KING'S MARK ENVIRONMENTAL REVIEW TEAM

REPORT FOR

LYMAN MEADOW GOLF COURSE

MIDDLEFIELD,
CONNECTICUT

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

LYMAN MEADOW GOLF COURSE

MIDDLEFIELD, CONNECTICUT

Environmental Review Team Report

Prepared by the King's Mark Environmental Review Team
of the King's Mark Resource Conservation
and Development Area, Inc.

Wallingford, Connecticut

for the

Middlefield Inland Wetlands Commission

This report is not meant to compete with private consultants by supplying site designs or detailed solutions to development problems. This report identifies the existing resource base and evaluates its significance to the proposed development and also suggests considerations that should be of concern. The results of the Team action are oriented toward the development of a better environmental quality and long-term economics of the land use. The opinions contained herein are those of the individual Team members and do not necessarily represent the views of any regulatory agency with which they may be employed.

NOVEMBER 1990

ACKNOWLEDGMENTS

The King's Mark Environmental Review Team Coordinator, Nancy Ferlow, would like to thank and gratefully acknowledge the following Team members whose professionalism and expertise were invaluable to the completion of this study:

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EXECUTIVE SUMMARY

Introduction

The Middlefield Inland Wetlands Commission requested a review of the Lyman Meadows Golf Course expansion. The approximately 145-acre site contains a combination of woodland and agricultural fields with many areas of wetlands. Half of the site is located in the Coginchaug River floodplain. The developer proposes to expand the existing golf course by adding 18 holes for a total of 36 holes. Plans include excavating 4 ponds in the wetlands and using several areas of wetlands for fairways. Some wetlands will be filled to accommodate tees, sand traps, greens and safety berms to separate fairways.

The review process consisted of 4 phases: 1) inventory of the site's natural resources; 2) assessment of the resources; 3) identification of resource problem areas; and 4) presentation of planning and land use guidelines. Based on the review process, specific resources, areas of concern, development limitations and development opportunities were identified.

Location, Zoning and Land Use

The site is located in southern Middlefield near the Durham Town Line. Zoning for the site includes a residential zone and an agricultural zone. Golf courses are not allowed by right in the agricultural zone and will require a special permit. The site contains fruit orchards, open fields, wooded land and floodplain forest. Surrounding land uses include residential, agricultural and industrial uses.

Project Description

The project consists of an 18 hole golf course on approximately 145 acres. The proposed "front 9" holes will be on uplands, and the "back 9" will be on the floodplain. Approximately 52 acres of wetlands will be disturbed. No expansion of the existing facilities is planned at present.

Topography

The site contains 2 major topographic features: the drumlin and the floodplain. Slopes range from flat to moderately steep. The maximum and minimum elevations are approximately 340 and 150 feet above mean sea level, respectively.

Geology

Bedrock underlying the site consists of the Portland Arkose. Exact depth to bedrock is unknown, but it should pose no limitations to development. The bedrock is covered by glacial till and stratified drift. The texture of the till ranges from sandy and loose on the south and west parts of the drumlin to silty and compact on the north and east. A hardpan layer in the compact till results in a seasonally high watertable. Cuts in the hardpan are difficult to stabilize. A small area of stratified

drift is located on the west flank of the drumlin. Finer grained stratified drift is located in the floodplain. Post glacial alluvial deposits cover the stratified drift in the floodplain.

The alluvial deposits have severe limitations for golf courses. To overcome these limitations, the applicant proposed to fill for the tees, greens and fairway berms. Additional wetlands will be disturbed by clearing and filling. If possible, bridges should be used to cross wetlands rather than fill, and all disturbances should be minimized. Erosion and sedimentation is a concern and should be addressed.

Sewage Disposal/Water Supply

According to the plans, new buildings or expansion of existing buildings is not proposed. The new golf course will have some impact on the existing well(s) and septic system(s), especially during peak playing periods. This should be evaluated by the applicant. Projected flows due to additional golfers may indicate the need to expand the present well(s) and septic system(s). Soil data indicated that the areas northeast and southeast of the clubhouse are marginal for on-site sewage disposal. Detailed soil testing should be conducted to determine the suitability. Bedrock is the principal source of water for any expanded facilities.

Hydrology

The entire site eventually drains to the Coginchaug River. Surface runoff from the eastern half of the site flows directly to the Coginchaug River. The central parts drain to an unnamed watercourse which flows into Lyman Meadow Brook. The northwest corner drains to Lyman Brook via 2 small, unnamed watercourses. The southwest corner drains either directly to Sawmill Brook or to an unnamed tributary. The Coginchaug River is a Class Bc water resource that is known or inferred to be degraded and considered a coldwater fishery. Sawmill Brook is a Class B/A water resource and is known or inferred to be degraded by the small landfill on the site. The State's goal is to upgrade the quality to Class A. The remaining watercourses have not been classified and are assumed to be Class A. Groundwater on the site is classified as GA except for the water under the landfill which has been degraded.

A golf course is considered an intermediate risk to groundwater quality. A comprehensive fertilizer/pesticide management plan has been submitted. Providing the plan is closely followed, the potential adverse impacts to water quality should be minimized. The ponds proposed for the floodplain will be excavated below the watertable. Based on the water budget and plan, irrigation water from the ponds can be withdrawn with little or no impact on the Coginchaug River. This should be illustrated by cross-section for the Commission members. Proposed conservation measures should reduce the impact during low water periods. The construction of the ponds may cause some turbidity of the water. Ponds should be excavated fist and the fine sediment allowed to settle before the hydrologic connection to the watercourse is made.

Flooding Impacts

The eastern half of the site lies within the 100-year floodplain for the Coginchaug River which includes the floodway fringe and the floodway. The floodway includes the channel of the river and the adjacent floodplain that must be reserved to discharge the base flood without increasing the flood level by more than 1.0 foot. Because these boundaries are important, they should be superimposed on the plans. The project will involve some fill in the designated floodway. The hydraulic analysis prepared by the applicant attempts to establish a revised floodway configuration. The Town should request a revision to the floodway boundaries from FEMA. The filling activity in the floodway poses a flooding risk, and alternate plans should be considered for the floodway areas.

Soil Resources

Limitations for the soils on the site include moderate to severe erosion hazard, hardpan soils, wetness and frequent flooding. A soils map was not provided for the review. The wetland boundaries appear reasonable as shown. Additional work was done for the Army Corps permit application as required. A major portion of the upland acreage, which might be used as an alternative site, contains unique farmland. It is the policy of the State and Federal government to preserve farmland wherever possible.

Erosion and Sediment Control

The Army Corp permit application contains general recommendations for E&S control, as do the plans. The Connecticut Guidelines for Soil Erosion and Sediment Control should be followed. Items which should be addressed include a narrative, a plan map, the name of the responsible party, a detailed construction sequence, location of all disturbed land, the wetland crossing for Hole 4, the grading details for Fairway 8, the boundaries of the "disturbed wetland," details for the ponds, the 9% grade near Hole 10, stabilization for subsurface drain outlets, details for fill close to the streambanks, drain tile location and E&S controls for the cart paths.

Water Quality Considerations

If properly managed, the project should have little effect on the quality of the water in the Coginchaug River. Some additional concerns that need to be addressed include E&S control, details on full management of the fertilizers and pesticides, control of aquatic vegetation in the irrigation ponds and disturbance to the floodplain.

Wetland Resources and Impacts

The project will affect approximately 52 acres of wetlands with a variety of habitats. The impact to the upland wetlands is relatively minor compared to the impact on the floodplain. The functional value for the floodplain wetland is enhanced by its large size. Floodplain forests are considered critical habitat, especially for songbirds and floodplain plant species. The Smallflowered Agrimony is found on the site and is being evaluated for protection under the new State listing.

Durham Meadows has been identified as critical habitat for 4 "Species of Special Concern." One of these will be directly affected by the project and the other 3 will be affected by encroachment into the buffer. The Coginchaug River is considered an important fishery. Activity in the floodplain should be avoided where possible. The proposed impacts to the floodplain can be mitigated only by reducing the level of activity.

Wildlife Considerations

The major wildlife habitats on the site are mixed hardwoods, open fields and wetlands. Development will affect the upland wooded habitat by fragmentation and loss of habitat. It will affect the wetland habitat through sedimentation, pollution from stormwater, vegetation clearing, habitat alteration and barriers to animal movement. A buffer zone around the wetlands should minimize impacts to wildlife. Development will affect the open field habitat through a loss of diversity. Some methods to mitigate impacts include using natural landscaping techniques, utilizing buffers, maintaining hedgerows and stonewalls, maintaining forest wildlife requirements and constructing ponds outside of the wetlands whenever possible.

Fishery Resources

The Coginchaug River supports a diversity of coldwater and warmwater fish species. The project will cause a permanent loss of floodplain wetlands and their value for water storage, sediment trapping and habitat. Filling the wetlands and using the ponds for irrigation may affect the streamflows in the river. Loss of the riparian vegetation can affect the fisheries in the river. Increases in temperature are a major concern, especially for the coldwater trout fishery. Erosion and sedimentation is also a major concern for the Coginchaug River. Some recommendations include investigating alternatives for the proposed Holes 10-18 in the floodplain and analyzing the affect of irrigation drawdown on the river.

Archaeological Resources

A review of the Archaeological Site Files shows no recorded sites in the project area. However, the Coginchaug River floodplain is a prime area for possible prehistoric occupation due to the proximity of the river and the rich agricultural soils of the floodplain. Known site locations of Indian camps and villages correspond to similar natural settings. The Office of State Archaeology strongly recommends a reconnaissance survey to locate and identify all prehistoric sites. Archaeological sites are relatively shallow, and the landscaping proposals for the golf course expansion could threaten these cultural resources.

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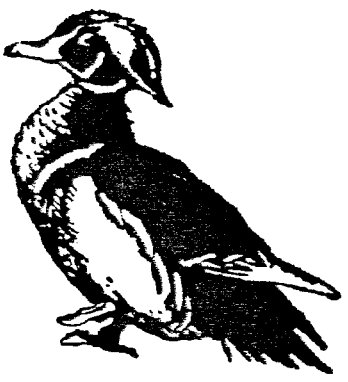


INTRODUCTION

The Middlefield Inland Wetlands Commission requested a review of the Lyman Meadows Golf Course expansion. The approximately 145-acre site is located in south central Middlefield along the Durham border. The site contains a combination of woodland and agricultural fields with many areas of wetlands. Half of the site is located in the Coginchaug River floodplain. Access to the site is provided by Route 147, Route 157 and Lyman Road.

The developer proposes to expand the existing golf course by adding 18 holes for a total of 36 holes. Plans include excavating 4 ponds in the wetlands and utilizing several areas of wetlands for fairways. Some wetlands will be filled to accommodate tees, sand traps, greens and safety berms to separate fairways. The ponds will be used for irrigation and stormwater retention. An existing diversion and the groundwater table should maintain pond water levels. Much of the infrastructure (i.e., clubhouse, parking, driving range, putting green, etc.) currently exists.

The purpose of this review is to inventory and assess existing natural resources and discuss recreational opportunities, erosion and sediment (E&S) controls and the impacts of the proposed development. This environmental information will be used to assist the Town in guiding conservation and recreation in the area. Specific objectives include:

1) Assessing the hydrological and geological characteristics of the site, including geological development limitations and opportunities;

2) Determining the suitability of existing soils to support recreational development;

3) Discussing soil erosion and sedimentation concerns;

4) Assessing the impact of the golf course on water quality;

5) Assessing the impact of the golf course on the wetland and floodplain resources; and

6) Assessing the impact of recreational development on the wildlife and fisheries, including alternatives for consideration.

THE ERT PROCESS

Through the efforts of the Middlefield Inland Wetlands Commission, the developer's representative and the King's Mark ERT, this environmental review and report was prepared for the Town. This report primarily provides a description of on-site natural resources and presents planning and land use guidelines. The review process consisted of 4 phases:

1) Inventory of the site's natural resources (collection of data);

2) Assessment of these resources (analysis of data);

3) Identification of resource problem areas; and

4) Presentation of planning and land use guidelines.

