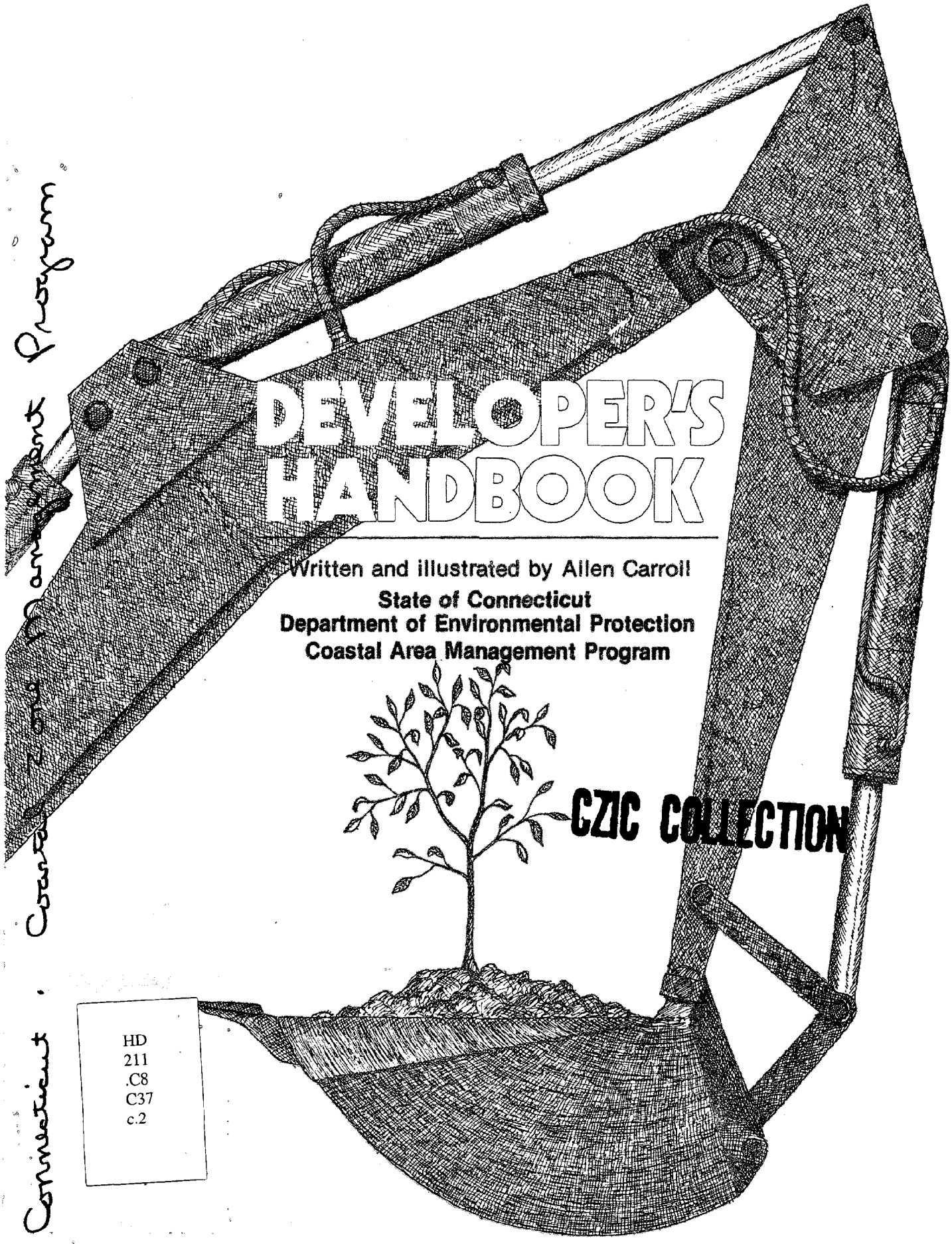
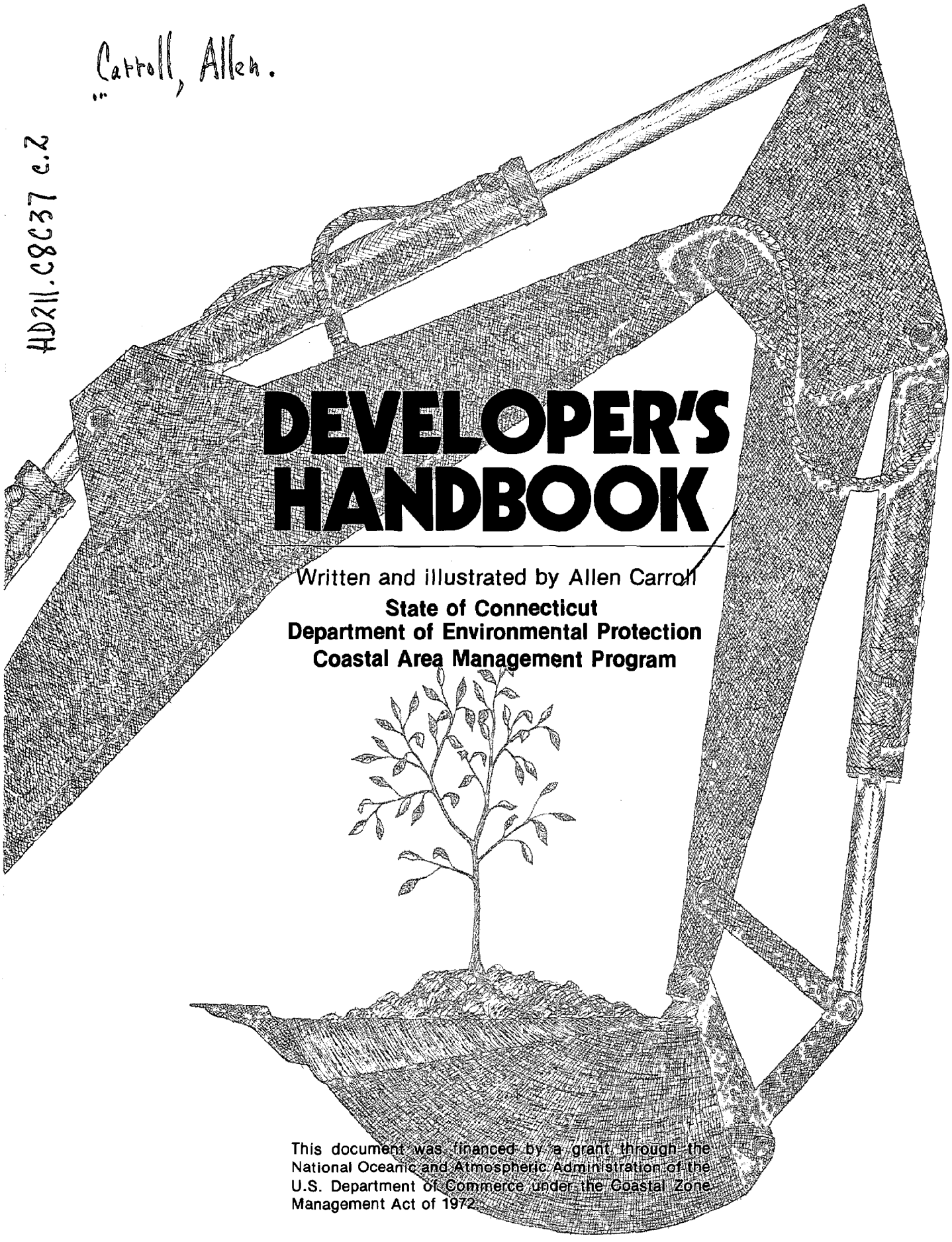


DEVELOPER'S HANDBOOK

Written and illustrated by Allen Carroll

State of Connecticut
Department of Environmental Protection
Coastal Area Management Program



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This document was financed by a grant through the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce under the Coastal Zone Management Act of 1972.

Table of contents

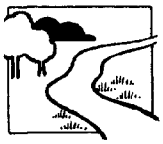
Introduction

The State of Connecticut, primarily through the Department of Environmental Protection, administers a large number of environmental laws and regulations covering such diverse areas as dredging, filling, burning and polluting. There are permit programs for each of these activities, and each permit program has its own requirements for applications, plans, public notices and public hearings.

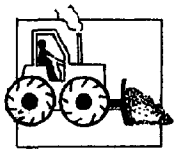
Even though these programs are important to maintaining environmental quality, it is understandable that many citizens — especially developers — have become confused by the maze of legal requirements. **The Developers' Handbook** is designed to help make the legal maze more manageable and to provide some basic information and advice on subdivision planning. The major natural systems and resources are briefly explained, and the opportunities and limitations they impose on development are summarized. In Chapter 4, a system of evaluating the characteristics of potential development sites is outlined. The Handbook also covers each of the regulatory programs at DEP with which developers may have to concern themselves.

It is hoped that this information, presented in a non-technical, graphic format, will help developers avoid expensive corrective measures and equally costly delays in obtaining permits.

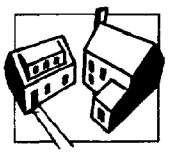
Chapters 2, 3 and 4 contain several pages of sketches with accompanying paragraphs explaining subdivision design and construction practices. On these pages, the drawings on the left represent improper methods of development that often result in environmental problems; those on the right illustrate recommended development practices. The symbols at the top of these pages are intended as a reference guide. The six symbols are:



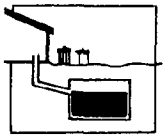
Environmentally sensitive areas



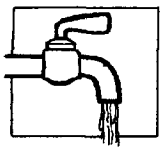
Site preparation and construction



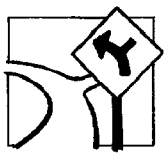
Buildings



Waste disposal



Water supply



Roads and parking areas

A reader desiring information on waste disposal, for instance, would turn to the pages where the appropriate symbol appears.

This Handbook can be used by developers as a general guide to subdivision planning. Since conditions vary widely from place to place, however, it is essential that the developer have a thorough knowledge of the site with which he is working. Much of this knowledge can be gained from secondary sources such as surveys, maps and printed information. The rest must be obtained from walking the site and noting first-hand the opportunities and limitations that its characteristics impose upon development.

It should also be noted that the Handbook deals primarily with DEP permit programs; local governments and other state agencies should be contacted to determine other legal requirements. Since DEP regulations may periodically change, developers should contact the Department's Information and Education Unit for guidance on permit application procedures. Once specific permit requirements are determined, developers will be referred to the appropriate regulatory units of DEP. Early consultation with DEP staff is also important in gaining an indication of the need for permits, specific information required on plans and applications, and the types and sizes of proposals that are likely to be approved or disapproved. Doing so will save considerable time and expense for both the developer and DEP.

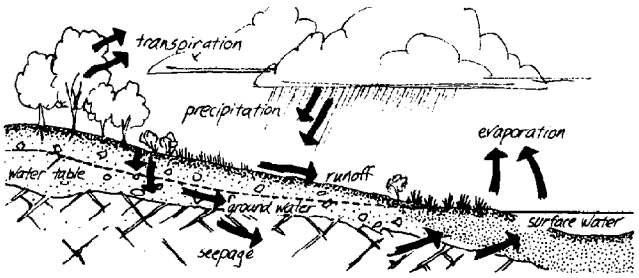
DEP's address is:
The Connecticut Department of
Environmental Protection
State Office Building
165 Capitol Ave.
Hartford, CT 06115

1 Using the land, water and air

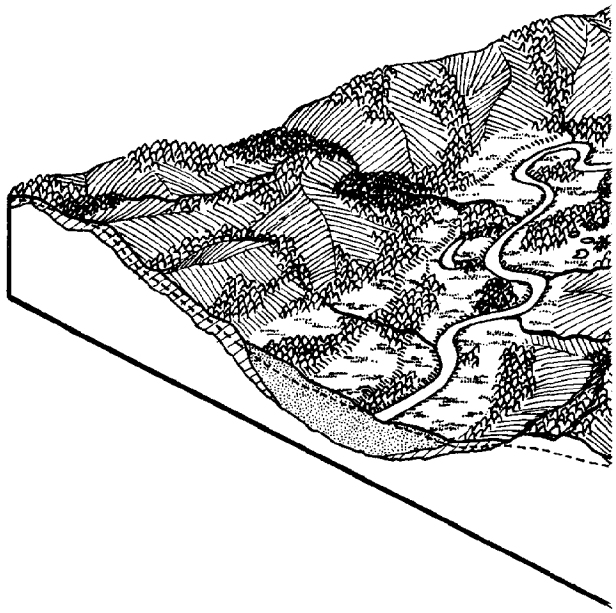
With a population of over three million people and an average of one person per acre of land, Connecticut is one of the nation's most densely populated states. Yet, surprisingly, about 65 percent of the state is forested, a higher percentage (due primarily to abandonment of agricultural land) than 50 years ago. Connecticut also has an abundance of water, with wetlands comprising about one fifth of the state.

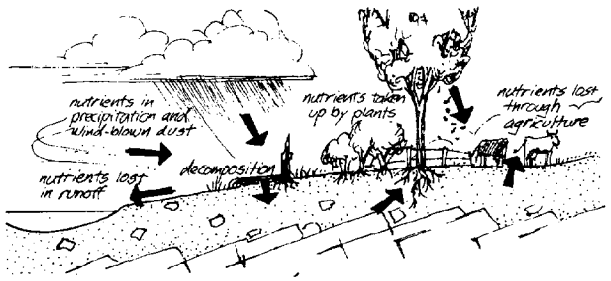
Although Connecticut has no large wilderness areas, its natural character has added immeasurably to property values and quality of life. Without adequate planning, future development will result in the eventual loss of many of the state's most valuable assets. Proper use and protection of natural resources may require greater initial expense. However, it is generally less costly to anticipate environmental problems and take measures to avoid them rather than to correct past mistakes.

The natural system

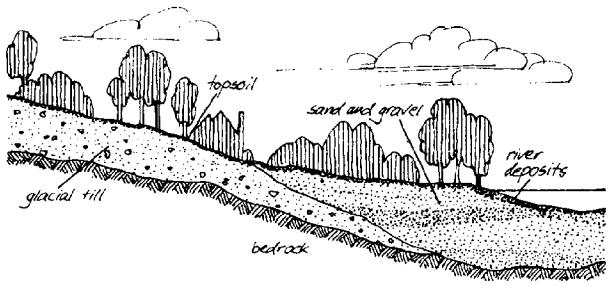


The water cycle is the constant movement of water through the natural system. Water falls on earth as precipitation, where it either seeps into the ground, flows along the surface to rivers and streams, evaporates, or is taken up by plants and released into the atmosphere. Groundwater flows very slowly through subsoils and bedrock until it enters nearby streams, lakes, or wetlands. Water evaporating from lakes, rivers, and the ocean forms clouds; precipitation from the clouds completes the cycle. The water cycle provides a basic link between natural systems such as upland forests, wetlands and aquatic habitats, and is important to man in maintaining water supplies and removing and cleansing pollutants.

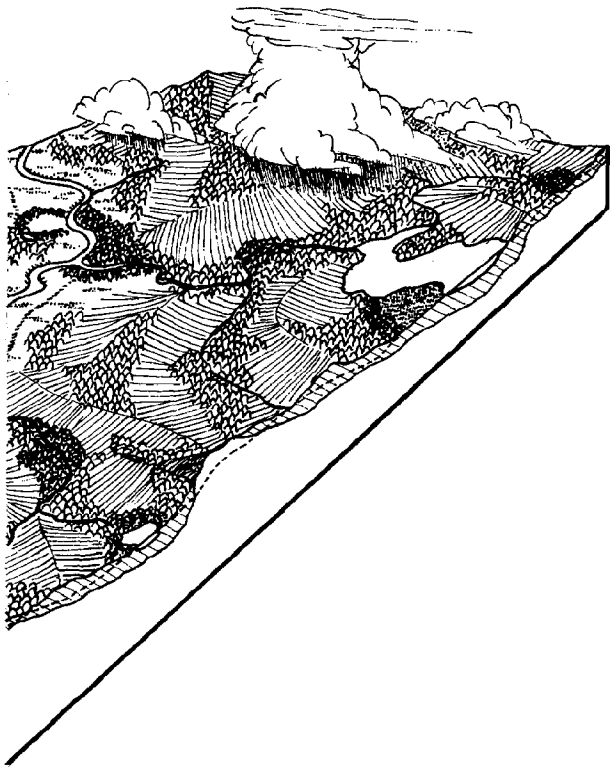


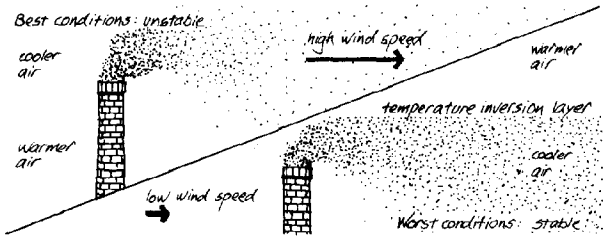


The cycling of nutrients (including organic compounds and minerals such as potassium and phosphorous) is essential to the maintenance of the natural system. Mineral elements from rocks are made available to plants and animals by weathering and by dissolving and entering the water cycle. Nutrients in the soil are taken up by plants and passed on to grazing animals and finally predators. They are returned to the soil through decomposition. Additions to the nutrient cycle occur through precipitation and wind-blown dust, and nutrients are lost through erosion and runoff, hunting, and harvesting of trees and crops. Environmental disturbance may cause more nutrients to be lost than are added, upsetting the nutrient cycle of an area and decreasing its productivity.

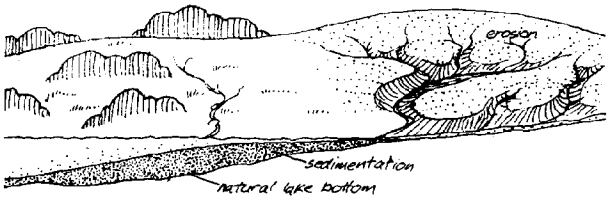


Unconsolidated materials extend from the land surface down to bedrock (ledge). The most common of these materials is glacial till, which consists of a heterogeneous mixture of clay, sand, gravel and boulders varying widely in size and shape. The ability of ground water to travel through till is directly related to the amounts of silt and clay found in the till; the more silt and clay, the slower the water will travel. Sand and gravel deposits contain very little silt and clay, and ground water can travel through them very easily. These deposits are usually found in river valleys, although a few may be found in till areas. Large sand and gravel deposits that are saturated with ground water can often be used as sources for private and public water supply.





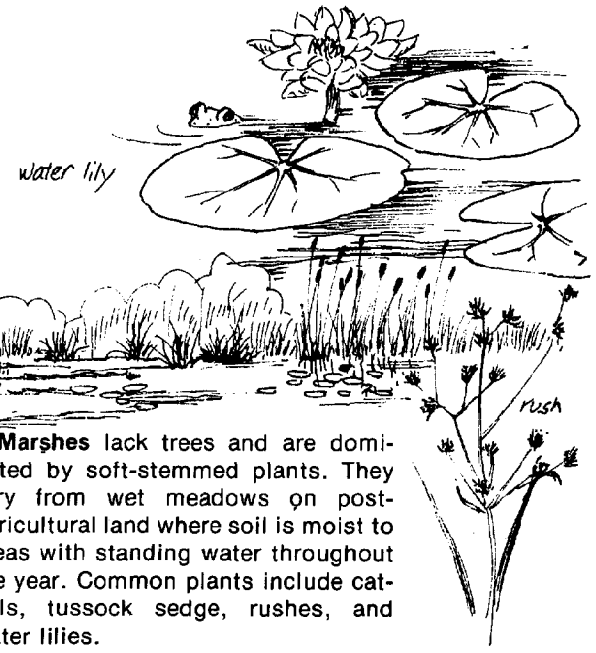
The **movement** and dispersion of **air pollution** is essentially determined by three natural factors: wind speed, wind direction, and atmospheric stability. Pollution will, of course, move in the same direction as the wind, and will disperse more rapidly in a strong wind than when there is little or no air movement. The vertical movement of pollutants is determined by atmospheric stability. If air temperature decreases rapidly with height, the atmosphere is unstable and vertical air movement increases dispersion of pollution. If there is little or no change in temperature as height increases, less mixing occurs. Pollution problems are greatest when a layer of warm air forms an "inversion" above cool air near the ground. Pollution becomes trapped beneath the inversion, and, since there is inadequate air movement to dissipate pollutants, air quality deteriorates.



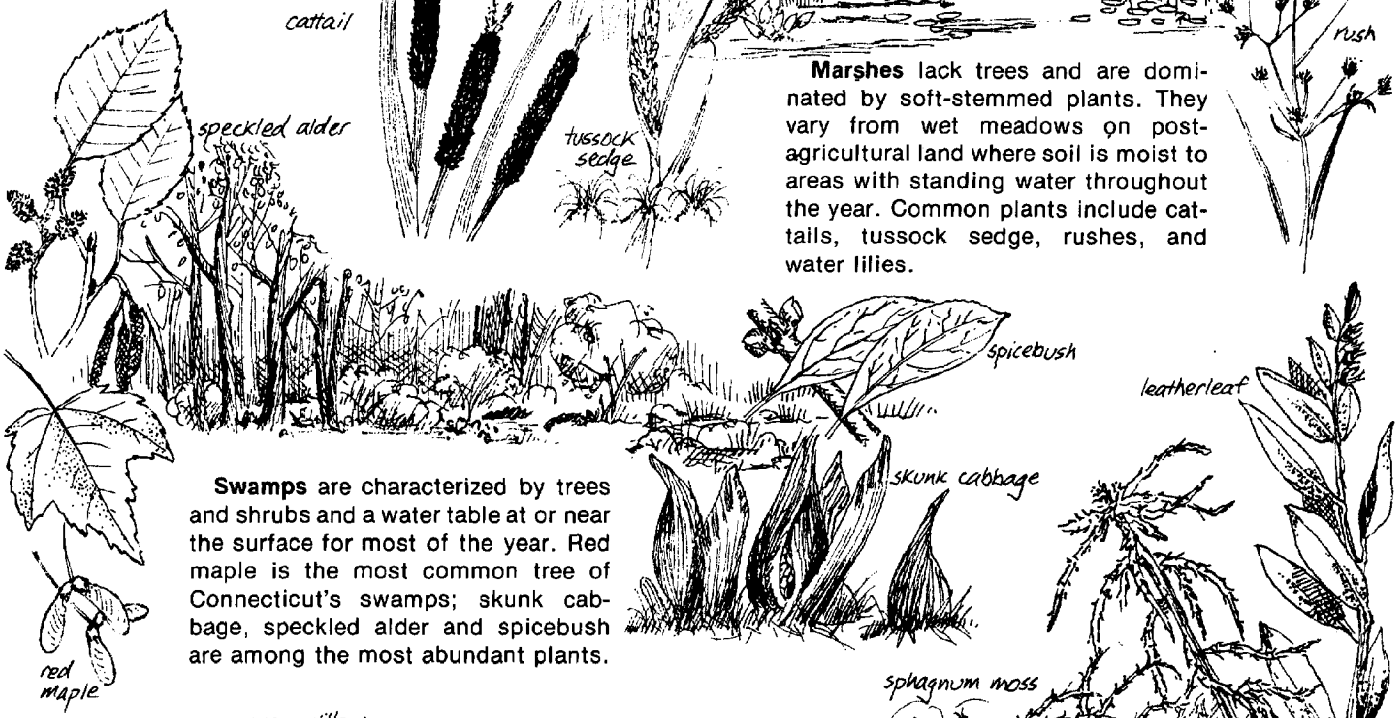
Lakes, streams, and rivers are heavily influenced by surrounding upland areas. If the amount of organic material (from sewage systems, agricultural runoff, or industrial sources) entering bodies of water increases, growth of aquatic plants also sharply increases. This process, which is called "eutrophication", often causes the oxygen dissolved in the water to be depleted, killing fish and most other animals. The loss of upland vegetation (due to construction, fires, and other activities) exposes the soil and creates erosion problems. Silt carried by runoff pollutes the water and eventually settles to the bottom, killing aquatic plants and animals and causing lakes, ponds and stream channels to silt in.

