Tongass Second Growth Transition Project

Results of an Intensive Three Year Study to Determine Whether an Accelerated Transition to Young Growth Logging Can Be Operable by 2020

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Why Tongass? Why Now?

- The Tongass is the only National Forest System in the US continuing to log old growth supply.
- The forest – particularly the old growth stands - stores enough carbon to equal almost 10% of all greenhouse gas emissions caused by vehicular traffic in the US each year. Its contribution to climate and climate change is recognized internationally and was highlighted at the recent Paris Talks on Climate in 2016.
- Litigation due to old growth logging will likely increase, given recent election results and the Record of Decision (ROD) just signed by the Tongass Forest Supervisor committing to another 16 years of old growth logging, but limiting harvest to 46 mmbf/yr. Industry is caught in the middle : unreliable supply caused from litigation and too small supply pool if litigation fails.

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The answer lies, if possible, in accelerating the timeline to transitioning to second growth supply focused on not only low litigation risk acres, but acres that will produce equivalent or higher annual supply volumes to maintain and grow a new forest products industry.

But progress hampered by major confusion and contradiction
in messages being released. As examples:

Solving for Confusion: General Viability of Second Growth		
Jan. 2013	**Juneau Empire; My Turn:** *The Way Forward for Young Growth in the Tongass* by Beth Pendleton (Head of Region 10) & Forrest Cole (Tongass Forest Sup)	*Most young growth is simply too young for commercial timber harvest — biologically, it is too small for an operator to make a profit. Further, young growth that is large enough for commercial harvest is scattered across the Forest, making harvest prohibitively expensive and logistically problematic. There is simply not enough young growth available today to support a viable timber industry.*
Aug. 2014	**Alaska Business** *Tongass Bellwether: Dargon Point Timber Sale* (quoting Tongass Supervisor Forrest Cole)	*Forrest Cole reports the Tongass's acreage includes 450,000 acres of second growth stands with many of these acres on highly productive and quickly regenerating sites.*
Jan. 2015	**High Country News** *The Forest Service Bets on Second-Growth Logging in Alaska* (quoting Tongass supervisor Forrest Cole; and Frontier Inc)	*A private analysis by the NRDC and Geos Institute found in 2013 that there's already "sufficient volume" of younger trees in the region ready for harvest. But Tongass Supervisor Forrest Cole says that's simply not the case. The Geos / NRDC report assumes timber is ready at 55 years; Cole says 80 to 120 years is more realistic. Cole admits that his agency hasn't yet identified who will buy this new second-growth.*
Sept. 2015	**KRBD** *POW Offers First All Young-Growth Timber Sale* (quoting Thorne Bay District Ranger Rachelle Duddleston-Lorton)	*"This transition preserves some centuries-old trees by harvesting a hopefully sustainable rotating crop of trees as young as 55 years old, just big enough to use as lumber at about 9 inches in diameter. What we're looking at right now are stands that are 55 years or older that have a minimum of two 36-foot logs in each tree, up to a 6-inch top."*

Solving for Confusion: Market Viability of Second Growth		
Jan. 2016	**Juneau Empire** *Industry: Tongass Timber Forecast Flawed* (quoting Owen Graham of the Alaska Forest Association)	*Graham has said the industry needs to harvest at least some old-growth trees for about another 30 years to allow young, or second-growth, stands to fully mature, which takes about 90 years for most trees in SE Alaska.* *Southeast sawmills will not be able to manufacture that high-value lumber from the 60-year-old, young-growth trees that would be available under an expedited shift away from old-growth harvesting, according to Graham.*
Feb/Mar 2016	**The Nature Conservancy** *The Emerald Edge*	*The Conservancy's first batch of products manufactured by Good Faith Lumber from 60-70 year old second growth logs, approximately 10,000 board feet, sold out nearly as soon as it was milled.*
Aug 2016	**KTOO** *Tongass Forest Plan Amendment Prompt Objections* (quoting Owen Graham of the Alaska Forest Association)	*"Our biggest concern is that we don't believe that the young growth is big enough right now, nor is there enough acreage of young growth to support a small-log mill,"* *"The sawmill people tell me that the only thing they can produce is the lowest grade of commodity lumber, construction-grade lumber," said Graham.*
Oct. 2013	**KCAW** *Can Logging Switch to Second-Growth Sooner?* (Quotes from Rick Harris, VP of Sealaska Timber Corporation)	*The Sealaska regional Native corporation has been harvesting and selling 50 to 70 year old second growth for about the past five years. "We've been able to get those trees into the market and the market took them on an experimental basis. But in subsequent years, they've actually been asking for it."*

Solving for Confusion: ***Value of the Dargon Point Second Growth Sale to Transition Efforts***		
Aug. 2014	**Alaska Business** *Tongass Bellwether:* *Dargon Point Timber Sale* (quoting Tongass supervisor Forrest Cole; and Frontier Inc)	*"I'm amazed that the Dargon Point (second growth) sale attracted the bids that it did," says Forrest Cole, supervisor for the Tongass National Forest. "It definitely shows the promise for second growth." The 4.5 million board-foot sale sparked an entrepreneurial buzz, drawing four bids instead of the normal one or two.* *Clarence Maxey owner of Frontier, Inc., the firm that put up the high bid for the Dargon Point sale: "I was just amazed at the uniformity of the trees, the height; the volume per acre is just amazing. It probably has five times the volume per acre as what they take off in old-growth. We're talking maybe 2 percent defect, versus old-growth being closer to 60 to 70 percent defect. We prefer the size of the timber in the second growth because it's easier to manage and handle. The majority of the old growth timber is rotted and over mature."*
Aug. 2014	USFS news release *Tongass Transition:* *The Future is Now* (quoting Tongass supervisor Forrest Cole)	*"We are confident this transition will work long term and we are excited that it has already started with Dargon Point, which could become a benchmark for future projects."*
2014	**USFS**: *Tongass Young Growth Management Strategy 2014*	*Dargon Point young growth project will provide valuable data for developing cost estimates.*
Sept 2016	Letter to C. Mater from Beth Pendleton and Felipe Sanchez (Director of USFS PNW Research Station)	*Your proposed case study [with Good Faith Lumber harvesting their Dargon Point timber sale purchase] would sample a single, highly productive 70-year-old stand. The findings from such a limited study could not be applied to the wide range of conditions in stands considered for harvest during the transition to a young-growth based timber program.*

***Charting the Tongass Course*: Understanding the Past**

What ? Who? When? Why?
(1950 to present)

Three "Walls":

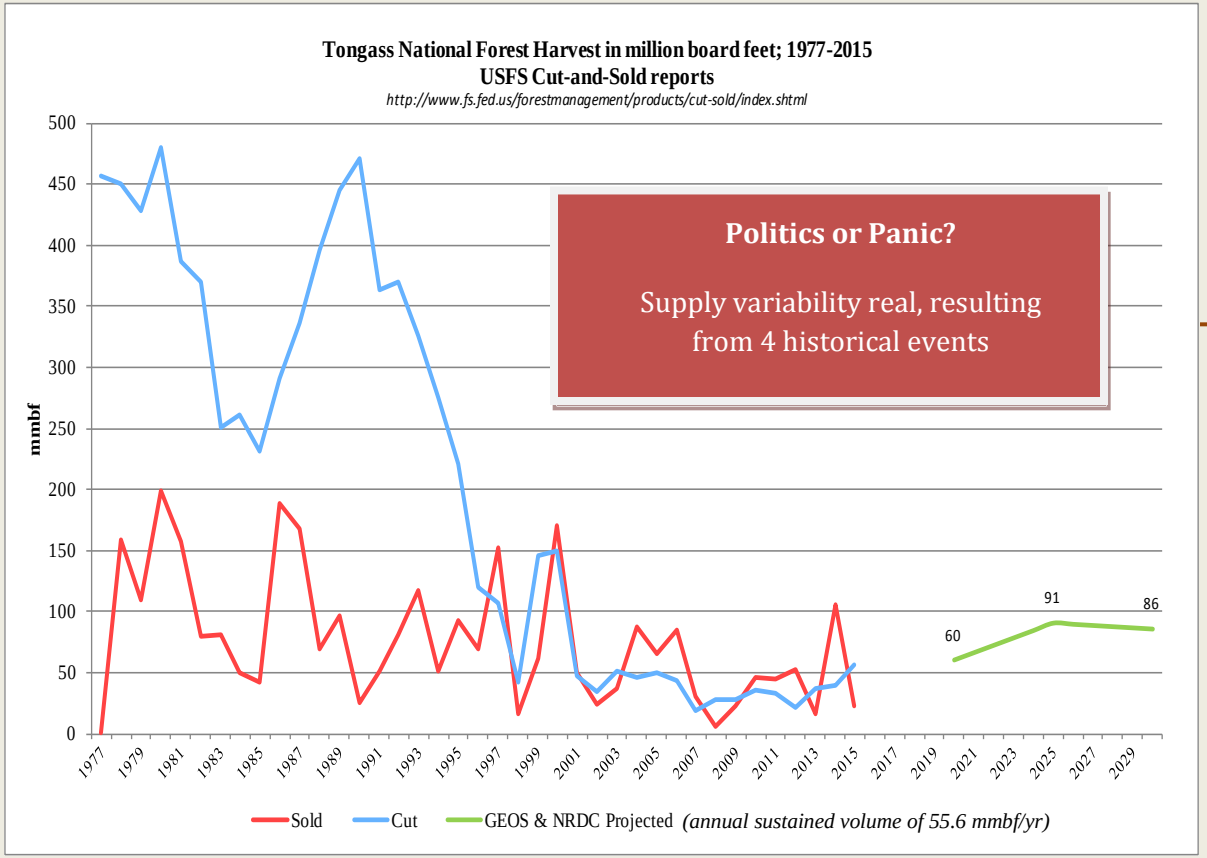
- Wall of Litigation
- Wall of Wood
- Wall of Closure

Seven Main Event Phases:

- Supply panic
- Tongass Futures Roundtable
- Mandate
- Dargon Point Second Growth Sale
- NRDC/Geos Institute
- Tongass Advisory Committee (TAC)
- Record of Decision (ROD)

Supply Panic *Phase*

Tongass National Forest



1950:

- 50-yr contract with Ketchikan Pulp and Paper (KPP) guaranteeing ***165 mmbf cut per year*** over 50 years.
- Contract completed in 2000.

1953:

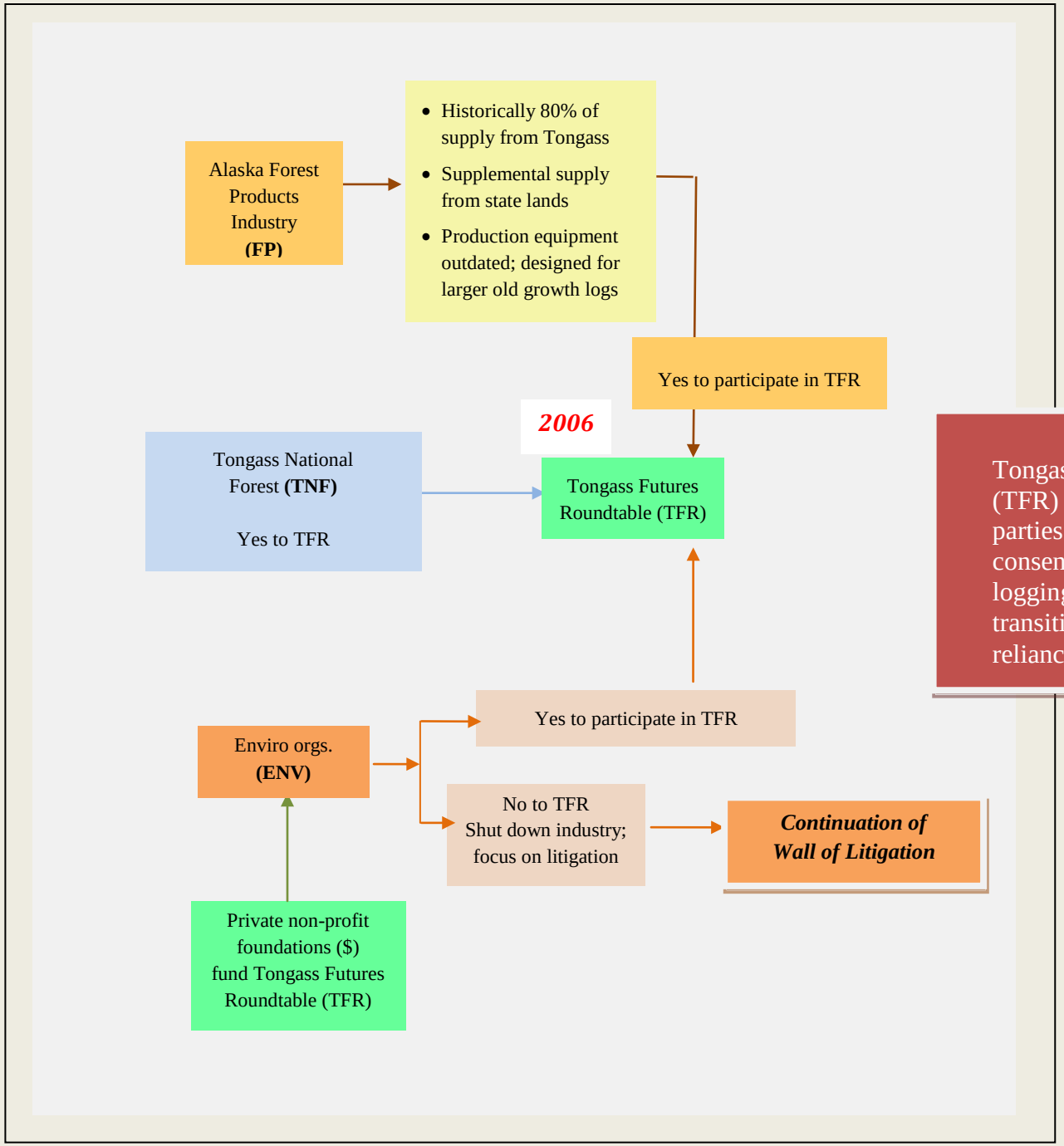
- 50-yr contract with Alaska Pulp Company (APC) guaranteeing ***104 mmbf cut per year*** over 50 years.
- Contract terminated in 1994.

1957:

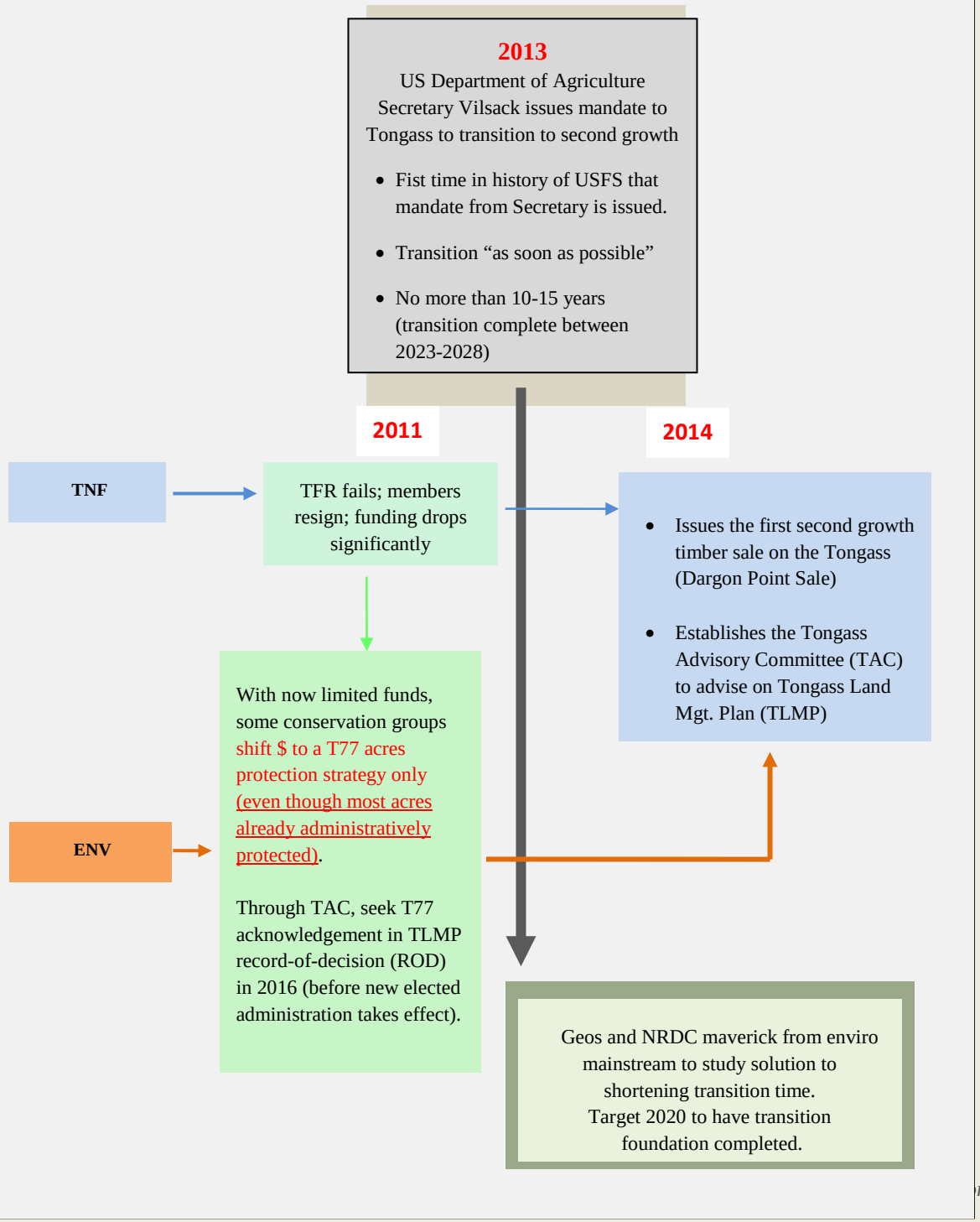
- 50-yr contract with Wrangell Lumber Company (WLC) guaranteeing ***60 mmbf cut per year***.
- 1967, contract downsized to ***20 mmbf cut per year***.
- Contract terminated in 2007.

