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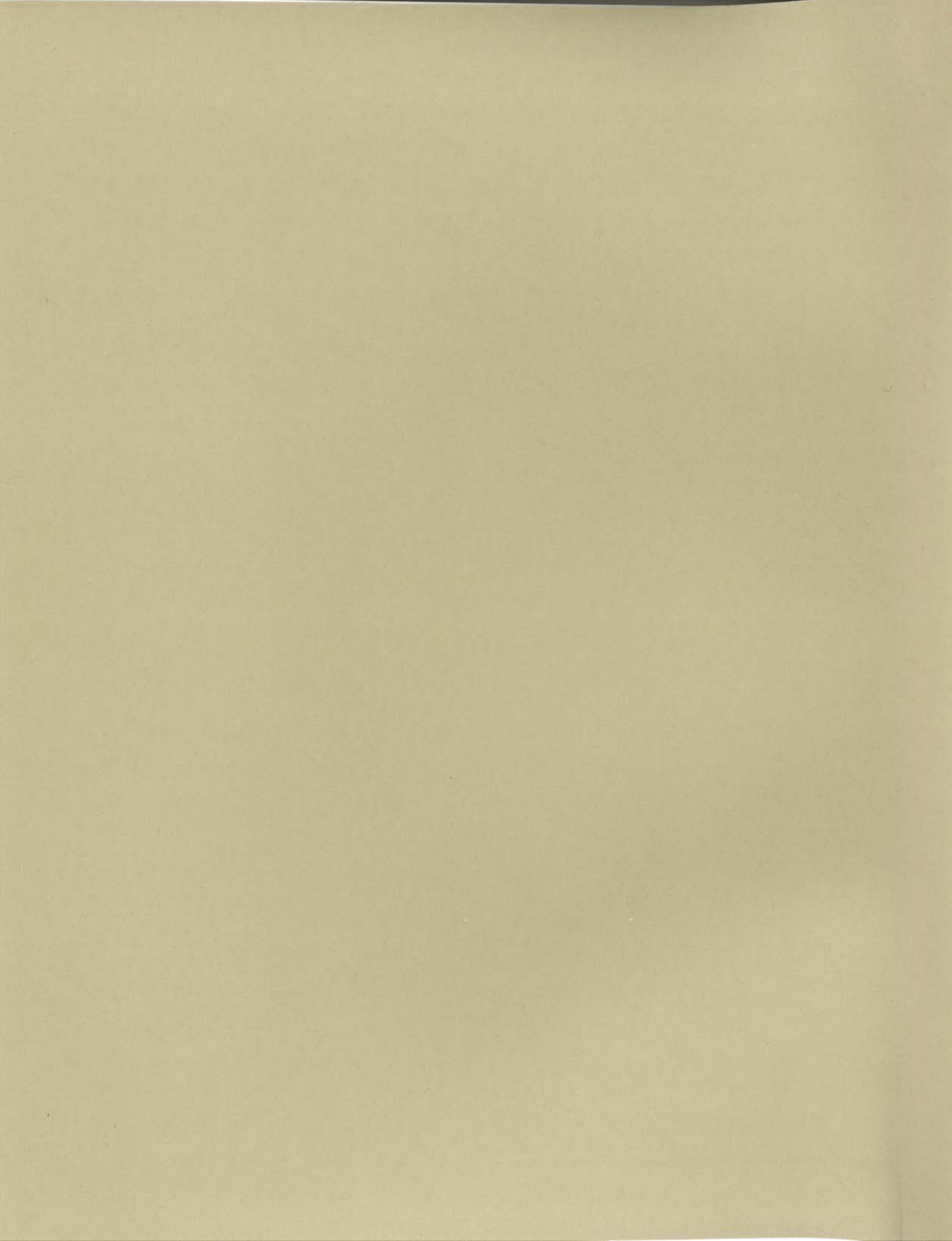
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Eolian Sand Deposits in Maine

Executive Department

**Maine State Planning Office
August 1990**



EOLIAN SAND DEPOSITS IN MAINE

by:

Joshua Katz

Timson, Schepps & Peters, Inc.

Hallowell, Maine

Planning Report No. 91

A Report Prepared for the
Maine Critical Areas Program
State Planning Office
Augusta, Maine 04333

August, 1990

EOLIAN SAND DEPOSITS IN MAINE

Contents

| | |
|--|-----|
| LIST OF FIGURES | i |
| LIST OF MAPS AND TABLES | ii |
| ACKNOWLEDGEMENTS | iii |
| INTRODUCTION | 1 |
| Purpose of Report | 1 |
| State Significance..... | 1 |
| INLAND EOLIAN SAND DEPOSITS | 2 |
| Defined | 2 |
| Eolian Processes | 3 |
| Sand Dune Formation | 5 |
| Conditions for Formation | 5 |
| Bedding | 6 |
| Dune Types | 7 |
| Dunes in History | 8 |
| RESEARCH METHODS | 10 |
| RATING METHODS | 11 |
| SIGNIFICANT CRITERIA | 12 |
| SUMMARY OF RESULTS | 15 |
| SIGNIFICANT EOLIAN DEPOSITS IN MAINE | 21 |
| SITE DESCRIPTIONS | 23 |
| RECOMMENDATIONS | 73 |
| GLOSSARY | 75 |
| REFERENCES CITED | 77 |

List of Figures

| | Figure Title | Page No. |
|--------|---|----------|
| Fig. 1 | Grains in Motion | 3 |
| Fig. 2 | Dune Cross Section with Bedding | 6 |
| Fig. 3 | Dune Cross Section with Slip Face | 6 |
| Fig. 4 | Sand Dune Types | 7 |
| Fig. 5 | Ventifact | 13 |
| Fig. 6 | Eolian Sand Deposit Localities | 18 |

List of Maps

| | Map Title | page |
|--------|-------------------------------|------|
| Map 1 | Wayne Locality Map | 24 |
| Map 2 | Freeport Locality Map | 33 |
| Map 3 | Leeds Locality Map | 36 |
| Map 4 | Madison Locality Map | 39 |
| Map 5 | Fryeberg Locality Map | 43 |
| Map 6 | Bethel Locality Map | 47 |
| Map 7 | Skowhegan Locality Map | 50 |
| Map 8 | Standish Locality Map | 54 |
| Map 9 | Farmington Locality Map | 56 |
| Map 10 | Casco Locality Map | 61 |
| Map 11 | Medford Locality Map | 64 |
| Map 12 | Lincoln Locality Map | 68 |
| Map 13 | Salmon Pond Locality | 71 |

List of Tables

| | Table Name | Page No. |
|---------|--|----------|
| Table 1 | Particle Size and Transport Data | 4 |
| Table 2 | List of Localities and Sites | 16 |
| Table 3 | Site Rating Scores | 22 |
| Table 4 | List of Recommended Sites | 74 |

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This inventory and description of inland eolian sand deposits was made possible by the people of the State of Maine because they have mandated recognition and preservation of unique natural resources. One result of the mandate was creation of the Critical Areas Program, under whose auspices this inventory was conducted.

Woody Thompson and Bob Johnston at the Maine Geological Survey provided important assistance with research and access to archives. Hank Tyler of the Maine State Planning Office, Critical Areas Program, offered excellent and valuable editorial direction. The critical eye and enthusiasm of Gretchen Pickart (Timson, Schepps & Peters) was essential to formation of the final report that is presented herein.

Timson, Schepps & Peters, Inc. of Hallowell and Portland Maine, deserves special recognition and thanks for donating innumerable hours of my time toward completion of this project, and thereby, to the people of Maine.

INTRODUCTION

The Critical Areas Program of the State of Maine Planning Office retained Timson, Schepps & Peters, Inc. (TSP) to conduct an inventory of inland eolian sand deposits within the State of Maine. Eolian sand deposits were recognized by D. Caldwell (1982) as having potential significance that could make them worthy of inclusion in the State Register of Critical Areas.

Almost all known sand deposits in Maine have been transported and deposited by rivers or the ocean. Occasionally, conditions are right for these fluvial or marine sands to be remobilized by the wind, thereby creating eolian sand deposits.

In Maine, eolian sand deposits that are now inland were actively forming near the retreating front of the Late Wisconsinan ice sheet from approximately 14,000 to 11,000 thousand years ago. McKeon (1989) dates the formation of eolian sand deposits near Anson at 12,900 to 12,600 yr B.P. These mobile sand deposits were stabilized in position by advancing vegetation and can often be found today in their original form. Also found in Maine today are unvegetated active inland sand dunes that are related to recent land use practices. Valuable knowledge about environmental history and ecological balance can be gained from sand deposits in Maine. The ancient inland eolian sand deposits help the viewer visualize a vastly different paleoenvironment, and the modern active sand dunes serve as a stark reminder of the fragility of the ecosystems that we live with.

The inland eolian deposits of Maine are widely scattered across southern and central Maine from near the New Hampshire Border (Fryeberg and Bethel localities) to the Penobscot River Valley (Lincoln locality). They are found in association with major rivers and lakes.

In the following report there is a generic description of eolian processes involved in the transport of sand and resultant deposits, a description of the eolian sand deposits field checked as part of this project, and recommendations for inclusion on the Register of Critical Areas.

STATE SIGNIFICANCE

Inland eolian sand deposits are uncommon and often unrecognized in Maine and elsewhere. The need to preserve rare and endangered components of the natural environment is widely accepted, and inland eolian sand deposits, both active and

preserved, are no exception to this need. The potential benefits to society from a specific deposit give that deposit a level of significance. Significance of a specific site is enhanced by the presence and relative quality of particular features that are the criteria for ranking the sites. Specific criteria are defined and weighted in the Rating Methods section of this report.

If a site was found to have a combination of well-preserved or well-defined dune morphology, large size features, ventifacts, outstanding educational or research potential, or some unique attribute, it earned at least 40 points in the rating scheme. A site with 40 points or more was considered to have high value and to be of State significance. Inland eolian sand deposits of high value are significant features of the natural environment of Maine and are recommended for inclusion on the Register of Critical Areas.

INLAND EOLIAN SAND DEPOSITS

DEFINED

Aeolus is the ruler of the winds in Classic Greek mythology. An eolian deposit is an accumulation of wind-transported grains. Sand, according to the American Geological Institute, is a grain of detrital material that ranges in diameter from 0.0025 to 0.08 inches (0.062 to 2 mm). A deposit of wind-transported sand is considered to be inland for the purposes of this report if it is not associated with recent ocean or lake shorelines.

Embleton and King (1975) elaborate on the work of R.A. Bagnold (father of eolian transport theory) in noting that sand has "one peculiar characteristic which is not shared by coarser or finer materials - namely, the power of self-accumulation - of utilizing the energy of the transporting medium to collect their scattered components together in definite heaps, leaving the intervening surface free of grains. The common mode of transport of sand is by the migration of such heaps or dunes..."

EOLIAN PROCESSES

The wind is very effective at sorting detrital particles, or grains, by size and density (Bagnold, 1942). Coarse sand grains (0.039 - 0.078 in) are generally too massive to be made airborne by wind. Grains that are 0.039 in (1 mm) and smaller are made airborne by wind: sand size particles typically move less than several meters per 'hop', silt size grains (0.002 - 0.0005 in. or 0.062 - 0.015 mm) travel further, and clay size particles (less than 0.0005 in) will travel furthest. One of the most distinctive features of any eolian deposit is that it is very well sorted.

Windblown sand moves primarily by saltation, traction, and impact creep (Greeley and Iversen, 1985; Figure 1). The saltation process operates as follows: When wind flows across the earth's surface, aerodynamic drag is selectively created by turbulent air flow near the air/ground interface and a threshold of motion is achieved and the sand grain is lifted into motion. Greeley and Iversen (1985) present thorough quantitative description of the process.

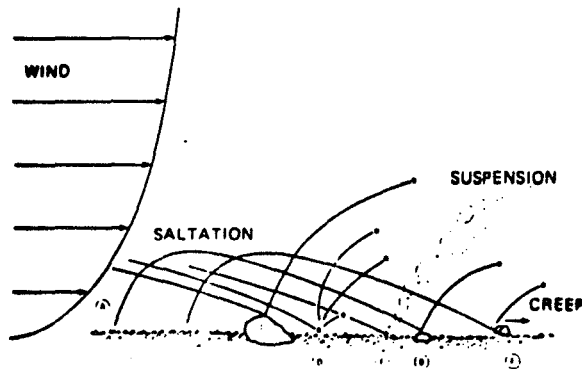


FIGURE 1: A view of the saltation process (from: Greeley & Iversen, 1985).

Wind speeds of around 13 mi/hr (22 km/hr) will lift grains of very fine to medium (0.002 - 0.02 in.) size sand as well as silt and clay (Pettijohn, Porter, and Siever, 1987). The sand grains are rolled and then bounced into suspension and carried in a low parabolic arc (Figure 1) in the down wind direction. The height and length of the arc are dependent on particle size and geometry, wind velocity, and the shape of the surface that the grain is passing over.

The grain falls to the ground and typically strikes a grain (several grains) on the ground. Kinetic energy is transferred to the grain on the ground and it becomes airborne. It is probable that the falling sand grain also causes other grains to move by traction (rolling or sliding) and impact creep.

Silt and clay sized particles are made airborne by strong gusty winds and become suspended. Silt drops out of suspension to form thin to massive, highly cohesive deposits known as loess within several hundred miles of the source area (Table 1). The clay particles can rise to great heights and become entrained in transglobal winds.

| | Diameter mm | Fall velocity cm/s | Flight time | Distance | Maximum height |
|------|----------------|--------------------------|-------------|---------------------------|-------------------|
| Clay | 0.001 | 0.00824 | 9-90 yr. | 4-40 × 10 ⁶ km | 6.1-61 km |
| Silt | 0.01 | 0.824 | 8-80 yr. | 4-40 × 10 ² km | 61-610 m |
| Sand | 0.1 | 82.4 | 0.3-3 s | 46-460 m | 0.61-6.1 m |

* For a wind of 1500 cm/s.

TABLE 1: Grain Size Table
(from: Pettijohn, Potter, & Siever, 1987).

Loess deposits can form dramatic landscapes because thick deposits of the highly cohesive silt particles will stand with nearly vertical faces. World-rekknowned loess deposits are found in massive 650 feet (200 meter) high cliffs in China. Other significant loess deposits are found in many places across the globe, including the midwest of the United States.

In Maine and New England, a thin veneer of loess was probably deposited at about the same time the eolian sand deposits were forming. In Maine, any loess has since become incorporated into the soil by biological and chemical processes and is generally not distinguished as a separate surficial geological deposit. In southern New England and other parts the Northeast that were further downwind from the retreating ice front, source area for silt particles, thicker deposits of loess are found. On Block Island, Rhode Island, 1.5 feet of loess has been observed (Sirkin, 1981).

SAND DUNE FORMATION

Sand dune formation requires an ample supply of sand and enough wind energy to put the sand grains into motion. Sand dunes are usually associated with sources of supply such as deserts and beaches. However, sand dunes also form in proximity to glacial margins, lake shores, and river valleys. In a periglacial environment, strong consistent katabatic winds (winds that result from downward convection of cooled air) are generated by the thermal contrast between the ice sheet and warmer bare land. Sediment-laden rivers flow out of the ice, and vast outwash plains, temporarily barren of vegetation, are exposed to strong steady winds.

Various lines of evidence, including radiocarbon dating and observations of current analogies, indicate plants colonize the bare ground left behind by a retreating glacier very quickly. It is, therefore, likely that the eolian deposits which are the subject of this report formed rather quickly. McKeon (1972, 1989) presents a detailed discussion of climactic conditions at the time of deglaciation in Maine and suggests that a maximum of 500 years, and probably much less, was the time span available for dune building conditions.

Wind is very effective at sorting the glacial outwash sediments; gravel and boulders are left behind while sand, silt and clay are mobilized by strong winds and carried increasingly farther from the continental glacier. Coarse material left behind by an eroding wind is known as a lag deposit or deflation surface.

CONDITIONS FOR FORMATION

Critical conditions which must be met for eolian sand dunes to form include an ample supply of sand, relatively broad open space free of significant vegetation, and adequate wind velocity and directional consistency.

The process of dune formation is essentially the same for all dune types. Sand is moved by the wind up an inclined windward slope by saltation, traction, and impact creep. Some of the sand will remain on the top of the sand pile causing it to get larger, while other sand grains will go over the crest of the dune and roll down the leeward face (slipface). The slope on the windward side of the dune is typically 10 - 15 degrees, while the leeward slip face will have a slope that is nearly the angle of repose, which for dry sand is about 33 degrees. As this process

continues, sand is moved by the wind from the windward to the leeward side of the dune, and the dune migrates (Figure 2).

Various types of bedding form as eolian processes operate (Figure 2). Slipface bedding orientation is sometimes used to establish paleowind directions.

Bedding forms as a result of wind velocity which is variable and able to move particles of different sizes, shapes and densities at different times. Graded bedding forms when there is a change in grain size within a single bed. Compositional bedding can also occur because different minerals (eg. quartz and mica) which make up the sand grains have different densities and shapes and are sorted by wind.

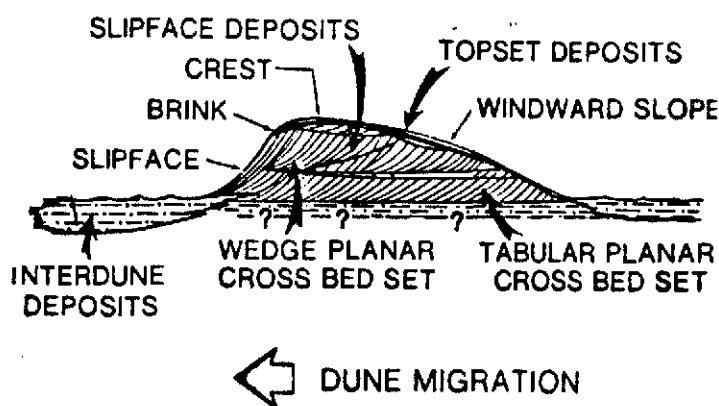


FIGURE 2: A cross-section of a dune form showing components and migration process (from Ahlbrandt & Fryberger, 1982).

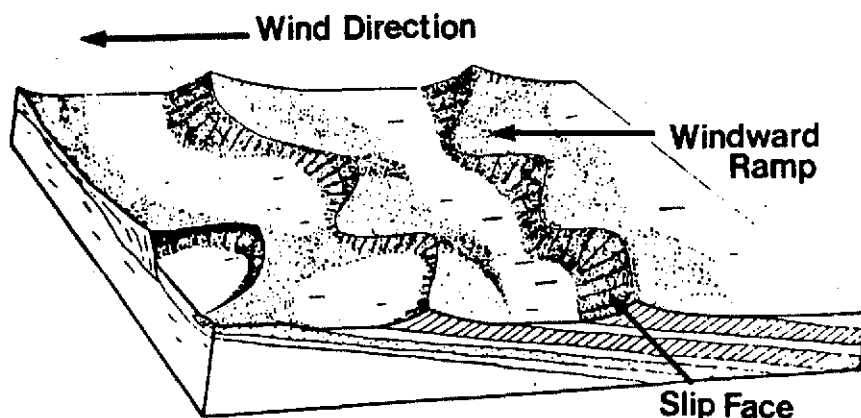


FIGURE 3: An illustration of parallel transverse dunes which exhibit barchanoid elements. Internal stratification is seen in the cut-away portion. A windward ramp and slipface are shown. The dunes are migrating in the down wind direction (from Kocurek, 1986).

DUNE TYPES

The type of dune that forms depends on sand supply, topography, wind velocity, and consistent wind direction. Up to eleven dune forms have been recognized (Pettijohn, Potter, and Siever, 1987). For this report, four primary dune forms are considered: barchan, barchanoid ridge, transverse, and linear (Figure 4) because they are the only forms that were identified in the field.

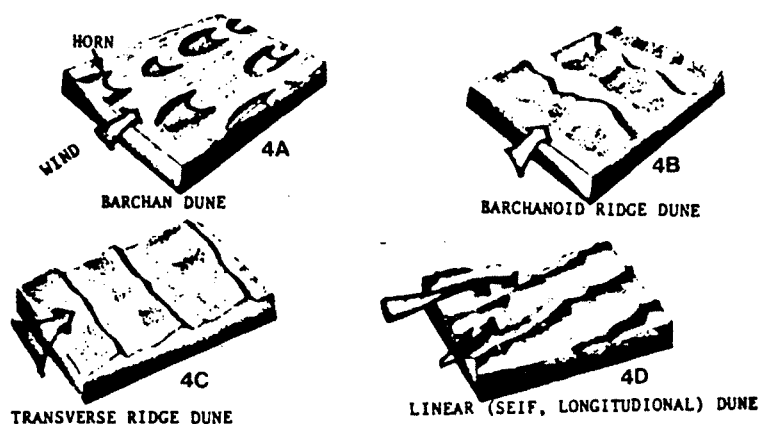


FIGURE 4: Block diagrams of four primary dune forms (from Albrandt & Fryberger, 1982).

A barchan dune (4A) forms when strong wind is constant from one direction. This dune type is crescentic in plan with the points oriented downwind. In cross section, the dune is asymmetric with a relatively steep slip face downwind and a more gentle climbing surface upwind. A barchan dune can form if there is a somewhat limited supply of sand at times during its formation and migration.

A barchanoid ridge (4B) dune form results from the imposition of barchan slipfaces on a transverse dune. This combination of morphological characteristics was most common in the field.

