INVENTORY OF YOUNG GROWTH TIMBER
TONGASS NATIONAL FOREST IN SOUTHEAST ALASKA

PREPARED FOR:

SOUTHEAST CONFERENCE

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Cascade Appraisal Services, Inc.

Forest Consultants/Industrial Appraisers

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COVER PHOTO - **Logs harvested from Unit 4 of the inventory layout prior to field work. The timber stand has a year of origin on 1945, age 66, non-thinned, and an average diameter at breast height (DBH) of ±14.2 inches with an estimated net volume per acre of ± 40 MBF based upon nearby inventoried stands.**

Photo: Owen Graham, Alaska Forest Association.

Cascade Appraisal Services, Inc. is a diversified organization combining traditional forestry services with a wide variety of industrial appraisal capabilities. Incorporated in 1977, Cascade Appraisal as a company has provided services to clients over the past 34 years. Clients include numerous major forest products companies, law firms, public agencies, accountants, private landowners, and investors. The company principal, Ray E. Granvall Jr., has 42 years of forest products experience both in timber and timber land projects and industrial forest product plants nationwide and an additional 7 years in logging operations. Cascade Appraisal Services, Inc. has its own computer network, library, mapping, photogrammetric, and drafting facilities.

EXECUTIVE SUMMARY

This project was designed to prepare a report that would help substantiate the inventory of young growth timber and conditions necessary for reconstituting a viable timber industry in SE Alaska. The final work product is a report correlating data from different parties with the results of a field inventory. Inventory plot locations were mapped in Geographic Information System (GIS) format with latitude and longitude coordinates calculated for each individual plot in the North America Data 1983 coordinate system. The inventory design prescribed for the project in its entirety can be applied to specific areas such as Prince of Wales Island or a single drainage within that area.

The data collected for this study is considered to be accurate in the initial review for the purposes it was intended. The standard error at a 95% confidence level (2 Standard Deviations – T2) is 3.7% for the entire inventory. The data was used to develop volume estimates in varying age classes over 40 years in age. Inventory plots were placed in timber equal too or greater than 40 years of age. Approximately 98% of this category is found in timber 41-60 years of age. Timber over 40 years old is significant in that its contribution to industry annual harvest would be targeted first. These stands are thinned but lightly stocked with a basal area of less than 92 square feet. The average diameter is 12.2" DBH and the merchantable bole length is 32 feet. Stands in the 41-60 year old age classes show an average net volume per acre of less the 6 MBF in the lower ages increasing with age to 9.5 MBF per acre for the older ages. Average site index for Sitka spruce is calculated at ± 93 (92.9) and for western hemlock ± 87 (86.8) on the FARR 50-year site indices.

Final inventory volume extensions have been compared to estimated volumes projected by the Tongass National Forest (TNF). Selected TNF inventory areas or polygons were taken from the GIS mapping and the volume extensions used the respective acreage for each polygon. The final volume predictions from this study are 37.5% below those same figures for the national forest comparative estimates on an age class weighted basis.

The volumes reported and discussed herein represent full utilization of a given stand. If the entire stand volume is not harvested, a proportionate reduction in volume is necessary. Harvesting timber prematurely as seen in the cover photo destroys the future potential and removes that acreage from the next rotation. The young growth resource at this age is not ready and will not be available in sufficient volume for several decades (35 – 40 years) into the future.

CONTENT

GENERAL DATA

TONGASS NATIONAL FOREST DATA - USFS timber stand information is quite limited, especially from a GIS perspective, in that it is applied to broad areas on the TNF. GIS layers for Value Comparison Units (VCU), existing vegetation maps and timber stand for the entire TNF are available.

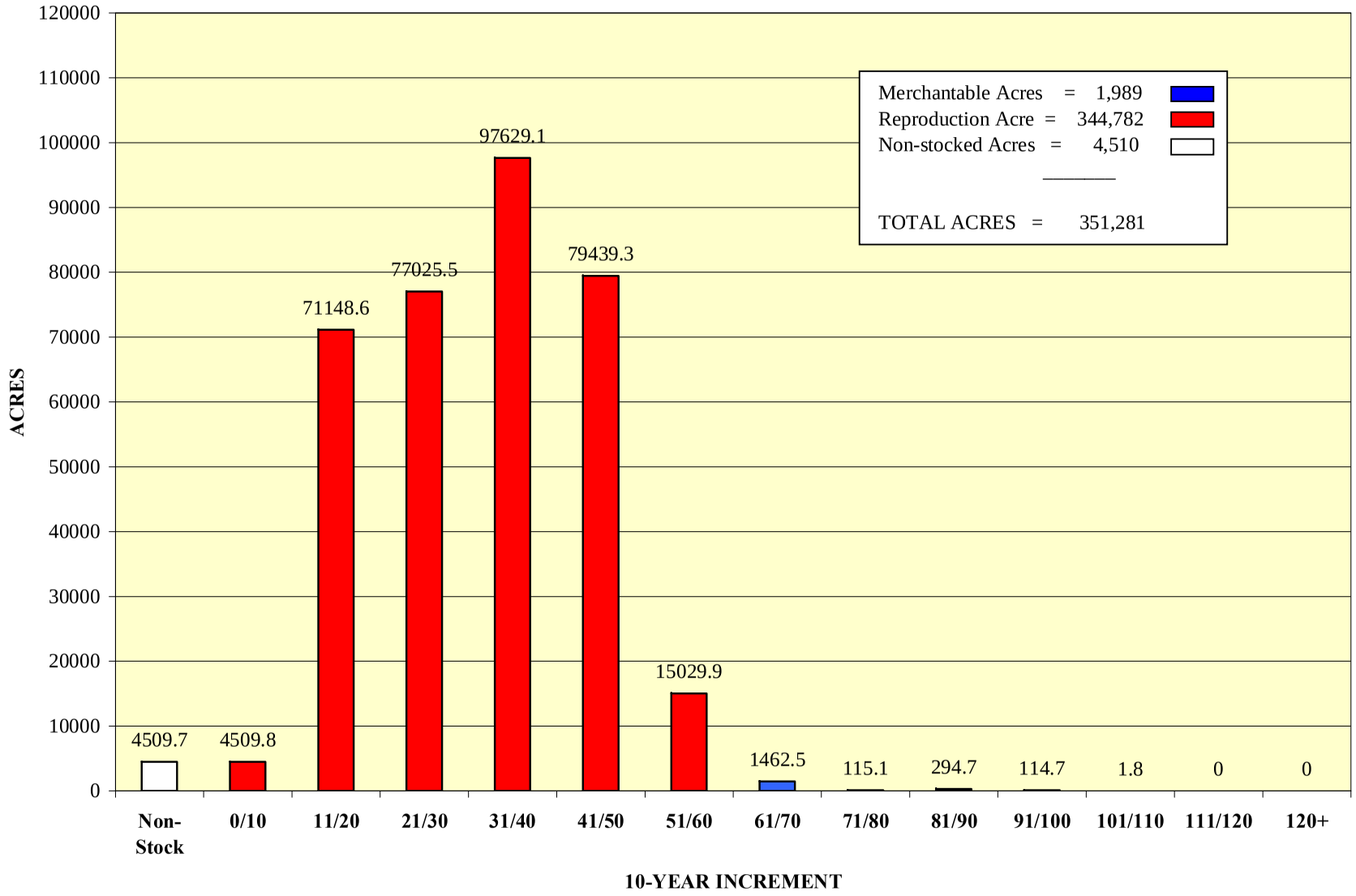
The timber type maps for the TNF made available as part of 2008 Tongass Land and Resource Management Plan Amendment (TLMP) are one source that can be utilized in the location of young growth areas. The basic assumptions utilized within the TLMP are not in sufficient detail to provide any degree of confidence in the determination of alternatives. Broad volumes per acre are applied to GIS mapped stands or polygons to develop an estimate of timber volume per acre and gross volume per stand. Many attributes assigned to each mapped stand are derived from prior studies and historic harvesting records. The GIS mapping of the specific stands is created from aerial photography, both color and black/white, and orthorectified aerial photos, orthophotos. The per acre volume estimates are generally not field verified. The historic harvest record is also the basis for the decadal ages of young growth. A graphic presentation of the historic harvest record by age class is seen in Graph 1, page 4. This graph is based upon the TLMP mapping.

The majority of the young timber, 254,823 acres out of the 351,000 base acres (See Graph 1, page 4) or ±75.6 % is less than 40 years of age. The SPECTRUM program used for analysis performed as part of TLMP shows (164) VCU areas containing ± 193,055 acres of positive value young growth.

There are (51) VCU's lying north of Frederick Sound that the SPECTRUM program lists as positive with 24,507 acres of young growth timber. These lands are not economically viable under current industry standards and would be eliminated from further consideration. The balance of positive indicated acreage would then contain (103) VCU areas with an acreage estimate of positive young growth of ± 168,548 acres. The prior USFS inventory work included (33) of the positive VCU areas with 53,581 acres and an additional (3) non-positive VCU's.

TONGASS NATIONAL FORES
YOUNG GROWTH ACRES BY HARVEST PERIOD
SOURCE: SPECTRUM ANALYSIS 2008 TLMP

GRAPH 1



SAMPLE AREA – This inventory was designed to sample a subset of the remaining (70) positive VCU's lying south of Frederick Sound. These areas contain an estimated 115,000 acres. These areas comprise the young growth timber area present on the TNF that are commercially available to industry.

The inventory of young growth units commenced with a mapping of all young growth units provided by Mr. Eric Henderson the U. S. Forest Service – Land Management Planner, Hiawatha National Forest – Region 9 located in Michigan. Eric is the analyst for the TNF in regards to the SPECTRUM program. Criteria quantifying the volume found on each individual unit (polygon) were set forth in an accompanying document presented on pages 6 and 7 along with a set of descriptive points.

Work undertaken in 2009 to modify the 2008 TLMP listing of stands created a comparison discrepancy between the sets of data. As such, communication with Mr. Henderson to alleviate the apparent differences resulted in a set of maps and areas considered to be suitable for the inventory selection process. One of the major variances was the inclusion versus exclusion of old growth reserve areas, scenic view sheds, experimental forest areas, and other non-suitable areas. It was concluded that all young growth stands should be included as a starting point since the inventory was intended to determine the volume characteristics of the various stands. Mr. Henderson provided a GIS format map showing all of the known young growth stands in the TNF totaling some 862,091 acres. This map includes not only TNF acreage but all private and other non-TNF acreage.

TNF volumes per acre are presently estimated by entering the volume table shown on accompanying, page 6, and selecting the Productivity Group (Prod) and Volume code for each polygon. As an example, a stand that is a Thinned, 5th decadal or 40-50 years old stand (T5) located in the fastest growing or Prod1 polygon would have an estimated volume of 11,452 BF per acre. Each polygon stand with age and productivity calls has a volume estimate developed in this manner. So all TNF stands that have a similar T5-Prod1 attribute will have the same projected volume per acre. These are the volume estimates that this inventory compares to determine the accuracy of the projected TNF volumes by stand.