1980:
Alaska National Interest Lands Conservation Act (ANILCA) guaranteeing ***450 mmbf cut per year***.

1990:
Tongass Timber Reform Act (TTRA) eliminated ANILCA

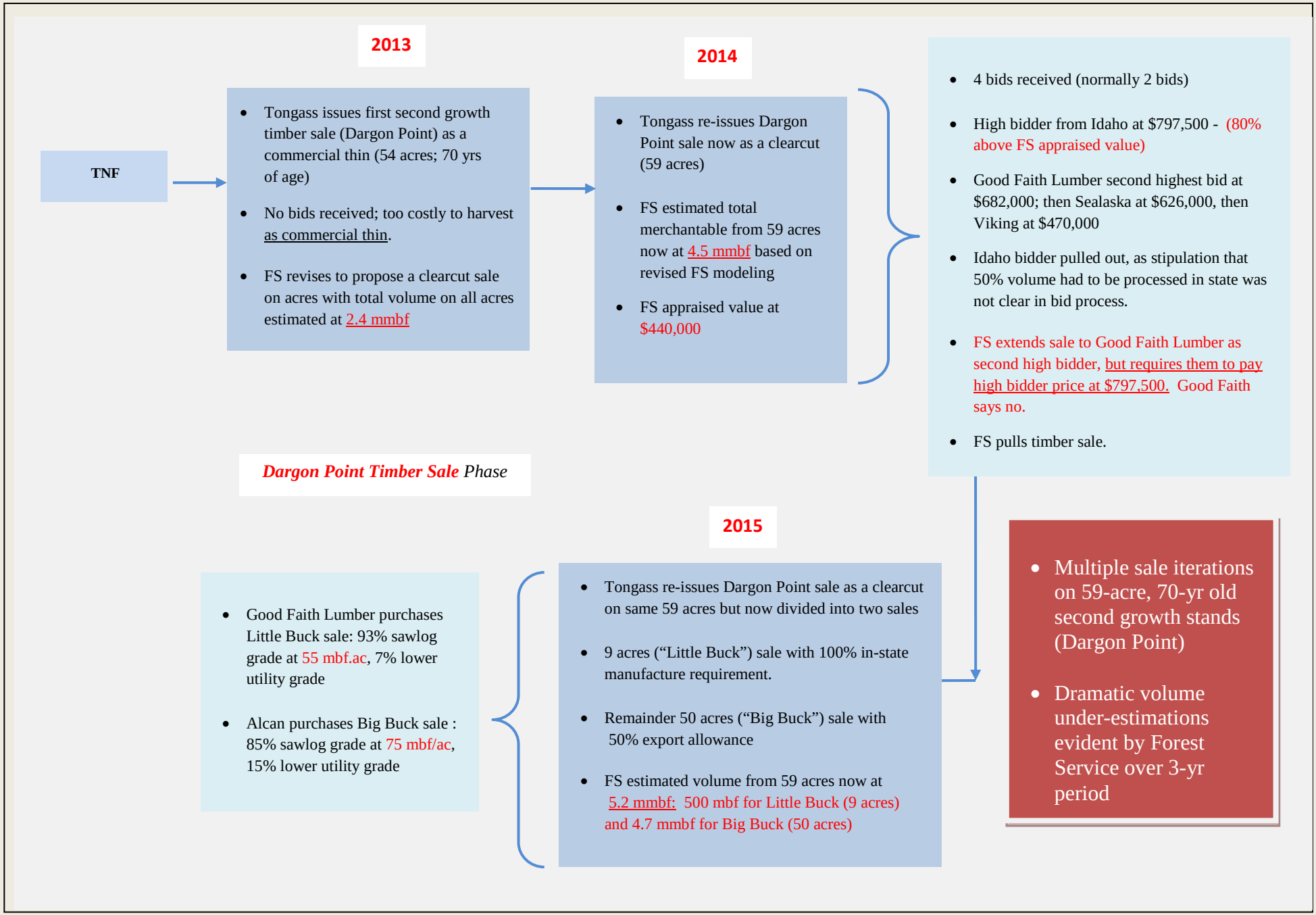


Tongass Futures Roundtable *Phase*



***Mandate** Phase*

- Tongass Futures Roundtable fails
- Enviro funding significantly drops
- Enviros shift to T77 strategy
- Secretary Vilsack issues mandate to transition
- GEOS and NRDC join forces to evaluate reduced timeline for transition


2013
2014
TNF
Tongass issues first second growth timber sale (Dargon Point) as a commercial thin (54 acres; 70 yrs of age)
No bids received; too costly to harvest as commercial thin.
FS revises to propose a clearcut sale on acres with total volume on all acres estimated at 2.4 mmbf
Tongass re-issues Dargon Point sale now as a clearcut (59 acres)
FS estimated total merchantable from 59 acres now at 4.5 mmbf based on revised FS modeling
FS appraised value at $440,000
4 bids received (normally 2 bids)
High bidder from Idaho at $797,500 - (80% above FS appraised value)
Good Faith Lumber second highest bid at $682,000; then Sealaska at $626,000, then Viking at $470,000
Idaho bidder pulled out, as stipulation that 50% volume had to be processed in state was not clear in bid process.
FS extends sale to Good Faith Lumber as second high bidder, but requires them to pay high bidder price at $797,500. Good Faith says no.
FS pulls timber sale.
Dargon Point Timber Sale Phase
2015
Good Faith Lumber purchases Little Buck sale: 93% sawlog grade at 55 mbf.ac, 7% lower utility grade
Alcan purchases Big Buck sale : 85% sawlog grade at 75 mbf/ac, 15% lower utility grade
Tongass re-issues Dargon Point sale as a clearcut on same 59 acres but now divided into two sales
9 acres (“Little Buck”) sale with 100% in-state manufacture requirement.
Remainder 50 acres (“Big Buck”) sale with 50% export allowance
FS estimated volume from 59 acres now at 5.2 mmbf: 500 mbf for Little Buck (9 acres) and 4.7 mmbf for Big Buck (50 acres)
Multiple sale iterations on 59-acre, 70-yr old second growth stands (Dargon Point)
Dramatic volume under-estimations evident by Forest Service over 3-yr period

2013-2016

Geos and NRDC undertake intensive 3-yr study

- Conduct most intensive timber cruise ever conducted on the Tongass (1 plot per acre instead of FS standard of 1 plot per 10-15 acres).
- Target low-litigation acres (all environmental concern acres taken out of analysis).
- Target only lower cost acres (acres with access to currently open FS roads).
- Target desired log characteristics for new small log (HewSaw) technology (from 4.5" to 22" diameter).

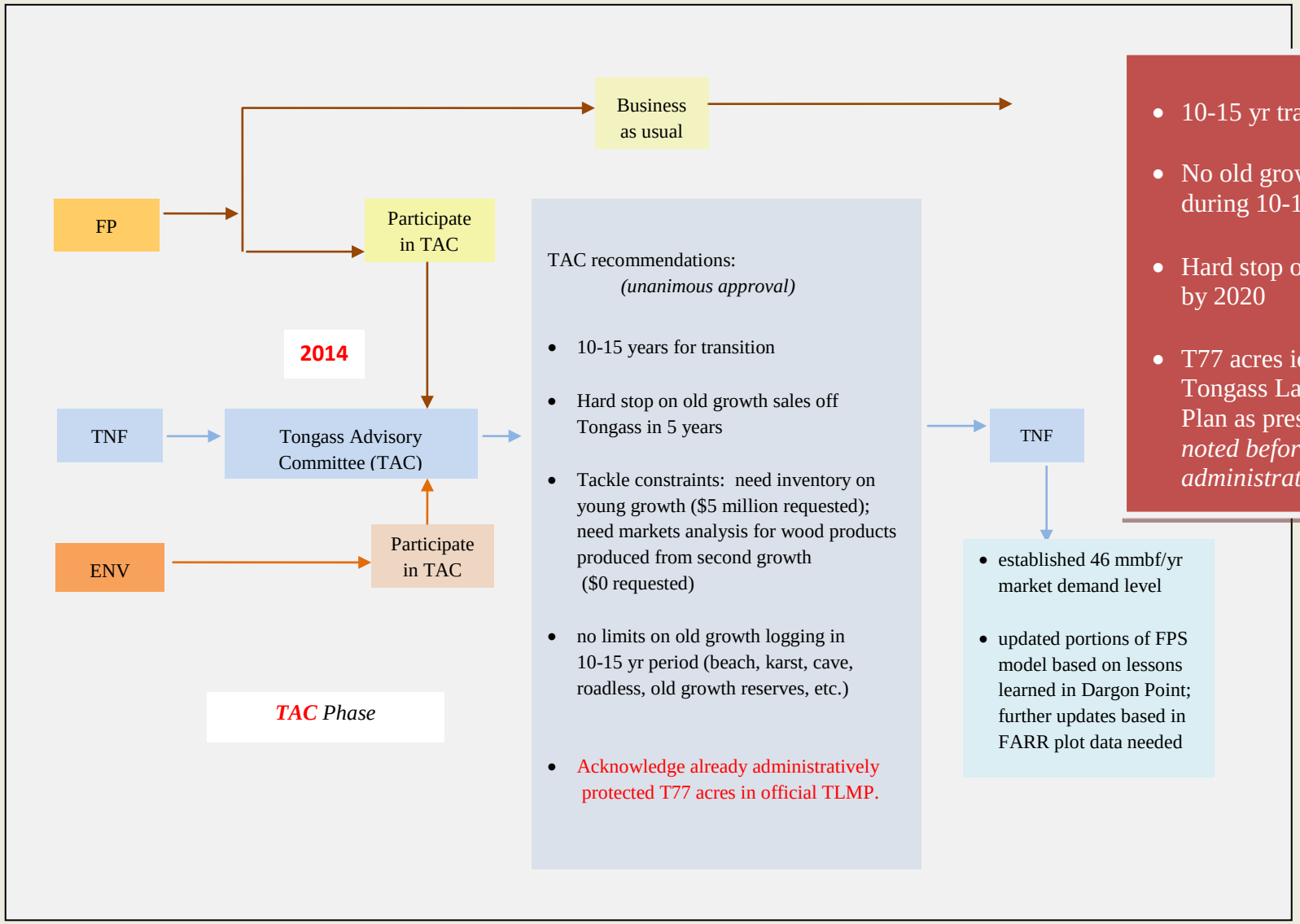
Study Results Show Wall of Wood

Proposes pilot project with Good Faith Lumber

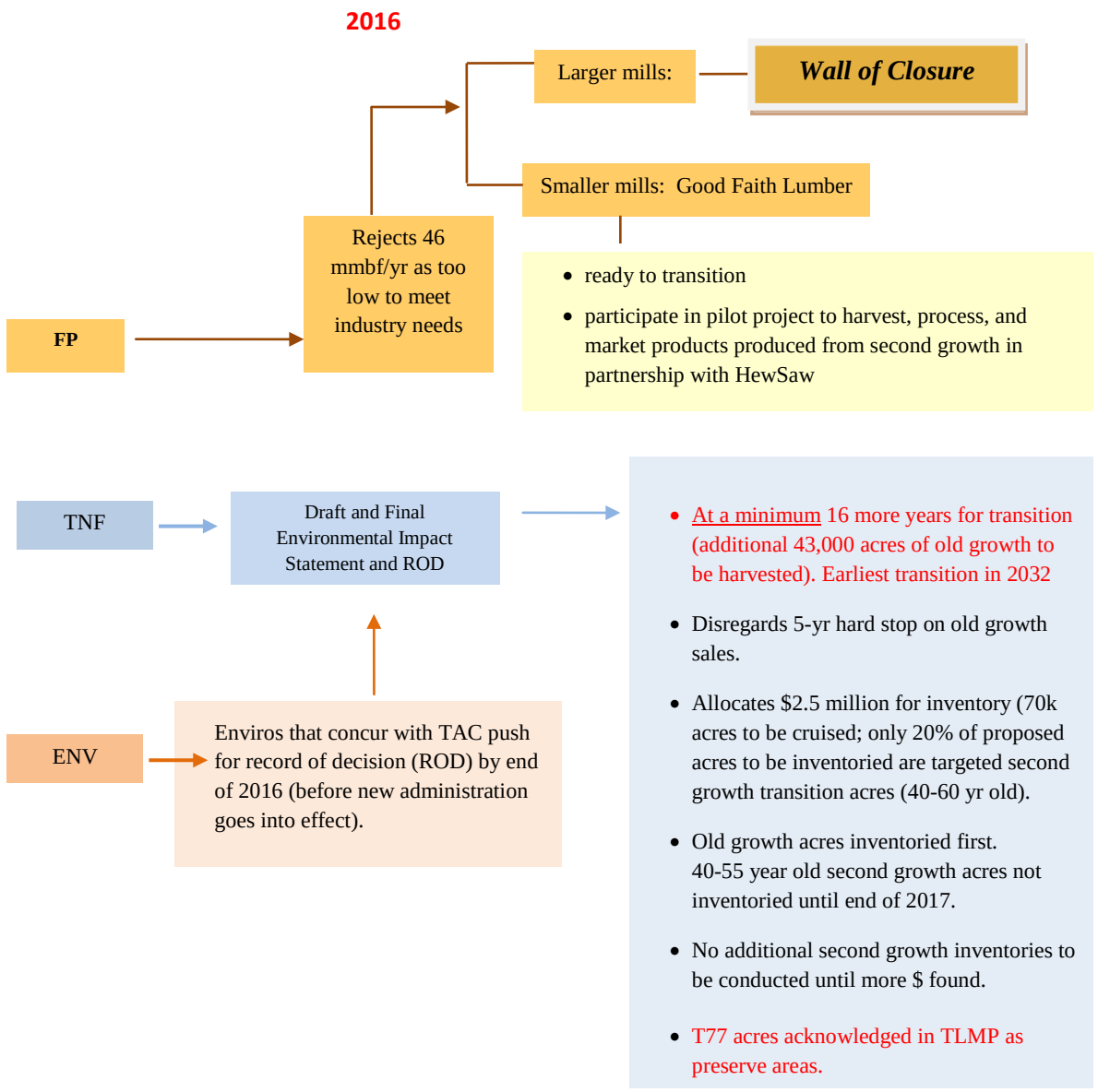
- 200,000 board feet of Tongass second growth to be harvested in 2017 from Dargon Point sale.
- HewSaw technology to be tested on site
- Documentation of market response to products
- Documentation of lumber volume and grade recovery
- Documentation of harvest & production costs
- 50% of gross revenues from sale of second growth products reinvested back into mill for small log infrastructure improvements
- TNF denies request from Good Faith Lumber to provide letter of support for pilot project to be used for non-government funding requests to undertake pilot project.

