

Forest Resources

Fort Yukon Village Yukon/Porcupine Corridor

Fort Yukon Vicinity

Alaska, 1984

By

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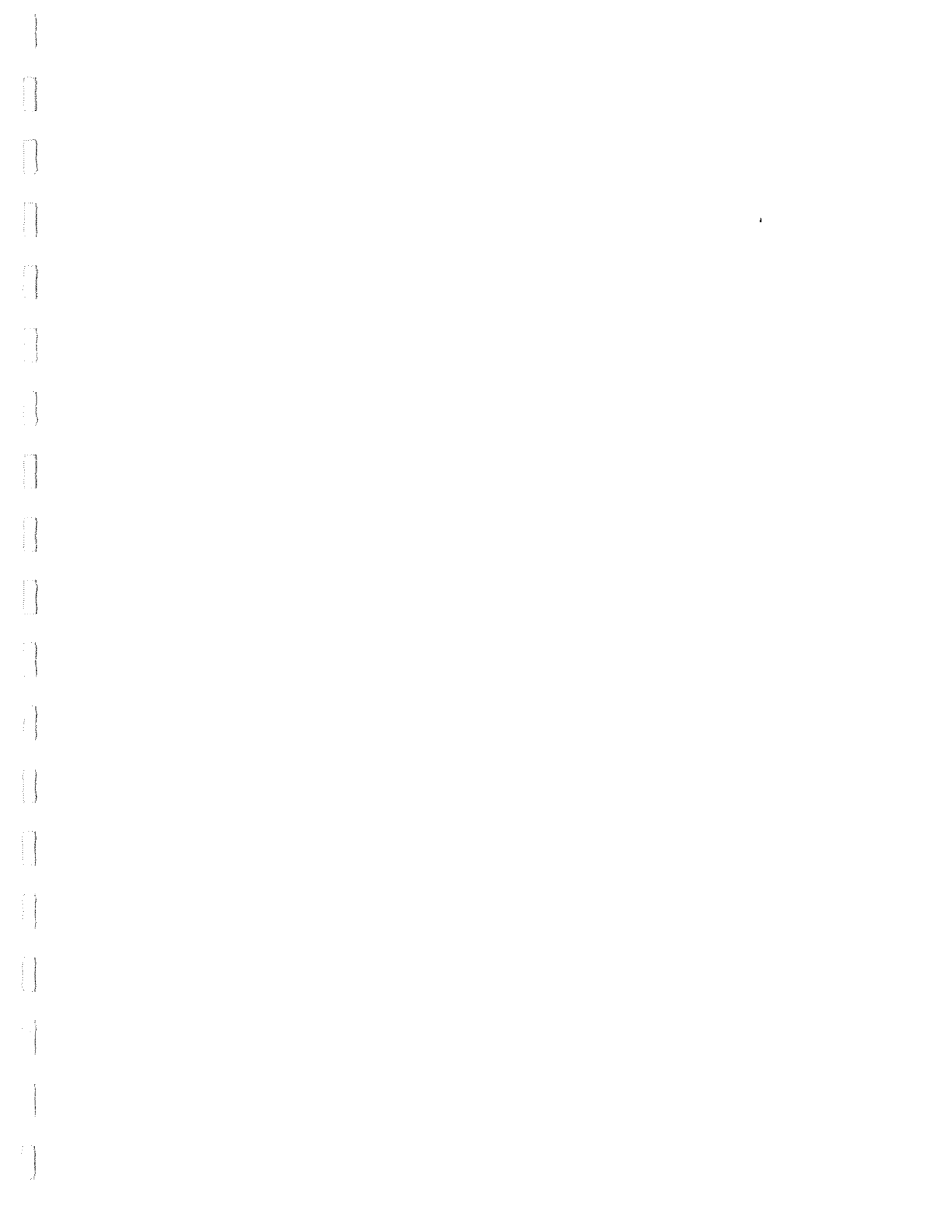
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Introduction:

At the request of the Fort Yukon Native Association, Tanana Chiefs Conference, Inc. with assistance from the Bureau of Indian Affairs completed a forest inventory of the river corridor forest lands for the Fort Yukon village corporation, Gwitchyaa Zhee Corporation. Under the terms of the Alaska Native Claims Settlement Act, Gwitchyaa Zhee Corporation is entitled to and has selected 161,280 acres of land.

Completed during the field season of 1982, the inventory was confined to corporation lands located within $\frac{1}{2}$ mile either side of the Yukon and Porcupine Rivers. The project area contains approximately 85,000 acres of land and water and was determined by Gwitchyaa Zhee Corporation as the area of their holdings containing the best and most accessible forest stands. The corporation has purchased a small sawmill and plans to develop a local wood products industry utilizing corporate timber resources.

