



Site Visit Reference Materials

Cloquet Forestry Center and Fond du Lac Forestry Field Tour

Lake States Fire Science Consortium

Thursday, September 20th, 2018

Tour Guide Contact Information

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A. CFC - Camp 8 Old Growth Red & White Pine Reserve

46.691340°, -92.526048°

Woodland restoration treatments (west half, 25 acres) and Untreated (east half, 20 acres)

Guided by: Kyle Gill, Evan Larson, Lane Johnson

Figure 1. Picture (a) demonstrates the fire-influenced stand conditions in Camp 8 ca. 1924. Blueberry, honeysuckle, sweet fern, and wintergreen were reported as the dominant ground cover. Picture (b) demonstrates the forest structure in August of 2018 in the western half of the stand that was mechanically treated in 1984 and 2009 to simulate surface fire structure conditions.



Background: This stand of red and white pine has been managed as a reserve to serve as an example of pre-EuroAmerican-settlement red pine stands of northern Minnesota. A majority of the canopy trees in

the stand germinated in the 1820s following a stand-reinitiating fire. Tree-ring reconstructions provide 18 fire years in this stand from the mid-1700s to the last fire in 1908. These fires predominately occurred in the dormant season, likely the spring or early summer of the fire year (April-early June). Exceptions are 1809 and 1881 which were late growing season fires (Aug-Oct).

UMN management of the stand commenced in 1910; this started an era of fire-exclusion in the stand. According to a 1955 stand description, there was no underbrush or regeneration in this stand in the early 1920s owing to its history of frequent fire. But by the mid-1950s there was “good regeneration of white pine in portions of the stand.” The lack of fire also encouraged the establishment of more nitrogen-rich litter-bearing species, such as red maple, paper birch, and beaked hazelnut, species that appeared to be shifting the stand composition away from pine. As such, a few structural restoration management treatments have been implemented on the western half of the stand with the goal of mimicking the structural effects of regular surface fires.

Structural restoration treatment descriptions (West half)

Treatment year: November 1984

Wood removed: Red and white pine and balsam fir (0.2 cd/ac – bolts), jack pine (0.3 cd/ac – pulp), and other species (0.4 cd/ac – pulp).

Goals: Preserve stand as an example of a once common pre-European settlement forest type

Objectives: Maintain half of stand in an untreated reserve and, in the other half, use active reserve management to restore historical understory conditions and reduce fuels.

Prescription: No treatment in half of the stand (#84.6). In the other half (#84.3), perform a restoration harvest. For this, salvage dead trees and those showing low vigor in the canopy and remove all understory spruce fir, white pine, and hardwoods. A similar understory treatment was done in 2009, although some white pine regeneration was retained.

Prescribed Fire: From 1992 to 2002, two small prescribed burns were accomplished but deemed failures by Forest managers. Both burns had minimal effect on reducing woody understory vegetation. A combination of limited personnel and infrequent safe burning conditions were major limiting factors preventing effective and regular burns.

2009 re-treatment: In November 2009, 19.5 tons/ac of mixed species biomass was removed.

Herbicide treatments: Multiple understory sprayings (1986, 1989, 1994, and 2010). Except for the spraying in 2010, most treatments were on the south half of the treatment area and near the road to keep the road clear. In 2010, however, our records indicate that a majority of the “treated” half of the stand was sprayed with Garlon 4, presumably for reducing hazel and red maple resprouts.

2018 Status: Mortality due to age and *Armillaria* fungi are creating canopy gaps. The most apparent gap is in the treated side and was first noticed within a few years after the 2009 treatment. White pine and other species (birch, red maple, hazel, and raspberry) are growing in these various-sized gaps and in groups throughout the treated half of the stand. Questions remain whether fire can be successfully used to maintain the stands old-growth character and promote natural regeneration of red pine while mitigating overstory mortality from a century of duff accumulation.