The pattern of **succession** of plant species from farmland to mature forest can be seen throughout rural Connecticut. The grasses of abandoned pastures are partially replaced by weeds such as asters and goldenrod. The first trees to appear are usually red cedars and gray birches. These short-lived trees increase the amount of shade, creating favorable conditions for hardwoods such as oaks, hickories, and red maples. The cedars and birches are slowly shaded out as the invading trees reach maturity. In its naural "climax" state, Connecticut's forests are dominated by oaks, with red maple as the most common wetland tree. Pines prefer dry sandy soil, and hemlocks are frequent in moist areas where fires are infrequent.

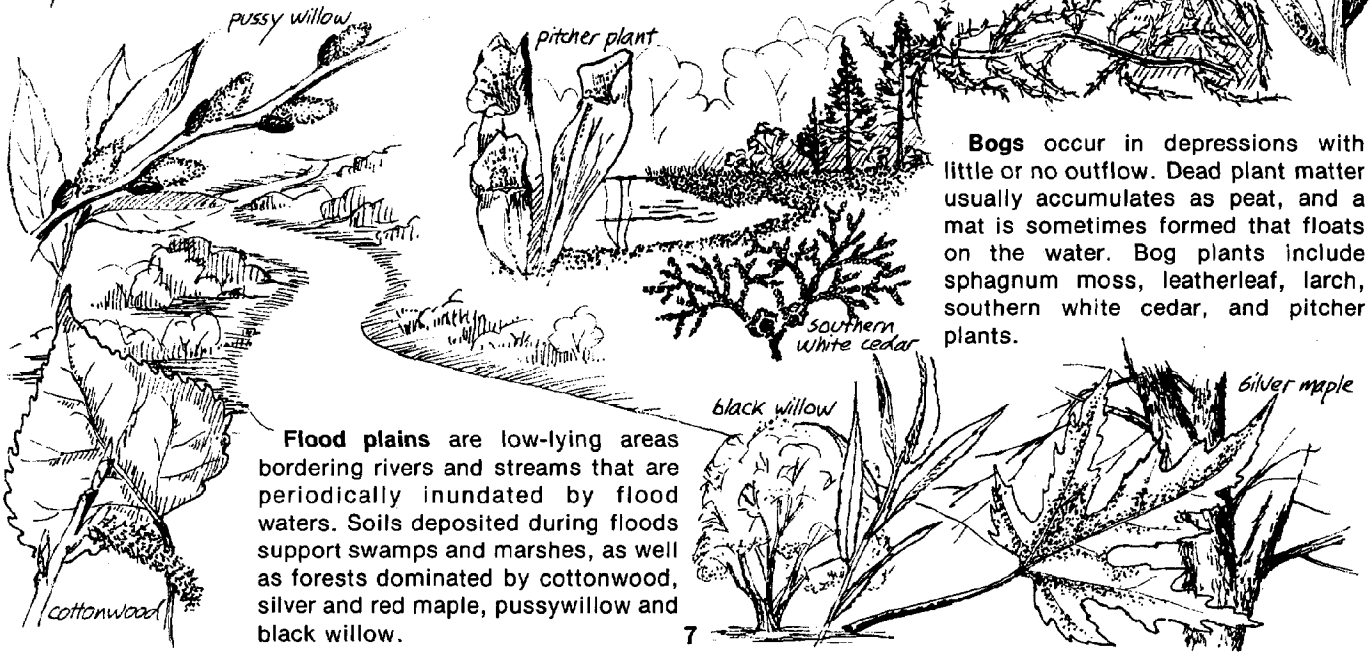
Inland wetlands serve many important ecological functions. Flood and erosion damage is reduced by the ability of wetlands to store and slow the speed of flood waters. Wetlands remove pollutants from water flowing through them by trapping sediments and by biologically breaking down impurities. Their role in the water cycle is varied: flood waters are released slowly into streams; in some areas, ground water is discharged into wetlands creating a valuable water supply source. Biologically, wetlands are highly productive, providing food and habitat for a large variety of wildlife.



Marshes lack trees and are dominated by soft-stemmed plants. They vary from wet meadows on post-agricultural land where soil is moist to areas with standing water throughout the year. Common plants include cattails, tussock sedge, rushes, and water lilies.

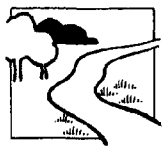


Swamps are characterized by trees and shrubs and a water table at or near the surface for most of the year. Red maple is the most common tree of Connecticut's swamps; skunk cabbage, speckled alder and spicebush are among the most abundant plants.

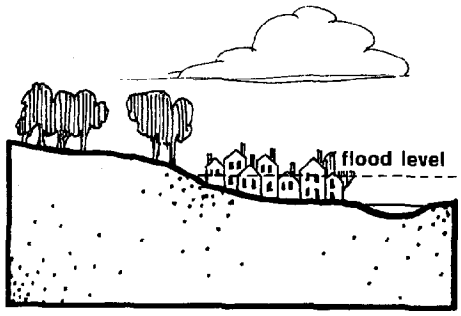


Bogs occur in depressions with little or no outflow. Dead plant matter usually accumulates as peat, and a mat is sometimes formed that floats on the water. Bog plants include sphagnum moss, leatherleaf, larch, southern white cedar, and pitcher plants.

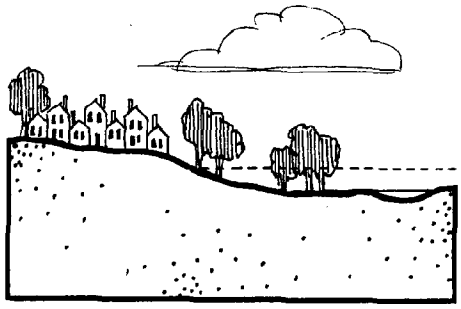
Flood plains are low-lying areas bordering rivers and streams that are periodically inundated by flood waters. Soils deposited during floods support swamps and marshes, as well as forests dominated by cottonwood, silver and red maple, pussywillow and black willow.

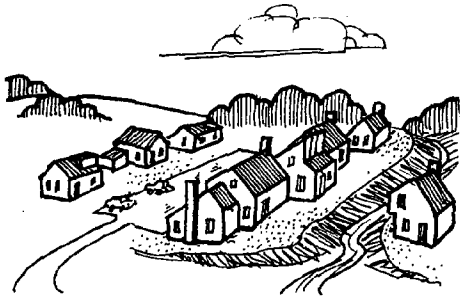


Environmentally sensitive areas

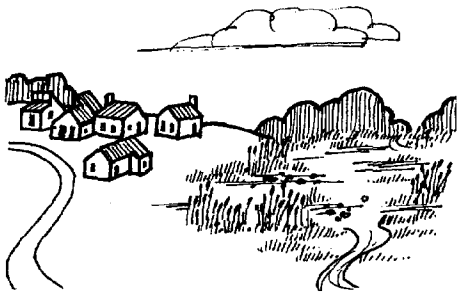


Development of **flood plains** can result in economic disaster and loss of life from flood waters. Frequently-flooded areas should be reserved for open space, recreation or agriculture; areas flooded only rarely may be suitable for limited development if adequate precautions are taken.

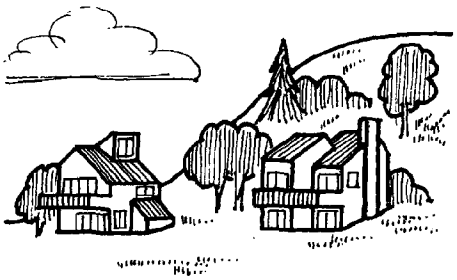


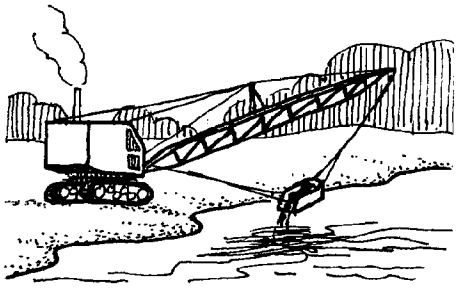


Generally, **swamps**, **marshes**, and **bogs** should not be filled or built upon. Developing in wetlands destroys wildlife habitat, may increase flood damage through loss of flood water storage areas, and often reduces the ability of a watercourse to cleanse itself of pollutants.

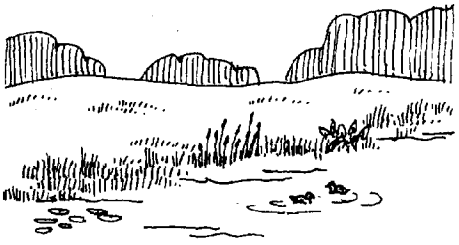


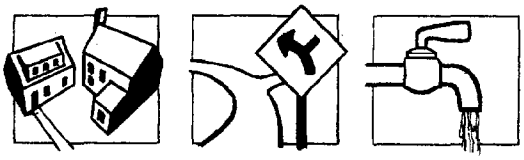
Unless considerable time and expense are taken for special precautions, **steep slopes** should not be built upon. Erosion from surface runoff is likely to be considerably more severe than on moderate slopes, and the weight of structures on steep hillsides may cause unstable soils to "slump" and weaken or crack foundations. In extreme cases, mud-slides may cause buildings to collapse.





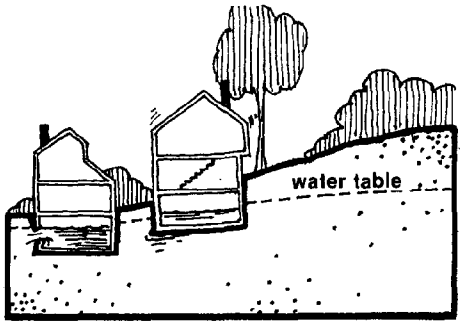
Dredging of rivers, lakes, and wetlands has numerous adverse effects. Silt disturbed by dredging reduces water quality and damages productive bottom habitat. Altered speed and direction of flow through dredged channels can increase flooding and erosion problems downstream. If dredging is necessary, the amount should be minimized. Dredge spoils should be deposited at a suitable site and confined with dikes.



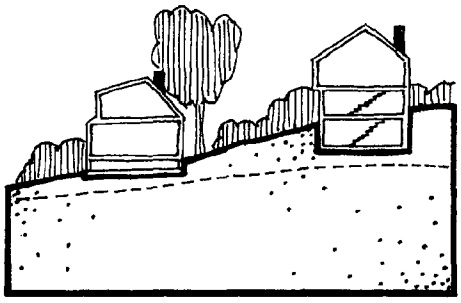


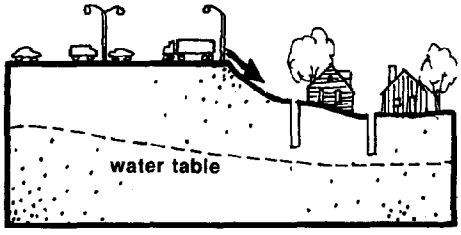
Using the land, water and air

Footings, parking areas, wells

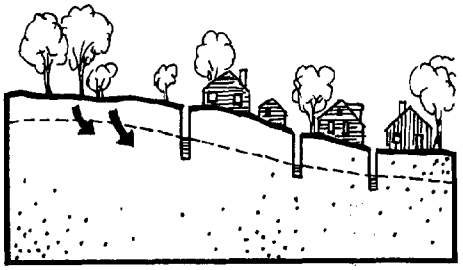


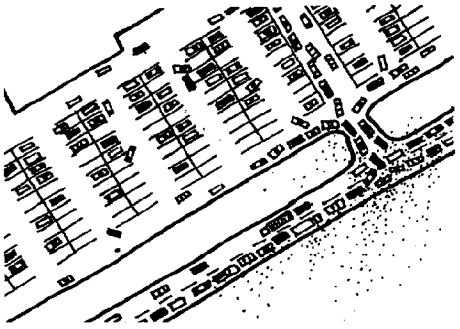
In low areas with high ground water, care must be taken to insure that building foundations are above the maximum high ground water level. Foundations built below the water level may flood and settle, are subject to cracking, and, in extreme cases collapse. Buildings should generally be excluded from such areas; otherwise, special engineering measures such as slab foundations or curtain drains must be used.



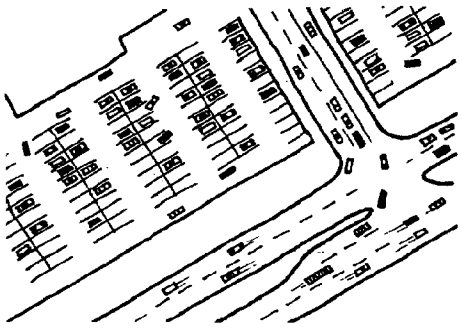


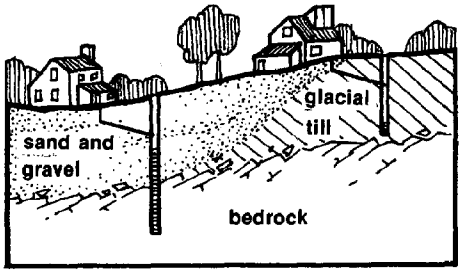
Extensive paving over of ground water **recharge areas** causes water that would normally filter through the soil to remain on the surface. This may lower the water table to such a degree that shallow wells go dry. Increased runoff from paved areas becomes polluted, worsens erosion and, because it no longer slowly percolates through the soil, increases flooding. Streams formerly supplied by ground water may periodically go dry.



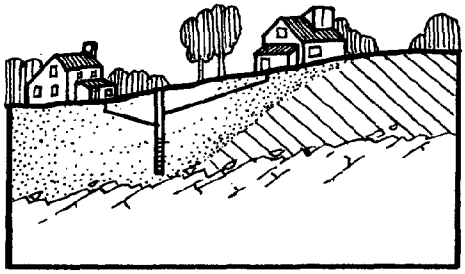


Large developments that are likely to generate a significant amount of vehicular traffic should be located in areas where existing traffic flow is good and where roads can handle increased traffic. Parking areas should be designed with easy entrance and egress, and through traffic should be hindered as little as possible. Idling cars can cause a large increase in local air pollution levels.



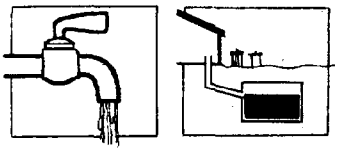


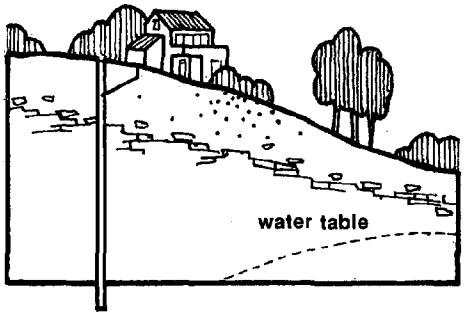
Generally, wells will be less expensive to install and will yield more water in sand and gravel rather than in glacial till. Drilling deep into bedrock is often unnecessary if the water table is relatively close to the surface. Installing a single well for several homes rather than using individual wells is less expensive and allows for choice of an optimum site.



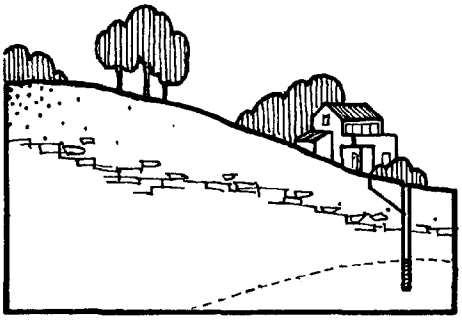
Using the land, water and air

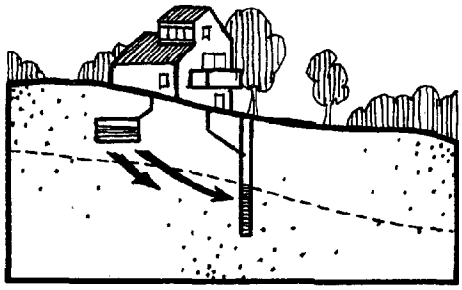
Wells and septic systems



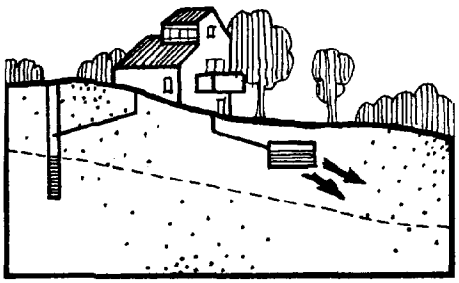


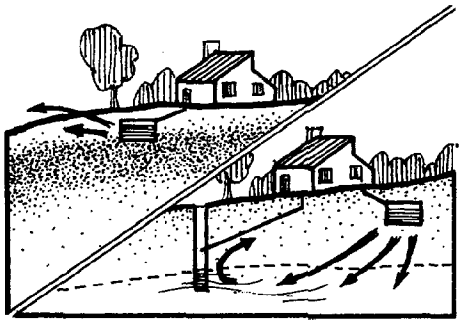
In Connecticut, most water from a bedrock well will be obtained at a depth of less than 200 to 250 feet. Drilling substantially deeper than this level is rarely productive and is often prohibitively expensive. The water storage capacity provided by a deep well can be more cheaply provided by a basement holding tank. If little or no water is found at this level, it is usually better to start again at a different site rather than to continue drilling.



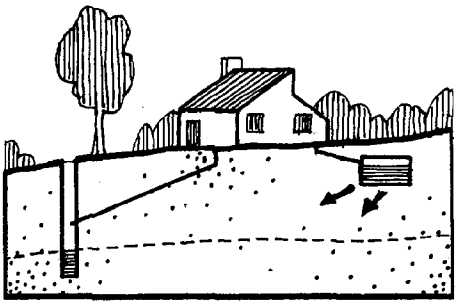


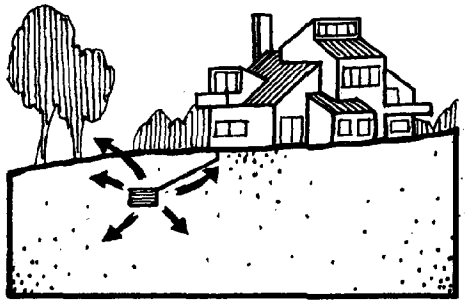
Drinking water can become contaminated by improper placement of septic systems. To insure reasonable protection from contamination, residential water supply wells should be at least 75 feet from septic systems. If possible, leaching fields should be placed so that leachate flows away from nearby wells.



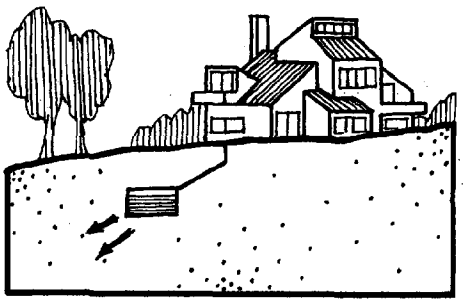


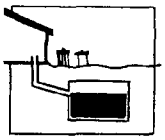
Improper septic system design relative to soil characteristics often results in unsanitary conditions. Relatively impermeable soils such as clay may cause sewage to come to the surface. Sandy, highly permeable soils may allow sewage to enter groundwater or lakes and streams before it is sufficiently purified.





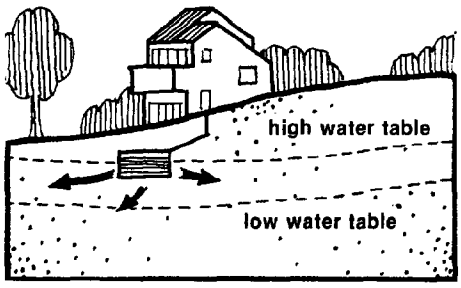
In order to function properly, septic systems must be large enough to handle the amount of sewage produced by the buildings they serve. Otherwise, inadequately purified sewage may reach the surface or contaminate water supplies. A three-bedroom house requires a 1000 gallon septic tank; tank capacity should be increased by 250 gallons for each additional bedroom. Leaching fields should also be of adequate size; dimensions vary according to soil characteristics.



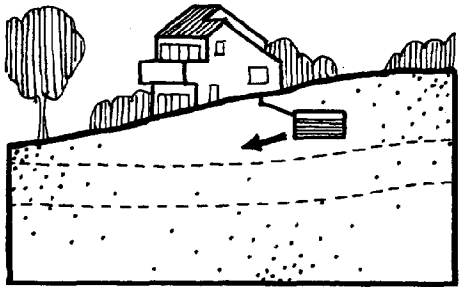


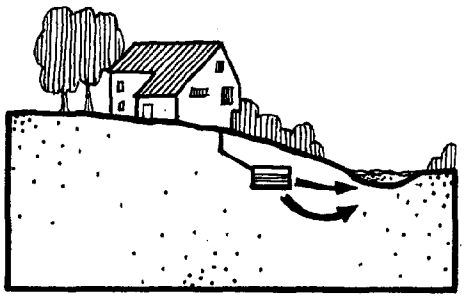
Using the land, water and air

Septic systems

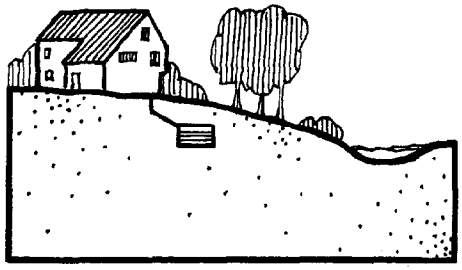


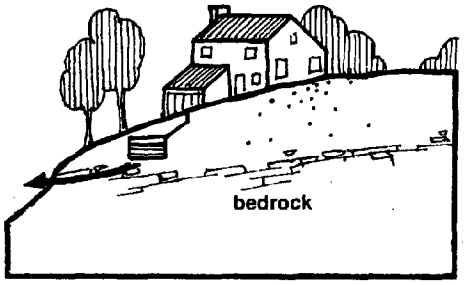
A septic system installed above the water table during the dry season may be in or near groundwater when the rains come, allowing sewage to contaminate drinking water supplies. Systems should be installed in areas where the land surface is at least 10 feet above the low ground water level and 4½ feet above the high water level. Leaching systems must be at least 18 inches above the maximum ground water level.



