brownstone was quarried for use as building stone.

These sedimentary rocks were deposited during the middle to late Triassic geologic period, approximately two hundred million years old. Sedimentary rocks are rocks formed by the deposition and cementation of eroded material derived from either igneous (formed from molten magma), metamorphic rocks (rocks altered by great heat and pressure within the earth's crust) or other sedimentary rocks.

The layering in the rock unit dips gently to the east. Because the surface of the bedrock is deep, it should not pose any problems, in terms of active or passive recreational uses on Fisher Meadows.


BEDROCK GEOLOGY
▨ Entire parcel underlain by New Haven Arkose
1" = 1000'
OLD
250
200
160
CANAL
ABAND
Avon Old Farms Sch
FARMS
ROAD
159
Beaverdam Pond
Brook
TILLOTT
FARMINGTON
Cider Brook Cem
BM
203
10
202
215
250
300


SURFICIAL GEOLOGY
Alluvial deposits
Terrace alluvium
Stratified drift
Water
1" = 1000'
OLD
250
200
160
CANAL
ABAND
Avon Old Farms Sch
FARMS
ROAD
159
Beaverdam Pond
Brook
TILLOTT
FARMINGTON
Cider Brook Cem
200
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202
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4. HYDROLOGY

Fisher Meadows lies entirely within the watershed of the Farmington River. The River originates in Massachusetts and empties into the Connecticut River in Windsor. The Farmington River drains a total of 601 square miles or about 385,000 acres from its point of origin in Massachusetts to its point of outflow into the Connecticut River at Windsor. Because of the sandy nature of the overburden on the parcel, most of the rainfall is absorbed into the ground rather than passing overland via streamcourses. It seems likely that groundwater movement on the site is towards the Farmington River.

According to the proposed water quality classifications for the Connecticut River Basin, which includes the Farmington (January 1, 1986), groundwater for most of the parcel is classified by the Department of Environmental Protection as GA. A GA classification means that the water is suitable for private drinking water supplies without treatment. It should be pointed out that groundwater in a small area between the northcentral part of the lake and the western property boundary is classified GAA, which means that it is an existing or proposed public drinking water supply use without treatment. It appears that this classification reflects the water quality of a well which serves Avon's Old Farms School.

Surface waters are also classified by DEP in the publication mentioned above. The section of the Farmington River which flows through the Fisher Meadows site is classified as B_{bc}. A "B" classification means that the surface water may be suitable for some recreational purposes (not bathing), agricultural uses, certain industrial processes and cooling; excellent fish and wildlife habitat; good aesthetic value. The subscript beneath the letter "B" means that bathing is not acceptable, probably due to a sewer outfall along the upstream parts of the river. The subscript "c" means that the water body can support cold water fisheries such as trout. The surface water classification described to the surface water body on the parcel is "A" which means that it may be suitable for drinking water supply and/or bathing; suitable for all other water uses; character uniformly excellent; may be subject to absolute restrictions on the discharge of pollutants.

The Federal Emergency Management Agency has issued a Flood Boundary and Floodway Maps for the Town of Avon. According to the map, nearly all of Fisher Meadows lies within the floodway fringe. The "floodway" is defined as the area of land bordering a river or other watercourse that must be kept free of encroachment in order to assume that the 100-year flood levels would not be raised significantly (more than a foot). The 100-year flood is a flood with a one chance in 100 or 1% chance of occurring during any given year. It should be pointed out that a flood of this magnitude will occur only one time in 100 years, but, that the probability of occurrence remains the same each year, regardless of what happened the year before. The drier land on the parcel composed of stratified drift and terrace alluvium in northern parts of Fisher Meadows lies within the 100-year flood boundary.

Based on a map entitled Groundwater Availability in Connecticut (Meade, 1970), it appears that the unconsolidated materials in Fisher Meadows have varying potential for use as a groundwater supply source. The potential of any particular location depends upon the texture and thickness of the deposits at that location, the proximity to streams and the size of those streams, and other factors. According to Meade's map, coarse-grained material found in the southern parts along Farmington River have the greatest potential. These types of deposits are known or inferred to be capable of yielding moderate to very large amounts of water (50-2,000 gallons per minute). The unconsolidated materials which cover the remaining parts of this parcel consist largely of fine-grained stratified drift, a difficult material in which to finish wells and a relatively slow permeable medium. According to Meade's map, these deposits are known or inferred to be capable of yielding small to large amounts of water (1-500 gallons per minute). In order to determine the exact potential of the unconsolidated materials on the property, hydrogeologic testing, which includes drilling a well(s) would be required in order to obtain a firmer estimate of the sites water-supply potential.

5. WETLAND SETTING AND MANAGEMENT

Wetland Setting:

The Fisher Meadows property consists of predominantly well drained flood plain soils; virtually the entire site falls into regulated wetland soils. For purposes of this section, the discussion will be confined to the poorly drained areas, watercourses and the lake.

1. There exists on the site a drainage way approximately 2,500 feet long which was mostly likely artificially excavated as part of previous agricultural or gravel mining operations on the parcel. This ditch carries sluggish flow owing to the relative levelness of the entire property. During times of high river flow, floodwaters will "back up" into this area. The margins of the ditch are densely vegetated with wetland and upland shrubs providing excellent shelter and food for birdlife, small mammals and amphibians.

2. The Farmington River borders the eastern portion of the site. The river flow in this area is relatively slow due to the level character of this reach of the river and its floodplain. The riverbanks are well wooded with a dense understory of shrubs and succulent seasonal vegetation. The riverbank tends to be very steep (nearly vertical) along most of the Fisher Meadows property inhibiting access to and from the river.

3. The approximately 30 ± acre lake dominates the eastern central portion of the site. The lake was formed by major gravel excavation which has taken place during the past fifteen (15) to twenty (20) years. The lake water quality appeared excellent during the June 26, 1986 site inspection. Water clarity was good, no noticeable algae blooms or weed problems ere in evidence. The lake banks are lightly vegetated primarily by grasses, light brush and saplings. The entire perimeter of the lake is accessible by virture of a well developed walking tail. A washout of the outlet stream to the Farmington River has recently occurred as a result of flood water movements which probably created a hydraulic gradient across the pathway which could not be adequately equalized by the existing culvert.

4. Three (3) outlying poorly drained pockets exist north of the lake. These areas appear as dense brushy or wooded areas isolated by the open cultivated grasslands. These areas lend diversity to the site and provide refuge areas for wildlife including deer, small mammals and bird life.

Management Suggestions:

1. The drainage way needs no management. It's existing condition provides good shelter and food stock for the local wildlife populations.

2. The steepness of the Farmington River banks make access to and from the river difficult. Selected locations may be carefully cleared of undergrowth and some minor regarding of one of the less steep riverbank areas may be beneficial for canoeists and fishermen. Such an access point should be carefully selected to minimize the grading work necessary to provide a stable access way to the water.

3. Based upon casual observations, there are no immediate needs for management efforts to improve habitat or water quality in the lake. Development of a bathing area may be desired by the town in the future. Prior to doing such, a limnologist should study the lake characteristics to predict water quality conditions and forecast any potential problems which may result from swimmer use. The outlet stream culvert needs repair. The redesign of this area should probably allow overtopping sooner during storm events, thereby lessening the waterflow velocities over this area.

4. Other small poorly drained portions of the Fisher Meadows site are presently in good condition; no management is considered necessary at this time. By keeping the open field areas regularly mowed (i.e.: on a yearly basis) the value of the wooded and shrub areas is enhanced from a habitat standpoint.

Conclusion:

By and large, the on-site wetlands need little remedial work or management. Repair of the washout at the lake outlet is the most significant and urgent. Existing management practices (tillage of rye fields, roadway maintenance) are consistent with good land use principles and should be continued. Improved access to the river and potential bathing beach creation at the lake should be carefully studied and designed to avoid unnecessary environmental degradation.

6. SOIL RESOURCES AND FUTURE LAND USE

Soil Resources:

The soils on the site were evaluated by a variety of methods. Since a portion of the site had been modified by the cutting and tilling associated with the development of the recreational fields, and the excavation of the pond, additional soils information was needed. A large portion of the parcel was evaluated with spade and auger, other portions were evaluated by air photo interpretation and the use of the Soil Survey of Hartford County, 1962.

The soils on the parcel have dominately formed in floodplain sediments on various terrace levels of the Farmington River; a small area of glacial outwash soils are located on the north end of the site. A soil map at a scale of approximately one (1) inch equals 1,000 feet has been included to show the location of the soil map units. Because of the number of soils present on the parcel, basic information about soil properties and interpretations is included in chart form.

Future Land Use:

Future land use of the parcel will remain as recreational (passive and active) and agricultural. Most of the soils on the parcel are floodplain soils, any investment in future recreational facilities should consider the costs associated with flooding and flood damage. About 38 acres of land is currently used for agricultural production on the western side of the river, about 12 acres are used on the eastern side. The quality of the various soils for agricultural production is listed by Farmland Importance in the enclosed chart. The soils with the highest potential for crop production are map units Ha, Oc, 10c, and Po. Other soils have some limitations for crops. The small field in the northern end of the property contains high quality soils, but is of small size and is not currently used for agriculture.

It is important that the site's agricultural potential and the loss of prime farmland soils be considered if the future expansion of recreational facilities should take place.

In walking the parcel, two (2) areas were found where erosion problems exist. The first area consists of bank erosion on the western shore of the pond, the location identified on the soil map by a "1e" symbol. In this area concentrated runoff from the nearby road has eroded the bank. A possible solution would be to stabilize this portion of the shoreline with flood tolerant plants such as "Streamco Willow" or a grass mixture. The more stable areas of shoreline with gravelly textured soils are less erosive and could be left open for recreational access to the pond. The other area of concern is the outlet channel of the pond, identified on the soil map by a "2e" symbol. This area consists of eroded, sloughed banks and an existing four (4) foot concrete pipe. To prevent the further erosion and scouring of this channel by retreating floodwaters and human activity, a properly sized culvert and crossing or a riprapped channel with a bridge crossing should be constructed.

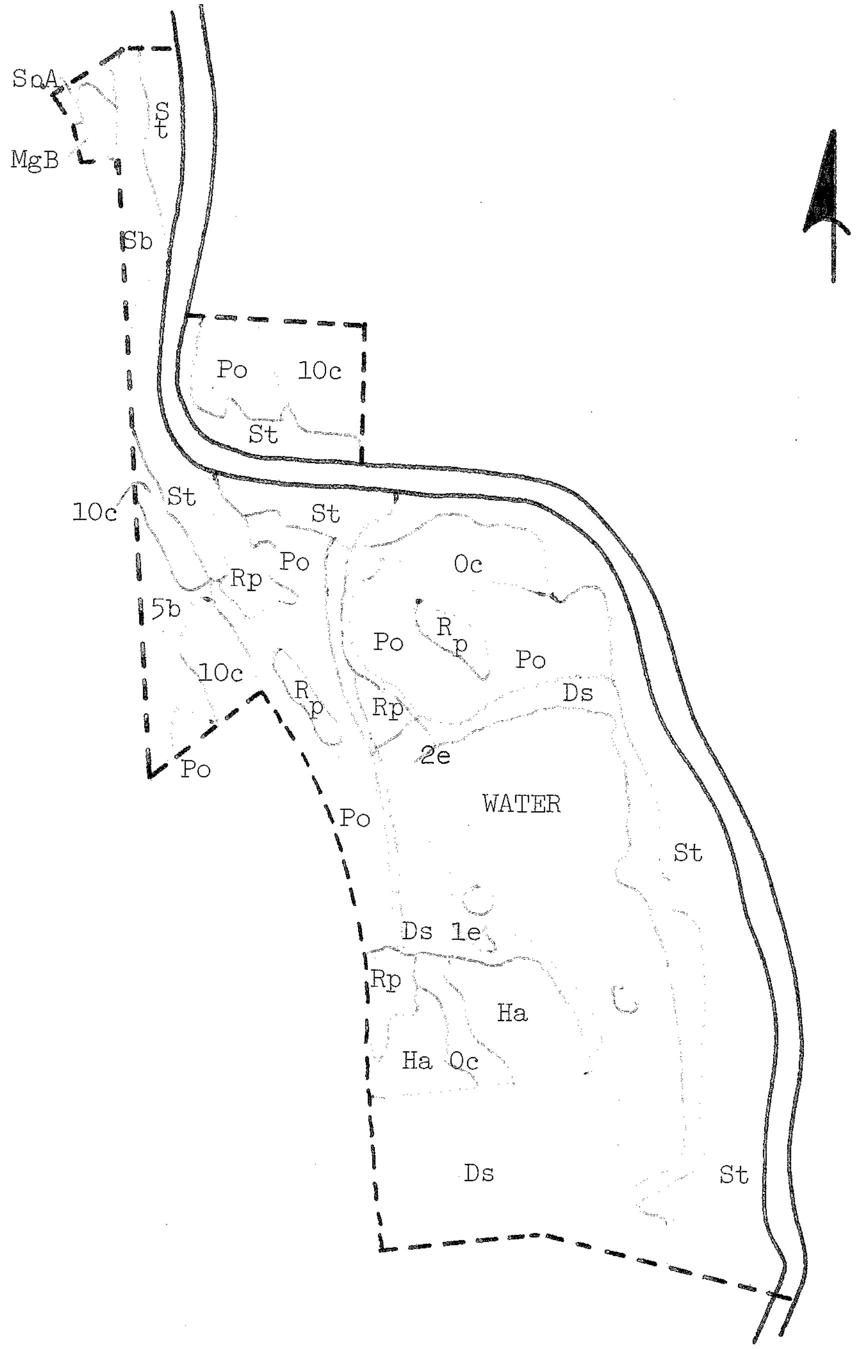
Some concern was expressed by the Town on any negative effects that "turf farming" may have on the parcel located east of the Farmington River. Fortunately floodplain soils have some capacity to "regenerate" themselves through the deposition of sediments during flood events. The accumulation of soil materials would offset any loss from turf harvesting on many of these soils. Proper turf farming methods and management should also minimize losses.

