Susitna River Basin Study - Alaska

Willow Subbasin

Final Report

by
U.S. Department of Agriculture

in cooperation with

State of Alaska and the
U.S. Fish and Wildlife Service

October 1981

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U.S. Department of Agriculture
Economic Research Service
Forest Service
Soil Conservation Service

in cooperation with the

Alaska Department of Natural Resources
Division of Agriculture
Division of Forestry
Division of Land and Water Management
Division of Parks
Division of Research and Development
Division of Technical Service

and the

Alaska Department of Fish and Game
Division of Game
Division of Sport Fish
Habitat Protection Section

and the

U.S. Department of Interior
Fish and Wildlife Service
Geological Survey

ACKNOWLEDGEMENTS

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PREFACE

The State of Alaska and the U.S. Department of Agriculture (USDA) are conducting a study of the quality, conditions, and deficiencies of the water and related land resources in the Susitna River Basin. Initiated in 1976 and fully staffed in 1978, the study is scheduled for completion in 1982. This report discusses results of the analysis conducted in the Willow Subbasin, one of the four principal watersheds of the Susitna River Basin. The results of analyses of the remaining three watersheds, covering the entire river basin, will be available shortly.

At the request of the Alaska Department of Natural Resources (DNR), the USDA is participating in this study as part of its continuing river basins program. Section 6 of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566, as amended) authorizes such participation in this study.

Authority for DNR to cooperate with USDA in river basin studies is set forth in Title 38 and 41.08 of the Alaska Statutes.

The Alaska Department of Fish and Game (ADF&G) is actively involved. Their authority for participation is set forth in Title 16 of the Alaska Statutes. Also actively involved is the U.S. Fish and Wildlife Service.

The report was prepared by the USDA's Soil Conservation Service (SCS); the Economic Research Service (ERS); and the Forest Service (FS); the Alaska Departments of Natural Resources and Fish and Game; the U.S. Fish and Wildlife Service, and the Matanuska-Susitna Borough. The report will be used by state and borough planners concerned with land use and natural resources management. The study was initiated by the State of Alaska in order to analyze and evaluate potential alternative resource uses and to provide guidelines for resolving any conflicts in these uses.

Agency responsibilities in this study are as follows:

A. USDA Agencies

The Soil Conservation Service is responsible for the administration of USDA activities in connection with river basin investigations and preparation of reports thereon. The SCS is responsible for development of general principles, criteria, and procedures.

The SCS is responsible for making physical appraisals of agricultural and rural water problems and resource development needs and defining them in terms of meeting regional and community economic needs for water-related goods and services. The SCS determines the conservation treatment needs for nonfederal open lands within river basins. The SCS determines the development potentials of upstream watersheds, including their physical and economic feasibility and development effects; determines the scope and scale of upstream watershed development needed, and coordinates this with the proposals of cooperating agencies.

The Soil Conservation Service, the Forest Service, and the Economic Research Service coordinate with the Water Resources Council as well as federal, state, regional, and local organizations in program formulation, budget coordination, and development of guidelines and procedures.

The Forest Service is responsible for all aspects of river basin planning relating to woodlands and forested lands, both federal and nonfederal, the

rangelands within national forests, and other mountainous watershed wild lands. The FS provides the analyses and projections of economic activity related to the multiple uses and products from forests, woodlands, and wild lands, and interprets these projections with respect to the use of and requirements for water and related lands.

The FS is responsible for appraising the suitability and capability of forested lands to satisfy future demands for products and services and determines the kinds, amounts, and costs of needed watershed management practices. The FS determines the hydrologic characteristics as to runoff, water yields, sediment, and erosion on forested and related wild lands.

The FS estimates and evaluates the impacts of water resource development plans and proposals of USDA and other agencies upon the forest resource—public and private. The FS carries out continuing coordination with other land management and conservation agencies—federal, state, and local. The FS participates in the identification of areas having opportunities for feasible USDA projects and programs (PL-566, RC&D, National Forest Development, etc.) to help meet the development needs of the River Basin.

The Economic Research Service is responsible for basin-wide economic aspects and elements of this planning effort. ERS develops and analyzes the economic base of the study area which includes an appraisal of trends in land and water use, projections of production, employment, income, and population, and land use needs and potentials. ERS also analyzes the economic impact of water development programs as applicable in the basin on production, employment, and income in the agricultural and related sectors of the economy.

The ERS evaluates the demand for water-based recreational needs of the basin and participates in the formulation of plans for recreation development including the analysis of economic benefits of alternative plans.

B. State Agencies

The State of Alaska, represented by DNR, will work directly with USDA until the study is completed. The DNR is involved in all phases of the project from development of objectives and priorities, to membership on the study team, to review of schedules, drafts, interim, and final reports. State agencies other than DNR are contacted as appropriate for information, technical assistance, or direct participation.

1. Introduction and Summary

1. Introduction and Summary

In recent years, the State of Alaska and the Matanuska-Susitna Borough have been transferring land to private ownership in the Susitna River Basin. These transfers are often accompanied by title restrictions for each particular parcel in question, i.e., the state or borough withholds certain development rights and allows only the uses it deems are best suited.

"Best uses" were at times based on insufficient data because adequate inventory information simply did not exist. As a result, in many instances inappropriate uses evolved on basin lands. For example, homes were built in flood plains and septic tanks were constructed in or adjacent to wetlands.

In addition to physical compatibility problems, social and environmental tradeoffs became major issues. The best wildlife land was at times the best agricultural or urban land, and disposal of land for its "best use" became even more subjective. Realizing these problems would grow with the population and the subsequent increases in demand for land for all uses, the State of Alaska in cooperation with the USDA embarked on the river basin study.

This report discusses the study process in five major sections. Section Two, discusses the study goal, the resource problems evidenced in the initial stages of the study, and the study objectives formulated to redress the resource problems and achieve the overall study goal. Section Three discusses the stocks and flows of the Willow Subbasin's natural resources and the important socioeconomic factors relating to the area's human resources. This section essentially presents the results of the early resource inventories and surveys conducted in the study. One of the most important features of this study consisted of several landscape capability/suitability analyses. Each analysis combined several physical/biological landscape attributes for a land site to determine that site's capability for supporting various land uses. Mapped results at a scale of 1:63,360 are available for the entire "Willow Subbasin Land Use Atlas" published under separate cover as part of this study effort. The same maps at a scale of 1:250,000 are included in the main report.

Section Four relates resource problems and concerns outlined in section Two with resource supply and quality discussed in Section Three. It displays a "snapshot" of the natural resource situation found in the Willow Subbasin at the present time and discusses the probable "future without" any changes or additions in public sector resource policies and programs.

Section Five suggests some alternative public sector approaches to ameliorating present or expected resource problems, or improving resource use. The final section, Six, discusses federal, state, and local resource-oriented programs and their alternatives.

2. Problems and Objectives

2. Problems and Objectives

The goal of this study is to provide resource managers, public and private, with the necessary information to make sound, rational decisions regarding the natural resources in their charge. To meet this goal, interim study objectives were defined, that provided the necessary information to address specific resource "problems" or anomalies which were evidenced early in this investigation. These problems stem from inefficient resource use, with inefficiency defined in economic, physical, and environmental terms.

From the outset, a lack of basic information about the character of the Willow Subbasin's natural resources: their location, quantity, and quality was the greatest problem encountered in the study. The principal objective was to gain a basic understanding of the subbasin's resources. This required major resource inventories, surveys, and evaluations. Of course, identified problem areas merited particular attention in the study design.

For purposes of the study, resource problems or concerns were identified for each of six functional land resource use types. They included agricultural land, urban/settlement land, recreational land, flood plains, timber land, and land and water areas important to fish and wildlife. It is important to note that any given site may be highly valued for several or even all of these functional uses. Multiple uses of resources may be compatible on a site, but other uses by their nature must be exclusive. Many resource problems and conflicts stem directly from noncompatibility of alternative resource uses. The identified resource problems and study objectives are displayed in Table 2.1.

Table 2.1 Problems and Objectives

Resource Area	Problems or Concerns	Objectives
A. Agricultural land	1. Best agricultural land is underutilized.	1. Identify lands suitable for agricultural production. Areas to be mapped and quantified.
	2. Lack of information to determine capability of land to support various agricultural enterprises.	2. Determine farming enterprises and practices which optimize net returns on lands with agricultural potential.
	3. Lack of demand data for potential agricultural enterprises.	3. Identify methods for maintaining existing agricultural land.
	4. Concern that Alaska's remoteness could result in food shortage during times of labor strikes, natural disasters or other such emergencies.	4. Determine production needed for self-sufficiency for those enterprises suitable for production in the basin.
	5. Loss of agricultural land to other uses such as urban development.	5. Determine economic feasibility for selected enterprises for export given present world prices.
	6. Statewide economic instability could be dampened by development of a larger agricultural sector.	6. Determine viable commodity prices for selected enterprises on alternative farm unit sizes.
B. Urban/settlement land	1. The Alaska state legislature has mandated disposal of land in five separate settlement categories, yet information on the capability and suitability of state land to support these uses is inadequate.	1. Determine resource information needed to assess capability and suitability of the land to support designated disposal categories. Collect appropriate data.
		2. Develop criteria to consolidate data into land use settlement maps and determine settlement areas suitable for disposal.
C. Recreation land	1. Overcrowding of developed recreation areas has resulted in poor quality recreation experience and made recreation opportunities unavailable for large segments of the population.	1. Identify demand and supply of selected recreation opportunities
	2. The capability and suitability of land to support recreational activities is unknown in many areas of the basin.	2. Determine resource information needed to assess capability and suitability of land areas to support recreation uses for which a shortage exists. Collect appropriate data.
		3. Develop criteria to consolidate data into "recreation model" and map recreation land.

Table 2.1 Problems and Objectives

Resource Area	Problems or Concerns	Objectives
D. Timber land	1. Timber is underutilized.	1. Identify lands suitable for timber production. Areas to be mapped and quantified.
	2. Lack of information to determine the capability and suitability of the land to support timber related enterprises.	2. Determine timber enterprises and practices which optimize net returns on lands with timber potential.
		3. Determine production needed for self-sufficiency for those enterprises suitable for production in the basin.
E. Fish and Wildlife Land	1) Value to public of fish and wildlife resources (populations and habitats) is difficult to quantify and often underestimated.	1) Develop and use adequate methodologies for determining value of fish and wildlife resources.
	2) Fish and wildlife resources (populations and habitats) are reduced in quantity and quality as suitable habitats are transferred into private ownership or other incompatible management/use categories associated with human population increases and increased pressures for development.	2a) Develop criteria for maintenance and enhancement of the quality and quantity of habitats required to support wildlife populations which can meet current or increased levels of human use; in the Willow Subbasin, focus habitats maintenance/enhancement on habitats which support moose, brown and black bear, caribou, mountain goat, Dall sheep, waterfowl, and protected species such as trumpeter swans and bald eagles.
		2b) Develop criteria for maintenance and enhancement of the quality and quantity of lakes and streams which provide, or could provide, fisheries habitats and angling opportunities.
		2c) Identify key habitat types, i.e. those which support a high abundance or variety of species, are of limited availability in the Subbasin, or are highly vulnerable to disruption; in the Willow Subbasin, habitats meeting one or more of these criteria are: tundra, riparian corridors, other wetlands, open forests, and ecotones ("edges").
		2d) Develop criteria for management of fish and wildlife species to maintain populations at optimum levels in terms of habitat carrying capacity, physical quality of managed animals and human user success.
	3) Public opportunities to use and enjoy fish and wildlife resources are reduced as public lands and public access are transferred into private ownership or other incompatible management/use categories associated with human population increases and increased pressures for development	3a) Develop criteria for areas which currently or potentially provide opportunities to harvest fish and wildlife; in the Willow Subbasin, focus maintenance/enhancement on areas which i) provide opportunities to harvest moose, brown or black bear, caribou, Dall sheep, mountain goat, willow ptarmigan, spruce grouse, waterfowl, or sport fish, and ii) provide opportunities to harvest game under aesthetically pleasing natural conditions.
		3b) Identify areas which currently or potentially provide opportunities for non-consumptive enjoyment of fish and wildlife resources, including areas where fish and wildlife resources can be enjoyed while driving, hiking, skiing, etc.
		3c) When access is opened to areas providing habitat for harvestable species listed under (3a, i), ensure that harvesting consistent with area species management goals is permitted.
		3d) Identify corridors that will improve access to existing fish and wildlife use areas, emphasize traditional access routes that cross lands which are now, or soon will be, in borough or private ownership.
		3e) Determine needed access to potential fish and wildlife use areas.

Resource Area	Problems or Concerns	Objectives
Fish and Wildlife Land (Continued)		3f) Identify needed access corridors and measures for providing them, e.g. continued government ownership of access corridors; securing, right-of-way easements; zoning; and tax incentives, direct payments, or management assistance for private landowners.
	4) Cook Inlet salmon fisheries may be negatively impacted by land uses in the Willow Subbasin which reduce the quality or quantity of anadromous fish streams.	4) Identify the quality and quantity of Subbasin anadromous fish streams which contribute to the Cook Inlet salmon fisheries.
	5) Activities occurring outside of fish and wildlife habitat lands may negatively impact conditions within habitat lands.	5 Identify and maintain flows of matter and energy which sustain fish and wildlife habitat quality.
	6) Data on fish and wildlife population dynamics, habitat requirements, responses to land uses and human activities, etc. are inadequate for many management purposes.	6a) Prioritize data needs on the basis of imminent or existing problems, concerns, conflicts, etc. and implement studies to collect necessary data.
		6b) Provide for reducing detrimental impacts to fish and wildlife associated with many land uses by improving the organization and accessibility of existing data bases to local, state, and federal resource and development agencies, as well as to private individuals.
	7) Damages to human life and property (e.g., crop damage, livestock predation, bear injuries, beaver damage, etc.) increase as human activities encroach on fish and wildlife habitats.	7a) Develop siting and design criteria which will minimize wildlife caused damages to life and property where necessary human developments conflict with fish and wildlife resources.
		7b) Improve public knowledge of methods to decrease wildlife-caused injuries and property damage by utilizing public information programs when instituting management programs.
	8) Implementation of fish and wildlife management activities is hampered by public unfamiliarity with the ecological/biological basis of management decisions and procedures.	8) Improve public knowledge of management programs.
	9) Coordination among agencies affecting fish and wildlife resources is often inadequate.	9) Formalize procedures for ensuring interagency communication, coordination, and cooperation.

3. Resource Base

3. Resource Base

Physical Factors

Location

The Susitna River Basin is located in southcentral Alaska and is bounded by the Copper and Matanuska River Basins to the east; the Tanana River Basin to the north; the Kuskokwim River Basin to the west, and Cook Inlet to the south. The basin includes about 13.7 million acres or about 3 percent of the total Alaska land area. For the Susitna Cooperative River Basin Study, the region was divided into four subbasins: Willow, Talkeetna, Beluga, and Upper Susitna. (Figure 3.1) The Willow Region includes the drainages of Little Willow and Willow Creeks and the Little Susitna River. It encompasses an area of 1 million acres and lies entirely within the southcentral portion of the Matanuska-Susitna Borough. (Figure 3.2)

Climate

The climate of this subbasin is greatly influenced by the air flow off Cook Inlet, and the air moving over the Chugach Mountains from the Gulf of Alaska. Interior Alaska's cold dry air occasionally crosses the Alaska Range from the north or northwest in winter. Summers are mild with high temperatures mostly between 60 degrees F and 70 degrees F in the lowlands. Freezing temperatures have been recorded in every month of the year. The winters are cold, but not as cold as the interior of Alaska. Springtime has little precipitation and summers are moist. Table 3.1 summarizes temperature and seasonal distribution of precipitation.

Topography

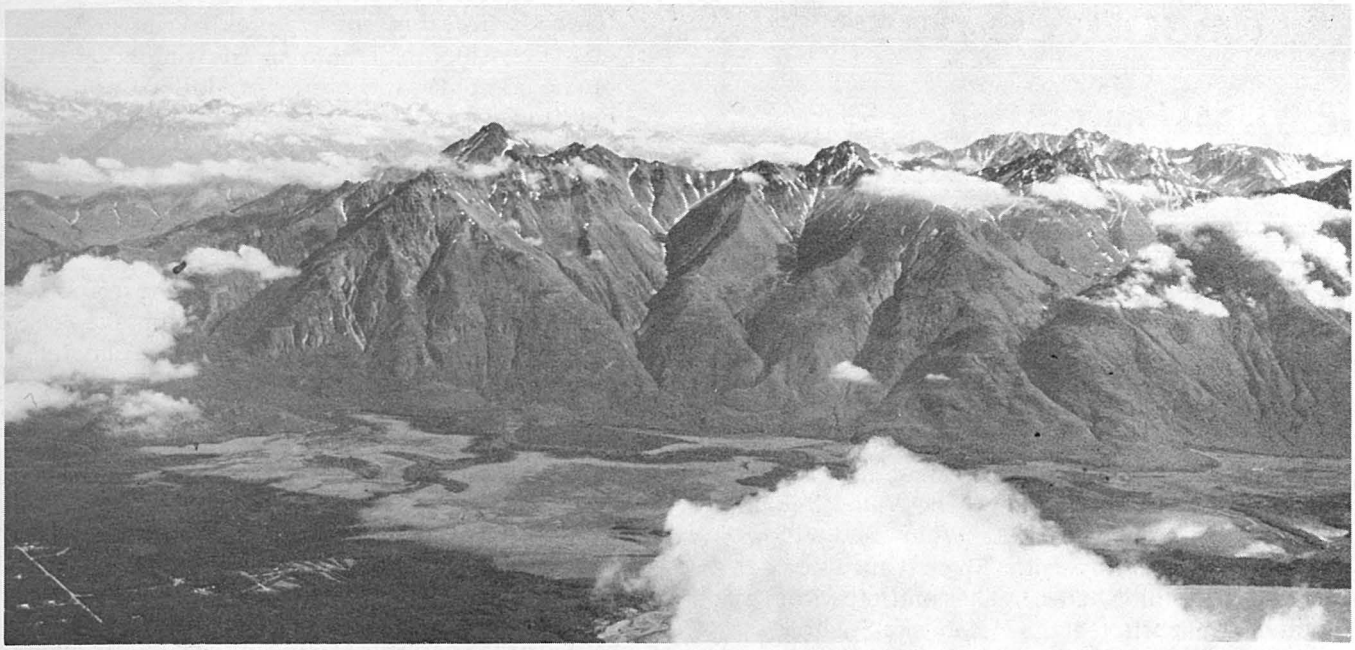
Elevations in the Willow Subbasin range from sea level to 6536 feet above sea level at Montana Peak, the extreme northeastern limit. The area generally slopes from northeast toward the south and west. Major drainages are the Susitna River to the west and Cook Inlet to the south. Tributaries are Little Willow Creek, Willow Creek, Little Susitna River, Goose Creek, Fish Creek, Cottonwood Creek, Lucille Creek and Wasilla Creek.

Topography to the northeast is dominated by the rugged Talkeetna Mountains where elevations are primarily between 3000 and 5000 feet above sea level. The remainder of the region is low with undulating surface typical of glacial deposits. There are many lakes, ponds, muskegs, and swamps among the wooded hills, but vegetation is sparse in the Talkeetna alpine areas. The Susitna River, draining portions of the Alaska Range and Willow Subbasin, is braided and heavily laden with glacier-fed silt. Glacial silt causes some discoloration in the Little Susitna River; all other basin streams are clear.

Table 3.1 Temperature and Precipitation Data Susitna, Alaska

	Temperature[1]				Precipitation				
			Two years in 10 will have at least 4 days with—			One year in 10 will have—			
Month	Average daily maximum	Average daily minimum	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Average total	Less than—	More than—	Days with snow cover	Average depth of snow on ground last day of month
					Inches	Inches	Inches	Number	Inches
January	23	2	40	-30	1.38	0.29	4.52	29	17
February	31	13	43	-17	1.28	.34	2.13	28	13
March	35	12	45	- 9	1.16	.60	1.68	31	12
April	48	24	58	10	.88	.37	1.61	17	1
May	60	32	71	20	1.46	.59	2.34	1	0
June	69	41	80	33	1.69	.52	2.94	0	0
July	70	46	79	38	2.55	1.24	3.77	0	0
August	67	44	74	34	5.52	2.52	9.71	0	0
September	57	38	65	27	5.07	2.49	7.84	0	0
October	44	27	54	3	3.53	1.84	4.20	3	1
November	31	13	41	- 8	1.82	.16	4.40	18	4
December	24	5	41	-27	1.71	.11	4.20	26	10
Year	47	25	——	——	28.05	——	——	153	——

[1]Maximum and minimum temperature data are for the period 1933-47. Temperatures are shown in degrees Fahrenheit.

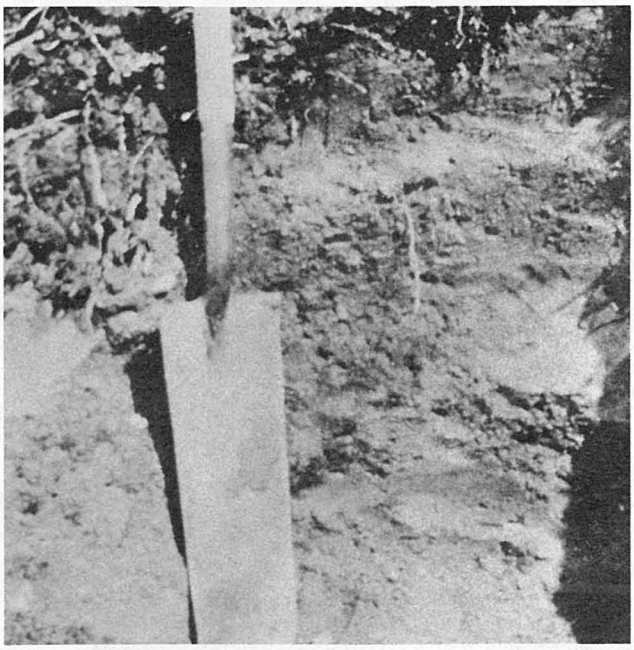


Topography to the northeast is dominated by the rugged Talkeetna Mountains where elevations are primarily between 3000 and 5000 feet above sea level.

Soils

Soils of the area have predominantly formed in very shallow to deep deposits of silty volcanic ash, loess, alluvial sediments, or colluvium over very gravelly sandy material derived from glacial till or outwash. The silty loess blown from the outwash plains of the Matanuska and Knik Rivers is mantled over much of the eastern part of the area. The thickness of the loess generally decreases depending upon the distance from the rivers, but the density is directly influenced by the direction of the winds from the Knik and Matanuska glaciers. Ash from ancient volcanoes in the Alaska Range and silty loess from the Susitna River is mantled over much of the western part of the area. The glacial till is dominantly very gravelly sand or very gravelly sandy loam. Compactness of the till can vary within a short distance. The outwash material is mostly loose very gravelly sands, but in places is stratified sand and gravel. Organic decomposing plant materials are found in muskegs and other depressional areas.

Soils on the upland terraces, outwash plains, and moraines are generally well-drained. Poorly and very poorly drained soils occur in depressions, along drainageways, in muskegs, and in areas that receive seepage from higher elevations. Terraces, outwash plains and muskegs are nearly level or undulating. Glacial moraines usually have complex slopes that range from undulating to very steep. Terrace escarpments include mostly steep slopes.



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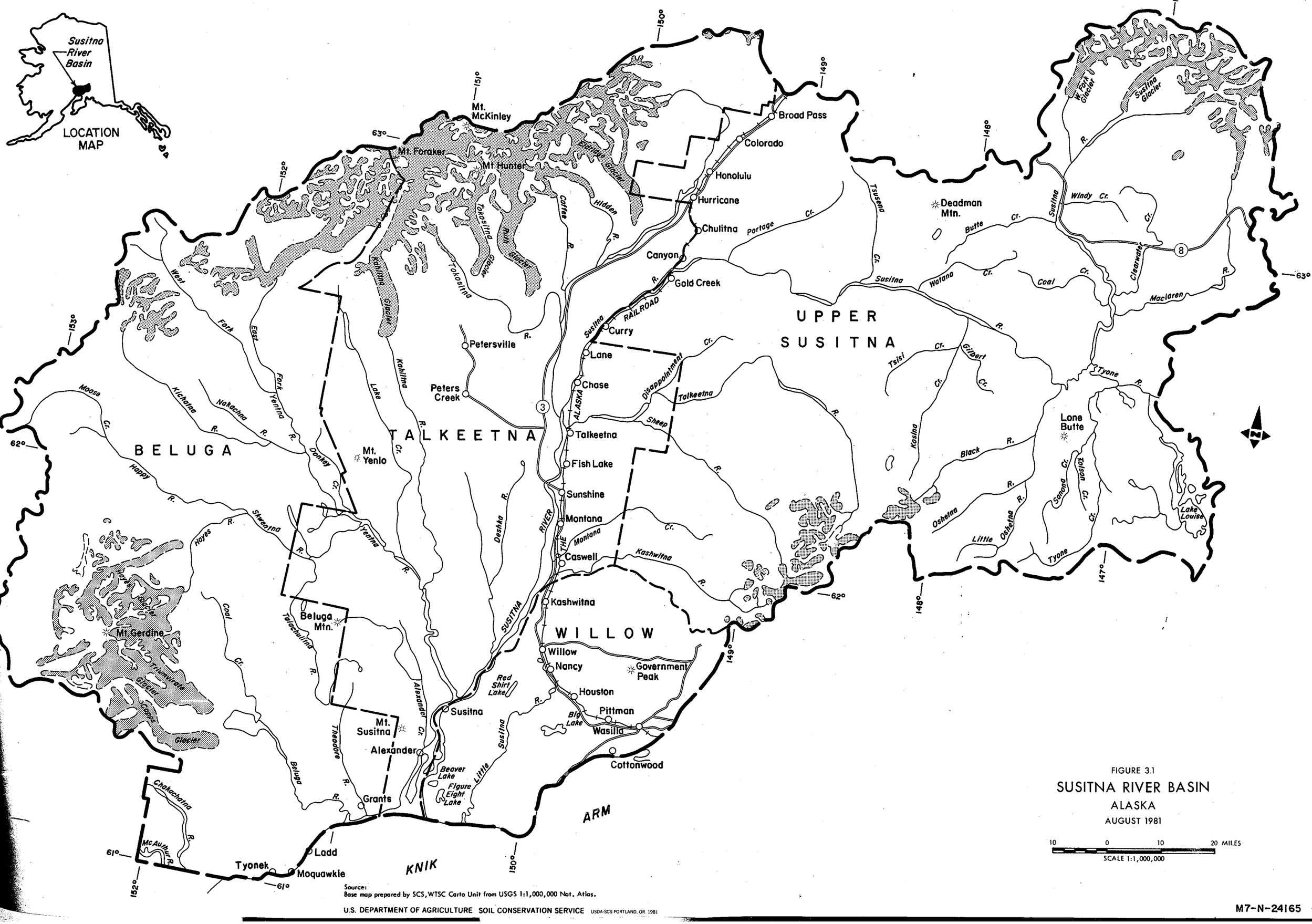

FIGURE 3.1

SUSITNA RIVER BASIN

ALASKA

AUGUST 1981

10 0 10 20 MILES

SCALE 1:1,000,000

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:1,000,000 Nat. Atlas.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND, OR. 1981

M7-N-24165

FIGURE 3.2
WILLOW SUBBASIN
ALASKA
AUGUST 1981.

SCALE 1:250,000
10 MILES
5 0 5

M7-N-24166

The general soil map (Figure 3.3) depicts the soil associations in the Willow Subbasin. A soil association has a distinctively proportional pattern of one or more major soils and at least one minor soil.

Soil association maps are useful to those who want to gain a general understanding of the soils in an area, to compare different parts of an area, or to establish the location of tracts that are capable of supporting certain types of land use. Such maps are useful as general guides for managing watersheds, wooded tracts, wildlife areas, or in planning engineering works, recreational facilities, and community developments.

Detailed soils maps of the Willow Subbasin showing the capability of specific sites to support various uses are available at the SCS office, Anchorage, Alaska. The soil capabilities are derived from the physical soil characteristics identified by the soil survey maps. Soil characteristics such as drainage, slope, texture, permeability, and so forth, determine soil interpretations for land capability and potential uses. For example, soils with poor drainage and excessive slope may render areas unsuitable for septic tanks, or construction of buildings and roads. See Figure 3.4 for drainage interpretations, 3.5 for slope, 3.6 for septic tank limitations, and 3.7 for building limitations.

The soil associations in the Willow Subbasins are briefly described in Appendix A.

Geology and Ground Water

The Willow Subbasin lies in a geologically important area between the Aleutian volcanic island arc system on the south and continental bedrock on the north. It is at the upper end of Cook Inlet basin which has a complex history of repeated large scale sedimentation, deformation, and intrusion. In more recent times glaciation has strongly influenced the area.

During late Paleozoic and early Mesozoic time, the sea covered the southcentral Alaska region, which was bordered on the north by an island arc system. Marine sedimentary deposits accumulated for a thickness of several miles. Intervals of volcanic activity resulted in layers of volcanic lava and volcaniclastic rocks intermixing with sedimentary rock units. The Mesozoic era included several cycles of sedimentation, along with mountain building resulting from implacement of large masses of igneous rock which form the heart of the present-day Talkeetna Mountains. The processes of mountain building and erosion resulted in thick sequences of sedimentary units in the Cook Inlet region, creating probable source beds and reservoir rocks for petroleum deposits. By the end of the Mesozoic period, a trough had gradually formed in the vicinity of the present-day Cook Inlet basin between the ancestral Alaska Range to the northwest and primitive Kenai-Chugach Mountains to the east.

During the Tertiary epoch more uplift occurred in the Talkeetna mountain province, with subsequent increases in erosion into the lowlands. These sediments were deposited in the Willow region, along with other sediments derived from interior Alaska, western Canada, and adjacent borderlands. A broad linear trough formed in the Cook Inlet vicinity, and climatic conditions were generally warmer and more temperate than today. Early Tertiary sedimentation centered in the region now known as the Matanuska Valley region, where thick sequences of conglomerate, sandstone, and siltstone were interlayered with seams of coal. During the late Tertiary period, thousands of feet of sediment were deposited in a large, slowly subsiding trough in the lowlands of the region west and southeast of the Talkeetna Mountains. This sedimentary sequence, known as the Kenai Group, consists of conglomerate, sandstone, shale, claystone, and interbedded coal. Deposition was primarily by rivers and streams with at least one marine estuary. Present-day commercial oil and gas production, which is centered generally southwest of the Willow Subbasin in Cook Inlet, is derived from reservoirs in the Kenai Group. The final element of late Tertiary activity was deposition of some basaltic lava flows with associated dikes and sills.

The major topographic elements of the subbasin were established by late Tertiary time, i.e., the Talkeetna highlands. The elements are flanked by major valleys to the west and southeast. The present topographic configuration is a reflection of glacial and interglacial processes which occurred primarily in the Pleistocene era, with fluvial deposition and reworking since then. Five sequences of glaciation occurred, filling the valleys with ice and extending into Cook Inlet. Deposition in the lowlands was predominantly unstratified glacial till, with some stratified outwash and fluvial sediments. These deposits are up to several hundred feet thick and have resulted in complex drainage and ground water conditions. The water table is shallow and the ground is frozen seasonally. See Figure 3.8 for ground water availability. Local eolian deposits cause further complications. Glacial landforms dominate the present lowland topography in the subbasin.

The setting of the Willow Subbasin shows it to be a juncture of two structural troughs which merge into

SOIL ASSOCIATIONS

SOILS OF THE MOUNTAINS
- A1 Rock Outcrop
- A2 Talkeetna-Torpedo Lake
- A3 Talkeetna-Starichkof
- A4 Torpedo Lake-Starichkof
- A5 Mutnala-Starichkof
- A6 Torpedo Lake-Homestead

SOILS OF THE VALLEYS
- B1 Homestead-Knik
- B2 Knik-Coal Creek
- B3 Doone-Knik
- B4 Bodenberg
- B5 Homestead-Salamatof
- B6 Naptowne-Salamatof
- B7 Rabideaux-Salamatof
- B8 Nancy-Homestead
- B9 Nancy-Kashwitna

SOILS OF THE LOWLANDS
- C1 Salamatof-Moose River
- C2 Tidal Marsh-Clunie
- C3 Susitna-Salamatof

FIGURE 3.3

GENERAL SOIL MAP

WILLOW SUBBASIN

ALASKA

AUGUST 1981

5 0 5 10 MILES

SCALE 1:250,000

Source:
Base map prepared by SCS, WTSC Carto Unit from AMS 1:250,000 series.
Thematic detail compiled by state staff.

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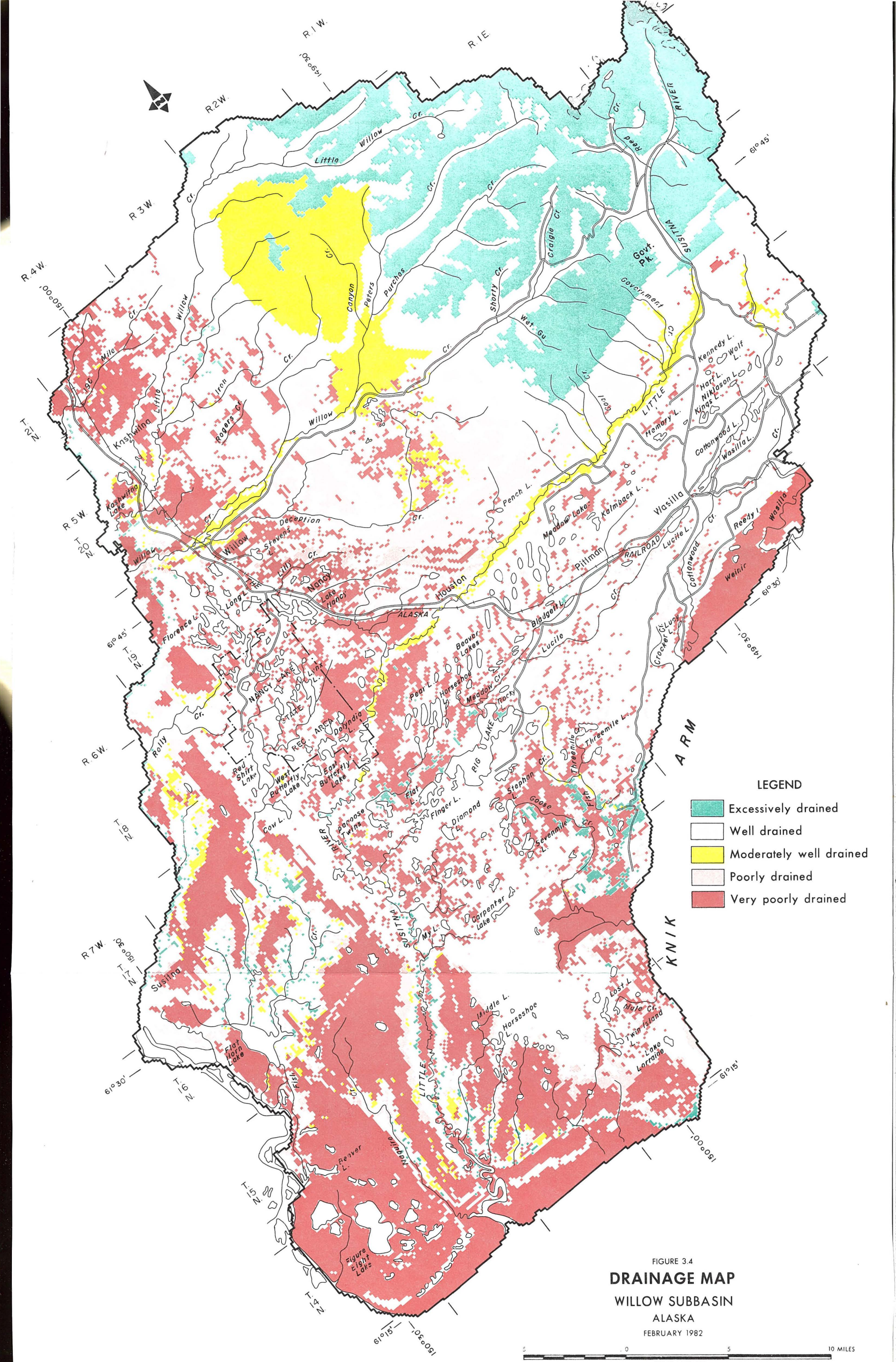
M7-N-24166-1



LEGEND

- Excessively drained
- Well drained
- Moderately well drained
- Poorly drained
- Very poorly drained

FIGURE 3.4

DRAINAGE MAP

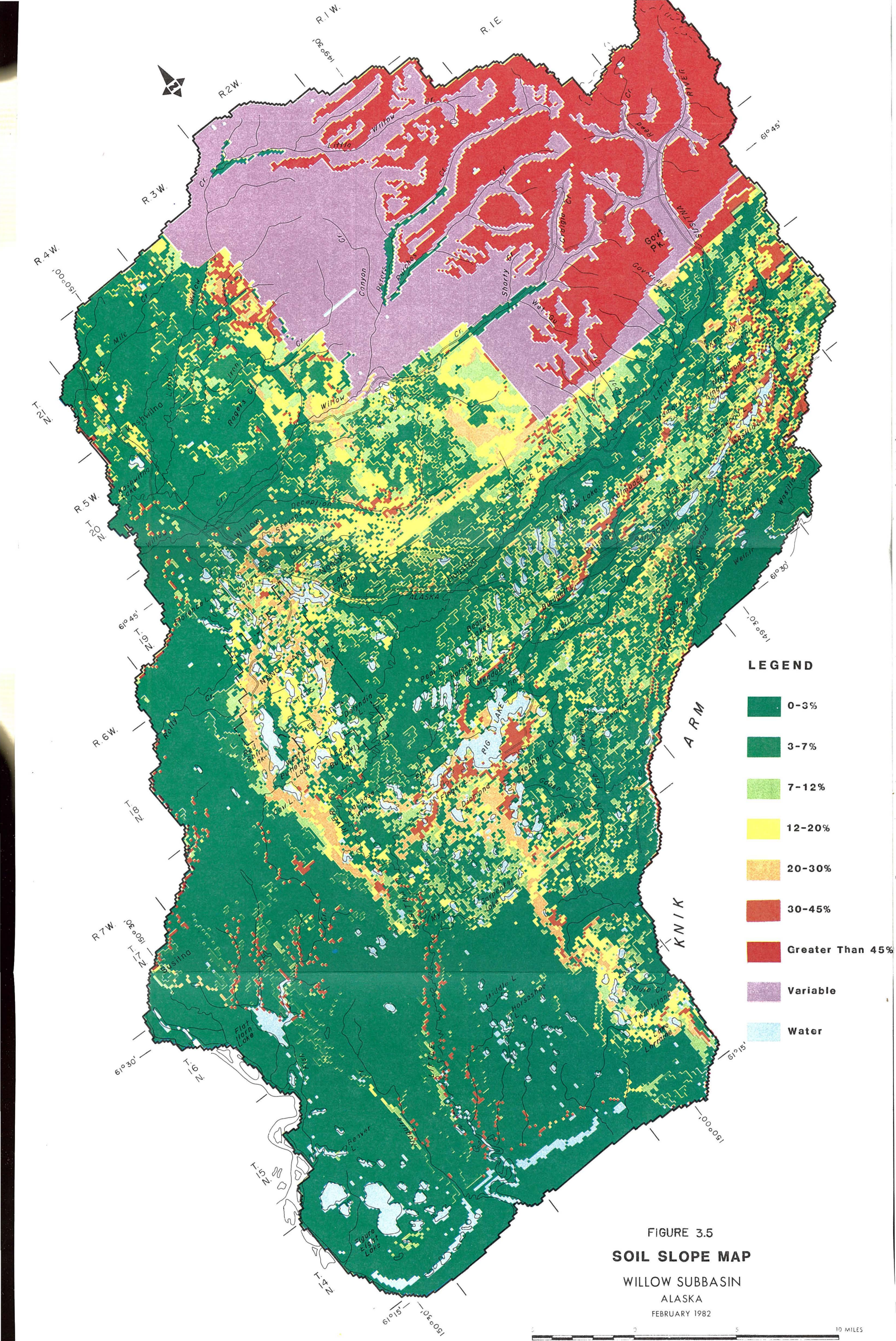
WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1:250,000