There are approximately 5,716 units with volumes of second growth timber older than 40-years. This listing comes from the most recent USFS data provided by Eric Henderson.

Notes on quantifying standing young growth volume on Tongass National Forest

Prepared by Eric Henderson, Analyst
October 20, 2010

Key Attributes in the Young Growth File:

PROD_GRP: Productivity Group. 1 = fastest growing 3= slowest
YEAR_ORIGI: Year of Origin; used to determine age of the stand and volume
YG: 2-digit code used by Spectrum model. Y stands have not been precommercially thinned. "T" stands have been thinned. The number corresponds with which decade of growth they are in; so for example a T5 stand will have been thinned and in its 5th decade of growth (40-50 years old).
VolumePerAcre: Per-acre board-foot volume of the stand
Acres: Acre value of the polygon
VolumePerPoly: Board-foot calculation for the polygon

Volume Estimates (based on FVS output runs). MBF/acre

Volume Code	Prod1 BF/Acre	Prod 2 BF/Acre	Prod 3 BF/Acre
Y1			
Y2			
Y3		1005	
T3		1005	
Y4		3991	
T4		3991	
Y5	7722	6036	
T5	11452	6036	
Y6	18092	9379	
T6	24845	9379	
Y7	29003	12479	575
Y8	40304	15368	1851

Yellow cells represent values that were not explicitly calculated, but were implied

Analysis Process:

- Intersected SD7 and Prod Class layers (.1 Meter Cluster tolerance)

- Exported YG-only, based on code in the SD7 fields
- Unioned with Thinned layer (.1 m Cluster tolerance)
- Deleted slivers less than .1 acres (about 1700 polygons)
- VegCode is “S1”, Volume is Y2 (20-year old never been thinned stand)
- VegCode is “S2”, Volume is Y4 (40-year old never been thinned)
- VegCode is “S3”, Volume is Y8 (80-year old never been thinned)
- 2000+ Without thin = “Y1”, with thin = “T1”, although T1 should not occur…
- 1990-2000 = Y2
- 1980-1990 = Y3 without thin, and T3 with thin
- 1970-1980 = Y4 without thin, T4 with
- 1960-1970 = Y5 without thin , T5 with
- 1950-1960 = Y6 without thin, T6 with
- 1940-1950 = Y7 without thin, T7 with (no T7 exists)
- < 1940 = Y8
- There were a few polys that had a vegetation code of “HS1” with no Year of Origin. These were assigned a value of “Y2”, based on most other “HS1” polygons were coded “Y2”

“1. 538976304 in the YEAR_ORIGI column is, as you may have guessed, a bogus number and I don't know where it came from. It appears to show up in stands of "natural origin" (such as a blowdown), or no data. The relevant column to determine volume is "VEG_CODE", which has size information. YEAR_ORIGI combined with VEG_CODE is used to calculate the size class call in "SPEC_CODE". SPEC_CODE is consistent with how we modeled for the forest plan, and is as accurate as we can get at this time. “

“2. Volumes only appear for 1969 and earlier because volumes were not calculated for high site stands younger than 50. This was OK for forest planning since the first entry for commercial thinning was about 50-60 years old with the first clearcut option at around 70-80 on our best sites. “

“3. The latest YEAR_ORIGI in the data is 2006, so activities that have taken place since then are not reflected in this data. However, since activities probably did not occur in the young growth and sites regenerated since 2006 will not have any commercially viable volume, it should not affect your calculations.”

“4. Your 5.5 MBF/acre is, as calculated, accurate. It is so low because you are averaging young sites (less than 50) with 0 volume in with everything else. That is one way to portray the data. Another way is to calculate average volume per acre on sites with positive numbers, which is 17.7

MBF/acre (646,500 MBF on 36,500 acres). Again, though, this averages the very poor sites with the very best sites. Higher sites over 50 is 23.1 MBF/acre (622,500 MBF on 26,900 acres). "

"If you want to get an estimate of volume on sites younger than 50 (whether it is commercial or not), let me know and I can maybe do some "backwards extrapolation" to fill in the gaps. Otherwise, I thought you wanted to focus on inventorying VCUs with the highest chance of harvest in the near future - which would be those that have significant acres of older stuff (?)"

SOURCE: Explanatory notes from Eric Henderson

A great number of the units are not identified as to the year of origin. All though there is volume associated with the unidentified areas, selections on those units with an identified date of origin was not made. Only 1,899 of the units show a year of origin between 1750 and 1969. These units total 13,319.5 acres with an estimated 11.76 MBF per acre.

INVENTORY DATA

TIMBER TO BE INVENTORIED - 1) Species inventoried included Sitka spruce, western redcedar, hemlock, Alaska yellow-cedar, red alder and lodgepole pine. 2) One inch diameter breast high (DBH) classes ≥ 8" DBH (7.6" to 8.5" = 8" DBH class) were inventoried with a fixed Prism Factor sweep at DBH. Height in 32-foot (32'8") logs. Trees less than 24"DBH – Merchantable height to a 6" top. Trees greater than or equal to 25"DBH – Merchantable height to 50% diameter outside bark (DOB) at 16 feet, (±40% DBH).

The "sample points" consist of variable sub-plots on a ratio of one measure plot for each nine count plots for each stand selected. Sub-plots are variable in size utilizing an appropriate basal area factor (BAF) prism that selected ± 5-6 trees per plot. Depending upon stand and resulting volume variability, some sub-plots were combined and re-calculated to give a higher degree of accuracy to better fit the specific units. Sub-plots comprising each of the cruise plots were placed in a fixed grid pattern of 2-chains (132 feet) by 5-chains (330 feet) as seen in the example (See Addendum - Sample Units 2 and 3, page 18). This resulted in ± 1 sub-plot per acre overall.

MAPPING AND PLOT SELECTION - GIS mapping of (28) candidate units totaling an estimated 2,707.63 acres containing 2,713 plots in these units (See Table 1, page 10) was developed. These units became the base for selection of those that were inventoried. In total, (16) of the units were selected and inventoried with an acreage estimate of 1,400.58 acres. The selected units are highlighted in yellow on Table 1. The field work done in early November, 2010 placed 1,408 plots within the selected units, essentially one plot per acre (See Table 4, Addendum – page 29). One unit (Unit 4) had been harvested prior to our field work (PHOTO – Front Cover).

TONGASS NATIONAL FOREST
2010 SECOND GROWTH VOLUME INVENTORY
HARVEST UNITS SELECTED FOR SAMPLING

TABLE 1

UNIT NO.	USFS OBJECT ID	THINNED	PROD_ GRP	VEG_ CODE	ASPECT	YEAR OF ORIGIN	YG_Type	Decade	YG	Volume Per ACRE (USFS Est.)	Volume Per POLYGON (USFS Est.)	ACRES
1	13557	0	1	HS3	WEST	1950	Y	6	Y6	18,092	1,629,784.98450	90.08318508170
2	13518	0	1	HS3	WEST	1945	Y	7	Y7	29,003	1,399,949.06696	48.26911240080
3	13514	0	1	HS3	WEST	1945	Y	7	Y7	29,003	426,111.99166	14.69199709210
4	13507	0	1	HS3	WEST	1945	Y	7	Y7	29,003	2,948,971.91169	101.67816817900
5	26844	1	1	HS2	WEST	1969	T	5	T5	11,452	2,425,963.01082	211.83749657900
6	26806	1	1	HS2	NORTH	1969	T	5	T5	11,452	1,620,335.83914	141.48933279300
7	26820	1	1	HS2	EAST	1969	T	5	T5	11,452	1,262,720.44940	110.26200221800
8	26814	1	1	HS2	WEST	1961	T	5	T5	11,452	1,715,573.14649	149.80554900000
9	26639	1	1	HS2	WEST	1969	T	5	T5	11,452	2,406,115.54862	210.10439649200
10	26588	1	1	HS2	WEST	1969	T	5	T5	11,452	548,335.96311	47.88124023000
11	26530	1	1	HS2	WEST	1968	T	5	T5	11,452	819,352.85463	71.54670403700
12	26275	1	1	HS2	WEST	1969	T	5	T5	11,452	1,916,131.75503	167.31852558800
13	27083	1	1	HS2	SOUTH	1960	T	5	T5	11,452	959,131.85861	83.75234532020
14	27085	1	1	HS2	WEST	1960	T	5	T5	11,452	839,384.20090	73.29586106340
15	27041	1	1	HS2	WEST	1962	T	5	T5	11,452	565,506.84233	49.38061843570
16	27024	1	1	HS2	WEST	1961	T	5	T5	11,452	888,030.35000	77.54369105840
17	12783	0	1	HS2	SOUTH	1959	Y	6	Y6	18,092	2,691,973.40224	148.79357739600
18	27007	1	1	HS2	WEST	1959	T	6	T6	24,845	5,394,187.87101	217.11361928000
19	3453	0	1	HS3	EAST	1924	Y	8	Y8	40,304	2,216,009.81519	54.98237929700
20	14863	0	2	HS3	NORTH	1924	Y	8	Y8	15,368	2,148,270.25737	139.78853835000
21	3758	0	1	HS3	SOUTH	1927	Y	8	Y8	40,304	602,122.53829	14.93952308180
22	3756	0	1	HS3	SOUTH	1927	Y	8	Y8	40,304	412,467.39005	10.23390705770
23	3932	0	3	HS3	SOUTH	1922	Y	8	Y8	1,851	18,442.45222	9.96350741403
24	3753	0	1	HS3	SOUTH	1922	Y	8	Y8	40,304	3,742,035.21902	92.84525652600
25	3922	0	3	HS3	SOUTH	1919	Y	8	Y8	1,851	7,173.86715	3.87567106753
26	3751	0	1	HS3	SOUTH	1919	Y	8	Y8	40,304	2,016,369.37715	50.02901392290
27	15405	0	1	HS3	SOUTH	1935	Y	8	Y8	40,304	12,488,329.37620	309.85334895400
28	3854	0	2	HS3	SOUTH	1935	Y	8	Y8	15,368	96,275.59893	6.26467978467
		(13) Listed as thinned with (15) unthinned								20.02 MBF per ACRE	54,205,056.93871	2707.62324769993
YELLOW HIGHLIGHTED UNITS WERE INVENTORIED.										23.01 MBF per ACRE	32,232,009.22304	1400.58116121833

Plots were placed in units found on Betton Island, the Cleveland Peninsula, Hump Island, Prince of Wales Island, and Revillagigedo Island. Each selected unit was mapped with a black and white orthophoto background as illustrated for Units 2 and 3 of the inventory (See Addendum, page 25). Part of the GIS mapping process included determining the latitude and longitude for each uniquely numbered plot and presenting them in the North America Datum 1983 (NAD 83) coordinate system that is compatible with handheld Geographic Positioning System (GPS) units. An example of the GPS coordinates for those plots assigned to Units 2 and 3 are shown in the Addendum at page 26.