B. CFC - Tunnel Road Red Pine Understory Treatments

46.697826°, -92.537371°

Red pine shelterwood and understory treatment trial – 17 years later (5 acres)

Guided by: Kyle Gill, Lane Johnson

Reference: D’Amato, A. W., Segari, J., & Gilmore, D. (2012). Influence of Site Preparation on Natural Regeneration and Understory Plant Communities within Red Pine Shelterwood Systems. *Northern Journal of Applied Forestry*, 29(2), 60–66. <https://doi.org/doi:10.5849/njaf.11-021>

Pre-harvest condition: Ninety year old even-aged red pine regenerated following 1910 forest cutover and thinned multiple times between the 1950s and 1970s.

Harvest year: 2000 with understory treatments in 2001– Overwood never removed

Goals: Evaluate the success of four alternative vegetation management methods in promoting the natural regeneration

Prescription: Overstory density was reduced to 108 ft²/ac.

Understory treatments:

- A. **Herbicide:** Pronone 10G (hexazinone), [note: velpar is liquid formulation] at 30 lbs/ac. Applied on June 5, 2001.
- B. **Mechanical mulching:** [note: equipment usage was provided gratis from Rich Hendricks of Sundance Silviculture]: Completed October 1, 2000
 - a. Glyphosate (ACCORD Concentrate 5% solution) applied September 9, 2003 to one-half the area of each of the mechanical plots.
- C. **Burning:** Brush was cut June 12, 2001 and burning completed August 8, 2001
- D. **Control**

Figure 2. (a) Mechanical mulching and (b) burning treatments within the red pine regeneration study immediately following treatment implementation.

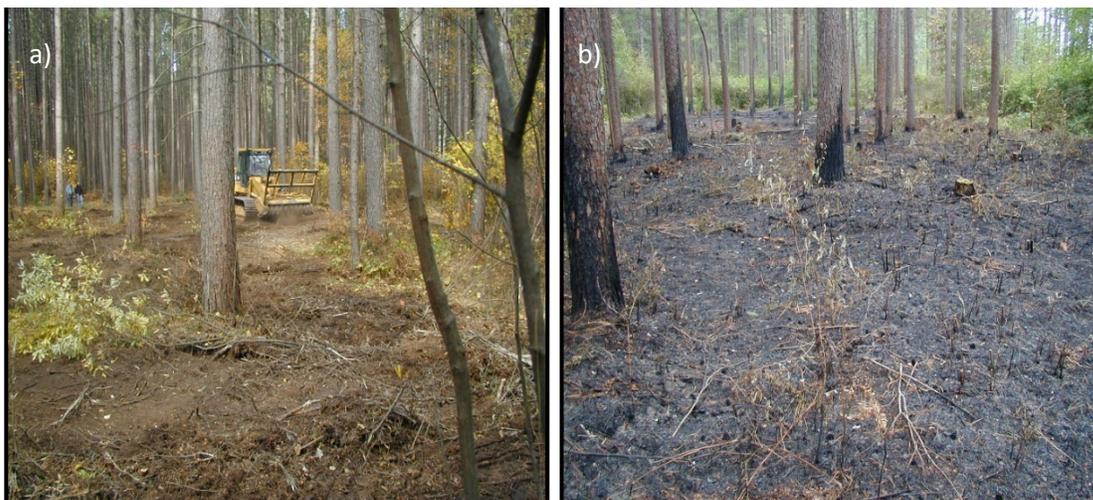
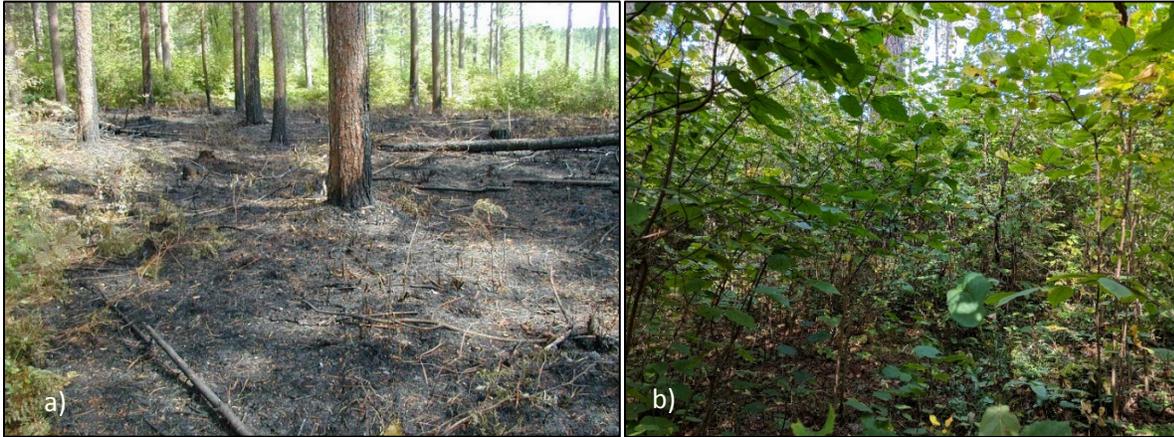