LEGEND

- 0-3%
- 3-7%
- 7-12%
- 12-20%
- 20-30%
- 30-45%
- Greater Than 45%
- Variable
- Water

FIGURE 3.5

SOIL SLOPE MAP

WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1:250,000

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1982

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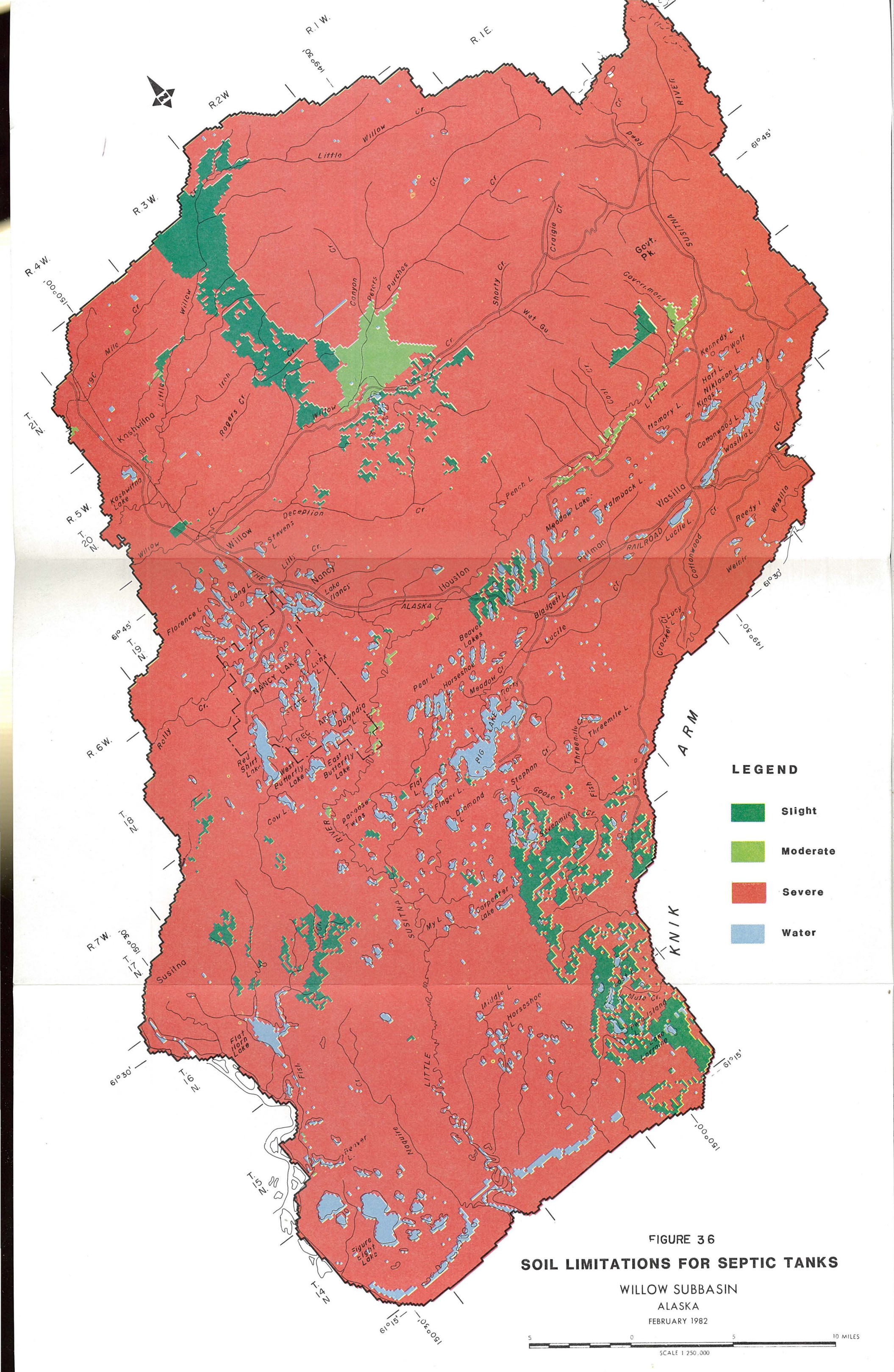

LEGEND

- Slight
- Moderate
- Severe
- Water

FIGURE 36

SOIL LIMITATIONS FOR SEPTIC TANKS

WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1:250,000

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (USDA SCS PORTLAND, OR 1982)

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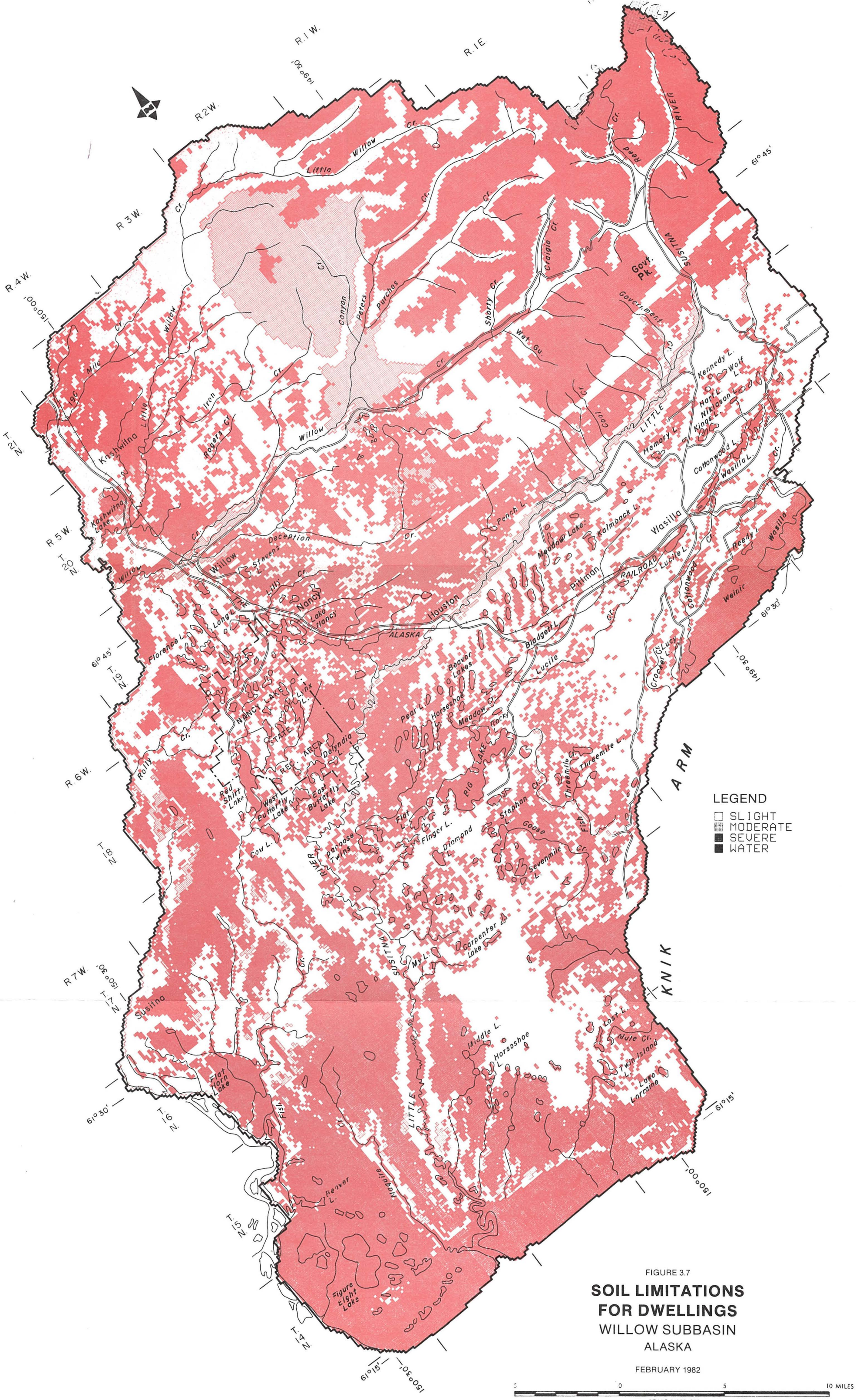


LEGEND

- SLIGHT
- MODERATE
- SEVERE
- WATER

FIGURE 3.7

SOIL LIMITATIONS FOR DWELLINGS

WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1:250,000

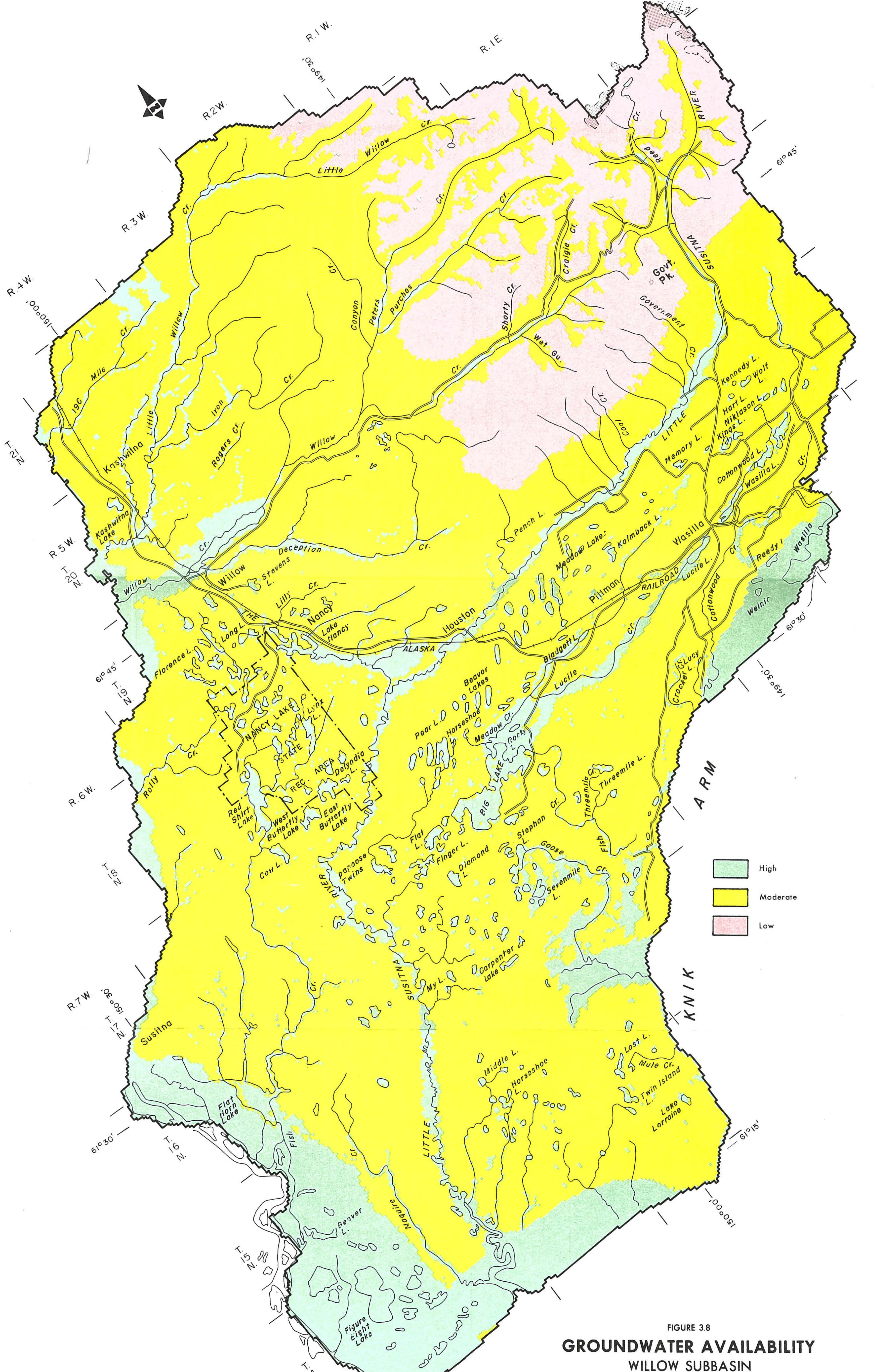


FIGURE 3.8
GROUNDWATER AVAILABILITY
WILLOW SUBBASIN
ALASKA

JUNE 1982

the upper end of the Cook Inlet Tertiary basin, an elongated basin superimposed on older sedimentary rocks. Between the troughs are the Talkeetna Mountains.

The major regional tectonic feature, the Castle Mountain fault, trends northeast by southwest and essentially bisects the subbasin. It has been mapped further northeast through the Matanuska Valley and also to the southwest; it probably is continuous with the Lake Clark and Bruin Bay faults. In the subbasin lowlands and Talkeetna Mountains the fault plain dips steeply northward and is nearly vertical.

South of the fault system, the Tertiary sediments in the subbasin have been deformed into a series of broad asymmetric folds trending northeast by southwest. These folds generally plunge southwest, and fold axes are possible prospects for oil and gas deposits.

Vegetation Cover (Forestry/Range)

Less than 4 percent of the acreage in the Willow Subbasin has been cleared for agricultural land or other uses. About 50 percent of the study area is wooded, 16 percent consists largely of very poorly drained muskegs and tidal plains that support low growing plants, and 22 percent consists of grass and alder. The grass and alder grow at elevations of 1500 to 2500 feet above sea level and tundra at higher altitudes. About 4 percent of the area is water and 4 percent is snow, ice, and rock. The root systems of most plants and trees are generally shallow and concentrated in the surface layer of the soil.

The vegetation in the subbasin varies by location. The predominant vegetation is a mixed forest of paper birch and white spruce, although pure stands of paper birch, white spruce, and aspen occur in some places. Cottonwood stands are common on alluvial flood plains and thrive on some uplands. Above 1000 feet elevations, clear stands of white spruce are fairly common. Forests of black spruce dominate muskeg borders with sedges, mosses, shrubs, and forbs common within the muskegs. Tidal flats have a cover of grass, sedges, and associated species. Alluvial stream deposits, tidal flats, and rough mountainous areas are barren.

For purposes of this study, a total of 34 vegetation cover types were identified and mapped at a scale of 1:63,360 (1 inch = 1 mile). These types were then consolidated and mapped according to groupings oriented either toward timber or range production. Figures 3.9 and 3.10 illustrate existing timber and range resources. A complete set of these as well as the original 34 category type maps are available for the entire Willow Subbasin, and may be obtained at the SCS office, Anchorage, Alaska.

The vegetation in the area varies by location. The predominant vegetation is a mixed forest of paper birch and white spruce, although pure stands of paper birch, white spruce, and aspen do thrive in places.

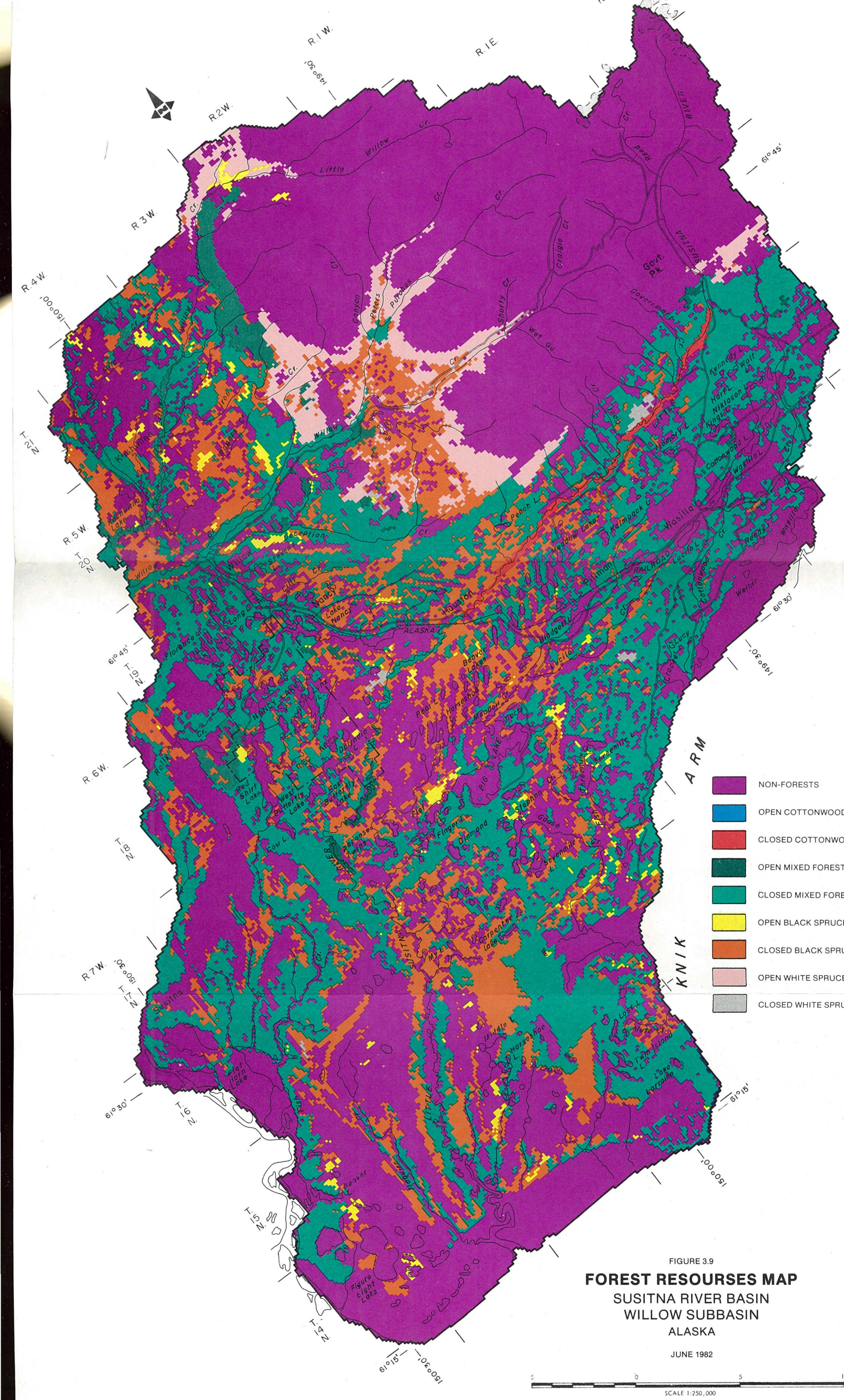
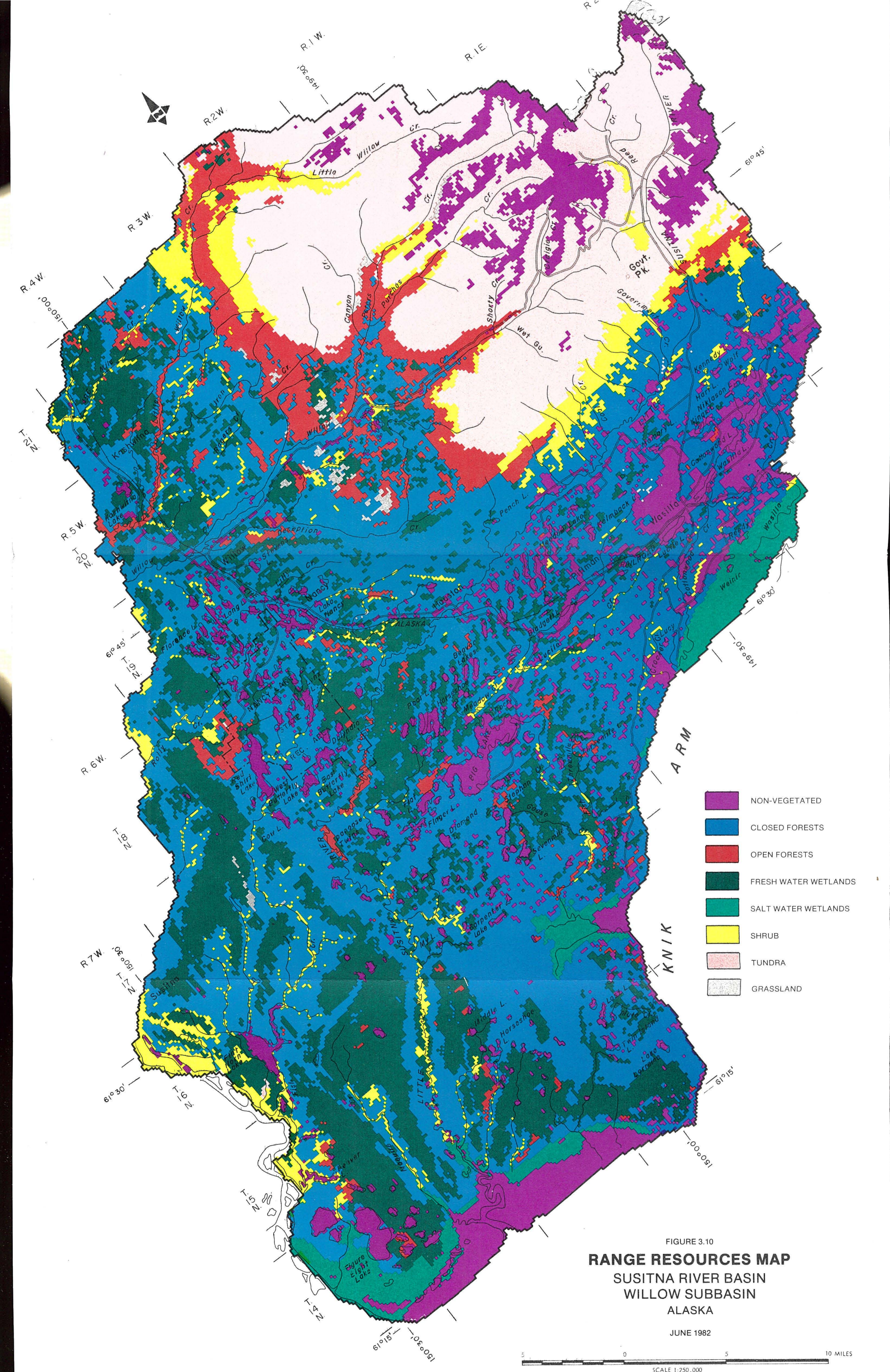


FIGURE 3.9

FOREST RESOURSES MAP

SUSITNA RIVER BASIN
WILLOW SUBBASIN
ALASKA

JUNE 1982



NON-VEGETATED

CLOSED FORESTS

OPEN FORESTS

FRESH WATER WETLANDS

SALT WATER WETLANDS

SHRUB

TUNDRA

GRASSLAND

FIGURE 3.10

RANGE RESOURCES MAP

SUSITNA RIVER BASIN
WILLOW SUBBASIN
ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

Socioeconomic Factors

Background, Population, and Growth

Fur trading was the principal enterprise in Alaska during the period of Russian settlement, 1741 to 1867. Except for fur trading with the Athabascan Indians, the area was virtually untouched and unexplored by "white man" during this period. After the purchase of Alaska by the United States in 1867, conditions remained generally stagnant until placer gold was discovered in the district around Willow Creek in 1897 and in other areas shortly thereafter.

Although a trading station had been previously located at Susitna, the first major center of population was at Knik where a trading post was established about 1900 and a post office in 1905. This village was a major point of departure for prospectors and miners. The Knik village continued to be the transportation and trading center of the region, reaching a peak population of about 1500 in 1915. During this early period, a number of homesteads were established around Knik and along radiating trails.

With construction of the Alaska Railroad—which runs from Seward to Fairbanks, bypassing Knik—starting in 1915, there was a population shift. Within the region, mining camps and trading centers grew at Pittman, Houston, Willow, and Kashwitna. A major village center was also established at Wasilla.

Homesteading contributed to regional growth in the early years, however between 1930 and the end of World War II, the population remained relatively stable. After the war, favorable veteran's clauses in the Homestead Act provided a new incentive for growth with notable expansion taking place along the Willow-Hatcher Pass Road.

The Homestead Act, however, imposed a 160-acre limitation for farms and many farmers found this size to be an uneconomical enterprise unit. As a result, many continued ownership but opted to seek employment elsewhere. Those who chose this alternative profited in the early 1970's when subdivision activity increased. This activity continues, boosted substantially by a statewide referendum calling for a new Alaska State Capital site at Willow.

The 1976 population for the Willow Subbasin was estimated at 6,759 people. More than 40 percent of this total were concentrated in Big Lake (pop. 721); Wasilla (pop.384); and Houston (pop. 166).

Figures for 1981 are not available currently, however, construction activity within the past 5 years indicates that substantial growth has occurred.

Growth projections for this study have been made for two scenarios: (1) with and (2) without the Alaska state capital move from Juneau to Willow. This was made necessary because of a recent statewide referendum indicating the public will not support bonded funding for a new capital. Table 3.2 displays population projections for the Willow Basin.

Employment and Work Force

Population, employment, and income for the Matanuska-Susitna census district are shown in Table 3.3. This census district coincides with the Matanuska-Susitna (Mat-Su) Borough and encompasses the drainages of the Matanuska and Susitna Rivers. While most of the district's economic activity takes place outside the study area, in the vicinity of Palmer, USDA economists felt that the economic indicators are valid for the study area as a whole.

Although Anchorage serves as the place of work for a large number of borough residents—some 24 percent of the work force—employment fluctuations are much greater locally than in Anchorage. As of March 1981, the Mat-Su Borough's unemployment rate was 13.8 percent [1] compared to a rate of 7.5 percent for Anchorage and 10.5 percent statewide. This is unusual considering the total number of borough workers employed in typically stable employment categories, e.g., government; transportation, communications and utilities and finance, insurance, and real estate.

One explanation for the unemployment discrepancies is that those on the Borough unemployment rolls had previously worked in other areas of the state such as the North Slope or the coastal fishery. Subsequently, upon job termination they took up residence in the Mat-Su Valley because of its milder climate and private land availability. Another explanation offered by some residents is that unemployment is part of an accepted lifestyle for many in the area. Many work when they can and when weather permits. During the so-called off-season many of the jobless resign themselves to the fact that no local jobs are availabe and commuting to Anchorage, where jobs may be availabe, is untenable during the winter months.

In 1978 [2], the per capita income of $8,803 annually was about 28 percent less than that of nearby Anchorage and 19 percent less than the state average of $10,851.

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[1] This may be understated, particularly in remote areas, because of Alaska Department of Labor reporting procedures.

[2] Most recent published data.

Table 3.2 Population Projections,[1] Willow Subbasin

	1976	1985		2000		2025	
	Existing	Without	With	Without	With	Without	With
Willow-Houston	550	597	7,080	749	43,602	793	69,402
Wasilla	1,566	4,318	6,942	13,119	27,618	15,751	37,720
Big Lake	721	1,526	2,453	4,218	8,880	5,020	12,022
Other	3,922	6,471	10,403	14,633	30,805	17,060	40,855
TOTAL SUBBASIN	6,759	12,192	26,878	32,719	110,905	38,624	159,999

[1] "With" and "Without" refer to new state capital development at Willow.

Table 3.3 Population, Employment, and Income —Matanuska-Susitna Census Division, by year

	1975	1976	1977	1978	1979	1980
Population (thousand persons)	10.9	13.3	14.2	14.2	18.9	17.8
Employment (persons employed)						
Total	2,155	2,405	2,660	3,090	3,206	3,341
Federal government[2]	130	136	115	103	97	113
State and local government	758	856	904	1,125	1,101	1,212
Transportation communication and utilities	218	243	279	307	316	314
Wholesale and retail trade	315	419	554	588	745	725
Construction	188	208	219	235	184	178
Finance, real estate, insurance	62	82	105	124	129	117
Services	288	288	305	363	433	466
Farm	129	129	129	129	129	117
Other[3]	67	44	50	116	72	99
Unemployment rate	11.1%	14.3%	14.6%	18.2%	14.6%	15.0%
Income						
Total wages ($ millions)	30.2	37.1	43.6	51.0	56.7	60.1
Total personal income ($ millions)	88.2	115.5	133.1	150.0	167.9	[5]
Per capita personal income ($)	8,092	8,664	9,020	8,939	8,878	[5]
Ratio of per capita income to U.S. average per capita income[4]	[5]	0.90	0.88	0.77	[5]	[5]

[1] Preliminary
[2] includes military
[3] mining, manufacturing, and miscellaneous
[4] adjusted for cost of living differential
[5] not available
Source: Alaska Department of Commerce and Economic Development, Division of Economic Enterprise, **Basic Economic Statistics of Alaska Census Divisions, November 1979.**

Assuming that workers commuting to Anchorage are paid on a par with Anchorage residents, it follows that jobs within the basin pay significantly less. In 1978, the average wage was $16,505 compared with $19,188 in Anchorage.

General Social Conditions

The residents of the Susitna Basin, like those in much of Alaska, fall largely into four loosely defined, indistinct groups. These groups are composed of individuals who prefer primitive ("bush") living, community, commercialism, or recreation. Many persons like to hear the term "rugged individualist" and maintain a degree of respect for one another's preferences.

Several hundred people live in the "bush" without road access. They derive a large portion of their income from subsistence activities (hunting, farming, trapping, and so forth) supplemented by outside seasonal employment. They are not enamored of government and wish to keep "public services and control to a minumum."[3] The services they seek "must, of necessity, be few and rudimentary,"[4] for example, an airstrip, trading post, elementary school, and post office. These residents live in the bush because they like it and wish to maintain the status quo as voiced in public meetings. They disapprove of economic development occurring in their proximity.

[3] Matanuska-Susitna Borough, Planning Department, **Goals Statement, Phase two: Comprehensive Development Plan,** Palmer, May 1978. p. 20.
[4] Matanuska-Susitna Borough, p. 19.

The community oriented tend to gather, though not closely, and provide consumable goods and services for themselves, bush people, and the occasional passer-by. In many instances, they were one time bush residents to whom a road was constructed; they, too, may be seasonally employed elsewhere.

The commercially oriented population consists of individuals who are employed—usually full time—in commercial or public establishments in the larger communities. The largest Matanuska-Susitna community, Palmer, lies outside the study area but draws many persons from within the area for employment.

These people wish to avail themselves of goods and services, such as roads, water, sewer, waste disposal, educational facilities, and police and fire protection. This type is interested in local economic development and population growth to help minimize per unit cost of social services as well as to enhance opportunities for personal income growth.

The recreationally oriented types may be permanent or part-time residents who locate in the area because of the abundant recreational and aesthetic amenities. They may be retired, employed locally, or employed outside the area. Generally in the upper income classes, as private landowners they have distinct ideas about the course of resource development in the area.

The path of resource development in the Susitna River Basin will depend largely on the degree of resolution among the conflicting goals and objectives of the residents. The information presented in this study will aid the public, the state, and local officials in resolving these conflicts.

Transportation

The central portion of the area is well serviced by the Parks (Anchorage-Fairbanks) Highway and several secondary roads. From the northwest the Parks Highway provides the only access to the basin while to the east the area may be reached via several secondary roads in addition to the Parks Highway. Hatcher Pass Road running east and west traverses the northern portion of the subbasin, however, because of the rough mountainous terrain and other construction limitation factors, there are few tributary roads. To the south most areas remain inaccessible to all but air transportation as evidenced by the large numbers of light aircraft landing strips. A new road has recently been constructed to Point McKenzie. A potential route selection model developed for this study to tie several existing key areas together is presented on Figure 3.11. The model depicts an approximation of the most cost-effective method of providing general access to subbasin lands.

Influence of Nearby Urban Centers

Located less than 50 highway miles from the basin, Anchorage plays a major role in the local economy. It is estimated that 1,700 of the subbasin residents are employed, of which 300 or about 18 percent work in Anchorage. In addition to being a source of employment, Anchorage generates a significant demand for Willow area resources. The entire road network is within 2 hours driving time of Alaska's most populated urban center. This convenience factor has contributed to the recreational cabin boom in recent years; as noted by the fact that approximately 55 percent of the Mat-Su Borough tax notices are mailed to Anchorage addresses.

Recreational vehicles from Anchorage occupy most of the fishing sites in the subbasin on any given summer day. A large percentage of the traffic that passes through the basin has Anchorage as either its departure point or final destination.

Basin residents also depend on Anchorage for many of their goods and services. Many local residents have indicated that, although commercial stores are available nearby, Anchorage's large shopping malls and supermarkets are frequented by many on a weekly basis. The primary reasons for this being that many goods sold in Anchorage are not available locally; prices for many items are lower; and the convenience factors associated with mall shopping.

Influence of Tourism

In 1977, more than 500,000 people spent nearly 370 million dollars traveling to, from, and within Alaska. Over 75 percent of those visitors entered the state partly for pleasure, e.g. sightseeing, camping, hiking, fishing, and so forth, and 55 percent came solely for this purpose. The most frequently visited places in the state by non-residents included Anchorage (358,300 visitors), Fairbanks (174,000 visitors), and Mt. McKinley National Park (120,200 visitors). A large number of visitors pass through the Willow Basin en route to special interest areas such as Mt. McKinley and Fairbanks. A good many visitors utilize basin recreational resources in their travels.

Many commercial establishments scattered along the Parks Highway are geared to the tourist industry. Gift shops, restaurants, and lodges are common and sporting equipment is sold at gasoline stations as well as commercial sporting outlets. Tourism is a significant factor in the region's

economy at present and has been projected to grow even more important in years to come. However, projections made in Alaska during the past five years have often been no more than "best guesses" because of a lack of sufficient data. Energy costs are increasing at a tremendous rate, and as real disposable income decreases, tourism may decline.

Archeological and Historical Resources

Several sites in the Willow Subbasin have been identified as having archeological and historical significance. Detailed descriptions and interpretations of site values may be found in the **Report of Archeological Field Survey in the Willow-Wasilla Area, 1978** by Douglas R. Reger, undertaken as part of this study. A listing of those sites is presented in Table 3.4.

Table 3.4 Important Historical or Archeological Sites, Willow Subbasin

National Register Historic Sites	Confirmed Alaska Heritage Resource Survey Sites		Reported Sites With Unconfirmed Existence or Location
Knik Town Site	Cottonwood Creek Vicinity		Memory Lake
Teeland's Country Store	Knik Lake Locale		Anc 12
Wasilla Depot	Fish Creek Site	Nancy Lake Site	Meadow Creek Locality
	Fisher-Hong Site	Tyo 8	Fish Creek Crossing
	Big Lake Vicinity	Alexander	Tyo 9
	Lake Creek No. 1	Tyo 14	Tyo 12
	Crocker Creek Site	Susitna Roadhouse	Nancy Lake Village
	Lake Creek No. 2	Fish Creek No. 2	Niklason Lake
	Blodgett Lake Site	Horseshoe Caches	Red Shirt Lake Inlet
	Kroto	Deshka River No. 1	Cow Lake Village
	Red Shirt Village		

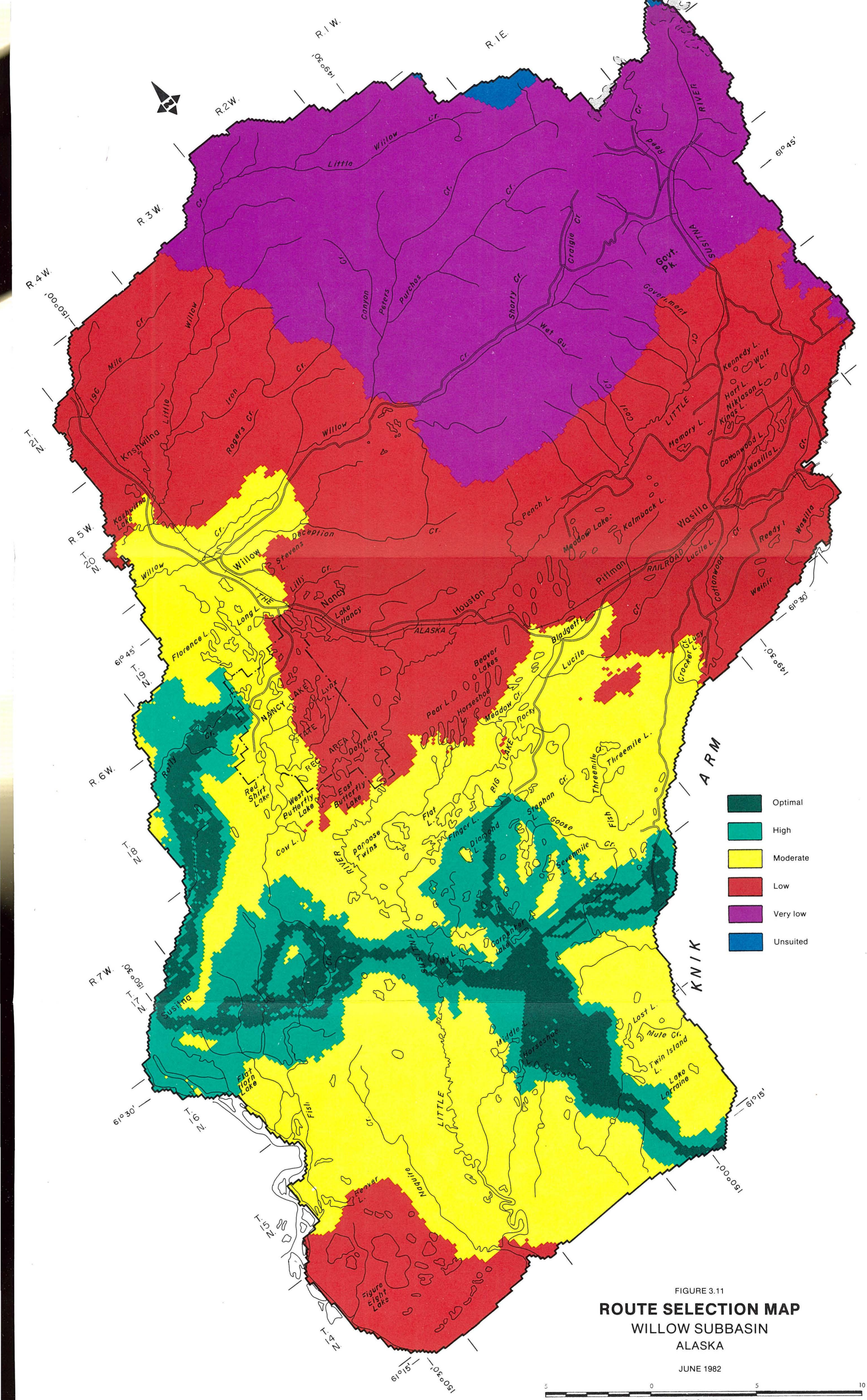


FIGURE 3.11

ROUTE SELECTION MAP

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

4. Present and Future Conditions under Existing Programs

4. Present and Future Conditions under Existing Programs

Background

The Principles and Standards for Planning include a major requirement to "evaluate resource capabilities and expected conditions without any plan." This involves an appraisal of future economic and environmental conditions expected without a plan, so that these conditions may be compared with those desired for the planning area.

For a selected future date, projections are made which reflect the inventory and capabilities of the natural resources, the trends which are likely to continue into the future, and the effects of any authorized public projects which may alter conditions in the region. The "without-plan" portion of the title implies that the future conditions are to be projected without consideraton of any projects which may be in planning stages. This restraint makes it possible to project future conditions which could be expected in the absence of any new programs or projects.

Resource Conditions

Relative to most areas in the United States, the resources of the Willow Subbasin are virtually undeveloped, a situation that is rapidly changing. At present only 9.8 percent of the land area is not in its natural state as illustrated in Figure 4.1. The development that has occurred, however, has often been poorly planned; examples include homes constructed in flood plains and on poorly drained soils, septic tanks found in and adjacent to wetlands, and disturbed areas devoid of vegetation making them subject to erosion. This is expected to be the "future-without-project" condition.

