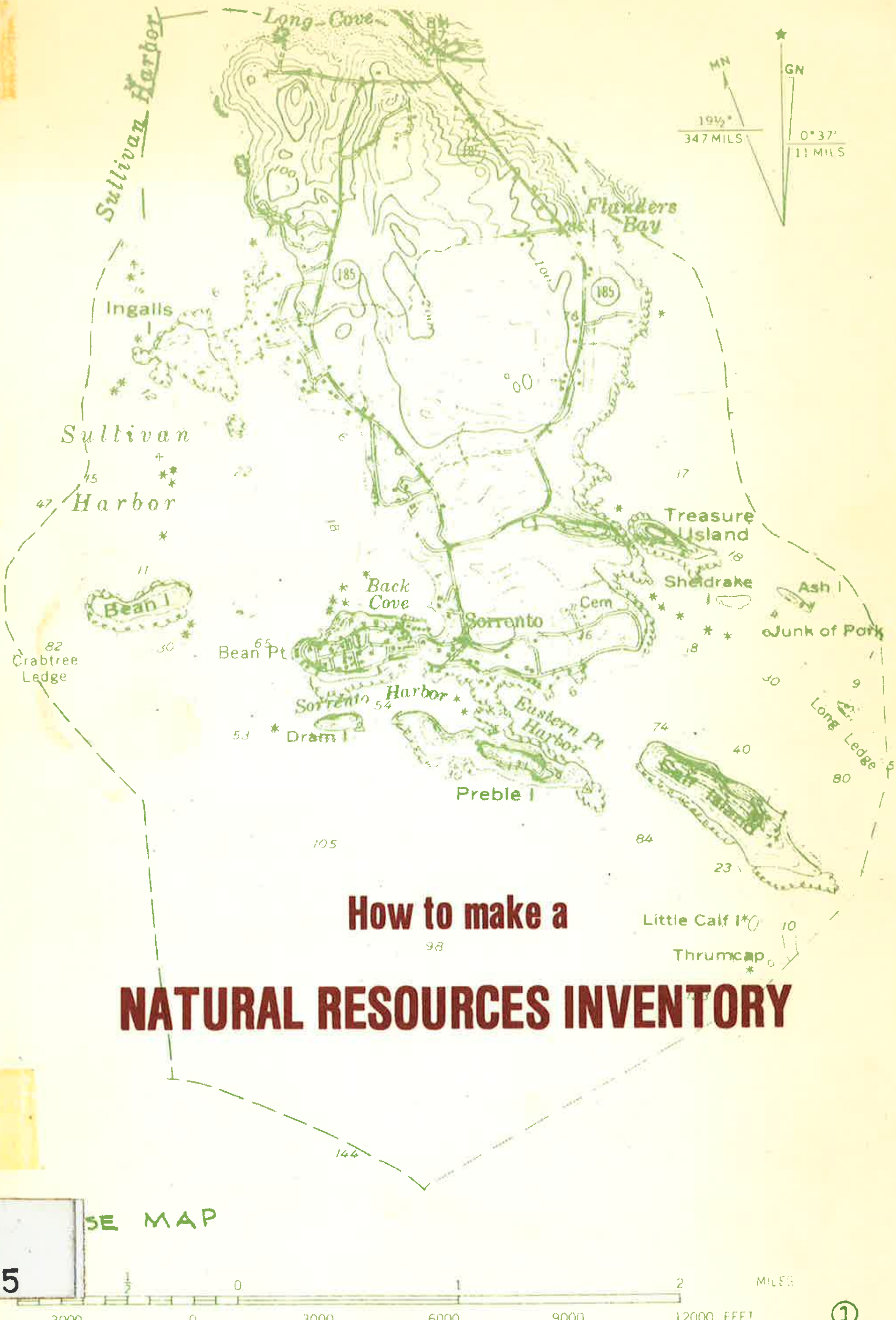
1975

How to Make a Natural Resources Inventory

Community Natural Resources Inventory Project

How to make a

NATURAL RESOURCES INVENTORY



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COMMUNITY NATURAL RESOURCES INVENTORY PROJECT
Title I, Higher Education Act

1975

The University of Maine at Portland-Gorham
Project Sponsor

The Maine Association of Conservation Commissions
Project Co-Sponsor

This handbook is published as a result of a grant from the U.S. Office of Education, Department of Health, Education and Welfare under the Higher Education Act, Title I. No official endorsement by the U.S. Office of Education should be inferred.

A HANDBOOK

How to make a

NATURAL RESOURCES INVENTORY

for your Community

Prepared by:

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Dean B. Bennett, Project Director

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PREFACE

The publishing of this handbook is the result of efforts begun several years ago. It was at that time that Dr. Dean Bennett, Director of the Maine Environmental Education Project (MEEP), developed with Sterling Dow III, Executive Director of the Maine Association of Conservation Commissions (MACC), a guideline publication, *THE COMMUNITY ENVIRONMENTAL INVENTORY*. This booklet was used in 1972 as the basis for a community inventory workshop for both citizens and teachers taught by Dr. Dean Bennett and sponsored by the Woolwich Conservation Commission and the local school system. The result was a Woolwich community natural and cultural resources inventory, which was distributed to over 200 residents at the 1973 town meeting.

At approximately the same time but independently of the Woolwich Project, a Natural Resources Inventory (NRI) was being prepared for the Winthrop Conservation Commission under the direction of James Connors, resource planning consultant. Concurrent with these activities more and more communities have evidenced a recognition of the need for the NRI through inquiries to MEEP and MACC for information and assistance in preparing inventories.

In response to these events, the University of Maine at Portland-Gorham sponsored in 1974 the Community Natural

Resources Inventory Project financed under Title I of the Higher Education Act. The co-sponsor of the Project was the Maine Association of Conservation Commissions.

This handbook is intended to be instructional for individuals involved in a Community NRI. A step-by-step guide is provided giving examples and exercises; and details for final map preparation. Finally, suggestions are made as to the usefulness of the inventory and how it might be implemented.

It is hoped that this handbook will lead citizens through the process of developing an NRI, with assistance from outside sources.

INTRODUCTION

INVENTORY OVERVIEW

The Natural Resources Inventory (NRI) is a compilation in map and written form of the natural resources characteristics of an area. The process of inventorying accumulates data available from different sources in order to learn about natural systems and their limitations and opportunities for human use.

The NRI has several recognized benefits:

1. It provides a sound basis for town planning and the establishment of ordinances.

2. It will expose areas sensitive to improperly conducted land use activities as well as identify areas best suited for various land uses.

3. Once problems and opportunities are seen, alternatives can be suggested resulting in better land uses.

4. Knowledge about the land will be furthered, thus benefiting the land owner and the general public through the resulting improved land use.

5. The inventory involves local people in a common cause which increases commitment for a better community environment.

6. The inventory is an **educational** tool by which young people, new residents, and old timers can learn more about their community and its natural surroundings. The NRI helps to build an appreciation of the town.

The inventory is not static. It can be added to and refined to be an even more useful tool. As new knowledge is gained and as more refined data become available, they can be added. The inventory is a notebook, then, in which can be kept the accumulated knowledge about the town's natural resources.

The inventory as it is done is not a substitute for an on-site inspection in relation to a specific kind of land use. Through the inventory, the **general** characteristics of an area are known, but the **actual** site conditions must be surveyed and assessed in each case. For any land use proposal, a first-hand investigation is a must.

SELECTION OF INVENTORY ITEMS

The resources selected for inventorying, and the categories used for presentation are chosen based on a well recognized and demonstrated need. This is reflected in the need for problem-solving which communities face today regarding the proper use of their natural resources.

Natural resources data are utilized to define the limits for various land uses. Using natural resource characteristics to define limitations is in a sense listening to the land. The land has a voice which warns that man's activities on the land have natural limitations. To overcome those limitations, more time and money needs to be expended as the environmental hazards are increased.

Other factors, of course, influence an inventory and analysis process for land use planning. Social, economic and legal factors place limitations on land use which should be recognized. In many cases these factors and their effects can be shown on maps.

INVENTORY ITEMS

TOPOGRAPHY refers to the lay of the land or the land forms as they exist. Topography includes such land characteristics as slopes, relief or elevation, and land forms such as hills or flats. We need to know about topography because of its influence on aesthetics and suitability for development. Slopes, for example, affect the economy and functioning of septic systems, placement of roads, etc. Relief and land form affect climate, success of farming, and development (aesthetics, drainage, general characteristics).

Combined with other data such as soil characteristics, water table or hydrology, the effects of slope and elevation on erosion potential become apparent. For example, soil erosion is detrimental because it creates surface water contamination, loss of topsoil, and sedimentation of surface waters.

HYDROLOGY refers to the natural system of surface water drainage and storage in lakes, ponds, rivers, streams and brooks. It is important to understand the function and structure of these water forms because of their inter-relationships.

Watersheds are the areas drained by streams and lakes; thus activities in a watershed can adversely affect water quality in the immediate area as well as far downstream.

GEOLOGY includes surficial and bedrock geology. These features are of interest because of their effects on construction and water supplies.

Surficial deposits can be groundwater recharge areas as well as water supply areas. These deposits are also sources of sands and gravels for contruction purposes.

Bedrock is important both for building purposes and as a groundwater supply area. Many drilled wells derive water from bedrock.

SOIL refers to the surface layers of the ground which are influenced by weather and climate. It is these layers in which trees grow and which we use for farming, gardening and other agricultural uses. The characteristics of soil have a large bearing on the feasibility of building houses with on-site sewage disposal.

Because soil is the medium most commonly used to support land use activities, we need to know its general character and distribution.

VEGETATION refers to the existence and quality of vegetative growth which is important both for physical protection of soil and visual quality. Unprotected soil is easily eroded by rain, often resulting in water pollution.

The visual quality of lake shores, hill tops, roadsides, etc., depends on the nature and quality of the vegetation. The age, condition and type of vegetation is important.

LAND USE refers to man's activities on the land which create patterns and changes in the natural landscape, affecting the health and convenience of the people. We need to know what these activities are and how they are arranged so that we can prevent and/or solve conflicts. New growth can then be analyzed and made to fit into the existing character of the community.

Once the basic inventory items are identified and inventoried, plans are then made to combine and analyze the data to solve specific problems. Much of this analysis is aimed at the problem of identifying areas naturally suited for development.

INVENTORY FORMAT

It is important to recognize that in order to solve specific problems we need to have the basic data in a form that can be usable. This handbook provides a method for putting that data into just such a form.

The inventory will be produced as a *manual* of maps and descriptions. Each map will be prefaced with a write-up to explain the inventory item and to highlight important aspects of that map. Specifically, the write-up should include a condensation of material presented in this handbook, as well as a summary of local features.

MATERIALS AND SERVICES NEEDED

In order to begin the inventory it will be necessary to purchase materials and services. Based on 1975 costs, the total community expenditure for maps and drawing supplies would be approximately $70.00.

A decision will be needed as to whether the inventory will be published. If it is to be published, the various classes on each map will need to be done in shades of gray which will print more clearly. If it is not to be printed, then the original maps will be more effective when done in colors.

Listed below are suggested materials, suppliers, and services to aid in the production of inventory maps.

MATERIALS	SUPPLIERS
Base Maps	Regional Planning Commission State Planning Office Soil Conservation Service USGS Topographic Sheets
Drawing Supplies marking pens overlay material	Contact MACC for suggested list of suppliers
SERVICES	
Reproduction Printing	Contact MACC for suggested list of suppliers

Do not overlook information and help available from local and regional planning groups, conservation commissions, state agencies, historical societies and other groups or individuals knowledgeable about the town.

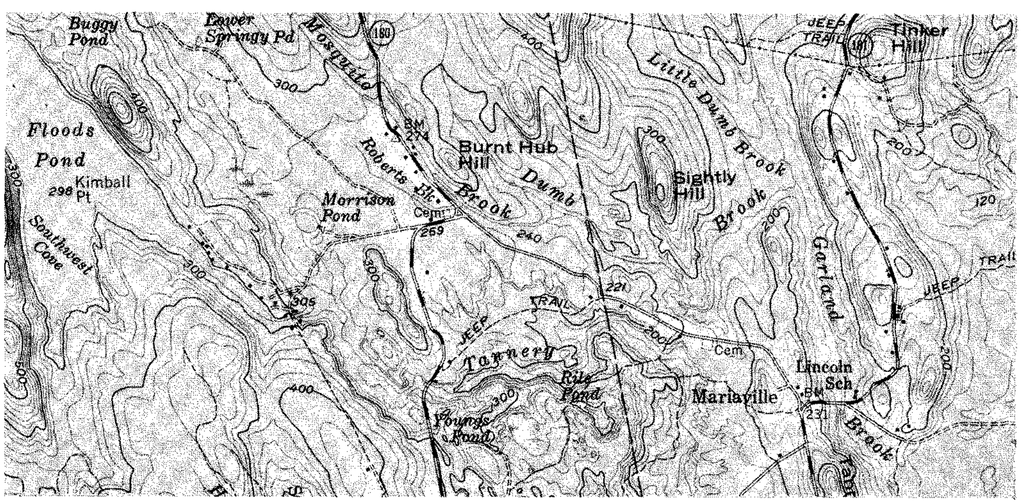
MAPPING

DEFINITION

A map is a graphical representation, at an established scale, of a part of the earth's surface. Maps represent on a flat surface, as accurately as possible, the curved surface of the earth.

TYPES OF MAPS

The most common and widely used maps are the topographical maps produced by the U. S. Geological Survey. These topographical sheets occur as 15 minute and 7.5 minute quadrangles. The U.S.G.S. topographical sheets depict terrain, water features, man-made structures and cultural features by symbols. Hence, these are known as line and symbol maps.



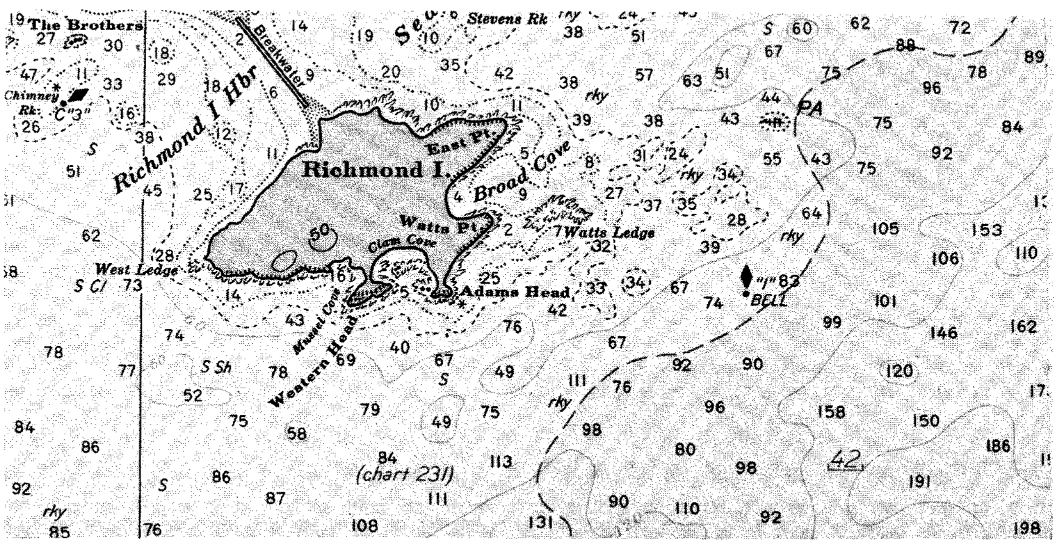
USGS Topographic Map (15 min. series)

The difference between a 15 minute and a 7.5 minute topographical map is scale. The numbers 15 and 7.5 relate to the amount of latitude and longitude covered by each map. Thus, the 15 minute maps show 15 minutes of latitude and 15 minutes of longitude. The same applies to a 7.5 minute map. The 7.5 minute maps show one-quarter of the area that a 15 minute map depicts. Therefore, it requires four sheets of 7.5 minute maps to depict the same area covered by one 15 minute sheet. Thus, information can be shown on the 7.5 minute map with more detail and accuracy. This fact allows the presentation of more detail and increases accuracy of the map. All new topographical maps are being completed on the 7.5 minute sheets by the U.S.G.S. Index maps are available from local map distributors that show the location and type of topographic maps.

Terrain is shown on maps by the use of contours. Contours are lines connecting points of the same elevation above a given point or Datum, which is usually mean sea level. It may be helpful to think of contours as similar to an island in a lake. When the lake is full a highwater line forms around the shore. If the water drops to a new level, a new highwater line forms. As this process continues the result will be a series of highwater lines, each lower than the other ringing the island. Now, looking down from above, you will see a system of lines which reflect the shape of the island. Some will be close together, which indicates steep sloping sides. Some will be widely spaced, indicating lesser slopes. Hence, contour lines show the shape of the land.

Other types of topographic maps are produced by the Federal government. These show similar data as the 15 minute sheets but at different scales.

The Coast and Geodetic Survey produces maps of coastal areas. These maps show land forms and ocean areas, as well as man-made features and cultural features.



USC&GS Coastal Chart

Many other types of maps have been produced for special purposes. Some of these are:

tax maps	street maps
zoning maps	forest type maps
hydrology maps	soils maps
highway maps	land use maps
geologic maps	wetland maps
minor civil divisions and county maps	

Some of these maps use a U.S.G.S. topographic map as a base, some produce their own base maps, and others use aerial photos.

MAP MEASUREMENTS

The scale of the map is the ruler by which distances are measured. The map scale is expressed as a representative fraction such as 1/62,500. This fraction or ratio means that one inch on the map is equal to 62,500 inches on the ground. Thus, 1:62,500 means one inch equals 5,208 feet or nearly one mile. Scale is also expressed in graphical form as a bar graph. Any change in map size will change the bar graph. Therefore, the bar graph always shows the true scale.

Other means of measuring map locations are the coordinate systems of Longitude - Latitude, UTM (Universal Transverse Mercator), and State Plane Coordinate system. Without a great deal of technical explanation, these are simply ways of locating a point on the map in relation to a reference point.

The accuracy of the map as a representation of the earth's surface depends on its scale and the degree of detail to be shown. At any given scale, only a certain amount of detail can be accurately shown. In addition, the scale limits the amount of area that can be represented. This area is termed the minimum mapable area.

The problem then is to match the amount of detail to be shown with a suitable map scale. Generally, the scale of 1" = 1000 ft. is suitable to show land use and natural resource information for a town. For large towns, 1" = 2000 ft. may be easier to work with. In many cases, the available data or data maps are no more accurate than what can be plotted at these scales.

Area is usually measured in square feet or acres using planimeters or dot grids.

USES OF MAPS

Because a map is graphical or visual representation, a great deal of area data, as well as point data, can be shown. Point data are discrete items such as houses, stores, buildings, roads, etc. These are generally shown as symbols. Area data such as soil types, fields, vegetation, water, etc.,are shown by locating boundaries and using colors or symbols to indicate what they are. Most information connected to, or a part of, the earth's surface, can be effectively shown on a map.

In this connection then, a good deal of natural resources data is available only on a map. Soils and geology, for example, are inventoried on maps. Other data may be already mapped. Most source data is in map form at various scales. All data is mapped at the same scale for an NRI.

Using a map for presentation provides a readily understandable expression of the amount, size, and location of various data.

PLOTTING AND TRANSFERRING DATA

Basic raw data is collected either in map form, written form, or both. In map form this data exists at various scales and presentations. It must be converted to a standardized scale and presented in a way which will make subsequent analysis easier.

All data is plotted on paper copies of the base map, in pencil, so that corrections can be made. Once a map is ready, it is finalized by outlining, coloring or shading. Overlay maps are produced by tracing, then overlaid on a fresh base map. Thus, several specific maps are prepared, each being overlaid on the base map to show conflicts, etc.,for whatever the analysis problem is. (See *Analysis Techniques*)

AERIAL PHOTOGRAPHY

Aerial photography is taking photographs of the earth's surface at some height above the ground. The science and technology of aerial photography is complex and beyond the scope of this handbook.

Aerial photography is divided into major levels or groups of photos. These groups are based on the altitude of the platform from which photos are taken. Low to medium altitude photos (20,000-40,000 feet) are taken by regular aircraft. Soils maps and forest type maps are developed from these photographs. The high altitude photos (60,000-80,000 feet) are taken from U-2 or RB-57 aircraft. These photographs are good for identifying geologic features, surface waters, and general land use. Satellite photos are the newest and are taken from satellites and space stations (500+ miles).

Aerial photos are taken as nearly vertical as possible in relation to the plane of the earth's surface. This is needed to control scale and thus accuracy. These photos are maps in a sense in that they are representations. To interpret or understand the image primarily requires experience.

Aerial photography is available from the Soil Conservation Service and other governmental agencies as well as private companies. Photo index sheets are available from which the necessary photos can be selected.

The uses of aerial photography range from base maps to a source of basic data about natural resources. As base maps, they show a great deal of information not usually shown on line and symbol maps. For example, more detail is shown about land use and vegetation types. In addition, photos are used to up-date existing base maps.

SELECTING THE APPROPRIATE BASE MAP

Experience in the pilot study shows that a two base map system is desirable. A U.S.G.S. topographical map is useful for slope, relief, surface water/watershed, and land use. A SCS soils map is useful for bedrock, water table and erodibility analysis. Other inventory items can be plotted on the U.S.G.S. map, such as vegetation and geology.

It was found that a scale of 1" = 1000 ft. is the best for Community NRI's. In some cases, large townships will find it more convenient to use a scale of 1" = 2000 ft. In most cases, a Maine township will fit a standard sized reprographic paper (36" or 42" width). Also, these scales are adequate to display the level of detail inventoried.

It is imperative that the base maps be at the desired scale. This will require photo enlargement and production of a reproducible original, from which copies will be made (see list of materials and services).

For the inventory described herein, a number of copies of the base maps will be necessary. A minimum of eleven copies of the U.S.G.S. base map and a minimum of three SCS soils maps will be needed.