The data collection phase involved both literature and field research. The ERT field review took place on October 16, 1990. Field review and inspection of the site proved to be a most valuable component of this phase. The emphasis of the field review was on the exchange of ideas, concerns or alternatives. Mapped data or technical reports were also perused, and specific information concerning the site was collected. Being on-site also allowed Team members to check and confirm mapped information and identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. The results of this analysis enabled the Team members to arrive at an informed assessment of the site's natural resource development opportunities and limitations. Individual Team members then

prepared and submitted their reports to the ERT Coordinator for compilation into the final ERT report.

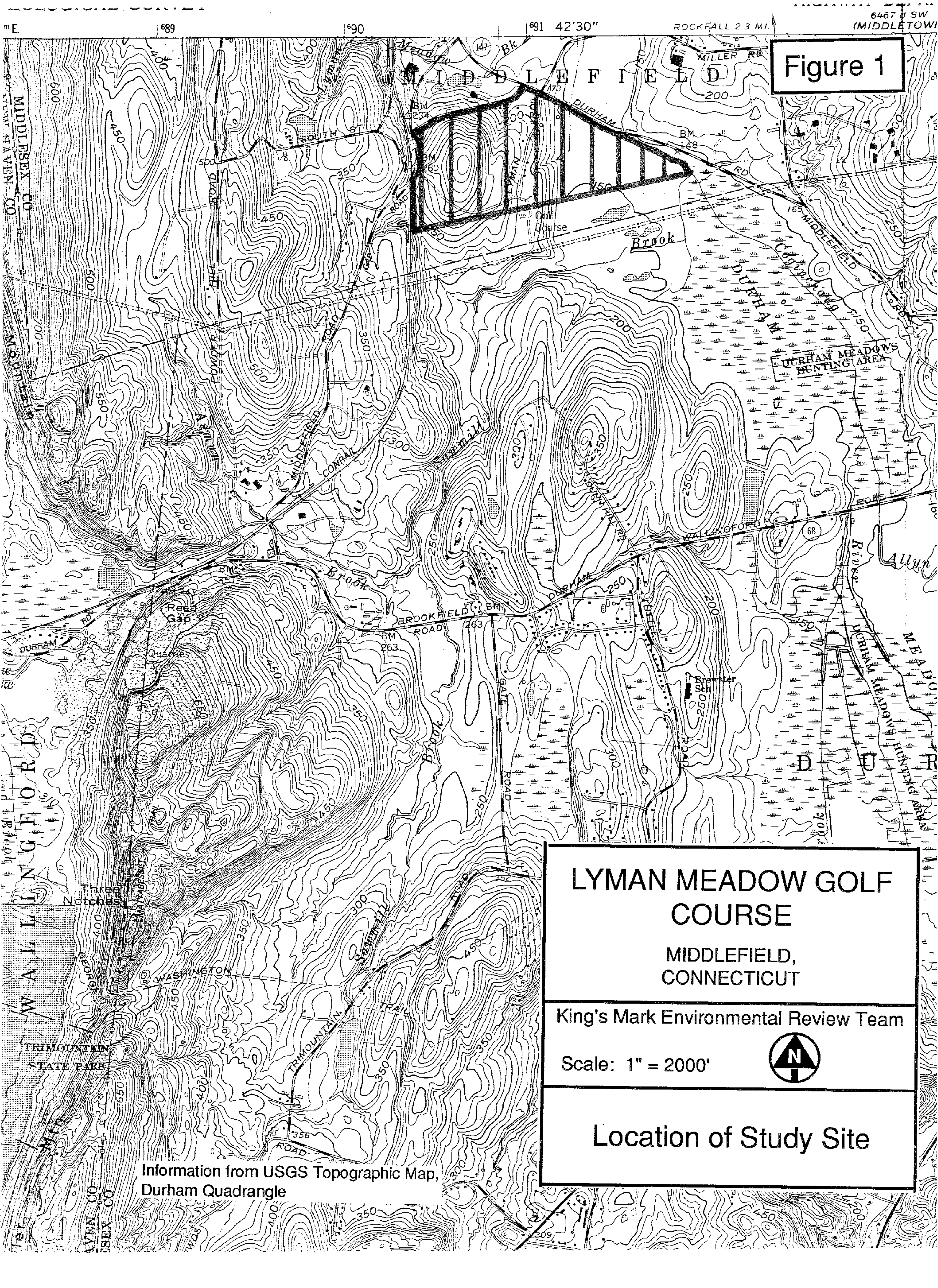


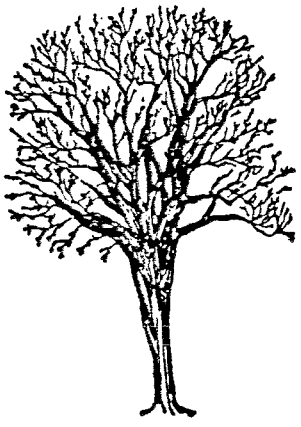
Figure 1

LYMAN MEADOW GOLF COURSE

MIDDLEFIELD, CONNECTICUT

Location of Study Site

PHYSICAL CHARACTERISTICS



LOCATION, ZONING AND LAND USE

The Lyman Meadows Golf Course expansion site is approximately 145 acres in size and is located in southern Middlefield near the Durham Town Line. The site is bordered on the south by the Lyman Meadows Golf Club, an approximately 100-acre 18-hole golf course which includes a driving range, clubhouse and restaurant, on the west by a Conrail right-of-way and Route 157, on the north by South Street Extension and Route 147 and on the east by the Sawmill Brook/Coginchaug River floodplain (northern parts of Durham Meadows). Access is available via Lyman Road which traverses the site from Route 147 to Route 157.

Approximately 30 acres of the site is located in a MD zone which allows residential buildings on 1-acre lots (40,000 square feet or more). The remainder of the site is located in an AG2 zone which permits agricultural land uses and residential buildings on 2-acre lots (80,000 square feet or more). Construction of an 18-hole golf course is not compatible with the AG2 zone and will require a special permit.

The site consists of fruit orchards, open fields that are mowed, hedge rows and a floodplain forest (eastern parts). There is also wooded land in the northwest corner near proposed Holes 4 and 5. Several residential and farm/fruit orchard buildings are located along Lyman Road south of Route 147. An abandoned landfill is located in the western part of the site. Surrounding land uses include residential, agricultural and industrial uses.

PROJECT DESCRIPTION

The proposed project consists of an 18-hole golf course on 145 acres of floodplains, wooded areas and open fields which include fruit trees. In general, the "front 9" are located on uplands and the "back 9" on floodplains. In all,

approximately 52 acres of regulated areas (i.e., wetlands/floodplains) will be disturbed for the construction of the proposed 18-hole golf course. Approximately 85% of this disturbance will result from filling, excavating and modifying the Coginchaug River/Sawmill Brook floodplain. No expansion of the existing clubhouse and restaurant is proposed at present. With construction of the golf course, South Street Extension will be eliminated. Plans include constructing 4 new ponds in the Coginchaug River floodplain by excavating/dredging below the watertable. These ponds will be used for aesthetic and irrigation purposes, as well as water hazards for the golf course. The ponds will be hydraulically connected by subsurface piping to the largest irrigation pond which serves the existing Lyman Meadows Golf Course. According to information supplied, an existing water diversion hydraulically connects Sawmill Brook to the existing irrigation pond. This water diversion is registered with Department of Environmental Protection (DEP) at 1.1 million gallons per day (gpd). Withdrawal from this watercourse occurs only during periods of high flows (approximately 5 months out of the year).

TOPOGRAPHY

The site contains 2 major topographical features: the Coginchaug River floodplain which is located in the eastern portion of the site and a drumlin hill which takes the shape of an inverted spoon and is located in the western half of the site (see Figure 2). The drumlin's shape was created from the smoothing action of overriding glacial ice.

Slopes on the site range from flat to moderately steep. Flat slopes occur throughout the Coginchaug River floodplain mainly east of the 150-foot contour. Moderately steep slopes flank the drumlin hill. Additionally, the land area in the central parts that separates uplands from floodplain is moderately sloping.

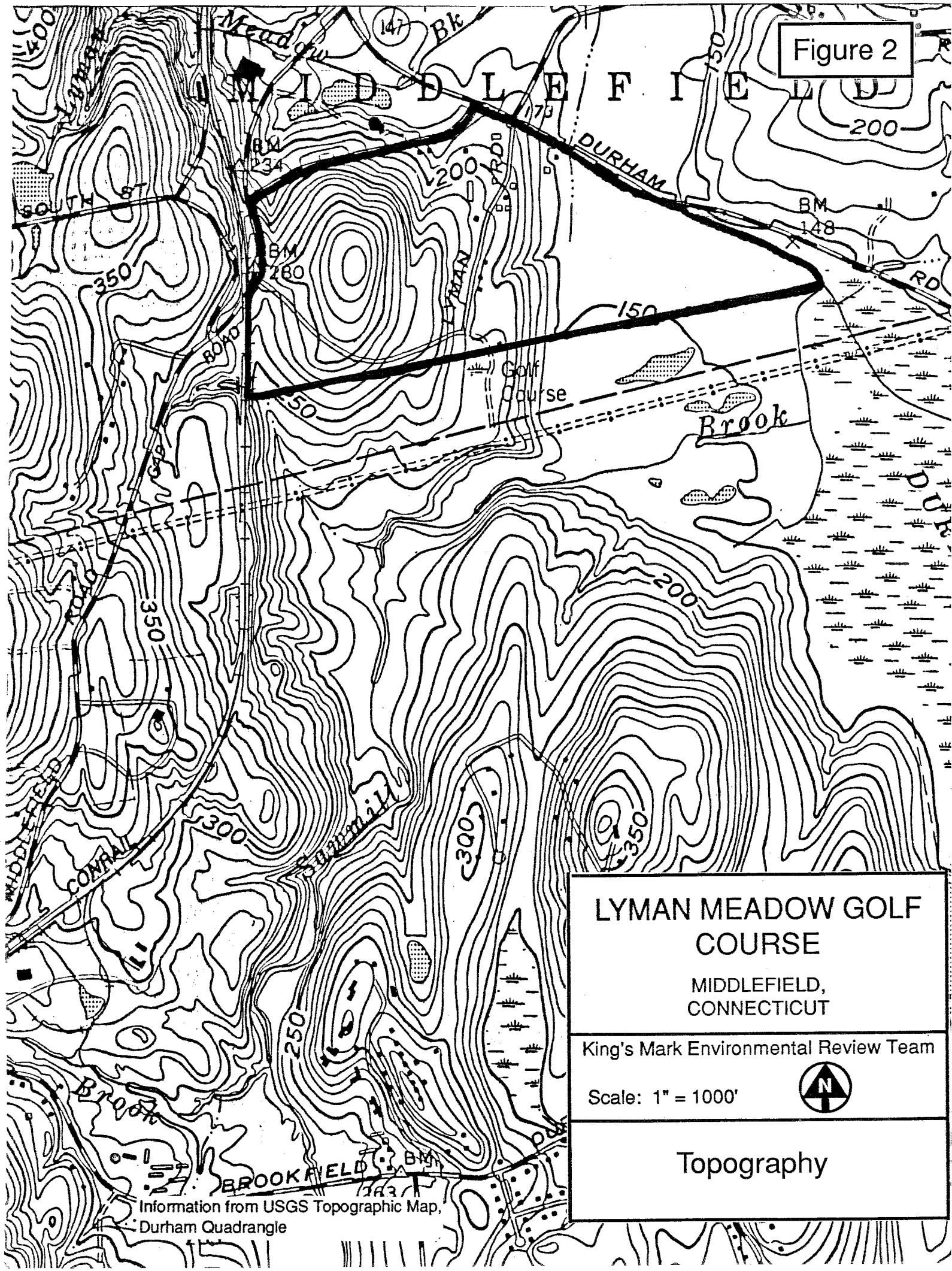


Figure 2
MIDDLEFIELD
Meadow
Bk
147
173
DURHAM
RD
SOUTH ST
BM
234
BM
280
BM
148
LYMAN
Golf
Course
Brook
CONRAIL
Brook
BROOKFIELD
BM
Information from USGS Topographic Map,
Durham Quadrangle
LYMAN MEADOW GOLF COURSE
MIDDLEFIELD,
CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Topography

Maximum and minimum elevations on the site are 340 feet above mean sea level (top of drumlin hill) and 150 feet above mean sea level (Coginchaug River floodplain), respectively.