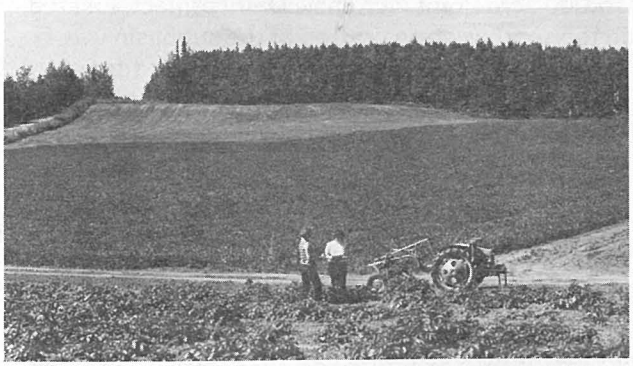
Given present development patterns and trends, problems are likely to increase. A projected population growth of over twentyfold by 2025 has the potential of destroying many current basin amenities unless steps are taken to insure proper use of the resources. In this regard the Susitna Cooperative River Basin Study conducted a suitability/capability analysis, a procedure whereby the entire basin was subdivided into land units (polygons) two acres or greater in size. The size and shape of each polygon was determined from several hundred resource properties or bits of information distinguishing each individual polygon from all others. Once the polygons and their attributes had been identified, criteria were developed for various land uses. The land use criteria were then matched to polygon information to determine the capability and suitability of each land unit for each selected use.

The following sections discuss, in more detail, present and future conditions for each resource concern and, where applicable, display suitability/capability information developed for this study.

Agricultural Land

Agriculture occupies a minor role among the land use types in the Willow Subbasin, even though it is adjacent to Alaska's traditional "breadbasket," the Matanuska Valley. Historically, crop production was not established to any degree in the subbasin because of remoteness, insufficient supply and market infrastructure, lack of availability of privately owned land, clearing difficulties, and the overall malaise of Alaskan agriculture. A small amount of land (0.8 pecent) in the subbasin has been cleared over the years, but little is presently utilized in agriculture. Most of the remainder has grown to brush. (Table 4.1)

Within the decade a new factor has come to dominate the region's landscape. The impediments to agricultural development listed above have been compounded by competition for home and recreation sites. Coincidental with the North Slope oil boom, land in the area which was priced at $70 per acre in the mid 1960's was selling in excess of $7,500 per acre in the mid 1970's.[5] Given this return to land for urban purposes it is impossible for agriculture to be competitive.



University of Alaska Agricultural Experiment Station, Mat-Su Valley.

[5] Matanuska-Susitna Borough, Planning Department, **Comprehensive Development Plan Background Report,** April 1978, p. 108.

Table 4.1 Land Cleared and Presently in Agricultural Use by Watershed, Willow Subbasin

Drainage	Land in use, 1979 (acres)	Land not in use (acres)	Total land cleared (acres)
Cottonwood Creek	399	314	713
Fish Creek	429	3,010	3,439
Goose Creek		730	730
Little Susitna	1,159	1,214	2,373
Willow Creek	6	469	475
Little Willow Creek		149	149
Other		218	218
TOTAL	1,993	6,104	8,097

Source: Allen D. Koester, District Conservationist, SCS, Palmer Alaska

While gardening and other subsistence type activities may flourish as the population expands away from metropolitan Anchorage, past trends of settlement and development indicate that commercial agriculture may take second place to competing uses. In light of the state's current agricultural land policy however, past trends do not appear likely to continue.

The state expects to have 250,000 **additional** acres in agricultural production by 1983 and a total of about 500,000 acres of agricultural land in production by 1990. Alaska's dedication to agricultural land disposals is evidenced by a legislative decree mandating that 650,000 acres be set aside for farming. Outside the subbasin, 65,000 acres are in the process of being developed for grain farming in the Delta Juction and Tanana loop areas, and The Two Rivers agricultural disposal, scheduled to take place in 1981, is estimated to involve 10,000 acres. The 15,000 acre Point McKenzie Dairy project, located in the southwestern portion of the subbasin was disposed of on March 6, 1981 (subject to litigation at this writing). There are nearly 40,000 acres in total which have potential for being developed in this area.

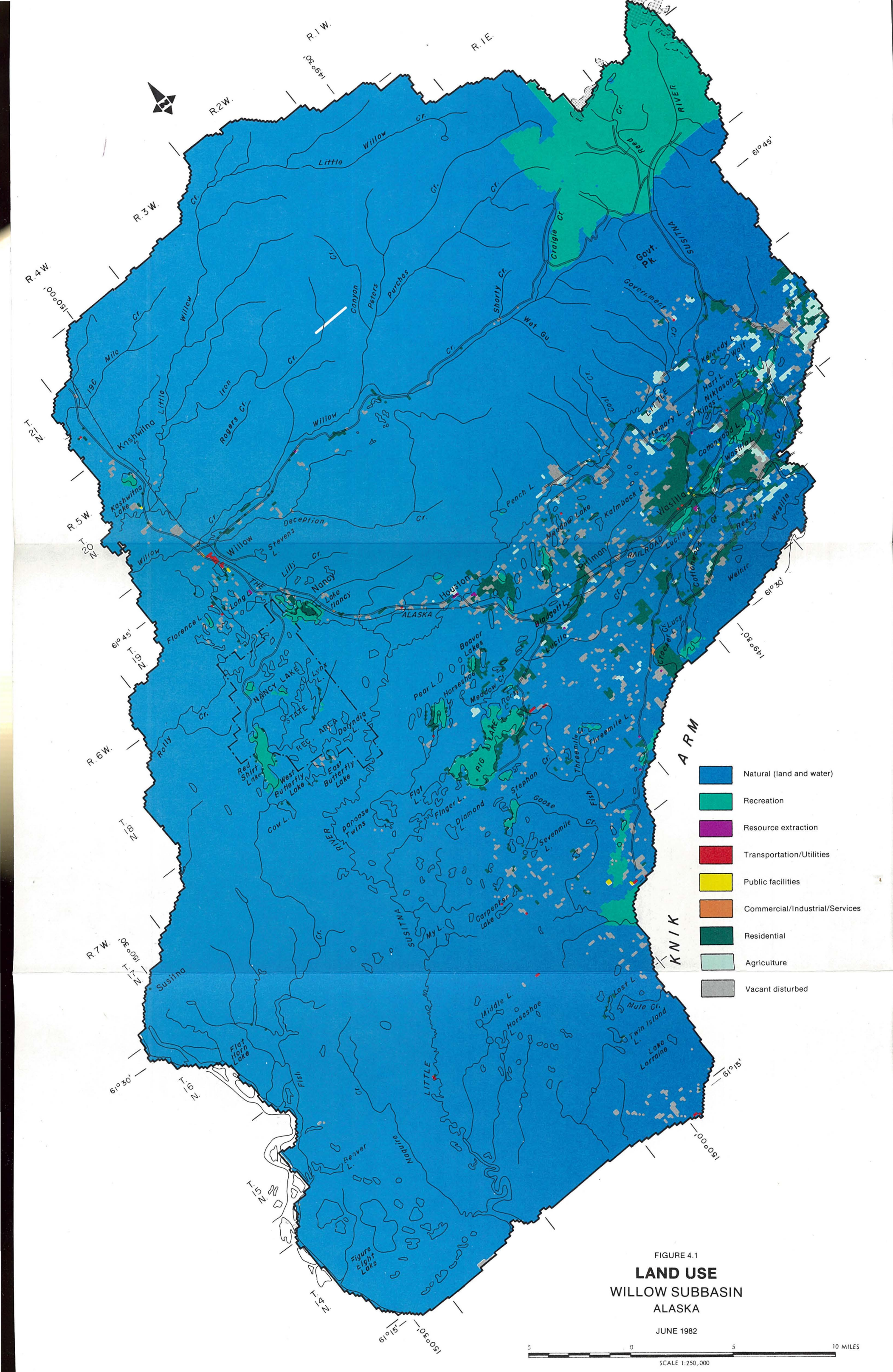
Cost/return information developed for this study indicates that agriculture is viable in certain areas under specific conditions as explained below. Figures 4.2, 4.3, 4.4, and 4.5 show various combinations of production and prices received necessary for feasibility according to farm size. These curves are based on 1979 farm input prices and will shift upward as costs of production increase.

The important farmlands model, Figure 4.6, rates land in six categories. Table 4.2 presents what these ratings mean in terms of output under improved management[6] conditions. This table, when used in conjunction with the break-even curves and model output, identifies feasibility for the crops analyzed.

It is emphasized that the six groups shown are average ratings only and represent the overall potential of the land in terms of grain, hay, and potato production. Because of the particular interest expressed by agricultural concerns in dairy potential, a separate model (Figure 4.7) depicting potential grazing lands has been developed. Ratings shown on the potential grazing map are converted to animal unit months per acre as illustrated on Table 4.3. Both the important farmlands model and grazing model are based upon soils variables including pH, texture, moisture holding capacity, organic content, and so forth, as well as topography.

Future agricultural development in the subbasin will be a function of economic feasibility which in turn depends largely on demand for both agricultural products and other competing land uses, e.g. urban, recreation, etc. Feasibility is a function of demand for agricultural products because prices are partially established by that demand. In Alaska, prices received by farmers tend to approximate the Seattle, Washington price **plus** transportation to Alaska markets. This price remains in effect up to the point when the local demand has been largely saturated; beyond this point the prices received by farmers would tend to drop sharply towards the Seattle, Washington price **less** transportation to Alaska markets. For the products analyzed in this study, i.e. barley, oats, potatoes, and brome, feasibility does not exist at the latter price for yields which can reasonably be expected in the Susitna Basin. In many cases, however, feasibility does exist at the former price; farming can survive in the basin, but production in excess of the quantity that will be readily used locally will cause economic failure.

[6] The following practices and conditions are included under improved management: (1) fertilizer is applied at maximum rates determined from periodic soil tests, and adequate fertility is maintained for optimum plant growth; (2) barnyard manure, crop residue, and grass crops are used intensively, and sufficient organic matter is maintained for the most efficient use of moisture and plant nutrients; (3) conservation practices are applied to the fullest extent to prevent wind and water erosion; (4) weeds and harmful insects are controlled on crops as well as pastures; (5) cutting and grazing for forage is carefully managed to maintain vigorous stands; (6) if necessary, lime is applied at rates required to bring the soil reaction within the range that is most desirable for optimum plant growth.



Natural (land and water)

Recreation

Resource extraction

Transportation/Utilities

Public facilities

Commercial/Industrial/Services

Residential

Agriculture

Vacant disturbed

FIGURE 4.1

LAND USE

WILLOW SUBBASIN

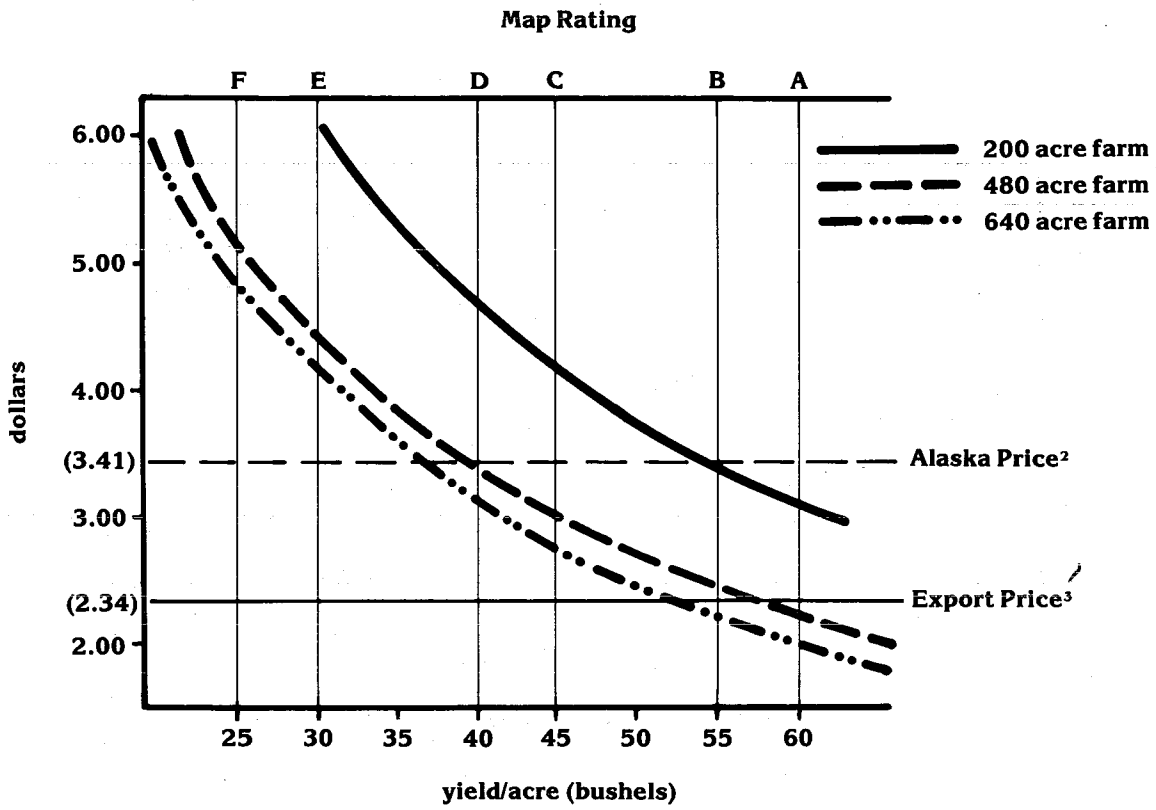
ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

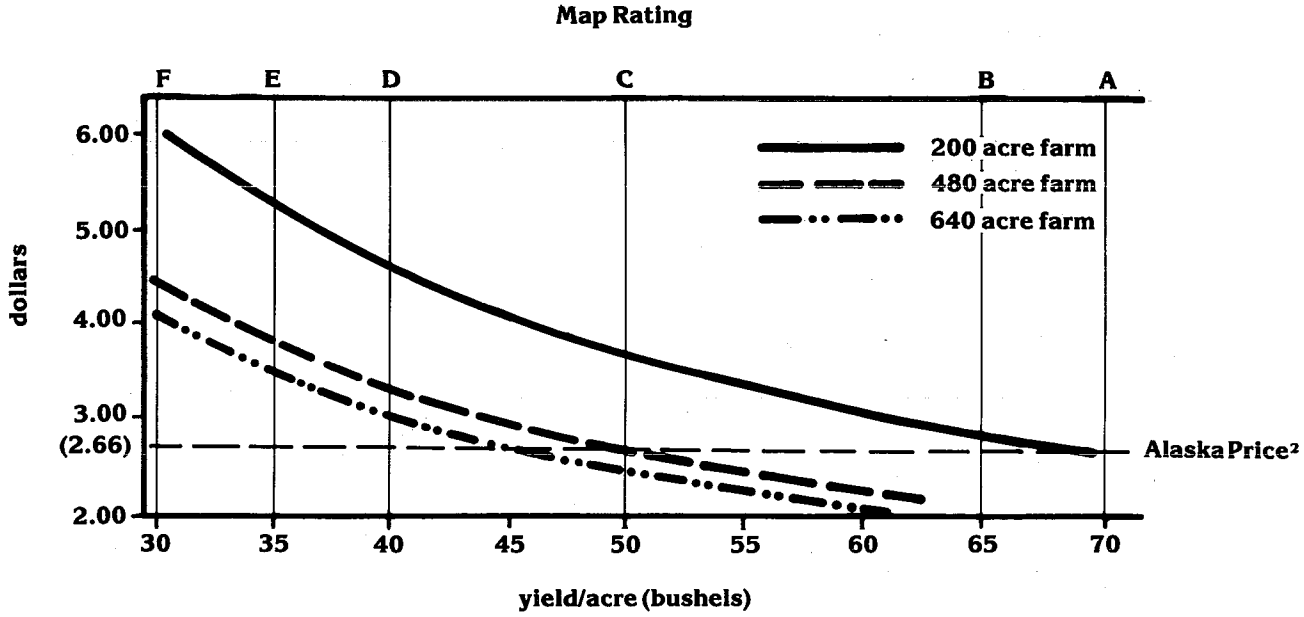
Figure 4.2
Barley Prices Required to "Break Even"[1] at Various Yields, Willow Subbasin



53.9 bu./acre is break even point on 200 acre farm (domestic)
38.7 bu./acre is break even point on 480 acre farm (domestic)
36.1 bu./acre is break even point on 600 acre farm (domestic)
78.6 bu./acre is break even point on 200 acre farm (export)
56.5 bu./acre is break even point on 480 acre farm (export)
52.6 bu./acre is break even point on 600 acre farm (export)

[1] Exclusive of payments to land, overhead, risk, and management. Curves are based on 1979 prices paid by farmers.
[2] Derived from weighted average of prices received by farmers from 1976 through 1979.
[3] Represents Seattle, Washington normalized price for 1979.

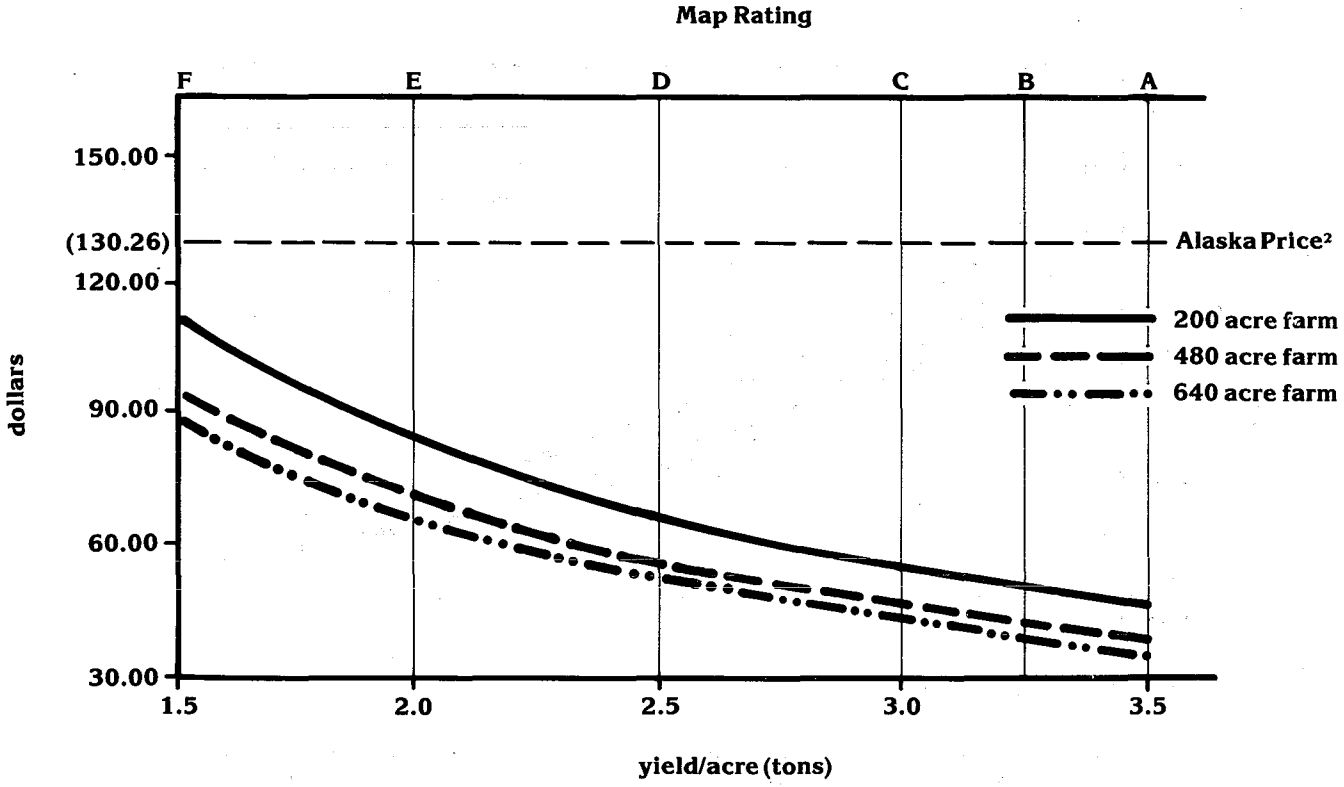
Figure 4.3
Oat Prices Required to "Break Even"[1] at Various Yields, Willow Subbasin



69.1 bu./acre is break even point on 200 acre farm.
49.7 bu./acre is break even point on 480 acre farm.
46.3 bu./acre is break even point on 640 acre farm.

[1] Exclusive of payments to land, overhead, risk, and management.
[2] Derived from weighted average of prices received by farmers from 1976 through 1979.

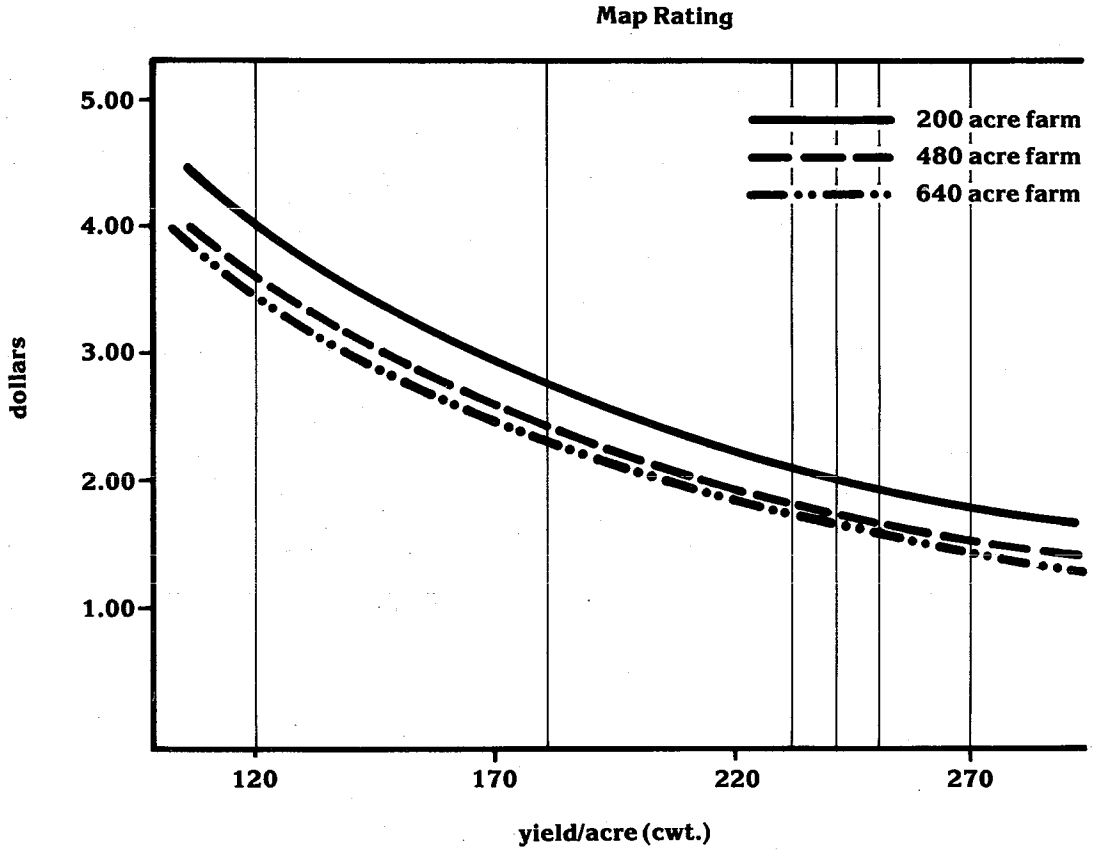
Figure 4.4
Hay Prices Required to "Break Even"[1] at Various Yields, Willow Subbasin



1.28 tons/acre is break even point on 200 acre farm.
1.09 tons/acre is break even point on 480 acre farm.
1.04 tons/acre is break even point on 640 acre farm.

[1] Exclusive of payments to land, overhead, risk, and management.
[2] Derived from weighted average of prices received by farmers from 1976 through 1979.

Figure 4.5
Potato Prices Required to "Break Even"[1] at Various Yields, Willow Subbasin



41.6 cwt./acre is break even point on 200 acre farm.
37.3 cwt./acre is break even point on 480 acre farm.
36.1 cwt./acre is break even point on 640 acre farm.

[1] Exclusive of payments to land, overhead, risk, and management.
[2] Present Alaska price is $11.61/cwt. Derived from weighted average of prices received by farmers from 1976 through 1979.

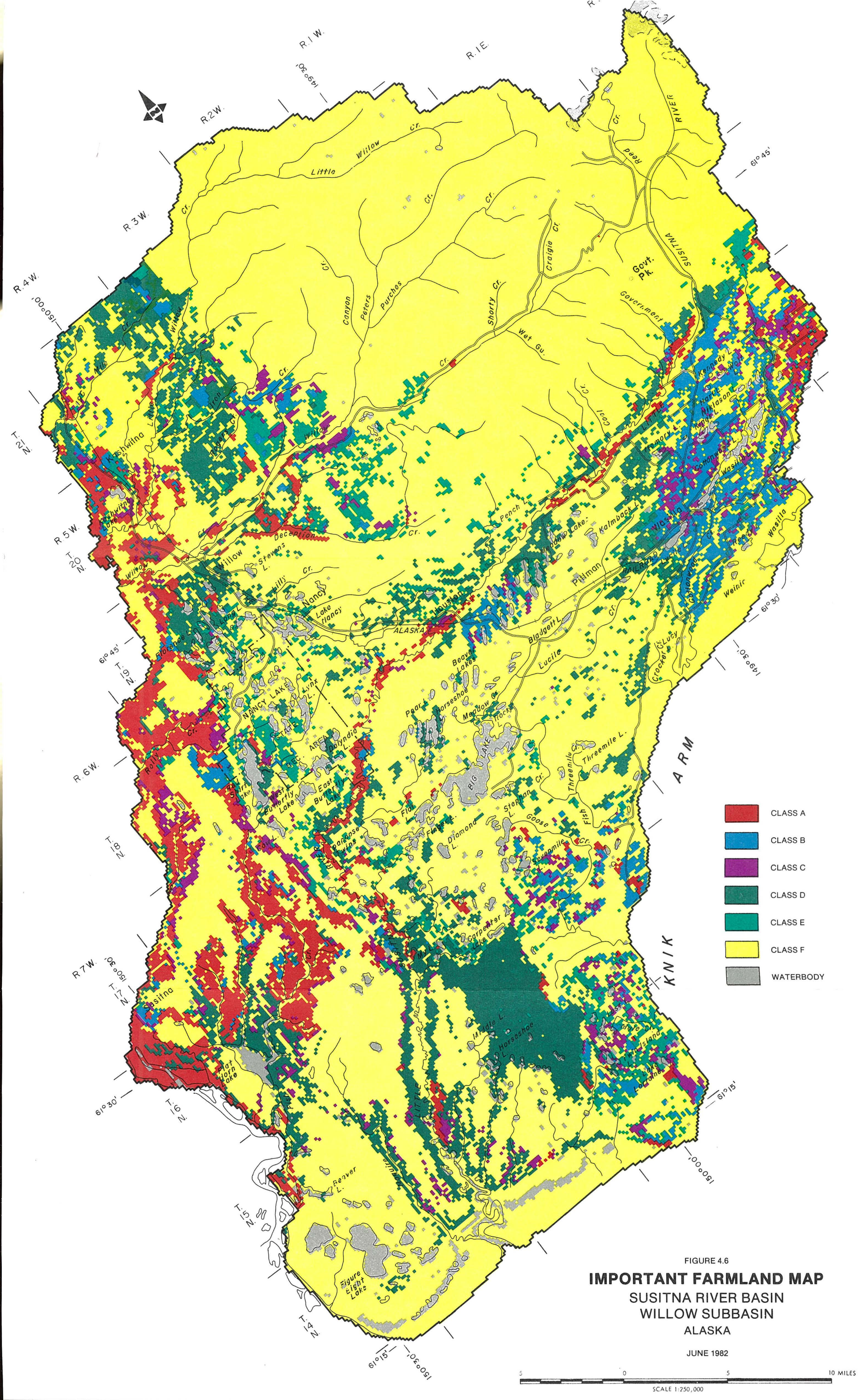
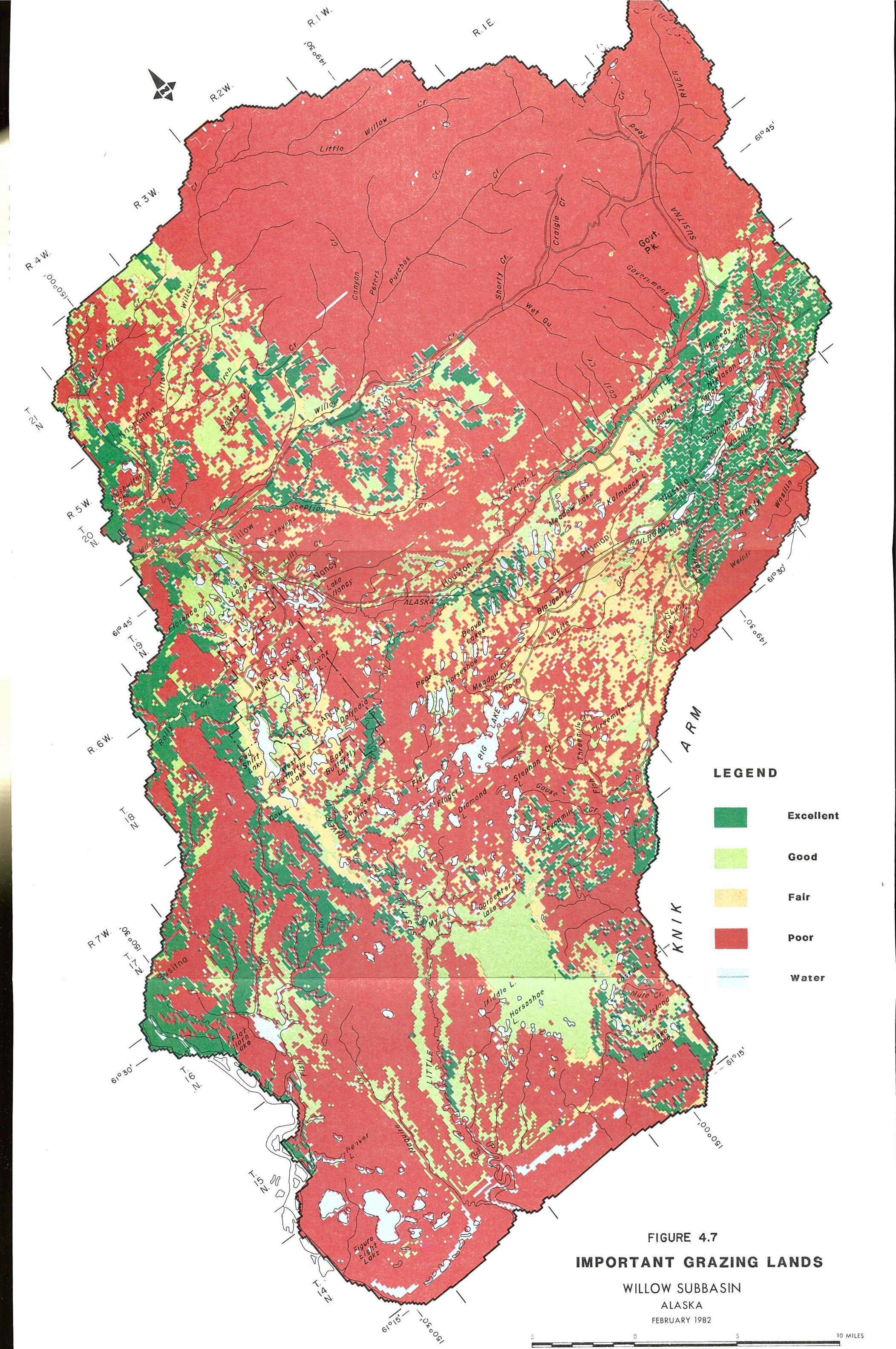


FIGURE 4.6

IMPORTANT FARMLAND MAP

SUSITNA RIVER BASIN
WILLOW SUBBASIN
ALASKA

JUNE 1982



LEGEND

- Excellent
- Good
- Fair
- Poor
- Water

FIGURE 4.7

IMPORTANT GRAZING LANDS

WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1 250,000

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1982

7-N-24192

Table 4.2 Average Yield (Improved Management), Willow Subbasin

Map Rating	Grains (Bu./Acre)		Hay & Silage (Tons/Acre)		Potatoes (Cwt./acre)
	Barley	Oats	Brome Hay (2 cuttings)	Oats & Peas for Silage	
A	60	70	3.5	12.0	270
B	55	65	3.25	11.5	250
C	45	50	3.0	11.0	240
D	40	40	2.50	9.0	230
E	30	35	2.0	8.0	180
F	25	30	1.5	7.0	120

Table 4.3 Capability of Grazing Model Rating Categories in Animal Unit Months, Willow Subbasin

Grazing Model Rating	Animal Unit Months[1] (per acre)[2]
Excellent	6 - 7
Good	5 - 6
Fair	3 - 5
Poor	less than 3

[1] An animal unit (AU) is generally one mature cow of approximately 1,000 pounds and a calf as old as 6 months, or their equivalent. An animal unit month (AUM) is the amount of forage required by an animal unit for one month.

[2] Three month grazing period.

It should be noted that the preceding discussion assumes the existence of only two markets—Alaska and the lower forty-eight states. There has been much recent discussion of a third market, the Orient, which now counts the contiguous U.S. west coast as one of its major suppliers of grains. Alaska can compete on the world market if it can produce and ship grain to the Orient at a cost equal to or less than production and shipping costs from the west coast. Labor, equipment, and building costs per unit of output are usually higher in Alaska but the distance from Seattle to the Orient exceeds the distance from the lower Basin to the Orient. Whether or not Alaska's mileage advantage can offset[7] its higher production costs will be known soon from the Delta Barley project.

Regardless of the world market situation, a good deal of agricultural potential exists at the local level yet Alaska continues to import literally every product which economically could be grown and processed locally. Some of the underlying reasons for this anomally include:

1. Inability of farmers to market products locally as a result of limited production.—Alaska's short growing season requires that local grocery distributors buy local produce for resale for only about 3 months, and import during the remainder of the year unless freezing and storage facilities are available. In the absence of these facilities, distributors must switch sources of supply; this is inconvenient and is disruptive of normal wholesale supply channels.

2. Lack of farmer experience.—Agricultural experts generally agree that management is one of the most important factors in determining agricultural feasibility. The state has provided an excellent incentive for residents to obtain agricultural land rights through their disposal program. The program offers a 5 percent discount for each year of residency up to a total of 50 percent. It is doubtful that experienced farmers with necessary management capabilities will be attracted to the state unless incentives are also provided for these nonresidents.

3. Lack of processing facilities.—For certain enterprises, such as beef, dairy, and pork operations, processing plants are required. Economies of size and scale for these plants are such that several farms are often necessary to support one plant. To be feasible in the short run several beef and hog enterprises would have to come on line simultaneously. This is not likely without short term subsidies. As an example, machines used for milk packing in the Seattle, Washington area can process milk at two to three times the speed and at a much lower per unit cost than machinery currently used in Alaska. Alaskan firms cannot justify the cost of this machinery because total sales volume is not sufficient. A relatively small population simply prohibits some Alaskan firms from taking advantage of technologies which otherwise would make them competitive with contiguous U.S. firms.

[7] Quality is an important consideration—the discussion assumes grain quality in Alaska is equal to that shipped from the contiguous U.S. to the Orient. Recent tests have shown Alaska barley is of sufficient quality to meet the needs expressed by Japan and generally of superior quality to that produced in the contiguous U.S. At this time however Japan does not appear willing to pay a premium price for Alaska's higher protein barley.

4. Competition from other land uses.—Lack of private land in relation to population has placed heavy demands on this land for urban uses. This demand has driven land values to a point where returns on urban land investments far exceed returns from agriculture on the same acreages. It should be noted that the state's current policy of selling only agricultural rights in certain areas effectively prohibits competition from other uses.

While each of these areas merit individual study, it must be emphasized that agricultural development in Alaska must depend on continued public support. The rationale for government support of an industry must stem from a concept of benefits received, that is, in the case of agriculture, will income increase and/or food prices decrease by amounts commensurate with the public subsidies?

Timber land

Past utilization of the timber resources in the Willow Subbasin has been light and sporadic. Logs for cabins and pit props for the mining activities of the early 1900's were the first noted uses for commercial purposes. A peak probably was attained in 1915-20 during the construction and early operation of the Alaska Railroad.

Small sawmills have operated at various times over the years. One of the first recorded was at Eklutna in 1916. Similar operations have continued throughout the years with 14 sawmills now located in Palmer-Wasilla-Willow area. These sawmills are all small units which have a rated capacity of producing between 2-7 MBF[8] per day. Based upon 250 working days per year (normal working years for a sawmill) the sawmills could conceivably produce 12.5 MMBF[9] per year for both local and regional markets.

Because of a restricted market and limited sales of standing timber, the total annual production of all the mills in 1979 was 1.1 MMBF, less than 9 percent of their capacity. The production was mostly for private and local use with a small amount going for regional consumption. More than half of the volume cut was cottonwood which was sawed into dimensional lumber. The main use of white spruce, the other major species used, was for manufactured house logs.

Just over half of the logs for the mills came from outside the Willow Subbasin in 1979. Timber originating in the subbasin came mostly from private land as the result of clearing projects. The breakdown of log sources is as follows:

0.10	MMBF from Canada
0.28	MMBF from Borough land near Talkeetna
0.18	MMBF from State land on the Kenai Peninsula
0.24	MMBF from Private land in the subbasin
0.30	MMBF from other sources
1.10	MMBF TOTAL

[8] One thousand board feet.

[9] One million board feet.

With the energy problem facing the Nation, firewood is becoming a major use of the timber resource in the subbasin both on a commercial and private use basis.

With the energy problem facing the Nation, firewood is becoming a major use of the timber resource in the subbasin both on a commercial and private use basis. The exact amount of wood being cut is unknown because of the availability of private land where no records are kept on cutting activities. The State issued 266 firewood permits from November 1979 to March 1980 representing a total of 915 cords. The borough has not issued any firewood permits on their land, although they are looking into suitable sites for firewood cutting.

Table 4.4 displays present and future demand for sawtimber and fuelwood from both the Willow Subbasin and other areas within the Cook Inlet area. Figure 3.9 illustrates the forest land resources of the study area.

Table 4.4 Projected Timber Demand, Willow Subbasin

Product	Demand From			
	Willow Subbasin		Other Cook Inlet Area	
	Present	Year 2000 Without New Capital Site	Present	Year 2000 Without New Capital Site
Sawtimber (MMBF)	2.8	13.8	85.2	164.9
Fuelwood (cords)[1]	720	3,500	21,600	41,840

[1] Standard cord is 4' x 4' x 8' and contains 80 cu. ft. of solid wood with a mositure content of approximately 20%. Assumes average cord produces approximately 16 million B.T.U.'s. This is equivalent to approximately 120 gallons of fuel oil.

Settlement Land

Settlement in the Willow Subbasin can be described as sparse, sporadic, and ungoverned. Wasilla, the major community, is characterized by commercial strip development along the Parks Highway, the old Palmer-Wasilla Highway, Fishhook Road, and Knik Road. Primary and secondary residences are located on generally large (1-5 acre) lots along roads and in clusters around lakes. Most of the population is concentrated in the eastern portion of the area. As yet, no central water and sewer systems exist in the subbasin although these services are in the development stage in Wasilla, just recently incorporated.

