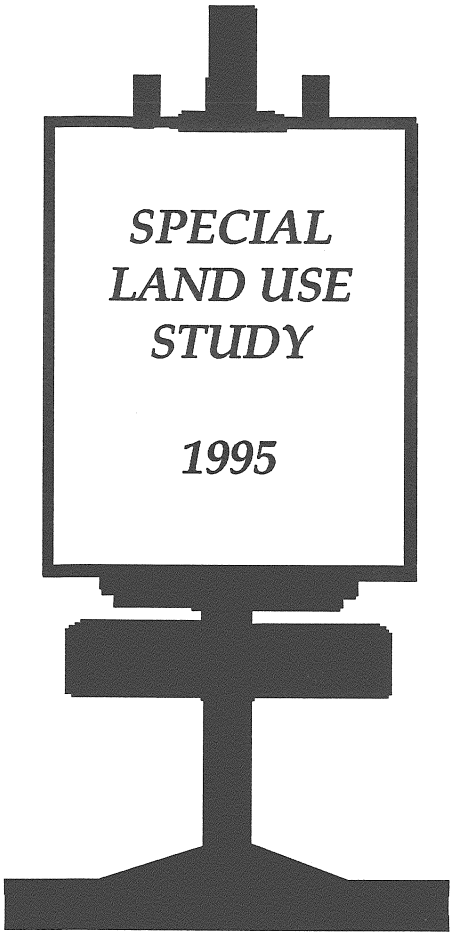

Office/Research Zone
North Stonington
Connecticut

Eastern Connecticut Environmental Review Team Report

Eastern Connecticut Resource Conservation and Development Area, Inc.

Office/Research Zone

North Stonington, Connecticut
February 1995

Eastern Connecticut Environmental Review Team Report

Prepared For

The North Stonington First Selectman and the Economic Development Commission

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ACKNOWLEDGEMENTS

Special Land Use Study - Office/Research Zone
North Stonington, Connecticut

This report is an outgrowth of a request from the North Stonington First Selectman and the Economic Development Commission to the New London County Soil and Water Conservation District (SWCD). The S&WCD referred this request to the Eastern Connecticut Resource Conservation and Development (RC&D) Area Executive Council for their consideration and approval. The request was approved and the measure reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The ERT met and field checked the site on Tuesday, October 18, 1994. Team members participating on this review include:

Nicholas Bellantoni	State Archaeologist Office of State Archaeology CT Museum of Natural History
Scott Choquette	Environmental Analyst II DEP - Bureau of Water Management Flood Management Program
Richard Corona	Supervising Planner CT Department of Transportation Bureau of Policy and Planning
Mark Edmonds	District Conservationist USDA - Natural Resource Conservation Service New London County Field Office
Doug Hoskins	Environmental Analyst II DEP - Bureau of Water Management Inland Water Resources Division
Robert Hust	Senior Environmental Analyst DEP - Bureau of Water Management Planning and Standards Division
Stacey Kingsbury	Environmental Analyst DEP - Natural Resources Center Natural Diversity Data Base

Brian Murphy	Fisheries Biologist DEP - Inland Fisheries Eastern District Headquarters
Dave Poirier	Archaeologist CT Historical Commission
Tom Seidel	Regional Planner Southeastern CT Council of Governments
Randalph Steinen	Associate Professor UCONN Department of Geology and Geophysics
Johnathan Stake	B.S., Graduate Student UCONN Department of Geology and Geophysics
Elaine Sych	ERT Coordinator Eastern CT ERT Eastern CT Resource Conservation & Development Area

Prior to the review day, each Team member received a summary of the proposed project, a list of the town's concerns, a location map, a topographic map, and a soils map. During the field review the Team members were given a zoning map and aquifer information. The Team met with, and were accompanied by the North Stonington Town Planner, members of the Planning & Zoning Commission, the Planning Task Force, the Water Pollution Control Authority and a representative from Town of Westerly, Rhode Island. Following the review, reports from each Team member were submitted to the ERT Coordinator for compilation and editing into this final report.

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

The Eastern Connecticut RC&D Executive Council hopes you will find this report of value and assistance in making your decisions on this environmentally sensitive area.

If you require additional information, please contact:

Elaine A. Sych
ERT Coordinator
Eastern Connecticut RC&D Area
P.O. Box 70
Haddam, Connecticut 06438
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Contents

ILLUSTRATIONS

Introduction

The North Stonington First Selectman and the Economic Development Commission have requested Eastern Connecticut Environmental Review Team assistance in reviewing the Office/Research (O-R) Zone located along CT Routes 2 and 184, and involving CT Route 49.

The study area is located in southern North Stonington along CT Route 2, from I-95 to 1500' north of the CT Route 184 rotary. It encompasses approximately 2000' feet on the west side of the road and 1200' on the east side of the road. The study area includes mostly undeveloped land on the western side of CT Route 2 and a restaurant/bed and breakfast, the eastern portion contains a sand and gravel excavation site, the Shunock River and some office/research development.

Two previous studies of this general area have been conducted, one in 1973 and an update of that report in 1979. These reports focused on the development potential and the limitations in the area. It is recognized that this area is environmentally sensitive due to the Shunock River aquifer.

The current review is requested to update and reassess the previous two reports. The area is being considered for rezoning as a result of a new sewer line and potential road widening of CT Route 2. The town wants to support development in this area with appropriate standards to preserve the visual quality of the entryway to the town and permit tax generating non-residential development while protecting the Shunock River aquifer. The town needs updated information on the extent of the area that needs to be protected along the CT Route 2 corridor, and guidance as they consider revising the commercial and industrial regulations in this area.

Figure 1

LOCATION MAP

N

Scale 1" = 2000'

Approximate Site

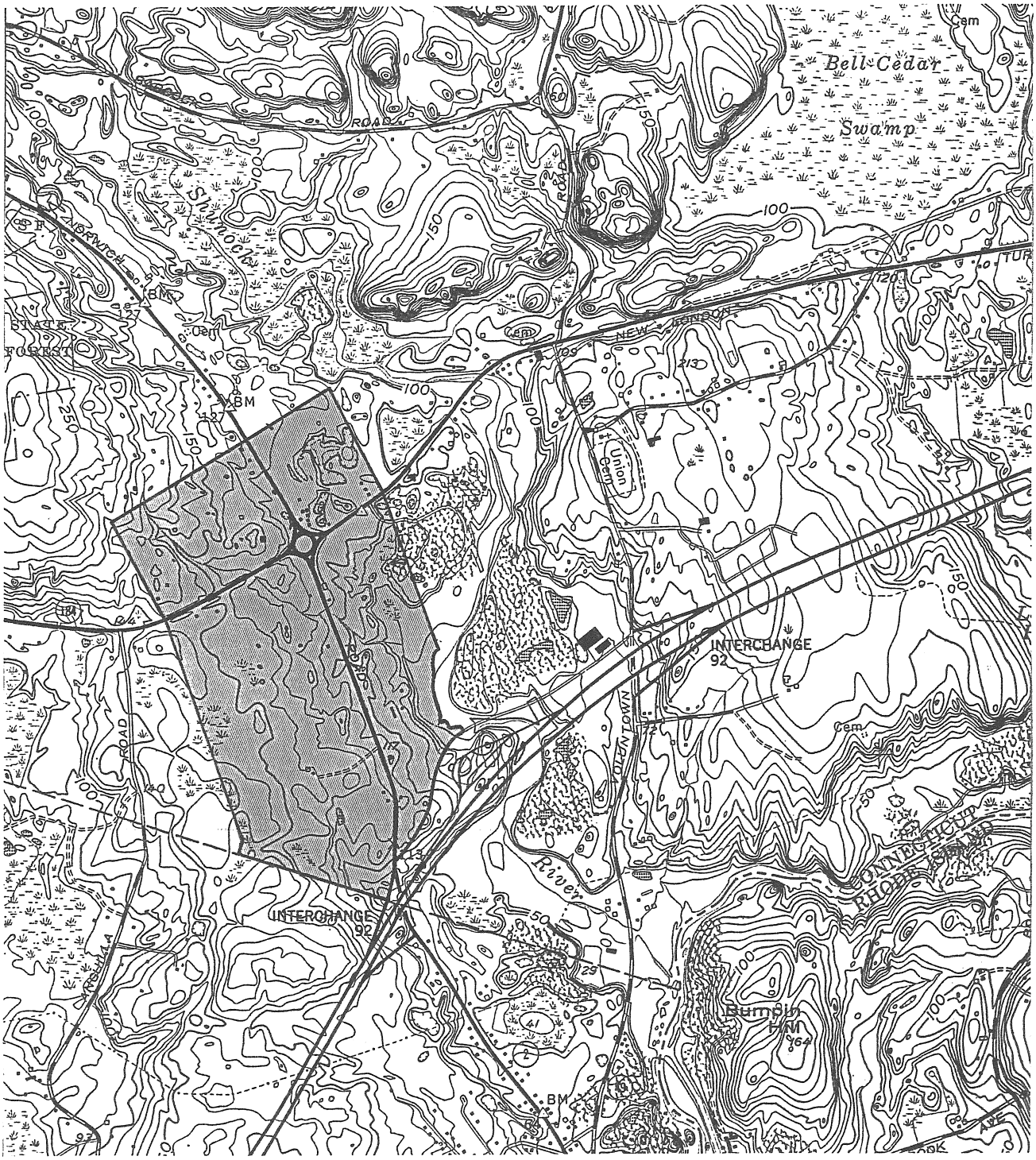

Figure 2

ZONING MAP

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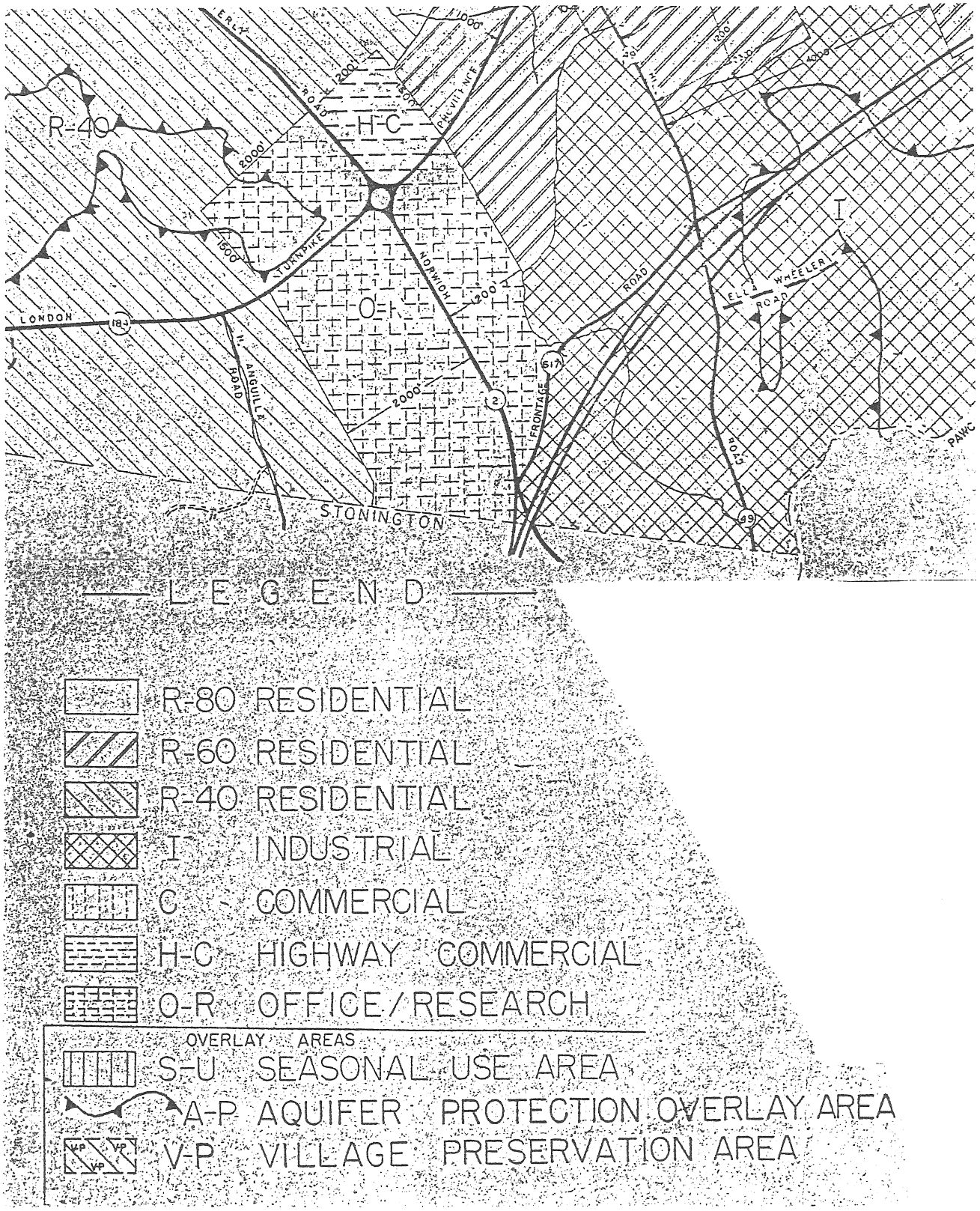
Scale 1" = 2000'



Geology

Two distinct geologic formations are present in the site that have different topographic, hydrologic, and geologic characteristics. Upland areas are underlain by metamorphic bedrock which are mostly covered by a thin veneer of glacial till. Lowland areas contain stratified sand and gravel valley train deposits which contain excellent porosity and permeability making them good aquifers. The Shunock River drainage basin comprises both terrains and the aquifer may expect to receive recharge from both terrains. Aquifer protection should carefully monitor development beyond the immediate extent of the aquifer.

Upland Areas

Bedrock underlying most of the site consists of granite gneiss (referred to as the Potter Hill Granite-gneiss by Feinenger, 1965) that dips moderately to steeply toward the northwest and northeast. It consists of quartz and feldspar with minor amounts of other minerals, including magnetite (an iron oxide) that gives the weathered surface a slightly rusty appearance. Just south of Randall's' Ordinary is a small lense of quartzite which contains minor amounts of calcium-bearing silicate minerals. Neither bedrock type is unusual or noteworthy.

The bedrock was eroded during the last ice age by glaciers that formed NNW-SSE trending hills. The hills have generally gentle grades on their north and east sides, but rather abrupt and locally precipitous southerly and westerly grades. Most of the bedrock outcrops are found on the steep south and west slopes. Such hills form typical "roche moutonee" landforms, especially north of the site. Roche moutonees are formed by glacial abrasion on the gentle upflow slope and glacial plucking on the steep down-flow slope. All of the gentle upland surfaces are covered by a veneer of glacial till, which was deposited either beneath moving glacial ice or was left as debris when the glaciers melted. Glacial till is poorly sorted granular material composed of a mixture of mud, sand and gravel. Some is very compact and poorly drained as evidenced by numerous upland swamps in and around the site area.

The bedrock does contain fractures that could be a reservoir for groundwater. Vertical and steeply inclined fractures are widely spaced but are interconnected by prominent near horizontal fractures in several outcrops. Bedrock fractures could be

developed for domestic water supplies with relatively low yielding wells.

Lowland Areas

The Shunock River Valley comprises the lowland area of the site. It is slightly less than a mile wide and is partly filled with stratified sand and gravel (see Figure 4). Most of the stratified deposits were deposited by glacial melt-water streams at the end of the last ice-age. The sand banks have a kettled (collapse) topography and structure indicative of sand deposition upon and around blocks of left-over, stagnant, melting ice. Kettles are slightly irregular topographic depressions that can be seen on the map region just north and east of CT Routes 2 and 184; several were present in the mined-out area of the site. The depressions formed when ice melted after deposition of the sand and gravel. Some of the stratified deposits immediately adjacent to the Shunock River are terrace deposits, representing former river levels.

The sand and gravel deposits are well sorted with very high porosity and permeability. They form the principle aquifer on the site. Hence they are very well drained where the water table is not close to the ground surface. The aquifer contains numerous observation well points in the mined-out area south of CT Route 184. Although the thickness of the stratified deposits was not determined during the site visit, those data should be available. The Team Geologists have estimated that the aquifer is 50 or more feet thick for the cross-section.

Aquifer Protection

The main aquifer on the site is the stratified sand and gravel filling the valley. The stratified drift has excellent interparticle porosity and good hydraulic conductivity and will provide high yielding wells when developed. Because the aquifer has extreme porosity and permeability, potential contaminants could travel rapidly, and future development within the drainage basin, particularly upstream from the Town of Westerly's well field, should be regulated and then routinely monitored. Because heavy pumping of the well field could cause a local reversal of the hydraulic gradient (cone of depression), downstream development likewise requires regulation. Because the area will be sewered prior to development, "housekeeping" practices of tenants in the immediate area of influence must be monitored to maintain water quality.