Units selected for inventory included timber harvested as early as 1919 that is now over 90-years old. Units selected included thinned and un-thinned timber, changes in elevation from sea level to above 1,000', various aspect orientation, and varying age classes. Other units such as 19, 20 and 23-28 were selected because of their year of origin placing them in some of the older age classes.

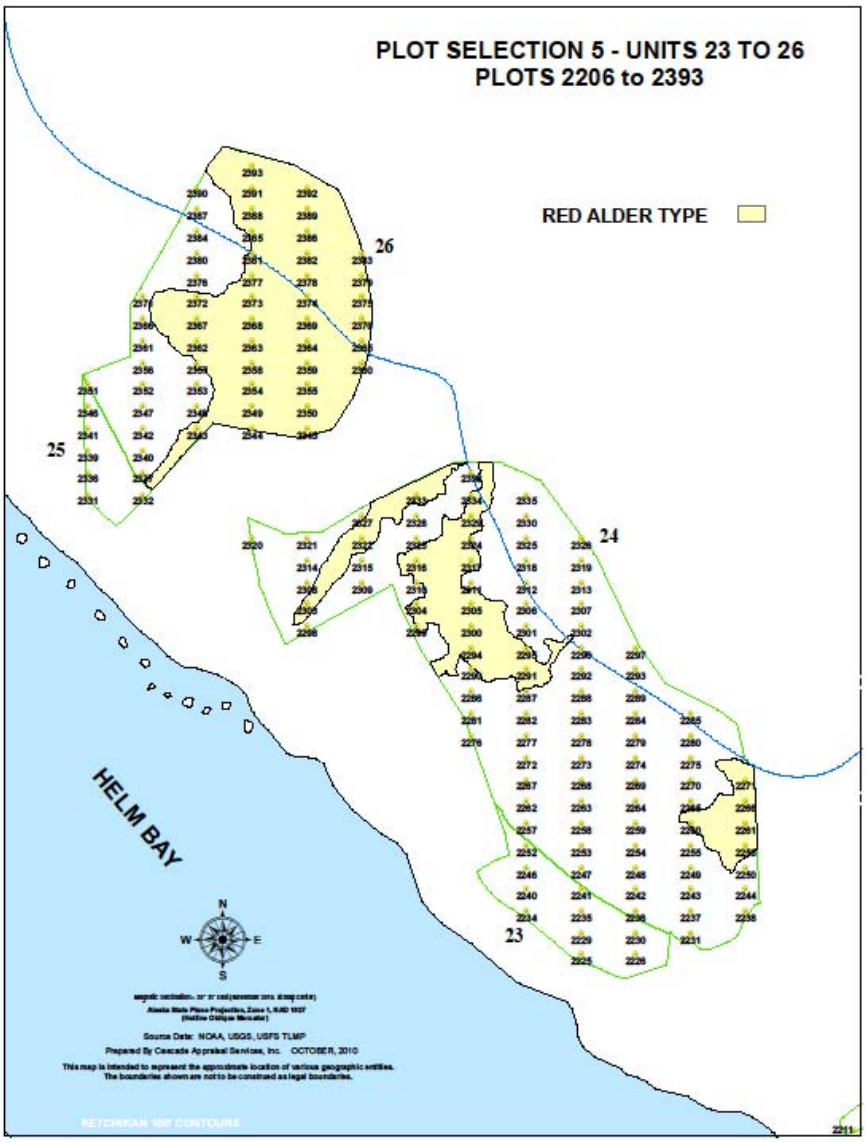
INVENTORY EXTENSION - The individual plot cards were entered into an extension program to calculate the volume estimate per unit. An example of the calculation printout for Unit 5 is shown in the Addendum at pages 27 and 28. These (2) pages show the type of information created from the field data in regards to tree size, log sizes, basal area, standard error, etc. The extension of the inventory data was done on a unit by unit basis (See Table 4 – Addendum, pages 29-31). The results were reviewed and in some instance a re-aggregation of the data was done to develop better information.

RE-AGGREGATION OF UNITS - Units 2 and 3 were combined to better reflect volume found on both units. Since Unit 3 was small in overall size (14.69 acres) certain tree species did not appear in the initial volume extension.

Units 5, 6 and 7 were also combined to develop a broader sample of this timber 42-year old age class. As indicated in the discussion at pages 3-5, it is this age class that represents the largest acreage component that has the earliest potential to become available for harvest in future decades.

Units 23-26 were combined into (2) units by taking Unit 23 and 24 as a separate re-aggregation along with Unit 25 and 26 also is combined into a single unit. This was done to adjust for the presence of large areas of Pacific red alder that have little industry value. This can be seen in the accompanying diagram to the right. The pale yellow areas are predominantly very poor quality Pacific red alder stands with some Sitka spruce and western hemlock trees growing up through the canopy. The situation precludes the harvest of the conifer species in these units that are found within the delineated hardwood stands. The result is a reduction in the overall area available for second growth harvest. These particular units are in the Helm Bay area on the north shore of the bay. The stands are some of the older ones inventoried. The Unit 23 and 24 timber was harvested in 1922. The Unit 25 and 26 timber was originally cut in 1919.

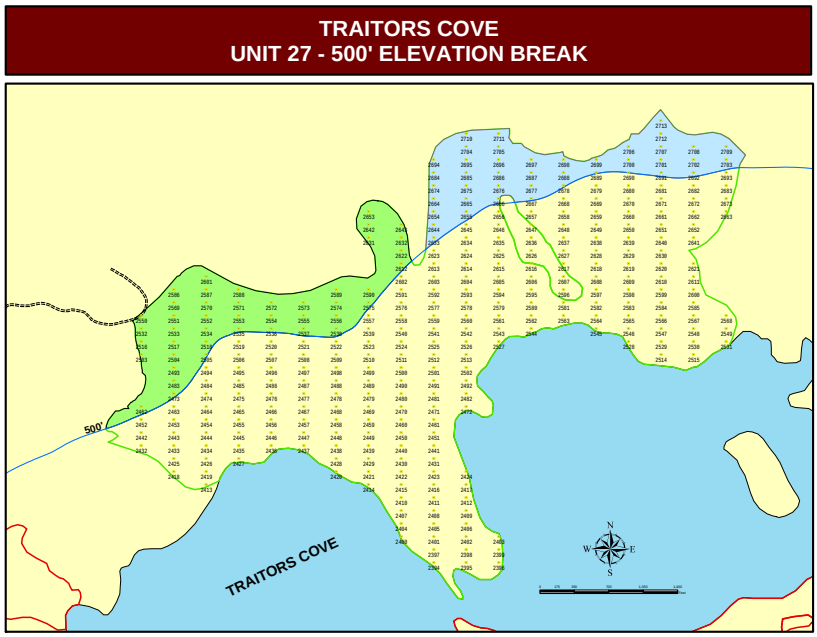
MAP 1



ELEVATION - Unit 27 is located in Traitors Cove north of Ketchikan on Revillagigedo Island. The unit was harvested in 1935 and is a rather large unit of 309.85 acres, excluding the slide area to the center east of the unit that has 6.26 acres. The unit was harvested from the cove with full utilization in the lower

portion of the unit below 500' elevation. Above the 500' elevation line the unit was partially cut with a series of vertical stringers or strips left with mature timber.

MAP 2



Plots taken above the 500' elevation were determined by GIS mapping of that specific elevation as seen here on the simplistic map to the left. The shape of the unit created (2) separate sub-types above the 500' mark. The plots for each of these sub-types were extended to derive the volume for that individual type. Additionally, the portion of the original unit was re-calculated to reflect those plots left under 500' . The volumes were compared along with other characteristics including species composition. That timber found above 500' is ±7% less in volume per acre and contains a 7% higher western hemlock component. The original harvesting of this unit, as discussed on the preceding page, creates a bias to the higher elevation because of strips of mature timber. Additional work would be required to confirm the variance.

ASPECT - Younger second growth found at the head of Staney Creek and harvested in 1969 was inventoried in Units 5, 6 and 7. As an example, Units 5, 6 & 7 were selected because they were all cut in the same year, they adjoin each other, have the same elevation, all have been thinned, but each has a different aspect. This keeps the majority of the variables constant with only the aspect changing and should provide a good indicator for that particular feature. Unit 5 has a west exposure and an inventoried gross volume of 6,701 BF/acre. Unit 6 exhibits a northern exposure and has an inventoried gross volume of 6,717 BF/acre. Unit 7 has an easterly aspect with an inventoried gross volume of 4,457 BF/acre. The easterly exposure has only ± 66% of the volume found on the northern and western slopes.

The final calculation of volumes for the inventoried units was then directly compared to those projected by the TNF. Table 2, page 21, in the summary section provides the analysis of that comparison.

SITE - Forestlands are typically classified by their relative productivity or site quality. The "site index" system has been developed as a practical, indirect method of estimating this timber growing potential. For a given species, site index is defined as the total height in feet of trees that have consistently been in a dominant or co-dominant position in well-stocked stands at a specified index age. Commonly used site indicators are at ages of 50 or 100 years. Using the site index, forest sites are typically classified into five site classes (I, II, III, IV, and V) with "I" being the most productive and "V" the least productive. In general terms, site class I is the best, site class II is good, site class III is average, and site class IV or below is poor. Under some analyses, this site class system is further broken down so that finer distinctions may be made.

One index was developed by Walter H. Meyer (USDA Technical Bulletin 544) in 1937 (MEYER) and is based upon the total height in feet of Sitka spruce and western hemlock trees at a total age of 100 years. MEYER plots totaled 658 with 294 in Oregon-Washington, 64 in British Columbia, and 300 in Alaska. The plot analysis concluded an average 100-year site index of 159 for Oregon and Washington, 127 for British Columbia, and 106 for the Alaska plots, decreasing with increase in latitude.

A second study by George H. Barnes (USDA Technical Bulletin 1273) in 1962 (BARNES) is also based upon total age at 100 years for western hemlock. The BARNES study was an attempt to correct discrepancies found in the MEYER study. BARNES used a total of 549 plots located in Oregon-Washington, British Columbia and Alaska. Oregon-Washington provided 252 plots, British Columbia 71 plots and Alaska 226 plots. BARNES concluded from his work that Alaska was predominately site class IV with 96% of the plots in classes IV – VI. Both the MEYER and the BARNES indices were used generally for old growth timber.