TOPOGRAPHY

Topography is a term used to refer to the land form of an area. Areas are described as being rough or hilly or flat depending on the character of the land. A topographic map is the presentation of land form by symbols on a map. Topography can be depicted by contours or shading. Contours have been discussed on page 10. Topographic maps are very useful because they present characteristics of the land which affect man and his uses of the land. Two of the most important aspects of land form are relief and slope.

RELIEF

Relief is an expression of elevation or height above a given datum or plane. In most cases mean sea level (average high water level) is the datum. Relief reflects the height of land forms above sea level and relative height to surrounding land forms.

Relief identifies significant or dominant physical features that form natural barriers for development. The height of land and its relation to the sun affect the siting of houses, living conditions, the time when snow melts, the readiness of soils to be worked, types of vegetation, rain and snow run off patterns on the land, etc. Relief combined with vegetation reveals areas of scenic quality both as viewed and as view points. Relief also determines drainage patterns, to some extent.

How to Make a Relief Map

1. Locate and note the elevation of the highest and lowest points on the map.

2. Intervals of elevation are found in even hundreds of feet; i.e., 100, 200, 300, etc. Determine the number of hundred foot intervals needed to include in your range of elevation. For example, if the lowest point is 250 feet, and the highest is 850 feet, there are seven intervals, beginning with 200 feet and going to 900 feet.

3. If the number of intervals is five or less, then the relief map will be done in 100 foot intervals. If the number of intervals is six to ten, the map will be done in 200 foot intervals. In the example above, the categories would be:

   200 - 400 ft.
   400 - 600 ft.
   600 - 800 ft.
   800 - 1000 ft.

   In some towns 300 ft. or 400 ft. intervals will be required.

4. To delineate the categories draw a heavy black line along the appropriate contour line. Do this for each interval as needed.

5. Shade or color each area with the darkest shade for the highest elevation.

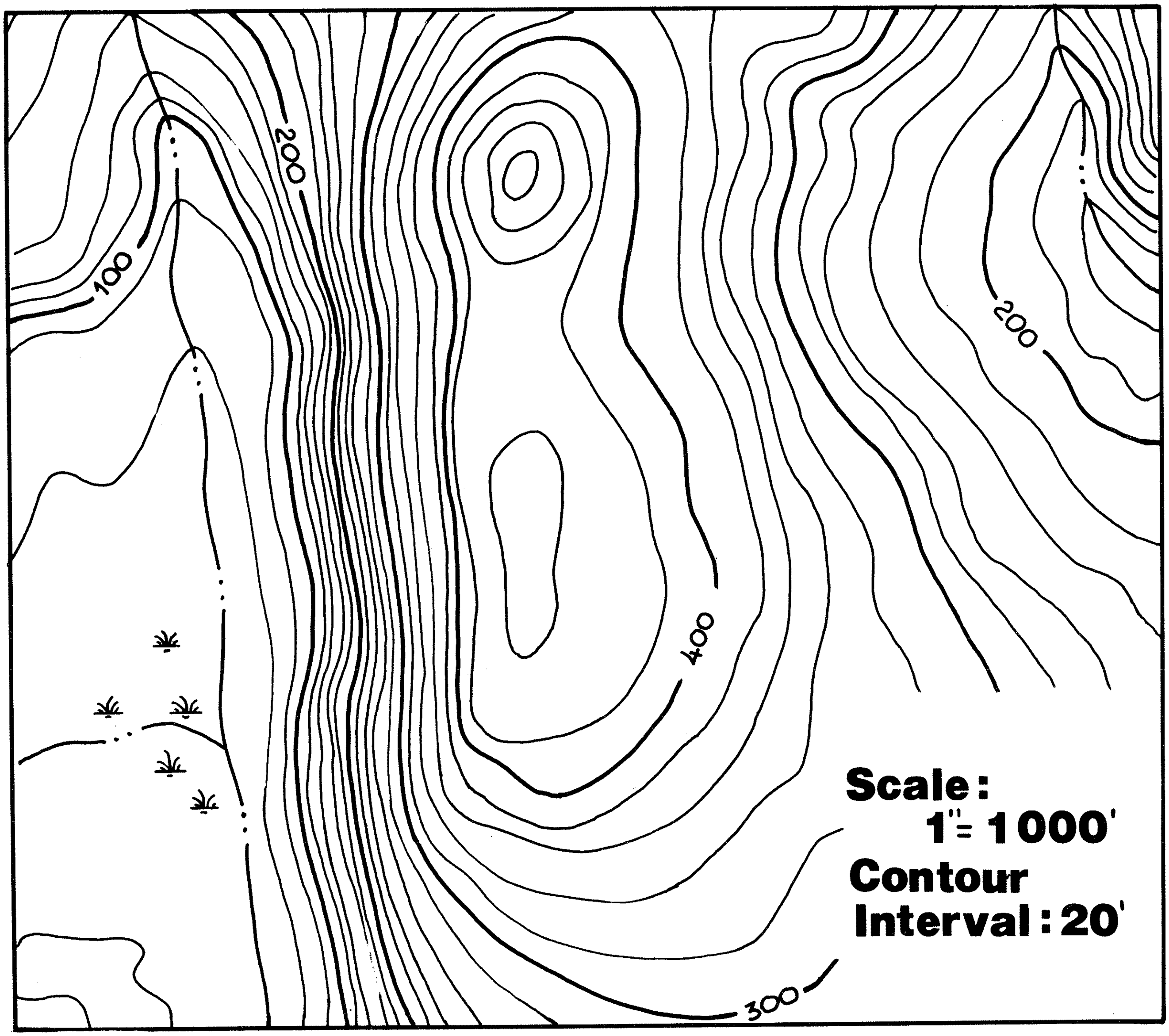
6. Attach the prepared legend and title to the map (see Figure 1, page 21).

Source of data: U.S.G.S. topographic map.

RELIEF MAP

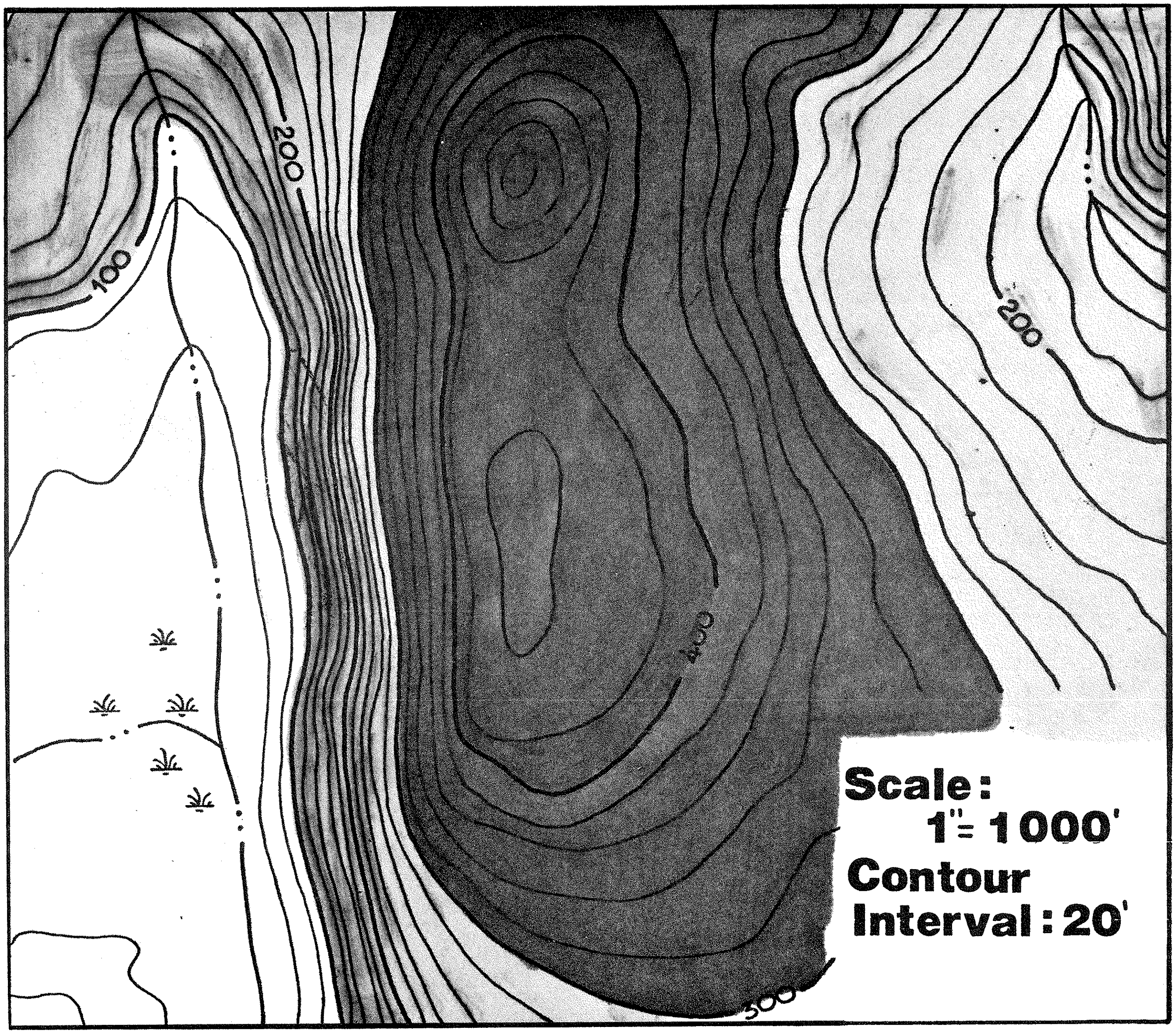
LEGEND

☐	0'-100' elevation
☐	101'-200' " "
☐	201'-300' " "
☐	301'-400' " "
☐	401'-500' " "



LEGEND

☐	0' - 100' elevation
☐	101' - 200' " "
☐	201' - 300' " "
☐	301' - 400' " "
☐	401' - 500' " "



LEGEND

0' - 100' elevation

101' - 200' " "

201' - 300' " "

301' - 400' " "

401' - 500' " "

SLOPE

Slope is the amount of rise or fall in feet for a given horizontal distance. It is expressed in percent. An 8% slope means that for a 100 ft. horizontal distance, the rise (or fall) in height is 8 ft. (see Figure 2).

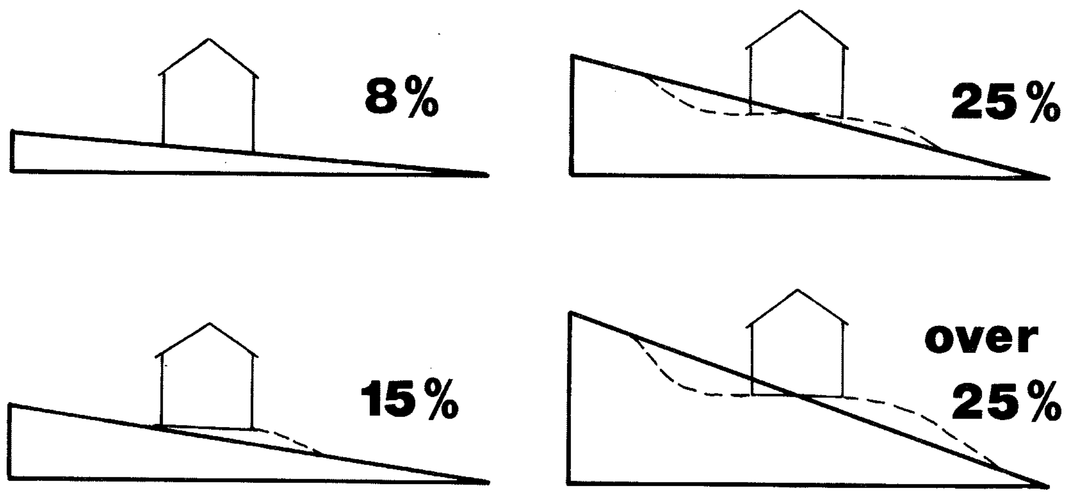


Figure 2. Degree of Slope

Slope can also be expressed in degrees. The number of degrees refers to the angle between the horizontal plane and the incline plane. A 45 degree slope would be a 100% slope.

Slope is one significant aspect of land form which presents limitations for development. As slopes become steeper, the cost of building becomes more expensive. Structures, roads, and services become more difficult as well as expensive to construct.

In addition, when slope is considered with other natural characteristics such as soil or vegetation, limitations to development become evident. For example, when considered with soils data, easily eroded areas are identified; and when considered with vegetation, scenic qualities become evident.

One good and valid reason for slope considerations is the limitation for septic system placement on steeper slopes. Special engineering is required on slopes in excess of 15%. This increases costs. In addition, the potential for environmental degradation is much greater because of faster percolation.

The new Maine Plumbing Code recognizes these slope categories: 0 - 15%, 15 - 25%, greater than 25%. On slopes up to 15%, on-site septic systems can be installed with a minimum of special engineering. More excessive slopes require a case-by-case study. Thus, the slope limitations for plumbing create real limitations on building.

One additional point about slopes is their effect on soil erodibility. Basically, for an unvegetated site, as the slope increases, so does erodibility. Other soil characteristics modify this effect, and will be covered in the soils section.

How to Make a Slope Map

1. Inspect the map or area to get a feel for the land form. Are there hills and valleys, flat areas, cliffs, etc.?

2. Select the correct slope scale of the map and contour interval (see Figure 3). Copy intervals onto separate sheet for mapping use.

3. Use the slope scales as follows:

   The slope will be 0 to 8% if the distance between the contour lines is wider than the dark area in the 0-8% block; it will be 9 to 15% if the distance between contour lines is narrower than the 0-8% darkened area but wider than the 9-15% darkened area, etc.

   a. Using scale card (page 27), move about map from area to area and determine the slope by measuring the distance between contour lines.

   b. Roughly mark off boundaries of slope classes in pencil or other non-permanent means.

   NOTE: As experience is gained, the mapper will be able to visually determine slope boundaries without the slope card in many instances.

4. Draw a heavy solid line around each area of slope category. For a map with a scale of 1" = 1000 ft., the smallest area that can be conveniently and accurately shown is approximately 6 acres or ¼ square inch, for

example, areas with the following dimensions, ½ x ½ in. or 1/8 x 2 in.

5. Shade or color each slope category with the darkest shade for the steepest slope.

6. Attach prepared legend and the title (see Figure 4, page 28).

Source of data: U.S.G.S. topographic map.

0-8% 9-15% 16-25%

Intervals/inch

MAP SCALE: 1"=1,000'

20' CONTOUR INTERVAL

SLOPE SCALE

0-8% 9-15% 16-25%

Intervals/inch

MAP SCALE 1"=1,320'

20' CONTOUR INTERVAL

0-8% 9-15% 16-25%

Intervals inch

MAP SCALE: 1"=2,000'

20' CONTOUR INTERVAL

SLOPE MAP

LEGEND

☐	0- 8 % slope
☐	9-15 % " "
☐	16-25 % " "
☐	26+ % " "

SLOPE MAP EXERCISE

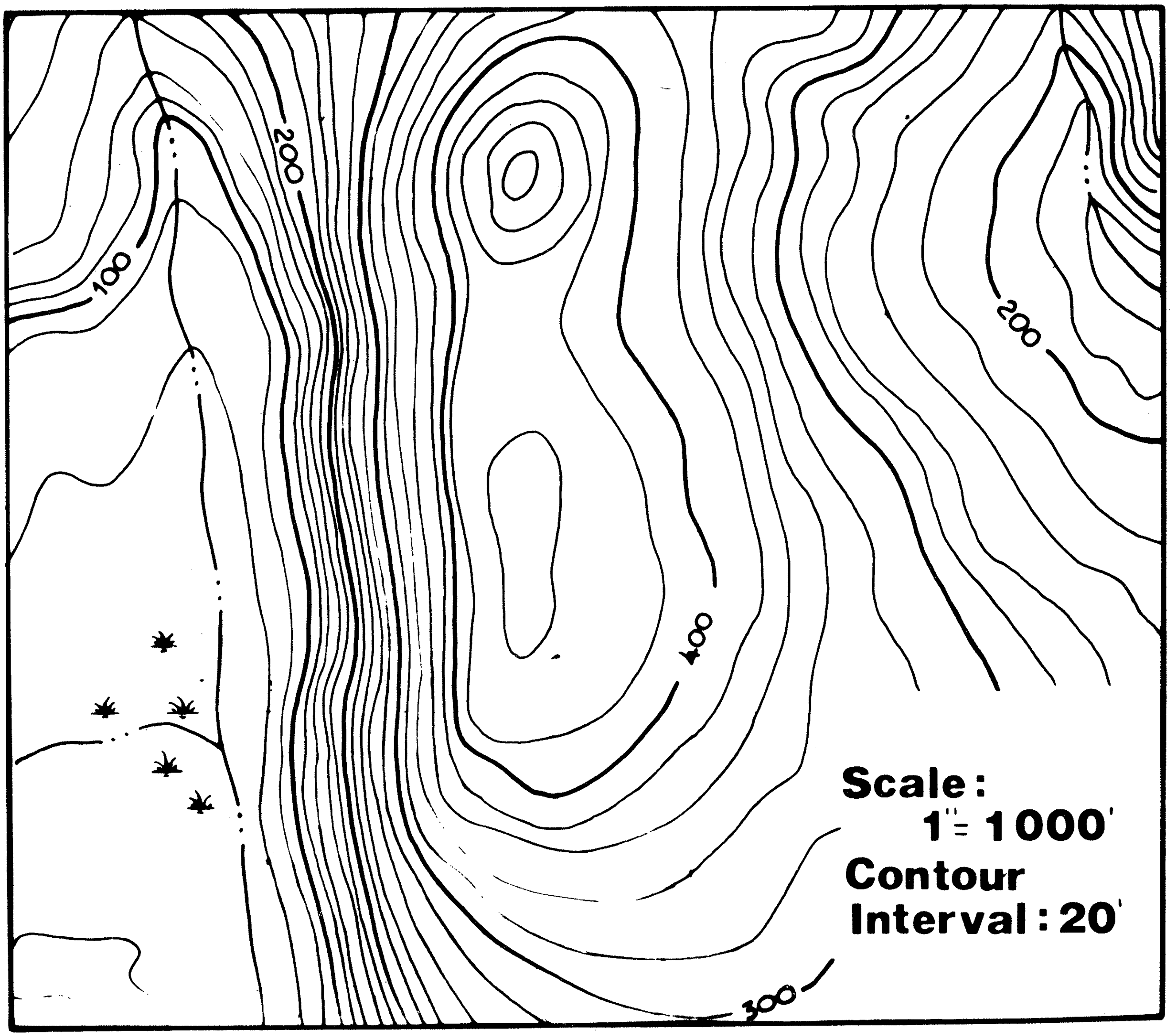
Using the appropriate slope scale:

1. Identify and outline all areas with a slope of 0 - 8%.

2. Identify and outline all areas with a slope of 9 - 15%.

3. Identify and outline all areas with a slope of 16 - 25%

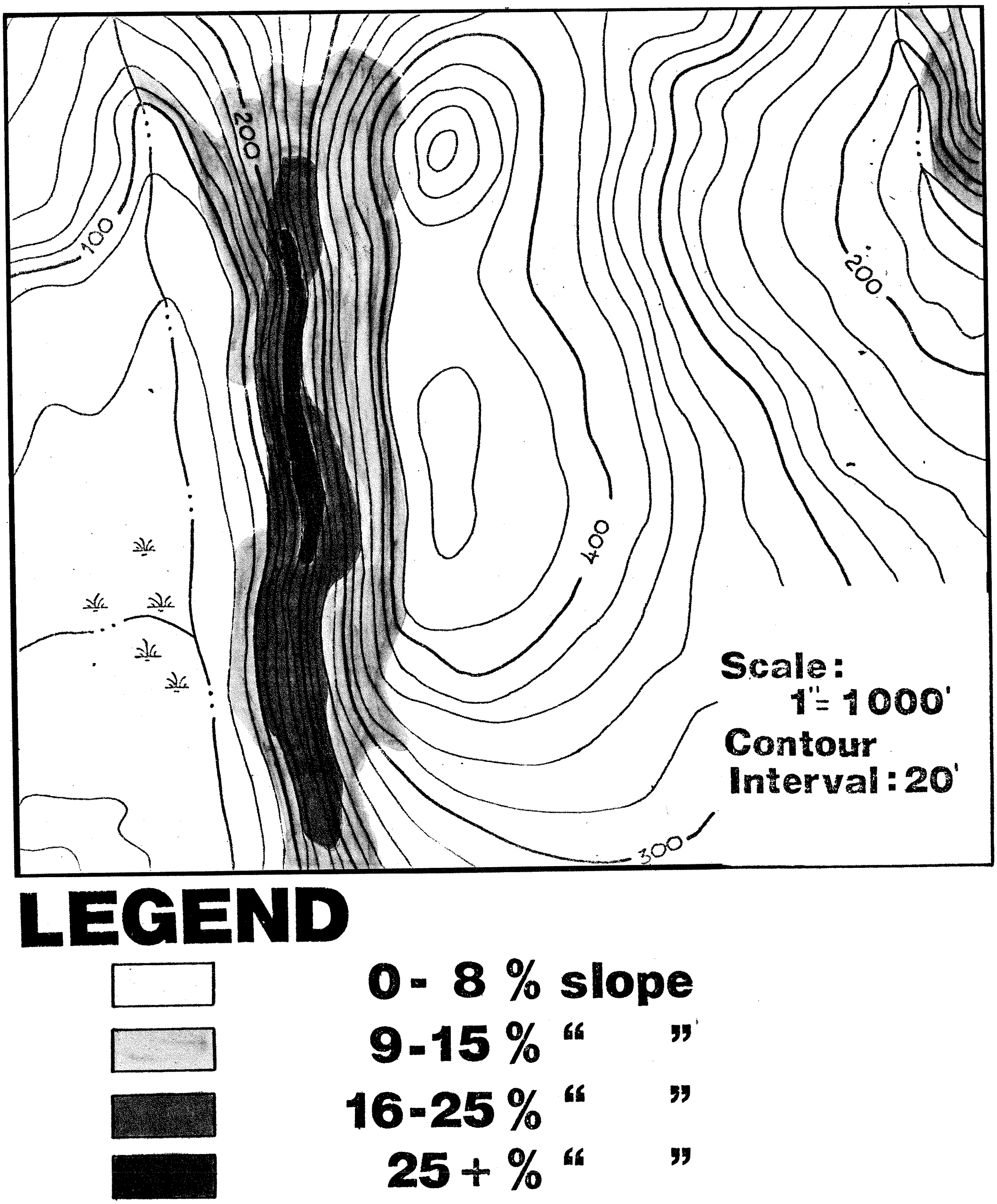
4. Identify and outline all areas with a slope over 25%.