Nonpoint source pollution will become the main concern after sewering. Highway and parking areas are the most likely sites for contamination. Winter salt use might be restricted in parking areas to reduce chloride in-put to the aquifer, especially on the downslope side of CT Route 2. Catch basins large enough to contain a sizeable spill might be provided for all internal parking and driving areas. Such catch-basins could be outfitted with valves that could be closed in case of a spill.

Development on the upslope side of CT Route 2, such as Randall's Ordinary, seem to have less direct impact on degradation of aquifer quality from contaminated runoff or accidental spills. Because of the lower permeability of those materials, contaminants will take longer times to get to the aquifer and thus can be intercepted and remediated before aquifer pollution occurs. Nonetheless, catch basins are recommended for this area also.

Map Resources

Feinenger, Tomas, 1965, Bedrock Geologic Map of the Ashaway Quadrangle, CT-RI: U.S. Geological Survey Map GQ-403.

Shafer, J.P., 1968, Surficial Geologic Map of the Ashaway Quadrangle, CT-RI: U.S. Geological Survey Map GQ-712.

Figure 3

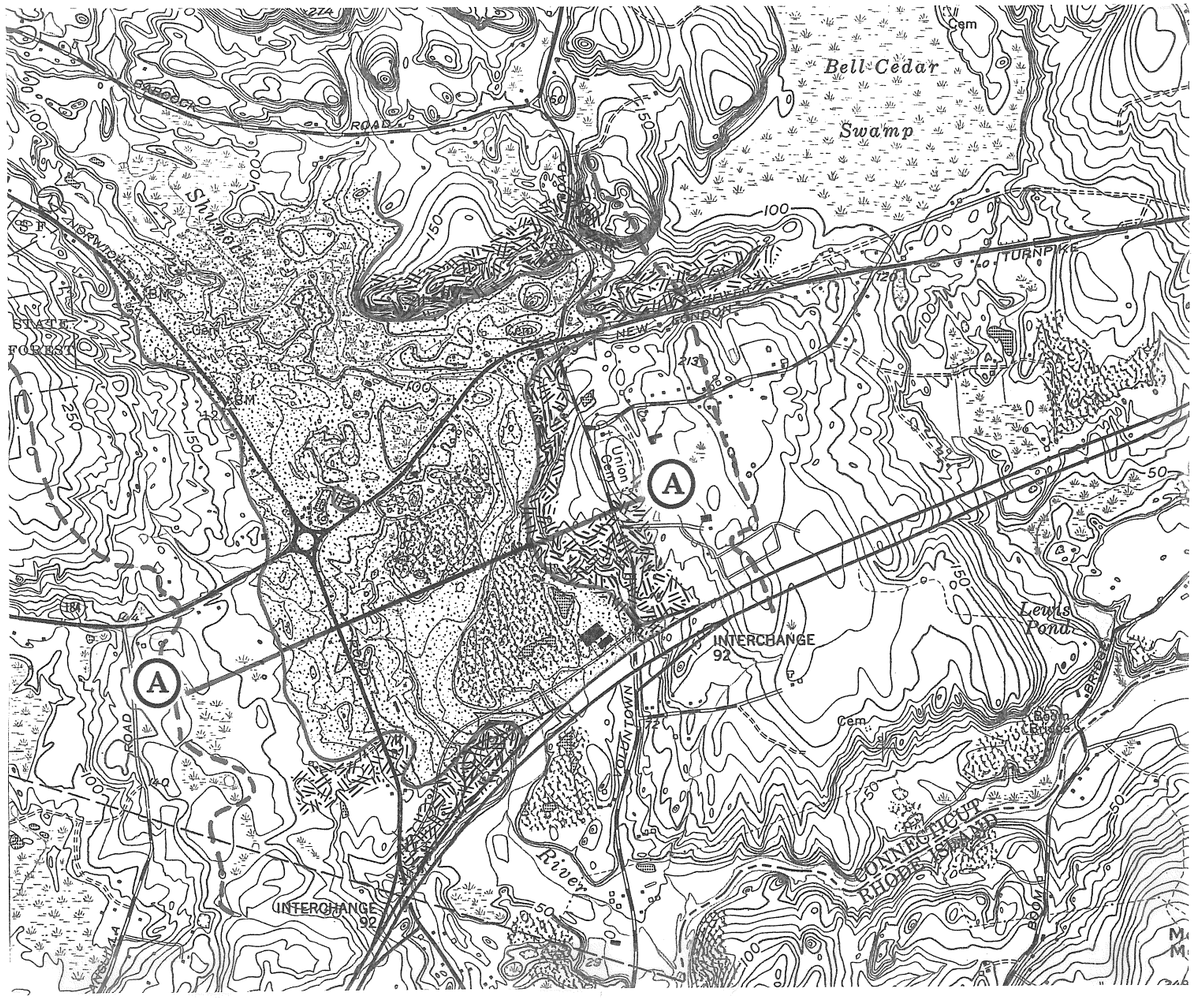
TOPOGRAPHIC MAP

N

Scale 1" = 2000'

Figure 4

SURFICIAL GEOLOGIC MAP AND CROSS- SECTION



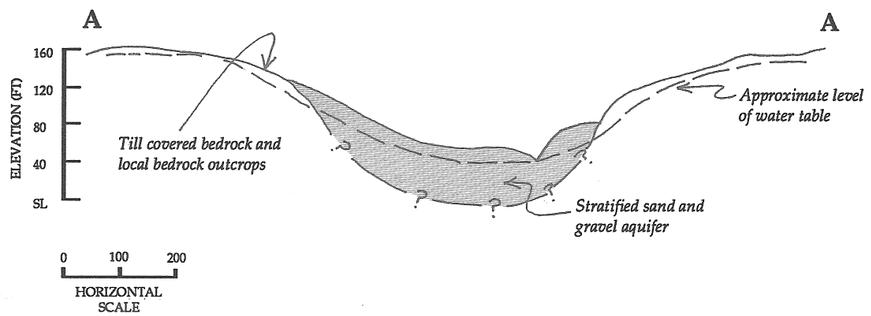
N

Scale 1" = 2000'

Till covered upland surfaces; pattern where bedrock crops out or close to the surface

Stratified sand and gravel valley train deposits; principal aquifer

Shunock River drainage divide



Soils

The soils in this area range from excessively drained sand and gravel to very poorly drained fine sandy loam. A soil map of the area is included in this section (see Figure 5). The soil map is useful for planning and provides a good indication of what soil characteristics can be expected in a given area. However, because of the map scale and the variability of the soil, most map units shown on the soil survey actually include small areas of soils different from those shown (the smallest area delineated is about 2.5 acres). Some of these included soils have properties that differ substantially from those of the major soil. Many of the mapped soil units can contain inclusions of wetland soils. Because these differences could significantly affect the use of these soils a site specific investigation should be done as part of the planning for specific projects. The last column of the soil interpretation table indicates which soils meet wetland criteria and which soils commonly have inclusions of wetlands soils (see Figure 6). It also indicates which soils are Prime Farmland and Farmland of Statewide Importance.

The September 21, 1979 memorandum from James S. Butler to the North Stonington Economic Development Commission contained tables showing limitation ratings for various soils. Some of the ratings have since been changed slightly as new information was obtained. The soil interpretation table contains the current ratings for the soils in the study area. Moderate or severe ratings do not necessarily mean that the site cannot be used for the planned purpose. In these cases special conditions must be taken into consideration in planning and design, and usually results in higher site development costs.

Many parts of the aquifer are composed of very permeable soils. Best Management Practices (BMP) should be used to capture oils, etc. from paved areas before stormwater runoff infiltrates into the soil. This is especially a concern where gravel was removed leaving the land surface only slightly above the water table. A maintenance plan should be established for such structures. These soils are also a poor filter for wastewater treatment. Providing a municipal sewer system would be beneficial. Any chemical wastes generated in this area should be carefully handled and stored until they can be removed.

During the site review it was indicated that a large piece of property on the west side of CT Route 2 may be developed soon. Based on the soil survey much of this area

should be suitable for development. Wetlands and watercourses will have to be avoided, particularly in the northern portion of this area. Limited access to CT Route 2 (and/or CT Route 184) and use of internal connections between developed sites may help avoid wetland crossings while reducing the visual impact along the road.

Figure 5

SOILS MAP

N

Scale 1" = 1320'

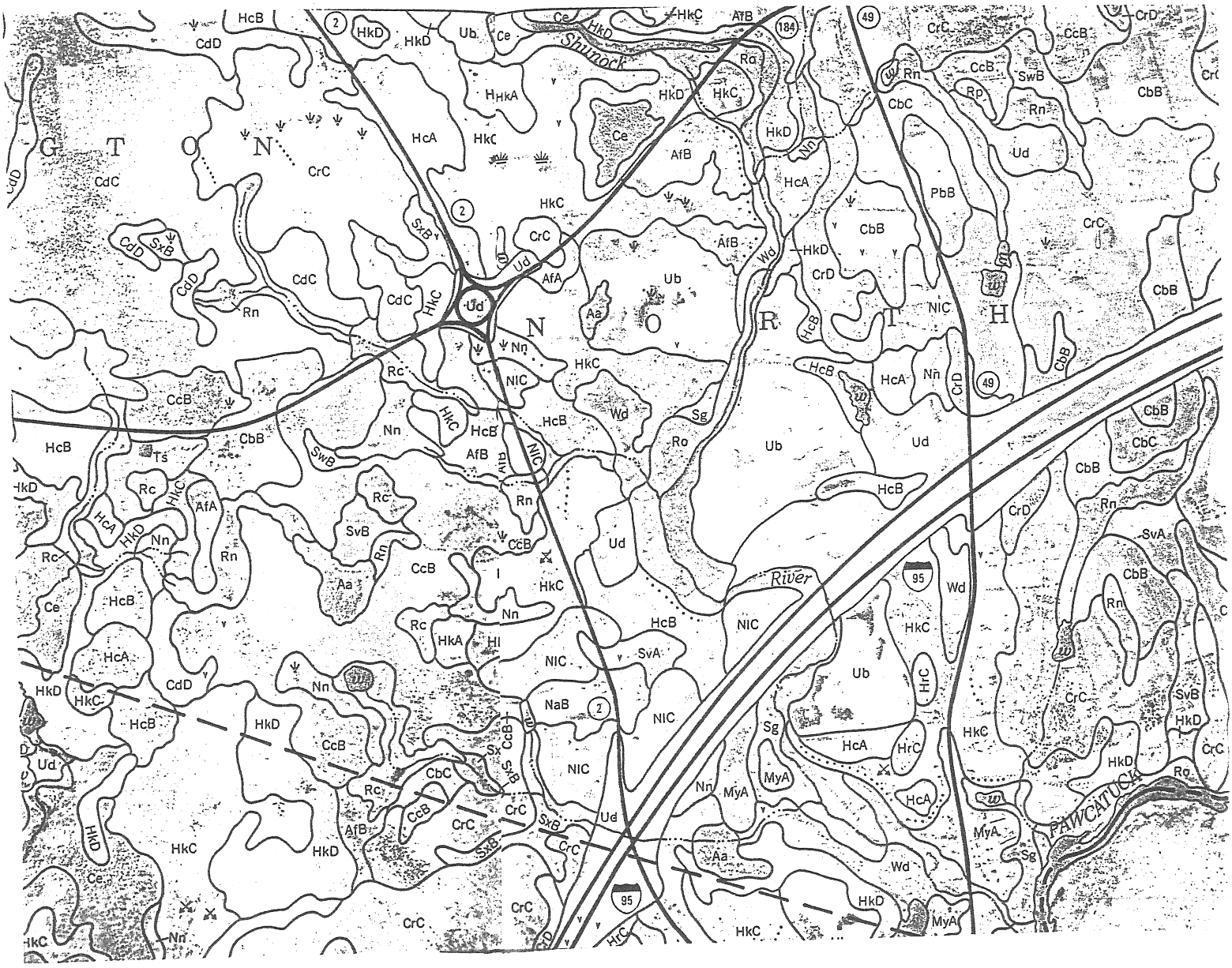


Figure 6

SOIL INTERPRETATION REPORT

SOIL INTERPRETATION REPORT

Survey Area- NEW LONDON COUNTY, CONNECTICUT

Map Symbol, Soil Name		Septic Tank Absorption Fields	Dwellings Without Basements	Dwellings with Basements	Small Commercial Buildings	Local Streets and Roads	Farmland/ Wetland Soils*
Aa	ADRIAN	SEVERE Subsides Ponding Percs Slowly	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding Frost Action	W
	PALMS	SEVERE Subsides Ponding Percs Slowly	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding	SEVERE Subsides Ponding Low Strength	SEVERE Ponding Frost Action Subsides	
AfA	AGAWAM	SEVERE Poor Filter	SLIGHT	SLIGHT	SLIGHT	SLIGHT	P|
AfB	AGAWAM	SEVERE Poor Filter	SLIGHT	SLIGHT	MODERATE Slope	SLIGHT	P|
BrB	BROADBROOK	SEVERE Percs Slowly	MODERATE Wet	MODERATE Wet	MODERATE Wet Slope	MODERATE Wet Frost Action	P|
CbB	CANTON	SEVERE Poor Filter	SLIGHT	SLIGHT	MODERATE Slope	SLIGHT	P|
	CHARLTON	SLIGHT	SLIGHT	SLIGHT	MODERATE Slope	SLIGHT	
CbC	CANTON	SEVERE Poor Filter	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	S
	CHARLTON	MODERATE Slope	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	

* This category indicates: P- Prime Farmland Soil, S- Farmland of Statewide Importance, W- Wetland Soil, I- Soil with possible inclusion(s) of wetland soils.

SOIL INTERPRETATION REPORT Continued

SOIL INTERPRETATION REPORT

Survey Area- NEW LONDON COUNTY, CONNECTICUT

Map Symbol, Soil Name		Septic Tank Absorption Fields	Dwellings Without Basements	Dwellings with Basements	Small Commercial Buildings	Local Streets and Roads	Farmland/ Wetland Soils*
CcB	CANTON	MODERATE Large Stones	SLIGHT	SLIGHT	MODERATE Slope	SLIGHT	I
	CHARLTON	SLIGHT	SLIGHT	SLIGHT	MODERATE Slope	SLIGHT	
CdC	CANTON	SEVERE Large Stones	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	I
	CHARLTON	MODERATE Slope	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	
Ce	CARLISLE	SEVERE Subsides Ponding Percs Slowly	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding Low Strength	SEVERE Subsides Ponding Frost Action	I
CrC	CHARLTON	MODERATE Slope	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	
	HOLLIS	SEVERE Depth To Rock	SEVERE Depth To Rock	SEVERE Depth To Rock	SEVERE Slope Depth To Rock	SEVERE Depth To Rock	
CrD	CHARLTON	SEVERE Slope	SEVERE Slope	SEVERE Slope	SEVERE Slope	SEVERE Slope	
	HOLLIS	SEVERE Depth To Rock Slope	SEVERE Slope Depth To Rock	SEVERE Depth To Rock Slope	SEVERE Slope Depth To Rock	SEVERE Depth To Rock Slope	

* This category indicates: P- Prime farmland soil, S- Farmland of Statewide Importance, W- Wetland Soil, I- Soil with possible inclusion(s) of wetland soils.

SOIL INTERPRETATION REPORT Continued

SOIL INTERPRETATION REPORT

Survey Area- NEW LONDON COUNTY, CONNECTICUT

Map Symbol, Soil Name		Septic Tank Absorption Fields	Dwellings Without Basements	Dwellings with Basements	Small Commercial Buildings	Local Streets and Roads	Farmland/ Wetland Soils*
HcA	HAVEN	SEVERE Poor Filter	SLIGHT	SLIGHT	SLIGHT	MODERATE Frost Action	
HcB	HAVEN	SEVERE Poor Filter	SLIGHT	SLIGHT	MODERATE Slope	MODERATE Frost Action	P
HkA	HINCKLEY	SEVERE Poor Filter	SLIGHT	SLIGHT	SLIGHT	SLIGHT	S
HkC	HINCKLEY	SEVERE Poor Filter	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope	S
NaB	NARRAGANSETT	MODERATE Poor Filter	SLIGHT	SLIGHT	MODERATE Slope	MODERATE Frost Action	Pl
NlC	NARRAGANSETT	MODERATE Slope Poor Filter	MODERATE Slope	MODERATE Slope	SEVERE Slope	MODERATE Slope Frost Action	I
	HOLLIS	SEVERE Depth To Rock	SEVERE Depth To Rock	SEVERE Depth To Rock	SEVERE Slope Depth To Rock	SEVERE Depth To Rock	
Nn	NINIGRET	SEVERE Wet Poor Filter	MODERATE Wet	SEVERE Wet	MODERATE Wet	SEVERE Frost Action	Pl
Rc	RAYPOL	SEVERE Wet Poor Filter	SEVERE Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet Frost Action	SW

* This category indicates: P- Prime farmland soil, S- Farmland of Statewide Importance, W- Wetland Soil, I- Soil with possible inclusion(s) of wetland soils.

