# FOREST MANAGEMENT PLAN
for
ANNE'S HUNDRED ACRE WOOD, LLC
DOBSON, NC, USA
APRIL 2025

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Master of Forestry

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# Table of Contents

# List of Tables



# List of Figures

# Forest Overview and Owner's Intent

Anne's Hundred Acre Wood, LLC., (A100AW) owns and operates a forest of approximately 100 acres in Surry County, North Carolina. The forest is approximately 15 miles west of Pilot Mountain, in the upper piedmont of northwest North Carolina. This forest consists of approximately 55 acres of southern yellow pine and 45 acres of mixed hardwoods spread across 5 stands (Figure 1). An overview of cover type, age, basal area and merchantable acres by stand is presented in Table 1.

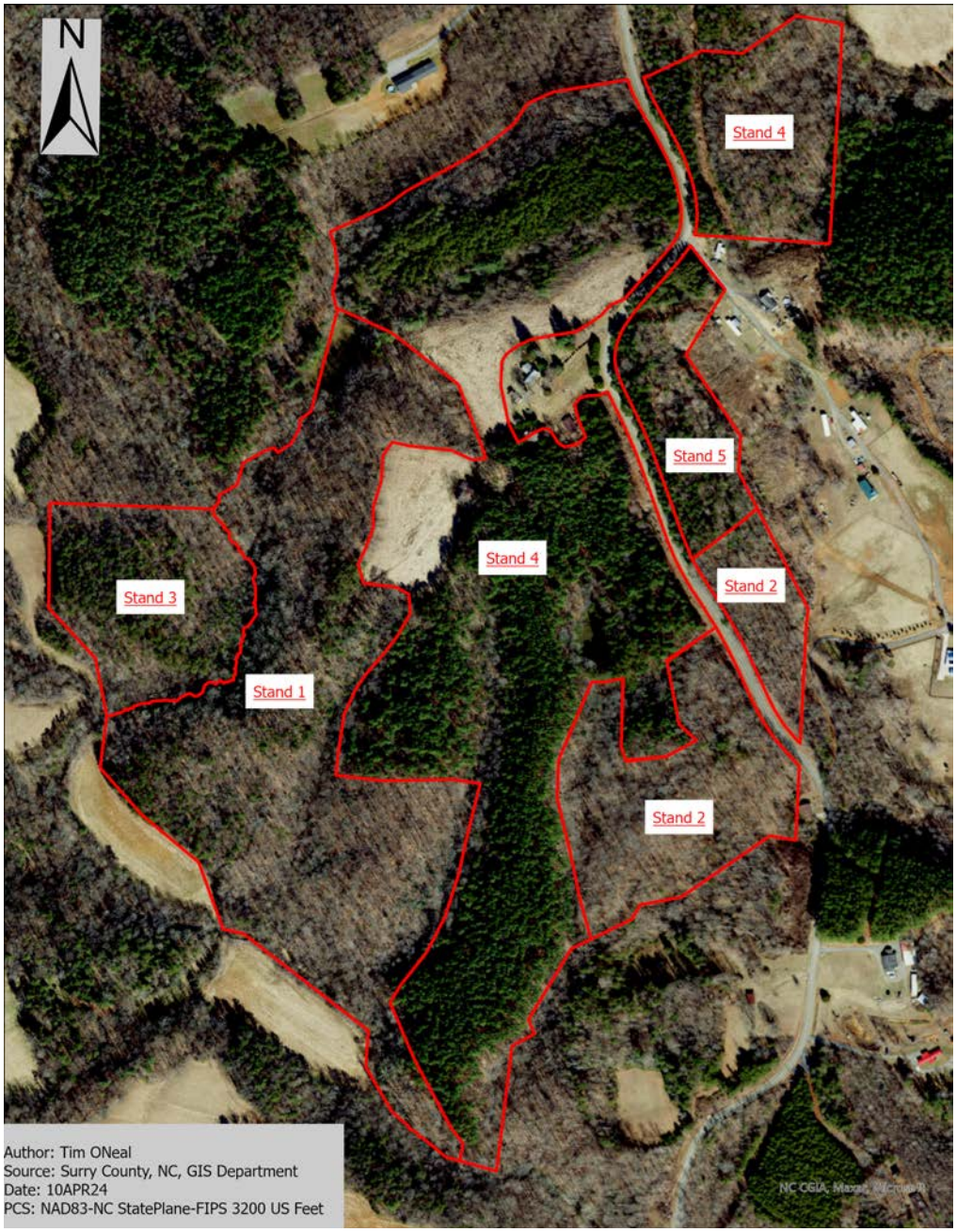


Figure 1. Forest stand map for Anne's Hundred Acre Wood

Table 1. Anne's Hundred Acre Wood Forest Overview. Merchantable acreage is all acreage outside of streamside management zones and neighbor boundary buffers.

| Stand Number | Cover Type | Age | SI | Basal Area | Merch. Acreage |
|---|---|---|---|---|---|
| 1 | Oak--Tulip Poplar--Southern Yellow Pine | 85 | 75 | 109.6 | 20.66 |
| 2 | Oak--Tulip Poplar--Hickory | 65 | 90 | 130.91 | 10.12 |
| 3 | Southern Yellow Pine--Tulip Poplar--Red Maple | 45 | 60 | 110 | 6.44 |
| 4 | Loblolly Plantation | 0 | 70 | 0 | 45.42 |
| 5 | Southern Yellow Pine--Oak--Hickory | 85 | 75 | 110 | 3.93 |

### Owner's Intent

A100AW intends to maximize their economic return off of the loblolly pine stands. This is best done with a 30-year rotation that incorporates two commercial thinning harvests at years 10 and 20. Stand 3 should be converted from Virginia pine to loblolly pine during the next cutting cycle, which is projected for 2035.

A100AW intends to maintain constant forest cover, successfully regenerate oak, and create periodic income by small-scale timber removals within the mixed hardwood stands. This is best done by a patch selection system that is synchronized with the loblolly pine cutting cycles.

A100AW intends to maintain the ecosystem services provided by the forest to the maximum extent possible, while meeting economic goals. These services include carbon sequestration, wildlife habitat promotion, and protecting soil and water quality. The best way to maintain these services is by afforesting the old fields, creating structural diversity within the stands, and burning where possible.

### Key Takeaway

It is not feasible to conduct small harvests in this forest without synchronizing stand management schedules. All harvests schedules will be dictated by Stand 4, the loblolly pine plantation, which will be planted in March 2025. All timelines will be synchronized with this stand. That means "year 0" for the entire forest occurs in 2025.

Thinning Stand 4 at years 10 and 17, with a final harvest at year 27 generates the highest economic return. Operationally, the year 17 thin be delayed until year 20 and final harvest will occur at year 30. While this generates slightly less income for this stand in isolation, it brings the other stands into the cutting cycle, greatly increasing the value of the forest.

Thinning the large loblolly pine stands at years 10 and 20, with a final harvest at year 30 allows for smaller harvests within Stands 1, 2 and 3 every ten years. This puts all stands on a ten-year harvest schedule, whether managed for loblolly pine or oak-poplar patches. See Appendix A-Detailed Schedule, for a breakdown of activities by year.

## Forest History

### Usage History

This forest has been passively managed. The mixed hardwood stands probably originated from an early 20th century clearcut that was subjected to fire. The loblolly pine plantation (Stand 4) is now in its second rotation. It was harvested in 2023 and replanted in March 2025.

Prior to the first plantation establishment nearly 30 years ago, Stand 4 was a naturally regenerated pine stand. Five acres of former agricultural fields, five acres of mixed hardwoods, and five acres of Virginia pine was added to Stand 4 following the 2023 harvest and 2025 replanting.

Across the property there are indications of subsistence agriculture along the creek floodplains. Evidence of a main road running from Romie Snow Road. to Double Creek Rd. also exists. It is unknown when that road was abandoned. Efforts to learn more about the natural heritage of this forest are ongoing with the NC Natural Heritage Foundation.

## Weather History

The Piedmont region of North Carolina has a humid sub-tropical climate with four distinct seasons. The region is characterized by mild winters, hot and humid summers, and abundant precipitation year-round (WeatherStem, 2017) (Table 2). This area receives approximately 50 inches of annual precipitation, which should not be a limiting factor, though sporadic droughts do occur. The pine seedlings planted in March of 2025 in Stand 4 were planted under abnormally dry conditions, which have persisted through much of the spring (NC Drought Monitor-2025) (Figure 2).

This forest is on the northwest edge of the loblolly pine range. Minimum winter temperatures here are 5-10 degrees (F) colder than those of the loblolly pine seed origin, as depicted in Figure 3. This is an acceptable range, and it is unlikely the trees will suffer from cold injuries. The last rotation of loblolly pine grew to maturity with few deformities from cold injury.

Table 2. Average annual precipitation and temperature-Elkin, NC (1991-2020) (National Center for Environmental Information).

| Season | Max Temp (ºF) | Min Temp (ºF) | Avg Temp (ºF) | Precip (in) | Snow (in) |
|---|---|---|---|---|---|
| Annual | 69.1 | 42.8 | 56 | 49.03 | 3 |
| Winter | 50.9 | 24.6 | 37.7 | 10.98 | 2.8 |
| Spring | 69.2 | 40.4 | 54.8 | 12.88 | 0.2 |
| Summer | 85.7 | 62.6 | 74.2 | 14.16 | 0 |
| Autumn | 70.8 | 43.6 | 57.2 | 11.01 | 0 |

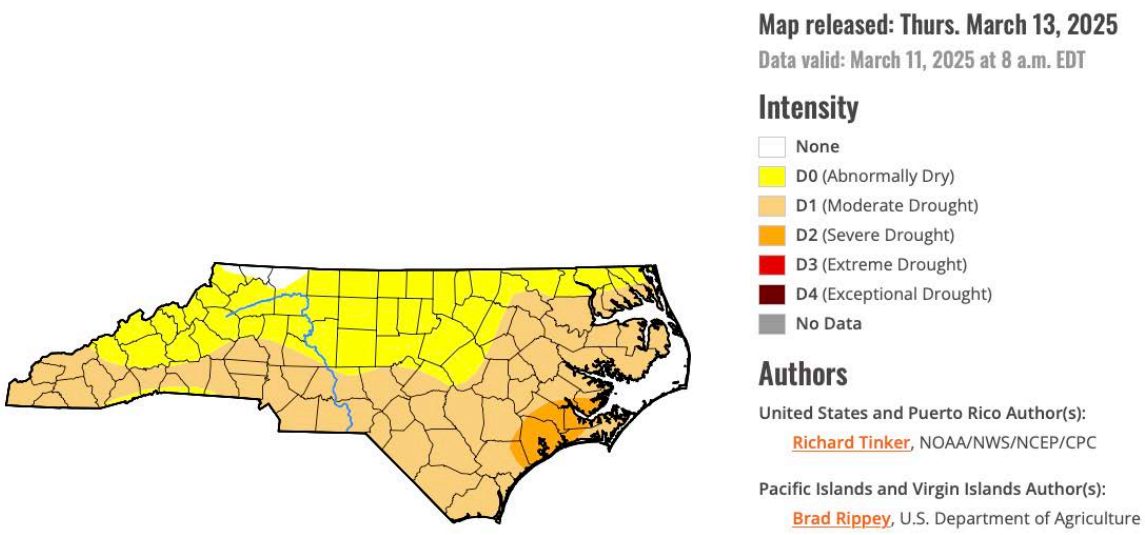


Figure 2. North Carolina Drought Map-March 2025 (National Drought Mitigation Center).

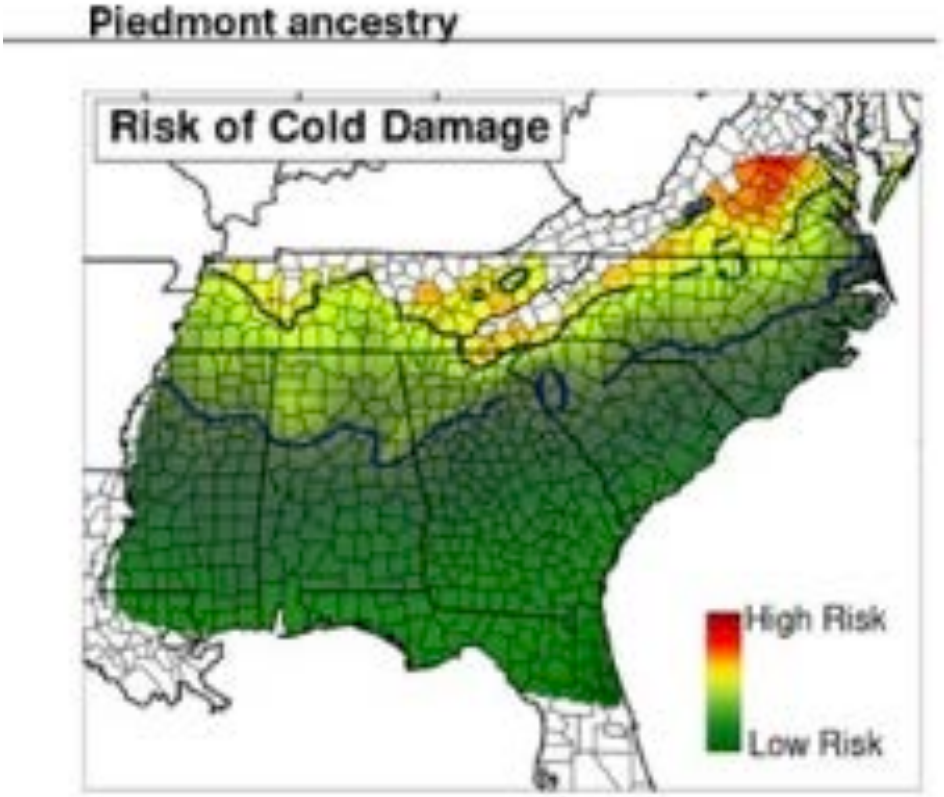


Figure 3. Risk of Cold Damage by distance moved for piedmont origin loblolly pine seedlings. Surry County has a minimum winter temperature 5-10 degrees colder than origin location and is considered low-moderate risk (NCSU-Extension).

# Forest Ecology

## Forest Soils

A soil series is the smallest functional classification of a soil (Brady/Weil, 2010). This forest consists of Fairview series soils, which are well drained and originate from granite and sandstone parent materials (rocks). Because they are well drained, these soils are generally operable year-round. Fairview soils are known to have nitrogen deficiencies, but recent foliar analysis suggests it is not currently an issue for this site (forestproductivitycooperative.org, 2025).

Figure 4 depicts the locations of the various Fairview series soils in this forest. Functionally, the only real difference between each series is their slope steepness. There is an insignificant portion of Braddock series soils in the flood plain of Double Creek (USDA-NRCS, 2024).

In general, the piedmont soils of North Carolina are eroded due to heavy agricultural usage. This is especially prevalent within the former agricultural fields of Stand 4. Three soil profiles within these fields were examined, and rock was hit at approximately three feet for each profile. There are minimal amounts of topsoil within these former fields, as seen in Figure 5. For comparison, a profile from an adjacent area, that was protected from tillage and erosion is included below (Figure 6). It has noticeable differences in its topsoil, clay layers, and depth to bedrock.

Foliar analysis is a good indicator of plant nutrition, and therefore any potential limitations in soil nutrient availability. Loblolly pine foliar samples were taken in November 2023 from Stand 4 and sent to Waters Agricultural Laboratory for testing. The lab results show 1.6% nitrogen dry mass and 0.12% phosphorous dry mass within the samples. The recommended levels for loblolly pine are 1.2% and 0.12%, respectively (Albaugh, et al. 2010). There is adequate nitrogen and phosphorous availability within this stand and presumably the entire forest.

These Fairview series soils are conducive to forestry operations for 10-12 months out of the year (foresporductivitycooperative.org). During the winter months, care must be given to monitor logging conditions. Soils are typically more saturated during these months and heavy logging equipment can cause soil compaction, which impacts the rooting ability of future stands. Tillage is not recommended for site preparation of these soils (forestproductivitycooperative.org). Ample secondary road frontage and previously constructed haul roads from the log deck to Romie Snow Road. make this forest a better wintertime option for loggers.

Bottom Line: During periods of heavy precipitation, the forester must monitor operations and soil conditions. If it becomes too wet, the forester must temporarily halt the operation.