LEGEND

- ☐ **0- 8 % slope**
- ☐ **9-15 % " "**
- ☐ **16-25 % " "**
- ☐ **26+ % " "**

SLOPE MAP SOLUTION



HYDROLOGY

The hydrologic cycle is the path or course by which water is circulated from the earth to the atmosphere and back to the earth's surface (see Figures 5 & 6).

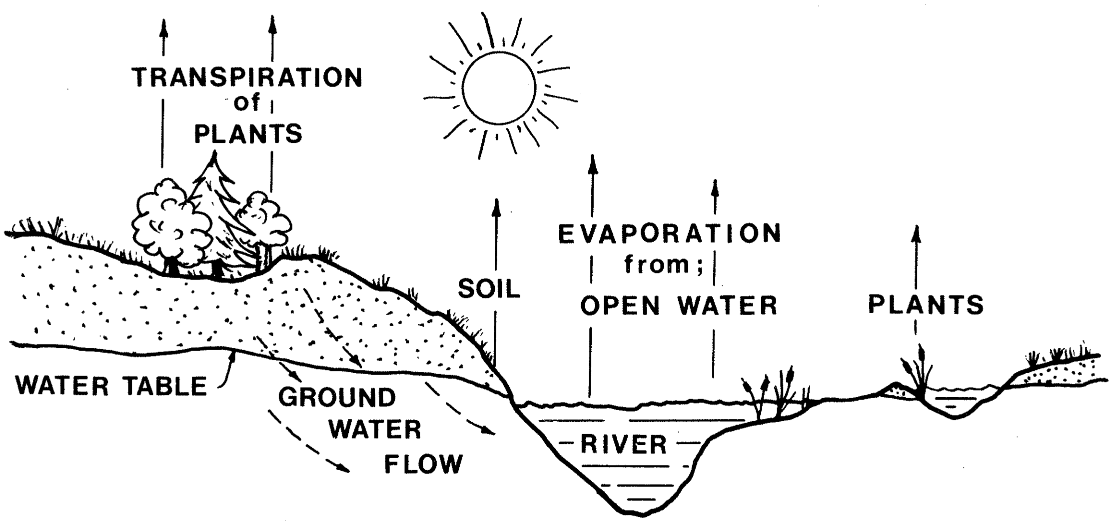


Figure 5

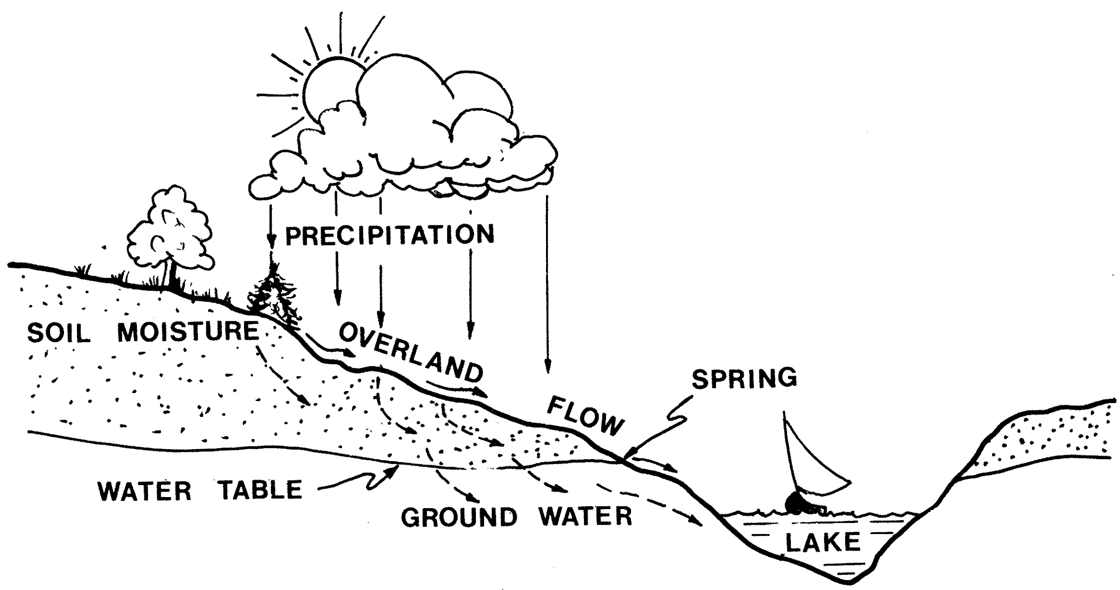


Figure 6

Several aspects of this cycle are of interest. They are:

1. the accumulation of water as surface water;

2. the percolation of water through the earth's surface and its storage in the soil, rock and surficial deposits;

3. the rainfall as it can contribute to erosion.

Precipitation in Maine is approximately 45 inches per year, with roughly half being rain and half being snow. Falling rain hits the earth's surface where some of it penetrates into the soil, and the rest collects in brooks and streams. This surface water or runoff is temporarily stored in lakes and ponds, and eventually reaches the ocean. During all these stages, water can be evaporated into the atmosphere to return again as rain or snow to the surface.

The water that soaks into the ground is stored for a temporary period as groundwater until it seeps out and becomes surface water, is used by plants or is removed by wells. The point is that once rain falls the water does not remain static or still. It is moving over or through the land surface or is stored and used by plants and animals.

The condition of the earth's surface determines how the rain water will behave. Vegetation (grass or trees) tends to break the fall of raindrops and lets it drip more softly to the ground. Vegetation also retards surface flow. This enables more water to percolate into the ground.

The force of a falling raindrop can be enough to move soil particles. If vegetation is absent, the full force of a raindrop will hit and dislodge soil particles, and thus begins erosion. Once loosened, soil is easily transported by water flowing over the surface into brooks and other surface water.

Snow melt water can have the same effect by carrying away any loosened soil particles. Unvegetated areas that frost heave and thaw can result in loosened soil particles, which will be washed away.

The slope of the land is another condition influencing the action of water on the land surface. The steeper the slope, the more quickly rainfall will accumulate and run off. The erosive power of runoff is greater on steep slopes. Therefore, erosion will occur easily and will be more severe. Also, on steeper slopes it takes less surface runoff to cause erosion.

Depending on the texture or particle size of the soil, erosion will occur more rapidly in some places than others. Smaller particles (clay and silt) are more easily moved by water than are larger particles (sand). When this factor is combined with greater slope, the potential for erosion is multiplied. Hence, the combination of slope and soil texture (erodibility) determine the potential for erosion. It should be pointed out that vegetation is the prime protector of the soil and thus the best protection against erosion. In paved areas, runoff increases in speed and quantity, thus compounding erosion problems.

Groundwater is another major area of concern in the hydrologic cycle. The rain water that seeps into the ground is held for a while in the soil and underlying materials. The nature of these materials determine how much water will be held and available for use.

Groundwater percolating through the soil is channeled by subsurface layers of materials or cracks in the bedrock. The rainwater from an area can be circulated through the ground and come to the surface in another place. Groundwater is stored in subsurface areas called aquifers. These areas vary from location to location depending on the type of bedrock and surficial deposits.

Areas where surface materials absorb a great amount of water are known as aquifer recharge areas. In these areas the rainwater percolates into the ground to replenish ground water supplies held in aquifers.

Aquifers are tapped to provide water supplies for drinking and industrial use. Thus, the location of aquifers and their depths are important to know. Land use activities that discharge pollutants in an aquifer recharge area may directly affect an aquifer, and hence the quality of drinking water.

The runoff of rain water is directed by slopes and water channels. Thus, when all the runoff from an area is collected and drains to one point, the area above that point is known as a watershed. Watersheds are bounded by ridge lines or divides. Examples of watersheds include the drainboard which carries dishwater back into the sink, or the area within ridge lines of a roof where all runoff has a common drainpipe.

The land surface is a series of watersheds which abut one another. All land is a part of a watershed. Smaller watersheds accumulate or add up to larger watersheds. Thus, the Penobscot River Watershed is comprised of smaller watersheds, including the Piscataquis and Mattawamkeag.

Each brook has a watershed area, no matter how small it is. As each brook becomes a tributary to a larger stream, the watershed enlarges. Because of these downstream connections, a chain of effect or impact is created. For example, a change in water quality in the brook will affect the water quality in the stream and, potentially, all the rest of the way down the stream.

Surface water runoff is channeled by a watershed into flowing waters, which are often stored for some time in lakes and ponds. The levels of flowing surface waters fluctuate with each rain storm or snow melt. Thus, they can become filled and overflow their banks. In this situation the condition is known as a flood and the area flooded is the flood plain.

A flood plain is an area that is innundated yearly, usually during spring runoff. Many areas are flooded occasionally and are called flood prone or flood hazard areas. In either case, the damage to life and property is equally severe.

The location and extent of flood plains (including flood prone areas) is important because of:

1. potential damage to buildings, roads and equipment,
2. effect on further development,
3. water pollution and downstream damage, and
4. flood damage insurance.

Wetlands are important in the hydrologic cycle because they slow down and store runoff, which is then released slowly to feed brooks, and other surface waters. Wetlands are also productive wildlife habitats; they reduce flooding; they are recharge areas.

In summary, the hydrologic cycle has been discussed and several aspects of importance to proper land use have been identified. The major points are:

1. Moisture in the cycle is not static but is always moving due to evaporation and gravity.

2. Falling rain can be destructive to soil and land surface if the surface is not protected by vegetation.

3. Slope and soil texture as well as vegetation are major factors influencing the effect of runoff and percolation.

4. Groundwater is stored and available in subsurface deposits.

5. The moisture in the hydrologic cycle serves to bind many natural systems together so that a chain of cause and effect is established.

6. In addition to watershed areas, such features as flood plains and wetlands play important roles.

How to Make a Surface Water Map

1. Inspect the map and locate lakes and ponds, rivers, streams, brooks, and tidal water. Surface water features may be enhanced by outlining with a fine tip black marker. Lakes and ponds as well as wide places in rivers may be shaded. (In most cases, base maps will depict surface waters. However, corrections may be necessary).

2. Attach prepared legend and title to the map (see Figure 7, page 39).

Source of data: *U.S.G.S. Topographic Map*
Aerial Photographs

SURFACE WATER MAP

LEGEND

Surface water

How to Make a Watershed Map - refer to page 43 for an example.

1. Outline lakes and ponds, and trace brooks and streams.

2. Inspect the map and locate the major divides or ridges between surface water features and draw a dashed division line with a heavy black felt marker along the ridge (do not cross a brook).

3. Next, extend heavy division lines down slopes between brooks, etc. Lines will branch. Do not cross water features.

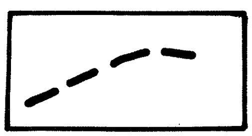
4. Complete by checking for short spurs between smaller brooks.

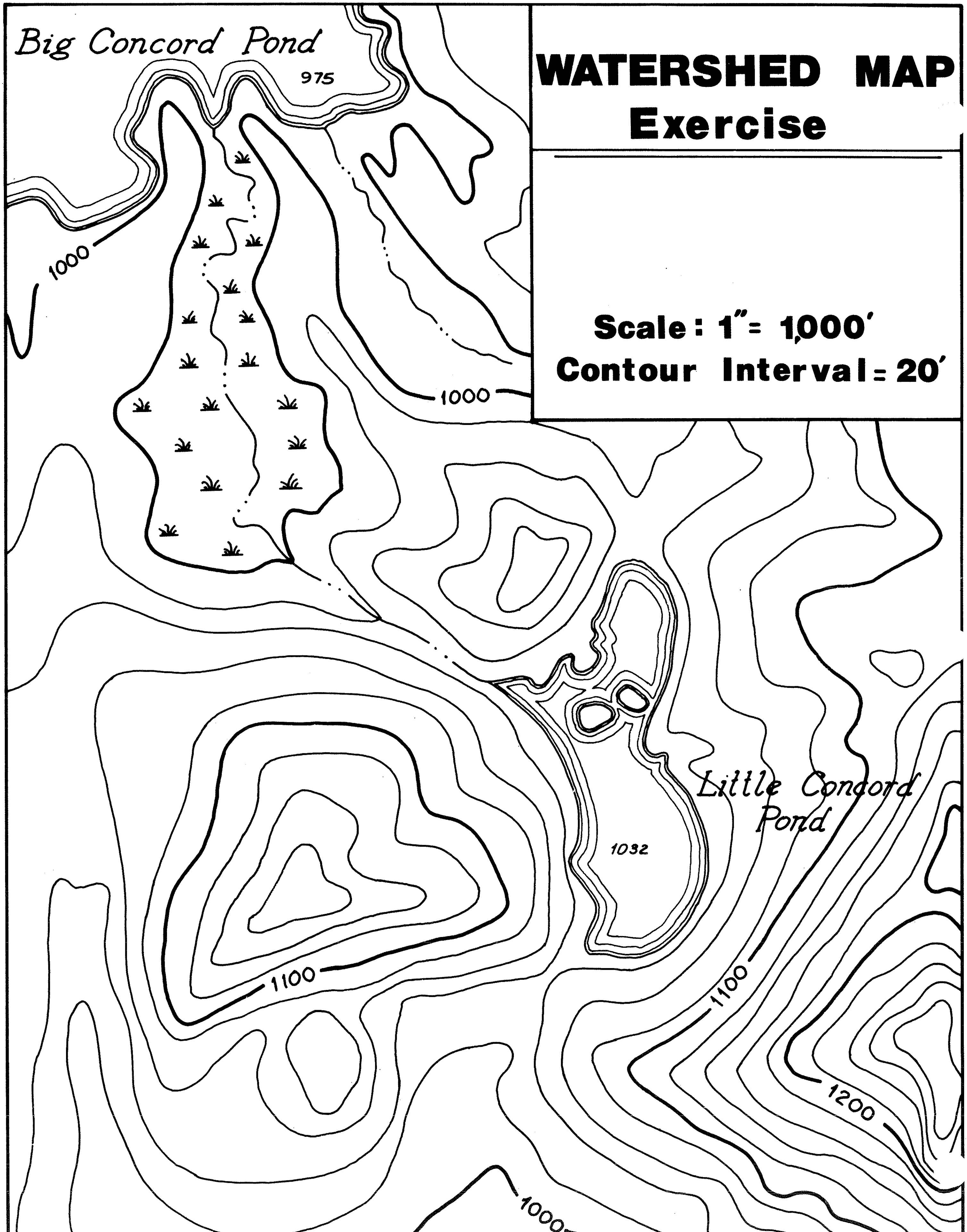
5. Attach prepared legend and title to the map (see Figure 8, page 41).

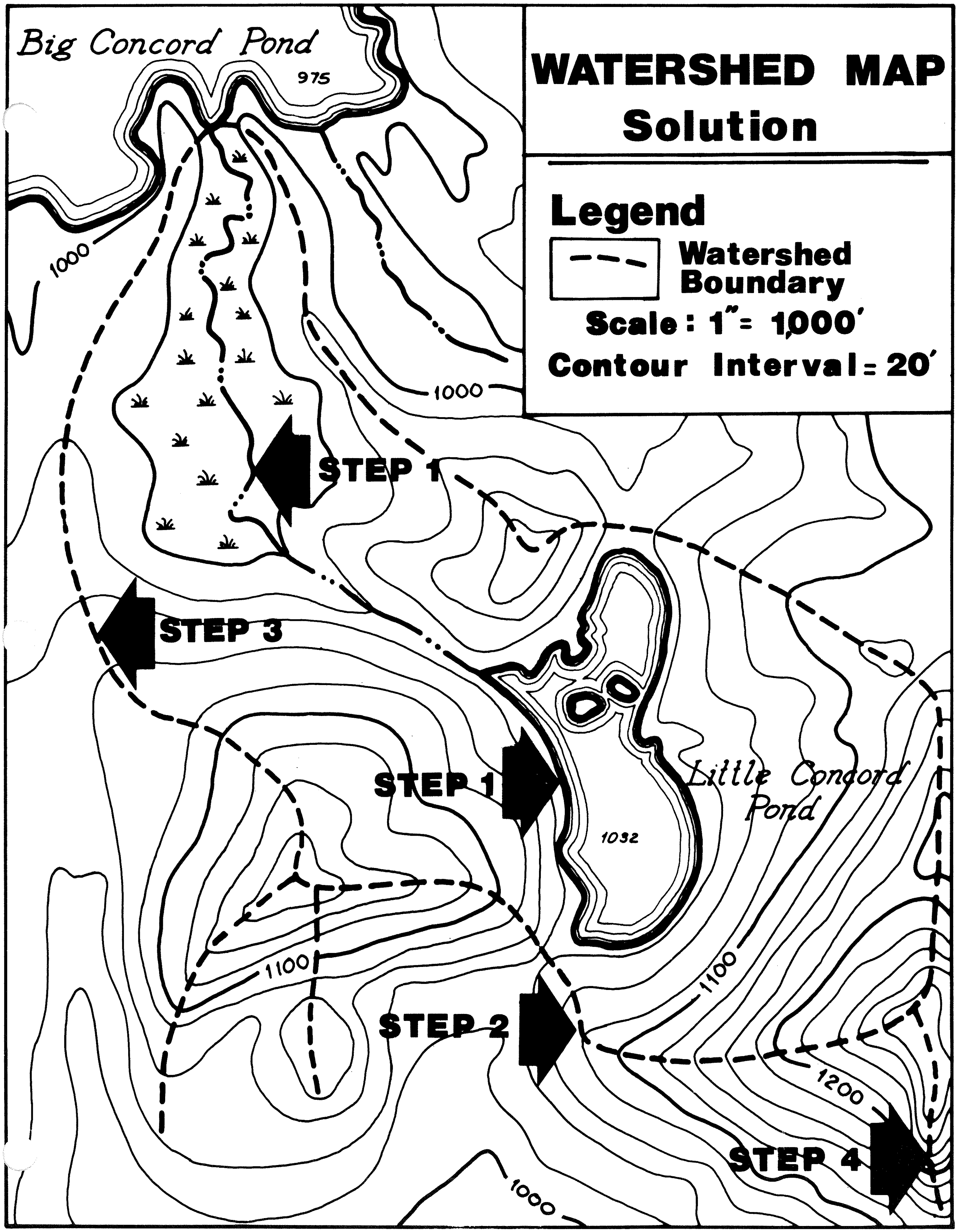
Source of data: U.S.G.S. Topographic Map
Aerial Photographs

WATERSHED MAP

LEGEND

 **Watershed Boundary**


WATERSHED MAP
Exercise
Scale: 1" = 1,000'
Contour Interval = 20'
Big Concord Pond
975
1000
1000
Little Concord Pond
1032
1100
1100
1200
1000


WATERSHED MAP
Solution
Legend
Watershed Boundary
Scale: 1" = 1,000'
Contour Interval = 20'
Big Concord Pond
975
1000
STEP 1
STEP 3
STEP 1
Little Concord Pond
1032
1100
STEP 2
1100
1200
STEP 4
1000

How to Make a Groundwater Map

1. Plot on the base map the location of drilled wells.

2. Determine well depth and flows from:

   a. land owners,
   b. well drillers (well information is sometimes considered confidential),
   c. published surveys (see sources below).

3. Note on the map the depth of the well and the flow of water or number the well and note depth and flow on a table in the legend. Mark each well with a symbol, as $\frac{90}{5}$, meaning a well with a depth of 90 feet and a flow of 5 gallons per minute.

4. If a groundwater favorability survey is available, transfer this information to the base map. Utilize symbols and legends as found in the survey.

5. When enough data is collected from sources, other than a published survey, to reveal areas and depth of good, fair or poor water yield, the areas can be outlined with a heavy solid black line and labeled as good, fair or poor.

6. Shade or color each area with darkest for poor water yield and lightest for good.

7. Attach prepared legend and title to the map (see Figure 9, page 46).

Source of data: -U S G S

-Water Resources Division
Maine Public Utilities Commission
Augusta, Maine 04333

GROUNDWATER MAP

Legend

- good
- fair
- poor

GEOLOGY

Geology, the study of the earth's crust, is divided into bedrock and surficial categories. As the name implies, bedrock geology is concerned with the underlying "hard rock." These layers are solid and massive. The depth to bedrock below the surface varies from zero to many hundreds of feet.

Surficial geology is concerned with those deposits above bedrock and below the surface. The surface layer of weathered material, soil, is not included in the study of surficial geology. Surficial deposits are unconsolidated, loose conglomerations of rock fragments.

Knowledge of bedrock geology is important because:

1. Some kinds of bedrock are good sources of ground water for human uses.

2. The permeability of bedrock influences the effect of waste disposal, septic and solid waste, on the quality of groundwater.

3. Cost for construction is increased when bedrock must be removed.

4. The stability of road cuts or other exposures is determined by the kind of bedrock.

5. The bearing strength of bedrock affects the locations and construction of heavy structures.

Knowledge of surficial geology is important because:

1. Many construction materials are taken from these deposits such as sand and gravel.

2. Some deposits provide water supplies as well as being areas where groundwater is recharged.

3. The nature of surficial deposits determines bearing strength which is important because most buildings are located on these deposits.