SOIL INTERPRETATION REPORT Continued

SOIL INTERPRETATION REPORT

Survey Area- NEW LONDON COUNTY, CONNECTICUT

Map Symbol, Soil Name		Septic Tank Absorption Fields	Dwellings Without Basements	Dwellings with Basements	Small Commercial Buildings	Local Streets and Roads	Farmland/ Wetland Soils
Rn	RIDGEBURY	SEVERE Percs Slowly Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet Frost Action	W
	LEICESTER	SEVERE Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet Frost Action	
	WHITMAN	SEVERE Percs Slowly Ponding	SEVERE Ponding	SEVERE Ponding	SEVERE Ponding	SEVERE Frost Action Ponding	
Sg	SUDBURY	SEVERE Wet Poor Filter	MODERATE Wet	SEVERE Wet	MODERATE Wet	MODERATE Wet Frost Action	PI
SvA	SUTTON	SEVERE Wet	MODERATE Wet	SEVERE Wet	MODERATE Wet	SEVERE Frost Action	PI
SvB	SUTTON	SEVERE Wet	MODERATE Wet	SEVERE Wet	MODERATE Wet Slope	SEVERE Frost Action	PI
SwB	SUTTON	SEVERE Wet	MODERATE Wet	SEVERE Wet	MODERATE Wet Slope	SEVERE Frost Action	I
SxB	SUTTON	SEVERE Wet	MODERATE Wet	SEVERE Wet	MODERATE Wet Slope	SEVERE Frost Action	I
Ts	TISBURY	SEVERE Wet Poor Filter	MODERATE Wet	SEVERE Wet	MODERATE Wet	SEVERE Frost Action	PI

* This category indicates: P- Prime farmland soil, S- Farmland of Statewide Importance, W- Wetland Soil, I- Soil with possible inclusion(s) of wetland soils.

SOIL INTERPRETATION REPORT Continued

SOIL INTERPRETATION REPORT

Survey Area- NEW LONDON COUNTY, CONNECTICUT

Map Symbol, Soil Name		Septic Tank Absorption Fields	Dwellings Without Basements	Dwellings with Basements	Small Commercial Buildings	Local Streets and Roads	Farmland/ Wetland Soils*
	PITS	SEVERE Poor Filter	SLIGHT	SLIGHT	SLIGHT	SLIGHT	
	URBAN LAND						
Wd	WALPOLE	SEVERE Wet Poor Filter	SEVERE Wet	SEVERE Wet	SEVERE Wet	SEVERE Wet Frost Action	SW

* This category indicates: P- Prime farmland soil, S- Farmland of Statewide importance, W- Wetland Soil, I- Soil with possible inclusion(s) of wetland soils.

The Natural Diversity Data Base

The Natural Diversity Data Base maps and files have been reviewed regarding the study area. According to the information, there are no known extant populations of Federal or State Endangered, Threatened or Special Concern Species occurring at the site in question.

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

Please contact the Data Base at (203) 424-3584 if you have any questions regarding this information. Also be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for the proposed site.

Water Management - Planning & Standards Review

General Setting and Topography

The study area is located in the lower Shunock River valley in the southeastern corner of North Stonington. The site can be divided into 3 distinct areas; central, east, and west. The site is dominated by the central, flat river valley including the river, wetland floodplain, and outer plain. Substantial gravel excavation has leveled this area in sections. The eastern area consists of a bedrock controlled hillside, sloping up steeply to the east and leveling off at the top. The western area is mostly moderate to gently sloping hillside. Site elevations range from about 70 feet above MSL (mean sea level) in the valley to about 150 feet MSL in the east and west hills.

Geology

Below are some observations regarding the surficial geology and how it would affect use of the site.

The site is dominated by a deep stratifed drift plain in the central area. This material thins to the outer edges along the east and west hills. Areas of till occur in hills at the the eastern area of the site near CT Route 49, and is shallow in areas. The western hillside along CT Route 2 consists mostly of sand and gravel, and is fairly deep. The stratified drift ranges in thickness up to 100 feet in the central valley and is predominately sand and gravel. Alluvium, areas of recently deposited fine grained sand and silt, exists on adjacent floodplains of the Shunock River.

From a geologic perspective the most limiting factors to development are: 1) steep slopes, shallow to bedrock till (including rock outcrop areas) in the eastern section; and 2) in the central portion where excavation of sand and gravel has lowered areas, which are very permeable, close to groundwater level making it floodprone, and overlays the most productive part of the aquifer. The western area along CT Route 2 has relatively few limitations. Limitations will be discussed later in more detail.

Hydrology

Surface Water

All of the site lies within the watershed of the Shunock River, except the southeast corner which flows overland to a small watercourse to the Pawcatuck River. (See Figure 7) The Shunock River is a subregional basin which drains a total area of approximately 16.8 square miles. The site is located at the very lower end of the watershed, with about 15.7 square miles draining through the site. The river drains a large part of the town center area to the north, and flows southerly through the site to the Pawcatuck River.

Site drainage in the central area and adjacent hillsides is primarily via overland flow to wetlands along the river. The northwest area along CT Route 2 drains to a wetland system and small tributary which flows easterly to the river. The northeast corner drains via a small intermittent stream flowing west to the river. Figure 8 shows the site drainage areas. A large portion of the central area contains a long flat strip of wetlands associated with and contiguous to the river. Wetlands can serve many valuable hyrologic functions including retention of runoff, flood storage, discharge of groundwater to maintain base stream flow, and maintaining stream water quality by performing filtering and biochemical processes. The central site wetlands system from a hydrology standpoint is an especially important streambelt area for flood storage, runoff control, and maintaining stream quality. Although most wetlands discharge as opposed to recharge groundwater, the wetlands in the valley may also recharge groundwater in dry periods. A few isolated wetland areas and manmade ponded areas from past excavation in the central area collect some runoff and may provide opportunities for stormwater management.

DEP classifies water quality conditions and sets goals for all surface and groundwater in the state by their designated use. The classifications are based on the adopted Water Quality Standards and together establishes the state management system to protect health, environment, and legimate uses of water resources. The Shunock River is classified as "A" water quality. It is high quality, essentially unpolluted, and has good water quality suitable for fish and wildlife habitat, recreation, and potential drinking water supply. The goal is to maintain this natural condition. Wastewater discharges to the river are not allowed.

Groundwater

Significant groundwater resources exist at the site. Local topography and geology in the drainage basin are responsible for groundwater conditions at the site. Groundwater is stored and transmitted within the surficial materials and bedrock fractures. Groundwater recharge is predominately from precipitation over the local drainage basin. Greater recharge occurs over the porous flat stratified drift in the central valley, as much as 60% of precipitation. Flow is concentrated in the upper part of the saturated zone and generally coincides with surface water drainage divides. Natural flow is generally downgradient from the east and west hills, and the north discharging to adjacent wetlands and the river. Deep groundwater flow under the stream valley at the site is generally south toward the Pawcatuck River. The surface water and ground water are really one interconnected hydrologic system.

Groundwater supply can be derived from two basic types of aquifers, bedrock and stratifed drift. The bedrock can yield small amounts of water (1-10 GPM (gallons per minute)) for domestic and small commercial/industrial use. Exisiting uses within the area currently have such bedrock wells. Stratified drift aquifers can be very productive (50-2000 GPM) especially when coarse grained, thick saturated, and hydraulically connected to large streams. A significant, potentially high yielding, stratifed drift aquifer exists in the central valley of the site associated with the Shunock River. Detailed hydrogeologic data of the site is published in Connecticut Water Resources Bulletin No. 15, Lower Thames and S.E. Coastal River Basins. The Shunock River aquifer, and other selected area stratified drift aquifers, were further evaluated in a special USGS study, Hydrogeology of S.E. Conn. (1974). In the 1974 study, the Shunock Aquifer was modeled and hypothetical wells were proposed in potential high yield areas. These are shown on figure 9. The site was determined to have potential long term yields of approximately .4 to 1.5 MGD (million gallons per day). These projected yields may be high however, because of assumptions made regarding allowed reductions in stream flow and existing well withdrawals within the basin. The town has recognized the potential of this area for future public water supply and has protected it with an aquifer protection overlay zone.

Recently an approximately 44 acre parcel of land has been purchased by the Westerly, RI Water Department with plans to develop a wellfield at the site. Permits are needed from the State DEP Water Management Bureau, Diversion Program, and

the Department of Public Health and Addiction Services, Water Supply Section for the wellfield. A pre-application for the diversion permit has been submitted, but additional information is needed. It could be one year for the application and permit process to take place. A major issue to be addressed for the permit is the impacts to reduction of stream flow caused by the withdrawal. The diversion process is coordinated with the new State Aquifer Protection Area Program. This DEP program is currently beginning implementation and would affect the site if the wellfield is developed. The program will regulate surrounding land areas recharging stratified drift wellfields serving over 1000 people. The Town of North Stonington has been kept advised of this new program and how it may affect local land use by restricting types of land uses. Based on preliminary and limited information submitted for the diversion permit, the DEP Water Management Bureau has estimated the potential recharge area that could be regulated as the Aquifer Protection Area. The entire site is included in the estimated area as shown on Figure 10. When a pumping well withdraws water from an aquifer it essentially diverts natural water flow to the well. So the Aquifer Protection Area (sometimes referred to as a "wellhead protection area") is really that portion of the aquifer directly contributing water to the well.

Groundwater quality conditions at the site are classified "GA". These are groundwaters within the influence of private and potential public wells, and water quality is presumed suitable of human consumption (meets drinking water standards). Discharges of wastewaters other than domestic sewage are not allowed to the ground. The site of the former Posi-Seal International (now Fisher Controls) near CT Route 49 had been identified as an area of past potential contamination from a former metals rinse water discharge to the ground. Water quality testing done recently for the proposed wellfield showed good water quality conditions, meeting drinking water standards. The most common threats to groundwater quality include: underground fuel and chemical storage, improper use of septic systems, waste disposal, chemical storage and handling, and other chemical spills and leaks from commercial and industrial facilities. A recent USGS report "Effects of Land Use on Quality of Water in Stratified Drift Aquifers in Connecticut" (1993) verified that these "non-point sources" of pollution are not reduced by the presence of public sewers, and in fact sewers caused secondary impacts that increased groundwater pollution in areas. Land uses which represent threats to groundwater quality are a special concern for this site.

The site is also within the federally designated Pawcatuck River Sole Source Aquifer. This is a federal EPA program which recognizes regions highly dependent on groundwater for supply with little alternative supply. The designation broadly covers the whole Pawcatuck River basin. If federal funds are to be used, or if it is a federal agency project, then a review by EPA for potential groundwater impacts must be done.

Development Constraints, Planning Concerns, and Recommendations

In general, there are a number of natural limitations at the site which will restrict the extent of usable land, and involve additional costs for development. Also, development of the proposed public supply wellfield will significantly restrict the type of commercial and industrial land uses that should be allowed. Many of the resource constraints were well described in the "Physical Constaints Map" in the 1973 report done of the site. Based on this, there are basically four or five areas which may lend themselves to reasonably good size sites suitable for development. These areas probably comprise less than 50% of the total undeveloped area of the site however, public sewers would be almost necessary. With the resource limitations and availability of public sewer and water, innovative zoning techniques such as cluster, planned unit development, or performance zoning should be considered if commercial and industrial uses are proposed.

Limitations and recommendations are discussed further below.

1. Watercourses/Wetlands/Floodplain

The Shunock River and its associated wetlands and floodplain occupy a large segment of the central site and will restrict development opportunities there. As discussed previously, this "streambelt" consisting of the river, contiguous wetlands and floodplain, and other contiguous land areas with habitat, buffering, and open space values provide certain ecological functions and should be avoided. Restrictions and setbacks of certain associated activities are necessary to protect water quality and aquatic habitat, as well as protect development from flood damage or aggravating flooding conditions. Although a fixed setback or buffer is simple to administer for this area, it is not always ecologically accurate or practical and flexibility must be considered for the individual site and use proposed. The DEP Water Management Bureau is currently conducting a study to develop a scientific methodology for delineating stream buffers. Again, the 1973 Recommended Land Use Plan outlined a reasonably good area for

streambelt protection. The following guidelines should be considered for protecting the Shunock River and tributaries :

- Preservation of the remaining natural wetlands, except where no alternatives exists for access.

- Require buffers or setbacks of 100 feet from the river and its tributaries; 50 feet from contiguous wetlands; or areas of the 100 year flood zone, which ever is further, for major disturbances such as buildings, parking lots, storage areas, and stormwater management structures. Where steep slopes (> 15%) occur adjacent to the stream or contiguous wetland, or other special habitat or vegetation, the buffer requirement could be increased to 300 feet. Again, these buffer should not be absolutely fixed and include opportunities for flexibility based on the specific use and site conditions.

- Streambelt areas along the Shunock River in the central area which have been disturbed should be revegetated to provide streambank erosion control, shading for the streambed, and a filter strip for stormwater. The existing river crossing in the central site appears to have been designed for temporary use for the gravel operation. The culvert is probably significantly under sized, and is also elevated which may be creating an impass for fish. With plenty of site access, the first alternative would be to remove the crossing and restore the stream. A permanent road would involve a much larger culvert and filling to widen the road and elevate it above the flood zone.

2. Soils/Geology

In addition to the streambelt, the central portion of the site is further limited by the past excavation of gravel on the north and south side of the river. The removal of soil in this area has created conditions in which the groundwater table is close to the surface (-2 to -3 feet) creating problems for both building contruction and especially on-site sewage disposal. Fill will be required for most uses in these areas. Sewage disposal on site is further limited because of the high permeablity of the sand and gravel soils throughout the site, shallowness to bedrock in portions of the east and west hills, and the proposed wellfield. Steep slopes and shallow bedrock in the eastern sections will limit building opportunities there. The areas along the CT Route 2 area have the least limitations.

Considering the limitations, and if commercial and industrial development is proposed, public sewers would be almost necessary (see further discussion below).

3. Aquifer/Wellfield Protection

The entire site is within the high yielding stratified drift aquifer area. If the proposed Westerly Water Company Wellfield site is approved, it will have an established State Aquifer Protection Area around it covering all, or most of, the development site. The types of uses currently prohibited in the town's overlay zone, as well as some others, are proposed to be prohibited in Aquifer Protection Areas. An attached table (see Appendix A) lists the types of uses which are proposed to be prohibited, and ones to be regulated. Many industrial uses will not be allowed, as well as some commercial uses. The DEP Water Management Bureau can discuss these regulations further with the town as they are developed. Although public sewers will reduce some wastewater concerns, numerous non-point sources of pollution from raw hazardous material storage, use, and handling can actually be increased with sewers unless controls are taken. So restrictions on the types of land use as well as density controls are necessary even with sewers. Sewers may allow some additional industrial types of uses with limited ancillary activities which otherwise would not be allowed, such as minor testing or processing.

The following recommendations are made for aquifer protection:

- Continue currently to protect the site area with the local aquifer protection zone. When the proposed wellfield site is approved and final protection area is delineated, consideration should given to re-examining the Shunock aquifer and the existing protection zone. Development of this wellfield, along with the SCWA wellfield (in which an approximate recharge area had been mapped under the state program and forwarded to the town) in the upper watershed, may represent full groundwater supply development of the aquifer. If this is the case, the local Aquifer Protection Zone which had to be delineated to broadly protect potential areas of the aquifer (not knowing exact future wellfield locations), could be revised and protection efforts concentrated on the wellfield recharge areas through the State Aquifer Protection Area Program or continue zoning if necessary. This will target protection where it is most needed, and may free-up land from restrictions no longer needed. Some basic protection measures should be provided in all groundwater supply areas, however. The DEP Water Management Bureau can assist the town in this examination.

- The current overlay protection zone could be upgraded to match recommendations in the DEP Guide for Drafting Local Aquifer Protection Regulations regarding prohibited uses and standards. Changing section 406.4.a, Prohibitions, to read: "any use in which the manufacture, use,

handling, storage, or disposal of hazardous substances is a principal use" provides a good overall restriction. You can then continue to list specific prohibited uses, or list only those low risk uses that are allowed and prohibit all others. Road salt storage facilities should be prohibited. Accessory and special permit uses including: laboratories, machine shops, commercial photographic processing, and medical arts should only be allowed if connected to public sewers.

