RESOURCES OF THE TUG HILL REGION

prepared for the
temporary state commission
on tug hill

by the

state university of new york
college of environmental
science and forestry
syracuse, new york
february 1974

PREFACE

As we approach the beginning of our third century as a nation, it is increasingly clear that we must quickly learn to temper the use and development of our natural resources with a system of environmental protection. While a new awareness of natural resources and environmental problems has swept across the land in a tidal wave of enthusiasm, Stuart Udall has admonished us to recognize two important factors demanding attention, i.e., "The quality of human life we seek to establish, and the specific meld of environmental ingredients that make up that quality." Udall further stated that, "Both of these goals require methodology if we are to achieve them."

Hopefully, this report to the Temporary State Commission on Tug Hill addresses both goals, by providing a synthesis of information on the people and resources of the Region.

Thus we believe that it will form the basis for formulating policy decisions on the future of the Tug Hill Region. And we sincerely hope that the methodology employed in this study will provide valuable guidelines for additional studies of Tug Hill and other regions. If we have accomplished this, even partially, in the time available for the work, we will have made a significant beginning in the six short months available for the study.

We believe that the intensive effort culminating with this report was possible due largely to the unique nature and capabilities of the State University of New York College of Environmental Science and Forestry. These attributes allowed us to quickly mount a multi-disciplinary study of the Tug Hill Region, and to meld the results of several investigators into one integrated, comprehensive report. Thus scientists and students from the College's Schools of Environmental and Resource Management; Biology, Chemistry and Ecology; and Landscape Architecture; and, from the Applied Forestry Research Institute and the Adirondack Ecological Center worked closely together on this project. All of these efforts were initiated and coordinated through the College's new Institute of Environmental Program affairs, and were aided greatly by the excellent cooperation obtained from the commissioners and staff of the Tug Hill Commission.

It is our sincere hope and firm belief that the Temporary State Commission on Tug Hill, the New York State Legislature, and the people of both the Region and the State will find this report valuable in helping to guide the future of the Tug Hill Region. Accordingly, we deem it a privilege for the State University of New York College of Environmental Science and Forestry to have had the opportunity to pursue its educational and public service missions by assisting the Commission in its timely and important task.

Donald F. Behrend, Executive Director
Institute of Environmental Program Affairs

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APPENDIX

Many persons contributed to these studies of the resources of the Tug Hill Region, both directly and indirectly. Agencies of state and local government freely opened their files to us. Faculties of educational institutions gave advice and shared results of their past work. Throughout the SUNY College of Environmental Science and Forestry, people contributed time and resources to bring the studies to successful completion. Under auspices of the Institute for Environmental Program Affairs, students and faculty alike joined into the work, providing a unique combination of skills and techniques needed to assemble information and lend interpretation to it. Especially, credit must be given to those who took responsibility for arranging and supervising individual component studies reported herein. From this multi-disciplinary effort we report to the Temporary Commission on Tug Hill.

FORETHOUGHT

by

ralph d. nyland
jean e. fisher
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THE COMMISSION AND ITS RESPONSIBILITIES

In its 1972 session, the Legislature of the State of New York created a temporary commission to study New York's Tug Hill Region. It assigned several responsibilities, including study of:

1. conservation and development of natural resources;
2. cultural resources, social organizations, economy and general well-being of the Region's rural communities;
3. measures for drawing strength from neighboring areas while controlling local development; and
4. needs for strengthening policy in management, acquisition, and use of public land, controls for highways, public buildings and highways, and control by local government over private land development.

Recommendations must be submitted to the Legislature for consideration during its 1974 session.

Boundaries of the Tug Hill Region were established by the enabling legislation and have been shown on Map 1 of the accompanying Atlas. The Region generally is bounded by the Black River on the east, and the Ontario Lake plain on the west. It extends from Oneida Lake and the Mohawk Valley at the south, and ranges north to the Black River as it flows toward Lake Ontario. The core of the Region is occupied by the Tug Hill Plateau, characterized by a largely undeveloped expanse of forest traversed by few roads and occupied by few permanent residents. Around this core extend important farming lands to the north and east, an urbanizing zone at the south used increasingly for residential purposes, and the zone of land largely abandoned from active agricultural use to the west, also where residential development appears on the increase. These sub-regions and their individual features blend together to make a broader region characterized by wide diversity of land forms, natural resources, existing developments, and uses.

STUDYING THE RESOURCES

To fulfill part of its mandate, the Commission contracted with the SUNY College of Environmental Science and Forestry through the Institute for Environmental Program Affairs to study resources of the Region and lend interpretation to quantitative information about them. The study would inventory resources of the Tug Hill Region and describe key features of interest to the Commission for its future deliberations. As an underlying rationale, the Commission and the College agreed that a thorough inventory of indigenous resources should precede any serious analysis of social, cultural, and economic potentials. Consequently, the analysis concentrated upon natural vegetation, geology and soils, water resources, climate and meterology, and fish and wildlife. With these as a foundation, the College was to outline promising avenues for study of economic, social, political, and institutional arrangements in the Region.

To study the Region, the College divided its work into five component studies and under arrangements of the Institute for Environmental Program Affairs organized a task force of faculty and students to evaluate each component and define characteristic interrelationships. The task force included:

Dr. James Geis, assisted by Lewis Cutler and John Mundy, to study vegetation;

Dr. Albert Leaf and Dr. Robert Wittwer to explore soils and geology;

Dr. Lee Herrington, assisted by John Sterling and Nancy Herrington, to develop the climatological picture;
Dr. Arthur Eschner, assisted by John Osinski, Deborah Howe, and Scott Shupe, to study water resources and outline the hydrology;
Dr. Rainer Brocke, aided by John Zarnetske, to evaluate fish and wildlife resources;
Dr. George Armstrong and Dr. Alan Lewis, assisted by John Bovet, Louis Mills, and Margaret Parsons, to prepare analyses of existing land uses, population, and the economy, and to develop proposals for comprehensive study of these factors;
Mr. David Harper, assisted by James Gilford and students of the School of Landscape Architecture, to prepare maps and graphics needed to depict findings of the study; and
Dr. Ralph D. Nyland and Prof. Jean E. Fisher, to act as task force coordinators and editors for the report.

Based upon specific questions posed by the Commission, the task force searched out available data, compiled it, integrated fragments of information into a coordinated picture of the whole Region, evaluated the information, and described characteristics and features revealed in the data. For the most part, we utilized existing statistics available from agencies of local, state, and federal government, and from educational and research institutions. We acted to collect, integrate, evaluate, and analyze the facts, pulling together many pieces of information available from numerous sources. Wherever possible, we made field checks to verify results from this integration, or to determine appropriateness of the data.

Results presented in the report, then, provide a broad picture of resources of the Tug Hill Region. These were developed to facilitate regional planning and decision making, rather than to guide development and use of specific small acreages. The results reveal regional characteristics, trends, and patterns, and should be applied to expanses of area rather than individual parcels of land. However, lists of source documents have been included. Reference to these will often provide more elaborate information about specific areas and should facilitate making decisions about more localized matters that might be lost in the broader regional treatment.

The report includes discussions of specific resource components, giving detailed information about each. These are prefaced by a summary review that provides a broad overview of the Region and identifies key features and characteristics that may prove important as a perspective during deliberations by the Commission. Finally, the discussions have been capstoned by a problem analysis that draws together features of the resource study with concerns for social, economic, and land use attributes, and outlines a plan for research into means for enhancing the culture and economy of the Region.

To aid the Commission, we attach to the report an Atlas of maps depicting the resources and their distribution throughout the Region. These summarize findings of the component resource studies. Written materials largely interpret the maps, present statistical information, and elaborate upon questions posed by the Commission. The Atlas and written report constitute a package that describes and evaluates resources of the Tug Hill Region. They represent a starting point for comprehensive decision making and planning.

CONSIDERATIONS FOR USING THE REPORT

Studies reported herein focus upon resources of the Tug Hill Region as they occur today. The College has limited its efforts to inventorying those resources as a basis for showing where they exist, in what amounts, and how the nature of one influences others. To facilitate future use of data presented, we preface the report by some philosophical observations.

First, while dealt with separately for convenience, all resources are interrelated. One cannot be evaluated without thought to the way it is influenced by and dependent upon others. Each resource component must be viewed as an extension of others. Furthermore, the way man relates to, uses, or bypasses one component of the Region is usually tempered by his reaction to others. Thus a holistic concept of total resources appears essential to proper understanding and use of the information presented herein.

Secondly, the degree that one component is present in scarcity or oversupply will often determine the level at which others occur. Development or presence of one component will depend upon an adequate supply of others essential to it. And development can be influenced by too much as well as to little. So the requisite balance between components must be recognized and kept in mind when interpreting comments about resources of the Region.

Thirdly, we do not wish to underplay the diversity and complexity of resources in the Region, despite the simplistic language and word pictures used to describe them. Variety characterizes the Region. Responses of the environment to different types of changes and influences are not always totally predictable. The enormity of the task required to offset natural limitations may prove prohibitive, despite desire. Reversion to past conditions to capture the good old days may prove impossible because of social influences as well as natural forces. Yet, when human desire grows intense, great undertakings become possible. Happily, the diversity also provides a wide range of alternatives for people to work with in striving to satisfy their interests.

Fourthly, the Tug Hill Region must be viewed as part of the State of New York, with its future being determined in part by what happens around it, by conditions and abundance of natural and human resources outside the Region, and by people who live and function outside it. People who make up the Region's population, and resources at their disposal, cannot be isolated from the rest of the world. They must respond to demands from outside the Region. But at the same time, they may look to their neighbors and draw upon resources from other regions in shaping their own future.

And lastly, man's response to the natural resources he has available cannot always be accurately predicted by rigid technical analysis. Even in this computer age, man cannot be catagorized precisely into fixed, well-defined stereotypes. He is an emotional animal and often tends to react in technically non-rational ways. So people of the Region, too, must be understood in striving for meaningful interpretation of potentials for use and development of the Region's resources. Ultimately, a real strength of the Tug Hill Region may be found to rest in its people.

Throughout our studies of the Region's resources, and reflections upon their importance, a wheel-like image developed. Five factors combined to form the regional wheel. These included the land and its form, the proportion of forest

Table 1. Soil drainage and slope class definitions.[a]

Drainage class	Description
Very poorly drained	Water is removed from the soil so slowly that the water table remains at or on the surface the greater part of the time
Poorly drained	Water table is commonly at or near the surface during a considerable part of the year
Somewhat poorly drained	Water is removed slowly enough to keep it wet for significant periods but not all of the time
Moderately well drained	The soil profile is wet for a small but significant part of the year
Well drained	Water is removed readily but not rapidly
Excessively drained	Water is removed from the soil very rapidly

Code	Percent slope[b]	Description
A	0-3	Level or nearly level
B	3-8	Gently sloping
C	8-15	Sloping or rolling
D	15-25	Moderately steep or hilly steep
E	25-35	Steep
F	35 and more	Very steep

[a] Source: Coop. Ext. Serv., 1972

[b] Vertical rise or fall in feet for a horizontal distance of 100 feet.

Table 2. Suitability characteristics of Tug Hill Region soils.

Soil mapping units	Soil drainage class[a]	Seasonal water table depth[b]	Topsoil suitability[c]	Sand suitability[c]	Gravel suitability[c]	Road fill suitability[c]	Septic tanks, low buildings, picnic and play areas, tent and trailer campsite suitability[c]
Adams-Deerfield	E-M	D-S	M	G	P	M	M
Adams-Windsor	E	D	M	G	M	P	M
Agawan-Nirigret	W-M	D-MD	P	G	M	M	G
Alton-Altmar	W-SP	D-S	P	P	P	G	M
Alton-Hinckley	W	D	P	P	M	G	M
Alton-Howard	W	D	P	M	M	G	M
Alton-Otisville	W	D	P	M	G	G	M
Amenia-Kendaia	M-SP	S	G	P	P	M	M
Amenia-Lowville	M	MD	M	P	P	M	M
Amenia-Vergennes	M	S	M	P	P	P	P
Arkport-Nellis	W	MD	P	P	P	P	M
Benson-Nellis-Amenia	W	MD	M	P	P	M	P
Broadalbin-Mosherville	M	MD	G	P	P	M	P
Camroden-Marcy	SP-P	S-VS	P	P	P	M	P
Camroden-Pinckney-Marcy	W-P	MD-VS	M	P	P	M	P
Canandaigua-Niagara	P-VP	VS-S	G	P	P	P	P
Chenango-Braceville	W-M	D-S	P	M	G	G	M
Chenango (hilly phase)	W	D	P	M	G	G	M
Collamer-Amenia-Nellis	M	D	M	P	P	M	M
Collamer-Canandaigua	M-P	MD-VS	G	P	P	P	M
Collamer-Nellis	M-W	MD	G	P	P	M	M
Colonie-Kars	E-SP	D-S	P	M	M	M	M
Colonie-Windsor	E-W	D	P	G	P	P	M
Colosse	E	D	P	G	G	G	M
Colton	E	D	P	G	G	G	M
Colton-Windsor-Scarboro	E-VP	D-VS	M	G	G	M	M
Croghan-Adams	M-E	MD-D	P	G	P	M	G
Darien-Danley	M-SP	MD-S	M	P	P	M	P
Darien-Illion	M-P	MD-VS	M	P	P	M	P
Empeyville-Westbury-Worth	W-SP	D-S	P	P	P	M	P
Empeyville-Worth	M-W	D	P	P	P	M	M
Galway-Vergennes	M	MD-S	G	P	P	P	P
Genesee-Eel	W-M	D-MD	G	P	P	M	P
Gloucester-Ridgebury	E-P	D-S	P	P	P	G	M
Hartland-Collamer	W-M	D-MD	G	P	P	M	M
Herkimer	W	MD	M	P	P	G	G

Table 2 . Continued.

Soil mapping units	Soil drainage class[c]	Seasonal water table depth[b]	Topsoil suitability[c]	Sand suitability[c]	Gravel suitability[c]	Road fill suitability[c]	Septic tanks, low buildings, picnic and play areas, tent and trailer campsite suitability[c]
Herkimer-Fredon	W-SP	MD-S	M	M	M	G	M
Hermon-Becket-Charlton-Scituate	W-M	D-S	P	P	P	G	M
Hinckley	W	D	P	M	G	G	M
Hinckley-Otisville	W	D	P	M	G	G	M
Howard	W	D	P	G	G	G	M
Hudson-Rhinebeck	M-SP	MD-S	M	P	P	P	P
Ira-Sodus	M-W	MD-D	M	P	P	M	M
Junius-Granby	SP-VP	S-VS	M	P	P	P	P
Kars	W	D	P	M	G	G	M
Lamson-Minoa	P-SP	VS-S	M	G	P	P	P
Lowville-Amenia	W-M	MD-S	M	P	P	G	M
Madrid-Nellis	W	MD	G	P	P	G	M
Manheim-Illion	SP-P	MD-VS	M	P	P	M	P
Marcy-Aden-Camroden	SP-VP	MD-VS	M	P	P	M	P
Minoa-Rumney	SP-P	S-VS	G	M	P	M	P
Mohawk-Manheim	M-SP	MD	G	P	P	G	M
Mohawk-Manheim-Illion	M-P	MD-VS	M	P	P	M	P
Naumburg-Scarboro	P-VP	S-VS	P	M	P	M	P
Nellis	W	MD	G	P	P	G	M
Nellis-Amenia	W-M	MD-S	M	P	P	M	M
Otisville-Hinckley	E-W	D	P	G	G	G	M
Palmyra	W	D	P	M	G	G	M
Pinckney-Camroden	W-SP	MD-S	M	P	P	M	P
Pinckney-Manlius-Camroden	W-SP	MD-S	M	P	P	M	M
Podunk-Ondawa	M-E	MD	G	P	P	M	P
Podunk-Ondawa-Saco	E-P	MD-VS	M	P	P	P	P
Podunk-Rumney	M-P	MD-VS	G	P	P	M	P
Rhinebeck-Madalin	SP-P	S-VS	G	P	P	P	P
Rumney	P	VS	M	P	P	M	P
Saco-Rumney	P	VS	M	P	P	P	P
Scantic-Collamer	SP-M	VS-MD	M	P	P	P	P
Scarboro-Duane	VP-M	VS-S	M	G	P	M	P
Scriba-Ira	SP-M	VS-MD	M	P	P	M	P
Sloan-Wayland	VP-P	VS	M	P	P	M	P
Sodus-Ira	W-M	D-MD	M	P	P	M	M

Table 2 . Continued.

Soil mapping units	Soil drainage class[a]	Seasonal water table depth[b]	Topsoil suitability[c]	Sand suitability[c]	Gravel suitability[c]	Road fill suitability[c]	Septic tanks, low buildings, picnic and play areas, tent and trailer campsite suitability[c]
Teel-Hamlin	M	S-MD	G	P	P	M	P
Teel-Hamlin-Wayland	M-P	MD-VS	M	P	P	M	P
Vergennes	M	S	M	P	P	P	P
Wallington	SP	S	G	P	P	P	P
Wallington-Niagara	SP	S	G	P	P	P	P
Wareham-Scarboro	SP-VP	S-VS	P	M	P	M	P
Wayland	P	VS	M	P	P	M	P
Westbury-Empeyville	SP-M	S-MD	P	P	P	P	P
Westbury-Tughill-Empeyville	M-VP	MD-VS	P	P	P	M	P
Williamson-Amboy	M-W	S-D	G	P	P	P	M
Windsor (hilly phase)	W	D	G	G	G	M	M
Windsor-Adams	W-E	D	M	G	M	M	M
Windsor-Croghan	W-M	D-MD	P	G	M	M	M
Windsor-Naumburg-Wareham	W-P	D-S	M	G	M	M	P
Woodbridge	M	S	M	P	P	M	M
Worth-Empeyville	W-M	D-MD	P	P	P	M	M
Worth-Empeyville (stony phase)	W-M	D-MD	P	P	P	M	M
Worth-Empeyville-Westbury	W-SP	D-S	P	P	P	M	M

[a] Soil drainage classes: E-Excessive; W-Well; M-Moderate; SP-Somewhat poorly; VP-Very poorly. Data shows ranges encountered within each mapping unit. First letter indicates dominant class.

[b] Seasonal water table depth: VS-Very shallow (0-½ feet); S-Shallow (½-2 feet); MD-Moderately deep (2-4 feet); D-Deep (4 feet or more). Data shows ranges encountered within each mapping unit. First letter indicates dominant class.

[c] Suitability ratings: G-Good; M-Moderate; P-Poor/Not suitable.

among the best for the rated use. Soils rated fair have properties that are moderately favorable or perform satisfactorily for the rated use. Soils rated poor have properties that make them unfavorable or unsatisfactory for the rated use.

The soil series descriptions (Appendix 2) also provides information about limitations for recreation, community development, and wildlife uses. Soils limitations ratings are given for most of these uses, as follows:

Slight--relatively free of limitations, or limitations are easily overcome. Potentially the best site for the intended use.

Moderate--limitations need to be recognized, but they can be overcome with good management and careful design. Intermediate potential for the intended use.

Severe--limitations are severe enough to make use questionable. The poorest potential for intended use. Extremely good management and extensive design are required.

Through use of Map 5 and other soils maps, coupled with interpretative information from Appendix 2, planners can select sites having fewest limitations for some intended use. Best results usually accompany development on soils rated highest for a use. However, a severe rating does not necessarily mean that a soil cannot be used for that purpose. Rather, where soils carry severe ratings, development and use must be accompanied by proper design and operation. Many poorly drained soils hold severe ratings in their natural state. Properly designed drainage structures may improve the potential for use. But it is usually more expensive to develop those soils having severe limitations.

Factors Influencing Suitability as a Resource Material

Topsoil

Suitability of a soil for use as topsoil involves evaluating a soil, preferably rich in organic matter, for use to top-dress roadbanks, lawns, gardens, and other landscaped sites. Texture of the material, thickness of the deposit, presence of coarse fragments, difficulty in extracting the material due to wetness or other factors, and organic matter content are major factors considered in rating the soils. Usually only the surface layer is rated as a topsoil. However, loamy materials at greater depths, when properly fertilized and managed, may also be good materials for topsoil. The ratings used are good, fair, poor, and not suitable, and apply to uneroded soils as they occur in place. Eroded soils are less desirable for topsoil.

Sand and gravel

Suitability of the soil as a source of sand or gravel is given for material to a depth of aboutfive feet. In some soils the sand or gravel extends further downward, whereas in other areas of the same soil unsuitable material may be located just below five feet. Some soils rated as not suitable may have sand or gravel at a depth below five feet. The ratings used are good, fair, poor, and not suitable. The ratings do not indicate quality of the deposits for specific uses such as concrete.

Road fill

Suitability of the soil for road fill is based on performance of the soil material when excavated and used as borrow for highway subgrades. Some of the

factors considered in making this rating are compressibility, workability, compaction characteristics, susceptibility to frost action, depth to water table, and presence of stones or boulders. The ratings used are good, fair, poor, and not suitable.

Factors Affecting Suitability for Engineering Uses

Pond reservoir area

Features and qualities of undisturbed soil that affect their suitability for water impoundments and reservoir areas are considered. Of primary concern are factors that affect the seepage rate. Items such as permeability, depth to bedrock, water table, slope gradient, or material that will allow seepage are evaluated.

Pond embankment

The suitability of disturbed soil material for constructing embankments to impound or contain water are also considered. Some soil features that affect construction and use of the soil material include stability, compaction characteristics, susceptibility to piping, shear strength, erodibility, presence of stones or boulders, and compacted permeability.

Drainage

Features and qualities of the soil which affect the instaff installation and performance of surface and subsurface drainage are considered. The more important factors are permeability, depth to contrasting layers (such as fragipan, bedrock, sand), flooding hazard, depth to water table, stability of ditch banks, slope gradient, and availability of outlets.

Highway or road location

Those soil features that affect construction and performance are evaluated. The entire soil is evaluated on the basis of an undisturbed soil. One should assume that the surface soil, because of its higher amount of organic matter, will be removed in construction. Factors affecting this use are presence and thickness of organic material, depth to bedrock, presence of stones and boulders, depth to water table, stability of slopes, frost heave potential, flooding hazard, slopes for cuts and fills, and ease of hauling and excavation.

Low building foundation

Those features and qualities of undisturbed soils that affect their suitability for supporting foundations of buildings up to three stories high are considered. The substrata of soil usually provide the base for foundations and are the materials that are evaluated. The suitability of the natural soil is dependent primarily on the shear strength, compressibility, depth to water table, depth to bedrock, steepness of slope and flood hazard (Table 3).

Pipeline construction and maintenance

The factors considered are features and qualities of undisturbed soil that affect their suitability for the construction and maintenance of pipelines.

Table 3 . Soil limitations for low buildings.[a]

Major soil properties influencing use	Degree of soil limitation		
	None to slight	Moderate	Severe
Depth to seasonal[b] high water table related to natural soil drainage classes			
With basements	Deeper than 4 feet below the surface (Dominantly well, somewhat excessively, and excessively drained classes)	1½-4 feet below the surface (Dominantly moderately well drained class)	Less than 1½ feet below the surface plus some ponding (Dominantly somewhat poorly, poorly, and very poorly drained classes)
Without basements	1½-4 feet or more below the surface (Same as with basements plus moderately well drained class)	½-1½ feet below the surface (Dominantly somewhat poorly drained class)	Less than ½ feet below the surface plus some ponding (Dominantly poorly and very poorly drained classes)
Slope[c] in subdivisions with or without basements	0-8 percent	8-15 percent	15 percent or more
Depth to bedrock[d] (Use this property for soil areas with essentially uniform depth to bedrock)			
With basements	More than 5 feet	3-5 feet	Less than 3 feet
Without basements	More than 3 feet	Less than 3 feet	This rating not used
Surface rockiness[b] (Use this property for soil areas with undulating or outcropping bedrock to reflect dominant depth condition)	Class 0 (No rocky soils)	Class 1 (Slightly rocky soils)	Classes 2, 3, 4, 5 (Very rocky and extremely rocky soils or rockland)
Surface stoniness[b] (Stones 10 inches or more in diameter)	Classes 0, 1 (None to slightly stony soils)	Class 2 (Very stony soils)	Classes 3, 4, 5 (Extremely stony soils or stony land)
Flood hazard[e] (Stream overflow)	No flooding	This rating not used	Subject to flooding

[a] Source: Coop. Ext. Serv., 1972.

[b] Classes of drainage, rockiness, and stoniness are used as defined in the Soil Survey Manual (Soil Survey Staff, 1951).

[c] Slope ranges indicated are considered dominant condition throughout most of New York. Adjustment to reflect different slope breaks are necessary in some soil survey areas. These adjustments generally range from 2-5 percent.

[d] Requires on-site investigation to determine actual depth to bedrock at a construction site.

[e] This flood hazard is an estimate of the dominant average condition during most years. Even on-site investigation cannot always determine the actual frequency of flooding.

Factors affecting this use are depth to bedrock, presence of stones or boulders, soil wetness, slope gradient, and stability of ditch walls. Corrosion potential is not considered in this rating.

Features Affecting Community Development, Recreation, and Farmland Uses

The second page of the interpretation sheets for each soil lists the degree and kind of limitations for various specified uses. Soil criteria used in indicating the degree and kinds of limitations are given in Tables 3-8 for septic tank filter fields, low buildings, sanitary landfill, play and picnic areas, campsites, and field crops. By coupling the soil map with the interpretations, it is possible to identify areas that have the least limitations for these intended uses.

Septic tank filter fields

This use refers to drainage filter fields for the disposal of effluent from adequately designed and installed home septic tank systems. The major soil property affecting the movement of effluent from a septic tank filter field is the permeability of the soil layers at the depth of the tile lines and below. If the soil has a water table over the tile, or the area is flooded by stream overflow at any time, the system will obviously not function even if the soil permeability is rapid. Other soil properties that affect disposal of effluent from filter fields are slope gradient, presence of stones, and depth to bedrock. Care must be taken to avoid contaminating nearby groundwater with this effluent in areas that are rapidly permeable (with sand and gravel), and areas where the depth to fractured bedrock is less than four feet below the tile (Table 4).

Low building locations with and without basements

This use is applicable to homes or buildings of three stories or less. The first line of the Appendix chart rates the soils for buildings with basements at least five feet below soil level, and the second line rates the soils for buildings without basements. Standard dampproofing procedures for basement walls and foundation drains are assumed to be installed in all soils. The main soil properties considered are soil wetness, flooding hazard, slope gradient, presence of stones, and depth to bedrock. Seasonal soil wetness, stoniness, or depth to bedrock are not considered as restrictive for buildings without basements as they are for those with basements. Sewerage, water supply, access roads, and other location factors are not considered as part of this rating (Table 3).

Sanitary landfill

A sanitary landfill is a waste disposal area for trash and garbage. Soil is used as the covering and sanitizing material. The solid waste is placed in contact with soil either in a trench or on an area fron which some soil has been stripped. It is compacted and every day's deposit is covered with six inches of soil. Several alternating layers of waste and soil are built up. The final cover of soil material must be at least two feet thick (Table 5).

The features considered in rating the soils for sanitary landfill are depth to hard bedrock, depth to seasonal high water table, risk of free flow of potential pollutants to groundwater, slope gradient, dominant texture of soil profile, presence of stones, and flooding hazard. No importation of fill or cover material is considered in the ratings.

Table 4. Soil limitations for disposing effluent from septic tanks.[a]

Major soil properties influencing use	Degree of soil limitation		
	None to slight	Moderate	Severe
Permeability[b] (Soil layers at depth of title line and below)	More than 1.0 inches per hour (Upper end of moderate, moderately rapid, and rapid drainage classes)[c]	0.63-1.0 inches per hour (Low end of moderate class)	Less than 0.63 inches per hour (Moderately slow and slow classes)
Depth to seasonal high water table[b] (Related to natural drainage classes)	More than 4 feet below the surface (Dominately well, somewhat excessively, and excessively drained classes)	1½-4 feet below surface (Dominately moderately well and well drained classes)	Less than 1½ feet below the surface plus some ponding (Dominantly somewhat poorly, poorly, and very poorly drained classes)
Depth to bedrock[de]	More than 10 feet	4-10 feet	Less than 4 feet
Surface rockiness[bd] (Use this property for soil areas with undulating and outcropping bedrock to reflect dominant depth condition)	Class 0 (Few or no rock outcrops)	Class 1 (Slightly rocky soils)	Classes 2, 3, 4, 5 (Very rocky to extremely rocky soils or rockland)
Slope[f]	0-8 percent	8-15 percent	Greater than 15 percent
Surface stoniness[b] (Stones 10 inches or more in diameter)	Classes 0, 1, 2 (None to very stony soils)	This rating not used	Classes 3, 4, 5 (Extremely stony soils or stony land)
Flood hazard	Not subject to flooding	This rating not used	Subject to flooding

[a] Source: Coop. Ext. Serv., 1972.

[b] Classes of permeability, drainage, rockiness, and stoniness as defined in the Soil Survey Manual (Soil Survey Staff, 1951).

[c] Possible pollution hazard to lakes, springs, or shallow wells where permeability rates are rapid.

[d] Fissured or shattered bedrock would be quite permeable but would also likely cause a pollution problem. Soils underlain by limestone may also enable pollution problems by providing passageways for unfiltered effluent.

[e] Requires on-site investigation to determine actual depth to bedrock before construction starts.

[f] Slope ranges are considered dominant condition throughout most of New York. Adjustments to reflect different slope breaks are necessary in some soil survey areas. These adjustments generally range from 2-5 percent.

Table 5. Soil limitations for sanitary landfill.[a]

Major soil properties influencing use	Degree of soil limitation		
	None to slight	Moderate	Severe
Depth to bedrock	More than 8 feet	6-8 feet	Less than 6 feet
Depth to seasonal[b] high water table related to natural drainage classes	Deeper than 12 feet below the surface	6-12 feet below the surface	Less than 6 feet below the surface
Risk of free flow of potential pollutants to ground water	Not underlain by porous bedrock or coarse sand and gravel within 12 feet	6-12 feet of moderately coarse to fine textured soil over porous bedrock or coarse sand and gravel	Less than 6 feet of moderately coarse to fine textured soil over porous bedrock or coarse sand and gravel
Slope[c]	0-8 percent	8-15 percent	Greater than 15 percent
Dominant texture of soil, including coarse fragments from 2 mm. to 10 inches in diameter	Sandy loam, fine sandy loam, loam, silt loam, silty clay loam, sandy clay loam	Loamy sand, silt, clay loam, sandy clay	Clay, silty clay, sand, organic soils
Surface stoniness[b] (Stones 10 inches or more in diameter)	Classes 0 and 1 (None or slightly stony soils)	Class 2 (Very stony soils)	Classes 3, 4 and 5 (Extremely stony soils or stony land)
Flooding hazard (Stream overflow)	Not subject to flooding	Flooded less frequently than once in 50 years	Flooded more frequently than once in 50 years

[a] Source: Coop. Ext. Serv., 1972.

[b] Classes of drainage, rockiness, and stoniness are used as defined in the Soil Survey Manual (Soil Survey Staff, 1951).

[c] Slope ranges indicated are considered dominant condition throughout most of New York. Adjustments to reflect different slope breaks are necessary in some survey areas. These adjustments usually range from 2-5 percent.

In general, soils that are deep, well drained, not stony, not too permeable, not too plastic and sticky, not flooded, and level or gently sloping are suitable for sanitary landfill. Rapidly permeable gravelly and sandy soils manipulate easily but have a severe hazard for pollution of wells, lakes, and streams that are in close proximity to the landfill.

Play and picnic areas

These are areas used extensively for play or picnicking. Problems of water supply and sewage disposal are not considered in the ratings. The soil properties considered in making the ratings are wetness, slope gradient, surface texture, stones, and flood hazard during the use period (Table 6).

Campsites for tents and trailers

These ratings refer to the use of the soils for either tent or trailer sites. It is assumed that thes areas will receive frequent use during the camping season involving heavy foot and vehicular traffic. Problems of sewage disposal, water supply and access roads are not considered in this rating. The soil properties which impose limitations are wetness, permeability, slope gradient, depth to bedrock, surface stoniness, surface texture, and flood hazard (Table 7).

Field crops

Soils vary widely in their potential for field crop production. These very general ratings are based on the land capability classification system for agriculture purposes devised by the Soil Conservation Service. Soil properties such as slope gradient, susceptibility to erosion or adverse effects of past erosion, flood hazard, wetness, rooting depths, available water capacity, natural fertility, favorable or unfavorable soil textures, and presence of stones or rocks are properties used in rating the soils (Table 8).

Soil Features Affecting Suitability for Wildlife Uses

The welfare of any wildlife species depends upon the presence and adequate distribution of food, shelter, and water, plus other suitable habitat conditions. The influence of a soil on the growth of food and cover plants can be inferred from an interpretation of soils. The soils can be rated according to their suitability for eight different elements of wildlife habitat and three classes of wildlife. The ratings are: 1. well suited; 2. suited; 3. poorly suited; and 4. unsuited. Soils that are well suited have few limitations, those that are suited have moderate limitations, and those that are poorly suited have severe limitations. Not considered in the ratings are present land use, the location of the soil in relation to other soils, and the mobility of wildlife.

Ratings for different classes of wildlife are based on those listed for separate habitat elements. For openland wildlife the rating is based on suitability of the soil for growing grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous wildlife habitat. The rating for woodland wildlife is based on all the suitability classifications except grain and seed crops. For wetland wildlife the rating is based on capability to produce wetland food and cover plants, support marshes, and be used for shallow excavated impoundments. Examples of openland wildlife are pheasants, meadowlarks, field sparrow, doves, cottontail rabbits, red foxes, and woodchucks.

Table 6. Soil limitations for play and picnic areas.[a]

Major soil properties influencing use	Degree of limitation		
	None to slight	Moderate	Severe
Depth to seasonal[b] high water table (Related to natural drainage classes)	Deeper than 1½ feet below the surface (Dominantly moderately well, well, somewhat excessively, and excessively drained classes)	½-1½ feet below the surface (Dominantly somewhat poorly drained classes)	At surface plus some ponding (Dominantly poorly and very poorly drained classes)
Slope[c]	0-8 percent	8-15 percent	15 percent or more
Depth to bedrock[d] (Use this property for soil areas with essentially uniform depth to bedrock)	More than 20 inches	This rating not used	Less than 20 inches
Surface rockiness[b] (Use this property for soil areas with undulating or outcropping bedrock to reflect dominant depth condition)	Classes 0, 1 (None to slightly rocky soils)	Class 2 (Very rocky soils)	Classes 3, 4, 5 (Extremely rocky soils or rockland)
Surface stoniness[b] (Stones 10 inches or more in diameter)	Classes 0, 1, 2 (None to very stony soils)	Class 3 (Extremely stony soils; wet soils rated severe)	Classes 4, 5 (Stony land)
Surface soil texture including coarse fragments from 2 mm. to 10 inches in diameter[b]	sl, fsl, vfsl, l, sil, with up to 35 percent coarse fragments less than 3 inches in diameter	ls, lfs, silt, sicl, scl, cl with up to 35 percent coarse fragments less than 3 inches in diameter	s, sc, sic, c, muck, peat, plus soils with more than 35 percent coarse fragments less than 3 inches in diameter and all soils with measurable amounts (15 percent or more) of coarse fragments greater than 3 inches in diameter
Flood hazard[e] (Stream overflow)	Floods less than 1 year out of 5 during heavy use period	Floods once in 2-5 years during heavy use period	Floods more frequent than once in 2 years during heavy use period

[a] Source: Coop. Ext. Serv., 1972.

[b] Drainage, rockiness, stoniness, and textural classes are used as defined in Soil Survey Manual (Soil Survey Staff, 1951).

[c] Slope ranges indicated are considered dominant condition throughout most of New York. Adjustments to reflect different slope breaks are necessary in some soil survey areas. These adjustments generally range from 2-5 percent.

[d] Requires on-site investigation to determine actual depth to bedrock at a construction site.

[e] This flood hazard is an estimate of the dominant average condition during most years. Even on-site investigation cannot always determine the actual frequency of flooding.

Table 7. Soil limitations for campsites.[a]

Major soil properties influencing use	Degree of soil limitation		
	None to slight	Moderate	Severe
Depth to seasonal[b] high water table related to natural drainage classes	Deeper than 4 feet below the surface (Dominantly well, somewhat excessively, and excessively drained classes)	1½-4 feet below the surface (Dominantly moderately well drained class)	Less than 1½ feet below the surface plus some ponding (Dominantly somewhat poorly, poorly, and very poorly drained classes)
Permeability[b] (Layer in profile restricting drainage)	More than 0.63 inches per hour (Moderate, moderately rapid, and rapid classes)	0.20-0.63 inches per hour (Moderately slow class)	Less than 0.20 inches per hour (Slow class)
Slope[c]			
Trailers	0-3 percent	3-8 percent	8 percent or more
Tents	0-8 percent	8-15 percent	15 percent or more
Depth to bedrock (Used for soil areas with essentially uniform depth to bedrock)	More than 20 inches	This rating not used	Less than 20 inches
Surface rockiness[b] (Use this property for soil with undulating or outcropping bedrock to reflect dominant depth condition)	Classes 0, 1 (None to slightly rocky soils)	Class 2 (Very rocky soils)	Classes 3, 4, 5 (Extremely rocky soils or rockland)
Surface soil texture (Includes coarse fragments from 2 mm. to 10 inches in diameter)	sl, fsl, vfsl, l, sil all with less than 15 percent coarse fragments less than 3 inches in diameter	ls, lfs, silt, sicl, scl, cl with up to 35 percent coarse fragments less than 3 inches in diameter plus 15-35 percent coarse fragments less than 3 inches in diameter of textures rated none to slight	Sand, sc, sic, c, muck, and peat plus soils with more than 35 percent coarse fragments less than 3 inches in diameter and all soils with measurable amounts (15 percent or more) of coarse fragments greater than 3 inches in diameter
Flood hazard[d] (Stream overflow)	Floods less than 1 year out of 10 during heavy use period (Very infrequent)	Floods once in 5-10 years during heavy use period	Floods more frequently than once in 5 years during heavy use period

[a] Source: Coop. Ext. Serv., 1972.

[b] Classes of drainage, permeability (value adjusted), rockiness, stoniness, and texture are used as defined in the Soil Survey Manual (Soil Survey Staff, 1951).

[c] Slope ranges indicated are considered dominant condition throughout New York. Adjustments to reflect different slope breaks are necessary in some soil survey areas. These adjustments generally range from 2-5 percent.

[d] This flood hazard is an estimate of the dominant average condition during most years. Even on-site investigation cannot always determine the actual frequency of flooding.

Table 8. Soil limitations for field crops.[a]

The degree of limitation is based on the Land Capability Classification System of the Soil Conservation Service.

Slight	Capability Classes I and II
Moderate	Capability Class III
Severe	Capability Classes IV, V, VI, VII, VIII

Class I	Soils that have few limitations that restrict their use
Class II	Soils that have some limitations that reduce the choice of plants or require moderate conservation practices
Class III	Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both
Class IV	Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both
Class V	Soils that are not likely to erode but have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, woodland, or wildlife food or cover
Class VI	Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, woodland, or wildlife food and cover
Class VII	Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife
Class VIII	Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants and that restrict their use to recreation, wildlife, or esthetic purposes

[a] Source: Coop. Ext. Serv., 1972.

Woodland wildlife includes woodcocks, thrushes, vireos, scarlet tanagers, gray and red squirrels, gray foxes, white-tailed deer, raccoons, and wild turkeys. Wetland wildlife consist of ducks, geese, rails, herons, shore birds, minks, muskrats, and beaver.

Grain and seed crops

These crops include seed producing annuals like corn, sorghum, wheat, barley, oats, millet, buckwheat, and sunflower. Soils well suited for growing them are deep, nearly level or very gently sloping, medium textured, well drained, and free of stones or not excessively stony. They have high moisture-holding capacity and are not subject to frequent flooding.

Grasses and legumes

These are domestic grasses and legumes that are established by planting. Examples include alfalfa, trefoil, clover, bluegrass, switchgrass, fescue, bromegrass, timothy, orchard grass, and reed canarygrass. On soils that are well suited, many kinds of plants can be maintained in adequate stands for at least 10 years without renovation. Good soils for these plants have slopes of less than 15 percent, are well or moderately well drained, and have high or moderately high moisture-holding capacity.

Wild herbaceous upland plants

These are perennial grasses and weeds that establish themselves naturally. They include bluestem, quackgrass, panicgrass, goldenrod, wild carrots, nightshade, and dandelion. Soils that are well suited for these plants range widely but are generally well to somewhat poorly drained.

Hardwood plants

These are non-coniferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They are also valuable as cover. They include native oaks, cherry, maple, birch, poplar, apple, hawthorne, dogwood, viburnum, grape, and briars. Soils well suited for these plants are deep or moderately deep, medium textured to moderately fine textured, and well to somewhat poorly drained. Slope and surface stones are of little significance to hardwood plants. Planted varieties include autumn olive, armor honeysuckle, tatarian honeysuckle, crabapple, multi-flora rose, highbush cranberry, and silky dogwood.

Conifers

Conifers are cone-bearing evergreen trees and shrubs that are used by wildlife primarily for cover though some provide browse and seeds. Norway spruce, white pine, white cedar, and hemlock are examples. Soils rated as well suited are those with characteristics which cause conifers to grow at a moderate to rapid rate. These characteristics include well to moderately well drainage, good moisture capacity over 20 inches deep. Soils rated as poorly suited are those which cause conifers to grow very slowly.

Wetland food and cover plants

These plants consist of wild herbaceous annual and perennial plants that grow on moist to wet sites. They include smartweed, wild millet, common rush, spikerush, sedges, rice, cutgrass, mannagrass, and cattails. Soils rated as well suited are nearly level and poorly to very poorly drained. Depth, stoniness, and texture are of little concern for wetland habitat.

Marsh areas

These areas need surface runoff or springs as a source of water. They are rated on the basis of suitability of the soil for the construction of a low dike to impound a shallow body of water. Soils rated as well suited are nearly level, more than 6 feet to bedrock, slowly permeable below 15 inches, and poorly to very poorly drained. They do not flood frequently.

Excavated impoundments

Soils for this use are rated for the construction of level ditches, potholes, and shallow excavations. The purpose of these excavations is to create open water areas in wetland soils for waterfowl use. Soils that are well suited are deep, nearly level, and poorly drained. They do not flood frequently.

A GENERALIZATION ABOUT THE SOILS

While soils of the Tug Hill Region present a complex picture because of their diversity and the irregular pattern of their distribution, some generalization can be given. The generalization must be preceeded by a precaution that great on-site variations occur in soils. Over even a small area wide ranges of soil conditions can occur. However, using the broad classifications by Cline (1955), and filling in information protrayed on Map 5 and in Appendix 2, we can identify areas of differing productive potential and having differing engineering capabilities.

Figure 2 portrays eight separate zones useful in generalizing about the Tug Hill Region. Again, these generalizations should not be taken to circumvent the need for on-site evaluation as a prerequisite to any development. Furthermore, comprehensive understanding of Tug Hill Region soils can come only from careful study and use of the more detailed materials presented. These generalizations serve only to spotlight areas where special opportunities exist for development and use, or where careful detailed analyses and planning appear expecially important before development.

In the central Upland and in an area extending southwest from it (Zone 1) soils are predominantly stony, medium- to coarse-textured, highly acid and on glacial till derived from sandstone origin. Worth, Empeyville, and Westbury soil series typify the area. Their stony nature, acidity, and low productivity make agriculture difficult. Abundance of poorly-drained sites in low places and stream channels on the Upland limits suitability for engineering uses to the better drained places. On-site inspection is an essential prerequisite to development. These conditions represent an important segment of the Tug Hill Region.

Terraces of the Upland's eastern escarpment (Zone 2), the Black River Valley (Zone 3), and the hilly area in the northern part of the Region (Zone 4) support

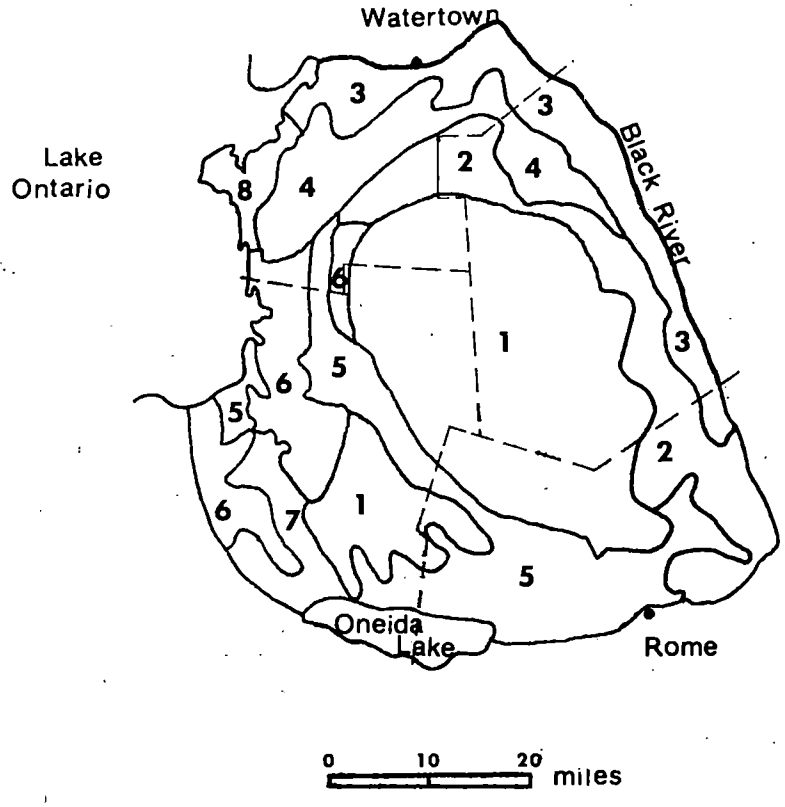


Figure 2. Generalized soils zones of the Tug Hill Region (after Cline, 1955).

prosperous dairy farming. In these three zones soils have medium to moderately fine texture. Zone 2 soils are acid with neutral to slightly acid fragipans on glacial till, and somewhat poorly drained. In Zone 3 soils are deep, high in lime, and well to moderately well drained. Zone 4 has soils lacking fragipans, low to medium in lime, and well to moderately well drained. Numerous different soils occur in the three zones. But generally they are productive for a wide variety of crops and generally appear better suited to engineering uses than the Upland. They hold fewer restrictions and require less extensive design or special management. However, inclusions of somewhat poorly drained soils at the transition between the Upland and the Black River Valley, and along the Upland's north end, make on-site evaluation a necessary prerequisite to development there.

Areas of coarse-textured soils predominate in the McConnelsville-Camden area, along the Oneida Lake plain, and extending around the west side of the Upland along the approximate path of Route 11 (Zone 5). Several different soils in these old glacial lake beaches are mostly well to moderately well drained, except along the north and east sides of Oneida Lake. There they show poor drainage. Throughout the zone, soils are low in plant nutrients. Agricultural potential is poor. But except as noted above they provide good drainage and generally rate high for development of homes, camps, and campsites.

Between Lake Ontario and the Upland, soils are on glacial till, medium textured, and with neutral to slightly acid fragipans (Zone 6). The deep and well or moderately well drained Ira and Sodus series are common, except immediately along Lake Ontario. Some crops can be grown, but fertility limits agriculture. In level places, inclusions of poorly drained soils impose important engineering limitations necessitating on-site evaluations before development.

Northwest of Oneida Lake (Zone 7), Fulton and Toledo series predominate. These have generally medium to fine texture and occur on glacial or marine sediments. Mostly, they are poorly drained, not well suited to agricultural use, and have important engineering limitations. Good management and design are essential, along with on-site evaluation before development.

Lastly, the most northwestern corner of the Region (Zone 8) is extensively occupied by rocky land and very shallow soils designated Rockland. Along the lake these change to medium- to fine-textured glacial and marine sediments of the Collamer and Dunkirk series. Again these impose important limitations for agriculture and engineering uses.

To reiterate, these generalizations cannot be used to supplant need for careful on-site evaluation as a prerequisite to development or agricultural use. They only give a sweeping overview of conditions existing among the Region's soils. Important problems could follow development undertaken without proper evaluation at places proposed for development. And proper design and management can overcome some engineering limitations, though they often are costly to apply.

OIL AND GAS RESOURCES

Since 1950 the New York State Museum and Science Service has maintained records of gas drilling activities in New York State. Information pertaining to the Tug Hill Region is found in Selected Deep Wells and Areas of Gas Production in Eastern and Central New York (Kreidler, 1959), and Deep Wells in New York State (Kreidler, VanTyne, and Jorgensen, 1972). These compilations show major gas

production to be from the Trenton limestone, Medina sandstone and Oriskany sandstone geologic groups. Locations, dates of drilling, drilling depths and flow rates of gas and oil are reported (Figure 3).

The earlier report on wells completed before 1957 lists about 90 locations within the Tug Hill Region, the greatest concentration being found in the Camden-Florence area of northwestern Oneida County. Many of these wells showed some natural gas to be present. The recent report (Kreidler, VanTyne, and Jorgensen, 1972) lists 5 deep wells in the Tug Hill Region, all of which were explored in the period 1961-64. These include one site in the Town of High Market, Lewis County and one each in the Towns of Hastings, Richland, Sandy Creek and Williamstown. While apparently not attractive for commercial development, small to moderate amounts of gas were reported at each locale. However, no oil was found.

LITERATURE CITED

Buckman, H.O., and Brady, N.C.
1969. The nature and properties of soils. MacMillan Co., N.Y., 7 ed.

Cline, M.G.
1955. Soils and soil associations of New York State. Cornell Univ., Cornell Ext. Bull. 930.

Coop. Ext. Serv.
1972. Soil survey interpretations of the soils in New York State. Prepared by Dep. Agron, Cornell Univ., and U.S. Dep. Agric., Soil Conserv. Serv., in coop. with Coop. Ext. Serv., Agron. Mimeogr. 72-4.

Cressey, G.B.
1966. Land forms. Chapt. 7 in, Geography of New York State, J.D. Thompson, ed., Syracuse Univ. Press., Syracuse, N.Y.

Davis, J.F., Rickard, L.V., and Fisher, D.W.
1970. Geologic map of New York State. N.Y. State Mus. and Sci. Serv., Map and Chart Ser. Number 15.

Fairchild, H.L.
1909. Stages in the waning of the ice sheet in New York State. N.Y. State Mus. and Sci. Serv., Mus. Bull. Number 160.

Forster, S.W.
1971. Pleistocene geology of the Carthage 15-minute quadrangle, New York State. Unpubl. Ph. D. thesis, Syracuse Univ.

Hodnett, R.C., and Feuer, R.
1958. Jefferson County soils. N.Y. State Coll. Agric., Cornell Univ., Soil Assoc. Leafl. Number 9.

Kaiser, R.F.
1957. The surficial geology of the southeastern segment of the Lake Ontario plain, New York. Unpubl. Ph. D. thesis, Syracuse Univ.

Kreidler, W.L.
1959. Selected deep wells and areas of gas production in eastern and central New York. N.Y. State Mus. and Sci. Serv., Mus. Bull. Number 373.

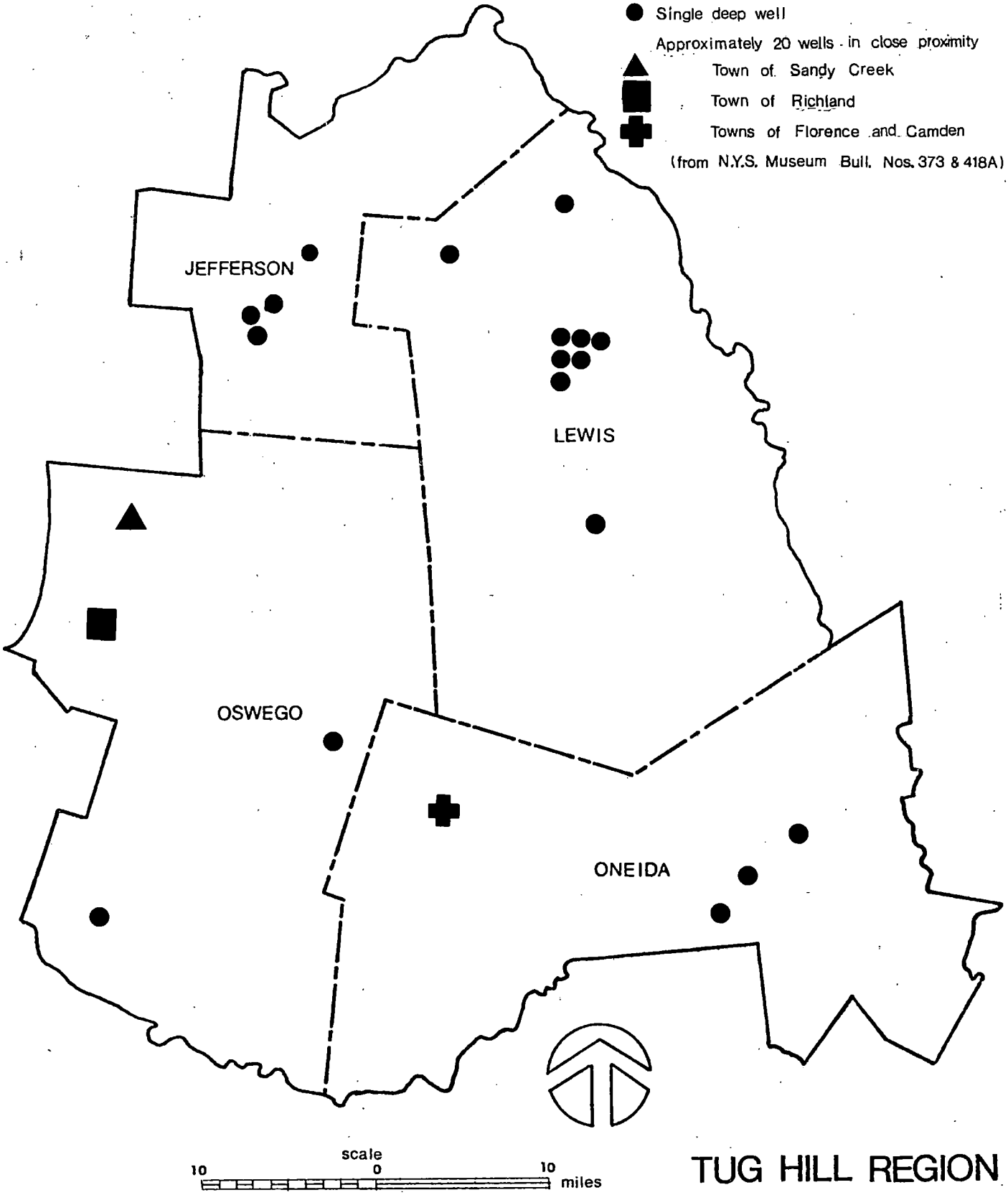


Figure 2. Distribution of deep wells in the Tug Hill Region.

Kreidler, W.L., VanTyne, A.M., and Jorgensen, K.M.
1972. Deep wells in New York State. N.Y. State Mus. and Sci. Serv., Mus. Bull. Number 418A.

Newell, J.G.
1939. Geomorphic development of the Tug Hill Plateau. Unpubl. M.S. thesis, Syracuse Univ.

O'Brien and Gere Eng.
1968. Jefferson County. N.Y. State, Dep. Health, Compr. Water Supply Stud., CPWS-38.

Pearson, C.S., and Cline, M.G.
1960. Soil survey of Lewis County, New York. U.S. Dep. Agric., Soil Conserv. Serv., Ser. 1954, Number 10.

Pearson, C.S., Feuer, R., and Cline, M.G.
1960. Oneida County soils. N.Y. State Coll. Agric., Cornell Univ.

Soil Conserv. Serv.
1969. Soils interpretation for regional planning. U.S. Dep. Agric., Soil Conserv. Serv., Central N.Y. Reg. Plann. and Dev. Bd., Syracuse, N.Y.

Soil Surv. Staff.
1951. Soil survey manual. U.S. Dep. Agric., Soil Conserv. Serv., Agric. Handbk. Number 18.

Stewart, D.P.
1958. The pleistocene geology of the Watertown and Sacketts Harbor quadrangles. N.Y. State Mus. and Sci. Ser., Mus. Bull. Number 369.

Street, J.S.
1966. Glacial geology of the eastern and southern portions of the Tug Hill Plateau, New York. Unpubl. Ph. D. thesis, Syracuse Univ.

Wright, F.M.
1972. The pleistocene and recent geology of the Oneida-Rome district, New York. Unpubl. Ph. D. thesis, Syracuse Univ.

Assistance was given by John Sterling and Nancy Herrington in assemblying and analyzing data. Acknowledgement is given to Livingston Lansing of Boonville, N.Y., and Raymond Falconer of SUNY Albany for their assistance in providing data needed in the study.

AIR

RESOURCES

by

lee p. herrington

SUMMARY OF AIR RESOURCES

Climate of the Tug Hill Region is cold, snowy and windy in the winter, and cool and moist in the summer. The elevational changes in the Tug Hill Upland, coupled with the prevailing west and northwest winds blowing over Lake Ontario, are responsible for much of the weather near the Lake Ontario shore. For 10-20 miles inland, the climate is moderated by the presence of the lake, making the area cooler in summer and warmer in winter than the more easterly portions of the Region. In early winter the cold dry air sweeping over relatively warm water of Lake Ontario picks up considerable amounts of moisture, that later is deposited over the Region as heavy snow during so-called lake effect storms. While Lake Ontario is responsible for most of the precipitation falling on the Region, a fair proportion of precipitation, particularly in summer, is derived from moist oceanic air in cyclonic systems moving across the country to the north of New York State.

The air flowing from the west through northwest after a long passage over open water of Lake Ontario is very free of pollutants. No large pollution sources exist in the Region, save Watertown and some of the towns on the Black River. Furthermore, there is a cleaning action over the Region due to precipitation. Consequently, air leaving the Tug Hill Region is clean. The Tug Hill Region does not act as an air reservoir, since there is no controlled or even cyclic release of clean air from it. The region does have clean air flowing over it, and activities in the Region do little to pollute this air. Since the Region is up-wind of the Adirondack Mountains and Mohawk River Valley, it might be considered as part of the air shed of those areas.

The air pollution potential of the Tug Hill Region is about the same as the rest of the state. There appears little need to impose standards other than the state standards already in force.

CLIMATE OF TUG HILL

The climate of New York State, generally described as the humid continental type (Pack, 1972) typical of the northeastern United States, shows considerable variability. Differences in climate between specific places result from variations in latitude and topography, and from the presence or absence of large bodies of water. Local differences can be considered modifications of the general climate, which is determined by the large scale patterns of atmospheric circulation. Tug Hill Region qualifies as an area showing modified climate due to these local factors.

The climate of the Tug Hill Region, as for most areas of its size, has not been well quantified. But the Region is generally considered to have a climate characterized by cool, moist summers, and cold, windy, snowy winters. Quantitative data assembled below bear out these generalities.

Table 9 compares the range of climatic conditions existing in the Tug Hill Region to conditions over the whole state. It shows the Region having average winter temperatures similar to the midpoint of the range for the state as a whole. Summer maximums tend to be low, and summer minimums tend to be high. The average temperature range over the Tug Hill Region occurs within the lower half of the range for New York State.

Climatic variations within the Tug Hill Region are determined by topography and lake effects, described below. Except for precipitation, climatic data for the interior of the Region was derived from quantitative information collected at stations around the edges of the Region. Temperature data are available only for Pulaski, Watertown, Boonville, and Mallory. Wind data are available only from Syracuse, Griffiss Air Force Base in Rome, and Watertown. Air quality data are available only from Syracuse, Fulton, Oswego, Watertown, Lowville and Utica. All information presented herein for the interior of the Tug Hill Region has been extrapolated from surrounding stations. The extrapolation has been based on estimated of the effects of elevation, and of Lake Ontario upon the climatic variables.

EFFECTS OF ELEVATION AND LAKE ONTARIO

Elevation

When air rises without condensation it cools at the rate of approximately 5.4° F per thousand feet of uplift. However, the observed average decrease in temperature with increased elevation in the atmosphere is actually about 3.5° F per thousand feet, because condensation often occurs to release latent heat. Since the change in elevation from Lake Ontario to the center of the Tug Hill Upland is roughly 1000 feet (Map 2), temperatures at the center of the Tug Hill Region should be about 3-5° F cooler than those recorded at surrounding stations. This expected differential can serve as a basis for extrapolating values to create a broad regional picture of temperature patterns over the Tug Hill Upland.

Topography will also play a role in determining differences between the climate of the Tug Hill Upland and that of the adjoining Black River and Mohawk River Valleys. Cold air draining at night from the Upland and other

Table 9. Summary of New York State and Tug Hill Region climatic ranges.

Climatic variable	Observed range	
	New York State	Tug Hill Region
Mean winter minimum temperature, °F	4-28	10-14
Mean winter maximum temperature, °F	26-40	28-30
Mean summer minimum temperature, °F	52-68	52-56
Mean summer maximum temperature, °F	78-86	78-82
Mean annual precipitation, in inches of water	28-60	36-52
Mean annual snowfall, in inches of snow	25-180	90-180

highlands will pool in the valleys, resulting in cooler morning temperatures therein. Commonly, daily morning inversions develop over the valley areas, especially when the night is clear and with low winds from the west or east.

Lake Effects

Lake Ontario is a large body of water and thus shows seasonal thermal lag when compared to the surrounding land. The lake will be cooler than the land in the summer, with a maximum difference appearing in the spring. It will be warmer in the winter, with the maximum effect occuring early in the season. This thermal lag will noticably modify the climate of the lakeshore as much as 10-20 miles inland. In the moderated zone along the lake, spring thaws and fall freezes will occur later than further inland over the Upland.

Thermal lag is also partly responsible for the lake effect storms common to the Tug Hill Region during winter. These storms have been best described by Falconer, Lansing, and Sykes (1964). They are caused by the generally west to east flow of cold air over the warm lake water during early winter (Tiusto and Kaplan, 1972), resulting in the evaporation of moisture from the lake into the air. In addition, the cold air passing over the warm lake becomes unstable, causing its upward motion to form large clouds over and to the lee of the lake. Storms thus formed move inland and deposit large amounts of snow over the Region. These storms are usually long and narrow (10 by up to 70 miles), and oriented parallel to the wind. As the direction of the wind chantes, the storms move about like water leaving an upheld hose (Falconer et al., 1964).

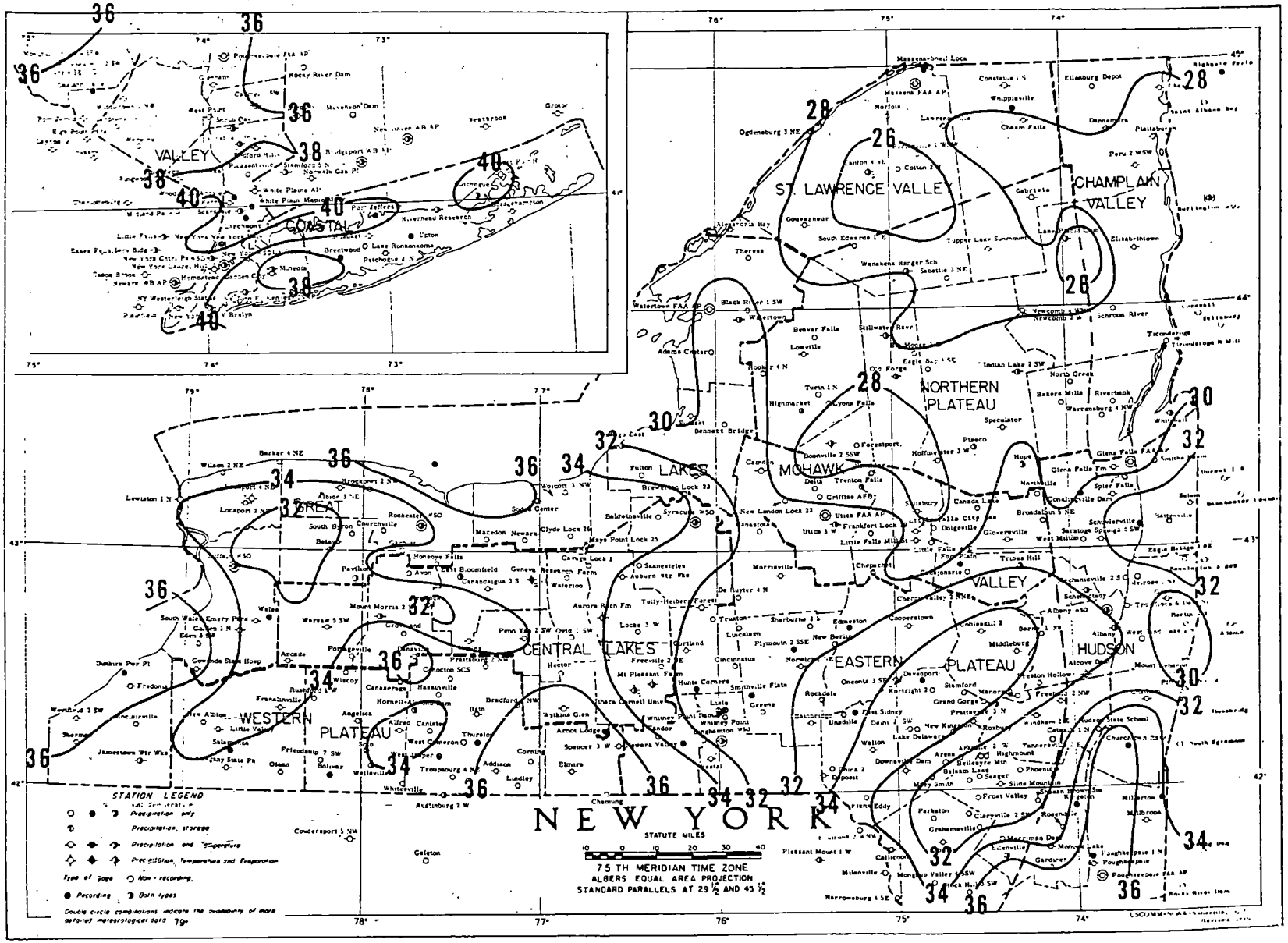
CHARACTERISTICS OF THE REGION

Temperature

Figures 3 through 6 from Pack's (1972) Climate of New York show summer and winter maximum and minumum temperatures for the state as a whole. Note that these include little data for the Tug Hill Region. Care should be used in applying them to specific places within the Region. Effects of the rise in elevation over the Upland, and pooling of cool air in the valley areas, may not be reflected in the placement of temperature lines on these maps. Overall, they show no great extremes in temperature patterns for the Region, compared to other parts of the State.

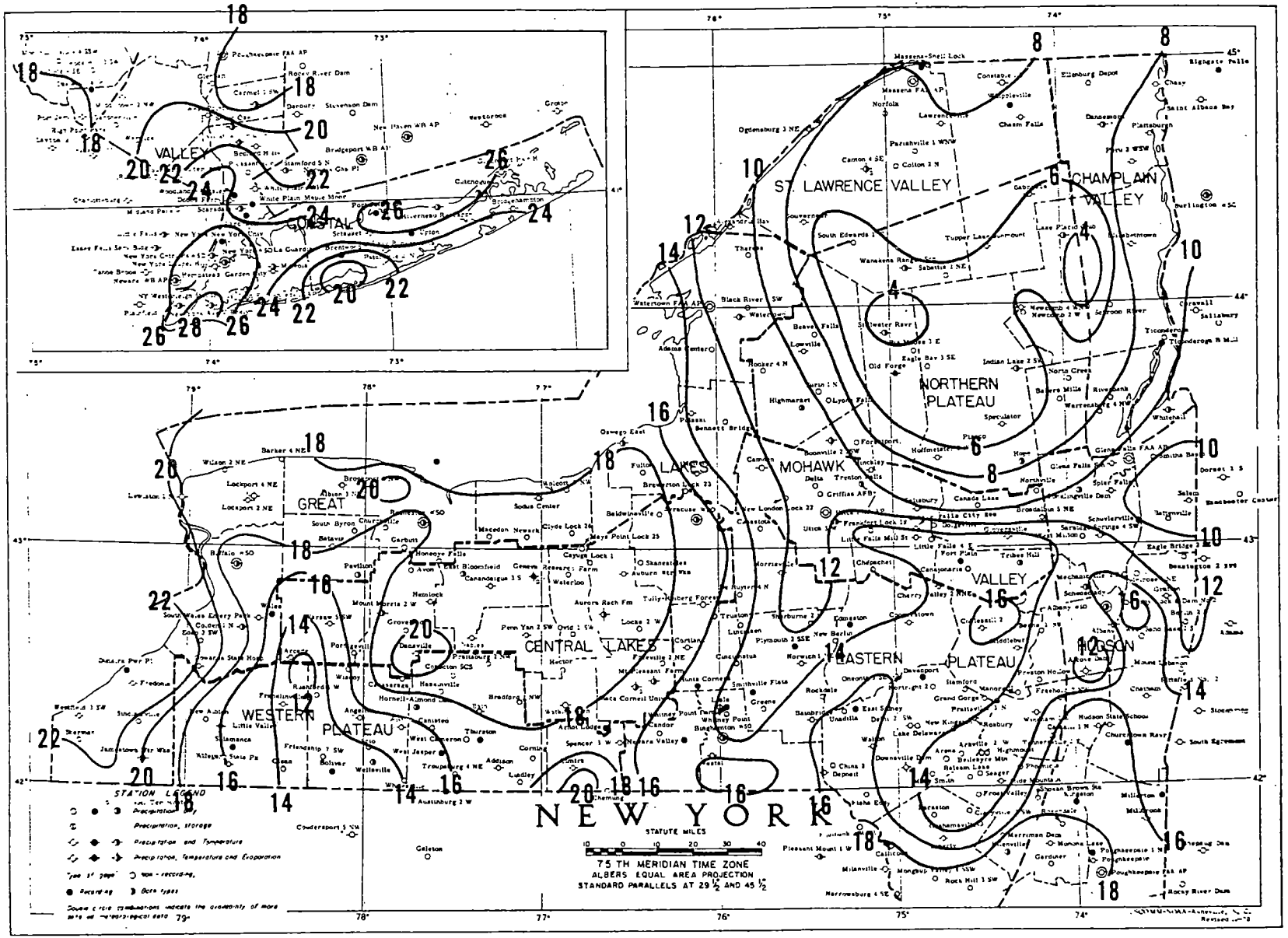
Figures 7 through 10 show isotherms for the three month average temperature for each season. These maps were drawn using data from the Watertown, Pulaski, Mallory, and Boonville stations (Table 10) extrapolating for places at the Region's interior. An attempt to include the effects of both elevation and Lake Ontario on the temperature pattern. Again, careful thought is urged in applying the information to specific places within the Region. While these graphs adequately reflect Regional patterns of temperature, they may not show local variations due to topography and elevation at specific places. Rather, Figures 7 and 10 provide a regional adaptation of the broader patterns depicted by Pack (1972), reinforcing the notion that the Tug Hill Region does not exhibit great extremes of temperature compared to other areas of New York State.

Figures 11 through 13 were redrawn from data presented in Spring and Fall Freezing Temperatures in New York State, (Frederick et al., 1959). However, effects of elevation on these data are not strongly expressed, and application to



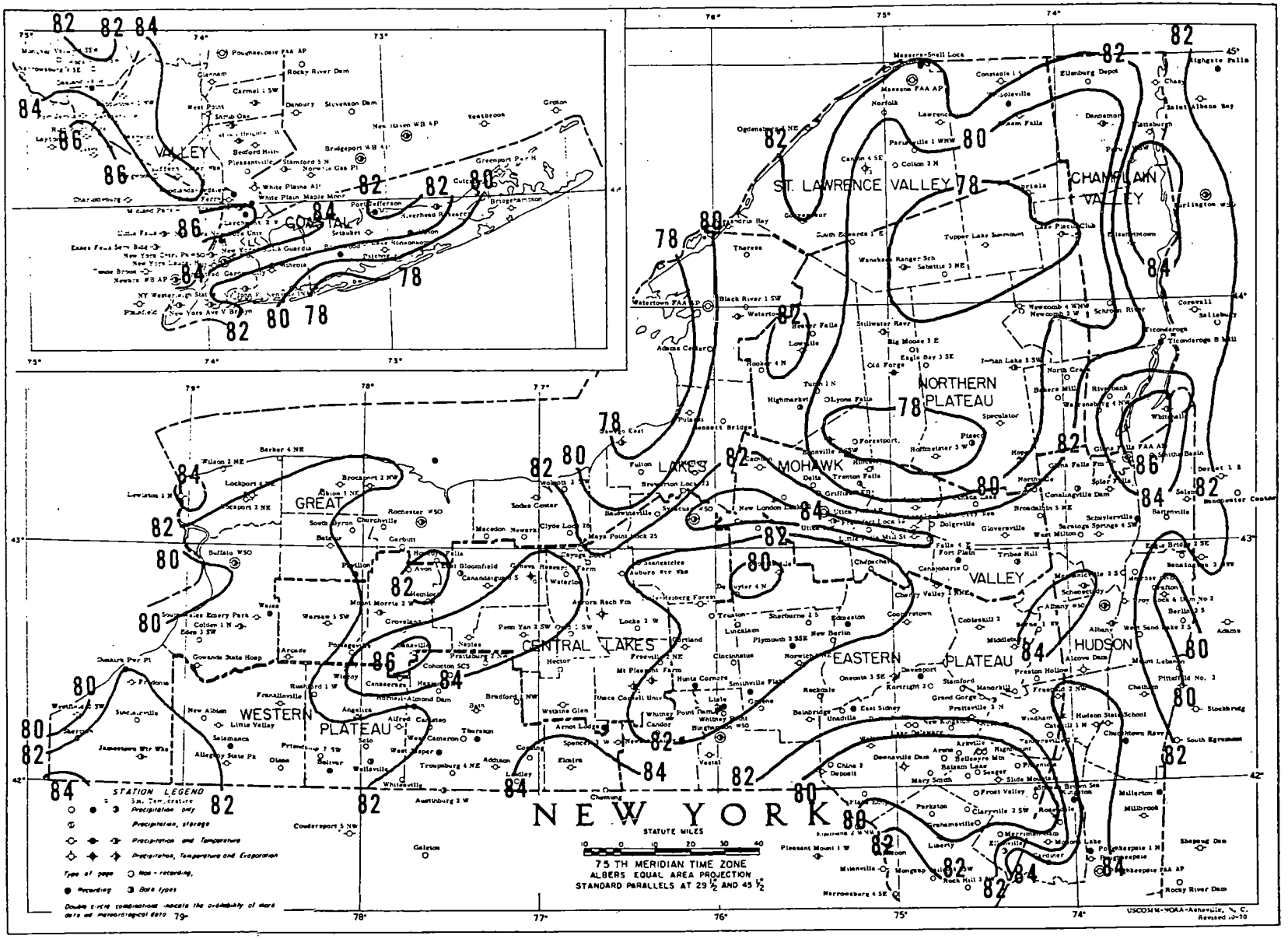
Data are based on the period 1931-52. Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

Figure 3. Mean maximum temperature (°F), January, New York State (from Pack, 1972).



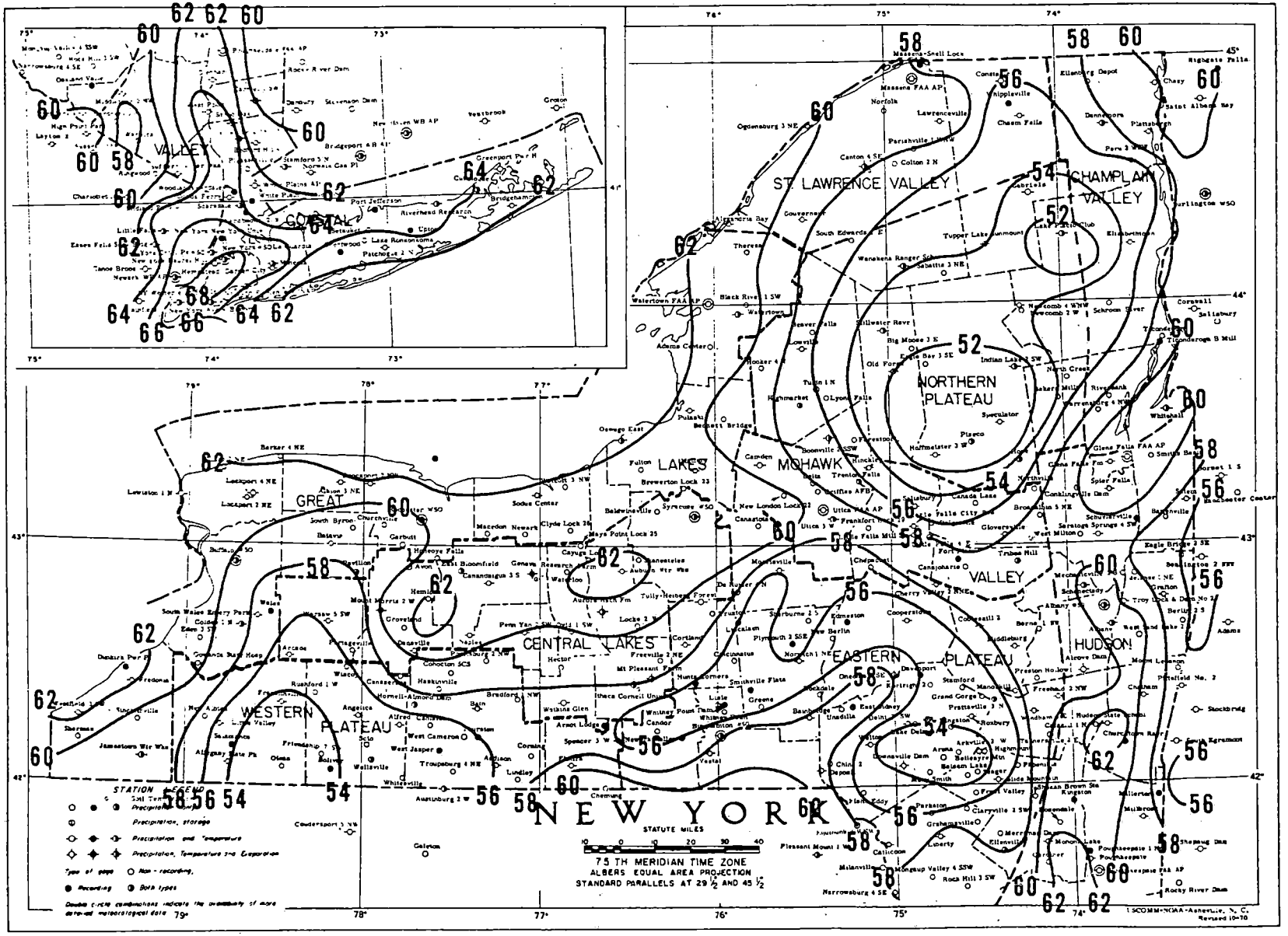
Data are based on the period 1931-52. Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

Figure 4. Mean minimum temperature (°F), January, New York State (from Pack, 1972).



Data are based on the period 1931-52. Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

Figure 5. Mean maximum temperature (°F), July, New York State (from Pack, 1972).



Data are based on the period 1931-52. Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

Figure 6. Mean minimum temperature (°F), July, New York State (from Pack, 1972).

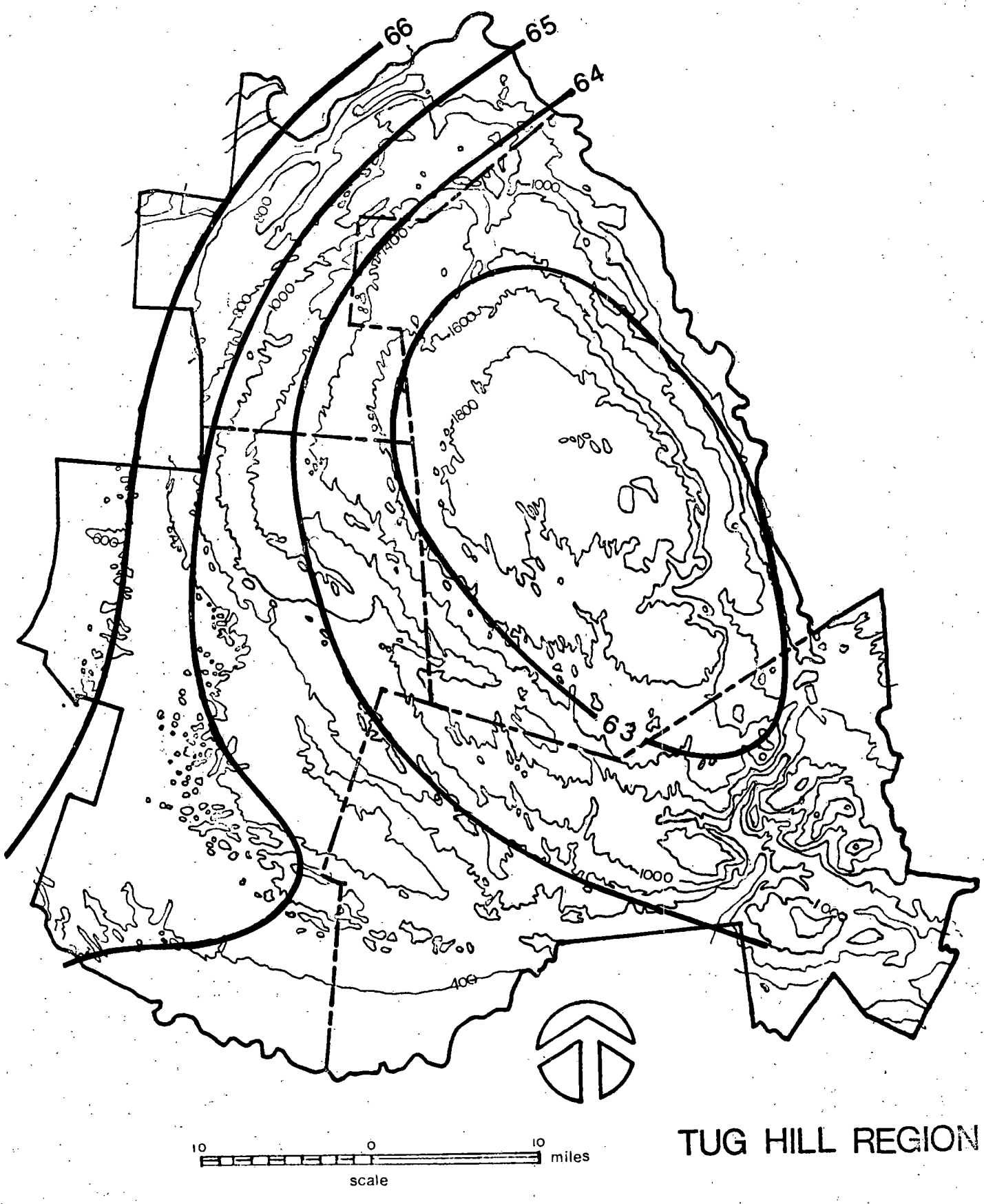


Figure 7. Average temperature (°F), summer season, Tug Hill Region.

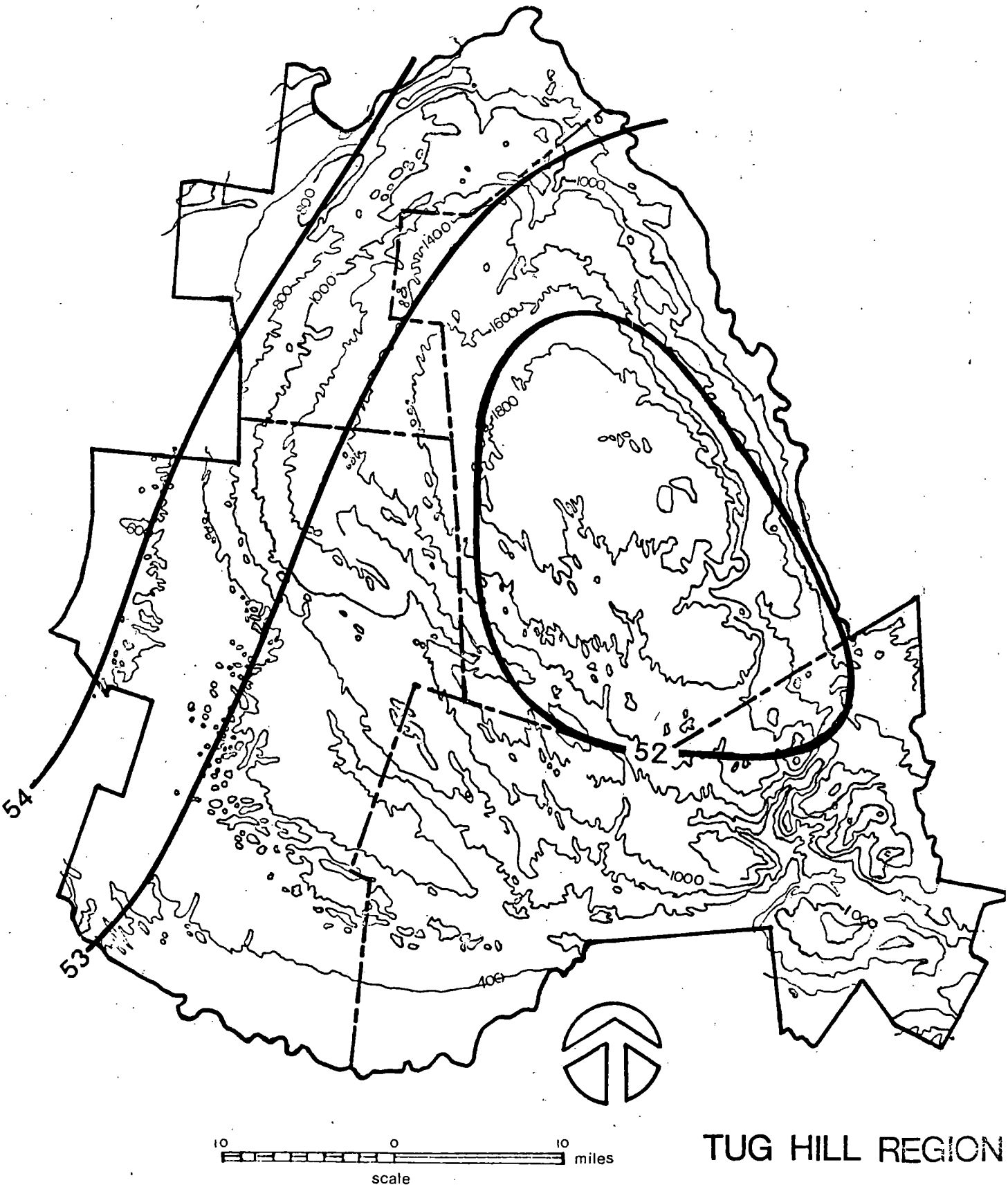


Figure 8. Average temperature (°F), summer season, Tug Hill Region.

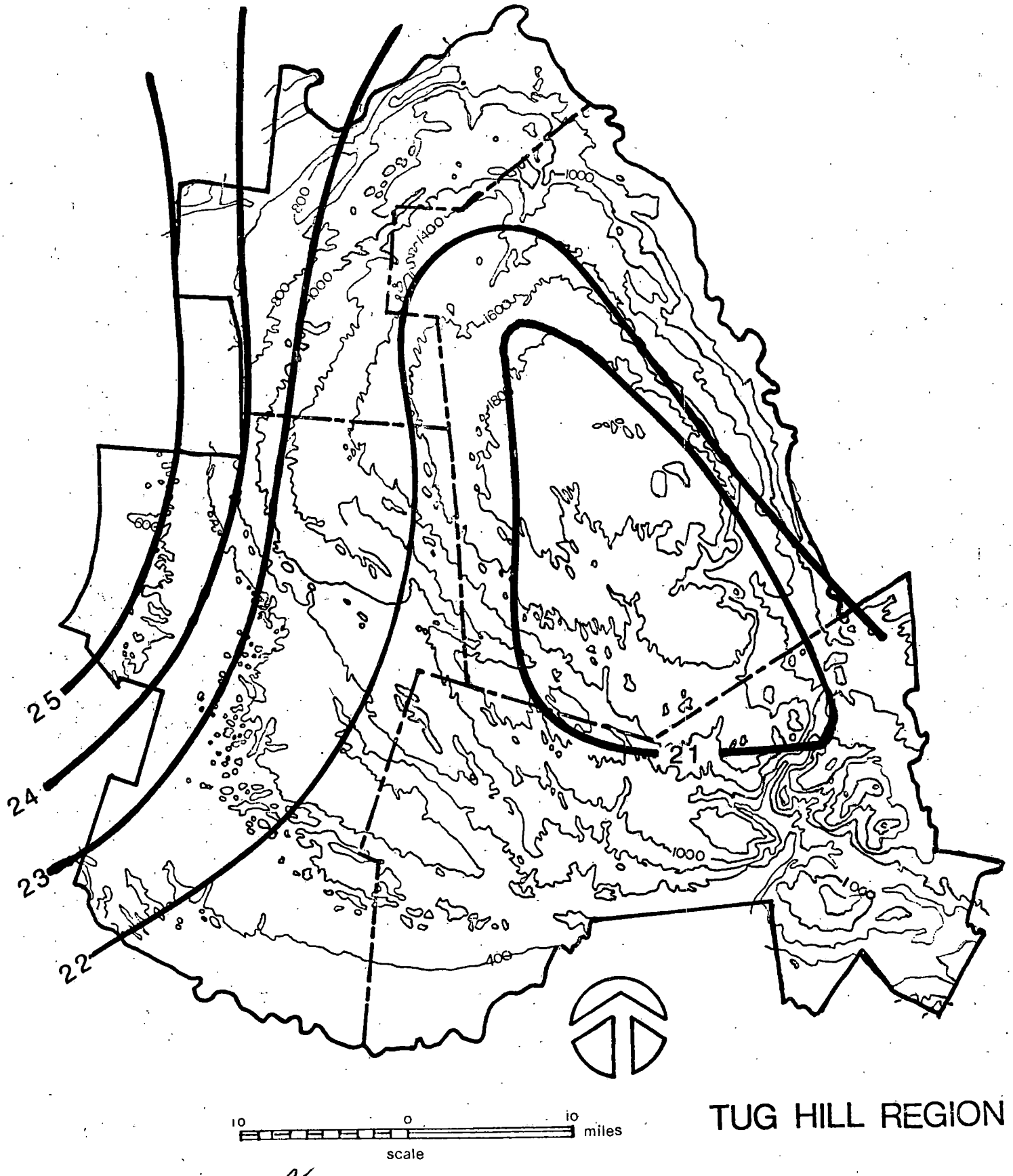


Figure 9. Average winter temperature (°F), winter season, Tug Hill Region.

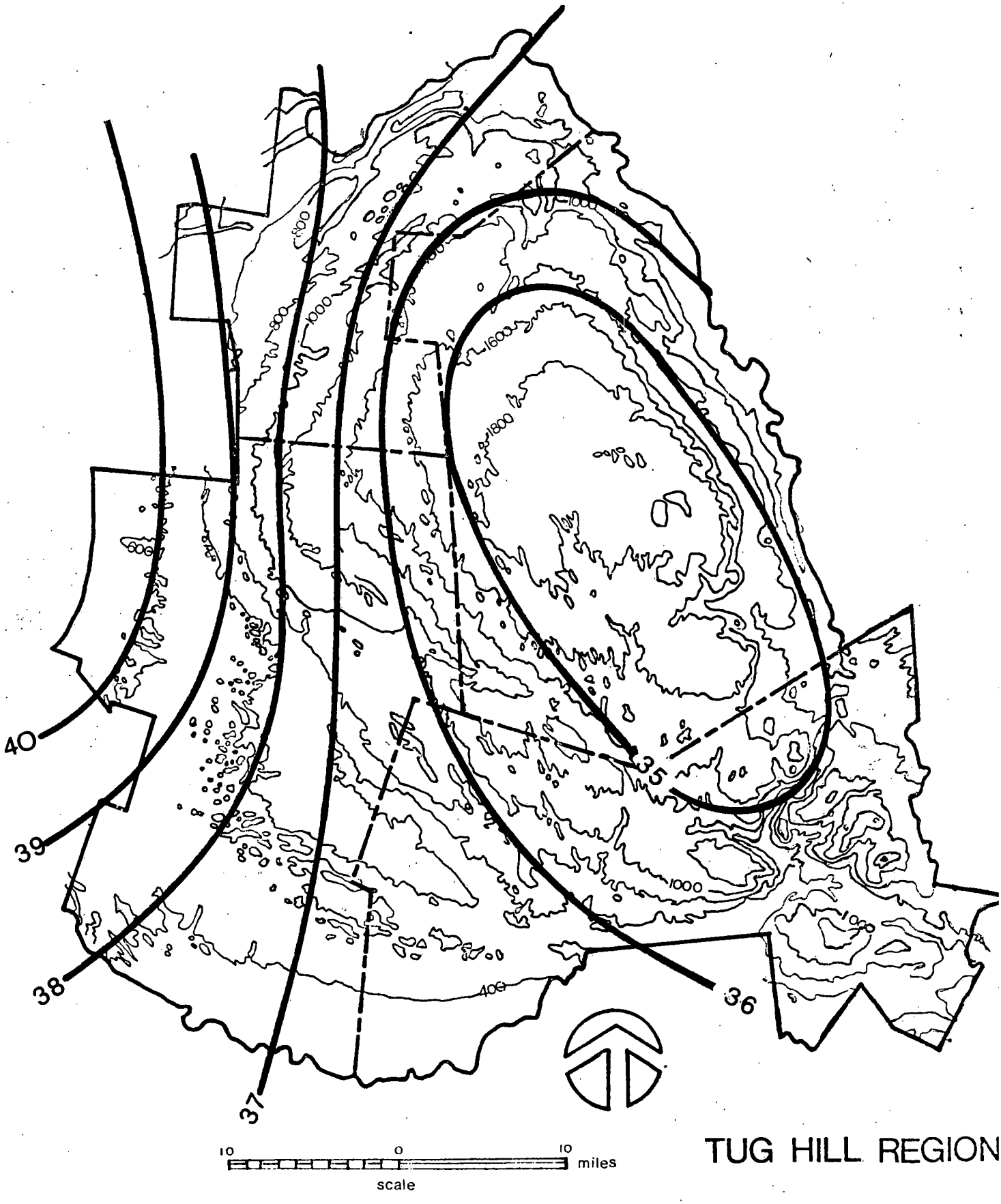


Figure 10. Average temperature (°F), fall season, Tug Hill Region.

Table 2. Average temperature by degrees Fahrenheit by seasons, Tug Hill Region.

Season	Station				
	Boonville	Mallory	Pulaski	Watertown	Watertown FAA
Winter January-March	21.0	22.2	25.1	23.3	22.7
Spring April-June	51.9	53.4	54.5	54.8	53.8
Summer July-September	62.6	64.7	66.2	66.0	65.4
Fall October-December	34.7	37.8	39.5	38.0	37.7

specific places in the Tug Hill Region could lead to misjudgment. The date lines in Figures 11 and 12 show that both the earliest frost and the latest frost occur at the highest elevations, and that land along the western-most rim of the Region benefits from the moderating effect of Lake Ontario. This gives a greatly shortened frost-free period over the Tug Hill Upland (Figure 13), the length of the growing season decreasing with the gradual rise in elevation from west to east. The curves show a difference of as much as 40 days between parts of the Region.

Wind

General circulation of the atmosphere results in a prevailing west to northwest flow over the Lake Ontario Region. Figures 14 through 22 present wind data for Syracuse, Rome (Griffiss Air Force Base), and Boonville, reflecting this prevalent pattern. Wind data for Watertown are available through the National Weather Records Center in Asheville, North Carolina.

Figures 14 through 17 show data for Syracuse, New York, by season. These are presented only for comparison to data from other stations. As expected, the most common wind direction is from the west. The wind roses for winter and spring show a large percentage of northwest winds. Although normal for this area, the very strong showing of the northwest winds in spring may be an anomaly. On the otherhand, the Griffiss Air Force Base and Boonville stations also show this situation, so it may be normal in the Syracuse area, too. Data are inconclusive.

Note the large number of occasions that winter winds blow from the southwest at Syracuse. This pattern is not evident at Rome, 45 miles to the east. It could be caused by a convergence. As cold west to northwest winds cross the relatively warm lake waters the air is warmed. And being less dense it ascends. At that same time, air flowing along the south shore of Lake Ontario is drawn in over the lake to replace the ascending air. Air flowing overland farther south of the lake is subject to more friction than air crossing the lake, and thus its general west to east flow is not strong enough to completely balance the pressure gradient caused by the movement of air onto the lake. The net result is that the winds cut across the pressure field onto the lake. Stations to the north of Lake Ontario may register wind directions slightly north of west, while those south of the lake, including Syracuse, get winds south of west. South wind, as expected, is more frequent in the summer. But wind speeds are not as high as during the colder months. The high incidence of east wind in the fall may be due to the blocking action of highs. The east winds in winter are probably due to cyclones through the funneling effect of the Mohawk Valley lying to the east.

Figures 18 through 21 show windrose data for Griffiss Air Force Base at Rome, New York. These data for the four seasons show a large percentage of southeast winds. They are probably due to the channeling effect of the Mohawk Valley. The axis of that valley runs east to west, except in its western section where Griffiss is located. Near Rome it is aligned northwest to southeast. In addition, South Hill, a broad gradual sloping hill rising 700 feet above Griffiss Air Force Base, is located to the northeast and likely also influences wind movement. Consequently, data for Griffis Air Force Base can be applied only to towns lying in the western end of the Mohawk Valley.

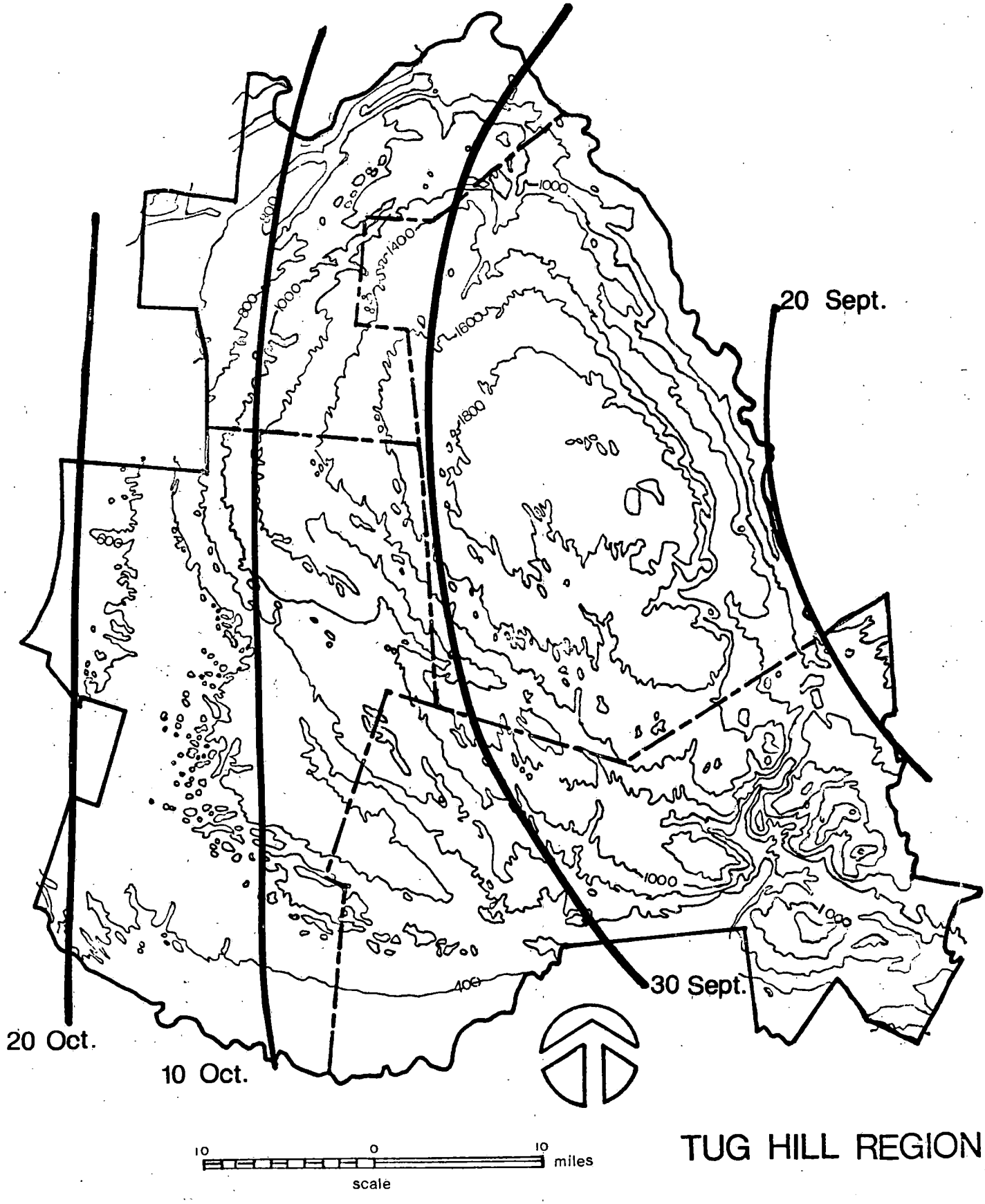


Figure 11. Mean date of first 32° F. or lower temperature, fall, Tug Hill Region (after Frederick, et al., 1959).

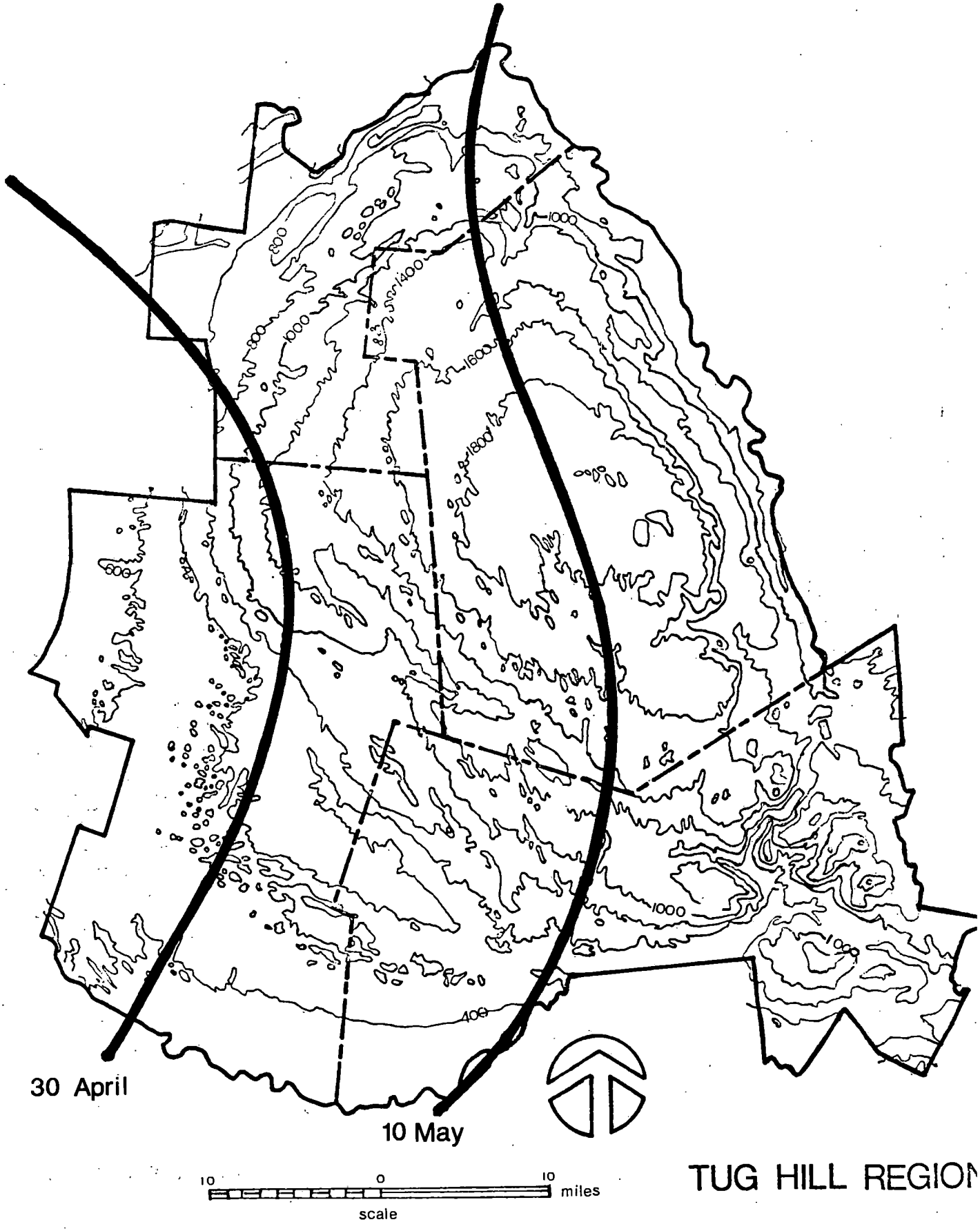


Figure 12. Mean date of last 32° F or lower temperature, spring, Tug Hill Region (after Frederick et al., 1959).

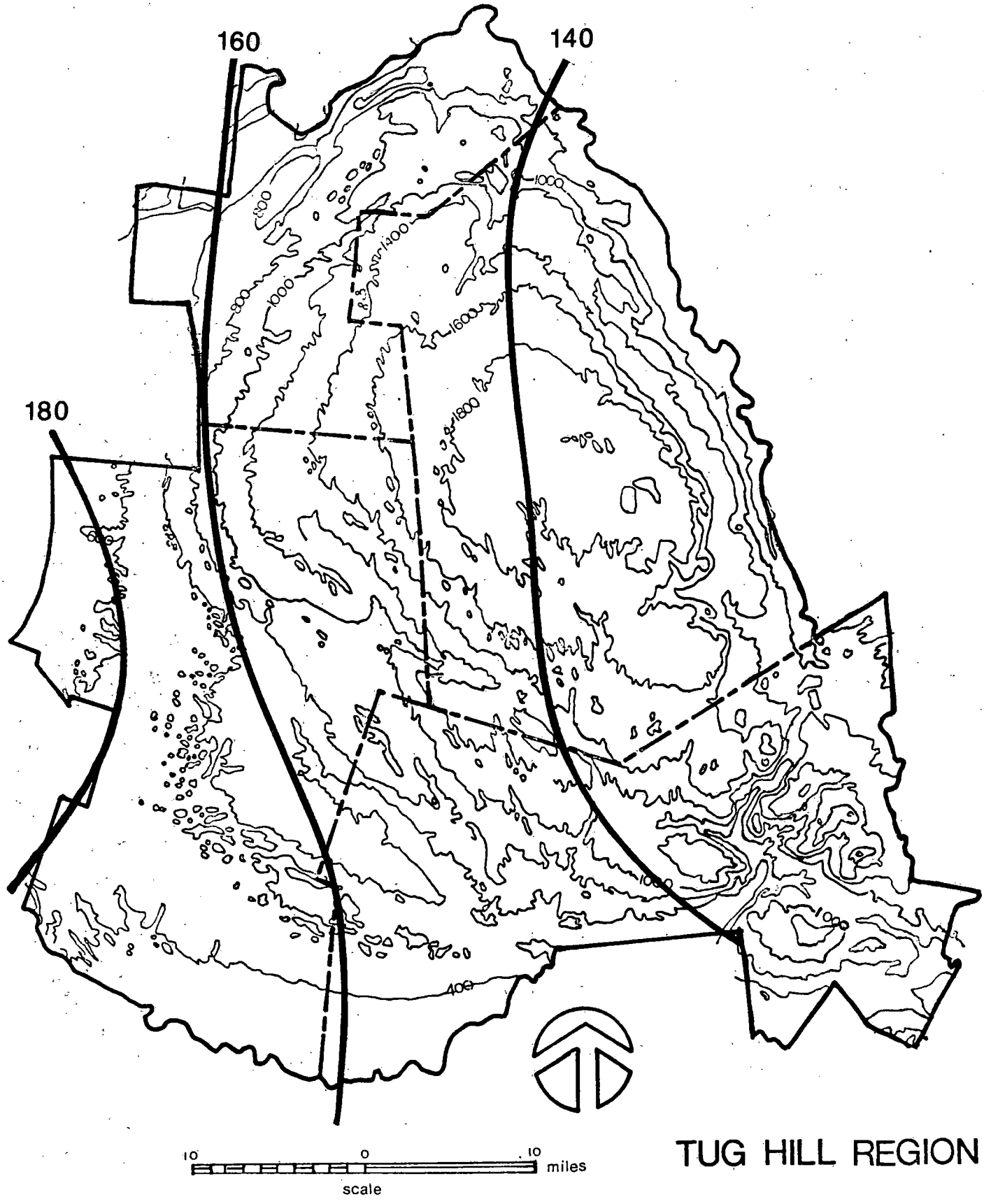


Figure 13. Number of days between mean last day with temperature of 32° F in spring, and mean first day with temperature of 32° F and lower in fall. Tug Hill Region (after Frederick et al., 1959).

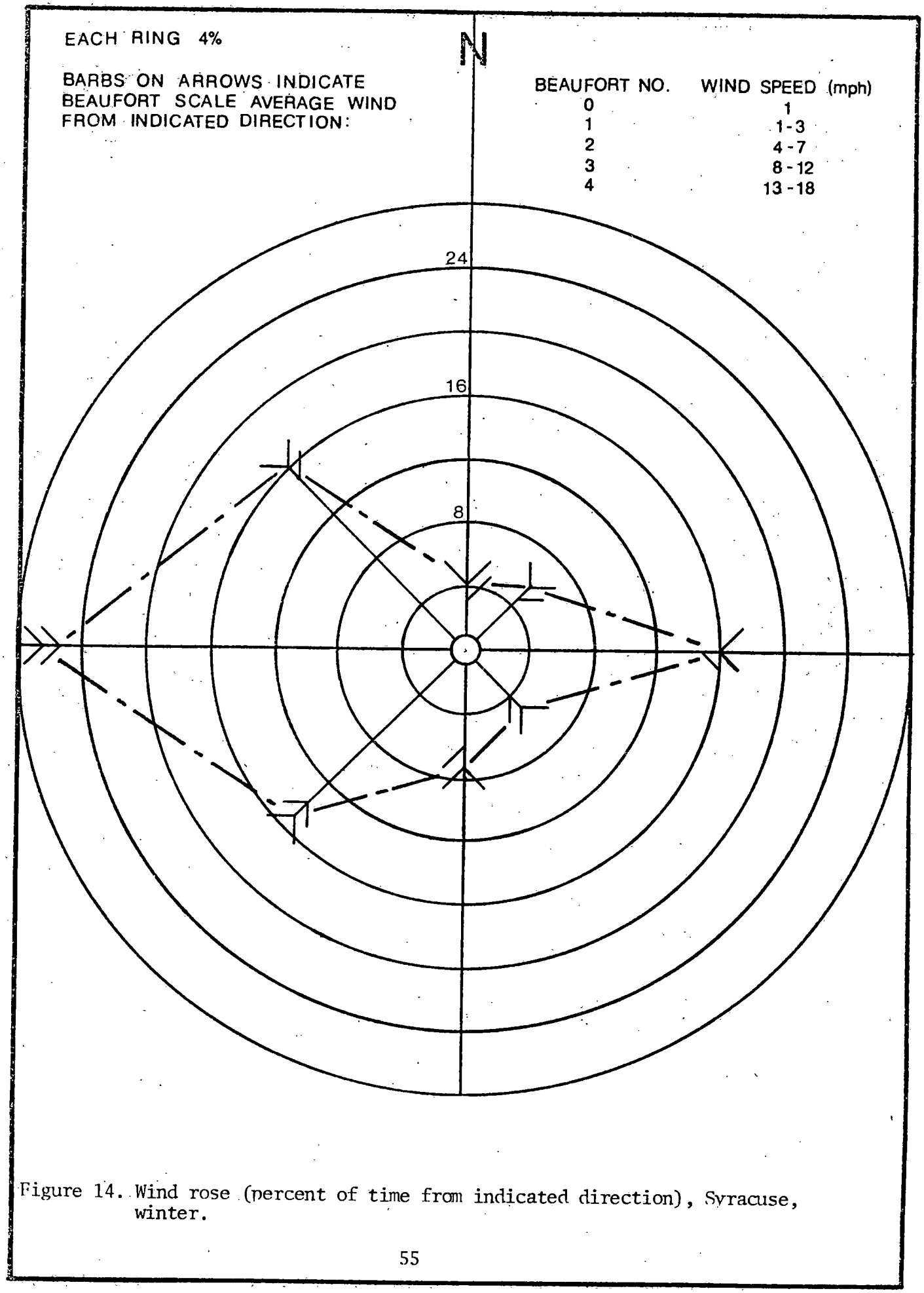


Figure 14. Wind rose (percent of time from indicated direction), Syracuse, winter.

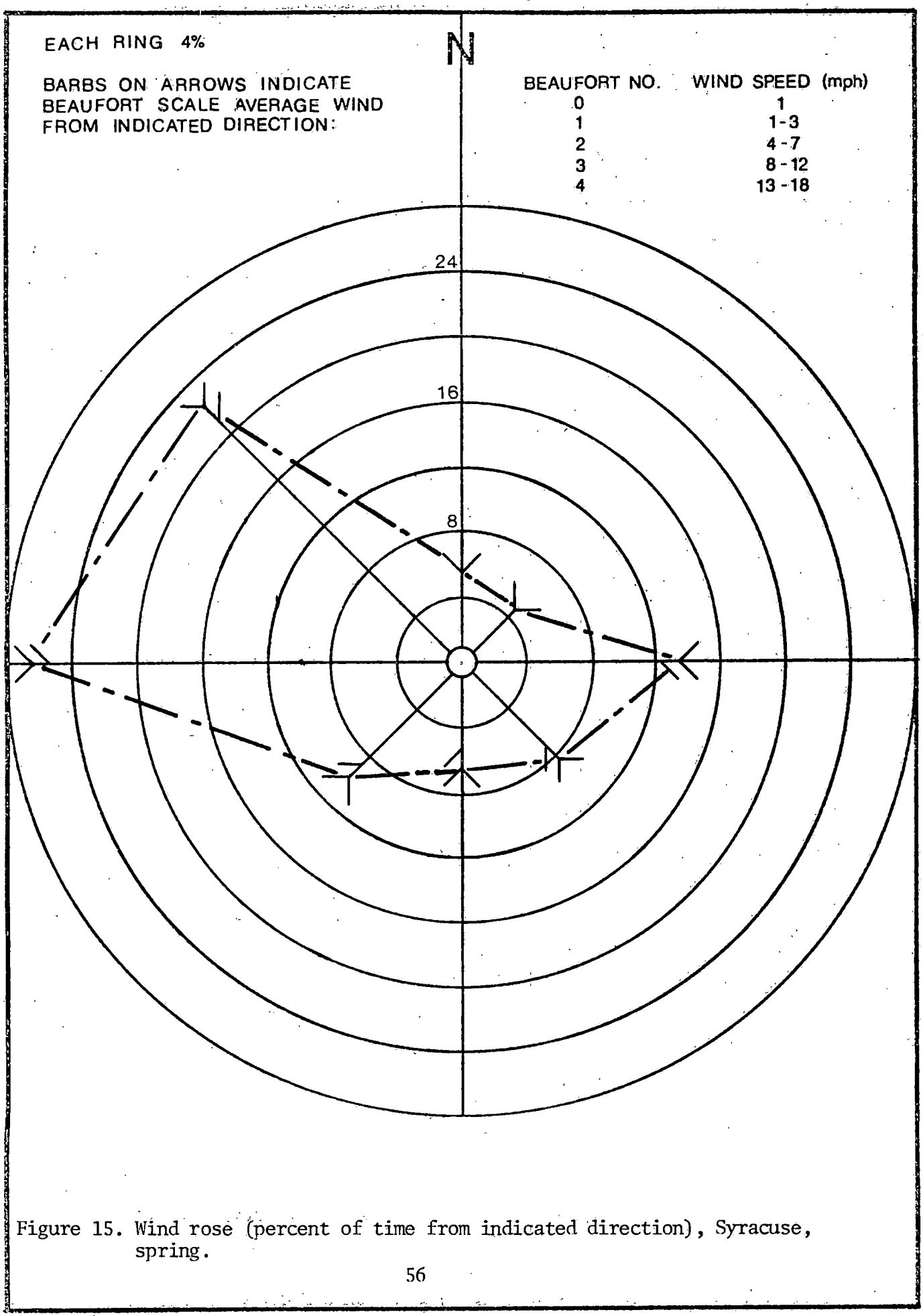


Figure 15. Wind rose (percent of time from indicated direction), Syracuse, spring.

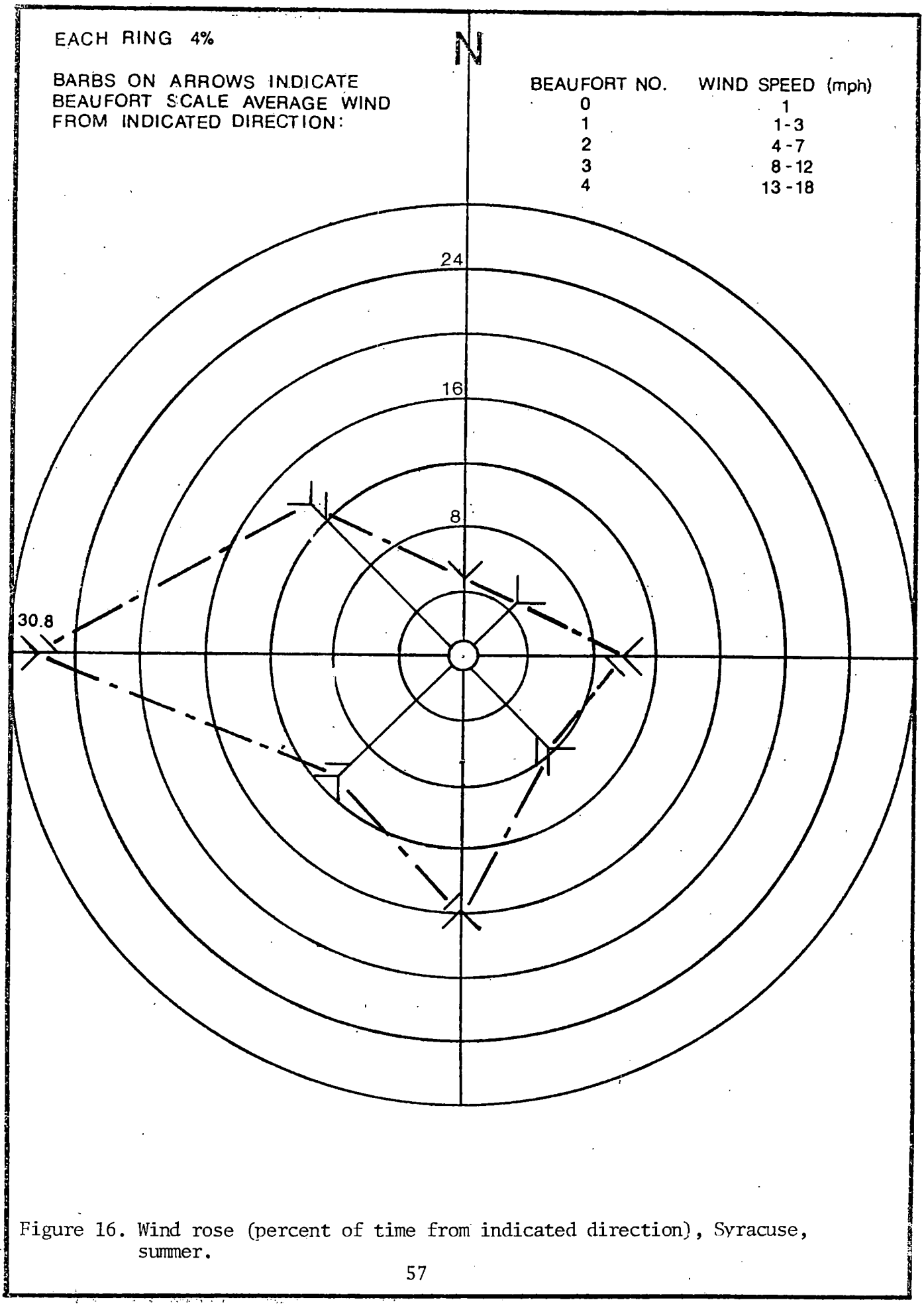


Figure 16. Wind rose (percent of time from indicated direction), Syracuse, summer.

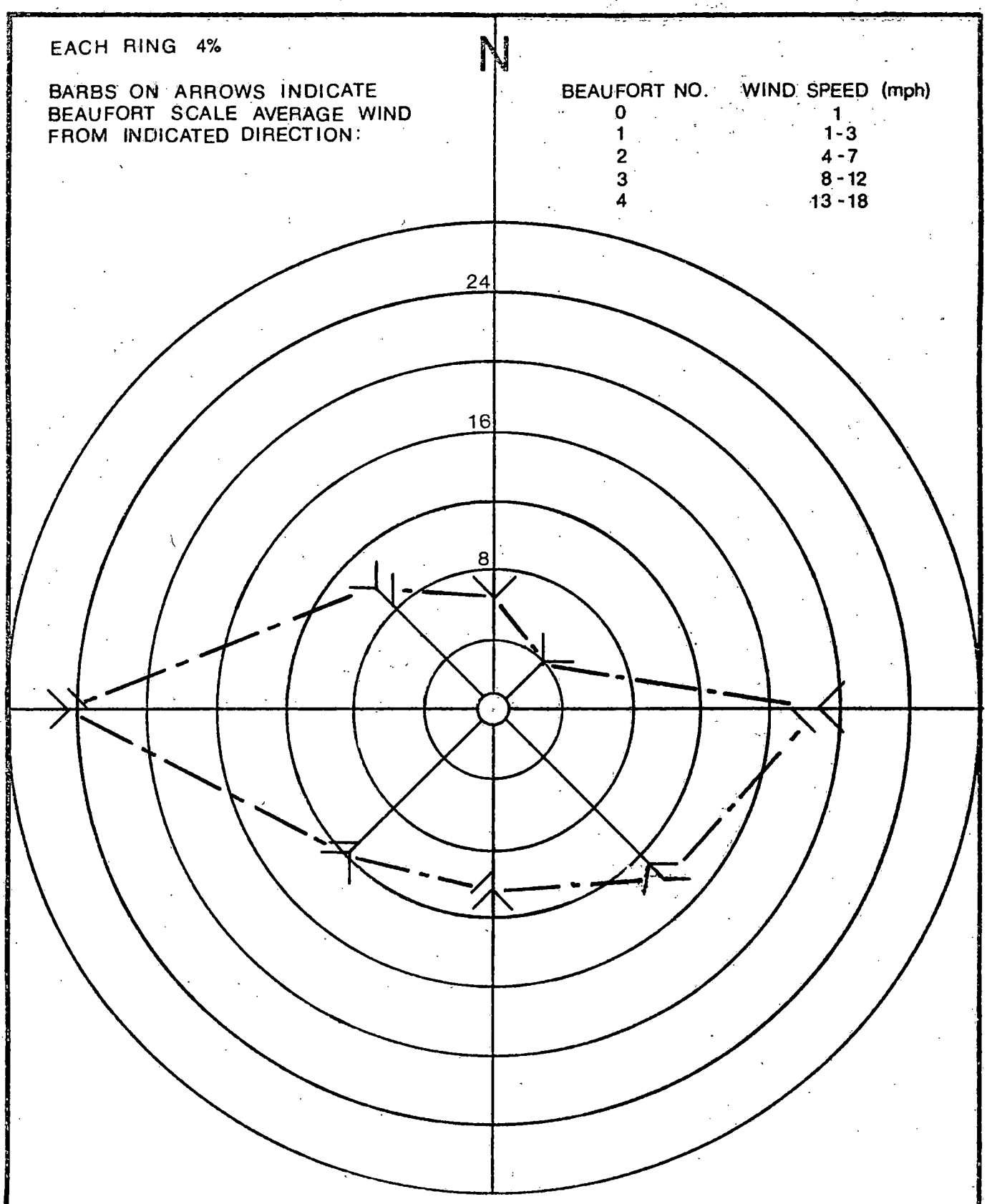


Figure 17. Wind rose (percent of time from indicated direction), Syracuse, fall.

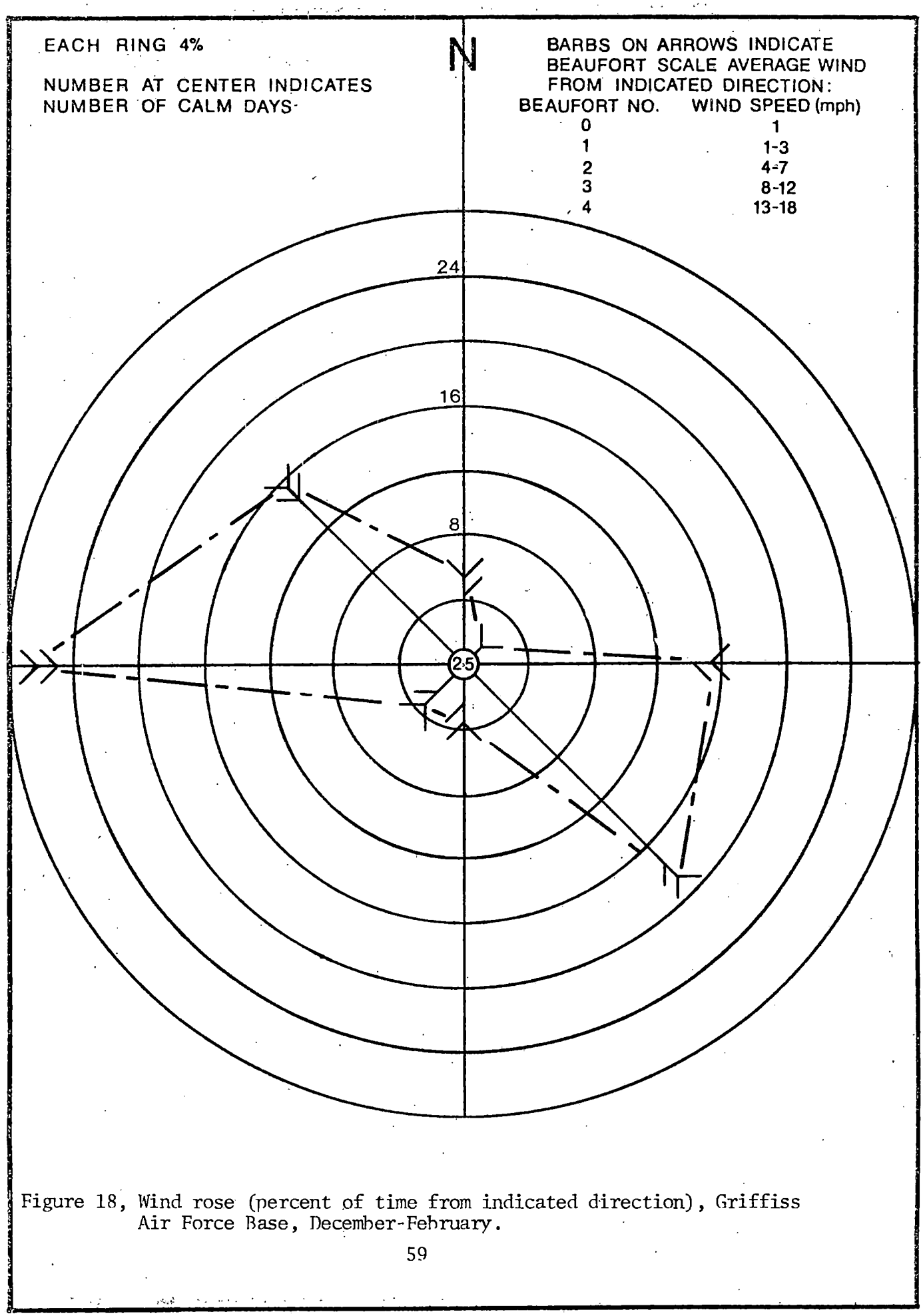


Figure 18, Wind rose (percent of time from indicated direction), Griffiss Air Force Base, December-February.

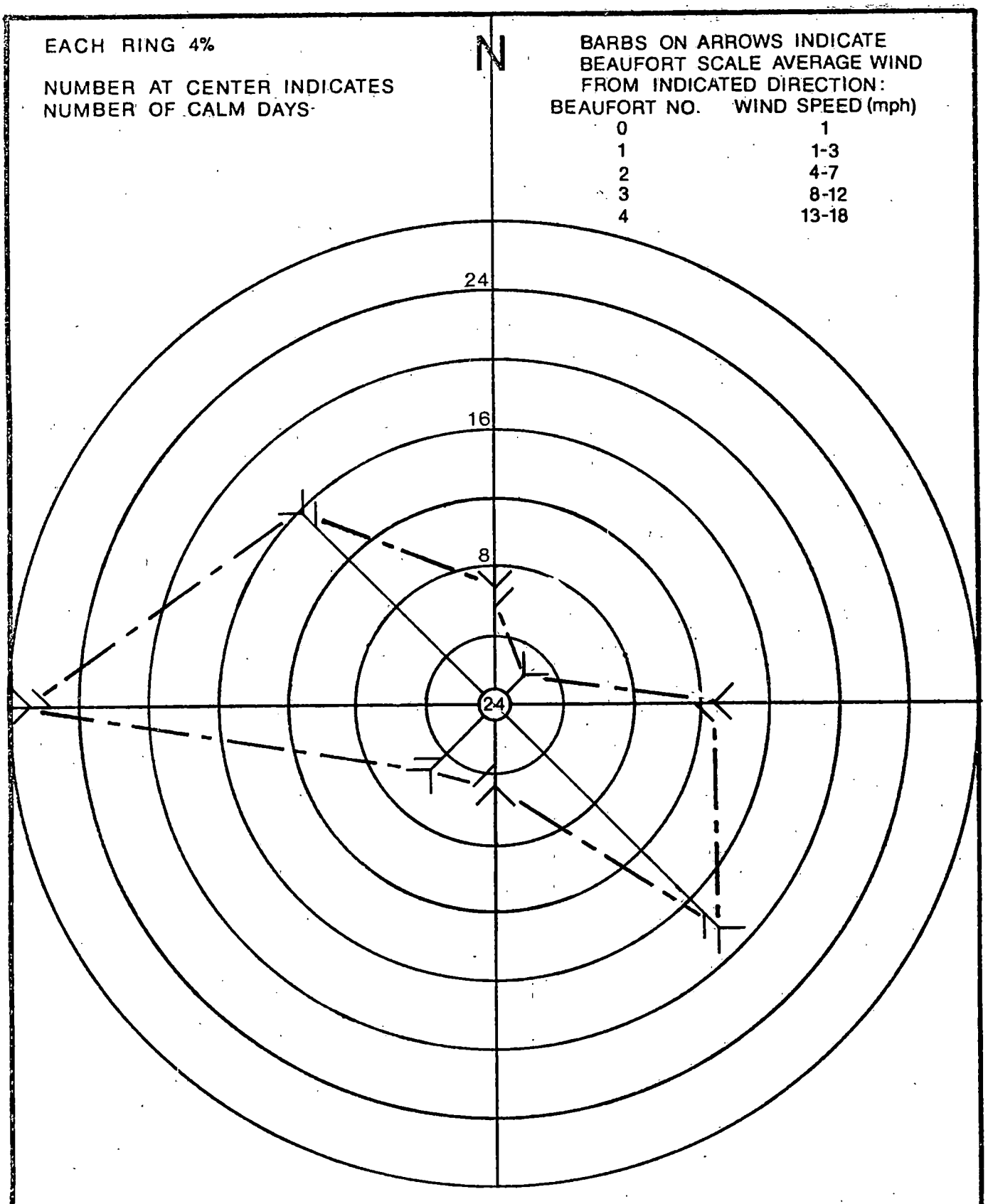


Figure 19. Wind rose (percent of time from indicated direction), Griffiss Air Force Base, March-May.

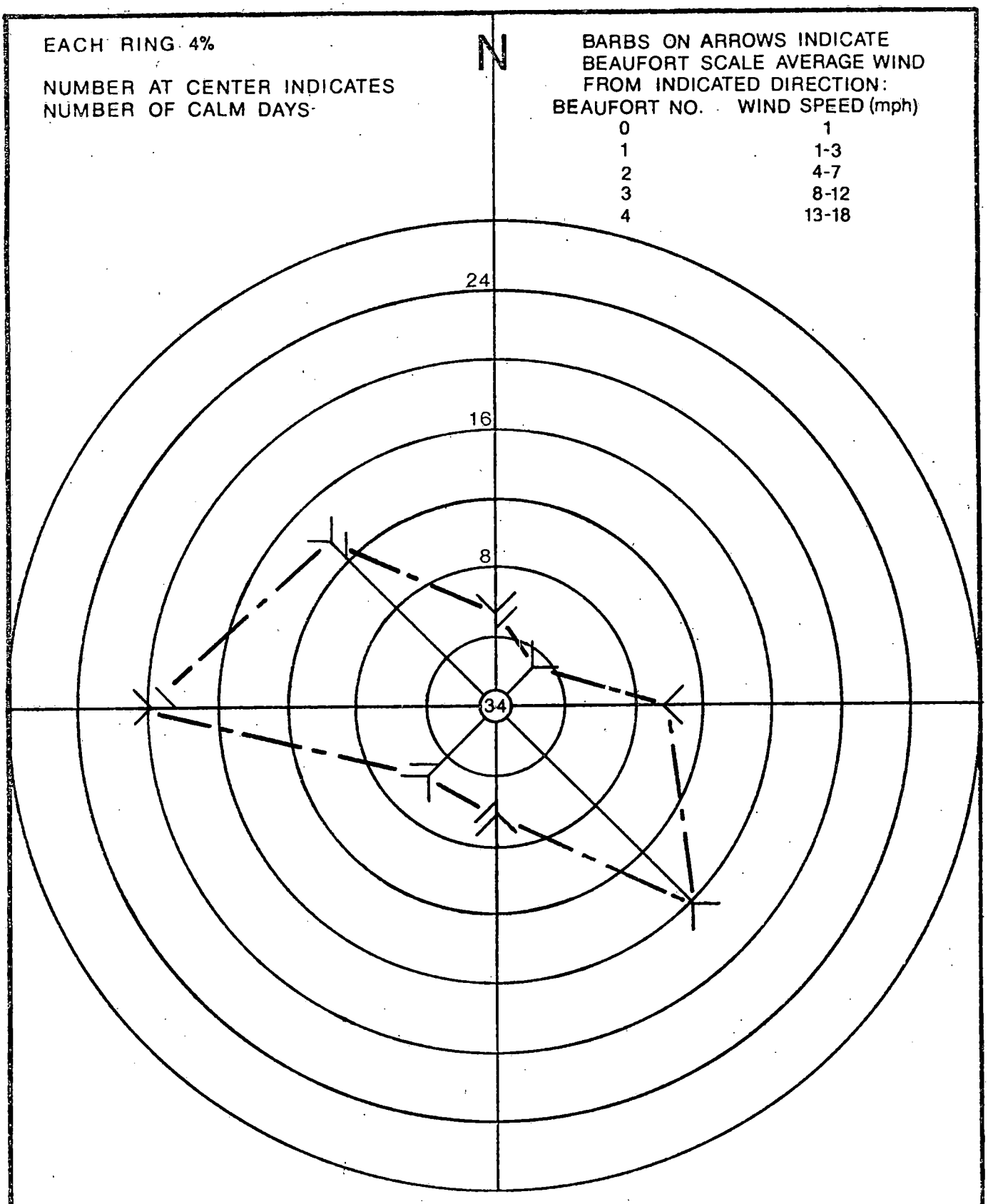


Figure 20. Wind rose (percent of time from indicated direction), Griffiss Air Force Base, June-August.

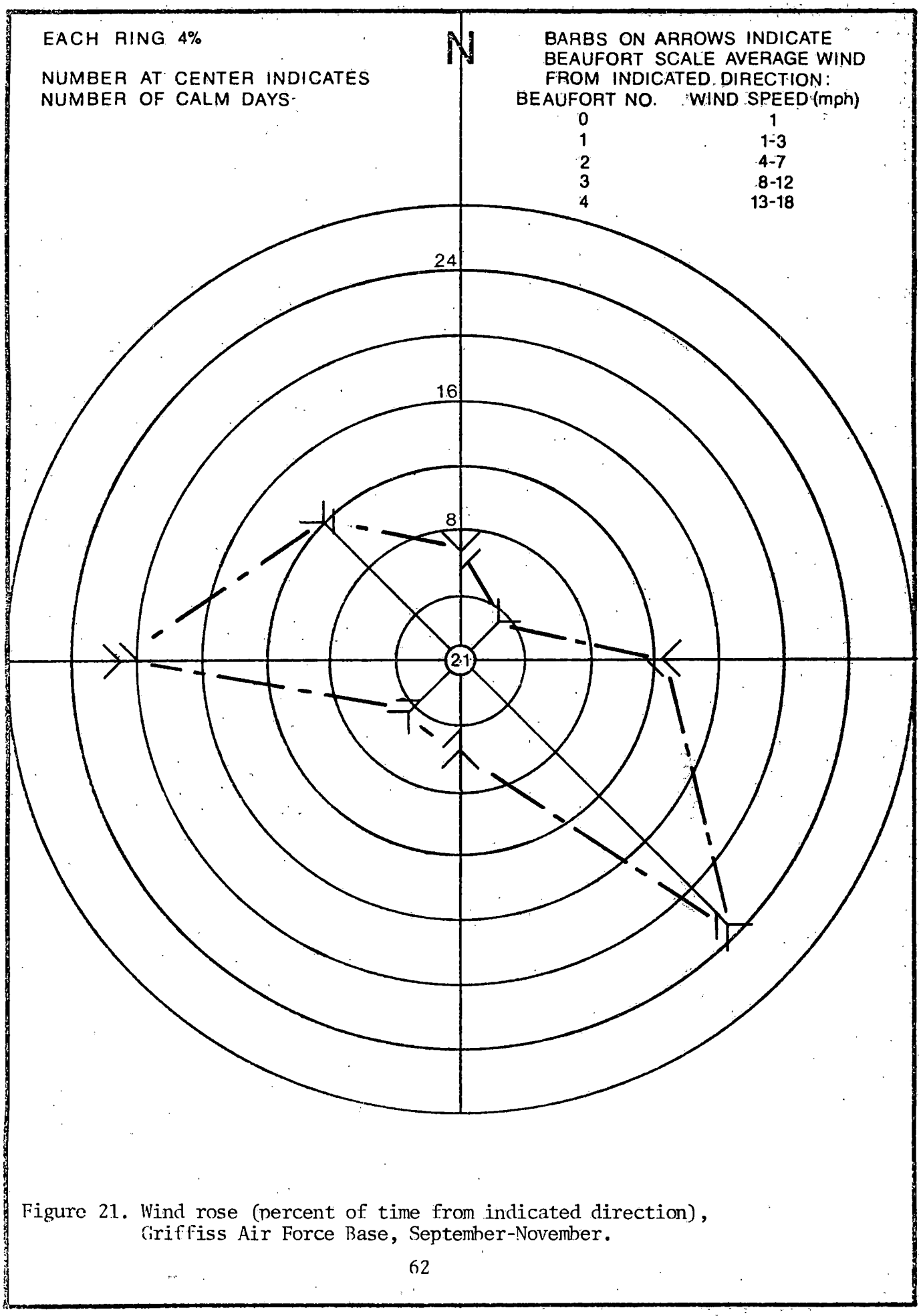


Figure 21. Wind rose (percent of time from indicated direction), Griffiss Air Force Base, September-November.

As at Syracuse, west wind is reported most frequently at Rome except in the fall when southeast winds predominate. This phenomenon may be attributed to blocking highs which settle in the area and provide days of pleasant fall temperature. South and southwest winds increase in frequency during the summer months. North and northwest winds have an even distribution, with northwest winds decreasing only slightly in frequency in the summer and fall. East winds are more common in the winter due to increased cyclonic activity. Again as with Syracuse, wind speeds at Rome are usually higher during the colder parts of the year.

Figures 22 and 23 show windrose data for the Boonville station, located atop the eastern end of the Tug Hill Upland. These data are based upon only three observations per day. Note the absence of easterly winds and the strong preponderance of west, northwest, and southerly winds. Since the Upland contains no topographic features to alter winds caused by the general circulation, as occurs both at Syracuse and Griffiss Air Force Base, and since Boonville wind direction data seem to closely parallel observations made atop the Alleghany Plateau at Tully, New York, we can assume that they are fairly representative of the exposed Tug Hill Upland.

None of the Boonville wind data can be applied to the Black River Valley. As a general rule, winds that blow perpendicular to a valley will not penetrate it unless the air mass is composed of cold, dense air. Thus, the Black River Valley would not be subjected to the strong westerly winds prevailing on the Tug Hill Upland. Northerly and southerly winds, funning parallel to the axis of the Black River Valley would be felt in it. If data were available, we would expect to find a preponderance of northerly and southerly flow in the Black River Valley itself.

Data about wind speed are not available for the central area at the Region. Nevertheless, many signs indicate that winds often blow strongly across the featureless Tug Hill Upland. For example, people familiar with the area speak of the windy conditions in that part of the Region. At exposed places, conifer trees show distorted shapes due to persistent winds, with branches distended eastward, leaving the westward side almost branch free. During winter, snow drifts high into road cuts, often forming banks as tall as 20-30 feet. Many exposed knolls remain clear of snow during winter, despite the great amounts that fall on the Upland. Winds blow the snow into depressions and off the crests of hills. Anyone who has frequently driven across the Upland on a winter's day via Route 177 knows to expect poor visibility due to blowing snow. In late summer, the few fields of grain and hay that are still produced in parts of the Upland may be bent from the wind and driving rains that accompany them. Roofs of many abandoned buildings show wind damage, and shutters of the old houses have blown off. Even some old buildings lean out of plumb. The signs are numerous. Tug Hill Upland is a windy place. But there are not data to show how strongly and persistently the winds blow.

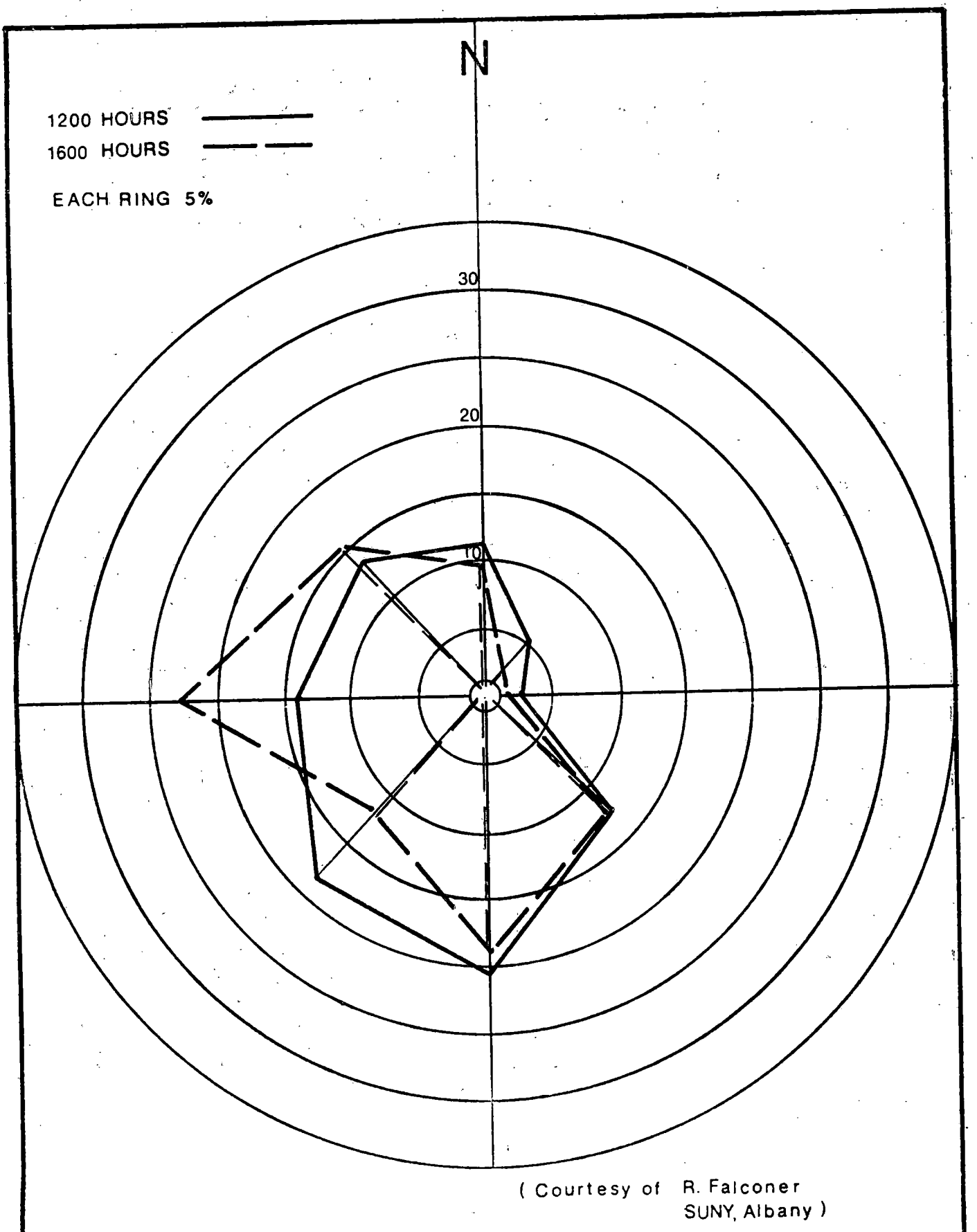


Figure 22. Wind rose (percent of time from indicated direction), Boonville, May-October, 1971-73.

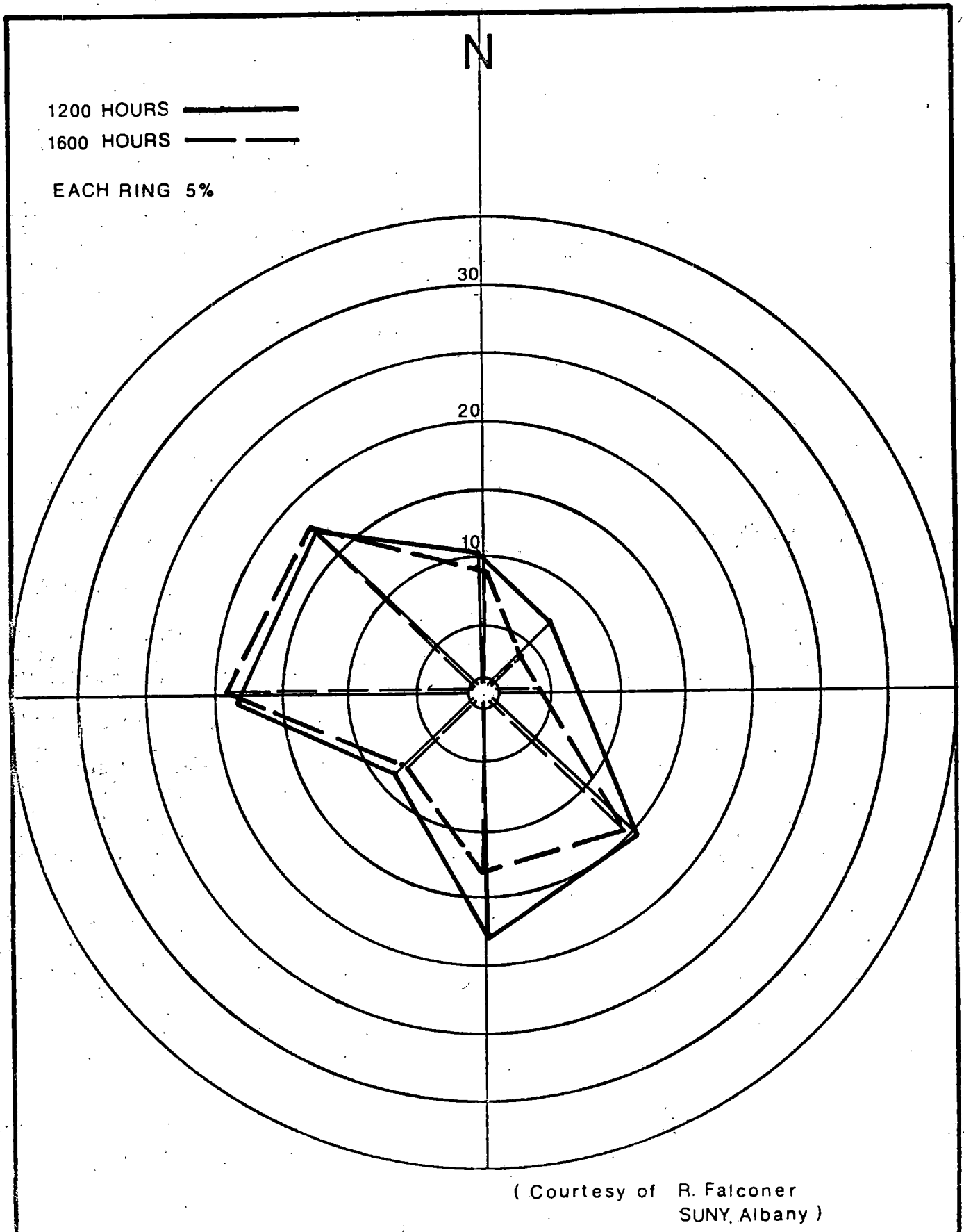


Figure 23. Wind rose (percent of time from indicated direction), Boonville, April, 1971-73.