Transverse (4C) and linear dunes (4D) form when there is a relatively large supply of sand. Transverse dunes form perpendicular to steady unidirectional wind and are asymmetric

in cross section. Like the barchan dune, the transverse dune has a gentle windward and steeper leeward slope. Linear dunes form where there are consistent bimodal winds blowing from adjacent quarters of the compass causing the dunes to align between the two dominant wind directions. For example, NE and NW winds would produce linear dunes with a N-S orientation, with west and east facing slopes having similar steepness.

Sand dunes can be seen forming and migrating in many places today, including some of the sites that are described in this report. Popham Beach State Park in Phippsburg, Maine, presents an excellent opportunity to watch eolian transport processes at low tide when over 100 acres of source area is exposed to strong desiccating winds.

During the past year, formation and migration of various dune types have been observed by the author at Popham Beach. At low tide, this setting is an excellent environment for eolian sand activity because very broad expanses of sand are available as a source area and wide open spaces permit strong winds to flow unimpeded across the ground surface. Both classical and atypical transport and deposition of windblown sand grains were observed.

Well-formed barchan dunes (up to two feet high) migrating en echelon down the beach parallel to the shoreline provided a classic 'textbook' example of eolian sand activity. Variation from classic dune morphology was seen where discontinuous transverse dunes combined with barchanoid segments in irregular deposits. Other observations of atypical eolian activity included windblown sand grains climbing up rough rocky slopes to a height of 10 feet and existing small (less than 3 feet high) dunes being eroded by wind driven sand so that, in cross section, the windward slope was nearly vertical and the leeward slope was a gradually sloping ramp, contrary to typical constructional dune morphology.

SAND DUNES IN HISTORY

Evidence that sand dunes existed hundreds of millions of years ago can be found recorded in rock. Some sandstones, that are now part of the Rocky Mountains in western areas of the United States, are ancient sand dunes. Several National Parks, including Zion, Bryce Canyon, Canyonlands, and Arches feature spectacular landforms developed in the ancient eolian sand deposits. Other windblown sand deposits, lithified into a rock known as eolianite, can be found in many periods of geologic history throughout the globe.

The largest area of inactive sand dunes in the western hemisphere, the Sand Hills of Nebraska, is associated with meltwater deposits of the most recent glaciation. After these dunes formed, a hospitable climate permitted grasses to grow on the dunes and the Sand Hills became immobilized. The Sand Hills formation was nearly contemporaneous with the inland sand dunes that are found in Maine.

Today, vast inland dune fields are associated with subtropical deserts, particularly in North Africa and the Middle East part of Asia. Other active dunes are found in rain shadows of major mountain ranges throughout the world, such as the southwest of the United States.

HISTORY OF INLAND EOLIAN SAND DEPOSITS IN MAINE

As recently as fourteen thousand years ago, Maine and the rest of New England was covered with a massive continental glacier, known as the Pleistocene, Laurentide, or Late Wisconsinan ice sheet. The weight of the ice mass caused the crust of the earth to subside which permitted the ocean to inundate coastal and central Maine. As time passed, the glacier melted back toward the north, the crust rebounded, and the ocean shoreline retreated south and east beyond its present position and then back to its present position. Extensive research has been conducted in an effort to more fully understand the processes and products of deglaciation in Maine, and the reader is encouraged to review Borns, LaSalle, and Thompson (1985) and Smith and Hunter (1989) for a more detailed discussion of the subject. A detailed chronology of the formation of the eolian sand deposits in the Anson area is presented by McKeon (1989) which could be generally applicable (except for exact dates) to the formation of other eolian sand deposits in Maine.

Deglaciation in Maine occurred over a period of several thousand years and was characterized by numerous minor advances and retreats of the glacier. Vast amounts of detrital material were available for eolian transport because the newly bared earth was not fully vegetated and streams with very heavy sediment loads were flowing out of and off the melting glacier. Another potential source of sand for eolian transport was the migrating coastline.

During the interval of deglaciation, large glacial lakes existed in the New England area. Large lakes are good settings for eolian sand deposition to occur because the open fetch of water facilitates consistent strong winds with the shoreline offering a source of sand. Glacial Lake Hitchcock, in what is now the Connecticut River Valley, and Glacial Lake Champlain, in what is now the Champlain Valley, were both sites of relatively

large eolian sand deposits (Woody Thompson, pers. comm.). In New Sharon, Maine, the Sandy River may have been temporarily blocked and formed into a lake (Weddle, 1989), and, in fact, inland eolian sand dunes are found in association with the Sandy River in New Sharon.

MODERN DESERTS

'Deserts' are found in New England where bare open sand creates a striking contrast to the typical complete vegetative cover. The 'Desert of Rhode Island' is found in the Narragansett area. It is considered to be a remobilized glacial outwash deposit (Schafer, 1981) much like the Freeport locality (Desert of Maine).

Modern 'deserts' in Maine are formed when natural vegetative cover over sand soils and subsoils is disturbed. Formation of the 'deserts' is often associated with agricultural activity that removes the vegetative cover and disturbs the topsoil. Sheep grazing has been implicated in 'desert' formation because sheep will eat grasses down to the root zone, thus killing the plant.

RESEARCH METHODS

Seven sources of information were utilized during this investigation. The sources are listed below in the order that they were used.

1. A 1:500,000 scale map of the surficial geology of the State of Maine (Thompson and Borns, 1985) was initially investigated and 13 areas mapped as eolian deposits were found.
2. Conversations were held with geologists working in the State of Maine who were familiar with local surficial geological conditions, resulting in insight into eolian processes and field identification of eolian deposits. Woody Thompson at the Maine Geological Survey was especially helpful. However, additional areas of eolian deposits not shown on 1:500,000 scale map were not found.
3. A literature review was conducted at the library of the Maine Geological Survey. The earliest recorded observations of inland eolian sand deposits were by Hitchcock in 1861 (McKeon, 1972). Since the nineteenth century, nearly a dozen workers have described various aspects of Maine's eolian deposits. Much of the body of eolian deposit work centers on Freeport and Wayne localities, although the Bethel area and Upper Kennebec River Valley deposits and ventifacts are also described.

Unfortunately, none of the ventifact location descriptions were useful for finding described sites due to changed land use.

4. Surficial geologic maps (7.5 minute and 15 minute USGS topographic quadrangles) were used to locate known deposits depicted on the 1:500,000 surficial geology map. These surficial geologic maps delineate eolian sand deposit units and were extremely valuable tools for focusing field work.

5. Aerial photographs on file at the Maine Geological Survey were selected and observed based on locations identified in Step 4. The utility of the aerial photographs was limited to areas with exposed sand.

6. Soil maps prepared by the U.S.D.A. Soil Conservation Service were studied in conjunction with the larger scale surficial geology maps. The surveys with a soil category of 'dune land' were quite useful. Other surveys without this designation were less so.

7. Field inspections were made at localities with previously mapped inland eolian sand deposits during October, November, and December of 1988 and September and October, 1989.

RATING METHODS

All field-checked eolian sand deposit sites were given a score based on 9 criteria. Each of the criteria was given a relative weight through assignment of a point multiplier. The criteria used in the final rankings are described below and are listed from most to least important, although all contribute to the significance of a site.

For each criteria at a given site, 0 - 5 points are awarded, based on increasing value. The points are multiplied by a weighting factor of 1, 2, or 3 (shown after heading in parentheses) to give total points for the specific factor of significance at that site. The most significant factors had a 3 multiplier and the least significant factors a 1 multiplier.

The maximum number of points that could be assigned to any site is 90. The most points earned was 81 at the Wayne, Long View site and points ranged down to 21 (excluding Bethel Riverbend) in Lincoln.

SIGNIFICANT CRITERIA

1. Preserved Dune Morphology (3)

Readily apparent, well-preserved sand dune morphology causes an inland eolian sand deposit to strongly evoke images of a radically different climate and environment. Well-preserved dune forms cause geologic history to come to life.

Eolian sand deposits with well-preserved dune morphology are referred to as 'fossilized' for the purposes of this report, which is partly to provoke the interest of the reader in these features, and thereby encourage the preservation of the deposits. In reality, the fossilized dunes are not true fossils, but rather, they are temporarily immobilized by a vegetative cover. As is seen at several 'deserts' in the Maine, the dunes can be remobilized when the vegetative cover is disturbed.

Variations of three dune forms (barchan, transverse, and longitudinal (Figure 4) were found in the eolian sand deposits of Maine. Distinct 'textbook example' dune morphological features of any type of dune, including slipfaces, internal stratification, and well-defined dune crests are given high ranking values, as are distinct readily identifiable dune types.

2. Ventifacts (3)

Rocks that are sculpted and polished by wind-borne sand grains have very distinctive and attractive features and are rare in Maine. Although three ventifact localities are mentioned in the literature (McKeon, 1972, 1989), only two were found during the field research for this report. Therefore, these ventifact localities, Wayne (Long View Site) and Leeds, have added significance. The third possible ventifact locality in Bethel could not be located.

Ventifacts are formed by sandblasting where airborne saltating sand grains repeatedly strike a rock and wear down the upwind surface of the rock. The sandblasting action creates very smooth concave surfaces, and often an angular ridge will form where two fluted surfaces meet. A rounded ridge is sometimes seen where the sand grains pass along and over the top of the fluted surface.

Wind-abraded rocks have one or more fluted or faceted surfaces that are concave in an upwind direction. Sharp angular ridges, smoothly rounded surfaces, grooves, and pits are also common ventifact features. Greeley and Iverson (1985) offer a thorough description of ventifact formation processes and notable localities. Figure 5 is a photograph of an 7 inch (18 cm) ventifact from Wyoming that is carved from dolerite (Br.), a fine-grained igneous rock.



FIGURE 5: A ventifact from Wyoming (from Greeley & Iverson, 1985).

3. Size of Features (2)

Active and fossilized dune height or length are the attributes that are rated in this category, and points are awarded for size. Typically, the height of the slipfaces was the feature observed in the field that was the basis of the score for a specific site. Any feature higher than 16 feet (5 meters) was given a value of 5 points, a feature between 13 and 16 feet (4 - 5 m) earned 4 points, 3 points were awarded to features 10 to 13 feet (3 - 4 m) high, 2 points for 7 to 10 feet (2 - 3 m), 1 point for 3 to 7 feet (1 - 2 m), and zero points were awarded for features less than 3 feet (1 m) high.

4. Active Features (2)

Bare, exposed sand at inland locations appears anomalous and quite striking to the observer. Where bare sand is present, it is moved, sorted and stacked up by the wind, and eolian transport processes are seen in action. Exposed sand was found at only six localities in Maine during field work for this report (although more undoubtedly exist in isolated locations) and therefore, 3 points are automatically awarded just for its presence. Large exposed areas (greater than 3 acres) and sites with active medium or large scale migrating dunes received 4 or 5 points.

5. Research Interest (2)

Sites with unique features, assemblages of many features, or peculiar characteristics may have answers to geological and paleo-environmental questions buried or exposed within their sands. Unique features that earned points include topographic distribution (Bethel for being 1150 feet above sea level), outstanding preserved morphology (Standish, Wayne, Freeport), presence of lag deposits (Wayne, Long View) and outstanding features (internal stratification at Fryeberg). Points were given for relative uniqueness.

6. Naturalness (2)

Sites with no apparent modern alteration, such as material extraction, recent timber harvesting, and commercial or residential development, were considered to be in a natural condition and were assigned maximum point values. Various degrees of resource development or active land use caused a loss of points for any specific site.

7. Educational Potential (1)

Well-developed and readily discernable features of eolian deposition, proximity to population centers, and easy access from roads all contribute to a high educational potential value. Some sites where fossil features were readily discernable were wooded (Standish) and others were open field and pasture (Farmington). Other sites where learning about eolian processes has high potential were areas of active open sand such as Freeport.

8. Accessibility (1)

A short easy walk from parking areas to multiple features of interest rates 5 points. A hike involving strenuous climbing or more than twenty minutes of walking were deemed inaccessible to some people and received 0 points.

9. Other Considerations (1)

Sites representing geographical extremes within Maine (Salmon Pond, Lincoln) were deemed to have some statewide significance and were awarded points. Sites where there were good views toward the source area were awarded points because they display important geographical relationships.

RESULTS

In the following discussion the term 'locality' is used for a deposit of eolian sand identified by Thompson and Borns (1985) that may be areally extensive. 'Deposit' is used to describe an aggregate of sand particles that can be anywhere from a few square yards to a few square miles in area. The term 'site' is used to identify a sub-area within a locality that is described in detail in this report. An area was identified as a site through one of two methods: either it was mapped on a 7.5 or 15 minute surficial geology map, or it was seen in the field.

Fourteen localities where eolian sand is present were mapped at a scale of 1:500,00 by Thompson and Borns (1985, Table 2). After surficial geology maps, SCS soils maps, and aerial photographs of the 14 localities were investigated, a total of 73 discreetly mapped eolian sand sites were identified. Some areas, such as Wayne-Fayette, were shown as large blanket deposits on surficial geology maps, and aerial photographs were useful for delineating specific sites for field checking. Other potential localities, such as Madison, were mapped as numerous discrete eolian sand deposits, and each mapped deposit was considered an individual site subject to field inspection. Table 2 lists localities and the number of potential sites at each locality.

Field checking of sites occurred in the Fall of 1988 until frozen snow covered ground precluded adequate observation of surficial deposits. Additional field checking was performed in the Fall of 1989.

Considerable variety exists among the eolian sand deposits that were field checked during this investigation. There was a broad range in the scale of the features of the deposits and relationships to source areas in terms of relief and distance. The overall form of the deposits ranged from small, discontinuous sand ridges to massive sand bodies with superposed dunes.

Field-checked sites were found in association with the Androscoggin, Kennebec, Penobscot, Saco, and Sandy rivers and Sebago Lake. The eolian sand deposits were located to the east or south of their probable supply source. However, comparison of the location of eolian deposits (Figure 6) with the inferred limit of marine invasion (Thompson and Borns, 1985) shows that almost all of the deposits are in areas that were once submerged during the marine transgression. Therefore, at one time a retreating shoreland would have been located near where the deposit is now found, which suggests the possibility that the inland eolian sand deposits may be associated with former marine shorelines rather than the above mentioned rivers and lakes.

TABLE 2
 EOLIAN SAND DEPOSITS IN MAINE
 LOCALITIES AND SITES

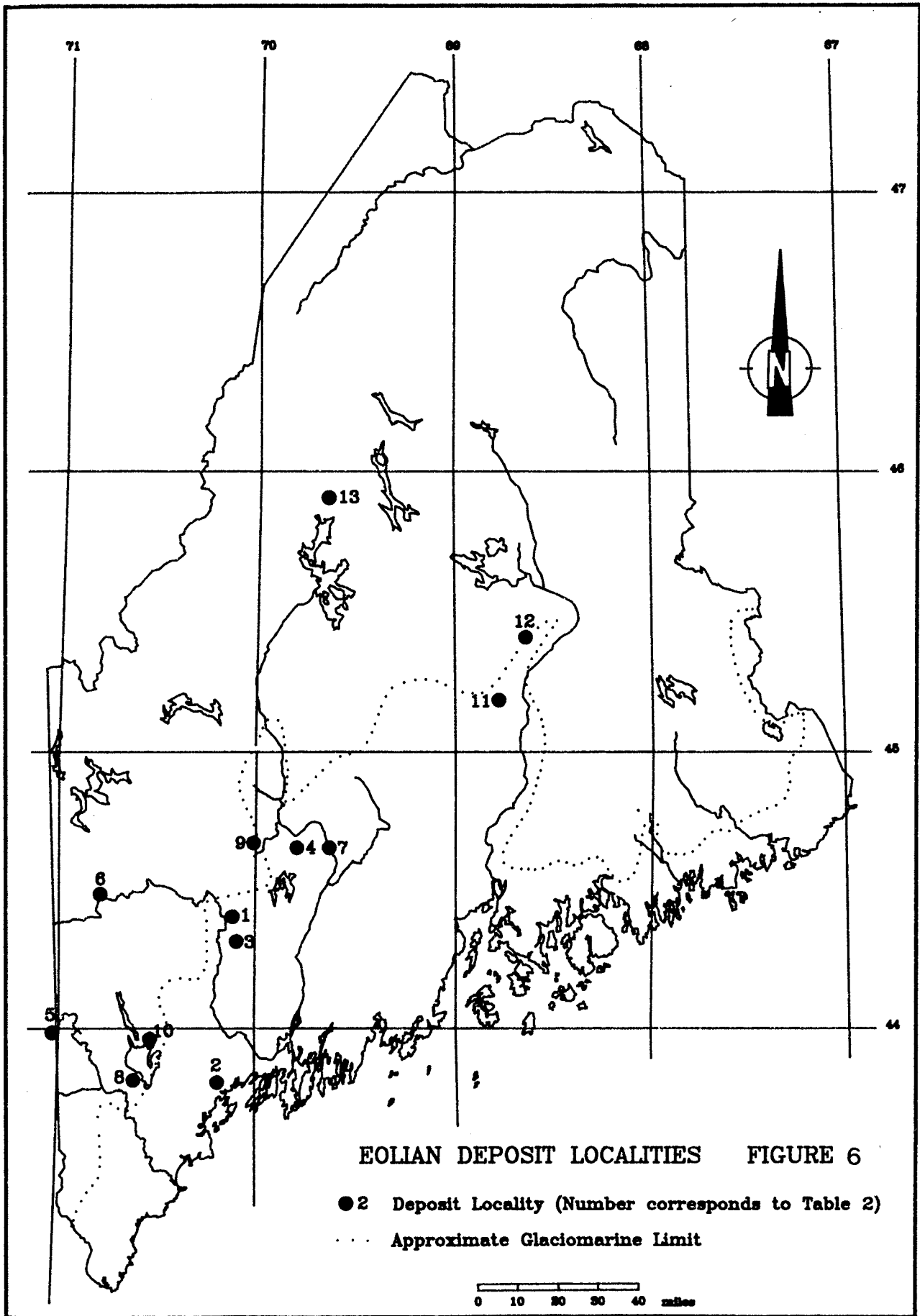
Localities from: Thompson and Borns, 1985, and surficial geologic maps, and SCS County Soils Maps

* indicates surficial geology not mapped at 7.5 or 15 minute scale.

Localities are listed from west to east. The number preceding the locality name corresponds to Figure 7.

| Deposit Locality | Total # mapped sites | Lat/ Long | # sites Field Ch. | Described Site Name |
|------------------|----------------------|------------------|-------------------|---|
| 1. Fryeberg | not mapped* | 44 00' 71 00' | 4 | Sand Pit Highlands |
| 2. Bethel | not mapped* | 44 30' 70 45' | 6 | Uplands Riverbend |
| 3. Standish | 2 | 43 50' 70 35' | 1 | Stndsh |
| 4. Casco | 2 | 43 59' 70 30' | 2 | Tenney Hill Leach Hill |
| 5. Freeport | 1 | 43 40' 70 10' | 2 | Freeport - Desert |
| 6. Leeds | 2 | 44 20' 70 10' | 2 | Sand Hill |
| 7. Farmington | 6 | 44 40' 70 05' | 7 | New Sharon N.Chstrvllle Fmngtn Falls |
| 8. Wayne | 12 | 44 25' 70 05' | 12 | Broad Sands Long View Rainbow Farm Beechnut Hill |

| | | | | | |
|---------------|-------------|--------|--------|----|---------------|
| 9. Madison | 13 | 44 40' | 69 45' | 9 | Madison |
| 10. T4R14 | not mapped* | 45 55' | 69 35' | 1 | Salmon Pond |
| 11. Skowhegan | 13 | 44 40' | 69 35' | 10 | Skhgn |
| 12. Madison | not mapped* | 45 20' | 69 05' | 3 | Madison |
| 13. Medford | not mapped* | 45 20' | 68 55' | 3 | Atkinson Cor. |
| 14. Lincoln | 18 | 45 25' | 68 35' | 11 | Lincoln |



EOLIAN DEPOSIT LOCALITIES FIGURE 6

● 2 Deposit Locality (Number corresponds to Table 2)

... Approximate Glaciomarine Limit

0 10 20 30 40 miles

A distinction is made between 'fossilized' dunes and areas of active open sand (known as 'Deserts'). Fossilized dunes are eolian sand deposits that formed during or just after deglaciation and were subsequently covered with vegetation which has served to stabilize and preserve the dune forms (see discussion under Significant Criteria, Preserved Dune Morphology). Fossilized dunes are relatively easy to recognize in the field because of the generally hummocky topography and steep slip faces if they are fairly large (at least 7 - 10 ft). The presence of boulders at the surface was a reliable indicator that a surficial deposit was not a fossilized dune.

Areas of active open sand where eolian processes are operating today have formed in areas of soil developed on sand that were devegetated during the past 200 years. Existing soils at sites such as Long View (Perkins, 1968, Walton, 1898) and Freeport (Gerber, 1969) are thought to have been destroyed by overintensive agricultural use, particularly sheep grazing. Because the well-sorted sand is highly permeable and therefore drains with excessive rapidity, soils and vegetation have not been able to become re-established. The 'Deserts' are quite striking in visual appearance because of the contrast to typical lush Maine vegetative cover.

Barchan, transverse, and linear dune segments are present in both active and preserved forms. Distinct individual dunes that are classic examples of a particular dune type are uncommon. Rather, dunes seen in the field are mostly complex composite dunes. One sand body is generally joined with other sand bodies that may or may not be the same style and form, such as a barchanoid ridge.