4. Frost action can be predicted by understanding the nature of surficial deposits.

5. Suitability for construction and waste disposal are influenced by the type of surficial materials.

BEDROCK

The type of bedrock is difficult to ascertain because it is covered by surficial deposits, soil and vegetation. In Maine, however, bedrock is often exposed at the surface which provides an opportunity to identify its nature. By piecing together scattered rock exposures, geologists can map the pattern of each bedrock type. In addition, borings and soundings provide further information.

Bedrock is classified into three basic types. Igneous rock is dense, solid rock formed from molten materials deep beneath the earth's surface. *Granite is an example of igneous rock.* **Metamorphic rock** has been formed from other rock types by the action of heat and pressure. *Shale is an example.* **Sedimentary rocks** are formed when sediments are compressed and fused under pressure. *Sandstone is an example.* Each rock type has particular characteristics for engineering properties, water source, and other uses.

Information about bedrock in Maine is available from the State Geologist in Augusta.

SURFICIAL

Surficial deposits in Maine occur as a result of glaciation. There have been several periods of glaciation, with the most recent period ending 10,000 - 12,000 years ago. As glaciers advance, the bedrock is gouged and scraped, and this material is picked up and moved along. When a glacier melts these materials are "dumped" and create deposits of surficial material.

The manner of dumping, by dropping in place or by water movement, results in various kinds of deposits and land forms. **Ground moraines** are created when the rock fragments are dropped in place. This results in a mixture of rock sizes - big boulders, very fine clay, microscopic particles - referred to as **glacial till.** **End moraines** and side moraines are created when a large amount of rock fragments are carried along at the margins of the glacier and then dumped. These features mark the farthest extent of the glacier. They are usually long, rounded ridges and may extend from several hundred feet to several miles in length.

Eskers are another ridge-like formation that are created in cracks and fissures of the glacier. These materials are deposited by glacial rivers and streams (water worked) and are found as long sinuous ridges. **Eskers** are included in deposits described as ice-contact stratified materials. Water has worked these materials and sorted them into layers. For example, sand and gravel pits located in an esker will show layers of differing sized rock fragments.

Another water worked feature is a **delta.** This is made up of materials that have been washed out of a glacier. Such a deposit will also show sorting or layering and is a good source of sand and gravels.

Glacial lakes often occur at the melting edge of a glacier. Surficial deposits occur as a result of the creation of a glacial lake. A **kame terrace** is a lake feature created by the action of retreating lake water. Essentially, a lake shore is created, then the water line lowers leaving a terrace or bench formation.

Another lake-associated deposit is lake bottom sediments known as **lacustrine deposits**. These are deposits of small sized particles that washed into the lake as sediments.

To this point the glacial story has depicted the advance and retreat of glacial ice sheets. In Maine, as the glacier melted, the land surface remained depressed allowing the ocean to cover a large amount of land. Apparently, at that time, the land was some 300 feet lower than at present. The sea intrusion created additional surficial deposits. Most notable are **marine deposits** of fine grained sediments and clay. In addition, glacial deposits were reworked by the sea creating such formations as beaches.

Eventually, the sea retreated as the land sprang back thus exposing the glacial and marine deposits to the forces of erosion. This resulted in additional reworking of surficial deposits so that, today, surficial deposits are a complex mixture. Patterns are not clear cut, and geologists can only identify portions of former formations.

Once vegetation became established the rate of erosion and change slowed, so that present day deposits have existed for some time. During this time weather and vegetation have modified the surface layer of surficial deposits to create

soil. Soil is the top, weathered section of surficial deposits. The natural resource inventory treats soil as a separate resource.

One final surficial deposit is sometimes identified as **peat**. This is a layer of vegetative matter partially decomposed and formed in old lakes and wetlands.

How to Make a Bedrock Geology Map

NOTE: This map cannot be made unless the bedrock types have been mapped by a geologist or other qualified person. Check with the State Geologist at the Maine Geologic Survey, Augusta, Maine 04333. If no information is available, see page 54.

1. Outline on the base map the location of bedrock types in solid black lines.

2. Shade or color the areas and label according to bedrock type.

3. Prepare a legend and title and attach to the map.

Source of data: Maine Geologic Survey, Generalized Geologic Map of Maine

How to Make a Surficial Geology Map - Alternative A*

1. Outline on the base map the location of surficial deposits in solid black lines.

2. Shade or color the areas, and label according to the type of surficial deposit.

3. Prepare a legend and title and attach to the map.

Source of data: Maine Geologic Survey

* This map cannot be made unless the surficial deposits have been mapped by a geologist or other qualified person. Check with the State Geologist at the Maine Geologic Survey, Augusta, Maine 04333. If no information is available, see page 54.

How to Make a Surficial Geology Map - Alternative B

NOTE: This method can be used when a detailed soils inventory is available. The base map required here is a soils map obtained from the county office of the Soil Conservation Service. The scale should be the same as other base maps used for this inventory. Photographic enlargement/reduction services are available. Contact MACC for suggested list of suppliers.

1. Read the soil description and underline the statements relating to parent material (formed in deposits such as marine sediments, lacustrine, glacial till, outwash, bottom land, flood plain, terrace.

2. When the type of parent material is not clearly indicated, contact the county office of Soil Conservation Service for clarification.

3. Prepare a table listing all soil types having a common parent material. For example:

PARENT MATERIAL	SOIL TYPE
Glacial till	Sutton (41) Ridgebury (25)
Lacustrine	Hartland (68) Biddeford (67)
Outwash	Hinckley (52)

4. Shade or color each type of parent material (surficial deposit) according to individual taste.

5. Prepare a legend and title, and attach to the map.

How to Make a Geology Map

NOTE: If information is not available for detailed bedrock or surficial maps, a geology map can be prepared. This map is a first step toward understanding the geologic character of the area. As more information becomes available it can either be added to this map, or a "proper" bedrock or surficial map can be made.

1. Outline in solid black lines on the base map the location of bedrock outcrops. Data can be assembled from soil surveys, personal knowledge, field investigation, and aerial photography.

2. Using same procedure as #1 above, map the location of gravel and sand pits.

3. Shade or color the areas.

4. Prepare a legend and title and attach to the map.

Sources of data: *Field survey*
Personal knowledge
Contractors
Soil survey
Aerial photography

SOILS

Soil is a basic resource of major importance to land use activities. It is the underlying material upon which roads, buildings, sewage and waste disposal, and recreation occur. Because a soil layer underlies most activities on the earth's surface, it is important to understand its properties and limitations.

Soil is the layer of the earth's surface that has been modified by weathering processes. Five factors determine the kind of soil to be found in a given area. They are the parent material, the climate, the vegetation, the topography, and time. Thus, soil is formed through the action of climate and vegetation on parent material. This action is affected by local topography. In addition, time determines how well "developed" a soil becomes.

Parent materials are the unweathered deposits from which soil is formed. The source of most parent materials are surficial deposits. Glacial till is probably the most commonly occurring parent material in Maine. Some soils, however, are derived directly from the weathering of bedrock, especially in hilly and mountainous regions. Often organic deposits occur which are the basis for peat and muck soil types.

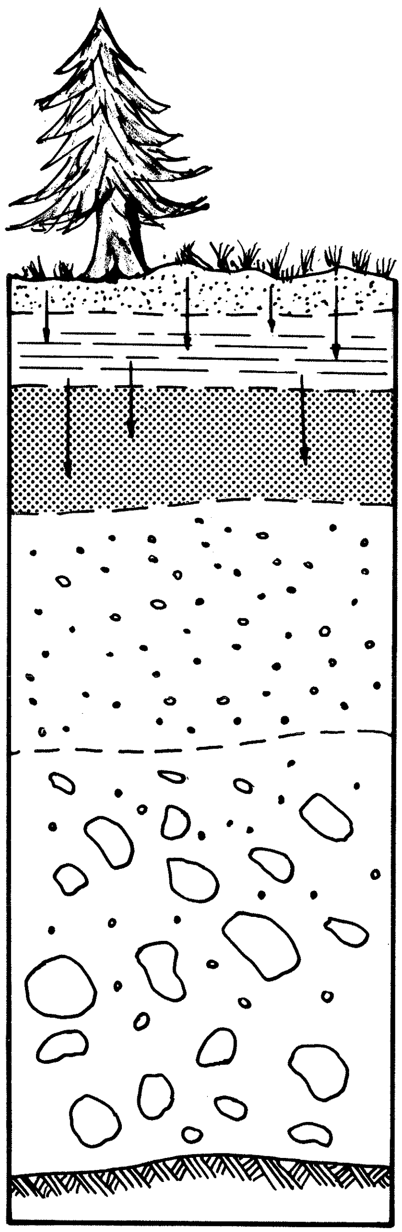
Climate has the greatest influence on soil formation. The cool summers and long cold winters with annual precipitation of 40 - 45 inches evenly distributed through the year create Maine's soil types. The rainfall leaches through the parent material. Some minerals are dissolved and carried deeper into the soil layer where they are deposited. This leaching action creates the layers found in a soil profile. (See Figure 10, page 58). This results in an infertile, acid layer near the surface.

Vegetation generally contributes organic matter to the soil. This material can interact to create acid conditions. It also can alter the texture and composition of the existing soil. For example, soil conditions under softwood vegetation are more acidic than under hardwood vegetation. Accumulated organic material also releases acids, making the soil even more acidic. It is for these reasons that Maine soils tend to be acidic.

Topography determines the natural drainage of the soil material and, thus, influences soil type. Shallow, stony soil occur on ridge tops and tends to be better drained. Deeper, heavier or wetter soils occur on lower slopes, valleys and stream bottoms.

When climate and vegetation have acted for a long time on parent material, a strong soil profile is developed. This

HORIZONS



O ORGANIC LAYER

A ZONE of LEACHING

B1 } ZONES of DEPOSITION
B2 }

C PARENT MATERIAL

BEDROCK

is an indication of the acids that are produced and the elements that are leached from the upper layers. Thus, a well developed soil has distinct layers or zones. (See Figure 10, page 58).

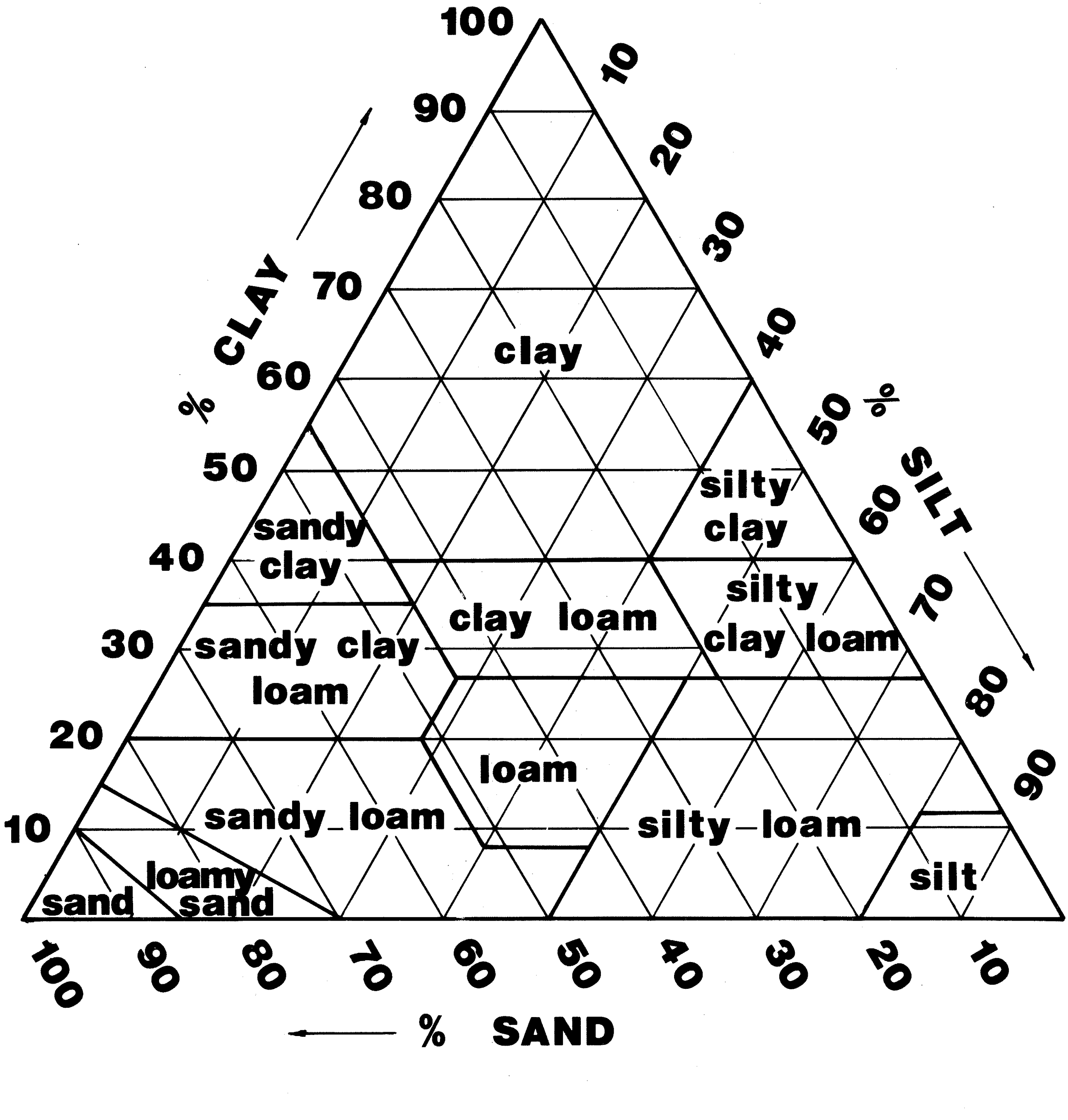
Physical Properties of Soil

A soil is described by its physical appearance and properties. This characterization is the basis for establishing soil types.

Color: Color indicates soil age, drainage, amount of organic matter, and, most importantly, the height of a seasonal water table. Mottling is a color characterization which identifies a fluctuating water table.

Texture: Texture refers to the relative amounts of sand, silt and clay in a soil. (See Figure 11, page 60). Textures range from coarse to fine or from light to heavy. **Sand** is the most coarse and feels gritty to the fingers when rubbed. **Silt** is finer and feels like flour or talcum, smooth but not sticky when wet. **Clay** is the finest and is microscopic. It feels smooth when dry and sticky when wet. There are 20 classes of soil texture. In Maine, four are commonly found. These are **sand, loam, silt loam** and **silty clay loam.** Loam is a

Figure 11. Soil Triangle



balanced mixture of sand, silt and clay and has average characteristics for drainage, as well as moisture holding capacity.

Structure: Structure is the arrangement of particles in the soil. It is the way in which sand, silt and clay "fit" together. This fit is influenced by moisture and organic content. Normally, particles tend to clump together. A soil with a crumbly structure is best for soil drainage, workability, etc. The addition of organic matter can improve the soil structure resulting in better plant growth.

Moisture: Moisture holding capacity is influenced by texture and structure of the soil. Moisture classes are described in terms of drainage. These are: **excessively well drained, well drained, moderately well drained, poorly drained and very poorly drained.** Depending on the proportions of soil, silt and clay and how they fit together, the ability of the soil to hold and release water is determined. Finer textured or heavy soils are usually poorly drained and lighter sandy soils are usually well drained.

In addition to the above general soil conditions, several other factors about soils should be considered.

A **fragipan** is an impermeable layer in the soil. This layer restricts water movement downward and causes an artifically high ground water table. Thus, a "**pan**" can cause a soil to be wet and poorly drained although the soil below the pan can be well drained.

Occasionally a soil is influenced by a "**perched water table.**" This occurs when water movement is blocked by an underlying layer or dyke, usually ledge. The result is again a wet soil.

Soil Names

The name of a soil is established at the time a new soil is identified. The name generally refers to the geographic area where the soil is first found.

There is a hierarchy in defining soils and establishing names. The first and more general system of soils classification is the soil series. Each series includes soil types with similar physical properties but different texture. Once the texture is named, the soil type is established. Thus the Bangor series of soils, for example, is further classed as a type, such as Bangor silt loam.

Soil Survey

The Soil Conservation Service is the government agency in charge of undertaking surveys of the location and extent of soil types.

Presently, the State of Maine is partially surveyed. Several counties have been completed, including Penobscot, Aroostook, Cumberland, Androscoggin and Somerset.

During the process of soil inventory, town reports are published as interim soil surveys. Many towns are surveyed on this basis. This program makes the information available for use before a county report would be ready. A basic problem remains, however, because some towns have soils data and others do not.

Soil Suitability Guide

An extremely useful and informative guide for soil analysis is presented in the *Maine Soil Suitability Guide.** This guide presents background and soil ratings for some 33 land uses. It provides a rating based on the limitations of each for a given use. Since the soils characteristics for each use are not readily shown, it is difficult to understand which soil factor creates the limitation. The inventory maps for soil characteristics are depth to bedrock, depth to water table, and erodibility. These soil characteristics are inventoried because of their limiting effect on residential land use suitability.

In summary, the reasons for acquiring soils data are:

1. To locate areas best suited to specific activities;

2. To identify areas where additional investment in development will be necessary and/or where environmental hazard is the greatest;

3. To direct land management activities to the most productive sites.

* *<u>Maine Soil Suitability Guide</u> available from the Soil & Water Conservation Commission, State House, Augusta, Maine 04333.*

Depth to Bedrock

The depth of soil above bedrock is an important consideration for building and development activities. Roads, utilities and cellar foundations, for example, are difficult and expensive to install when bedrock is present. Septic systems are also difficult to place and may easily pollute ground water.

Shallow depth to bedrock is considered to be 0 - 20 inches and presents severe limitations for foundations and septic system installation. Special or alternate ways of construction are usually more expensive and perhaps more damaging. Areas having moderately deep soils (20-40 inches) are more suited to housing uses. These areas are suitable for septic disposal fields but may have limitations for other types of land uses.

Areas having deep soils (greater than 40 inches) are generally suitable for development, at least from a depth point of view.

Depth to Water Table

The depth to the water table is extremely important because of the potential for groundwater pollution from septic systems. Groundwater in the soil fluctuates in height and drains through the ground. Thus a source of pollution can be carried to other areas by the moving groundwater.

Wet, very poorly drained soils where the water table is at or within 9 inches of the surface for some part of the year are inherently unusable for septic system use and house building.

Poorly drained soils (9-18 inches depth to water table) also place severe limits on the use of the land. Frequent fluctuations in water level as well as frost heaving can be damaging to buildings, roads and the proper functioning of septic systems.

Moderately well drained soils (18-30 inches to water table) have less severe limitations on land uses, and deep, well drained soils present few problems. The latter have a depth greater than 30 inches to water table.

ERODIBILITY

The erodibility of a soil is important because many land use activities expose the soil to the weather and thus increase the chance for erosion and sedimentation.

The erodibility of a soil depends on the texture of the soil and the slope of the land. Steeper slopes or finer textured soils are more easily eroded.

How to Make a Depth to Bedrock Map

NOTE: The base map required here is a soils map obtained from the county office of the Soil Conservation Service. The scale should be the same as other base maps used for this inventory.* In addition, procure copies of the soil description sheets for the township or county.

If there is no soils map, do not attempt to do this inventory item.

1. Read the soil description and underline the sentences related to depth to bedrock.

2. When no bedrock information is given, contact the county office of the Soil Conservation Service for the information.

3. Prepare a table listing all soil types having 0-20 inches depth to bedrock, 20-40 inches, and greater than 40 inches. For example:

DEPTH TO BEDROCK	SOIL TYPE
0 - 20	Hollis (31)
20 - 40	
40+	Sutton (41) Ridgebury (25)

4. Shade or color each area with the darkest shade for the shallowest category.

5. Attach the prepared legend and title to the map (see Figure 12, page 68).

DEPTH TO BEDROCK

Legend

- ☐ Shallow (0"- 20")
- ☐ Moderately deep (20"-40")
- ☐ Deep (40"+)

How to Make a Depth to Water Table Map

NOTE: The base map required here is a soils map obtained from the county office of the Soil Conservation Service. The scale should be the same as other base maps used for this inventory.* In addition, procure copies of the soil description sheets for the township or county.

If there is no soils map do not attempt to do this inventory item.

1. Read the soil description and underline the sentences related to depth to water table.

2. When no water table information is given, contact the county office of Soil Conservation Service for the information.

3. Prepare a table listing all soil types having greater than 30 inches depth to water table, 18-30 inches, 9-18 inches, less than 9 inches. For example:

DEPTH TO WATER TABLE	SOIL TYPE
0 - 9 in.	Biddeford (67) Ridgebury (42)
9 - 18 in.	
18 - 30 in.	Sutton (40)
30+ in.	Charlton (36)

4. Shade or color each area with the darkest shade for the shallowest category.

5. Attach the prepared legend and title to the map (see Figure 13, page 71).

Photographic enlargement/reduction services are available. Contact MACC for suggested list of suppliers.

DEPTH TO WATER TABLE

Legend

- ☐ Deep, well drained (30″+)
- ☐ Moderately well drained (18″-30″)
- ☐ Poorly drained (9″-18″)
- ☐ Very poorly drained (-9″)

How to Make an Erodibility Map

NOTE: The base map required here is a soils map obtained from the county office of the Soil Conservation Service. The scale should be the same as other base maps used for this inventory.* In addition, procure copies of the soil description sheets for the township or county.

If there is no soils map do not attempt to do this inventory item.

1. Read the soil description and underline the sentences related to erodibility.

2. When no erodibility information is given, contact the county office of the Soil Conservation Service for the information.