Storm Tracks

Four maps (Figures 24 to 27) depict storm tracks for well defined cyclones (lows) of the four seasons, covering the specific period indicated on each map. Tracks with labeled numbers and the term "filled" at their ends represent parent storms that weakened rapidly and their energy, vorticity, etc., were transferred to a secondary cyclone identified by a corresponding number at the point of development.

Numbers listed at the beginning of a storm track record the precipitation, in melted form, that each low deposited on Syracuse. Since the center of the Tug Hill Region is only 50 miles northeast of Syracuse, and since storms usually cover hundreds of square miles, inferences can be drawn regarding the cyclonic precipitation in Tug Hill Region, using Syracuse as a reference.

The winter map (Figure 24) illustrates two favored storm tracks. Most obvious is the Atlantic Coast storm track which also seems to produce the most precipitation. The other track follows a broad belt from the Great Lakes to an area north of New York State, with a concentration over northern New York and New England. Precipitation is usually light from these lows.

The primary feature of the spring map (Figure 25) is the large number of secondary storms that develop from the parent lows. Most secondary spring storms fill in the Great Lakes region, with secondary cyclogenesis occuring along the mid-Atlantic coast. Precipitation is evenly distributed. The East Coast is in a common spring storm track, but to a lesser degree than in winter.

The summer map (Figure 26) is noteworthy in that few tracks are evident. Most systems move across Canada. Lows are weaker, as temperature differences supplying energy for storms are diminished. The jet stream, and greatest temperature contrasts, are usually found in Canada. Most precipitation falls from convective clouds either of the air mass or frontal variety. Cold fronts emanate from lows crossing Canada. Note the sparsity of East Coast storms due to presence of the Bermuda High and its ridges. Also, note the path of Hurricane Agnes.

The East Coast again stands out as the scene of frequent storm activity during fall, as storm tracks move south out of Canada (Figure 27). Precipitation is evenly distributed. Those storms moving southeast deposit only a couple tenths of an inch of precipitation. But lows moving in from the northwest produce significant precipitation at Syracuse because the air is relatively warm (can hold more moisture), and the relatively warm waters of the Great Lakes serve as a moisture source to supply the warm air as it moves across the lakes.

For the year as a whole, most storms travel along the East Coast, or approach New York from the Great Lakes and move past New York to the north. Few traverse west to east in the area south of New York, since the Appalachians act as a barrier to storm movement. Frequently a low will pass west of the Appalachians on a northeast heading, fill or occlude, and form a secondary low over the Virginia Capes. Note that few lows actually exit via the St. Lawrence Valley. In the summer, temperature contrasts, and the jet

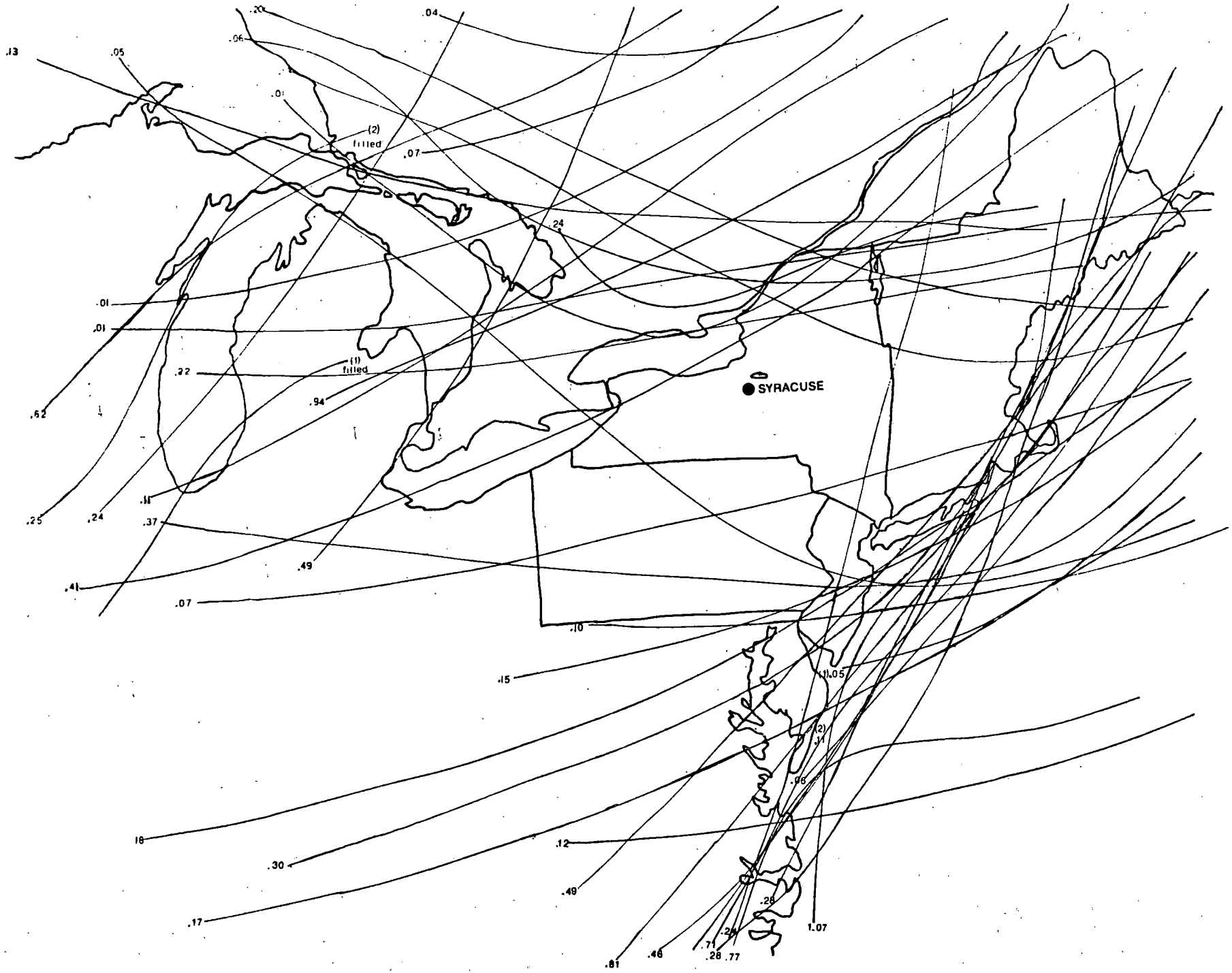


Figure 24. Winter storm tracks, 1971-72 and 1972-73.

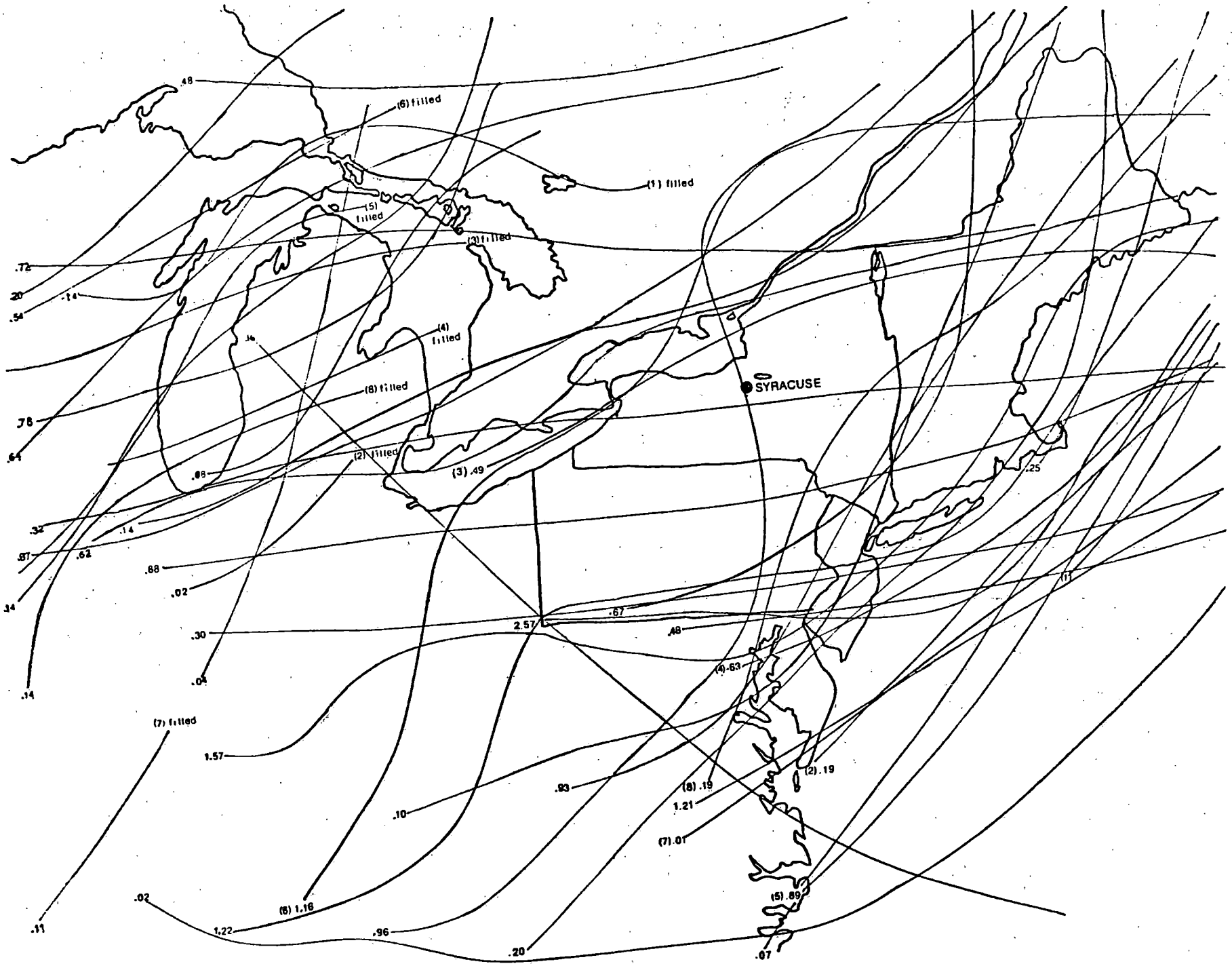


Figure 25. Spring storm tracks, 1972 and 1973.

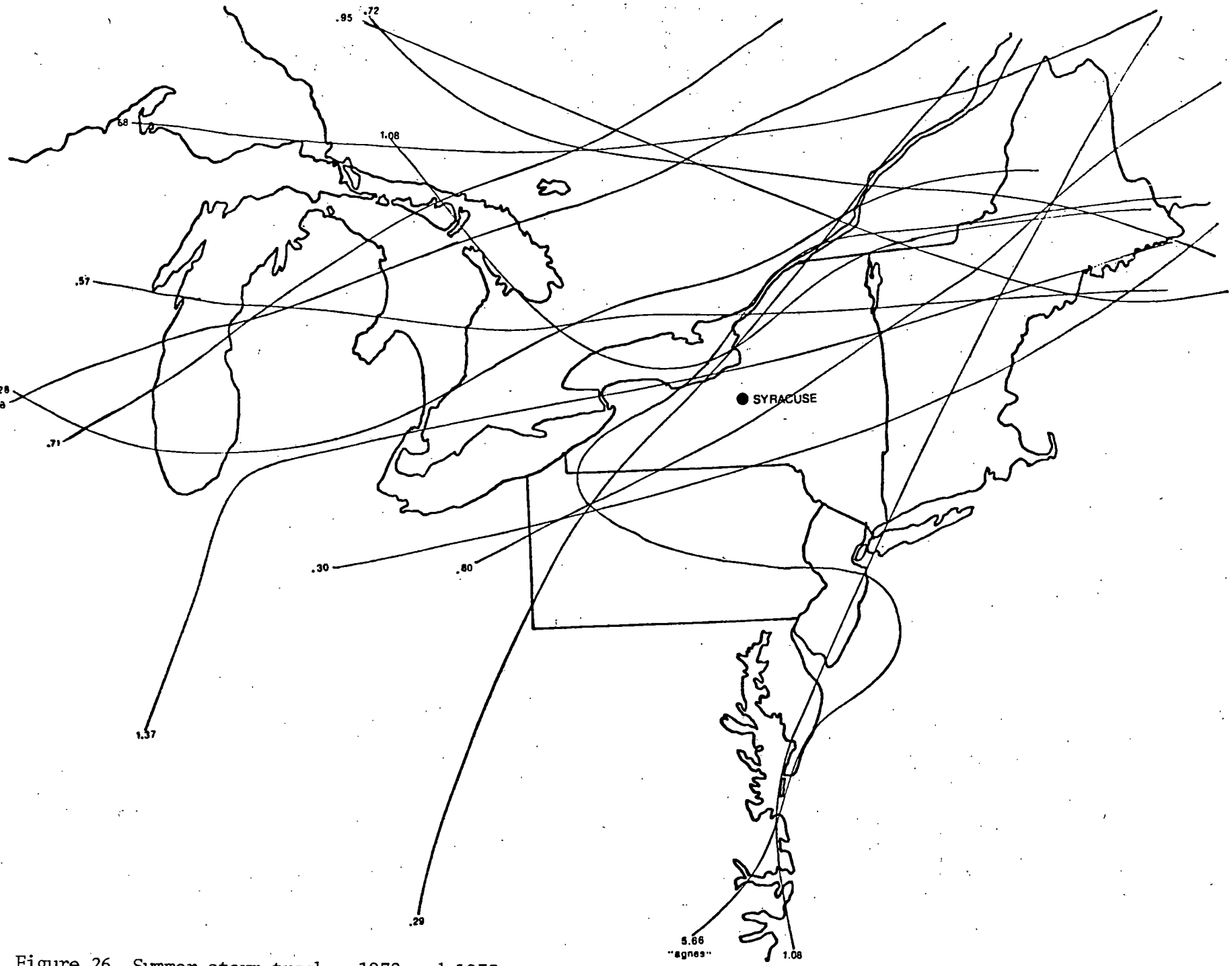


Figure 26. Summer storm tracks, 1972 and 1973.

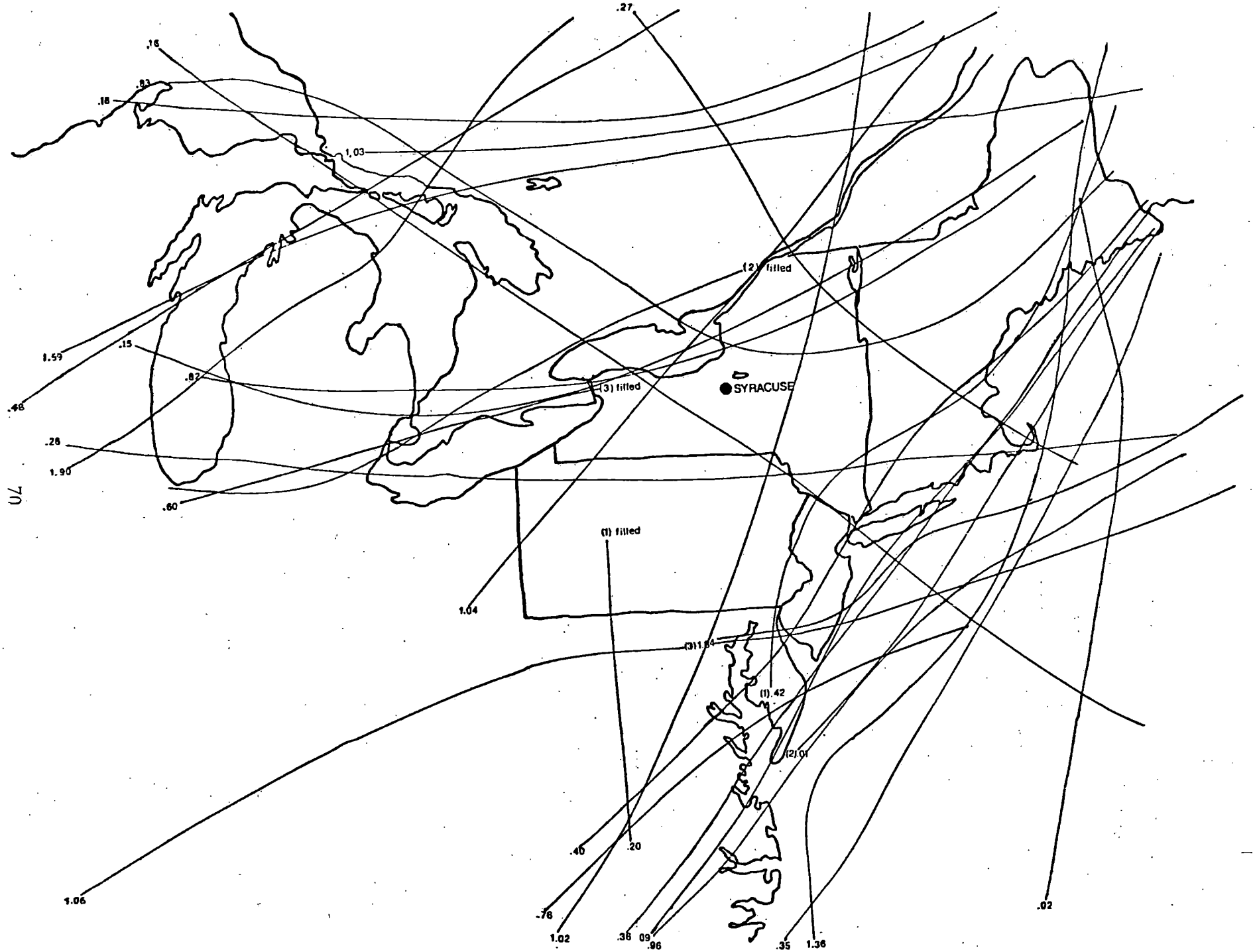


Figure 27. Fall storm tracks, 1971 and 1972.

stream and its associated storm activity, move north into central Canada.

In addition to that produced by cyclones, precipitation also falls from ill-defined lows, troughs, overrunning effects, instability showers and weaknesses in the pressure field. Fronts emanating from lows off the borders of these maps may also trigger precipitation.

The maps show storm tracks over a short period of time but are likely representative of the long term average. Generalizations can be made with caution, since nothing in weather is consistent except its inconsistency.

Precipitation

Quantitative data for precipitation can be found in Figures 28 and 30, and Figures 35 through 37. Its significance to the Tug Hill Region is best considered in detail with discussion of the Region's water resources that follow. However, generally precipitation is abundant throughout the year, averaging about 45 inches or more of water equivalent annually.

Winter precipitation data (Figure 29) show a direct correlation with elevation, and appear primarily due to lake effect storms. These occur most commonly in early winter associated with winds moving from the west across Lake Ontario. As the unstable, moisture-laden west winds are pushed upward by the land, they cool and cause precipitation over the Region, often as heavy snowfall. Strong wind blowing across the exposed, featureless Upland cause considerable drifting.

Note that winter season isohytes in Figure 2 closely conform to the pattern of contours on Map 2. In winter most of the storm precipitation comes from storms moving up the Atlantic Coast. Tug Hill Upland lies to the north of these cyclones. Thus winter snowfalls, aside from those coming from lake effect storms in early winter, would be associated with southerly and easterly winds. These, too, are pushed up by the rise of land within the Upland, cool, and result in precipitation as snow.

Summer precipitation (Figure 30) shows a pattern apparently associated with both elevation and some factor other than lake effect storms. The summer storm tracks run north of the Region and most precipitation is associated with either a convective storm in the warm sector of the cyclone, or with cold front activity. Both of these depend upon warm air for moisture. With the storms passing to the north where the air is cooler, and pushing against warm air to the south, an increase in precipitation in the south must be expected. The wedge-shaped set of isohyets showing a maxim over Trenton, however, is hard to explain. Since lake effect storms are not active in the summer the high amount of summer precipitation at Trenton must be due to air mass or cyclonic storms.

AIR QUALITY OF TUG HILL

Air Quality Climatology

General climatological characteristics important to air pollution in the Tug Hill Region are: 1) the generally strong west or northwest winds blowing over the Upland; 2) precipitation associated with this flow; and 3) the location

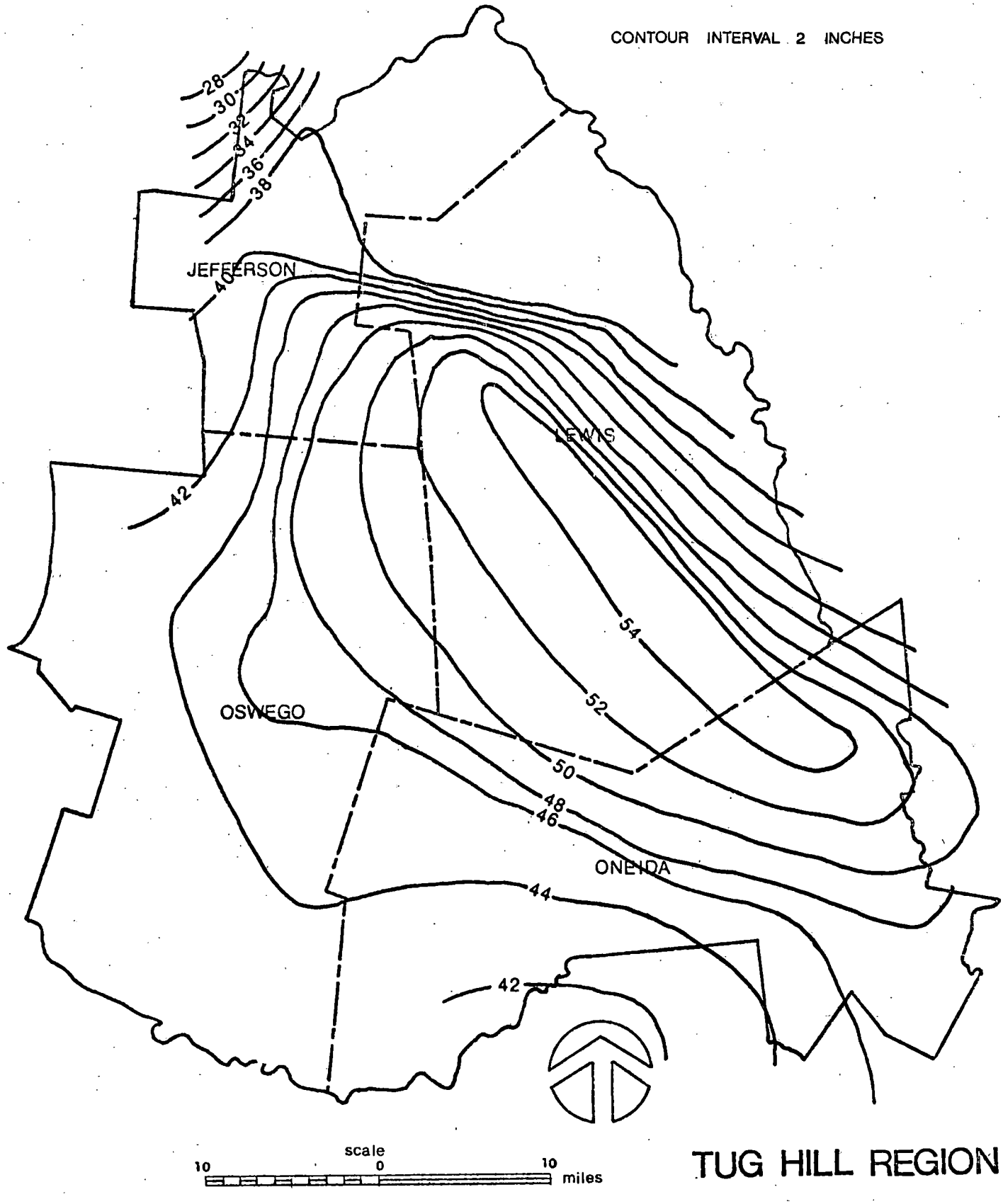


Figure 28. Isohyetal map of annual precipitation, Tug Hill Region.

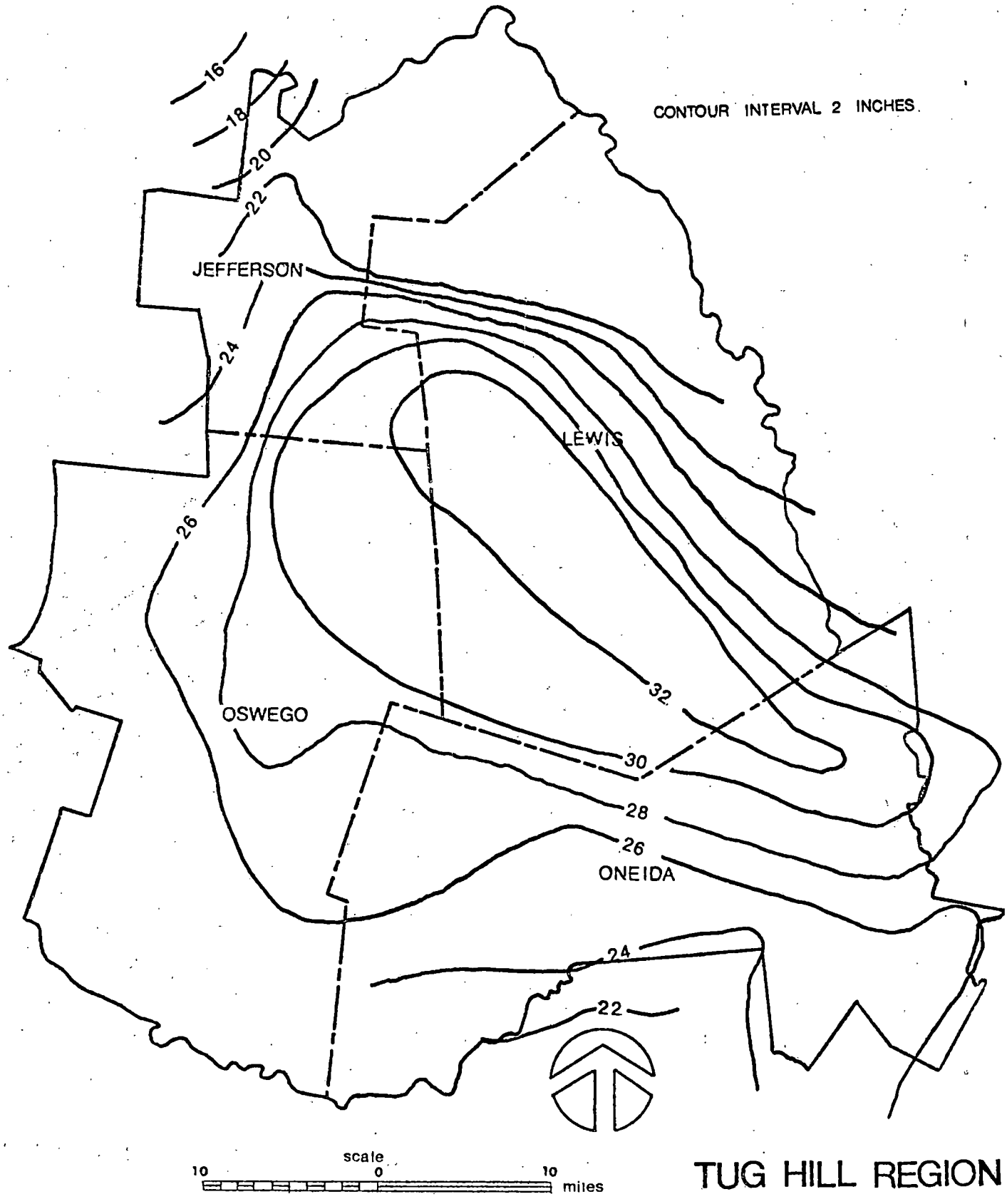


Figure 29. Isohyetal map of precipitation for the Tug Hill Region, October-April.

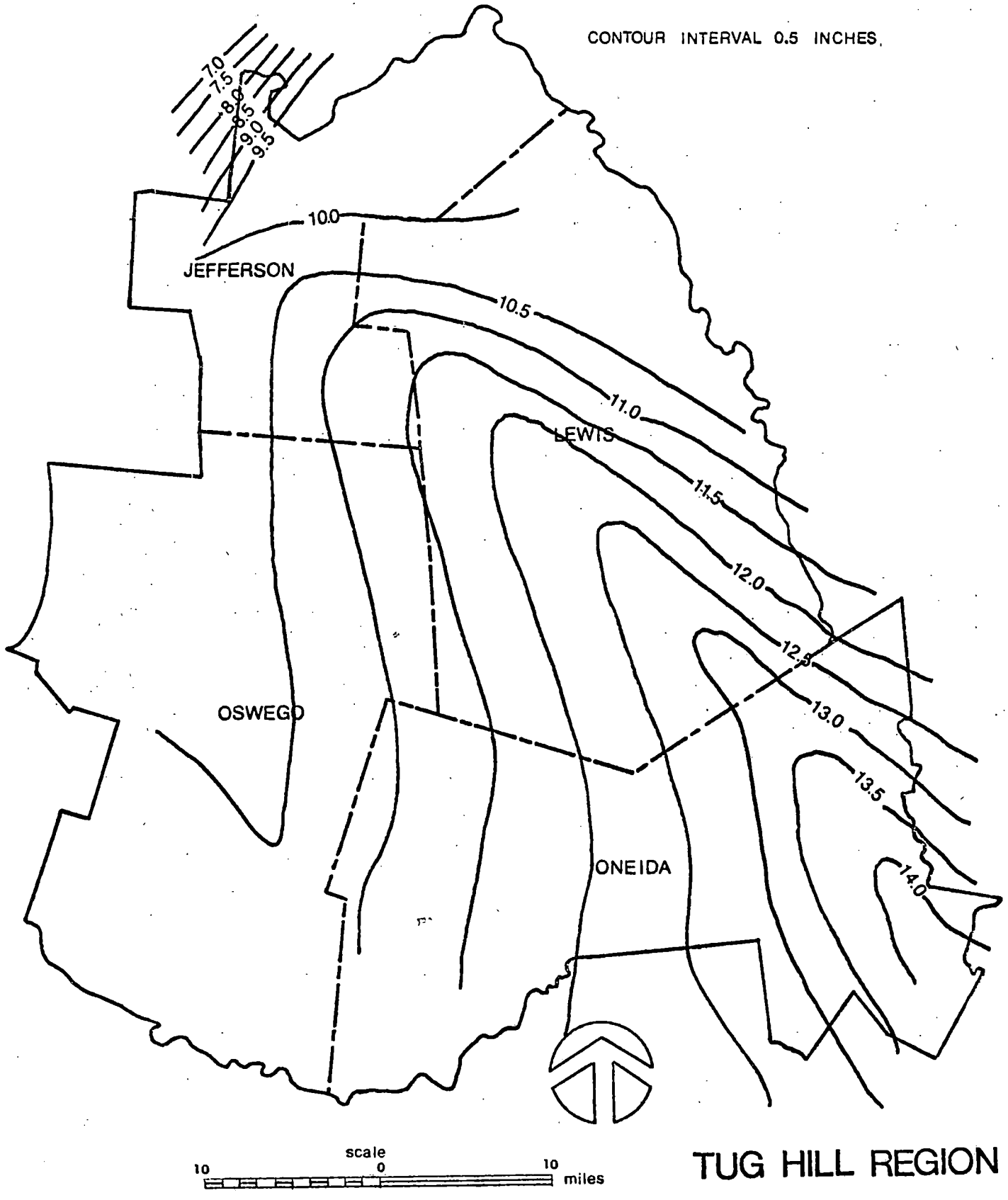


Figure 30. Isohyetal map of growing season precipitation for the Tug Hill Region, June-August.

of some towns within the Mohawk and Black River valleys.

The large scale climatology of potential urban air pollution for the Region can be obtained from a publication by Holzworth (1972). Therein he describes mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous states. Three parameters are important to the potential for urban air pollution. These are mixing height, wind speed, and size of the city.

Mixing height is the height above the surface through which relatively vigorous vertical mixing occurs. The deeper this mixed layer, the less the potential for air pollution problems since the pollutant can be dispersed through a greater thickness of atmosphere. The mean wind speed of the mixed layer is also directly corralated with air pollution potential. Higher wind speeds lead to lower air pollution potentials.

Table 11 lists these two variables as extracted from the maps in Holzworth's (1972) publication. For comparison, data for Albany, New York are also included. Using the two variables of mixing height and wind speed, plus a standard city size of 10 kilometers, the average urban concentration of air pollutants as normalized by the average urban emission rate can be computed. This quantity is called the average normalized concentration (X/Q), and is listed in the table as values which will be exceeded 50 percent, and 10 percent of the time. Although the Tug Hill Region is not heavily urbanized, the normalized concentration does, never-the-less, indicate its general air pollution potential. The higher the X/Q, the higher the pollution potential.

Data in Table 11 show that for the Tug Hill Region the potential for air pollution is quite similar to that for Albany for the 50 percent probability of occurring, both in morning and afternoon. However, for the 10 percent probability values at all seasons under mean morning conditions, the potential for pollution shows up for the Tug Hill Region about half as high as calculated for Albany. Afternoon conditions appear similar, even at the 10 percent probability level.

Maps by Holzworth show that the Region is not much different from the rest of the state, except for the 10 percent morning X/Q values. National maps delineate an area of 10-percentile maximum average normalized concentration as running on a northeast-southwest axis through Albany. Thus, the Tug Hill Region shows a climatological advantage in terms of air pollution only during winter mornings.

Air pollution episodes are not only a function of the parameters listed above, but are also of the occurence of stagnated high pressure systems. These high pressure systems, with their characteristic large-scale downward motion in the atmosphere, produce low level inversions that trap pollution near the ground and result in "episode days". Holzworth (1972) has calculated extensive charts for predicting the total number of "episode days" in given periods of time. In general, the Tug Hill Region shows up favorably in these charts. The summary chart listing total number of forecast days of high meterological potential for air pollution in a 5 year period indicates that Tug Hill would appear to have less than 10 days of high potential for air pollution. This compares with 70 days for the California coast, for instance, which is notorious for air pollution "episodes".

Table 11 . Mixing heights, wind speeds, and potential for urban air pollution for Tug Hill Region and Albany, N.Y.

Time period	Mixing heights, in meters		Wind speed, in meters per second		X/Q, in seconds per meter			
	Tug Hill	Albany	Tug Hill	Albany	Tug Hill		Albany	
					50 percent	10 percent	50 percent	10 percent
Mean morning conditions								
Annual	600	675	6.0	5.4	10	30	10	75
Winter	800	800	7.0	6.7	9	30	9	74
Spring	600	786	6.0	6.1	10	30	10	58
Summer	400	527	4.0	4.1	13	40	12	88
Fall	600	583	5.0	4.8	11	40	11	74
Mean afternoon conditions								
Annual	1200	1484	7.0	7.6	9	10	9	10
Winter	800	967	8.0	7.6	9	11	9	12
Spring	1400	1753	8.0	8.7	9	10	9	10
Summer	1700	1943	7.0	7.0	10	10	9	10
Fall	1200	1272	7.0	7.2	10	11	9	11

On a more local scale, the Region may actually fare better in terms of air pollution potential than the charts indicate. Being situated to the east of Lake Ontario, and being subjected to the prevailing westerly and northwesterly winds, the air entering the Region is relatively clean. High rates of rain and snowfall tend further to scavenge the air of pollutants that may be held in it (Engelmann, 1968).

Areas within the Black River Valley and Mohawk Valley will be subjected to higher air pollution concentrations than places on the Tug Hill Upland. During clear nights these valleys tend to accumulate cold air draining off the surrounding highlands as they cool by radiation. Collection of cold air in the valley bottom will create inversions that trap air pollutants from industry, homes and vehicles.

AIR QUALITY DATA

Except for the monitoring of air-borne particles having a high affinity to water vapor, called condensation nuclei, by Livingston Lansing at Boonville, there are no air pollution or air quality data available for the Tug Hill Region. The New York State Department of Environmental Conservation maintains numerous air quality sampling stations throughout the state. Near the Tug Hill Region they have samplers located in Syracuse, Fulton, Oswego, Waterville, Lowville, and Utica. These sampling stations are located within cities or towns and all include high volume samplers to measure suspended particulates. Only a few include measurements of settleable particulates (dust fall), photochemical oxidants, hydro-carbons, carbon monoxide, nitrogen dioxide, florides, and beryllium. Data from these stations have not been included in this report because they have only limited usefulness. Cities and towns are uncommon in the majority of the Tug Hill Region. Although the Department of Environmental Conservation does maintain "background" stations, none of these are located within the Tug Hill Region.

Mr. Ray Falconer of the State University of New York at Albany has provided data dealing with the concentration of small particles (condensation nuclei) at Boonville and several other New York State locations (Table 12). The table shows that air at the Boonville station is relatively clean. Figures 31 through 34 show Boonville data as a function of wind direction. Wind speed data are also included in these diagrams. The measuring station at Boonville is located southwest of the village and the high concentrations recorded with winds from the north and northeast undoubtedly reflect the presence of Boonville and the other towns in the Black River Valley. Even so, these data would indicate that, in general, the Tug Hill Region is relatively clean and the only major sources of pollution would be fumes originating from sizable villages and towns in and around the area. This conclusion is borne out by the Department of Environmental Conservation engineers engaged in air quality measurement. They consider the Tug Hill Region to be clean and, therefore, not needing air quality monitoring. Therefore, preparation of a catalog of pollution sources seems unnecessary.

CLEAN AIR RESERVOIR

In our opinion, the concept of a clean air reservoir has limited applicability to the Tug Hill Region. The term "reservoir" implies impoundment and controlled release or, at the very least, periodic release. This concept seems most appropriate to areas situated in large valleys regularly subject to

Table 12. Average concentration of small particles by wind direction, including wind speed in miles per hour at 4:00 p.m.[a]

Station	Particles per cubic centimeter at different wind directions								
	North	Northeast	East	Southeast	South	Southwest	West	Northwest	Calm
Whiteface (1980 feet)									
May-Oct, 1971-72	4080-5	8600-6	5730-6	3140-5	4330-5	3540-7	4100-7	5840-5	4090
Nov-Apr, 1971-73	5130-6	5850-4	6000-5	4650-5	2520-7	4220-0	4530-10	4580-7	4260
Bemus Point									
May-Oct, 1971-72	15,950-7	16,090-10	16,350-6	15,300-7	9030-9	8757-12	12,260-14	9280-0	10,060
Nov-Apr, 1971-73	10,340-11	15,760-8	12,690-8	11,760-10	10,000-10	7210-11	6400-14	8300-12	9000
Lockport									
May-Oct, 1971-72	41,200-7	45,000-7	44,500-8	58,250-7	47,230-8	46,910-10	42,410-9	42,100-10	35,750
Nov-Apr, 1971-73	42,100-8	43,150-11	46,600-8	39,500-3	47,350-11	43,950-10	41,200-9	40,400-10	44,400
Boonville									
May-Oct, 1971-72	9600-7	2070-3	1430-6	4150-9	5580-8	5430-8	5140-11	5230-10	6190
Nov-Apr, 1971-73	11,200-6	5390-5	3740-7	3800-12	4290-10	3580-7	3750-12	6230-7	9000

[a]Data courtesy of R. Falconer, SUNY Albany.

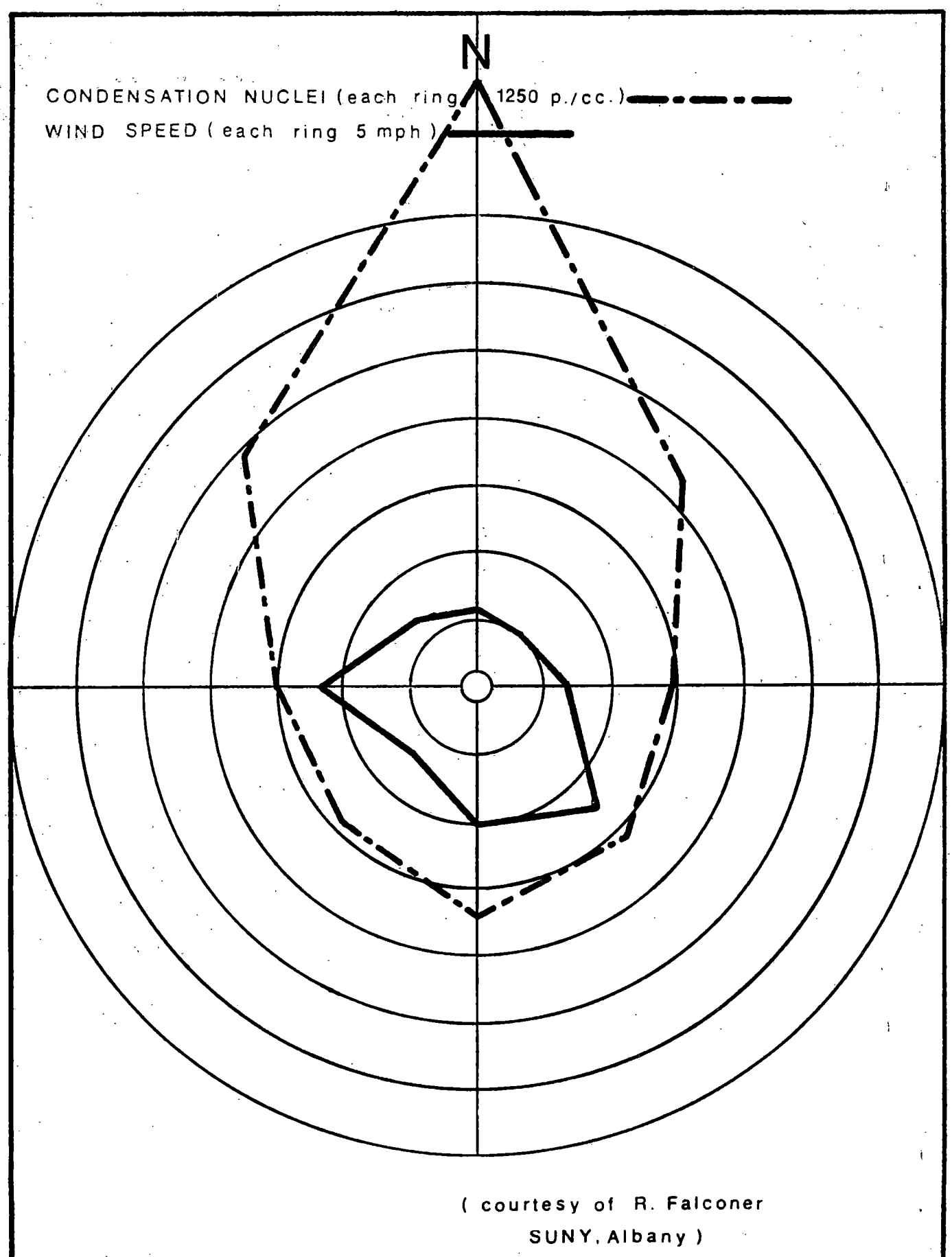


Figure 31. Condensation nuclei and wind speed at Boonville, November-April, (1971-73), 1600 hours.

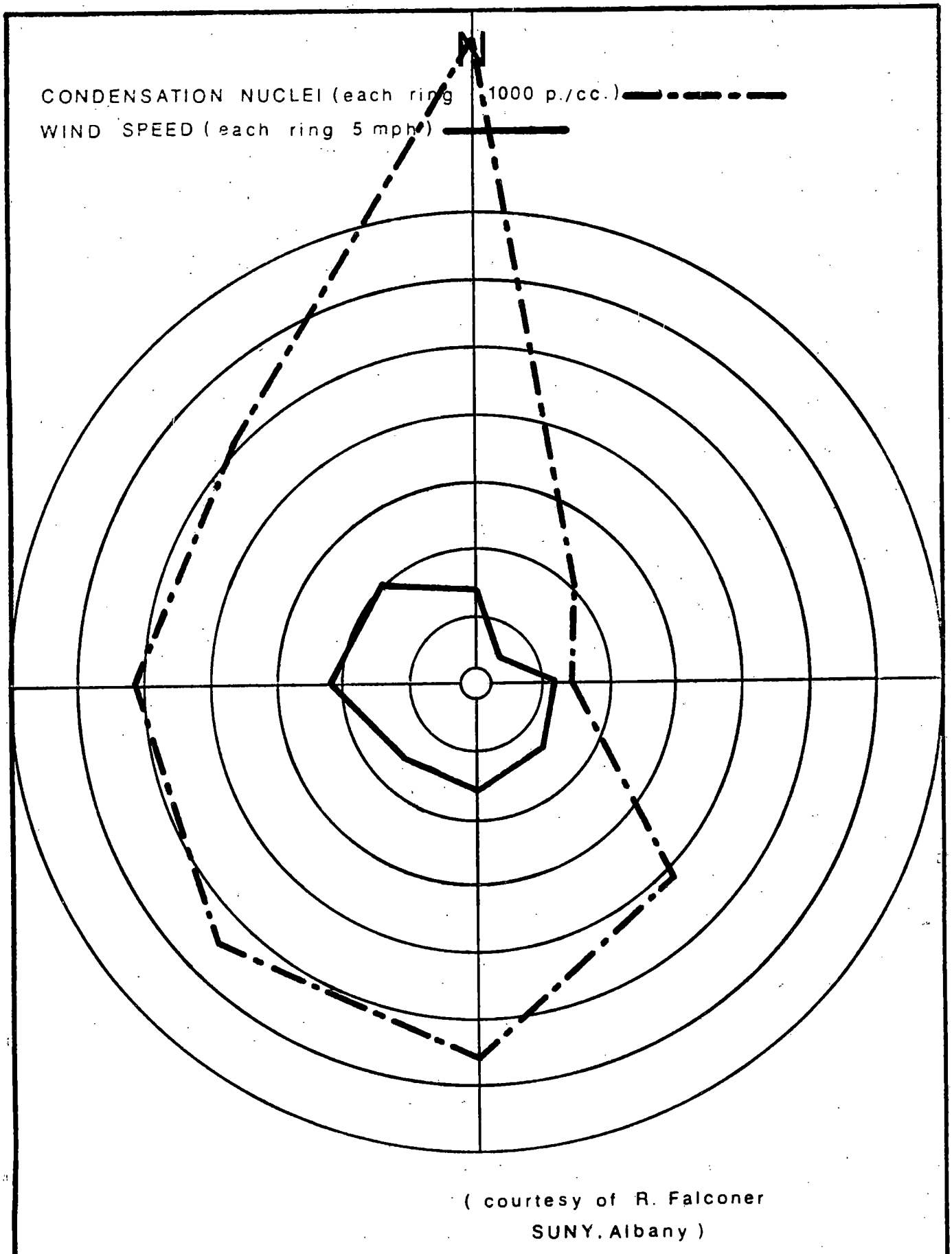
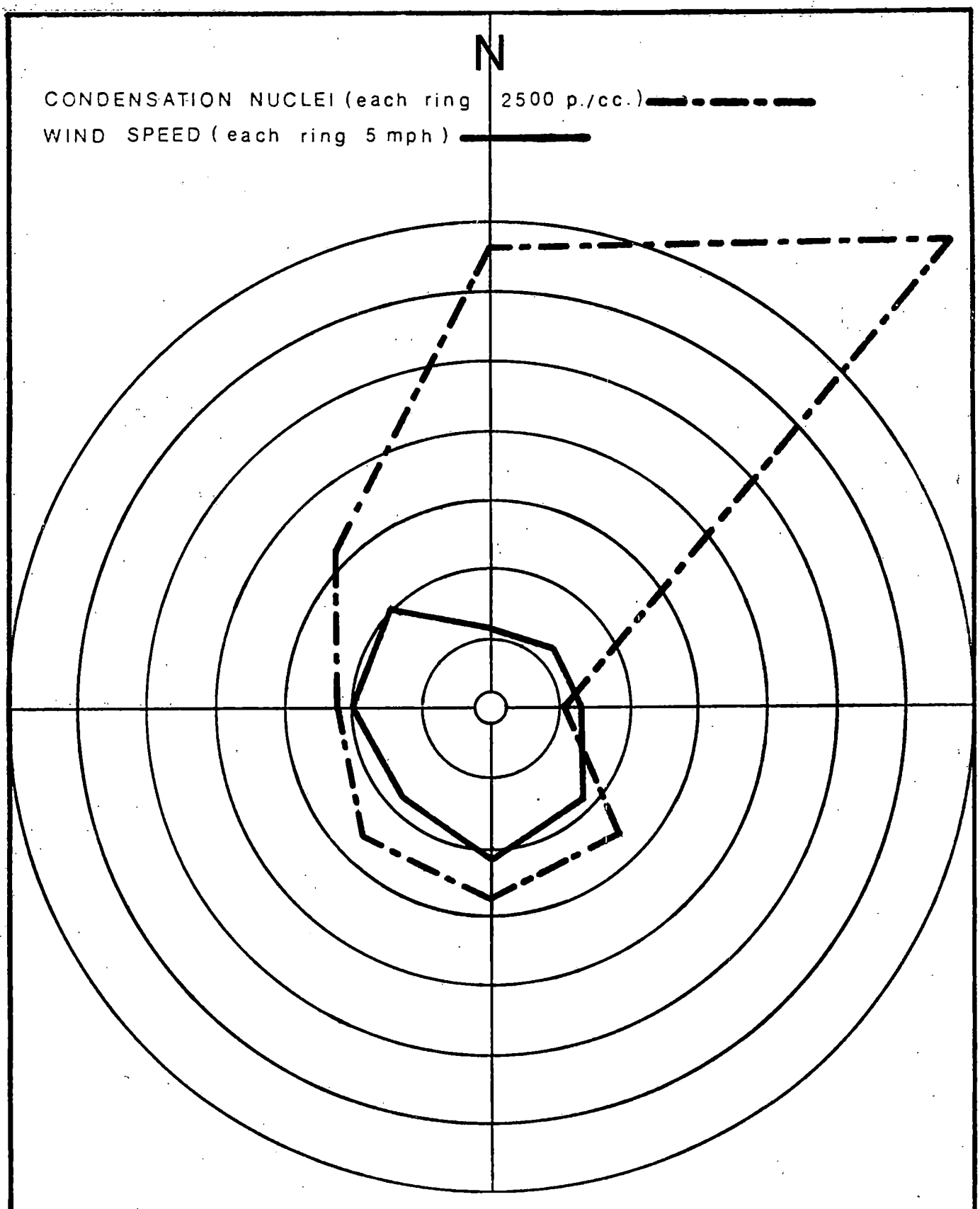


Figure 32. Condensation nyclei and wind speed at Boonville, May-October, (1971-72), 1600 hours.



(courtesy of R. Falconer
SUNY, Albany)

Figure 33. Condensation nyclei and wind speed at Boonville, May-October, (1971-72), 1200 hours.

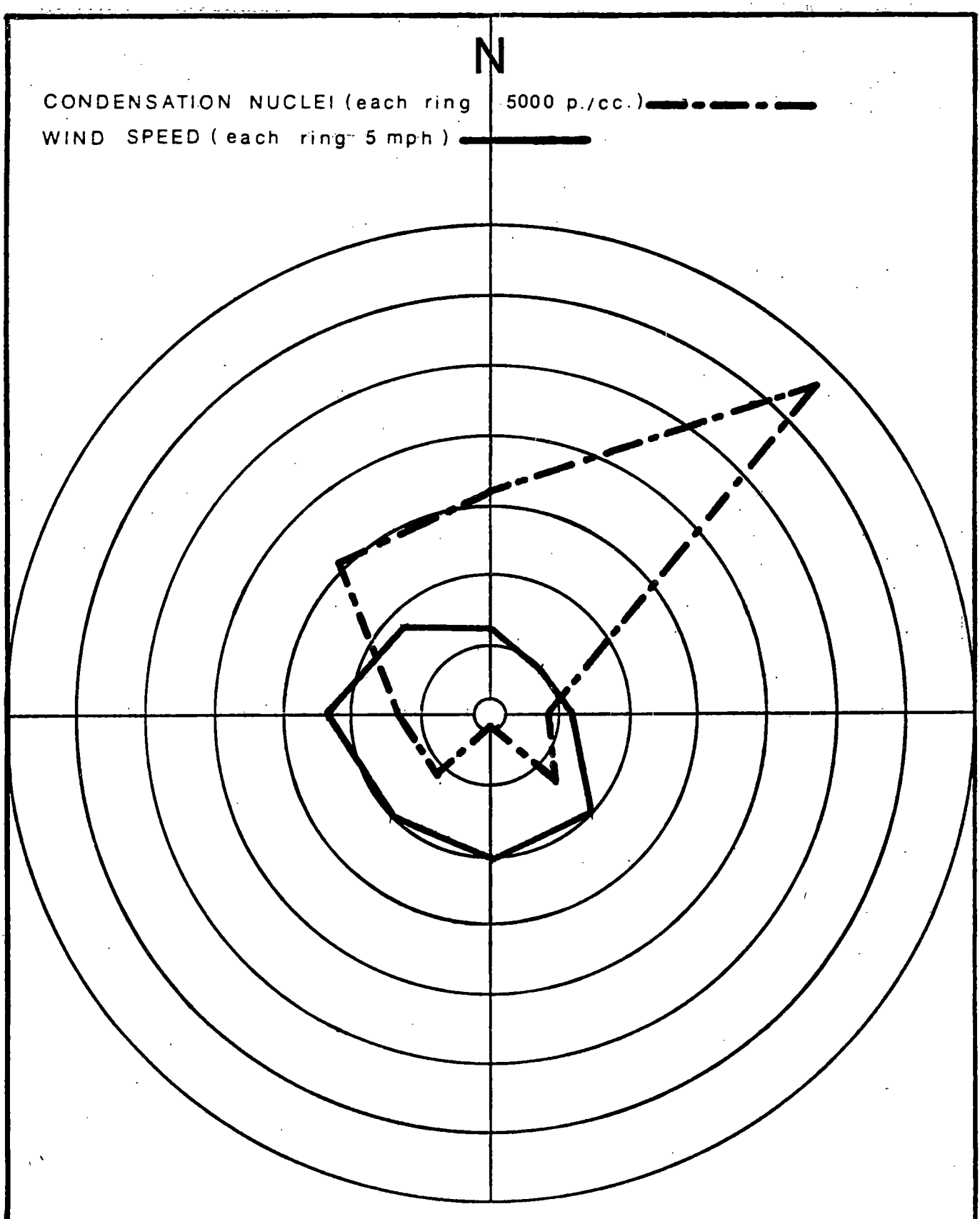


Figure 34. Condensation nyclei and wind speed at Boonville, November-April, (1971-72), 1200 hours.

the valley type of local circulation. In these cases, side valleys can be kept free of industrial or commercial development in order that the main valley might be purged of its polluted air each night by the down-valley flow. This principal has been applied in Germany.

The Tug Hill Region does not fit these criteria. Rather, it is an area which has clean air flowing across it due to the long trajectory of the northwest and west winds passing over the Great Lakes. Thus, air arrives at the Region free of pollution. In addition, development in the Tug Hill Region does nothing to significantly add to the pollution load of the air and, in fact, the heavy precipitation over it may actually further clean the air. Unless extremely heavy development occurred along the Route I-81 corridor to the west of the Tug Hill Region, there would appear to be no serious air management problem for the Region.

A search was made of the air quality management literature to determine if there was a "clean air reservoir" concept worth exploring. The nearest we came was the concept of the air shed. In this regard, the Tug Hill Region could be considered as part of the air shed for the Adirondack and Mohawk River regions of the State. Large quantities of air supplied to these areas flows over the Tug Hill Upland. Thus agencies planning the development of leeward regions might look askance at major developments that would add large amounts of pollutants to air within the Tug Hill Region. In general, the Region plays a passive but important role in insuring a supply of clean air to adjoining areas.

To this end, the New York Air Pollution Control Act, as modified by the 1970 Environmental Conservation Law, created machinery to police air quality within New York State. Codes, rules and regulations created by the defunct Air Pollution Control Board, and the Department of Environmental Conservation, delineate the degree of air pollution permitted. These air quality standards set allowable emision rates for pollutants, and standards for the composition of fuels. Pertinent standards are listed in Appendix 7.

Developments within the Tug Hill Region must conform to these codes, rules, and regulations as specified by state law. Thus, implications of potential development in the Region should be studied carefully. Most air quality professionals do not recommend establishing an intensive air quality sampling network in any region unless planners identify specific reason for doing so. (Morgan and Keitz, 1972). To measure all air quality parameters would be prohibitively expensive. Documentation of the cleanliness of the Tug Hill air could be a specific reason, if planners felt that data were needed to guide development of the Upland area and sub-regions not now described by air quality data. For that job a single year of high volume sampler data (particulates) at four to six stations would be sufficient.

LITERATURE CITED:

Engleman, R. J.
1968. The colevation of precipitation scavenging. In Meterology and Atomic Energy, P. H. Slade, ed., U.S.A.E.C., NTIS, Springfield, Va.

Falconer, R., Lansing, L., and Sykes, R.
1964. Studies of weather phenomena to the lee of the eastern great lakes. Weatherman 17(6): 256-302.

Frederick, R. H., Johnson, E. C., and MacDonald, H. A.
1959. Spring and fall freezing temperatures in New York State. N.Y. State Coll. Agric., Cornel Univ., Misc. Bull. 33

Holzworth, G. C.
1972. Mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous United States. Environ. Prot. Agency., Off. Air Programs., Publ. AP-101.

Jiusto, J. E., and Kaplan, M.L.
1972. Snowfall from lake-effect storms. Mon. Weather Rev. 100:62-66

Morgan, T. R., and Keitz, E. L.
1972. Aerometic data: needs and networks. In Determination of Air Quality, G. Mamantov and W. D. Shultz, ed., Plenum Press, N. Y.

Pack, B. A.
1960. Climate of New York. U.S. Gov. Print. Off., Climatol. of the U.S. Number 60-30.

WATER RESOURCES

by

arthur eschner
john osinski
deborah howe
scott shupe

SUMMARY OF WATER RESOURCES

The Tug Hill Region is one of the most well-watered portions of New York, receiving a regular, generous supply of precipitation. Because it receives more snow than any other area east of the Rockies, this is one of the most pertinent bits of hydrologic information. The annual snow accumulation ultimately provides most of the Region's usable water in surface streams or groundwater aquifers. Precipitation falling during the warmer months of the year is largely used by the vegetation.

The stream system of the Tug Hill Region was disturbed by glacial activity over 10,000 years ago, and has not yet evolved into a very effective network for disposing of surplus water. As a result, ponds and swamps are numerous, if not very great in total acreage.

Relatively high quality groundwater is available throughout the Region. In a large portion of the area, its yield is very low, but at some places, such as the area around Camden, aquifers have enormous capacity and potential yield.

Use of water in the Region is relatively low when compared to the total amount available annually. Most of the use--and problems associated with use--originate on the periphery of the Region. Municipal and industrial pollution, as well as sediment and agricultural pollution occur mostly on the fringes.

RECOMMENDATIONS

In order to utilize more effectively the water resources of the Tug Hill area, several steps should be taken to assess fully the character of the resource. We recommend:

1. an expanded regional program of streamgaging, including reactivation of the recently inactivated Deer River gage, planned in conjunction with the development of explicit regional resource management objectives;
2. a comprehensive groundwater survey for those parts of the Region where this information is patchy and limited, primarily in Jefferson and Lewis Counties;
3. a designed sampling network and sampling schedule to better define the water quality of Tug Hill's water bodies and aquifers, and clearly indicate the range of variation regularly experienced;
4. additional snow survey courses in the western portion of the Region, to provide better information on snow accumulation and to evaluate random reports indicating that it may receive greater snowfall than anticipated.

INTRODUCTION

Water is probably one of the most important resources of the Tug Hill Region, and because its' utility affects, and can be so drastically affected by, land use, any planning for this purpose requires consideration of water--how much is present, in what form and quality does it occur, and when is it in excess or deficient.

Hydrologic information traditionally consists of various types of water measurements including amount of precipitation and streamflow, depth to groundwater, groundwater yield, and water quality. Some of this information can be readily used in planning; other information must be analyzed, interpreted and combined with other data (geolgic, topographic and demographic), as planning progresses.

WATER SUPPLY

Precipitation

Few areas in New York State receive more precipitation than the Tug Hill Region. The average annual precipitation for the study area during the period between 1963 and 1972 was 45.18 inches, with some portions receiving in excess of 54 inches (Figure 35). Precipitation is rather evenly distributed throughout the year; average monthly totals range from 7.2 percent (March) to 10.8 percent (November) of the annual value. Precipitation distribution over the area conforms closely to the topography (Table 13).

Growing-season precipitation (June-August) appears to be produced primarily by frontal activity (Figure 36). Maximum precipitation during this season occurs in the southeastern portion of the study area, and decreases northward. Prolonged droughts are rare.

Dormant season precipitation (October-April) is greatly influenced by Tug Hill's geographic position to the lee of Lake Ontario (Figure 37). The orographic effect produced by air being forced to rise as it moves from west to east from 250 feet at the lake shore to above 1700 feet elevation, results in a decrease in the moisture holding capacity of air masses moving across the Upland. In addition, "lake effect" storms are also important factors in dormant season precipitation. These storms commonly occur in late fall and early winter when Arctic air masses pass over the relatively warm, open lake surface. The resulting energy and moisture fluxes alter horizontal winds, convergence fields, and vertical motions (Jiusto and Kaplan, 1971). Bands of intense snowfall are generated that commonly leave a foot or more of snow in their wake. The most intense storms have been observed to occur in November, and "lake effect" intensity decreases as the winter progresses, due to the gradual lowering of lake temperatures (Jiusto and Kaplan, 1971).

The part of the study area to the east of the Upland, near the Black River Valley, is in a "rain shadow". It receives less precipitation than the area to the west because most of the precipitable moisture has fallen on the windward slope and the crest of the Upland. Descending winds become warmer and condensation and precipitation is not likely to occur.

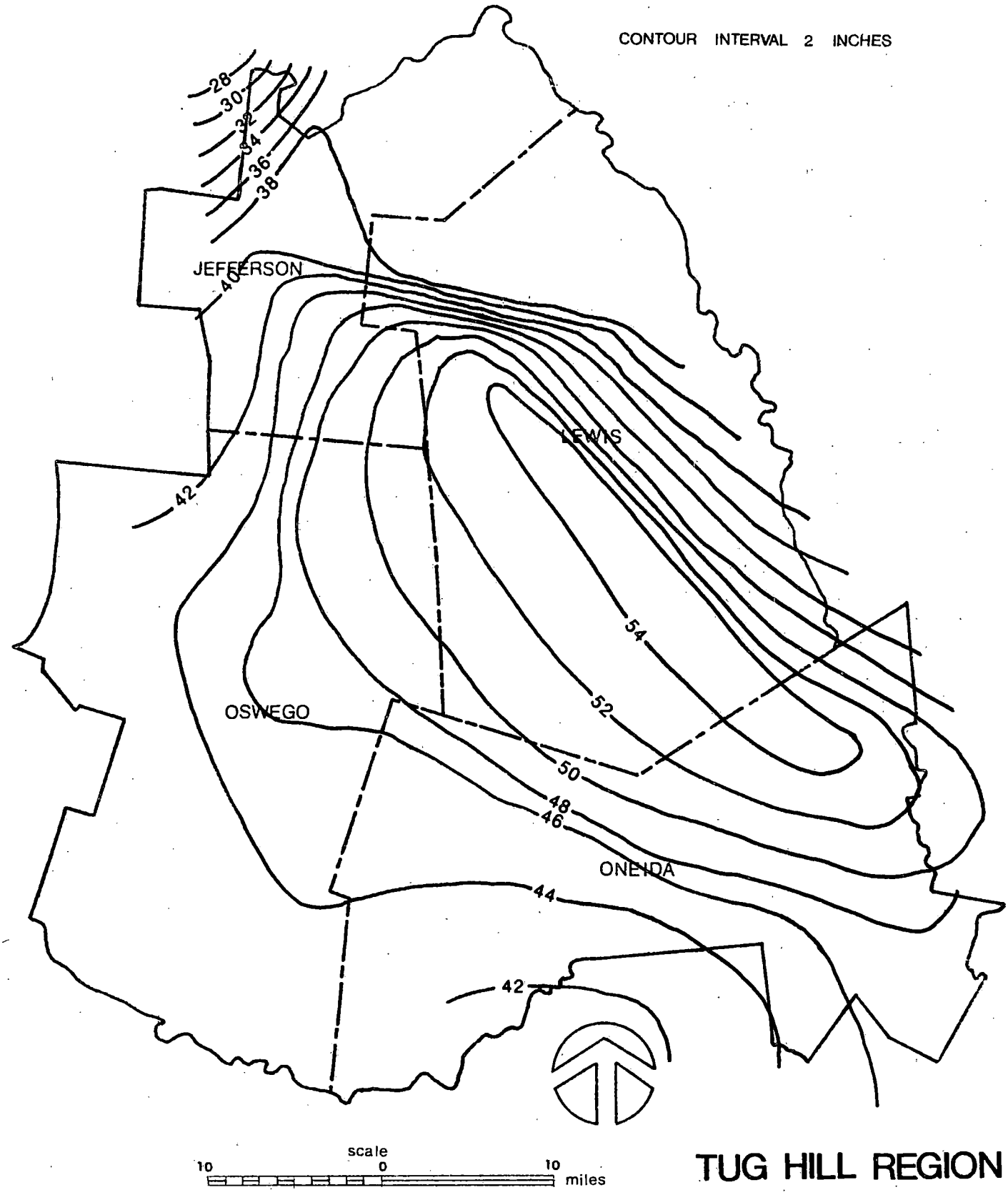


Figure 35. Isohyetal map for annual precipitation, Tug Hill Region.

Table 13. Ten year average precipitation in inches, 1963-72.[a]

Station	North Latitude	West Longitude	Elevation in feet	Monthly precipitation in inches of water[b]												Total in inches of water		
				October	November	December	January	February	March	April	May	June	July	August	September	Annual	June to August	October to April
Adams Center[c]	43°49'	76°01'	640	3.51	4.32	4.25	2.75	3.06	2.52	2.31	3.10	3.53	2.84	3.63	3.78	39.60	10.00	22.72
Bennett Bridge	43°32'	75°57'	660	3.59	5.43	4.98	4.00	4.18	3.62	3.41	3.85	3.53	2.68	3.97	3.35	46.59	10.18	29.21
Boonville	43°27'	75°21'	1,580	3.64	5.88	5.08	4.72	4.93	4.13	4.23	4.76	4.31	4.29	4.90	4.43	55.30	13.50	32.61
Camden-Mallory[d]	43°20'	75°57'	495	3.17	4.95	4.23	3.60	3.91	3.50	3.42	3.65	3.86	2.87	3.84	3.42	44.42	10.57	26.78
Delta	43°16'	75°26'	560	3.28	4.43	3.75	2.71	2.90	3.11	3.67	4.03	4.28	4.25	4.18	3.74	44.33	12.71	23.85
Forestport	43°27'	75°14'	1,180	3.52	5.06	4.46	3.56	4.31	4.29	3.32	4.73	3.92	3.96	4.42	4.55	50.01	12.30	28.43
Highmarket	43°35'	75°31'	1,790	4.34	5.64	3.59	3.03	3.29	3.08	3.75	5.09	4.45	3.59	4.92	4.55	49.32	12.96	26.72
Hooker	43°35'	75°44'	1,680	4.66	6.46	5.45	4.93	4.21	3.80	3.78	4.46	4.32	3.52	4.02	4.43	54.04	11.86	33.29
Lowville	43°47'	75°29'	880	2.80	4.19	3.29	2.66	2.62	2.62	2.62	3.28	3.52	2.93	3.58	2.83	36.94	10.03	20.80
New London Lake	43°13'	75°37'	400	2.88	4.04	3.19	2.57	2.48	2.86	3.36	3.83	4.35	3.68	4.09	3.03	40.63	12.12	21.38
Pulaski	43°34'	76°08'	390	3.34	4.74	4.30	3.69	3.95	2.24	3.13	3.50	3.65	2.88	3.91	3.35	42.68	10.44	25.39
Trenton Falls	43°16'	75°09'	800	3.29	4.56	4.10	2.89	3.09	3.71	3.54	4.47	4.68	4.57	5.10	3.67	47.67	14.35	25.18
Utica (FAA)	43°09'	75°23'	718	2.97	4.33	4.68	3.41	3.41	3.62	3.57	3.73	4.26	4.24	4.35	3.41	45.98	12.85	25.99
Watertown	43°58'	75°52'	497	2.83	4.34	3.56	2.89	2.58	2.52	2.68	3.29	3.52	2.52	3.91	3.18	37.82	9.95	21.40
Watertown (FAA)	44°00'	76°01'	322	1.86	3.25	2.70	2.17	1.84	2.29	1.62	1.97	2.05	1.61	2.77	2.04	26.17	6.43	15.73

[a] Source: U. S. Weather Bureau, 1963-72.

[b] Data arranged by water-year.

[c] Period of record 7 years (1966-72).

[d] Combined data of the Camden and Mallory Climatological Stations (Camden, 1963-67; Mallory, 1968-72).

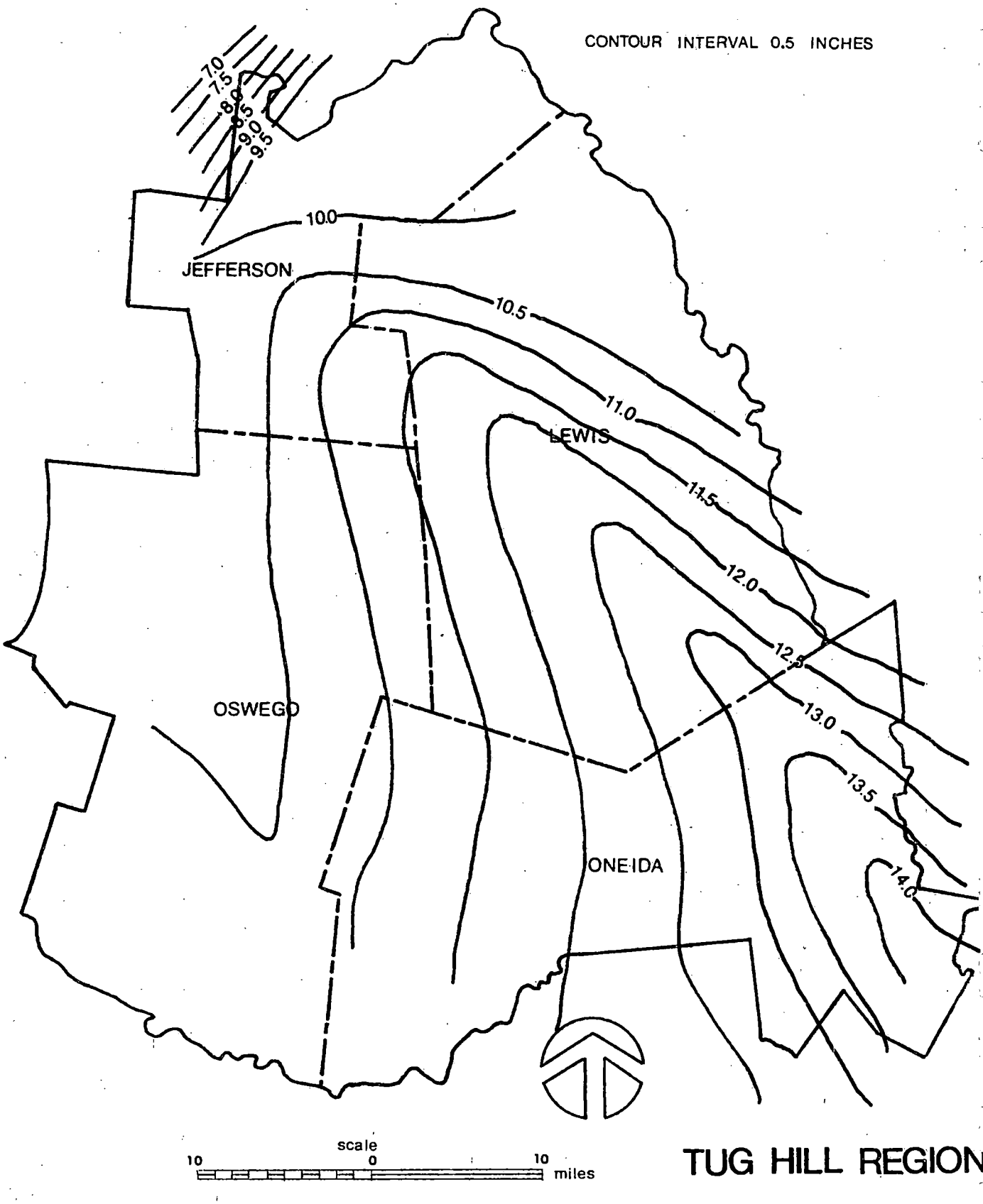


Figure 36. Isohyetal map of growing season precipitation (June-August), Tug Hill Region.

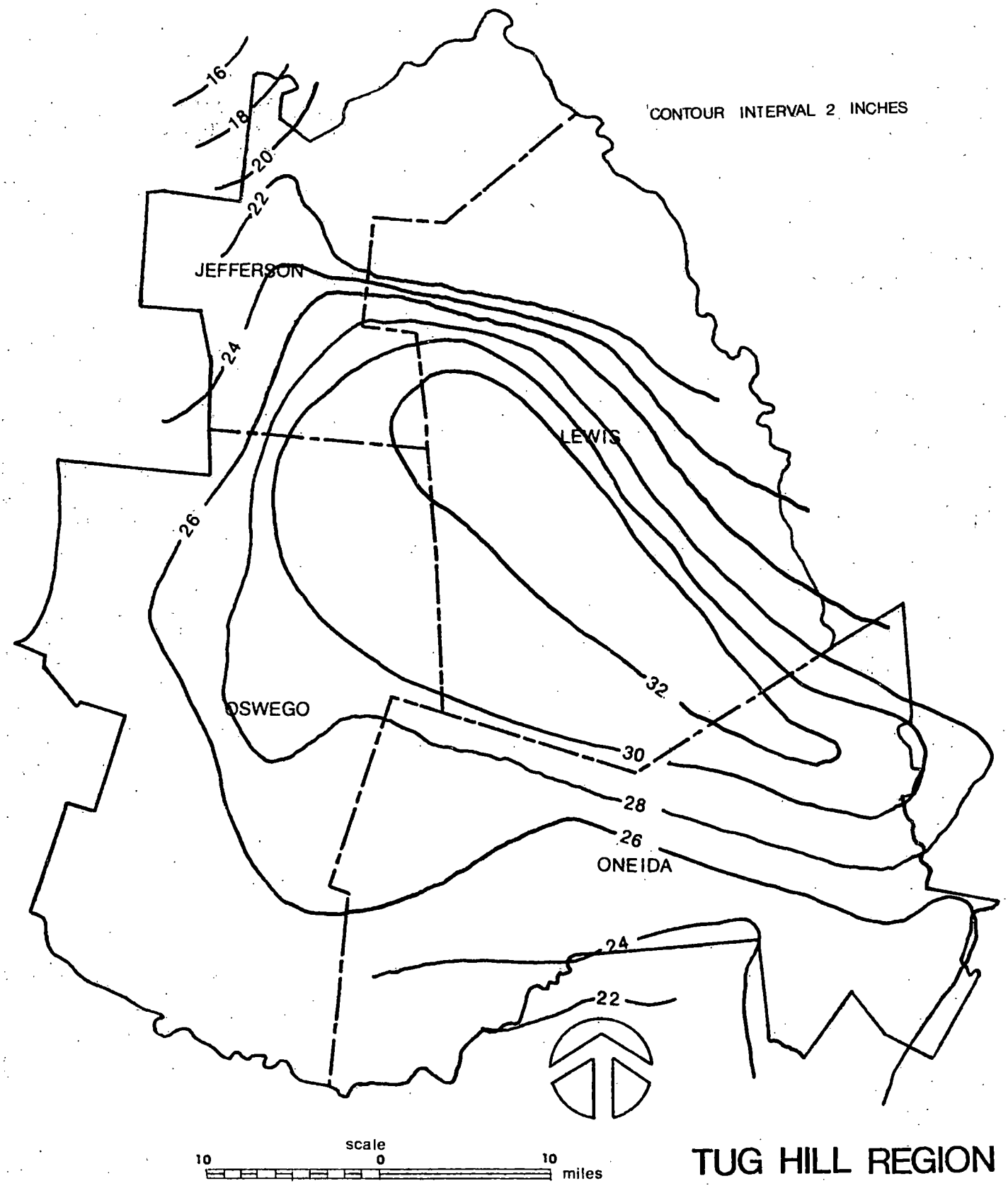


Figure 37. Isohyetal map of winter precipitation (October-April), Tug Hill Region.

Snow Accumulation

Tug Hill Region is one of the snowiest areas in the eastern United States. Long term averages of accumulated annual snowfall exceed 200 inches in depth for Tug Hill Upland, with no portion of the Region averaging less than 100 inches annually (Muller, 1960). During the period 1963-72, snow fell as early as September and as late as June. The record winter of 1970-71 produced 302.1 inches of snow at Boonville, while Hooker received 352 inches, 101.2 inches falling in January alone.

Peak snowpack accumulation prior to melt off in the spring is hydrologically important in that it makes up the bulk of the annual streamflow, and can be used as a valuable prediction parameter. Tug Hill Region is covered by an extensive network of snow courses operated by state agencies, semi-public, and private concerns. During the 16 year period from 1958 to 1973, on the average, peak and seasonal snowpack accumulation occurred on the "March 15" sampling date. Figure 38 shows the March 15 distribution of snow depth, while Figure 39 provides the distribution of snow pack water equivalent (the amount of liquid water obtainable from the snowpack if melted). The 14 inches of water shown at High Market in Figure 38, approximates the entire precipitation for the months of December, January, February and March. Most of this water is not released for streamflow until April or May, and its effect can be detected well into June and July. The rate of melt of the snowpack determines in large measure whether the snow is a valuable, usable resource, or the cause of downstream flood damage.

Surface Water

Streams

The Tug Hill Region lies within the Lake Ontario, and the Hudson River drainage systems. Of the 3879.2 miles of stream channel draining the Region, 3402.2 miles drain toward Lake Ontario (Appendix 3). Although 17 drainage basins are found within the Lake Ontario system (those whose main stream is directly tributary to the lake), the major ones are the Black River (1025.9 miles), the Oneida River (via Oswego River, 1027.6 miles), and South Sandy Creek (173.8 miles). The Mohawk River drainage basin with 477.0 miles of stream channel, is within the Hudson River system. Map 6 in the Atlas shows the drainage patterns of the Region.

The Region as a whole has a drainage density (miles of stream channel per square mile of land) of 1.88, while drainage densities within individual drainage basins range from 1.29 to 3.11 (Table 14). Drainage density can be thought of as an expression of the closeness of spacing of channels, and as such is an indicator of the length of overland flow. These very low drainage densities indicate, in this case, resistant subsoil materials and generally low relief.

The Tug Hill Region exhibits an overall radial drainage pattern whose hub occurs within the Towns of Osceola, Montague and High Market. From this source water flows into the Black River, Salmon River, and Fish Creek drainage systems. Within individual drainage basins, several different drainage patterns exist, some of them exclusively characteristic of glaciated areas.

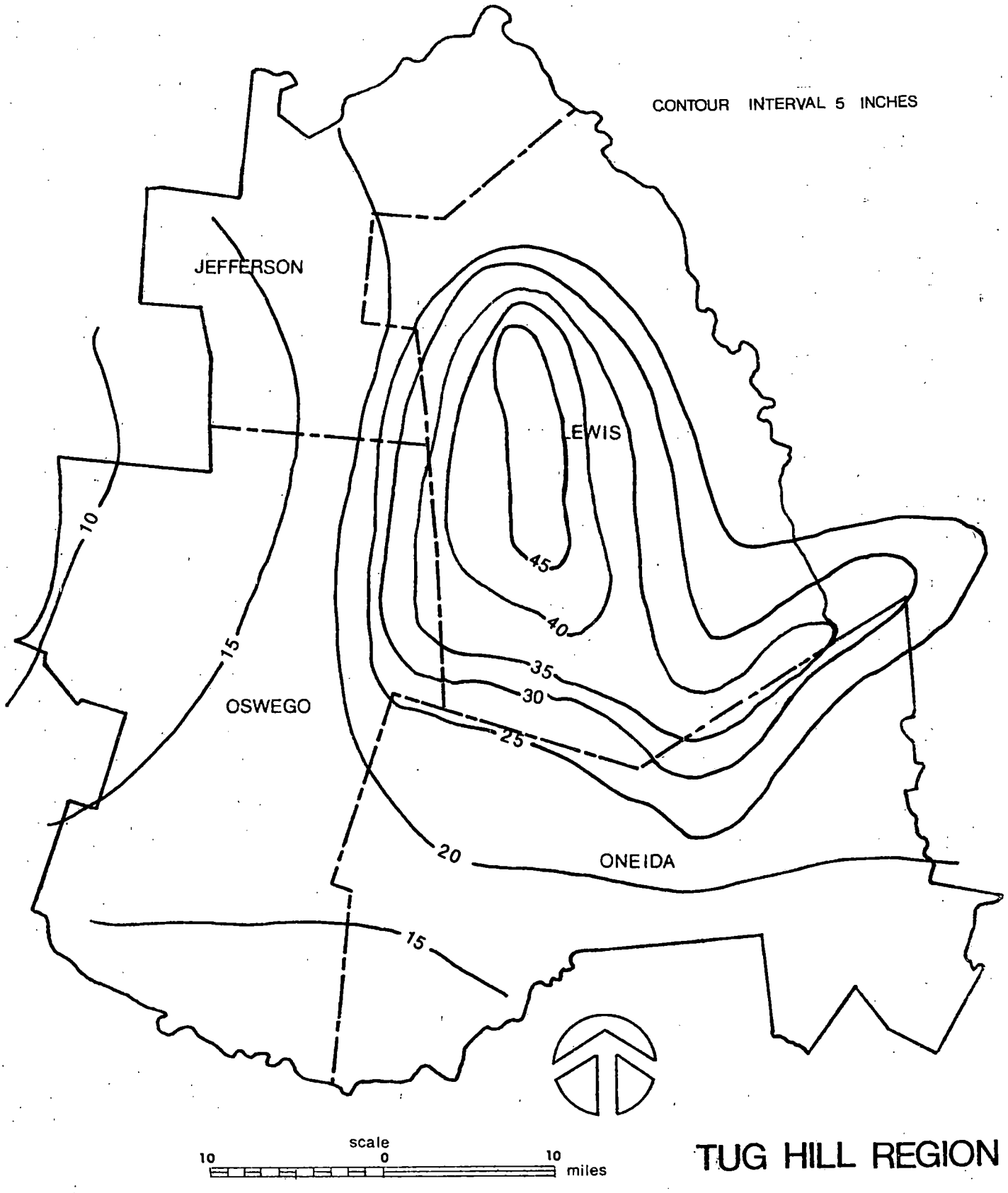


Figure 38. Average snow pack depth for March 15, Tug Hill Region.

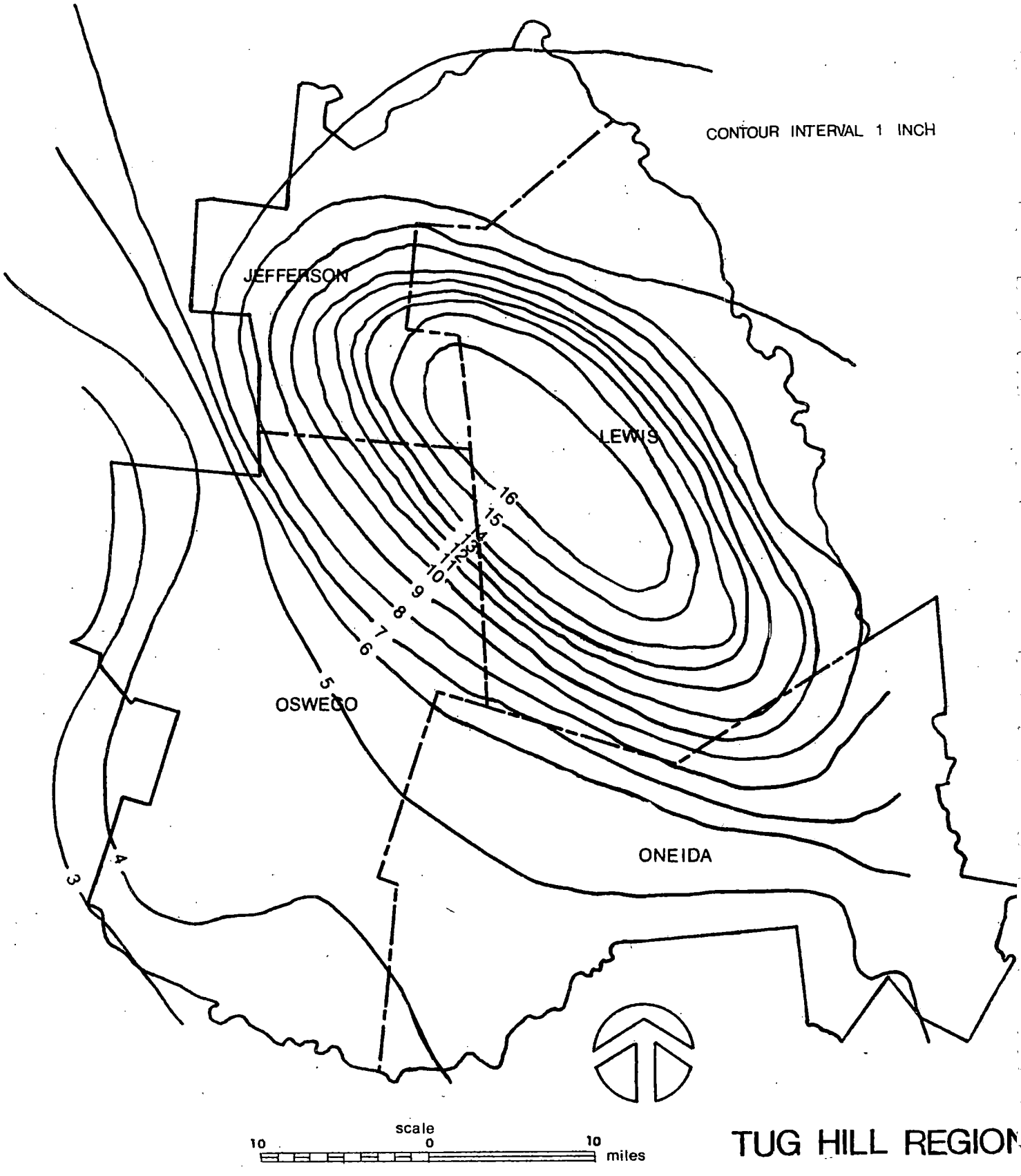


Figure 39. Average water equivalent for March 15, Tug Hill Region.

Table 14 . Drainage density of selected streams in the Tug Hill Region.

Stream	Drainage basin	Total relief in feet	Miles of stream	Area in square miles	Drainage density
Edick Creek	Black River (Deer River)	250	13.92	8.20	1.59
Moose Creek	Black River (Sugar River)	740	37.70	21.10	1.74
Olmstead Brook	Black River (Sugar River)	580	20.83	6.70	3.11
House Creek	Black River	1,360	22.43	7.90	2.84
Mill Creek	Black River	-	87.90	38.00	2.31
Roaring Brook	Black River	-	57.90	30.00	1.93
Fall Brook	Oneida River (Fish Creek)	480	15.32	9.40	1.63
Pringle Creek	Oneida River (Fish Creek)	390	19.99	9.30	2.14
Penrock Brook	Salmon River	310	6.32	4.90	1.29
Stinson Creek	Little Sandy Creek	300	8.25	3.30	2.50
Bear Gulf	Sandy Creek	630	14.03	5.50	2.55
All streams, Tug Hill Region		1,830	3,879.20	2,116.11	1.88

River is impounded by Niagara Mohawk Power Corporation just above the hamlet of Orwell, creating the Redfield Reservoir. The Salmon River Falls, over 100 feet high, are found just below the dam. In the Towns of Lorraine, Rodman, Worth and Pickney, several gorges or gulfs up to 200 feet deep are found on the headwater tributaries to Sandy Creek and South Sandy Creek. Stream gradients here exceed 100 feet per mile.

Lakes, Ponds and Swamps

With the exception of Oneida Lake (79.9 square miles), the Tug Hill Region contains no large, naturally occurring lakes or ponds. However, there are 93 bodies of water having surface areas greater than 0.01 square miles (total area 18.1 square miles), while 827 lakes and ponds less than 0.01 square miles cover an area of 2.24 square miles. Map 6 shows the major water bodies in the Region.

Only 9 bodies of water, out of 920, have surface areas greater than 0.1 square miles, but these 9 comprise 51 percent of all water surface present in the Region. The largest artificial body of water, the Redfield Reservoir, covers 5.28 square miles; the largest natural pond, North Pond (Town of Amboy), covers only 0.34 square miles. The total surface area of all water, 21.05 square miles, represents only about 1 percent of the entire Region.

Approximately 1,320 individual swamps, marshes, or wet land areas are present in the Tug Hill Region. The total area of 84.70 square miles (54,208 acres) comprises approximately 4 percent of the study area. Major wetlands include Toad Harbor Swamp (3.85 square miles), Big Bay Swamp (2.59 square miles), Deer Creek Marsh (1.74 square miles), and Adam's Swamp (1.65 square miles).

Although lacking any large, continuous swamp areas, the Towns of Worth, Osceola, Pinckney, Albion, Parish, Hastings and Amboy exhibit extensive coverage by many small swamps.

The numerous small lakes, ponds, marshes and swamps found within the Tug Hill Region can be explained, in part, by the glacial history of the area. Till of varying thickness was laid down over a large portion of the area. Till is marked by its heterogeneity of particle size classes, and, as a result, forms a very compact, almost impervious layer. This compacted material caused lakes or swamps to form as water accumulated in surface depressions. As the till weathers, and permeability is improved through the development of soil structure, drainage improves and many ponds eventually become swamps. Although the glaciers have been gone for 10,000 years, the drainage system of the Tug Hill Region still has not recovered from their impact. The main topographic features of the Tug Hill Upland developed before glaciation, and were only modified by glacial erosion and deposition (Street, 1966). The deposition of till in existing stream courses interrupted flow, impeded drainage, and, in many cases, caused a reversal or change of flow direction. The pre-glacial northern segment of the East Branch of Fish Creek flowed westward into the Salmon River System. Glacial erosion of the stream bed, followed by extensive deposition of debris in the valley, resulted in the establishment of post-glacial southward flow, and the creation of the bedrock gorge in the Point Rock area (Street, 1966). On a smaller scale such reversal of flow also occurred in the upland tributaries of many streams. Until channel erosion reestablishes stream gradients similar to those existing before the reversal, the drainage of these areas will be impeded. Numerous marshes or ponds will remain along stream courses, and in upland areas. This situation can be found throughout the Tug Hill Region.

The deranged pattern is the most common in the central portion of Tug Hill, and is usually found in recently glaciated areas where pre-existing stream courses were disturbed, and new drainage has yet to develop (Thornbury, 1969). Deranged streams commonly exhibit short, irregular stream courses flowing into and out of numerous small lakes and swamps.

The trellis pattern, a network of sub-parallel streams aligned with major topographic features, is often associated with drumlins (elongate, ellipsoidal hills resulting from glacial activity) (Thornbury, 1969). The High Market area, with its drumloid hills, exhibits this drainage pattern.

Around the periphery of the Region, the dendritic drainage pattern is most common. This pattern is characterized by the irregular branching of tributary streams in many directions, and the lack of geologic structural control.

Drainage typical of karstic (solution) topography is present in the vicinity of escarpment of the Tug Hill Upland where it meets the Black River Valley. Karst is found in areas with limestone or dolomite bedrock, and is characterized by such features as sink holes, lapies (solution pits or rills on limestone surfaces), caverns, and disappearing streams (Thornbury, 1969). Negro Creek, a tributary to the Black River north of Lowville, disappears, then reappears approximately ½ mile down slope. The Sugar River, near Constableville, exhibits lapies along its bedrock channel.

Tug Hill Upland is a cuesta--a gently inclined landscape terminated by an abrupt escarpment. The Upland's escarpment parallels the Black River and its crest is approximately 1000 feet higher than the Black River Valley. Streams flowing off the escarpment into the Black River (Douglas Creek, House Creek, Whetstone Creek, Mill Creek and Deer River) are deeply incised, and are rapidly cutting headward into the sandstone and shales of the Utica and Lorraine formations. Stream gradients of 170 feet per mile or greater are found in this area.

The southeastern portion of the Tug Hill Region is drained by the Mohawk River. A deep gorge (100 feet deep) is found on the East Branch of the Mohawk River, with similar gorges through Lorraine group shales and silt stones on Ava Brook, Wood Creek, Blue Brook, and Haynes Brook (Street, 1966). The Boonville Gorge, presently followed by the Lansing Kill, attains a depth of 500 feet. This gorge was cut by pro-glacial waters flowing from the Black River into the Mohawk Valley (Muller, 1964). The New York State Department of Transportation maintains the Delta Reservoir on the Mohawk River just below Westernville.

The south-central portion of the Tug Hill Region is drained by the Oneida River system, with Fish Creek being the major tributary. Stream gradients in this area seldom exceed 50 feet per mile. The East Branch of Fish Creek, from Lake Tagasoke almost to its junction with the West Branch of Fish Creek below Taberg, is incised through upper Ordovician sandstones and shales forming a gorge at times greater than 50 feet deep. Fish Creek is a mature stream, exhibiting many meanders and ox bow lakes in its lower portion.

Several different stream systems drain the western portion of the Region, including the Little Salmon River, Salmon River, South Sandy Creek, and Sandy Creek. Stream gradients generally range from 50 to 75 feet per mile. The Salmon

South of the Tug Hill Upland, in the Holland Patent-Camden area, ice contact and disintegration features (eskers, kames, kettles, etc.) are common. These features result from stagnant ice melting in place. A kettle basin is formed when a block of ice breaks off and is then covered by debris. Subsequent melting of the ice causes a depression to form at the surface. Many small lakes and ponds, such as Mack Pond in the Town of Annsville, are found in kettle basins.

Extensive swamplands are found along the north shore of Oneida Lake in the Towns of West Monroe and Constantia. Post-glacial Lake Iroquois, an arm of which was a predecessor to Oneida Lake, covered this area until approximately 10,000 years ago (Wright, 1972). Lacustrine deposits of silt and clay, such as those found in the soil profiles along the north shore of Oneida Lake, impede surface drainage. When coupled with a gentle slope (less than 10 feet per mile) and a high water table (due to the immediate presence of Oneida Lake), extensive swampland development is inevitable.

Drainage classifications for the various soil associations present within the study area can be found in Appendix 2.

Streamflow

Runoff

Average annual streamflow for the Tug Hill Region is probably as high as any other part of the state. Annual water surplus values, from water balance calculations using monthly precipitation and potential evapotranspiration, are rational, objective estimates of the water available for streamflow (Thornwaite, Mather, and Carter, 1958). For Tug Hill Upland, the central area around High Market, a surplus in excess of 40 inches per year has been calculated while peripheral areas yield a surplus of only 12 to 16 inches (Figure 40). Average annual runoff for the relatively few gaged streams conforms closely to the estimates of mean annual water surplus presented in Figure 40. The East Branch of Fish Creek, with headwater tributaries in the Town of High Market, is gaged at Taberg. For a 46 year period, average discharge was 527 cubic feet per second (cfs) or 236,517.6 gallons per minute (gpm), with average runoff being 38.1 inches per year. A maximum discharge of 14,500 cfs (6,507,760 gpm) occurred June 22, 1972, a result of Hurricane Agnes.

Sandy Creek is gaged near Adams. For a 12 year period of record, average discharge was 271 cfs (121,624.8 gpm), and average yearly runoff 25.6 inches. Maximum discharge during the period of record was 11,800 cfs (5,295,840.0 gpm) on April 4, 1963.

Deer River, a tributary of the Black River, was gaged at Deer River until 1968. During a 12 year period, average discharge was 232 cfs (104,121.6 gpm), and annual runoff 32.1 inches. Maximum discharge was 11,400 cfs (5,116,320.0 gpm) on April 4, 1963.

The Mohawk River is gaged below Delta Dam. Therefore, its pattern of runoff is strongly modified from the natural. The long term average discharge has been 371 cfs (166,504.8 gpm). The Black River, gaged at several places along its course, has an average discharge of 670 cfs (300,696.0 gpm) at Boonville, and 3,814 cfs (1,711,723.2 gpm) at Watertown.

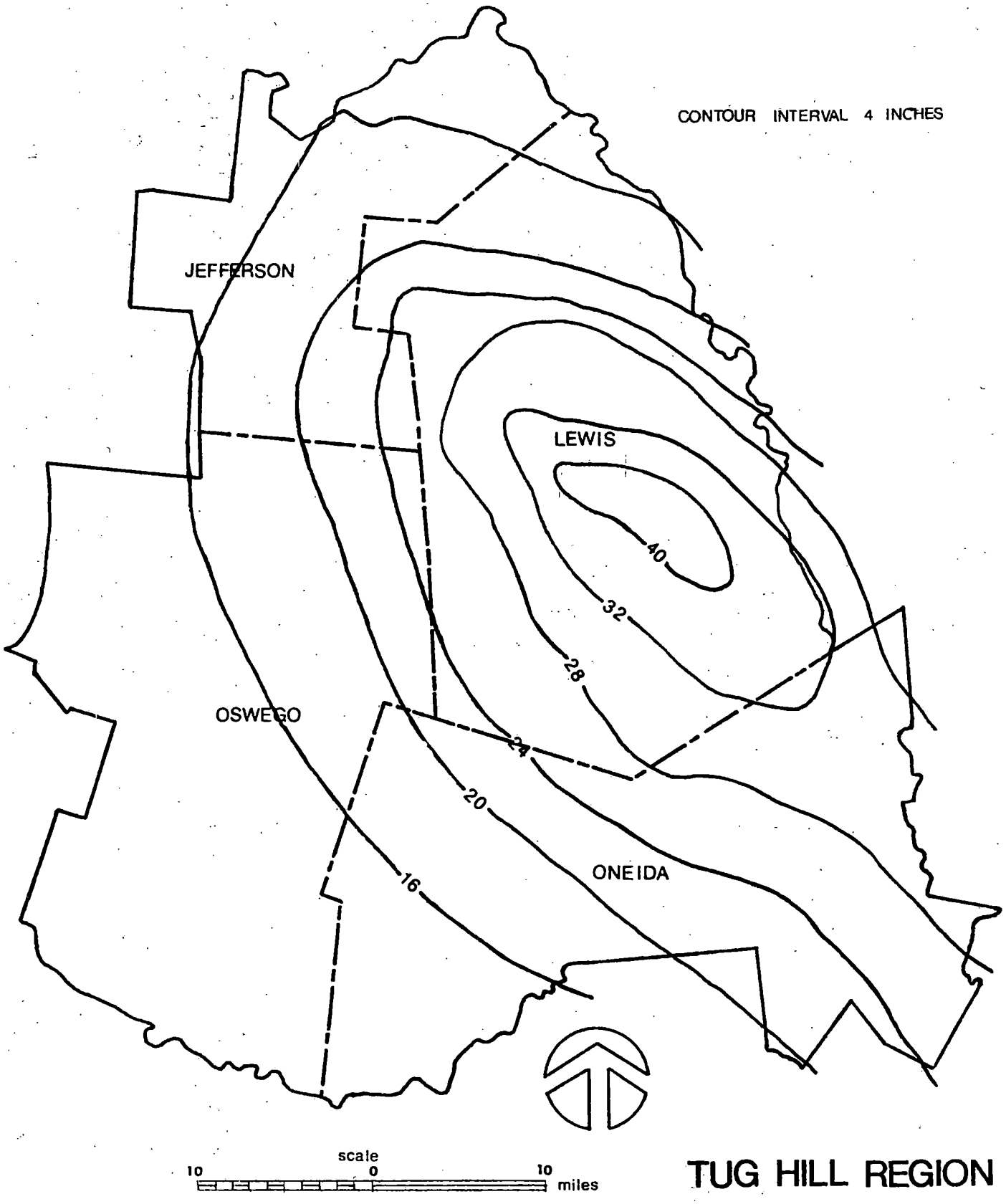


Figure 40. Mean annual water surplus, Tug Hill Region (after Thornthwaite et al., 1958).

The patterns of flow from gaged stations generally indicate peak flows occurring in March, April and May, and slightly lower than average discharges in July and August. Although floods can occur in any month of the year, snowmelt floods are the most common. The Black River seems to flood almost annually in the 42 mile section between Lyons Falls and Carthage (Black River Basin Reg. Water Resourc. Plann. Bd., 1973). During a 44 year period, 74 percent of all flooding took place in the months of March and April. The record flood on the Black River discharged 39,700 cfs at Watertown in April 1969. Average annual flood damage exceeds 164,000 along the main stem of the Black River. Other streams in the Region having a history of flooding include Fish Creek, and the West Branch of Fish Creek (E. Ontario Basin Reg. Water Resourc. Plann. Bd., 1973)

Ground Water

Ground water, water that is found in the soil and rock, is a valuable resource. It is the primary source of streamflow during rainless periods and makes up the steady, dependable flow component in surface streams. The quantity, quality, mode of occurrence, rate and direction of movement of groundwater must be better understood if the resource is to be used effectively. Maps 3 and 4 of the Atlas show distribution of the various bedrock and surficial geologic formations. Gravel, sand and unconsolidated deposits are major aquifers. Limestones and sandstones may be important locally. The groundwater supply is generally adequate for domestic and agricultural use as well as limited industrial use. It is estimated the average small household utilizes 100 gallons per day. A well yielding 1 gallon per minute would provide more than 10 times this amount. The average yield of wells in the central and southern portions of the Region is 10 gallons per minute. This is more than 3 times the 4,000 gallons per day needed to supply a large farm. Tables 15 and 16 provide data on selected characteristics of water wells in the Tug Hill Region.

The flow through glacial till in the central Upland, is not sufficient to supply driven or drilled wells. Dug wells, which provide a reservoir within the system, are generally used in these areas where silty and clayey unconsolidated materials would plug the drilled well intakes. These wells generally yield five gallons per minute or less.

Sand and gravel form major aquifers in the south central portion of the Region. These deposits yield water freely to most common types of wells, so the type of well depends on how much water is wanted, the position of the aquifer, the nature of the aquifers, and economic considerations. One major gravel aquifer near Camden has an estimated capacity of 30 billion gallons. Forced pumping of 60 million gallons per day, without recharge, would require a year to deplete the supply (Krantrowitz, 1970). A well with a 6 inch casing generally yields 10 gallons per minute or less. A driven well is usually limited to areas where gravel is 1 inch in diameter or less. Frictional resistance to driving the well point limits maximum depths to 50 feet. Because their smaller diameter limits the surface area exposed to the aquifer, yields from driven wells are generally less than those from drilled wells in the same material.

Water in bedrock is held in a series of interconnected fractures. The larger the fractures and the greater the degree of interconnection, the greater the potential yield of drilled wells tapping these fractures. Generally speaking, shale yields the least water (3 gallons per minute),

Table 15. Records for selected water wells in the Eastern Oswego River Basin.[a]

Town	Location		Depth in feet			Diameter in inches	Water bearing material	Elevation	Chloride concentration		Use	G.p.m.
	Latitude	Longitude	Of well	To bedrock	To water level				P.p.m.	Date		
Amboy	43°22'	75°53'	189	-	28.8	6.00	Sandstone	760	2	7/19/60	Commercial	<8
Amboy	43°22'	75°58'	27	-	14.1	36.00	Till	640	13	9/7/60	Domestic	-
Amnsville	43°18'	75°38'	130	-	59.9	6.00	Sand and gravel	700	1	9/6/60	Domestic	2
Amnsville	43°25'	75°34'	12	-	3.9	36.00	Till	1,330	1	6/22/60	Domestic	-
Ava	43°24'	75°32'	36	-	20.0	1.25	Sand	1,150	-	-	Domestic	2
Camden	43°18'	75°46'	49	27	12.0	6.00	Sandstone	515	10	4/21/65	Domestic, stock	6
Camden	43°22'	75°43'	18	-	-	72.00	Sand and gravel	760	-	-	Public supply	80
Constantia	43°14'	75°54'	101	86	17.3	6.00	Sand and shale	405	23	8/25/60	Domestic	3
Constantia	43°16'	76°01'	15	-	11.2	36.00	Till	490	2	8/22/60	Domestic	-
Florence	43°23'	75°44'	14	-	6.8	63.00	Till	820	1	7/13/60	Domestic	-
Florence	43°25'	75°44'	78	20	12.0	6.00	Sandstone	940	3	7/13/60	Domestic	30
Hastings	43°17'	76°08'	21	-	11.0	216.00	Sand and gravel	390	72	11/29/60	Public supply	425
Hastings	43°20'	76°09'	42	-	13.2	6.00	Sandstone	530	2	7/25/60	Domestic	-
High Market	43°34'	75°31'	6	-	.6	36.00	Till	1,720	37	6/27/60	Stock	-
High Market	43°36'	75°32'	17	-	10.6	36.00	Till	1,780	-	-	Domestic	-
Lee	43°18'	75°31'	10	-	-	102.00	Sand and gravel	640	-	-	Public supply	-
Lee	43°18'	75°34'	84	65	23.9	6.00	Shale	660	2	9/1/60	Domestic, stock	5
Lewis	43°26'	75°32'	38	15	16.0	6.00	Shale	1,400	2	6/28/60	Domestic	<1
Lewis	43°29'	75°30'	17	-	11.2	32.00	Till	1,600	14	6/28/60	Domestic	-
Osceola	43°27'	75°43'	82	20	22.0	6.00	Sandstone	1,140	2	7/13/60	Domestic	20
Vienna	43°14'	75°38'	23	-	18.8	36.00	Sand	390	14	7/11/60	Domestic	3
Vienna	43°15'	75°41'	78	-	35.0	6.00	Sand and gravel	520	11	6/30/60	Public supply	18
West Monroe	43°17'	76°03'	92	-	29.1	6.00	Sand and gravel	450	2	7/25/60	Commercial, domestic	-
West Monroe	43°20'	76°03'	37	-	13.2	6.00	Sandstone	530	2	7/25/60	Domestic	-
West Turin	43°33'	75°30'	92	-	8.0	6.00	Sand	1,700	4	6/28/60	Domestic	2

[a] Source: Kantrowitz, 1970.

Table 16. Selected characteristics of drilled water wells, Jefferson County.[a]

Town	Depth in feet	Overburden	Bedrock	Flow g.p.m.	Flow Quality	Use
Adams	66	Clay	Limestone	3.0	-	Manufacturing
Adams	45	Sand and gravel	Shale	18.0	Good	Domestic
Champion	63	Sand and boulders	Limestone	5.0	-	Domestic
Champion	182	Sand and gravel	Limestone	15.0	Good	Domestic
Rodman	119	Clay	Limestone	6.5	Good	Domestic and stock
Rutland	106	Sand and gravel	Limestone	185.0	Slightly sulfur	Municipal
Rutland	62	Clay	Limestone	6.0	Good	Domestic
Watertown	367	Clay	Limestone, sandstone, and gravel	21.0	Trace of salt	Manufacturing
Watertown	38	Sand	Limestone	-	-	Domestic
Worth	158	Clay and shale	Limestone	2.0	-	Home

[a] Source: O'Brien and Gere, 1968.

while limestone yields the most water (25 gallons per minute) of any bedrock unit found in the Region; sandstone yields 10 gallons per minute. Well depths commonly exceed 100 feet.

When bedrock aquifers are in hydraulic continuity with streams, well yields are greatly increased. This situation is found near Camp Drum where wells in sandstone yield up to 450 gallons per minute, and those in limestone produce up to 300 gallons per minute.

Although groundwater is sufficient to meet the present demands, future development in the northern portion of the Region will require increased utilization of surface water supplies. Most effective utilization of the water resource will occur when surface water and groundwater are used together. This is called a conjunctive use.

WATER USE

The Tug Hill Region relies heavily on groundwater as a source of domestic and municipal supply. It is estimated that approximately 30 to 40 percent of the regions population is serviced by privately owned wells. Of the 31 municipalities within the Region for which water supply data was obtained, 21 obtain all or part of their supply from wells or springs.

From the data collected, daily demand upon Tug Hill water for municipal usage is 25.253 million gallons (Table 17.) Of this figure, approximately 16 million gallons are diverted out of the Region for use by Oneida and Rome. The City of Watertown, also outside the Region, uses approximately 4.8 million gallons per day (mgd) derived from the natural flow of the Black River, part of which comes from the Tug Hill Region. Quantitative data on the industrial use of Tug Hill water is limited to the Black River basin. In this portion of the Region, industries not tied to municipal systems utilized an average 26.56 mgd (Table 18.) The paper industry is the major water user, averaging 25.432 mgd.

Jefferson County

Of the 10 municipalities in Jefferson County for which data were obtained, only 2 derive water from surface sources (Table 17). Watertown uses 4 mgd, after filtration, from the Black River; West Carthage utilizes 0.500 mgd of chlorinated Pleasant Lake water. Groundwater withdrawal averages 0.513 mgd in the other 8 municipalities.

By the year 2020, demand for water should increase by 48 percent in the City of Watertown, and 345 percent in the hamlet of Herrings (Table 19). A comprehensive water supply study for Jefferson County, by O'Brien and Gere Engineers (1968), presents several alternatives for meeting this increased demand.

Three potential reservoir sites have been identified in Jefferson County (Table 20 and Map 6). These 3, if constructed, would provide a daily yield of 5.942 million gallons.

Seven industries utilize 17.288 mgd (Table 18). The largest single user, St. Regis Paper Co., at Deferiet, draws 15.864 mgd from the Black River near Copenhagen.

Table 17. Existing public water supply systems, Tug Hill Region.

Municipality or district	Source	Impoundment or storage: Type	Impoundment or storage: Capacity (m.g.)	Safe yield (m.g.d.)	Treatment	Daily consumption (m.g.d.)	Remarks	Source of data[a]
Jefferson County								
Adams (Village)	Spring	-	0.750	-	Chlorination	0.360[b]	-	2
Black River (Village)	Springs, well	Underground reservoir	.208	0.460	None	.125[b]	-	4
Champion (Town)	Private wells	-	-	-	-	-	-	2
Deferiet (Village)	Well	Storage tank	.200	.240	None	.090[b]	-	4
Herrings (Village)	Well	Storage tank	.050	-	None	.018[b]	-	4
Rodman (Hamlet)	Spring	None	-	.013	None	.020[b]	-	2
Rutland (Town)	Private wells	-	-	-	-	-	-	2
Watertown (Town)	City of Watertown Private wells	-	-	-	-	-	-	2
Watertown (City)	Black River	2 reservoirs	8.400	5.030	Filtration	4.800[b]	-	4
West Carthage (Village)	Pleasant Lake	Standpipe	.300	.700	Chlorination	.500[b]	-	4
Lewis County								
Castorland (Village)	Deep well	Elevated tank	.242	.072	None	.036[b]	-	4
Constableville (Village)	Springs, White River	Reservoir	1.000	.144	None	.038[b]	-	4
Copenhagen (Village)	Deer River	Standpipe	.150	.500	Chlorination, filtration	.040[b]	-	4
Glenfield (Hamlet)	5 springs	-	-	-	None	.003[b]	-	4
Lowville (Village)	Crystal Creek, Youngs Pond	2 reservoirs	4.250	1.200	Partially chlorinated	.450[b]	-	4
Lyons Falls (Village)	Beauty Creek	Reservoir	1.000	.790	Chlorination	.090[b]	-	4
Martinsburg (Town)	Brooks	-	.150	-	None	.018[b]	-	4
Port Leyden (Village)	Cold Brook	2 reservoirs	.400	-	None	.065[b]	-	4
Turin (Village)	Lee Gulf Creek	2 reservoirs	1.710	-	Chlorination	.060[b]	-	4
Oneida County								
Boonville (Village)	Rogers Creek 12 wells	3 collecting reservoirs	21.000 -	.160 .325	Chlorination	.207	-	1
Camden (Village)	Emmons Brook 3 springs	Unnamed reservoir Tank	1.700 .100	- .685	- Chlorination	- .719[b]	- -	1
Holland Patent (Village)	Beaver Creek	Diversion dam	-	-	Chlorination	.080[b]	-	1
McConnellsville (Village)	Springs	Concrete reservoir	.042	-	-	-	Coliform count often exceeds limits	
Oneida (City)	Florence Creek	Glenmore Reservoir	300.000	3.500	Chlorination, ammonia, lime	3.000[b]	Exceeds limits for color, turbility, iron	1
Prospect (Village)	Well	-	-	.075	None	.020[b]	-	1
Rome	East branch of Fish Creek	Tagasoke Reservoir diversion dam, tunnel Stokes Reservoirs	65.000	-	- Chlorine, ammonia	- 13.000[b]	Exceeds Health Department limits for color, iron turbility	1
Sylvan Spring (Private Supplier)	Vienna Brook Mill Stream	Vienna Reservoir Hollenback Reservoir	2.500 1.500	- -	-	.240	-	1
Trenton (Village)	3 springs	-	-	.125	None	.050[b]	Exceeds Health Department standards	1
Oswego County								
Central Square (Includes Town of Hastings, Village of Central Square, Town of West Monroe)	Municipal wells	-	.200	-	Clorination	.280[c]	-	2
Constantia (Includes Town of Constantia, Village of Cleveland)	Spring fed reservoirs	-	-	-	Clorination	.200[c]	-	2
Parish (Town and village)	Private wells	-	-	-	-	-	-	2
Pulaski (Village)	Municipal springs	-	.300	-	-	.750[c]	-	2
Sandy Creek - Lacona	Municipal wells	-	.300	-	Chlorination	.390[c]	-	2

[a] Source: 1. Malcom Pirnie Eng., 1968.
2. O'Brien and Gere Eng., 1968.
3. Barton, Brown, Clyde, and Logudice Engineers, 1967.
4. Black River Reg. Water Resourc. Plann. Bd., 1972.

[b] Average daily consumption.

[c] Maximum daily consumption.

Table 18. Major industrial water users, Tug Hill Region.[a]

Establishment	Location[b]	Product	Daily consumption in 1000's gallons Intake	Return	Source
		Jefferson County			
St. Regis Paper	Deferiet	Paper	15,864	15,459	Black River, Village of Copenhagen
Black-Clawson	Watertown	Machinery	64	58	City of Watertown
Green Dairy	Watertown	Milk	4	4	Not available
Knowlton Brothers	Watertown	Paper	563	550	Black River
Taylor-Stone Dairy	Watertown	Milk	22	20	City of Watertown
New York Airbrake	Watertown	Motor vehicle parts	750	675	Not available
Carthage Paper Mill	West Carthage	Paper	21	-	Black River
		Lewis County			
Queens Farms	Copenhagen	Milk	222	220	Deer River, Village of Copenhagen
Hoffman and Dudo	Lowville	Cheese	1	1	Not available
Payne-Jones	Lowville	Textiles	133	120	Not available
Georgia Pacific	Lyons Falls	Paper	9,004	8,500	Black River
		Oneida County			
Laribee Machine Co.	Camden	Annealers, spooling equipment	-	-	West branch of Fish Creek
Olney and Floyd	Camden	Canned vegetables	-	-	West branch of Fish Creek
Olney and Floyd	Lee Center	Canned vegetables	-	-	West branch of Fish Creek
Harden Furniture	McConnellsville	Household furniture	-	-	West branch of Fish Creek

[a] Source: N. Y. S. Dept. Health, 1965.
O'Brien and Gere Eng., 1968.
Black River Reg. Water Resourc. Plann. Bd., 1972.

[b] Data not available for Oswego County.

Table 19. Projected water demand by 2020.[a]

Municipality	Current demand (m.g.d.)	Projected demand, 2020 (m.g.d.)	Projected change (Percent)
Jefferson County			
Black River	0.125	0.240	92
Deferiet	.090	.190	110
Herrings	.018	.070	345
Watertown	4.800	7.130	48
Lewis County			
Constableville	.038	.088	132
Copenhagen	.040	.092	130
Lowville	.450	.730	62
Lyons Falls	.090	.164	82
Port Leyden	.065	.142	118
Turin	.060	.168	180
Oneida County			
Boonville	.207	.800	285
Camden	.719	1.430	85
Rome	13.000	25.000	92
Oswego County			
Central Square	.200	3.650	1,680
Parish	-	.700	-
Pulaski	.750	1.150	53
Sandy Creek - Lacona	.390	.590	51

[a] Source: Black River Basin Reg. Water Resourc. Plann. Bd., 1972.
Malcom Pirnie Eng., 1968.
N. Y. S. Dept. Health, 1972.

Table 20. Potential reservoir sites, Tug Hill Region.[a]

Drainage basin	Stream	Drainage area (Square miles)	Maximum dam height (Feet)	Conservation pool			Total yield (m.g.d.)	Project cost in dollars (Millions)
				Elevation (Feet)	Surface area (Acres)	Total storage (m.g.)		
Jefferson County								
Black River	Mill Creek	3.9	69	990	150	879.7	3.165	0.678
Mill Creek	Mill Creek	2.2	25	551	110	218.3	1.550	.305
Sandy Creek	Freeman Creek	1.4	31	1,031	90	153.1	1.227	.223
Lewis County								
Black River	Deer River	6.1	45	1,756	460	1,919.1	8.721	1.270
Black River	Deer River	33.7	110	1,467	100	987.2	21.542	2.421
Black River	Deer River	18.9	89	1,368	50	312.7	8.204	.978
Black River	Mill Creek (Boonville)	2.9	46	1,353	130	540.8	3.165	.529
Black River	Mill Creek (Lowville)	11.9	73	1,190	420	1,524.8	10.400	1.600
Black River	Moose Creek	9.1	76	1,328	210	1,528.1	10.206	1.307
Black River	Roaring Brook	8.9	49	1,800	90	133.5	3.682	.537
Black River	Whetstone Creek	7.0	40	1,910	761	1,954.9	9.367	.306
Black River	White River	8.7	71	1,251	930	5,490.2	11.240	3.238
Oneida County								
Fish Creek	Cody Brook	3.9	40	1,131	60	350.0	2.200	1.200
Fish Creek	Florence Creek	12.0	85	1,095	200	1,400.0	8.000	2.800
Mohawk River	Mohawk River (Hillside)	75.0	185	806	1,300	28,000.0	94.000	41.700

[a] Source: Black River Basin Reg. Water Resourc. Plann. Bd., 1972.
Malcolm Pirnie Eng., 1968.

Lewis County

Nine communities in Lewis County together use an average of 0.8 mgd (Table 17). Streams tributary to the Black River provide the major sources of supply. The largest single user, Lowville, requires 0.450 mgd.

By the year 2020, projected demand in Lewis County is expected to increase by 100 percent (Table 19). O'Brien and Gere Engineers are currently working up a comprehensive water supply study for Lewis County.

Nine potential reservoir sites have been identified in Lewis County on streams tributary to the Black River System (Table 20 and Map 6). The largest reservoir site on the White River near Constableville would store 5,490.2 million gallons and provide a total yield of 11.240 mgd.

Industrial users of water are listed in Table 18. The largest in Lewis County, Georgia Pacific at Lyons Falls, draws 9.004 mgd from the Black River.

Oneida County

Nine communities in Oneida County use an average 17.316 mgd of water from Tug Hill sources (Table 17). Surface water provides the major source of supply. The East Branch of Fish Creek and 1 of its tributaries, Florence Creek, provide 16 mgd for Oneida and Rome. Camden, the largest water user within this portion of the Region requires 0.719 mgd derived from 3 springs and wells.

The use of water is expected to increase by approximately 100 percent by the year 2020 (Table 19). New York State Health Department comprehensive water supply study for Herkimer and Oneida Counties, by Malcolm Pirnie, Engineers, (1968), provides several alternatives for meeting this increased need.

Three potential reservoir sites have been identified in Oneida County, (Table 20 and Map 6). The largest of them, on the Mohawk River, would provide total storage of 28,000 million gallons, and safe yield of 94.0 mgd.

Although quantitative data on industrial water use is not provided, existing and potential industrial water users are identified in Tables 18 and 21.

Oswego County

Seven communities in Oswego County use in excess of 1.620 mgd. Groundwater is the major source of supply. The village of Pulaski, utilizing 0.750 mgd, is the largest single user in this portion of the Region.

With the exception of Central Square, demand for water by 2020 is expected to increase by approximately 50 percent in the Oswego County portion of the Region (Table 19). Central Square, within the influence of future growth of the Syracuse standard metropolitan service area, has a projected increase in demand of 1680 percent. New York State Health Department's comprehensive water supply for Oswego County, by Barton, Brown, Clyde and Lojudice (1967), should provide more information on Oswego County.

Table 21. Potential industrial water users and potential pollution point sources, Tug Hill Region.[a]

Establishment	Location	Product
	Jefferson County	
Dairymen's League Co-op.	Adams	Newspaper
Journal Publishing Co.	Adams	Newspaper
Aco Machinery Co.	Watertown	Paper machines
Borden Ice Cream Co.	Watertown	Ice cream
Brockway Co.	Watertown	Newspaper
Fisher Gage Inc.	Watertown	Zinc die casting
Niles Mfg. and Distributing Co.	Watertown	Cleaning compounds
	Lewis County	
Climax Mfg. Co.	Castorland	Paper boxes
Hoffman and Dudo Inc.	Lowville	Cheese
	Oneida County	
Boonville Furniture Co.	Boonville	Furniture
Boonville Mfg. Co.	Boonville	Gaskets
Camden Wire Corp.	Camden	Copper wire
Farnsworth and Sons Inc.	Camden	Printers
	Oswego County	
Blount Lumber Co.	Lacona	Hardwood lumber, furniture millwork
General Crushed Stone	Lacona	Sand and gravel
De Gramo Lumber Co.	Parish	Industrial pallets
Parish Canning Co., Inc.	Parish	Canned beans, corn
Fulton Boiler Works Inc.	Pulaski	Boilers
Ontario Iron Works Inc.	Pulaski	Boilers
Pulaski Democrat	Pulaski	Newspaper
Schwiller Technical Papers	Pulaski	Photographic papers
U. S. Forge and Foundry Co.	Pulaski	Foundry sand, chemicals
W. P. Curtiss Co., Inc.	Richland	Tables
Corse Press Inc.	Sandy Creek	Magazines, newspapers
Williamstown Wire and Cable	Williamstown	Copper conductors

[a] Source: N. Y. S. Industrial Directory, 1969.

Potential industrial water users in Oswego County can be found listed in Table 21.

WATER QUALITY AND POLLUTION

Water quality is difficult to characterize because different water uses impose different standards of quality. Quality assessment must be associated with the intended use of the water.

Ground Water

Although the quality of ground water varies with the character of the aquifer, generally the ground water derived from Tug Hill sources is of suitable quality for most domestic uses (Krantrowitz, 1970; O'Brien and Gere, 1968; Malcolm Pirnie, 1968). The pH ranges from slightly acidic (6.5) to mildly alkaline (8.4). Water from limestone (and some sandstone) aquifers in some cases is excessively hard. Several wells tested contained iron and manganese concentrations higher than those recommended by the Public Health Department for drinking water. Chloride and sulfate concentration are generally well below the maximum acceptable values. "Sulfur" water was reported in only one case. Bacterial concentrations were found to be troublesome only in areas where waste disposal systems were improperly placed with respect to the wells, or entirely inadequate for the strata of the Region. Ground water contamination is most common in areas serviced by shallow, dug wells.

Surface Water

Surface water originating in the central portion of the Region is generally of good quality. Although often high in color and turbidity, the water is generally soft and suitable as a public supply after minimal treatment. The sparse population and low level of industrial development in the area do not indicate too great a likelihood of adverse changes in water quality in the near future. Streams flowing through, or originating along, the periphery of the Region are subjected to greater volumes of waste effluent from communities and industrial sources. Under the New York State pure waters program, all communities and industries discharging wastes into streams will be required to provide at least secondary treatment to their effluent. This type of treatment implies that up to 90 percent of the organic matter in sewage will be removed by making use of the bacteria in it. However, the actual level of waste removal achieved by a treatment plant is often strongly dependent upon the skill and ability of the plant operators.

In addition to pollution from industries and municipalities, a large amount of material detrimental to water quality reaches streams from non-point sources. Runoff from agricultural lands is a major source of pollution in rural areas. An estimated 33 percent of the waste loading in the Black River basin can be attributed to agricultural lands. Manure spread over snow is often delivered directly to the streams after melt-off in the spring. Storm runoff from plowed fields carries with it chemical fertilizers, pesticides, and soil material. Other non-point sources of pollution in the study area may include urban runoff, erosional products, and de-icing compounds used on streets.

Most streams within the study area are classified either C or D by the New York State Health Department. The best usage of waters in Class C is

ERRATA

RESOURCES OF THE TUG HILL REGION

Table of Contents, second page, line 5: WILD LIFE should be WILDLIFE

Table of Contents, second page,
line 15: 242 should be 244
line 16: 272 should be 274
line 17: 281 should be 282
line 18: 299 should be 301
line 19: 308 should be 309
line 20: 313 should be 314
line 21: 313 should be 314
line 22: 317 should be 321
line 23: 317 should be 321
line 24: 317 should be 321
line 25: 320 should be 324
line 26: 323 should be 327

Page 1, line 11: Institute for Environmental should be Institute of Environmental

Page 3, paragraph 3, line 2: Institute for Environmental should be Institute of Environmental

Page 3, paragraph 4, line 2: Institute for Environmental should be Institute of Environmental

Page 4, paragraph 1, line 7: Alan should be Allen

Page 7, line 7: King should be Kick

Page 7, line 9: McDonald should be McDowell

Page 34: Figure 2 should be Figure 3

Page 47: summer season should be spring season

Page 65: April should be November to April

Page 71, paragraph 4, line 1: Figures 28 and 30 should be Figures 28 through 30

Page 71, paragraph 6, line 1: isohytes in Figure 2 should be isohyets in Figure 29

Page 80, line 3: nyclei should be nuclei

Page 81, line 3: nyclei should be nuclei

Pages 96 and 97: page numbers are switched

Page 100, paragraph 1, line 9: 164,000 should be $164,000

Page 100, paragraph 3, line 1: Upland, should be Upland

Page 100, paragraph 4, line 7: Krantrowitz should be Kantrowitz

Page 108, paragraph 10, line 4: Syracuse standard metropolitan service area should be Syracuse Metropolitan Statistical Area (SMSA)

Page 109, line 5: Newspaper should be Cheese

Page 110, paragraph 3, line 3: Krantrowitz should be Kantrowitz

Page 118, line 14: Kasocy should be Kasoag

Page 118, line 16: Krantrowitz should be Kantrowitz

Page 170, lines 3 and 4: ill parameter should be kill parameter

Page 219, line 4: Ottom Mills should be Otto Mills

Page 262, line 1 of legend: 0.1 and below should be -0.1 and below

Page 287: page is switched with page 289

Page 287: Figure 78. Law enforcement agencies of the Tug Hill Region should be Figure 79. School districts of the Tug Hill Region (see page 290 for proper legend)

Page 289: page is switched with page 287

Page 289, paragraph 5, lines 3 and 4: television stations in the vicinity. should be television stations in the vicinity are shown in Figure 83.

Page 291: legend is missing, should be Figure 78. Law Enforcement agencies of the Tug Hill Region

Page 301, footnote: Biological should be Biochemical

Atlas, Map 3: Quartz-Feldspar Gneiss should be 9 Quartz-Feldspar Gneiss

Atlas, Map 8: Symbol designating key natural areas is omitted from legend

fishing. Although disinfection of waste effluents is not required, the removal of organic loads, solids, and toxic wastes is necessary to prevent damage to fish life. Class C streams must maintain a dissolved oxygen concentration of four parts per million (ppm). Class Ct streams (trout waters) require minimum oxygen concentration of five ppm.

Class D, agricultural and process water, is the least stringent stream classification. Treatment is required to remove toxic wastes, oil, and organic wastes from effluents. A dissolved oxygen concentration of at least three ppm is required. Table 22 lists pH and dissolved oxygen requirements for the various water classifications.

Chemical analyses of various Tug Hill streams and reservoirs are presented in Tables 23 and 24. With the exception of the Black River, most streams are of high quality, though exhibiting high color and turbidity. The Black River has been called one of the "hardest working" rivers in the state. Below Lyons Falls, the river receives waste discharges from several municipalities and industries. Chlorides, nitrates, and dissolved solids show a marked increase between Carthage and Watertown. The river is high in color, iron, and phosphates, and low in pH. Bacterial counts are sometimes excessive. The water used by Watertown is suitable for human consumption only after extensive chemical treatment.

Table 25 presents data on existing sewage treatment facilities. All communities will be required to provide at least secondary treatment to their wastes. A comprehensive sewerage study for Jefferson County (O'Brien and Gere, 1968), recommended that in addition to expanding all existing facilities in the county to secondary treatment, Adams, Adams Center, and Black River should construct secondary treatment facilities; tertiary treatment facilities were recommended for Watertown. Lewis County is currently the subject of a comprehensive sewerage study by Stearns and Wheeler. Municipal and industrial sewage requirements within the Black River Basin are presented in Table 26.

Existing industries and potential pollution point sources are presented in Tables 26 and 27. Georgia-Pacific Corporation at Lyons Falls, is currently completing work on a pollution abatement system for their plant.

LITERATURE CITED

Barton, Brown, Clyde, and Lojudice
1967. Oswego County (Summary). N.Y. State Dep. Health, Compr. Water Supply Stud., CPWS-23.

Black River Basin Reg. Water Resour. Plann. Bd.
1972. Alternatives for water resources management. Black River Reg. Water Resour. Plann. Bd., Rev. Draft, March 1972.

Black River Basin Reg. Water Resour. Plann. Bd.
1973. Alternatives for water resources management. Black River Basin Reg. Water Resour. Plann. Bd., Rev. Draft, Feb. 1973.

E. Oswego Basin Reg. Water Resour. Plann. Bd.
1973. Summary report on the tentative plan. E. Oswego Basin Reg. Water Resour. Plann. Bd., Work. Draft, June 1973.

Table 22 . Surface water classification, Tug Hill Region.[a]

Water classification	Best use	pH range	Minimum dissolved oxygen (mg/liter)	
			Non-trout	Trout
AA	Municipal water supply (after disinfection)	6.5-8.5	4.0	5.0
A	Municipal water supply (after treatment and disinfection)	6.5-8.5	4.0	5.0
B	Bathing	6.5-8.5	4.0	5.0
C	Fishing	6.5-8.5	4.0	5.0
D	Agricultural, industrial	6.0-9.5	3.0	---

[a]Source: N.Y.S. Dept. Health, 1965.

Table 23. Chemical analysis of water delivered from Tug Hill sources.[a]

Location	pH	Color units	Turbidity units	Dissolved oxygen		Dissolved material in milligrams/liter[b]																	Specific conductivity μ mhos/cm at 25°C	Hardness
				mg/liter	Percent saturation	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Floride (F)	Manganese (Mn)	Iron (Fe)	Nitrate (NO_3)	Nitrite (NO_2)	Ammonium nitrogen (NH_4)	Phosphates (PO_4)	Dissolved solid residue at 180°C		
NYSDH standards drinking water	-	15.0	5.0	-	-	-	-	-	-	-	-	-	250	250	-	0.30	0.30	10	-	-	-	-	-	-
Black River at Watertown	6.8	12.0	<1.0	-	-	5.7	14.0	2.4	3.1	0.70	36.0	0	17.0	3.20	0.2	0.00	-	0.600	-	-	-	91	112.0	--
Black River above Carthage (May 1967)	6.6	13.0	<1.0	-	-	7.4	20.0	-	<5.0	.67	24.0	-	27.0	1.57		.00	-	.024	0.009	0.230	0.70	55	134.0	28
Sandy Creek, North Branch above Adams	7.6	1.7	<1.0	-	-	2.6	76.0	-	<5.0	.78	85.0	-	33.0	2.63	-	.00	-	.019	.006	.230	.26	150	220.0	90
Oneida River at Caughdenoy	7.7	-	-	9.89	86.7	1.6	41.0	8.8	5.0	.90	109.0	-	52.0	8.70	.1	-	-	.200	.010	.110	.18	170	294.0	-
Scriba Creek near Constantia	7.1	-	-	8.59	81.2	2.7	9.4	3.1	1.5	.40	34.0	-	8.4	1.40	.1	-	-	.700	.010	.020	.18	45	77.4	-
West Branch Fish Creek at Blossvale	7.4	-	-	8.66	87.5	2.9	11.3	4.0	1.9	.40	45.0	-	9.3	2.50	.1	-	-	.800	.010	.180	.12	55	155.0	-
East Branch Fish Creek at Taberg	7.4	48.0	1.5	8.19	76.9	2.8	9.2	2.7	1.2	.30	37.0	-	7.9	1.30	.1	.00	0.17	.900	.010	.160	.90	45	84.0	-
Mohawk River above Lansing Kill (1 sample)	8.1	6.0	6.0	-	-	-	-	-	-	-	51.0	-	10.6	1.50	-	.02	.04	.420	.001	.312	-	93	-	48
Mohawk River at Westernville	8.1	8.0	6.0	-	-	-	-	-	-	-	70.0	-	12.2	2.30	-	.02	.03	.410	.001	.244	-	122	-	71

[a] Source: Black River Reg. Water Resourc. Plann. Bd., 1972.
O'Brien and Gere, 1968.
Greeson, 1971.

[b] Average of 5 samples unless otherwise noted.

Table 24. Water quality analysis of existing and potential sources of supply, Tug Hill Region.[a]

Location	Date collected	Color units	Turbidity units[b]	Odor units[b]	Temp--°C	pH	Ammonia (as N) mg/l	Nitrites (as N) mg/l	Nitrates (as N) mg/l	Sulfates mg/l	Iron mg/l	Manganese mg/l	Chlorides mg/l	Hardness as $CaCO_3$ mg/l	Bicarbonate alkalinity as $CaCO_3$ mg/l	Dissolved solids mg/l	Suspended solids mg/l	Total solids mg/l	Coliforms MPN per 100 ml[c]	Source[d]
NYSDH standards drinking water	-	15	5	3	-	-	-	-	10	250	0.3	0.3	250	-	-	-	-	500	-	-
Lake Tagasoke Rome Reservoir	7/7/68	70	12.0	0	21.5	7.2	0.464	0.012	0.10	3.00	0.18	0.08	0.80	18.00	24.0	135.0	6.0	141.0	39.0	B
Boonville Reservoir	8/25/68	25	13.0	0	25.0	8.1	.806	.003	.00	.01	1.50	.00	3.00	100.00	86.0	163.0	2.0	165.0	<3.0	B
	8/30/65	3	7.0	ZV	-	-	-	.001	.10	-	.28	<.01	2.60	108.00	96.0	-	-	-	-	A
Glenmore Reservoir	5/17/66	13	1.5	2A	6.7	7.5	-	-	-	-	.12	.00	5.50	28.00	22.0	-	-	42.0	-	C
Oneida city supply	1/16/67	20	2.8	0	3.3	7.1	-	-	-	-	.38	.00	3.00	36.00	23.0	-	-	47.0	-	C
Mohawk River above Lansing Kill	5/6/68	6	6.0	0	8.5	8.1	.312	.001	.42	10.60	.04	.02	1.50	48.00	51.0	93.0	20.0	113.0	93.0	B
East Branch Fish Creek at Taberg	8/29/67	48	1.5	1A	-	7.8	-	-	-	19.80	.17	.00	1.50	54.00	36.0	-	-	81.0	-	C
Stokes Reservoir raw water	1966-67																			
Average of 22 samples		24	2.5	1	9.0	7.5	-	-	-	-	.11	.00	2.37	42.00	30.5	-	-	81.2	-	D
High		47	5.0	2	24.0	8.7	-	-	-	-	.24	.00	3.50	54.00	44.0	-	-	110.0	-	D
Low		5	.5	0	.4	7.1	-	-	-	-	.03	.00	1.50	28.00	18.0	-	-	55.0	-	D
Lake Delta near dam	5/6/68	5	5.0	0	11.0	7.7	.260	.002	.37	10.90	.05	.02	2.80	47.00	52.0	105.0	15.0	120.0	3.0	B
Mohawk River at Westernville	5/6/68	8	6.0	0	8.0	8.1	.244	.001	.41	12.20	.03	.02	2.30	71.00	70.0	122.0	18.0	140.0	240.0	B
North Bay Spring	6/27/67	2	tr	-	-	-	.006	.004	1.00	-	<.02	.01	8.10	70.00	60.0	-	-	-	-	A
Oneida Lake Average of 9 samples	6/4/67 to 3/4/68	12	9.0	-	10.7	7.9	.587	.007	.10	64.30	.05	.15	10.70	1.48	94.0	240.0	22.0	262.0	79.0	E
Wood Creek	8/29/67	40	4.0	1A	-	7.7	-	-	-	15.20	.22	.00	13.00	102.00	36.0	-	-	172.0	-	C
	2/16/68	35	2.5	-	0.0	7.7	-	.260	.10	20.58	.31	.00	20.00	134.00	96.0	173.5	.5	174.0	-	C
Beaver Creek at Holland Patent intake	8/25/68	5	8.0	0	25.0	8.2	.572	.007	.40	.12	2.06	.02	1.50	130.00	95.0	226.0	4.0	230.0	16.0	B
Trenton Spring	8/25/68	7	7.0	0	14.0	7.8	.400	.006	.44	.12	.36	.00	4.00	79.00	95.0	152.0	10.0	162.0	9.1	B

[a] N. Y. S. Dept. Health, 1968.

[b] Abbreviations: A - aromatic odor
V - vegetable odor
tr - trace

[c] The arithmetic average of the most probable number (MPN) per 100 ml of all samples examined in any month shall not exceed 1.1 coliform orgainsms per 100 ml of sample. A most probable number (MPN) per 100 ml of 8.8 or greater shall not occur in: (1) 2 consecutive samples; (2) more than 1 sample per month when less than 20 are examined per month; or (3) more than 5 per cent of the samples when 20 or more are examined per month.

[d] Source of analysis: A - New York State Department of Health.
B - Malcom Pirnie Eng., 1968.
C - Oneida Area Comprehensive Public Water Supply Study CPWS-12.
D - City of Rome.
E - Comprehensive Sewerage Study, Rome Area, WPC-CS-138.

Table 25. Existing sewage treatment facilities, Tug Hill Region.[a]

Community or facility	Receiving stream	Population connected to sewers	Average daily discharge(m.g.d.)	Type of sewage facility
		Jefferson County		
Deferiet	Black River	700	0.03	Primary treatment
Watertown	Black River	34,000	4.00	Primary treatment
West Carthage	Black River	1,800	0.32	Collection only
		Lewis County		
Castorland	Black River	630	0.06	Secondary (Lasoon)
Lowville	Mill Creek	4,000	0.50	Secondary (Lasoon)
Port Leyden	Black River	900	0.04	Primary treatment
		Oneida County		
Boonville	Mill Creek	2,500	0.40	Primary treatment
Camden	West branch, Fish Creek	2,400	-	Primary treatment, bar screen Imhoff tank
Cleveland	Black Brook	-	-	Collection only Private systems only
McConnellsville	West branch, Fish Creek	10	-	Private systems only
Sylvan Beach	Oneida Lake	110	-	Private systems only
		Oswego County		
Caughdenoy	Oneida River	-	-	Collection only Private systems only
Central Square	Little Bay Creek	-	-	Collection only Private systems only
Central Square Central School	Little Bay Creek	1,400	-	Septic tank and sand filtration

[a] Source: Black River Reg. Water Resourc. Planning Bd., 1972.
N. Y. S. Dept. Health, 1965.
O'Brien and Gere, 1968.

Table 26. Municipal and industrial sewage requirements, Black River Basin.[a]

Service area	Type of waste[b]	Waste discharge (m.g.d.)	Population served	Receiving stream	Improvements required	Project status
Jefferson County						
Black River - Felts Mills	M	0.20	1,900	Black River	Expand to secondary treatment	Preliminary design
Carthage - West Carthage	M,I	4.00	7,180	Black River	Renovation of collection and treatment facilities	Under construction
Deferiet, Herrings	M	0.09	730	Black River	Expand to secondary treatment	Preliminary design
Watertown (City)	M,I	8.00	33,350	Black River	Improvement of collection and treatment facilities	Under construction
Watertown (Town)	M	0.10	1,000	Black River	Collection and treatment facilities	Preliminary engineering
Knowlton Brothers Co.	I	0.75	-	Black River	Expand to secondary treatment	Completed 3/73
St. Regis Paper Co.	I	13.83	-	Black River	Treatment facilities	Completed 12/72
Lewis County						
Castorland	M	0.02	630	Black River	Collection and treatment facilities	In operation
Copenhagen	M	0.09	685	Deer River	Collection and treatment facilities	System defeated in referendum
Glenfield - Martinsburg	M	0.05	370	Black River	Collection and treatment facilities	In operation
Lowville	M,I	1.00	4,000	Black River	Expand to secondary treatment	In operation
Lyons Falls	M	0.13	1,200	Black River	Collection and treatment facilities	Preliminary engineering
Port Leyden	M	0.20	965	Black River	Expand to secondary treatment	Preliminary engineering
Turin	M	0.10	800	Mill Creek	Collection and treatment facilities	Preliminary engineering
Georgia Pacific (Lyons Falls	I	6.64	-	Black River	Collection and treatment	Completed 9/73
Oneida County						
Boonville	M	0.64	3,000	Mill Creek	Improvement of collection, expand to secondary treatment	Under construction

[a] Source: Black River Basin Reg. Water Resourc. Plann. Bd., 1973.

[b] Codes: M - municipal
I - industrial

Table 27. Pollution point sources, Tug Hill Region.[a]

Establishment	Location	Product	Type of waste	Treatment	Stream	Average daily discharge (m.g.d.)
			Jefferson County			
Crown Zellerbach Co., Inc.	Carthage	Paper	Not identified	Partial vacuum filtration	Black River	2.60
St. Regis Paper Co.	Deferiet	Paper	Not identified	Partial sedimentation & floatation	Black River	15.50
Knowlton Bros.	Watertown	Paper	Not identified	Partial vacuum	Black River	0.55
			Lewis County			
Georgia Pacific Paper Co.	Lyons Falls	Paper	Not identified	Partial vacuum filtration	Black River	8.50
			Oneida County			
Queensboro Farm Products Inc., receiving station	Blossvale	Raw fluid milk	Milk, washwater, sanitary	Septic tank	West Branch, Fish Creek	---
Laribee Wire & Equipment Corp.	Camden	Copper wire	Cleaning solubles, oil, sanitary	None	West Branch Fish Creek	---
Olney & Floyd Co., Inc.	Camden	Beans	Cannery	Siltation	West Branch Fish Creek	---
Anken Cheese Factory	Florence	Cheese	Milk, whey, washwater	None	Tributary to Mad River	---
Lee Center Cheese Factory	Lee Center	Cheese	Milk, whey, washwater	None	Canada Creek	---
Olney & Floyd Co., Inc.	Lee Center	Peas, beans, corn, pumpkin	Cannery	Lagoons	Tributary to Canada Creek	---
Harden Furniture Co.	McConnellsville	Furniture	Overflow from log washing tank, silt, bark, sanitary	None	West Branch Fish Creek	---
Rome Specialty Corp.	Rome	Fishing tackle	Plating	None	Wood Creek	---
Murphy's Custom Canning	Verona	Beans, Corn, tomatoes	Cannery	None	Tributary to Stoney Creek	---
P. & K. Dairy Co., Inc. receiving station	West Lee	Raw fluid milk	Milk, washwater, sanitary	Septic tank	Canada Creek	---

[a]Source: Black River Reg. Water Resourc. Plann. Bd., 1972.
NYS Dept. Health, 1965.
NYS Dept. Health, 1968.

E. Snow Conf.
1958-73. Snow cover survey. U.S. Dep. Comer., Weather Bur. and Natl. Weather Sev., E. Snow Conf.

Greeson, P.E.
1971. Limnology of Oneida Lake with emphasis on factors contributing to algal blooms. N.Y. State Dep. Environ. Conserv.

Greeson, P.E., and Robinson, F.L.
1970. The characteristics of New York lakes (Gazetteer). N.Y. State Dep. Environ. Conserv.

Jiusto, J.E., and Kaplin, M.L.
1971. Snowfall properties of Lake Erie and Ontario storms. E. Snow Conf., Proc.: 17-25.

Kaiser, R.F.
1939. The composition and origin of glacial till in the Mexico and Kasocy quadrangles, New York. Unpubl. M.S. thesis, Syracuse Univ.

Krantrowitz, I.H.
1970. Eastern Oswego ground water, N.Y. State Conserv. Dep., Water Resour. Comm., Basin Plann. Rep.: ORB-2.

Leopold, L.B., and Langbein, W.H.
1964. A primer on water. U.S. Dep. Inter.

Malcolm Pirnie Eng.
1968. Herkimer-Oneida Counties. N.Y. State Dep. Health, Compr. Water Supply Stud., CPWS-47.

Muller, E.H.
1964. Geomorphology of Oneida Basin and south slope of the Tug Hill Plateau. N.Y. State Geol. Assoc., Guideb.: 42-50.

Muller, R.A.
1960. Some economic consequences of deep snowfalls in northern New York. Unpubl. M.S. thesis, Syracuse Univ.

Newell, J.G.
1939. Geomorphic development of the Tug Hill Plateau. Unpubl. M.S. thesis, Syracuse Univ.

N.Y. State
1957. Oneida River drainage basin. N.Y. State Dep. Health, Oswego River Drainage Basin Surv. Ser., Rep. 5.

N.Y. State
1965. Classifications and standards of quality and purity. N.Y. State Dep. Health, Lake Ontario Drainage, 1965.

N.Y. State
1969. Industrial directory. N.Y. State, Dep. Labor.

N.Y. State
u.d. Periodic report of the water quality surveilance network, 1965 through 1967 water years. N.Y. State, Dep. Environ. Conserv.

O'Brien and Gere Eng.
1968a. Jefferson County. N.Y. State, Dep. Health, Compr. Water Supply Stud., CPWS-38.

O'Brien and Gere Eng.
1968b. Jefferson County. N.Y. State Dep. Environ. Conserv., Compr. Sewerage Stud., WPC-CS-159.

Street, J. S.
1966. Glacial geology of eastern and southern portions of the Tug Hill Plateau. Unpubl. Ph.D. thesis, Syracuse Univ.

Swenson, H. A., and Baldwin, H. L.
1965. A primer on water quality, U. S. Dep. Inter.

Thornbury, W. D.
1969. Principles of geomorphology. John Wiley and Sons, Inc., N. Y.

Thornthwaite, C. W., Mather, J. R., and Carter, D. B.
1958. Three water balance maps of eastern North America, in Resources for the future.

U. S. Geol. Surv.
u.d. Water resources data for New York. Part 1: Surface water records. U. U.S. geol. surv.

U. S. Geol. Surv.
u.d. Water resources data for New York. Part 2: Water quality records U. S. geol. surv.

U. S. Weather Bur.
1963-72. Climalological data, New York. U. S. Weather Bur.

SUMMARY

The dominant vegetative pattern in the Tug Hill Region is one of increasing density of forest cover from the periphery to the core of the Region. The high plateau at its center is covered by largely unbroken forests. Successional forests and brushlands dominate upland sites surrounding the forested core, while active agriculture and successional fields are most prominent on the flood plains east of Lake Ontario, in the Black River Valley, and in the Mohawk Valley. Throughout all areas, wet woodlands of varying species composition occupy low-lying and depressional areas.

While forests occupy about 65 percent of the Tug Hill Region, 9 distinct natural vegetation-land use types have been identified. These represent a highly variable series of intergrading plant communities that collectively contain about 885 species, including 52 rare or endangered plant species or varieties.

Seven groups of unique and important natural areas have been identified and described, based upon the presence of rare or endangered species, unique groupings of habitats or cover types, or sensitivity to even minimal human impact (as in dunes, bogs, or gorges). Large portions of these areas should be studied for withdrawal from destructive development, or assigned limited-access use such as timber management zones, wildlife management areas, or low intensity recreational use. River systems within the Tug Hill Region represent additional unique natural and scenic assets. Eleven appear to qualify for inclusion in New York State Wild, Scenic, and Recreational Rivers System.