**United States
Department of
Agriculture**

**Soil
Conservation
Service**

Hartford County USDA-SCS
1101 Kennedy Road, Room 105B
Windsor, CT 06095
688-7725

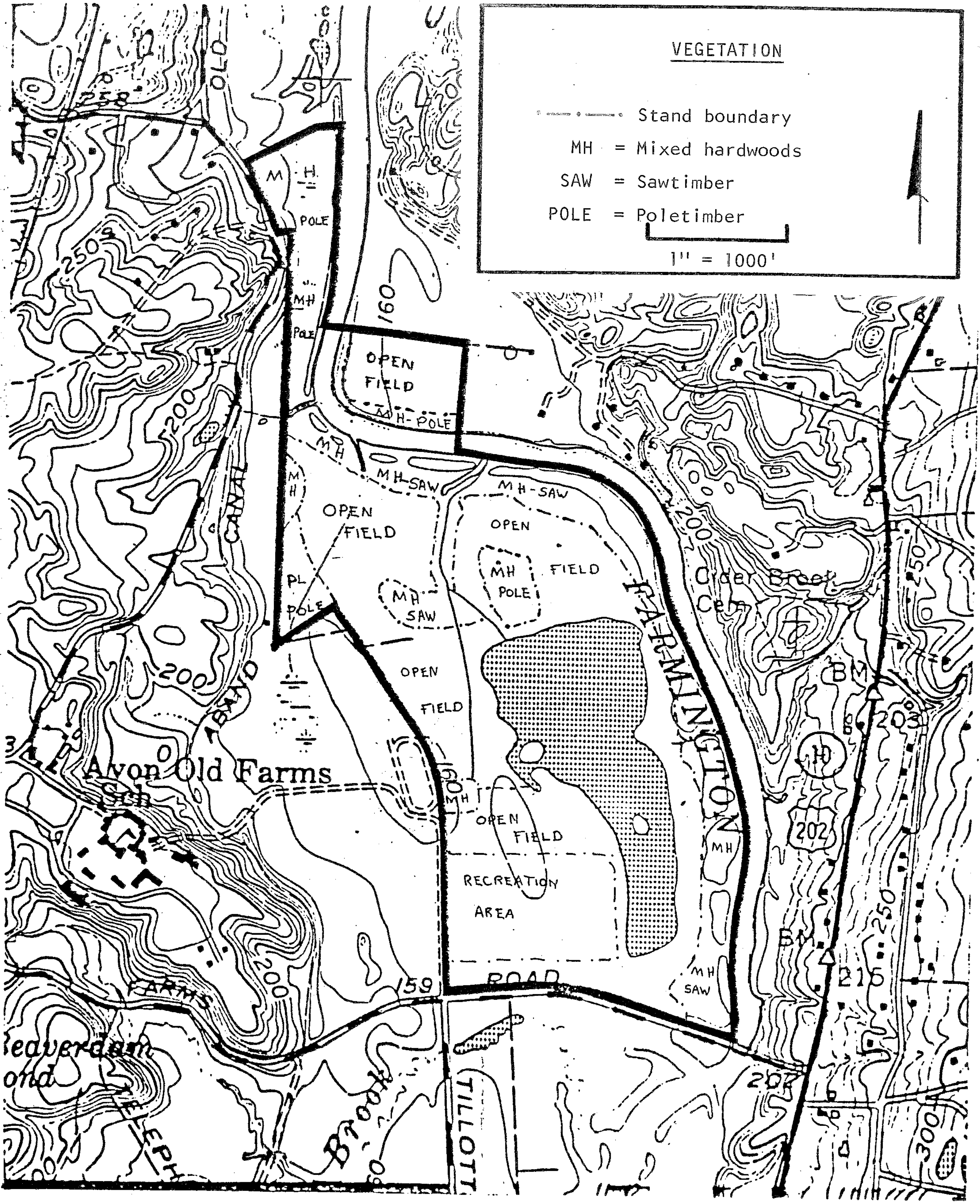
Scale 1" = 1000'



MAP UNIT	GENERAL SOIL PROPERTIES	DRAINAGE CLASS AND DEPTH TO SEASONAL HIGH WATER TABLE	MAJOR LIMITATIONS FOR THE DEVELOPMENT OF PLAYGROUNDS AND PLAYING FIELDS	FARMLAND IMPORTANCE
Ds-Disturbed land	Cut and filled Alluvial soils. Textures are variable from very gravelly sand to silt loam	Variable, dominately well drained to moderately well drained >4 ft to 1.5 ft	Flooding Variable surface texture Droughtyness Small surface stones	Variable
Ha-Hadley silt loam 0-3% slopes	Alluvial soils formed in silty materials	Well drained >3 ft.	Flooding	Prime
MgB-Merrimac fine sandy loam 3-8% slopes	Glacial outwash soils formed in sandy over sand and gravel materials	Somewhat excessively drained >6 ft	Slope Small surface stones	Prime
Oc-Occum fine sandy loam 0-3% slopes	Alluvial soils formed in loamy over sandy and gravelly materials.	Well drained >3 ft	Flooding	Prime
Po-Pootatuck fine sandy	Alluvial soils formed in loamy over sandy and gravelly materials. Contains some areas of disturbed soils	Moderately well drained 1.5-3 ft.	Flooding Seasonal wetness	Prime
Rp-Rippowam sandy loam 0-37% slopes	Alluvial soils formed in loamy over sandy and gravelly materials. Contains some areas of disturbed soils.	Poorly drained 0 - 1.5 ft	Wetness flooding	Statewide Importance
SaA-Sudbury sandy loam, 0-3% slopes	Glacial outwash soils formed in sandy over sand and gravel soils	Moderately well drained 1.5 - 3 ft	Seasonal wetness Small surface stones	Prime
Sb-Saco silt loam, 0-3% slopes	Alluvial soils formed in silty to loamy materials	Very poorly drained 0 - .5 ft	Wetness Flooding	
St-Suncook loamy sand, 0-3% slopes	Alluvial soils formed in sandy materials	Excessively drained > 3 ft	Flooding Droughtiness	Statewide Importance
10c-Occum fine sandy loam, 0-3% slopes, high terrace phase	Alluvial soils formed in loamy over sandy and gravelly material. These soils are on higher terraces of the Farmington River, and are subject to less frequent flooding and flooding of shorter duration.	Well drained > 3 ft	Flooding	Prime

Prime Farmland - Includes those soils best suited for producing food, feed, fiber and forage crops, and the land is also available for these uses.

Farmland of Statewide Importance - Includes those soils, in addition to prime farmland soils, which are of statewide importance for the production of food, feed, fiber, and forage crops. The soils are wetter, have steeper slopes, or are more droughty than prime farmland soils.


VEGETATION
Stand boundary
MH = Mixed hardwoods
SAW = Sawtimber
POLE = Poletimber
1" = 1000'
MH
POLE
MH
POLE
OPEN FIELD
MH-POLE
MH
MH-SAW
MH-SAW
MH
OPEN FIELD
OPEN FIELD
MH POLE
PL POLE
MH SAW
OPEN FIELD
MH
OPEN FIELD
RECREATION AREA
MH
MH SAW
FARMINGTON
CANAL
ABAND
Avon Old Farms Sch
FARMS
ROAD
TILLOTT
Brook
Beaverdam Pond
OLD
Cider Brook Cem
BM
203
10
202
215
250
200
300
258
160
159
208

7. VEGETATION

Fisher Meadows is approximately +265 acres, of which 70 acres is wooded. The remaining acreage is comprised of agricultural land, water recreational fields and parking lots.

The forested portion of the property consist of two (2) broad vegetation cover types. These are a softwood plantation and mixed hardwood. Each cover type is described in detail below.

In a commercial sense, the value of the wood on the property is moderate. The majority of the valuable sawtimber is in the mixed hardwood stands along the Farmington River. Although there is a sufficient number of quality sawtimber-sized trees to make a commercial timber sale economically feasible, such an operation would not be recommended for several reasons. The property's current use as a recreation area and agricultural land would not be compatible to a commercial timber sale. The close proximity of the sawtimber stands to both the pond and the Farmington River would make the threat of possible erosion and sedimentation to great to justify andy economic gains.

The real value of the property's woodland is the aesthetics and the water storage capacity in flooding situations. In addition the woodland provides a renewable resource in the form of wood growth, a diversified wildlife habitat and sites for passive recreation.

Vegetative Type Descriptions:

Softwood Plantation - This six (6) acre stand was apparently an old field that was planted 15-20 years ago, with a mixutre of white pine, larch and white spruce. Other softwood species present are pitch pine and red cedar, which have naturally seeded-in. Hardwood species that have invaded the stand are ash, hickory, red maple, red oak and apple.

Mixed Hardwood - The remainder of the forested area (64 acres) can be lumped into this broad cover type. The hardwood species present are ash, aspen, basswood, beech, black birch, black cherry, cottonwood, elm, hickory, red maple, silver maple, sugar maple, red oak, swamp white oak and sycamore. The softwood species present are hemlock and white pine. The hardwood species are found in all size classes, while the softwood species are most abundant in the sawtimber size class. The understory species most commonly found are barberry, multiflora rose, poison ivy and Virginia creeper.

The mixed hardwood area is broken down into individual stands by the size class and the species composition present. Sawtimber-sized stands of ash, basswood, beech, hickory, sugar maple, red oak, white pine and hemlock were found in the eastern and southeastern sections. Pole-sized stands of ash, aspen, elm, red maple, silver maple and swamp white oak were found in the western and northwestern sections.

Limiting Conditions and Potential Hazards:

This section will address the factors that could limit forest management activities on the property.

The soil types, though well drained, are subject to seasonal flooding which would severly restrict equipment operability and create a high windthrow hazard if openings were made in the stands.

As mentioned previously, the proximity of the sawtimber stands to the major water resources would restrict commercial forestry operations due to the threat of possible erosion and sedimentation damage.

Management Considerations;

Although the mixed hardwood sawtimber stands do have the potential for a commercial timber sale, this is not receommended for the aforementioned reasons.

Forest management activities may be limited to boundary line maintenance and cutting by the Town or the farmer to maintain field edges and access roads. If the Town is willing to invest the manpower, the plantation would benefit from thinning out the softwoods and removing the competing hardwoods.

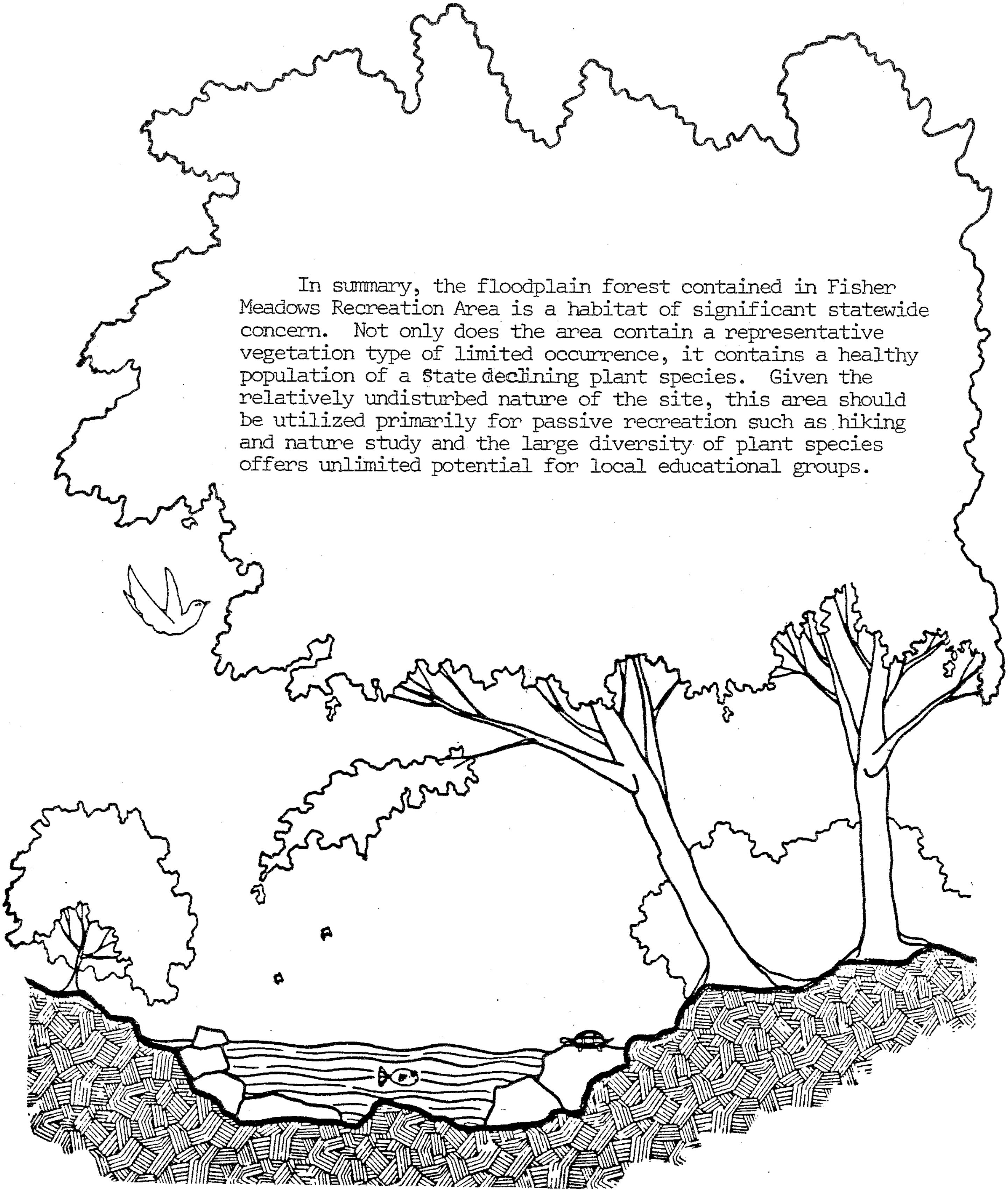
A public service forester or a private consulting forester may be of assistance in the on the ground planning of such an operations.