Due to the moderate slopes which flank the drumlin, some cutting and filling may be necessary to accomplish desired grades for fairway lines-of-sight (i.e., Hole 8). Cut slopes in this area may be difficult to stabilize due to the presence of a compact soil zone (hardpan) which causes a seasonally high watertable condition (see Geology section).

GEOLOGY

The site is located entirely in the Durham topographic quadrangle. A surficial geologic map (GQ-756, by Howard E. Simpson) for the quadrangle has been published by the Connecticut Geological and Natural History Survey. No bedrock geologic map for the quadrangle has been published to date. John Rodger's Bedrock Geological Map of Connecticut (1985) and preliminary bedrock geologic information not yet published for the quadrangle were referenced. This mapping information is available for review at the DEP Natural Resources Center in Hartford.

Based on visual observations made at the field review and the review of geologic mapping data, bedrock does not appear to break ground surface on the site. Rodger's (1985) indicates that the southeastern third of Middlefield, which includes the site, is underlain by Portland Arkose, a reddish-brown arkose (i.e., brownstone) (see Figure 3). The term arkose refers to a sandstone that contains a high percentage of feldspar. Portland Arkose is a sedimentary rock. Sedimentary rocks are composed of bits and pieces of older rocks that were eroded from an area, transported to and re-deposited in another area and then cemented together. The entire process occurred over long periods of time.

The exact depth to bedrock on the site is unknown. In the central parts of the site along Lyman Road, the log of a residential well completion report indicates 40 feet of unconsolidated material above bedrock. A test hole boring, located near Sawmill Brook in the southern parts, advanced through 54 feet of unconsolidated materials before reaching bedrock refusal. As a result, the underlying bedrock should not pose any major obstacles with regard to the construction of the proposed golf course.

The underlying bedrock aquifer may be tapped as a water supply source for drinking water or irrigation water. Sedimentary rock has potential for low, moderate or even high yields, depending to some extent on the depth of the well drilled.

Bedrock on the site is covered by 2 types of glacial sediments: till and stratified drift. In general, glacial till covers the western half of the site (i.e., uplands) and stratified drift covers the eastern half of the site (i.e., lowlands) (see Figure 4). There is a small area of stratified drift (sand and gravel) on the west flank of the drumlin hill. The texture of this material, which was mined in the past, is generally gravelly, but also includes medium sand and cobbles.

The till comprising the drumlin hill consists of varying proportions of reddish-brown sand, silt, gravel, clay and boulders that were deposited directly by glacier ice as it advanced through the region. Particles of different sizes are generally mixed together in a complex fashion.

According to surficial geologic mapping data, the texture of the till on the site varies from a sandy and non-compact (i.e., loose) variety to a siltier variety that is characterized by a hardpan layer. The sandy, loose variety of till covers the west flank and southern parts of the drumlin hill. The remainder of the hill is characterized by the siltier and compact variety of till. The presence of the hardpan layer usually results in a seasonally high watertable condition. During the wet time

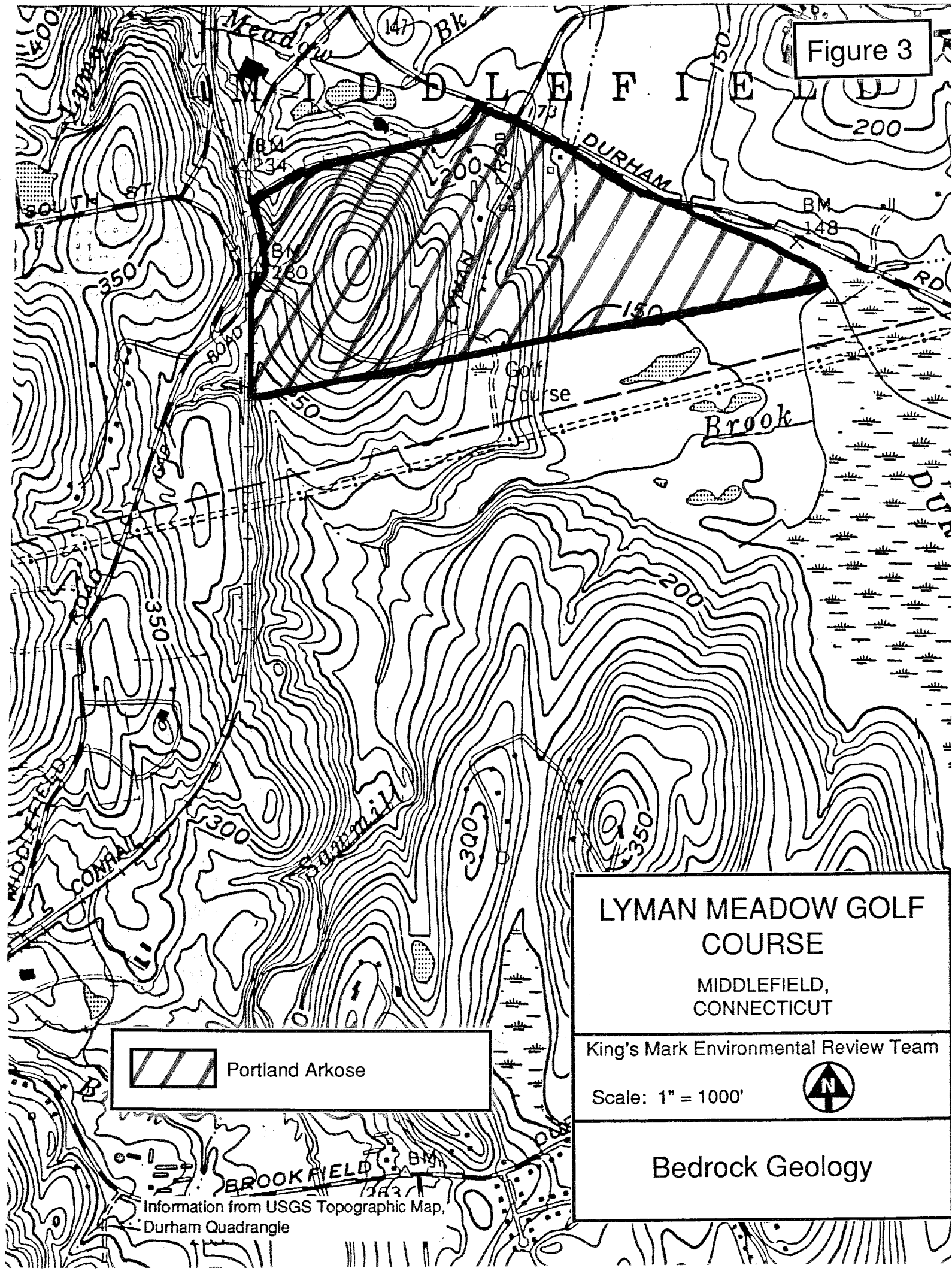


Figure 3
MIDDLEFIELD
Meadow
Bk
DURHAM
BM 134
BM 148
BM 280
SOUTH ST
LYMAN RD
ROAD
Golf Course
Brook
CONRAIL
Summit
BROOKFIELD
BM
350
300
200
150
LYMAN MEADOW GOLF COURSE
MIDDLEFIELD, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
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Bedrock Geology
Portland Arkose
Information from USGS Topographic Map, Durham Quadrangle

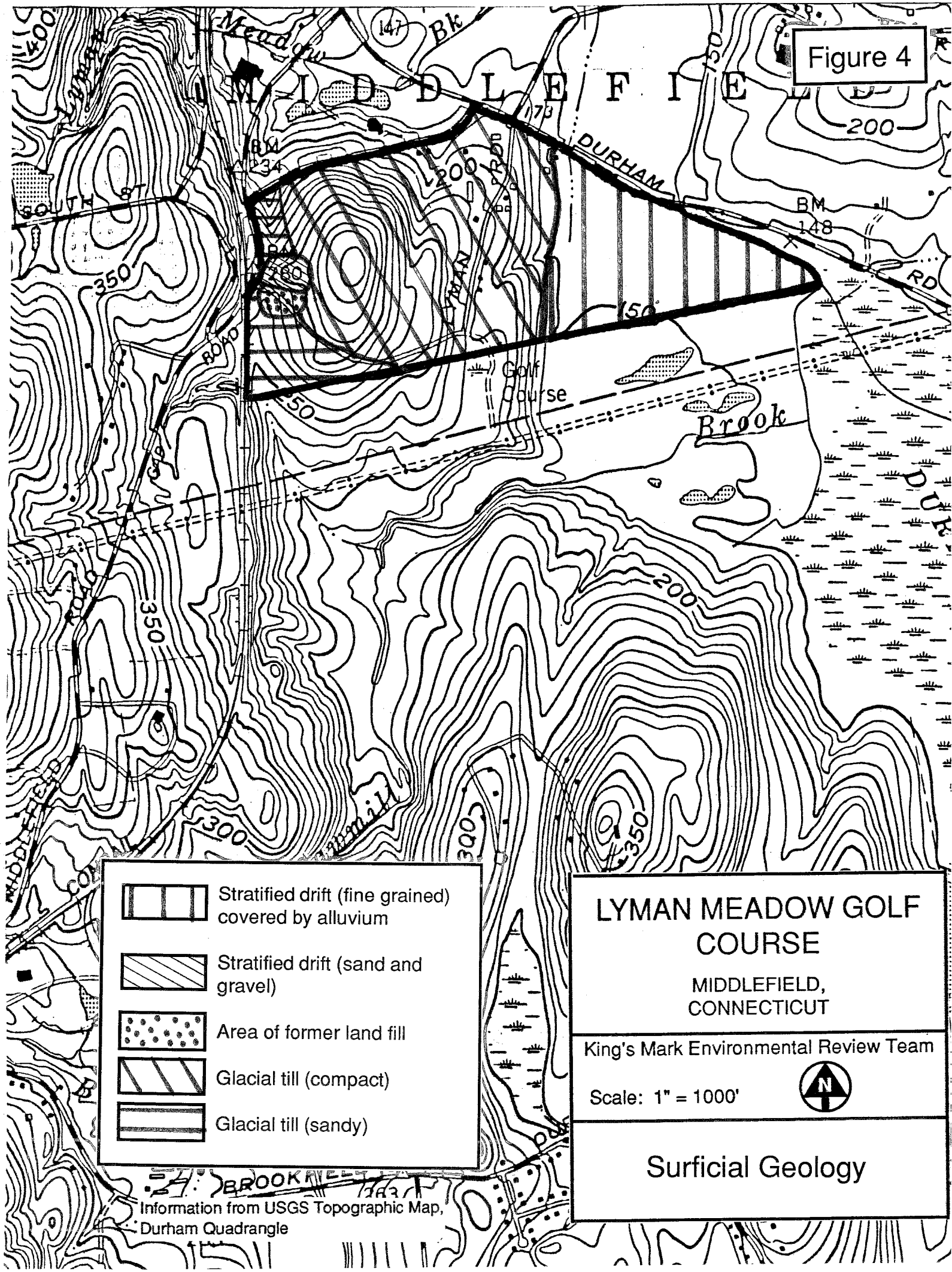


Figure 4
MIDDLEFIELD
Lyman Meadow
Bk
147
DURHAM
BM 234
SOUTH ST
200
BM 148
RD
350
150
Golf Course
Brook
300
Stratified drift (fine grained) covered by alluvium
Stratified drift (sand and gravel)
Area of former land fill
Glacial till (compact)
Glacial till (sandy)
LYMAN MEADOW GOLF COURSE
MIDDLEFIELD, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Surficial Geology
Information from USGS Topographic Map, Durham Quadrangle

of year or following periods of heavy precipitation, the more permeable soil zone that occurs above the hardpan layer becomes saturated, resulting in soggy conditions. This condition may dampen golfer play during wet periods unless drainage is installed to lower the watertable. Also, cuts in hardpan soils are usually extremely difficult to stabilize. This is due mainly to the seepage of water over the hardpan layer which creates an unstable condition below the seepage line. The weight of the unstable soil causes the soil to flow down the slope. Once this begins, the slope is difficult to stabilize. The establishment of good vegetative cover is practically impossible on these eroding slopes. Structural features such as geotextile fabrics and netting may be necessary for stabilization of this area. Groundwater intercepting drains may also be needed in these areas to enhance playing conditions during the months when the watertable is high.