Well-developed transverse dune forms occur in fossilized form at the Standish locality. They are less than 7 feet high but despite their small size are readily distinguished as distinct dune forms. This is because they are not part of a continuous sand body but sit as isolated dunes on underlying glacial till and can be observed as entire discrete shapes.

Barchan and transverse dune segments are forming and migrating at the Freeport and Long View sites. These dune forms are replicated in small scale in ripples on the sand surface. Repeated on a larger scale at both sites, the slip faces of these dunes are up to 40 feet tall.

Similarities between geographically dispersed sites include a preponderance of white pine trees, hummocky irregular topography, and fine to medium extremely well-sorted sand. Sand composition was observed in the field with a hand lens, and a preponderance of quartz and other felsic minerals was noted. Mafic minerals were present in small percentages. All of the sands were light gray to light brown in color.

Position of the deposits in the landscape varied widely, with eolian sand found in lowlands, uplands, upper hill slopes, and hill tops. However, all deposits were within several miles of a river or lake to the north and west.

Some observations regarding current cultural use of Maine's inland eolian sand deposits can be made. The deposits are used as sources of clean sand for commercial and road maintenance purposes. The soils that develop on the sand are excessively drained and not well suited to cultivation, although hay production and limited grazing are found. One common cultural use that seems appropriate for eolian sand deposits is for cemeteries because the material is easily dug and the higher portions of dunes have a deep water table.

It was found during field investigations that distinction between eolian and fluvial sand deposits is most reliably made by observing the texture and degree of sorting within a sample with a hand lens. Prior to field work, it was considered possible that frosting and the degree of roundness would be useful parameters for field identification, but this proved to be less apparent than texture and sorting.

There are eolian sand deposits that have not been mapped on surficial geology maps due to the style of an individual mapper, the relatively small size of the deposits, and difficulty distinguishing them in the field. Therefore, the list of deposit localities that have been observed and field checked (Table 2) is not a totally inclusive list, but rather a list of the largest, most easily recognizable, and most significant inland eolian sand deposits in Maine.

SIGNIFICANT EOLIAN SAND DEPOSITS IN MAINE

The most significant eolian sand deposit in Maine is located in Wayne and Fayette. This deposit is named the Wayne Locality in this report, and there are four distinct sites within the locality that are described, rated, and recommended for inclusion on the Register of Critical Areas. The following features are highlights of what can be found within the Wayne Locality: large well-formed fossilized barchan and longitudinal sand dunes, ventifacts, a deflation pavement, active eolian transport of sand, and easy access.

The 'Desert of Maine' in Freeport is a very significant eolian sand deposit in Maine because it includes the largest open fetch of active sand in the state as well as very well-preserved fossil dunes. Other significant deposits that are worthy of inclusion on the Register of Critical Areas and are described in the following section, include these Localities: Leeds, Madison, Fryberg, Bethel, Skowhegan, and Standish.

The ranking scores of the sites are presented in Table 3. The order of the following site descriptions is organized by the localities with sites ranking from highest to lowest.

TABLE 3

| | PRESERVED DUNE MORPHOLOGY | VENTIFACTS | SIZE OF FEATURES | ACTIVE FEATURES | RESEARCH INTEREST | NATURALNESS | EDUCATIONAL POTENTIAL | ACCESSIBILITY | OTHER FEATURES | TOTAL |
|--------------------|---------------------------|------------|------------------|-----------------|-------------------|-------------|-----------------------|---------------|----------------|-------|
| MULTIPLYING FACTOR | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | |
| LONGVIEW | 15 | 15 | 10 | 10 | 10 | 8 | 4 | 5 | 4 | 81 |
| BROAD SANDS | 15 | 9 | 10 | 10 | 6 | 10 | 5 | 3 | 5 | 73 |
| BEECHNUT HILL | 15 | 12 | 10 | 4 | 6 | 8 | 3 | 5 | 3 | 66 |
| FREEPORT DESERT | 9 | 0 | 10 | 10 | 10 | 8 | 5 | 4 | 2 | 58 |
| RAINBOW FARM | 12 | 0 | 6 | 4 | 10 | 6 | 5 | 5 | 5 | 53 |
| SAND HILL SITE | 6 | 9 | 6 | 8 | 4 | 6 | 4 | 3 | 6 | 52 |
| MADISON SITE | 12 | 0 | 6 | 8 | 6 | 4 | 2 | 5 | 5 | 48 |
| FRYEBURG HIGHLANDS | 15 | 0 | 10 | 0 | 0 | 8 | 3 | 3 | 6 | 45 |
| BETHEL UPLANDS | 6 | 0 | 4 | 0 | 10 | 8 | 1 | 3 | 10 | 42 |
| SKOWHEGAN | 9 | 0 | 10 | 0 | 0 | 8 | 3 | 5 | 7 | 42 |
| STANDISH | 12 | 0 | 4 | 0 | 0 | 10 | 5 | 5 | 4 | 40 |
| FARMINGTON FALLS | 9 | 0 | 10 | 0 | 0 | 6 | 4 | 5 | 4 | 38 |
| NEW SHARON SITE | 15 | 0 | 4 | 0 | 2 | 4 | 3 | 5 | 4 | 37 |
| NORTH CHESTERVILLE | 12 | 0 | 10 | 0 | 0 | 6 | 4 | 5 | 0 | 37 |
| TENNEY'S HILL SITE | 9 | 0 | 4 | 0 | 0 | 6 | 3 | 4 | 4 | 30 |
| ATKINSON CORNER | 6 | 0 | 2 | 4 | 2 | 4 | 4 | 4 | 0 | 26 |
| FRYEBURG SANDPIT | 0 | 0 | 6 | 0 | 10 | 0 | 3 | 4 | 3 | 26 |
| LEACH HILL SITE | 3 | 0 | 4 | 0 | 6 | 2 | 3 | 4 | 2 | 24 |
| LINCOLN | 0 | 0 | 2 | 0 | 2 | 6 | 3 | 3 | 5 | 21 |
| SALMON LAKE SITE | 0 | 0 | 0 | 0 | 10 | 8 | 1 | 1 | 0 | 20 |
| BETHEL RIVERBEND | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

WAYNE LOCALITY

An extensive eolian sand deposit several square miles in area is shown on Wayne and Fayette 7.5 minute surficial geology maps. Field reconnaissance revealed that there were four distinct sub-areas within this sand deposit that, because of a combination of outstanding features, merit designation as individual sites. For the purposes of this report, these four locations have been named Long View, Rainbow Farm, Beechnut Hill, and Broad Sands (Maps 1A, 1B). There are numerous other areas within the Wayne Locality with some significant features, but because these features are common throughout the locality, only areas with numerous features in close proximity were designated as sites.

SITE NAME: Long View

LOCATION: Wayne and Fayette, Kennebec County

TOPOGRAPHIC QUADRANGLES: Wayne 7.5', 1964
Fayette 7.5', 1966

SIZE: Approximately 80 acres

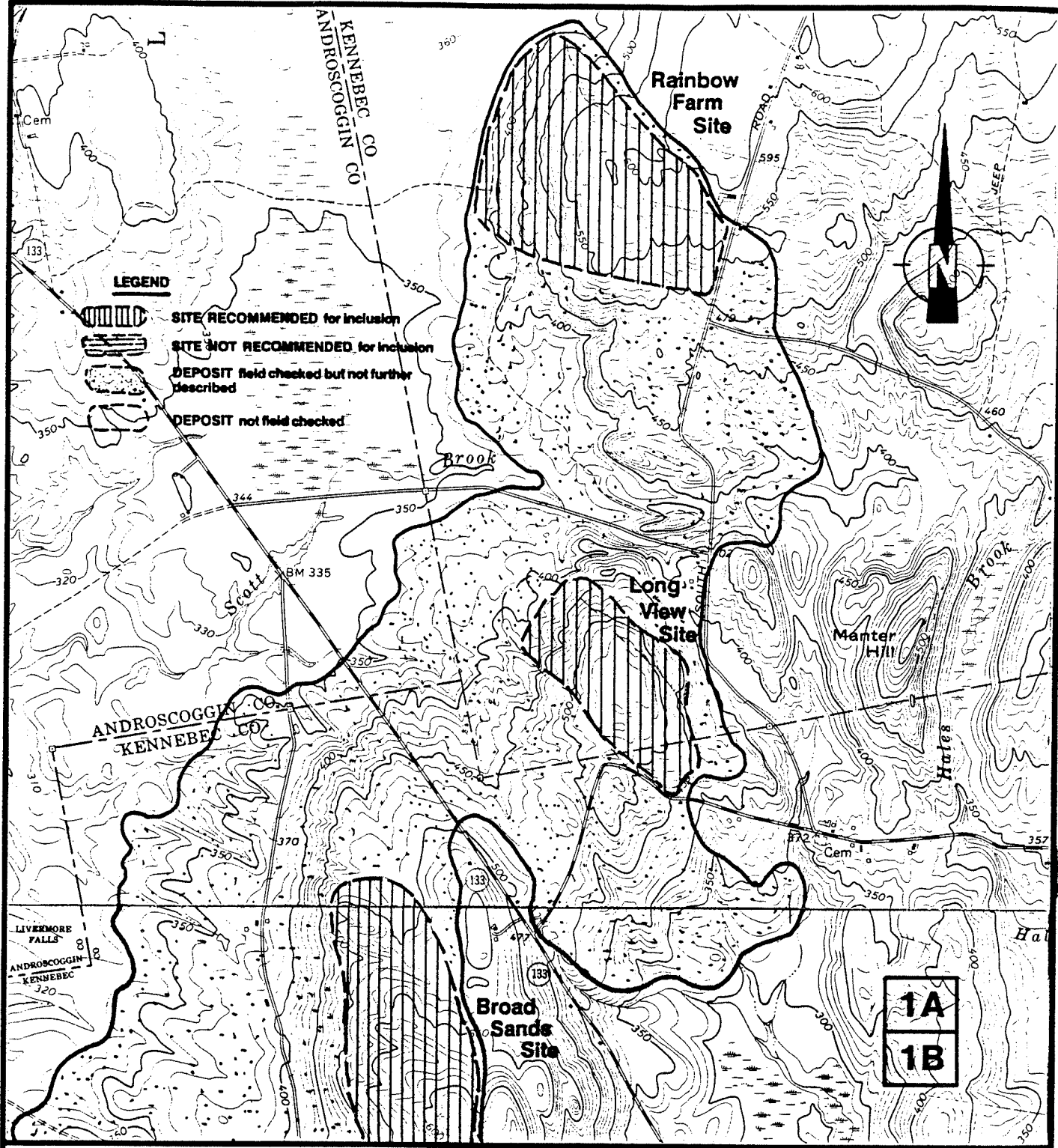
RATING: 81

SIGNIFICANT FEATURES:

- Open fetch of sand with active eolian transport and depositional features.
- Large, well-formed ventifacts.
- Undisturbed barchanoid and transverse dune segments in woods surrounding open sand.
- Lag deposit.
- Well-formed internal stratification.
- Good views to the south and west.

RECOMMENDATION:

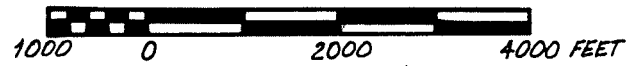
The Long View site is most highly recommended for inclusion on the Register of Critical Areas. 81 points was the highest rating score for any site (Freeport Desert is second with 58 points), and the largest number of specific features is found here.



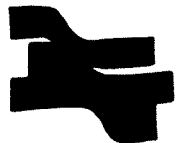
WAYNE LOCALITY

MAP: 1A

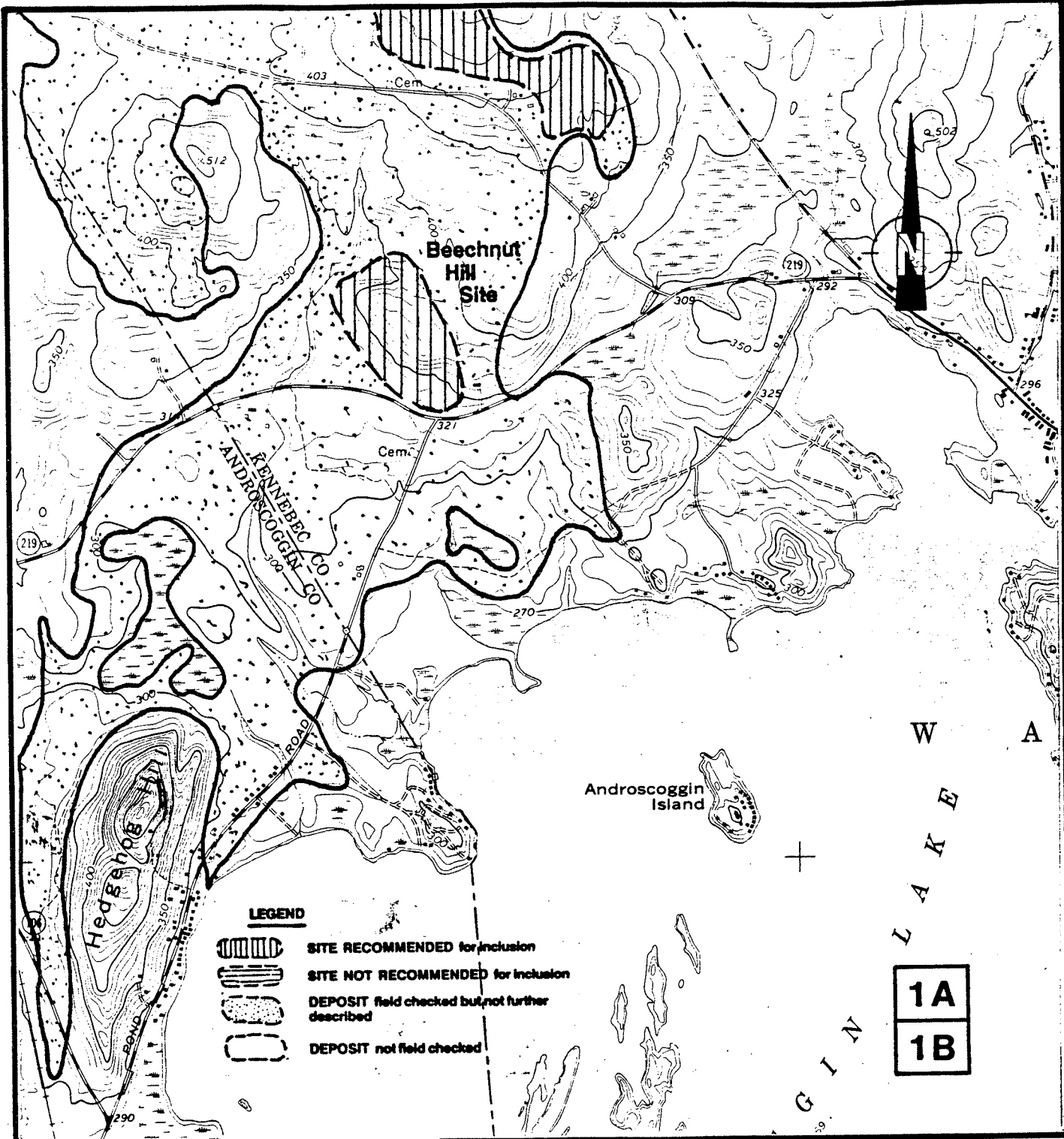
Scale:



Source: USGS 7.5' Quad. Wayne 1966 - Fayette 1966



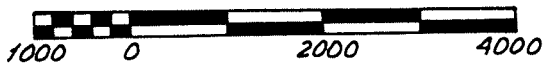
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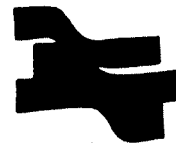
WAYNE LOCALITY

MAP: 1B

Scale:



Source: USGS 7.5' Quad Wayne 1966 -
Fayette 1966



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DESCRIPTION:

General

The Long View site consists of approximately 80 acres of open sand and adjacent woodlands. The site occupies a height of land and adjacent slopes and is more than two hundred feet above its probable source area, the Androscoggin River and associated floodplains.

Cultural:

Land use in the area is primarily residential with some agricultural activity in the lower elevations. The immediate vicinity of the Long View site is wooded with a few scattered residences. The site is currently used for assorted recreational activities including hunting, hiking, all terrain vehicle riding, and small bonfires.

Deposit Morphology:

The Long View site consists of a large open fetch of sand and the nearby surrounding woods. The fetch of open sand is oriented northwest to southeast and is roughly 2,000 feet long and 200 to 500 feet wide. There are isolated groupings of vegetation within the open sand, and the boundaries of the open sand form a series of irregular embayments.

There are numerous arcuate sand ridges near the southern and eastern margins of the open sand and scattered throughout the woods. The ridges are up to 40 feet high and extend for up to 300 feet in the woods. Some ridges are approximately parallel to the presumed dominant paleowind direction (NW to SE) and can be considered longitudinal dune segments. Others are perpendicular to the presumed paleowind direction and can be considered barchanoid or transverse dune segments.

Within the open fetch of sand, modern, active, depositional features resulting from eolian transportation processes can be seen at sizes ranging from 0.4 inches or less up to over 33 feet. Small scale ripples (less than 0.4 inches high) are analogous in cross section and orientation to transverse dunes and are present on some gently sloping surfaces. Large (greater than 20 feet) barchanoid slipfaces are at the southern and eastern margins of the open sand.

Other Features:

There is a height of land near the center of the open fetch of sand that is dominated by several dozen ventifacts ranging in size up to approximately 6 feet (long axis). An exposed deflation pavement is at the edge of the woods northwest of the open fetch and dramatic slipfaces (49 feet) are at the southeast

margin of the sand. Internal stratification in the form of thin (less than 0.2 inches) sorted bedding is found within the southeastern area of open sand that is dipping roughly 25 degrees southeast. There are broad views to the south from the height of land in the center of the site.

The Long View site was awarded 8 of 10 possible points for naturalness (Table 2) despite current activities at the site because the wooded portions are undisturbed.

Vegetative Cover:

Vegetation at the site is dominated by white pine and gray birch is commonly found with the pine in isolated clumps within the sand. Lichen typically forms a mat in a band 5 to 10 feet wide between the forest and open sand. Star puffballs, little bluestem grass, and star asters are also growing at the site.

SITE NAME: Broad Sands

LOCATION: Wayne, Kennebec County
North of Route 219.

TOPOGRAPHIC QUADRANGLE: Wayne 7.5', 1964

SIZE: Approximately 50 acres

RATING: 73

SIGNIFICANT FEATURES:

- Large areas of open sand.
- Well-preserved fossil dune morphology in woods.
- Some small ventifacts.
- Largely undisturbed, very natural.

RECOMMENDATION:

The Broad Sands site is an outstanding example of active and preserved eolian deposit features within the Wayne Locality. A combination of large fetches of active open sand, well-preserved dune morphology, and naturalness caused this site to have a relatively high rating score of 73 points. Therefore, this site is highly recommended for inclusion on the Register of Critical Areas.

DESCRIPTION:

Cultural:

Evidence of cultural activity at the Broad Sands site is limited to several overgrown woods roads, all-terrain vehicle tracks and shotgun shells. There are no residential or commercial uses of the site at this time.

Deposit Morphology:

A large fetch of open sand and large well-preserved linear and barchanoid dune forms are the salient morphological features at the Broad Sands site.

The open fetch of sand covers an area of approximately 10 acres and is diamond-shaped in plan view. The open fetch is unusual because it is on a fairly steep (10 to 25 percent) slope that faces south to southwest. Approximately 30 percent of the open fetch is vegetated with gray birch and white pine 'islands'. There are small areas of open sand in isolated locations of the wooded portions of the Broad Sands site.

Barchanoid and linear dune segments are found in the wooded areas adjacent to the open fetch. The dune forms range in size up to 20 feet in height and 100 feet in length. There are some distinct and well-formed south and east facing slipfaces associated with these dune segments. Orientation of the dune is quite variable, possibly as a result of blowouts at the time of deposition.

Other Features:

Several hundred feet to the north of the open fetch is an area where ventifacts are located. These wind carved rocks are at the ground surface, and they overly glacial till rather than sand. There are less than twenty ventifacts in this location, and they range in size up to 1.5 feet.

Evidence of active eolian processes at the Broad Sands site includes ripples and very small (less than three feet high) dunes in the area of the open fetch as well as some burial of small trees by blowing sand. The roots of several trees are exposed to the air where wind action has caused the removal of loose sand.

Vegetative Cover:

Most of the area of the Broad Sands site is forested with white pine as the dominant species. Some areas are covered with mature forest, and mixed hardwoods and other softwoods can be found. Mosses and lichens are common around the perimeter of the open sand area.

SITE NAME: Beechnut Hill

LOCATION: Wayne, Maine
North and east of Tucker Road

TOPOGRAPHIC QUADRANGLE: Wayne 7.5'

SIZE: Approximately 200 acres

RATING: 66

SIGNIFICANT FEATURES:

- Well-preserved dune morphology.
- Medium size areas of open sand.
- Ventifacts

RECOMMENDATION:

The Beechnut Hill site contains examples of all of the features that cause the Wayne locality to be an outstanding inland eolian sand deposit. With a rating score of 66, this site is highly recommended for inclusion on the Register of Critical Areas.