8. FLOODPLAIN HABITAT

The Fisher Meadows Recreation Area contains a well-developed floodplain forest with a rich diversity of plant species and associated wildlife. The area is somewhat unique since much of the habitat similar to this has been encroached by agricultural useage, gravel quarriers and other forms of clear-cutting. The floodplain forest is very rich in its species assemblage with many spring ephemerals characteristic of rich upland slopes; especially those found in the limestone regions of western Connecticut. This area has been mapped by the Connecticut Natural Diversity Data Base on a good example of a floodplain forest in Connecticut. Similar areas can be found on other parts of the Farmington, the Housatonic, the Quinebaug and the Quinnipiac Rivers. Along the Connecticut River, this habitat has been mostly lost to agriculture; although good examples of low floodplain remain. Enclosed is a copy of a recent paper discussing the relationships between the various floodplain types along the Connecticut River. The high floodplain is discussed on page 359 of the paper.

Fisher Meadows also contains a small, but healthy population of Virginia Waterleaf (Hydrophyllum virginianum L.). This plant occurs in two (2) other locations along the Farmington River and on a few rich lower slopes in western Connecticut. This species is listed by the Connecticut Natural Diversity Data Base as infrequent or declining, with extant populations numbering less than 12.

In summary, the floodplain forest contained in Fisher Meadows Recreation Area is a habitat of significant statewide concern. Not only does the area contain a representative vegetation type of limited occurrence, it contains a healthy population of a State declining plant species. Given the relatively undisturbed nature of the site, this area should be utilized primarily for passive recreation such as hiking and nature study and the large diversity of plant species offers unlimited potential for local educational groups.



16 PLOT SIZE: 20 X 20 m²

	Coll.	CODE #	VEGETATION DESCRIPTION 70	STRATUM 73	Number of spp.
					E = 56
					S = 52
				TOTAL	

PLOT # 19004

DESCRIBED BY:

2

TYPE OF PLOT

3

4 Element

5 Cover element %

	Tree layer 90% 18m
1+	Quercus rubra
+	Prunus serotina
1+	Carya ovata.
2-	Fraxinus cf. americana
[illegible]	Carya cordiformis
1-	Acer saccharinum
1+	Quercus alba
2-	Acer saccharum
+	Carpinus caroliniana
r	Tsuga canadensis
	Shrub layer 15% 2m
1+	Ulmus rubra
1+	Prunus serotina
+	Rhus radicans
+	Vitis labruska ?
1-	Quercus rubra
1-	Acer saccharum
1-	Staphylea trifoliata
1-	Cornus amomum
+	Acer negundo
+	Berberis thunbergii

	Herb layer 85% 25cm
2-1	Dicentra cucullaria
2-2	Claytonia virginica
1+1	Sanguinaria canadensis
2+3	Carex sprengalii
1+2	Carex cf. deweyana
1+1	Viola pubescens.
1p1	Rhus radicans
1-1	Arisaema atrorubens
1-1	Geum canadense
+1	Prunus (s).
1-1	Galium sp.
+1	Solidago sp.
+1	Rubus sp.
+1	Alium sp.
+1	Polygonatum canaliculatum
1-2	Viola sororia
1-1	Lilium canadense
1-1	Parthenocissus quinq
+1	Osmorhiza claytoni
2m1	Erythronium americana
1p1	Impatiens sp (s)
+1	Dentaria laciniata
+1	Athyrium ff.
+1	Cardamine impatiens
+1	Hydrophyllum virginianum
1-3	Asarum canadense
1-3	Veratrum viride
+1	Laportea canadensis
1-1	Viola papilionacea
1-1	Tovara virginiana
1-1	Aster sp
+1	Thalictrum polygonum
+1	Polygonum convolvulus cf
+2	Onoclea sensibilis
+1	Ranunculus abortivus

Moss layer <1%

Atrichum undulatum

VEGETATION AND HABITAT - SHORT

AD '77

Checked by:

PLOT # 79004

1

DESCRIBED BY:

2

TYPE OF PLOT

3

TOWN Farmington

LOCATION Old Farms Rd

6 N of intersection

MAP NAME

7 Tariffville

MAP #

8

MAP SCALE

9

AIR PHOTOGR. #

14

SCALE

15

DATE year / month / day

10 79 5 7

SLOPE %

18

SLOPE ASPECT

19

SLOPE SHAPE

20

SLOPE POSITION

21

TOPOGRAPHIC POSITION

22

TOPOGRAPHY

→ 70° E

↓

Farm R.

17

LAT.

11

LONG.

12

ALTITUDE

13

M.R.

27 2-3

EXPOSURE

40

R#

PHYSIOGNOMY

47

VEGETATION STRUCTURE

46

SOIL TYPE / SUB-GROUP

63 Suncook ?

SURFICIAL DEPOSIT

32

DEPTH DEPOSIT

33

AVERAGE TEXT.

fisal.

ORIGIN

53

CHRONOSEQUENCE

58

REMARKS

Parmelia rudecta rare

71 Corticolous lichens:

STRATUM					
COVER %					
HEIGHT 70					

PRELIMINARY VEGETATION TYPE

65

VEGETATION TYPE

66

SOIL PROFILE DESCRIPTION:

Suncook

uniform lt. brown

fisalo

ROOT PENETRATION

61

81 WATER TABLE

DEPTH

TYPE

74-80

Naturaliste can. (Rev. Écol. Syst.), 112: 535-547 (1985).

VEGETATION PATTERNS IN THE CONNECTICUT RIVER FLOOD PLAIN IN RELATION TO FREQUENCY AND DURATION OF FLOODING

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Résumé

La partie aval de la rivière Connecticut est soumise à une crue annuelle qui survient de 1 à 2 mois après celles des rivières avoisinantes et, parfois, à de très grosses crues en été. Cet article porte sur la composition floristique des forêts d'*Acer saccharinum* de sa plaine d'inondation, en rapport avec la fréquence, la durée et la période de crue. Il présente des données sur les importantes variations annuelles de la végétation de quelques habitats. À l'aide des données de niveau d'eau en longue période (depuis 1896), nous avons calculé la durée et la fréquence des crues d'été pour chaque niveau dans la plaine d'inondation. Le patron de végétation de la zone d'écoulement libre de la plaine d'inondation est principalement contrôlé par son emplacement et son élévation alors que celui des marécages et des dépressions l'est par l'évapotranspiration et l'infiltration d'eau. L'élévation affecte également la fréquence des crues dans les marécages et les dépressions. L'occurrence et la période des crues d'été déterminent alors la composition et le développement de la végétation, quelle que soit l'année.

Abstract

The lower part of the Connecticut River has an annual flood season that is 1-2 months behind that of local rivers, and severe floods occur occasionally in summer. This paper describes the floristic composition of the *Acer saccharinum* forests of the Connecticut River flood plain in relation to the frequency, duration and timing of floods, and it documents the large annual changes in the vegetation of some habitats. Long-term river level records, starting in 1896, were used to calculate the duration of flooding as well as the frequency of summer floods at any level in the flood plain. In the freely drained flood plain, elevation and location with respect to the river channel are the principal factors controlling the vegetation pattern. Elevation also affects flooding frequency of the sloughs and depressions that retain water after floods, but their vegetation pattern is controlled primarily by subsequent water level changes caused by evapotranspiration and percolation. Here, the occurrence and timing of summer floods determine the composition and development of the vegetation in any one year. This paper illustrates the value of water level duration and flood frequency curves in analyzing the vegetation patterns of a flood plain.

Introduction

The Connecticut River, flowing from southern Québec to Long Island Sound is the largest river in New England. It drains approximately 29,100 km^2 and, with an average discharge of 560 m^3/s, supplies more than one-half the freshwater input into Long Island Sound (Meade, 1966). The drainage area is relatively long and narrow, mostly hilly, and more than 70% forested. From northern Massachusetts through central Connecticut, the river flows through a broad lowland. Here the flood plain reaches its greatest development, overbank flow is substantial, and channel migration is prevalent.

Almost all of the high flood plain has been cleared and very little it is now forested. The low flood plain has also not escaped the effects of agriculture and urbanization but enough of the marshes and forests are left to show the original vegetation patterns. The most striking features of the flood plain forests are the sharp contrasts in species dominance and floristic composition of the ground vegetation and the dramatic year to year variation in its floristic composition. These

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are especially obvious on the frequently flooded parts of the flood plain.

In Connecticut, *Acer saccharinum* forests are restricted to flood plains (Bromley, 1935; Westveld, 1956). Nichols (1916) gave a general description of these forests as well as other vegetation on the flood plain of the lower Connecticut River. The vegetation of marshes and oxbows was described from an adjacent part of the flood plain in Massachusetts (Burk, 1977; Sackett, 1974, 1977).

The flooding history of the Connecticut River can be traced from 1683 (Thompson *et al.*, 1964), and since 1896 excellent records have been kept on river level fluctuations at Hartford, Connecticut. This provides an opportunity to correlate vegetation boundaries with long term river level data, to determine the flooding frequency and duration to which plant communities are subjected, and to relate sudden changes in vegetation with unusual flooding events.

The purpose of this paper is (1) to describe the floristic composition of the flood plain forests in northern Connecticut, (2) to draw attention to the large year to year differences in the composition of some flood plain communities, (3) to correlate spatial and temporal differences in vegetation with flooding and habitat conditions, and (4) to describe and explain the topographical sequences of plant communities in the flood plain. This paper will focus on the forest vegetation of the low flood plain, partially because the effects of flooding are most clearly expressed on these sites, but also because a complete toposequence of vegetation units is still available for study.

Geographical setting

The study area includes the flood plain on the reach of the Connecticut River flowing through north-central Connecticut (Fig. 1). It is underlain by Triassic-Jurassic sandstones and shales. The surrounding topography is flat to rolling, with elevations averaging 15 to 75 m above sea level. Similar reaches can be found to the north, whereas to the south the river is confined within a bedrock channel until it reaches Long Island Sound. In the vicinity of Hartford, much of the flood plain was diked during the 1940's, increasing flood levels to the north by less than 30 cm during periods of high flow (L. Weiss, Water Resources Division, U.S. Geological Survey, pers. comm.).

The study area is located in the northern part of the Appalachian oak forest zone (Küchler, 1964), has a growing season of about 180 days, a mean annual temperature of 10°C, and mean monthly temperatures of −3°C and 27°C for January and July, respectively. Annual precipitation is well-distributed throughout the year and averages 1090-1200 mm (Brumbach, 1965).

The Connecticut River is an early spring flooding river (Hoyt & Langbein, 1955) with autumn flooding not uncommon. In most years, deep snow accumulates in the upper reaches of the basin causing high flood levels during spring thaws. In the late summer and early autumn, flooding is caused by heavy precipitation associated with equinoctial tropical storms. During periods of low flow, the Connecticut River is subject to tidal fluctuation with the upper limit of tidal influence corresponding to the bedrock riffles on the northern boundary of the study area. The maximum tidal amplitude in Hartford is approximately 30 cm.

Along the Connecticut River, erosional and depositional features are well represented with

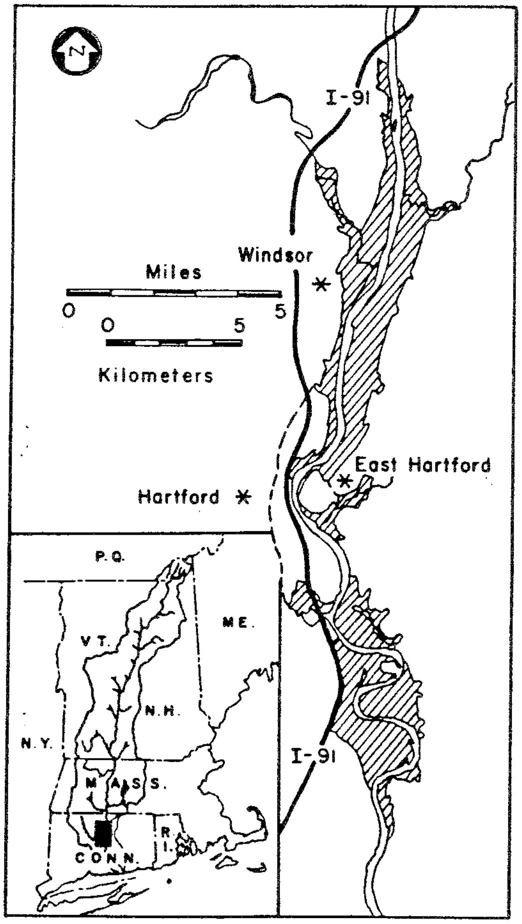

Figure 1. Map of the study area (shaded) and its location within the Connecticut River Basin. The broken line indicates part of the flood plain lost to urban development.

steep-cut banks, point bars, and scroll bars recording the history of lateral channel migration (Fig. 2). Oxbow-lakes and remnants of more ancient channels can also be found with meander cut-offs described and dated by Holland & Burk (1982) for the flood plain in Massachusetts and by Flint (1930) for the flood plain in the vicinity of Hartford. Natural levees parallel many of the straighter channels, and terracing caused by base-level changes gives a broad step-like appearance to the surface of the flood plain. Five terrace and flood plain levels have been described for the flood plain in Massachusetts with only the two lower levels presently inundated (Jahns, 1947): an upper level or high flood plain inundated for short periods during extreme floods and a low flood plain inundated annually for much longer periods of time.