***NRDC/GEOS** Phase*

- 3 year results conclude that 55 mmbf/yr can be supplied from second growth stands starting 2020
- Forest Service slow-walks transition effort (see Decision of Record Phase) and denies industry support letter to move forward on Dargon Point harvest/ manufacturing pilot


Business as usual
FP
Participate in TAC
2014
TNF
Tongass Advisory Committee (TAC)
ENV
Participate in TAC
TAC Phase
TAC recommendations:
(unanimous approval)
10-15 years for transition
Hard stop on old growth sales off Tongass in 5 years
Tackle constraints: need inventory on young growth ($5 million requested); need markets analysis for wood products produced from second growth ($0 requested)
no limits on old growth logging in 10-15 yr period (beach, karst, cave, roadless, old growth reserves, etc.)
Acknowledge already administratively protected T77 acres in official TLMP.
TNF
established 46 mmbf/yr market demand level
updated portions of FPS model based on lessons learned in Dargon Point; further updates based in FARR plot data needed
10-15 yr transition period
No old growth logging limits during 10-15 yrs
Hard stop on old growth sales by 2020
T77 acres identified in Tongass Land Management Plan as preserve acres (as noted before, most already administratively preserved).

Decision of Record (ROD) Phase



- Enviros push for ROD signing in 2016. Rod signed November 30, 2016
- Mills threaten closure
- Forest Service says at least 16 more years of old growth logging needed
- Forest Service establishes inventory program with early focus on inventorying old growth. Of 70,000 acres to be inventoried, only 20% appear to be targeted second growth transition acres (40-60 year old stands).

Three-Year Study Methodology

For the study effort, what to solve for?

Tackling perceptions . . . fact or fiction?

- Too few acres; too little volume
- Acres too scattered for economic viability
- Too much single log (32') only capture; too much forest residual left on the ground after harvest; needs at least another 5-10 years to grow.
- Poor access to acres
- Non-operability of acres (slopes too steep)
- Too many acres in low site productivity soils
- No markets for second growth
- Poor economics of harvesting second growth
- Lack of compliance with TAC recommendations
- Required changes in milling operations to transition to second growth processing

Goal: Identify 'reduced risk' acres in POW region that may help to reduce the glide path to a second growth transition in SE Alaska.

"Reduced Risk" acres are:

a) **acres outside of *litigious environmentally sensitive areas***

and

b) **acres that can be accessed by currently open FS roads resulting in *significantly reduced logging costs.***

Petersburg 8.1

Result: Move from all second growth acres to emphasis on "suitable" pre-commercially thinned (PCT) and non-PCT acres with access to currently open FS roads.

- **2013-2014:** Conducted comprehensive GIS analysis on 78,000 pre-commercially thinned (PCT) acres and 46,000 non-PCT acres servicing the Prince of Wales (POW) region. 43 analysis zones in five Ranger Districts were created for 3-year study. All acres have access to currently open FS roads

- **2014:** Established free public portal access to all Forest Service (FS) GIS data analysis via DataBasin (www.DataBasin.org). 900 acres cruised in Thorne Bay and Petersburg Ranger Districts. Complete transparency on all work.

- **2015:** Undertook the most intensive timber cruises ever conducted on the Tongass National Forest to date (one plot per acre cruise protocol). Shared all raw cruise data with the Tongass NF (at no cost to the agency).

- **2015-2016:** Analyzed all past FS stand exams conducted on the targeted PCT and non-PCT acres (over 3,500 plots analyzed in the POW region over the last 10 years). Compared findings to 2015 cruise results.

- **2016:** Used updated (2016) FPS modeling produced by the FS to estimate growth and yield from second growth acres cruised in 2015. Extrapolated to larger GIS-analyzed landscape.

- **2016:** Compared all results back to Tongass Advisory Committee recommendations.

- **2016:** Established Good Faith Lumber Company pilot project for completion in 2017 to address specific lumber grade and volume recovery issues in second growth transition effort. Project will harvest 200,000 board feet of second growth timber from Dargon Point timber sale in Thorne Bay Ranger District; process logs through portable HewSaw scanning system and Good Faith mill, and flow product into market.

4 areas in **Craig** Ranger District
(10,205 roaded PCT & Non-PCT ac.)

7 areas in **Wrangell** Ranger District
(18,486 roaded PCT & Non-PCT ac.)

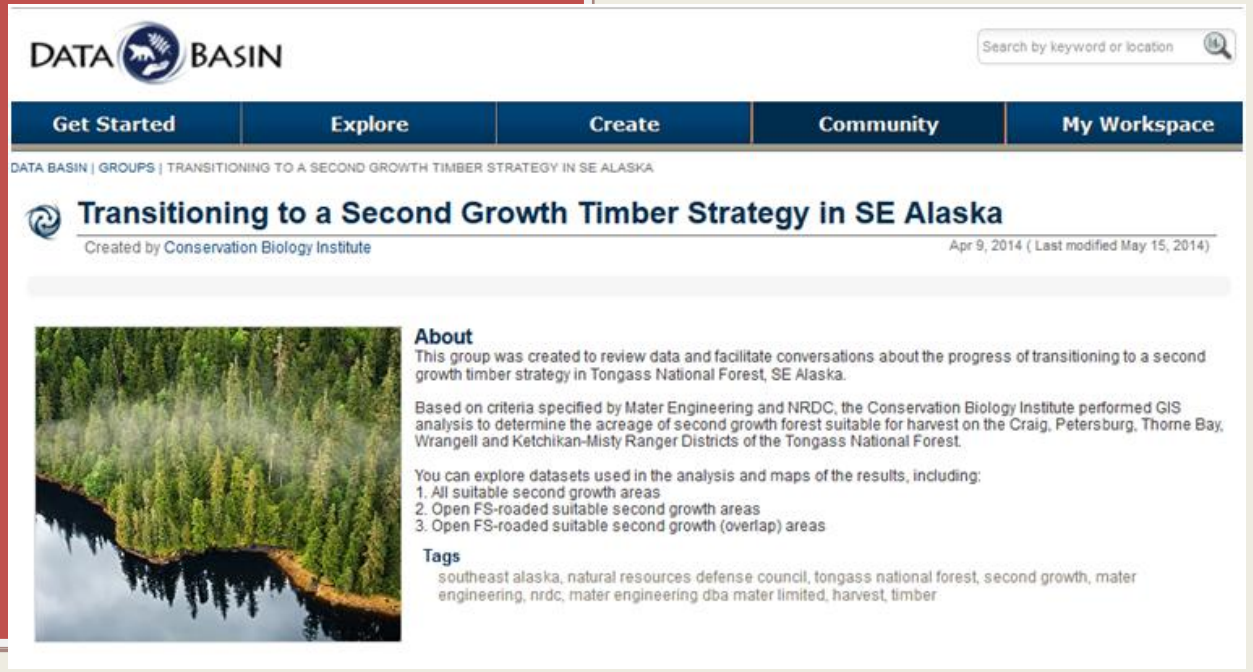
9 areas in **Petersburg** Ranger District
(24,851 roaded PCT & Non-PCT ac)

43 Ranger District Analysis Zones

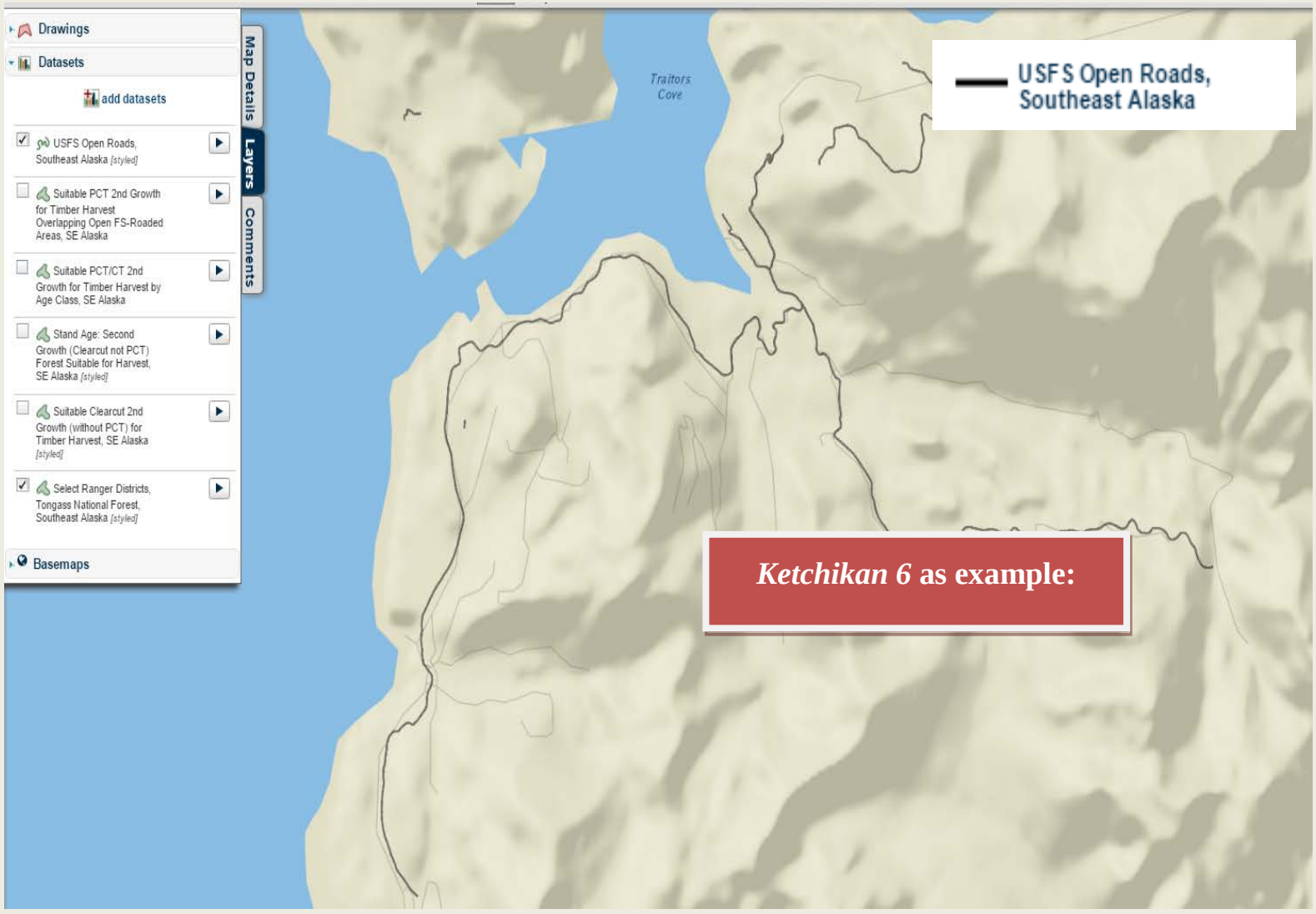
15 areas in **Thorne Bay** Ranger District
(58,060 roaded PCT & Non-PCT ac)

8 areas in **Ketchikan** Ranger District
(14,180 roaded PCT & Non-PCT ac)

All efforts transparent: In 2013-2014, Conservation Biology Institute (CBI) *(www.consbio.org)* retained to conduct GIS modeling on Tongass National Forest. Project establishes free public portal access through CBI's DataBasin program to all GIS data and data sort results used in three-year study.

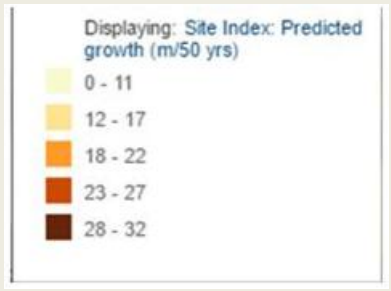


Sort by Currently-Open Forest Service Roads

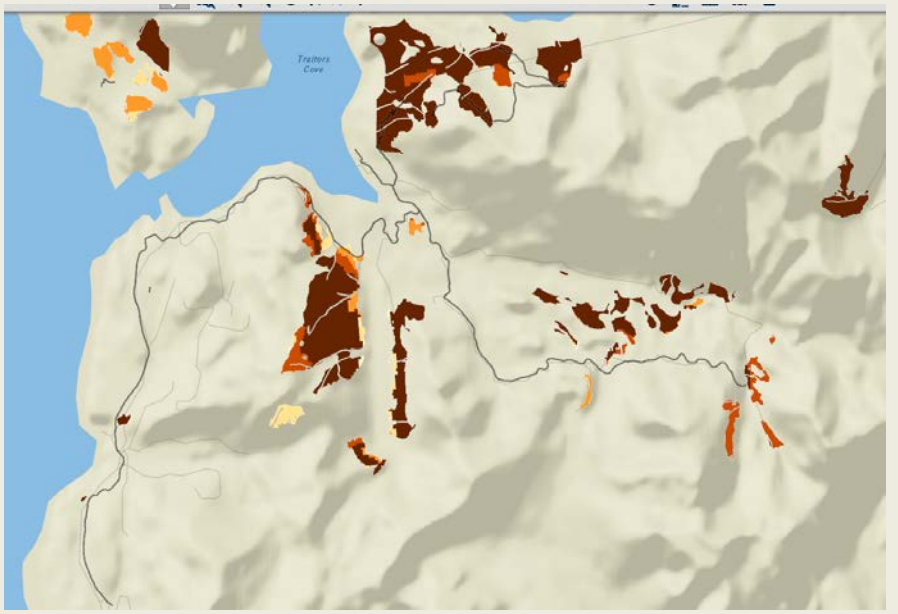


Sort for "Roaded" PCT and "Roaded" Non-PCT by Age Class

Sort by site index for PCT . . .

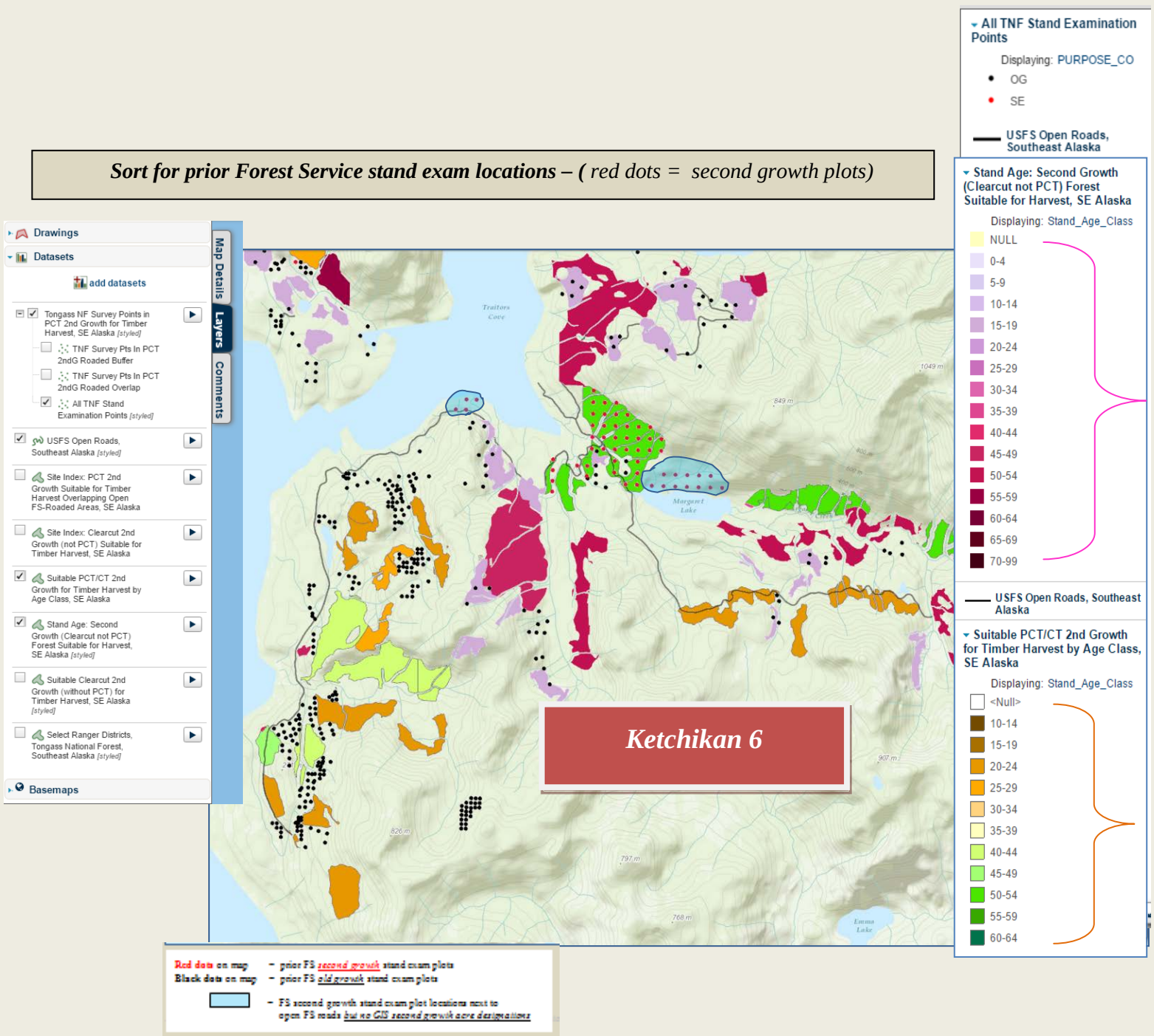


. . . and for non-PCT



Ketchikan 6

Sort for prior Forest Service stand exam locations – (*red dots = second growth plots)*