DESCRIPTION:

Cultural:

Most of the Beechnut Hill site is on land belonging to the Beechnut Hill farm. The southern portion of the site is pasture and hay field, and the northern portion is wooded. Some of the wooded land is managed for timber production as evidenced by signs of logging and tree planting. The far northern portion of the Beechnut Hill site is heavily wooded and in an apparently natural condition.

Deposit Morphology:

The Beechnut Hill site is located along the northwestern flanks of a hill and pinches out along the crest of the hill. Well-formed barchanoid and transverse dune segments are located on the flanks of the hill where slip faces attain heights of up to 30 feet. There are several areas of open sand on the northwest facing flank of the hill that are up to 300 feet long and 100 feet wide.

Other Features:

A deflation pavement is found near the northern end of the hill crest. There are several small (maximum diameter 6 inches) weathered ventifacts found in this area. These ventifacts are described as weathered because their wind blasted surfaces are pitted, apparently due to chemical decomposition, rather than smooth, such as the ventifacts at the Long View site. This difference may be a result of having different time periods of exposure to air.

Vegetative Cover:

The northern part of the Beechnut Hill site is wooded, primarily with mature white pines. The southern part of the site is partly wooded with white pine and mixed hardwoods and partly grass-covered meadow.

SITE NAME: Rainbow Farm

LOCATION: Fayette, Maine
West of South Road

TOPOGRAPHIC QUADRANGLE: Fayette 7.5'

SIZE: Approximately 250 acres

RATING: 53

SIGNIFICANT FEATURES:

- Well-preserved dune morphology in wooded areas.
- Excellent exposures of internal stratification in borrow pit.
- Excellent views toward source area.
- Succession plant community in former open fetch.
- Excellent views to the north, south, and west.

RECOMMENDATION:

The Rainbow Farm site is recommended for inclusion on the Register of Critical Areas because it has numerous outstanding examples of features associated with inland eolian sand deposits.

DESCRIPTION:

Cultural:

The Rainbow Farm site is named for the farm which occupies the eastern portion of the site. The site includes a hilltop and associated northern and western flanks. Pasture and hay fields of the farm are on the upper portions of the hill, and the rest of the site is wooded with several old unused roads. Land use at the Rainbow Farm site is limited to farming activities and possibly hunting and hiking.

Deposit Morphology:

The eolian sand of the Rainbow Farm site is on the western and northern flanks of a hill that rises more than 250 feet above the presumed source area. There are large climbing dunes found en echelon on the western flanks of the hill. These are linear dunes, some of which are more than 100 feet long with east facing slipfaces more than 40 feet high. Near the crest of the hill, the deposit assumes a blanket morphology and then the eolian sand pinches out to the east of the hill crest.

A borrow pit is located west of South Road to the south of the Rainbow Farm farmhouse. There are several small fetches of open sand above the pit to the west. This is the only open active sand at the Rainbow Farm site.

Large (50 feet by 100 feet by 20 feet) well-formed barchan dunes are found in the wooded areas near the southern end of the Rainbow Farm site. Segments of barchan, transverse, and longitudinal dunes are found throughout the woods in the rest of the site.

Other Features:

The borrow pit to the west of South Road is a feature with excellent research and educational potential. The pit face is more than 100 feet long and up to 30 feet high. Internal stratification is clearly visible and substantial information about depositional history can be gleaned from the stratification.

A small spring (flow approximately 0.1 cfs) is located on the lower western slopes of the Rainbow Farm site. The spring appears to be associated with a thin (0.5 inch) firm layer of black silty sand.

A cluster of large, poorly formed ventifacts are located near the northern margin of the Rainbow Farm site. These ventifacts are approximately half way up the hill and are heavily covered with lichens.

Vegetative Cover:

Grasses cover the upper portions of the site where land is used for pasture or hay. The rest of the site is wooded with a mature white pine-dominated, mixed deciduous and coniferous forest.

Several areas that were recently open sand are now in early stages of vegetative succession to the immediate west and south of the borrow pit. Juniper, purple thistle, red maples, and tall grasses were the predominant plants present along with many other unidentified species. Based on the size of the maples (less than three inches DBH), it appears that the revegetation of open sand has been occurring for 15 to 20 years. The presence of red maple in this location is anomalous because red maple typically grows in wet areas, and drainage would be expected to be very rapid in sand soils.

FREEPORT LOCALITY

The Freeport Locality (Map 2) is located on an extensive glacial outwash plain that is associated with the ancestral Androscoggin River. Most of the land use at this locality is residential and agricultural and access to much of the deposit was not possible. However, near the center of the deposit is the 'Desert of Maine', a private campground that is open to the public. Therefore, this area is the one site within the Freeport Locality that was fully investigated and is designated as a site for the purposes of this report.

SITE NAME: Freeport Desert

LOCATION: "Desert of Maine" Freeport, Cumberland County

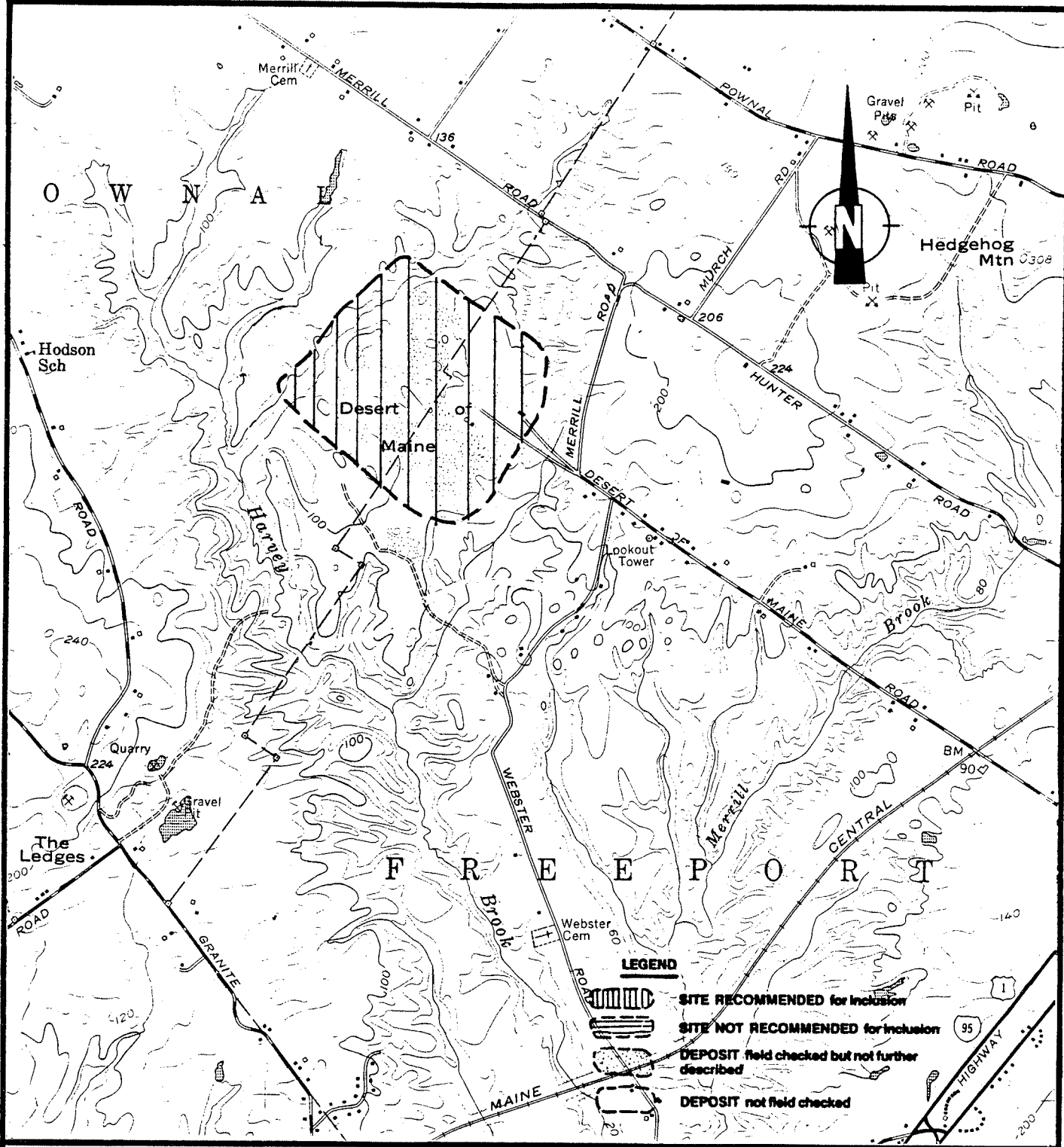
TOPOGRAPHIC QUADRANGLE: Yarmouth 7.5'

SIZE: Approximately 180 acres

RATING: 58

SIGNIFICANT FEATURES:

- Largest open fetch of sand in Maine.
- Active eolian transport and associated erosional and depositional features.
- Undisturbed fossil dune forms in wooded areas.



FREEPORT LOCALITY

MAP: 2

Scale:



Source: USGS 7.5' Quad. Yarmouth
Photorevised 1970



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- Historical data base regarding position and magnitude of unvegetated sand deposit.

RECOMMENDATION:

The Freeport Desert site is highly recommended for inclusion on the Register of Critical Areas. The large fetch of open sand, well-formed modern and fossil sand dunes, educational potential, accessibility, and history of scientific investigation all combine to make this site a highly ranked eolian deposit for the purposes of this report.

DESCRIPTION:

Cultural:

The Freeport Desert site includes land that is a privately owned visitor attraction known as the "Desert of Maine". The facility includes a campground, gift shop, farm museum, and 'the Desert'. A recent informational brochure states that "The Management of the Desert has striven, from the very beginning of its discovery, to keep this scientific phenomenon in its natural state". In the 'off - season' the facility was found to be in a 'natural' state with no apparent attempts to control sand movement.

There are several buildings associated with the visitor facilities located along the eastern margin of the site where Desert Road terminates. Otherwise, the site is predominantly open sand with interspersed stands of vegetation. Stakes that serve as position markers from earlier research are seen in scattered locations throughout the site. Outlying areas of the site are wooded.

Deposit Morphology:

Vast expanses of open unvegetated sand form the first visual impressions upon entering the site. Further inspection reveals that the open sand is found in a primary central fetch of open sand approximately 3,000 feet long with a NNW - SSE orientation and roughly 500 feet wide that is partially connected to other open sand expanses. The open sand appears to be in the topographic form of numerous partial bowls strung together in a NW- SE direction. There are widely scattered islands of vegetation along the open fetch of sand.

From the upwind to the downwind (NW - SE, 3,000 feet) ends of the open fetch, the land surface slopes upward approximately 60 feet in an undulating fashion. The upward sloping surface can be considered as a series of ramps formed by windblown climbing sand. These long gradual ramps are an integral part of the process of building the 60 foot tall slipfaces that are seen at the southern and eastern margins of the sand.

Numerous features of active eolian sand transport are seen at this site. Erosional features include deflation pavements, scour areas in front of immovable objects and the undermining of vegetation, including relatively large trees. Depositional features that can be seen include assorted wave forms (from small sand ripples with an amplitude less than 0.2 in. and a wavelength less than 4 in. to large dunes with an amplitude greater than 49 ft. and a wavelength of approximately 300 ft), segments of barchan, longitudinal, and transverse dunes, prominent steeply dipping slipfaces, and active burial of trees and other objects.

Fossil slipfaces up to 50 feet high can be seen in some wooded portions of the site.

Other Features:

To the west of the 'Desert', heavily forested relict dunes are seen with slipfaces up to 45 ft high. A meandering stream with high sinuosity (typically found in areas of uniform fine-grained sediment with low gradient) is found between sand bodies and is an interesting landscape feature here.

Vegetative Cover:

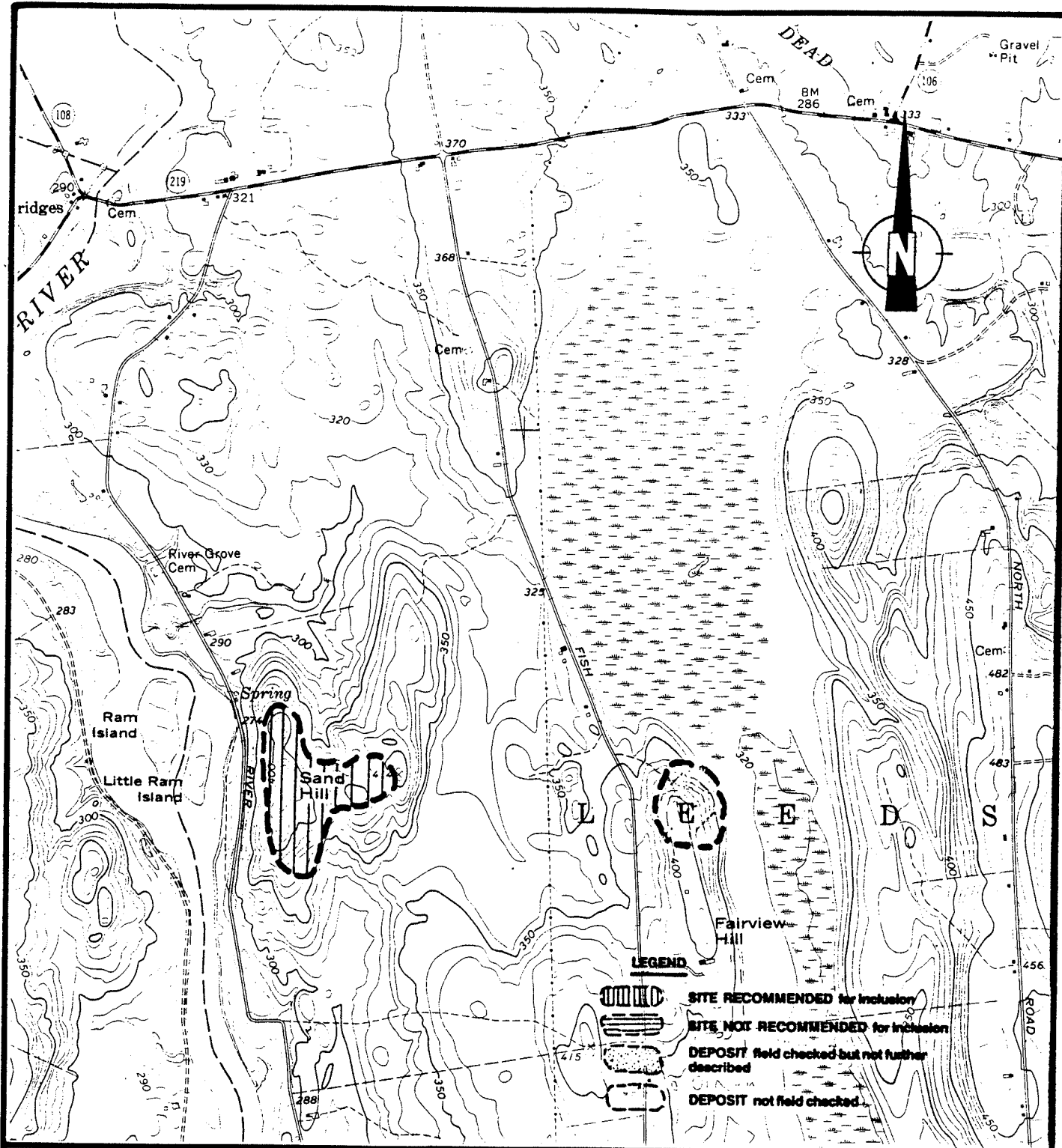
Most of the Freeport Desert site is unvegetated. The margin of the site is 10 percent to 20 percent forested, and there is a transitional zone between woods and open sand. Some of the trees are very mature white pine (greater than two foot diameter) with some hemlock and a few mixed hardwoods. There are several 'islands' of vegetation within the open fetch of sand which include mature gray birch, white pine, and transitional zones.

Plants within the transitional zones between woods and open sand include grasses, mosses, lichens, and low shrubs.

LEEDS LOCALITY

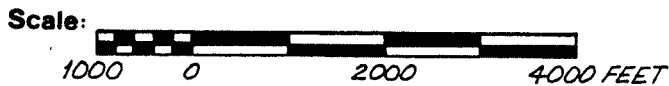
Two eolian sand deposits are shown on the 7.5' Turner Center surficial geology map and Map 3. The westernmost deposit on Sand Hill is described below as the Leeds site. The other mapped deposit was not accessible due to posted land.

SITE NAME: Sand Hill Site



LEEDS LOCALITY

MAP: 3



Source: USGS 7.5' Quad. Turner Center
1967



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LOCATION: Sand Hill, Leeds, Androscoggin County

TOPOGRAPHIC QUADRANGLE: Turner Center 7.5'

RATING: 52

SIGNIFICANT FEATURES:

- Fetch of open sand.
- Large ventifacts.
- Good views toward source area.
- Spring below deposit.

RECOMMENDATION:

The Leeds site is recommended for inclusion on the Register of Critical Areas because of the open sand, large ventifacts, good views and other attributes.

DESCRIPTION:

Cultural:

The Sand Hill site is in an area of a few scattered residences and farms and is otherwise forested.

Deposit Morphology:

Little evidence of the sand body can be seen along River Road and a short climb is required to view the site. The bulk of the sand is on the southeast flank of Sand Hill and is approximately 150 feet above the modern Androscoggin River. The sand forms a thick continuous blanket on the higher portions of Sand Hill.

The open fetch of sand at this site is roughly 55 yards wide and 137 yards long with an undulating margin. It is oriented in a roughly northwest to southeast direction and an 26 foot tall slipface is seen at the southern terminus of the open sand.

Other Features:

The large ventifacts (up to 6.5 ft, long axis) are located just to the northwest of the crest of the hill. Approximately 6 large boulders and perhaps a dozen smaller ventifacts can be seen here. There are very good 270 degree views from west to north to

east. Substantial relief between source and deposition areas is easily seen.

Vegetative Cover:

The site exhibits a variety of vegetative cover. The area that contains the ventifacts has recently been logged, and this helps open up the good views. As the site is traversed toward the southeast, a stand of mature mixed hardwood/softwood trees is encountered, then a very attractive stand of mature red pine, then mostly young white pine, and finally open sand is reached. The open sand vegetative suite is typical, with isolated clumps of gray birch and white pine surrounded by lichens and then unvegetated sand.

MADISON LOCALITY

There are a total of 13 discrete areas at the Madison Locality that are mapped as eolian sand deposits. These deposits are scattered across the towns of Madison, Norridgewock, and Solon, and all of them are on the east side of the Kennebec River Valley. Of these, nine potential sites were field checked (Maps 4A, 4B), and one, named the Madison site, was found to be of high value. Access problems prevented viewing of the remaining three potential sites.

SITE NAME: Madison Site

LOCATION: Madison, Somerset County

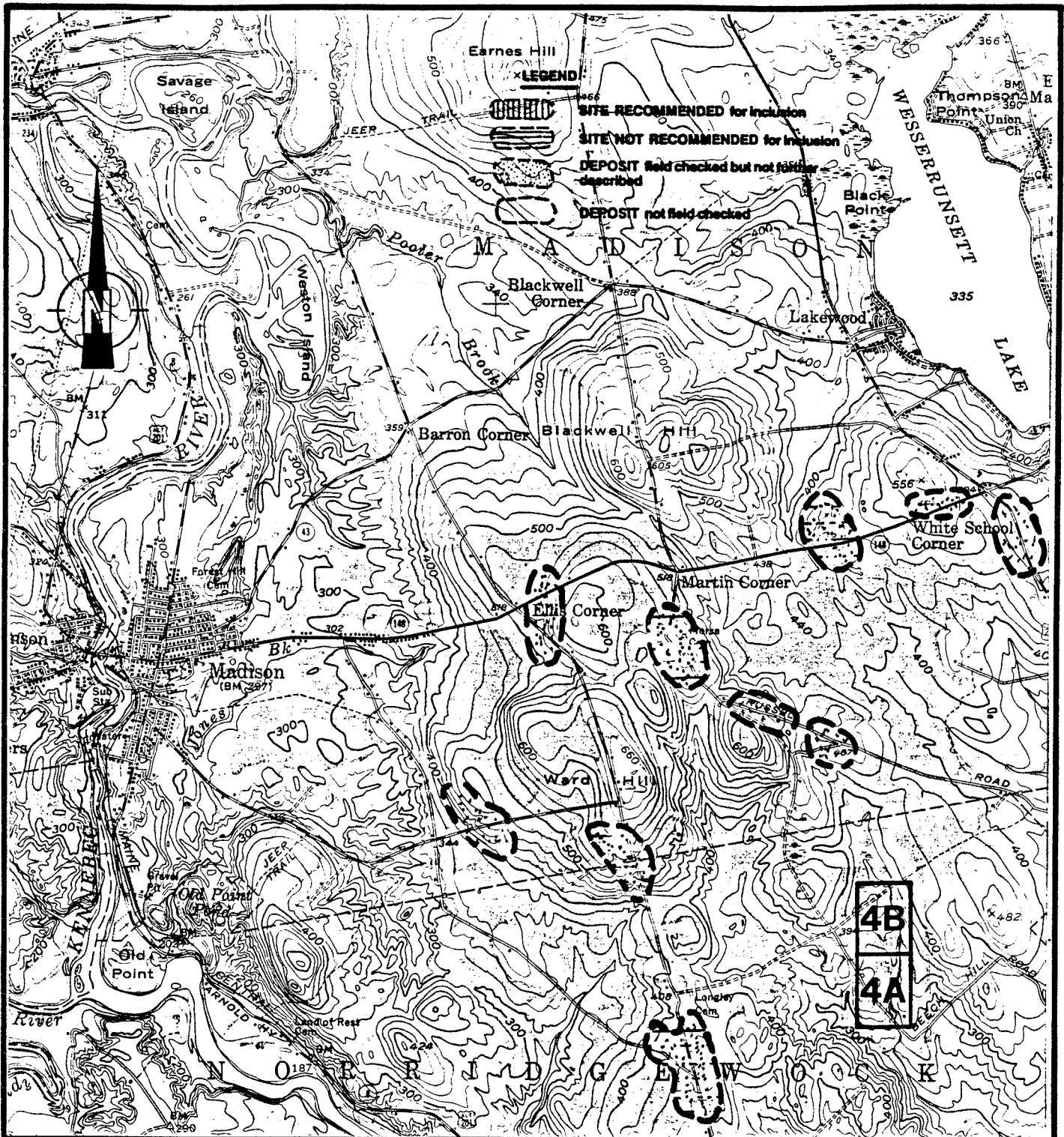
TOPOGRAPHIC QUADRANGLE: Anson 15', 1955

SIZE: approximately 30 acres

RATING: 48

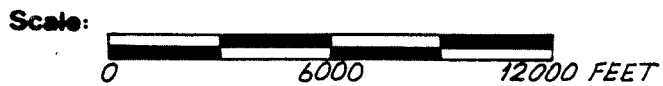
SIGNIFICANT FEATURES:

- Fossil dune morphology seen in pasture and woods.
- Good-sized fetch of open active sand.

