# P R E L I M I N A R Y  D R A F T  P R O G R E S S  R E P O R T

## Project:

Determine with a decadal resolution**,** when the young rotation forest on the Tongass National Forest will be available to timber harvest and what timber harvest levels will it support? This project will utilize existing datasets, growth, and yield projections to approximate this answer.

## Introduction:

The Tongass National Forest is the largest national forest in the United States of America. It is located in Southeast Alaska and covers about 17 million acres of the Alexander Archipelago. Acting as the managing body for this land base, the United States Forest Service has worked to balance multiple uses of this resource. In the recent past, the Tongass National Forest has produced a large amount of timber. This fueled the timber industry in Southeast Alaska and in turn made it possible for a network of logging communities and saw mills to prosper in the region. In the mid and late 1990's the major consumers of Tongass wood fiber, the pulp mills, all closed down resulting in a major decline in the timber based economies. Small scale timber harvest and saw milling still exist in Southeast Alaska, but the activity has shrunk to such a level that it is at risk of vanishing completely.

A group, collectively called the Tongass Futures Roundtable has formed to discuss the diverse set of issues facing Southeast Alaska and the Tongass National forest. As a part of its wider mission the Tongass Futures Roundtable is considering the question of timber supply from the Tongass National Forest. Toward this end Mr. Rick Harris of Sealaska Corporation (a member of the roundtable) has offered to leverage his organization's research and experience toward understanding the potential growth and yield of the national forest. The question of near term harvest activity pivots on access to the old growth forests on the Tongass, which is largely a question of policy. The Roundtable decided to consider the viability of young growth timber regenerating on lands that were previously harvested and further managed with a silvicultural treatment for stand improvement. Of paramount concern is the growth potential of these lands and at what point in time the Tongass National Forest will be able to transition to a timber economy based on these regenerated forests.

The following report endeavors to add perspective to a few basic questions about young growth timber on the Tongass. This body of work is a collaboration of the technical work group embodied by the Young Growth committee and is presented with the intent of providing the Roundtable group with an idea of the rate of growth and a sustainable harvest level from previously harvested and managed lands on the Tongass National Forest.

## Materials:

The components that make up the body of this analysis and report include:

1. The USFS Harvest and Managed Stands GIS layer (This spatial dataset tracks 514,000+ acres that were harvested between 1820 and 2007. Harvest area, harvest date, activity type, and silvicultural treatment is tracked for each harvest unit);
2. USFS Land Use dataset refined to spatially identify acres within the managed stand dataset that are classified "Suitable" for future harvest activity.
3. USFS Roads dataset refined to spatially identify acres within the suitable managed stand dataset that are considered feasible for future harvest activity by this analysis (within 800' of an open road).

4. The Sealaska 2004 field sample of young forest stands (stocking surveys of naturally regenerated harvest areas less than 15 years old);
5. Calibration of growth and yield projections utilizing long-term permanent plot measurements obtained from the Tongass National Forest; Site stratification for the harvested acres as defined by the Young Growth Committee, technical work group.
6. Tree taper volume localization of USFS standard volume equations;
7. Calibration of silvicultural treatment effects on potential sustainable harvest levels and merchantability;
8. Integration of all above components into an analysis of sustainable harvest levels for all previously harvested and managed USFS Tongass lands for both the near-term and long-term harvest capacity.

## Methodology:

The potential of site productivity was determined and assigned for each harvest unit represented in the harvest unit GIS layer.

The harvest layer was broken into two habitat groups based on the presence or absence of Red Cedar *(Thuja plicata).* This delineation was determined by using the tree species distribution maps developed by the USFS (Little, E.L., Jr., 1971, Atlas of United States trees, volume 1, conifers and important hardwoods: U.S. Department of Agriculture Miscellaneous Publication 1146, 9 p., 200 maps). Refer Map 1. The purpose of this stratification is to facilitate a refinement in the growth and yield modeling that would closer approximate the actual bio-geoclimatic regions.

An average regeneration stocking was determined for each habitat group using data from regeneration surveys that Sealaska Corporation collected in 2004. Species, size and stocking information was collected in 21 stands on Sealaska land representing 2,400 acres. All stands were natural regeneration, age 15 or less and had no silvicultural