In 1976 there were 2,180 primary residences in the study area with an average of 3.1 persons per household. On lots ranging in size from less than an acre to more than 40 acres, the 2,180 residences occupied 7,266 acres of land in 1976. In accordance with the projected population shown in Table 3.2, it was estimated that by 2000, 18 thousand acres of additional land will be required for residential development in the "without capital" case and 55 thousand additional acres in the "with capital" case (Table 4.5).

There were 1,333 recreational or "second" dwellings in the subbasin in 1980. It was estimated that 456 acres will be diverted to this type of use by 1985 and 1,090 additional acres by 2000 (Table 4.5). For land devoted to commercial use, it is estimated that by 2000, 145 acres will be required in the "without" case and 723 in the "with" case (Table 4.5).

Land sites capable of supporting residential, recreational, and commercial uses were identified in the computerized capability analysis discussed earlier. Five different settlement "models" were developed using soils data and spatial criteria. The five settlement models included commercial/light industrial, remote subdivision, large lot residential, moderate/high density residential, and low density remote residential land use types. The resulting maps are shown in Figures 4.8 through 4.12.

Table 4.5 Projected Settlement Land Requirements, 1980-85 and 1980-2000, Willow Subbasin

	Projected Land Requirements			
	1980-85		1980-2000	
	without[1]	with[1]	without[1]	with[1]
	acres			
Primary residences	3,648	16,295	17,458	53,098
Secondary residences	486	1,576	486	1,576
Commercial property	34	144	145	723
TOTAL	4,168	18,015	18,089	55,397

[1] Projections made pending proposed capital move (Table 3.2).

Source: data compiled by Land and Resource Planning Section, Division of Research and Development, Alaska Department of Natural Resources.

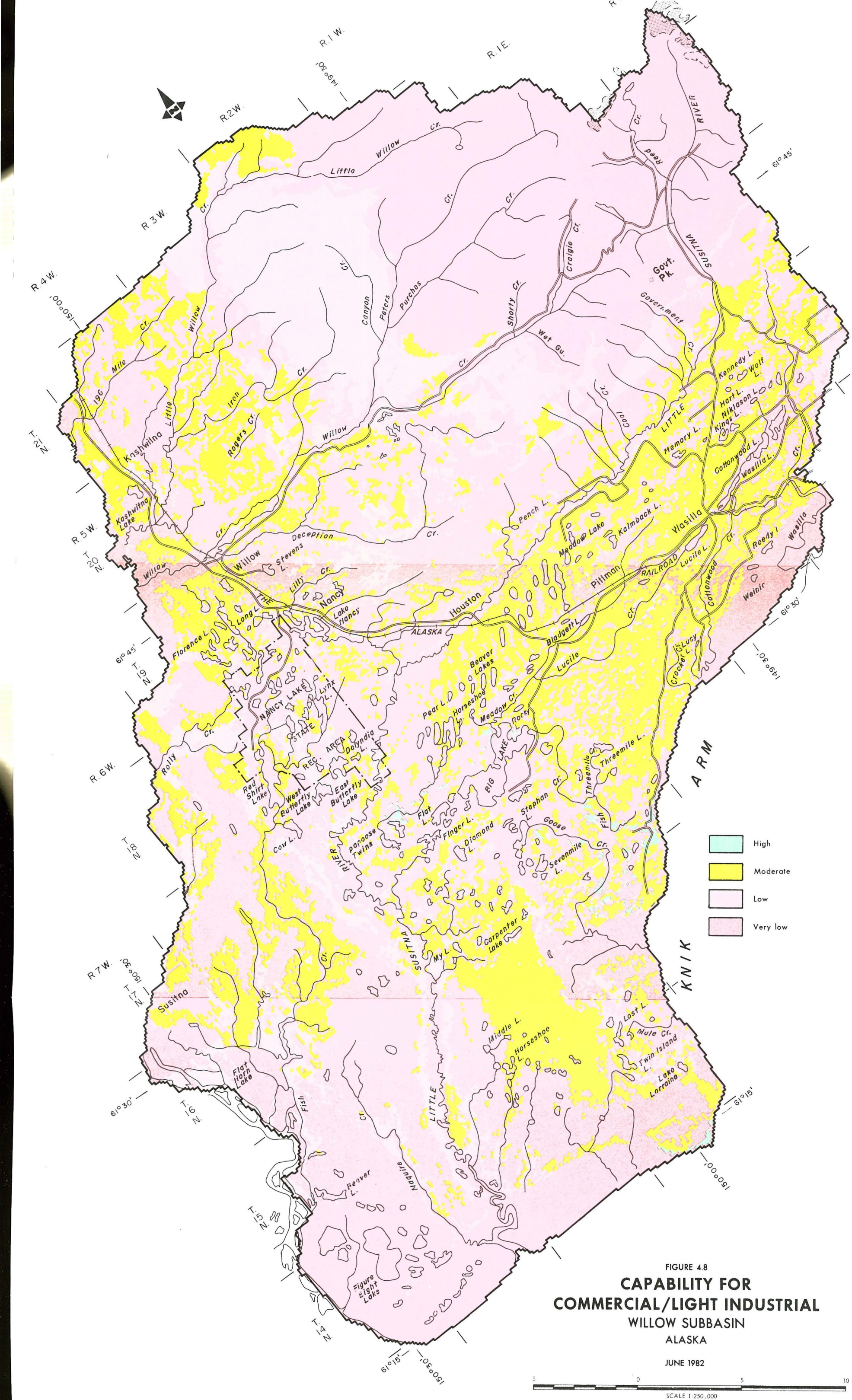


FIGURE 4.8

CAPABILITY FOR COMMERCIAL/LIGHT INDUSTRIAL

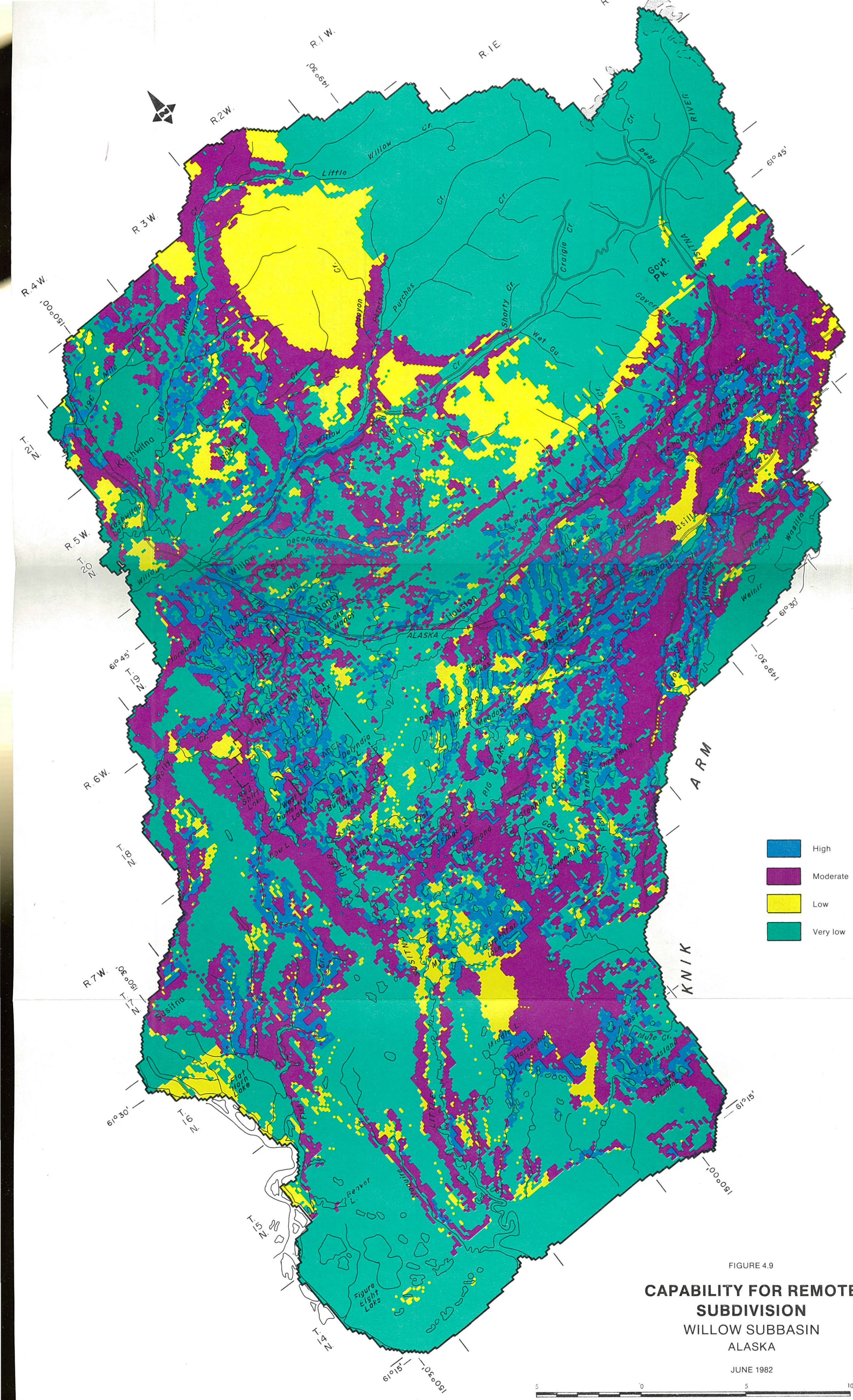
WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000



High

Moderate

Low

Very low

FIGURE 4.9

CAPABILITY FOR REMOTE SUBDIVISION

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

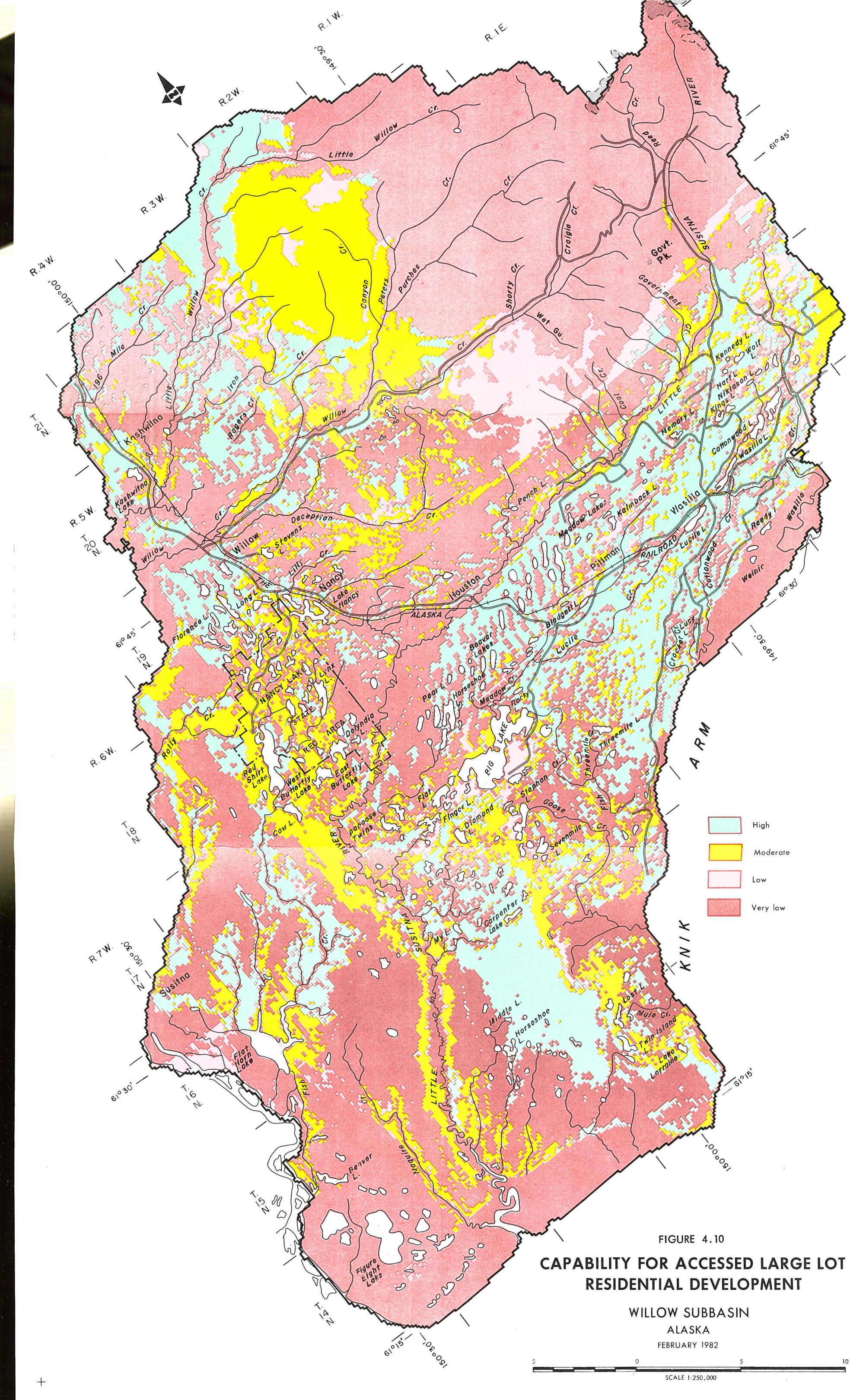


FIGURE 4.10

CAPABILITY FOR ACCESSED LARGE LOT RESIDENTIAL DEVELOPMENT

WILLOW SUBBASIN

ALASKA

FEBRUARY 1982

5 0 5 10 MILES

SCALE 1:250,000

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1982

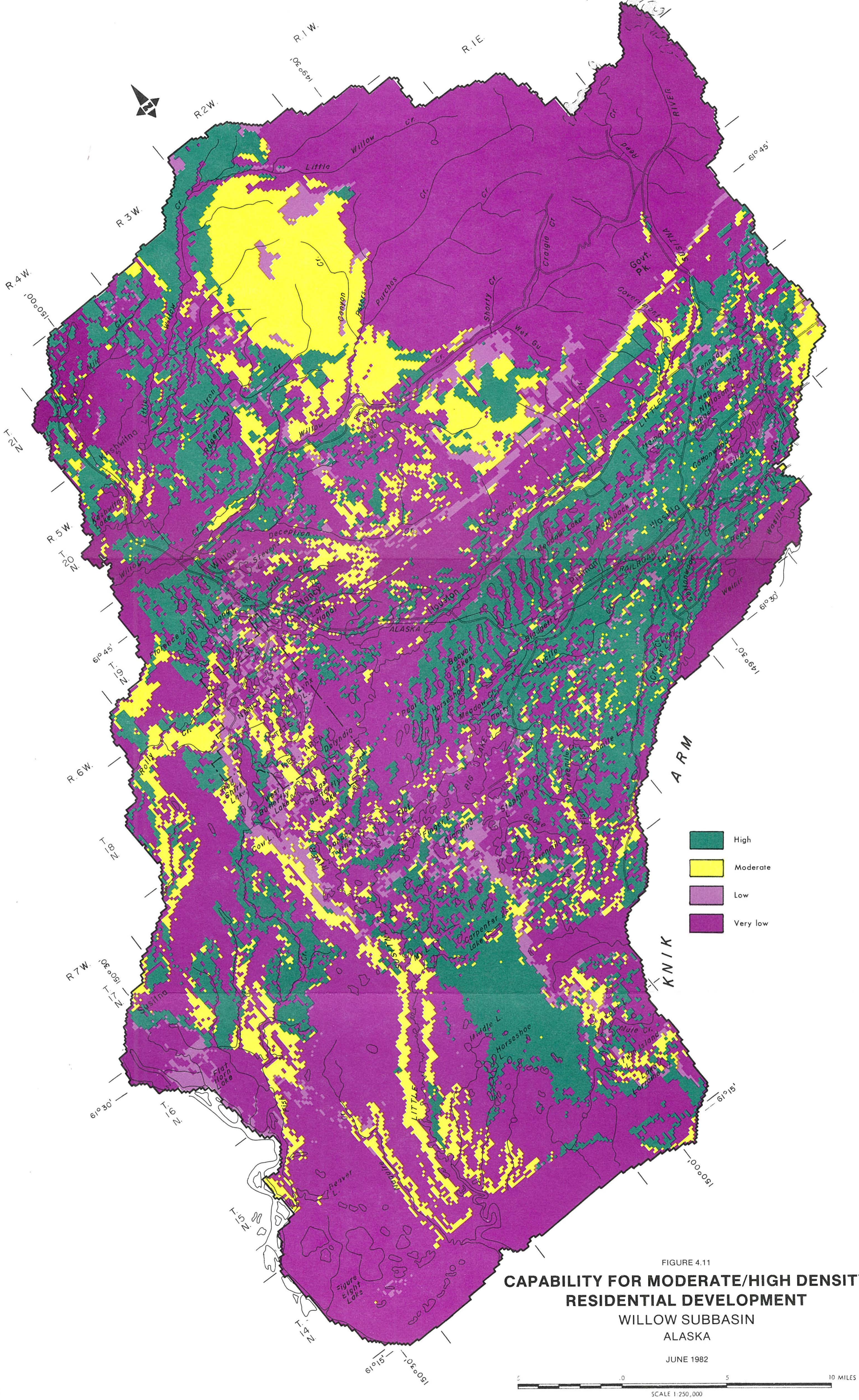


FIGURE 4.11

CAPABILITY FOR MODERATE/HIGH DENSITY RESIDENTIAL DEVELOPMENT

WILLOW SUBBASIN

ALASKA

JUNE 1982

SCALE 1:250,000

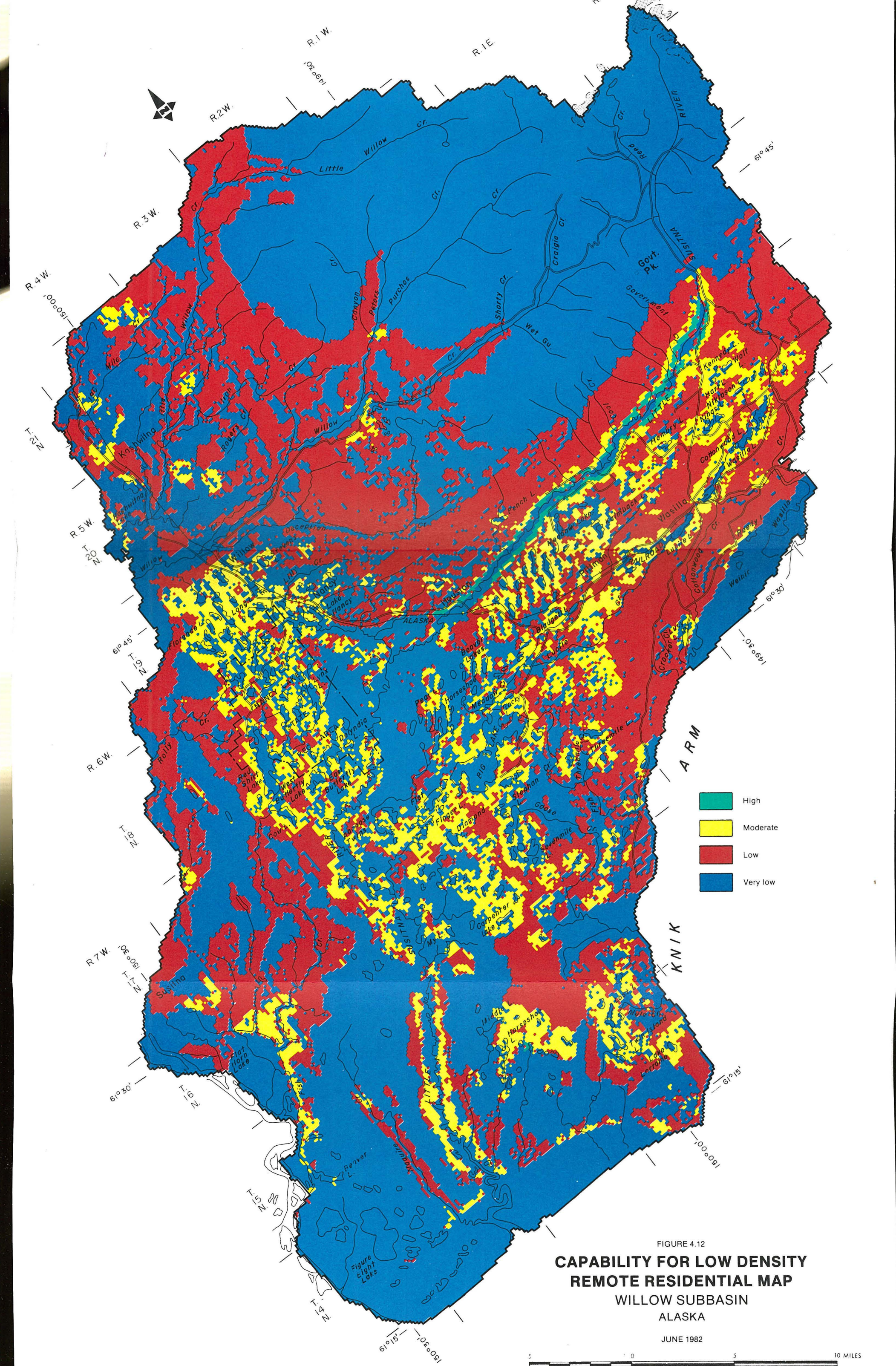


FIGURE 4.12

CAPABILITY FOR LOW DENSITY REMOTE RESIDENTIAL MAP

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

Flooding

There is little information available concerning flooding within the subbasin other than newspaper accounts and interviews, however, the SCS estimated that there are approximately 44,000 acres of land within the 100-year flood plain. Damaging floods occurred within the subbasin in 1938, 1942, 1955, 1959, 1964, 1969, 1971, 1975, and 1979.

Historically, there has not been a lot of flooding damage. This can be attributed primarily to the low population (less than four persons per square mile), the lack of available private land for development, and the lack of pressure for development within the area.

The following flood damage information was identified from historical records:

1. In 1938, an ice jam caused overtopping of the railroad on Willow Creek.

2. In 1955, the railroad at Willow Creek was damaged by a flood resulting from heavy rainfall.

3. In 1959, portions of Fishhook Road were washed out by Wasilla Creek.

4. In 1964, Willow Creek flooded as a result of an ice jam.

5. In 1971, the Alaska Railroad bed at Houston was undermined causing derailment of 13 cars. The bridge crossing the Little Susitna River was washed out closing a section of the Hatcher Pass Road. Damage also occurred to residences.

6. In 1975, ice, log jams, and glaciation caused flooding on Willow Creek. Five homes were flooded near Hatcher Pass Road.

7. In 1979, flooding similar to 1975 occurred with more homes being damaged.

The U.S. Army Corps of Engineers has completed an **Expanded Flood Plain Information Study for Willow, Alaska.** The Corps has identified existing average annual damage for Willow Creek as $625,700 with damages for the 1 percent chance storm (commonly called the 100-year flood) estimated at $1,233,100. They have projected potential future possible damages with no constraints on development in excess of 4 million dollars. It is expected that the National Flood Insurance Program (NFIP) and the Matanuska-Susitna Borough Flood Plain Management Ordinance will curtail most of the future development in flood plains. However, it should be noted that development in the watersheds may cause increased runoff

There are approximately 44,000 acres of land within the 100-year flood plain.

resulting in larger flood peaks and increased damages even if no more development were to occur in the flood plain.

The other subbasin flood plains experience minor damage except for the road and railroad on the Little Susitna River. Both the State of Alaska and the borough have accepted the provisions set forth in the NFIP. The NFIP was established under the National Flood Insurance Act of 1968 and the Federal Disaster Protection Act of 1973, the latter of which requires essentially compulsory participation through two provisions. The first, Section 102.(a), requires that all federally funded construction in flood hazard areas be insured while the second, Section 102.(b), forbids all federally supervised, approved, regulated or insured banking institutions from providing mortgae loans on flood hazard area properties, unless flood insurance is acquired for that property.

With participation being essentially compulsory, comes the land use management provisions which must be adopted by each community. These provisions require communities to:

1. Insure that all new construction is designed to minimize flood loss.

2. Require all new construction or substantial improvements to have the first floor (including basement) at or above the 100-year flood level and all utilities be flood-proofed.

The NFIP, however, is expected to do little in reducing future highway and railroad damages. Transportation networks are often found in and adjacent to flood plain lands due to construction cost considerations. Even when flood damages are added to construction and operation and maintenance costs, it is still usually less expensive to build on flat flood plains than on upland terrain.

Erosion and Sediment

Soil erosion results from the action of moving water, wind, gravity, frost, or a combination of these forces on the land. The main concerns in the region are wind and water activated erosion and their by-products, dust and sediment. In addition, natural or geologic erosion should be differentiated from accelerated (or manmade) erosion.

> "Natural or geologic erosion is a continuing process and will go on into the future regardless of anything man can do. Quickening of the pace of erosion, owing to changes wrought by man, has produced definitely abnormal conditions. Accelerated erosion, an abnormal and undesirable process, was started by man's activities and is subject to his control."[10]

Sheet, rill, gully, stream and roadbank erosion occur in the region; but, in general, the erosion rate is low compared to most other areas of the United States.

Soil erosion has not yet become a widespread problem in the Willow Subbasin because of the following:

1. Generally the land is covered with dense vegetation.

2. Most development has been in scattered, relatively small areas on nearly level land.[11]

3. Most of the disturbed soil has a residue of organic matter which stabilizes the soil against both wind and water erosion.

4. Most rainfall is gentle, resulting in minimal runoff.

Turbidity in the streams results from glacial melt or natural erosion. Currently, accelerated erosion is a minor factor in stream sedimentation within the study area, compared to the total stream sediment load in the basin from natural factors. However, with topsoil quite shallow in many areas, erosion could turn a high potential farming operation into a failure within a few years, even though resulting sedimentation may not create a significant off-site problem. See Figure 4.13 for soil erosion potential.

Seasonal winds in the spring carry large amounts of airborne dust particles through the study area. This dust originates from the outwash plains of the Matanuska and Knik Rivers lying to the east of the Willow Subbasin. While the dust is a nuisance it does not represent a significant problem which is just as well since field trials by the SCS to stabilize the outwashes have been unsuccessful.

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[10] North Atlantic Regional Water Resources Coordinating Committee, North Atlantic Regional Water Resources Study, Appendix Q, Erosion and Sedimentation, May 1972, p. Q-3.

[11] Less than 10 percent of the subbasin's total land area has been disturbed.

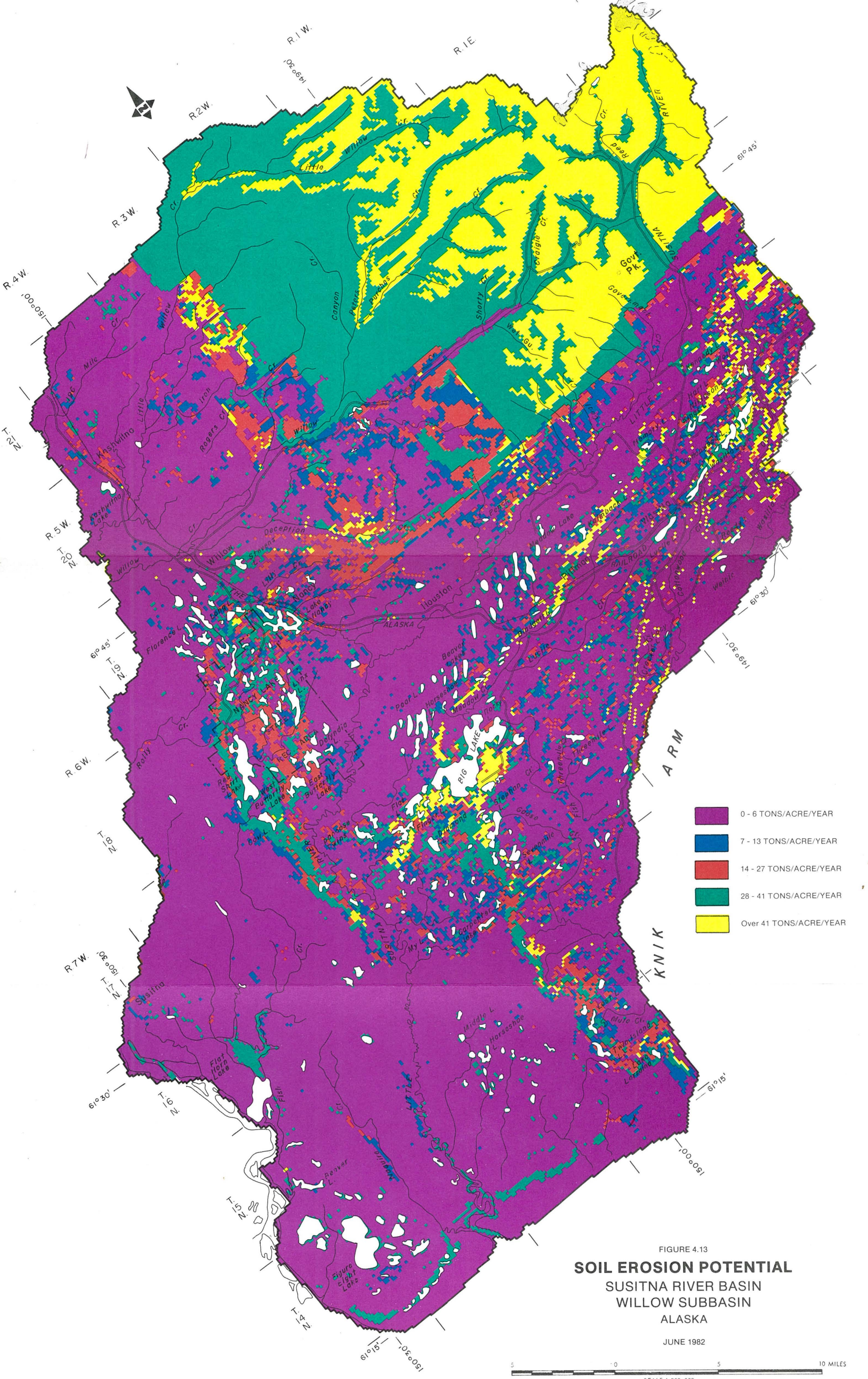

FIGURE 4.13

SOIL EROSION POTENTIAL

SUSITNA RIVER BASIN
WILLOW SUBBASIN
ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

Recreation

Recreation sites are currently the most highly utilized of the basin's resources. Tables 4.6 and 4.7 illustrate the present demand and user day values for eight popular recreational activities in the area by location of demand origin. Table 4.8, a composite of the first two tables, presents the existing total value of the recreation resource for the selected activities. Since only eight activities and four demand locations were analyzed, the total recreation value of over 2.7 million dollars is very conservative and at best represents only the minimum annual worth of the subbasin's recreation resources.

More importantly, this value will increase as Alaska's population grows. If transportation costs relative to disposable income were to remain constant through the year 2025, recreation value would increase directly with growth. With the current energy shortage facing our state and nation however, this is not likely to be the case. It is the opinion of many recreation planners that use will decline as costs increase, but the percentage use decline will be less than the percentage cost increase. Economists commonly refer to this demand situation as "inelastic." The most conservative population projections for the areas of recreational use by point of origin are found in the preceding tables. These indicate that overall demand for recreation in the subbasin will increase substantially by the year 2000. Table 4.9 presents these projected user-day demand figures.

Table 4.7 User-Day Values[1] (Dollars), Willow Subbasin

	User Origin			
Activity	Within Willow Subbasin	Anchorage	Fairbanks	Outside Alaska
Freshwater fishing	1.95	6.80	28.17	68.13
Developed camping	1.59	5.55	22.99	87.85
Hiking	1.20	4.18	17.32	64.21
Picnicking/ sightseeing	1.20	4.18	17.32	63.00
Waterfowl hunting	2.39	8.35	34.60	74.31
Big game hunting	3.13	10.95	45.37	347.09
Canoeing	3.13	10.95	45.37	76.94
Cross-country skiing	1.49	5.20	21.54	67.12

[1] Values "within Alaska" were calculated using the Travel Cost Method while values "outside Alaska" were derived using the same method, but adding special fees, i.e., rentals, game tags, etc.

Table 4.6 Existing User-Day[1] Demand, Willow Subbasin

	User Origin					
Activity	Within Willow Subbasin	Anchorage	Fairbanks	Total	Outside Alaska	Grand Total
Freshwater fishing	21,975	23,506	3,967	49,448	4,152	53,600
Developed camping	2,068	1,343	3,899	7,310	4,479	11,789
Hiking	8,668	9,758	2,128	20,554	469	21,023
Picnicking/ sightseeing	29,544	58,786	4,795	93,125	10,821	103,946
Waterfowl hunting	2,535	1,975	533	5,043	126	5,169
Big game hunting	5,343	7,501	2,211	15,055	376	15,431
Canoeing	1,500	2,054	533	4,087	93	4,180
Cross-country skiing	3,123	1,659	—	4,782	109	4,891
TOTAL	74,756	106,582	18,066	199,404	20,625	220,029

[1] Participation by one person in an activity during part or all of any one day. Per capita use figures used in calculating demand were taken from the 1970 State Comprehensive Outdoor Recreation Plan.

Table 4.8 Existing Annual Recreation Resource Values, Willow Subbasin

Activity	Dollar Value to Residents From:				
	Within Willow Subbasin	Anchorage	Fairbanks	Outside Alaska	Grand Total
Freshwater fishing	42,850	159,840	111,750	282,880	597,320
Developed camping	3,290	7,450	89,640	393,480	493,860
Hiking	10,400	40,790	36,860	30,110	118,160
Picnicking/ sightseeing	35,450	245,730	83,050	681,720	1,045,950
Waterfowl hunting	6,060	16,490	18,440	9,360	50,350
Big game hunting	16,720	82,140	100,310	130,510	329,680
Canoeing	4,700	22,490	24,180	7,160	58,530
Cross-country skiing	4,650	8,630	—	7,320	20,600
TOTAL	124,120	583,560	464,230	1,542,540	2,714,450

Table 4.9 Year 2000 User Day[1] Demand (without new Capital Site), Willow Subbasin

Activity	User Origin					
	Within Willow Subbasin	Anchorage	Fairbanks	Alaska Total	Outside Alaska	Grand Total
Freshwater fishing	106,359	49,598	8,291	164,248	5,107	169,355
Developed camping	10,009	2,833	8,149	20,991	5,509	26,500
Hiking	41,953	20,589	4,448	66,990	577	67,567
Picnicking/ sightseeing	142,993	124,038	10,022	277,053	13,310	290,363
Waterfowl hunting	12,269	4,167	1,114	17,550	155	17,705
Big game hunting	25,860	15,827	4,621	46,308	462	46,770
Canoeing	7,260	4,334	1,114	12,708	114	12,822
Cross-country skiing	15,115	3,500	—	18,615	134	18,749
TOTAL	361,818	224,886	37,759	624,463	25,368	649,831

[1] Participation by one person in an activity during part or all of any one day.

Fish and Wildlife

Assessment of existing and future fish and wildlife resources in the area considered three integrated factors: 1) existing fish and wildlife populations (e.g., species diversity, abundance, and distribution); 2) habitat conditions which support existing fish and wildlife populations and provide the basis for their continuation and enhancement; and 3) value of present and potential fish and wildlife resources to current and future human users.

1. Fish and Wildlife Populations.

The abundance, variety, and distribution of fish and wildlife species in an area is largely a product of previous and existing physical conditions such as vegetation, soils, topography, climate, water availability, etc., and cultural conditions, that is, human activities affecting fish, wildlife, and their habitats. In addition, interactions within and between fish and wildlife species (e.g., competition, predation, etc.) affect their populations. The Alaska Department of Fish and Game (ADF&G 1980) has identified 41 mammal species, 156 bird species, and 26 species of fishes believed to be present within the Willow Subbasin at some time during the year (see Appendix B). Although the subbasin represents less than 0.3% of the land area in Alaska, approximately 42% of the State's species of birds, 50% of its terrestrial mammal species, and 50% of its freshwater and anadromous fish species are represented in the area.

Existing habitats within the Willow Subbasin support a diversity of fish and wildlife species.

Subbasin species can be grouped into three categories for discussion: 1) threatened and endangered species; 2) game species; and 3) nongame species. Though arbitrary, these categories generally reflect particular management activities.

No threatened or endangered species have been reported in the Willow Subbasin. As a result, none of the federally legislated restrictions (P.L. 93-205) dealing with threatened and endangered species are currently applicable in the area.

Many species are hunted, trapped, or fished by recreational, commercial, and subsistence users in the Willow Subbasin. Waterfowl and gamebird species are numerous including 28 species of ducks and geese and 4 species of gamebirds. The Susitna Flats and Palmer Hay Flats are among the most popular waterfowling areas in Alaska[12]. Eight species of Alaskan big game (black bear, brown bear, wolf, wolverine, caribou, dall sheep, moose, and mountain goat) may be hunted in the subbasin, as well as many species of fur bearers and small mammals[13]. Three species of sport fish (rainbow trout, Dolly Varden, and Arctic grayling) and five species of Pacific salmon (pink, chinook, coho, sockeye and chum) are among the fish harvested in subbasin lakes and streams. In addition, Beluga whales and harbor seals occur in the estuarine waters of Cook Inlet adjacent to the study area. Taking either of these two species is restricted under the Marine Mammal Protection Act of 1972 (P.L. 92-522). Existing information on subbasin species ranges from general life history data on most species to local specific data on some game species actively managed by the ADF&G.

2. Habitat Conditions.

All environmental conditions with which an organism or population interacts in its search for food, water, shelter, and reproductive opportunities is called its "habitat." Habitat components such as climate, vegetation, soils, hydrology, landform, land use, and geology were examined during this study and are discussed elsewhere in this report.

Habitats are typically classified in terms of plant communities, physcial features, or both. For exam-

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[12] Timm, D.E. and D. Sellers. 1979. Annual report of survey and inventory activities, waterfowl. Volume Z. Fed. Aid in Wildlife Restoration Project W-1711, Job No. 10.0 ADF&G. Anchorage. 29 pp.

[13] Alaska Department of Fish and Game (ADF&G). 1973. Alaska's wildlife and habitat, volume I. ADF&G. Juneau. 44 pp. + maps.

ADF&G. 1976a. A fish and wildlife resource inventory of the Cook Inlet, Kodiak areas, volume I: wildlife. ADF&G. Juneau. 251 pp.

ADF&G. 1978c. Alaska's wildlife and habitat, volume II. ADF&G. Juneau 74 pp. + maps.

ple, thirteen subbasin wetland habitat types were identified and mapped on the basis of both soil drainage and vegetation. Wetland types are described and mapped in the next section of this report. Plant communities provide particularly useful habitat categories because they respond to, and therefore integrate, all environmental and human influences affecting an area. Six general vegetation-based habitat types were identified: coniferous forests, deciduous forests, mixed coniferous-deciduous forests, shrubland, grasslands, and tundras. These general vegetation types encompass a high diversity of plant communities which provide a variety of specific habitats. Plant communities corresponding to each general vegetation-habitat type are presented in Table 4.10 and mapped in Figures 3.9 and 3.10.

Biologists agree that habitat conditions are dynamic. As a result, mapped vegetation communities and physical features represent only the present condition. The structure and composition of plant communities change over time progressing through several stages until a climax plant community develops or until a disturbance, such as fire or human activity, interrupts the succession.

Because there is not much data on subbasin species-habitat interactions available, it is not possible to evaluate the suitability of all habitats for each species. However, the suitability of habitats for five species[14] has been evaluated using ADF&G data and habitat evaluation procedures (HEP) developed by the USF&WS (1980). Habitat suitability maps produced during the HEP analyses can be compared with other mapped land-use suitabilities such as settlement and forestry. These five evaluations are described under separate cover in the "Fish and Wildlife Technical Appendix." Results of these suitability evaluations are summarized in Table 4.11. In addition, general vegetation-type habitats utilized by mammals have been identified in Appendix B.

