SMC TAC Meeting
January 12, 2016
Port Blakely, Tumwater, WA

ATTENDEES

SMC's January 12, 2016 TAC meeting took place at Port Blakely's Tumwater office beginning at 10:00 AM. Listed below are the 25 attendees from 17 organizations. Louise de Montigny, Tod Haren, Tony Powell, and Margaret Bank took part via conference call.

ORGANIZATION	REPRESENTATIVE(S)
B.C. Ministry of Forests	Louise de Montigny (teleconference)
Bureau of Land Management	George McFadden
Campbell Global, LLC	Dave Hamlin
Green Diamond Resource	Eric Schallon
Hancock Forest Management	Florian Deisenhofer, Jim Vander Ploeg
Lone Rock Timber Co.	Tim Drake
Olympic Resource Management	Ryan Schlecht
Oregon Department of Forestry	Tod Haren (teleconference)
Oregon State University	Doug Mainwaring
Plum Creek Timber Co.	Mic Holmes
Port Blakely Tree Farms	Gareth Waugh
Rayonier Forest Resources	Candace Cahill
Roseburg Resources	Tony Powell (teleconference)
Sierra Pacific Industries	Josh Misenar
Stimson Lumber Company	Margaret Banks (teleconference)
University of Washington	Jason Cross**,** Rob Harrison, Kim Littke, Megan O'Shea, Eric Turnblom
USFS PNW RS	Eini Lowell
WA DNR	Scout McLeod
Weyerhaeuser Company	Scott Holub, Greg Johnson, Dave Marshall

AGENDA

- Finalize the Late Fertilization plan, approve budget
- Progress update on 722 sunset project
- New / Old Business

UPDATES

SUNSETTING INSTALLATION 722, SILVER CREEK MAINLINE, TYPE I

Harvested December 2015 (9 plots total)

Type I's: 12- full measurements (F), 15 -plots marked for no thinning, (NT), 7- plots marked for minimal thinning (once) and RD checks, (MT+RD), 1- repeated thinning and RD check (RT+RD), 12-fertilization (5 times, F), 11-fertilization and minimal thinning (F+MT), 10-fertilization and repeated Thinning (F+RT).

Phase I and II: Tree Characterization Updates

Sampled plots were selected to provide data for developing a better understanding of how stands that followed certain silvicultural pathways with given characteristics could be most profitably managed for the mix of materials that might be produced. Possible comparisons include basic treatments and supplementary treatments, note: pruned and selection thinning treatments were not sampled.

Members agreed on four, circular vegetation sampling sub-plots (0.01 acres) for characterizing the understory. Trees on each plot were sorted by the most recent dbh measurements in database (2013) and divided into quintiles. A 30-tree sub-sample (6 trees / quintile) was selected for non-destructive (standing tree) testing. In August SMC field crew members Bob Gonyea and Bert Hasselberg collected 2 increment cores at breast height (90 degrees apart), and recorded other NDT measures (TreeSonic and resistograph).

Eleven of the 30 standing trees were selected for destructive (felled tree) testing; no cookies were taken at breast height in order to preserve the first log's value. OSU's 3-trees per plot biomass sample included crown and stem sampling for biomass estimation, foliage chemistry identification, measuring and sampling of dead branches (27 trees total), but root analysis was not conducted.

Since September, the final measurement of all 15 plots was conducted using standard SMC installation measurement protocol. Weyerhaeuser's contract crew completed the felling and bucking. Disk collection, measuring disks for diameters, weights, and volumes, and cutting strips for x-ray densitometry analysis was a group effort which included; Jason Cross, Jeff Comnick, Eric Turnblom, Eric's graduate students John Kirby and Hollis Crapo, Rob Harrison's graduate student Cole Gross and of course SMC's outstanding field crew. Data compilation and the density characteristics analyses will be ongoing throughout 2016.

The major expense is x-ray densitometry; the decision was made to go with full x-ray densitometry measurements that include microfibril angle and ultra sound velocity. Starting winter 2016, Weyerhaeuser will scan the tree cores (30 trees x 2 cores/tree = 60 cores per plot. Cost per plot is $7,500; total cost works out to $67,500. The U of GA (Joe Dahlen) will scan the 55 disk strips (1 strip/5 disks/tree x 11 trees/plot), for a cost of $1,485 per plot, total cost $13,365. Page 6, Addendum A: Sunsetting Costs and Page 7, Addendum B: Sunsetting SMC Type 1 Sunset Protocol.

Comments: A combinations of factors put additional pressures on the project that we hope to avoid in the future. First of all, in order to avoid rushing to get the wood out before the loggers hit the site we'll convene an IRC meeting to determine if we can modify the protocol by looking at redundancies and possibly establishing soil pits at plot establishment. Some members felt redundancies were ok; tossing unwanted data

is easier than adding data. Secondly, we'll visit sites close to sunsetting and, working closely with landowners we'll review the harvest plan, making sure everyone's onboard with the timeline.