Young growth indices are most often based upon a breast height age (BH) at 50 years. The study by Wilbur A. Farr (USDA PNW-326) completed in 1984 (FARR) was entirely done in southeast Alaska with 31 plots taken in 1967-68 and 60 plots in 1977. All plots were located at elevations below 500 feet and most were adjacent to the shoreline. The 1967-68 plots were at a BH age of 110 to 180. The 1977 plots were mostly in stands 45 to 60 years old at BH. Several of the 91 plots were later eliminated because they did not have suitable hemlock and spruce trees. Suitable hemlock site trees were found on 57 of the plots and spruce on 71 of the plots.

The Kenneth N. Wiley study Site index tables for western hemlock in the Pacific Northwest (Weyerhaeuser Forestry Paper No. 17) in 1978 (WILEY) reported the results found on 109 sample plots in Washington, Oregon, and British Columbia. Site index samples consisted of the 10 trees of the largest DBH from a

group of 50 (all being hemlock). He based site index on BH age and total height at an index age of 50 years.

The site index studies done by FARR and that of WILEY for young growth western hemlock and Sitka spruce are all presented on a 50 year basis. Both indices are widely accepted by the industry and the one by FARR is used in Alaska by the USFS.

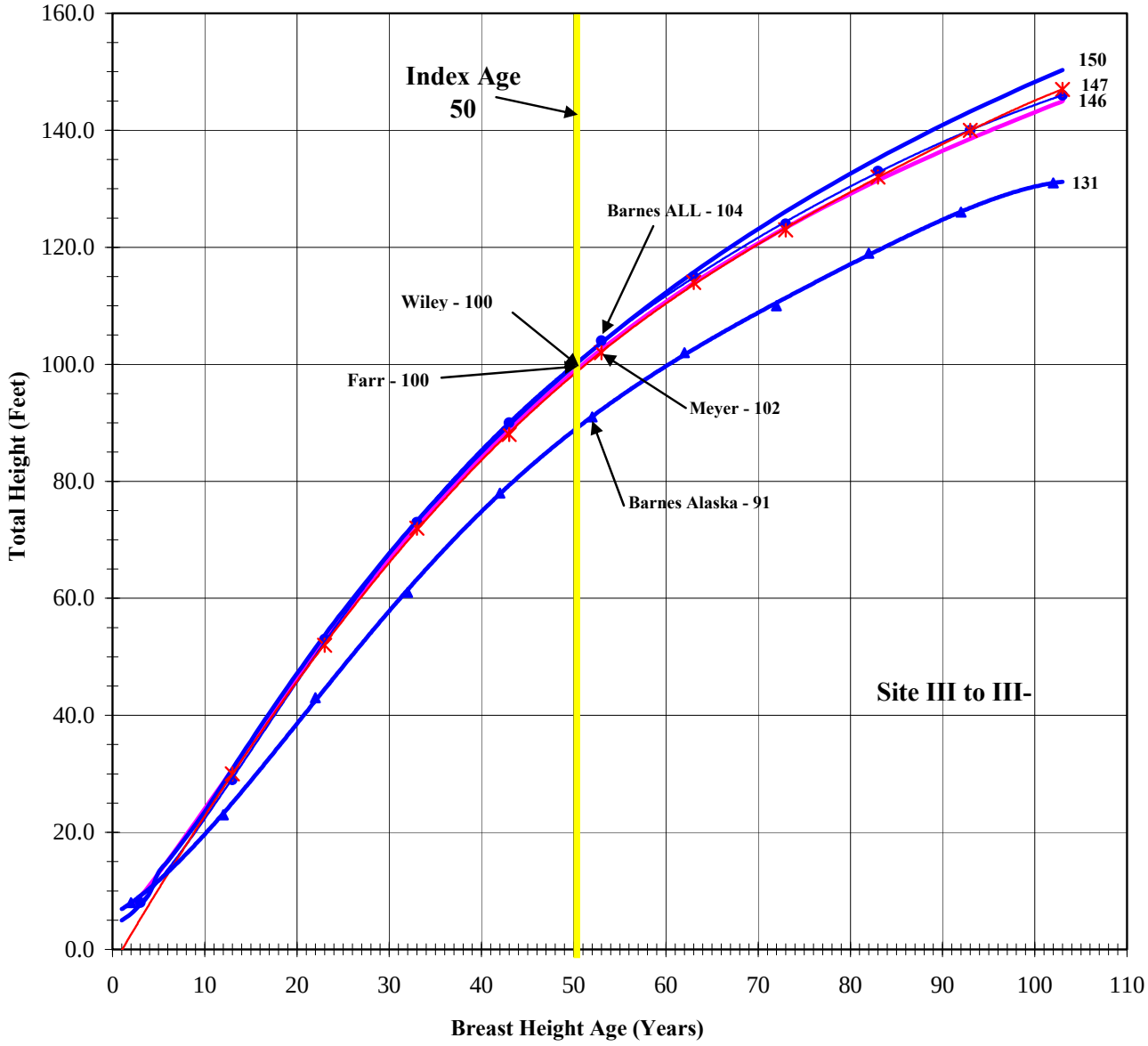
Graph 2, page 16, presents a visual representation of the site index curves for each of the 4 studies for western hemlock. The graph depicts total height in feet as it relates to site and age. NOTE that the site index curves on a 50 year basis are for site index 100 and on a 100 year basis for site index 140. This is necessary to compare indices that have different age basis. The 100-year indices are to a total age where the 50-year is to a BH. BARNES in his work added 7 years to the BH age for trees in Oregon and Washington; in British Columbia and Alaska, 8 years were added. The independent studies are very close in form and value even though they are from diverse areas. The BARNES study is the only one that compiles all of the data into a single table and then breaks Alaska out on a separate table. The apparent variance seen for the Alaska only curve may be a function of the site index selected for BARNES.

It is interesting to note the all of these prior studies rely upon on much fewer sample plots than the 2010 inventory conducted on the Tongass. In much of the prior work (MEYER, BARNES & others) the sample trees were felled and bucked. The FARR study fell trees on 1/5 acre plots and bucked them into sections at stump height, at breast height, at 10 feet, and succeeding 10 intervals up the tree.

The FARR study was selected for further review because of the close relationship to the WILEY study at the same index age and the fact that the USFS work generally uses FARR. Graph 3, page 17, compares the work accomplished by FARR for both western hemlock and Sitka spruce independently. The data graphed is based upon the formulae presented in the FARR study for each species. We have compared the two species for site index 80, site index 85, and site index 90. There is virtually no variance between the species up to BH age of 100 when hemlock starts to gain a height advantage. This indicates that the species can be viewed on a combined basis when examining the 2010 inventory data.

GRAPH 2

WESTERN HEMLOCK Site Index Curves
FARR & WILEY 50 Year Base Index - Site 100
BARNES & MEYER 100 Year Base Index - Site 140



Barnes, George H. Yield of EVEN-AGED STANDS OF WESTERN HEMLOCK. Technical Bulletin No. 1273. U. S. Department of Agriculture - Forest Srvice. Portland, Oregon September, 1962. 52 p.

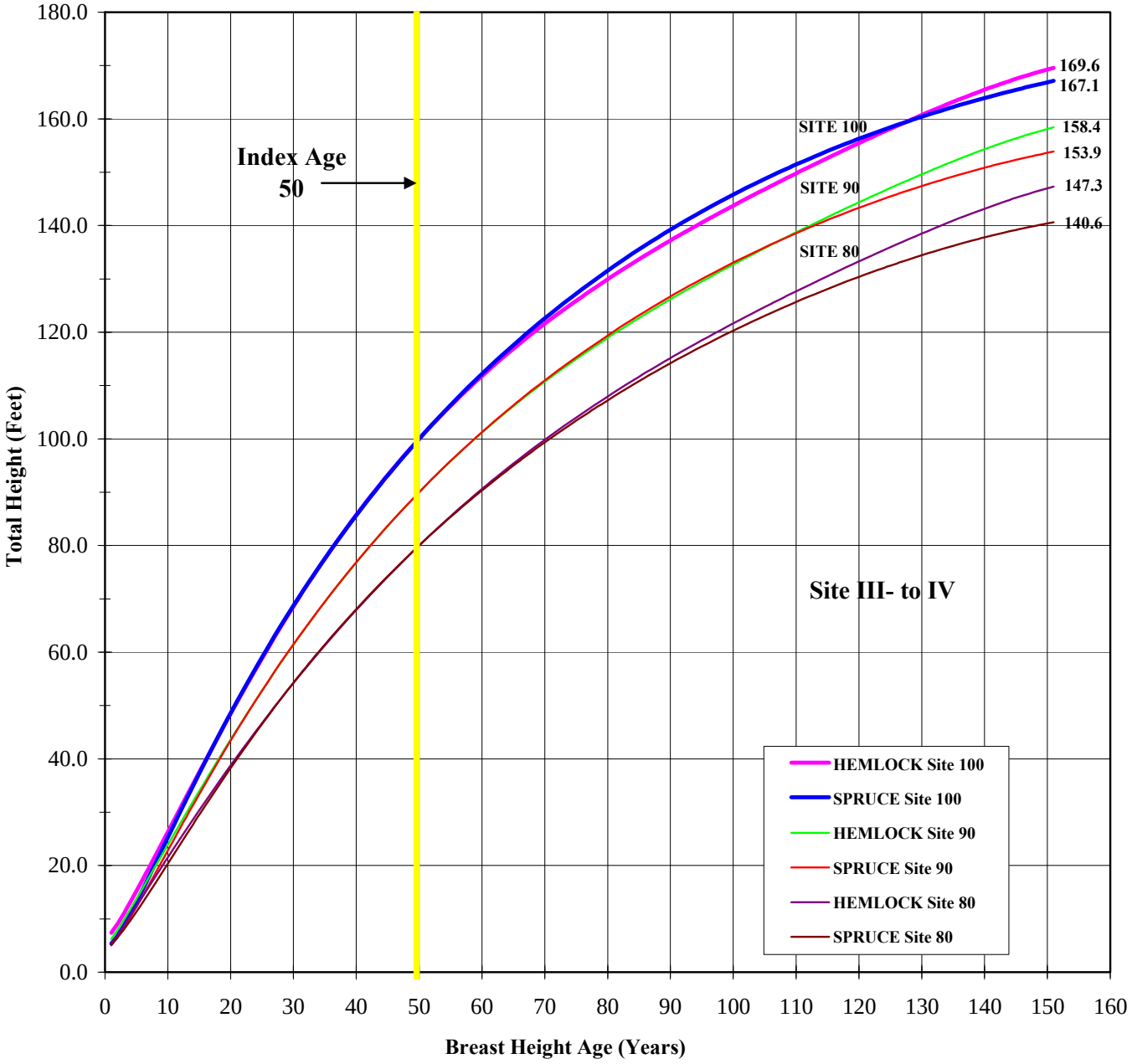
Farr, Wilbur A. Site index and height growth curves for unmanaged even-aged stands of western hemlock and Sitka Spruce in southeast Alaska. Re. Pap. PNW-326. Portland, OR: U.S. Department of Agriculture, Forest Service, PNW Research Station: 1984. 26 p

Meyer, Walter H. YIELD OF EVEN-AGED STANDS OF STIKA SPRUCE AND WESTERN HEMLOCK. Technical Bulletin No. 544. United States department of Agriculture, Washington, D. C. March, 1937. 86 p

Wiley, Kenneth N. 1978. Site Index curves for western hemlock in the Pacific Northwest. Weyerhaeuser Forestry Paper No. 17. Centralia, WA: Weyerhaeuser Forestry Research Center. Graph and tables actually generated using the published formulae.