GIS-confirmed non-PCT acres

GIS-confirmed PCT acres

Reduced risk acres further analyzed by:

"Buffer" acres = acres within 800' of a current open FS road

"Overlap" acres = acres with stands that straddle buffer acres (a portion of the stand is in the 800' buffer; the remaining portion is outside the buffer)

"Contiguous" acres = acres immediately adjacent to overlap acre boundaries

Total second growth on Tongass (450,000 + acres)

Reduced risk second growth acres (aka "suitable acres")

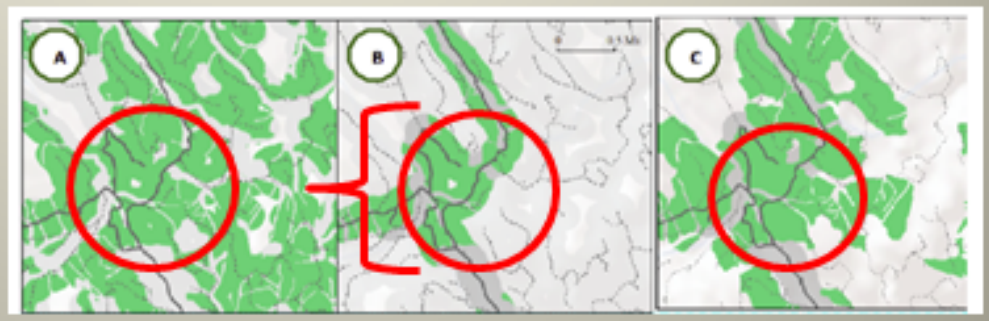
(netdowns from total SG acres):

- stream and riparian buffers
- karst
- cave
- beach
- wilderness LUDII & monument
- roadless
- non-timber LUDs
- natural disturbance acres
- >70% slope
- T77 acres

~50% of all total second growth netted out to achieve reduced risk or 'suitable'.

230,000 + acres

Example: After environmental netdowns, for PCT acres in POW region



A (PCT)

All "buffer", "overlap" and "contiguous" acres:

~78,000 acres

B (PCT)

All "buffer" acres

~36,000 acres (45% of total)

C (PCT)

All "buffer" plus "overlap" acres

~56,000 acres (70% of total)

At-a-Glance Summary of Study Results:
What We Now Know and Don't Know

What we now know:

Overall:

- Approximately 78,000 acres of low-risk PCT stands exist just within 5 RDs that service the POW region and are located next to current open FS roads (low cost access). Another 13,000 acres of low-risk PCT acres exist within ranger districts adjacent to the POW service region.

- Approximately 46,000 acres of low-risk non-PCT stands exist within the same 5 RDs and are located next to current open FS road (low cost access).

- Acres by age class distribution within those PCT and non-PCT acres are significant and evenly-distributed allowing volume rollover for sustainable harvest from year to year beginning 2020. Harvest at 55 years.

- The Dargon Point sale highlights the need for changes in the Forest Service FPS model (estimating growth and yield), as projected second growth volumes were significantly under-estimated. This under-estimation was due to the difference between second growth and old growth tree characteristics (lower defect, less taper, etc.) not reflected in the FPS model. The Forest Service updated their FPS model in 2016 to more accurately reflect second growth conditions based on lessons learned at Dargon Point, but more updates are anticipated with the expected Forest Service release of Farr plot (young growth) data in 2017.

- Based on 2015 cruise data, 2016 FPS modeling, and prior FS stand exams going back ten years, beginning 2020, between 41 mmbf/yr to 55 mmbf/yr of second growth merchantable volume could be available for harvest at 55 years of age. This volume can be a sustained annual volume over time for the next 50+ years before re-harvest. Market demand @ 46 mmbf/yr was established by the Forest Service in 2016.

- 2020-2014 annual harvest is based on 12.2 mbf/ac. 2025 and beyond annual harvest is based on 14.6 mbf/ac for PCTstands and 15.4 mbf/ac for non-PCT stands, with harvest down to 4.5” tops. All mbf/ac volumes are recognized as conservative.

What we now know:

Based on <u>2015 cruise results</u>:

- There is lower-cost logging operability on almost 90% of the targeted acres (~ 45% of acres are < 30% slope; another 40% are between 30% and 50% slope).
- Over 90% of the PCT acres cruised in 2015 were located on highly productive sites (site index 90+), even though GIS data indicated over 50% of acres would be in lower site index sites (site index 74-89).
- Defect in both hemlock and spruce overall is both comparable and low (5% to 7%). (Old growth is typically 50% defect).
- Trees are notably larger (both in height and dbh) than expected, achieving desired log characteristics for small log processing technology currently being evaluated for SE Alaska. Approximate dbh for harvest at 55 years will be between 13" to 14"; approximate tree height will be 78'.
- Based on 2016 updated Forest Service FPS modeling and growing out for 10 years: mean dbh change over a decade will be +1.5"; mean tree height change will be +17'.
- Based on 2016 updated Forest Service FPS modeling and growing out for 10 years: stands aged 50-54 years (40-44 in 2015) will produce between 16-20 mbf/ac; stands aged 55-59 yrs (45-49 in 2015) will produce 18 mbf/ac; and stands aged 60-64 yr (50-54 in 2015) will produce 24 mbf/ac.
- Based on 2016 updated Forest Service FPS modeling and growing out for 10 years:, at least 55% of merchantable volume per stand will come from trees that produce at least 2 Grade A logs (32' log length) or one Grade A log and one Grade B log (26' - 31' log length) at harvest time at 55 years.

What we now know:

Based on <u>past Forest Service stand exams</u> over the last decade:

- Over 80% of all second growth trees cruised by the Forest Service over the last ten years in the targeted PCT and non-PCT stands were aged 39 yrs or younger. Only 4% of trees cruised were in stands aged 45 - 49 years; only 1% were in stands aged 50 years and older. The 2015 timber cruises conducted for this study supplied a significant portion of updated stand exam data for second growth stands older than 45 yrs.

- Based on updated FPS modeling not available to the public until mid 2016, past FS estimates on volume availability from second growth stands were <u>under-estimated</u> by the Forest Service (up to 10% under-estimations for current volume conditions). Additional under-estimations are expected with the release of new Farr plot data showing existing Taylor growth and yield curves require adjustment upward for second growth accuracy.

- The PCT acres are comprised of highly productive soils; more than 60% of acres in all but the Wrangell RD have site index of > 90 (tree height in feet grown over a 50-year period). 40% of the non-PCT acres are in highly productive stands.

- <u>At survey time</u>: For PCT sites with site index 90+ at age 45-49 years, dbh range was 13" to 16"; height range was 56' to 81'. For non-PCT sites with site index 90+ at age 45-49 years, mean dbh was 12"; mean height was 66'. For non-PCT sites with site index 90+ at age 50-54 years, mean dbh was 15"; mean tree height was 80'.

- For stands 49 years and younger: there appears little variation in tree height between PCT and non-PCT stands in the same age class, regardless of site indices. However, variations in tree height are notable in stands aged 50 yrs and older based on site index (90+ stands produce taller trees). Similar results are noted in the dbh data.

What we now know:

Based on SE Alaska <u>Industry Preparedness to Transition</u> to Second Growth Processing:

- Current industry operates off of three log grades: Grade A log = 32' or longer length; Grade B log = 26' to 31' log length; Grade C = 8' to 25' log length.
- No mills currently operating in SE Alaska have small log processing equipment in place to efficiently process smaller diameter second growth logs.
- New small log processing technology (HewSaw) is readily available to beta-test on small diameter second growth logs off the Tongass. This technology economically processes down to 4.5" diameter logs and is established small log processing equipment used in many regions across the US. Harvesting down to 4.5" tops produces notable increases in log Grade recovery.
- HewSaw equipment manufacturers are ready to partner with industry in SE Alaska to beta-test their small log processing technology on-site in SE Alaska.
- Good Faith Lumber Company in Thorne Bay has offered to participate in a pilot project with HewSaw to test the technology on the harvest of their Dargon Point second growth timber sale purchase. Assuming funding for the pilot is secured, harvest and processing will occur in 2017.
- Lessons learned from a Good Faith pilot project (Dargon Point sale) will have immediate application to larger second growth landscape: While mbf/ac off of Dargon Point appears higher than the anticipated norm (likely due to tree height), dbh is 11"- 12", matching 40-49 yr old tree characteristics cruised in 2015. Processing of Grade A, B, and C logs from the Dargon Point sale with regard to lumber and grade recovery <u>from log *segments*</u> will directly inform transition efforts at larger scale.

What's next? **Getting answers to what we don't know . . .**

What we don't know . . .

. . . about forest inventory work underway

We know that past Forest Service stand exams relied on a cruise protocol of one plot per 10-15 acres. We also know that variability within stands can be substantial from acre to acre (as noted in the 2015 cruise results), and that one plot per 2-4 acres cruise protocol is preferred in order to reduce high chances for error. More intensive timber cruise work is needed to shore up missing data points. As a result of the TAC recommendations, that work has already begun by the Forest Service (at one plot per 2.5 acres), but acres identified for cruising do not appear to focus on the most important acres needed for timely transition (40 to 60 year old stands). From FS data we see:

- The largest bulk (284,045 acres or 66%) of all second growth acres on the Tongass are 45 years old or younger
- Another 20% (78,844 acres) are aged 46-52 years
- Another 10% (40, 360 acres) are aged 53-59 yrs
- The remaining 4% (17,456 acres) are aged 60 years and above, with 65% of those acres aged 60-69 yrs.

With only 4% of all second growth acres on the Tongass aged 60 yrs and older and past Forest Service stand exams primarily focused on 35-39 yr old acres, current inventory work should be solely focused on those acres that could supply the production chain in the next 5 years, 10 years, and 15 years out (ie 40-59 yr old stands)

The current forest inventory work being undertaken by the Tongass encompasses 70,000 acres, but only 20% of acres being cruised appear to fall into the important 40-60 year age bracket.

20,000 acres = old growth (30% of inventory volume)
15,000 acres = 50-54 yr old stands (20% of inventory volume)
35,000 acres = "55+" (50% of inventory volume) – with no indication that focus will be on 55 to 59 yr old stands vs. 60 yr old and older stands

What we don't know . . .

. . . about wood volume and lumber grade recovery

- Currently there is no data available on volume recovery from second growth supply in SE Alaska.
- Prior limited research on grade recovery from second growth only looked at dimension grade recovery, and did not evaluate for value-added grade recovery. The number of logs sampled was very small.
- Some very limited (and not well-documented) processing of second growth supply to market has occurred at Good Faith Lumber (for TNC) and Icy Straits Lumber (for Sealaska), but in both cases supply provided to the mills for processing had been either downed or decked for several years, resulting in wood over-dryness (TNC) and a high percentage of ambrosia (Sealaska). No testing has been done on fresh-cut second growth supply in sufficient quantities to capture market attention.
- ***The Dargon Point sale can be effectively used as an important case study to help inform the overall second growth strategy in SE Alaska. With funding approval, this research project could be completed by end of 2017.***

What we don't know . . .

. . . about replication of volume and grade recovery results at larger landscape scale

- No data currently exists documenting application of site specific ('case study') research to larger landscape scale replication.
- The US Forest Service Pacific Northwest (PNW) Research Station is currently engaged in a large scale second growth wood quality research study that would evaluate wood volume and grade recovery by species and site index from at least 10 representative second growth cut block locations across the Tongass.
- The project would entail processing of second growth at 3 mills in SE Alaska and an outside mill employing high-tech internal log scanning technology. As much as 80 log sorts would be processed through each mill (8 sorts per cut block location).
- Current funding for this larger scale project covers study design and peer review phase, selection of cut blocks, NEPA on cut blocks, and project budget development. An additional $3 million is estimated to be required to fully engage the project in the field. Currently, NEPA is not scheduled to be completed until early 2018.
- ***Top priority should be to accelerate this project so full completion can occur by end of 2018.***

What we don't know . . .

. . . about efficient processing of second growth supply

- Application of new small log processing technology (like HewSaw) needs to be tested to determine appropriateness of application on SE Alaska supply and conditions
- If changes in infrastructure are required to efficiently process second growth, what are the costs to completing infrastructure change-out and what lead time is needed before becoming fully operational?
- Even if new infrastructure is not required (like use of existing dry kilns), securing appropriate dry kiln schedules for processing second growth is quickly needed.

What we don't know . . .

. . . about overall economics of processing second growth supply in SE Alaska

This remains the over-arching question surrounding transitioning to second growth supply, and rotates back to the key "what to solve for" questions and perceptions detailed earlier in this report (see pages 4-7). Key actions proposed to be accomplished in 2017 and 2018 to help address transition economics are as follows:

1) Complete the Good Faith Lumber Company case study by 2017. The case study may not be able to address volume per acre (mbf/ac) application to larger landscape scale (as the Dargon Point sale is on a karst site that , on the surface, appears to produce taller trees than other sites at same age), but it will be able to address:

- volume and grade recovery from log *segments* (as dbh matches to other second growth sites aged 45 to 60 years)
- harvesting costs, especially distinguishing between roaded vs non-roaded conditions for access to supply
- processing requirements such as lumber drying schedules for second growth
- market acceptance of products produced from second growth
- application of new small log processing technology

2) Secure commitment of funding to allow the larger PNW wood quality study to move quickly forward and have completion by end of 2018.