Timber inventory data indicate that about 775,000 acres in the Region (60 percent) support commercial forests, most of which is held in private ownerships. Hardwoods predominate, and softwood stands are limited to about 15 percent of the area. Sawtimber stands contain the majority of both sawtimber and growing stock volume but are present on only 25 percent of the commercial forest area. About 1.3 million board feet of sawtimber and 600,000 cubic feet of growing stock are present. However, Tug Hill forests can be generally described as poorly stocked, with low proportions of high quality timber.

RECOMMENDATIONS

The natural vegetation-land use map presents a broad regional perspective of the Tug Hill Region's highly variable natural systems. More specific information will be needed to evaluate proposed developments of different types and at different places. Such information should be provided in relation to specific development proposals. Sensitive vegetational analysis, recognizing the desirability of retaining a diversity of natural habitats and preferentially reserving mature forest which require long periods for natural successional replacement, should be included along with other land use and development suitability considerations.

Thorough analysis of the Region's timber resources awaits collection of extensive data on current and projected harvesting, merchantable volumes, yields from representative stands, growing stock quality, growth, suitability of various management and cultural techniques, and the economies of local wood-using industries. Since forested lands and timber represent an important resource to the Tug Hill Region, further study into these matters seems warranted.

The 7 groups of unique natural areas and 11 potential wild, scenic, or recreational river systems should be carefully studied. Their importance to the future of the Tug Hill Region warrants careful consideration, along with means to insure their maintenance for future generations.

VEGETATIVE PATTERNS

The Tug Hill plateau has long interested botanists, partially because of its isolation and inaccessibility, and partially because it represents a unique meeting ground where species of northern and southern floristic affinities have differentiated into regionally unique plant communities under the influence of climatic severity and environmental variability.

Yet, surprisingly few formal botanical studies have been conducted within the Tug Hill Region. The only comprehensive vegetational survey was that by Hotchkiss (1932). Building on the classification system provided by Bray (1930), Hotchkiss described the plant community composition of the entire plateau at the Region's center, stressing compositional variations related to local habitat features. Both Hotchkiss and Braun (1950) considered the area to represent a zone of transitional mixing between hardwood forests of the Allegheny Plateau to the south, and hardwood and coniferous forests of the Adirondack Mountains to the east. More recent, though less thorough, accounts of the natural vegetation of the area have been given by Armstrong (1954), and Connor (1966).

Natural vegetation of the broader Tug Hill Region forms an even more highly variable series of intergrading plant communities. Floristic elements are derived from the northern hardwood forests of the Appalachian Plateau to the south, the spruce-fir forest of the Adirondack Mountains to the east, and the flood plain communities of Lake Ontario and the St. Lawrence River. Environmental variation is high due to the presence within the Region of several distinctly different physiographic sub-regions as illustrated in Figure 1. These can be summarized into five units useful in describing vegetation patterns across the Region:

1. the level flood plains of Lake Ontario with minimum elevations of 250 feet above sea level;
2. the less extensive but more highly dissected flood plains of Oneida Lake to the south;
3. the broad alluvial valley bottoms of the Black River Valley and the Mohawk River Valley;
4. the flat to broadly undulating till plain in the central portion of the Region, with elevations from 1500 to slightly over 2100 feet; and
5. the gently sloping till plain called the Tug Hill Fringe, composed of low rolling hills that form a transition between the highest elevations at the Region's center, and the low areas around its periphery (Figure 41).

Equally variable climatic and soils conditions are present across the area.

Imposed over this highly variable natural complex has been a history of diverse land use practices. Timber harvesting and land clearing for agriculture flourished throughout the Region over 100 years ago, resulting in the virtual absence of undisturbed forest remnants. Major shifts in agricultural practices have taken place within the past 60 years, especially in the Tug Hill Fringe, with widespread land abandonment on the least productive lands. Better sites have been converted from field crops to dairy and hay production. More recently, changes have included the application of forestry practices, especially establishment of plantations using both native and exotic coniferous species.

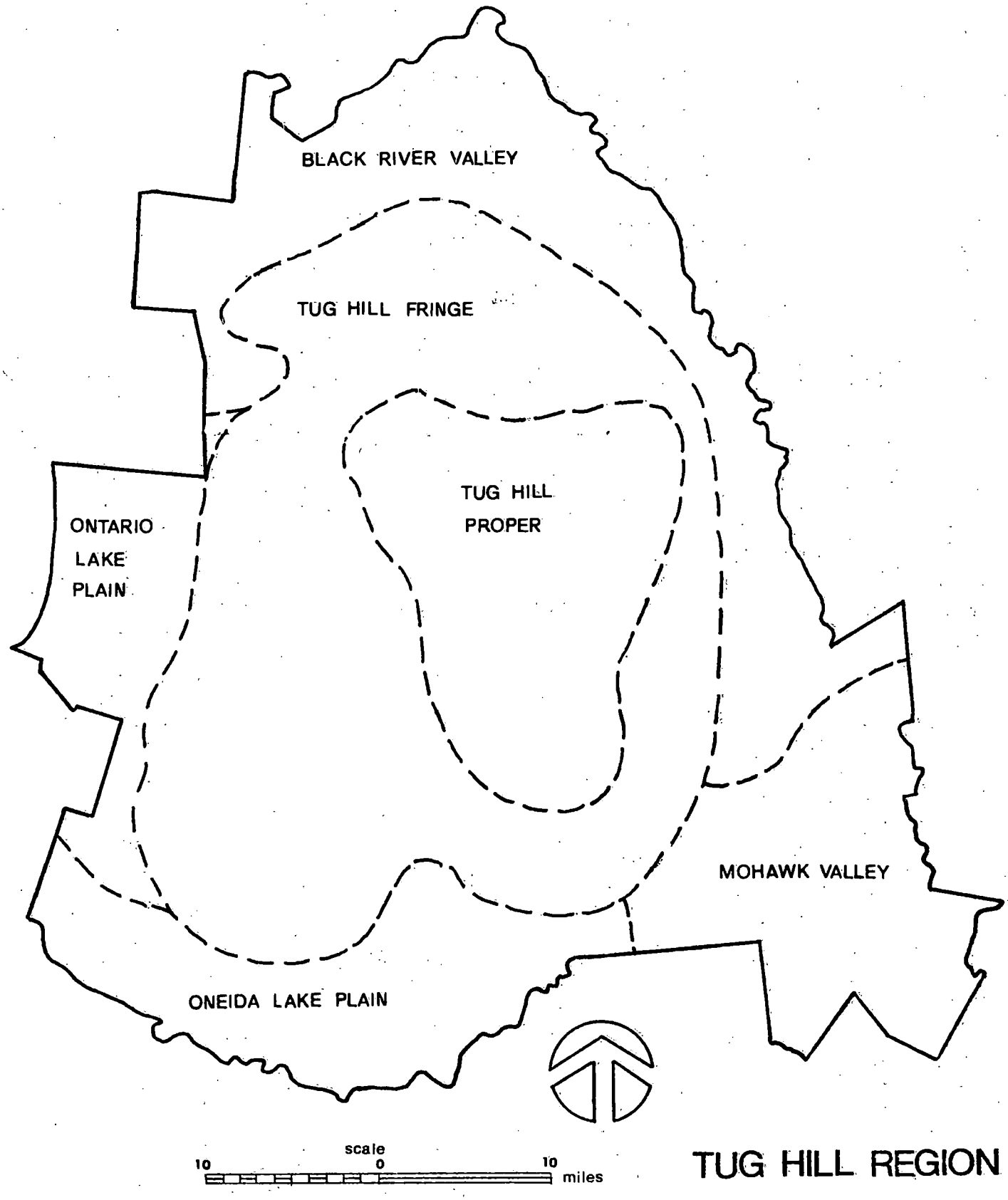


Figure 41. Subregions used to describe vegetation-land use patterns of the Tug Hill Region.

NATURAL VEGETATION AND LAND USE MAP

The vegetative character of the Tug Hill Region and its sub-regions is shown on Map 7 in the Atlas. Since high quality aerial photographic coverage was not uniformly available for the Region, mapping data were obtained from the land use and natural resource inventory (LUNR), prepared by the New York State Office of Planning Services (Off. Plann. Serv., 1972). This survey delineated 51 land use categories through the interpretation of aerial photographs taken between 1967 and 1970. These categories were displayed on U. S. Geological Survey quadrangle overlays at a scale of 1:24,000. Field checks within the Tug Hill Region indicated that while substantial variation in natural vegetation exists within LUNR categories, summarization and interpretation of LUNR provides adequate preliminary description of broad vegetational patterns within the Region.

In developing Map 7, nine natural vegetation-land use mapping units were defined by combining LUNR categories according species composition and successional relationships observed in the field. For example, LUNR categories Ai (inactive agriculture), Ns (non-productive sandy areas), and Nr (non-productive rocky areas) are all included in our "successional fields" type because of similarities in plant cover and natural successional tendencies. Patterns were further generalized to allow the preparation of a final map at a scale of 1:125,000. Extensive field surveys were made to define the natural vegetation complex associated with each of these mapping units, and detailed accounts of variations in community composition were generated within each type. While Map 7 provides a generalized projection representing broad regional patterns rather than specific local features, field checks indicate that it adequately gives a regional perspective of this highly variable natural system called the Tug Hill Region.

Forested Lands

Areas characterized by the occurrence of forest cover or on which vegetational development toward forest communities has progressed to the stage where brushlands and young stands of pole-sized, pioneer tree species are present account for almost 65 percent of the Region (Table 28). The four forest cover types identified in the Tug Hill Region are described below.

Well drained mature forests--LUNR code-Fn.

This category includes well drained forests of trees over 30 feet in height and 50 years in age, usually representing natural, second-growth stands. Deciduous hardwood species are dominant, although white pine (Pinus strobus) and eastern hemlock (Tsuga canadensis) are frequent associates. Compositional changes have occurred in portions of the area as a result of the application of low intensity forestry practices.

Forest composition throughout much of the Tug Hill Upland resembles that of the lower elevation forests of the Adirondacks. Communities dominated by deciduous hardwood species occupy the better drained upland sites. Major species include sugar maple (Acer saccharum), red maple (Acer rubrum), American beech (Fagus grandifolia), yellow birch (Betula lutea), black cherry (Prunus serotina), and red spruce (Picea rubens). At higher elevations in the northeastern portion of the area balsam fir (Abies balsamea), red spruce (Picea

Table 28. Land area by natural vegetation--land use types for the Tug Hill Region.

Type of vegetation	Area occupied		
	Acres	Square miles	Percent of region
Forested lands			
Well drained mature forests	437,094	683.0	32.4
Wet woods	84,531	132.1	6.3
Successional forests and brushlands	297,830	465.4	22.1
Forest plantations	52,224	81.7	3.9
Total forested lands	871,679	1,362.2	64.7
Open space			
Successional fields	55,757	87.1	4.1
Wet	32,461	50.7	2.4
Water	10,957	17.1	0.8
Total open space	99,175	154.9	7.3
Developed lands			
Active agriculture	352,102	550.2	26.1
Developed lands	26,163	41.0	1.9
Total developed lands	378,265	591.2	28.0
Grand total	1,349,119	2,108.3	100.0

rubens) and eastern hemlock (Tsuga canadensis) are present in high densities. Balsam fir is restricted to wetter areas between approximately 1400 and 1700 feet elevation, while above 1700 feet it occurs in association with other species on drier sites. Selective logging throughout the interior has greatly altered forest composition. The most striking example appears in areas where the removal of red spruce has created deciduous forest stands in place of the previous mixture of hardwoods and conifers. In other areas the removal of black cherry has resulted in the occurrence of pure stands of beech and maple.

Understory composition varies substantially on different sites; however, witchhobble (Viburnum alnifolium), currant (Ribes glandulosum), bramble (Rubus pubescens), mountain maple (Acer spicatum), striped maple (Acer pennsylvanicum), dogwood (Cornus alternifolia) and yew (Taxus canadensis) are present throughout as shrub components. The most common herbaceous species include: evergreen woodfern (Dryopteris spinulosa), Christmas fern (Polystichum acrostichoides), wood sorrel (Oxalis montana), sarsaparilla (Aralia nudicaulis), clintonia (Clintonia borealis), bunchberry (Cornus canadensis), club moss (Lycopodium spp.) Canada mayflower (Maianthemum canadense), goldthread (Coptis groenlandica), indian cucumber root (Medeola virginiana), partridge berry (Mitchella repens), star flower (Trientalis borealis), trout lily (Erythronium americanum), foam flower (Tiarella cordifolia), pyrola (Pyrola elliptica), rose-twisted stalk (Streptopus roseus), toothwort (Dentaria diphylla), spring beauty (Claytonia caroliniana), and wintergreen (Gaultheria procumbens).

Along the flood plains of Lake Oneida, Lake Ontario and the Black River Valley, forest composition is similar to that of the northern portions of the Allegheny Plateau. Dominant tree species include sugar maple (Acer saccharum), red maple (Acer rubrum), beech (Fagus grandifolia), black cherry (Prunus serotina), white ash (Fraxinus americana), black walnut (Juglans nigra), oaks (Quercus spp.), hickories (Carya spp.), white pine (Pinus strobus), and basswood (Tilia americana). Understory vegetation is similar to that found in the lower elevation forests of the Region's interior. However, the following species characteristic of more southerly affinities are also present: bellwort (Uvularia grandiflora), white trillium (Trillium grandiflorum), wild ginger (Asarum canadense), leak (Allium tricoccum), jumpseed (Tovara virginiana), nimble will (muhlenbergia schreiberi), shield fern (Dryopteris marginalis), mayapple (Podophyllum peltatum), and herb robert (Geranium robertianum).

The upper slopes and rims of deep gorges and ravines along both the western and eastern edges of the plateau are dominated by a mixed community of conifers and successional hardwoods. Major tree species include white pine (Pinus strobus) eastern hemlock (Tsuga canadensis), northern white cedar (Thuja occidentalis), big tooth aspen (Populus grandidentata), and trembling aspen (Populus tremuloides). The cool, moist conditions within these gorges permit the maintenance of a unique assemblage of uncommon plant species, including fragile fern (Cystopteris fragilis), green spleenwort (Asplenium viridi), grape fern (Botrychium simplex), bladder fern (Cystopteris bulbifera), stemless ladyslipper (Cypripedium acaule), harebell (Campanula rotundifolia), columbine (Aquilegia canadensis), and raspberry (Rubus odorathus).

Wet woods--LUNR code-Ww

Forest cover occurs throughout the Region in slight depressional areas or areas of low total relief where standing water is present for extended periods of time. The species composition of these forested wetlands varies greatly with elevation. Below 1450 feet deciduous hardwood species, mainly elm (Ulmus americana), white ash (Fraxinus americana), silver maple (Acer saccharinum) and red maple (Acer rubrum) predominate, and a dense shrub cover characterizes the lower strata of the community. Above 1450 feet coniferous species become increasingly more abundant, with the understory being composed of a rich mixture of boreal herbaceous species. Coniferous dominance increases progressively with elevation, and above 1750 feet red spruce (Picea rubens), black spruce (Picea mariana), balsam fir (Abies balsamea), and tamarack (Latrix laricina) form essentially pure coniferous communities. Common shrub species of lower elevation wet woods are tall blueberry (Vaccinium corymbosum), holly (Ilex verticillata), honey suckle (Lonicera canadensis), alder (Alnus rugosa), mountain holly (Nemopanthus mucronata), and witch hazel (Hamamelis virginiana). The most characteristic herbaceous species are sensitive fern (Onoclea sensibilis), marsh fern (Dryopteris thelypteris), royal fern (Osmunda regalis), cinnamon fern (Osmunda cinnamomea), horsetails (Equisetum spp.), rattle snake grass (Glyceria melicaria), blue flag (Iris versicolor), false hellebore (Veratrum viride), and several sedges (Carex spp.). Herbaceous dominants of higher elevation communities are gold thread (Coptis groenlandica), sedge (Carex intumescens), clintonia (Clintonia borealis) stemless ladyslipper (Cypripedium acaule), false violet (Dalibarda repens) bunchberry (Cornus canadensis), and creeping snowberry (Gaultheria hispidula).

Successional forests and brushlands--LUNR code--Fc

A highly variable category, brushlands and early successional forests generally represent older agricultural abandonments which have undergone 30 or more years of successional development. Such areas appear quite similar to heavily logged forests in the process of reverting back to forest cover. Lands which have experienced both kinds of cultural treatment are included in this type.

Brushlands considered in this classification may include as little as a 10 percent shrub cover and a mixture of annual and perennial herbaceous associates. Abandoned pastures have a somewhat different appearance due to the inclusion of certain shrub species, notably hawthorn (Crataegus spp.) which were selectively avoided by livestock during prior periods of active grazing. Other important shrub species composing brushland cover include meadow sweet (Spirea latifolia), dogwoods (Cornus spp.), arrowwoods (Viburnum spp.), willows (Salix spp.), alder (Alnus rugosa), sumac (Rhus typhina), buckthorn (Rhamnus cathartica), hazelnut (Corylus cornuta), chokeberry (Pyrus melanocarpa), and honeysuckle (Lonicera spp.).

The open nature of brushland cover allows the persistence of many of the annual and perennial herbaceous species which characterize successional fields. The most common herbaceous associates are orchard grass (Dactylis glomerata), timothy (Phleum pratense), sweet vernal grass (Anthoxanthum odoratum), oat grass (Danthonia spicata), red top (Agrostis alba), quack grass (Agropyron repens), wild carrot (Daucus carota), club mosses (Lycopodium spp.), beggars ticks (Bidens spp.), sheep sorrell (Rumex acetosella), goldenrods (Solidago spp.), and burdock (Arctium minus).

Seedlings and saplings of tree species are common brushland components, increasing in abundance with time since abandonment. Species present throughout the study area include red maple (Acer rubrum), sugar maple (Acer saccharum), black cherry (Prunus serotina), pin cherry (Prunus pennsylvanica), choke cherry (Prunus virginiana), white ash (Fraxinus americana), trembling aspen (Populus tremuloides), eastern cottonwood (Populus deltoides), gray birch (Betula populifolia), white pine (Pinus strobus), and elm (Ulmus americana). On limestone rich soils surrounding Watertown and portions of the Lake Ontario flood plain, eastern red cedar (Juniperus virginiana) is an abundant component of shrubby fields. At higher elevations in the northeastern portion of Tug Hill balsam fir (Abies balsamea) and red spruce (Picea rubens) are early brushland invaders.

Successional forests composed of trees up to 40 to 50 years of age with diameters less than 6 inches and heights less than 30 feet are also included within this type. Common species of widespread occurrence throughout the Region are trembling aspen (Populus tremuloides), red maple (Acer rubrum), white ash (Fraxinus americana), black cherry (Prunus serotina), white pine (Pinus strobus), and eastern hemlock (Tsuga canadensis). In the southern half of the area, especially along the flood plains of Lake Ontario, Lake Oneida, and the Black River, eastern cottonwood (Populus deltoides), basswood (Tilia americana), and several species of oaks (Quercus spp.) and hickories (Carya spp.) become prominent associates. At higher elevations in the interior of the Region, mature forest species are frequently present in these younger stands, and the stands represent regrowth following logging rather than old field succession following agricultural abandonment. On drier sites the list would include sugar maple (Acer saccharum), American beech (Fagus grandifolia), and yellow birch (Betula lutea); while on wetter sites red spruce (Picea rubeus), balsam fir (Abies balsamea), tamarack (Larix laricina) and eastern hemlock (Tsuga canadensis) are more abundant. In response to the denser canopy associated with stands of pole-sized timber, woodland herbaceous species increase in importance in the understory. The most common species are club moss (Lycopodium obscurum and Lycopodium annotinum), woodland aster (Aster acuminatus), woodland grass (Cinna latifolia), erect woodland grass (Brachyelytrum erectum), clintonia (Clintonia borealis), sarsaparilla (Aralia nudicaulis), and evergreen wood fern (Dryopteris spp.).

Forest plantations--LUNR code--Fp

Forest plantations of all age and size classes are presented together within this single cover type. They have been most frequently established on abandoned agricultural lands owned by the State of New York and managed by the Department of Environmental Conservation. Other privately held lands have been reforested through cooperative arrangements with the Department. Plantations may be composed of single species or mixtures of coniferous species; less frequently, hardwood species are also included. Further information concerning species composition, acreages, merchantable volumes, and past silvicultural treatment of State reforestation areas within the Tug Hill Region may be obtained from the Department's Regional Offices in Dadville (Lowville), Herkimer and Cortland. The most common coniferous species present on State reforestation lands include white pine (Pinus strobus), red pine (P. resinosa), Austrian pine (P. nigra), jack pine (P. banksiana), Scots pine (P. sylvestris), Norway spruce (Picea abies), white spruce (Picea glauca), European larch (Larix leptolepis).

Open Space

Undeveloped lands which lack a forest or brushland cover make up about seven percent of the Tug Hill Region. Three cover types are identified and described below.

Successional fields--LUNR codes Ai, Ns, and Nr

Inactive agricultural lands, which have experienced less than 30 years of undisturbed natural succession, are usually dominated by a mixture of annual and perennial herbaceous species. Tree and shrub species become established during this period, and, with increasing age, successional fields develop into brushlands and successional forests. Fields with up to 10 percent shrub cover are included within this unit. Major species include orchard grass (Dactylis glomerata), timothy (Phleum pratense), panic grass (Panicum spp.). foxtail grass (Setaria viridis), sedges (Carex spp.), red top (Agrostis alba), oat grass (Danthonia spicata), buttercup (Ranunculus acris), ox-eyed daisy (Chrysanthemum leucanthemum), devil's paint brush (Hieracium aurantiacum), sheep sorrel (Rumex acetosella), cinquefoil (Potentilla canadensis), wild carrot (Daucus carota), goldenrods (Solidago spp.), asters (Aster spp.), pussytoes (Antennaria neglecta), yarrow (Achillea millefolium), and milkweed (Asclepias syriaca).

Non-productive lands with beach sand, exposed rock, or rocky cliffs and slopes occurring along the Lake Ontario shoreline are also included within this unit, owing to similarities in the physiognomy or appearance of the community. However, successional relationships are substantially different from those of the abandoned fields, with many more years of development required for the invasion of large shrubs and forest trees.

Rock outcrop areas provide shallower soils and a drier soil moisture regime. Many old field species are present on such sites along with an abundance of hair cap moss (Polytrichum spp.), reindeer lichen (Cladonia spp.), blueberry (Vaccinium angustifolium), spreading juniper (Juniperus communis) and eastern red cedar (Juniperus virginiana).

Sandy areas along the lake shore represent extremely unstable habitats dominated by plants adapted to shifting sands and dry environments. The major species are beach grass (Ammophila breviligulata), wormwood (Artemisia caudata), seaside spurge (Euphorbia polygonifolia), cocklebur (Xanthium echinatum), false Solomon's seal (Smilacina stellata), grape (Vitis vulpina), evening primrose (Oenothera biennis), poison ivy (Rhus radicans), saltwort (Salsola kali), silverweed (Potentilla anserina), and Virginia creeper (Parthenocissus quinquefolia).

Wetlands--LUNR code-Wb.

Marshes, shrubby marshes, and bogs greater than 10 acres in size are included together within this single mapping unit. Habitat variability is extremely high, ranging from depressional sites with waterlogged soils to floating aquatic systems rooted in three to five feet of water at the perimeter of ponds and lakes. Four general types of wetlands are considered. Gramineous marsh meadows and shrubby marshes are present throughout the Region, while bogs and coniferous bogs are limited in occurrence to elevations above 1500 feet.

Gramineous marsh meadows are flat areas, appearing like a grassy field from a distance. They occur along the edges of shallow ponds, in depressions within agricultural fields, and along the banks of streams with broad valley bottoms. Standing water is present only in the spring, but the soils remain waterlogged throughout the year. Cattail (Typha latifolia), blue joint grass (Calamagrostis canadensis), hair grass (Deschampsia caespitosa), deep-tongue grass (Panicum clandstinum), and beaked sedge (Carex rostrata) give these meadows their characteristic appearance. Other common species are rattle snake grass (Glyceria canadensis), reed meadow grass (Glyceria grandis), meadow grass (Poa palustris), beaked rush (Rhynchospora alba), spikerush (Eleocharis palustris), meadow rue (Thalictrum polygamum), St. John's wort (Hypericum spp.), several species of sedge (Carex spp.), Joe-pye weed (Eupatorium maculatum), mint (Lycopus americanus), sensitive fern (Onoclea sensibilis), and cinnamon fern (Osmunda cinnamomea).

Shrubby marshes occur on flat lands adjacent to streams or in depressional areas between adjacent upland ridges. They are dominated by several species of willow (Salix spp.) and alder (Alnus rugosa). Brush cover ranges from 30 to 100 percent, with the inclusion of occasional tree species listed in the wetwoods category. Many of the plant species found in gramineous meadows are also present in this unit, especially when shrub cover is sparse. Common shrub species include sweet gale (Myrica gale), meadow sweet (Spirea latifolia), buckthorn (Rhamnus alnifolia), red-osier dogwood (Cornus stolonifera), honey suckle (Lonicera villosa), and arrowwood (Viburnum dentatum).

Bogs occur at the perimeter of small, closed-drainage ponds or in shallow upland depressions with poor drainage. Bog vegetation is rooted in a matrix of partially decomposed organic matter and sphagnum moss. Dominant species are low shrubs, many of which belong to a single plant family, the Ericaceae or heath family. Characteristic shrub species include Labrador tea (Ledum groenlandica), bog rosemary (Andromeda glaucophylla), blueberry (Vaccinium angustifolium), small cranberry (Vaccinium oxycoccus), large cranberry (Vaccinium macrocarpon), sheep laurel (Kalmia angustifolia), bog laurel (Kalmia polifolia), and leatherleaf (Chamaedaphne calyculata), mountain holly (Nemoponthus mucronata), chokeberry (Pyrus melanocarpa), Juneberry (Amelanchier spp.), and meadow sweet (Spirea latifolia). Growing in and among the shrubs are a number of grass, sedges, and rush species (Glyceria spp., Carex paupercula, Carex crinita, Scirpus spp., and Juncus effusus). Rare species of orchids and insectiverous plants are occassionally present in these fragile systems.

Coniferous bogs are similar in species composition and distribution to the previous type. However, widely speced coniferous tree species represent the dominant plant form rooted in the Sphagnum matrix. The most common tree species are balsam fir (Abies balsamea), red spruce (Picea rubens), black spruce (Picea mariana), and tamarack (Larix laricina). Shrubby and herbaceous species listed in the previous type occur between the trees.

Water--LUNR codes-Wn, Wc, Ws, Wh, Wm

All bodies of water greater than 10 acres in size are delineated in this single category. Smaller ponds, lakes, and rivers may be included within other mapping units. Submerged or floating plants occurring in open bodies of water are described as aquatic macrophytes. Taxonomically, they are representatives of the following genera Potamogeton, Sagittaria, Elodea, Calla, Lemna, Numphae, Nuphar, and Utricularia.

Developed Lands

About 28 percent of the land area in the Tug Hill Region is classified in some form of human land use pattern. All such land uses have been combined into these two types. Further information and greater detail are available from the LUNR data base.

Active agriculture--LUNR codes-Ay, Ao, Av, Al, At, Ac, Ap.

The main agricultural industry in the Tug Hill Region is dairying with some beef cattle and field crop production. Fields are either pastures or in rotational corn, alfalfa, clover or hay. Christmas trees and pulpwood production represent a minor component of the total farm industry. LUNR breaks down agricultural lands into many catagories, but all of these are presented in this single mapping unit. Christmas tree plantings are included as Forest Plantations, while land areas in pulpwood production would be classified in one of the several forest land categories. Natural vegetation occurring along fences and hedge rows would be similar to that described for Successional Fields, and Successional Forests and Brushlands.

Developed lands--LUNR codes--Ui, Uc, OR, and P, R, C, E, T, I (All categories).

Developed lands are prominent features, even though the Tug Hill Region is sparsely populated. All classes of developed lands (urban, transportation, public, commercial, residential, shoreline development, industrial, extractive mining, and outdoor recreation) are combined in this single category. Vegetation occurring in and around developed areas contains elements of all previously delineated natural vegetation--land use types.

Distribution of Cover Types

The distribution of natural vegetation-land-use types within the Tug Hill Region is illustrated on Map 7 of the Atlas, and the area occupied by each unit is summarized in Table 29. This map must be viewed as a generalized projection representing regional patterns rather than specific local features. Such generality results both from the map scale (1:125,000) and the inherently variable character of the natural system.

The dominant regional pattern is one of increasing density of forested lands from the periphery of the Region to the high plateau at its center. Active agricultural land use is concentrated in the level flood plain areas of the Black River Valley and Lake Ontario. The greatest concentration of successional fields, representing recent agricultural abandonment, also occurs there. Extensive agricultural development on the Lake Oneida flood plain has been limited by its higher degree of topographic diversity, and forested lands predominate today.

Contemporary vegetational diversity is greatest in the Tug Hill fringe, where timbering, land clearance, agricultural failure, and land abandonment patterns have been the most historically variable, resulting in a complex mosaic of mapping units. Here, brushlands and early successional forests are more common than successional fields, suggesting land abandonment in the early 1900's, rather than late 1930's and early 1940's. Many of these areas have

Table 29. Total land area and commercial forest land area by county, by towns within the Tug Hill Region, and conversion factors.

County	Land area in square miles		Commercial forest land area in square miles[a]		Conversion factors	
	County total	Tug Hill Region	County total	Tug Hill Region	Percent of total land area in Tug Hill Region	Percent of commercial forest land area in Tug Hill Region
Jefferson	1293.5	295.8	498.16	147.60	22.87	29.63
Lewis	1291.3	635.7	865.10	372.51	49.23	43.06
Oneida	1223.4	564.0	662.00	356.02	46.10	53.78
Oswego	964.4	524.3	620.55	395.60	54.37	63.75

[a] Defined as including LUNR land use classes for mature forest, forest brushland, plantations, and inactive agriculture. See text.

been purchased by the State of New York and reforested with coniferous species. Isolated stations of well-drained, mature forests and wet woods form the remaining elements of the patchwork of habitats characterizing this portion of the Region.

Agricultural development in the center of the Region has been minimal. Early timbering and regrowth following timber harvest represent the major cultural influences on the natural system. The interior is dominated today by well-drained, mature forests interspersed with wet woods and wetland systems oriented in a northwest-southeast direction. Changes in community patterns within this area are often associated with minimal differences in elevation.

Floristic Survey

A preliminary flora for the region was prepared by updating the species lists provided by Hotchkiss (1932). Taxonomic terminology was revised to comply with Gray's Manual of Botany, 8th Edition, (Fernald, 1950). Additions to the Hotchkiss list were made on the basis of field observations and the reports of others working in comparable areas (Geis and Luscombe, 1972). A list of rare and endangered plant species was prepared with the assistance of Mr. Stanley J. Smith of the New York State Museum in Albany.

The list of species occurring in the Tug Hill Region is presented in Appendix 4. Included are 109 families of vascular plants with 381 genera and 885 species. The list must be viewed as preliminary. Careful study over several seasons would likely result in a substantial number of additions. The list is arranged by families in the order that they appear in Gray's Manual of Botany (Fernald, 1950). Each plant is identified by genus, species, and citation. A short habitat description derived from the descriptions in Gray's Manual and the Hotchkiss report is also provided, along with notations indicating the natural vegetation land use unit or units where the species would most likely be found.

A separate list of known rare and endangered plant species is given in Appendix 5. Rare species have been collected fewer than 10 times in the state. Endangered species are more common, but since they have a limited distribution or are limited in occurrence to rare habitats, they, too, are worthy of special attention.

The natural vegetation-land use map (Map 7), coupled with the type descriptions and species lists, provides a regional perspective on the distribution of vegetational units and their composition. However, these give general descriptions most applicable for small scale mapping. Considerable variation can occur within individual mapping units, and local community patterns can be ascertained only through on-site field surveys of a more detailed nature. Therefore, proposals for future development should include a sensitive vegetational analysis as part of the suitability rating. High priority should be given to recognizing the desirability of retaining a diversity of natural habitats, and preferentially reserving mature forest systems which require long periods for natural successional replacement.

The natural vegetation of the Tug Hill Region represents a subject for further botanical studies. Detailed taxonomic surveys and the analysis of plant

community-environment relationships will yield significant insights into the operation of this natural system. Coupled with studies to define compatible uses for various natural systems, these would facilitate evaluation of likely effects of proposed developments upon the various plant communities. While the potential consequences of various development programs can be forecast with some reasonable assurance for upland systems, considerable uncertainty remains relative to wetlands. Abundance of wet woods and marsh systems within the Region, and the subtilty associated with environmental variations controlling their distribution, suggest a need for cautious study before major alterations are undertaken in them.

UNIQUE AND IMPORTANT NATURAL AREAS AND RIVERS

The location of unique, rare, or fragile natural systems within the Tug Hill Region relied heavily on the knowledge of others familiar with the Region. Local conservation groups, museums, libraries, educational institutions and individuals were consulted. Many areas suggested by these sources were surveyed in the field. In addition, others were selected for field evaluation on the basis of topographic diversity and geographic isolation, determined by analysis of U.S. Geological Survey maps. All potential natural areas were surveyed and evaluated in the field.

Unique and Important Natural Areas

Unique and important natural areas were recognized and identified in each of the major physiographic sections of the Tug Hill Region. They vary in size from several acres to many thousands of acres. Seven regionally distinct categories of unique areas are depicted on Figure 42. Individual areas within each category are described below on the basis of field survey. A general description of each, including its specific location and in some instances its size, is given in the context of the broader grouping. Unless otherwise indicated, species composition parallels that of the preceding natural vegetation-land use type descriptions.

Several criteria were employed in selecting the unique areas. From a practical standpoint, only areas well insulated from developed lands by distance or topography were included. As a result, larger areas and areas that lie adjacent to state-owned forestry and wildlife management areas were given preference. From an ecological standpoint, communities exhibiting a high degree of successional stability were given preference, owing to the longer time of natural succession required for equivalent replacements to develop.

In terms of specific criteria, unique area status was applied to areas that:

1. contain rare or endangered plant species;
2. contain unique groupings of cover types, or usual combinations of wildlife habitats;
3. represent fragile systems (such as bogs, dunes, and gorges), highly sensitive to degradation of both the biotic and physical environment as a result of minimal human activity.

Many of these criteria overlap in specific unique areas. High aesthetic appeal is usually associated with areas meeting these criteria, but aesthetic

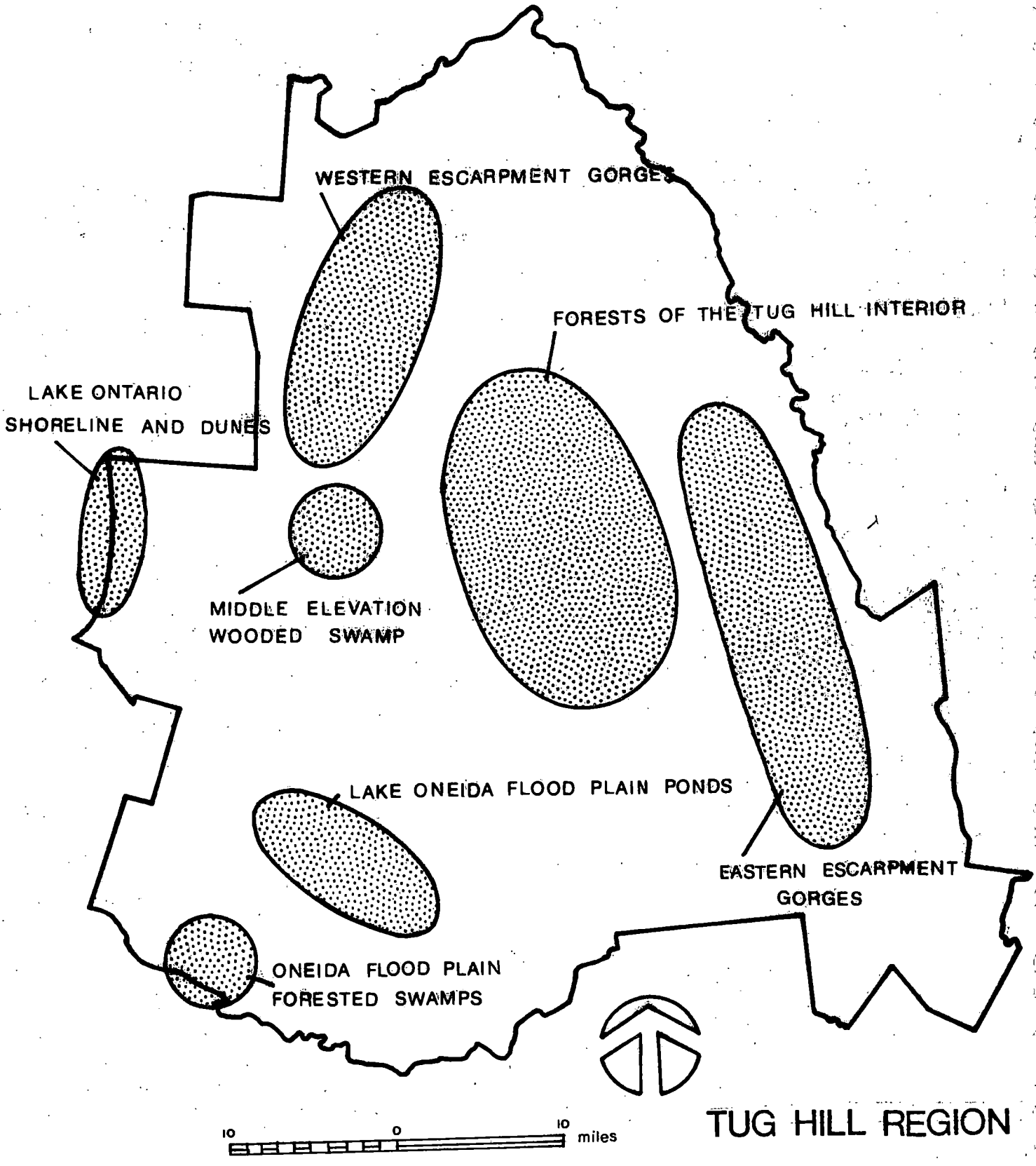


Figure 42. Location of unique and important natural areas within the Tug Hill Region.

appeal alone was not used as a selection criterion. An attempt was made, however, to locate examples of as many different representatives of the original natural system of the Tug Hill Region as possible. Consideration should be given to withholding these areas from destructive development. They could be retained in an undisturbed or near-natural condition through preservation, or by limited-access management, such as zoned timber management, wildlife management, or low intensity recreational use. All should be considered irreplaceable material assets warranting special planning attention.

Lake Ontario shoreline and dunes

The marshlands and dunes north of Selkirk along the Lake Ontario shoreline represent natural systems of a regionally unique character. Although the construction of seasonal dwellings and trailer parking sites has modified drainage patterns and altered the landscape over much of this area, several sections remain in near natural condition.

Deer Creek Marsh (Oswego County, Town of Sandy Creek, 2.0 miles north of Selkirk on the Lake Ontario shoreline) is a 1.7 square-mile wetland, including a wide diversity of community types and wildlife habitats. Shrubby thickets of willows, alders and dogwoods are broken by expansive swales of sedges and grasses. Other wetland herbaceous communities border open water along tributaries or surrounding included ponds. Mature forest stands of mixed species composition are present on raised areas within the wetland.

North Pond barrier dunes (Oswego County, Town of Sandy Creek, 3.0 miles north of Selkirk on the Lake Ontario shoreline), includes about 3 miles of undeveloped dunes surrounding the inlet to North Pond. Dune vegetation forms an unstable natural successional sequence. Only species adapted to extremes of environmental severity and surface instability occur there. Early invaders such as dune grass and wormwood dominate young dunes. After a lengthy series of plant colonizations, pioneer trees and shrubs such as choke cherry, willows, and cottonwood became established. Further soil amelioration produces a dry, sandy site suitable for the growth of pine and oaks.

Both the Deer Creek Marsh and the North Pond barrier dunes must be considered very fragile and subject to destruction from minimal human activity. They represent examples of the only such systems in the Region area.

Oneida Lake flood plain ponds

Dutch, Cody, Carterville, Chase, North and South Ponds are part of a system of small ponds draining extensive lowland swamps in the northern portion of the Lake Oneida flood plain. They all lie within the Towns of Amboy and Constantia between 11 and 20 miles north of the Oneida shoreline. Pond size and habitat diversity in and around the open waters is in harmony with natural fluctuations in the water table and drainage flow from the swamps.

Of ecological interest are the wetland types bordering many of the ponds. Field surveys located highly productive graminoid meadow complexes confined to the shoreline of Dutch and St. Mary's Ponds. The latter is within the Happy Valley Management Area. Similar complexes occur in association with the other ponds described in this section. With the exception of Carterville Pond and North Pond, most of the ponds are undeveloped and used only by hunters.

Francis Pond, less than one mile east of Dutch Pond, is protected as a duck breeding ground, and the potential in adjacent ponds for use by both resident and migratory waterfowl is also high.

North, South and Chase Ponds lie close to the Town of Parish boundary in western Amboy. South Pond and Chase Pond represent different sections of the same water course in which pooling is a result of topography. North Pond drains large wetland areas to the north. Together, the three ponds form the headwaters of Scriba Creek. Although the western shore of North Pond has been developed, its eastern half is insulated by a State reforestation area, extending southward almost to Chase Pond.

Carterville Pond lies in a northwest-running valley. It formed as a result of pooling of a section of the Little River. A few houses are scattered around its southeast end, and it is surrounded by well-drained mature forests of good quality.

Cody Pond drains a swampy area above the West Branch of the Little River. Wetlands and wet woods surround the immediate pond area while successional forests and well-drained mature forests occur on the higher ground. The successional forest is composed of a diverse group of young hardwoods dominated by red maple, hemlock, yellow birch, black cherry, and white ash. A wet area exhibiting bog-like community structure occurs on the southern end.

Dutch Pond lies in a westerly-oriented valley, draining into Francis Pond and Scriba Creek. It appears to be man-made, but beaver activity is readily apparent. Mixed hardwood forests of good quality have been carefully logged on the north side.

These six ponds, along with the surrounding forested areas represent a highly diverse habitat system. Development activities, especially those involving changes in water levels or drainage patterns, can initiate widespread changes in species composition and ecosystem stability. In addition, the general scarcity of natural ponds within the Tug Hill Region gives these six an added level of importance. Specific locations are:

North Pond, South Pond and Chase Pond--Oswego County, Town of Amboy; immediately south of the junction of routes 69 and 26.
Carterville Pond--Oswego County, Town of Amboy; near the junction of routes 17 and 34;
Cody Pond--Oswego County, Town of Constantia; one mile south of Panther Lake, between Drought and Center Street roads.
Dutch Pond--Oswego County, Town of Constantia; immediately north of the junction of Kibby Lake and Dutchville roads.

Oneida flood plain forested swamps

Toad Harbor is a large swamp composed primarily of wet woods extending for approximately three miles from the north shore of Lake Oneida, northward onto the flood plain. It is separated from Big Bay Swamp to the west by a small ridge of inactive agricultural land. Habitats in both areas are quite similar, and together they represent an area of over 6.5 square miles. Forest cover is dense, the canopy being composed of red maple with some elm and hemlock. Of particular interest is a diverse understory adapted to periodic inundations and constant soil saturation. Hummocks, formed largely of accumulated organic

matter at the base of trees, support a layered complex of shrubs, seedlings, taller perennials, annuals, ferns, and mosses. The hummocks are dispersed within pools of standing water rich in algae and emergent aquatic plant species. On drier sites, diversity in the fern layer is reduced by the dominance of royal fern. Though changes in canopy composition were difficult to detect, an increase in oak density was noted in these areas.

At present these swamps are not insulated from human development, and some filling for the construction of roads and houses has occurred. About one-third of the Toad Harbor swamp is, however, within the Three Mile Point Game Management Area. Both areas are regionally unique, biotically diverse, and highly sensitive to man-induced environmental change. Specific locations are:

Toad Harbor--Oswego County, Towns of West Monroe and Constantia; one mile south of West Monroe, north of Lake Oneida.

Big Bay Swamp--Oswego County, Towns of West Monroe and Constantia; south of route 49 and west of Constantia.

Middle elevation wooded swamp

Tamarack Swamp occupies a 2-mile long glacial depression at 1200 feet elevation within the Tug Hill Upland. It is one of the larger swamps in this portion of the Region, differing substantially in species composition from areas of similar wetwoods classification on the Lake Oneida flood plain. The surrounding well-drained mature forest is dominated by hemlock with associated red maple, red spruce, and yellow birch. Red maple and yellow birch increase in abundance on the moist organic soils of the swamp. The understory is rich in mosses, club mosses, and alders. The area is characterized by minimal relief and drainage is slow throughout the year. Open water, where it occurs, tends to stagnate.

At present the swamp is well buffered, and field survey indicated little evidence of human alteration of the overall drainage system. Large State-owned reforestation areas are nearby to the north and southwest, and the Little John State Game Management Area provides further insulation on the northeast. Both the size and natural fragility of the area justify its classification as a unique area. Its location is:

Tamarack Swamp--Oswego County, Town of Boylston; one mile south of Smartville.

Forests of the Tug Hill Upland

One of the largest continuous tracts of forest land in the State spreads throughout the Towns of Worth, Redfield, Montague, Martinsburg, High Market, Lewis and Osceola. It contains the headwaters for innumerable streams feeding the Deer, Mad, Salmon, and Mohawk Rivers and Fish and Sandy Creeks. Many distinct cover types are present as a result of variations in the natural environment and past land use practices.

Mature forests in the western towns around Osceola are dominated by sugar maple, red maple, hemlock, and yellow birch, with beech, black cherry, and red spruce as associated species. Hemlock, balsam fir, and red spruce increase in importance in the eastern portion of the area, extensive wetlands and wet woods are interspersed in northwest oriented glacial depressions.

The entire area represents second growth forests resulting from extensive timbering almost a centry ago. Active harvesting continues today, and high quality, hardwood timber is being removed to supply several active sawmills within the area. Periodic use by hunters is also high. Yet, the area has not been excessively altered by human activity. It remains today as a continuous, essentially roadless wilderness.

We have assigned unique area status to this entire section as a result mainly of its size and insularity. While comparable forest stands and habitats are present in other areas, its existence as a continuous, predominately non-public section of forest land is unique to the entire eastern United States.

Eastern escarpment gorges

Seven gorges on the eastern escarpment of the Tug Hill Upland are designated as unique natural areas. They are strikingly different from those studied on the western fringe due to the rapid elevational decrease to the Black River Valley. For example, the escarpment near Houseville falls 600 feet in less than 2 miles, while an equal drop occurs in less than 5 miles near Inman Gulf. In response to this decrease, the Whetstone, House, Mill, and Chase Creeks, and the Lansing Kill, Olmstead, and Stringer Brooks have cut a series of deep, short dendritic gorges. Most have V-shaped valleys with very steep sides. The sheer unstable walls are covered with a luxuriant growth of mosses and ferns. Microclimatic differences between north-and south-facing slopes are extreme. Field survey indicated that northern white cedar, hemlock, and white pine occur in greatest abundance on ridges and north-facing slopes. The south-facing slopes are dominated to a greater degree by hardwoods with some hemlock.

Whetstone Gulf is in State ownership and is known to contain several rare plant species. The unique microclimatic conditions within the other gulfs suggest a similar situation. Apart from Lansing Kill, none of the gulfs has been disturbed by development, nor do the streams appear to be diverted or impounded throughout their length. Sections of Whetstone Creek, Mill Creek, and Olmstead Brook are in State ownership, and all are close to extensive State owned reforestation areas.

The complexity of these drainage systems coupled with their rare biologic, topographic, and geologic characteristics provide a basis for their classification. Specific locations are:

Whetstone Gulf--Lewis County, Town of Martinsburg; off route 26, 2.4 miles south of Martinsburg.
House Creek Gulf--Lewis County, Town of Turin; off route 26, 0.4 miles south of Houseville.
Mill Creek Gulf--Lewis County, Town of Turin; 0.5 miles south of Turin.
Olmstead Brook Gulf--Lewis County, Town of West Turin; off route 26, 2.3 miles south of Constableville.
Stringer Brook Gulf--Oneida County, Town of Western; 0.3 miles north of North Western.
Lansing Kill--Oneida County, Town of Ava; about three miles north of North Western.
Chase Creek Gulf--Oneida County, Town of Ava; northwest of the mouth of Lansing Kill.

Western fringe gulfs

Fast flowing streams draining the upper elevation forests of the Tug Hill Upland have cut a series of six gorges through weak shale deposits on the western side of the Region. From these areas, the streams flow into the predominantly agricultural Towns of Rodman and Lorraine, ultimately forming Sandy Creek.

Inman Gulf is typical of the conditions found in Bear and Shingle Gulfs. The stream drops 600 feet in less than 5 miles, through a gorge 200 feet deep, before flowing into Sandy Creek. Forest community composition is diverse, and areas of abandoned agricultural fields and forest plantations are interspersed. The area is well insulated from human development by State-owned reforestation areas to the south, and extensive private forests to the north.

Lorraine Gulf was created by South Sandy Creek, which drops 450 feet in elevation in the 5 miles of its length. Totman and Mooney Gulfs are similar, though less spectacular. Well-drained mature forests cover all three areas. Forest density and State ownership insulate portions of all three areas.

The geologic rarity of these six areas, as well as their rich mixture of habitats, justifies their unique area status. Specific locations are:

Inman Gulf--Jefferson County, Town of Lewis; between Old State and Whitesville roads, one mile northwest of Barnes Corners.
Bear Gulf--Lewis County, Town of Pinkney; 0.3 miles east of East Rodman.
Shingle Gulf--Jefferson County, Town of Rodman; one mile south of East Rodman.
Lorraine Gulf--Jefferson County, Town of Lorraine; parallel to route 178 between Allendale and Worth.
Totman Gulf and Mooney Gulf--Jefferson County, Town of Lorraine; parallel to route 178 between Allendale and Worth, north of route 17E.

Unique River Systems

One of the outstanding natural features of the Tug Hill Region is its system of streams and rivers. Many of these remain in an unpolluted condition, free from major impoundments and diversions, draining remote or isolated areas with unique natural communities and high scenic appeal. The extent of such a system today represents a unique natural feature in itself. However, we have attempted a preliminary evaluation of the major watercourses of the Tug Hill Region, looking specifically at how well they satisfy criteria for classification as wild, scenic, and recreational rivers, as outlined by Article 5, Part III-C of the Environmental Conservation Law. The criteria used in river classification are those outlined in Chapter 869 of the Laws of New York, 1972, and the terms "wild", "scenic", and "recreational" are applied below as defined therein. Our proposals are clearly recognized as preliminary and need thorough study and field investigation by appropriate state agencies. However, we feel that this list does indicate the major river systems of the Tug Hill Region that have potential for inclusion within the system. The preliminary list presented below could be forwarded to the New York State Department of Environmental Conservation for further study. Inclusion of some, if not all, of these water courses within the protective restrictions of that system would do much to preserve the unique natural character of the Tug Hill Region.

Deer River

Deer River flows through the Towns of Montague, Pinkney, Harrisburg and Denmark. The main branch and small unnamed tributaries are approximately 74 miles long. The river appears to qualify for a scenic classification from its beginning, as it is impounded at Sears Pond. It may qualify for a recreational classification below the Town of Copenhagen. The river drops some 1150 feet in elevation from its headwaters to the Black River.

Sandy Creek

The North and Main branches of Sandy Creek flow through the Towns of Watertown, Rutland, Pinkney, and Adams. These two branches, with their tributaries, are about 80 miles long. Large sections might qualify for classification as scenic and recreational above Adams. Down stream from their junction, the main branch becomes highly developed. The system drops about 900 feet in elevation before flowing into Lake Ontario.

South Sandy Creek

The creek flows through the Towns of Pinkney, Worth, Lorraine, and Adams. The main branch and unnamed tributaries are over 52 miles in length. It appears to qualify as scenic throughout its length. Special attention should be given to the section within Lorraine Gulf. The creek flows through an elevational change of 1250 feet before reaching Lake Ontario.

Mad River of the Salmon River

The river flows through the Towns of Montague, Worth, and Redfield. The main branch and small tributaries are almost 36 miles long. Most of its extent might qualify for a wild classification, but it is broken into sections five to eight miles in length by roads crossing the river. Each of these sections is without access and free from diversions and impoundments. The river drops 630 feet through isolated forests to flow into the north branch of the Salmon River.

Salmon River

The river passes through the Towns of Osceola, Lewis, Redfield, Albion, and Richland. Including unnamed tributaries, it measures approximately 88 miles in length. The watercourse above the Redfield Reservoir should qualify as scenic, becoming recreational to the south. Of particular scenic interest is the Salmon River Falls. The river drops 1600 feet over its entire length, 120 feet being lost in 1 1/2 miles at the falls.

Fish Creek, East Branch

The East Branch of Fish Creek flows from Martinsburg through the Towns of High Market, Osceola, Lewis and Annsville. It is approximately 75 miles in length, and except for a 3-mile section above Fish Creek, the creek may qualify as wild to Swancott Mill. Thereafter, it appears suitable for scenic designation, becoming recreational at the Town of Taberg. This branch drops 1550 feet before meeting with the main branch in Annsville.

Fish Creek, West Branch

The entire West Branch of Fish Creek in the Towns of Williamstown, Amboy and Camden would qualify as recreational due to the urganization around Williamstown and McConnellsville. The 60 mile water system drops about 300 feet before joining the main stem.

Fish Creek, Main Stream

The Main Stream is only 22 miles long, with unnamed tributaries included. It drops only 30 feet from the junction of the East and West branches in the Town of Vienna to Lake Oneida. Sections of the flow may qualify as recreational, although it is heavily urbanized near the lake.

Mad River of West Fish Creek

The river courses through the Towns of Redfield, Florence, Camden and Williamstown. It appears to qualify for scenic classification throughout its 21-mile length, dropping 450 feet before joining the West Branch of Fish Creek in Williamstown.

Sugar River

The river flows through the Towns of High Market, West Turin, and Leyden. It may qualify as scenic upstream from Constableville, and recreational below that point. Including unnamed tributaries, it is approximately 48 miles long, and drops some 650 feet before joining Moose Creek.

Mohawk River

The Mohawk River flows through the Towns of Lee and Western. It is 5.7 miles long; 29 miles in length with unnamed tributaries included. This section is truly worth serious study as a wild river. It has no access and no diversions or impoundments. Through much of its length, the river flows through a gorge about 100 feet deep. It drops 240 feet before joining the Lansing Kill River.

TIMBER INVENTORY

Timber inventory information was adapted from The Timber Resources of New York, (Ferguson and Mayer, 1970). These data were gathered by the U.S. Forest Service resurvey of New York's forest resources in 1968. Timber inventories were taken by counties, with smaller political subdivisions not enumerated within a county. Since only portions of Jefferson, Lewis, Oneida, and Oswego Counties are contained within the Region, an estimate of the timber resources was obtained by applying several conversion factors to scale down the county estimates.

Summaries of LUNR area land-use data were obtained by town for each of the four counties. Then, land areas classified as mature forest, forest brushland, plantations, and inactive agriculture were combined to provide an estimate of commercial forest land for each town. Commercial forest land, as defined for these four LUNR land use classes, is quite similar to the descriptions of commercial forest used during U.S. Forest Service inventory (Ferguson

and Mayer, 1970). Working with the totals for towns within and outside the Tug Hill Region, a percentage conversion-factor was developed for each county. This gave a ratio between commercial forest land of the towns within the Region and the total commercial forest land area of the county. A second conversion factor was established by dividing the area in all land-use classes of towns within the Region, by the total county land area. These conversion factors are listed in Table 29.

County summaries for sawtimber volume, sawtimber composition, growing stock volume, growing stock composition, and forest land ownership were adjusted to reflect the proportion of each county's commercial forest land that fell within the Tug Hill Region. Non-forest land ownership patterns were determined in similar fashion. Summary data for the Tug Hill Region were obtained by adding together county data after conversion.

Forest Area

The Tug Hill Region covers almost 1.3 million acres of land, with 60 percent, or 775,000 acres classified as commercial forest land. By definition (Ferguson and Mayer, 1970), commercial forest land is "forest land that is producing or capable of producing industrial wood and is not withdrawn from timber utilization". Industrial wood includes all roundwood products such as sawlogs, pulpwood bolts, poles, and construction timbers, with the exception of fuel wood. This does not include lands withdrawn from timber utilization for purposes of recreation, preservation, and the like.

A summary of land areas and ownerships for the Tug Hill Region is given in Table 30. Land use and ownership are quite similar to comparable averages provided for the entire state (Ferguson and Mayer, 1970). The proportion of total commercial forest land area is somewhat higher than found state-wide (60 percent vs. 47 percent), and commercial forest in state ownership is also somewhat higher (5.5 percent vs. 2.3 percent). As with other regions of New York State, the majority of the commercial forest land (686,500 acres, or 53 percent of the Region), is held in private ownership.

The approximate land area by major forest type is given in Table 31. Hardwoods types predominate, occupying 662,200 acres, or over 85 percent of all the commercial forest land. Softwood types are about equally divided between natural stands (spruce-fir and a portion of the "other softwoods" category), and plantations (white pine-red pine and the remainder of the "other softwoods" category). Differences in forest composition within the Region are pronounced, as reflected by variability in the data from the four counties.

The area in commercial forest is partitioned by stand size class in Table 32. Data indicate that young, poorly stock stands are abundant. Non-stocked stands occur on 16 percent of the land area, and seedling-and sapling-sized stands occupy 46 percent. Pole-sized timber occupies 13 percent of the area, and sawtimber-sized stands are limited to 25 percent of all the commercial forest land in the Tug Hill Region.

Volume

Sawtimber and growing stock volumes are summarized in Tables 33 and 34. Over 1271 million board feet of sawtimber and 594 million cubic feet of growing stock are present within the Region. This accounts for 5.2 percent of all the total sawtimber volume and 4.9 percent of the growing stock volume in New York State.

Table 30. Mean land acreages of the Tug Hill Region.

County	Thousands of acres by land area									
	Total county land area	Land area in Tug Hill Region	Percent of county land area in Tug Hill Region	Non-forested land	Non-commercial forest land	Commercial forest land				Total all owners
						Public ownership		Private ownership		
						State owned	Other	Farmer owned	Other	
Jefferson	828.1	189.4	22.9	109.0	8.5	4.4	4.5	35.9	48.4	93.2
Lewis	826.4	406.9	49.2	100.6	29.9	31.8	6.7	35.4	167.8	241.7
Oneida	783.0	361.0	46.1	180.9	15.3	17.0	4.8	48.6	121.9	192.3
Oswego	617.2	335.6	54.4	123.6	0.5	18.0	1.5	51.3	177.2	248.0
Tug Hill total	3,054.7	1,292.9	-	514.1	54.2[a]	71.2[b]	17.5	171.2	515.3	775.2

[a]Includes 4,285 acres of non-commercial forest lands publically held as State Forest Preserve, in parcels at least 10 acres in size.

[b]N. Y. State, Dep. Environ. Conserv. records indicate that these projections are low. The actual combined acreage of State Forests and game Management Areas within the Tug Hill Region is 135,874 acres. See Table 61.

Table 31. Area of commercial forest land by forest type within the Tug Hill Region.

County	Thousands of acres by forest type							
	White or red pine	Spruce-fir	Other softwoods	Oaks	Elm-ash-red maple	Maple-beech-birch	Aspen-birch	Total all types
Jefferson	5.8	11.9	2.8	1.3	20.5	32.5	18.3	93.1
Lewis	17.6	19.4	6.6	3.8	43.9	125.5	24.9	241.7
Oneida	11.1	13.9	4.1	1.9	24.7	110.2	26.4	192.3
Oswego	7.3	-	12.5	16.3	100.3	98.6	13.1	248.1
Tug Hill total	41.8	45.2	26.0	23.3	189.4	366.8	82.7	775.2
Percent of Tug Hill Region	5.4	5.8	3.4	3.0	24.4	47.3	10.7	100.0

Table 32. Area of commercial forest land by size class within the Tug Hill Region.

County	Thousands of acres by size class				
	Sawtimber stands	Pole timber stands	Seedling-sapling stands	Non-stocked areas	Total commercial forest land
Jefferson	15.8	12.3	51.0	14.0	93.1
Lewis	72.5	34.0	100.1	35.1	241.7
Oneida	40.7	18.8	83.7	49.2	192.4
Oswego	64.1	37.5	122.9	23.4	248.0
Tug Hill total	193.1	102.6	357.7	121.7	775.2
Percent of Tug Hill Region	24.9	13.2	46.2	15.7	100.0

Table 33. Volume of sawtimber by size class on commercial forest lands within the Tug Hill Region.

County	Millions of board feet by size class			
	Sawtimber stands	Pole timber stands	Other stands	Total all sizes
Jefferson	54.9	16.5	23.9	95.4
Lewis	314.8	60.4	77.5	452.7
Oneida	233.2	42.8	60.1	336.1
Oswego	260.5	58.3	69.0	387.8
Tug Hill total	863.4	178.0	230.5	1,271.9
Percent of Tug Hill Region	67.9	14.0	18.1	100.0

Table 34. Net volume of growing stock by size class on commercial forest lands within the Tug Hill Region.

County	Millions of cubic feet by size class			
	Sawtimber stands	Pole timber stands	Other stands	Total all sizes
Jefferson	19.5	13.8	14.7	48.0
Lewis	109.1	47.7	38.7	195.5
Oneida	80.3	33.6	33.9	147.8
Oswego	104.7	49.9	48.3	202.9
Tug Hill total	313.6	145.0	135.6	594.2
Percent of Tug Hill Region	52.8	24.4	22.8	100.0

However, the majority of both the sawtimber and growing stock volume is concentrated in sawtimber-sized stands, or on about 25 percent of the commercial forest area. The majority of the Region seems to be characterized by low levels of stocking.

Sawtimber and growing stock volumes are tabulated by forest type and species in Tables 35, 36, 37, and 38. Hardwood species predominate. Well-drained woods dominated by maple, beech, and birch account for the greatest timber volumes, and sugar maple is the most abundant timber species. Large amounts of elm, ash, and soft maple are present in Oswego County, reflecting the predominance of wet woods communities in that portion of the Region.

Although these data provide a general indication of the character of the Region's timber resources, a complete analysis of the resource vitality awaits development of several basic pieces of information. Quantitive estimates of usable and cull volumes of sawtimber and growing stock were not provided by past timber surveys. Also lacking are current figures on amounts harvested, volumes consumed by local industries, volumes exported from or imported to the Region, and growth. Stands of high quality sawtimber or high growing stock levels are limited. Timber quality and stocking levels are low. And stocking with desirable timber species is often poor.

Since forested lands comprise such a substantial proportion of the Tug Hill Region, a thorough analysis of the vitality of that resource should be developed. Basic data on current and projected harvesting levels, merchantable volumes and yield from representative stands, the suitability of various management and cultural techniques, the economics of local wood-using and other factors need to be collected and compiled to facilitate planning for regional forestry programs.

LITERATURE CITED

Armstrong, G. R.
1954. The forests and economy of Lewis County, New York. N.Y. State Coll. For., Bull. 33.

Braun, E. L.
1950. Deciduous forests of eastern North America. Blakestone Co., Phila.

Bray, W. L.
1930. Development of the vegetation of New York State. N.Y. State Coll. For., Tech. Publ. 20.

Connor, P. F.
1966. The mammals of the Tug Hill Plateau, New York, N. Y. State Mus. and Sci. Serv., Bull. 406

Ferguson, R. H., and Mayer, C. E.
1970. The timber resources of New York. U.S. Dep. Agric., For. Serv. Resour. Bull. NE-20.

Table 35. Volume of sawtimber by forest type on commercial forest land within the Tug Hill Region.

County	Millions of board feet by forest type							
	White or red pine	Spruce-fir	Other softwoods	Oaks	Elm-ash-red maple	Maple-beech-birch	Aspen-birch	Total all types
Jefferson	14.8	12.0	2.6	2.2	19.4	38.7	5.7	95.4
Lewis	53.0	44.0	10.7	6.8	92.8	225.5	19.9	452.7
Oneida	42.2	39.4	7.0	4.1	63.6	159.6	20.1	336.1
Oswego	21.2	-	14.3	41.3	137.8	168.8	4.5	387.9
Tug Hill total	131.2	95.4	34.6	54.4	313.6	592.6	50.2	1,272.1
Percent of Tug Hill Region	10.3	7.5	2.7	4.3	24.7	46.6	3.9	100.0

Table 36. Volume of growing stock by forest type on commercial forest land within the Tug Hill Region.

County	Millions of cubic feet by forest type							
	White or red pine	Spruce-fir	Other softwoods	Oaks	Elm-ash-red maple	Maple-beech-birch	Aspen-birch	Total all types
Jefferson	5.3	8.0	2.6	0.9	10.3	16.8	4.1	48.0
Lewis	23.6	22.0	8.6	4.2	42.8	84.2	10.1	195.5
Oneida	18.1	20.3	5.7	2.4	30.0	60.6	10.9	148.0
Oswego	8.8	-	12.2	20.2	75.4	82.8	3.5	202.9
Tug Hill total	55.8	50.3	29.1	27.7	158.5	244.4	28.6	594.4
Percent of Tug Hill Region	9.4	8.4	4.9	4.7	26.7	41.1	4.8	100.0

Table 37. Volume of sawtimber by species on commercial forest lands within the Tug Hill Region.

Millions of board feet

County	Softwood timber							Hardwoods															
	White pine	Red pine	Spruce	Fir	Hemlock	Other softwoods	Total softwoods	Selected white oaks	Selected red oaks	Other oaks	Hickory	Yellow birch	Sweet birch	Sugar maple	Soft maple	Beech	Ash	Basswood	Aspen	Black cherry	Elm	Other hardwoods	Total hardwoods
Jefferson	7.4	2.8	6.8	2.5	8.3	4.3	32.1	-	4.0	-	-	5.5	-	14.8	10.5	8.5	1.8	3.0	4.4	3.4	6.9	0.5	63.3
Lewis	39.7	7.2	44.0	4.7	58.3	3.7	157.6	-	10.1	-	-	41.1	-	61.9	47.9	49.8	15.0	6.5	12.9	22.1	19.7	7.9	294.9
Oneida	32.5	4.6	35.8	4.0	45.6	3.9	126.4	-	6.9	-	-	31.6	-	42.8	32.8	35.6	9.5	4.5	10.7	16.1	12.0	7.4	209.7
Oswego	15.0	6.5	-	-	20.8	2.6	44.9	4.7	12.2	2.5	16.1	3.6	0.8	72.3	51.9	19.6	27.5	38.3	4.4	16.1	56.2	16.7	342.9
Tug Hill total	94.6	21.1	86.6	12.2	133.0	14.5	361.0	4.7	33.2	2.5	16.1	81.6	0.8	191.8	143.1	113.5	53.8	52.3	32.4	57.7	94.8	32.5	910.8
Percent of Tug Hill Region	7.4	1.7	6.8	0.9	10.5	1.1	28.4	0.4	2.6	0.2	1.3	6.4	0.1	15.1	11.3	8.9	4.2	4.1	2.5	4.5	7.5	2.6	71.6

Table 38. Volume of growing stock by species on commercial forest lands within the Tug Hill Region.

Millions of cubic feet

County	Softwood timber							Hardwoods															
	White pine	Red pine	Spruce	Fir	Hemlock	Other softwoods	Total softwoods	Selected white oaks	Selected red oaks	Other oaks	Hickory	Yellow birch	Sweet birch	Sugar maple	Soft maple	Beech	Ash	Basswood	Aspen	Black cherry	Elm	Other hardwoods	Total hardwoods
Jefferson	3.0	1.9	4.4	2.0	2.8	2.7	16.8	-	1.6	-	-	2.0	-	7.6	6.8	3.1	1.4	1.1	2.8	1.3	2.5	0.8	31.0
Lewis	15.2	5.3	19.8	4.8	23.9	4.3	73.3	-	4.0	-	-	14.5	-	27.5	25.4	16.3	6.8	2.6	7.0	8.5	6.1	3.7	122.4
Oneida	11.9	3.0	15.9	4.2	18.2	4.9	58.1	-	2.7	-	-	10.8	-	19.5	18.1	12.0	4.7	1.9	5.6	6.0	4.0	4.5	89.8
Oswego	7.8	4.5	-	-	10.3	3.2	25.8	1.6	3.8	0.6	11.2	3.7	0.9	38.0	30.2	9.3	17.9	16.7	5.2	7.8	23.0	7.2	177.1
Tug Hill total	37.9	14.7	40.1	11.0	55.2	15.1	174.0	1.6	12.1	0.6	11.2	31.0	0.9	92.6	80.5	40.7	30.8	22.3	20.6	23.6	35.6	16.2	420.3
Percent of Tug Hill Region	6.4	2.5	6.7	1.9	9.3	2.5	29.3	0.3	2.0	0.1	1.9	5.2	0.2	15.6	13.5	6.8	5.2	3.8	3.5	3.9	6.0	2.7	70.7

Fernald, M. L.
1950. Gray's manual of botany. Van Nostrand-Reinhold Co., N.Y. 8 ed.

Geis, J. W. and Luscombe, S. F.
1972. Natural vegetation. St. Lawrence-Eastern Ontario Shoreline Study. SUNY Coll. Environ. Sci. and For., Appl. For. Res. Inst., Tech. Rep.

Hotchkiss, N.
1932. A botanical survey of the Tug Hill Plateau. N.Y. State Mus., Bull. 287

Off. Plann. Serv.
1972. LUNR classification manual. State of N.Y., Off. Plann. Serv.

WILD ANIMALS

AND

FISH

by

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SUMMARY OF WILD ANIMALS AND FISH RESOURCES

Wild animals and fish resources of the Tug Hill Region offer recreational and cultural values, scientific and educational values, subsistence and survival values, and values presently not appreciated, but likely to be realized in the future.

Management of forest game species, including ruffed grouse, woodcock, varying hare, gray squirrel and white-tailed deer, is best suited to fringes of the Tug Hill Upland. There, brushlands and successional forest predominate. Overall, the potential for small game management is excellent. Possibly, turkey could become established in the western part of the Region. Farmland game species are restricted to areas of lighter snowfall, where Hungarian partridge and European hare may become established. The potential for waterfowl management is excellent along the Black River and shorelines of Lake Ontario. White-tailed deer populations are fair at best, with deer practically absent in some areas despite good habitat. Probably reasons include lack of adequate yarding areas in the snow belt, poaching, and predation by dogs. Solutions depend largely upon citizen support. The total expenditures for hunting in the Tug Hill Region is at least $2,145,360 annually. Income from fur harvest is $18,030.

Excellent naturally producing brook trout populations occur in the high quality waters of the central Upland, and in headwaters of the Black River. Medium quality waters produce outstanding fisheries for trout and smallmouth bass in a belt around the Upland, in the upper Mohawk and Lansing Kill drainages, and in parts of the Black River. Other waters provide outstanding fishing for warm water species. Pollution abatement has been beneficial to all fisheries. New York's salmon program, centered near Pulaski, is progressing well and offers considerable potential benefit to the Region.

Negative effects of pesticides on wildlife have apparently declined significantly since 1972, when the State began regulating pesticide applications. Applications of approved pesticides apparently have not harmed vertebrates directly. However, killing of insects may have eliminated the food supply of some birds.

A catalog listing 490 vertebrates has been prepared, including 57 mammals, 280 birds, 25 amphibians, 19 reptiles, and 109 fishes. About 138 species are rarely encountered, but not all are endangered. Establishment of conifers throughout the Upland could provide the basis for reintroducing martin, lynx, black bear, and spruce grouse, all presently uncommon or absent from the Region. It appears impossible to reestablish wolf, cougar, and moose.

RECOMMENDATIONS

Key natural areas include the scenic stream gorges along the eastern and western fringes of the Upland, segments of the Lake Ontario shoreline, the Black River marshes near Castorland, the scenic Lansing Kill-Mohawk River Valley, and remote areas at the core of the Region. Special provisions, such as zoning or public acquisition, should be considered as a means to protect the integrity of these vital areas.

Real benefit would accrue from creative schemes for cooperative private-state management of small game populations along fringes of the Tug Hill Upland. Especially, attention might be given to management opportunities on private lands, including ways to capitalize upon hunting opportunities. Coordinated public-private efforts are also needed to improve the health of the Region's deer herd, with attention given to reducing predation and poaching, and toward expanding and improving yarding areas. Some type of wetland complex is needed to serve as a refuge for waterfowl along the Black River. Opportunities for private, state, and federal cooperation should be explored, including means to interprete the value and role of wild animals in our environment. Some attention is also needed to enhance fishing opportunities in conjunction with the emerging salmon program.

THE VALUES OF WILD ANIMALS

Wild animals offer many and varied values to man. Some are obvious and others subtle. Sport hunting and fishing have historically provided many well recognized aesthetic and recreational benefits. Numbers of sport hunters and fishermen continue to increase nationally (National Survey of Hunting and Fishing, 1970), despite counter efforts by some special interest groups who seek an end to these sports. The desire to enjoy the beauties of nature gives strong motivation, particularly for urbanites. Public participation in nature clubs, bird clubs, wildlife photography and interpretive programs continues to burgeon. In a universal sense, modern man is discovering that he is a part of nature and not apart from it. The subtle attraction that wild creatures offer to man is perhaps a reflection of his own yearning for a more natural condition, not inherent in his civilized creations.

Some wildlife values are cultural in nature. Ralph Waldo Emerson observed that we would all be poorer if lions became extinct. How could we know what it means to have "the courage of a lion" if we had no real lions to remind us? Animals enrich the folkways and lore of all people, including those of the Tug Hill Region. How important is it that the endangered American eagle continues to fly through Tug Hill country along the Lake Ontario shoreline?

Wild animals also contribute to scientific and educational values. Modern life styles demand that an increasingly important share of our energies and resources be devoted to science and learning. Wild lands of the Tug Hill Region are repositories of uncommon life forms whose presence is essential for scientific explanations. The ecological health of our environment cannot be monitored effectively without reference to some natural baseline. The decline in diversity of wild species is often a first clue to a deteriorating environment. Since scientific and educational efforts are so uniquely human, some of the most important values of the Region's wild lands may come from the varied biota they provide for human contemplation and study.

Thirdly, wildlife have value for human subsistance and survival. Animals provide us with food, clothing, transportation and companionship. All genetic stocks adapted by man to satisfy his needs are traceable to wild animals. The potentials of wild animals to provide food and fiber appear to have been largely overlooked. However, Blaxter (1971) and his coworkers found that red deer stags in Scotland convert three pounds of dry feed to one pound of weight gain after weaning. They produced a 6-point stag in 8.5 months! Blaxter says, "These findings alone make us begin to ask questions which are not about deer farming at all. What indeed have our animal breeders been doing in the improvement of cattle and sheep when a wild animal, properly fed, can compete on equal terms." Research in domesticating muskoxen is currently underway in Alaska, and captive herds have already been established in Norway and Canada. In the American west, some ranchers herd buffalo instead of cattle. There are many other examples. They all point out that we should keep our options open by ensuring the survival of locally adapted wild genetic stocks. Who knows, there may be a future for deer ranching in forests of the Tug Hill Region!

Finally, we must recognize that there are unknown values of wildlife. Man is basically an arrogant, self-centered creature. Each generation thinks that its problems are the most severe, its needs the most important, its wisdom the greatest, and its rights to dispense with resources the most absolute.

But values change and needs change and what seems unimportant today may be important tomorrow. Giant hemlocks were once logged from the Tug Hill Upland merely to provide bark for tanneries. (Samson, 1971). In today's terms, what would be the value of the millions of board feet that were left to rot? It behooves us to adopt a "spaceship earth" philosophy, husbanding natural resources for those yet unborn. They will have perceptions, thoughts, needs and values which are now unknown or undreamed.

From the standpoint of relevance, these wildlife values seem to be of two kinds. First, there are currently relevant values whose importance is immediately apparent. Secondly, there are values whose importance is in doubt because they offer largely unknown future potential. In studying the resources of the Tug Hill Region, emphasis has been given to the status and management of wildlife that provide immediately apparent values. But, this emphasis is not one of choice. Rather, it partly reflects the constraints of available information, the current level of technology, the state of the art of wildlife management and limitations of our own preconceptions. However, there is a realistic way to plan for obscure and unknown wildlife values, too. We can encourage biotic diversity to the maximum extent practicable. It is axiomatic among ecologists that the largest representation of wild species which can realistically be attained within an ecosystem will yield the greatest number of biological options for the future. Hence, we propose a philosophy of maximizing species diversity in the Tug Hill Region ecosystem as a basic premise for planning its future.

LAND OF CONTRASTS -- AN ECOLOGICAL PERSPECTIVE

By any measure, the Tug Hill Region is not an ordinary ecosystem. Vital relationships of wildlife living there must be understood in their unique context. The Region is a land of contrasts, the foremost one deriving from its geography. The central Upland dominates. Like a giant, truncated pie tipped westward, it rises from the flatlands, shedding water in the form of swift, crystal-clear and even-flowing streams having trout habitat second to none. Tug Hill lands are strangely devoid of natural lakes, in contrast to the neighboring Adirondacks. And while a host of beavers work busily to impound waterways of the central Upland, fish and wildlife common to lakes are largely absent there. In contrast, the Black River along the Region's eastern rim is a minor flyway for ducks and geese. In the west along the dune-lined Lake Ontario shoreline, the most sophisticated birder will delight in seeing a variety of migrating shore and land birds. And along the southern border, Oneida Lake and its main tributaries provide an excellent warm water fishery for the sport angler.

A second set of contrasts comes with the legacy of Tug Hill's snow. From Lake Ontario, water laden winds driven upward by the land give up their gift of winter white. Like the ramifying branches of a phantom snow crystal, the Upland's mammoth snowfalls reach out and profoundly affect the composition of its wildlife. Yet, along fringes of the Upland, snowfalls are locally much lighter, permitting survival of a richer wildlife complex.

In the friendly summer, the heavy imprint of the wild northern winter is hardly apparent. Think back to August, on a bench of the Upland's eastern escarpment, just north of Turin. Tangles of wild grape and nightshade clamber over saplings at the forest edge beside berry-laden raspberries and highbush cranberries. Lush grass grows along the field borders, all but hiding the dark fertile soil. A woodchuck wallows through the alfalfa while

a meadowlark heralds the autumn. Overhead, a broadwinged hawk lazily circles over this wildlife Eden.

But, is it an Eden? On closer inspection, there is a strange emptiness in the habitat. Where are the pheasant paths through blue-green alfalfa, or their dusting spots between the corn rows? Runways of cottontails do not invade the protective tangles. There are no empty husks of corn below the big maples and butternuts to mark the whereabouts of gray squirrels. And the track of a white-tailed deer is a rarity, browse marks are few and cedars grow to the ground. But, let the visitor travel a few miles toward the brooding banks of the Black River near Lowville and in the valley bottomlands with its prosperous dairy industry he will find gray squirrels and cottontails. Even an occasional stocked pheasant may survive the relatively lighter snowfall there. Deer will be even fewer in this, their ancestral wintering ground, but that is a story told elsewhere.

Contrasts are also inherent in the fertility of the Region's soils. On the one hand, prosperous dairy farms carpet the Black River and portions of the Ontario lake plain. The potential for wildlife on these fertile lands with limestone-origin soil is attested by the hordes of waterfowl raiding the wet cornfields in spring. On the other hand, the soils of the Upland and its fringes are poor, as many a pioneering farmer learned to his chagrin. Big trees do not necessarily mean good crops or much wildlife. Bare patches of soil still persist on abandoned Tug Hill farmlands, even after many years of fallowing. Elsewhere moss, lichens, poverty grass, spirea and alder bear mute testimony to the Upland's low productivity. For the foreseeable future, wildlife will not abound there.

Finally, there are contrasts derived from modern man's indelible stamp on the Tug Hill Region's ecosystem. The central Upland area can legitimately be classified as"wild", in contrast to the highly man-modified lands around it. However, to the ecologist, the "wild" lands of the Region's interior stand as a mere shadow of the wilderness it once was with a rich compliment of wildlife characteristic of true wilderness. This land was once called "The Lesser Wilderness" by its native Indian inhabitants, in contrast to the "Greater Wilderness" of the Adirondacks (Krueger, 1967). In its forests, Oneidas, Onondagas, Algonquins and Iroquois hunted, fished and lived with deer, elk, moose, mountain lions, wolves, bears, ducks, pigeons and salmon.

Today, most of Tug Hill country is farmland, abandoned farmland, town, or resort development surrounding its less accessible forested core. Even the character of this interior forest land has been greatly altered. It now stands as a heavily cutover hardwood forest of beech, yellow birch, maples and cherry. Gone is the erstwhile "cold sprucy" character described by the early surveyor Benjamin Wright (Krueger, 1970). Fir, hemlock and red spruce of the mixed virgin forest were sought out and first logged during Tug Hill's historic logging era (Bowen, 1970). Only a few conifer patches persisted into the mid-twentieth century. These, too, are now gone. And the current distribution of forest types within the central Upland plays a crucial role in the ecology of various wild animals, particularly the white-tailed deer.

In summary, geography, snow, soils and man account for the principle forces that influenced the Tug Hill Region's fish and wildlife resources. Through eons, they have molded the character of the plant and animal communities living there. Now some species that once lived in the Tug Hill Region

are ecologically barred from it for the foreseeable future. Still, while the hands of time cannot be turned back, the future wildlife potentials of the Tug Hill Region are exciting and attractive.

THE WILDLIFE RESOURCE

The status, ecology and management of wildlife can be pigeonholed into categories for convenience. These classifications must not be interpreted too literally. For example, an animal labelled as a game species has values other than those accruing from hunting. Therefore, the full spectrum of potential values described earlier applies with various emphases to each species or category. Of course, some animals are not considered as game species under any circumstances and offer value for totally different reasons.

Forest Game

Forest game includes all species that normally require mature timber or early stages of forest succession (i.e. young forests of sprouts, saplings and pole-size timber) as part of their habitat. In addition, game species often occur in patches of woods or wooded fencerows among farmland not normally classified as forest (Map 8, Zones W-1 and W-2).

Ruffed grouse

This superb bird is the most ubiquitous game species in the Tug Hill Region. It is well adapted to deep snow, feeding on tree buds in winter and roosting in snow banks when it can do so. There are probably few square miles of the Region, excepting lakes, rivers, wetlands and towns, which have not seen these birds at least briefly. In spring, the ruffed grouse raises its broods in "doghair" thickets of maple, cherry and aspen. The "drummer" feeds on a variety of foods including buds, berries, insects, greens and nuts. In the fall, grouse will frequently be found near stands of beech trees where they stuff their crops with the readily available beechnuts. The ruffed grouse also favors the overgrown apple orchards, with their vine covered stone fences so typical of Tug Hill's abandoned farms.

Grouse populations within the Tug Hill area are good. Tug Hill counties consistently have the highest grouse hunter success rates in New York State (Tables 39 & 40). The highest success rate for any New York county for any year (1961-69) occurred in Lewis County, with 0.85 grouse bagged per hunter per day in 1963-64. The state average for that year was 0.47 birds per hunter per day (Table 39). The mean success rates (Table 40) for 1961-68 vary between 0.37 birds per hunter per day for Oneida County, to 0.60 birds per hunter per day for Lewis County. Generally, it appears that of the four Tug Hill counties, Oswego and Oneida have fielded most of the grouse hunters and accounted for larger bags per season (Table 40). This can be expected in view of the proximity of these lands to the large population centers of Syracuse, Utica and Rome.

Trends in the grouse population for the Tug Hill counties seem to coincide with those of New York State as a whole (Table 39). Apparently, a peak occurred in 1963-64, reflecting the classical grouse population cycle (Keith, 1963), and lasting 9-10 years. Interestingly, the number of grouse hunters going afield did not vary a great deal over the eight year period, despite the lower hunting success rates (Table 39) in the latter part of this period.

Table 39. Trends in ruffed grouse hunting statistics.[a]

Kill parameters, by season	Yearly statistics				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
1961-62					
Hunters	3,685	3,116	5,690	5,907	174,444
Days afield	16,325	12,736	29,763	29,439	3,952,606
Birds taken	8,544	8,081	12,299	14,177	436,941
Birds/hunter/day	0.52	0.63	0.41	0.46	0.46
1962-63					
Hunters	4,502	3,640	6,586	6,947	-
Days afield	21,942	17,882	36,153	34,985	1,187,046
Birds taken	11,968	12,579	13,578	19,687	492,960
Birds/hunter/day	0.55	0.70	0.38	0.56	0.42
1963-64					
Hunters	3,775	3,362	7,164	6,007	-
Days afield	17,402	17,457	45,615	34,832	1,135,963
Birds taken	11,177	14,893	18,610	16,986	533,769
Birds/hunter/day	0.64	0.85	0.41	0.49	0.47
1964-65					
Hunters	4,378	3,697	7,247	6,625	-
Days afield	19,666	16,670	38,976	33,488	1,213,000
Birds taken	10,028	9,851	14,717	14,629	509,268
Birds/hunter/day	0.51	0.59	0.38	0.44	0.42
1965-66					
Hunters	3,413	2,952	6,088	5,319	-
Days afield	12,512	12,420	32,073	27,282	1,278,589
Birds taken	7,527	6,040	10,439	10,129	532,507
Birds/hunter/day	0.59	0.48	0.32	0.37	0.42
1966-67					
Hunters	3,622	1,970	5,782	5,337	174,996
Days afield	14,317	8,933	28,761	26,734	1,051,318
Birds taken	7,679	5,672	9,336	9,686	413,428
Birds/hunter/day	0.53	0.63	0.32	0.36	0.39
1967-68					
Hunters	3,998	3,391	5,182	5,470	-
Days afield	18,944	18,823	29,102	35,044	1,177,477
Birds taken	7,884	7,435	9,647	13,429	435,169
Birds/hunter/day	0.42	0.50	0.33	0.49	0.37
1968-69					
Hunters	3,775	3,363	4,530	5,525	180,400
Days afield	19,469	14,464	22,896	36,229	1,098,603
Birds taken	8,417	6,699	8,829	13,742	379,758
Birds/hunter/day	0.43	0.46	0.39	0.38	0.35

[a] Based on statistics and data compiled by the New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

Table 40. Ruffed grouse hunting statistics, 8-year means for 1961-69.[a]

Seasonal kill parameter	Mean values				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters	3,893	3,186	6,084	5,892	-
Days afield	17,572	14,972	32,917	32,254	1,511,825
Birds	9,153	8,906	12,181	14,058	466,725
Birds/hunter/day	0.52	0.60	0.37	0.44	0.43

[a] Based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

The recreational value afforded by grouse hunting within the Tug Hill Region can be only approximately assessed. Such an estimate is necessarily conservative because it is impossible to assign an exact monetary value to intangible aesthetic and recreational benefits. However, assume that each hunter spends $7.62 per day afield, a value derived from the 1970 National Survey of Hunting and Fishing [1] (Table 41). The total days spent afield annually for the 4 Tug Hill counties were 97,715, based on the 8 year means in Table 40 (county totals summed). If this total is proportional to land area, and assuming that the Tug Hill Region is roughly one-half of the total county acreage (it is actually about 45 percent), then the days spent afield within the Tug Hill Region for grouse hunting are approximately 50,000 annually. At $7.62 per hunter per day, the total value conservatively amounts to $381,000.

Currently, there is little effort directed at grouse management in the Tug Hill Region. The optimum grouse habitat on Tug Hill Upland is merely a product of natural plant succession and past agricultural land use patterns. The grouse hunting is currently "free" and apparently good enough to entice most of the hunters who use the region. However, those Tug Hill lands abandoned earliest from active agricultural use now support homogenous stands of forests which have grown beyond the optimum stage for grouse. This is particularly true for the State's Wildlife Management Areas and, consequently, the best grouse hunting will generally be found on private lands.

The fall densities of grouse on Tug Hill lands probably seldom exceed 10 birds per 100 acres, based upon representative figures from Bump, Darrow, Edminster and Crissey (1947). Gullion, working in Wisconsin, has found that ruffed grouse are highly dependent on aspen for survival, and particularly male aspen trees. By managing aspen stands through a rotational block cutting scheme, he has attained remarkable fall grouse densities.

Woodcock

Woodcock hunting has its share of devotees. In mid-October, when migrants move southward across Tug Hill, it provides some outstanding hunting and with ruffed grouse is often the larger part of the day's bag. The ready availability of the woodcock on the Tug Hill Upland in fall lends consistency to small game hunting there by making up for the periodic scarcity of grouse.

The literature on the biology and management of woodcock is extensive. Two prominent publications are those of Sheldon (1967) and Liscinsky (1963). In the Tug Hill Region, woodcock research is currently being conducted by Dr. Robert Chambers of the State University College of Environmental Science and Forestry. Working at the Happy Valley Wildlife Management Area south of Altmar, he and his students have cataloged band returns, finding that woodcock produced at Altmar and on the Camp Drum Military Reservation have been shot in Pennsylvania, New Jersey, Delaware, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Tennessee, Kentucky, Ohio, New Hampshire, and in Quebec. Of the 165 woodcock banded by this group in 1973 none were recovered locally.

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[1]This value represents data from resident and non-resident hunters from the U. S. as a whole. Most Tug Hill grouse hunters are probably non-resident, and spend much more per day.

Table 41. Cost per day of small game hunting.[a]

Total expenditure in U.S. by small game hunters = $945,634,000.
Total number of recreation days spent hunting small game = 124,041,000.
Therefore, the expenditure per day is: $945,634,000 ÷ 124,041,000 = $7.62 per day.

[a] Source: U. S. Dep. Inter., 1972.

There is currently little habitat management directed toward woodcock in the Tug Hill Region as is also the case for ruffed grouse. The early stages of forest succession favored by woodcock include alder stands, ideally 9 - 10 years of age. These occur at widespread places throughout Tug Hill Region on abandoned farmland. The ultimate requirement for a good woodcock population within these vegetation types is a rich supply of earthworms living in moist soil.

Some of the Tug Hill woodcock habitats have passed beyond the optimum stage of forest succession. Woodcock populations reflect this. For example, on the Happy Valley Game Management Area, the once ideal sapling hardwood stands have grown into pole-sized timber. There has been a corresponding decline in the local woodcock population (Pers. commun., Oct. 1973, from R. Chambers, SUNY Coll. Environ. Sci. and For., Syracuse, N. Y.). In 1969, weekend checks of hunter bags yielded 40 birds, compared to 12 in 1973. Spring surveys of singing male woodcock ranged from 25 to 35 per 4-mile route in the mid-1950's. From 1969-73, surveys along the same routes yielded 2-4 singing males.

Management of woodcock can be conveniently combined with ruffed grouse habitat management. These two species have quite similar habitat requirements. There is considerable potential for such management in the Tug Hill Region, particularly on abandoned farmland.

Varying hare

This hare, often called "snowshoe hare" or "snowshoe rabbit", is ideally adapted to regions with severe winter weather, and can exist throughout the entire Tug Hill Region. Its snowshoe-like feet allow it to travel easily over snow and its fur is highly insulating.

Young conifers are an essential in snowshoe hare habitat. Specific requirements are currently being investigated at the Adirondack Ecological Center, of the State University College of Environmental Science and Forestry, Newcomb, New York. Research there indicates that "doghair" thickets of conifers, 10-15 feet tall, are ideal (Brocke, 1973). Such stands can consist of a variety of species, including balsam fir, red spruce, hemlock, cedar and various pines. Wherever dense stands of young conifers occur in the Tug Hill Region, good populations of snowshoe hares will be found.

Hare hunting with hounds is popular among city dwellers from Syracuse, Watertown, Utica and Rome. In the southeast, the area east of Camden is a favorite hunting spot (Pers. commun., Oct. 1973, from S. Free, N.Y.S Dep. Environ. Conserv., Cortland, N. Y.), as is the area between Barnes Corners and Copenhagen (Pers. commun., Oct., 1973, from W. Stiles, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). However, good snowshoe hare hunting is quite widespread on the Upland, generally east of Route 81. On the basis of Table 42, hunters spent 70,333 days afield hunting hares during 1966-67, and approximately 35,000 days afield within the Tug Hill Region, based upon the assumption that the Region occupies about 50 percent of the total county area. Assuming that hare hunting costs $7.62 per day, (Table 41), then $226,700 were spent hunting hares.

Snowshoe hare populations on the Tug Hill Upland are currently the product of existing land use practices, rather than specific management. Conifer

Table 42. Varying hare hunting statistics, for 1966-67.[a]

Kill parameter	1966-67 statistics				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters	4,031	4,154	3,324	3,416	-
Days afield	13,608	21,161	21,834	13,730	270,631
Hares taken	12,635	22,080	14,214	8,423	193,487
Hares/hunter/day	0.92	1.03	0.64	0.61	0.71

[a] Based on statistics and data compiled by the New York State Department of Environmental Conservation titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

plantations on State-owned lands dating back to the 1930's, and natural conifer regeneration on abandoned farmlands, constitute the majority of habitat for this species. Opportunities for hare management on private lands are excellent. Results can practically be guaranteed if young stands of conifer are provided through proper silvicultural and management schemes. Hare populations can be hunted hard and still rebound if good habitat is available. In 2 experiments conducted at the Adirondack Ecological Center at Newcomb, 86 percent of the local hare population was removed by simulated hunting. Yet in both cases the population returned to its previous level in one year through immigration and reproduction (Brocke, 1973).

The success among hare hunters in the Tug Hill Region appears to be better than elsewhere in the state. For the 4 Tug Hill counties, the mean success rate of 0.80 hares per hunter per day exceeds that of 0.71 hares per hunter per day for other areas (Table 42). Hare hunting success rates decline periodically, reflecting cyclic declines of hare populations (MacLulick, 1937; Green and Evans, 1940; and Keith, 1963). A cyclic "high" occurred in the Region around 1968 (Pers. commun., Oct. 1973, from E. Kornmeyer, Ga. Pac. Corp., Lyons Falls, N. Y.), when hares were a common sight west of Turin, and probably elsewhere.

It is noteworthy that in the late 1950's hares were trapped from the Tug Hill Region by the Department of Environmental Conservation and stocked elsewhere, providing excellent populations in other areas of New York (Pers. commun., Oct. 1973, from J. Dell, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.)

Gray squirrel

Gray squirrel populations tend to be limited by long and severe winters. Nut-bearing trees favored by gray squirrels, such as the white and red oaks, shagbark hickory and butternut, are limited within the Tug Hill Region. Deep snows tend to reduce winter recovery of nuts buried by this species. And protracted low winter temperatures can take their toll, particularly where squirrels must rely on leaf nests instead of tree cavities (Allen, 1943). Principally for these reasons, the gray squirrel range follows the periphery of the Tug Hill Region, where winters are less severe. Fair populations of gray squirrels can be found along the bottomlands of the Black River, on the Ontario lake plain west of Route 81, and along the southern rim of the Region at the north of Oneida Lake and the environs of Rome.

Hunting statistics for gray squirrels are given in Table 43. It appears that this sport holds a secondary rank compared with other forms of small game hunting in the Tug Hill Region. Interestingly, the mean success rate of 1.03 squirrels per hunter per day for the 4 Tug Hill counties exceeds that of 0.86 squirrels per hunter per day for New York State as a whole. As one might expect, the two southernmost counties provide most of the squirrel hunting (Table 43). On the basis of Table 43, hunters spent a total of 53,790 days afield in Tug Hill counties, or approximately 26,900 days afield in the Tug Hill Region, assuming that this area is about one-half of the total county area. Assuming that squirrel hunting costs $7.62 per day (Table 41), then approximately $204,980 were spent on squirrel hunting.

Gray squirrel populations are heavily dependent on good stands of existing nut trees. Hence, on a short term basis, habitat management for this

Table 43. Gray squirrel hunting statistics for 1962-63, and 1963-64.[a]

ill parameter	Mean values				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters per season	2,045	663	4,946	2,736	-
Days afield per season	8,496	3,366	25,737	16,193	910,544
Squirrels per season	9,357	4,983	23,419	10,741	786,786
Squirrels/hunter/day	1.10	0.91	1.48	0.66	0.86

[a] Based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

species consists primarily of enhancing local nut production. Nest boxes, and growing corn next to squirrel-inhabitated woods are successful management measures (Allen, 1943). According to studies conducted in Michigan, squirrel populations are rarely exploited to their full potential by hunters.

White-tailed deer

To many, the word "wildlife" is synonymous with white-tailed deer. Certainly, this is one of the most attractive creatures to be found anywhere on earth and is a source of enjoyment when seen in the wild. Also, from all standpoints, it is an ideal game species. No wonder that this deer arouses strong emotions in most people, hunters and non-hunters alike.

It is perhaps paradoxical that the white-tailed deer are more abundant now than they were in historical times (Severinghaus and Brown, 1956). Today, the principal range of white-tailed deer coincides closely with human settlement and civilization. It thrives in areas having vegetation in early stages of forest succession, created directly or indirectly by man. This ecological relationship, most people will agree, is fortunate. The white-tailed deer was almost exterminated at the turn of the century by indiscriminate hunting. Institution of the buck law, and modern concepts in deer management pioneered in New York State, have brought the species back to the point of relative abundance in many places.

The status and ecology of the white-tailed deer in the Tug Hill Region are complex. On balance, it appears that most of the problems and challenges concerning this species have human, rather than biological dimensions.

Two parameters of interest are: 1. the current level of the Tug Hill Region deer herd; and 2. deer population trends over the years. As deer have not been actually counted in the Tug Hill Region, population levels and trends must be inferred from available statistics. One statistic consistently compiled by the New York State Department of Environmental Conservation is the annual legal deer kill. Knowing the kill and making some assumptions, it is possible to make approximate estimates of the minimum size of the population. In a relatively stable population, it can be conservatively assumed that for every deer which dies from various causes, there are at least five other deer (does, bucks and fawns) in the population (Pers. commun., Oct. 1973, from D. Behrend, SUNY Coll. Environ. Sci. and For., Syracuse, N. Y.). The mean annual legal buck kill was 504 animals for all Tug Hill Region towns for a 19-year period, 1954-73 (Table 44 & 45). Conservatively assuming that the mortality from other causes such as illegal kill, dog kill and starvation is approximately equal to the legal kill, an annual mortality rate of about 1,000 animals can be inferred. It follows that the deer herd in the Tug Hill Region has averaged about 6,000 animals for the 19-year period.

Another way to compute the total deer herd from buck kill per square mile of range is to multiply the buck kill by 12.8 (Pers. commun., Oct. 1973, from S. Free, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.) This factor has been derived by the Bureau of Wildlife, New York State Department of Environmental Conservation after extensive experience, and accounts for losses through illegal kill, dog kill and other causes. Using this factor, the deer herd seems to have numbered about 6,000 animals on Tug Hill, agreeing with the previous value.

Table 44. Summary of legal deer kill statistics for the Tug Hill Region for 1954-72.[a]

Tug Hill counties	Regional mean annual kill		Square miles of deer range	Buck kill per square mile of range
	Adult bucks	All deer		
Jefferson	39.59	48.52	182	0.22
Lewis	160.87	200.39	458	.35
Oneida	111.31	124.55	473	.23
Oswego	191.87	216.18	465	.41
Region total	503.64	589.64	1,578	0.32

[a] Based on data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation.

Apparent trends in the size of the Region's deer herd can be inferred from the legal buck kill data given in Table 45, and graphed in Figure 43. Peaks in the herd size appear to have occurred in 1954, 1957, 1962 and 1967. Low points occurred in 1956, 1959, 1964 and 1971. These peaks and troughs coincide exactly with ones plotted for the Adirondack deer herd (see Severinghaus, 1972). Both herds are subject to the same primary factors limiting deer populations, namely severe winter weather and deep snow. General coincidence between the Tug Hill Region's buck kill and the state-wide buck kill is seen in Figure 43, although the two statistics do not coincide in some years. This similarity in population levels is to be expected. State-wide buck kill totals reflect the Adirondack component of the deer kill.

Buck kill and deer kill statistics for individual towns within the Tug Hill Region are given in Table 46. These are mean values for the 19-year period, 1954-72, computed from Department of Environmental Conservation tables. The mean annual buck kill per town ranges from 0.16 for Champion, to 61.00 for Osceola. The mean annual deer kill, including bucks and party permit deer, ranges from 0.16 for Champion, to 76.84 for Osceola (Table 46). The highest total legal deer kill for various towns (Table 46) ranges from 1 for Champion, to 164 for Osceola.

To gain a perspective on the relative health of the Region's deer herd, it is instructive to compare its deer kill statistics with those of other areas. Bucks killed per square mile of deer range is a useful value for this purpose. The total available deer range in the Tug Hill Region, including summer and winter range, is about 1,500 square miles (based on data from Severinghaus and Sauer, 1959). This comprises about three-quarters of the total land surface in the Tug Hill Region. The mean annual buck kill per square mile of range for all Tug Hill towns is 0.32 (Table 46), and individual values range from 0.01 for the Towns of Champion and Denmark, to 0.80 for the Town of Osceola (Table 46).

The highest values for buck kill per square mile over the Tug Hill Region have generally been recorded for the four central towns of Worth, Redfield, Osceola and High Market. The mean buck kill per square mile of range for these 4 towns is 0.72 (Table 46). This relatively high legal deer kill is due in large part to the four major deer yards (Map 8). These yards are located, respectively, just southwest of Barnes Corners, at Otto Mills in the Town of Redfield, at Osceola, and at High Market. In late fall, deer migrate out of the more remote central hardwood area that provides their summer range, into the surrounding conifer yards on abandoned farmland. As these yards are highly accessible, they are hunted hard. In some years when heavy snowfalls occur late in the deer hunting season, the deer kill rises sharply in the "deer yard towns", as the deer are forced out of the central hardwood Upland (Pers. commun., Oct. 1973, from S. Cameron and S. Free, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). Buck kill statistics for the Region's less accessible core area can be compared with those of adjacent Adirondack towns in Lewis County, east of the Black River (Table 47). These Adirondack towns, including Croghan, Diana, Greig, Lyonsdale and Watson, have a mean buck kill per square mile of range of 0.84, compared to 0.72 for towns in the central part of the Tug Hill Region.

Strikingly low buck kills per square mile of range have been recorded for towns bordering the Black River, including the lake plain section just south of Watertown. Adams, Watertown, Rutland, Champion, Denmark, Lowville,

Table 45. Total legal buck take per year for towns within the Tug Hill Region.[a]

Year	Legal buck kill
1954	654
1955	537
1956	448
1957	576
1958	477
1959	360
1960	433
1961	424
1962	502
1963	499
1964	435
1965	583
1966	557
1967	761
1968	607
1969	502
1970	406
1971	387
1972	426
Total	9,574
Mean per year	504

[a] Based on data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation.

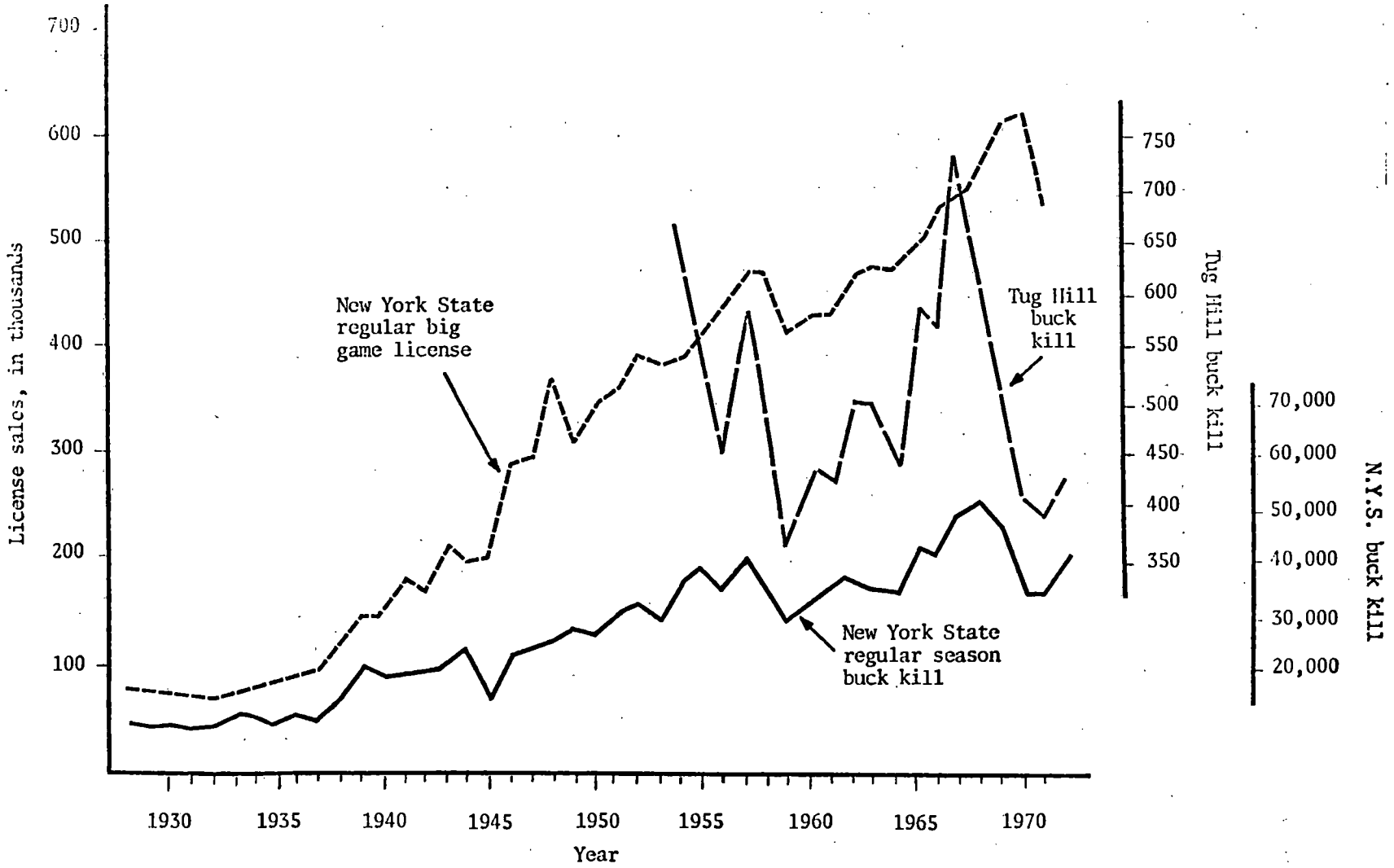


Figure 43. Buck kill in the Tug Hill Region and New York State (after Eabry, 1973).

Table 46. Legal deer kill for the towns within the Tug Hill Region, 1954-72.[a]

Town	Adult buck kill: Mean annual	Adult buck kill: Highest	Total deer kill: Mean annual	Total deer kill: Highest	Square miles of deer range	Buck kill per square mile of range
Jefferson County						
Adams	1.00	4(1967)	1.10	4(1967)	23	0.04
Champion	.16	1(1965)	.16	1(1965)	24	.01
Lorraine	7.58	16(1965)	9.10	18(1957)	30	.40
Rodman	4.79	17(1967)	5.26	20(1967)	32	.25
Rutland	.53	3(1972)	.53	3(1972)	22	.03
Watertown	.58	4(1969)	.58	4(1969)	18	.03
Worth	24.95	67(1967)	31.79	100(1967)	33	.76
Lewis County						
Denmark	.26	1(1971)	.31	1(1971)	25	.01
Harrisburg	2.94	16(1957)	3.89	24(1957)	33	.09
High Market	32.26	81(1967)	36.89	111(1968)	46	.70
Lewis	16.84	35(1967)	21.05	46(1969)	58	.29
Leyden	4.21	9(1968)	4.52	12(1957)	25	.17
Lowville	2.42	7(1954)	4.58	19(1968)	10	.24
Martinsburg	8.84	19(1968)	10.63	30(1968)	48	.18
Montague	20.16	31(1967)	27.10	58(1969)	54	.37
Osceola	61.00	102(1967)	76.84	164(1967)	76	.80
Pinckney	6.52	20(1967)	8.37	27(1967)	34	.19
Turin	3.53	9(1969)	4.16	15(1969)	20	.18
West Turin	1.89	6(1971)	2.05	6(1971)	29	.06
Oneida County						
Annsville	11.21	21(1960)	13.73	22(1970)	49	.23
Ava	4.37	11(1966)	4.89	11(1966)	30	.14
Booneville	24.84	49(1957)	25.89	55(1957)	63	.39
Camden	10.05	24(1955)	11.00	25(1957)	35	.29
Florence	15.58	33(1957)	20.16	43(1957)	46	.34
Floyd	2.63	112(1965)	2.84	186(1969)	68	.04
Lee	2.53	8(1969)	2.63	8(1969)	28	.09
Steuben	6.31	10(1972)	6.58	13(1957)	33	.19
Trenton	.58	3(1961)	.68	3(1961)	27	.02
Vienna	18.53	36(1956)	21.05	57(1958)	52	.36
Western	14.68	36(1972)	15.10	36(1972)	42	.35
Oswego County						
Albion	9.31	18(1955)	9.84	25(1957)	40	.23
Amboy	8.95	22(1954)	9.58	22(1954)	32	.28
Boyleston	12.58	22(1967)	13.84	24(1967)	37	.34
Constantia	37.79	56(1961)	39.53	61(1957)	51	.74
Hastings	4.84	13(1959)	5.89	18(1956)	32	.15
Orwell	15.58	24(1954)	16.05	24(1954)	39	.40
Parish	10.16	18(1957)	10.63	21(1957)	35	.29
Redfield	55.73	89(1967)	72.63	137(1969)	88	.63
Richland	8.63	15(1968)	8.73	15(1968)	30	.29
Sandy Creek	3.47	5(1957)	3.57	5(1957)	22	.16
West Monroe	17.47	28(1965)	18.05	28(1965)	25	.70
Williamstown	7.36	21(1957)	7.84	28(1957)	34	.22

[a] Based upon data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation.

Table 47. Legal deer kill for Adirondack towns (Lewis County) adjacent to the Tug Hill Region, 1954-72.[a]

Town	Adult buck kill		Total deer kill		Square miles of deer range	Buck kill per square mile of range
	Mean annual	Highest	Mean annual	Highest		
Lewis County						
Croghan	111.47	151(1954)	153.10	303(1968)	153	0.72
Diana	96.68	131(1957)	123.42	231(1968)	134	.72
Greig	93.36	146(1966)	148.05	372(1967)	92	1.01
Lyonsdale	72.26	122(1965)	99.79	197(1967)	68	1.06
Watson	75.53	118(1954)	108.60	233(1967)	111	.68

[a] Based upon data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation.

Martinsburg, Turin, West Turin and Leyden have a mean buck kill per square mile of range of 0.09, with values ranging from 0.01 for Champion and Denmark, to 0.24 for Lowville. With such low densities of less than one deer per square mile, deer are rarely seen. The caretaker at Whetstone Gulf State Park southwest of Martinsburg, informed us that he had not seen a deer in the wooded park in four years. Apparently the sight of a deer which broke through the Black River ice just east of Lowville during the winter of 1972-73 was unusual enough to make the headlines of a local paper (Pers. commun., Nov. 1973, from T. Wolfe, Lowville, N. Y.). In various field trips through this belt of agricultural towns, we found no evidence that deer were present, although this was admittedly a restricted sampling. By contrast, in southern New York, the agricultural and semi-agricultural country in Tioga County is comparable to the Black River Valley, and the Ontario Lake plain lands of Tug Hill Region. For Tioga County, the buck kill per square mile of range averages 2.5 (Pers. commun., Nov., 1973, from S. Free, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.), 28 times greater than the average value (0.09) for Tug Hill Region farmlands.

For the remaining Tug Hill Region towns, the mean level of buck kill per square mile is 0.28. Most of this land can be characterized as hilly or gently rolling abandoned farmland being invaded by forest (Map 7). As might be expected, almost all State-owned lands lie within these towns (Map 8). Although most values for bucks killed per square mile (Table 46) fall close to the mean for these towns, there are some exceptions. Values for Constantia and West Monroe are 0.74 and 0.70, respectively, among the highest in the Tug Hill Region. They are located just north of Oneida Lake and include much private land. On the other hand, values for the Towns of Floyd and Trenton are 0.04 and 0.02, respectively, among the lowest for the Region. Those towns are located just north of the population centers of Utica and Rome.

The deer population level among towns dominated by abandoned farmland can be compared to that of similar country represented by Chenango County, north of Binghamton. Chenango County's value of 2.5 bucks killed per square mile of range compares with 0.28 for similar lands in the Tug Hill Region. Some towns in Chenango County have buck kills in excess of five per square mile of range (Pers. commun., Nov., 1973, from S. Free, N.Y.S. Dept. Environ. Conserv., Cortland, N. Y.).

From any standpoint it appears that the population of white-tailed deer in the Tug Hill Region is low. A desirable population level might be attained at a density of about 12 deer per square mile, a density equivalent to a population of 18,000 deer in the Tug Hill Region. At this density, deer could be seen and enjoyed throughout the year, while yielding an acceptable kill of about one buck per square mile of range. Still, deer would not constitute a liability to the Region's timber industry, as no appreciable damage to forest regeneration has been found to occur with densities below 14 deer per square mile (Behrend et al., 1970). If a herd of 18,000 deer is judged desirable for the Tug Hill Region, then the present deer herd is about one-third of what it should be.

The principal causes for the Region's low deer densities are interrelated. They can be grouped into two broad categories: ecological causes, principally related to the interaction of deer behavior in deep snow with the availability, dispersion and condition of winter deer yards; and sociological and economic causes, leading to widespread poaching, and winter predation by domestic dogs.

Ecological causes are closely tied to the Region's heavy snowfalls, among the highest in North America (Figure 38). The belt of heaviest snowfall extends across the central Upland from the Towns of Montague to Booneville, diminishing in intensity toward the Region's periphery. Deer are adversely affected by deep snow. It takes vastly increased amounts of energy for movement when the sinking depth exceeds 18 inches (Mattfeld, 1973). Consequently, deer seek conifer yards in areas of heavy snowfall. In the yards they find walking conditions easier, afforded by the partially packed snow under the conifer trees. Easier walking results in less energy expenditure. However, if too many deer congregate in a yard, they soon overbrowse the vegetation in and around the yard, destroying its carrying capacity. Ultimately, the deer starve, particularly during long winters (see Severinghaus, 1972).

In the central reaches of the Tug Hill Region, since the turn of the century the composition of the mature forests has been greatly shifted to a preponderance of hardwoods by selective removal of conifers. Most deer migrate out of this hardwood-dominated interior seeking the stands of young conifers growing on surrounding abandoned farmlands (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y. and E. Kornmeyer, Ga. Pac. Corp., Lyons Falls, N. Y.). These stands of conifer have been either planted by man, (e.g., near Barnes Corners) or consist of natural regeneration in old fields.

There are only 4 major yards (Map 7) to serve the 200 square miles of summer range in the Upland. Deer concentrate in large numbers within these yards, browsing them intensively. In some portions of the Highmarket yard, every balsam fir and black cherry is barked, and all available hardwood twigs, growing above snow line, have been removed (Pers. commun., Nov. 1973, from T. Brown and S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Deposits of manure resemble that in a barnyard. Elsewhere on the abandoned farmlands of the Upland's slopes where the snowfall is still high, potentially good yarding areas are scarce. Most patches of red spruce, balsam fir, hemlock or pine are too small or too close to human activity to be useful. In the Upland's fringes where snowfalls are lighter, particularly in the southwestern towns, and among towns in the Ontario lake plain south of Adams, deer use pockets of conifer ("pocket yards") scattered throughout private lands. It appears that deer are less vulnerable in these situations compared to major concentration areas, a relationship reflected in the locally higher **buck kill** levels of some towns (e.g. West Monroe and Constantia).

Interacting closely with the yarding relationships of deer are human pressure factors. As pointed out (Map 8), deer yards are located close to human developments, a legacy of Tug Hill's logging history and normal forest succession on abandoned farmlands. For example, at a tavern in Highmarket within sight of the deer yard, 150 snowmobiles can be seen on occasion (Pers. commun., Nov. 1973, from T. Brown, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). A major snowmobile trail passes through the Highmarket yard. A similar situation prevails at Barnes Corners. We are convinced that responsible snowmobiling does not disturb deer. However, snowmobiling and deer yards can only coexist if snowmobilers accept and strictly practice responsible conduct.

Major negative factors affecting deer in the Tug Hill Region are poaching, and winter predation by domestic dogs. There is no quantitative information

on the number of illegally killed deer and dog predation in the Region. However, indirect evidence and reports of informed people suggest that they are high. It appears that deer herd densities as indicated by the legal deer kill are inversely related to the degree of road access and human development. Compare, for example, the buck kill per square mile for towns in Table 46 with degree of human development shown on Map 1. The highest densities of deer are in the central Upland which is least accessible. Elsewhere, lower densities appear to occur where human development and access are greatest. Perhaps the apparently higher deer densities of towns such as Constantia and West Monroe reflect in part the limited public access across private lands.

An illuminating situation appears to exist on the Camp Drum Military Reservation, adjoining the northernmost boundary of the study area. Within the fenced portion of this reservation, the deer density is among the highest in northern New York. However, outside the fence where the incidence of poaching is much higher, deer are practically non-existent (Pers. commun., Nov., 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). There is also some dog control within the fenced area. In 1 recent winter, 2 conservation officers destroyed almost 200 dogs within the fenced reservation. Of these, only a very few had collars.

The illegal deer kill problem in the Tug Hill Region is similar to that of many peripheral locations in the Adirondack mountains. In those economically depressed areas, poaching is socially acceptable. A study conducted by the Department of Environmental Conservation in one Adirondack town indicated that the extremely low densities of deer were largely due to poaching and dog predation. An indirect indication of the extent of such pressure is provided by the known biotic potential of the white-tailed deer. In one Michigan experiment (Jenkins and Bartlett, 1959), four does and two bucks were introduced into the fenced two-square-mile area of the George Reserve owned by the University of Michigan. All other deer had been removed. These 6 deer were introduced in 1928. By the spring of 1934, there were 160 deer in the enclosure, and an average of 20 deer (bucks and does) have been removed annually ever since to keep the herd in balance. The George Reserve has a habitat similar to the abandoned farmlands of the Tug Hill Region.

What are the values of deer to the Tug Hill Region? The relative importance of most values will have to be surmised. Fortunately, the economic value of the white-tailed deer as a game animal can be approximated. Let us conservatively assume that the monetary expenditure by hunters is related to the legal buck kill. The mean annual buck kill in the Tug Hill Region is 504 (19 year mean, Table 45). The success rate for deer hunting in New York for 9 years, 1963-71, was 13.5 hunters licensed per buck killed (Eabry, 1973). This means that, on the average, 6,804 hunters used the Tug Hill Region annually to account for the legal kill of 504 bucks.[2] Using the average expenditure of a U. S. big game hunter in 1970 (Table 48) each hunter (residents and non-residents averaged) spent about $122 per hunting trip. On this basis, 6,800 hunters spent about $830,000 to hunt in the Tug Hill Region. However,

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[2]Number of buck kill and hunter success per buck killed are reported for all years. The additional number of party permit deer (Table 44) for some years and their implied economic value make this a conservative estimate.

Table 48. Expenditures of U.S. big game hunters in 1970.[a]

Item	Mean annual expenditure
Food and beverage	$ 11.36
Lodging	3.10
Transportation	10.59
Equipment	45.15
Arms and ammunition	27.69
Licenses, permits	9.93
Other expenses	14.71
Total	$122.53

Success rate for deer hunting, New York, for 9 years, 1963-71.

Equalled 13.5 hunters licensed per buck killed.

Mean annual buck kill for all Tug Hill towns is 504.

Thus: 504 * 13.5 = 6,084 hunters in Tug Hill Region.

So: 6,800 * $122 = $829,600 spent in Tug Hill counties.

[a] Source: U. S. Dep. Inter., 1972

this estimate may be too low. According to an estimate made for Michigan hunters in 1957 (Jenkins, 1961), about $225 were spent per deer killed, not taking into account our presently devalued currency. On this basis, Tug Hill deer hunters spend about $1,531,000 annually for their sport.

Much of the money spent directly on developing recreational facilities in the Region seems to be tied in with the deer resource. According to Kornmeyer (Pers. commun., Oct. 1973), director of Georgia Pacific Corporation's timber operations, the majority of members in clubs leasing their lands do so primarily to hunt deer. Kornmeyer estimates that 500 members belong to the 20 clubs that lease Georgia Pacific lands. A total of 55,000 acres are leased at 55¢ per acre, a return which does not quite cover tax expenditures of 72¢ per acre. The four major clubs involved are the Rainy Club, Roaring Brook Club, Mad River Club and Pringle Valley Club. The cost of membership varies, but 1 of these clubs charges $30.00 per member per year, granting in return the privilege of year-round recreation.

In conclusion, it appears that from many standpoints, the white-tailed deer is a valuable resource to the Tug Hill Region. It is also evident that this resource can be greatly improved.

Potential forest species

As the Tug Hill Region is largely forested, its principal game species are ones common to a forested environment. One game species which may eventually become established in the parts of the Tug Hill area is the wild turkey. Certainly, its return to New York State has been one of the outstanding success stories in the history of wildlife conservation (Lee DeGraff, 1973). Through the trap-and-transfer program of the Bureau of Wildlife, Department of Environmental Conservation, and natural population expansion, wild turkeys now occur in most counties of southern New York. Some populations even have become established as far north as Fulton County in the southern Adirondacks. The western portion of the Tug Hill Region is listed by DeGraff (1973) as having limited potential for this grand species. Unfortunately, the turkeys do not tolerate deep snow.

Farmland Game

The Region's farmland game (Map 8, Zone W-3) is the weakest component of its game resource, largely because of severe winters and heavy snowfall. Many of the Region's open fields and fencerows are devoid of cottontail rabbits and ringnecked pheasants, common among similar habitats farther south. Of course, the label "farmland game" is only one of convenience. Deer, ruffed grouse, gray squirrels and varying hare may be locally present in farmlands wherever wooded pockets are large enough to satisfy their habitat needs.

Cottontail rabbit

The habitat of the cottontail rabbit in the Tug Hill Region includes meadows, brushy fencerows and vine tangles. However, there is an uncommon and interesting variation. In the northern and western sections of the Region, cottontails inhabit thickets of white cedar growing on the limestone outcrops. In these thickets, rabbits live alongside the varying hare.

Generally, cottontail rabbits do not occur in the Tug Hill Upland

(Pers. commun., Nov., 1973, from E. Kornmeyer, Ga. Pac. Corp., Lyons Falls, N. Y.; Conner, 1966), or its immediate slopes. They can be found wherever snowfall levels are lighter, as in the bottomlands of the Black River Valley, in the flatlands south of Watertown, and adjacent to Lake Ontario. In western parts of the Region, cottontails expand their range eastward into the Town of Boyleston during years with mild winters (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). However, these "outpost" populations invariably collapse during severe winters. Cottontails once occurred in the southern portion of Camp Drum, but were eliminated there in the severe winter of 1969. Similar effects have been observed following severe winters in portions of the Black River Valley (Pers. commun. Nov. 1973, from L. Stewart, Lowville, N. Y.).

Even though cottontails have a precarious status in the Hill Region, they do provide recreation there. Hunting statistics for the four Tug Hill counties are given in Table 9. These should be interpreted with caution. The greater part of cottontail range in Jefferson, Oswego and Oneida Counties is located outside of the Tug Hill Region. The statistics for Lewis County probably best reflect the nature of recreation furnished by this species for the Region. Mean values for Lewis County for the 4 years shown in Table 49 are 1,179 hunters per season, 5,982 days spent afield, 3,891 rabbits bagged per season and 0.73 rabbits bagged per hunter per day. The last statistic compares with a mean success rate of 0.74 rabbits bagged per hunter per day for New York State. Apparently, hunters know where to hunt cottontails in the Tug Hill Region!

The recreation values furnished by the cottontail rabbit should be considered jointly with those provided by the varying hare. Hunting the two is similar. These species are complementary in their range in most sections of the Tug Hill Region, although they do occur together in some locations. However, there are large open sections of the Region which are not inhabited by either species in most years, and by cottontails only in some years. It is difficult to estimate the economic value of cottontail rabbit hunting because data in Table 49 are based on hunting conducted largely outside of the four counties. However, by inspection of the map, it is reasonable to assume that the range of the cottontail in the Tug Hill Region is at least two times that provided by Lewis County. Hence, the mean value of days afield for Lewis County, namely 5,980, can be multiplied by 2, giving an estimated total of 11,960 days spent afield for the Tug Hill Region. At a daily expenditure rate of $7.62 (Table 41) rabbit hunters likely spend about $91,140 annually for their sport in the Tug Hill Region.

Ringneck pheasant

If the corn and alfalfa fields and brushy fencerows of the Region's dairylands were located 100 miles to the south, they would furnish good pheasant range. However, the deep snows and long winters of the Tug Hill Region severely limit pheasants. Naturally reproducing populations are sparsely distributed through the farmlands of the Region's western periphery. In the Black River Valley, naturally reproducing populations have not become established, despite stocking efforts in past years. (Pers. commun., Nov. 1973, from T. Brown, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Currently, pheasants are released in the Black River Valley by sportsman's clubs and 4H groups, and hunting in this area is strictly a put-and-take affair. The state hunting regulations reflect these biological realities as cocks and hens are

Table 49. Cottontail rabbit hunting statistics for Tug Hill counties between 1962 and 1969.[a]

Kill parameters, by season	Yearly statistics				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
1962-63					
Hunters	6,256	1,409	8,285	6,764	-
Days afield	39,210	7,029	58,547	56,091	2,057,696
Rabbits taken	49,121	4,340	39,398	52,841	1,453,225
Rabbits/hunter/day	1.25	0.62	0.67	0.94	0.71
1963-64					
Hunters	4,939	1,093	7,678	6,381	-
Days afield	31,875	7,831	54,759	50,176	1,855,137
Rabbits taken	36,853	3,864	38,494	42,063	1,344,168
Rabbits/hunter/day	1.15	0.49	0.70	0.83	0.72
1966-67					
Hunters	5,616	778	7,207	5,650	-
Days afield	35,283	3,186	52,421	41,890	2,259,428
Rabbits taken	47,030	4,642	36,075	28,498	1,764,181
Rabbits/hunter/day	1.32	1.37	0.68	0.67	0.78
1968-69					
Hunters	5,960	1,437	5,855	6,731	-
Days afield	48,108	5,883	35,333	48,909	2,259,428
Rabbits taken	51,831	2,719	25,809	39,403	1,764,181
Rabbits/hunter/day	1.06	0.46	0.72	0.79	0.78

[a] Based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

fair game in Lewis County, while only cocks may be shot west of Route 81, where pheasant populations naturally maintain themselves.

Hunting statistics for ringnecked pheasant are given in Table 50. A conservative estimate of the economic value of pheasant hunting can be made if the days spent afield within the Tug Hill Region are considered to equal twice the mean Lewis County value of 5,385. (Table 50) or 10,770 for the Region. At a daily expenditure rate of $7.62 (Table 41), pheasant hunters likely spend $82,070 annually in the Tug Hill Region.

Woodchuck

While the woodchuck is not protected by law as a game species, it is hunted for sport during the summer. Woodchucks occur throughout the Tug Hill Region in the logged forests of the higher Upland, in the abandoned farmlands of its slopes, and in the farmed flatlands of the river valleys (Conner, 1966). The economic value of this animal as a game species cannot be assessed. No data are available for it.

Potential farmland species

It is tempting to speculate that the large stretches of Tug Hill farmland, now almost completely devoid of game, could be occupied by ecologically adapted game species. Where the snowfalls are heavy, this may be too much to hope for. However, two species could potentially occupy some of the farmlands influenced by less severe winters, particularly along the western periphery of the Tug Hill Region. These species are the Hungarian Partridge (Perdix perdix), simply called "partridge" in Europe, and the European Hare (Lepus europaeus). Both animals inhabit open farm country, particularly where active farming is in progress.

Scattered populations of the Hungarian partridge have become established west of a line from Watertown to Adams through stocking by the Bureau of Wildlife (Pers. commun. Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). These populations are barely holding their own and there is currently no open season for hunting the Hungarian partridge.

The status of the European hare in the Tug Hill Region is interesting. This mammal may expand its range southward from farmlands north of Watertown. Recent records taken north of Watertown (Table 51) suggest that viable populations exist there, apparently started by hares which have crossed over the ice of the St. Lawrence River from Ontario, Canada.

The European hare is not a newcomer to New York. Huntable populations exist in several southeastern counties. There, open seasons extend from December 5 to February 28. The hare was first introduced into Duchess County from Europe by a wealthy resident in 1893 (Dell, 1957). It increased rapidly and farmers soon complained of orchard damage. The hare was bountied in Duchess County from 1912-17. Later, populations declined, although the hare extended its range to other counties.

It appears that the European hare will determine its own future in the Tug Hill Region. If it does become established, chances are good that it will be a decided asset as a game species. Wherever it does occur in Europe and North America, this large nine-pound hare is highly esteemed as a game

Table 50. Ringnecked pheasant hunting statistics for Tug Hill counties between 1962 and 1969.[a]

Kill parameters, by season	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
1962-63					
Hunters	4,700	2,022	7,597	5,220	-
Days afield	14,336	7,360	28,179	16,863	1,084,683
Pheasants taken	4,976	2,719	8,755	6,743	396,278
Pheasants/hunter/day	0.35	0.37	0.31	0.40	0.37
1963-64					
Hunters	3,186	1,357	7,230	4,709	-
Days afield	8,963	4,564	25,515	15,672	955,844
Pheasants taken	4,047	1,284	9,266	6,224	392,200
Pheasants/hunter/day	0.44	0.28	0.36	0.39	0.41
1965-66					
Hunters	3,596	1,228	7,221	4,970	-
Days afield	12,075	3,986	28,077	17,702	1,091,203
Pheasants taken	4,986	1,487	9,098	5,307	419,152
Pheasants/hunter/day	0.41	0.37	0.32	0.30	0.38
1968-69					
Hunters	4,219	1,654	6,378	5,332	-
Days afield	15,950	5,631	24,111	20,873	1,220,029
Pheasants taken	6,113	2,668	9,745	7,836	521,389
Pheasants/hunter/day	0.38	0.47	0.40	0.38	0.43

[a] Based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

Table 51. Recent records of the European hare seen near Watertown, New York.

Date	Sex	Location of record
Winter, 1968	M	Cape Vincent
May 16, 1969	M	Route 72 at Depeauville
April 3, 1971	F	Watertown, 1½ miles north of Race's Corners
September 1971	-	3 animals killed on Valley Road, Cape Vincent
April 13, 1972	-	Route 12, one mile north of Cape Vincent
October 26, 1972	M	Killed on Route 12E, one-half mile south of Cape Vincent
August 5, 1973	-	Valley Road, Cape Vincent

[a] Contributed by Don Schierbaum and Steve Eabry, biologists in the Bureau of Wildlife, New York State Department of Environmental Conservation. Most of these records are of road-killed hares.

animal.

Waterfowl

Waterfowl found in the Tug Hill Region are either migrants, or breeding residents. Each species occupies a characteristic wetland habitat. These include four major wetland categories or natural complexes: 1. large lakes and adjacent marshes; 2. rivers and riverine marshes; 3. flooded farmlands; and 4. ponds and flooded woodlands. Details of the vegetation within these complexes have already been discussed. Other pertinent information will be found in the chapters dealing with geology and soils, and water resources.

Waterfowl habitats and associated species

A series of exquisite beaches and barrier beaches with their marshy hinterlands skirt Lake Ontario's shoreline northward from the mouth of Grindstone Creek, particularly in a stretch between the mouth of the Salmon River and South Pond (Map 8). This is beautiful scenery by any standard. They are the summer home for a number of breeding waterfowl and serve as way stations for many unusual migrants. This shore lies in the path of an important flyway following the eastern edge of Lake Ontario.

In the spring, the annual pageant of waterfowl begins here. Out in the Big Lake, rafts of goldeneyes, scaups, buffleheads and oldsquaws settle on their journey north, while herring gulls and common terns wheel overhead. In the marshes, mallards, black ducks, coots and blue-winged teal dabble. On the beaches, a seemingly endless assortment of plovers and sandpipers leave their little arrow-like tracks in the sand. Only the breeding residents remain in summer, including mallards, black duck, blue-winged teal, red-breasted merganser, killdeer, spotted sandpiper and common snipe. In the fall, the direction of migration is reversed and the bird procession once again passes through on its way southward. Plovers, sandpipers and ducks challenge the skills of even the expert birder, although wedges of migrating Canada geese leave little doubt about their identity.

Excellent vantage points for observing this pageant are located around the Deer Creek Marsh (Pers. commun., Nov. 1973, from L. Chamberlaine, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Here, the serious birder will delight in seeing unusual migrants such as the golden plover, greater yellowleg, ruddy turnstone, Hudsonian curlew, whimbrel, dowitcher, upland plover, gallinule, American egret, crested cormorant and many others. Gordon (1972) lists about 100 possible marsh and water birds to be seen along the Lake Ontario and St. Lawrence River shorelines, out of a possible 269 species. This is truly an impressive variety of waterfowl.

The diversity of waterfowl along the shores and in the western marshes of Oneida Lake is not as varied as that of the Lake Ontario shoreline. However, a good selection of species will be found there, too. Vantage points for observation are located in the vicinity of Constantia, and from the Toad Harbor Road. Public hunting for ducks is available in the Three Mile Bay Wildlife Management Area, east of the Toad Harbor Road.

Another group of waterfowl habitats occurs in an outstanding complex of riverine marshes along the Black River. These wetlands are at their best between

Carthage and a point upriver from Castorland. Here, mallards, blue-winged teal, black ducks and wood ducks rear their broods, while kingfishers ply the open water. In the cattails, sedges and rushes, red-winged blackbirds short-billed marsh wrens, sora rails, common gallinules, and common snipe hold forth (Pers. commun., Nov. 1973, from L. Chamberlain, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.), while marsh hawks and an occasional osprey beat the air overhead. All these species, with the possible exception of the osprey, nest here.

Much of the Black River marshland near Castorland has been drained for farming by a network of canals. In spring, large sections of these flatlands flood over. Then, buffleheads, goldeneyes, pintails, green-winged teals and occasionally shovelers, can be seen in migration (Pers. commun., Nov. 1973, from T. Wolfe, Lowville, N. Y.). While some farmers have abandoned these low farmlands, others are attempting to drain more marshland for agriculture (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). There is currently excellent duck brood production in these marshes (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). In the stretch between Lowville and Glenfield, the Black River makes a series of lazy arcs through the rich farm country. Here, in the flooded corn and alfalfa fields of the west bank, waterfowl gather on their spring migration. The chief actor on the scene is the Canada goose. These grand birds gather by the hundreds in the flooded, picked cornfields, finding perfect resting and feeding spots. Unfortunately, some farmers pay a price for this spectacle. Geese pull up the succulent alfalfa seedlings and in the soft ooze make puddling holes as big as bushel baskets (Pers. commun., Nov. 1973, from L. Stewart, Lowville, N. Y.).

Negative features of the honkers' spring stopover is at least partially redeemed in the fall when they once again land, this time in dry cornfields. Goose hunting can be excellent in this area, as many hunters have discovered. But there is untapped potential for outstanding hunting that will be discussed later.

With the exception of the few lakes along its periphery, the Tug Hill Region is not well endowed with large bodies of water (Map 6). However, it is dotted with many small ponds, particularly in the level and poorly drained sections of the Upland. Most are beaver ponds. But a number of natural ponds and small lakes also exist in the southwestern section of Tug Hill Region, in Oswego County.

In summer, the beaver ponds of the central Upland have a quiet beauty and appeal all their own. Along one edge of a pond, a white-tailed deer may be feeding on swamp saxifrage. In front of the beaver house, a great blue heron may stand poised in one of the beaver's channels, ready to capture a minnow. Overhead, a brilliant drake wood duck may land gracefully on the gray, skeletal branch of a dead, flooded red maple. In a bay across the pond, a black duck nervously herds her flock of yellow ducklings, all busily feeding on the tiny, floating leaves of duckweed.

The larger of these ponds and small lakes serve as brief resting spots for migrating waterfowl. Canada geese occasionally use them during inclement weather (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y. and T. Wolfe, Lowville, N. Y.) as they trade across the top of the Upland between Lake Ontario and the cornfields around Lowville.

With this full combination of diverse habitats, from the large lakes and marshy shores, the rivers and riverine marshes, the flooded farmlands, to the small scattered ponds of the central Upland, comes an unusual diversity of waterfowl species. Collectively, they lend special character to the Tug Hill Region, and must be considered one of its vital resources.

Waterfowl hunting statistics and economic values

Waterfowl hunting statistics are given in Table 52. The totalled means for all Tug Hill counties (1962-63, and 1963-64) are 5399 hunters per season, 27,829 days spent afield, 26,048 birds bagged, and a mean value of 0.88 birds bagged per hunter per day. The success rate of 0.88 birds bagged per hunter per day for Tug Hill counties is better than the seasonal average of 0.83 per hunter per day for New York State as a whole.

Goose hunting statistics for 1968-69 are given in Table 53. Total values for all 4 Tug Hill counties are 3864 hunters per season, 17,726 days spent afield, 2533 birds bagged per season and a mean value of 0.13 birds bagged per hunter per day. The latter statistic compares with 0.27 birds bagged per hunter per day for New York State as a whole. Apparently, there are better places than the Tug Hill Region to hunt geese in New York.

An estimate of the economic value of all waterfowl hunting can be made if the data for days spent afield in Tables 52 and 53 are combined. On this basis, about 45,550 days are spent afield by waterfowl hunters annually in the Tug Hill counties. This is probably a conservative estimate. The number of hunters has probably increased since these data were collected. If we assume that the distribution of waterfowl hunting is roughly equivalent to land area, and the Tug Hill Region is equal to one half of the total for the 4 Tug Hill counties, then we can infer that 22,780 days were spent afield by waterfowl hunters in the Tug Hill Region. Assuming that $9.73 were spent per day of waterfowl hunting (Table 54), then for 22,780 days afield, hunters spent $221,650.

Increased interest has been shown recently by sportsmen's clubs in leasing farmlands near Lowville specifically for goose hunting. One club leased about 5,000 acres near Lowville at 50¢ per acre for exclusive rights to hunt these lands. The club also releases pheasants in the leased area. At their own expense, club members post the lands against trespassing. One lessor, a dairy farmer, leased 200 acres, bringing him a gross income of $100.00 (Pers. commun., Nov. 1973, from L. Stewart, Lowville, N. Y.). However, the liability insurance on the farm increased $40.00 annually because of the lease, leaving a net income of $60.00. The farmer expressed apprehension about the success of his leasing program because fall geese flights were sporadic. In some years goose hunting has been good, at other times, few geese used the fields.

Furbearers and Mammalian Predators

The important furbearers in the Tug Hill Region are muskrat, beaver, otter, mink, fisher, red fox, gray fox and raccoon. A relative newcomer on the scene is the eastern coyote. It may soon be abundant enough to contribute significantly as a furbearer. The bobcat is currently an unprotected predator, and locally considered a game animal.

Table 52. Waterfowl hunting statistics for Tug Hill counties, for 1962-64.[a]

Seasonal kill parameter	Mean values 1962-64				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters	2,022	612	882	1,883	-
Days afield	11,424	2,063	4,963	9,379	262,064
Birds taken	12,988	1,757	2,765	8,538	217,152
Birds/hunter/day	1.15	0.87	0.57	0.92	0.83

[a] Includes data on all huntable waterfowl, except geese. It is based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

Table 53. Goose hunting statistics for Tug Hill counties, for 1968-69.[a]

Kill parameter	Mean values				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters	1,436	513	513	1,402	-
Days afield	5,772	2,869	2,664	6,421	181,187
Birds taken	924	445	137	1,027	49,823
Birds/hunter/day	0.16	0.15	0.05	0.16	0.27

[a] Based on statistics and data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

Table 54. Cost per day of waterfowl hunting.[a]

Total expenditure in the U.S. by waterfowl hunters = $244,451,000.

Total number of recreation days spent waterfowl hunting = 25,113,000.

Therefore, the expenditure per day is:
$244,451,000 ÷ 25,113,000 = $9.73 per day.

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[a] Source: U. S. Dep. Inter., 1972.

Muskrat

Muskrats are common throughout the Upland (Conner, 1966), along its streams, rivers, ponds and lakes. Houses are common in the marshlands along the Black River, particularly in the vicinity of Castorland. This interesting large "mouse" of the marshes is the mainstay of many predators, including otter, mink, marsh hawk, and great horned owl. It probably contributes significantly as a furbearer in the Tug Hill Region, although no statistics are available on trapping. The 1973-74 value of a muskrat pelt was $2.75 (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.).

Beaver

One of the most impressive sights to be seen anywhere is an aerial view of the central Tug Hill Upland, dotted with scores of beaver ponds. The retaining dams are clearly visible from the air as are the commanding beaver houses, usually one to a pond. Beaver, animal of legend and history, appears to be very much at home in the watery wildlands of the Region. From all reports, beavers have increased greatly in the entire Tug Hill Region in recent years.

Statistics on beaver pelts taken in Tug Hill counties and other Northern Zone counties are given in Table 55. These include the fur harvest for towns outside the Tug Hill Region. They show a low in the fur take around 1970-71, followed by an almost 5-fold increase in the last 3 years. Beaver pelt take for the Region's towns is given in Table 56 for 1972-73. Assuming that 550 state-tagged beaver pelts conservatively represent 80 percent of the actual take (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.), and that each pelt had a mean value of $20.00, then the value derived from beavers trapped in the Tug Hill Region was about $13,750 in 1972-73.

Otter

The otter probably frequents most waterways in the more remote towns of the Tug Hill Region, although it may also be found close to human habitation. One was seen in October 1973 (Pers. commun., Nov. 1973, from R. Chambers, SUNY Coll. Environ. Sci. and For., Syracuse, N. Y.) along the north shore of Oneida Lake among the summer cottages.

Statistics for otter pelts taken from 1965-73 in Tug Hill counties are given in Table 57. These data are for entire counties. Table 56 includes the otter harvests for towns of the Tug Hill Region only, for 1972-73. It appears that the population of otters has held its own and perhaps increased slightly since 1965 (Table 57). However, the otter population in the Tug Hill Region must be small, judging from the otter harvest within Tug Hill towns (Table 57). Only 16 otters were taken by trappers in 1972-73, apparently in the western portion of the Tug Hill Region. Assuming that these 16 State-tagged pelts represent 80 percent of the actual take (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.), and that each pelt had a mean value of $38.00, then the economic value of otter pelts taken in 1972-73 was $760.00. A comparison to otter fur harvest in the Tug Hill counties (including towns outside the Tug Hill Region) and other Northern Zone Counties (Table 57) shows that with the exception of Lewis County, which lies to a large extent in the Adirondacks, Tug Hill counties contribute little to the Northern Zone otter fur harvest.

Table 55. Beaver pelts tagged in Tug Hill counties and Northern Zone counties, 1966-73.[a]

Area	Year							1966-73	
	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	Total	Mean
Jefferson	106	240	268	181	103	283	693	1,874	268
Lewis	547	711	666	145	201	503	1,146	3,919	560
Oneida	64	105	92	34	47	91	182	615	88
Oswego	153	189	204	137	121	202	233	1,239	183
Tug Hill counties, total	870	1,245	1,230	497	472	1,079	2,254	7,647	-
Tug Hill counties, mean	217	311	310	124	118	270	563	-	273
Total Northern Zone[b]	3,454	5,033	4,437	3,099	1,680	3,654	8,478	29,835	-
Mean per county, Northern Zone	247	360	317	221	120	261	605	-	304
Total statewide	5,110	6,721	6,356	4,863	2,840	5,647	12,417	43,954	-

[a] Based on Pittman Robertson Report W-126-R-2:II-6(s), by E. McCaffrey and D. Ball, 1973, titled "Beaver, Otter and Fisher Take, 1972-73."

[b] The Northern Zone as defined by the Department of Environmental Conservation includes all or portions of the following counties: Clinton, Franklin, St. Lawrence, Jefferson, Lewis, Oswego, Oneida, Herkimer, Hamilton, Warren, Fulton, Saratoga and Washington.

Table 56. Total fur harvest for the Tug Hill Region, 1972-73.[a]

	Furbearer		
County	Beaver	Otter	Fisher
Jefferson	26	0	1
Lewis	323	13	18
Oneida	49	0	9
Oswego	152	3	34
Total	550	16	62

[a] Only fur take for Tug Hill towns is included. Data based on Pittman Robertson Report W-126-R-2:II-6(s), by E. McCaffrey and D. Ball, titled "Beaver, Otter and Fisher Take, 1972-73."

Table 57. Otter pelts tagged in Tug Hill counties and Northern Zone counties, 1965-73.[a]

Area	Year								1966-73	
	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	Total	Mean
Jefferson	3	2	8	9	8	10	16	21	77	10
Lewis	39	21	33	24	14	8	26	42	207	26
Oneida	3	3	4	5	6	6	10	8	45	6
Oswego	2	2	5	4	5	4	1	3	26	3
Tug Hill counties, total	47	28	50	42	33	28	53	74	355	-
Tug Hill counties, mean	12	7	12	10	8	7	13	18	-	11
Total Northern Zone[b]	197	213	227	233	240	147	244	353	1,854	-
Mean per county Northern Zone	14	15	16	17	17	10	17	25	-	16
Total statewide	244	249	256	255	263	171	329	413	2,180	-
(28 counties) Mean statewide	9	9	9	9	9	6	12	15	-	10

[a] Based on Pittman Robertson Report W-126-R-2:II-6(s), by E. McCaffrey and D. Ball, 1973, titled "Beaver, Otter and Fisher Take, 1972-73."

[b] The Northern Zone as defined by the Department of Environmental Conservation includes all or portions of the following counties: Clinton, Franklin, St. Lawrence, Jefferson, Lewis, Oswego, Oneida, Herkimer, Hamilton, Warren, Fulton, Saratoga and Washington.

The total monetary value of otter pelts (at $780 each) for 1972-73 must be weighed against other values of this fascinating mammal. One can infer from the currently low fur harvest that otters are uncommon in the Tug Hill Region and probably seldom seen. With such a low population level, the species may require protection if it is to provide aesthetic values and contribute to wildlife diversity of the Region.

Fisher

Conner (1966), who has studied the mammals of Tug Hill, wrote, "The fisher, although still uncommon, has returned to the Tug Hill Plateau after a long absence." Today, we can be even more enthusiastic, for the fisher appears to be common again in its ancestral Tug Hill range. While the fisher probably occupied virgin forests on the Tug Hill Upland during the last century, most fishers are currently trapped in the abandoned farmlands along fringes of the central Upland (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). This outstanding example of ecological adaptability is a beacon of hope for the future survival of other threatened vertebrates.

Data in Table 58 indicate an increasing fisher population for the Tug Hill counties since 1967. In 1973, 62 fisher pelts were taken within the Tug Hill Region (Table 58). Assuming that these State-tagged fisher pelts represent 80 percent of the actual take (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.), and that each pelt was valued at $45 in 1972-73 (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.), then income realized from fisher pelts trapped in the Tug Hill Region was about $3,500.

The natural increase of a predator such as the fisher does have an impact on its prey species. One is the porcupine. Kornmeyer (Pers. commun., Nov. 1973, Ga. Pac. Corp., Lyons Falls, N. Y.) observed that porcupines decreased greatly on the Tug Hill Upland, coincident with the increase in fishers a few years ago. Elsewhere, fishers from New York State were introduced into northern Michigan to control porcupines (Brander and Books, 1973). The first fisher introductions occurred in 1962 when the population of porcupines in 1 area was 36 per square mile. By 1970, porcupines in that area of Michigan numbered only 9 per square mile. The fishers were thriving and foresters were happier about the lower porcupine damage to conifers!

Raccoon

Raccoons are common throughout the Tug Hill Region. Conner (1966) writes, "State fox trappers in the 1950's captured raccoons in all townships of the plateau." The aesthetic values of a familiar species such as the raccoon are perhaps too easily overlooked. To the urbanite who has set up his camp in the "wilds" of Tug Hill, a raccoon presents an appealing sight as it forages busily along a stream bank. The raccoon is always there to be enjoyed. Yet despite its abundance, it embodies a sense of untamed nature which campers hope to find on their safaris.

The raccoon has the status of furbearer as well as game species. Hunting and trapping seasons for it overlap. Raccoon hunting with dogs has its share of devotees. It appears from Table 59, that the mean success rate of 0.94 raccoons per hunter per day for 1963-64, bested the mean value of 0.89 for New York State as a whole.

Table 58. Fisher pelts tagged in Tug Hill counties and Northern Zone counties, 1965-73.[a]

Area	Year								1966-73	
	1965-66	1966-67	1967-68	1968-69	1969-1970	1970-71	1971-72	1972-73	Total	Mean
Jefferson	0	2	1	1	5	7	6	8	30	4
Lewis	48	67	28	92	111	114	38	55	553	69
Oneida	15	9	18	31	74	71	45	30	293	37
Oswego	4	1	0	2	8	31	25	34	105	13
Tug Hill counties, total	67	79	47	126	198	223	114	127	981	-
Tug Hill counties, mean	17	20	12	31	49	56	28	32	-	31
Total Northern Zone[b]	487	565	322	907	953	918	869	1,008	6,029	-
Mean per county, Northern Zone	35	40	23	65	68	65	62	72	-	54

[a] Based on Pittman Robertson Report W-126-R-2:II-6(s), by E. McCaffrey and D. Ball, 1973, titled "Beaver, Otter and Fisher Take, 1972-73."