3. Prepare a table listing all soils types having erodibilities of slight, moderate, or high. For example:

ERODIBILITY	SOIL TYPE
Slight	Charlton (36)
Moderate	Sutton (41) Hollis (31)
High	Hartland (68)

4. Shade or color each area with the darkest shade for the highest category.

5. Attach the prepared legend and title to the map (see Figure 14, page 74).

* *Photographic enlargement/reduction services are available. Contact MACC for suggested list of suppliers.*

ERODIBILITY

Legend

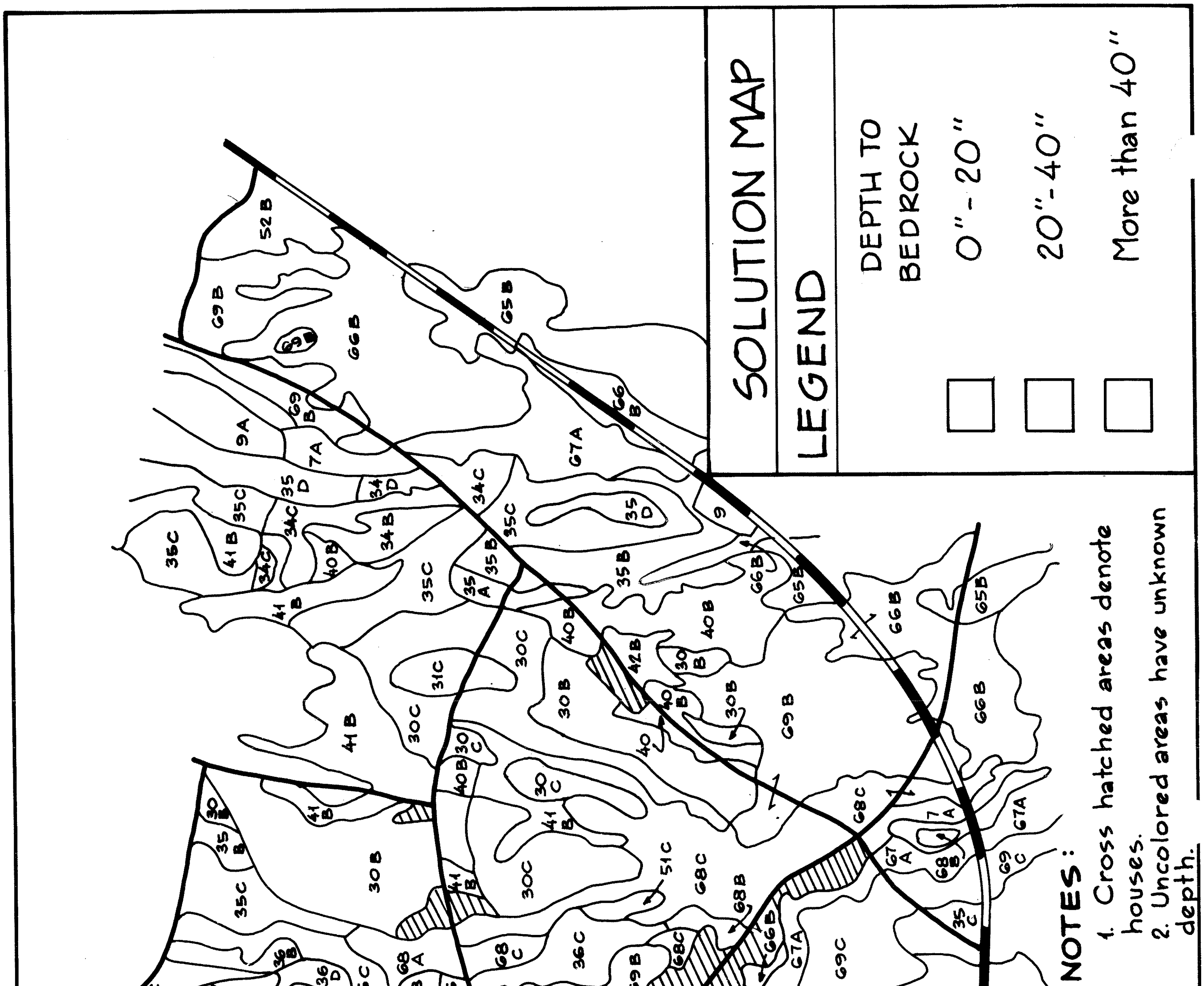
- ☐ Slight
- ☐ Moderate
- ☐ High

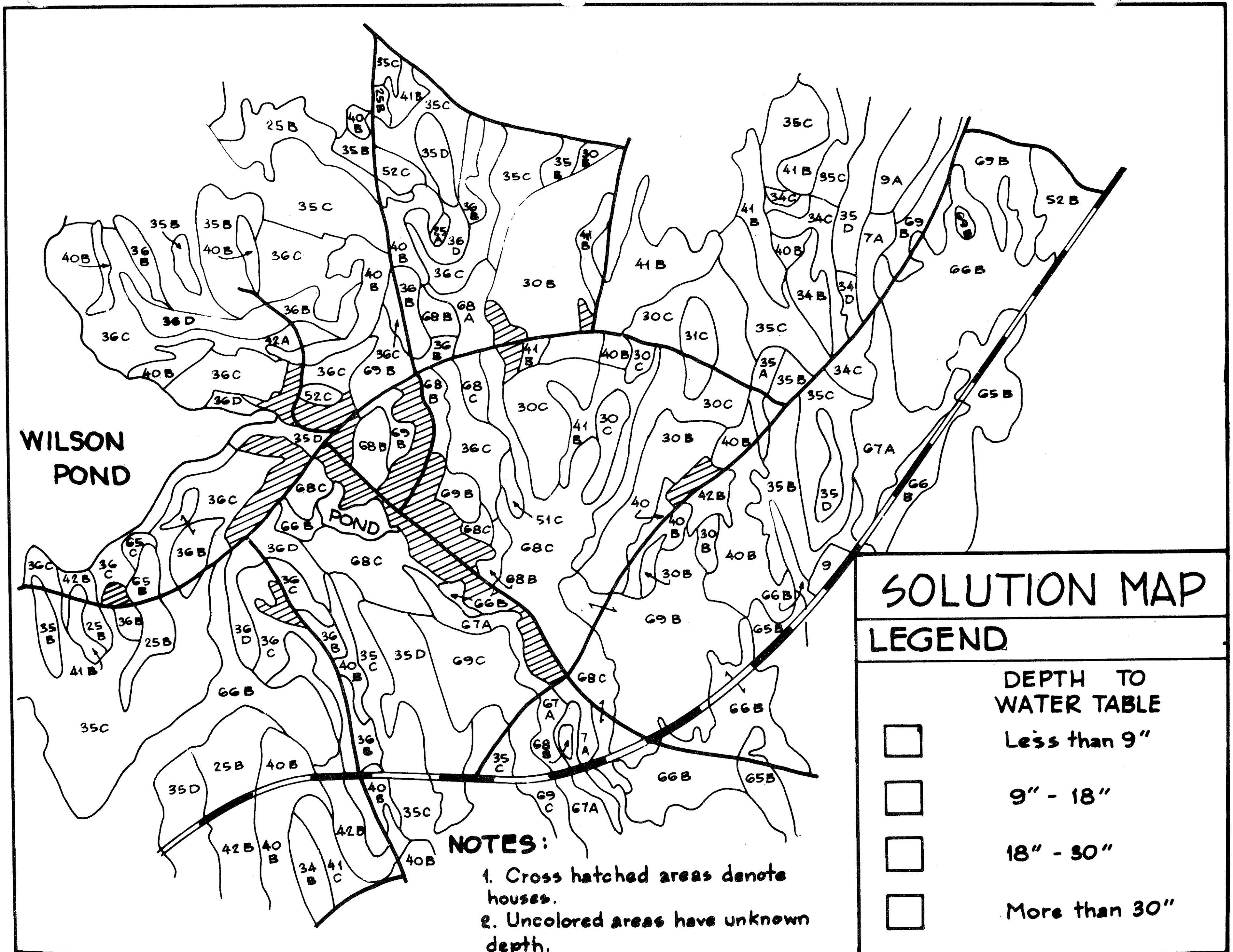
Soil Map Exercises

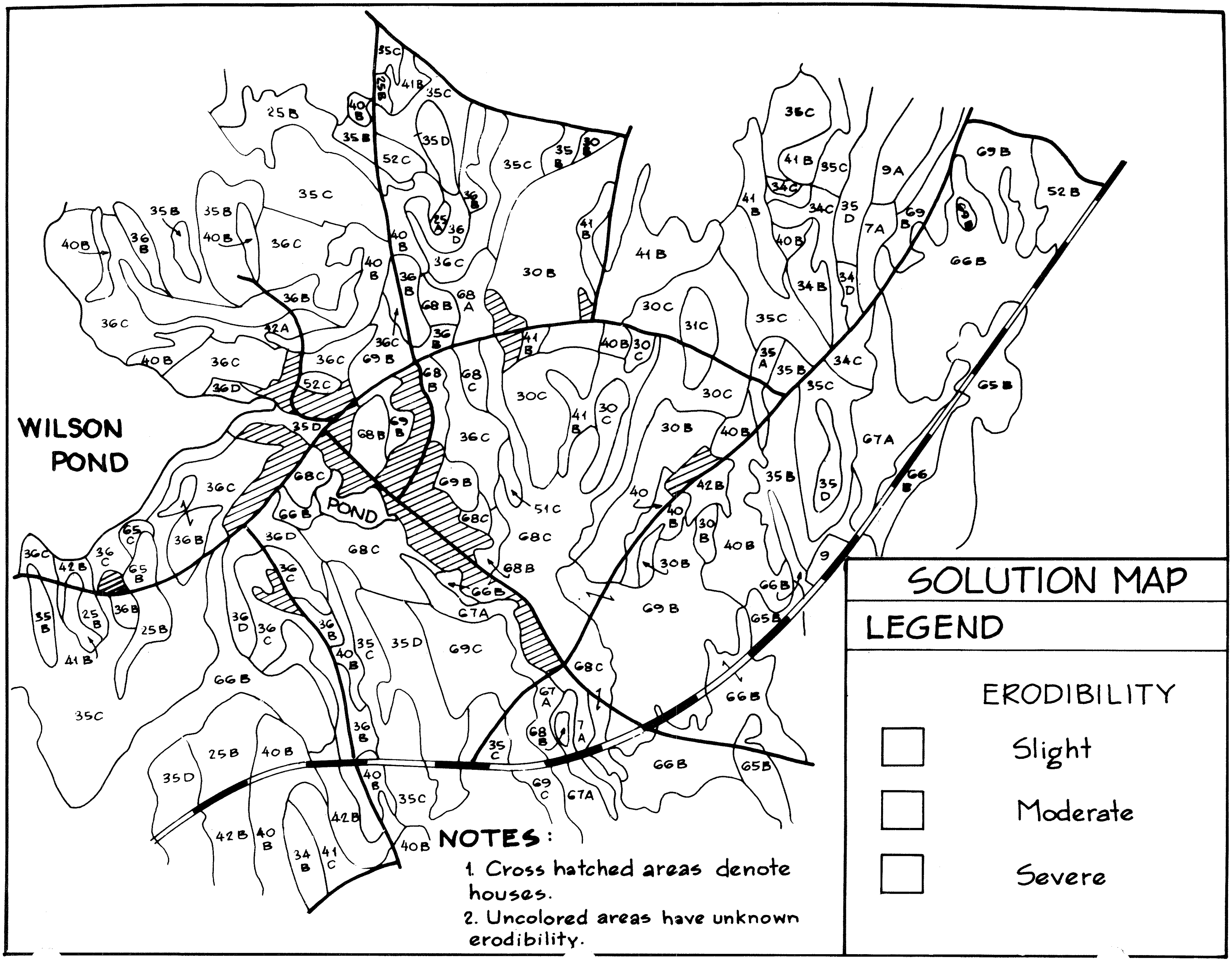
The following materials are to be used in the soil map exercises. Included are three copies of a sample soils map, list of soil types, and appropriate soil description sheets.

Using the sample maps produce depth to bedrock, depth to water table, and erodibility maps according to the instruction on pages 66 - 73. Do not use the titles and legends for these exercises.

Solutions will be found on pages 84a, 84b and 84c.


SOLUTION MAP
LEGEND
DEPTH TO BEDROCK
0"-20"
20"-40"
More than 40"
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown depth.
WILSON POND
POND


SOLUTION MAP
LEGEND
DEPTH TO WATER TABLE
Less than 9"
9" - 18"
18" - 30"
More than 30"
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown depth.
WILSON POND
POND



WILSON POND
POND
SOLUTION MAP
LEGEND
ERODIBILITY
Slight
Moderate
Severe
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown erodibility.

TOWNSHIP OF MONMOUTH - KENNEBEC COUNTY

Field Symbol for Major Soil Unit	Inclusions found Within Major Soil Unit	Field Name for Major Soil Unit
90		Agawam fine sandy loam
65	64	Buxton Silt loam
35	15, 35V 15V, 84	Charlton very stony fine sandy loam
36	14, 34, 80	Charlton fine sandy loam
68	60	Hartland very fine sandy loam
52	50, 95	Hinckley gravelly sandy loam
30	32, 85	Hollis fine sandy loam
31	33, 88	Hollis very rocky fine sandy loam
9M		Peat and Muck
25		Ridgebury very stony fine sandy loam
66	63	Scantic silt loam
40	72	Sutton fine sandy loam
41	70	Sutton very stony fine sandy loam
51		Windsor loamy sand

State: Maine Date: September 1968 Soil: Agawam fine sandy loam

SUBJECT TO UPDATING Map Symbol: 90

These are deep well drained sandy soils having 1-1/2 to 2 ft. of fine sandy loam over loamy sand or sands containing some gravel. They lie on nearly level to gently sloping stream terraces located above the flood zone with narrow steep terrace faces dividing the levels. Most of these soils lie on slopes of 2 to 8 percent but terrace face slopes may be as steep as 45%. Moisture holding for plants is moderate to high. Permeability in the upper 2 feet is rapid but in the substratum it is very rapid. Natural fertility is low but response to fertilization is good. Reaction ranges from very strongly to medium acid. This soil dries quickly after rains and is easy to work. Compaction characteristics are fair to poor because of the general poor grading. Erodibility is slight on the gently sloping areas but the steeper slopes erode easily. Banks and deep cuts slough easily. Frost susceptibility is moderate. Depth to water table is greater than 5 feet. Bearing ratio is moderate. Depth to bedrock is 10 feet or more. The subsoil and substratum are non-sticky and non-plastic and has a unified classification for both layers of SM.

State: Maine Date: September 1968 Soil: Buxton silt loam

TENTATIVE. Subject to updating Map Symbol: 65 64

These are deep, moderately well drained silty and clayey soils formed in fine textured sediments. They occupy gently sloping to rolling lake and marine terraces in the coastal counties and in the interior lowland along the Androscoggin River. Slopes range from 0 to 15 percent. Typically these soils have 12 to 18 inches of friable yellowish silt loam over silty clay loam. Stones or course fragments of any kind are uncommon. Depth to bedrock is more than 6 feet. Moisture holding for plants is high. Permeability of the substratum is slow to very slow. Reaction is strongly acid in the surface but ranges to slightly acid in the substratum. Susceptibility to frost is high. The surface dries slowly after rains and is sticky and plastic. The substratum has low sheer strength and low bearing capacity when wet in addition to being very sticky and very plastic. Erodibility is high on the moderately steep slopes. Natural fertility is low but productivity is moderate. The unified classification is principally ML for the surface and CL for the substratum.

State: Maine   Date: August 1968   Soil: Charlton very stony fine sandy loam

SUBJECT TO UPDATING   Map Symbol: 35 15

These are deep well drained fine sandy soils dveloped in a slightly firm glacial till high in mica. They lie mainly on the low rolling hills and ridges in south central and southern Maine. Slopes range from 0 to 35% but slopes of 5 to 15% are most common. This Carlton soil is principally forested. It has a thin (3-5 inch) dark brown surface high in organic matter underlain by 18 to 24 inches of yellowish brown subsoil. A friable olive gray sandy till 3 1/2 feet or more thick lies below the subsoil. From 0.1 to 3 percent of the surface is covered with stone 10 inches to more than 2 feet in diameter (43 to more than 1300 stones per acre). Small stones 2 mm to 10 inches make up 5 to 20 percent of the soil body. Depth to seasonal high water table is over 4 feet. Moisture holding for plants is high. Permeability is moderate to moderately rapid in the subsoil and moderately rapid in the substratum. Reaction is medium to very strongly acid. Susceptibility to frost is moderate. Compactibility is fair to good. Bearing strength is moderate. They are non-sticky and non-plastic wet and are easy to work under most conditions. Out banks are stable. Erodibility is low. Unified classification is principally SM for the subsoil and substratum.

State: Maine   Date: August 1968   Soil: Charlton fine sandy loam

SUBJECT TO UPDATING   Map Symbol: 36 14, 34, 80

These are deep well drained fine sandy soils developed in a slightly firm glacial till high in mica. They lie mainly on the low rolling hills and ridges in south central and southern Maine. Slopes range from 0 to 35% but slopes of 5 to 15% are most common. This Charlton soil is a cultivated phase and has a 6 to 13 inch dark brown surface over 18 to 24 inches of yellowish brown subsoil. A friable olive gray sandy till 3 1/2 or more feet thick lies below the subsoil. About 5 to 50 large stones 10 inches in diameter and over are common in some areas. Small stone 2 mm to 10 inches make up 5 to 15 percent of the soil body. Depth to a seasonal high water table is over 4 feet. Moisture holding for plants is high. Permeability is moderate to moderately rapid in the subsoil and moderately rapid in the substratum. Reaction is medium to very strongly acid. Susceptibility to frost is moderate. Compactibility is fair to good. Bearing strength is moderate. They are non-sticky and non-plastic wet and are easy to work under most conditions. Cut banks are stable. Runoff is moderate on the steeper slopes. Erodibility is low. Unified classification is principally SM for the subsoil and substratum.

State: Maine | Date: October 1968 | Soil: Hartland very fine sandy loam

SUBJECT TO UPDATING | Map Symbol: 68 60

These are deep well drained silty soils formed in windblown or lakelaid deposits on the sides and floors of stream valleys. Slopes range from 2 to 60% but most areas of these soils lie on slopes of 8 to 25%. These Hartland soils have a brown very fine sandy loam surface layer and brownish or olive colored very fine sandy subsoil to depth greater than 5 feet. The lower subsoil typically has thin bands of silts and very fine sands. These soils are nearly free of stones or stone fragments. Depth to bed rock is greater than 5 feet. Depth to seasonal water table is more than 5 feet. Moisture holding for plants is very high. Permeability in the upper subsoil is moderate to rapid but permeability in the lower subsoil (3-4 feet) is moderate to slow. Acidity ranges from strongly to medium acid. Erodibility is high. Natural fertility is low to moderate but they respond well to fertilization. Susceptibility to frost is severe. They are easy to work and they dry rather quickly after rains. Cut banks are unstable and ditches are susceptible to piping. Bearing ratio is low. The unified classification is mainly ML.

State: Maine | Date: September 1968 | Soil: Hinckley gravelly sandy loam

TENTATIVE - Not coordinated and for limited local use only | Map Symbol: 52 50,85

These are deep, excessively drained sandy and gravelly soils developed in coarse outwash material composed of sandstone, granites, quartzite, quartz and some slate and shale. They occupy nearly level and gently rolling outwash areas and steep sided long low ridges called "horsebacks". Slopes of the outwash plains range from 0 to 25% while slopes of the horsebacks range from 0 to 60%. Most of these Hinckley soils have a dark brown gravelly sandy loam surface 6 to 10 inches thick over a yellowish brown gravelly sandy loam 8 to 12 inches thick. Sand and gravel lies below the second layer. Coarse fragments 2 mm to 3 inches range from 20 to 30% in the upper soil layers. Depth to bedrock is more than 10 feet; depth to water table is more than 5 feet. Moisture holding for plants is very low. Permeability is very rapid. Runoff is slight. Reaction ranges from very strongly to slightly acid. Natural fertility is very low. Susceptibility to frost is low. Bearing ratio is high. Cut slopes and trench faces are unstable and subject to sloughing. These Hinckley soils are non-sticky, non-plastic poorly graded sands boderline to silty sands in the upper horizons and poorly graded sands or poorly graded gravels in the substratum. Unified classification is principally SP-SM for the subsoil and GP for the substratum.

State: Maine   Date: September 1968   Soil: Hollis fine sandy loam

SUBJECT TO UPDATING   Map Symbol: 30 32,85

These are shallow, well drained fine sandy soils developed in schistose glacial till. They lie on nearly level to steep upland areas throughout the central and southern parts of Maine. These Hollis soils have 6 to 10 inches of dark brown fine sandy loam surface over 4 to 14 inches of yellowish or olive brown subsoil. A schistose bedrock lies on the average at 10 to 20 inches but small shallower or deeper spots may make up to 20 percent of the area. Coarse fragments up to 3 inches make up 1 to 20 percent of the soil. Depth to seasonal water table is greater than 3 feet. Moisture holding for plants is low to moderate. Permeability is moderately rapid. Slopes range from 0 to 45 percent with the greater portion on slopes of 8 to 15 percent. Reaction is strongly to very strongly acid. Susceptibility to frost is moderate. Bearing ratio is moderate. They are non-sticky and non-plastic, dry early in the spring and quickly shed rains, and are easy to work if outcrops do not interfere. Low fertility, erodibility is moderate. Most of these soils have a united classification of SM.

State: Maine   Date: October 1968   Soil: Hollis very rocky fine sandy loam

SUBJECT TO UPDATING   Map Symbol: 31 33,88

These are shallow, well drained glacial till soils developed in primarily schistose soil materials on the uplands. Topography is very irregular. Slope range is 0 to 60 percent but 50% or more of these soils lie on slopes of 15 to 25%. These Hollis soils have 3 to 5 inches of brownish fine sandy loam over a yellowish brown fine sandy loam subsoil to a depth of 10 to 18 inches. Schistose bedrock lies at 10 to 18 inches and is often shattered or crevassed. Bedrock outcrops are numerous and occupy 10 to 25 percent of the surface area. Moisture holding ability per inch of soil is moderate but total moisture holding capacity for plants is low. Depth to seasonal water table is over 3 feet. Reaction is very strongly to strongly acid. Susceptibility to frost is moderate. Erodibility is moderate. Bearing ratio is moderate. Compactibility is moderate to poor. Numberous outcroppings make this soil difficult to work or use. It is non-sticky and non-plastic and has a nearly uniform unified classification of SM.