Methods

The vegetation and habitat conditions were described during a survey of the Connecticut River flood plain from 1978-1980 and were supplemented with descriptions made in the flood plain forests south of Hartford from 1972-1982. Studies in the latter area also provided detailed information on the relationship between vegetation and flooding levels.

The floristic composition of the vegetation was described in plots uniform with respect to vegetation cover and soil conditions, and large enough to include the normal species combination of the habitat. Most plots were 20 × 20 m, but in order to sample areas with uniform vegetation and soil it was occasionally necessary to use rectangular or smaller plots. Plot sizes are indicated in the vegetation table. Within each plot, abundance-cover and sociability of all vascular plants and bryophytes present was estimated using the Braun-Blanquet scale (Mueller-Dombois & Ellenberg, 1974), except that no sociability values were used for trees and shrubs. Descriptions were tabulated and then organized into a vegetation synthesis table on the basis of similarities and differences in species composition (Mueller-Dombois & Ellenberg, 1974). Vegetation patterns identified in this table were checked during subsequent field work to refine or correct the classification.

The plant communities recognized are mostly at the level of subassociation in the Zürich-Mont-

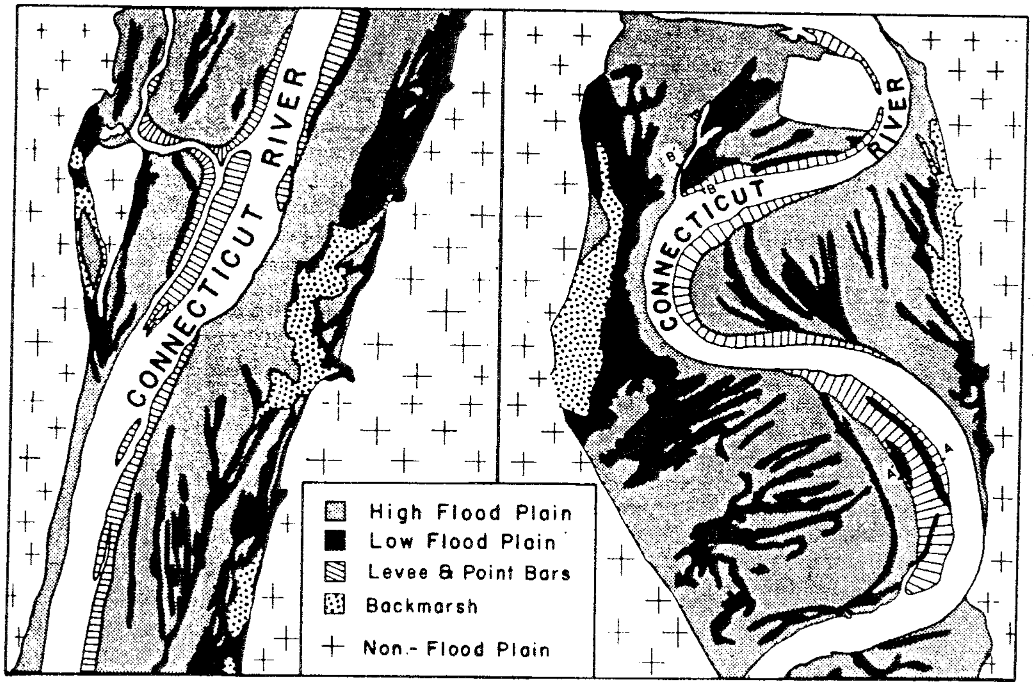

Figure 2. Distribution of major physiographic subdivisions of the flood plain along two sections of the Connecticut River. Depositional patterns occur throughout the flood plain. Levees and point bars parallel much of the river channel and the succession of scroll bars records the history of both present and previous meanders. The river has cut frequently into older deposits and, as a result, the high flood plain occurs often adjacent to the river channel. Almost all the high flood plain has been cleared for agriculture, whereas most of the low flood plain is forested. A-A' and B-B' indicate the approximate location of the transects illustrated in Figure 7.

pellier tradition (Mueller-Dombois & Ellenberg, 1974), and variants and facies of some of the communities are recognized. These units are defined by differential species only. No association and subassociation names have been assigned to them. Such an informal classification is preferred until further data, collected over a much larger geographic area, provide a clear concept of the associations.

Elevational differences were measured with a transit on transects across the major topographical features, such as levees and sloughs. The elevation of vegetation boundaries was also recorded on these transects. The elevation of the transects was tied in with the Bulkeley Bridge gauge in Hartford, so that river-level records could be used in determining the flooding frequency and duration for plant communities.

Species density, based on number of stems, and height were recorded each autumn on several permanent transects. Density was determined in circular plots located at 1-m intervals on the transects; plot size varied from 0.1-1.0 m depending on the density of the species. Height was recorded as the maximum height within 0.5 m from the plot center.

Records of Connecticut River water levels at Hartford (supplied by the Water Resources Division, U.S. Geological Survey and the National Weather Service, U.S. Department of Commerce) were used in a variety of ways. A water level duration curve was prepared to show the average period of time in days and percent of year that water levels were at or above a certain level. This was based on data for the period 1896-1942 compiled by the Department of Engineering, City of Hartford. The number of years that a certain level was reached at least once during the summer (15 May-15 September) and during each of the periods 15-31 May, June, July, August, and 1-15 September, was calculated using river level records from 1905-1982. From this the probability of flooding was determined for various summer periods after the regular spring floods. The same data were also used to calculate the flood recurrence intervals for the period 1 June-15 September following the guidelines of the Water Resources Council (1981). The nomenclature of the vascular plants follows Fernald (1950), for mosses Crum *et al.* (1973) and for hepaticae Stotler & Crandall-Stotler (1977).

Results

FLOOD DURATION AND INUNDATION PERIOD

Flood duration is longest in the spring with peak flows occurring between 15 March and 15 May (Fig. 3). Therefore spring flooding often occurs well into the vegetative season and at a time when *Acer saccharinum* trees are already in full

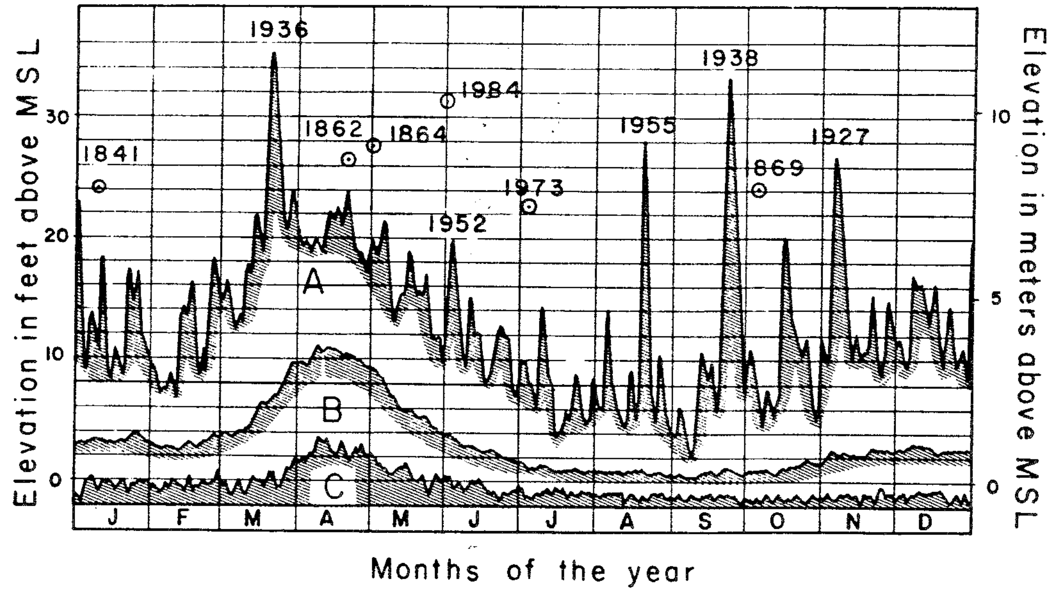

Figure 3. Daily maximum (A), mean (B) and minimum heights (C) of the Connecticut River above mean sea level at Hartford, 1908-1957. Data are from the Greater Hartford Flood Commission, Hartford, Connecticut. The dates in the graph indicate years with maximum gauge heights; the level of some historic floods (Thomson *et al.*, 1964), the July 1973 and the June 1984 floods are also shown.

flower. By late May, flood waters have generally receded, and much of the flood plain has drained leaving only sloughs, backmarshes, and other depressions filled with water. Summer floods occur in some years (Fig. 3). Characteristically, they peak for very short periods and the river returns rapidly to regular summer levels.

Since flood duration was thought to be a major factor controlling the vegetation pattern of the flood plain, a flood duration curve was constructed from the river water levels at Hartford. This curve (Fig. 4) shows the inundation period for any level in the freely drained part of the flood plain.

The asymmetry of this curve is striking. River levels remain between 0.3 and 1.5 m mean sea level (MSL) for half the year and are between 0.8 and 1.5 m for 40% of the time, whereas during the remainder of the year they fluctuate between 1.5 and 10 m MSL. Consequently, elevational differences have their greatest effect on flood duration at low levels in the flood plain, and they become progressively less important with increasing height above sea level. For instance, an increase in elevation of 10 cm will reduce the inundation period by 30 days at 1 m MSL, by less than 4 days at 1.5 MSL and for only about one day at 3 m MSL.

Flood duration is of little value in predicting inundation periods in parts of the flood plain that do not drain freely after a flood, such as sloughs and depressions without an outlet into the river. Here, water is trapped and water levels will be lowered only by evapotranspiration and percolation. After a summer flood such sites will remain inundated for weeks or months and often for the remainder of the summer. Severe summer floods can return water levels throughout the flood plain to those of early spring, but less severe floods will only affect the low-lying sloughs. Therefore, it is not flood duration but its maximum level and its timing that are critical for the vegetation, and it is the frequency of such events that affect the vegetation pattern of these sites.

Two types of graphs are necessary to show the hydrological regime of these undrained or partially drained sloughs in such a way that they indicate the effect on the vegetation. One graph to show the recurrence interval and another to show the timing of the flooding events.

The relationship between flood level and its frequency of occurrence (Fig. 5) can be used to predict the recurrence interval of flooding; provided the lowest level at which river water can enter and leave the slough is known. In the low flood plain, sloughs with in-flow thresholds below 0.5 m MSL will be flooded every summer. Those with an inflow level of 4 m MSL have a recurrence interval of 7 years for summer floods but they will be flooded every year in the spring. Figure 5 also shows the importance of summer floods for sloughs in the high flood plain, even for those at levels where spring floods are not an annual event.

The probability of a flood during each of the summer months is plotted in Figure 6. The chance of a flood decreases as the vegetative season progresses. For example, the probability of a 3 m flood occurring between 15-31 May is 42%, during June 24%, and during July, August or the first half of September only 5-10%. However, it is clear from Figures 3 and 6 that high flood levels (stage levels over 5 m MSL) can occur during any month of the year. Moreover, although severe summer floods are uncommon, it is worth emphasizing that they have occurred several times during one vegetative season, e.g. in 1973 in late May (4.9 m) and July (6.1), in 1969 in late May (3.0 m) and twice in August (3.4 m).

PLANT COMMUNITIES OF THE FLOOD PLAIN

Excluding the anthropogenic vegetation, the flood plain vegetation can be conveniently divided into: (1) forests on the high flood plain (2) forest on the low flood plain and (3) marshes and herbaceous riverbank vegetation. The major part of this section will be devoted to the forest vegetation of the low flood plain. The plant communities of the high flood plain and those without tree cover will be defined very briefly with respect to major physiognomical and floristic characteristics. This description will be limited to plant communities referred to in the discussion on ecological relationships.

High flood plain forests

The high flood plain forests differ floristically and ecologically from the *Acer saccharinum* forests of the low flood plain. They resemble the *Acer saccharum-Fraxinus americana* forests on fertile, upland soils (Damman & Kershner, 1977) and show a close floristic similarity to forests on moist lower slopes in basalt and limestone areas. Both contain species such as: *Tilia americana, Ulmus americana, Carya cordiformis, Staphylea trifolia, Carex sprengelii, Asarum canadense, Dicentra cucullaria, Menispermum canadense* and *Hydrophyllum virginianum*, all of which are absent in the low flood plain forests. Only small fragments of the high flood plain remain since it occurs on prime agricultural land. These forests are simply referred to as high flood plain forest.