When the question of including a carry-over study came up, members noted it was a good project but felt it needed more vetting, specifically looking at the "so what" question, what's the hypnosis, what's collected, what's it used for, what about cost and how can it be built into the tools. Members also mentioned looking at vegetation interferences, do we need additional untreated plots, (four, circular vegetation sampling sub-plots 0.01 acres), or not?

Rob was tasked with taking a closer look at setting up a carry-over study and working on monitoring treatments. Eric will update the Installation Review Committee (IRC) Report, by contacting landowning members and consulting with the IRC, and scheduling a meeting if necessary around June 2016. If you would like to be part of the IRC please send Eric an email. A refined end-of-rotation sunset plan will be presented at the annual fall meeting in September.

Phase III: Soil Characterization Updates

From August 2015 through November 2015, Rob Harrison's graduate student Cole Gross collected soil samples on Installation 722. His preliminary results show differences in total and subsurface soil C and N; with high variability, Rob noted changes in nitrogen aren't as easy to pin point. Excavated soil pits reveal horizon differences over relatively short distances, with topography playing a role; soils were very dense and frequently rocky. Roots were observed in all soil profiles to depths of at least 80 cm, and often deeper.

Rob presented for Cole going over his study methods, overview and progress. At least three pits were excavated at each plot. More than half of the soil pits were sampled using an auger to 150 cm, with the remaining pits sampled to 100 cm. Soil was sampled to a depth of at least 100 cm at nine 0.2-ha plots with differing thinning and fertilization treatments and/or differing initial stems per acre. Summer 2016 is the projected end date for the bulk density calculations and chemical analysis.

The results of this study will help guide sustainable and best stand management practices by providing data for regional responses of soil carbon, nitrogen, and other nutrient content by depth to fertilization and thinning treatments. Page 15, Addendum C: Soil Sampling Updates-Installation 722, Silver Creek Mainline, Type I.

Costs: Phase I, II and III

In 2015 members committed $150,000 to Sunsetting of Type I Installation 722; we've had to adjust the budget to a certain degree, but as of December 2015, expenditures for Phase I and II are at $74,394, this does not include $80,865 for the X-ray densitometry scanning. Phase III's total budget of $37,855 is based on the funding of 3-Research Assistants' (RA). Two RAs will work on plot characterizations ($595 per plot/$5,355 per year). Cole Gross will focus on data compilation and analyses; his funding comes in part from CAFS Phase II ($32,500/total) and various UW fellowships. Page 6, Addendum A: Sunsetting Costs.

STAND AND TREE RESPONSE TO LATE-ROTATION FERTILIZATION

Since most members in attendance were already familiar with the protocols, Eric gave just a brief project overview: install four (or five) temporary, 0.5-acre square plots, select the two most similar plots from among those plots that "match," one is randomly selected for fertilization, hold them for at least 8-years. Meeting

was then opened up for discussion. Members approved the $28,000 annual budget for installation establishment.

Comments:

There was much discussion on choosing candidate stands. The overarching criterion is that the forester in charge would choose to fertilize it. Beyond this, decisions among the following were made.

- Stands are between the ages of 30 and 50 years total
- Stands are at least 85% conifer by basal area
- Stands are at least 75% Douglas-fir by basal area
- Stands may have been PCT'd, thinned, or fertilized in the past
- Landowners must commit to holding the stand for eight years after plot establishment

The observation was made that using these criteria may result in about 10 to 15% of a landowner's total area qualifying, as expected for 40 to 60 yr rotations (assuming some combination of area- and volume- control). All twenty to 24 stands (budget limit) will be chosen the first year, with ten to twelve being installed the first year.

Further discussion surrounded how to "match" plots. Decisions among the following were made.

- Each plot in a pair must be within +/- 10% of their mean basal area
- Each plot in a pair must be within +/- 10% of QMD
- Each plot in a pair should have similar understory (main concern is salal component)
- The non-conifer proportions of each plot in a pair should have similar species composition
- If a matched pair cannot be derived from the four temporary plots, install a fifth for another try
- If a pair cannot be derived using a fifth plot, abandon the stand and go to the first backup for the stand
- The randomly chosen plot (one per pair) to be fertilized will be fertilized during dormant season when it is wet (fall / winter / spring)

Page 19, Addendum D: Stand and Tree Response to Late-Rotation Fertilization (with budget).

NEW BUSINESS:

Brian Schlaefli with Plum Creek Timber contacted Acting SMC Director Eric Turnblom and SMC Policy Committee Chair Candace Cahill to make note of the fact as the current Policy Committee Vice Chair, he's slated to take over the Policy Committee Chairship in 2016. In light of Weyerhaeuser's recent acquisition, a new Vice Chair may need to be appointed.