The future of fish and wildlife resources will be determined largely by land ownership and land use decisions. Maintenance and human use of fish and wildlife resources have already been legislatively recognized as the priority land uses on four areas of state land in the subbasin: Goose Bay, Palmer Hayflats and Susitna Flats State Game Refuges: and Nancy Lake State Recreation Area. State law also protects anadromous fish habitats by requiring permits for many uses of anadromous fish streams and lakes (A.S. 16), and recognizes the need to maintain aquatic and riparian habitats (H.B. 118). Fish and wildlife areas protected through state legislation are

[14] Moose, snowshoe hare, willow ptarmigan, spruce grouse, and red squirrel.

Table 4.10 General Vegetation Types and Associated Plant Communities, Willow Subbasin

General Vegetation Types[1]	Plant Community Types	No. of Plant Communities Distinguished During Vegetation Mapping	Total Acreages
A) Coniferous Forests	white spruce communities	4	32,580
	black spruce communities	3	139,430
B) Mixed Forests	communities of paper birch, aspen, and/or cottonwood with white spruce and/or black spruce	5	276,010
C) Deciduous Forests	cottonwood communities	5	3,390
D) Shrublands	tall shrub communities: alder, alder-willow	2	49,670
	low shrub communities; willow-resin birch, shrub tundra	2	12,730
E) Grasslands	communities of tall grass, midgrass, and/or sedge-grass, (also grassland and sphagnum bog wetlands)	3	194,580
F) Tundra	herbaceous tundra, sedge-grass tundra, mat and cushion tundra	3	145,150
TOTAL		27	853,540

[1] General vegetation types are defined in Appendix B. Wetlands are not included in general vegetation types, but are discussed in part h, page 90.

Table 4.11 Suitability of Willow Subbasin for Selected Wildlife Species

Species	Habitat Function	Total Acres of Potentially Suitable Habitat	Percent of Subbasin Potentially Suitable
moose	winter range (food and cover)	519,270	54
	spring, summer, fall food	808,600	83
	spring, summer, fall cover	613,610	63
snowshoe hare	food and/or cover	491,620	51
red squirrel	food and/or cover	415,700	43
spruce grouse	winter range (food and cover)	415,700	43
	spring, summer, fall food	377,050	39
	spring, summer, fall cover	415,700	43
willow ptarmigan	winter range (food and cover)	288,200	30
	spring, summer, fall food	225,930	23
	spring, summer, fall cover	235,510	24

Table 4.12 Legislatively Protected Areas in the Willow Subbasin

Designations	Approximate Acreage or Miles	Year Established	Purpose Protect & Perpetuate
Goose Bay State Game Refuge	13,262 acres	1975	waterfowl habitat
Palmer Hayflats State Game Refuge	21,840 acres	1975	waterfowl habitat
Susitna Flats State Game Refuge	1,950 acres	1976	waterfowl and big game habitat
Nancy Lake State Recreation Area	19,400 acres	1966	recreational opportunities
Anadromous Fish Streams	Not available	1968 (with subsequent revisions)	spawning, incubation, rearing, passage, and overwintering habitats of anadromous fishes

outlined in Table 4.12. In addition, a variety of federal laws protect subbasin wildlife and habitats, and ensures that fish and wildlife resources be considered in private or public water-related developments, as well as other uses of public resources (e.g., National Environmental Policy Act, 42 U.S.C. 4321 et. Seq.; Fish and Wildlife Coordination Act, 16 U.S.C. 661 et. seq.; Clean Water Act, 33 U.S.C. 1251 et. seq.; and River and Harbor Act of 1899, 33 U.S.C. 403 et. seq.).

Four habitat categories are particularly significant for maintenance of fish and wildlife resources: 1) habitats utilized by a large abundance or variety of species (e.g., open forests, ecotones and riparian corridors), 2) habitats crucial to the survival of one or more species (e.g., shrublands which support ptarmigan, coniferous forests which support spruce grouse and marten), 3) habitats which are especially sensitive to degradation (e.g., tundra, fragile wetlands), and 4) habitats with limited availability in the subbasin (e.g., open forests, tundra). Areas supporting these four habitat categories can be integrated with HEP suitability maps (Figures 4.14 and 4.15) and with existing legislatively-designated fish and wildlife habitat lands to produce fish and wildlife suitability maps.

3. Value of Fish and Wildlife Resources to Human Users.

Value to the public constitutes the third consideration in assessing existing and future fish and wildlife resources. Public use and attitudes largely determine: 1) value and therefore management, of a particular species, 2) species distributions and population levels, and 3) the degree to which fish and wildlife considerations are incorporated into particular land-use decisions. Two sources of information indicate public use and value of subbasin fish and wildlife resources: 1) ADF&G records and 2) studies of public attitudes.

Human Use

ADF&G records indicate that over 40 percent of Alaska's licensed hunters and trappers, and over 55 percent of its licensed sport fishermen, reside within or in close proximity to the Willow Subbasin. In 1979, over 23,600 hunters and trappers, and over 66,100 sport anglers, were licensed in Anchorage. Another 3,530 hunters and trappers, and 7,390 recreational anglers were licensed in the Matanuska-Susitna Borough. The ADF&G collects several types of data on consumptive human uses of fish and wildlife. In general, consumptive recreational[15] use of fisheries resources is measured in angler days, recreational harvests, and catch per unit of effort. Selected sport fish data available for streams are presented in Appendix B. Available data on consumptive human uses of game resources consists primarily of user days, harvests, and numbers of applications for selected permit hunts. Tables 4.13 and 4.14 present game use data for selected species. (The Willow Subbasin covers parts of Game Management Subunits, 14A and 14B. As a result, separation of subbasin specific data is difficult in some cases.) The data which is available indicates that sport fish and big game resources are very heavily used. (Tables 4.15, 4.16, 4.17).

Public Attitudes

Public attitudes towards fish and wildlife in the United States and Alaska have recently been investigated by Kellert (1979)[16]. These data indicate that Alaskans are interested in the outdoors, concerned about the environment, and considerably knowledgeable about wildlife. Alaskans indicated high disapproval of development adversely affecting wildlife populations. Kellert's findings further indicated that Alaskans interest in wildlife was not correlated with any moralistic objection to consumptive wildlife use. His investigation also showed that the numbers of hunters, fishermen, trappers, and other consumptive wildlife users in Alaska were significantly greater than any other region.

[15] Subbasin streams and lakes contribute an undetermined amount to commercial harvests of anadromous fish in Cook Inlet.

[16] Kellert, S.R. 1979. Public attitudes toward critical wildlife and natural habitat issues. (Phase 1 results of a USFWS funded study of "American attitudes, knowledge and behaviors toward wildlife and natural habitats," grant #14,16-009-77-056.) USFWS. 138 pp.

Table 4.13 Human Use of Moose, Willow Subbasin 1979-1980

	No. of Hunters		Total No. Days Hunted	Ave. No. Days/Hunter	No. Local Residents	% Local Residents
Drawing permit hunt - successful	37		155	4.2	Not Determined	Not Determined
Drawing permit hunt - unsuccessful	21		120	5.7		
Total	58	(64% successful)	275			
License hunt - successful	93		399	4.3	91	98
License hunt - unsuccessful	331		1,632	4.9	320	97
Total	424	(22% successful)	2,031			
Grant Total	482		2,306	4.8		

Source: ADF&G records

Local communities include all communities within the Willow Subbasin and communities south from Palmer to Anchorage (inclusive).

Drawing permit hunts = antlerless moose hunts.

License permit hunts = antlered moose hunts.

Table 4.14 Fall 1979 Drawing Permit Applications

Species	Hunt #	Season Dates	Area & Game Management Unit[1]	# of Permits to be Issued	# Applications Rec'd	Total Harvested	Percent Successful Hunts
Caribou (either sex)	503	Aug 20-Sep 20	Units 13 & 14, except 14C	1,300	5,600	630	48
Moose (antlerless)	910	Sep 1-Sep 20	Matanuska Valley-14A	200	2,740	97	48
	911	Sep 1-Sep 20	Willow to Talkeetna-14B	100	667	22	22
	913	Jan 23-Feb 6	Willow to Talkeetna	50	6,011	43	86

[1] The Willow Subbasin encompasses southwest portion of 14B and western half of 14A

Source: ADF&G records.

Table 4.15 Waterfowl Hunter Days and Average Harvest Per Day on Willow Subbasin Refuges, 1971-1976, Calculated from Statewide Waterfowl Hunter Mail Surveys

Refuge	Hunter Days 1971	1972	1973	1974	1975	1976	1971-1976 Average	% of State Waterfowl Hunter Days 1971-1976	Average Ducks/ Day/ Hunter	Average Geese/ Day/ Hunter
Susitna Flats	3885	3798	7060	3763	3112	5280	4473	7.9	2.3	0.05
Palmer Hay Flats	3081	3561	4861	4162	4292	4945	4150	7.3	1.5	0.02
Goose Bay	--	--	984	342	161	601	522	0.9	1.6	0.0
TOTAL	6966	7359	12905	8267	7565	10826	9145	16.1		

Source: Sellers 1979

Table 4.16 Willow Subbasin Refuge Duck Harvests 1971-1976 Calculated from Statewide Waterfowl Hunter Mail Surveys

Refuge	Duck Harvest 1971	1972	1973	1974	1975	1976	1971-1976 Average	Percent of State Duck Harvest 1971-1976
Susitna Flats	7442	9696	16385	6750	9485	11836	10266	12.6
Palmer Hay Flats	5854	4677	7879	5458	7114	6326	6218	7.4
Goose Bay	NS	NS	2238	287	351	510	846	0.9

NS = not surveyed

Source: Sellers 1979

Table 4.17 Willow Subbasin Refuge Goose Harvests 1971-1976 Calculated from Statewide Waterfowl Hunter Mail Surveys

Refuge	Goose Harvest 1971	1972	1973	1974	1975	1976	1971-1976 Average	Percent of State Goose Harvest 1971-1976
Susitna Flats	669	357	1030	224	173	418	478	3.3
Palmer Hay Flats	45	65	257	112	173	72	121	0.8
Goose Bay	NS	NS	0	0	0	0	0	0.0

NS = not surveyed

Source: Sellers 1979

Table 4.18 Factors Affecting Use and Value of Subbasin Fish and Wildlife Resources

Factors increasing use of (demand for) fish and wildlife resources	Factors decreasing supply of fish and wildlife resources
1. increases in human population within and in close proximity to the subbasin.	1. increases in human population within and in close proximity to the subbasin.
2. relative accessibility of subbasin fish and wildlife resources.	2. relative accessibility of subbasin fish and wildlife resources.
3. proximity of subbasin to major population centers.	3. proximity of subbasin to major population centers.
4. availability of highly sought after species, e.g., moose, black bear, brown bear, waterfowl, salmon, etc.	4. destruction and/or degradation of habitats supporting fish and wildlife species.
	5. transfer of public fish and wildlife lands and associated access routes to private ownership.

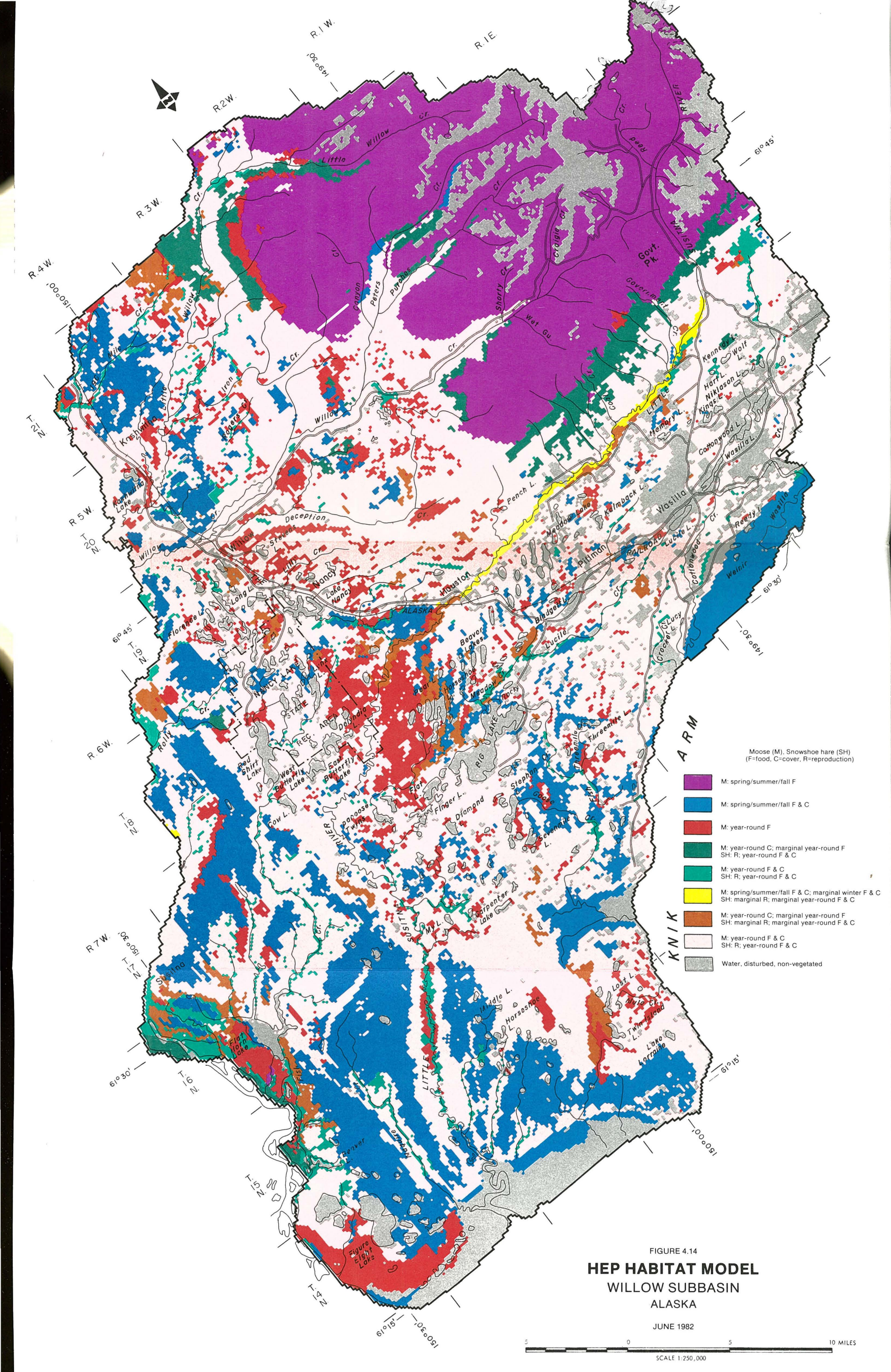
The Willow Subbasin and surrounding areas are unique in providing many opportunities to use and enjoy fish and wildlife resources on accessible public lands in close proximity to urban areas. Use and value of these resources on public subbasin lands are expected to increase as a result of the following factors: 1) human population increases in and around the Willow Subbasin, 2) increased accessibility to over half of Alaska's population, 3) transfer of public land into private ownership, and 4) increasing travel costs which promote use of fish and wildlife resources in the subbasin vis-a-vis the remainder of the state. Factors which will ultimately affect the value of the wildlife resource are shown in Table 4.18.

Wetlands

Up until the 1960's, wetlands[17] were popularly regarded as "swampy" areas which required drainage to be usable or were valuable only in terms of their contributions to waterfowl populations. However, as understanding and appreciation of environmental systems evolved throughout the 1960's and '70's, an increasing variety of wetland values were generally recognized. It became increasingly clear, for example, that tidal marshes stablize shorelines and contribute significantly to the biomass of adjoining estuaries by providing bacterially enriched detritus. Estuaries, in turn, were recognized as among the world's most productive ecosystems and as essential nursery areas for a wide variety of organisms including economically valuable fish and shellfish. Inland wetlands were seen to provide habitat for many birds, mammals, and other organisms. They also provide ground water recharge, flood water storage, and natural filtration of many water pollutants.

By the mid 1970's, recognition of the importance of wetlands resulted in Federal legislation to halt their unwarranted degradation or destruction. The Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-217) and President Carter's Wetlands Protection and Flood Plain Management Executive Orders (EO's 11990 and 11988), the National Coastal Zone Management Program, and the National Flood Insurance Program are examples. Together they

[17] Defined later in this section.



Moose (M), Snowshoe hare (SH)
(F=food, C=cover, R=reproduction)

- M: spring/summer/fall F
- M: spring/summer/fall F & C
- M: year-round F
- M: year-round C; marginal year-round F
  SH: R; year-round F & C
- M: year-round F & C
  SH: R; year-round F & C
- M: spring/summer/fall F & C; marginal winter F & C
  SH: marginal R; marginal year-round F & C
- M: year-round C; marginal year-round F
  SH: marginal R; marginal year-round F & C
- M: year-round F & C
  SH: R; year-round F & C
- Water, disturbed, non-vegetated

FIGURE 4.14

HEP HABITAT MODEL

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

Red squirrel (RS), Spruce grouse (SG), Willow ptarmigan (WP)
(F=food, C=cover, R=reproduction)

- WP: R; year-round F & C
- Not utilized by RS, SG or WP
- WP: R; winter F & C, marginal summer F & C
- WP: R; year-round F & C
- RS and SG: R; year-round F & C
- RS: marginal F & C
- RS: R; year-round F & C; WP: marginal year-round F & C SG: R; winter F & C; marginal spring/summer/fall F
- Water, disturbed, non-vegetated

FIGURE 4.15

HEP HABITAT MODEL

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

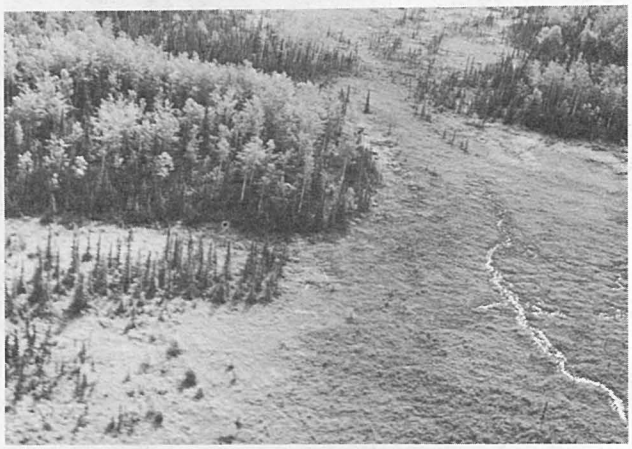
SCALE 1:250,000

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Z-N-24192

focused national attention on the importance of wetlands to environmental quality, articulated a national policy concerning their use and protection, and established permit review procedures for many activities affecting waterways and associated wetlands.[18].

In order to manage wetland use and protection in accordance with Federal legislation and regulations, Federal, state, and local agencies have begun to develop methods for defining, identifying, classifying, and evaluating wetland areas under their jurisdictions. Results to date include a variety of wetland definitions (see below), a system for classifying the Nation's wetlands[19]; a National Wetland Inventory Program (USF&WS in progress); several methods for assessing relative wetland values[20]; local, regional, and national symposia on wetland issues; and state efforts to map and develop management recommendations for wetlands within their boundaries. The wetlands map developed for this study (Figure 4.16) represents a cooperative Federal-State effort to identify, classify, and map wetlands in the Willow Subbasin.



Up until the 1960's, wetlands were popularly regarded as "swampy" areas which required draining to be developed or were valuable only in terms of their contributions to waterfowl populations.

Despite general interest, defining wetlands to the satisfaction of all interested parties has proven difficult. There is no single definition for wetlands, primarily because of the diversity of wetlands and because the interface between dryland and wetland environments is indistinct. The following definition of wetlands was used in this study:[21] "Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. A single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water"[22]. For purposes of this study, land areas must fall into one of the following two categories to be identified and mapped as wetlands:

1) land areas which, at least periodically, support predominantly hydrophytes[23] and in which the substrate is predominantly very poorly drained or undrained hydric soil[24]; or
2) land areas which are located within an active flood plain[25]; regardless of vegetation or soil conditions.

In accordance with the previous definition, wetlands in the Willow Subbasin were identified and mapped by combining data on soil drainage obtained from SCS, and data on wetland vegetation types provided by the USF&WS. The two sets of data were combined because neither set provided sufficient information when used individually—wetland vegetation types were found to occur on well-drained (non-wetland) soils, while very poorly drained soils did not always support wetland vegetation types. Areas containing **both** a USF&WS wetland vegetation type and a soil type classified by SCS as very poorly drained, were identified and mapped as wetlands. Figure 4.17 presents the vegetation-soil matrix used to identify subbasin wetlands.

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18 Kusler, J.A. 1978. Strengthening state wetland regulations. USFWS, Office of Biological Services, FWS/OBS-78/98. Washington, D.C.

19 Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. USFWS, Office of Biological Services, FWS/OBS-79/31. Washington, D.C. 103 pp.

20 Reppert, R.T., W. Sigleo, E. Stakhiv, L. Messman, and C. Meyers. 1979. Wetland values-concepts and methods for wetlands evaluation. U.S. Army Corps of Engineers, Institute for Water Resources, Fort Belvoir, Virginia 22060. 109 pp.

21 This definition corresponds closely to the legal definition of wetlands used by the U.S. Army Corps of Engineers during its "404" wetland permit review activities: 'Wetlands' means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (33 U.S.C. 323.2(c))

Identified wetlands were classified according to the classification system developed by the USF&WS for their on-going National Wetlands Inventory Program[26]. Table 4.19 presents the USF&WS wetland classes corresponding to the various vegetation-soil and vegetation-flood plain classes displayed in Figure 4.17. Acreages and percent-of-subbasin encompassed by each of these USF&WS wetland classes are presented in Table 4.20.

Two limitations of the wetland identification and mapping process used in the subbasin should be noted. First, the minimum map unit, or smallest area resolvable on the wetlands map, is 10 acres. As a result, wetland areas that are less than 10 acres are not accurately delineated. Wetland areas 5 acres or larger may be mapped as 10-acre wetlands, while wetlands smaller than 5 acres may not be identified on the map. Second, on rare occasions, wetlands may occur on poorly as well as on very poorly drained soils; a typical example would be the presence of hydrophytic vegetation in a depressional area with poorly drained soils. For this reason, poorly drained depressional landforms were identified and mapped as "potential wetland inclusions." Field checks of these areas would be required to determine whether or not wetland conditions exist.

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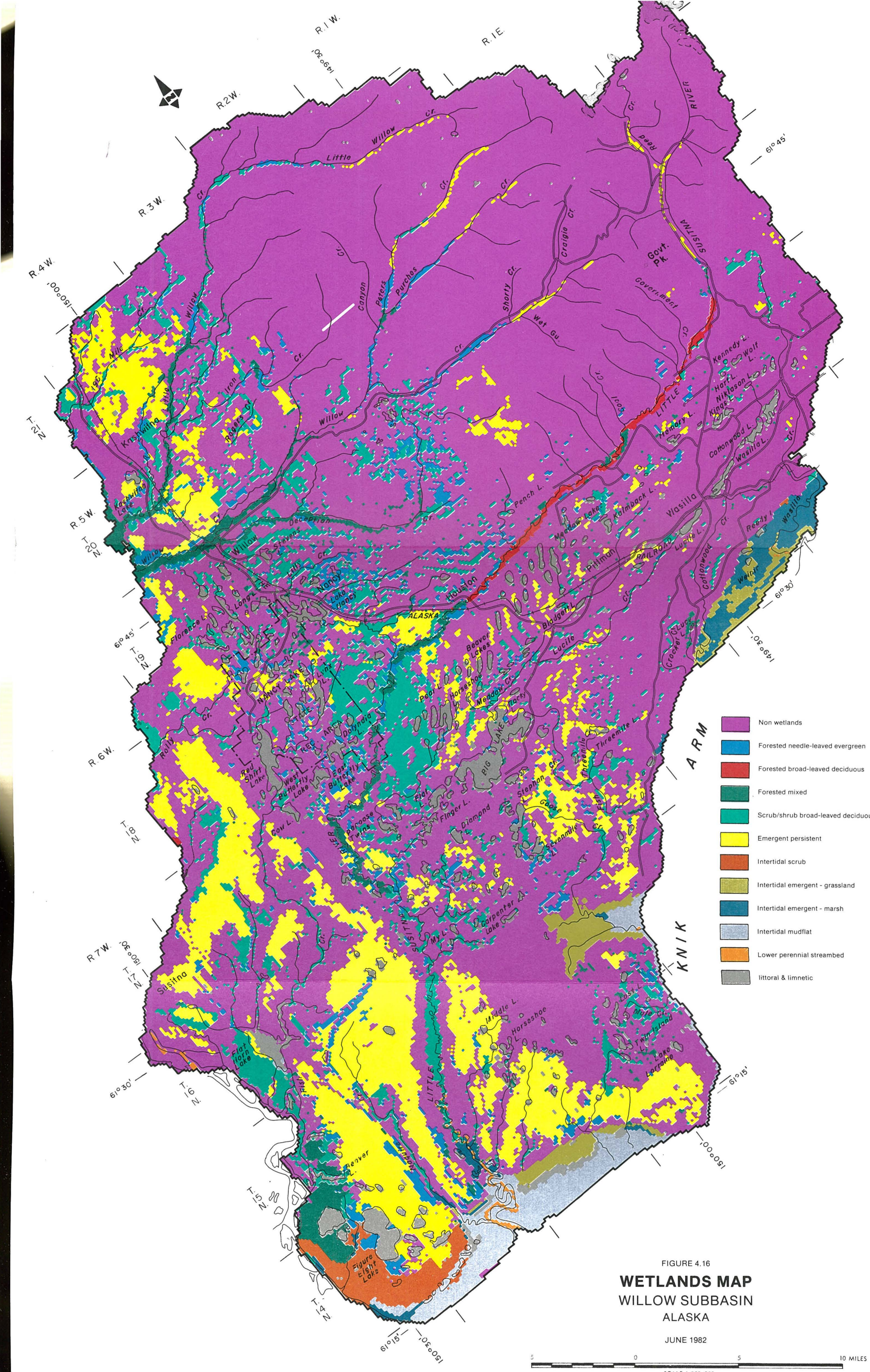
[22] Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. USFWS, Office of Biological Services, FWS/OBS-79/31. Washington, D.C. 103 pp.

[23] hydrophyte: any plant growing in water or on a substrate that is periodically deficient in oxygen as a result of excessive water content.

[24] hydric soil: soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

[25] active flood plain: the flood-prone lowlands and relatively flat areas adjoining inland and coastal waters including contiguous wetlands and flood plain areas of offshore islands; this will include, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year (100-year flood plain).

[26] Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. USFWS, Office of Biological Services, FWS/OBS-79/31. Washington, D.C. 103 pp.



Non wetlands
Forested needle-leaved evergreen
Forested broad-leaved deciduous
Forested mixed
Scrub/shrub broad-leaved deciduous
Emergent persistent
Intertidal scrub
Intertidal emergent - grassland
Intertidal emergent - marsh
Intertidal mudflat
Lower perennial streambed
littoral & limnetic

FIGURE 4.16

WETLANDS MAP

WILLOW SUBBASIN

ALASKA

JUNE 1982

5 0 5 10 MILES

SCALE 1:250,000

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS PORTLAND, OR 1982

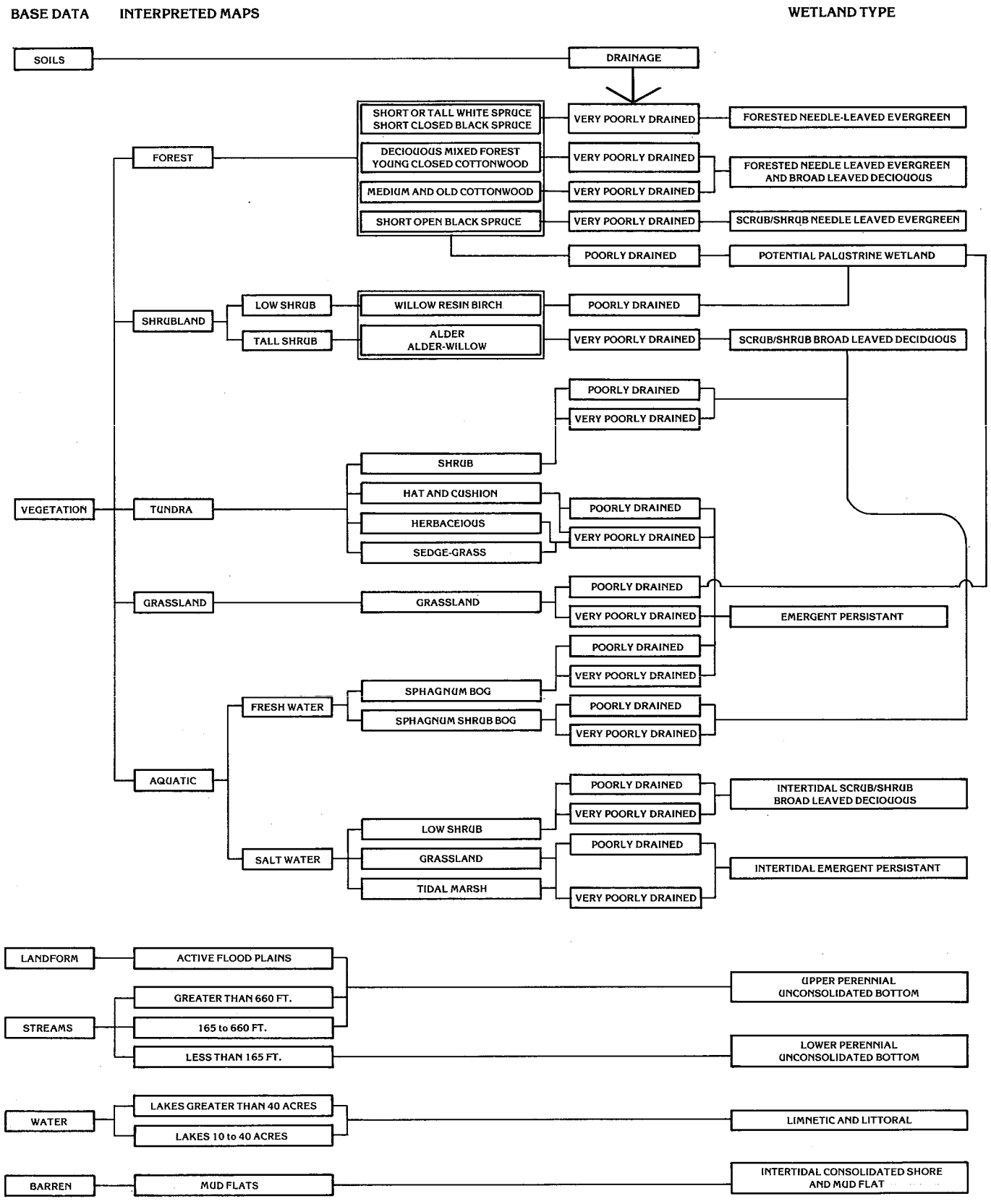


Figure 4.17 Wetland Identification Matrix

Table 4.19 Classification of Wetlands in the Willow Subbasin (classification after Cowardin et al. 1979)

System	Subsystem	Class*	Subclass	Dominance Type	SCS Code	USFWS Code
Palustrine: includes all nontidal wetlands dominated by trees, shrubs, persistant emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 0/00 (parts per thousand); also includes wetlands lacking such vegetation, but with all the following characteristics: 1) size less than 8 ha, 2) absence of an active wave-formed or bedrock shoreline feature, 3) water depth in the deepest part of basin less than 2 m at low water, and salinity due to ocean-derived salts less than 0.5 0/00; includes vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie; also includes the small, shallow, permanent or intermittent water bodies often called ponds.	no subsystem	**Forested:** includes areas in one of three SCS vegetation categories: a) closed forest, in which tree canopy cover equals or exceeds 60%; b) open forest, in which tree canopy cover equals 25-59%; and c) woodland, in which tree canopy cover equals 10-24% (trees are defined by SCS as "woody plants having one well-developed stem and usually more than 12 ft. in height.")	**Needle-leaved evergreen:** predominant woody life form is needle-leaved evergreen	**Picea mariana:** black spruce constitutes the dominant subclass species	1	PF04
				Populus balsamifera: cottonwood (balsam popular) constitutes the dominant subclass species	2	PF01
			Broad-leaved deciduous: predominant woody life form is broad-leaved deciduous			
			Needle-leaved evergreen and Broad-leaved deciduous: these two woody life forms are co-dominant		3	PF04-PF01
		Scrub-shrub: includes areas dominated by woody vegetation less than 12 ft. tall; species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions; tree canopy cover is less than 10%, shrub cover equals or exceeds 25%	**Needle-leaved evergreen:** predominant woody life form under 12 ft. tall is needle-leaved evergreen	**Picea mariana:** black spruce constitutes the dominant subclass species	4	PSS4
			Broad-leaved deciduous: predominant woody life form under 12 ft. tall is broad-leaved deciduous		5	PSS1
		Emergent: includes areas dominated by erect,rooted, herbaceous hydrophytes; this vegetation is present for most of the growing season in most years; tree canopy cover is less than 10%, shrub cover less than 25%	**Persistent:** dominated by species that normally remain standing at least until the beginning of the next growing season		6	PEM1
Estaurine: includes deep-water tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land; the salinity may be periodically increased above that of the open ocean by evaporation.	**Intertidal:** substrate is exposed and flooded by tides; includes the associated splash zones	**Scrub-shrub:** (see Palustrine, Scrub-shrub)	**Broad-leaved deciduous:** (see Palustrine, Scrub-shrub, Broad-leaved deciduous)	**Myrica:** sweetgale or other broad-leaved deciduous shrubs constitute the dominant subclass species	11	E2SS1
		Emergent: (see Palustrine, Emergent)	**Persistent:** (see Palustrine, Emergent, Persistent)	**Elymus, Calamagrostis:** grasses constitute the dominant subclass species	12	E2EM1
				Scirpus, Carex, etc.: emergent persistent wetlands dominated by rushes, sedges, or other forbs	13	E2EM1
		Flat: includes all wetlands having three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) any appropriate water regime (e.g. regularly flooded)	**Mud:** the unconsolidated particles smaller than stones are predominantly silt and clay; anaerobic conditions often exist below the surface		14	E2FL3

* SCS definitions of vegetation classes coincide with Viereck and Dyrness (1980), definitions of non-vegetation classes coincide with Cowardin et. al. (1979).

Table 4.19 (continued)

System	Subsystem	Class*	Subclass	Dominance Type	SCS Code	USFWS Code
Riverine; includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 0/00; terminates at the downstream end where the concentration of ocean-derived salts in the water exceeds 0.5 0/00 during the period of annual average low flow, or where the channel enters a lake; terminates at the upstream end where tributary streams originate, or where the channel leaves a lake.	**Upper perennial:** stream gradient is high and velocity fast; no tidal influence and some water flows throughout the year; substrates consist of rock, cobbles, or gravel with occasional patches of sand; natural dissolved oxygen concentration is normally near saturation; very little flood plain development	**Unconsolidated bottom:** all wetlands with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%	**Cobble-gravel:** the unconsolidated particles smaller than stones are predominantly cobble and gravel, although finer sediments may be intermixed		21	R3UB1
	Lower perennial: gradient is low and water velocity is slow; there is no tidal influence, and some water flows throughout the year; substrate consists mainly of sand and mud; oxygen deficits may sometimes occur; floodplain is well-developed	**Unconsolidated bottom:** (see Riverine, Upper perennial, Unconsolidated bottom)			22	R2UB
Lacustrine: includes wetlands and deep-water habitats with all of the following characteristics: (1) situated in a topographic depression or dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 10% canopy cover; and (2) total area exceeds 8 ha (20 acres); similar wetland habitats totaling less than 8 ha are also included if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m (6.6 ft.) at low water; ocean-derived salinity is always less than 0.5 0/00	**Limnetic:** all deep-water habitats within the Lacustrine system; (in the Willow Subbasin, Littoral wetland habitats are included in the Limnetic Subsystem because data resolution does not permit differentiation of these two Lacustrine Subsystems)	**Unconsolidated bottom:** (see Riverine, Upper perennial, Unconsolidated bottom)	**Cobble-gravel:** (see Riverine Upper perennial, Unconsolidated bottom, Cobble-gravel)		31	L1UBI
Potential Wetland Inclusions:	Wetlands may occur on poorly as well as on very poorly drained soils, particularly in poorly drained depressional land forms. For this reason, poorly drained depressional landforms have been mapped as Potential Wetlands Inclusions. Field-checking is required to determine if these areas are wetlands.					

* SCS definitions of vegetation classes coincide with Viereck and Dyrness (1980), definitions of non-vegetation classes coincide with Cowardin et. al. (1979).

Table 4.20 Wetland Types, Willow Subbasin

	Acres	Percent
Forested Needle-leaved Evergreen	21,450	2.2
Forested Needle-leaved Evergreen and Broad-leaved Deciduous	12,370	1.4
Scrub-shrub Needle-leaved Evergreen and Broad-leaved Deciduous	47,480	4.9
Emergent Persistant	106,370	10.9
Potential Palustrine Wetland Inclusions	53,250	5.5
Intertidal Scrub-shrub Broad-leaved Deciduous	7,780	0.8
Intertidal Emergent Persistant (Calimagrostis)	8,300	0.9
Intertidal Emergent Persistant	7,290	0.8
Intertidal Unconsolidated Shore Mud Flat	10,020	1.0
Upper Perrenial Riverine	136,980	14.1
Littoral and Limnetic	34,940	3.6
Non-wetland	523,040	53.9
	969,270	100.0

5. Functional Resource Needs and Alternative Programmatic Approaches

5. Functional Resource Needs and Alternative Programmatic Approaches

Introduction

Two major premises underlie the planning analysis of the Susitna Cooperative River Basin Study. The first is that the goods, services, and amenities which residents derive from the basin's natural resources, renewable and nonrenewable, can be enhanced. This infers that **opportunities** exist for improved resource utilization. The second major premise is that certain **problems** exist or will exist because of social-environmental interaction. Functional resource needs, then, represent the extent that opportunities may be gained and/or problems alleviated through public sector policies and programs.

The vehicles for meeting these needs are the alternative plans ("alternatives") which are specifically designed to address one or more opportunities and/or problems. These alternatives meet the NED and EQ objectives in varying degrees. The next section discusses those resource problems and opportunities (needs) evidenced in the resource inventory and projections analyses. The following section presents, by functional resource area, the alternatives developed to serve the specific needs.

Problems and Opportunities (Needs)

Resource needs were perceived in six functional areas: agricultural land, timber land, settlement land, flood plains, recreation areas, and fish and wildlife habitat areas. Of course many, and in some cases all, of these functional areas overlap at any given land site. However, the functional areas were separated for analytical and discussion purposes.

Agricultural Land

Land in the Willow Subbasin devoted to crops has never exceeded more than a few hundred acres (see Table 4.1). An accelerated demand for settlement land has precipitated a decline in available agricultural acreage. Other needs from the NED and EQ objective standpoints include opportunities for increased crop commodity production, the preservation of open space, and the amelioration of potential off-site pollution problems. Table 5.1 details agricultural land use needs.

Table 5.1 Agricultural Land Use Needs, Willow Subbasin

Primary Objectives	Needs
National and State Economic Development	1. Maintain or enhance the long-term productivity of agricultural land by:
	a. Reversing the trend of agricultural land loss estimated at 300 acres per year.
	b. Insuring proper land use planning to minimize irreversible commitments on agricultural lands.
	c. Moving toward self-sufficiency in Alaskan Agriculture.
	2. Increase the output of goods and services by bringing land into production for economically feasible agricultural enterprises.
Environmental Quality	Maintain or enhance attributes of the environment by:
	1. Locating future agricultural developments to minimize impacts on environmentally sensistive areas.
	2. Preserving open land to contribute to an aesthetically pleasing land use mix.
	3. Minimizing nonpoint pollution from agricultural sources.