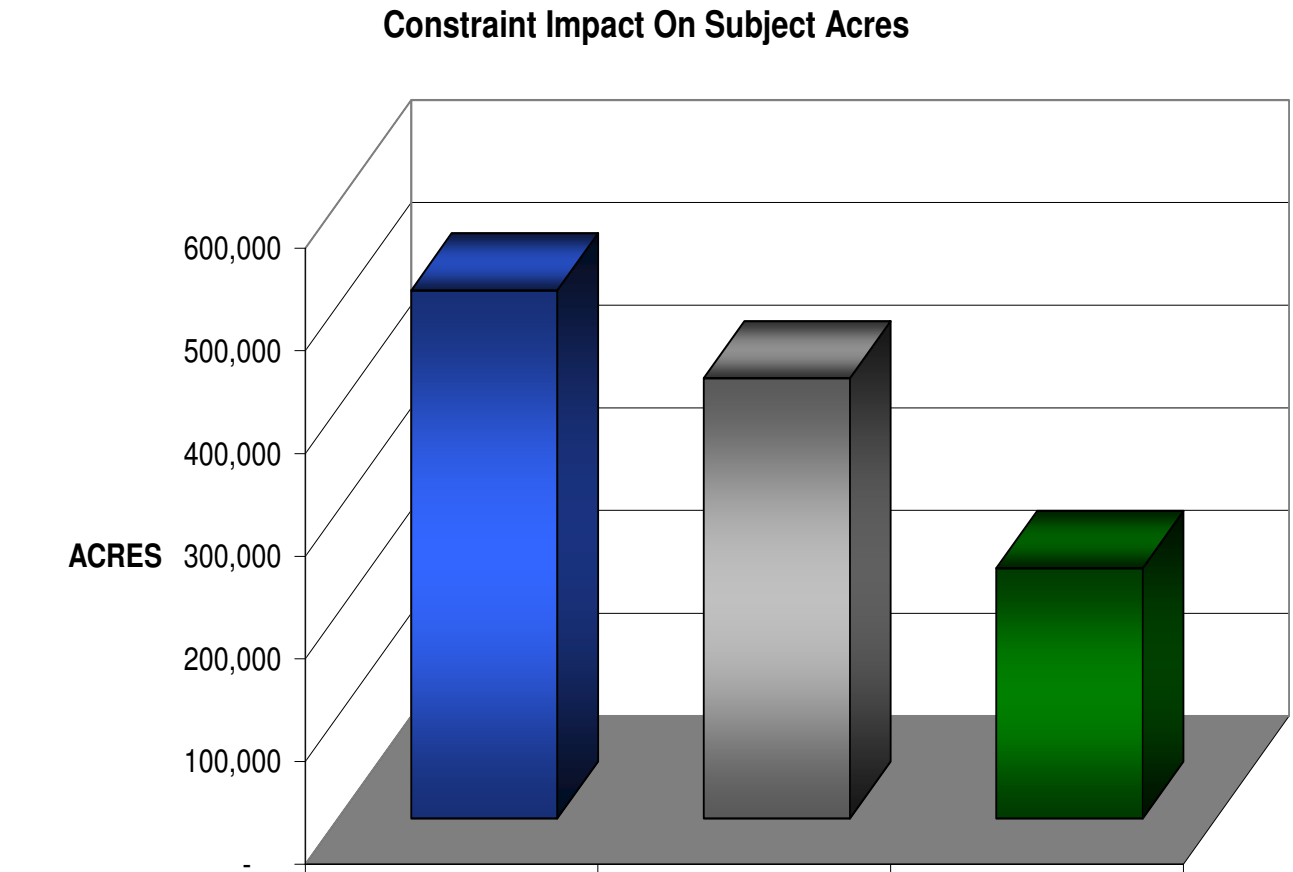
treatment prior to sampling. A weighted by acres average initial stocking was established for each habitat group

The permanent plot database obtained from the U.S. Forest Service Pacific Northwest Experiment Station in 2004 (the Bill Farr plots) was utilized to calibrate and verify all growth projections of potential yield capacity over the next 100 years on USFS lands under alternative silvicultural regime assumptions. This provides a localized Regional Species Library of all volume, growth and mortality dynamics under any potential management alternative. The combined tree taper and volume datasets were used to develop locally accurate calibrations of all volume estimates for all tree species on these lands under any set of merchantability specifications.
All acres were merchandised with the same specifications. Three broad sort descriptions were developed based on scaling diameter, 4"-8" DIB, 8"-11" DIB, and 12"+ DIB. A 20' nominal log length was used with a minimum 8' length. Volumetric projections are based on Long Log Scaling Rules.

GROW and PCT:

Each harvest unit was grown forward 100 years using one of four silvicultural regimes. The first regime assumed natural regeneration and no silvicultural activity. This is effectively a harvest and walk away management strategy. The second regime included a pre-commercial thin at age 15 to a stocking level of 350 trees per acre. Sitka Spruce *(Picea sitchensis),* Red Cedar *(Thuja plicata),* and Yellow Cedar *(Chamaecyparis nootkatensis)* were favored in this thinning approach. The third regime was a commercial thin regime that thinned from below to a residual stand level of 130 TPA. The fourth regime incorporated both a pre-commercial thin and a commercial thin. These regimes are discussed in further detail below.
Stand specific silvicultural treatment information for each harvest unit was extracted from the managed stands dataset. This represented the third reduction in our working dataset from all managed stands to all clear-cut harvested acres (428,972 acres) to clear-cut with a classification of "Suitable and available" acres (243,922 acres). This subset of acres from the managed stands dataset is the baseline for generating reports on these analyses. This subset was subjected to additional broad constraints, both administrative and financial, to demonstrate the impact of policy and operational feasibility. The impact from implementing these constraints is shown in the following Figures 1 and 2.

Figure 1




| | Total Harvest Activity Acres | Clear-Cut Harvest Acres | Suitable/Available Acres |
|---|---|---|---|
| Acres Reduction Impact | 514,509 | 428,972 | 243,922 |

Suitable and available acres were further classified by proximity to an open road system, early silvicultural treatment, and candidacy for a commercial thin regime. Four classifications were determined and assigned to the appropriate acres.

The following is a description of the management prescription for each regime:

PCT/CT Regime/Within Road - Stand was harvested, allowed to regenerate naturally; pre-commercial thin regime implemented at stand age 15. Stand is thinned from below favoring Sitka Spruce, Red Cedar, and Yellow Cedar to an even distribution of 350 trees per acre. Stand was then commercially thinned at stand age 55. Stand is thinned from below to 130 trees per acre with a maximum DBH of 12" for candidate cut trees. Stand was grown undisturbed from this point to final harvest. This regime was applied to all acres that had received early silviculture (PCT) and where less than 800 feet from an open road system.

