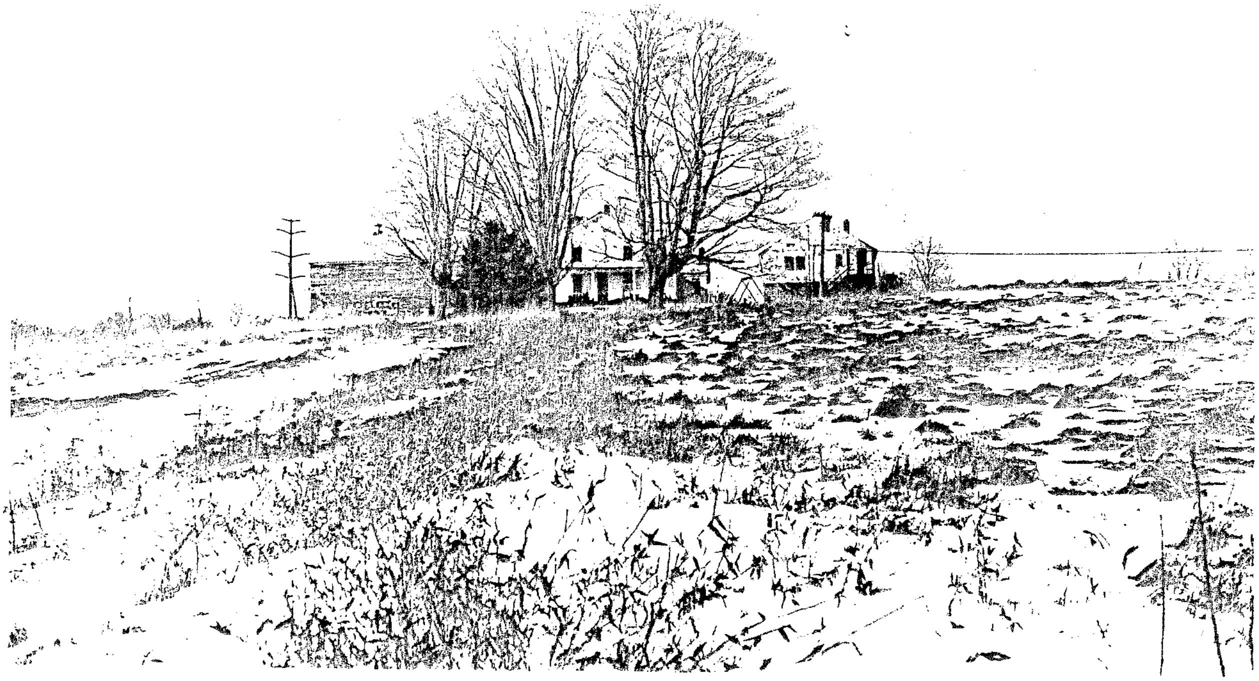
KING'S MARK
ENVIRONMENTAL REVIEW TEAM



REPORT FOR

GREENBRIER ESTATES
TORRINGTON, CONNECTICUT

GREENBRIER ESTATES

TORRINGTON, 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

Torrington 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 to the Inland Wetlands Commission and the City. 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.

DECEMBER 1987

ACKNOWLEDGEMENTS

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:

* William Warzecha, Hydrogeologist
Department of Environmental Protection - Natural Resource Center

* Kathy Hanford, District Conservationist
USDA - Soil Conservation Service

* Kenneth Metzler, Wetland Specialist
Department of Environmental Protection - Natural Resource Center

* Russell Handsman, Archaeologist
American Indian Archaeological Institute

* Richard Lynn, Regional Planner
Litchfield Hills Council of Elected Officials

* Harry Siebert, Transportation Planner
Department of Transportation

I would also like to thank Laverne Mendela, Secretary, and Janet Jerolman, Cartographer of the King's Mark Environmental Review Team for assisting in the completion of this report.

Finally, special thanks to Edward Lukacovic of the Torrington Inland Wetlands Commission and Barry Shapiro, developer, J.I. Black, engineer for the developer, and Katherine Stadtmuller, land use planner for the developer, for their cooperation and assistance during this environmental review.

EXECUTIVE SUMMARY

Introduction

The Torrington Inland Wetlands Commission has requested that an environmental review be conducted on Greenbrier Estates, a site proposed for a subdivision development. The 155-acre site is characterized by second growth, mixed hardwood forests, meadows, and former agricultural lands. Steep slopes occur in the western section of the site. There are scattered wetland communities as well as numerous streamcourses. A 100-foot easement for the CL&P transmission lines runs through the property.

The proposed subdivision would encompass 234 house lots, ranging in size from 15,000 square feet to 125,370 square feet. A number of access roads and cul-de-sacs are proposed to serve the subdivision. The subdivision would rely upon Torrington sewer and water systems.

The City was primarily concerned with the potential impact that the proposed development would have on: (1) existing wetland corridors; (2) effects of erosion and sedimentation; (3) stormwater drainage; and (4) site design compatibility. Therefore the City asked the ERT to inventory on-site resources and determine their suitability for the proposed development.

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

Topography, Setting and Geology

The land surface of the site ranges from gently sloping to steeply sloping. It is located on a hill known as a rock-core drumlin. Geologic mapping indicates the glacial till covering the site is 6 to 8 feet thick with areas that are shallow to bedrock having much thinner layers. The mode of deposition of this till allowed a shallow "hardpan" layer to develop over much of the site. The bedrock of most of the site has been identified as the Hartland Formation. The northwestern parts have bedrock known as the Hodges Mafic Complex. The bedrock structure has influenced the shape of the land forms and the drainage patterns on the site.

Geologic Development Concerns

The availability of public sewer and water to the site have allayed many of the hydrogeologic concerns. However, there are still several concerns that need to be addressed. These include: (1) shallow to bedrock areas in the western parts which may necessitate blasting; (2) the presence of "hardpan" soils which are seasonally wet and may cause soil stabilization problems; (3) the presence of regulated inland wetland soils which are being disturbed in many places; and (4) moderate slopes which will need carefully planned roads and drainage systems.

Hydrology

Because of the high density of homes proposed, development of the site would be expected to significantly increase the amount of runoff. A series of detention basins are proposed to handle the additional runoff. Most of the detention basins are located in regulated wetlands. An alternative may be to construct the detention basins in the uplands, rather than replace the wetlands, which have some intrinsic capacity for storm water retention.

There are several lots containing a high percentage of wetland soils. Experience has shown that lot owners with limited upland areas are likely to fill the wetlands in order to create "dry land". The density of housing may be too high in these areas.

Sedimentation of wetlands from construction and from road sanding may be increased. Measures may mitigate the damages to the wetlands. A determination should be made as to who will maintain the detention basins, clean the catch basins and sweep streets so that no sediments will enter the wetlands or streamcourses.

Soil Resources

The major soils limitations on the site are wetland soils, soils with high water tables and soils on steep slopes. Wetlands have the potential to be filled in by future owners because they will limit the use and maintenance of yards and driveways. Soils with high water tables are difficult to stabilize and are subject to frost heaves. Soils on steep slopes require much more care with erosion and sediment control than those on lesser slopes. This is especially true if there soils also have a high water table.

Erosion and sediment controls currently shown on the plans include filter fabric sediment fences, hay bale check dams, rip-rap splash pads and small sediment basins within the detention basins. These are designed to reduce sediment from entering the wetlands. Further erosion and sediment controls may be needed for the road filling and construction and to protect adjacent property owners from sediment deposition on their properties. Minor adjustments would improve the controls along the drainage system.

The planned storm drainage system includes road catch basins and pipe outlets, piping of streams for road crossings and eight storm water detention basins. Hydraulic calculations for pre and post development conditions for a 25 year storm are given. The detention basins are planned for a 100 year storm.

Inland Wetlands and Watercourses

Greenbrier Estates will have a substantial impact on inland wetlands and watercourses on the site. This will include road crossings and excavation for detention/sedimentation basins as well as minor crossings to access buildable land. Recommendations for mitigating some of the impacts are: (1) Consideration should be given to locating the detention/sedimentation basins on upland sites to minimize impact to wetlands and to maximize on-site retention of sand and salts from road maintenance; (2) Guidelines should be established for house setbacks from wetland and watercourses. Setbacks vary from 50 to more than 100 feet in many towns throughout the state; (3) Wetland conditions around the cul-de-sac on the southern portion of London Gate should be studied further to decide if this construction is feasible. Redesign of the area may mitigate the effects on the wetland ; and (4) The existing number of crossings will have an adverse impact to the wetlands. Redesign of the roadways and lots may ameliorate these impacts.

Threatened and Endangered Plant and Animal Species

According to the DEP - Natural Diversity Database there are no Federally listed Endangered Species or Connecticut "Species of Special Concern" that occur within the study area.

Archaeological Potential of Greenbrier Estates

Artifacts, representative of prehistoric sites between 6000 and 3000 years old, have been reported from several locations along Richards Road between Newberry Corner and Route 118. Other materials also have been found on the landforms north of Gulf Stream including the formerly cultivated fields along Wilson Road in Litchfield. The drainages of Spruce Brook and Gulf Stream clearly were the focus for periodic native settlement and use for several thousand years. Systematic archaeological surveys in several towns in Litchfield County have indicated that wetlands were an important focus for native Indian settlement throughout prehistory, perhaps more important even that river valleys. Thus, archaeological resources are expected on many of the lands surrounding the wetland system along Gulf Stream.

Although no archaeological sites are known from the specific project area, it is likely that some evidence of prehistoric use once could have been found there. However, the construction of the transmission line disturbed portions of the locality, resulting in the loss of archaeological integrity and research potential. Undisturbed parts of the site will be lost if the proposed development is constructed. However, such parts are suspected to be minimal and additional archaeological losses will be small.

Planning Considerations

The proposed project is consistent with the density of proposed land use and zoning in this section of Torrington. While the project would result in residential development of considerably greater density than allowed in the abutting R-80 zone of Litchfield, the project is not viewed as incompatible with adjacent land use or zoning in Litchfield. Consideration might be given to creating a buffer strip along the rear lot line. This will serve to soften the transition between the comparatively dense development at the subject site and any large residential lots created in the future adjacent to the site in Litchfield.

The development is generally compatible with the intensity of development proposed in the State Policies Plan and local zoning regulations and may serve to further the affordable housing goals of the State Plan. To the extent that the project will exacerbate the effective treatment of sewage in the near term at the Torrington Sewage Treatment Plant, it is inconsistent with the spirit of the the State Plan to protect the quality of water resources.

The Torrington Water Company is capable of providing water to the proposed project. It is estimated that the project would require 46,800 gallons of water per day, which is 5% of the available capacity of the Water Company. The Torrington Sewage Treatment Plant is regularly exceeding its design capacity. This means that the wastewater is not treated properly and is reducing the water quality in the Naugatuck River. Stormwater infiltration and illegal hookups are the major concerns. The City is attempting to address these problems. An existing 8" sewer line is available for the project. According to the City's consulting engineer, certain sections of this line may not be able to handle the sewage from the project. This may cause sewage to backup into the residences or cause manholes to overflow. Consideration should be given to not approving the project until such time as it can be demonstrated that the project will not exceed the capacity of the sewer lines or there is assurance that the sewer lines will be improved to accommodate the additional flows. It would be judicious for the city to plan the sewer line improvement in this area based on the development potential of the entire area to be served by the line.

Open space on the project totals approximately seven acres, most of which is wetlands or steep slopes which present limitations for recreational use. Due to the density of the project and the need for playground facilities as identified in the "Town Plan Update" report, consideration might be given to providing playground facilities.

Traffic Considerations

The conceptual roadway network within the subdivision appears to be generally consistent with engineering practice. Traffic operations should be reviewed with respect to the primary development road acting as a connector between Route 202 and Highland Avenue. Short driveways may present operational problems and safety.

Numerous roadway crossings of wetland and streams will be encountered on the site. Without a reduction in the number of wetland crossing, long term environmental maintenance problems may occur. The large number of in-roadway facilities as, water, sewer, electric, CATV, telephone, drainage, etc. can transmit subsurface water. The design of the roadway should reflect subsurface water level changes, both seasonal and induced by the development.

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INTRODUCTION

The review process consisted of four 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.

(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 November 13, 1987. Field review and inspection of the proposed development 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 the Team members had assimilated an adequate data base, it was then necessary to analyze and interpret their findings. The results of this analyses 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.

The primary goal of this ERT is to inventory and assess existing natural resources occurring on the site as well as providing planning and traffic/access information. Specific objectives include:

(1) assess the hydrological and geological characteristics of the site, including geological development limitations and opportunities, natural drainage patterns, postdevelopment stormwater runoff potential, and flooding;