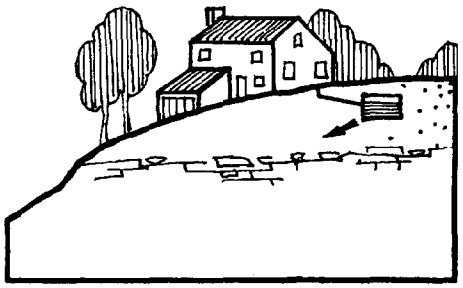


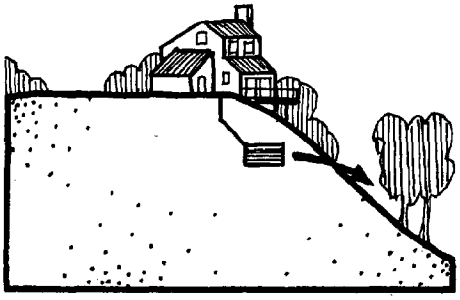
State law requires that septic systems be installed no closer than 50 feet from tributaries to drinking water supplies or 25 feet from any other lake, stream or standing surface water. It is recommended that systems be installed at least 50 feet away from all watercourses, since septic system failure can pollute streams and add large amounts of nutrient matter to lakes and ponds, causing them to become clogged with algae.



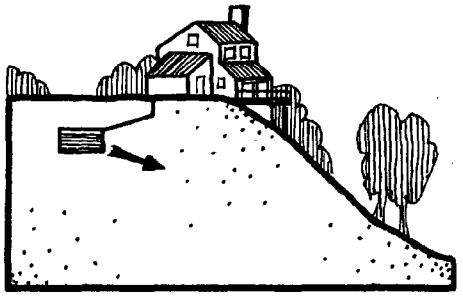


If bedrock is close to the surface, sewage may travel along shallow bedrock and through its fissures, coming to the surface before it has been adequately purified. Bedrock should be at least 7 feet below the surface. If depth to bedrock is less than 7 feet, special design may be necessary. The bottom of the leaching trenches must be at least four feet above the bedrock surface.

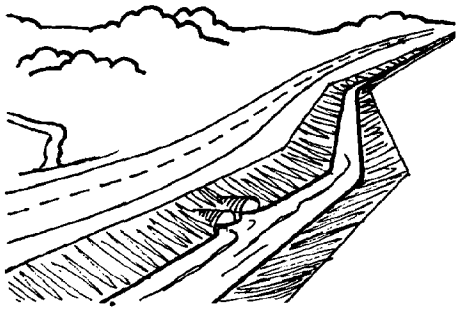




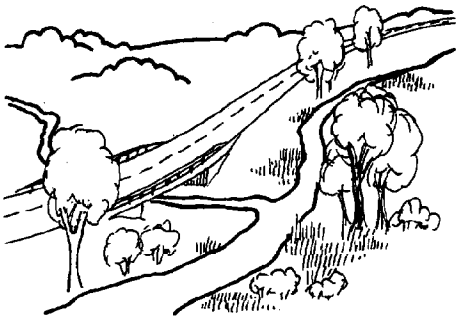
Septic systems should be placed a minimum of 15 feet from steep slopes (of 15 percent or greater). Sewage entering the soil close to a slope will move too quickly to be adequately purified, and may come to the surface, creating unsanitary conditions.

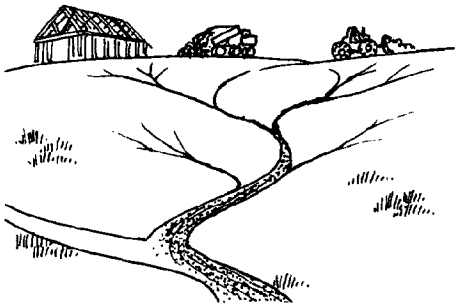


Construction practices

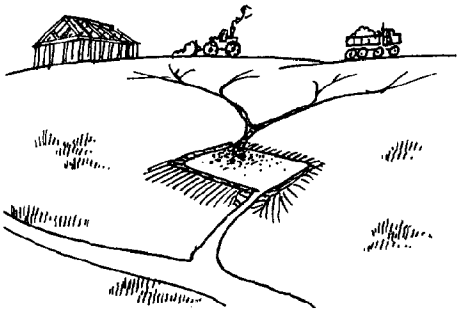


Stream channelization and the use of culverts should be minimized. Alteration of the natural flow of surface water usually results in a loss of biological productivity and a reduction in the scenic value of the area. Increased velocity of water flowing through pipes and man-made channels aggravates erosion, especially downstream from the site.

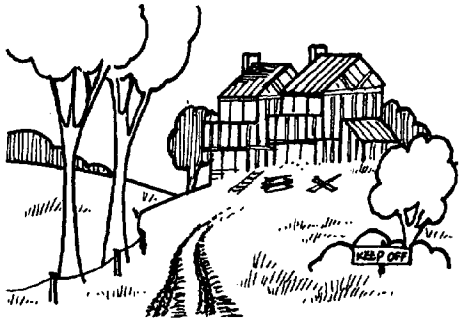




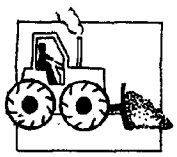
Runoff from construction sites can badly pollute streams with silt. Temporary sedimentation basins, which allow much of the silt to settle out of the water, can reduce pollution problems. At small construction sites, bales of hay can be anchored to the ground where water drains from the site. The bales trap sediments and slow the flow of the water, reducing erosion and pollution.



Erosion, sedimentation, and damage to existing vegetation can be reduced by grading only those parts of the site where construction will occur. Fencing off or posting "off limits" areas will preserve the natural character of the site and increase its value after construction is completed.

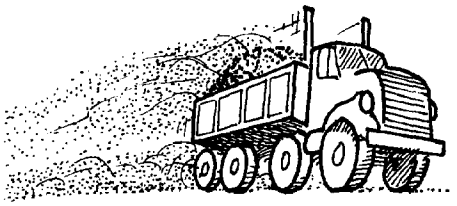


Bare earth should be graded and seeded as soon after construction as possible. Allowing exposed topsoil to erode away reduces the visual quality of the site, increases sedimentation, and requires unnecessary expense in preparing the area for later landscaping.

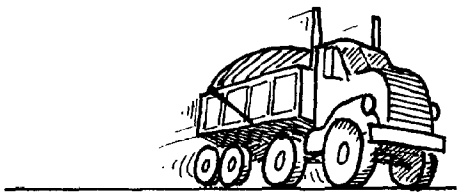


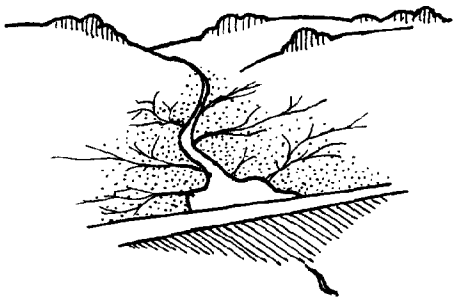
Using the land, water and air

Construction practices, dams and ponds

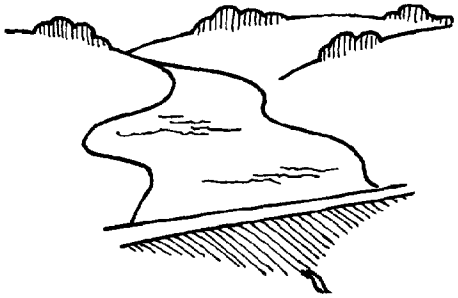


Dust released at construction sites can be a nuisance and a health hazard. Unpaved roads should be regularly sprinkled (or paved if heavily used or semi-permanent). Trucks hauling earth materials should be equipped with a cover that is regularly used. Failure to do so is punishable by a fine under the State "Fugitive Dust" laws.

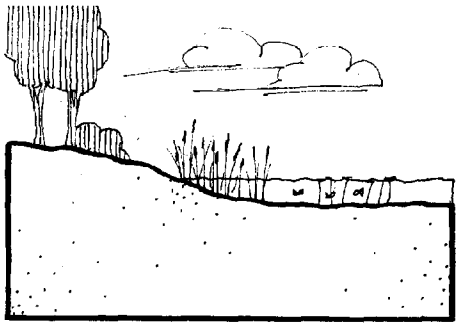




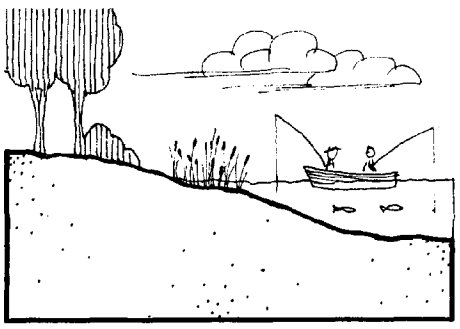
Several factors should be considered in planning an artificial pond. If the watershed draining into the site is too small, the pond may stagnate or not fill properly. If the soil is highly permeable (sand and gravel, for instance), the pond may drain quickly. Erosion and pollution upstream may preclude use of a site. Evaporation may exceed the flow of water into the pond, especially if there are large shallow water areas.



Dams should be designed by a professional engineer and constructed in such a way that seepage and the possibility of overtopping are minimized. Relatively non-porous material should be used as fill; the material should be compacted, graded to a slope shallow enough to prevent serious erosion, and seeded. The top of the dam should be at least two feet above the high water level of the pond, and a spillway should be large enough to pass severe storm runoff.



The recreational potential of a site can be increased by designing ponds to be suitable for stocking with trout or other species. Although design requirements vary from site to site, a half-acre pond should be about 12 feet deep over at least 30 percent of its area. Depth should be increased to 15 feet for a one acre pond. Trout can be stocked at a rate of 300 fingerlings per acre. Near-shore areas should be shallow if children's play areas are nearby.



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Carroll, State of Connecticut, Dept. of Environmental Protection, Coastal Area
Management Program. %
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$   7  300     60 p. : 'b ill. ; 'c 28 cm. %
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DEP's regulatory programs

Inland wetlands

In passing the State's Inland Wetlands and Water Courses Act, the legislature acknowledged that wetlands are "an indispensable and irreplaceable but fragile natural resource" and concluded that "the preservation and protection of the wetlands and water courses . . . is in the public interest and is essential to the health, welfare and safety of the citizens of the State." To that end, the Act authorizes the towns to establish inland wetlands agencies to regulate (under State guidelines) the use of wetlands and water courses. Most of Connecticut's 169 towns have done this; DEP regulates wetlands in towns that have not established their own programs. Although the following information will apply to most town programs, persons planning work in wetlands areas should contact officials in the town involved.

What areas are regulated? Wetlands are defined as areas where soil is designated "poorly drained", "very poorly drained", "alluvial", and "flood plain" on maps of soil types compiled by the Soil Conservation Service of the U.S. Department of Agriculture. Copies of the SCS soils maps are on file at DEP and in the town clerks' offices of each town. Since definition and interpretation of soil types varies, SCS maps should be used as the basis for wetlands delineation rather than private engineers' or consultants' surveys. Analysis of vegetation in the field can give a general indication of wetlands boundaries.

What activities require permits? A permit is needed for "any operation within or use of a wetland or water course involving removal or deposition of material, or any obstruction, construction, alteration or pollution of such wetlands or water courses." A few uses do not require permits; these include farming, grazing, farm ponds of three acres or less, boat moorings and "uses incidental for the enjoyment and maintenance of residential property." In addition, residential homes and subdivisions for which building or subdivision permits were issued prior to the effective date of local wetlands regulations do not require permits.

Who should be contacted? Applications and inquiries should be addressed to the local inland wetlands agency of the town involved. If the town has no wetlands program, the Information and Education Unit of DEP should be contacted. If a DEP inland wetlands permit is required, applicants will be referred to the Inland Wetlands section of the Water Resources Unit.

What constitutes an application? Since application requirements vary somewhat among local wetlands agencies, the appropriate agency should be contacted

before an application is prepared. State and local inland wetlands agencies will also require more information for major proposals. Unnecessary delays can be avoided if applications are complete upon first submission. In most cases, however, minimum requirements for wetlands applications include the applicant's name, property owner's name (if the applicant does not own the property upon which the proposed work will be done), the applicant's interest in the land, geographical location of the land, the purpose and description of the proposed activity, a site plan, and a list of the adjacent property owners. The agency may require additional information such as soil sample data, biological information, characteristics of the water course affected by the proposed work, analysis of materials to be used as fill, and detailed engineering drawings. Five copies of the application must be submitted.

How are applications processed? Upon receipt of an application, the appropriate inland wetlands agency reviews the proposed project and includes in its consideration the following factors (as outlined in the Inland Wetlands Act):
—The environmental impact of the proposed action;
—The alternatives to the proposed action;
—The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity;
—Irreversible and irretrievable commitments of resources which would be involved in the proposed activity;
—The character and degree of injury to, or interference with, safety, health or the reasonable use of property which is caused or threatened;
and
—The suitability or unsuitability of such activity to the area for which it is proposed.
Public hearings may be held for proposed projects that are likely to have a major effect on a wetland or water course.

The length of time involved in processing applications varies: local agencies are required to reach a decision within 65 days of receipt of a complete application; the State must act within 90 days. Conditions and limitations may be attached to wetlands permits.

Stream channel encroachment lines

Development of flood plains raises flood heights, increases flood damage, and endangers life and property. In recognition of this fact, the State has established lines along flood-prone rivers within which encroachments are permitted. Encroachment lines are established on the basis of a "design storm". In most cases, there is approximately one chance out of one hundred that a storm as severe as the design storm will occur in any given year. The amount of flooding caused by the design storm is calculated, and encroachment lines are established along the predicted high water lines.

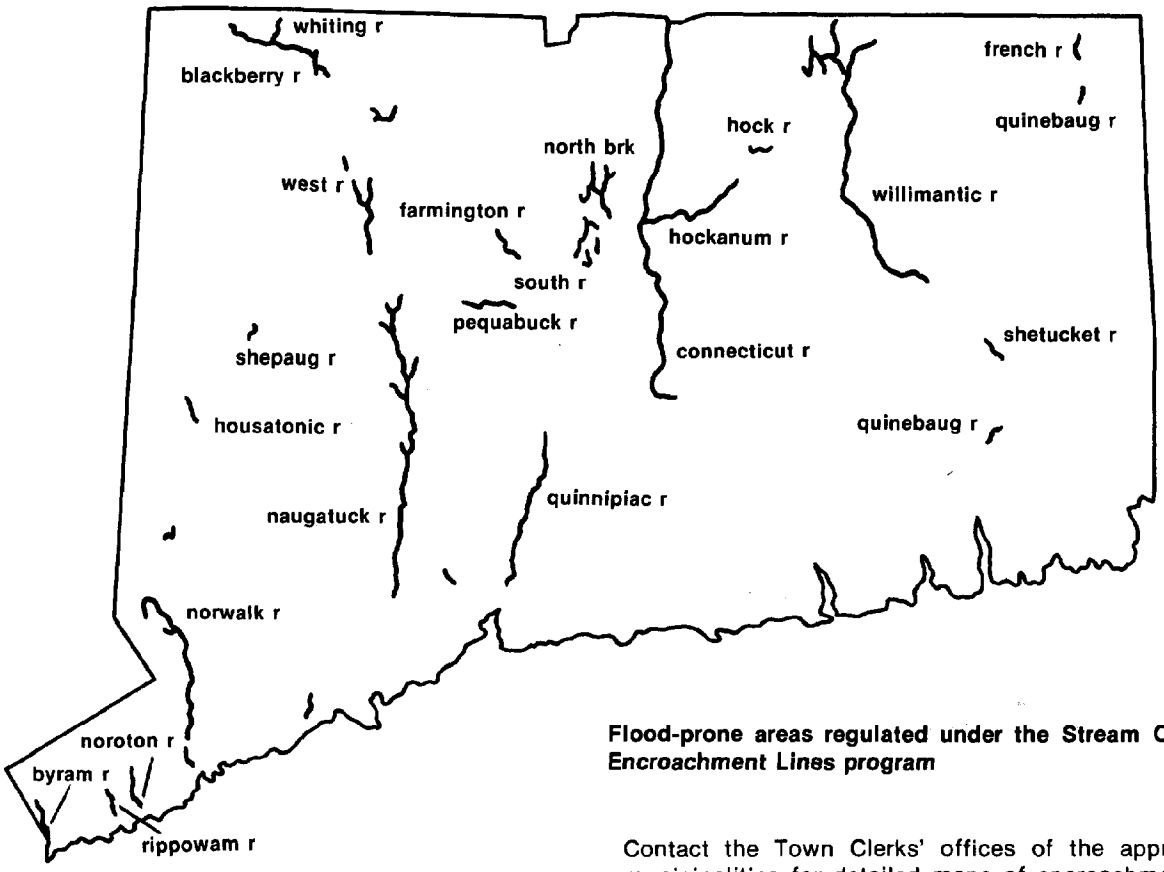
What Areas Are Regulated? Areas where encroachment

lines have been established are outlined on the accompanying map. Detailed surveyor's maps showing encroachment lines in relation to property lines and the river are on file at clerks' offices in the appropriate towns and in the Water Resources Unit of DEP.

What Activities Require Permits? No "obstruction, encroachment or hindrance of any nature", including buildings, dikes and fill can be placed within encroachment lines without a state permit. The removal of any material from the flood plain or any alteration that will adversely affect the river's ecosystem is also regulated. In addition, a permit is required to repair any structure damaged to the extent of more than half of its market value.

Who Should Be Contacted? Initial inquiries to the Information and Education Unit; detailed applications to the Inland Section, Water Resources Unit, Department of Environmental Protection.

What Constitutes An Application? Applicants are required to submit a letter of application, cross sections of the river and property, and a site plan showing existing build-



Flood-prone areas regulated under the Stream Channel *Encroachment Lines program*

Contact the Town Clerks' offices of the appropriate municipalities for detailed maps of encroachment line locations.

ings, physical features, the dimensions of the proposed work, and the location of the flood encroachment lines. The names and addresses of adjacent property owners should be included. Additional information including a detailed hydraulic analysis may be required. A detailed permit request information sheet can be obtained from the Water Resources Unit.

How Are Applications Processed? DEP reviews flood encroachment applications in terms of the following factors:

- the capacity of the river system to carry and store flood waters.
- the effect of the proposed encroachment on the flood heights of the design storm; i.e., will the proposal cause increased flooding to the degree that lives and property will be endangered.
- the effects of the encroachment on the river ecosystem and on the State's natural resources.

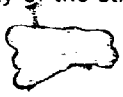
Processing time for applications is approximately two months.

Supervision of dams

Under State Statutes, any dam, dike or reservoir which, by breaking away might endanger life or property shall be subject to inspection and investigation by DEP. In addition, a permit is required for the construction or alteration of such structures. If the Department determines that an existing or proposed dam does not pose a potential danger to life or property, no construction permit is required from DEP.

Inquiries should be addressed to the Information and Education Unit, and applications should be filed with the Inland Section of the Water Resources Unit, Department of Environmental Protection. Information required for a construction permit application includes the applicant's name, location of the proposed dam, dimensions of the dam and pond, and proposed use of the pond. The Department will determine whether an inland wetlands permit is required for construction of the dam.

If a dam construction permit is issued, DEP personnel will inspect the construction site to determine whether the structure will be safe. If existing or new dams are found to be safe, the Department issues certificates of approval, to which conditions may be attached in order to insure the long-term safety of the structure.



Water pollution

Under federal legislation, a program of water pollution control was begun in the late 1940's and early 1950's. Major progress in Connecticut began with the Clean Water Act in 1967. Then in 1972, amendments to the Clean Water Act called for the elimination of existing sources of water pollution and prevention of future pollution

sources. The Water Compliance Unit of DEP joinly administers federal and state water pollution laws under a single permit system. Since sizes and types of pollution sources vary so widely, however, the time and procedures involved in the permit processes also vary. The following is a general guide to the water pollution permit process; the Water Compliance staff should be contacted before permit applications are submitted for informal consultation and for specific directions concerning permit applications.

What activities require permits? A permit is required from the Water Compliance Unit of DEP for the following activities:

— all new industrial discharges
— all new sanitary sewage discharges greater than 5000 gallons per day (including septic systems and discharges into municipal sewage systems)
— all increases in industrial or sanitary discharges over 5000 gallons per day

Sanitary discharges of less than 5000 gallons per day (which include most single-family dwellings) should be referred to the municipality. Plans for any septic systems with capacities of 2000 gallons per day or more must be approved by the Connecticut Department of Health. These plans must be prepared by a certified professional engineer. For proposed discharges into municipal sewage systems, the local sewer agency should be contacted; the local health officer should be notified of proposed septic systems that will receive discharges of less than 5000 gallons per day.

In addition, all **marine terminals** must be licensed by Water Compliance; all **waste chemical collectors** must be licensed; and all **automobile dealers and repairers** must be certified for waste oil disposal. For further information on these matters, contact the Information and Education Unit.

Permits are not required for private swimming pools and filter discharges and for ground water drainage systems (such as foundation drains) not connected with sanitary waste disposal. Permits are also not required for storm water collection systems; for large systems, however, it is recommended that developers contact Water Compliance for informal review of plans.

What constitutes an application? Applicants must submit a completed form including the applicant's name and address, the volume and nature of the proposed discharge, and detailed descriptions of the location of the discharge, the type of operation producing the discharge, and the anticipated quality of the effluent. Separate applications (and separate permits) are required for each proposed discharge. Applications and plans for conventional single-home systems of less than 2000 gallons per day may be prepared without the assistance of a professional engineer.

How are applications processed? The method and length of time for processing applications varies according to the size and nature of the proposed discharge and the conditions of the site. Generally, applications for discharges

under 5000 gallons per day are processed without public hearings. For other proposals, the Water Compliance Unit, upon receipt of a complete application, reviews the application and prepares a "tentative determination". This is, in effect, a proposed decision to grant or deny a permit on the grounds of the discharge's potential effect on the quality of the ground or surface water. A public hearing is then held to discuss the tentative determination (the hearing is usually held from 30 to 60 days after an application is submitted). A final decision is made, in most cases, from one week to two months after a hearing. If a proposed discharge is approved, the Department receives and reviews detailed plans for the discharge. Upon approval of the plans, a permit is granted. Special conditions may be attached to the permit by the Department.

Minimum flow regulations

DEP regulates the construction of dams and the diversion of water from rivers and streams that are stocked with fish by the Department. These activities are regulated because dams and diversions could reduce the amount of flow in the streams to the point where stocked fish could not survive. Exempt from the regulations are impoundments that receive water from a drainage basin of less than two square miles in size. Developers and individuals potentially affected by these regulations should contact the Information and Education Unit for possible referral to the Water Resources Unit, Department of Environmental Protection.