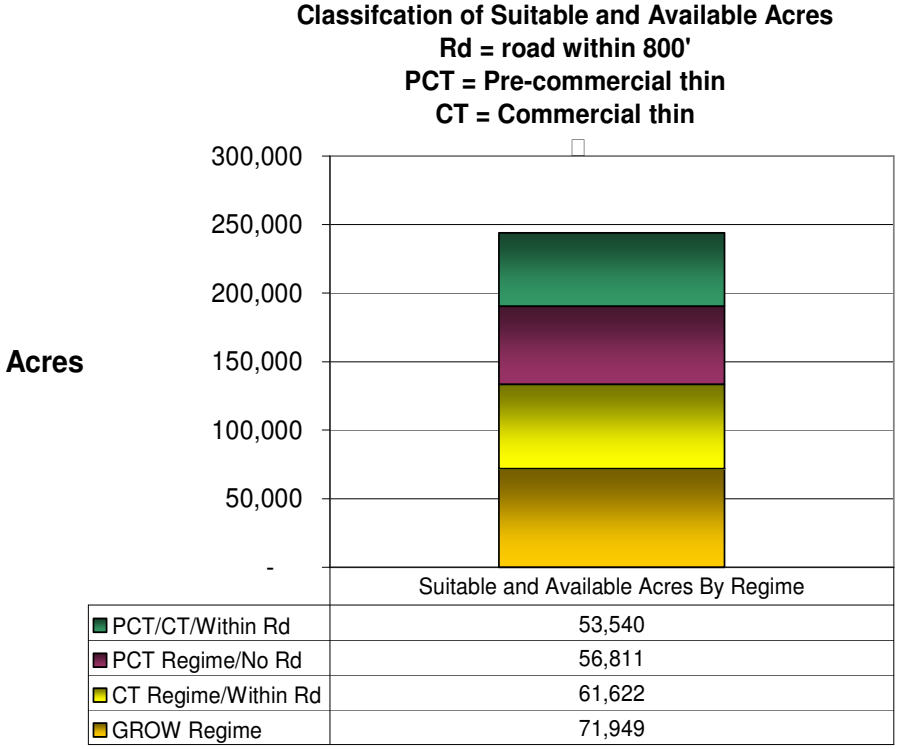
PCT Regime/Not within Road - Stand was harvested, allowed to regenerate naturally; pre-commercial thin regime implemented at stand age 15. Stand is thinned from below favoring Sitka Spruce, Red Cedar, and Yellow Cedar to an even distribution of 350 trees per acre. Stand was grown undisturbed from this point to final harvest. This regime was applied to all acres that had received early silviculture (PCT); however, where greater than 800 feet from an open road system.

CT Regime/Within Road– Stand was harvested, allowed to regenerate naturally; no early silvicultural treatments; Commercial thin regime was implemented at stand age 55. Stand is thinned from below to 130 trees per acre with a maximum DBH of 12" for candidate cut trees. Stand was grown undisturbed from this point to final harvest. This regime was applied to all acres that were less than 800 feet of an open road system; however, had received no early silvicultural treatment.

GROW Regime/Not within Road/ No silviculture – Stand was harvested, allowed to regenerate naturally; no silvicultural treatments; left undisturbed to grow until final harvest. This regime was applied to all acres that were greater than 800 feet from an open road system with no early silviculture.

The following Figure 2 displays the distribution of the "suitable and available" acres from Figure 1 within these four regimes.

**Figure 2**



**Definitions:**

**FPS: Forest Biometrics "Forest Projection and Planning System"**
Completely integrated software package designed for inventory management, growth and yield projections, and harvest planning.

**SYP: Sustained Yield Capacity:** (Harvest Level)

- It is essentially the Identification of Even-Flow over a Specified Time Frame
- Components:
  - Magnitude of Even-Flow Exceeds Perturbations (Harvest Fluctuations)
  - The Time Frame equals or exceeds Growth Cycle
- Examples in Forestry
  - Equal or Exceed Expected Rotation Age (60 – 90 years in SE Alaska)

The growth projections were used to calculate sustained yield capacities for the 243,922 acres of previously harvested, suitable and available, forest land under the different management scenarios.

**PCT: Pre-commercial thin**
Partial cutting in stand structure of an aggregation of trees. Designed to improve future growth by regulating stand density. Deemed pre-commercial thinning when initiated, usually at an early age with no utilization of product.

**CT: Commercial thin**
Partial cutting in stand structure of an aggregation of trees. Designed to improve future growth by regulating stand density. Some or all of the wood harvested is utilized.

**GIS: Geographic Information System**
For the purposes of this exercise this can be defined as mapping and spatial referencing software.

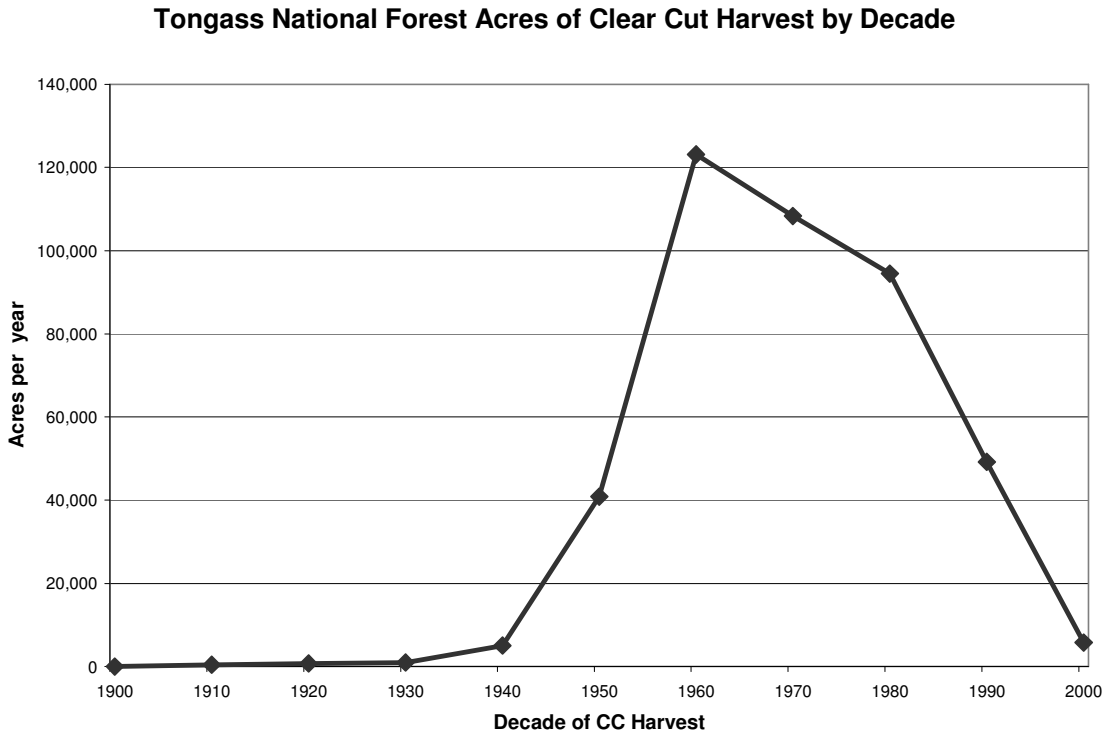
**DBH: Diameter Breast Height**
Biometric measurement of tree diameter at 4.5 feet.