- Basic standards should be applied to all uses including:

  - No underground fuel or chemical storage.
  - Storage of hazardous materials shall be indoors, or within a roofed structure with secondary containment. Loading and handling areas shall be roofed and have spill containment.
  - No drywells or leaching structures shall be used for non-domestic wastewater discharges or stormwater from paved surfaces.
  - Material Management Plans should be provided covering inventory, storage, handling, disposal operations, and emergency response for hazardous materials.
  - Stormwater management systems should concentrate on preventing pollution of groundwater by: preventing stormwater contact with sources; providing impervious surfaces where releases can occur; provide land discharge, and treatment if necessary, for paved surfaces; and recharge clean water such as roof tops. Directing stormwater from developed paved surfaces such as roads and parking areas to direct recharge structures such as drywells should not be allowed because many pollutants of concern would be directed to the aquifer with little treatment ability.

Stormwater management is discussed further below.

4. Sewers

There have been a number of issues raised regarding extending public sewers to the site area. DEP's position regarding extending sewers into this area has been stated in the October 1, 1993 response letter to the Town WPCA, and includes the following:

- Sewer extensions into the potential public supply aquifer areas is a concern because of secondary development impacts to water quality. Existing local aquifer protection measures should be continued.

- Although capacity is set aside for North Stonington in the Pawcatuck Sewage Treatment Plant (STP), DEP approval is required for the sewer extension plans and specifications.

- The town should initiate a facilities planning effort to evaluate long term needs, and to define sewer service and sewer avoidance areas. DEP recently approved plans for a sewer extension into North Stonington.

The proposed sewerline plans provides service to A&T and the DOT Rest Stop. The proposed plan shows a 10" trunkline which is at a minimum .28% slope and is capable of handling in excess of 500,000 gpd. Based on this, the pipe line should not provide any flow restrictions for the site. Also, it apppears that the Pawcatuck STP has capacity beyond the original 250,000 GPD set aside for North Stonington, and it is primarily a matter of the town negociating for that additional capacity.

Other recommendations regarding sewering are:

- Estimates of flows from typical industrial uses should be 20-25 gpd rather than 30, unless shower facilities are proposed onsite.

- The service area should probably be extended to serve existing uses near the State Route 184 circle, and property which abuts State Route 184 to the north. Installation of sewers along State Route. 2 should be coordinated with any reconstruction being proposed to avoid additional resurfacing.

- A trunkline system for the site should be planned which will minimize pump stations, but also avoid construction within the low lying streambelt of the Shunock River. If a crossing of the river is necessary it should be coordinated with the existing road crossing if possible. Sewerline construction must be avoided within the 250' well radius setback in the Public Health Code.

- Special considerations for construction of the sewer line may need to be taken including shallow bedrock, high water table conditions, and flood proofing.

5. Stormwater Management

Stormwater from urbanization is a significant "non-point" source of pollution. It is becoming clear that management of both the quantity and quality of runoff must be considered, and management must be on a watershed basis to protect receiving waters. Where waters are used for drinking purposes, such as this site, extra provisions are necessary.

Certain stormwater discharges are now regulated by the State DEP Water Management Bureau through a general permit. These include:

- Construction activities which disturb 5 acres or more ; and
- Certain industrial activities.

The program centers on stormwater pollution prevention plans for these uses, as opposed to end of pipe treatment which still has a significant role. DEP is also considering expanding the general permit requirements to additional industries and some commercial uses. Sites that are very large, or have significant pollution potential, can be required to obtain an individual permit from DEP.

Local land use regulation, however will continue to be an important way stormwater is managed. Within the limits of this report, and not having specific site development plans, a thorough review can not be done. However, given the known nature of the site and proposed development types being considered there are certain guidelines that can be made. Studies have generally shown that water quality impacts to surface waters begin to show up when impervious coverages approach 15%, between 30-60% impacts become significant, and > 60% can become servere. Stormwater documents and guides are available which provide impact assessment, management options, and design criteria to implement them. Determining stormwater impacts and what to do for commercial or industrial land uses should be looked at in the following manner.

Individual Site Layout and Natural Resources

Site layout and design is important to minimizing impacts and providing natural protection to receiving waters. In particular subdivision of land and individual site development plan layout must maintain the natural streambelt system and buffers discussed previously and concentrate development on the buildable land. This takes advantage of the natural overland dispersion and recharge of runoff, the natural passive treatment and flood control capacities, and minmizes the use and maintenance of structures. Generally small industrial or commerical sites < 1 acre and with < 30% impervious surfaces require little more than source controls and passive management.

Source Controls

Pollution prevention measures should be a major practice for commercial/industrial uses. By restricting high risk uses in aquifer protection area, significant threats to groundwater quality will be eliminated. The following practices should be part of a stormwater pollution prevention plan:

- Insure all wastewater discharges are properly connected and disposed of.
- Prevent stormwater contact with all waste and material storage areas, and divert clean storm water from these areas.
- Avoid or minimize the application of sodium chloride chemicals as a deicing agent for snow and ice control, and maximize the use of abrasives.
- Only apply chemical fertilizers after soil test indicate the need. Minimize chemical pesticides, require use of a licensed applicator, and use non-chemical alternatives where available. (the primary concern with chemical fertilizers and pesticides is handling, over application, and not applying according to directions).

Runoff Treatment and Renovation

Regardless of the extent of source controls, stormwater will pickup and transport pollutants from incidental sources such as litter, vehicle use, atmospheric deposition, and landscaped areas. Contaminants from paved surfaces include suspended solids, hydrocarbons, metals, nutrients, bacteria, road salt, and thermal pollution. These contaminants are contained primarily within the first 1/2 - 1 inch of runoff. This "first flush" may need treatment depending on the types of land uses. It has been shown that treatment to remove gross particles and floatables followed by a land surface type of treatment such as vegetated swales, filter strips, or detention basins are the most effective and protect both surface and ground water.

For the type of industrial and commercial development proposed, the following guidelines can be used.

- ***Small Sites, < 1 acre contiguous pavement and < 30% impervious coverage.***
  - Minimize the use of drainage structures
  - Encourage sheet flow to natural drainage areas - recharge clean roof water
- ***Large, High Vehicle Use, or High Materials Handling Sites***
  - Minimal treatment by diverting first flush to a particle/oil separator which removes heavy sediment and floatables as well as provides emergency spill containment. Lower intensity sites could use hooded (baffled) catch basins instead.

• Discharge of first flush to a vegetated detention basin to encourage settling, infiltration, filtration, and biological uptake. Designs should generally be for detention times which will remove 80% of suspended materials. Wet basins and manmade wetlands are the most effective because of better detention and biological activity. Because you are only handling the first 1/2 inch of runoff, land areas needed are relatively small.

Peak Flow Controls

Controls of large storms may be necessary to protect downstream flooding or streambank erosion. The entire watershed must be considered when determining the affect of development runoff on peak flows of the receiving stream. Again where soils conditions exist, usually sandy or gravelly conditions, direct recharge of clean roof runoff by drywell or leaching structures should be encouraged, and will help reduce post development runoff. The location of the site in the watershed and relation to downstream flow restrictions needs to be examined when considering the use of detention measures. The following general guidelines can be used:

- In the lower 1/3 of the watershed: little or no detention.
- In the middle 1/3: limited detention.
- In the upper 1/3: longer detention.

The effects of each individual site development plan needs to be calculated for pre- and post development runoff and the affect on peak flow of the stream. As discussed earlier, the study site is located in the low end of the watershed so the need for detention measures may be minimal

Where needed the use of combined structures for treatment and runoff control is possible, and shared facilities for more than one site should be encouraged where possible. There are a number of technical sources available for stormwater management design including *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs* by the Metropolitan Washington Council of Governments.

Density Considerations and Water Quality

The density, as well as the type and location of land use, can have a bearing on the quality of surface and ground waters. As discussed under stormwater, some direct relationships can be made for impervious coverage and surface water quality impacts for conventional pollutants. But for unconventional pollutants such as solvents, petroleum, and other hazardous substances, this can not be easily done. As discussed under aquifer protection, the type of land use has more to do with groundwater quality than density, except for known discharges such as sewage disposal. For example, just one isolated gasoline station tank leak, or chemical spill, can affect the water quality of an entire aquifer area. Again, to truely consider the cumulative affect of all potential development (built out conditions), you must consider the overall watershed or resource area. There are mathmatical models which can predict certain water quality conditions, but this requires detailed analysis, and has inherent assumptions and limitations. Although there is no simple formula for density, there are some basic principles such as "buildable land" that can be incorporated into land use regulations. Buildable Land Criteria is basically a performance standard where the lot is more truely characterized as to its ability to support development. Required lot bulk requirements should consider sensitive resource areas, areas of servere limitation, and maintenance of natural areas. Some recommendations are:

- ◆ Minimum lot area requirements should prorate the lot by excluding, or limiting the percentage of, the unbuildable lot areas such as wetlands, floodplain, and severely steep land which can be used for lot size. This essentially establishes densities based on truely usable conditions, protects sensitive areas, and doesn't give a density bonus to poor lots.

- ◆ Lot coverage requirements should establish maximum impervious coverage in addition to building coverage. Both should be based on the buildable area.

There has been inquires from the town as to whether nitrogen models should be incorporated into local land use regulations to determine density. Although nitrate can be a limiting pollutant for sewage disposal, and related to overall development lot size, there are several concerns about using nitrate models.

- ◆ Except for domestic sewage and other organic waste discharges such as agriculture, sources of nitrate would probably be minimal and difficult to predict accurately with models. Model assumptions would vary and the town would have to establish a model and set the assumptions. The value of such

determination would also be questionable. The WPCA's consultant provided an analysis of nitrogen loading for both sewered and non-sewered industrial development senarios showing non-sewage loads to be less than 1 mg/l. The drinking water standard is 10 mg/l.

◆ Large sewage discharges are well regulated in the state already. Community and large on-site systems of > 5,000 GPD require a state DEP permit which requires a nitrate renovation analysis. Other wastewater discharges are not allowed to the ground in existing or proposed water supply areas. For cumulative development of smaller individual lots with on-site systems a maximum benchmark to consider should be the equivalent of 1 household (or 350 GPD) per acre, especially in water supply areas. If sewage disposal is proposed greater than this density, then the town could incorperate requirements for a pollutant renovation analysis as required under state permitting. Development with on-site sewage disposal systems discharging between 2,000 and 5,000 GPD can be required, under the state health code, to perform a pollution renovation analysis.

It recommended that the town use the above guidance to establish reasonable lot requirements and densities based on buildable land criteria, retention of protective streambelts, and source controls rather than new models at this time.

Figure 7

N

WATERSHED MAP

Site

Watershed Boundary Lines

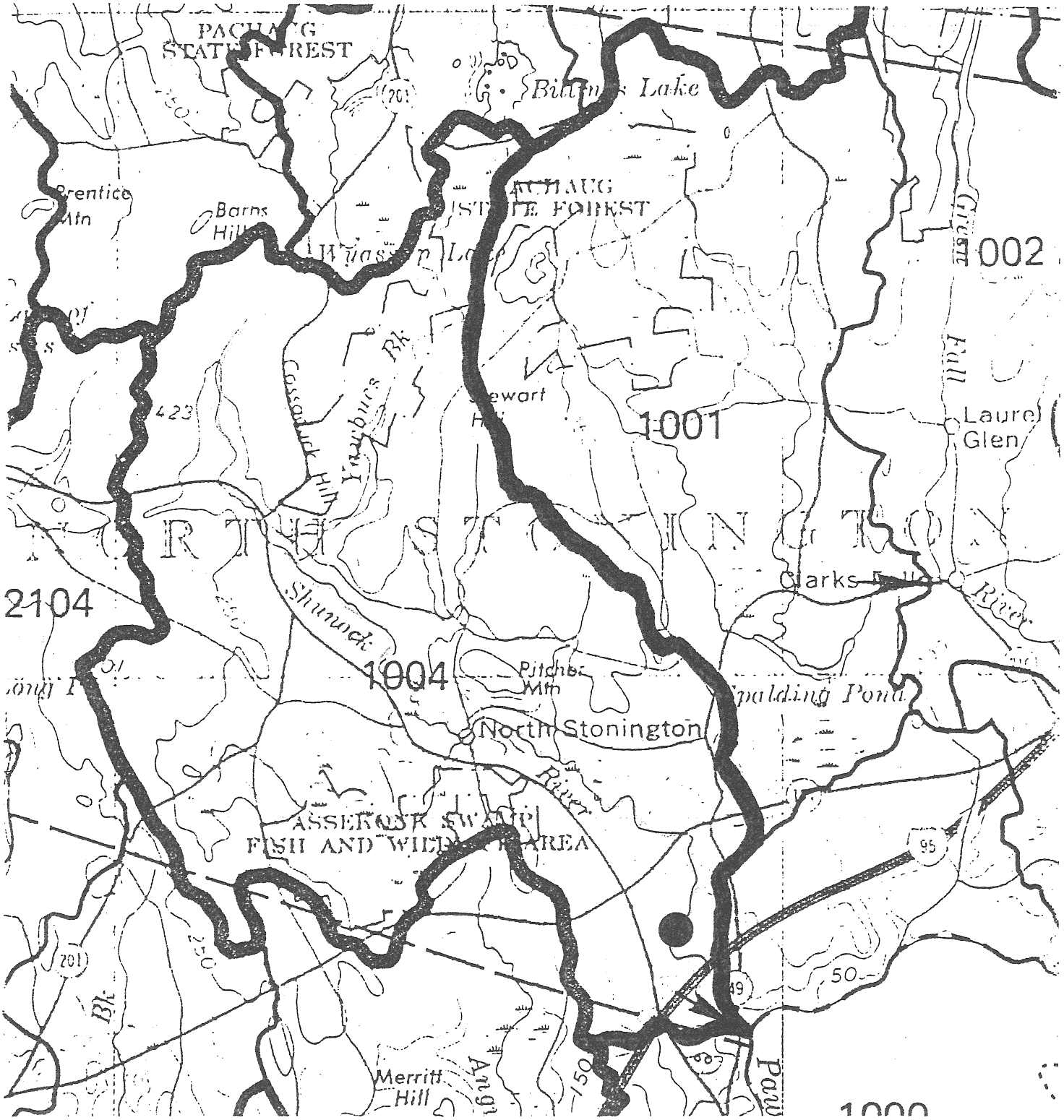


Figure 8

SITE DRAINAGE AREAS

N

Site

Shunock River Watershed

Tributary Watershed

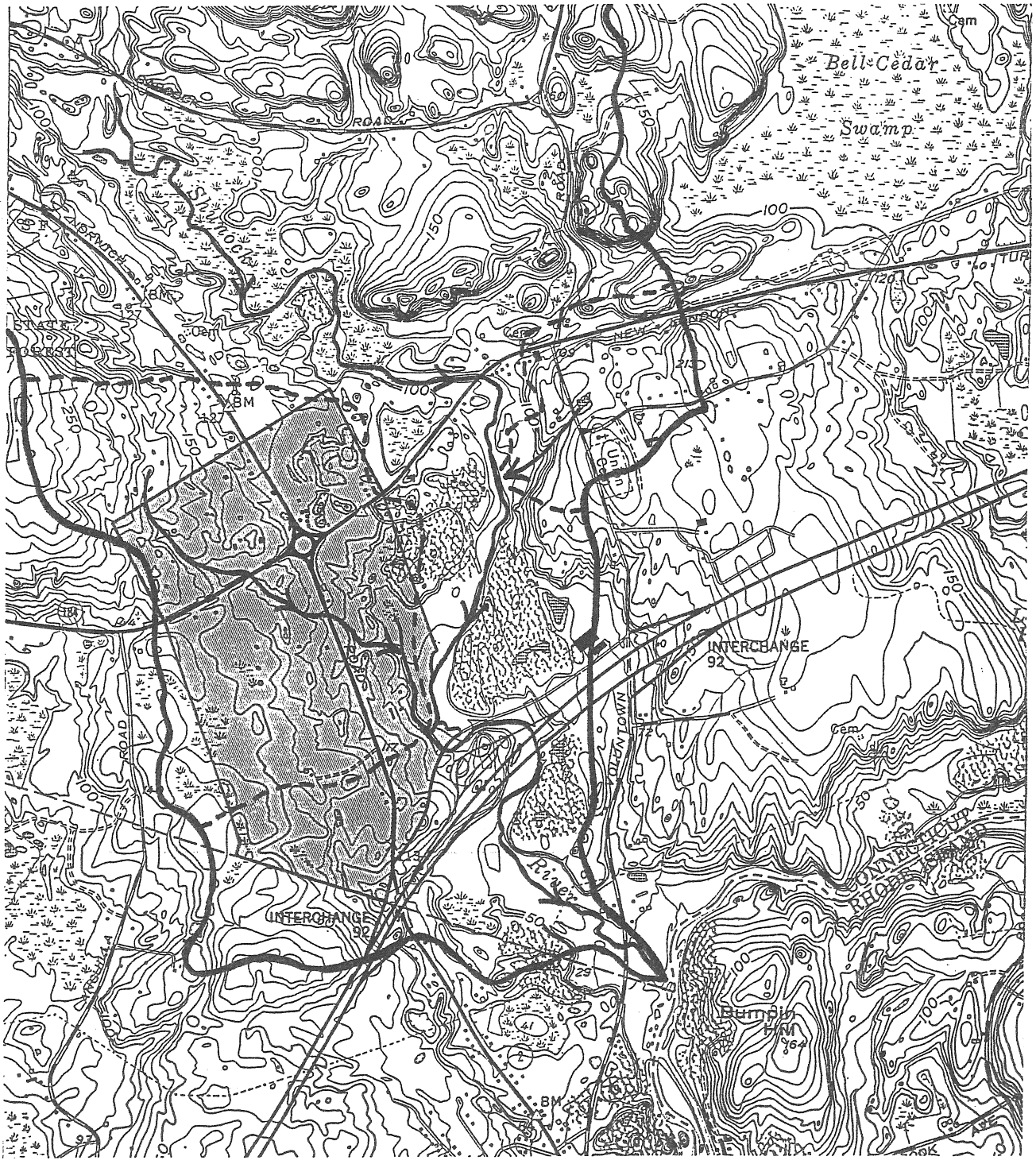


Figure 9

N

1974 HYPOTHETICAL WELL LOCATIONS

Scale 1" = 2000'