Hubert Hasenauer, a Professor at (BOKU) University of Natural Resources and Life Sciences in Vienna recently met with Greg Ettl while Greg was in Germany to discuss opportunities for collaborative research with a similar research coops in central Europe. As Acting Director, Eric discussed the proposal with Candace and Brian and noted that potential opportunities for possible collaborations abound in many places, but this is not the right time for the SMC to pursue this idea or agreement - for a multitude of reasons. Pursuing this idea now would dilute the current mandated focus of SMC and divert energy away from sunsetting installations, getting the late fertilization trials in the ground and replacing the field crew. So, for now, it's best to table the collaboration idea until Greg's return in the fall.

Mark your calendar

- Policy Committee Meeting March 3rd, Weyerhaeuser's Vancouver, WA location (16821 SE McGillivray Blvd STE 210, 98683)
- IRC Meeting (location and date TBD, but soon after our annual spring meeting)
- SMC Annual Spring Meeting April 19th, Vancouver, WA (property location TBD)
- SMC Annual Fall Meeting the third week in September (date TBD) at Pack Forest, Eatonville, WA

We want to thank Gareth Waugh for hosting a top notch SMC meeting! Not only did he arrange for 4 members to attend via conference call, he provided morning refreshments *and* lunch from Meconi's Italian Subs!

Meeting adjourned at 2:30.

ADDENDUM A: SUNSETTING COST SMC Type 1 Sunset Protocol Installation 722, Type I

Phase	Description- short	Who	Cost/plot	Total cost
Phase 0	Standard SMC measurement protocol	SMC crew		
Phase 1	Veg. plot measurements (4 veg plots/treatment plot)	UW or SMC	$200	$1,800
Phase 2a standing tree: 30 trees/plot	WQ 30 tree sub-sample • Tree sonic • Resistograph • dbh cores (2/tree)	SMC crew	$1,800	$16,200
Phase 2b standing tree; 11 trees/plot	Crown width measurements (11-tree sub-sample)	SMC crew	(included above)	
Phase 2c felled: 11 trees/plot	Felling, height, crown height measures, LLAD, taper, bucking, HM200	Weyerhaeuser	$1,100	$9,900
	Biomass sample–3 trees (includes all lab work and data compilation)	Oregon State	3,066	$27,594
	X-ray densitometry (30 trees x 2 cores/tree = 60 cores per plot)	Weyerhaeuser	$7,500	$67,500
	X-ray densitometry (55 disks, 1 strips/disk)	U of GA	$1,485	$13,365
	Volumetric density, other disk measures	UW & SMC	$2,100	$18,900
Phase 3	Soils characterization	UW Grad students	$595	$5,355
Field Assistance, analysis	Research Assistant (2 quarters)- Field time, data compilation, analyses	U of WA/CAFS	$32,500 / year	$32,500
TOTAL				$193,114

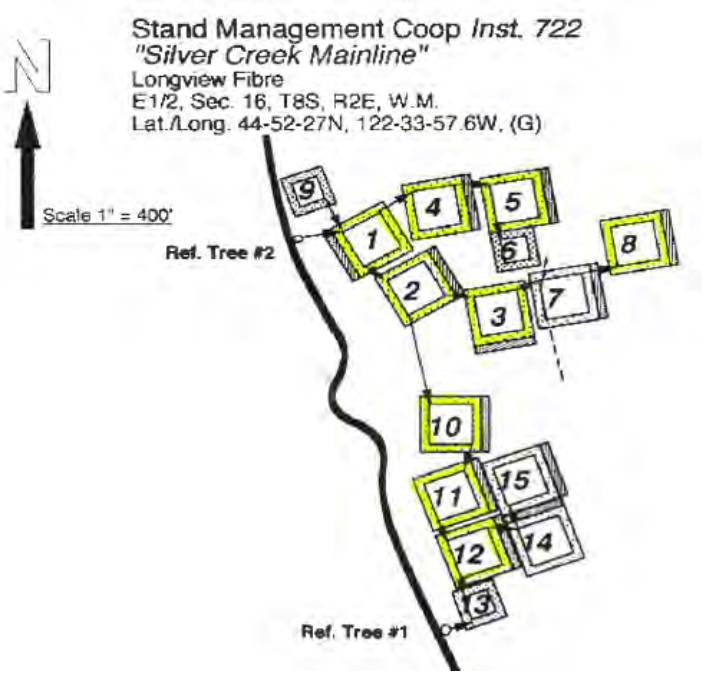
SMC Type 1 Sunset Protocol

Installation 722, Type I

Updated
1/12/2015

Treatments 1-6 and 13-15 (9 plots total)

Treatment	Initial Stocking	Regime	Installation 722 Plot No.
1	ISPA/4	No Thinning	2
2	ISPA/2	No Thinning	8
3	ISPA/2	Minimal Thinning: RD55-RD35 once (MT)	3
4	ISPA	No Thinning	5
5	ISPA	Minimal Thinning: RD55-RD35 once (MT)	4
6	ISPA	Repeated Thinning: RD55-35, 55-40 and 60-40 (RT)	1
13	ISPA/4	Fertilization with 200 lbs/acre N as urea 5 times (F)	12
14	ISPA/2	Fertilization and Minimal Thinning (F+MT)	11
15	ISPA	Fertilization and Repeated Thinning (F+RT)	10