Low flood plain forests

These forests are differentiated from those of the high flood plain by the dominance of *Acer*

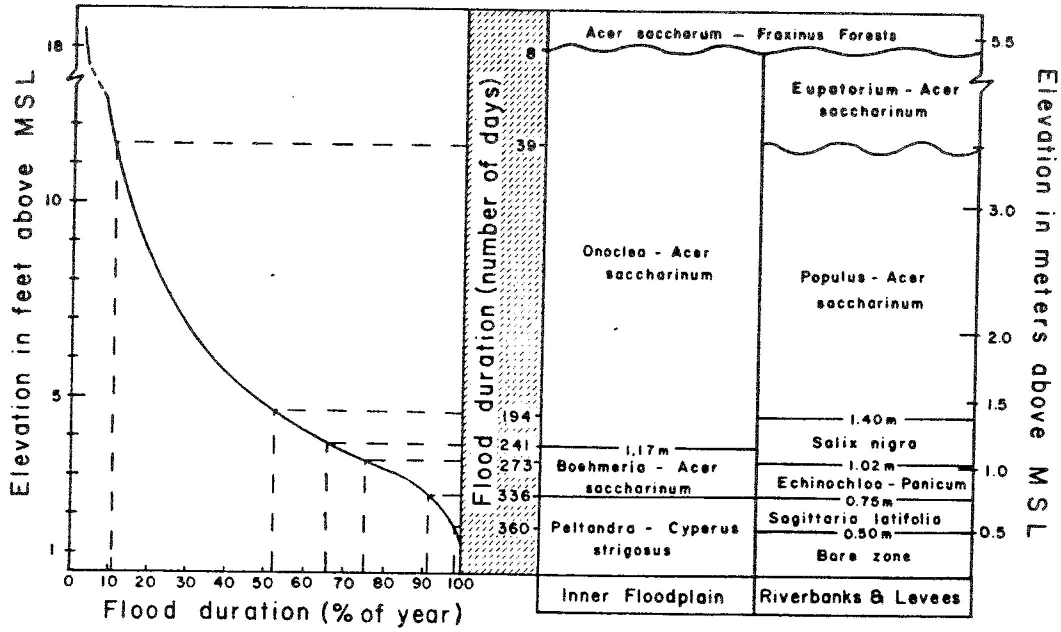

Figure 4. Relationship between elevation, flood duration, and distribution of plant communities on the freely drained parts of the Connecticut River flood plain. The water level duration curve at left shows the percentage of the year that the river is at or above a certain level based on the period 1896-1942. The upper and lower limits of each plant community are shown on the right. These levels can be traced to the duration curve to find the period of inundation. Flood duration data were supplied by the Greater Hartford Flood Commission.

saccharinum and the common occurrence of *Populus deltoides, Sicyos angulatus, Echinocystis lobata, Cuscuta gronovii, Vitis riparia* and *Arisaema dracontium. Acer negundo* occurs sporadically on the low flood plain of the Connecticut River but is abundant on calcareous flood plains in western Connecticut.

Ecologically, there is a clear distinction between the *Acer saccharinum-Populus deltoides* forests on riverbanks and levees and the virtually pure *Acer saccharinum* forests of the inner portions of the flood plain. However, a floristic distinction between these two units cannot be easily made. Physiognomically, the low flood plain forests can be separated into: 1) those with a luxuriant herb layer and 2) those with a generally sparse ground cover that varies greatly in its development from year to year. The former includes the *Eupatorium-Acer saccharinum*, the *Onoclea-Acer saccharinum*, and the *Boehmeria-Acer saccharinum* communities, whereas the *Populus-Acer saccharinum*, the *Acer saccharinum* seedling, and the *Salix nigra* riverbank communities belong to the latter. Each of these is briefly described below.

Eupatorium rugosum-Acer saccharinum community. An *Acer saccharinum* forest with an admixture of *Populus deltoides* and *Ulmus rubra*. It is characterized by a lush ground cover of tall herbs and the presence of shrubs. Species of group c (Table I) differentiate this community from all other *Acer saccharinum* forests and it shares species of group b (Table I) with the *Onoclea-Acer saccharinum* community. Several other species of group a (Table I) reach their optimal development in both this and the *Onoclea-Acer* community. In a variant of this community, *Laportea canadensis* completely dominates the ground vegetation (Table I, no. 16-22).

Populus deltoides-Acer saccharinum community. A *Populus deltoides* forest with *Acer saccharinum* often occurring as a low tree under the *Populus* canopy. The herbaceous cover is generally sparse, but *Leersia virginica* is always present. Differential species of the low flood plain and species of group a (Table I) are poorly represented. *Populus deltoides* reaches its greatest abundance here.

Salix nigra riverbank community. A riverbank shrub community with *Salix nigra* as the dominant low tree and shrub. The composition of the ground cover is affected greatly by the adjacent vegetation but it is generally weedy and highly variable. Summer annuals such as *Panicum dichotomiflorum, Echinochloa crusgalli, Sicyos angulatus* and several *Bidens* and *Polygonum* species are often dominant. The composition and development of the vegetation varies greatly from year to year.

No descriptions are included in Table I because of the narrow and transitional nature of this zone along this part of the Connecticut River.

Onoclea sensibilis-Acer saccharinum community. An *Acer saccharinum* forest with an occasional *Populus deltoides* tree and scattered shrubs. *Ulmus rubra* and *Fraxinus pennsylvanica* occur commonly as low trees. Most characteristic for this community is the fern-covered forest floor. It is further distinguished from all other low flood plain forests, except the *Eupatorium-Acer* community, by the presence of species of group e (Table I).

This community has a wide ecological amplitude with flood duration determining the floristic composition of the ground cover. In its typical expression (Table I, no. 29-34), *Onoclea sensibilis* dominates the forest floor completely. A floristically impoverished variant (Table I, no. 35-38) occurs in the lower part of its elevational range; shrubs are absent here and the species of group b (Table I) are poorly represented. The *Pteretis pensylvanica* variant (Table I, no. 23-28) occupies the highest ridges in the inner flood plain.

Boehmeria cylindrica-Acer saccharinum community. An *Acer saccharinum* forest in which *Boehmeria cylindrica* either forms a luxuriant ground cover or is a prominent species in the herb layer. It is differentiated by the absence or very sporadic occurrence of species of groups b, c, and d (Table I).

Three variants can be recognized. A) *Onoclea sensibilis* variant (Table I, no. 39-46) with an open *Boehmeria cylindrica* cover in which clumps of *Onoclea sensibilis* occur regularly and *Laportea canadensis, Rhus radicans* and other species (Table I, group a) occur sporadically. B) *Leersia virginica* variant (Table I, no. 47-49) with *Leersia* as the dominant species on the forest floor. C) *Boehmeria cylindrica* variant (Table I, no. 50-55) dominated completely by a dense ground cover of *Boehmeria cylindrica*. This and the *Leersia* variant lack the differential species of group a (Table I) and *Onoclea sensibilis* occurs sporadically in both.

Acer saccharinum seedling community. This community occurs in undrained sloughs and depressions in which flood waters are ponded. Trees do not occur within this community, but the site is heavily shaded by the overhanging canopy of trees growing on adjacent higher soils. The ground cover is usually very open, but its cover

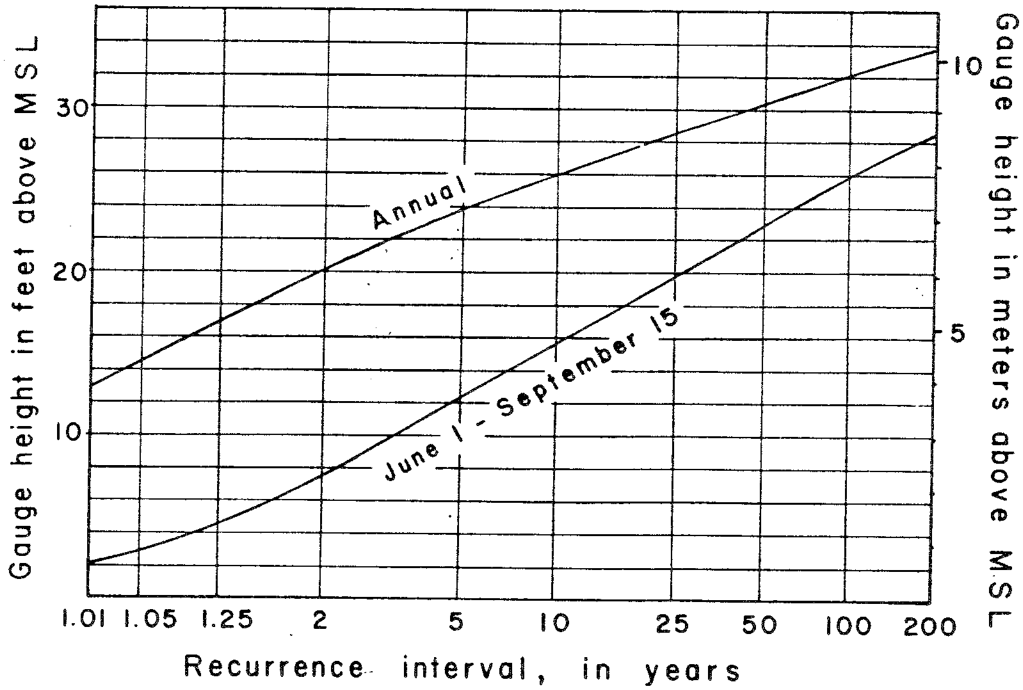

Figure 5. Recurrence interval of annual and summer floods of the Connecticut River at Hartford. Data for annual floods are based on maximum and historic flood levels calculated by the U.S. Geological Survey for the period 1683-1982. Data for the summer period are based on 7 AM readings from the U.S. National Weather Service and the U.S. Geological Survey for the period 1905-1932. Recurrence intervals were calculated following the guidelines of the Water Resources Council (1931).

and height are highly variable depending on the flooding regime during any one year. *Ricciocarpus natans* and *Lemna minor* are usually present on the muddy soil. Seeds of many species accumulate here with floating debris, and seedlings of a wide variety of plants, from *Quercus rubra* to garden vegetables, can occur. In some years, a facies dominated by *Pilea pumila* (Table I, no. 56-60) occupies the upper part of this habitat.

Flood plain marshes and herbaceous riverbank vegetation

These marshes occupy open sites in coves with tidal influence, in oxbows and sloughs that have permanent standing water, and in back-marshes that receive drainage from the adjacent upland. In contrast, the herbaceous riverbank vegetation occupies sandy beaches and shores adjacent to the river channel but above the influence of normal summer low water levels. For the purpose of this paper only three vegetation types will be described.

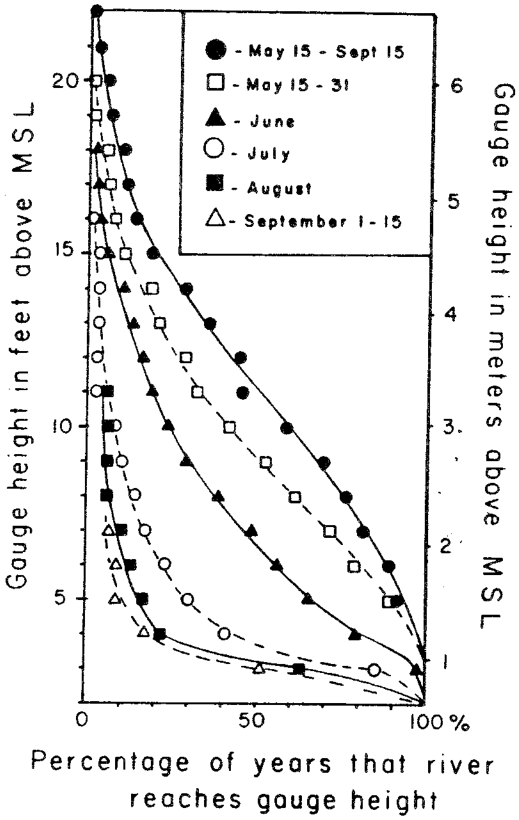

Figure 6. Probability of summer flooding of the Connecticut River at Hartford based on data for the period 1905-1982. Each curve shows the percentage of years that a certain gauge height was reached at least once during the period 15 May-15 September and each of the periods 15-31 May, June, July, August, and 1-15 September. Note that the probability of summer flooding decreases as the summer progresses. Data are based on 7 AM readings supplied by the U.S. Weather Service and the U.S. Geological Survey.

Sagittaria latifolia community. A herbaceous community occurring in the tidal zone of the river channel, inlets, and coves connected to the river. Along the river, this community generally has a sparse vegetation cover of *Sagittaria latifolia* and *Lindernia dubia*. However, in protected inlets and coves with a large expanse of tidal mud, a dense growth of annual grasses, such as *Zizania aquatica*, can dominate the vegetation. The *Sagittaria* community occupies very little area within the study area and is better expressed along the lower Connecticut River where intertidal mud flats are more extensive.

Peltandra virginica-Cyperus strigosus community. A herbaceous marsh community that develops in low-lying swales along the large meanders. These marshes have a low point of entry and are frequently flooded. After the floods recede, water is trapped in these shallow swales. The emergent marsh vegetation consists mainly of *Peltandra virginica* with *Sagittaria latifolia, Cyperus strigosus, Leersia oryzoides, Lindernia dubia*, and *Ludwigia palustris*. *Peltandra virginica* is always abundant. *Cyperus strigosus* or *Leersia oryzoides* are sometimes abundant and then determine the physiognomy of this community.

Echinochloa-Panicum dichotomiflorum community. A highly variable community that occurs on low riverbanks and shores above the influence of the summer river level. Summer annuals predominate: e.g. *Echinochloa pungens, E. crus-galli, Panicum dichotomiflorum, Polygonum pensylvanicum, P. lapathifolium, Xanthium pensylvanicum, Eragrostis hypnoides, Gnaphalium uliginosum, Mollugo verticillata*, and several *Bidens* species. The floristic composition varies from year to year with seed supply and the timing and duration of floods.

FLORISTIC CHANGES IN UNDRAINED SLOUGHS

The physiognomy and species composition of undrained sloughs can change dramatically from year to year depending on the history of flooding. The *Boehmeria* variant of the *Boehmeria-Acer* community occupying the upper part of the slough is little affected by summer floods, but during a year with summer floods most species below this zone are killed. Few *Acer saccharinum* seedlings survive, *Arisaema* resprouts but has small leaves and does not flower, and *Pilea* and *Bidens frondosa* seedlings occur as scattered, low plants. If a slough is not flooded for several summers, *Boehmeria* seedlings become established throughout most of the slough and persist until the following summer flood.

Table II illustrates the changes during 3 consecutive years without summer flooding. The most luxuriant growth of *Pilea pumila* occurs during the first year a slough is not flooded in summer. This can be seen in Table II although the height of *Pilea* was also decreased by its greater density and by the short growth period during 1978 and 1979 when spring floods receded late in the season.