Figure 1

LOCATION OF STUDY SITE

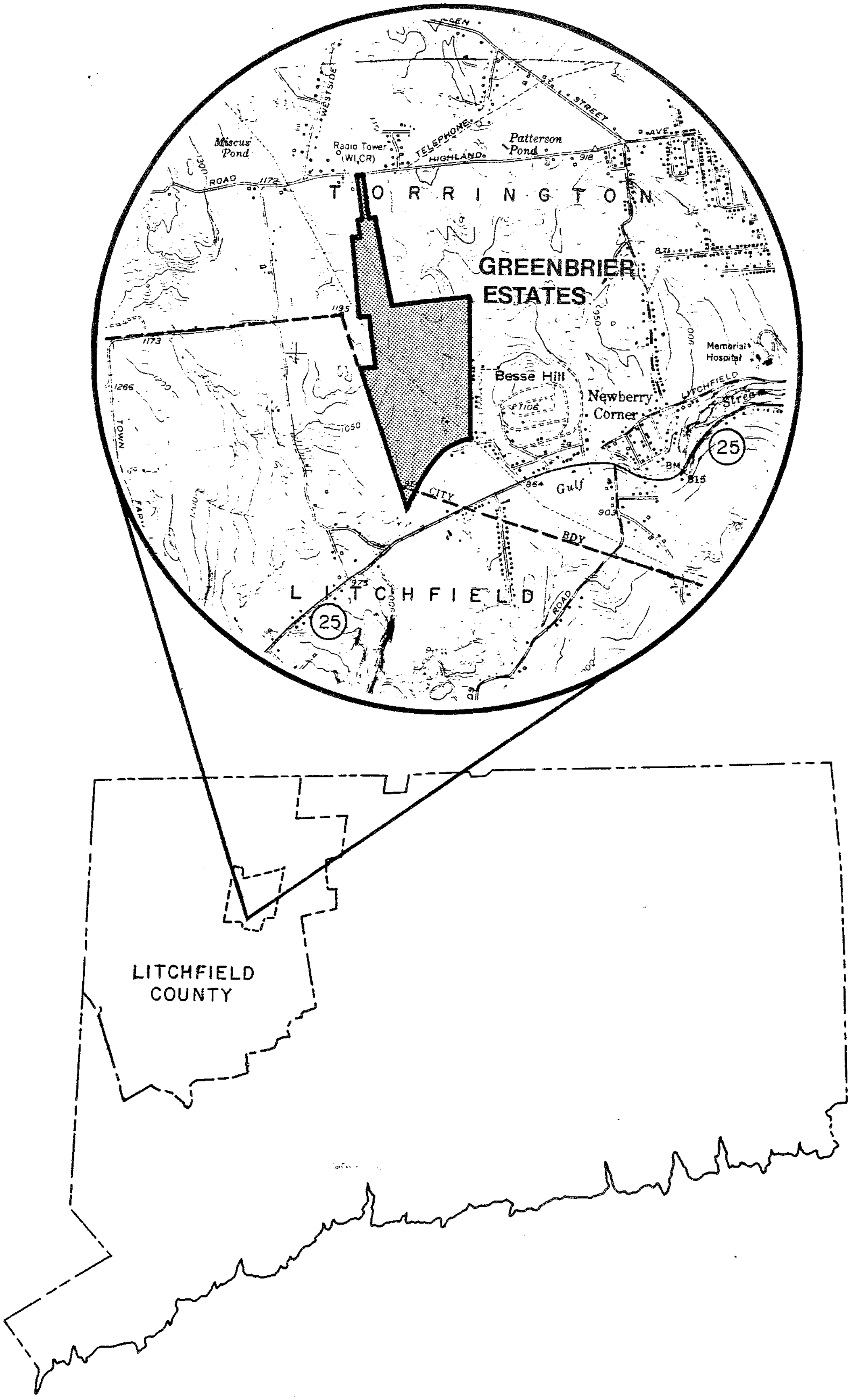
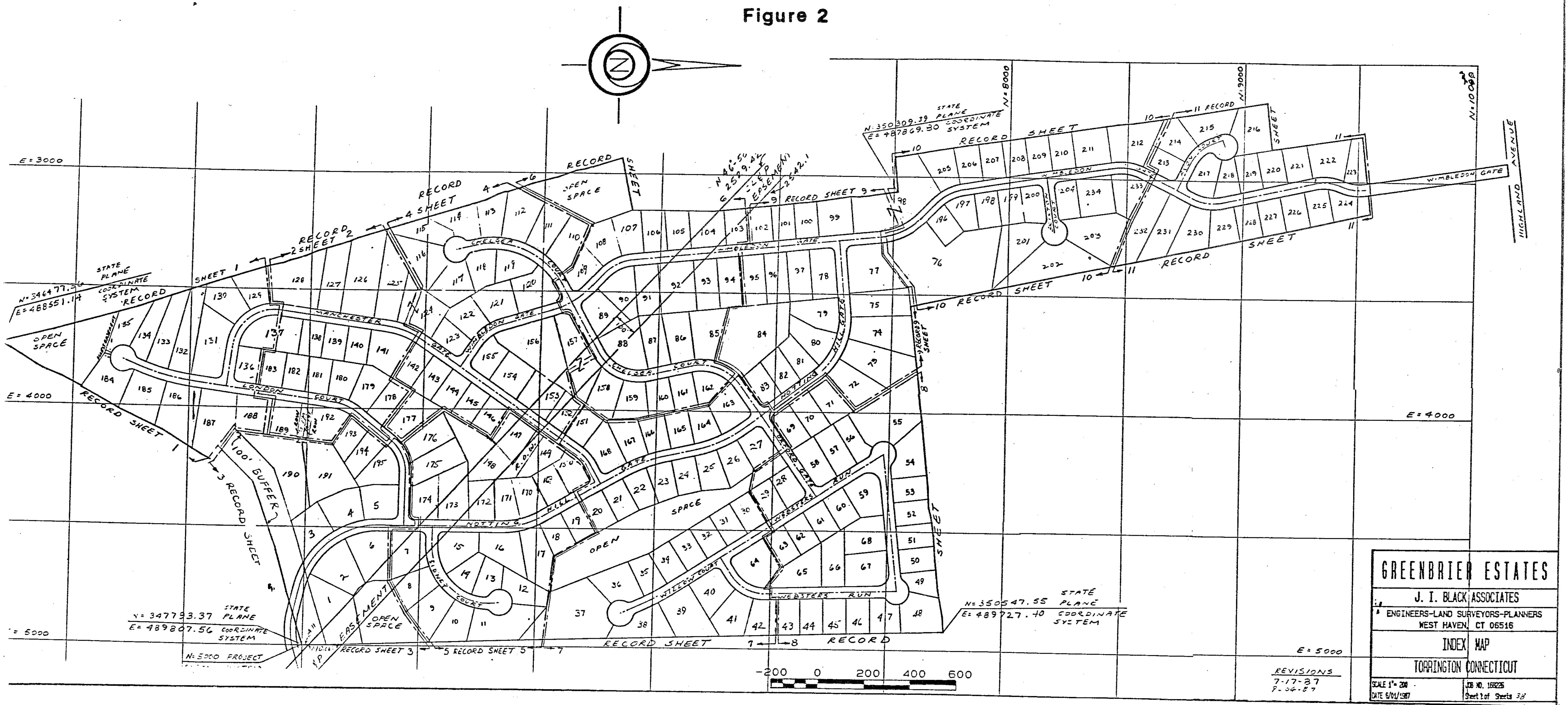


Figure 2



GREENBRIER ESTATES
Torrington, Connecticut

PROPOSED SITE PLAN

King's Mark Environmental Review Team

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(2) determine the suitability of existing soils to support the proposed development;

(3) discuss soil erosion and sedimentation concerns;

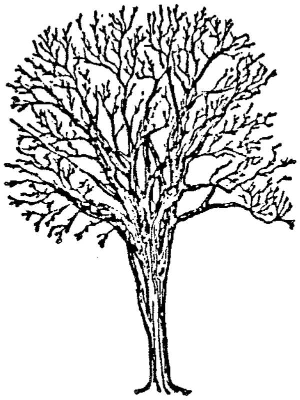
(4) assess the impact of the development on the wetlands;

(5) assess the impact of the development on the archaeological resources;

(6) evaluate traffic and access concerns, and;

(7) assess planning and land use issues.

PHYSICAL CHARACTERISTICS



Although no subsurface data was available to team members, soil and geologic mapping indicates the till in this shallow to bedrock area is quite thin, probably ranging between 0 and 5 feet thick. The till covering the remainder of the site is probably at least 6 to 8 feet thick, but may be thicker on the hill north of the farm house (Figure 4).

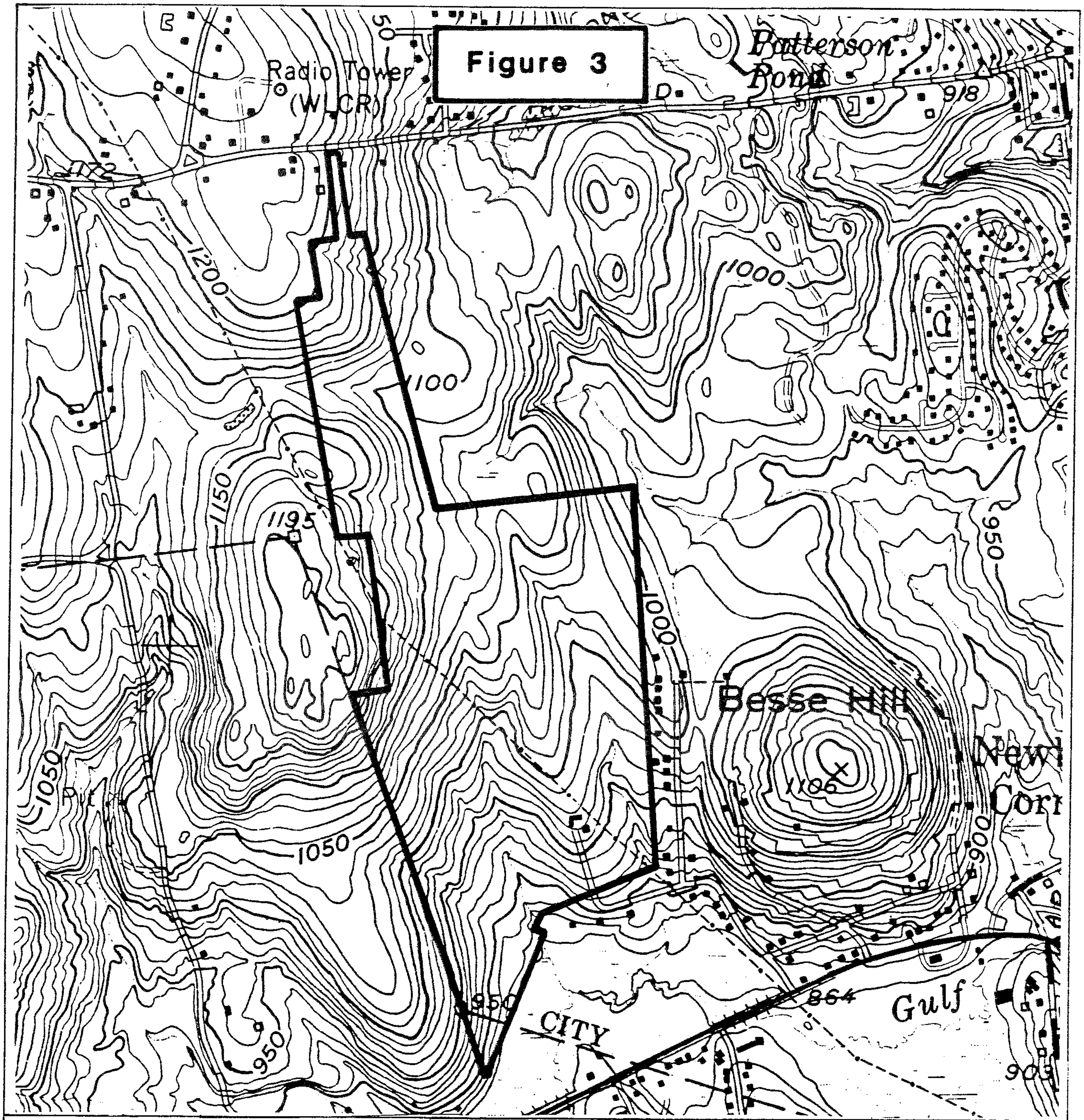
The till materials were deposited by glacial ice moving across the hill of bedrock from the north to the south-southeast. Because of this mode of deposition, a relatively shallow "hardpan" developed below the weathered and surficial soil zone. This type of unconsolidated material, which covers most of the parcel, is called lodgement till. The shallow to bedrock areas in the western parts lack the "hardpan" zone. The texture of the till in these areas is generally sandy and loose.

The bedrock geology of the site has been well described in map QR-17 (Geological Map of the West Torrington Quadrangle - see Figure 5). Except along the northwestern parts, the bedrock core of the site is identified as the Hartland Formation. These rocks are described as light grey, fine to medium-grained "granulite", composed of the minerals mica, quartz and plagioclase. The term granulite refers to a metamorphic rock (rock changed in texture and composition mainly by heat and pressure) which is characterized by even-sized, interlocking granular minerals.

The remaining northwestern parts of the site are underlain by the Hodges Mafic Complex. These rocks consist of dark-colored, fine to medium-grained amphibolites composed mainly of the minerals hornblende and plagioclase. The term "amphibolite" refers to a metamorphic rock, composed largely of minerals of the amphibole group, e.g. hornblende and plagioclase.

The bedrock structure has influenced the shape of the land forms and the drainage patterns on the site. Many homes in the region rely on the underlying bedrock as a domestic water supply source.

Figure 3



GREENBRIER ESTATES
Torrington, Connecticut

TOPOGRAPHY

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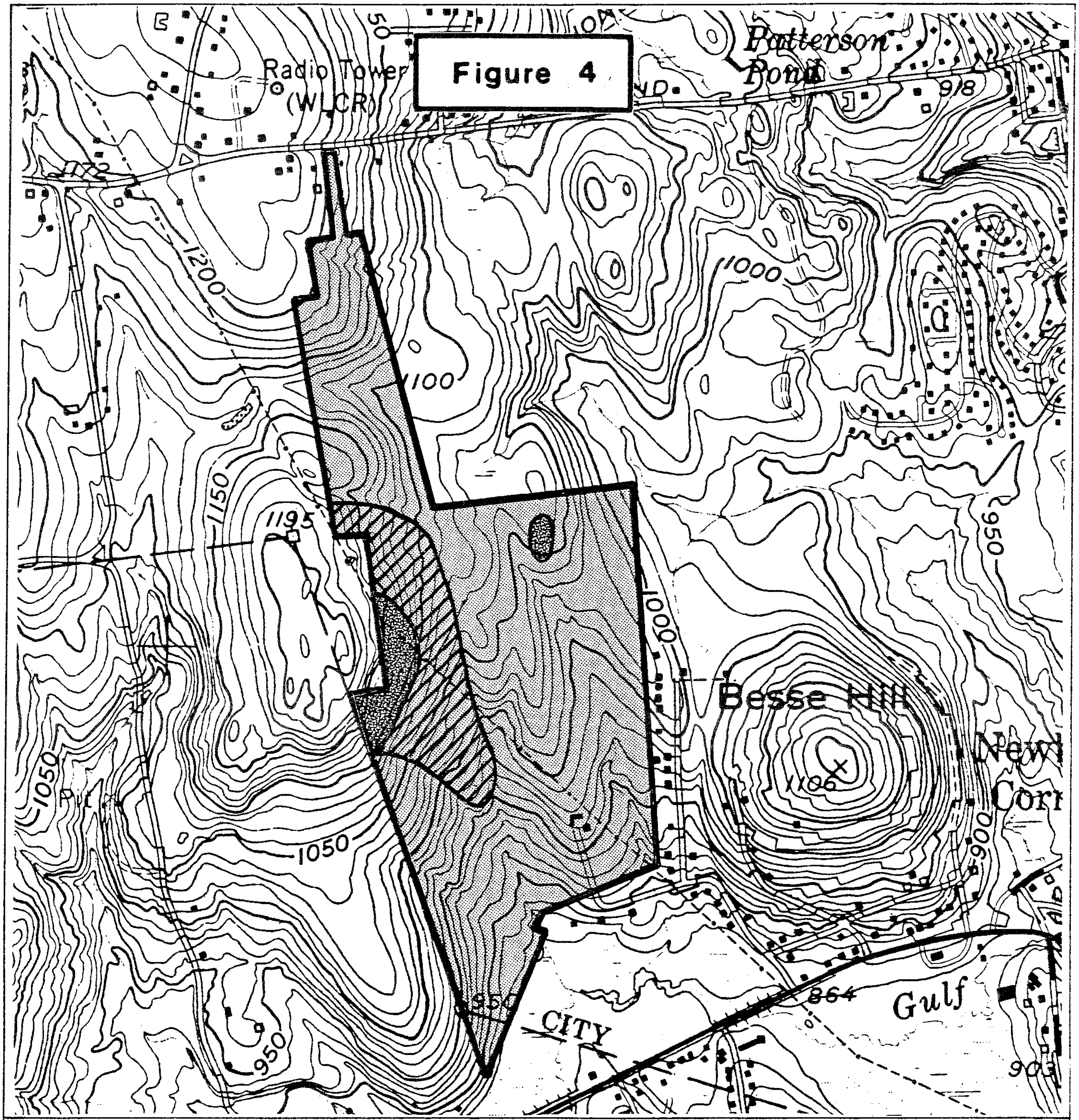
Figure 4