Possible Comparisons

- Basic Treatments
  - Ho: ISPA = ISPA/2 = ISPA/4
  - Ho: ISPA = ISPA + MT
  - Ho: ISPA/2 = ISPA/2 + MT
- Supplementary Treatments
  - Ho: ISPA/4 vs. ISPA/4 + F
  - Ho: ISPA/2 vs. ISPA/2 + F + MT
  - Ho: ISPA vs. ISPA + F + RT
- Did not sample felled trees for pruned or selection thinning treatments

Sample sizes and data collection

Vegetation plots

- four, circular vegetation sampling sub-plots (0.01 acres)

Soil sampling

Plot data

- stratified by most recent dbh measurements in database (2013) and divided into quintiles

30-tree sample (standing tree) = 6 trees / quintile

- crown width
- tree sonic
- resistograph
- dbh core (2 / tree)

11-tree sub-sample (felled tree) = 2,2,3,2,2 trees per quintile

- Taper
- Hitman – starting with longest merchantable length and working back to shortest length
- Disks cut at 5 locations
  - At 4-in top
  - Half-way between base of crown and 4-in top
  - base of crown (between 40 & 50 ft)
  - 17-ft
  - stump
- LLAD measurments

3-tree Biomass Sample

- *Trees P10, P50 and P90 only:*
  - crown and stem sampling for biomass estimation
  - remove branches and measured all knots by 16-ft log lengths

- *Trees representing the 10th and 90th percentile only:*
  - identify the foliage chemistry
  - measure and sample dead branches

Status

- ✓ July 2015
  - Study Plan (Eric, Eini, Doug, Kim/Rob)

- ✓ July 2015
  - Sample trees selected (Eric/Jason)

- ✓ August 2015
  - Standing tree NDT (TreeSonic and resistograph) (SMC field crew)
  - Increment cores (SMC field crew)
  - Soil samples taken

- ✓ Fall 2015
  - Standard installation measurement protocol (SMC field crew)
  - Harvesting
  - Branch measurements
  - Disk collection/strips cut/measurements taken

- Winter 2015/2016
  - X-ray densitometry on cores and strips

Logistics Update from September

- Felling and bucking of trees by Weyerhaeuser crew
- X-ray densitometry (Weyerhaeuser) including microfibril angle and ultra sound velocity of DBH cores
- X-ray densitometry disk strips - 55 disk strips (5 disks/tree x 11 trees/plot)
- Research assistant assisted in field time and will help with data compilation and analyses
- OSU did not do any analysis of roots

Phase	Description- short	Who	Cost/plot	Total cost
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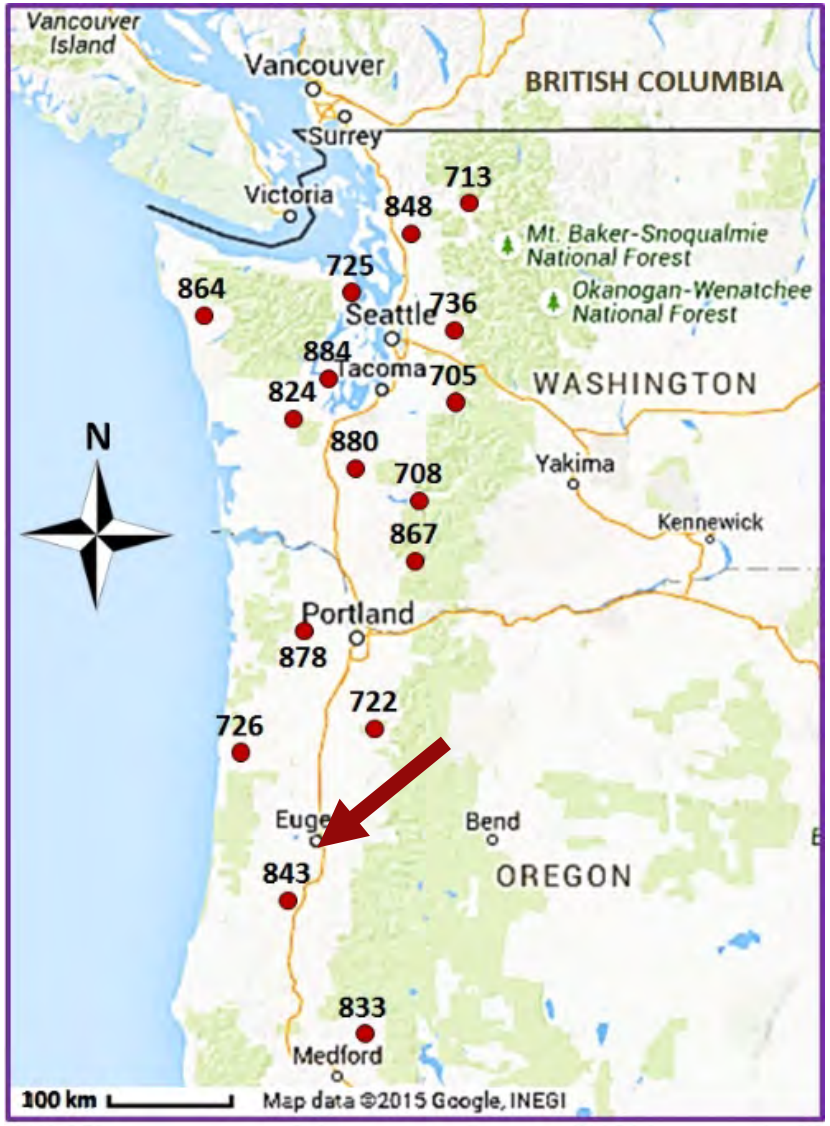
Progress on soil sampling