Figure 3. Repeat images of the 11/D mechanical + burn treatment in (a) summer 2001 and (b) summer 2018. Notice the same red pine bole in the top center of each image



Results:

Figure 4. Density of (a) red pine seedlings and (b) all species combined five years (2006) following the application of underburning (B), herbicide (H), mechanical mulching (M), and mechanical mulching followed by herbicide (M+H) treatments. C=untreated control. Means with different letters are significantly different at $P < 0.05$.

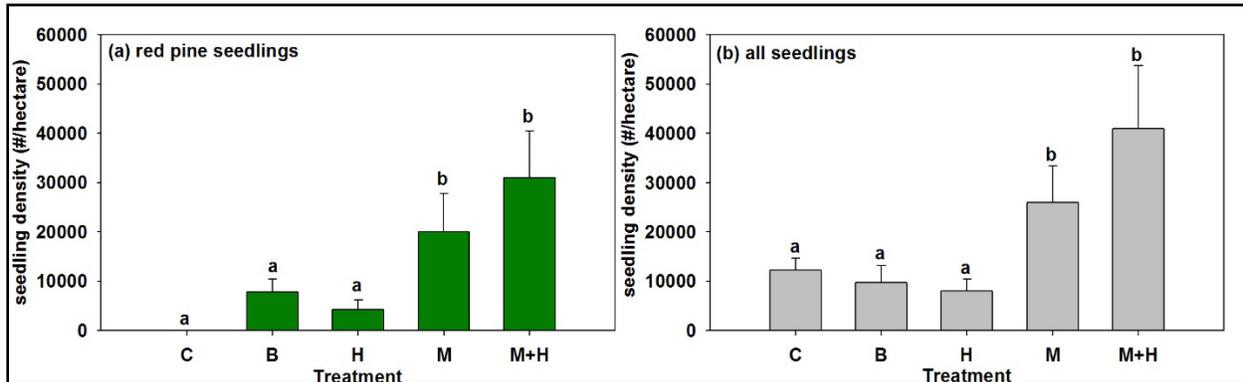
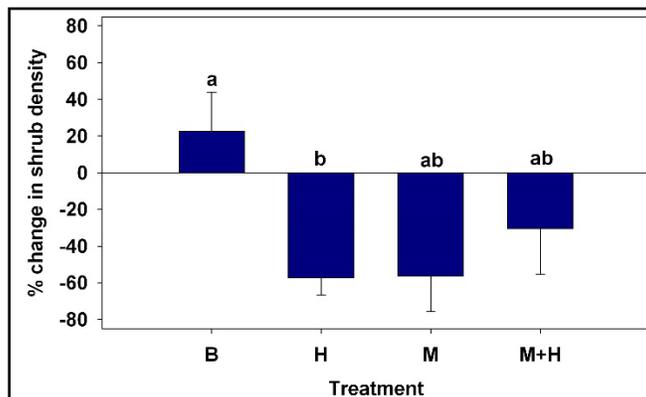