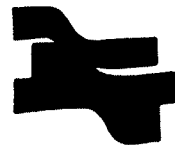


MADISON LOCALITY

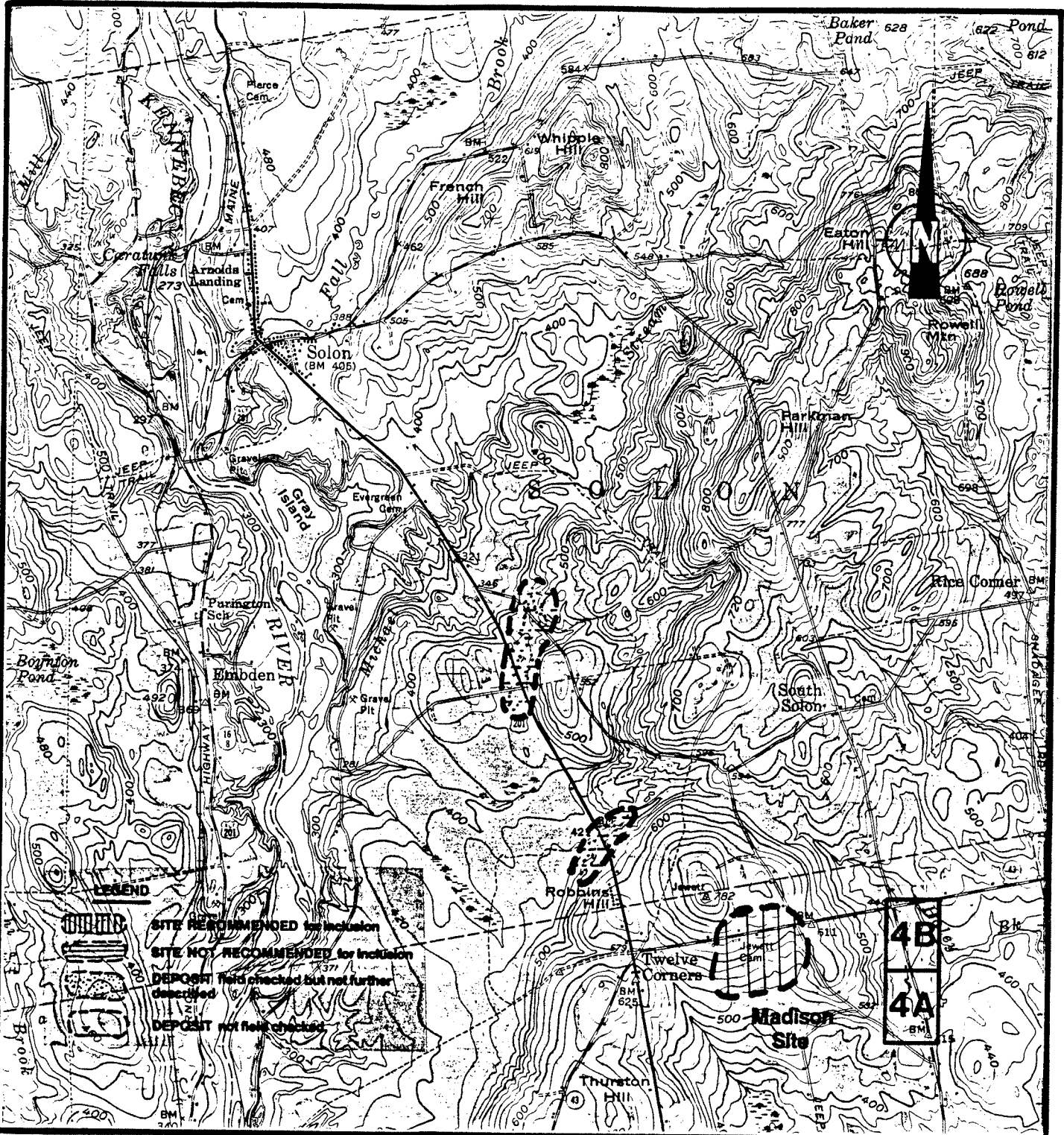
MAP: 4A



Source: USGS 15' Quad. Anson 1955



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MADISON LOCALITY

MAP: 4B



Source: USGS 15' Quad. Anson 1955



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RECOMMENDATION:

The Madison site is recommended for inclusion on the Register of Critical Areas because it is a good, very typical example of active and fossil eolian sand deposits.

DESCRIPTION:

Cultural:

The Madison site is on a farm that is half wooded and half pasture. The area in the vicinity of the site is a mix of uses including residential, pasture, and woodlot. There were numerous no trespassing signs in the area and some potential sites were not field checked due to access problems.

Deposit Morphology:

Several dunes are distinctly visible sitting on top of glacial till in the pasture, and others are evident in the woods where they are separated by wet areas. The adjoining areas are used for agricultural and residential purposes.

The probable source area for this sand is the Kennebec River approximately 3.1 miles west and 110 yards below the site. It is possible that the floodplain of the ancestral Kennebec was located closer to this site than the modern floodplain when this eolian deposit was forming.

Within the woods is a fetch of open sand approximately 55 yards wide and 219 yards long where ongoing eolian transport and deposition processes are evident. Segments of barchan and transverse dunes are seen in the open sand area, and longitudinal dune forms are seen in the woods, as well. The dune features range in height up to 10 feet and in length to 164 feet.

Other Features:

Madison is the only site observed during field research for this report with good potential for inclusion on the Register of Critical Areas in the upper Kennebec River Valley above Skowhegan, and therefore, has added value for geographic distribution. The site has experienced minor disturbances in the form of small borrow pits: these detract from the naturalness of the site but adds to research and educational value because good exposures of internal stratification are present.

Vegetative Cover:

The wooded portions of the site are covered with a mature pine, hemlock, fir and mixed hardwood forest.

FRYEBERG LOCALITY

The eolian sand deposits in the Fryeberg area are mapped at a scale of 1:500,000. Detailed surficial maps of the area are in progress but were not available for this report. Dr. Woody Thompson of the Maine Geological Survey suggested several locations in the Fryeberg area with known eolian sand deposits, which resulted in a general automobile reconnaissance of the area. Four separate deposits were observed (Map 5), and two had sufficient attributes to be designated as sites (Fryeberg Highlands and Fryeberg Sandpit) and are described below.

SITE NAME: Fryeberg Sandpit

LOCATION: Fryeberg, Oxford County

TOPOGRAPHIC QUADRANGLE: Fryeberg 7.5', 1963

SIZE: Approximately 20 acres

RATING: 26

SIGNIFICANT FEATURES:

- Very extensive internal stratification exposed in pit.

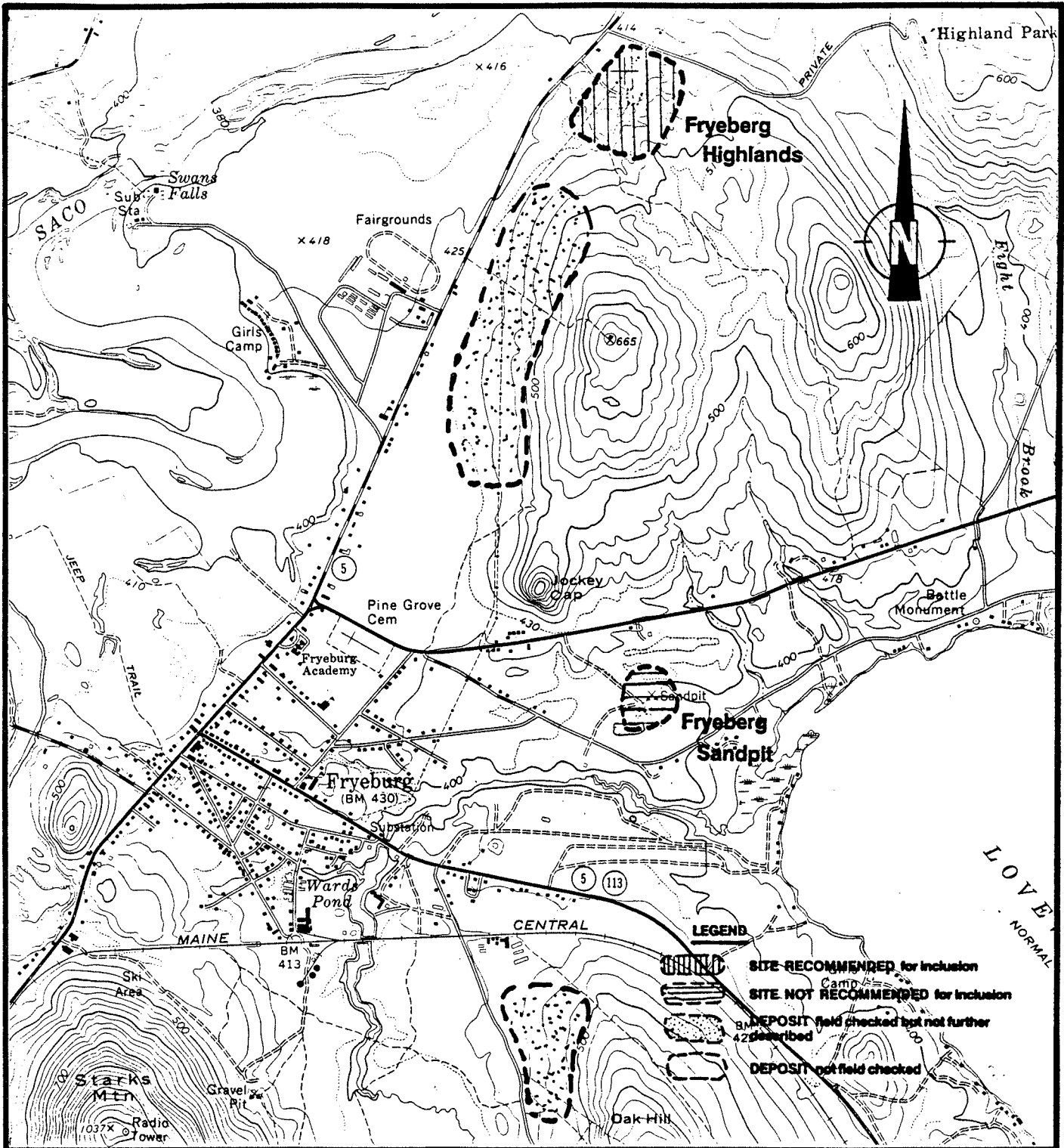
RECOMMENDATION:

The Fryeberg Sandpit site should be field checked again. There is some question as to whether the deposit is of eolian or fluvial origin. If this site is an eolian sand deposit, it may be worthy of inclusion on the Register of Critical Areas despite its low rating score because the exposure of internal stratification would be the best in the state.

DESCRIPTION:

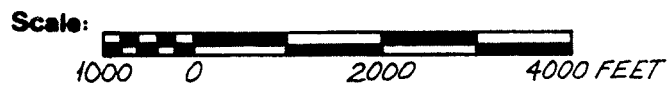
Cultural:

The Fryeberg Sandpit site is an open sand pit with the most extensive and clearly expressed internal bedding seen anywhere. The sand extraction activities appear to be ongoing although there was no equipment present or excavation activity at the site at the time of the site visit. The area around the site has mixed land use including residential, commercial and small scale industrial activities. The immediate surroundings of the pit are wooded with evidence of disturbance.

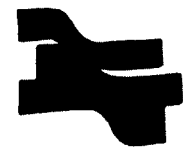


FRYBERG LOCALITY

MAP: 5



Source: USGS 7.5' Quad. Fryberg 1963



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Deposit Morphology:

The exposed pit face is approximately 150 feet long and over 10 feet high. The bedding that is seen is predominantly composed of beds that are about 10 feet high, dipping at about 25 to 30 degrees southeast. On top of the dipping beds are horizontal laminar beds. It is possible that the exposed sand in the pit was deposited as part of a delta system entering a lake rather than having an eolian transport history, and further research is recommended before inclusion of this site on the Register of Critical Areas. Reasons for determining that this deposit probably is the result eolian transport of sand include the very well-sorted fine to medium fairly well-rounded sand grains, the uniformness of the bedding, and the orientation of the bedding.

Some possible dune forms can be seen in the woods adjacent of the pit, but they are disturbed and not reliably identified.

Vegetative Cover:

The Fryeberg Sandpit site is surrounded by mostly white pine forest, but the site, itself, is devoid of significant vegetation as a result of extraction activities.

SITE NAME: Fryeberg Highlands

LOCATION: Fryeberg, Oxford County

TOPOGRAPHIC QUADRANGLE: Fryeberg 7.5', 1963

SIZE: approximately 50 acres

RATING: 45

SIGNIFICANT FEATURES:

- Well-preserved fossil dunes in woods and power line cut.
- Westernmost eolian deposit locality in Maine
- Easily visible dune morphology in open areas

RECOMMENDATION:

The Fryeberg Highlands site is recommended for inclusion on the Register of Critical Areas on the basis of its geographic distribution and large, well-formed, well-preserved, readily apparent dunes.

DESCRIPTION:

Cultural:

The Fryeberg Highlands site is largely wooded with scattered residences along the access road. There is a double pole power line that cuts a swath through the vegetation and opens up good views of dune topography. Otherwise, the site is largely undisturbed.

Deposit Morphology:

Large (up to 25 feet high) well-preserved transverse and barchan dunes are seen in mature white pine-dominated woods and along the open cut of the power line. Spacing of the three dune crests seen along the power line was approximately 500 feet, with the intervening ground covered with a thin and sometimes absent veneer of fine sand.

The flood plains of the Saco River and the Old Course of the Saco River converge less than one third of a mile west and northwest of this site and provide a ready source of material for eolian transport.

Other Features:

The Fryeberg Locality is geographically isolated and therefore, offers a unique educational opportunity to local residents and students at the Fryeberg Academy. The large transverse dunes are readily apparent in the open grassy areas of the power line cut.

Vegetative Cover:

There is a very attractive stand of mature white pines in the northwest section of the site. Other wooded portions of the site are covered with stands of mixed age white pines, hemlock, spruce, and mixed hardwoods.

BETHEL LOCALITY

Ventifacts were reported in the Bethel area by Hitchcock in the nineteenth century (McKeon, 1972), and so this area has historical significance in the literature of eolian processes in Maine. However, due to changes in land use, efforts to locate the ventifacts were not successful during the field visit.

At the time of the field visit to the Bethel locality, surficial geologic maps at the 7.5' scale were not available. Several wide turns and the broad floodplain of the Androscoggin River combined with mountainous topography that funnels wind make the area a likely place for high quality eolian deposits and prompted a general walking and driving reconnaissance. Although many likely areas were observed during the field visit, only one site, named Bethel Uplands (Map 6), had enough distinctive features to merit a full description. Bethel Riverbend is included as a site description and on Figure 13 because an extensive walkover was conducted in this very likely area.

SITE NAME: Bethel Uplands

LOCATION: Bethel, Oxford County

TOPOGRAPHIC QUADRANGLE: Bethel 7.5', 1970

SIZE: Approximately 450 acres

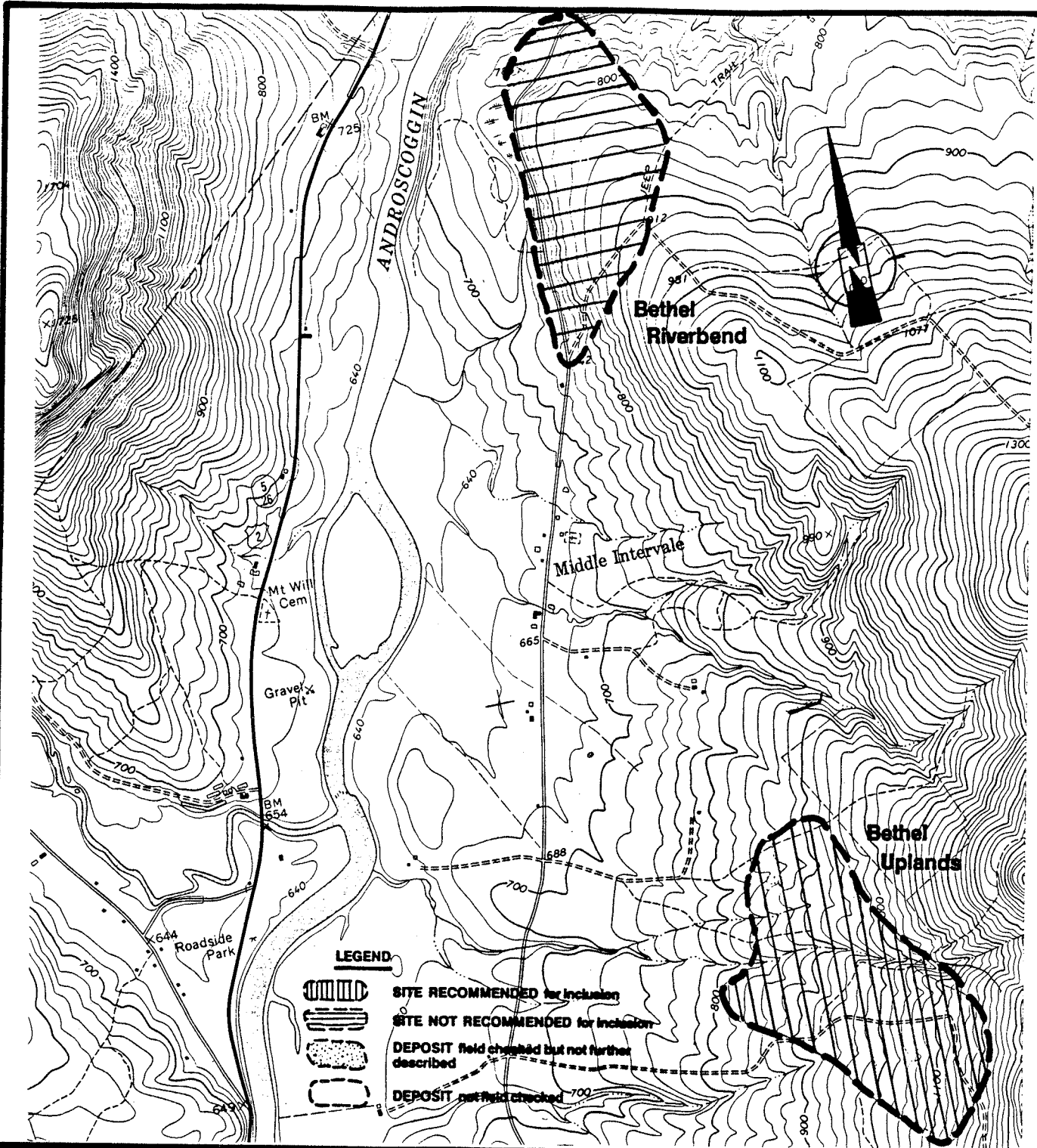
RATING: 42

SIGNIFICANT FEATURES:

- Highest known eolian sand deposit in Maine
- Fairly well-preserved dune morphology in woods

RECOMMENDATION:

The Bethel Uplands site earned 42 rating points primarily because of its relative and absolute elevation, naturalness, and geographic distribution. Therefore, this site is recommended for inclusion on the Register of Critical Areas.



BETHEL LOCALITY

MAP: 6

Scale:



Source: USGS 7.5' Quad. Bethel 1970



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DESCRIPTION:

Cultural:

The Bethel Uplands site is almost entirely forested, the expanse of woods broken only by a several long abandoned farmsteads and logging roads. Limited timber harvesting has been ongoing at the site recently.

Deposit Morphology:

The sand is found on moderately steep slopes well up out of the modern day river valley. The eolian deposit is sitting on top of glacial till and the sand forms a discontinuous blanket. In places, the sand is piled into dune forms that are up to 6.5 feet high, 33 feet wide and up to 164 feet long. The long dimensions are sometimes aligned in a roughly NE - SW direction, oblique to the hill slope.