SMC 722

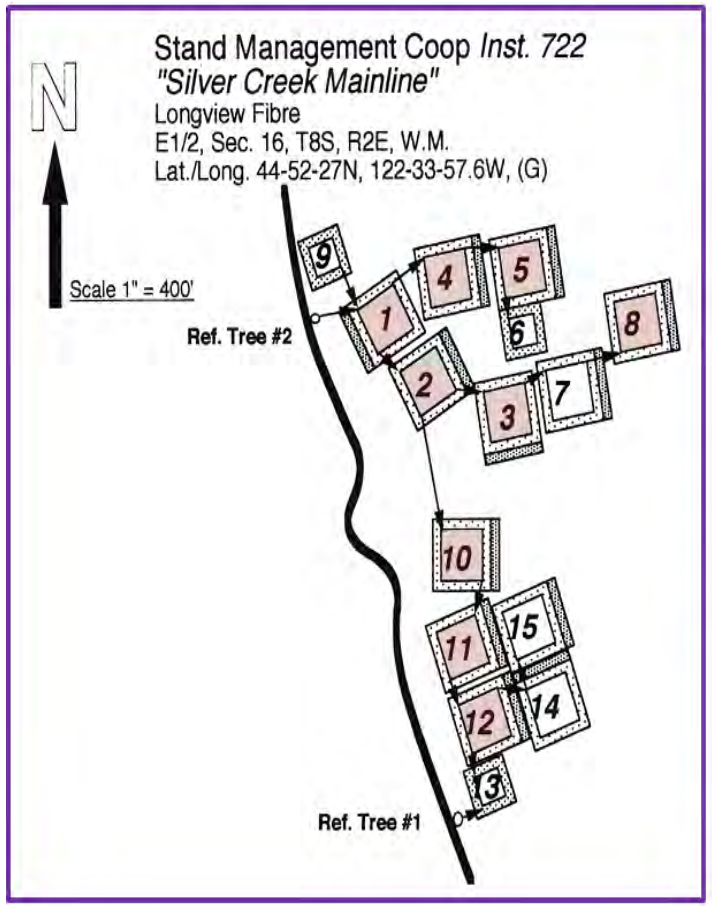
“Silver Creek Mainline”

Cole Gross M.S. project



Methods

- Forest Floor, 0-10, 10-20, 20-50, 50-100, and 100-150 cm.
- Auger, volumetric, and aggregate methods (plot for forest floor)



Plot	Treatment	Initial Stocking	Regime
1	4	ISPA*	Repeated thinning: RD†55→RD35; RD55→RD40, subsequent thinnings RD60→RD40
2	1	ISPA/4‡	No thinning
3	2	ISPA/2‡	Minimal thinning: RD55→RD35, no further thinning
4	5	ISPA	Minimal thinning: RD55→RD35, no further thinning
5	6	ISPA	No thinning
8	3	ISPA/2	No thinning
10	15	ISPA	Fertilization§ + repeated thinning: N fertilization + treatment #4
11	14	ISPA/2	Fertilization + minimal thinning: N fertilization + treatment #2
12	13	ISPA/4	Fertilization + no thinning: N fertilization + treatment #1

* ISPA = number of stems per acre at time of plot establishment and after preliminary thinning.