Figure 5. Percent change in shrub densities five years following underburning (B), herbicide (H), mechanical mulching (M), and mechanical mulching followed by herbicide (M+H) treatments. Means with different letters are significantly different at $P < 0.05$



2012 Study Conclusions:

- Mechanical mulching and mechanical mulching + herbicide site preparation treatments were the most effective at securing natural red pine regeneration within a shelterwood setting.
- Although underburning has been suggested as a technique for reducing competition and preparing seedbeds for red pine, findings indicate that a single prescribed burn is not sufficient for achieving favorable conditions for natural regeneration.
- Red pine natural regeneration harvesting treatments can successfully secure red pine regeneration when appropriate site preparation treatments are applied
- Red pine natural regeneration silvicultural systems should be aware of and plan for the risk of shoot blight (*Diplodia/Sirococcus*) – it is thought that seedling mortality from shoot blight would have been drastically reduced by simply removing the seed trees from the study site.

2018 Status: The red pine regeneration have nearly all died, likely due to red pine shoot blight. However, there are stark visual differences between the treatments. These differences are most apparent in the development, or lack thereof, of tree and shrub species, primarily paper birch and beaked hazelnut, respectively. It is not currently known whether the apparent difference in conditions by treatment type are merely the result of different development stages or, potentially, plant community changes. To assess these, a quantitative assessment of the composition and structure of mid-story, understory, and ground-level strata is in the works for 2019.

Eventually the stand is likely to be incorporated into a larger experimental harvesting prescription for the red pine stands that run north-south along Tunnel Road. This may be a variable retention harvest with potential for repeat underburning or passive scarification techniques post-harvest to stimulate natural red pine regeneration. The broad goal will be to get at the broad question: Are fire dependent plant communities truly dependent on occasional fire for their continued existence?