Other Features:

The highest sand deposits seen during the field check are approximately 1150 feet above modern day sea level and approximately 500 feet above the Androscoggin River. The site with the next highest elevation is in Farmington Falls (Map 9A) which is less than 650 feet above sea level. The next largest amount of relief between a deposit and the modern day water body that is the probable source of sand is approximately 300 feet at several sites. The absolute elevation and relative relief of the Bethel Uplands site are significant features. Additional significance is attributed to this site because it is the most northwesterly of any known eolian deposit in Maine.

Vegetative Cover:

Mature pine forest with 20% other conifers and scattered stands of hardwood cover the site. Some areas have been selectively logged in the recent past but not clearcut.

SITE NAME: Bethel Riverbend

LOCATION: Bethel, Oxford County

TOPOGRAPHIC QUADRANGLE: Bethel 7.5'

RATING: 0

SIGNIFICANT FEATURES:

- None

RECOMMENDATION:

This site is not recommended for further research or consideration.

DESCRIPTION:

This site was investigated for two reasons. The first reason was that the SCS Oxford County soils map shows sand soil units in the area. The second reason was that the site is to the southeast (downwind) of a stretch of the Bear River valley and a wide bend in the Androscoggin River floodplain, and therefore, is open to unrestricted winds. The upwind river junction was judged a very likely source area worthy of investigation.

Small scattered sand bodies exist as infilling of low spots in the local topography separated by mounds and hills of glacial till. No identifiable dune forms were seen.

SKOWHEGAN LOCALITY

There are a total of 13 areas in this upper Kennebec River locality that are mapped as eolian sand deposits (Clinton and Hinckley 7.5' Surficial Geology quadrangles). These deposits are scattered in the towns of Clinton and Skowhegan and are all to the east of the Kennebec River. Ten potential sites were field checked, and three were not field checked due to access constraints (Maps 7A, 7B). Of the sites field checked at this locality, only the site named Skowhegan was deemed worthy of recommendation for inclusion on the Register of Critical Areas.

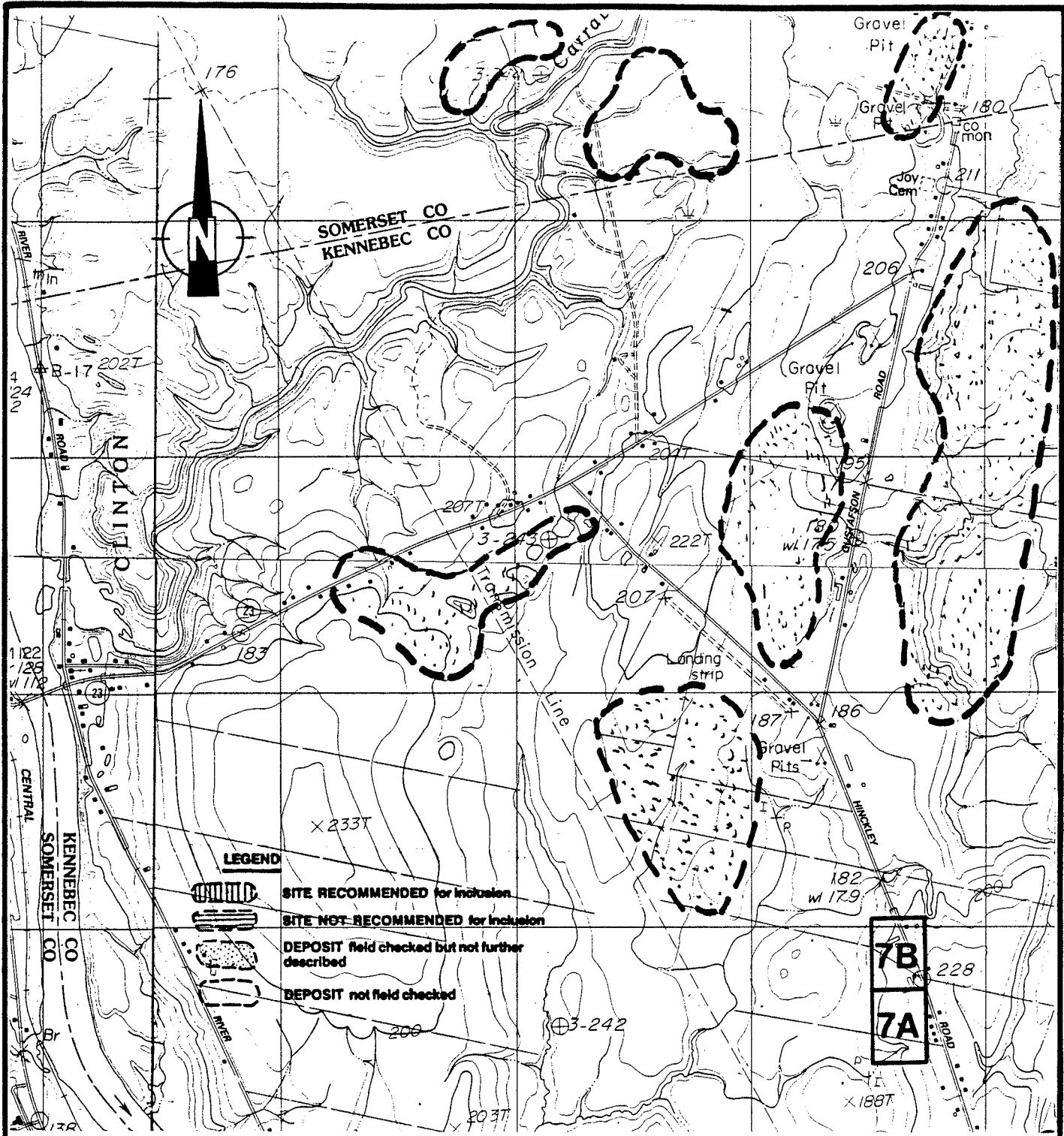
SITE NAME: Skowhegan

LOCATION: Skowhegan, Somerset County

TOPOGRAPHIC QUADRANGLES: Hinckley and Clinton 7.5', 1972

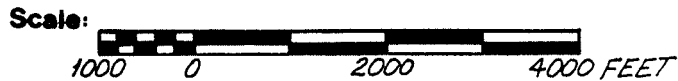
SIZE: Approximately 30 acres

RATING: 42

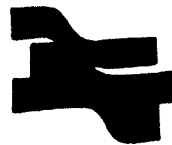


SKOWHEGAN LOCALITY

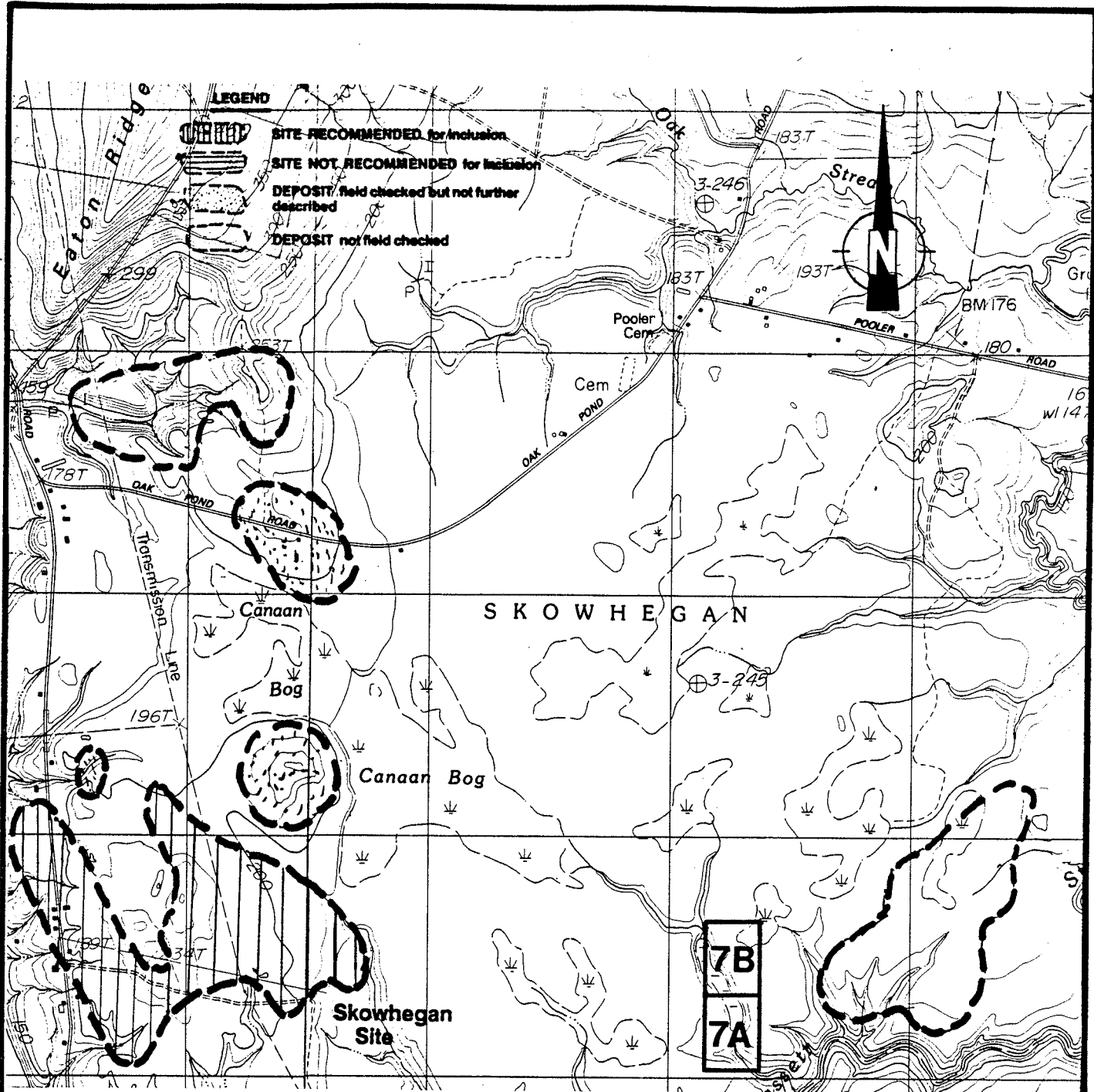
MAP: 7A



Source: USGS 7.5' Quad. Hinckley 1982
Clinton 1982

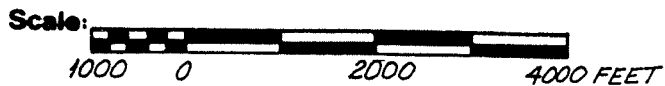


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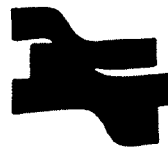


SKOWHEGAN LOCALITY

MAP: 7B



Source: USGS 7.5' Quad. Hinckley 1982
Clinton 1982



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SIGNIFICANT FEATURES:

- Well-preserved fossil dune morphology

RECOMMENDATION:

The Skowhegan site earned a ranking score of 42 points based on well-preserved fossil dune morphology, fairly large size dune features, naturalness, accessibility and educational potential. The site is recommended for inclusion on the Register.

DESCRIPTION:

Cultural:

The dunes at the Skowhegan site are in open pasture and mature woods. Land use is sparsely residential with assorted agricultural activity in the Kennebec Valley. The Skowhegan Rod and Gun Club has a shooting area within a wooded portion of the site.

Deposit Morphology:

The dunes at the Skowhegan site are up to 20 feet high and are largely longitudinal. Slopes on either side of the dune crests vary frequently in angle and orientation. Features that are clearly slipfaces are not seen and excavation would be required to determine depositional events. The dunes are at least 110 yards long in places.

The probable source of the sand, the Kennebec River, is less than a third of a mile west and less than 98 feet below the site.

Vegetative Cover:

The forested portions of the site are covered with a mix of approximately 50 percent white pine and 50 percent oak/maple.

STANDISH LOCALITY

The Sebago Lake 7.5 minute surficial geology map depicts one eolian sand deposit (Map 8) that is named the Standish site in this report.

SITE NAME: Standish

LOCATION: Standish, Cumberland County

TOPOGRAPHIC QUADRANGLE: Sebago Lake 7.5', 1983

SIZE: Approximately 2,400 acres

RATING: 40

SIGNIFICANT FEATURES:

- Well-developed, readily apparent dune morphology in mature woods.
- Undeveloped area adjacent to (within) Wildlife Management Area

RECOMMENDATION:

The Standish site is located near major population centers and is easily accessible by automobile. The dunes are relatively easy to see, and visualization of a dramatically different paleoenvironment is easy here. Therefore, this site has high educational potential. Because of proximity to the Wildlife Management area, the naturalness of the area will be preserved. This site is recommended for inclusion in the Register of Critical Areas despite its modest rating because it represents a unique educational opportunity.

DESCRIPTION:

Cultural:

The Standish site is largely undeveloped and is only penetrated by one road. There is evidence of recent selective logging in the area. Signs posted on trees designating the Steep Falls Wildlife Management Area are seen along the road where the eolian sand occurs, but the WMA boundary is shown approximately 3 miles west of the site on the 1983 topographic quadrangle.

Deposit Morphology:

Fine sand forms a thin discontinuous blanket of uneven thickness that in many places is formed into small dunes that are readily apparent within the woods. These dunes are widely spaced

LEGEND



SITE RECOMMENDED for inclusion



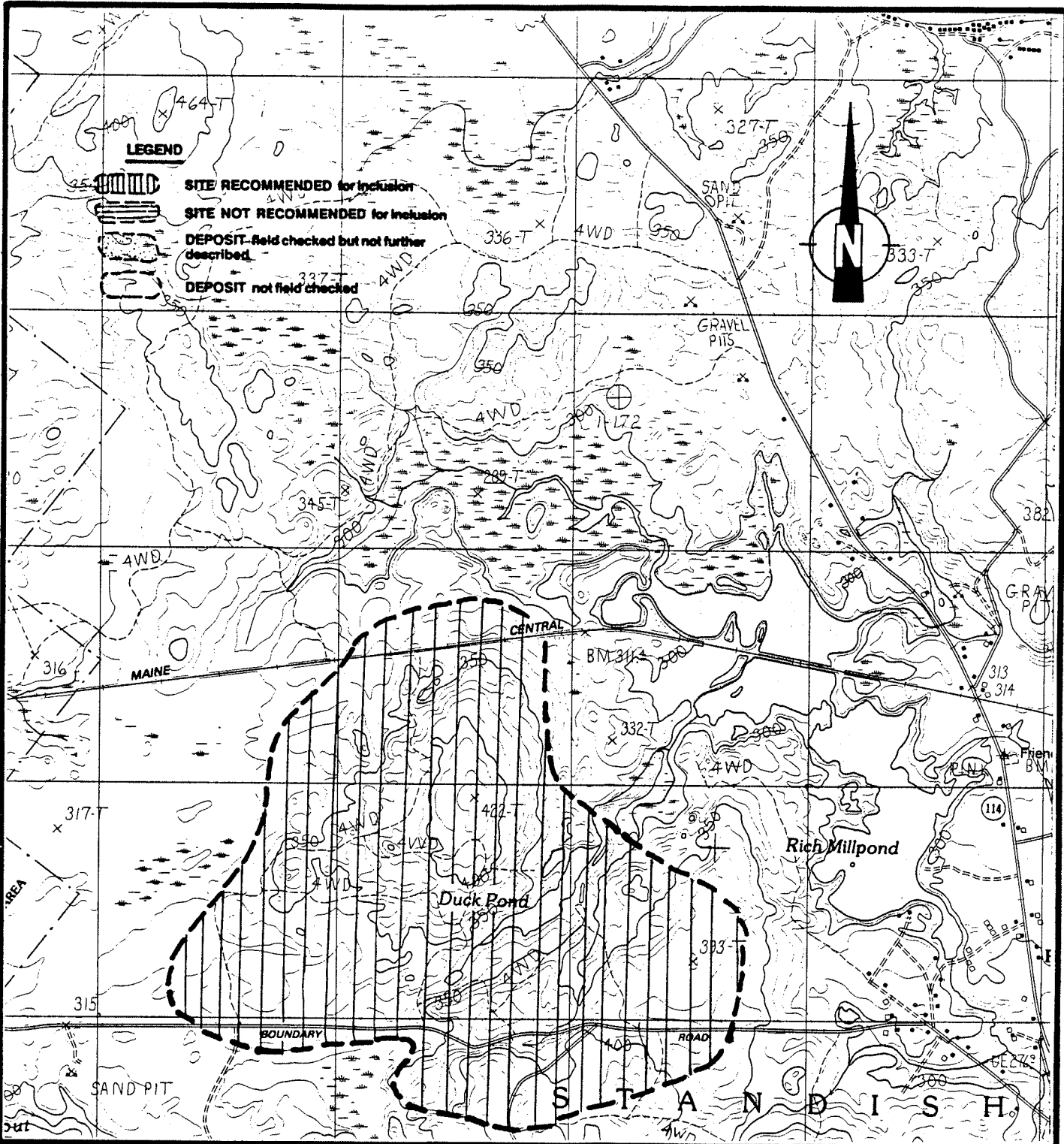
SITE NOT RECOMMENDED for inclusion



DEPOSIT field checked but not further described

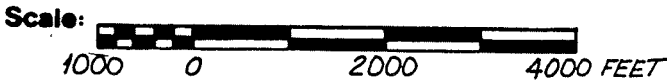


DEPOSIT not field checked

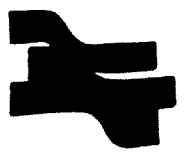


STANDISH LOCALITY

MAP: 8



Source: USGS 7.5' Quad. Sebago Lake
1983



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in places (up to 110 yards) and contiguous in other areas. The sand overlies glacial till that is characterized by boulders at the surface and a high water table, and between sand bodies, free water at the surface is sometimes present.

The dunes are generally oriented NE-SW, perpendicular to the presumed dominant wind direction at the time of deposition. The height ranges up to 6.5 feet, and dune crests are up to 164 feet long. There are arcuate segments of dune crests that combine with the predominant transverse dunes to form barchanoid dune ridges. There are also segments of longitudinal dunes seen in widely scattered locations.

Other Features:

Unlike other inland eolian deposits in Maine, the Standish site is associated with a lacustrine rather than a riverine source of sediment, in this case Sebago Lake.

Vegetative Cover:

Mature white pine-dominated forest covers the site, with spruce and gray birch common. Several deer were seen at the time of the field check.

FARMINGTON LOCALITY

Seven discrete eolian sand deposits are mapped on the 7.5 minute surficial geology map (Maps 9A, 9B). These deposits are scattered across the towns of New Sharon, Chesterville, and Farmington, and all are in association with the Sandy River. Six were field checked and three were determined to have a sufficient number of features to be worthy of description as sites.