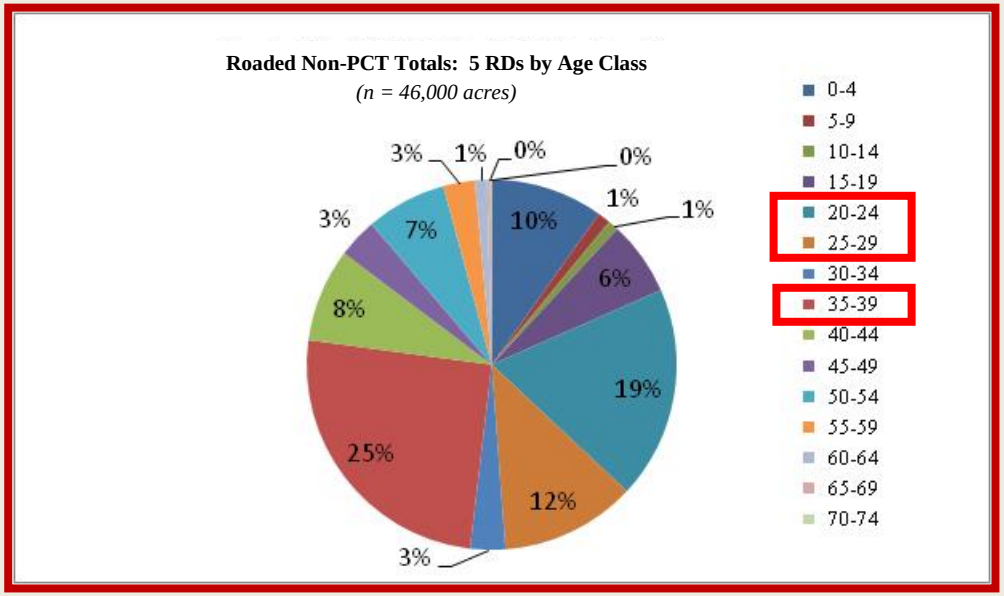
Detailed Study Results

Results of GIS analysis for suitable, roaded PCT and Non-PCT acres in POW region:

- **Age class distribution**
- **Site index**
- **Access**
- **Elevation**
- **Impacts of Sealaska Land Legislation**
- **Past Forest Service Stand Exam Locations**

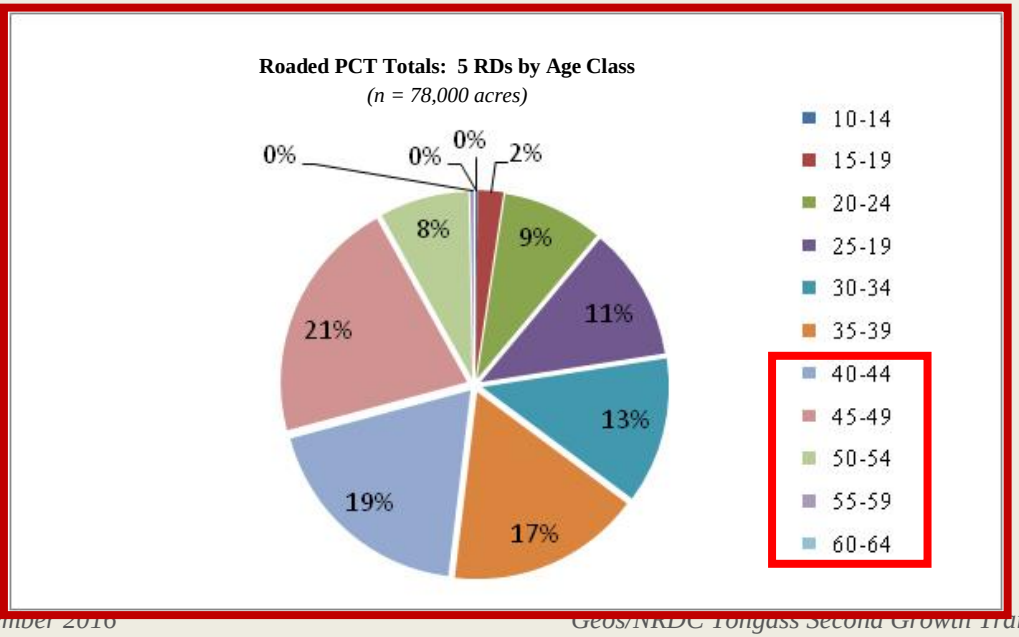
See Exhibits section at the end of this document for results by each analysis zone in every ranger district.

Results by Age Class – (see Exhibits A and C)



For suitable <u>non-PCT</u> acres with access to open FS roads in 5 RDS:

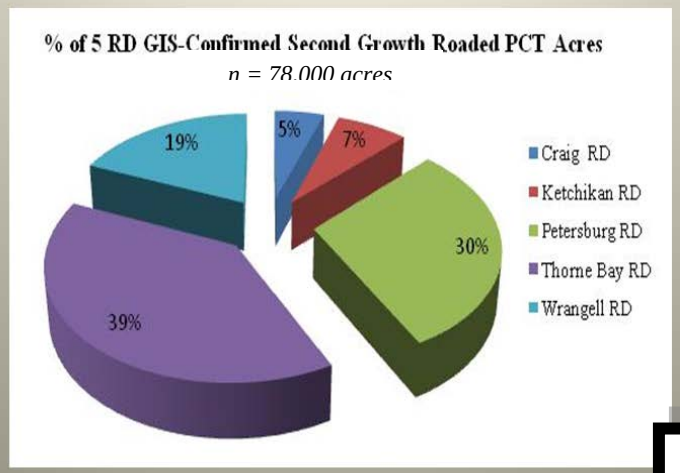
Predominately younger SG stands (<u>70%</u> of acres) are aged 39 yrs and younger) …



For suitable <u>PCT</u> acres with access to open FS roads n 5 RDS:

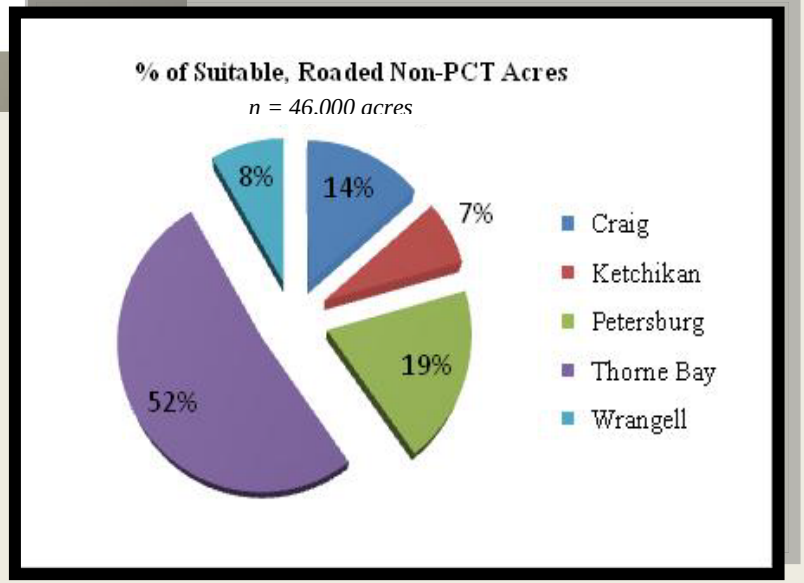
Predominately older SG stands (~<u>50%</u> of acres are aged 40 yrs and older).

"Roaded" PCT: ***almost 70% acres in Petersburg and Thorne Bay RDs***



Results by District Ranger – (see Exhibits A and C)

Similar results for roaded non-PCT



Results by Site Index– (see Exhibit B)

Over 60% of all suitable, roaded PCT acres are in high productive sites (site index 90+); the remainder acres are in medium productive sites (site index 84-89)

(site index numbers above = amount of added tree height in feet over 50 years of growth)

% of roaded PCT acres in each RD with site index 90+ that could be available for harvest @ 55 years of age in year:

Ranger Districts	*Harvest 2020* (2015 age 50-54 years)	*Harvest 2025* (2015 age 45-49 years)	*Harvest 2030* (2015 age 40-44 years)
Craig	60%	72%	92%
Ketchikan	82%	82%	79%
Petersburg	88%	62%	46%
Thorne Bay	52%	53%	47%
Wrangell	0%	0%	6%

Results by Site Index– (see Exhibit D)

Only 40% of all suitable, roaded <u>non-PCT</u> acres are in high productive sites (site index 90+); the remainder acres are in <u>medium productive sites</u> (site index 84-89)

% of roaded Non-PCT acres in each RD with <u>site index 90+</u> that could be available for harvest @ 55 years of age in year:			
Ranger Districts	***Harvest 2020*** (2015 age 50-54 years)	***Harvest 2025*** (2015 age 45-49 years)	***Harvest 2030*** (2015 age 40-44 years)
Craig	45%	45%	47%
Ketchikan	84%	64%	86%
Petersburg	0%	0%	75%
Thorne Bay	55%	56%	35%
Wrangell	0%	0%	38%

Results: Potential Access Issues

Overall – only 2% of all targeted acres in the POW region may have some access issues primarily due to stream crossings

Ranger District	Analysis Zones	*mean % of acres with potential access issues*
Craig	1-4	2%
Ketchikan	1-8	2%
Petersburg	1-9	2%
Thorne Bay	1-15	2%
Wrangell	1-7	1%

Results: Potential Elevation Issues

For stands over 1,000' in elevation, re-growth may be more suppressed, potentially affecting future volumes and timelines. Regardless – only 5% of all targeted acres in the POW region have elevations over 1,000'.

Ranger District	Analysis Zones	*mean % of acres with elevation over 1,000'*
Craig	1-4	2%
Ketchikan	1-8	4%
Petersburg	1-9	2%
Thorne Bay	1-15	5%
Wrangell	1-7	10%

Results: Affected Acres Due to Sealaska Land Legislation

Of the 70,000 acres transferred from the Tongass to Sealaska, 22,000 acres were second growth, and 50% of those acres were PCT acres. Regardless – the legislation affected only 7% of the suitable, roaded PCT targeted for second growth transition.

Ranger District	*# of acres affected by land legislation*
Craig	*688*
Ketchikan	*70*
Petersburg	*847*
Thorne Bay	*0*
Wrangell	*0*

Results of the 2015 Timber Cruises Conducted for This Project Effort

See Exhibits E, F, and G

Cruise Protocol

- Almost 900 acres cruised in July 2015 (316 ac) and in September 2015 (580 ac). Over 5,000 trees cruised.
- Stands initially harvested in 1960, 1970, and 1975
- Total of 30 stands cruised located in Thorne Bay and Petersburg RDs
- Selected acres were in three stand designations: 'buffer', 'overlap' and 'contiguous'
- Site index verified
- Tree coring in every cruised stand conducted to verify current tree age at breast height from initial harvest date.
- Nothing smaller than 4.5" tops counted

1 plot per acre cruise protocol used
(the most intensive cruise conducted on the Tongass to date)

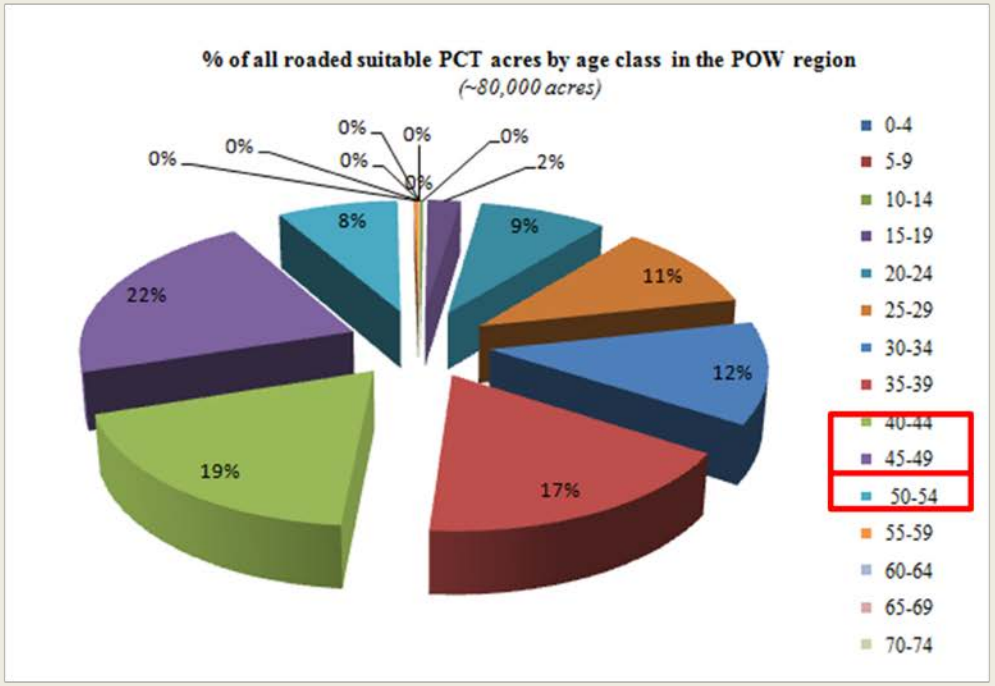
Cruise acres originally selected by variations in site index based on GIS, but . . .

Actual cruise site index verification showed more acres to be in higher site indices.

			% of acres Site Index		
			58.73	74-89	90+
July 2015 Cruise	Petersburg 8.1	GIS data		40%	60%
		2015 Cruise: Stands 1-7 *96.3 ac*			100% Low (95) High (121)
	Thorne Bay 7.1 and 7.3	GIS data		33%	67%
		2015 Cruise: Stands 8-11 *130.1 ac*			100% Low (91) High (98)
	Thorne Bay 6.1	GIS data	10%	45%	45%
		2015 Cruise: Stands 12-14 *89.8 ac*			100% Low (95) High (121)
September 2015 Cruise	Petersburg 7.2 and 7.3	GIS data		72%	28%
		2015 Cruise: Stands 721-726 & 731-732 *334 ac*		2% Low/High (89)	98% Low (95) High (108)
	Thorne Bay 4.1 and 4.3	GIS data		33%	69%
		2015 Cruise: Stands 411-414 & 431 *136 ac*		21% Low/High (85)	79% Low (92) High (105)
	Thorne Bay 7.9	GIS data		33%	66%
		2015 Cruise: Stands 791-793 *101 ac*			100% Low/High (95)

Age Class Distribution

Age class distribution of suitable PCT stands fairly *evenly distributed* allowing for sustainable harvest volume over time.



September 2015 cruise:

Focused on:

- **45-49 yr old stands** *(21% of total targeted PCT stands).*
- **40-44 yr old stands** *(19% of total targeted PCT stands).*

July 2015 cruise:

Focused on 50-54 yr old PCT stands *(8% of total targeted PCT stands).*

- **Retained *Terra Verde* (Jim McWhorter). McWhorter assisted by SeaWolfe Consulting** (Ron Wolfe – past Timber Manager for Sealaska). Terre Verde has history of timber cruise contracts with the Tongass National Forest, and McWhorter has served on many timber working groups for SE Alaska

- **All field work completed by early July 2015 (316 acres) and in late September 2015 (580 acres)**

Plot variability maps detailing results of *current conditions* and *conditions at time of proposed harvest* for 2015 cruised stands are provided in Exhibits F and G showing :

- **# of trees cruised**
- **average dbh**
- **average tree height**
- **cored tree age @ breast height**
- **slope**
- **net bf/ac by plot and overall stand level.**

Total trees cruised: 100 *(7% of total)*
Avg height (weighted): 83'
Avg dbh (weighted): 14.2" (arithmetic)
Quadratic mean diameter: 11"

Avg age (breast hgt): 42.1 yrs
SI: 95
Net BF/Ac: 17,456
Acres: 18.1

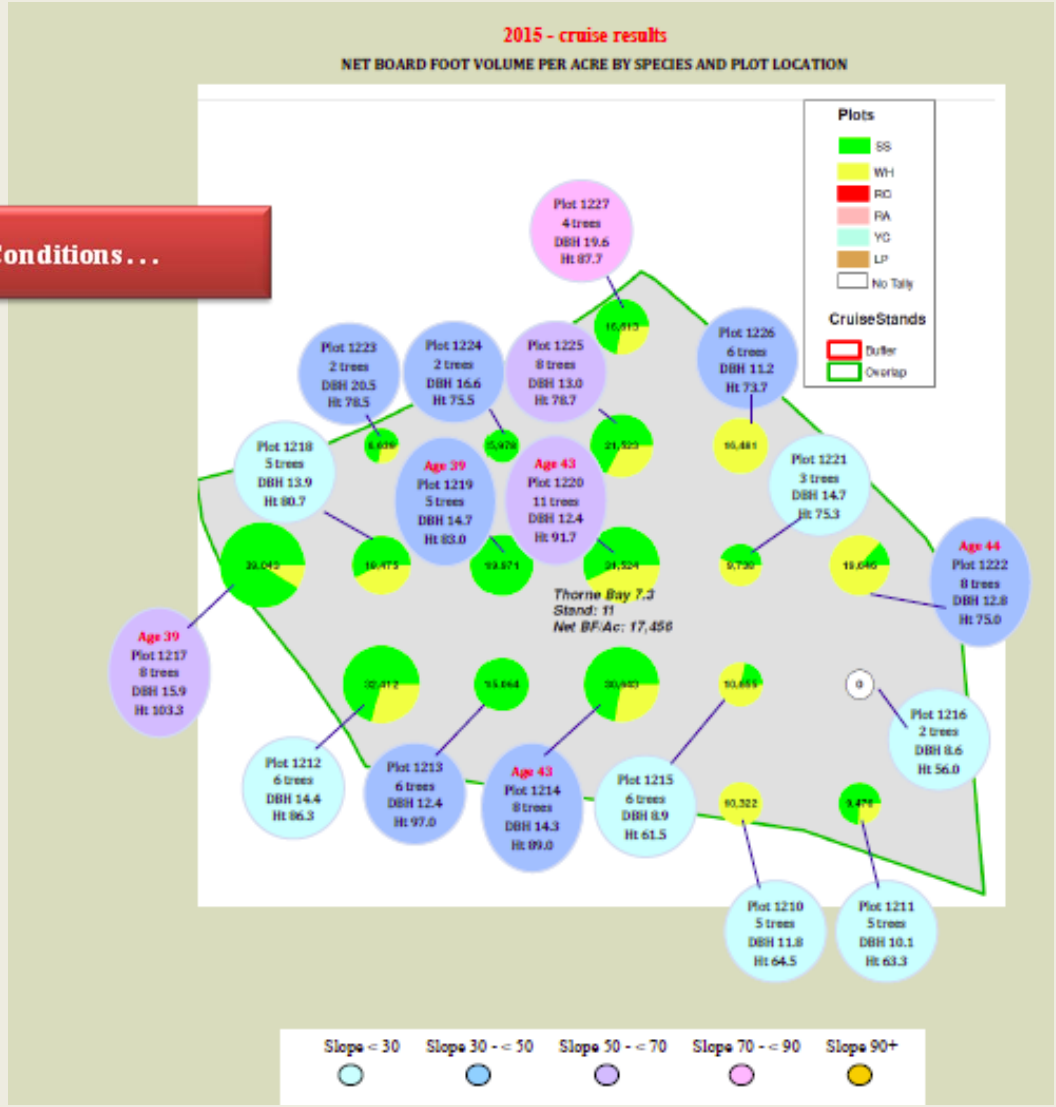
29% Defect:
24% Crook
2% Dead Top
2% Fork