State: Maine   Date: November 1970   Soil: Peat and Muck

TENTATIVE-Not coordinated and for limited local use only.   Map Symbol: 9M

These are organic materials 1 1/2 feet or more to inorganic sandy, clayey or loamy soil materials or, in places bedrock, usually very poorly drained. This unit is a mixture of brown peat and black muck. The peat is quite fibrous and may be considered undecomposed while the muck is non-fibrous and is very decomposed. Peat and Muck is the principal material in many bogs and swamps in Maine. Slopes are level or very nearly so. Stones and other coarse fragments are absent. The water table is near the surface throughout the year. Reaction is strongly to extremely acid. Susceptibility to frost action is high. Unified calssification is Pt.

State: Maine   Date: November 1968   Soil: Ridgebury very stony fine sandy loam

SUBJECT TO UPDATING   Map Symbol: 25

These are deep poorly drained sandy soils with fragipan developed in granitic, gneissic and schistose glacial till. They lie on nearly level and depressional areas predominently in upland hills and ridges and occur mainly in southern Maine. Slopes range from 0-8%. This Ridgebury soil has a surface layer of dark gray fine sandy loam 4 to 10 inches thick and underlain by an olive-gray mottled fine sandy loam or sandy loam subsoil. A very firm compact fragipan lies at 14 to 16 inches depth. Stones 10 inches to 2 feet diameter occupy .1 to 3% of the surface (43-1300 stones per acre). Coarse fragments 2 mm to 10 inches in diameter comprise 10 to 20 percent of the soil volume. The depth to bedrock is more than 4 feet. The surface is saturated during the late fall, winter and spring seasons by a perched water table. The surface may become quite dry in late summer but saturates quickly with the first rains. The moisture holding capacity for plants is moderate. Permeability above the fragipan is moderate and is slow to very slow in the fragipan. Susceptibility to frost action is high. Compactibility is fair to good. Bearing ratio is medium to high. Runoff is slight. These soils are difficult to work under natural conditions because of wetness and stoniness. The unfied classification is a sand silt mixture (SM, SP-SM) and is non-plastic to slightly plastic when wet.

State: Maine Date: October 1968 Soil: Scantic silt loam

SUBJECT TO UPDATING Map Symbol: 66 63

These soils are deep poorly drained silt loams over very firm marine and lacustrine deposits of silts and clays. These soils occur in small depressions and nearly level to gently undulating lowlands of the coastal and inland waterways. The Scantic soils generally contain no coarse fragments greater than 2mm. They have 12 inches to 16 inches of grayish brown silty surface layer that is underlain by a silty clay loam or silty clay subsoil. Below the subsoil is a very firm silt and clay substratum. These marina and lacustrine deposits generally range from 6 to 20 feet thick. The water table is about 1 foot or less below the surface for 9 months each year. Slopes range from 0-8%. Permeability is very slow. The soil reaction ranges from slight to strongly acid, but is usually neutral at depths of three feet and below. Natural fertility is low. Moisture for plants is very high to excessive. Susceptibility to frost is severe. Compressibility is slight. Shear strength is low. Workability is poor. Bearing ratio is low. The soil, subsoil, and substratum is highly sticky and plastic especially when wet. It ranges from organic silts and clay (OL,OH) in the surface to silts and clays (ML, CL, MH, CH) in the subsoil and substratum.

State: Maine Date: October 1968 Soil: Sutton fine sandy loam

SUBJECT TO UPDATING Map Symbol: 40 72

These are deep moderately well drained fine sandy soils developed in slightly firm glacial till. They occupy the lower slopes of upland till ridges on gently sloping to moderately steep areas. Slopes range from 1 to 15 percent but most areas of these soils have slopes of 3 to 8%. Most of the Sutton soils have 6 to 8 inches of dark grayish brown fine sandy loam surface layer over a yellowish brown or olive below the subsoil. A few stone (1 to 40 per acre) may lie on the surface and in the soil body. Smaller stone fragments 2mm to 10 inches diamter comprise 5 to 20% of the soil. Depth to bedrock is greater than 4 feet. Water holding capacity is high. A seasonal water table lies at 1 1/2 to 2 1/2 feet. Permeability is moderate throughout the soil except during periods when the water table is high. Reaciton ranges from strongly to medium acid. Surface runoff is moderate except for the steeper slopes, where it is rapid. Natural fertility is low. Roads and ditch banks have good stability but seepage in ditch banks is common during periods when water table is high. Bearing ratio is moderate to moderately low. Workability is poor because of slow drying after rains. Compactibility is fair. Erodibility is moderate. The unified classification is mainly silty sands (SM) for the entire soil.

State: Maine   Date: September 1968   Soil: Sutton very stony fine sandy loam

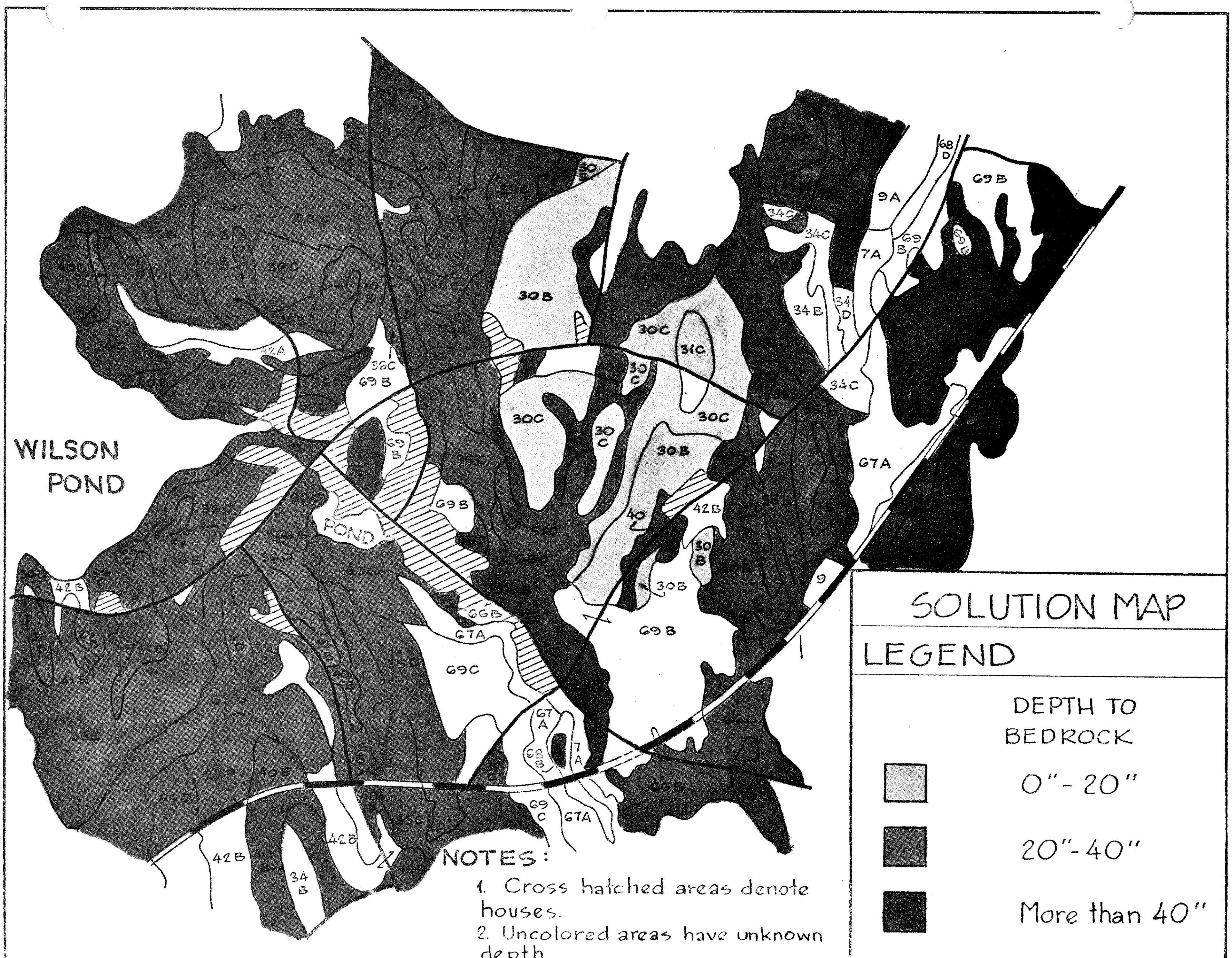
SUBJECT TO UPDATING   Map Symbol: 41 70

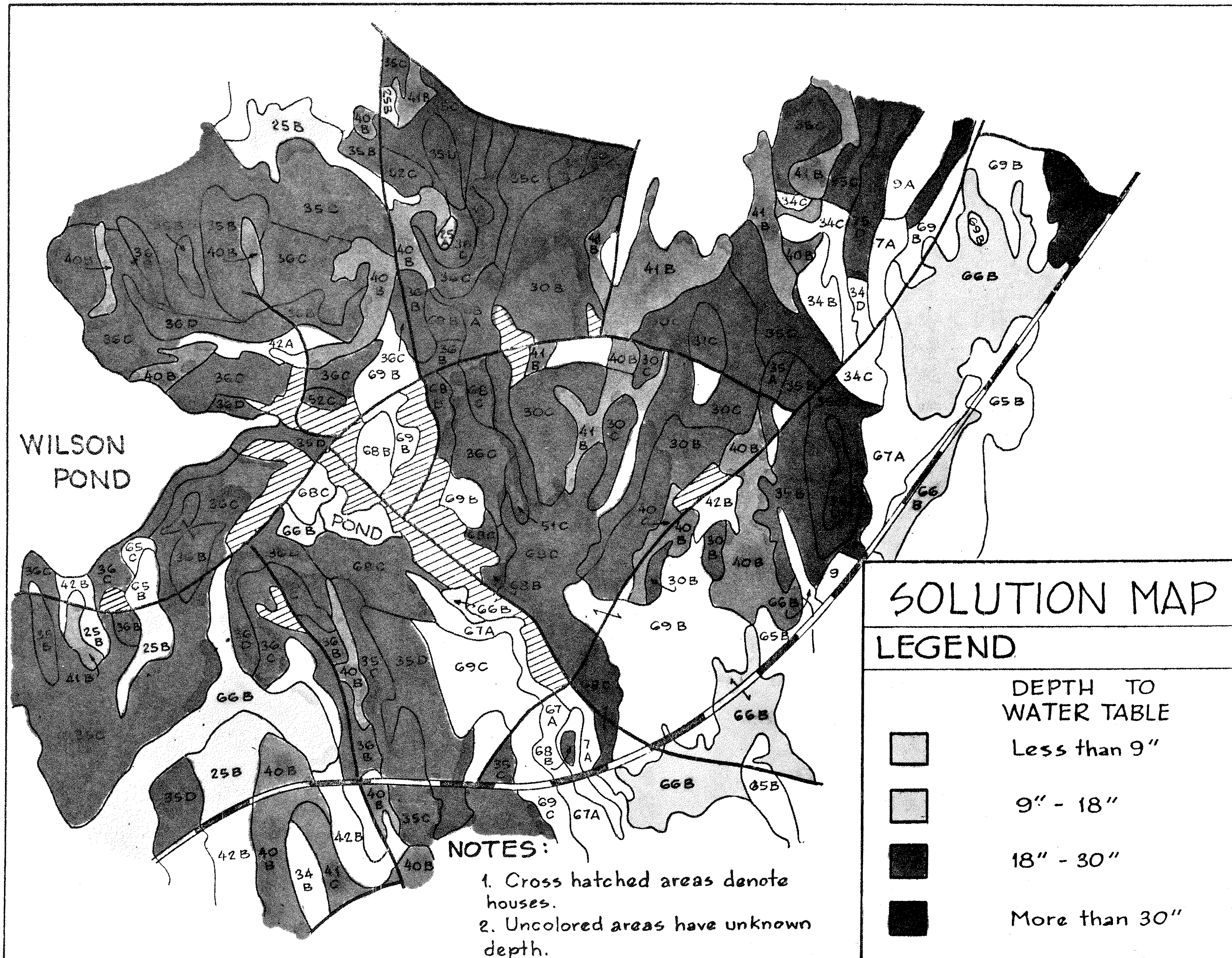
These are deep moderately well drained fine sandy soils developed in slightly firm glacial till. They occupy the lower slopes of upland till ridges on gently sloping to moderately steep areas. Slopes range from 0 to 15 percent but most of these soils lie on slopes of 3 to 8 percent. Most Sutton soils have 6 to 8 inches of dark grayish brown fine sandy loam surface layer over a yellowish brown or olive brown fine sandy loam subsoil from 14 to 24 inches. Mottled fine sandy loam lies below the subsoil. Many large stone (43 to 1300 per acre) lie on the surface and within the soil. Smaller stone fragments 2 mm to 10 inches comprise 5 to 20% of the soil body. Depth to bedrock is greater than 4 feet. A seasonal water table lies at 1 1/2 to 2 1/2 feet beneath the surface. Water holding capacity is high. Permeability is moderate throughout the soil except in the substratum during periods when the water table is high at which time it is slow. Reaction ranges from strongly to medium acid. Surface runoff is moderate. Natural fertility is low. Road and ditch banks have good stability but seepage is common during periods when water table is high. Bearing ratio is moderate to moderately low. Workability is poor because of slow drying after rains. Compactibility is fair. Frost susceptibility is moderate. Erodibility is moderate. The Unified Classification is mostly silty sands (SM) for the entire soil.

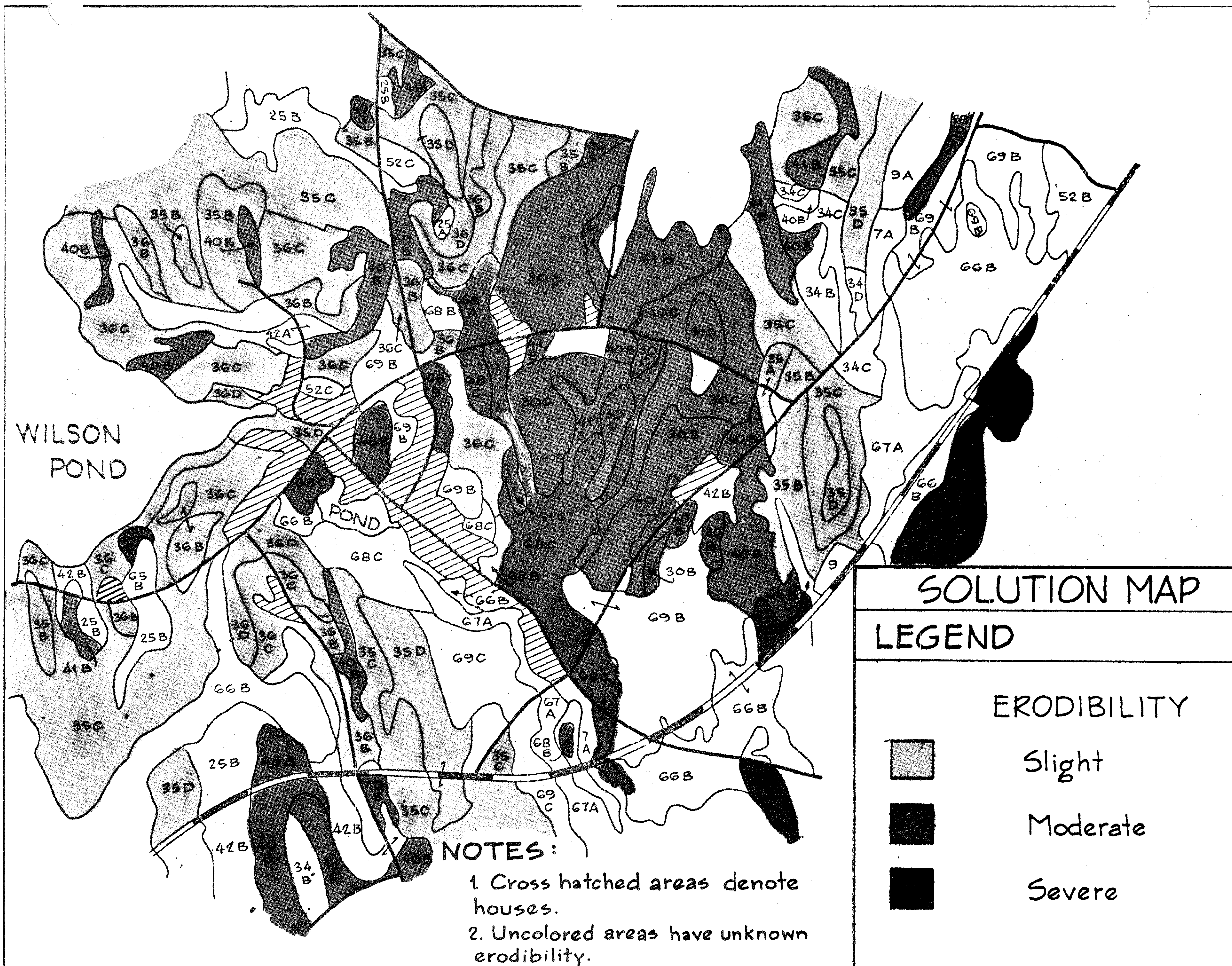
State: Maine   Date: October 1968   Soil: Windsor loamy sand

SUBJECT TO UPDATING   Map Symbol: 51

These are deep excessively drained sandy soils developed on nearly level to steep glacial outwash terraces. Slopes range from 0 to 45 percent but most Windsor soils are on 3 to 15 percent slopes. Cultivated areas have about 8 inches of dark brown loamy fine sand surface underlain by a brownish loamy sand or sand subsoil. The substratum to 10 feet or more is loose sand. Gravel may be present below 40 inches depth. Bedrock is greater than 10 feet but in some areas a clay layer may be present at 5 to 7 feet. Seasonal high water table is below 5 feet. Water holding capacity is low to very low. Natural fertility is very low. Permeability is rapid to very rapid. Soil raction ranges from very strongly to medium acid. Susceptibility to frost is low. Stability is poor in deep cuts and trench faces will slough. Windsor soils are non-sticky and non-plastic and easily workable under most conditions. Steep slopes are erodible. Bearing ratio is moderate. Grading is poor. Most Windosr soils have a unified classification of SM in the surface and SP in the subsoil and substratum.


SOLUTION MAP
LEGEND
DEPTH TO BEDROCK
0"- 20"
20"-40"
More than 40"
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown depth.
WILSON POND
POND


WILSON POND
POND
SOLUTION MAP
LEGEND
DEPTH TO WATER TABLE
Less than 9"
9" - 18"
18" - 30"
More than 30"
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown depth.


SOLUTION MAP
LEGEND
ERODIBILITY
Slight
Moderate
Severe
WILSON POND
POND
NOTES:
1. Cross hatched areas denote houses.
2. Uncolored areas have unknown erodibility.

VEGETATION

Vegetation is the plant life that covers the surface of the land. A great deal of vegetation is manipulated to provide food and fiber products. The type of vegetative ground cover is an expression of climate, soil, and past history.

In Maine the land area is 89% forested with natural and plantation forest stands. Agricultural land accounts for another 5% and urban or built-up areas account for the remainder.

The natural forests of Maine are of two general types. These are boreal or northern forests of conifers (evergreens) in the north and east, and northern hardwood forests in the south and west. These generalized forest types are modified by past cutting history and fires, resulting in a complex mix of forest stands.

The existing forests of Maine are third and fourth generation stands that resulted from cutting "virgin forests." These forest lands supply a great deal of man's needs for fiber, building materials and recreation.

Forest land is also the habitat for many wildlife species which are valued for food, beauty, and sport. Many forested areas are crucial links in the survival of important wildlife species. Forest trees help maintain water quality by regulating run-off and by preventing undue warming. These cooler waters provide suitable habitat for fish and other aquatic life.

To provide for these needs, forest land is manipulated. The science and art of forestry is the body of knowledge that guides the management of a forest. The principle management technique used in the past has been the cutting and harvesting of standing trees. The proper removal of mature and useful trees provides room for a new, more vigorous growth.

Man has cultivated plants for some 5,000 years as a source of food for himself and other animals. This agricultural activity involves planting, tending, and harvesting of many vegetables and grains. Row crops and grains are good examples of plants established and harvested on a yearly cycle. Other areas such as hay fields, pastures, and orchards are created and managed to provide food over a longer period.

Agricultural activity usually requires periodic disturbances of the land surface by plowing or some other means. During these periods the soil is exposed to the weather and the potential for erosion is greatly increased.

Likewise, the harvest of forest trees usually involves the disturbance of the soil. Road building and machinery operations are the major causes of soil exposure. Again, exposure of the soil creates a potential for erosion.

Maintaining a continuous ground cover is essential to protect the soil from erosion and the resulting degrading of surface water by sedimentation. Erosion and sedimentation often occur as the result of the misuse of forest and agricultural lands.

Although agriculture and forestry activities can cause erosion, it is the wholesale bulldozing of areas for development that results in the most serious erosion problems in Maine. The ground cover is removed, and the site is exposed. Unless precautions are taken, a very severe case of sedimentation may occur.

Erosion preventive measures are well documented by various Soil Conservation Service publications. The Environmental Quality Handbook available from the Maine Soil and Water Conservation Commission in Augusta provides a guide for revegetating disturbed areas. It recommends the right ground cover for an area based on the soil type and the expected uses of the area.

Trees and other vegetation use up carbon dioxide in the atmosphere and generate oxygen. This action results in a purification of the atmosphere.

Vegetative ground cover can provide a good deal of screening for homes and other developed sites. Vegetative buffer zones reduce noise as well as blot out unwanted scenes. In Maine, it is the vegetative character that determines the natural beauty of an area. For example, large tall trees along a lake shore, or hardwood vegetation in fall coloration along a ridge, or hillside orchards in bloom add character to a region, and provide pleasing visual experiences.