▨ GLACIAL TILL

▩ BEDROCK OUTCROP

▧ AREAS OF ABUNDANT OUTCROPS AND THIN GLACIAL TILL

GREENBRIER ESTATES
Torrington, Connecticut

SURFICIAL GEOLOGY

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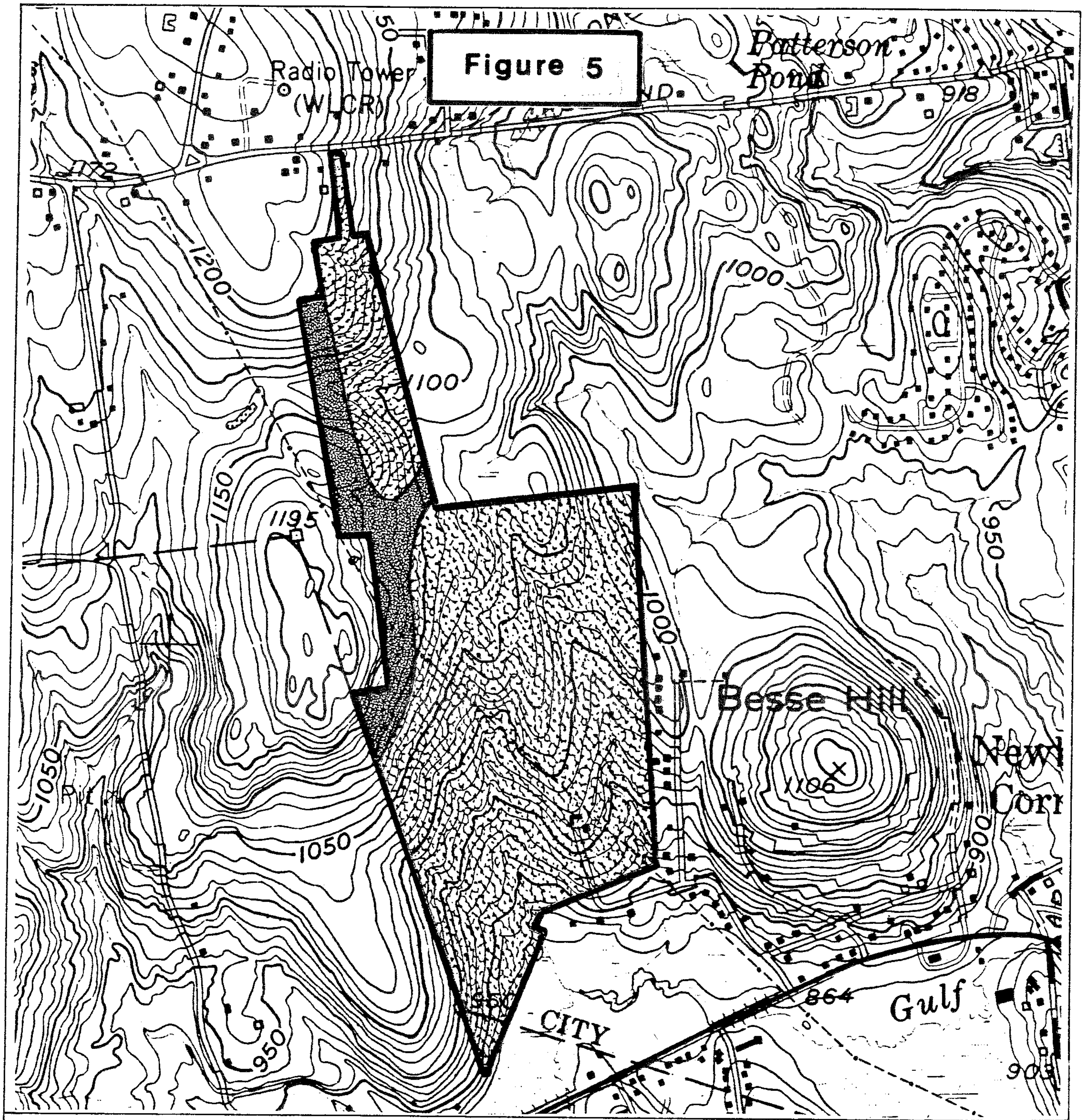
Figure 5



▨ HARTLAND FORMATION

▩ HODGES MAFIC COMPLEX

GREENBRIER ESTATES
Torrington, Connecticut

BEDROCK GEOLOGY

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0 1000'

GEOLOGIC DEVELOPMENT CONCERNS

It is understood that the parcel of land lies within a R-15 zone (15,000 square foot lots), and would be served by public water from the Torrington Water Company and by public sewers tied into the Torrington municipal system. The applicant wishes to develop 234 house lots, ranging in size from 15,000 square feet to 125,370 square feet on the 155 acre site. Because of the availability of public sewers and water, the principal hydrogeologic concerns (i.e. septic system effluent, water supply, etc.) commonly associated with residential development would not be expected to be overly problematic. However, the there is concern about the potential hydrogeologic impacts of the development with respect to wetlands, seasonally wet soils and shallow to bedrock conditions as well as potential problems arising from construction (i.e. erosion and sediment control).

As mentioned above, the major geologic limitations on this site, in terms of the proposed development, include: (1) the shallow to bedrock areas in the western parts (see Figure 4); (2) the presence of "hardpan" soils, which are seasonally wet; (3) the presence of regulated inland-wetland soils; and (4) moderate slopes.

Each of the concerns is discussed below:

(1) Because of the shallow to bedrock conditions found in the western parts of the site, it seems likely that blasting will be required in order to construct roads and place house foundations. Any blasting that is conducted on the site should be done under the strict supervision of personnel familiar with the state-of-the-art blasting techniques.

In order to minimize potential damage to nearby structures, wells, etc., it is suggested that a survey be conducted prior to blasting. At least initially, blasting can affect groundwater quality by creating turbidity conditions, especially in the immediate vicinity. It can also affect the porosity of the water-bearing fractures in the bedrock. This can be a major concern, particularly if nearby homes rely on the underlying bedrock as a water supply source. It is recommended that a detailed engineering study, which included borings, be conducted in this area to determine a profile of the bedrock surface and the extent of the blasting required, if any. It would be wise to do the necessary blasting before actual construction commences. Because the areas which require blasting contain moderate to steep slopes, it is strongly recommended that an erosion and sediment control plan be developed for any activity which takes place in these areas.

(2) Most of the site is characterized by "hardpan" soils. During wet times of the year or following significant periods of rainfall, the weathered and rooted zone above the restrictive "hardpan" layer becomes saturated with water. This is called a perched water table and results from the low permeability of the "hardpan" layer. It is characterized by sloping areas that seep, especially where the surficial soil has been disturbed.

In order to prevent wet basements, all house foundations should be properly protected by building foot drains. The footing drains should be properly outletted to the storm drainage system serving the subdivision.

Deep cuts into hardpan soils can be extremely difficult to stabilize due to seepage of water over the hardpan layer. This later creates an unstable condition just below the seepage line. The weight of the unstable soil causes the soil to slump. Once this begins, the slope is very difficult to stabilize. Even with good vegetative cover, it is impossible to keep these soils from slumping. If deep cuts are required, they should be kept to a minimum and properly stabilized as soon as possible.

(3) Wetland soils on the site have been flagged by a certified soil scientist and their boundaries superimposed on the subdivision plan. These soils are regulated under Connecticut's Inland Wetland and Watercourses Act, Connecticut General Statutes Section 22a-36 through 22a-45, inclusive (see Inland Wetlands Section).

Based on the subdivision plan on display during the prereview meeting, several road crossings of the wetlands are proposed. It is estimated that a total of 1337 feet of wetlands will need to be crossed. As discussed during the pre-review meeting, there appears to be some flexibility for the realignment of roads, which would result in less of an impact on the wetlands within the site. It is strongly suggested that these alternative routes be considered. In some cases, certain lots may need to be eliminated.

Wetland road crossings can be feasible, provided they are properly engineered. Provisions should be made for removing unstable material beneath the roadbed, backfilling with a permeable road base fill material, and installing culverts as necessary. When crossing any wetland, the road should be at at least 1.5 and preferably 2 feet above the surface elevation of the wetlands. This will allow for better drainage of the roads. It will also decrease the frost heaving and should be done at a dry time of the year. Provisions should include an effective erosion and sediment control plan.

(4) Town Officials noted on the review day that there is no restriction on grades of roads and driveways. In view of the moderate and steep slopes within the site, it seems likely that interior roads and driveways may need to be constructed on grades exceeding 10 percent. Road and driveway development on

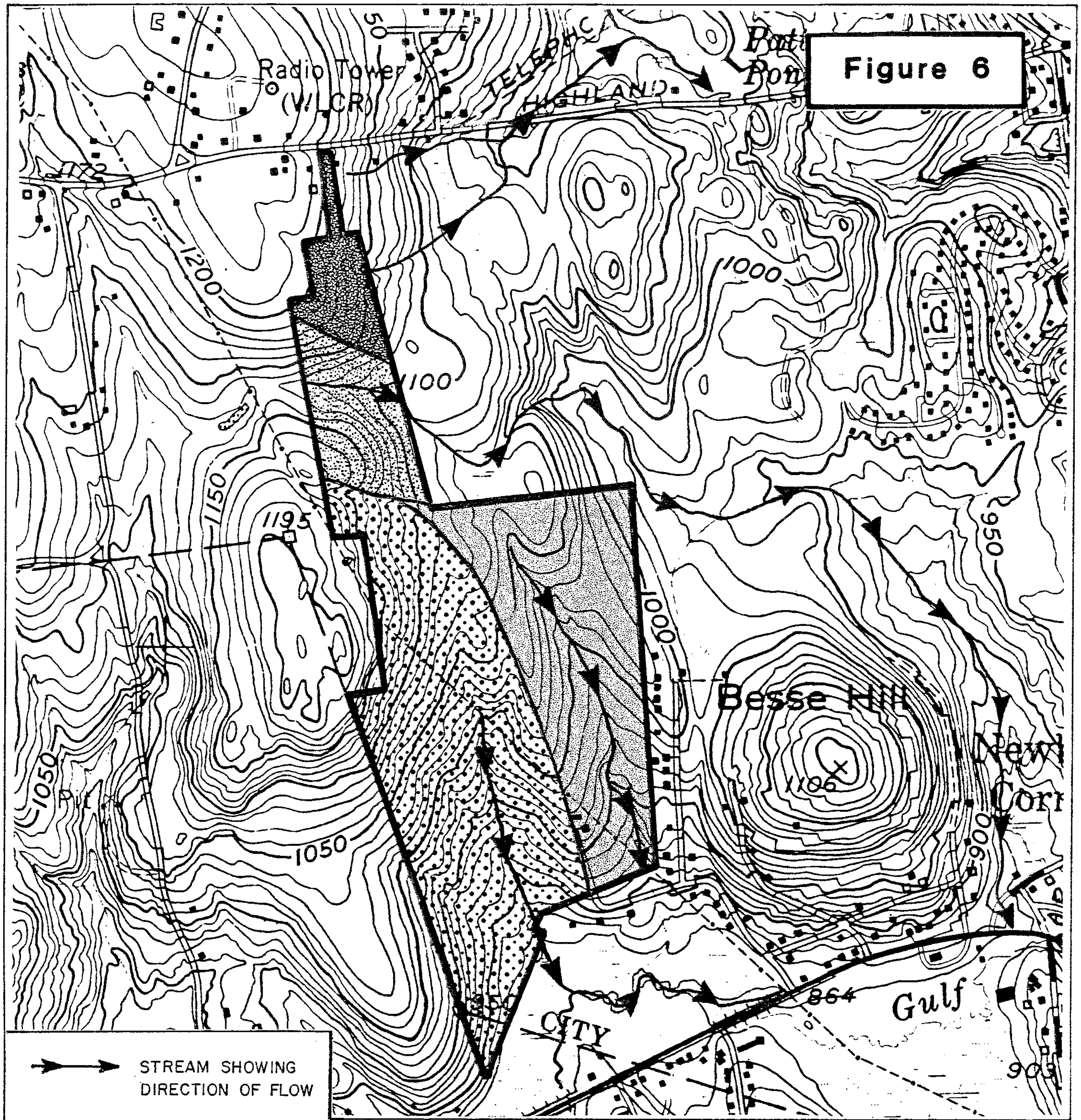
slopes exceeding 10 percent may be subject to serious erosion and mass movement (large scale sliding of overburden) problems, particularly where roads remain unimproved for extended periods of time. Additional road maintenance, such as road sanding and salting would be required on the steep slopes. Road drainage in these areas will need to be carefully planned and maintained on a regular basis otherwise problems such as gullying, siltation and road salt contamination to watercourses on or off the site may result (see Hydrology section).

HYDROLOGY

The site can be divided into four drainage areas (see Figure 6). Surface drainage in the northern limits flows easterly to a wetlands area just east of the site. The outlet stream for the wetland routes the water to Patterson Road and ultimately into the Naugatuck River. Surface runoff in the north central parts of the site forms the headwater regions for a streamcourse near lots 211-212. This unnamed watercourse flows in an easterly direction north of Besse Hill. It then flows southerly, enroute to Gulf Stream. Finally, surface drainage in the southern half of the site is divided by two southerly flowing streamcourses, which are tributary to Gulf Stream (see Figure 6).

Because of the high density of residential homes presently proposed, development of the site would be expected to significantly increase the amount of runoff during periods of rainfall. These increases would result from soil compaction, removal of vegetation and placement of impervious surfaces (roof tops, parking areas etc.) over otherwise pervious soils. The applicant's engineer is presently proposing a series of detention basins to handle post development flows so that they do not exceed pre-development flows. It will

Figure 6



→ STREAM SHOWING DIRECTION OF FLOW

▨ NORTHERN PARTS OF THE SITE THAT DRAIN TO PATTERSON POND AND ULTIMATELY NAUGATUCK RIVER

▨ NORTH CENTRAL PARTS OF THE SITE THAT DRAIN EASTWARD TO AN UNNAMED TRIBUTARY TO GULF STREAM

▨ EAST SIDE OF THE SOUTHERN HALF OF THE SITE THAT DRAINS TO THE SOUTH-FLOWING TRIBUTARY TO GULF STREAM

▨ WEST SIDE OF THE SOUTHERN HALF OF THE SITE THAT DRAINS TO THE OTHER SOUTH-FLOWING TRIBUTARY TO GULF STREAM

GREENBRIER ESTATES
Torrington, Connecticut

WATERSHED BOUNDARY

King's Mark Environmental Review Team

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be difficult to assess runoff without a proper management plan which includes all pre and post-development runoff calculations. It is recommended that Connecticut's Guidelines for Erosion and Sediment Control be closely followed with regard to stormwater management on the site (see Soil Resources section). The management plan and calculations should be carefully reviewed by the City engineer and other appropriate town officials.

Most of the detention basins are located in regulated wetland areas. Wetlands already have have some intrinsic capacity for storm water retention. One of the alternatives may be to construct the detention basins on upland soils. This will minimize wetland impacts while providing the desired detention basin system. It is suggested that the applicant contact Robert Gilmore (566-7220) of the DEP's Water Resource Unit to discuss the proposed stormwater management plan and to determine whether or not a diversion permit will be required.

There are several lots containing a high percentage of wetland soils. Experience has shown that lot owners with limited upland areas are likely to fill the wetlands on their respective properties in order to create "dry land", particularly if the lot is small to begin with. The density of houses in these areas may be too high.

Any activity which involves modification, filling, removal of wetland or alluvial soils, etc., will require a permit and ultimate approval by the City's Inland Wetland Commission. In reviewing a proposal, the Commission needs to determine the impact that the proposed activity will have on the wetlands. If the Commission determines that the wetland is serving an important hydrological or ecological function and that the impact of the proposed activity will be significant, they may deny the activity altogether or, at least, require measures that would minimize the impact (see Wetlands section).

Sedimentation of wetlands may be increased by unwanted sediments generated during site preparation and construction and road sand following construction. Certain measures may be needed to mitigate the damage to the wetlands. This can be accomplished with a detailed erosion and sediment control plan. A combination of adequate natural buffers of soil and vegetation (should be widest in areas of moderate to steep slopes) and hay bale/silt fence erosion controls should be installed. Also, there may be a need for a temporary sediment pool during active construction periods, in view of the silty soils present on the site and seasonally high water table. If the primary purpose of a sediment basin is to minimize erosion and sedimentation, the peak discharge from the 2-year and 10-year frequency storms should be analyzed. Moreover, there should be a determination made as to who will maintain detention basins, clean catch basins, sweep streets, etc. They must be cleaned regularly so as to prevent sedimentation into the wetlands, detention basins (if they are designed to provide a dual function) and streamcourses on the site. Also, access roads for maintenance purposes should be shown on the lots that contain detention basins.

SOIL RESOURCES

The soils occurring in Greenbrier Estates subdivision are described and mapped in the soil survey of Litchfield County, Connecticut, 1970 (map scale 1:15840). The soils on site are further described by Soil and Environmental Services, Inc., Soils Report for Greenbrier Estates, Torrington, CT. A copy of the soil survey map, increased in size to 1"=200' has been overlaid with the subdivision map on the Soils and Topography Index map (Rev. 9-4-87) of the subdivision plans (see Figure 7). The wetland boundaries were flagged in the field by Soil and Environmental Services, Inc. surveyed and overlaid onto subdivision plan record maps at a scale of 1"=40'.

The wetlands flagging and scale of mapping are at a scale adequate for subdivision and lot planning. No map legend is shown on the subdivision record maps, but a legend is needed to clarify all wetland boundaries. For the purposes of the Environmental Review Team report it was assumed that the dashed line with triangles represents the flagged wetland boundary and the solid line with triangles represents the areas where the soil survey map was different than the flagged boundaries.

The wetlands map (record maps) is not adequate in the area described as Subwatershed C in the Engineering Report for Greenbrier Estates (Rev. 9/4/87) (see Appendix C). The wetland boundaries shown are not clear.