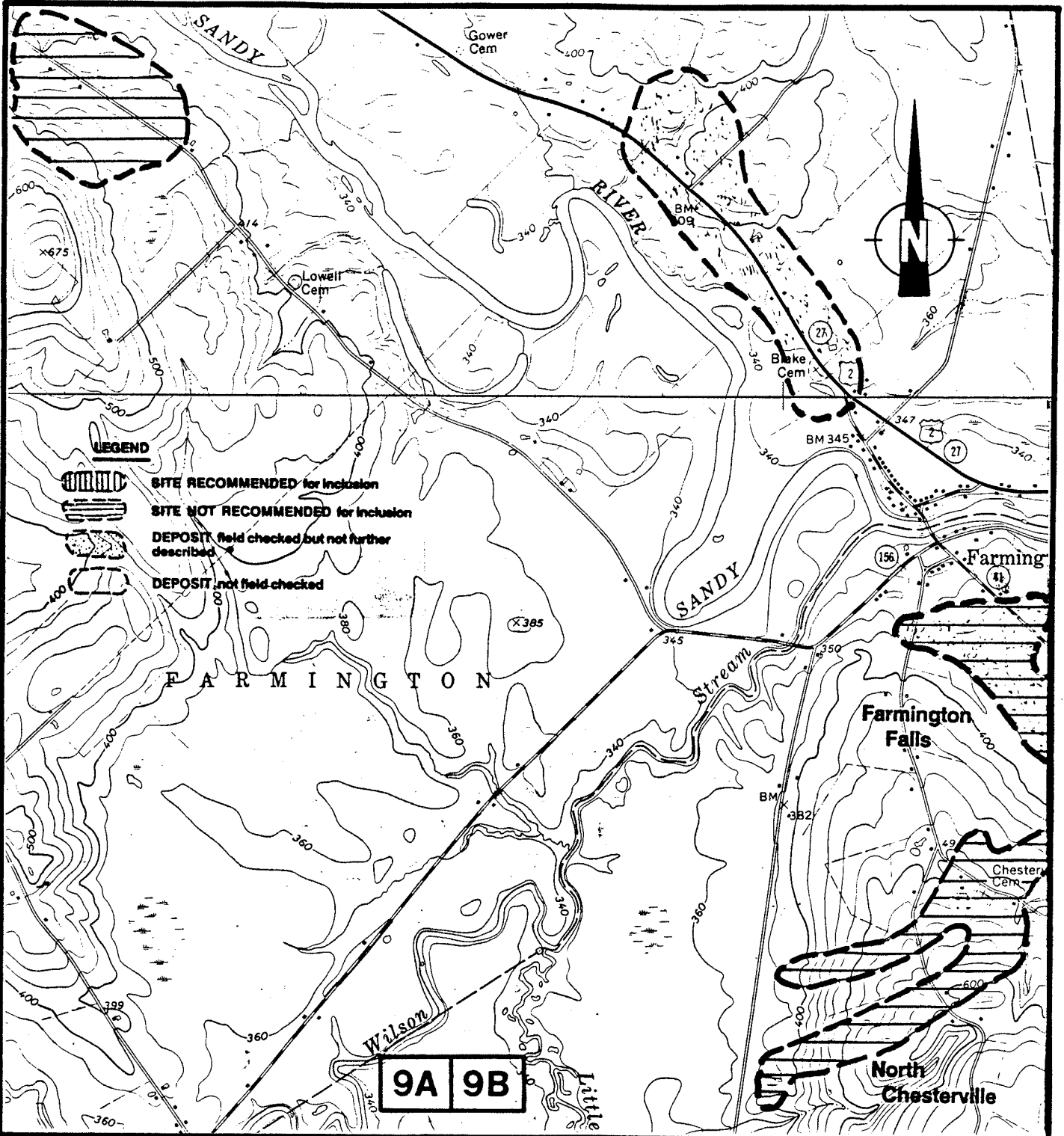
NAME: New Sharon Site

LOCATION: New Sharon, Franklin County

TOPOGRAPHIC QUADRANGLE: New Sharon, 7.5', 1968

SIZE: less than 5 acres

RATING: 37



FARMINGTON LOCALITY

MAP: 9A

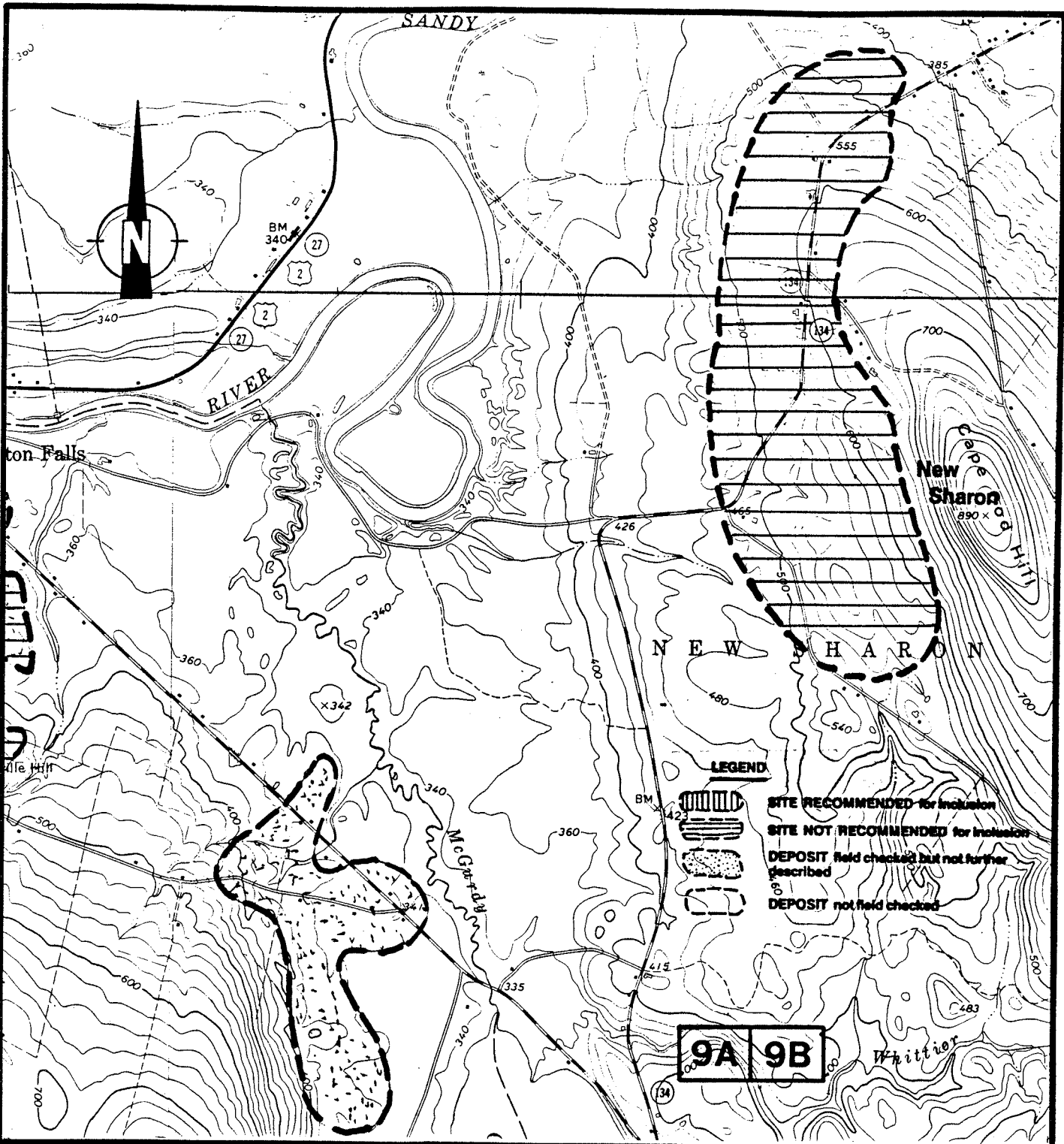
Scale:



Source: USGS 7.5' Quad. New Sharon
1968 - Farmington Falls 1968

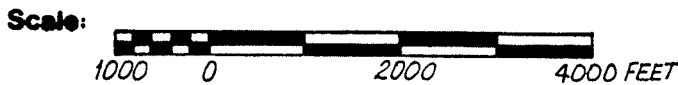


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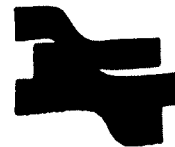


FARMINGTON LOCALITY

MAP: 9B



Source: USGS 7.5' Quad. New Sharon
1968 - Farmington Falls 1968



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SITE NAME: North Chesterville Site

LOCATION: North Chesterville, Franklin County

TOPOGRAPHIC QUADRANGLE: Farmington Falls 7.5', 1968

SIZE: Approximately 5 acres

RATING: 37

SIGNIFICANT FEATURES:

- Well-preserved fossil dune in woods and pasture.
- Cemetery on top of dune.

RECOMMENDATION:

Although the North Chesterville site is readily identified as an eolian deposit and has pleasing attributes, it did not rate a high enough score for inclusion on the Register of Critical Areas.

DESCRIPTION:

Cultural:

At the North Chesterville site is a clearly defined individual dune that is partially wooded and partially in pasture. Franklin cemetery is on the crest of the dune. The road at the western edge of the site cuts off the western toe of the upwind slipface.

Deposit Morphology:

A large slipface (39 feet) is clearly seen in a wooded area at the south end of this barchan dune. Just south of the dune is a small stream that is evidence of the dune being an isolated sand body sitting directly on glacial till.

The probable source area for the eolian sand, the Sandy River, is approximately two miles to the north. There is a broad floodplain there where Wilson Stream joins the Sandy River.

Vegetative Cover:

The windward slopes of the primary dune at this site are in pasture. Cemetery lawn occurs near the dune crest. The slipface is covered with mature mixed woods that include oak, hemlock, beech and pine trees.

NAME: Farmington Falls Site

LOCATION: Farmington Falls

TOPOGRAPHIC QUADRANGLE: Farmington Falls 7.5', 1968

SIZE: Approximately 30 acres

RATING: 38

SIGNIFICANT FEATURES:

- Fairly well-preserved fossil dune morphology.
- Good views toward source area

RECOMMENDATION:

Although the Farmington Falls site is readily identifiable as an eolian deposit and has pleasing attributes, it did not rate a high enough score for inclusion on the Register of Critical Areas.

DESCRIPTION:

Cultural:

The Farmington Falls site is an area of mixed use, with an approximately equal mix of open pasture and woodland. There are residences scattered along the two roads dissecting the site. The Chesterville Hill Cemetery is on top of a dune crest.

Deposit Morphology:

Two fairly distinct transverse dunes are seen in pastures running approximately parallel for about 110 yards. The dunes are about 33 feet high and 164 feet apart. They are good examples of transverse dune morphology.

Other Features:

There are good northwest views toward the probable source area, the Sandy River, which is about two thirds of a mile to the northwest and 44 yards below the site. There is a sense of a large open funnel for wind when looking northwest toward the mountains.

Vegetative Cover:

The wooded portions of the site are mostly young white pine.

CASCO LOCALITY

Two eolian sand deposits are mapped in the Casco area on the Naples 7.5' surficial geology map. Both sites were field checked (Map 10).

SITE NAME: Tenney's Hill Site

LOCATION: Tenney's Hill, Casco, Cumberland County

TOPOGRAPHIC QUADRANGLE: Naples 7.5', 1975

SIZE: Approximately 230 acres

RATING: 30

SIGNIFICANT FEATURES:

- Fairly well-preserved dune morphology which can be seen in open pasture from Tenney Hill Road across from cemetery.

RECOMMENDATION:

This site is not recommended for inclusion on the Register of Critical Areas due to lack of sufficient high quality features.

DESCRIPTION:

Cultural:

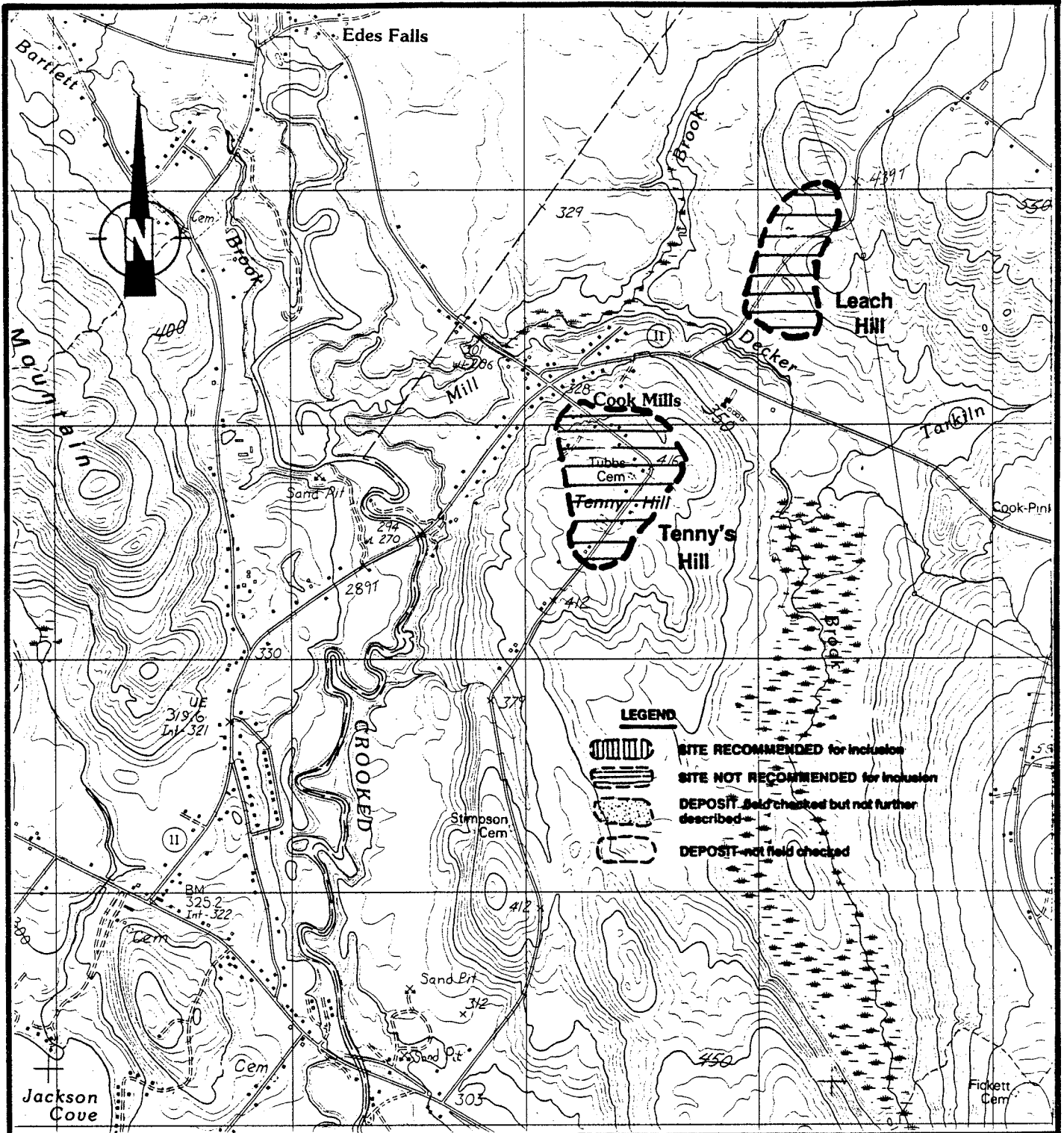
The area of the Tenny's Hill site is used for residential and agricultural purposes. Approximately 10 homes of various ages are scattered along the road, one active dairy farm, and a cemetery are found on this eolian sand deposit.

Deposit Morphology:

Subdued dune morphology is seen in open pasture and many patches of pale yellow sand are seen in roadcuts. Overall, the sand at Tenny's Hill is in the form of a thin discontinuous blanket. There are some views to the northwest where the probable source area (Crooked River and Bartlett Stream floodplain) can be seen. There is over 200 feet of relief between site of deposition and the source area.

Other Features:

There are no particular features of high value that are associated with the Tenny's Hill site.



CASCO LOCALITY

MAP: 10



Source: USGS 7.5' Quad. Naples 1975



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Vegetative Cover:

Most of the deposit is covered with a mature white pine-dominated forest. The rest of the vegetative cover is pasture and lawn grasses.

SITE NAME: Leach Hill Site

LOCATION: Leach Hill, Casco, Cumberland County, Maine

TOPOGRAPHIC QUADRANGLE: Naples 7.5'

SIZE: Approximately 190 acres

RATING: 24

SIGNIFICANT FEATURES:

- Open sand pit adjacent to road that displays sand overlying till with large boulders.

RECOMMENDATION:

The Leach Hill site is not recommended for inclusion on the Register of Critical areas due to a lack of high quality features.

DESCRIPTION:

Cultural:

The eastern lower portions of the deposit are disturbed by assorted commercial uses including a wood processing plant, town dump, and sand extraction activities. The upper portions of the site are largely wooded with new residential development presently occurring.

Deposit Morphology:

The sand deposit at Leach Hill is generally thin and discontinuous, although a thickness of up to 16 feet can be seen in the borrow pit at the southern end of the site.

Some bedding (compositional variation) is seen in the sand pit, and the till/sand contact is also seen. A bed dip of approximately 20 degrees SE was observed. The till contains boulders of up to 6 feet in diameter, and they partially protrude into the overlying sand.

Other Features:

The higher elevations of the deposit are over 250 feet above the probable source area (Crooked River floodplain).

Vegetative Cover:

The deposit is covered with a forest that is 80% white pine, with mixed hardwoods and softwoods making up the remaining 20%.

MEDFORD LOCALITY

Three eolian sand deposits are shown by Thompson and Borns (1985) in the Medford area. Surficial geology maps at the 7.5' scale (Dover-Foxcroft and Boyd Lake) show five eolian sand deposits in association with the Piscataquis River in the towns of Atkinson Corner, Medford, and Milo (Maps 11A, 11B). All five deposits were field checked, and only one, named the Atkinson Corner site, had enough significant attributes to merit detailed description.

SITE NAME: Atkinson Corner

LOCATION: Atkinson Corner, Piscataquis County

TOPOGRAPHIC QUADRANGLE: Dover-Foxcroft 15', 1932

SIZE: Approximately 5 acres

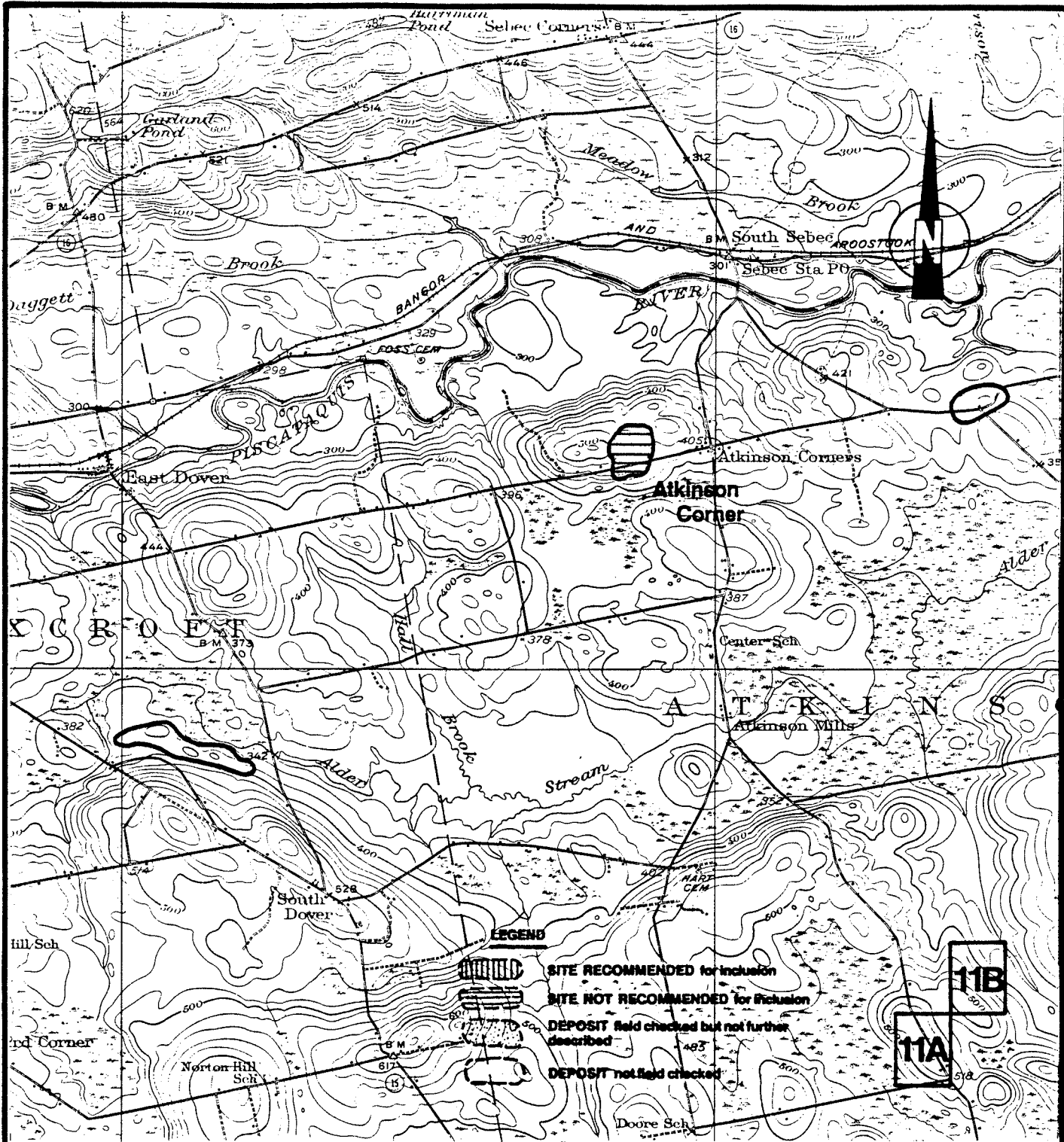
RATING: 26

SIGNIFICANT FEATURES:

- Some small well-preserved dune segments.
- Good exposures of internal stratification in two pits.
- Small fetch of open sand.

RECOMMENDATION:

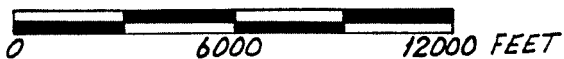
The Atkinson Corner site is not recommended for inclusion on the Register of Critical Areas because it does not have a strong combination of significant attributes.