Timber Land

The Willow Subbasin contains 230 thousand acres of commercial timber land (Figure 3.9) However, the local sawmills operate at less-than-full capacity. Opportunities and problems associated with enhanced timber production are shown in Table 5.2.

Table 5.2 Timber Land Use Needs, Willow Subbasin

Primary Objectives	Needs
National and State Economic Development	1. Increase the output of goods and services by: a. Increasing timber production. b. Developing wood-base energy resources. c. Improved management of timber resources. 2. Maintain or enhance the long-term productivity of forest land by setting aside managed public forests.
Environmental Quality	Maintain or enhance attributes of the environment by: 1. Creating "multiple use" forest lands. 2. Preserving or enhancing wildlife habitat. 3. Controlling erosion and runoff.

Settlement Land

By 2000, the demand for additional settlement land is expected to range between 18 and 55 thousand acres (Table 4.5). This large demand will both present opportunities and create significant problems for the Willow Subbasin land resource. These needs are summarized in Table 5.3

Table 5.3 Settlement Land Use Needs, Willow Subbasin

Primary Objectives	Needs
National and State Economic Development	Increase economic efficiency by: 1. Developing 18 to 55 thousand acres by 2000. 2. Providing adequate municipal goods and services.
Environmental Quality	Maintain or enhance attributes of the environment by: 1. Maintaining landscape aesthetics. 2. Preventing construction site erosion. 3. Maintaining water quality.

Flood Plains

The interaction between people and floods presents a significant problem. Where society has encroached on active flood plains, real costs are encountered, both calcuble and incalcuble. Efforts can be made to reduce these costs in the short-term and to prevent long-term costs in the future. Table 5.4 shows needs associated with flood plain lands in the Willow Subbasin.

Table 5.4 Flood Plain Land use Needs, Willow Subbasin

Primary Objectives	Needs
National and State Economic Development	1. Reduce floodwater damages to roads and railroads.
	2. Reduce floodwater damages to commercial and residential properties.
Environmental Quality	1. Reduce threat of loss of life.
	2. Enhance natural and aesthetic values.
	3. Preserve existing values of natural resources.
	4. Minimize pollution created by construction activity in and adjacent to floor plains.
	5. Establish greenbelts where necessary to maintain water quality.

Recreation Land

Needs for recreational user days and facilities are shown in Table 5.5. These needs are substantial, resulting in part from the Basin's proximity to the Anchorage area.

The Alaska Department of Natural Resources, Division of Parks has made an inventory of existing recreation facilities within the subbasin.

Table 5.5 Recreation Land Use Needs, Willow Subbasin

Activity	User Day Demand (annual)	Total Facility Demand	Existing Facilities	Facility Needs
Freshwater fishing				
Stream	106,694	135 miles	8 miles	127 miles
Lake	62,661	48 access pts.	18 access pts.	30 access pts.
Developed camping	26,500	1005 units[1]	474 units	531 units
Hiking	67,567	113 miles	76 miles	37 miles
Picnicking/sightseeing	290,363	742 units	383 units	359 units
Canoeing	12,822	21 miles	113 miles	—
Cross-country skiing	18,749	19 miles	106 miles	—

[1] Of this total, 184 are associated with single purpose camping while the remaining 821 represent facilities desired by an estimated 33% of those involved in fishing and canoeing.

Fish and wildlife habitat (including wetlands)

The fish and wildlife habitat needs stem largely from opportunities to avoid future problems (Table 5.6). While changes in land use will adversely impact many species, habitats for other species may actually improve, particularly when specifically addressed in resource development and management plans.

Table 5.6 Fish and Wildlife Needs

Objective	Resource Area	Needs
Environmental Quality and/or National and State Economic Development	1) Fish and wildlife production and use lands - e.g. tundra, riparian corridors, other wetlands, open forests, shrublands	1a) Retain an integrated system of state-owned lands for fish and wildlife production and associated human uses.
		1b) Establish (legally, procedurally, etc.) that the maintenance/enhancement of fish and wildlife resources, including permitted human uses, be the primary managment objective on these lands.
		1c) Maintain and enhance sports and commercial fisheries.
	2) Existing State Refuges (e.g., Susitna Flats, Goose Bay, Palmer Hayflats) and State Recreation Areas (e.g., Nancy Lake)	2) Intergrate location and management of State Refuges and Recreation Areas into above fish and wildlife production and use system.
	3) Resource development lands - e.g., forests, agricultural lands, mineral lands	3) Establish (legally, procedurally, etc.) that the maintenance/enhancement of wildlife resources (including permitted associated human uses) be the secondary management objective on resource development lands; develop formal procedures for ensuring that appropriate design guidelines, best management practices, etc. be incorporated throughout all phases of resource developments.
	4) Moose spring/summer/fall habitats and winter habitats	4) Delineate habitat management units which can and will be managed for the primary objectives of (a) maintaining and enhancing habitat suitability for moose, while (b) maintaining and enhancing human opportunities to use and enjoy moose.
	5) Furbearer and/or small game habitat lands	5) Delineate furbearer/small game habitat management units which can and will be managed for the primary objectives of a) producing furbearers and other designated small game while b) maintaining and enhancing human opportunities to use and enjoy these wildlife resources.
	6) Ecotones (ecological edges)	6a) Recognize high values of ecological edges (e.g., high species diversity, uniqueness, etc.). 6b) Develop and institute siting and design criteria as well as best management practices for developments affecting ecological edges.
	7) Wetlands	7) Formulate and institute a wetland management policy or plan for the Willow Subbasin.
	8) State, Borough and private lands	8a) Institute a State/Borough policy of "clustering" commercial, industrial, and high density residential developments
Environmental Quality and/or National and State Economic Development (continued)		8b) Maintain undisturbed "natural" buffers between any of the following activities/developments and state lands designated as fish and wildlife production and use lands, State Refuges, State Recreation Areas, moose habitats, wetlands, or furbearer/small game habitats.

Activities/Developments	Alaska Dept. of Fish and Game Suggested Natural Buffer Widths (modify as data indicate)
Agriculture/Grazing	400 feet
Commercial	800 feet
Forestry	400 feet
Industrial	800 feet
Material extraction, processing, etc.	800 feet
Mineral extraction, processing, etc.	800 feet
Private Recreation Facilities	200 feet
Residential	800 feet
Energy	800 feet
Utility (aboveground)	800 feet
Transportation	200-800 feet, depending on type

Table 5.6 Fish and Wildlife Needs (continued)

Objective	Resource Area	Needs
		8c) Strengthen and expand procedures for involving fish and wildlife agencies in the initial planning, siting, designing, construction, operation, maintenance, and decommissioning of developments to ensure that currently recommended guidelines, criteria, best management practices, etc. are incorporated.
	9) Private lands	9) Strengthen and expand programs which involve private landowners in wildlife planning for their lands and which provide incentives to private landowners who are willing to implement habitat maintenance/enhancement activities or regulated public uses on their lands (maintenance or enhancement activities to be determined by the ADF&G working with the landowners).

Alternatives

In this section alternative solutions or plans are presented by functional resource area. Each alternative is designed to alleviate specific problems or to take advantage of specific opportunities as outlined in the previous section. Table 5.16 displays multi-objective alternative accounts.

Alternatives for crop and timber land

Because of their land-intensive production requirements, crop and timber land alternatives were developed in tandem. Using a computerized mathematical model developed specifically for the purpose of incorporating several alternative future conditions, programs, and policies, the impacts of four land resource alternatives were estimated. These include policies of laissez faire, agricultural land preservation, subbasin self-sufficiency, and full development of the agricultural and timber resources. These alternatives are tabulated in Table 5.16.

Each of these four alternatives result in different areas and locations of land which are economically feasible for the establishment of agricultural and/or timber enterprises. A description of the analysis used and a map showing the location of the feasible areas are presented in Appendix C.

Alternatives for settlement land

The most important need in terms of settlement land is to insure that acreages devoted to this purpose are both economically and environmentally suitable. The land capability settlement models developed in this study provide an indication of those lands physically suited to development. However, the models do not contain criteria which restrict settlement in environmentally sensitive areas, for example, areas identified in the fish and wildlife models. To determine locations where conflicts do not exist, settlement maps must be matched with fish and wildlife and other capability models to outline conflicts.

The following settlement alternatives have been developed for this study.

1. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models.
2. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models **and** with priority for development emanating from existing urban centers and moving outward as population growth warrants.
3. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models, but not being essential habitat areas.
4. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models, but not being essential habitat areas **and** with priority for development emanating from existing urban centers and moving outward as population growth warrants.

5. Require that all future settlement be restricted to those areas identified as having "high or moderate capability" on the settlement models, **and** with priority for development emanating from existing urban centers and moving outward as population growth warrants.

Alternatives for flood plains

These alternatives are arrayed with reference to both existing problems and future opportunities.

1. For Existing Property:
   (a) Flood-proofing structures by raising the floor elevation of the structure and flood proofing walls and reinforcing foundations.
   (b) Install sewer check valves and manually removable bulkheads.
   (c) Relocate contents to flood free areas and supply emergency procedures such as sandbagging.
   (d) Relocation of existing structures to flood free areas and restoration of flood plain to natural condition.
   (e) Establish flood watch and warning systems.
   (f) Require flood insurance on all property within the flood plain to equalize the flood hazard risk.
   (g) Purchase existing private flood plain lands; retain public ownership and manage for nonflood prone uses.
2. For New Construction:
   (a) Analyze the long-term cost of inappropriate construction design.
   (b) Use engineering designing criteria to consider flood hazard as related to soils, geology, hydrology and hydraulics.
   (c) Identification of flood hazard areas. Install water monitoring stations to define flows necessary for proper design of roads and railroad culverts and bridges.
   (d) Implement flood plain management regulations aimed at flood proofing all new and existing damageable properties.
   (e) Enforcement of the National Flood Insurance Program required ordinance.
   (f) Create an environmental corridor inclusive of 100-year (1 percent chance) flood plain and appropriate buffer zone; retain existing state and borough lands in public ownership to be managed for environmental or recreational values.

Alternatives for recreational land

A total of 109 potential single purpose recreation sites were evaluated (Figure 5.1) both on a benefit/cost basis and for the contribution each could make toward meeting the needs set forth in the previous section. Benefits are based on user day estimates together with recreational values calculated for this study. Costs include expenditures for facilities, i.e. campsites, trail clearing, parking, etc., as well as operation, maintenance and replacement of these facilities over a 50 year period. A standard $2000 per acre was included as a land purchase cost. All costs and benefits are presented on an average annual[27] basis (Tables 5.7 through 5.11).

Tables 5.12 through 5.15 show four recreational development alternatives which have been selected as examples from the previous 109 single purpose sites. These examples were chosen at random as an illustration of possible site combinations. The alternatives are by no means limited to the four shown, but may be derived in any combination from those previously listed sites.

Alternatives for fish and wildlife habitat lands (including wetlands)

While many problems are evidenced in the human/wildlife interface the principal alternatives are couched in terms of avoiding future problems or taking advantage of preserving or enhancing habitat. These alternatives are shown in Table 5.16.

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[27] Water Resource Council discount rate of 7-3/8 percent, 50 year evaluation period.

Table 5.7 Hiking (Need = 37 trail miles)

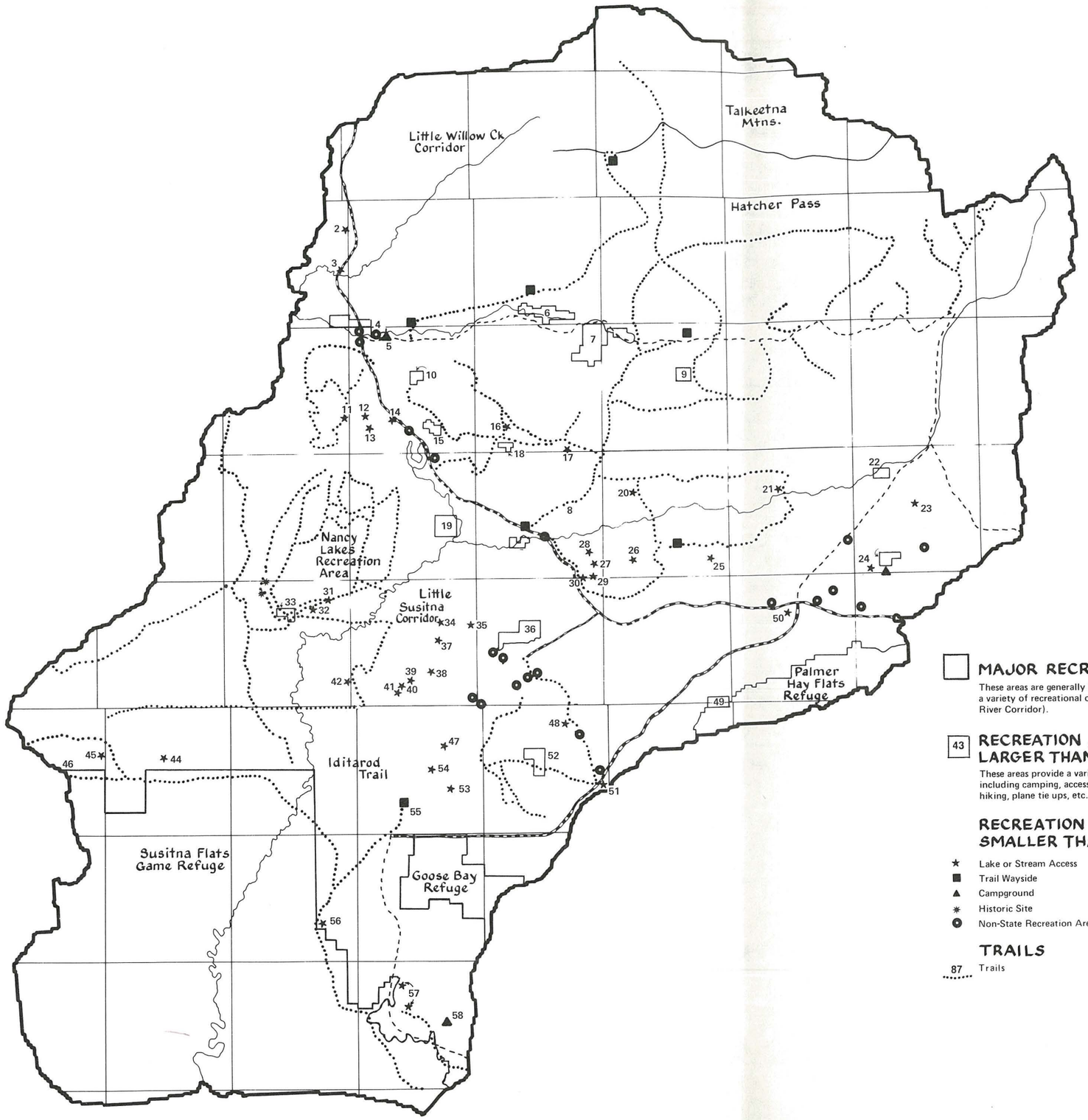
Potential Park Name	Approx. Park Acreage	Units Provided (miles)	User Days Provided	Average Annual Rec. Benefits (dollars)	Average Annual Cost (dollars)	Net Average Annual Benefits (dollars)
Bench Lake	180	3	1,794	13,150	31,270	-18,120
Sled Trail	30	14	8,372	61,370	23,560	37,810
Hatcher Pass Rec. Area	71,040	66	39,468	289,300	10,871,990	-10,582,690
Three Beauties	80	24	14,352	105,200	64,570	40,630

Table 5.8 Stream Fishing (Need = 127 stream access miles)

Potential Park Name	Approx. Park Acreage	Units Provided (miles)	User Days Provided	Average Annual Rec. Benefits (dollars)	Average Annual Cost (dollars)	Net Average Annual Benefits (dollars)
Three Mile Lake	10	4	3,160	32,610	10,630	21,980
Little Willow	20	4	3,160	32,610	7,780	24,830
Flathorn Lake	20	2	1,580	16,310	5,410	10,900
Fish Creek (off Flathorn Lake)	60	4	3,160	32,610	13,850	18,760
Fish Creek-Knik	30	2	1,580	16,310	6,930	9,380
Willow Creek Canyon	750	6	4,740	48,920	120,980	-72,060
Willow Creek #2	480	6	4,740	48,920	79,990	-31,070
Willow Creek #1	240	3	2,310	24,460	39,940	-15,480
Little Susitna Access "A"	160	4	3,160	32,610	30,190	2,420
Little Susitna Access "B"	320	4	3,160	32,610	53,330	-20,720

Table 5.9 Lake Fishing (Need = 30 access points)

Potential Park Name	Approx. Park Acreage	Units Provided (miles)	User Days Provided	Average Annual Rec. Benefits (dollars)	Average Annual Cost (dollars)	Net Average Annual Benefits (dollars)
Horseshoe Lake #1 and #2	25	1	1,305	13,470	12,100	1,370
Three Mile Lake	10	1	1,305	13,470	9,820	3,650
Kalmback Lake	10	1	1,305	13,470	9,820	3,650
Finger Lake	7	1	1,305	13,470	9,370	4,100
Flat Lake	5	1	1,305	13,470	9,060	4,410
Kashwitna Lake	40	1	1,305	13,470	14,380	-910
Long Lake	40	1	1,305	13,470	14,380	-910
Twin Island Lake #1 and #2	120	2	2,610	26,940	34,820	-7,880
Lake and Trail	60	1	1,305	13,470	17,410	-3,940
Flathorn Lake	20	1	1,305	13,470	11,340	2,130
Anna Lake	80	1	1,305	13,470	20,450	-6,980
Stephan Lake	20	1	1,305	13,470	11,340	2,130
Fish Creek (off Flathorn Lake)	60	1	1,305	13,470	17,410	-3,940
Prator Lake	7	1	1,305	13,470	9,370	4,100
Seymour Lake	40	1	1,305	13,470	14,380	-910
Bench Lake	180	1	1,305	13,470	35,630	-22,160
Cheri Lake	20	1	1,305	13,470	11,340	2,130
Sara Lake	10	1	1,305	13,470	9,820	3,650
Meadow Creek	960	1	1,305	13,470	154,050	-140,580
Stevens Lake	420	1	1,305	13,470	72,070	-58,600
Mud Lake	20	1	1,305	13,470	11,340	2,130
Honeybee Lake #1	10	1	1,305	13,470	9,820	3,650
Honeybee Lake #2	40	1	1,305	13,470	14,380	-910
Kelly Lake	4	1	1,305	13,470	8,910	4,560
Delyndia Lake	40	1	1,305	13,470	14,380	-910
Papoose Twins	60	1	1,305	13,470	17,410	-3,940
Low Lake	160	1	1,305	13,470	32,590	19,120
Wolf Lake	30	1	1,305	13,470	12,860	610
Hourglass Lake	10	1	1,305	13,470	9,820	3,650
Lake Access "C"	40	1	1,305	13,470	14,380	-910
Lucy Lake/ Cottonwood Creek	320	1	1,305	13,470	56,880	-43,410
Lake Access "A"	10	1	1,305	13,470	9,820	3,650
Three Beauties	80	1	1,305	13,470	20,450	-6,980
Four Lakes	160	1	1,305	13,470	32,590	-19,120
Eastside Lake	135	1	1,305	13,470	2,880	10,590
Lynx Lake	300	1	1,305	13,470	53,850	-40,380
Twelve Mile Lake	1,025	1	1,305	13,470	163,920	-150,450
Lake Marion	50	1	1,305	13,470	15,890	-2,420
Loon Lake	10	1	1,305	13,470	9,820	3,650
Blodgett Lake	10	1	1,305	13,470	9,820	3,650
Houston Lake	640	1	1,305	13,470	105,470	-92,000
Frog Lake	40	1	1,305	13,470	14,380	-910
Lake Lorraine	80	1	1,305	13,470	20,450	-6,980
Seven Mile Lake	60	1	1,305	13,470	17,410	-3,940



LIST OF SITES

Figure 5.1 Map of Sites

Table 5.10 Developed Camping (Need = 531 units)

Potential Park Name	Approx. Park Acreage	Units Provided (miles)	User Days Provided	Average Annual Rec. Benefits (dollars)	Average Annual Cost (dollars)	Net Average Annual Benefits (dollars)
Seymour Lake	40	80	11,520	207,010	88,528	118,482
Bench Lake	180	80	11,520	207,010	88,528	118,482
Sara Lake	10	4	576	10,350	5,640	4,710
Stevens Lake	420	180	25,920	465,780	249,290	216,490
Mud Lake	20	40	5,760	103,510	44,260	59,250
Willow Creek #2	480	60	8,640	155,260	134,720	20,540
Willow Creek #1	240	100	14,400	258,770	139,080	119,690
Honeybee Lake #1	10	20	2,880	51,750	22,130	29,620
Honeybee Lake #2	40	20	2,880	51,750	26,690	25,060
Papoose Twins	60	120	17,280	310,520	132,790	177,730
Wolf Lake	30	24	3,456	62,100	29,290	32,810
Three Mile Lake	10	12	1,728	31,050	151,110	-120,060
Finger Lake	7	4	576	10,350	5,190	5,160
Flat Lake	5	8	1,152	20,700	9,010	11,690
Little Willow	20	20	2,880	51,750	23,650	28,100
Twin Island Lake #1 and #2	120	60	8,640	155,260	301,800	-146,540
Lake and Trail	60	21	3,024	54,340	30,750	23,590
Flathorn Lake	20	20	2,880	51,750	23,650	28,100
Susitna Crossing-(Highway)	60	120	17,280	310,520	132,790	177,730
Anna Lake	80	60	8,640	155,260	73,990	81,270
Stephan Lake	20	20	2,880	51,750	23,650	28,100
Fish Creek (off Flathorn Lake)	60	80	11,520	207,010	73,990	133,020
Fry-pan Lake	300	100	14,400	258,770	148,620	110,150
Twelve Mile Lake	1,025	100	14,400	258,770	258,690	80
Lake Marion	50	75	10,800	194,080	84,890	109,190
Loon Lake	10	20	2,880	51,750	22,130	29,620
Houston Lake	640	200	28,800	517,540	303,300	214,240
Little Susitna Access "A"	160	100	14,400	258,770	127,360	131,410
Frog Lake	40	40	5,760	103,510	47,300	56,210
Lake Lorraine	80	80	11,520	207,010	94,600	112,410

Table 5.11 Picnicking (Need = 359 units)

Potential Park Name	Approx. Park Acreage	Units Provided (miles)	User Days Provided	Average Annual Rec. Benefits (dollars)	Average Annual Cost (dollars)	Net Average Annual Benefits (dollars)
Stevens Lake	420	100	39,100	239,680	124,150	115,530
Willow Creek #2	480	75	29,325	179,760	118,160	61,600
Willow Creek #1	240	125	48,875	299,600	111,920	187,680
Delyndia Lake	40	50	19,550	119,840	36,270	83,570
Low Lake	160	100	39,100	239,680	86,050	153,630
Wolf Lake	30	30	11,730	71,900	23,080	48,820
Hourglass Lake	10	10	3,910	23,970	7,560	16,410
Lake Access "C"	40	25	9,775	59,920	21,170	38,750
Horseshoe Lake #1 and #2	25	20	7,820	47,940	15,870	32,070
Three Mile Lake	10	10	3,910	23,970	7,560	16,410
Kalmback Lake	10	25	9,775	59,920	21,170	38,750
Finger Lake	7	5	1,955	11,980	4,080	7,900
Flat Lake	5	10	3,910	23,970	6,800	17,170
Little Willow	20	25	9,775	59,920	18,130	41,790
Long Lake	40	25	9,775	59,920	21,170	38,750
Twin Island Lake #1 and #2	120	50	19,550	119,840	48,410	71,430
Lake and Trail	60	35	13,690	83,890	30,250	53,640
Flathorn Lake	20	25	9,775	59,920	18,130	41,790
Anna Lake	80	30	11,730	71,900	30,260	41,640
Willow Creek Canyon	750	60	23,460	143,810	150,100	6,290
Susitna Scenic Area	150	100	39,100	239,680	83,160	156,620

Table 5.12 Recreation Alternative No. 1, Willow Subbasin

	ACTIVITY UNITS					
Potential Sites	Hiking (miles)	Camping (camp-sites)	Picnicking (picnic sites)	Stream Fishing (miles)	Lake Fishing (ac. pts)	Net Benefits
Willow Creek #1		100	125	6		$364,760
Willow Creek #2		60	75	3		196,820
Houston Lake		200			1	219,400
Stevens Lake		180	100		1	400,950
Delyndia Lake			50		1	88,730
Cheri Lake					1	2,130
Lake Access "A"					1	3,650
Eastside Lake					1	10,590
Blodgett Lake					1	3,650
Prator Lake					1	4,100
Kelly Lake					1	4,650
Fish Creek				2	1	9,380
Three Beauties	24			2	1	45,800
Sled Road Trail	14					37,810
TOTALS	38	540	350	11	10	$1,392,330

Table 5.13 Recreation Alternative No. 2, Willow Subbasin

Potential Sites	ACTIVITY UNITS					Net Benefits
	Hiking (miles)	Camping (camp-sites)	Picnicking (picnic sites)	Stream Fishing (miles)	Lake Fishing (ac. pts)	
Papoose Twins		120			1	$182,900
Low Lake			100		1	158,800
Little Susitna Access "A"		100		4		158,120
Susitna Crossing (Highway)		120				177,730
Horseshoe Lake #1 & #2			20		1	37,240
Lake Access "C"			25		1	43,910
Kalmback Lake			25		1	43,920
Three Beauties	24				1	45,800
Sled Road Trail	14					37,810
Fish Creek				2		9,380
Delyndia Lake			50		1	88,730
Hourglass Lake			10		1	21,580
TOTALS	38	340	230	6	8	$1,005,920

Table 5.14 Recreation Alternative No. 3, Willow Subbasin

Potential Sites	ACTIVITY UNITS					Net Benefits
	Hiking (miles)	Camping (camp-sites)	Picnicking (picnic sites)	Stream Fishing (miles)	Lake Fishing (ac. pts)	
Prator Lake					1	$4,100
Seymour Lake		80			1	123,640
Bench Lake	3	80			1	117,670
Cheri Lake					1	2,130
Finger Lake		4	5		1	19,290
Flat Lake		8	10		1	34,790
Little Willow		20	25	4		100,790
Susitna Scenic Area			100			156,520
Three Beauties	24				1	45,800
TOTALS	27	192	140	4	7	604,730

Table 5.15 Recreation Alternative No. 4, Willow Subbasin

Potential Sites	ACTIVITY UNITS					Net Benefits
	Hiking (miles)	Camping (camp-sites)	Picnicking (picnic sites)	Stream Fishing (miles)	Lake Fishing (ac. pts)	
Anna Lake		60	30		1	140,220
Wolf Lake		24	30		1	91,350
Lake and Trail		21	35		1	91,510
Eastside Lake					1	10,590
Frog Lake		40			1	61,370
Sled Road Trail	14					37,810
Willow Creek Canyon			60	6		35,520
Willow Creek #1		100	125	6		364,760
TOTALS	14	245	280	12	5	$833,130

Alternative Accounts

In Table 5.16, the specific functional resource alternatives are shown along with the beneficial and adverse effects of each of the four objective accounts. These include national economic development, environmental quality, regional economic development, and other social effects. The format permits a ready reference to compare and contrast the relative merit of the alternatives presented.

Willow Subbasin
Alternative Accounts Display

Table 5.16

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
A. Agriculture/Timber Land				
1. Maintain "hands off" land use policy.	**Beneficial Effects** Minimal public sector administrative costs. Tendency toward land uses exhibiting greatest short-term private returns. **Adverse Effects** Pre-emption of future options for alternative land uses. Unpatterned development resulting in inefficient allocation of publicly provided goods and services.	**Beneficial or Adverse Effects** Land use changes undertaken without regard to environmental impacts. Impairment of aesthetic landscape amenities. Potential for water pollution and subsequent health hazard.	**Beneficial Effects** Minimal public sector administrative costs. Tendency toward land uses exhibiting greatest short-term private returns. **Adverse Effects** Pre-emption of future options for alternative land uses. Unpatterned development resulting in inefficient allocation of publicly provided goods and services.	**Beneficial or Adverse Effects** Inadequate or poorly distributed social overhead capital.
2. Preserve current agricultural land.	**Beneficial Effects** Help ensure continued production of agricultural commodities. Maintain stability of settlement patterns. **Adverse Effects** Cost of preservation program administration and enforcement.	**Beneficial or Adverse Effects** Maintain "open space." Continue present ag. off-site pollution levels.	**Beneficial Effects** Help ensure continued production of agricultural commodities. Maintain stability of settlement patterns. Maintains intra-area employment opportunities. Tends to stabilize community economic base. **Adverse Effects** Cost of preservation program administration and enforcement.	**Beneficial or Adverse Effects** Deaccelerate change in area "lifestyle."
3. Strive for self-sufficiency in production of local agricultural/timber products.	**Beneficial Effects** Release extra-area resources for alternative uses. **Adverse Effects** Decreased demand for commodities produced elsewhere. Increased inefficiency in national production of goods and services. Development cost: land clearing $16 mil. road construction $7 mil.	**Beneficial or Adverse Effects** Loss of 28,000 acres of wildlife habitat to agricultural production. Conversion of 280,000 acres of timber land from natural state to multiple use land.	**Beneficial Effects** Slacken dependency on in-shipped commodities. Increase intra-area employment opportunities. Tends to stabilize community economic base. **Adverse Effects** Precludes alternative higher-valued land uses.	**Beneficial or Adverse Effects** Psychological satisfaction from the action. Reduces high unemployment rate.

Table 5.16 (continued)

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
4. Strive for maximum benefits from agricultural/timber production.	**Beneficial Effects** Present value of net benefits: $375 mil. Enhance GNP. Improve employment opportunities. **Adverse Effects** Pre-empt alternative use of productive inputs. Development cost: land clearing $24 mil. road construction $7 mil.	**Beneficial or Adverse Effects** Loss of 80,000 acres of wildlife habitat to agricultural production. Clearcut 220,000 acres of timber land on a cut-and-run basis or 2,750 acres annually on a sustained yield basis.	**Beneficial Effects** Enhance area income. Improve employment opportunities. Present net benefits valued at $374 million. Tends to stabilize community economic base. **Adverse Effects** Precludes alternative higher-valued land uses.	**Beneficial or Adverse Effects** Psychological satisfaction from the action. Reduces high unemployment rate.
5. Establish priorities for assistance in planning and installation of erosion control practices on existing and developing crop and timber lands.	**Beneficial Effects** Productivity of farmland is maintained. **Adverse Effects**	**Beneficial or Adverse Effects** May reduce sedimentation of streams.	**Beneficial Effects** Productivity of farmland is maintained. **Adverse Effects**	**Beneficial or Adverse Effects**
B. Settlement Land 1. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models.	**Beneficial Effects** Costs associated with settlement will be minimized. **Adverse Effects** Costs associated with settlement i.e. residential construction, land clearning, etc.	**Beneficial or Adverse Effects** Widely dispersed development may occur. May result in significant loss of essential habitat areas. Land alteration will result. Irreversible and irretrievable commitment of land for development.	**Beneficial Effects** Will create skilled and semi-skilled employment opportunities associated with residential and commercial construction. **Adverse Effects** Local costs associated with settlement.	**Beneficial or Adverse Effects** Some adjacent landowners may be adverse to the action. Reduced health and safety hazards associated with construction on unsuitable sites. Psychological satisfaction of bringing land into private ownership.
2. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models and with priority for development emanating from existing urban centers and moving outward as population growth warrants.	**Beneficial Effects** Costs associated with settlement will be minimized. Economics associated with more concentrated development. **Adverse Effects** Costs associated with settlement i.e. residential construction, land clearing, etc.	**Beneficial or Adverse Effects** Development will tend to be contained in smaller areas. May result in some loss of essential habitat areas. Land alteration will result. Irreversible and irretrievable commitment of land for development.	**Beneficial Effects** Will create skilled and semi-skilled employment opportunities associated with residential and commercial construction. **Adverse Effects** Local costs associated with settlement.	**Beneficial or Adverse Effects** Some adjacent landowners may be adverse to the action. Reduced health and safety hazards associated with construction on unsuitable sites. Psychological satisfaction of bringing land into private ownership.
3. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models but not identified as essential habitat areas.	**Beneficial Effects** Costs associated with settlement will be minimized on available land. **Adverse Effects** Costs associated with settlement i.e. residential construction, land clearing, etc. Some land with development potential will be reduced in value.	**Beneficial or Adverse Effects** Widely dispersed development may occur. Habitat areas and associated fish and wildlife populations will be maintained. Encroachment on wetland areas will be minimized. Land alteration will result. Irreversible and irretrievable commitment of land for development.	**Beneficial Effects** Will create skilled and semi-skilled employment opportunities. Recreational, commercial, and subsistence uses of fish and wildlife will be maintained. **Adverse Effects** Local costs associated with settlement.	**Beneficial or Adverse Effects** Some adjacent landowners may be adverse to the action. Reduced health and safety hazards associated with construction on unsuitable sites. Psychological satisfaction of bringing land into private ownership.

Table 5.16 (continued)

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
Settlement Land (Cont.)				
4. Require that all future settlement be restricted to those areas identified "high capability" on the settlement models, but not identified as essential habitat areas **and** with priority for development emanating from existing urban centers and moving outward as population. growth warrants.	**Beneficial Effects** Costs associated with settlement will be minimized on available land. **Adverse Effects** Costs associated with settlement i.e. residential construction, land clearing, etc. Some land with development potential will be reduced in value.	**Beneficial or Adverse Effects** Development will tend to be contained in smaller areas. Tends to minimize loss of essential habitat areas and associated fish and wildlife populations. Land alteration will result. Encroachment on wetland areas will be minimized. Irreversible and irretrievable commitment of land for development.	**Beneficial Effects** Will create skilled and semi-skilled employment opportunities. For recreational, commercial, and subsistence uses of fish and wildlife will be maintained. **Adverse Effects** Local costs associated with settlement.	**Beneficial or Adverse Effects** Some adjacent landowners may be adverse to the action. Reduced health and safety hazards associated with construction on unsuitable sites. Psychological satisfaction of bringing land into private ownership.
5. Establish an erosion and sediment control ordinance in the Matanuska-Susitna Borough for urban development.	**Beneficial Effects** Reduces erosion and sediment from construction.	**Beneficial or Adverse Effects** Reduces erosion on new construction. Tends to maintain existing water quality.	**Beneficial Effects** Reduction in regional costs of sediment control. **Adverse Effects** Regional cost of establishing and maintaining the program.	**Beneficial or Adverse Effects** Will increase the cost of developing land.
C. Flood Plains				
1. Greenbelt the 100-year (1% chance) flood plain and appropriate safe buffer zone. Identify and retain existing state and borough flood plain lands in public ownership. Purchase or lease development rights on existing private flood plain lands.	**Beneficial Effects** Prevents increase in damageable properties. **Adverse Effects** Initial cost of development rights. Initial cost of identification of flood plains. Cost of operation and management of program.	**Beneficial or Adverse Effects** Tends to maintain water quality by preventing development close to streams. Maintenance of riparian habitat and species of animals, fish and plants. Provides passage corridors for upland and riparian wildlife species such as moose, bear, mink, etc.	**Beneficial Effects** Prevents increase in damageable property. Creates jobs. Maintains recreational opportunities, including riparian trails for hiking, riding, cross-country skiing, etc., fishing areas, boat launch sites, etc. **Adverse Effects** Flood plain land no longer available for development. Cost of development rights and flood plain identification, operation, and maintenance cost of program.	**Beneficial or Adverse Effects** Present landowners may face loss of property values due to program. Program will maintain natural character of flood hazard area. Maintains and assures recreational opportunities, including riparian trails for hiking, riding, cross-country skiing, etc., fishing areas, boat launch sites, etc.
2. More effective implementation of the National Flood Insurance Program. Requires detailed identification of flood plains and regulation and permitting systems.	**Beneficial Effects** Prevents increases in damageable properties. **Adverse Effects** Cost of flood plain identification. Cost of enforcement staff.	**Beneficial or Adverse Effects** Tends to maintain water quality by preventing development close to streams. Tends to maintain riparian habitat by preventing its removal. (Also maintains fish, riparian and upland, wildlife species.)	**Beneficial Effects** Slows increases in damageable property. Creates employment opportunities associated with administration of the program. **Adverse Effects** Cost of flood plain identification, regulation and permitting systems.	**Beneficial or Adverse Effects** Tends to decrease property values in flood plain, but increase adjacent property values. Tends to maintain natural character of flood hazard areas.
3. Implement flood-proofing measures. Raise elevations of structures and reinforce walls. Install closeable valves and removable bulkheads. Relocate structures and/or contents to flood free areas. Establish flood warning systems.	**Beneficial Effects** Reduction in average annual flood damages. **Adverse Effects** Cost of measures and annual operation and maintenance cost.	**Beneficial or Adverse Effects** May adversely effect the appearance of some existing structures.	**Beneficial Effects** Reduction in average annual damages. Creation of employment. **Adverse Effects** Cost of measures and annual operation and maintenance cost.	**Beneficial or Adverse Effects** Reduce health and safety hazard due to flooding. Landowners will be adverse to some of the actions. Creation of employment.

Table 5.16 (continued)

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
D. Recreation Land RECREATION ALTERNATIVE NO. 1 Provide recreation facilities at the following locations: Willow Creek No. 1 Willow Creek No. 2 Houston Lake Stevens Lake Delyndia Lake Cheri Lake Lake Access "A" Eastside Lake Blodjett Lake Prator Lake Kelly Lake Fish Creek Three Beauties Sled Trail Provides for the creation of the following facilities: a. 38 hiking trail miles b. 540 campsites c. 350 picnic sites d. 11 stream fishing access miles e. 10 lake fishing access sites	**Beneficial Effects** Provides an additional 259,074 activity days or about $2,627,200 in recreation benefits annually. **Adverse Effects** Average annual cost including O, M, and R of about $1,234,900.	**Beneficial or Adverse Effects** Provides opportunity to maintain or increase landscape quality. Modifies 2,146 acres of natural land for recreation use. May reduce quality of wildlife habitat on approximately 2,146 acres.	**Beneficial Effects** Will annually create 18.9 person years of semi-skilled jobs directly related to O&M of the facilities. Will create approximately 167,182 activity days or about $535,900 in recreation benefits annually to those within Anchorage, Alaska and vicinity. May attract recreation oriented firms. **Adverse Effects** Loss of other potential uses such as timber harvest on approximately 2,146 acres. Precludes other types of development such as residential and commercial on the same acreage.	**Beneficial or Adverse Effects** Will provide 259,074 activity days of recreation opportunities. Action would increase public awareness of the recreation resource. Provides for a more equitable distribution of recreation resources. May create a seasonal population influx. Psychological satisfaction from the action. Some landowners may be adverse to the action.
RECREATION ALTERNATIVE NO. 2 Provide recreation facilities at the following locations: Papoose Twins Low Lake Little Susitna (A) Susitna Crossing Horseshoe Lake 1 & 2 Lake Access "C" Kalmback Three Beauties Sled Trail Fish Creek Delyndia Lake Hourglass Lake Provides for the creation of the following facilities a. 38 hiking trail miles b. 340 campsites c. 230 picnic sites d. 6 stream fishing access miles e. 8 lake fishing access sites	**Beneficial Effects** Provides an additional 176,794 activity days or about $1,754,300 in recreation benefits annually. **Adverse Effects** Average annual cost including O, M, and R of about $748,400.	**Beneficial or Adverse Effects** Provides opportunity to maintain or increase landscape quality. Modifies 705 acres of natural land for recreation use. May reduce quality of wildlife habitat on approximately 705 acres.	**Beneficial Effects** Will annually create 8.0 person years of semi-skilled jobs directly related to O&M of the facilities. Will create approximately 116,489 activity days or about $369,445 in recreation benefits annually to those within Anchorage, Alaska and vicinity. May attract recreation oriented firms. **Adverse Effects** Loss of other potential uses such as timber harvest on approximately 705 acres. Precludes other types of development such as residential and commercial on the same acreage.	**Beneficial or Adverse Effects** Will provide 176,794 activity days of recreation opportunities. Action would increase public awareness of the recreation resource. Provides for a more equitable distribution of recreation resources. May create a seasonal population influx. Psychological satisfaction from the action. Some landowners may be adverse to the action.