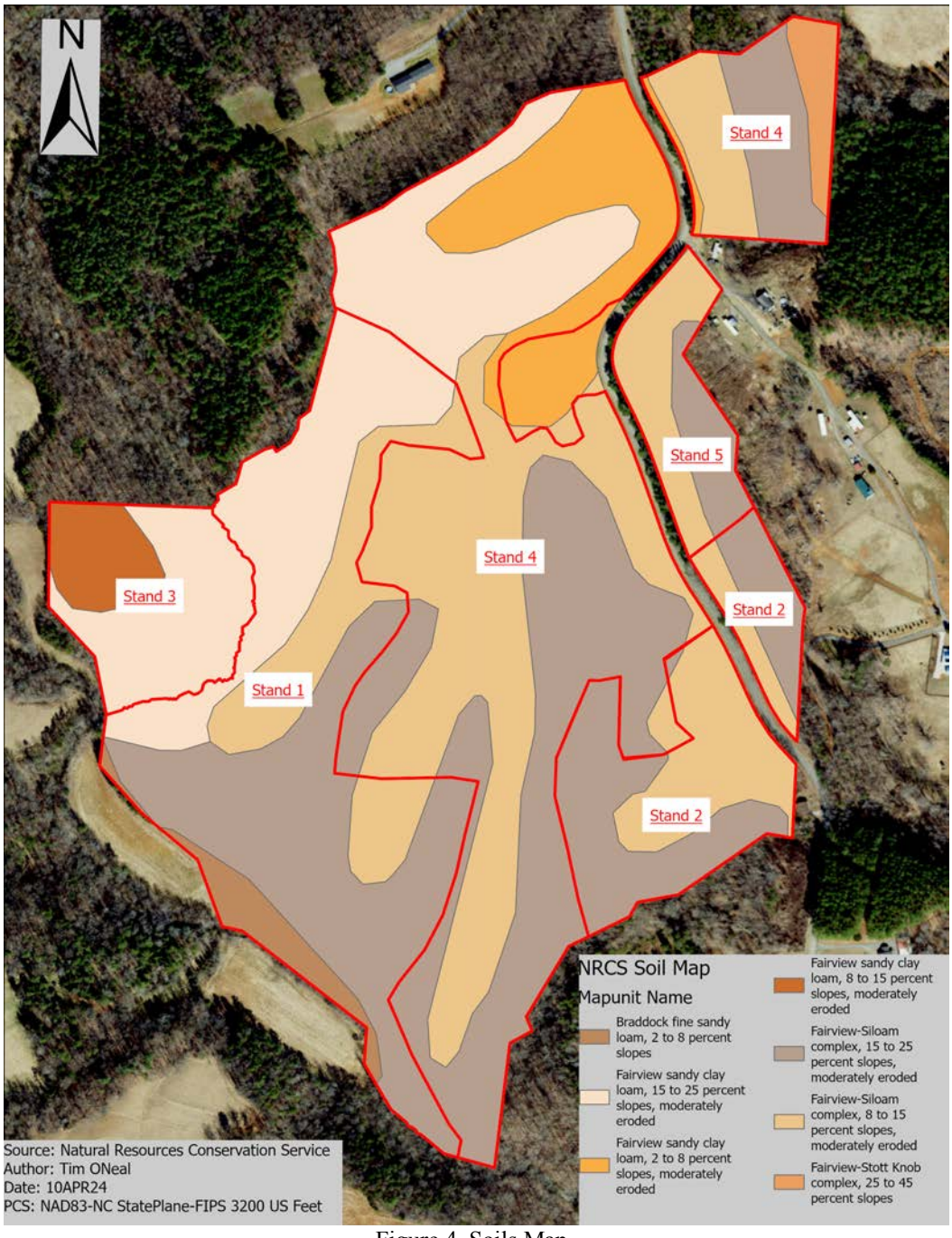

Figure 4. Soils Map.

Figure 5. Soil profile from agricultural fields that will be planted in loblolly pine (Stand 4).

Figure 6. Soil profile adjacent to profiles from old fields. Note the difference in topsoil depth (darker soils at top of picture) as well as the overall color difference. The red color means there is more clay minerals within the undisturbed soils.

## Forest Waters

Sediment pollution in North Carolina is regulated by the N.C. Sedimentation Pollution Control Act of 1973 (SPCA, N.C.G.S. 113A-50). Forestry-related land disturbing operations are exempt from the permitting and planning requirements of the SPCA if they comply with the nine forest practice guidelines (FPGs). The FPGs are big picture, generalized prescriptions. Compliance with the FPGs is interpreted by the North Carolina Forest Service (NCFS), who utilize county NRCS Web Soil Survey Stream Maps and the most recent USGS topographic maps (1:24,000) for stream assessments (NC BMP, 2021).

The best way to ensure FPG compliance is by implementing appropriate Best Management Practices (BMP's) (NC BMP, 2021). These are operational techniques that limit erosion and stream pollution. When and where BMP's are used is situationally dependent and determined by the forester in charge. The streamside management zone (SMZ) BMP's are the most important for forest planning. The rest govern things like stream crossings, equipment pollution, fertilization, etc., and will be implemented as necessary.

This property contains one perennial stream (East Double Creek), two perennial ponds, five intermittent streams, and numerous ephemeral drains (Figure 7). For this plan, a 50' SMZ has been implemented along all bodies of water, to include ephemeral streams. Fifty-foot buffers have been used on the ephemerals due to the steep terrain surrounding them, but are not as critical as those around perennial and intermittent streams.

There are 20 acres of SMZs in this forest that have been excluded from merchantable timber inventories. If desired, high value timber can be removed individually within these areas. Such removals must be spaced out and the total basal area removed should not exceed 50% of that contained in the SMZ. Additionally, trees with roots in the SMZ should be preserved to protect stream banks (NC BMP, 2021).

Currently, the Yadkin River is not subject to NC riparian buffer rules. These rules require more stringent water protection measures for river basins experiencing high pollution. High Rock Lake, the terminus of the Yadkin River, experiences algal blooms due to agricultural runoff. Riparian Buffer rules have been proposed for the Yadkin River watershed, but not formally adopted. If these rules are adopted, 50' SMZs will be mandatory (NC DEQ, 2025).

In some ways, the SMZs of this forest act as their own miniature forest stands. They contain much of the beech, ironwood, river birch, and black walnut not found elsewhere on the property. It is recommended to keep them intact, "feather" prescribed fire through them, and embrace the variety they bring to the forest. If money is limiting, the SMZs can be removed from the ephemeral streams, and reduced to 25' on the intermittent streams. This would add nine acres of total merchantable area. Given the steepness of the surrounding terrain, this is not recommended.

## Forest Health

Invasive plants, pests, and disease create forest health concerns for this property. Invasive plants and pests often outcompete native species due to having few predators in the areas they invade. No co-evolved species are present that can keep them in check.

Invasive plants of concern are kudzu, tree-of-heaven, multi-floral rose, Japanese stiltgrass, and privet. See Figure 8 for a map of known locations of invasive species found within the forest. Everything but the privet and Japanese stiltgrass has undergone annual treatments starting in 2021. Privet and Japanese stiltgrass need to be treated with foliar treatments or possibly basal bark treatments, annually. Privet is one of the primary woody shrubs of the understory in Stands 1 and 3. See Appendix B (Figures 12, 16, and 20).

Any future harvests will require invasive plant management beforehand. If invasive plants are not kept in check, they could become more problematic post-harvest when there is less competition.

For invasive pests, hemlock wooly adelgid and emerald ash borer has been active here in the past decade. Due to the small population, the individual hemlocks could be treated (Stands 1 and 5). Emerald ash borer appears to have already left, having killed all the white ash present within this forest. The large white ash in the front yard of the residence is all that remains. It should probably be removed due to poor health and risk to infrastructure. See Figure 8 for known locations of hemlock wooly adelgid.

Nearby invasive pests and disease to watch for include spongy moth, elm zig-zag sawfly, spotted lantern fly, Asian long horned beetle, and beech leaf disease. For pine production, there are no reported incidents of pine tip-moth in this area and fusiform rust is rare. The last major outbreak of southern pine beetle was in the 1990's and there are no recent outbreaks in North Carolina (NCFS-Forest Health, 2025).

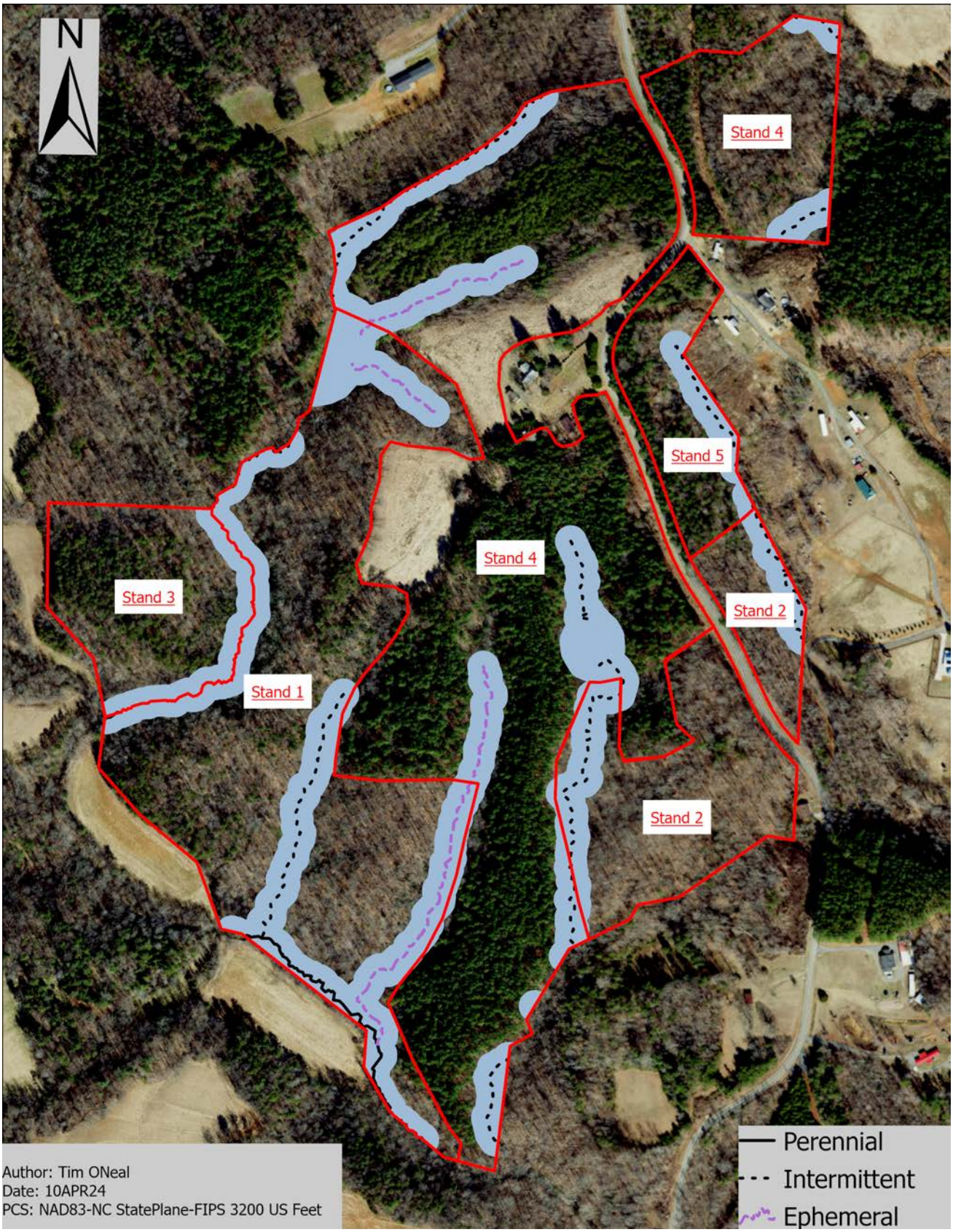


Figure 7. Water Map.

For more detailed information on invasive plants, pests, and diseases, see the NCFS Forest Health Reference. It provides detailed information on all invasive pests in North Carolina. For specific herbicide treatments, see Appendix A-Detailed Schedule and Appendix C-Herbicide.

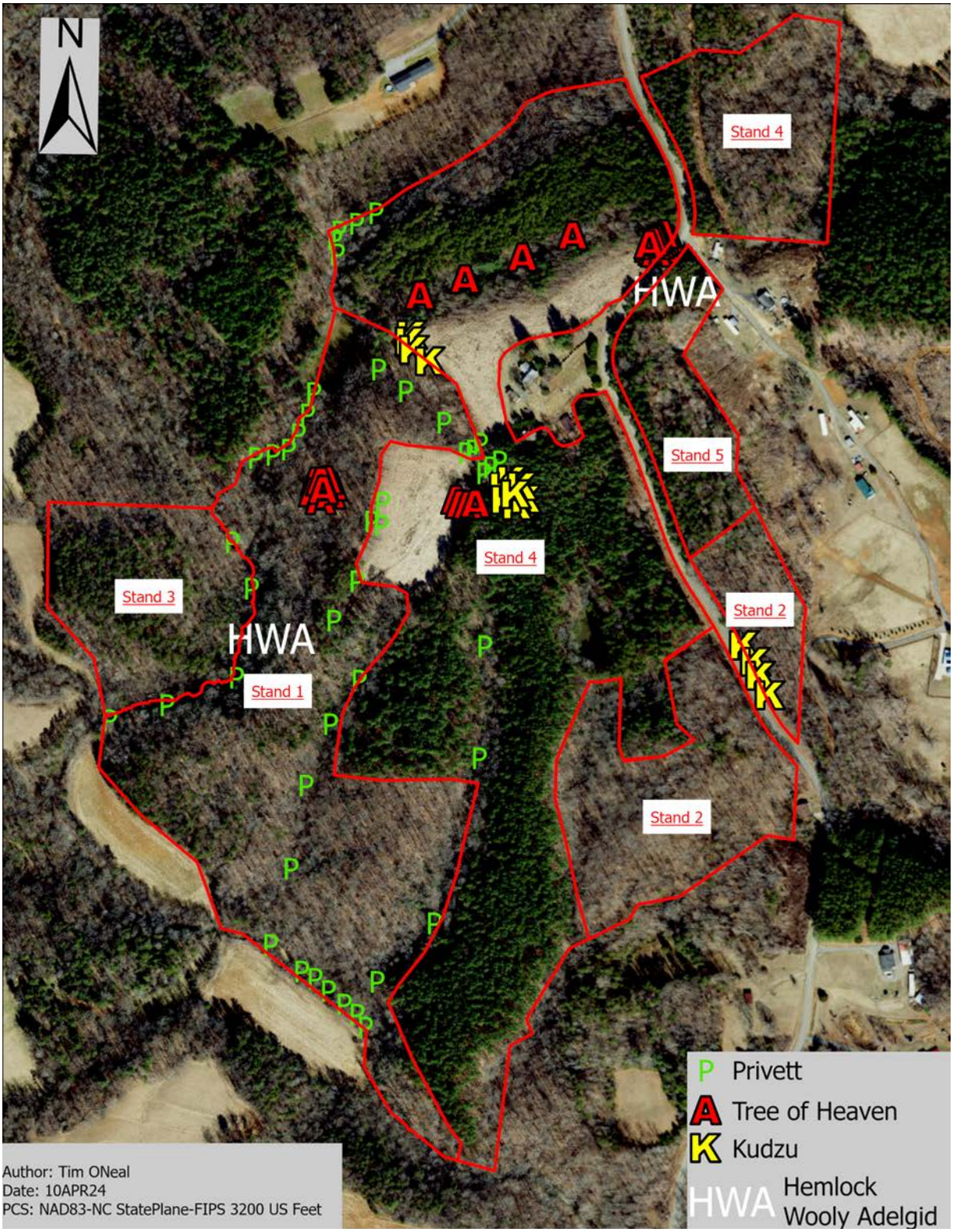


Figure 8. Invasive plants and pests.

## Mesophication

Quercus alba, American white oak, possesses a compound in its medullary rays known as tyloses. Tyloses can be thought of as cellular waste that essentially clogs the pores of the wood, preventing movement of water within the heartwood of the tree. This blocking of water is especially useful for storing liquids and aging alcohol (Conner et al. 2003).

While the bourbon industry may be reliant solely on American white oak, oak species in general are a sought-after economic commodity (Brose, et al, 2014). Ecologically, oak leaves are food staples to numerous butterflies and moths, and many mammals rely on oak mast (Brose, et al., 2014).

In the United States, beginning around 1920, fire suppression became central to forest management policies. It was unforeseen how this could create a closed canopy forest that allows shade tolerant tree species to dominate. Oak species compete best in fire prone environments because they prioritize root development over stem development. If a fire top kills a young forest, oaks are more likely to sprout back because they have such robust root systems (Brose, et al., 2014).

Fire suppression policies have created an "oak bottleneck" where the understory and mid-story of most oak-hickory forests are currently dominated by species such as beech and maple. Shifting forest composition towards mesic, fire intolerant species is known as mesophication (Nowacki and Abrams, 2008). This means the next stage within oak-hickory forests may be that of a mesic-hardwood variant. This hypothesis is supported by the understory and mid-story components for Stands 1 and 2 as documented in Appendix B (Figures 9 – 11 and 13 - 15).

Shelterwood regeneration is the best way to regenerate oak within these stands. It is aptly named because it curates canopy cover to allow diffuse light to the forest floor, sheltering oak seedlings. Oaks compete best with 30-50% full sunlight. However, fire excluded eastern hardwoods often only allow 1-2% sunlight to the forest floor (Ashton and Kelty, 2018).

This is a tedious harvest technique that puts surrounding timber and profits at risk. For this reason, patch selections are the best option for regenerating these hardwood stands. A Shelterwood regeneration has been planned for in case future economic situations allow for lower returns. See Appendix D-Shelterwood contingency.

## Wildlife Habitat Management

There are tradeoffs between timber production and improving wildlife habitat. A forest that maximizes timber output is not the best habitat for big game species in North Carolina. Fully stocked forests prevent sunlight from reaching the forest floor, where softer plants and young trees can compete. These low-lying woody shrubs and herbaceous plants provide cover, concealment, and food for numerous species (Dickinson, 2002). This plan will focus on white tailed deer management, which also benefits other species such as wild turkey, cottontail rabbits, owls, and potentially fox (Working with Wildlife, 2024).

There are several mast-producing species on this property, which is favorable to deer. Implementing patch selection systems in the hardwood stands will keep these mast producing trees and get more sunlight to the forest floor, creating early successional habitat. These habitats foster yound, soft woody browse, and herbaceous plants (Working with Wildlife, 2024).

Permanent early successional habitat can be maintained within this forest by "daylighting" the road networks. This just means cutting more trees along the roadside allowing more light to the roadbeds and ditches. This also helps to keep the road drier and prevent rutting (Working with Wildlife, 2024).

Prescribed fire is a great tool for promoting wildlife habitat. It helps to eliminate mesic mid-canopy trees, getting more sunlight to the forest floor. It also kills low-lying woody plants, allowing new, more succulent shoots to emerge (Dickinson, 2002).

Burning should be performed in the spring when it favors oak, which also ensures good browse availability in the late summer, when other foods may be limiting. Deliberately allowing burns to "feather" into riparian areas will create patchiness due to variations in burn intensity, creating additional cover and browse (Dickinson, 2002).