Discussion

THE EFFECT OF RIVER WATER LEVELS ON THE VEGETATION

The frequency, duration and timing of flooding are the master factors controlling the vegetation pattern in the low flood plain. Elevation above river level is clearly an important factor determining the vegetation pattern of flood plains (Barnes, 1978; Frye & Quinn, 1979), primarily because it is correlated with flooding frequency and duration as well as soil aeration. However, elevation alone does not adequately represent the gradient of site inundation and soil aeration in most flood plains (Robertson *et al.*, 1978; Buchholz, 1981). This also applies to the Connecticut River flood plain.

In interpreting the vegetation pattern of the flood plain, a clear distinction has to be made between sites which drain freely into the Connecticut River and those in which river water becomes entrapped. Water levels in the former fluctuate with the river level, whereas the latter, once flooded, remain inundated for long periods after the flood waters have receded.

In the freely drained parts of the flood plain, the start of the vegetative season depends on the timing of the spring floods. Thus, the development of the ground vegetation is controlled by snow melt in Vermont and New Hampshire rather than by the spring temperatures in Connecticut. This does not apply to trees; *Acer saccharinum* is often in full flower when only the tree crowns are above the flood waters.

In the sloughs and depressions in which flood waters are trapped, the ground vegetation does not develop until water losses by evapotranspiration and percolation lower the water level and expose the soil surface. In these areas the effective vegetative season, at least for the ground vegetation, becomes shorter with increasing water depth.

ECOLOGICAL RELATIONSHIPS IN THE FREELY DRAINED FLOOD PLAIN

The freely drained part of the flood plain includes areas adjacent to the river channel as well as areas in the inner flood plain. Here, water levels fluctuate with the river level. Flooding duration increases at lower elevations (Fig. 4) and becomes increasingly important in controlling the floristic composition of the vegetation. Consequently, plant communities occupy increasingly smaller elevation ranges as one approaches mean sea level (MSL) (Fig. 4). Since the effect of flooding on the vegetation adjacent to the river channel differs greatly from the inner flood plain, it is necessary to discuss these areas separately.

Inner flood plain

The inner flood plain comprises all areas behind the river levees and away from swift water. Water is usually trapped in the sloughs after flooding, although channels and marshes with open connections to the river do occur. In general, sites in the inner flood plain are flooded by slowly moving water, receive fine textured sediments, and are not subjected to erosion or heavy sedimentation.

TABLE II

Changes in height and density of *Pilea pumila* and *Boehmeria cylindrica* below the *Boehmeria* zone of an undrained slough after a summer flood in 1976*

Year	*Pilea pumila*		*Boehmeria cylindrica*		*Latest date that river level exceeded slough entry level*
	Height (cm)	*Density* (stems/m²)	*Height* (cm)	*Density* (stems/m²)	
1976	4.9 ± 0.5	6.3 ± 1.2	—	—	14 August
1977	40.8 ± 2.3	68.8 ± 9.7	11.0 ± 1.0	0.9 ± 0.7	29 April
1978	31.8 ± 2.0	107.0 ± 14.2	21.6 ± 6.8	2.2 ± 0.8	19 May
1979	17.0 ± 1.6	103.5 ± 23.2	42.8 ± 4.6	6.7 ± 2.8	2 June

*Data were collected in the middle of September when the species had reached their maximum height. A stage level of 3.20 m MSL will flood this slough.

The low-lying parts of the inner flood plain are covered mostly with an *Acer saccharinum* forest. During spring floods these trees can be flooded up to their crowns but during the major part of the vegetative season most of the flood plain is above the river level. The distribution of the plant communities within the inner flood plain and their occurrence with respect to duration of flooding and elevation above MSL is shown in Figures 7 and 4, respectively.

Acer saccharinum forests do not occur on the wettest sites. In the detailed study area south of Hartford, sites below 75 cm MSL are occupied by an open marsh vegetation with *Sagittaria latifolia, Peltandra virginica* and *Zizania aquatica*. This corresponds to a flooding duration of approximately 340 days/year (Fig. 4). *Leersia oryzoides, Cyperus strigosus*, or *Peltandra virginica* can be dominant in sheltered inlets that are not drained completely at low tide during low river levels, with the *Peltandra* occupying the wettest sites.

The *Boehmeria-Acer* community includes the wettest *Acer saccharinum* forests. It occurs on sites that are still regularly flooded during the summer. Its upper boundary is just below 1.17 m; this corresponds with a flooding duration of 241 days/year.

The *Onoclea-Acer* community occurs above this level and occupies the entire range from about 1.2-5.4 m MSL. Flooding duration varies from 241 days at its lower boundary to about 8 days at its upper level. In essence, this community occupies the part of the inner flood plain that is above the river level from the time the spring floods recede, although it can be flooded occasionally during the summer. The recurrence interval of summer floods varies from 1.1 years at its lower to 11 years at its upper border.

The floristic composition of this community changes with elevation. The low-lying sites are occupied by an impoverished variant with the ground cover completely dominated by *Onoclea sensibilis*. Shrubs and low trees, such as *Fraxinus pennsylvanica* and *Ulmus rubra*, appear in the *Onoclea-Acer* community at higher elevations together with a large number of less flood-tolerant species, e.g. *Cinna arundinacea, Geum canadense* and *Chelone glabra* (Table I). These species, including *Onoclea sensibilis*, can grow on soils which are saturated throughout the vegetative season outside the flood plain. Their absence from the lower elevations of the flood plain appears to be associated with their vulnerability to inundation of their foliage during the vegetative season.

Pteretis pennsylvanica can locally dominate this community on ridges over 3 m MSL. This *Pteretis* variant occurs under openings in the *Acer saccharinum* canopy; the increased light intensity appears to be primarily responsible for this change in floristic composition compared to the typical *Onoclea-Acer* community at the same elevation above the river.

Forests similar in floristic composition to those of moist, nutrient-rich uplands occupy sites above the *Onoclea-Acer saccharinum* community. The exact lower boundary of these forests is difficult to determine because the high parts of the flood plain are mostly under cultivation. Therefore, the boundary had to be inferred from small patches of forest left in the flood plain. The lowest level at which these upland *Acer saccharum-Fraxinus* forests have been found was 5.4 m MSL, and this has been used as the boundary between these types in Fig. 4.

Areas adjacent to the river

These include the levees, areas of active deposition such as scroll bars, and steep river banks cut into older deposits. These sites are exposed to fast flowing river water during periods of high flow, and their soils are coarser textured than those in the inner flood plain. Plants growing on these sites have to cope with mechanical damage during flooding, especially at lower elevations, and with erosion and sedimentation. The occurrence of *Populus deltoides* as a regular component of the forest appears to be associated with the better aeration of these soils.

Soils below 1.40 m MSL are occupied by a river bank vegetation. Four zones (Fig. 4) can usually be recognized.

A) A bare zone below 0.5 m which is flooded over 360 days/year.

B) A zone with the *Sagittaria latifolia* community. Its upper level coincides about with the high tide level during periods of low flow.

C) A zone with the *Echinochloa-Panicum* community, a weedy vegetation made up primarily of summer annuals and very variable in composition.

D) A transition zone to the forested flood plain with *Salix nigra* as a shrub or low tree. This occurs as a narrow, interrupted band along the river and separates the herbaceous river bank vegetation from the *Populus deltoides-Acer* community on the levees. It is located above the regular water level fluctuations of the river during the summer, but it takes the brunt of ice damage during spring break-up.

The *Populus-Acer* community occupies the low levees above 1.40 m MSL that are still subjected to strong currents during flooding (Fig. 7). The swift currents and active sedimentation account for the very poorly developed ground vegetation. At about 3.5 m MSL it is replaced by the *Eupatorium-Acer saccharinum* community. Generally, these are steep river banks. Sites with active deposition are occupied by the *Laportea* variant.

Above about 5.4 m MSL these communities are replaced by *Acer saccharum-Fraxinus* forests comparable to those in the inner flood plain.

ECOLOGICAL RELATIONS IN UNDRAINED SLOUGHS

Undrained sloughs occur in the inner flood plain. Characteristically, they fill with water when the river level rises above the inflow level of the depression, but they do not drain when the river level falls. Such sites are filled with water at all elevations in the flood plain during spring flooding, and most of them are filled with water all winter long due to fall flooding. Most of these sloughs are narrow enough to be shaded completely by mature *Acer saccharinum* trees growing on the low ridges. Trash and debris carried by the river at flood stage is often trapped in these sloughs. For years after a severe sleet storm in late December 1973, the sloughs were filled with branches.

During a summer without floods, sites gradually become available for colonization. Some sloughs dry out completely while others have deep, permanently flooded parts. The period available for the development of the ground vegetation decreases from the level at which the water is trapped to the permanent water level. This results in 3 distinct vegetation belts (Fig. 7C).

A) The *Onoclea-Acer* community occupying the ridges and occurring to about 3 cm below the level at which the water is trapped in the slough.

B) A belt completely dominated by 75-85 cm high *Boehmeria cylindrica* and occurring to 35-50 cm below the *Onoclea* level. This is the *Boehmeria* variant of the *Boehmeria-Acer* community. It forms a very sharp boundary to both the *Onoclea-Acer* community and the lower part of the slough.

C) The remainder of the slough is occupied by the *Acer saccharinum* seedling community, unless the slough is deep enough to hold water during a summer without flooding. The vegetation here is well-developed and clearly differentiated into an upper part dominated by luxuriantly growing *Pilea pumila* (*Pilea* facies, Table II) and well-developed *Arisaema dracontium*, a central part with abundant *Acer saccharinum* seedlings and scattered *Arisaema dracontium*, and a lower part with exposed mud and scattered annuals.

In the undrained sloughs and depressions, the effects of summer floods can be disastrous. Below the *Boehmeria* belt the foliage rots and the plants have to resprout from seeds or rhizomes. Such events and their timing have a profound effect on the vegetation of the sloughs and of the flood plain as a whole.

Obviously, a summer flood only affects sloughs with inflow levels below its flood stage. Therefore, not all sloughs in the floods plain will have the same flooding history at any one time, and the vegetation patterns of adjacent sloughs with different inflow levels can be strikingly different. This highly dynamic nature of the slough vegetation below the persistent *Boehmeria cylindrica* belt (Table II) shows a temporal and spatial pattern in the flood plain that is difficult to understand without a knowledge of recurrence intervals (Fig. 5) and timing (Fig. 6) of summer floods.

DISTINCTIVE CHARACTERISTICS OF THE FLOOD PLAIN

Flood seasons in New England show a clear geographical pattern (Hoyt & Langbein, 1955). Winter flooding is dominant in the southern parts, whereas the northern and eastern parts are characterized by spring floods. However, since the Connecticut River is greatly affected by the snow melt in northern New England, water levels are clearly out-of-phase with those of other rivers in southern New England. As a result, major flooding occurs at a time that the vegetative season is well-advanced. This has two effects:

1) Spring ephemerals, such as *Claytonia virginiana, Erythronium americanum, Dicentra cucullaria* and *Sanguinaria canadensis*, which are a distinctive part of the vegetation along local rivers, are absent from most of the Connecticut River flood plain. Obviously, this is because in most years the tree canopy is in full foliage by the time the flood waters recede.

2) The boundary between the *Acer saccharinum* forests and the *Fraxinus-Acer saccharum* forests occurs at a much higher level above the prevailing summer levels along the Connecticut River than in other local rivers. This is partly a result of the large water level fluctuations of the river but apparently the duration of the flooding also eliminates species intolerant to flooding outside the dormant season.

Geographical variation in the vegetation is also apparent on different segments of the Connecticut River. South of the study area, for example, the proximity of Long Island Sound reduces the magnitude of the annual floods. Floods of long duration affect a much smaller part of the flood plain and as a result the *Onoclea-Acer saccharinum* com-

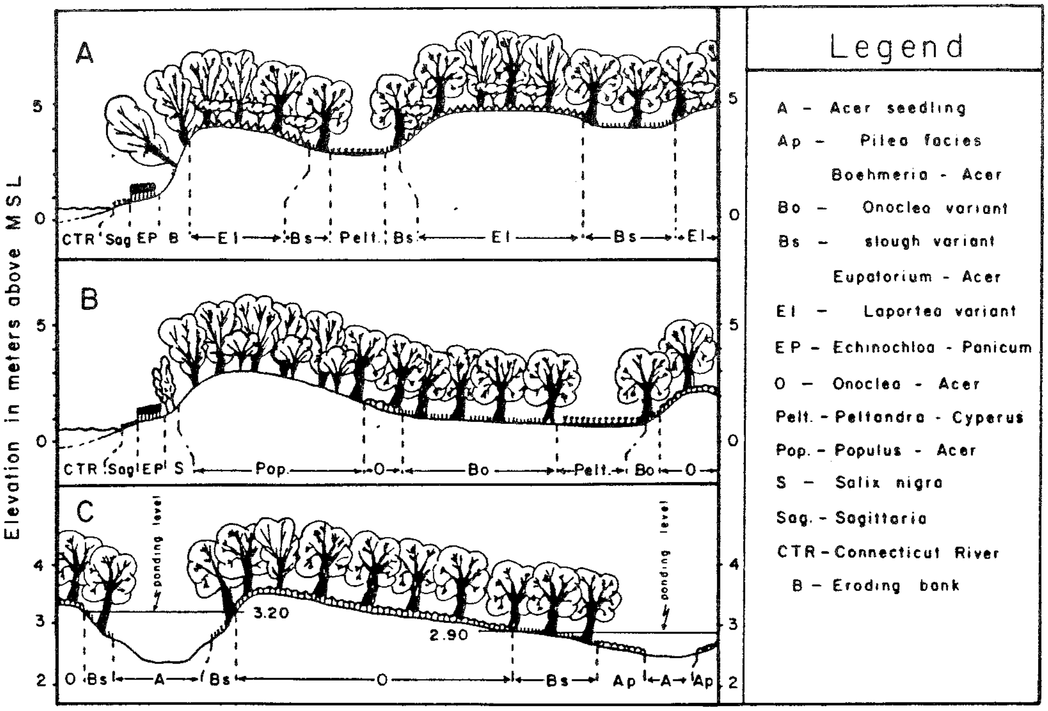

Figure 7. Toposequences of plant communities on the Connecticut River flood plain for (A) a stable meander scroll, (B) a low levee and a part of the inner flood plain, and (C) the ridges and sloughs in the inner flood plain. In sequence C, note the expanded vertical scale and the different lower level of the *Onoclea-Acer* community on opposite sides of the ridge. Approximate locations for toposequence A and B are indicated in Figure 2.

munity dominates much of the forested flood plain and extensive tidal marshes occupy low-lying areas. These types of hydrological variation within a river basin can complicate geographical comparisons of the vegetation; the flood season and the position in the basin are important in determining its characteristics.