Air pollution

Air pollution is one of Connecticut's most persistent — and technically complex — environmental problems. Not only are chemical reactions of pollutants in the atmosphere difficult to analyze and predict, but the nature of air movements and weather patterns makes the effect of air pollution highly variable. A steady wind may harmlessly disperse large amounts of pollutants while an inversion or air stagnation could cause concentrations to rise to dangerous levels.

Several air pollutants are known to be dangerous to health. Increased incidence of heart and lung disease, respiratory conditions, and premature death are among the known health effects of air pollution. In order to minimize these health effects, the federal government (under the 1970 Clean Air Act Amendments) established maximum allowable concentrations for air pollution. These "primary ambient air quality standards" have been set for six major air pollutants, which are discussed briefly below.

Air pollution also has adverse impacts on visibility, weather, materials, crops and other factors affecting welfare or property. These effects have been considered in the establishment of "secondary ambient air quality

standards". Secondary standards are more strict than primary standards, and reflect the level of pollution below which no significant effects on material welfare are evident.

The six pollutants regulated under the Clean Air Act vary widely in their characteristics and effects. Four are produced primarily by the automobile and other mobile sources:

Carbon monoxide (CO) is a poisonous gas produced during combustion. Since it reacts relatively quickly in the atmosphere to form less harmful materials it is a local problem and is usually worst during hours of peak traffic generation.

Nitrogen Oxides (NOx) are by-products of combustion that have a number of adverse health effects. The extent of the NOx problem is poorly understood because of difficulty in monitoring and modeling its levels in the atmosphere.

Hydrocarbons are a large group of molecules, most of which are not known to be directly harmful. Hydrocarbons are regulated because of their tendency to react in sunlight with nitrogen oxides in the air to form photochemical oxidants.

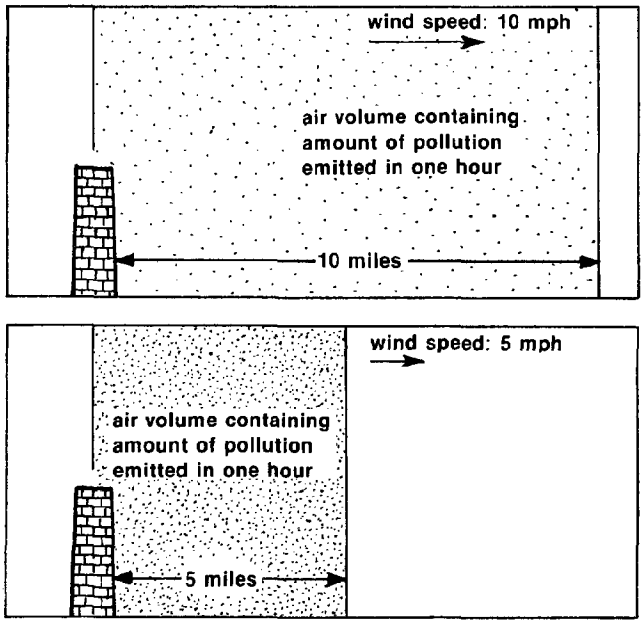
Photochemical oxidants (primarily ozone) are strong oxidizing agents known to have harmful effects on heart and lung function. Commonly called smog, oxidants are produced by a complex series of chemical reactions between hydrocarbons and nitrogen oxides in the presence of sunlight. These reactions may take place over several hours and occur dozens of miles from the pollution source. Smog is a regional phenomenon, and is Connecticut's most serious air pollution problem.

Both **sulfur oxides** (SOx) and **particulate matter** are released primarily by stationary sources such as industrial facilities and power plants. Particulates consist of microscopic particles that remain in the atmosphere until settling out on their own or in precipitation. Although particulates consist of many materials, lead and asbestos fibers are among the most inherently harmful. Other particulates often act as vehicles carrying molecules of harmful gases such as sulfur oxides into the lungs. Sulfur oxides are a product of the oxidation of sulfur in fuels. Among their many harmful effects is increased acidity of rain, which increases corrosion of man-made materials and lowers productivity of plants. Both sulfur oxides and particulate matter have a deleterious effect on lung function.

The Clean Air Act directs the states to regulate air pollution under guidance from the federal Environmental Protection Agency. Several methods are utilized to bring air pollution levels into compliance with the federal standards:

— Emission standards have been set for stationary sources, such as factories and power plants, and where necessary, pollution control equipment is installed. (Emission standards apply to a particular source, whereas ambient standards apply to a general area-wide pollution standards).

- Emission standards have been set by the U.S. Environmental Protection Agency (EPA) for automobiles, and other mobile sources.
- Open burning is regulated.
- Large developments such as shopping centers, parking facilities, sports complexes and highways are regulated as "indirect sources". Although large facilities by themselves may cause minimal air pollution, they indirectly cause pollution because of the relatively large amounts of vehicular traffic they attract. Pollution from these developments can be minimized through careful siting and traffic control measures.
- Plans are being developed at the federal level to prevent the degradation of air quality in "clean" areas where air pollution is currently below primary and secondary standards. This may result in the establishment of "tertiary" standards for some regions.



Any consideration of the effects of a proposed source of pollution on the air quality of an area must take into account not only typical conditions, but the worst conditions as well. When there is a steady breeze and atmospheric conditions are unstable (see page 6) even large amounts of pollution may be dispersed so effectively that air quality will not be seriously affected. But when the air is stable and there is little or no wind, the same amount of pollution could result in dangerously polluted air.

The effect a certain amount of pollution will have on ambient air quality is related to the volume of air through which pollution can diffuse or mix (see diagrams). If wind speed is 10 miles per hour, for instance, pollution emitted from a stack will have half the amount of air to mix with (if other factors are constant) than if there was a 20 mile per hour breeze. In addition, if there is considerable vertical air movement, pollution can mix with a larger volume of air than if there is little vertical movement. A temperature inversion limits the air volume pollutants can be dispersed into by restricting the vertical movement since temperature differences prevent the pollution from rising above the inversion layer. The closer to the ground the inversion is, the smaller the volume of air available for mixing becomes, and pollution concentrations increase.

Air pollution: point sources

Two types of permits are issued under the point source (or stationary source) program. Construction permits are issued on the basis of projected operational emissions. Operation permits are issued after construction has been completed and an inspection made to insure that actual emissions do not exceed the projected amounts and do not violate air quality standards.

What air pollution sources require permits? A permit is required for any fuel-burning source with a capacity of five million BTU or greater, or any boiler that burns coal or number 4 or number 6 fuel oil. All incinerators in commercial and industrial buildings and in dwellings of six or more family units also require permits. In addition,

permits are required for certain types of manufacturing equipment; contact the Information and Education Unit for additional information.

Construction Permits

What information must applicants supply? If, through correspondence with the Air Compliance Unit, it is determined that a permit is required, the applicant is requested to fill out a standard form. Required information includes the type and size of the equipment to be installed, the type of fuel used, pollutants emitted (if known), and location of the proposed source. Applications should be addressed to the Permit Group, Engineering Section, Air Compliance, DEP.

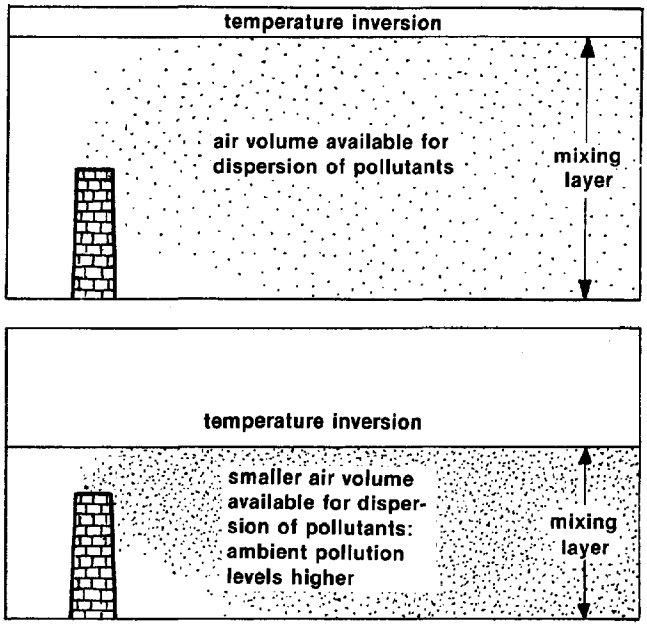
How are applications processed? The Department evaluates applications to determine probable emissions and the effects those emissions would have on the local area. (Since existing air quality varies widely in various areas of the state, the effects of an air pollution source could be far greater in some regions than in others.) Public hearings are required for sources which will emit more than 100 tons of air pollutants without control equipment; however, a hearing may be held on other applications at the request of members of the public or the parties involved in the application. In most cases, the Depatment issues a decision within 60 days of receipt of a complete application. Processing time is longer for major proposals and for applications that are taken to public hearing. Construction permits usually expire after one year; however, extensions are, in most cases, routinely granted.

Operation Permits

During the period when the construction permit is valid and within ten days after the initial start-up, an inspection is made to determine that the equipment is operating efficiently. Provided no problems arise, an operation permit is issued. Permits are valid for a period of one to five years, depending upon the type of source. Renewal of operation permits usually involves a reinspection and a determination that no changes have been made to the equipment or its operation.

Registration of Existing Air Pollution Sources

Point sources installed prior to June, 1972 and operating prior to October, 1972 do not require a permit, but may have to be registered with the Air Compliance Unit. A form for this purpose is available from the Engineering Section.



Air pollution: indirect sources

The greatest air pollution impact of development is often that associated with vehicular traffic. In fact, vehicular pollution is Connecticut's most severe air pollution problem. This is due to the difficulty of controlling vehicular sources either by use of emission control equipment on the vehicle or by increasing the use of different travel modes such as trains and buses. Under the indirect source program, proposals for major developments are

evaluated in terms of the potential traffic generated, the degree of congestion caused by the additional traffic and the resulting air pollution.

What developments require permits? Indirect source permits are required only for large developments that are likely to generate 500 or more vehicle trips during the peak hour of traffic generation. Such developments include:

— Multi-family dwellings of 630 units or more
— Single-family dwellings of 500 units or more
— Shopping centers of 90,000 square feet gross floor area or more
— Sports complexes or entertainment theaters of 1,250 seats or more
— Independent parking areas of 400 parking spaces or more.

(A complete list is available from DEP's Indirect Source Studies Group.) Potential applicants should request an "Indirect Source Questionnaire" from the Indirect Source Studies Group, Air Compliance, Department of Environmental Protection. The Department will review completed questionnaires and determine whether a permit is required.

What information must applicants supply? Applicants must submit information showing anticipated vehicle traffic patterns and an analysis of the amount of congestion that will occur in the vicinity of the site. The analysis should deal particularly with intersections that fail to meet criteria established by DEP. Details on application requirements are available from the Indirect Source office.

How are applications processed? The Department utilizes information supplied by the applicant to determine the amount of carbon monoxide that will be emitted by traffic associated with the proposed development. Existing pollutant concentrations at the site are evaluated as well as projected concentrations after completion of the development. Issuance or denial of permits is based upon the probability that the maximum allowable carbon monoxide levels at points of congestion will be exceeded.

Within 60 days of submission of a complete application, the Department issues a preliminary report. The report, along with the application, is made available to the public for inspection by interested parties. A public hearing may be held if requested by the applicant, state, municipality, or members of the public.

Operation permits. An operation permit is issued if the Department determines that the development has been constructed in accordance with the conditions of the construction permit and that no substantial changes have been made since issuance of the construction permit.

Air pollution: open burning

Open burning is defined in state regulations as "the burning of any matter in such a manner that the products of combustion from the burning are emitted directly into the ambient air without passing through an adequate

stack or flue." DEP, in cooperation with the municipalities, regulates open burning because uncontrolled burning can have a serious impact on air quality, particularly in terms of particulate matter. In fact, prior to its regulation, it was estimated that open burning contributed up to 25% of the particulate matter in Connecticut's air.

What activities require permits? Permits are required either from the municipality or the state, depending upon the proposed activity. A local permit is required for:

- Fires for training personnel in methods of fighting fires, but excluding the burning of structures
- Fires for the prevention or control of disease or pests
- Fires for the prevention, control, or destruction of agricultural diseases and pests, and agricultural burning for vegetation management
- Fires by any resident to dispose of brush or leaves on the property where he resides

State permits are needed for:

- Fires for the disposal of dangerous material such as toxic gases where there is no reasonable alternative method
- Fires to thwart a hazard which cannot properly be managed by any other means or is necessary for the protection of public health
- Fires in tidal marshes
- Fire training exercises in which structures are to be burned
- Any other fires not specifically listed as permitted, prohibited or requiring a local permit.

The following are conditions under which no permits can be issued:

- Where garbage, paper, metal, plastics, rubber, painted materials or demolition waste is to be burned
- If the burning creates hazardous health conditions
- If ambient air quality standards might be exceeded
- If salvage operation would be conducted by the burning (from wire, cans, etc.)
- If advisory threatening atmospheric conditions or any other air pollution emergency has been issued by the Commissioner
- If forest fire danger is high in that area
- Where a reasonable alternative exists (i.e., if a refuse disposal area exists in a reasonable proximity, if applicant has sufficient area to dispose of the materials, and if the town collects these materials, and if the town collects these materials at least annually).

No permits are required for:

- Barbecues, etc.
- Campfires, bonfires for ceremonial or recreational purposes
- To abate fire hazard (must be controlled by a responsible fire official)
- Fires in salamanders, etc. used by construction workers for heat; fires used for street installation or paving activities, the repairing of utilities or similar work.

Who should be contacted? Most municipalities have designated a local burning official to administer open burning regulations who may be contacted through the town offices. Inquiries to the State should be addressed

to DEP, Information and Education Unit; if it is determined that a permit is necessary, applications should be addressed to DEP's Air Compliance Unit, Field Operations and Enforcement section.

What constitutes an application? Applicants are required to submit a form (available from State and local offices) requesting the applicant's name and address, the quantity and type of material to be burned, the location of the proposed burning, the purpose of the burning, and an explanation of why practical alternatives to the burning are not feasible.

The HUD flood insurance program

The U.S. Department of Housing and Urban Development (HUD) has designated 166 Connecticut communities as flood-prone and, under the federal Flood Disaster Protection Act, will make available flood insurance to property owners in towns participating in the program. The goal of the program is to reduce through preferential insurance rates the amount of property subject to flood damage without unduly penalizing current property owners. Therefore, developers who are planning construction on land which is potentially flood-prone should contact local officials to determine whether the town is affected by and participating in the program. Flood hazard boundary maps are available for public inspection at the town offices.

In participating towns, flood insurance rates for existing structures are subsidized by the federal government; current actuarial rates are charged for new construction in flood hazard areas. All policies are available from licensed property and casualty insurance agents and brokers. To paticipate in the program, a town must assure that development sites are reasonably safe from flooding before building permits are granted. Once the municipality is accepted in the flood insurance program, a more detailed flood hazard study is conducted. After completion and federal acceptance of the study, the town is required to adopt a flood standard in its zoning regulations.

Towns containing flood-prone communities which have not entered the program by July 1, 1975, or within one year of publication of their flood hazard maps, will be unable to receive federal financial assistance for construction. In addition, residents in both the flood hazard area and in the town in which it is located would be ineligible for loans from **any** federally-insured or regulated lending institution.

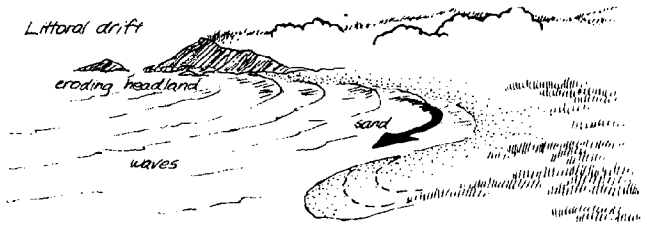
2 The coastline

Because of its scenic, recreational, and commercial value, Connecticut's coastline has been heavily developed along most of its 271 miles. Seasonal and permanent homes, public and private beaches, marinas, and port facilities all compete for shoreline space. Yet the natural assets that attracted much of the development have deteriorated as a result of intensive and poorly planned human use of the coastline.

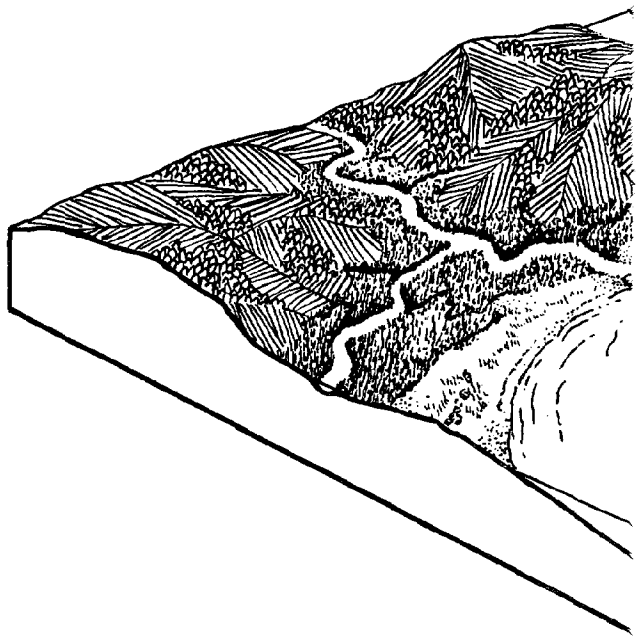
In response to this problem, DEP has been mandated to insure the preservation of tidal wetlands and to regulate dredging, filling, and the building of structures in tidal waters. The Department, in cooperation with other state agencies, coastal municipalities, and the public, is investigating ways to protect and enhance the natural resources of the coastline under the Coastal Area Management program. Voluntary measures by private developers and individuals, however, could be the most effective means of insuring that the scenic and natural qualities of the coastal area are properly used.

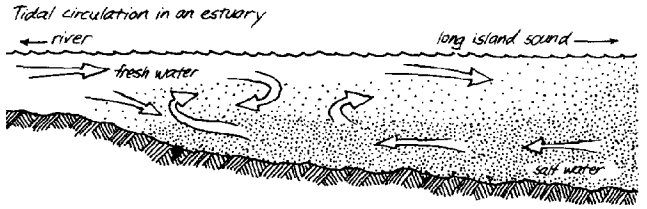
Besides describing DEP's coastal permit programs, this chapter outlines some of the special factors that developers should consider when dealing with a site on or near the coastline. It should be kept in mind, though, that these factors do not rule out the considerations that apply to development in inland areas. In fact, nearly all the issues described in Chapter 1 also apply to coastal locations. The use of the coastline, with its unusual and valuable characteristics, logically requires some additional precautions.

The natural system

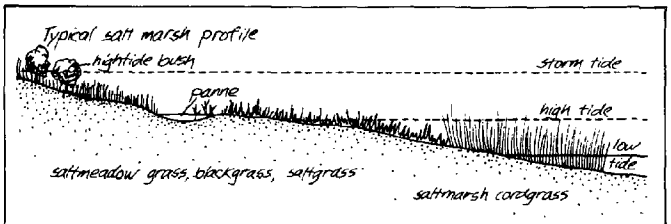


Beaches and dunes protect marshes and adjacent uplands from storms and erosion, provide wildlife habitat, and are of obvious scenic and recreational value. Waves and wind are constantly altering beaches and dunes. This is especially true during and after storms. The action of tidal currents and of waves striking a shoreline at an angle slowly moves sand and other materials along the shore. This **littoral drift**, as it is called, resupplies eroding beaches with sand transported from offshore or other points along the coast. Erosion and movement of dunes is reduced by **dune grasses** and other vegetation, which trap and anchor the sand against naural forces.

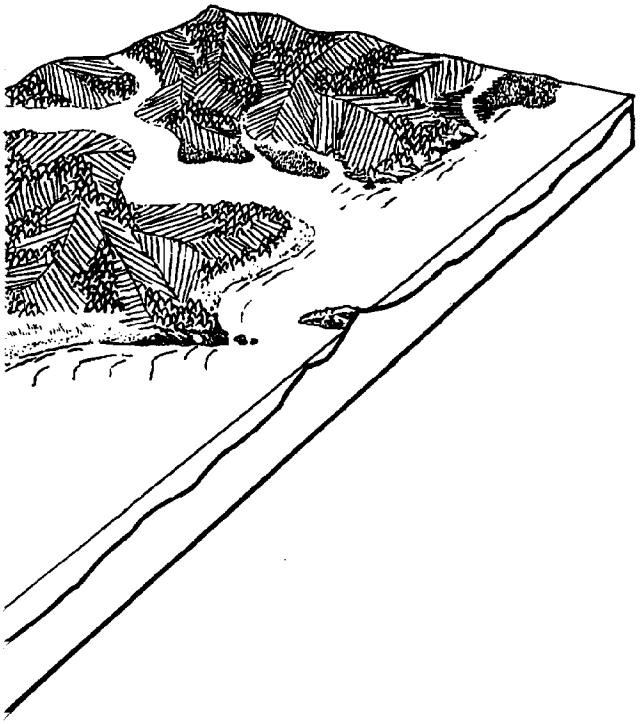


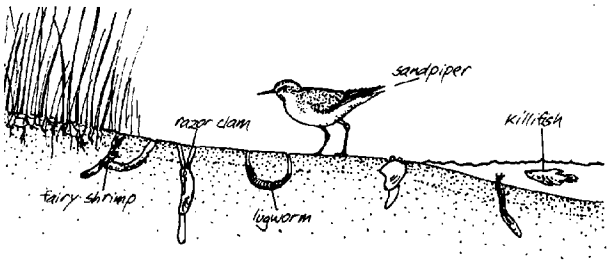


Estuaries are river mouths and bays where fresh and salt water meet. Because salt water is slightly heavier than fresh water, it usually moves up the estuary underneath outflowing fresh water. Fine-grained material tends to move upstream by this process, frequently causing dredged channels to silt in quickly. The mixing of water in estuaries creates a nutrient-rich habitat favorable to many forms of life, and helps to naturally clean polluted water. Nearly all of the fish of Long Island Sound are in one way or another dependent upon estuaries. Salmon and shad migrate through them to fresh-water spawning areas; other species, such as striped bass, use estuaries as nursery areas. For many other marine animals, estuaries are important in feeding and reproduction. Estuaries also provide habitat for blue crabs, oysters, and other commercially valuable shellfish.



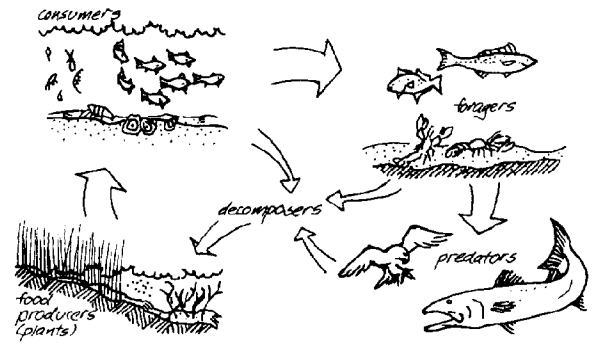
Tidal wetlands (or salt marshes) trap and store enormous amounts of energy in soil and plants. **Tidal flushing,** the daily movement of salt water into and out of the marshes, washes this energy as dead plant matter and microscopic organisms out into the estuaries and Long Island Sound, where it serves as the primary link in the food web for marine life. Salt marshes are pollution filters, removing contaminants from water flowing through them. By slowing the surge of flood waters, they can reduce not only shore erosion but flood damage to upland structures. Many fish species spawn or spend part of their life cycles in tidal wetlands; marshes are also important breeding areas for certain waterfowl.