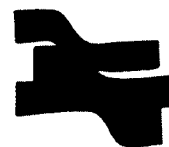
MEDFORD LOCALITY

MAP: 11A

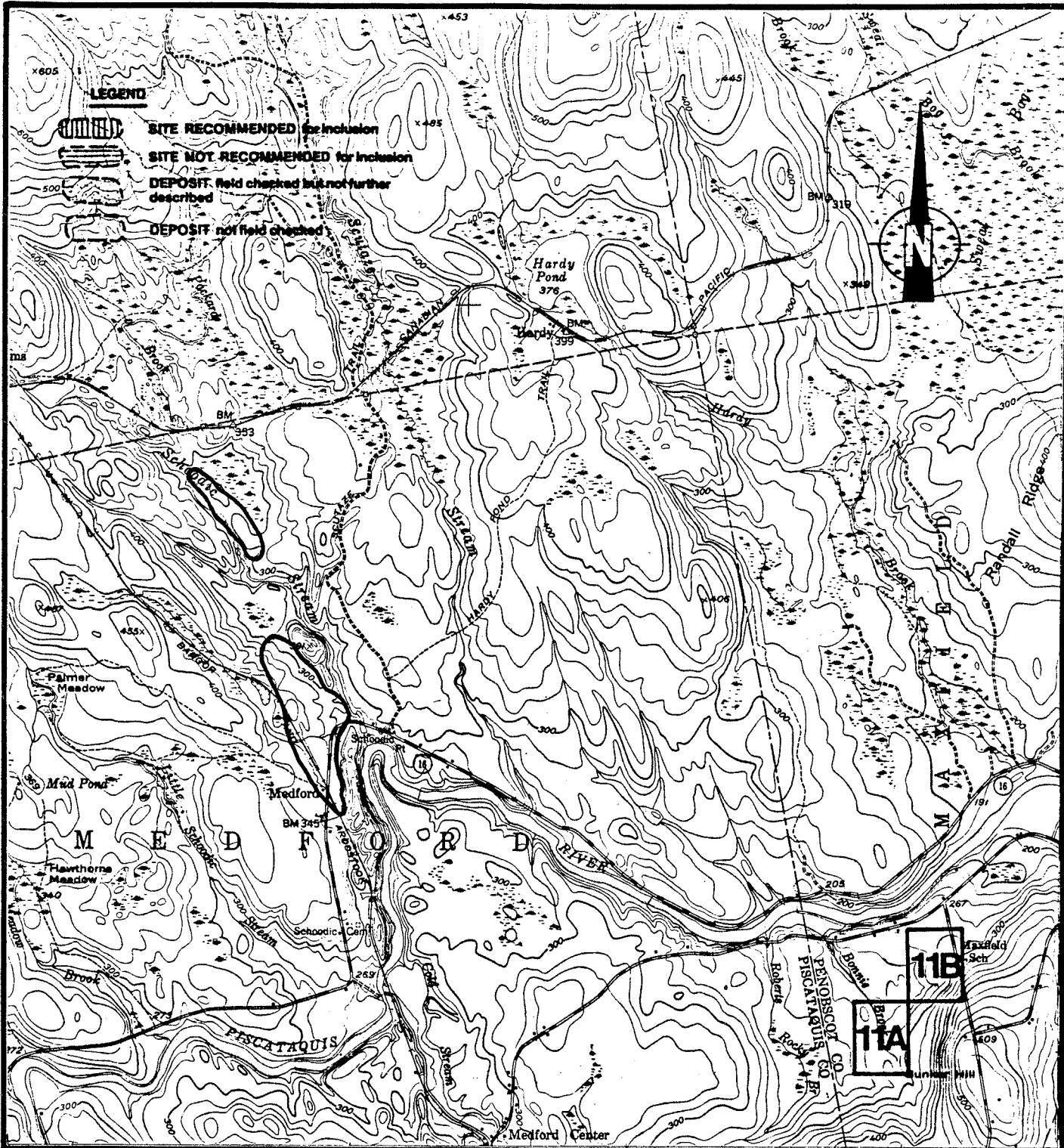
Scale:



Source: USGS 15' Quad. Dover-Foxcroft
1932



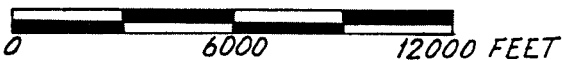
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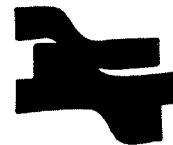
MEDFORD LOCALITY

MAP: 11B

Scale:



Source: USGS 15' Quad. Schoodic 1947



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DESCRIPTION:

Cultural

Land use in the vicinity of the Atkinson Corner site is a mix of residential and agricultural activity. Residences are widely scattered and agricultural activity is largely limited to hay production and pasture. There are two small to medium sized borrow pits at the site which were not active at the time of the site visit.

Deposit Morphology:

All of the mapped eolian sand deposits at the Medford locality were relatively thin blanket-type deposits with the exception of the Atkinson Corner site. At this site most of the sand was in a thin blanket form except for the central area where the two sand pits are located. Here the sand thickness attained a maximum of eight to ten feet. Several small areas of open sand were above the faces of the pits and in this area were several small (less than five feet high) segments of barchanoid and transverse dunes.

The Piscataquis River is approximately one half mile to the north of the Atkinson Corner site. This is the probable source of sediment required for formation of the eolian deposit. The site is also within several miles of the limit of marine invasion associated with crustal depression under the weight of the Late Wisconsinan ice sheet. The ancient shoreline of the transgressed sea is also a potential source of sand that is required for formation of the Medford locality deposits.

Other Features:

Interviews with long time residents in the area revealed two interesting facts. One is that the curve in the east-west road that traverses the site was the result of a realignment of the road approximately fifty years ago in response to drifting sand from what was then a much larger fetch of open sand. The second interesting fact was that the trees which were growing at the time when the much larger fetch of open sand was in existence are now very difficult to saw through because the quartz sand embedded in the bark is highly resistant to a saw.

Vegetative Cover:

Vegetation covering the Atkinson Corner site is a mix of young to mature white pine mixed with other coniferous and deciduous trees. There are also extensive areas of assorted grasses and clover.

LINCOLN LOCALITY

There are 18 discrete eolian sand deposits mapped at the 15 minute scale on the Lincoln and Winn surficial geology maps (Maps 12A, 12B). Of the 18 deposits, 11 were field checked. Access and time restraints prevented checking the other 7 deposits. Of the 11 sites that were field checked, only one was of sufficient size and form to be worthy of detailed description.

SITE NAME: Lincoln

LOCATION: Lincoln, Penobscot Valley, Penobscot County

TOPOGRAPHIC QUADRANGLE: Lincoln 15', 1957

SIZE: approximately 200 acres

RATING: 21

SIGNIFICANT FEATURES:

- Most easterly known inland eolian sand deposit.
- Well-preserved fossil dunes in woods.

RECOMMENDATION:

The Lincoln site is not recommended for inclusion on the Register of Critical Areas because it does not contain sufficient distinctive features to rate a score of 40 or more points.

DESCRIPTION:

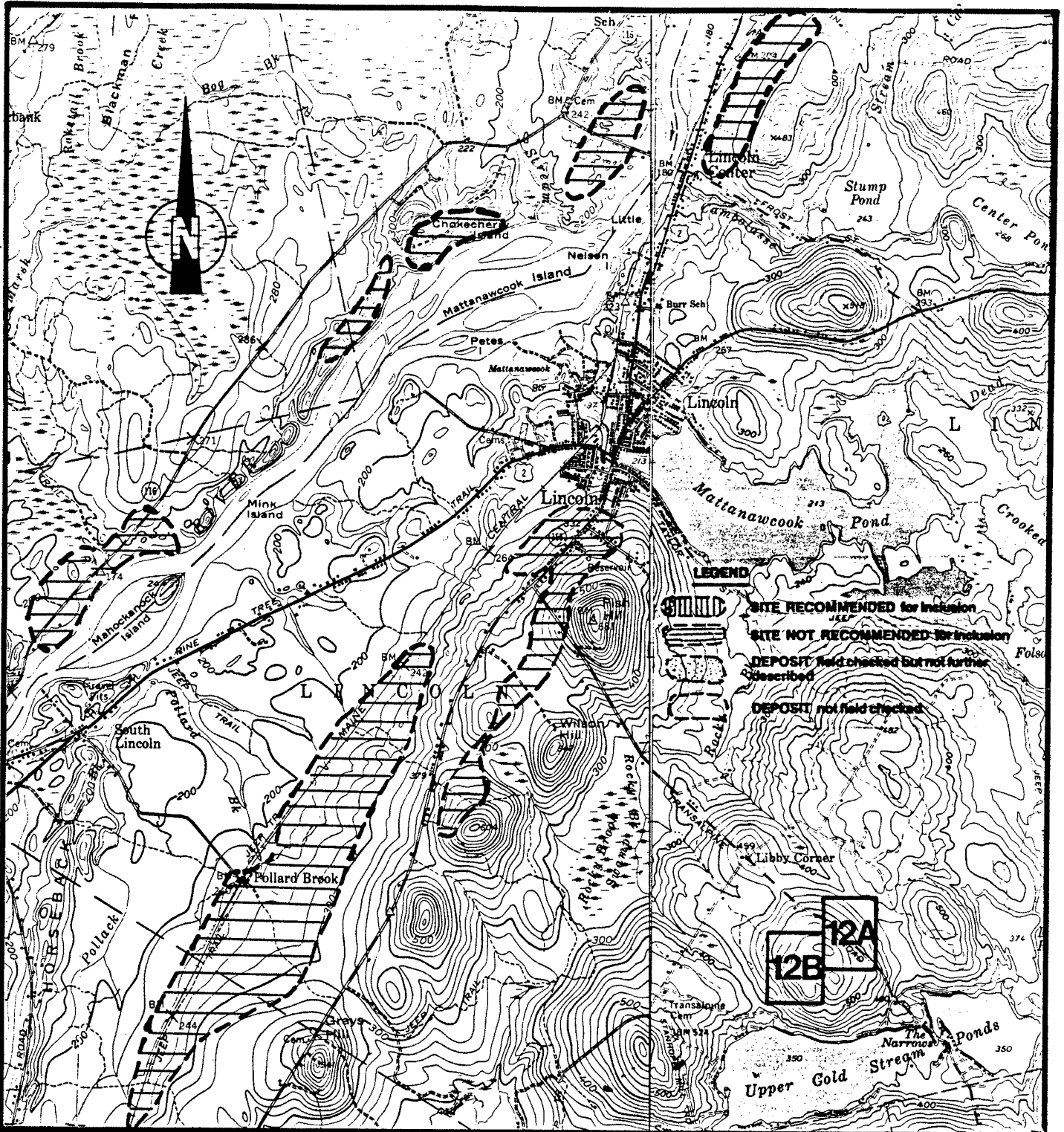
Cultural:

Land use at the Lincoln site is scattered residences and woods. The site is immediately south of the town center.

Deposit Morphology:

The sand deposit at the Lincoln site is thin and discontinuous. The thickest portion of the deposit is on Fish Hill where steep slopes up to a 33 foot height in apparently random orientations are seen. It appears as if many of these slopes could be related to old blowouts, and excavations would be required for further information.

The majority of the rest of the site is in the form of a thin discontinuous blanket with scattered small barchanoid dune forms. The highest of these is less than 6.5 feet tall and not judged significant enough for separate description.



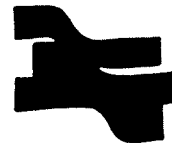
LINCOLN LOCALITY

MAP: 12A

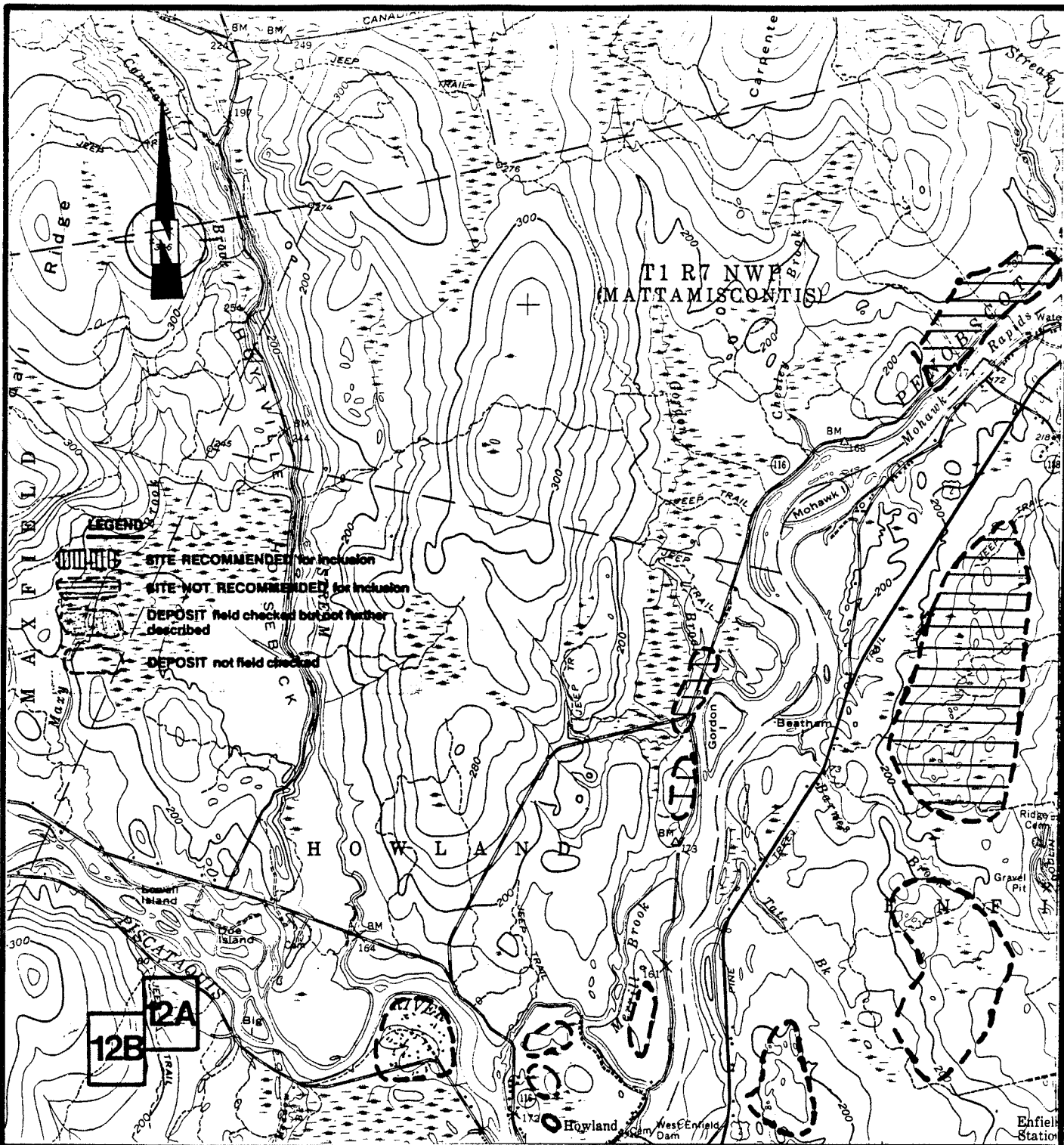
Scale:



Source: USGS 15' Quad. Lincoln 1957
Winn 1960



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LINCOLN LOCALITY

MAP:12B

Vegetative Cover:

The forest covering this area is medium aged mixed hardwoods and softwoods.

SALMON LAKE LOCALITY

An eolian deposit is shown on the Reconnaissance Surficial Geology Map of the Ragged Lake Quadrangle (Map 13). The deposit was field checked in October, 1989.

SITE NAME: Salmon Lake Site

LOCATION: Southeast Corner of T4 R14, Piscataquis County

TOPOGRAPHIC QUADRANGLE: Ragged Lake 15', 1954

SIZE: Approximately 250 acres

RATING: 20

SIGNIFICANT FEATURES:

- Most northerly deposit in Maine.

RECOMMENDATION:

The Salmon Lake Site is not recommended for inclusion on the Register of Critical Areas because it lacks an adequate number of significant features.

DESCRIPTION:

Cultural:

The site is located in a largely uninhabited area where land use is devoted primarily to timber production. There is some recreational use of the area. The site is easily accessible via timber company roads.

Deposit Morphology:

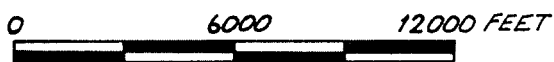
The Salmon Pond Site is a broad blanket deposit of eolian sand. Nearly 50 percent of the surface of the deposit was visible due to recent clearcutting of timber and roadcuts and no distinctive dune forms were visible. However, physical and visual access to much of the deposit was very difficult due to dense coniferous growth.



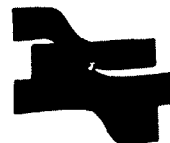
SALMON POND LOCALITY

MAP: 13

Scale:



Source: USGS 15' Quad. Ragged Lake 1954



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A test pit was excavated in a roadcut on the Salmon Pond Road and a thickness of eight feet of very well-sorted fine sand was found to be underlain by well-rounded boulders. The lower two feet of sand was gray to dark gray with a strong odor of organic decay.

Other Features:

The most significant feature of the Salmon Pond Site is that it located more than 50 miles beyond (inland) the maximum limit of the Pleistocene marine transgression, while all other deposits are within the limit. This may imply a different genesis for this site as compared to other eolian sand deposits in Maine.

Vegetative Cover:

The Salmon Pond Site is or was covered with a dense coniferous forest dominated by spruce and fir. Forest age ranged from young to mature on the site.

RECOMMENDATIONS

Inland eolian sand deposits are uncommon in the geologic record, and are relatively rare natural geological phenomenon in Maine and New England. Valuable information about environmental history and ecological balance is buried in and around these dunes. Because nearly everyone is familiar with modern sand dunes, viewing forested inland eolian deposits is particularly enlightening for the non-geologist attempting to understand geologic history.

Perhaps the most significant of all inland eolian deposits are the 'Deserts' or open fetches of sand. This is because they have unique educational and scientific value. The opportunity to observe effects of soil destruction and revegetation in a humid temperate climate is important, and it should be utilized. But, perhaps an even more valuable aspect of these deposits is that they are stark reminders of what can result from poor husbandry of the Earth.

1. Ten sites, Long View, Rainbow Farm, Broad Sands, Beechnut Hill, Freeport Desert, Leeds, Madison, Fryeberg, Bethel, and Skowhegan at seven localities (Table 4) are deemed to be of state significance and are recommended for inclusion on the Register of Critical Areas. These sites are the best known examples of inland eolian sand deposits in Maine and are worthy of attention.
2. Long View, Beechnut Hill, Rainbow Farm, Broad Sands, Freeport, Leeds, and Madison are the 'Deserts' that are listed in this inventory. Sites at all of these localities are recommended for inclusion on the Register of Critical Areas because of their rarity and research and educational potential.
3. Ventifacts are reported only at Long View, Beechnut Hill and Leeds and are very rare in Maine, deeming them significant, and therefore, these sites are highly recommended for inclusion on the Register of Critical Areas.
4. The ten sites chosen as significant inland eolian deposits should be field checked in the summer by a botanist to determine if any rare plants or unique plant assemblages can be identified in association with the sites.
5. An educational brochure describing inland eolian sand processes and deposits should be prepared by the Critical Areas Program.
6. Long term protection for the most significant inland eolian deposits including Long View, Broad Sands, Beechnut Hill, Freeport Desert, Leeds, Madison, and Fryeberg through conservation easements or ownership should be explored.

TABLE 4

SITES RECOMMENDED FOR INCLUSION ON THE REGISTER OF CRITICAL AREAS

| Site Name (Locality) | Rating | Significant Features |
|--------------------------|--------|--|
| Long View (Wayne) | 81 | Open sand, ventifacts, fossil dunes, lag deposit, internal stratification. |
| Broad Sands (Wayne) | 73 | Open sand, fossil dunes, ventifacts. |
| Beechnut Hill (Wayne) | 66 | Open sand, fossil dunes, ventifacts. |
| Freeport Desert | 58 | Open sand, large fossil dunes, historical data base. |
| Rainbow Farm (Wayne) | 53 | Exposed internal stratification, fossil dunes, excellent views. |
| Sand Hill (Leeds) | 52 | Open sand, ventifacts, good views. |
| Madison | 48 | Open sand, well-preserved dune morphology. |
| Highlands (Fryeberg) | 45 | Large well-preserved dunes, westernmost eolian sand deposit in Maine. |
| (Uplands) (Bethel) | 42 | Well-preserved dune morphology, highest elevation of any eolian sand deposit in Maine. |
| Skowhegan | 42 | Well-preserved dune morp[hology]. |

GLOSSARY

- Barchan dune - A dune having crescentic ground plan, with the convex side facing the wind; the profile is asymmetric, with the gentler slope on the convex side and the steeper slopes on the concave or leeward side.
- Barchanoid ridge - A dune form combining the linear, perpendicular to wind alignment of a transverse dune with the curved slipface of a barchan dune. ²²
- Bedding - Collective term signifying existence of beds or laminae. Can be created by variations in grain size or grain composition.
- Dune - A mound, ridge, or hill of wind-blown sand, either bare or covered with vegetation.
- Eolian - Applied to deposits arranged by the wind.
- Impact creep - Movement of material along the surface by being struck by the impact of grains. ¹
- Katabatic - Winds that are the result of downward convection of cooled air.
- Lag deposit - Residual accumulations of coarser particles from which the finer material has been blown away. Similar to deflation surface and desert pavement.
- Loess - A homogeneous, non-stratified, unindurated deposit consisting predominantly of silt, with subordinate amounts of very fine sand and/or clay.
- Longitudinal dune - Any linear dune ridge, usually more or less symmetrical in cross-profile, which extends parallel to the direction of the dominant wind. ¹
- Outwash - Drift deposited by meltwater streams beyond active glacier ice.
- Periglacial - Refers to area adjacent to margin of glacier.
- Saltation - Bouncing or leaping movement of rock particles, usually sand-size, carried by wind or water currents. ¹

- Sand - Detrital material of size range 2-1/16 mm. diameter.
- Silt - A clastic sediment, most of the particles of which are between 1/16 and 1/256 mm. in diameter.
- Slipface - Steep face on the lee side of a dune which stands at the angle of repose of sand. ¹
- Stratification - A structure produced by deposition of sediments in beds.
- Transverse dune - Assymetrical dune ridge transverse to the dominant direction of sand transporting winds, in which the leeward slope is the angle of repose of sand and the windward slope is comparatively gentle.
- Traction - Mode of transport in which material rolls, slides, or is pushed along the surface. ¹
- Ventifact - A general term for any stone or pebble shaped, worn, faceted, cut, or polished by the abrasive or sandblast action of windblown sand.

NOTE * All definitions are from the American Geological Institute Dictionary of Geological Terms, Revised 1976 unless footnoted.

- 1 - Definition from Greely and Iverson, 1985.
- 2 - Term used by Albrandt and Fryberger, 1982; words in the definition are the author's.

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