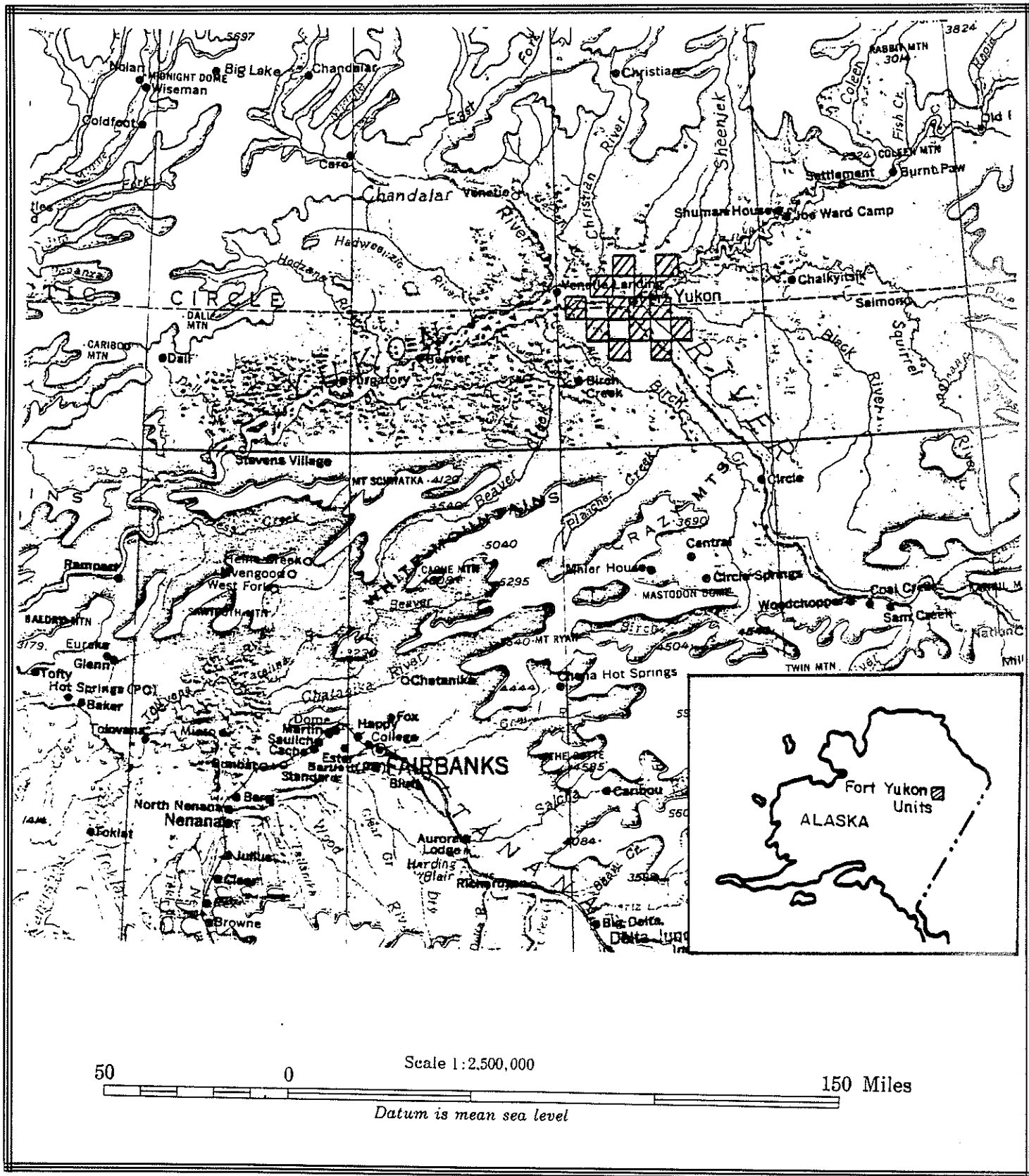
Accessible only by regularly scheduled and charter air service and by river travel on the Yukon River, the project area is located approximately 140 miles northwest of Fairbanks, Alaska. The Yukon Flats National Wildlife Refuge, containing nearly 9 million acres of land, completely surrounds lands owned by the Fort Yukon village.

Physical Description:¹

Topography and Drainage:

The project area is located in an eastern Interior region of Alaska known as the Yukon Flats, an alluvial basin surrounding the Yukon River where it reaches farthest north at Fort Yukon (see map, Figure: 1). The Yukon Flats serves as a collection basin for alluvial deposits from surrounding mountain ranges and hills. The Brooks

1 Physical description from information of Alaska Regional Profile, State of Alaska.



FORT YUKON FOREST INVENTORY
Vicinity Map

LEGEND

Inventory Units



Range lies to the north and the White and Crazy mountains lie to the south. Mountain elevations range in excess of 7,000 feet directly to the north and in excess of 6,000 feet directly to the south. The larger water courses draining into the area are the Chandalar, Christian, Porcupine, Sheenjek, Black, and Yukon Rivers.

The Yukon Flats is what its name implies: flat. Elevations in the project area average approximately 450 feet and that elevation is consistent within 25 to 30 feet throughout the project area. The area is dotted with numerous lakes and marshy wetlands through which the Yukon River flows.

When traveling within the project area by boat or on foot, there are no nearby visible terrain features to guide navigation other than sandbars, slough entrances, river course changes and points where side streams enter. In this regard, timberline has no meaning in this portion of Alaska.

The Yukon River and its tributaries are the dominating feature and force within the project area and the Flats. Constantly changing course and creating new channels and side sloughs, the river both destructs and creates forested lands on a periodic basis.

Severe flooding of surrounding land occurs periodically, particularly during spring breakup when ice jams and associated high water conditions occur. Huge masses of ice and water periodically overflow river banks, severing trees and flooding the surrounding area. As recently as the spring of 1982 severe flooding and resulting property damage occurred in the village of Fort Yukon near the confluence of the Porcupine and Yukon Rivers.

Soils:

Parent materials for soils in the area are generally well-sorted flood-plain terrace and alluvial fan deposits commonly associated with streams and rivers. Additionally, the Flats are underlain by fine lake sediments

thought to be the result of a late tertiary lake. As much as 100 feet of alluvial deposits overlie 300 feet of lake sediments.

Soils are generally silty and sandy loams varying significantly depending on the stage of development, how well-drained the soils are, depth of permafrost, and existence and depth of any overlying peat layer. Permafrost is discontinuous throughout the area; areas immediately adjacent to the Yukon River and associated sloughs are generally free of permafrost and support the better forest stands in the area.

Soil patterns are somewhat complex owing to the randomness of parent material deposition, stream river course scars, and associated periodic flooding.

Table 1 gives a general description of the soils and associated vegetation found in the Yukon flats area. The better drained, more permafrost free soils support the bottomland spruce/balsam poplar forests characterized by tall stands of white spruce and balsam poplar. Understory includes high and low shrubs and a carpet of ferns, mosses, and lichens.

The less developed and poorer drained permafrost soils support thickets of willow, alder, and birch and a variety of smaller shrubs, forbs, grasses, ferns, and mosses.

Climate:

The climate of the area is best described as Continental where generally summer and winter temperatures are extreme and precipitation is light.

The Yukon Flats is at a low elevation surrounded by mountain ranges where the air loses most of its moisture before reaching the flats. The average annual precipitation is 7 inches with most of this falling in late summer and early fall. Maximum monthly rainfall (1.25 inches) occurs in August. The average annual snow fall is approximately 45 inches.

Mean maximum temperature is 70° F. with a mean minimum temperature of minus 20°F. Extreme recorded temperatures vary between minus 75°F and 100°F. Seasonal temperatures are: 1) summer, 34°F to 72°F, and 2) winter, minus 29°F to 18°F. Frost free days generally occur in the area from mid-May to mid-August.