NET BOARD FOOT VOLUME PER ACRE BY SPECIES AND PLOT

2015 Conditions . . .

Example:

Thorne Bay 7.3
Stand 11



Example:

Thorne Bay 7.3
Stand 11

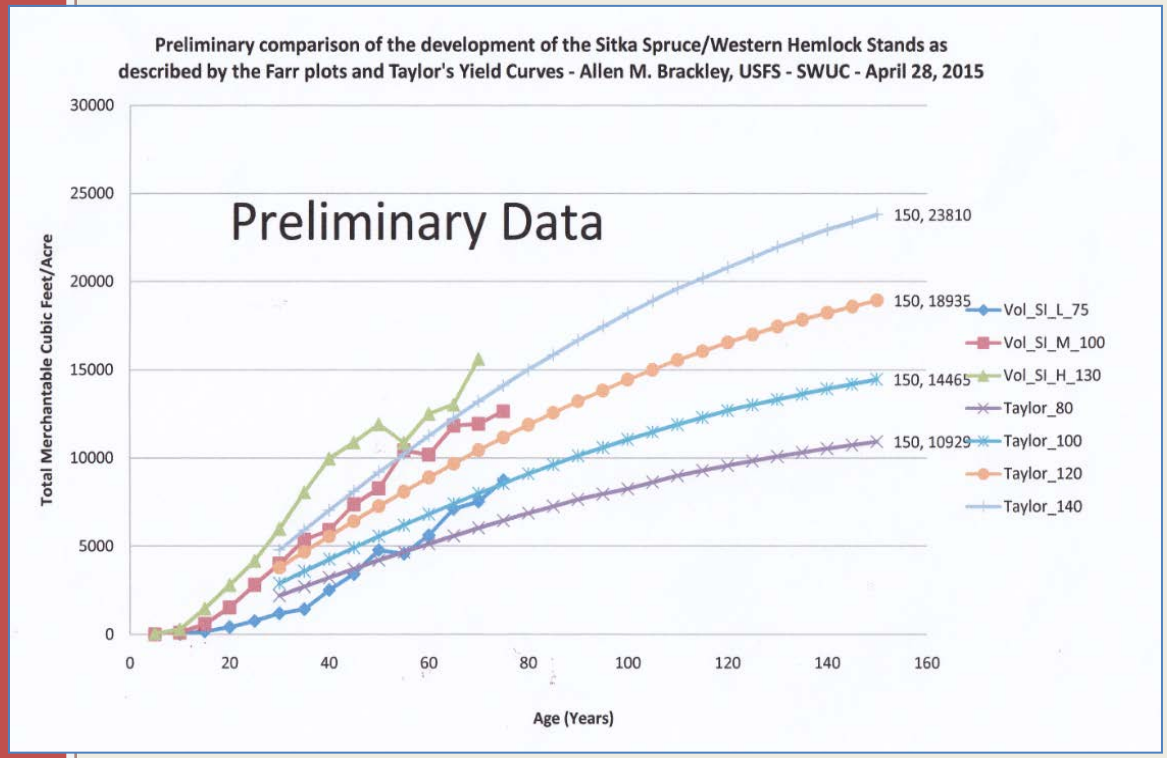
Cruise data and grow-out on plot by plot basis

	Plot # *(cored height)*	# trees cruised	2015 Avg. dbh* ** = below 7"	2015 Avg. height	2015 Merch volume *(bf/ac)*	2015 Stand *(bf/ac)*	10-yr grow-out using 2016 Forest Service FPS model (4.5" top) Avg. dbh*	Avg. height	Stand merchantable volume *(bf/ac)*	% volume from trees with: Grade A log = 32' Grade B log = 26' - 31' Grade C log = 8' - 25'
Stand 11 (18 ac) **50-54 yrs**	1210	5	11.8	64.5	9,525		13.6	81.5		
	1211	5	10.1	63.3	11,039		11.9	80.3		
	1212	6	14.4	86.3	33,415		16.2	103.3		
	1213	6	12.4	97.0	16,665		14.2	114.0		
	1214 *(43 yrs)*	8	14.3	89.0	33,027		16.1	106.0		
	1215	6	8.9	61.5	17,523		10.7	78.5		
	1216	2	8.6	56.0	3,982		10.4	73.0		
	1217 *(39 yrs)*	8	15.9	103.3	43,349		17.7	120.3		1A = 7% 1A and 1B = 10% 1A and 1C = 22% ≥ 2A = 60%
	1218	5	13.9	80.7	18,285	**18,880**	15.7	97.7	**35,384**	
	1219 *(39 yrs)*	5	14.7	83.0	19,539		16.5	100.0		
	1220 *(43 yrs)*	11	12.4	91.7	34,481		14.2	108.7		
	1221	3	14.7	75.3	10,482		16.5	92.3		
	1222 *(44 yrs)*	8	12.8	75.0	22,082		14.6	92.0		
	1223	2	20.5	78.5	6,847		22.3	95.5		
	1224	2	16.6	75.5	6,071		18.4	92.5		
	1225	8	13.0	78.7	21,330		14.8	95.7		
	1226	6	11.2	73.7	15,016		13.0	90.7		
	1227	4	19.6	87.7	17,182		21.4	104.7		

* arithmetic

Projections of mbf/ac in 10-year grow-out likely under-estimated.

New preliminary Forest Service 60-year old second growth "Farr" plot data for PCT stands released in April 2015 shows Taylor growth and yield curves for old growth used in current FPS modeling substantially underestimating documented merchantable volume per acre in second growth PCT stands (10,000 cu ft/ac with site index of 100 for medium thin regime compared to Taylor projections of 6,000 cu ft/ac in same site index; ***almost a 70% volume difference***).



Cruise Results - See Exhibits F and G

Species Results

More hemlock than anticipated . . .
but very little (~ 5%) other species

July 2015 Cruise of 55 yr old stands:

By trees cruised:

- 56% spruce
- 34% hemlock

By merchantable volume:

- 66% spruce
- 29% hemlock

September 2015 Cruise of 40-44, and 45-49 year old stands

By trees cruised:

- 64% spruce
- 36% hemlock

By merchantable volume:

- 68% spruce
- 29% hemlock

Trees larger than expected . . .

especially in the 40-49 yr old stands *(see Exhibits F and G)*

	Ranges noted in 2015 cruises (low / high)	
	dbh	*Tree height*
50-54 yr old	10.8” – 14”	53.7’ – 76.7’
45-49 yr old	11.3” – 15.7”	57.7’ – 66.6’
40-44 yr old	11.7” – 14.8”	59.1’ – 68.4’

Cruise Results - See Exhibits F and G

50-54 yrs

Pet 8.1: 50-54 yr

Stand 2
SI = 121
307 TPA

Mean dbh: 13.4"
Mean height: 81'

Harvest 2020

Trees larger than anticipated in 2015 . . .

Cruise Results - See Exhibits F and G

45-49 yrs

TB 7.1: 45-49 yr

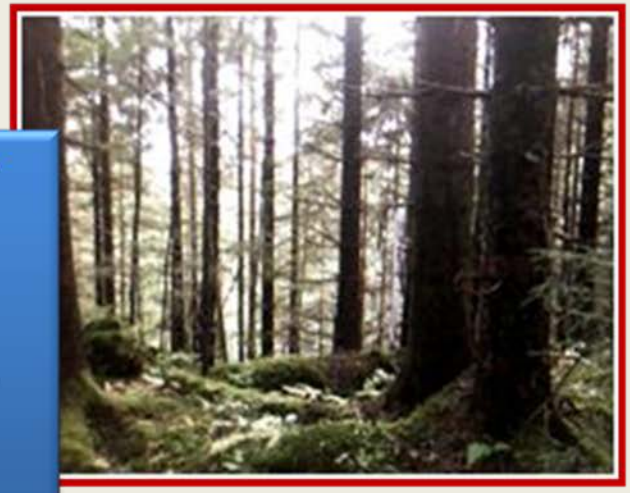
Stand 9
SI =92
376 TPA

Mean dbh: 10.5"
Mean height: 66'

Harvest 2030

Trees larger than anticipated in 2015 . . .

40-44 yrs



PET 7.2: 40-44 yr

Stand 723
SI = 98
201 TPA

Mean dbh: 14.4"
Mean height: 69'

Harvest 2030

Phase	Zone	Stand	Age Class	Acres	TPA
1	Pet 8.1	1	50-54	8.7	336
1		2		14	307
1		3		10.8	361
1		4		11	373
1		5		32.8	330
1		6		16.1	272
1		7		2.9	303
1	TB 7.3	8	50-54	16.9	287
1		9	40-44	39.3	376
1	TB 7.3	10	50-54	55.8	321
1		11		18.1	349
1		12		25.5	207
1		13		50.7	233
1		14		13.6	177
2	TB 4.1	411	45-49	21.7	184
2		412		2.3	182
2		413		17.2	163
2		414		23.5	244
2	TB 4.3	431	40-44	70.8	214
2	Pet 7.2	721	40-44	47.8	280
2		722		7.5	351
2		723		8.6	201
2		724		43	273
2		725		1.7	263
2		726		41	255
2	Pet 7.3	731	45-49	41.5	256
2		732		143	343
2	TB 7.9	791	45-49	7.1	481
2		792		7.3	556
2		793		87.3	264

Weighted Means	Age	TPA
	50-54 yrs	288
	45-49 yrs	294
	40-44 yrs	271

FS Farr plot data for stands aged 45 to 55 years.

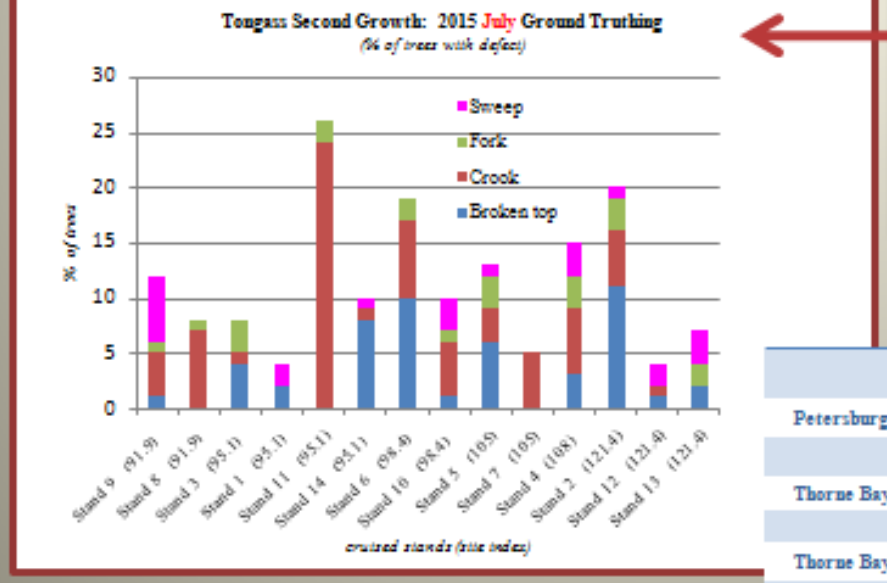
Control: 825 stems/ac

Low Thnning: 425 stems/ac
Medium Thinning: 237 stems/ac
High Thinning: 146 stems/ac

For PCT stands. . .
documented trees per acre (TPA) indicates <u>medium</u> thinning was employed on these stands

Cruise Results - See Exhibit F

And *defect was notably lower* than anticipated . . .



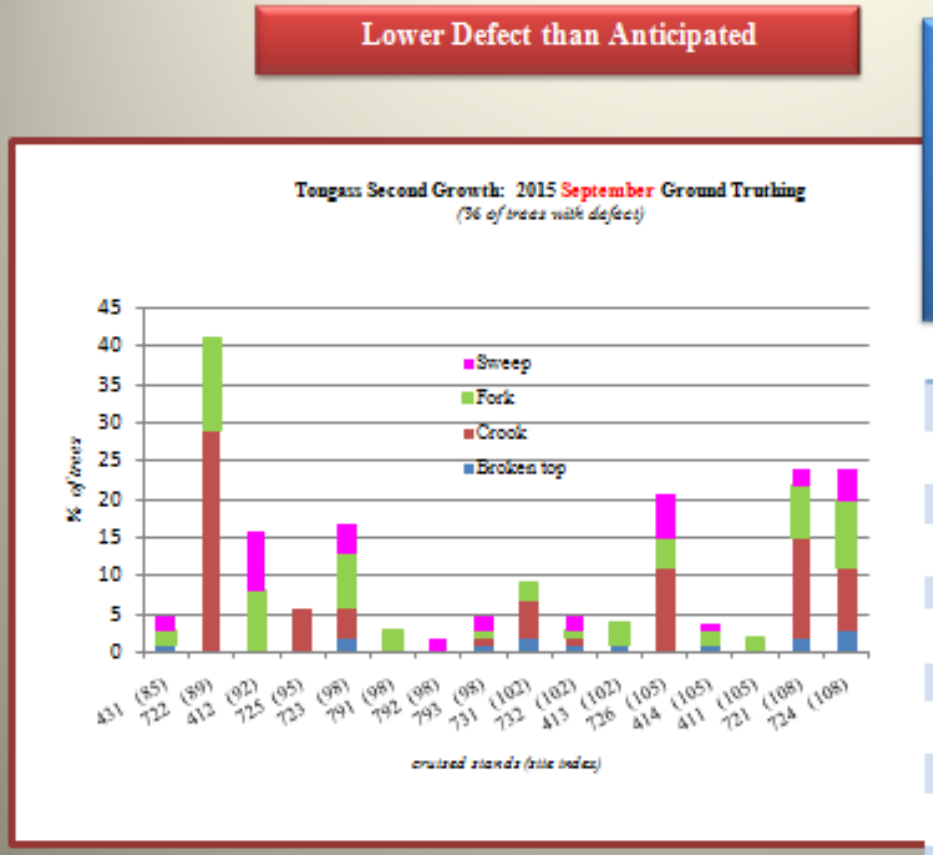
July 2015 Cruise (50-54 yrs):

- Surprisingly *little defect* across the board in July 2015 cruise.
- . . . and within tree sections.