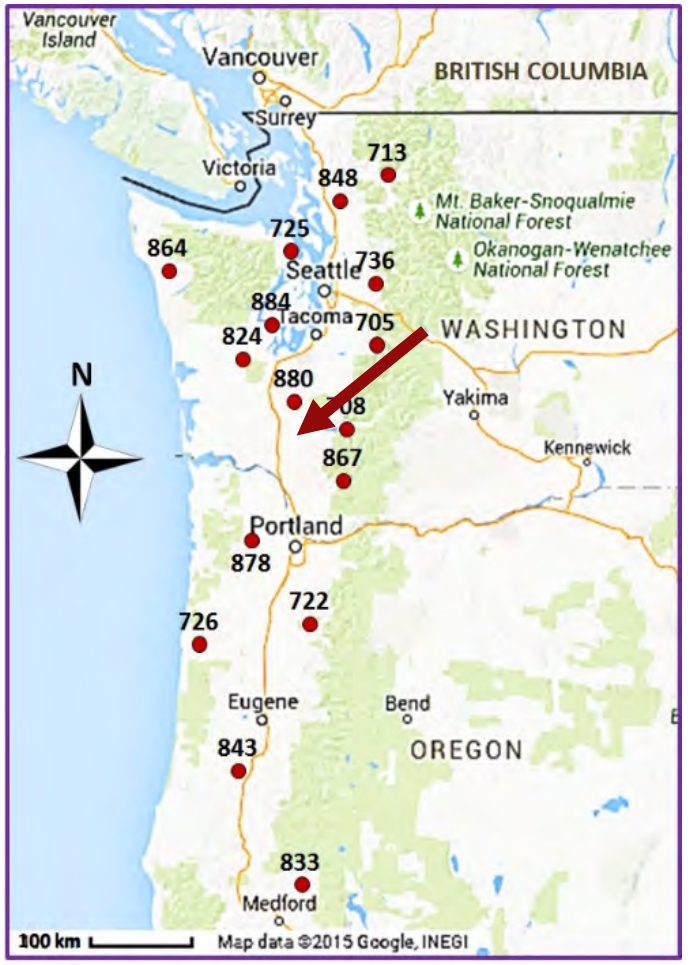
† RD = Curtis's (1982) relative density.

‡ ISPA systematically reduced to one-half (ISPA/2) and one-fourth (ISPA/4).

§ Nitrogen fertilizer applied at rate of 224 kg N/ha as urea with frequency of once every four to six years commencing at time of plot establishment.

Overview & Progress

- Soil was sampled by depth to at least 100 cm at SMC Installation 722, a Type I installation established in 1989 in a juvenile stand with ≥90% (by stem count) Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco).
- Samples were taken at nine 0.2-ha plots with differing thinning and fertilization treatments and/or differing initial stems per acre (ISPA).
- Sampling in the field has been completed with at least three pits excavated at each plot.
- More than half of the soil pits were sampled to 150 cm, with the remaining pits sampled to 100 cm.
- Work in the field totaled 20 days and 193 hours between August and November of 2015.
- Bulk density calculations and chemical analysis of the soil samples is projected to be completed by the end of summer 2016.
- The results of this study will help guide sustainable and best stand management practices by providing data for regional responses of soil carbon, nitrogen, and other nutrient content by depth to fertilization and thinning treatments.

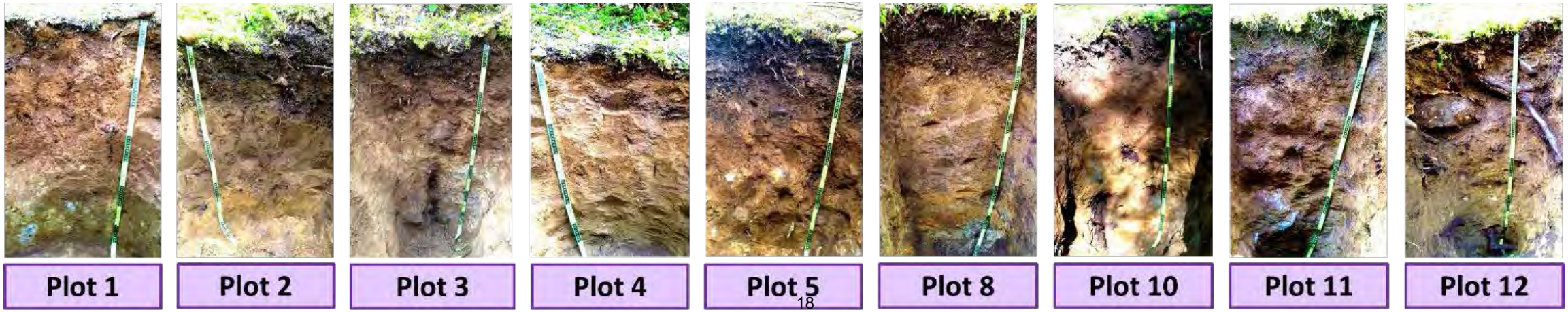


Preliminary Results

- Results show differences in total and subsurface soil C and N; however, high variability also.

- Excavated soil pits reveal horizon differences over relatively short distances, with topography playing a role; soils were very dense and frequently rocky.

- Roots were observed in all soil profiles to depths of at least 80 cm, and often deeper.