C. FDL - White Pine Shelterwood

46.732861°, -92.725639°

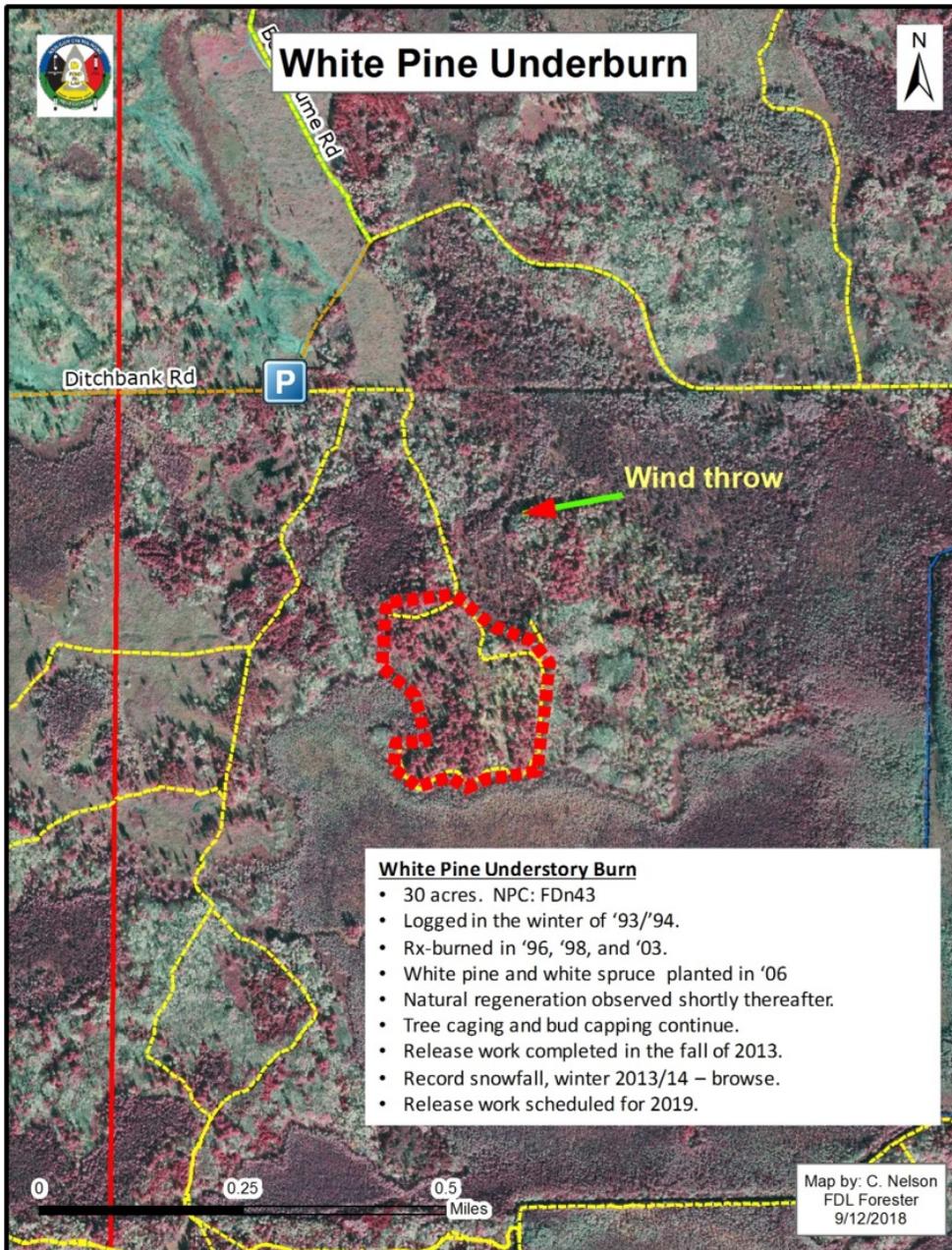
Repeat Underburns for Site Preparation and Natural Regeneration of White Pine (28 acres)

Guided by: Christian Nelson, Steve Olson

Background: The Fond du Lac Reservation, much like much of Northern Minnesota, has only a very small percentage of the pine resource that would have been present before the logging era of the 1880's removed much of the large, old white pines. Subsequent forest fires burned up many unlogged white pines and seedlings and saplings, an increase in browse pressure on young white pine, and the introduction of non-native pathogens have all contributed to a regional decline in white pine reproduction.

This white pine stand is a two-aged stand with an overstory of 100+ year old white pines that escaped the devastating 1918 fire that burned much of the Fond du Lac Reservation, and a 12-24 year old white pine understory that recruited into the stand over the last two decades, after a timber harvest and subsequent prescribed burns, starting in 1994.

The soils on this site are a well-drained ahmeek loam and the native plant community, using the MN DNR's ecological classification system, is FDn43 (*Northern Mesic Mixed Forest*), a relatively wet and nutrient poor fire dependent site.



Management History and Rx Fire Treatments: In the winter of 1993/94 the site was partially harvested. Paper birch, red and sugar maple, and aspen were harvested with a goal of reducing the canopy closure. White pine showing signs of blister rust were also removed at this time. This opened the site up, allowing more sunlight to reach the forest floor.

Records show 200 cords of paper birch, 106 cords of white pine, 91 cords of red maple, and 78 cords of aspen were marked for removal from the site or approximately 16 cords per acre.

In the spring of 1996, 1999, and 2003, prescribed burns were completed on the site. The intent of the initial two burns was to reduce slash, prepare a seedbed, and reduce competition. The burn in 2003 was conducted when it seemed the first two burns had failed to result in white pine seedling recruitment.