[b] The Northern Zone as defined by the Department of Environmental Conservation includes all or portions of the following counties: Clinton, Franklin, St. Lawrence, Jefferson, Lewis, Oswego, Oneida, Herkimer, Hamilton, Warren, Fulton, Saratoga and Washington.

Table 59. Raccoon hunting statistics for Tug Hill counties, for 1963-64.[a]

Kill parameter	Mean values				
	Jefferson County	Lewis County	Oneida County	Oswego County	New York State
Hunters	554	738	1,292	646	-
Days afield	3,579	2,478	7,740	4,069	233,932
Raccoons taken	4,483	2,690	3,741	2,906	207,825
Raccoons/hunter/day	1.24	1.07	0.74	0.71	0.89

[a] Based on data compiled by the Bureau of Wildlife, New York State Department of Environmental Conservation, titled "Standard Errors of Estimate of Take and Days Afield." The Department used expansions from survey samples for its information.

An approximation of the value of raccoon hunting can be made on the basis of Table 59. Raccoon hunters in Tug Hill counties spent a total of 17,866 days afield in 1963-64. Assuming that raccoon hunting is proportional to land area, then approximately 8,900 days were spent afield within the Tug Hill Region, within an expenditure of $7.62 per day (Table 41), or about $67,820 annually.

The value of a raccoon pelt on the fur market has gone up from about $5.50 in 1972-73, to about $8.50 in 1973-74 (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.). No statistics are available on the raccoon fur harvest.

Wild canids

Three species of wild dogs inhabit the Tug Hill Region; red fox, gray fox and eastern coyote. None of these predators are protected by New York State laws, yet all three species are hunted on occasion, and are important furbearers.

By virtue of the recent dictates in fashion, long haired pelts currently fetch high prices. In 1973-74, pelts of the red fox, gray fox and coyote have been valued, respectively, at $30.00, $14.00 and $22.50 each (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.). These are about double the value from two years earlier and consequently have encouraged increased trapping in the Tug Hill Region. In the fall of 1973, 1 trapper operating near Barnes Corners caught 18 red foxes in 4 days. Another trapper had 20 red foxes, 1 gray fox and 9 coyotes in 1 month in the New Boston area (Pers. commun., Nov. 1973, from P. Gaskin, Adams Center, N. Y.).

In the Tug Hill Region, red foxes currently seem to be more common than gray foxes, a situation apparently unchanged since 1966 (see Conner 1966). However, if trends in the Adirondacks give any indication, this pattern may reverse itself. It also appears from the current trapping success that red fox populations in the Tug Hill Region are now relatively unaffected by sarcoptic mange. Mange infestations almost invariably kill red foxes (Stone, Parks and Weber, 1972), while the gray fox is relatively immune to the disease. (Pers. commun., Nov. 1973, from W. Stone, N.Y.S. Dep. Environ. Conserv., Delmar, N. Y.). Stone believes that the sharp decline in red foxes in southern New York may be due to mange. Apparently very few red fox pelts are currently being contributed from that region by trappers (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.). It is possible that a similar fate may befall Tug Hill foxes. One trapper reported from Camp Drum that some foxes and coyotes trapped there in the fall of 1973 were mangy (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.).

Coyote populations have apparently increased in the Tug Hill Region, particularly during the last year (Pers. commun., Nov. 1973, from P. Gaskin, Adams Center, N. Y.). Gaskin has studied this species intensively in the Tug Hill Region for the last five years, particularly in the northeast corner of the Upland around Barnes Corners. In 1966, Conner (1966) observed, "Coyotes were fairly numerous in the winter of 1959-60 along the northern edge of the main forested section, in the townships of Montague and Martinsburg." Apparently, coyotes are still fairly common today in that section. Gaskin (Pers. commun., Nov. 1973, from P. Gaskin, Adams Center, N. Y.) claims that 2 groups of about 12 coyote hunters who hunt with dogs accounted for 38 coyotes

in the vicinity of Barnes Corners and New Boston.

The food habits of the Region's coyotes have been studied by Gaskin (Pers. commun., Nov. 1973, from P. Gaskin, Adams Center, N. Y.) who found that snowshoe hares and mice are common items in the stomachs he analyzed. Deer meat also is a fairly common item in their diet. The predatory relationships of coyotes to deer in the Region is not known. Deer wounded during the hunting season, dog kills and winter starved deer are probably regular fare.

Bobcat

Conner (1966) wrote, "Bobcats are common on the plateau at the present time. Of the 157 bobcat bounties reported for 1963 and 1964, 98 of the cats or 62 percent of the (Lewis County) total, were listed for the 5 high, heavily wooded Tug Hill townships of High Market, Lewis, Martinsburg, Montague and Osceola." The value of a bobcat pelt is currently high, being about $35.00 (Pers. commun., Nov. 1973, from T. Gebo, Westport, N. Y.).

There are indications that bobcats may not be as common in the Tug Hill Region as during past years. Bobcat hunters who hunt with dogs in the southwestern portion of the Upland around Osceola, have found so few cats during the last two winters that they put their dogs on sale (Pers. commun., Nov. 1973, from W. Stiles, Cortland, N. Y.). The status of the bobcat in the Region deserves attention. The species currently is not protected by New York law, although prized as a game species and furbearer. Its status as a unique component of Tug Hill's wildlife must not be endangered.

Summary of Ecomonic Values of Hunting and Trapping

Estimates of annual expenditures for hunting in the Tug Hill area are summarized as:

White-tailed deer	$ 830,000
Ruffed grouse	381,000
Varying hare	266,700
Waterfowl	221,650
Gray squirrel	204,980
Cottontail rabbit	91,140
Ring-necked pheasant	82,070
Raccoon	67,820
	$2,145,360

Expenditures for woodcock and woodchuck hunting are not included. Statistics are lacking for these species. However, the estimate for ruffed grouse hunting will include much of the expenditure for woodcock hunting. The two species are usually hunted together.

Any error inherent in these estimates is likely on the conservative side. The values probably are minimum estimates because: 1. data are frequently several years old and do not take into account recent population increases; 2. dollar values do not reflect recent monetary inflation; and 3. expenditures by hunters may be greater in the Tug Hill Region than elsewhere, because of the number of non-resident users. Values used to estimate expenditures presume an average composition of resident and non-resident hunters.

The extent to which expenditures of $2.14 million by hunters benefit the local economy is open to conjecture. However, it would probably be conservative to assume that one-half of this amount is spent within the Tug Hill Region. Most likely, food, beverage and lodging expenses, and one-half of other expenditures, occur in the immediate vicinity of the hunt (Table 41).

Finally, the estimates do not include any value for the game meat. At current meat prices, this value alone is considerable.

Income from the fur harvest is given for three species:

Beaver	$ 13,750
Fisher	3,500
Otter	780
	$ 18,030

The total does not include income from muskrat, raccoon, red fox, gray fox and coyote pelts. Expenditures of trappers have not been considered here.

Statistics for hunting and trapping suggest an interesting relationship. It seems that the money expended for wildlife values are directly related to their degree of intangibility and inversely related to their tangibility. The total estimates for hunting far exceed the income derived from the more tangible fur harvest. This relationship is also reflected in the deer hunting statistics. A large proportion of the values derived by deer hunters appear to be intangible, or aesthetic. Each year only 1 in 13.5 hunters bags a buck. Or, for the average hunter more than a dozen years will elapse between buck kills. Thus, a deer hunter expends about 13.5 x $122 = $1,647 for every buck killed, or $1,647 - $122 = $1,525 for hunting in the 12.5 years between kills. Much of the benefit derived by the hunter from wildlife must indeed be intangible and aesthetic, quite apart from other recreational benefits which he derives of the hunt.

Aesthetic Wildlife Values

Who questions the universal appeal of wild animals? Lois Crisler (1968) once observed, "Wilderness without wildlife is mere scenery." Her words apply equally well to any and all wild settings. The Tug Hill Region is richly endowed with beautiful scenery, and its wildlife adds a vital spark. The upper Whetstone Creek gorge is impressive, but the red-tailed hawk which I saw sailing over it made the scene immortal.

Then, there are the silent hardwoods of the Upland's interior, throbbing with life in spring as Blackburnian warblers, wood thrushes and white throated sparrows fill the woods with song as they prepare to nest. The valley of the Lansingkill with Pixley Falls, dark evergreen clad side gorges and remnants of an historic canal will stir any traveler. But a colorful brook trout caught on a fly in the bubbling stream is a climactic experience. The dairy farmlands around Lowville are attractive, but a wedge of honking geese overhead make them memorable.

The dunes and shorelines of Lake Ontario attract many people for their sheer beauty. However, the experienced bird watcher knows that this magnificent setting is the backdrop for a fabulous display of migrating hawks in autumn. Here, from vantage points along the shore, hundreds of hawks fly by

at eye level, including rarely seen osprey, golden eagle, peregrine falcon, and goshawk (Pers. commun., Nov. 1973, F. Scheider, Syracuse, N. Y.).

How does one value these experiences in an economically oriented culture? Should tourists, cars, campers and dollars be counted? What is the worth of birds at a feeding station to a watchful housewife? What is the importance of a sick blue jay nursed back to health by a child? Or the value of a garter snake brought to school in a grimy pocket for "show and tell"? What is the worth of a chipmunk stuffing its cheek pouches with seeds at a campsite, while many little faces watch? Who can value these? Some say that they have no value. Others believe that they cannot be valued, for their value is infinite. We had best err on the generous side.

THE FISH RESOURCE

Fish resources of the Tug Hill Region can be grouped into four broad classes: 1. cold water fishery; 2. transition water fishery; 3. warm water fishery, and 4. salmonid program. Approximate boundaries delineating categories are outlined on Map 8 (Zones F-1, F-2, and F-3).

Cold Water Fishery

Centrally located on the Tug Hill Upland are some of the best brook trout streams in the northeastern United States (Map 8, Zone F-1). These streams are generally small. Water temperatures do not exceed 65° F. They flow through deep sandy and gravelly hills. Their riffles and pools harbor good, naturally reproducing populations of brook trout. The sculpin minnow, an excellent indicator of high quality trout water, is common in these streams. However, the fast flowing, stony brooks located in a narrow band along the Upland's steep eastern escarpment (Map 2 and 3) provide poor trout habitat.

The principal watersheds in the central Upland include the Mad River, the North Branch of the Salmon River, the East Branch of the Salmon River, and the East Branch of the Fish Creek system above Rowe Reservoir (Powlish Pond Brook dam). Not all trout in these waters are brook trout. Populations of rainbows, probably originating from Lake Ontario stock, occur in the upper reaches of the Salmon River above the Reservoir and in one section of Prince Brook (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.).

A portion of the cold water fishery is also located beyond the bounds of the Upland, in a stretch of the Black River, from its source to Boonville. The quality of the river above Boonville is good. Brook, brown and rainbow trout occur there.

Transition Water Fishery

The title of this section is one of convenience, with no general significance beyond this report. This category Transition Water Fishery includes waters with characteristics between true cold waters, and warm waters (Map 8, Zone F-2). Summer water temperatures range between 65° and 70° F, the amount of dissolved solids is higher and sculpin minnows are few. For trout, these are medium quality waters with only a few naturally reproducing trout populations. However, they are excellent waters for trout stocking. Warm water species of various kinds, such as smallmouth bass and perch, also occur in

this habitat. [3]

Upland slopes

Most of the transition waters are located on the slopes surrounding the central Upland, among farmland or abandoned farmlands. These transition waters were once high quality, but have been subsequently altered by human activities, primarily farming. For example, in the Deer Creek system in the Town of Montague, some excellent streams were destroyed (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Ploughing and pasturing of cattle caused siltation. And as farmers commonly made cheese in the early 1900's, their whey and milk wastes were frequently dumped into the streams.

Today many of the transition water streams are showing improvement in quality, as farming decreases in the area. However, a new potential threat is developing as urbanites, seeking recreation, buy up the old farms for camps. New trails are frequently built across lands by the new owners, adding silt to the streams (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Construction of trout ponds has helped increase water temperatures beyond the level tolerable for brook trout. These new potential threats are growing in towns such as Camden, Annsville, Lee, Florence and Western. Many homes are being built in these towns for permenent residences, their owners commuting to Utica and Rome (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S Dep. of Environ. Conserv., Watertown, N. Y.).

Tributaries of the Salmon River just east of Richland in the Town of Orwell contain naturally reproducing brown trout and rainbow trout populations, as do portions of Orwell Creek (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). In the Town of Williamstown, just south of the Salmon River, Kasoag Lake and a series of spring fed ponds contain trout and smallmouth bass. These are all on private lands. Professional help by the Bureau of Fish, Department of Environmental Conservation, is limited to advice and surveying for the owners.

The very narrow strip of transition waters along the steep eastern slope of the plateau are small, swift, stony and of little value from a fisheries standpoint (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.).

Salmon River Reservoir

The Upper and Lower Salmon River Reservoirs are managed for electrical power production by the Niagara Mohawk Power Corporation. Water levels fluctuate to a considerable extent, particularly in the Upper Reservoir. When we flew over this artificial lake in October, 1973, extensive mud flats were exposed at its upper end. The Upper Reservoir currently contains a few trout, largemouth bass and perch. The potential for a trout fishery is very limited because of the fluctuating water level (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). A fair brown trout population currently exists in the Lower Reservoir.

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[3] Details of fish stocking can be obtained from job reports of the Bureau of Fish, N.Y.S. Department of Environmental Conservation.

Some timbered bottomlands along the Salmon River below the dams are continuously inundated by the large volumes of water released from the reservoirs. At one location just east of Pulaski, and upriver from a highway fill, I observed that almost all trees and shrubs along a half-mile section of the river had been killed by flooding. (R. Brocke, Oct. 1973).

Mohawk River and Lansing Kill drainage

There is an out-pocketing of transition waters in the southeastern section of the Tug Hill Region (Map 8) which includes the drainages of the upper Mohawk River and the Lansing Kill. These streams and tributaries flow through abandoned farmland. The quality of water is good, and they contain some naturally reproducing brook trout populations. Like other transition waters, these streams are stocked with trout by the Department of Environmental Conservation.

Black River

The section of the Black River from Boonville to Lyons Falls contains brown and rainbow trout, some of large size. There is also a good population of largemouth and smallmouth bass. The public fishing access across private lands is excellent along the Black River. Few stretches of the river are posted (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.).

Warm Water Fishery

All remaining waters of Tug Hill Region are warm waters (Map 8, Zone F-3). The bulk lie on the Tug Hill periphery. To a person not acquainted with fisheries biology, the phrase "warm water" may be misleading. Many "warm waters" are indeed quite cool in summer. However, summer water temperatures usually exceed 70° F. The amount of solids and dissolved nutrients can be high, so that the waters are often quite murky. The oxygen content is usually lower than that of trout water.

Characteristic fish species include the smallmouth bass, largemouth bass, yellow perch, walleye, northern pike, carp, bluegill, pumpkinseed, rock bass and a variety of minnows. Some of these fishes, such as the yellow perch and northern pike, have wide tolerances for water temperature. Consequently, they can exist in cold lake or pond waters. In cold waters, these species select warmer micro-environments, where they survive and reproduce.

Tug Hill periphery

The bulk of the Region's warm water fishery lies in a peripheral band of the Tug Hill Region. Much of the land in this zone is actively farmed. In some sections, abandoned farms are common. The majority of streams and tributaries contain warm water fish species. However, there are exceptions. For example, the upper section of Scriba Creek (flowing into Oneida Lake at Constantia) contains brook trout, with some brown trout in the lower sections. Streams along western half of the northern shore of Oneida Lake are stocked with trout (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.).

Other exceptions in the warm water zone include tributaries of Little

Sandy Creek and a stream flowing into the northern end of North Pond, northeast of Lacoma near Lake Ontario (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.). These streams provide good brown trout fishing. North of Oneida Lake, the West Branch of Fish Creek between McConnelsville and Williamstown contains a good brown trout fishery. In the southwestern Town of Trenton, fishing for brown trout can be excellent in Beaver Creek near Holland Patent (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.).

Western Tug Hill - Lake Ontario influence

Waters adjacent to Lake Ontario contain resident fish populations as well as seasonal migrants from Lake Ontario. Smallmouth bass from Lake Ontario spawn in Grindstone Creek and in the Salmon River, west of Pulaski. The Salmon River is also heavily used by spawning rock bass. All streams flowing into Lake Ontario have smelt runs in spring. Carp are also present in the lower end of all these streams.

The fishery of North Pond, west of the Village of Sandy Creek, deserves special mention. This lake is separated from Lake Ontario by a series of discontinuous barrier beaches. Hence, the lake is directly connected with Lake Ontario. The resident fish population in North Pond includes northern pike, yellow perch, largemouth bass, bluegill, pumpkinseed, bullheads and minnows. In addition, migrant population of fishes from Lake Ontario over-winter in North Pond. These species include the yellow perch, white perch (Roccus americanus), smallmouth bass and rock bass. In addition, there is seasonally outstanding fishing for northern pike, rock bass and bullheads, drawing anglers from long distances (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.).

South Pond, a small lake connected to North Pond at its southern extremity, contains a good walleye fishery. Just to the south, Deer Creek flowing through marshes into Lake Ontario, provides bullhead and northern pike fishing (Pers. commun., Nov. 1973, from C. Creech, N.Y.S. Dep. Environ. Conserv., Cortland, N. Y.).

Fish Creek

Fish Creek, flowing into the eastern end of Oneida Lake, serves as the principal spawning stream for Oneida Lake walleyes. And, the Oneida Lake Walleye fishery is probably the best in North America, producing 20-30 pounds per acre (Pers. commun., Nov. 1973, from J. Forny, Cornell Univ., Ithaca, N. Y.). Fish Creek meanders slowly through the lowlands east of Oneida Lake. Fish moving upstream from Oneida Lake are stopped by a dam at McConnelsville.

The Oneida Lake walleye fishery is maintained through a heavy annual stocking involving about 200 million fry annually. These fry are raised at the Oneida Lake Hatchery at Constantia. Angling pressure is heavy, and 25 percent of the walleye population is caught annually (Pers. commun., Nov. 1973, from J. Forny, Cornell Univ., Ithaca, N. Y.).

Black River

An excellent warm water fishery in the Black River stretches from Lyons Falls to the river's mouth at Lake Ontario. Trophy-sized northern pike,

weighing 12-30 pounds, have been caught. Walleyes, largemouth bass and smallmouth bass range up to six pounds. Bullheads reach an exceptionally large size and spring fishing for them is excellent (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). The chief forage fish in this stretch of the river is the mudminnow, produced in large numbers on the flooded bottomlands, upstream from Carthage (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.).

Pollution abatement is a prime consideration with this fish resource. From the air, sources of pollution are clearly visible at Carthage and Castorland. Some improvement in fishing is already evident in the stretch of river below Lyons Falls in just the short time since the Georgia Pacific Co. Corporation improved pollution control measures at its plant. (Pers. commun., Nov. 1973, from B. Buffington, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.)

Salmonid Program

New York's salmonid program had its tangible beginnings in 1968, when 25,000 coho fingerlings were planted in streams along the eastern end of Lake Ontario. Since then, coho and chinook fingerlings have been stocked annually by the Department of Environmental Conservation. Two streams in the Tug Hill study Region have figured prominently in the stocking program. They are Skinner Creek and the Salmon River. Skinner Creek flows into North Pond in the Town of Sandy Creek. The Salmon River flows through the Village of Pulaski in the Town of Richland. In 1973, 155,000 cohos and 575,000 chinooks were released in the Salmon River, while Skinner Creek was planted with 30,000 cohos (Jolliff, 1973).

Salmon management in the Great Lakes hinges on the life cycle of these fish, typified by the coho. Coho adults gather at the mouth of spawning streams in the late summer of their third year. In fall, the fish ascend the spawning stream, lay and fertilize their eggs and then die. The eggs hatch in winter and the fry remain in the spawning stream for one year, growing to five inches long. During the spring of their second year, the coho swim downstream to Lake Ontario, where they grow rapidly.

A few cohos are sexually mature in the first fall after entering the lake, and ascend the streams to spawn as "jack" salmon. In New York, a silvery jack salmon averages about 1.4 pounds. Adult 3-year old cohos reach an average weight of 5.0 pounds. Chinook jacks average 4.3 pounds, and 3-year old adults average 9 pounds. The largest chinook caught in New York was an exceptionally large 4-year old weighing 18.4 pounds (Jolliff, 1973). All chinooks and cohos die after spawning.

For stocking, cohos and chinooks are hatchery-raised to 5 inches and 2.5 inches, respectively. These fingerlings descend the stream almost immediately after being stocked. After several months in Lake Ontario, a few jack salmon ascend the river again to spawn. Since adults and jack salmon die after spawning, foul-hooking with gang hooks (snatching) is permitted. Also, spawning salmon usually do not bite on artificial lures once they are in their spawning stream.

There are two other forms of fishing for cohos and chinooks. First, they can be caught with artificial lures along shores in spring, or in late summer as they gather at the mouth of their spawning streams. Secondly, some anglers

catch them in summer by trolling from a large boat.

The success of New York's salmon program has been greatly hampered by lamprey parasitism. Prior to the onset of the lamprey control program in 1972, returns from salmon stocking amounted to a meager 0.1 percent of the cohos and chinooks released. All 3-year old salmon observed in Department of Environmental Conservation samplings had been attacked by lampreys, and each fish bore 10-13 scars (Pers. commun., Nov. 1973, from T. Jolliff, N.Y.S. Dep. Environ. Conserv., Cape Vincent, N. Y.). Consequently, in 1972, 20 streams southward of Stony Point (near Henderson, Jefferson Co.) along Lake Ontario's east shore were treated with lampreycide (Pers. commun., Nov. 1973, from T. Jolliff, N.Y.S. Dep. Environ. Conserv., Cape Vincent, N. Y.). As young lampreys mature in about three years in New York streams, treatments will have to be renewed every three years to affect all lamprey age classes. A lamprey control program was initiated in Canadian Lake Ontario streams in 1971 by the Great Lakes Fisheries Commission (Jolliff, 1973).

Results from the lamprey control appear encouraging. In the fall of 1973, 2-year old chinooks showed only 70 percent incidence of scarring, a marked improvement over previous levels (Pers. commun., Nov. 1973, from T. Jolliff, N.Y.S. Dep. Environ. Conserv., Cape Vincent, N. Y.). Also, even though all 3-year old spawning chinooks were scarred as they entered the Salmon River in the fall of 1973, these fish had been parasitized before the spring of 1973. Department of Environmental Conservation biologist Tom Jolliff believes that salmon and trout survival should be adequate with current lamprey control, and provide good fishing in the spring of 1974 for cohos and chinooks, as well as stocked steelheads and brown trout.

It appears that New York's salmon program is rolling. Its future looks bright, judging from the successes of the salmon program in Michigan where the Great Lakes salmon programs originated. The economic impact of a salmon fishery on local communities can be considerable. For example, in Grand Traverse Bay of Northern Michigan, total community income in several towns increased by $204,000 in the 1971-72 season, due to the salmon fishery (Mich. Dep. Nat. Resour., 1973). The equivalent of 21.5 full time jobs were attributable to this resource, including work in the boat charter industry, boat launching facilities, tackle and bait stores and all other enterprises providing goods and services to anglers. Spending by non-resident anglers provided an estimated gross income of $419,000 to bay communities. Statewide, in 1970 Michigan residents spent an estimated $15.5 million for salmon and steelhead fishing. Sixty percent of their expenditures ($9.4 million) for gas, oil, food, lodging, bait, rental fees, and the like, were made at or near the location fished. Non-resident fishermen spent about $6 million (Mich. Dep. Nat. Resour., 1973).

Current plans by the Department of Environmental Conservation's Bureau of Fisheries include the construction of a $5.5 million hatchery probably in the vicinity of Orwell and Trout Brook (letter from W. A. Pearce, N.Y.S. Dep. Environ. Conserv., Cape Vincent, N. Y.). Some money has been appropriated by the legislature at this writing (1973), permitting planning and site acquisition. The hatchery will be equipped to raise cohos, chinooks and rainbow trout (steelheads). Long range plans include raising of Atlantic salmon, a difficult species to work with, but desirable from many standpoints (Pers. commun., Nov. 1973, from H. Loeb, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.). A study funded by the Sea Grant Program is planned to study the impact of the

developing Lake Ontario salmon program upon New York State's economy. The Bureau of Fisheries is currently planning a survey to provide information on angler use and harvest on the Salmon River (Jolliff, 1973). Salmon are currently being caught as far inland as Altmar.

A few cautionary comments are in order. New York State is in a fortunate position. It can profit from the negative experiences of other salmon programs. As Michigan pioneered these programs, we can learn much from that state. Most of the problems encountered in Michigan have human dimensions. The most disastrous event ever to befall Michigan fishermen occurred soon after cohos were first introduced in Lake Michigan. Hundreds of fishermen, gripped by "coho fever", ventured out into the lake one calm fall day to reap the bonanza. Hundreds sallied forth in small boats, ignoring the small craft warnings. When the storm struck, it caught most by surprise. A number of people drowned and many were injured in that catastrophe. A lesson had been learned.

Shortly after the initial legalization of snatching in Michigan, indiscriminate killing of game fish developed. Anglers snatching salmon also hooked steelheads and brown trout in streams where these species occurred together. Many illegally caught fish were kept. The Michigan Department of Natural Resources subsequently legalized snatching only for waters where this method was not detrimental to other game fish.

Problems also included damage by coho fishermen to banks of streams, leading to erosion and siltation. Many private landowners suffered severe property damage on their streamside properties as a result of unthoughtful actions by hordes of coho fishermen. In addition, property owners along some tributaries were subjected to the stench of dead, decaying salmon, following the spawning run.

Other potential problems involve the quality of salmon fishing. Of the three common types of salmon fishing, namely deep fishing from boats, angling at mouths of spawning streams, and angling in spawning streams, the first has generally yielded the highest quality of sport in Michigan. Fishing for salmon from a boat in un-crowded waters provides an exhilarating experience. However, over the years, a stigma has been attached to other types of salmon fishing in Michigan. Purist fly fishermen, who used to have some streams all to themselves in November for the fine steelhead fishing, were suddenly forced to compete with hordes of stampeding salmon fishermen. Their reactions were understandable. There is a difference between the delicate presentation of a fly to a superb steelhead, and the mechanical flailing by coho fishermen standing shoulder to shoulder.

There are solutions to all these problems. Regulated use, zoning, designated points of entry and exit from the river, programs of cooperation between landowners and fishermen, and self-enforced etiquette among anglers will accomplish a lot. However, planning and implementing efforts to enhance the quality of salmon fishing should proceed hand in hand with biological aspects of the salmon program. Potential problems should be anticipated. When cohos and chinooks finally come in force to dual with New York anglers, the stage for high quality sport should be completely set!

VERTEBRATES OF THE TUG HILL REGION

A list of vertebrates found in the Tug Hill Region is presented in Appendix 6. This will provide an accurate overview of Tug Hill's fish and wildlife. The best local and general sources of information known to us have been used in forming the list, giving the most up-to-date catalog of Tug Hill's wild animals.

A total of 490 species of vertebrates have been listed, including 57 mammals, 280 birds, 25 amphibians, 19 reptiles and 109 fishes. About 138 of these species are rarely encountered, but are not endangered species.

For each species, notation is provided to show its common habitats, abundance, and status within the Tug Hill Region. This classification is simplified, applying to all vertebrates. Undoubtedly, it will not satisfy serious students of zoology. But references and sources presented in the Appendix give additional information about each species.

The full spectrum of Tug Hill's original wildlife assemblage will never be known. The average pioneer, fighting a harsh environment for survival, can hardly be blamed for not keeping detailed records about wildlife. However, in the process of protecting his crops and herds, the early settler well knew which animals were harmful. He also knew which fish, birds and mammals could provide him with meat and clothing. And those species have been cited in written records, such as Dr. Franklin Hough's (1860), "History of Lewis County". Krueger (1966) summarized much of this information in a lively picture of Tug Hill's former fish and wildlife species.

The pre-colonial fauna of the Tug Hill Region was apparently quite typically northeastern. White-tailed deer were locally common. One farmer captured 40 deer in 1 night merely by building a corral across a deer runway, just north of Snow Ridge, near Carpenter Hill Road (Krueger, 1966). These deer were probably moving to their ancestral wintering grounds in a Black River Valley swamp. Elk and moose were occasionally taken. A huge moose shot in 1821 by a 12 year old boy was mounted in the State Museum at Albany (Hough, 1860). Wolves and panthers were bountied. Wolves were common until 1840, but occasional wolves reported in northern New York today are either transients or animals which have escaped from captivity. (See The Conservationist, Dec.-Jan., 1968-69, 23(3):34) It is interesting that wolves were classed either as small, common wolves, or larger, black wolves (Krueger, 1966). Could it be that the smaller common wolves were really the eastern coyotes which are now making a dramatic comeback? The point would be worth investigating, because the origins of the eastern coyote remain a mystery (Silver and Silver, 1969).

The black bear, prominent in Tug Hill folklore (Bowen, 1970; Krueger, 1966) were apparently more numerous in the early 1800's than in other years. The Atlantic salmon probably made spawning runs up the Salmon River from Lake Ontario as late as the early 1800's (Pers. commun., Nov. 1973, from H. Loeb, N.Y.S. Dep. of Environ. Conserv., Albany, N. Y.). Moose, elk, puma, wolf, and Atlantic salmon are now gone from Tug Hill Region. The passenger pigeon is extinct. Unfortunately, the written records of Tug Hill's former wild animals extend little beyond these species. However, the former presence of other wildlife can be inferred. The wolverine (Conner, 1966) was probably an inhabitant of the Region, although no records list its existence.

Undoubtedly, resident populations of the marten and spruce grouse once inhabited Tug Hill's magnificent conifer stands, which are now almost completely logged off (Bowen, 1970; Samson, 1971). Any martens encountered on Tug Hill Upland today must be transient animals. The same is true for the lynx and black bear.

Today, of the approximately 483 animal species still seen on Tug Hill, 138 have been listed as rare in this report (Appendix 6). This category requires qualification. Animals are classified "rare" when infrequently seen or encountered by humans. However, infrequent sightings or encounters are due to any one of several reasons. Some species are rarely seen simply because they escape detection, even though they may be locally common. Two Tug Hill species fall in this category, namely the pygmy shrew and least shrew (Appendix 6). Neither species has been collected in the Region, although the pygmy shrew may not be uncommon (Conner, 1966). In any case, it is doubtful that the apparent rarity of these species reflects low population levels due to ecological changes wrought by man. A species also may be rarely encountered if sought in an area outside of its normal range. These are transients, exemplified by birds such as the hawk owl, cattle egret, European widgeon, ruff and northern three-toed woodpecker. Several transient animals use the Tug Hill Region. A species may be rarely seen because its distribution is naturally sparse. This situation is quite normal for some "top" predators such as the goshawk. Animals at the top of their food chain require a large prey base and, consequently, a large area to support them. Also, species may be rarely encountered because it is universally rare due to widespread negative factors in its environment. Examples include the bald eagle, peregrine falcon and golden eagle. Populations of these species have been decimated due to destruction of their habitat, human harassment and pesticides. A species may be rare because the lack of important habitat components limits its population. This limitation may be natural and permanent, as in the case of the loon in the Tug Hill Region. Loons will always be sparse there, because ponds and lakes are few. Lack of a crucial habitat factor may also be due to man-induced ecological changes. Such situations are often reversible and temporary. For example, resident populations of the spruce grouse could be reestablished on Tug Hill if undisturbed conifer cover were present. A species may be rare, even in ideal habitat, if it is adversely affected by direct human pressures. Such pressures include unregulated hunting, excessive trapping, urbanization and harassment by dogs. The black bear, lynx, marten and possibly the bobcat and otter appear to be affected in the Region due to such human pressures. It is ironic that in some sections of Tug Hill, the white-tailed deer also falls into this category.

From a practical standpoint, rarity induced by factors in the last three categories should cause primary concern. It is possible to aid universally rare species such as the bald eagle by establishing and enforcing strict environmental standards. It seems possible to reestablish certain species such as the spruce grouse by appropriate habitat manipulation. It is possible to aid species adversely affected by direct human pressures if these pressures are clearly identified and appropriate counter measures are adopted.

Endangered species occurring in the Tug Hill area received that designation because of their national and international status. An endangered species is one whose ability to survive is in doubt. Populations of an endangered species are always small and usually declining, and lack vitality.

Even minor adversities in the environment can push an endangered species over the brink to extinction. One Tug Hill species designated as being threatened with extinction by the International Union for the Conservation of Nature and Natural Resources (IUCN) is the peregrine falcon (See Appendix I, World Wildlife Conference, Dept. of State Publ. 8729). Two species, the golden eagle and the lake sturgeon (Acipenser fulvescens), are threatened with extinction, according to the IUCN (Appendix II, World Wildlife Conference, Dept. of State Publ. 8729).

Nationally, wildlife species threatened with extinction are listed in the Red Book (Rare and Endangered Fish and Wildlife of the United States, Bureau of Sport Fisheries and Wildlife, U.S.D.I. 1968, Supt. of Documents, Wash., D.C. For endangered species of New York, see also Forbes, 1970). Some endangered species listed in the Red Book occur in the Tug Hill Region, namely the bald eagle, peregrine falcon, Indiana bat and shortnose sturgeon (Acipenser brevirostrum). The lake sturgeon is listed as "rare" in the Red Book. In general, all endangered species occurring in the Tug Hill Region are not unique to it, or confined to the Region. These animals will benefit most from strict enforcement of environmental standards, and by informing the public of their plight.

PESTICIDES

North Americans have made some progress in their ecological awareness since Rachel Carson first called attention to the widespread biological havoc wrought by pesticides. Pesticides are target-specific only in degree. Most are designed to disrupt basic biochemical processes common to many organisms. However, as man is heavily dependent on the benefits of pesticides, every potential decision to regulate them is also accompanied by a health-related or economic decision. In practice, some middle ground is usually chosen. Most pesticides presently legal to use are known to have some negative effects, but their use may be permitted by law if toxic affects of the pesticides and their breakdown products on non-target species, including man, are minimal. Of course, it often is not known what non-target species are affected.

Pesticides in New York

New York State established stringent regulations on the use and sale of pesticides, effective December 31, 1971. These laws are administered by the Bureau of Pesticide Regulation in the Department of Environmental Conservation. Monitoring of pesticides in the environment is done by the Bureau of Ecological Standards.

According to New York's new laws, pesticides fall into two major groups: 1. those pesticides which can be used and sold without restriction and for which no use permit is required, including Methoxychlor, Malathion, Vapona and Dibrom 14; and 2. restricted pesticides, for which regulations are described in Article II of the Agriculture and Markets Law. There are three pesticide lists covering this latter group and designating their use status. List A contains 55 pesticides which may be purchased, sold or used only by holders of commercial and purchase permits. Purchase permits provide blanket authority to use and purchase these chemicals without any required specifications or declamations of use. This restriction keeps toxic chemicals out of most homes.

List B contains seven types of pesticides which may be used only for specific purposes and under permit. These "restricted use" pesticides include aldrin, arsenic compounds, chlordane, Dicamba, Deildrin, Heptachlor and Lindane.

List C contains 10 pesticide groups whose use has been completely forbidden in New York State since December 31, 1971. They include Bandane, BHC, DDD (TDE), DDT, Endrin, mercury compounds, selenites and selenates, sodium flouroacetate (1080), Strobane and Toxaphene. All supplies of these chemicals must be disposed of in the officially approved manner (Report of the Pesticides Committee, New York Chapter of the Wildlife Society, 1971). A historical note of interest is that the use of DDT by the Department of Environmental Conservation on watersheds inhabited by lake trout was prohibited as early as 1964 (Pers. commun., Nov. 1973, from R. Colson, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.).

Pesticide Applications in the Tug Hill Region

A general outline of pesticide use in the Tug Hill Region is given below. This is by no means a complete list. Records of some pesticide applications have not been kept, particularly those by private individuals and farmers. The information which follows has been largely compiled from the flight logs and records of Tom Duflo, pilot and aerial pesticide applicator of the Duflo Spray-Chemical Co., New Bremen. Almost all aerial applications of pesticides in the Tug Hill Region have been done by him. Three other pilots have made occasional pesticide applications in the Tug Hill Region. They fly out of Cicero, Canastota and Watertown (Pers. commun., Nov. 1973, from T. Duflo, Duflo Spray-Chemical Co., New Bremen, N. Y.). Other information and records have been supplied by the New York State Department of Environmental Conservation.

Nuisance mosquito control

Date	Pesticide	Remarks
1961	DDT 10 percent by fogging	Aerial application by Duflo along the north shore of Oneida Lake from Constantia to Monroe, on 2,000 acres. Contracted by North Shore Lions Club.
1963 July 4	DDT, 12 percent 0.5 pounds per acre	Aerial application by Duflo at Sylvan Beach on the eastern end of Oneida Lake, on 800 acres.
1964 July 18	DDT, 12 percent 0.5 pounds per acre	Aerial application by Duflo at Sylvan Beach, on 800 acres.

Blackfly and mosquito control

Date	Pesticide	Remarks
1973 June 10	Dibrom 14 0.05 to 0.1 pounds per acre	Aerial application by Duflo, village of Carthage, on 880 acres

Duflo (Pers. commun., Nov. 1973, from T. Duflo, Duflo Spray-Chemical Co., New Bremen, N. Y.) knows of no incidence where DDT was used in streams for larval black fly control within the Tug Hill Region, even though this was a common practice in the Adirondacks.

Control of Mosquitos and Eastern Equine Encephalomyelitis:

The New York State Department of Health initiated a mosquito control program in 1971 in Constantia, because of the death of a horse from eastern equine encephalomyelitis. This disease is carried by mosquitos and affects humans.

Date	Pesticide	Remarks
1971 August	Vapona 0.5 percent	Aerial application by Duflo, 12,000 acres of lowland north of Constantia
1972 June 28	Malathion 3.5 ounces per acre	Aerial application by Duflo, 13,000 acres between Constantia and Route I-81.
1973 July 6	Dibrom 14 14 pounds per gal	Aerial application by Duflo, 13,000 acres between Constantia and Route I-81.

Forest tent caterpillar control

Date	Pesticide	Remarks
1953	DDT	No details. Source of information is a letter from R. Colson, N.Y.S. Department of Environmental Conservation, Albany, N. Y.
1955	DDT, 6 percent 1 gallon per acre	Turin and Martinsburg area, 600 acres, sugar maple stands and orchards.

White pine weevil control

Date	Pesticide	Remarks
1951	DDT	Maps available
1959	DDT	" "
1960	DDT	" "
1961	DDT	" "
1962	DDT	" " , 324 acres

These data are from a letter dated October 3, 1973 by Ralph Colson, Supervising Aquatic Biologist, Department of Environmental Conservation, Albany, N. Y. The maps are on file in the Bureau of Forest Insect and Disease Control, 50 Wolf Road, Albany, N. Y.

Army worm control

Date	Pesticide	Remarks
1963	Malathion	Aerial application on green oats by Duflo, between Adams Center and Ellisburg.

Aerial spraying, rather than application by individual farmers, is done to control army worm because this species attacks oats just before it ripens and is ready for harvest. At this stage, farmers would damage their crops if they were to do the job themselves.

Alfalfa weevil control

Date	Pesticide	Remarks
--	Malathion 95 percent 10 ounces per acre	Aerial application by Duflo from Boonville to Copenhagen and Carthage

Aerial application of alfalfa weevil control is only done when the ground is too wet for application with ground equipment by individual farmers. Most control by alfalfa weevil is done by farmers themselves using a combination of malathion and methoxychlor.

Miscellaneous pesticide applications

Individual farmers spraying for alfalfa weevil usually use a combination of malathion and methoxychlor. Many farmers also use malathion to control army worms. Most dairy farmers do very little pesticide spraying (Pers. commun., Nov. 1973, from T. Duflo, Duflo Spray-Chemical Co., New Bremen, N. Y.).

The Towns of Floyd and Trenton near Rome are major producers of truck crops such as potatoes, sweet corn, brussel sprouts and onions. Farmers in this area apply considerable quantities of pesticides to their crops (Pers. commun., Nov. 1973, from T. Duflo, Duflo Spray-Chemical Co., New Bremen, N. Y.). One aerial operator in this area uses Malathion and Sevin in his

applications on onion fields. In the Williamstown area, a major potato farmer sprays his fields throughout the summer.

Herbicides

No direct deleterious effects on wildlife have been found from herbicides. However, because they may have some indirect effects, information on herbicide applications is given below.

Farm spraying of herbicides to control weeds among crops is common in the Tug Hill farmlands. Herbicides commonly used on corn are Atrazine and 2-4-D, while 2-4-D and MCP are often used on oats. Aerial spraying of herbicides on about 3,000 acres has been done annually by Duflo Spray-Chemical Company between 1958 and 1969. In these applications between Carthage and Boonville, they have used Atrazine and 2-4-D.

In 1968, Duflo Chemical-Spray Company was contracted by the U. S. Fish and Wildlife Service to kill out pockets of cattails in a marsh (Floodwood Pond) to produce open resting spots for ducks. They applied Radapon and Dowpon to 500 acres.

Effects of Pesticides on Wildlife

On the basis of the information presented here, five pesticides have been used in major applications in the Tug Hill area. They include DDT, Malathion, Vapona, Dibrom 14 and Sevin. There are no records for other pesticides, although some may have been applied.

Of the major pesticides employed in the Tug Hill Region, DDT has probably been the most destructive to wildlife. Large applications were made between 1951 and 1964. No formal records exist of pesticide-induced mortality following these applications. However, judging from studies conducted elsewhere, wildlife mortality probably did occur. For example, severe mortality of robins following DDT applications has been documented (Barker, 1958; Hickey and Hunt, 1960, Wallace et al., 1961, 1962; Bernard, 1963). Populations of other birds such as the brown creeper, Baltimore oriole, cardinal, yellow shafted flicker, and common grackle have been decimated by DDT spraying for Dutch elm disease control (Hunt, 1960; Hickey and Hunt, 1960). Most bird species affected are predatory or partially predatory, feeding on insects and other animals. DDT does not usually kill these birds on contact. mortality results when DDT and its metabolite DDE accumulate in a bird's tissues through the injestion of contaminated insects, earthworms, or other animals. Mortality and abnormal behavior has also been observed in frogs, toads and their tadpoles after experimental exposure to DDT (Cooke, 1972).

One of the most sinister aspects of DDT is its action on the reproduction of some animals. Various workers (Hickey, 1969; Lincer, White, and Swartz, 1971) have found a strong inverse correlation between eggshell thickness and the DDT-DDE content in the eggs among hawks and eagles. Hawks and eagles experimentally fed with diets containing DDT produced thin-shelled eggs. In the wild, brooding hawks and eagles have been observed to inadvertently destroy their own thin-shelled eggs, causing widespread reproductive failure. This is perhaps the single most important factor which has been responsible for the recent decline in bald eagle populations, bringing this grand bird to the brink of extinction.

Other species are affected similarly. The devastating action of DDT on lake trout reproduction was first observed by fisheries' biologists in New York (Burdick et al., 1964). These investigators found that DDT, which had accumulated in lake trout eggs before deposition by females, was slowly being absorbed by sacfry once they had hatched in the lake (Lake George), eventually killing them. This finding was the major impetus for the ban in 1964 by the Department of Environmental Conservation on the use of DDT in watersheds affecting lake trout (Pers. commun., Nov. 1973, from R. Colson, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.). The total banning in 1971 of DDT and other virulent pesticides (Chemicals in List C, Agriculture and Markets Law) has probably been one of the most effective measures ever adopted by this State in the interests of conservation. The Tug Hill Region is the better for it.

Other pesticides used in the Tug Hill Region, namely Vapona, Dibrom 14, Malathion and Sevin, apparently do not cause direct mortality of vertebrates (Pers. commun., Nov. 1973, from R. Colson, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.). An experimental study to determine the effects of Sevin and Malathion in a grassland community (McEwen et al., 1972) yielded no apparent pesticide-induced mortality in any local bird or mammal. A study conducted by the New York State Department of Environmental Conservation showed no observable effects of Dibrom 14 on salamanders, frogs or brook trout after experimental exposure to this pesticide (Pers. commun., Nov. 1973, from R. Colson, N.Y.S. Dep. Environ. Conserv., Albany, N. Y.). The Department also investigated possible effects of Vapona sprayed on Scriba Creek and Three Mile Creek as part of the eastern equine encephalomyelitis program in August, 1971 (Skea, 1971). Although the pesticide killed insects, no mortality was observed in fishes, including those feeding on pesticide-killed insects.

There is some evidence that currently approved pesticides such as Malathion, Vapona, Dibrom 14, and Sevin may effect some bird populations negatively by eliminating their food supply. McEwen et al. (1972) observed this apparent phenomenon by experimental exposure of a grassland community to Malathion and Sevin. They observed significant decreases in the bird population following their pesticide application. The emigration of birds was apparently related to a decline of their insect food (grasshoppers). An apparent decline in the total bird population in the area that was sprayed west of Constantia for eastern equine encephalomyelitis control in August, 1971, was noted by Scheider. Dr. F. Scheider of Syracuse is an expert ornithologist who has observed and studied Tug Hill birds for many years. According to his notes (Pers. commun., Nov. 1973, from F. Scheider, Syracuse, N. Y.), he walked for 20 miles in the sprayed area a few days after the pesticide applications and noted a complete absence of bird life. He did see two chipmunks. It is possible that birds emigrated from the sprayed area because of the decline in insects. The survival rate of such emigrating birds is generally lower than normal because most ecological niches elsewhere are already occupied.

Scheider has used a site near Otto Mills on Tug Hill Upland (north of the Salmon River Reservoir) as a control plot in his study of effects of pesticides on birds in the Camillus Valley, near Syracuse. The site near Syracuse has been sprayed for one year with approved insecticides, while the Otto Mills area has not been sprayed. His comparative notes on singing males heard on a four mile walk are given in Table 60. These data are by no means conclusive. However, they are suggestive.

Table 60. Numbers of singing male birds in sprayed and unsprayed areas.

Bird species	Area	
	Unsprayed	Sprayed
	Ottom Mills, Tug Hill	Camillus Valley, Syracuse
Least flycatcher	83	1
Redstart	63	17
Red-eyed vireo	75	25
Ovenbird	9	0
Veery	34	6
Total	264	49

Data on herbicides have been included in this report because recent evidence indicates that large-scale applications on forests and wetlands can significantly alter these ecosystems and their wildlife components (Boffey, 1971; Rose and Rose, 1972). However, such massive applications have apparently not occurred in the Tug Hill Region.

In conclusion, the impact of pesticides on Tug Hill wildlife apparently has never been as great as in most other sections of New York. It also appears that pesticide effects on wildlife have probably declined in Tug Hill Region since State regulations controlling pesticide use went into effect in 1972.

HORIZONS IN MANAGEMENT

The status of the Tug Hill Region's fish and wildlife resource has been broadly traced. Now, we can draw conclusions, highlight potentials and outline possibilities for future research and management. We have assumed a priori that the values discussed earlier are desirable, and that their full realization is a worthwhile objective.

Key Natural Areas

Several natural areas, alluded to throughout this report, are either unique as a total natural complex, or are vital to the health of the fish and wildlife resource, or both. These natural areas merit special consideration in future planning and management. In them lies the key to quality in Tug Hill's wild animal resources. These natural areas include:

1. the most central portion of the Tug Hill Upland (Area TH-PI on Map 8), which has never been farmed, and is least accessible to humans;
2. the conifer deer yards at High Market, Barnes Corners, Otto Mills and Osceola which serve the white-tailed deer herd summering on the central plateau (Areas marked Dy-Be, Dy-HM, Dy-O, and Dy-OM on Map 8);
3. unique gorges, including those of Whetstone Creek and the Lorraine gorge, mentioned earlier;
4. the Black River marshes between Carthage and Lowville (Area W-BR on Map 8);
5. the Lansing Kill and Mohawk Valley, lying in the southeastern portion of the Tug Hill Region (Area SA-LKM on Map 8);
6. Lake Ontario shoreline, north of the Salmon River (Area W-LO on Map 8).

Boundaries depicted by the map are not significant in detail. They merely give the general locations of these areas.

Wildlife Diversity

The central portion of the Tug Hill Upland (Area TH-PI on Map 8) can contribute admirably to the diversity of Tug Hill's wildlife resource. Even now, it serves as a refugium for unusual species such as the bobcat. It is perhaps ironic that the population health of such an adaptable species as the white-tailed deer in central Tug Hill depends on the protection from humans afforded by this inaccessible area.

Much can be done here. Native conifer stands of balsam fir, hemlock, spruce and tamarack, once a distinctive feature on the Tug Hill Upland, could be gradually reestablished by positive management. Growth of such stands could be encouraged by selective cutting of hardwoods around low, wet areas, and around beaver ponds. Eventually, if reestablished, the conifer stands can serve as prime habitat for the reintroduction of the spruce grouse and marten. Rare birds such as the red crossbill and white-winged crossbill which favor conifers would probably benefit. Other bird species which might respond positively include myrtle, parula, magnolia, blackburnian, and black-throated green warblers (Pers. Commun., Nov. 1973, from F. Scheider, Syracuse, N. Y.).

But, the primary benefit of the Region's central core to the entire fish and wildlife resource comes from its inaccessibility. This characteristic is vital from several standpoints. Inaccessibility will protect the quality of the headwaters and insure a top-notch fishery for the whole Tug Hill Region. Inaccessibility is vital to the survival of some wildlife species which now live there. And, if inaccessibility is insured for the future, other native species extirpated from the Tug Hill Upland, such as the lynx and black bear, may be reintroduced.

The key, then, is to enhance the wild and inaccessible quality of this area. We do not wish to imply that the central core of forests could not be used for recreation. Far from it. This area could remain open to hunting, hiking, primitive camping and all other uses compatible with a relatively roadless area. Use restrictions could remain at a minimum. Conceivably, responsible use by snowmobilers would not be harmful. Simply limiting road access, and perhaps eventually phasing out some roads entirely, will prevent major disturbances by humans. With a minimum number of access trails, the central core will protect itself by its very wildness.

Probably, the objective of inaccessibility can be attained either if the area remains in private hands, or by State acquisition. In the former case, some sort of zoning to restrict use and development appears necessary. Logging could proceed, hopefully incorporating a program to restore conifers. One problem with this approach is that some accessibility is obviously necessary.

The other alternative is state acquisition. A partial move in this direction has been initiated by Thomas Brown, Regional Supervisor for Fish and Wildlife (Watertown Office) of the Department of Environmental Conservation. (Brown, 1972, memo to John Wilson, Tug Hill Plateau Land Use Proposal, 6pp. with map.) The outcome of that proposal remains uncertain.

In summary, we would emphasize that the central portion of the Tug Hill Region should not be locked up in an untouchable forest preserve. It should be judiciously and carefully managed to contribute toward maximum species diversity in Tug Hill's fish and wildlife resource. "Locking up" this area will merely perpetuate the status quo of its impoverished biota, a condition which the people of the Tug Hill Region can ill afford.

Small Game

The Tug Hill Region is richly endowed with early stages of forest succession (Successional forest type, Map 7). These stands are favored by ruffed grouse, woodcock, and varying hare. Populations are currently good. But, the opportunity for private landowners to enhance hunting for these species is excellent. This can be done with a minimum of effort. Extensive tracts of this vegetation type already exist. Economic gain could be realized if landowners organized into cooperatives, advertising the hunting opportunities (the key to success!), and selling hunting rights for appropriate fees. The future quality of such hunting would be insured by long-range management schemes, including rotational cutting.

Management of habitat for small forest game could be coupled with pheasant releases during the hunting season, where lands are suitably open. A total complex of good hunting (and fishing) opportunities, combined with attractive guest facilities, can be advertised and sold as a package to attract urban sportsmen who seek quality sport, but do not have the time to find it on public lands. The undeveloped economic potential of this small game resource is suggested by the estimated amount expended by small game hunters within the Tug Hill Region (ruffed grouse, varying hare, cottontail rabbit, and ring-necked pheasant hunting), namely in excess of one million dollars.

On State Game Management Areas (Tug Hill, Little John, Happy Valley and Three Mile Bay, see Map 8), it appears that the quality of small game hunting has declined in recent years. Stages of forest succession favoring ruffed grouse, woodcock and varying hare have passed beyond the optimum level. The current thrust of activity in these areas is essentially one of maintaining roads and facilities. Little habitat management is in progress. In some places, conifers had been planted in the last few remaining open areas. Adjacent plantations of pole-sized pine, with closed canopies and open understories, remained uncut. It appears that clear management objectives and operating funds are currently lacking. Current designation of these areas does not reflect the kind and degree of effort actually expended in them.

White-tailed Deer

The Tug Hill Region is well supplied with summer deer range. However, much of the Tug Hill plateau receives heavy snowfalls, forcing deer to use the few available conifer yards in the deep-snow belt. This belt of heavy snowfall coincides quite closely with the interior Upland and the abandoned farmlands on the slopes of its fringe. Establishment and management of additional deer yards on public and private lands, particularly in the inactive farmland section, along the Tug Hill fringe would greatly benefit the herd. Habitat management programs would have to be coupled with a concentrated educational effort aimed at reducing poaching, and strictly enforcing leash laws to prevent harassment by free-running pet dogs in winter.

The aesthetic and sporting value of the deer herd cannot be overemphasized. Where deer are common, people will come to see them and enjoy them in summer. A good deer herd is the hunter's delight. The million or so dollars currently expended by hunters could be just a beginning. Good hunting offered through private cooperatives would surely lure hunters, judging from the success of club leases by lumber and paper companies in the Tug Hill

Region and in the Adirondacks.

The initiative to improve the quality of the deer herd in the Tug Hill Region must come from concerned citizens, sportsmen's clubs, local chambers of commerce and area boosters. It must be a coordinated regional effort including the Department of Environmental Conservation. Expertise is available from New York State's deer biologists, some of the finest in the nation. Nothing less than new, imaginative approaches, and programs of cooperation between the State and the local citizenry, will solve the Region's deer problem. In sum, the solution appears to be: 1. establishing and managing a sufficient number of deer yards in the heavy snow sectors to capitalize upon the full productive potential of existing summer range; 2. minimize undesirable human pressures on the deer herd, through education and regulation; and 3. establish imaginative programs of cooperation between the public and private sectors, supported by the initiative, effort and money of the Region's citizens.

Waterfowl

The marshes and lowlands lying along the Black River between Carthage and Glenfield (Area W-BR on Map 8) offer excellent possibilities to enhance existing waterfowl habitat. An attractive feature of the entire waterfowl potential in this area is that involvement by private, State and Federal sectors is possible. Such cooperation could resolve a crucial problem by creating standing water in autumn to attract migrating ducks and geese. At present, goose hunting in the farmlands between Lowville and Glenfield is unpredictable. Fall goose flights across the Upland from Lake Ontario are sporadic. Apparently, this is partly due to a lack of resting ponds during dry years. Also, goose flights seem to decline in years of poor nesting success, in areas having limited corn acreage (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). In any case, it seems most probable that a complex of well-managed wetlands including a Federal refuge, State-owned marshes and seasonally flooded private farmlands would increase and stabilize the numbers of migrating waterfowl.

Such a wetland complex would also boost the local production of ducks and geese, while serving as a focus for migrants. Ecological precedents are not hard to find. To the north, a nesting flock of Canada geese, numbering about 2000 birds has been established at the Wilson Hill Wildlife Management Area between Messina and Waddington. The highly successful Perch River Wildlife Management Area north of Watertown is a series of flooded farmlands and lowlands producing about 2000 ducks annually. A nesting flock of 350 geese has also been established there by multiple releases of goslings (Pers. commun., Nov. 1973, from T. Brown, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.)

One advantage of the program suggested here is that its implementation can proceed piecemeal. Private efforts to dam satellite lowlands, coupled with the organization of cooperatives, could proceed before State and Federal governments acquire any lowland areas. One potential problem in dam construction is that special techniques may be needed to counter engineering difficulties with local soils (See Appendix 2 and Map 5). Research may be required to solve this problem.

There is much to be gained by a wetlands complex in the Black River

Valley. Besides the potential for unparalleled hunting, it would serve as a major attraction for summer visitors. Interpretive and educational programs could be developed on the refuge. It could become a distinctive feature of the northeastern part of the Tug Hill Region. Establishing such a complex will take time. Interest, support and initiative of the local citizenry would accomplish much. Potential economic losses suffered by local farmers in spring would have to be weighed against the sale of hunting rights. The first order of business would be to conduct a feasibility study jointly by the Department of Environmental Conservation and concerned Tug Hill citizens.

The most fragile, and one of the most valuable sections of the Tug Hill Region from the standpoint of fish and wildlife conservation, is the Lake Ontario shoreline (Area W-LO on Map 8). This is an outstanding area for observing waterfowl. More than one-third of the total bird species occurring in the Tug Hill Region occur here. The marshes, particularly the Deer Creek marsh, are excellent waterfowl producers. The sandy shores and dunes are an outstanding natural asset. North Pond and South Pond currently provide excellent sport fisheries, and Grindstone Creek and the Salmon River will play an increasingly important role in the Salmon program.

The threat of unregulated development in this area is great. Some sections of the shoreline are already lined with second homes and trailers. Presently, there is still little development along a segment of the shore between Deer Creek marsh and the Lake. With the exception of Selkirk Shores State Park (Map 8), none of this land is now in public ownership. The Deer Creek marsh is currently leased by a sporting club (Pers. commun., Nov. 1973, from S. Cameron, N.Y.S. Dep. Environ. Conserv., Watertown, N. Y.). Several marinas have been proposed. Just north of the Deer Creek marsh, extensive developments occur along the shore of North Pond, although the barrier beaches between the pond and the Lake have been spared. A trailer park is located between North Pond and South Pond.

A comprehensive program to enhance and preserve the natural values of this shoreline seems called for. It could include long range planning, development of zoning regulations and state acquisition. Perhaps State acquisition could proceed more expeditiously with the help of such organizations as the Nature Conservancy. Time is of the essence.

Fishery Resource

A key consideration to the quality of the Tug Hill Region's fishery is the health of the central watershed. Higher elevations of the Upland contain the headwaters of the Region's major drainage systems, namely the Salmon River, Deer River and Fish Creek (Map 6). Possibly, strict zoning regulations and/or acquisition of land within Zone 1 (Map 8) would protect the quality of these headwaters. Likewise, some regulations of streamside development in Zones 2 and 3 would also be beneficial.

Fortunately, most waters of the Tug Hill Upland are still of excellent quality, and steps to perpetuate that quality by protecting the interior watershed are still possible. In Florida, decades of haphazard development have severely damaged the fragile watershed of that state (Carter 1973). Belatedly, comprehensive legislation is being passed to arrest and reverse

abuses there.

Recreational possibilities and economic potentials of the incipient Salmon program have been briefly discussed. Since local Tug Hill communities such as Pulaski will benefit importantly from this program, local citizens can gain much by supporting it. Support can take the form of economic assistance whose nature can be determined in conjunction with the Department of Environmental Conservation. For example, construction of a combination breakwater and fishing pier at the mouth of Salmon River would prevent the formation of barrier bars. These currently hinder the passage of boats. Other possibilities include the construction of weirs, and planting of willows on stream banks to minimize erosion. It also seems essential that local communities participate with the Department of Environmental Conservation in program planning, and establishing zoning regulations. Currently, cattle are damaging the banks of some crucial salmon streams (Pers. commun., Nov. 1973, from T. Jolliff, N.Y.S. Dep. Environ. Conserv., Cape Vincent, N. Y.). Eventually, when angling pressure becomes heavy, restrictions to protect property and insure quality salmon fishing should be ready for implementation.

Rare and Endangered Species

Some problems concerning rare and endangered species have been discussed. Positive steps to reestablish conifers in the central Upland in conjunction with limiting access (i.e., fewer roads and trails) may eventually provide habitat suitable for the re-introduction of spruce grouse, marten and Canada lynx.

There is every reason to believe that black bears will be a regular part of the Tug Hill fauna again, if the Region's interior were to become more inaccessible than it is now. Forests of this section seem ideal for bears in other respects. Currently, bears cannot be legally hunted in the Tug Hill Region. This provision should remain in force as long as necessary.

The status of the otter and bobcat is in doubt. A study to determine the distribution and population levels of these two species would be useful. Closure of otter trapping might increase population levels of this interesting mammal. Current otter fur harvest is negligible in the Region. Bobcat requires regulatory protection. In any event, elevation of the latter species to game animal status (as has been done in Michigan) would be psychologically and biologically beneficial.

Reestablishment of species extirpated from the Tug Hill Region, such as the wolf, cougar and moose, appears impossible. A major problem for all these species is the limited size of the inaccessible interior of the Region. While this relatively trailless area seems large, it is only about 10 miles in diameter. Wolves on Isle Royale in Lake Superior regularly travel the entire length of the 40-mile-long island. On the average, a pack will travel about 25 miles between kills, and occasionally as much as 75 miles (Mech, 1966). Likewise, the winter territory of the cougar is about four to five miles in width (Hornocker, 1969). The Upland's interior could hardly support a viable population of these animals, if they elected to stay there at all. For moose, besides the problem that the "undisturbed" section of the Upland is probably too limited in size, moose cannot coexist with high deer densities. A parasitic brainworm (Behrend, 1970; Severinghaus, 1972) carried by deer is fatal to infected moose.

The role of pollutants and pesticides in the decline of some endangered species such as the bald eagle, golden eagle and peregrine falcon has been briefly discussed. The best hope for these species is a clean environment and minimal harassment by man.

Pesticides

It appears that damage to wildlife from recent pesticide applications in the Tug Hill Region has been minimal. This is primarily the result of stringent State regulations. However, if major spray programs are continued, such as the one near Constantia to control eastern equine encephalomyelitis, it seems advisable to investigate the effects of spraying on wildlife, particularly insect-eating birds.

Aesthetic Values and Interpretation

The enjoyment we derive from wild animals is, in good measure, traceable to their setting. Several of the outstanding scenic areas in the Tug Hill Region do not have exceptional fish or wildlife values. However, the fact that people may stop to admire the scenic beauty and occasionally observe a bird or mammal there, may lift the total experience out of the ordinary.

One of the most outstanding of the Region's scenic spots is the Lansing Kill and Upper Mohawk Valley, along Route 46. From a point just south of Boonville the highway follows a narrow valley that cradles these streams to the sleepy town of North Western, where the valley suddenly broadens. Besides being scenic, this valley is excellent for fishing and birding. In it, birds of the Adirondacks, Tug Hill birds, boreal (northern) species, and more southern birds can be observed (Pers. commun., Nov. 1973, from F. Scheider, Syracuse, N. Y.). In the center of this valley, Pixley Falls State Park surrounds a delightful waterfall. It would be an ideal spot for an interpretive center, where nature, as well as the nearby historic barge canal, could be interpreted.

Whetstone Gulf State Park, the only State Park in Lewis County, includes one of the Region's natural wonders — a deep gorge cut by Whetstone Creek through many layers of sedimentary rock. The upper end of this gorge is visable from a hiking trail. This is certainly one of the most spectacular sights in the eastern United States. The park caters to campers and picnicers. A total of 12,761 campers (using 52 campsites) and 20,947 day-users registered here in the summer of 1973 (Pers. commun., Nov. 1973, from R. Berry, Thousand Islands Park Commission, Alexandria Bay, N. Y.). This park would provide an excellent location for an interpretive program and nature center. Day use might be emphasized and camping facilities reduced. Camping facilities can be located in less spectacular areas.

The Lake Ontario Shoreline and marshes north of Pulaski are perhaps unparalleled as a potential setting for a comprehensive interpretive program. Such a program would not only serve the western Tug Hill Region and would be accessible to southern metropolitan areas, via Route I-81. The location for a center might be selected in conjunction with the proposed salmon hatchery. This combination would provide an exceptional educational facility.

ACKNOWLEDGMENTS

We have drawn upon local knowledge and expertise generously given by many people. We thank them all sincerely. Special thanks are due to Mr. Thomas Brown and Mr. Stuart Free, Regional Supervisors of the New York State Department of Environmental Conservation (D.E.C.) at Watertown and Cortland respectively. They generously made themselves and their staffs available for consultation. We thank Mr. Stuart Cameron, Mr. Wesley Stiles, Mr. John Proud and Mr. Robert Goudy, Department of Environmental Conservation Wildlife Managers for sharing their intimate knowledge of Tug Hill's wildlife resource.

We are grateful for the extensive and detailed information about Tug Hill fishery resource supplied by Mr. Burtell Buffington, Mr. Clifford Creech and Mr. Thomas Jolliff, fisheries managers for the Department of Environmental Conservation. We also thank Dr. John Forney of Cornell University, and Mr. Howard Loeb of the Department of Environmental Conservation for supplying information on fish. We thank Mr. Merrill Petoskey, Chief of the Wildlife Division, Michigan Department of Natural Resources, and Mr. Ludwig Frankenberger, Anadromous Fisheries Specialist of the same organization for providing information on Michigan's salmon program.

We are grateful to biologists at the Delmar Wildlife Research Laboratory of the Department of Environmental Conservation, who supplied statistics vital to this report. They include Mr. William Severinghaus and Mr. Eugene McCaffrey, Supervising Wildlife Biologists, Mr. Donald Schierbaum and Mr. Eric Fried, Associate Wildlife Biologists, Mr. Lawrence Jackson, Senior Wildlife Biologist and Mr. Robert Thurber, Technician.

Valuable information on local birds was provided by Dr. Fritz Scheider, a Syracuse physician, Mr. Lee Chamberlaine, Wildlife Biologist for the Department of Environmental Conservation, and Mr. Chris Spies of Syracuse. Dr. Paul Conner, Senior Scientist at the State Museum at Albany generously provided information about Tug Hill mammals. We also thank Dr. Robert Chambers of the State University College of Environmental Science and Forestry for information about the Region's wildlife.

We are grateful to Mr. Tom Duflo of the Duflo Spray-Chemical Company at New Bremen for supplying extensive information on pesticide applications. Mr. Howard Dean, stationed at the Rome Fish Hatchery, Department of Environmental Conservation, also provided useful data on pesticides. We are grateful to Mr. Thomas Wolfe of Lowville who served as local guide, and to Mr. and Mrs. Kenneth Wolfe of Lowville for their generous hospitality.

LITERATURE CITED

Allen, D. L.
1943. Michigan fox squirrel management. Mich. Dep. Conserv., Lansing, Mich.

Am. Fish. Soc.
1970. Common and scientific names of fishes from the United States and Canada. Am. Fish. Soc. Spec. Publ. 6, 3 ed.

Am. Ornithol. Union
1957. Checklist of North American birds. Am. Ornithol. Union, Lord Baltimore Press., Baltimore, Md., 5 ed.

Am. Ornithol. Union
1973. Thirty-second supplement to the North American Ornithologists Union check-list of North American Birds. Auk. 90(2):411-419.

State of N. Y.
u.d. Article II, Agriculture and markets law, State of N. Y., Dep. Environ. Conserv., Albany, N.Y.

Barber, R. J.
1958. Notes on some ecological effects of DDT sprayed on elms. J. Wildl. Manage. 22:269-274.

Bean, T. H.
1903. Catalogue of the fishes of New York. N. Y. State Mus., Bull. 60.

Behrend, D. F., Mattfeld, G. F., Tierson, W. C., and Wiley, J. E., III
1970. Deer density control for comprehensive forest management. J. For. 68(11):695-700.

Bernard, R. F.
1963. Studies of the effects of DDT on birds. Mich. State Univ. Mus., Biol. Ser. 2(3):155-192.

Bishop, S. C.
1941. The salamanders of New York. N. Y. State Mus., Bull. 324.

Blaxter, L. L.
1971-72. Scottish Agric. 51(5):272-278

Boffey, P. M.
1971. Herbicides in Vietnam. AAA's study finds widespread devastation. Sci. 171(3966):43-47.

Bowen, G. B.
1970. History of Lewis County, New York 1880-1965. The Willard Press, Boonville, N. Y.

Branden, R. B., and Books, D. J.
1973. Return of the fisher. Nat. Hist. 82(1):52.

Brocke, R. H.
1973. Behavior and movements of snowshoe hares in relation to winter cover. Joint Meet., NE Rabbit and Hare Tech. Group, and Grouse and Woodcock Biol. Symp., Sept. 12-14, 1973, Long Lake, N. Y., Pap.

Bump, G., Darrow, R. W., Edminister, F. C., and Crissey, W. C.
1947. The ruffed grouse - Life history. propogation, management. N.Y.S. Conserv. Dep., Albany, N.Y.

Burdick, G. E., Harris, E. J., Dean, H. J., Walker, T. M., Skea, J., and Colby, D.
1964. The accumulation of DDT in lake trout and the effects on reproduction. Trans. Am. Fish. Soc. 93(2):127-136.

Burt, W. H.
1957. Mammals of the Great Lakes region. Univ. Mich. Press, Ann Arbor, Mich.

Cade, T. J., Lincer, J. L., White, C. M., Rosenau, D. G., and Swartz, L. G.
1971. DDE residues and eggshell changes in Alaskan falcons and hawks. Sci. 172(3986):955-957.

Carr, A.
1952. Handbook on turtles. Turtles of the United States, Canada, and Baja California. Cornell Univ. Press, Ithaca, N. Y.

Carter, L. J.
1973. Land use law (II): Florida is a major testing ground. Sci. 182: 902-908.

Conner, P. F.
1966. The mammals of the Tug Hill Plateau, New York. N.Y. State Mus. and Sci. Ser., Bull. 406.

Cooke, A. S.
1972. The effects of DDT, Deildrin and 2,4-D on amphibian spawn and tadpoles. Environ. Pollut. 3:51-68.

Crisler, L.
1958. Arctic wild. Harper and Bros., N. Y.

DeGraff, L. W.
1973. Return of the wild turkey. The Conservationist, Oct.-Nov. 28(2): 24-27.

Dell, J.
1957. The European hare in New York. The Conservationist, Feb.-Mar. 2(4):28-29.

Eabry, S.
1973. Summary of New York's big game seasons. N. Y. State Dep. Environ. Conserv., Pitman-Robertson Rep. W-126-R-2, Job II-6.

Forbes, J. E.
1970. Environmental deterioration and declining species. The Conservationist, Aug.-Sept. 25(1):21-26.

Gordon, D. C.
1968. Birds of north country, New York (Jefferson, Lewis, and St. Lawrence Counties). Private print.

Green, R. G., and Evans, C. A.
1970. Studies on population cycle of snowshoe hares on the Lake Alexander area. I. Gross annual censuses, 1932-39. J. Wildl. Manage. 4(2): 220-238.

Gullion, G. W.
1972. Improving your forested lands for ruffed grouse. Ruffed Grouse Soc. of N. Am., Rochester, N. Y.

Hickey, J. J., and Hunt, L. B.
1960. Initial songbird mortality following a Dutch elm disease control program. J. Wildl. Manage. 24:259-265.

Hickey, J. J., ed.
1969. Peregrine falcon populations: Their biology and decline. Univ. Wis. Press, Madison, Wis.

Hough, F. B.
1860. A history of Lewis County in the State of New York from the beginning of its settlement to the present time. Munsell and Rowland Publ., Albany, N. Y.

Hubbs, C. L., and Lagler, K. F.
1958. Fishes of the Great Lakes region. Cranbrook Inst. Sci., Bloomfield Hills, Mich.

Hunt, L. B.
1960. Songbird breeding populations in DDT-sprayed Dutch elm disease communities. J. Wildl. Manage. 24(2):139-146.

Jenkins, D. H.
1961. Michigan's deer industry. Mich Conserv., Nov.-Dec.:17-21.

Jenkins, D. H., and Bartlett, I. O.
1959. Michigan white-tails. Game Div., Mich. Dep. Conserv., Lansing, Mich.

Jolliff, T. M.
1973. Status report on New York State's Lake Ontario salmonid development program. N. Y. State, Dep. Environ. Conserv., Cape Vincent Fish. Stn., Mimeogr.

Kieth, L. B.
1963. Wildlife's ten year cycle. Univ. Wis. Press, Madison, Wis.

Krueger, H. E.
1966. The lesser wilderness-Tug Hill. Part I. The Conservationist, Dec.-Jan. 21(3):12-16,38.

Krueger, H. E.
1966. The lesser wilderness - Tug Hill. Part II. The Conservationist, Feb.-Mar. 21(4):18-22.

Liscinsky, S. A.
1963. The American woodcock in Pennsylvania. Pa. Game Comm., Harrisburg, Pa.

MacLulich, D. A.
1937. Fluctuations in the numbers of the varying hare (Lepus americanus). Univ. Toronto Stud., Biol. Ser. 43.

Mattfeld, G. M.
1973. The effect of snow on the energy expenditure of walking white-tailed deer. NE Fish and Wildl. Conf., Mt. Snow, Vt., Pap.

McEwen, L. C., Knittle, C. E., and Richmond, M. L.
1972. Wildlife effects from grasshopper insecticides sprayed on short-grass range. J. Range Manage. 25(3):188-194.

Mich. Dep. Nat. Resour.
1973. Michigan's Great Lakes trout and salmon fishery. Mich. Dep. Nat. Resour., Fish. Manage. Rep. 5.

N. Y. State Dep. Environ. Conserv.
1973. Hunting, trapping and fishing guide 1973-1974. N. Y. State, Dep. Environ. Conserv., Albany, N. Y.

N. Y. State Dep. Environ. Conserv.
1973. Regional fish surveys by Department biologists. N. Y. State, Dep. Environ. Conserv., Mimeo.

N. Y. State Dep. Environ. Conserv.
1972. Computer tabulated hunting statistics on the white-tailed deer by town and county. Data for Jefferson, Lewis, Oneida, Oswego, and neighboring Adirondack Counties. N. Y. State, Dep. Environ. Conserv., Bur. Wildl., Albany, N. Y.

N. Y. State Dep. Environ. Conserv.
1973. Tabulated data entitled: Standard errors of estimate of take and days afield, for the years 1961 onward. N. Y. State Dep. Environ. Conserv., Bur. Game, Albany, N. Y.

Rose, H. A., and Rose, S.P.R.
1972. Chemical spraying as reported by refugees from South Vietnam. Sci. 177(4050):710-712.

Samson, H. E.
1971. Tug Hill country. Tales from the big woods. Millard Press, Boonville, N. Y.

Severinghaus, C. W.
1972. Weather and the deer population. The Conservationist, Oct.-Nov. 27(2):28-31.

Severinghaus, C. W., and Brown, C.P.
1956. History of the white-tailed deer in New York. N. Y. Fish and Game J. 3(2):130-167.

Severinghaus, C. W., and Sauer, P. R.
1969. Estimated area of deer habitat in New York State. N. Y. Fish and Game J. 16(2):129-135.

Sheldon, W. G.
1967. The book of the American woodcock. Univ. Mass. Press, Amherst, Mass.

Silver, H., and Silver, W. T.
1969. Growth and behavior of the coyote-like canid of northern New England with observations on canid hybrids. Wildl. Manage. 17:1-41.

Skea, J. C.
1971. Field study of effects of application of Vapona. N. Y. State, Dep. Environ. Conserv., Bur. Fish., Intern. Rep.

Stejueger, L., and Barbour, T.
1933. A checklist of North American amphibians and reptiles. Harvard Univ. Press, Cambridge, Mass., 3 ed.

Stone, W. B., Parks, E., and Weber, B.
1972. The little foxes. The Conservationist, Feb.-Mar. 26(4):8-9, 47.

Taylor, W. P., ed.
1956. The deer of North America, their history and management. Stackpole Co., Harrisburg, Pa., and Wildl. Manage. Inst., Wash., D. C.

U. S. Dep. Inter.
1972. National survey of hunting and fishing. 1970. U. S. Dep. Inter., Bur. Sport Fish. and Wildl., Wash., D. C.

U. S. Dep. State
1973. World wildlife conference. Intern. Union for the Conserv. Nature and Nat. Resour., U. S. Dep. State, Publ. 8729.

Wallace, G. J., Nickell, W. P., and Bernard, R. F.
1961. Bird mortality in a Dutch elm disease program in Michigan. Cranbrook Inst. of Sci., Bull. 41.

Wallace, G. J., and Boykins, E. A.
1965. The continued die-off of robins in a DDT-Methoxyehlon area. Jack Pine Warbler 43(1):13-19.

Wahler, J.
1973. Hunting in the Catskills. The Conservationist, Oct.-Nov. 28(2): 20-23.

Whitaker, J. O., Jr.
1968. Keys to the vertebrates of the eastern United States, excepting birds. Burgess Pub. Co.

We acknowledge the support given by the many groups, agencies, and firms who contributed information. Their cooperation has been indispensable. Especially we acknowlege contributions to the study by Margaret Parsons.

SOCIO–ECONOMIC CONDITIONS

by

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SUMMARY OF SOCIO-ECONOMIC CONDITIONS

The Tug Hill Region may be viewed as a giant ring of concentrated social activity, with a relatively undeveloped core having low viability for agriculture. Most of the Region's population, much of its farming, and virtually all of its major social facilities are concentrated in the rim towns. Population movements are also heaviest there. People who live in the rim towns or who pass through the Region tend to limit their travel to the rim, and to exit outwards from the rim toward nearby population centers. Much less frequently do they enter the core or cross the core.

The rim is not homogenous. It has two major segments. The northeastern rim is heavily agricultural, relatively lightly populated and exhibits low potential for population growth. Farms there are large and tend to increase in size due to scale economies. The southwest portion of the rim is more heavily populated and subject to strong growth pressures because of its proximity to major population centers, and because major highway development promotes traffic flow to and through the area. Average size of landholding is somewhat smaller in the southwestern than in the northeastern rim, or than in the core. Its residents are somewhat more likely to be service, sales and clerical workers and to have jobs outside the area. In spite of population pressures, towns of the southwestern rim show a high incidence of open space because agriculture is not competing for the land.

Efforts to provide uniform social services make heavy demands on service agencies located in or around the rim. Long distances and difficult access to the core, particularly in winter, make costs of busing, patrolling, medical care and sanitary services higher than they would be otherwise. Moreover, the consensus is that social services in the Region generally need to be upgraded in order to meet increasing demands. Towns now spend a large part of their income on schools and highways, but rising costs of other important social amenities seem to be calling for larger borrowings. This raises the question of what priority will be given to recreational development and to its attendant public costs.

Public ownership of land in the area is substantial. Close to 12 percent of the area is publicly owned now. Relatively few private owners control another 35-40 percent of the Region. Many of the large landholders are resident farmers, but in the core area private owners are more likely to have recreational or speculative interests.

Because the two rim areas and the core have owners and residents with significantly different characteristics and potentially unlike reactions to what is done in the Tug Hill Region, it may be desirable to consider them as sub-regions for planning purposes. A changing pattern of core ownership, and the implications of the heavy population pressures to which the towns in Oneida and Oswego Counties are subject, call for special attention. Roading in the area, one of its most vital social structures, is almost unused as a planning tool. Zoning and planning activity in the various towns has been developing on a piecemeal basis without local appreciation of the impact of such an approach.

Recreation pressures are already heavy and increasing throughout the Region. Prospects for the relatively near future are for existing facilities to be overused or approaching capacity during peak load times. This is partly because much of the open space already set aside for recreational purposes is not well adapted to special needs of users.

Incomes are low in much of the Region, and welfare costs already above average for the State. So the central question becomes one of how to balance development of the Region to meet income needs of a rising resident population, against the need for a hinterland which can serve as a backyard for that larger population which lies not only within, but also adjoining the Tug Hill Region.

LAND OWNERSHIP[1]

The 42 towns in the Tug Hill Region cover 1,354,290 acres of land and water. These are held in two general types of ownership, public and private. State lands, mostly reforestation lands and game management areas, represent slightly more than 10 percent of the total. County and federal lands bring public ownership to almost 12 percent (Table 61). The tendency over time has been for public ownership to increase through purchase, gift and tax reposession.

The great bulk of the land, more than 85 percent of it, is held in private ownership. The literature provides no comprehensive studies of private land ownership for the Region. Planning agencies have considered land use in some areas, but have not studied the owners and their objectives. In order to gain some grasp of owner characteristics, an exhaustive search of tax records was made in Lewis, Jefferson and Oswego counties. Separate statistics were gathered on size of holdings, type of holdings and origin of owner.

This detailed investigation revealed three major aspects of land ownership in the Tug Hill Region. First, more than one-third (37 percent) of the area sampled was found to be in holdings of more than 200 acres. If this percentage applies to Oneida County as well, then fewer than 900 owners (including state and county) control almost 50 percent of the land in the entire Tug Hill Region. However, it should also be noted that those who own 500 acres or more probably number fewer than 100.

A second aspect of the ownership picture is that because farms are getting larger, many of those who own 200 acres or more are resident farmers, particularly in the northern and eastern towns (Figure 44). In the central and more southern towns there is more of a tendency toward non-resident ownership.

Third, among land owners there is a large component (in terms of numbers rather than acreage) of seasonal users. Tax records are not precise on this point since seasonal residences are defined in several ways, and much seasonal use may not be recorded as such. Nevertheless, some 2,700 owners making primarily seasonal use of their holdings were recorded in Lewis, Jefferson and Oswego counties. The individual parcels held tended to be small, averaging 16 acres in Lewis and Jefferson Counties, and often measuring less than 1 acre.

Interviews with informed persons suggest that farms in the area are becoming larger, and that the smaller farms continue to be abandoned from active agriculture use. Non-farm lands which sold for $6/acre in 1960 may now sell for up to $300/acre.

Although some farmers from high cost areas in other States (Connecticut, New Jersey) are filtering into the Region, their numbers are small. Consequently, the total number of farm owners in the Region is tending to decline.

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[1]Basic and secondary sources of data describing land ownership did not always agree. Data provided in the tables should be regarded as preliminary and subject to revision.

Table 61. Land holdings by town and type of owner, Tug Hill Region, 1972-73.

Town	Federal acres	State acres	County acres	Large private		Seasonal residential		All other acres	Total acres
				Acres	Number of owners	Acres	Number of owners		
Jefferson County									
Adams		0		16,390	20	0	0	10,906	27,296
Champion		0	231	7,289	25	136	70	20,990	28,646
Lorraine	418	4,820	3,792	4,654	16	298	17	10,620	24,602
Rodman		4,286	119	6,203	22	438	19	16,256	27,302
Rutland		220	282	11,834	36	21	1	16,846	29,203
Watertown		0		12,742	15	122	3	9,913	22,777
Worth	1,399	4,873	1,850	10,922	13	2,585	87	6,179	27,808
County total	1,817	14,199	6,274	70,034	147	3,600	197	91,710	187,634
County percent	0.97	7.57	3.34	37.32					100.00
Lewis County									
Denmark		47		13,087	47	10	9	19,080	32,224
Harrisburg		2,486		12,779	35	8	1	9,975	25,248
High Market		8,210		21,981	22	988	53	8,578	39,757
Lewis		1,919		24,680	50	1,130	69	13,935	41,664
Leyden		0		7,716	25	16	19	13,682	21,414
Lowville		87		9,938	38	0	0	14,621	24,646
Martinsburg		5,723		19,607	58	78	7	22,726	48,134
Montague		16,448	731	15,995	24	1,678	100	6,959	41,811
Osceola		4,363		40,578	50	2,737	149	8,028	55,706
Pinckney		9,912	387	6,291	16	126	19	10,094	26,810
Turin		1,142		9,216	30	18	6	9,605	19,981
West Turin		2,111		9,239	33	59	4	15,817	27,226
County total		52,448	1,118	191,107	428	6,848	436	153,100	404,621
County percent		12.96	0.28	47.23					100.00
Oneida County									
Annsville		5,164	4					33,430	38,598
Ava		1,149	1,082					21,788	24,019
Boonville		5,128	1,458					39,814	46,400
Camden		708						22,390	23,098
Florence		11,511						14,537	26,048
Floyd		0	150					22,231	22,381
Lee		1,154						27,480	28,634
Steuben		5,546	319					21,341	27,206
Trenton		0						27,802	27,802
Vienna		1,158	136					58,642	59,936
Western		2,997	1,371					30,614	34,982
County total		34,515	4,520					320,069	359,104
County percent		9.61	1.26						100.00
Oswego County									
Albion		6,003	735	5,250	16		18	18,559	30,547
Amboy		2,359		8,263	21		124	13,692	24,314
Boylston		7,714		5,144	17		198	12,128	24,986
Constantia		960		7,880	18		325	53,733	62,573
Hastings		0		2,996	11		46	26,169	29,165
Orwell		3,443		3,631	15		105	19,185	26,259
Parish		1,702	367	3,379	12		16	20,888	26,336
Redfield		12,828		38,730	33		191	8,000	59,558
Richland		1,060		8,224	22		225	28,828	38,112
Sandy Creek		458		8,500	26		559	21,576	30,534
West Monroe		2,240		2,460	9		120	20,804	25,504
Williamstown		2,547	1,137	7,977	18		144	13,382	25,043
County total		41,314	2,239	102,434	218		2,066	256,944	402,951
County percent		10.25	0.56	25.42					100.00

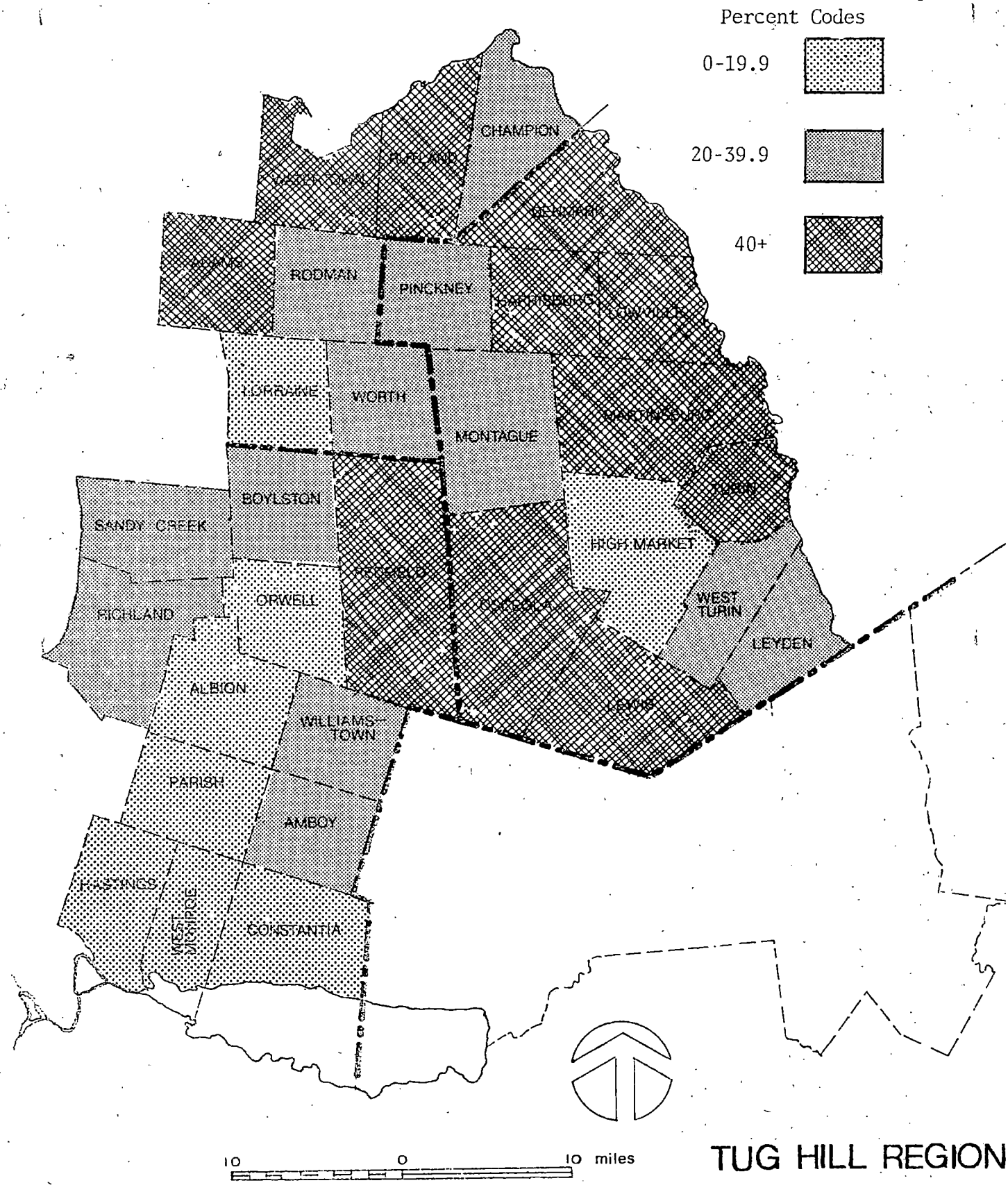


Figure 44. Percent of land in parcels of more than 200 acres, by towns, excluding Oneida County.

The small, seasonal-use owner is seeking a recreational haven. The numbers are increasing and are most numerous in towns having extensive waterfronts, like Sandy Creek and Constantia, and in the more remote towns like Osceola and Redfield (Figure 45). Speculative ownership is also becoming more common in the remote towns, according to interviewees.

Where population pressures are great and rapidly increasing, the tendency is for a property to be subdivided as land values increase. In Oswego County and in the southern-most towns of Oneida County (i.e. Vienna, Western, and Floyd) this trend is most noticeable, and total number of land owners generally is increasing rapidly.

LAND USE

Lands of the Tug Hill Region may be divided into five major use categories, namely agricultural, residential, commercial, open space and other.[2] The proportions of total acreage by use categories within towns are shown in Table 62. Although lands in agricultural use are a significant part of the total, the proportion varies importantly from town to town, ranging from a low of 1 percent (in Redfield and Osceola) to a high of 76 percent (in Lowville). Importantly, as shown in Figure 46, the sparsely populated central area is not heavily farmed. Rather, agricultural lands are concentrated in towns around the rim of the Region. This is because farmland of low viability predominates in the central core area of the Tug Hill Upland. Figure 46 shows the high degree of correlation between low viability farmland and proportion of the land in agriculture.

Proportions of land in residential and commercial use are shown, by towns, in Figure 47. Again, it is towns in the rim which show a higher proportion of total acreage in such use. There is strong correlation between the proportion of residential and commercial land use, and population density.

In general, the category listed as "other" represents less than five percent of all acreage in the Region, except in the westernmost towns of Oswego County. There, areas of non-productive land are substantial.

The remaining areas are "open space". They consist of woodlands, wetlands and water. Figure 48 shows high concentrations of open space to be roughly correlated with incidence of low viability farmland, as outlined earlier. But open space also is to some extent affected by residential pressures. As a consequence, two categories of rim towns emerge; those with relatively low proportions of open space (i.e. less than 60 percent) and those having more than three-fifths of their acreage in open space. The former tend to be located far out on the perimeter of the Region.

As recreational use of the land grows in significance, planning agencies at the state, county and local levels have entered into intensive studies of local and regional potentials. From such studies it is possible to draw some general conclusions about present and future recreation pressures in the Tug Hill Region and the Region's ability to meet them.

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[2] "Other" includes public and semi-public, outdoor recreation, transportation, and non-productive lands.

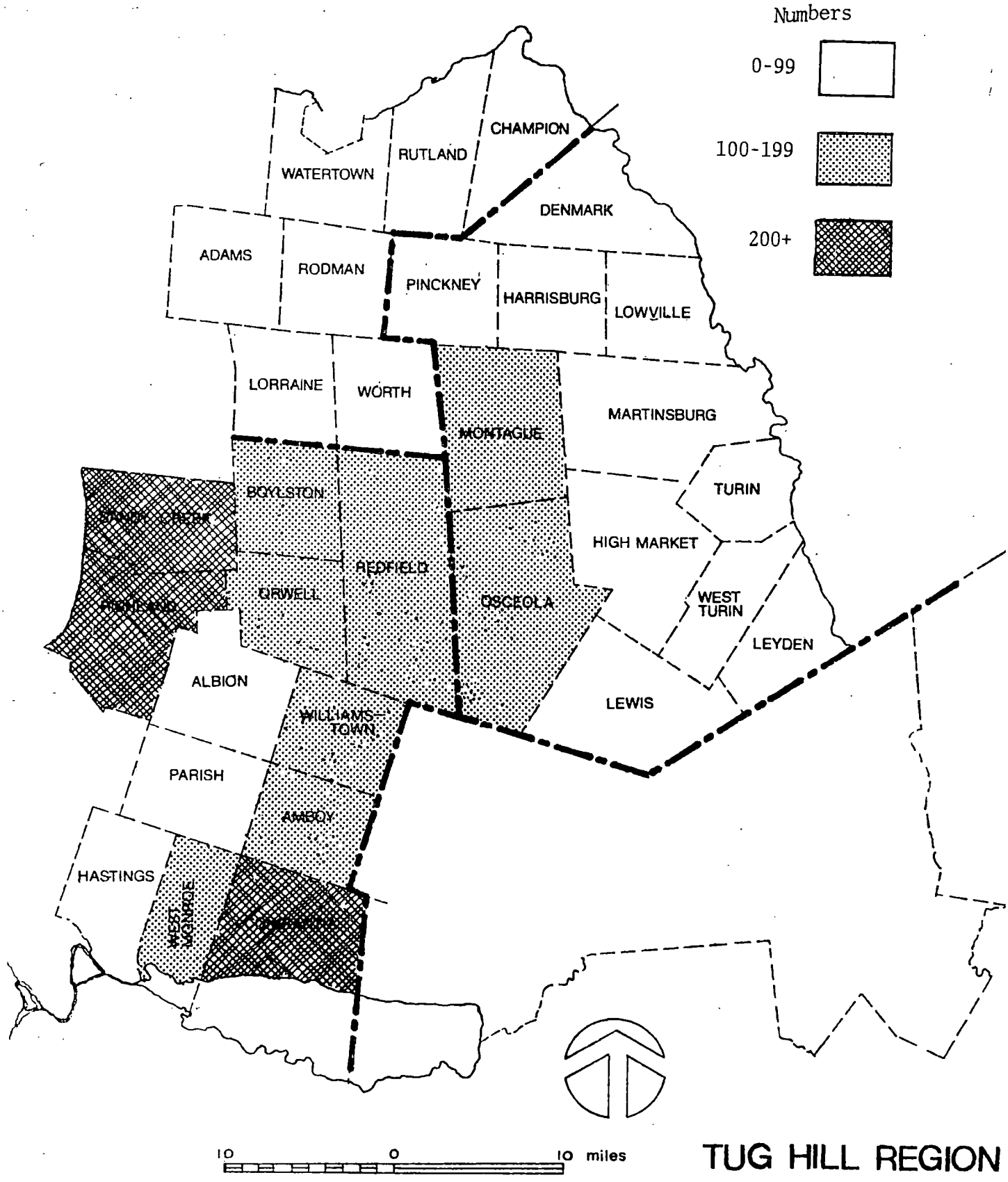


Figure 45. Numbers of seasonal residence owners, by towns, excluding Oneida County.

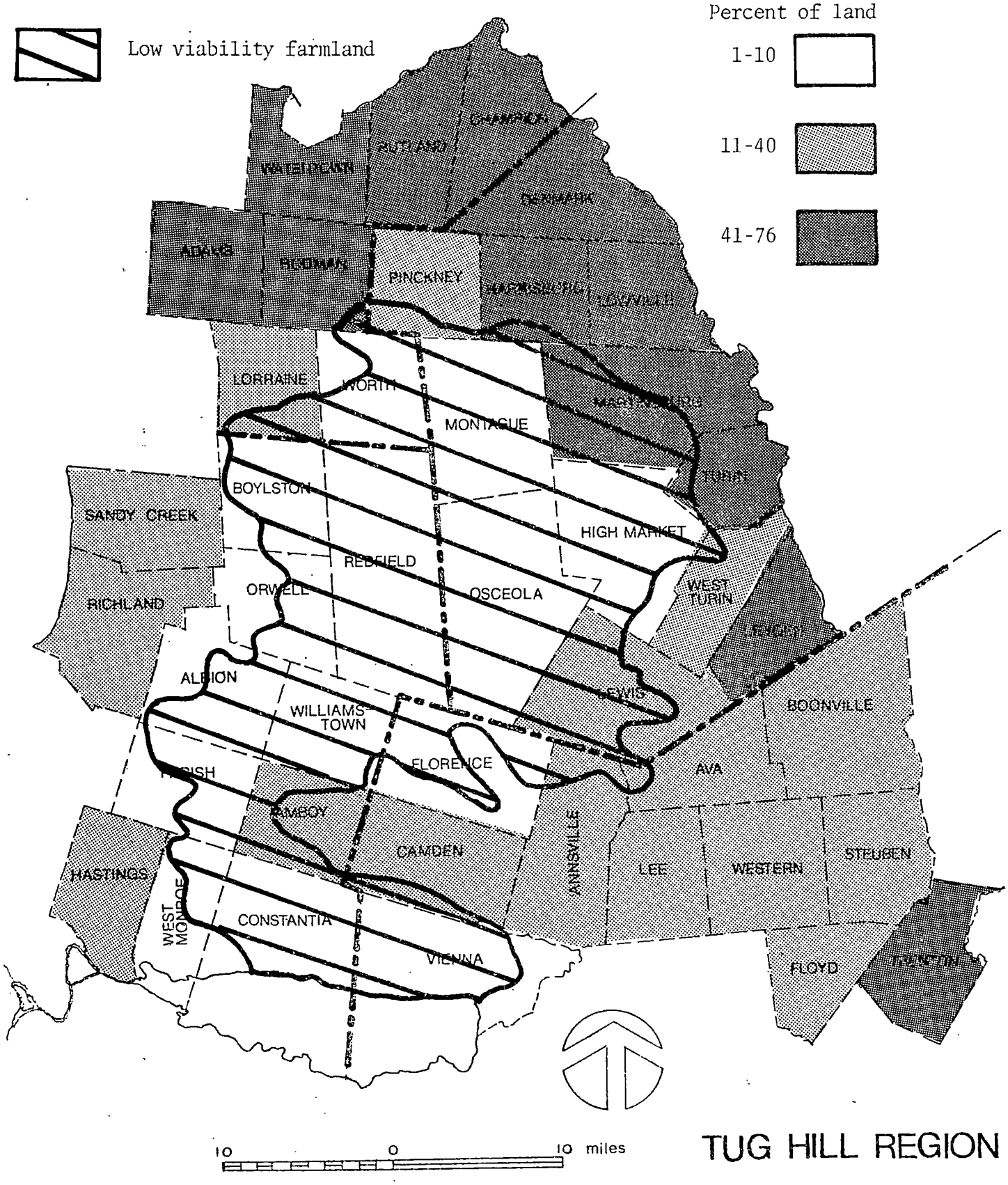


Figure 46. Percent of land in agricultural use (from LUNR data).

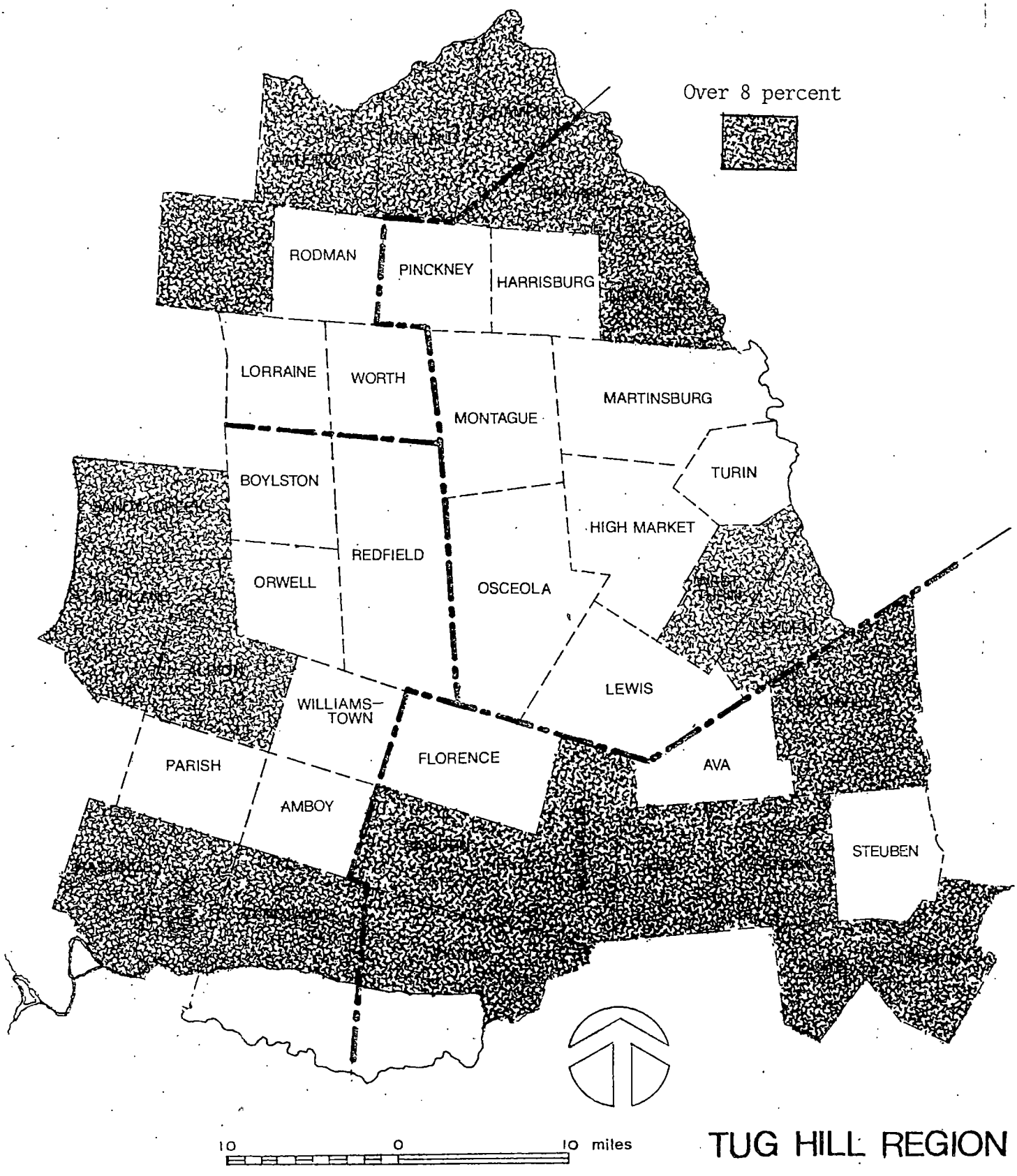


Figure 47. Percent of land in residential and commercial use.

Table 62. Percent of land area by type of use, Tug Hill Region.

Towns	Agriculture	Open space	Residential	Commercial	Other
Jefferson county[a]					
Adams	45.1	43.4	1.8	1.0	8.6
Champion	55.9	33.7	1.8	.8	7.6
Lorraine	26.0	69.2	.1		4.6
Rodman	46.5	49.9	.1	.1	3.3
Rutland	61.8	31.4	1.4	.5	5.0
Watertown, City of	4.6	26.9	34.2	11.0	23.5
Watertown, Town of	41.5	38.7	2.8	2.2	15.7
Worth	10.3	88.3			1.4
Lewis county[a]					
Denmark	67.8	26.8	.9	.2	4.3
Harrisburg	52.4	44.9			2.7
High Market	3.3	94.7			2.0
Lewis	16.7	81.4	.1	.1	1.7
Leyden	56.3	37.9	.6	.7	4.5
Lowville	76.4	16.3	2.0	.8	4.4
Martinsburg	41.5	53.9	.3		4.2
Montague	2.2	95.8		.1	2.0
Osceola	1.2	97.9			.8
Pinckney	18.3	77.3	.1		4.2
Turin	55.8	39.1	.4	.3	4.4
West Turin	30.3	64.5	.7	.2	4.2
Oneida county					
Annsville	19.8	75.2	.4	.5	4.2
Ava	34.9	58.3	.1	.1	6.4
Boonville	20.0	74.4	.9	.5	4.1
Camden	15.9	77.9	.5	.3	5.3
Florence	7.4	89.1	.1	.0	3.4
Floyd	35.1	55.7	3.3	.2	5.8
Lee	29.1	61.2	2.8	.5	6.5
Steuben	28.7	69.5	.0	.0	1.6
Trenton	45.5	43.9	3.0	1.1	6.4
Vienna	8.3	86.0	1.5	.4	3.7
Western	30.0	66.5	.7	.2	2.5
Oswego county					
Albion	9.0	82.3	.7	.2	7.8
Amboy	10.8	82.3	.3	.1	6.6
Boylston	5.3	92.8	.0	.0	2.0
Constantia	2.3	91.3	1.8	.2	4.3
Hastings	19.8	50.5	2.4	1.3	26.0
Orwell	10.1	84.1	.4	.0	5.3
Parish	8.0	79.3	.1	.2	12.5
Redfield	.9	97.6	.1	.0	1.5
Richland	30.6	52.3	2.3	.7	14.1
Sandy Creek	27.7	56.3	2.9	1.1	12.0
West Monroe	10.2	72.6	.8	.1	16.5
Williamstown	10.2	84.4	.5	.1	4.8

[a] LUNR compilation.

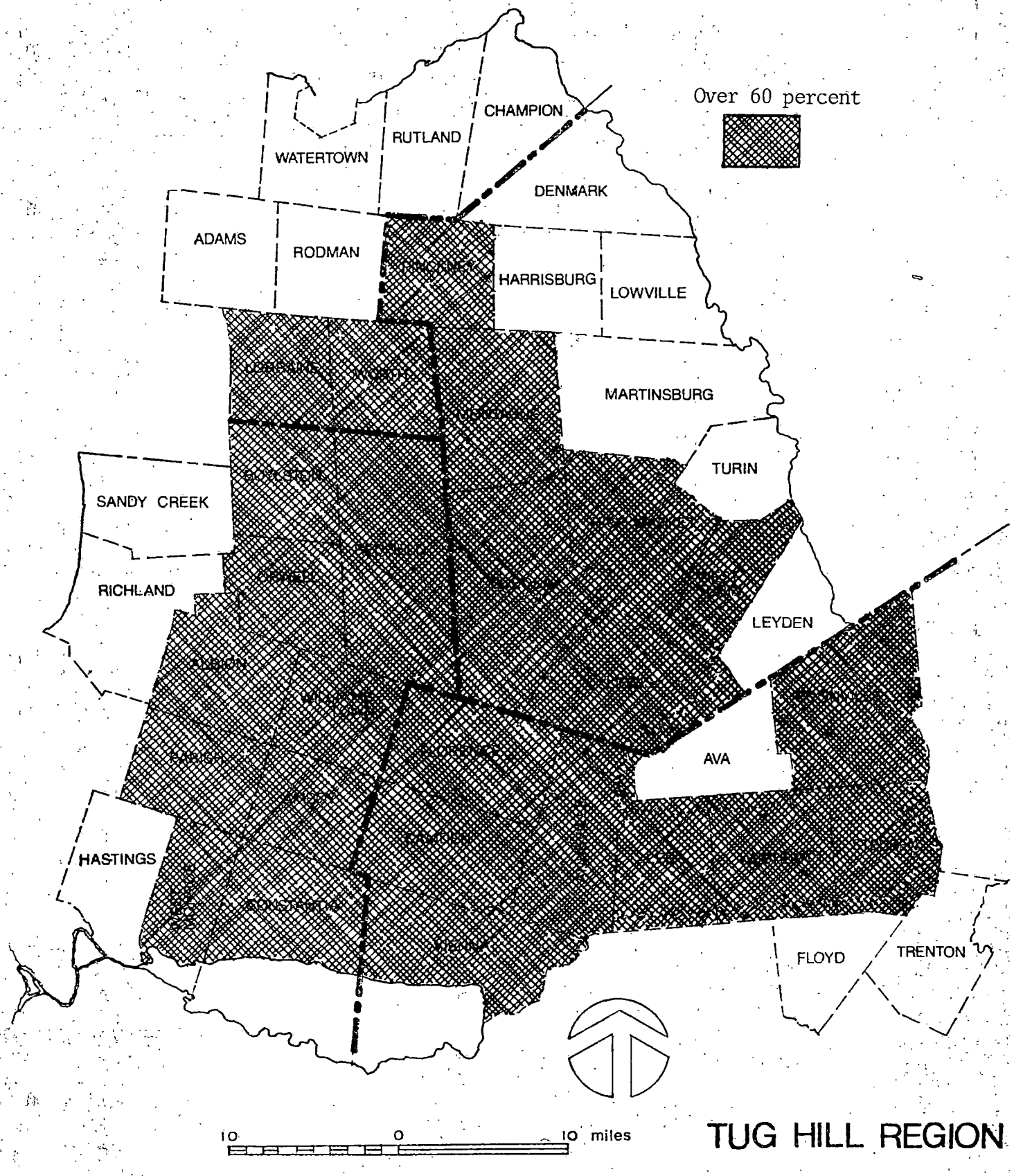


Figure 48. Towns having more than 60 percent open space (from LUNR data).

There is substantial recreational use of the Region now. As shown by Table 63, Oneida County is the leading county in New York State in terms of snowmobile use, and Oswego and Jefferson Counties are among the top 10. Furthermore, only 3 other counties had more boats in use in 1971 than did Jefferson County (N.Y. State Off. Parks and Recreation, 1973). A summary of outdoor recreation pressures, by counties, for 1970 and 1990 (N.Y. State Off. Parks and Recreation, 1973), shows that Oneida County can be expected to experience the heaviest use pressures, followed by Oswego, Jefferson and Lewis Counties, in that order. The pressures for various kinds of outdoor recreation will differ greatly. The great bulk of the people will seek picnicking and swimming sites. Boating, fishing and local winter sports will absorb the next largest group. Hunting, camping and skiing, because of their rigor, will lure smaller followings. Most publicly-owned lands are not suited to meet the demand for water-oriented activities. The study suggests that in Oneida and Oswego Counties, particularly, existing facilities are being used at rates close to capacity now, and that by 1990 their capacity will have been reached or exceeded for virtually all major activities.

The New York State Outdoor Recreation Facilities Inventory conducted by the N.Y.S. Office of Parks and Recreation (1973) is presently incomplete. However, the data already suggest the significent contribution being made to recreation activity by quasi-public and private lands. Figure 49 shows only the larger recreation units now in existence or planned for the Tug Hill Region. These data tend to de-emphasize the impact of less extensive but more intensively used lands. They also raise the question of how current acquisition and development plans can be fitted to meet particular recreation needs rather than merely providing large areas of open space.

WHO LIVES ON THE LAND

Characteristics of the population (total size of the population, mobility, dependent population, and family income) are basic elements in a Region's growth or social stability. Although some of these factors are difficult to measure and to evaluate precisely, sufficient information exists to describe what has happened in the Region and to point out some implications for the future.

To facilitate the analysis the Region was divided into three areas: 1. the northeast rim, running along the Black River Valley; 2. the southwest rim, lying across the north side of Oneida Lake and up the western side of the Region; and 3. the core, being the heavily forested area of the Tug Hill Upland (Figure 50). This division was based upon an evaluation of social and economic characteristics of the population and land use data. Additionally, all data shown are from the 1970 U.S. Census of Population, unless another source is specifically indicated.

Total Population and Population Change

Table 64 shows total population for the Tug Hill Region from 1870 to 1970. The 1970 population was 89,499, an increase of 13,916 from 1960. However the population growth was not evenly distributed throughout the Region as indicated by the following data:

Table 63. Top 10 New York State counties in terms of snowmobile use, 1972.[a]

County	Number of snowmobile operators
ONEIDA	10,578
Onondaga	8,368
St. Lawrence	7,374
Erie	6,843
OSWEGO	6,456
Monroe	6,324
JEFFERSON	5,375
Saratoga	4,452
Herkimer	4,166
Wayne	4,157

[a] Source: New York State, Division of Parks and Recreation, 1973.

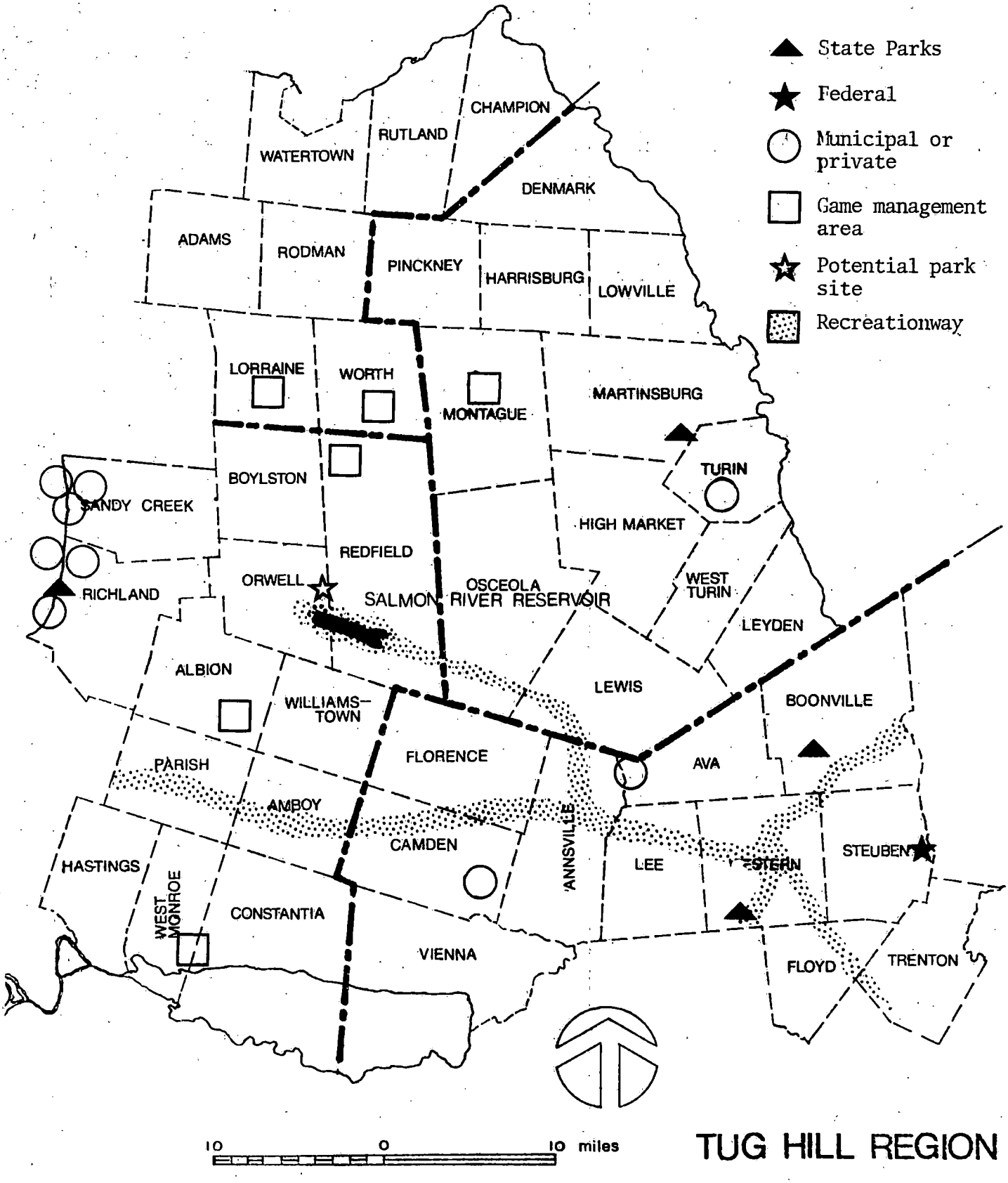


Figure 49. Major recreational developments (from New York Statewide Comprehensive Recreation Plan).

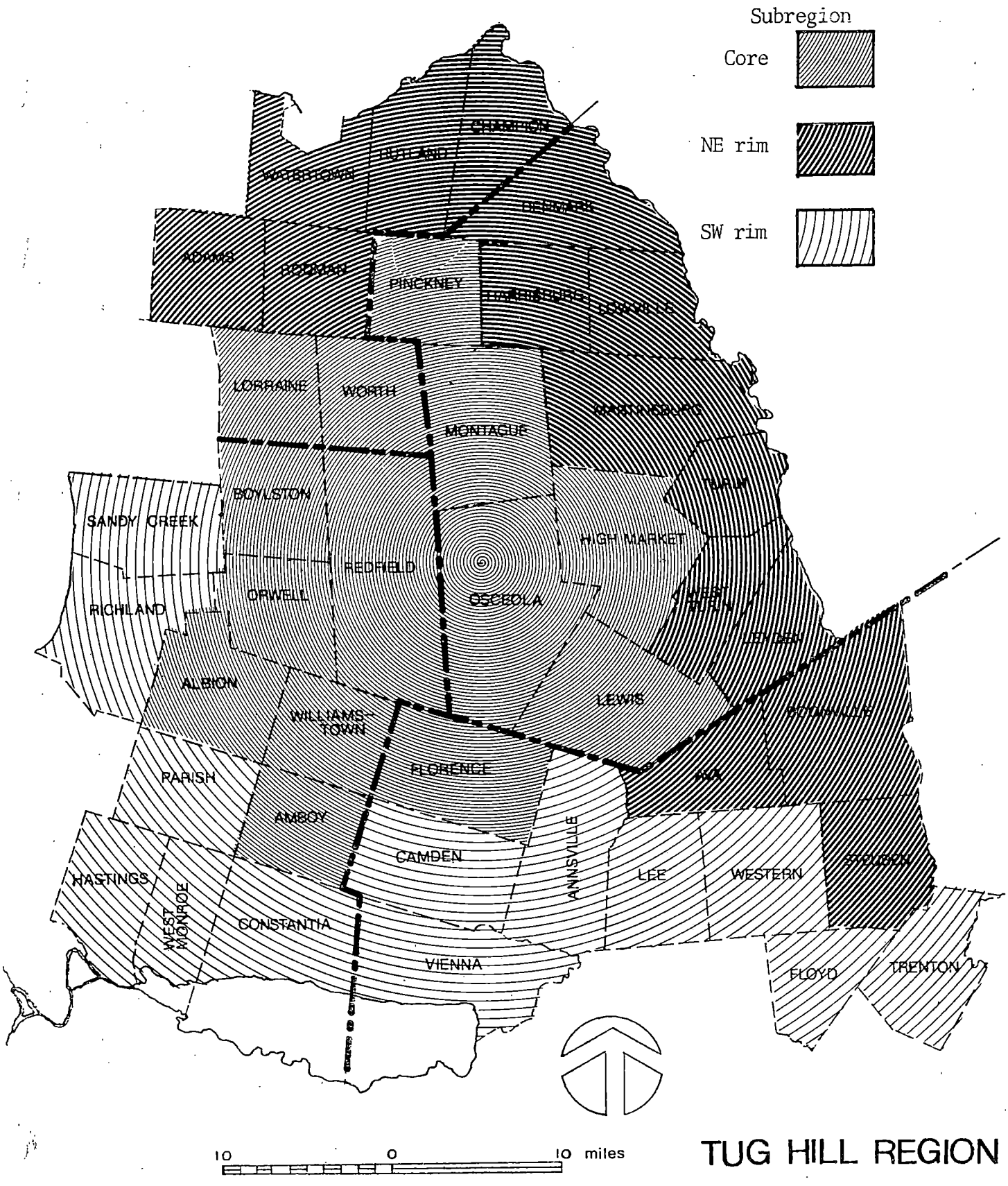


Figure 50.Core, northeast rim, and southwest rim, Tug Hill Region.

Table 64. Population of the Tug Hill Region, 1870-1970.[a]

Year	Core area			Northeast rim			Southwest rim			Entire Region		
	Number of people	Change from preceding census		Number of people	Change from preceding census		Number of people	Change from preceding census		Number of people	Change from preceding census	
		Number	Percent		Number	Percent		Number	Percent		Number	Percent
1870	16,177			30,729			37,658			84,564		
1880	16,941	+764	+4.7	30,588	-141	-0.5	35,679	-1,979	-5.3	83,208	-1,356	-1.6
1890	14,164	-2,777	-19.6	28,507	-2,081	-6.8	30,434	-5,245	-14.7	73,105	-10,103	-12.1
1900	14,533	+369	+2.6	27,921	-586	-2.1	26,919	-3,515	-11.5	69,373	-3,732	-5.1
1910	10,043	-4,490	-30.9	27,033	-888	-3.2	25,809	-1,110	-4.1	62,885	-6,488	-9.4
1920	9,727	-316	-3.1	27,012	-21	--	23,644	-2,165	-8.4	60,383	-2,502	-4.0
1930	7,734	-1,993	-25.8	27,859	+847	+3.1	22,308	-1,336	-5.6	57,901	-2,482	-4.1
1940	7,991	+257	+3.2	27,649	-210	- .8	22,704	+396	+1.8	58,344	+443	+ .8
1950	6,158	-1,833	-29.8	29,849	+2,200	+8.0	28,135	+5,431	+23.9	64,142	+5,798	+9.9
1960	7,851	+1,693	+21.6	31,457	+1,608	+5.4	36,275	+8,140	+28.9	75,583	+11,441	+17.8
1970	8,877	+1,026	+13.1	33,476	+2,019	+6.4	47,146	+10,871	+30.0	89,499	+13,916	+18.4

[a] Source: U.S. Bur. Census

Area	1960	1970	Change	
			Number	Percent
Northeast Rim	31,457	33,476	2,019	6.4
Southwest Rim	36,275	47,146	10,871	30.0
Core	7,851	8,877	1,026	13.1
Entire Region	75,583	89,499	13,916	18.4

The population for each municipality in the Region is shown on Figure 51.

The maps that follow (Figures 52-62) show the density of population per square mile for municipalities in the Tug Hill Region and surrounding 5 counties, from 1870 to 1970. Changes in population growth within the Region are evident.

Most of the changes in population growth are closely related to economic activity. Two major trends are evident from 1870 to the present, namely the consistent growth of population around urban centers, and the decline of population in the more remote towns. Although the 1950, 1960, and 1970 maps indicate some spreading of growth to a larger ring of towns around most of the urban centers, the towns in the core of the Tug Hill Region remain largely unaffected. In fact, 7 of the 10 towns showing a decline in population from 1960 to 1970 (Figure 63) are located in the core area, and 8 of the 10 towns showing increases of 25 percent or more in population from 1960 to 1970 are located in the southwestern rim.

Population projections for 1980 have been made for municipalities of the Tug Hill Region by the Area Development Department of the Niagara Mohawk Power Corporation. The individual projections for towns are shown on Figure 64, and summarized as follows:

Area	Population		Change	
	1970	1980	Number	Percent
Northeast rim	33,476	32,970	-506	-1.5
Southwest rim	47,146	55,176	+8,030	+17.0
Core	8,877	8,648	-229	-2.6
Entire Region	89,449	96,794	+7,295	+8.2

The pressure on towns in the southwest rim is apparent.

The migration of population from central cities to suburban and urban-fringe areas is an important aspect in the growth of many communities in the United States. The effect of this trend on communities in the southwestern rim of the Tug Hill Region is clearly evident in Figure 63 and in the comparison of Figures 61 and 62.

Mobility

Population change is affected by migration in and out of a region and by births and deaths. Because appropriate data were not available, and because of the complex nature of each of these factors, extensive analysis of them could not be made. However, some inferences were drawn from the limited information which was available. These are reported below.

Of the persons living in the Tug Hill Region in April, 1970 who were 5 years of age or older, 63 percent lived in the same house in 1965. However,

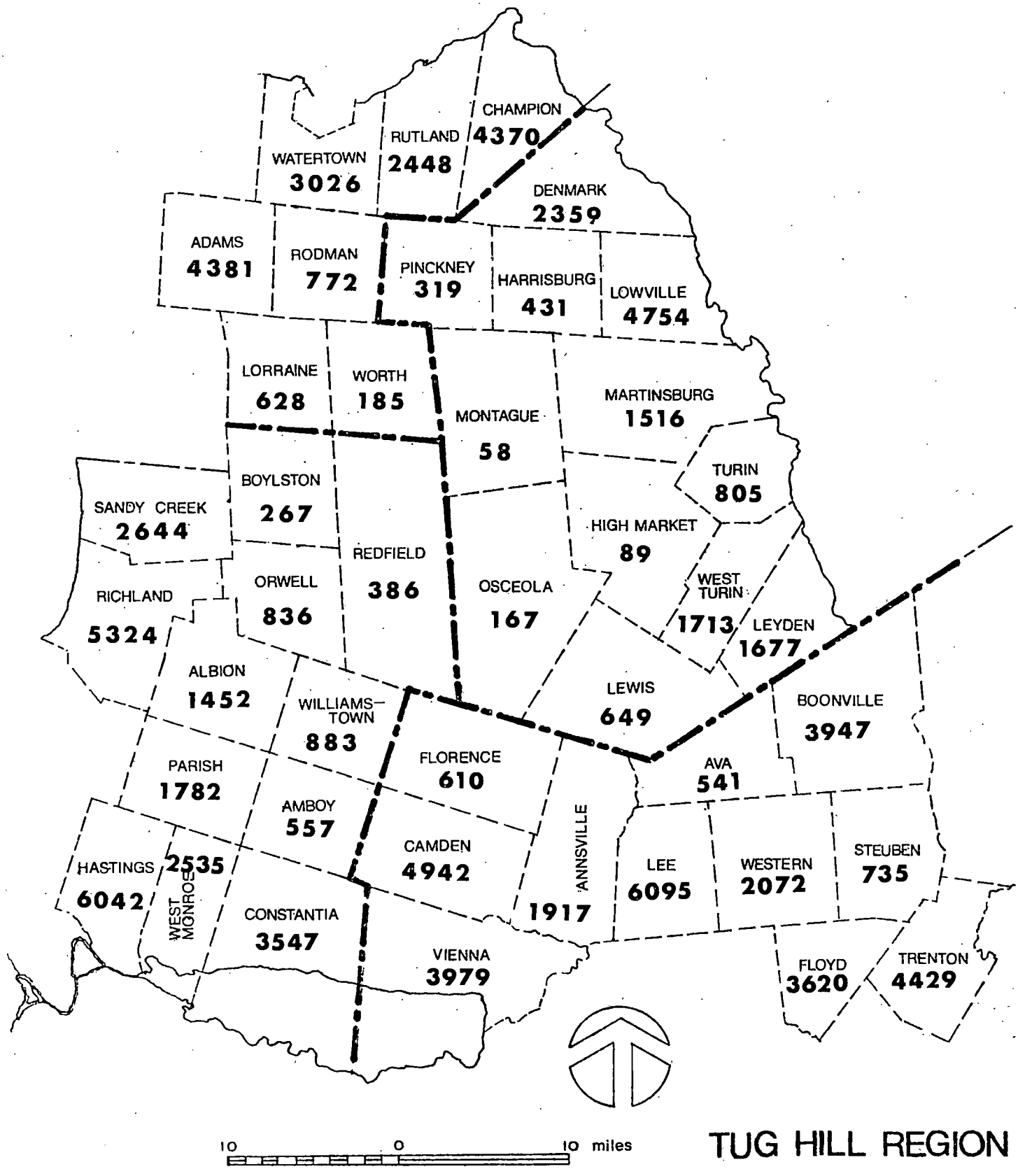


Figure 51. Population, 1970.

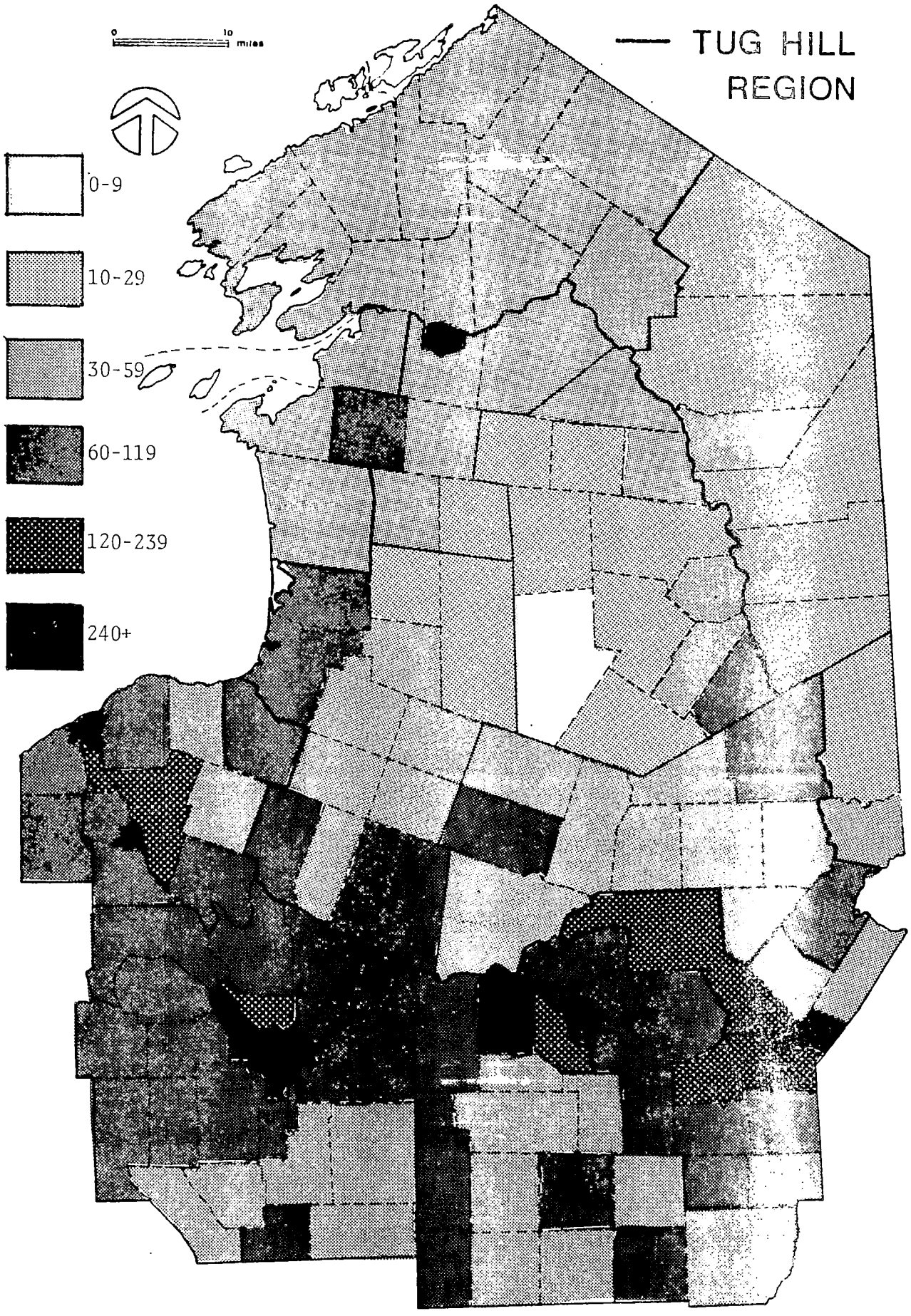


Figure 52. Persons per square mile, 1870.

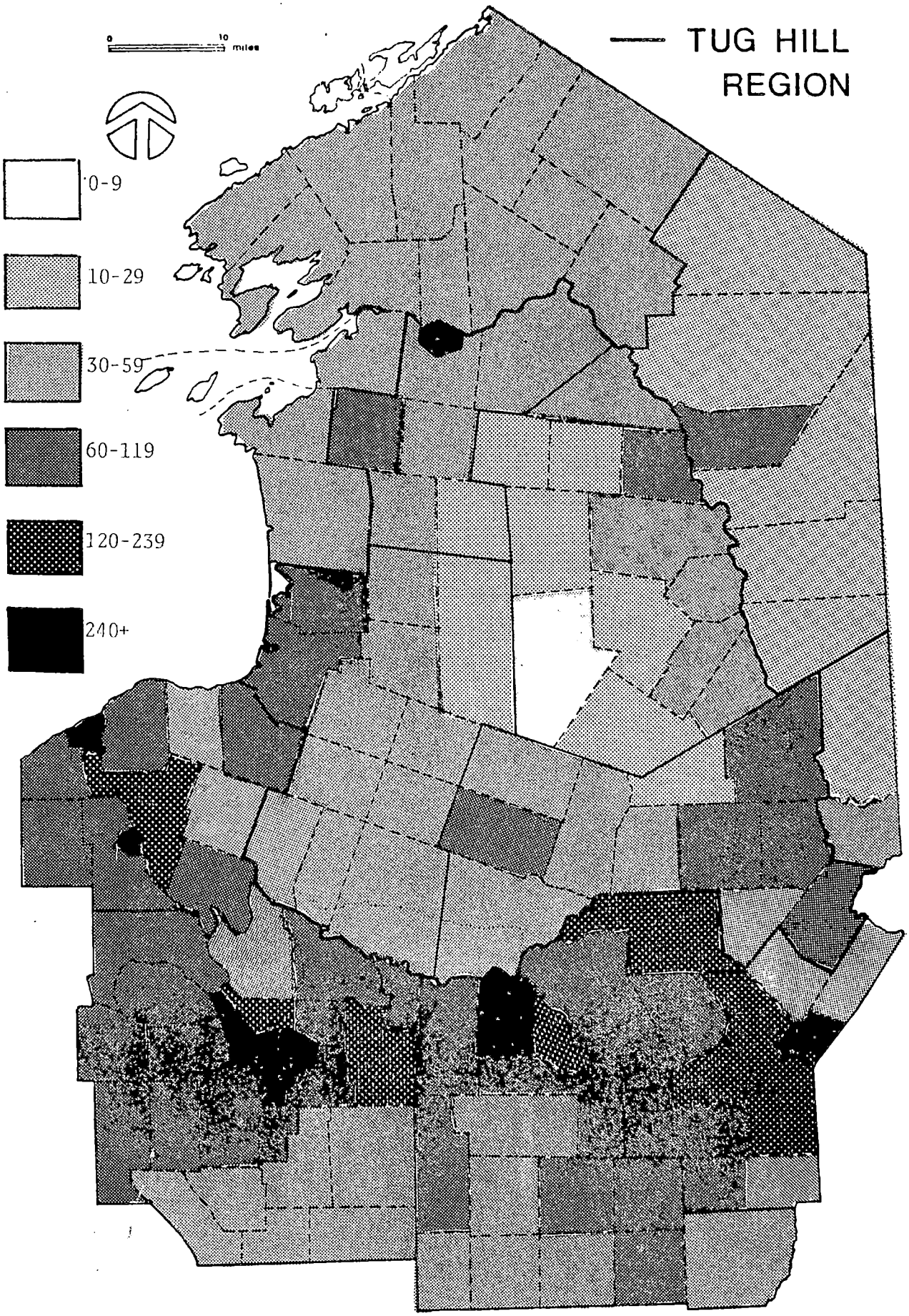


Figure 53. Persons per square mile, 1880.

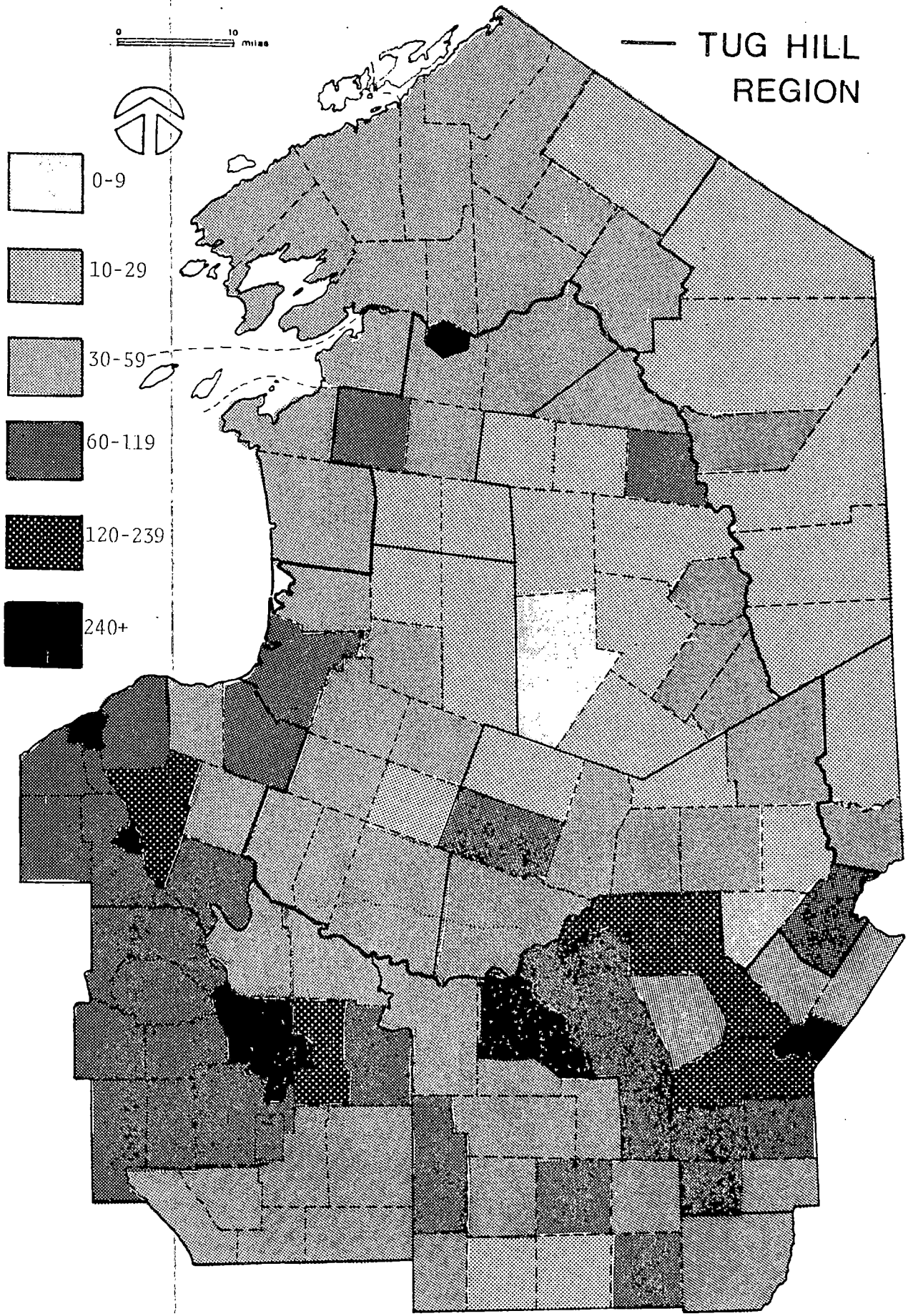


Figure 54. Persons per square mile, 1890.

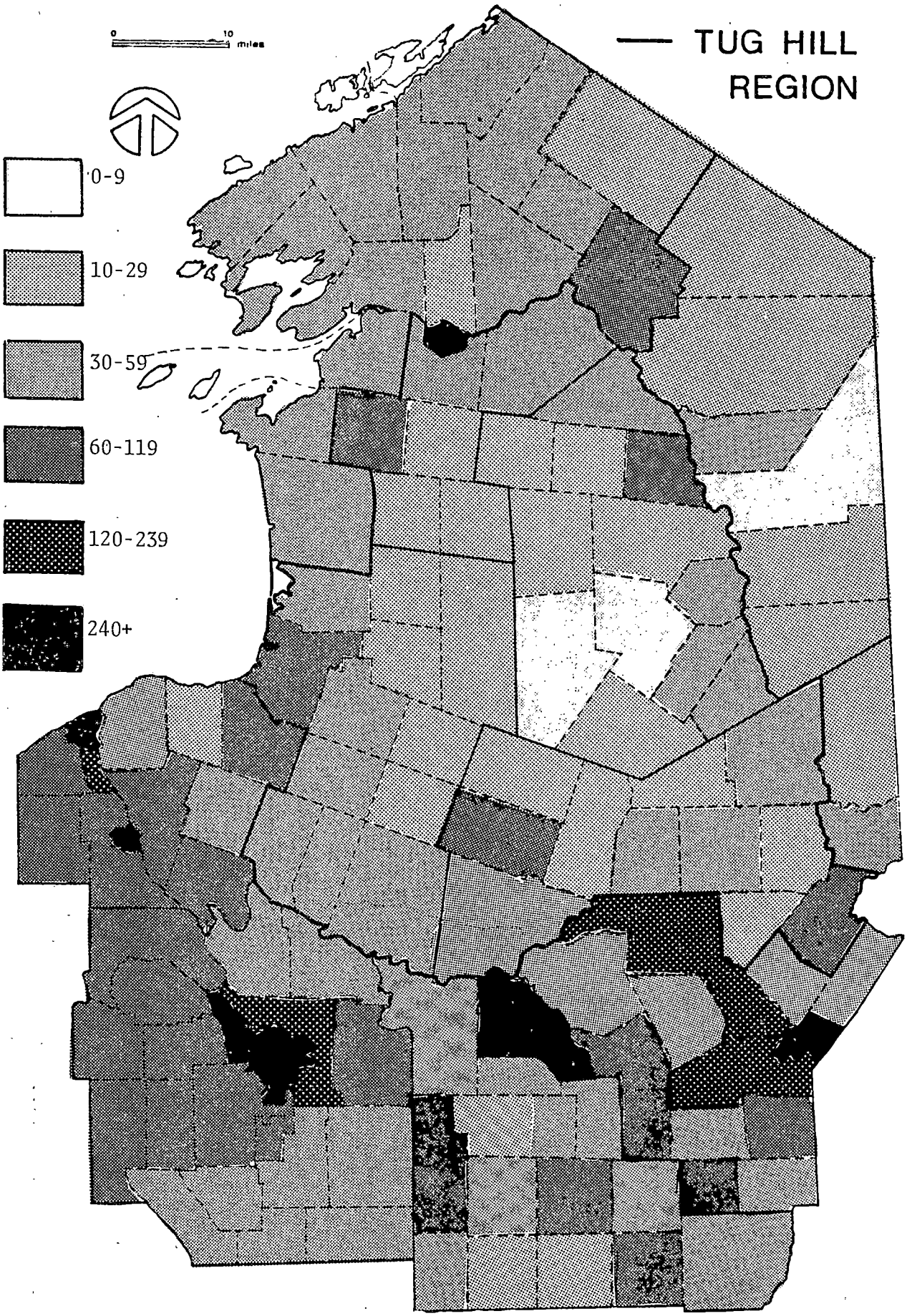


Figure 55. Persons per square mile, 1900.

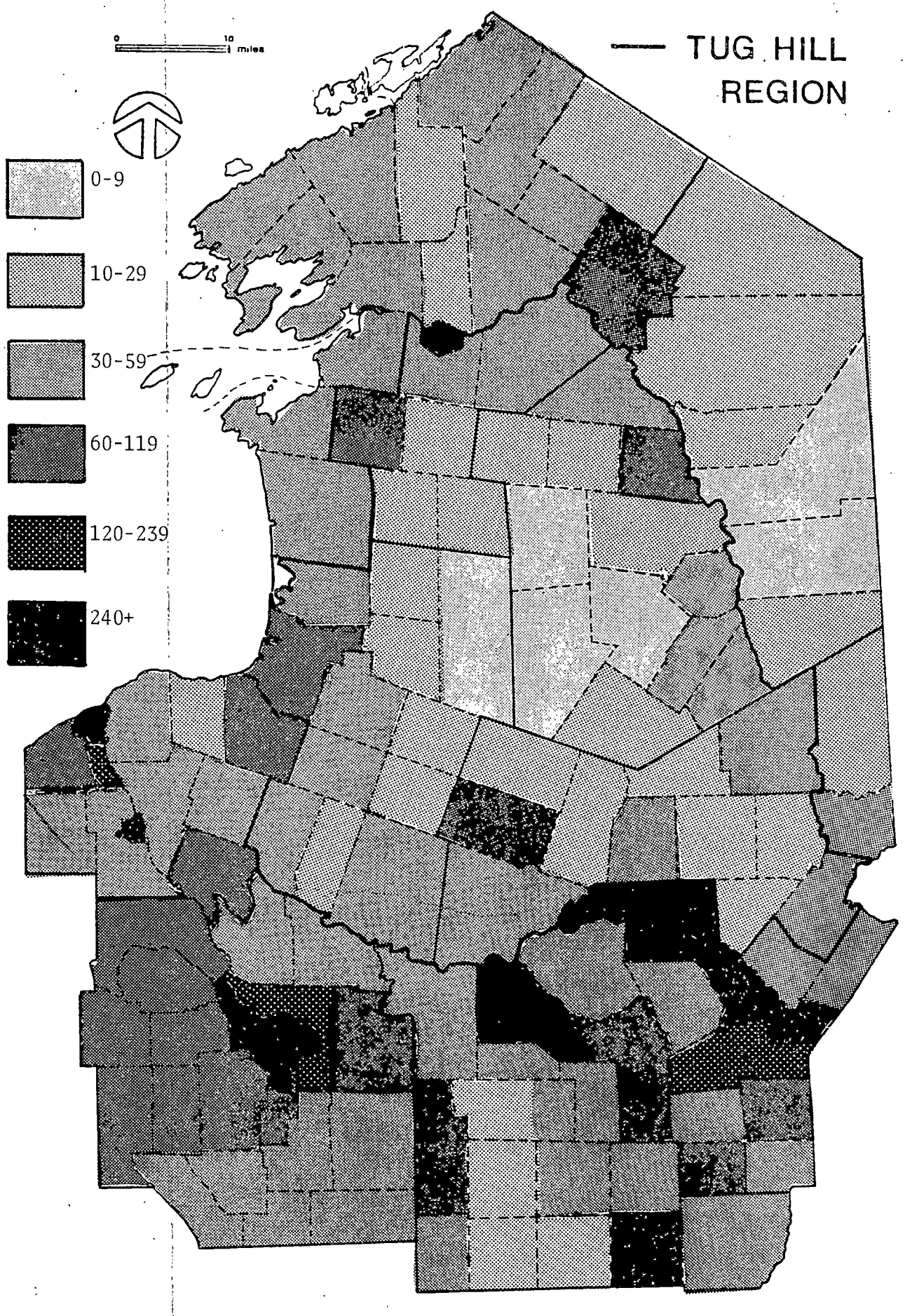


Figure 56. Persons per square mile, 1910.

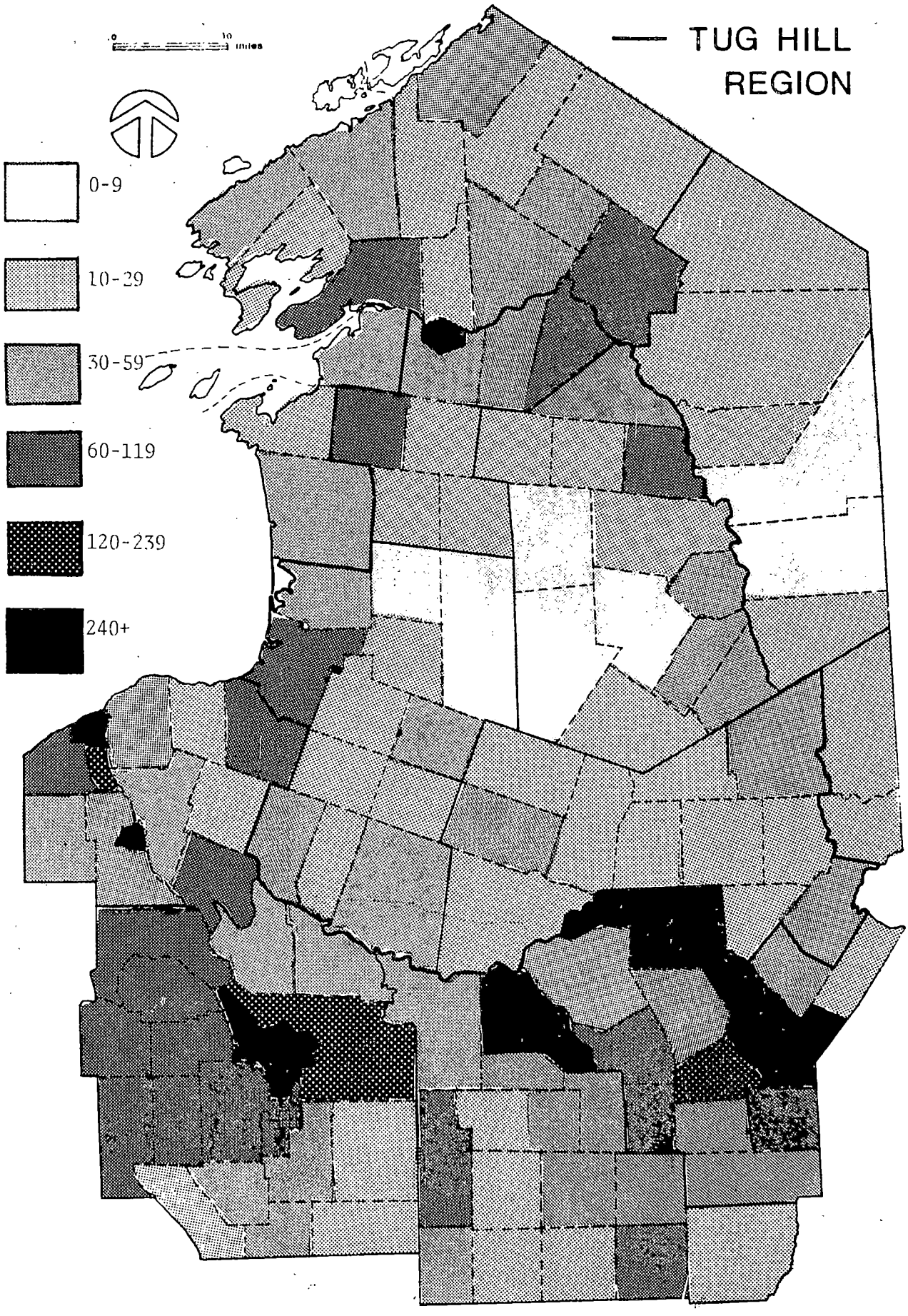


Figure 57. Persons per square mile, 1920.