Stand and Tree Response to Late-Rotation Fertilization – rev. 4

Eric Turnblom, Rob Harrison. Kim Littke-Hanft, Louise de Montigny,
David Marshall, Greg Johnson, Scott Holub

Background: Late-Rotation Fertilization

- Much research has shown that Douglas-fir plantations on many Pacific Northwest sites are nitrogen deficient and on average will respond to fertilization with urea.
- Inherent risks to fertilization
  - the high cost of fertilizer and amortization of its costs to rotation,
  - the loss of volume from competition-induced mortality, and
  - the potential of stand damage or loss due to fire, insects and diseases
- An alternative strategy that could be economically attractive and may reduce these risks is to apply a single fertilizer application five to ten years before final harvest

Objectives: Late-Rotation Fertilization

The objectives of this project are:

- Derive a Regional Response Estimate for late-rotation fertilization (the RRE), i.e., an average regional area-based volume response to late-rotation fertilization;
- Provide data for members to determine economic returns of late-rotation fertilization investments;
- if possible w/out compromising goals, to validate site-specific responsiveness predictions of the current model developed from Type V sites

Approach: Late-Rotation Fertilization

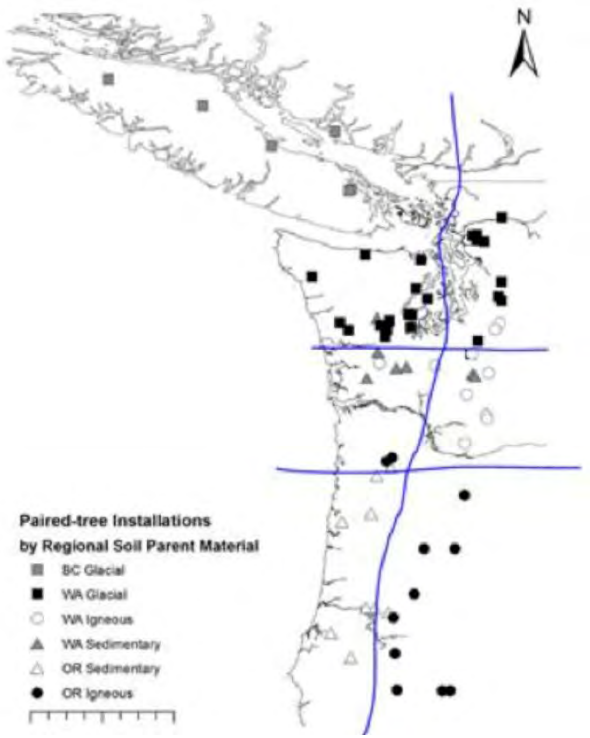
- Stand criteria
  - If rotation ages range 40 to 60 yr "Late" is age 30 to 50 yr
  - At least 75% DF by basal area
  - Has not been fertilized more recently than 8 yr ago
  - PCT'd or commercially thinned OK
- Stand Selection
  - Define polygons
  - Randomly select polygons
  - Survey cooperative members having land within said polygon to provide list of candidate stands
  - Establish an installation in selected stands

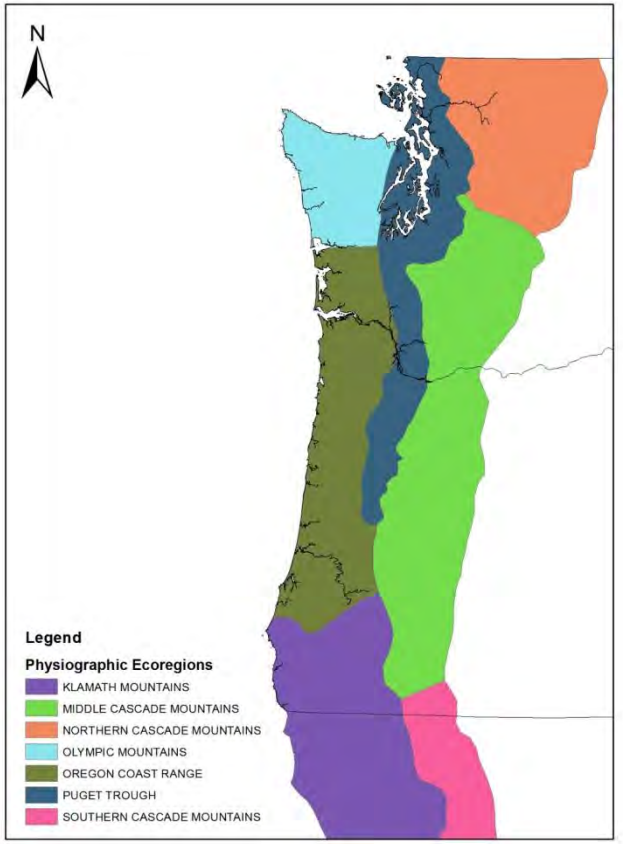
Approach: Late-Rotation Fertilization

- Polygon definitions
  - Simple Random Sampling design
    - Random Lat/Long defines center of polygon equal in area to a township (3.38 miles or 5.44 km)
  - Stratified Random Sampling w/ proportional allocation
    - Choose number of stands within geographic zones (strata) proportional to cooperative membership holdings