GRAPH 3

50 Year Base Site Index Curves
WESTERN HEMLOCK and SITKA SPRUCE
FARR Site 80 - Site 90 - Site 100



Farr, Wilbur A. Site index and height growth curves for unmanaged even-aged stands of western hemlock and Sitka Spruce in southeast Alaska. Re. Pap. PNW-326. Portland, OR: U.S. Department of Agriculture, Forest Service, PNW Research Station: 1984. 26 p. ***Graph and tables actually generated using the published formulae.***

Total height was measured on (143) Sitka spruce trees and (164) western hemlock trees. A total of (20) trees from each species were rejected as either being a residual tree from the initial harvest or a suppressed tree not exhibiting dominant and/or co-dominant features. To develop an indication of site index, the individual trees were entered into the FARR formulae according to species.

SITKA SPRUCE

$$X_5 = -0.2050542+1.449615*LN(AA6) -0.01780992*(LN(AA6))^3 +0.00006519748*(LN(AA6))^5 -1.095593E-23*(LN(AA6))^30$$

$$X_6 = -5.611879+2.418604*LN(AA6) -0.259311*(LN(AA6))^2 +0.0001351445*(LN(AA6))^ -0.000000000001701139*(LN(AA6))^16 +7.964197E-27*(LN(AA6))^36$$

$$HT = 4.5+EXP(AC6)-EXP(AD6)*86.43+EXP(AD6)*(SiteIndex-4.5)$$

WESTERN HEMLOCK

$$X_2 = 0.3621734+1.149181*LN(AA6) -0.005617852*(LN(AA6))^3 -0.000007267547*(LN(AA6))^7 +1.708195E-16*(LN(AA6))^22 -2.482794E-22*(LN(AA6))^30$$

$$X_3 = -2.146617-0.109007*LN(AA6) +0.099403*(LN(AA6))^3 -0.003853396*(LN(AA6))^5 +0.00000001193933*(LN(AA6))^12 -9.486544E-20*(LN(AA6))^27 +1.431925E-26*(LN(AA6))^36$$

$$HT = 4.5+EXP(AC6)-EXP(AD6)*83.2+EXP(AD6)*(SiteIndex-4.5)$$

A program was developed in Microsoft Excel format as an aid in calculating the site index. The BH age of a single tree or a series of trees is entered along with the respective total height(s) and the site index is calculated. The given site index or an average of site tree indices can be entered into the graph portion of the program and the corresponding FARR site index curve is plotted listing BH age and height from 5-year old to 104-year old – a 100-year span.

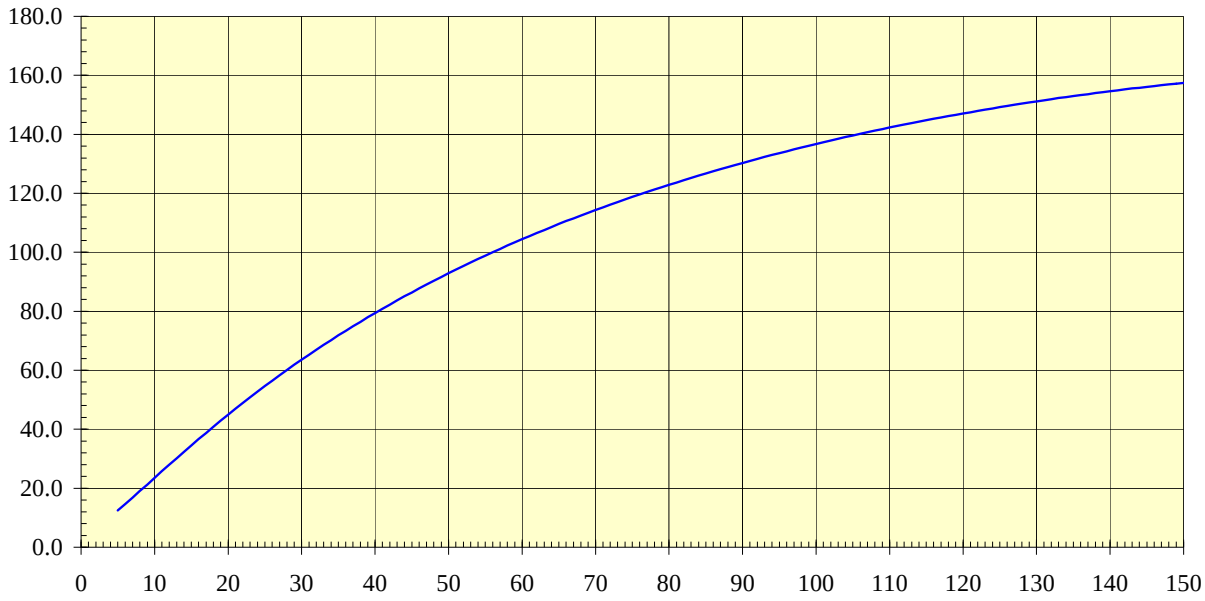
The average site index for Sitka spruce was calculated at 92.9 or 93. The site index for western hemlock averaged 86.8 or 87. The FARR site index curve for Sitka spruce is shown on Graph 4, page 19. The western hemlock site index curve is shown on Graph 5, page 20.

GRAPH 4

Site Index 92.9

Site Index and Height Growth Curves For SITKA SPRUCE In Southeast Alaska

FARR - Unmanaged Even-Aged ***(Fifty Year Base Index)***



BH Age	Height	BH Age	Height	BH Age	Height	BH Age	Height
5	12.5	30	63.6	55	98.9	80	122.9
6	14.6	31	65.3	56	100.0	81	123.7
7	16.8	32	66.9	57	101.2	82	124.5
8	19.0	33	68.6	58	102.3	83	125.2
9	21.3	34	70.2	59	103.4	84	126.0
10	23.5	35	71.8	60	104.4	85	126.7
11	25.8	36	73.4	61	105.5	86	127.5
12	28.0	37	74.9	62	106.5	87	128.2
13	30.2	38	76.4	63	107.6	88	128.9
14	32.4	39	77.9	64	108.6	89	129.6
15	34.5	40	79.4	65	109.6	90	130.3
16	36.7	41	80.9	66	110.6	91	131.0
17	38.8	42	82.3	67	111.5	92	131.7
18	40.9	43	83.7	68	112.5	93	132.3
19	42.9	44	85.1	69	113.4	94	133.0
20	44.9	45	86.4	70	114.4	95	133.6
21	46.9	46	87.8	71	115.3	96	134.3
22	48.9	47	89.1	72	116.2	97	134.9
23	50.8	48	90.4	73	117.1	98	135.5
24	52.8	49	91.6	74	117.9	99	136.1
25	54.6	50	92.9	75	118.8	100	136.7
26	56.5	51	94.1	76	119.6	101	137.3
27	58.3	52	95.4	77	120.5	102	137.9
28	60.1	53	96.5	78	121.3	103	138.5
29	61.8	54	97.7	79	122.1	104	139.1

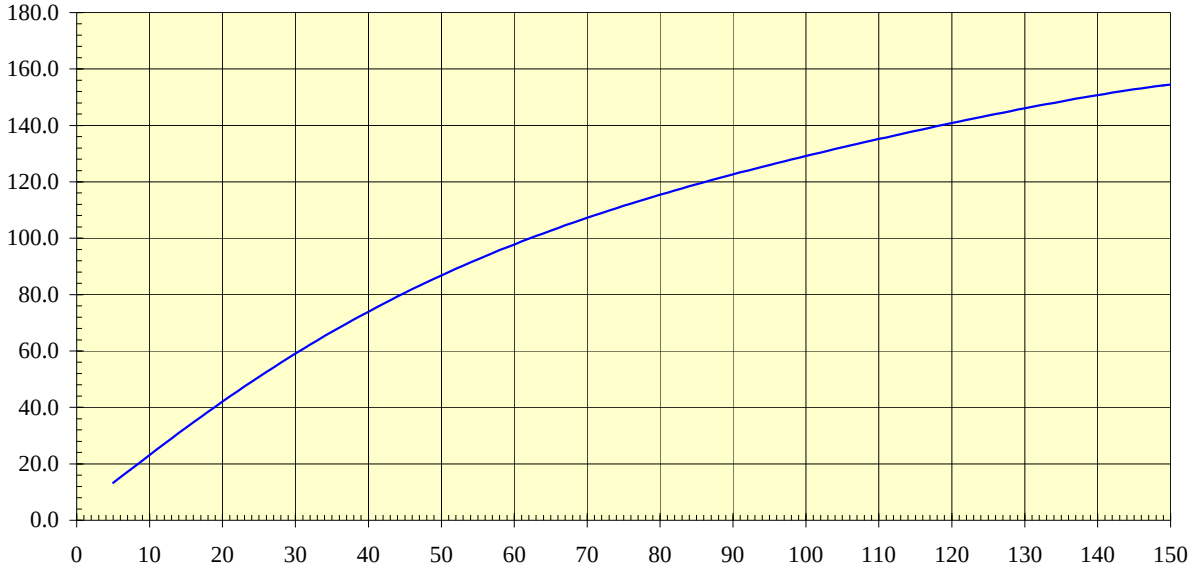
Source: **Farr, Wilbur A**. Site index and height growth curves for unmanaged even-aged stands of western hemlock and Sitka Spruce in southeast Alaska. Re. Pap. PNW-326. Portland, OR: U.S. Department of Agriculture, Forest Service, PNW Research Station: **1984**. 26 p.