Table 1: Soil Description, Occurrence, and Associated Vegetation in Yukon Flats, Fort Yukon Forest Inventory.

Estimated %	Soil Occurrence/Description	Associated Vegetation
50%	Lenses of silt loam and fine sandy loam and is calcareous.	White Spruce Balsam Poplar
25%	Silt loam, occurs in slight depression and meander scars.	Black Spruce Willow Sedges Mosses
15%	Deep fibrous peat, occurs in slight depressions and meander scars.	Low shrubs Sedges Mosses
10%	Stratified silt loam occurs in slight depressions	Willows

Methods:

Planning for the Fort Yukon inventory began in the fall of 1981 when aerial photographs were ordered of the land base and initial discussions were held with village representatives. It was agreed upon by the Village Council that Tanana Chiefs Forestry would work directly with the village corporation (Gwitchyaa Zhee) in formulating guidelines for the project. Subsequently, it was determined that the major goal of the inventory was to give information on accessible stands for use in planning possible timber harvest operations in the Fort Yukon area. It was further determined, mainly because of limited funding and a desire for a more accurate cruise, to only inventory timber within $\frac{1}{2}$ mile of the Yukon river and major sloughs, where it was felt that the more accessible and valuable stands of timber were located.

Timber stands were delineated on 1:60,000 scale color infrared imagery by species, size class, density and estimated volume per acre. Field plots were then selected for each type to be sampled. This selection process was determined by placing a dot grid containing one point for every 100 acres over each photo and recording the type call at each point. The proportion of each type to total area was then calculated. The typed individual stands to be sampled were then selected randomly from the photo grids based on the actual proportions of each type. The total number of plots to be sampled was based on past inventory experience and funds available. The total dollars available were approximately \$21,000.

Types visited in the field included spruce poletimber and sawtimber and hardwood poletimber and sawtimber. Sapling stands were not inventoried. The variable plot sampling method of data collection was used in the field. In each timber stand sampled, 10 plots were mechanically spaced uniformly across the typed stand. At each plot, tree diameter and heights were measured; and in spruce stands, representative trees were bored with an increment core to determine age and growth. This data was then entered into a computer program to determine average net volume per acre of each stand visited and average height and diameter.

Table 1A: Vegetation Type Designation
Fort Yukon Forest Inventory

TIMBER COVER TYPES			STAND SIZE CLASS		VOLUME CLASS	
Symbol		Symbol		Symbol		
S	White Spruce	1	Seedling Sapling 0.1-4.4"d.b.h.	1	0-799 cubic feet per acre	
H	Hardwood	2	Poletimber 4.5-8.4"d.b.h. softwoods 4.5-10.4"d.b.h. hardwoods	2	800-2199 "	
		3	Sawtimber 8.5+"d.b.h. softwoods 10.5+"d.b.h. hardwoods	3	2000+ "	
NON FORESTED TYPES						
			DENSITY CLASS		EXAMPLES OF CLASSIFICATION SYSTEM	
NFWM	Wet Meadow					
NFDM	Dry Meadow				S323	White spruce sawtimber medium stocked 2200 or more gross cubic feet volume per acre.
NFTS	Tall Shrub	1	(Sawtimber/Poletimber) Poorly stocked		S311	
NFDS	Dwarf Shrub	2	Medium stocked		H211	White spruce sawtimber poorly stocked 0-799 cubic feet per acre, hardwood poletimber understory poorly stocked 0-799 cubic feet per acre.
NFD	Barren	3	Well stocked			
NFO	Other	u	(Seedling saplings) Under stocked			
W	Water	s	Satisfactorily stocked		H1S	Hardwood seedling and sapling satisfactory stocked.
		o	Over stocked			

Twenty stands were sampled in the first phase of the inventory in the Porcupine River area. Timber typing on the aerial photographs was then re-edited for the whole land base using the stand information generated from the first phase. Variables used in the editing process included species, size class, and estimated volume per acre. Density class was not used for stratification. An additional 60 stands along the Yukon River were visited in September which completed the field work.

A timber type map was then drawn depicting the locations of each stand identified on the imagery. This map was compiled by using a zoom transfer scope which transferred the stand delineations from the photos to a 1:63360 scale topographic base map. Each stand or type was labeled and an acreage figure was calculated using an electronic planimeter. Total volume was found by expanding the per acre figures by the total acreage in each type class.

See Table 1a for vegetation type designations.

Results:

Forest Lands:

A distinction is made between forest and non-forest lands for the purpose of this inventory. In the absence of any clear parameters to distinguish between operable and non-operable and/or commercial forest land of the area, photo interpreters relied on judgment to differentiate between non-forest bog, forested bog and other "non-productive" forest lands and "productive" forest lands in general.

Forest lands are the white spruce and poplar forested lands located on the better-drained, more productive sites where tree growth is characterized by high crown density, medium to tall tree heights, and other identifiable characteristics associated with bottomland spruce/ poplar stands.

The non-forest lands are the wetter, colder bog-type areas characterized by poor drainage and include tall and dwarf shrub, wet and dry meadows, and barren ground.

Approximately 47% or about 40,000 acres of the Fort Yukon project area was forest land. The non-forest lands, such as tall and dwarf shrub bog, account for 16% of the project area or about 13,000 acres. The remaining 37% of the project area is covered by lakes, ponds, and rivers.

Table 2. Area by Forest and Non-Forest Acres,
Fort Yukon Forest Inventory.

Land Class	Acres	% of Area
Forest Land	39,846	47
Non-forest Land	13,395	16
Water	31,914	37

Ponds smaller than 5 acres were usually combined with surrounding types unless there was a high concentration of water bodies smaller than this size.

Forest Volume/Species Composition:

Volume estimates for the forested areas of the Fort Yukon project area have been made in gross cubic feet measurements. Gross means that no deductions have been made for defect. Defect is wood that is made unusable due to insect damage, rot, or physical damage, such as broken tops or sweep and crook. No deductions were made for defect during field work; however, field observations indicate that white spruce defect is probably about 5-6% and limited primarily to butt rot in the first 4-6' of the trees. Butt rot is common in mature spruce stands in the area. Poplar defect is probably much higher, at least 15-20%, and occurs in all areas of the bole.

A cubic foot is a measure of the wood volume and may be hard to conceptualize in terms of usable product. About 100 cu. ft. of solid wood equals a pile of stacked round wood 4' by 4' by 8' in dimensions, otherwise known as a cord of wood.