**DIB: Diameter Inside Bark**
For the purpose of this analysis this can be defined as a biometric measurement of the top end diameter (scaling diameter) of a log inside the bark.
This measurement is used in the applicable Scaling Rule for volumetric calculations.

**Results:**

The primary focus of this analysis was previously harvested acres on the Tongass National Forest. The "Managed Stands" dataset provided by the USFS contained harvest activity by date and harvest type. The harvested acres were subset to reflect clear-cut harvest activity only. This encompassed 429,000 acres which meet the criterion, clear-cut harvest acres with harvest years ranging from 1820 to 2007. The Harvest activity per decade is summarized in Figure 3. As can be readily interpreted from the chart, the Tongass National Forest was subjected to minimal harvest activity in the earlier decades. Beginning in the 1940's harvest activity steadily increased with the greatest activity occurring from 1960 to around 1980. After 1980 we see a steep decline in harvest activity. This harvest activity pattern results in an unbalanced distribution of age classes within the young growth forest. We have the majority of young growth stands that are about the same age. The impact of this imbalance is realized in the early decades of our future sustained yield projections. This effect is partially minimized due to a significant amount of acres with older aged young growth soon becoming available for harvest scheduling. This trend is intuitively displayed in Figure 3 below.

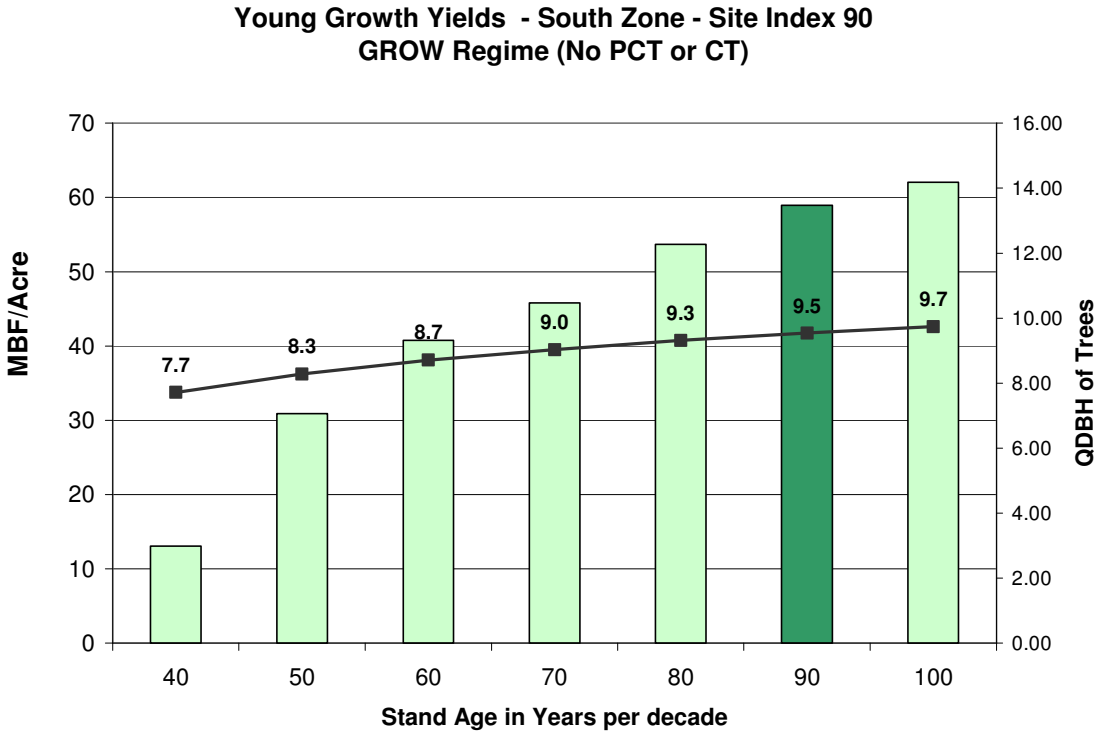
Figure 3




Four management scenarios were modeled in this analysis. All of these silvicultural regimes are in practice and considered likely management techniques utilized on the Tongass National Forest.