GRAPH 5

Site Index 86.8

Site Index and Height Growth Curves For WESTERN HEMLOCK In Southeast Alaska

FARR - Unmanaged Even-Aged ***(Fifty Year Base Index)***



BH Age	Height	BH Age	Height	BH Age	Height	BH Age	Height
5	13.3	30	59.1	55	92.5	80	115.4
6	15.3	31	60.7	56	93.6	81	116.2
7	17.2	32	62.2	57	94.7	82	116.9
8	19.2	33	63.8	58	95.7	83	117.7
9	21.2	34	65.3	59	96.8	84	118.4
10	23.1	35	66.8	60	97.8	85	119.1
11	25.1	36	68.3	61	98.8	86	119.8
12	27.1	37	69.7	62	99.8	87	120.6
13	29.0	38	71.2	63	100.8	88	121.3
14	30.9	39	72.6	64	101.7	89	121.9
15	32.8	40	74.0	65	102.7	90	122.6
16	34.7	41	75.3	66	103.6	91	123.3
17	36.6	42	76.7	67	104.6	92	124.0
18	38.4	43	78.0	68	105.5	93	124.7
19	40.3	44	79.3	69	106.4	94	125.3
20	42.1	45	80.6	70	107.2	95	126.0
21	43.9	46	81.9	71	108.1	96	126.6
22	45.6	47	83.2	72	109.0	97	127.3
23	47.4	48	84.4	73	109.8	98	127.9
24	49.1	49	85.6	74	110.6	99	128.5
25	50.8	50	86.8	75	111.5	100	129.2
26	52.5	51	88.0	76	112.3	101	129.8
27	54.2	52	89.1	77	113.1	102	130.4
28	55.9	53	90.3	78	113.9	103	131.0
29	57.5	54	91.4	79	114.6	104	131.6

Source: Farr, Wilbur A. Site index and height growth curves for unmanaged even-aged stands of western hemlock and Sitka Spruce in southeast Alaska. Re. Pap. PNW-326. Portland, OR: U.S. Department of Agriculture, Forest Service, PNW Research Station: 1984. 26 p

SUMMARY

The overall volume is ± 10% below the TNF estimate in the combined aggregate using the direct extension volumes by unit. There is a ± 14% total volume reduction in TNF volume when re-aggregated results are viewed. The initial field work extension shows no consistent correlation in one direction for all units. The direction of movement, up and/or down, in comparison to the base TNF projected volume varies by age class.

TABLE 2

TONGASS NATIONAL FOREST
2010 SECOND GROWTH VOLUME INVENTORY
COMPARATIVE RESULTS TO TNF VOLUME PROJECTIONS

UNIT NO.	THIN.	PROD_GRP	YEAR OF ORIGIN	Age	ACRES	Volume Per ACRE - TNF (BF)	Volume Per POLYGON TNF (MBF)	Vol per acre diff.	INVENTORIED VOLUME PER ACRE (BF)	TOTAL NET VOLUME (MBF)	VARIANCE ON TOTAL NET VOLUME
25	NO	3	1919	92	3.8757	1,851	7	558	1,293	5	
26	NO	1	1919	92	50.03	40,304	2,016	15,617	24,687	1,235	
23	NO	3	1922	89	9.96	1,851	18	(14,177)	16,028	160	
24	NO	1	1922	89	92.85	40,304	3,742	754	39,550	3,672	
19	NO	1	1924	87	54.98	40,304	2,216	3,741	36,563	2,010	
20	NO	2	1924	87	139.79	15,368	2,148	(26,353)	41,721	5,832	
				88	351.48	28,873	10,148	(7,869)	36,741	12,914	27.26%
							0				
27	NO	1	1935	76	309.85	40,304	12,488	31,465	8,839	8,839	
28	NO	2	1935	76	6.26	15,368	96	6,049	9,319	58	
2	NO	1	1945	66	48.27	29,003	1,400	(12,538)	41,541	2,005	
3	NO	1	1945	66	14.69	29,003	426	10,839	18,164	267	
				74	379.08	38,015	14,411	8,551	29,464	11,169	-22.50%
							0				
13	YES	1	1960	51	83.75	11,452	959	3,040	8,412	705	
14	YES	1	1960	51	73.30	11,452	839	5,782	5,670	416	
15	YES	1	1962	49	49.38	11,452	566	(5,645)	17,097	844	
				50	206.43	11,452	2,364	1,933	9,519	1,965	-16.88%
							0				
5	YES	1	1969	42	211.84	11,452	2,426	5,250	6,202	1,314	
6	YES	1	1969	42	141.49	11,452	1,620	4,735	6,717	950	
7	YES	1	1969	42	110.26	11,452	1,263	7,189	4,263	469	
				42	463.59	11,452	5,309	5,557	5,895	2,733	-48.52%
					1400.58 ACRES		32,232 MBF			28,781 MBF	-10.71%
RE-AGGREGATED UNIT VOLUME COMPARISON										27,720 MBF	-14.00%

The 41-50-year old units (5-6 and 13-15) show more consistency than the others. The volume in this age class is only ± 61% of the TNF estimate with the exception of Unit 15. Unit 15 exhibits a positive increase over the TNF. When removed from the unit selection it would drop the comparison to about 54% of the TNF estimate. All of these units were cut in the 60's and have been thinned. There are (5) more units in the Staney Creek drainage (Units 8-12) that fall into the same

category as to thinning and age. These units were mapped but no field data was taken due to time constraints during the field work segment.

Units inventoried in the 60-80 year old class exhibit 22.5% less volume when compared to the TNF estimates for the same areas. These units were harvested in 1935 and 1945. These are un-thinned stands that again show one unit increasing in volume comparison.

Stands over 80 years in age show a positive increase of 27.26% that can be attributable to the single unit on Betton Island. This particular unit carries a Prod_Grp 2 classification that drops the volume from Prod_Grp 1 of 40,304 BF down to 15,368 BF.

Referencing Graph 1, page 4, the contributory percentages for timber by age class in the 41-year and older categories we see the following percentage distribution:

AGE 41-60	**94,469.2 acres**	**97.94%**
AGE 61-80	**1,577.6 acres**	**1.63%**
AGE 80+	**411.2 acres**	**.43%**

The volume variance as directly calculated in this inventory study and weighted by contributing acreage of earliest available young growth stands indicates that the TNF volume may be overestimated by 37.5%. Note that the volumes reported and discussed herein represent full utilization of a given stand. If the entire stand volume is not harvested, a proportionate reduction in volume is necessary.

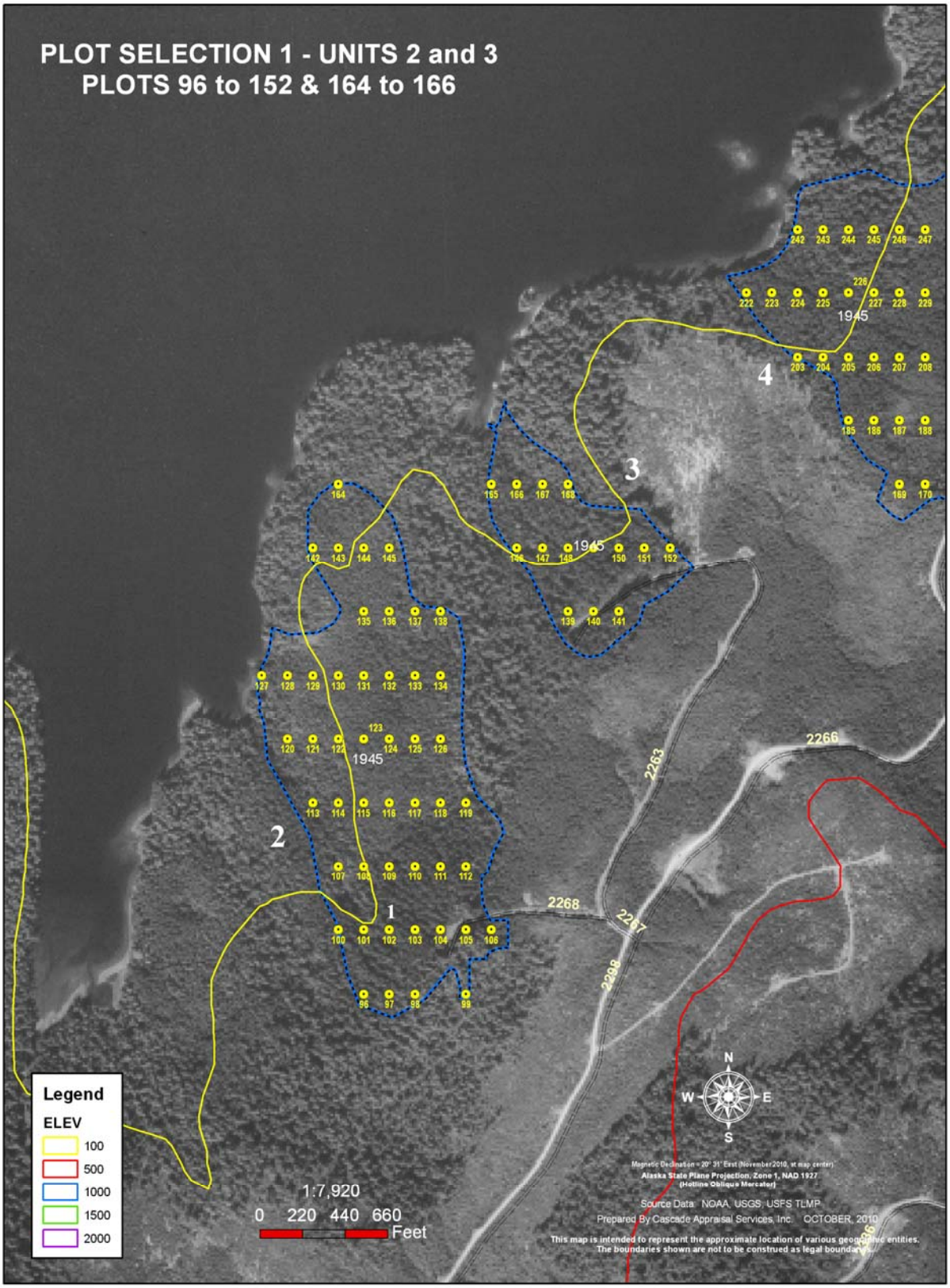
The age classes of greatest significance, AGE 41-60, show the greatest variance in volume reduction. These stands are thinned but lightly stocked with a basal area of less than 92 square feet. The average diameter is 12.2" DBH and the bole length is 32 feet. Harvesting timber prematurely as seen in the cover photo destroys the future potential and removes that acreage from the next rotation. The young growth resource at this age is not ready and will not be available in sufficient volume for decades into the future.

Since the sample is designed as a random selection with a traceable methodology, it is also possible to add to the sample at any time to correct specific deficiencies that may develop or target certain areas. An example would be the estimation of volume found within a specified distance and/or multiples of various distances from roads or stream courses. Another may be the volume surrounding eagles nesting trees.

Additional sampling capability only needs to be designed into the model by making these areas distinct polygons (stand types) when pre-mapping additional

project work. If they are distinct stands, they would be sampled in the overall update. These areas can also be more intensely sampled by making them the general population and excluding all other stand types.

ADDENDUM


PLOT SELECTION 1 - UNITS 2 and 3
PLOTS 96 to 152 & 164 to 166
1945
1945
1945
2
3
4
1
2263
2266
2268
2267
2269
Legend
ELEV
100
500
1000
1500
2000
1:7,920
0 220 440 660
Feet
N
W
E
S
Source Data: NOAA, USGS, USFS TLMP
Prepared By Cascade Appraisal Services, Inc. OCTOBER, 2010
This map is intended to represent the approximate location of various geographic entities.
The boundaries shown are not to be construed as legal boundaries.