Another common term used to measure wood is the board foot volume measure. The board foot is used to measure the quantity of boards that can be sawn from sawlog sized trees; i.e., 9.5 inches and larger for spruce or 10.5 inches and larger for poplar measured at breast height or 4.5' above the ground.

In the poletimber/sawtimber classes, the white spruce type (Picea glauca) dominates the forest lands, occupying approximately 17,000 acres or 44% of the forest lands and accounting for 79% of the gross cubic volume (see Table 3).

Table 3. Forest Land Area and Volume by Timber Type
(Species and Size Class), Fort Yukon Forest Inventory

Species/Size Class*	Acres	% of Area	TOTAL GROSS VOLUME			
			Cubic Feet	%	Board Feet	%
Sawtimber Type:						
White Spruce	8,291	21	15,687	43	37,518	50
Balsam poplar	134	1	143	1	323	1
Subtotal	8,425	21	15,830	43	37,841	51
Poletimber Type:						
White Spruce	9,123	23	13,237	36	21,791	29
Balsam poplar	7,685	19	7,556	21	15,600	21
	16,808	42	20,793	57	37,391	49
Seedling/Sapling Type:						
White Spruce	1,640	4	No volume data taken in these types			
Hardwoods	12,973	33				
Subtotal	14,613	37				
Total	39,846		36,623	100	175,232	100

* Note: The acreages shown in Table 3 are the timber type acreages by type species and size class. Since the timber types are not entirely homogeneous, all size classes and/or species can be represented in any given type. Thus the volumes represented for each type may include volume from all species and size classes represented in that type. Appendix D gives a species/size class volume summary for each individual type found in the inventory unit. Volumes are in thousands of cubic feet and board feet.

Table 4. Product Summary - Gross Volume by Species/Size Class
without regard to timber types, Fort Yukon Forest Inventory

	Gross Volume in Thousands			
	Cubic Feet	%	Board Feet**	%
<u>Sawtimber:</u>				
White spruce	11,897	33	55,477	74
Balsam poplar	3,683	10	15,853	21
	<u>15,580</u>	<u>43</u>	<u>71,330</u>	<u>95</u>
<u>Poletimber:</u>				
White Spruce	15,547	42		
Balsam poplar	3,933	11		
	<u>19,480</u>	<u>53</u>		
<u>Seedling/Sapling:</u>				
White Spruce	<u>696</u>	<u>2</u>		
<u>Dead Sawtimber:</u>				
White Spruce	685	2	3,167	4
Balsam poplar	187	1	732	1
	<u>872</u>	<u>2</u>	<u>3,899</u>	<u>5</u>
<u>Totals</u>	<u>36,628</u>	<u>100</u>	<u>75,229</u>	<u>100</u>

** International 1/4" board foot

White spruce occurs in pure stands and in mixed stands with balsam poplar (Populus balsamirifera), where balsam poplar and shrubs are usually the pioneer species first occupying sand bars and areas immediately adjacent to rivers and streams.

Balsam poplar accounts for the remaining 21% of the gross cubic foot volume of the poletimber/sawtimber stands which occupy approximately 8,000 acres of forest land.

While white spruce timber types occupy 44% of the forest land area, the white spruce type accounts for almost 80% of the total gross cubic volume. This is due largely to the higher tree stocking and greater size of spruce trees in the white spruce stands.

Excluding seedling/sapling stands, white spruce timber types occupy 69% of the forest land while balsam poplar timber types occupy the remaining 31% of the forest lands.

Two isolated sightings of paper birch (Betula papyrifera) were made during field work; however, the presence of birch is insignificant as far as volume of timber and number of trees are concerned.

Black spruce (Picea mariana) is common in the area and is generally limited to colder, wetter soils where it is usually stunted (less than 20-25 feet tall) and offers little commercial potential other than as a firewood source.

Forest Volume by Size Class:

To make it easier to understand the volume estimates of the Fort Yukon project area, volume estimates have been divided into size class components; sawtimber trees, poletimber trees and seedling/sapling trees. See Table 1A for a discussion of size differences between sawtimber and poletimber and seedling/sapling trees. Volume estimates for seedling/sapling trees were for trees between 2.0" dbh and 4.5" dbh. No tree measurements or volume estimates were made for trees less than 2.0" dbh.

Because timber stands are not entirely homogeneous, all three size classes can occur on all the timber types of the project area. For example, the spruce poletimber type is predominately spruce poletimber, but also includes volume of other species and size classes. To get the total net volume of the sawtimber class, we combine the sawtimber volume of that type with the sawtimber volume of the other forest types to get total gross sawtimber volume.

Approximately 15,580,000 gross cubic feet or 43% of the gross cubic volume is composed of sawtimber size trees (See Table 4). The remaining 57% of gross cubic volume or 21,018,000 cubic feet is composed of poletimber size trees.

Spruce accounts for the majority of the volume: 76% of the sawtimber volume and 80% of the poletimber volume. The spruce sawlog component is presently considered the most valuable forest component due to its widespread use for lumber and houses logs. From Table 5, the average white spruce sawlog tree is about 10-12 inches in diameter (breast height) and 60 to 70 feet in total height.

Table 5. Number of Live Trees Per Acre by Diameter and Height Class, White Spruce Sawtimber (Sawlog trees only), Fort. Yukon Forest Inventory

DBH Class	TOTAL TREE HEIGHT						Total	Percent
	40	50	60	70	80	90		
10		2	7	5	1		15	38
12		2	4	6	4	2	18	45
14			1	2	2	1	6	15
16						1	1	2
18								
Total		4	12	13	7	4	40	100
Percent		10	30	32	18	10	100	

Volume Per Acre Classes:

To aid in describing the forests of the area, forest lands were classified by timber volume per acre, expressed as gross cubic feet of merchantable timber. The term "gross" refers to the volume of standing timber without deductions for tree rot, crookedness, and other defects. This system of classification lends itself well to aerial photo interpretation where tree heights and crown density can be coupled with on-the-ground reconnaissance experience.

Merchantable timber includes all live trees at least 2.0" dbh; where dbh is the tree stem diameter measured at 4½ feet above the ground.