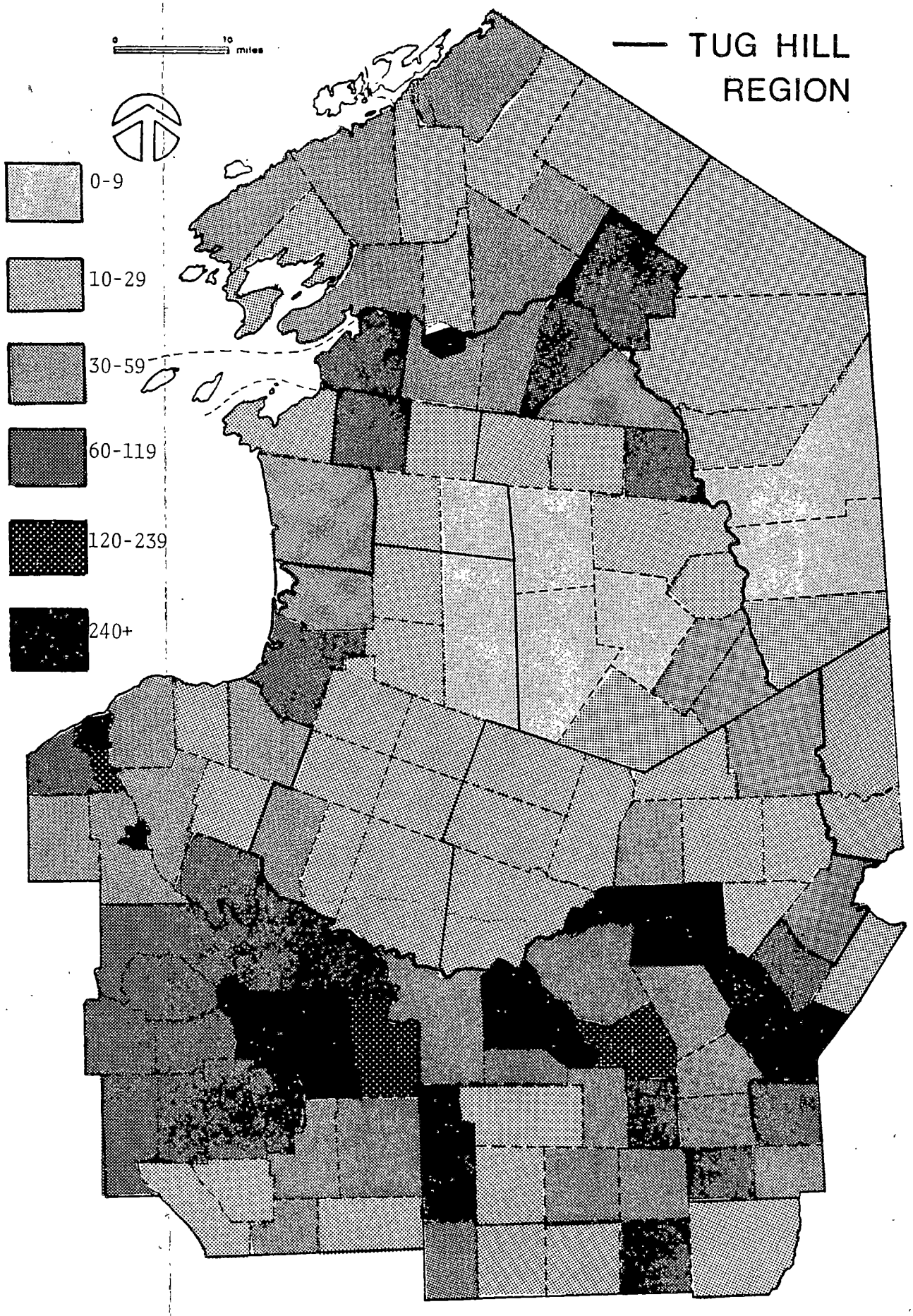


Figure 58. Persons per square mile, 1930.

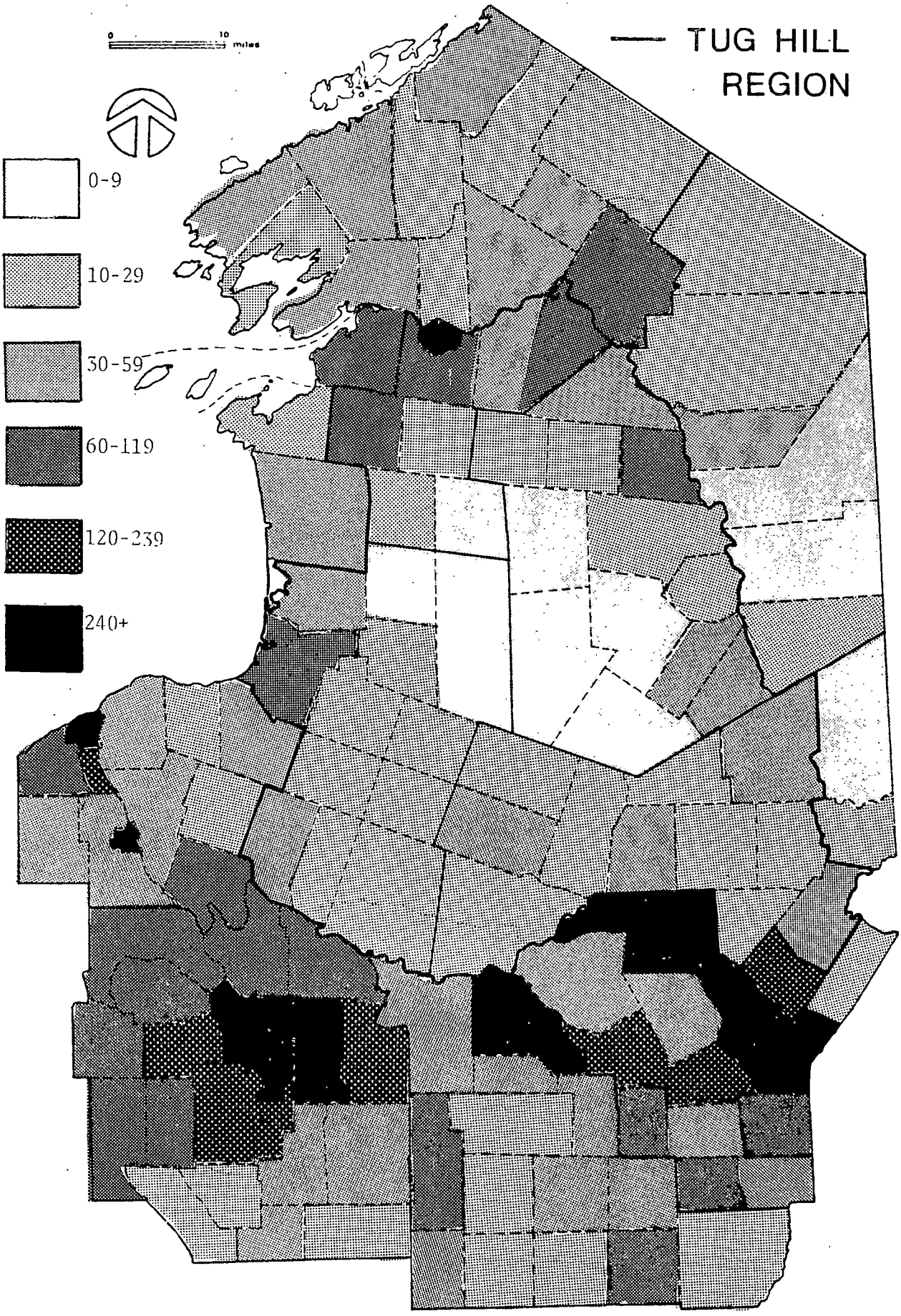


Figure 59. Persons per square mile, 1940.

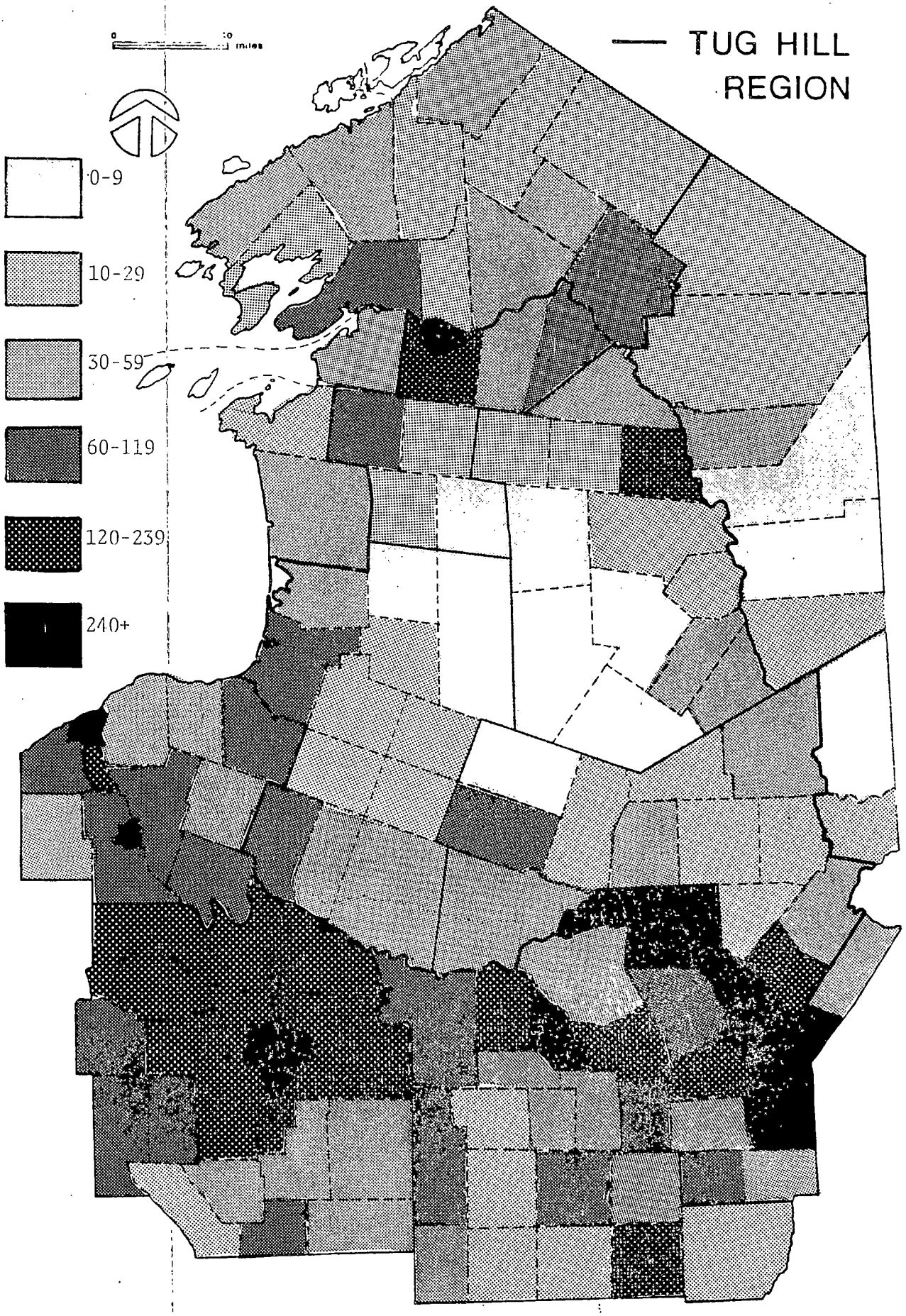


Figure 60. Persons per square mile, 1950.

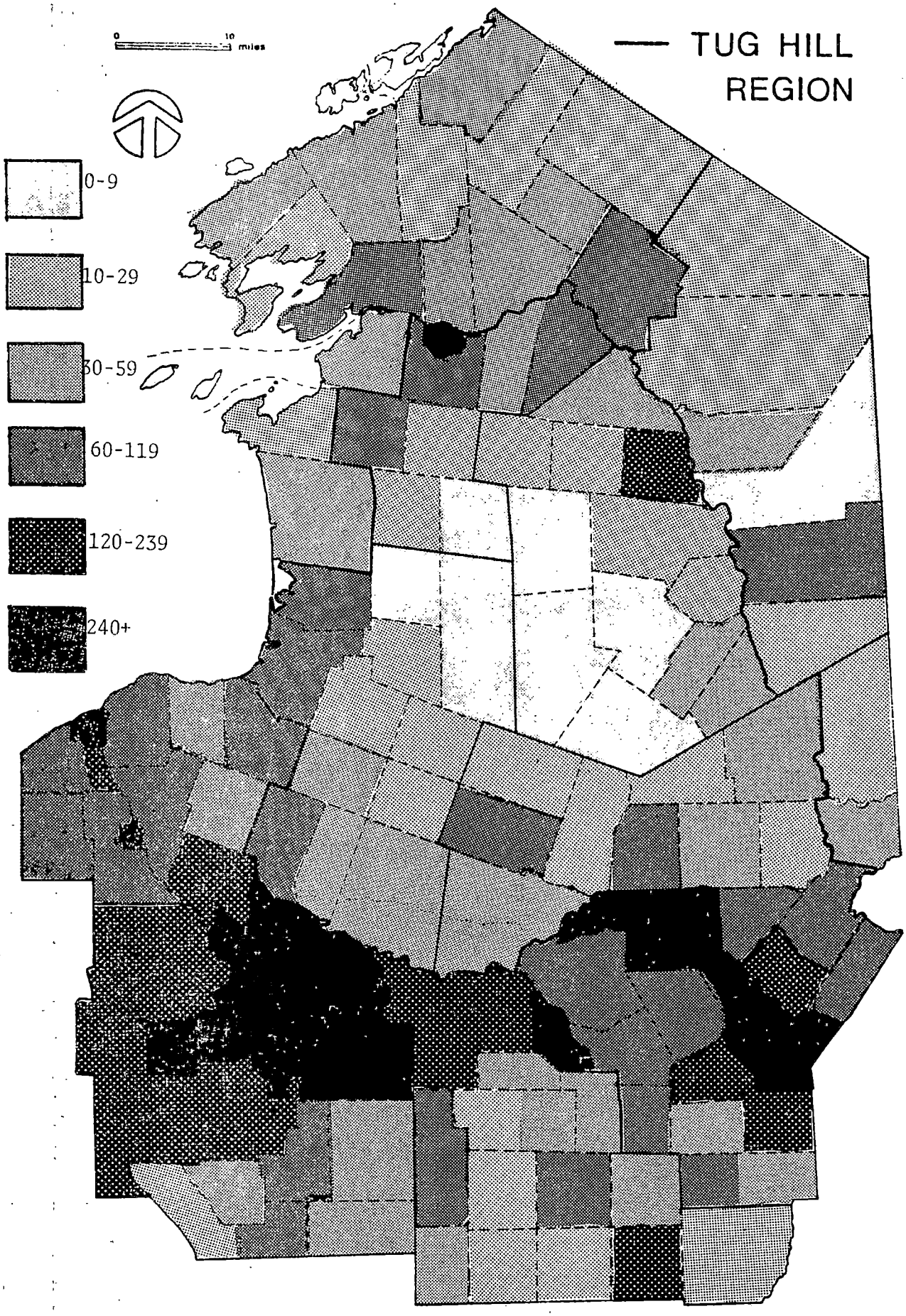


Figure 61. Persons per square mile, 1960.

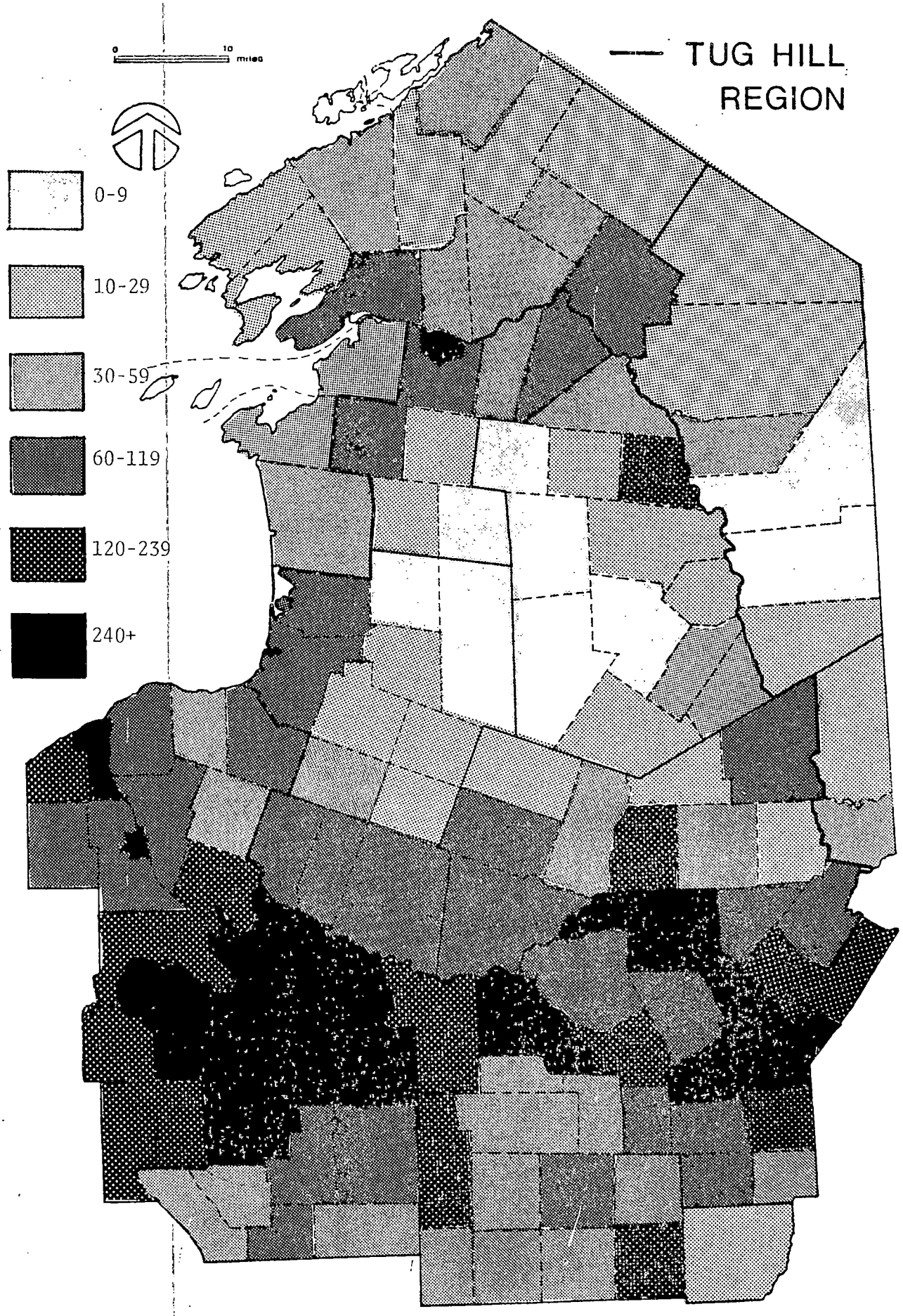


Figure 62. Persons per square mile, 1970.

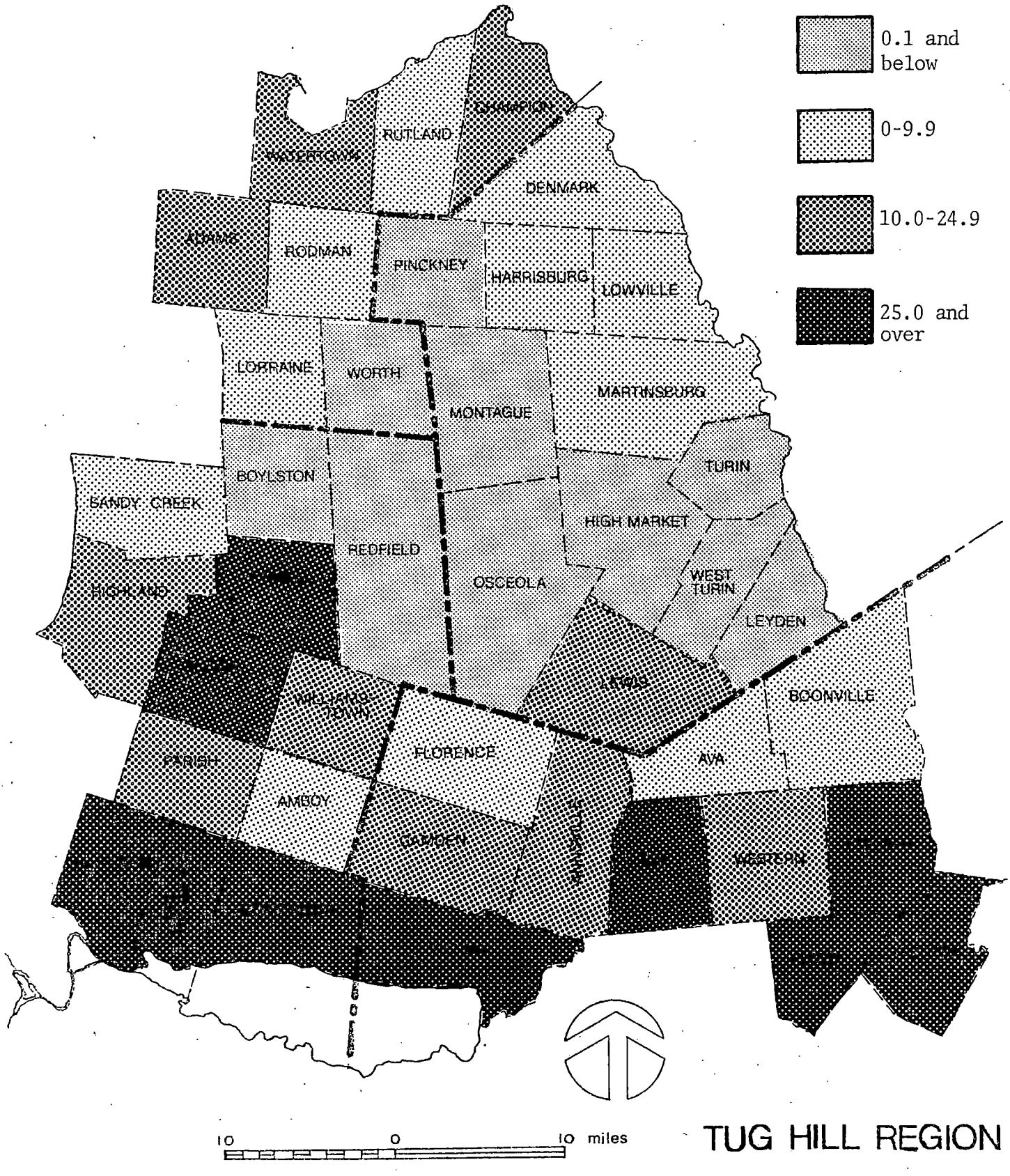


Figure 63. Percent of change in population, 1960 to 1970.

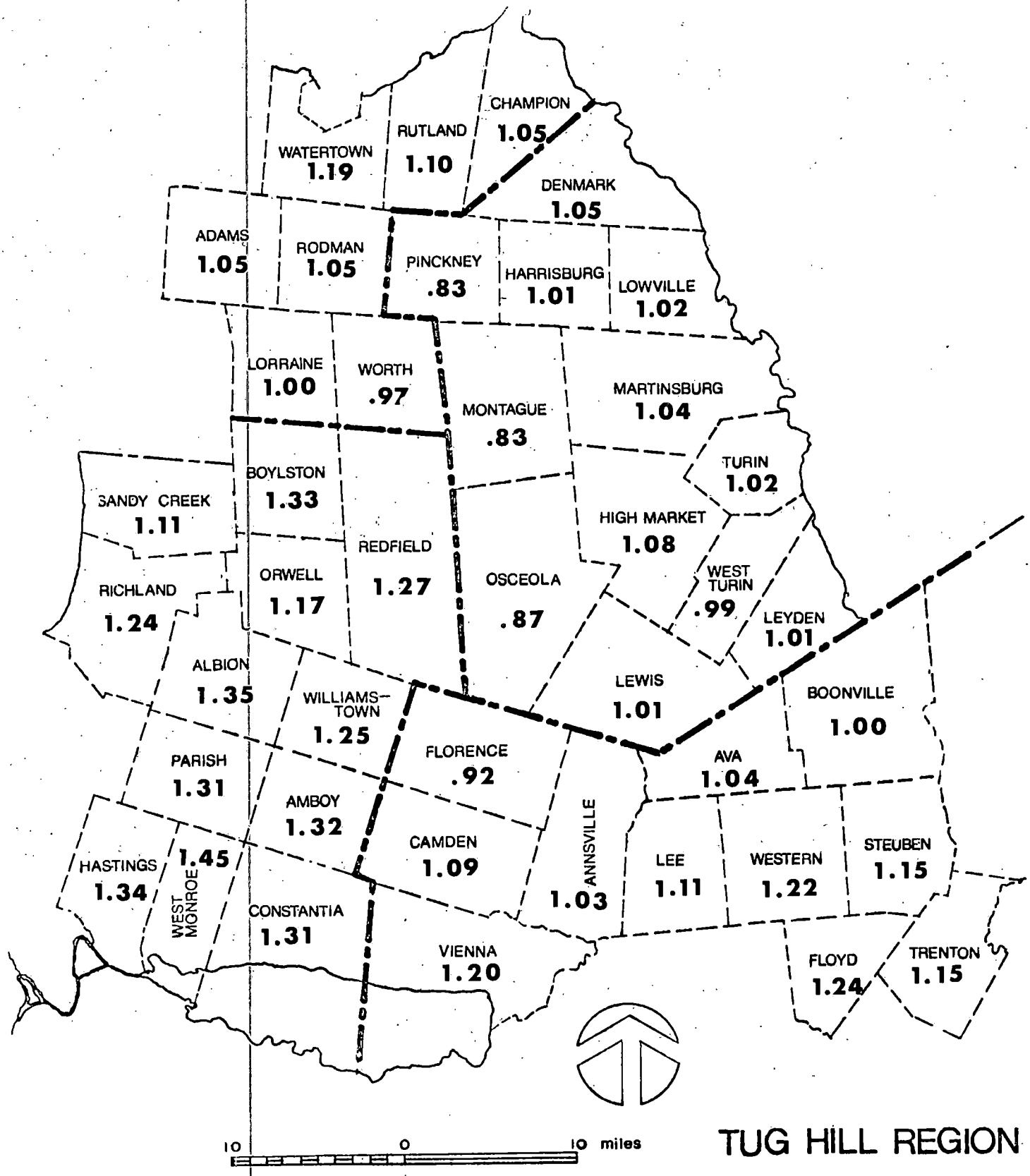


Figure 64. Ratio of 1980 projected population to 1970 population.

the percentage living in the same house varies considerably by municipality as Figure 65 indicates. For example, 9 of the 14 towns showing 75 percent or more of the population living in the same house from 1965-70 are located in the core area of the Region.

Similarly, 20 percent of the Region's 1970 population has lived in the same house since 1949, or earlier (Figure 66), and 28 percent moved into their home between 1968 and 1970 (Figure 67). Substantial differences occur in different parts of the Region:

Area	Percent by year moved into unit, as of 1970	
	1949 or earlier	1968 to April 1970
Northeast rim	23.6	26.3
Southwest rim	15.3	9.3
Core	27.7	18.6
Entire Region	19.7	27.8

A relatively large percentage of persons living in the same house for 30 years or longer are located in both the northeast rim and the core areas. The "old time" population provides much of the social stability in these areas, as well as much of the local leadership.

The relatively large percentage of persons in the northeast rim and core areas, as of 1970, who are recent arrivals (since 1968) indicates that a substantial portion of the population in these areas are transient. They move every couple of years in response to job opportunities, or to the requirements of their particular job.

The southwest rim is influenced relatively less by both the older residents and the transient population. Larger proportions of its population appear to be families who are moving into the area for relatively permanent residence.

Age

The term "dependent population" refers to the proportion of the people under 20 years of age and over 65 years of age. Both of these segments of the population are generally non-income producing--thus the term "dependent". The use of this concept contributes to the determination of the types of housing, facilities, and services which are needed. It also serves as a general indication of the ability of the population to pay for needed services through tax or private funds.

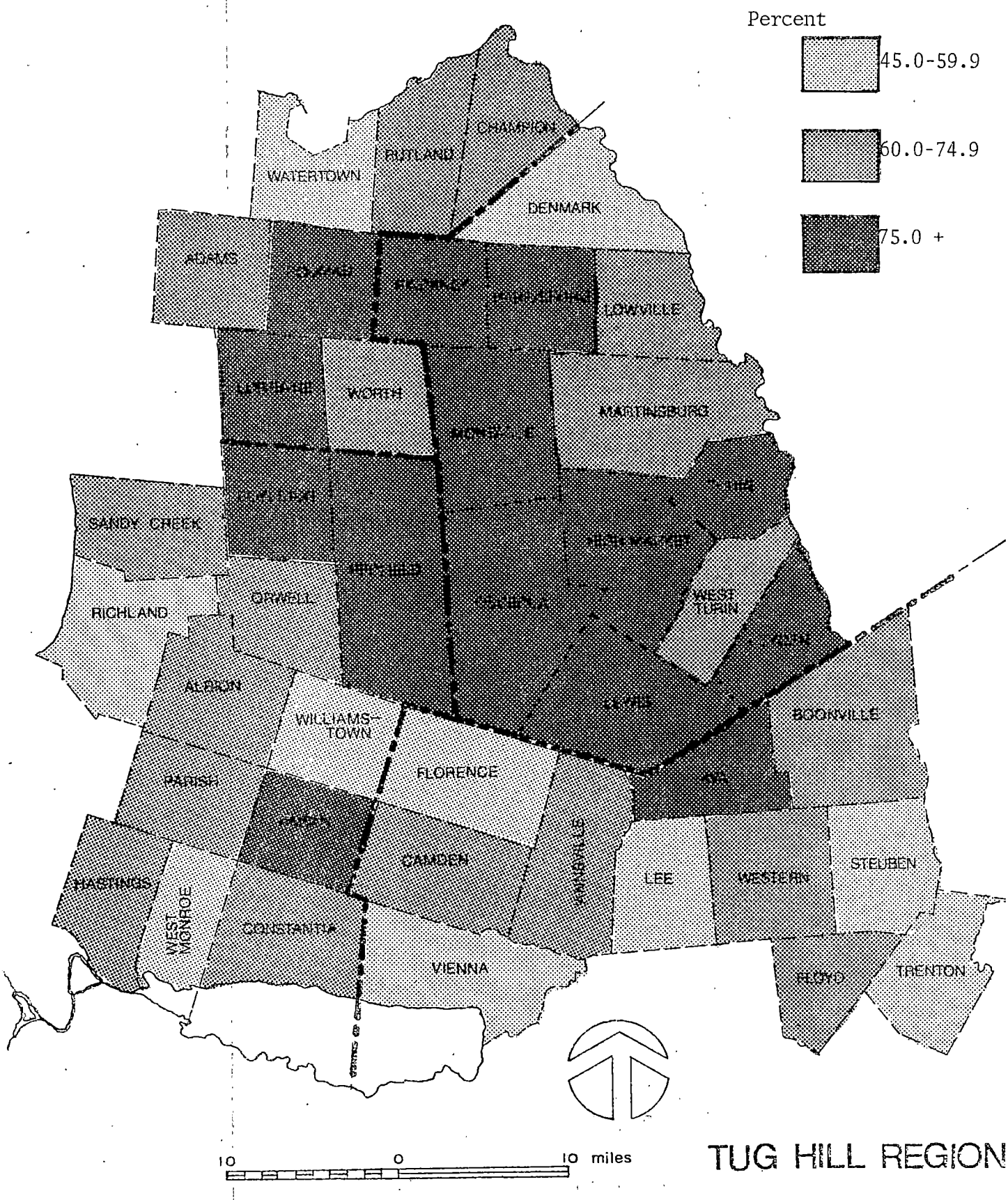


Figure 65. Persons 5 years old and over living in the same house in 1965 as a percent of the total population 5 years old and over, 1970.

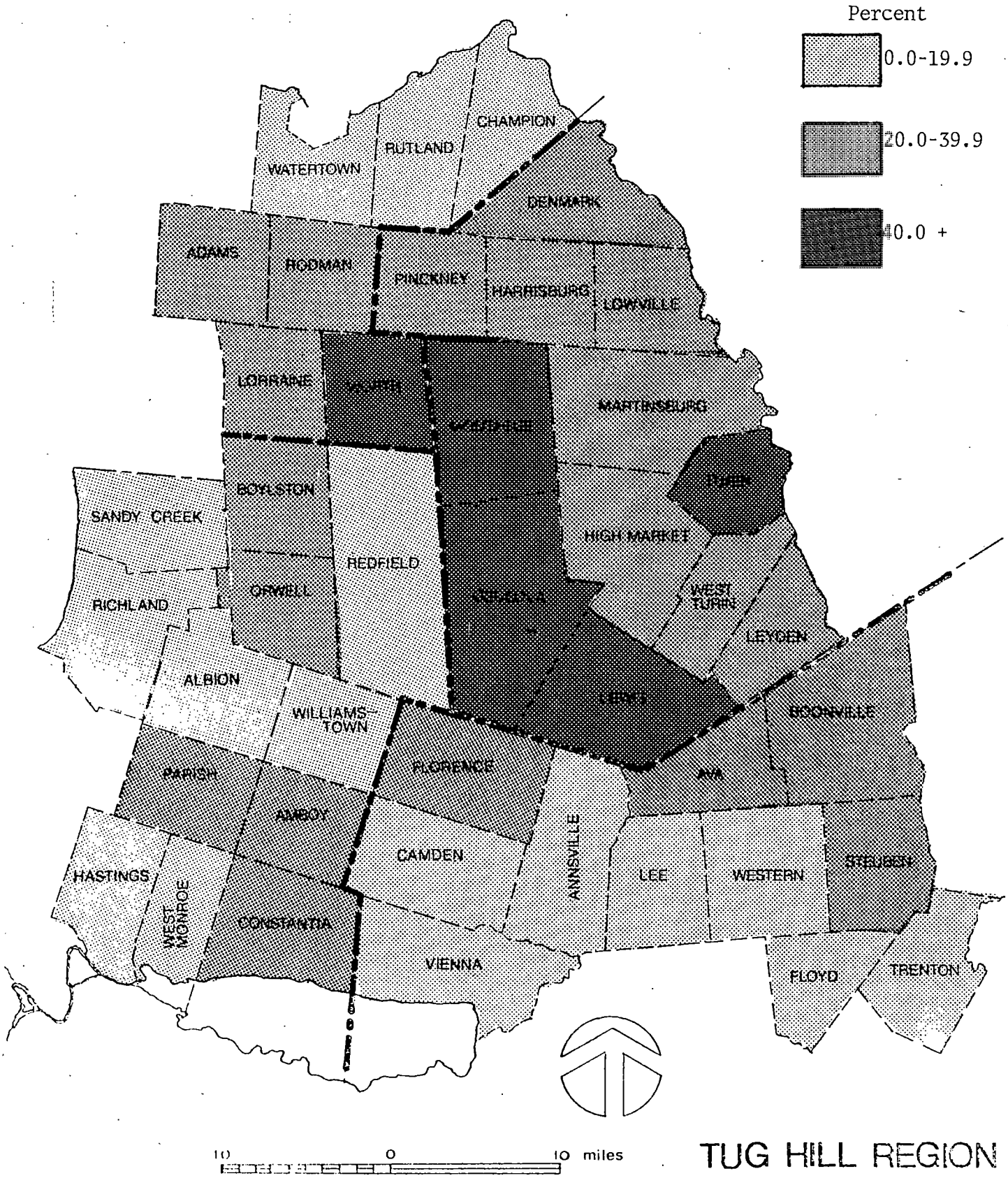


Figure 66. Persons who moved into housing unit in 1949 or earlier as a percent of total population, 1970.

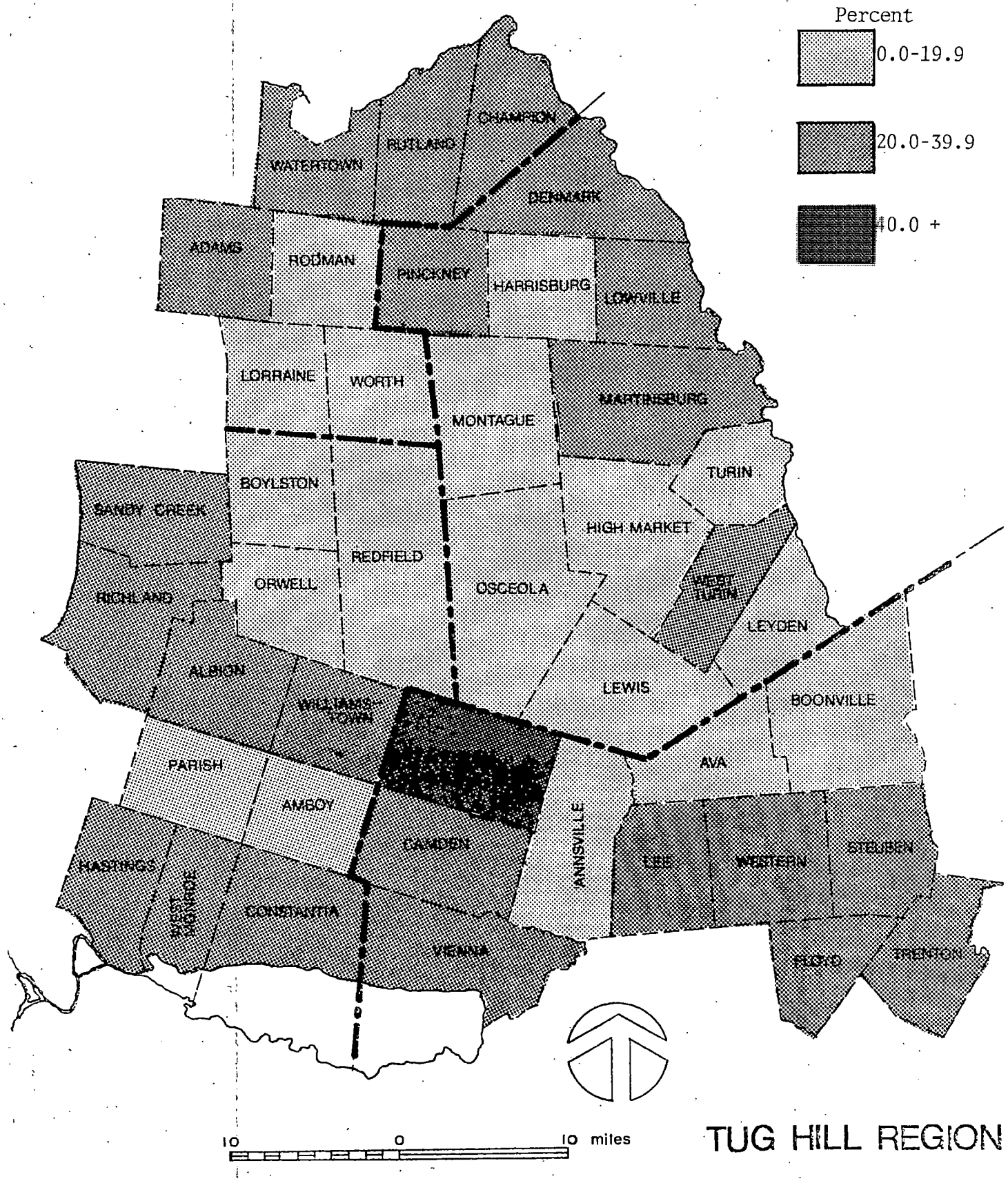


Figure 67. Persons who moved into housing unit from 1968 to April 1970 as a percent of total population.

The dependent population for major part in the Tug Hill Region is:

Area	Percent by age group 0-19	65+	Total
Northeast rim	41.8	10.5	52.3
Southwest rim	43.1	8.0	51.1
Core	46.8	8.6	55.4
Entire Region	43.0	9.0	52.0

The larger concentration of people under 20 in the core area reflects somewhat larger family sizes in the child rearing ages. The larger concentration of persons 65 and over in the northeast rim is combined with a slightly smaller concentration of persons under 19 years of age, indicating, along with the mobility data, a population consisting of 2 major groups. First is an older and long-time resident population, and second is a substantial transient population (Figures 68 and 69).

An additional measure of the dependency of the population of an area is the reliance on social security income. In this instance the family income derived from social security payments amounts to eight percent of all family income, in marked contrast to four percent for both the northeastern and southwestern rim areas of the Region. The concentration of dependency on social security income by towns is shown in Figure 70.

Income

The concentration of families earning incomes under $4,000, and over $15,000, in 1969 are as follows:

Area	Percent of families 0-$3,999	$15,000 or over
Northeast rim	15.4	13.5
Southwest rim	11.3	16.5
Core	16.6	8.8
Entire Region	13.3	14.7

Although relatively large concentrations of families earning less than $4,000, and a relatively small concentration of families earning over $15,000, are located in the core of the Region, their numbers are relatively small. Only 354 families earn under $4,000, and 187 families earn over $15,000. The relatively large concentration of families earning over $15,000 in the southwest rim again shows the influence of urban-related growth spreading into the suburban and rural-urban fringe areas.

The map showing family income under $4,000 (Figure 71), and the map showing the family income over $15,000 (Figure 72), show these comparisons between towns within the Region.

In order to present income data in a way more accurately reflecting poverty conditions, the 1970 Census reported the number of families in relation to a level of poverty, which reflected family size, housing needs,

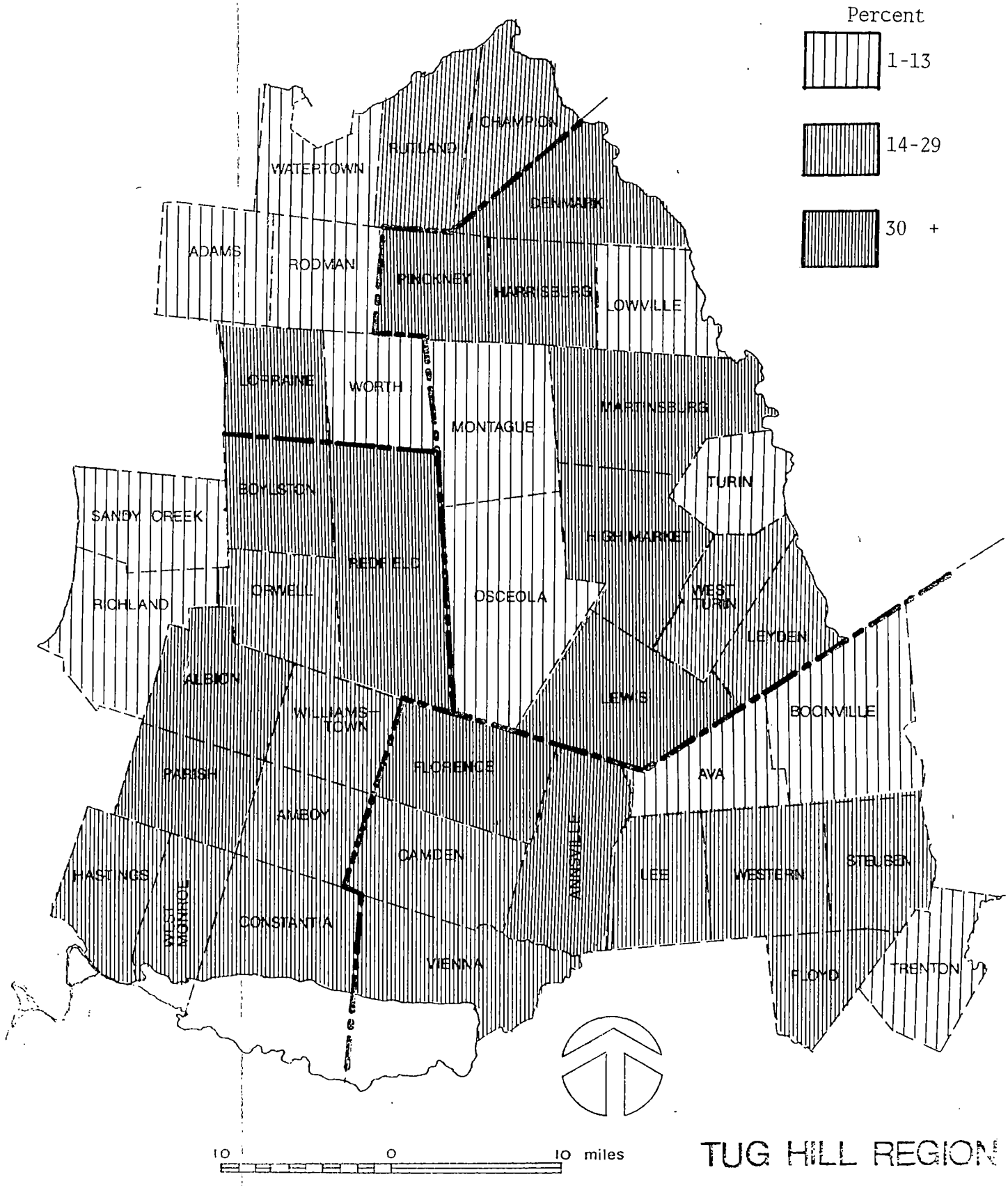


Figure 68. Population 0 to 19 years of age, 1970.

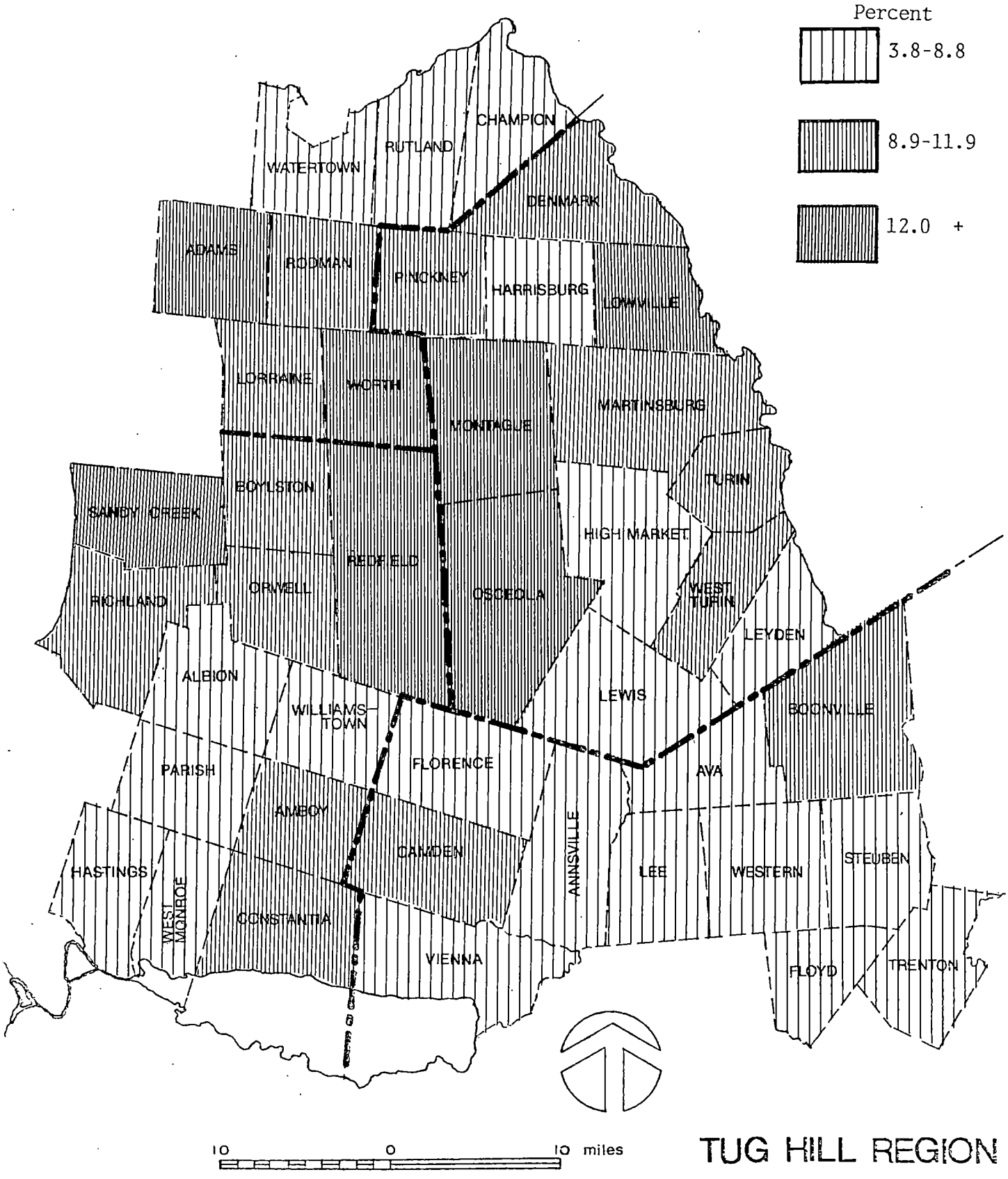


Figure 69. Population 65 years of age and over, 1970.

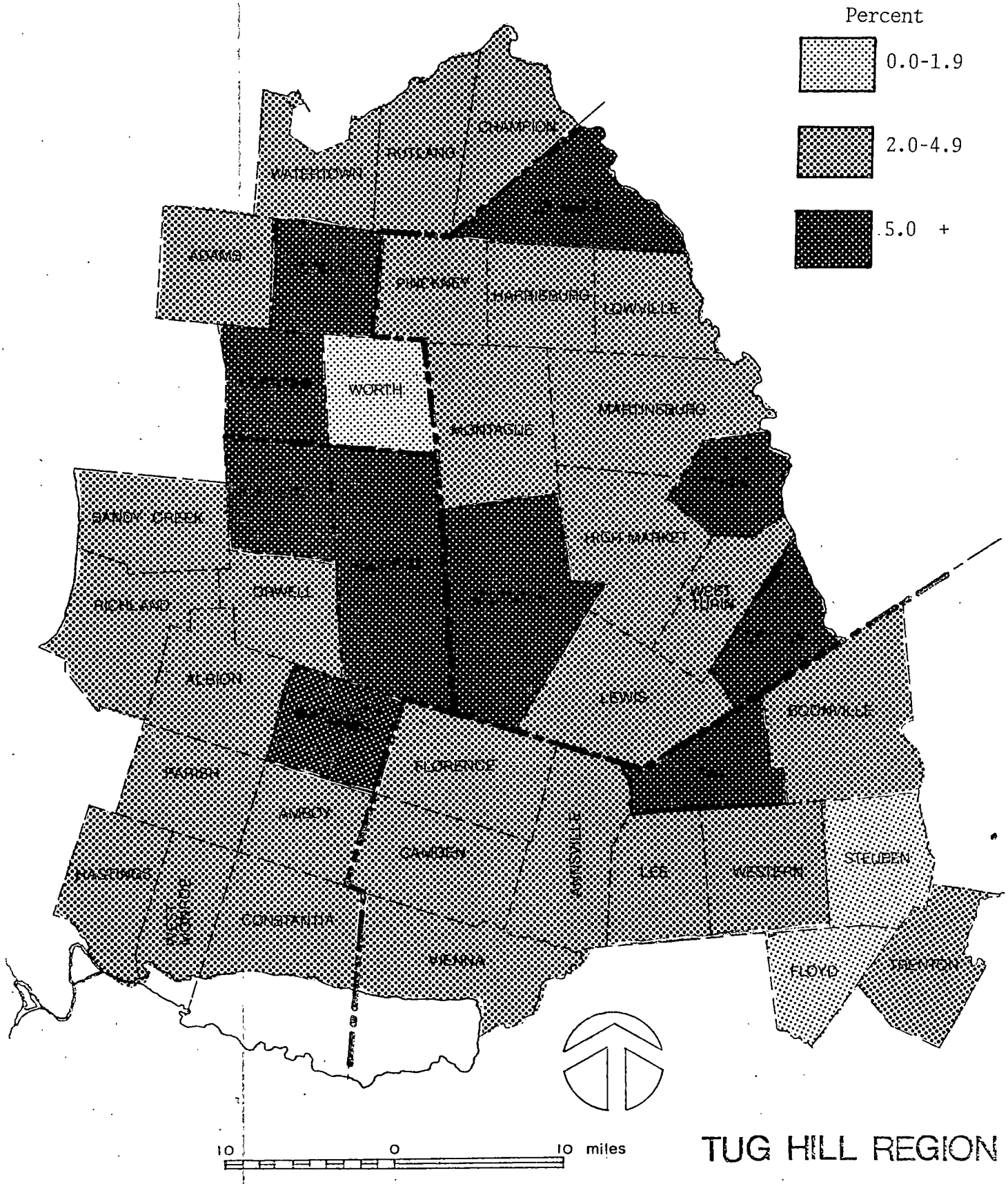


Figure 70. Family income from Social Security as a percent of total family income, 1969.

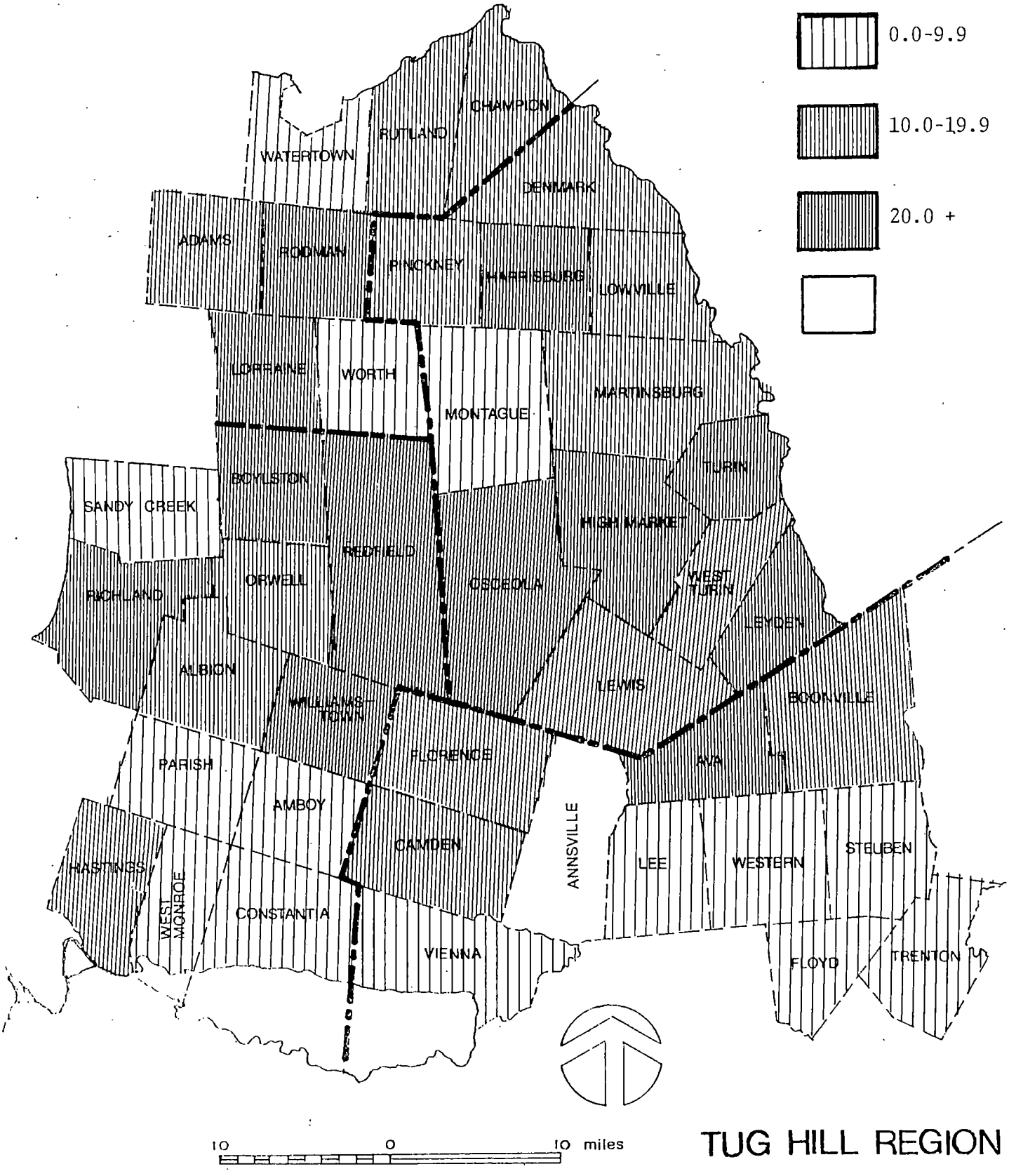


Figure 71. Families earning 0 to $3,999 as a percent of all families, 1969.

and other expenses as well as total family income. These data, the number of families below the poverty level, are shown on Figure 73, and are summarized:

Area	Percent of families below poverty level, 1969
Northeast rim	7.7
Southwest rim	8.0
Core	10.4
Entire Region	8.1

Again, the core area shows the largest concentration, 10 percent, or 281 families. The northeastern rim shows 7.7 percent, or 900 families. And the southwestern rim has 8.0 percent, or 732 families.

WHO WORKS IN THE REGION

Approximately 28,000 residents of the Tug Hill Region were employed in 1970. On the other hand the number of jobs available in the Region, while not easily determined, are considerably less, being perhaps only one-third of the total number of resident workers employed. Thus, a primary function of the Region is to provide desirable living areas for families having workers employed outside the Region.

Occupation

More frequently than education, occupation is used to describe the social and economic characteristics of a region. Like education, assumptions are possible regarding the population's economic ability, life style, participation in formal organizations, leadership, and interests in educational and related activities. These are based on the distribution of occupation types in a Region.

In 1970, sales and clerical, professional and managerial, and farmers and farm laborors constituted nearly half (45 percent) of all employed persons living in the Tug Hill Region. The distribution of these workers within the Region is shown in Tables 65 and 66, and in Figures 74-76.

The largest concentration of the urban-related sales and clerical workers is in the southwest rim, where nearly 20 out of 100 workers are employed in sales and clerical activities. At the same time only 5 workers out of 100 workers in the southwest rim are farmers. The reverse condition exists for the core area. And the northeast rim shows the largest concentration of farm workers. Altogether for the Region, there exists double the number of both professional and clerical workers than of farm workers.

The geographic distribution of these workers (especially as shown in Figures 74 and 76) reinforces earlier conclusions concerning the essential characteristics of the northeast rim (agricultural), southwest rim (part of the rural-urban fringe), and core (separate and isolated from surrounding activities).

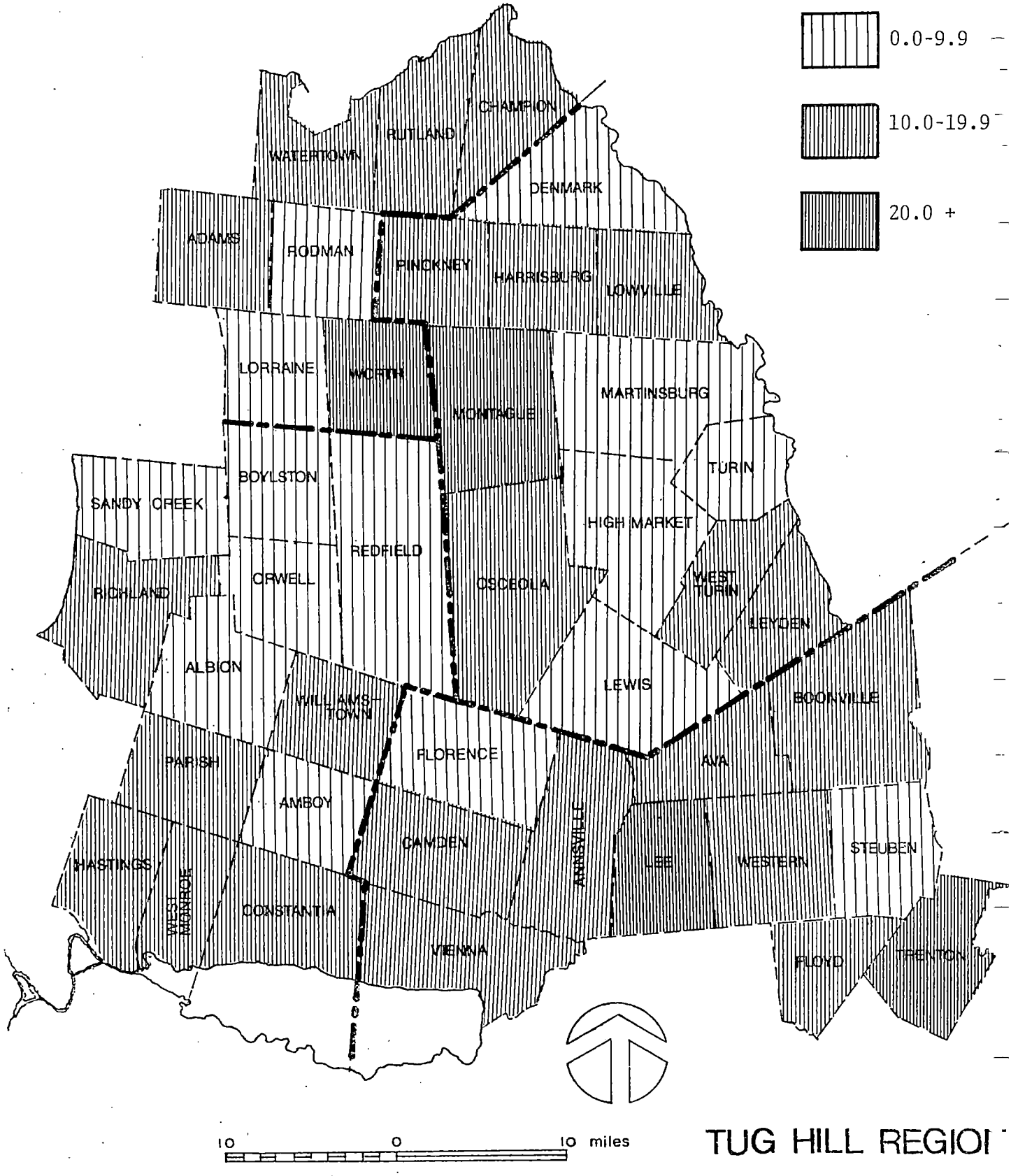


Figure 72. Families earning $15,000 or more as a percent of all families, 1969.

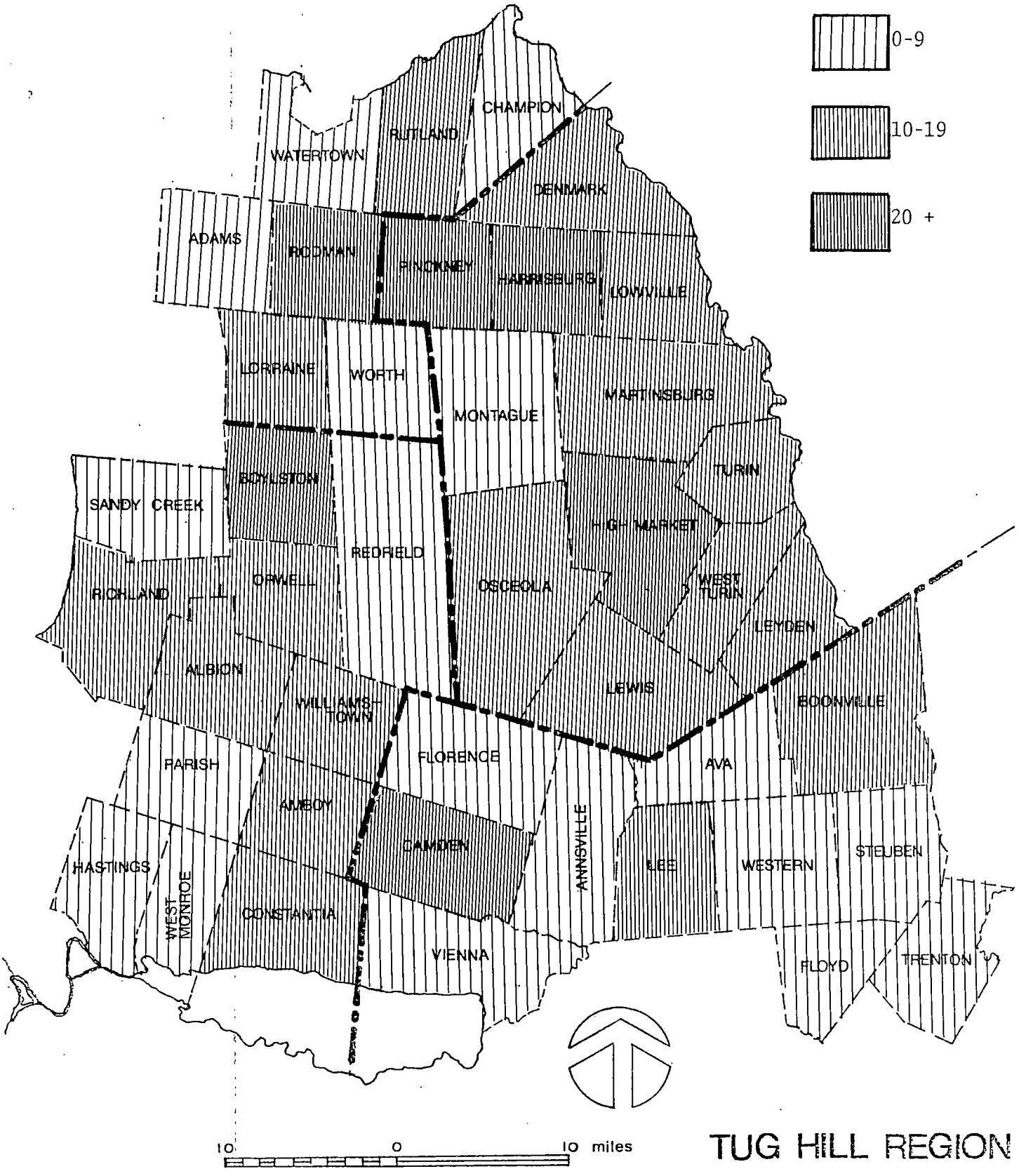


Figure 73. Families with income below the poverty level as a percent of all families, 1969.

Table 65. Selected occupational characteristics for employed persons of the Tug Hill Region, 1970.

Area	Professional and managerial		Sales and clerical		Farmers and farm laborer		All	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Core	279	11.2	280	11.2	320	12.8	2,490	100.0
Northeast rim	2,391	19.3	1,931	15.9	1,614	13.3	12,164	100.0
Southwest rim	3,225	20.2	3,051	19.2	729	4.6	15,928	100.0
Entire Region	5,895	19.1	5,262	17.2	2,663	8.9	30,582	100.0

Table 66. Proportional distribution of selected occupational characteristics for employed persons of the Tug Hill Region, 1970.

Area	Percent by area within occupational classes			
	Professional and managerial	Sales and clerical	Farmers and farm laborer	All
Core	4.8	5.3	12.0	8.1
Northeast rim	40.2	36.7	60.6	39.8
Southwest rim	55.0	58.0	27.4	52.1
Entire Region	100.0	100.0	100.0	100.0

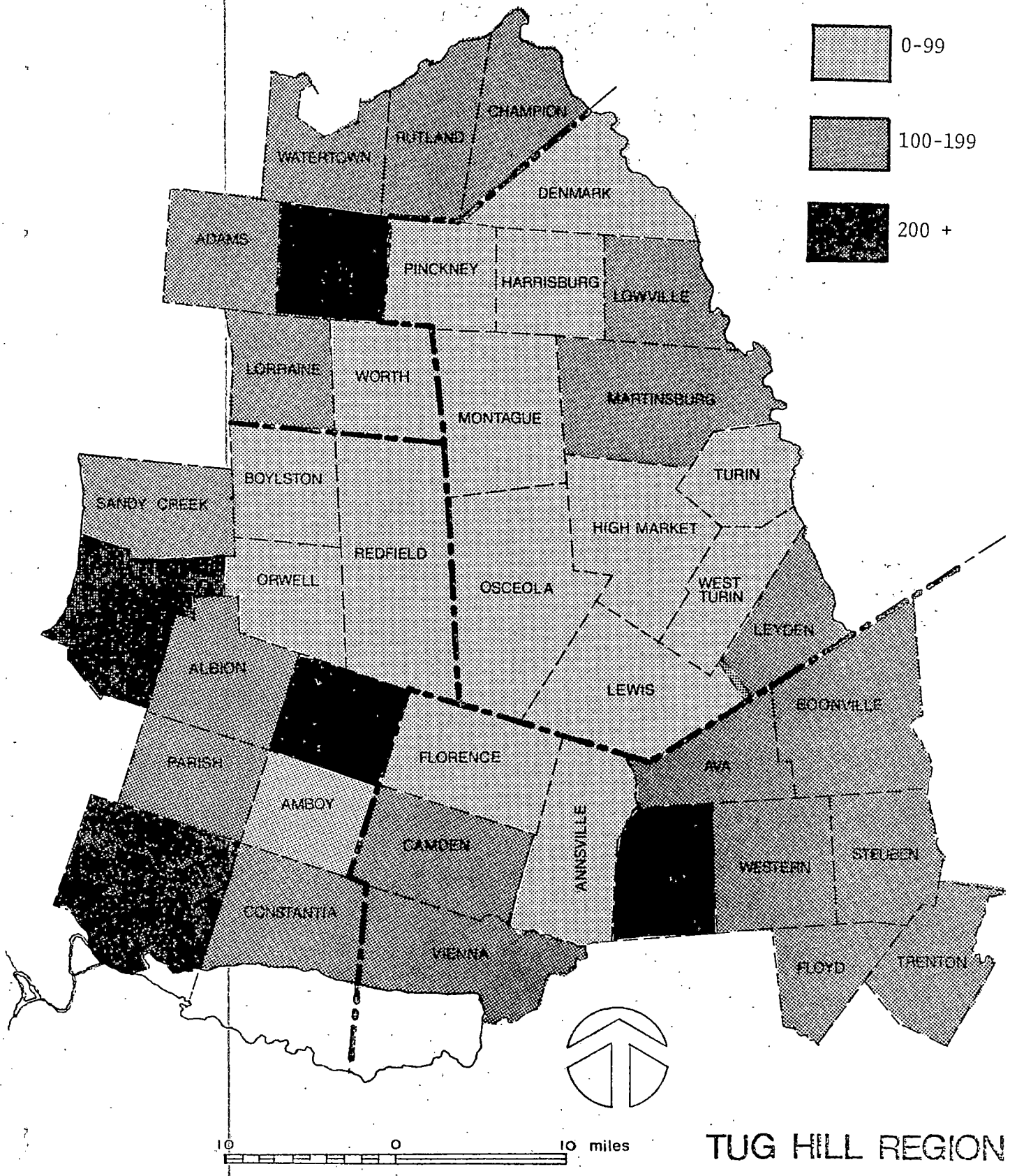


Figure 74. Sales and clerical workers per 1000 employed workers, 1970.

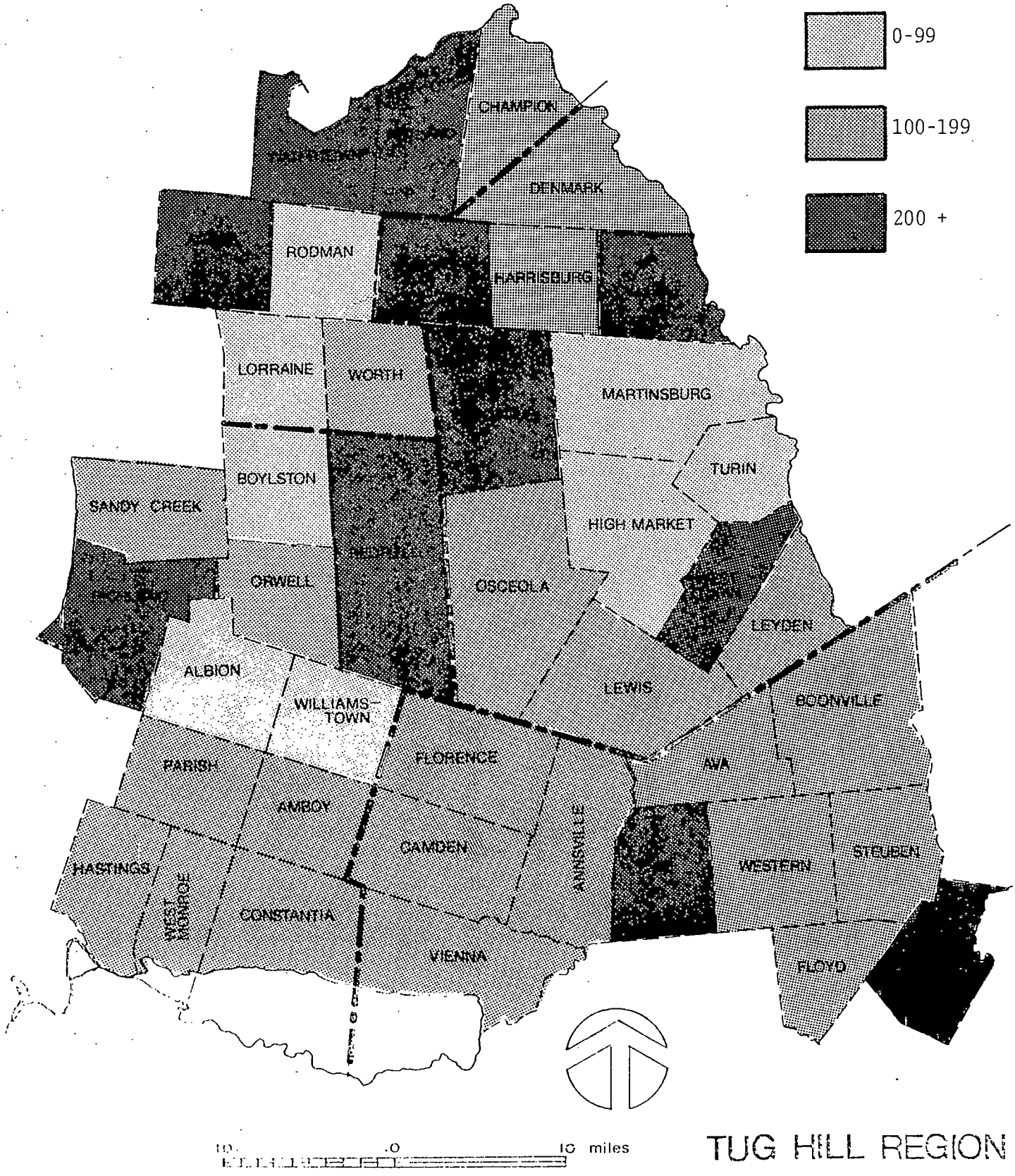


Figure 75. Professional and managerial workers per 1000 employed workers, 1970.

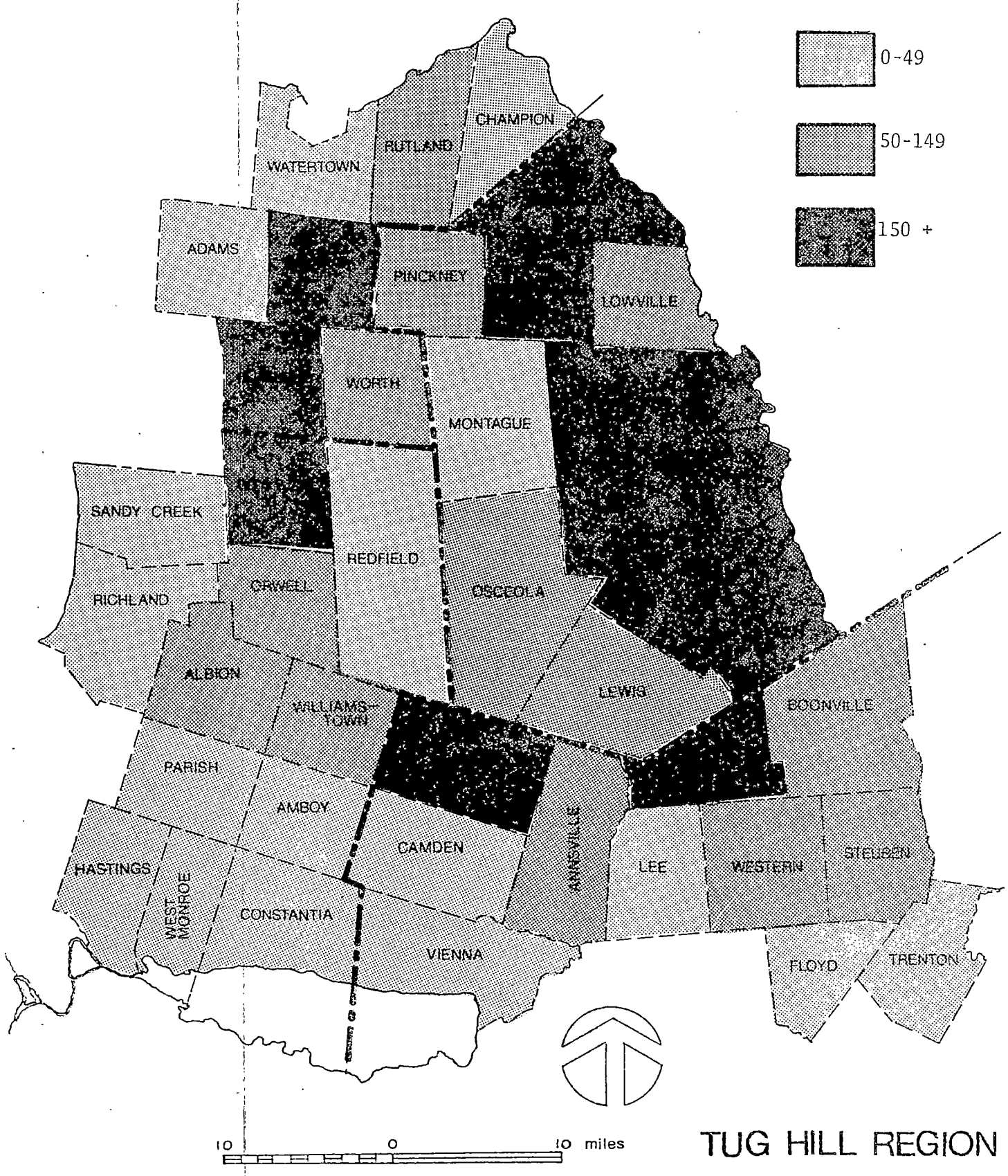


Figure 76. Farmers per 1000 employed workers, 1970.

Jobs

The number of jobs available in the Region is not known, but some estimates of farm and industrial employment can be made from both published and unpublished sources. No information is available for retail sales, service, or government employment in the Region.

Farm employment can be estimated from the number of farm workers residing in the Region, or about 2,700. Part of the importance of farming activities can be measured by the percentage of total family income derived from farming. Farming provides seven percent in the core and northeast rim, and two percent in the southwest rim (Figure 77).

Industrial employment for 1973, estimated from unpublished state sources, indicates that there were a minimum of 4,600 industrial jobs, with the actual number probably slightly over 5,000. The number of firms, and the percentage distribution of employment between major industrial types, is as follows:

Type firm	Number of firms	Percent of employment
Lumber	31	2.3
Wood products and paper	17	56.7
Food processing	16	6.5
Sand and gravel	6	1.3
Printing and publishing	14	4.7
Machinery and metal mfg	14	22.3
Miscellaneous	24	6.2
Entire Region	122	100.0

Eleven of the firms employed over 100 people, and 7 of the 11 largest firms were wood products or paper related industries. For the Region, over one-half of the industrial jobs were related to the paper industry, with two firms accounting for nearly one-half of these jobs.

Of the 31 firms engaged in lumber activities, one-third were logging camps and logging contractors, one-third sawmills and planing mills, and one-third lumber companies. Food processing employment was divided almost equally between milk and cheese processing, with a small number engaged in feed processing. Machinery and metal firms were engaged in manufacture of machinery and parts and in the production of wire. Miscellaneous manufacturers included five firms engaged in production of concrete products, and four in manufacture of clothing.

In conclusion, a substantial and active employment base exists, related to some of the major resources of the Region, namely forestry, agriculture, and people. Yet of far greater significance is the employment of the Region's population in jobs outside the Region. This employment of people at jobs outside the Region will probably become greater in the future, relative to employment within the Region. In fact, because of the urban-related growth that will likely occur adjacent to the southwestern rim, it is important to prepare the Region to receive the residential and residential-related growth that it will likely receive.

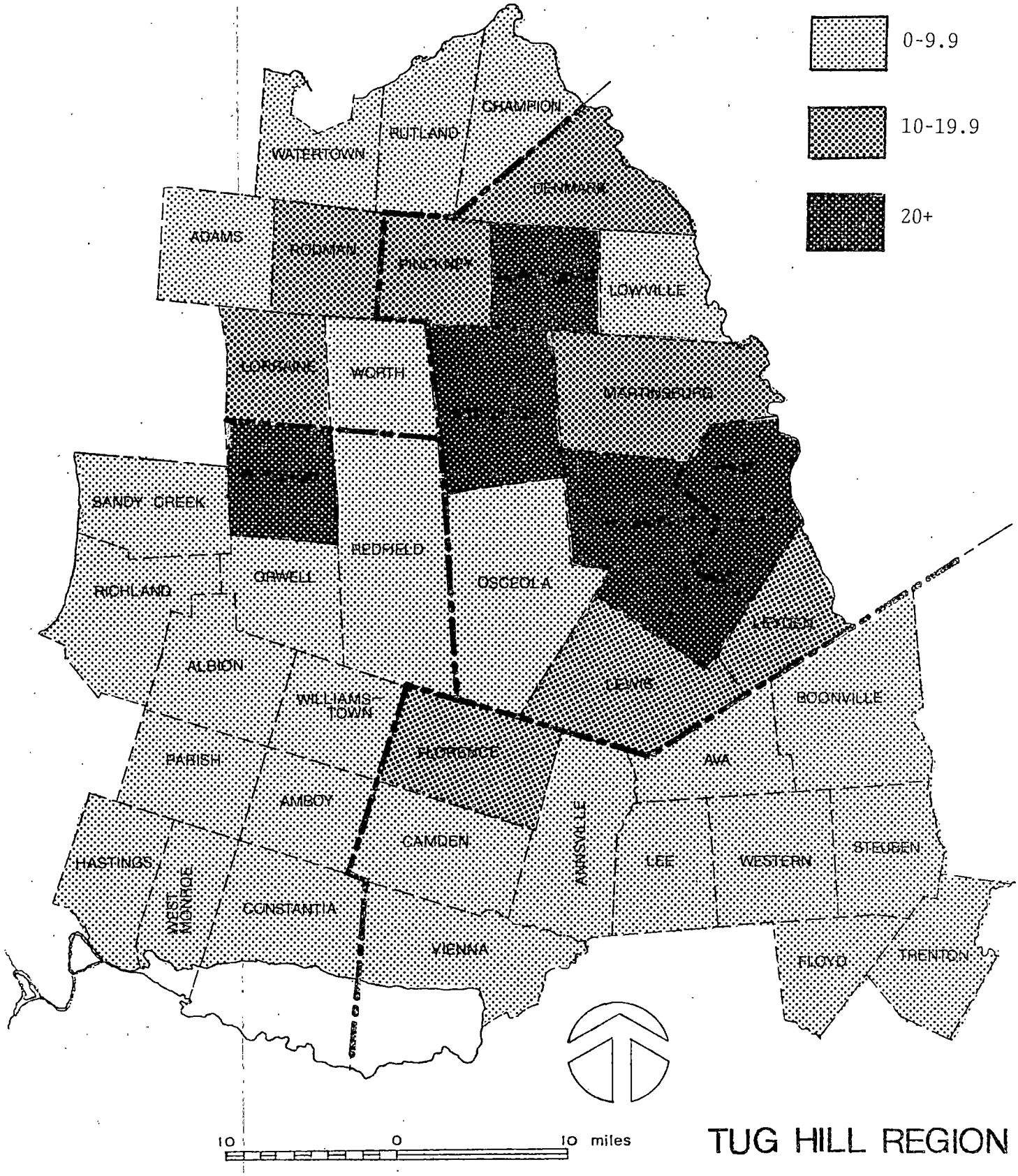


Figure 77. Family income from farm employment as a percent of total income, 1969.

SOCIAL AND INSTITUTIONAL FACILITIES

Major Medical Facilities

The Tug Hill Region contains only one major hospital (Lewis County General Hospital), plus the Adirondack Health Center near Boonville. Watertown and Carthage in Jefferson County offer nearby facilities to the north, and Utica and Rome in Oneida County offer extensive facilities to the south (Table 67). There are no hospitals or nursing homes in the 12 Oswego County towns that lie inside the Region. A few proprietary homes care for people who do not need intensive nursing care. A nursing home will be opened in Williamstown sometime in 1974, with 15-20 beds. Currently, people in Oswego County who need hospitalization go to the following areas:

Sandy Creek to Watertown
Richland to Syracuse and Watertown
Mexico to Syracuse and Oswego
Altmar and Redfield to Watertown, Syracuse, and Rome
Parish and Central Square to Syracuse
Cleveland to Syracuse and Rome.

Pulaski has a clinic, staffed five days a week by Family Practice Residents out of St. Joseph's Hospital of Syracuse. The clinic has no overnight capability. It takes emergencies in the daytime, but at night emergency cases are taken to the nearest hospital.

Physicians are few in the Region. Larger communities have a few. Smaller communities typically do not have any. Several villages have recruitment programs, but have not necessarily been successful. For example, the Village of Copenhagen in Lewis County cannot find a doctor, even though it has a building. Constableville never had a doctor. Lowville has an active recruitment program, but even with a hospital in the village does not consider the program "too successful".

Ambulance service is a problem. Facilities are limited and distances great. West Leyden and Constableville are serviced by their Fire Departments, but must go to Rome to find an emergency treatment center. Lowville, a hospital center, has one ambulance, operated by a funeral home. This service is to be dropped and there is no immediate plan to replace it. A voluntary ambulance service just formed in Pulaski must serve Boylston, Sandy Creek, Redfield, Richland, Orwell, Albion, Williamstown, Parish and Amboy.

In summary, major medical support services generally lie outside the Region or along its perimeter. There are difficulties in maintaining local medical support at present levels, and emergency services tend to lose effectiveness because of problems of distance and poor coverage. Increased informal coordination between and among medical service agencies, and social service and law enforcement agencies operating within the Region, might result in stronger, better-knit support.

Table 67. Hospitals and nursing homes of the Tug Hill Region and vicinity.[a]

Health care facility	Location	Bed capacity
Jefferson county hospitals[b]		
Carthage Area Hospital	Village of Carthage	50
House of the Good Samaritan	City of Watertown	219
Mercy Hospital	City of Watertown	192
Jefferson county nursing homes[b]		
Greenbriar Nursing Home	Village of Carthage	40
Samaritan Keep Home	City of Watertown	158
Madonna Home of Mercy Hospital	City of Watertown	120
Lewis county hospitals and nursing homes[c]		
Lewis County General Hospital	Village of Lowville	88
Lewis County Nursing Home[d]	Village of Lowville	120
Oneida county hospitals[e]		
St. Elizabeths Hospital		306
St. Luke's Memorial Hospital		248
St. Luke's Extended Care		106
Faxton		140
Children's Hospital		54
Adirondack Health Center	Boonville	
Rome County Hospital		200
Rose Hospital		100
Oneida county nursing homes[e]		
Eden Park (nursing)	Utica	80
Eden Park (health related)	Utica	36
Presbyterian	Utica	80
Sitrin	Utica	30
St. Joseph's	Utica	120
Genesee	Utica	112
Broad Acre	Utica	168
Stonehedge	Rome	164
Rome Nursing	Rome	80
Bethany (health related)	Rome	100
Lutheran (nursing)		40
(health related)		26
Sunset	Boonville	75
Evergreen	Camden	

a See text for information about Oswego County health care facilities.
b Compiled by B. Rosenquist, Jefferson County Planning Board.
c Interview, A. Raymond, Administrative Assistant, Lewis County General Hospital.
d Scheduled to open early in 1974.
e Interview, M. Tellariko, Oneida County Department of Social Services.

Welfare[4]

In New York State, in 1970, public assistance recipients outside of New York City, including the medically needy, represented 8.2 percent of the population. Table 68 shows that in the four Tug Hill Counties, assistance equaled or exceeded this level. Indications are that they are higher now. In late 1972, unemployment in the Rome-Utica area was the highest in the state (Oneida Co. Dep. Social Serv., 1972) with consequent effects in the Tug Hill Region. In Lewis County, a total of 12.5 percent of the families had incomes below the poverty line, and for every working person in the county there were 1.71 people not working.

There are two fundamental categories of welfare recipients. One group is the physically handicapped (including the blind or disabled, the mentally retarded, and both children and the elderly who have no one to support them). The other group includes those who need assistance because they are very poor, or cannot find jobs at all.

There is some indication that physical and economic dependence are exaggerated by the remoteness of much of the Tug Hill Region. There may be a greater caseload in the rim towns, but the most extreme conditions are found in the core. The more able "escape" to the populated areas in search of jobs, specialized rehabilitation, and medical care programs, and better housing. Those who remain are people rooted to the land, the extremely poor and elderly, and the mentally deficient. In some remote areas, small groups of people of low intelligence intermarry, creating a problem of inbreeding and severe retardation. The same names appear over and over again in the case records of remote Tug Hill towns.

Lack of transportation is a major obstacle for the poor and elderly in remote areas, particularly in winter. Shopping and even getting to the doctor or the employment office are problems. Even when transportation to the city can be arranged, there are problems of clients following through. The city can be mystifying and stressful to someone who has spent a lifetime in a tiny hamlet. Thus, unfamiliarity with the outside world tends to perpetuate itself and cultivates poverty. Consolidated school districts, BOCES and Head Start (all designed to overcome cultural shock) do not reach many needy people in the core of the Region.

If the poor of the Tug Hill Region stay where they are, perhaps the only significent structural change which would help them would be an increase in economic activity and general movement of people through the Region. But their way of life may not be very significantly changed by an influx of seasonal landowners and visitors.

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[4]The substance of these comments is based on interviews with:

Alan Stoughton	UDC Albany
Carl Parsons	Black River/St. Lawrence Regional
Shirley Jones	Social Services, Utica
Martha Steel	Social Services, Watertown
B. Burnholz	Social Services, Lowville
Don Clemons	Social Services, Mexico

Table 68. Medically needy and public assistance recipients as a percent of total population, for Tug Hill counties, 1970.[a]

County	Percent of population assisted
Jefferson	10.0
Lewis	9.3
Oneida	8.2
Oswego	9.4
All New York State, outside New York City	8.2

[a] Source: N.Y.State Off. of Stat. Coord., 1972.

Table 69. Law enforcement agencies of the Tug Hill Region.

Map code[a]	Agency and location
	Jefferson County
1	Adams Village
2	Jefferson County Sheriff (Watertown)
3	Watertown City
4	State Police (Watertown)
5	Carthage Village
6	State Police (West Carthage)
	Lewis County
7	Lewis County Sheriff (Lowville)
8	Lowville Village
9	State Police (Lowville)
10	Lyons Falls Village
	Oneida County
11	Boonville Village
12	State Police Substation (Remsen)
13	Holland Patent Village
14	Oneida County Sheriff (Westmoreland)
15	State Police Zone Headquarters (New Hartford)
16	State Police Troop D Headquarters (Oneida)
17	State Police Substation (Sylvan Beach)
18	Camden Village
	Oswego County
19	Cleveland Village
20	Constantia Village
21	Central Square Village
22	Parish Village
23	Pulaski Village
24	State Police Substation (Pulaski)
25	Oswego City
26	Oswego County Sheriff (base station)
27	Oswego County Sheriff (substation)
28	Mexico Village
29	State Police Substation (Minetto)
30	Fulton City
31	Phoenix Village

[a] Map code applies to locations drawn in Figure 78.

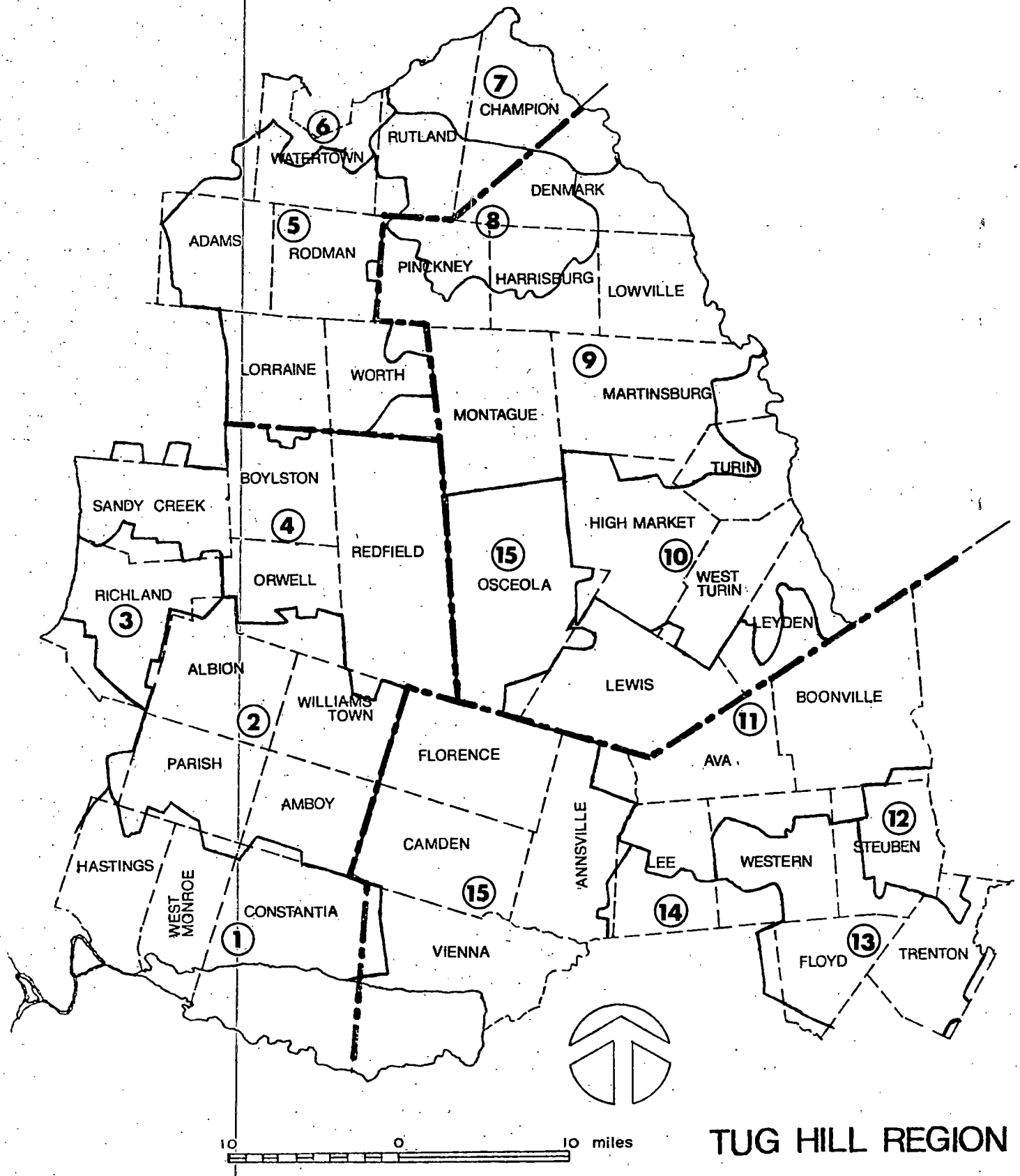


Figure 78. Law enforcement agencies of the Tug Hill Region.

Inadequate housing creates a hardship shared by welfare recipients and everyone else with less than a moderate income. Housing in the rim towns may be bad, but in the core some houses have no electricity, water, insulation or floors. Under current conditions, low income rental housing cannot be provided. Because of high construction costs, rents would be set at $135-165 per month, even after federal subsidy. Many residents are just getting by on $75-95 per month for rentals of dilapidated farm houses. Concentrations of mobile homes raise problems of waste disposal and rapid depreciation of value. Subsidized housing needs to be concentrated in order to be economical, but Tug Hill's poor are not clustered.

In sum, Tug Hill faces a somewhat larger than average welfare burden. In much of the Region, the economic development which could ameliorate the problem is not forthcoming. Costs of meeting local requirements are somewhat higher than they would be in urban centers, because of special needs for transportation over long distances and often in severe weather. The most extreme needs are in the remote areas, but these are less susceptible to remedy than the more numerous cases in the rim towns.

Law Enforcement Agencies

The Tug Hill Region is serviced by State Police, County Sheriff's Departments, by Village and City Police Departments, by the National Guard and by Federal agencies (Table 69). All counties with land in the Tug Hill Region are also a part of New York's Central Civil Defense District, with headquarters at Marcy State Hospital near Rome. Major local facilities and headquarters are as shown in Figure 78 and take the familiar ring shaped form described earlier.

Written reports and interviews suggest that police support may fall slightly short of current needs, particularly in suburban areas. Standard rate tables support these claims, but nowhere is the shortage deemed serious. The several law enforcement agencies concerned can and do coordinate to some extent, thus providing for more efficient supervision of the Region than would result otherwise.

Schools

The Tug Hill Region is divided into 15 school districts. Their boundaries are shown in Figure 79. As with most other social facilities serving the Region, schools form a ring around its periphery, with school bus routes reaching far into the sparsely settled core area. The locations and types of existing units are indicated in Figure 80. Only one college,[5] and relatively few combined schools, serve the Region.

The Board of Cooperative Educational Services (B.O.C.E.S.) has centers at Watertown (serving the Carthage and South Jefferson school districts), and at Glenfield in Lewis County (serving the Adirondack, Copenhagen, Lowville and South Lewis Central School districts). Another center is under construction at Sherrill, southeast of Verona. It will serve the Rome and Camden school

[5]Jefferson County Community College, a two-year college, outside of Watertown is part of the S.U.N.Y. system. Its 72-acre campus has a 1500 student capacity.

districts. These centers provide member school districts with services best organized on a cooperative basis, to reduce costs.

Area schools face two major problems. One is that facilities are antiquated and inadequate in size. This is particularly serious in areas faced with rapid growth during the next 25 years. The other problem is high costs. Because economies of scale tend to be great in education, consolidation of school districts has been recommended where growth rates do not promise to support an educational complex of sufficient size. In the Tug Hill Region, consolidation of the Holland Patent-Remsen districts has been recommended but not acted upon.

Libraries

Library facilities in the Tug Hill Region are of three general forms: regional, community, and rural. The four counties fall within the "North Country" and "Mid York" regional public library systems. Most of the libraries are community libraries, corporate bodies chartered by the State to provide "free and equal services to the general public". Most of them are maintained by town, village, city or county governments. The 21 community libraries of the Tug Hill Region are located as shown in Figure 81. Their comparative sizes are itemized in Table 70. Significantly larger collections are available in major cities and towns surrounding the Region. Bookmobiles and local reading centers are provided by the regional library system for rural residents living outside the zones of effective municipal library service.

Two major problems have been defined. One is the need for closer coordination between libraries in order to make more efficient use of resources (for example, among municipal, school, specialized and private libraries and in developing bookmobile routes). The other is the need for sufficient and more equable financial support. Resources per person are already inadequate in some areas, based on standards set by the American Library Association. Current incomes are not sufficient to remedy the situation. Moreover, only a few towns support the libraries. The community libraries must depend principally on local rather than on State or Federal support, but in 1971 less than half of the Region's 42 towns expended moneys for library support. Residents of all towns had access to the facilities, by law. An example used (Herkimer-Oneida Co. Compr. Plann. Program, 1968) is Camden's library which 'obtains its local funds from Town of Camden taxes. Yet library users from the Towns of Annsville, Florence and Vienna--'non-resident users' of Camden's facilities--have the same benefits of the library without sharing in its local support."

Communications Facilities

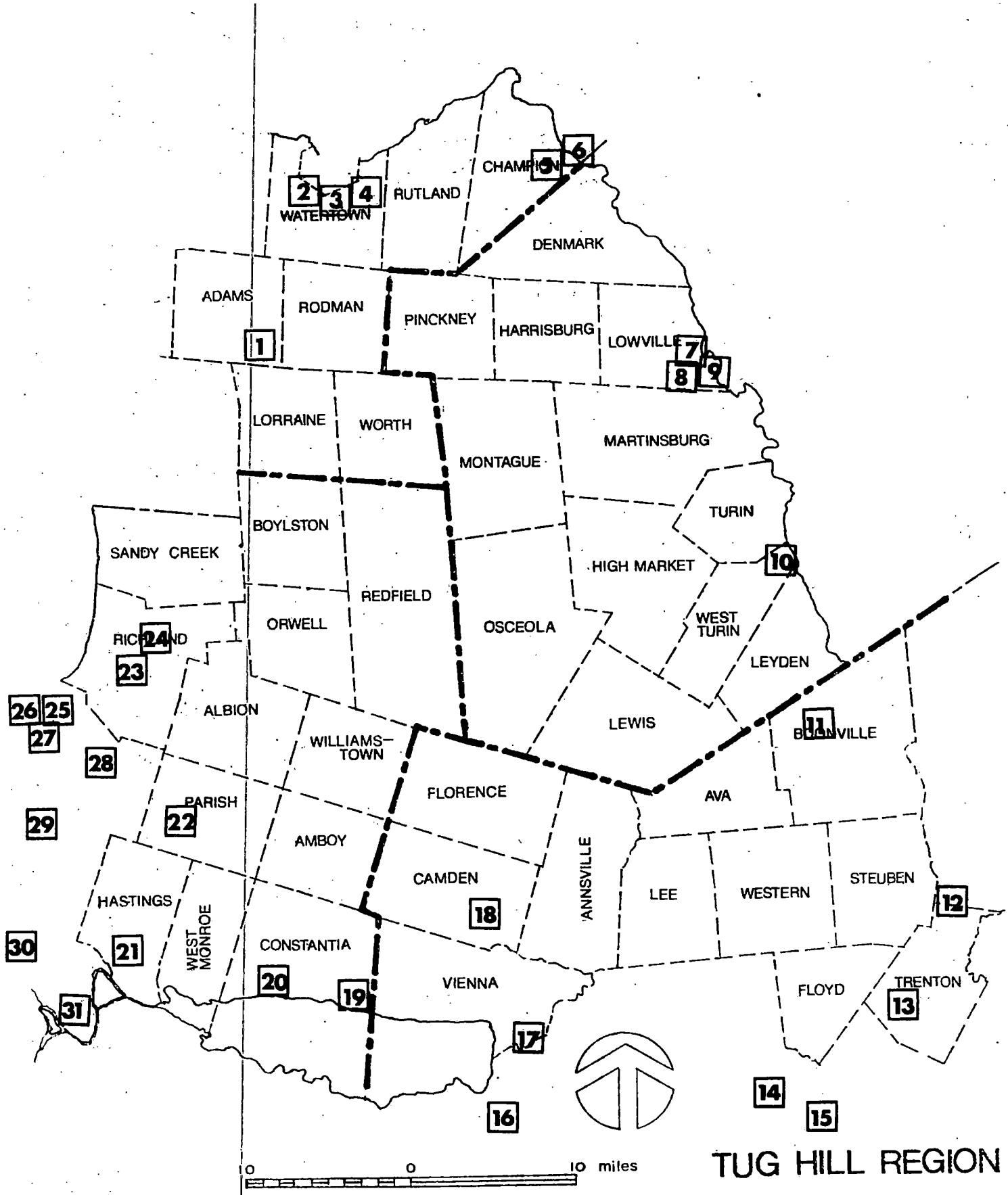
Seventeen daily, weekly and Sunday newspapers serving the Tug Hill Region are listed in Table 71. Figure 82 shows the locations and call letters of six radio stations within the area[6] and of seven television stations in the vicinity. In addition, application has been made by a Utica station for television translator stations at Lowville and at Watertown. These would carry the signal of WUTR (TV) Utica. One translator would be located three miles south-southwest of Copenhagen. The other would be 10 miles south of Lowville.

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[6]Many AM and some FM stations lying outside the Tug Hill Region have signal strength adequate to cover the Region, but are not listed here.

1. Central Square
2. A. P. W.
3. Pulaski
4. Sandy Creek
5. South Jefferson Central
6. Watertown City
7. Carthage Central
8. Copenhagen Central
9. Lowville Academy and Central
10. South Lewis Central
11. Adirondack Central
12. Remsen
13. Holland Patent
14. Rome
15. Camden

Figure 79. School districts of the Tug Hill Region.



TUG HILL REGION

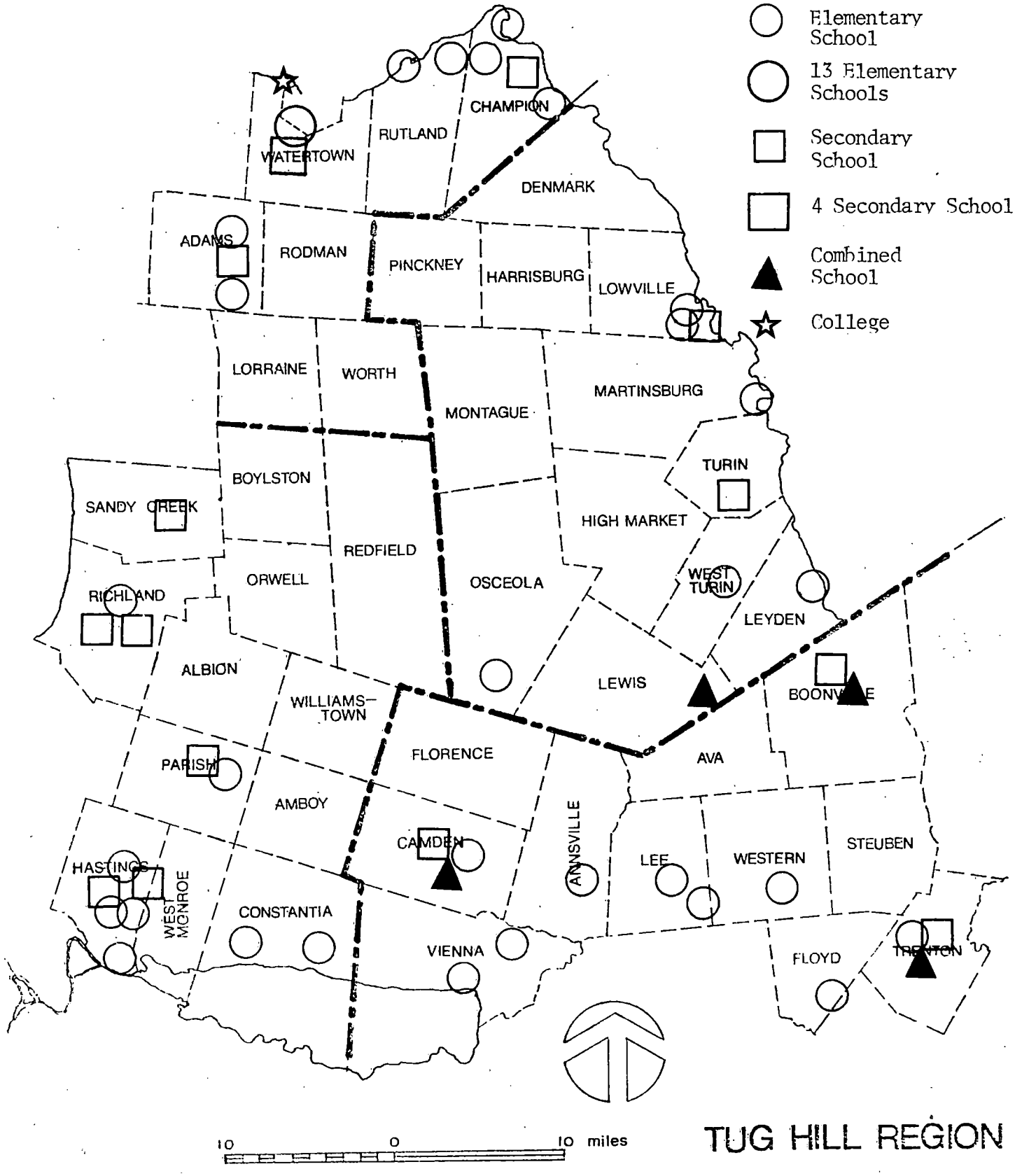


Figure 80. Schools of the Tug Hill Region.

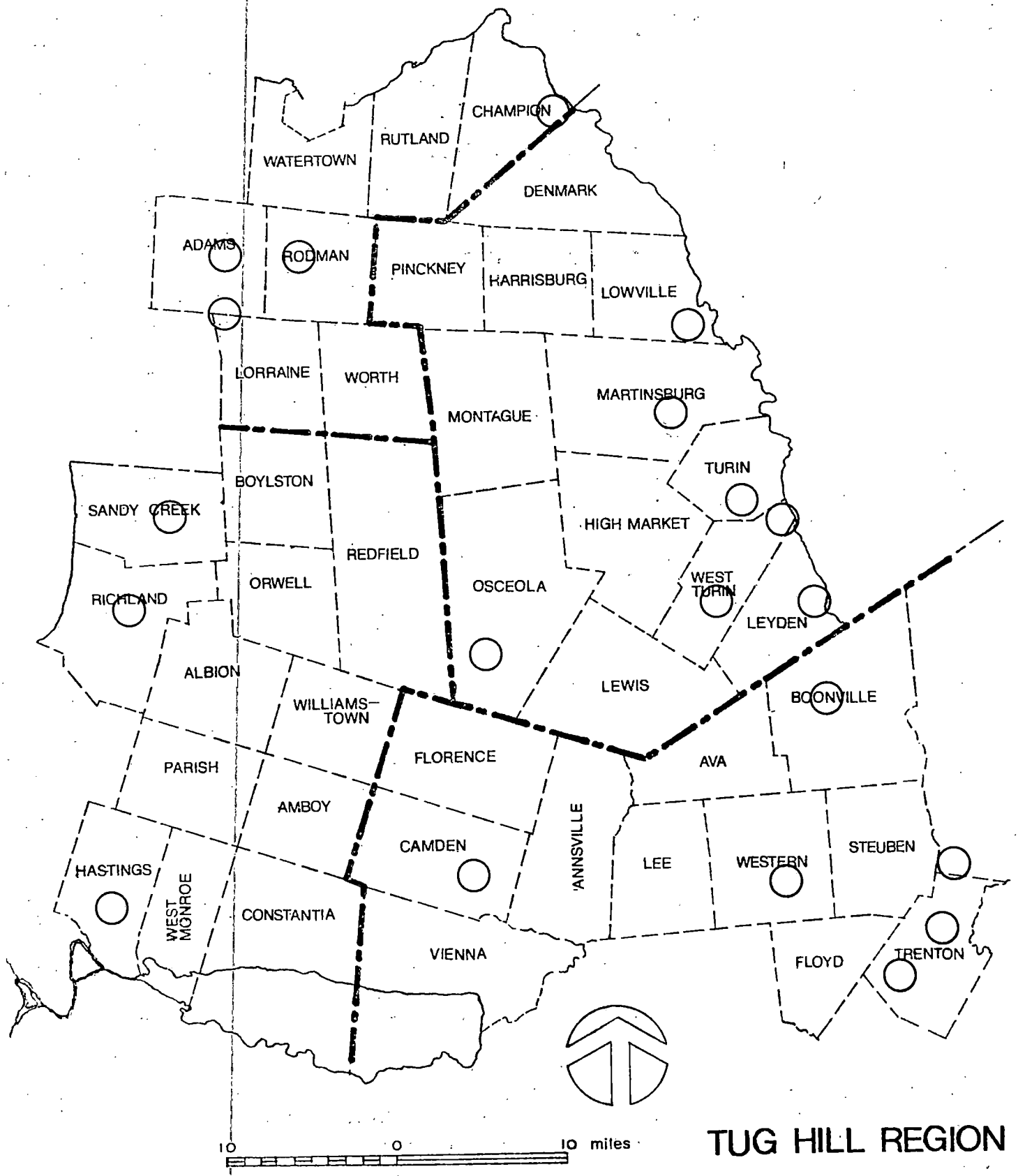


Figure 81. Libraries.

Table 70. Libraries of the Tug Hill Region.

Location	Number of books
Jefferson county[a]	
Adams	6,893
Adams Center	3,534
Belleville	2,621
Carthage	8,517
Rodman	2,139
Lewis county[b]	
Constableville	906
Lowville	12,025
Lyons Falls	4,314
Martinsburg	5,383
Osceola	1,360
Port Leyden	3,161
Turin	2,062
Oneida county[c]	
Barneveld	7,657
Boonville	13,793
Camden	11,061
Holland Patent	8,322
Remsen	7,416
Westernville	4,185
Oswego county[d]	
Ainsworth (s.c.)	3,242
Central Square	8,094
Pulaski	3,414

Sources:

a Jefferson County Department of Planning.
b Interviews, Lewis County Municipal Libraries.
c Herkimer-Oneida County Comprehensive Planning Program.
d Oswego County Planning Board Survey, April 1970.

Table 71. Daily, weekly, and Sunday newspapers serving the Tug Hill Region.

Newspaper	Location	Circulation
Jefferson county		
Watertown Times (daily and Sunday)	Watertown	43,635
Oswego county		
Central Square Citizen (weekly)	Central Square	4,000
Parish Mirror (weekly)	Parish	660
Pulaski Democrat (weekly)	Pulaski	2,750
Sandy Creek News (weekly)	Sandy Creek	2,100
Lewis county		
Journal and Republican (weekly)	Lowville	
Oneida county		
Boonville Herald (weekly)	Boonville	2,276
Camden Advanced Journal (weekly)	Camden	1,674
Rural Oneida Newsweek (weekly)		
Oneida Democrat Union (weekly)	Oneida	1,050
Madison County Times	Oneida	1,650
Oneida Dispatch (daily)		10,202
Other areas		
Rome Sentinel (daily)	Rome	19,089
Syracuse Herald Journal (daily)	Syracuse	132,811
Syracuse Post Standard (daily)	Syracuse	99,261
Herald-Journal Post Standard (Sunday)	Syracuse	232,072
Oswego Palladium Times (daily)	Oswego	16,000

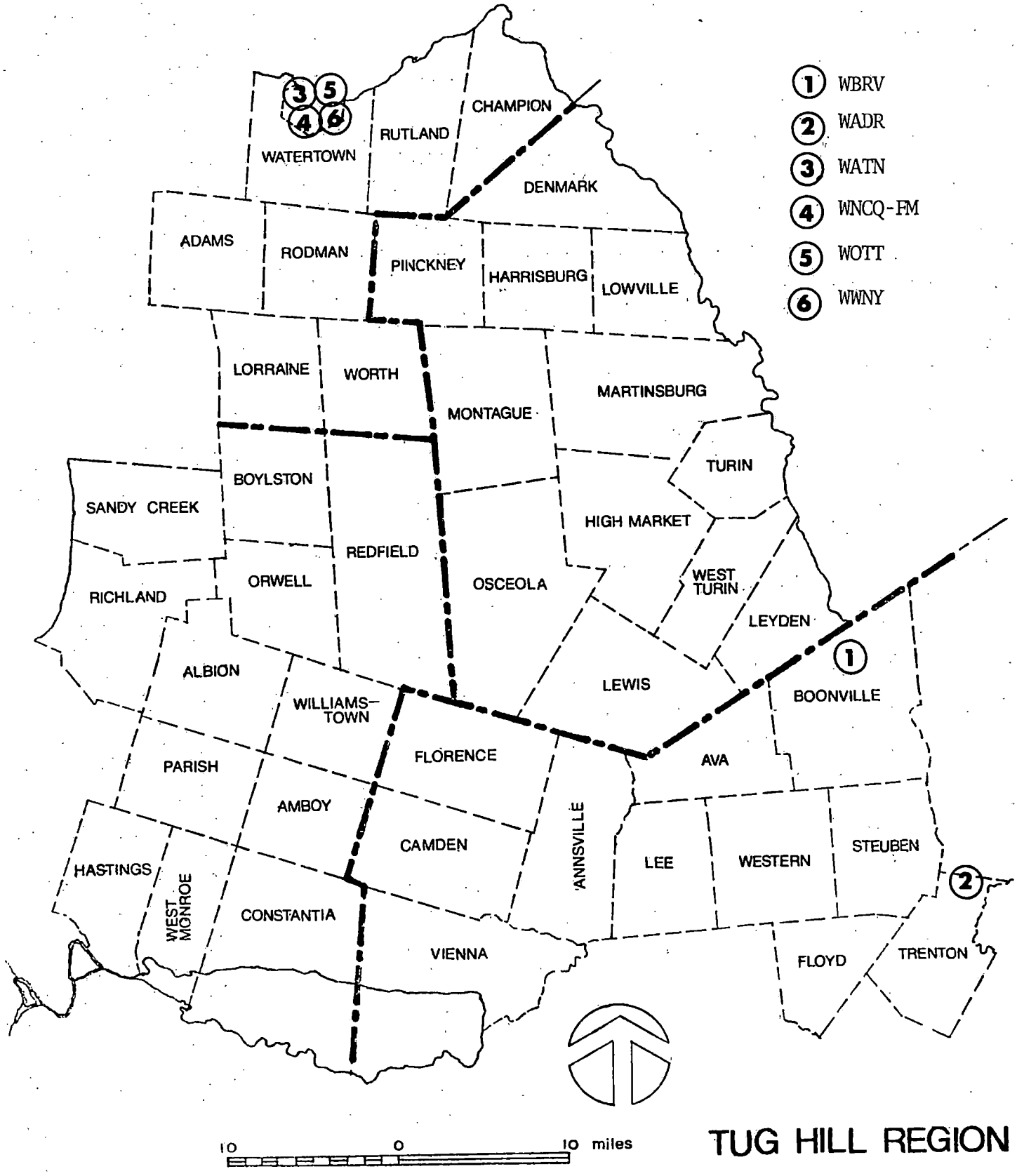


Figure 82. Local radio stations.

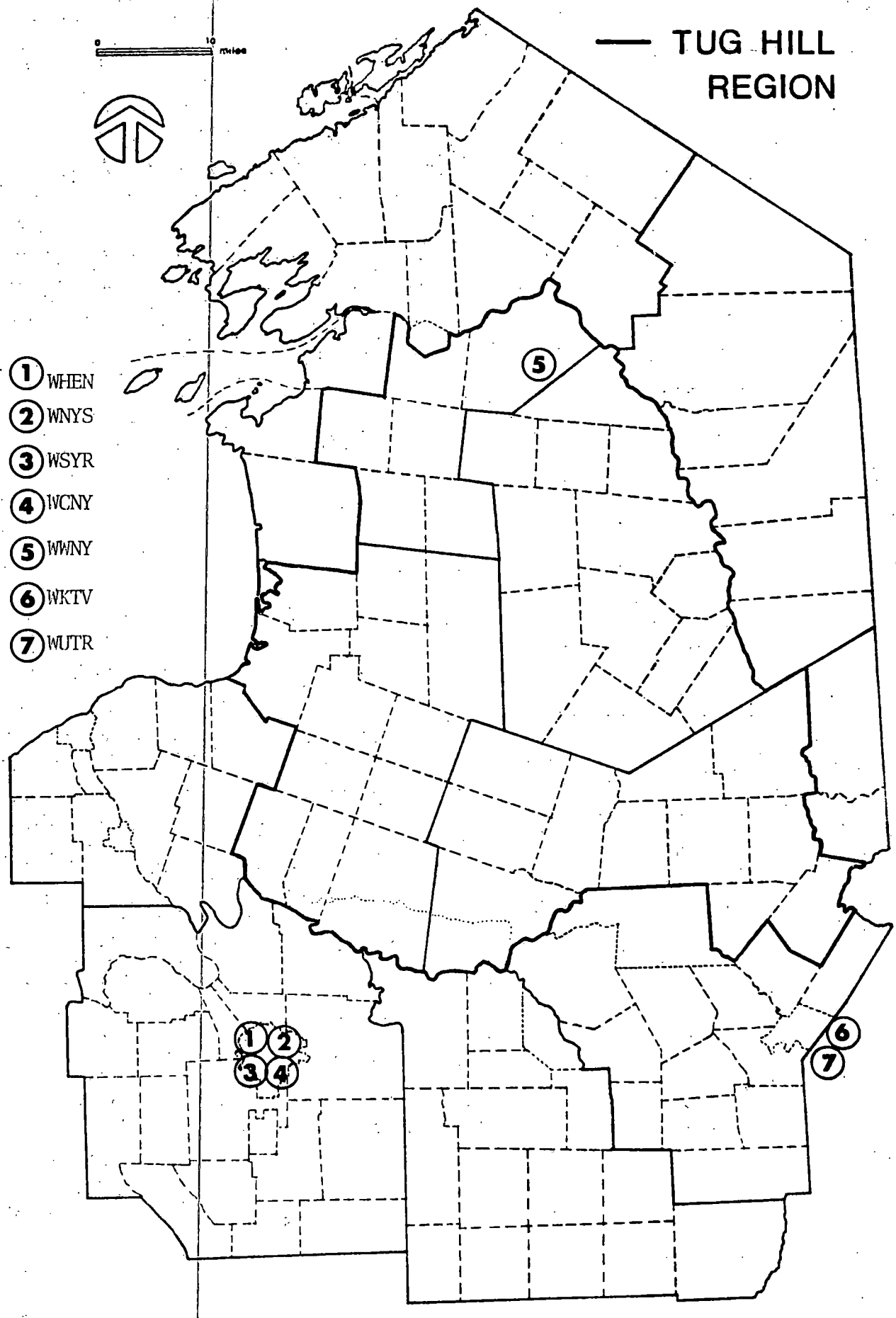


Figure 83. Television stations serving the Tug Hill Region.

Public Utilities

Electric service is provided throughout the Tug Hill Region by Niagara Mohawk Power Corporation, Central Division. In a small area surrounding Boonville, Niagara Mohawk sells power to be transmitted through facilities of the Boonville municipal system.

Gas service is also provided by Niagara Mohawk Power Corporation, but not to all areas of the Tug Hill Region. Figure 84 shows the 11 towns which presently have access to gas service.

Telephone service is provided by several firms. Figure 85 provides an outline of their jurisdictions.

The various utility companies, as a group, are equipped to provide service anywhere in the Tug Hill Region, on demand, at current rates.

Water, Solid Waste Disposal, and Sewage

Present water, waste treatment and solid waste disposal facilities in the Tug Hill Region are generally considered inadequate to satisfy projected demand, or to meet current standards. Several fairly comprehensive studies have been made of conditions in the Region. These all point up the need for planning toward development expected beyond the year 2000, and particularly emphasize integration and intercommunity amalgamation of resources.

There is no evidence of significant concern in published reports as to the adequacy of surface and underground water supplies in the area for the next 30 years, given predicted growth rates.

Communities in the Black River Basin and in Oswego and Oneida Counties are generally considered too widely separated to permit economical interconnection of supply systems. The exceptions are: 1. between Watertown and surrounding communities; 2. between Carthage and West Carthage; 3. between Constableville, Turin, Lyons Falls, and Port Leydon; and 4. between Constantia and Cleveland. But none of these communities have taken full advantage of this potential. The studies suggest that wells, springs and streams should continue to serve as local supply sources. Even so, annual cost per residence served could substantially exceed $200 in some areas if improvements were made in advance of development expected over the next 20-30 years. Ability to finance recommended supply systems thus becomes a limiting factor in many communities, even though local surface and underground water supplies are substantial. Recreational activity and seasonal homes have a significant impact on water use, which must be reflected in financial planning.

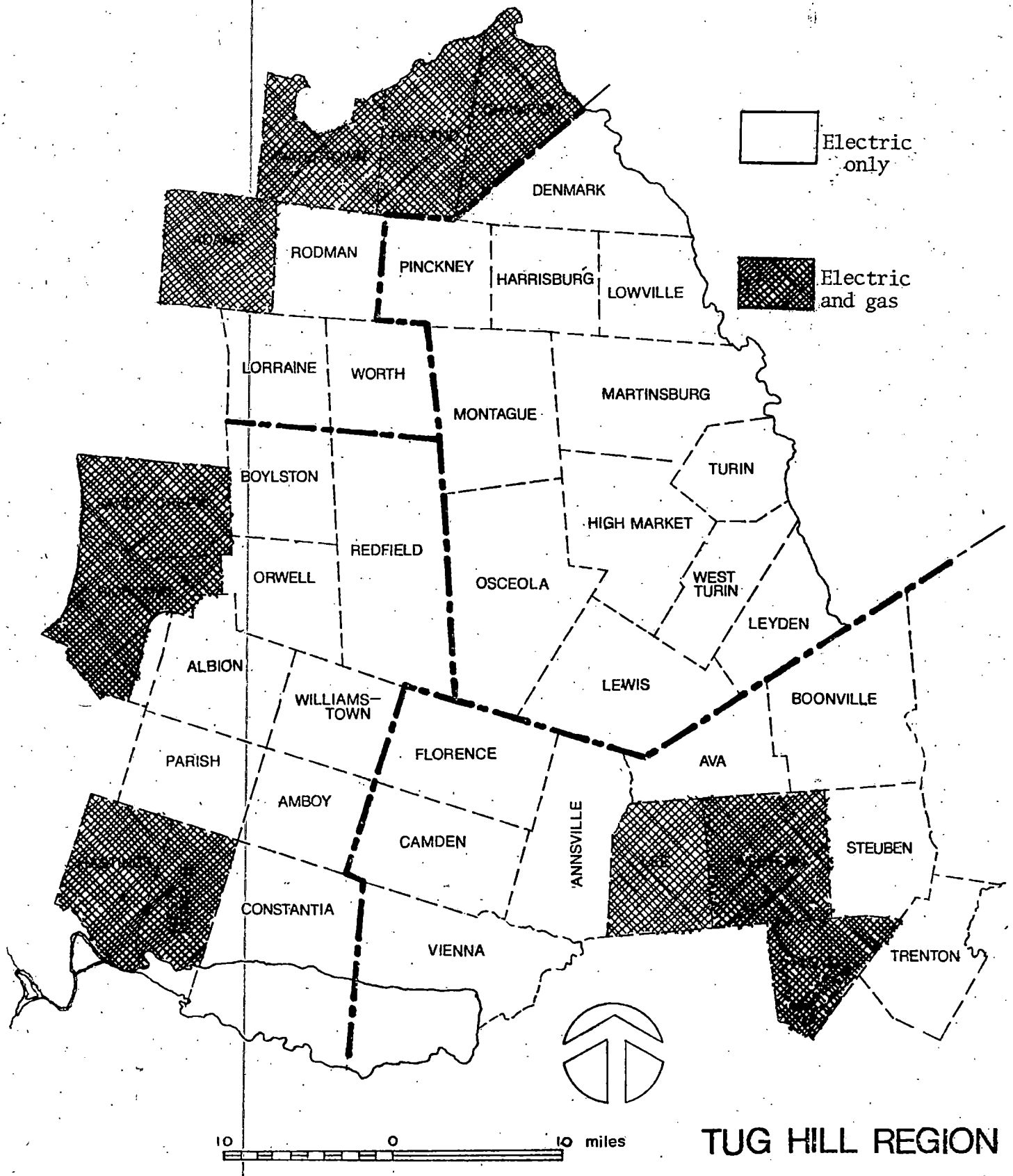


Figure 84. Gas and electric service facilities, Tug Hill Region.

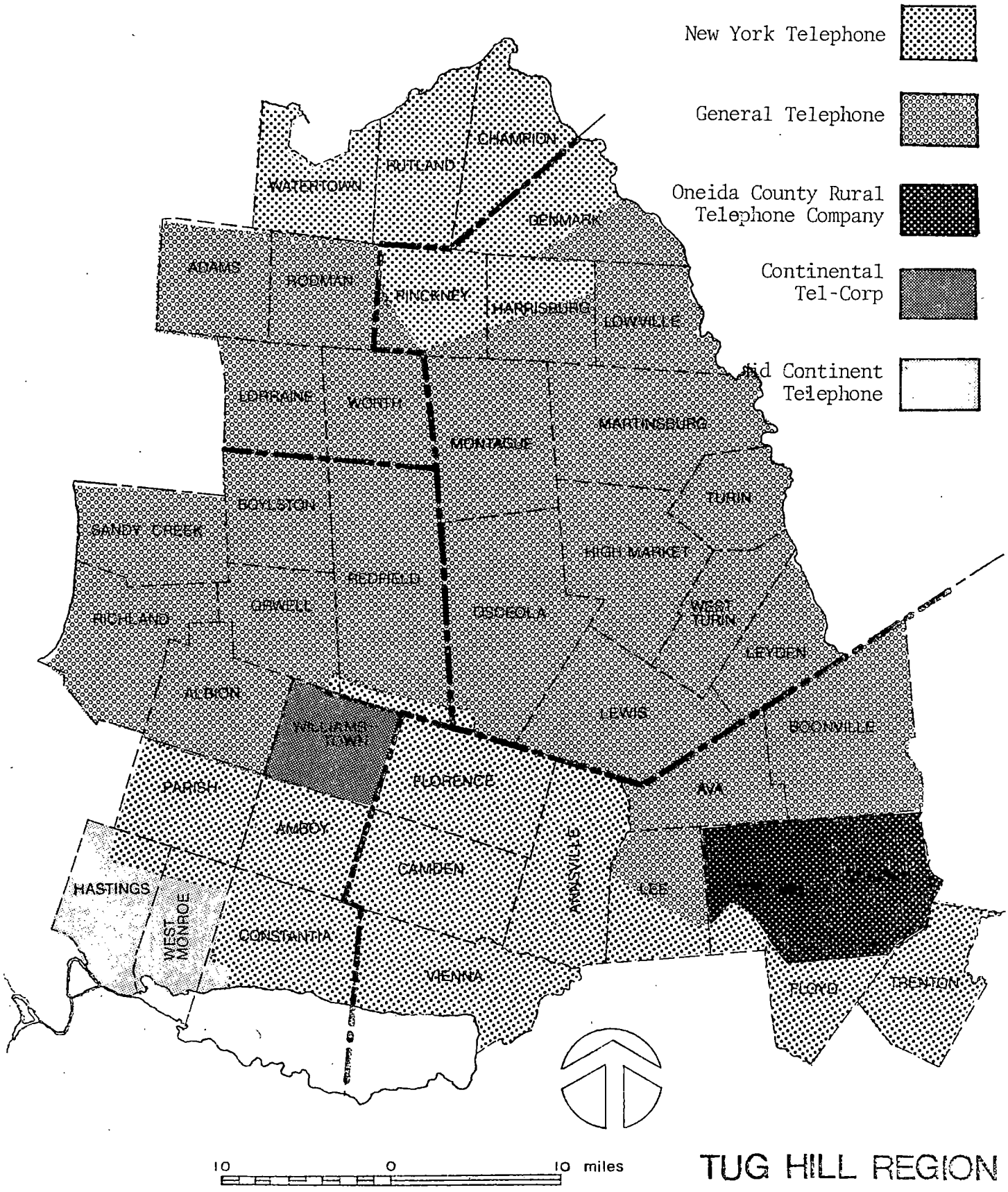


Figure 85. Telephone facilities of the Tug Hill Region.

Solid waste disposal

Changes in solid waste disposal techniques are actively being considered in the Tug Hill Region. One approach currently under study in much of the Region would consolidate collection into a few well-placed receiving centers (e.g. four in all of Lewis County), and possibly to supplement landfill operations with incineration at each center, at additional cost. Resource recovery is also under consideration. Rule-of-thumb costs run $2.00 to $3.00 per ton of waste for landfill, and $7.00 to $10.00 per ton for thermal reduction. Resource recovery (fibre, metals, and glass) costs depend on rates of recovery and values of residues. Usually, recovery systems have not proven useful except in areas with high populations.

Sanitary sewerage

Long range plans for adequate sewerage facilities embrace individual population centers of the Region area . In some cases proposals call for costs exceeding $200 per year per household. Alternative recommendations, suitable for the shorter run, are less costly. Outside the population centers, septic systems are the normal form of disposal. Since industrial plants are major contributors to BOD[3] current recommendations call for city and village systems adequate to service major industries when feasible, thus increasing efficiency while spreading costs.

TRANSPORTATION

Rail, air, water and road systems service the Tug Hill Region. Their extent, plus current and future impacts warrant review.

Airports

Sixteen airports lie within or immediately adjoining the Tug Hill Region (Figure 86 and Table 72). Six are private and restricted. The remainder are open to public use. Of the nine fields located within the Tug Hill Region, only three are open to the public and only one (Becks Grove) has service facilities.

Watertown International Airport and Oneida County Airport are the largest public facilities adjoining the Region. Watertown served as a local base for direct air passenger service to New York City and other principal cities throughout the northeastern United States and eastern Canada. Allegheny Airlines and Air North have handled this service. In addition they have provided connecting service with major airlines. They also handle air freight. Application was made for improvement and expansion of this airport, although total traffic volume did not increase notably during the 4-year period of 1967-70. There are no known plans for developing additional major facilities in or near the Tug Hill Region. As of January 1974, Allegheny Airlines planned to cease operations at the Watertown Airport.

[3]Biological oxygen demand

Table 72. Public and private airports of the Tug Hill Region and vicinity.[a]

Map code[b]	Airport	Location	Status	Length of runway in feet
1	Beaver Falls	Beaver Falls	Private	1,900
2	Duflo	New Bremen	Civil	2,900
3	Merek	Ava	Private (R)[c]	2,000
4	Riverside	Utica	Civil	2,600
5	Oneida County	Utica Rome	Civil	6,900
6	Buks Grove		Civil	3,400
7	North Bay	North Bay	Private (R)	1,600
8	Braebrook	Camden	Private (R)	2,700
9	Sherwood	West Monroe	Civil	1,600
10	Enterprise	Brewertown	Civil	3,000
11	Oswego County	Fulton	Civil	4,000
12	Pulaski	Pulaski	Civil	3,100
13	Richland	Richland	Private (R)	2,500
14	Kidder	Sandy Pond	Private (R)	1,800
15	Drake Field	Adams	Private (R)	1,800
16	Watertown	Watertown	Civil	5,000

a Military air fields (Wheeler-Sack and Griffiss) not included. Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, January 3, 1974.

b See Figure 86.

c (R) means restricted use.

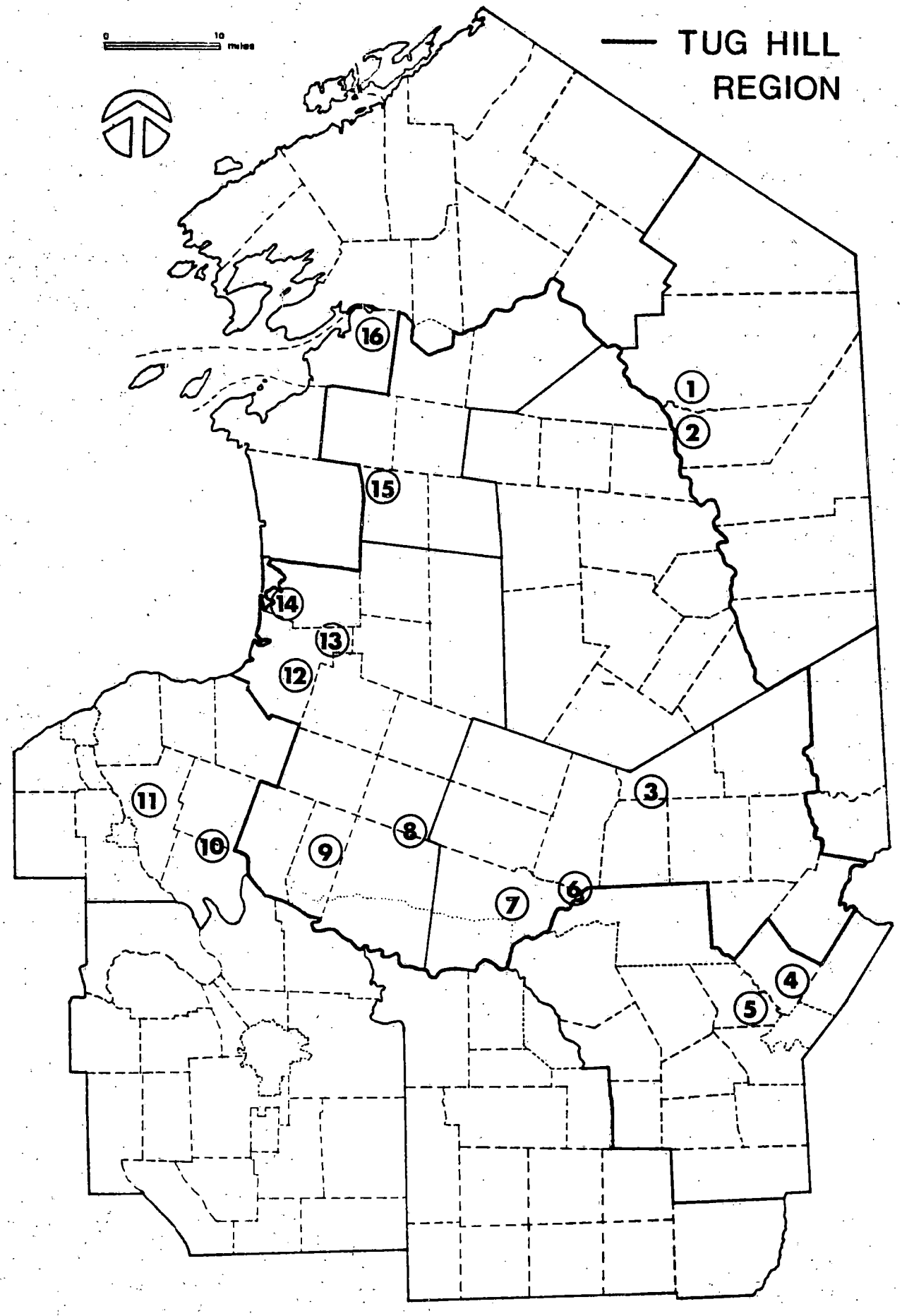


Figure 86. Public and private airports in the Tug Hill Region and vicinity.

Railroads

Like other transport facilities, rail lines are concentrated around the perimeters of the Region. Penn Central trackage crosses parts of 15 Tug Hill Region towns, as shown in Figure 87. No other railroads service the Region, except the Lowville-Beaver River Railroad which travels east from Lowville. Penn Central handles freight only. Passenger service is not available. During the last quarter of 1973, a plan was introduced to reduce the Penn Central system. Under this plan, the Carthage to Lowville spur, the Utica to Lyons Falls spur, and the Rome to Camden spur would have been abandoned. At last report, the plan had been rejected. However, other similar plans were being developed.

Recent events suggest that rail carrier service is more likely to diminish than to expand. In that event, local industrial development necessarily will be tied more closely to trucking and to the highway system in future years.

Waterways

The only major waterways affecting the area in any way are the Black River and the shore facilities bordering Lake Ontario and Black River Bay. At present, they represent a largely unexploited opportunity for increased water traffic. They exert negligible influence on activity and development in the Tug Hill Region. The old Black River Canal locks are considered of historical interest only. (Plann. Collaborative, 1972).

Highways

The auto provides the principal means of travel in the Tug Hill Region. Although more than 3,000 miles of State, County and Town roads transect the area, preliminary review of traffic count patterns suggests that most movement occurs around the perimeter, on State arterials (Figure 88).

At present, there is more attention to reconstruction and rehabilitation of existing roads in the Region than to new construction. Mass transit facilities are an unrealized dream of some bordering cities and towns. A north-south industry expressway, recently considered, could have affected Oneida and Lewis counties, but it did not prove economically justifiable. An east-west corridor for Watertown is planned (Figure 88).

Table 73 shows, by counties, the total miles of road under State, County and Town control in the Region. Aggregate figures are shown in Table 74. Road construction, maintenance and snow removal operations on these roads account for major expenditures annually, and strongly affect area tax assessments. Cities and villages contribute to development and maintenance activities, along with Federal, State, County and Town governments. Each has its own separate standards and programs, leading to difficulties in coordination. Thus, roading and expenditure patterns may develop independently of development plans for the Region as a whole.

Since existing road systems establish and dominate the accessibility of the Region, they stand as a critical influence on its past, present and future development. In laying the groundwork for comprehensive, wise and effective future use of the Tug Hill Region, the road systems appear to merit the most careful consideration. Currently, a great deal of effort is being expended

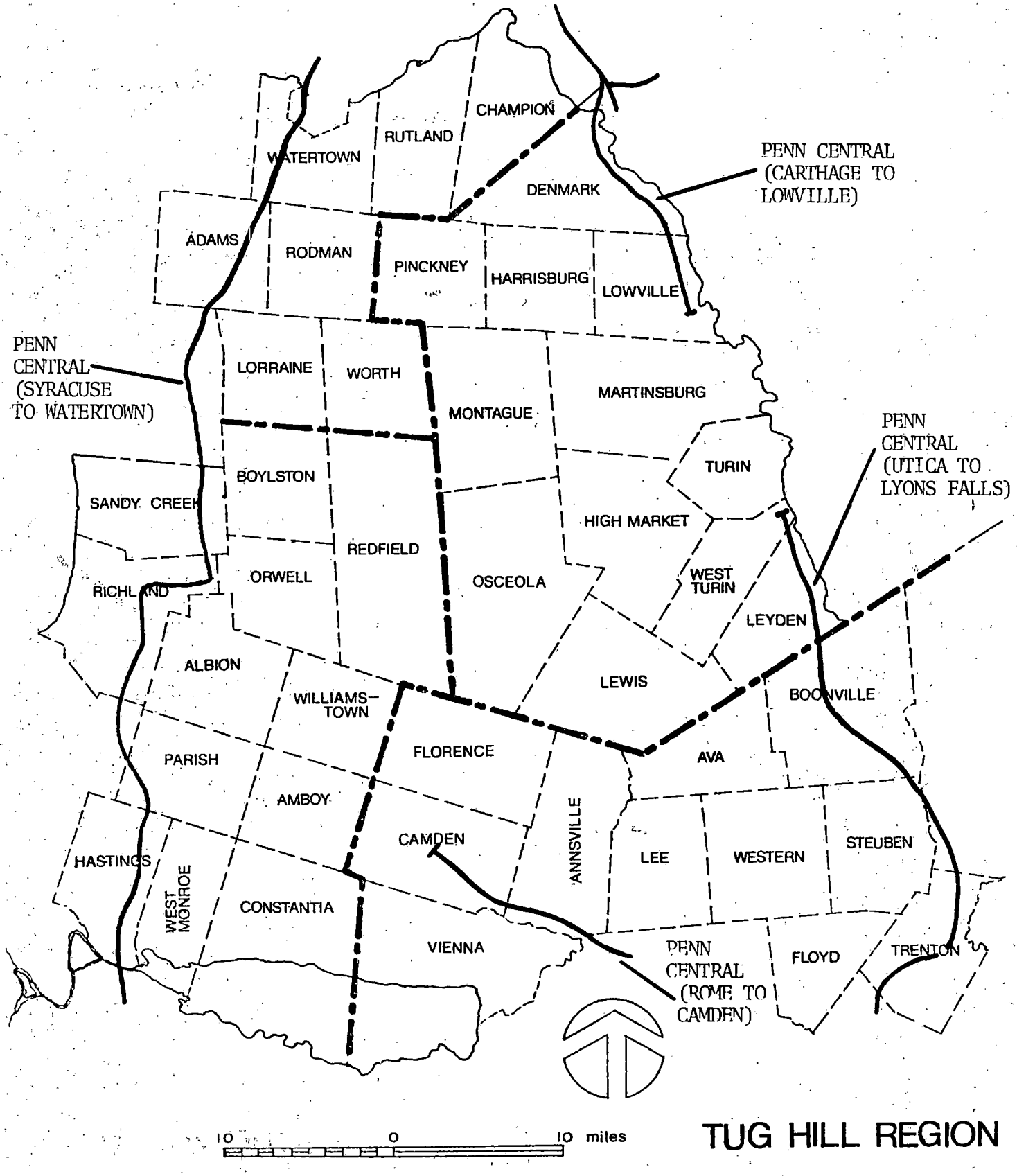


Figure 87. Railroads of the Tug Hill Region.

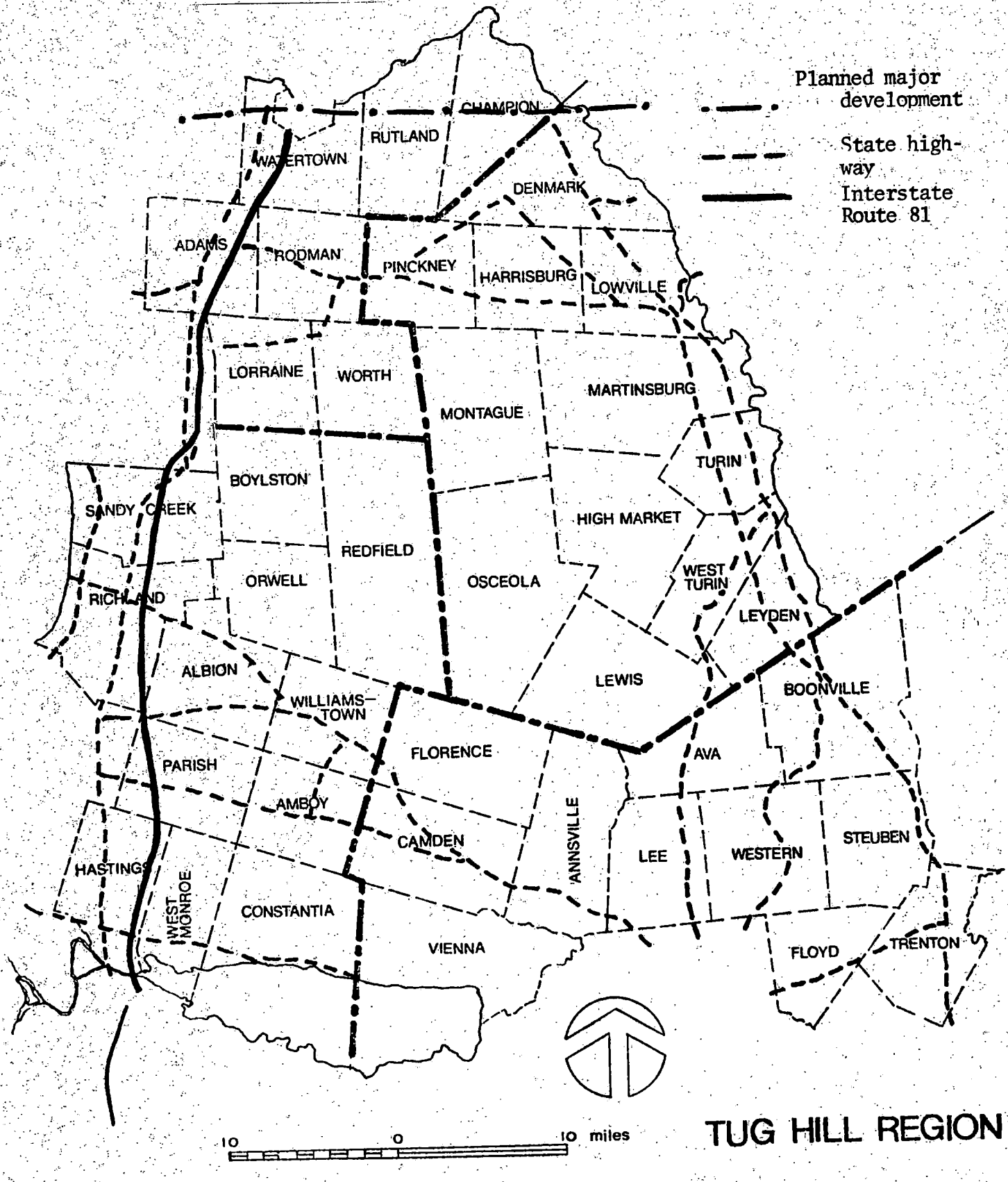


Figure 88. Major highways of the Tug Hill Region.