		% of defect in tree section		
	Species	Bottom of log	Middle of log	Top of log
Petersburg 8.1	SS	5.4%	6.7%	14.1%
	WH	5.4%	4%	4.4%
Thorne Bay 7.1	SS	.9%	1.1%	1%
	WH	8%	2.6%	2.7%
Thorne Bay 7.3	SS	1.2%	.3%	0%
	WH	8.6%	9.2%	7.4%
Throne Bay 6.1	SS	.9%	.9%	1.6%
	WH	18.5%	10.5%	14.7%
Overall	SS	2.6%	3%	5.8%
	WH	8.6%	6%	6.1%

Cruise Results - See Exhibit G

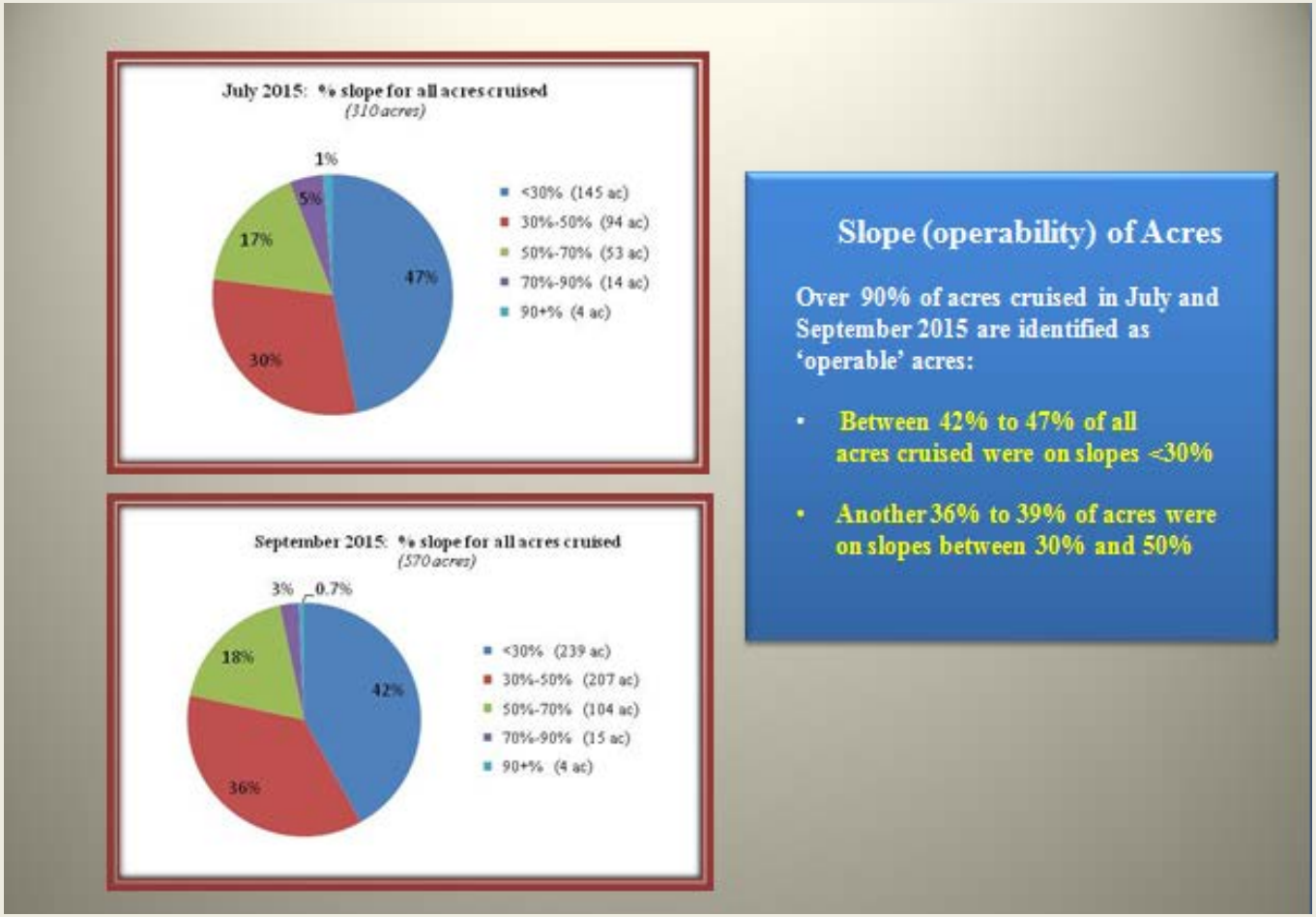
Lower Defect than Anticipated



Overall, September 2015 cruise *results similar to July :* focused on 40-44 yr old and 45-49 yr old PCT stands.

		% of defect in tree sections		
	Species	Bottom of log	Middle of log	Top of log
Thorne Bay 4.1	SS	2.6%	1%	2.3%
	WH	3.8%	3%	2.2%
Thorne Bay 4.3	SS	<1%	<1%	<1%
	WH	5.7%	5%	2.3%
Petersburg 7.2	SS	8.1%	13%	17.5%
	WH	9.2%	6%	6.9%
Petersburg 7.3	SS	1.7%	2%	2.5%
	WH	3.5%	2%	1.6%
Thorne Bay 7.9	SS	1.2%	<1%	<1%
	WH	6.2%	3%	7.9%
Overall	SS	4.1%	6%	7.9%
	WH	5.7%	3%	3.1%

Cruise Results - See Exhibits F and G



Terra Verde 10-yr growout of 2015 cruise results *using updated FPS data*

2015 age	*age at growout*	*dbh*	*hgt*	*mbf/ac*	*# of trees*
40-44	**50-54 yrs**	13.8	79.5	17.8	1464
45-49	**55-59 yrs**	13.2	77.8	18.6	1783
50-54	**60-64 yrs**	12.1	75.4	22.6	1330

Overall change from 2015 (mean Δ)	**Δ dbh**	**Δ hgt**
10-year grow-out (rounded)	**1.5”**	**17’**
5-year grow-out (*assumed*)	**.8”**	**9’**

Summary of PCT stand average *% increases in mbf/ac over <u>10-yr grow-out</u>* using 2016 FS FPS Model *(see next slide for data breakout)*

	40-44 yrs		45-49		50-54	
Site Index	74-89	90+	74-89	90+	74-89	90+
	at age 50-54		*at age 55-59*		*at age 60-64*	
Petersburg	na	119%	na	156%	169%	111%
Thorne Bay	na	184%	na	129%	na	111%

Terra Verde 2015 cruise results and 10-year grow-out using Forest Service updated FPS model

(Mean mbf/ac, mean dbh, mean tree height)

PCT - *Terra Verde 2015 Cruise (4,577 plots)*

Stand age	30-34		35-39		40-44		45-49		50-54		55-59		60-64	
Site Index	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**
mean mbf/ac														
Petersburg	*No trees cruised in these age classes*					9.0		7.2	5.1	11.7				
Thorne Bay						5.7		7.9		11.3				
Petersburg	**Based on 10-yr growout from 2015 cruise using Forest Service 2016 FPS model**									19.7		18.4	13.7	24.7
Thorne Bay										16.2		18.1		23.8
mean dbh														
Petersburg	*No trees cruised in these age classes*					12.5		11.1	11.2	11.8				
Thorne Bay						11.6		12.4		12.8				
Petersburg	**Based on 10-yr growout from 2015 cruise using Forest Service 2016 FPS model**									14.3		12.6	12.8	13.0
Thorne Bay										13.2		13.8		14.3
mean tree height														
Petersburg	*No trees cruised in these age classes*					65.6		59.8	53.7	67.7				
Thorne Bay						56.6		61.6		70.6				
Petersburg	**Based on 10-yr growout from 2015 cruise using Forest Service 2016 FPS model**									82.1		77.4	69.7	83.3
Thorne Bay										76.0		78.2		88.8

Past Forest Service Stand Exam Results
compared to
2015 Terra Verde Cruise Results

Prior # of FS plots per Ranger District
(2005 through 2013)

RD	PCT # of plots	Non-PCT # of plots
Craig	101	252
Ketchikan	50	27
Thorne Bay	899	1073
Petersburg	640	166
Wrangell	65	2
	1755	1520

Suitable, roaded PCT stands targeted for transition in POW region:

Targeted for transition:

- 78,000 acres in POW region
- Over **60%** of acres in high productive sites **(SI 90+).**
- Almost **50%** of all acres aged at least 40+ yrs old with **highest percentage in 45-49 yr stands.**
- Over **6,500 acres** aged **50-54 yrs** in 2015. Harvest at 55 years in 2020.

Targeted by Forest Service for timber cruise in same acres over last 10 years:

- 16,957 acres cruised by Forest Service on same PCT targeted acres (78,000 ac).
- 1,755 plots (1 plot:10 ac cruise protocol)
- 8,896 trees cruised. **Only 363 trees aged 45-49 years cruised in last decade. No trees older than 45-49 years of age cruised.**
- **67%** of cruised trees in lower productive stands (**SI 74-89**). 33% in higher productive stands (SI 90+).
- Merchantable volume per acre recorded by FS based on old FPS model (*model updated in 2016 to reflect more second growth conditions*).

Suitable, roaded non-PCT stands targeted for transition in POW region:

Targeted for transition:

- 46,000 acres
- ~ **40%** of acres in high productive sites **(SI 90+). 60%** in lower productive stands (SI 74-89).
- Only **22%** of all acres aged at least 40+ yrs old. **Highest percentage of acres with stands are aged 35-39 years.**
- Over **5,500 acres** aged **50-54 yrs** in 2015. Harvest at 55 yrs in 2020.

Targeted by Forest Service for timber cruise in same acres over last 10 years:

- 18,190 acres cruised by Forest Service on same non-PCT targeted acres (46,000 ac).
- 1,520 plots (1 plot:12 ac cruise protocol)
- 9,000 trees cruised. **Only 385 trees aged 45+ years cruised.**
- **67%** of cruised trees in lower productive stands (**SI 74-89**). 33% in higher productive stands (SI 90+).
- Merchantable volume per acre recorded by FS based on old FPS model (*model updated in 2016 to reflect more second growth conditions*).

Trees cruised in the targeted PCT and non-PCT suitable, roaded acres located in the POW

Since 2005, ***only 5%*** of all trees cruised by the Forest Service in the targeted PCT and non-PCT transition acres were ***aged 45 years and older.***

Over 80% of cruised trees were ***39 years or younger***. It is unclear why the Forest Service focused so much cruise effort on 35-39 year old stands, while overlooking older young growth stands.

	Trees cruised by FS over last decade	% of total	Trees cruised by Terre Verde in 2015
39 yrs & <	14,565	81%	
40-44	2,583	14%	1464
45-49	680	4%	1783
50 and up	118	1%	1330
Totals	17,896		4577

The TerraVerde 2015 cruise results contributed significantly to shoring up information gap in the Forest Service data.

Prior FS Stand Exam data going back to 2005

Data below only in acres targeted for transition (suitable, roaded PCT and non-PCT in POW region)

Data at year of survey (*based on non-updated FPS model. Update occurred in 2016.*)

Non-PCT 74	dbh	hgt	mbf/ac	# of trees
30-34	7.7	38.4	5.0	127
35-39	9.9	53.2	8.8	1,191
40-44	11.1	59.2	12.1	314
45-49	12.8	64.0	11.0	9
50-54	11.2	58.2	11.0	37
				1,678

PCT 74	dbh	hgt	mbf/ac	# of trees
30-34	8.4	40.3	3.8	728
35-39	11.4	54.2	7.5	2,798
40-44	12.1	59.6	9.5	499
45 +	*No trees cruised*			
				4,025

Non-PCT 90	dbh	hgt	mbf/ac	# of trees
30-34	11.1	54.0	8.2	223
35-39	11.0	56.8	9.7	1,039
40-44	11.8	60.1	11.2	679
45-49	11.9	66.4	14.3	258
50-54	10.3	56.6	13.0	25
55-59	13.0	61.9	13.3	34
60-64	11.8	67.1	16.2	22
				2,280

PCT 90	dbh	hgt	mbf/ac	# of trees
30-34	9.9	47.1	4.5	581
35-39	11.4	53.4	7.1	2,496
40-44	12.7	65.4	11.2	1,091
45-49	14.0	65.2	11.5	363
50-89	*No trees cruised*			
				4,531

The Forest Service Timber Cruising Handbook stipulates ***32' logs*** for all young growth timber cruising (see below) .

R-10 SUPPLEMENT 2409.12-2011-3
EFFECTIVE DATE: 05/27/2011
DURATION: This supplement is effective until superseded or removed.

2409.12_90
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FSH 2409.12 – TIMBER CRUISING HANDBOOK
CHAPTER 90 – MISCELLANEOUS TABLES

91 - Exhibit 15, Table VI (A)
Board Foot Volume Table

Gross board foot volume for young growth Sitka Spruce (1-foot stump to a 6-inch top diameter inside bark) by 32-foot logs and for the total tree, given diameter at breast height (DBH) and total tree height, using the Flewelling profile model A02F32W098, processed using the 20101109 version of cruise processor.

DBH	Total Tree Height	No. of 32' Logs	Log Number 1	2	3	4	5	Chunk Volume	Total Tree Volume Board Ft.	Chunk Length
14	50	1	50						50	
14	60	1	60						60	
14	70	1	90					10	100	14
14	80	1	90					30	120	16
14	90	1	120					40	160	30
14	100	2	120	50					170	
14	110	2	140	60				10	210	12
14	120	2	140	70				20	230	16

The Forest Service Timber Cruising Handbook includes merchantable board feet down to 8' log lengths, as noted above. As example, ***a 14" dbh young growth sitka spruce at 80' tall would produce one 32' log segment with 90 merchantable board feet in it and one 16' log segment with 30 merchantable board feet in it (total of 120 board feet in cruised tree).*** *(Note: the Handbook does not reflect updated mbf/ac capture in second growth as revised in the 2016 FPS model).*

Logs delivered to mills in Alaska typically operate off of three different log grades:

Grade A: 3 2 '+ plus trim
Grade B: 26' - 31' plus trim
Grade C: 8' - 25' plus trim

Logs delivered to the mill are then bucked to *merchantable* log lengths: 10' to 16' lengths. The amount of log board feet captured from long logs (32') to merchantable log is a significant economic factor for mills (and is often highly guarded information). Working with both long logs (32' + trim) and short logs (between 8' and 31' logs) is a standard in the industry.

Using the current USFS Timber Cruise Handbook, the chart to the right shows the average log segment capture per tree that might be expected from prior Forest Service cruised stands when grown out to 55 years for harvest in 2020, 2025, and 2030. *Note: the Handbook does not reflect updated model values now used in the Forest Service FPS model to more accurately represent young growth log segment capture. The data also assumes harvest down to 6" top.*

Forest Service PCT & Non-PCT plots since 2005 (3,300 plots)

Mean dbh & tree height at harvest time (55 yrs) by site index
(assumes .8" dbh growth every 5 yrs; 9" tree height growth every 5 yrs)

Harvest Yr.		SI 74-89 dbh	SI 74-89 hgt	Log segments per tree* (log grades)	SI 90+ dbh	SI 90+ hgt	Log segments per tree* (log grades)
Non-PCT							
2020	Craig	13.9	83.4	A + C	14.0	84	A + C
	Petersburg	13.0	75	A + C	*No trees cruised that would be 55 yrs*		
	Thorne Bay	13.8	87	A + C	14.3	90	A + B
2025	Craig	13.9	88	A + C	13.9	90	A + B
	Petersburg	*No trees cruised that would be 55 yrs*			13.6	83	A + C
	Thorne Bay	13.5	88	A + C	14.8	82	A + C
2030	Craig	*No trees cruised that would be 55 yrs*			13.1	85	A + C
	Petersburg	14.5	93	A + B	12.6	84	A + C
	Thorne Bay	11.9	83	A + C	14.2	85	A + C
PCT							
2020	*All three RDs*	*No trees cruised that would be 55 yrs*					
2025	Craig	14.9	83	A + C	15.7	88	A + B
	Petersburg	14.4	91.5	A + B	16.9	98	A(x2) + C
	Thorne Bay	14.6	82	A + C	14.2	81	A + C
2030	Craig	18.1	97	A(x2)	14.9	91	A(x2)
	Petersburg	14.9	88	A + B	15.2	93	A(x2)
	Thorne Bay	15.2	89	A(x2)	14.6	83	A + C

**Based on USFS Timber Handbook for Region 10 (May 2011)*

With new small log processing technology like HewSaw, harvest down to 4.5" top instead of standard 6" top is recommended.

The table to the right shows the volume capture difference between Tongass Timber Cruise Handbook requirements (cruise to 6" tops) used in the original 2015 cruise results and revised 2015 cruise data run using the updated 2016 FPS model and harvest down to 4.5" tops to match new small log processing technology (HewSaw) being considered for SE Alaska.

. . . and . . .

	Stands	Original 2015 Terra Verde (TV) (*based on 6" top*) *mbf/ac*	Revised 2015 (*based on updated FPS and 4.5" top*) *mbf/ac*	% Change
50-54	1	6.3	7.4	18%
	2	14.8	15.6	5%
	3	14.1	15.7	11%
	4	11.2	12.4	11%
	5	7.9	9.6	22%
	6	4.5	5	12%
	7	8	10	26%
	8	4.3	5.4	27%
	10	10.9	12.2	12%
	11	17.4	18.8	8%
	12	9.4	10.3	9%
	13	11.2	11.6	4%
	14	5.2	5.5	6%
			mean	**10%**
45-49	411	8.5	8.5	1%
	412	4.7	5	5%
	413	5.1	5.2	2%
	414	9	9.4	5%
	731	7.7	7.9	3%
	732	6.5	7	7%
	791	5.8	6.5	11%
	792	9.8	10.3	5%
	793	7.3	7.7	4%
			mean	**5%**
40-44	9	5.8	6.8	18%
	431	4.8	5	3%
	721	8.3	8.8	6%
	722	7.1	6.8	-5%
	723	9.4	9.5	2%
	724	10.2	10.7	5%
	725	7	7.2	3%
	726	7.4	7.7	3%
			mean	**6%**

. . . similar differences for log segment capture.