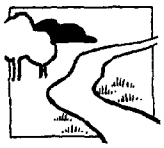


Tideflats are unvegetated sandy or muddy areas exposed at low tide. Despite their barren appearance, they support large animal populations. Worms, crabs, and clams feed at high tide, and retreat into burrows as the tide recedes. High tide also brings juvenile and even adult fish, which graze on the exposed food supply. Millions of microorganisms in the tideflats serve as natural filters for cleaning polluted water.

Shorelands exert an important influence on the natural systems of the coastline. The amount and quality of fresh water draining from shorelands into estuaries determines the salinity and water quality of all coastal waters. The salinity in turn helps determine the type of animal and plant species in the estuaries, and to a degree the type of wetlands vegetation bordering the estuaries. Many animals need the lowered salinity in estuaries for spawning, for use as nursery areas, and for protection from salt-water predators.

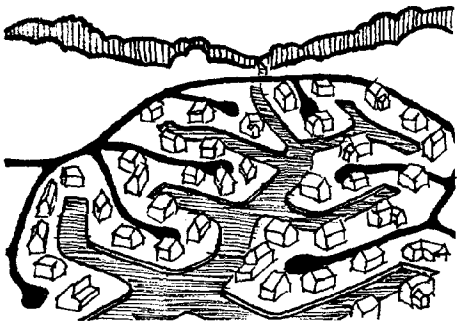


The food web of Long Island Sound begins with dead plant and animal matter and other sediments flowing into estuaries from upland areas. These materials are converted into food by marsh vegetation, marine algae, bacteria, and minute floating plants. The plants are eaten either by small fish, shellfish and other invertebrates, or by microscopic floating animals, which in turn are preyed upon by larger animals. Large fish, birds, and man are at the top of the food web, having no natural predators. Other animals feed on dead plants and animals, reducing them into basic chemical constituents. These materials are used by plants, thus completing the cycle. Because all aspects of the biological system are interrelated, disruption of one part of the food web can affect many other parts.

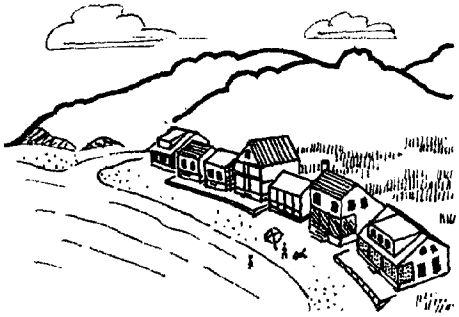


The coastline

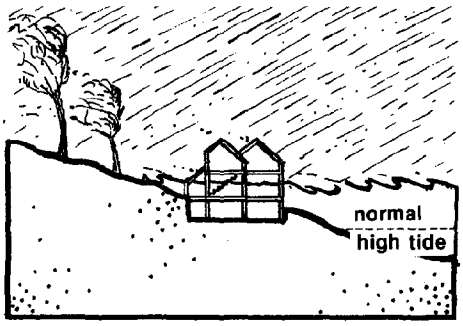
Environmentally sensitive areas



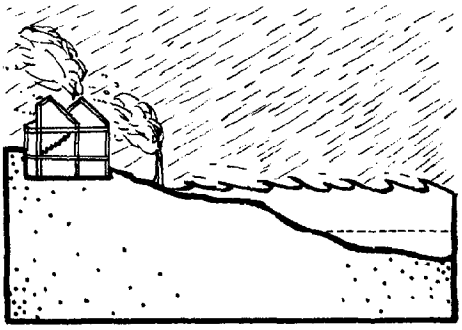
Generally, **tidal wetlands** and tideflats should not be filled or built upon. High water table, unstable soils, and flooding hazard makes development difficult. The value of marshes as wildlife habitat, cleansers of pollutants, nutrient producers and aesthetic attractions makes their preservation vital.

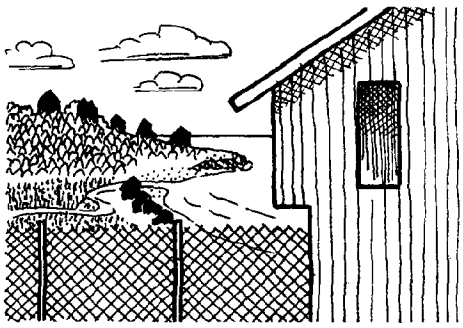


Dunes are easily damaged by almost any human use. Loss of dune grasses through trampling will increase erosion. Foundations for structures are usually unstable, danger of flooding and storm damage is extremely high, and water supply and waste disposal problems are frequent and expensive to solve. Development and heavy use of dune areas is not recommended.

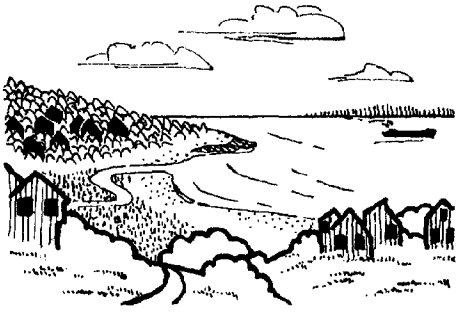


Low-lying areas bordering estuaries and the coastline may be prone to periodic flooding and storm damage. Development of these areas should be limited to water-related activities such as boating and recreation; other development should be carefully planned and regulated.

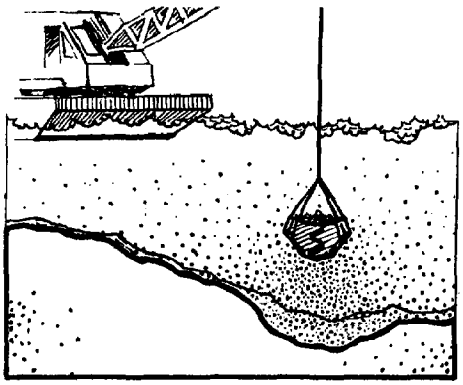




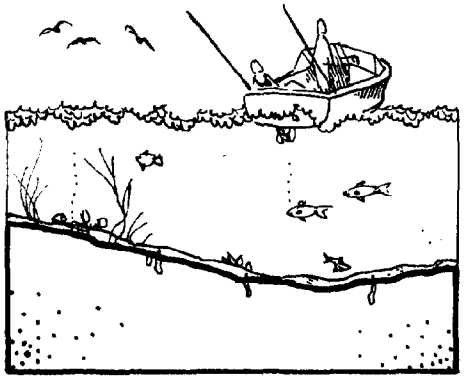
The design of any coastal development should take **scenic areas** into consideration. Public access to scenic views should be allowed and encouraged. Vistas of the Sound and its estuaries can be preserved through the use of buffer zones or by planning the size and location of roads and structures with their visual impact in mind.

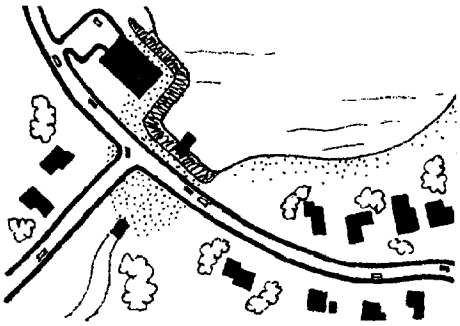


Dredging, fill and structures

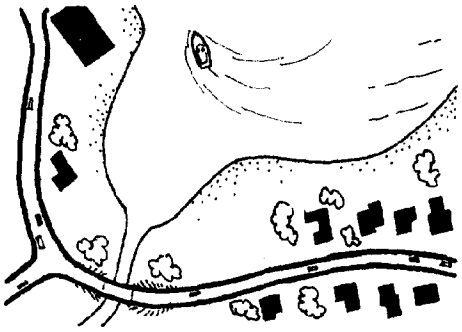


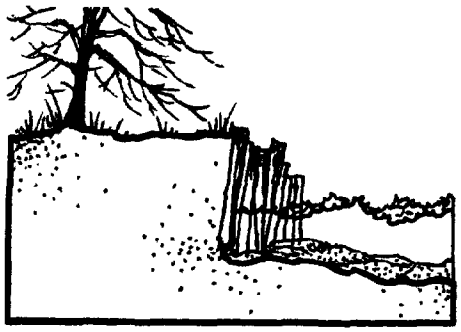
Dredging frequently changes water circulation and salinity and releases pollutants from bottom sediments. Fine silt disturbed through dredging clouds the water and creates poor habitat for bottom organisms after settling. The silt is easily moved by tides and currents; clogged channels may require frequent redredging. Whenever possible, dredging should be avoided. If it is necessary, the amount should be kept to a minimum.



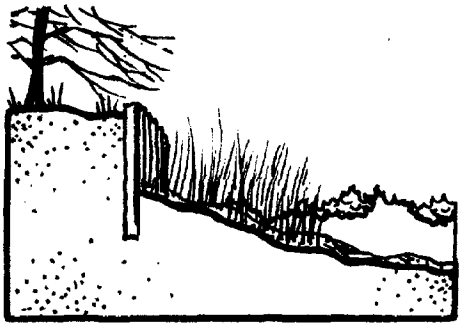


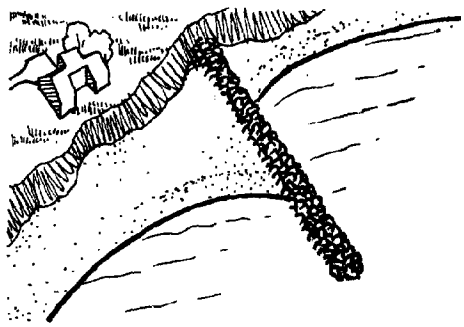
As a rule, coastal and tidal waters should not be filled or otherwise altered. Filled tidal areas are often subject to flooding and may result in erosion problems. In addition, filling alters the flow of water and sediments and destroys wildlife habitat and productive shallow areas. It is generally more expensive to "create" land by filling than to buy prime shorefront property.



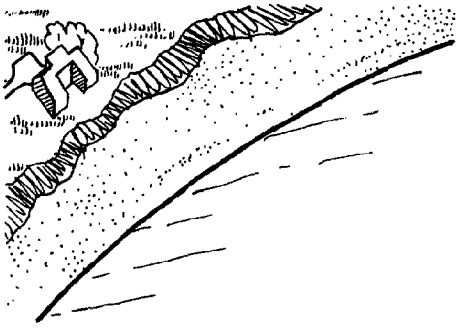


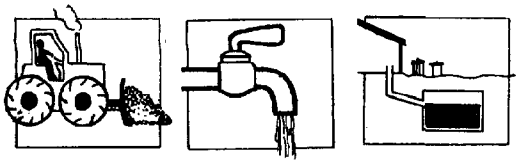
With careful planning, **bulkheading** can usually be avoided by locating development away from eroding shorelines. If not, it may be possible to retain or establish a buffer strip of vegetation between the bulkhead and the water. This will help prevent undermining of the bulkhead, and will protect wildlife habitat.





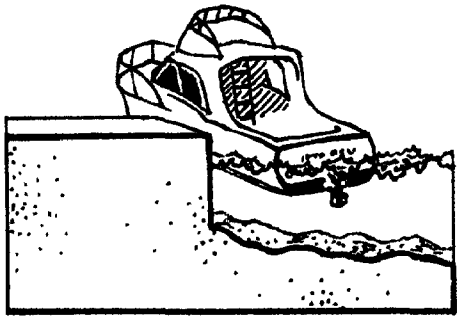
Jetties, groins, and other structures perpendicular to the shoreline often cut off the transport of sand by wave action. Sand may build up on one side of the barrier while the beach on the other side is starved for sand and erodes away. Avoiding such structures allows natural processes to resupply eroding beaches with sand.



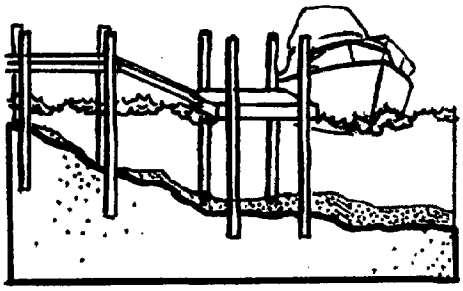


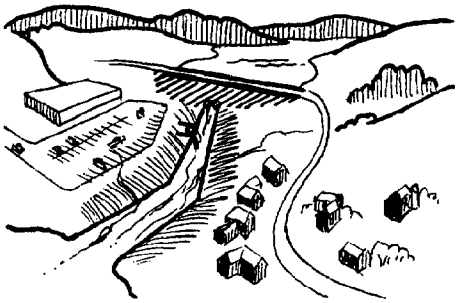
The coastline

Coastal water systems

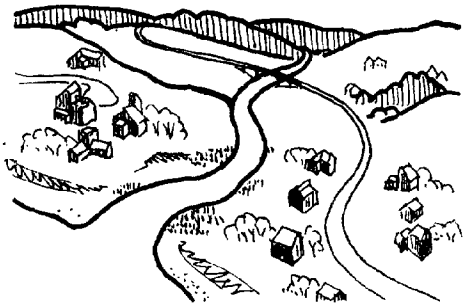


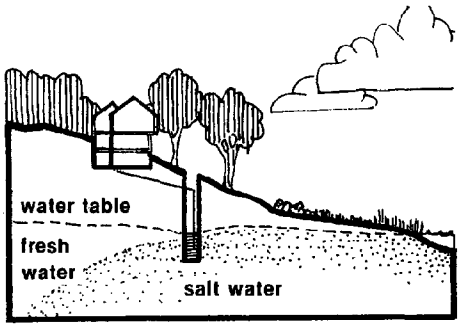
If it is necessary to install a structure in tidal waters, **pilings** are better than fill. Water, sediments, and wildlife can live and move freely beneath the pilings where a solid structure would have created an obstruction.



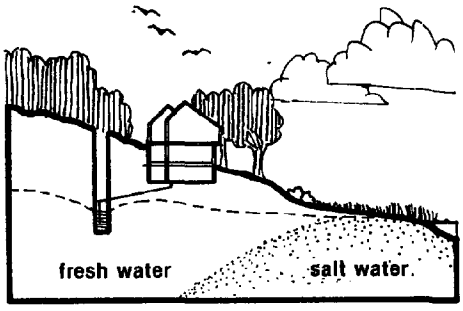


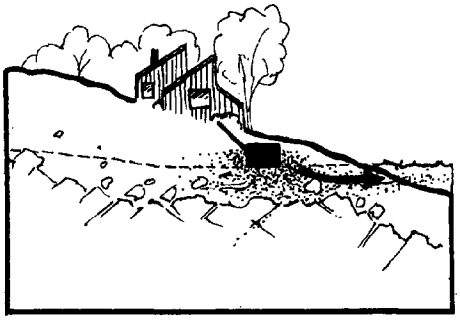
Natural drainage patterns of shorelands should be maintained. Channelization and diversion of coastal streams can increase pollution, change salinity levels, and decrease biological activity in estuaries by diverting flow from marshes, tideflats, and other shallow areas.



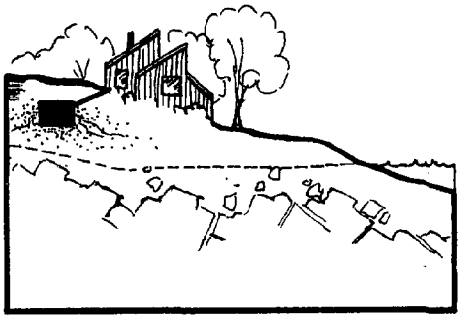


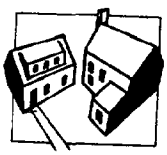
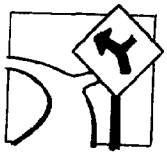
If **wells** are going to be used for water supply, fresh groundwater may be in short supply in many coastal areas. Pumping water out of the ground sometimes causes salt water to contaminate wells. This potential problem should be thoroughly studied prior to development of a coastal site.



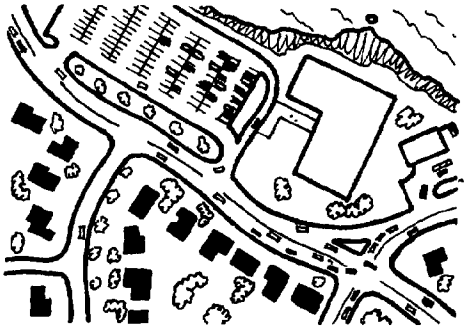


Poorly planned **septic systems** can be especially troublesome near the coastline. Since the water table is usually close to the surface, wastewater may enter the groundwater before it is properly cleansed. Highly permeable sandy soils and relatively impermeable marsh soils require special consideration in design and may limit development sites; bedrock close to the surface may also cause problems.

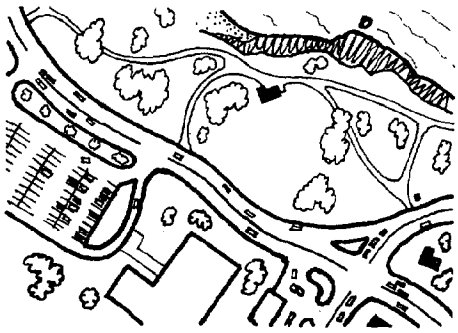


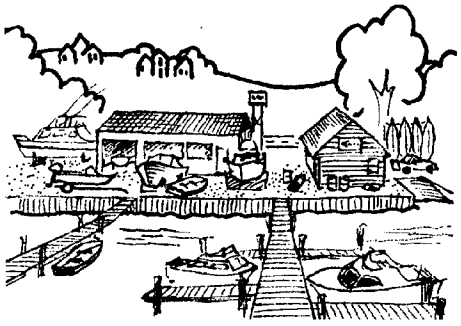



Coastline development and roadbuilding

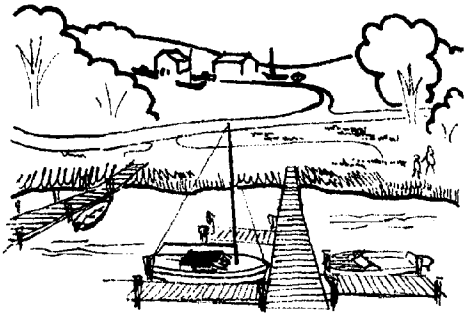


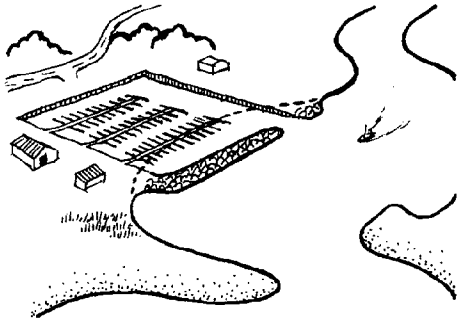
Buildings and other types of development that do not require a coastal location should be inland of the coastline. Locating such development inland will keep coastal areas free for more appropriate water-related uses.



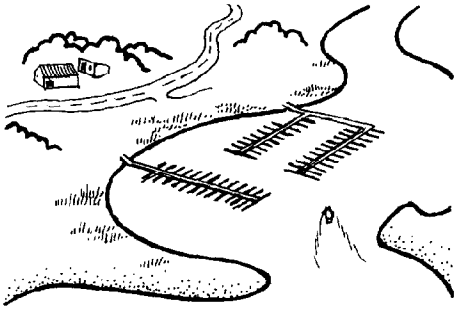


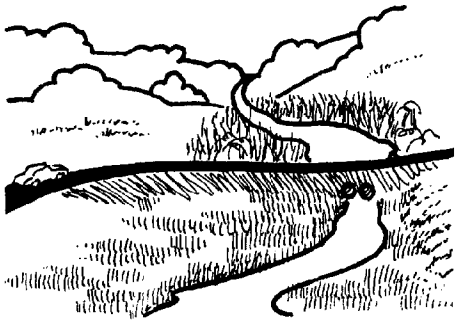
Supporting facilities for marinas, including buildings and storage areas, should be located inland. Locating these facilities on the shoreline preempts valuable open space, pollutes surrounding waters with storm runoff, and greatly increases the probability of serious storm damage.



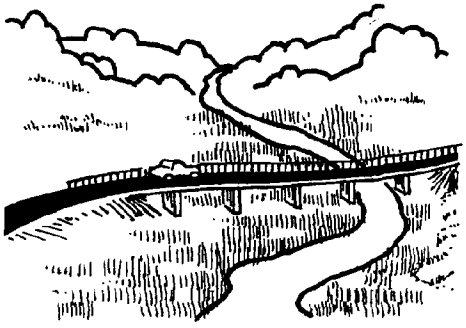


Marinas should be located in areas with steep banks and good water circulation that provide wave and storm protection. In many cases, the natural shoreline can be largely preserved by placing boat slips farther out into the water and connecting them to the shore with wharfs. This will reduce expensive dredging and bulkheading, and will preserve shoreline for recreation and wildlife.





Bridges, causeways, and docks in tidal waters and wetlands should be built so that water circulation is not blocked or impeded. Bridges are more desirable than culverts; pile-supported causeways across marshes and tideflats preserve natural habitat and are less disruptive than solid fill.



The coastal permit programs

Two DEP permit programs deal specifically with the coastline: Structures and Dredging and Tidal Wetlands. It should be noted that these programs deal not only with the shoreline directly facing Long Island Sound, but also with harbors, coves, estuaries, and rivers as far inland as the limit of tidal action. The Structures and Dredging program also includes navigable waters; the program thus applies to the Connecticut River as far north as Windsor Locks. Other DEP regulatory functions, such as the water discharge permits program described in Chapter 2, apply throughout the State, including the coastline. In all cases, developers are encouraged to contact DEP as early in the planning process as possible for information and technical assistance.