# Forest Economics

## Economic Modeling Overview

Economic analysis in this plan is based on net present values (NPV) of the timber using 3rd quarter, 2024, regional prices published by Timber Mart South (TMS, 2024). Net Present Value is simply taking future revenue and costs, and reducing the value by a predetermined discount rate, to account for risk and missed opportunity costs (Klemperer, et al, 2022).

For example, 1 million dollars today is not the same as 1 million dollars in the future. Natural disaster or missed investment opportunities elsewhere make future revenue less valuable than present day revenue. This analysis uses a 5% discount rate, which is comparable to current 10-year treasury yields (CNBC, 2025). If a more curated discount rate is desired, consultation with a professional accountant is required.

Internal Rate of Return (IRR) has been calculated and can be thought of as a metric to compare forest returns with more traditional investment returns such as stocks and bonds. If predicted IRR for this forest is less than projected stock market returns, it will generate less long-term income. If income generation is the only objective, IRR is the best metric for choosing between forest investments and more traditional options (Klemperer, et al, 2022).

A sensitivity analysis has been conducted by calculating NPV at various discount rates to see the range of potential returns. Discount rates used for the sensitivity analysis are 3%, 5%, and 7%. Sensitivity analysis with discount rates helps develop intuition about the overall risk potential of an investment (Klemperer, et al, 2022). 3% rates simulate lower risks and cheaper opportunity costs, creating higher NPV at the end of the rotation.

The market for wood products is strong here and this area is less prone to hurricane damage than other parts of the southern wood basket. There are over 20 sawmills throughout Surry, Alleghany, Yadkin, Stokes, Forsyth, and Wilkes Counties. Weyerhaueser has a pine pulp processing facility 15 miles from this tract, which may provide a vital market for mid-rotation thinning (NCFS-Timber Buyers, 2023). For the 2023 pine timber sale, sawmills were willing to pay hauling costs as far as Statesville, NC. It is reasonable to assume there will not be a shortage of buyers for quality timber in this region, potentially justifying a lower discount rate.

This model is using fixed annual costs of 13.80 $ $ac^{-1}$. This factors in present use value taxes, insurance, fuels, and herbicide. All labor is owner supplied. Total annual fixed costs are 1,380 $ $yr^{-1}$.

This economic analysis does not include an annual hunting lease, which can be adjusted as opportunities arise. If patch systems and prescribed fire are used within this forest, the diversity of vertical structure and availability of young stems for browse could greatly improve wildlife habitat and therefore hunting lease rates.

Cost share opportunities with the Natural Resources Conservation Service or North Carolina Forest Service have not been factored into this analysis. See Appendix E-Cost Share. For additional information on North Carolina present use valuation taxes for forestry, see Appendix F-Taxation.

Lastly, all models are wrong, but some are useful. The intent of modeling in forestry is to predict stand growth and yield so that a reasonable plan can be formulated. The idea is to get close with modeling and find the optimal rotation length, but regular site surveys are required to adjust the plan over time.

## Hardwood Economics

All hardwood economic analysis is based on the 2024 timber inventory, as described in Appendix G-Forest Inventory. For the hardwood stands, the highest per acre net present values can be obtained by immediately selling the timber for a clear-cut regeneration harvest. Early gap or patch selections would generate the same NPV per acre but would be worth significantly less towards the end of the cutting cycle (year 70) (Table 3).

Shelterwood regeneration methods are the best potential way to regenerate oak within these stands. However, the economic losses are hard to justify. A shelterwood regeneration is often a 20-year event, excluding the necessary crop tree releases that should be done approximately 20 years after the final harvest (40 years total). This system also requires multiple fire and herbicide applications. See Appendix D-Shelterwood, for a detailed description of this system.

The biggest economic issue with a shelterwood system is the preparatory removal, which is rarely profitable. Preparatory removals target the mid-canopy stems to promote oak seedling development. Hardwood pulpwood is the main product class removed, and its low value often cannot cover fixed operational costs for loggers. This pulpwood value would be realized by the landowner in a typical clearcut system (Schweitzer, et al., 2024).

Ranges of net present values ($ ac $^{-1}$) and internal rates of return for hardwood Stands 1 and 2 by prescription. All values are net present values ($ ac$^{-1}$). Shelterwood NPV's incorporate year 40 crop tree release expenses. Patch selection system values are variable by year of harvest (beginning in 2035). Internal rate of return is not calculated for clearcut options because a year zero harvest is assumed.

For modeling simplicity, these shelterwood and patch systems are assumed to have minimal growth between harvests, but in reality, there will be volume gains between cuts. Modeling via USFS-FVS software has been conducted. Predicted gains range between 3.5-7 tons ac$^{-1}$ decade$^{-1}$ (USFS, 2025). See Appendix H-Quantitative Thinning for the Gingrich Stocking estimates of Stands 1 and 2.

Table 3. Ranges of net present values ($ ac -1) and internal rates of return for hardwood Stands 1 and 2 by prescription. Shelterwood NPV's incorporate year 40 crop tree release expenses. Patch selection system values are variable by year of harvest (beginning in 2035). Internal rate of return is not calculated for clearcut options because a year zero harvest is assumed.

| Stand | Prescription | NPV ($ ac $^{-1}$) | IRR (%) |
|---|---|---|---|
| 1 | Yr 0 CC | 2300 | |
| 1 | 70 Yr Patch | -150 to 1300 | 1.9 to 33.8 |
| 1 | SW w/ CTR | 505 | 8.7 |
| 2 | Yr 0 CC | 2874 | |
| 2 | 70 Yr Patch | -175 to 1653 | 2.3 to 36.8 |
| 2 | SW w/ CTR | 295 | 6 |

## Pine Economics

For the pine stands, all yields are predicted using LOBDSS commercial software, a growth and yield model for loblolly pine (forestproductivitycooperative.org-2024). Predictions with this software account for region (piedmont), site productivity, and mid-rotation management practices such as thinning.

Four different scenarios have been modeled here:

1) 25-year business as usual (BAU)
2) 30-year rotation with two commercial thins
3) 25-year rotation with one commercial thin
4) Wildlife

Business as usual (BAU) is simply planting improved seedlings at 435 trees per acre and harvesting them at year-25. The 30-year rotation with two commercial thins provides the highest NPV and IRR by thinning at years 10 and 17, but they have been adjusted to 10 and 20 to synchronize harvesting with other stands. The overall change in predicted returns is minimal with this alteration and rotation lengths will likely vary by 3-5 years. The wildlife approach entails always keeping the stand basal area below 80ft$^2$ ac$^{-1}$ to promote habitat (Dickinson, 2002).

Stand 3 has only been modeled with a 30-year rotation and two thins. Establishment income from harvesting the pre-existing Virginia pine has been accounted for.

See Table 4 below for breakdowns of NPV and IRR for Stands 3 and 4 under different scenarios.

## Whole Forest Economics

The total Net Present Value of the forest is predicted to be $68,006 over 70 years (Table 5). It is important to remember that this is discounted value (5%), raw dollar amounts accrued will be much higher. For comparison, the old management regime of passively managing Stand 4 would have an NPV of about $15,000 over 75 years. This is a dramatic improvement.

Table 4. Pine Stands 3 and 4 net present values ($ ac -1) and internal rates of return by prescription.
CT = Commercial Thin. BAU = business as usual (25-year rotation without thinning), Wildlife = using multiple thins to keep basal area below 80 $ft^2$ $ac^{-1}$ and employing multiple fires.

| Stand | Prescription | NPV ($ ac $^{-1}$) | IRR (%) |
|---|---|---|---|
| 4 | 25 yr BAU | 227 | 7.23 |
| 4 | 30 Yr, CT-15 | 465 | 9.2 |
| 4 | 30 YR-CT-10,20 | 963 | 11.63 |
| 3 | 30 YR-CT-10,20 | 993.9 | 27.3 |
| 4 | Wildlife | 365 | 7.76 |

By incorporating a linear program into this analysis, simple re-valuations can be easily produced as future economic opportunities arise (rentals of the homesite, blueberry cultivation, hunting leases, agroforestry, NRCS conservation practices, etc). Net present values in this plan should not be used if this property is ever sold. Soil expectation values are better since they account for indefinite investment lengths. This requires using Faustmann's equation, which can easily be built into this analysis (Klemperer, et al, 2022).

Bottom Line: Based on 2024 forest inventory (Appendix G-Forest Inventory) and third quarter, 2024 Timber Mart South region wide stumpage prices (TMS, 2024), this forest is projected to generate a 12.67% internal rate of return over the next 70 years. Results of the sensitivity analysis are in Table 6, which incorporates the same stumpage prices, but at different discount rates, to account for risk variation.

Table 5. NPV ($) predictions for the entire forest after 70 years.

| Period | Year | NPV($) | Activity |
|---|---|---|---|
| 1 | 10 | $634 | Stand 4 Thin, Stand 3 Regenerate, Stand 1/2 Patch |
| 2 | 20 | $24,171 | Stand 4 Thin, Stand 3 Thin, Stand 1/2 Patch |
| 3 | 30 | $30,262 | Stand 4 Final, Stand 3 Thin, Stand 1/2 Patch |
| 4 | 40 | $3,058 | Stand 4 Thin, Stand 3 Final, Stand 1/2 Patch |
| 5 | 50 | $4,428 | Stand 4 Thin, Stand 3 Thin, Stand 1/2 Patch |
| 6 | 60 | $5,857 | Stand 4 Final, Stand 3 Thin, Stand 1/2 Patch |
| 7 | 70 | -$406 | Stand 4 Thin, Stand 3 Final, Stand 1/2 Patch |
| Total | | $68,006 | |

Table 6. Sensitivity analysis of whole forest NPV ($) over 70 years at three discount rates.

| Discount Rate | NPV |
|---|---|
| 3% | $138,802 |
| 5% | $68,006 |
| 7% | $33,910 |

## Carbon Markets

In 2023 the Intergovernmental Panel on Climate Change published a climate summary for policy makers. The IPCC assessed with high confidence that 2019 atmospheric CO2 levels of 410 ppm were higher than at any other time in the previous 2 million years. This has been a contributing factor in the 1.09 deg. Celsius global average temperature rise since the mid-19$^{th}$ century (IPCC, 2023).

There is an emerging voluntary carbon sequestration market in the southeastern United States. Greenhouse gas emitters can pay forest owners to delay their forest harvests, therefore offsetting their emissions. In 2016, voluntary carbon markets traded 63.4 MegaTons of CO2 emissions ($191.3 million).

Unfortunately, the average family woodlot size of 67.2 acres is usually not large enough to profit from carbon incentives (Butler et al. 2016) (Hamrick/Grant, 2018). Scales of 1,500 acres or more are needed (Kerchner and Keeton, 2015). An examination of "break-even" carbon prices for this small forest has been conducted. If carbon prices ever increase, it may be a viable option.

Modeling has been performed for the loblolly pine with a 14.5 $ ac $^{-1}$ yr $^{-1}$ carbon sequestration price on Stands 3 and 4, with a 20-year deferment (Forte, 2024) In order to be compensated for carbon, these tracts of pine cannot be harvested at the 30-year optimal length, harvest would have to be deferred to year 51. With a 14.5 $ ac $^{-1}$ yr$^{--1}$ carbon payment and 20-year harvest delay, the NPV at the end of the rotation (age 51) is 680 $ acre $^{-1}$. This is 230 dollars lower than the optimal harvest NPV of 910 $ acre $^{-1}$.

It is not recommended to take part in a carbon exchange program until rates increase. In order to reduce lost NPV by waiting 20 extra years, annual carbon payments per acre must be 88 $ ac $^{-1}$ yr $^{-1}$ for the 20-year deferment period. This is the break-even carbon price for these stands. It creates a year 51 NPV of 910 $ ac$^{-1}$.

# Stand 1: Oak-Tulip Poplar-Southern Yellow Pine

## Stand 1 Summary

Stand 1 is 29 total acres, 20 of which are merchantable. The nine acres not considered merchantable are SMZ buffers and boundary buffers with adjoining parcels. The primary overstory components of this stand are oak (33.7%), tulip poplar (25%), and southern yellow pine (15.4%). Stand 1 is approximately 85 years old with a site index of 75 (base age 50) (Carmean, et al, 1989) (Table 7). The primary mid-story components are ironwood, red maple, and beech. Tables 8 and 9 provide a detailed breakdown of the stand composition. The primary ground layer components are red maple, oak, and privet.

Table 7. Stand 1 site index and age estimates.

| Stand | Plot | Species | DBH (inches) | Age (years) | Height (feet) | Site Index |
|---|---|---|---|---|---|---|
| 1 | 43 | White Oak | 16 | 85 | 80 | 70 |
| 1 | 42 | White Oak | 20.5 | 85 | 100 | 85 |
| 1 | 37 | White Oak | 18 | 100 | 85 | 70 |
| 1 | 27 | Hickory | 20 | 90 | 85 | 70 |
| 1 | 9 | White Oak | 16.5 | 75 | 85 | 75 |
| 1 | 5 | Tulip Poplar | 24.5 | 90 | 100 | 90 |
| 1 | 5 | Red Oak | 19.5 | 80 | 90 | 75 |
| 1 | 11 | Hickory | 14 | 85 | 85 | 70 |
| Mean | - | - | | 86.25 | - | 75.625 |

## Stand 1 - Owner's Intent

The intent for this stand is to maintain continuous forest cover, generate periodic revenue, and maintain the oak composition. Additionally, less vigorous or dead trees are to be harvested for firewood and lumber, as needed.

## Stand 1 - Location and Terrain

Stand 1 is located southwest of the home site and west of Stand 4 (Figure 1). It is east of Stand 3, separated by East Double Creek. A tractor road is situated along the knoll from Stand 4 down through Stand 3, which creates

Table 8. Stand 1 trees per acre by species group and 4-inch diameter at breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [18,22] | [22,26] | [26+] | Totals |
|---|---|---|---|---|---|---|---|---|
| Hickory | 0 | 0 | 6.76 | 2.12 | 0.41 | 0.28 | 0 | 9.56 |
| Mixed Hardwood | 16.44 | 14.35 | 2.8 | 1.36 | 0.36 | 0.29 | 0.14 | 35.74 |
| Red Maple | 8.15 | 22.93 | 3.26 | 0.57 | 0.41 | 0.26 | 0.14 | 35.73 |
| Red Oak | 4.85 | 1.73 | 2.17 | 1.68 | 1.68 | 0.24 | 0.4 | 12.75 |
| So. Yellow Pine | 0 | 1.59 | 3.82 | 7.88 | 0 | 0 | 0 | 13.29 |
| Tulip Poplar | 0 | 15.7 | 6.27 | 6.06 | 2 | 0.52 | 0.2 | 30.75 |
| White Oak | 0 | 3.6 | 1.81 | 4.41 | 3.33 | 0.55 | 0.33 | 14.01 |
| Totals | 29.44 | 59.91 | 26.88 | 24.07 | 8.19 | 2.14 | 1.20 | 151.83 |

Table 9. Stand 1 stocking-basal area (ft 2 ac-1) by species group and 4-inch diameter at breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [18,22] | [22,26] | [26,+] | Totals | % of Total |
|---|---|---|---|---|---|---|---|---|---|
| Hickory | 0 | 0 | 4.8 | 3.2 | 0.8 | 0.8 | 0 | 9.6 | 8.76 |
| Mixed Hardwood | 3.2 | 4.8 | 2.4 | 1.6 | 0.8 | 0.8 | 0.8 | 14.4 | 13.14 |
| Red Maple | 1.6 | 6.4 | 2.4 | 0.8 | 0.8 | 0.8 | 0.8 | 13.6 | 12.41 |
| Red Oak | 0.8 | 0.8 | 1.6 | 2.4 | 3.2 | 0.8 | 1.6 | 11.2 | 10.22 |
| So. Yellow Pine | 0 | 0.8 | 3.2 | 9.6 | 0 | 0 | 0 | 13.6 | 12.41 |
| Tulip Poplar | 0 | 6.4 | 5.6 | 8.8 | 4 | 1.6 | 0.8 | 27.2 | 24.82 |
| White Oak | 0 | 1.6 | 1.6 | 6.4 | 7.2 | 1.6 | 1.6 | 20 | 18.25 |
| Totals | 5.6 | 20.8 | 21.6 | 32.8 | 16.8 | 6.4 | 5.6 | 109.6 | 100 |

good access to the interior areas. Stand 1 does not have road front access and must be accessed via logging road/skid trail.

Stand 1 contains "choppy" terrain with perennial and intermittent water bodies. Of the 30 total acres in Stand 1, five are located within the streamside management zones of two intermittent streams, East Double Creek, and a pond located in the northwest corner of the stand.

There are 10.9 acres of slopes that are greater than 30% located throughout Stand 1. These are situated adjacent to the water features discussed above. This terrain will make shelterwood regeneration difficult.

There is approximately 0.5 miles of property boundary that is shared with a neighbor in the northwest and southern portions of the stand. See Appendix I-Terrain Analysis, for better visualization of the terrain.

## Stand 1 - Options

1) Patch selections to promote oak and tulip poplar in the upland areas
2) Shelterwood regeneration to promote oak in areas more conducive to logging
3) Single-tree selection in mesic areas to promote American beech

### Patch Selection

Patch openings are canopy openings greater than twice the height of surrounding trees and are designed to mimic small-scale, naturally occurring lethal disturbances such as tornadoes, pest outbreaks, and landslides (Ashton & Kelty, 2018). Complete removal of all stems should be utilized to mimic a lethal disturbance and stump sprouts and seedlings of undesirable species should be treated with herbicide according to Appendix C-Herbicide. Prescribed fire is also an option within the patches. These small-scale harvests should be performed in conjunction with the loblolly pine cutting cycle. The recommended size of the disturbance is 1 acre.

Benefits of this system include improving wildlife habitat and periodic revenue. Tulip poplar is a very valuable tree and it grows well in this area. Currently, it is averaging about $30.00/ton in the southeastern United States (TMS, 2024). Poplar will be more prevalent at the center of the patches, while oak should be more common along the edges where light is more diffuse. If desired, poplar can be left to grow or be treated post-harvest.