The following three volume per acre classes were used to separate different levels of volume per acre in the project area:

1. 0-799 gross cubic feet per acre.
2. 800-2199 gross cubic feet per acre.
3. 2200 + gross cubic feet per acre.

Reasons for subdivision of stands into volume per acre categories are:

1. Approximately 800 cubic feet per acre is generally considered the minimum volume per acre that can be economically harvested in more developed areas of the country under current conditions of market and technology.
2. By categorizing the forest lands by volume per acre, the higher volume forest stands can be separated from the lower volume forest stands.

Approximately 69% or about 17,000 acres of the poletimber/sawtimber timber types produce at least 800 to 2,199 gross cubic feet per acre. Only 2% of these poletimber/sawtimber stands produce more than that volume (Table 6).

White Spruce timber types account for 81% of the 800 to 2,199 gross cubic foot volume per acre class or about 14,000 acres (Table 6 and 7). The balsam poplar timber type accounts for the remaining 19%, with the poplar poletimber type accounting for most of that (18%).

Table 6. Area of Forest Land by Stand Volume Per Acre and Poletimber/ Sawtimber Timber Types, Fort Yukon Forest Inventory

Stand Volume Gross Cubic Feet/Acre	Acres		Acres		Total	%
	Poletimber Type	%	Sawtimber Type	%		
0-799	7,004	42	337	4	7,341	29
800-2199	9,804	58	7,641	91	17,445	69
2200 +	- 0 -	-0-	447	5	447	2
	16,808	100	8,425	100	25,233	100

Table 7. Area of Forest Land by Stand Volume Per Acre, and
Poletimber/Sawtimber Timber Types, Fort Yukon Forest Inventory

Species/ Size Class	Stand Volume Cubic Feet/Acre					
	0-799	%	800-2199	%	2200+	%
Sawtimber Type:						
White Spruce	337	5	7507	43	447	100
Hardwood	-0-	-	134	1	-0-	-
Subtotal	337	5	7641	44	447	100
Poletimber Type:						
White Spruce	2502	34	6621	38	-0-	-
Hardwood	4502	61	3183	18	-0-	-
	7004	95	9804	56	-0-	
Total	7341	100	17445	100	447	100

Estimated Sampling Error:

Sampling error for the Fort Yukon forest inventory is estimated by total gross volume and gross volume by size class; i.e., sawtimber and poletimber. The actual calculations used for estimating the sampling error are given in Appendix A.

Sampling error calculations are reported within one standard deviation of the mean. For example, the sawtimber volume sampling error is estimated to be 4.4%. This means that there is a 68% chance (1 standard deviation) that the sawtimber volume is within plus or minus 4.4% of that estimated for the project.

Table 8. Gross Cubic Foot Volume Sampling Error by Size Class,
Fort Yukon Forest Inventory

Size Class*	Sampling Error	Total Inventory Sampling Error
Sawtimber	4.4	2.7%
Poletimber	3.4	

* Represents the estimated sampling error for each size class
without regard to timber type.

Estimated Allowable Harvest

The Fort Yukon village plans future harvests in the project area. Some conservative estimates of allowable harvest level (amount of timber that can be harvested annually or periodically) is necessary to guide future harvest activities.

In arriving at an allowable harvest level the following assumptions were made.

1. The project area is not now, nor likely to be in the near future, an area of intensive forestry. Harvest levels are likely to be well below the potential for the area.
2. The most logical base for planning purposes would appear to be those lands that have 800 or more gross cubic feet of timber per acre.
3. White spruce will be the targeted crop tree. Balsam poplar is likely to remain non-marketable for at least the near future.
4. Growth and age information suggest that the desired products (sawlogs, houselogs, poles) can be produced by age 100-120 years. Beyond that age, tree growth is beginning to decline.
5. There may be a regeneration gap after cutting. However, areas adjacent to rivers such as the project area appear to present fair to good seed bed conditions because of periodic flooding and the resulting silt deposition. It is anticipated that with normal seed production conditions, natural regeneration will be secured within 5-10 years following harvest. Clear cut harvest blocks of 20 acres or less will be utilized.

From the inventory data, there are 14,128 acres of land in the spruce types that have at least 800 gross cubic feet of spruce timber per acre. If it takes 120 years to produce the desired product (sawlogs, houselogs, poles), and there is a regeneration lag of 10 years, then the allowable harvest would be:

$$\frac{\text{Allowable}}{\text{Harvest}} = \frac{14,128 \text{ acres}}{130 \text{ years}} = 109 \text{ acres/year}$$

Assuming that the above stands have approximately 1700 gross cubic feet per acre,* the annual harvest could be about 185,000 cubic feet or about 835,000 board feet.

Cutting in areas having less than 800 gross cubic feet per acre would be considered non-regulated cut or cut incidental to the above allowable cut. The assumption is that these areas have a low volume per acre due mostly to site limitations and not understocking.

As a test to the above allowable harvest level, periodic monitoring of harvest areas should be made to test the assumptions made in establishing the harvest level; i.e., period to regenerate cutover areas, age to produce desired product, etc.

* Volume of spruce timber in stands with at least 800 gross cubic feet per acre divided by the acreage of those stands.

Fort Yukon Sampling Error % by Size Class
Sawlog Error % in Cubic Feet

Unit	NS	NS ²	S \bar{x}	S \bar{x}^2	\bar{X}	(Ns ² S \bar{x}^2)	% of Sample
S21	120	14,400	59.1	3492.81	477		15.1
S22	160	25,600	53.5	2862.25	505		20.1
S31	20	400	174.8	30555.04	662		2.5
S32	180	32,400	71.9	5169.61	934		22.6
S33	20	400	139.8	19544.04	926		2.5
H21	155	24,025	55.0	3025.0	440		19.5
H22	120	14,400	53.6	2872.96	483		15.1
S31/H21	10	100	52.0	2704.0	52		1.3
H32	<u>10</u>	<u>100</u>	211.6	<u>44774.56</u>	591		<u>1.3</u>
	795	111825		115000.27		425,869,165	100.0

$$SE = \sqrt{\frac{\sum (N_s^2 S_{\bar{x}}^2)}{N^2}} = 25.95 \text{ cu ft.}$$

$$\bar{X} = 477(.151) + 505(.201) + 662(.025) + 934(.226) + 926(.025) + 440(.195) + 483(.151) + 52(.013) + 591(.013)$$

$$\bar{X} = 591.41 \text{ cu. ft./acre}$$

$$E\% = \frac{1 (25.96)(100)}{591.41} = 4.4\%$$

Where:

- SE = standard error of mean (overall)
- \bar{X} = overall population mean as estimated by sampling
- \bar{X}_s = mean of a stratum as estimated by sampling
- N = number of plots in the inventory
- N_s = number of plots in a type or stratum
- S \bar{x} = standard error of the mean for a type or stratum
- \sum = sum of
- E% = sampling error in percent (overall)

Fort Yukon Sampling Error % by Size Class
Poletimber Error % in Cubic Feet

Unit	NS	NS ²	S \bar{x}	S \bar{x}^2	\bar{X}	(Ns ² S \bar{x}^2)	% of Sample
S21	120	14,400	64.9	4212.01	746		15.1
S22	160	25,600	57.6	3317.76	944		20.1
S31	20	400	104.4	10899.35	373		02.5
S32	180	32,400	60.8	3696.64	908		22.6
S33	20	400	165.6	27423.36	1166		02.5
H21	155	24,025	52.3	2735.29	534		19.5
H22	120	14,400	49.9	2490.01	489		15.1
S31/H21	10	100	39.0	1521.0	109		01.3
H32	<u>10</u>	<u>100</u>	157.0	<u>24649.0</u>	480		01.3
	795	111825		80944.43		<u>384,876,306</u>	

$$SE = \sqrt{\frac{\sum (N_s^2 S_{\bar{x}}^2)}{N^2}} = 24.68 \text{ cu ft.}$$

$$\bar{X} = 746(.151) + 944(.201) + 373(.025) + 908(.226) + 1166(.025) + 534(.195) + 489(.151) + 109(.013) + 480(.013)$$

$$\bar{X} = 731.7 \text{ cu. ft./acre}$$

$$E\% = \frac{1 (24.68)(100)}{731.7} = 3.4\%$$

Where:

- SE = standard error of mean (overall)
- \bar{X} = overall population mean as estimated by sampling
- \bar{X}_s = mean of a stratum as estimated by sampling
- N = number of plots in the inventory
- N_s = number of plots in a type or stratum
- S \bar{x} = standard error of the mean for a type or stratum
- \sum = sum of
- E% = sampling error in percent (overall)

Fort Yukon Sampling Error % by
Sawtimber/Poletimber Combined

Unit	NS	$(NS)^2$	$S\bar{x}$	$S\bar{x}^2$	\bar{X}_S	$(N_s^2 S\bar{x}^2)$	% of Sample
Pole	795		58.67	609.10	731.7	384,966,427	.50
Saw	<u>795</u>		62.0	<u>673.92</u>	591.41	<u>425,934,288</u>	<u>.50</u>
	1590	2,528,100				4.6050416 ⁹	

$$SE = \sqrt{\frac{\sum (NS^2)(SE^2)}{ENS^2}} = \sqrt{320.755} = 17.91$$

$$\bar{x} = 731.7(.50) + 591.41(.50)$$

$$\bar{x} = 661.56$$

$$\% = \frac{1 (17.91)(100)}{661.56} = 2.7\%$$

Where:

- SE = standard error of mean (overall)
- \bar{X} = overall population mean as estimated by sampling
- \bar{X}_S = mean of a stratum as estimated by sampling
- N = number of plots in the inventory
- N_s = number of plots in a type or stratum
- $S\bar{x}$ = standard error of the mean for a type or stratum
- \sum = sum of
- E% = sampling error in percent (overall)

FORT YUKON

Spruce Sawtimber Volume Class 1

n=2
(S31)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	647	3,073
Hardwood	15	63
Total	<u>662</u>	<u>3,136</u>
<u>Dead Sawlog Volume</u>		
Softwood	128	576
Hardwood	-	-
Total	<u>128</u>	<u>576</u>
<u>Live Poletimber Volume</u>		
Softwood	373	
Hardwood	-	
Total	<u>373</u>	
<u>Live Convertible Products</u>		
Softwood	21	
Hardwood	-	
Total	<u>21</u>	
Grand Total Gross Volume	1,056	3,136

Spruce Sawtimber Volume Class 2

n=18
(S32)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	916	4,286
Hardwood	<u>18</u>	<u>79</u>
Total	934	4,365
<u>Dead Sawlog Volume</u>		
Softwood	66	305
Hardwood	<u>8</u>	<u>34</u>
Total	74	339
<u>Live Poletimber Volume</u>		
Softwood	895	
Hardwood	<u>14</u>	
Total	909	
<u>Live Convertible Products</u>		
Softwood	33	
Hardwood	<u>-</u>	
Total	33	
Grand Total Gross Volume	1,876	4,365

Spruce Sawtimber Volume Class 3

n=2
(S33)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	895	4,155
Hardwood	31	133
Total	<u>926</u>	<u>4,288</u>
<u>Dead Sawlog Volume</u>		
Softwood	-	-
Hardwood	31	60
Total	<u>31</u>	<u>60</u>
<u>Live Poletimber Volume</u>		
Softwood	1,166	
Hardwood	-	
Total	<u>1,166</u>	
<u>Live Convertible Products</u>		
Softwood	33	
Hardwood	-	
Total	<u>33</u>	
Grand Total Gross Volume	2,125	4,288

Spruce Poletimber Volume Class 1

n=12
(S21)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	410	1,880
Hardwood	68	281
Total	<u>478</u>	<u>2,161</u>
<u>Dead Sawlog Volume</u>		
Softwood	25	113
Hardwood	6	23
Total	<u>31</u>	<u>136</u>
<u>Live Poletimber Volume</u>		
Softwood	723	
Hardwood	23	
Total	<u>746</u>	
<u>Live Convertible Products</u>		
Softwood	47	
Hardwood	-	
Total	<u>47</u>	
Grand Total Gross Volume	1,271	2,161

Spruce Poletimber Volume Class 2

n=16
(S22)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	499	2,321
Hardwood	<u>6</u>	<u>22</u>
Total	505	2,343
<u>Dead Sawlog Volume</u>		
Softwood	17	80
Hardwood	<u>-</u>	<u>-</u>
Total	17	80
<u>Live Poletimber Volume</u>		
Softwood	944	
Hardwood	<u>-</u>	
Total	944	
<u>Live Convertible Products</u>		
Softwood	41	
Hardwood	<u>-</u>	
Total	41	
Grand Total Gross Volume	1,490	2,343