Conclusions

Flood frequency, flood duration, and the timing of floods clearly control the pattern of plant communities on the flood plain. Water level duration curves and flood recurrence intervals for summer periods, when tied in with elevations on vegetation transects, proved valuable in analyzing the environmental conditions controlling the vegetation pattern. The long period of record of Connecticut River water levels permitted the correlation of long-term water fluctuation patterns with the distribution of plant communities on the flood plain.

Elevation above the summer river level integrates soil aeration and the duration and frequency of flooding. This is clearly reflected in the vegetation. However, this study shows that three other conditions are of critical importance in determining the vegetation pattern of the flood plain: 1) the ponding of flood waters in depressions and sloughs, 2) the sedimentation rate, and 3) the occurrence of summer floods.

The ponding of flood waters is not completely independent of elevation since inflow and outflow levels determine the frequency of flooding. The vegetation pattern of these ponded areas is determined by the water table changes after the river level has dropped below the outflow level. This pattern is highly dynamic with cyclical changes due to summer flooding being much more dramatic than the successional changes.

Differences in sedimentation rate, and the associated texture of the sediment, cause the development of two entirely different toposequences in the freely drained inner flood plain and near the river channel. Tidal fluctuations in this area, although only 30 cm, are clearly reflected in the vegetation, most extensively in shallow, muddy inlets and coves.

Acknowledgments

Our interest in the flood plain vegetation was kindled during field trips in a plant ecology course. Students in classes from 1976-1979 collected the density and height data for a year with summer flooding and the three subsequent years with low summer river levels. We are grateful to them as well as to those whose data we did not use, but who forced us to return to the flood plain annually and to look at the vegetation closely. We would also like to thank Larry Weiss, U.S. Geological Survey, who was particularly cooperative in retrieving data, Dr. Hugo Thomas and Sidney Quarrier, Natural Resources Center, Connecticut Department of Environmental Protection, for their support throughout this study, and especially Mrs. Elna DeCarli who cheerfully typed the various drafts of the manuscript.

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9. WILDLIFE HABITAT AND MANGEMENT

The study site (+265 acres) may be divided into three (3) wildlife habitat types. These are mixed hardwoods, open field and wetlands. This assortment of habitat types is beneficial to many species of wildlife because it creates diversity in the types of food, cover, water and special factors necessary for wildlife to exist.

Mixed Hardwoods:

This habitat type consists of a variety of hardwood species including red maple, sugar maple, red oak, ash, hickory, hop hornbeam, birch, aspen, cottonwood and silver maple. Species composition varies with exact site location (i.e. dry upland, riverbank, etc.). There is also a limited amount of scattered white pine.

Understory composition includes sassafras, cherry, elm, juniper, barberry, false-Solomon's seal, poison ivy, Virginia creeper, Christmas fern, clematis, multiflora rose, blackberry and grasses.

Wildlife frequenting such habitat types include deer, gray squirrels, flying squirrels, chipmunks, woodpeckers, owls, hawks, grouse and a great variety of non-game species.

The riparian strip within the hardwood type provides an excellent wildlife corridor for deer and other wildlife moving throughout the area.

Open Field:

The presence of agricultural fields is very beneficial to wildlife on the study site. The fields provide food and cover through the presence of corn, rye, timothy or clover. In addition to the obvious food supply, the crops provide structural diversity which creates cover for a great array of wildlife ranging from mice and shrews to deer. The fields also attract numerous insects which are a major food item of various wildlife species including birds, small mammals and bats. Another value of these fields is the edge which is created where fields meet forest. This valuable zone for food and cover consists of dense berries, shrubs and grasses.

Naturally reverting fields comprised of dogwood, cedar, grape, elderberry, milkweed, cherry clematis, red maple, sassafras, blackberry, birch, locust, honeysuckle and herbaceous species provide excellent habitat diversity essential to numerous wildlife species.

Wildlife utilizing open field habitats include deer, woodcock, mourning dove, eastern kingbird, mockingbird, fox, flycatchers, warblers, robin, raccoon, hawks and owls, rabbits and various non-game species.

Wetlands:

This habitat type consists of a $\pm$30 acre pond with two (2) small islands and a section of canals/stream.

The pond itself consists of open water and edges varying from open rocky surfaces to densely vegetated with willow, alder and dogwoods. The open edges have value as nesting habitat for killdeer and spotted sandpipers. Thickly vegetated edges are utilized by red-winged blackbirds, willow flycatchers, yellow warbler, eastern kingbird and various other passerines. The open water habitat typically is utilized by waterfowl, herons, feeding swallows, kingbirds, kingfishers and flycatchers.

The canal/stream areas are heavily vegetated with willow, alder, sumac and red maple. This area had much evidence of wildlife use including raccoon, deer, and numerous birds. The Farmington River also provides valuable riparian habitat and serves as a travel corridor as well.

Conifers:

Although not listed as an individual habitat type due to its limited acreage, the conifer present provide suitable habitat for seed eating birds such as black capped chickadees, and ruby and golden crowned kinglets. The areas also serve as roosting and nesting cover for various birds including owls, hawks and mourning doves.

Discussion:

Overall the Fisher Meadow study site has a good mixture of wildlife habitat types. This mixture has created adequate edge habitat (where two (2) habitat types meet) which is very valuable to insure a rich and diverse wildlife resource.

In a small but heavily developed and highly populated state like Connecticut, where available habitat continues to decline on a daily basis, it is critical to maintain and enhance existing wildlife habitat. The following practices will help to improve conditions within the various habitat types.

Forestland Guidelines:

1. Create a diversity of habitat by making small irregularly shaped openings (¼ to 1 acre) in an east to west direction (to obtain maximum sunlight). This will encourage fruit producing shrubs valuable to many types of wildlife. Edges of openings should be feathered (gradually blended into the forest type).

2. Pile brush along edges of openings for small mammals and birds.

3. Maintain 5 to 7 snag trees per acre as they provide nesting and escape cover.

4. Encourage the release and expansion of aspen clumps. The buds are a preferred food of ruffed grouse.

5. Release, prune and fertilize existing apple trees.

6. Enhance distribution of small clumps of conifer (1/8 -- ½ acre) with white pine seedlings.

7. If a timber harvest is planned these practices should be followed:

   a. Encourage mast producing species (oak, hickory, beech).
   b. Leave 5 to 7 snags per acre.
   c. Exceptionally tall trees are utilized by raptors for nesting and perching and should be encouraged.
   d. Trees with vines (berry producers) should be encouraged.
   e. Create small openings with feathered edges.
   f. Construct small brush piles.
   g. Release aspen clumps.
   h. Release apple trees.

Wetland Guidelines:

1. Leave buffer strips (100 feet) of natural vegetation along wetland areas to help filter and trap silt and sediments which might otherwise reach the site.

2. If geese are desired the two (2) islands should be cleared of woody vegetation and be maintained with herbaceous growth.

3. Maintain areas with open edges around pond for ground nesting birds, as well as thickly vegetated protions for otherwildlife species.

Open Fields Guidelines:

Early successional stage vegetation which is essential to many wildlife species, is limited in Connecticut. This habitat type (agricultural fields, pasture, reverting fields, etc.) should be encouraged.

1. Encourage utilization by local farmer.

2. Hay and/or sweetcorn should be maintained over silage corn (to provide cover).

3. Hay fields should not be cut prior to July 1 to avoid possible damage to nesting birds and mammals. Also, a fifteen (15) foot border should be left surrounding the fields. The zone should be mowed every 3 to 5 years (after July 1) to maintain early successional vegetation. Mowing of borders should be scheduled on a staggered basis.

4. Reverting fields should be mowed every 3 to 5 years to maintain early successional vegetation.

5. Large agricultural fields should be broken up with hedgerows.

6. Placement of bluebird boxes along edges of fields.

It should be recognized that the optimum wildlife habitat potential a variety of successional stage vegetation must be encouraged. Proper maintenance of openings and field borders needs to be conducted.

Another potential use of the study site would be the development of an environmental education trail system with an accompanying informational pamphlet. If any of the management recommendations are carried out they should be added to the guide (i.e. small openings, brush piles, aspen releases, bluebird boxes). Discussion should center around vegetation succession and its value in wildlife management.

Habitat development projects could also be used to provide excellent educational benefits for youth groups:

1. Install bluebird boxes along with cataloging yearly nest box results.

2. Numerous studies to document wildlife diversity and abundance according to habitat types.

   a. Bird transects
   b. Small mammal trapping
   c. Amphibian and reptile sampling
   d. Vegetation transects and photographic plots

3. Have youth groups do some aspen releases, trail clearing, construction of brush piles, placement of bird houses, etc.

Further assistance is available from the DEP Western District Headquarters at 485-0226.

10. FISH RESOURCES

A snorkeling survey of the pond found at the Fisher Meadows site revealed that largemouth bass, yellow perch, white suckers, and bluegill sunfish inhabit the pond. Other species expected to be present would be common and golden shiners, chain pickerel, pumpkinseed sunfish, rock bass, brown bullhead, carp, and possibly smallmouth bass. The fishery appears to be well balanced based on the observations of several different age groups of the species of fish observed. The presence of the different age classes of largemouth bass indicates that they are successfully reproducing and should exert some control over the populations of the other fish species. Fishing access to the pond is excellent for both shore and car-top fishermen. A good ratio of shallow to deep water areas exists and some, small patches of aquatic weeds were also observed.

It is the opinion of the Team's fishery biologist that there presently is a scarcity of fish attracting cover (large boulders, weed beds, stumps, brush piles) in this pond. For this reason it is recommended that some sort of fish attracting devices be added to the pond. Fish attracting devices or artificial reefs have proved to be very effective for enhancing small pond fisheries by increasing the amount of suitable habitat for such species as largemouth bass, sunfish and yellow perch. These devices can be easily made from a variety of materials such as old brush, christmas trees, or tires. The materials are tied together, cemented at the base, and sunk at various locations (both deep and shallow) by either placing them on the ice shortly before iceout or with the aid of a boat. They can be marked with small floats to enable fishermen to more easily find them or simply left unmarked. The devices have been shown to work quite well by congregating both fish and fishermen to a specific site. Labor to build the artificial reefs could possibly be supplied from youth groups such as the Boy Scots, Girl Scouts or other organizations. The D.E.P. Western District Fisheries staff could provide some technical assistance in the form of helping with material selection, size and placement of devices, and best time of year to install them.

Fisher Meadows provides public access to the stretch of the Farmington River located within its boundaries. Fish species that would likely inhabit this area are white suckers, fallfish, common shiner, bluegill sunfish, rockbass, smallmouth bass and possibly brown trout.

The river in this area consists primarily of long, sandy-bottom pools interspersed with rocks, driftwood and a small amount of short, shallow riffles. The major source of cover providing habitat for fish is comprised of undercut banks and root systems and shoreline debris extending into the water. The existing overstory of hardwoods provides shade during times of year when solar heating could be detrimental to stream-dwelling fishes. This area of the river is a good fisheries resource and it presently provides a diversity to the Fisher Meadows area.

11. RECOMMENDATIONS FOR RECREATION USE

Existing Uses: Major use areas or uses include:

1. An excellent ballfield complex on the level, well-drained meadow at the southwestern corner of the property.

2. The pond, which reportedly provides good fishing especially for largemouth bass and which offers opportunity for small boating. Several roadside picnic sites were noted on the westside of the pond and the unpaved roadway circling the pond receives use by walkers and by joggers.

3. Agriculture, which occupies the bulk of the remaining, moderately to well-drained soils.

4. Reverting land, including a relatively small acreage around the margin of the pond and to its west, north of the ballfied complex.

5. Wooded land, including riverbank areas, several poorly drained drainage swales and the narrow northern end of the property.

Recommendations:

In general the Fisher Meadows seems to be well managed in terms of its physical character and few corrective measures seem needed. Various comments on opportunities and problems are as follows:

1. The best use for the pond should continue to be for fishing and small boating (canoes, sailboats). Non-polluting electric-powered boats also may be a possibility, although it is understood there is resistance to anv tvpe of machine-powered boats in this waterbody. If there is any volume of oxygenated deep water, the pond may have limited potential for supporting a permanent population of trout. However, it could be an attractive seasonal put-and-take trout pond.

There may also be some merit in considering the pond's future potential for swimming, although periodic flooding will pose serious constraints as in development of sanitary facilities. Nevertheless, the existing volume of the pond, enhanced by natural groundwater inflow and possible inflow from a nearby well or wells, which could be developed, may be able to provide the potential for a moderate volume of swimming use, with the facility supported by portable toilets.