Oak can be favored even more by performing a mid-story removal within the patches 2-3 years prior to harvesting. This would help create advanced regeneration oak seedlings, as discussed in Appendix D-Shelterwood.

Shelterwood Regeneration

This stand is a borderline candidate for shelterwood regeneration due to terrain and site quality. The average site index for Stand 1 is 75 (base age 50) based on eight core samples taken from various cruise plots throughout the stand (Table 7). If attempted, this method should be reserved for the gentler topography of the south side of this stand and residual basal area after the establishment cut should be approximately 70 $ft^2$ $ac^{-1}$. This can help mitigate mesic competition due to site quality (Ashton & Kelty, 2018). It will be difficult to find a logger trained and equipped for a system like this. As with the patch cut options, harvests for this system will occur in conjunction with the loblolly pine cutting cycle. See Appendix D-Shelterwood and Appendix H -Quantitative Thinning for more information.

Single Tree Selection

Single-tree selection is a regeneration method focused on removing individual canopy trees in order to secure regeneration in the gap left behind (Ashton & Kelty, 2018). American beech is an understory tolerant tree that is capable of thriving in the lower lying areas of this forest and it can be promoted with this system. Beech is a valuable mast source for wildlife, produces hard lumber, and is aesthetically pleasing in the forest.

There are forest health considerations associated with managing for beech, such as beech leaf disease and beach bark disease. Beach leaf disease is currently located in northern Virginia up though New England and beech bark disease is primarily confined to the higher elevations of the Appalachian Mountains (Perkins, 2024). If beech leaf disease begins affecting this area, this option will need to be revised.

If single tree selection occurs, care must be taken to leave the more vigorous beech canopy components and only remove suppressed or codominant stems from competing species (Ashton & Kelty, 2018). This system should be reserved for lower elevation, mesic areas, possibly within the SMZs. If trees are harvested in the SMZs, removals must be spaced out and total basal area removed should be less than 50% of that contained in the SMZ. Additionally, trees with roots in the SMZ should be left in place to protect stream banks (NC BMP, 2021).

In time, these mesic areas would develop irregular and uneven age class distributions. This means the density of each age class does not adhere to any discernible pattern. This random age and size class distribution would mimic conditions found in more mature old-growth forests (Ashton & Kelty 2018).

## Stand 1 Prescription

Perform 1-acre patch removals every 10 years, beginning in year 2035. This should occur in conjunction with the loblolly pine harvests and Stand 2 patch harvests. Total hardwood removals between Stands 1 and 2 should be 5 acres per cutting cycle. This will eventually create a balanced, all-aged hardwood component that contains 6 distinct age classes (Ashton & Kelty, 2018).

Conduct pre-harvest timber inventories one year before the harvests using a 100% sawtimber tally of each patch. For pulp products, $1/10^{th}$ acre fixed radius sampling is needed. While potentially costly, mid-canopy removal should also be considered in these patches 2-3 years prior to harvest.

After harvests, stump sprouts of undesirable species should be treated with basal bark herbicide application. Alternatively, prescribed fire can be used 3-5 years post-harvest to top kill regeneration, which favors oak production over poplar and maple. See Appendix J-Burn Plan. This stand should receive invasive plant treatments annually. Each patch should receive foliar invasive species treatments 6-12 months prior to harvest, if present. See Appendix A-Detailed Schedule and Appendix C-Herbicide.

Boundary marking of Stand 1 should be performed as described in Appendix K-Posted Laws.

# Stand 2: Oak-Tulip Poplar-Hickory

## Stand 2 Summary

Stand 2 is 12.3 total acres, 10.1 of which are merchantable. The 2.2 acres not considered merchantable are SMZ buffers and boundary buffers with adjoining parcels. The primary overstory components of this stand are oak (40%), tulip poplar (29.1%), and southern yellow pine (12.7%). The primary mid-story components are red maple, sourwood, and beech. The primary herbaceous layer components are red maple, oak, and wild blueberry. The stand and stocking tables below provide a detailed listing of mid-canopy and canopy components (Tables 10, 11 and 12).

Stand 2 is approximately 65 years old with a site index of 90 at base age 50 (Carmean, et al, 1989). Younger trees within this stand are larger than those in Stand 1 due to harvests (thinning) that occurred in conjunction with nearby loblolly pine harvests in 1998, as well as potential storm damage that necessitated those loblolly harvests. Additionally, these areas may have soils originating from mafic parent materials, instead of felsic. These mafic rocks may have imparted more micronutrients into the soil (USDA-NRCS, 2024).

Table 10. Stand 2 site index and age estimates.

| Stand | Plot | Species | DBH (inches) | Age (years) | Height (feet) | Site Index |
|---|---|---|---|---|---|---|
| 2 | 13 | Red Oak | 24 | 50 | 100 | 100 |
| 2 | 23 | Red Oak | 18.5 | 55 | 100 | 95 |
| 2 | 24 | Red Oak | 24 | 70 | 90 | 80 |
| 2 | 7 | Red Oak | 26 | 80 | 100 | 85 |
| Mean | - | - | | 63.75 | - | 90 |

Table 11. Stand 2 trees per acre by species group and 4-inch diameter breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [18,22] | [22,26] | [26,30] | Totals |
|---|---|---|---|---|---|---|---|---|
| Black Walnut | 0 | 4.31 | 0 | 0 | 0 | 0 | 0 | 4.31 |
| Hickory | 0 | 15.43 | 0 | 5.69 | 1.63 | 0.65 | 0 | 23.4 |
| Mixed Hardwood | 20.28 | 24.66 | 6.75 | 1.39 | 0 | 0 | 0 | 53.09 |
| Red Maple | 11.02 | 23.46 | 0 | 4.55 | 0 | 0 | 0 | 39.03 |
| Red Oak | 0 | 0 | 0 | 1.03 | 5.25 | 2.52 | 0.4 | 9.19 |
| Southern Yellow Pine | 0 | 0 | 4.95 | 1.14 | 0 | 0 | 0 | 6.09 |
| Tulip Poplar | 0 | 3.55 | 10.12 | 6.03 | 2.68 | 1.74 | 0 | 24.11 |
| White Oak | 0 | 7.21 | 8.34 | 1.5 | 3.05 | 1.19 | 0 | 21.28 |
| Totals | 31.3 | 78.62 | 30.16 | 21.32 | 12.6 | 6.1 | 0.4 | 180.5 |

## Stand 2 - Owner's Intent

The intent for this stand is to maintain continuous forest cover, produce periodic income, and keep oak on the landscape. Additionally, less vigorous or dead trees can be harvested for firewood and lumber, as required.

## Stand 2 - Location and Terrain

Stand 2 is in the southeast portion of the property, adjacent to Stands 4 and 5. Stand 2 is divided by Romie Snow Road, with approximately 3 acres on the east side of the road and 10 acres on the west side. This creates easy road access to this stand, possibly increasing wintertime logging value. Recommended access points are a central logging deck located by the barn in Stand 4 or the logging deck established for the 2023 harvest. There is approximately 0.5 miles of property boundary that is shared with neighbors on the south and east sides of Stand 2.

Table 12. Stand 2 stocking-basal area (ft 2 ac-1) by species group and 4-inch diameter breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [18,22] | [22,26] | [26,30] | Totals | % of Total |
|---|---|---|---|---|---|---|---|---|---|
| Black Walnut | 0 | 1.82 | 0 | 0 | 0 | 0 | 0 | 1.82 | 1.39 |
| Hickory | 0 | 5.45 | 0 | 7.27 | 3.64 | 1.82 | 0 | 18.18 | 13.89 |
| Mixed Hardwood | 3.64 | 7.27 | 5.45 | 1.82 | 0 | 0 | 0 | 18.18 | 13.89 |
| Red Maple | 1.82 | 7.27 | 0 | 5.45 | 0 | 0 | 0 | 14.55 | 11.11 |
| Red Oak | 0 | 0 | 0 | 1.82 | 10.91 | 7.27 | 1.82 | 21.82 | 16.67 |
| So. Yellow Pine | 0 | 0 | 3.64 | 1.82 | 0 | 0 | 0 | 5.45 | 4.16 |
| Tulip Poplar | 0 | 1.82 | 9.09 | 9.09 | 5.45 | 5.45 | 0 | 30.91 | 23.61 |
| White Oak | 0 | 1.82 | 5.45 | 1.82 | 7.27 | 3.64 | 0 | 20 | 15.28 |
| Totals | 5.45 | 25.45 | 23.64 | 29.09 | 27.27 | 18.18 | 1.82 | 130.91 | 100 |

Stand 2 contains "choppy" terrain with intermittent water features. Approximately 1.3 acres of timber is in the streamside management zones of these water features. There are approximately 2.7 acres of slopes greater than 30%. There is evidence of an old road through the western portion of Stand 2, which can facilitate harvest operations. The eastern side of Stand 2 will be difficult to harvest due to limited locations for logging decks. See Appendix I-Terrain Analysis for depictions of the topography.

### Stand 2 - Options

1) Patch Selections to promote oak and tulip poplar in the upland areas
2) Shelterwood regeneration to promote oak in areas with suitable topography
3) Single-tree selection in mesic areas to promote American beech

### Stand 2 - Prescription

Perform 1-acre patch removals every 10 years, beginning in year 2035. This should occur in conjunction with the loblolly pine harvests and Stand 1 patch harvests. Total hardwood removals between Stands 1 and 2 should be 5 acres per cutting cycle. This will create a balanced, all-aged hardwood component that contains seven distinct age classes (Ashton & Kelty, 2018).

Timber inventory of acres to be harvested should be performed one year before the harvests using a 100% sawtimber tally of each patch and $1/10^{th}$ acre fixed radius plots for pulp products. After harvests, stump sprouts of undesirable species should be treated with basal bark herbicide application. Alternatively, prescribed fire can be used 2-3 years post-harvest to top kill regeneration, which favors oak production over poplar and maple. See Appendix J-Burn Plan, for tentative burn units.

This stand should receive invasive plant treatments annually. Each patch should receive foliar invasive species treatments 6-12 months prior to harvest, if present. See Appendix A-Detailed Schedule and Appendix C-Herbicide.

## Stand 3: Virginia Pine-Tulip Poplar-Red Maple (Convert to Loblolly Pine-2035)

### Stand 3 Summary

Stand 3 is 7.6 total acres, 6.4 of which are merchantable. The 1.2 acres not considered merchantable are SMZ buffers and boundary buffers with adjoining parcels. The primary overstory components of this stand are Virginia pine (37.5%), tulip poplar (31.25%), and red maple (12.50%). The primary mid-story data is skewed by the presence of the riparian area. The riparian areas have a mesic mid-story, while the upland Virginia pine area has a sparser understory component.

Stand 3 is approximately 45 years old with a site index of 60 (Virginia pine-Base age 50) (Carmean, et al, 1989). This site is presumably former pastureland that was abandoned in the early 1990's. There are numerous "wolf" trees throughout this stand, that can be left for aesthetics and habitat. Wolf trees are simply field grown trees with large crown structures (Ashton & Kelty, 2010). The primary product type in this stand is pine pulp wood and pine chip-n-saw. See Tables 13 and 14 below for a detailed breakdown of the forest composition by stem density and basal area. See Appendix B for graphical depictions of tree composition (Figures 17, 18, and 19).

Table 13. Stand 3 trees per acre by species group and 4-inch diameter breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [22,26] | Totals |
|---|---|---|---|---|---|---|
| Hickory | 0 | 0 | 0 | 2.07 | 0 | 2.07 |
| Mixed Hardwood | 20.2 | 48.1 | 4.62 | 0 | 0 | 72.92 |
| Red Maple | 0 | 0 | 9 | 0 | 0 | 9 |
| Southern Yellow Pine | 0 | 71.28 | 19.38 | 4.03 | 0 | 94.7 |
| Tulip Poplar | 16.98 | 22.37 | 20.25 | 0 | 0 | 59.6 |
| White Oak | 0 | 0 | 0 | 0 | 1.25 | 1.25 |
| Totals | 37.18 | 141.75 | 53.25 | 6.1 | 1.25 | 239.53 |

Table 14. Stand 3 stocking-basal area by species group and 4-inch diameter breast height classes.

| Species Group | [2,6] | [6,10] | [10,14] | [14,18] | [22,26] | Totals | % of Total |
|---|---|---|---|---|---|---|---|
| Hickory | 0 | 0 | 0 | 3.33 | 0 | 3.33 | 3.03 |
| Mixed Hardwood | 3.33 | 13.33 | 3.33 | 0 | 0 | 20 | 18.18 |
| Red Maple | 0 | 0 | 6.67 | 0 | 0 | 6.67 | 6.06 |
| Southern Yellow Pine | 0 | 26.67 | 13.33 | 6.67 | 0 | 46.67 | 42.43 |
| Tulip Poplar | 3.33 | 10 | 16.67 | 0 | 0 | 30 | 27.27 |
| White Oak | 0 | 0 | 0 | 0 | 3.33 | 3.33 | 3.03 |
| Totals | 6.67 | 50 | 40 | 10 | 3.33 | 110 | 100 |

## Stand 3 - Owner's Intent

The intent for this stand is to maximize economic return, with the potential to prioritize wildlife habitat over timber production beginning around year 20. This will require an economic decision by the landowner around year 19.

## Stand 3 - Location and Terrain

Stand 3 is located on the southwest side of the forest and is isolated from other stands by Double Creek, a 20' wide perennial stream. This isolation has prevented active management. Stand 3 shares approximately 0.25 miles of boundary with neighboring properties. See Figure 1-Stand Map.

Stand 3 slopes are conducive to all logging operations. The 50' buffer for East Double Creek must be respected, it accounts for approximately 1.2 acres of streamside management zone. The tractor road running through Stand 1 also provides access to Stand 3. As this road approaches East Double Creek and Stand 3, it is approximately 30% slope. There must be adequate protection of the steeper portions of this trail. See Appendix I-Terrain Analysis for depictions of the topography.

## Stand 3 - Options

1) Regenerative clearcut and loblolly plantation establishment in 2035.

### Stand 3 Prescription

This stand should be regenerated in 2035 in conjunction with harvests on Stands 1, 2, and 4. After the regenerative clearcut, chemical site preparation may be required, followed by planting of 2nd cycle or better loblolly pine seedlings at a density of 435 trees per acre. Commercial thinning cuts should be performed when the stand is 10 and 20 years old with a target residual basal area of 60 $ft^2$ $ac^{-1}$. Final harvest should occur at age 30. If required, invasive species should be treated annually with herbicide.

While not critical for timber production, prescribed fire can be used in this stand after each commercial thinning. This can help clean up the stand and release the pines from hardwood competition. If allowed to "feather" down into the gullies, fire can create stand variability, improving wildlife habitat.

All thinning schedules are performed based on relative density analysis. At a relative density of 55%, loblolly pine begins self-thinning due to competition between the trees. The idea is to thin before this and sell the trees that would otherwise die in the woods (Westoby, 1984). Thins one and two are projected to occur at a relative density of 45-50% (basal area-120$ft^2$ $ac^{-1}$). See Appendix H-Quantitative Thinning for a visual depiction.

## Stand 4: Loblolly Pine Plantation

### Stand 4 Summary

Stand 4 is 53 total acres, 45.4 of which are merchantable. The eight acres not considered merchantable are SMZ buffers and boundary buffers with adjoining parcels. Stand 4 has a site index of 70 (base age 25) (Carmean, et al, 1989) and has shown adequate levels of nutrition based on foliar analysis.

This stand was clearcut harvested in 2023, with a chemical site prep in 2024, and was re-planted in March 2025 with bareroot loblolly pine seedlings at a density of 435 trees per acre. Therefore, it is currently in "year 0" of the prescription schedule. The riparian areas contain pine and mixed hardwoods that were not harvested in 2023. A majority of these remaining stems are small diameter tulip poplar and do not appear to be flowering or spreading competing seed.

The northeast section of Stand 4 is a former mixed hardwood-Virginia pine stand that will require chemical treatment of hardwood regeneration 2-5 years after stand establishment. Stand 4 also consists of approximately eight acres of converted agricultural fields. These fields contain degraded soils with minimal topsoil, but they may contain residual nitrogen from past corn and soybean rotations. The best method to restore topsoil within these fields is to plant trees on them.

### Stand 4 - Owner's Intent

The intent for this stand is to maximize economic return and restore organic matter to heavily used agricultural land. There is potential to prioritize wildlife habitat over timber production beginning around year 20. This will require an economic decision by the landowner around year 19.

### Stand 4 - Location and Terrain

Stand 4 is spread throughout the northern and more central portions of the property. In the northern area, it is split by Romie Snow Road, with approximately 5 acres on the east side of Romie Snow Road, north of Hattie Lane. There is approximately 0.5 miles of road frontage. The portions west of Romie Snow Road extend south to the southern property border and contain converted pastures and agricultural fields. There is evidence of an old logging deck by the barn in the central portion of this stand, which can be used for future harvests of all stands.

Stand 4 consists primarily of knolls that are former agricultural lands. There are numerous drainages and gullies, which create approximately 3.2 acres of streamside management zones. These gullies introduce a significant mixed hardwood component into the stand, and they were not harvested in 2023. There are approximately 13.3 acres of slopes greater than 30%, primarily located adjacent to the streamside management zones. There is approximately 0.55 miles of property boundary shared with neighbors. See Appendix I-Terrain Analysis for depictions of the topography.

## Stand 4 Prescription

Stand 4 underwent foliar analysis and regenerative clearcut in 2023, chemical site preparation in 2024, and was planted with bareroot loblolly pine at a density of 435 trees per acre in March of 2025. At ages 10 and 20, this stand should be commercially thinned to a basal area of 60-70 $ft^2$ $ac^{-1}$, with a final harvest at age 30. All cutting should be synchronized with other management throughout the forest.