Hardwood Poletimber Volume Class 1

n=16
(H21)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	6	27
Hardwood	434	1,890
Total	440	1,917
<u>Dead Sawlog Volume</u>		
Softwood	-	-
Hardwood	10	41
Total	10	41
<u>Live Poletimber Volume</u>		
Softwood	6	
Hardwood	529	
Total	535	
<u>Live Convertible Products</u>		
Softwood	1	
Hardwood	-	
Total	1	
Grand Total Gross Volume	976	1,917

Hardwood Poletimber Volume Class 2

n=12
(H22)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	67	316
Hardwood	416	1,781
Total	483	2,097
<u>Dead Sawlog Volume</u>		
Softwood	-	-
Hardwood	17	67
Total	17	67
<u>Live Poletimber Volume</u>		
Softwood	65	
Hardwood	425	
Total	490	
<u>Live Convertible Products</u>		
Softwood	4	
Hardwood	-	
Total	4	
Grand Total Gross Volume	977	2,097

Hardwood Sawtimber Volume Class 2

n=1
(H32)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	104	500
Hardwood	487	1,913
Total	591	2,413
 <u>Live Poletimber Volume</u>		
Softwood	52	
Hardwood	428	
Total	480	
 Grand Total Gross Volume	 1,071	 2,413

Spruce Sawtimber Volume Class 1
Hardwood Poletimber Understory Volume Class 1

n=1
(S31)
(H21)

<u>Live Sawlog Volume</u>	<u>Gross Volume/Acre cubic foot</u>	<u>Gross Volume/Acre board foot</u>
Softwood	52	248
Hardwood	-	-
Total	<u>52</u>	<u>248</u>
 <u>Live Poletimber Volume</u>		
Softwood	109	
Hardwood	-	
Total	<u>109</u>	
 <u>Live Convertible Products</u>		
Softwood	144	
Hardwood	-	
Total	<u>144</u>	
 Grand Total Gross Volume	305	248

Fort Yukon
White Spruce Growth Information

S33

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-year Growth (1/20 inch)</u>
93	122	75	126	4
	113	81	148	4
	104	76	109	6

White Spruce Growth Information

S32

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-year Growth (1/20 inch)</u>
190	88	71	130	10
	129	96	139	2
	134	81	131	5
	119	80	154	3
191	70	51	123	3
	82	65	154	1
	90	71	153	3
	77	60	180	4
213	105	64	246	4
	122	71	186	4
	96	67	114	5
	128	60	330	2
222	115	94	135	2
	116	85	178	2
	128	86	220	4
	110	100	174	4
223	110	76	135	2
	70	55	135	3
	100	65	130	4
385	120	71	242	3
	118	75	215	8
	122	82	160	2
	95	69	158	2
388	107	60	43	21
	178	78	78	6
	151	72	66	8
	114	80	82	8

APPENDIX C-2

116k5

White Spruce Growth Information

S32

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-year Growth (1/20 inch)</u>
381	122	69	156	4
	83	62	143	1
	110	57	160	2
	81	65	147	1
401	113	70	157	3
	99	74	218	1
	96	63	120	6
	118	81	110	8
473	94	64	140	4
	99	59	184	4
	73	51	121	2
	109	71	124	8
489	113	89	110	14
	139	96	122	2
	157	110	124	5
	123	78	101	6
495	136	86	116	4
	109	87	91	10
	114	74	79	8
	100	65	80	4
629	160	90	107	7
	104	74	106	5
	136	81	112	7
	100	60	86	6
633	100	69	77	12
	129	90	159	3
	110	76	216	4
	120	70	156	14
645	110	80	187	5
	130	90	105	5
	130	65	350	3

APPENDIX C-3

116k6

White Spruce Growth Information

S32

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-year Growth (1/20 inch)</u>
657	133	89	227	4
	120	69	127	8
	133	90	191	4
	122	70	193	8
693	70	50	90	4
	121	79	99	6
	110	65	113	6
	100	66	71	8
697	127	87	89	10
	126	89	108	10
	90	70	90	10
	132	85	140	2
	131	87	148	4
701	114	61	75	8
	110	76	126	6
	130	80	170	4
	90	70	98	6
777	95	72	124	3
	114	87	124	6
	110	84	138	3

White Spruce Growth Information

S31

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-year , Growth (1/20 inch)</u>
214	103	76	151	3
	121	71	295	4
	133	72	216	5
	130	64	136	11

White Spruce Growth Information

S31

H21

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year Growth (1/20 inch)</u>
439	51	40	51	5
	50	37	52	8

White Spruce Growth Information

S22

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year Growth (1/20 inch)</u>
169	133	78	159	7
	81	75	169	2
	148	77	115	7
	120	88	147	5
192	94	66	201	1
	102	65	200	1
	123	76	185	4
	92	70	183	2
240	70	46	188	1
	73	60	160	3
	78	50	132	3
	82	58	146	3
282	93	51	188	4
	91	52	197	4
	64	39	178	4
	79	44	182	4
284	110	80	97	7
	120	65	165	1
	100	65	143	8
340	98	61	97	5
	111	69	119	5
	108	73	112	4
	131	71	97	3
408	154	72	139	4
465	117	65	182	4
	102	51	197	4
	91	49	174	4
	104	51	197	4

APPENDIX C-7

White Spruce Growth Information

S22

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year Growth, (1/20 inch)</u>
467	80	55	130	5
	70	50	250	1
472	80	50	114	5
	80	50	160	4
	80	60	95	5
	130	65	360	1
629	73	63	180	2
	90	53	193	2
	55	47	182	2
	50	45	195	2
615	100	60	92	10
	150	80	87	7
	130	90	112	6
	110	75	82	5
794	90	51	110	4
	110	65	183	2
	110	59	260	3
	130	70	150	7
86	122	74	112	5
	95	67	128	2
	88	60	121	2
	105	64	143	3

White Spruce Growth Information

S22

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year Growth, (1/20 inch)</u>
132	106	72	142	3
	93	65	139	2
	125	75	155	2
156	88	66	177	3
	112	71	172	2
	96	71	206	3
	100	70	182	2