In 2005 it was thought the three burns had failed to result in white pine regeneration and plans were made and ultimately implemented to plant white pine into the site in the spring of 2006. A dozer was used to create planting lanes, knocking any brush back that had come back after the last prescribed burn. Approximately 150 white pine and 150 white spruce per acre were planted. White pine was caged to prevent deer browse using nylon mesh tree cages.

Late in 2006 or 2007, after planting the site, natural white pine regeneration was observed recruiting in to the site.

In October 2006, regeneration surveys showed 152 white pine, 150 white spruce, and 14 red pine per acre growing on the site. In 2014 that number increased substantially, due to natural recruitment. Approximately 820 white pine, 195 white spruce, and 14 red pine per acre were observed.

TSI/Tending: Following planting in the spring of 2006 cage maintenance and budcapping was done each fall as needed.

In late fall and early winter of 2013 release work was completed. White pine seedlings had competing vegetation cut away, using chainsaws or brush saws, with a radius of approximately six feet around each seedling/small-sapling.

Many small-saplings had reached 5-6 tall and budcapping was not done because it was thought they were out of the reach of deer. In late-winter 2013 and extending into May of 2014, the area received record snowfall. This gave deer a height boost, and a strong incentive due to food shortages and mobility problems, to browse everything they could on this site and many white pines were browsed heavily.

Current Conditions: This site was cruised in September of 2018.

Overstory (trees >5" DBH)

<u>Species</u>	<u>Trees/Ac</u>	<u>BA/Ac</u>	<u>QMD</u>	<u>Pulp</u>	<u>Pulp Top</u>	<u>Net Saw</u>	<u>Total Cds</u>
White Pine	21.6	58	22.2	.0	.8	12073	25.0
Red Maple	7.6	4	9.8	.4	.1	205	.9
Sugar Maple	2.5	2	12.0	.0	.2	166	.5
Paper Birch	3.7	4	14.1	.0	.3	418	1.1
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Total	35.4	68	18.8	.4	1.4	12862	27.5

Regeneration (trees <5" DBH)

<u>Species</u>	<u>Trees/Acre</u>
White Pine	1,075
Tamarack	225
White Spruce	200
Total:	1,500

Most pine in plots are small seedlings. Seen but not included in plots: red maple, sugar maple, white cedar, paper birch, and aspen. Despite deer browse and competition, the number of white pine seedlings has been increasing since the site was planted in 2006.

Future TSI plan: Release work has been planned for the fall/winter/spring of 2018/2019. After leaf-drop, approximately 100-200 pine trees per acre will be flagged and then hand crews will cut back competing vegetation 8' around each stem. The seedlings will then be caged to prevent deer browse.

Desired Future Condition: Ultimately this stand will be a mixed stand of older overstory white pine, and a second cohort of white pine, as well as white spruce, with a component of volunteer aspen, paper birch, and both red and sugar maple trees.

Possible discussion stop along the white pine shelterwood access trail – post-windthrow salvage harvesting and site prep.

Background: In July 2018, a downburst blew down approximately 16 acres of over-mature aspen and balsam fir. Many trees snapped, others tipped over at the roots.

Preliminary thoughts: A dozer line may be constructed around the perimeter of the site and used as a future fire break. FDL's Forestry crew will harvest the site this winter. Products will be sorted. Sound 8' sticks of aspen may be delivered to SAPPI or Savanna Pallets. Wood not suitable for a mill but still sound, may be brought to a location near the Sawyer Community Center's biomass boiler where it can be chipped and use as a fuel source.