The stratified drift deposits on the site were laid down by glacial meltwater in streams and lakes in front of the retreating ice margin during glacial retreat. These deposits are composed of well-sorted, thin layers of alternating silt and clay or thicker layers of very fine sand and silt. Very fine sand commonly occurs at the surface and grades down rhythmically to bedded silt and clay (i.e., varves). The log of a well located near Sawmill Brook south of the site verifies these textural conditions.

Post-glacial sediments overlying the fine-grained deposits comprise floodplain alluvium. These deposits, which were largely re-worked from the fine-grained glacial materials and which have similar physical characteristics, consist of sand, silt and clay in layers containing variable amount of organic material. The thickness of the alluvium probably averages 3.5 feet, but may be thicker in places.

According to the Soil Survey of Middlesex County, Connecticut, the alluvial soils that cover the fine-grained deposits in the eastern parts of the site are rated as severe for golf fairways due to wetness and flooding. To overcome these conditions (i.e.,

wetness and flooding) during wet periods, the applicant proposes filling in the floodplain for the "back 9" tees, greens and safety berms with an estimated 282,000 cubic yards of fill material. The total surface area to be disturbed in the floodplain is approximately 50 acres. (For the hydrological implication of this filling activity in the floodplain, see Flooding Impacts.)

In addition to the floodplain soils, other regulated areas (i.e., wetlands) on the site have been mapped by a certified soil scientist, and their boundaries were superimposed onto the site plan. The 2 principal wetland areas in the western half of the site flank the drumlin hill. They parallel north draining watercourses. The other regulated area occurs north of the existing clubhouse/restaurant and parallels a watercourse that flows to the floodplain in the eastern part of the site. Based on present plans, regulated areas in the western half will be affected by the proposed golf course layout (i.e., fairways and/or golf cart paths), primarily on Holes 3, 4 and 8 due to filling with potential hydrologic alterations to watercourses. Every effort should be made to minimize impacts to these wetland areas. Consideration should be given to shifting the fairway for Hole 3 to the east outside of wetlands, utilizing bridges rather than fill for crossing wetlands and watercourses on Holes 4 and 8 and minimizing line-of-site vegetation clearing for fairways that traverse regulated areas.

Another concern relative to golf course construction activity on or near wetland areas is the potential for erosion and siltation to adversely affect water resources on- and off-site. This underscores the need for proper E&S control measures, particularly in view of the till soils on the site which contain high percentages of fine sand and silt. If the proposed wetland activities are approved, all work should be conducted during the dry time of the year.

SEWAGE DISPOSAL/WATER SUPPLY

According to golf course plans, new buildings and/or expansion of existing buildings is not proposed at present. However, the construction of the proposed 18-hole golf course will have at least some impact on the existing well(s) and septic system(s) which currently serve the Lyman Meadows Golf Course clubhouse/restaurant, particularly during peak periods (i.e., during golf tournaments and summer months). Because no public water or sewer mains serve this part of Middlefield, the existing infrastructure, particularly well(s) and on-site septic system(s), may be overtaxed during peak playing periods, resulting in an inadequate water supply or septic system failure. Therefore, the applicant should be required to evaluate the potential impacts of the proposed 18-hole golf course on the existing well(s) and septic system(s) that serve the existing restaurant and golf course. Projected flows due to additional golfers may indicate a need to expand the existing septic system or construct a new septic system and/or drill a new well or increase the existing water storage facility. This work should be coordinated through the Town sanitarian.

Soil mapping data indicates that soils in the areas northeast and southeast of the existing clubhouse/restaurant are marginal for on-site sewage disposal due mainly to a restrictive hardpan layer which causes a seasonally high watertable condition. Detailed soil testing, including deep test holes and percolation/ permeability tests, will be necessary to determine subsurface conditions and suitability for on-site sewage disposal. The Town sanitarian should be contacted regarding any soil testing on the site.

The underlying bedrock aquifer is the principal source of drinking water for the site. Sedimentary rock is capable of yielding low, moderate or even high yields. The till covering the western half of the site is slowly permeable and above the watertable

only part of the year. Therefore, till is generally not a dependable aquifer. Although the fine-grained deposits in the eastern half of the site (floodplain) may be capable of yielding small to moderate amounts of water (1-100 gallons per minute) to individual wells, they are difficult materials in which to finish a well.

HYDROLOGY

The entire site lies within the Coginchaug River drainage area. At its point of outflow to the Connecticut River, the Coginchaug River drains an area of 108 square miles or approximately 70,000 acres. More specifically, the site can be divided into 4 subdrainage areas (see Figure 5). The eastern half of the site, which includes the floodplain area, drains directly to the Coginchaug River. The central parts drain to the unnamed watercourse that originates near the existing clubhouse/restaurant. This watercourse flows in a northerly direction to Lyman Meadow Brook, a Coginchaug River tributary. At its point of outflow, Lyman Meadow Brook drains an area of approximately 1.03 square miles or 660 acres. The northwest corner of the site, which encompasses the northern half of the drumlin hill, drains to the 2 unnamed watercourses which flank the east and west side of the drumlin. Both watercourses also ultimately flow to Lyman Meadow Brook. Finally, the southwest corner of the site, which includes the southern half of the drumlin hill, drains either directly to Sawmill Brook or to an unnamed tributary that originates near Reed Gap Road west of the site. During periods of high flow, water in Sawmill Brook is diverted to the largest irrigation pond located on the existing Lyman Meadows Golf Course. This pond drains directly to Coginchaug River.

According to the Water Quality Classification Map of Connecticut (James E. Murphy, 1987), the segment of the Coginchaug River that passes east of the site is a Class Bc water resource, indicating that currently the water quality is known or

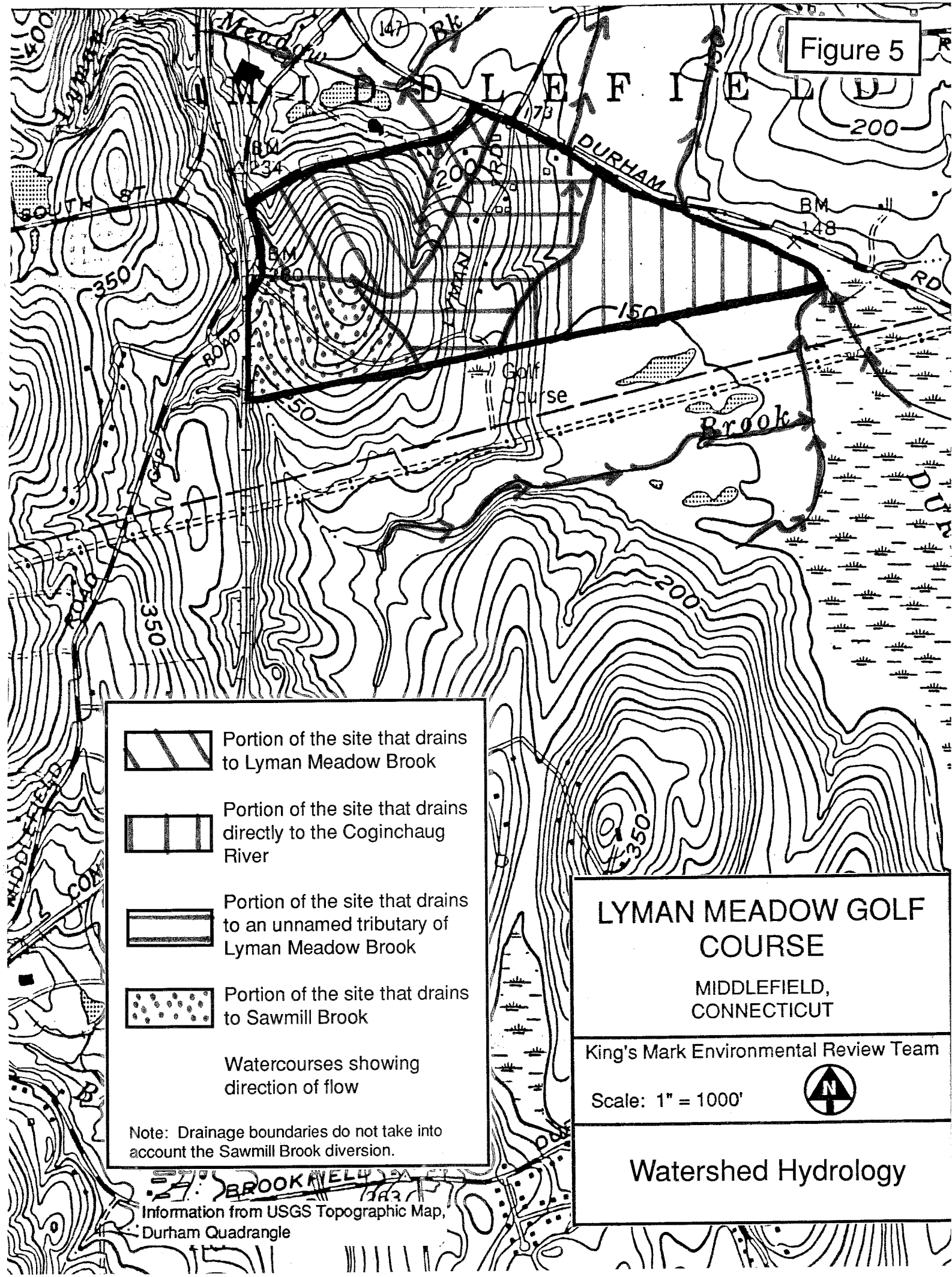


Figure 5
MIDDLEFIELD
Meadow
Bk
147
173
DURHAM
RD
LYMAN
SOUTH ST
BM
234
BM
148
200
350
150
Golf
Course
Brook
ROAD
MIDDLEFIELD
CONN
BROOKFIELD
Portion of the site that drains to Lyman Meadow Brook
Portion of the site that drains directly to the Coginchaug River
Portion of the site that drains to an unnamed tributary of Lyman Meadow Brook
Portion of the site that drains to Sawmill Brook
Watercourses showing direction of flow
Note: Drainage boundaries do not take into account the Sawmill Brook diversion.
LYMAN MEADOW GOLF COURSE
MIDDLEFIELD, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Watershed Hydrology
Information from USGS Topographic Map, Durham Quadrangle

inferred to be degraded. The subscript "c" means that the watercourse is suitable for coldwater fisheries, for spawning, growth and passage. Class B water resources are also generally suitable for recreational, agricultural or certain industrial uses such as process or cooling water. Sawmill Brook is a Class B/A water resource, indicating that currently the water quality is known or inferred to be degraded. This is due to the closed landfill in the northwest corner of the site. It is regulated similarly to the Bc water resource except that the State's goal is to improve, through management, the quality to that of a Class A water resource. Class A water resources may be suitable for drinking, recreational or other uses and may be subject to absolute restrictions on the discharge of pollutants, although certain discharges may be allowed.

Lyman Meadow Brook and the unnamed streamcourse on the site have not been classified by the DEP to date and are considered Class A water resources by default.

Groundwater beneath the site is classified as GA, except for groundwater in the area of the abandoned landfill which has been degraded. A GA classification means groundwater is suitable for private drinking water supplies without treatment.

A DEP ranking of land use categories by their risk to groundwater quality indicates that golf courses are an intermediate risk due to application of fertilizers and pesticides on the tees, greens and fairways. Land uses such as water company lands, open space land, state forests and low density residential (lots 2 acres or more in size) pose the least risk, while land uses such as waste disposal sites, industrial, retail and commercial (i.e., gasoline stations, dry cleaners, photo processors, etc.) pose the greatest risk.