Table 73. Mileage of highways in the Tug Hill Region, 1972.

Jurisdiction	State	County	Town	Total
Jefferson County, 1972[a]				
Adams	20.78	24.17	36.39	81.34
Champion	6.18	29.11	39.97	75.26
Lorraine	8.21	23.40	33.23	64.84
Rodman	9.39	22.37	34.02	65.78
Rutland	9.29	26.68	48.01	83.98
Watertown	21.35	25.76	31.51	78.62
Worth	2.41	16.64	22.27	41.32
Miles in Region	77.61	168.13	245.40	491.14
Lewis County, 1972[b]				
Denmark	16.86	19.09	37.36	73.31
Harrisburg	11.06	14.51	36.04	61.61
High Market	0.00	8.47	33.47	41.94
Lewis	3.97	19.43	37.38	60.78
Leyden	12.47	15.51	35.69	63.67
Lowville	20.54	12.37	40.17	73.08
Martinsburg	10.84	17.71	76.16	104.71
Montague	0.00	8.49	35.69	44.18
Osceola	0.00	8.68	27.18	35.86
Pinckney	14.09	8.16	38.93	61.18
Turin	11.48	12.64	31.32	55.44
West Turin	15.75	15.50	39.56	70.81
Miles in Region	117.06	160.56	468.95	746.57
Oneida County, 1970[c]				
Annsville	10.77	12.57	71.25	94.59
Ava	8.38	15.76	23.38	47.52
Boonville	21.02	17.86	72.02	110.90
Camden	17.32	23.71	50.36	91.39
Florence	2.48	24.35	57.53	84.36
Floyd	13.10	23.77	30.57	67.44
Lee	9.23	23.04	63.17	95.44
Steuben	7.04	22.60	37.84	67.48
Trenton	23.72	27.49	51.00	102.21
Vienna	19.65	19.78	84.47	123.90
Western	12.96	17.54	44.68	75.18
Miles in Region	145.67	228.47	586.27	960.41
Oswego County, 1973[d]				
Albion	15.42	18.79	43.65	77.86
Amboy	10.84	15.50	32.05	58.39
Boylston		20.29	21.68	41.97
Constantia	9.86	21.56	58.59	90.01
Hastings	15.13	29.65	52.19	96.97
Orwell		21.68	37.97	59.65
Parish	11.24	19.64	45.90	76.78
Redfield		27.22	29.28	56.50
Richland	20.57	29.48	59.60	109.65
Sandy Creek	11.49	24.43	43.80	79.72
West Monroe	4.15	21.52	33.75	59.42
Williamstown	10.09	17.53	25.74	53.36
Miles in Region	108.79	267.29	484.20	860.28
Total miles, Tug Hill Region	449.13	824.45	1,784.82	3,058.40

a Source: Jefferson County Highway Department.

b Source: 1972 Annual Report, Lewis County Highway Department.

c Source: Oneida County Highway Department.

Table 74. Road mileage by type of jurisdiction in the Tug Hill Region, 1970-72.

Jurisdiction	Miles of road	Percent of total
State	449.13	14.7
County	824.45	27.0
Town	1,784.82	58.3
All	3,058.40	100.0

to integrate and coordinate water, sewer, solid waste, fire, police and other systems. But there does not appear to be strong coordination regarding road development. Individual highway departments know what facilities they have, and the condition of them. And traffic counts have established patterns of current use. What seems to be needed is careful integration of existing and planned facilities with prospective land use and development patterns, and with planned systems of trails for snowmobiling, hiking, skiing and cycling.

Also, if roads are to be used more effectively as a planning tool, an examination must be made of: 1. opportunities for better coordination through revision of current patterns of jurisdiction (for trails as well as for roads); 2. possibilities for retrenchment, including outright road abandonment, abandonment of snow removal and other winter maintenance in some areas, restricting some areas by setting strict road load limits, and the like; and 3. adjustment of size and carrying capacities of some roads in advance of development, as a means of guiding patterns of use and regulating speed of development. These would require joint planning involving many agencies which currently hold responsibilities, and careful thought to finding a means to gain public acceptance of any changes planned.

GOVERNMENT FINANCE

Within each county, revenues are derived by county government, by cities, towns and villages, and by special school and fire districts. School district assessments are large, and in each of the 4 Tug Hill counties in 1969 accounted for between 45 and 56 percent of all revenues. County government represented up to one-third.

The individual towns normally derive their revenues principally from real property taxes and assessments, and secondarily from State aid. Table 75 shows that in the Tug Hill Region all but six of the towns derived more than two-thirds of their income from these two sources. Some received more than 90 percent of it in this way. In some towns, State aid exceeds 30 percent of all income (Figures 89 and 90).

Total expenditures in individual towns in 1971 ranged from $24,000 to $1,265,000. Variations can be accounted for primarily by differences in population, and to some extent by rates of population increase. Although such expenditures covered a wide range of activities, the very largest part, normally more than one half, went to highways (Table 76). Two other aspects of recent expenditure patterns stand out. First is the wide variability among towns as to the types of activities being supported, and the degree of support given them. The second is the current rising dependence on borrowing in the towns. Debt service (other than for special districts) was included in budgets of 3 out of 4 towns in 1971, accounting for as much as 20 percent of all expenditures. Taken by itself, this is not notable. But widespread emphasis currently upon restructuring major services, such as social services, sanitation, and library systems, and interest in uniformity of service offerings throughout the Region, could tend to raise debt service totals radically in some areas. That could place unequal pressures on communities having fundamentally different economic structures.

Table 75. Sources of income by towns, in percent, 1971[b]

Towns	(A) Real property taxes and assessments	Non-property taxes	(B) State aid	Special distributions: Other excluding special distributions	Special distributions: Real property taxes and assessments	Special distributions: Other revenues	(A + B)
Jefferson county							
Adams	38		23	19	13	5	61
Champion	56		25	13	4	a	81
Lorraine	27	3	24	41	2		51
Rodman	45	2	20	29	1		65
Rutland	56	a	15	23	4		71
Watertown	9	56	16	13	1	2	25
Worth	27		10	61	a		37
Lewis county							
Denmark	65		22	8	2		87
Harrisburg	54		33	10	1		87
High Market	67		30	a	a		97
Lewis	52		25	19	2		77
Leyden	58		27	11	2		85
Lowville	58		20	19	1		78
Martinsburg	48		28	6	11	4	76
Montague	65		26	7	a		91
Osceola	77		14	6	1		91
Pinckney	59		33	6	a		92
Turin	72		17	7	2		89
West Turin	55		21	20	1		76
Oneida county							
Annsville	54		23	19	4		77
Ava	48		13	38	1		61
Boonville	67		21	10	1		88
Camden	54		21	21	3	a	75
Florence	33		33	33	1		66
Floyd	45	7	32	16	a		77
Lee	45		37	17	1	a	82
Steuben	65		11	21	2		76
Trenton	65		18	12	5		83
Vienna	51		25	24	5	a	76
Western	41	9	29	7	4		70
Oswego county							
Albion	47		33	17	1		80
Amboy	40		30	27	2		70
Boylston	47		32	19	a		79
Constantia	53		23	18	4		76
Hastings	47		25	12	10	4	72
Orwell	80		6	8	4		86
Parish	64		20	13	2		84
Redfield	55		12	26	4		67
Richland	61		22	13	2	a	83
Sandy Creek	62		19	16	2		81
West Monroe	54		26	15	3		80
Williamstown	50		27	17	3		77

[a] Indicates values less than 1 percent.

[b] May not add to 100 due to rounding

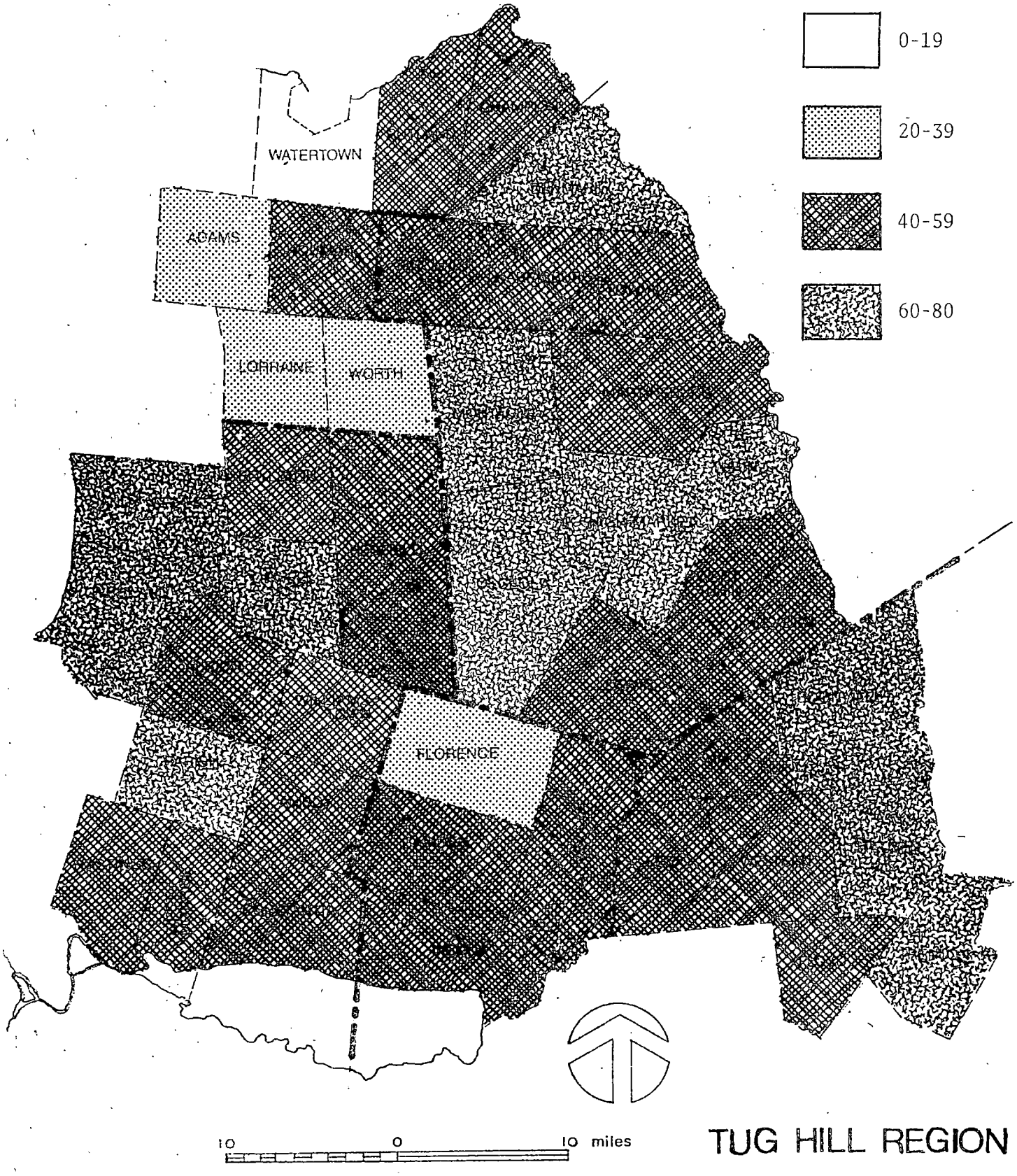


Figure 89. Real property taxes and assessments as a percent of total income, by towns, 1971.

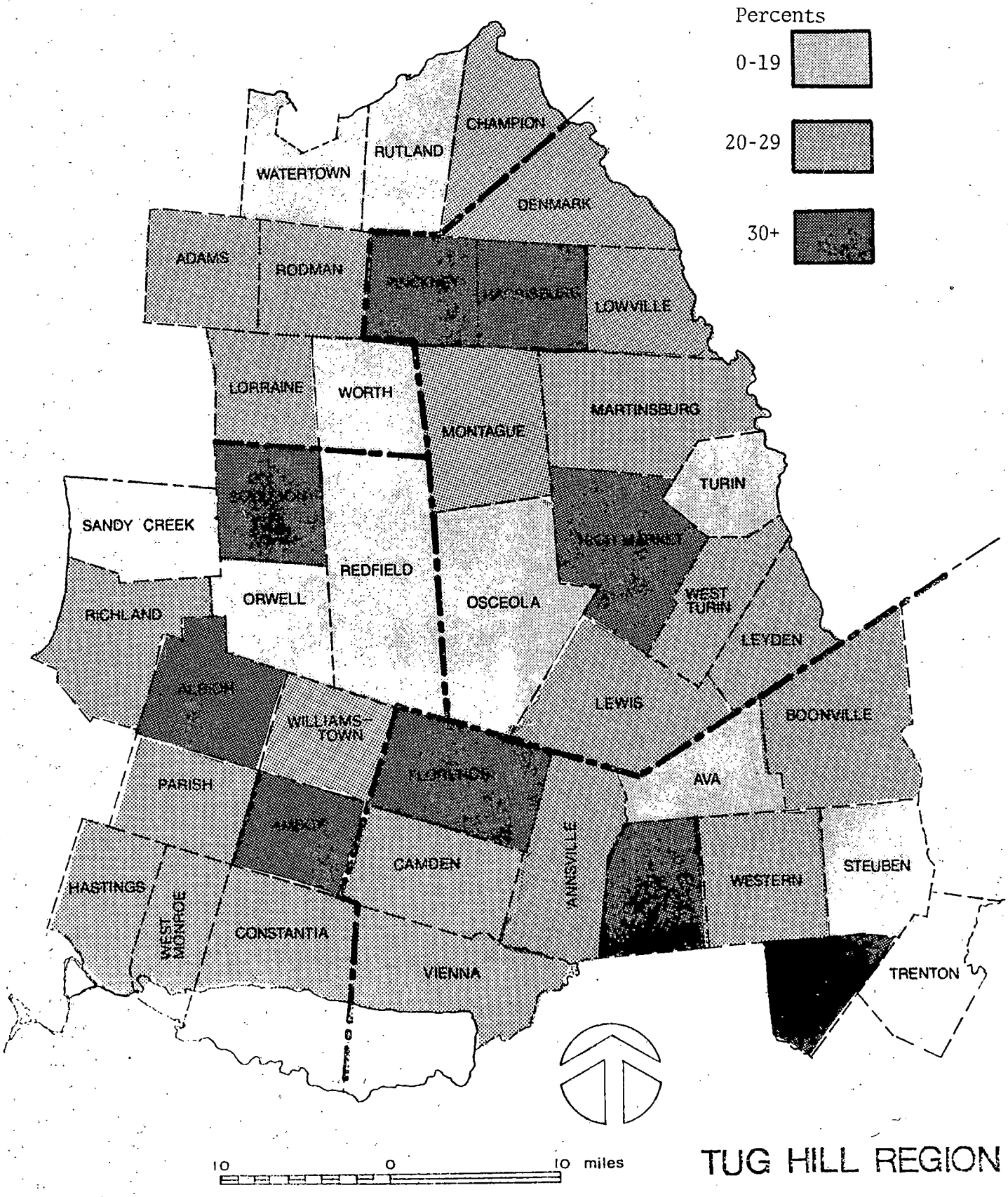


Figure 90. State aid as a percent of total income, by towns, 1971.

Table 76. Expenditures by towns, in percents, for 1971.[a]

Towns	Dollars, total expenses	Highways	General government	Social services	Health	Public safety	Sanitation	Libraries and Museums	Educational activities	Recreation	All other general	Capital outlay	Debt service	Special districts: Fire protection and alarm	Special districts: Lighting	Special districts: Water and water supply	Special districts: Refuse and garbage	Special districts: Capital outlay	Special districts: Debt service
Jefferson County																			
Adams	190,280	39.0	17.0	2.7	3.0	0.5	0.4	0.4		1.0	5.2	7.8		0.4	1.1	7.0			12.9
Champion	219,566	71.0	7.0	1.3	2.2	.5	3.7			.7	.5	5.3	3.1	3.2	.6				
Lorraine	41,254	70.0	17.0	2.7	.9	b			0.1		4.8			1.5	1.5				
Rodman	78,706	53.0	16.0	2.8	1.2	b	4.1	2.2		b	.9	3.3	17.4		1.0				
Rutland	203,383	40.0	8.0	1.5	.2		2.7	.1		.1	3.9	23.0	5.9	3.2	5.8				
Watertown	173,565	61.0	22.0	1.6	.3	.2	2.8		b		4.6	.4				3.8			1.6
Worth	42,770	80.0	12.0	.2	.5	b					1.6		4.0	.9					
Lewis County																			
Denmark	120,765	54.0	14.0		0.3	0.7	3.6			0.1		10.9	12.0	2.5					
Harrisburg	44,631	66.0	13.0		.3	.4			0.1			2.5	9.4	1.1					
High Market	27,241	65.0	15.0		.1								15.4	1.3					
Lewis	56,824	63.0	19.0		.2	.2			.1				14.0	2.6					
Leyden	143,668	33.0	6.0		.2	b		0.1		.4		37.3	19.8	1.3					
Lowville	197,063	67.0	16.0		.5	.1	.6		.1	1.8			3.6	1.0					
Martinsburg	144,327	49.0	10.0				.1		b	1.6		18.7	2.1	6.9	1.3	2.5			.7
Montague	23,585	75.0	22.0		.1									.6					
Osceola	41,988	58.0	19.0		.2	.1		.7	.1				16.1	1.2					
Pinckney	53,350	60.0	14.0		.2	b	.1			b		17.9	5.2	.6					
Turin	122,587	69.0	9.0		b			.2	b	1.6		1.3	11.8	2.0					
West Turin	162,844	76.0	8.0	b	.1	b		.3		b		4.9	2.5	1.6					
Oneida County																			
Annsville	201,537	59.0	13.0	1.8	0.3		3.4		b	1.2	0.8	10.7	5.2	2.4	.1				
Ava	73,748	74.0	8.0	.1	.1		2.1				3.4		10.0	1.0					
Boonville	215,022	64.0	14.0	4.3	3.0			0.1		1.3	6.5	1.7		1.5					
Camden	268,087	52.0	11.0	5.5	5.0		1.9	2.4		1.1	3.7	5.3	8.4	1.7	.2				
Florence	56,438	38.0	15.0	.8						b	2.9	40.4		1.8					
Floyd	145,276	58.0	23.0	.2	.1	0.1			b	.3	1.5		4.5		.4		8.9		
Lee	1,264,834	12.0	2.0	.5	b		.7	b		.4	.7	7.8			.1	1.2			73.9
Steuben	95,125	67.0	14.0	1.4	b	.1			b		2.2	3.4	8.3	2.3					
Trenton	234,273	47.0	18.0	1.3	.2	.8	b	.4	b	1.2	3.4		8.0	6.8					
Vienna	205,255	61.0	16.0	7.3	b	.4	2.0		.2	1.8	3.4			.6	5.8				
Western	132,836	56.0	13.0		.3		1.3	.5		.8	1.2	5.6	12.0	2.3	.7				
Oswego County																			
Albion	119,337	59.0	12.0	4.0	0.1	0.5					2.0	9.2	9.7	1.5					
Amboy	61,873	64.0	13.0	3.9	.1						.6	15.4		2.1					
Boylston	56,370	56.0	11.0	1.2	.3						.9	19.8	9.5	.6					
Constantia	207,119	56.0	12.0	3.4	.3	5.0	2.1			2.6	2.4		8.6	3.5	1.9				
Hastings	207,566	63.0	21.0	5.8	.5	1.2	4.1	.6	.2	1.4	4.0	5.5	6.4	7.4	1.7	8.0			2.7
Orwell	190,195	76.0	9.0	1.2	.1	b	1.0	.2			2.3		15.1	3.3					
Parish	170,873	64.0	10.0	3.6	.1	3.1	.6		b	.7	1.6	4.5	8.8	1.8					
Redfield	72,551	76.0	13.0	0.5	.2	.4	1.4		b	.3	2.3			2.8	1.8				
Richland	224,674	70.0	16.0	2.6	.4	.4	1.2	.4		.7	4.3	.5		1.1	1.3				
Sandy Creek	169,814	69.0	12.0	1.3	.3	.3	1.9	7.1		.3	2.5		2.3	1.9					
West Monroe	128,356	43.0	17.0	3.0	.4	1.2	3.1	.2			3.3	15.7	9.2	2.9					
Williamstown	102,455	60.0	12.0	1.1	.2	.2	.2		b		1.5	21.4		1.5	.9				

[a] May not add to 100, due to rounding

[b] Less than 0.1

ZONING AND PLANNING

Table 77 shows zoning and planning capabilities of towns and selected population centers in Jefferson, Oneida and Oswego Counties. In Lewis County, the Town and Village of Lowville are the only communities with a zoning or land use plan. None of the county's 11 other towns have them. There is a County Planning Board which is part of the Lewis County Board of Legislators. It is a committee with no staff. It promotes studies on water, solid waste, and the like, as a prerequisite to getting State aid for projects. The Black River-St. Lawrence Regional Planning Board gives advice but is not staffed to do planning for the County. Some Lewis County towns are more interested than others in land use regulations, but none have been successful in adopting them. The Town of Turin, for example, hired a consultant to develop zoning laws, but these were defeated when submitted to public referendum (Pers. commun., 1973, from Urban Karcher, Treasurer, Lewis County, Lowville, N. Y.).

In general, areas subject to heavier population pressures have leaned toward zoning and planning. Consequently, rim towns, particularly in the south and west of the Region, are more likely to have adopted master plans and selected planning boards (Figure 91). Piecemeal adoption has had its implications for adjoining towns without similar sanctions. Thus, certain types of activity or land uses may be "chased" from town to town by slowly developing regulations. And the current pattern of development suggests inward pressures, toward the core of the Region.

At present, planning boards have been established in 40 percent of the towns, master plans in 30 percent, zoning ordinances in 20 percent, and junk yard and trailer regulations in 17 percent. These have been largely independent actions, widely spaced over time. There is no strong evidence of close coordination in the development of zoning and planning regulations among towns.

LITERATURE CITED

Anony.
1973. Landfill sites. Lowville J. and Repub. Oct. 10, 1973.

Barton, Brown, Clyde, and Lojudice
1967. Oswego County (Summary). N.Y. State, Dep. Health. Compr. Water Supply Stud., CPWS-23.

Herkimer-Oneida Co.
1970. Schools, libraries, fire protection. Part II. Libraries. Herkimer-Oneida Co. Compr. Plann. Program.

Herkimer-Oneida Co.
1970. Outdoor recreation and open space. Herkimer-Oneida Co. Compr. Plan. Program.

Herkimer-Oneida Co.
1970. Sewerage study. Herkimer-Oneida Co. Compr. Plan. Prog.

Lewis Co.
1972. Lewis County comprehensive water supply study. Lewis Co. Water Resourc. Plann. Bd., Draft Rep. CPWS-71.

Table 77. Zoning and planning capabilities in selected towns and population centers of the Tug Hill Region.

Towns and villages[a]	Planning board	Master plan	Adopted	Zoning ordinance	Date adopted	Officer	Junk yard and trailer yard	Board of zoning appeals	Subdivision control
Jefferson county, 1973									
Adams	Yes	Yes	No	Prop[b]	None	No	Yes	No	
Champion	No	Yes	No	No	None	No	Yes	No	
Lorraine	Yes	Yes	No	No	None	No	Yes	No	
Rodman	No	No	No	No	None	No	No	No	
Rutland	Yes	No	No	Prop	None	No	Yes	No	
Watertown	Yes	Yes	No	Yes	8/6/58	Yes	Yes	Yes	
Worth	No	No	No	No	None	No	No	No	
Village of Adams	Yes	Yes	No	Yes	9/27/71	Yes	No	Yes	
Village of Black River	Yes	No	No	Yes	4/66	Yes	Yes	Yes	
Village of West Carthage	Yes	Yes	No	Yes	11/3/68	No	No	Yes	
City of Watertown	Yes	Yes	No	Yes	1/26/59	Yes	Yes	Yes	
Oneida county, 1974									
Annsville	Yes	None		None		None		None	None
Ava	None	None		None		None		None	None
Boonville	Yes	Yes		Yes		Yes		Yes	Prop
Camden	Yes	Yes		Yes		Yes		Yes	Yes
Florence	None	None		None		None		None	None
Floyd	Yes	Yes		Prop		None		None	Prop
Lee	Yes	Yes		Yes		Yes		Yes	Yes
Steuben	Yes	None		None		None		None	None
Trenton	Yes	Yes		Yes		Yes		Yes	None
Vienna	Yes	Prop		Prop		None		None	Prop
Western	Yes	Yes		Prop		None		None	Prop
Oswego county, 1974									
Albion	None	None	None	None	None	None	None	None	
Amboy	None	None	None	None	None	None	None	None	
Boylston	None	None	None	None	None	None	None	None	
Constantia	Yes	Yes	None	Prop	None	None	None	None	
Hastings	Yes	Yes	None	Yes	?	Yes	Yes	Yes	
Orwell	None	None	None	None	None	None	None	None	
Parish	Yes	Prop		Yes	1961[c]	Yes	Yes	Yes	
Redfield	None	None	None	None	None	None	None	None	
Richland	Yes	Prop	None	Yes	1973	Yes	None	Yes	
Sandy Creek	None	None	None	None	None	None	None	None	
West Monroe	None	None	None	None	None	None	None	None	
Williamstown	None	None	None	None	None	None	None	None	
Central Square Village	Yes	Yes		Yes			Yes	Yes	
Cleveland Village	Yes	Yes	?	Prop			Yes	None	
Pulaski Village	Yes	Yes	?	Yes	?	None	Yes	Yes	
Sandy Creek Village	None	None	None	None	None	None	Yes	None	

[a] Source: Data obtained from the three county planning offices.

[b] Proposed

[c] Presently being redone

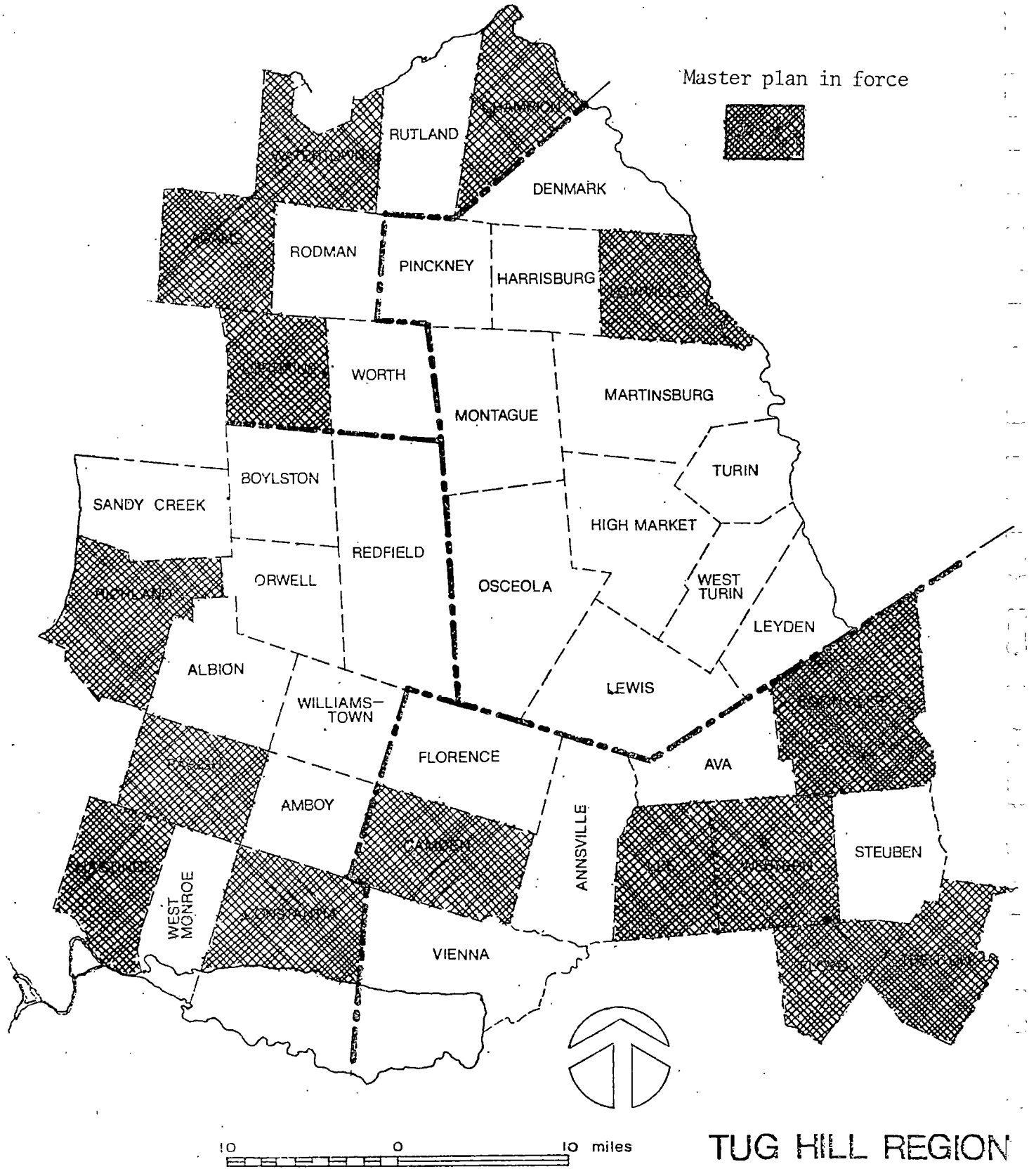


Figure 91. Towns having master plan in force or proposed, 1973.

Malcolm Pirnie Eng.
1968. Herkimer-Oneida Counties. N.Y. State, Dep. Health, Compr. Water Supply Stud. CPWS-47.

N.Y. State
Outdoor recreation facilities inventory. N.Y. State, Off. Parks and Recreation. Albany, N. Y.

N.Y. State
1971. Forecast of outdoor recreation in New York State 1970-1990. N.Y. State, Off. Parks and Recreation, Albany, N. Y.

N.Y. State
1972. Black River Basin: Alternatives for water resources management. N.Y.S. Dep. Environ. Conserv., Unit of Water Manage. Plann., Albany, N. Y. Draft.

N.Y. State
1972. N.Y. State, Off. Plann. Coord.

N.Y. State
1973. New York State statistical yearbook-1972. N.Y. State, Dep. Budget, Off. Stat. Coord., Albany, N. Y.

N.Y. State
1973. Analysis of New York State snowmobile registrations. N.Y. State, Off. Parks and Recreation, Albany, N. Y.

O'Brien and Gere Eng.
1968. Jefferson County comprehensive sewerage study. N.Y. State, Dep. Environ. Conserv., Compr. Sewage Stud., WPC-Cs-159.

O'Brien and Gere Eng.
1969. Summary. N.Y. State, Dep. Environ. Conserv., Oswego Co. Compr. Sewerage Stud., WPC-CS-166.

O'Brien and Gere Eng.
1973. Report of district formation-Jefferson County Solid Waste District No. 1. Jefferson Co. Refuse Agency.

Oneida Co.
1971. Intrum report. Oneida Co., Solid Waste Agency.

Oneida Co.
1972. Annual report. Oneida Co., Dep. Soc. Serv.

Oswego Co.
n.d . Open space and outdoor recreation. Oswego Co. Plann. Bd., and Town of Parish, Rep.

Plann. Collaborative
1972. Town of Lowville, General development plan-1972. Plann. Collaborative, Syracuse, N. Y.

U.S. Bur. Census
1970. Census of population. U.S. Dep. Comm., Bur. Census, Washington, D.C.

In developing these lookings into the future for the Tug Hill Region we drew heavily upon observations reported by the several faculty who undertook the component resource studies presented above. Also, we acknowledge contributions by Jean E. Fisher, David Harper, and Allen R. Lewis.

SUMMARY AND ANALYSIS

by

george r. armstrong
ralph d. nyland

PURPOSE

The charge of the Commission is to study:

1. the conservation and development of the Region's natural resources;
2. the strengthening of its communities; and
3. measures by government in support of these long range planning needs.

As a base for these studies, this report helps to define what the Region's physical, biological, human and cultural resources are, their geography and special characteristics. Individual summaries in the body of the text delineate major findings.

But the report also provides tentative reactions to important subsidiary questions of interest to the Commission.

WHOSE NEEDS ARE TO BE MET

The study suggests that there are at least five major populations with a significant interest in the future of the Region. Three of them are resident. Two others lie outside of the Tug Hill Region.

Socio-economic development in the Region has progressed differently in three major zones. These have been described as the northeastern rim, the core, and the southwestern rim. In the northeastern rim lies a population which is largely agricultural, largely resident, of moderate density and rooted to the land. The long term prospects are for moderate growth of this population. In the core are few residents, widely dispersed, and consisting primarily of an admixture of seasonal-recreational, speculative (often non-resident), and low income farming interests. Long term prospects are for this population to decline even further. By contrast, the population of the southwest rim is relatively large and increasing rapidly. It has two major elements. One is the year-round resident. He may work in the Region, particularly in a service capacity, or he may commute to surrounding urban centers. In either case, his economic future is closely tied to the cities. The other is the seasonal owner, predominately non-resident, who has found in the Region a recreational haven.

Outside of the Tug Hill Region reside two other groups with a strong stake in its future. One is the prospective resident, and according to projections there are thousands of them. Their interest is most likely to be to locate in the southwest rim. The other is the city dweller who will continue to view Tug Hill as a recreational escape and as a change of pace.

Each group merits recognition, and each group offers special characteristics which profoundly affect its impact on regional development.

WHAT ARE THE NEEDS

A second fundamental question, given these discrete populations, is what are their needs? They seem to boil down to two, both important but in opposition. One is the need for social and urban development within the Region. The other is for preservation of its rural and primitive aspects.

Exactly how feelings concerning these basic objectives are balanced among the named interest groups has not yet been defined adequately, but study results do make some major points.

The Southwest Rim

The southwest rim towns promise to be subject to many heavy and immediate pressures. A rising tide of full time and seasonal residents will make simultaneous demands for urban amenities and for retention of the benefits of a rural-primitive environment. Nowhere in the Tug Hill Region will the joint issues they raise be as extreme as in this area.

There is some indication that without careful and prompt planning the affected towns will be confronted by at least four large problems. The first, depending on the rate of population influx, is prospect of a time lag between the need for sanitary and health facilities (such as water, sewage, and solid waste disposal) and the ability to realize them, along with the high costs associated with their development. The second is indiscriminate application of zoning regulations within the area, which tends to "chase" elements which have been zoned out of one town into those adjoining, with a consequent intensification of the problem. A third is a current lack of low and middle income housing both to replace units which are past repair and to serve the needs of a substantial and increasing low income segment of the population. A fourth problem is created by the progression of urban development without due regard for preservation of open space and scarce resources in appropriate areas.

Study results suggest that even within the southern rim towns these pressures will not be uniform. Thus, in the more poorly drained soils of Parish, Hastings, West Monroe and Constantia, housing development and waste disposal problems stand to be larger than in towns located farther to the east where soils are better suited to development.

These western towns, plus Sandy Creek and Richland, also offer prospects for sustaining three wildlife resources: 1. the walleye of Oneida Lake; 2. the salmon of Lake Ontario and of the spawning streams in Sandy Creek and Richland, and 3. an abundant game population. All of them offer important recreational values for urbanites, yet none of these resources can survive continuing urbanization without suitable provision for their survival. Long term efforts to increase, maintain or abandon efforts in their behalf depend on early recognition of who will benefit and how much, what it will cost, and who is willing to pay for it.

Increased urbanization will also conflict with consumptive use of local resources. New residents will tend to withhold increasing amounts of the land from commodity uses, pushing out farming and making difficult the procurement of roundwood materials from southwestern rim towns.

In the easternmost reaches of this same area, eye catching gulfs, winding waterways and points of historical interest add recreational values of another dimension.

The Northeast Rim

Pressures in the northeast rim are somewhat different from those of the southwest. Dairy farming is strong and promises to continue to dominate the

landscape. Much of the land is too remote to act as a bedroom for the big urban centers. What development does occur may tend to be concentrated along the escarpment, where engineering limitations call for careful pre-assessment. The eastern escarpment of Tug Hill Upland, which rises steeply out of the Black River Valley, is a prominent feature of the landscape and of interest to the traveler. It offers opportunity for winter skiing and for water impoundments at many points along its length, should they be wanted. The latter offer utilitarian and recreational values of one kind, while to some extent, canceling others including the unique vegetation and the visual impact of the gorges.

Abundant game in the zone of transitional agriculture and possibilities for encouragement of migratory waterfowl along the Black River are modest additional recreational options, not necessarily applauded by farmers.

The primary current needs of area residents appear to be urban needs rather than recreational. Low incomes, poor housing facilities especially in the villages, a narrow industrial base, potential loss of rail facilities, rising taxes and a higher than average welfare ratio are primary concerns to those who live there. In the minds of many, maintenance, not growth, is a major goal.

The Core

Most of that great area which marks the top of the plateau is unremarkable as to topography, soils, and type of vegetative cover or wildlife. Attractive major water bodies are few, and opportunities for impoundments seriously limited by its flatness and soil structure. Wildlife is scarce. Deer and small game prefer the transitional farmlands on the perimeter. Trout fishing is good, but access to streams is difficult. An almost unbroken timber cover is slowly replenishing the cutovers, offering some prospect for future support of the wood industries which provide income to over half of Tug Hill's resident workers.

Three conditions within the core give it distinctive quality. One is its winter aspect. The great snowfalls which blanket the area provide a winter recreational potential of significance. Another is its remoteness. Because of its long winter and poor soils it was never developed for agriculture. Because of its distance from major population centers, it never offered major promise for year-round living space. And because it has always been in few hands, the pressures for roading and access have been limited.

The third important aspect, from the planning viewpoint, is its ownership pattern. More than two-thirds of all the land in the core is held by only 300 owners. This includes two-thirds (68 percent) of all land owned in the Tug Hill Region by the State.

To date, the state-owned lands are predominantly reforestation lands, of limited use for recreational purposes and clustered most heavily along the northern and eastern perimeters, away from the areas of greatest population pressure. If additional State holdings are considered, serious thought should be given to what their specific contributions are to be and how they will be managed to meet an expanding range of needs.

At present, if the core seems to have potentials it is as a source of water, power, timber and recreation, and increasingly, winter recreation. These industrial outputs are reasonably compatible and may continue to exist side by side without detracting materially from each other, particularly if the land is not divided into too many small parcels. Owners are currently few enough that a change in policy by any one of them regarding the use to which his land will be put can significantly alter the pattern of future contributions. At the same time, size of ownership is generally large enough to make most owners look upon the land as a significant investment, with their committments dominated by careful evaluation of alternatives, particularly regarding size and timing of potential returns, either alone or by joint agreement. In any event, as land values in the area rise, pressures will tend toward multiple use rather than single use management.

Recapitulation

This brief review of conditions in the three socio-economic areas of the Tug Hill Region suggests major variations in their needs and priorities. In the northeast rim, the basic problem is to assure better incomes for those who live there now. Fundamental dependence is on the land and on industries which draw upon the land. In the southwest rim, the basic problem is to create a new suburbia for the cities, in a relatively short period of time, without sacrificing too much of the open space and rural atmosphere which the new residents came to find. The pressures of change will be greatest in this area. In the core, the problem is to achieve that balance among recreational and other industrial uses which will help to absorb the recreational overflow from the new communities of the southwest rim while helping to strengthen the industrial base for the northeast rim. A trend toward small ownership may jeopardize this aim. Figure 92 summarizes some of the potential conflicts that may require attention in different parts of the Region.

OPPORTUNITIES FOR CONTROL

In order to insure problem solution or amelioration, some degree of control is desirable over who owns the land, how much he owns, where it is located and how and by whom it is used. Several alternative methods of control are available to government, providing a broad range of command, from very strong to relatively weak guides.

Public Ownership

The most direct control is through government purchase and ownership. Government already owns almost 12 percent of the Tug Hill Region, predominantly in the transition zone between rim and core. Because of its location (away from the populous areas) and the use to which it has been put (mostly reforestation), much of the acreage owned by the State does not contribute effectively to public needs of the near future. Public land ownership in the southwest rim could serve some most pressing needs by promoting access to major bodies of water and fisheries, by protecting some wetlands against deterioration, by guaranteeing major suburban open space among the developed areas for relatively intensive recreational use, and the like. The counties, towns and villages may see advantages in sharing this responsibility.

Public land ownership in the core, particularly in the southern part, could be a guard against its fragmentation into many hands, with consequent

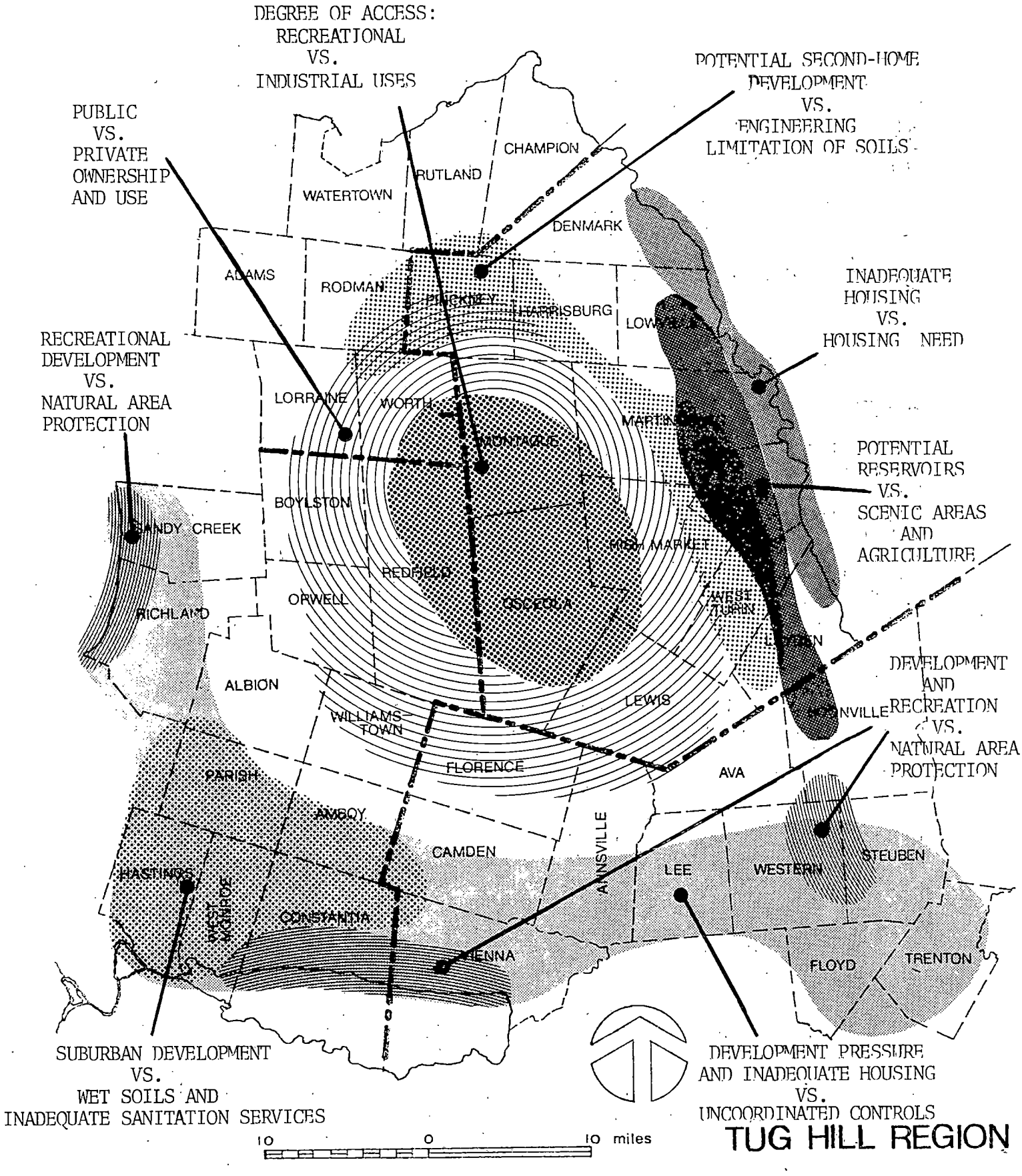


Figure 92. Areas of potential land use conflict, Tug Hill Region.

difficulty of securing its use for industrial consumers and for public recreation purposes. It might also serve to create a refugium and sanctuaries, by appropriate consolidation of lands already owned along the perimeters. But this raises the question again of who really gains, and how much, compared to other alternatives.

As for use, the valid question can be raised as to whether it is time to reconsider and restate the uses to which lands already publicly owned shall be put, and to redefine the management plans by which the roster of agreed upon needs shall be met.

An important constraint on outright ownership is its inflexibility. There are very limited provisions for getting State land back into private hands, no matter how valid the reason.

Easements

Another, less heroic form of control is gained through the easement. Its major uses are to insure public access (such as to fishable streams and to extensive State-owned properties blocked in by private lands), and to maintain sought-after landscape values. In brief, New York has employed the easement largely as a means of obtaining public rights to use private lands. Its utility for keeping private owners from following courses of action that segments of the public would find undesirable has been largely ignored in New York State. It often generates lower costs than ownership, and many afford protection over long periods. It could be a particularly useful tool in the southwest rim.

Zoning

Zoning can take several forms. Two that stand out are: 1. adopting ordinances that limit use, as is done regularly in urban areas; and 2. development of regulations that facilitate use, such as through the State's Agricultural Districting law.

Examples of limited use zoning would be limits of lot size, thereby controlling density of housing and building; or exclusion of unacceptable uses, perhaps through a flexible permit system; or establishing the proportion of a given region which may be put to a certain type of use. In the southwest rim, an ecologically based zoning plan could be protective of both the suburban and the rural environment, while channeling activities so as to keep development costs and taxation at reasonable levels. It might fit some needs in the core as well.

In recent years, legislative action has enabled localities to establish agricultural districts. These provide tax relief to farmers, enabling them to continue farming in the face of pressures from expanding residential settlements. Dedication of parts of some regions to this use has proved a powerful tool in shaping their future. An important question is whether this concept can be applied to a wider range of uses. For example, could "recreational" or "forestry" or "natural resource" districts facilitate integrated use of forested and open space lands? Could they provide a tax framework for amalgamating the efforts of industry and other private landholders with those of government?

A strong possibility is to regulate by coordinating zoning among the towns

and counties. This would prevent "dumping" of undesirable elements from one town to other adjoining towns which lack restrictions. Integration of zoning plans would allow for each legitimate form of use to be directed toward places best suited to accommodate it, and thus prevent creation of blights and urban pressure points which zoning is supposed to avoid.

Financial Aids And Subsidies

Local units of government often are subject to the influence of higher authority by virtue of financial aid arrangements. Recipients of educational aid payments must meet certain minimum educational quality requirements, for example, in return for such support. There is room for innovation as to the kinds of services which may be provided by counties and towns to garner additional supports. This form of regulation seems to have greatest utility where the type of service provided is relatively uniform and its quality easily measured. With financial resources of the towns already heavily taxed in many instances, this device could serve to ease substantially the burden of development.

Subsidies may be in the form of direct payments for actions taken or withheld, or encouragement in the form of technical services and guidance in making land use decisions and acting on them. Subsidy arrangements have been widely used in recreation, housing, utilities, agriculture and in forestry, at both the Federal and State levels, and several such programs are currently available to Tug Hill residents. Worthy of exploration is whether, taken together, they provide an opportunity package fitted to the needs of the Tug Hill Region. And if not, what changes and additions may be called for.

Access Controls

The counterpart to the easement, which improves public access to selected lands, is the form of control which limits access and thereby channels and sets the pace of development in ways which can substantially reduce long term social costs. In the Tug Hill Region, control of roading offers to serve such a purpose, particularly in the core. As set forth earlier in this report, closing roads, setting load limits, providing summer maintenance only, and other techniques, are a virtually unexplored opportunity to guide development. Another opportunity is through control of regional water supplies to achieve similar aims, but its utility in the Tug Hill Region is probably much more restricted than is road development.

OPPORTUNITIES FOR ACTION

No one of the above-mentioned control techniques is necessarily more attractive than the others. Each has its strengths and each its drawbacks with respect to particular problems. The task is to employ the least restrictive procedure to achieve a set of desired goals which tend to change over time as local society grows and changes.

The Commission has several opportunities available to it in seeking the answers to the five central questions: 1. whose needs are to be met; 2. what are those needs; 3. how shall they be met; 4. in what priority order; and 5. who will pay for them?

A first opportunity is the power to question; to seek a response from the

relevant populations which will help to identify needs and priorities, responses from appropriate informed sources as to the nature of the Region's resources, and responses to basic questions which have not been addressed adequately in this report; such as internal financial stability of the Region, resource productivity potentials, impacts of development in adjoining regions, and the like.

A second opportunity is the power to inform; this serves to strengthen the data gathering phase of the work, reduces the chances of misguided actions by some and mistrust arising out of inadequate knowledge. News sources of the Tug Hill Region listed in this report offer opportunity for wide dissemination of Commission findings, goals and actions. So, too, do local informational meetings, hearings, seminars, discussions, and the like.

A third great opportunity is the power to test. The Tug Hill Region embraces parts of 4 counties and 42 towns. A "test town" in one of the more sensitive areas (perhaps in the southwestern rim) would offer opportunity for serious consideration of special problems and alternative devices for meeting them. The repercussive effects of pilot projects could be monitored closely.

Fourth, there is the opportunity for political restructuring. In a region like Tug Hill, with its social services concentrated in the rim, the original system of town boundaries, and districts of many descriptions, may not fit current or prospective future needs. The recent agreement on amalgamation of the towns of West Turin and High Market in Lewis County is a case in point. Helpful consideration can be given to more widespread revision of old patterns to improve efficiency in social services.

A final opportunity, very powerful, is the power of cohesion. As this study dramatizes, there are literally hundreds of agencies (federal, state and local-public and private) working in the Tug Hill Region with social aims in mind but never achieving broad coordination of what they are trying to do. Thus, thousands of people and millions of dollars in resources are engaged in somewhat redundant, spotty and sometimes opposing actions to achieve greater social promise for the Region. Day to day working conditions tend to iron out some duplication of effort. Less frequently are the gaps and omissions percieved and allocated. Even less frequently is there joint agreement as to goals and priorities and conjoint action to increase efficiency. A profound opportunity for the Commission is to bring together such agencies in a refreshing restatement of what each is seeking and how it is proceeding in the light of both the Commission's findings and its own broadened conception of what opportunities exist for further coordination.

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Appendix 1. Glossary of terms for geology and soils

A horizon--surface layer of mineral soil having maximum organic matter accumulations, maximum biological activity and/or eluviation of material

Acid soil-soil having a preponderance of hydrogen and aluminum ions in proportion to hydroxl ions; technically with a pH value less than 7.0, but practically with pH less than 6.6

Akaline soil--specifically a soil with pH value greater than 7.0, but practically with a pH greater than 7.3

Alluvial deposit--material transported and deposited by running water

Arkose--sandstone rich in feldspar

Association--a group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a region

B horizon--a soil layer below the A horizon and characterized by the accumulation of materials leached from the A horizon, and/or a blocky or prismatic structure

C horizon--a layer beneath the solum which is relatively little affected by soil forming activities and may or may not be like the material from which the A and B horizons have been formed

Clay--a soil with at least 40 percent of particles less than 0.02 mm in diameter, and less than 45 percent sand and less than 40 percent silt

Delta--accumulation of sediments deposited by running water entering a pond or lake

Dolostone--sedimentary rock composed primarily of calcium and magnesium carbonate

Eluviation--the removal of soil material in suspension (or in solution) from a layer or layers of soil, and usually called leaching

Feldspar--primary mineral containing potassium, sodium, or calcium

Fine textured--containing large quantities of the smaller soil separates, particularly silt and clay, usually exhibited by clay and clay loam soils

Fragipan--a dense, brittle layer in soils that owes its hardness mainly to extreme density or compactness rather than high clay content or cementation, and is friable when removed, but is so dense in place that roots cannot penetrate it and water moves through it slowly

Friable--a soil consistency pertaining to the ease of crumbling

Gneiss--metamorphic rock modified from an igneous rock

Granite--an igneous rock

Ground Moraine--till material deposited underneath glacial ice

Hametite--a primary mineral composed of iron oxide

Humus--relatively stable fraction of the soil, organic matter remaining after the major portion of the plant and animal residues in the soil have decomposed

Igneous rock--rocks formed during the solidification of hot, volcanic products

Illuvial horizon--the soil layer where material carried from an overlaying layer has been precipitated from solution or deposited from suspension and accumulated

Kame--a hill or ridge composed of stratified glacial outwash

Kettle--a depression in the topography caused by the melting of large blocks of glacial ice covered with glacial deposits

Loam--soil having a moderate amount of sand, silt and clay in it

Metamorphic rock--igneous or sedimentary rocks that have been changed in form when subjected to high pressure and high temperatures

Mineral soil--soil consisting predominately of, and having properties determined mainly by, mineral matter, and usually containing less than 20 percent organic matter

O horizon--organic horizon of a mineral soil

Parent material--the unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed

Permeability--the ease with which gases, liquids, or plant roots can penetrate or pass through a bulk mass of soil, or a layer of the soil

Sand--a soil composed predominately of particles between 0.05 and 2.00 mm in diameter

Sandstone--sediments of quartz sand particles consolidated by pressure and cementing material

Sedimentary rock--rocks produced either by cementation of deposited minerals, rock fragments and shells of organisms, or by precipitation of salts from solution

Shale--laminated sedimentary rocks formed by the consolidation of fine, silt-sized particles

Silt--a soil composed predominately of particles between 0.002 and 0.05 mm in diameter

Appendix 2. Soils of the Tug Hill Region, Adams series.[a]

Description: Adams soils are deep, excessively drained, very strongly acid, coarse textured soils that formed in deltaic or outwash deposits that are dominated by medium and fine sand. The soil is typically free of gravel throughout the profile but may contain up to 20 percent gravel below 20 inches. These level to rolling soils are on areas of sand plains. Adams soils have 18 to 30 inches of loose or very friable rapidly permeable sand or loamy sand over loose rapidly permeable coarse or medium sand. Depth of bedrock is over 5 feet and usually exceeds 10 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually too sandy	Good--may occasionally be high in fines	Poor--usually always sand	Poor--too sandy, difficult to compact

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-D	Sandy material with rapid permeability; seepage rate likely to be very high
Pond embankment	All	Difficult to compact; compated permeability high; poor stability; subject to piping
Drainage	All	Not needed
Highway or road location	A-B	Sandy, unstable material; highly erodible on slopes
	C-D	Cuts and fills necessary because of slope
Low building foundation	All	Sandy, unstable material; moderate to low bearing strength; low shear strength
Pipeline construction and maintenance	All	Sandy material with rapid permeability; trench walls likely to be very unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Adams series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-D	Severe--rapid permeability which may make pollution a serious hazard
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-D	Severe--slope hazard
Field crops	A-B	Moderate--sandy texture and slope hazard on B slopes
	C-D	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-D	4	3	3	3	3	4	4	4	3	3	4

Appendix 2. Soils of the Tug Hill Region, Agawam series.[a]

Description: Agawam soils are deep, well drained, strongly to slightly acid and moderately course textured soils that formed in deltaic or outwash terrace sits that are dominated by schist, granite, gneiss, and phyllite. The soil is typically free of gravel but may contain up to 10 percent and more than 35 per cent in the substratum of some profiles. These nearly level to sloping soils are on outwash plains and on high stream terraces. Agawam soils have 15 to 35 inches of very friable, moderately rapidly permeable fine sandy loam over very friable to loose, rapidly permeable loamy fine sand that is stratified and contains some gravel. Depth to bedrock is 4 feet and usually exceeds 20 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair to good in upper foot--usually somewhat sandy	Good--usually is poorly graded	Fair below 3 feet--is usually small in size and poorly graded	Fair--generally sandy

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Subject to excess seepage
Pond embankment	A-C	Piping hazard; outside shell not stable; compacted permeability high
Drainage	A-C	Usually not needed
Highway or road location	A-C	Some cuts and fills may be needed. Soil material is highly erosive when exposed on enbankments
Low building foundation	A-C	Generally moderately high bearing capacity
Pipeline construction and maintenance	A-C	Unstable ditch walls; material may flow when wet

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Agawam series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Sanitary landfill	A-C	Severe--rapid permeability below 3 feet may make pollution a serious problem
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4

Appendix 2 . Soils of the Tug Hill Region, Alden series.[a]

Description: Alden soils are deep, very poorly drained, slightly acid to neutral, silty soils formed in calcareous silty material. They occupy level to slightly depressed areas mainly on lake plains but including local depressions of till plains. Alden soils have 1 to 1 1/2 feet of very fine sandy loam to silt loam, high in organic matter, over 1 to 1 1/2 feet of slowly permeable, very fine sandy loam to coarse silty clay loam. This material is underlain by massive or platy, water sorted, very fine sandy loam to coarse silty clay loam. Glacial till may be present at depths greater than 40 inches. Depth of bedrock is over 5 feet. Seasonal water table is usually ponded.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair to poor--prolonged wetness.	Not suitable	Not suitable	Poor--poorly graded, unstable material

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Prolonged wetness; slow permeability; seepage usually no problem
Pond embankment		Mucky surface material unsuitable; underlying material somewhat clayey and difficult to work; compacted permeability low
Drainage		High water table much of year; outlets usually difficult to obtain; slow permeability
Highway or road location		Mucky surface needs to be removed; soil is wet or ponded most of the year
Low building foundation		Soil is wet or ponded most of the year; shear strength and compressibility are moderate.
Pipeline construction and maintenance		Soil is wet or ponded most of the year

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2 . Alden series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--prolonged wetness; slow permeability
Low buildings		
With basement	A	Severe--prolonged wetness
Without basement	A	Severe--prolonged wetness
Sanitary landfill	A	Severe--prolonged wetness
Play and picnic areas	A	Severe--prolonged wetness
Campsites		
Tents	A	Severe--prolonged wetness; slow permeability
Trailers	A	Severe--prolonged wetness; slow permeability
Field crops	A	Moderate--prolonged wetness; needs drainage

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	3	1	2	1	3	2	1

Appendix 2. Soils of the Tug Hill Region, Altmar series.[a]

Description: Altmar soils are deep, moderately well to somewhat poorly drained, strongly to medium acid, gravelly sandy soils that have formed in slightly acid to neutral glacial outwash and gravel. They occupy nearly level areas or depressions on outwash plains. Altmar soils have 4 or more feet of rapidly permeable gravelly, cobbly or sandy loam to cobbly loamy fine sand usually over a slowly permeable contrasting layer beneath that may be of glacial till or lacustrine origin. Depth of bedrock is 4 feet. Depth of seasonal water table is 1-2 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor in upper foot--seasonally wet; usually gravelly	Poor--usually high in fines; seasonally wet	Poor--usually high in fines; seasonally wet	Good--seasonally wet; may contain some stones

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Sandy,gravelly material with rapid permeability and seepage rate
Pond embankment	A-C	Sandy gravelly material likely to have rapid permeability when compacted; subject to piping
Drainage	A-C	Rapid permeability; seasonal wetness; unstable ditch banks
Highway or road location	A-C	Seasonally high water table; frost heaving generally low
Low building foundation	A-C	Shear strength fair; compressibility low; seasonally high water table
Pipeline construction and maintenance	A-C	Seasonally high water table; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Altmar series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--seasonal wetness and C slope
Low buildings		
With basement	A-C	Moderate--seasonal wetness and C slope
Without basement	A-C	Moderate--seasonal wetness and slope hazard on C slopes
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-C	Moderate--seasonal wetness and slope hazard on C slopes
Campsites		
Tents	A-C	Moderate--seasonal wetness; C slope
Trailers	A-B	Moderate--seasonal wetness and slope hazard on B slopes
	C	Severe--slope
Field crops	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-B	3	2	2	2	1	4	4	4	2	2	4
C	3	2	2	2	1	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Alton series.[a]

Description: Alton soils are deep, well drained, strongly to medium acid, moderately coarse textured soils that have formed in neutral to calcareous glacial outwash and beach deposits dominated by fragments of red or mixed red and gray sandstone. They occupy broad nearly level terraces, short moderate to steep slopes of terrace faces or beach ridges, and kame topography. Alton soils have 2 to 4 feet of moderately to rapidly permeable gravelly sandy loam over rapidly permeable stratified gravel and sand, with some limestone and shale pebbles locally mixed with red sandstone gravel. Depth of bedrock is over 4 feet and usually exceeds 15 to 20 feet. Depth of seasonal water table is 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually contains much gravel and cobbles	Upper 3 feet--Poor Below 3 feet--Fair Usually high in gravel	Upper 3 feet--fair Below 3 feet--good	Good--may contain some stones and boulders

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Sandy, gravelly material with rapid permeability and seepage rate;
	D-F	Slope severely limits storage potential
Pond embankment	All	Sandy, gravelly material likely to have rapid permeability when compacted; generally good for outside shells
Drainage	All	Generally not needed
Highway or road location	A-B	Conditions usually favorable.
	C-F	Conditions favorable however cuts and fills necessary because of slope.
Low building foundation	A-C	Fair shear strength; low compressibility; generally high bearing capacity.
	D-F	Usually not feasible because of slope
Pipeline construction and maintenance	All	Ditch walls usually unstable; may contain stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Alton series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--little or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Sanitary landfill	All	Severe--because of rapid permeability at 3 feet and deeper which may make pollution a serious problem; and slope hazard on over C slopes.
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope
	D-F	Severe--because of slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slopes
	C-F	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope
	D-F	Severe--because of slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	4	4	1	2	4
B-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2 . Soils of the Tug Hill Region, Amboy series.[a]

Description: Amboy soils are deep, well drained, strongly acid, medium textured soils that formed in strongly acid silty and very fine sandy wind-or water-deposited material. They occupy distinctly convex undulating or rolling to strongly sloping or steep dissected areas of the uplands. Amboy soils have 1 1/2 to 2 feet of moderately permeable very fine sandy loam to silt loam over a slowly permeable, fairly dense, silt loam or very fine sandy loam fragipan that is 2 to 2 1/2 feet thick. This fragipan is underlain by silts and very fine sands. Depth of bedrock is over 4 feet. Depth of seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good in upper foot	Poor in upper 2 feet--not suitable below this	Not suitable	Fair to poor--low sheer strength; erodible on slopes

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-D	Generally good however some mapping units may contain small areas of deep sandy material with a moderate seepage rate
Pond embankment	A-D	Poor stability, compaction properties, and resistance to piping; permeability likely to be moderate when compacted
Drainage	A-D	Generally not needed
Highway or road location	A-D	High potential frost heaving; soil material tends to be somewhat unstable and erodible especially on slopes
Low building foundation	A-D	Moderate compressibility; low shear strength
Pipeline construction and maintenance	A-D	Ditch walls may be unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2 . Amboy series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--moderately slow permeability and slope hazard on D slopes
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-C	Moderate--seasonal wetness and slope hazard on C slopes
	D	Severe--slope hazard. ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-C	Moderate--moderately slow permeability and slope hazard on C slopes
	D	Severe--slope hazard
Trailers	A-B	Moderate--moderately slow permeability and slope hazard on B slopes
	C-D	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4

Appendix 2 . Soils of the Tug Hill Region, Amenia series.[e]

Description: Amenia soils are deep, moderately well drained slightly acid to neutral, medium textured soils that formed in highly calcareous glacial till. They are on convex, nearly level to undulating areas of till plains. Amenia soils have 2 to 2 1/2 feet of moderately permeable silt loam or loam over moderately slowly permeable, gravelly fine sandy loam glacial till dominated by limestone, shale, or slate. Depth of bedrock is over 4 feet. Depth to seasonal water table is 1 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot fair--usually is stony; seasonally wet	Not suitable	Not suitable	Fair--seasonally wet; usually somewhat stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-D	Generally most features favorable; seepage rate low; fractured bedrock may occur within 4 feet occassionally
Pond embankment	A-D	Fair stability and compaction properties; likely to have moderate permeability when compacted
Drainage	A-C	Moderately slow permeability; stones and boulders may interfere with construction
	D	Not feasible
Highway or road location	A-D	Moderate potential frost heaving; stones and boulders may interfere with construction; seasonal wetness
Low building foundation	A-D	Seasonal wetness; fair shear strength; low to moderate compressibility; moderate bearing capacity
Pipeline construction and maintenance	A-D	May contain some stones and boulders; somewhat seasonally wet

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Amenia series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--moderately slow permeability below about 30"; C slope.
	D	Severe--because of slope hazard
Low buildings		
With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
	D	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Sanitary landfill	A-D	Severe--because of seasonal wetness and slope hazard on D slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-B	Moderate--moderately slow permeability
	C	Moderate--moderately slow permeability, slope
	D	Severe--slope
Trailers	A	Moderate--moderately slow permeability
	B	Moderate--moderately slow permeability, slope
	C-D	Severe--slope
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	3
B-C	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region, Arkport series.[a]

Description: Arkport soils are deep, well drained, medium to strongly acid, moderately coarse textured soils developed in fine to very fine lacustrine sands. They occupy nearly level or gently sloping deltas and their associated sloping to steep deltaic frontal areas and dissection forms. The upper 2 feet is permeable very fine sandy loam to loamy fine sand. The material below 2 feet is moderately permeable and consists of mostly very fine and fine sand but includes bands of very fine sandy loam 1 to 5 inches thick. Depth of bedrock is over 5 feet and usually exceeds 20 to 30 feet. Depth to seasonal water table is over 5 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--very sandy; unstable on slopes	Poor--too many fines	Poor--low gravel content	Poor--unstable

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Very sandy material with rapid permeability and seepage rate
Pond embankment		Sandy material likely to have high permeability when compacted; subject to piping; fair stability
Drainage		Generally not needed
Highway or road location		Moderate frost heave potential; some cuts and fills may be necessary; material likely to be unstable on slopes
Low building foundation		Moderate to low shear strength; moderate bearing capacity
Pipeline construction and maintenance		Ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2 . Arkport series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--because of rapid permeability at 3 feet and deeper which may make pollution a serious problem.
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C-D	Moderate--slope and erosion hazard
	E-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Becket series.[a]

Description: Becket soils are deep, well drained, very strongly acid, moderately coarse textured soils that have a fragipan. They formed in firm glacial till that is dominated by granitic and schistose rocks. The coarse fragment content ranges from 5 to 25 percent throughout. These gently sloping to steep soils occur on till plains in the Adirondack Mountains. Becket soils have 18 to 36 inches of friable, moderately rapidly permeable fine sandy loam to sandy loam over firm, slowly permeable sandy loam fragipans and glacial till. Depth of bedrock is over 3 1/2 feet. Depth to seasonal water table is over 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--too stony and has coarse textures	Poor--contains too many fines	Poor--contains too many fines	Good--generally contains stones that need to be removed or crushed

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Seepage rate usually is high
	C-F	Storage potential limited because of slope
Pond embankment	All	Generally has moderate compacted permeability Good stability for outside shell
Drainage	All	Well drained
Highway or road location	A-C	Soil material is easily worked; stones may interfere with construction
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Stable building foundation material. Has fairly high strength; moderate shear strength
Pipeline construction and maintenance	All	Presence of stones may interfere with construction. Hard bedrock may occur within 5 feet of the surface

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Becket series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--slow permeability
	D	Severe--slow permeability; slope
Low buildings		
With basement	A-B	Slight
	C	Moderate--slope
	D	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D	Severe--slope
Sanitary landfill	A-C	Slight
	D	Severe--slope
Play and picnic areas	A-B	Slight
	C	Moderate--slope
	D	Severe--slope
Campsites		
Tents	A-B	Slight to moderate--may be stony
	C	Moderate--may be stony
	D	Severe--slope
Trailers	A	Slight to moderate--may be stony
	B	Moderate--slope may be stony
	C-D	Severe--slope
Field crops	A-B	Slight
	C	Moderate--slope
	D	Severe--slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	4	4	1	2	4
B-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Benson series.[a]

Description: Benson soils are well drained, mildly alkaline to slightly acid soils that formed in medium textured, highly calcareous glacial till ranging in depth 10 to 20 inches to bedrock. They occupy nearly level to steep uplands. Benson soils have 1/2 to 1 foot of moderately permeable silt loam over 1/2 to 1 foot of moderately permeable silt loam of fine silt loam with many limestone fragments. Benson soils are underlain by hard limestone bedrock or calcareous shale. Depth of bedrock is 1 to 2 feet. Depth to seasonal water table is 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--usually rocky or stony	Not suitable	Not suitable	Poor--limestone bedrock at 1-2 feet deep

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-D	Fractured limestone bedrock occurs below 1-2 feet which will likely allow rapid seepage
Pond embankment	A-D	Limestone bedrock occurs 1-2 feet deep; upper foot usually contains stones
Drainage	A-D	Generally not needed; bedrock at 1-2 feet deep
Highway or road location	A-D	Limestone bedrock at 1-2 feet deep
Low building foundation	A-D	Limestone bedrock at 1-2 feet deep
Pipeline construction and maintenance	A-D	Limestone bedrock at 1-2 feet deep

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Benson series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Low buildings		
With basement	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Without basement	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Sanitary landfill	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Play and picnic areas	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Campsites		
Tents	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes
Trailers	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on C-D slopes
Field crops	A-D	Severe--bedrock at 1-2 feet deep and slope hazard on D slopes

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	2	2	2	2	4	4	4	2	2	4
D	3	2	2	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Braceville series.[a]

Description: Braceville soils are deep, moderately well drained, strongly acid soils developed in medium textured water-sorted materials. These soils are on nearly level to gently sloping glacial outwash terraces, beach ridges, fans, and water-sorted moraines. Braceville soils have 2 feet of permeable, friable, gravelly loam over a slowly permeable fragipan about 1 foot thick. Stratified acid sands and gravels occur below 3 feet. Depth of bedrock is much greater than 5 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--coarse fragments	Good--not well suited for concrete	Good--seasonal wetness	Good--wet at 1-1 1/2 feet; some boulders

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Rapid to very rapid permeability
Pond embankment		High permeability when compacted
Drainage		Seasonal wetness; thin fragipan near the surface; occasional included "wet spots"; moderate permeability
Highway or road location		Seasonal wetness near the surface; included seepy areas fairly frequent; low potential frost heave; may be a moderate hazard on C slopes
Low building foundation		Seasonal wetness near the surface imposes some foundation drainage problems. Generally moderately high bearing capacity; negligible compressibility
Pipeline construction and maintenance		Ditch walls unstable; seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Braceville series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability
	C	Severe--slow permeability
Low buildings		
With basement	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Campsites		
Tents	A-B	Moderate--seasonal wetness
	C	Severe--seasonal wetness; slope hazard
Trailers	A	Moderate--seasonal wetness
	B	Moderate--seasonal wetness; slope hazard
	C	Severe--seasonal wetness; slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4

Appendix 2. Soils of the Tug Hill Region, Broadalbin series.[a]

Description: Broadalbin soils are deep, well drained, medium textured, acid soils formed in firm glacial till derived from granite, gneisses, and dark alkaline shales. They are on nearly level to hilly areas and have 1 1/2 to 3 feet of moderately permeable stone free loam or very fine sandy loam underlain by 1 1/2 to 2 feet of firm, dense, very slowly permeable fine sandy loam fragipan. This is all underlain by sandy loam glacial till. Depth of bedrock is over 5 feet. Depth to seasonal water table is over 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good	Not suitable	Not suitable	Fair--subject to frost heave; shear strength low

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Conditions usually good; permeability and seepage rate low
	C-D	Storage potential limited because of slope
Pond embankment	All	Stability fair; shear strength low; close control of compaction required
Drainage	A-B	Moderately slowly permeable layer at 1 1/2 to 3 feet deep; water seeps along this layer
	C-D	Generally not feasible because of slope
Highway or road location	A-B	Moderate frost heave potential; material is easily worked
	C-D	Cuts and fills necessary because of slope
Low building foundation	All	Fair to good stability; foundation drainage may be required
Pipeline construction and maintenance	All	Conditions generally favorable; may contain a few stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Broadalbin series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Moderate--slow permeability below about 30 inches
	C	Moderate--slow permeability below about 30 inches; slope
	D	Severe--slope
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Sanitary landfill	All	Severe--because of seasonal water table at less than 6 feet deep and slope hazard on D slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-C	Moderate--because of slow permeability below about 20 inches; C slopes
	D	Severe--because of slope hazard
Trailers	A-B	Moderate--because of slow permeability below about 20 inches; B slopes
	C-D	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Camroden series.[a]

Description: Camroden soils are deep, somewhat poorly drained, strongly acid, medium textured soils that formed in acid glacial till. They are on gently moderately to moderately sloping areas in undulating and rolling till plains. Camroden soils have 1 to 1 1/2 feet of moderately permeable channery silt loam over a dense, very firm, slowly permeable channery silt loam fragipan that is dominated by shale fragments. This all is underlain with firm loam or silt loam glacial till. Depth of bedrock is over 4 feet. Depth to seasonal water table 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot fair to poor--seasonally wet usually contains coarse fragments	Not suitable	Not suitable	Fair--seasonally wet; usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Generally most features favorable; seasonal high water table
Pond embankment	A-C	Has fair stability and compaction properties; permeability likely to be low to moderate when compacted; usually contains stones and cobbles
Drainage	A-C	Slowly permeable fragipan at 1-3 feet deep; soil usually has some stones and boulders that will interfere with construction
Highway or road location	A-C	Seasonally high water table; stones and boulders in soil may interfere with construction; moderate frost heaving potential
Low building foundation	A-C	Seasonally high water table; low shear strength; low to moderate compressibility
Pipeline construction and maintenance	A-C	Seasonally high water table; usually has appreciable stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Camroden series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--slow permeability; seasonal wetness
Low buildings		
With basement	A-C	Severe--seasonal wetness and slope hazard on C slopes
Without basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Campsites		
Tents	A-C	Severe--because of slow permeability and seasonal wetness
Trailers	A-C	Severe--because of slow permeability; seasonal wetness; and slope hazard on C slopes
Field crops	A-B	Moderate--because of seasonal wetness; moderate available moisture; low fertility and slope hazard on C slopes
	C	Severe--slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	2	2	2	3	2	2	2	2	2
B	2	2	2	2	2	3	4	4	2	2	4
C	2	2	2	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Canandaigua series.[a]

Description: Canandaigua soils consist of deep, poorly drained, slightly acid to neutral silty soils formed in calcareous glacial lake deposits. They occupy level areas or depressions. Canandaigua soils have 1 1/2 to 3 1/2 feet of moderately permeable silt loam or very fine sandy loam over slowly permeable massive or platy water-sorted very fine sandy loam to coarse silty clay loam. Depth of bedrock is over 5 feet. Depth to seasonal water table is not over 1/2 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--in upper foot	Not suitable	Not suitable	Not suitable--unstable material

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Wet much of year; seepage rate low
Pond embankment		Moderate stability; moderate volume change when compressed; low permeability when compacted
Drainage		Wetness at or near surface much of year and lack of available outlets make drainage difficult
Highway or road location		Seasonal wetness at or near surface with ponding and frequent seepy areas severely affect workability
Low building foundation		Wetness at or near surface much of year and slow permeability in subsoil present very severe foundation drainage problems; seldom desirable as a building site in undisturbed state
Pipeline construction and maintenance		Ditch wall stability good; soil wet much of the year

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Canandaigua series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--prolonged wetness; slow permeability
Low buildings		
With basement	A	Severe--prolonged wetness
Without basement	A	Severe--prolonged wetness
Sanitary landfill	A	Severe--prolonged wetness
Play and picnic areas	A	Severe--prolonged wetness
Campsites		
Tents	A	Severe--prolonged wetness
Trailers	A	Severe--prolonged wetness
Field crops	A	Moderate--prolonged wetness; requires drainage

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	2	2	3	2	2

Appendix 2. Soils of the Tug Hill Region, Charlton series.[a]

Description: Charlton soils are deep, well drained, very strongly to strongly acid, moderately coarse to medium textured soils that formed in glacial till derived from schist and gneiss. The coarse fragment content ranges from 5 to 30 percent and the soils are frequently stony or very stony. These gently sloping to moderately steep soils are upland till plains. Charlton soils have 20 to 30 inches of very friable, moderately permeable fine sandy loam, or loam over friable, moderately rapidly permeable fine sandy loam or sandy loam that is commonly gravelly. Depth of bedrock is over 4 feet. Depth to seasonal water table is 4 feet and over.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually stony	Poor--usually has a high content of fines	Poor--usually has a high content of fines	Good--contains stones which must be removed

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Very permeable material which will likely allow rapid seepage rate
	D-F	Storage potential limited because of slope
Pond embankment	All	Sandy, gravelly material; moderate compacted permeability stones must be removed
Drainage	All	Well drained
Highway or road location	A-C	Usually stony; material makes good subgrade when stones are removed
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Generally adequate strength; low compressibility
Pipeline construction and maintenance	All	Stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Charlton series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Low buildings		
With basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Sanitary landfill	A-F	Severe--rapid permeability below 3 feet which makes pollution a hazard
Play and picnic areas	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Campsites		
Tents	A-B	Slight--may be very stony
	C	Moderate--slope; may be very stony
	D-F	Severe--slope
Trailers	A	Slight--may be very stony
	B	Moderate--slope; may be very stony
	C-F	Severe--slope
Field crops	A-B	Slight to severe--may be very stony
	C	Moderate to severe--slope; may be very stony
	D-F	Severe--slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-D	3	2	2	2	2	4	4	4	2	2	4
E	4	3	2	2	2	4	4	4	3	2	4
F	4	4	2	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Chenango series.[a]

Description: Chenango soils are deep, well to somewhat excessively drained, strongly acid, medium textured, gravelly soils formed in glacial outwash sand and gravel which contains very little lime. They occupy level outwash terraces in the valleys, alluvial fans where postglacial side streams left gravelly or channery deposits on the valley floors, and hilly gravel deposits where streams that issued from the glacier dropped their loads. Chenango soils have 1 to 1 1/2 feet of gravelly silt loam or gravelly loam over 1 to 1 1/2 feet of very gravelly loam or very gravelly silt loam that is underlain by gravel and cobblestones with stratified sand. Depth of bedrock is over 5 feet and usually exceeds 20 feet. Depth to seasonal water table is over 5 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--coarse fragments	Fair below 3 feet	Good--below 3 feet	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Slopes seepage rate high, rapid to very rapid permeability
	D-F	Slopes restrict storage potential
Pond embankment		High to moderate permeability when compacted; stability is good for outside shells
Drainage	A-B	Slopes rarely needed; rapid permeability
	C-F	Slopes construction generally not practical
Highway or road location	A-C	Slopes generally no adverse conditions Cuts and fills necessary on D-F slopes
Low building foundation		Low compressibility, trench slope perhaps unstable, moderate bearing capacity
Pipeline construction and maintenance		Trench slope perhaps unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Chenango series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--because of rapid permeability at 3 feet and deeper which may make pollution a serious problem
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	2	2	2	2	4	4	4	2	2	4
D	3	2	2	2	2	4	4	4	2	2	4
E	4	3	2	2	2	4	4	4	3	2	4
F	4	4	2	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Collamer series.[a]

Description: Collamer soils are deep, moderately well drained, strongly acid to neutral, stone-free silty soils formed in calcareous deposits of glacial lakes. They occupy gently sloping or undulating topography. Collamer soils have about 1 foot of moderately permeable silt loam over 1 to 2 1/2 feet of fine silt loam or coarse silty clay loam that is moderately permeable and is underlain by layers of silt with lenses of very fine sand and clay. Depth of bedrock is over 4 feet and usually exceeds 20 feet. Depth to seasonal water table is 1 1/2 to 2 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--in upper foot	Not suitable	Not suitable	Poor--poorly graded silt and very fine sand

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Slopes are generally adequate sites; seepage rate low
	C-D	Slopes are usually too steep and thus present a size limitation
Pond embankment		Silty material subject to piping when wet; should be mixed with other coarse material; when properly compacted permeability is low
Drainage	A-B	Slopes-silty material with moderately slow permeability, stability of ditch walls may be a problem
	C-D	Slopes too steep; drainage not needed
Highway or road location		Seasonal wetness; high frost heave potential; material is fairly easy worked; tends to be unstable on slopes
Low building foundation		Low shear strength; low to moderate bearing capacity; seasonal wetness
Pipeline construction and maintenance		Seasonal wetness; ditch walls may be somewhat unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Collamer series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B C-D	Moderate
Low buildings		
With basement	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-D	Severe--seasonal wetness; D slope
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-B	Moderate--seasonal wetness; moderately slow permeability
	C	Moderate--seasonal wetness; moderately slow permeability; slope hazard
	D	Severe--slope hazard
Trailers	A	Moderate--seasonal wetness; moderately slow permeability
	B	Moderate--seasonal wetness; moderately slow permeability; slope hazard
	C-D	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D	Severe--slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	3
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix 2. Soils of The Tug Hill Region, Colonie series.[a]

Description: Colonie soils are deep, well to excessively drained, strongly to medium acid, coarse textured soils that formed in outwash or lacustrine materials and associated aeloian deposits dominated by fine and very fine sand. The soil is typically free of gravel. These nearly level to steep soils are on landforms associated with deltaic deposits. Colonie soils have 16 to 24 inches of very friable, rapidly permeable loamy fine sand over very friable to loose, rapidly permeable fine sand containing thin moderately permeable dark brown bands. Depth of bedrock is over 5 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--sandy	Good for molding sand; poor for other uses--too fine	Poor	Poor--unstable

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Excessive seepage rate
Pond embankment	All	Sandy material, rapid seepage rate; difficult to vegetate; piping hazard
Drainage	All	Well drained
Highway or road location	A-B C-F	Easy to dig; unstable. Cuts and fill necessary because of slope
Low building foundation	All	Stable soil, usually not feasible on steeper slopes; high bulk density; low shrink-swell
Pipeline construction and maintenance	All	Deep trenches subject to sloughing

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Colonie series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Low buildings With basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Sanitary landfill	All	Severe--ground water pollution hazard
Play and picnic areas	A-B	Moderate--soil texture
	C	Moderate--soil texture and slope
	D-F	Severe--slope
Campsites Tents	A-B	Moderate--soil texture
	C	Moderate--soil texture and slope
	D-F	Severe--slope
Trailers	A	Moderate--soil texture
	B	Moderate--soil texture and slope
	C-F	Severe--slope
Field crops	A-B	Moderate--surface soil texture
	C-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-D	3	3	3	3	3	4	4	4	3	3	4
E	4	3	3	3	3	4	4	4	3	3	4
F	4	4	3	3	3	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Colosse series.[a]

Description: Colosse soils are deep, excessively drained, strongly to very strongly acid, moderately coarse textured soils that formed in outwash deposits that are dominated by conditions and granitic rocks. The content of coarse fragments exceeds 35 percent. These nearly level to steep soils occur on outwash plains and valley drains, kames, and eskers, and water worked moraines. Colosse soils have 24 to 38 inches of very friable, rapidly permeable, gravelly sandy loam or fine sandy loam over loose, very rapidly permeable cobbles, gravel and sand. Depth of bedrock is over 4 feet and usually exceeds 10 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually too high in coarse fragments	Good--usually high in gravel	Good	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Rapidly permeable
Pond embankment	All	Compacted permeability; generally good for outside shells; cobbly
Drainage	All	Excessively drained
Highway or road location	A-C	Good sub-base material; variable bearing capacity; stable
	D-E	Cuts and fills necessary because of slope
Low building foundation	All	Variable bearing capacity due to stratification
Pipeline construction and maintenance	All	Well drained sandy, gravelly soil; ditch walls likely to be unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Colosse series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight
	C	Moderate--slope
	D-E	Severe--slope
Low buildings		
With basement	A-B	Slight
	C	Moderate--slope
	D-E	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D-E	Severe--slope
Sanitary landfill	A-E	Severe--rapid permeability makes pollution a serious hazard
Play and picnic areas	A-B	Slight
	C	Moderate--slope
	D-E	Severe--slope
Campsites		
Tents	A-B	Moderate--coarse fragments
	C	Moderate--coarse fragments; slope
	D-E	Severe--slope
Trailers	A	Moderate--coarse fragments
	B	Moderate--coarse fragments; slope
	C-E	Severe--slope
Field crops	A-B	Moderate--moderately coarse textured surface soil
	C-E	Severe--slope;moderately coarse textured surface

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-D	3	3	3	3	3	4	4	4	3	3	4
E	4	3	3	3	3	4	4	4	3	3	4

Appendix 2. Soils of the Tug Hill Region, Colton series.[a]

Description: Colton soils are deep, excessively drained, very strongly acid, coarse textured, gravelly soils that formed in gravelly or cobbly glacial outwash sediments that are dominated by conditions and granite rocks. Gravel or cobbles in the upper 2 feet ranges from 25 to 35 percent while that of the substratum ranges up to 75 percent. These nearly level to very steep soils are on outwash terraces and their dissection forms, kames and eskers. Colton soils have 18 to 30 inches of very friable, rapidly permeable, gravelly loamy sand or sand over loose, very rapidly permeable, stratified sand and gravel. Depth of bedrock is over 4 feet and usually exceeds 10 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--gravelly, cobbly, sandy	Good--usually contains a high amount of gravel	Good	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Sandy, gravelly material with excessive seepage rate
Pond embankment	All	Sandy, gravelly material; compacted permeability rapid; generally good for outside shells
Drainage	All	Excessive drained
Highway or road location	All	Gravelly or cobbly; cut slope somewhat unstable; usually good source of sub-base material
Low building foundation	All	Generally adequate strength; well drained, rapidly permeable soil
Pipeline construction and maintenance	All	Well drained, sandy, gravelly soil; ditch walls likely to be unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Colton series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Low buildings		
With basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Sanitary landfill	A-F	Severe--rapid permeability makes pollution a serious hazard; slope hazard on D-F slopes
Play and picnic areas	A-B	Moderate--surface soil texture
	C	Moderate--slope hazard; surface soil texture
	D-F	Severe--slope
Campsites		
Tents	A-B	Moderate--surface soil texture
	C	Moderate--slope; surface soil texture
	D-F	Severe--slope
Trailers	A	Moderate--surface soil texture
	B	Moderate--slope; surface soil texture
	C-F	Severe--slope
Field crops	A-B	Moderate--coarse textured surface soil
	C-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-E	4	3	3	3	3	4	4	4	3	3	4
F	4	4	3	3	3	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Croghan series.[a]

Description: Croghan soils are deep, moderately well drained, coarse textured, strongly acid soils that formed on sand sediments high in quartz. They occupy nearly level to sloping areas on sand plains that were deposited in or next to proglacial lake basins. Croghan soils have 2 to 4 feet of rapidly permeable loamy sand over rapidly permeable sand. Depth of bedrock is over 4 feet and usually exceeds 10 feet. Depth to seasonal water table is 1 1/2 to 2 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--too sandy	Good--slight seasonal wetness	Poor--usually all sand	Fair--usually all sand

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Excessive seepage rate
Pond embankment	A-C	Fair stability; compacted permeability rapid; subject to piping
Drainage	A-C	Rapidly permeable; drainage generally not needed
Highway or road location	A-C	Slopes highly erodible; fair stability; seasonal wetness; moderate frost heave potential
Low building foundation	A-C	Shear strength low; seasonal high water table; foundation drainage may be needed
Pipeline construction and maintenance	A-C	Seasonal wetness; ditch walls unstable; very sandy soil

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Croghan series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Low buildings With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
Sanitary landfill	A-C	Severe--because of seasonal wetness and water table pollution
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
Campsites Tents	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Trailers	A-B	Moderate--because of seasonal wetness and slope hazard on B slopes
	C	Severe--because of slope hazard
Field crops	A-B	Moderate--because of sandy texture, low fertility and low available moisture
	C	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	3	2	2	2	1	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Danley series.[a]

Description: Danley soils are deep, moderately well drained, medium and moderately fine textured, slightly to strongly acid soils that have formed on calcareous glacial till. They are on undulating to moderately steep areas of till plains. Danley soils have about one foot of moderately slowly permeable silt loam over a slowly permeable , firm silty clay loam till containing many soft shale fragments. Depth of bedrock is over 4 feet usually exceeds 10 feet. Depth to seasonal water table is 1 1/2 to 2 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good	Not suitable	Not suitable	Fair to poor--clayey material

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Low seepage rate; seasonal wetness.
	C-D	Limited storage potential because of slope
Pond embankment	All	Fair to good stability; fair compaction properties; compacted permeability low
Drainage	A-B	Moderately slow permeability; seasonal wetness.
	C-D	Usually not needed or feasible because of slope
Highway or road location	All	Erodible on slopes; seasonal water table; moderate to high potential frost heaving
Low building foundation	All	Seasonal wetness; fair stability; moderate to high bearing capacity
Pipeline construction and maintenance	All	Seasonal wetness; clayey material somewhat difficult to work with

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Danley series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--slow permeability; slope hazard on on D slopes
Low buildings		
With basement	A-C	Moderate--seasonal wetness and slope hazard on C slopes.
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-D	Severe--because of seasonal wetness
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-C	Severe--slow permeability
	D	Severe--slow permeability; slope
Trailers	A-B	Severe--slow permeability
	C-D	Severe--slow permeability; slope
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	3
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4
E	4	3	1	1	3	4	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Darien series.[a]

Description: Darien soils are deep, somewhat poorly drained, medium acid to neutral, moderately fine textured soils formed in calcareous glacial till, derived from fragments of dark soft shale. They occupy nearly level to sloping landforms in undulating to rolling ground- and end-moraines. Darien soils have 1 foot of silt loam over 1 1/2 to 2 feet of slowly permeable fine silt loam or silty clay loam. This is underlain by slowly permeable, calcareous, shaly clay loam glacial till. Depth of bedrock is over 5 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--somewhat clayey	Not suitable	Not suitable	Fair to poor--plastic when wet

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Low seepage rate; seasonally high water table
Pond embankment		Clayey material; poor compaction characteristics; slow permeability when compacted
Drainage		Moderately slow permeability; seasonally high water table
Highway or road location		Unstable material; subject to frost heave; seasonally high water table; clayey material difficult to work
Low building foundation		Clayey subsoil with poor stability; seasonal wetness
Pipeline construction and maintenance		Seasonal wetness; clayey material

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Darien series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--seasonal wetness; slow permeability
	C	Severe--seasonal wetness; slow permeability; slope hazard
Low buildings		
With basement	A-B	Severe--seasonal wetness
	C	Severe--seasonal wetness; slope hazard
Without basement	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Campsites		
Tents	A-B	Severe--seasonal wetness; slow permeability
	C	Severe--seasonal wetness; slow permeability slope hazard
Trailers	A	Severe--seasonal wetness; slow permeability
	B-C	Severe--seasonal wetness; slow permeability
Field crops	A-B	Moderate--seasonal wetness; clayey
	C	Moderate--seasonal wetness; slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	2	2	2	1	2
B	2	2	1	1	2	3	4	4	2	1	4
C	2	2	1	1	2	4	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Deerfield series.[a]

Description: Deerfield soils are deep, moderately well drained, strongly acid, coarse textured soils that have formed in strongly acid wind or water-deposited sands. They occupy level to sloping deltas and outwash plains. Deerfield soils have 2 to 2 1/2 feet of rapidly permeable loamy sand over sand which usually extends to over 10 feet and is rapidly permeable. Depth of bedrock is over 5 feet and usually extends over 20 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good	Good to fair--usually not well graded	Poor--may contain an occasional thin gravel layer	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Rapid to very rapid permeability and seepage rate
Pond embankment	A-C	Sandy material; compacted permeability likely to be high; subject to piping
Drainage	A-C	Practice usually not needed
Highway or road location	A-C	Seasonal wetness may present a slight problem; material is erodible on slopes
Low building foundation	A-C	Moderately high bearing capacity; negligible compressibility; seasonal wetness presents foundation drainage problems
Pipeline construction and maintenance	A-C	Seasonal wetness; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Low buildings With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Without basement	A-B C	Slight--few or no adverse conditions Moderate--because of slope hazard
Sanitary landfill	A-C	Severe--because of seasonal wetness
Play and picnic areas	A-B C	Slight--few or no adverse conditions Moderate--because of slope hazard
Campsites Tents	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Trailers	A-B C	Moderate--because of seasonal wetness Severe--because of slope hazard
Field crops	A-B C	Slight--few or no adverse conditions Moderate--because of slope and erosion hazards

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	3	2	2	2	1	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Duane series.[a]

Description: Duane soils are deep, moderately well drained, strongly to extremely acid, coarse textured soils that formed in outwash sand and gravel mainly derived from sandstone, granite, gneiss and other acid rocks. The coarse fragment content averages more than 35 percent but may be less in the upper horizons. This nearly level soil is on outwash terraces and seep spots at the base of kame moraines. Duane soils have 10 to 20 inches of very friable, rapidly permeable sand or loamy sand over 6 to 15 inches of loose, rapidly permeable gravelly sand. The subtratum is loose, rapidly permeable, very gravelly sand. Depth of bedrock is over 10 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--sandy; coarse fragments	Good	Good	Fair--may be stony; fair stability

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Rapid permeability; seasonal high water table
Pond embankment	A	Fair stability and compaction characteristics, moderate to high compacted permeability; fair to poor variance to piping
Drainage	A	Sandy; seasonal high water table; unstable ditch banks; fair to poor resistance to piping
Highway or road location	A	Seasonal high water table; loose sand hinders hauling; fair stability
Low building foundation	A	Fair to good consolidation characteristics; poor resistance to piping; sandy; seasonal high water table
Pipeline construction and maintenance	A	Seasonal high water table; ditch banks may slough

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Duane series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Moderate--seasonal high water table; hazard of ground water pollution
Low buildings		
With basement	A	Moderate--seasonal high water table
Without basement	A	Slight
Sanitary landfill	A	Severe--seasonal high water table; free flow of pollutants
Play and picnic areas	A	Moderate or severe--surface soil texture; surface texture and coarse fragments in some areas
Campsites		
Tents	A	Moderate or severe--surface soil texture; surface texture and coarse fragments in some areas
Trailers	A	Moderate or severe--surface soil texture; surface texture and coarse fragments in some areas
Field crops	A	Moderate--seasonal high water table

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	3	3	4	4	4	3	3	4

Appendix 2. Soils of the Tug Hill Region, Eel series.[a]

Description: Eel soils are deep, moderately well drained, neutral, medium textured soils derived mainly from strongly calcareous alluvium. They occupy nearly level to depressional areas, including old ox-bows, adjacent to streams. Eel soils have 1 1/2 to 3 feet of moderately permeable silt loam over mildly alkaline or calcareous alluvium of variable texture. Depth of bedrock is 4 feet and usually exceeds 20 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good	Not suitable	Not suitable	Not suitable

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		High seepage rate; subject to flooding
Pond embankment		Poor stability when compacted and saturated; moderate shrink-well potential; medium to high compressibility; compacted permeability moderate
Drainage		Subject to flooding and siltation; requires considerable maintenance; unstable ditch walls when saturated
Highway or road location		Subject to frequent flooding and frost heaving
Low building foundation		Moderate compressibility, fair shear strength; subject to frequent flooding
Pipeline construction and maintenance		Ditch walls unstable; seasonal wetness; subject to frequent flooding

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Eel series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--subject to flooding
Low buildings		
With basement	A	Severe--subject to flooding
Without basement	A	Severe--subject to flooding
Sanitary landfill	A	Severe--subject to flooding
Play and picnic areas	A	Moderate--subject to flooding
Campsites		
Tents	A	Severe--subject to flooding
Trailers	A	Severe--subject to flooding
Field crops	A	Slight--few or no adverse conditions

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	3

Appendix 2. Soils of the Tug Hill Region, Empeyville series.[a]

Description: Empeyville soils are deep, moderately well drained; strongly acid, moderately coarse textured stony soils developed from acid glacial till. They occupy undulating to sloping areas that are slightly convex, in glacial till plains. Empeyville soils have 1 to 2 1/2 feet of moderately permeable stony loam over a slowly permeable stony sandy loam, very firm, fragipan that is 3 feet thick. This fragipan rests on glacial till that is massive, stony sandy loam to loamy sand. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--seasonally wet usually stony	Not suitable	Not suitable	Fair--seasonally wet; usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Seasonally wetness; seepage rate is low.
Pond embankment	A-C	Compacted permeability is low to moderate; material is fairly easily worked; contains some stones which may need removal
Drainage	A-C	Permeability is slow; seasonal wetness; presence of some stones likely to hinder construction
Highway or road location	A-C	Seasonal wetness; fairly easily worked; some stones will need removal; fairly stable soil
Low building foundation	A-C	High bearing capacity; seasonal wetness
Pipeline construction and maintenance	A-C	Seasonal wetness; stones will interfere with construction; permeability is slow

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Empeyville series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--because of very slow permeability
Low buildings		
With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
Sanitary landfill	A-C	Severe--because of seasonal wetness
Play and picnic areas	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Campsites		
Tents	A-C	Severe--because of very slow permeability
Trailers		
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	3	3	1	2	3
B-C	2	1	1	2	2	4	4	4	1	2	4

Appendix 2. Soils of the Tug Hill Region, Fredon series.[a]

Description: Fredon soils are deep, somewhat poorly drained, medium acid to neutral, medium textured soils that have formed in mildly to strongly calcareous, layered glacial outwash deposits. They occupy nearly level to slightly concave spots, seepy places on steep slopes, and stream terraces. Fredon soils have 1 1/2 to 3 1/2 feet of moderately permeable silt loam or loam over stratified glacial outwash deposits of gravel, sands, and dominated by fragments of siltstone, shale, and limestone. Depth to bedrock is over 5 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually gravelly; seasonally wet	Fair to good below 2 feet--is usually high in fines	Fair to good below 2 feet--may be high in fines	Good--if sandy will be erodible on slopes

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Permeable material when water table is absent
Pond embankment	A-B	Fairly stable material but permeability is rapid
Drainage	A-B	Seasonal high water table; cut slopes unstable; pockets of sand subject to piping; suitable natural outlets often lacking
Highway or road location	A-B	High frost heaving; usually depressional areas with prolonged seasonal wetness
Low building foundation	A-B	Fair stability; subject to prolonged seepage problems; moderate bearing capacity
Pipeline construction and maintenance	A-B	Ditch banks unstable; seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Fredon series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--because of seasonal wetness
Low buildings		
With basement	A-B	Severe--because of seasonal wetness
Without basement	A-B	Moderate--because of seasonal wetness
Sanitary landfill	A-B	Severe--because of seasonal wetness
Play and picnic areas	A-B	Moderate--because of seasonal wetness
Campsites		
Tents	A-B	Severe--because of seasonal wetness
Trailers	A-B	Severe--because of seasonal wetness
Field crops	A-B	Moderate--because of seasonal wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	4	4	2	1	4
B	2	2	1	1	2	3	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Galway series.[a]

Description: Galway soils are moderately deep, well and moderately well drained, medium acid to neutral, medium textured soils that formed in glacial till over limey bedrock. The coarse fragment content is 2 to 35 percent in the upper horizons and 10 to 70 percent just above the bedrock. These nearly level to steep soils are on bedrock controlled landforms that have thin till mantles. Galway soils have 18 to 30 inches of friable, moderately permeable loam or silt loam over 5 to 15 inches of friable, moderately permeable, gravelly loam. Bedrock is encountered at 20 to 40 inches. Depth to bedrock is 1 1/2 to 3 1/2 feet. Depth to seasonal water table is 2 to 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good to fair--may contain excessive gravel; depth to bedrock	Not suitable	Not suitable	Fair to poor--limited quantity over bedrock

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Moderate permeability; moderate depth to bedrock; seasonal high water table
	C-E	Slope
Pond embankment	A-C	Fair to poor stability; fair to poor compaction characteristics; moderate compacted permeability; poor resistance to piping
	D-E	Slope
Drainage	A-B	Moderate depth to bedrock; unstable ditch banks
	C-E	Slope
Highway or road location	A-B	Moderate depth to bedrock; seasonal high water table; poor stability on cut slopes; high frost heave potential
	C-E	Slopes; cuts and fills necessary
Low building foundation	A-B	Moderate depth to bedrock; seasonal high water table; fair to poor consolidation characteristics
	C-E	Slope
Pipeline construction and maintenance	All	Moderate depth of bedrock; seasonal high water table

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Galway series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--depth to bedrock
	D-E	Slope--depth to bedrock
Low buildings		
With basement	A-C	Moderate to severe--seasonal high water table; depth to bedrock on part; slope on C
	D-E	Severe--slope; depth to bedrock on part
Without basement	A-B	Slight to moderate--depth to bedrock on part
	C	Moderate--slope; depth to bedrock on part
	D-E	Severe--slope
Sanitary landfill	A-C	Severe--depth to bedrock
	D-E	Severe--depth to bedrock; slope
Play and picnic areas	A-B	Slight
	C	Moderate--slope
	D-E	Severe--slope
Campsites		
Tents	A-B	Moderate--seasonal high water table; coarse fragments on some areas
	C	Moderate--seasonal high water table; coarse fragments on some areas
	D-E	Severe--slope
Trailers	A	Moderate--seasonal high water table; coarse fragments on some areas
	B	Moderate--seasonal high water table; slope; coarse fragments on some areas
	C-E	Severe--slope
Field crops	A-B	Slight
	C	Moderate--slope; erosion hazard
	D-E	Severe--slope; erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Genesee series.[a]

Description: Genesee soils are deep, well drained, slightly acid to neutral, medium textured soils that have formed in nearly neutral or calcareous recent alluvium. They occupy nearly level areas near the major streams and are subject to flooding. Genesee soils have 3 1/2 to 5 feet of moderately permeable silt loam or very fine sandy loam that is underlain by rapidly permeable, stratified alluvial sediments of silt loam, fine sandy loam, gravel, and sand. Depth to bedrock is over 4 feet and usually exceeds to 20 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good	Not suitable	Not suitable	Good to fair--subject to flooding; low shear strength.

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Unstable, subject to flooding; permeability moderately rapid
Pond embankment	A	Medium to high compressibility; permeability slow when compacted; poor resistance to piping
Drainage	A	Subject to flooding and silting; ditch banks unstable
Highway or road location	A	High frost heave potential; subject to flooding; unstable material
Low building foundation	A	Subject to flooding; medium to high compressibility; poor bearing capacity
Pipeline construction and maintenance	A	Subject to flooding; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Genesee series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--subject to flooding
Low buildings		
With basement	A	Severe--subject to flooding
Without basement	A	Severe--subject to flooding
Sanitary landfill	A	Severe--subject to flooding
Play and picnic areas	A	Slight--few or no adverse conditions
Campsites		
Tents	A	Moderate--subject to occasional flooding
Trailers	A	Moderate--subject to occasional flooding
Field crops	A	Slight--few or no adverse conditions

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region, Gloucester series.[a]

Description: Gloucester soils are deep, somewhat excessively drained, extremely acid to medium acid, moderately coarse to coarse textured soils that formed in sandy and stony glacial till derived mainly from granite and gneiss. The content of coarse fragments ranges from 35 to 75 percent. These nearly level to steep soils are on glacial till upland plains, hills and ridges. Gloucester soils have 20 to 30 inches of very friable, rapidly permeable stony sandy loam to loamy sand over very friable, rapidly permeable, gravelly loamy sand. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--too stony	Poor--too stony and usually too many fines	Poor--usually too many large stones and too many fines	Good--contains stones which must be removed or re-processed

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Very permeable material which allows rapid seepage rate.
	D-E	Storage potential limited because of slope
Pond embankment	All	Sandy, gravelly, stony material; compacted permeability high; stones may need to be removed
Drainage	All	Somewhat excessively drained
Highway or road location	A-C	Stony; moderate bearing capacity
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Low compressibility; good foundation strength
Pipeline construction and maintenance	All	Stoniness may hinder construction; is workable most of the time

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Gloucester series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--stoniness may be a problem with construction
	C	Moderate--slope
	D-E	Severe--slope
Low buildings		
With basement	A-C	Moderate--stoniness
	D-E	Severe--slope
Without basement	A-C	Moderate--stoniness
	D-E	Severe--slope
Sanitary landfill	A-C	Severe--pollution hazard
	D-E	Severe--slope; pollution hazard
Play and picnic areas	A-B	Slight to severe--may be stony
	C	Moderate--slope; may be stony
	D-E	Severe--slope
Campsites		
Tents	A-C	Moderate--stoniness; slope hazard on C slopes
	D-E	Severe--slope
Trailers	A-B	Moderate--stoniness; slope hazard on B slopes
	C-E	Severe--slope
Field crops	A-B	Slight to severe--may be stony
	C	Moderate to severe--slope may be stony
	D-E	Severe--slope may be stony

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	2	2	2	2	4	4	4	2	2	4
D	3	2	2	2	2	4	4	4	2	2	4
E	4	3	2	2	2	4	4	4	3	2	4
F	4	4	2	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Granby series.[a]

Description: Granby soils are deep, very poorly and poorly drained, moderately coarse textured, slightly acid to alkaline soils developed in sandy deposits of glacial lake bottoms. They occupy flat or slightly depressed areas. Granby soils have 1/2 to 1 foot of rapidly permeable loamy fine sand over a very friable very rapidly permeable sand. Depth to bedrock is over 4 feet. Seasonal water table is at the surface.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--soil is wet much of the year	Fair--soil is wet much of the year	Poor--usually sand; is wet much of the year	Fair--sandy; wet much of the year

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	High water table; excessive seepage when water table lowered
Pond embankment	A	Sandy permeable material; rapid seepage rate; piping hazard; unstable
Drainage	A	Material flow when wet; unstable ditch banks; prolonged high water table
Highway or road location	A	Prolonged wetness; unstable; poorly graded material
Low building foundation	A	Unstable; low bearing capacity; prolonged wetness
Pipeline construction and maintenance	A	Unstable ditch banks; material flows when wet; prolonged high water table

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Granby series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--because of prolonged wetness
Low buildings		
With basement	A	Severe--because of prolonged wetness
Without basement	A	Severe--because of prolonged wetness
Sanitary landfill	A	Severe--because of prolonged wetness
Play and picnic areas	A	Severe--because of prolonged wetness
Campsites		
Tents	A	Severe--because of prolonged wetness
Trailers	A	Severe--because of prolonged wetness
Field crops	A	Moderate--because of wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	1	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Hamlin series.[a]

Description: The Hamlin series consists of well to moderately well drained, slightly acid to neutral, medium textured soils that have formed in alluvial deposits and are dominated by silt and sand. They are typically free of stones and gravel in the upper 40 inches. Below 40 inches, the soil material is very variable. Some areas are underlain by bedrock. Depth to bedrock is over 3 1/2 feet. Depth to seasonal water is over 1 1/2 feet, except for occasional flooding.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good	Not suitable	Not suitable	Good to fair

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Moderate permeability; flooding hazard
Pond embankment	A	Fair stability; low shear strength; variable permeability; low resistance to piping
Drainage	A	Not needed
Highway or road location	A	Flooding hazard; potential frost heave and poor stability; water table at variable depth during year
Low building foundation	A	Flooding hazard; and variable depth to water table during year
Pipeline construction and maintenance	A	Variable depth to water table; seasonal flooding; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Hamlin series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--flooding hazard and seasonal high water table
Low buildings		
With basement	A	Severe--subject to flooding
Without basement	A	Severe--subject to flooding
Sanitary landfill	A	Severe--subject to flooding
Play and picnic areas	A	Moderate--subject to flooding
Campsites		
Tents	A	Moderate--subject to occasional flooding
Trailers	A	Moderate--subject to occasional flooding
Field crops	A	Slight

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region, Hartland series.[a]

Description; Hartland soils are deep, well drained, medium textured, very strongly acid soils that have formed in lake laid or wind blown very fine sands and silts. They occupy gentle to strongly rolling slopes resembling kames. Hartland soils have 1 to 1 1/2 feet of moderately permeable very fine sandy loam over 2 to 2 1/2 feet of moderately permeable coarse silt loam to very fine sandy loam. This soil material is underlain by moderately permeable lake laid silt. Depth to bedrock is over 5 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good	Not suitable--too many fines	Not suitable	Good--easy to work; low volume change

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Seepage rate moderate
	C-D	Storage potential limited because of slope
Pond embankment	All	Compaction properties fair; compacted permeability moderate; slight volume change; subject to piping
Drainage	All	Not needed
Highway or road location	All	In many places small seepy areas are included; soil material is highly erodible on slopes; moderate potential frost heave
Low building foundation	All	Moderate bearing capacity; slight compressibility
Pipeline construction and maintenance	All	Ditch walls may be somewhat unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Hartland series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Sanitary landfill	A-C	Moderate--because of seasonal water table at 6 feet
	D	Severe--because of slope hazard
		ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--because of slope hazard
	C-D	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Herkimer series.[a]

Description: Herkimer soils are deep well drained, medium textured, medium to slightly acid soils that have formed in outwash deposits or alluvial fans. They occupy nearly level to gently sloping areas in outwash plains. Herkimer soils have 1 1/2 to 2 1/2 feet of moderately to rapidly permeable shaly silt loam over rapidly permeable stratified shale fragments, sand, and gravel. Depth to bedrock is over 4 feet. Depth to seasonal water table is 2 to 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--usually gravelly or shaly	Poor--usually shaly	Fair to poor--usually shaly	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Seepage rate likely to be high
Pond embankment	All	Compacted permeability likely to be moderate to high; fair stability
Drainage	A-C	Generally not needed
Highway or road location	All	Material easily worked; fairly stable soil
Low building foundation	All	Fair to good stability; moderate bearing capacity
Pipeline construction and maintenance	All	Ditch walls likely to be unstable otherwise conditions favorable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Herkimer series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Sanitary landfill	A-C	Severe--seasonal wetness and rapid permeability below 3 feet may make pollution a serious hazard
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Campsites		
Tents	A-C	Moderate--coarse fragments and slope hazard on C slopes
Trailers	A-B	Moderate--coarse fragments and slope hazard on C slopes
	C	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region Hermon series.[a]

Description: The Hermon soils are deep, well to somewhat excessively drained, strongly acid, moderately coarse to coarse textured stony soils that formed in sandy glacial till derived from granite and gneiss. Stone content of the upper portion of the soil ranges from 10 to 15 percent while that of the lower subsoil and substratum ranges to more than 35 percent. These nearly level to moderately steep soils are on glacial till hills. Hermon soils have 15 to 35 inches of very friable, moderately rapidly permeable gravelly or stony sandy loam or loamy sand over slightly firm, rapidly permeable gravelly or stony loamy sand or sand. Depth to bedrock is over 4 feet. Depth to seasonable water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually too stony	Not suitable	Not suitable	Good--however stones must be removed

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Coarse textured soil likely to have high seepage rate
Pond embankment	All	Compacted permeability likely to be high; usually stony
Drainage	All	Not needed
Highway or road location	All	Generally stony which may interfere with construction; stability is fair to good
Low building foundation	All	Good shear strength; low compressibility; moderately rapid permeability
Pipeline construction and maintenance	All	Stones may be interfering with construction

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Hermon series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-C	Moderate--seasonal wetness, stoniness, and slope hazard on C slopes
	D-F	Severe--slope hazard
		ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Hinckley series.[a]

Description: Hinckley soils are deep, well drained, coarse textured, very strongly acid soils developed from glacial outwash deposits. They occupy steep slopes of terrace faces and nearly level areas on terraces. Hinckley soils have 1 1/2 to 2 feet of rapidly permeable gravelly loamy sand over very rapidly permeable stratified sand, gravel, and cobbles that are dominated by granite, gneiss, and schists. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually coarse textured	Fair--usually gravel	Good	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Coarse textured material subject to excess seepage
Pond embankment	All	Compacted permeability likely will be high; usually stony or cobbly
Drainage	All	Not needed
Highway or road location	A-C	Cut slopes likely to be gravelly and cobbly and unstable
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Moderate bearing capacity; low shear strength.
Pipeline construction and maintenance	All	Ditch walls likely to be very unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Hinckley series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--rapid permeability may make pollution a serious hazard and slope hazard on D-F slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Moderate--coarse textured surface soil and droughty
	C-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-E	4	3	3	3	1	4	4	4	3	3	4
F	4	4	3	3	1	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Howard series.[a]

Description: Howard soils are deep, well drained, medium acid to neutral, medium to coarse textured soils developed in gravelly glacial outwash material. They occupy nearly level to sloping or undulating outwash plains and valley trains and rolling to steep kames and kettles. Howard soils have 3 to 4 feet of moderately to rapidly permeable gravelly or very gravelly loam over stratified sands and gravel which are calcareous and very rapidly permeable. Depth to bedrock is over 10 feet. Depth to seasonable water table is over 5 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--sandy and gravelly	Good	Good	Good--erosion potential on slopes

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Pervious material; rapidly permeable; seepage a problem
Pond embankment		Sandy materials; rapid seepage rate; good stability; gravelly; generally good for outside shells
Drainage		Usually not needed
Highway or road location		Some cuts and fills needed; good bearing capacity; gravelly; may be subject to differential frost heaving
Low building foundation		Moderately high bearing capacity
Pipeline construction and maintenance		Gravelly material; unstable ditch banks

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Howard series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--rapid permeability at 3 feet and deeper which may make pollution a serious problem
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Hudson series.[a]

Description: Hudson soils are deep, moderately well to well drained, medium acid to neutral, fine textured soils formed in calcareous, clayey glacial lake deposits. They occupy level to dissected lake plains and other glacial landforms that were mantled with lake sediments. Hudson soils have 1 to 2 feet of moderately slowly permeable silt loam or silty clay loam over slowly permeable silty clay to a depth of 3 1/2 feet. These materials are underlain by slowly permeable lake-laid deposits consisting of layers of silty clay or clay separated by thinner silty layers. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1 1/2 to 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--clayey	Not suitable	Not suitable	Poor--high in clay; poor workability

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Seasonal wetness; generally favorable sites; storage potential limited on C slopes and steeper
Pond embankment		Clayey material; poor compaction and workability
Drainage		Very slow permeability; ditch banks may be unstable; generally not feasible on C slopes and steeper
Highway or road location		Clayey material; subject to frost heave; seasonal high water table; cuts and fills necessary on the steeper slopes
Low building foundation		Seasonal water table; slow internal drainage
Pipeline construction and maintenance		Seasonal wetness; clayey material difficult to work with

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Hudson series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	B	Severe--slow permeability
	C-E	Severe--slow permeability; slope hazard
Low buildings		
With basement	B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
	D-E	Severe--slope hazard
Without basement	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-E	Severe--slope hazard
Sanitary landfill	B	Severe--seasonal wetness
	C-E	Severe--seasonal wetness
Play and picnic areas	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-E	Severe--slope hazard
Campsites		
Tents	B	Severe--slow permeability
	C-E	Severe--slow permeability; slope hazard
Trailers	B-E	Severe--slow permeability; slope hazard
Field crops	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-E	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4
E	4	3	1	1	3	4	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Ilion series.[a]

Description: Ilion soils are deep, poorly drained, slightly acid, moderately fine textured soils developed in calcareous glacial till. These soils occupy nearly level to gently sloping areas on till plains. Ilion soils have about 1 foot of moderately permeable silt loam; usually having a few if any coarse fragments, over a slowly permeable silty clay loam subsoil 1 1/2 to 2 feet thick and containing soft shale fragments. The underlying material is slowly permeable, calcareous, shaly silty clay loam glacial till. Depth to bedrock is over 4 feet. Depth to seasonal water table is 0 to 1/2 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good to fair in upper foot; prolonged wetness	Not suitable	Not suitable	Fair--prolonged wetness high in clay

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Slowly permeable material; prolonged wetness
Pond embankment		Poor stability, poor workability when wet; slowly permeable material
Drainage		Slowly permeable material; prolonged wetness; small ponded areas; outlets frequently unavailable
Highway or road location		Slope stability a problem. Prolonged wetness; clayey material difficult to work when wet
Low building foundation		Unstable; soil is wet much of the year
Pipeline construction and maintenance		Prolonged wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Ilion series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--prolonged wetness; slow permeability
Low buildings		
With basement	A-B	Severe--prolonged wetness
Without basement	A-B	Severe--prolonged wetness
Sanitary landfill	A-B	Severe--prolonged wetness
Play and picnic areas	A-B	Severe--prolonged wetness
Campsites		
Tents	A-B	Severe--prolonged wetness; very slow permeability
Trailers	A-B	Severe--prolonged wetness; very slow permeability
Field crops	A-B	Moderate--prolonged wetness; requires drainage; clayey

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	3	3	3	2	3
B	4	3	3	2	2	3	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Ira series.[a]

Description: Ira soils are deep, moderately well drained, medium textured, strongly acid soils developed in acid glacial till. They are on nearly level, undulating or strongly sloping uplands. Ira soils have 1 1/2 to 2 feet of moderately permeable gravelly loam to gravelly fine sandy loam over 1 to 2 feet of slowly permeable gravelly loam to gravelly fine sandy loam, very firm to hard, fragipan, underlain by slowly permeable gravelly fine sandy loam glacial till dominated by hard sandstone. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot fair--seasonal wetness; usually gravelly	Not suitable	Not suitable	Fair to good--seasonal wetness; usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Seasonal wetness; seepage along top of fragipan layer sometimes a problem
	C-D	Storage potential reduced
Pond embankment	All	Good stability; compacted permeability low; usually contains stones that will need to be removed
Drainage	A-B	Seasonal wetness; slowly permeable fragipan at 1 1/2 to 2 feet deep
	C-D	Usually not feasible or needed
Highway or road location	A-B	Seasonal wetness; seepy areas sometimes present.
	C-D	Cuts and fills necessary because of slope
Low building foundation	All	Seasonal wetness; good bearing capacity; negligible compressibility
Pipeline construction and maintenance	All	Seasonal wetness; likely to contain some stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Ira series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--because of slow permeability and slope hazard on D slopes
Low buildings		
With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
	D	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Sanitary landfill	A-D	Severe--because of seasonal wetness and slope hazard on D slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-C	Moderate--slow permeability
	D	Severe--because of slope hazard
Trailers	A-B	Moderate--because of slow permeability
	C-D	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	3	3	1	2	3
B-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Junius series.[a]

Description: Junius soils are deep, somewhat poorly drained, coarse textured, slightly acid to alkaline soils developed on sandy deposits of glacial lake and pond bottoms. The areas are nearly flat or slightly depressional. Junius soils have 1 1/2 to 3 feet of rapidly permeable loamy sand over stratified fine sand and sand. Depth to bedrock is over 5 feet. Depth to seasonal water table is 1/2 to 1 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--sandy material; seasonally wet	Poor--poorly graded; seasonal high water table	Not suitable	Poor--mostly poorly graded sand; seasonal high water table

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	High water table; excessive seepage if water table is lowered
Pond embankment	A	Sandy, permeable material; rapid seepage rate; unstable; piping hazard
Drainage	A	Material flows when wet; unstable ditch banks; prolonged high water table
Highway or road location	A	Seasonal wetness; unstable poorly graded material
Low building foundation	A	Unstable; seasonal wetness
Pipeline construction and maintenance	A	Unstable ditch banks; material flows when wet; seasonal high water table

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Junius series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--because of seasonal wetness
Low buildings		
With basement	A	Severe--because of seasonal wetness
Without basement	A	Moderate--because of seasonal wetness
Sanitary landfill	A	Severe--because of seasonal wetness
Play and picnic areas	A	Moderate--because of seasonal wetness
Campsites		
Tents	A	Severe--because of seasonal wetness
Trailers	A	Severe--because of seasonal wetness
Field crops	A	Moderate--because of seasonal wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Kars series.[a]

Description: Kars soils are deep, well to excessively drained, medium acid to neutral, moderately coarse to medium textured soils that formed in gravelly outwash deposits high in limestone. The content of coarse fragments ranges from 15 to 25 percent in the surface; 35 to 50 percent in the subsoil, and 35 to 70 percent in the substratum. These nearly level to steep soils are on outwash plains, kames, and eskers. Kars soils have 15 to 35 inches of very friable, rapidly permeable gravelly loam or sandy loam over loose, rapidly permeable stratified sand and gravel. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually gravelly	Fair--usually gravelly or cobbly	Good	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Coarse textured soil likely to have high seepage rate
Pond embankment	All	Compacted permeability high; may be cobbly or stony
Drainage	All	Not needed
Highway or road location	All	Coarse textured, rapidly permeable soil; good subbase material
Low building foundation	All	Low shear strength; rapid permeability
Pipeline construction and maintenance	All	Sandy, gravelly soil with rapid permeability; ditch walls likely to be unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Kars series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--rapid permeability may make pollution a serious hazard and slope hazard on D-F slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-F	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Kendaia series [a].

Description: Kendaia soils are deep, somewhat poorly drained, slightly acid to neutral, medium textured soils formed in calcareous glacial till. They occupy level to very gently sloping areas from which runoff is very slow or on which water accumulates from adjacent areas. Kendaia soils have 1 to 1 1/2 feet of moderately permeable silt loam over 1 to 1 1/2 feet of fine silt loam that is underlain by firm, dense, slowly permeable, gravelly silt loam glacial till dominated by fragments of limestone, siltstone, and shale. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good to fair--some stones	Not suitable	Not suitable	Fair--seasonal wetness; some stones

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Slow permeability; seasonal wetness; occasional sand lens may cause seepage
Pond embankment		Good stability, slow permeability when compacted
Drainage		Slow permeability; seasonal wetness; contains stones and boulders
Highway or road location		Cuts deeper than 4 feet may encounter bedrock; seasonal wetness; stones usually found in cuts
Low building foundation		Stable; prolonged seepage problems
Pipeline construction and maintenance		Seasonal wetness; occasional stone or boulder may interfere with construction

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Kendaia series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability; seasonal wetness
Low buildings		
With basement	A-B	Severe--seasonal wetness
Without basement	A-B	Moderate--seasonal wetness
Sanitary landfill	A-B	Severe--seasonal wetness
Play and picnic areas	A-B	Moderate--seasonal wetness
Campsites		
Tents	A-B	Severe--seasonal wetness; slow permeability
Trailers	A-B	Severe--seasonal wetness; slow permeability
Field crops	A-B	Moderate--seasonal wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	2	2	2	1	2
B	2	2	1	1	2	3	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Lamson series.[a]

Description: Lamson soils are deep, poorly or very poorly drained, medium acid to neutral, moderately coarse textured soils that have formed in thick calcareous glacial till deposits of predominately fine and very fine sand. They occupy nearly level or slightly depressed areas. Lamson soils consist of 1/2 to 1 1/2 feet of very fine sandy loam high in organic matter over 2 to 3 feet of fine or very fine sandy loam which is underlain by lake-laid fine sand, very fine sand, or loamy fine sand which has silty and clayey lenses in some places. Depth to bedrock is over 4 feet. Seasonal water table is at the surface.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--soil is wet much of the year	Good--especially below 3 feet deep	Poor--usually all sand	Poor--soil is wet much of the year; unstable

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Prolonged wetness; previous material; susceptible to piping
Pond embankment	A	Sandy material; moderately rapidly permeable; piping hazard
Drainage	A	Prolonged wetness; unstable ditch banks; outlets difficult to obtain
Highway or road location	A	Prolonged wetness; highly erodible on slopes
Low building foundation	A	Prolonged wetness making foundation drainage very necessary; low bearing capacity
Pipeline construction and maintenance	A	Prolonged wetness; unstable ditch banks

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Lamson series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--because of prolonged wetness
Low buildings		
With basement	A	Severe--because of prolonged wetness
Without basement	A	Severe--because of prolonged wetness
Sanitary landfill	A	Severe--because of prolonged wetness
Play and picnic areas	A	Severe--because of prolonged wetness
Campsites		
Tents	A	Severe--because of prolonged wetness
Trailers	A	Severe--because of prolonged wetness
Field crops	A	Moderate--because of wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	1	4	4	3	2	4

Appendix . Soils of the Tug Hill Region, Lowville series.[a]

Description: Lowville soils are deep, well drained, medium textured, strongly acid to neutral soil developed in acid aeolin silt and very fine sand over calcareous glacial till. They are on nearly level to hilly, glacial till, areas that occasionally are shallow to moderately deep over limestone bedrock. Lowville soils have 2 to 2 1/2 feet of moderately permeable coarse silt and very fine sand over moderately slowly permeable calcareous loam or loam glacial till derived from limestone and granitic materials. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--usually somewhat sandy	Poor--usually contains too many fines	Not suitable	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-D	Sandy soil with high seepage rate
Pond embankment	All	Sandy, gravelly material; compacted permeability likely to be high; suceptible to piping; material is fairly easily worked
Drainage	All	Not needed
Highway or road location	A-C	Material is easily worked; subject to frost heaving
	D	Cuts and fills are necessary because of slope
Low building foundation	All	Fairly high bearing capacity; moderate permeability
Pipeline construction and maintenance	All	Sandy, gravelly material with moderate permeability; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Lowville series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--moderately slow permeability and slope hazard on D slopes
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-C	Moderate--seasonal wetness and slope hazard on C slopes
	D	Severe--slope hazard. ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED.
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-C	Moderate--moderately slow permeability
	D	Severe--slope hazard
Trailers	A-B	Moderate--moderately slow permeability
	C-D	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Madalin series.[a]

Description: Madalin soils are deep and poorly drained, medium acid to weak calcareous fine textured soils formed in calcareous glacial lake deposits. They occur on flat to slightly depressed areas. Madalin soils have 1 to 2 feet of slowly permeable silt loam or silty clay loam over very slowly permeable silty clay or clay. Depth to bedrock is over 5 feet. Depth to seasonal water table is 0 to 1/2 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--clayey; wet	Not suitable	Not suitable	Poor--seasonal wetness; clayey

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Prolonged wetness; seepage rate very low
Pond embankment		Clayey material; poor compaction; wet much of year
Drainage		Slowly permeable; prolonged wetness; surface ponding; check for suitable outlets
Highway or road location		Prolonged wetness; clayey material; subject to frost heaving
Low building foundation		High bearing capacity; high water table; poor internal drainage
Pipeline construction and maintenance		Clayey material difficult to work; construction seasonal because of prolonged high water table

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Madalin series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--prolonged wetness; slow permeability
Low buildings		
With basement	A	Severe--prolonged wetness
Without basement	A	Severe--prolonged wetness
Sanitary landfill	A	Severe--prolonged wetness
Play and picnic areas	A	Severe--prolonged wetness
Campsites		
Tents	A	Severe--prolonged wetness
Trailers	A	Severe--prolonged wetness; slow permeability
Field crops	A	Severe--prolonged wetness; requires drainage

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	2	1	3	2	2

Appendix 2. Soils of the Tug Hill Region, Madrid series.[a]

Description: The Madrid soils are deep, well drained, strongly acid to neutral, medium and moderately coarse textured soils that formed in medium textured till that they have been reworked by water. Coarse fragment content ranges from 0 to 25 percent in the upper layers and from 10 to 35 percent in the subsoil and substratum . These gently sloping to very steep soils are on morainic or till plain landforms and are commonly near the margins of old glacial lakes. Madrid soils have 36 to 60 inches of friable, moderately permeable fine sandy loam or loam over firm, moderately rapid to moderately slowly permeable fine sandy loam or loam till. Depth to bedrock is over 4 feet and usually exceeds to 10 feet. Depth to seasonal water table is over 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--may be stony or gravelly	Not suitable	Not suitable	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Permeability moderate; seepage rate likely to be moderate
	D	Storage potential limited because of slope
Pond embankment	All	Compacted permeability slow; material fairly stable
Drainage	All	Usually not needed
Highway or road location	All	Good to fair stability and compaction properties
Low building foundation	All	Stable; moderate permeability; moderate shear strength
Pipeline construction and maintenance	All	Occasional stone or boulder may be encountered; otherwise conditions favorable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Madrid series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--moderate permeability and slope hazard on C slopes
	D	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A-D	Severe--seasonal wetness and slope hazard on D slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-D	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Manheim series.[a]

Manheim soils are deep, somewhat poorly to moderately well drained, medium textured, medium acid soils developed in mildly calcareous till over shale. They are on gentle to moderately sloping uniform bedrock-controlled landforms. Manheim soils have 1 1/2 to 2 feet of moderately permeable silt loam over 1 1/2 to 2 feet of moderately permeable silt loam or silty clay loam. This material is underlain by soft, dark, calcareous shale, or by deep till witha high component of dark shale. Depth to bedrock is over 3 1/2 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--seasonal wetness may be a problem.	Not suitable	Not suitable	Fair--seasonal wetness; subsoil clayey

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Moderately slow permeability below 20 inches; seepage low
Pond embankment	A-C	Fair stability; slow permeability when compacted; close control of compaction required
Drainage	A-C	Moderately permeable; seasonal wetness
Highway or road location	A-C	Cut slopes fairly stable; some seepage areas; seasonally wet areas
Low building foundation	A-C	Seasonal wetness; foundation drainage needed; poor to fair stability; generally high bearing capacity
Pipeline construction and maintenance	A-C	Seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Moderate--because of seasonal wetness; slope hazard on C slopes; moderately slow permeability below about 30 inches
Low buildings		
With basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
Sanitary landfill	A-C	Severe--because of seasonal wetness
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
Campsites		
Tents	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Trailers	A-B	Moderate--because of seasonal wetness and slope hazard on B slopes
	C	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	3	3	2	1	3
B	2	2	1	1	2	3	4	4	2	1	4
C	2	2	1	1	2	4	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Manlius series.[a]

Description: Manlius soils are moderately deep, well drained, very strongly acid, medium textured soils developed in glacial till derived from shale bedrock. They occupy gently sloping or undulating to steep bedrock-controlled landforms. Manlius soils have 2 to 3 feet of moderately permeable shaly or very shaly silt loam over acid shale bedrock. Depth to bedrock is 2 to 3 feet. Depth to seasonal water table is over 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot; --usually shaly	Not suitable	Not suitable	Fair--coarse fragments; shallow to bedrock

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Seepage along the top of the moderately shallow bedrock is a severe use limitation; on C slopes or steeper storage is reduced
Pond embankment		For material above bedrock: good stability; moderate permeability when compacted; contains at least some coarse shale fragments which need to be removed
Drainage		Not needed, except for occasional included "wet spots"
Highway or road location		Bedrock near the surface; rock outcrops fairly frequent; moderate frost heave potential; at least moderate erosion hazard on C-slopes or steeper
Low building foundation		Bedrock at 2 to 3 feet; generally high bearing capacity; negligible compressibility
Pipeline construction and maintenance		Usual presence of rippable bedrock near the surface presents construction problems

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Manlius series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--shallow to bedrock
	C-F	Severe--shallow to bedrock; slope hazard
Low buildings		
With basement	A-B	Severe--shallow to bedrock
	C-F	Severe--shallow to bedrock; slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-B	Severe--shallow to bedrock
	C-F	Severe--shallow to bedrock; slope hazard
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Trailers	A	Slight--few or no adverse conditions
	B	Moderate--slope hazard
	C-D	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	E-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	3	2	2	2	1	4	4	4	2	2	4
B-C	3	2	2	2	1	4	4	4	2	2	4
D	3	2	2	2	1	4	4	4	2	2	4
E	4	3	2	2	1	4	4	4	3	2	4
F	4	4	2	2	1	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Marcy series.[a]

Description: Marcy soils are deep, poorly drained, strongly acid to neutral, medium to moderately fine textured soils that formed in weakly calcareous glacial till dominated by dark gray shale. They occupy nearly level or slightly concave spots in the uplands. Marcy soils have 1 to 1 1/2 feet of moderately permeable silt loam or channery silt loam, high in organic matter over a firm, dense, very slowly permeable, silty clay loam fragipan. This fragipan rests on channery or silt loam glacial till at a depth of 3 to 4 feet. Depth to bedrock is over 4 feet. Depth to seasonal water table is less than 1/2 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--in upper foot soils are wet much of the year	Not suitable	Not suitable	Fair--soil is wet much of year; usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	High water table much of the year; seepage rate is usually low
Pond embankment	A	Fairly stable material; compacted permeability low; soil is wet much of the year and difficult to work
Drainage	A	Fragipan at 1-3 feet deep, with very slow permeability restricts water movement; stones and boulders may interfere with construction
Highway or road location	A	Water table at or near the surface much of the year; may contain some stones and boulders; very slow permeability
Low building foundation	A	High water table much of the year making foundation drainage a serious problem; has moderate bearing capacity
Pipeline construction and maintenance	A	High water table much of the year; presence of an occasional stone or boulder may hinder construction

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Marcy series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--because of prolonged wetness and very slow permeability
Low buildings		
With basement	A	Severe--because of prolonged wetness
Without basement	A	Severe--because of prolonged wetness
Sanitary landfill	A	Severe--because of prolonged wetness
Play and picnic areas	A	Severe--because of prolonged wetness
Campsites		
Tents	A	Severe--because of prolonged wetness
Trailers	A	Severe--because of prolonged wetness
Field crops	A	Severe--because of prolonged wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	2	2	3	2	1

Appendix 2. Soils of the Tug Hill Region, Minoa series.[a]

Description: Minoa soils are deep, somewhat poorly drained, medium acid to neutral, moderately coarse textured soils that have formed in neutral to mildly calcareous sandy glacial lake deposits. They are in nearly level to gently sloping areas associated with sandy deltas of former glacial lakes. Minoa soils have 3 to 5 feet of very fine sandy loam, fine sandy loam or loamy very fine sand that is underlain by alternating layers of fine and very fine sand. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good in upper foot--however it is seasonally wet	Good below 2 feet	Poor--usually sand	Fair--usually too sandy; highly erodible

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Sandy material with rapid seepage rate
Pond embankment	All	Subject to piping; compermeability likely to be rapid
Drainage	A-B	Material flows when wet; unstable ditch banks; seasonal wetness
	C	Slope hazard
Highway or road location	A-C	Seasonal wetness; loose sand may hinder construction; erodible on slopes
Low building foundation	A-C	Seasonal wetness; low bearing capacity
Pipeline construction and maintenance	A-C	Ditch banks unstable; seasonal wetness; material likely to flow when wet

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Minoa series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--seasonal wetness
Low buildings		
With basement	A-C	Severe--seasonal wetness
Without basement	A-C	Moderate--seasonal wetness
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-C	Moderate--seasonal wetness and slope hazard on C slopes
Campsites		
Tents	A-C	Severe--seasonal wetness
Trailers	A-C	Severe--seasonal wetness and slope hazard on C slopes
Field crops	A-C	Moderate--seasonal wetness and slope hazard on C slopes

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	3	3	2	1	3
B-C	2	2	1	1	2	3	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Mohawk series.[a]

Description: Mohawk soils are deep, well to moderately well drained, slightly acid to neutral, medium textured soils formed in calcareous glacial till high in black shale. They occupy gently to moderately sloping areas in glacial till plains and till-mantled dissected plateaus. Mohawk soils have 1 to 2 feet of gravelly or nearly gravel-free fine silt loam or loam over ½ to 1½ feet of moderately permeable gravelly or nearly gravel-free fine silt loam or silty clay loam. The subsoil is underlain by slowly permeable, dense, firm, gravelly silt loam or loam glacial till with fragments derived mainly from soft black shale. Depth to bedrock is over 3 feet. Depth to seasonal water table is 2 to 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good in upper foot	Not suitable	Not suitable	Good to fair--some frost heave

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Moderate to low seepage rate; storage potential limited on C-F slopes
Pond embankment		Permeability slow when compacted; fair stability
Drainage		Moderate permeability; usually only wet spots need drainage: not feasible on over C slopes
Highway or road location		Occasional seasonal wetness; moderate to high frost heave potential; cuts and fills necessary on steeper slopes; stable material
Low building foundation		Good bearing capacity; high shear strength
Pipeline construction and maintenance		May contain some stones and boulders; occasional seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Mohawk series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	B-C	Moderate--slow permeability below 30 inches; C slope; seasonal wetness
	D-F	Severe--slow permeability; slope hazard.
Low buildings		
With basement	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	B	Severe--seasonal wetness
	C-F	Severe--slope hazard
Play and picnic areas	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	B-C	Moderate--some seasonal wetness; C slope
	D-F	Severe--slope
Trailers	B	Moderate--some seasonal wetness; B slope
	C-F	Severe--slope
Field crops	B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4
E	4	3	1	1	3	4	4	4	3	2	4
F	4	4	1	1	3	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Mosherville series.[a]

Description: Mosherville soils are deep, moderately well to somewhat poorly drained, medium textured, strongly acid soils formed in acid glacial till. They are on nearly level to sloping areas in the till plain. They have 1 to 1½ feet of loam textured, moderately permeable material over 1½ to 2 feet of slowly permeable, sandy loam fragipan. This is underlain with moderately permeable sandy loam glacial till that was derived from granitic rocks, gneisses and dark alkaline shales. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1 to 1½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot fair--seasonal wetness	Not suitable	Not suitable	Fair--seasonal wetness

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Seasonal wetness; low seepage rate
Pond embankment	A-C	Good stability; low to moderate permeability when compacted
Drainage	A-C	Practice usually needed; fragipan at 1 to 1½ feet deep limits permeability to very slow
Highway or road location	A-C	Seasonal wetness; seepy areas frequent; high frost heave potential; erodible on slopes
Low building foundation	A-C	Seasonal wetness; very slow permeability; high bearing strength; negligible compressibility
Pipeline construction and maintenance	A-C	Seasonal wetness otherwise soil properties favorable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Mosherville series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--because of slow permeability and seasonal wetness
Low buildings		
With basement	A-C	Severe--because of seasonal wetness
Without basement	A-C	Moderate--because of seasonal wetness and slope hazard on C slopes
Sanitary landfill	A-C	Severe--because of seasonal wetness
Play and picnic areas	A-B	Moderate--because of seasonal wetness
	C	Severe-because of slope hazard
Campsites		
Tents	A-C	Severe--because of seasonal wetness
Trailers	A-C	Severe--because of seasonal wetness and slope hazard on C slopes
Field crops	A-B	Moderate--needs drainage
	C	Moderate--because of slope and erosion hazard, and wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	2	2	2	3	3	3	2	2	3
B	2	2	2	2	2	3	4	4	2	2	4
C	2	2	2	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Naumburg series.[a]

Description: Naumburg soils are deep, poorly to somewhat poorly drained, strongly to very strongly acid, coarse textured soils that formed in glacio-lacustrine deposits dominated by medium and fine sand. These soils are typically free of coarse fragments. These nearly level soils are in depressional or low lying areas of sand plains. Naumburg soils have 3 to 8 inch organic surfaces that overlie 12 to 18 inches of very friable rapidly permeable loamy fine sand or sand over 6 to 18 inches of loose, rapidly permeable sand. The substratum is loose, rapidly permeable fine and medium sand. Depth to bedrock is over 4 feet. Depth to seasonal water table is 0 to 1½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--sandy	Good	Not suitable	Poor--unstable

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Rapid permeability; excessive seepage
Pond embankment	A	Fair stability; moderate compacted permeability; poor resistance to piping; erodible
Drainage	A	Seasonal high water table; unstable ditch banks; poor resistance to piping
Highway or road location	A	Seasonal high water table; unstable cut slopes; erodible
Low building foundation	A	Seasonal high water table; poor resistance to piping
Pipeline construction and maintenance	A	Seasonal high water table; unstable trench walls

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Naumburg series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--seasonal high water table
Low buildings		
With basement	A	Severe--seasonal high water table
Without basement	A	Severe to moderate--seasonal high water table
Sanitary landfill	A	Severe--seasonal high water table; pollution hazard
Play and picnic areas	A	Severe to moderate--seasonal high water table
Campsites		
Tents	A	Severe--seasonal high water table
Trailers	A	Severe--seasonal high water table
Field crops	A	Severe--seasonal high water table; surface texture; low productivity

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	4	3	3	2	3

Appendix 2. Soils of the Tug Hill Region, Nellis series.[a]

Description: Nellis soils are deep well drained, slightly acid to neutral, medium textured soils that formed in calcareous glacial till. They are on convex, nearly level to very steep areas of till plains. Nellis soils have 1½ to 2 feet of moderately permeable loam over a moderately slowly permeable, firm, gravelly, fine sandy loam or gravelly loam till dominated by limestone, shale or slate. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good in upper foot--Some stones	Not suitable	Not suitable	Good--may contain some stones and boulders

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Seepage rate usually moderate
	C-F	Storage potential limited because of slope
Pond embankment	All	Compacted permeability low; compaction properties good; may contain some stones and boulders
Drainage	A-B	Usually not needed
	C-F	Not feasible because of slope
Highway or road location	A-B	Material is easily worked; some stone and boulders present.
	C-F	Cuts and fills necessary because of slope
Low building foundation	All	Moderately high bearing capacity; good shear strength
Pipeline construction and maintenance	All	Construction conditions favorable except for some stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Nellis series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-F	Severe--because of moderately slow permeability and slope hazard on D slopes and steeper
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Sanitary landfill	A-C	Moderate--because of seasonal water table at 6 feet deep
	D-F	Severe--because of slope hazard ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D-F	Severe--because of slope hazard
Campsites		
Tents	A-C	Moderate--because of moderately slow permeability
	D-F	Severe--because of slope hazard
Trailers	A-B	Moderate--because of moderately slow permeability; B slope
	C-F	Severe--because of slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard
	D-F	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	1	1	1	1	3	4	4	4	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4
E	4	3	1	1	3	4	4	4	3	2	4
F	4	4	1	1	3	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Niagara series.[a]

Description: Niagara soils are deep, somewhat poorly drained, medium acid, silty soils developed in stratified, calcareous glacial lake deposits. They occupy nearly level to gently sloping parts of lake plains. Niagara soils have about 1 foot of friable silt loam over 1½ to 2 feet of moderately slowly permeable, silt loam to silty clay loam material. The underlying material is friable, calcareous silt loam, with bands of fine sand and clay. Depth to bedrock is over 5 feet. Depth to seasonal water table is ½ to 1½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--seasonal wetness	Not suitable	Not suitable	Not suitable--unstable material

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		High water table; seepage generally low
Pond embankment		Compacted permeability low; silty, clayey material; somewhat difficult to work
Drainage		High water table; cut slopes unstable; seasonal wetness
Highway or road location		High water table; high frost heave potential
Low building foundation		Fair to poor stability; seasonal wetness
Pipeline construction and maintenance		Seasonal wetness; slow permeability

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Niagara series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability; seasonal wetness
	C	Severe--slow permeability; seasonal wetness; slope hazard.
Low buildings		
With basement	A-B	Severe--seasonal wetness
	C	Severe--seasonal wetness; slope hazard
Without basement	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Sanitary landfill	A-B	Severe--seasonal wetness
	C	Severe--seasonal wetness; slope hazard
Play and picnic areas	A-B	Moderate--seasonal wetness.
	C	Moderate--seasonal wetness; slope hazard
Campsites		
Tents	A-B	Severe--slow permeability
	C	Severe--slow permeability
Trailers	A	Severe--slow permeability
	B-C	Severe--slow permeability; slope hazard
Field crops	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	2	2	2	1	2
B	2	2	1	1	2	3	4	4	2	1	4
C	2	2	1	1	2	4	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Ninigret series.[a]

Description: Ninigret soils are deep, moderately well drained, very strongly acid, moderately coarse textured soils that are on glacial outwash terraces and deltas. They have 2 to 3½ feet of moderately rapidly permeable fine sandy loam over rapidly permeable stratified sand and some gravel. They are on nearly level to slightly sloping areas. Depth to bedrock is over 4 feet and usually exceeds 20 feet. Depth to seasonal water table is 1½ to 2½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--too sandy	Good	Poor--usually sand	Fair--low sheer strength

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Sandy soil with high seepage rate
Pond embankment	A-B	Sandy soil compacted permeability likely to be high; subject to piping
Drainage	A-B	Somewhat seasonally wet; sandy soil with rapid permeability; ditch walls likely to be unstable
Highway or road location	A-B	Seasonal wetness; material somewhat unstable; subject to frost heaving
Low building foundation	A-B	Seasonal wetness; moderate to low bearing capacity
Pipeline construction and maintenance	A-B	Seasonal wetness; ditch walls likely to be very unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2 . Ninigret series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Moderate--because of seasonal wetness
Low buildings		
With basement	A-B	Moderate--because of seasonal wetness
Without basement	A-B	Slight--few or no adverse conditions
Sanitary landfill	A-B	Severe--because of seasonal wetness and rapid permeability at 3 feet and below which may make pollution a serious problem
Play and picnic areas	A-B	Slight--few or no adverse conditions
Campsites		
Tents	A-B	Moderate--because of seasonal wetness
Trailers	A-B	Moderate--because of seasonal wetness
Field crops	A-B	Slight--few or no adverse conditions

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-B	3	2	2	2	1	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Ondawa series.[a]

Description: Ondawa soils are deep, well drained, moderately coarse textured, strongly acid soils developed on bottomlands of rivers and small streams. They are on nearly level to slightly convex areas of active flood plains or alluvial fans. Ondawa soils have 1½ to 2½ feet of rapidly permeable sandy loam over rapid to very rapidly permeable loamy sand and sand with gravel in some places. Depth to bedrock is over 4 feet and usually exceeds 20 feet. Depth to seasonal water table is 2½ to 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good	Fair--below upper 2 to 3 feet--usually high in fines	Fair to poor below 2 to 3 feet--generally sand	Fair

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Excess seepage; subject to flooding
Pond embankment	A	Sandy material, rapid seepage rate, piping hazard; fair stability
Drainage	A	Not needed
Highway or road location	A	Subject to flooding
Low building foundation	A	Subject to flooding; moderate to low bearing capacity
Pipeline construction and maintenance	A	Sandy material; ditch walls unstable; subject to flooding

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Ondawa series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--flood hazard
Low buildings		
With basement	A	Severe--flood hazard
Without basement	A	Severe--flood hazard
Sanitary landfill	A	Severe--flood hazard
Play and picnic areas	A	Moderate--flood hazard
Campsites		
Tents	A	Severe--flood hazard
Trailers	A	Severe--flood hazard
Field crops	A	Slight--few or no adverse conditions

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	4	4	1	1	4

Appendix . Soils of the Tug Hill Region, Otisville series.[a]

Description: Otisville soils are deep, excessively drained, very strongly or strongly acid, moderately coarse to coarse textured, gravelly soils that formed in outwash deposits dominated by siliceous rocks. Coarse fragment content ranges from none to 40 percent in the upper horizons and 35 to 70 percent in the lower horizons. These nearly level to steep soils are on glacial outwash terraces, kames, eskers, and beaches. Otisville soils have 5 to 9 inches of very friable, rapidly permeable, gravelly sandy loam or loamy sand over very friable to loose, rapidly permeable, gravelly loamy sand or sand. The substratum is loose, rapidly permeable, gravelly sand. Depth to bedrock is over 20 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor, coarse fragments.	Good	Good	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Excess seepage rate
Pond embankment	All	Adequate strength and stability for outside shell; very permeable
Drainage	All	Excessively drained
Highway or road location	A-B	Stable soil; mixing needed to prevent differential heaving and settling
	C-F	Cuts and fill necessary because of slope
Low building foundation	A-B	Stable
	C-F	Excessive slope
Pipeline construction and maintenance	All	Soil features favorable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Otisville series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Low buildings		
With basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Without basement	A-B	Slight
	C	Moderate--slope
	D-F	Severe--slope
Sanitary landfill	A-B	Severe--pollution to ground water
	C-F	Severe--slope; pollutants to ground water
Play and picnic areas	A-B	Moderate--soil texture
	C-F	Severe--slope
Campsites		
Tents	A-B	Moderate--soil texture
	C-F	Severe--slope
Trailers	A	Moderate--soil texture
	B	Moderate--slope; soil texture
	C-F	Severe--slope
Field crops	A-C	Severe--droughtiness
	D-F	Severe--slope and erosion hazard; droughtiness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-E	4	3	3	3	3	4	4	4	3	3	4
F	4	4	3	3	3	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Palmyra series.[a]

Description: Palmyra soils are deep, well drained, medium textured, gravelly soils formed in strongly calcareous deposits of glacial outwash sand and gravel. They occupy nearly level valley floors where glacial rivers once ran, or hilly areas where meltwaters emerged from the glacier and deposited hills of gravel. Palmyra soils have 1 to 1½ feet of moderately to rapidly permeable gravelly loam over a moderately permeable zone of gravelly loam to clay loam that extends to a depth of 1¼ to 2½ feet and tongues downward into very rapidly permeable stratified gravelly and sandy outwash dominated by fragments of limestone, sandstone, and shale. Depth to bedrock is over 4 feet and usually exceeds 20 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--coarse fragments	Fair--calcareous; gravelly	Good--calcareous; some stones	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Permeable material; seepage a problem; storage potential limited on over C slopes
Pond embankment		Stability good; material when compacted is permeable; generally good for outside shells
Drainage		Usually not needed. Not suitable on greater than C slopes
Highway or road location		Cuts and fills needed; good bearing capacity; good source of fill material
Low building foundation		Moderately high bearing capacity
Pipeline construction and maintenance		Ditch banks are unstable; cobbles and some stones present

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Palmyra soils continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--rapid permeability at 3 feet and deeper which may make pollution a serious problem
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-B	Moderate--coarse fragments
	C	Moderate--slope hazard; coarse fragments
	D-F	Severe--slope hazard
Trailers	A	Moderate--coarse fragments
	B	Moderate--slope hazard; coarse fragments
	C	Severe--slope hazard
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Pinckney series.[a]

Description: Pinckney soils are deep, moderately well to well drained, medium textured acid soils developed on acid, glacial till. They are on gently sloping to steep areas in upland glacial till plains. They have 1½ to 2 feet of moderately permeable silt loam over 2 to 4 feet of dense, very firm, slowly permeable silt loam fragipan. This material is underlain with firm loam or silt loam glacial till that is calcareous at 6 to 8 feet deep. Depth to bedrock is over 4 feet. Depth to seasonal water table is 3 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--usually stony or gravelly	Not suitable	Not suitable	Fair to good--usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Seepage rate low
	D-F	Storage potential reduced because of slope
Pond embankment	All	Compacted permeability low; compaction properties generally good; usually contains some stones that need removing
Drainage	A-B	Occasionally random drainage needed; slowly permeable layer at 2 to 4 feet deep.
	C-F	Usually not needed or feasible
Highway or road location	A-C	Moderate to high bearing capacity; slight seasonal wetness
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Slight seasonal wetness; moderately high bearing capacity
Pipeline construction and maintenance	All	Construction conditions generally favorable except for an occasional stone or boulder and slight seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Pinckney series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-F	Severe--slow permeability and slope hazard on D-F slopes
Low buildings		
With basement	A-C	Moderate--seasonal wetness and slope hazard on C slopes
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--seasonal wetness and slope hazard on D slopes and steeper
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	A-F	Severe--slow permeability and slope hazard on D slopes and steeper
Trailers	A-F	Severe--slow permeability and slope hazard on C slopes and steeper
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	3	3	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Podunk series.[a]

Description: Podunk soils are deep, moderately well to somewhat poorly drained, moderately coarse textured, strongly acid soils, developed on bottom lands of rivers and streams. They are on nearly level to slightly depressional areas in active, flood plains or alluvial fans. Podunk soils have 1½ to 2½ feet of rapidly permeable sandy loam over rapid to very rapidly permeable gravelly loamy sand and sand with gravel in places. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1 to 2½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--seasonally wet; subject to flooding	Poor--has high contact of fines	Poor--has high content of fines; is usually sand	Fair--usually sandy; seasonally wet

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Previous material; seasonal wetness; high seepage rate; subject to flooding
Pond embankment	A	Sandy material; moderate seepage rate; adequate strength and stability
Drainage	A	Surface drainage needed; outlets not readily avialable, seasonal wetness; subject to flooding
Highway or road location	A	Subject to flooding
Low building foundation	A	Frequent spring flooding limits use for building sites
Pipeline construction and maintenance	A	Seasonal wetness; spring flooding; unstable ditch banks under wet conditions

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Podunk series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--flooding hazard
Low buildings		
With basement	A	Severe--flood hazard
Without basement	A	Severe--flood hazard
Sanitary landfill	A	Severe--flood hazard
Play and picnic areas	A	Moderate--flood hazard
Campsites		
Tents	A	Severe--flood hazard
Trailers	A	Severe--flood hazard
Field crops	A	Slight--few or no adverse conditions

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region, Potsdam series.[a]

Description: Potsdam soils are deep, well drained, medium textured, acid soils that have developed in acid glacial till that has an upper layer of aeolian silt and very fine sand. They are on nearly level to moderately steep slopes on the upland. Potsdam soils have 2 to 2½ feet of moderately permeable silt loam or very fine sandy loam over a slowly permeable, firm, stony fine sandy loam fragipan dominated by sandstone and granitic rock. Depth to bedrock is over 4 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair in upper foot--usually sandy and erosive on slopes	Fair--usually high in silt and clay	Not suitable	Fair to good--erosive on slopes

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Sandy material likely will have moderate to rapid seepage rate
	D	Storage potential limited because of slope
Pond embankment	All	Compacted permeability high; subject to piping; sandy material tends to be unstable
Drainage	All	Usually not needed
Highway or road location	All	Moderate bearing capacity; high potential frost heaving
Low building foundation	All	Sandy material with moderate to low bearing capacity; low shear strength
Pipeline construction and maintenance	All	Sandy material with unstable ditch walls

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Potsdam series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	B-D	Severe--slow permeability and slope hazard on D slopes
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	B-C	Moderate--seasonal wetness and slope hazard on C slopes
	D	Severe--slope hazard ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED.
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	B-D	Severe--slow permeability and slope hazard on D slopes
Trailers	B-D	Severe--slow permeability and slope hazard on C and D slopes
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Rhinebeck series.[a]

Description: Rhinebeck soils are deep, somewhat poorly drained, medium acid to neutral, fine textured soils, free of coarse fragments. They occupy gently sloping areas once occupied by glacial lakes. Rhinebeck soils have 1 foot of moderately to slowly permeable fine silt loam over slowly permeable silty clay loam or silty clay that extends to a depth of 2 to 3 feet. This soil material is underlain by layers of lake-laid calcareous silty clay separated by thin silty layers. Depth to bedrock is over 5 feet and usually exceeds 20 feet. Depth to seasonal water table is 1 to 1½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good to fair in upper foot--seasonal wetness; may be clayey	Not suitable	Not suitable	Poor--seasonal wetness; clayey; highly plastic

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Slow to very slow permeability; seepage presents no problem
Pond embankment		Clayey material; high volume change; poor compaction characteristics
Drainage		Very slowly permeable; seasonal wetness; artificial drainage often highly desirable but difficult to effect in these clayey soils
Highway or road location		Seasonal wetness; clayey, slowly permeable soils; poor compaction characteristics; high frost heave, low permeability when compacted; all combine to present serious construction problems
Low building foundation		Seasonal wetness and clayey slowly permeable subsoils present serious foundation drainage problems; high compressibility and poor compaction characteristics
Pipeline construction and maintenance		Ditch well seepage a major problem; seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Rhinebeck series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability; seasonal wetness.
	C	Severe--slow permeability; seasonal wetness; slope hazard
Low buildings		
With basement	A-B	Severe--seasonal wetness
	C	Severe--seasonal wetness; slope hazard.
Without basement	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Sanitary landfill	A-B	Severe--seasonal wetness
	C	Severe--seasonal wetness; slope hazard
Play and picnic areas	A-B	Moderate--seasonal wetness
	C	Moderate--seasonal wetness; slope hazard
Campsites		
Tents	A-B	Severe--seasonal wetness; slow permeability
	C	Severe--seasonal wetness; slope hazard; slow permeability
Trailers	A	Severe--seasonal wetness; slow permeability
	B-C	Severe--seasonal wetness; slope hazard; slow permeability
Field crops	A-B	Moderate--requires drainage; clayey textures
	C	Moderate--requires drainage; clayey textures; slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	1	2	3	2	2	2	1	2
B	2	2	1	1	2	3	4	4	2	1	4
C	2	2	1	1	2	4	4	4	2	1	4

Appendix 2. Soils of the Tug Hill Region, Ridgebury series.[a]

Description: Ridgebury soils are deep, poorly drained, medium textured, strongly acid soils developed in acid glacial till. They are on level to gently sloping, slightly depressional areas in the uplands. Ridgebury soils have 2 to 2½ feet of moderately permeable stony sandy loam over a very firm, stony sandy loam or loamy sand, slowly permeable, fragipan. This is underlain with stony, sandy loam glacial till. Depth to bedrock is over 3½ feet. Depth to seasonal water table is ½ to 1½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually stony and wet	Not suitable	Not suitable	Fair--seasonally wet and usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Permeability slow; prolonged high water table; stony
Pond embankment	A-C	Fair stability; compacted permeability slow; stony
Drainage	A-C	Prolonged high water table; sand layers subject to piping; cut slopes may be unstable
Highway or road location	A-C	Fair stability; prolonged high water table; moderate frost heave potential
Low building foundation	A-C	Fair stability rolonged high water table; foundation drainage needed
Pipeline construction and maintenance	A-C	Prolonged wetness; may be stony; slow permeability

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Ridgebury series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--slow permeability and prolonged wetness
Low buildings		
With basement	A-C	Severe--prolonged wetness
Without basement	A-C	Moderate--prolonged wetness
Sanitary landfill	A-C	Severe--prolonged wetness
Play and picnic areas	A-C	Severe--prolonged wetness
Campsites		
Tents	A-C	Severe--slow permeability and prolonged wetness
Trailers	A-C	Severe--slow permeability and prolonged wetness
Field crops	A-C	Moderate--prolonged high water table

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	3	2	2	2	2	3	3	3	2	2	3
B	3	2	2	2	2	3	4	4	2	2	4
C	3	2	2	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Rumney series.[a]

Description: Rumney soils are deep, poorly to somewhat poorly drained, moderately coarse textured, strongly acid soils developed on bottomlands of alluvial flood plains. They are on nearly level to depressional areas in sediments that have washed from adjacent uplands. Rumney soils have 1 to 1½ feet of rapidly permeable sandy loam over moderate to rapidly permeable stratified silty sand and gravel. Depth to bedrock is over 4 feet and generally greater than 10 feet. Depth to seasonal water table is 0 to ½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good--however is wet much of year	Not suitable	Not suitable	Fair to poor--wet much of year

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Subject to flooding; soil is wet most of year
Pond embankment	A	High organic matter content; hazard of frequent flooding; high permeability when compacted
Drainage	A	Subject to frequent stream overflow; soil is wet most of year; artificial drainage possible where adequate outlets are available
Highway or road location	A	Frequent stream overflow; soil wet most of year; high organic matter content
Low building foundation	A	Soil is wet most of year; subject to frequent flooding
Pipeline construction and maintenance	A	Soil is wet most of year; stability of ditch wall usually a problem

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Rumney series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--frequent flooding
Low buildings		
With basement	A	Severe--frequent flooding
Without basement	A	Severe--frequent flooding
Sanitary landfill	A	Severe--frequent flooding
Play and picnic areas	A	Severe--quite frequently wet from flooding during heavy use period
Campsites		
Tents	A	Severe--frequently wet from flooding during heavy use period
Trailers	A	Severe--frequently wet from flooding during heavy use period
Field crops	A	Moderate--frequent flooding, soil wet much of year

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	3	3	3	2	3

Appendix 2. Soils of the Tug Hill Region, Saco series.[a]

Description: Saco soils are deep, very poorly drained, medium textured, moderately acid soils developed on alluvial flood plains. They are on nearly level to depressed flood plains in old ox-bows. Saco soils have ½ to 1 foot of moderately permeable silt loam or very fine sandy loam over moderately permeable stratified silty clay loam, silts or very fine sand. Depth to bedrock is over 4 feet and usually exceeds 20 feet. Depth to seasonal water table is 0 to ½ foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot good--however it is wet much of the time	Not suitable	Not suitable	Fair to poor--wet much of the year

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Usually not suitable for anything but "dug-out" ponds and wildlife marshes; soil is wet much of year; seepage rate likely to be low
Pond embankment	A	Not suitable; high organic matter content; hazard of very frequent flooding; high to moderate permeability when compacted
Drainage	A	Subject to very frequent stream overflow; wet at surface much of year; surface ponding frequent; artificial drainage sometimes possible when adequate outlets are available
Highway or road location	A	Frequent stream overflow; soil wet at surface with frequent surface ponding much of year; high organic matter content
Low building foundation	A	Soil wet at or near surface with frequent ponding much of year; these present very severe to almost prohibitive limitations
Pipeline construction and maintenance	A	Ditch wall stability usually a problem; soil wet much of year

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Saco series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--very frequent flooding
Low buildings		
With basement	A	Severe--very frequent flooding
Without basement	A	Severe--very frequent flooding
Sanitary landfill	A	Severe--very frequent flooding
Play and picnic areas	A	Severe--normally very wet or ponded from flooding during heavy use period
Campsites		
Tents	A	Severe--frequent flooding
Trailers	A	Severe--frequent flooding
Field crops	A	Severe--too wet for crops; wet at surface much of year; drainage seldom feasible

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	1	3	3	3	2	3

Appendix 2. Soils of the Tug Hill Region, Scantic series.[a]

Description: Scantic soils are deep, somewhat poorly to poorly drained gray and yellowish brown strongly to medium acid, medium textured soils that formed in lake-laid or reworked glacial outwash deposits. They occupy nearly level upland topography. Scantic soils, have less than 6 inches of organic material over 1 to 2 feet of silt loam or clay loam. This material is underlain by 2 feet or more of a reddish silty clay or silty clay loam that is slowly permeable. Depth to bedrock is over 20 feet. Depth to seasonal water table is 0 to 1 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper 1 foot fair to good-- soil is wet much of year	Not suitable	Not suitable	Poor, high water table, usually clayey

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Seepage rate is low; soil is wet much of year
Pond embankment	A	Soil is wet much of year; compacted permeability is low; stability low to fair; not susceptible to piping. Compaction characteristics fair to poor
Drainage	A	Soil is wet much of year; outlets difficult to obtain; permeability is slow
Highway or road location	A	Soil has a high water table; low stability; hauling excavation is difficult; moderate potential frost heave
Low building foundation	A	Soil has a high water table; bearing capacity and shear strength are low
Pipeline construction and maintenance	A	Soil is wet much of year; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Scantic series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--slow permeability; high water table
Low buildings		
With basement	A	Severe--high water table
Without basement	A	Severe--high water table
Sanitary landfill	A	Severe--high water table
Play and picnic areas	A	Severe--high water table
Campsites		
Tents	A	Severe--high water table, permeability
Trailers	A	Severe--high water table; permeability
Field crops	A	Severe--high water table; permeability

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	2	2	3	2	2

Appendix 2. Soils of the Tug Hill Region, Scarboro series.[a]

Description: Scarboro soils are deep, very poorly and poorly drained, coarse textured, strongly acid soils that formed in stratified sandy or sandy and gravelly glacial outwash materials. They occupy nearly level areas or slight depressions on outwash terraces or deltaic deposits. Scarboro soils have ½ to 1 foot of rapidly permeable sandy loam or fine sandy loam, high in organic matter, over ½ to 1½ feet of rapidly permeable loamy sands or sands. This material rests on layers of sands or stratified sand and gravel. Depth to bedrock is over 4 feet. Seasonal water table is at surface.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--sandy and wet in natural state	Fair--wet much of the time	Poor--wet much of the time and usually sand	Fair--wet much of the time

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	High water table; permeable materials; excessive seepage
Pond embankment	A	Poor stability; fair compaction; compacted permeability high
Drainage	A	High water table; fine sands subject to piping; cut slopes unstable
Highway or road location	A	High water table; usually 12 to 18 inches surface organic materials
Low building foundation	A	Fair stability; high water table; foundation drainage problems
Pipeline construction and maintenance	A	Soil is ponded or wet most of year; sandy textures; ditch walls unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Scarboro series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--prolonged high water table
Low buildings		
With basement	A	Severe--prolonged high water table
Without basement	A	Severe--prolonged high water table
Sanitary landfill	A	Severe--prolonged high water table
Play and picnic areas	A	Severe--prolonged high water table
Campsites		
Tents	A	Severe--prolonged high water table
Trailers	A	Severe--prolonged high water table
Field crops	A	Severe--prolonged high water table

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	1	1	4	4	3	2	4

Appendix 2. Soils of the Tug Hill Region, Scituate series.[a]

Description: Scituate soils are moderately well drained, moderately coarse textured, strongly acid soils developed in acid, stony glacial till. They are located on nearly level to moderately steep slopes in the uplands. Scituate soils have 1 to 2 feet of moderately permeable stony fine sandy loam over 2 to 3 feet of slowly permeable, very firm, stony sandy loam fragipan. This material is underlain by firm slowly permeable glacial till mainly of granite and gneiss. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1½ to 2½ feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Upper foot fair--seasonal wetness; stony	Not suitable	Not suitable	Fair to good--usually contains some stones

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Seepage rate low if soil is not disturbed; however if fragipan is disturbed seepage will likely be moderate
	C-D	Storage potential limited because of slope
Pond embankment	All	Upper 2 to 3 feet would be good with low compacted permeability; the underlying coarser textured material would have to be checked carefully
Drainage	A-B	Permeability is slow in fragipan layer; ditch walls may be unstable
	C-D	Usually not feasible or necessary
Highway or road location	A-B	Soil is fairly stable; stone may interfere some; slight seasonal wetness
	C-D	Cuts and fills necessary because of slope
Low building foundation	All	Seasonal wetness; slow permeability; moderate bearing capacity
Pipeline construction and maintenance	All	Slight seasonal wetness; stones may interfere with construction; ditch walls may be somewhat unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2 . Scituate series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-D	Severe--because of slow permeability and slope hazard on D slopes
Low buildings		
With basement	A-B	Moderate--seasonal wetness
	C	Moderate--because of slope hazard and seasonal wetness
	D	Severe--because of slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Sanitary landfill	A-D	Severe--because of seasonal wetness and slope hazard on D slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope hazard
	D	Severe--because of slope hazard
Campsites		
Tents	A-B	Moderate--slow permeability below about 20 inches; seasonal wetness
	C	Moderate--slow permeability below about 20 inches; seasonal wetness; slope
	D	Severe--slope
Trailers	A	Moderate--slow permeability below about 20 inches; seasonal wetness.
	B-C	Moderate--slow permeability below about 20 inches; seasonal wetness; slope
	D	Severe--slope
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--because of slope and erosion hazard and coarse fragments
	D	Severe--because of slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	3	3	1	2	3
B-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Scriba series.[a]

Description: Scriba soils are deep, somewhat poorly drained, slightly to strongly acid, medium to moderately coarse textured soils that have a fragipan. They formed in dense basal till that is dominated by red and gray sandstone with a lesser component of limestone. They are typically gravelly or stony, containing 10 to 30 percent coarse fragments in the upper horizons and 20 to 60 percent in the fragipan and substratum. These level to gently sloping soils are on till plains and concave areas between drumlins. Scriba soils have 9 to 18 inches of friable, moderately permeable loam or fine sandy loam over firm, slowly permeable loam to sandy loam fragipan and till. Depth to bedrock is over 4 feet. Depth to seasonal water table is 0 to 1 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--usually gravelly and wet	Not suitable	Not suitable	Fair--seasonally wet

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-B	Permeability slow; prolonged high water table; usually gravelly or stony
Pond embankment	A-B	Fair stability; permeability is slow; usually gravelly or stony
Drainage	A-B	High water table; problem of surface and subsurface drainage
Highway or road location	A-B	Fair stability; prolonged high water table; moderate frost heave potential
Low building foundation	A-B	Fair stability; prolonged high water table; foundation drainage needed
Pipeline construction and maintenance	A-B	Soil is wet much of year; permeability is slow

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Scriba series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability and prolonged wetness
Low buildings		
With basement	A-B	Severe--prolonged wetness
Without basement	A-B	Severe--prolonged wetness
Sanitary landfill	A-B	Severe--prolonged wetness
Play and picnic areas	A-B	Severe--prolonged wetness
Campsites		
Tents	A-B	Severe--slow permeability and prolonged wetness
Trailers	A-B	Severe--slow permeability and prolonged wetness
Field crops	A-B	Moderate

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	3	2	2	2	2	3	3	3	2	2	3
B	3	2	2	2	2	3	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Sloan series.[a]

Description: Sloan soils are deep, poorly to very poorly drained, slightly acid to calcareous, moderately fine textured soils high in organic matter developed in alluvium. They occur on nearly level to depressional areas on the flood plains of streams. Sloan soils are composed of moderately permeable, coarse loam to coarse silty clay loam material. Depth to bedrock is over 10 feet. Depth to seasonal water table is 0.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--high water table	Not suitable	Not suitable	Fair--inaccessible due to wetness

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Subject to flooding; prolonged high water table
Pond embankment		Poor stability; usually contains high amount of organic material
Drainage		Subject to flooding, prolonged wetness; no outlets
Highway or road location		Poorly drained ponded areas; subject to flooding; fills required
Low building foundation		Subject to flooding; prolonged high water table
Pipeline construction and maintenance		Prolonged wetness; usually ponded; subject to flooding

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Sloan series continued.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--frequent flooding; prolonged wetness
Low buildings		
With basement	A	Severe--frequent flooding; prolonged wetness
Without basement	A	Severe--frequent flooding; prolonged wetness
Sanitary landfill	A	Severe--frequent flooding; prolonged wetness
Play and picnic areas	A	Severe--prolonged wetness
Campsites		
Tents	A	Severe--frequent flooding; prolonged wetness
Trailers	A	Severe--frequent flooding; prolonged wetness
Field crops	A	Moderate--prolonged wetness; requires drainage

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	1	3	3	3	2	3

Appendix 2. Soils of the Tug Hill Region, Sodus series.[a]

Description: Sodus soils are deep, well drained, strongly acid to neutral, moderately coarse to medium textured soils that have formed in neutral to weakly calcareous glacial till. They occupy drumlins and convex landforms of glacial till plains. Sodus soils have 1½ to 2½ feet of moderately permeable, gravelly or stony loam to sandy loam over a dense, firm to very firm, slowly to very slowly permeable gravelly or stony fine sandy loam or loam fragipan that is 2 to 3½ feet thick. This fragipan rests on dense, firm, gravelly to stony sandy loam to loam glacial till dominated by red and gray sandstone, with small amounts of limestone and shale. Depth to bedrock is over 4 feet and usually exceeds 10 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--usually gravelly	Not suitable	Not suitable	Good

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Seepage not likely to be a problem
	D-F	Storage potential reduced because of slope
Pond embankment	All	Good stability; moderate to low permeability when compacted; contains at least some stone fragments which need to be removed
Drainage	All	Not needed except for an occasional included "wet spot"
Highway or road location	A-C	Moderate to high frost heave potential; erodible on slopes; material is easily worked
	D-F	Cuts and fills needed because of slope
Low building foundation	All	Generally moderately high bearing capacity; negligible compressibility
Pipeline construction and maintenance	All	May contain some stone and boulders; permeability is slow

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-F	Severe--slow permeability and slope hazard on D-F slopes
Low buildings With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe slope hazard
Without basement	D-F	Severe--slope hazard
Sanitary landfill	A-C	Moderate--seasonal wetness and slope hazard on C slopes
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites Tents	A-F	Severe--slow permeability and slope hazard on D-F slopes
Trailers	A-F	Severe--slow permeability and slope hazard on D-F slopes
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 2. Soils of the Tug Hill Region, Teel Series[a].