Table 5.16 (continued)

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
Recreation Land (Cont.) RECREATION ALTERNATIVE NO. 3 Provide recreation facilities at the following locations: Prator Lake Seymour Lake Bench Lake Cheri Lake Finger Lake Flat Lake Little Willow Susitna Scenic Area Three Beauties Provides for the creation of the following facilities: a. 27 hiking trail miles b. 192 campsites c. 140 picnic sites d. 4 stream fishing access miles e. 7 lake fishing access sites	**Beneficial Effects** Provides an additional 110,829 activity days or about $1,077,600 in recreation benefits annually. **Adverse Effects** Average annual cost including O, M, and R of about $472,900.	**Beneficial or Adverse Effects** Provides opportunity to maintain or increase landscape quality. Modifies 509 acres of natural land for recreation use. May reduce quality of wildlife habitat on approximately 509 acres.	**Beneficial Effects** Will annually create 4.7 person years of semi-skilled jobs directly related to O&M of the facilities. Will create approximately 73,332 activity days or about $233,092 in recreation benefits annually to those within Anchorage, Alaska and vicinity. May attract recreation oriented firms. **Adverse Effects** Loss of other potential uses such as timber harvest on approximately 509 acres. Precludes other types of development such as residential and commercial on the same acreage.	**Beneficial or Adverse Effects** Will provide 110,829 activity days of recreation opportunities. Action would increase public awareness of the recreation resource. Provides for a more equitable distribution of recreation resources. May create a seasonal population influx. Psychological satisfaction from the action. Some landowners may be adverse to the action.
RECREATION ALTERNATIVE NO. 4 Provide recreation facilities at the following locations: Anna Lake Wolf Lake Lake and Trail Eastside Lake Frog Lake Sled Lake Willow Creek Canyon Willow Creek No. 1 Provides for the creation of the following facilities: a. 14 hiking trail miles b. 245 campsites c. 280 picnic sites d. 12 stream fishing access miles e. 5 lake fishing access sites	**Beneficial Effects** Provides an additional 169,137 activity days or about $1,507,200 in recreation benefits annually. **Adverse Effects** Average annual cost including O, M, and R of about $674,100.	**Beneficial or Adverse Effects** Provides opportunity to maintain or increase landscape quality. Modifies 1,365 acres of natural land for recreation use. May reduce quality of wildlife habitat on approximately 1,365 acres.	**Beneficial Effects** Will annually create 6.6 person years of semi-skilled jobs directly related to O&M of the facilities. Will create approximately 117,929 activity days or about $380,855 in recreation benefits annually to those within Anchorage, Alaska and vicinity. May attract recreation oriented firms. **Adverse Effects** Loss of other potential uses such as timber harvest on approximately 1,365 acres. Precludes other types of development such as residential and commercial on the same acreage.	**Beneficial or Adverse Effects** Will provide 169,137 activity days of recreation opportunities. Action would increase public awareness of the recreation resource. Provides for a more equitable distribution of recreation resources. May create a seasonal population influx. Psychological satisfaction from the action. Some landowners may be adverse to the action.
E. Fish and Wildlife 1. From existing state-owned land, establish an integrated system of habitats to be used for fish and wildlife production and associated human use;	**Beneficial Effects** Will contribute to meeting recreational, educational and scientific needs.	**Beneficial or Adverse Effects** Will maintain wildlife habitats and populations. Will tend to maintain water quality. May preserve some environmentally unique areas.	**Beneficial Effects** Create some jobs. Will maintain opportunities for local recreational, subsistence, and commercial uses of wildlife.	**Beneficial or Adverse Effects** Landowners will be adverse to the action.

Table 5.16 (continued)

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Economic Development (RED)	Other Social Effects (OSE)
integrate this system with the State Refuge System; develop public access to areas with high potential for fish and wildlife use. Develop management and enhancement plans. This system will enhance wetlands, flood plains, and existing refuges and recreation areas.	**Adverse Effects** Annual cost to operate and maintain.		**Adverse Effects** Annual cost to operate and maintain. Decrease in buildable land base. Decrease in tax base.	
2. Maintain natural buffers between wetlands, refuges, recreation areas, flood plains, key habitats, and development lands.	**Beneficial Effects** Will contribute to some recreational needs **Adverse Effects** Annual cost to operate and maintain.	**Beneficial or Adverse Effects** Will tend to maintain water quality. Will tend to maintain natural quality of areas. Will maintain habitats and associated wildlife species. Will provide passage corridors for wildlife species (e.g., moose, bear, etc.) moving through development areas.	**Beneficial Effects** Will contribute to some recreational needs. **Adverse Effects** Annual cost to operate and maintain. Decrease in buildable land base and tax base.	**Beneficial or Adverse Effects** Landowners and public may be adverse to the action.
3. Establish priorities for assistance in planning for maintenance of fish and wildlife resources in siting, designing and installing developments.	**Beneficial Effects** Will contribute to maintaining fish and wildlife resources. **Adverse Effects** May add to cost of development.	**Beneficial or Adverse Effects** Will tend to maintain natural habitats and associated wildlife species.	**Beneficial Effects** Will contribute to maintaining fish and wildlife resources. **Adverse Effects** May add to cost of development.	**Beneficial or Adverse Effects** Landowners may be adverse to the action.
4. Preserve existing known wetlands (does not include floodplains) by purchase of private lands and incorporation of existing state, borough and purchased wetlands into the state's refuge system.	**Beneficial Effects** Will contribute to meeting recreational hunting needs and educational and scientific needs. Will retain areas which are capable of storing flood waters, will retain ground water recharge areas. **Adverse Effects** Cost of land and annual cost of management of refuges.	**Beneficial or Adverse Effects** Will preserve 128,490 acres of existing natural system. May preserve some environmentally unique and natural areas. Will tend to maintain water quality. Will help maintain fish and wildlife species associated with wetlands.	**Beneficial Effects** Will contribute to meeting recreational, educational and scientific needs **Adverse Effects** Cost of land. Average annual cost of maintenance and management. Decrease in available private land and tax base.	**Beneficial or Adverse Effects** Some landowners may be adverse to the action. Citizens may be adverse to the reduction of the land base available for private use and to loss of tax base.
5. Evaluate existing potential wetlands for incorporation into the state's Refuge System.	**Beneficial Effects** Will contribute to meeting recreational hunting needs and educational and scientific needs. Will retain areas which are capable of storing flood waters, will retain ground water recharge areas. **Adverse Effects** Cost of land and annual cost of management of refuges. Cost of evaluation process.	**Beneficial or Adverse Effects** Will preserve part of 30,870 acres of natural lands. May preserve some environmentally unique and natural areas. Will tend to maintain water quality. Will help maintain fish and wildlife species associated with wetlands.	**Beneficial Effects** Will contribute to meeting recreational, educational and scientific needs. Will provide jobs. **Adverse Effects** Cost of land. Average annual cost of maintenance and management. Decrease in available private land and tax base. Cost of evaluation process.	**Beneficial or Adverse Effects** Some landowners may be adverse to the action. Citizens may be adverse to the reduction of the land base available for private use and to loss of tax base.

6. Programs for Implementation of Alternatives

6. Programs For Implementation of Alternatives

Introduction

There are many federal, state, and local policies and programs which are resource or land use oriented. Several are directly applicable to the needs and alternatives identified in Chapter 5. The following section discusses these programs and the alternatives they address. The final section discusses changes or additions to the programs making them more suited to Alaska's social and environmental conditions.

Current Programs

USDA Programs

Resource Conservation and Development Program. —Under this program the State of Alaska and/or the Matanuska-Susitna Borough can establish a Resource Conservation and Development Area (RC&D) for the Matanuska-Susitna Borough. The Soil Conservation Service (SCS) would be the lead USDA agency for this RC&D Area. The SCS will assist the RC&D Area executive directors to develop a coordinated plan for local decision-makers with technical information and financial aid for measures which seek to better utilize, manage, and protect the area's natural resources. RC&D can provide technical and financial assistance for flood prevention, erosion and sediment control, public water based recreation, fish and wildlife development, soil and water conservation, agriculturally-related pollution control, and water quality management.

Conservation Operations Program. —This is an ongoing program of the Soil Conservation Service. Technical assistance is available through the Palmer and Wasilla Soil Conservation Subdistricts for the planning and installation of measures to develop and conserve natural resources. The field office is located in Palmer. Assistance is available to farmers, forest owners, and local communities to develop erosion and sediment control and resource conservation measures for developed and developing land.

Soil Survey Program. —Soil surveys conducted by the Soil Conservation Service include the mapping, classification, correlation, and interpretation of soils according to national standards. Soil mapping has been completed for the entire Willow Subbasin. Soil surveys are essential to any development where land use changes will occur and for transportation or utilities corridors identification. Soil surveys play a vital part in planning by:

a. Providing a permanent inventory of the soil resources.

b. Providing soil interpretations for various uses to guide planners at the local, regional, and state levels in making sound land use decisions for developing comprehensive plans.

c. Providing data on the location of:

   (1) wet and poorly drained soils, steep land, rocky land and areas with high water tables;

   (2) areas suitable for waste disposal;

   (3) areas that are suitable for use as residential, commercial, industrial, agricultural or school sites.

d. Providing many other soil interpretations that contribute to planning for a better-quality environment.

Public Law 83-566. —The Small Watershed and Flood Prevention Act of 1954 provides technical and financial assistance to solve water and related land resource problems. Under PL-566 the Soil Conservation Service can assist state or local governments in the identification of flood plains and in the development of plans for flood prevention.

Project purposes which may be included in a PL-566 watershed plan include: watershed protection, flood prevention, agricultural water management, industrial and municipal water supply, recreation, and fish and wildlife protection. PL-566 watersheds are limited to 250,000 acres in size. The program applies to land and water resource problems which may be solved by individual landowners on their own property or broader resource problems which may require a solution by a group of landowners.

The PL-566 watershed program helps improve the quality of the natural resource base, the quality of the environment, and the quality of the standard of living by:

a. Reducing erosion and sedimentation through the application of land treatment and structural practices.

b. Identifying flood hazard areas for flood plain management measures.

c. Promoting proper land use and management.

d. Improving agricultural water management practics.

e. Reservoirs intended primarily for flood preven-

tion or agricultural water management may include recreation, fish and wildlife protection, and water supply as additional purposes.

f. Reducing flood damages, hazards to life and health, and the inconvenience caused by flooding.

Renewable Resources Program. —The Forest and Rangelands Renewable Resources Planning Act of 1974 provides for long-term planning for the management, protection and utilization of all renewable resources on forest land. The USDA's Forest Service and the State of Alaska DNR cooperatively conduct forestry programs on federal, state, and privately-owned forest land.

The programs or activities are classified in five management systems as follows:

a. Recreation System - The goal of this system is to increase the supply of outdoor recreation opportunities and services through programs which emphasize dispersed recreation. Assistance is given private forest landowners who are interested in helping provide public recreation opportunities or in integrating multiple uses into their forest management programs. Research is conducted to strengthen technology and understanding of recreation demands, trends, values, and environmental impacts and to qualify and rank the commodity and amenity values of outdoor recreation.

b. Wildlife System - This system provides for increasing both the diversity and numbers of fauna and the protection of threatened and endangered species. Technical assistance and financial incentives encourage non-industrial private forest landowners to include habitat protection and development among their own management objectives. Research emphasizes habitat identification and improvement for endangered species, and the impact of alternative forest practices on game and nongame habitats and populations.

c. Timber System - The goal for the timber system is to increase timber supplies and quality to the point where benefits are commensurate with costs. Opportunities to increase timber supply exist on federal and private holdings as well as on Alaska state-owned forest areas. The program provides incentives for private timber landowners to grow timber commercially and for improved use of the trees and logs that are harvested. Major research includes improved utilization of timber, improving the rates of timber growth and yield, improving the protection for forests from wildfire, insects and diseases and providing better inventory and evaluation of resources.

d. Land and Water System - The land and water system is an aggregation of many basic stewardship and land treatment activities to meet minimum air and water quality standards. This system permits control of human-caused erosion on federal, state and private forest lands through technical assistance and program support. Important areas of research include the nature and extent of nonpoint sources of pollution, improved logging practices for fragile soils and steep slopes, and improved efficency of fire prevention and firefighting operations.

e. Human and Community Development System -This system is concerned with the relationship between man and the forest environment. All renewable resource programs are focused to increase goods and services from forest land; this means serving employment, housing, and other social needs. Assistance to communities is provided for urban and community forestry, rural community fire protection and land use planning. Conservation education and manpower training programs are designed to enhance the knowledge and skills of rural residents.

Farmers Home Administration (FmHA) Loans and Grants. —The FmHA has a number of loan and grant programs designed to encourage the economic development of rural areas. Loans are available to assist sponsoring public agencies in Resource Conservation and Development Areas. Soil and water loans are designed to aid landowners in utilizing improved land use techniques. Loans and grants are available to improve rural water systems.

Agricultural Conservation Program. —This program, administered by the USDA's Agricultural Stabilization and Conservation Service, can provide cost sharing incentives to landowners to implement soil and water conservation measures and other land improvement practices.

Other Federal Programs

National Flood Insurance Program. —The Matanuska-Susitna Borough is a participant in the National Flood Insurance Program. Property owners can purchase low cost flood insurance protection. In return for this federally-subsidized insurance, the borough is required to consider flood hazards before issuing building permits, subdivision approvals, or zoning variances. After detailed hydrologic and hydraulic studies are made, the Department of Housing and Urban Development (HUD) will issue flood zone maps which accurately

delineate the flood hazard area and depth of flooding. The borough must then require that all new construction be above the 100-year flood elevation. Most financial institutions must require that flood insurance be purchased on any property within the flood hazard zone on which mortgages are accepted.

Under this program the Matanuska-Susitna Borough (1) requires building permits for all new construction and substantial improvements and (2) reviews permits to assure that sites are reasonably free from flooding. For flood prone areas the borough must require: (1) proper anchoring of structures, (2) the use of construction materials and methods that will minimize flood damage, (3) adequate drainage for new subdivisions, and (4) that new or replacement utility systems be located and designed to preclude flood loss.

Land and Water Conservation Fund. —The Land and Water Conservation Fund administered by the Heritage Conservation and Recreation Service of the Department of the Interior (or its successor) provides cost sharing to finance recreation developments and open space programs.

State of Alaska Programs

Land use regulation. —Land Classification - Alaska Statutes 38.05.300 and 38.05.325 provide for the State of Alaska to classify agricultural lands based on USDA Soil Surveys and to use these surveys in identifying potential homesite entry lands.

Land Disposal. —Alaska Statutes 38.08 and 38.05.077 establish the homesite entry program and the remote parcel program which provide for the disposal of state lands to eligible individuals. The director of the Division of Lands, Department of Natural Resources, shall assess the supply and demand for land based on applications submitted by persons in the state who are eligible to participate.

Under Alaska Statute 38.05.035 the director of DNR, Division of Lands may sell land by lottery for less than its appraised value when, in his judgment, past scarcity of land suitable for private ownership in any particular area has resulted in unrealistically high land prices. The director may also dispose of an interest in land limited to use for agricultural purposes by lottery.

Land Disposal. —Alaska Statute 29.18.201 - The General Grant Land Determination of Entitlement for Boroughs and Unified Municipalities is set out in this section and the acreage is specified. Determination of Entitlement for cities is specified as 10 percent of the maximum total acres of vacant, unappropriated, and unreserved land within the boundaries of each city. Determination of Entitlement for newly incorporated Municipalities is 10 percent of the total acreage of vacant, unappropriated, unreserved land within the boundaries of the municipality on the date of incorporation of the municipality.

Land Selection. —Alaska Statute 38.05.290 established "A Land Act" under which the State of Alaska can select federal lands based on soil surveys. Conditions for selection are set forth in the Statehood Act of 1959.

Agricultural land. —Agricultural Development -Alaska Statute 03.22.050 established a plant materials center to research and determine the most suitable agricultural enterprises for Alaska.

Preferential taxation. —Alaska Statute 29.53.035 provides that "farm lands shall be assessed on the basis of full and true value for farm use, and shall not be assessed as if subdivided or used for some other nonfarm purpose." Should the farm be disposed of, the owner will be responsible for paying the additional taxes for the preceding 2 years and applicable portion of the current year. This law encourages the maintenance of productive agricultural land and also has the effect of preserving open space. Alaska is one of 32 states that provides for such assessments.

Agricultural Development. —Alaska Statutes 38.04.020 and 38.05.070 provide for issuing grazing leases, both short and long-term, on certain lands within the state.

Forest land. —Alaska Statute 41.17.010 establishes the Forest Resources and Practices Act which provides for the state to insure the management of forest resources guarantees perpetual supplies of renewable resources and provides nonrenewable resources in a manner consistent with that obligation and serves the needs of all Alaska for the many products, benefits, and services obtained from them.

Fish and wildlife habitat. —Alaska Statute 16.05.255 allows for the Board of Fish and Game to make regulations it considers advisable in accordance with the Administrative Procedure Act (AS44..62) for (1) setting apart game reserve areas, refuges, and sanctuaries in the waters or on the lands of the state over which it has jurisdiction, subject to the approval of the legislature and (2) engaging in biological research, watershed and habitat improvement, game management, protection, propagation, and stocking.

Cooperative Extension Service. —The Extension Service is responsible for providing information and technical assistance regarding resource use to a large segment of Alaska's population. Types of assistance range from village gardening and home economics to commercial farming practices and advice on reindeer production. Typically, the Extension Service acts as a bridge between university basic and applied research results and practical applications in the field. The Alaska Cooperative Extension Service is not as heavily oriented toward commercial agriculture as is the case in the other states, but is playing a larger role as interest in agriculture development expands.

Agricultural Experiment Station. —The Experiment Station, headquartered at the University of Alaska in Fairbanks with research centers at Fairbanks, Palmer, and Homer, and experimental farms in Fairbanks and the Matanuska Valley, conducts agriculturally-related research in the basic and applied sciences. The Experiment Station is responsive to research needs and can design programs emphasizing natural resources needs, uses, and environmental considerations.

Matanuska-Susitna Borough Program

Zoning regulations. —Alaska Statute 29.33.090 contains the basic authority for municipal zoning, predicated on the traditional police power concept of the promotion of health, safety, morals and general welfare. The act authorizes municipalities to enact zoning laws designed to lessen congestion in the streets, to conserve health; to secure safety from fire, panic, and other dangers; provide adequate light and air; to prevent overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewage, schools, parks, and other public requirements; to conserve the value of land and buildings; to encourage the most appropriate use of land; and to preserve and increase its amenities.

Zoning may regulate and restrict the size of lots, the percentage of a lot that may be occupied, the size of yards, courts and other open spaces, the density of population, and the location and use of buildings, structures, and land for trade, industry, agriculture, residences or other purposes.

Program Summary

A summary of the programs listed in this section is shown in Table 6.1. Under each program heading the agency responsible for program implementation is shown. The applicability of the programs to each of the resource needs alternatives outlined in Chapter 5 is also presented.

Program Implementation

The programs identified in the previous section are applicable in varying degrees to implementing the alternatives outlined in Chapter 5. In general, the federal programs are nonregulatory; they provide technical or financial assistance to state, local, and private resource managers and landowners for the purpose of more effective land use decisions. State and local programs are generally directed at regulation of land and water resource use for the purpose of enhancing public welfare and the quality of the environment.

The implementation of the alternatives required to meet the recognized resource needs will require careful attention and cooperation among the public agencies involved, particularly those of the State of Alaska, the major landowner within the Willow Subbasin.

Table 6.1 Applicability of public resource programs for implementing alternatives

Identified Alternatives	Federal Programs								
	Resource Conservation and Development	Conservation Operations	Soil Survey	Small Watersheds PL83-566	Renewable Resources Program	Loans and Grants	Agricultural Conservation Program	National Flood Insurance	Land and Water Conservation Fund
	SCS	SCS	SCS	SCS	FS	FmHA	ASCS	HUD	HCRS
A. Agricultural/timber land									
1. Maintain "hands off" land use policy.	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Preserve current agricultural land.	IA	IA	IA	NA	NA	DA	DA	NA	NA
3. Strive for self-sufficiency in production of local agricultural/timber products.	DA	DA	DA	DA	DA	DA	DA	NA	NA
4. Strive for maximum pecuniary benefits from agricultural/ timber production.	DA	DA	DA	DA	DA	DA	DA	NA	NA
5. Establish priorities for assistance in planning and installation of erosion control practices on existing and developing crop and timber lands.	DA	DA	DA	DA	DA	DA	DA	NA	NA
B. Settlement Land									
1. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models.	IA	NA	DA	IA	NA	NA	NA	IA	NA
2. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models and with priority for development emanating from existing urban centers and moving outward as population growth warrants.	IA	NA	DA	IA	NA	NA	NA	IA	NA
3. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models but not identified as essential habitat areas.	IA	NA	DA	IA	NA	NA	NA	IA	NA

DA - directly applicable IA - indirectly applicable NA - not applicable

Table 6.1 Applicability of public resource programs for implementing alternatives

Identified Alternatives	Federal Programs								
	Resource Conservation and Development	Conservation Operations	Soil Survey	Small Watersheds PL83-566	Renewable Resources Program	Loans and Grants	Agricultural Conservation Program	National Flood Insurance	Land and Water Conservation Fund
	SCS	SCS	SCS	SCS	FS	FmHA	ASCS	HUD	HCRS
4. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models, but not identified as essential habitat areas and with priority for development emanating from existing urban centers and moving outward as population growth warrants.	IA	NA	DA	IA	NA	NA	NA	IA	NA
5. Establish priorities for assistance in planning and installation of erosion control practices on existing and developing settlement land.	IA	DA	DA	IA	DA	NA	NA	NA	NA
C. Floodplains									
1. Greenbelt the 100-year (1% chance) flood plain and appropriate safe buffer zone. Identify and retain existing state and borough flood plain lands in public ownership. Purchase or lease development rights on existing private flood plain lands.	DA	IA	IA	DA	IA	NA	NA	DA	NA
2. More effective implementation of the National Flood Insurance Program. Requires detailed identification of flood plains and regulation and permitting systems.	DA	IA	NA	DA	IA	NA	NA	NA	NA
3. Implement floodproofing measures. Raise elevations of structures and reinforce walls. Install closeable valves and removeable bulkheads. Relocate structures and/or contents to flood-free areas. Establish flood warning systems.	DA	IA	NA	DA	NA	NA	NA	DA	NA

DA - directly applicable IA - indirectly applicable NA - not applicable

Table 6.1 Applicability of public resource programs for implementing alternatives

Identified Alternatives	Federal Programs								
	Resource Conservation and Development	Conservation Operations	Soil Survey	Small Watersheds PL83-566	Renewable Resources Program	Loans and Grants	Agricultural Conservation Program	National Flood Insurance	Land and Water Conservation Fund
	SCS	SCS	SCS	SCS	FS	FmHA	ASCS	HUD	HCRS
D. Recreation Land									
1-4 Provide recreation facilities as appropriate.	DA	NA	IA	DA	IA	NA	NA	NA	DA
E. Fish and Wildlife Habitats									
1. From existing state-owned land, establish an integrated system of habitats to be used for fish and wildlife production and associated human use; integrate this system with the State Refuge System; develop public access to areas with high potential for fish and wildlife use. Develop management and enhancement plans. This system will enhance wetlands, flood plains, and existing refuges and recreation areas.	IA	NA	NA	IA	IA	NA	NA	IA	DA
2. Maintain natural buffers between wetlands, refuges, recreation areas, flood plains, key habitats, on the one hand, and development lands on the other.	DA	DA	NA	IA	IA	NA	NA	IA	DA
3. Establish priorities for assistance in planning for maintenance of fish and wildlife resources in siting, designing and installing developments.	DA	DA	IA	DA	IA	NA	DA	IA	DA
4. Preserve existing known wetlands (does not include flood plains) by purchase of private lands and incorporation of existing state, borough and purchased wetlands into the state's refuge system.	IA	DA	DA	IA	IA	NA	NA	NA	DA
5. Evaluate existing potential wetlands for incorporation into the state's Refuge System.	IA	DA	DA	IA	IA	NA	NA	NA	DA

DA - directly applicable IA - indirectly applicable NA - not applicable

Table 6.1 Applicability of public resource programs for implementing alternatives

Identified Alternatives	State and Local Programs									
	Land Classification	Land Disposal	Agricultural Development Assistance	Preferential Taxation	Grazing Permits	Forest Resources & Practices	F & W Reserves & Research	Cooperative Extension Service	Agricultural Experiment Station	Borough Zoning
	DNR	DNR	DNR	Dept. Rev.	DNR	DNR	ADF&G	U of A	U of A	M-S Borough
A. Agricultural/timber land										
1. Maintain "hands off" land use policy.	NA	NA	NA	IA	NA	NA	NA	NA	NA	IA
2. Preserve current agricultural land.	IA	IA	NA	DA	NA	NA	NA	DA	DA	DA
3. Strive for self-sufficiency in production of local agricultural/timber products.	DA	DA	DA	IA	DA	DA	IA	DA	DA	DA
4. Strive for maximum pecuniary benefits from agricultural/ timber production.	DA	DA	DA	IA	DA	DA	IA	DA	DA	DA
5. Establish priorities for assistance in planning and installation of erosion control practices on existing and developing crop and timber lands.	NA	NA	DA	NA	NA	DA	NA	DA	DA	NA
B. Settlement Land										
1. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models.	DA	DA	NA	IA	NA	NA	NA	IA	NA	DA
2. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models and with priority for development emanating from existing urban centers and moving outward as population growth warrants.	DA	DA	NA	IA	NA	NA	NA	IA	NA	DA
3. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models but not identified as essential habitat areas.	DA	DA	NA	IA	NA	NA	DA	IA	NA	DA

DA - directly applicable IA - indirectly applicable NA - not applicable

Table 6.1 Applicability of public resource programs for implementing alternatives (continued)

Identified Alternatives	State and Local Programs									
	Land Classification	Land Disposal	Agricultural Development Assistance	Preferential Taxation	Grazing Permits	Forest Resources & Practices	F & W Reserves & Research	Cooperative Extension Service	Agricultural Experiment Station	Borough Zoning
	DNR	DNR	DNR	Dept. Rev.	DNR	DNR	ADF&G	U of A	U of A	M-S Borough
4. Require that all future settlement be restricted to those areas identified as having "high capability" on the settlement models, but not identified as essential habitat areas and with priority for development emanating from existing urban centers and moving outward as population growth warrants.	DA	DA	NA	IA	NA	NA	DA	IA	NA	DA
5. Establish priorities for assistance in planning and installation of erosion control practices on existing and developing settlement land.	IA	IA	NA	NA	NA	NA	NA	IA	NA	IA
C. Flood Plains										
1. Greenbelt the 100-year (1% chance) flood plain and appropriate safe buffer zone. Identify and retain existing state and borough flood plain lands in public ownership. Purchase or lease development rights on existing private flood plain lands.	DA	DA	IA	DA	NA	NA	NA	IA	NA	DA
2. More effective implementation of the National Flood Insurance Program. Requires detailed identification of flood plains and regulation and permitting systems.	DA	DA	IA	DA	NA	NA	NA	IA	NA	DA
3. Implement floodproofing measures. Raise elevations of structures and reinforce walls. Install closeable valves and removeable bulkheads. Relocate structures and/or contents to flood-free areas. Establish flood warning systems.	DA	DA	IA	DA	NA	NA	NA	IA	NA	DA

DA - directly applicable IA - indirectly applicable NA - not applicable

Table 6.1 Applicability of public resource programs for implementing alternatives

Identified Alternatives	State and Local Programs									
	Land Classification	Land Disposal	Agricultural Development Assistance	Preferential Taxation	Grazing Permits	Forest Resources & Practices	F & W Reserves & Research	Cooperative Extension Service	Agricultural Experiment Station	Borough Zoning
	DNR	DNR	DNR	Dept. Rev.	DNR	DNR	ADF&G	U of A	U of A	M-S Borough
D. Recreation Land										
1-4 Provide recreation facilities as appropriate.	DA	DA	NA	NA	NA	IA	DA	NA	NA	NA
E. Fish and Wildlife Habitats										
1. From existing state-owned land, establish an integrated system of habitats to be used for fish and wildlife production and associated human use; integrate this system with the State Refuge System; develop public access to areas with high potential for fish and wildlife use. Develop management and enhancement plans. This system will enhance wetlands, floodplains, and existing refuges and recreation areas.	DA	DA	NA	NA	NA	NA	DA	NA	NA	IA
2. Maintain natural buffers between wetlands, refuges, recreation areas, flood plains, key habitats, on the one hand, and development lands on the other.		DA	NA	NA	NA	NA	DA	NA	NA	IA
3. Establish priorities for assistance in planning for maintenance of fish wildlife resources in siting, designing and installing developments.	DA	DA	IA	IA	NA	NA	DA	NA	NA	DA
4. Preserve existing known wetlands (does not include floodplains) by purchase of private lands and incorporation of existing state, borough and purchased wetlands into the state's refuge system.	DA	DA	NA	NA	NA	NA	DA	NA	NA	DA
5. Evaluate existing potential wetlands for incorporation into the state's Refuge System.	DA	DA	NA	NA	NA	NA	DA	NA	NA	DA

DA - directly applicable IA - indirectly applicable NA - not applicable

Appendices

Appendix A
Major Soil Associations of the Willow Subbasin

This appendix describes the soil associations depicted in Figure 3.3 of the main report. Soils information is available in greater detail at the Soil Conservation Service, U.S. Department of Agriculture, Anchorage, Alaska.

A1. Rock Outcrop - Dominantly steep to very steep areas of bedrock in mountains.

A2. Talkeetna-Torpedo Lake Association - Dominantly rolling to very steep, well drained silt loams that are shallow to moderately deep over very gravelly sandy loam; and nearly level to hilly, poorly drained silt loams, on glacial moraines.

A3. Talkeetna-Starichkof Association - Dominantly gently sloping to hilly slopes, well drained silt loams that are shallow to moderately deep over very gravelly sandy loams on ground moraines; and nearly level, very poorly drained, partly decomposed peat in muskegs.

A4. Torpedo Lake-Starichkof Association - Dominantly nearly level to undulating, poorly drained loams on ground moraines; and nearly level, very poorly drained, partly decomposed peat in muskegs.

A5. Mutnala-Starichkof Association - Dominantly rolling to steep, well drained silt loams that are shallow to moderately deep over gravelly sandy loam on lateral moraines; and nearly level to gently sloping, very poorly drained, partly decomposed peat in muskegs.

A6. Torpedo Lake - Homestead Association - Dominantly gently sloping to strongly sloping poorly drained silt loams that are shallow over gravelly silty clay loam, and rolling to steep, well drained silt loam soils that are very shallow and shallow over very gravelly sand, on lateral moraines.

B1. Homestead-Knik Association - Dominantly nearly level to steep, well drained silt loams that are very shallow and shallow over gravel and sand; on high terraces and moraines.

B2. Knik-Coal Creek Association - Dominantly nearly level to steep well drained silt loams that are shallow over coarse gravelly material on moraines; and nearly level poorly drained mucky silt loams along drainageways and depressions.

B3. Doone-Knik Association - Dominantly nearly level to undulating well drained silt loams that are moderately deep to deep over loose sand and gravel on high terraces; and rolling to steep well drained silt loams that are shallow over coarse gravelly material on moraines.

B4. Bodenberg Association - Dominantly nearly level to moderately steep, well drained silt loams or very fine sandy loams that are moderately deep to deep over sand and gravel on terraces.

B5. Homestead-Salamatof Association - Dominantly nearly level to undulating, well drained silt loams that are very shallow to shallow over gravelly sand on broad outwash plains and low moraines; and very poorly drained coarse peat in muskegs.

B6. Naptowne-Salamatof Association - Dominantly undulating to moderately steep well drained moderately deep to shallow over gravelly sandy loam on glacial moraines; and very poorly drained coarse peat in muskegs.

B7. Rabideaux-Salamatof Association - Dominantly undulating sloping to rolling, well drained soils that are shallow to very shallow over loose sand and gravel on terraces; and nearly level very poorly drained partly decomposed peat in muskegs.

B8. Nancy-Homestead Association - Dominantly rolling to steep, well drained silt loams that are shallow to moderately deep and very shallow over very gravelly sand on terminal moraines.

B9. Nancy-Kashwitna Association - Dominantly nearly level to steep, well drained silt loams that are moderately deep and shallow over sand or gravelly sand; on terraces and moraines.

C1. Salamatof-Moose River Association - Dominantly nearly level very poorly drained deep coarse peat in muskegs; and nearly level poorly drained stratified sandy and silty sediments bordering muskegs.

C2. Tidal Marsh-Clunie Association - Dominantly nearly level and poorly drained clayey sediments on very poorly drained, fibrous peats; on tidal plains.

C3. Susitna-Salamatof Association - Dominantly nearly level, well drained, stratified fine sandy loams and silt loams that are deep over sand or gravelly sand on alluvial plains; and nearly level very poorly drained fibrous peat in muskegs.

Appendix B Wildlife Species of the Willow Subbasin

Mammals of the Willow Subbasin

(sources: ADF&G 1973, 1978; MacDonald 1980; Manville and Young 1965, Youngman 1975)

Insectivora (small insect-eating mammals)

Masked Shrew	Sorex cinereus
Dusky Shrew	Sorex monticolus
Water Shrew	Sorex palustris
Pygmy Shrew	Sorex hoyi

Chiroptera (bats)

Little Brown Bat	Myotis lucifugus

Lagomorpha (rabbits, hares, pika)

Collared Pika	Ochotona collaris
Snowshoe (varying hare)	Lepus americanus

Rodentia (mammals with two chisel-shaped incisors in each jaw)

Hoary Marmot	Marmota caligata
Arctic Ground Squirrel	Spermophilus parryii
Red Squirrel	Tamiasciurus hudsonicus
Northern Flying Squirrel	Glaucomys sabrinus
Beaver	Castor canadensis
Northern Red-backed Vole	Clethrionomys rutilus
Meadow Vole	Microtus pennsylvanicus
Tundra Vole	Microtus oeconomus
Singing Vole	Microtus miurus
Brown Lemming	Lemmus sibiricus
Muskrat	Ondatra zibethicus
Northern Bog Lemming	Synaptomys borealis
Meadow Jumping Mouse	Zapus hudsonius
Porcupine	Erethizon dorsatum
Norway Rat*	Rattus norvegicus
House Mouse*	Mus musculus

* introduced

Cetacea (whales, dolphins, porpoises)

Beluga (white whale)	Delphinapterus leucas

Carnivora (carnivorous mammals)

Coyote	Canis latrans
Wolf	Canis lupus
Red Fox	Vulpes vulpes
Black Bear	Ursus americanus
Brown (grizzly) Bear	Ursus arctos
Marten	Martes americana
Ermine (short-tailed weasel)	Mustela erminea
Least Weasel	Mustela nivalis
Mink	Mustela vison
Wolverine	Gulo gulo
River (Land) Otter	Lutra canadensis
Lynx	Felis lynx
Harbor Seal	Phoca vitulina

Artiodactyla (even-toed hoofed mammals)

Moose	Alces alces
Caribou	Rangifer tarandus
Mountain Goat	Oreamnos americanus
Dall Sheep	Ovis dalli

Birds of the Willow Subbasin

(source: Anchorage Audubon Society, Inc. 1978;)

Common Loon	Gavia immer
Arctic Loon	Gavia arctica
Red-throated Loon	Gavia stellata
Red-necked Grebe	Podiceps grisegena
Horned Grebe	Podiceps auritus
Great Blue Heron	Andea herodias
Whistling Swan	Olor columbianus
Trumpeter Swan	Olor buccinator
Canada Goose	Branta canadensis
Brant	Branta bernicla
White-fronted Goose*	Anser albifrons
Snow Goose	Chen caerulescens
Mallard	Anas platyrhynchos
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged Teal	Anas crecca
Northern Shoveler	Anas clypeata
European Wigeon	Anas penelope
American Wigeon	Anas americana
Canvasback	Aythya valisineria
Redhead	Aythya americana
Ring-necked Duck	Aythya collaris
Greater Scaup	Aythya marila
Lesser Scaup	Aythya affinis
Common Goldeneye	Bucephala clangula
Barrow's Goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Oldsquaw	Clangula hyemalis
Harlequin Duck	Histrionicus histrionicus
Common Eider	Somateria mollissima
White-winger Scoter	Melanitta deglandi
Surf Scoter	Melanitta perspicillata
Black Scoter	Melanitta nigra
Common Merganser	Mergus merganser

* The Tule White-fronted Goose, a subspecies of the White-fronted Goose, may be nominated for inclusion on the endangered species list in the future (Cannon 1980)

Appendix B
Wildlife Species

Red-breasted Merganser	Mergus serrator
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	Accipiter striatus
Red-tailed Hawk	Buteo jamaicensis
Rough-legged Hawk	Buteo lagopus
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Circus cyaneus
Osprey	Pandion haliaetus
Gyrfalcon	Falco rusticolus
Peregrine Falcon	Falco peregrinus
Merlin	Falco columbarius
American Kestrel	Falco sparverius
Willow Ptarmigan	Lagopus lagopus
Rock Ptarmigan	Lagopus mutus
Spruce Grouse	Canachites canadensis
Sandhill Crane	Grus canadensis
Semipalmated Plover	Charadrius semipalmatus
Killdeer	Charadrius vociferus
American Golden Plover	Pluvialis dominica
Black-bellied Plover	Pluvialis squatarola
Hudsonian Godwit	Limosa haemastica
Whimbrel	Numenius phaeopus
Greater Yellowlegs	Tringa melanoleuca
Lesser Yellowlegs	Tringa flavipes
Solitary Sandpiper	Tringa solitaria
Spotted Sandpiper	Actitis macularia
Wandering Tattler	Heteroscelus incanus
Ruddy Turnstone	Arenaria interpres
Northern Phalarope	Phalaropus lobatus
Common Snipe	Gallinago gallinago
Short-billed Dowitcher	Limnodromus griseus
Long-billed Dowitcher	Limnodromus scolopaceus
Surfbird	Aphriza virgata
Sanderling	Calidris alba
Semipalmated Sandpiper	Calidris pusilla
Western Sandpiper	Calidris mauri
Least Sandpiper	Calidris minutilla
Baird's Sandpiper	Calidris bairdii
Pectoral Sandpiper	Calidris melanotos
Dunlin	Calidris alpina
Parasitic Jaeger	Stercorarius parasiticus
Long-tailed Jaeger	Stercorarius longicaudus
Glaucous Gull	Larus hyperboreus
Glaucous-winged Gull	Larus glaucescens
Herring Gull	Larus argentatus
Mew Gull	Larus canus
Bonaparte's Gull	Larus philadelphia
Arctic Tern	Sterna paradisaea
Great Horned Owl	Bubo virginianus
Snowy Owl	Nyctea scandiaca
Hawk Owl	Surnia ulula
Great Gray Owl	Strix nebulosa
Short-eared Owl	Asio flammeus
Boreal Owl	Aegolius funereus
Rufous Hummingbird	Selasphorus rufus
Belted Kingfisher	Megaceryle alcyon
Common Flicker	Colaptes auratus
Hairy Woodpecker	Picoides villosus
Downy Woodpecker	Picoides pubescens
Black-backed Three-toed Woodpecker	Picoides arcticus
Northern Three-toed Woodpecker	Picoides tridactylus
Say's Phoebe	Sayornis saya
Alder Flycatcher	Empidonax alnorum
Western Wood Pewee	Contopus sordidulus
Olive-sided Flycatcher	Nuttallornis borealis
Horned Lark	Eremophila alpestris
Violet-green Swallow	Tachycineta thalassina
Tree Swallow	Iridoprocne bicolor
Bank Swallow	Riparia riparia
Gray Jay	Perisoreus Canadensis
Steller's Jay	Cyanocitta stelleri
Black-billed Magpie	Pica pica
Common Raven	Corvus corax
Black-capped Chickadee	Parus atricapillus
Boreal Chickadee	Parus hudsonicus
Red-breasted nuthatch	Sitta canadensis
Brown Creeper	Certhia familiaris
Dipper	Cinclus mexicanus
Winter Wren	Troglodytes troglodytes
American Robin	Turdus migratorius
Varied Thrush	Ixoreus naevius
Hermit Thrush	Catharus guttatus
Swainson's Thrush	Catharus ustulatus
Gray-cheeked Thrush	Catharus minimus
Wheatear	Oenanthe oenanthe
Townsend's Solitaire	Myadestes townsendi
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	Regulus calendula
Water Pipit	Anthus spinoletta
Bohemian Waxwing	Bombycilla garrulus
Northern Shrike	Lanius excubitor
Starling	Sturnus vulgaris
Orange-crowned Warbler	Vermivora celata
Yellow Warbler	Dendroica petechia
Yellow-rumped Warbler	Dendroica coronata
Townsend's Warbler	Dendroica townsendi
Blackpoll Warbler	Dendroica striata
Northern Waterthrush	Seiurus noveboracensis
Wilson's Warbler	Wilsonia pusilla
Red-winged Blackbird	Agelaius phoeniceus
Rusty Blackbird	Euphagus carolinus
Pine Grosbeak	Pinicola enucleator
Gray-crowned Rosy Finch	Leucosticte tephrocotis
Hoary Redpoll	Carduelis hornemanni
Common Redpoll	Carduelis flammea
Pine Siskin	Carduelis pinus
Red Crossbill	Loxia curvirostra
White-winged Crossbill	Loxia leucoptera
Savannah Sparrow	Passerculus sandwichensis
Dark-eyed Junco	Junco hyemalis
Tree Sparrow	Spizella arborea
White-crowned Sparrow	Zonotrichia leucophrys
Golden-crowned Sparrow	Zonotrichia atricapilla
Fox Sparrow	Passerella iliaca
Lincoln's Sparrow	Melospiza lincolnii
Lapland Longspur	Calcarius lapponicus
Snow Bunting	Plectrophenax nivalis