The applicant has employed the services of a technical consultant to address the potential concerns of fertilizer/pesticide application with respect to surface and groundwater quality. A comprehensive fertilizer/pesticide management plan was developed for the proposed 18-hole golf course. Several of the recommendations in the

plan are similar to those for golf courses constructed in an aquifer protection area. Providing the plan is closely followed, potential adverse water quality impacts to surface and groundwater can be minimized, and if problems do arise, they can be corrected expeditiously. Implementation of the plan, along with the surface and groundwater monitoring program, should be coordinated with a Town official to ensure compliance. Where feasible, drainage for the golf course is designed to intercept and recycle surface water that may be laden with fertilizers and pesticides. This drainage system layout, along with surface water monitoring of pond outlets, should protect the Coginchaug River, the Sawmill Brook and the unnamed watercourses on the site. Monitoring wells will be installed to evaluate potential water quality impacts to groundwater for each subwatershed area and beneath selected tees and greens.

The 4 new ponds proposed in the floodplain area will be constructed by excavating below and intercepting the underlying watertable. Ponds A, B and C will be hydraulically connected to the largest irrigation pond located on the existing Lyman Meadows Golf Course to which water is diverted from Sawmill Brook during periods of high flows. The outlet for these ponds will ultimately drain to an unnamed Lyman Meadow Brook tributary.

Based on the applicant's technical consultant's water budget and proposed water plan, irrigation water withdrawn from the proposed artificial ponds for the golf course can be accomplished with little or no impact on the Coginchaug River (i.e., reducing its flows due to induced infiltration). For the benefit of Commission members, the applicant's technical consultant should illustrate by cross-section the impacts of drawdown on the watertable in the vicinity of the proposed irrigation ponds with respect to the Coginchaug River due to the proposed withdrawal rates of 300,000 gpd. Proposed water conservation practices for the new golf course will also reduce potential impacts to water levels in the river, particularly during droughty or

low-flow periods. The applicant should coordinate the proposed water use plan with a Town official to ensure that local surface water resources are not adversely impacted by irrigation water withdrawals.

During the construction of Ponds A, B and C, it is likely that some turbid to lightly-colored water containing colloidal soil material could be discharged to the unnamed tributary to Lyman Meadows Brook even with the most stringent E&S controls. If the proposed golf course development is approved, he ponds should be excavated first, and the hydraulic connections to respective watercourses made after fines have settled in the ponds. Also, during the construction of the ponds, there will be a minor drain of the aquifer system to fill the ponds, replacing the volume that is unconsolidated materials (i.e., fine sand, silt and clay) with water from the aquifer. However, this effect will be gradual and will be a one time event.

FLOODING IMPACTS

According to the Flood Boundary and Floodway Map for Middlefield, Connecticut (March 28, 1980), the eastern half of the site comprises the 100-year floodplain for the Coginchaug River which includes the floodway fringe and the floodway. The floodway fringe boundary which ranges between 260 and 400 feet in width on the site roughly parallels the Coginchaug River and a segment of Route 147 in the eastern and northeastern parts, respectively. The 100-year flood boundary represents approximately 40 acres west of the floodway fringe and is where the majority of the "back 9" is proposed to be constructed. Although not encompassed by the 100-year floodplain, the 500-year flood boundary occurs on the site as a narrow band, ranging between 20 and 100 feet in the eastcentral parts. It is located between the 100-year flood boundary and upland parts of the site.

A 100-year flood is a flood with a one chance in 100 or 1.0% chance of occurring during a given year. A 500-year flood has a one chance in 500 or 0.2% chance of occurring during a given year. The floodway includes the channel of the river and the adjacent floodplain that must be reserved in an unobstructed condition to discharge the base flood without increasing flood levels by more than 1.0 foot. The Town should prohibit development within the designated floodway that would cause any additional rise in base flood elevations. Because these boundaries are important relative to potential adverse impacts due to loss of floodplain storage resulting from the filling activity proposed for golf course construction in the 100-year floodplain, these boundaries should be superimposed onto the site plan. This will assist Commission members and Town officials in reviewing the project.

As proposed, the golf course expansion appears to fill parts of the designated floodway of the Coginchaug River. This appears to include the tees, fairways and greens of Hole 13, parts of Holes 11, 12 and 16 and Ponds C and D. This can be verified by delineating the boundaries on the site plan.

The National Flood Insurance Program (NFIP) policy requires that municipalities adopt the regulatory floodway published by the Federal Emergency Management Agency (FEMA) or designate another floodway which will not increase the base flood elevation more than 1.0 foot. The Town of Middlefield has adopted the regulatory floodway designated by FEMA, by reference, as a part of their local zoning regulations. Therefore, the applicant's engineer is required to base the hydraulic evaluation of the proposed impacts to the floodway on the original floodway analysis used by FEMA in the flood insurance study. The hydraulic analysis prepared by the applicant attempts to establish a revised floodway configuration. The revised floodway analysis shows an increase in the floodway profile when comparing the proposed development floodway profile with the original profile. Under these conditions, the Town should request a revision to the floodway boundaries prior to

granting approval to this proposal. Additionally, the report indicates the hydraulic effects of the filling activity proposed for the golf course may translate into an increased flood hazard in the Town of Durham due to flat gradients that characterize the upstream areas (i.e., Durham Meadows). It is understood that further technical comments will be forthcoming from the DEP Inland Water Resources staff regarding the proposed floodplain activity. Town officials should await the arrival of these comments before making a decision on the proposal.

The filling activity of the Coginchaug River floodway for the proposed golf course expansion poses a significant flooding risk, particularly to another community. As such, the placement of fill in the floodway should not be permitted, and alternate plans for the proposed "back 9" should be considered.

SOIL RESOURCES

Soil map units for the site as shown in the Soil Survey of Middlesex County, Connecticut (issued in February, 1979) are contained in Figure 6. General soil properties, drainage characteristics and major limitations for some of the proposed uses are listed in Appendix A.

The drainageway along Reed Gap Road, the portion of the "front 9" south of the existing golf course access road, the area around the Apple Barrel store and the hillside east of Lyman Road have outwash derived soils. These soils include Branford silt loams (BoB and BoC), Ellington fine sandy loams (EfA), Hinckley and Manchester soils (HME), Manchester gravelly sandy loams (MgC) and Raypol silt loams (Rb). These soils tend to have rapid to very rapid permeability in the substratum. On sloping areas, there is a moderate to severe risk of erosion.

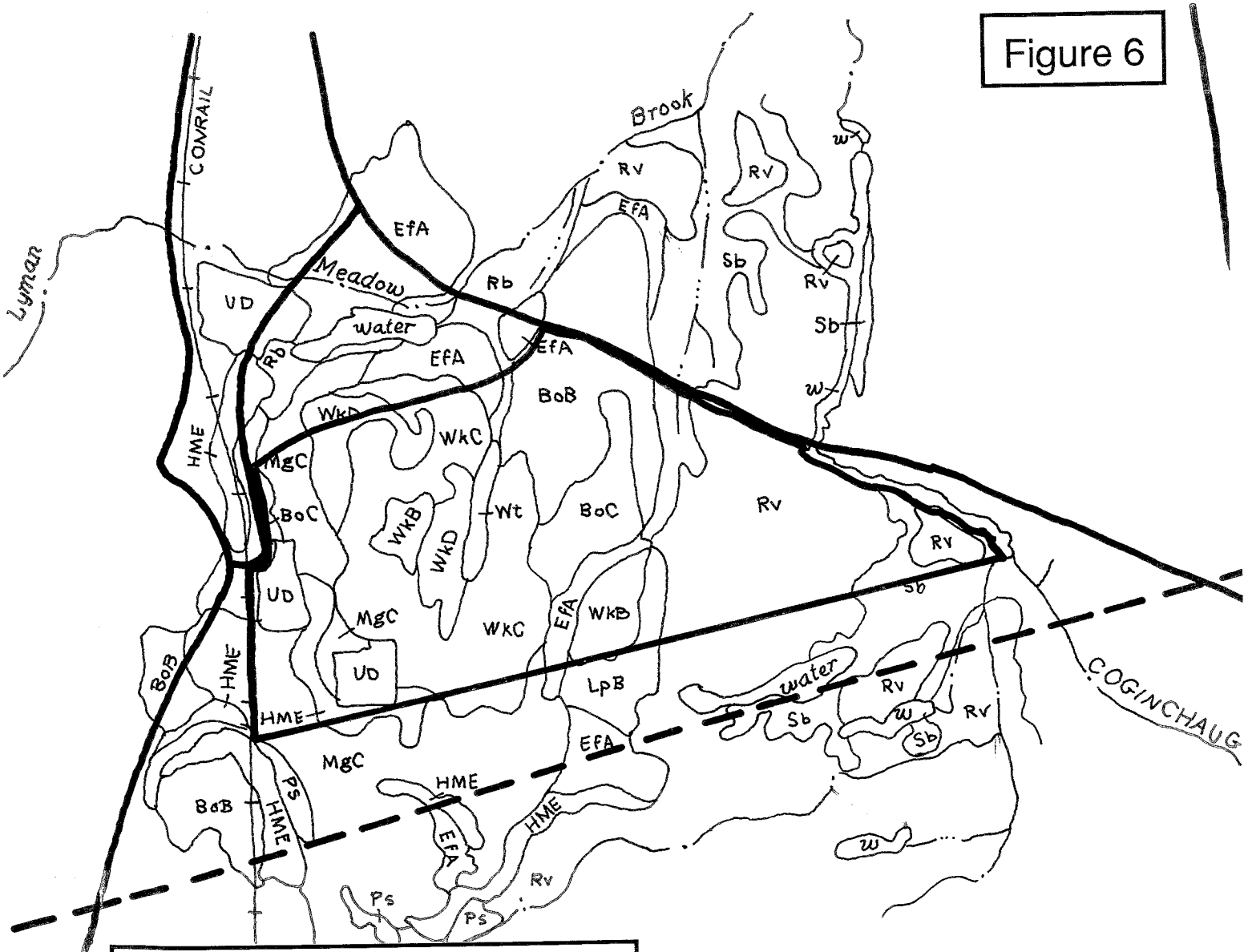
Soils on the drumlin include Wethersfield loams (WkB, WkC and WkD) and Wilbraham extremely stony silt loams (Wt). These are soils with a slowly to very

slowly permeable substratum formed in glacial till derived from red sandstone, shale and conglomerate. Due to slope, subsurface seepage and physical properties, these soils can pose a severe erosion hazard when disturbed. Cuts or fills in this material can be very unstable if not properly stabilized via measures such as surface water diversions, subsurface drainage, establishment of stable slope grades, seeding and mulching. The very deep (i.e., up to 30 feet) cut proposed along Fairway 8 will require special attention in the E&S control plan.

Soils in the more level "back 9" area in the Coginchaug River floodplain are mapped as Rumney Variant silt loams (Rv) and Saco silt loams (Sb). These soils are formed in recently deposited alluvial material. Wetness and frequent flooding for brief periods between the months of November and April are characteristics of these soils. Runoff on Saco soils is slow or very slow, and water covers some areas from late fall through early spring. To accommodate the proposed golf course use, a large acreage of these soil areas will be filled, and they will consequently no longer be wetland/floodplain soils described by the Rumney and Saco map units.

A soils report and plan scale soils map were not provided for review. Plan sheets 11-19 show wetland boundaries and flag numbers. These boundaries appear reasonable as shown. The name of the soil scientist who performed the delineation and the date(s) the delineations were performed should be provided on the plans. The applicant reported at the field review that Richard Snarski of New England Environmental Services, Salem, Connecticut is the consulting soil scientist who performed this work. A later phone call to Frank Magnotta on February 7, 1990 and a phone call to Mr. Snarski confirmed that additional wetland definition work was performed on the site to obtain information required in the 1989 "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." Such definition is required in the U.S. Army Corps of Engineers permit process. This information was not included in the materials provided to the ERT for review.