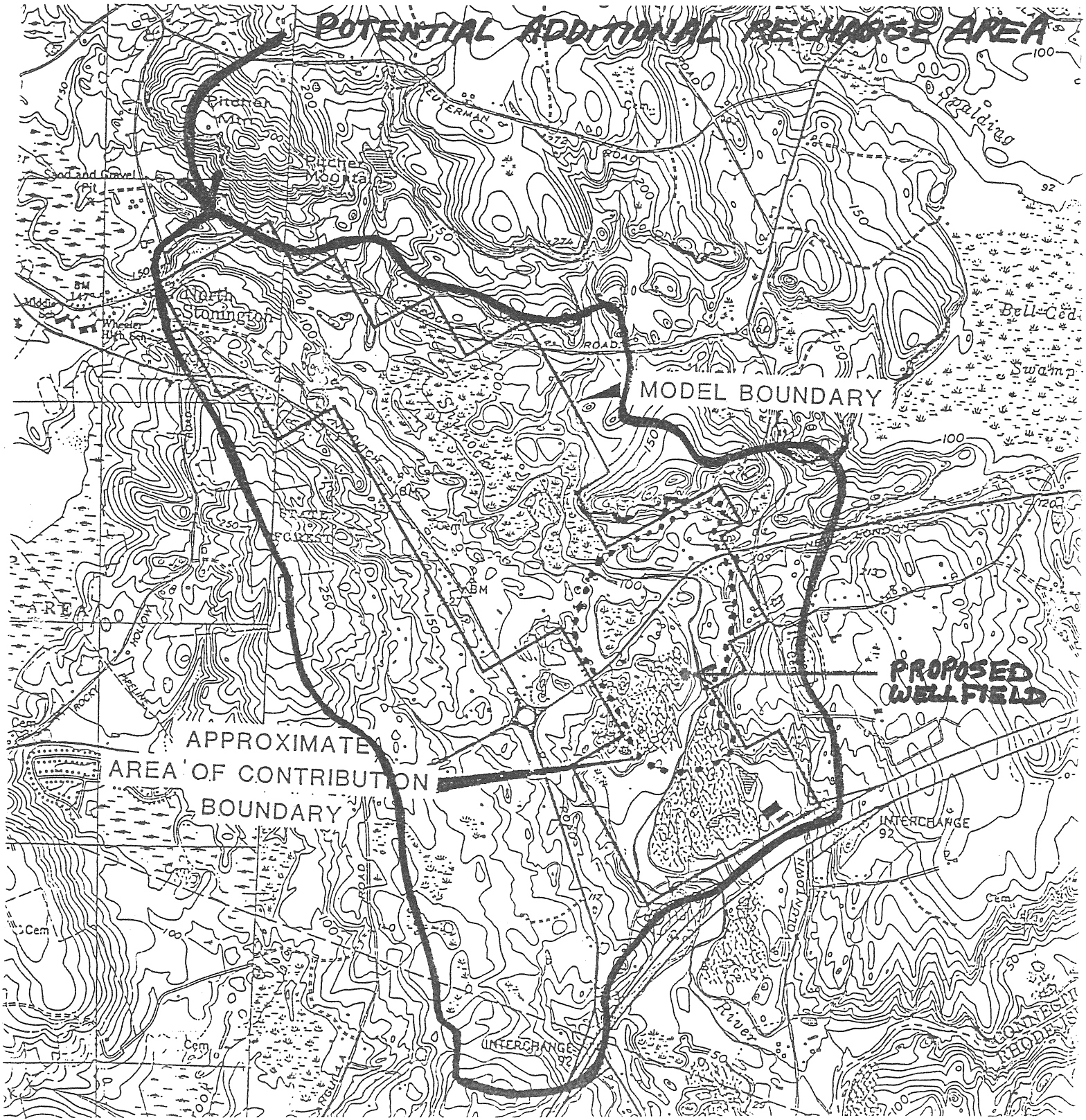
● Hypothetical well in potential high yielding area of aquifer
USGS, Hydrogeology of Southeastern Connecticut, 1974.

Figure 10

POTENTIAL RECHARGE AREA

N

Scale 1" = 2000'



Wetland Resources

Included in this section are observations of the existing wetland resources and recommendations for future development of this parcel.

Existing Wetland Resources

The following wetland descriptions and locations were derived as a result of soil map and aerial photo interpretation. Field verification was not performed.

A majority of the wetlands within the study area are of a riparian nature. This type of wetland parallels the banks of watercourses and functions as an extension of that watercourse. The primary watercourse, flowing north to south through the study area, is the Shunock River which originates in west North Stonington and joins the Pawcatuck River at the Rhode Island/Connecticut border just north of this Town's border with Stonington (wetland area #1 on Figure 11). A study of 1965 aerial photos reveal that the physical nature of this riparian system has remained essentially unchanged since that time. Elevated terraces on both sides of the river that once were in agriculture have now been utilized for their gravel resources, however, the overall effect on the floodplain areas have been minimal, except for the construction of an unimproved river crossing. Other stream corridors exist feeding into the Shunock River across Norwich Road from the east, however these have minimal amounts of associated riparian wetlands (area #2, Figure 11).

Two smaller, isolated wetlands are located in what appear to be "kettle holes" or small depressions formed during the retreat of the last continental ice sheet (areas #3 and #4, Figure 11). Other wetlands within the study area include a non-alluvial area adjacent to the Shunock floodplain which appears to have been ditched and perhaps partially drained prior to 1965 to allow pasturing to take place (area #5, Figure 11), as well as a series of small ponds created as a result of gravel extraction activities (area #6, Figure 11).

Wetland Functional Values

The most significant wetland system on this parcel is the riparian system adjacent to the Shunock River (area #1 and #5, Figure 11). The primary functional values for this wetland area include water quality, flood control and wildlife habitat.

Riparian wetlands protect the water quality of the associated watercourse by acting as a buffer between it and any upland land-uses which may negatively impact water quality. These wetlands act to "treat" the surface water, and to a limited extend the groundwater, flowing into them before reaching the watercourse. The vegetation in these wetlands effectively "take up" or contain pollutants such as heavy metals and hydrocarbons while the wetland soils can trap or absorb particles such as suspended sediments and road salts.

Riparian wetlands largely coincide with the floodplain of a watercourse. This area accepts water from the river after it has reached "bank full" capacity, reducing flood flow velocities and acting as a storage area for the flood waters. A well maintained system of floodplains can naturally provide what may otherwise cost millions of dollars to provide through man-made flood control projects.

Besides the rich diversity of wildlife a healthy wetland can provide an additional function as a wildlife corridor. This corridor can effectively hook-up larger, more contiguous wildlife habitats as it passes through more populated areas.

The small, isolated wetlands (#3 and #4, Figure 11), if confirmed to be "kettle holes", not only have geologic significance but also, because of a fluctuating water table, may contain unique flora and fauna.

Recommendations for Maintaining Wetland Functions

The "Recommended Land-Use Plan" (1973) generally recognizes the existence of the above described wetlands and adequately provides for their protection against any direct impacts through the creation of a "Streambelt" area. It also provides for the enhancement of the wetland systems for this area by proposing the creation of an open water body in the area of the existing gravel operation. If designed properly this pond could increase the overall diversity of wildlife for this area.

Potential indirect impacts to these watercourses and wetlands could occur in the form of reduced water quality as a result of sedimentation during construction of commercial/industrial complexes, inadequate post-construction stormwater management, and acute pollution episodes from industrial activities. Without more detailed plans for future development, it is difficult to give specific recommendations to reduce these indirect wetland impacts.

The highly permeable nature of most of the upland soils found throughout this site, as well as the potential of this area as a groundwater supply, should require prohibiting those land-uses with the highest pollution potentials as well as stringent pollution prevention plans for any permissible land-uses. More detailed information on water quality/water supply issues can be found elsewhere in this report.

The prominence of the Shunock River and its floodplain necessitates a more detailed discussion of its characteristics and limits to development. The Shunock River is a principal source of flooding in North Stonington. The Federal Emergency Management Agency (FEMA) has studied the hydrology and hydraulics associated with this section of the river and has produced a Flood Insurance Study (FIS, 1985), Flood Insurance Rate Maps (FIRM) and Floodway maps (see Figure 12). The 100-year floodplain is delineated within the study and depicted along with the Regulatory Floodway on the mapping. FEMA has formulated use regulations (44 CFR 60.3) for development activities within these Special Flood Hazard Areas (SFHA). In order for North Stonington to remain eligible to participate in the National Flood Insurance Program (NFIP) it must maintain legally enforceable local regulations which equal or exceed the requirements of FEMA. To this end, the Town has adopted the "North Stonington, Connecticut, Flood Loss Reduction Ordinance."

Development may be allowed within the flood fringe if designed in accordance with FEMA standards (44 CFR 60.3) and the local ordinance. Development may not, however, be allowed within the regulatory floodway unless it can be demonstrated through hydraulic and hydrologic analysis, performed in accordance with standard engineering practices, that no (0.00) increase in flood heights will occur during the base flood (100-year) discharge.

The Floodplain crossing the site ranges from 150 feet to 800 feet in width. In general, the width of the Floodway changes proportionately with the width of the entire floodplain, leaving a very narrow developable flood fringe. From a public safety perspective, prudent design should avoid development of structures in the floodplain leaving it available for open space or recreational development. Since the primary transportation corridors are located around the perimeter of the study area and the floodplain is near its center, the site naturally lends itself to this type of planning. In addition to the public safety objective achieved by avoiding the floodplain, water

quality, flood storage, recreational opportunities, educational opportunities, habitat, and other environmental objectives may be enhanced.

Examination of a 1990 aerial photograph of the subject site indicates that an excavation operation has been in progress on the southeastern portion of the site. Significant excavation appears to have occurred within the floodplain. The map included in the existing land-use plan delineated a 100-year floodplain but gave no reference for the hydraulic study used to derive those elevations. Text within that report cites elevations that are far different than those found in the FEMA study as well as U.S.G.S. topography maps. It may be necessary to have this area of the site re-studied to produce mapping that more accurately depicts current site conditions. Should the existing access road be improved, it may be necessary to change certain floodplain characteristics, thereby further changing the delineation of the regulated areas under the National Flood Insurance Program. If these changes occur, it will further the necessity to restudy the area and apply to FEMA for a map revision.

Figure 11

WETLAND RESOURCES

N

Scale 1" = 1320

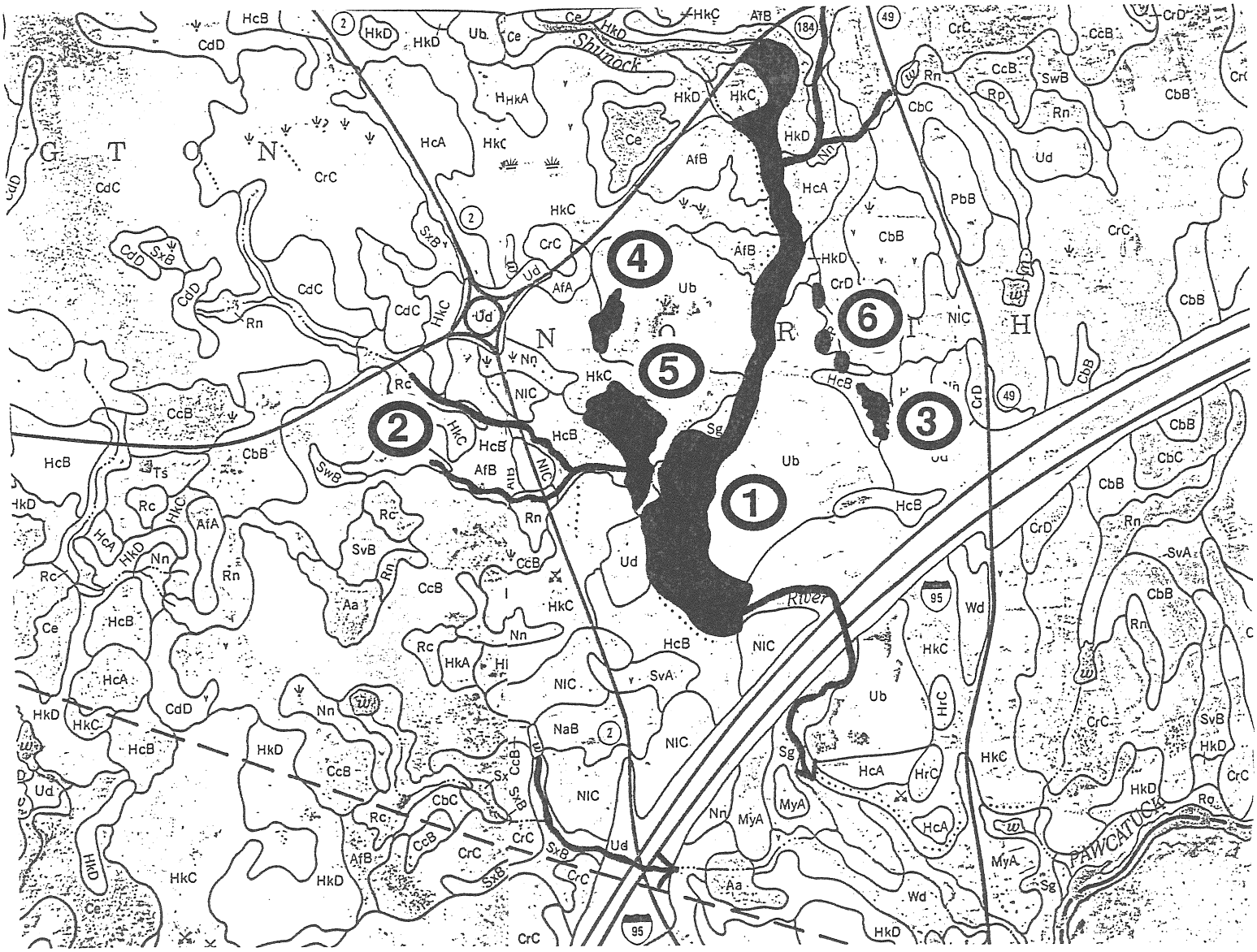


Figure 12

FEMA MAP

KEY TO MAP

500-Year Flood Boundary

100-Year Flood Boundary

FLOODWAY FRINGE

FLOODWAY

100-Year Flood Boundary

500-Year Flood Boundary

Approximate 100-Year Flood Boundary

Cross Section Line (A — A)

Elevation Reference Mark RM7 ×

River Mile • M1.5

NOTES TO USER

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

This map was prepared to facilitate flood plain management activities only; it may not show all special flood hazard areas in the community or all planimetric features outside of the flood plain. Refer to the latest official Flood Insurance Rate Map for any additional areas of special flood hazard.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

For adjoining map panels, see separately printed Index to Map Panels.