Approach: Late-Rotation Fertilization

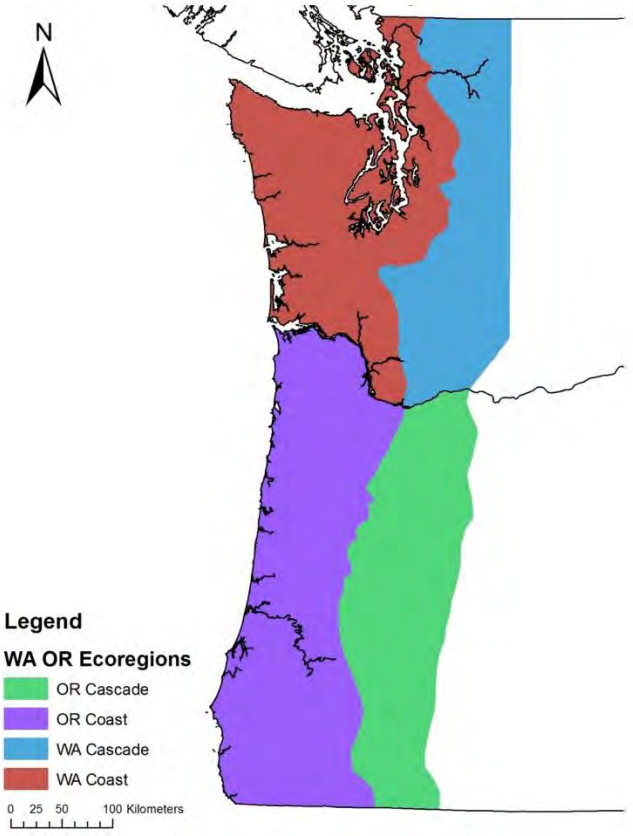
- Definition of geographic zones (SPM, climate, etc.)





Approach: Late-Rotation Fertilization

- Definition of geographic zones (SPM, climate, etc.)



Approach: Late-Rotation Fertilization

- Plot procedure
  - Establish ~ four temporary, 0.5-acre (0.2 ha) square plots w/ 33 ft. (10 m) buffer
  - Measure species, DBH on all trees; subset for heights, HLCB
  - Two most "similar" plots selected for the pair
  - One plot in the pair randomly selected to be fertilized
  - Take 'before and after' soil samples
    - Sample soil down to one meter on all plots, and if not rocky down to 3 or 4 meters

Approach: Late-Rotation Fertilization

- Definition of "Similar"
  - +/- 5% in BA; +/- 10% in TPA originally proposed
  - Examining Type II establishment measurements showed:

IID	mean, <10%		min, <10%		min, <=	
	5 plots	4 plots	5 plots	4 plots	5 plots	4 plots
801	3	1.8	1	0.6	1	0.6
802	2	1.2	1	0.6	1	0.6
804	4	2.4	3	2	4	2.4
805	6	3.6	3	1.8	3	1.8
806	5	3	1	0.6	1	0.6
807	4	2.4	3	1.8	3	1.8
808	1	0.6	0	0	0	0
809	1	0.6	1	0.6	1	0.6
810	6	3.6	2	1.2	2	1.2
811	6	3.6	2	1.2	2	1.2
812	1	0.6	1	0.6	1	0.6

Approach: Late-Rotation Fertilization

- Urea fertilizer will be applied to each 0.20-acre measurement plot and it's corresponding buffer
- Measurements will be taken at the time of fertilization, after two years and after four years
- Next (and last) measurement will be after 8 years, or when landowner decides to harvest whichever is sooner
- Interim results available after year 2 and "final" report issued after all installations have 4 year responses

Timeline: Late-Rotation Fertilization

Period	Activity
2016 (WI-SP)	Stand selections for year 1st yr (also 2nd?)
2016 (SU)	Establish 1st yr plots (boundaries, tags)
2017 (AU-WI)	Measure/treat yr 1 plots; Locate yr 2 stands?
2017 (SU)	Establish 2nd yr plots (boundaries, tags)
2018 (WI-SP)	Measure/treat 2nd yr plots
2018 (AU)	Measure year 1plots at 2 years
2019 (AU)	Measure year 2 plots (2 years)
2020 (SP)	Report 2-yr results
2020 (AU)	Measure 1st yr plots (at 4 years); report
2021 (AU)	Measure 2nd yr plots
2021 (SP)	Final report of 4-yr results

Budget: Late-Rotation Fertilization

	Per stand time and cost estimates[&]		
Task	Time	Who	Cost
Locate suitable stand	1 day	SMC crew (1 pers)	$400
Establish plots (4or5 / stand)	1 day	SMC crew	$1200
Measure & Apply Fertilizer	1 day	SMC crew	$1200
Total for 10 plots (1st year)	~ 30 days		$28,000
Travel time	~ 10 days		

[&] Assumed: SMC crew will perform tasks using 40-day 'extra capacity' over next four years (equivalent to ~ $1,200/day: includes vehicle, mileage, petroleum products, salary, benefits, per diem, lodging, misc. supplies & materials) Travel time is accounted for separately.