If required, invasive species should be treated annually as described in Appendix C-Herbicide. While not critical for timber production, prescribed fire can be used in this stand after commercial thinning. This can help clean up the stand and release the pines from hardwood competition. If allowed to "feather" down into the drains, this fire will help promote wildlife habitat. See Appendix J-Burn Plan for tentative burn units.

All thinning schedules should be performed based on relative density analysis. At a relative density of 55%, loblolly pine begins self-thinning due to competition between the trees. The idea is to thin before this and sell the trees that would otherwise die in the woods (Westoby, 1984). Thins one and two are projected to be at a relative density of 45-50% (basal area-120$ft^2$ $ac^{-1}$). See Appendix H-Quantitative Thinning for the density management diagram.

All management activities for this stand assume thinning harvests are economically feasible for loggers. If this assumption proves false, the timelines will be delayed until the trees are large enough to make a commercial thin viable.

# Stand 5: Southern Yellow Pine-Oak-Hickory

## Stand 5 - Owner's Intent

The intent for this stand is to conduct single tree removals of co-dominant and suppressed trees, which will promote beech and potentially poplar canopy recruitment. Additionally, this stand is to be used as a source of firewood for home heating.

## Stand 5-Summary

Stand 5 is 5 total acres with an average age of 85 years and a basal area of approximately 110 $ft^2$ $ac^{-1}$. The primary cover type for this stand is pine-oak-hickory and it contains an eastern hemlock understory component along the shoulder of the hill, adjacent to Romie Snow Road.

A full timber inventory is not necessary for this stand due to the owner's intent; therefore, this section contains no stand and stock tables. Basal area and site index measurements were taken to establish baseline stocking and develop a general idea of composition. Composition and structure resemble that of Stand 2.

## Stand 5 - Location and Terrain

Stand 5 is on the east side of Romie Snow Road, just south of Hattie Lane (Figure 1). The northeast boundary has road frontage along Hattie Lane and the entire western boundary sits along Romie Snow Road.

Stand 5 consists primarily of an eastern aspect hillside with approximately 1.8 acres of slope greater than 30%. There is an intermittent stream at the base of this hill, near the property boundary, which creates approximately 0.5 acres of streamside management zone. There are no roads internal to the stand. There is approximately 0.2 acres of powerline right-of-way, and 0.2 miles of boundary shared with neighbors.

See Appendix I-Terrain Analysis for depictions of the topography.

## Stand 5 - Prescription

1) Single-tree selection system for lumber and firewood production. Removals should aim to recruit desirable understory components into the mid and upper canopy.

# Appendix A-Detailed Schedule

| Calendar Year | Management Year | Stands | Activity | Status | Coordinating Instructions: |
|---|---|---|---|---|---|
| | Annual | a/r | Invasive Plant Treatment | Annual RX | 50% Triclopyr or glyphosate (amine) Cut-Stump (Late growing season) |
| | Annual | a/r | | Annual RX | 2:1 Triclopyr: Glyphosate foliar (amine w/ aquatic label) (Late growing season) (3% glyphosate, 1.5% triclopyr ). |
| | Annual | a/r | | Annual RX | Basal Bark-20% triclopyr ester in bark oil carrier-Year-round application window. |
| | Annual | a/r | Mid-story Control | Annual RX | 50% Triclopyr or glyphosate (amine) Hack/Squirt (Late growing season) |
| | Annual | a/r | Single-Tree Selection | Annual Removal | Co-dominant/suppressed trees of poor form. Consult forester for best mill locations. |
| | | | | | Treat undesirable stumps. |
| | | | | | Goal is to promote mid-canopy beech recruitment into the overstory. |
| 2025 | 0 | All | Inventory | Complete | |
| 2025 | 0 | All | Boundary Marking | IP | Posted signs on main roadways. Purple paint on forested boundaries. See Appendix K-Posted Laws.. |
| 2025 | 0 | All | NRCS-EQIP to CSP | Pending | POC: Matt Ware-Surry NRCS. |
| 2025 | 0 | 5 | HWA Treatment | Pending | Imadicloprid soil tablets (approx. 8 years coverage). |
| 2025 | 0 | 4 | Planting | IP | 2nd/3rd Cycle Piedmont Loblolly pine-(435 TPA) |
| 2026 | 1 | 4 | Survival Check | | 1/10th Ac Fixed Radius Plots (5% Inventory) |
| 2026 | 1 | 4 NE | Hardwood Control | | Hardwood competition control (3 % triclopyr-foliar-amine after pine bud hardening) |
| 2034 | 9 | 1,2,3,4 | Inventory-Pre-Harvest | | Inventory/re-inventory stands for potential 2035 harvests. Overstory and understory. |
| 2034 | 9 | 1,2,3,4 | Logger Coordination | | Assess feasibility of thinning Stand 4 and conducting patch/shelterwood cuts on Stands 1/2. |
| 2034 | 9 | 1,2,3,4, | Invasive Check | | Check/Treat invasives in harvest areas, as required |
| 2035 | 10 | 1,2,3,4 | Harvest | | Stand 1/2-Patch cut or shelterwood prep cut |
| | | | | | Stand 3-Clearcut |

| Calendar Year | Management Year | Stands | Activity | Status | Coordinating Instructions: |
|---|---|---|---|---|---|
| | | | | | Stand 4-1st Commercial Thin |
| 2036 | 11 | 1,2,4 | Re-Inventory | | Post Harvest / Understory inventory. |
| 2036 | 11 | 1,2,3 | Chemical Site Prep | | Chemical Site Prep (mid-growing season) to prepare for winter planting of loblolly pine. |
| 2036 | 11 | 1,2 | Chemical Site Prep | | Stands 1/2. Basal bark of maple (1:5 triclopyr (ester):bark-oil). Leave tulip poplar unless shelterwood option is taken. |
| 2036 | 11 | 3,4 | Release/Prep Burn | | Consider site prep burn for Stand 3. Consider Release burn for Stand 4. |
| 2037 | 12 | 3 | Planting | | Loblolly Pine-Improved-435 TPA |
| 2038 | 13 | 4 | Survival Check | | 1/10th Ac Fixed Radius Plots (5% Inventory) |
| 2040 | 15 | 1, 2 | Potential Burn | | Potential burn in patch or shelterwood areas could promote oak regeneration. |
| 2040 | 15 | 4 | Potential Burn | | Consider cleaning burn-Stand 4. Allowing it to "feather" into gullies will create "patchiness" |
| 2044 | 19 | 1,2,3,4 | Inventory-Pre-Harvest | | Inventory/re-inventory stands for potential 2045 harvests. Overstory and understory. |
| 2044 | 19 | 1,2,3,4 | Logger Coordination | | |
| 2044 | 19 | 1,2,3,4, | Invasive Check | | Check/Treat invasives in harvest areas, as required |
| 2044 | 19 | 3,4 | Foliar Analysis | | Winter-time foliar analysis/LAI analysis to determine if nutritional requirements are met |
| 2045 | 20 | 1,2 | Harvest | | Patch/group selections (shelterwood a/r). |
| | | | | | Stand 3-1st Commercial Thin |
| | | | | | Stand 4-2nd Commercial Thin |
| 2045 | 20 | 4 | Decision Point | | Shift management for wildlife/woodland or thin for final harvest preparation |
| 2046 | 21 | 1,2,3,4 | Inventory-Post Harvest | | Overstory Basal area and understory |
| 2046 | 21 | 1,2 | Chemical Site Prep | | Stands 1/2. Basal bark of maple (1:5 triclopyr (ester): bark-oil). Leave tulip poplar unless shelterwood option is taken. |
| 2050 | 25 | 1,2,3,4 | Burn | | Potential Release Burn for hardwood. Pine burn a/r. |
| 2054 | 19 | 1,2,3,4 | Inventory-Pre-Harvest | | Inventory/re-inventory stands for potential 2055 harvests. Overstory and understory. |

| Calendar Year | Management Year | Stands | Activity | Status | Coordinating Instructions: |
|---|---|---|---|---|---|
| 2054 | 19 | 1,2,3,4 | Logger Coordination | | |
| 2054 | 19 | 1,2,3,4, | Invasive Check | | Check/Treat invasives in harvest areas, as required |
| 2055 | 30 | 1,2 | Harvest | | Patch cut (shelterwood as required). |
| 2055 | 30 | 3 | Harvest | | Stand 3-2nd Commercial Thin |
| 2055 | 30 | 4 | Harvest | | Final |
| 2056 | 31 | 1,2,3,4 | Inventory-Post Harvest | | Overstory Basal area and understory |
| 2056 | 31 | 1,2 | Chemical Site Prep | | Stands 1/2. Basal bark of maple (1:5 triclopyr (ester): bark-oil). Leave tulip poplar unless shelterwood option is taken. |
| 2064 | 19 | 1,2,3,4 | Inventory-Pre-Harvest | | Inventory/re-inventory stands for potential 2065 harvests. Overstory and understory. |
| 2064 | 19 | 1,2,3,4 | Logger Coordination | | |
| 2064 | 19 | 1,2,3,4, | Invasive Check | | Check/Treat invasives in harvest areas, as required |
| 2065 | 40 | 3 | Harvest | | Final |
| 2065 | 40 | 4 | Harvest | | Commercial Thin |
| 2065 | 40 | 1,2 | Harvest | | Continue Patch Harvest |
| 2066 | 31 | 1,2,3,4 | Inventory-Post Harvest | | Overstory Basal area and understory |
| 2066 | 31 | 1,2 | Chemical Site Prep | | Stands 1/2. Basal bark of maple (1:5 triclopyr (ester):bark-oil). Leave tulip poplar unless shelterwood option is taken. |
| 2066 | 41 | 3 | Chemical Site prep | | Chemical Site Prep (mid-growing season) to prepare for winter planting of loblolly pine. |
| 2067 | 42 | 3 | Planting | | Loblolly Pine-435 TPA |
| 2070 | 45 | 4 | Burn | | |
| 2075-2095 | | | | | BAU-10 year cutting with Annual check-ins/treatments. |

## Appendix B-Stand Graphs

Stand 1 Graphs

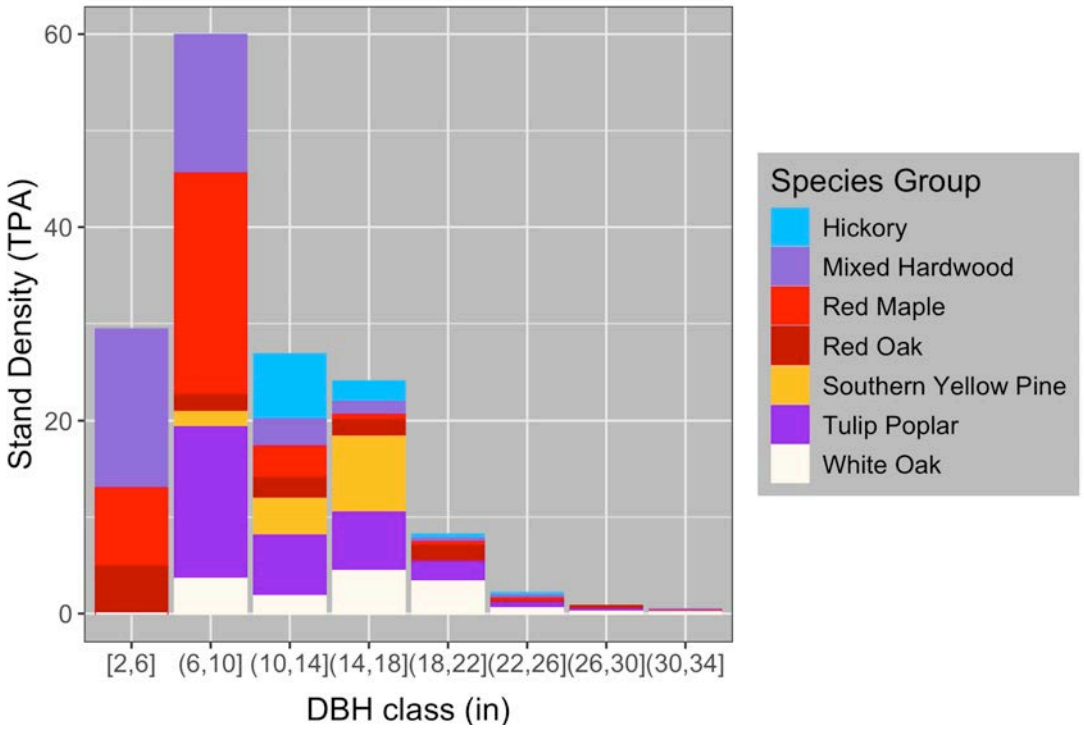


Figure 9. Number of trees per acre by species group and 4-inch DBH classes in Stand 1.

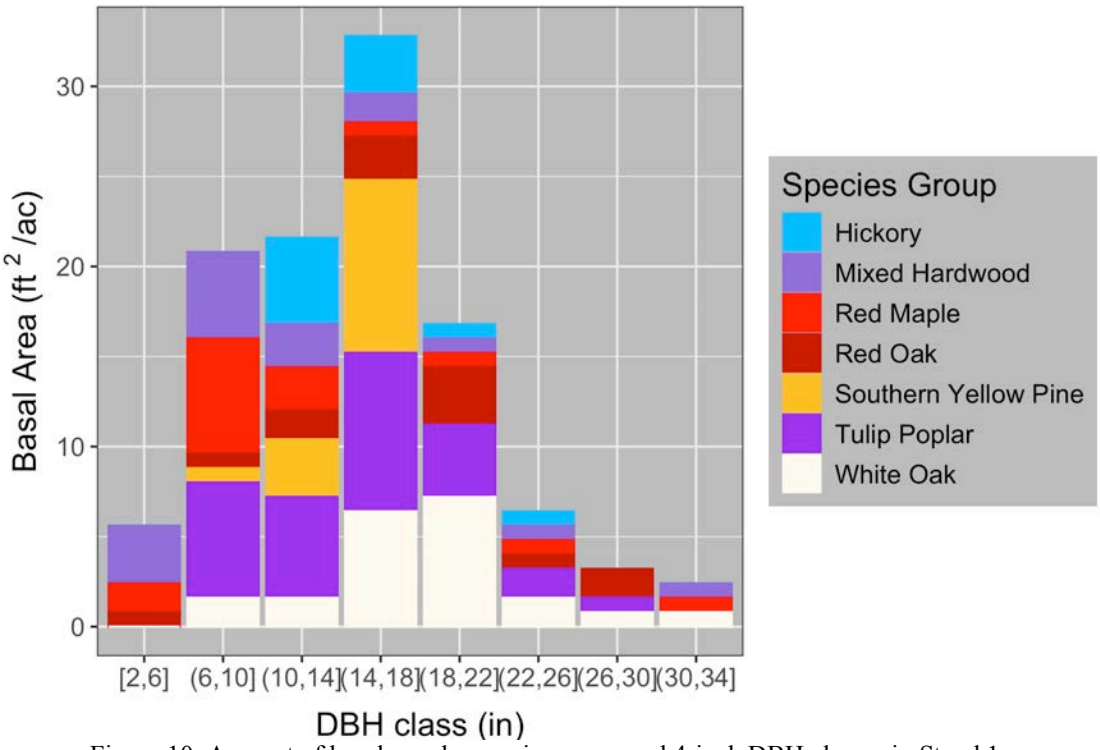


Figure 10. Amount of basal area by species group and 4-inch DBH classes in Stand 1.

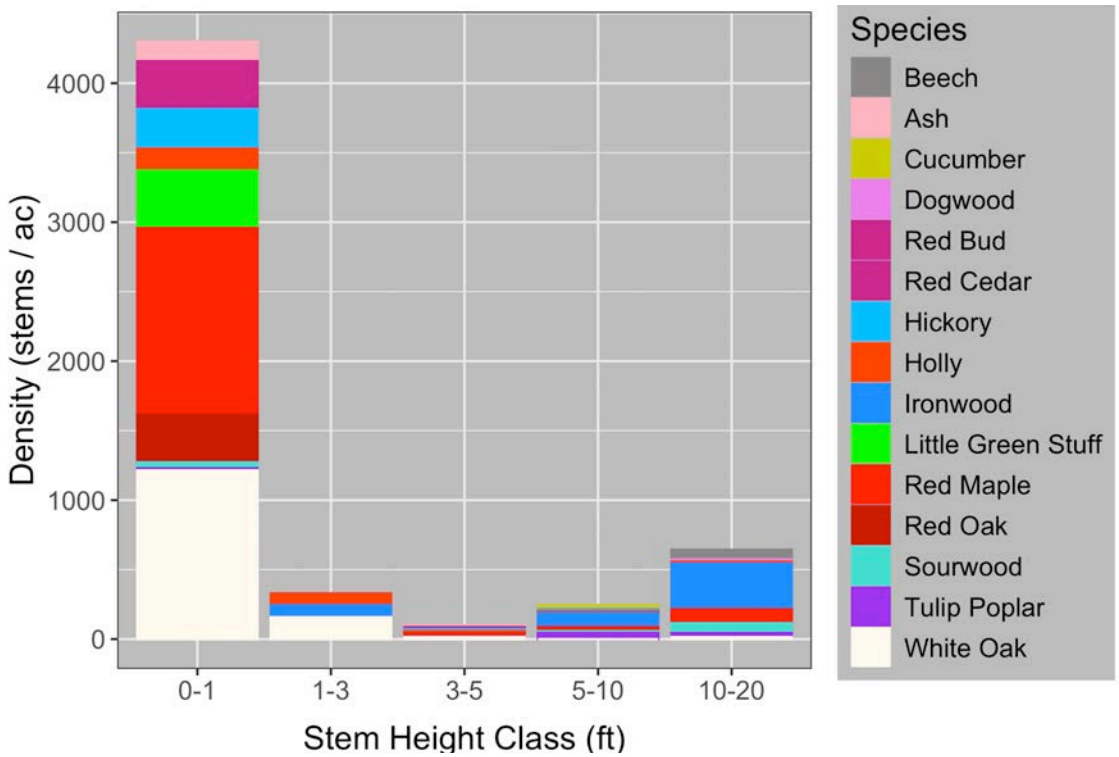


Figure 11. Number of understory trees per acre by stem height class in Stand 1. Red maple and ironwood are significant components. 2023 was a heavy masting year for oak.