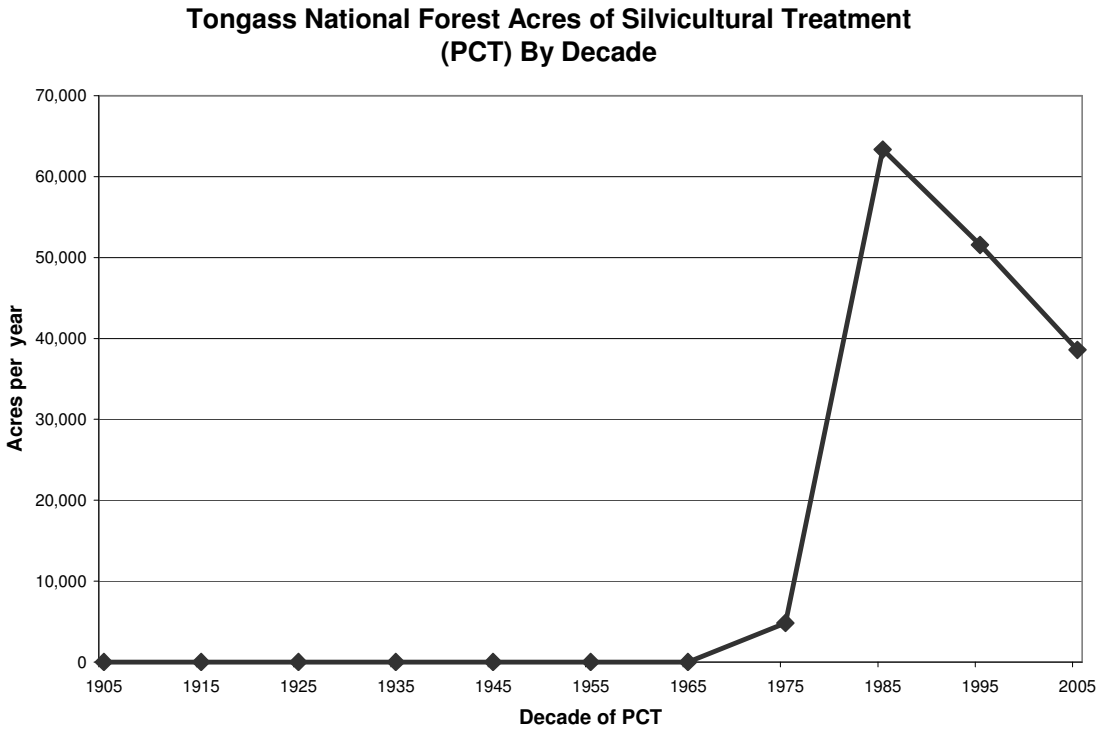
The first regime was a growth projection of the harvested stands without any management practices. Stands were allowed to regenerate naturally and grow forward to future harvest without application of silvicultural prescriptions or additional harvest entries. Figure 4 shows the GROW regime yield results for site 90 in the southern, Red Cedar zone. This yield curve shows the stand achieving merchantable size and reasonable yield at age 50 -60 and later. Note that although this stand condition carries a considerable amount of volume per acre, the average tree never exceeds a 10" (9.6-10.5) diameter class. We have a large volume of small piece size wood.

**Figure 4**



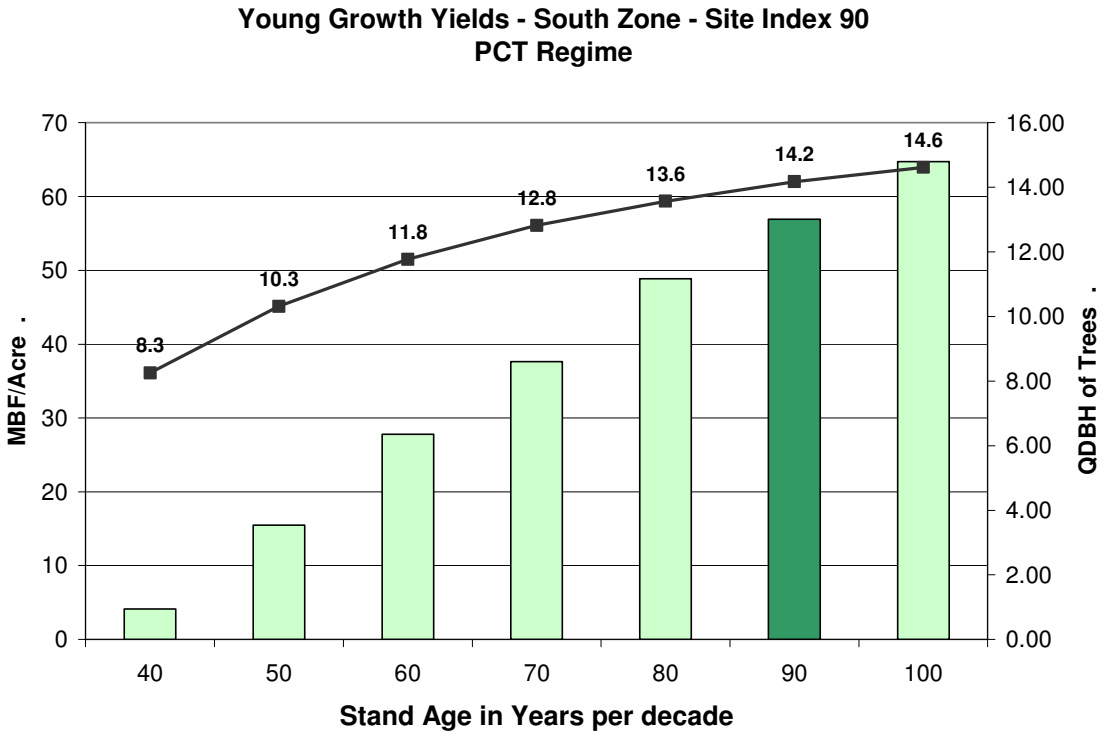

The results of the GROW regime dictate the need for a stand improvement activity. In an effort to produce wood with a greater piece size we modeled a PCT (pre-commercial thin) regime. The PCT scenario was also allowed to regenerate naturally. The stands were pre-commercially thinned at age 15 years to a residual level 350 trees per acre favoring Sitka Spruce, Red Cedar, and Yellow Cedar. This regime was applied to acres that were actually pre-commercially thinned as determined from the managed stand dataset. The regime was applied to 158,334 acres in the managed stand layer commencing in 1965 and continuing to the present. The PCT activity is summarized by decade in Figure 5. This analysis only incorporates 110,351 PCT acres classed "suitable and available".