Grade A: 3 2 ’+ plus trim
Grade B: 26’ - 31’ plus trim
Grade C: 8’ - 25’ plus trim

The table to the right shows the log segment capture difference between Tongass Timber Cruise Handbook requirements (cruise to 6” tops) used in the original 2015 cruise results and revised 2015 cruise data run using the updated 2016 FPS model and harvest down to 4.5” tops.

Technology improvements make a difference!

2015 Terra Verde Cruised Stands				10-yr grow-out log segments per mean dbh and hgt	
				Terra Verde (4.5" top)	Forest Service (6" top)
2015 Age	Stand	dbh	hgt	Log Grades	
50-54 (60-64)	1	12.9	77	A + C	A
	2	14.5	86	A + C	A
	3	12.9	87	A + C	A
	4	12.5	81	A + C	A
	5	12.5	84	A + C	A
	6	12.8	70	A	A
	7	13.3	82	A + C	A
	8	11.9	79	A + C	A
	10	13.7	89	A + B	A + C
	11	13	96	A + B	A + C
	12	14.8	87	A + B	A
	13	16	91	A + B	A + C
	14	14.9	84	A + C	A

2015 Terra Verde Cruised Stands				15-yr grow-out log segments per mean dbh and hgt	
				Terra Verde (4.5" top)	Forest Service (6" top)
2015 Age	Stand	dbh	hgt	Log Grades	
40-44 (55-59)	9	12.5	89.4	A + B	A + C
	431	17.3	82.6	A + B	A + C
	721	16.6	89.1	A + B	A + C
	722	13.8	83	A + C	A
	723	17.6	92.9	A (x2)	A + B
	724	16.9	94.4	A (x2)	A + B
	725	13.5	89.1	A + B	A + C
	726	15.6	91.1	A + B	A + C

Comparing Past Forest Service Stand Exam Data to 2015 Cruise Data

Merchantable Volume Per Acre (mbf) by Age Class and Site Index

Summary regarding mbf/ac:

- Within the same age class and Ranger District, there appears ***more mbf/ac in non-PCT stands compared to PCT stands***.
- The difference in mbf/ac between PCT and non-PCT stands is ***especially notable in lower site index sites.***
- 10-yr grow-out volumes using the updated Forest Service FPS model project ***notably higher volumes than recorded in past Forest Service stand exam data.*** This may in part be due to the small number of trees actually cruised by the Forest Service in higher age class stands, as discussed earlier.
- *(Note: past Forest Service stand exam data for mbf/ac not revised using 2016 FPS model update.)*

***Mean mbf/ac* range during last decade of Forest Service cruise by age class and site index (low / high)**

Stand age	30-34		35-39		40-44		45-49		50-54		55-59		60-64	
Site Index	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**
Non-PCT *Forest Service Cruise (1,755 plots over 10 years)*														
Craig		8.1	12.2	10.4	13.3	9.7	11.0	14.9		10.7		13.3		
Petersburg	3.5 / 8.8	4.2 / 5.7	13.2	9.8					11.0		*No trees cruised in this age class on targeted acres (suitable, roaded)*			
No SI data	1.3		10.3											
Thorne Bay	5.7 / 7.4	4.2	2.4 / 10.2	9.6 / 12.9	11.5	9.7 / 12.5		7.3						16.9
No SI data			5.9 / 7.7		3.5 / 10.2		10.6 / 16.9		6.5 / 19.5		5.6 / 19.4		8.4 / 15.5	
PCT *Forest Service Cruise (1,520 plots over 10 years)*														
Craig	9.7	6.3	6.6			1.3 / 18.5			*No trees cruised in this age class on targeted acres(suitable, roaded)*					
Petersburg	1.5	3.5 / 3.7	6.5	7.7 / 8.8	11.0	11.7		15.5						
Thorne Bay	2 / 3.3	5.9	5 / 9.1	5.3 / 10.7	8.6 / 9.4	11.2		4.9 / 12.6						
Wrangell	5.4													
PCT - *Terra Verde 2015 Cruise (4,577 plots)*														
Petersburg						9.0		7.2	5.1	11.7				
Thorne Bay						5.7		7.9		11.3				
Petersburg			** volumes based on 10-yr growout from 2015 using Forest Service 2016 FPS model							19.7		18.4	13.7	24.7
Thorne Bay										16.2		18.1		23.8

Comparing Past Forest Service Stand Exam Data to 2015 Cruise Data

Mean dbh by Age Class and Site Index

Summary regarding mean dbh:

- ***Little variation in dbh within same age class*** between lower and higher site index stands.
- PCT acres cruised in 2015 reflect ***similar results to prior FS stand exam data*** for same age class and site index in PCT stands.
- Results of 10-yr grow-out for 2015 cruised stands using updated 2016 FPS model ***reflect similar dbh results to prior FS stand exam data*** for same age class and site index.

***Mean dbh* (inches) range during last decade of Forest Service cruise by age class and site index (low / high)**

	30-34		35-39		40-44		45-49		50-54		55-59		60-64	
Stand age														
Site Index	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**
Non-PCT *Forest Service Cruise (1,755 plots over 10 years)*														
Craig		8.6	10.3	10.3	11.2	11.3		11.9		15.2		13.0		
Petersburg	8.0	11.9	10.7	10.3		11.8			11.2		*No trees cruised in this age class on targeted acres (suitable, roaded)*			
Thorne Bay	6.8	12.6	9.3	11.0	11.2	11.7	12.8							12.7
No SI data	**7.4 / 7.6**				3.5		10.6 / 12.2		6.5 / 7.8		5.6		8.4	
PCT *Forest Service Cruise (1,520 plots over 10 years)*														
Craig	13.6	10.5	11.3			14.0								
Petersburg	7.9	8.6	11.0	11.2	12.0	13.4		15.8	*No trees cruised in this age class on targeted acres(suitable, roaded)*					
Thorne Bay	7.9	11.7	11.5	11.5	12.1	11.4		12.9						
Wrangell	7.0													
PCT *- Terra Verde 2015 Cruise (4,577 plots)*														
Petersburg						12.5		11.1	11.2	11.8				
Thorne Bay						11.6		12.4		12.8				
Petersburg			** volumes based on 10-yr growout from 2015 using Forest Service 2016 FPS model							14.3		12.6	12.8	13.0
Thorne Bay										13.2		13.8		14.3

Comparing Past Forest Service Stand Exam Data to 2015 Cruise Data

Mean Tree Height by Age Class and Site Index

Summary regarding <u>tree height</u>:

- ***Little variations in tree height between non-PCT and PCT stands*** in stands aged 49 years and younger.
- ***Little variations in tree height between higher and lower site index sites*** in stands aged ***49 years and younger.***
- ***Notable variations*** in tree height between lower and higher site index sites apparent in stands aged ***50 years and older***.
- PCT acres cruised in 2015 reflect ***similar results to prior FS stand exam data*** for same age class and site index in PCT stands.

Mean tree height ***(feet) range during last decade of Forest Service cruise by age class and site index (low / high)***

	30-34		35-39		40-44		45-49		50-54		55-59		60-64	
Stand age														
Site Index	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**	**74-89**	**90+**
Non-PCT *Forest Service Cruise (1,755 plots over 10 years)*														
Craig		42.6	54.0	56.4	57.9	58.5		66.4		79.2		61.9		
Petersburg	38.9	61.7	54.5	61.4		63.5			58.2		*No trees cruised in this age class on targeted acres (suitable, roaded)*			
Thorne Bay	36.8	47.5	52.0	52.8	61.8	58.1	64.0							
No SI data	53.8				48.1		59.8 / 63		44.3 / 68.9		38.3		59.6	
PCT *Forest Service Cruise (1,520 plots over 10 years)*														
Craig	54.4	49.0	49.1			66.1								
Petersburg	36.3	42.7	54.4	56.7	63.1	70.5		80.8						
Thorne Bay	41.8	52.9	54.7	51.6	57.7	57.8		55.5			*No trees cruised in this age class on targeted acres(suitable, roaded)*			
Wrangell	37.1													
PCT *- Terra Verde 2015 Cruise (4,577 plots)*														
Petersburg						65.6		59.8	53.7	67.7				
Thorne Bay						56.6		61.6		70.6				
Petersburg			** volumes based on 10-yr growout from 2015 using Forest Service 2016 FPS model							82.1		77.4	69.7	83.3
Thorne Bay										76.0		78.2		88.8

Given GIS data, prior Forest Service stand exam data, and 2015 cruise results . . .

. . . what does it look like projecting forward starting harvesting in 2020 at age 55 years?

Roaded, Suitable PCT and Non-PCT Acres Available for Harvest at 55 Years

By Age Class *PCT Null acres distributed among age classes based on known distributions

Tongass total	Age Class in 2014 (yrs)	Acres PCT 2G	Acres non-PCT 2G	Total GIS	Harvest year
Craig	0-4	-	4,777	4,777	2070
Ketchikan	5-9	-	591	591	2065
Petersburg	10-14	150	511	661	2060
Thorne Bay	15-19	1,760	3,459	5,219	2055
Wrangell	20-24	6,753	9,252	16,005	2050
	25-29	8,356	6,127	14,483	2045
	30-34	9,761	11,203	20,964	2040
	35-39	13,660	2,353	16,013	2035
	40-44	14,699	1,669	16,367	2030
	45-49	16,961	1,393	18,353	2025
	50-54	6,405	3,586	9,991	2020
	55-59	248	1,237	1,485	2020
	60-64	-	501	501	2020
	65-69	-	143	143	2020
	70-74	-	71	71	2020
		78,754	46,871	125,625	
			125,625		

Juneau Sitka

By Age Class

Age Class in 2015 (yrs)	All Suitable Acres by Age	% is PCT 45% Estim PCT Acres by Age	Harvest year
0-4	-	-	
5-9	-	-	2065
10-14	600	270	2060
15-19	1,109	499	2055
20-24	3,796	1,708	2050
25-29	2,090	940	2045
30-34	794	357	2040
35-39	2,131	959	2035
40-44	6,984	3,143	2030
45-49	5,255	2,365	2025
50-54	4,794	2,157	2020
55-59	1,098	494	2020
60-64	206	93	2020
65-69	107	48	2020
70-74	52	23	2020
75-80	871	392	2020
	29,886	13,448	

- ***139,000*** acres of **roaded, suitable PCT and Non-PCT Acres available for harvest at 55 years**
- ***78,000*** **acres of PCT in the immediate POW region (5 RDs);** ***13,000*** **additional PCT acres available in adjacent RDs (Juneau and Sitka)**
- ***46,000*** **roaded, suitable non-PCT acres available in the POW region.**

Assumptions Used for Analysis

Harvest @ 55 years:

2020 (55-59 yrs)	= 12.2 mbf/ac (PCT & non-PCT)
2020 (60+ yrs)	= 19.4 mbf/ac (PCT & non-PCT)
2025 and beyond:	= 14.6 mbf/ac; (PCT); 15.4 mbf/ac (non-PCT)

Multipliers for mbf/ac:

- a) long log to merchantable log scale at mill = +20%
- b) from 6" top to 4.5" top at harvest = +10%
- c) continued FPS model updates based on Dargon Point lessons learned and FARR plot results = +20%

For 1.5 multiplier = a + b + c
For 1.3 multiplier = b + c
For 1.1 multiplier = only b

Multiplier results: ***almost all multiplier scenarios at or above stated market demand of 46 mmbf/yr.***

(Note: sustainable breakeven volumes noted below continue for over 50+ years)

		No Multiplier		+ 10%		+ 30%		+ 50%	
		Breakeven volume	Residual acres harvested next 5 yrs at age 60	Breakeven volume	Residual acres harvested next 5 yrs at age 60	Breakeven volume	Residual acres harvested next 5 yrs at age 60	Breakeven volume	Residual acres harvested next 5 yrs at age 60
		If roll-over of residual acres run at conservative 55 yr mbf/ac for 2025, 2030 ***(PCT @ 14.6 mbf/ac; non-PCT @ 15.4 mbf/ac)***							
	2020 *(12 mbf/ac)*	37.1 *mmbf/yr*	3,285 ac	40.8 *mmbf/yr*	3,623 ac	48.2 *mmbf/yr*	4,300 ac	55.6 *mmbf/yr*	4,977 ac
PCT @ 14.6 mbf/ac Non-PCT @ 15.4 mbf/ac	2025		26,905 ac		29,615 ac		35,036 ac		40,457 ac
	2030		47,041 ac		51,775 ac		61,244 ac		70,712 ac
		If roll-over of residual acres run at 60 yr mbf/ac ***(19.4 mbf/ac)***							
	2020 *(12 mbf/ac)*	40.4 *mmbf/yr*	0	44.4 *mmbf/yr*	0	52.5 *mmbf/yr*	0	60.5 *mmbf/yr*	0
PCT @ 14.6 mbf/ac Non-PCT @ 15.4 mbf/ac	2025	48.4 *mmbf/yr*	800 ac	53.2 *mmbf/yr*	883 ac	62.9 *mmbf/yr*	1,041 ac	72.6 *mmbf/yr*	1,200 ac
	2030		1,582 ac		1,746 ac		2,059 ac		2,372 ac

What about meeting TAC recommendations?

The Forest Service says 50% of merchantable volume ***in each stand*** must come from trees that produce two 34' logs.

Why 34' log segments? The Forest Service Timber Cruising Handbook stipulates ***32' logs*** for all young growth timber cruising . . . so justification for a 34' requirement is unexplained.

Why only 32' log segments? The Forest Service Timber Cruising Handbook includes merchantable board feet down to 8' log lengths. Recognizing the full value each tree brings to the plate makes good economic sense!

What about merchantable volume in each stand?

Given standard log grades used in the industry in SE Alaska and harvest at 55 yrs, *the highest percentage of volume will come from trees that produce two Grade A logs*. Over 50% of total volume will come from trees that either produce two Grade A logs or trees that produce one Grade A log and one Grade B log.

For 2015 Timber Cruises at 10-yr grow-out:
(based on 2016 FPS update modeling)

Grade A: 32'
Grade B: 26'-31'
Grade C: 8'-25'

		Average % of merchantable volume per stand in trees that produce:						
2015 (yrs)	10-yr grow-out	one C	one B	one A	one A one C	one A one B	two or more A logs	*at least* 2 A logs *plus* another one A and one B
50-54	60-64	0%	1%	15%	22%	12%	50%	62%
45-49	55-59	2%	2%	20%	21%	20%	35%	55%
40-44	50-54	0%	1%	14%	27%	20%	37%	57%

What about forest residual?

The assumption that letting trees grow older produces less residual on the forest floor lacks technical merit. As the example below shows, for 45-49 yr old stands (cruised in 2015) that come to harvest age (55 ys) in 2025, total tree residual would equal almost | 16,000 lineal feet, the majority from tree tops < 4.5" in diameter. Should those stands be allowed to grow for another 5 years (harvest in 2030), residual would increase by 8%. More importantly ***the amount of residual from log (vs tree) segments <8' in length would increase by almost 80%.***

	Harvest in 2025 at 55 yrs.			Harvest in 2030 at 60 yrs.		
	Lineal feet of residual left on the forest floor					
45-49 yr old stands cruised in 2015	< 8' log segments (excludes tops and butt ends)	Tree tops (<4.5" diameter)	Total Residual	< 8' log segments (excludes tops and butt ends)	Tree tops (<4.5" diameter)	Total Residual
411	113	1,733	1,846	303	1,802	2,105
412	23	323	346	55	336	391
413	86	1,284	1,370	229	1,340	1,569
414	104	1,604	1,708	221	1,668	1,889
731	98	1,727	1,825	124	1,791	1,915
732	216	2,681	2,897	342	2,774	3,116
791	40	1,188	1,228	96	1,222	1,318
792	50	1,071	1,121	80	1,106	1,186
793	258	3,278	3,536	318	3,402	3,720
	988	**14,889**	**15,877**	**1,768**	**15,441**	**17,209**