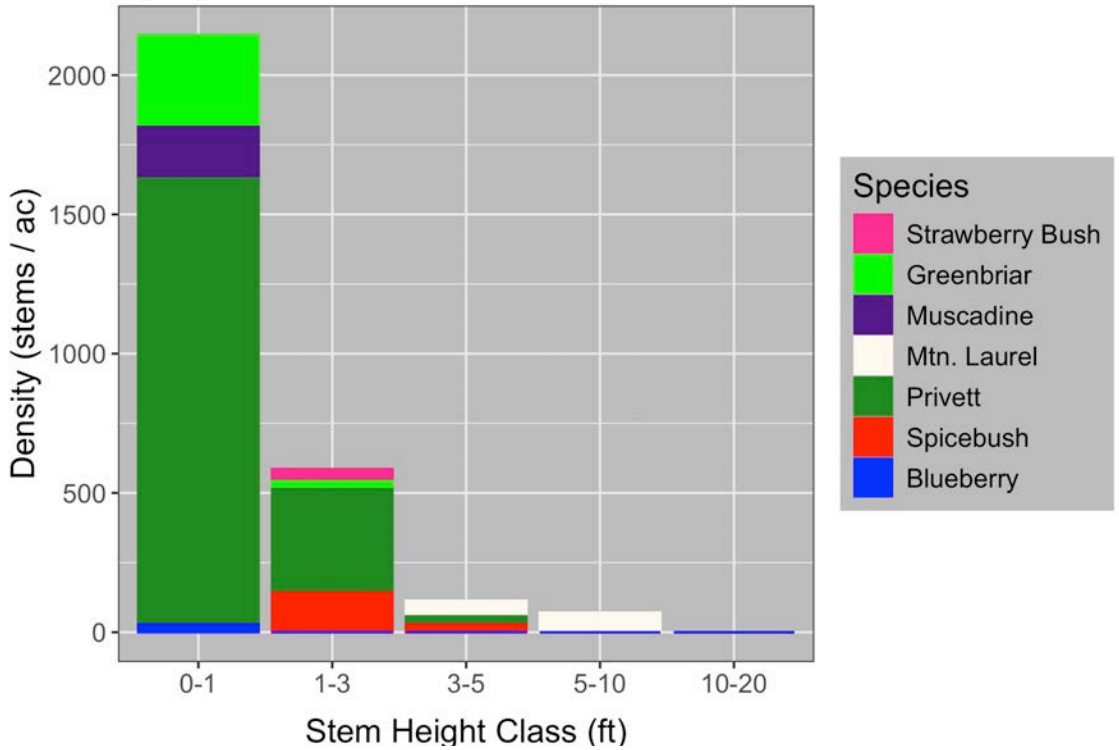


Figure 12. Number of understory shrubs and vines per acre by stem height class in Stand 1. Privet is the primary component and should be addressed annually.

Stand 2 Graphs

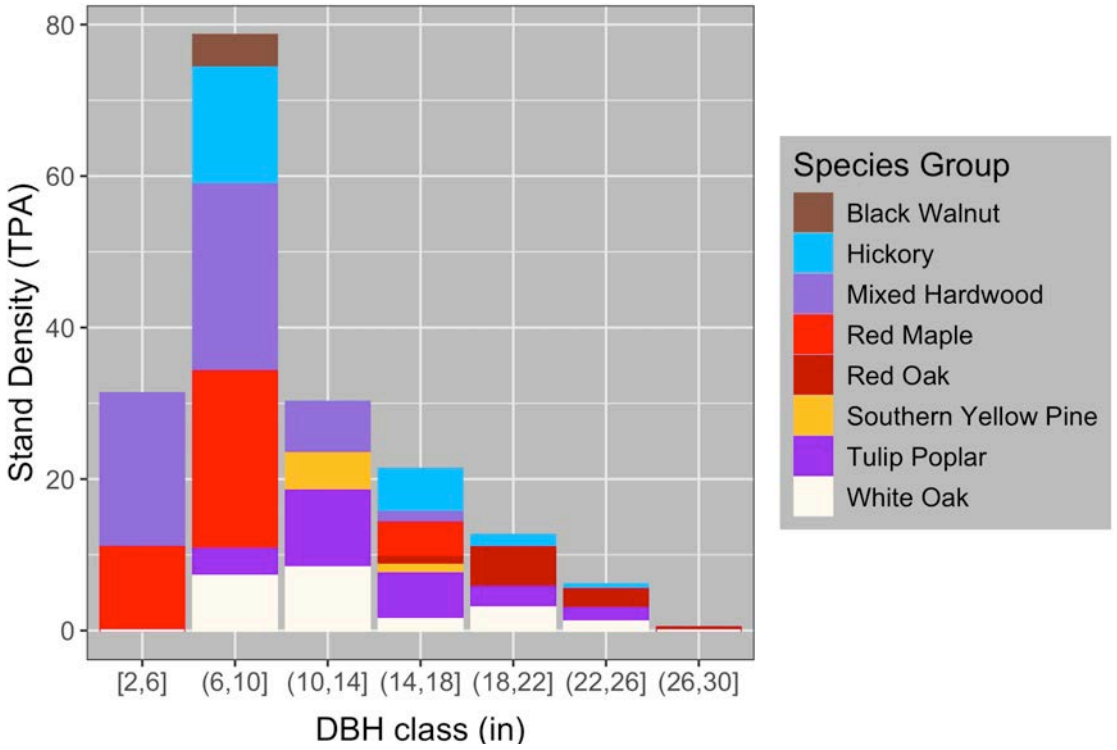


Figure 13. Number of trees per acre by species group and 4-inch DBH classes in Stand 2.

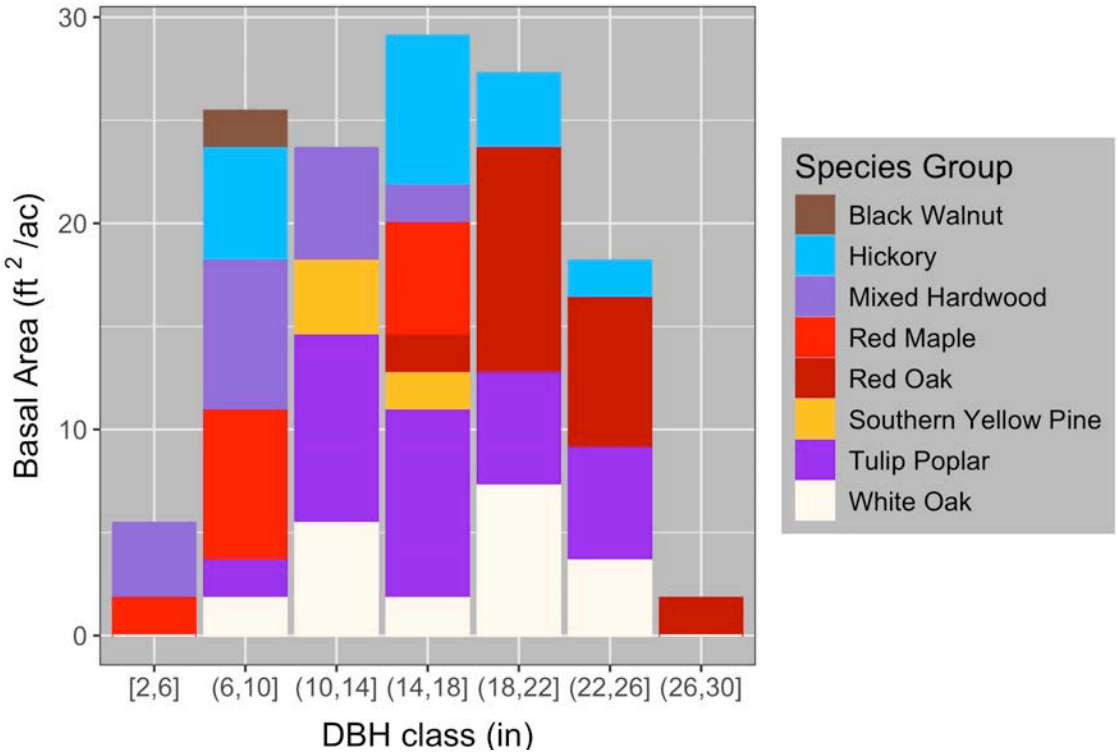


Figure 14. Amount of basal area by species group and 4-inch DBH classes in Stand 2.

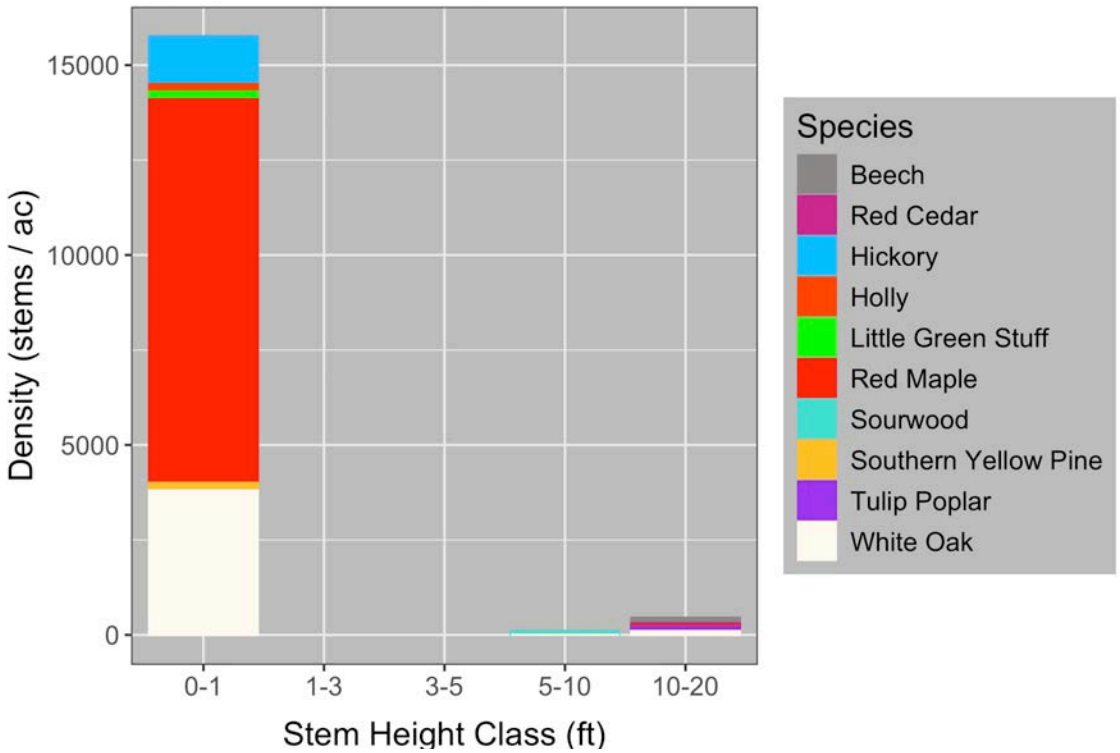


Figure 15. Number of understory trees per acre by stem height class in Stand 2. Red maple and ironwood are significant components. 2023 was a heavy masting year for oak. The red maple is significantly higher here than for Stand 1.

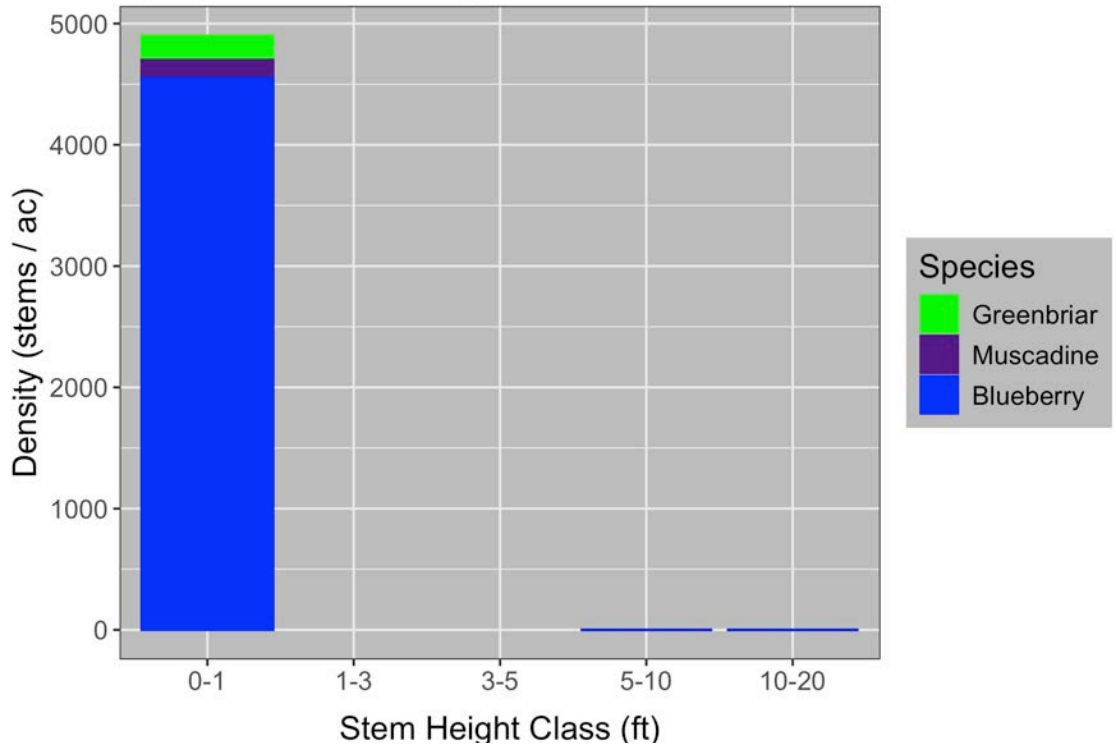


Figure 16. Number of understory shrubs and vines per acre by stem height class in Stand 2.

Stand 3 Graphs

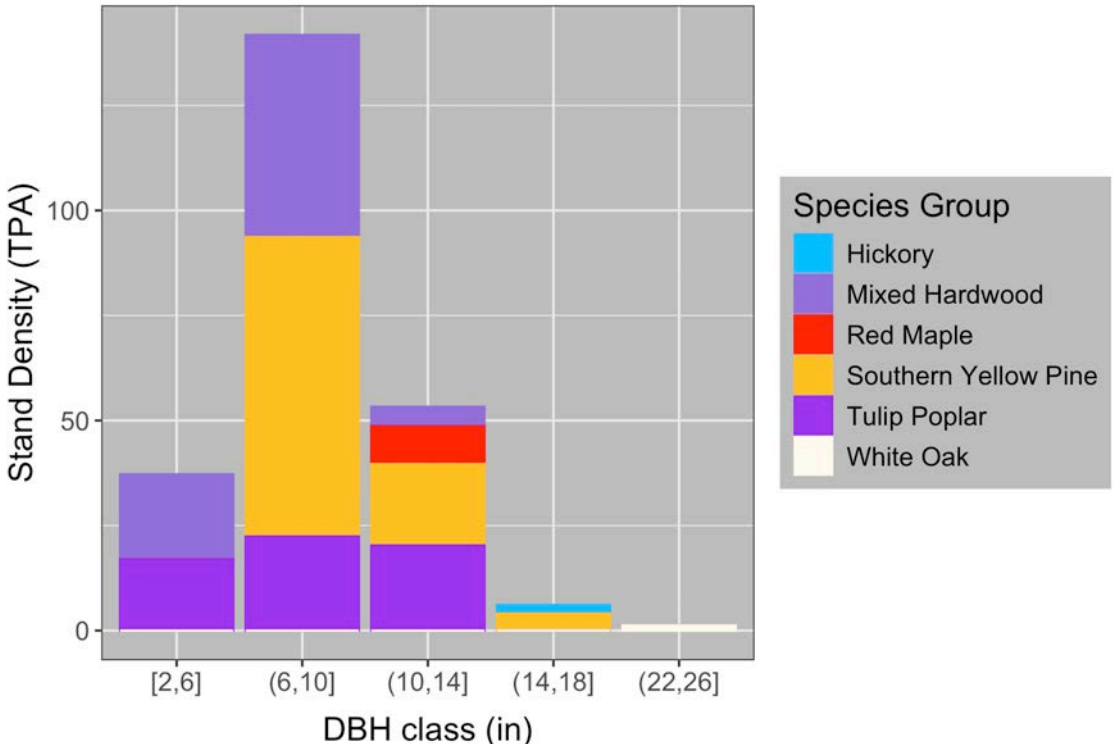


Figure 17. Number of trees per acre by species group and 4-inch DBH classes in Stand 3.