Figure 6



BoB	Branford silt loam, 3-8% slopes
BoC	Branford silt loam, 8-15% slopes
EfA	Ellington fine sandy loam, 0-5% slopes
HME	Hinckley Manchester soils, 15-45% slopes
MgC	Manchester gravelly sandy loam, 3-15% slopes
Rb	Raypol silt loam
Rv	Rumney variant silt loam
Sb	Saco silt loam
WkB	Wethersfield loam, 3-8% slopes
WkC	Wethersfield loam, 8-15% slopes
WkD	Wethersfield loam, 15-35% slopes
Wt	Wilbraham extremely stony silt loam
UD	Udorthents-Urban land complex

Information from Middlesex County Soil Survey, Scale: 1" = 1320'

LYMAN MEADOW GOLF COURSE

MIDDLEFIELD, CONNECTICUT

King's Mark Environmental Review Team

Scale: 1" = 1000'

N

Soils

A major portion of the remaining upland acreage on the Lyman Farm which might be developed as an alternative site to the Coginchaug River floodplain for golf course expansion is currently in agricultural uses. These areas comprise unique farmland suited for orchard crops. It is a policy of the State and the Federal Government that productive farmland be preserved wherever possible. Maintaining the agricultural land use was a factor in the applicant's evaluation of alternatives and selection of the golf course expansion site submitted for review.

EROSION AND SEDIMENT CONTROL

In 1983, Public Act No. 83-388, "An Act Concerning Soil Erosion and Sediment Control" was passed to "reduce the danger from stormwater runoff, minimize non-point sediment pollution from land being developed and conserve and protect the land, water, air and other environmental resources of the state." Under this law, most applications for development must have a comprehensive E&S control plan, including a map and narrative.

Materials received for the proposed golf course included general recommendations for E&S control on a hole by hole basis in the Army Corps permit application narrative and E&S control notes on sheet 38 of the golf course plans. While the E&S control notes are fairly comprehensive, the Connecticut Guidelines for Soil Erosion and Sediment Control should be followed in preparing a "separate and distinct erosion and sediment control plan" as noted in the Corps application narrative. To meet this requirement, items which should be addressed by the applicant include:

1) The narrative should describe the application sequence of E&S control measures.

2) The plan map should show the location of erosion control measures.

3) The name of the individual who will be responsible for maintenance of measures during and after construction should be provided.

4) A detailed construction sequence describing the phasing of the operation should be outlined. For example, the construction process is expected to take 14 to 18 months. Whether the entire site will be opened at the beginning of this time period or whether development will be phased should be clarified. Presumably pond construction will take place in the initial stages to provide fill for later stages.

5) The location of all areas to be cleared/disturbed for seeding should be defined in addition to the graded areas shown on the plans.

6) Whether or not there will be a wetland crossing to get from the tee to the green on Hole 4 (sheet 13) should be decided.

7) Details on grading of Fairway 8 should be clarified, including plans for topsoil removal, stockpiling and re-spreading. Test holes should determine depth to bedrock and whether or not blasting might be required to reach planned grade. The location and details for the sediment pond mentioned in the Army Corps application (page 65) are needed. Details on how the slope will be stabilized should be provided.

8) Approximately 282,000 cubic yards of fill will be placed in the "back 9" area. The Army Corps application narrative on page 65 notes that most of the fill will be placed in areas designated as "disturbed wetland." Presumably these areas were designated by the biological consultant, Environmental Planning Services. The boundaries of this disturbed wetland area should be shown on a map.

9) Details for E&S control during pond construction and pond cleanout should be provided. Of particular concern are the location and temporary stabilization of piles of excavated material and temporary sediment basins for treatment of pump water during the de-watering process.

10) Near the tees for Hole 10 on either side of the natural wetland drainageway, there are areas (i.e., waterways or cartpaths) on approximately 9% grade where water can concentrate and pose erosion problems. The soils in this slope area are mapped as erodible outwash derived soils which should be protected by a carefully planned erosion control strategy.

11) On Hole 12 subsurface drainage is shown which outlets into the Coginchaug River. Installation of the drainage pipe will cause some disturbance of the river bank which should be carefully stabilized.

12) In some locations along Sawmill Brook and the Coginchaug River, fill is placed close to the streambanks. A buffer strip should be maintained in these areas, and erosion controls should be planned and implemented.

13) Drain tiles from Lyman Road mentioned on page 69 of the Army Corps application should be located on the plans.

14) Careful planning of E&S control measures is needed for graded cart paths and/or waterways on the hillside where the tees for Hole 15 and the greens for Holes 14 and 18 are located.

The Middlesex County Soil and Water Conservation District is available to assist the applicant in preparing the E&S control plan. Request for assistance can be made by calling the office in Haddam (345-3219).

WATER QUALITY CONSIDERATIONS

If properly managed, the proposed golf course expansion should have little effect on the water quality of the Coginchaug River and Sawmill Brook. The report entitled, "Proposed Lyman Meadow Golf Course Expansion Water Use and Water Quality Impacts" has addressed many of the potential problems. However, this report could be more complete by addressing some additional concerns.

Due to the extensive amount of proposed soil disturbance and the proximity of the site to the river and brooks, soil erosion will be a major concern. At the time of the review, a comprehensive E&S control plan was not available. Therefore, this subject cannot be addressed in detail. An E&S control plan should be developed and reviewed before final approval is granted. An agent from the Middlefield Inland Wetlands Commission should visit the site frequently during construction to prevent problems from developing and to assure compliance with the E&S control plan.

Fertilizers and pesticides have the potential of degrading surface and groundwater. The proposed management plan broadly addresses many of the potential problems, but does not provide enough detail to fully evaluate how it will be

implemented. If Commission members would like this plan reviewed, the Middlesex County Extension Service (354-4511) should be contacted.

Shallow man-made ponds that are exposed to fertilizers such as the proposed irrigation ponds have the potential of becoming highly eutrophic waterbodies. An eutrophic waterbody is characterized as having intense algae blooms and often extensive beds of aquatic weeds. Nuisance vegetation may block irrigation equipment such as pumps, pipes and machinery. If aquatic vegetation in the irrigation ponds is controlled with algaecides and herbicides, these chemicals could be dispersed throughout the golf course when the ponds are used for irrigation. Therefore, proposed methods to control aquatic vegetation should be incorporated and reviewed as part of the pesticide and fertilizer management plan.

Perhaps the most serious environmental problem related to this project is the disturbance of the floodplain. Without a thorough review of the anticipated change in water storage capacity of this area, the potential environmental and property damage cannot be assessed. Commission members should seek advice from the DEP Division of Inland Water Resources or a wetlands consultant. This will allow Commission members to formulate decisions based on the professional expertise needed to analyze this aspect of the proposal.

BIOLOGICAL RESOURCES

WETLAND RESOURCES AND IMPACTS

The Lyman Meadows Golf Course expansion will impact approximately 52 acres of inland wetlands with a variety of habitats. The largest wetland area to be modified is on the floodplain of the Coginchaug River where approximately 50 of the 64 existing wetland acres on-site will be filled and excavated for ponds, tees, greens and berms to separate the fairways. In comparison, the proposed impacts to the other 2 wetland systems is relatively minor with clear-cutting and minor excavating and grading proposed only to provide a line-of-site from the tees to the greens. Based upon a review of the information submitted by the applicant and a field review of the site, these comments are offered:

1) The report submitted by Environmental Planning Services, "Wetland Inventory, Evaluation and Impact Assessment" dated June 14, 1990, is substantially correct. However, it is misleading in the conclusions that it draws for the functional values of and the impacts to the wetland area on the floodplain of the Coginchaug River. The value of this wetland is enhanced by its size and cannot be "normalized to correct for its large size" when its functional values are compared to the values of other wetlands on-site, as stated in the consultant's report. This wetland is the largest and most diverse on the site. It provides significant flood storage within this reach of the basin and will be significantly affected by the proposed filling and excavation. The floodplain forest is the most biologically important wetland on-site, especially the mature Pin oak *(Quercus palustris)* - Red maple *(Acer rubrum)* remnant. This remnant, in combination with the adjacent area of young trees, provides floodplain forest habitat in an area where much of the original forest has been clear-cut for agriculture. Floodplain forests are considered critical habitat by the Connecticut Natural Diversity Data Base and are especially important as nesting areas for songbirds and for the diversity of plant species that have limited distribution within Connecticut.

2) As stated in the "Wetland Inventory Evaluation and Impact Assessment" report, the site contains a population of Smallflowered Agrimony *(Agrimonia parviflora)*. The population on-site is currently among 4 existing populations in Connecticut. The other 3 populations occur in the western part of the State. *Agrimonia parviflora* historically occurred in Middletown where it was reported in the 1930 "Addition to the Flora of Connecticut" (Connecticut Geological and Natural History Survey Bulletin No. 14). This plant is presently proposed for State listing according to

guidelines pursuant to P.A. No. 89-224 "An Act Establishing a Program for the Protection of Endangered and Threatened Species," and its protection should be of utmost importance. Since this plant occurs in wet meadows and thickets, the periodic removal of trees from this area may enhance the growth of this species on-site. Bridging should be considered rather than filling for crossings over Wetland 3 in the consultant's report.

3) The Durham Meadows has been identified as critical habitat for 3 bird "Species of Special Concern": Sora *(Porzana carolina)*, Least Bittern *(Ixobrychus exilis)* and Blue-winged Teal *(Anas discors)*. Savannah Sparrow *(Passerculus sandwichensis)* has been documented as nesting in the wet meadow on-site. All 4 birds are currently proposed for State listing pursuant to P.A. No. 89-224. Of these, the Savannah Sparrow will be most directly impacted through actual loss of habitat, and the Sora and Bittern may be indirectly impacted through encroachment within a currently undisturbed buffer zone. The Durham Meadows and adjacent Coginchaug River have also been identified by the DEP Inland Fisheries Division as a significant recreational finfish habitat and as important areas for maintaining low-flow stability within the basin. In this respect, all activity within the meadows and floodplain of the Coginchaug River should be avoided whenever possible.

4) The proposed impacts to the floodplain of the Coginchaug River can be mitigated only by reducing the level of proposed activity. All activity within the floodway as mapped by FEMA "Flood Boundary and Floodway Map for Middlefield, Connecticut" (March, 1980) should be eliminated, because much of the critical wetland habitat on-site is contained within this boundary. In addition, the entire floodplain wetland of the Coginchaug River is critical to the Town of Middlefield for all the functional values which it provides and should remain in a diversity of habitats, from field to forest, in an unrestricted state.

WILDLIFE CONSIDERATIONS

The proposed golf course expansion involves a 145-acre site located in Middlefield. Approximately 52 acres of wetland habitat will be directly impacted by project implementation.

Habitat Type Descriptions

The vegetation of the site has been identified and categorized in the consultant's report (Environmental Planning Services, June 14,1990). The major habitat types

include mixed hardwoods, wetlands and open fields. The wildlife associated with the site has been documented also in the consultant's report.

Mixed Hardwood Forest: This habitat consists of a variety of hardwood species, including sugar maple, ash, birch, oak and hickory. Understory vegetation includes witchhazel, elderberry, multiflora rose, grape, blackberry and hardwood regeneration. Wildlife species frequenting this habitat type include deer, fox, raccoon, gray squirrel, woodpeckers (pileated, hairy and downy), ovenbirds, scarlet tanangers, black-throated, blue and green warblers, barred owls, broad-winged hawks and various non-game species such as shrews, voles and snakes.

Wetland/Riparian Habitat: This habitat type consists of various combinations of streams/brooks, open ponds, swamps and small marsh areas. Associated vegetation includes red maple, birch, alder, cattails, dogwood, jewel-weed, spicebush, sweet pepper bush, skunk cabbage, false hellebore, duckweed and various grasses and sedges. Wildlife species utilizing these areas include deer, fox, raccoon, skunk, muskrat, mink, swallows, red-winged blackbirds, grackles, kingbirds, cedar waxwings, hooded and Wilson's warblers, titmice, woodpeckers, wood ducks and numerous amphibians and reptiles, including water and garter snakes, salamanders, newts and spotted and painted turtles.