Description: Teel soils are deep, moderately well to somewhat poorly drained, slightly acid to neutral, medium to moderately coarse textured soils that formed in alluvial deposits derived mainly from limestone with some shale and sandstone influence. Most areas are essentially free of coarse fragments but the content in some soils may range to 20 percent in the substratum. These nearly level soils are on flood plains along streams and are subject to spring flooding. Teel soils have 24 to 40 inches of friable, moderately permeable silt loam to fine sandy loam over friable, moderately permeable silt loam or fine sandy loam that may be gravelly. Depth to bedrock is over 5 feet. Depth to the seasonal water table is 1 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good	Not suitable	Not suitable	Fair--unstable seasonal high water table

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Seepage rate moderate to high; subject to flooding
Pond embankment	A	High to moderate compacted permeability; poor resistance to piping; erodible
Drainage	A	Seasonal high water table, unstable ditches, subject to flooding
Highway or road location	A	Seasonal high water table; subject to flooding; unstable
Low building foundation	A	Seasonal high water table; subject to flooding
Pipeline construction and maintenance	A	Seasonal high water table; unstable trench sides, subject to flooding

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--subject to flooding; seasonal high water table
Low buildings With basement	A	Severe--subject to flooding; seasonal high water table
Without basement	A	Severe--subject to flooding
Sanitary landfill	A	Severe--subject to flooding; seasonal high water table
Play and picnic areas	A	Moderate--subject to flooding; seasonal high water table
Campsites Tents	A	Severe--subject to flooding; seasonal high water table
Trailers	A	Severe--subject to flooding; seasonal high water table
Field crops	A	Slight

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	1	4	3	3	1	1	3

Appendix 2. Soils of the Tug Hill Region, Tughill series.

Description: Tughill soils are deep, very poorly drained, strongly to extremely acid, moderately coarse to medium textured soils that formed in glacial till that is dominated by moderately coarse material from siliceous rocks. Coarse fragment content ranges from none to 40 percent in the surface horizons and from 35 to 60 percent below 20 inches. These nearly level soils are in wet depressional areas of till plains. Tughill soils have thick, black, organic surfaces that overlie 18 to 36 inches of friable to firm, moderately to moderately slowly permeable, fine sandy loam to loam. The substratum is firm, slowly permeable, fine sandy loam to loam till. Depth of bedrock is over 4 feet. Depth to seasonal water table is 0.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--high water table; stony	Not suitable	Not suitable	Fair--high water table; stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Permeability slow; stony; high water table
Pond embankment	A	Fair stability; poor shear strength; high water table; stony; compacted permeability low
Drainage	A	Slow permeability; water table at or near surface
Highway or road location	A	Fair stability; water table at or near surface; stony
Low building foundation	A	Fair stability; water table at or near surface
Pipeline construction and maintenance	A	Soil is wet most of year; stony; ditch walls likely to be unstable

[a]Source: Coop. Ext. Serv., 1972.

Appendix . Soils of the Tug Hill Region, Tughill series [a].

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--prolonged wetness, slow permeability
Low buildings With basement	A	Severe--prolonged wetness, slow permeability
Without basement	A	Severe--prolonged wetness, slow permeability
Sanitary landfill	A	Severe--prolonged wetness
Play and picnic areas	A	Severe--prolonged wetness
Campsites Tents	A	Severe--prolonged wetness; slow permeability
Trailers	A	Severe--prolonged wetness; slow permeability
Field crops	A	Severe--prolonged wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	3	3	1	2	1	3	2	1

Appendix 2. Soils of the Tug Hill Region, Vergennes series

Description: Vergennes soils are deep, moderately well drained, medium acid, fine textured soils developed in calcareous marine or lacustrine clay. They occupy nearly level to moderately sloping glaciolacustrine terraces. Vergennes soils have 2 to 3 feet of very firm, very slowly permeable clay over very firm, very slowly permeable varved silt and clay. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1-2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--usually clayey	Not suitable	Not suitable	Poor--clayey

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Permeability is slow to very slow
Pond embankment	A-C	Poor stability; compacted permeability very slow; clayey soil difficult to work with
Drainage	A-C	Cut slopes unstable; soil material very slowly permeable; sub surface drainage difficult
Highway or road location	A-C	Poor stability; fair to poor compaction; moderate shrink-swell
Low building foundation	A-C	Poor stability; subject to high consolidation; seasonal high water table
Pipeline construction and maintenance	A-C	Seasonal wetness; clayey soils difficult to work with; slow permeability

[a]Source: Coop. Ext. Serv., 1972.

Appendix 2. Soils of the Tug Hill Region, Vergennes series [a].

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--slow permeability
Low buildings		
With basement	A-C	Moderate--seasonal wetness and slope hazard on C slopes
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Sanitary landfill	A-C	Severe--seasonal wetness
Play and picnic areas	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
Campsites		
Tents	A-C	Severe--slow permeability
Trailers	A-C	Severe--slow permeability and slope hazard on C slopes
Field crops	A-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	4
B-C	2	1	1	1	3	4	4	4	1	1	4

Appendix 2. Soils of the Tug Hill Region, Wallington series [a].

Description: Wallington soils are deep, somewhat poorly drained, strongly acid, medium textured soils formed in wind-or water-deposited material high in silts and very fine sands. They occupy nearly level to gently sloping landscapes and a few spots in dissected areas of lake plains. Wallington soils have 1 to 1 1/2 feet of moderately permeable, very fine sandy loam or silt loam over 2 to 4 feet of dense, firm, or very firm, brittle, slowly or very slowly permeable, very fine sandy loam or silt loam fragipan. This fragipan rests on strongly to medium acid stratified silts and very fine sands. Depth to bedrock is over 10 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--seasonal wetness; unstable on steep slopes	Not suitable	Not suitable	Unsuitable--unstable material

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Seasonal wetness; seepage usually low
Pond embankment		Poor stability; poor compaction; and piping a hazard; poorly graded material
Drainage		Seasonal wetness; ditchbanks unstable; fragipan at 1 1/2 feet
Highway or road location		Unstable material with a seasonal high water table
Low building foundation		Bearing capacity low; unstable; seasonal wetness
Pipeline construction and maintenance		Very unstable ditch banks; material flows when wet; seasonal wetness

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A & B	Severe--seasonal wetness; slow to very slow permeability
Low buildings With basement	A & B	Severe--seasonal wetness
Without basement	A & B	Severe--seasonal wetness
Sanitary landfill	A & B	Severe--seasonal wetness
Play and picnic areas	A & B	Moderate--seasonal wetness
Campsites Tents	A & B	Severe--slow to very slow permeability
Trailers	A & B	Severe--slow to very slow permeability
Field crops	A & B	Moderate--seasonal wetness; slow permeability

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	1	2	2	3	4	4	2	2	4
B	2	2	1	2	2	3	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Wareham series [a].

Description: Wareham soils are deep, somewhat poorly to poorly drained, extremely to slightly acid, coarse textured soils that formed in sandy outwash materials that are dominated by granite and gneiss. The content of coarse fragments ranges from none to 15 percent with a few layers in the substratum containing up to 75 percent. These level to gently sloping soils are on glacio-fluvial outwash plains, deltas, and high stream terraces. Wareham soils have 10 to 30 inches of very friable, rapidly permeable loamy sand or sand over loose, rapidly permeable stratified sand. Depth to bedrock is over 10 feet. Depth to seasonal water table is 1/2 to 1 1/2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--coarse texture	Fair	Poor--insufficient amount of gravel	Fair--subject to erosion; seasonal wetness

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A	Permeable; sand lenses subject to piping
Pond embankment	A	Poor stability; permeable material; sand lenses subject to piping
Drainage	A	Sand--subject to piping; cut slopes unstable; surface drainage is slow to ponded; outlets a problem; somewhat poorly to poorly drained
Highway or road location	A	Prolonged wetness; unstable when wet
Low building foundation	A	Seasonal high water table; foundation drainage required
Pipeline construction and maintenance	A	Cut slopes may slough; high water table

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--high water table
Low buildings With basement	A	Severe--high water table
Without basement	A	Severe--high water table
Sanitary landfill	A	Severe--high water table
Play and picnic areas	A	Moderate--high water table
Campsites Tents	A	Severe--high water table
Trailers	A	Severe--high water table
Field crops	A	Severe--high water table; coarse texture

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	4	4	4	3	3	4

Appendix . Soils of the Tug Hill Region, Wayland series. [a]

Description: Wayland soils are deep, poorly drained, neutral to mildly alkaline, medium textured soils formed in neutral or calcareous recent alluvium. They occupy nearly level areas or depressions on floodplains of streams receiving erosion from uplands that contain some calcareous materials. Wayland soils have 3 to 5 feet of moderately permeable silt loam or coarse silty clay loam over stratified alluvial sediments consisting of layers of sands, silts, clays, and gravel. The surface is high in organic matter. Depth to bedrock is 5 feet, but usually exceeds 20 feet. Depth to seasonal water table is 0 to 1/2 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--highwater table	Not sutiable	Not suitable	Fair to poor--prolonged wetness

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Subject to flooding; soil is wet much of year
Pond embankment		High organic matter content; hazard of frequent flooding; moderate permeability when compacted
Drainage		Subject to frequent stream overflow; soil is wet most of year; artificial drainage possible where adequate outlets are available
Highway or road location		Frequent stream overflow; soil is wet most of year; high organic matter content
Low building foundation		Soil is wet most of year; subject to frequent flooding
Pipeline construction and maintenance		Soil is wet most of year; stability of ditch walls usually a problem

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A	Severe--subject to frequent flooding
Low buildings		
With basement	A	Severe--subject to frequent flooding
Without basement	A	Severe--subject to frequent flooding
Sanitary landfill	A	Severe--subject to frequent flooding
Play and picnic areas	A	Severe--frequently wet from flooding during heavy use periods
Campsites	A	Severe--frequently wet from flooding during heavy use periods
Tents		
Trailers	A	Severe--frequently wet from flooding during heavy use periods
Field crops	A	Moderate--subject to frequent flooding

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	4	3	3	2	2	2	3	3	3	2	3

Appendix 2. Soils of the Tug Hill Region, Westbury series[a].

Description: Westbury soils are deep, somewhat poorly drained, very strongly acid, medium to moderately coarse textured soils that formed in strongly to medium acid glacial till. They occupy nearly level to gently sloping till plains. Westbury soils have 1 1/2 to 2 feet of moderately permeable stony fine, sandy loam to stony silt predominately from sandstone fragments but including a small number of pieces of shale. This is underlain by 2 to 4 feet of slowly permeable fragipan. Depth to bedrock is over 4 feet. Depth to seasonal water table is 1/2 to 1 foot.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Poor--usually stony and wet	Not suitable	Not suitable	Poor--usually stony and wet

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Seepage rate low; soil is wet much of the year
Pond embankment	All	Soil is wet much of year; usually contains stones which must be removed; compacted permeability is low
Drainage	All	Soil is wet much of year; outlets difficult to obtain; permeability is slow in the subsoil; stones and boulders in the soil
Highway or road location	All	Soil is wet much of year; usually contains some stones and boulders
Low building foundation	All	Soil is wet much of year; bearing capacity is moderate to low
Pipeline construction and maintenance	All	Soil is wet much of year; usually contains some stones and boulders

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Severe--slow permeability and prolonged wetness
Low buildings With basement	A-B	Severe--prolonged wetness
Without basement	A-B	Severe--prolonged wetness
Sanitary landfill	A-B	Severe--prolonged wetness
Play and picnic areas	A-B	Severe--prolonged wetness
Campsites Tents	A-B	Severe--prolonged wetness and slow permeability
Trailers	A-B	Severe--prolonged wetness and slow permeability
Field crops	A-B	Moderate--prolonged wetness

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	2	2	2	2	3	2	2	2	2	2
B	2	2	2	2	2	3	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Williamson series. [a]

Description: Williamson soils are deep, moderately well drained, strongly acid, silty soils formed in silty and very find sandy wind or water deposited material. They occupy nearly level to sloping and rolling landscapes of lake plains and uplands, mantled by wind-or-water-deposited silts and very, fine sands. Williamson soils have 1 1/2 to 2 feet of moderately permeable silt loam over a moderately slowly permeable, very fine, sandy loam fragipan that is 2 to 2 1/2 feet thick. This fragipan is underlain by strongly to medium acid stratified silts and very fine sands. Depth to bedrock is over 10 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good--erodible on steep slopes	Not suitable	Not suitable	Poor--poorly graded silt and very fine sand

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		Seepage moderate to low
Pond embankment		Poor stability; poor compaction; piping hazard
Drainage		Moderately slow permeability due to fragipan at 20 inches; ditchbanks unstable; not feasible on D slopes
Highway or road location		Unstable material; erosive when exposed on embankments; seasonal wetness; cuts generally erode on C-D slopes
Low building foundation		Bearing capacity low; seasonal wetness; unstable soil material
Pipeline construction and maintenance		Unstable ditch banks; seasonal wetness; material tends to flow when wet

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A & B	Severe--moderately slow permeability
	C & D	Moderately slow permeability; slope hazard
Low buildings		
With basement	A & B	Moderate--seasonal wetness
	C	Seasonal wetness; slope hazard
	D	Severe--slope hazard
Without basement	A & B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Sanitary landfill	A & B	Severe--seasonal wetness
	C-D	Severe--seasonal wetness; slope hazard
Play and picnic areas	A & B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope hazard
Campsites		
Tents	A-C	Moderate--moderately slow permeability; C slope
	D	Severe--slope
Trailers	A & B	Moderate--moderately slow permeability; B slope
	C-D	Severe--slope
Field crops	A & B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D	Severe--slope

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	1	3	4	3	3	1	1	3
B-C	2	1	1	1	3	4	4	4	1	1	4
D	3	2	1	1	3	4	4	4	2	2	4

Appendix . Soils of the Tug Hill Region, Windsor series. a

Description: Windsor soils are deep, well drained, strongly acid, coarse, textured soils that have formed in deep sandy deposits on glacial outwash terraces. They occupy nearly level or gently rolling areas, and in a few places, steep slopes. Windsor soils have 2 to 2 1/2 feet of rapidly permeable strongly to medium acid sand, loamy sand, or loam fine sand over sand derived mainly from sandstone fragments. Depth to bedrock is 4 feet and over, and usually exceeds 20 feet. Depth to seasonal water table is over 4 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Good in upper foot	Good	Good--upper 2-4 feet is usually sandy	Fair--usually too sandy

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	All	Sandy material subject to excessive seepage
Pond embankment	All	Compacted permeability high; sandy material subject to piping
Drainage	All	Not needed
Highway or road location	A-C	Sandy material, erosive on slope, tends to be unstable
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	Sandy material with low bearing capacity; shear strength is low
Pipeline construction and maintenance	All	Sandy material, very unstable ditch banks; material likely to flow when wet

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Low buildings		
With basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	A-B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	A-F	Severe--rapid permeability at 3 feet and deeper which may make pollution a serious problem
Play and picnic areas	A-C	Moderate--sandy texture and slope hazard on C slopes
	D-F	Severe--slope hazard
Campsites		
Tents	A-C	Moderate--sandy texture and slope hazard on C slopes
	D-F	Severe--slope hazard
Trailers	A-B	Moderate--sandy texture and slope hazard on C slopes
	C-F	Severe--slope hazard
Field crops	A-C	Moderate--sandy texture and slope hazard on C slopes
	D-F	Severe--slope hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-E	4	3	3	3	1	4	4	4	3	3	4
F	4	4	3	3	1	4	4	4	4	3	4

Appendix 2. Soils of the Tug Hill Region, Woodbridge series

Description: Woodbridge soils are deep, moderately well drained, strongly to medium acid, medium to moderately coarse textured soils that have a fragipan and formed in compact glacial till derived mainly from mica schist and granite. Coarse fragment content ranges from 3 to 30 percent in the profile and fragipan. These nearly level to sloping soils are on drumlins and glaciated uplands. Woodbridge soils have 12 to 36 inches of friable, moderately permeable sandy loam or loam over thin, firm loam to sandy loam upper substrata. The lower substratum is a very firm, slowly permeable loam to sandy loam fragipan. Depth to bedrock is over 3 1/2 feet. Depth to seasonal water table is 1 1/2 to 2 feet.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--stony	Not suitable	Not suitable	Fair--fair stability fair to good compaction; may be stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area	A-C	Permeability slow; may be stony
Pond embankment	A-C	Fair stability; permeability moderate when compacted; may be stony
Drainage	A-C	Slowly permeable layer at 16 to 36 inches; subsurface drainage difficult; needs some surface drainage
Highway or road location	A-C	Fair stability; fair to good compaction; moderate compacted permeability; slight compressibility; moderate frost heave potential
Low building foundation	A-C	Seasonal high water table; foundation drainage may be required; generally adequate strength
Pipeline construction and maintenance	A-C	Seasonal high water table; may be stony; ditch walls may be unstable

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	A-C	Severe--slow permeability
Low buildings		
With basement	A-B	Moderate--seasonal high water table
	C	Moderate--seasonal high water table; slope
Without basement	A-B	Slight
	C	Moderate--slope
Sanitary landfill	A-C	Severe--seasonal high water table
Play and picnic areas	A-B	Slight
	C	Moderate--slope
Campsites		
Tents	A-C	Severe--slow permeability
Trailers	A-B	Severe--slow permeability
	C	Severe--slope, slow permeability
Field crops	A-B	Slight to severe--content of coarse fragments on some areas
	C	Moderate to severe--slope; coarse fragments on some areas

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A	2	1	1	2	2	4	3	3	1	2	3
B-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4

Appendix 2. Soils of the Tug Hill Region, Worth series.[a]

Description: Worth soils are deep, well drained, very strongly acid, moderately coarse textured soils that formed in strongly to slightly acid glacial till. They occupy undulating till plains and local hilly or steep areas. Worth soils have 1 1/2 to 2 feet of moderately to rapidly permeable, stony or gravelly fine sandy loam over a dense, firm, slowly permeable stony sandy loam or loam fragipan that is 1 to 3 feet thick. Beneath the fragipan is massive, stony fine sandy loam to loamy sand glacial till formed predominately from red and gray sandstone fragments.

SUITABILITY OF SOIL AS SOURCE OF MATERIAL:

Topsoil	Sand	Gravel	Road fill
Fair--usually contains stones and/or gravel	Not suitable	Not suitable	Fair to good--usually stony

SOIL FEATURES AFFECTING SPECIFIED ENGINEERING USES:

Use	Slope	Soil features
Pond reservoir area		
	B-C	Seepage rate low
	D-F	Too steep; storage potential limited
Pond embankment	All	Usually contains stones which need to be removed; compacted permeability low; stable material
Drainage	All	Usually not needed except for an occasional included seep spot
Highway or road location	B-C	Usually contains stones and boulders
	D-F	Cuts and fills necessary because of slope
Low building foundation	All	High bearing capacity; good shear strength
Pipeline construction and maintenance	All	Usually contains some stones and boulders otherwise conditions favorable

[a]Source: Coop. Ext. Serv., 1972.

COMMUNITY DEVELOPMENT AND RECREATION USES:

Use	Slope	Degree and kind of limitation
Septic tank and filter fields	B-F	Severe--moderately slow permeability and slope hazard on D-F slopes
Low buildings		
With basement	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Without basement	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Sanitary landfill	B-C	Moderate--seasonal wetness and slope hazard on C slopes
	D-F	Severe--slope hazard; ON SITE INVESTIGATION NEARLY ALWAYS REQUIRED
Play and picnic areas	B	Slight--few or no adverse conditions
	C	Moderate--slope hazard
	D-F	Severe--slope hazard
Campsites		
Tents	B-C	Moderate--moderately slow permeability and slope hazard on C slopes
	D-F	Severe--slope hazard
Trailers	B	Moderate--moderately slow permability
	C-F	Severe--slope hazard
Field crops	(A)-B	Slight--few or no adverse conditions
	C	Moderate--slope and erosion hazard
	D-F	Severe--slope and erosion hazard

SUITABILITY FOR WILDLIFE USES:

	Habitat elements								Classes of wildlife		
Slopes	Grain	Grass	Herbs	Hard-wood	Conifer	Wet place	Marsh	Excavated ponds	Open land	Wood-land	Wet land
A-C	2	1	1	2	2	4	4	4	1	2	4
D	3	2	1	2	2	4	4	4	2	2	4
E	4	3	1	2	2	4	4	4	3	2	4
F	4	4	1	2	2	4	4	4	4	2	4

Appendix 3. Lakes, ponds, swamps, and streams of the Tug Hill Region, Jefferson County.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF ADAMS							
Ponds							
13 unnamed ponds[a]			360 - 720	38.4	0.06[b]		0.14
Swamps							
Adams Swamp	43°50'00"	76°03'30"	550	1,056.0	1.65[b]	15.15[c]	
12 unnamed swamps			540 - 680	915.2	1.43[b]	20.82[c]	
Swamp total				1,971.2	3.08[b]	35.97[c]	7.22
TOWN OF CHAMPION							
Lakes							
Pleasant Lake	43°56'19"	75°40'20"	1064	128.0	.20	3.20	.67
Swamps							
3 swamp areas			698 - 1060	76.8	.12[b]	2.70[c]	.26
TOWN OF LORRAINE							
Ponds							
7 unnamed ponds[a]			760 - 1100	12.8	.02[b]		.05
Swamps							
23 swamp areas			600 - 1350	339.2	.53[b]	16.70[d]	1.37

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Jefferson County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF RODMAN							
Ponds							
Unnamed pond	43°48'16"	76°52'30"	1245	6.4	0.01	0.30	
9 unnamed ponds[a]			800 - 1250	25.6	.04[b]		
Pond total				32.0	.05[b]	.30[c]	0.11
Swamps							
11 swamp areas			685 - 1170	211.2	.33[b]	10.20[d]	.77
TOWN OF RUTLAND							
Lakes							
Rutland Lake	43°57'03"	75°47'03"	977	12.8	.02	.61	.04
Ponds							
Unnamed pond	43°57'59"	75°46'51"	1065	6.4	.01	.46	
12 unnamed ponds[a]			780 - 1120	19.2	.03[b]		
Lakes and ponds total				38.4	.06[b]	1.07[c]	
Swamps							
18 swamp areas			700 - 1170	544.0	.85[b]	20.40[d]	1.86

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Jefferson County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF WATERTOWN							
Ponds							
26 unnamed ponds[a]			460 - 900	51.2	0.08[b]		0.22
Swamps							
Beaver Meadows	44°57'30"	75°57'30"	400	364.8	.57[b]	5.10[d]	
Jacobs Creek "Marsh"	43°55'00"	75°52'00"	900	262.4	.41[b]	6.80[d]	
10 unnamed swamps			450 - 916	569.6	.89[b]	14.30[d]	
Swamp total				1196.8	1.87[b]	26.20[d]	5.25
TOWN OF WORTH							
Ponds							
Unnamed pond	43°45'07"	75°07'32"	1671	25.6	.04	.70	
25 unnamed ponds[a]			1150 - 1671	57.6	.09[b]		
Pond total				83.2	.13[b]	.70[c]	.29
Swamps							
113 swamp areas			1150 - 1650	2476.8	3.87[b]	106.40[d]	8.90

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Jefferson County continued.

STREAMS

		Miles
TOWN OF ADAMS		
Stony Creek Drainage Basin		
Stony Creek and unnamed tributaries		22.2
Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		16.5
	Town of Adams, Total	38.7
TOWN OF CHAMPION		
Black River Drainage Basin		
Black River and unnamed tributaries		34.1
White Creek		1.5
Huddle Creek		11.4
Mill Creek		10.2
	Total	57.2
Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		6.4
Stebbins Creek		8.3
	Total	14.7
	Town of Champion, Total	71.9
TOWN OF LORRAINE		
Sandy Creek Drainage Basin		
Unnamed tributaries		5.8
South Sandy Creek Basin		
South Sandy and unnamed tributaries		22.3
Fox Creek and tributaries		23.9
Raystone Creek		10.2
Bear Creek		7.9
	Total	64.3
Skinner Creek Basin		
Skinner Creek and unnamed tributaries		11.0
	Town of Lorraine, Total	81.1

TOWN OF RODMAN

		Miles
Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		29.0
Gulf Creek		12.1
Fish Creek		23.9
	Total	65.0
Stony Creek Drainage Basin		
Unnamed tributaries		2.3
South Sandy Drainage Basin		
Grunley Creek and unnamed tributaries		9.8
Town of Rodman,	Total	77.1

TOWN OF RUTLAND

Black River Drainage Basin		
Black River and unnamed tributaries		8.9
Felts Mills Creek		5.5
White Creek		.4
Rutland Hollow Creek		4.9
	Total	19.7
Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		11.7
Staplin Creek		11.7
Boynton Creek		6.1
Jacobs Creek		10.6
Freeman Creek		4.5
Stebbins Creek		4.5
	Total	49.1
Town of Rutland,	Total	68.8

TOWN OF WATERTOWN

Black River Basin		
Black River (Including City of Watertown)		16.8
Stony Creek Basin		
Stony Creek and unnamed tributaries		5.3
Town of Watertown,	Total	66.2

TOWN OF WORTH

		Miles
South Sandy Creek Drainage Basin		
South Sandy Creek and unnamed tributaries		16.1
Clora Creek		2.4
Abijah Creek		20.8
Fox Creek (By Brook, Guyette Creek)		28.6
Pigeon Creek		2.7
Raystone Creek		6.1
Grunley Creek		11.9
	Total	88.6
Salmon River Drainage Basin		
Mad River and unnamed tributaries		11.6
	Town of Worth, Total	100.2
	GRAND TOTAL Jefferson County	504.0

Appendix 3. Lakes, ponds, swamps, and streams of the Tug Hill Region, Lewis County.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF DENMARK							
Ponds							
10 unnamed ponds[a]			730 - 1180	19.2	0.03[b]		0.05
Swamps							
10 swamp areas			739 - 1200	665.6	1.04[b]	19.70[d]	2.06
TOWN OF HARRISBURG							
Ponds							
3 unnamed ponds[a]			1300 - 1360	12.8	.02[b]		.05
Swamps							
3 swamp areas			1240 - 1680	300.8	.47[b]	3.80[d]	1.19
TOWN OF HIGHMARKET							
Ponds							
Unnamed pond	43°39'27"	75°33'57"	1930	19.2	.03	1.14	
Unnamed pond	43°40'41"	75°37'10"	1840	25.6	.04	.99	
17 unnamed ponds[a]			1600 - 1820	44.8	.07[b]		
Pond total				89.6	.14[b]	2.13[c]	.22

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Lewis County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF HIGHMARKET (Continued)							
Swamps							
34 swamp areas			1660 - 1940	1292.8	2.02[b]	48.40[d]	3.25
TOWN OF LEWIS							
Lakes							
Bloodsucker Lake	43°26'30"	75°35'00"	1290	6.4	0.01	0.64	
Tagasoke Reservoir	43°26'15"	75°35'30"	1260	211.2	.33	4.70	
Mud Lake	43°28'49"	75°31'50"	1525	12.8	.02	1.42	
Ponds							
14 unnamed ponds[a]			1260 - 1590	38.4	.06[b]		
Lakes and ponds total				268.8	.42[b]	6.76[c]	.64
Swamps							
38 swamp areas			1200 - 1640	1126.4	1.76[b]	40.52[d]	2.70
TOWN OF LEYDEN							
Ponds							
34 unnamed ponds[a]			940 - 1740	57.6	.09[b]		.26

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Lewis County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF LEYDEN (Continued)							
Swamps							
17 swamp areas			1280 - 1740	128.0	0.20[b]	5.70[d]	.59
TOWN OF LOWVILLE							
Ponds							
Unnamed pond	43°50'10"	75°26'24"	770	12.8	.02	.50	
13 unnamed ponds[a]			720 - 1220	25.6	.04[b]		
Pond total				38.4	.06[b]	.50[c]	.15
Swamps							
3 swamp areas			740 - 1220	1152.0	1.80[b]	11.40[d]	4.67
TOWN OF MARTINSBURG							
Ponds							
Haber Pond	43°42'56"	75°35'03"	1890	6.4	.01	.92	
Unnamed pond	43°41'12"	75°37'05"	1890	6.4	.01	.99	
Unnamed pond	43°45'30"	75°35'30"	1800	6.4	.01	.43	

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Lewis County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF MARTINSBURG (Continued)							
15 unnamed ponds[a]			1780 - 1820	25.6	0.04[b]		
Pond total				44.8	.07[b]	2.34[c]	0.09
Swamps							
23 swamp areas			750 - 1900	1184.0	1.85[b]	33.70[d]	2.45
TOWN OF MONTAGUE							
Ponds							
Sears Pond	43°44'31"	75°43'08"	1735	83.2	.13	3.51	
Unnamed pond	43°43'41"	75°46'25"	1682	19.2	.03	1.53	
Unnamed pond	43°44'47"	75°45'40"	1665	6.4	.01	.84	
Unnamed pond	43°46'04"	75°47'12"	1661	6.4	.01	.53	
5 unnamed ponds[a]			1660 - 1720	25.6	.04[b]		
Pond total				140.8	.22[b]	6.41[c]	.33
Swamps							
49 swamp areas			1600 - 1880	2220.8	3.47[b]	69.68[d]	5.31

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Lewis County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF OSCEOLA							
Ponds							
7 unnamed ponds[a]			1400 - 1740	25.6	0.04[b]		0.04
Swamps							
67 swamp areas			1200 - 1840	1420.8	2.22[b]	48.1[d]	2.55
TOWN OF PICKNEY							
Ponds							
9 unnamed ponds[a]			1300 - 1570	19.2	.03[b]		.07
Swamps							
53 swamp areas			1284 - 1590	1523.2	2.38[b]	49.8[d]	5.68
TOWN OF TURIN							
Ponds							
52 unnamed ponds[a]			750 - 2010	70.4	.11[b]		.35
Swamps							
18 swamp areas			750 - 1960	204.8	.32[b]	7.6[d]	1.02

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Lewis County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF WEST TURIN							
Ponds							
27 unnamed ponds[a]			950 - 1630	38.4	0.06[b]		0.14
Swamps							
19 swamp areas			750 - 1840	249.6	.39[b]	9.46[d]	.91

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

STREAMS

TOWN OF DENMARK

		Miles
Black River Drainage Basin		
Black River and unnamed tributaries		21.6
Deer River		27.6
Stony Creek		9.8
Negro Creek		9.1
	Total	68.1
Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		1.9
Stebbins Creek		1.5
	Total	3.4
Town of Denmark,	Total	71.5

TOWN OF HARRISBURG

Black River Drainage Basin		
Deer River and unnamed tributaries		20.8
Silver Brook		9.1
Cobb Creek		17.4
Mud Creek		14.7
Stoney Creek		4.5
Negro Creek		1.9
Mill Creek		6.8
Unnamed tributaries to Black River		10.8
Town of Harrisburg,	Total	86.0

TOWN OF HIGHMARKET

Black River Drainage Basin		
Whetstone Creek		6.1
Sugar River		
North Branch Sugar River		8.3
West Branch Sugar River		6.4
	Total	20.8
Oneida River Drainage Basin		
Fish Creek		
East Branch Fish Creek and unnamed tributaries		23.0
North Branch Fish Creek		4.5

TOWN OF HIGHMARKET (Continued)

	Miles
Seven Mile Creek	1.5
Six Mile Creek	.8
Roaring Brook	1.0
Direen Creek	3.0
Pringle Creek	13.3
Moore Meadow Stream	5.7
Alder Creek	23.9
Kelly Creek	2.6
Sucker Creek	16.3
Little Alder Creek	5.3
Total	100.9
Town of Highmarket, Total	121.7

TOWN OF LEWIS

Salmon River Drainage Basin	
Salmon River and unnamed tributaries	3.2
West Fork Salmon River	2.4
East Fork Salmon River	9.2
Total	14.8
Oneida River Drainage Basin	
Fish Creek	
East Branch, Fish Creek and unnamed tributaries	20.4
Alder Creek	.4
Mud Brook	5.7
Broad Brook	7.3
Beaver Meadow Brook	6.1
Heron Brook	3.3
Powlish Pond Brook	4.9
Searles Brook	2.7
Fall Brook	
Cody Brook	1.1
Florence Creek	5.4
Point Rock Creek	25.7
Pond Brook	3.0
Pigeon Brook	4.5
Total	90.5
Mohawk River Drainage Basin	
East Branch Mohawk River and unnamed tributaries	9.8
West Branch Mohawk River	
Egger Brook	.1
Lyman Brook	2.4
Total	12.3
Black River Drainage Basin	
Sugar River	
Moose Creek	2.7
Town of Lewis, Total	120.3

TOWN OF LEYDEN

		Miles
Black River Drainage Basin		
Black River and unnamed tributaries		27.3
Sugar River		24.2
White River		1.5
Olmstead Creek		3.0
Moose Creek		21.6
Stucky Creek		12.5
	Total	90.1
Mohawk River Drainage Basin		
East Branch Mohawk and unnamed tributaries		1.5
	Town of Leyden, Total	91.6

TOWN OF LOWVILLE

Black River Drainage Basin		
Black River and unnamed tributaries		55.3
Negro Creek		6.8
Mill Creek		32.9
Rainbow Creek		.2
	Town of Lowville, Total	95.2

TOWN OF MARTINSBURG

Black River Drainage Basin		
Black River and unnamed tributaries		36.4
Deer River		
Cobb Creek		4.5
Mud Creek		6.8
Mill Creek		24.9
Rainbow Creek		6.4
Roaring Brook		57.9
Atwater Creek		9.8
Whetstone Creek		10.9
House Creek		2.6
	Total	160.2
Oneida River Drainage Basin		
Fish Creek		
East Branch Fish Creek and tributaries		1.2
North Branch Fish Creek		8.3
	Total	9.5
	Town of Martinsburg, Total	169.7

Appendix 3. Lewis County continued.

TOWN OF MONTAGUE

		Miles
Black River Drainage Basin		
Deer River and unnamed tributaries		11.7
Silver Brook		6.4
Mud Creek		1.1
West Branch Deer River and tributaries		16.3
Perrigo Creek		5.7
East Branch Deer River		18.2
Edick Creek		11.6
Mulligan Creek		4.9
	Total	75.9
Salmon River Drainage Basin		
Mad River and unnamed tributaries		13.3
Slide Creek		3.0
Cold Brook		5.1
Twomile Creek		.8
Mill Stream		
Grindstone Creek		1.7
Mad River		
Hooker Brook		2.8
North Branch (Mad)		7.2
South Branch (Mad)		.4
	Total	34.3
Oneida River Drainage Basin		
Fish Creek		
East Branch, Fish Creek		1.1
Seven Mile Creek		5.3
Deep Creek		.7
	Total	7.1
	Town of Montague, Total	117.3

TOWN OF OSCEOLA

Salmon River Drainage Basin	
Salmon River	17.4
North Branch, Salmon River	
Mad River	
Cold Brook	1.9
North Branch Mad River	.5
South Branch Mad River	3.4
Lilly Pad Creek	.8
Mill Stream	8.7
Grindstone Creek	7.6
Stony Brook	8.3
Line Brook	3.8
Prince Brook	13.6
Mulligan Brook	3.4
Little Baker Brook	3.2
Baker Creek	3.8

Appendix 3. Lewis County continued.

TOWN OF OSCEOLA (Continued)

		Miles
Fall Creek		11.7
Crooked Brook		2.3
One Mile Creek		.6
Threemile Creek		3.0
Two Mile Creek		3.2
Malloy Brook		1.1
Cowles Creek		1.3
Smith Brook		6.2
Keese Brook		6.8
Finnegan Brook		7.2
Puhens Brook		1.5
West Fork Salmon River		9.5
East Fork Salmon River		6.4
	Total	137.2
Oneida River Drainage Basin		
Fish Creek		
East Branch, Fish Creek		3.0
Seven Mile Creek		1.5
Deep Creek		1.1
Six Mile Creek		4.2
Roaring Brook		3.4
Dirreen Creek		1.1
Pringle Creek		.9
Broad Brook		3.2
Beaver Meadow Brook		3.1
	Total	21.5
	Town of Osceola, Total	158.7

TOWN OF PICKNEY

Sandy Creek Drainage Basin		
Sandy Creek and unnamed tributaries		13.0
Bear Gulf Stream		15.5
Gulf Stream		17.4
Denning Creek		5.7
Stebbins Creek		1.1
Fish Creek		1.5
	Total	54.2
South Sandy Creek Drainage Basin		
Grunley Creek		8.3
Black River Drainage Basin		
Deer River and unnamed tributaries		13.6
	Town of Pickney, Total	76.1

Appendix 3. Lewis County continued.

		Miles
TOWN OF TURIN		
Black River Drainage System		
Black River and unnamed tributaries		34.1
Whetstone Creek		6.4
House Creek		22.3
Douglass Creek		16.7
Mill Creek		22.3
Town of Turin, Total		101.8
TOWN OF WEST TURIN		
Black River Drainage Basin		
Black River and unnamed tributaries		16.3
Mill Creek		1.0
Sugar River		15.4
White River		18.9
North Branch, Sugar River		7.2
West Branch, Sugar River		18.6
Olmstead Brook		19.7
	Total	97.1
Oneida River Drainage Basin		
Fish Creek		
East Branch, Fish Creek and tributaries		2.1
Point Rock Creek		7.9
	Total	10.0
Mohawk River Drainage Basin		
East Branch, Mohawk River and tributaries		3.2
Town of West Turin, Total		110.3
GRAND TOTAL Lewis County		1,320.2

Appendix 3. Lakes, ponds, swamps, and streams of the Tug Hill Region, Oneida County.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF ANNSVILLE							
Ponds							
Mack Pond	43°19'26"	75°40'04"	750	6.4	0.01	0.50	
Oneida City Reservoir	43°21'46"	75°37'07"	922	38.4	.06	3.56	
12 unnamed ponds[a]			480 - 1100	25.6	.04[b]		
Pond total				70.4	.11[b]	4.06[c]	0.18
Swamps							
33 swamp areas			440 - 1100	838.4	1.31[b]	27.40[d]	2.17
TOWN OF AVA							
Lakes							
Bullhead Lake	43°23'40"	75°32'10"	1060	12.8	.02	1.33	
6 unnamed ponds[a]			1140 - 1460	6.4	.01[b]		
Lake and pond total				19.2	.03[b]	1.33[c]	.07
Swamps							
31 swamp Areas			1100 - 1600	364.8	.57[b]	16.30[d]	1.51

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oneida County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF BOONVILLE							
Lakes							
Echo Lake	43°25'09"	75°15'56"	1302	102.4	0.16	3.63	
Kayuta Lake	43°25'14"	75°12'27"	1143	473.6	.74	13.13	
Unnamed pond	43°28'28"	75°14'14"	1085	12.8	.02	1.79	
36 unnamed ponds[a]			1080 - 1580	64.0	.10[b]		
Lake and pond total				652.8	1.02[b]	18.55[c]	1.40
Swamps							
39 swamp areas			950 - 1380	627.2	.98[b]	23.10[d]	1.35
TOWN OF CAMDEN							
Lakes							
Gifford Lake	43°23'48"	75°49'45"	535	19.2	.03	1.23	
Ponds							
Unnamed pond	43°21'22"	75°48'27"	620	6.4	.01	2.00	
36 unnamed ponds[a]			510 - 690	51.2	.08[b]		
Lake and pond total				57.6	.09[b]	2.00[c]	.33

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oneida County continued.

LAKES, PONDS, AND SWAMPS Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF CAMDEN (Continued)							
Swamps							
30 swamp areas			510 - 700	1152.0	1.80[b]	36.40[d]	4.98
TOWN OF FLORENCE							
Ponds							
Unnamed pond	43°26'10"	75°48'17"	978	12.8	.02	1.24	
Unnamed pond	43°23'48"	75°41'17"	995	12.8	.02	1.26	
Unnamed pond	43°25'32"	75°45'59"	830	6.4	.01	.94	
Unnamed pond	43°28'45"	75°48'00"	884	6.4	.01	.51	
13 unnamed ponds[a]			790 - 1080	19.2	.03[b]		
Pond total				57.6	.09[b]	3.95[c]	.22
Swamps							
40 swamp areas			700 - 1280	1030.4	1.61	26.70[d]	3.95
TOWN OF FLOYD							
Ponds							
11 unnamed ponds[a]			540 - 1100	12.8	.02[b]		.05

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oneida County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF FLOYD (Continued)							
Swamps							
21 swamp areas			430 - 1200	294.4	0.46[b]	9.20[d]	1.31
TOWN OF LEE							
Ponds							
Rome Reservoir	43°18'03"	75°28'56"	675	12.8	0.02	1.28	
Unnamed pond	43°17'40"	75°34'39"	585	6.4	.01	.54	
17 unnamed ponds[a]			480 - 1120	25.6	.04[b]		
Pond total				44.8	.07[b]	1.82[c]	.15
Swamps							
34 swamp areas			480 - 1060	1216.0	1.90[b]	37.87[d]	4.27
TOWN OF STEUBEN							
Ponds							
8 unnamed ponds[a]			900 - 1520	12.8	.02[b]		.04
Swamps							
36 swamp areas			820 - 1680	569.6	.89[b]	24.80[d]	2.09

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oneida County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF TRENTON							
Ponds							
6 unnamed ponds[a]			740 - 980	12.8	0.02[b]		0.04
Swamps							
13 swamp areas			640 - 1020	128.0	.20[b]	6.60[d]	.46
TOWN OF VIENNA							
Ponds							
Gorton Pond	43°17'19"	75°50'40"	595	25.6	.04	2.13	
Starkweather Pond	43°17'02"	75°45'11"	475	6.4	.01	1.30	
Unnamed pond	43°13'13"	75°38'35"	370	12.8	.02	.87	
Unnamed pond	43°13'33"	75°40'48"	370	19.2	.03	1.14	
Unnamed pond	43°13'53"	75°40'07"	370	6.4	.01	.53	
46 unnamed ponds[a]			370 - 610	89.6	.14[b]		
Pond total				160.0	.25[b]	5.97[c]	.26
Lakes							
Oneida Lake	43°14'20"	76°08'30"	369	22694.4	35.46[k]	9.65[L]	37.86
Swamps							
43 swamp areas			370 - 600	2419.2	3.78[b]	56.80[d]	4.03

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.
[k] Area of that portion of Oneida Lake in the Town of Vienna.
[L] Northern Shoreline of Oneida Lake in the Town of Vienna.

Appendix 3. Oneida County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF WESTERN							
Ponds							
Delta Reservoir	43°16'30"	75°25'44"	542	2483.2	3.88	19.14	
5 unnamed ponds[a]			842 - 1220	6.4	.01[b]	--	
Pond total				2489.6	3.89[b]	19.14[c]	7.11
Swamps							
8 swamp areas			551 - 1300	108.8	.17[b]	4.54[d]	.31

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

TOWN OF ANNSVILLE

	Miles
Oneida River Drainage Basin	
Fish Creek and unnamed tributaries	6.8[a]
East Branch, Fish Creek and unnamed tributaries	28.8[b]
Fall Brook	5.5
Cody Brook	6.8
Sullivan Brook	3.4
Finn Brook	3.2
Hennesey Brook	1.6
Mack Brook	2.7
Sash Factory Creek	1.9
Florence Creek	22.3
Christian Brook	4.9
By Brook	4.5
Furnace Creek	25.7
West Branch, Fish Creek	15.9[c]
Cold Brook	10.6
Town of Annsville, Total	144.6

TOWN OF AVA

Oneida River Drainage Basin		
Fish Creek		
East Branch, Fish Creek		3.6[d]
Point Rock Creek		7.4
	Total	11.0
Black River Drainage Basin		
Mill Creek		2.3
Sugar River		
Moose Creek		7.6
	Total	9.9
Mohawk River Drainage Basin		
Mohawk River		
Blue Brook		2.3
Flint Brook		2.3
East Branch, Mohawk River		6.6
Wood Creek		9.5
Haynes Brook		1.1
Turtle Lot Brook		2.3

[a] Includes 1.3 miles of common border with Vienna.
[b] Includes 3.6 miles of common border with Ava; 2.8 miles of common border with Lee.
[c] Includes 6.4 miles of common border with Vienna.
[d] Common Border with Annsville.

TOWN OF AVA (Continued)

		Miles
Mohawk River Drainage Basin		
Lansing Kill		.8
Cluse Brook		2.8
Dunn Brook		2.0
Clark Brook		5.1
West Branch, Mohawk River		
Ava Brook		3.9
Egger Brook		3.2
Lyman Brook		3.6
Harger Creek		5.8
	Total	51.3
Town of Ava,	Total	72.2[a]

TOWN OF BOONVILLE

Black River Drainage Basin		
Black River and unnamed tributaries		22.7
Alder Creek		10.2
Cold Brook		2.7
Crystal Creek		2.8
Cummings Creek		4.0
North Branch, Cummings Creek		3.9
Long Lake Outlet		1.5
Mile Creek		11.2
Cropsey Creek		1.2
Mill Creek		14.0
Sugar River		3.0
Moose Creek		5.8
West Kent Creek		11.4
East Kent Creek		7.0
Streams tributary to the Black River Canal		7.9
	Total	109.3
Mohawk River Drainage Basin		
Mohawk River		
Lansing Kill and unnamed tributaries		19.7
Clark Brook		.7
Tributaries to the Black River Canal		2.7
Stringer Brook		1.0
	Total	24.1
Town of Boonville,	Total	133.4

TOWN OF CAMDEN

Oneida River Drainage Basin		
Fish Creek		
West Branch, Fish Creek		31.1[b]
Little River		17.0
Pierce Brook		4.5

[a] Includes Fish Creek; 68.6 miles without Fish Creek.
[b] Includes 0.8 miles common border with Vienna.

TOWN OF CAMDEN (Continued)

		Miles
Oneida River Drainage Basin (Continued)		
Trout Brook		1.9
West Branch, Little River		11.4
Wetmore Brook		4.5
Bullhead Brook		.6
Cobb Brook		9.6
Emmons Brook		5.5
Mad River		8.3
Thompsons Branch		2.8
Hyatt Branch		4.7
	Town of Camden, Total	91.7

TOWN OF FLORENCE

Oneida River Drainage Basin		
Fish Creek		
East Branch Fish Creek		
Florence Creek		7.4
Big Brook		4.6
Furnace Creek		6.8
Fall Creek		
Cody Brook		.4
	Total	19.2
West Branch, Fish Creek		
Cobb Brook		9.6
Emmons Brook		1.3
Mad River		27.3
Wickwing Brook		2.7
Finnegan Brook		4.7
Spellicy Brook		3.2
Perry Brook		1.9
Little River		5.5
Smith Brook		4.9
Maloney Brook		2.4
Unnamed tributaries to West Branch, Fish Creek		15.5
	Total	79.0
	Town of Florence, Total	98.2

TOWN OF FLOYD

Mohawk River Drainage Basin		
Mohawk River		3.8
Hurlbut Glen Brook		3.6
Nine Mile Creek		13.6
Dry Creek		7.6
Great Gulf Creek		3.8
Willow Creek		5.1
Six Mile Creek (via Erie Canal)		3.8
Slate Creek		14.8
Nutt Creek		3.6
West Canada Creek		
Cincinnati Creek		
Steuben Creek		6.8
	Total	66.5

TOWN OF FLOYD (Continued)

		Miles
Erie Canal		2.7
	Town of Floyd, Total	69.2

TOWN OF LEE

Oneida River Drainage Basin		
Fish Creek		
East Branch, Fish Creek		4.1[a]
Point Rock Creek		1.1
Sash Factory Creek		8.4
Wood Creek		2.3
Canada Creek		40.5
Burk Creek		15.2
Beaver Creek		.4
	Total	72.0
Mohawk River Drainage Basin		
Mohawk River and unnamed tributaries		3.8
East Branch, Mohawk River		1.5
Wood Creek		.2
West Branch, Mohawk River		7.9
Ava Brook		1.1
Lyman Brook		1.3
Egger Brook		1.7
Spring Brook		2.3
Potash Creek		7.9
Big Gulf		1.7
	Total	29.4
	Town of Lee, Total	101.4

TOWN OF STEUBEN

Black River Drainage Basin		
Black River		
Alder Creek		1.5
Mohawk River Drainage Basin		
Mohawk River		
Strenger Brook		9.5
Bunt Brook		1.7
Wells Creek		
Big Brook		16.3
Beaver Meadow Brook		10.6
West Canada Creek		
Cincinnati Creek		24.6
Steuben Creek		25.8
Shepards Brook		1.3
	Total	89.8
	Steuben, Total	91.3

[a]Includes 2.8 miles of common border with Annsville.

TOWN OF TRENTON

	Miles
Mohawk River Drainage Basin	
Mohawk River	
Morgans Trout Brook	1.7
Nine Mile Creek	29.9
Beaver Creek	14.5
Vaughn Brook	1.5
Wallow Creek	2.8
Feeder Canal	1.3
West Canada Creek	9.7
Cincinnati Creek	11.9
Steuben Creek	6.6
Shepards Brook	2.3
Drumlin Brook	.8
Feeder Canal	4.2
Cady Brook	5.8
Town of Trenton, Total	93.0

TOWN OF VIENNA

Oneida River Drainage Basin	
Fish Creek and unnamed tributaries	22.5[a]
West Branch, Fish Creek and unnamed tributaries	14.9[b]
Little River	7.6[c]
Fields Brook	3.0
West Branch, Little River	
Bullhead Brook	1.7
South Branch, Little River	8.7
Gorton Brook	2.3
Brockway Brook	2.8
Mill Stream	3.4
Wood Creek and unnamed tributaries	8.7
Murry Brook (lake)	5.5
Hall Brook (lake)	9.2
Cold Spring Brook (lake)	3.2
Unnamed tributaries to the Oneida Lake	9.1
Total	102.6
Erie Canal	1.5
Town of Vienna, Total	104.1

TOWN OF WESTERN

Mohawk River Drainage Basin	
Mohawk River and unnamed tributaries	37.7
Blue Brook	1.3
Flint Brook	1.1
Dean's Gulf	3.9
Haynes Brook	5.1
Turtle Lot Brook	1.5

[a] Includes 1.3 miles of common border with Annsville.
[b] Includes 6.4 miles of common border with Annsville; 0.8 miles of common border with Camden.
[c] Includes 2.0 miles of common border with Camden.

TOWN OF WESTERN (Continued)

		Miles
Mohawk River Drainage Basin (Continued)		
Lansing Kill		7.0
Chase Brook		2.4
Dunn Brook		0.8
McMullen Brook		4.2
Potash Creek		3.2
Big Gulf		0.9
Spinks Brook		1.9
Stringer Brook		6.6
Cyprus Brook		5.1
Bunt Brook		.9
Tannery Brook		4.3
Wells Creek		0.8
Gifford Creek		4.5
Big Brook		6.8
Gulf Creek		3.6
Beaver Meadow Brook		3.4
West Branch, Mohawk River		
Spring Brook		.2
	Total	107.2
Oneida River Drainage Basin		
Wood Creek		
Canada Creek		
Burk Creek		.4
	Town of Western, Total	107.6
	GRAND TOTAL Oneida County	1,178.7

Appendix 3. Lakes, ponds, swamps, and streams of the Tug Hill Region, Oswego County.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF ALBION							
Ponds							
Mosher Pond	43°28'05"	76°00'33"	583	57.6	0.09	1.50	
Round Pond	43°28'35"	75°57'35"	665	6.4	.01	.40	
Bud Lee Pond	43°29'51"	75°58'55"	605	6.4	.01	1.21	
Unnamed pond	43°32'06"	76°01'43"	534	19.2	.03	1.07	
Unnamed pond	43°28'35"	75°58'32"	645	19.2	.03	1.23	
Unnamed pond	43°31'50"	76°01'43"	544	12.8	.02	.53	
Unnamed pond	43°30'19"	75°57'26"	650	25.6	.04	2.67	
11 unnamed ponds [a]			425 - 656	134.4	.21[b]		
Pond total				281.6	.44[b]	8.61[c]	0.92
Swamps							
27 swamp areas			420 - 700	2649.6	4.14[b]	62.66[d]	8.67
TOWN OF AMBOY							
Ponds							
Carterville Pond	43°20'19"	75°53'36"	562	57.6	.09	3.85	
Chase Pond	43°21'00"	75°59'06"	563	64.0	.10	2.09	
Coan Pond	43°24'21"	75°58'13"	612	57.6	.09	1.60	

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF AMBOY (Continued)							
Ponds							
Hotel Pond	43°22'26"	75°56'48"	618	25.6	0.04	1.05	
North Pond	43°21'59"	75°59'33"	575	217.6	.34	2.80	
South Pond	43°21'19"	75°59'55"	561	76.8	.12	1.36	
14 unnamed ponds[a]			540 - 770	32.0	.05[b]		
Pond total				531.2	.83[b]	12.75[c]	2.18
Swamps							
53 swamp areas			530 - 710	2739.2	4.28[b]	70.06[d]	11.26
TOWN OF BOYLSTON							
Ponds							
44 unnamed ponds[a]			1020 - 1380	12.8	.02[b]		.05
Swamps							
Tamrack Swamp	43°37'30"	75°56'00"	1230	320.0	.50[b]	4.50	
20 swamp areas			880 - 1380	422.4	.66[b]	18.00	
Swamp total				742.4	1.16[b]	22.50[d]	2.97

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF CONSTANTIA							
Ponds							
Cody Pond	43°19'00"	75°52'48"	606	44.8	0.07	2.43	
Dutcher Pond	43°17'36"	75°57'43"	489	12.8	.07	1.81	
Francis Pond	43°17'16"	75°56'28"	520	51.2	.08	2.57	
41 unnamed ponds[a]			390 - 620	76.8	.12[b]		
Pond total				185.6	.34	6.81[c]	0.34
Lakes							
Kibbie Lake	43°16'05"	75°57'58"	471	19.2	.03	.87	
Panther Lake	43°19'33"	75°54'03"	600	121.6	.19	2.98	
Vanderkamp Lake	43°15'30"	75°54'40"	466	44.8	.07	1.33	
Oneida Lake	43°14'20"	76°08'30"	369	25250.0	39.46[i]	10.79[j]	
Lake total				25435.6	39.75	15.97	40.65
Swamps							
Toad Harbor Swamp	43°15'00"	76°03'30"	370	889.6	1.39[b]	6.10	
44 swamp areas			370 - 610	3212.8	5.02[b]	64.10	
Swamp total				4102.4	6.41[b]	70.10[d]	6.55

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.
[i] Area of that portion of Oneida Lake in the Town of Constantia.
[j] Northern Shoreline of Oneida Lake in the Town of Constantia.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF HASTINGS							
Ponds							
Unnamed pond	43°22'39"	76°07'09"	431	06.4	0.01	0.60	
Unnamed pond	43°19'38"	76°07'19"	410	12.8	.02[b]	1.28	
13 unnamed ponds[a]			400 - 470	12.8	.02[b]		
Pond total				32.0	.05	1.88	0.10
Lakes							
Oneida Lake	43°14'20"	76°08'30"	369	57.6	.09[e]	.57[f]	.19
Swamps							
27 swamp areas			370 - 480	2809.6	4.39[b]	55.10[d]	9.63
TOWN OF ORWELL							
Ponds							
Jackson Pond	43°34'41"	75°54'19"	1145	6.4	.01	.69	
Lower Salmon River Reservoir	43°31'26"	75°57'34"	651	166.4	.26	4.50	
Lower Reservoir	43°31'26"	75°57'54"	651	153.6	.24	4.10	
Salmon River Reservoir	43°32'39"	75°55'10"	937	3379.2	5.28	30.60	

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.
[e] Area of that portion of Oneida Lake within the Town of Hastings.
[f] Northern Shoreline of Oneida Lake within the Town of Hastings.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF ORWELL (Continued)							
Ponds							
Gowdy Pond	43°32'22"	75°59'09"	585	19.2	0.03	1.14	
Unnamed pond	43°31'52"	75°58'16"	650	44.8	.07	2.29	
Unnamed pond	43°30'43"	75°56'16"	718	12.2	.02	.84	
Unnamed pond	43°34'46"	75°56'14"	1125	12.2	.02	.84	
Unnamed pond	43°35'50"	75°55'21"	1195	19.6	.03	1.22	
9 unnamed ponds[a]			610 - 1150	38.4	.06[b]		
Pond total				3852.8	6.02	46.22	14.67
Swamps							
23 swamp areas			560 - 1220	742.4	1.16[b]	24.80[d]	2.82
TOWN OF PARISH							
Ponds							
Fritz Pond	43°24'01"	76°01'52"	532	25.6	.04	.89	
St. Mary's Pond	43°25'19"	76°02'05"	542	19.2	.03	.96	
Whitney Pond	43°25'38"	75°59'38"	601	76.8	.12	2.89	
20 unnamed ponds[a]			430 - 570	38.4	.06[b]		
Pond total				160.0	.25[b]	4.74[c]	.60

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF PARISH (Continued)							
Swamps							
Kipp Swamp	43°27'00"	76°06'30"	520	102.4	0.16[b]	2.30	
Steward Swamp	43°27'30"	76°05'30"	510	243.2	.38[b]	4.90	
36 swamp areas			470 - 610	2124.8	3.32[b]	59.50	
Swamp total				2470.4	3.86[b]	66.70[d]	
TOWN OF REDFIELD							
Ponds							
Alder Bed Pond	43°39'40"	75°47'01"	1620	12.8	.02	.84	
Castor Pond	43°35'27"	75°50'54"	1050	57.6	.09	.99	
Unnamed pond	43°39'38"	75°51'55"	1405	6.4	.01	.76	
Unnamed pond	43°40'30"	75°46'30"	1630	12.8	.02	1.10	
Unnamed pond	43°35'12"	75°52'10"	1150	19.2	.03	1.22	
Unnamed pond	43°35'45"	75°52'13"	1130	25.6	.04	1.60	
48 unnamed ponds[a]			1100 - 1630	44.8	.07[b]		
Pond total				179.2	.28[b]	6.51[c]	0.30
Swamps							
98 swamp areas			940 - 1640	2816.0	4.40[b]	77.20[d]	4.72

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF RICHLAND							
Ponds							
Grindstone Reservoir	43°29'30"	76°09'00"	350	12.8	0.02	1.10	
Spring Brook Reservoir	43°34'00"	76°07'00"	390	12.8	.02	1.10	
Unnamed Pond	43°34'22"	76°12'10"	246	153.6	.24	3.80	
73 unnamed ponds[a]			240 - 400	32.0	.05[b]		
Pond total				211.2	.33[b]	6.00[c]	0.55
Swamps							
Deer Creek Marsh	43°35'30"	76°11'30"	246	1088.0	1.70[b]	11.00	
25 swamp areas			246 - 510	595.2	.93[b]	17.40[d]	4.41
Swamp total				1683.2	2.63[b]	28.40[d]	
TOWN OF SANDY CREEK							
Ponds							
North Pond	43°39'11"	76°11'39"	246	2400.0	3.75	13.43	
South Pond	43°37'52"	76°11'33"	246	300.0	.47	4.43	
Unnamed pond	43°37'17"	76°10'22"	246	6.4	.01	.61	
22 unnamed ponds[a]			260 - 800	19.2	.03[b]		

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF SANDY CREEK (Continued)							
Pond total				2726.4	4.26[b]	18.47[c]	8.92
Swamps							
Deer Creek Marsh	43°37'00"	76°11'30"	250	25.6	.04[b]	1.20	
21 swamp areas			250 - 800	179.2	.28	4.20	
Swamp total				204.8	.32[b]	5.40[d]	.67
TOWN OF WEST MONROE							
Ponds							
19 unnamed ponds[a]			430 - 500	19.2	0.03[b]		.07
Lakes							
Oneida Lake	43°14'20"	76°08'30"	369	2937.6	4.59[g]	7.20[h]	11.51
Swamps							
Big Bay Swamp	43°15'00"	76°07'00"	370	1657.6	2.59[b]	13.25	
Toad Harbor Swamp	43°15'00"	76°03'30"	370	1574.4	2.46[b]	9.84	
19 swamp areas			370 - 520	1644.8	2.57[b]	32.56	
Swamp total				4876.8	7.62[b]	55.65[d]	19.12

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.
[g] Area of Oneida Lake in the Town of West Monroe.
[h] Northern Shoreline of Oneida Lake in the Town of West Monroe.

Appendix 3. Oswego County continued.

LAKES, PONDS, AND SWAMPS

Name	North latitude	West longitude	Elevation in feet	Surface area		Shoreline in miles	Percent surface area
				Acres	Square miles		
TOWN OF WILLIAMSTOWN							
Lakes							
Bass Lake	43°29'12"	75°56'36"	645	12.8	0.02	0.90	
Kasoag Lake	43°28'04"	75°55'21"	619	57.6	.09	4.53	
Lake Lorraine	43°27'05"	75°57'42"	651	19.2	.03	.64	
Lake total				89.6	.14	6.07	0.35
Ponds							
Black Pond	43°28'28"	75°56'05"	635	38.4	.06	1.37	
Green Pond	43°28'35"	75°55'34"	615	44.8	.07	2.01	
Long Pond	43°25'58"	75°57'50"	648	76.8	.12	3.34	
Sisley Pond	43°28'55"	75°55'25"	645	6.4	.01	.93	
Sisley Pond (upper)	43°29'00"	75°55'47"	645	12.8	.02	.94	
Unnamed pond	43°27'39"	75°55'40"	615	6.4	.01	.87	
Unnamed pond	43°25'41"	75°52'54"	520	6.4	.01	.82	
21 unnamed ponds[a]			560 - 970	38.4	.06[b]		
Pond total				230.4	.36[b]	10.28[c]	.91
Swamps							
27 swamp areas			550 - 930	1328.6	2.09[b]	28.20[d]	5.34

[a] The unnamed ponds include the approximate total for all ponds less than 0.01 square miles in area.
[b] Approximate area.
[c] Total shoreline of all ponds 0.01 square miles or larger.
[d] Approximate shoreline of swamps.

Appendix 3. Oswego County continued.

		Miles
TOWN OF ALBION		
Grindstone Creek Drainage Basin		
Grindstone Creek		
North Branch, Grindstone Creek		14.4
South Branch, Grindstone Creek		9.3
Little Grindstone Creek		5.3
	Total	29.0
Salmon River Drainage Basin		
Salmon River and unnamed tributaries		18.0
Beaverdam Brook		5.5
Orwell Creek		3.8
Trout Brook		4.7
	Total	32.0
Little Salmon River Drainage Basin		
Little Salmon River		
North Branch, Little Salmon River		3.9
	Town of Albion, Total	64.9
TOWN OF AMBOY		
Oneida River Drainage Basin		
Fish Creek		
West Branch, Fish Creek and unnamed tributaries		6.6
Rowell Brook		2.4
Wells Brook		3.4
Little River		11.9
West Branch, Little River		.5
Scriba Creek (via Oneida Lake)		9.5
	Total	34.3
Little Salmon River Drainage Basin		
Little Salmon River		
North Branch, Little Salmon River		
Unnamed tributary		3.4
South Branch, Little Salmon River		7.7
	Total	11.1
	Town of Amboy, Total	45.4
TOWN OF BOYLSTON		
Salmon River Drainage Basin		
Trout Brook and unnamed tributaries		25.4
Orwell Brook and unnamed tributaries		4.5
North Branch, Salmon River		
Pine Creek		.8

		Miles
TOWN OF BOYLSTON (Continued)		
Salmon River Drainage Basin (Continued)		
Beech Creek		3.8
Cottrell Creek		
Unnamed tributaries		2.6
	Total	37.1
Little Sandy Creek Drainage Basin		
Little Sandy Creed and unnamed tributaries		22.7
Stinson Creek		8.6
	Total	31.3
Lindsey Creek Drainage Basin		
Lindsey Creek and unnamed tributaries		13.8
Skinner Creek Drainage Basin		
Skinner Creek		.8
South Sandy Creek Drainage Basin		
South Sandy Creek		
Raystone Creek		.2
	Town of Boylston, Total	83.2
TOWN OF CONSTANTIA		
Oneida River Drainage Basin		
Fish Creek		
West Branch, Fish Creek		
Little River		
West Branch, Little River		3.9
Scriba Creek		22.9
Potter Creek		.9
Crandall Creek		7.2
Spring Brook		7.0
Fredrich Creek		5.8
Threemile Creek		3.0
Dakin Creek		5.8
Lydiatt Creek		.9
Crandell Creek		2.8
Sulfer Spring Brook		1.5
Black Brook		14.0
Cold Spring Brook		.8
Unnamed tributaries to Oneida Lake		.8
	Town of Constantia, Total	77.1
TOWN OF HASTINGS		
Oneida River Drainage Basin		
Oneida River and unnamed tributaries		5.1
Caughdenoy Creek		9.5
Crippen Creek		6.6
Burton Creek		.2
Little Bay Creek (Lake)		8.1

		Miles
TOWN OF HASTINGS (Continued)		
Oneida River Drainage Basin (Continued)		
By Bay Creek (Lake)		2.7
Dykeman Creek		4.9
Shanty Creek		3.3
	Total	40.4
Little Salmon River Drainage Basin		
Little Salmon River		
South Branch, Little Salmon River		5.7
Catfish Creek		3.4
	Total	9.1
	Town of Hastings, Total	49.5
TOWN OF ORWELL		
Salmon River Drainage Basin		
Salmon River and unnamed tributaries		14.8
Beaverdam Brook		1.5
Pine Meadows Creek		2.8
Coey Creek		
Unnamed tributaries		2.3
Pennock Brook		8.7
Orwell Creek and unnamed tributaries		18.6
Perkin Brook and unnamed tributaries		14.9
Trout Brook and unnamed tributaries		15.3
	Town of Orwell, Total	78.9
TOWN OF PARISH		
Grindstone Creek Drainage Basin		
Grindstone Creek		
South Branch, Grindstone Creek		
Unnamed tributary		.8
Little Salmon River Drainage Basin		
Little Salmon River		
North Branch, Little Salmon River and unnamed tributaries		34.2
South Branch, Little Salmon River		16.7
	Total	50.9
Sage Creek Drainage Basin		
Sage Creek		
Unnamed tributary		2.8
Snake Creek Drainage Basin		
Snake Creek		
Unnamed tributary		.5
Oneida River Drainage Basin		
Scriba Creek (via Oneida Lake)		
Potter Creek		
Unnamed tributary		2.7
	Town of Parish, Total	57.7

TOWN OF REDFIELD		Miles
Salmon River Drainage Basin		
Salmon River and unnamed tributaries		19.7
Beaverdam Brook		1.0
Pine Meadows Creek		1.7
Fox Brook		2.5
Coey Creek		6.6
Kenney Brook		3.8
Prince Brook		1.0
Little Baker Brook		.4
Stoney Brook		4.9
Line Brook		.4
Muddy Brook and unnamed tributaries		6.6
North Branch, Salmon River and unnamed tributaries		32.0
Pine Creek		1.0
Beech Creek		.4
Cottrell Creek and unnamed tributaries		19.3
Mill Stream and unnamed tributaries		14.4
Grindstone Brook		3.2
Castor Brook		4.7
Mad River and unnamed tributaries		10.6
Cold Brook		12.3
Two Mile Creek		2.4
Rat Creek		2.6
Beaver Creek		11.0
McDougal Creek		1.5
Gillman Creek		4.3
West Brook		1.9
Willow Creek		1.9
River Brook		3.4
Slide Creek		15.5
North Branch		1.9
	Total	192.9
South Sandy Creek Drainage Basin		
South Sandy Creek		
Raystone Creek		2.6
Oneida River Drainage Basin		
Fish Creek		
West Branch, Fish Creek		
Mad River		3.2
Perry Brook		1.7
Spellicy Brook		.8
	Total	5.7
	Town of Redfield, Total	201.2

TOWN OF RICHLAND		Miles
Snake River Drainage Basin		
Snake River and unnamed tributaries		7.9
Grindstone Creek Drainage Basin		
Grindstone Creek and unnamed tributaries		10.1
Little Grindstone Creek and unnamed tributaries		16.6
North Branch, Grindstone Creek and unnamed tributaries		3.0
South Branch, Grindstone Creek and unnamed tributaries		3.6
	Total	33.3
Salmon River Drainage Basin		
Salmon River and unnamed tributaries		14.8
Mud Creek		2.3
Spring Brook and unnamed tributaries		8.3
Trout Brook and unnamed tributaries		3.8
	Total	29.2
Deer Creek Drainage Basin		
Deer Creek and unnamed tributaries		4.6
Little Deer Creek and unnamed tributaries		9.8
Alder Creek and unnamed tributaries		8.5
	Total	22.9
Unnamed tributaries to Lake Ontario		1.1
	Town of Richland, Total	94.4
TOWN OF SANDY CREEK		
Deer Creek Drainage Basin		
Deer Creek and unnamed tributaries		23.6
Little Deer Creek		1.5
	Total	25.1
Trout Brook Drainage Basin		
Trout Brook and unnamed tributaries		2.5
Little Sandy Creek Drainage Basin		
Little Sandy Creek and unnamed tributaries		33.7
Blind Creek Drainage Basin		
Blind Creek		7.2
Mud Creek Drainage Basin		
Mud Creek		4.9
Lindsey Creek Drainage Basin		
Lindsey Creek and unnamed tributaries		4.5
Skinner Creek Drainage Basin		
Skinner Creek		.8
Unnamed tributaries to Lake Ontario		2.3
	Town of Sandy Creek, Total	81.0

Appendix 3. Oswego County continued.

TOWN OF WEST MONROE		Miles
Little Salmon River Drainage Basin		
Little Salmon River		
South Branch, Little Salmon River		1.5
Oneida River Drainage Basin		
Scriba Creek		
Potter Creek		6.6
Threemile Creek		1.3
Slocum Creek		6.9
Big Bay Creek		16.3
Little Bay Creek		2.3
Unnamed tributaries to Oneida River		2.4
	Total	35.8
Town of West Monroe,	Total	37.3
TOWN OF WILLIAMSTOWN		
Oneida River Drainage Basin		
Fish Creek		
West Branch, Fish Creek		23.9
Gardner Creek		4.9
Indian Camp Brook		7.2
Mad River		3.0
Miller Creek		2.8
Poth Brook		1.9
Potter Creek		9.8
Rowell Brook		.4
	Total	53.9
Little Salmon River Drainage Basin		
Little Salmon River		
North Branch, Little Salmon River		3.6
Salmon River Drainage Basin		
Salmon River		
Beaverdam Brook		7.9
Pine Meadow Creek		.5
	Total	8.4
Town of Williamstown,	Total	65.9
GRAND TOTAL Oswego County		936.5

Appendix 3. Summary of streams by drainage basin, Tug Hill Region.

Lake Ontario Drainage Basin	Miles
Black River and unnamed tributaries	284.3
Alder Creek	11.7
Cold Brook	2.7
Crystal Creek	2.8
Cummings Creek	4.0
North Branch	3.9
Long Lake Outlet	1.5
Deer River and unnamed tributaries	73.7
Cobb Creek	21.9
Mud Creek	22.6
East Branch Deer River	18.2
Edick Creek	11.6
Mulligan Creek	4.9
Silver Brook	15.5
West Branch, Deer River	16.3
Perrigo Creek	5.7
(Deer River, Sub-total 190.4)	
Douglass Creek	16.7
Felts Mills Creek	5.5
House Creek	24.9
Mile Creek	11.2
Cropsey Creek	1.2
Mill Creek (Lewis County)	87.9
Mill Creek (Oneida County)	16.3
Negro Creek	17.8
Rainbow Creek	6.6
Roaring Brook	57.9
Atwater Creek	9.8
Rutland Hollow Creek	4.9
Stoney Creek	14.3
Sugar River and unnamed tributaries	42.6
Moose Creek	37.7
North Branch, Sugar River	15.5
Olmstead Brook	22.7
Stucky Creek	12.5
West Branch, Sugar River	25.0
White River	20.4
(Sugar River, Sub-total 176.4)	
West Kent Creek	11.4
East Kent Creek	7.0
Whetstone Creek	23.4
White Creek	1.9
Huddle Creek	11.4
Mill Creek	10.2
Tributaries to the Black River Canal	7.9
Total	1025.9

Appendix 3. Summary continued.

Lake Ontario Drainage Basin (Continued)

Blind Creek	Total	7.2
Deer Creek and unnamed tributaries		28.2
Little Deer Creek		11.3
Alder Creek		8.5
	Total	48.0
Grindstone Creek and unnamed tributaries		10.1
Little Grindstone Creek		21.9
North Branch, Grindstone Creek		17.4
South Branch, Grindstone Creek		13.7
	Total	63.1
Lindsey Creek	Total	18.3
Little Salmon River		
North Branch, Little Salmon River		45.1
South Branch, Little Salmon River		31.6
Catfish Creek		3.4
	Total	80.1
Little Sandy Creek		56.4
Stinson Creek		8.6
	Total	65.0
Mill Creek	Total	22.3
Mud Creek	Total	4.9
Oneida River (Including Oneida Lake)		26.0
Black Brook		14.0
Big Bay Creek		19.0
Dykeman Creek		4.9
Shanty Creek		3.3
Burton Creek		0.2
Caughdenoy Creek		9.5
Crippen Creek		6.6
Cold Spring Brook		4.0
Crandell Creek		2.8
Dakin Creek		5.8
Erie Canal		4.2
Fish Creek and unnamed tributaries		28.0
East Branch, Fish Creek and unnamed tributaries		80.9
Alder Creek		24.3
Kelly Creek		2.6
Sucker Creek		16.3
Little Alder Creek		5.3
Beaver Meadow Brook		9.2
Broad Brook		10.5
Dirreen Creek		4.1

Appendix 3. Summary continued.

Oneida River (Continued)	
Fall Brook	5.5
Cody Brook	8.3
Hennesy Brook	1.6
Mack Brook	2.7
Sullivan Brook	3.4
Finn Brook	3.2
Florence Creek	35.1
Big Brook	9.1
Christian Brook	4.9
Furnace Creek	32.5
Heron Brook	3.3
Mud Brook	5.7
Pidgeon Brook	4.5
Point Rock Creek	42.1
Pond Brook	3.0
Powlish Pond Brook	4.9
Searles Brook	2.7
Pringle Creek	14.2
Moore Meadow Stream	5.7
Roaring Brook	4.4
Sash Factory Creek	10.3
Sevenmile Creek	8.3
Deep Creek	1.8
Sixmile Creek	5.0
North Branch, Fish Creek	12.8
(East Branch, Fish Creek, Sub-Total 388.2)	
Mill Stream	3.4
West Branch, Fish Creek and unnamed tributaries	100.7
Cold Brook	10.6
Cobb Brook	19.2
Emmons Brook	6.8
Gardner Creek	4.9
Hyatt Branch	4.7
Indian Camp Creek	7.2
Little River and unnamed tributaries	40.0
Fields Brook	3.0
Maloney Brook	2.4
Pierce Brook	4.5
Smith Brook	4.9
South Branch, Little River	8.7
Brockway Brook	2.8
Gorton Brook	2.3
Trout Brook	1.9
West Branch, Little River	15.8
Bullhead Brook	2.3
Wetmore Brook	4.5
Mad River and unnamed tributaries	41.8
Finnegan Brook	4.7
Perry Brook	3.6
Spellicy Brook	4.0
Wickwire Brook	2.7
Miller Creek	2.8
Poth Brook	1.9

Oneida River (Continued)

West Branch, Fish Creek (Continued)		
Potter Creek		1.9
Rowell Brook		9.8
Thompson Branch		2.8
Wells Brook		3.4
(West Branch, Fish Creek, Sub-total 326.6)		
(Fish Creek, Sub-total 746.2)		
Hall Brook		9.2
Little Bay Creek		10.4
Lydiatt Creek		0.9
Murray Brook		5.5
Scriba Creek		32.4
Crandall Creek		7.2
Frederick Creek		5.8
Potter Creek		10.2
Spring Brook		7.0
Slocum Creek		6.9
Sulfur Spring Brook		1.5
Threemile Creek		4.3
Wood Creek		11.0
Canada Creek		40.5
Beaver Creek		0.4
Burk Creek		15.6
Unnamed tributaries to Oneida Lake		12.3
	Total	1027.6
Sage Creek	Total	2.8
Salmon River and unnamed tributaries		87.9
Baker Creek		3.8
Beaver Dam Brook		15.9
Pine Meadow Creek		5.0
Cocy Creek		8.9
East Fork, Salmon River		15.6
Fall Creek		11.7
Crooked Brook		2.3
One Mile Creek		0.6
Threemile Creek		3.0
Twomile Creek		3.2
Fox Brook		2.5
Kenney Brook		3.8
Malloy Brook		1.1
Cowles Creek		1.3
Finnegan Brook		7.2
Smith Brook		6.2
Keese Brook		6.8
Mud Creek		2.3
Muddy Brook		6.6
North Branch, Salmon River		32.0
Beetle Creek		4.2
Cottrell Creek		21.9

Salmon River (Continued)

Mad River and unnamed tributaries		35.5
Beaver Creek		11.0
Gillman Creek		4.3
West Brook		1.9
Willow Brook		1.9
McDougal Creek		1.5
Cold Brook		19.3
Hooker Brook		2.8
North Branch, Mad River		7.7
Rat Creek		2.6
River Brook		3.4
Slide Creek		18.5
North Branch		1.9
South Branch, Mad River		3.8
Lilypad Creek		0.8
Two-mile Creek		3.2
Mill Stream		23.1
Castor Brook		4.7
Grindstone Brook		12.5
Pine Creek		1.8
Orwell Brook		26.9
Perkin Brook		14.9
Pennock Brook		8.7
Pickens Brook		1.5
Prince Brook		14.6
Little Baker Brook		3.6
Mulligan Brook		3.4
Spring Brook		8.3
Stony Brook		13.2
Line Brook		4.2
Trout Brook (Orwell)		20.0
Trout Brook (Richland)		29.2
West Fork, Salmon River		11.9
	Total	576.4
Sandy Creek and unnamed tributaries		94.1
Bear Gulf Stream		15.5
Boynton Creek		6.3
Fish Creek		25.4
Freeman Creek		9.6
Gulf Creek		29.1
Denning Creek		5.7
Jacobs Creek		16.0
Staplin Creek		13.0
Stebbens Creek		15.4
	Total	230.1
Skinner Creek	Total	12.6

Appendix 3. Summary continued.

Snake River	Total	8.4
South Sandy Creek and unnamed tributaries		41.4
Abyah Creek		20.8
Bear Creek		7.9
Clora Creek		2.4
Fox Creek		52.5
Grunley Creek		27.0
Pigeon Creek		2.7
Raystone Creek		19.1
	Total	173.8
Stoney Creek	Total	29.8
Trout Brook	Total	2.5
Unnamed tributaries to Lake Ontario	Total	3.4

(Lake Ontario Drainage, Total 3402.2)

Hudson River Drainage Basin

Mohawk River and unnamed tributaries	45.3
Blue Brook	3.3
Flint Brook	3.4
Deans Gulf	3.9
East Branch, Mohawk River	22.6
Wood Creek	9.7
Haynes Brook	6.2
Turtle Lot Brook	3.8
Hurlbut Glen Brook	3.6
Lansing Kill and unnamed tributaries	27.5
Clark Brook	5.8
Chase Brook	5.2
Dunn Brook	2.8
Tributary to Black River Canal	2.7
McMullen Brook	4.2
Morgans Trout Brook	1.7
Ninemile Creek	43.5
Beaver Creek	14.5
Dry Creek	7.6
Feeder Canal	1.3
Great Gulf Creek	3.8
Vaughn Brook	1.5
Willow Creek	7.9
Potash Creek	11.1
Big Gulf	2.6
Sixmile Creek	3.8
Slate Creek	14.8
Nutt Creek	3.6
Spinks Brook	1.9
Stringer Brook	17.1
Bunt Brook	2.6
Cypress Brook	5.1

Hudson River Drainage Basin (Continued)

Mohawk River (Continued)	
Tannery Brook	4.3
Wells Creek	0.8
Big Brook	23.1
Beaver Meadow Brook	14.0
Gulf Creek	3.6
Gifford Creek	4.5
West Branch, Mohawk River	7.9
Ava Brook	5.0
Egger Brook	5.0
Lyman Brook	6.3
Harger Creek	5.8
Spring Brook	2.5
West Canada Creek	9.7
Cincinnati Creek	36.5
Cady Brook	5.8
Feeder Canal	4.2
Steuben Creek	39.2
Drumlin Brook	0.8
Shepards Brook	3.6
Total	477.0

All streams, Tug Hill Region, Total 3879.2

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Equisetaceae--Horsetail family									
Equisetum arvense L. Common horsetail--low swampy woods, roadsides, moist gorge slopes			X	X			X	X	
Equisetum fluviatile L. forma linnaeanum (Doll) Broun Water horsetail--wet roadsides, pond margins, cedar swamps					X		X	X	X
Equisetum hymenale L. var affine (Engelm.) A. A. Eat Scouring rush--shaded or open banks		X	X				X		
Equisetum scirpoides Michx. Dwarf scouring rush--woods, thickets, mossy knolls, springy banks		X	X	X	X				
Equisetum sylvaticum L. var. pauciramosum Milde Wood horsetail--open to partially wooded swamps, pastures, ditches				X	X	X	X		
Equisetum variegatum Schleich. Variegated horsetail--damp calcareous shores, marly bogs, dunes					X		X		
Lycopodiaceae--Club-moss family									
Lycopodium annotinum L. var. acrifolium Fern. Sharp-leaved clubmoss--dry woods, roadsides, old fields		X	X				X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Lycopodium clavatum L. Common club moss--dry woods, roadsides, forests, old fields		X	X				X		
Lycopodium clavatum L. var. megastachyon Fern. Bissell Large spiked common club moss--sand lands		X					X		
Lycopodium complanatum L. var. flabelliforme Fern. Fan shaped running ground pine--woods, thickets and clearings		X	X				X		
Lycopodium inundatum L. Bog club moss--bogs					X				
Lycopodium lucidulum Michx. Shining club moss--woods			X						
Lycopodium obscurum L. var. dendroideum (Michx.) D. C. Eat. Tree club moss--woods, clearings		X	X				X		
Lycopodium obscurum L. var. obscurum Tree club moss--woods, clearings		X	X				X		
Lycopodium tristachyum Pursh. Ground cedar--openings, dry, thickets		X					X		
Lycopodium tristachyum Pursh. X Lycopodium complanatum L. Hybrid--thickets, dry old fields		X					X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Selaginellaceae--Spike moss family									
Selaginella rupestris (L.) Spring Spikemoss--sand, dry rocks							X		
Ophioglossaceae--Adder's-tongue family									
Botrychium dissectum Spreng. forma obliquum (Muhl.) Fern. Oblique grapefern--dry grassy pastures, coniferous woods, wet meadows		X	X		X	X	X	X	
Botrychium matricariaefolium A. Br. Grape fern--dry and open woods		X	X						
Botrychium simplex E. Hitchc. var. angustisegmentum Pease and Moore Lance-leaved grape fern--deciduous woods and openings		X	X				X		
Botrychium simplex E. Hitchc. var. simplex Grape fern--meadows, pastures						X	X		
Botrychium simplex E. Hitchc. var. tenebrosum (A. A. Eat.) Clausen Grape fern--damp woods				X					
Botrychium virginianum (L.) Sw. Rattlesnake fern--rich deciduous woods, calcarious areas			X						
Ophioglossum vulgatum L. Common adder's tongue--marsh meadows, pastures, fields					X	X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Osmundaceae--Flowering fern family									
Osmunda regalis L. Royal fern--swamps, wet woods				X	X				
Osmunda claytoniana L. Interrupted fern--moist woods and thickets				X	X				
Osmunda cinnamomea L. Cinnamon Fern--swamps, low woods, thickets			X	X	X				
Schizaeaceae--Curly-grass family									
Lygodium palmatum (Bernh.) Sw. Climbing fern--thickets, marshes, open woods		X			X				
Polypodiaceae--Fern family									
Adiantum pedatum L. Maiden hair fern--low woods, wooded gorge banks, lower altitudes		X	X						
Aspelnium viride huds. Green spleenwort--moist shale, calcareous rock		X					X		
Asplenium trichomanes L. Maidenhair spleenwort--shaded, calcareous rock crevices							X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Athyrium filix-femina (L.) Roth var. Michauxii (Spreng.) Farw. Lady fern--damp thickets, meadows and swamps		X			X		X	X	
Athyrium pynocarpon (Spreng.) Tidestr. Glade-fern--rich wooded slopes, ravines, bottoms		X	X	X					
Athyrium thelypterioides (Michx.) Desv. Silvery spleenwort--rich woods, bottom lands and shaded slopes		X	X	X					
Cryptogramma stelleri (Gmel.) Prantl. Rock brake--cool and shaded calcareous rocks or springy slopes		X	X		X				
Cystopteris bulbifera (L.) Bernh. Bulblet-Fern--shaded ravines, rocky calcareous slopes and steep banks		X	X				X		
Cystopteris fragilis (L.) Bernh. Fragile fern--damp rocks, rocky slopes, rich open woods, limestone outcrops.		X	X			X	X		
Dennstaedtia punctilobula (Michx.) Moore Hay-scented fern--shady places, rocky open woods, pastures, damp slopes, sterile soil, roadsides		X	X			X		X	
Drytoperis cristata (L) Gray var. clintoniana (D. C. Eat.) Underw. Crested wood fern--rich woods, wooded gorge slopes.		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Dryopteris disjuncta (Ledeb.) C. V. Mort. Oak fern--cool mossy, rocky woods arborvitae swamps			X	X					
Dryopteris goldiana (Hook.) Gray Goldie's fern--rich, calcareous woods, wooded gorge slopes		X	X						
Dryopteris marginalis (L.) Gray Marginal shield-fern--woods, clearings, rocky slopes, limestone		X	X				X		
Dryopteris noveboracensis (L.) Gray New York fern--dry to damp woods and thickets, pastures			X	X			X		
Dryopteris phengopteris (L.) Christens Long beech-fern--woods, thickets and cool rocky banks		X	X						
Dryopteris spinulosa (O. F. Muell.) Watt var. intermedia (Muhl.) Underw. Spinulose wood-fern--dry to wet woods, thickets		X	X	X	X				
Dryoteris thelypteris (L.) Gray var. pubescens (Lawson) Nakai Marsh-fern, meadow fern--swamps, sterile meadows, bogs, low woods, thickets				X	X				
Onoclea sensibilis L. Sensitive fern--low open ground, alluvial thickets, low woods, wet roadsides, pastures, swamps		X	X		X	X	X	X	X
Polypodium virginianum L. Rock polypody--rock outcrops, gorges		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Polystichum acrostichoides (Michx.) Schott Christmas fern--climax forest, borders open field		X	X				X		
Polystichum Brannii (Spenner) Fee var. Purshii fern Braun's holly fern--rich woods, glades to shaded rockslides and ravines		X	X		X	X	X		
Pteretis pensylvanica(Willd.) Fern. Ostrich fern--rich bottomland to thickets, woods, alluvium, wooded gorge bottoms		X	X	X	X				
Pteridium aquilinum (L.) Kuhn var. latiusculum (Desv.) Underw. Bracken fern--roadsides, pastures, clearings		X				X	X	X	
Woodwardia virginica (L.) Sm. Virginian chain fern--acid bogs, swamps, wooded bottoms		X	X	X	X				
Taxaceae--Yew family									
Taxus canadensis Marsh. Ground hemlock--shady to swampy woods, cedar swamps, gorge banks, forests		X	X	X	X				
Pinaceae--Pine family									
Abies balsamea (L.) Mill. Balsam fir--swamps, pastures, forests	X	X	X	X	X		X		
Juniperus communus L. var. depressa Pursh. dry pastures, gorge margins		X				X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Juniperus virginiana L. Red cedar--fields, thickets		X					X		
Larix decidua Mill. European Larch--cultivated	X								
Larix laricina (DuRoi) K. Koch Tamarack--swamps, bogs, pastures				X	X				
Larix leptolepis (Sieb. and Zucc.) Gord. Japanese larch--cultivated	X								
Picea abies (L.) Karst Norway spruce--cultivated	X								
Picea glauca (Moench) Voss White spruce--woods, good soils, cultivated	X	X	X				X		
Picea mariana (Mill.) BSP. Black spruce--bogs					X				
Picea rubens Sarge Red spruce--climax forests, swamps, bogs		X	X	X	X				
Pinus banksiana Lamb. Jack pine--cultivated	X								
Pinus nigra Arnold Austrian pine--cultivated	X								
Pinus resinosa Ait. Red pine--cultivated	X								
Pinus strobus L. White pine--forest plantations, woods thickets, old fields	X	X	X	X			X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Pinus sylvestris L. Scots pine--cultivated	X						X		
Thuja occidentalis L. Northern white cedar--swamps, bogs, woods, hemlock		X	X	X	X				
Tsuga canadensis (L.) Carr. Hemlock--swampy woods, forests, gorges		X	X	X	X				
Typhaceae--Cat-tail family									
Typha latifolia L. Cat-tail--wet areas, swamps, marshes					X		X	X	
Sparganiaceae--Bur-reed family									
Sparganium americanum Nutt. Burweed--marshy areas, cedar swamps				X	X				
Sparganium chlorocarpum Rydb. Green fruit burweed--marshy areas, stream sides					X				
Sparganium chlorocarpum Rydb. var. acaule (Beeby) Fern. Stemless burweed--swamps					X				
Zosteraceae--Pond weed family									
Potamogeton alpinus Balbis. Pond weed--water									X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type: Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Potamageton amplifolius Tuckerm. Large leaved pond weed--slow moving streams									X
Potamogeton epihydrus Raf. Pond weed--water									X
Potamageton foliosus Raf. Pond weed--water									X
Potamageton gramineus L. Grasslike pondweed--water									X
Potamogeton natans L. Swimming pondweed--water									X
Potamageton pulcher Tuckerm. Pond weed--water									X
Potamageton pusillus L. Small pondweed--water									X
Potamageton zosteriformis Fern. Flat stem pondweed--ponds									X
Najadaceae--Niad family									
Najas flexilis (Willd.) Rostk. and Schmidt. Naiad--ponds									X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Juncaginaceae--Arrow-grass family									
Scheuchzeria palustris L. var. americana Fern. Marsh arrowgrass--marshes					X				
Altismataceae--Water-plantain family									
Alisima triviale Pursh. Water plantain--marshy areas					X				
Sagittaria cuneata Sheldon Wedge shaped arrowhead--calcarious muddy shores					X				
Sagittaria latifolia Willd. Broad-leaved arrowhead--wet soils along streams					X				
Hydrocharitaceae--Frog's-bit family									
Elodea canadensis Michx. Waterweed--ponds									X
Gramineae--Grass family									
Agropyron repens (L.) Beauv. Quack grass--gravelly, sandy shores, gardens, meadows		X			X	X	X		
Agrostis alba L. Red top--damp thickets, swales, shores, fields, roadsides, open swamps		X		X	X	X	X	X	
Agrostis alba L. var. palustris (Huds.) Pers. Creeping bent grass--shores, shallow water, damp sands, moist rocks				X	X		X		X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Agrostis hyemalis (Walt.) BSP. Ticklegrass--dry or damp open sterile soil, bogs, thin woods, roadsides, meadows		X			X	X	X	X	
Agrostis tenuis Sibth. Rhode Island Bentgrass--fields, pastures, roadsides, thickets		X				X	X	X	
Agrostis tenuis Sibth, forma artistata (Sincl.) Wieg. Bentgrass--fields, pastures, roadsides, thickets		X				X	X	X	
Alopercurus aequalis Sobol. Floating foxtail--shallow water shores, ditches, swampy woods				X	X			X	
Alopecurus pratensis L. Meadow foxtail--meadows, pastures, damp clearings, roadsides		X			X	X	X	X	
Ammophlia breviligulata Fern. Beech grass--dunes, sands							X		
Anthoxanthum odoratum L. Sweet vernal grass--meadows, swales, shores, meadows, pastures, roadsides						X	X	X	
Aristida basiramea Engelm. Branching needle grass--dry sterile soil							X	X	
Avena sativa L. Cultivated oats--active agricultural lands						X			
Brachyelytrum erectum (Schreb.) --woods, thickets, banks		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Bromus ciliatus Wood chess--thickets, shores, rocky slopes, roadsides		X	X				X	X	
Bromus inermis Leyss. --roadsides, fields, cultivated		X				X	X	X	
Bromus purgans L. forma glabriflorus Wiegand --rich woods, thickets, rocky slopes, limestone woods		X	X						
Calamagrotis canadensis (Michx.) Nutt. Blue-joint grass--meadows, bogs, wet thickets, wet roadsides		X		X	X			X	
Cinna latifolia (Trev.) Geiseb. Woodreed grass--woods, thickets, clearings, swamps, rich low woods		X	X	X	X		X	X	
Dactylis glomerata L. Orchard grass--fields, roadsides, waste places		X				X	X	X	
Danthonia compressa Aust. --woodlands, clearings.		X	X			X	X	X	
Danthonia spicata (L.) Beauv. Wild cat grass--dry to damp peaty soil, thin woodland, roadsides, pastures		X	X			X	X	X	
Deschampsia caespitosa (L.) Beauv. var.glauca, (Hartm.) Lindm. Tuffed hairgrass--shores, mountains, damp soil, marshes, meadows		X		X	X		X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Digitaria ischaemum (Schreb) Muhl. Finger grass--cultivated waste grounds, roadsides		X				X	X	X	
Echinochloa crushgalli (L.) Beauv. Barnyard grass--waste or cultivated ground, roadsides		X				X	X	X	
Echinochloa crusgalli (L.) Beauv. forma longiseta (Trin.) Farw. Barnyard grass--waste, cultivated ground, roadsides		X				X	X	X	
Elymus canadensis L. Wild rye--dunes, upper beaches							X		
Elymus riparius Wieg. Wild rye--rich thickets, stream sides		X		X					
Festuca elatior L. Meadow fescue--meadows, roadsides, cultivated areas		X				X		X	
Festuca obtusa Biehler --moist woods, copses, shady banks, limestone woods			X	X					
Festuca ovina L. var. duriuscula (L.) Koch Sheep's fescue--dry open soil, rocky slopes						X	X	X	
Glyceria borealis (Nash.) Batchelder places, shallow water, marshy pond margins				X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Glyceria canadensis (Michx.) Trin. Rattlesnake grass--bogs, meadows, damp thickets, shores, roadsides		X		X	X		X	X	
Glyceria Fernaldii (Hitchc.) St. John --shallow water, and wet places				X	X				
Glyceria grandis S. Wats. Reed meadow grass--stream banks, wet meadows, ditches				X	X		X	X	
Glyceria melicaria (Michx.) Hubbard --wet woods, swamps				X	X				
Glyceria striata (Lam.) Hitchc. Fowl meadow grass--moist ground, marsh meadows, wet woods				X	X				
Holcus lanatus L. Velvet grass--sterile fields, meadows						X	X		
Holcus mollis L. Soft velvet grass--waste ground							X	X	
Hystrix patula Moench. Bottle-brush grass--rich low woods, limestone woods		X	X						
Leersia oryzoides (L.) Sw. Rice cut grass--swamps, ditches, shores					X			X	
Milium effusum L. Millet-grass--climax forest, rich wooded stream bottoms, thickets, glades		X	X	X			X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type									
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Muhlenbergia racemosa (Michx.) BSP. --dry prairies, rocks, bluffs, marsh meadows		X			X		X		
Muhlenbergia schreberi J. F. Gmel. Drop-seed nimble will--woodlands, thickets, dooryards, roadside		X	X				X	X	
Muhlenbergia sylvatica Torr. Dry prairies, rocks, bluffs		X				X	X		
Muhlenbergia uniflora (Muhl.) Fern. --bogs, swales, sandy shores, damp fields, marsh meadows		X		X	X	X	X		
Nardus stricta L. Mat grass--sandy and peaty soil, roadsides, pastures						X	X	X	
Panicum aculeatum Hitch. and Chase Prickly panic grass--swampy woods				X	X				
Panicum boreale Nash. --marsh meadows, dry pastures, shores, thickets		X			X		X		
Panicum capillare L. Old-witch grass--open sandy and stony soil, cultivated land, roadsides		X				X	X	X	
Panicum clandestinum L. Deer-tongue grass--moist, dry thickets, shores, borders of alluvial woods		X	X	X		X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Panicum commonsianum Ashe Common panic-grass--sands							X		
Panicum lanuginosum Ell. var. fasciculatum (Torr.) Fern. Panic-grass--dry, moist, sterile open soil, thickets and thin woodlands		X	X			X	X	X	
Panicum lanuginosum Ell. var. implicatum (Scribn.) Fern. --pastures, meadows, marsh meadow, dry-moint open, sterile soil, thickets, thin woodlands		X	X		X	X	X		
Panicum subvillosum Ashe Hairy panic-grass--dry sandy soils							X		
Panicum virgatum L. Switch grass--sandy fields, dry-moist shores		X				X	X		
Phalaris arundinacea L. Reed canary grass--shores, swales, meadows, bordering brooks		X		X	X		X		
Phleum pratense L. Common timothy--fields, roadsides, clearings		X				X	X	X	
Phragmites communis Trin. Reed--roadsides, ditches							X	X	
Poa alsodes Gray --rich woods, thickets		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type									
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Poa annua L. Low spear grass--cultivated and waste lands, clearings, wet woods				X		X	X	X	
Poa compressa L. Canada blue grass, wire grass--dry soil, roadsides							X	X	
Poa palustris L. Fowl meadow grass--marsh meadows, shores, thickets		X		X	X				
Poa pratensis L. Kentucky blue grass--forests, wooded roads, roadsides, moist slopes, shores, meadows and fields		X	X			X	X	X	
Poa saltuensis Fern. and Wieg. --open woods, thickets, shandy gorge banks, forests		X	X						
Poa trivialis L. Rough-stalked meadow grass--glades, spring-heads, brooksides, thickets, damp slopes, wet woods		X		X	X				
Oryzopsis asperifolia Michx. Mountain rice--woods, thickets, peaty openings, open woods, in heavy dry soils.		X	X						
Setaria glauca (L.) Beauv. Yellow foxtail, pigeon-grass--cultivated or waste lands, roadsides		X				X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Setaria viridis (L.) Beauv. Green fox tail, bottle grass--cultivated and disturbed soil						X	X	X	
Schizachne purpurascens (Torr.) Swallen --thickets and woods, limestone areas.		X	X						
Spenopholis pallens (Biehler) Scribn. --Springheads, wet woods, shady shale gorge banks			X	X					
Sporobolus cryptandrus (Torr.) Gray Sand dropseeds--dunes, upper beaches							X		
Cyperaceae--Sedge family									
Carex aenea Fern. --open woods, dry slopes, gravel, rocks		X	X				X	X	
Carex albursina Sheldon. Unnamed--calcareous hardwoods and ravines		X	X						
Carex angustior Mackenez. --swales, swampy thickets, shores, marsh meadows, bogs, wet roadsides		X		X	X		X	X	
Carex arctata Boott. --woods, thickets, clearings, roadsides		X	X				X	X	
Carex atherodes Spreng. --calcareous meadows, swales, shores				X			X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type									
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex aurea Nutt. --meadows, springy banks, damp shores		X		X		X	X		
Carex bromoides Schkuhr --rich, low woods and swamps		X	X	X					
Carex brunnescens (Pers.) Poir. var. sphaerostachya (Tuckerm.) Kukenth --dry to moist woods, clearings, rocky slopes, dry pastures, open grassy woods		X	X			X	X		
Carex buxbaumii Wahlenb. --wet shores, swamps, bogs				X	X				
Carex canescens L. var. disjuncta Fern. --swamps, shallow pools, swales, marsh meadows				X	X				
Carex castanea Wahlemb. --calcareous woods, thickets, shores, meadows		X	X		X		X		
Carex cephaloidea Dew. --rich woods, thickets, bottom lands, swales		X	X	X	X				
Carex chordorrhiza L. --quagmires and inundated bogs				X	X				
Carex communis Bailey --woods, clearings, roadsides		X	X			X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex crawfordii Fern. --dry to damp open ground, pastures						X	X	X	
Carex comosa Boott --swamps, shallow water, bogs				X	X				
Carex crinita Lam. --swales, damp thickets, low woods, moist meadows, brooksides		X	X	X	X		X		
Carex crinita Lam. var. gynandra (Schwein.) Schwein. & Torr. --wet roadside ditches					X			X	
Carex debilis Michx. var. rudgei Bailey --open woods, thickets, meadows road sides		X	X				X	X	
Carex deflexa Hornem. --woods, clearings, turfy slopes, pastures		X	X			X	X		
Carex deweyana Schwein. --rich open woods and banks		X	X						
Carex diandra Schrank --peaty bogs, swamps, often calcareous				X	X				
Carex disperma Dew. --mossy or damp woods and clearings, swamps		X	X	X	X		X		

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex eburnea Boott. --calcareous ledges, gravels, sands		X	X				X		
Carex emmonsii Dew. --dry woods, thickets, clearings		X	X				X		
Carex flava L. --meadows, swales, shores, alder swamps				X	X		X		
Carex flava L. var. fertiles Peck --meadows, swales, shores				X			X		
Carex folliculata L. --peaty thickets, swampy woods, swales, marsh meadows		X		X	X				
Carex gracillima Schwein. --woodlands, thickets, meadows, pastures, roadsites		X	X			X	X	X	
Carex granularis Muhl., var. haleana (Olney) Porter --calcerous shores, meadows, woods		X	X				X		
Carex haydenii Dew. --meadows, swales, thickets, pastures		X		X	X	X	X		
Carex hirta L. --dry fields, roadsides						X	X	X	
Carex hitchcockiana Dew. --calcareous, rich woods		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex hystericina Muhl. --swales, swamps, shores				X	X		X		
Carex interior Bailey --damp, wet, often calcareous soils, marsh meadows				X	X				
Carex intumescens Rudge, var. Fernaldii Bailey --alluvial woods, meadows, swales, climax forests, roadsides		X	X	X			X	X	
Carey knieskernii Dew. Hybrid--woods, thickets		X	X						
Carex lacustris Willd. --swamps, shallow water, wet meadows				X	X				X
Carex laxiculmis Schwein. --rich woods, glades		X	X	X					
Carex laxiflora Lam. --rich hardwoods, loamy slopes		X	X						
Carex leptalea Wahlenb. --mossy or wet woods, swales clearings, pastures		X	X	X		X	X	X	
Carex leptonervia Fern. --low woods, clearings, thickets, roadsides, swamp margins		X	X	X			X	X	
Carex limosa L. --wet bogs, peaty quagmires, pond margins				X	X				

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex lupulina Muhl. --swamps, wet woods				X	X				
Carex lurida Wahlenb. --swales, swamps, wet woods, damp roadsides				X	X		X	X	
Carex michauxiana Boeckl. --acid peats, wet sands, marsh meadows				X	X				
Carex novae-angliae Schwein. --woodlands, damp slopes, pastures		X	X	X		X	X		
Carex oligosperma Michx. --peat bogs, acid swamps, shallow water				X	X				X
Carex ormostachya Wieg. --low woods, clearings, thickets		X	X	X		X	X		
Carex pallescens L. var. neogaea Fern. --meadows, thickets, grasslands, glades, roadsides		X		X		X	X	X	
Carex paupercula Michx. var. irrigua (Wahlenb.) Fern. --moist meadows, roadsides				X	X			X	
Carex peckii Howe --dry calcareous, rocky slopes; rich open woods, ravines		X	X						
Carex pedunculata Muhl. --rich woods, slopes		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex plantaginea Lam. --rich hardwoods			X						
Carex prasina Wahlenb. --rich low woods, glades			X	X	X				
Carex pseudo-cyperus L. --shallow water, swamps, bogs				X	X				X
Carex projecta Mackenzie --swales, thickets, damp woods, roadsides		X		X	X			X	
Carex rosea Schkuhr. --rich open woods and thickets		X	X						
Carex rostrata Stokes --shallow water, wet shores, swamps				X	X				X
Carex retrorsa Schwein. --rich low woods, alluvial woods, roadsides			X	X				X	
Carex scabrata Schwein. --wet woods, glades, meadows, swales				X	X		X		
Carex scoparia Schkuhr --moist to dry open grounds, thickets, open woods, pastures		X	X	X		X	X		
Carex stipata Muhl. --low grounds, swamps				X	X				

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Carex stricta Lam. var. strictior (Dew.) Carey --acid-sub acid swamps, swales, low woods, roadsides, brook banks		X	X	X	X			X	
Carex swanii (Fern.) Mackenz. --woods thickets, clearings, pastures, swamp edges		X	X	X		X	X		
Carex sychnocephala Carey --meadows, open woods, clearings		X	X				X		
Carex torta Boott. --stream sides, swamps				X	X				
Carex trisperma Dew. --mossy woods, clearings and bogs			X	X	X		X		
Carex tuckermani Boott. --rich or calcareous meadows, swales, low woods				X	X		X		
Carex vesicaria L. var. monile (Tuckerm.) Fern. --meadows, swales, shores				X			X		
Carex vulpinoidea Michx. --low wet woods, wet pastures, wet grounds			X	X	X	X	X		
Cladium mariscoides (Muhl.) Torr. Twig rush--swamps, marshes, sandy shores, pond margins				X	X		X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Cyperus engelmanni Steud. Galingale--low ground				X			X		
Cyperus filiculmis Vahl. var. macilentus Fern. --dry rocky, gravelly or sandy ground							X	X	
Cyperus strigosus L. --meadows, swales, damp thickets, shores				X	X		X		
Dulichium arundinaceum (L.) Britton Three way sedge--swamps, pool and stream sides, marshes, meadows, wet roadsides				X	X		X	X	
Eleocharis acicularis (L.) R. & S. Spike rush--damp shores and low grounds				X	X				
Eleocharis geniculata (L.) R. & S. Spike rush--damp sand and gravel, swampy places				X	X		X		
Eleocharis obtusa (Willd.) Schultes Spike rush--muddy or wet places, roadsides, pastures, borders of swamps				X	X	X	X	X	
Eleocharis palustris (L.) R. & S. Spike rush--margins of ponds, streams, shallow water and marshes				X	X				X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Eriophorum spissum Fern. Hare's tail --acid bogs and peat					X				
Eriophorum tenellum Nutt. Cotton grass--peaty soil, bog meadow					X				
Eriophorum virginicum L. Tawny cotton grass--bogs, peaty meadows				X	X				
Eriophorum virdi-carinatum (Engelm.) Fern. Cotton grass--peats, wet meadows, swampy woods				X	X				
Rhynchospora alba (L.) Vahl Beak rush--bogs, wet peats, sands, marsh meadows				X	X		X		
Scripus acutus Muhl. Hardstem bull rush--marshes, shores, pond margins, shallow water				X	X				X
Scirpus atrocinctus Fern. --meadows, swamps, moist pastures, bogs, wet roadsides		X		X	X	X	X	X	
Scirpus atrovirens (Willd.) --meadows, bogs, low thickets, moist pastures, roadsides		X		X	X	X	X	X	
Scirpus cyperinus (L.) Kunth var. pelius Fern. --wet meadows, swamps, moist pastures, roadsides		X		X	X	X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type: Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Scirpus heterochaetus Chase Slender bull rush--calcareous, Basic deadwaters, shores, swamps				X	X				X
Scirpus hudsonianus (Michx.) Fern. Alpine cotton grass--springy or boggy meadows, marly swamps, wet gravels, peat bogs				X	X				
Scirpus rubrotinctus Fern. --damp open soil, marshes, low thickets, meadows, roadsides		X		X	X		X	X	
Scirpus validus Vahl. Great bullrush--brackish or fresh shallow water, marshes, swales, ponds				X	X				X
Araceae--Arum family									
Arisaema stewardsonii Britt. Jack-in-the-pulpit, Indian turnip--wet, swampy woods and thickets		X	X	X	X				
Arisaema triphyllum (L.) Schott Small jack-in-the-pulpit, Indian turnip--wet woods, swamps, peat bogs				X	X				
Acorus calamus L. Sweetflag--wet places, swales, wet meadows, roadsides		X		X	X			X	
Calla palustris L. Wild calla--quagmires, bog margins, wet bogs				X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Peltandra virginica (L.) Schott & Endl. Tuckahoe--swamps, streams or pool side					X				
Lemnaceae--Duckweed family									
Lemna minor L. Lesser duckweed--quiet waters					X				X
Lemna trisulca L. Star-duckweed--ponds and springy places					X				X
Spirodela polyrhiza (L.) Schleid. Greater duckweed, water-flaxseed--pools, ponds, and stream margins					X				X
Juncaceae--Rush family									
Juncus articulatus L. --wet ground				X	X				
Juncus balticus Willd. var. littoralis Engelm. --dunes, upper beach							X		
Juncus brevicaudatus (Engelm.) Fern. --muddy, wet places				X	X				
Juncus bufonius L. Toad rush--damp, open ground, roadsides, wet meadows, pastures		X		X		X	X	X	
Juncus canadensis J. Gay --marshy places, usually acid-sub-acid				X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Juncus dudleyi Wiegand --damp, dry calcareous-sweet soil		X	X	X		X	X		
Juncus effusus L. var. decipiens Buchenau Common or soft rush--swales, damp ground, wet pastures, open swamps, bogs				X	X	X	X		
Juncus effusus L. var. pylaei (Laharpe) Fern. & Wieg. --swampy thickets, peats and wet clearings				X	X		X		
Juncus filiformis L. --wet shores, bogs, wet meadows				X	X				
Juncus tenuis Willd. Path rush--damp-dry open soils, roadsides, thickets, swamps, pastures		X		X	X	X	X	X	
Luzula acuminata Raf. Wood rush--woods, clearings, bluffs		X	X	X			X		
Luzula multiflora (Retz.) Lejeune --fields, meadows, open woods, roadsides		X	X			X	X	X	
Luzula multiflora (Retz.) Lejeune var. fusconigra Celak. --peaty barrens, turfy slopes, clearings, fields		X	X			X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Liliaceae--Lily family									
Allium schoenoprasum L. Chive--calcareous rocks, gravels, shores					X		X	X	
Allium tricoccum Ait. Wild leek--rich woods, bottomland		X	X	X					
Asparagus officinalis L. Asparagus--sandy fields, roadsides						X	X	X	
Clintonia borealis (Ait.) Raf. Yellow clintonia, corn lily--woods, thickets, swamps, roadsides, clearings		X	X	X		X	X	X	
Erythronium americanum Ker Yellow adder's tongue, Dog's tooth violet--rich woods, bottomland, meadows, roadsides		X	X	X			X	X	
Lilium canadense L. Wild yellow, meadow lily--meadows, low thickets, wet woods, wet roadsides		X	X	X			X	X	
Maianthemum canadense Desf. Wild lily of the valley--woods, clearings, sub-alpine areas.		X	X			X	X		
Medeola virginiana L. Indian cucumber-root--rich woods, dry woods		X	X						
Polygonatum pubescens (Willd.) Pursh. Small Solomon's seal--woods, wooded bluffs		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Smilacina racemosa (L.) Desf. False spikenard, Solomon's zigzag--woods, clearings, bluffs			X			X	X		
Smilacina stellata (L.) Desf. False Solomon's seals--gravelly or alluvial shores, bluffs, thickets, open meadows, swampy woods		X		X			X		
Smilacina trifolia (L.) Desf. False Solomon's seal--bogs, mossy woods, peaty shores				X	X				
Smilax herbacea L. Carrion-flower, Jacob's ladder--rich or alluvial thickets, meadows, low woods, roadsides		X	X	X		X	X	X	
Smilax tamnoides L. var. hispida (Muhl.) Fern. Bristly greenbrier--rich calcareous woods, thickets, bottomlands, swampy woods		X	X	X					
Streptopus amplexifolius (L.) DC. Twisted-stalk, white mandarin--low woods, wet gorge slopes				X					
Streptopus roseus Michx. Rose twisted-stalk, rose mandarin--woods, wet thickets		X	X	X					
Trillium erectum L. Red trillium, stinking Benjamin--rich woods		X	X	X					

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Trillium grandiflorum (Michx.) Salisb. White trillium--rich woods, rich thickets		X	X						
Trillium undulatum Willd. Painted trillium--acid-subacid woods and swamps		X	X	X	X				
Uvularia grandiflora Sm. Bell wort--rich woods, thickets, calcareous sites		X	X						
Uvularia sessilifolia L. Wild oats--woods, thickets, clearings		X	X				X		
Veratrum viride Ait. White hellebore, Indian poke--swamps, low grounds, roadsides		X	X	X	X			X	
Iridaceae--Iris family									
Iris versicolor L. Blue flag, poison flag--marshes, meadows, ditches, turfy shores, wet pastures				X	X	X	X	X	
Sisyrinchium angustifolium Mill. Blue-eyed grass--meadows, low woods, thickets, damp shores, roadsides		X	X	X		X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Orchidaceae--Orchis family									
Calopogon pulchellus (Salisb.) R. Br. Grass-pink--sphagnous bogs or peaty meadows, wet shores				X	X				
Calypso bulbosa L. Oakes --cool, mossy woods, calcareous locations				X					
Corallorhiza maculata Raf. Large or spotted coral root--dry woods		X	X						
Corallorhiza striata Lindl. Striped coral root--calcareous or rich woods, swamps			X	X	X				
Corallorhiza trifida Chatelain Early coral root--thickets, bogs, woods, swampy-dry evergreen woods			X	X	X				
Cypripedium acaule Ait. Moccasin flower--dry acid soil in woodlands, moss, bogs, wet woods		X	X	X	X				
Cypripedium calceous L. var. parviflorum (Salisb.) Fern. Small yellow lady's slipper--bogs, mossy swamps and woods, wet shores, damp rocks			X	X	X				
Cypripedium reginae Walt. Showy lady's slipper--damp calcareous slopes and shores				X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Goodyera repens (L.) R. Br. var. ophioides Fern. Rattlesnake plantain--damp woods			X	X					
Goodyera tesselata Lodd. Rattlesnake plantain--dry-moist woodland			X	X					
Habenaria andrewsii M. White --swamps				X	X				
Habenaria blephariglottis (Willd.) White fringed orchis--wet boggy, peaty soil				X	X				
Habenaria clavellata (Michx.) Spreng. Green woodland orchis--mossy-wet sandy woods, thickets, spring-heads, shores, marsh meadows, open swamps		X	X	X	X		X		
Habenaria dilatata (Pursh) Hook. Leafy white orchis--swales, meadows, bogs, wet woods				X	X				
Habenaria fimbriata (Ait.) R. Br. Purple or large purple fringed orchis--rich woods, thickets, meadows		X	X	X			X		
Habenaria hyperborea (L.) R. Br. Northern or leafy northern green orchis--peaty thickets, limestone-barrens, swamps				X	X				
Habenaria lacera (Michx.) Lodd. Ragged orchis--dry, wet meadows, old fields, clearings, thickets, alluvial-wet woods, roadsides		X		X		X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Habenaria obtusata (Pursh.) Richards Blunt leaf orchis, one leaf rein-orchis--mossy, chiefly coniferous- mixed woods, swamps			X	X	X				
Habenaria psycodes (L.) Spreng. Small purple fringed orchis--meadows, damp thickets, alluvial or springy shores, low woods, wet roadsides, wooded-open swamps		X		X	X		X	X	
Habenaria viridis (L.) R. Br. var. bracteata (Muhl.) Gray Bracted or long bracted green orchis--rich woods, thickets and meadows		X	X				X		
Liparis loeselii (L.) Richard Loesel's, bog- or yellow Twayblade--bogs, peaty meadows, damp thickets		X		X	X				
Listera auriculata (Wieg.) Auricled twayblade--alluvial banks, calcareous silts, thickets, swamps		X	X	X	X				
Listera convallarioides (Sw.) Nutt. Broad-lipped twayblade --damp, peaty or mossy glades, woods, thickets, swamps, shores		X	X	X	X				
Listera cordata (L.) R. Br. Heartleaf twayblade--mossy knolls and woods, swamps		X	X	X	X				
Malaxis unifolia Michx. Green adder's mouth--dry-moist woods, swamp and bog borders, roadsides, meadows		X	X	X	X		X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Orchis rotundifolia Banks Small round-leaved orchis--mossy calcareous swamps and woods				X	X				
Orchis spectabilis L. Showy orchis--rich, mostly calcareous woods		X	X						
Pogonia ophioglossoides (L.) Ker. Rose pogonia--sphagnous bogs, peaty swales, wet mossy shores				X	X				
Spiranthes cernua (L.) Richard Ladie's tresses--wet-dryish, open soil; bogs, low thickets, shores, roadsides, pastures		X		X	X	X	X	X	
Spiranthes lucida (H. H. Eat.) Ames Ladie's tresses--alluvial-damp, rocky shores and slopes, rich, damp thickets and meadows		X		X			X		
Spiranthes romanzoffiana Cham. Hooded or Romanzoff's ladie's tresses--meadows, swamps, clearings, thickets, roadsides		X		X	X	X	X	X	
Salicaceae--Willow family									
Populus balsamifera L. Balsam poplar--riverbanks			X	X					
Populus grandidentata Michx. Larged-toothed aspen--dry woods, slopes, recent burns		X	X			X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Populus tremuloides Michx. Trembling aspen--dry open fields, recent burns		X				X	X	X	
Salix bebbiana Sarg. Long beaked willow--moist-dry thickets, roadsides, pastures		X		X		X	X	X	
Salix cordata Michx. --gorge slopes, rocky stream bottoms			X	X				X	
Salix discolor Muhl. Large pussy or glaucous willow--damp thickets, shores, swamps, roadsides		X		X	X			X	
Salix fragilis L. Crack willow--roadsides, borders of woods		X	X					X	
Salix gracilis Anderss. var. textoris Fern. Textoris--meadows, swales, roadsides, swamps		X		X		X	X	X	
Salix lucida Muhl. Shining willow--swamps, bogs, wet roadsides		X		X	X			X	
Salix pedicellaris Pursh. Bog willow--acid bogs, sphagnous shores				X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Salix sericea Marsh Silky willow--low thickets, streambanks, swamps, wet roadsides				X	X			X	
Salix syrticola Fern. Sand dune willow--dunes, beaches							X		
Myricaceae--Wax myrtle family									
Myrica gale L. Sweet Gale--shallow water and swamps				X	X				X
Myrica gale L. var. subglabra (Chev.) Fern --brook bank, marsh meadows and bogs				X	X				X
Juglandaceae--Walnut family									
Carya cordiformis (Wang.) K. Koch Bitternut or swamp hickory, pignut hickory --wet-dry woods, stream banks, swamps			X	X	X				
Carya ovata (Mill.) K. Koch --woodlands, dry slopes		X	X						
Juglans cinerea L. Butternut--rich woods, river terraces, roadsides, gorge bottoms		X	X	X				X	
Juglands nigra L. Black walnut--rich woods		X	X	X					

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Corylaceae--Hazel family									
Alnus rugosa (Du Roi) Spreng. --wet areas		X			X				
Betula lutea Michx. f. Gray or yellow birch--rich woods, wet woods, arbor vitae swamps			X	X					
Betula papyrifera Marsh. Paper, white or canoe birch--woods, slopes			X	X					
Betula populifolia Marsh. White, gray, fire or old field birch--sterile dry-wet soil		X	X				X		
Carpinus caroliniana Walt. Blue or water beech, American horn beam--rich woods, swamps, roadsides, thickets		X	X	X	X		X	X	
Corylus cornuta Marsh. Beaked hazelnut--rich thickets, clearings, borders of woods, roadsides		X					X	X	
Ostrya virginiana (Mill.) K. Koch American hop-hornbeam; ironwood--rich woods		X	X	X					
Fagaceae--Beech family									
Castanea dentata (Marsh) Borkh. Chestnut--dry gravelly or rocky, mostly acid soil		X	X				X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Fagus grandifolia Ehrh. Beech--climax forest, rich uplands		X	X						
Quercus alba L. White oak--dry woods		X	X						
Quercus macrocarpa Michx. Bur oak--bottomlands, rich woods, fertile slopes		X	X	X					
Quercus muehlenbergii Engelm. Oak--stable dunes		X	X						
Quercus rubra L. Red oak--dry or upland woods		X	X						
Ulmaceae--Elm family									
Celtis occidentalis L. Hackberry, sugarberry--dry-moist, rich woods; river banks, rocky barrens, sands		X	X	X			X		
Ulmus americana L. American or white elm--bottomlands, fields, swampy woods		X		X			X	X	
Ulmus rubra Muhl. Slippery or red elm--rich calcareous soil		X	X				X		
Ulmus thomasi Sarg. Rock or cork elm--rich woods, calcareous uplands		X	X				X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Cannabinaceae--Hemp family									
Humulus lupulus L. Common hop--alluvial thickets, roadsides		X		X			X	X	
Urticaceae--Nettle family									
Boehmeria cylindrica (L.) Sw. var. drummondiana Webb. False nettle--moist, open ground		X	X	X			X		
Laportea canadensis (L.) Webb Wood nettle--rich, low woods; stream banks			X	X	X				
Pilea pumila (L.) Gray Richweed, clearweed--cool moist, shaded places, rich low woods			X	X					
Urtica procera Muhl. Nettle--thickets, roadsides		X	X				X	X	
Loranthaceae--Mistletoe family									
Arceuthobium pusillum Peck. Dwarf mistletow--on Picea branches in bogs			X	X	X				
Aristolochiaceae--Birthwort family									
Asarum canadense L. Wild ginger--Rich woods, calcareous ledges		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type									
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Asarum canadense L. var. acuminatum Ashe --rich woods, wooded gorge slopes	X		X						
Polygonaceae--Buckwheat family									
Polygonella articulata (L.) Meisn. Coast jointweed--dry sands							X		
Polygonum amphibium L. var. stipulaceum Coleman --meadows, open wooded swamp, shores, ditches				X	X		X	X	
Polygonum amphibium L. var. stipulaceum Coleman forma fluitans (Eat.) Fern. --meadows, open or wooded swamps, shores, ditches				X	X		X	X	
Polygonum aviculare L. Knotweed--yards, disturbed soils, roadsides						X	X	X	
Polygonum aviculare L. var. vegetum Ledeb. --disturbed soil, roadsides		X				X	X	X	
Polygonum cilinode Michx. --dry thickets, rocky slopes, wood's borders		X	X						
Polygonum convolvulus L. Black bindweed--meadows, waste ground, roadsides		X				X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well-drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Polygonum hydropiper L. Smartweed, waterpepper--damp soils				X	X				
Polygonum lapathifolium L. --swampy thickets, shores, damp clearings, cultivated fields				X	X	X	X		
Polygonum pensylvanicum L. var. laevigatum Fern. Pinkweed--damp shores, thickets, clearings, disturbed or cultivated soil		X		X		X	X	X	
Polygonum persicaria L. Lady's thumb--damp clearings, cultivated ground, roadsides, shores		X				X	X	X	
Polygonum sagittatum L. Arrow-leaved tearthumb--low grounds, brooksides, wet roadsides				X	X			X	
Rumex acetosella L. Common or sheep sorrel--roadsides, pastures, meadows, woods, clearings		X	X			X	X	X	
Rumex crispus L. Yellow dock--cultivated and waste soil, old fields, roadsides		X				X	X	X	
Rumex obtusifolius L. Bitter or blunt-leaved dock--waste places, roadsides, shaded byways, fields						X	X	X	
Rumex orbiculatus Gray Water dock--wet meadows, swamps, shores					X		X		

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Rumex patientia L. Patience dock--waste places, rich thickets, roadsides		X					X	X	
Tovara virginiana L. Buckwheat--roadsides, thickets		X	X				X	X	
Chenopodiaceae--Goosefoot family									
Chenopodium album L. Lamb's quarters; pigweed--weed of cultivated and waste ground						X	X	X	
Chenopodiaceae botrys L. Jerusalem oak, feather geranium--waste places, roadsides, disturbed soil, open rocky bottom land		X				X	X	X	
Chenopodium capitatum (L.) Asch. Strawberry blite--light soil, burns, clearings						X	X	X	
Chenopodium hybridum L. var. gigantospermum (Aellen) Rouleau Maple-leaved goose foot--rocky woods, thickets, clearings, waste places		X	X			X	X	X	
Salsola kali L. var. kali Saltwort --mid-beach dunes, upper beach							X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Amaranthaceae--Amaranth family									
Amaranthus graecizans L. Tumble weed--disturbed or waste ground						X	X	X	
Amaranthus retroflexus L. Pigweed, green amaranth--waste or cultivated land						X	X	X	
Amaranthus spinosus L. Thorny tumbleweed--dunes							X		
Phytolaccaceae--Pokeweed family									
Phytolacca Americana L. Pokeweed, scoke--rich, low ground, clearings, roadsides		X		X		X	X	X	
Aizoceae--Sea-purslane family									
Mollugo verticillata L. Carpet weed--sandy riverbanks, roadsides, cultivated ground		X				X	X	X	
Portulacaceae--Purslane family									
Claytonia Caroliniana Michx. Spring beauty--rich open woods, alluvial thickets, upland slopes		X	X				X		
Caryophyllaceae--Pink family									
Arenaria lateriflora L. Grove sandwort--gravelly or turfy shores, meadows, borders of woods		X	X	X			X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Arenaria serpyllifolia L. Thyme-leaved sandwort--dry, sterile fields, roadsides, rich, dry limestone woods		X	X			X	X	X	
Cerastium arvense L. Field mouse, ear chickweed--gravelly, turfy or rocky, basic soils, meadows		X				X	X	X	
Cerastium vulgatum L. Common mouse-ear chickweed--roadsides, fields		X				X	X	X	
Sagina procumbens L. Pearlwort, birdseye--damp, open soils, damp open soils, shores				X	X		X		X
Saponaria officinalis L. Bouncing bet, sandwort--roadsides		X					X	X	
Silene cucubalus Wibel Bladder-campion, maiden's-tears--roadsides, borders of fields, gravelly shores		X				X	X	X	
Silene noctiflora L. Night flying catchfly--cultivated ground, waste places						X	X	X	
Silene virginica L. Fire pink--open woods, clearings, slopes		X	X				X		
Spergula arvensis L. Corn spurrey--weed of cultivated grounds, along ditches						X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Stellaria calycantha (Ledeb.) Bong. --swamps, brooksides				X	X				
Stellaria graminea L. Common stitchwort--dry pastures, roadsides		X				X	X	X	
Stellaria longifolia Muhl. --damp thickets, meadows and shores				X	X				
Stellaria media (L.) Cyrillo Common chickweed--lawns and roadsides		X				X	X	X	
Ceratophyllaceae--Hornwort family									
Ceratophyllum demersum L. Hornwort--quiet waters					X				X
Ceratophyllum echinatum Gray --quiet water					X				X
Nymphaeaceae--Water-lily family									
Nuphar variegatum Engelm. Bullheaded-lily--pond margins, slow streams, pools					X				X
Nymphaea odorata Ait. Sweet-scented or white water-lily ponds, dead waters, bog pools					X				X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Ranunculaceae--Crowfoot family									
Actaea pachypoda Ell. White baneberry, doll's-eyes--rich woods, thickets		X	X						
Actaea rubra (Ait.) Willd. Red baneberry, snakeberry--woods, thickets		X	X						
Anemone canadensis L. Anemone--damp thickets, meadows, rocky streams, swamps, stream bottoms				X	X		X		X
Anemone cylindrica Gray Thimbleweed--day, open soil, slopes						X	X		
Anemone quinquifolia L. Wood anemone--open woods, thickets, clearings, streamsides		X	X	X	X		X		
Anemone virginiana L. Tall anemone, thimbleweed--dry or rocky open woods, thickets and slopes		X	X						
Aquilegia canadensis L. Wild columbine--rocky, wooded, open, and springy slopes		X	X	X					
Aquilegia vulgaris L. Garden columbine--roadsides, borders of woods and fields		X				X	X	X	
Caltha palustris L. Marsh marigold, cowslip--swamps, wet meadows, wet woods			X	X	X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Clematis virginiana L. Virgin-s bower--low grounds, thickets, borders of woods, roadsides		X		X	X		X	X	
Coptis groenlandica (Oeder) Fern. Canker-root, gold thread--mossy woods, swamps, pastures, forests, bogs		X	X	X	X	X	X		
Hepatica acutiloba DC. Hepatica--rich, calcareous woods		X	X						
Ranunculus abortivus L. Small-flowered crowfoot, kidneyleaf-buttercup--low woods, thickets, damp shores		X	X	X	X		X		
Ranunculus acris L. Common buttercup--fields, clearings, roadsides, marsh meadows		X			X	X	X	X	
Ranunculus bulbosus L. Bulbous buttercup--pastures, fields, open woods, roadsides		X				X	X	X	
Ranunculus flabellaris Raf. Yellow water crowfoot--quiet waters and muddy shores				X	X				X
Ranunculus recurvatus Poir. Hooked crowfoot--rich, low woods		X	X	X			X		
Ranunculus septentrionalis Poir. Swamp buttercup--alluvial thickets, woods, meadows, swamps		X	X	X	X		X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Ranunculus subrigidus W. B. Drew White water-crowfoot--calcareous or brackish waters									X
Thalictrum dioicum L. Early meadow rue--rich, rocky woods, ravines, alluvial terraces		X	X						
Thalictrum polygamum Muhl. Tall meadow rue--meadows, cow thickets, swamps, brooksides, roadsides				X	X		X	X	
Berberidaceae--Barberry family									
Caulophyllum thalictroides (L.) Michx. Blue cohosh, papoose-root--rich woods			X						
Podophyllum peltatum L. May apple--rich woods, thickets, pastures		X	X			X	X		
Menispermaceae--Moonseed family									
Menispermum canadense L. Moonseed--rich thickets, stream banks		X		X	X				
Lauraceae--Laurel family									
Lindera benzoin (L.) Blume Spice bush--damp woods, brooksides, swamps				X	X				
Papaveraceae--Poppy family									