The Soils Limitation Chart, included in Appendix A of this report, lists the soils occurring on the property, important soil characteristics which influence development, and lists which lots are likely to have these soil types. The scale of mapping of the upland soils is too small to adequately describe each lot. The soil survey map does give you an idea where these soils are likely, however, so that potential problems can be anticipated and planned for. Since no basements or septic systems are currently planned, soil limitations for these development features have not been included in the Soil Limitation Chart.

The current layout of roads and house lots has numerous lots which contain inland wetland soil types (see Soil Limitation Chart and Subdivision Record Maps). The high water table in the inland wetland areas is likely to be a dominant problem to future homeowners. The potential for filling of the wetland areas by future homeowners is very high because the wetlands will limit usage and maintenance of yards and driveways.

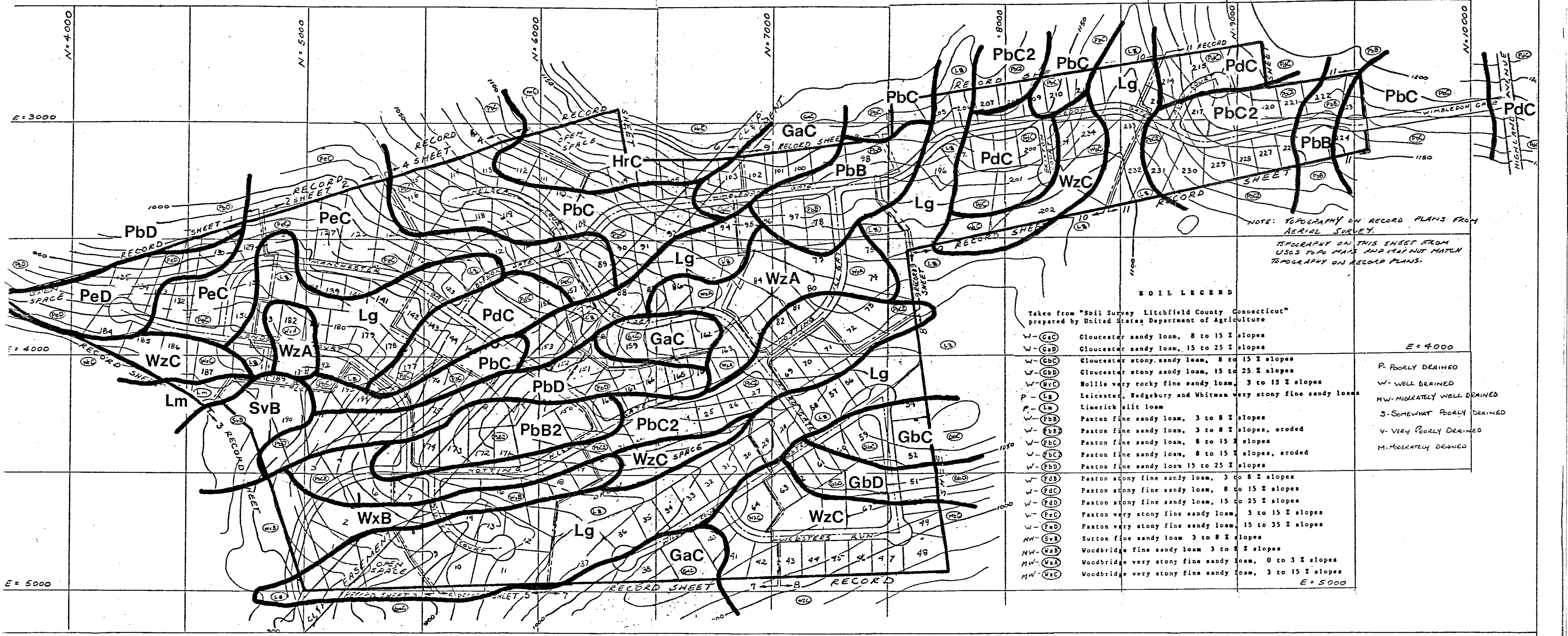
Two areas of particular concern in the proposed project are the wetlands in subwatershed C south of Chelsea Court and those in subwatershed D (as described in the engineering report). Alternative road and lot layouts may be feasible which could reduce the impact on the wetland areas.

The soils with seasonal high water tables (moderately well drained) can cause potential problems both during and after construction. Cut slopes can have water seeps which make the slopes difficult to stabilize. Water seepage can make it difficult to maintain retaining walls due to water pressure behind the walls. Paved driveways and roads may have frost heaving problems. These drainage related problems might be able to be overcome by installing drainage pipe or by land grading. Drainage pipe needs an outlet such as a storm drainage system or stream channel. After lots are sold it may be difficult for lot owners to find a drainage outlet without effecting neighboring lots.

The Paxton soils are well drained and have a dense soil layer at about 24 inches in depth. Water flows over this dense layer and can seep out if the dense layer is intercepted by a cut caused by land grading. The seeps in Paxton soils typically occur less frequently than seeps in the moderately well drained soils, however, the Paxton soils can also have some bank stabilization problems due to seepage.

The property is gently rolling to steep in slope. A few soils are very steep and are likely to cause special problems for development. These areas can be seen by the topographic contour lines on the subdivision plan Record Maps. The areas with steep slopes are also noted by the slope class in the soil name (see Soil Limitation Chart). Extensive land grading is planned in

Figure 7



NOTE: TOPOGRAPHY ON RECORD PLANS FROM AERIAL SURVEY.

TOPOGRAPHY ON THIS SHEET FROM USGS TOPO MAPS AND MAY NOT MATCH TOPOGRAPHY ON RECORD PLANS.

SOIL LEGEND

Taken from "Soil Survey Litchfield County Connecticut" prepared by United States Department of Agriculture

W-	GaC	Gloucester sandy loam, 8 to 15 % slopes
W-	GaD	Gloucester sandy loam, 15 to 25 % slopes
W-	GbC	Gloucester stony sandy loam, 8 to 15 % slopes
W-	GbD	Gloucester stony sandy loam, 15 to 25 % slopes
W-	HrC	Hollis very rocky fine sandy loam, 3 to 15 % slopes
P -	Lg	Leicester, Ridgebury and Whitman very stony fine sandy loams
P -	Lm	Limerick silt loam
W-	PbB	Paxton fine sandy loam, 3 to 8 % slopes
W-	PbB2	Paxton fine sandy loam, 3 to 8 % slopes, eroded
W-	PbC	Paxton fine sandy loam, 8 to 15 % slopes
W-	PbC2	Paxton fine sandy loam, 8 to 15 % slopes, eroded
W-	PbD	Paxton fine sandy loam 15 to 25 % slopes
W-	PdB	Paxton stony fine sandy loam, 3 to 8 % slopes
W-	PdC	Paxton stony fine sandy loam, 8 to 15 % slopes
W-	PdD	Paxton stony fine sandy loam, 15 to 25 % slopes
W-	PeC	Paxton very stony fine sandy loam, 3 to 15 % slopes
W-	PeD	Paxton very stony fine sandy loam, 15 to 35 % slopes
MW-	SvB	Sutton fine sandy loam 3 to 8 % slopes
MW-	WxB	Woodbridge fine sandy loam 3 to 8 % slopes
MW-	WxA	Woodbridge very stony fine sandy loam, 0 to 3 % slopes
MW-	WzC	Woodbridge very stony fine sandy loam, 3 to 15 % slopes

P- POORLY DRAINED
W- WELL DRAINED
MW- MODERATELY WELL DRAINED
S- SOMEWHAT POORLY DRAINED
V- VERY POORLY DRAINED
M- MODERATELY DRAINED

GREENBRIER ESTATES
Torrington, Connecticut

SOILS

King's Mark Environmental Review Team

0 400'

The following items are comments or recommended additions to the E&S control plan.

1. A sediment barrier is needed downslope of construction along property lines. Of special concern is the eastern property line.

2. A sediment barrier is needed downslope of construction of roads in all areas where inland wetlands or watercourse crossings are made, or where construction is adjacent to these land features. All roads have wetland crossings except Webster's Run.

3. The line of clearing of existing vegetation should be shown on the subdivision site plan.

4. The construction should be phased so that the entire site is not disturbed at one time. The phasing sequence should be described in the "Sequence of Activity" on the E&S details sheet.

5. Retention walls should be included on the E&S details sheet.

6. Natural revegetation of the storm water detention ponds is not adequate to control erosion. Another means of stabilization should be planned.

7. The detention basins as designed will all have cut slopes in soils with high water tables. Since the ponds are planned to be dry except in very large storm events, this cut slope is likely to erode. Some options for stabilization are: subsurface drainage, rock rip-rap, or flatter slopes.

8. The pipe outlets from the storm drainage system currently outlet on the top of cut slopes. Since no water will be in these ponds on most occasions, a gully is likely to form between the pipe outlets and the small sediment traps planned in the detention ponds. This erosion should be prevented. Some alternative solutions might be to increase the pipe length or create a stone lined water way within the detention pond area.

9. All disturbed soil areas should be stabilized with vegetation, not just the "cut/fill embankments".

10. Construction may produce more sedimentation of wetlands without additional sediment barriers on lots #13, 129, 183, 128, 142, 155, 89, 163, 14, 29, 28, 205, 226, 225, and 222 to keep sediment out of the wetlands.

11. The existing E&S plan stresses sediment control rather than erosion control. No E&S measures are planned for the upland lots except seeding. Depending on the extent of disturbed area, erosion control measures may be needed on the upland soil areas. If sediment is washing into road and storm drains additional measures will be needed.

12. E&S controls are needed for the sanitary sewer line construction through lots 12, 37, and 76.

13. The road culvert outlet between lots 186 and 187 is not in a natural watercourse. A concentrated flow of water outletting at this point is likely to cause erosion. An alternative would be piping the water to the nearest watercourse.

14. A construction entrance pad(s) should be shown in the site plans and in the E&S details.

15. The sediment barrier should be moved down slope of the land grading activities on lot 196.

16. The E&S controls (rip-rap and hay bales) are shown to be off the property line at the subdivision entrance off Hassig Road. Care should be taken to ensure the developer has the legal right to install those measures shown on the plans.

17. Proposed stock piled soil areas should be shown on the plans and E&S measures planned for these stockpiles.

Stormwater Drainage System

The planned storm drainage system includes: road catch basins and pipe outlets, piping of streams for road crossings and 8 stormwater detention basins. Hydraulic calculations for pre and post development conditions for a 25 year storm event are shown in the Engineering Report for Greenbrier Estates Rev. 9/4/87 (Appendix C). Worksheets for the 8 detention basin designs are also included. These worksheets show the basins being designed with a single stage outlet sized for a 100 year storm event. The numerous watercourses in the area of the proposed project are delineated on the Record Map Sheets (Rev. 9/4/87) in the subdivision plans. The following items are comments on the current planned drainage system:

1. The proposed houses on lots 155, 177, 192, 183, 142, and the unnumbered lot between lots 137, 138 and 183, are very close to the watercourses. Flooding may occur without the application of flood prevention measures.

2. At the entrance to the subdivision from Hassig Road, the stream is proposed to be piped for about 100 feet north of the road crossing. This requires filling the inland wetlands and diverting the water flow off the neighboring property to the east. It is unclear from the plans why this piping and wetland filling are necessary. There may be other alternatives.

3. Detention Pond #7 is in the CL&P right-of-way (ROW). The disturbed area within the ROW is shown as being 120 feet for the pond and 170 feet for the pond plus the adjacent road. Will this construction be feasible with the power line supports in this area?

4. Detention Pond #4 is shown on the land grading plan (Record Map Sheet 8 of 38 Rev. 8-24-87). It is omitted from the Record Map Rev. 9-4-87. The installation of this pond needs to be clarified.

5. Culverts are needed where roads cross the wetland areas so that drainage is not blocked. Areas of concern are between lots 128 and 137, lots 98 and 77, and lots 212 and 283.

6. The grading/drainage plan in lot 133 may cause ponding without a plan alternative.

7. The design for the detention basins implies that all waterflow from storms smaller than the 100 year storm will flow through the basins with no detention. There is only a single stage outlet. If flooding or potential flooding occurs downstream in smaller storms, then multiple stage outlets may be necessary. The Soil Conservation Service recommends analyzing the 2, 10 and 100 year storm events in designing detention basins to control flooding.

The following items are comments on the calculations in the Engineering Report for Greenbrier Estates revised 9-4-87 (Appendix C).

1. The runoff curve number for predevelopment conditions (76) is based on a totally wooded watershed with soils all in hydrologic group C. This does not describe the existing watershed conditions.

2. No channel flow was calculated in any of the subwatersheds in determining the time of concentration. Defined channels exist in the watershed and should be used in watershed calculations using the TR-55 method. The 5,000 feet shallow concentrated flow length used in the calculations is unusually long. Typically, channel flow develops within the first 2,000 feet of flow.

3. The same soil hydrologic groups should be used in pre and post development hydrologic calculations. An exception to this would be if the wetland filling has significantly altered the acreage of wetland soils on site.

4. The curve number used for post development calculations seems low. Typical runoff curve numbers in developed watersheds are shown in Appendix B of this report.

5. The acreages in the subwatersheds (system 1-4) used to calculate post development runoff (total of 209.2 acres), do not equal the stated watershed size (154.8 acres).

6. All post development watershed calculations are for a 25 year storm but the detention basins are sized for a 100 year storm. These runoff calculations should also be supplied.

7. If there is no detention in the proposed ponds until the 100 year storm event then no detention should be assumed when comparing the pre and post development runoff from the 25 year event.

Because it is questionable whether the figures used in calculating the runoff adequately describe the watershed, and all the hydrologic and hydraulic calculations have not been included in the report, it is not possible to compare pre and post development runoff from the engineering report supplied. This information is important to determining the effect of the project on the environment. When this information is supplied it is recommended that it be reviewed by a professional engineer familiar with the methods used for calculations.

INLAND WETLANDS AND WATERCOURSES

Greenbrier Estates will have a substantial impact on the inland wetlands and watercourses on the site. This will include approximately 1,400 feet of road crossings and over three acres of excavation for detention/sedimentation ponds in wetlands, not including "minor" stream crossing and driveway crossings to access buildable land from the proposed roads. This represents a significant impact on the wetlands, not to mention the possible degradation of water quality by the input of stormwater discharge into the wetland system. Due to recent changes in the State Inland Wetlands and Watercourses Legislation, Section 22t-36 to 45, inclusive, of the General Statutes, as amended by Public Acts 87-338 and 87-533, the City needs to decide if this project represents a "reasonable and prudent" alternative for the use of the site.

Wetland Characteristics, Ecological Value and Impacts of the Development

The characteristics of the inland wetlands and watercourses on the site appear to have been adequately described by Jodie T. Chase, an environmental consultant to the developer. Since this report is available, the consultants descriptions are sufficient to facilitate the review of this proposal. However, it would be to the towns advantage to question some of the conclusions made by the consultant and conduct an independent evaluation of their own. Conclusions that might be questioned include:

1) "storm water runoff is discharged from the site in an efficient manner" - Detention basins will be in wetland areas. Stormwater detention will be difficult during periods of high flow when the ground is fully saturated and the basins are full.

2) "downstream wetlands continue to receive runoff typical of pre-development conditions so that their functions and characteristics remain unaltered and uninterrupted" - There might be a substantial increase in runoff. Also, input of road salts and chemicals from lawn maintenance is not typical and might alter the downstream wetland character and functions.

3) "wildlife habitat within the wetland areas is maintained" - Each wetland will be isolated and surrounded by numerous houses which makes wildlife habitat difficult to maintain.

Additionally, there is no consideration of the impacts of the proposed construction on the adjacent wetlands. There are at least 25 proposed houses within 20 feet of wetland boundaries, and it is unreasonable to expect that construction activities will not affect the adjacent areas. Also, if these houses are built with such close proximity to wetland areas, measures will need to be considered to prevent future impact such as illegal filling by the home owners.