APPROXIMATE SCALE

400 0 400 FEET

Fisheries Resources

This section will document fisheries resources of importance in the project area, address potential impacts to these resources and delineate measures necessary to effectively mitigate impacts.

Fish Population

The Shunock River, a vital tributary of the Pawcatuck River, supports a coldwater fishery of significant recreational value. It is annually stocked by the DEP Fisheries Division with over 2,100 adult brook, brown, and rainbow trout at various locations in the Town of North Stonington. The river was last sampled adjacent to the Romanella Property on June 15, 1993. In addition to stocked trout, the survey documented the presence of a wild (naturally reproducing) population of brown trout and a native brook trout population, as well as a diverse mixture of resident finfish. Most dominant species were tessellated darter, American eel, white sucker, common shiner, and longnose dace. Less common species included fallfish, brown bullhead, bluegill, redbreast sunfish, pumpkinseed, chain pickerel, grass pickerel, yellow perch, and golden shiner.

The river also supports anadromous fish species. Anadromous fish runs of alewives, blueback herring, and sea-run brown trout can be expected.

The unnamed watercourse, tributary to the Shunock River which is conveyed under both CT Route 184 and CT Route 2 is not expected to support fish populations. Although it is indicated on the USGS Ashaway Quadrangle as a perennial watercourse, it appears to be more intermittent in nature.

Impacts

The following impacts to aquatic ecosystems can be expected if wise land use management practices are not implemented within the proposed area considered for development.

1. Depletion of stream flow in the Shunock River due to withdrawal of groundwaters.

The proposed use of the Romanella site by the City of Westerly, RI as an active site for withdrawal and diversion of groundwaters is an impact of most concern to the

Fisheries Division. Preliminary analysis by a consultant assumed under low flow conditions, 100% of the recharge to the wells is induced from the Shunock River. Given that the 7Q10 is 2.14 cfs (cubic feet per second) or 960 GPM (gallons per minute) , the proposed well withdrawal of 1,000 GPM would completely dry-up the river during 7Q10 flows. Flow reduction would severely alter fisheries through a complete loss of instream habitat. Riparian wetlands would also be degraded. Resident fishes would experience a "significant" reduction in the quantity and quality of instream habitat throughout the entire summer-early fall base flow period. Habitat loss can be directly correlated with a reduction in biomass, reduced species diversity, and reduced numbers of individual organisms. An indirect effect or reduced flows will be an increase in stream temperatures. Coldwater species such as trout are especially sensitive to increases in ambient stream temperatures.

2. Construction site soil erosion and sedimentation of streams through increased runoff from unvegetated areas.

Roadway widening, installation of sewer lines and commercial building development are all types of construction which can disturb topsoil. Disturbed soils are susceptible to runoff events, especially if erosion and sediment controls are not properly installed and maintained. Specifically, the following impacts to fisheries could be expected if erosion and sedimentation occurs:

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

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

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

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

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

opercular cavity and gill filaments.

(6) Sediment encourages the growth of filamentous algae and nuisance proportions of aquatic macrophytes. Eroded soils contain plant nutrients such as phosphorous and nitrogen. Once introduced into aquatic habitats, these nutrients function as fertilizers resulting in accelerated plant growth.

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

3. Aquatic habitat degradation due to the influx of stormwater drainage.

Development of the corridor will lead to an increased amount of impervious surfaces in the form of parking lots, new roadways and rooftops. Stormwaters can contain a variety of pollutants that are detrimental to aquatic ecosystems. Pollutants commonly found in stormwaters are: hydrocarbons (gasoline and oil), herbicides, heavy metals, road salt, fine silts, and coarse sediment. Nutrients in stormwater runoff can fertilize stream waters causing water quality degradation. In extreme situations, spilled petroleum based chemicals or other toxicants can result in partial or complete fishkills.

4. Transport of lawn fertilizers and chemicals.

Runoff and leaching of nutrients from fertilizers on lawns associated with commercial development will stimulate filamentous algae growth in streams and degrade water quality. Introduction of lawn herbicides can result in "fish kills" and overall water quality degradation. Rooted or floating aquatic vegetation may proliferate in slower moving stream reaches.

Recommendations

The following recommendations are provided to assist with the mitigation of the previously outlined impacts.

1. Minimum instream flow protection.

To ensure adequate stream flows in the Shunock River adjacent and downstream from the proposed water diversion, the Fisheries Division may request that an instantaneous minimum instream flow be utilized to protect and maintain resident finfish populations. The Division endorses a standard setting method, termed the New England Aquatic Based Flow Methodology developed by the U.S. Fish and

Wildlife Service. This methodology applies a minimum flow standard of 0.5 cubic feet per square mile (cfsm) of upstream watershed or project inflow, whichever is less. As an alternative to this flow regime, the City of Westerly, RI can conduct a comprehensive IFIM (Instream Flow Incremental Study) or similar approved fisheries habitat based study to quantify specific site flow requirements that will protect fisheries resources downstream of the diversion. The information generated from this study will be crucial in determining groundwater withdrawal rates that will not negatively impact fisheries resources.

2. It is highly recommended that a 100 foot riparian buffer be maintained along the Shunock River.

See DEP Fisheries Division policy on riparian corridor protection for specifics (found in Appendix B).

3. Develop an aggressive and effective erosion and sediment control plan for each development project.

Proper installation and maintenance of erosion/sediment controls is critical to environmental well being. This includes such mitigative measures as filter fabric barrier fences, staked hay bales, and sediment catch basins. Land disturbance and clearing should be kept to a minimum and all disturbed areas should be restabilized as soon as possible. Exposed, unvegetated areas should be protected from storm events. Proper installation and maintenance of controls is particularly important near the Shunock River and the unnamed tributary.

4. The effective management of stormwaters and roadway runoff can be accomplished through proper design, location, and maintenance practices.

Non-structural drainage design is encouraged where feasible rather than the use of standard closed systems which concentrate stormwaters (Refer to Stormwater BMP Fact Sheet, Appendix C). Stormwaters should be only be outletted into non-wetland habitat; thus avoiding direct contact with wetlands. Maintenance of catch basins is very critical. Roadway catch basins should be regularly maintained to minimize adverse impacts to riverine/wetland habitats. The use of road salt to deice roads should be minimized. Catch basins and plunge-pools will only trap heavy, coarse sediments reducing the likelihood of excessive stream sedimentation; however, waters that contain pollutants such as salts and even small amounts of fine enriched sediments will eventually cause water quality and aquatic habitat degradation. This impact can

not be prevented since catch basins will not effectively remove and renovate these materials.

5. Limit liming, fertilization, and the introduction of chemicals to lawns associated with commercial development.

This will help abate the amount of additional nutrients to aquatic resources. Non-phosphorus lawn fertilizers are currently available from various lawn care distribution centers.

Planning Considerations

The area under consideration is located in southeastern North Stonington north of the interchange of I-95 and CT Route 2. Traffic volumes on this section of CT Route 2 have increased considerably, reflecting a major access route to the Mashantucket Pequot Casino from the southeast direction. Existing land uses in the corridor are commercial, offices, low density residential, limited agriculture, and undeveloped. The CT Route 2 corridor area is depicted as Office/Research and the Shunock River corridor as Open Space in the North Stonington Plan of Development. The adopted Regional Development Plan depicts these areas as mixed suburban uses, which are a combination of economic and residential uses and an economic center. The Shunock valley is indicated as an aquifer and conservation area on the Regional Plan.

The basic zoning question is the broadening of permitted uses in the Office/Research zone to include more commercial uses such as retail and other uses which are permitted in the Commercial and Highway Commercial districts and are not currently permitted in the Office/Research district. With the distinct possibility of public sewer and water being extended through the corridor area, many of the physical site development restraints of intensive development are reduced. However, in order to avoid the area becoming a commercial strip with the accompanying traffic and aesthetic problems, several design ideas could be explored. Included among these are larger lot sizes and street frontages, utilization of frontage or service roads, shared parking lots with fewer driveway entrances onto CT Route 2 or service roads, deeper front yard setbacks (especially if the possibility exists that CT Route 2 could at some point be widened to four lanes), and landscaping/architectural treatments. Several surrounding towns have developed major commercial districts which incorporate these ideas. To help cope with the problems of strip development for instance, some commercial zones now require minimum five acre lot sizes and 500 feet of frontage on a street to help cope with the problems of strip development. Provision for reduced frontages can be made if frontage or service roads are utilized to provide access to adjacent state highways at a minimum number of points. These kinds of roads could be utilized in this corridor, and especially on the southern side of Route 2 where the depth of the Office/Research zone is 2000 feet and the land ownership is still in relatively large tracts. In terms of front yard setbacks, some communities now require up to 200 feet. As noted above, North Stonington should consider the future widening

of CT Route 2 in evaluating setback requirements. North Stonington's zoning regulations contain standards for buffers, landscaping, plantings, and architectural compatibility which are good and should be utilized for new developments in this CT Route 2 area. One downside to a broadening of permitted uses in the Office/Research zone is that potentially less land will remain for the basic office and research uses if these new uses are developed first.

A large and potentially restricting unknown is the utilization of a 44 acre tract of land owned by the City of Westerly, RI to the east of the Office/Research zone for a public water supply. Wells in this area will be located in stratified drift materials which means that their recharge areas will be subject to aquifer protection controls for both existing and proposed land uses. Depending on the number of wells developed and the finally mapped recharge areas which will have to be certified by the Connecticut Department of Environmental Protection, these areas could intersect the Office/Research zone, as well as other nearby zones such as the Industrial and R-60 Residential. The Office/Research zone currently extends to the easterly side of CT Route 2 for a depth of 1,200 feet. North Stonington currently has aquifer protection controls in its zoning regulations; however, these mapped areas might have to be altered to reflect the new recharge areas, and most likely the regulatory text will have to be changed to reflect the Department of Environmental Protection model aquifer protection regulations. North Stonington should review the proposed state regulations against its regulations to determine what changes should be made and the effect of these changes on uses currently permitted or intended for the Office/Research zone.

Traffic Planning

Development pressures have recently increased dramatically along CT Route 2 near the study area. Additional development in this area could adversely impact traffic flow in the corridor due to an increased number of driveways that access developed properties.

In an effort to control ingress/egress locations along CT Route 2 and CT Routes 49 and 184, it is suggested that the town develop an access management program which will regulate the access to, and improve traffic flow in the study area. An appropriate access management program should be developed prior to development. Some of the techniques that may be appropriate in this study area would include the follow:

- Exclusive turning lanes into developed sites
- Consolidation of access points (driveways)
- Frontage roads or access roads to take traffic off the arterial roadway
- Coordination of traffic signals
- Land use controls.

It should be noted that this is not a finite list. The type(s) of strategies that may be used depends on the specific site characteristics and on how the site is proposed to be developed. In light of these issues, it is recommended that the town hire a consultant with expertise in land use and traffic engineering to prepare a comprehensive access management program for this area.

Below are more detailed descriptions of some of the access management techniques.

The basic objective of Access Management is to preserve the integrity of arterial traffic while maintaining essential access to adjacent property. Problems arise when the spacing of driveways significantly impedes the flow of traffic on the arterial and causes congestion. An access management program attempts to modify or control access to improve the flow on the arterial. There is no single access management strategy, rather, access management encompasses a wide range of different strategies each intended to address a unique situation.

The list below is representative of the more common access management strategies. The following briefly describes the strategies and when it may be appropriate to use a particular strategy:

Exclusive Left Turn Lanes - The installation of left turn lanes at commercial and industrial site driveways separates turning traffic from through traffic. In this way through traffic is not impeded by turning vehicles and can continue without having to stop. Traffic flow is maintained. When the amount of left turning traffic is high, it may be appropriate to install dual-left turn lanes.

Exclusive Right Turn Lanes - In some cases the amount of traffic making a right turn into a commercial and industrial site driveway causes problems on the arterial street. Installing a right turn separates turning traffic from through traffic. In this way through traffic is not impeded by turning vehicles and can continue without having to stop. Traffic flow is maintained. When the amount of right turning traffic is high, it may be appropriate to install dual-right turn lanes.

Limit the Number of Site Driveways - Along sections of roads where the demand for commercial and industrial development is high, the town can ensure traffic flow on the arterial by simply limiting the number of driveways. The fewer the number, the less often through traffic will be impeded by vehicles turning into site driveways. It is also important to have adequate spacing between driveways. Closely spaced driveways reduces traffic flow and increases the potential for accidents.

Driveway Consolidation - The purpose of this strategy is the same as limiting the number of driveways. In this case, two or more adjacent parcels or developments would be allowed or required to consolidate their driveways. Instead of each having their own driveway, one driveway would serve all.

Construct Frontage Road or Single Access Road - A method to controlling access to the arterial street is to construct a parallel frontage road which serves to collect and distribute traffic to/from the arterial to adjacent development. The commercial and industrial developments would have access on the frontage road, not the arterial street. Similarly, a single access road could be constructed which again would provide access to adjacent developments from the arterial street. Site driveways would be located on the

access road not the arterial street.

Continuous Two-Way Left Turn Lane - In some cases where strip development is allowed or occurs and numerous driveways are present, access can be managed by constructing a continuous, two-way left turn lane in the center of the arterial street. All left turns are made from the center lane. The advantage of this lane is that through traffic can proceed without having to stop for turning traffic. Care must be exercised in the design of the center lane and it may not be appropriate in all situations. When the number of driveways is very high and interlocking left turns occur, the center lane concept may result in an unacceptable potential for accidents.

Median Divided Roadway - If a high number of driveways are located along both sides of the road and a high traffic volume is present, it may be appropriate to install a median down the center of the arterial roadway and prevent left turns. This concept limits access to adjacent property from the travel lanes next to it. Left turns are accommodated at major intersections. Reverse direction turns would be allowed. In cases where any turns would severely restrict traffic flow, all turns would be made from the right lane and via a connecting roadway to the intersecting street. This would be appropriate only when traffic volumes are very high and allowing left turns at the major intersection would severely impact the capacity of the intersection.

Traffic Signals - The installation of traffic signals would control the movement of traffic at site driveways or access roads. Traffic signals would be installed in conjunction with exclusive turn lanes. The timing and phasing of the signal would control when traffic could move and protect the movement of turning vehicles, that is, the left turn would be made while opposing through traffic is stopped.

Land Use and Zoning Controls - A key element in managing access is through the adoption of sufficient land and zoning regulations. Traffic flow on the arterial street is impeded by the number and frequency of driveways. The greater the number of driveways and the more often they occur, greatly reduces the ability of traffic to move through the area. A simple approach that can be adopted by the town is to require commercial and industrial development in office/industrial parks or shopping centers. These types of developments typically limit the number of driveways. By contrast, zoning regulations that allow or encourage strip developments usually result in many and closely spaced driveways.

Turn Prohibitions - These involve prohibiting certain movements in particular directions. The most common is prohibiting left turns from a driveway when it is close to an intersection or when the turning vehicle must cross several lanes of traffic. The amount of traffic is also a consideration. When traffic volumes are high, a left turning vehicle may have to wait a long time before an acceptable gap opens in the vehicle stream. If the driver becomes impatient, he/she may move when an acceptable gap is not present. This causes a slow down in the arterial traffic flow and increases the potential for accidents. Turn prohibitions may apply at all times or only during peak periods of traffic. The problem with turn prohibitions is that control does not involve physical barriers but instead is accomplished by signs. Motorists tend to ignore the signs and turn anyway. Therefore, enforcement becomes an issue.

Proper Driveway Design - Movement into and out of a site driveway should be properly designed. The design should clearly indicate desired paths; where vehicles should enter the site and where vehicles should exit. Lane widths and driveway widths should be sized to ensure "controlled" turning movements. In some cases, access to a site is uncontrolled and vehicles can move into and out of a site along a stretch of the arterial street. Movements become unpredictable and more random. As a result the accident potential increases. Curbing should be installed to define driveways and points of ingress and egress.

Archaeological Review

A review of the State of Connecticut Archaeological Site Files and Maps show two known prehistoric sites in the project area and two sites immediately adjacent. These sites represent Native American hunting and gathering camps, including a rockshelter site dating to 4,000 years ago. The extensive wetlands and the study area's proximity to Bell-Cedar Swamp combined with its location in the greater Pequot and Narragansett sphere of land use would suggest a high sensitivity for undiscovered Native American-related archaeological resources.

The OR Zone study area also includes the location of the John Randall House which is listed on the National Register of Historic Places. It is imperative that the rural ambience (i.e., mature tree species) which buffer this important historic property from the existing I-95 interchange be retained. Likewise, any proposed development in this area must be sensitively designed (i.e., building height limitations, retention of mature trees, etc.) to ensure the rural 18th century character of the John Randall House.