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Chelidonium majus L. Celandine--rich, damp soil along roadsides								X	
Cruciferae--Mustard family									
Arabis glabra (L.) Bernh. Tower mustard--ledges, cliffs, thickets, fields		X				X	X		
Arabis hirsuta (L.) Scop., var. pycnocarpa (M. Hopkins) Rollins Rock cress--cliffs, ledges, gravels		X	X	X					
Arabis laevigata (Muhl.) Poir. Rock cress--rich woods, slopes, or shaded ledges		X	X						
Armoracia aquatica (Eat.) Wieg. Lake-cress--lakes, quiet streams					X				X
Armoracia lapathifolia Gilib. Horseradish--moist ground, roadsides, ditches				X				X	
Barbarea orthoceras Ledeb. --stream banks, swamps, wet rocks, roadsides				X	X			X	X
Barbarea vulgaris R. Br. Common inter cress--meadows, brooksides, damp woods				X	X				
Brassica kaber (DC) L. C. Wheeler var. pinnatifida L. C. Wheeler Wild mustard--cultivated ground, roadsides						X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Brassica rapa L. Bird's rape, rutabaga--cultivated fields, roadsides		X				X	X	X	
Cakile edentula (Bigel.) Hook. Sea rocket--sandy or gravelly beaches							X		
Cakile edentula (Bigel.) Hook. var. lacustris Fern. Sea rocket--sand dunes, mid-beach, upper beach							X		
Capsella bursa-pastoris (L.) Medic. Shepherd's purse--roadsides, cultivated ground		X				X	X	X	
Cardamine pensylvanica Muhl. Bitter cress--springs, rills, wet clearings, swamps, shallow brooks				X	X		X		X
Cardamine pratensis L. var. palustris Wimm. & Grab. Cuckoo flower--calcareous, shallow water; bogs, springs, swampy woods				X	X				X
Corydalis aurea Willd. var. aurea Golden corydalis--calcareous, rocky slopes, gravelly or sand shores		X	X				X		
Dentaria diphylla Michx. Crinkle root, toothwort--rich woods, wet forest			X	X					
Dentaria heterophylla Nutt. --rich woods			X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type: Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Dentaria laciniata Muhl. Pepper-root--rich woods, wooded bottomlands, calcareous, rocky banks			X	X	X				
Dicentra canadensis (Goldie) Walp. Squirrel-corn--rich woods			X						
Dicentra cucullaria (L.) Bernh. Dutchman's-breeches, breeches-flower--rich woods, roadside woods			X						
Draba arabisans Michx. --argillaceous or calcareous rocks		X	X						
Erucastrum gallicum (Willd.) Schulz --roadsides, fields, waste places		X				X	X	X	
Erysimum cheiranthoides L. Wormseed mustard--waste places, cultivated fields, rich meadows						X	X	X	
Lepidium densiflorum Schrad. Peppergrass--roadsides and waste places		X					X	X	
Rorippa islandica (Oeder) Borbas, var. hispida (Desv.) Butt. & Abbe Marsh cress--shores, wet openings, waste places				X	X		X	X	
Sanguinaria canadensis L. Bloodroot--rich woods, bottomland woods			X	X					
Sisymbrium altissimum L. Tumble mustard--field, roadsides, waste places		X				X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Sisymbrium officinale (L.) Scop., var. leiocarpum DC Hedge mustard--roadsides, common weed						X	X	X	
Resedaceae--Mignonette family									
Reseda lutea L. Mignonette--fields, roadsides, waste places						X	X	X	
Sarranceniaceae--Pitcher-plant family									
Sarracenia purpurea L. Pitcher-plant--sphagnous bogs, peaty barrens					X				
Droseraceae--Sundew family									
Drosera rotundifolia L. Round-leaved sundew--peaty or moist acid soils, bogs, wet roadsides					X			X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Crassulaceae--Orphine family									
Sedum purpureum (L.) Link Live-forever--roadsides, open banks, open woods		X	X			X	X	X	
Saxifragaceae--Saxifrage family									
Chrysosplenium americanum Schwein Golden saxifrage--water-mat, springheads, rills, cold wet places, wet woods and swamps				X	X				X
Mitella diphylla L. Miterwort--loamy-rockywoods		X	X						
Mitella nuda L. Miterwort--cool or mossy woods or swamps			X	X	X				
Parnassia glauca Raf. Grass of parnassus--wet calcareous soils				X	X				
Penthorum sedoides L. Ditch stone crop--wet, low grounds				X	X				
Ribes americanum Mill. Wild black currant--rich thickets and slopes		X		X					
Ribes cynosbati L. Prickly gooseberry--open loamy or rocky woods			X	X					
Ribes glandulosum Grauer Skunk currant--wet woods or clearings, rocky slopes		X	X	X			X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Ribes hirtellum Michx. Smooth gooseberry--rocky-swampy woods and clearings, open pastures		X	X	X		X	X		
Ribes lacustre (Pers.) Poir. Swamp or bristly black currant--cold woods and swamps			X	X	X				
Ribes triste Pall. Swamp red currant--cool woods, swamps			X	X	X				
Saxifraga aizoides L. Yellow mountain saxifrage--calcareous gravels, cool damp slopes		X	X	X			X		
Saxifraga pensylvanica L. Swamp, saxifrage, wild-beet--wet meadows, swamps, boggy thickets, wet roadsides		X		X	X		X	X	
Saxifraga virginiensis Michx. Early saxifraga--dry, wet rocks, gravelly open-shaded slopes		X	X				X		
Tiarella cordifolia L. False miterwort, foam flower--rich woodlands, pastures		X	X			X	X		
Hamamelidaceae--Witch hazel family									
Hamamelis virginiana L. Witch hazel--dry-moist woods, pastures		X	X			X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Platanaceae--Plane-tree family									
Platanus occidentalis L. Sycamore, buttonwood--rich soil		X	X					X	
Rosaceae--Rose family									
Agrimonia gryposepala Wallr. Agrimony--thickets, borders of woods, rich, dry limestone woods		X	X				X		
Agrimonia striata Michx. Agrimony--thickets, borders of woods, roadsides		X	X				X	X	
Amelanchier bartramiana (Tausch) Roemer Juneberry--peaty or boggy thickets, swamps				X	X				
Amelanchier canadensis (L.) Medic. Juneberry--swamps, low grounds, thickets				X	X				
Amelanchier intermedia Spach. Juneberry--swamps, bogs, damp or dry thickets and shores		X		X			X		
Amelanchier laevis Wieg. Shadbush, Juneberry--dry-moist thickets, borders of woods, swamp margins, clearings, roadsides		X	X	X	X		X	X	
Amelanchier sanguinea (Pursh) DC. Juneberry--open woods, rocky slopes, river banks		X	X	X					

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Crataegus chrysocarpa Ache, var. phoenicea Palmer Hawthorn--thickets and rocky ground along streams		X				X	X		
Crataegus punctata Jacq. Hawthorn--open rocky ground, thickets, pastures		X				X	X		
Dalibarda repens L. Robin-run-away, false violet--woods, clearings, hummocks in swamps and bogs		X	X	X	X				
Fragaria vesca L. var. americana Porter Wood strawberry--wooded slopes, rocky banks			X	X			X		
Fragaria virginiana Duchesnea Wild or field strawberry--fields, roadsides, borders of woods		X				X	X	X	
Geum aleppicum Jacq. var. strictum (Ait.) Fern. Yellow avens--thickets, meadows, clearings		X				X	X		
Geum canadense Jacq. White avens--rich thickets, borders of woods, wet woods		X	X	X					
Geum rivale L. Water or purple avens--wet meadows, bogs, peaty slopes, roadsides		X		X	X		X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Physocarpus opulifolius (L.) Maxim. Nine-bark--shores, rocky banks, thickets		X			X		X		
Potentilla anserina L. Silverweed--dunes, upper beaches							X		
Potentilla argentea L. Silvery cinquefoil--dry open ground		X				X	X	X	
Potentilla arguta Pursh. --rocky, bushy or alluvial soils		X				X	X	X	
Potentilla canadensis L. Common cinquefoil--dry, open soil		X				X	X	X	
Potentilla fruticosa L. Shrubby cinquefoil--wet or dry open ground				X			X		
Potentilla norvegica L. --thickets, roadsides, clearings, waste places, alder swamps		X		X	X	X	X	X	
Potentilla palustris (L.) Scop. Marsh cinquefoil--inundated meadows, stream margins, swales				X	X				
Potentilla recta L. --dry fields, roadsides		X				X	X	X	
Prunus nigra Ait. Canada plum "Pomegranate"--thickets, stream banks, borders of woods, roadsides		X	X	X	X			X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Prunus pensylvanica L. f. Bird, pin or fire cherry--dry woods, recent burns, openings, fence rows, roadsides		X	X			X	X	X	
Prunus pumila L., var. pumila Sand cherry--dunes, sand							X		
Prunus serotina Ehrh. Black cherry--dry woods, fence rows, roadsides		X	X			X	X	X	
Prunus virginiana L. Choke cherry--thickets, shores, borders of woods, fence rows, roadsides		X	X			X	X	X	
Prunus americana (Marsh.) DC American mountain ash--woods, roadsides, swamps, pastures		X	X	X		X	X	X	
Pyrus aucuparia (L.) Gaertn. European mountain ash--roadsides, borders of woods		X				X	X	X	
Pyrus malus L. Apple--roadsides, wood edges, clearings, pastures		X				X	X	X	
Pyrus melanocarpa (Michx.) Willd. Black chokeberry--bogs, roadsides, pastures		X			X	X	X	X	
Rosa blanda Ait. Rose--dry-moist, rocky slopes; shores, roadsides		X					X	X	

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Rosa cinnamomea L. Cinnamon rose--roadsides, fence rows						X	X	X	
Rosa eglanteria L. Sweet-brier, eglantine--thickets, clearings, roadsides		X				X	X	X	
Rosa palustris Marsh. Swamp rose--swamps, wet thickets, shores, bogs, marsh meadows				X	X				
Rubus allegheniensis Porter Sow-teat blackberry--dry clearings, thickets, roadsides		X					X	X	
Rubus canadensis L. Smooth blackberry--thickets, clearings, roadsides		X					X	X	
Rubus frondosus Bigel. --thickets, borders of woods		X					X		
Rubus glandicaulis Blanch. Glandular bramble--thickets, fields		X				X	X		
Rubus signatus L. var. major Blanch-- Bristly bramble--woods, fields, thickets									
Rubus idaeus L., var. aculeatissimus Regel and Tiling Red raspberry--roadsides, thickets, clearings, pastures, woods, swamps		X	X	X		X	X	X	

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Rubus odoratus L. Purple flowering raspberry, thimble berry--thickets, borders of woods		X	X				X		
Rubus occidentalis L. Black raspberry--rich thickets, ravines, borders of woods		X	X				X		
Rubus pubescens Raf. Dwarf raspberry--damp slopes, rocky shores, low thickets, dry-wet mucky richwoods, swamps		X	X	X	X				
Rubus recurvans Blanch. (R. herterophyllus Willd.) Recurving bramble--thickets, fields		X				X	X		
Rubus setosus Bigel. --swamps, thickets, swales, meadows, roadsides		X			X	X	X	X	
Rubus trifrons Blanch Bramble--thickets, open woods		X					X		
Sanguisorba canadensis L. Canadian burnet--peaty or boggy soils, marsh meadows				X	X				
Spiraea alba Du Roi Meadow-sweet--low grounds, roadsides, swampy woods				X	X		X	X	
Spiraea latifolia (Ait.) Borkh. Meadow-sweet--roadsides, pastures, marsh meadows, brooksides		X		X	X	X	X	X	

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Spiraea tomentosa L. Hardhack, steeple bush--low grounds, roadsides, pastures		X				X	X	X	
Waldsteinia fragarioides (Michx.) Tratt. Barren strawberry--woods, thickets, clearings		X	X			X	X		
Leguminosae--Pulse family									
Amphicarpa bracteata (L.) Fern. Hog-peanut--moist gorge banks, open bottoms		X					X		
Lathyrus palustris L. var. linearifolius Ser. Vetchling --shores, thickets		X			X		X		X
X Lespedeza nuttallii Darl. --open areas						X	X		
Medicago luplina L. Black Medick --roadsides, fields		X				X	X		
Melilotus alba Desr. White melilot--fields						X	X		
Melilotus officinalis (L.) Lam. Yellow sweet clover--old fields		X					X		
Robinia pseudo-acacia L. Black locust--roadsides		X					X	X	
Trifolium agrarium L. Yellow clover--fields, roadsides		X				X	X	X	

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Trifolium hybridum L. Alsike clover--pastures, fields						X	X		
Trifolium pratense L. Red clover--fields, roadsides		X				X	X	X	
Trifolium repens L. White clover--fields, roadsides		X				X	X	X	
Vicia cracca L. Blue vetch--fields, roadsides		X				X	X	X	
Vicia villosa Roth Hairy vetch--fields, roadsides		X				X	X	X	
Oxalidaceae--Wood-sorrell family									
Oxalis europaea Jord. forma villicaulis Wieg. Sorrell--wet places					X				
Oxalis montana Raf. Wood sorrel--climax forests			X						
Oxalis montana Raf. forma rhodantha Fern. Rose flowered wood sorrel--damp woods			X						
Oxalis violacea L. Violet wood-sorrel--woods, shaded slopes		X	X						
Geraniaceae--Geranium family									
Geranium maculatum L. Wild cranesbill--woods, thickets, meadows		X				X	X		

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Geranium robertianum L. Herb-Robert--rocky woods, ravines, gorges		X	X						
Geranium sphaerospermum Fern. Cranesbill--calcareous clearings							X		
Rutaceae--Rue family									
Xanthoxylum americanum Mill. Northern prickly ash--rich woods, river banks		X	X						
Polygalaceae--milkwort family									
Polygala polygama Walt. Milkwort--dry woods			X						
Euphorbiaceae--Spurge family									
Acalypha virginica L. Three-seeded mercury--roadsides, fields		X					X	X	
Euphorbia cyparissias L. Cypress spurge--roadsides		X					X	X	
Euphorbia polygonifolia L. Seaside spurge--sand dunes, mid-beach, upper beach							X		
Euphorbia vermiculata Raf. Spurge--open soils		X					X	X	

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Callitrichaceae--Water-starwort family									
Callitrichace deflexa A. Br. var. austini (Engelm.) Hegelm. Water starwort--damp places, fields		X				X	X		
Callitriche palustris L. Water-starwort--water, brooks, ponds									X
Limnanthaceae--False mermaid family									
Floerkea proserpinacoides Willd. False mermaid--brooks, pools, mudholes					X				X
Anacardiaceae--Cashew family									
Rhus copallina L. Dwarf sumac--dry woods, openings		X	X				X		
Rhus radicans L. Poison ivy--beaches, dunes							X		
Rhus toxicodendron L. Poison oak--gorges, swamps		X		X	X				
Rhus typhina L. Staghorn sumac--roadsides		X					X	X	
Aquifoliaceae--Holly family									
Ilex verticillata (L.) Gray Black alder--open swamps, bogs					X				
Ilex verticillata (L.) Gray var. padifolia (Willd.) T. & G. Holly--wet areas					X				

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Nemopanthus mucronata (L.) Trel. --swamps, bogs					X				
Celastraceae--Staff-tree family									
Celastrus scadens L. Bittersweet--dry, open woods; gorges		X							
Aceraceae--Maple family									
Acer pensylvanicum L. Moosewood--forests, swamps			X	X					
Acer saccharinum L. Silver maple--wet woods				X					
Acer saccharum Marsh. Sugar maple--woods		X	X						
Acer spicatum Lam. Mountain maple--woods, gorges		X	X						
Acer rubrum L. Red maple--wet woods, forests, bogs		X	X	X	X				
Balsaminaceae--Touch-me-not-family									
Impatiens capensis Meerb. Touch-me-not--wet areas		X			X		X		
Impatiens pallida Nutt. Pale touch-me-not--wet areas		X			X		X		

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Rhamnaceae--Buckthorn family									
Ceanothus ovatus Desf. Redroot--sandy slopes		X					X		
Rhamnus alnifolia L'Her Swamp buckthorn--marsh meadow margins		X			X				
Rhamnus cathartica L. Common buckthorn--open woods, pastures		X				X	X		
Vitaceae--Vine family									
Parthenocissus quinquefolia (L.) Planch. forma hirsuta (Donn) Fern. Virginia creeper--woods, rocky banks, creek bottoms		X	X		X				
Parthenocissus inserta (Kerner) K. Kritsch Virginia creeper--woods, thickets, banks, gorges		X	X						
Vitis riparia Michx. var. syrticola Fern. & Wieg. Grape--dunes, upper beaches							X		
Vitis vulpina L. Frost grape--riverbanks, bottomlands		X		X	X				
Tiliaceae--Linden family									
Tilia americana L. Basswood--wet woods, climax forests, gorges		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Malvaceae--Mallow family									
Abutilon theophrasti Medic. Indian mallow--roadsides		X				X	X	X	
Malva moschata L. Musk-mallow--roadsides, fields		X				X	X	X	
Malva rotundifolia L. Musk-mallow, common mallow--roadsides, fields		X				X	X	X	
Guttiferae--St. John's-wort family									
Hypericum boreale (Britt.) Bickn. Northern St. John's wort--damp meadows					X				
Hypericum canadense L. Canadian St. John's wort--wet roadsides, ditches, or dry places		X					X	X	
Hypericum ellipticum Hook. St. John's wort--damp shores					X				
Hypericum mutilum L. St. John's wort--low grounds, marsh meadows					X		X		
Hypericum perforatum L. Common St. John's wort--pastures, roadsides, fields		X				X	X	X	
Hypericum punctatum Lam. Dotted St. John's wort--marsh or bog meadows					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Hypericum pyramidatum Ait. Great St. John's wort--rocky margins, thickets, river meadows		X			X		X		
Hypericum virginicum L. Marsh St. John's wort--wet sands, bogs, swamps					X				
Violaceae--Violet family									
Viola adunca Sm. Hooked violet--dry roadsides, pastures		X				X	X	X	
Viola adunca Sm. var. minor (Hook.) Fern. Hooked violet--wet areas					X		X		
Viola blanda Willd. Sweet white violet--deciduous woods		X	X						
Viola canadensis L. Canadian violet--rich woods, roadsides		x	X				X	X	
Viola conspersa Reichenb. Dog violet--dry or evergreen woods, meadows, damp places		X	X	X	X				
Viola cucullata Ait. Marsh blue violet--wet meadows, swamps, bogs					X				
Viola fimbriatula Sm. Fringed violet--sand lands, sterile woods		X					X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Viola incognita Brainerd Violet--forests, climax			X						
Viola pallens (Banks) Brainerd Sweet white violet--marsh meadows, wet woods		X	X		X				
Viola pensylvanica Michx. --damp woods			X	X					
Viola pubescens Ait. Yellow downy violet--deciduous woods			X						
Viola renifolia Gray var. brainerdii (Greene) Fern. --limestone woods, cool woods			X						
Viola rostrata Pursh. Long-spurred violet --dry, rocky, open woods, orwell		X	X						
Viola rotundifolia Michx. Round-leaved violet--rich woods			X						
Viola selkirkii Pursh. Selkirk violet--climax forests			X						
Viola sororia Willd. Violet--dry woods, meadows		X	X				X		
Thymelaeaceae--Mezereum family									
Dirca palustris L. Wicopy, rope bark--brook banks, woodlands		X	X		X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Elaeagnaceae--Oleaster family									
Shepherdia canadensis (L.) Nutt. Soapberry--dry, shale banks; limestone areas		X							
Lythraceae--Loosestrife family									
Cuphea petiolata (L.) Koehne Clammy cuphea--dry open soils, woods, fields		X	X				X		
Decodon verticillatus (L.) Ell. var. laevigatus T. & G. Water-willow--swamps, shallow pools					X				X
Onagraceae--Primrose family									
Circaea alpina L. Enchanter's nightshade--cool, moist woods			X						
Circaea quadrisulcata (Maxim.) Franch. & Sav. var. canadensis (L.) Hara Enchanter's nightshade--woods and thickets		X	x						
Epilobium angustifolium L. Great willow herb--clearings, roadsides							X	X	
Epilobium glandulosum Lehm. var. adenocaulon (Haussk.) Fern. --brooksides, wooded swamps, clearings		X		X	X		X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Epilobium strictum Muhl. --bogs, mossy thickets		X			X				
Ludwigia alternifolia L. Seedbox--swamps					x				
Ludwigia palustris (L.) Ell. Water-purslane--wet roadsides		X					X	X	
Oenothera biennis L. Evening primrose--dunes, upper beach							X		
Oenothera parviflora L. Evening primrose--shores, gravelly, meadows, roadsides					X		X	X	
Oenothera perennis L. --open ground						X	X		
Haloragaceae--Water-milfoil family									
Proserpinaca palustris L. Marsh Water-milfoil--pool margins									X
Araliaceae--Ginseng family									
Aralia hispida Vent. Bristly sarsaparilla--open sandy woods		X					X		
Aralia nudicaulis L. Wild sarsaparilla--woods		X	X						
Aralia racemosa L. Spikenard--woods and thickets		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Panax trifolium L. Dwarf ginseng--climax forests			X						
Umbelliferae--Parsley family									
Angelica atropurpurea L. Angelica--wet roadsides, meadows					X	X	X	X	
Carum carvi L. Caraway--roadsides, fields		X					X	X	
Conioselinum chinense (L.) BSP. Hemlock parsley--thickets & slopes		X							
Conium maculatum L. Poison hemlock--waste places		X					X	X	
Cryptotaenia canadensis (L.) DC. Honewort--woods, thickets		X	X						
Daucus carota L. Queen Anne's lace--fields		X				X	X		
Heracleum maximum Bartr. Masterwort--rich or low ground		X					X		
Hydrocotyle americana L. Water pennywort--moist soil, woods, meadows		X	X				X		
Osmorhiza claytoni (Michx.) C. B. Clarke Sweet cicely--rich, low woods; roadsides		X	X				X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Pastinaca sativa L. Parsnip--roadsides		X					X	X	
Sanicula marilandica L. Snakeroot--roadsides, brooksides		X					X	X	
Sium suave Walt. Water parsnip--marshy meadows					X				
Zizia aurea (L.) W. D. J. Koch Golden alexanders--meadows, shores, damp thickets				X	X		X		
Cornaceae--Dogwood family									
Cornus alternifolia L. F. Alternate leaved-dogwood--roadsides, gorges, borders of woods, climax forest		X	X				X		
Cornus amomum Mill. "Red willow"--swamps, damp thickets, limestone regions		X		X	X				
Cornus canadensis L. Bunchberry--dry pastures, roadsides, forests, swamps, bogs		X	X	X	X	X	X	X	
Cornus rugosa Lam. Round-leaved dogwood--wooded gorges		X	X						
Cornus stolonifera Michx. Red osier--swamps, wet fields		X			X	X	X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Pyrolaceae--wintergreen family									
Chimaphila umbellata (L.) Bart. var. cisatlantica Blake Prince's pine--dry, evergreen woods		X	X						
Monotropa uniflora L. Indian-pipe--low or evergreen woods		X	X						
Pterospora andromedea Nutt. Pine drops--pine woods			X						
Pyrola asarifolia Michx. var. purpurea (Bunge) Fern. Purple pyrola--arbor vitae swamp				X					
Pyrola elliptica Nutt. Shinleaf--climax forest			X						
Pyrola rotundifolia L. var. americana (Sweet) Fern. Round-leaved pyrola--dry roadsides		X					X	X	
Pyrola secunda L. Pyrola--dry, moist woods, banks		X	X				X		
Pyrola secunda L. var. obtusata Turcz. Pyrola--arbor vitae swamp				X	X				
Pyrola virens Schweigger Green pyrola--evergreen woods			X						
Ericaceae--Heath family									

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Andromeda glaucophylla Link. Bog rosemary--bogs, marshes					X				
Chamaedaphne calyculata (L.) Moench Leather-leaf--bogs					X				
Epigaea repens L. Trailing arbutus--wooded gorges, woods		X	X						
Gaultheria hispidula (L.) Bigel. Creeping snowberry--woods, knolls, bogs		X	X		X				
Gaultheria procumbens L. Teaberry, wintergreen--pastures, coniferous woods		X	X			X	X		
Gaylussacia baccata (Wang.) Koch Black huckleberry--bogs, woods			X		X				
Kalmia angustifolia L. Sheep laurel--bogs, marshes					X				
Kalmia polifolia Wang. Bog-laurel--bogs, swamps					X				
Ledum groenlandicum Oeder. Labrador-tea--bogs					X				
Rhododendron canadense (L.) Torr. Rhodora--swamps					X				
Rhododendron maximum L. Great laurel--swamps					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Vaccinium angustifolium Ait. Low sweet blueberry--open dry barrens						X	X		
Vaccinium corymbosum L. Swamp blueberry--roadsides, pastures, bogs		X			X	X	X	X	
Vaccinium corymbosum L. var. albiflorum (Hook.) Fern. --roadsides, pastures, bogs		X			X		X	X	
Vaccinium macrocarpon Ait. Large cranberry--bogs					X				
Vaccinium myrtilloides Michx. Sour-top-blueberry--roadsides, pastures, bogs		X		X	X		X	X	
Vaccinium oxycoccos L. Small cranberry--bogs					X				
Vaccinium uliginosum L. Swamp blueberries--peaty barrens					X		X		
Vaccinium vacillans Torr. Low blueberry--roadsides, woods, thickets		X	X				X	X	
Primulaceae--Primrose family									
Lysimachia ciliata L. Fringed loosestrife--wet areas					X				
Lysimachia nummularia L. Moneywort--wet areas					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Lysimachia terrestris (L.) BSP. Swamp loosestrife--marsh meadows, roadsides					X		X	X	
Lysimachia thrysiflora L. Tufted loosestrife--wet areas					X				
Primula mistassinica Michx. var. noveboracensis Fern. Bird's eye primrose--cliffs, shale areas		X					X		
Trientalis borealis Raf. Star-flower--forests			X						
Oleaceae--Olive family									
Fraxinus americana L. White ash--forests, roadsides, wet woods		X	X	X			X	X	
Fraxinus nigra Marsh. Black ash--wet woods, swamps				X	X				
Gentianaceae--Gentian family									
Gentiana linearis Froel. Closed gentian--marshes, roadsides					X		X	X	
Menyanthes trifoliata L. Buckbean--wet areas, bogs					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Apocynaceae--Dogbane family									
Apocynum androsaemifolium L. Dogbane--roadsides, clearings		X					X	X	
Apocynum cannabinum L. Indian hemp--lower altitude, open ground, thickets		X					X		
Vinca minor L. Periwinkle--old fields		X					X		
Asclepiadaceae--Milkweed family									
Asclepias incarnata L. Swamp milkweed--swamps					X				
Asclepias syriaca L. Common milkweed--old fields, roadsides, dunes, upper beaches		X					X	X	
Convolvulaceae--Convolvulus family									
Confolvulus pellitus Ledeb. Bindweed--waste ground							X	X	
Convolvulvus sepium L. Hedge bindweed--roadsides		X					X	X	
Polemoniaceae--Polemonium family									
Phlox divaricata L. Blue phlox--damp to open woods		X	X						

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Phlox maculata L. Sweet William--roadsides							X	X	
Phlox subulata L. Moss pink--roadsides							X	X	
Polemonius Van-Bruntiae Britt. Jacob's ladder--swamps, marshes, wet places					X				
Hydrophyllaceae--Waterleaf family									
Hydrophyllum canadense L. --damp, rich woods			X						
Hydrophyllum virginianum L. John's cabbage--forests, wet woods, fence rows			X	X		X	X		
Boraginaceae--Borage family									
Cynoglossum officinale L. Common hound's tongue--roadsides							X	X	
Echium vulgare L. Blueweed--roadsides, dry fields						X	X	X	
Lappula echinata Gilib. Prickly stickseed--pastures, roadsides						X	X	X	
Lithospermum officinale L. European gromwell--roadsides, pastures						X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Myosotis scorpioides L. Forget-me-not--wet and shaded wet areas		X			X		X	X	
Symphytum officinale L. Common comfrey--moist roadsides							X	X	
Verbenaceae--Vervain family									
Verbena hastata L. Blue vervain--wet roadsides, swamps					X		X	X	
Verbena urticifolia L. White vervain--thickets, borders of woods		X					X		
Labiatae--Mint family									
Blephilia hirsuta (Pursh.) Benth. Wood mint--wet woods				X					
Collinsolia canadensis L. Horse-balm--limestone woods			X						
Galeopsis tetrahit L. var. bifida (Boenn.) Lej. & Court Hemp nettle--waste places							X	X	
Glechoma hederacea L. Gill-over-the-ground--fields, roadsides						X	X	X	
Lamium maculatum L. Dead nettle--roadsides							X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Leonurus cardiaca L. Common motherwort--pastures, roadsides, lower altitudes						X		X	
Lycopus americanus Muhl. Water horehound--open swamps, wet areas					X				
Lycopus uniflorus Michx. Bungleweed--meadows						X	X		
Mentha piperita L. Peppermint--moist roadsides					X		X	X	
Mentha spicata L. Spearmint--wet places near settlements					X	X	X	X	
Monarda didyma L. Horsemint, Oswego tea--wet places					X			X	
Monarda fistulosa L. Wild bergamot--thickets		X							
Monarda fistulosa L. var. mollis (L.) Benth. Wild bergamot--thickets, clearings		X					X		
Mondara fistulosa var. rubra Gray --shady roadsides		X					X	X	
Nepeta cataria L. Catnip--fields, developed areas						X	X	X	
Prunella vulgaris L. Selfheal--roadsides, pastures						X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Pycnanthemum flexuosum (Walt.) BSP. Mountain mint--ditches, dry clearings						X	X	X	
Satureja vulgaris (L.) Fritsch--Basil. Dry pastures, borders of woods		X				X	X	X	
Scutellaria epilobiflora A. Hamilton Common skullcap--sandy, gravelly shores					X				X
Scutellaria lateriflora L. Mad-dog skullcap--swamps					X				
Stachys tenuifolia Willd. var. platphyila Fern. Hedge-nettle--rich shores, meadows, woods		X	X		X		X		
Solanaceae--Nightshade family									
Datura stramonium L. Jimsonweed--roadsides							X	X	
Solanium dulcamara L. Bittersweet--shady woods, swamps		X	X		X				
Solanium nigrum L. Common nightshade--roadsides, waste places							X	X	
Physalis heterophylla Nees Ground cherry--woodlands		X	X						
Scrophulariaceae--Figwort family									
Chelone glabra L. Turtlehead--wet places					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Gratiola neglecta Torr. Hedge-hyssop--wet places, pastures					X	X			
Linaria minus (L.) Desf. --waste places							X	X	
Linaria vulgaris Hill Common butter-and-eggs--roadsides							X	X	
Lindernia dubia (L.) Pennell var. dubia False pimpernel--wet places					X				
Mimulus moschatus Dougl. Musk flower--swamps					X				
Mimulus ringens L. Monkey-flower--swamps					X				
Scrophularia lanceolata Pursh. Figwort--thickets & borders of woods		X					X		
Verbascum thapus L. Mulleim--dry pastures						X	X		
Veronica americana (Raf.) Schwein. American brooklime--wet places, pastures					X				
Veronica arvensis L. Corn speedwell--gorge slopes, waste places		X					X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Pedicularis canadensis L. Lousewort--dry woods			X						
Veronica chamaedrys L. Birdseye--roadsides, fields						X	X	X	
Veronica officinalis L. Common wpeedwell--dry woods, pastures, wet woods		X	X	X		X	X	X	
Veronica peregrina L. Neckweed--dry, open soils		X				X	X	X	
Veronica scutellata L. Marsh speedwell--wet places					X				
Veronica serpyllifolia L. Thyme-leaved speedwell--pastures						X			
Veronica tenella All. --roadsides, wet places					X		X	X	
Orobanchaceae--Brook-rape family									
Epifagus virginiana (L.) Bart. Beech-drops--beech-woods			X						
Orobanche uniflora L. Cancer-root--wooded areas		X	X						
Lentibulariaceae--Bladderwort family									
Utricularia cornuta Michx. Bladderwort--water									X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Utricularia intermedia Hayne Bladderwort--water									X
Phrymaceae--Lopseed family									
Phyrma leptostachya L. Lopseed--rich woods, thickets		X	X						
Plantaginaceae--Plantain family									
Plantago lanceolata L. Ribgrass--waste places, fields		X				X	X	X	
Plantago major L. Great plantain--waste places		X					X	X	
Plantago rugelii Dcne. Plantain--roadsides		X					X	X	
Rubiaceae--Madder family									
Galium aparine L. Cleavers--woods, thickets		X	X						
Galium asprellum Michx. Rough bedstraw--wet places					X				
Galium boreale L. Northern bedstream--rocky banks		X					X		
Galium lanceolatum Torr. Wild licorice--limestone woods		X	X						

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Galium palustre L. Marsh bedstraw--wet areas					X				
Galium tinctorium L. --wet meadows					X				
Galium triflorum Michx. Sweet-scented bedstraw--swamps				X					
Houstonia caerulea L. Bluets--grassy areas						X	X		
Houstonia longifolia Gaertn. Bluets--sandy roadsides		X					X	X	
Mitchella repens L. Partridge-berry--forests, pastures		X	X			X	X		
Caprifoliaceae--Honeysuckly family									
Diervilla lonicera Mill. Bush-honeysuckle--woods, clearings		X	X				X	X	
Linnaea borealis L. var. Americana (Forbes) Rehd. Twinflower--cool woods			X						
Lonicera dioica L. Honeysuckle--woods, thickets		X	X						
Lonicera canadensis Bartr. Fly honeysuckle--woodlands			X						

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Lonicera villosa (Michx.) R. & S. var. tonsa Fern. --roadsides, pastures		X				X	X	X	
Sambucus canadensis L. Common elder--wet, damp soils		X					X		
Sambucus pubens Michx. Red elder--roadsides, ditches		X					X	X	
Trioseteum aurantiacum Bickn. Wild coffee--woods, thickets		X	X						
Viburnum acerifolium L. Arrow-wood--dry, rocky woods		X	X						
Viburnum alnifolium Marsh. Witch-hobble--mature woods			X						
Viburnum cassinoides L. Witherod--thickets, clearings, swamps		X	X		X		X		
Viburnum dentatum L. Southern arrow-wood--moist, dry, sandy thickets		X			X				
Viburnum lentago L. Sweet viburnum--borders of woods, swamps		X			X		X		
Viburnum rafinesquianum Schultes var. affine (Bush) House Downy-arrow-wood--open woods, barrens		X					X		

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Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Viburnum trilobum Marsh. Highbush cranberry--cool woods, thickets		X	X						
Dipsacaceae--Teasel family									
Dipsacus sylvestris Huds. Wild teasel--roadsides, old fields		X					X	X	
Cucurbitaceae--Gourd family									
Echinocystis lobata (Michx.) T. & G. Wild cucumber--fence rows, fields		X					X	X	
Campanulaceae--Bluebell family									
Campunula aparinoides Pursh.--Marsh Bluebell--meadows, swales, wet areas					X	X	X		
Campanula rapunculoides L. var. ucranica (Bess.) K. Koch Bell flower--roadsides, meadows, thickets		X					X	X	
Campanula rotundifolia L. Harebell--open meadows, dry banks		X				X	X		
Campanula uliginosa Rybd. Marsh bluebell--marsh meadows, wet areas									
Lobelia cardinalis L. Cardinal flower--water shores, wet places					X				X

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Lobelia inflata L. Indian tobacco--wet meadows, wet thickets		X			X		X		
Lobelia kalmii L. Lobelia--moist cliffs, gorges, wet acres		X			X				
Lobelia spicata Lam. Highbelia--weedy meadows, thickets		X					X		
Compositae--Composite family									
Achillea borealis Bong. Yarrow--upper beach, dunes								X	
Achillea lanulosa Nutt. Yarrow--upper beach, dunes							X		
Achillea millefolium L. Common yarrow--roadsides, fields						X	X	X	
Achillea ptarmica L. Sneezeweed--damp fields, roadsides						X	X	X	
Ambrosia artemisiifolia L. Ragweed--fields, roadsides		X					X	X	
Anaphalis margaritacea (L.) C. B. Clarke Pearly everlasting--dry roadsides, fields		X				X	X	X	
Antennaria canadensis Greene Pussy's toes--roadsides, pastures		X				X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Antennaria fallax Greene Pussy's toes--pastures, open woods, lower altitudes		X				X	X	X	
Antennaria neodioica Greene Pussy's toes--dry fields, pastures, rocky barrens						X	X	X	
Antennaria parlinii Fern. Pussy's toes--thin woods, fields		X				X	X		
Antennaria petaloidea Fern. Pussy's toes--roadsides, fields, pastures, open thickets		X				X	X	X	
Anthemis cotula L. Mayweed--yards, roadsides								X	
Articum lappa L. Great burdock--waste places							X	X	
Articum minus (Hill) Bernh. Burdock--waste places							X	X	
Artemisia caudata Michx. var. calvens Lunell Wormwood--upper beaches, dunes							X		
Aster acuminatus Michx. Wood aster--woods, clearings		X	X				X		
Aster cordifolius L. Aster--open woods, thickets, clearings		X					X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Aster linariifolius L. Aster--dry, open soil; sandy areas							X	X	
Aster macrophyllus L. Aster--dry, moist, open woods; thickets, clearings		X					X	X	
Aster novae-angliae L. New England aster--dry soil, damp thickets, shores, meadows, roadsides		X				X	X	X	
Aster prenanthoides Muhl. Aster--thickets, woods, shores, gorges, lower altitudes		X	X		X				
Aster puniceus L. Purple aster--wet places					X		X		
X Aster tardiflorus L. Aster--fields						X	X		
Aster tradescanti L. Aster--damp gravelly shores; pastures, swamps					X	X	X		X
Aster umbellatus Mill. --thickets, woods, borders, pastures, swamps		X	X		X	X	X		
Bidens bipinnata L. Spanish needles--waste places							X	X	
Bidens cernua L. Stick-tight--wet places					X				

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Bidens vulgata Greene Beggar-ticks--ditches, roadsides, moist fields		X				X	X	X	
Centaurea maculosa Lam. Star-thistle--dry pastures, fields, roadsides		X				X	X	X	
Centaurea nigra L., var. radiata DC. Knapweed--fields, roadsides						X	X	X	
Chrysanthemum balsimata L. Costmary--pastures, roadsides						X	X	X	
Chrysanthemum leucanthemum L. Ox-eyed daisy--fields, roadsides						X	X	X	
Cichorium intybus L. Chicory--roadsides, fields						X	X	X	
Cirsium arvense (L.) Scop. Canada thistle--pastures						X	X		
Cirsium muticum Michx. Swamp thistles--swamps, marsh meadows					X				
Cirsium discolor (Muhl.) Spreng. Thistle--thickets, riverbanks		X							
Cirsium vulgare (Savi.) Tenore Common bull thistle--fields						X	X	X	
Erigeron annuus (L.) Pers. Daisy fleabone--dry roadsides, fields						X	X	X	

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Erigeron canadensis L. Horseweed--waste places							X	X	
Erigeron philadelphicus L. Fleabane--shales, slopes, gorges		X					X		
Erigeron pulchellus Michx. Robin's-plantain--roadsides, meadows		X					X	X	
Erigeron strigosus Muhl. Daisy fleabane--dry roadsides		X					X	X	
Eupatorium maculatum L. Joe-pye-weed--swamps, wet areas					X				
Eupatorium perfoliatum L. Thoroughwort--open swamps, depressions in woods, lower altitudes				X	X				
Eupatorium rugosum Houtt. White snakeroot--open swamps, wooded banks		X	X		X				
Gnaphalium macounii Greene Everlasting--clearings, pastures, woods borders		X				X	X	X	
Gnaphalium obtusifolium L. Common everlasting--open sands							X	X	
Gnaphalium uliginosum L. Low cudweed--roadsides, ditches					X		X	X	
Helenium autumnale L. Sneezeweed--thickets, meadows, shores		X			X		X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Hieracium canadense Michx. Hawkweed--roadsides, thickets		X					X	X	
Hieracium aurantiacum L. Orange hawkweed--clearings, fields						X	X	X	
Hieracium florentinum All. King devil--pastures, meadows		X				X	X	X	
Hieracium paniculatum Michx. Hawkweed--open woods, pastures		X				X	X	X	
Hieracium scabrum Michx. Hawkweed--dry roadsides								X	
Inula helenium L. Elecampane--developed areas								X	
Lactuca biennis (Moench) Fern. Blue lettuce--moist roadsides							X	X	
Lactuca canadensis L. Lettuce--roadsides						X	X	X	
Polymnia canadensis L. Leafcup--limestone woods		X	X						
Prenanthes alba L. White lettuce--roadsides, woods, thickets		X	X				X	X	
Prenanthes altissima L. Snake-root--moist woods			X	X					

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Rudbeckia hirta L. Black-eyed susan--meadows, roadsides						X	X	X	
Rudbeckia laciniata L. Cone-flower--roadsides								X	
Senecio aureus L. Golden ragwort--calcareous woods, wet spots		X	X		X				
Senecio obovatus Muhl. Golden ragwort--marsh meadows, wet pastures					X	X	X		
Senecio vulgaris L. Common groundsel--wastelands								X	
Solidago caesia L. var. axillaris (Pursh.) Gray Blue stem goldenrod--deciduous woods, thickets, clearings		X	X				X		
Solidago bicolor L. White goldenrod--sterile soils		X					X	X	
Solidago canadensis L. Goldenrod--thickets, roadsides, marsh meadows		X			X	X	X	X	
Solidago flexicaulis L. Goldenrod--woodsides, banks		X	X						
Solidago gigantea Ait. Goldenrod--stabilized dunes		X					X		

Appendix 4. Plants of the Tug Hill Region.

Plants and habitats	Occurrence by vegetation type								
	Plantations	Successional forests and brushlands	Well drained mature forest	Wet woods	Wetlands	Active agriculture	Successional fields	Developed lands	Water
Solidago graminifolia (L.) Salisb. --shores, pastures, marshes					X	X	X	X	
Solidago hispida Muhl. Dry, moist rocky places		X					X		
Solidago juncea Ait. --dry, open soil; roadsides		X					X	X	
Solidago macrophylla Pursh. --cold, damp woods; thickets		X	X	X					
Solidago nemoralis Ait. --dry, sterile soil; roadsides							X	X	
Solidago rugosa Ait. --damp soil, roadsides		X			X		X	X	
Solidago uliginosa Nutt. --swamps, meadows					X		X		
Tanacetum vulgare L. Common tansy--roadsides						X	X	X	
Taraxacum officinale Weber Dandelion--gardens, yards, roadsides fields		X				X	X	X	
Tragopogon pratensis L. Goats-beard--fields, roadsides						X	X	X	
Tussilago farfara L. Coltsfoot--moist ground					X	X	X		
Xanthium strumarium L. var. canadense (Mill) T. & G. Cocklebur--mid-beach, dunes							X		

Appendix 5 . Rare or endangered plants of the Tug Hill Region.

The following list was compiled with the assistance of Mr. Stanley J. Smith, Curator of the Herbarium, New York State Museum, Albany, New York. All species tabulated below occur within the Region. "Rare" species have been collected and recorded throughout the state fewer than 10 times. While they must be considered "Endangered", we have also included "Endangered" plants which, although collected somewhat more frequently, occur only in isolated stations, particularly along the Lake Ontario shoreline.

Equisetaceae
- Equisetum variegatum Schleich.--Variegated horsetail
- Equisetum scirpoides Michx.--Dwarf scouring-rush

Lycopodiaceae
- Lycopodium complanatum L. var. complanatum--Ground cedar

Selaginellaceae
- Selaginella rupestris (L.) Spring--Spikemoss

Ophioglossaceae
- Botrychium simplex E. Hitchc. var. simplex--Grape-fern
- Botrychium simplex E. Hitchc. var. tenebrosum (A.A. Eat.) Clausen--Grape-fern

Schizaeaceae
- Lygodium palmatum (Bernh.) Sw.--Climbing fern

Polypodiaceae
- Asplenium viride Huds.--Green spleenwort
- Cryptogamma stelleri (Gmel.) Prantl.--fragile rock-brake
- Polystichum braunii (Spenner) Fee--Braun's Holly-fern
- Woodwardia virginica (L.) Sm.--Virginian chain-fern

Zosteraceae
- Potamogeton alpinus Balbis--Pondweed
- Potamogeton pulcher Tuckem.--Pondweed

Juncaginaceae
- Scheuchezeria palustris L. var. americana Fern.--Arrow grass

Gramineae
- Ammophlia breviligulata Fern.--Beachgrass
- Panicum commonsianum Ashe--Common's panic-grass
- Panicum subvillosum Ashe--Panic-grass
- Panicum aculeatum Hitchc. & Chase--Tall rough panic-grass

Cyperaceae
- Cyperus engelmannii Steud.--Engelmann's cyperus
- Scirpus heterochaetus Chase--Slender bulrush
- Carex aenea Fern.--Sedge
- Carex atherodes Spreng.--Sedge
- Carex buxbaumii Wahlenb.--Sedge
- Carex canescens L. var. disjuncta Fern.--Sedge

Appendix 5 Continued.

X Carex knieskernii Dew.--Sedge
Carex chordorrhiza L.--Sedge
Carex emmonsii Dew.--Sedge
Carex haydenii Dew.--Sedge
Carex sychnocephala Carey--Sedge

Juncaceae
Luzula multiflora (Retz.) Lejeune var. fusconigra Celak.--Rush

Orchidaceae
X Habenaria andrewsii M. White--Orchis
Listera auriculata Wieg.--Auricled twayblade
Listera convallarioides (Sw.) Nutt.--Broad-lipped twayblade

Salicaceae
Salix syrticola Fern.--Sand-dune willow

Utricaceae
Boehmeria cylindrica (L.) Sw. var. drummondriana Webb.--Bog-hemp.

Ceratophyllaceae
Ceratophyllum echinatum Gray--Hornwort

Ranunculaceae
Ranunculus subrigidus W.B. Drew--Crawfoot

Papaveraceae
Corydalis aurea Willd. var. aurea--Golden corydalis

Cruciferae
Cakile edentula (Bigel.) Hook. var. edentula--Sea rocket

Rosaceae
Amelanchier canadensis (L.) Medic.--Juneberry
Rubus frondosus Bigel.--Leafy bramble
Rubus glandicaulis Blanch.--Bramble
Rubus signatus L. var. major Blanch.--Bramble
Prunus pumila L. var. pumila--Sandcherry

Leguminosae
Lathyrus palustris L. var. linearifolius Ser.--Vetchling
X Lespedeza nuttallii Darl.--Bush-clover

Callithrichaceae
Callitriche deflexa A.Br. var. Austini (Engelm.) Hegelm.--Water-storwart

Aquifoliaceae
Ilex verticillata (L.) Gray var. padifolia (Willd.) T. & G.--Holly

Violaceae
Viola labradorica Schrank.--Violet

Ericaceae
Vaccinium uliginosum L.--Bilberries

Appendix 5 Continued.

Scrophulariaceae
Lindernia dubia (L.) Pennell var. dubia--False pimpernel

Compositae
X Aster tardiflorus L.--Aster

Appendix 6. Vertebrates of the Tug Hill Region.

The following catalog of vertebrate species and classification by habitat, abundance, and residential status is based upon 16 sources: 1. Mammals of the Great Lakes Region, by W. H. Burt (1957); 2. Mammals of the Tug Hill Plateau, New York, by P. F. Connor (1966); 3. Keys to the Vertebrates of the Eastern United States Excepting Birds, by J. O. Whitaker, Jr. (1968); 4. Checklist of North American Birds, by the American Ornithologists' Union (1957); Thirty-second supplement to the North American Ornithologists' Union checklist of North American birds, by its Committee on Classification and Nomenclature (1973); 6. Birds of North Country New York, by D. C. Gordon (1968); 7. Field Notes of Birds in the Tug Hill Region, by F. G. Scheider (1973); 8. The Salamanders of New York, by S. C. Bishop (1941); 9. Handbook of Turtles: The Turtles of the United States, Canada, and Baja California, by A. Carr (1952); 10. A Checklist of North American Amphibians and Reptiles, by L. Stejneger and T. Barbour (1033); 11. Amphibians and Reptiles Observed on the Tug Hill Plateau, Lewis County, During 1960, by P. F. Connor (1973); 12. A list of common and scientific names of fishes of the United States and Canada, 3rd ed., by the American Fisheries Society (1970); 13. Catalogue of the Fishes of New York, by T. H. Bean, (1903); 14. Cornell University Survey of the Fishes of Oneida Lake, by M. Clady and J. Forny (1973); 15. Fishes of the Great Lakes Region, by L. L. Hubbs and K. F. Lagler (1958); and 16. New York State Department of Environmental Conservation Fish Surveys, by its staff (1973).

Codes for their classification include:

General habitat

W - - woodland or forest
F - - field and farmland
O - - Lake Ontario and its shoreline
L - - lake or pond
M - - marsh or wetland
S - - stream and brook
R - - river

Apparent abundance

1 - - common
2 - - uncommon
3 - - rare

Residential status

r - - resident
m - - migrant
i - - irregular transient

Appendix 6. Continued.

List of mammals	Habitat	Abundance	Status
Class Mammalia			
Order Marsupialia			
Family Didelphiidae - Opossums			
Opossum - - Didelphis marsupialis L.	F	1	r
Order Insectivora			
Family Soricidae - Shrews			
Masked shrew - - Sorex cinereus Kerr	W,F	1	r
Smoky shrew - - Sorex fumeus Miller	W	2	r
Water shrew - - Sorex palustris Richardson	W,M	1	r
Longtail shrew - - Sorex dispar Batchelder	W	2	r
Pigmy shrew - - Microsorex hoyi (Baird)	W,F	3	r
Least shrew - - Cryptotis parva (Say)	F	3	r
Short-tailed shrew - - Blarina brevicauda (Say)	W,F	1	r
Family Talpidae - Moles			
Common mole - - Scalopus aquaticus (L.)	F	1	r
Hairy-tailed mole - - Parascalops breweri (Bachman)	F	1	r
Star-nosed mole - - Condylura cristata (L.)	F,M	1	r
Order Chiroptera			
Family Vespertilionidae - Common bats			
Little brown bat - - Myotis lucifugus (Le Conte)	W,F	1	r
Indiana bat - - Myotis sodalis Miller and Allen	W	3	r
Keen's bat - - Myotis keenii (Merriam)	W	2	r
Small-footed bat - - Myotis subulatus (Say)	W	2	r
Silver-haired bat - - Lasionycteris noctivagans (LeConte)	W	2	m
Eastern pipistrelle - - Pipistrellus subflavus (Cuvier)	W	2	r
Big brown bat - - Eptisicus fuscus (Beauvois)	W,F	2	r
Red bat - - Lasiurus borealis (Müller)	W	2	m
Hoary bat - - Lasiurus cinereus (Beauvois)	W	3	m
Order Lagomorpha			
Family Leporidae - Hares and Rabbits			
Varying hare - - Lepus americanus Erxleben	W	1	r
European hare - - Lepus europaeus Pallas	F	3	r
Eastern cottontail - - Sylvalagus floridanus (Allen)	F	1	r

Appendix 6. Continued.

List of mammals	Habitat	Abundance	Status
Order Rodentia			
Family Sciuridae - Squirrels			
Woodchuck - - Marmota monax (L.)	W,F	1	r
Chipmunk - - Tamias striatus (L.)	W	1	r
Red squirrel - - Tamiasciurus hudsonicus (Erxleben)	W	2	r
Gray squirrel - - Sciurus carolinensis Gmelin	W	2	r
Southern flying squirrel - - Glaucomys volans (L.)	W	2	r
Northern flying squirrel - - Glaucomys sabrinus (Shaw)	W	2	r
Family Castoridae - Beavers			
Beaver - - Castor canadensis Kuhl	L,S	1	r
Family Cricetidae - Mice, Rats, and Voles			
Deer mouse - - Peromyscus maniculatus (Wagner)	W,F	1	r
White-footed mouse - - Peromyscus leucopus (Rafinesque)	W,F	2	r
Southern bog lemming - - Synaptomys cooperi Baird	F,M	2	r
Red-backed vole - - Clethrionomys gapperi (Vigors)	F	2	r
Meadow vole - - Microtus pennsylvanicus (Ord)	F,M	1	r
Pine vole - - Microtus pinetorum (LeConte)	W,F	2	r
Muskrat - - Ondatra zibethicus (L.)	O,L,M	1	r
Family Muridae - Old World Rats and Mice			
Norway rat - - Rattus norvegicus (Berkenhout)	F	1	r
House mouse - - Mus musculus L.	F	1	r
Family Zapodidae - Jumping Mice			
Meadow jumping mouse - - Zapus hudsonicus (Zimmerman)	W,F	1	r
Woodland jumping mouse - - Napaeozapus insignis (M ller)	W	2	r
Family Erethizontidae - Porcupines			
Porcupine - - Erethizon dorsatum (L.)	W	1	r
Order Carnivora			
Family Canidae - Coyotes and Foxes			
Coyote - - Canis latrans	W,F	2	r
Gray fox - - Urocyon cinereoargenteus (Schreber)	W,F	2	r
Red fox - - Vulpes vulpes L.	F	1	r

Appendix 6. Continued.

List of mammals	Habitat	Abundance	Status
Family Procyonidae - Raccoons			
Raccoon - - Procyon lotor (L.)	W,M	1	r
Family Ursidae - Bears			
Black bear - - Ursus americanus Pallas	W	3	i
Family Felidae - Cats			
Lynx - - Lynx canadensis Kerr	W	3	i
Bobcat - - Lynx rufus (Schreber)	W	2	r
Family Mustelidae - Weasel-like Mammals			
Marten - - Martes americana (Turton)	W	3	i
Fisher - - Martes pennanti (Exleben)	W	2	i
Short-tailed weasel - - Mustela erminea L.	W,F	1	r
Long-tailed weasel - - Mustela frenata Lichtenstein	W,F	1	r
Mink - - Mustela vison Schreber	W,S	1	r
River otter - - Lutra canadensis (Schreber)	L,S	2	r
Striped skunk - - Mephitis mephitis (Schreber)	W,F	1	r
Order Artiodactyla			
Family Cervidae - Deer			
White-tailed deer - - Odocoileus virginianus (Zimmermann)	W,F	2	r
List of birds			
Class Aves			
Order Gaviiformes			
Family Gaviidae - Loons			
Common loon - - Gavia immer (Brünnich)	O,L	2	m
Arctic loon - - Gavia arctica (L.)	O	3	i
Red-throated loon - - Gavia stellata (Pontoppidan)	O,L	3	m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Order Podicipediformes			
Family Podicipedidae - Grebes			
Red-necked grebe - - Podiceps grisegena (Boddaert)	O,L	2	i
Horned grebe - - Podiceps auritus (L.)	O,L	1	m
Pied-billed grebe - - Podilymbus podiceps (L.)	O,L	1	r,m
Order Pelicaniformes			
Family Phalacrocoracidae - Comorants			
Double-crested comorant - - Phalacrocorax auritus (Lesson)	O	2	m
Order Ciconiiformes			
Family Ardeidae - Herons and Bitterns			
Great blue heron - - Ardea herodias L.	O,L	1	r,m
Green heron - - Butorides virescens (L.)	O,L	1	r,m
Little blue heron - - Florida caerulea (L.)	O,L	3	i
Cattle egret - - Bubulcus ibis L.	O,L	3	i
Common egret - - Casmerodius albus (L.)	O,L	3	i
Snowy egret - - Leucophoyx thula (Molina)	O,L	3	i
Black-crowned night heron - - Nycticorax nycticorax (L.)	O,L	2	m
Least bittern - - Ixobrychus exilis (Gmelin)	O,L,M	3	r
American bittern - - Botaurus lentiginosus (Rackett)	O,L,M	1	r
Family Threskiornithidae - Ibises			
Glossy ibis - - Plegadis falcinellus (L.)	O,L	3	i
Order Anseriformes			
Family Anatidae - Swans, Geese, and Ducks			
Mute swan - - Cygnus olor (Gmelin)	O,L,R	3	i
Whistling swan - - Olor columbianus (Ord)	O	3	i
Canada goose - - Branta canadensis (L.)	O,L	1	m
Brant - - Branta bernicla (L.)	O,L	2	m
Snow goose - - Chen hyperborea (Pallas)	O,L,M	3	i
Mallard - - Anas platyrhynchos L.	O,L,M	1	r,m
Black duck - - Anas rubripes Brewster	O,L,M	1	r,m
Gadwall - - Anas strepera L.	O	2	m
Pintail - - Anas acuta L.	O,L,M	1	m
Green-winged teal - - Anas carolinensis Gmelin	O,L,M	1,3	m,r
Blue-winged teal - - Anas discors L.	O,L,M	1	r
American widgeon - - Mareca americana (Gmelin)	O,L,M	1	m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Shoveler - - Spatula clypeata (L.)	O,L,M	3	m
Wood duck - - Aix sponsa (L.)	L,R,M	1	r
Redhead - - Aythya americana (Eyton)	L	2	m
Ring-necked duck - - Aythya collaris (Donovan)	L,M	2	m
Canvasback - - Aythya valisineria (Wilson)	O,L,M	2	m
Greater scaup - - Aythya marila (L.)	O,L,M	1	m
Lesser scaup - - Aythya affinis (Eyton)	O,L,M	3	m
Common goldeneye - - Bucephala clangula (L.)	O,L	1	m
Bufflehead - - Bucephala albeola (L.)	O,L,R	1	m
Oldsquaw - - Clangula hyemalis (L.)	O,L	1	m
Common eider - - Somateria mollissima (L.)	O,L	3	i
King eider - - Somateria spectabilis (L.)	O,L	3	i
White-winged scoter - - Melanitta deglandi (Bonaparte)	O,L	2	m
Surf scoter - - Melanitta perspicillata (L.)	O,L	3	m
Common scoter - - Oidemia nigra (L.)	O,L	3	m
Ruddy duck - - Oxyura jamaicensis (Gmelin)	O,L,R	2	m
Hooded merganser - - Lophodytes cucullatus (L.)	L,S	2	r,m
Common merganser - - Mergus merganser L.	L,R,S	1,3	m,r
Red-breasted merganser - - Mergus serrator L.	L,R	1	r,m
Order Falconiformes			
Family Cathartidae - American Vultures			
Turkey vulture - - Cathartes aura (L.)	W,F	2	r,m
Family Accipitridae - Hawks			
Goshawk - - Accipiter gentilis (L.)	W,F	3	r,m
Sharp-shinned hawk - - Accipiter striatus Vieillot	W,F	3,2	r,m
Cooper's hawk - - Accipiter cooperii (Bonaparte)	W,F	3	r,m
Red-tailed hawk - - Buteo jamaicensis (Gmelin)	W,F	1	r,m
Red-shouldered hawk - - Buteo lineatus (Gmelin)	W,F	3	r,m
Broad-winged hawk - - Bueto platypterus (Vieillot)	W,F	2	r,m
Rough-legged hawk - - Bueto lagopus (Pontoppidan)	F,M	2	m
Golden eagle - - Aquila chrysaetos (L.)	W,F	3	i
Bald eagle - - Haliaeetus leucocephalus (L.)	W,F,O	3	m
March hawk - - Circus cyaneus (L.)	F,M	2	m
Osprey - - Pandion haliaetus (L.)	O,L,R	2	m
Family Falconidae - Falcons			
Gryfalcon - - Falco rusticolus L.	O	3	i
Peregrine falcon - - Falco peregrinus Tunstall	O,W,F	3	i
Pigeon hawk - - Falco columbarius L.	O,F	3	m
Sparrow hawk - - Falco sparverius L.	W,F	1	r,m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Order Galliformes			
Family Tetraonidae - Grouse			
Spruce grouse - - Canachites canadensis (L.)	W	3	i
Ruffed grouse - - Bonasa umbellus (L.)	W	1	r
Family Phasianidae - Pheasants			
Ring-necked pheasant - - Phasianus colchicus L.	W,F	1	r
Gray partridge - - Perdix perdix (L.)	F	3	r
Family Meleagrididae - Turkeys			
Turkey - - Meleagris gallopavo L.	W,F	3	r
Order Gruiformes			
Family Rallidae - Rails, Gallinules, and Coots			
Virginia rail - - Rallus limicola Vieillot	M	1	r,m
Sora - - Porzana carolina (L.)	M	1	r,m
Common gallinule - - Gallinula chloropus (L.)	M	1	r,m
American coot - - Fulica americana Gmelin	O,L	1	m
Order Charadriiformes			
Family Charadriidae - Plovers, Turnstones, and Surfbirds			
Simipalmated plover - - Charadrius semipalmatus Bonaparte	O	1	m
Piping plover - - Charadrius melodus Ord	O	3	i
Killdeer - - Charadrius vociferus L.	O,F	1	m,r
American golden plover - - Pluvialis dominica (Müller)	O,L	3	m
Black-bellied plover - - Squatarola squatarola (L.)	O,L	2	m
Ruddy turnstone - - Arenaria interpres (L.)	O,L	2	m
Family Scolopacidae - Woodcock, Snipe, and Sandpipers			
American woodcock - - Philohela minor (Gmelin)	W,M	1	r,m
Common snipe - - Capella gallinago (L.)	R,M	2	r,m
Whimbrel - - Numenius phaeopus (L.)	O,F,M	3	i
Upland plover - - Bartramia longicauda (Bechstein)	O,F	3	r,m
Spotted sandpiper - - Actitis macularia (L.)	O,L,M	1	m,r
Solitary sandpiper - - Tringa solitaria Wilson	O,L,M	2	m
Willet - - Catoptrophorus semipalmatus (Gmelin)	O,L	3	i
Greater yellowlegs - - Totanus melanoleucus (Gmelin)	O,L,M	2	m
Lesser yellowlegs - - Totanus flavipes (Gmelin)	O,L,M	1	m
Knot - - Calidris canutus (L.)	O,L	2	m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Purple sandpiper - - Erolia maritima (Brünnich)	O	3	i
Pectoral sandpiper - - Erolia melanotos (Vieillot)	O,L,F,M	2	m
White-rumped sandpiper - - Erolia fuscicollis (Vieillot)	O,L,M	2	m
Baird's sandpiper - - Erolia bairdii (Coues)	O,L,M	2	m
Least sandpiper - - Erolia minutilla (Vieillot)	O,L,R	1	m
Dunlin - - Erolia alpina (L.)	O	1	m
Short-billed dowitcher - - Limnodromus griseus (Gmelin)	O	1	m
Long-billed dowitcher - - Limnodromus scolopaceus (Say)	O, L	3	m
Stilt sandpiper - - Micropalama himantupus (Bonaparte)	O,M	2	m
Semipalmated sandpiper - - Ereunetes pusillus (L.)	O,L	1	m
Western sandpiper - - Ereunetes mauri Cabanis	O	3	m
Buff-breasted sandpiper - - Tryngites subruficollis (Vieillot)	O,F	3	i
Marbled godwit - - Limosa fedoa (L.)	O	3	i
Hudsonian godwit - - Limosa haemastica (L.)	O,M	3	i
Sanderling - - Crocethia alba (Pallas)	O	1	m
Family Phalaropodidae - Phalaropes			
Red phalarope - - Phalaropus fulicarius (L.)	O,L	3	m
Wilson's phalarope - - Steganopus tricolor Vieillot	O,L	3	i
Northern phalarope - - Lobipes lobatus (L.)	O,L	3	m
Family Stercorariidae - Jaegers and Skuas			
Pomarine jaeger - - Stercorarius pomarinus (Temminck)	O,L	3	m
Parasitic jaeger - - Stercorarius parisiticus (L.)	O,L	3	i
Family Laridae - Gulls and Terns			
Glaucous gull - - Larus hyperboreus Gunnerus	O,L	3	m
Iceland gull - - Larus glaucoides Meyer	O,L	3	m
Great black-backed gull - - Larus marinus L.	O,L	2	m
Herring gull - - Larus argentatus Pontoppidan	O,L	1	m
Ring-billed gull - - Larus delawarensis Ord	O,L	1	m
Black-headed gull - - Larus ridibundus L.	O	3	i
Laughing gull - - Larus atricilla L.	O	3	i
Franklin's gull - - Larus pipixcan Wagler	O	3	i
Bonaparte's gull - - Larus philadelphia (Ord)	O,L	2	m
Little gull - - Larus minutus Pallas	O	3	i
Black-legged kittiwake - - Rissa tridactyla (L.)	O	3	i
Forster's tern - - Sterna forsteri Nuttall	O	3	m
Common tern - - Sterna hirundo L.	O,L	1	r,m
Caspian tern - - Hydroprogne caspia (Pallas)	O,L	2	r,m
Black tern - - Chlidonias niger (L.)	O,L	2	r

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Order Columbiformes			
Family Columbidae - Pigeons and Doves			
Rock dove - - Columba livia Gmelin	F	1	r
Mourning dove - - Zenaidura macroura (L.)	F	1	r,m
Order Cuculiformes			
Family Cuculidae - Cuckoos			
Yellow-billed cuckoo - - Coccyzus americanus (L.)	W,F	3	r,m
Black-billed cuckoo - - Coccyzus erythropthalmus (Wilson)	W,F	2	r,m
Order Strigiformes			
Family Tytonidae - Barn owls			
Barn owl - - Tyto alba (Scopoli)	F,M	3	r
Family Strigidae - Typical owls			
Screech owl - - Otus asio (L.)	W,F	2	r
Great horned owl - - Bubo virginianus (Gmelin)	W,F	2	r
Snowy owl - - Nyctea scandiaca (L.)	O,F	3	i
Hawk owl - - Surnia ulula (L.)	W,F	3	i
Barred owl - - Strix varia Barton	W,F,M	2	r
Long-eared owl - - Asio otus (L.)	W,F	3	r
Short-eared owl - - Asio flammeus (Pontoppidan)	F,M	3	m
Boreal owl - - Aegolius funereus (L.)	W	3	i
Saw-whet owl - - Aegolius acadicus (Gmelin)	W	3	r,m
Order Caprimulgiformes			
Family Caprimulgidae - Goatsuckers			
Whip-poor-will - - Caprimulgus vociferus Wilson	W,F	2	r
Common nighthawk - - Chordeiles minor (Forster)	F	2	r
Order Apodiformes			
Family Apodidae - Swifts			
Chimney swift - - Chaetura pelagica (L.)	F	1	r,m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Family Trochilidae - Hummingbirds			
Ruby-throated hummingbird - - Archilochus colubris (L.)	W,F,S	2	r,m
Order Coraciiformes			
Family Alcedinidae - Kingfishers			
Belted Kingfisher - - Megaceryle alcyon (L.)	O,L.R	2	r,m
Order Piciformes			
Family Picidae - Woodpeckers			
Yellow-shafted flicker - - Colaptes auratus (L.)	W,F	1	r,m
Pileated woodpecker - - Dryocopus pileatus (L.)	W	2	r
Red-headed woodpecker - - Melanerpes erythrocephalus (L.)	F,W	3	r,m
Yellow-bellied sapsucker - - Sphyrapicus varius (L.)	W	1	r,m
Hairy woodpecker - - Dendrocopos villosus (L.)	W	1	r,m
Downy woodpecker - - Dendrocopos pubescens (L.)	W	1	r,m
Black-backed three-toed woodpecker - - Picoides arcticus (Swainson)	W	3	i
Northern three-toed woodpecker - - Picoides tridactylus (L.)	W	3	i
Order Passeriformes			
Family Tyrannidae - Tyrant Flycatchers			
Eastern kingbird - - Tyrannus tryannus (L.)	W,F	1	r,m
Great-crested flycatcher - - Myiarchus crinitus (L.)	W	1	r,m
Eastern phoebe - - Sayornis phoebe (Latham)	R,S,F	1	r,m
Yellow-bellied flycatcher - - Empidonax flaviventris (Baird & Baird)	F	3	r,m
Willow flycatcher - - Empidonax traillii (Audubon)	F,M	1	r,m
Alder flycatcher - - Empidonax alnorum Brewster	M,W	2	r,m
Least flycatcher - - Empidonax minimus (Baird & Baird)	W,F	1	r,m
Eastern wood pewee - - Contopus virens (L.)	F,W	1	r,m
Olive-sided flycatcher - - Nuttallornis borealis (Swainson)	W	2	r,m
Family Alaudidae - Larks			
Horned lark - - Eremophila alpestris (L.)	O,F	2	r,m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Family Hirundinidae - Swallows			
Tree swallow - - Iridoprocne bicolor (Vieillot)	O,L,R,S,M,F	1	r,m
Bank swallow - - Riparia riparia (L.)	O,L,R,F	1	r,m
Rough-winged swallow - - Stelgidopteryx ruficollis (Vieillot)	O,L	2	r,m
Barn swallow - - Hirundo rustica L.	R,S,F	1	r,m
Cliff swallow - - Petrochelidon pyrrhonota (Vieillot)	L,F	2	r,m
Purple martin - - Progne subis (L.)	O,L,F	1	r,m
Family Corvidae - Jays and Crows			
Blue jay - - Cyanocitta cristata (L.)	W,F	1	r,m
Common crow - - Corvus brachyrhynchos Brehm	F,M	1	r,m
Family Paridae - Titmice, verdins, and bushtits			
Black-capped chickadee - - Parus atricapillus L.	W	1	r,m
Boreal chickadee - - Parus hudsonicus Forster	W	3	i
Tufted titmouse - - Parus bicolor L.	W	3	i
Family Sittidae - Nuthathches			
White-breasted nuthatch - - Sitta carolinensis Latham	W	1	r,m
Red-breasted nuthatch - - Sitta canadensis L.	W	2	r,m
Family Certhiidae - Creepers			
Brown creeper - - Certhia familiaris L.	W	1	r,m
Family Troglodytidae - Wrens			
House wren - - Troglodytes aedon Vieillot	W,F	1	r,m
Winter wren - - Troglodytes troglodytes (L.)	W	2	r,m
Carolina wren - - Thryothorus ludovicianus (Latham)	W	3	i
Long-billed marsh wren - - Telmatodytes palustris (Wilson)	M	2	r,m
Short-billed marsh wren - - Cistothorus platensis (Latham)	F,M	3	r,m
Family Mimidae - Mockingbirds and Thrashers			
Mockingbird - - Mimus polyglottos (L.)	F	3	r
Catbird - - Dumetella carolinensis (L.)	W,M	1	r,m
Brown thrasher - - Toxostoma rufum (L.)	W,F	2	r,m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Family Turdidae - Thrushes, Solitaires, and Bluebirds			
Robin - - Turdus migratorius L.	W,F	1	m,r
Wood thrush - - Hylocichla mustelina (Gmelin)	W,F	1	m,r
Hermit thrush - - Hylocichla guttata (Pallas)	W	2	m,r
Swainson's thrush - - Hylocichla ustulata (Nuttall)	W	2	m,r
Gray-cheeked thrush - - Hylocichla minima (Lafrsnaye)	W	2	m
Veery - - Hylocichla fuscescens (Stephens)	W,M	1	m,r
Eastern bluebird - - Sialia sialis (L.)	W,F	2	m,r
Family Sylviidae - Gnatcatchers and Kinglets			
Blue-gray gnatcatcher - - Polioptila caerulea (L.)	W	3	i
Golden-crowned kinglet - - Regulus satrapa Lichtenstein	W	1,2	m,r
Ruby-crowned kinglet - - Regulus calendula (L.)	W	1	m
Family Motacillidae - Wagtails and Pipits			
Water pipit - - Anthus spinoletta (L.)	O,F	2	m
Family Bombycillidae - Waxwings			
Bohemian waxwing - - Bombycilla garrula (L.)	W	3	i
Cedar waxwing - - Bombycilla cedrorum Vieillot	F,W	1	r
Family Laniidae - Shrikes			
Northern shrike - - Lanius excubitor L.	W,F	2	m
Loggerhead shrike - - Lanius ludovicianus L.	F	2	r
Family Sturnidae - Starlings			
Starling - - Sturnus vulgaris L.	F	1	r
Family Vireonidae - Vireos			
Yellow-throated vireo - - Vireo flavifrons Vieillot	W,F	2	m,r
Solitary vireo - -Vireo solitarius (Wilson)	W	2	m,r
Red-eyed vireo - - Vireo olivaceus (L.)	W	1	m,r
Philadelphia vireo - - Vireo philadelphicus (Cassin)	W,F	2	m
Warbling vireo - - Vireo gilvus (Vieillot)	W	1	m,r
Family Parulidae - Wood Warblers			
Black-and-white warbler - - Mniotila varia (L.)	W	2	m,r
Prothonotary warbler - - Protonotaria citrea (Boddaert)	O	3	i
Golden-winged warbler - - Vermivora chrysoptera (L.)	W,F	2	r,m
Blue-winged warbler - - Vermivora pinus (L.)	W,F	3	m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Tennessee warbler - - Vermivora peregrina (Wilson)	W	1	m
Orange-crowned warbler - - Vermivora celata (Say)	W,F	3	m
Nashville warbler - - Vermivora ruficapilla (Wilson)	W,M	2	m,r
Parula warbler - - Parula americana (L.)	W	2	m
Yellow warbler - - Dendroica petechia (L.)	W,F	1	m,r
Magnolia warbler - - Dendroica magnolia (Wilson)	W	1	m,r
Cape May warbler - - Dendroica tigrina (Gmelin)	W	2	m
Black-throated blue warbler - - Dendroica caerulescens (Gmelin)	W	1,2	m,r
Myrtle warbler - - Dendroica coronata (L.)	W	1,2	m,r
Black-throated green warbler - - Dendroica virens (Gmelin)	W	1	m,r
Cerulean warbler - - Dendroica cerulea (Wilson)	W	3	m
Blackburnian warbler - - Dendroica fusca (Müller)	W	1	m,r
Yellow-throated warbler - - Dendroica dominica (L.)	W	3	i
Chestnut-sided warbler - - Dendroica pensylvanica (L.)	W	1	m,r
Bay-breasted warbler - - Dendroica castanea (Wilson)	W	1	m
Blackpoll warbler - - Dendroica striata (Forster)	W	1	m
Pine warbler - - Dendroica pinus (Wilson)	W	3	m,r
Prairie warbler -- Dendroica discolor (Vieillot	W,F	3	i
Palm warbler - - Dendroica palmarum (Gmelin)	W,F,M	2	m
Ovenbird - - Seiurus aurocapillus (L.)	W	1	m,r
Northern waterthrush - - Seiurus noveboracensis (Gmelin)	M	1	m,r
Louisiana waterthrush - - Seiurus motacilla (Vieillot)	R,M	3	m,r
Connecticut warbler - - Oporornis agilis (Wilson)	W	3	m
Mourning warbler - - Oporornis philadelphia (Wilson)	W	2	m,r
Yellowthroat - - Geothlypis trichas (L.)	F	1	m,r
Yellow-breasted chat - - Icteria virens (L.)	W	3	i
Hooded warbler - - Wilsonia citrina (Boddaert)	W	3	r
Wilson's warbler - - Wilsonia pusilla (Wilson)	W	2	m
Canada warbler - - Wilsonia canadensis (L.)	W	2	m,r
American redstart - - Setophaga ruticilla (L.)	W	1	m,r
Family Ploceidae - Weaver Finches			
House sparrow - - Passer domesticus (L.)	W,F,M	1	r
Bobolink - - Dolichonyx oryzivorus (L.)	F,M	1	m,r
Eastern meadowlark - - Sturnella magna (L.)	F	1	m,r
Yellow-headed blackbird - - Xanthocephalus xanthocephalus (Bonaparte)	M	3	i
Red-winged blackbird - - Agelaius phoeniceus (L.)	F,M	1	m,r
Baltimore oriole - - Icterus galbula (L.)	L,R,S,W,F	1	m,r
Rusty blackbird - - Euphagus carolinus (Müller)	W,F,M	1	m
Common grackle - - Quiscalus quiscula (L.)	W,F	1	r,m
Brown-headed cowbird - - Molothrus ater (Boddaert)	F	1	r,m

Appendix 6. Continued.

List of birds	Habitat	Abundance	Status
Family Thraupidae - Tanangers			
Scarlet tananger - - Piranga olivacea (Gmelin)	W	2	m,r
Family Fringillidae - Grossbeaks, Finches, Sparrows, and Buntings			
Cardinal - - Richmondena cardinalis (L.)	W,F	2	r
Rose-breasted grosbeak - - Pheucticus ludovicianus (L.)	W	1	m,r
Indigo bunting - - Passerina cyanea (L.)	W	1	m,r
Dickcissel - - Spiza americana (Gmelin)	F	3	i
Evening grosbeak - - Hesperiphona vespertina (Cooper)	W	2	m
Purple finch - - Carpodacus purpureus (Gmelin)	W,F	1	r,m
Pine grosbeak - - Pinicola enucleator (L.)	F,W	3	m
Hoary redpoll - - Acanthis hornemanni (Holboell)	W,F	3	i
Common redpoll - - Acanthis flammea (L.)	F	2	m
Pine siskin - - Spinus pinus (Wilson)	W	2	m
American goldfinch - - Spinus tristis (L.)	W,F	1	r,m
Red crossbill - - Loxia curvirostra L.	W	3	m
White-winged crossbill - - Loxia leucoptera Gmelin	W	3	m
Rufous-sided towhee - - Piplo erythrophthalmus (L.)	W,F	1	r,m
Savannah sparrow - - Passerculus sandwichensis (Gmelin)	F	1	m,r
Grasshopper sparrow - - Ammodramus savannarum (Gmelin)	F	2	r,m
Henslow's sparrow - - Passerherbulus henslowii (Audubon)	F	2	r,m
Sharp-tailed sparrow - - Ammospiza caudacuta (Gmelin)	F,M	3	i
Vesper sparrow - - Pooecetes gramineus (Gmelin)	F	2	m,r
Slate-colored junco - - Junco hyemalis (L.)	W,F	1	r,m
Tree sparrow - - Spizella arborea (Wilson)	M,W,F	1	m
Chipping sparrow - - Spizella passerina (Bechstein)	F	1	m,r
Clay-colored sparrow - - Spizella pallida (Swainson)	F	3	i
Field sparrow - - Spizella pusilla (Wilson)	F	1	r,m
White-crowned sparrow - - Zonotrichia leucophrys (Forster)	W,F	1	m
White-throated sparrow - - Zonotrichia albicollis (Gmelin)	W,F	1	r,m
Fox sparrow - - Passerella iliaca (Merrem)	W,F	2	m
Lincoln's sparrow - - Melospiza lincolnii (Audubon)	W,F,M	2	m
Swamp sparrow - - Melospiza georgiana (Latham)	F,M	1	r,m
Song sparrow - - Melospiza melodia (Wilson)	W,F	1	r,m
Lapland longspur - - Calcarius lapponicus (L.)	O,F	3	m
Snow bunting - - Plectrophenax nivalis (L.)	O,F	1	m

Appendix 6. Continued.

	Habitat	Abundance	Status
Class Amphiaia			
Order Caudata			
Family Necturidae - Mudpuppies			
Mudpuppy - - Necturus maculosus (Rafinesque)	O,L,R	2	r
Family Cryptobranchidae - Hellbenders			
Hellbender - - Cryptobranchus alleganiensis (Daudin)	W,L,M	3	r
Family Salamandridae - Newts			
Newt - - Notophthalmus viridescens (Rafinesque)	W,L,M	1	r
Family Amblostomidae - Salamanders			
Blue-spotted salamander - - Amblostoma laterale (Hallowell)	W,M,S	2	r
Jefferson's salamander - - Amblostoma jeffersonianum (Green)	W,M,S	2	r
Spotted salamander - - Amblostoma maculatum (Shaw)	W,L	1	r
Family Plethodontidae - Lungless salamanders			
Four-toed salamander - - Hemidactylium scutatum (Schlegel	W,M	2	r
Red-backed salamander - - Plethodon cinereus (Green)	W	1	r
Slimy salamander - - Plethodon glutinosus (Green)	W	2	r
Purple salamander - - Gyrinophilus porphyriticus (Green)	W,L,M	2	r
Two-lined salamander - - Eurycea bislineata (Green)	W,S	1	r
Long-tailed salamander - - Eurycea longicauda (Green)	W,S	3	r
Dusky salamander - - Desmognathus fuscus (Rafinesque)	W,S	1	r
Mountain salamander - - Desmognathus ochrophaeus (Cope)	W,S	2	r
Order Salientia			
Family Bufonidae - Toads			
American toad - - Bufo americanus Holbrook	W,F	1	r
Fowler's toad - - Bufo fowleri Hinckley	W,F	3	r
Family Hylidae - Tree frogs			
Chorus frog - - Pseudacris nigrita (LeConte)	F,L,M	3	i
Spring-peeper - - Hyla crucifer Wied	W,M	1	r
Tree-toad - - Hyla versicolor (LeConte)	W,M	2	r

Appendix 6. Continued.

List of amphibians and reptiles	Habitat	Abundance	Status
Family Ranidae - True Frogs			
Bullfrog - - Rana catesbeiana Shaw	L,M	1	r
Green frog - - Rana clamitans Latreille	L,M	1	r
Pickerel frog - - Rana palustris Le Conte	F,M	1	r
Leopard frog - - Rana pipiens Schreber	F,M	1	r
Mink frog - - Rana septentrionalis Baird	W,F,M	3	r
Wood frog - - Rana sylvatica Le Conte	W	1	r
Class Reptilia			
Order Squamata			
Family Colubridae - Common Snakes			
Eastern ring-necked snake - - Diadophis punctatus (L.)	W	1	r
Smooth green snake - - Opheodrys vernalis (Harlan)	F	2	r
Black snake - - Coluber constrictor (L.)	W,F	1	r
Rat snake - - Elaphe obsoleta (Say)	F	2	r
Milk snake - - Lampropeltis doliata (L.)	F	2	r
Water snake - - Natrix sipedon (L.)	O,L,M	2	r
DeKay's snake - - Storeria dekayi (Holbrook)	W,F	1	r
Red-bellied snake - - Storeria occipitomaculata (Storer)	W,F	1	r
Ribbon snake - - Thamnophis sauritus (L.)	W,F,M	2	r
Common garter snake - - Thamnophis sirtalis (L.)	W,F	1	r
Massasauga - - Sistrurus catenatus (Rafinesque)	F,M	3	i
Timber rattlesnake - - Crotalus horridus L.	W	3	r
Order Chelonia			
Family Chelydridae - Snapping Turtles			
Common snapping turtle - - Chelydra serpentina (L.)	O,L,M	1	r
Family Testundinidae - Common Turtles			
Spotted turtle - - Clemmys guttata (Schneider)	L,M	1	r
Wood turtle - - Clemmys insculpta (Le Conte)	W,F,L,M	2	r
Muhlenberg turtle - - Clemmys muhlenbergii (Schoepff)	W,M	3	r
Map turtle - - Graptemys geographica (LeSueur)	L,M,S	3	r
Painted turtle - - Chrysemys picta (Schneider)	L,S	1	r
Family Trionychidae - Soft-shelled turtles			
Spiny softshell - - Trionyx spinifer (LeSueur)	L,S	3	r

Appendix 6. Continued.

List of fishes	Habitat	Abundance	Status
Class Agnatha - Jawless fishes			
Order Petromyzontiformes			
Family Petromyzontidae - Lampreys			
Silver lamprey - - Icthyomyzon unicuspis Hubbs and Trautman	O	3	r
American brook lamprey - - Lampetra lamottei (LeSueur)	O,R,S	3	r
Sea lamprey - - Petromyzon marinus L.	O,L	1	r
Class Osteicthyes - Bony Fishes			
Order Acipenseriformes			
Family Acipenseridae - Sturgeons			
Shortnose sturgeon - - Acipenser brevirostrum LeSueur	O	3	r
Lake sturgeon - - Acipenser fulvescens (Rafinesque)	O,R	3	r
Order Semionotiformes			
Family Lepisosteidae - Gars			
Longnose gar - - Lepisosteus osseus (L.)	O,L	2	r
Order Aniiformes			
Family Amiidae - Bowfins			
Bowfin - - Amia calva L.	O,L.R	2	r
Order Anguilliformes			
Family Anguillidae			
American eel - - Anguilla rostrata (LeSueur)	O,L,R	1	r
Order Cupeiformes			
Family Clupeidae - Herrings			
Alewife - - Alosa pseudoharengus (Wilson)	O	1	r
Gizzard shad - - Dorosoma cepedianum (LeSueur)	O	1	r

Appendix 6. Continued.

List of fishes	Habitat	Abundance	Status
Order Osteoglossiformes			
Family Hiodontidae - Mooneyes			
Mooneye - - Hiodin tergisus LeSueur	L,R	1	r
Order Salmoniformes			
Family Salmonidae - Trouts, Whitefishes, and Graylings			
Cisco - - Coregonus artedii LeSueur	O,L	1	r
Lake whitefish - - Coregonus clupeaformis (Mitchill)	O	3	r
Bloater - - Coregonus hoyi (Gill)	O	3	r
Kiyi - - Coregonus kiyi (Koelz)	O	3	r
Blackfin - - Coregonus nigripinnis (Gill)	O	3	r
Shortnose cisco - - Coregonus reighardi (Koelz)	O	3	r
Shortjaw cisco - - Coregonus zenithicus (Jordan and Evermann)	O	3	r
Coho salmon - - Oncorhynchus kisutch (Walbaum)	O,R,S	3	r
Chinook salmon - - Oncorhynchus tshawytscha (Walbaum)	O,R,S	3	r
Rainbow trout - - Salmo gairdneri Richardson	L,R,S	2	r
Brown trout - - Salmo trutta L.	L,R,S	1	r
Brook trout - - Salvelinus fontinalis (Mitchill)	L,S	1	r
Lake trout - - Salvelinus namaycush (Walbaum)	O,L	2	r
Family Osmeridae - Smelts			
Rainbow smelt - - Osmerus mordax (Mitchill)	O,R,S	1	r
Family Umbridae - Mudminnows			
Central mudminnow - - Umbra limi (Kirtland)	L	1	r
Family Esocidae - Pikes			
Redfin pickerel - - Esox americanus Gmelin	L,R	3	r
Northern pike - - Esox lucius L.	L,R	1	r
Muskellunge - - Esox masquinongy Mitchill	L,R	3	r
Chain pickerel - - Esox niger LeSueur	L	1	r
Order Cypriniformes			
Family Cyprinidae - Minnows and Carps			
Stoneroller - - Campostoma anomalum (Rafinesque)	R,S	1	r
Goldfish - - Carassius auratus (L.)	L,R,S	2	r
Redside dace - - Clinostomus elongatus (Kirtland)	R,S	3	r

Appendix 6. Continued.

List of fishes	Habitat	Abundance	Status
Carp - - Cyprinus carpio L.	O,L,R	1	r
Cutlips minnow - - Exoglossum maxillingua (LeSueur)	R,S	1	r
Silvery minnow - - Hybognathus nuchalis Agassiz	R,S	1	r
Lake chub - - Couesius plumbeus (Agassiz)	O,L,R	3	r
Golden shiner - - Notemigonus crysoleucas (Mitchill)	L,R	1	r
Comely shiner - - Notropis amoenus (Abbott)	S	3	r
Satinfin shiner - - Notropis analostanus (Girard)	L,R	1	r
Pugnose shiner - - Notropis anogenus Forbes	L	2	r
Emerald shiner - - Notropis atherinoides Rafinesque	L,R	1	r
Bridle shiner - - Notropis bifrenatus (Cope)	L	2	r
River shiner - - Notropis blennius (Girard)	L,R	3	r
Common shiner - - Notropis cornutus (Mitchill)	L,R	1	r
Bigmouth shiner - - Notropis dorsalis (Agassiz)	L,R	3	r
Blackchin shiner - - Notropis heterodon (Cope)	L	2	r
Blacknose shiner - - Notropis heterolepis Eigenmann & Eigenmann	L,S	1	r
Spottail shiner - - Notropis hudsonius (Clinton)	O,L,R	1	r
Swallowtail shiner - - Notropis procne (Cope)	R,S	1	r
Rosyface shiner - - Notropis rubellus (Agassiz)	L,S	3	r
Spotfin shiner - - Notropis spilopterus (Cope)	O,R	2	r
Sand shiner - - Notropis stramineus (Girard)	L,R	3	r
Mimic shiner - - Notropis volucellus (Cope)	L,R	3	r
Northern redbelly dace - - Phoxinus eos Cope	L,R	1	r
Bluntnose minnow - - Pimephales notatus (Rafinesque)	L,S	1	r
Fathead minnow - - Pimephales promelas Rafinesque	L,S	2	r
Blacknose dace - - Rhinichthys atratulus (Hermann)	R,S	2	r
Longnose dace - - Rhinichthys cataractae (Valenciennes)	O,R,S	2	r
Creek chub - - Semotilus atromaculatus (Mitchill)	L,R	2	r
Fallfish - - Semotilus corporalis (Mitchill)	L,S	2	r
Pearl dace - - Semotilus margarita (Cope)	L,R	3	r
Family Catostomidae - Suckers			
Quillback - - Carpiodes cyprinus (LeSueur)	O	2	r
Longnose sucker - - Catostomus catostomus (Forster)	O,R,S	1	r
White sucker - - Catostomus commersoni (Lacepède)	L,R,S	1	r
Creek chubsucker - - Erimyzon oblongus (Mitchill)	R,S	1	r
Northern hog sucker - - Hypentelium nigricans (LeSueur)	R,S	1	r
Silver redhorse - - Moxostoma anisurum (Rafinesque)	L,R	1	r
Black redhorse - - Moxostoma duquesnei (LeSueur)	R	2	r
Copper redhorse - - Moxostoma hubbsi Legendre	O,R	3	r
Shorthead redhorse - - Moxostoma macrolepidotum (LeSueur)	O,L,R	1	r
Greater redhorse - - Moxostoma valenciennesi Jordon	O,L,R	2	r

Appendix 6. Continued.

List of fishes	Habitat	Abundance	Status
Order Siluriformes			
Family Ictaluridae - Catfishes			
Black bullhead - - Ictalurus melas (Rafinesque)	L,R	3	r
Yellow bullhead - - Ictalurus natalis (LeSueur)	L,R	2	r
Brown bullhead - - Ictalurus nebulosus (LeSueur)	L,R	1	r
Channel catfish - - Ictalurus punctatus (Rafinesque)	L,R	1	r
Stonecat - - Noturus flavus Rafinesque	L,R	1	r
Tadpole madtom - - Noturus gyrinus (Mitchill)	L,R	2	r
Margined madtom - - Noturus insignis (Richardson)	L,R	2	r
Brindled madtom - - Noturus miurus Jordan	L,R	1	r
Order Percopsiformes			
Family Percopsidae - Trout-perches			
Trout-perch - - Percopsis omiscomaycus (Walbaum)	O,L,R	1	r
Order Gadiformes			
Family Gadidae - Codfishes			
Burbot - - Lota lota (L.)	O,L	1	r
Order Atheriniformes			
Family Cyprinadontidae - Killifishes			
Banded killfish - - Fundulus diaphanus (LeSueur)	O,L,R	1	r
Family Antherinidae - Silversides			
Brook silverside - - Labidesthes sicculus (Cope)	L,S	2	r
Order Gasterosteiformes			
Family Gasterosteidae - Sticklebacks			
Brook stickleback - - Culaea inconstans (Kirkland)	O,L,S	1	r
Order Perciformes			
Family Percichthyidae - Temporate basses			
White perch - - Morone americana (Gmelin)	O,L,R	1	r
White bass - - Morone chrysops (Rafinesque)	O,L,R	2	r

Appendix 6. Continued.

List of fishes	Habitat	Abundance	Status
Family Centrarchidae - Sunfishes			
Rock bass - - Ambloplites rupestris (Rafinesque)	L,S	1	r
Green sunfish - - Lepomis cyanellus Rafinesque	L,R	3	r
Pumpkinseed - - Lepomis gibbosus (L.)	L,S	1	r
Bluegill - - Lepomis macrochirus Rafinesque	L,S	2	r
Smallmouth bass - - Micropterus dolomieui Lacepède	L,R	1	r
Largemouth bass - - Micropterus salmoides (Lacepède)	L,R	1	r
White crappie - - Pomoxis annularis Rafinesque	L,R	1	r
Black crappie - - Pomoxis nigromaculatus (LeSueur)	L,R,S	2	r
Family Percidae - Perches			
Greenside darter - - Etheostoma blennioides Rafinesque	L,R	1	r
Fantail darter - - Etheostoma flabellare Rafinesque	O,L,R	1	r
Johnny darter - - Etheostoma nigrum Rafinesque	O,L	1	r
Yellow perch - - Perca flavescens (Mitchill)	O,L,R	1	r
Logperch - - Percina caprodes (Rafinesque)	L,S	1	r
Channel darter - - Percina copelandi (Jordan)	O,R	1	r
Blackside darter - - Percina maculata (Girard)	L,R	2	r
Shield darter - - Percina peltata (Stauffer)	O,R	3	r
Sauger - - Stizostedion canadense (Smith)	O,R	3	r
Walleye - - Stizostedion vitreum (Mitchill)	O,L	2	r
Family Sciaenidae - Drums			
Freshwater drum - - Aplodinotus grunniens Rafinesque	O,L	3	r
Family Cottidae - Sculpins			
Mottled sculpin - - Cottus bairdi Girard	O,L,R	2	r
Slimy sculpin - - Cottus cognatus Richardson	O,R	2	r
Spoonhead sculpin - - Cottus ricei (Nelson)	O	2	r

Appendix 7. Air quality standards applicable to the Tug Hill Region.[a]

PART 257

AIR QUALITY STANDARDS

(Statutory authority: Environmental Conservation Law, § 15)

Subpart 257-1 Air Quality Standards—General
Subpart 257-2 Air Quality Standards—Sulfur Dioxide (SO_2)
Subpart 257-3 Air Quality Standards—Particulates
Subpart 257-4 Air Quality Standards—Carbon Monoxide (CO)
Subpart 257-5 Air Quality Standards—Photochemical Oxidants
Subpart 257-6 Ambient Air Quality Standard—Hydrocarbons (Non-Methane)
Subpart 257-7 Air Quality Standards—Nitrogen Dioxide (NO_2)
Subpart 257-8 Ambient Air Quality Standards—Fluorides
Subpart 257-9 Ambient Air Quality Standard—Beryllium
Subpart 257-10 Ambient Air Quality Standard—Hydrogen Sulfide (H_2S)

Historical Note

Part filed June 29, 1961; renum 250.4; new filed Aug. 9, 1963; repealed, new filed May 8, 1969; Dec. 24, 1970; (§§ 257.1—257.11) renum. Part 408, Title 9, filed Sept., 1971; new Subparts 257-1—257-10 filed April 28, 1972 eff. May 1, 1972.

Sections 257.1-257.5

Historical Note

Secs. filed June 29, 1961; renum. 250.4; new filed Aug. 9, 1963; repealed, new filed May 8, 1969; Dec. 24, 1970; renum. 408.1—408.5, Title 9, filed Sept., 1971.

257.6-257.11

Historical Note

Secs. added, filed Dec. 24, 1970; renum. 408.6—408.11, Title 9, filed Sept., 1971.

SUBPART 257-1

AIR QUALITY STANDARDS—GENERAL

Sec.
257-1.1 Foreward
257-1.2 Definitions
257-1.3 Application
257-1.4 Compliance

Historical Note

Subpart (§§ 257-1.1—257-1.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-1.1 Foreward. Air quality standards are designed to provide protection from the adverse health effects of air contamination; and they are intended further to protect and conserve the natural resources and environment and to promote maximum comfort and enjoyment and use of property consistent with the economic and social well-being of the community.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-1.2 Definitions. When used herein the following terms shall be interpreted to mean:

(a) *Air quality standard.* A numerically prescribed contaminant level that shall not be exceeded in a specified area of the State. Such contaminant levels may include instantaneous, short term, or long term concentrations of individual contaminants or grouping of contaminants having synergistic effects. Such standards may also be

[a]Taken from parts of Chapter III, Air Resources, of the Environmental Conservation Law.

described in terms of net effects resulting from the occurrence of individual contaminants or grouping of various contaminants.

(b) *Commissioner.* The Commissioner of the New York State Department of Environmental Conservation.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-1.3 Application. (a) The standards shall be applicable, as specified in the individual Subpart, to the levels as described in Part 501 of this Title and as assigned in Subchapter C. In addition, emissions in a classified area shall be controlled to the extent required to be compatible with standards established in other areas.

(b) The procedures and techniques employed to determine ambient air concentrations of contaminants shall be as specified in the standard or in accordance with other methods or techniques acceptable to the commissioner. Acceptable methods may be published from time to time by the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-1.4 Compliance. (a) No person shall permit, suffer or allow the emission of contaminants from an emission source which alone or in combination with emissions from other sources cause contravention of air quality standards promulgated in this Part.

(b) Notwithstanding the existence of specific standards, emissions of odorous, toxic, or deleterious substance in concentrations or of such duration that will affect human health or well-being, or unreasonably interfere with the enjoyment of property, or unreasonably and adversely affect plant or animal life shall not be permitted.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-2

AIR QUALITY STANDARDS—SULFUR DIOXIDE (SO_x)

Sec.		Sec.	
257-2.1	Definitions	257-2.3	Standards
257-2.2	Objective	257-2.4	Measurement

Historical Note

Subpart (§§ 257-2.1—257-2.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-2.1 Definitions. (a) *Sulfur dioxide (SO_2).* A nonflammable, nonexplosive, colorless gas, having a pungent, irritating odor. For the purpose of this Subpart, this term shall also include other material that may test as sulfur dioxide by the specified method of measurement.

(b) *Ppm.* Parts of contaminant per million parts of air by volume.

(c) *Mg/m^3.* Micrograms of contaminant per cubic meter of air.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-2.2 Objective. Sulfur dioxide has been associated with increase in chronic respiratory disease on long term exposures and alteration in lung and other physio-

logical functions on short term exposures. Although plant damage to sensitive vegetation and significant metal corrosion and other effects may occur at other ambient air concentrations, the primary objective of these standards is to prevent adverse health effects.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-2.3 Standards (SO_2). (a) During any 12 consecutive months, 99 percent of the one-hour average concentrations shall not exceed 0.25 ppm (650 $\mu g/m^3$) and no one-hour average concentration shall exceed 0.50 ppm (1300 $\mu g/m^3$). (Applicable in all levels.)

(b) During any 12 consecutive months, 99 percent of the 24-hour average concentrations shall not exceed 0.10 ppm (260 $\mu g/m^3$); and no 24-hour average concentration shall exceed 0.14 ppm (365 $\mu g/m^3$). (Applicable in all levels.)

(c) During any 12 consecutive months, the annual average of the 24-hour average concentrations shall not exceed 0.03 ppm (80 $\mu g/m^3$). (Applicable in all levels.)

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-2.4 Measurement. (a) Sulfur dioxide in air is determined by the West Gaeke method of analysis, or by other methods acceptable to the commissioner.

(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-3

AIR QUALITY STANDARDS—PARTICULATES

Sec.		Sec.	
257-3.1	Definition	257-3.4	Standard for settleable particulates (dustfall)
257-3.2	Objective		
257-3.3	Standard for suspended particulates	257-3.5	Measurement

Historical Note

Subpart (§§ 257-3.1—257-3.5) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-3.1 Definition. *Particulate* is any matter dispersed in the atmosphere, whether solid or liquid, in which the individual particles are larger than single molecules (about 0.0002 μ in diameter), but smaller than about 500 μ. Settleable particulates, or dustfall, is normally in the size range greater than 10 μ, and suspended particulates range below 10 μ in diameter. For the purpose of this Subpart, the suspended and settleable particulates are as collected and measured by the method specified or other methods acceptable to the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-3.2 Objective. (a) For suspended particulates protection from adverse health effects, taking into consideration its synergistic effects.

(b) For settleable particulates to alleviate the nuisance of dustfall and to reduce the economic cost of air pollution.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-3.3 Standard for suspended particulates. (a) *Short term value—for all levels.* For any 24-hour period, the average concentration shall not exceed 250 μg/m³.

(b) *Long term values* (1) During any 12 consecutive months, 50 percent of the values of the 24-hour average concentrations shall not exceed:

Level I	45 μg/m³	Level III	65 μg/m³
Level II	55 μg/m³	Level IV	75 μg/m³

(2) During any 12 consecutive months, 84 percent of the values of the 24-hour average concentrations shall not exceed:

Level I	70 μg/m³	Level III	100 μg/m³
Level II	85 μg/m³	Level IV	110 μg/m³

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-3.4 Standard for settleable particulates (dustfall). (a) During any 12 consecutive months, 50 percent of the values of the 30 day average concentrations shall not exceed:

Level I	0.30 mg/cm²/mo	Level III	0.40 mg/cm²/mo
Level II	0.30 mg/cm²/mo	Level IV	0.60 mg/cm²/mo

(b) During any 12 consecutive months, 84 percent of the values of the 30-day average concentrations shall not exceed:

Level I	0.45 mg/cm²/mo	Level III	0.60 mg/cm²/mo
Level II	0.45 mg/cm²/mo	Level IV	0.90 mg/cm²/mo

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-3.5 Measurement. (a) Concentration of suspended particulates is determined gravimetrically by the use of high-volume sampling techniques by drawing air through a glass fiber filter for 24 hours and is expressed in micrograms of suspended particulate per cubic meter of air (μg/m³).

(b) Concentration of settleable particulates or dustfall is determined gravimetrically by the collection of the settleable particulate in a one-gallon glass jar without a lid. Area on which the particles have settled is computed from the inside diameter of the jar mouth. The results are expressed as miligrams of settleable particulate per square centimeter per month (mg/cm²/mo).

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-4

AIR QUALITY STANDARDS—CARBON MONOXIDE (CO)

Sec.
257-4.1 Definition
257-4.2 Objective
257-4.3 Standard
257-4.4 Measurement

Historical Note

Subpart (§§ 257-4.1—257-4.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-4.1 Definition. *Carbon monoxide (CO).* A colorless, odorless gas, produced by the incomplete combusiton of carbonaceous material, having an effect which is predominantly one causing asphyxia.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-4.2 Objective. Protection from adverse health effects caused by the affinity of hemoglobin for carbon monoxide which is over 200 times greater than that for oxygen, resulting in a decrease of oxygen circulation through the body.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-4.3 Standard. (a) (*For all levels.*) For an eight hour period, the average concentration of carbon monoxide shall not exceed nine ppm (10 mg/m³).

(b) (*For all levels*) For a one hour period, the average concentration of carbon monoxide shall not exceed 35 ppm (40 mg/m³).

Historical Note

Sec. added, filed April 28, 1972; amd. filed May 19, 1972. New sec. substituted.

257-4.4 Measurement. (a) Carbon monoxide (CO) is determined continuously by the nondispersive infrared spectrometry.

(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-5

AIR QUALITY STANDARDS—PHOTOCHEMICAL OXIDANTS

Sec.
257-5.1 Definition
257-5.2 Objective
257-5.3 Standard (for all levels)
257-5.4 Measurement

Historical Note

Subpart (§§ 257-5.1—257-5.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-5.1 Definition. *Photochemical oxidants* are those substances in the atmosphere which are produced when reactive organic substances, principally hydrocarbons, and nitrogen oxides are exposed to sunlight. For the purpose of this Subpart, they shall include ozone, peroxyacyl nitrates, organic peroxides and other oxidants as measured by the method specified, or by an equivalent method approved by the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-5.2 Objective. Photochemical oxidants cause irritation of the mucous membranes, damage to vegetation, and deterioration of materials. They affect the clearance mechanism of the lungs and later resistance to bacterial infection. The objective of these standards is to prevent such effects.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-5.3 Standard (for all levels). In any one-hour period, the average concentration of photochemical oxidant shall not exceed 0.08 ppm (160 μg/m³).

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-5.4 Measurement. (a) Photochemical oxidant is determined by the liberation of iodine from a buffered, neutral potassium iodide solution, corrected for interferences of sulfur dioxide and oxides of nitrogen and is expressed as photochemical oxidant (ozone equivalent) per million parts of air (ppm) by volume.

(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-6

AMBIENT AIR QUALITY STANDARD—HYDROCARBONS (NON-METHANE)

Sec.
257-6.1 Definition
257-6.2 Objective
257-6.3 Standard
257-6.4 Measurement

Historical Note

Subpart (§§ 257-6.1—257-6.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-6.1 Definition. *Hydrocarbons* are organic compounds consisting only of hydrogen and carbon. However, for the purpose of this Subpart, *hydrocarbons (non-methane)* shall refer to the total air borne hydrocarbons and other organic compounds excluding methane (CH_4) as measured by the specified technique, or other method acceptable to the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-6.2 Objective. Although ambient air concentrations of gaseous hydrocarbons as a group have not been associated with health effects, it has been demonstrated that ambient levels of photochemical oxidant which do have adverse effects on health are associated with the occurrences of concentrations of non-methane hydrocarbons. The objective of this standard is to inihibit such photochemical reactions which lead to photochemical smog formation.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-6.3 Standard. During the three hour period from 6 to 9 a.m., the average non-methane hydrocarbon concentration must not exceed 0.24 ppm (160 $\mu g/m^3$ as methane).

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-6.4 Measurement. (a) Hydrocarbons (non-methane) is determined by the flame ionization technique with correction for methane by a methane analyzer.

(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-7

AIR QUALITY STANDARDS—NITROGEN DIOXIDE (NO_2)

(Statutory authority: Environmental Conservation Law, §§ 15, 77)

Sec.
257-7.1 Characteristics
257-7.2 Objective
257-7.3 Standard
257-7.4 Measurement

Historical Note

Subpart (§§ 257-7.1—257-7.4) added, filed May 19, 1972.

Section 257-7.1 Characteristics. Nitrogen dioxide is a reddish-orange-brown gas with a characteristic pungent odor. The partial pressure of NO_2 in the atmosphere restricts it to the gas phase at usual atmospheric temperatures. It is corrosive and highly oxidizing and may be physiologically irritating. The presence of nitrogen dioxide in ambient air has been associated with a variety of respiratory diseases. NO_2 is essential to the production of photochemical smog. At higher concentrations, its presence has been implicated in the corrosion of electrical components as well as vegetation damage.

Historical Note

Sec. added, filed May 19, 1972.

257-7.2 Objective. The objective of this Subpart is the attainment of the annual average which, with an adequate safety margin, will provide for protection of public health and will protect against known and anticipated adverse effects on public welfare.

Historical Note

Sec. added, filed May 19, 1972.

257-7.3 Standard. During any 12 consecutive months, the annual average of the 24-hour concentrations, shall not exceed 0.05 ppm ($100\mu g/m^3$) in all levels.

Historical Note

Sec. added, filed May 19, 1972.

257-7.4 Measurement. (a) The concentration of NO_2 is determined by the method specified or by an equivalent method approved by the commissioner.

(b) NO_2 is collected in a sodium hydroxide solution and determined colorimetrically by reacting the exposed absorbing reagent with phosphoric acid, sulfanilamide, and N-1-naphthylethylenediamine dihydrochloride.

(c) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed May 19, 1972.

SUBPART 257-8

AMBIENT AIR QUALITY STANDARDS—FLUORIDES

Sec.
257-8.1 Definitions
257-8.2 Objectives
257-8.3 Standards
257-8.4 Measurement

Historical Note

Subpart (§§ 257-8.1—257-8.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-8.1 Definition. The term *fluorides* refers to a heterogeneous group of compounds formed from the highly reactive, nonmetallic gaseous element known as fluorine. For the purpose of this Subpart the term *fluoride* will include material that tests as fluoride by the method specified or other methods acceptable to the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-8.2 Objectives. Fluorosis in grazing ruminants has been shown to occur with continuing low level fluoride ingestion. Also excessive atmospheric fluoride concentration has been associated, in varying degrees, with vegetation damage. The objective of the standard for forage is to protect against adverse effects on grazing ruminants while the objective of the standard for total fluorides in air is to provide protection against adverse effects on vegetation.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-8.3 Standards. (a) Total fluorides, parts per million (ppm), dry weight basis (as F) in and on forage for consumption by grazing ruminants. Average concentration shall be less than the following in all levels:

(1) For growing season (not to exceed six consectuive months) — 40 ppm
(2) For any 60 day period — 60 ppm
(3) For any 30 day period — 80 ppm

(b) Gaseous fluorides in air (parts per million parts of air) as F—all levels. (25 degrees Centigrade, 760 min. Hg.)

(1) 12 hour averages to be less than 4.5 ppb (3.7 $\mu g/m^3$)
(2) 24 hour averages to be less than 3.5 ppb (2.85 $\mu g/m^3$)
(3) 1 week averages to be less than 2.0 ppb (1.65 $\mu g/m^3$)
(4) 1 month averages to be less than 1.0 ppb (0.8 $\mu g/m^3$)

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-8.4 Measurement. (a) Total fluorides in and on forage is determined by fusion of a representative sample by the Schoniger flash oxygen combustion method and analysis by specific ion electrode* or other methods acceptable to the commissioner.

(b) Gaseous fluorides in air will be collected and analyzed by methods acceptable to the commissioner.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

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* *Standard Method For Fluorides From Vegetation*, New York State Department of Health, Division of Labs. & Research, August, 1970 (or subsequent revision). ppb = 0.82 $\mu g/m^3$ as F.

SUBPART 257-9

AMBIENT AIR QUALITY STANDARD—BERYLLIUM

Sec.
257-9.1 Definition
257-9.2 Objective
257-9.3 Standard
257-9.4 Measurement

Historical Note

Subpart (§§ 257-9.1—257-9.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-9.1 Definition. For the purpose of this Subpart, the term *beryllium* shall include metallic beryllium and all beryllium compounds that may test as beryllium by the acceptable analytical method.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-9.2 Objective. Beryllium is extremely toxic in most of its physical and chemical forms, and can result in acute respiratory and skin problems or chronic beryllium disease. While industrial hygiene safety procedures now in effect have minimized the potential for acute effects, long term exposure to relatively low level ambient air concentrations that might occur in proximity to industrial plants still pose a potential for chronic beryllium disease. Compliance with the proposed standard should preclude such effect.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-9.3 Standard. Applicable in all levels during any month, the average concentration of beryllium shall not exceed 0.01 $\mu g/m^3$.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-9.4 Measurement. Beryllium in air is sampled by filtering through a cellulose or membrane filter at a rate and for a time necessary to meet detection limits. Following acid digestion of the filter, analysis is made for beryllium with the atomic absorption spectrophotometer using an acetylene nitrous oxide flame.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

SUBPART 257-10

AMBIENT AIR QUALITY STANDARD—HYDROGEN SULFIDE (H_2S)

Sec.
257-10.1 Definition
257-10.2 Objective
257-10.3 Standard
257-10.4 Measurement

Historical Note

Subpart (§§ 257-10.1—257-10.4) added, filed April 28, 1972 eff. May 1, 1972.

Section 257-10.1 Definition. *Hydrogen sulfide* (H_2S) is a colorless gas having a characteristic, disagreeable odor often described as that of rotten eggs. For the

purpose of this Subpart the term *hydrogen sulfide* will include hydrogen sulfide and other sulfides as measured by the acceptable analytical method.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-10.2 Objective. Hydrogen sulfide can cause odors which unreasonably interfere with the comfortable enjoyment of life and property. Although tarnishing of metals and discoloring of paint may occur at higher ambient air concentrations the primary objective of this standard is to prevent disagreeable odors.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-10.3 Standard. Applicable in all levels. In any one-hour period, the average concentration of hydrogren sulfide shall not exceed 0.01 ppm (14 $\mu g/m^3$).

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

257-10.4 Measurement. (a) Hydrogen sulfide is determined by the Cadmium Hydroxide-Methylene Blue method and expressed as parts of hydrogen sulfide per million parts of ambient air (ppm) by volume.

(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

PART 258

Historical Note

Part (§§ 258.1—258.5) added, filed June 29, 1971. 1961; renum. Part 409, Title 9, filed Sept.,

Sections 258.1-258.5

Historical Note

Secs. added, filed June 29, 1961; renum. 409.1—409.5, Title 9, filed Sept., 1971.

PART 281

JEFFERSON COUNTY

(Statutory authority: Public Health Law, §§ 1271, 1276)

Sec.		Sec.	
281.1	General classification	281.3	Level II
281.2	Level III	281.4	Level I

Historical Note

Part (§§ 281.1—281.15) renum. Part 425, Title 9, filed Sept., 1971; new (§§ 281.1—281.4) filed April 28, 1972 eff. May 1, 1972.

Section 281.1 General classification. (a) The air quality within the political boundaries of Jefferson County shall be maintained using Levels III, II, and I as set forth in Part 256, Ambient Air Quality Standards—Classifications System, for the areas described in the following sections.

(b) The classification of the air over Lake Ontario and the St. Lawrence River and their islands shall be the same as the classification of the adjacent land mass.

Historical Note

Sec. renum. 425.1, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

281.2 Level III. All that area bounded by a line commencing at the intersection of Holcom Street and Flower Avenue West; thence easterly along Flower Avenue West to Flower Avenue East; thence easterly and northeasterly along Flower Avenue East to Academy Street; thence southeasterly along Academy Street to Central Street; thence northeasterly along Central Street to Huntington Street; thence due north to the Black River; thence easterly along the Black River to the LeRay-Pamelia town line; thence northerly along the town line to the Penn-Central Railroad; thence due west of LeRay Street; thence southwesterly along LeRay Street to the Watertown city line; thence northwesterly along the city line to Bradley Street; thence southerly and southwesterly along Bradley Street to Superior Street; thence northwesterly along Superior Street to Mohawk Street; thence southwesterly along a straight line to the junction of Coffeen Street and Breen Avenue; thence southwesterly along Breen Avenue to Arsenal Street; thence westerly along Arsenal Street to Willow Street; thence southerly along a straight line to the junction of Ives Street and Flower Avenue West; thence easterly along Flower Avenue West to the beginning point.

Historical Note

Sec. renum. 425.2, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

281.3 Level II. All that area within the following boundaries:

(a) The corporate limits of the villages of Carthage and West Carthage.

(b) Commencing at the intersection of the Black River village line and Miser Road; thence southerly along Miser Road to Rutland Hollow Road; thence southwesterly along Rutland Hollow Road to the Rutland-Watertown town line; thence southerly along the town line to Route 12; thence westerly along Route 12 to Cemetery Road; thence westerly along Cemetery Road to Brookside Drive; thence westerly along Brookside Drive to Gillette Road; thence westerly along Gillette Road to Ives Road; thence due west to the Watertown-Hounsfield town line; thence northerly along the town line to the Brownville village line (Brownville town line); thence clockwise along the village line to Glen Park village line; thence easterly along the village line to the Brownville-Pamelia town line; thence northerly

along the town line to Lane Road; thence easterly along Lane Road to Wayside Road; thence easterly along Wayside Road to Route 37; thence southerly along Route 37 to Route 11; thence due east to Pearl Road; thence northeasterly along Pearl Road to Lafave Road; thence easterly along Lafave Road to Route 342; thence due east to the Black River village line; thence clockwise along the village line to the beginning point; except that area delineated as Level III.

Historical Note

Sec. renum. 425.3, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

281.4 Level I. All that area in Jefferson County not delineated as Levels III and II.

Historical Note

Sec. renum. 425.4, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

281.5-281.15

Historical Note

Secs. renum. 425.5—425.15, Title 9, filed Sept., 1971.

PART 282

LEWIS COUNTY

(Statutory authority: Public Health Law, §§ 1271, 1276)

Sec.
282.1 General classification
282.2 Level II
282.3 Level I

Historical Note

Part (§§ 282.1—282.11) renum. Part 426, Title 9, filed Sept., 1971; new (§§ 282.1—282.3) filed April 28, 1972 eff. May 1, 1972.

Section 282.1 General classification. The air quality within the political boundaries of Lewis County shall be maintained using Levels II and I as set forth in Part 256, Ambient Air Quality Standards—Classifications System, for the areas described in the following sections.

Historical Note

Sec. renum. 426.1, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

282.2 Level II. All that area within the corporate limits of the Village of Lowville.

Historical Note

Sec. renum. 426.2, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

282.3 Level I. All that area in Lewis County not delineated as Level II.

Historical Note

Sec. renum. 426.3, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

282.4-282.5

Historical Note

Secs. renum. 426.4—426.5, Title 9, filed Sept., 1971.

282.6

Historical Note

Sec. amds. filed May 28, 1969; Dec. 24, 1970; renum. 426.6, Title 9, filed Sept., 1971.

282.7-282.8

Historical Note

Secs. renum. 426.7—426.8, Title 9, filed Sept., 1971.

282.9

Historical Note

Sec. amd. filed June 23, 1964; renum. 426.9, Title 9, filed Sept., 1971.

282.10

Historical Note

Sec. repealed, filed June 8, 1961.

282.11

Historical Note

Sec. renum. 426.11, Title 9, filed Sept., 1971.

PART 290

ONEIDA COUNTY

(Statutory authority: Public Health Law, §§ 1271, 1276)

Sec.
290.1 General classification
290.2 Level III
290.3 Level II
290.4 Level I

Historical Note

Part (§§ 290.1—290.2) added, filed July 10, 1968; renum. Part 431, Title 9, filed Sept., 1971; new (§§ 290.1—290.4) filed April 28, 1972 eff. May 1, 1972.

Section 290.1 General classification. The air quality within the political boundaries of Oneida County shall be maintained as set forth in Part 256, Ambient Air Quality Standards—Classifications System, using Levels III, II, and I as detailed below.

Historical Note

Sec. added, filed July 10, 1968; renum. 431.1, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

290.2 Level III. All that area within the following boundaries:

(a) Commencing at the intersection of the New York State Barge Canal and the Oneida-Herkimer county line; thence southwesterly along the county line (Utica city line) to Bleeker Street; thence westerly along Bleeker Street to the New York State Central Railroad; thence westerly along the New York Central Railroad to Genesee Street; thence southwesterly along Genesee Street to Sauquoit Creek; thence northerly along Sauquoit Creek to the Whitesboro village line; thence northwesterly along the village line to Clinton Street; thence northeasterly along Clinton Street to Mohawk Street; thence northeasterly along Mohawk Street to the New York State Barge Canal; thence southeasterly along the Canal to the point of beginning.

(b) Commencing at the intersection of Routes 233, 365, and 69; thence westerly along Route 365 to Route 26; thence northerly along Route 26 to the New York State Barge Canal; thence westerly along the canal to a point due south of the intersection of Route 49 (Route 69) and St. Charles Street; thence due north to said point; thence northeasterly along St. Charles Street to Liberty Street; thence southeasterly along Liberty Street to Jay Street; thence northeasterly along Jay Street to Embargo Street; thence southeasterly along Embargo Street to Floyd Avenue; thence northeasterly along Floyd Avenue to Bloomfield Street; thence southeasterly along Bloomfield Street to Garden Street; thence easterly along Garden Street to Culverton Street; thence easterly, southeasterly and southerly along Culverton Street to Nook Street; thence southeasterly along Nook Street to Ganeswort Drive;

thence southwesterly along Ganeswort Drive to Route 49; thence southerly along a straight line to the point of beginning.

Historical Note

Sec. added, filed July 10, 1968; renum. 481.2, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

290.3 Level II. All that area with the following boundaries:

(a) The corporate limits of the Village of Camden.

(b) The corporate limits of the Village of Boonsville.

(c) The corporate limits of the Village of Waterville.

(d) Commencing at the intersection of the Oneida-Herkimer county line at Cosby Manor Road; thence northwesterly along Cosby Manor Road to Grace Road; thence northwesterly along a straight line to the intersection of Browns Gulf Road and Route 8; thence northerly along a straight line to the intersection of the Deerfield, Marcy, and Trenton town lines; thence northwesterly along the Marcy town line to Malory Road; thence southwesterly along a straight line to the intersection of Morgan Road and Cavanaugh Road; thence westerly along a straight line to the intersection of Fox Road and Route 12C; thence northerly along Route 12C to Powell Road; thence northwesterly along a straight line to the intersection of Ritchie Road and Route 365; thence westerly along Route 365 to the Old Floyd Road; thence westerly along Lee Center Stokes Road to Thomas Road; thence southwesterly along Rabbitt Road to the Rome city line; thence counterclockwise along the Rome city line to the Lee town line; thence northerly along the Lee town line to Westernville Road; thence westerly along Westernville Road to Lee Center Stokes Road thence westerly along Lee Center Stokes Road to Thomas Road; thence southerly along Thomas Road to West Thomas Street; thence southerly along West Thomas Street to Link Road; thence southerly along Link Road to Route 69; thence southeasterly along Route 69 to Tannery Road; thence southwesterly along Tannery Road to Route 49; thence westerly along Route 49 to the Rome city line; thence counterclockwise along the Rome city line to Route 26; thence southerly along Route 26 to Eureka Road; thence southeasterly along Eureka Road to Bartlett Road; thence southeasterly along Bartlett Road to Creaser Road; thence southeasterly along Creaser Road to South Street; thence easterly along South Street to Route 233; thence southerly along Route 233 to Route 12B; thence easterly along Route 12B to Grant Road; thence southeasterly along Grant Road to South Street; thence northeasterly along South Street to Fountain Street; thence northerly along Fountain Street to the Clinton village line; thence northeasterly along the Clinton village line to Kellogg Street; thence southeasterly along Kellogg Street to Red Hill Road; thence easterly along Red Hill Road to the New Hartford town line; thence counterclockwise along the New Hartford town line to Butler Road; thence southerly and easterly along Butler Road to Orchard Street; thence due south to Paris Hill Road; thence due east to Route 8; thence southerly along Route 8 to Crooked Hill Road; thence easterly along Crooked Hill Road to the Clayville village line; thence counterclockwise along the Clayville village line to Church Road; thence northerly along Church Road to Mohawk Street; thence northerly along Mohawk Street to Pinnacle Road; thence easterly along Pinnacle Road to Eckhard Road; thence northeasterly along Eckhard Road to Roberts Road; thence northwesterly along Roberts Road to the New Hartford town line; thence easterly along the New Hartford town line to the Oneida-Herkimer county line; thence northeasterly along the county line to the point of beginning except those areas delineated as Level III.

(e) Commencing at the intersection of Peterboro Street and the Oneida-Madison county line; thence northeasterly along Peterboro Street to Youngs Road; thence easterly along Youngs Road to Stuhlman Road; thence northerly along Stuhlman Road to the Vernon village line; thence clockwise along the village line to Sconondoa Creek; thence westerly along Sconondoa Creek to Williams Street; thence northerly along Williams Street to the Vernon-Verona town line; thence westerly along the town line to Sconondoa Road; thence westerly along Sconondoa Road to the Oneida-Madison county line; thence southeasterly along the county line to the point of beginning.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

290.4 Level I. All that area in Oneida County not delineated as Levels III and II.

Historical Note

Sec. added, filed April 28, 1972 eff. May 1, 1972.

PART 295

OSWEGO COUNTY

(Statutory authority: Public Health Law, §§ 1271, 1278)

Sec.		Sec.	
295.1	General classification	295.3	Level II
295.2	Level III	295.4	Level I

Historical Note

Part (§§ 295.1—295.4) added, filed July 10, 1968; renum. Part 436, Title 9, filed Sept., 1971; new (§§ 295.1—295.4) filed April 28, 1972 eff. May 1, 1972.

Section 295.1 General classification. (a) The air quality within the political boundaries of Oswego County shall be maintained using Levels III, II, and I as set forth in Part 256, Ambient Air Quality Standards—Classifications System, for the areas described in the following sections.

(b) The classification of the air over Lake Ontario and Oneida Lake and their islands shall be the same as the classification of the adjacent land mass.

Historical Note

Sec. added, filed July 10, 1968; renum. 436.1, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

295.2 Level III. All that area bounded by a line commencing at the junction of East Seneca Street and Oswego city line; thence southwesterly along East Seneca Street to East 4th Street; thence southerly along East 4th Street to Utica Street; thence westerly along Utica Street to Oswego city line; thence clockwise along the city line to the beginning point.

Historical Note

Sec. added, filed July 10, 1968; renum. 436.2, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

295.3 Level II. All that area within the following boundaries:

(a) Commencing at the intersection of the Oswego-Hannibal town line and Route 104; thence northerly along Route 104 to Route 104A; thence due north to the Lake Ontario shoreline; thence northeasterly along the shoreline to a point due north of the junction of County Road 1A and Lakeview Road; thence due south to said point; thence southerly along Lakeview Road to County Road 1; thence westerly along County Road 1 to Creamery Road; thence southerly along Creamery Road to Klocks Corners Road; thence southerly along Klocks Corners Road to Myers Road; thence southerly along Myers Road to County Road 45; thence southerly along County Road 45 to Diston Road; thence southerly and southwesterly along Diston Road to County Road 57; thence southerly along County Road 57 to the New York, Ontario and Western Railroad (main line); thence southerly along the railroad to the Fulton city line; thence clockwise along the city line to the Delaware, Lackawanna and Western Railroad (north side of city boundary); thence northerly along the railroad to the Minetto-Granby town line; thence westerly along the Granby town line to the Oswego-Hannibal town line; thence westerly along the town line to the beginning point; except that area delineated as Level III.

(b) Commencing at the intersection of Interstate Route 81 and the Oswego-Jefferson county line; thence easterly along the county line to a point due north of the junction of Center Road and Willis Drive; thence due south to Little Sandy Creek; thence westerly along Little Sandy Creek to the Lacona village line; thence clockwise along the Lacona village line to the Sandy Creek village line; thence E. Dewey Thruway (Interstate Route 87, northeast side of the village line); thence northerly along the Thruway to Route 32; thence northeasterly along Route 32 to Quaker Street; thence easterly along Quaker Street to Route 9W; thence southeasterly along Route 9W to the Cornwall village line; thence counterclockwise along the village line to the west bank of the Hudson River; thence northerly along the west bank of the Hudson to the beginning point; except that area delineated as Level III.

Historical Note

Sec. added, filed July 10, 1968; renum. 434.3, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

293.4 Level I. All that area in Orange County not delineated as Levels III and II.

Historical Note

Sec. added, filed July 10, 1968; renum. 434.4, Title 9, filed Sept., 1971; new filed April 28, 1972 eff. May 1, 1972.

293.5-293.6

Historical Note

Secs. added, filed July 10, 1968; renum. 434.5—434.6, Title 9, filed Sept., 1971.

cover, the extent of present agricultural use, the concentration of people, and the general economic activity. At the center, the vast forested, largely unbroken central core took the form of a hub around which primary activity of the Region moves. The rim of the wheel that has formed around its forested core is represented at the north, east, and southeast by the population, agricultural, and business developments of the Black River Valley and the Mohawk Valley. Westward, activity along the Route I-81 axis and shore areas of Lake Ontario, and to the south the development of housing and camps on the Oneida Lake Plain, complete the circle.

Often, reference to a hub connotes the center of activity, with movement of people, business, and development radiating out from some central concentration, or funneling into it. But at times, the rim and hub arrangement of the Tug Hill Region seemed more donut-like. The essential part of the donut formed around the Region's rim, with the most intense past and present activity and development there. In the center rests a hole, with less activity, less population, less business, and presently less development. Perhaps we'd find a better metaphore by reference to a hurricane, whose calm eye rests at the center of the Region, with its real energy swirling around the rim.

In this framework we present our analysis of resources of the Tug Hill Region. We emphasize their diversity, their complexity, their present use, and some potentials they offer for the future.

Development of the soils map and interpretive materials pertinent to soil associations found in the Tug Hill Region depended heavily upon field mapping and classification by the Soil Conservation Service, U. S. Department of Agriculture. We especially acknowledge assistance from R. Marshall and W. King of the SCS state office in Syracuse, N.Y., and L. McDonald and L. Davis of the SCS field offices.

SOILS AND GEOLOGY

by

albert l. leaf
robert f. wittwer

SUMMARY OF SOILS AND GEOLOGY

The Tug Hill Region covers all or parts of six distinct physiographic subregions of New York. These include the Tug Hill Upland, Black River Valley, Eastern Ontario Hills, Ontario Ridge and Swamplands, Oneida Lake Plain, and Upper Mohawk Valley. These provide wide variation in landforms over the Region. Topography generally is gentle and lacks extreme features, except for the Upland's eastern escarpment and some deeply cut stream channels. The land rises gradually from a low elevation of about 250 feet at the shore of Lake Ontario, to over 2100 feet at the east side of the Upland.

The Tug Hill Region is characterized by relatively simple bedrock geology features, with nearly all of the area being underlain by sedimentary rocks composed of sandstones, siltstones, shales, and limestone. The depositional pattern of unconsolidated surficial material over the bedrock is relatively complex due to the glacial history. Action of moving ice fronts and glacial waters, both impounded and in running streams, sorted and mixed the mineral materials to cause this complex pattern. The complex distribution, along with topographic features that affect soil moisture drainage, have resulted in great variation in soil characteristics of the Tug Hill Region.

Mapping delineated 85 different soils over the Region. They range from shallow to deep, fine- to coarse-textured, very poorly drained to droughty, and acid to high in lime. The most productive ones for agricultural use occur in the Black River Valley; the least productive on the Tug Hill Upland. Detailed information about each soil has been provided.

Diversity and complexity of soil patterns make generalizations about the Region difficult. Variability is the rule. Intensive development at a specific place should be proceeded by detailed on-site evaluation. However, the soils and geology maps, plus accompanying interpretative information, should suffice for broad regional planning. Slope and drainage constitute important elements for consideration in judging the suitability of a site for some intended use.

RECOMMENDATIONS

Areas within the Tug Hill Region have been mapped to differing degrees of intensity, both for surficial geology and soils. More detailed information is not presently available. Additional field reconnaisance is needed to fill in the gaps. Continued efforts by the New York State Museum and Science Service, and by the U.S. Department of Agriculture Soil Conservation Service, should be encouraged. Especially, more detail would prove useful for areas identified as best situated for intensive development.

PHYSIOGRAPHY

The Tug Hill Region includes six distinct physiographic sub-regions, most of them extending beyond the Region's boundary into the surrounding area. As shown in Figure 1, these include: 1. Tug Hill Upland, 2. Black River Valley, 3. Eastern Ontario Hills, 4. Ontario Ridge and Swamplands, 5. Oneida Lake Plain, and 6. Upper Mohawk Valley (Cressey, 1966).

Its unique feature, the Tug Hill Upland, lies at the Region's center forming its core. The Upland is characterized by gentle relief rising gradually from west to east. Soils are poor, imperfectly drained, and acid. Largely unbroken by development, the Upland occupies a large part of the Region.

The eastern edge of the Upland is sharply cut by the Black River Valley as it arcs from south to northwest on its course to Lake Ontario, north of Watertown. This lowland separates the Tug Hill Upland from the Adirondack Mountains. It contains the deepest, most productive, least acid soils that support the best agriculture of the Region.

At its western terminus, the Valley spreads into the Eastern Ontario Hills, an area of low hills formed of glacial drift. These extend southward, separating the Upland from Lake Ontario. Sand dunes occur here along the lake's shore. The hills begin the lift that raises the land from its low elevation along Lake Ontario, up to the height of the Upland's eastern side.

Off the western end of Oneida Lake in the southwestern part of the Region lie the Ontario Ridge and Swamplands. Soils throughout this sub-region are poorly drained. Many swampy places and ridged ground moraines characterize its relief.

Finally, at its south the Tug Hill Upland slopes into the Oneida Lake Plain and the Upper Mohawk Valley, forming a rather featureless arm-like extension of lowlands that move eastward from the Great Lakes Basin and eventually separate the state into southern and northern portions. Little relief, broad swamps, mucklands, and deep sandy soils occur here.

In these distinct physiographic sub-regions soils show great diversity, having widely varying characteristics. They, in turn, lend great diversity to the Region through their effects upon plant life and man's activity. Especially, diversity comes from the combination of different land forms and soils that surround the Upland nucleus of the Region.

Throughout, the Tug Hill Region's topography is gentle, except at the escarpment of the Upland as it meets the Black River Valley, and in some drainages along the Upland's southeastern side (Map 2). In most places even the stream courses are weakly defined. And with a few localized exceptions, the Region lacks dominant land features like those characteristic of the Adirondack Mountains to the east, or the Allegheny Plateau to the south. At its maximum elevation, Gomer Hill in the Town of Turin, the Upland rises to 2111 feet above sea level. From there the land dips gradually westward to the low of about 250 feet along Lake Ontario, and northwest to less than 290 feet along the Black River Valley as it exits from the Region in the Town of Watertown. Southward the hills slope a bit more steeply, reaching about 370 feet at Oneida Lake.

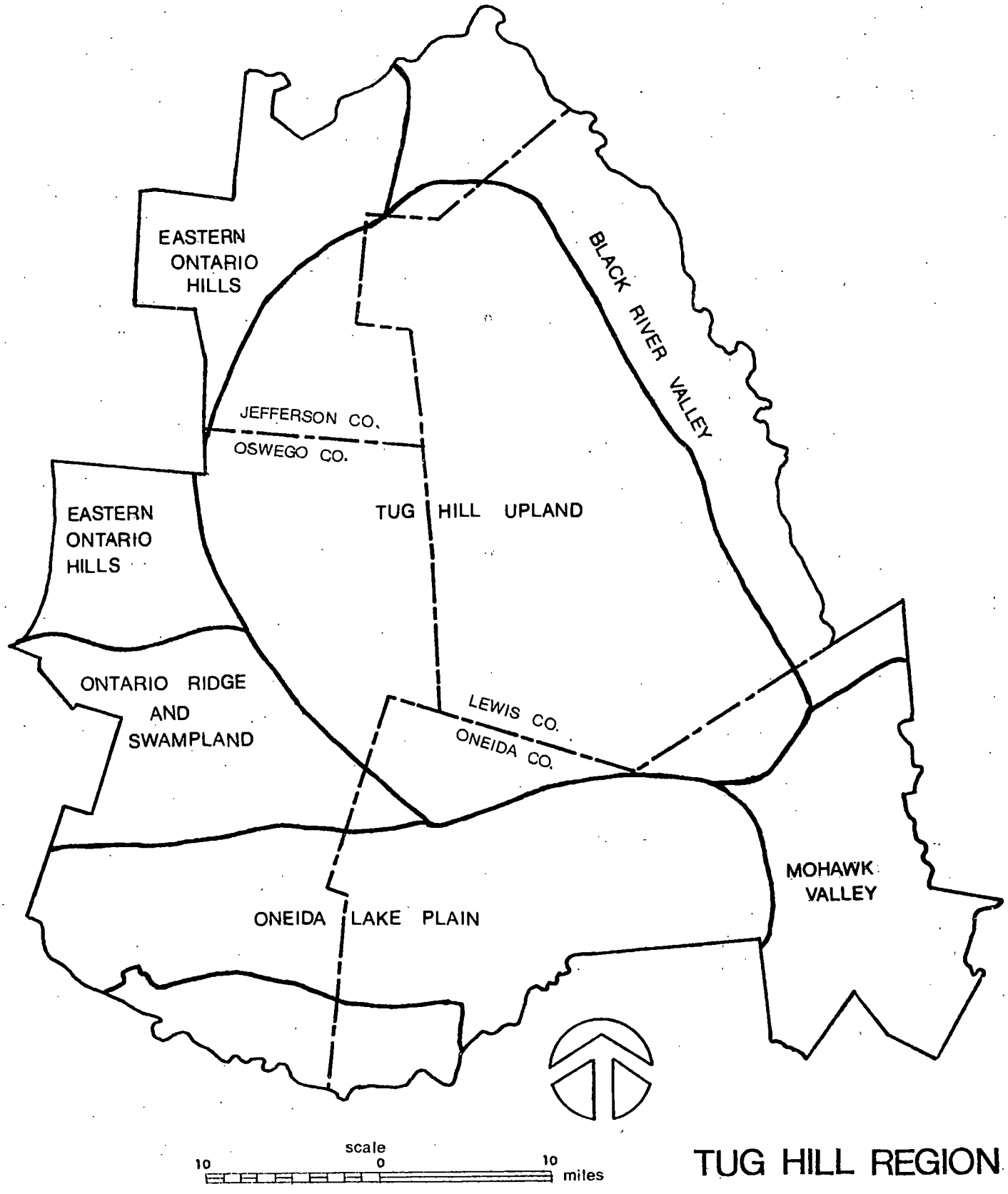


Figure 1. Land forms of the Tug Hill Region (adapted from Cressey, 1966).

The gradual uplift of nearly 1900 feet from Lake Ontario to the top of the Upland, coupled with the gentle relief and the absence of dominating land forms, importantly influence several components of the Region's resources. While lacking characteristics that lead men to romanticize about the land, the nondescript topography and its gentle form provide a critical thread that weaves throughout the story of the Region, appearing periodically to help shape its characteristic fabric.

GEOLOGY

Climate, vegetation, topography, parent materials available for soil formation, and time influence the kinds of soils found in an area (Buckman and Brady, 1969). Climate works largely through its effect upon vegetation. For a region of this size, that effect is relatively constant throughout. Vegetation, in turn, influences soil by the mechanical action of its roots, the deposit of organic matter onto the soil, and the subsequent decay and incorporation of the decayed matter into the soil. These, too, appear relatively constant over the Region as far as soil formation is concerned. And the entire area was subjected to the same glaciation, making time constant throughout. Soils found in the Tug Hill Region have the same age, all being formed since recession of the last ice sheet about 10,000 years ago.

With climate, vegetation, and time being relatively constant, variations in soils of the Tug Hill Region result largely from the way topography and parent materials have exercised influence over the soil forming process. Parent materials are largely related to underlying bedrock. In large measure, they provide the source of materials that eventually weather and break down to start the long process of soil formation. Local topography came about from glaciation. But glaciation also affected the distribution of parent materials by transporting them from one place to another, and in the sorting of various sized mineral particles by glacial melt waters. These factors have worked within the Tug Hill Region.

Bedrock Geology

Bedrock geology features resulted from events that began millions of years ago (Cressey, 1966). Previous to about 550 million years before the present time, much of eastern North America was a nearly featureless plain underlain by ancient igneous and metamorphic rocks.[1] However, at about that time in geologic history much of New York State except the Adirondacks sank and for the next 325 million years a sea of varying depth lay over the area. During this period great quantities of sediment were washed from the Adirondacks, New England, and parts of Canada into what is now the Tug Hill Region.

These sediments accumulated as thick beds of sand, silt, and clay, and eventually hardened into the sandstones, siltstones, and shales that comprise most of the underlying bedrocks of the Tug Hill Region. About 220 million years ago, the Appalachian Revolution permanently raised most of New York State above sea level, including Tug Hill. It is the erosion-resistant Oswego sandstone formation resulting from these events that has formed a "cap" over the Tug Hill Upland and is responsible for "holding-up" the plateau-like, upland land form at the Region's center. Along the eastern boundary of the Region, the Black River

[1] Appendix 1 provides a glossary of technical terms.

Valley forms a nearly perfect boundary between these sedimentary rocks and the igneous and metamorphic rocks of the Adirondack Mountain Region. Only minor areas of igneous and metamorphic bedrock are found along the eastern edge of the Tug Hill Region, just east of the Black River in Lewis County.

The steep escarpment of the Upland caused by the fracture of the horizontal-lying sedimentary beds is a unique geologic feature of the Region, defining the eastern boundary of the Tug Hill Upland where it meets the Black River Valley. This escarpment is most prominent from Lowville south to the Oneida County line. The well-known ski slopes at Turin are found along this escarpment. The relatively easily eroded Utica shale formation is exposed along much of the escarpment. Rapid erosion by streams flowing easterly from the Tug Hill Upland has led to the development of deeply-cut ravines, known locally as gulfs. The best known of these is Whetstone Gulf, north of Turin, which provides a unique natural attraction protected by a state park.

The sedimentary bedrock strata slope westerly from the eastern escarpment of the Upland towards the Ontario lake plain (Newell, 1939). Initially, the slope of the strata across the Town of High Market is very gentle, being about 15 feet per mile. This in part explains the nearly level topography and poorly developed drainage system in the High Market vicinity. Farther west, the slope of the underlying strata increases to 40-50 feet per mile and the stream network appears to be better developed with stream channels incised deeper into the unconsolidated material overlying the bedrock. The western and southern edges of the Tug Hill Upland are not well defined. The sloping sedimentary formations merge gradually with the Ontario and Oneida lake plain physiographic provinces.

Map 3 in the Atlas portrays existing bedrock geology that resulted from these events of its glacial history.

Surficial Geology

Nearly all of the surface materials overlying the bedrock of the Region result from glacial movement or associated action of glacial waters. Only a few areas covered by recent alluvial deposits or organic matter (peat and muck) resulted from other conditions.

The Wisconsin glacial age began about 50,000 years ago and the last ice front retreated from New York State about 8,000-10,000 years ago (Cressey, 1966). Studies provide evidence of two separate advances and subsequent retreats of the glacial front in New York. And as the ice front advanced and retreated across the landscape, great quantities of rock and soil material were mixed and transported from place to place. This unsorted material, called till, occupies much of the Tug Hill Region, especially at the higher elevations. These movements, coupled with flow of glacial melt waters, formed streams and lakes much different from present-day drainage patterns, and resulted in a very complex distribution of soil deposits and surface land forms over the Region's landscape.

An example of the effects of glacial waters on soil parent materials is found between Rome and McConnellsville in northeastern Oneida County. These include the Rome sand plains area. At one time, during the recession of the glacier from central New York, what are presently Lake Ontario and Oneida Lake were much larger, and the entire lowland area from Lake Ontario through the Mohawk Valley

was filled with melt waters from the retreating ice front located to the north (Fairchild, 1909). This body of water (glacial Lake Iroquois) deposited sand and gravel along the ancient lake's shoreline. The shoreline of old glacial Lake Iroquois is also present in Jefferson County, running approximately along U.S. Highway 11 in the Towns of Adams and Watertown. Soils derived from these shoreline deposits include the relatively coarse-textured, infertile Windsor, Scarboro and Adams series that have distinctly different characteristics from soils found further north and east, on the Tug Hill Upland.

Some of the most productive soils in the Region are found along the west side of the Black River Valley in Lewis County. These soils include the Herkimer, Howard and Kars series. Parent materials for these are mainly glacial outwash deposits, or recent alluvium derived from the shale and limestone bedrock along the escarpment of the Upland. These surficial materials deposited by running water are typically finer textured and other conditions being favorable, provide relatively productive soils.

Detailed field mapping of the complex features resulting from glacial activity has been only partially completed, providing only fragmentary information for a portion of the Tug Hill Region. The map of surficial geology deposits presented in Map 4 of the Atlas was compiled from several sources that included graduate student dissertations and water resource studies. Presumably, a long-range goal of the New York State Science Service is to compile an atlas of surficial geology features for the entire state, as has been done for the bedrock geology. Until that time, the compilation provided by this study should suffice for preliminary planning purposes.

SOILS

Since soil characteristics are influenced greatly by the kinds of materials available for soil formation, it might be expected that soils found in the Tug Hill Region are only as diverse as the variety of surficial materials depicted in Map 4. However, within an area of similar surficial deposits, local topography and slope position further modifies soil characteristics. For example, soils at the top of a hill or ridge are typically better drained than soils near the bottom of a slope or in a depression or valley, making more complex the classification of soils within areas of similar surface features. The drainage characteristics of soils are an important factor in the classification, since they limit certain uses, such as septic tank drainage fields, or prevent early spring tillage of the soil. Overall a great variety of soil conditions may exist in a relatively small land area.

Sources of Information

Soils information depicted in Map 5 of the Atlas is presented at a scale of 1 inch equals 125,000 inches, considered useful for broad planning. In most instances we could not show a soil mapping unit smaller than ¼x¼ inch, or representing an area smaller than 160 acres. Within even that small area, much variation can occur. Consequently, Map 5 should not be used for planning intensive development of specific sites. Rather for intensive local development, information should be obtained from individual Soil Survey Reports for individual counties, prepared by the U.S. Department of Agriculture, Soil Conservation Service. Coupled with on-site inspection, these detailed maps can be used to guide development at specific places.

The soil series is the basic unit of soil classification, and along with surface soil texture and slope class, provides the mapping unit used in the Soil Survey Reports for individual counties. That classification allows up to 15 percent of a mapping unit to comprise inclusions of other soil units that cannot be delineated because of the limits of map scale (Soil Survey Staff, 1951).

The primary mapping unit for soils shown on Map 5, the soil association, comprises a group of two or more soil series that typically occur together on the landscape. Soil associations are named for the soil series that predominate within the association. For example, the Worth-Empeyville-Westbury Association commonly occurs on the Tug Hill Upland. By percentage, its composition includes (Pearson and Cline, 1960): Worth series--40-60 percent; Empeyville series--20-40 percent; Westbury series--15-25 percent; and Tughill series--10-15 percent. All these separate soils are derived from similar parent materials, but differ in drainage characteristics due to topography or slope position. The well-drained Worth series is typically located on the upper slopes and ridge tops, while the Tughill series is very poorly drained, and typically occurs in depressions and valley bottoms. Thus, while 60-100 percent of a mapping unit comprised of this association is well to moderately well-drained, it may include up to 15 percent of the poorly drained Tughill series. This kind of variation exists within each mapping unit on the soils map, along with the variation allowed within an individual soil series that make up the association, as previously indicated.

Appendix 2 contains a description and pertinent information for every soil series found in the Tughill Region. Included are explanations of soil features, information about the suitability of each soil as a source of material, plus interpretations concerning suitability or limitations for various land uses. Each soil series is identified as to drainage class and slope position, representing important factors in land use planning (Table 1). This information has been abridged and reproduced from Soil Survey Interpretations of Soils in New York State, prepared by the Department of Agronomy, Cornell University (1972). These soils descriptions provide information for each soil series. By studying the data for the two or more soil series comprising an association, the range of conditions within a mapping unit can be determined. Appendix 1 contains a glossary of terms used in soil science that are useful for interpreting the information contained in this report. Characteristics for each association are summarized in Table 2.

Interpreting the Data

The interpretive information in Tables 3, 4, 5, 6, and 7 apply to soils in their natural state and not to disturbed areas that have been altered by cut and fill operations or cultivation. Interpretive information is presented by soil series and is not applicable to other soils that may be physically present in an area. The steepness of the slopes in an area is an important factor in land-use planning, and suitability of soil for a specified use depends on the slope of the land at the specific location the use is contemplated. The interpretive sheets give degrees of limitation for various land uses by slope class groupings (Appendix 2), as defined in Table 1.

Appendix 2 also provides suitability ratings where general statements are needed about suitability of the soil for plant growth, or use as a resource material. These ratings are good, fair, and poor. Soils rated good have properties that are favorable or perform very well for the kind of use rated. They are