**Figure 5**




When a pre-commercial thin regime is modeled, there is a resultant decline in volume per acre produced; however, there is a significant increase in dimensions of the residual trees. The result is a more favorable sort distribution; increased piece size of the targeted wood supply. As can be seen in Figure 6, at harvest target age 90 a stand subjected to the PCT regime carries a little less volume per acre, but a significantly greater average tree size of 13.6 DBH. The total amount of growth is similar between the non-PCT and PCT stands; however, the growth is allocated to fewer trees in the case of the PCT regime. Figure 6 shows the PCT regime yield results for site 90 in the southern, Red Cedar zone.

**Figure 6**

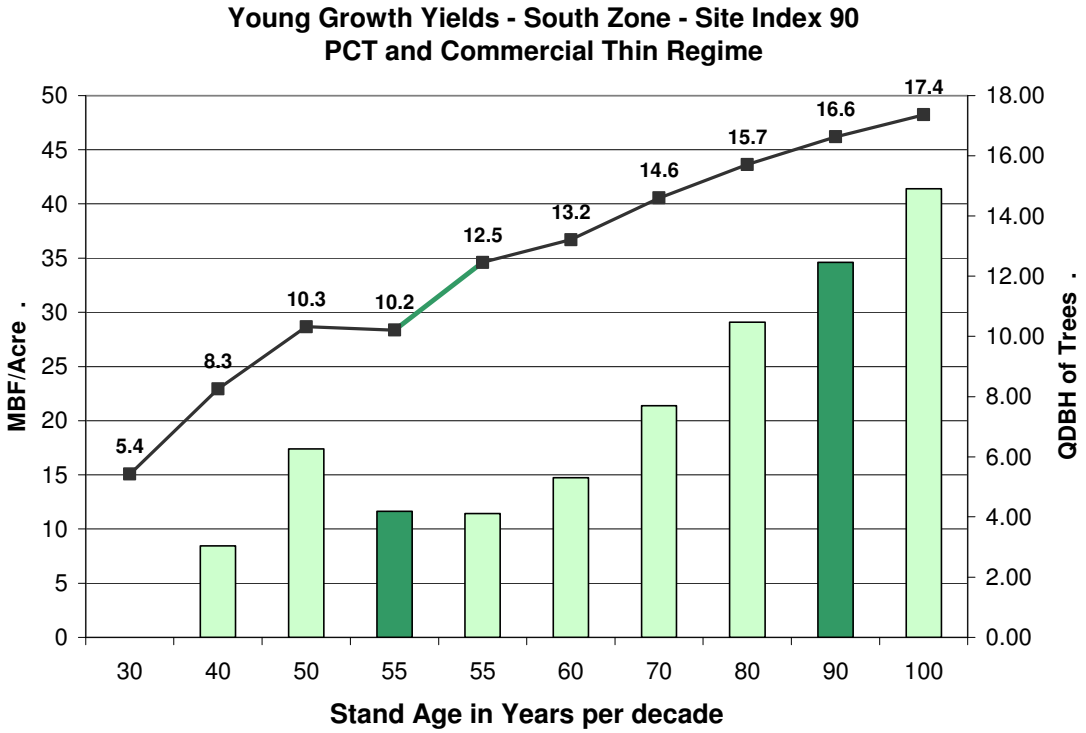



Commercial Thinning:

A commercial thin was modeled on both non-PCT and PCT acres from the managed stand dataset with the goal to provide an earlier wood flow and further increase piece size at rotational harvest. This regime was only applied to acres that were within 800 feet of an open road system. Numerous scenarios were modeled; however, the only practical and silviculturally viable scenarios were commercial thinning from below. The commercial thin (CT) regime assumed no PCT, commercial thin entry at age 55, thinning from below to a maximum diameter of 12" DBH to a residual stand target of 130 TPA and rotational harvest at culmination of mean annual increment (CMAI), age 90-100 years. This regime again sacrifices volume per acre and only supplies small dimension wood at the time of thinning and at final harvest. The commercial thin (PCT/CT) regime assumed PCT, commercial thin entry at age 55, thinning from below to a maximum diameter of 12" DBH to a residual stand target of 130 TPA and rotational harvest at culmination of mean annual increment (CMAI), age 90-100 years. This regime also produces small dimension wood at the time of thinning; however, it does increase the piece size at rotational harvest. The biometrics of this regime given our objective to produce greater piece size is advantageous, but viability and practical application are highly restricted from economic and operational constraints.

Figure 7 shows the PCT/CT regime yield results for site 90 in the south zone.

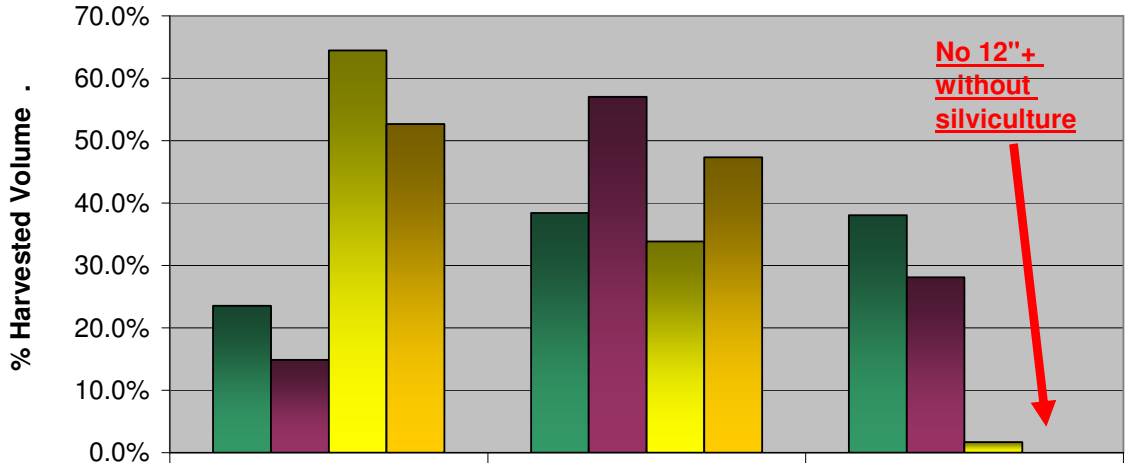
**Figure 7**



One of the primary directives in running this analysis was to maximize the proportion of wood in the 12"+ DIB sort. The most favorable regime to this goal is the PCT/CT, commercial thin regime. The following Figure 8 displays the scaling diameter (DIB) class distribution for all regimes.