Conclusions and Recommendations

The proposed subdivision will be a significant land-use change on the existing property. Wetlands will be most severely impacted with numerous road crossings and excavations for detention/sedimentation basins. Recommendations for mitigating some of the impacts are:

1) Consideration should be given to locating the detention/sedimentation basins on upland sites to minimize impact to wetlands and to maximize on-site retention of sand and salts from road maintenance.

2) Guidelines should be established for house setbacks from wetland and watercourses. Setbacks vary from 50 to more than 100 feet in many towns throughout the state.

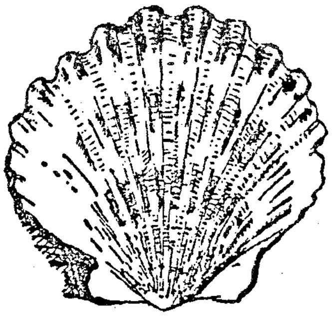
3) Wetland conditions around the cul-de-sac on the southern portion of London Gate should be studied further to decide if this construction is feasible. Redesign of the area may mitigate the affects on the wetland.

4) The existing number of crossings will have an adverse impact to the wetlands. Redesign of the roadways and lots may ameliorate these impacts.

THREATENED AND ENDANGERED PLANT AND ANIMAL SPECIES

According to the DEP - Natural Diversity Database there are no Federally listed Endangered Species or Connecticut "Species of Special Concern" that occur within the study area. The Natural Diversity Data Base contains the most current biologic data concerning endangered or threatened plant or animal species. On-going research continues to locate additional populations of species or locations of habitats of concern as well as updating existing data.

ARCHAEOLOGICAL RESOURCES



ARCHAEOLOGICAL POTENTIAL OF GREENBRIER ESTATES

The City of Torrington's archaeological resources have never been systematically surveyed or recorded. Consequently, there are only a few prehistoric sites identified in the files of the American Indian Archaeological Institute (AIAI). However, these data, several additional small collections at the AIAI, and the work of knowledgeable avocational archaeologists in the area provide information sufficient to characterize the research potential of the proposed subdivision.

The lands surrounding Gulf Stream and its wetlands, south and west of Newberry Corner, have been the focus of sporadic residential development for more that two decades. During this time, housing complexes have been built around Besse Hill and along Hassig Street, Hart Drive and Peck Road. As these lands were developed and intensively used, some archaeological site must have been partially disturbed or completely destroyed. Artifacts, representative of prehistoric sites between 6000 and 3000 years old, have been reported from several locations along Richards Road between Newberry Corner and Route 118. Other materials also have been found on the landforms north of Gulf Stream including the formerly cultivated fields along Wilson Road in Litchfield. The drainages of Spruce Brook and Gulf Stream clearly were the focus for periodic native settlement and use for several thousand years.

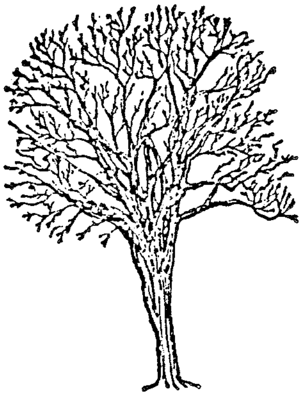
The richness projected for this four square mile area is not unexpected. Systematic archaeological surveys in several towns in Litchfield County have indicated that wetlands were an important focus for native Indian settlement throughout prehistory, perhaps more important even that river valleys. Thus, we would expect to find archaeological resources on many of the lands surrounding the wetland system along Gulf Stream.

Although no archaeological sites are known from the specific project area, it is likely that some evidence of prehistoric use once could have been found there. However, the construction of the transmission line, earlier in the twentieth century, undoubtedly disturbed portions of the locality, resulting in the loss of archaeological integrity and research potential.

Any undisturbed parts of the site which continue to exist now will be lost if the proposed development is constructed. However such parts are suspected to be minimal and additional losses will therefore be small. Thus, the construction of Greenbrier Estates is expected to have only a limited additional impact on the locality's archaeological resources.

It is important that various commissions in both Torrington and Litchfield recognize the continued archaeological richness of the area. Despite the twentieth century losses, many important sites remain. By limiting and controlling development and destructive land uses such as graveling, some of this region's prehistoric archaeological record can be preserved for future study. Wetlands are now commonly recognized to be rich and critically important environmental places. Yet this richness has always had a human dimension - specifically a Native American Presence - that is still largely unexplored. It is this record that deserves systematic and cooperative preservation efforts.

LAND USE AND PLANNING CONSIDERATIONS



PLANNING CONSIDERATIONS

Compatibility of Project with Surrounding Land Use

The proposed subdivision is zoned R-15 and abuts the town of Litchfield along its western border. This portion of Litchfield was recently rezoned from R-60 to R-80, requiring a minimum of about 2 acres per residential lot. Elsewhere, the project site is surrounded by R-10 and R-15 zones in Torrington. With the exception of the residential development along Hassig Road and Linton Street, the land abutting the subject site is largely undeveloped.

The proposed project is consistent with the density of proposed land use and zoning in this section of Torrington. While the project would result in residential development of considerably greater density than allowed in the abutting R-80 zone of Litchfield, the project is not viewed as incompatible with adjacent land use or zoning in Litchfield.

Consideration should be given by the applicant to creating a buffer strip along the rear lot line of the 14 lots which abut the Litchfield/Torrington town line. This will serve to soften the transition between the comparatively dense development at the subject site and any large residential lots created in the future adjacent to the site in Litchfield. Conifers such as white pine and spruce are often used. Deed restrictions on the cutting of the buffer strip trees should be considered together with routine maintenance of the strip by the proposed homeowner's association.

Consistency of the Project with State, Regional and Local Plans

The State Policies Plan for the Conservation and Development of Connecticut, 1987-1992 is a statement of the growth, resource management, and public investment policies of the state. The Plan was prepared by the Office of Policy and Management and adopted by the Connecticut General Assembly in 1987. The objective of the Plan is to give a balanced response to human, environmental and economic needs in a manner which best suits the future of Connecticut. Regional planning organizations in the state have been encouraged by OPM to foster implementation of the Plan at a local level.

According to the Locational Guide Map which accompanies the State Plan, the majority of the subject site has been classified as an area of long term urban potential. As such, it is considered suitable for intensive development provided urban facilities and infrastructure are developed.

The State Plan also endorses the maintenance of high quality waters to promote environmental values and protect the public health and welfare. To this end, the Plan discourages state-support of development projects where the design capacity of existing or programmed wastewater systems is inadequate.

The major housing goal of the State Plan is "to establish and maintain an adequate supply of decent and affordable housing in a suitable living environment for all citizens". The project's applicant has indicated that a major goal of this development is the provision of additional affordable housing units in Torrington. Affordable housing is a widely recognized need in the regional area.

The Litchfield Hills Council of Elected Officials is a new regional planning organization and does not currently have a regional plan of development. Thus an assessment of the consistency of the proposed project with the goals of a current regional plan is not possible.

The City of Torrington is in the process of updating its 1967 Master Plan. As noted above, the subject site is zoned R-15. Hence the density of the proposed project is consistent with the comprehensive plan of the city as expressed through its zoning regulations.

To conclude, the project is generally compatible with the intensity of development proposed in the State Policies Plan and local zoning regulations and may serve to further the affordable housing goals of the State Plan. To the extent that the project will exacerbate the effective treatment of sewage in the near term at the Torrington Sewage Treatment Plant, it is inconsistent with the spirit of the the State Plan to protect the quality of water resources.

Water and Sewer Facilities

The Torrington Water Company is well positioned to service the proposed project according to Richard Calhoun of the Torrington Water Company. A pipeline extension from Wyoming Avenue to Litchfield Street to Hassig Road would be required to service the project. According to Mr. Calhoun, lots at the site below 1130 feet in elevation can be served by gravity flow while those above 1130 feet will require pumping of the water supply.

With a safe yield of 4.7 million gallons per day (mgd), and over 1.0 mgd of available capacity, there is abundant water available at the Torrington Water Company to service the site, according to Mr. Calhoun. The Water Company has found that 200 gallons per day (gpd) per living unit is a reliable standard for estimating estimating residential needs. Thus, for design purposes, the proposed project of 234 units can be expected to require 46,800 gallons of water per day. This is less than 5% of the available capacity of the Torrington Water Company.

The sewage treatment plant in Torrington is operating at 80% of its design capacity based on average monthly flows, according to Gerald Rollet, a consulting engineer for the City. However, as shown in Table 1, average high monthly flows are routinely exceeding the 7.0 mgd design capacity of the plant. During such high flow periods, the wastewater may not be receiving adequate biological treatment prior to its discharge into the Naugatuck River. According to the Superintendent of the sewage treatment plant, discharge from the plant failed to meet DEP water quality permit standards 34 times between May 1986 and May 1987, based on testing conducted three times per week at the plant.

Stormwater infiltration is the principal cause of the high flows in the system according to the City's Public Works Director. The City's consulting engineer has indicated that infiltration from stormwater has been known to quadruple the normal sewage flows through the system. During one 3-day storm event in the spring of 1987, sewage flows into the plant exceeded 20 mgd, resulting in both hydraulic and biological failure of the plant. Due to the backup of wastewater into the plant and on-site flooding, evacuation of the plant was being considered at one point, according to the City's Public Works Director.

The City is addressing the infiltration problem along with the problem of illegal sewer hookups with the help of a consulting engineering firm which has been retained to identify and seal major points of infiltration and to locate illegal hookups into the system. In addition, the City is pursuing, in cooperation with DEP, the preparation of a facility study to upgrade the sewage treatment plant and sewer lines. According to the City's Public Works Director, it will be 6 to 8 years, at the earliest, before an expanded and upgraded sewage treatment plant and system is on line.

With regard to the proposed project, an existing 8 inch sewer line is available along Litchfield Road (Route 202) which the project may tie into. This line connects to a major interceptor line located along Park Avenue in downtown Torrington, which, in turn, connects to the sewage treatment plant located off of Bogue Road.

TABLE 1

HIGH AND LOW FLOWS AT THE TORRINGTON WASTE TREATMENT PLANT AND AVERAGES FOR THE MONTH*

	1986			1987		
	High	Low	Avg.	High	Low	Avg.
JAN.	8.6	4.1	6.52	7.2	3.5	5.5
FEB.	8.1	3.9	6.40	6.7	2.7	4.88
MARCH	9.8	5.3	7.88	9.04	4.83	7.23
APRIL	8.0	4.0	6.46	12.7	8.10	10.7
MAY	7.3	3.0	5.40	8.3	3.9	6.01
JUNE	9.0	4.4	6.80	7.4	2.7	4.9
JULY	7.0	2.7	4.99	6.2	2.0	4.10
AUG.	8.0	3.3	5.63	6.3	2.0	4.15
SEPT.	6.8	2.6	4.73	6.8	2.6	4.87
OCT.	6.5	2.1	4.30			
NOV.	7.3	2.7	4.83			
DEC.	7.0	4.2	6.30			

* 7.0 MGD/design capacity

According to the consulting engineer for the City, the existing sewer line along Litchfield Road is sufficient to handle current flows into the system. However, based on computer modeling conducted by the consulting engineer, it appears that certain sections of the line will not be able to hydraulically accommodate input from the Greenbrier Estates project. To avoid the spectre of sewage backup into residences or overflowing sewer manholes, it may be necessary to install larger sewer lines along portions of Litchfield Road.

Consideration should be given by the City to not approving the proposed project until such time as it can be demonstrated that the project will not exceed the capacity of the sewer lines or there is assurance that the sewer lines in this section of the City will be improved to accommodate the additional flows. In this regard, the City may wish to consider adopting an impact fee system whereby future developers in this part of the City are required to pay for a percentage of the necessary sewer line improvement based on the extent they will impact the system.

From a regional perspective, it would be judicious for the City to plan the sewer line improvement along Litchfield Road based on the development potential of the entire area to be served by the sewer line. Installing a 10 inch line to handle the Greenbrier Estates project alone may not be appropriate if a 15 inch line is needed in 5 or 10 years to service additional development. Intermunicipal cooperation between Litchfield and Torrington in addressing this issue based on local plans for the area is encouraged.

Open Space and Recreation

The proposed project calls for four separate areas for open space on the site varying from 1.3 to 2.3 acres in size and totaling approximately 7 acres or 4.5% of the site. Most of this land consists of wetland or steeply sloping land that presents severe limitations for recreational use.

Many communities in Connecticut require in their subdivision regulations the set aside of 10 to 15% of a site for open space and recreational purposes. Torrington's subdivision regulations do not provide for open space dedication as a general rule, however the regulations do stipulate that "Where deemed essential by the Commission, in large scale neighborhood unit developments not anticipated by the Comprehensive Plan, the dedication or reservation of additional areas or sites may be required of a character, extent and location suitable to the needs created by such development for schools, parks and other public purposes."

According to the "Community Facilities and Services" report of the Town Plan update, dated October 1987 by Lord-Wood, Larson Associates for the City of Torrington, the single major recreational deficiency in the City is playgrounds to serve newly developing, outlying residential areas. The report specifically identifies the southwest portion of the City (the area of the subject site) as in need of such facilities. According to the Recreation Facilities Map of the Lord-Wood, Larson report, there are no public recreational facilities within one mile of the subject site in Torrington.

The Lord-Wood, Larson report recommends the provision of a play area within one-half mile and safe walking distance of every child. The report further states that the facilities should by adequately furnished with well planned, well constructed equipment kept in good condition through a regular maintenance program.

Due to the density of the proposed project and the need for playground facilities as identified in the "Town Plan Update" report, consideration should be given to providing playground facilities at the subject site. This might include several pocket parks scattered throughout the site with routine maintenance of the land and facilities the responsibility of a homeowner's association.

TRAFFIC CONSIDERATIONS

A review of the site indicates concerns exist from the land use change; agricultural to moderate density housing. The subdivision road will provide access between Route 202 and Highland Avenue will also relate to additional land use changes in the area.

Traffic data provided by the site developer is consistent with this Department's statistical data:

CDOT ADT on Route 202

	1980/81	1983/84	1986
Litchfield town center	8100	7300	8200
West of Hart Road	6400	7800	8800
East of Hassig Road	7300	9000	9200
West of Weed Road	5600	6200	6600

The 1984 ADT at the intersection of Highland and Washington Avenues was 5900 ADT.

Reportable accident incidence was not significant from reports made up to 1986 along Route 202.

Traffic volume increases, coupled with turning movements, have a potential for increasing accident frequency and numbers. Trip generation from land use changes require special studies to determine specific traffic controls for safe operations.

The conceptual roadway network within the subdivision appears to be generally consistent with engineering practice. Residential structures front on development roadways and, in some instances, driveways are less than 30 feet in length. Traffic operations should be reviewed with respect to the primary development road acting as a connector between Route 202 and Highland Avenue. Short driveways may present operational problems and safety.

Numerous roadway crossings of wetland and streams will be encountered on the site. Without a reduction in the number of wetland crossings, some long term environmental maintenance problems may occur.

The large number of in-roadway facilities as, water, sewer, electric, CATV, telephone, drainage, etc. can transmit subsurface water. The design of the roadway should reflect subsurface water level changes, both seasonal and induced by the development. Techniques to reduce this concern are available which would be based on data.

The traffic study for the site addresses general concerns relative to generated traffic. Operationally, the subdivision road will be a connector between Route 202 and Highland Avenue which will require additional analysis to determine specific roadway improvements and traffic control requirements. The consultant's comment that Highland Avenue improvements are the town's responsibility is premature. This determination would be appropriate in the material prepared for the State Traffic Commission certificate.

In summary, it is recommended that the following be addressed relative to the proposed land use change:

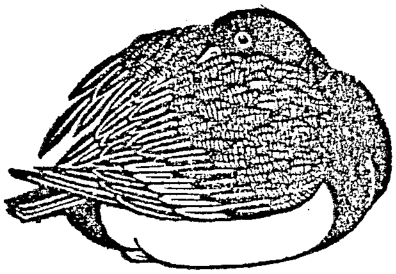
1. Traffic Operations - reconsider internal subdivision road configuration and specific off-site traffic controls.