Union Cemetery is located on the eastern border of the study area. James Slater has identified the Union Burying Ground as being 19th century with only two 18th century stones. Slater characterizes the graveyard as "nicely located on high ground adjacent to a beautiful white steepled church." Similar design caveats as noted for the John Randall House would also pertain to these historic properties.

The Connecticut Historical Commission notes that the Town of North Stonington has not undertaken a comprehensive inventory of historic and architectural resources. The town should consider coordinating with the State Historic Preservation Office regarding grant assistance for a townwide survey.

The Office of the State Archaeology and the Connecticut Historical Commission recommend an archaeological reconnaissance survey for portions of the study area that will be proposed for land use activities. Archaeological site location is maintained as confidential information, however, as the OR Zone Land Use study proceeds the Office of State Archaeology and the Connecticut Historical Commission will be pleased to share this information to preserve the integrity of these cultural resources. The area to be surveyed should only include those that have not been previously disturbed from development projects. In addition, this archaeological survey should be conducted in

compliance with the Commission's *Environmental Review Primer for Connecticut's Archaeological Resources*. The Office of State Archaeology is prepared to offer any technical assistance to the Town of North Stonington in conducting this survey and in the preservation of its archaeological and historic resources.

APPENDIX A

APPENDIX 2

Appendix 2 is organized by Standard Industrial Classification (SIC) codes. These codes should only be used as a preliminary guide, as the classifications are often quite broad and may contain both high and low risk uses. The actual list of uses in Column 2 and activities in Column 5 is a more accurate indicator for whether a use should be banned or regulated.

	SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
1	N.A.	WASTE DISPOSAL	X		Act. - Leachate generation from waste disposal	Prohibit - Adopt AA ground
2		- SANITARY LANDFILLS	X			water quality classification
3		- SEPTAGE LAGOONS	X		Chem.- Numerous chemical constituents	of GAA for AOC and direct
4		- HAZARDOUS WASTE DISPOSAL	X			recharge area
5		- BULKY & SPECIAL WASTE DISPOSAL	X			
6		- SLUDGE DISPOSAL	X			
7		- WATER SOFTENER BRINES	X		Salt contamination.	Prohibit discharge to ground
8						
9		- STUMP DUMPS		R	Chem.- Modest natural organic leachate	Site Plan review, limited
10						to immediate property needs
11						
12	N.A.	SEPTIC SYSTEM DISCHARGE OF NON-	X		Act. - Discharge of non-biodegradable wastes	Prohibit - Adopt GAA ground
13		DOMESTIC WASTE			to groundwater.	water quality classification
14						of GAA for AOC and
15					Chem.- Persistent organics and inorganics.	recharge area.
16						educate citizens
17						
18	N.A.	UNDERGROUND LEACHING SYSTEMS FOR	X		Act. - Parking lot runoff leaching systems for	Prohibit - Prevent during
19		STORMWATER FROM LARGE PAVED			stormwater runoff management	Site Plan review process
20		HIGHWAYS AND PARKING AREAS			Chem.- Sodium chloride, benzine and other gas,	
21					oil, or other automotive chemicals,	
22					transportation spills	
23						
24	N.A.	FLOOR DRAINS	X		Act. - Illegal or inadvertant disposal of	Prohibit discharge to ground
25					various pollutants through dry wells or	allow floor drains where dis
26					septic systems.	charge is connected to public
27						sewers or part of a DEC regu
28					Chem.- Organics and inorganic contaminants	lated treatment system
29						
30	N.A	WASTE PROCESSING SYSTEMS		R	Act. - Spills, leaks and possible leachate	Require - design considera-
31		RESOURCE RECOVERY FACILITIES FOR			from storage and processing of wastes.	tions for waste and process
32		MUNICIPAL SANITARY WASTES			Chem.- Potential organic & inorganic	material storage and handling
33		SOLID WASTE TRANSFER STATION			contaminants.	
34		RECYCLING PROCESSING CENTERS				
35		- SEWAGE TREATMENT PLANTS & ASSOC				Plans for increased inspection
36		FACILITIES, INCL. PUMP STA.				tions, spill response plans
37						
38	N.A.	UNDERGROUND STORAGE OR TRANSMISSION	X		Act. - Tank, pipeline or joint leaks or breaks	Prohibit
39		OF LIQUID FUELS AND HAZARDOUS				
40		CHEMICALS			Chem.- Liquid fuels, hazardous materials	
41		- UNDERGROUND STORAGE TANKS	X			
42		- UNDERGROUND DISTRIBUTION SYSTEMS	X			
43		- LIQUID FUEL PIPELINES	X			
44						
45	N.A.	OUTDOOR, UNPROTECTED STORAGE OF	X		Act. - Exposure of materials to precipitation,	Require indoor storage or
46		COMMERCIAL, INDUSTRIAL OR INSTITU-			and subsequent generation of leachate:	special safeguards against
47		TIONAL CHEMICAL PRODUCTS OR WASTES			spills; leaks; accidents	spills, or special out
48		ABOVE GROUND			Chem.- Various organic and inorganic contam.	protection measures
49						
50	N.A.	STORAGE OF GASOLINE, DIESEL AND		R	Act. - Leaks, drips, tank ruptures	Prohibit permanent gas tanks
51		FUEL OIL			Chem.- Hydrocarbons, benzene and other contam.	Diesel & Fuel Oil - inside
52						storage or special outdoor
53						above ground protection
54						measures required
55						
56	82xx	EDUCATIONAL FACILITIES				
57		- ELEMENTARY & SECONDARY SCHOOLS		R	Chemistry/physics/biology labs, automotive	Site Plan review, spill
58		- COLLEGES AND UNIVERSITIES		R	repair shops, industrial arts, hazardous	prevention plans, material
59		- JUNIOR COLLEGES		R	material storage and use, school, lab, and	storage and waste management
60		- VOCATIONAL SCHOOLS		R	shop wastes.	

	SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
61						
62	N.A.	PRISONS		R	Similar to educational facilities - see above	Site Plan review see above.
63						
64	N.A.	ROAD SALT STORAGE	X		Act. - Stockpiling of road salt for de-icing of roads and parking areas.	Prohibit
65						
66					Chem.- Sodium chloride, de-caking agents	
67						
68	N.A.	MUNICIPAL & STATE GARAGES FOR HIGHWAY & PUBLIC WORKS DEPARTMENTS	X		Act. - Road maintenace related equipment storage and maintenance, fuel storage.	Prohibit
69						
70					Chem.- Cleaning solvents, hydrocarbons, pesticides, and other organic chemicals.	
71						
72						
73	N.A.	ROADS, TRANSPORTATION CORRIDORS, INSTITUTIONAL, COMMERCIAL OR INDUSTRIAL PARKING AREAS		R	Act. - De-icing, highway runoff, drainage systems transportation spills/accidents.	Restrict use of sodium chl.
74						
75					Chem.- Sodium chloride, hydrocarbons, hazardous materials.	Design review - greater environmental safeguards
76						
77						
78	N.A.	AIRPORTS	X		Act. - De-icing, maintenace of aircraft and equipment, fuel storage & distribution.	Prohibit.
79						
80					Chem.- Hydrocarbons, solvents, waste oils, de-icing chemicals, and other wastes.	
81						
82						
83	15xx-17xx	CONSTRUCTION			Act. - Fuel, Vehicle Storage & Maintenance.	Management plan for vehicle refueling and maintenance and spill response
84		- HIGHWAY AND STREET CONSTRUCTION		R		
85		- BRIDGE, TUNNEL, ELEVATED HIGHWAY		R	Chem.- Hydrocarbons, cleaning agents	
86		- WATER, SEWER, AND UTILITY LINES		R		
87		- HEAVY CONSTRUCTION, NEC		R		
88						
89	01xx	AGRICULTURAL PRODUCTION - CROPS		R	Act. - Pesticide/Fertilizer Storage and Application	Farm Resource Management Plan
90						
91						
92					Chem.- Nitrates and certain pesticides such as EDB that can leach into ground water.	
93						
94						
95	02xx	AGRICULTURAL PRODUCTION - LIVESTOCK		R	Act. Animal Waste Management.	Farm Resource Management Plan
96						
97					Chem.- Nitrates	
98						
99	07xx	AGRICULTURAL SERVICES			Act. - Disposal of medical wastes, use of pesticides	Site Plan Review to address storage and disposal of pesticides and medical waste.
100		- VETERINARY SERVICES, LIVESTOCK		R		
101		- VETERINARY SERVICES, SPECIALTIES		R	Chem.- Pharmaceutical chemicals, pesticides, alcohols	
102						
103						
104	10xx-14xx	MINING ACTIVITIES		R	Act. - Fuel, Vehicle Storage & Maintenance.	Management plan for vehicle refuel/maint./spill response
105						
106					Chem.- Hydrocarbons, cleaning solvents	
107						
108	20xx	FOOD AND KINDRED PRODUCTS		R	Act. - Raw material storage, processing wastes	Site plan review & management Plan for hazardous materials
109						
110					Chem.- Nitrogenous wastes, preservatives	
111						
112	22xx	TEXTILE MILL PRODUCTION			Act. - Storage and use of hazardous materials, equipment cleaning, and hazardous wastes.	Prohibit listed uses
113		- DYEING	X			
114		- TANNING	X			
115		- TEXTILE COATING	X			
116		- FABRIC PRINTING	X		Chem.- Strong acids and alkalies, solvents, metals and hydrocarbons	
117						Site plan review & management Plan for critical chemicals
118		* ALL OTHER TEXTILE PRODUCTION *		R		
119						
120	23xx	APPAREL AND OTHER TEXTILE PRODUCTS			Act. - Storage and use of hazardous materials.	Prohibit banned uses.

	SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
121		- DYEING	X		equipment cleaning, and hazardous	
122		- TANNING	X		wastes.	
123		- TEXTILE/APPAREL COATING	X			
124		- FABRIC/APPAREL PRINTING	X		Chem.- Strong acids and alkalies, solvents,	
125					metals and hydrocarbons	Site Plan review & management
126		* ALL OTHER APPAREL PRODUCTION *		R		plan for critical chemicals
127						
128	24xx	LUMBER AND WOOD PRODUCTION			Act. - Chemical treatment of wood, chemical	Prohibit banned uses.
129		- HARDWOOD VENEER AND PLYWOOD	X		storage	
130		- SOFTWOOD VENEER AND PLYWOOD	X			
131		- WOOD PRESERVING	X		Chem.- creosotes, tars, trichlorophenol,	
132		- RECONSTITUTED WOOD PRODUCTS	X		pentachlophenol, metals, solvents, oils	
133						
134		* ALL OTHER ACTIVITIES *		R		Site Plan review
135						
136		WOOD HOUSEHOLD FURNITURE		R	Act. - Painting and finishing of wood, clean-	Site Plan review hazardous
137					ing and maintenace of equipment.	material and waste material
138						management plan.
139					Chem.- Solvents, preservatives, paint wastes	
140						
141	26xx	PAPER AND ALLIED PRODUCTS			Act. - Storage and use of hazardous and non	Prohibit listed activities
142		- PULP & PAPER MANUFACTURING	X		hazardous materials, large quantities	
143					of waste generation.	
144		* ALL OTHER ACTIVITIES *		R		Site Plan review hazardous
145					Chem.- Toxic organic and inorganic chemicals	material and waste material
146					metals, chlorinated hydrocarbons	management plan
147						
148	27xx	PRINTING AND PUBLISHING			Act. - Storage and use of organic chemicals,	Prohibit banned uses
149		* INCLUDING PLATE MAKING, COMM'L	X		equipment cleaning, engraving	
150		LITHOGRAPHIC, PHOTENGRAVING				
151		COMMERICAL PRINTING, GRAVURE			Chem.- Chlorinated solvents, phenols,	
152					hydrocarbon compounds	
153		* ALL OTHER ACTIVITIES *		R		Site Plan review, hazardous
154						materials, fuels, and waste
155						management plan
156						
157	28xx	CHEMICALS AND ALLIED PRODUCTS	X		Act. - Storage, use & production of chemicals,	Prohibit.
158					equipment cleaning and maintenance,	
159					hazardous waste generation.	
160						
161					Chem.- Organic and inorganic chemicals.	
162						
163	29xx	PETROLEUM AND COAL PRODUCTS	X		Act. - Storage & use of fossil fuels, machine	Prohibit
164					shops, equipment cleaning & maintenance	
165						
166					Chem.- Hydrocarbons, solvents	
167						
168	30xx	RUBBER AND MISC. PLASTIC PRODUCTS			Act. - Raw material storage, process hazardous	Prohibit banned uses
169		- RUBBER MANUFACTURING, E.G.	X		waste generation, machine shops	
170		FABRIC COATING, ELASTOMER AND				
171		RESIN CEMENTS, TIRES AND TUBES			Chem.- Waste oils, solvents, phenols	
172					strong organic and inorganic wastes	
173		* ALL OTHER ACTIVITIES *		R		Site Plan review hazardous
174						material and waste material
175						management plan.
176						
177	31xx	LEATHER AND LEATHER PRODUCTS			Act. - Storage and use of toxic chemicals	Prohibit.
178		- LEATHER TANNING AND FINISHING	X			
179					Chem.- Strong acids and alkalies	
180		* ALL OTHER ACTIVITIES *		R		

SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
32xx	STONE, CLAY AND GLASS PRODUCTS - GLASS MIRRORS, COATING	X		Act. - Machine shops, chemical processes for mirror and coating manufacturing	Prohibit banned uses.
	* ALL OTHER ACTIVITIES *		R	Chem.- Strong acids and alkalies	Site plan approval.
33xx	PRIMARY METAL INDUSTRIES	X		Act. - Foundaries, metal forming, machine shops, equipment cleaning & maintenance use and storage of fuels, hazardous and non hazardous waste generation. Chem.- Strong acids and alkalies, metals, chlorinated solvents, cyanides, waste oils	Prohibit.
34xx	FABRICATED METAL PRODUCTS * METAL PLATING OR CLEANING, ETCHING, AND DEGREASING	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops	Prohibit banned uses.
	* ALL OTHER ACTIVITIES *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, paint and thinner wastes, cyanides	Site Plan review, hazardous materials, fuels, and waste management plan.
35xx	INDUSTRIAL MACHINERY & EQUIPMENT * METAL PLATING OR CLEANING, ETCHING, DEGREASING, AND CONTRACT MACHINE SHOPS.	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops	Prohibit banned uses.
	* ALL OTHER ACTIVITIES *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, paint and thinner wastes, waste oils	Site Plan review, hazardous materials, fuels and waste waste management plan
36xx	ELECTRONIC & OTHER ELEC. EQUIP. * METAL PLATING OR CLEANING, ETCHING, AND DEGREASING	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops	Prohibit banned uses
	* ALL OTHER FABRICATION ACT. *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, paint and thinner wastes	Site Plan review, hazardous materials, fuels, and waste waste management plan
37xx	TRANSPORTATION & OTHER ELEC EQUIP. * METAL PLATING OR CLEANING, ETCHING, AND DEGREASING	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops	Prohibit banned uses
	* ALL OTHER ACTIVITIES *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, phenols, PCB's, cyanides	Site Plan review, hazardous materials, fuels, and waste management plan.
38xx	INSTRUMENTS & RELATED PRODUCTS * METAL PLATING OR CLEANING, ETCHING, AND DEGREASING	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops	Prohibit banned uses
	* ALL OTHER ACTIVITIES *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, oils	Site Plan review, hazardous materials, fuels, and waste management plan.
39xx	MISCELLANEOUS MANUFACTURING IND. * METAL PLATING OR CLEANING,	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment	Prohibit banned uses

	SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
241		ETCHING, AND DEGREASING			cleaning and maintenance, machine shops	
242						
243		* ALL OTHER ACTIVITIES *		R	Chem.- Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, oils	Site Plan review, hazardous materials, fuels, and waste management plan.
244						
245						
246						
247						
248	N.A.	MACHINE OR MAINTENACE SHOPS AS A		R	Act. - Accidental or illegal discharge of cleaning solvents and waste oils.	Site Plan Review - hazardous
249		SUPPORT ACTIVITY (no contract work)				material storage and use,
250					Chem.- Solvents, waste oils	waste handling, records of
251						waste material management,
252						spill control plan
253						
254	40xx-49xx	TRANSPORT; COMMUNICATIONS; UTILITY				
255		- TRANSPORTATION SYSTEMS MAINTEN.	X		Fuel storage/distribution, solvents, waste oil	Prohibit banned uses.
256		- CRUDE PETROLEUM PIPELINES	X		Hydrocarbon contamination.	
257		- REFINED PETROLEUM PIPELINES	X		Hydrocarbon contamination.	
258						
259		- FOSSIL FUEL POWER PLANTS	X		Risks asso. with fuels stor./use, large quan-	Prohibit.
260					tities of waste generation, machine shops,	
261					equipment maintenance.	
262						
263		- ELECTRIC SERVICES		R		
264		- ELECTRIC & OTHER SERVICE COMB.		R		Site Plan review, hazardous
265		- COMBINATION UTILITIES, NEC		R		materials, fuels, and waste
266						management plan.
267		- SEWERAGE SYSTEMS		R	Leaky pipes - exfiltration of contaminants	
268						Require Watershed equivalent
269						pipe specifications in AOC.
270	50xx-51xx	WHOLESALE TRADE				
271		- COAL AND OTHER MINERALS & ORES	X		Large volumes of various materials and	Prohibit banned uses.
272		- METAL & AUTO PARTS SALVAGE	X		products handled, stored and distributed that	
273		- CHEMICALS & ALLIED PRODUCTS, NEC	X		might contaminate groundwater as a result of	
274		- PETRO. BULK STATIONS/TERMINALS	X		accidents, poor management practices, flooding	
275		- PETROLEUM PRODUCTS, NEC	X		or fires. Solvents, organic and inorganic	
276		- PAINTS, VARNISHES & SUPPLIES	X		chemicals, and hydrocarbon contamination	
277					threats.	
278		* ALL OTHER WHOLESALE TRADE *		R		Site Plan Review
279						
280	52xx-59xx	RETAIL TRADE				
281		- NEW OR USED CAR DEALERS	X		Act. - Maintenance and repair of vehicles, use	Prohibit banned uses (ideal),
282		- GASOLINE SERVICE STATIONS	X		of solvents, lubricants, paints, brake,	or prohibit those activities
283		- BOAT DEALERS	X		and transmission fluids, generation of	and chemicals of concern.
284		- RECREATIONAL VEHICLE DEALERS	X		waste oils, hazardous and non-hazardous	
285		- MOTORCYCLE DEALERS	X		wastes.	
286		- OTHER AUTOMOTIVE DEALERS	X		Chem.- hydrocarbons, solvents, benzene, waste	
287		- FUEL OIL DEALERS	X		oil and other organic chemicals.	
288						
289		- LUMBER & OTHER BLDG. MATERIALS		R		
290		- PAINT, GLASS & WALLPAPER STORES		R		Site Plan review.
291		- HARDWARE STORES		R		Special storage provisions,
292		- RETAIL NURSERIES AND GARDENS		R		no dry wells or floor drains
293		- MOBILE HOME DEALERS		R		
294		- DEPARTMENT STORES		R		
295		- AUTO AND HOME SUPPLY STORES		R		
296		- OTHER FUEL DEALERS		R		
297						
298						
299	70xx-89xx	SERVICES				
300						

	SIC NUMBER	LAND USES OF CONCERN	BAN	REG	ACTIVITY/CHEMICAL CONCERN	RECOMMENDATION
301		PERSONAL OR BUSINESS SERVICES				Prohibit banned uses.
302		- DRY CLEANING PLANTS, EXCEPT RUG	X		Dry cleaning solvents, storage, use, disposal.	
303		- INDUSTRIAL LAUNDERERS	X		Industrial strength cleaning solvents/agents.	
304		- LAWN CARE BUSINESS	X		Storage & mixing of chemicals, equip. cleaning	
305		- HEAVY CONSTRUCTION EQUIP RENTAL	X		Heavy equipment fueling and maintenance.	
306						
307		- POWER LAUNDRIES (FAM./COMM'L.)		R	Chemicals & wastes associated with service,	Site plan review, require
308		- COIN OPERATED LAUNDRIES/CLEANING		R	e.g. chlorinated solvents and hydrocarbons.	connection to public sewers.
309		- BEAUTY SHOPS		R		
310		- FUNERAL SERVICE & CREMATORIES		R		
311		- PHOTOFINISHING LABORATORIES		R		
312						
313		- PHARMACIES		R	Waste management, secondary services.	Site Plan review.
314						
315	75xx	AUTOMOTIVE SERVICES:			Act. - Fuel storage, use and storage of oils,	Prohibit banned uses.
316		- TOP AND BODY REPAIR/PAINT SHOPS	X		paints, thinners, various solvents,	
317		- AUTO EXHAUST SYSTEM REPAIR SHOPS	X		brake and transmission fluids.	
318		- TIRE RETREADING AND REPAIR SHOPS	X			
319		- AUTOMOTIVE TRANSMISSION REPAIR	X		Chem.- hydrocarbons, solvents, benzene	
320		- GENERAL AUTOMOTIVE REPAIR SHOPS	X			
321		- OTHER AUTOMOTIVE REPAIR SHOPS	X			
322		- RADIATOR REPAIR	X			
323						
324		- OTHER AUTOMOTIVE SERVICES	?	R		Evaluate case by case.
325		- TRUCK RENTAL & LEASING, NO SERV.		R		Prohibit vehicle engine ser-
326		- PASSENGER CAR RENTAL		R		vicing and repair, require
327		- PASSENGER CAR LEASING		R		Site Plan review.
328		- UTILITY TRAILER RENTAL		R		
329		- AUTOMOTIVE GLASS REPLACEMENT		R		
330		- CAR WASHES		R		
331						
332	76xx	MISCELLANEOUS REPAIR SERVICES:			General use of cleaning solvents, hazardous	Prohibit banned uses.
333		- FURNITURE STRIPPING	X		materials, methylene chloride	
334		- ARMATURE REWINDING SHOPS	X			
335		- MARINE SERVICE AND REPAIR	X			
336						
337		- RADIO AND TELEVISION REPAIR		R	Cleaning, lubricating and regeneration of	Site Plan review, mngmt plan
338		- REFRIGERATION SERVICE & REPAIR		R	equipment and parts. Solvents, oils and other	for storage and use of
339		- OTHER ELECTRICAL REPAIR SHOPS		R	materials.	hazardous materials, waste
340		- REUPHOLSTERY & FURNITURE REPAIR		R		oil and hazardous waste mngnt
341						
342	8xxx	HEALTH/MISC. SERVICES:			Miscellaneous spills, leaks, illegal dis-	Site Plan review, regulate
343					charges, hazardous material storage, use, con-	to provide for spill preven-
344					tainer disposal, lawn care including use of	tion, proper waste handling,
345					fertilizers and pesticide use, hazardous and	storage and disposal
346					non-hazardous waste disposal.	
347		- HEALTH SERVICES		R		
348						
349		- BIOLOGICAL OR CHEMICAL RESEARCH	X		Laboratory chemicals and waste materials.	- Prohibit
350						
351		- TESTING LABORATORIES		R	Laboratory chemicals and waste materials.	- Spill prevention plans
352						connect to public sewers
353						
354		- GOLF COURSES		R	Act. - Lawn care including storage/use of	Mngmt Plan for lawn care,
355					fertilizers and pesticides, equipment	fertilizer/pesticide storage,
356					maintenance, and waste management.	equipment maintenance, waste
357					Chem.- pesticides/nitrates, waste oils,	management.
358					hydrocarbons	
359						

APPENDIX 3 - POSSIBLE REGULATORY APPROACHES

THE TYPES OF REGULATIONS THAT MAY BE NEEDED TO REDUCE THE THREATS OF GROUND WATER CONTAMINATION ARE LISTED BELOW.

REGULATIONS FOR NEW USES ONLY

REQUIRE CERTAIN FACILITIES TO BE CONNECTED TO PUBLIC SEWERS

SPECIAL EQUIPMENT SPECIFICATIONS, E.G. SEWER EXFILTRATION RATES

SITE PLAN REVIEW - ALL NEW DEVELOPMENT EXCEPT SINGLE LOT RESIDENTIAL

PROHIBITION OF NEW UNDERGROUND FUEL AND CHEMICAL STORAGE

REGULATIONS FOR BOTH NEW USES AND NON-CONFORMING USES

PROHIBITION OF ALL NON DOMESTIC WASTEWATER TYPE DISCHARGES TO GROUNDWATERS

PROHIBITION OF DRY WELLS

OUTSIDE STORAGE REQUIREMENTS

STORMWATER MANAGEMENT PLAN

PROHIBITION OF CERTAIN CHEMICALS, e.g. certain pesticides, others?

MATERIALS MANAGEMENT PLAN (SARA TITLE III MODEL?), INCLUDE:
- HAZARDOUS MATERIALS OR SUBSTANCES - STORAGE, TRANSPORT AND USE
- HAZARDOUS AND NONHAZARDOUS WASTE MANAGEMENT, HANDLING AND DISPOSAL
- RECORDS KEEPING REQUIREMENTS
- EMERGENCY SPILL RESPONSE
- FIRE PROTECTION AND RESPONSE

RESOURCE MANAGEMENT PLAN (see Agriculture Matrix)

CONSTRUCTION RELATED EQUIPMENT FUELING AND MAINTENANCE REQUIREMENTS

REGULATIONS FOR NON-CONFORMING USES ONLY

REGULATION OF EXISTING UNDERGROUND FUEL AND CHEMICAL STORAGE

GROUND-WATER MONITORING

APPENDIX B

DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND FISHERIES DIVISION

POLICY STATEMENT
RIPARIAN CORRIDOR PROTECTION

I. INTRODUCTION, GOALS, AND OBJECTIVE

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

Goals

Maintain Biologically Diverse Stream and Riparian Ecosystems, and

Maintain and Improve Stream Water Quality and Water Quantity.

Objective

Establish Uniform Riparian Corridor Buffer Zone Guidelines.

II. DEFINITIONS

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

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

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

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

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

III. RIPARIAN FUNCTION

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

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

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

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

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

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

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

IV. RIPARIAN CORRIDOR BUFFER ZONE GUIDELINES

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

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

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

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

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

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

12/13/91
Date

James C. Moulton
Acting Director

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

BY
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I. INTRODUCTION

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

II. STANDARD SETTING VERSUS SITE SPECIFIC BUFFER ZONES

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

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

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

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

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

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

III. RIPARIAN FUNCTION

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

Sediment Control

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

Temperature Control

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

Nutrient Removal

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

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

Large Woody Debris

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

Food Supply

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

Streamflow Maintenance

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

IV. OTHER POLICY CONSIDERATIONS

Measurement Determination

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

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

Home Rule

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

Allowable Uses in Buffer Zones

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

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

V. CONCLUSIONS

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

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

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

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APPENDIX C

The Land Management Project • Land Use and Water Quality Series

Stormwater Best Management Practices

THE LAND MANAGEMENT PROJECT

Best Management Practices Fact Sheet No. 1 • September 1990

The Problem

Stormwater runoff is simply the water that results from and occurs after a rainfall event. Stormwater becomes a management problem when natural lands are converted to other land uses, especially those involving paving or use of fertilizers and pesticides. Rainfall washes pollutants from impervious surfaces directly to water resources and causes chemicals to "leach" from turf.

"Natural" engineering techniques or Best Management Practices (BMPs) should be used to preserve and enhance the natural features and pollutant "treatment" processes of a site. The volume, rate, timing, and pollutant load of stormwater after development should closely approximate the conditions which occurred before development. A comprehensive stormwater management system provides flood protection, water quality protection, and erosion and sedimentation control. It is much easier and less expensive to prevent stormwater management problems through sound site planning and design than to correct them.

Key Findings:

- The pollutant removal capability of a BMP is primarily governed by three interrelated factors: the removal mechanisms used, the fraction of the annual runoff volume that is effectively treated, and the nature of the urban pollutant being removed.

- As a result of thoughful design, regular maintenance, and creative landscape planting, environmental and human amenities can be provided by BMPs.

- Developing areas offer the greatest potential for utilizing a full range of structural and non-structural BMPs, and provide the opportunity to reduce more future pollutant loadings for less cost.

- BMPs are designed to address site-specific problems, but often work best in a series, as part of a coordinated watershed master plan.

BMPs

Best Management Practices (BMPs) are nonstructural and low-structural practices or combinations of practices that are determined to be the most effective, practical means of preventing or reducing pollution inputs from nonpoint sources (e.g. stormwater runoff, pesticide and nutrient leaching, and construction and development practices) in order to achieve water quality goals. Improving quality and controlling the quantity of runoff to receiving groundwater and surface water is a common purpose among these primarily preventative practices.

BMPs are often "peak-shaving" devices, that is, they control post-development peak floodwater discharge rates to pre-development levels be providing temporary detention/storage time. To treat pollutants, BMPs can operate to infiltrate water, can allow sediment to settle out or can accomodate plant uptake or chemical transformation. The selection of BMPs should be based on: type of land use activity, physical conditions in the watershed, pollutants to be controlled, and site-specific conditions.

Types of BMPs

structural - practices that are aimed at controlling the volume and discharge rate of runoff from urban areas, as well as reducing the magnitude of pollutants in the discharge water. Examples include: wet basins, extended detention wet and dry basins, artificial wetlands, infiltration devices, sediment basins, swales, buffers, and pervious pavement.

nonstructural - measures which minimize the accumulation of pollutants on the land surface and in the atmosphere during periods when rainstorms are not occurring (reduction before transport in stormwater). Examples include: land use and site planning techniques, protection of natural buffer areas, fertilizer management, cleaning catch basins, vaccuum street sweeping, and other "good housekeeping" techniques.

erosion and sediment controls - practices that can be used to prevent transport of eroded material or soil in runoff, particularly from construction and other land disturbing activities. Examples include: road stabilization, sediment barriers, sediment traps and basins, and temporary vegetation. Cost-effectiveness for such practices is often measured in cost per ton of reduced soil erosion.

Definitions

retention - the holding of runoff in a basin without release except by means of evaporation, infiltration and emergency bypass. Physical, chemical and biological treatment processes can take place in the permanent pool.

detention - the temporary storage of storm runoff in a BMP in order to control the peak discharge rates, and to provide gravity settling of pollutants.

infiltration - the downward movement of water from the surface to the subsoil (expressed as inches/hour). Infiltration reduces the volume of rainwater discharged as runoff and allows for treatment within the soil.

detention time - the amount of time a parcel of water actually is present in a BMP. Hours can vary from 6 to 60, depending upon flood protection and water quality goals.

first flush - the runoff delivered to water courses during the earliest part of a storm. This runoff carries roughly 90% of all stormwater-borne pollutants. Often, BMPs are designed to hold this "first flush" for treatment.

Design Considerations

- pollutant removal efficiency
- site conditions
- cost effectiveness
- public safety
- aesthetics
- ease of maintenance (access)
- surrounding land uses
- available land area
- effectiveness in series
- depth to groundwater
- slope/soil conditions (e.g. infiltration rate, organic content)
- proximity to sensitive resources
- wildlife habitat

Maintenance

Like other pollution control devices, BMPs can only continue to be effective if they are installed properly, and regularly inspected and maintained. Maintenance tasks for most BMPs include both low-cost routine tasks, such as mowing and trash removal, and more expensive non-routine tasks, such as rehabilitation or sediment removal. Maintenance costs for BMPs can be significant. For example, capital costs for most structural flood storage devices range from $100 to $1000 per acre served and annual operation and maintenance costs range from $10 to $125 per acre served, depending on site conditions (EPA, 1988).

In most cases, the maintenance burden of a BMP depends primarily on the initial design and construction of the facility (Schueler, 1987). If maintenance requirements are addressed during the design and construction phases and a maintenance plan is implemented, both the scope and cost of future maintenance activities can be sharply reduced. Regional BMPs can offer significant economies of scale in terms of both capital investment and maintenance.

Pollutant Removal Benefits

(Depending on site-specific conditions)

BMP	*Suspended Sediments*	*Phosphorous*	*Nitrogen*	*Trace Metals*	*Organic Matter*	*Hydrocarbons*
grassed swale	0-40%	0-20%	0-20%	0-20%	0-20%	0-20%
wet pond	50-100%	40-80%	20-50%	30-50%	20-40%	60-70%
ext. detention dry basin	50-100%	40-50%	40%	50-90%	30-50%	60-70%
vegetated buffer	0-40%	0-20%	20-99%	0-99%	0-20%	0-20%
infiltration basin	75-90%	50-75%	45-70%	75-99%	70-90%	60-80%

Source: Schueler, 1987

The Land Management Project assists towns in water quality -related issues. For more information on this and other topics, contact the Land Management Project at 83 Park St., Providence, RI 02903, or telephone (401) 277-3434.

For more information on specific BMPs, consult the Land Management Project's Best Management Practices Fact Sheet Series.

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ABOUT THE TEAM

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

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

PURPOSE OF THE TEAM

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

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

REQUESTING A REVIEW

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

For additional information and request forms regarding the Environmental Review Team please contact the ERT Coordinator: 203-345-3977, Eastern Connecticut RC&D Area, P.O. Box 70, Haddam, Connecticut 06438.