**Figure 8**

**Regime Comparison**
**Total Harvested VolumeDistribution - By DIB Class**

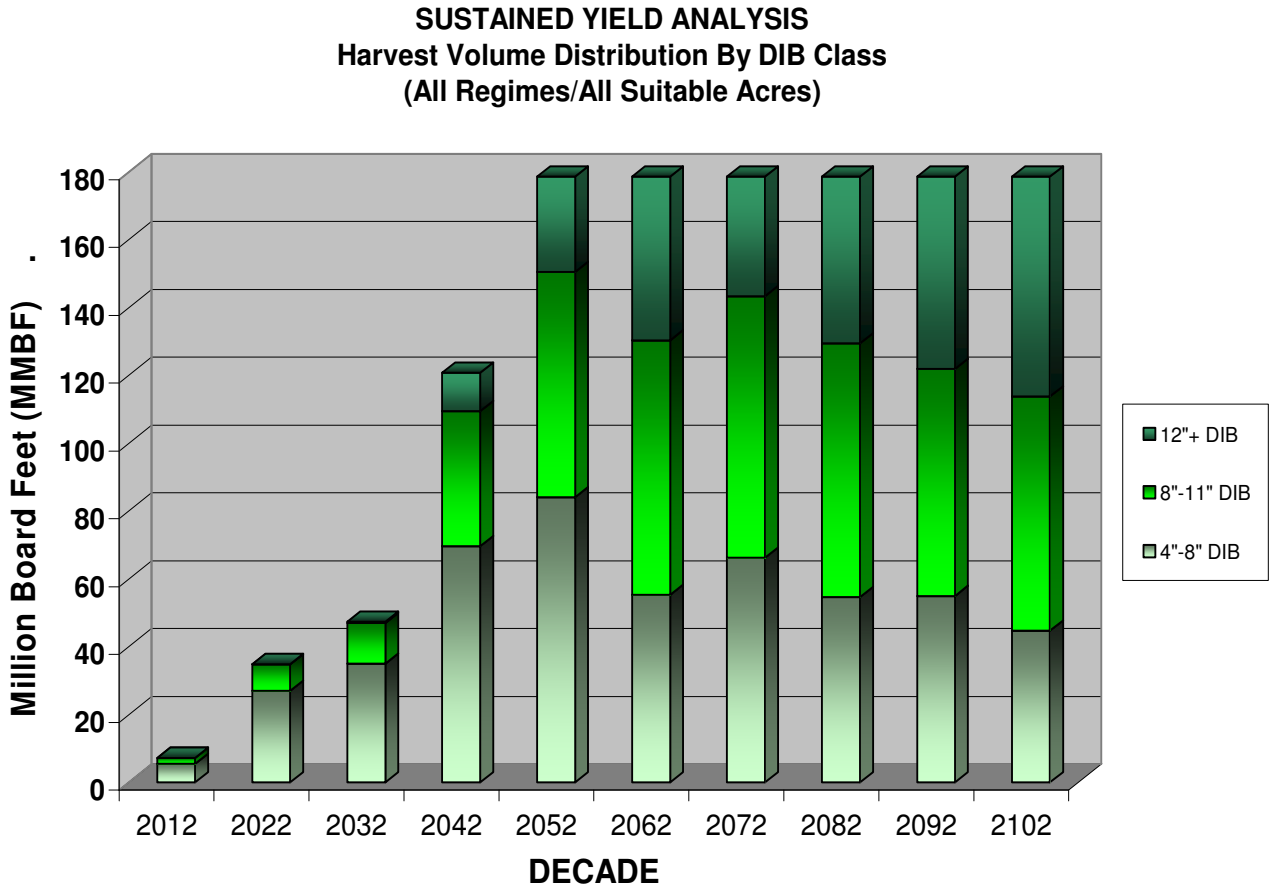



| | 4"-8" DIB | 8"-11" DIB | 12" + DIB |
|---|---|---|---|
| PCT/CT Regime | 23.6% | 38.4% | 38.0% |
| PCT Regime | 14.9% | 57.0% | 28.1% |
| CT Regime | 64.5% | 33.8% | 1.7% |
| GROW Regime | 52.7% | 47.3% | 0.0% |

**Diameter Inside Bark (DIB) CLASS**

The harvest volume DIB class distribution for the sustained yield analysis for all suitable and available acres which utilized all four regimes is displayed in Figure 9 below.