2. Wetland Crossings - review wetland crossings to reduce long term environmental impacts.

3. Roadway Design and Construction - review to reduce subsurface water concentration.

4. Off-Site Discharge of Surface and Subsurface Water - non-degradation of existing water quality in drainage-ways, wetlands and streams.

APPENDICES



Appendix A: Soils Limitation Chart

SOIL LIMITATIONS CHART

SOIL SYMBOL	SOIL NAME	LIMITING SOIL CHARACTER	POTENTIAL PROBLEMS	LOTS LIKELY TO CONTAIN THESE SOILS
HrC[1]	Hollis	Shallow depth to bedrock	High cost of land grading due to potential need for blasting	104-108, 110-112
Lg[2]	Leicester	High water table	Wet yards, cut slopes seep, wet driveways, and wet roads	1, 8, 9, 12, 13, 14, 16-27, 28-31, 36, 37, 55-58, 69-79, 84-88, 94-96, 98, 99, 117-122, 124, 128, 131-134, 138, 141-143, 153, 156-158, 160-164, 166, 167, 178, 179, 185-189, 192, 201-203, 211, 212, 221, 222, 225, 226, 230-234
GaD[1] GbD PbD PdD PeD	Gloucester " Paxton " "	Steep Slopes	Extensive land grading +/or retaining walls needed for construction. High potential for erosion due to steep slopes and land grading activities.	5, 50, 51, 60-62, 66, 68, 130-135, 147-149, 151, 152, 158, 164-168, 174, 175, 184, 185, 190, 191, 195
SvB[1] WxB WzA WzC	Sutton Woodbridge "	Seasonal high water table frost heaving	Needs drainage outlets, cut slopes seep and erode	2, 15-23, 40-50, 63-67, 73-75, 79-87, 163, 164, 181-187, 189-190, 201-204, 234

1 - Shown in Soil Survey of Litchfield County, Ct, scale 1:15840 (overlaid on Greenbrier Estates Index Map, 1"=800'

2 - Shown on Greenbrier Estates Record Maps, scale 1"=40' (wetland map)

Appendix B: Runoff Curve Numbers

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

---

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Appendix C: Engineering Report (Rev. 9/4/87)

Greenbrier Estates
Torrington, Connecticut

Engineering Report

July 17, 1987
Rev. July 24, 1987
Rev. Sept. 04, 1987

J.I. Black Associates Inc.
Engineers - Surveyors - Planners
2 Elizabeth Street
West Haven, Connecticut 06516
(203) 397-0000

WATERSHED STUDY

I. EXISTING SITE -

PARCEL 1 - 129 AC.
PARCEL 2 - 25.86

TOTAL = 154.86 AC ±

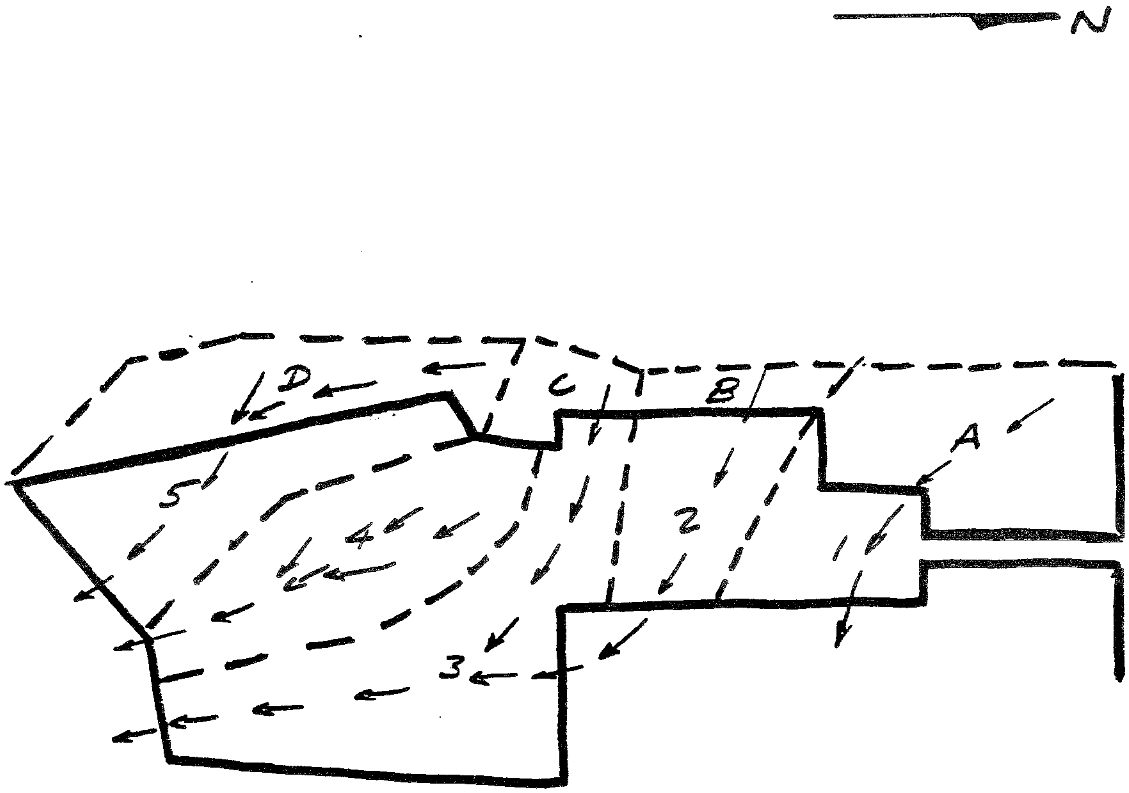
II. OFF-SITE WATERSHED

A. 12.4 AC.
B. 7.2 AC
C. 10.1 AC
D. 24.8 AC

TOTAL = 54.8 AC

GREENBRIER ESTATES

TORRINGTON, CONNECTICUT




WESTSIDE
TORRINGTON
CENTER
1200
1150
1100
1000
950
900
850
750
700
650
25
1 MI TO CONN 4
4630
47'30"
(TORRINGTON)
BAKERSVILLE 5.5 MI.
HARTFORD 31 MI.
6367 I SE
1" = 2000' → N

POST - DEVELOPMENT -

SYSTEM NO.	HOUSES	ROADWAY	SYSTEM AREA
1.	14	1400'	6.7 AC.
2.	26	1600'	12.9 AC
3.	88	6800'	51.7 AC
4.	72	4600'	59.8 AC
5.	54	3600'	23.7 AC.
TOTAL	254	18,000'	154.8 AC

INCREASE IN RUN-OFF -

BASED UPON 50'x 26' HOUSE, 15'x 35' DRIVEWAY AND 30' WIDE ROADWAY

SYSTEM NO.	HOUSE & D.W. AREA	ROADWAY AREA	TOTAL AREA
1.	0.58 AC	0.96 AC	1.54 AC
2.	1.09 AC	1.10 AC	2.19
3.	3.68 AC	4.68 AC	8.36
4.	3.02 AC	3.17 AC	6.19
5.	2.26 AC	2.48 AC	4.74
TOTAL	10.63 AC	12.39 AC	= 23.02 AC

= 14.8 % OF TOTAL SITE

WATERSHED - HYDROLOGIC GROUP

OFF-SITE

A- PAXTON -"C"

B- PAXTON/LEICESTER- "C"

C- HOLLIS (C/D) / GLOUCESTER Ⓐ / PAXTON Ⓒ - "C"

D- PAXTON-HOLLIS -"C"

ON-SITE

1 - PAXTON -"C"

2 - PAXTON Ⓒ - WOODBRIDGE Ⓒ - LEICESTER Ⓒ - "C"

3 - PAXTON Ⓒ - WOODBRIDGE Ⓒ - GLOUCESTER Ⓐ - "B"

4 - GLOUCESTER Ⓐ - WOODBRIDGE Ⓒ - PAXTON Ⓒ - "C"

5 - WOODBRIDGE- PAXTON - "C"

Worksheet 2: Runoff curve number and runoff

Project GREENBRIER ESTATES By JS Date 7-17-97
Location TORRINGTON CT. Checked ____ Date ____
Circle one: [✓ Present] Developed ____________

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/			Area ☒acres ☐mi^2 ☐%	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
GROUP 'C'	WOODS - GRASS TREES - FAIR COND	76			155	11,780
SEE MAP.						
				Totals =	155	11,780

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = ____; Use CN = 76

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			
Rainfall, P (24-hour)	in			
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in			

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREENBRIER By JS Date 7-17-87

Location TORRINGTON Checked _____ Date _____

Circle one: [✓ Present] Developed

Circle one: [✓ T_c] T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only) Segment ID		A-D		
1. Surface description (table 3-1)		WOODS		
2. Manning's roughness coeff., n (table 3-1)		0.4		
3. Flow length, L (total L $\leq$ 300 ft)	ft	300		
4. Two-yr 24-hr rainfall, P_2	in	3.2		
5. Land slope, s	ft/ft	0.12		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{\ 0.5}\ s^{0.4}}$ Compute T_t	hr	.42	+	= .42

Shallow concentrated flow Segment ID		1-5		
7. Surface description (paved or unpaved)		GRASS		
8. Flow length, L	ft	5000		
9. Watercourse slope, s	ft/ft	.10		
10. Average velocity, V (figure 3-1)	ft/s	5.2		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.27	+	= .27

Channel flow Segment ID				
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr .69

Worksheet 4: Graphical Peak Discharge method

Project GREENBRIER By JB Date 7-17-87

Location ______ Checked ______ Date ______

Circle one: [✓ Present] Developed ______

1. Data:

Drainage area .154....... A_m = 0.24 mi^2 (acres/640)

Runoff curve number .... CN = 76 (From worksheet 2)

Time of concentration .. T_c = 0.69 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 7.8 percent of A_m (12 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5.0		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.632		
5. Compute I_a/P		.126		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-____)	csm/in	420		
7. Runoff, Q .... (From worksheet 2).	in	2.5		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.7		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	176.4		

Worksheet 2: Runoff curve number and runoff

Project GREENBRIER By ____ Date ____

Location ____ Checked ____ Date ____

Circle one: Present [✓ Developed]

1. Runoff curve number (CN)

WEIGHTED CN BY COMPUTER

REACH NO.	Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area	(IN) Q
1	C	GRASS-GOOD = 5.2 HOUSE = 0.58 RD = 0.96	79			6.74	532.5	3.7
2	C	GRASS - 10.7 H - 1.1 RD - 1.1	78			12.9	1006.2	3.5
3	B	GRASS - 43.3 H - 3.7 RD - 4.7	67			51.7	3463.9	2.5
4	C	GRASS - 53.6 H - 3.0 RD - 3.2	76			59.8	4544.8	3.4
5	C	GRASS - 19.0 H - 2.3 RD - 2.5	79			23.7	1872.3	3.7
					Totals =	154.8	11,419.7	

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{11,419.7}{154.8} = 73.8$; Use CN = 74

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	100		
Rainfall, P (24-hour)	in	6.2		
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	3.2		

WEIGHTED

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREENBRIER By JB Date 7-17-87

Location TORRINGTON CT Checked ____ Date ____

Circle one: Present [✓ Developed] SYSTEM 1

Circle one: [✓ T_c] T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	A			
1. Surface description (table 3-1)		WOODS			
2. Manning's roughness coeff., n (table 3-1) ..		0.4			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	3.2			
5. Land slope, s	ft/ft	0.12			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.42	+	=	0.42

Shallow concentrated flow	Segment ID	1			
7. Surface description (paved or unpaved)		GRASS+ PAVED			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.14			
10. Average velocity, V (figure 3-1)	ft/s	7			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	.016	+	=	.016

Channel flow	Segment ID				
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr 0.44

Worksheet 4: Graphical Peak Discharge method

Project GREENBRIER By JB Date 7-17-87

Location TORRINGTON Checked ____ Date ____

Circle one: Present [✓ Developed] SYSTEM 1

1. Data:

Drainage area .19.1..... A_m = 0.03 mi^2 (acres/640)

Runoff curve number .... CN = 79 (From worksheet 2)

Time of concentration .. T_c = 0.44 hr (From worksheet 3)

Rainfall distribution type = ____ (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 0.5 percent of A_m (0.1 [✓ acres] or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5.0		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.532		
5. Compute I_a/P		.106		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-II)	csm/in	550		
7. Runoff, Q .... (From worksheet 2).	in	2.8		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.9		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	41.6		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREENBRIER By JB Date 7-17-87

Location ______ Checked ______ Date ______

Circle one: Present [✓ Developed] SYSTEM 2

Circle one: [✓ T_c] T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only) Segment ID		B			
1. Surface description (table 3-1)		WOODS			
2. Manning's roughness coeff., n (table 3-1)		0.4			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	3.2			
5. Land slope, s	ft/ft	.06			
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.56	+	=	0.56
Shallow concentrated flow Segment ID		2			
7. Surface description (paved or unpaved)		GRASS PAVED			
8. Flow length, L	ft	650			
9. Watercourse slope, s	ft/ft	.05			
10. Average velocity, V (figure 3-1)	ft/s	4			
11. $T_t = \frac{L}{3600 V}$ Compute T_t	hr	.045	+	=	.045
Channel flow Segment ID					
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600 V}$ Compute T_t	hr		+	=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				0.60

Worksheet 4: Graphical Peak Discharge method

Project GREENBRIER By ____ Date ________

Location ________________ Checked ____ Date ________

Circle one: Present [✓ Developed] SYSTEM 2

1. Data:

Drainage area ..20.1... A_m = 0.03 mi^2 (acres/640)

Runoff curve number .... CN = 78 (From worksheet 2)

Time of concentration .. T_c = 0.60 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 10 percent of A_m (2 [✓ acres] or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5.0		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.564		
5. Compute I_a/P		.113		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-____)	csm/in	460		
7. Runoff, Q .... (From worksheet 2).	in	2.7		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.7		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	26		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREEN BRIER By JB Date 7-17-87

Location ______ Checked ______ Date ______

Circle one: Present [✓ Developed]

Circle one: [✓ T_c] T_t through subarea SYSTEM 3

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only) Segment ID		1/2			
1. Surface description (table 3-1)		WOODS			
2. Manning's roughness coeff., n (table 3-1)		0.4			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	3.2			
5. Land slope, s	ft/ft	.12			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.42	+	=	0.42
Shallow concentrated flow Segment ID		3			
7. Surface description (paved or unpaved)		GRASS PAVED			
8. Flow length, L	ft	4000			
9. Watercourse slope, s	ft/ft	0.05			
10. Average velocity, V (figure 3-1)	ft/s	4			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.28	+	=	0.28
Channel flow Segment ID					
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				0.70

Worksheet 4: Graphical Peak Discharge method

Project ______________________ By ______ Date ______

Location ______________________ Checked ______ Date ______

Circle one: Present [✓ Developed] SYSTEM 3

1. Data:

Drainage area ..56.7.... A_m = 0.09 mi^2 (acres/640)

Runoff curve number .... CN = 67 (From worksheet 2)

Time of concentration .. T_c = 0.70 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 8.8 percent of A_m (5 [✓ acres] or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.985		
5. Compute I_a/P		.197		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-____)	csm/in	410		
7. Runoff, Q .... (From worksheet 2).	in	1.7		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		.72		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	45		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREENBRIER By JRS Date 7-17-97

Location ______ Checked ____ Date ______

Circle one: Present [✓ Developed] ______

Circle one: [✓ T_c] T_t through subarea SYSTEM 4

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only) Segment ID		C/2			
1. Surface description (table 3-1)		WOODS			
2. Manning's roughness coeff., n (table 3-1) ..		0.4			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	3.2			
5. Land slope, s	ft/ft	.14			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.39	+		= .39

Shallow concentrated flow Segment ID		4			
7. Surface description (paved or unpaved)		GRASS ROAD.			
8. Flow length, L	ft	2600			
9. Watercourse slope, s	ft/ft	.08			
10. Average velocity, V (figure 3-1)	ft/s	5			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.14	+		= 0.14

Channel flow Segment ID					
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr 0.53