Structures and dredging

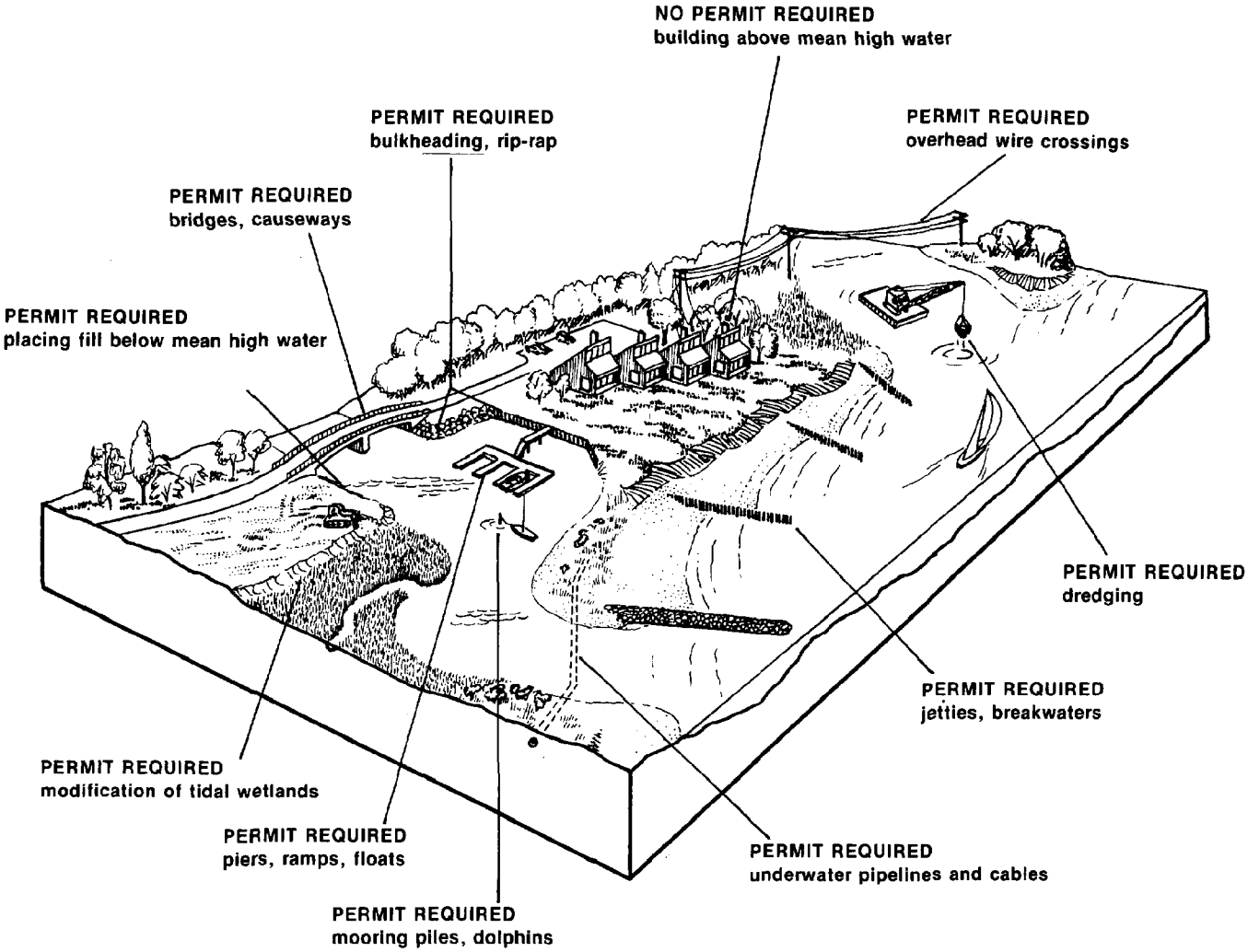
What areas are regulated? Permits are required only for work below the mean high water line (which is the average high tide level). The programs' jurisdiction includes all of the state's tidal waters (the shoreline, bays and estuaries, and rivers as far inland as tidal fluctuation is evident) and navigable rivers (the Thames to Norwich, the Connecticut to Windsor Locks, and the Housatonic to Shelton and Derby). If there is doubt as to whether proposed work will require a permit, contact DEP; a field inspector will, if necessary, visit the site and determine whether a permit is needed.

What activities require permits? As is shown in the diagram (which, by the way, does not illustrate sound development methods), any structure in, beneath, or over tidal and navigable waters requires a permit from DEP. Dredging and filling in these areas are also required.

Who should be contacted? Initial inquiries may be addressed to the Information and Education Unit of DEP. Both the State and the federal government regulate structures, fill and dredging. It is best to request the standard federal forms first from the Permits Branch of the New England Division, U.S. Army Corps of Engineers, 424 Trapelo Road, Waltham, Massachusetts, 02154. Once the forms have been completed, applications may be filed with the Army Corps of Engineers and with the Coastal Section of DEP's Water Resources Unit. No work may be carried out until permits have been obtained from both agencies.

What constitutes an application? Applicants should submit a letter of application that explains the location and purpose of the proposed project, whether it is intended for public or private use, the materials and methods of construction, and details on its design and configuration. Names and addresses of the applicant and adjacent property owners should be listed. In addition, copies of the federal application and plans drawn up in accordance with the Army Corps of Engineers guidelines should be submitted. A more detailed indication of application requirements can be obtained by contacting the Water Resources Unit.

How are applications processed? Once a complete application is received, a field inspector visits the site and evaluates possible impacts of the project, including effects on navigation, erosion, wildlife, and the use of adjacent areas. Comments are invited from town officials, other State units, and adjacent property owners. Public hearings are held for applications involving dredging and, in some cases, other major proposals. Processing of applications takes a minimum of two months if public hearings are not required; hearings lengthen the process to at least four months. Major projects usually require a longer period of time. Permits are effective for a maximum of three years, and must be renewed if work is not completed when the permit expires. Maintenance work may be done after the permit expires, but maintenance dredging cannot be carried out until a Water Quality Certifiate has been obtained from the Water Compliance Unit of DEP.



Tidal wetlands

What areas are regulated? Connecticut's tidal wetlands have been surveyed by the state; all "regulated activities" within the delineated areas require permits. Wetlands boundary maps are on file in the town clerks' offices of all the affected towns, and a complete set is kept at DEP. Copies of individual maps may be purchased from the Coastal Section, Water Resources Unit, DEP, State Office Building, Hartford, 06115. DEP personnel will stake out wetlands boundaries on applicants' properties if a written request is submitted.

What activities require permits? Dredging, filling, excavation, and removal of earth material from tidal wetlands can be carried out only after a permit has been obtained. The same is true for depositing materials, driving piles, or placing obstructions on tidal wetlands.

Who should be contacted? A detailed list of application requirements is available from the Coastal Section, Water Resources, DEP. The requirements include a letter of application to the Commissioner of Environmental Protection, a surveyor's map of the property, and drawings showing the design and location of the proposed work. Ten copies of the application materials are required.

How are applications processed? As with the structures and dredging program, incomplete applications will not be processed until the missing information is provided by the applicant. Copies of the application and plans are sent to town and State officials, and a public hearing is held. Applicants should expect a processing time of about 6 months from acceptance of plans to the final decision on the application.

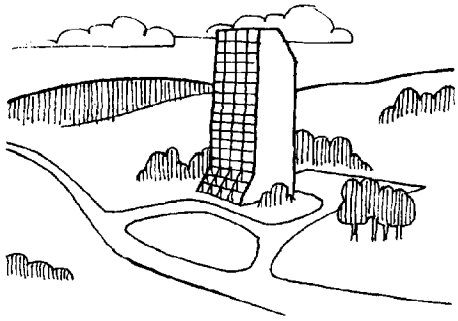
3 Further considerations

A look at recent suburban development in Connecticut will convince most observers that aesthetics is rarely treated as a major factor in subdivision planning. This is not surprising, considering that reactions to the visual environment are highly subjective, and that the economic benefits of good landscape design are difficult to assess. However, efforts to incorporate positive scenic and visual qualities into development pay off in the form of higher property values and improved quality of life.

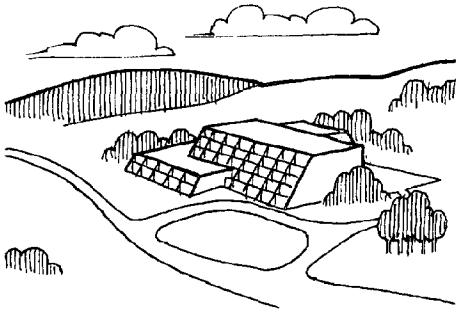
The following pages illustrate a few commonsense aesthetic considerations for development of suburban and rural sites. The advantages of open space preservation, cluster development and energy conservation are also discussed. Developers are advised to seek further information on energy conservation; the Connecticut Department of Planning and Energy Policy can be consulted for assistance.

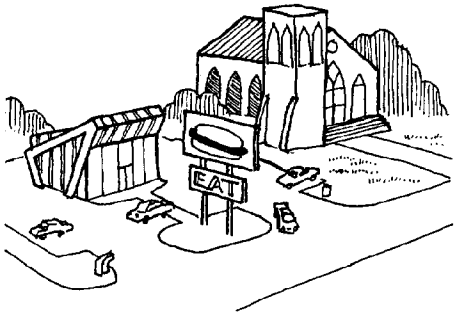
Further considerations

Harmonizing with the landscape

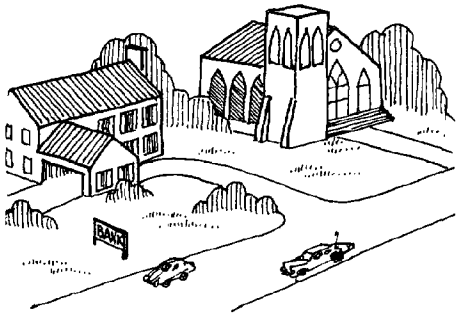


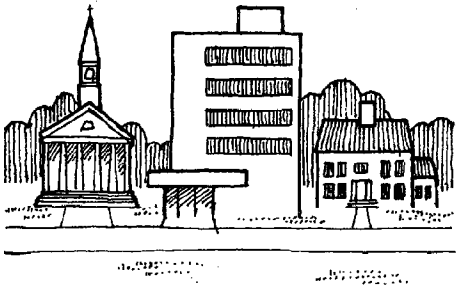
Buildings should be designed to blend with their natural surroundings rather than spoil them. Instead of ignoring or dominating the landscape, large structures should harmonize with the natural features of the area. Use of appropriate building materials and skillful landscaping will make new buildings less obtrusive.



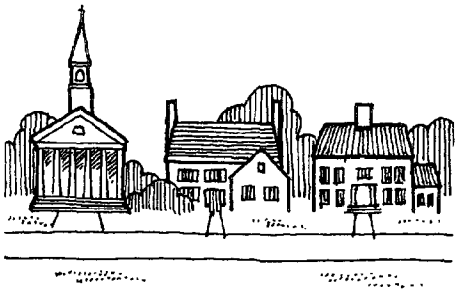


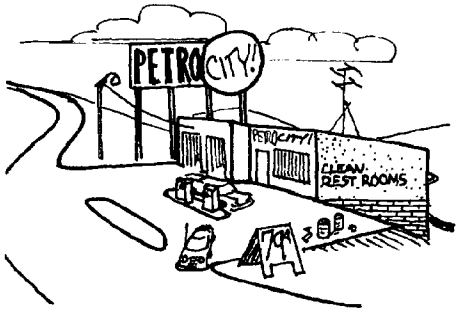
The use of a site should be compatible with other land use in the area. A commercial development that could be an asset in the right location may be a nuisance and an eyesore if improperly sited.



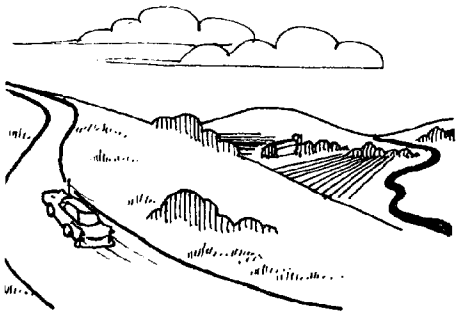


Improper scale and architectural style of buildings can visually spoil an entire street. The height, use of building materials, setback from the street, and landscaping of new buildings should harmonize with neighboring structures. Buildings should not "compete" with nearby visual attractions such as churches and historic houses.



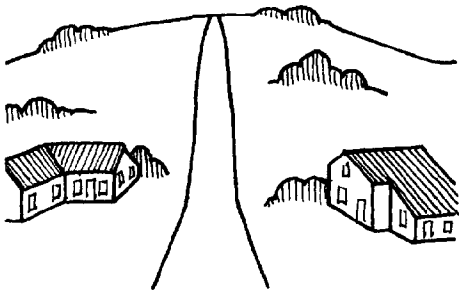


Buildings, signs, and parking areas should not block vistas from roads and other public areas. Pleasing views can be maintained by placing utilities underground, landscaping to prevent vegetation from obscuring the view, and locating buildings below or to one side of the line of sight.

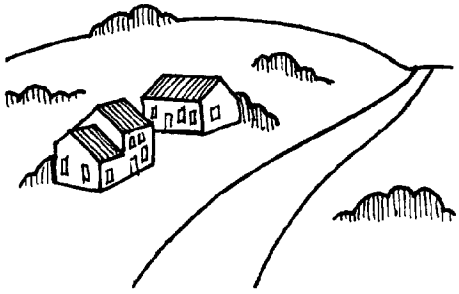


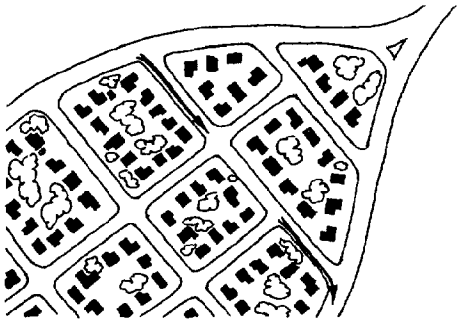
Subdivision design

Hilltops should be avoided as building sites. Exposure to winds increase heating costs; the natural horizon line is interrupted and buildings are highly visible. Buildings located below hillcrests are more sheltered and are less visible from distant viewpoints.

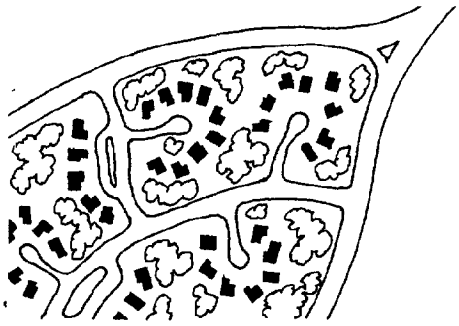


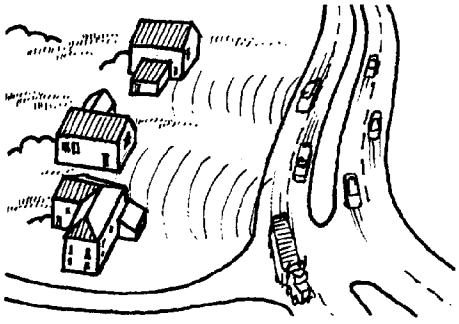
Roads should follow the contours of the site rather than run against them. Roads built straight up and down hills require more grading, are more expensive, need more maintenance, and may increase erosion problems. Visually, a carefully-planned circulation pattern is preferable to a monotonous grid system, and the natural assets of the site are more likely to be maintained.



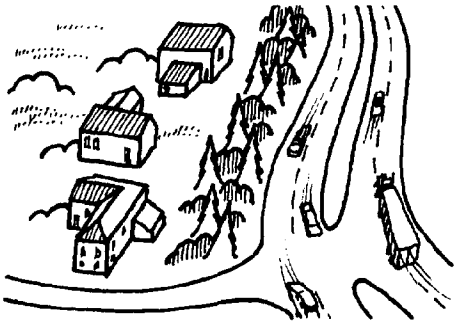


Subdivisions should not be designed with wide "straight through" streets that encourage outside traffic. Use of curves and cul-de-sacs will improve the visual quality of the subdivision as well as increase privacy and reduce unnecessary noise and traffic.



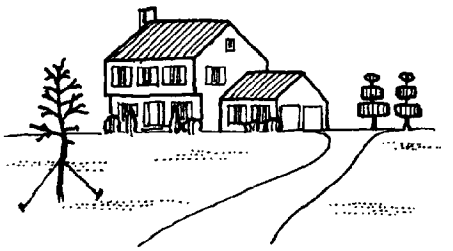


Residential areas should be separated from major highways, commercial areas, or factories by buffer areas. Existing or planted vegetation (especially evergreens) and bulldozed earthen berms can effectively increase privacy and reduce noise reaching the development.

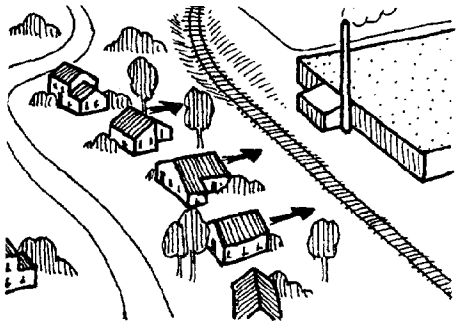


Further considerations

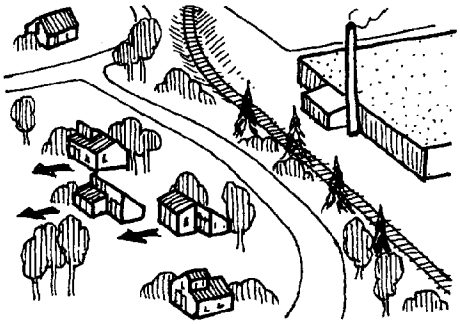
Subdivision design

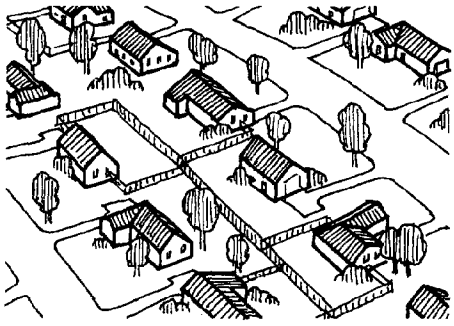


In developing a site, as much existing vegetation as possible should be preserved. Stripping an area of trees decreases its value and reduces its visual quality. When planting new vegetation, it is best to use native species, since they are generally hardier and better suited to the site than ornamental and exotic plants.

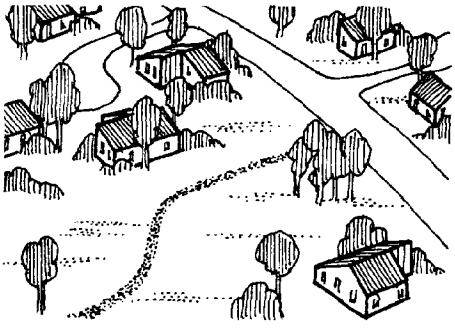


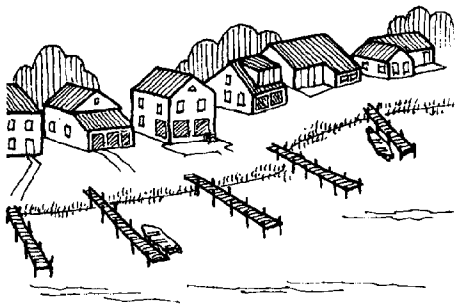
In addition to screening homes from undesirable views, subdivisions can be planned so that houses face away from unsightly buildings, roads, and parking lots, and take advantage of natural and open space areas. Trees and undergrowth can be thinned to open up distant vistas without stripping the site of vegetation.



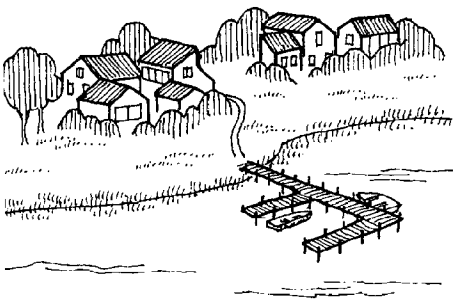


Maintaining portions of a site as open space has many advantages: privacy is improved through separation of buildings or groups of dwellings; car and play areas are separated for greater safety; the value and aesthetic quality of the development are improved. In addition, biologically valuable areas such as wetlands can be preserved, and buildings can be concentrated in areas best suited for them.

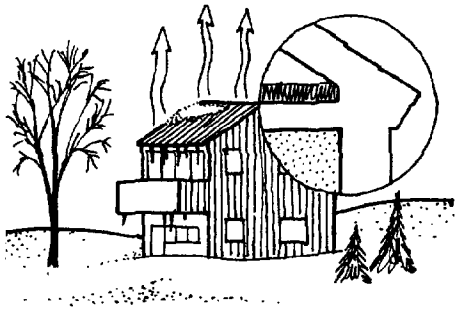




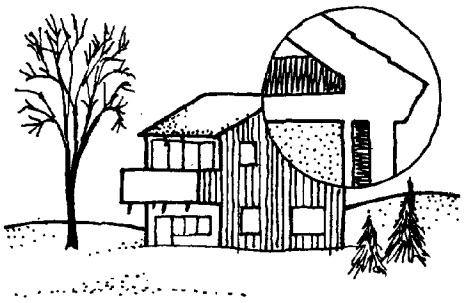
The natural quality and attractiveness of a lakefront or coastline can be destroyed by improper development. Heavy development of the immediate waterfront causes most vegetation to be stripped away and increases danger of pollution from septic systems. Houses should be set back and clustered, with common docks and access points instead of unsightly individual piers.

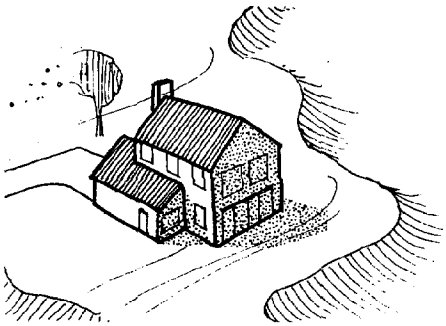


Energy conservation, utilities

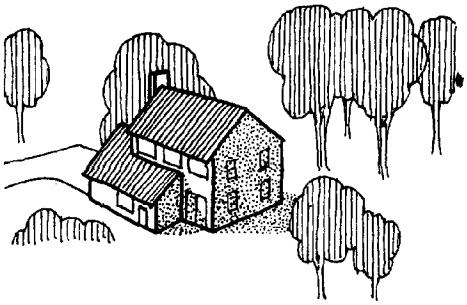


Increasing insulation in walls and ceilings can substantially reduce heating costs regardless of the type of heating system used. Increasing insulation in walls from 0 to 4 inches and in ceilings from 3 to 6 inches can lower heat loss on a cold day by roughly 30 percent. Reducing air leaks around doors and windows also reduces heat loss.

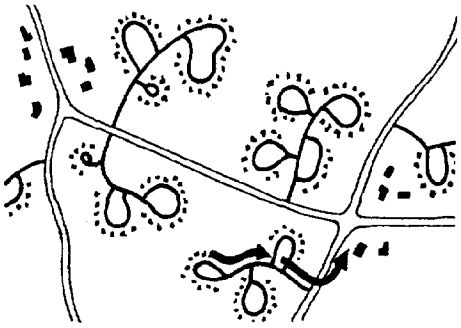


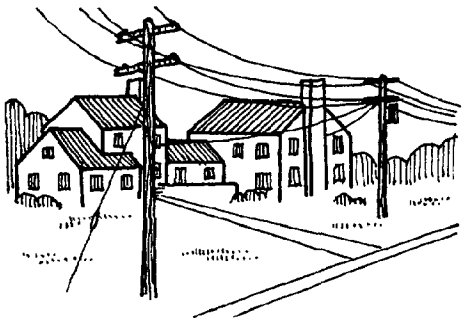


The location and exposure of buildings can have a major effect on energy consumption. Houses on exposed, windy sites will require more energy to heat than buildings in more sheltered areas. Large windows on shady northern walls will increase winter heat loss. Roof overhang on south-facing walls with large windows can be designed so that sunlight enters the house in the winter and is largely blocked in the summer.