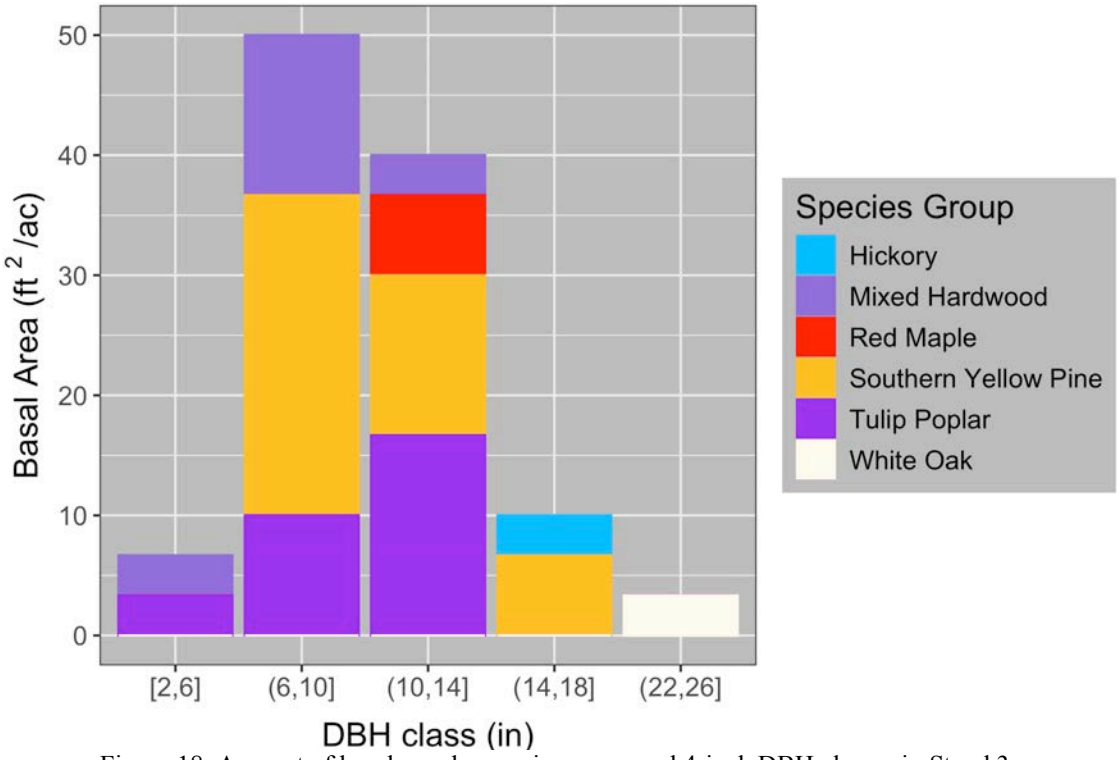


Figure 18. Amount of basal area by species group and 4-inch DBH classes in Stand 3.

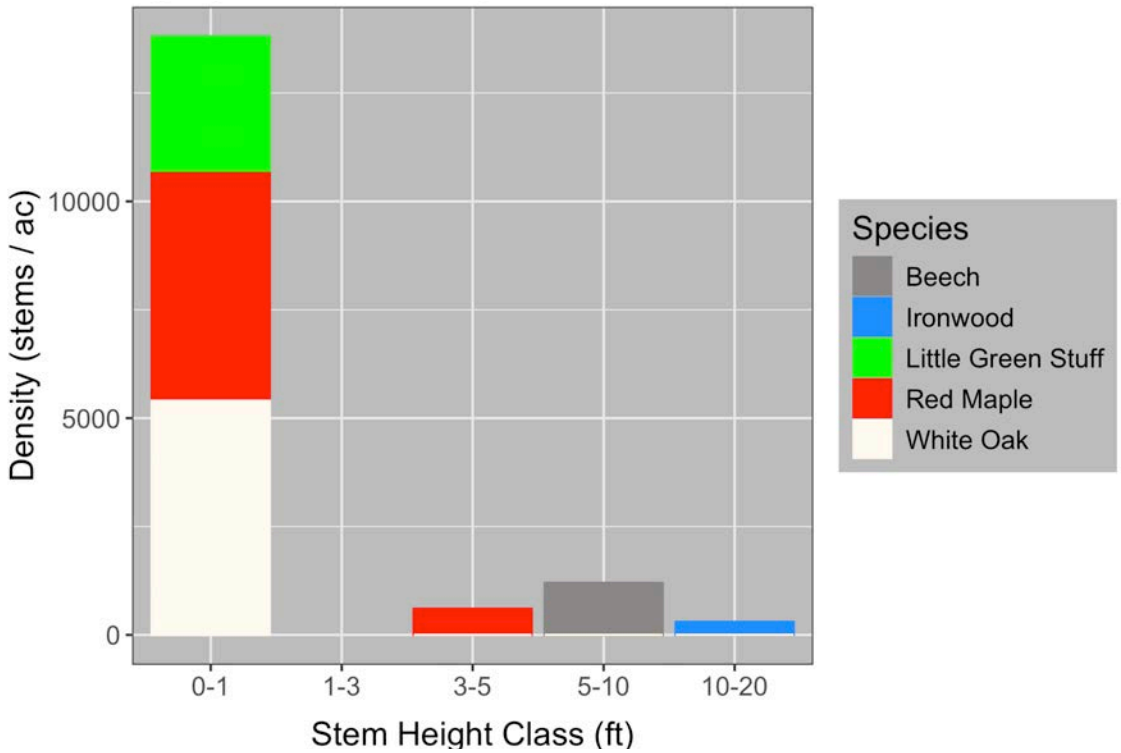

Figure 19. Number of understory tree regeneration stems per acre by stem height class and species in Stand 3.

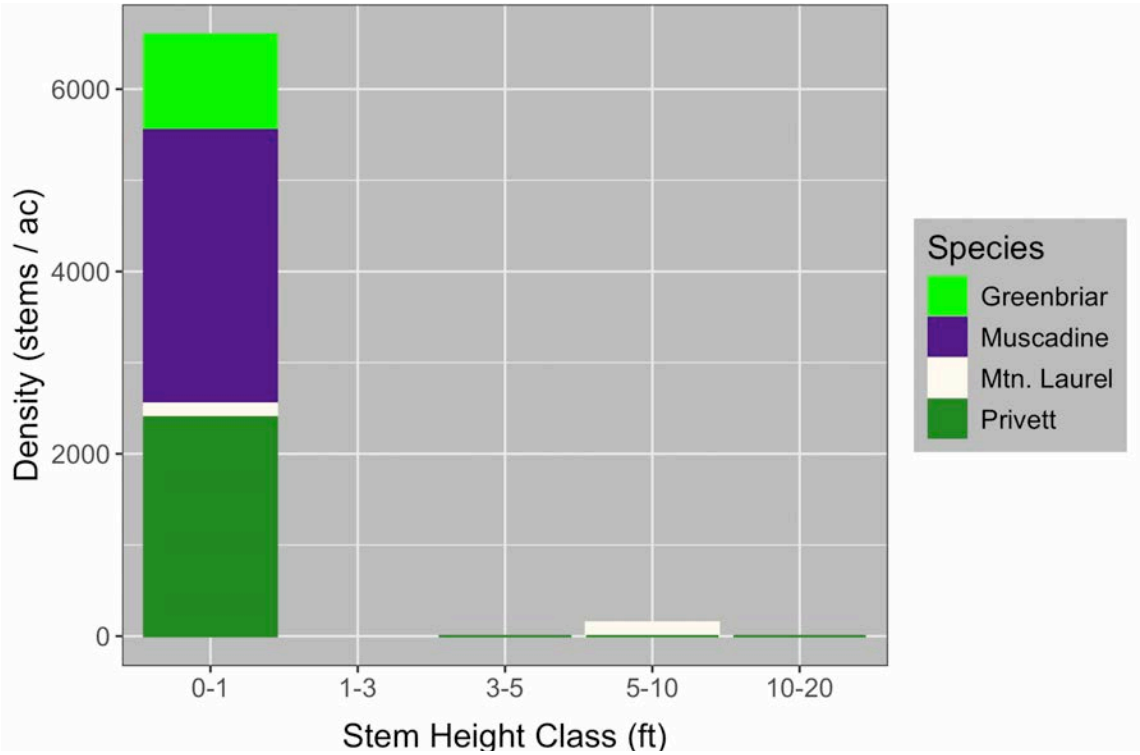

Figure 20. Number of understory shrubs and vines per acre by stem height class in Stand 3.

# Appendix C-Herbicide

This plan refers extensively to herbicide use, which is often a mystery due to confusing language and tedious product labels. This is meant to be a "cook-book" for all prescriptions mentioned within this plan. It is not meant as a substitute for reading product labels, which are legally binding. Alligare products are generic and usually cheaper, with the same formulations. All prescription options detailed here can be purchased off the shelf without an herbicide applicator's license.

Amines are salt based formulations and are best for foliar absorption or vascular injections. Esters are fat based formulations and best for basal bark applications. Surfactants are surface acting agents that make water less likely to form heavy beads. This is done by lowering the surface tension, causing it to form a thin film across the leaves instead of letting the heavy drops fall to the ground (Buhler, 2019).

General foliar treatments of all invasive plants:

Use an amine-based glyphosate product that is approximately 50% glyphosate formulation by volume. Use an amine based triclopyr product that is approximately 45% triclopyr formulation by volume.

Use 4 oz glyphosate and 2 oz triclopyr per gallon. Use non-ionic surfactant and ensure all products are labeled for aquatic usage. Recommended products are Alligare triclopyr 3, Alligare glyphosate 5.4, and Alligare 90 surfactant. Avoid spraying in water features as much as possible despite these products having aquatic-use labels.

Kudzu foliar treatment

0.75-1.0 oz clopralyid per gallon (Alligare-sonora). This is assuming a 15 gallon per acre backpack spray application rate. Just get a few drops on the leaves, it is not necessary to coat the leaves entirely. Use Alligare 90 surfactant. Clopralyid/Sonora is not a water safe product. If any water feature is present, switch to the general foliar mixture above.

Hack and squirt treatments

50% glyphosate or triclopyr in water (amine). For example, mix16 oz of chemical with 16 oz of water. Make circumferential hatchet marks around the tree. Opinions vary on whether to completely girdle the tree or leave cambial tissue intact. Fill each "hack" up with the chemical mixture.

Cut-Stump treatments

Use the same chemical mixture as hack and squirt. Immediately cover the outer 2-3" of the stump with chemical. Cutting a tree will introduce an air embolism into the vasculature, which prevents water from pumping to the roots. Immediately applying the herbicide helps ensure chemical uptake before emoboli form. There is no need to treat the interior of large stumps, it is dead non-vascular tissue.

# Appendix D-Shelterwood Prescription Contingency

A shelterwood regeneration has been planned for each of the hardwood stands here, strictly for contingency purposes. If monetary objectives change and losses can be absorbed, this is a viable oak regeneration option. Prescribed fire should be used between each cutting cycle and the process can take anywhere from 15-20 years, depending on how the regeneration responds. Both plans here call for leaving reserve trees after the final harvest to create uneven aged stands that more closely mimic old growth characteristics.

Selection of removal and reserve trees is planned by size class, which creates a heavier reserve component for Stand 2. If more precision is desired, these size classes can be broken down to 2" classes instead of 4". Obviously, these are planning numbers. Applying them in a three-dimensional space will create deviations from the prescription tables below. Even spacing throughout the forest is paramount when marking timber for removal. See tables 15, 16, 17, and 18 for further details on the removal and reserve targets.

The best plan is to perform a three-cut shelterwood system. This system should begin in years when the loblolly pine stands undergo final harvest, which will make it more attractive to loggers. Otherwise, an isolated preparatory cut might not cover logging expenses. In a clearcut or patch cut system, this lower value wood is realized by the landowner. The higher yield from the loblolly plantation could entice a logger to stay on site for the preparatory cut.

This plan calls for leaving reserves on the landscape, commonly known as an "irregular shelterwood". Reserves are simply trees that are left untouched. They promote vertical structure and diversity within the forest, provide nest, den, and perch sites for wildlife, and maintain an appealing aesthetic.

Preparatory cuts are the first cuts in this system and can be thought of as "removing the umbrella" of the mid-canopy component such as maple, sourwood, and dogwood allowing more light to reach the ground. The additional light helps generate the oak seedlings necessary to begin stand regeneration. These seedlings that are present underneath an intact canopy are known as "advanced regeneration" (Ashton & Kelty, 2018). Additionally, preparatory cuts allow the remaining trees to become more wind firm, prior to exposure by later cuts.

The establishment cut occurs once adequate advanced regeneration is present. The amount of regeneration required varies based on site quality, but 500 seedlings per acre is a reasonable target (Schweitzer/Stringer, 2024). Establishment cuts should strive to leave higher basal area than usual, as site quality is high in Stands 1 and 2. Ideally, 65-70% of the original basal area will remain (Ashton and Kelty, 2018).

Final removal of the shelterwood should occur as seedlings are moving into the sapling stages and beginning to compete for resources. Ideally, the removal would occur before they are too large and potentially brittle, making them less resilient to logging damage. This can range anywhere from 5-10 years post-establishment cut (Ashton & Kelty, 2018).

This system is fire dependent. As discussed in the Forest Ecology-Mesophication section, oak competes best in fire prone environments due to its root partitioning strategies. Fire should be employed between all cuttings, once root collar diameters of oak regeneration are 0.5-0.75". This will top kill everything, but the oak will re-sprout sooner with more vigor. Lastly, a crop tree release should be performed approximately 20 years after the final removal, when saplings are around 30-40 years old. The target should be 30-40 crop trees per acre (Stringer, 2024).

Table 15. Stand 1 shelterwood removal prescription.

| Cut | Timeline (years) | Removal Targets (4" DBH Class) | Starting BA ($ft^2$ $ac^{-1}$) | Ending BA ($ft^2$ $ac^{-1}$) | Est Removals (tons $ac^{-1}$) | Est Value ($/ac) |
|---|---|---|---|---|---|---|
| Preparatory | 0 | 5-9 | 110 | 83.2 | 13.5 | 111 |
| Establishment | Prep + 10 | 10-14, 30-34 | 83.2 | 59.2 | 15.3 | 525 |
| Final | Est. + 10 | 14-18, 22-30 | 59.2 | 16.8 | 36.6 | 1367 |
| Totals | - | - | - | - | 65.4 | 2003 |

Table 16. Stand 1 shelterwood final reserves.

| Size Class (DBH) | BA ($ft^2$ $ac^{-1}$) | TPA (stem $ac^{-1}$) | Volume (tons $ac^{-1}$) |
|---|---|---|---|
| 18-22 | 16.8 | 8.19 | 15.5 |

Table 17. Stand 2 shelterwood removal prescription.

| Cut | Timeline (Years) | Removal Targets (4" DBH Class) | Starting BA ($ft^2$ $ac^{-1}$) | Ending BA ($ft^2$ $ac^{-1}$) | Est Removals (tons $ac^{-1}$) | Est Value ($/ac) |
|---|---|---|---|---|---|---|
| Preparatory | 0 | 2-6, 6-10 | 130 | 100 | 15.5 | 110 |
| Establishment | Prep + 10 | 10-14 | 100 | 76.4 | 12.6 | 416 |
| Final | Est. + 10 | 14-18, 22-30 | 76.4 | 27.3 | 42.2 | 1673 |
| Totals | - | - | - | - | 70.3 | 2199 |

Table 18. Stand 2 Shelterwood final reserves.

| Size Class (DBH) | BA ($ft^2$ $ac^{-1}$) | TPA (stem $ac^{-1}$) | Volume (tons $ac^{-1}$) |
|---|---|---|---|
| 18-22 | 27.3 | 12.6 | 26.6 |

# Appendix E-Cost Share

This property was enrolled in the Natural Resource Conservation Service's (NRCS) environmental quality incentives program (EQIP) and the Surry County voluntary agriculture program in 2024. These programs are designed to help farmers and foresters practice good land stewardship while still meeting the production requirements of society. The EQIP program, as a part of the 2018 Inflation Reduction Act, allocated nearly 40 billion dollars to conservation practices in the United States (EQIP-NC, 2024).

Fiscal year 2023-2024 funds were briefly frozen at the start of 2025, but were ultimately thawed as producers had already committed to costly conservation practices (Farm Policy News, 2025). This property received cost share for chemical site preparation as well as tree planting, greatly reducing establishment costs and freeing up funds for other stewardship practices such as posting boundaries and treating invasive plants. See Appendix K-Posted Laws for boundary marking guidance.

This property should be enrolled in the conservation stewardship program (CSP), under the NRCS. CSP is meant to enhance existing conservation practices, not incentivize new ones (NRCS, 2023). Coordination for this transition has already taken place and will be finalized once reforestation is complete on Stand 4.

The North Carolina Forest Service has a similar conservation focused cost share program. The Forest Development Program is similar to EQIP/CSP (NCFS Cost Share, 2025). No cost share is guaranteed. Applying to both programs is recommended.

# Appendix F-Taxation & Capital Accounting

Under NC G.S. 105-275.15, standing timber, pulpwood, seedlings, and other forest growth are classified and taxed based on present-use valuation. This means that lands actively growing trees are taxed at a lesser rate than lands open for development or commercial usage (NCAGR, 2025).

The spirit of present use taxation is to encourage the development of forest resources within the state, which are critical for infrastructure and economic growth. This property currently meets the requirements for present use tax valuation because one of the primary ownership objectives is the cultivation of timber. This plan continues these cultivation objectives and projects them out 70 years into the future. This forest management plan serves as proof of sound management for the county tax office (NCAGR, 2025).

Improvements and investments in forest lands are considered capital investments. Best practice is to keep accurate records of all forestry expenses, whether they be for land acquisition, reforestation, conservation practices, or silvicultural improvements. These capital expenses can be carried to the time of timber or land sale, and potentially be recouped as a deduction from taxable income (Megalos et al., 2016).

Timber basis has already been established with a back-cruise used for determining capital gains in the 2023 timber sale. This basis will be useful when future timber sales occur. Capital gains (or losses) are simply any value changes of the property or forests between time of acquisition and time of sale. Timber is assessed separately from bare land for capital accounting (Megalos et al., 2016).

Lastly, cost share awards are taxable income, even if the cost share does not fully cover the practices implemented. A 1099 should be issued from the agency sharing the costs, this form needs to be submitted as apart of annual tax filings. Consult tax professionals for reporting procedures (NRCS, 2025).

Bottom line- anytime forest improvements are made, as outlined in the prescription schedule, expense records should be sent to a professional accountant to ensure proper reporting and alleviation of tax burdens, as statute allows. Cost share recipients must file a 1099 issued from the entity awarding the cost-share.

# Appendix G-Forest Inventory

An inventory of all overstory, mid-story, and understory components of Stands 1, 2 and 3 was conducted in August 2024. Stand 4 was not inventoried because it was undergoing stand establishment after the 2023 harvest. Stand 5 was inventoried for basal area and site index only, a full timber inventory was not conducted there due to owner's intent. See Figure 21 below for the sample locations.