Worksheet 4: Graphical Peak Discharge method

Project ________________ By _____ Date _______

Location ________________ Checked _____ Date _______

Circle one: Present [✓ Developed] SYSTEM 4

1. Data:

Drainage area ..64.$\overset{3}{0}$... A_m = 0.10 mi^2 (acres/640)

Runoff curve number .... CN = 76 (From worksheet 2)

Time of concentration .. T_c = 0.53 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 4.6 percent of A_m (3 [✓ acres] or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.632		
5. Compute I_a/P		.126		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-____)	csm/in	480		
7. Runoff, Q .... (From worksheet 2).	in	2.5		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.74		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	88		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project GREENBRIER By JB Date 7-17-97

Location ______ Checked ______ Date ______

Circle one: Present [✓ Developed]

Circle one: [✓ T_c] T_t through subarea SYSTEM 5

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	D		
1. Surface description (table 3-1)		WOODS		
2. Manning's roughness coeff., n (table 3-1) ..		0.4		
3. Flow length, L (total $L \leq 300$ ft)	ft	300		
4. Two-yr 24-hr rainfall, P_2	in	3.2		
5. Land slope, s	ft/ft	.14		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.39	+	= .39
Shallow concentrated flow	Segment ID	5		
7. Surface description (paved or unpaved)		GRASS ROAD		
8. Flow length, L	ft	1200		
9. Watercourse slope, s	ft/ft	.14		
10. Average velocity, V (figure 3-1)	ft/s	7		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	.07	+	= .07
Channel flow	Segment ID			
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr			0.46

Worksheet 4: Graphical Peak Discharge method

Project ______ By ______ Date ______

Location ______ Checked ______ Date ______

Circle one: Present [✓ Developed] SYSTEM 5

1. Data:

Drainage area A&5 .... A_m = 0.076 mi² (acres/640)

Runoff curve number .... CN = 79 (From worksheet 2)

Time of concentration .. T_c = 0.46 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 4.1 percent of A_m (2 [✓ acres] or mi² covered)

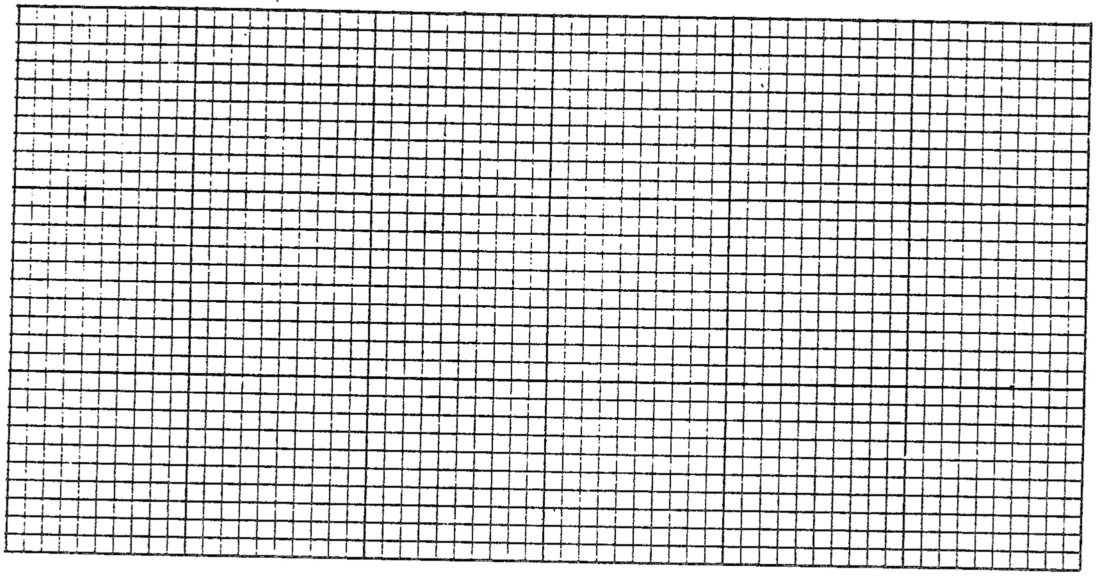
		Storm #1	Storm #2	Storm #3
2. Frequency	yr	25		
3. Rainfall, P (24-hour)	in	5		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	.532		
5. Compute I_a/P		.106		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-____)	csm/in	560		
7. Runoff, Q .... (From worksheet 2).	in	2.8		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.74		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	88		

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project GREENBRIER By JS Date 7-17-87

Location TORRINGTON Checked ____ Date ____

Circle one: Present [✓ Developed] POND 1 (0.8 AC)



1. Data:
Drainage area 8 AC. A_m = .01 mi^2
Rainfall distribution type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	2.4	
4. Runoff, Q ...... in (From worksheet 2)	3.5	
5. Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	1.87	
6. Compute $\frac{V_s}{V_r}$	1.28	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.1	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	9.0	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$)	0.9	[1]
10. Maximum stage, E_{max} (From plot)	>	

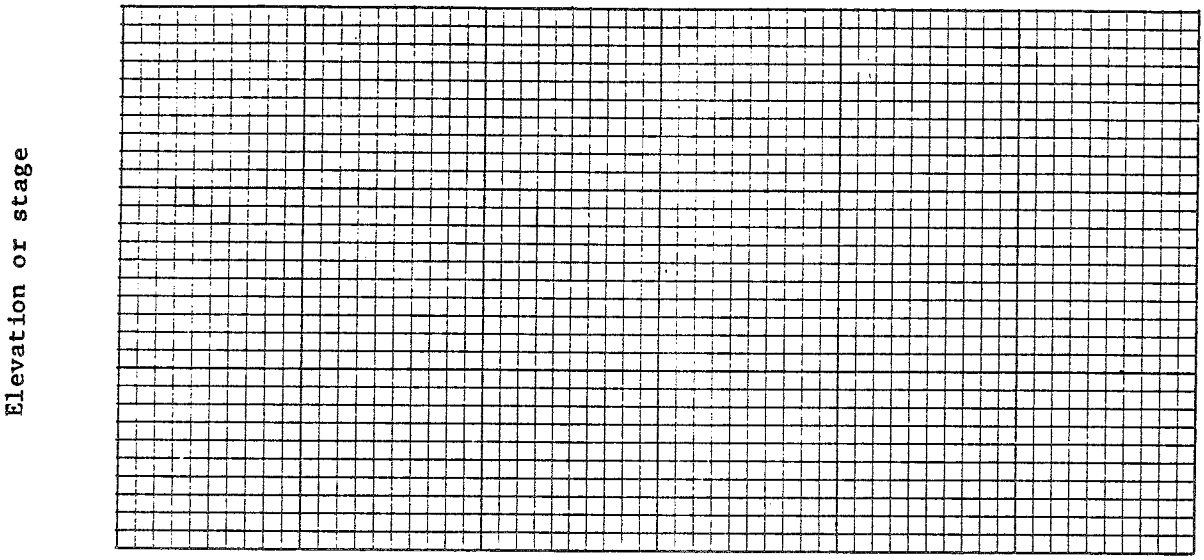
[1] 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________________ By ______ Date ________

Location ______________________ Checked ______ Date ________

Circle one: Present [✓ Developed] POND 2 (0.2 AC)



Detention basin storage

1. Data:
Drainage area ..5 Ac.. A_m = .008 mi^2
Rainfall distribution type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	0.6	
4. Runoff, Q ...... in (From worksheet 2)	3.5	
5. Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	1.49	

6. Compute $\frac{V_s}{V_r}$	0.4	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.27	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	9.0	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$)	2.43	1/
10. Maximum stage, E_{max} (From plot)	X	

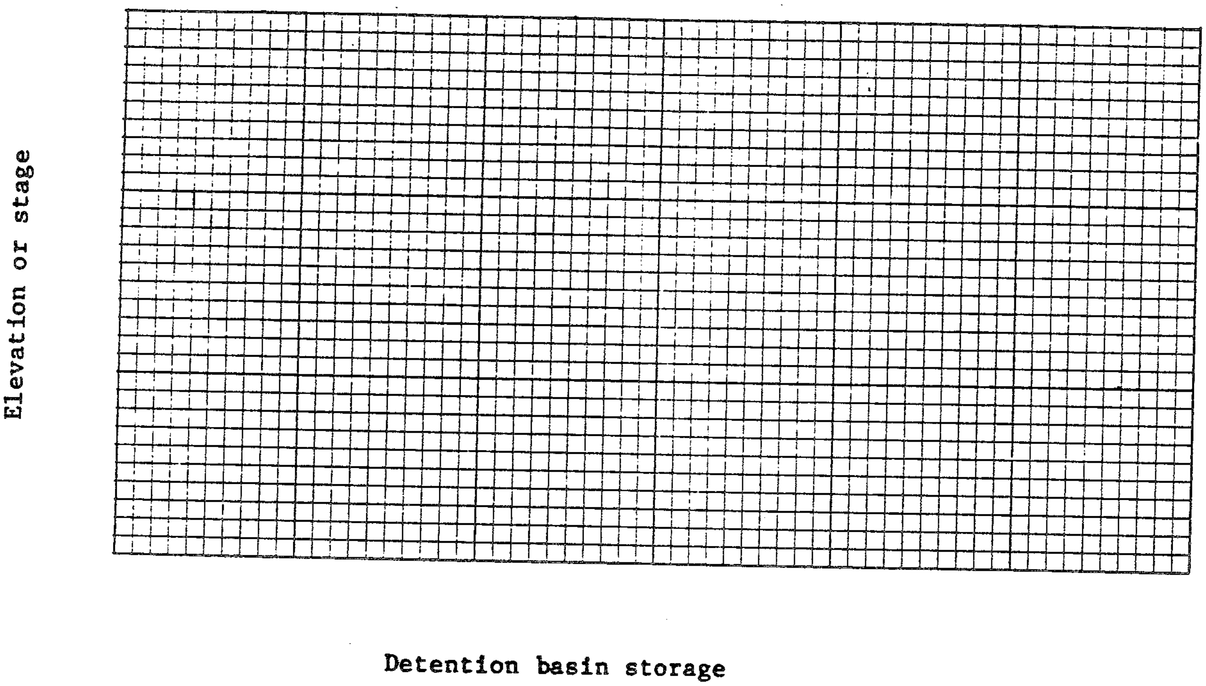
1/ 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ________________ By _____ Date _______

Location ________________ Checked _____ Date _______

Circle one: Present [✓ Developed] POND 3 (0.6 AC)



1. Data:
Drainage area 7 AC A_m = .01 mi^2
Rainfall distribution
type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	1.8	
4. Runoff, Q ...... in (From worksheet 2)	3.5	
5. Runoff volume, V_r .... ac-ft (V_r = $QA_m53.33$)	1.87	

6. Compute $\frac{V_s}{V_r}$	0.96	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.1	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	9.0	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$) [1/]	0.9	
10. Maximum stage, E_{max} (From plot)	X	

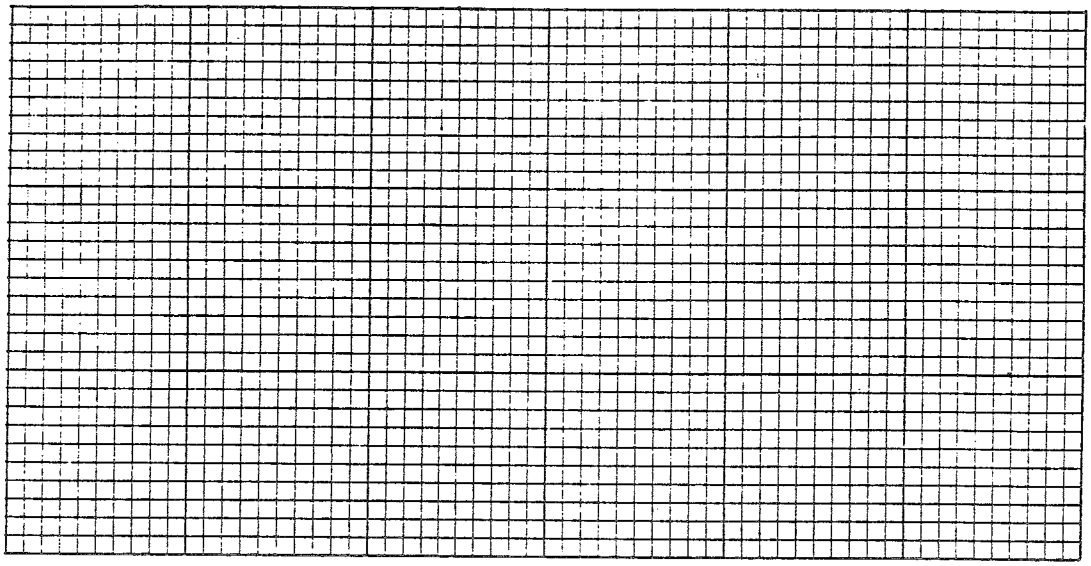
[1/] 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________________ By ______ Date ______

Location ______________________ Checked ______ Date ______

Circle one: Present [✓ Developed] POND 4 (0.4AC)



1. Data:
Drainage area 19AC .... A_m = .03 mi^2
Rainfall distribution type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	1.2	
4. Runoff, Q ...... in (From worksheet 2)	2.5	
5. Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	4.0	
6. Compute $\frac{V_s}{V_r}$	0.3	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.44	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	15	
9. Peak outflow discharge, q_o .... cfs[1/] ($q_o = q_i(\frac{q_o}{q_i})$)	6.6	
10. Maximum stage, E_{max} (From plot)	×	

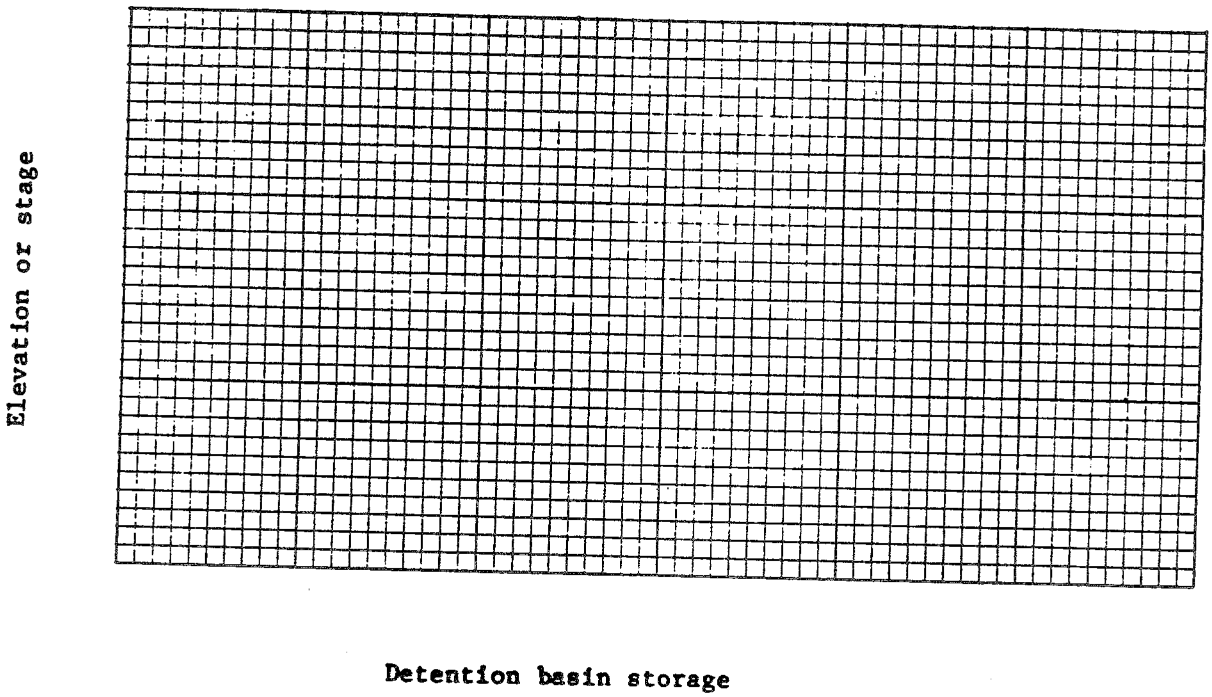
[1/] 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________ By ______ Date ______