**Figure 9**

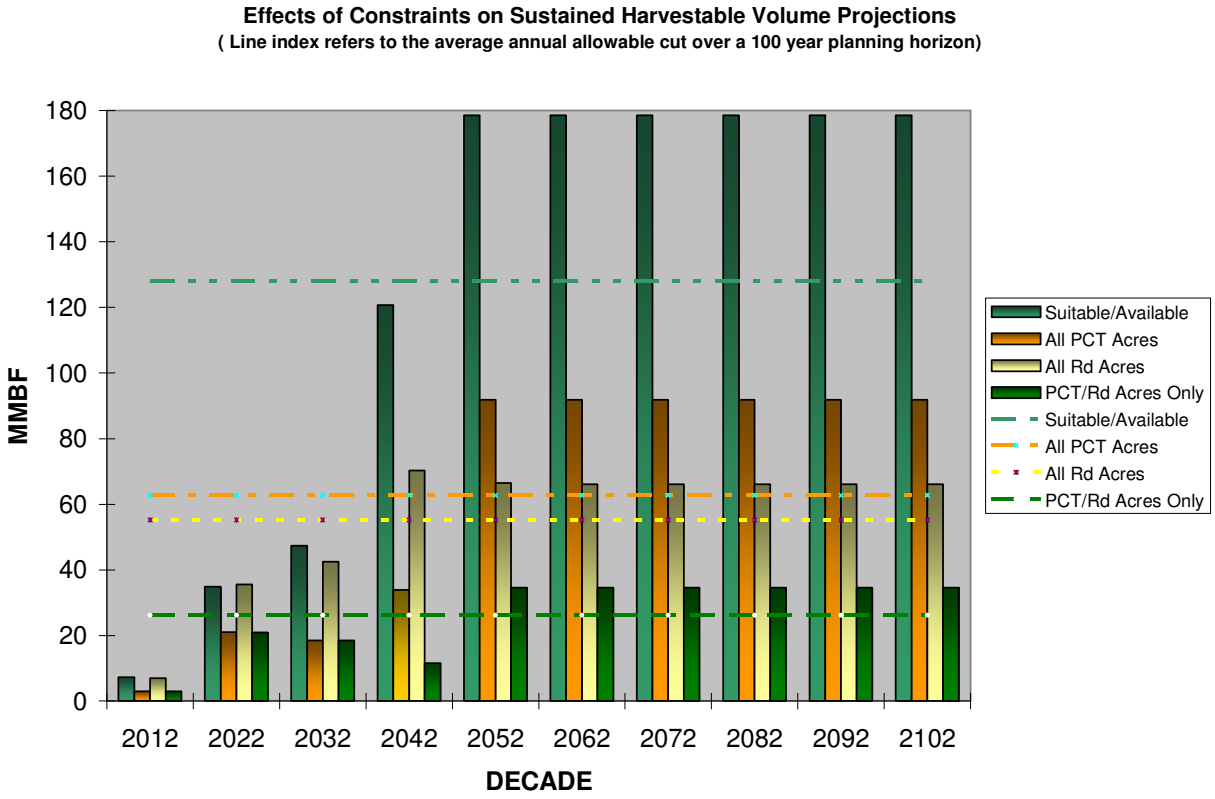



All grown stands were then run through a binary harvest scheduling routine to determine sustainable annual allowable cut. The candidate acres available for inclusion in these runs are subject to several net down constraints. Land use designation policy has resulted in a classification of suitable/non-suitable for future commercial timber harvesting. Economic and operational constraints can be and are numerous; however, this analysis invokes only one to demonstrate the anticipated impact of these additional restrictions to harvest activity. These yield figures are presented in Figure 10 as:

1. **Unconstrained** - The harvest run for all "suitable and available" acres with a rotational harvest at age 90-100 utilizing all four silvicultural regimes..
2. **Administrative/Economic constraint** - The harvest run for all managed acres (PCT) classified as "suitable and available" with a rotational harvest at age 90.
3. **Operational/Economic constraint** –

- The harvest run for all managed stand acres classified as "suitable and available" that are within 800 feet of an open road system with a rotational harvest at age 90-100.
- The harvest run for managed stand acres classified as "suitable and available" that have been pre-commercial thinned and are within 800 feet of an open road system with a rotational harvest at age 90-100.

**Figure 10**




## Conclusion and Discussion:

The original question posed was, when will the young rotation forest on the Tongass National Forest be available to timber harvest and what timber harvest levels will it support? The results of this analysis clearly show that the majority of the young rotation forests on the Tongass exhibit little diversity in age class distribution. It is also clear, that average harvest rotation is between 80 and 100 years of age depending on site quality. From the analysis comparing pre-commercial thin to non-thinned stands we can also demonstrate that without the benefit of the pre-commercial thinning regime these stands will not produce timber of adequate size to be sawn into dimensional lumber. Even by invoking the PCT and CT regimes we are producing a great quantity of small dimension wood. Without a market or technology shift we are safe to assume that the primary market for the majority of these stands is pulpwood or alternative energy source production.

The analysis pivots on three main variables, two of which are very well defined and the third of which is of a resolution more than sufficient to answer the question posed. The first two variables are, 1) the amount of acres that have been harvested, and 2) the initial stocking of the stand after harvest. We have made the assumption that the tracking of harvest and silvicultural activity is accurate and complete. We acknowledge the initial stocking (natural regeneration) is a broad average derived from stands across the Tongass. This is not of real concern in this analysis as by invoking the PCT regime we are manipulating stand structure to desired composition and stocking. The third variable, site stratification, could be defined with additional information. The cost to benefit ratio of collecting this information is questionable; however, as a significant number of acres would need to have their site class increased above site class 90 to have any impact on the reported results.

We can conclude that with this subset land base that a young growth timber economy would be a viable venture commencing in approximately year 2035 with an annual allowable cut quickly exceeding 100 MMBF (million board feet) per year. There is a young growth wood supply available for harvest today that within ten years will exceed an annual allowable cut of 35 MMBF; however, the dimensional size of this wood is only in the two smaller DIB size classes discussed earlier. Additional wood volume is available in numerous acres classified as "non-suitable" that have potential for a selection harvest regime. This scenario would produce wood in the larger 12"+ DIB class. The economic and operational viability of this selection scenario would be a site specific scenario. It should also be noted, this analysis did not take into account operability or accessibility for any of these stands beyond the greater than or less than 800 feet of an open road constraint.

To provide a more accurate answer to the question, "When, with a decadal resolution**,** the young rotation forest on the Tongass National Forest will be available to timber harvest and what timber harvest levels will it support?", will require implementing a sample design, field data collection, site index verification, and growth and yield modeling of actual stand biometric attributes.