Freshwater Fishes of the Willow Subbasin

(source: Morrow 1980)

Lampreys	
Pacific lamprey	Entosphenus tridentatus
Arctic lamprey	Lampetra japonica
Herring	
Pacific herring	Clupea harengus pallasi
Whitefish	
Round whitefish	Prosopium cylindraceum
Trouts and Salmon	
Rainbow trout/steelhead	Salmo gairdneri
Lake trout	Salvelinus namaycush
Dolly Varden	Salvelinus malma
Pink (Humpback) salmon	Oncorhynchus gorbuscha
Chinook (King) salmon	Oncorhynchus tshawytscha
Chum (Dog) salmon	Oncorhynchus keta
Coho (Silver) salmon	Oncorhynchus kisutch
Sockeye (Red) salmon	Oncorhynchus nerka
Grayling	
Arctic grayling	Thymallus arcticus
Smelts	
Pond smelt	Hypomesus olidus
Surf smelt	Hypomesus pretiosus
Eulachon (Hooligan)	Thaleichthys pacificus
Pike	
Northern pike	Esox lucius
Sucker	
Longnose sucker	Catostomus catostomus
Codfishes	
Burbot	Lota lota
Sticklebacks	
Threespine sticklepack	Gasterosteus aculeatus
Ninespine stickleback	Pungitius pungitius
Sculpins	
Slimy sculpin	Cottus cognatus
Coastrange sculpin	Cottus aleuticus
Pacific staghorn sculpin	Leptocottus armatus
Sharpnose sculpin	Clinocottus acuticeps
Flounder	
Starry flounder	Platichthys stellatus

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Shrews, Bats, Lagomorphs

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Masked or Common shew 5,6,7	insectivorous, e.g. isopods, insects, worms, other small animals	because of carnivorous habits, this and other shrews able to adjust to variety of physiographic habitats	variety of habitats where food abundant, including forest floor, wooded areas, open fields, marshy areas, rocky areas, and tundra	especially common in moist mixed forests			commonly found in low, wet meadows	
Dusky shrew 5,7,9	insectivorous	usually dependent on running water and overhead protection; obtains protection from the elements by inhabiting the floodplain edge, above stream, where both vegetation and shrew benefit from moderating influence of running water (9)	moist shaded areas associated with water, e.g. forests, shrubland			in Northern Alaska, adapted to riparian and spring communities of high overhead protection supplied by larger arborescent shrubs (willow and alder), and a relatively sparse ground vegetation of mosses, lichens, and grasses (9)		shrub tundra
Northern water shrew 5,6,7	insectivorous, e.g. searches along stream bottoms with flexible snout and sensitive vibrissae for snails, leeches, larval invertebrates, and tiny fish	riparian; close water-repellent fur keeps skin dry	riparian zones in forests and woodlands (associated with open water such as lakes, streams, and ponds)					riparian zones in alpine meadows
Pygmy shrew 5,7	insectivorous	prefers drier areas than do most other shrews	among leaf mold, thickets, ferns, etc. in open coniferous forests; also in grassy forest clearings, "parkland," and riparian vegetation				grassy clearings	
Little brown bat 5,6	insects caught in flight	utilizes caves, hollow trees, buildings, mine shafts, and other cavities; occurs in riparian areas	open forests and other areas providing cover near clearings					
Pika 4,5,6,7	herbivorous, e.g. leaves, stems, roots; collects and stores "hay" for winter food	among rockpiles, talus slopes, normally at high elevations but also found near sea level				rocky areas near grasses, herbs, small shrubs, and other sources of food		
Snowshoe hare 1,2*,3,4, 5,6	herbivorous summer—grasses, buds, twigs, leaves, forbs, berries, winter—spruce twigs and needles; tips, bark, and buds of hardwoods such as aspen, willow, birch	suitable habitats are those providing appropriate forage species and cover densities	spruce forest (but dense spruce climax communities lack suitable brushy understory)	white spruce-birch communities	open aspen and birch forests with brushy understory (willow alder, highbush cranberry, rose appear optimum	streamside areas with willows provide good habitat		

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Rodents

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Northern red-backed vole 5,7,8,9	herbivorous, (related species, **C. gapperi**, Known to eat fungi, seeds, bark, insects, green plant material)	widely distributed species found in variety of habitats; in Plateau Province of Northern Alaska, inhabits valley sides below singing vole and above valley floor habitat of tundra vole (9); "perhaps most common small mammal in Alaska"(5)	in all habitats, but as a general rule associated with plants giving overhead protection			in Northern Alaska, reaches greatest density in dwarf willow, or overgrown talus		
Meadow vole 5,7	herbivorous, especially succulent greens	accomplished swimmer	occurs in variety of habitats				typically in grassy areas and damp meadows	
Tundra vole (Northern vole) 5,9	herbivorous, especially sedges, grasses; when water freezes in marshes and protective layer of snow accumulates, eats aquatic plants usually unavailable because of water depth	prefers moist or wet soils on flat terrain where water levels remain relatively constant; often collected in same runways as meadow voles and brown lemmings, especially in wet grassy areas and riparian shrubs	mossy muskeg			wet brushy areas such as dwarf willow, dwarf birch, and alder near edges of lakes and streams	common in wet sedge meadows, particularly with drier ridges, polygons, etc. for burrows	sphagnum bogs, upland tundra around lakes and marshes
Singing vole 5,8,9	herbivorous, e.g. **Equisetum** spp., coltsfoot, willow leaves, lupine, vetch, etc., builds forage ("hay") piles for winter use, forage piles often kept in place by being built around basal stems of willow or dwarf birch	slopes blown free of snow in winter not inhabited; in Northern Alaska, singing voles replace tundra voles whenever stream and overflow channels stabilized by vegetation lead into willow communities				low shrub, tundra, damp swales, or grassy areas beyond timberline, especially brushy tundra with dwarf willows or other vegetation with similar growth habit; shrub cover must be open enough to permit growth of understory vegetation which provides food; in Brooks Range, prefers partial to well-drained soils near running water, and most numerous in habitats with early seral vegetation; low wet meadows seldom used except when bordered by willows or shrubs of required growth forms		
Muskrat 1,4,5,6,7	primarily herbivorous, e.g. aquatic plants, grasses; also some animal material, e.g. mussels, shrimp, small fish; stores vegetation for winter food	riparian, highest populations found in broad flood plains and deltas of major rivers and in marshy areas dotted with small lakes	riparian vegetation, primarily associated with slow quiet water such as marshes and lakes					
Northern bog lemming 4,5,7	primarily herbivorous, e.g. green parts of low vegetation, sedges, grasses; probably also snails, slugs	utilizes bogs, marshes, spring areas	muskeg and moist wooded habitats				occasionally meadows	wet tundra sphagnum bogs

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Rodents

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Hoary marmot 1,5,6,7,9	herbivorous, plant material often gathered some distance from home dens, including grasses, flowering plants, berries, roots, mosses, lichens	requires rocky outcrops or talus slopes for shelter, generally near or above timberline; true hibernator					grasslands and tundra near rocky shelter, commonly occurs at the base of active talus where boulders are large and have accumulated to a depth sufficient to give subsurface protection	
Arctic ground squirrel 1,5,9	herbivorous, e.g. seeds, flowers, stems, leaves (e.g. of dwarf willow, alder, birch), grasses, sedges, fungi, mosses, lichens; forages in a variety of plant associations	hibernates during winter; tolerant of other small mammals, e.g. voles, marmots, and may be found associated with them; excavates burrows					tundra and short grasslands on well-drained soils from sea level to uplands; optimum conditions for colonization in Northern Alaska are: 1) bare soils surrounded by vegetation in early xerosere stage of succession, 2) loose soils on well-drained slopes, and 3) vantage points from which surrounding terrain can be observed; dwarf shrubs (willow, alder, birch) provide cover (9)	
Red squirrel 1,2*,4,5,6,7	primarily herbivorous, e.g. berries, buds, fungi, seeds (especially spruce seeds), lichens; also animal matter, such as insects and bird eggs; winter—main food consists of green spruce cones cached in "middens" during summer and fall, also caches mushrooms on tree branches	caches cones in middens for winter consumption; middens located in moist areas, often next to logs, fallen trees	principally in mature spruce forests and	mixed coniferous-deciduous forests (especially aspen dominated deciduous stands)	mature deciduous forests provide marginal habitats			
Northern flying squirrel 1,5,6,7	primarily herbivorous, e.g. bark, seeds, fruits; also insects, bird eggs; summer—fungi important, winter—lichen important		coniferous and mixed forests, "animal of treetops" (6)					

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Rodents

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Brown lemming 4,5,9	herbivorous, summer—tender shoots of grasses and sedges, particularly on damp soils, winter—bark and twigs of willow and dwarf birch, other available vegetation	ecological requirements are precise in Northern Alaska: "grasses cannot be too wet, too sparse, or too dry, and should offer from 25-40 cm of overhead protection" (9); competition from related microtines (especially tundra voles) restricts distribution				riparian shrubs	moist medium and tall grasslands (short grasslands provide marginal habitats); in Northern Alaska, low ridges in wet meadows most often utilized	damp tundra on coastal plain
Meadow jumping mouse 5,7	herbivorous, primarily grass seeds	generally at low elevations; "partial to water," therefore prefers marshy areas, riparian areas, moist brushy and grassy areas; hibernates	----------open woods----------			marshy and grassy areas ----------		
Porcupine 1,4,5,6,7,9	herbivorous, favors salty substances and evergreen foliage, also eats aquatic plants, bark and other vegetation; winter—spruce bark is primary food, birch also important (prefers cambium) summer—leaves, buds, shrubs, herbs, and aquatic plants replace bark almost entirely; obtains phosphorus and calcium from bones, antlers		inhabits all wooded areas but prefers dry open forests, particularly conifers and aspens			also found less frequently far from heavy timber and in tundra beyond treeline ----------		

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Carnivores

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Coyote 1,2*,4,5,6,9	opportunistic carnivore, especially small mammals such as hares, rodents, any small mammal which can be captured; also fruits, birds, carrion		occurs in wide variety of habitats but prefers open country					
Grey wolf 1,2*,3,4,5, 6,9	primarily carnivorous, main food is hoofed mammals, especially moose and caribou, also sheep and goat in south-central Alaska; also eats fish, birds, small mammals, berries, carrion		wherever suitable prey are available					
Red Fox 1,4,5,6,9	primarily carnivorous, mice and voles seem to be preferred and dominant, also eats muskrats, squirrels, hares, birds, eggs, carrion, and some plant material such as fruits, vegetables	interspersion important	very adaptable to wide range of habitats which provide suitable food and cover, but prefers broken country where open patches are interspersed with cover					
Black bear 1,3,4,5, 6,9	opportunistic omnivore, e.g. animal matter, fish, fruits, vegetables; spring—frequently feeds in moist lowlands where early-growing green vegetation is available, also eats winter kills; summer—fish, if available e.g. salmon; summer/fall—frequently feeds in alpine areas where berries are plentiful winter—enters den and becomes torpid	interspersion important, particular habitats utilized in seasonal pattern	most often associated with forests and woodlands, but depending on season, may occur in variety of habitats from sea level to alpine areas; highest bear densities generally occur in areas having interspersed vegetation types;					
			preferred habitats appear to be semi-open forested areas with understories composed of fruit-bearing shrubs and herbs, lush, grasses, and succulent forbs					

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Carnivores

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Brown bear 1,2*,3,4,5 6,9	opportunistic omnivore, e.g. berries, grasses, sedges, fishes, roots, animal flesh, carrion; spring—roots, grasses and other early-growing herbaceous plants make up bulk of diet, also carrion, summer—grazes, primarily on grasses, sedges; also flowers, pods, fall—fish and berries constitute major food items	prefers isolation from human disturbance; particular habitats used in seasonal pattern	all habitat types utilized----------but---------- bear habitats in forested areas are characterized by substantial meadow, muskeg, sedge flats, or grassy areas				grass communities appear very important, especially during spring	
Marten 1,2*,4,5,6	primarily carnivorous, depends most on voles and mice, also hares, squirrels, pikas, eggs, carrion, other small mammals; also plant materials such as fruits, vegetables, and insects; food may be cached	dens in downed timber, stumps, rock cavities; reluctant to leave cover	inhabits coniferous and mixed coniferous-deciduous forests, especially mature closed-canopy forests close to climax stage and consisting of high percentage of coniferous trees					
Short-tailed weasel (Ermine) 1,5,6,9	carnivorous, e.g. mice, voles, shrews, hares, birds, and other vertebrates	"on the Arctic Slope, the ermine is the ecological equivalent of the long-tailed weasel in the western United States" (9)	occurs in most terrestrial habitats, prefers open areas such as open canopy woodlands in Northern Alaska, lives mainly in areas where there is relief such as on slopes of mountains and hills, in and around rockslides, and along banks of streams and shores of lakes;				(seldom in damp and wet grass-sedge meadows)	
Least weasel 1,5,6,8,9	carnivorous, e.g. mice, voles, shrews, insects	"the least weasel on the Arctic Slope is the ecological equivalent of the ermine of the Boreal regions of the Western U.S., both inhabit damp meadows supporting microtines" (9)	----------open woods and bushy areas----------				meadows	tundra

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Carnivores

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Mink 1,2*,4,5, 6,9	opportunistic carnivore, e.g. mice, voles, muskrats, other mammals, birds, fishes, insects, crustaceans, sea urchins, molluscs; generally adjacent to or near waterways but abundance of mice, hares, voles will encourage inland movement; generally forages along riparian shorelines and beaches, in or not far from cover	generally associated with wetland edge, e.g. riverine, marine, or estuarine shorelines; requires den sites, e.g. rock cavities, tree roots, vacated dens constructed by other species, (does not construct its own den)	occurs in forests, woodlands, shrublands, grass-sedge areas, and marshy tundras most commonly near streams, ponds, marshes, or beaches					
Wolverine 1,5,6,9	carnivorous, e.g. marmots, caribou, sheep, any mammals which can be captured; eggs, carrion, also wasps, berries; caches prey and carrion	wide-ranging, solitary, powerful carnivore; may climb trees, fur retains less moisture than any other furbearers'	variety of habitats including forests, brushland, and tundra					
River otter 1,2*,4,5, 6,9	carnivorous, primarily aquatic prey, e.g. fish, sea urchins, crustaceans, insects, molluscs; also birds, eggs, mammals (including mink, beaver, hares, squirrels); occassionally vegetable matter; forages in water and on land	generally occurs at water-land interface, requires open water throughout winter, utilizes water for foraging, traveling, and cover; cover also provided by natural cavities and excavations of other animals	adaptable, occurs in variety of plant communities adjacent to or near fresh or marine water bodies; may travel long distances overland between river drainages to find suitable winter habitat or food					
Lynx 1,4,5,6,9	carnivorous, primary food consists of snowshoe hares, eats other small mammals, birds, wolf kills, winter kills	distribution and abundance closely tied to availability of snowshoe hares; avoids human habitations	usually in or near woodlands, forests, shrublands and swamps where hares are available					
Harbor seal 4,5,6,9	primarily piscivorous, also eats squid, crustaceans, other marine organisms	generally marine, also occurs in protected bays, rivers, and lakes						

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Hoofed Mammals

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Moose 1,2*,3,4, 5,6,9	herbivorous, e.g. browse such as leaves, twigs, bark, especially of willow, birch, and to a lesser degree aspen, cottonwood, alder; also cranberry and other low shrubs, lichens, terrestrial and aquatic herbaceous plants, (sedges, horsetails, fireweed, lupine, etc.), summer—species mentioned above, as available. fall/winter—browse constitutes important winter staple, also foliose lichens, and available low shrubs	tends to be migratory, utilizing combination of habitats; interspersion important; marshy areas provide aquatic vegetation and may be key component of high quality calving habitat; winter range is critical, snowfall affects winter range suitability, closed canopy forests provide areas of reduced snow accumulation	occurs in coniferous, deciduous, mixed coniferous-deciduous forests, low and tall shrublands, grasslands, sedge-grass and other tundra; primarily associated with upland shrub and lowland bog, and seral communities created by fire and glacial or fluvial action; the upland shrub communities are usually composed of willow along streamsides and birch in the drier sites; lowland bogs are composed of interspersed black spruce forests, bogs, shrubs, subclimax hardwood communities, and numerous intermediate stages; greatest population densities are supported in fire-created seral habitats, usually dominated by birch, willow, aspen, or a combination of these					
Caribou 1,2*,3,4, 5,6,9	herbivorous, particularly woody browse and vegetation such as leaves, lichens, grasses, sedges, and decumbent shrub vegetation, summer—shrub birch leaves, willow leaves and catkins, grasses, sedges, mushrooms, other forbs and shrubs as available, fall—switches to lichens, (especially fruticose) and dried sedges, winter—fruticose lichens, grasses, sedges, decumbent shrub vegetation	depends on climax vegetation, especially lichens; wide-ranging movements allow recovery of slow-growing lichens; slow-recovery of forage species necessitates: 1) utilization of very large areas and 2) opportunities for unrestricted movements; calving area provides focal point of yearly wide-ranging migratory movements and constitutes a critical habitat area	timbered areas used extensively as winter range, especially spruce-lichen associations, but forests are abandoned as snow melts on tundra areas; snows deeper than 20 in. or with an ice crust over 1.5-2.5 in. thick generally make winter habitats unsuitable			spends much time on tundra and treeless uplands where sedge-tundra, tussock tundra, mat and cushion tundra, tall and low shrub, tall and mid-grass, herbaceous sedge-grass, and freshwater aquatic habitats are available; this zone generally lies between 3,000-5,000 feet in elevation in southcentral Alaska		
Mountain goat 1,3,4,5,6	herbivorous, summer—grasses, sedges, forbs comprise bulk of diet, winter—may also utilize brush, ferns, conifers	utilizes alpine and subalpine mountain zones characterized by rocky slopes and cliffs	heavy snows may force goats to lower timbered elevations for forage such as brush, ferns, conifers; use of mature coniferous forests well documented but not well understood				spring-fall, utilizes alpine and subalpine areas supporting grasses, sedges, and forbs; with onset of snow, moves to rocky wind-blown ridges and ledges where forage remains available	

Table B.1 Habitats Used For Food, Cover, and/or Reproduction — Hoofed Mammals

SPECIES	FOOD	UNIQUE FEATURES, COMMENTS	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Dall Sheep 1,2*,3,4, 5,6,9	herbivorous, e.g. grasses, forbs, sedges, low-growing willows, alpine shrubs, lichens, mosses; seeks out mineral licks, spring—leaves windswept wintering grounds and utilizes lower south-facing slopes where green plants first emerge, may be found in alders and near upper limits of timberline, winter—feeds on grasses, sedges, lichens, mosses, available browse	occurs in mountains protected from heavy coastal snowfall by intermediate ranges; utilizes alpine habitats characterized by cliffs, deep canyons, rock outcrops used as escape terrain; escape terrain represents an essential habitat component; summer distribution strongly affected by mineral licks	in local areas may range into timbered habitats			shrublands (e.g. alders) near upper limits of timberline	utilizes steep grasslands and tundra communities in alpine zone (approximately 2,000-6,000 feet elevation); winter ranges consist of wind-blown ridges and slopes where forage is available near escape terrain	

TOTALS:

No. Species in each Habitat Type

TAXA	TOTAL NO. SPECIES	CONIFEROUS A	MIXED FORESTS B	DECIDUOUS C	SHRUBLANDS D	GRASSLANDS E	TUNDRA F
Shrews, bats, and lagomorphs	7	6	6	6	4	4	4
Rodents	14	9	9	8	9	11	9
Carnivores	13	12	12	11	11	10	9
Hoofed mammals (ungulates)	4	4	1	1	3	3	4
All taxa combined	38	31	28	26	27	28	26

Footnotes for Table B.1

References

*Reference (2), USF&WS (1980), provided all or most information.

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9 Bee, J.W. and E.R. Hall. 1956. Mammals of Northern Alaska on the Arctic Slope. Museum of Natural History, University of Kansas, Lawrence, Kansas.

Definitions (after L.A. Viereck and C.T. Dyrness. 1980. A Preliminary Classification System for Vegetation of Alaska. USDA - Forest Service Gen. Tech. Report PNW-106)

A	Coniferous forest:	Tree canopy cover at least 10%, over 75% of total tree canopy cover contributed by conifer species; (includes closed and open white spruce forests, closed and open black spruce forests, and black or white spruce woodlands; SCS vegetation mapping units 21, 25, 31, 33, 41, 42, 43);
B	Mixed coniferous-deciduous forests:	Tree canopy cover at least 10%, neither coniferous nor deciduous species dominant, both contribute 25-75% of the total tree canopy cover; (includes closed and open mixed forests and mixed woodlands; SCS vegetation mapping units 22, 24, 26, 32, 34);
C	Deciduous forest:	Tree canopy cover at least 10%, over 75% of total tree canopy cover contributed by deciduous species; (includes closed and open deciduous forests and deciduous woodlands of paper birch, cottonwood, and/or aspen; SCS units 27, 28, 29, 35, 36);
D	Shrubland:	Tree canopy cover less than 10%, at least 25% cover contributed by erect to decumbent (but no matted) woody shrubs 20 cm (8 in.) tall or taller; if dominant shrubs are less than 1.5 m (5 ft.) tall, then not associated with typical tundra sedges, herbs, and mosses; located adjacent to tree line or in forested regions; (includes tall shrub and low shrub; SCS units 60, 61, 62, 66*, also SCS shrub wetland units 51, 69);
E	Grassland (equivalent to "Herbaceous vegetation" in Viereck and Dyrness):	Tree canopy cover less than 10%, shrub cover less than 25%, vegetation dominated by grass species, primarily **Calamagrostis** and **Elymus,** or if dominated by sedges and forbs, found primarily within forested areas; (includes tall grass, midgrass, and sedge-grass categories; SCS unit 63, also grassland and sphagnum wetlands, units 50, 68);
F	Tundra:	Tree canopy cover less than 10%, vegetation dominated by sedges, herbs, mosses, and low matted shrubs less than 1.5 m (5 ft.) tall; taller shrubs if present contribute less than 25% cover; if grasses are dominant, they are typical arctic species such as **Arctagrostis latifolia** or **Poa arctica;** located in areas above or beyond the limit of trees (includes sedge-grass tundra, herbaceous tundra, shrub tundra, and mat and cushion tundra; SCS units 64, 65, 66*, and 67);

*SCS unit 66, shrub tundra, mapped as shrubland on some maps in this report.

Appendix C Agricultural/Timber Alternatives for the Willow Subbasin

Problems and Objectives

The principal problem relating to any of Alaska's natural resources is lack of information. This is the largest single obstacle to coherent planning effort in resource development, conservation, and preservation. The Susitna Cooperative River Basin Study (CRBS) has gathered and processed a large amount of resource information for a relatively small corner of the State. In order to array and analyze these data, several techniques of interpretation, as reported elsewhere, were utilized. In this appendix, the results of an economic analysis of the agricultural and timber resource potential within the Willow Subbasin are presented.

Some of the questions addressed by the CRBS study team are listed:

1. Are productive soil and timber resources available in sufficient quantities?
2. Is agricultural and/or timber production on a continuing basis "feasible" from an economic standpoint?
3. What types of firm enterprise appear likely to be successful?
4. Can sufficient commodity quantities be produced to meet export, as well as local demand?
5. Can investment in roads and land clearing result in positive benefit?

In addressing these questions, several benefit-cost analyses, utilizing various assumptions of selling prices, road access to remote areas, and institutional structures, were conducted. The data sources and premises used in each analysis are presented in the following section.

Data Sources and Analytical Structure

Land Base

The CRBS capability/suitability analysis produced base maps of the subbasin delineating six agricultural productivity classes rated on a good-to-bad continuum and 39 land cover types including 17 timber types (Figure C.1). The soil surveys, upon which agricultural capability is based, included potential crop yields for several crop commodities under average and improved management conditions (Table C.1). For purposes of this study the three highest-rated agricultural classes were included in the agricultural land base. Of the timber types, two were included in the economic analysis, the medium and old-aged mixed deciduous forests. The volumes reported in the area timber inventory are shown in Table C.2.

Table C.1 Potential crop yield for improved and average management conditions by agricultural capability class, Willow Subbasin

Capability Class	Barley		Oats		Potatoes		Hay	
	imp.	avg.	imp.	avg.	imp.	avg.	imp.	avg.
	bu/ac		bu/ac		cwt/ac.		tons/ac.	
A	60	54	70	63	270	243	3.50	3.15
B	55	50	65	59	250	225	3.25	2.93
C	45	41	50	45	240	216	3.00	2.70
D	40	36	40	36	230	207	2.50	2.25
E	30	27	35	32	180	162	2.00	1.80
F	25	23	30	27	120	108	1.50	1.35

Table C.2 net growing stock volume and stand density by vegetation class, Willow Subbasin

Vegetation Class	Volume — cubic feet per acre — Sawtimber	Volume — cubic feet per acre — Sawtimber/ Poletimber	Density — number of stems per acre — Sawtimber	Density — number of stems per acre — Sawtimber/ Poletimber
21 - short white spruce, closed forest	217.8	388.0	12.8	69.0
31 - short white spruce, open forest - woodland	47.7	102.9	2.5	18.9
41 - short black spruce, closed forest	6.6	187.2	0.6	72.6
42 - tall black spruce	372.1	830.2	29.0	153.8
22 - young stands, closed deciduous forest	100.6	389.5	6.5	95.9
24 - medium-aged stands closed deciduous forest	459.0	1,006.2	28.6	149.9
26 - old stands, closed deciduous forest	891.2	1,654.9	49.0	189.3

Source: Susitna CRBS vegetation inventory; statistical analysis performed by Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, Anchorage.

The three agricultural capability classes and two timber types form the basis for the economic analysis. Singly or in combination these agricultural-timber areas form a total of eleven "land production classes" (LPC's). The agricultural LPC's were further delineated by size: 80 acres (the smallest unit considered in the analysis) through 320 acres, 320 through 640 acres, and greater than 640 acres. These site size delineations made possible an analysis of potential economies of size in agricultural production.

Using computer-produced grid map overlays of the agricultural capability classes and the timber types, aggregations of the LPC's were identified and delineated. These aggregations—called "land production areas" (LPA's)—thus identified the sites where timber and/or agricultural production activities can take place. In the Willow Subbasin 290 separate LPA's were identified ranging in size from 80 acres to 15,780 acres (see map, Figure C.1).

Land Access

The vast majority of the land resource in the subbasin remains in its natural state. Some development (clearing, construction, etc.) has occurred along existing roads centered around Wasilla and the Parks Highway. For production availability in many LPA's, the land resources must be transformed, first by gaining road access to them, and second, for agricultural production, by clearing the natural vegetation and readying for seed bed preparation. Of the 290 LPA's, half are located on or adjacent to the existing road network and half are remote.

To assess ultimate economic feasibility, information on the cost of constructing all-weather roads to each of the remote LPA's was required. Using engineering specifications, soils information, and construction cost estimates, the 1979 cost of building roads along likely routes to and among the 145 remote LPA's was estimated. Land clearing cost estimates were based on experience in the Delta Agricultural Project. Clearing costs were estimated to be slightly higher than at Delta because tree root systems tend to be deeper and more extensive in the Willow Subbasin.

Production Alternatives and Costs

Seven possible types of commodity production were included in the analysis, four crops and three timber products. They included barley, oats, potatoes, hay, sawlogs, pulpwood chips, and fuelwood. Production practices for each commodity were delineated and costs of production were estimated. These estimates include both fixed and variable annual costs for producing the seven commodities. For agricultural production, standard farming practices using 1979 technology and input prices were used throughout. For the timber commodities, mechanized logging practices as found in the Lake States were assumed.

Tables C.3 and C.4 show the estimated production costs for the crop and timber commodities. These costs include a charge for overhead, risk, and management, varying by farm size. There is no charge for land or stumpage included in the tables.

Table C.3 Estimated costs of crop production per acre and per unit of commodity produced by land class and farm size, 1979 — Willow Subbasin

Commodity	Unit	Estimated production costs (dollars)											
		Per acre of production			Per unit produced[1]								
					Capability Class A			Capability Class B			Capability Class C		
		small[2] farms	medium[3] farms	large[4] farms	small farms	medium farms	large farms	small farms	medium farms	large farms	small farms	medium farms	large farms
Barley	bu	224.36	158.54	145.31	4.15	2.94	2.69	4.49	3.17	2.91	5.47	3.87	3.54
Oats	bu	224.36	158.54	145.31	3.56	2.52	2.31	3.80	2.69	2.46	4.99	3.52	3.23
Potatoes	cwt	589.86	519.98	494.04	2.43	2.14	2.03	2.62	2.31	2.20	2.73	2.41	2.29
Hay	ton	204.07	170.27	160.06	64.78	54.05	50.81	69.65	58.11	54.63	75.58	63.06	59.28

[1] average management.

[2] 80 - 319 acres. Includes 22% overhead, management, and risk.

[3] 320 - 639 acres. Includes 20% overhead, management, and risk.

[4] more than 640 acres. Includes 18% overhead, management, and risk.

Table C.4 Estimated logging costs per acre and per unit of commodity produced by timber class, Willow Subbasin

Commodity	Unit	Estimated production costs[1] (dollars)			
		Per acre of production		Per unit produced	
		Class 24	Class 26	Class 24	Class 26
logs	mbf	621.56	889.22	270.83	199.56
chips	ft^3	1,561.25	2,179.98	0.28	0.23
fuelwood	cord	1,380.10	1,796.86	109.73	86.86

[1] Includes 24% overhead, management, and risk.

Demand Sector

Commodity selling prices were estimated for both the domestic and export markets. In general, there is a strong but limited local market for most domestic agricultural commodities. Buyers are in a sense "held captive" by the shipping costs of outside products. Since local production does not yet satiate local demand, producers enjoy transportation costs as an added margin of profit. As an example, horse owners exhibit a small but persistent demand for hay. The price (around $130 per ton) is 120 percent higher than in the state of Washington. This disparity will continue until such time as local production increases.

This situation does not exist, however, in the sawlog market. Here producers do not have a captive market; instead they have a captive supply. Local processing facilities are limited, mainly to the production of rough lumber, so local sawlog prices are tied closely to the local unplaned lumber market.

Table C.5 shows the selling prices used in the analysis. Domestic crop prices reported by the Alaska Crop and Livestock Reporting Service were "normalized"[1] for 1979. Domestic sawlog and fuelwood prices were obtained from local surveys. Export prices were taken from USDA reports. In Table C.5, the limits of local demand for the year 2000 are also included. Price/cost comparisons are shown in Table C.6.

Alternative Analyses

The cost, return, and productivity data described earlier were used to analyze the agriculture/timber alternatives developed in Section 5 of this report. Two of the alternatives are particularly well-suited for economic analysis: the self-sufficiency alternative and the maximum benefit alternative. The remaining alternatives require judgemental decisions not governed by economic choice.

[1] Adjusted for short term fluctuations and anomalies so that the price reflects the expected price during a "normal" year.

Both of these alternatives were analyzed by a computerized mathematical technique called linear programming. In the self-sufficiency analysis, the overall productivity of the Willow Subbasin in terms of the seven commodities was addressed. This analysis assessed the cost of meeting various minimum commodity demand levels. Here, the physical capability of the land resource and the (annual) cost of producing the seven commodities in sufficient quantities to meet the requirements of (1) the projected population of the Willow Subbasin, and (2) the projected population of the Greater Anchorage area for the year 2000 were addressed These population and associated demand figures are shown in Table C.7.

Table C.5 1979 domestic and export prices and projected domestic commodity needs, Susitna Cooperative River Basin Study

Commodity	Unit	Domestic Price (dollars)	Year 2000 Domestic Needs[1] (1000 units)	Export Price (dollars)
Barley	bu	3.41[2]	0	2.34[2]
Oats	bu	2.66[2]	1,164.4	0
Potatoes	cwt	11.61[2]	624.6	0
Hay	ton	130.26[2]	240.0	0
Pulpwood chips	ton	0	0	40.92[2]
Sawlogs	mbf	150.00	178.7	400.33
Fuelwood				
white spruce	cord	43.50	[3]	0
black spruce	cord	43.50	[3]	0
birch	cord	60.00	[3]	0
cottonwood	cord	37.14	[3]	0
aspen	cord	41.46	[3]	0

[1] Projected demand less projected supply from outside the study area.

[2] Normalized.

[3] Total fuelwood demand estimated at 725,043 million BTU's.

Table C.6 Comparison of Crop Prices and Cost of Production

		Cost per unit produced [1] (dollars)										
		Capability Class A			Capability Class B			Capability Class C			Price (dollars)	
		small farms [2]	med. farms [3]	large farms [4]	small farms	med. farms	large farms	small farms	med. farms	large farms	Domestic [5]	Export [5]
Barley	bu	4.15	2.94	2.69	4.49	3.17	2.91	5.47	3.87	3.54	3.41	2.34
Oats	bu	3.56	2.52	2.31	3.80	2.69	2.46	4.99	3.52	3.23	2.66	0
Potatoes	cwts	2.43	2.14	2.03	2.62	2.31	2.20	2.73	2.41	2.29	11.61	0
Hay	ton	64.78	54.05	50.81	69.65	58.11	54.68	75.58	63.06	59.28	130.26	0

[1] average management.

[2] 80 - 319 acres. Includes 22% overhead, management, and risk.

[3] 320 - 639 acres. Includes 20% overhead, management, and risk.

[4] more than 640 acres. Includes 18% overhead, management, and risk.

[5] Normalized.

Table C.7 Projected population and commodity demands for the year 2000, Willow Subbasin and Greater Anchorage Area

Commodity	Unit	Year 2000 Needs Willow Subbasin (pop. 32,719)	Year 2000 Needs Greater Anchorage Area (pop. 424,200)
Barley	bu	2,286,273[1]	29,641,401[1]
Oats	bu	90,108	1,168,246
Potatoes	cwt	53,168	689,325
Hay	ton	19,851	257,362
Sawlogs	mbf	13,778	178,715
Pulpwood chips	ft^3	1,855,167	24,054,140
Fuelwood	MMBTU's	55,923	725,043

Population source: Alaska Water Study Committee, "Southcentral Alaska's Economy and Population, 1965-2025: A Case Study and Projection," Southcentral Alaska Water Resource Study (Level B), February 1979.

Considering the Willow Subbasin to be a closed economy (at least in the production and consumption of the seven commodities included in this study) the self-sufficiency analysis considered the capability of the land resource to **annually** meet the needs of the population. It was found that by the year 2000, the needs of the projected subbasin population could be met for the agricultural commodities but fell short for the required timber commodities. It is estimated that there is a shortage of 120,000 acres of timber land required on a sustained yield basis to meet the needs of the subbasin population in the year 2000. Assuming no new road construction, the shortfall is 180,000

For the maximum benefit alternative, the potential of crop and timber land development was approached from an investment opportunity standpoint. The question posed was "will the annual stream of net benefits (returns) over time justify the expense of initial investment in the development of natural resources?" In addressing this question, a B/C analysis was conducted which assessed the cost of road building and land clearing, productivity, production costs, and returns.

B/C analysis compares the "present values" of annual returns and costs, including initial startup or investment costs. Present value is obtained through discounting using some appropriate interest rate. The rate used in this analysis was 7 1/8% discounted over a period of 50 years. A necessary (but not sufficient) condition for federally funded water resource development investments is that the B/C ratio is greater than one, that is, net benefits must be positive.

The important assumptions utilized in the B/C analysis are, 1) the agriculture/timber enterprises must pay the entire cost of building roads to the remote LPA's, 2) clearing cost was $300 per acre, 3) timber stumpage was $25 per thousand board feet, and 4) 1979 selling prices were used (Table C.5). The results of the B/C analysis are shown in Table C.8. After initial "startup" costs of $48 million in road construction, land clearing, and timber stumpage, it was estimated that the present (discounted) value of net benefits was $374.3 million. The B/C ratio was estimated at 1.93/1.

Table C.8 Results of the Agricultural/timber Benefit/cost Analysis, Willow Subbasin

Present value of net benefits	B/C ratio	Commodities produced		Land in production by commodity (acres)
		commodity	quantity	
$374,282,000	1.93/1	potatoes	624,600 cwt[1]	2,570
		hay	240,000 tons[1]	78,200
		sawlogs	637,439 mbf[2]	264,550[2]

Remote LPA's in production		Acres cleared		Timber purchased	
number	total road const. cost	number of acres	total clearing cost	number of acres	total stumpage
68	$7,693,008	80,770	$24,231,000	264,550	$15,937,239

[1] Annually.

[2] Initial year only.

Summary

Current marketing restrictions and state subsidy for agricultural development elsewhere in Alaska tend to make the Willow Subbasin relatively non-competitive in the production and sale of crop and timber commodities. The resources exist, but current prices indicate only marginal feasibility. There are two exceptions. The strong local prices for potatoes and hay indicate that an expansion in the production of these commodities would prove feasible, to a point. The saturation point for the local (Anchorage and vicinity) whole Irish potato is limited. Increases in potato production without concomitant development in processing facilities (and hearty cooperation by wholesale grocers) would cause the potato price to decrease rapidly to a level at or below production costs, a fact of which local potato producers should be keenly aware. A similar situation would occur in the local hay market, also to the dismay of today's local hay producers.

The second exception is the export pulpwood chip market. The price used in this study (1979 normalized) was $40.95/ton indicating only very marginal feasibility. In the first quarter, 1980, the price of chips was $83.49/ton, a reflection of an increasing worldwide shortage of newsprint. Any long-range timber development plan should carefully consider the world pulpwood market.

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