In summary, the reasons for concern about vegetative characteristics are:

1. Vegetation is a resource manipulated to produce goods and services.

2. Vegetation is a protective covering of the earth's surface.

3. Vegetation provides cover and food for wildlife.

4. Vegetation cleans the air by recycling oxygen and using up carbon dioxide.

5. Vegetation provides a screen to buffer against undesirable uses and noises.

6. Unique specimens of plants and animals occur in close association with vegetative types.

Classification of Ground Cover

There are a variety of ways to classify vegetative characteristics. For example, foresters interested in locating areas to be harvested break forest land down according to type, heights, and density. Thus, forest type maps will show:

- Softwood (SW)
- Hardwood (HW)
- Mixed wood (M)
- Alders (A)
- Cedar Swamp (CS)
- Other

plus a number and letter code as to height and crown closure (density). For example, M2B means mixed wood of medium height and medium density.

For planning purposes a more general descriptive system is desirable. For example:

Mature forest	-	large harvestable, but scenic trees
Young forest	-	smaller, non-harvestable trees
Cut-over forest	-	recently cut-over where there is evidence of tree removal (roads and exposed areas).

Thus the condition of the forest is described indicating its value as to screening, aesthetics, habitat and harvesting.

This classification can be expanded to include the types of trees such as hardwood, softwood or mixed wood.

Agricultural land can also be classified according to its condition. The classes of agricultural land are:

tilled	- flat, uniform surface capable of being tilled
pasture	- sloping, uneven land not capable of being tilled
abandoned	- land in the early stages of returning to forest cover
orchard	
blueberry	
other	

With this system, land used or available for agriculture is identified. These classes give some indication of the extent that the earth's surface will be disturbed, hence, the potential for erosion hazard is indicated.

To complete the classification of ground cover, several additional cover types must be identified. These are:

Wetlands	- including swamps, bogs, and marshes
Urban or built-up	- houses, buildings, roads, etc.; as well as open space such as cemeteries, junkyards, etc.
Barren land	- such as rock outcrops, gravel pits, and sandy areas
Surface water	- lakes, ponds, rivers, streams, brooks and tidal areas.

A useful guide to the classification of ground cover is the *"Standard Classification System for Land Cover in Maine"* published by the State Planning Office
184 State Street
Augusta, Maine 04333.

THE MAJOR FOREST TYPES IN MAINE

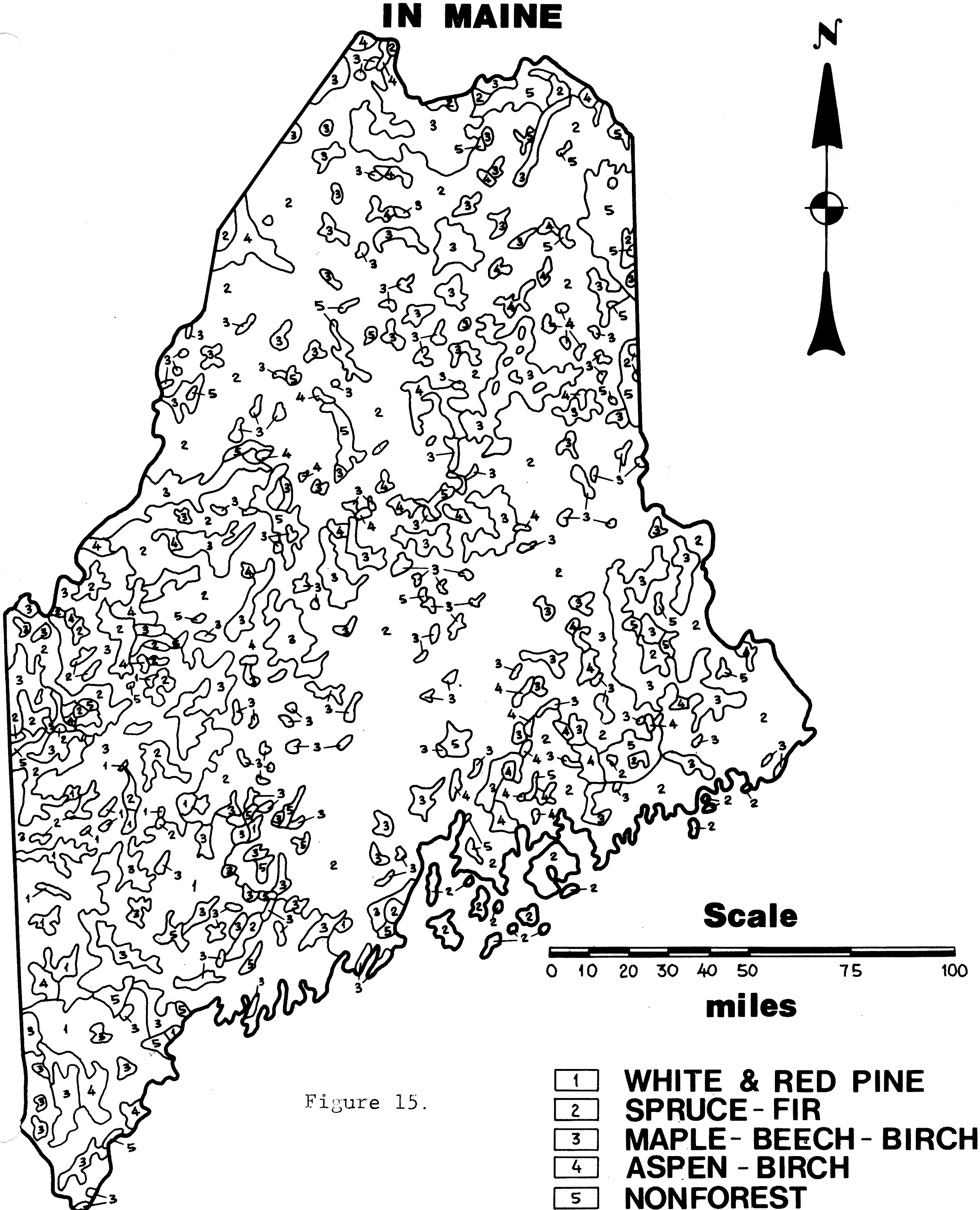


Figure 15.

How to Make a Ground Cover Map

1. In many cases ground cover information will not be available. The following sources, however, may be of help.

   Inland Fish & Wildlife - wetlands maps

   Major landowners - forest type maps

   Tax records - forest types, wetlands, agricultural land, urban and built-up

   Recent (within 10 yrs) USGS sheets - forest and agricultural land, wetlands.

2. Ground cover information can be interpreted from aerial photographs. In this case, experience is needed. Thus, a local person with experience would be helpful. Aerial photographs may be available through the SCS or local tax office.

3. Transfer and plot cover types from sources onto a base map.

4. Outline with a heavy black line the cover types on the base map and label according to a legend.

5. Prepare a legend and title, and attach to the map.

Suggested Ground Cover Map Legends

F - Forest/land

A - Agricultural land

U - Urban and built-up

W - Wetland

O - Other

OR

FOREST/LAND

SW

HW

MW

AGRICULTURAL

Tilled

Pasture

Orchard

Abandoned

URBAN & BUILT-UP

WETLAND

Bog

Swamp

Marsh

Mudflat

Figure 16.

LAND USE

Land use refers to human activity on the land. By mapping existing land uses one can anticipate where land use problems will occur. Secondly, one can assess better new proposals for development; one can see how they will fit into the natural and man-made community. Thirdly, by knowing existing conditions, one is better able to upgrade certain areas, due to problems and opportunities that may arise.

Land use is activity oriented, that is, the land is used to produce goods and services. These can be food, recreation, wildlife habitat, minerals, fibers, and many more.

Land use can be contrasted with land type or ground cover. Some of the natural resources, so far, can be viewed as expressions of the earth's natural cover; these are land cover types. For example, a forested area produces softwood and/or hardwoods. This same area, however, could support such land uses as timber management, hunting, wildlife habitat, etc.

Hence, many uses can occur in the same area. This fact gives rise to the multiple use concept - the concept that a resource can be used for several purposes without destroying its value for any one activity. Various types of land use activity make different demands on the land and its resources.

One could develop a shopping list of activities and then outline the necessary requirements for the successful occurrence of the activity. As might be guessed, similar requirements exist for classes of land use activity. For example, both housing and agricultural activities require level, well-drained land.

The reverse of this point is that a land use activity cannot occur until certain requirements are met. Thus, when the land has to be changed to accomodate an activity, the potential for environmental damage is increased. The correlary is that certain activities produce side effects or waste products that cannot be tolerated by the natural environment involved. Thus a land use activity can result in modification of the land as well as conflict with existing resources. For example, an industrial site such as a saw mill requires a level ground site. The land is cleared and leveled by bulldozers. The soil is exposed creating the potential for erosion and sedimentation. The sawdust produced is burned resulting in air pollution which affects plant growth downwind.

It is the concern with site alteration and the production of side effects that has given rise to land use planning and impact statements. Planning is aimed at minimizing site damage by identifying suitable sites and encouraging these sites to be used. Sometimes called land capability planning, the effort involves an inventory of existing natural and cultural resources such as has been outlined in this handbook. By inventorying the proper resources one is able to define areas where certain selected activities may occur and still minimize environmental impact and damage.

Land use activities break down into sites and areas. Buildings and structures are sites where an activity occurs; areas refer to farm land, roads, power lines, residential patterns, etc.

How to Make a Land Use Map

1. In many cases land uses may have already been inventoried by a planning board, regional planning commissions, or other special study. This information should be gathered for reference.

2. Transfer available land use information onto a base map.

3. Field observations are needed to up-date and correct the land use map due to constantly changing land use activities.

4. Based on information gathered, plot a symbol for each

land use site according to a legend. In areas of dense land use, each site cannot be plotted. Thus, a generalized area should be outlined. Examples are residential areas, downtown (central business district), industrial, etc.

5. When an area of land use is identified, outline it with a dark solid line. Label the area according to a legend. Shading is not possible because of the number of categories.

6. Prepare a legend based on Figure 17, pages 99 and 100 utilizing symbols or numbers. For example, a sawmill could be identified according to a numbering system or by the letters SM.

7. Attach prepared legend and title to the map.

Sources of data: *Town Planning Board*
Town Comprehensive Plan
Regional Planning Commission
Soil Conservation Service
Cooperative Extension Service

CATEGORY	EXAMPLE	SITE	AREA
RESIDENTIAL	single family year round	X	
	multi-family year round	X	
	seasonal residential	X	
MANUFACTURING	industrial activity	X	
	warehouses	X	
	sawmills	X	
TRANSPORTATION/ COMMUNICATION/ UTILITIES	highways and roads		X
	pipelines		X
	powerlines		X
	sewer lines		X
	railroads		X
TRADE	retail stores	X	
	department stores	X	
	gasoline stations	X	
	restaurants	X	
SERVICES	doctors	X	
	lawyers	X	
	hospitals	X	
CULTURAL/ ENTERTAINMENT/ RECREATIONAL	parks		X
	ball fields		X
	open space for public		X
	ski areas		X
	cemeteries		X

CATEGORY	EXAMPLE	SITE	AREA
RESOURCE PRODUCTION & EXTRACTION	farms		X
	tree farms		X
	gravel pits		X
	quarries		X
UNDEVELOPED LAND & WATER AREAS	historic sites	X	
	natural areas		X
	water supplies		X
	game preserves		X

FIGURE 17: Suggested Legend Categories for a Land Use Map

ANALYSIS TECHNIQUES

This section is intended to provide an overview of analysis techniques that are used for problem solving. Analysis techniques are systematic means of combining the data that has been inventoried to solve a problem. These problems are usually land use in nature, such as the siting of development or the determination of environmentally sensitive areas.

The central theme is problem solving. For example, if one were interested in the siting of a manufacturing plant, two factors, among others, that should be considered are slope and access. Slope is important because of the cost of construction and the potential for erosion. Access is important because of the need to transport materials and personnel to and from the site. Information on slope and access is available from the slope map and the land use map respectively. Studying these maps would show areas of level ground with good access. If one were able to combine the two maps into one, a single map could be created which would indicate the suitable sites, and thus lead to a solution.

The problem, as defined, dictates the type of information needed. In addition, the NRI produces a broad-based inventory of information related to natural and cultural resources. Hence, the problem combined with the proper NRI data leads to the solution.

The problem solving process involves five sequential steps. Each step leads to the next step.

1) a clear statement defining the problem,

2) identification of those general factors that are necessary to solve the problem,

3) the specific inventory maps needed,

4) a combination of the appropriate maps, and

5) the solution map.

By way of illustrating the problem solving process we will examine a real problem that the State of Maine faces. This problem involves the location of a 1000 acre public lot in an unorganized township. The first step is to define the problem.

Problem: A public lot is to be located such that in locating "said public lot, the Forest Commissioner shall to the extent feasible, include, but shall not be limited to, appropriate consideration of the following criteria:

1. Contiguousness to other public lands.

2. Public recreation needs.

3. Accessibility to roads, highways and other transportation.

4. Proximity to centers of population.

5. Needs of state agencies.

6. Scenic quality.

7. Value as to minerals.

8. Value as to timber.

9. The preservation of significant natural, recreational and historical resources including wildlife habitat and other areas critical to the ecology of the State.

10. The provisions of any applicable comprehensive or long-range management plan for use of public lands."

The second step in solving this problem is to identify the factors necessary to find the solution. To do this we can create a matrix.

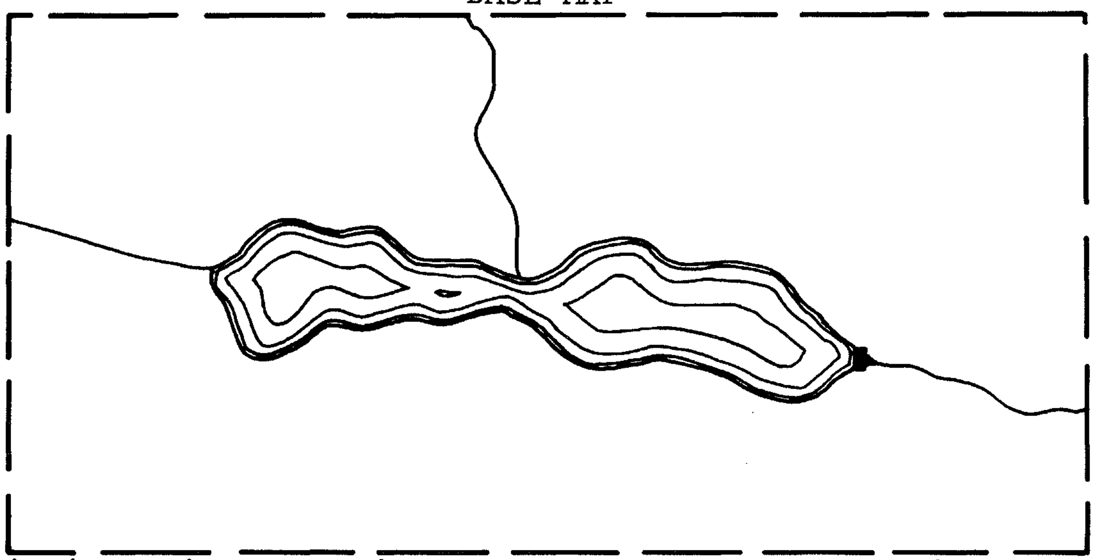
This matrix allows consideration of the relative importance of each factor, as well as the source of the data necessary for analysis.

# of FACTOR LISTED ABOVE	IMPORTANCE (PRIORITY) HIGH	MIDDLE	LOW	SOURCE OF DATA
1		x		Tax maps
2		x		Recreation Plan
3	x			Land Use Map
4			x	Land Use Map
5			x	Needs Plan
6	x			Relief Map
7		x		Geology Map
8	x			Forest Type Map
9	x			Land Use Map
10		x		Bureau of Public Lands

The third step is to determine the source maps that will be needed to make an analysis. This information is apparent from the matrix table. Thus, for this example, the high priority maps needed are the land use map, relief map, and forest type map.

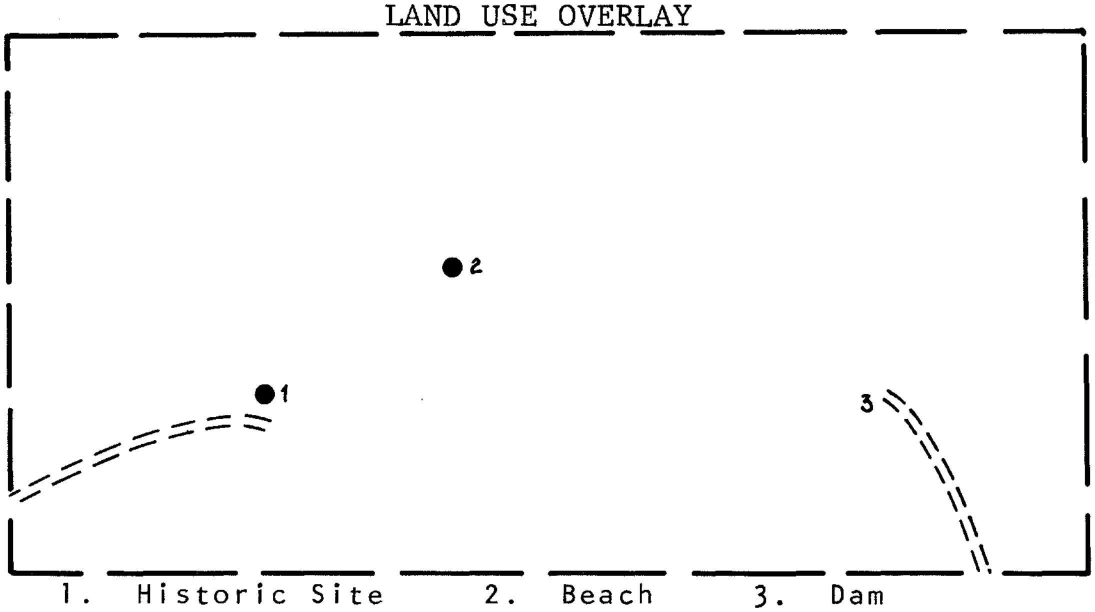
Step four is to combine the appropriate source map. This is accomplished by using overlays. First, a base map is needed that shows the township. For example:

BASE MAP



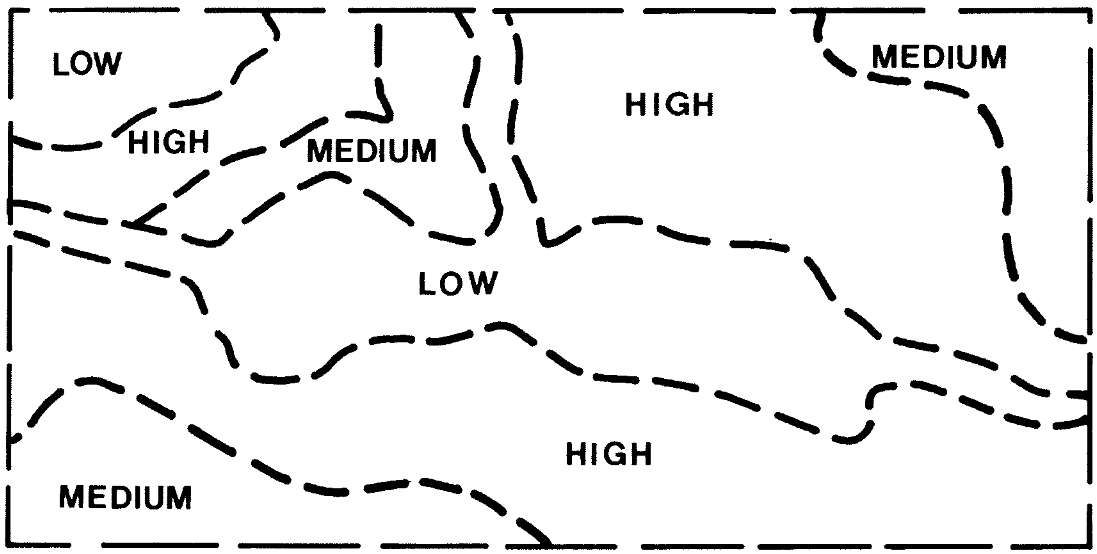
This is a simple outline map that shows the township boundaries and water features. Next, the three overlays are produced.

LAND USE OVERLAY



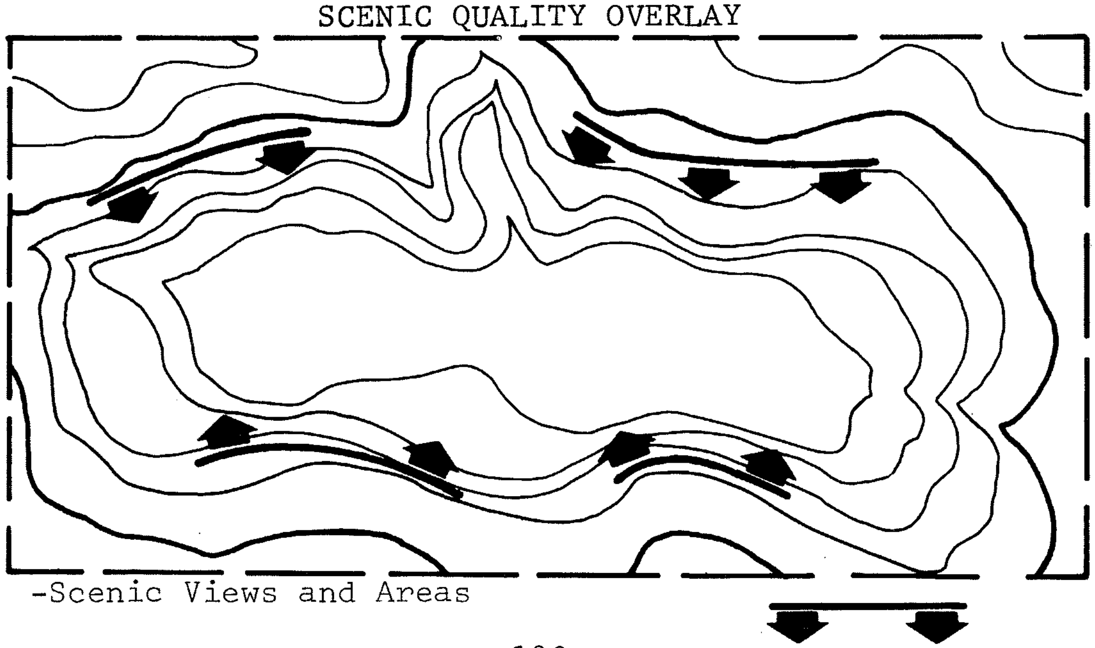
This overlay is produced from the land use inventory map by selecting only the necessary information for factors 3 and 9 (see matrix on page 104).