Location ______________ Checked ______ Date ______

Circle one: Present [✓ Developed] POND 5 (0.6 AC)



1. Data:
Drainage area 28 A.C. A_m = .04 mi^2
Rainfall distribution
type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	1.8	
4. Runoff, Q ...... in (From worksheet 2)	2.5	
5. Runoff volume, V_r .... ac-ft (V_r = QA_m53.33)	5.3	
6. Compute $\frac{V_s}{V_r}$	0.34	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.36	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	22	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$)	8	1/
10. Maximum stage, E_{max} (From plot)	X	

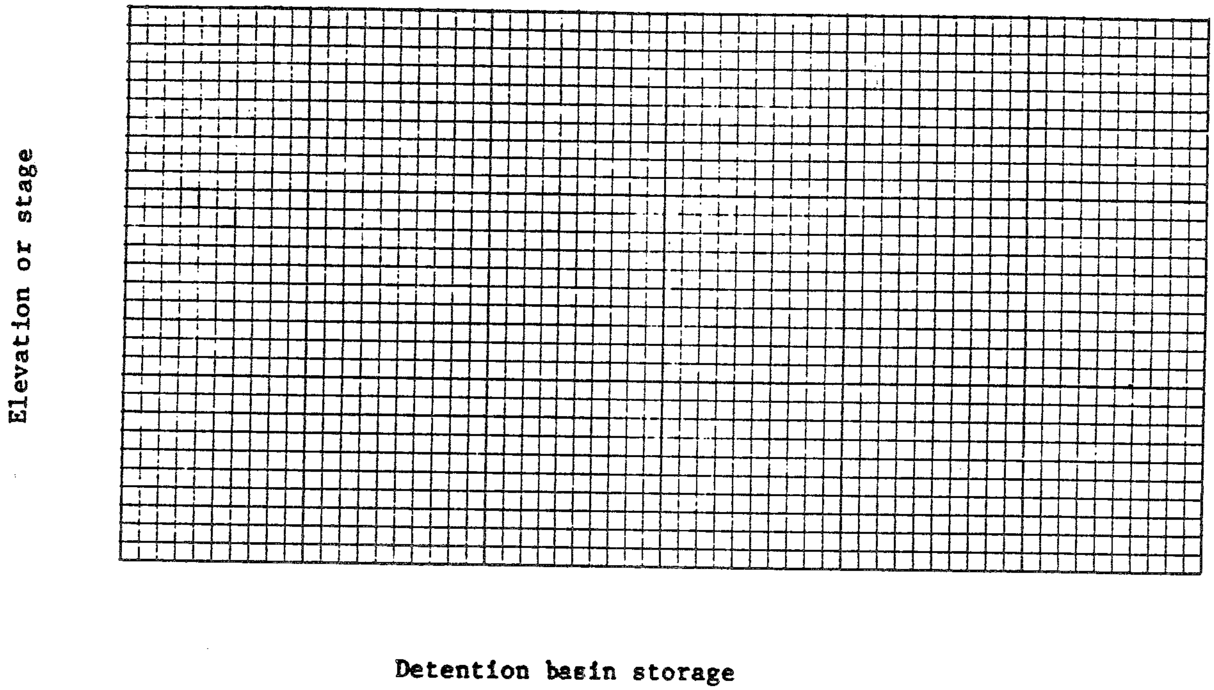
1/ 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________________ By ______ Date ________

Location ______________________ Checked ______ Date ________

Circle one: Present [✓ Developed] POND 6 (0.2AC)



1. Data:
Drainage area 10 AC A_m = .016 mi^2
Rainfall distribution type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	0.6	
4. Runoff, Q ...... in (From worksheet 2)	2.5	
5. Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	2.1	
6. Compute $\frac{V_s}{V_r}$	0.28	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.49	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	8	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$)	4	1/
10. Maximum stage, E_{max} (From plot)		

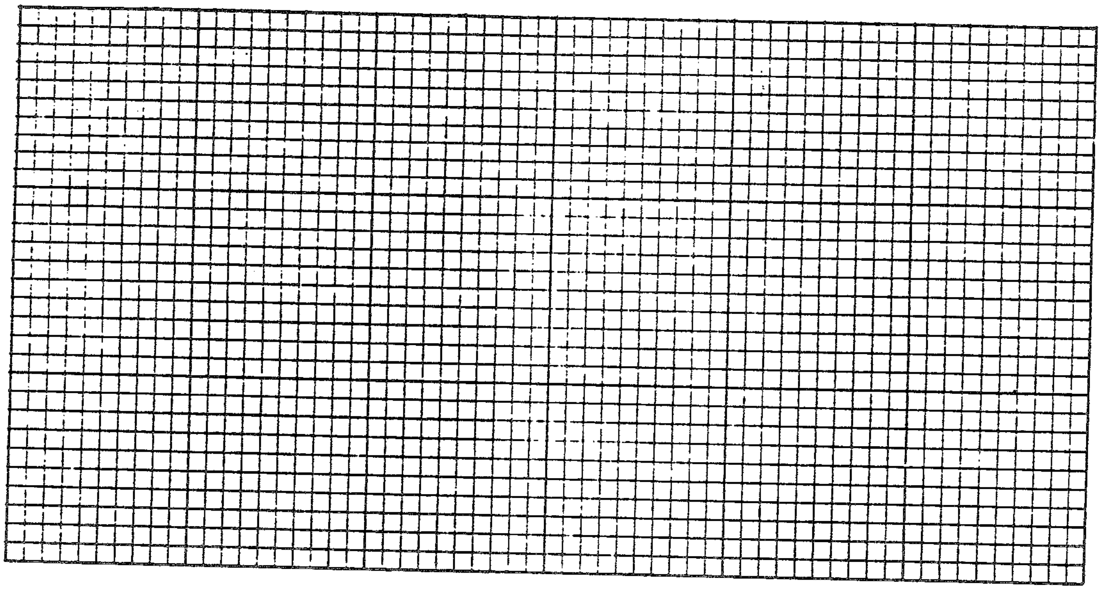
1/ 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________________ By ______ Date ________

Location ______________________ Checked ______ Date ________

Circle one: Present [✓ Developed] POND 7 (0.3 AC)



4' DEEP.

1. Data:
Drainage area ..65 AC.. A_m = 0,10 mi^2
Rainfall distribution type (I, IA, II, III) = II

	1st stage	2nd stage
2. Frequency ...... yr	100	
3. Storage volume, V_s .... ac ft	1,2	
4. Runoff, Q ...... in (From worksheet 2)	3,4	
5. Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	18,1	

6. Compute $\frac{V_s}{V_r}$	0,07	
7. $\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.8	
8. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	88	
9. Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$) 1/	70	
10. Maximum stage, E_{max} (From plot)	x	

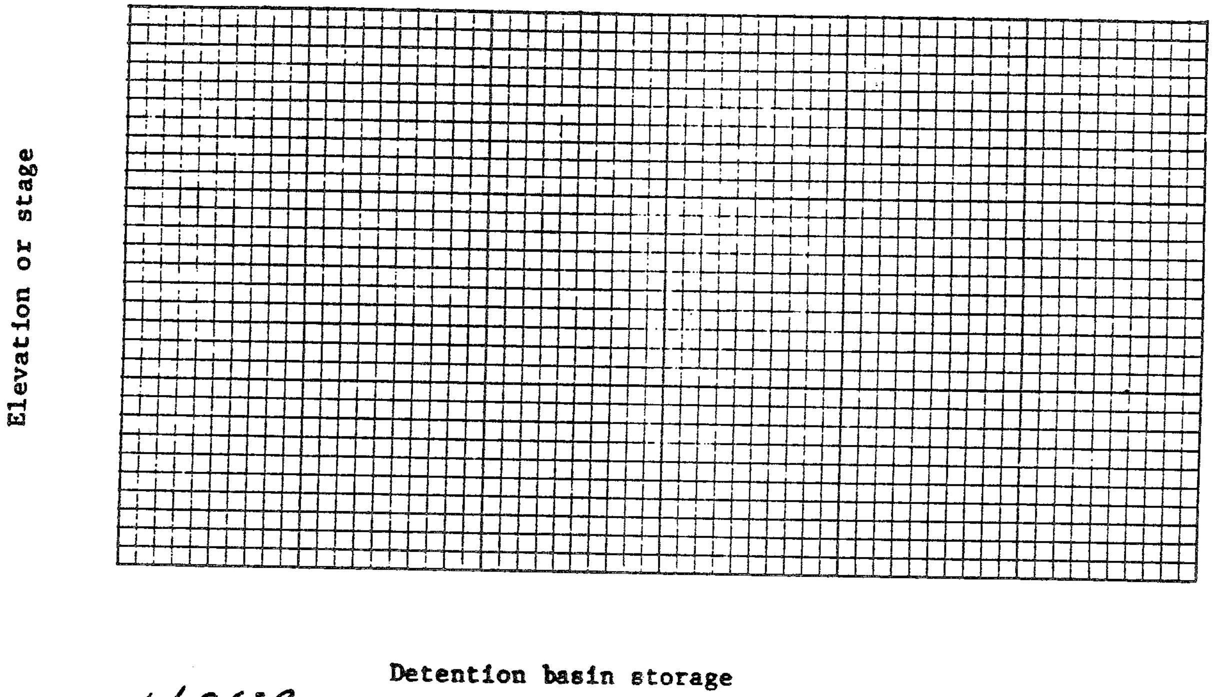
1/ 2nd stage q_o includes 1st stage q_o.

Worksheet 6b: Detention basin peak outflow, storage volume (V_s) known

Project ______________________ By ______ Date ______

Location ______________________ Checked ______ Date ______

Circle one: Present [✓ Developed] POND 8 (0.2 AC)



4' DEEP

1. Data:
Drainage area 48 AC .... A_m = .07 mi^2
Rainfall distribution type (I, IA, II, III) = II

		1st stage	2nd stage
2.	Frequency ...... yr	100	
3.	Storage volume, V_s .... ac ft	0.8	
4.	Runoff, Q ...... in (From worksheet 2)	3.7	
5.	Runoff volume, V_r .... ac-ft ($V_r = QA_m 53.33$)	13.8	

6.	Compute $\frac{V_s}{V_r}$	0.06	
7.	$\frac{q_o}{q_i}$ .... in (Use $\frac{V_s}{V_r}$ and figure 6-1)	0.8	
8.	Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	88	
9.	Peak outflow discharge, q_o .... cfs ($q_o = q_i(\frac{q_o}{q_i})$)	70	1/
10.	Maximum stage, E_{max} (From plot)	X	

1/ 2nd stage q_o includes 1st stage q_o.

DETAINMENT POND - SUMMARY

Pond #	Sht. #	Area Ac.	Max Depth	Exit pipe	Inv.	Spill way Inv.	Bot. Elev.	Elev. Sed Basin	Max cut	Max fill	storage Ac. Ft.
1	10	0.8	3.0	24"	1090	1093	1089.5	1088	8.0	3.0	2.4
2	10	0.2	3.0	18"	1080	1083	1079.5	1078	5.0	3.0	0.6
3	10	0.6	3.0	18"	1088	1091	1087.5	1086.0	5.0	3.0	1.8
4	8	0.4	3.0	21"	1055	1058	1054.5	1053.0	5.0	3.0	1.2
5	7	0.6	3.0	36"	977	980	976.5	975.0	7.0	3.0	1.8
6	9	0.2	3.0	18"	1080	1083	1079.5	1078.0	4.0	3.0	0.6
7	6	0.3	4.0	18"	1018	1022	1017.5	1016.0	6.0	4.0	1.2
8	1	0.2	4.0	18"	900	904	899.5	898.0	6.0	4.0	0.8

STORM WATER RUNOFF AND DETAINMENT SUMMARY

I. PRE-DEVELOPMENT RUNOFF – 176.4 CFS.

II. POST-DEVELOPMENT RUNOFF – 288 CFS.
(WITHOUT DETAINMENT)

III. NET INCREASE WITHOUT DETAINMENT – 111.6 CFS.

IV. POND DETAINMENT – 163.2 CFS.

NET **DECREASE** IN RUNOFF

a) RESULTING DEVELOPMENT + 51.6 CFS. (132%)

b) PREDEVELOPMENT WATERSHED – 13.2 CFS (7.5%)

Storm Sewer System Design

Project GREENBRIER ESTATES **Designed by** JAY I. BLACK P.E.

Town TORRINGTON **Route** WIMBLEDON GATE **Checked by**

Sheet No.

Line Segment 1	Time to Inlet MIN 2	Time in Pipe 3	Accumulated Time 4	AI Entering Catch Basin 5	Sum of AI in System 6	Rainfall Intensity 7	Q in System (CFS) 8	Pipe Size (IN.) 9	Length of Pipe FT. 10	Slope % 11	Average Velocity 12	Full Capacity 13	Headwater 14	"n" 15
42+55	5			2.3	2.3	7.0	16.1	18" RCP	330'	1.17			2.0	.011
39+07				0.9	3.2	6.0	19.2	24 ACCMA	25'	8.0			1.4	.015
36+45	8			0.68	0.68	6.0	4.0	15" RCP					1.0	.011
21+00				0.3	0.3	6.0	1.74	24 CMP	60	12.5			0.5	.015
33+55				1.38	2.06	6.0	12.36	30 RCP	298	1.91			0.7	.011

Storm Sewer System Design

Project

Town

MANCHESTER GATE

Route

Designed by

Checked by

Sheet No.

Line Segment	Time to Inlet	Time in Pipe	Accumulated Time	AI Entering Catch Basin	Sum of AI in System	Rainfall Intensity	Q in System	Pipe Size	Length of Pipe	Slope	Average Velocity	Full Capacity	Headwater	'n'
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13+30				1.77	3.51	6	21.1	36" CMP						
													0.75	015

Storm Sewer System Design

Project

Town NOTTING HILL GATE

Route

Designed by

Checked by

Sheet No.

Line Segment	Time to Inlet	Time in Pipe	Accumulated Time	AI Entering Catch Basin	Sum of AI in System	Rainfall Intensity	Q in System	Pipe Size	Length of Pipe	Slope	Average Velocity	Full Capacity	Headwater	'n'
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0+20					3.7	6	22.2	36 RCP					0.75	.011

Storm Sewer System Design

Project

CHELSEA COURT

Town

Route

Designed by

Checked by

Sheet No.

Line Segment	Time to Inlet	Time in Pipe	Accumulated Time	AI Entering Catch Basin	Sum of AI in System	Rainfall Intensity	Q in System	Pipe Size	Length of Pipe	Slope	Average Velocity	Full Capacity	Headwater	'n'
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8+50					1.94	6	11.6	36 CMP					0.5	.015

Storm Sewer System Design

Project GREENBRIER

Designed by

WILLOW COURT - WEBSTERS RUN

Town

Route

Checked by

Sheet No.

Line Segment	Time to Inlet	Time in Pipe	Accumulated Time	AI Entering Catch Basin	Sum of AI in System	Rainfall Intensity	Q in System	Pipe Size	Length of Pipe	Slope	Average Velocity	Full Capacity	Headwater	"n"
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
17+47					2.95	6	17.7	30 RCP					0.85	.011

Storm Sewer System Design

Project LONDON COURT

Town

Route

Designed by

Checked by

Sheet No.

Line Segment	Time to Inlet	Time in Pipe	Accumulated Time	AI Entering Catch Basin	Sum of AI in System	Rainfall Intensity	Q in System	Pipe Size	Length of Pipe	Slope	Average Velocity	Full Capacity	Headwater	'n'
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11+70					2.9	6	17.4	18"RCP					2.0	.011
6+00					3.4	6	20.4	24"RCP					1.4	.011

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 - a 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 the King's Mark ERT Coordinator. This request form must include a summary of the proposed project, a location map of the project site, written permission from the landowner/developer allowing the Team to enter the property for 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 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 Resource Conservation and Development Area, 322 North Main Street, Wallingford, Connecticut 06492. King's Mark ERT phone number is 265-6695.