Open Field: Open land habitat (i.e., pasture, old field and hay field) is very beneficial to wildlife. Vegetation provides food as well as structural diversity, creating cover for a great array of wildlife species, ranging from mice and shrews to deer. Small mammal populations provide a food base for predators such as red fox, coyotes and raptors. Fields also attract numerous insects, a major food item of various wildlife species such as birds and small mammals, including bats. The edge created where fields meet forest is a valuable zone for food and cover, consisting of dense berries, shrubs and grasses. Wildlife species utilizing open field habitat include deer, woodcock, woodchuck, fox, raccoon, skunk, mourning dove, bluebirds,

eastern kingbirds, mockingbirds, flycatchers, blue and golden-winged warblers, robins, kestrels, red-tailed hawks, eastern screech owls and cottontail rabbits.

Impacts of Development

Upland Wooded Areas: Fragmentation and loss of habitat will lead to a decline in species diversity and richness. Wildlife populations will be reduced in proportion to the amount of habitat lost.

Wetland/Riparian Habitat: Wetlands support a high diversity of wildlife species due to the complexity of the vegetative structure, high productivity and abundant food supply which allow for a high carrying capacity (Brown et. al. 1978). There are many species that require access to streams or waterbody margins for survival, even though they may spend much of their time in other habitats (Milligan and Raedeke 1986). Part of the food supply for many vertebrates is the high abundance and diversity of insect populations that are typical of wetland ecosystems (Brown et. al. 1978). Wetlands presently provide important habitat for a variety of wildlife species and function as areas for absorption of natural runoff. Any planned diversion of stormwater into wetlands will increase water flow, sedimentation and pollution. This may alter the present ecological structure of the wetland and reduce species diversity. Although stormwater retention and filtration plans may alleviate some of these problems, the long-term effects of stormwater diversion into wetlands tend to be negative. Retention and filtration systems may still allow fine silt and pollutants to enter. Not only are wetlands important to wildlife, but they are also important to humans. Various functions of wetlands include flood control, ecological integrity, fish and wildlife habitat, nutrient and sedimentation trappings, educational potential, visual/aesthetic quality, recreation, groundwater use potential and botanical sites. There are usually inherent limitations in developing wetlands due to poorly drained and unstable soil types.

Vegetation removal in wetlands may have severe impacts on wildlife, especially reptiles and amphibians. The cover, food, breeding habitat and hibernation areas may be altered. Species dependent on specialized habitat are eliminated, and more adaptable species are reduced in numbers (Campbell 1973). Barriers (i.e., roads) to seasonal movement and population dispersal also pose serious threats to wildlife (Campbell 1973). To minimize impacts, maintain a 100-foot wide buffer zone of vegetation around wetland/riparian areas. This buffer zone will filter and trap silt and sediments, provide excellent wildlife cover and be an aesthetic and educational asset to the community.

Open Field: Loss of open field habitat will lead to a decline in species diversity and richness. Wildlife species associated with this habitat type will be reduced in proportion to habitat lost. Habitat type conditions (i.e., manicured lawns) created by golf course development will not substitute for the existing field habitat. Habitats created are less diverse and will support typical urban species such as robins, starlings, mockingbirds, Canada geese, etc.

Mitigation of Disturbances

Several management guidelines should be considered during the planning process to minimize adverse impacts on wildlife. They include:

1) Make use of natural landscaping techniques, avoiding and/or minimizing chemical applications, to lessen acreage of habitat lost and possible wetland contamination.

2) Maintain a 100-foot wide buffer zone of natural vegetation around wetland/riparian areas to filter and trap silt and sediments. These vegetated zones provide excellent wildlife cover and travel corridors.

3) Stonewalls, shrubs, trees and fence rows should be maintained along field borders.

4) During land clearing, care should be taken to maintain certain forestland wildlife requirements:

    a) Encourage mast producing trees (i.e., oak, hickory and beech).

b) Leave 3-5 snag/den trees per acre because they are used by many birds and mammals for nesting, roosting and feeding.

c) Exceptionally tall trees are used by raptors as perching and nesting sites and should be encouraged.

d) Trees with vines (i.e., fruit producers) should be encouraged.

e) Brush debris could be windrowed to provide cover for small mammals, birds, amphibians and reptiles.

f) Removal of dead and down woody material should be discouraged where possible. The existence of many wildlife species (i.e., salamanders, snakes, mice, shrews and insects) depends on the presence of dead trees (Hassinger 1986).

5) In most cases, natural wetlands are more valuable than constructed ponds and ditches because of vegetative composition. Ponds should be constructed in non-wetland soils whenever possible.

FISHERY RESOURCES

Fish Population

The Coginchaug River supports a diversity of coldwater and warmwater fish species. It is stocked annually by the DEP Inland Fisheries Division in the Towns of Durham and Middlefield with more than 5,100 adult (9-12") brown, brook and rainbow trout. The river's fish population was most recently surveyed in 1989 by the Inland Fisheries Stream Survey Team. A sample taken downstream at the Wadsworth State Park included native brook trout, stocked brown and rainbow trout, blacknose dace, longnose dace, fallfish, white sucker, tessellated darter, largemouth bass, bluegill, pumpkinseed sunfish, redbreast sunfish and American eel.

Surface waters of the Coginchaug River are Class Bc. Designated uses for this classification include fish habitat capable of supporting a coldwater fishery, wildlife habitat, recreational use, agricultural and industrial supply and other legitimate uses.

Impacts

The proposed golf course expansion Holes 10-18 will cause a permanent loss of approximately 50 acres of invaluable wetland habitat. Wetlands have several beneficial functions. Wetlands control flood waters by acting as a water storage basin. Wetlands trap sediment from natural and man-made sources of erosion, filter pollutants from runoff entering watercourses and provide a diversity of habitats for wildlife utilization. The loss of these wetlands might degrade water quality and flow regimes of the Coginchaug River. Local flood storage and sediment trapping capabilities will be lost with the removal of wetlands. Previous filling and alteration of wetlands has already occurred in this area due to the creation of the existing 18-hole golf course.

The filling of 52 acres of wetlands that supply surface and groundwaters to the Coginchaug River and the alteration of the Coginchaug River's floodplain may effectively reduce river flows. This situation will be most critical during normal summer low-flow periods because Connecticut streams are dependent upon groundwater inputs to maintain base flows. The functional value of wetlands to supply water to the Coginchaug River will be lost with the elimination of wetlands. This alteration coupled with the actual withdrawal of groundwater from man-made ponds, an estimated 300,000 gpd for irrigation purposes, further compromises streamflows. The decrease of low flows in this section of the Coginchaug River will have great impact on local fisheries. Reduced stream flows can significantly elevate stream water temperatures, reduce the availability and quality of instream habitat for fish and aquatic insects and decrease dissolved oxygen levels. The Coginchaug River has historically experienced low dissolved oxygen levels which threaten fish growth and survival, especially in low gradient sections of the river such as in the proposed golf course expansion area where pool habitat is dominant. Riffle areas

contain turbulent fast flowing waters where dissolved oxygen levels can be inherently higher than in pools.

The proposed golf course expansion will result in the permanent loss of riparian vegetation along the Coginchaug River. The loss of riparian vegetation can have wide ranging implications for the environmental stability of the Coginchaug River. Specifically, riparian area functions include:

1) Filtering fine sediment, debris and man-induced pollutants from penetrating streams;

2) Providing invaluable shading of stream waters which maintain water temperature regimes necessary for survival of coldwater species such as trout;

3) Preventing excessive erosion of streambanks by maintaining masses of living roots;

4) Assisting in the regulation of stream hydrology;

5) Providing fallen trees, woody debris and leaves necessary for the survival of trout and aquatic insects; and

6) Regulating the natural productivity of aquatic ecosystems by supplying organic detritus to streams.

The existing golf course has already eliminated and/or altered riparian vegetation along the Coginchaug River. The proposed golf course expansion Holes 10-18 will further exacerbate riparian vegetation losses. Increased water temperatures in this area are a major concern, especially in regard to the impact on coldwater stocked trout species. If water temperatures increase markedly:

1) Fish growth may decline radically. Increased water temperatures result in increased metabolic rates and maintenance requirements. Therefore, as more energy is used to meet these requirements, less is available for net growth.

2) The incidence and virulence of trout diseases may increase.

3) Competing and predatory non-game fish may be favored. Trout have a lower level of thermal tolerance than many less desirable fish species in the

Coginchaug River such as fallfish and white sucker. If stream water temperatures increase above the trout's optimal level, a population shift that would actually displace trout species could result.

Site soil erosion and sedimentation of the Coginchaug River will be increased due to extensive filling activities. Without proper safeguards, the placement of 282,000 cubic yards of fill in concert with land disturbances associated with golf course construction may introduce suspended sediments to this watercourse. If not properly controlled, suspended sediments will cause stream degradation in downstream areas. Sedimentation is of special concern in a meandering, low gradient system such as the Coginchaug River where deposited sediments take much longer to be washed and transported downstream by spring freshets. Excessive sediment deposition could damage the aquatic ecosystem because:

1) Sediment reduces the survival of resident fish eggs and hinders the emergence of newly hatched fry. Adequate water flow, free of excess sediment particles is required for fish egg respiration and successful hatching.

2) Sediment reduces the survival of aquatic macroinvertebrates. Since aquatic insects are important food items in fish diets, reduced insect population levels in turn will adversely affect fish growth and survival. Fish require an excessive output of energy to locate preferred prey when aquatic insect levels decrease.

3) Sediment reduces the amount of usable habitat required for spawning purposes. Excessive fines can clog and even cement gravels and other desirable substrate materials together. Resident fish may be forced to disperse to other areas not affected by siltation.

4) Sediment reduces stream pool depth. Pools are invaluable stream components because they provide necessary cover, shelter and resting areas for resident fish. A reduction of usable fish habitat can effectively limit fish population levels.

5) Turbid waters impair gill functions of fish and normal feeding activities of fish. High concentrations of sediment can cause mortality in adult fish by clogging the opercular cavity and gill filaments.

6) Sediment encourages the growth of filamentous algae and nuisance proportions of aquatic macrophytes (DEP, 1989). Eroded soils contain plant nutrients, including phosphorous and nitrogen. Once introduced into

aquatic habitats, these nutrients function as fertilizers, resulting in accelerated plant growth.

7) Sediment contributes to the depletion of dissolved oxygen (DEP, 1989). Organic matter associated with soil particles is readily decomposed by microorganisms, thereby effectively reducing oxygen levels.

Recommendations

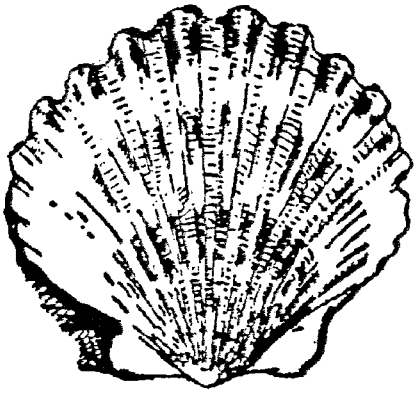
These recommendations are provided to assure protection of aquatic resources:

1) Investigate other feasible and prudent alternatives to the proposal. Regulatory agencies will request that the applicant review such alternatives. Proposed Holes 10-18 represent a significant and extensive loss of floodplain wetlands that cannot be recreated by present man-made wetland mitigation techniques. This project, as presently designed, may not receive approval of State and Federal regulatory agencies since recent policies are geared towards "no-net" loss of wetlands. The current proposal should be revised to minimize wetland losses at all costs. This objective can be accomplished at this site and still satisfy the demand for additional recreation. Wetland loss and associated aquatic resource concerns can be practically eliminated if golf course construction is limited to proposed Holes 1-9 which lie in uplands.

2) Hydrologic analyses should investigate anticipated impacts to riverine flow regimes. The DEP Inland Fisheries Division will request detailed information regarding the extent to which existing stream flows will be diminished due to the loss of 50 acres of floodplain wetlands. Information will also be requested regarding projected increases in stream water temperatures, increases in dissolved oxygen levels and projected losses of instream and riparian habitat.