TIMBER VALUE OVERLAY



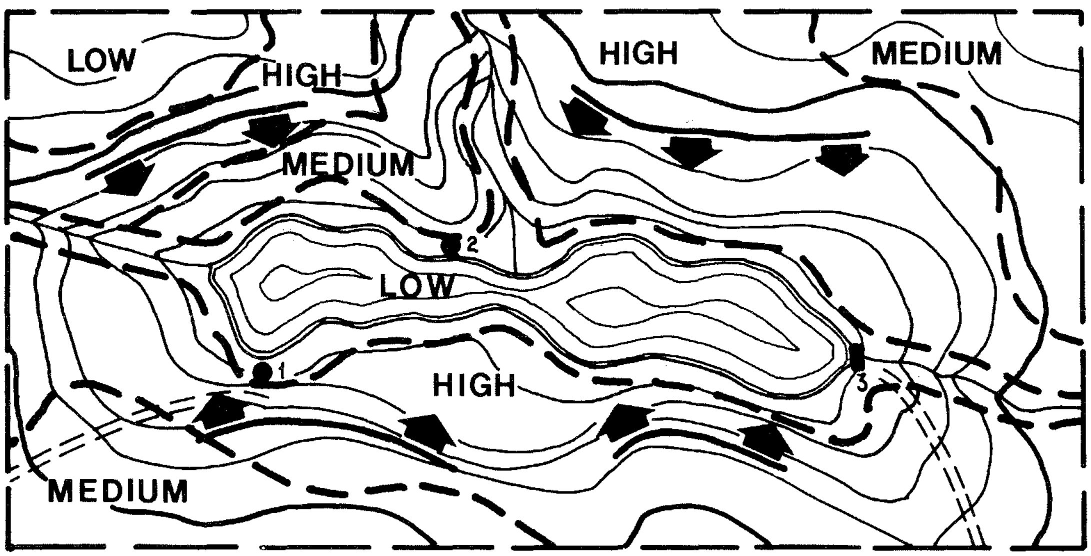
This overlay is produced from a forest type map by assigning dollar values to each forest type.

SCENIC QUALITY OVERLAY



This overlay is produced by using a relief map and indicating the areas with good views.

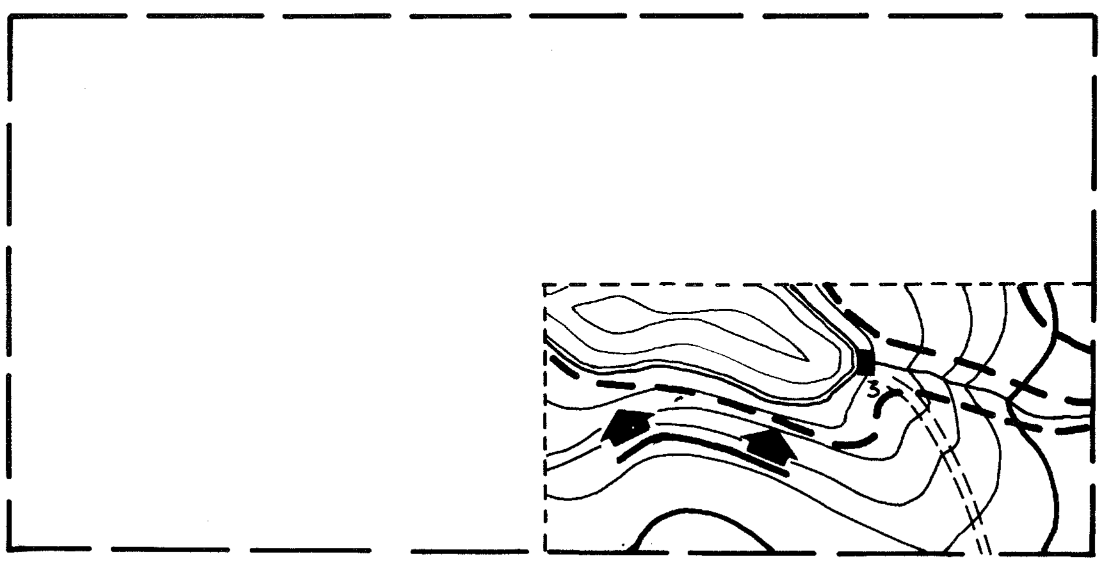
COMPOSITE MAP



The composite map shows the combination of factors. This leads to the solution of locating the public lot. The location of the public lot should include access, high value timberland, scenic areas, and sites or features of significant value.

One solution to the location of the public lot is as follows:

SOLUTION MAP



RESIDENTIAL SUITABILITY

An array of natural and cultural data have now been inventoried.

Residential suitability is the particular land use of concern for this analysis. Residential land use is chosen because it is the primary land use in Maine. Most new development occurring in the state is single family residences, utilizing on-site waste disposal techniques.

In the problem-solving procedure, the factors that affect the suitability for residential development must be listed. These could be:

1. Access
2. water supply
3. setting or view
4. soil suitability
5. land availability
6. erodibility
7. slope
8. wetlands
9. flood plains
10. wildlife habitat
11. surface water
12. gravel and fill material

The potential list is long and many interrelationships exist. A selection must be made of the factors that are most important.

Several factors are established by state law or regulation. These are soil suitability, water supply, surface water protection, and minimum lot size. Any analysis should take these kinds of factors into account.

Soils information is the primary basis for establishing residential suitability. Soils data were inventoried for depth to bedrock and water table. These factors can be combined with slope to determine suitability for residential development as follows:

TABLE 1

FACTORS FOR RESIDENTIAL SUITABILITY ANALYSIS

	SLIGHT LIMITATION [a]	MODERATE LIMITATIONS [b]	SEVERE LIMITATIONS [b]
SLOPE	0 - 8 %	9 - 15 %	greater than 15%
DEPTH TO WATER TABLE	greater than 30 inches	9 - 30 in.	less than 9 inches
DEPTH TO BEDROCK	greater than 40 inches	20 - 40 in.	0 - 20 in.

(a) all these conditions must apply

(b) based on occurrence of any one of these factors

When soils information is not available, other factors can be used to define residential suitability, such as slope, existing land use and existence of surface water.

TABLE 2

ALTERNATIVE FACTORS FOR RESIDENTIAL SUITABILITY ANALYSIS

	SLIGHT LIMITATIONS	MODERATE LIMITATIONS	SEVERE LIMITATIONS
SLOPE	0 - 8 %	9 - 15 %	greater than 15 %
SURFACE WATER	Far (greater than 250 ft)	Near (within 250 ft.)	--
LAND USE	Far (greater than 200 ft)	Near (within 200 ft.)	--

The proximity of surface water is a factor because of the potentially adverse effect of residential land use on water quality. The 250 foot limitation is recognized in the State Statutes as a minimum distance within which special planning is needed to protect water quality.

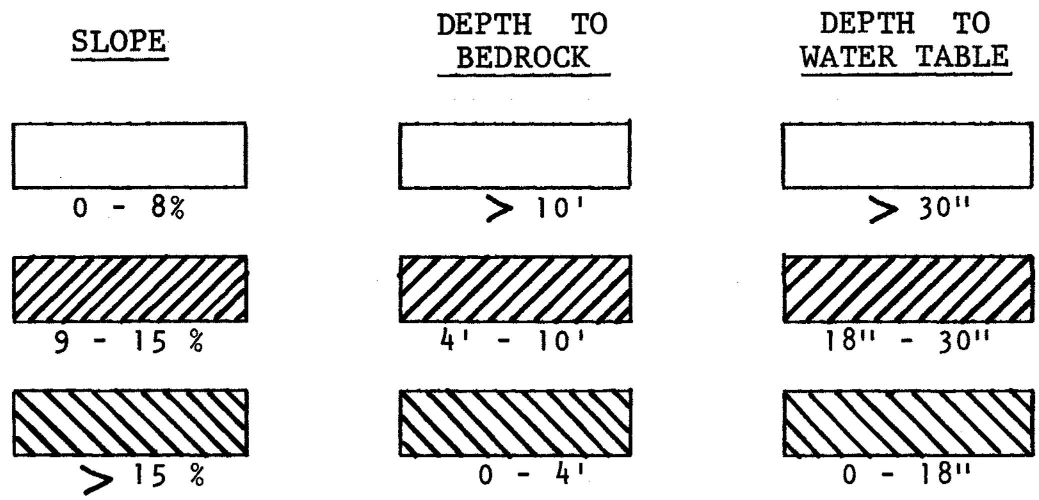
Residential suitability is influenced by the degree of compatibility with existing land uses. Certain land use activities are not compatible with residential activities. Examples might be a slaughter house, cow barn, superhighway, noisy factory, gravel pit, and so forth. The determination of land use compatibility is a value judgment. For the purposes of analysis, a 200 foot buffer zone is suggested to reflect the fact that residential suitability is adversely affected by an incompatible land use.

Some towns will need to use these factors because of the lack of soils data. Soil suitability is the primary limiting factor for residential suitability, however, and should be used when possible for this analysis.

How to Make a Residential Suitability Map

1. First select the factors that will be used to determine suitability (see Tables 1 and 2, pages 110 and 111 respectively).

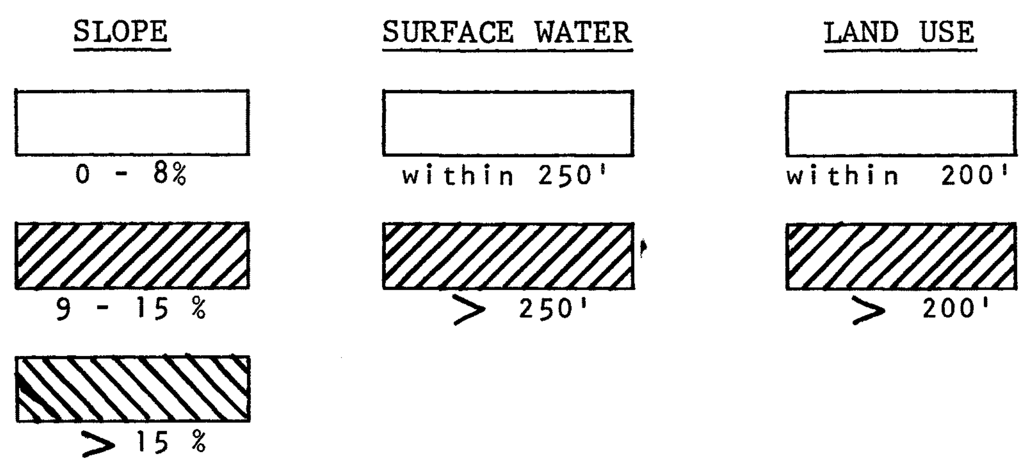
2. Transfer factors from appropriate source maps onto separate acetate overlays. Thus, for Table 1, the slope information is drawn onto one acetate overlay; the bedrock information on a second overlay; and the water table information on a third. For Table 2, do likewise for slope, surface water and land use. The analysis is facilitated by using the following system.

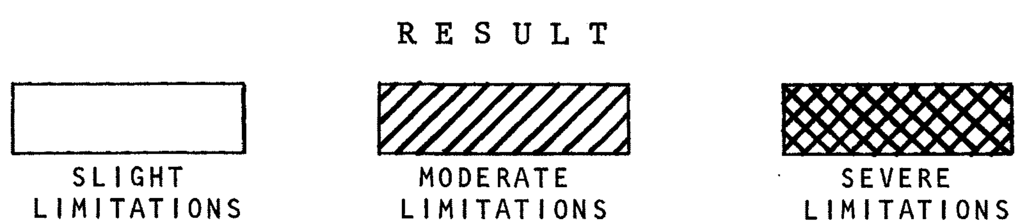


Thus each factor is either clear or coded by cross-hatching.

Note that some categories from the source maps have been combined to create single categories. Specifically, slope class > 15% is a combination of 15-25% and > 25%; and depth to water table class 0-18 inches is a combination of 0-9 inches and 9-18 inches.

When soils information is not available use the following system.





3. The transfer of data from source maps is accomplished by tracing. The acetate is overlayed on the source map and taped down securely with masking tape. The outline or location of the various categories referenced above are then traced on the acetate using a black magic marker or other non-smudge marking pen. Be sure to mask off the corners of the source map so that all the acetate overlays can be placed exactly on top of each other. Crosshatch according to the system defined in number 2 above.

4. Overlay all acetate sheets on a clean base map. They can be left at this point for display. To complete the overlay display, legends must be prepared and attached to the appropriate overlay. Another legend is needed to explain the results of the analysis. See number 6 below. For each overlay map the legend should be the same as that shown in number 2 above. The following section describes how to complete the composite map.

5. Produce the composite map by taping an overlay onto a light table, large window or other smooth surface where the light source is from behind. Next, tape the second overlay over the first, aligning the corner

marks exactly on top of each other. Do the same for the third overlay. Finally, tape a clean base map over the overlays so that its corners match up with the corner marks of the overlays.

This analysis results in defining limitations for residential suitability. These limitations can be described as slight, moderate or severe. Following the system outlined in 2 above, all areas that remain clear (not crosshatched in any direction) are areas with slight limitations. Outline these areas with black lines. Likewise, areas with crosshatching northeast to southwest only are outlined with a black line as areas with moderate limitations. Finally, areas with crosshatching from either northwest to southeast, or with crosshatching both ways are outlined as areas with severe limitations (see figure 18, page 116).

6. Prepare and attach a legend according to figure 19, page 117 to explain the results of the analysis on the composite map, and the overlay display.

Figure 18.

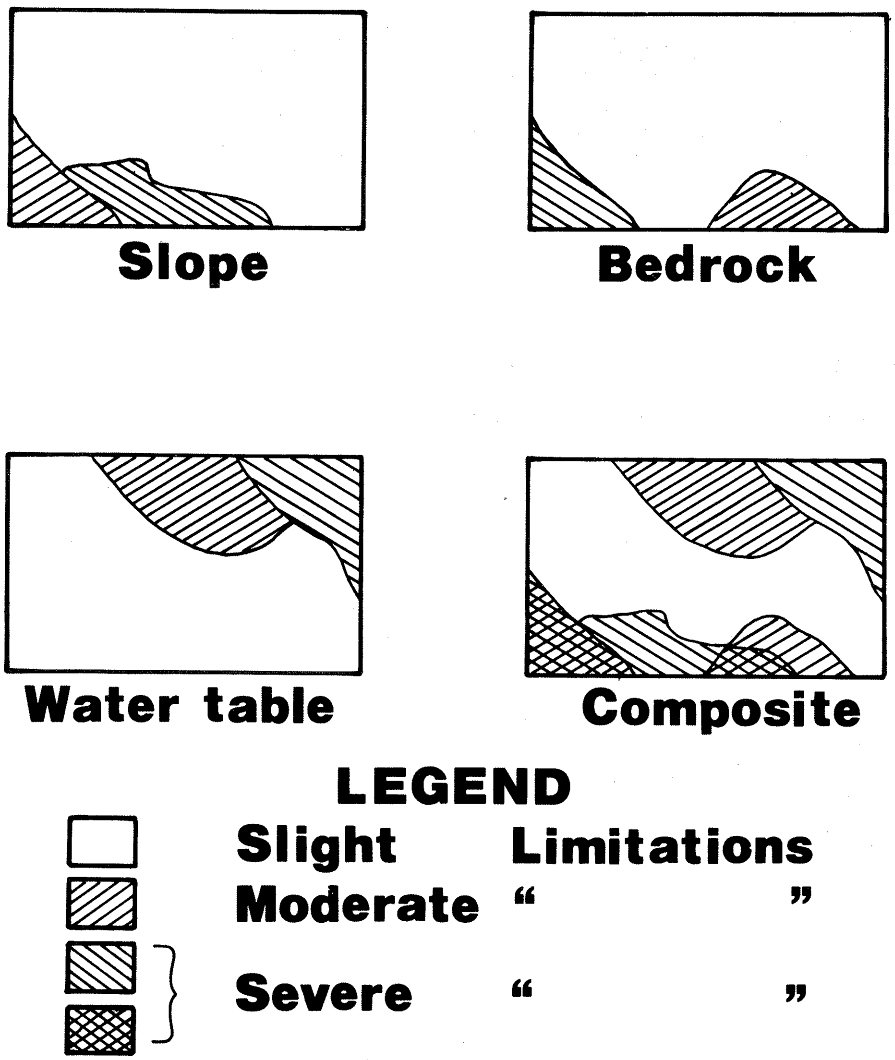

Slope
Bedrock
Water table
Composite
LEGEND
Slight Limitations
Moderate " "
Severe " "

Figure 19.

RESIDENTIAL SUITABILITY

LEGEND

SLIGHT	LIMITATIONS	
MODERATE	"	"
SEVERE	"	"

NATURAL SENSITIVITY

The purpose of analysis for natural sensitivity is to locate areas where changes in existing conditions may result in the greatest environmental harm. The identification of sensitive areas can result in:

1. an awareness of their existence
2. a planning process to recognize their importance
3. an analysis for land use suitability
4. a program of protection

An awareness of the existence of environmentally sensitive areas is the first step in an overall protection program. The more that local people can become familiar with the unique and fragile sites in town, the more they will be likely to support efforts to protect these areas.

An inventory of these sensitive areas can assist planning boards, code enforcement officers and selectmen to plan development of the town accordingly. For example, a subdivision proposed for an area where there is a group of mature pines can be laid out in such a manner as to permanently protect the trees.

The results of an analysis for natural sensitivity can also become a factor in determining the suitability of land for specific uses. For instance, the location of a sanitary land fill can be determined better if the critical natural conditions have been identified beforehand.

A protection program for environmentally sensitive areas is essential to the continued existence of these areas. The state recognized this in regards to shorelands by enacting the Mandatory Shoreland Zoning Law. Other areas, nevertheless, need some form of protection. Different "tools" for protection are identified and explained in the handbook entitled *THE NRI - A BASIS FOR COMMUNITY DECISIONS* due to be published in 1976.

The areas with the greatest sensitivity to change are those in which several limiting factors come together. The factors that create a limiting situation are:

1. Slope greater than 15%, because the state plumbing code requires special review of systems installed on slopes greater than 15%.

2. Surface water within 250 feet, because it is an area of special State concern as expressed by the Mandatory Shoreland Zoning Law.

3. Groundwater recharge area, because of the important relationship between septic waste disposal in the ground and the continued availability of drinking water supplies.

4. Bedrock within four feet of the ground surface, because of increased construction costs for roads, houses, etc., as well as the proper installation and functioning of septic systems.

5. Seasonal high water table within 18 inches of the ground surface, because the State plumbing code does not allow installation of septic systems in these areas.

6. Highly erodible soils, because of the potential for erosion and sedimentation when the ground cover is disturbed.

7. Mature forest vegetation, because of its scenic value and quality for recreation and educational uses.

8. Tillable agriculture land, because of its value for producing food crops.

9. Wetlands, because of the obvious limitations for development, as well as their value as wildlife habitat and their role in the food chain.

10. Recognized natural areas within 250 feet of surface water, because these are areas of recreational, educational and scientific value of more than local concern.

HOW TO MAKE A NATURAL SENSITIVITY MAP

1. First, select the factors that will be used to determine natural sensitivity (see figure 20, page 123).

2. Transfer factors from appropriate source maps onto separate sheets of tracing paper. The transfer of data is accomplished by tracing. The tracing paper is overlayed on the source map and taped down securely with masking tape. The outline or location of the factor is then traced using a black magic marker or other dark marker. Be sure to mark off the corners of the source map so that all the overlays can be placed exactly on top of each other. Follow this procedure for each factor to be used for the analysis.

3. Produce a composite map by taping an overlay onto a light table, large window or other smooth surface where the light source is from behind. Next, tape the second overlay over the first, aligning the corner marks exactly on top of each other. Do the same for the remaining overlays. Finally, tape a clean base map over the overlays so that its corners match up with the

corner marks of the overlays.

FACTORS	SOURCE MAP
Slope greater than 15%	Slope
Surface water within 250 ft.	Watershed
Groundwater recharge area	Surficial Geology
Bedrock depth less than 20 in.	Depth to Bedrock
Water table depth less than 18 inches	Depth to Water Table
Highly erodible	Erodibility
Mature forest vegetation	Vegetation
Tillable agricultural land	Vegetation
Wetlands	Vegetation or Watershed
Natural sites within 250 ft.	Land Use

FIGURE 20: FACTORS TO DETERMINE NATURAL SENSITIVITY

4. This analysis results in defining areas of natural sensitivity to change. The degree of sensitivity of an area is indicated by the number of factors that occur together in that area. The degree of sensitivity can be expressed as:

Number of Overlaying FACTORS	Degree of SENSITIVITY
1	slight
2 - 4	limited
5 - 7	moderate
more than 7	severe

Following this system, all areas where only one factor occur are areas of slight sensitivity. Outline these areas with a black line. Likewise, areas with two to four overlaying factors are outlined with a black line as areas with limited sensitivity. This procedure is also followed for areas with five to seven, and more than seven overlaying factors.

5. Prepare and attach a legend, according to figure 21, page 125, to show the results of the analysis.

NATURAL SENSITIVITY

LEGEND

- ☐ SLIGHT
- ☐ LIMITED
- ☐ MODERATE
- ☐ SEVERE