TNF SECOND GROWTH INVENTROY

PLOT LIST LATITUDE/LONGITUDE – UNITS 2 AND 3

TABLE 3

PLOT ID	YEAR	Timber Type	ELEV.	Stand	Decimal Degrees Longitude NAD83	Decimal Degrees Latitude NAD83	Degrees Minutes Longitude NAD83	Degrees Minutes Latitude NAD83
96	1945	HS3	100'-500'	2	133.21027358200	55.78478521050	-133° 12.616415	55° 47.087113'
97	1945	HS3	100'-500'	2	133.20963221900	55.78478277090	-133° 12.577933	55° 47.086966'
98	1945	HS3	100'-500'	2	133.20899085500	55.78478032790	-133° 12.539451	55° 47.086820'
99	1945	HS3	100'-500'	2	133.20770812700	55.78477543190	-133° 12.462488	55° 47.086526'
100	1945	HS3	100'-500'	2	133.21090402800	55.78569110710	-133° 12.654242	55° 47.141466'
101	1945	HS3	100'-500'	2	133.21026265000	55.78568867070	-133° 12.615759	55° 47.141320'
102	1945	HS3	100'-500'	2	133.20962127200	55.78568623090	-133° 12.577276	55° 47.141174'
103	1945	HS3	100'-500'	2	133.20897989400	55.78568378770	-133° 12.538794	55° 47.141027'
104	1945	HS3	100'-500'	2	133.20833851600	55.78568134120	-133° 12.500311	55° 47.140880'
105	1945	HS3	100'-500'	2	133.20769713900	55.78567889130	-133° 12.461828	55° 47.140733'
106	1945	HS3	100'-500'	2	133.20705576100	55.78567643800	-133° 12.423346	55° 47.140586'
107	1945	HS3	≤100'	2	133.21089311000	55.78659456740	-133° 12.653587	55° 47.195674'
108	1945	HS3	≤100'	2	133.21025171800	55.78659213070	-133° 12.615103	55° 47.195528'
109	1945	HS3	100'-500'	2	133.20961032500	55.78658969070	-133° 12.576620	55° 47.195381'
110	1945	HS3	100'-500'	2	133.20896893300	55.78658724740	-133° 12.538136	55° 47.195235'
111	1945	HS3	100'-500'	2	133.20832754100	55.78658480070	-133° 12.499652	55° 47.195088'
112	1945	HS3	100'-500'	2	133.20768615000	55.78658235060	-133° 12.461169	55° 47.194941'
113	1945	HS3	≤100'	2	133.21152359700	55.78750046110	-133° 12.691416	55° 47.250028'
114	1945	HS3	≤100'	2	133.21088219100	55.78749802760	-133° 12.652931	55° 47.249882'
115	1945	HS3	100'-500'	2	133.21024078500	55.78749559080	-133° 12.614447	55° 47.249735'
116	1945	HS3	100'-500'	2	133.20959937800	55.78749315060	-133° 12.575963	55° 47.249589'
117	1945	HS3	100'-500'	2	133.20895797200	55.78749070700	-133° 12.537478	55° 47.249442'
118	1945	HS3	100'-500'	2	133.20831656600	55.78748826020	-133° 12.498994	55° 47.249296'
119	1945	HS3	100'-500'	2	133.20767516000	55.78748580990	-133° 12.460510	55° 47.249149'
120	1945	HS3	≤100'	2	133.21215411300	55.78840635170	-133° 12.729247	55° 47.304381'
121	1945	HS3	≤100'	2	133.21151269200	55.78840392140	-133° 12.690762	55° 47.304235'
122	1945	HS3	≤100'	2	133.21087127200	55.78840148770	-133° 12.652276	55° 47.304089'
123	1945	HS3	100'-500'	2	133.21022985100	55.78839905070	-133° 12.613791	55° 47.303943'
124	1945	HS3	100'-500'	2	133.20958843100	55.78839661040	-133° 12.575306	55° 47.303797'
125	1945	HS3	100'-500'	2	133.20894701100	55.78839416660	-133° 12.536821	55° 47.303650'
126	1945	HS3	100'-500'	2	133.20830559100	55.78839171960	-133° 12.498335	55° 47.303503'
127	1945	HS3	≤100'	2	133.21278465600	55.78931223920	-133° 12.767079	55° 47.358734'
128	1945	HS3	≤100'	2	133.21214322100	55.78930981210	-133° 12.728593	55° 47.358589'
129	1945	HS3	≤100'	2	133.21150178700	55.78930738160	-133° 12.690107	55° 47.358443'
130	1945	HS3	100'-500'	2	133.21086035200	55.78930494780	-133° 12.651621	55° 47.358297'
131	1945	HS3	100'-500'	2	133.21021891800	55.78930251060	-133° 12.613135	55° 47.358151'
132	1945	HS3	100'-500'	2	133.20957748300	55.78930007010	-133° 12.574649	55° 47.358004'
133	1945	HS3	100'-500'	2	133.20893604900	55.78929762620	-133° 12.536163	55° 47.357858'
134	1945	HS3	100'-500'	2	133.20829461500	55.78929517890	-133° 12.497677	55° 47.357711'
135	1945	HS3	100'-500'	2	133.21020798400	55.79020597040	-133° 12.612479	55° 47.412358'
136	1945	HS3	100'-500'	2	133.20956653600	55.79020352970	-133° 12.573992	55° 47.412212'
137	1945	HS3	100'-500'	2	133.20892508700	55.79020108560	-133° 12.535505	55° 47.412065'
138	1945	HS3	100'-500'	2	133.20828363900	55.79019863820	-133° 12.497018	55° 47.411918'
139	1945	HS3	100'-500'	3	133.20507639700	55.79018635060	-133° 12.304584	55° 47.411181'
140	1945	HS3	100'-500'	3	133.20443494900	55.79018388300	-133° 12.266097	55° 47.411033'
141	1945	HS3	100'-500'	3	133.20379350100	55.79018141200	-133° 12.227610	55° 47.410885'
142	1945	HS3	≤100'	2	133.21147997500	55.79111430200	-133° 12.688799	55° 47.466858'
143	1945	HS3	≤100'	2	133.21083851300	55.79111186780	-133° 12.650311	55° 47.466712'
144	1945	HS3	100'-500'	2	133.21019705000	55.79110943020	-133° 12.611823	55° 47.466566'
145	1945	HS3	100'-500'	2	133.20955558700	55.79110698930	-133° 12.573335	55° 47.466419'
146	1945	HS3	≤100'	3	133.20634827500	55.79109473430	-133° 12.380897	55° 47.465684'
147	1945	HS3	≤100'	3	133.20570681200	55.79109227330	-133° 12.342409	55° 47.465536'
148	1945	HS3	≤100'	3	133.20506535000	55.79108980890	-133° 12.303921	55° 47.465389'
149	1945	HS3	≤100'	3	133.20442388800	55.79108734110	-133° 12.265433	55° 47.465240'
150	1945	HS3	100'-500'	3	133.20378242600	55.79108486990	-133° 12.226946	55° 47.465092'
151	1945	HS3	100'-500'	3	133.20314096300	55.79108239550	-133° 12.188458	55° 47.464944'
152	1945	HS3	100'-500'	3	133.20249950100	55.79107991760	-133° 12.149970	55° 47.464795'
153	1945	HS3	100'-500'	4	133.19416049800	55.79104740010	-133° 11.649630	55° 47.462844'
154	1945	HS3	100'-500'	4	133.19351903700	55.79104487530	-133° 11.611142	55° 47.462693'
155	1945	HS3	100'-500'	4	133.19287757500	55.79104234710	-133° 11.572655	55° 47.462541'
156	1945	HS3	100'-500'	4	133.19223611400	55.79103981550	-133° 11.534167	55° 47.462389'
157	1945	HS3	100'-500'	4	133.19159465300	55.79103728060	-133° 11.495679	55° 47.462237'
158	1945	HS3	≥500'	4	133.19095319100	55.79103474230	-133° 11.457191	55° 47.462085'
159	1945	HS3	≥500'	4	133.19031173000	55.79103220070	-133° 11.418704	55° 47.461932'
160	1945	HS3	≥500'	4	133.18967026900	55.79102965570	-133° 11.380216	55° 47.461779'
161	1945	HS3	≥500'	4	133.18902880800	55.79102710740	-133° 11.341728	55° 47.461626'
162	1945	HS3	≥500'	4	133.18838734700	55.79102455570	-133° 11.303241	55° 47.461473'
163	1945	HS3	≥500'	4	133.18774588600	55.79102200060	-133° 11.264753	55° 47.461320'
164	1945	HS3	≤100'	2	133.21082759200	55.79201532760	-133° 12.649656	55° 47.520920'
165	1945	HS3	≤100'	3	133.20697873200	55.79200065080	-133° 12.418724	55° 47.520039'
166	1945	HS3	≤100'	3	133.20633725600	55.79199819290	-133° 12.380235	55° 47.519892'
167	1945	HS3	≤100'	3	133.20569577900	55.79199573170	-133° 12.341747	55° 47.519744'
168	1945	HS3	≤100'	3	133.20505430300	55.79199326710	-133° 12.303258	55° 47.519596'
169	1945	HS3	100'-500'	4	133.19671511300	55.79196092170	-133° 11.802907	55° 47.517655'
170	1945	HS3	100'-500'	4	133.19607363800	55.79195841010	-133° 11.764418	55° 47.517505'

TC TSPCSTGR

Species, Sort Grade - Board Foot Volumes (Type)

Project: ALASKA

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Date 1/27/2011
Time 12:39:38PM

T71S R81E S9 T0005

Twp	Rge	Sec	Tract	Type	Acre	Plots	Sample Trees	CuFt	BdFt
71S	81E	9	STANEY	0005	211.84	216	142	S	W