3) The creation of ponds for irrigation and subsequent withdrawal of 300,000 gpd of groundwater is considered a water diversion and may require a State Water Diversion Permit. Existing diversions in the Coginchaug River Watershed have led to critically low summer flows. The applicant should contact the DEP Water Diversion Program Coordinator, Mr. Bob Gilmore, at 566-7160 for more information.

ARCHAEOLOGICAL RESOURCES



ARCHAEOLOGICAL CONSIDERATIONS

A review of the State of Connecticut Archaeological Site Files and Maps shows no recorded sites within the indicated project area. However, the portion of the project area located west of Lyman Road in the Coginchaug River floodplain is a prime area for possible prehistoric occupation due to the proximity of the Coginchaug River and the rich agricultural soils of the floodplain (see Figure 7). Known site locations of Indian camps and villages correspond to similar natural settings. Based on predictive models of prehistoric Indian settlements and environmental attributes of the project area, the Office of State Archaeology strongly recommends a reconnaissance survey to locate and identify all prehistoric sites.

Archaeological sites in Connecticut are relatively shallow in the ground, and the landscaping proposals for the golf course expansion threaten these cultural resources. All archaeological studies should be conducted in accordance with the Connecticut Historical Commission's Environmental Review Primer for Connecticut's Archaeological Resources.

The Office of State Archaeology is prepared to offer the Town of Middlefield and the developer any assistance necessary in preservation and mitigation of archaeological resources within the project area.

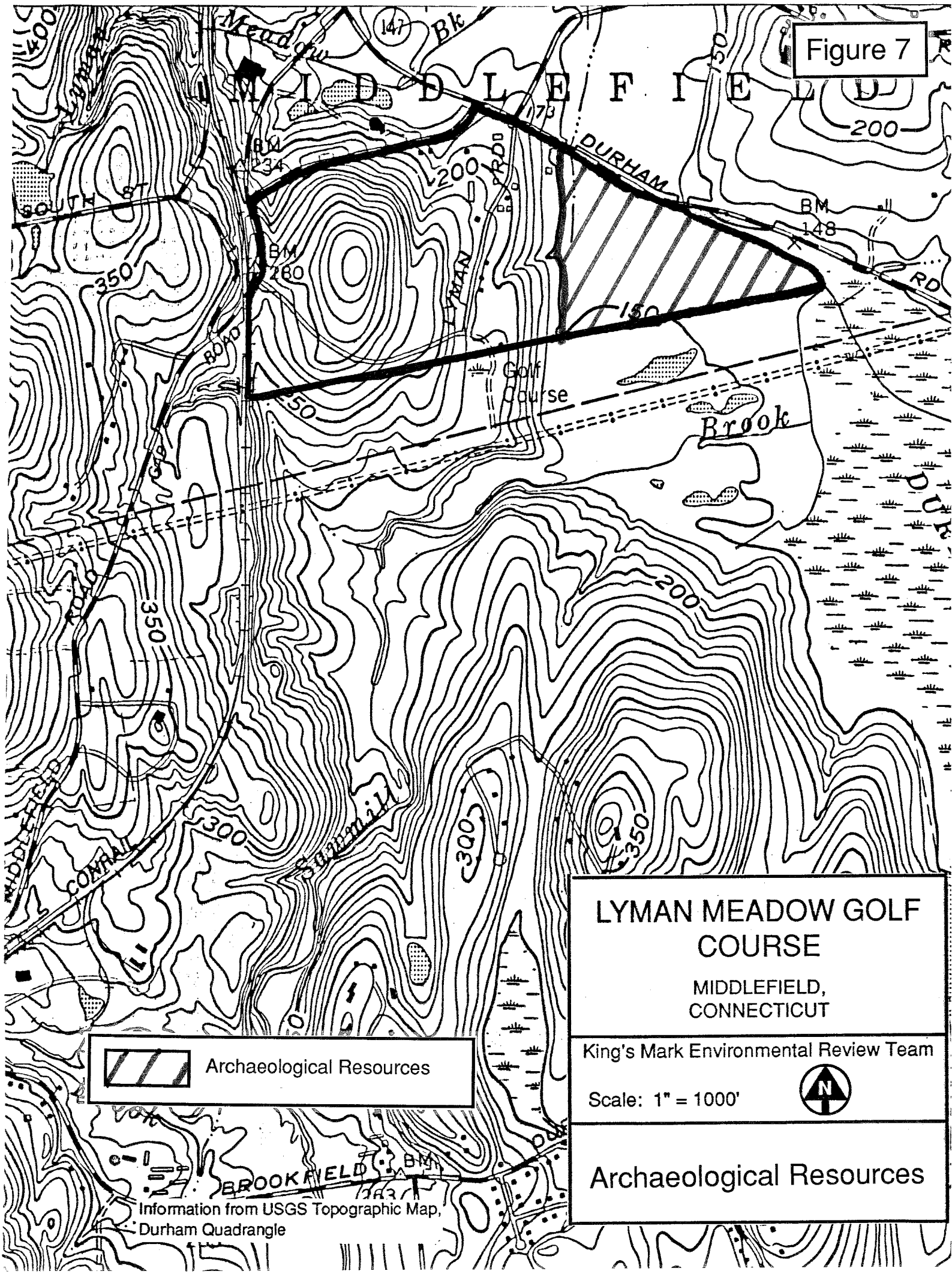


Figure 7
MIDDLEFIELD
Meadow
Bk
147
DURHAM
RD
BM
234
SOUTH ST
BM
280
LYMAN
RD
BM
148
Golf
Course
Brook
BOND
RD
CONRAIL
Summit
BROOKFIELD
BM
LYMAN MEADOW GOLF COURSE
MIDDLEFIELD,
CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Archaeological Resources
Archaeological Resources
Information from USGS Topographic Map,
Durham Quadrangle

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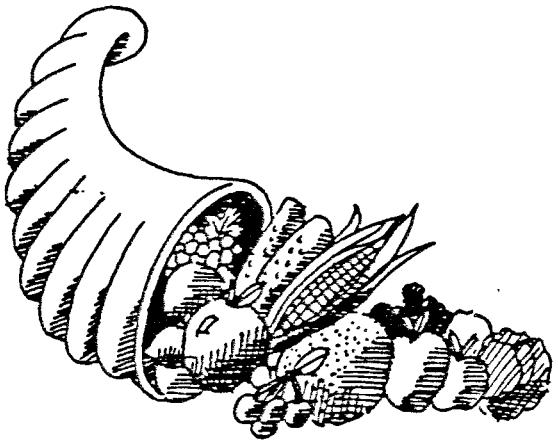
APPENDICIES



Appendix A: Soil Limitations Chart

SOIL LIMITATIONS

MAP UNIT NAME	GENERAL SOIL PROPERTIES	DRAINAGE CLASS AND DEPTH TO SEASONAL HIGH WATER TABLE	MAJOR LIMITATIONS TO THE DEVELOPMENT OF: LAWNS, LANDSCAPING AND GOLF FAIRWAYS	EXCAVATED PONDS	GRASSED WATERWAYS	PATHS AND TRAILS
▲ BoB - Branford silt loam, 3-8% slopes	Deep soils on outwash plains and stream terraces formed in water deposited sand and gravel	Well-drained >6 feet	None	No water	None	None
▲ BoC - Branford silt loam, 8-15% slopes	Deep soils on outwash plains and stream terraces formed in water deposited sand and gravel	Well-drained >6 feet	Slope	No water	Slope	None
▲ EfA - Ellington fine sandy loam, 0-5% slopes	Very deep soils on glaciofluvial landforms formed in loamy over sandy and gravelly glacial outwash derived from red sedimentary rocks and basalt	Moderately well-drained 1.2-2.5 feet	Wetness	Cut banks cave	Erodes easily	Wetness
HME - Hinckley Manchester soils, 15-45% slopes	Hinckley - Very deep soils on terraces, outwash plains, deltas, kames and eskers formed in water-sorted material	Excessively drained >6 feet	Droughty, slope	No water	Large stones	Slope

MAP UNIT NAME	GENERAL SOIL PROPERTIES	DRAINAGE CLASS AND DEPTH TO SEASONAL HIGH WATER TABLE	MAJOR LIMITATIONS TO THE DEVELOPMENT OF: LAWNS, LANDSCAPING AND GOLF FAIRWAYS	EXCAVATED PONDS	GRASSED WATERWAYS	PATHS AND TRAILS
HME cont.	Manchester - Deep, excessively drained soils on terraces formed in glacial outwash deposits	Excessively drained >6 feet	Droughty, slope	No water	Large stones	Slope
▲ MgC - Manchester gravelly sandy loam, 3-15% slopes	Deep soils on terraces formed in glacial outwash deposits	Excessively drained >6 feet	Droughty, slope	No water	Droughty 8+% slope	None
*▲ Rb - Raypol silt loam	Very deep soils on terraces and plains formed in loamy over sandy and gravelly glacial outwash derived mainly from acid crystalline and sedimentary rocks	Poorly drained 0-1.0 foot	Wetness	Cut banks cave	Wetness, erodes easily	Wetness
*▲ Rv - Rumney variant silt loam	Very deep soils formed in recent alluvial deposits formed from acid, reddish sandstone, siltstone and shale	Somewhat poorly drained to poorly drained 0.5-1.5 feet	Wetness, flooding	Slow refill, cut banks cave	Wetness	Wetness
* Sb - Saco silt loam	Deep soils formed in recently deposited alluvial material	Very poorly drained 0-0.5 feet	Flooding, wetness	Cut banks cave	Wetness	Wetness

MAP UNIT NAME	GENERAL SOIL PROPERTIES	DRAINAGE CLASS AND DEPTH TO SEASONAL HIGH WATER TABLE	MAJOR LIMITATIONS TO THE DEVELOPMENT OF: LAWNS, LANDSCAPING AND GOLF FAIRWAYS	EXCAVATED PONDS	GRASSED WATERWAYS	PATHS AND TRAILS
▲ WkB - Wethersfield loam, 3-8% slopes	Very deep soils on wetlands formed in glacial till derived mainly from red sandstone, shale and conglomerate	Well-drained 1.5-2.5 feet	None	No water	Rooting depth	None
▲ WkC - Wethersfield loam, 8-15% slopes	Very deep soils on wetlands formed in glacial till derived mainly from red sandstone, shale and conglomerate	Well-drained 1.5-2.5 feet	Slope	No water	Rooting depth	Slope
WkD - Wethersfield loam, 15-35% slopes	Very deep soils on wetlands formed in glacial till derived mainly from red sandstone, shale and conglomerate	Well-drained 1.5-2.5 feet	Slope	No water	Rooting depth	Slope
✳ Wt - Wilbraham extremely stony silt loam	Very deep soils on uplands formed in glacial till derived mainly from red sandstone, shale and conglomerate	Poorly drained 0-1.5 feet	Wetness	No water	Rooting depth	Wetness
UD - Udorthents-Urban land complex	Soils that have been disturbed by cutting or filling	Moderately well to excessively drained	Not rated			

✳ Inland wetland soil
▲ Prime Farmland or Farmland of State and Local Importance

NOTES

ABOUT THE TEAM

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

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

Purpose of the Environmental Review Team

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

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

Requesting an Environmental Review

Environmental Reviews may be requested by the chief elected official of a municipality or the chairman of an administrative agency such as planning and zoning, conservation or inland wetlands. Environmental Review Request Forms are available at your local Soil and Water Conservation District and through the King's Mark ERT Coordinator. This request form must include a summary of the proposed project, a location map of the project site, written permission from the land owner/ developer allowing the Team to enter the property for purposes of review and a statement identifying the specific areas of concern the Team should investigate. When this request is approved by the local Soil and Water Conservation District and King's Mark RC&D Executive Committee, the Team will undertake the review. At present, the ERT can undertake approximately two (2) reviews per month.

For additional information regarding the Environmental Review Team, please contact your local Soil and Water Conservation District or Nancy Ferlow, ERT Coordinator, King's Mark Environmental Review Team, King's Mark RC&D Area, 322 North Main Street, Wallingford, Connecticut 06492. King's Mark ERT phone number is 265-6695.