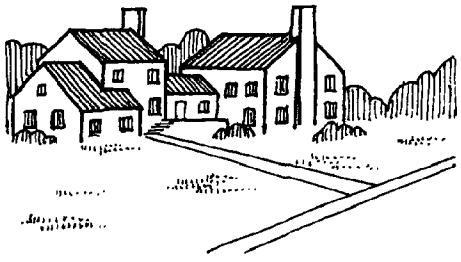


Widely dispersed residential development causes energy to be wasted in frequent and lengthy automobile trips. Increasing density of development and locating subdivisions, schools, shopping areas and employment centers near each other reduces gasoline consumption and makes possible the use of alternative forms of transportation.

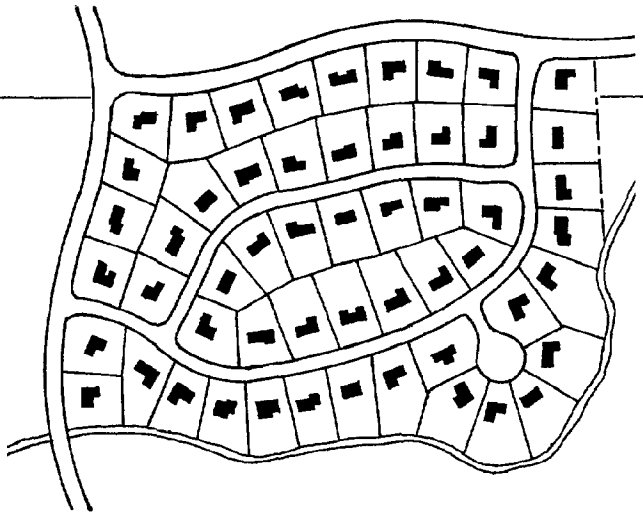




Utility poles and overhead wires create a cluttered effect and are susceptible to damage in storms. Installation of utilities can be timed to coincide with road-building operations so that expense and disruption of installing equipment underground are minimized.



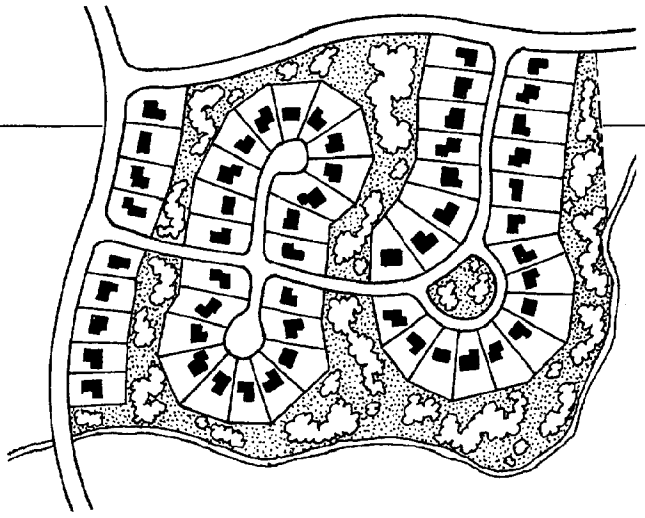
Cluster development



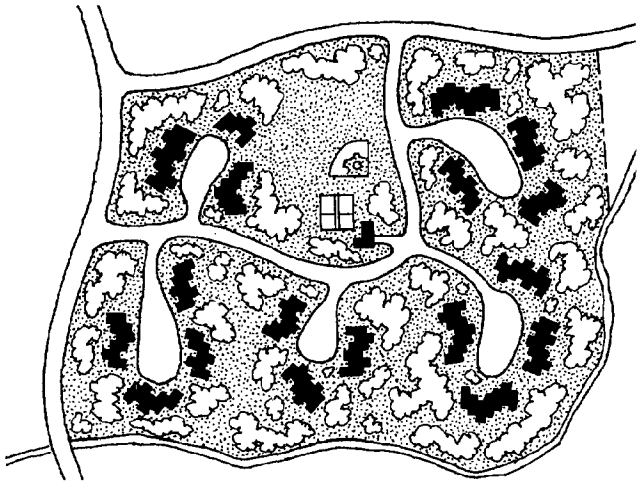
Site: 30 acres; 54-lot subdivision

Conventional subdivision design

In most subdivisions, the entire site is split up into single house lots of ½ acre or more. A large amount of roadway is required for access to the lots, and, since houses are dispersed, utility installation and maintenance costs are high. Lack of open space requires mixing of pedestrian and vehicular traffic, creating safety problems. Privacy is limited, and the landscape is often visually monotonous.



Cluster development: 54 lots



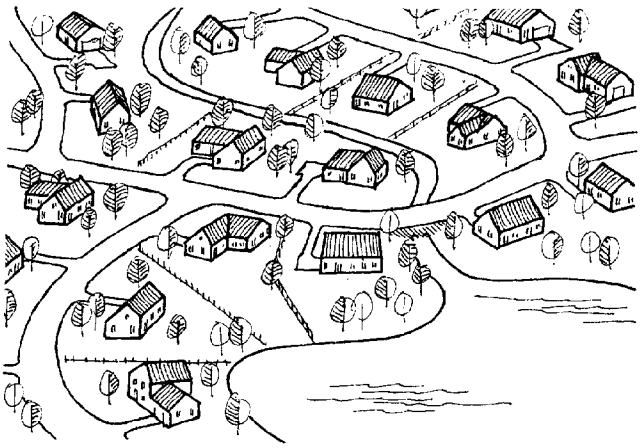
Cluster development: 112 townhouses

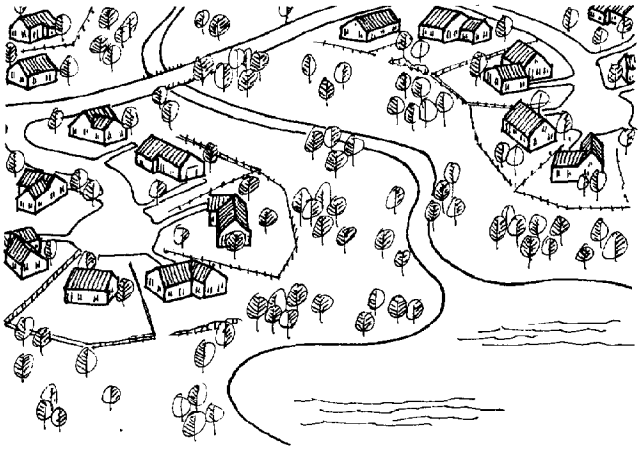
Cluster design

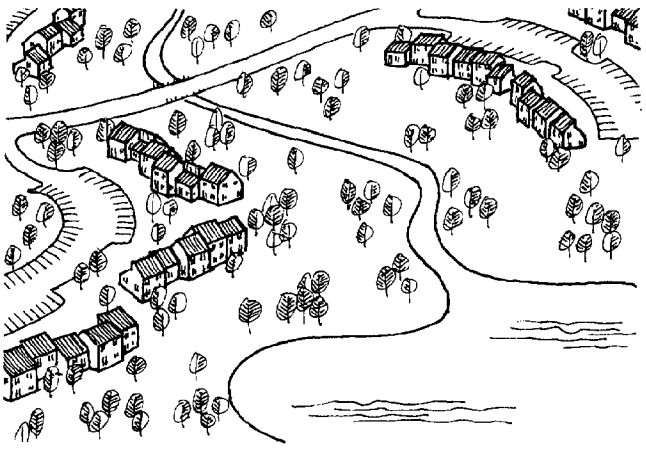
In cluster developments, individual lot size is reduced in favor of common open space areas. Clustering allows for utilization of the best building sites while preserving environmentally sensitive areas. Concentration of buildings lowers installation costs for utilities, and reduces roadbuilding requirements. Pedestrian and vehicular traffic can be separated; safety is increased by locating public recreational areas away from roads. Careful layout of open space can provide increased privacy, and will help maintain the natural character of the site.

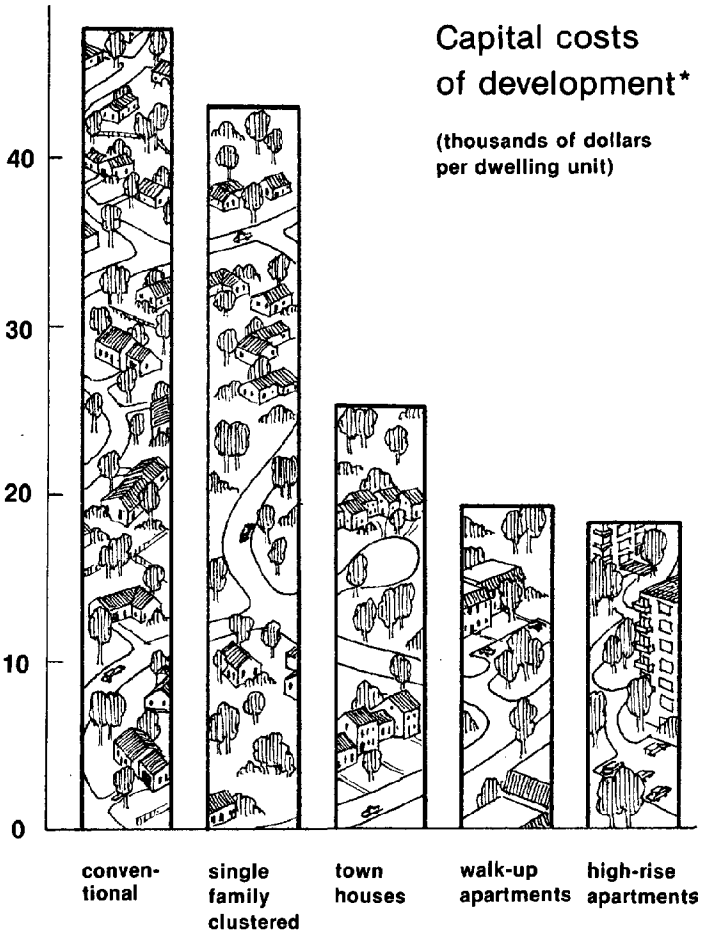
Clustering of single-family homes on private lots enables the benefits of private land ownership to be maintained. An alternative which provides larger open space areas and higher housing density is the construction of townhouses or apartments instead of individual homes. This type of development also allows for the most efficient layout of roads and utilities.

The zoning regulations of most Connecticut towns contain no provisions for cluster development; therefore variances would be necessary in most localities. Towns considering the adoption of cluster development ordinances should evaluate road width and surface water drainage standards to allow for narrower cul-de-sacs and drainage systems that, where possible, follow natural drainage patterns.









The conventional subdivision made up of single family homes is the most expensive type of development in terms of capital costs per dwelling unit. As clustering of housing and density increases, the economic and environmental costs of development generally decrease. Savings are made in both capital and maintenance costs, and are felt by government as well as the private sector.

* This analysis (from **The Costs of Sprawl**, prepared for the Council on Environmental Quality, the Department of Housing and Urban Development and the Environmental Protection Agency and available from the U.S. Government Printing Office) considers the costs of residential development, schools, open space, transportation and utilities for a 1,000 unit neighborhood.

4

Site evaluation

As the previous chapters have illustrated, there are a large number of environmental factors to be considered in the planning and construction of subdivisions. These include the opportunities and constraints that a site's physical characteristics impose upon development (Chapters 1 and 2) and additional environmental factors such as aesthetics, energy conservation and layout of buildings and roads (Chapter 3). Viewed individually, these considerations are relatively manageable in relation to the nature of the problems they pose and the ways in which developers can deal with them. It is considerably more difficult, however, to deal with all of the important environmental problems in coming up with a development plan that is in harmony with the characteristics of the site.

DEP's Natural Resources Center has developed a systematic approach which, in simplified form, can be utilized by developers to conduct a comprehensive analysis of development sites. To illustrate this system, an actual site has been chosen and, on the following pages is analyzed in terms of its major characteristics. The opportunities and limitations imposed by the site's natural qualities were then considered in drawing up a hypothetical development plan.

In considering the visual assets of a site, extensive field observation is necessary. Features observed in the field can be mapped (see accompanying **visual features** map) and considered along with the site's physical features in compiling the development plan. Visual characteristics to be considered include ridge tops and valley bottoms, brooks and streams, ledges, stone walls, views and vistas, significant vegetation (such as hemlocks and other evergreens, wetlands plants and wildflowers) and other aesthetic assets such as waterfalls and historic buildings.

The remainder of the analysis is conducted by considering each of the major natural resource characteristics of the site in relation to land uses proposed for the site. For a typical subdivision, the major land uses would be:

* **Water supply**
* **Septic systems or sewers**
* **Buildings and dwellings**
* **Roads and parking areas**

The primary natural resource factors affecting (and affected by) the land uses are:

* **Depth to water table**
* **Earth material characteristics (i.e. soil percolation rates, susceptibility to erosion, etc.)**
* **Slope**
* **Deth to bedrock**
* **Flood-prone and storm-prone areas**

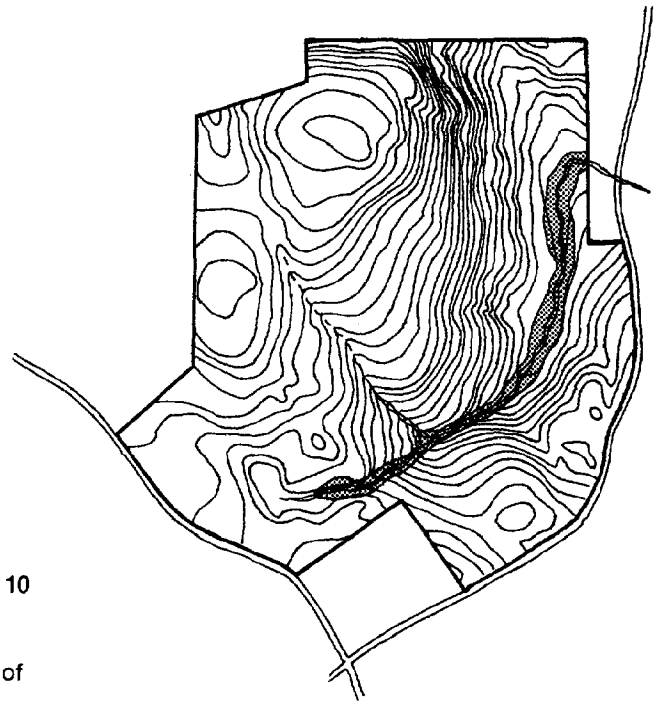
Depending on the site, its proposed use, and the level of detail of the analysis, additional natural resource factors can be considered. These include vegetation, wildlife value, wetlands, drainage areas, availability of ground water, bedrock type, agricultural capability and other factors.

The charts on the following pages evaluate two of the proposed land uses — septic systems and buildings — in terms of four resource factors — depth to bedrock, depth to water table, earth materials and slope. The degree to which a natural resource factor limits the proposed land use will vary from location to location. For example, in areas where bedrock is more than 10 feet below the surface, bedrock usually will not limit or make special design necessary for dwellings and septic systems. In areas where bedrock is somewhat closer to the surface, some special design measures may be required. The most severe limitations will be imposed where bedrock is shallow and outcrops are frequent. These varying conditions are designated on the charts as optimum, marginal, and critical, respectively.

The site has been mapped for each of the four major resource characteristics, with shaded areas designating portions of the site where design or development restrictions are imposed. When these maps are combined (page 51), overall development opportunities and limitations are revealed.

One of the greatest limitations to conducting an analysis of this type is lack of data. The mapping of natural features such as detailed soil types and surficial and bedrock geology has not been completed in some areas of the

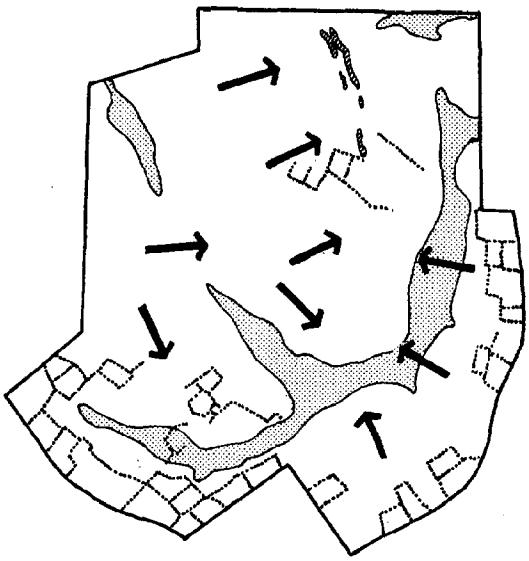
state. Even in mapped areas, information may not be detailed enough to be useful in site analyses. However, these inventory maps can be used to determine the specific resource concerns that should lead to further site investigation. Field observation at the site can provide information that is not otherwise available; field work is also important in confirming existing data and compiling information on unmapped features such as vegetation. The Natural Resources Center at DEP has up-to-date listings of the data available for each town in the state, and will assist developers in obtaining and interpreting this information.



Horizontal scale: 1 inch = 2,000 feet

Contours (vertical distance between contour lines is 10 feet)

Flood-prone areas (areas where there is a 1% chance of flooding in any given year)



The site is a tract of approximately 600 acres in rural Connecticut that contains many features typical of suburban and rural areas. A stream runs through the southeastern portion of the site and is fed by a spring and a small red maple swamp. The areas immediately adjacent to the streambanks are subject to occasional flooding. The land was formerly farmed, and consists primarily of second growth forest. Elevation varies from 325 to 600 feet above sea level.

Visual features

Views and vistas

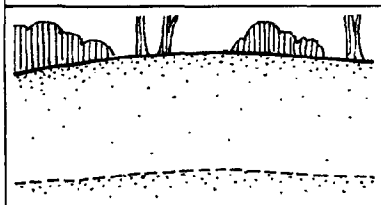
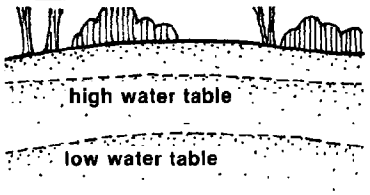
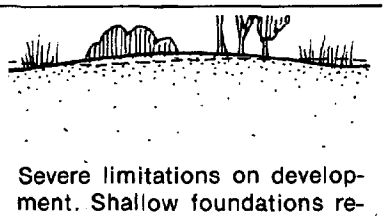
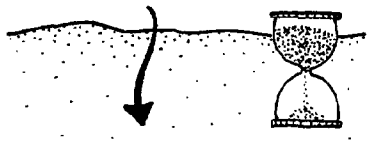
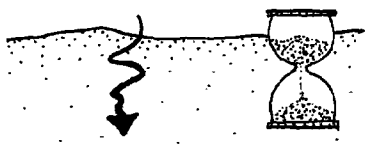
Stone walls

Ledges and rock outcrops

Significant vegetation

Depth to water table, earth materials (percolation)

Illustrated below are physical conditions commonly encountered at development sites, accompanied by brief descriptions of engineering measures (for foundations and septic systems) required for development in areas where these conditions are present. Development under "critical conditions" is usually prohibitively expensive as well as environmentally damaging.

	OPTIMUM CONDITIONS	MARGINAL CONDITIONS	CRITICAL CONDITIONS
DEPTH TO WATER TABLE	**Greater than 10 feet**	**fluctuates from 3 to 10 feet**	**Permanently high: wetlands***
			
	Conventionally designed basements and septic systems will not be flooded.	Building footings should be properly drained; shallow foundations may be necessary. Septic systems require curtain drain and/or use of fill material similar to existing soil.	Severe limitations on development. Shallow foundations required: site preparation includes removal of organic material and replacement with clean fill. Elaborate drainage and fill necessary for septic systems.
EARTH MATERIALS (PERCOLATION)**	**Percolation up to 20 minutes per inch**	**Percolation 20-60 minutes per inch**	***Percolation more than 60 minutes per inch***
			
	Conventional building design adequate. Standard septic systems adequate in most cases; special design needed where percolation exceeds .5 minutes/inch, which is too fast for adequate renovation.	Standard building design; larger leaching area required for septic systems, with standard or special trench design. Water mounding may occur because of slow percolation.	Standard building design; severe limitations on septic systems, with extensive leaching fields, fill, and/or aboveground systems required (see footnote, page 49).

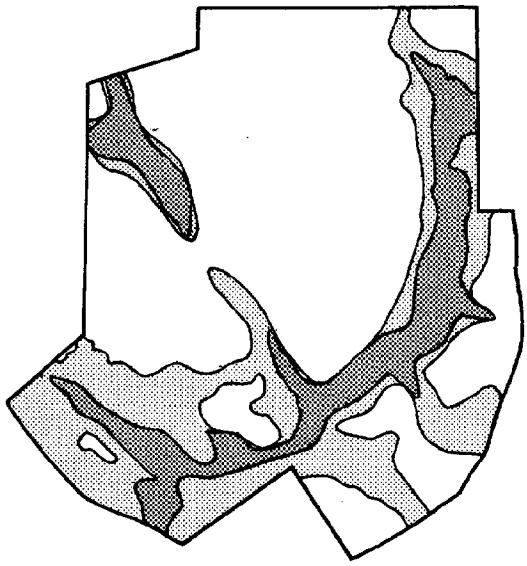
* Wetlands permit required

** The percolation rate, or the speed at which water can flow through the soil, is one of several soil characteristics that affect development. Another is the ability of various soil types to support foundations. Most upland soils (glacial till) and sand and gravel deposits will adequately support foundations. Problems are frequent in clays, peat deposits and other wetland soils, where special measures are necessary to prevent buildings from settling.

Depth to water table, earth materials (percolation)

Depth to Water Table

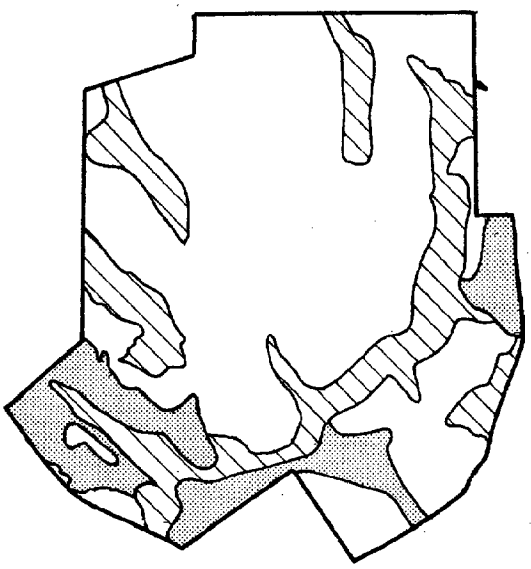
This information is not commonly available on maps. An indication of water table depth can be obtained from soils maps compiled by the Soil Conservation Service (SCS). Soils maps are available from SCS Field Offices and DEP's Natural Resources Center. Soils maps showing regulated inland wetlands may be obtained from the Water Resources Unit, DEP. SCS publications include tables which indicate saturated soils and soils with ground water within three feet of the surface. These tables can be used along with soils maps (and field testing where necessary) to complete a general map of ground water characteristics for development sites.*



Saturated soils (regulated inland wetlands)

Water table within three feet of surface

Optimum ground water conditions for development



* Assistance in interpreting soils data and compiling maps may be obtained from the Natural Resources Center.