T71S R81E S9 T0005

Spp	St	So rt	Gr ad	% Net BdFt	Bd. Ft. per Acre Def%	Gross	Net	Total Net MBF	Percent Net Board Foot Volume: Log Scale Dia. 4-5	6-11	12-16	17+	Log Length 12-20	21-30	31-35	36-99	Average Log: Ln Ft	Bd Ft	CF/ Lf	Logs Per /Acre
SS		DM	1S	2	10.0	107	96	20				100				100	40	4040	18.08	.0
SS		DM	2S	20	15.5	952	805	170		2	12	85	1		11	88	34	729	4.55	1.1
SS		DM	3S	47	1.0	1,937	1,919	406		92	8		1	2	31	66	35	81	0.76	23.7
SS		DM	4S	26	2.2	1,096	1,073	227	18	82			38	58	2	2	22	26	0.36	41.6
SS		DM	SM	4		168	168	36				100				100	38	767	3.65	.2
SS		DM	UT	0	17.3	24	20	4		42		58	58	42			25	45	0.87	.4
SS	**Totals**			66	4.8	4,284	4,079	864	5	65	6	24	11	17	17	55	27	61	0.66	67.0
WH		DM	2S	17	29.5	508	358	76			64	36				100	38	299	2.38	1.2
WH		DM	3S	45	6.9	1,003	934	198		94	6		1	1	37	61	35	66	0.62	14.1
WH		DM	4S	27	4.6	593	566	120	11	89			20	77		3	24	29	0.41	19.6
WH		DM	UT	10	18.6	261	212	45		25	4	71	4		8	89	35	205	1.77	1.0
WH	**Totals**			33	12.5	2,365	2,070	438	3	69	14	14	6	22	17	55	30	58	0.64	35.9
RC		DM	4S	100		52	52	11		100				100			23	30	0.59	1.7
RC	**Totals**			1		52	52	11		100				100			23	30	0.59	1.7
Type Totals					7.5	6,701	6,202	1,314	4	67	9	20	9	19	17	55	28	59	0.65	104.7

TC TSTATS

STATISTICS

PROJECT ALASKA

PAGE 1
DATE 1/27/2011

TWP	RGE	SECT	TRACT	TYPE	ACRES	PLOTS	TREES	CuFt	BdFt
71S	81E	9	STANEY	0005	211.84	216	835	S	W

	PLOTS	TREES	TREES PER PLOT	ESTIMATED TOTAL TREES	PERCENT SAMPLE TREES
TOTAL	216	835	3.9		
CRUISE	31	142	4.6	19,226	.7
DBH COUNT					
REFOREST					
COUNT	145	693	4.8		
BLANKS	40				
100 %					

STAND SUMMARY

	SAMPLE TREES	TREES /ACRE	AVG DBH	BOLE LEN	REL DEN	BASAL AREA	GROSS BF/AC	NET BF/AC	GROSS CF/AC	NET CF/AC
S SPRUCE	92	56.9	12.3	33		47.3	4,284	4,079	1,179	1,179
WHEMLOCK	48	32.1	12.8	35	6	28.5	2,365	2,070	679	679
WR CEDAR	2	1.7	12.5	24		1.5	52	52	24	24
TOTAL	*142*	*90.8*	*12.5*	*33*		*77.3*	*6,701*	*6,202*	*1,881*	*1,882*

SD: 1	COEFF VAR.%	S.E.%	SAMPLE TREES - BF LOW	AVG	HIGH	# OF TREES REQ. 5	10	INF. POP. 15
S SPRUCE	452.7	38.0	174	280	387			
WHEMLOCK	378.7	31.8	37	54	71			
WR CEDAR	839.6	70.5	0	0	1			
TOTAL	*380.7*	*31.9*	*228*	*335*	*441*	*5,797*	*1,449*	*644*

SD: 1	COEFF VAR.%	S.E.%	TREES/ACRE LOW	AVG	HIGH	# OF PLOTS REQ. 5	10	INF. POP. 15
S SPRUCE	105.9	7.2	53	57	61			
WHEMLOCK	124.0	8.4	29	32	35			
WR CEDAR	616.3	41.9	1	2	2			
TOTAL	*86.0*	*5.8*	*85*	*91*	*96*	*296*	*74*	*33*

SD: 1	COEFF VAR.%	S.E.%	NET BF/ACRE LOW	AVG	HIGH	# OF PLOTS REQ. 5	10	INF. POP. 15
S SPRUCE	115.7	7.9	3,758	4,079	4,400			
WHEMLOCK	133.1	9.1	1,882	2,070	2,257			
WR CEDAR	616.3	41.9	30	52	74			
TOTAL	*97.7*	*6.6*	*5,790*	*6,202*	*6,614*	*382*	*95*	*42*

TABLE 4

TONGASS NATIONAL FOREST
2010 SECOND GROWTH VOLUME INVENTORY
UNIT SUMMARY DATA W/RE-AGGREGATED ANALYSIS

TONGASS NATIONAL FOREST DATA								
UNIT NO.	TWP	RGE	SEC	TRACT AREA	ACRES	YEAR OF ORIGIN	AGE	THINNED
	COPPER RIVER MERIDIAN							
2	70S	80E	18-19	WINTER HARBOR	48.27	1945	66	NO
3	70S	80E	18-19	WINTER HARBOR	14.69	1945	66	NO
COMBINED	70S	80E	18-19	WINTER HARBOR	62.96	1945	66	NO
5	71S	81E	8, 9, 16, & 17	STANEY CR.	211.84	1969	42	YES
6	71S	81E	4, 8, & 9	STANEY CR.	141.49	1969	42	YES
7	71S	81E	9	STANEY CR.	110.26	1969	42	YES
COMBINED	71S	81E	4, 8, 9, 16, & 17	STANEY CR.	463.59	1969	42	
13	74S	83E	20	HYDABURG RD.	83.75	1960	51	YES
14	74S	83E	20	HYDABURG RD.	73.30	1960	51	YES
15	74S	83E	9	HOLLIS/CRAIG HWY.	49.38	1962	49	YES
19	73S	90E	20,21, & 29	HUMP ISL.	54.98	1924	87	NO
20	73S	90E	17-20	BETTON ISL.	139.79	1924	87	NO
23	72S	88E	6	HELM BAY	9.96	1922	89	NO
24	71S/72S	88E	31/6	HELM BAY	92.85	1922	89	NO
COMBINED	71S/72S	88E	31/6	HELM BAY HARDWOOD TYPE CONIFER TYPE	102.81 17.97 84.84	1922		
25	71S	87E	36	HELM BAY	3.88	1919	92	NO
26	71S	87E/88E	36/31	HELM BAY	50.03	1919	92	NO
COMBINED	71S	87E/88E	36/31	HELM BAY HARDWOOD TYPE CONIFER TYPE	53.91 33.99 19.92	1919		
27	71S	90E	3-5, 8, & 9	TRAITORS COVE	309.85	1935	76	NO
ELEVATION	71S	90E	3-5, 8, & 9	TRAITORS COVE HIGH ELEVATION LOW ELEVATION	309.85 81.98 227.87	1935		
28	71S	90E	4	TRAITORS COVE	6.26	1935	76	NO
TOTAL					1400.58 ACRES			

TABLE 4

TONGASS NATIONAL FOREST
2010 SECOND GROWTH VOLUME INVENTORY
UNIT SUMMARY DATA W/RE-AGGREGATED ANALYSIS

	INVENTORY DATA								
UNIT NO.	ASPECT	PLOTS	TREES PER ACRE	AVG. DBH (Inches)	BOLE LEN (Feet)	AVE LOG LEN (Feet)	AVE LOG BF	LOGS PER ACRE	BASAL AREA
2	WEST	48	220.6	14.2	59	35	118	351.0	243.3
3	WEST	12	127.1	13.4	47	35	110	165.8	125.2
COMBINED	WEST	60	218.1	14.2	57	35	118	336.5	239.3
5	WEST	216	90.8	12.5	33	28	59	104.7	77.3
6	NORTH	128	137.4	11.8	31	28	46	144.7	105.2
7	EAST	110	93.9	11.6	29	25	42	102.6	68.4
COMBINED	YES	454	103.1	12.2	32	27	53	115.0	83.0
13	WEST	83	94.2	13.5	40	28	67	125.1	94.1
14	WEST	73	127.3	11.8	27	24	43	131.3	96.7
15	WEST	48	150.5	14.2	39	29	88	194.3	165.5
19	EAST	57	218.1	15.6	65	33	92	397.1	290.5
20	NORTH	129	231.5	15.1	61	33	107	389.2	289.3
23	SOUTH	10	142.2	17.4	47	34	85	188.9	234.1
24	SOUTH	93	229.0	15.5	52	31	110	359.5	301.1
COMBINED									
		20	176.5	16.7	48	31	101	256.0	268.8
		83	197.2	16.0	54	32	114	315.6	275.2
25	SOUTH	7	38.0	9.9	26	25	34	38.0	20.1
26	SOUTH	51	208.7	13.9	39	30	96	257.8	219.1
COMBINED									
		36	223.8	12.3	35	28	80	254.5	185.2
		22	173.5	17.4	50	32	127	249.6	285.9
27	SOUTH	315	87.8	19.7	58	33	205	139.1	184.9
ELEVATION									
		85	57.3	24.0	73	34	259	104.8	179.7
		229	92.8	19.2	57	33	200	145.1	186.7
28	SOUTH	4	76.7	15.5	45	33	96	97.4	100.0
TOTAL									

TABLE 4

TONGASS NATIONAL FOREST
2010 SECOND GROWTH VOLUME INVENTORY
UNIT SUMMARY DATA W/RE-AGGREGATED ANALYSIS

UNIT NO.	INVENTORY DATA							
	SPECIES BY PERCENTAGE					GROSS BF/ACRE	NET BF/ACRE	UNIT TOTAL NET VOLUME (MBF 32')
	SITKA SPRUCE	WESTERN HEMLOCK	WESTERN RED CEDAR	ALASKA CEDAR	PACIFIC RED ALDER			
2	43%	57%				41,757	41,541	2,005
3		100%				18,164	18,164	267
COMBINED	44%	56%				39,984	39,783	2,505
5	66%	33%	1%			6,701	6,202	1,314
6	52%	46%	2%		T	6,717	6,717	950
7	73%	25%	1%		2%	4,457	4,263	469
COMBINED	63%	36%	1%		T	6,453	6,100	2,828
13	46%	39%	9%	6%		9,248	8,412	705
14	63%	33%			4%	5,847	5,670	416
15	62%	32%	1%		5%	17,444	17,097	844
19	18%	61%	18%		2%	39,386	36,563	2,010
20	27%	65%	9%			45,289	41,721	5,832
23	74%	4%	22%			19,183	16,028	160
24	45%	43%	2%		11%	41,811	39,550	3,672
COMBINED								3,514
	26%	36%			38%	28,515	25,821	464
	48%	49%	3%			38,273	35,950	3,050
25					100%	1,293	1,293	5
26	40%	25%	10%		26%	27,421	24,687	1,235
COMBINED								1,327
	45%	16%			39%	21,514	20,414	694
	27%	41%	25%		7%	37,901	31,752	633
27	36%	62%	1%	T	1%	31,898	28,526	8,839
ELEVATION								
	32%	68%		T		31,433	27,120	2,223
	37%	61%	1%		1%	32,119	28,985	6,605
28		72%			28%	12,367	9,319	58
TOTAL								28,781
							20.549 MBF/ACRE	
	ADJUSTED TOTAL REFLECTING RE-AGGREGATION AND CONIFER SELECTION							27,720