2. The large ballfield complex has no apparent need for improvement and would be a major asset to any community.

3. The maintenance of the bulk of the remaining good soil in active agriculture is commendable and should be continued. As development gradually squeezes out agriculture in the surrounding uplands, floodplain land may remain the sole landbase supporting the continuance of local farming. Therefore, Avon should actively encourage the lease to and active use by local farm operations. As several meadows, especially toward the northwestern section of the property seem to be of increasingly marginal quality, a lease policy should permit leases of a length which would encourage fertilizing, liming, reseeding, etc.

4. The currently wooded acres basically should be kept as is to maintain the stability of riverland and drainage swale areas.

5. Flood-caused erosion at the culverts draining the pond and the swale west of the pond need to be corrected to permit vehicular passage for patrol, rescue, fire, etc. Although high water may unavoidably cause scouring at these locations at certain periods during the rise and fall of the water level, more riprapping and periodic repair should make this a manageable problem.

6. The circum-pond roadway makes an excellent walk and should be designated and promoted as such.

7. A few additional pondside picnic sites should be considered if the demand appears to warrant it.

8. The roadway running the length of the property from near the junction of Country Club and Old Farms Roads to the pond - ballfield area offers the potential for a recreational trail and could be considered as a key link in developing a townside system of recreation trails and/or bikeways.

9. The considerable stretch of access to the Farmington River provides a major opportunity for protection of the scenic corridor of a significant stream and for public access for fishing and canoeing.

10. As part of a possible canoe camping "trail" on the Farmington River, consideration should be given to location of a primitive canoe campsite in an appropriate location on some Town-owned property in Avon. A more likely location in Avon may well be at the former Alsop Property southerly of Route 44, although the north central portion of the Fisher Meadows tract also may deserve consideration.

12. PLANNING AND LANDSCAPE ARCHITECTURE

The purpose of this section is to briefly provide some recommendations regarding management, maintenance and use of the Fisher Meadows property. As a preface to making a few recommendations a discussion of the aesthetic and natural resource attributes of the site is in order.

During the field visit ot Fisher Meadows the scenic beauty and environmental diversity offered by the site was most impressive. A particular advantage of Fisher Meadows is that approximately 40 acres are being used for agricultural use (mainly hay) based on an agreement with the former owner. The fields used for agriculture provide improved views both within the site and vista's to Talcott Mountain. Naturally, the open fields provide a more diverse habitat for wildlife than would strictly a forested site. The Parks and Recreation Director informed the Team that the gentleman who is currently farming the 40 acres in Fisher Meadows is considering retirement. An issue raised here is the desirability of utilizing a portion of the site for agricultural use and how to plan for this inthe long term. Recommendations regarding this issue will be given later in this section.

A major manmade feature of the site which is important to discuss is the ±30 acre pond created when a sand and gravel pit was allowed to fill in with spring water. The pond provides a scenic backdrop for the playing fields at the southern end of Fisher Meadows. Also, it adds an important recreational amenity to the site with excellent fishing and boating opportunities (canoes, rowboats, sailboats). The pond has not been developed for swimming and considerable work would be required to create a beach area. Although water quality was high on the review day (following several days of rain), town officials informed the Review Team that it may be a problem at times during the summer. Apparently a method to create an inflow of water into the pond by diverting a stream is being considered. Creating the inflow of water during summer months would improve water quality, thus making swimming feasible.

It is the Team Planner's opinion that the negative effects of dredging, disruption of aquatic vegetation and changing the natural character of the site would outweigh the advantages of creating a swimming area. Further reason not to pursue this idea is that the Town of Avon already has two (2) public swimming facilities.

Since the majority of the Fisher Meadows site is forested, a brief discussion of this resource and suitable management techniques is appropriate. In walking the site the Planner was impressed with the fact that forested areas vary from mature forest with little understory and a dense canopy to more of woodland with trees of varying heights and a pronounced understory. Since other Team members with greater expertise in forestry have addressed timber management in more detail, the intent here is to note a few simple observations from the perspective of a planner/landscape architect. Without mentioning species it is suggested that the mature forest areas with the tallest trees and least understory should be left untouched since that type of forest is somewhat unique and not commonly found in this area. Denser forested areas with thick understory growth should be selectively thinned out to promote better growth among healthy trees and to remove dead, damaged, or diseased trees. Particularly in areas along the Farmington River a selective thinning would allow better access to the river for hiking, fishing, and potentially for an access point for canoeing. Naturally, before undertaking any type of cutting program the potential effects on wildlife (notably a sizable deer population) should be analyzed.

As just mentioned, access to the Farmington River is a significant issue when considering potential uses of Fisher Meadows. Although the river delineates the eastern border of the site, it is not visible from the developed portion of the site, and access to it is difficult at best, due to dense vegetative growth. Since vehicular access has been limited to the extreme southern portion of the site (for security reasons) the most suitable area for a canoe landing could not presently be reached by automobile. Because the portion of the Farmington River bordering the site is slow moving and particularly suitable for safe canoeing, it would make a good deal of sense to develop an access point. The quality of experiencing Fisher Meadows would be improved if the beauty of the Farmington River could be observed and enjoyed.

A final comment before going to specific recommendations is directed at the need for additional playing field. The Parks and Recreation Department Director informed the Team that there is a need for additional soccer fields for practice purposes since the existing soccer and softball fields are maintained in excellent condition and their appearance certainly adds to the beauty of Fisher Meadows. The flat area directly adjacent to the soccer fields which had previously been farmed is being considered for additional playing fields. It was suggested that rough fields could be created simply by mowing the existing grass. It is suggested that this would be feasible, however, the area would have to be rolled and top dressed in areas with some additional seeding required. In the Planner's opinion addition of two (2) practice soccer fields somewhat smaller than regulation size as suggested by Town officials would not detract greatly from aesthetics of the site and would allow for increased recreational uses.

Recommendations:

1. Maintain approximately 40 acres of the site in active agricultural use. If the farmer currently working the land retires and ceases his operation than arrangements should be made with another local farmer to continue working the existing fields.

2. Do not develop a swimming area at the pond, but do promote use for fishing and non-motorized boating. It may be appropriate to develop a landing area for small boats to deter erosion on the steeper embankments and disruption of aquatic vegetation in shallow areas.

3. A selective cutting plan should be developed to thin-out densely forested areas with heavy undergrowth. In the southern portion of the site, closer to the areas used for active recreation, cutting should be geared to providing better access to the river, promoting improved growth of trees (by allowing more light to penetrate the canopy), and to eliminate damaged or unhealthy trees. Particularly in this area closest to where most people visit the site, trees to be cut should not be chosen based on their commercial value. It would be more appropriate to allow cutting of the more commercially valuable trees in less accessible portions of the site in order to generate a positive cash flow to offset maintenance costs.

4. From a design standpoint, the Planner strongly recommends that development of a canoe landing area be considred. Establishing a direct connection to the Farmington River would both functionally and visually help to define Fisher Meadows as a park offering a variety of recreational opportunities.

5. Two (2) practice soccer fields should be developed adjacent to the existing fields. Smaller than regulation fields would be adequate; 80 yards by 50 yards, is suggested.

6. A final recommendation is that a marked trail be developed to connect the southern portion of the site with an existing trail in the northern portion. Such a trail could offer an opportunity to view the Farmington River. If a trail is developed care should be taken not to interfer with frequently used deer runs which are prevalent where the forested and agricultural areas meet.

13. SUMMARY

NOTE: This is a brief summary of the major points, concerns and recommendations of the Team. You are strongly urged to read the entire report, and to refer back to specific sections in order to obtain all the information about a certain topic.

GEOLOGY: Page 5

--The greatest limitation of the alluvial soils, which comprise the bulk of the site, is that they are subject to inundation during flooding events.

--The bedrock beneath the site is quite deep and should not pose any problems in terms of active or passive recreation uses.

HYDROLOGY: Page 10

--Groundwater for most of the parcel is classified GA by DEP, which means that the water is suitable for private drinking water supplies without treatment.

--The section of the Farmington River that flows through the site is classified as B_{bc}. Which means that is may be suitable for some recreational purposes (not bathing), agricultural uses, certain industrial processes or cooling, excellent fish and wildlife habitat and good aesthetic value.

--The surface water classification for the pond/lake is "A" which means that it may be suitable for drinking water supply and/or bathing, suitable for all other water uses, character uniformly excellent, and may be subject to absolute restrictions on the discharge of pollutants.

--According to the FEMA Flood Boundary and Floodway Maps for Avon, nearly all of Fisher Meadows lies within the floodway fringe. This area must be kept free of encroachment in order to assume that the 100-year flood levels would not be raised significantly (more than a foot).

--Hydrogeologic testing would be required in order to obtain a firmer estimate of the sites water supply potential.

WETLAND SETTING AND MANAGEMENT: Page 11

--The wetlands on the site need little remedial work or management.

--Repair of the washout at the lake outlet is mostly significant and urgent.

--Improved access to the river and a potential bathing beach creation at the lake should be carefully studied and designed to avoid environmental degradation.

SOIL RESOURCES AND FUTURE LAND USE: Page 12

--Any investment in future recreational facilities should consider the costs associated with flooding and flood damage.

--It is important that the site's agricultural potential and the loss of prime farmland soils be considered if the future expansion of recreational facilities should take place.

--An erosion problem exists on the western shore of the lake. A possible solution would be to stabilize this portion of the shore with flood tolerant plants.

--The other problem area at the lake outlet should be repaired, a properly sized culvert and crossing or a riprapped channel with a bridge crossing is needed.

--The turf farming operation on the east side of the river should follow proper turf farming methods and management to minimize soil losses. The accumulation of soil materials from flood events would offset any loss from turf harvesting.

VEGETATION: Page 17

--The value of the wood on the property is moderate. A commercial timber sale while economically feasible would not be recommended because of the site's current use and the close proximity of the sawtimber stands to the lake/pond and the Farmington River.

--The real value of the site's woodland is the aesthetics and the water storage capacity in flooding situations. It also provides a renewable natural resource, a diversified wildlife habitat and sites for passive recreation.

--Forest management should be limited to boundary line maintenance and cutting to maintain field edges and access roads. The softwood plantation would benefit from thinning out the softwoods and removing the competing hardwoods.

FLOODPLAIN HABITAT: Page 18

--Fisher Meadows contains a well developed floodplain forest with a rich diversity of plant species and wildlife. It is somewhat unique because much similar habitat has been destroyed and encroached upon.

--Fisher Meadows contains a small, but healthy population of Virginia Waterleaf (Hydrophyllum virginianum L.) This species is listed by the Connecticut Natural Diversity Data Base as infrequent or declining.

--The floodplain forest is a habitat of significant statewide concern. It contains a representative vegetation type of limited occurrence and a healthy population of a State declining plant species.

--The area should be used primarily for passive recreation and offers unlimited potential for local educational groups.

WILDLIFE HABITAT AND MANAGEMENT: Page 35

--Overall the site has a good mixture of wildlife habitat types. An adequate edge habitat has been created which is very valuable to insure a rich and diverse wildlife resource.

--There are numerous guidelines for each habitat type which will maintain and enhance the existing conditions.

--The study site could also be used for the development of an environmental education trail system, and habitat development projects could be used to provide educational benefits for youth groups.

FISH RESOURCES: Page 38

--A snorkeling survey of the lake/pond revealed that the fishery appears to be well balanced based on the observations of several different age groups of the fish species observed.

--Fishing access to the pond is excellent and there is a good ratio of shallow to deep water and some small patches of aquatic weeds were observed.

--There is presently a scarcity of fish attracting cover. It is recommended that some sort of fish attracting devices be added to the pond.

--The Farmington River area of Fisher Meadows provides a good fisheries resource and provides a diversity to the area.

RECOMMENDATIONS FOR RECREATION USE: Page 39

--The best use of the pond should be for fishing and small boat use.

--There is the potential to create a moderate volume swimming area, with the facility supported by portable toilets.

--The use of some of the land for active agriculture is commendable and should be continued. The Town should actively encourage the use by local farm operations.

--The circum-pond roadway should be designated and promoted as a walkway trail.

--Additional pondside picnic areas should be considered if there appears to be a demand for them.

--The roadway trail running the length of the property has the potential for a recreational trail and could be considered as a key link in developing a townwide recreation/bike trail.

--The access to the Farmington River provides an opportunity for protection of the scenic corridor, and for public access for fishing and canoeing.

--As part of a canoe camping "trail" consideration should be given to location of a primitive campsite in an appropriate location on some Town-owned property. (i.e. former Alsop Property south of Route 44).

PLANNING AND LANDSCAPE ARCHITECTURE: Page 41

--It is the Team Planner's opinion that the negative effects of creating a swimming area and the fact that the Town already has two (2) public swimming facilities would outweigh the advantages of creating such an area.

--From a design standpoint it is recommended that the development of a canoe landing area be considered. This would greatly enhance the recreational opportunities at Fisher Meadows.

--Two (2) practice soccer fields should be developed adjacent to the existing fields. These should be smaller than regulation size.

--Selective cutting should be geared to providing better access to the river, promoting improved growth of trees and to eliminate damaged or unhealthy trees.

About The Team

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

The Team is available as a public service at no cost to Connecticut towns.

PURPOSE OF THE TEAM

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

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

REQUESTING A REVIEW

Environmental reviews may be requested by the chief elected officials of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the Chairman of your local Soil and Water Conservation District. This request letter should include a summary of the proposed project, a location map of the project site, written permission from the landowner allowing the Team to enter the property for purposes of review, a statement identifying the specific areas of concern the Team should address, and the time available for completion of the ERT study. When this request is approved by the local Soil and Water Conservation District and the Eastern Connecticut RC&D Executive Council, the Team will undertake the review on a priority basis.

For additional information regarding the Environmental Review Team, please contact Elaine A. Sych (774-1253), Environmental Review Team Coordinator, Eastern Connecticut RC&D Area, P.O. Box 198, Brooklyn, Connecticut 06234.