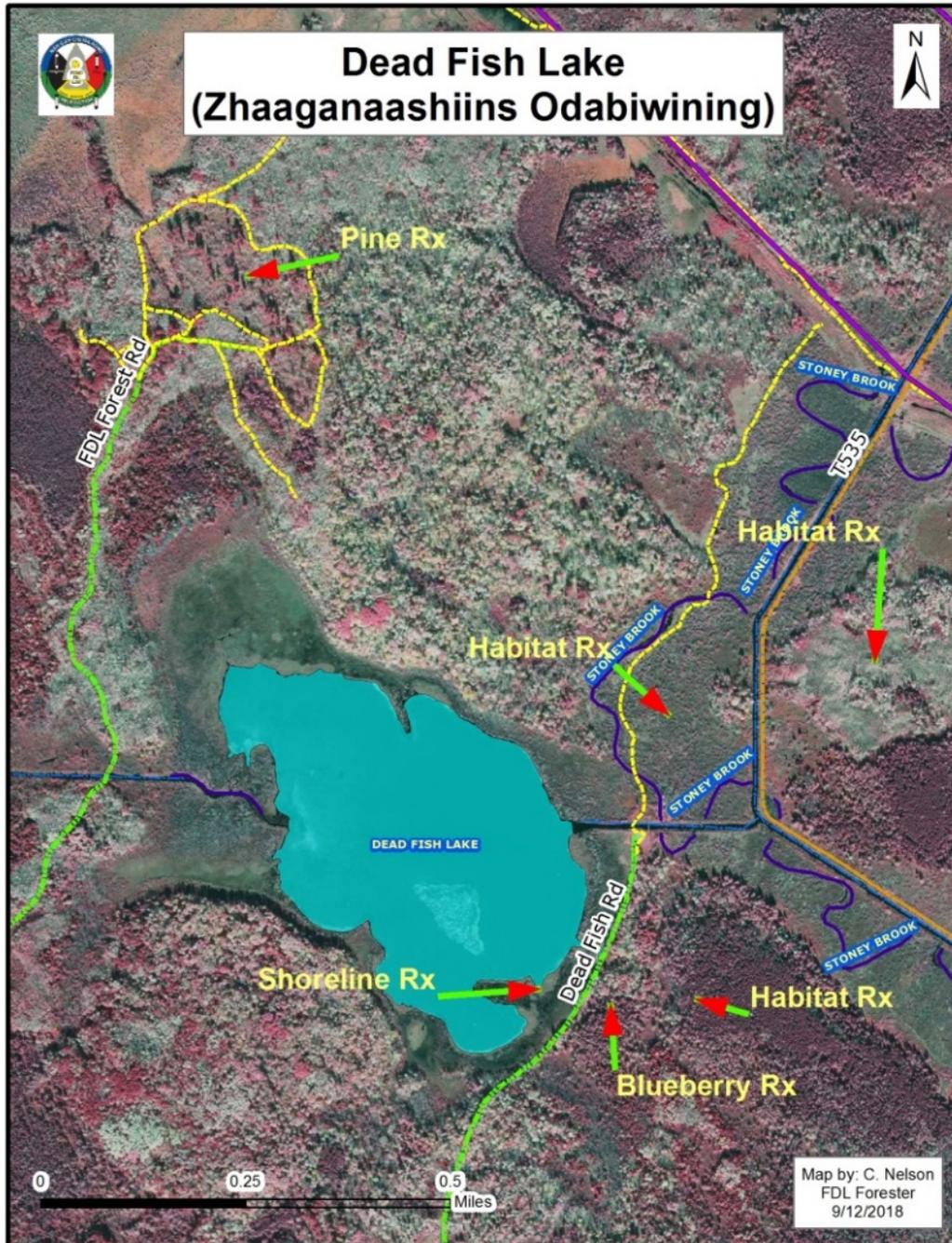
In Spring of 2019 the site could be burned to reduce fuel loading (approximately 11 tons per acre if not harvested), and planted.

D. FDL - Dead Fish Lake

46.744954°, -92.684985°

Topics will include Fond du Lac cultural history, the significance of wild rice, prescribed burning for wildlife habitat and food production.