Earth Materials: Percolation Probability

Percolation rates can be estimated from information compiled by the SCS. Detailed soils maps can be used in conjunction with SCS keys which indicate percolation rate probabilities for the various soil types. Each soil type has been placed into one of four categories: fast, probably fast, probably slow, and slow. Field testing will be necessary at possible septic system sites to provide more accurate data. The cross-hatched portions of the map represent areas where other resource characteristics (wetlands and shallow bedrock) preclude the use of percolation probability.

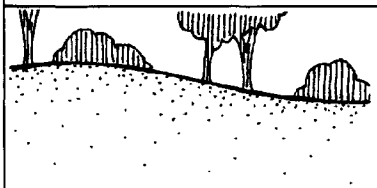
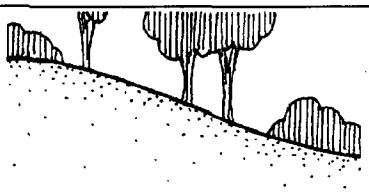
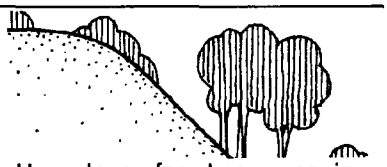
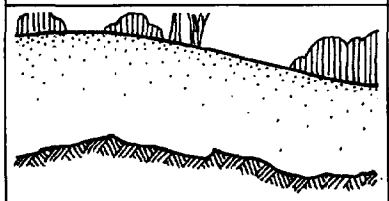
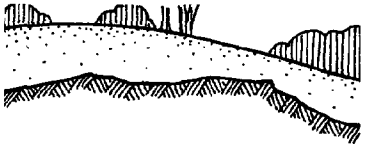
Slow percolation (80% chance that water in a test hole will take longer than 30 minutes to fall one inch)

Probably fast percolation (50% chance that water in a test hole will take 10 to 20 minutes to fall one inch)

Areas where other resource characteristics (shallow water table and bedrock) **preclude the use of percolation probability**

Slope, depth to bedrock

Frequently encountered physical conditions of development sites are outlined here along with the engineering measures commonly used in response to those conditions. Expense of site preparation and septic system installation is considerably greater on steep slopes and in areas where bedrock is near the surface than in areas where conditions are less restrictive for development.

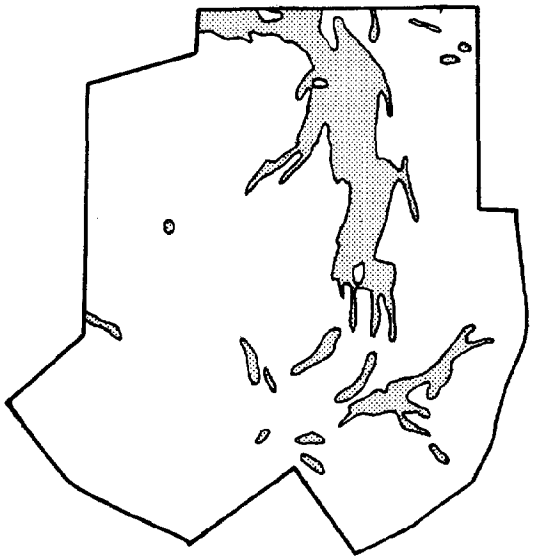
	OPTIMUM CONDITIONS	MARGINAL CONDITIONS	CRITICAL CONDITIONS
SLOPE	**Less than 10 percent**	**10 to 15 percent**	**Greater than 15 percent**
			
	Suitable for construction of buildings and septic systems using conventional design.	Some grading may be necessary to prepare building sites; septic system trench design should be adjusted to accommodate slope.	Hazardous for heavy equipment. Considerable grading necessary at building sites, requiring precautions against erosion and soil slumping. Extreme difficulty in septic system installation with use of grading and fill.*
DEPTH TO BEDROCK	**Greater than 10 feet**	**LESS THAN 10 FEET**	**Numerous outcrops**
			
	Conventional building and septic system design is adequate. Trenches should be 3-6 feet below surface and at least 4 feet above bedrock.	Septic system trenches should be 4 feet above bedrock and covered with fill to proper depth. Some removal of bedrock may be necessary for building sites; foundations should rest on same material throughout.	Fill required for septic system installation.* Blasting required for building site preparation; foundations should rest on gravel cushions to prevent uneven settling.

* Relatively complex and expensive measures are required for effective septic system operation where natural resource conditions are critical. These include techniques (such as fill and subsurface drainage systems) to make conventional systems function under unusual conditions, as well as the use of special equipment and methods such as leaching galleries and above-ground systems. In either case, a professional engineer and the Water Compliance Unit of DEP should be consulted.

Slope, depth to bedrock

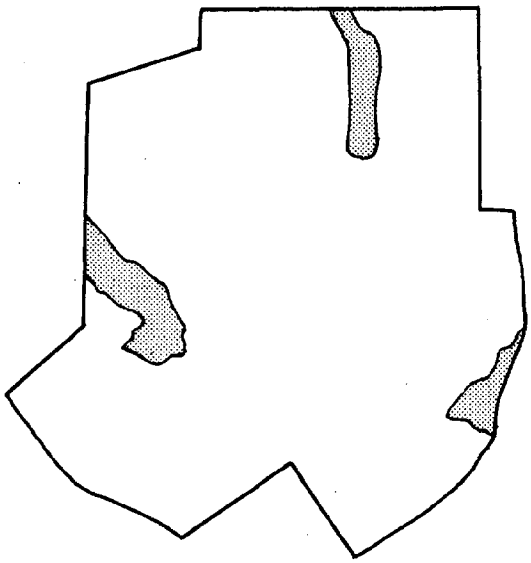
Slope

Maps showing steep slopes can be compiled from topographic maps, SCS maps and observations in the field. The Natural Resources Center offers technical assistance in the compilation of these maps. For smaller sites, field observations may be adequate for delineating areas with steep slopes.



Slope 15% or greater (elevation change of at least 15 feet per 100 feet horizontal distance)

Moderate: slope less than 15%



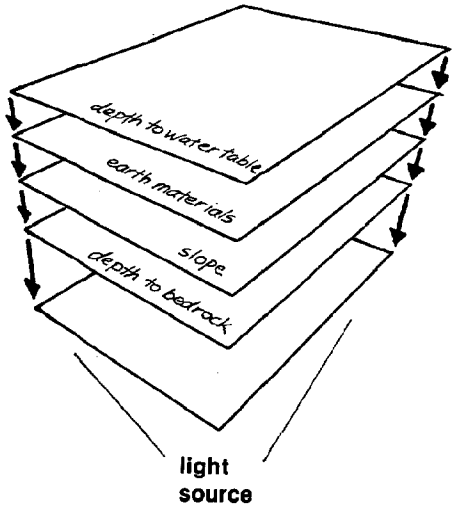
Depth to Bedrock

Bedrock outcrops can be mapped through field observations and may be visible in some aerial photographs. SCS maps and surficial geology maps can be used to generally determine shallow bedrock areas. Surficial geology maps show areas where bedrock is within 10 feet of the surface; SCS soils maps can be interpreted to show areas where soil is rocky or where bedrock is 2 feet or less below the surface.

Bedrock close to surface; frequent outcrops

Optimum depth to bedrock conditions for development

The composite map



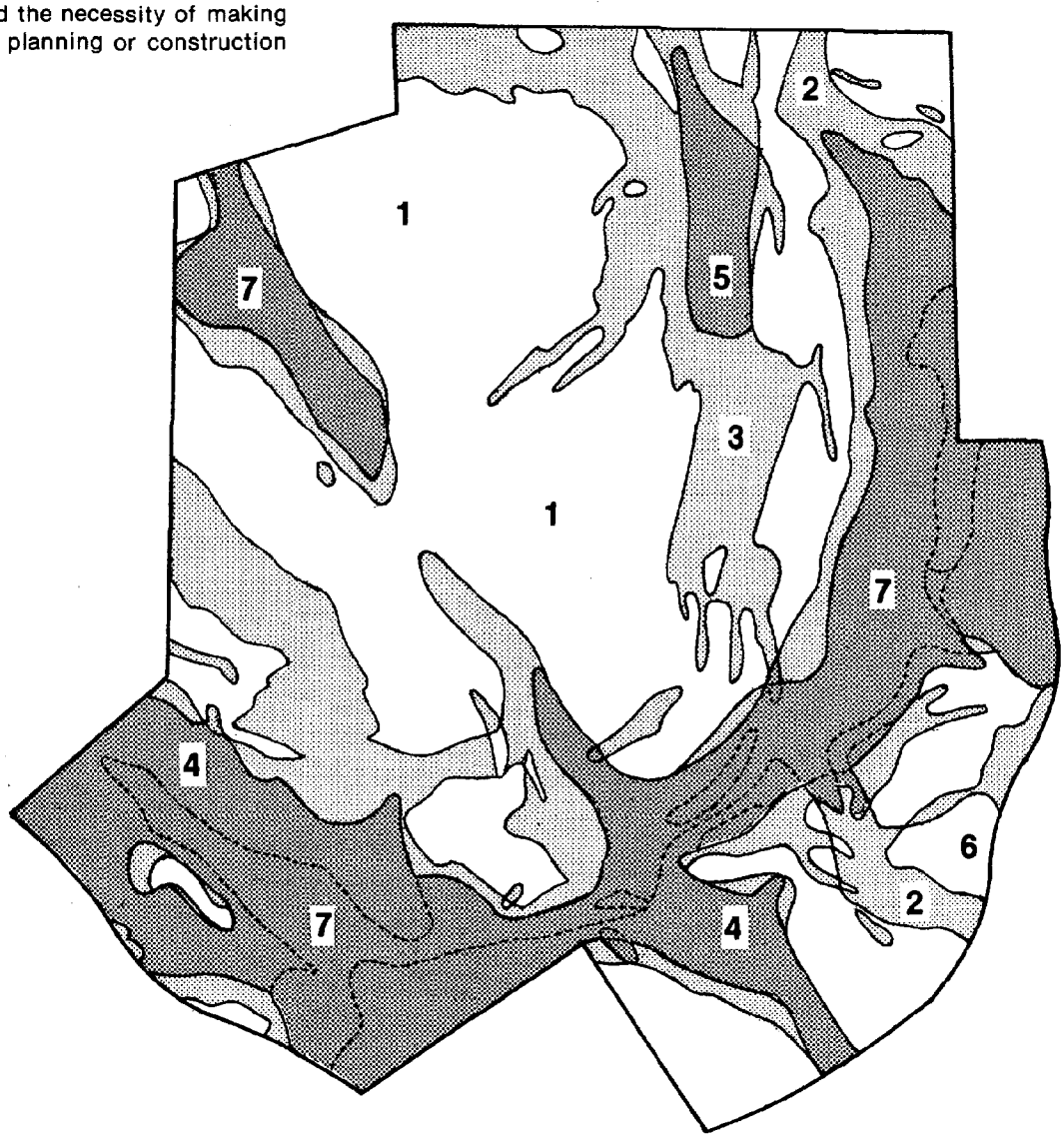
Each of the individual resource maps should be drawn to the same scale on tracing paper or acetate sheets. Areas where development constraints are greatest should be shaded, with areas imposing few or no limitations left clear. If the maps are then placed on top of each other and held to a light source, light and dark areas will be visible, giving an overview of the development opportunities and limitations imposed by the site's natural characteristics. The light and dark areas can be traced to make a composite or "overlay" map showing optimum development sites and areas with moderate and severe restrictions on development. The most important use of the composite map is the identification of the specific types of problems that exist on various parts of the site. Knowing these problems early in the planning stage allows the developer to use the characteristics of the site to his best advantage and avoid the necessity of making expensive changes later in the planning or construction processes.

Critical conditions for development

Moderate conditions

Optimum conditions

Scale: 1 inch = 1,000 feet



Development opportunities and constraints

The charts on pages 47 and 49 outline the limitations imposed by individual resource factors. In the final analysis, however, all of the factors will have to be considered together. Listed below are the combinations of resource characteristics that occur most frequently at the site, and the engineering measures required for development of areas with those characteristics.

1. **Conditions:** Bedrock 10 feet or more below surface, soil percolation probably fast, slope less than 15%, water table 10 feet or more below surface.

   These areas present the best conditions for development. Conventional construction methods and design can be used for buildings and septic systems, and little or no grading is required for roads and driveways.

2. **Conditions:** Bedrock 10 feet or more below surface, **soil percolation slow,** slope less than 15%, high ground water one to two months per year.

   Seasonally high ground water will require special septic system design, possibly including the use of curtain drains or fill. Shallow foundations may be necessary for buildings; basements should be adequately drained.

3. **Conditions:** Bedrock 10 feet or more below surface, soil percolation fast or probably fast, **slope 15% or greater,** water table 10 feet or more below surface.

   Grading for buildings and roads could cause erosion problems; proper fill should be used to prevent slumping or settling of foundations. Restrictions on septic systems are severe: elaborate leaching field design and fill may be necessary, and machine operation may be unsafe.

4. **Conditions:** Bedrock 10 feet or more below surface, **soil percolation slow,** slope less than 15% high ground water one to two months per year.

   Buildings should be properly drained; shallow foundations may be necessary. Septic system design requirements are complex and expensive, requiring increased leaching field size or leaching galleries to compensate for slow percolation, and the use of curtain drains or fill to prevent failure of systems due to seasonally high ground water.

5. **Conditions: Bedrock near surface with numerous outcrops, slope 15% or greater,** water table 10 feet or more below surface.

   These areas are unsuitable for septic systems and impose severe restrictions on building foundations, with blasting, grading and/or fill required.

6. **Conditions: Bedrock near surface with numerous outcrops,** slopes less than 15%, **seasonally high ground water.**

   Very severe restrictions are imposed upon spetic systems with fill and subsurface drainage systems probably necessary to prevent failure. Shallow foundations will be necessary for buildings with care taken to insure that buildings rest on the same material (such as gravel backfill) throughout to prevent uneven settling.

7. **Conditions:** Bedrock 10 feet or more below surface, slope less than 15%, **permanently high water table (wetlands).**

   Wetlands are unsuitable for septic systems without extensive excavation, filling and drainage. Restrictions on buildings are severe, with removal of organic material and replacement with clean and compacted fill necessary. Wetlands permit required.

suggested development plan

A suggested development plan

The composite map identified portions of the site where conditions for development are optimum. Buildings and roads were concentrated in these areas, leaving sensitive areas such as wetlands and steep slopes largely undisturbed. This serves the dual purpose of minimizing environmental disturbance and preserving the visual quality of the site since these areas are often of the greatest scenic value.

Clustered single family dwellings, townhouses and walk-up apartments are included in the plan to illustrate the various options open to the developer. (This plan is intended to give a general indication of how a site of this type could be developed and the exact types and positions of buildings and roads are not important.) Although lot sizes are somewhat smaller than normal, adjacent open space increases land area available for recreational use by residents.

A continual ribbon of open space — in areas where soil types pose limitations on development — provides pedestrian circulation that is separated from vehicular traffic. A buffer of open space on the southwestern portion of the site increases privacy and shields residential areas from traffic noise.

Roads, instead of being in conflict with the topography, are parallel or at an oblique angle to the site's contours. Residential development is located on loops and cul-de-sacs where traffic is light; and road layout discourages outside through traffic.

Sources of further assistance

The following index lists some of the state and federal agencies and a few of the documents available to private citizens for further information and assistance in subdivision planning. Telephone numbers have been omitted from agency descriptions because they frequently change; consult government listings in telephone directories or contact the Information and Education Unit of DEF for current numbers.

A

B

C

ment may be answered by calling (toll free) the Governor's Information Bureau, (800) 566-2750.

Construction practices, 12, 13

Cooperative Extension Service, University of Connecticut, Storrs, CT 06268

The Extension Service, the public education arm of UConn's College of Agriculture and Natural Resources, makes available through a staff of specialists and county extension agents research results and other information, and carries on community development programs. Individuals, community groups and public officials may receive assistance in research of community problems and in conducting educational activities concerning community development.

D

Dams 13
  supervision of 17

DEP: see Environmental Protection, Department of

Docks 31, 39

Dredging 8, 30, 33-34

Dunes 26
  development of 29

Dust control 13

E

Earth materials 47

Encroachment lines 15-16

Energy Agency, Connecticut: see Planning and Energy Policy, Department of

Energy conservation 40

Environmental Protection, Connecticut Department of, State Office Building, 165 Capitol Ave., Hartford, CT 06115. 1, 2, 14-19, 21-26, 33-35, 44, 48, 50

DEP's responsibilities cover a wide area including environmental quality, wetlands regulation, recreation, forestry, and fish and wildlife management. Most of DEP's units are discussed in the Handbook (see list under **agencies**); the Department's Information and Education Unit will answer inquiries or refer them to the appropriate units.

Erosion 6, 12, 13, 27, 29, 30, 38

Erosion and Sediment Control Handbook for Connecticut, Soil Conservation service (U.S. Department of Agriculture), Mansfield Professional Park, Rte. 44A, Storrs, CT 06268.

Estuaries 27

F

Filling 8, 29, 30, 33

Fires (air pollution) 23-25

Fish and Water Life Unit, DEP

Provides technical assistance on design of fish ponds, fish stocking, ecological and environmental planning for fish, stream and lake protection.

Flood encroachment lines 15-16

Flood insurance 25

The **Water Resources Unit,** DEP and the **U.S. Department of Housing and Urban Development,** Federal Insurance Administration, Washington, D.C. 20037 will provide information on the HUD Flood Insurance Program on request. Contact **town offices** in participating towns for **flood hazard boundary maps** and other information.

Flood plains
  description 6
  development of 8, 15, 29
  plants 7
  see also **streambelts**

Food web 28

Footings 8, 9, 47, 49

Forestry Unit, DEP

Provides assistance to individuals in foreest management, tree improvement, reforestation, and forest land tax classification.

Forests 4, 6

Foundations 8, 9, 47, 49

G

Geological Survey, U.S., 235 Post Office Building, P.O. Box 715, Hartford, CT 06101. The U.S.G.S. has mapped topographic, geologic and hydrologic features of Connecticut in a series of quadrangle maps that may be purchased through their Hartford office or the Connecticut State Library (see **maps**), and carries out a number of research projects in cooperation with state and federal agencies. Contact the Hartford office for publications.

Glacial till 5

Groins 30

Ground water 5, 10, 31, 48
  foundations and 9, 47
  septic systems and 11, 47
  see also **water table**

A Primer on Ground Water, Helene L. Baldwin and C. L. McGuinness, available from the Superintendant of Documents, U.S. Government Printing Office, Washington, D.C. 20242 ($.25).

H

Health, Connecticut Department of, Environmental Health Services Division, State Health Building, Room 416, 79 Elm St., Hartford, CT 06115. The Health Department works with DEP and local governments in enforcing septic code regulations. The Environmental Health Services Division also deals with public water supply, mosquito control, shellfish, and sanitation complaints. A Housing Section advises municipalities on subdivision control and sub-surface sewage disposal.

Hilltops 38, 40

HUD Flood Insurance Program: see Flood Insurance

Hydrocarbons 20

I

Indirect sources 9, 21, 22
Information and Education Unit, DEP
Makes available DEP publications, including a monthly newsletter, conducts educational programs, responds to questions and inquiries from citizens.
Insulation 40
Inversion, air 6, 21

J

Jetties 30

L

Lakefronts 39
Lakes 6
see also **Ponds**
Land Acquisition Unit, DEP
Supervises the state's purchase of lands for recreation, forestry, open space preservation and flood control.
Land use, land use planning
There is an enormous amount of written information on land use; only a few sources are listed here.
The Costs of Sprawl
Executive Summary ($.55)
Detailed Cost Analysis ($2.90)
Literature Review ($2.90)
Available from the Superintendant of Documents, U.S. Government Printing Office, Washington, DC 20242
Design With Nature, Ian L. McHarg, Doubleday/Natural History Press, Garden City, New York, 1969
Management and Control of Growth: Issues, Techniques, Problems, Trends, Urban Land Institute, 1200 18th St. NW, Washington, DC 20036 (three volumes, $23.75)
Plan of Conservation and Development for Connecticut, available from the Department of Planning and Energy Policy, 340 Capitol Ave., Hartford, Conn. 06115
Performance Controls for Sensitive Lands, Washington Environmental Research Center, U.S. Environmental Protection Agency. May be read at the Natural Resources Center of DEP, State Office Building, Room 561.
Use of Natural Resources Data in Land and Water Planning, Natural Resources Center, DEP (free).
Landscaping 30
Littoral drift 27

M

Mapping 46, 48, 50, 51-53
Maps
The U.S. Geological Survey has compiled topographic quadrangle maps for the entire state. Surficial and bedrock geology maps based on the topographic map series are available for most areas of the state; other resource characteristics, such as hydrologic features, have been mapped on a more limited basis. Indices of mapped areas are available from the USGS and DEP's Natural Resources Data Center.
Maps in the USGS series may be purchased at the Connecticut State Library.
The Department of Planning and Energy Policy has mapped land use (1970), zoning and major hydrologic features on a state-side basis for its **Plan of Conservation and Development;** contact DPEP for further information.
see also **Flood Insurance, Soil Conservation Service,** and **Wetlands.**
Marina design 32
Marshes
inland 6, 8
tidal: see **wetlands, tidal**
Minimum Flow Regulations 19

N

Natural Resources Center, DEP 44, 46, 48, 50
Collects and makes available maps, aerial photographs, and documents on natural resource characteristics, evaluation and planning; provides technical assistance to municipalities and citizens in environmental impact analysis, resource planning; conducts regional workshops on natural resources planning for local officials and private citizens.
Natural systems 5-7, 27-28
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Nutrient cycling 5

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Oxidants, photochemical 20

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indirect sources 22-23
open burning 23-25
point sources 21-22
dams 17
structures and dredging in tidal and navigable waters 33-34
tidal wetlands 35
water pollution 17-19
Piers 31, 39
Planning and Energy Policy, Department of, 340 Capital Ave., Hartford, Ct 06115
Works with other state agencies, and regional planning agencies in various land use and water resources planning functions; conducts periodic analyses of state land use patterns; forecasts energy demands and determines state's energy policies; maintains reference library of planning documents, information on state's physical characteristics and natural resources.
Point sources 21-22

Sources of further assistance

Acknowledgements and special thanks are extended to Arthur Rocque and Hugo Thomas for their guidance, inspiration and infinite patience, and to Rudy Faveretti for his special assistance in the preparation of the "suggested development plan".