White Spruce Growth Information

S21

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year Growth (1/20 inch)</u>
404	77	56	158	2
	98	57	148	2
	109	78	190	1
	84	52	165	1
661	98	48	73	20
	88	58	168	2
	110	67	168	3
	79	55	158	2
	78	70	167	2
663	88	62	124	4
	83	65	163	3
	70	45	165	2
758	138	71	116	6
	83	48	138	1
	62	43	57	4
	96	54	148	4
25	77	49	118	6
	73	45	155	3
	100	50	127	6
43	90	65	114	3
	97	63	231	7
	93	61	147	4
56	131	82	80	6
	140	81	91	7
	118	77	98	5

White Spruce Growth Information

S21

<u>Stand Number</u>	<u>Diameter (inches)</u>	<u>Total Height (feet)</u>	<u>Age</u>	<u>5-Year , Growth (1/20 inch)</u>
92	100	61	190	3
	75	57	155	3
	102	68	209	3
	100	71	209	2
102	73	52	104	4
	80	54	125	5
	74	53	130	3
114	90	53	105	1
	96	64	178	3
	117	76	145	5
	121	68	206	2
127	107	72	146	5
	126	70	156	5
	94	73	178	2
	101	69	171	3
159	171	81	135	6
	142	87	156	5
	139	80	138	5

Gross Volume by Species and Size Class for S323
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	400	42	1,857	96
Dead Sawtimber	-	-	-	-
Poletimber	521	54	-	-
Seedling/Sapling	<u>15</u>	<u>2</u>	<u>-</u>	<u>-</u>
Subtotal	936	98	1,857	96
<u>Balsam Poplar</u>				
Live Sawtimber	14	2	59	3
Dead Sawtimber	7	*	27	1
Poletimber	-	-	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	21	2	86	4
<hr/>				
Total	957	100	1,943	100

Total acreage of type = 447 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for S3-2
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	6,808	47	31,854	91
Dead Sawtimber	491	3	2,267	6
Poletimber	6,652	46	-	-
Seedling/Sapling	<u>245</u>	<u>2</u>	<u>-</u>	<u>-</u>
Subtotal	14,196	98	34,121	97
<u>Balsam Poplar</u>				
Live Sawtimber	134	1	587	2
Dead Sawtimber	59	*	253	1
Poletimber	104	1	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	297	2	840	3
<hr/>				
Total	14,493	100	34,961	100

Total acreage of type = 7,432 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for S3-1
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	99	55	470	83
Dead Sawtimber	20	11	88	15
Poletimber	57	31	-	-
Seedling/Sapling	<u>3</u>	<u>2</u>	<u>-</u>	<u>-</u>
Subtotal	179	99	558	98
<u>Balsam Poplar</u>				
Live Sawtimber	2	1	10	2
Dead Sawtimber	-	-	-	-
Poletimber	-	-	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	2	1	10	2
Total	181	100	568	100

Total acreage of type = 153 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for S222
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	3,304	33	15,367	96
Dead Sawtimber	113	1	530	3
Poletimber	6,250	63	-	-
Seedling/Sapling	<u>271</u>	<u>3</u>	<u>-</u>	<u>-</u>
Subtotal	9,938	100	15,897	99
<u>Balsam Poplar</u>				
Live Sawtimber	40	*	146	1
Dead Sawtimber	-		-	-
Poletimber	-		-	-
Seedling/Sapling	<u>-</u>		<u>-</u>	<u>-</u>
Subtotal	40	*	146	1
<hr/>				
Total	9,978	100	16,043	100

Total acreage of type = 6,621 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for S211
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	1,026	31	4,704	82
Dead Sawtimber	63	2	283	5
Poletimber	1,809	56	-	-
Seedling/Sapling	<u>118</u>	<u>4</u>	<u>-</u>	<u>-</u>
Subtotal	3,016	100	4,987	87
<u>Balsam Poplar</u>				
Live Sawtimber	170	5	703	12
Dead Sawtimber	15	*	58	1
Poletimber	58	2	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	243	7	761	13
<hr/>				
Total	3,259	100	5,748	100

Total acreage of type = 2,502 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for H312
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	14	10	67	21
Dead Sawtimber	-	-	-	-
Poletimber	7	5	-	-
Seedling/Sapling	-	-	-	-
Subtotal	122	15	67	21
<u>Balsam Poplar</u>				
Live Sawtimber	65	45	256	79
Dead Sawtimber	-	-	-	-
Poletimber	57	40	-	-
Seedling/Sapling	-	-	-	-
Subtotal	122	85	256	79
Total	143	100	323	100

Total acreage of type = 134 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for H222
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	210	7	991	15
Dead Sawtimber	-	-	-	-
Poletimber	204	6	-	-
Seedling/Sapling	<u>13</u>	<u>*</u>	<u>-</u>	<u>-</u>
Subtotal	427	13	991	15
<u>Balsam Poplar</u>				
Live Sawtimber	1,304	42	5,583	82
Dead Sawtimber	53	2	210	3
Poletimber	1,332	43	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	2,689	87	5,793	85
<hr/>				
Total	3,116	100	6,784	100

Total acreage of type = 3,135 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for H211
Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	27	*	122	1
Dead Sawtimber	-	-	-	-
Poletimber	27	*	-	-
Seedling/Sapling	<u>5</u>	<u>*</u>	<u>-</u>	<u>-</u>
Subtotal	59	1	122	1
<u>Balsam Poplar</u>				
Live Sawtimber	1,954	44	8,509	97
Dead Sawtimber	45	1	185	2
Poletimber	2,382	54	-	-
Seedling/Sapling	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Subtotal	4,381	99	8,694	99
Total	4,440	100	8,816	100

Total acreage of type = 4,502 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.

Gross Volume by Species and Size Class for
The S3-1/H211 Timber Type, Fort Yukon Forest Inventory

TOTAL VOLUME

Species/Size Class	Thousand Cubic Feet	%	Thousand Board Feet	%
<u>Spruce</u>				
Live Sawtimber	10	18	46	100
Poletimber	20	36	-	-
Seedling/Sapling	<u>26</u>	<u>46</u>	<u>-</u>	<u>-</u>
Total	56	100	46	100

Total acreage of type = 184 acres

* Less than 1% of total volume

** Board foot volumes in International $\frac{1}{4}$ inch log rule.