Guided by: Christian Nelson, Steve Olson



E. Optional Lunchtime Stop: CFC 2016 Rook Sale

46.702485°, -92.525704° Located on the south and east sides of the CFC buildings and grounds area.

Fire hazard reduction in a multi-aged red pine woodland

Self-guided stop: talk to Kyle Gill or Lane Johnson if you have questions



Stand conditions in the western block of the 2016 Rook Sale, September 2018.

Background: Available GIS records suggest a stand-origin date around 1854 though one fire-scarred cross-section sample collected following the harvest demonstrates that it, and likely other scattered individuals, was growing in the stand by 1778. Many of these older individuals display 5 or more fire scars that demonstrate a pre-European settlement surface fire regime with a fire return interval of approximately every ten to fifteen years; large diameter, gnarled branches in their lower canopy also indicate a history of a relatively open, low-density canopy conditions. The last fire in the scar record occurred in 1894, a widespread fire at the Cloquet Forestry Center as well as other

parts of Minnesota. Management records indicate three different merchantable harvests in 1927, 1940, and 1951, primarily to remove jack pine and promote red pine crop trees (See “Previous Harvests” below). No treatments occurred after 1951. As such, additional recruitment of red pine, balsam fir, spruce, and paper birch increased the overall stand density and connected the biomass between understory and canopy strata via ladder fuels.

Previous harvests: Cloquet Forestry Center management records indicate the following three merchantable harvest entries occurred within the stand boundaries.

- A 1927 harvest which removed selected mature timber, primarily jack pine with some red pine, from the eastern tract.
- A 1940 clear cut of mature jack pine (other species not harvested) on the southern half of the western tract south of nursery road and the entire eastern tract.
- A 1951 harvest with a prescription of “cut as marked” to favor potential red pine crop trees. Species removed included red pine, white pine, jack pine, and aspen.

2016 Silviculture prescription: The structural goals of the stand included creating a spatially heterogeneous arrangement of canopy trees with a range of diameters and, likely, ages. The targeted residual basal area was around 80-90 ft²/acre with a target spacing of about 25-40 feet between trees. Reserve trees were selected to retain a two-peak diameter distribution with peaks around ten and 24 inches. Large trees in the >24” diameter class were retained to promote visual appeal while red and white pine in the 8-11” diameter class were retained to serve as future crop trees, likely merchantable in 10-15 years. Snags and coarse woody debris, characteristic of old-growth stands, were kept for visual interest and wildlife habitat. The understory and mid-story was mostly cleared to discourage ladder fuels; some pockets of white pine and/or paper birch advanced regeneration were kept as future canopy replacement species.

In the short-term (~30 years), a canopy of red pine and some white pine (<10% basal area) is desired. In the longer-term (>30 years) a mixed canopy of red pine, white pine, and paper birch is desired; natural regeneration, and some artificial regeneration, of paper birch, white pine, and red pine in the understory will be permitted to promote this future canopy condition.

The harvest guidelines specified a spring/summer harvest, completed by the end of 2016, and required full-tree harvesting and chipping of tops and any red pine slash of three inches diameter or larger. Full-tree skidding and growing season harvest was specified in order to passively scarify the ground to encourage pockets of white pine and paper birch natural regeneration; though this is a lower-priority objective. Chipping of tops and >3" diameter red pine slash was specified to reduce the likelihood of a pine bark beetle outbreak.

2018 Status: Future plans include monitoring of understory density of hazel and highly flammable species, predominately balsam fir and spruce. Understory clearing with a brush saw or brush mower will occur as needed to maintain open conditions and prevent ladder fuels. Prescribed underburns and intensive grazing may be considered as well for demonstration purposes.

Between 2026 and 2031, the stand should be assessed for another crown thinning or alternate silvicultural treatment to promote understory re-initiation and regeneration.



If you use Avenza Maps or some other digital map app, a geoPDF version of this map is **available for download** at: https://z.umn.edu/LSFSC_2018_FDLNPCmap.