The intent of this forest inventory is to get an accurate measure of merchantable timber for Stands 1, 2, and 3 and also assess the composition of lower strata within these stands. A careful analysis of understory and mid-canopy components can help guide management decisions. For example, as shown in the individual stand graphs of Appendix B, there is a significant amount of privet within this forest. If not treated prior to any harvest activities, it could hinder future cohorts of trees. Additionally, 2023 was a heavy mast year for oaks in this area, which shows in the graphs. Cruise results for Stands 1, 2, and 3 are attached as tables to their respective stands within this document.

For merchantable overstory trees, a variable radius (20 BAF) systematic cruise was conducted. Each sample was taken at uniform spacing throughout the stand, with the intent being one sample taken per acre of merchantable timber. Samples were taken even if they fell within streamside management zones. For the economic analysis, these SMZ areas and samples were omitted, but the data is readily available should any management activities need to occur here.

For the mid-canopy components, any tree greater than 5.5" was considered pulpwood size and therefore inventoried. These trees are either perpetually in the mid-canopy until a release event occurs, or they are suppressed canopy level trees that will eventually die.

Understory inventories were conducted using 1/300$^{th}$ acre fixed area plots. Stems were identified to the species level when possible. They were categorized by height class (0-1 ft, 1-3 ft, 3-5 ft, 5-10 ft, 10-20 ft) (Wisconsin DNR, 2024). 27 samples total were taken at various plot locations throughout Stands 1, 2, and 3.

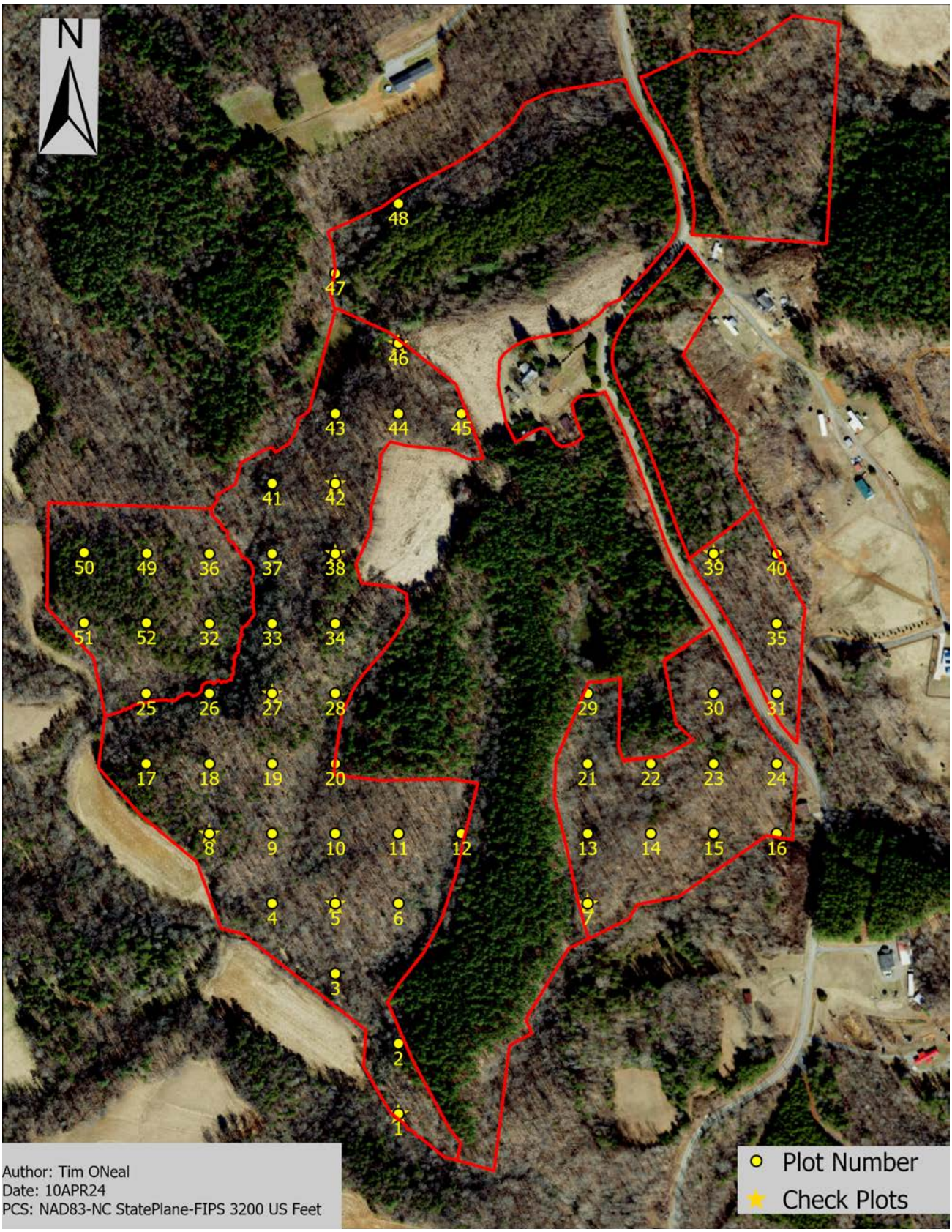


Figure 21. Forest inventory map.

# Appendix H-Quantitative Thinning

Quantitative thinning is based on well researched, universally accepted plant thinning laws. As stand density increases, trees begin to compete with one another and mortality results. The line that depicts average tree diameter as a factor of density has a -3/2 slope (Westoby, 1984). Stand density index (SDI) diagrams use this fundamental ecological concept to create thinning schedules for monoculture forests. The term stand density index refers to the logarithmic, straight-line relationship for quadratic mean diameter and stand density (trees per acre). The index value is always for a quadratic mean diameter of 10" (Reineke, 1933).

For loblolly pine, the maximum SDI is 450, and mortality begins to occur at 250, which is the 55% relative density point (Ashton & Kelty, 2018). Based on the yield predictions from LOBDSS, the quantitative thinning plan for Stands 3 and 4 is depicted below (Figure 22). The management zone runs from 135-200 SDI (35-45% relative density). The idea is to capture mortality and sell it to sawmills before that wood rots in the woods.

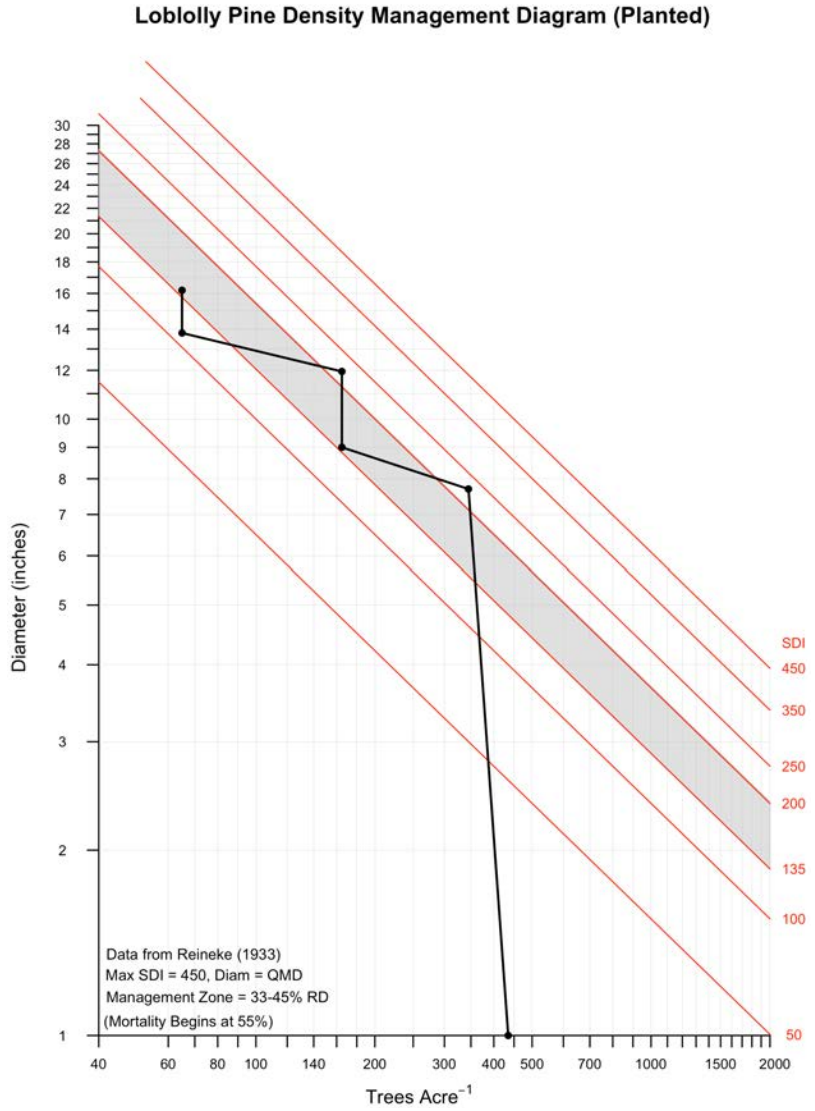


Figure 22. Stands 3 and 4 loblolly pine quantitative thinning plan.

Mixed hardwood forests rely on a slightly different concept than monoculture density management diagrams. For mixed hardwoods, Gingrich stocking charts are used. Gingrich charts rely on crown competition factors, which are derived from the crown size of open grown, competition free trees. Regression techniques are

used to determine the relationship between stem diameter and crown competition factors. By knowing the space that open grown canopies occupy and at what stem size, predictions of how many stems can occupy a site are formulated. This is collectively known as "stocking" (Ashton & Kelty, 2018). Figures 23 and 24 indicates the current stocking and predicted stocking after preparatory, establishment, and final cuts.

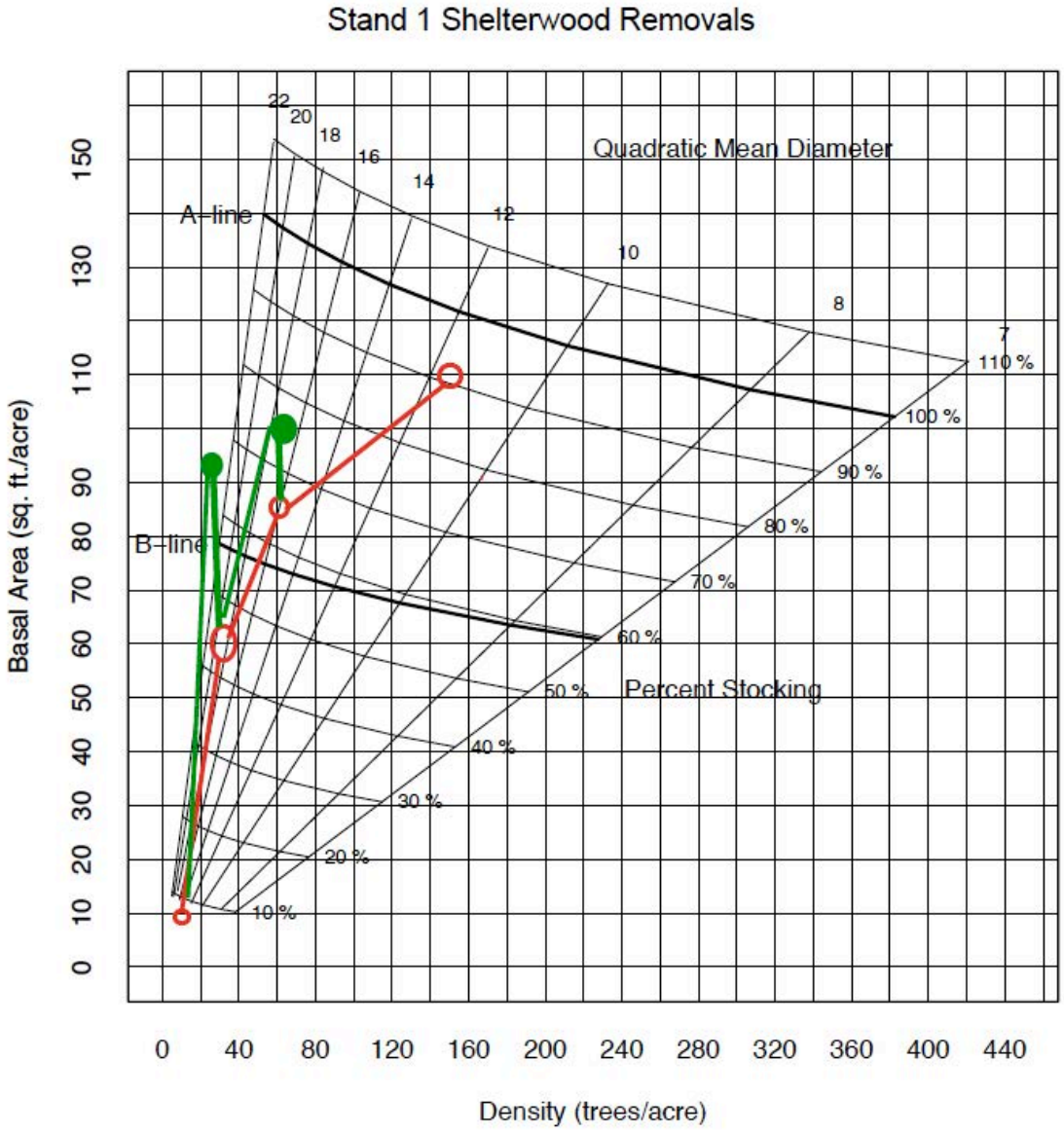


Figure 23. Stand 1 stocking and predicted shelterwood removals. Red is the current stocking and predicted stocking after preparatory, establishment, and final cuts. Green is the predicted growth trends between cuts. This chart does not reflect the stocking impacts of the regeneration.

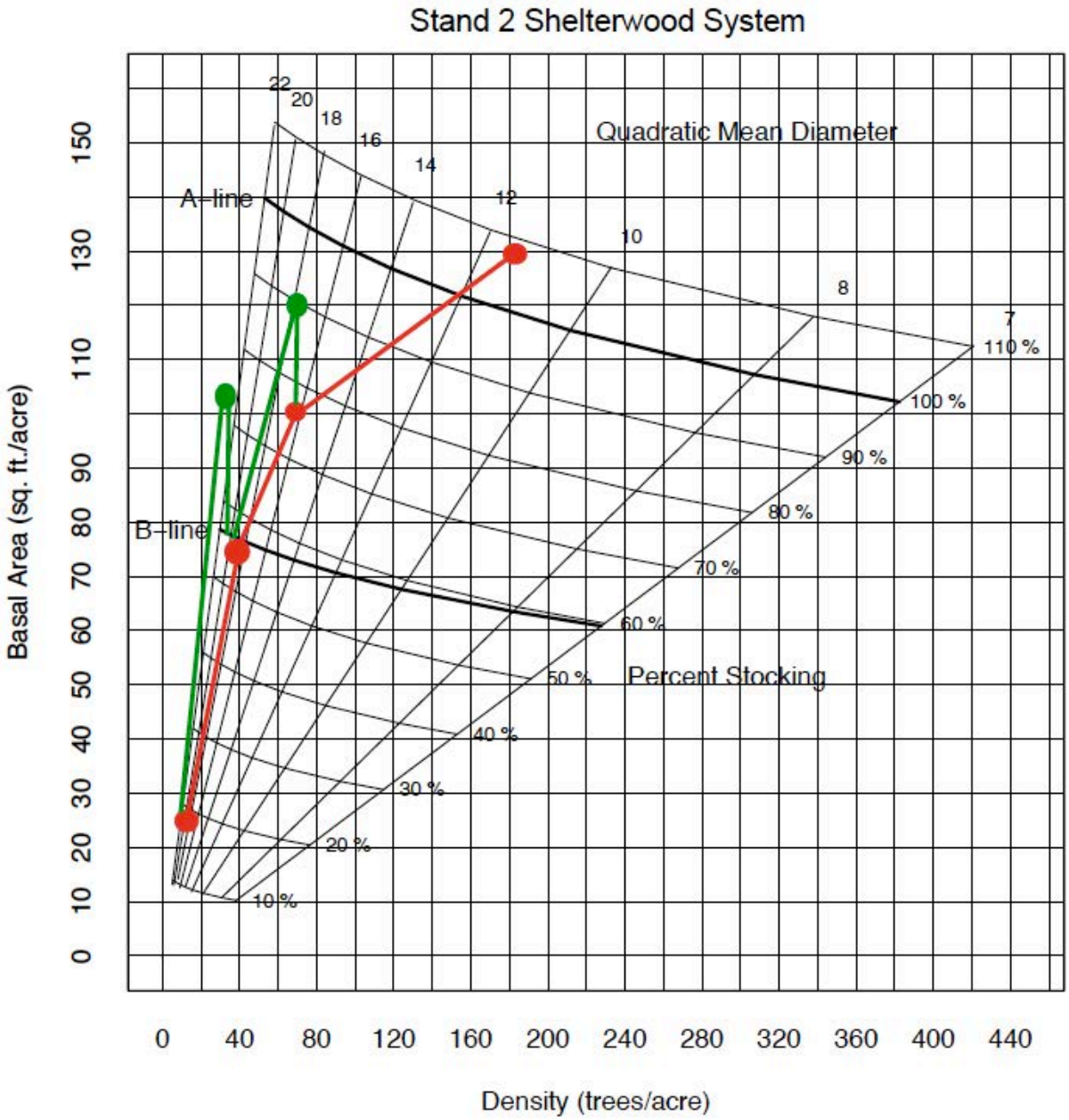


Figure 24. Stand 2 stocking and predicted shelterwood removals. Red is the current stocking and predicted stocking after preparatory, establishment, and final cuts. Green is the predicted growth trends between cuts. This chart does not reflect the stocking impacts of the regeneration.

# Appendix I-Terrain Analysis


Figure 25. Digital Elevation Model (1 meter resolution).

# Appendix J-Burn Plan

Prescribed fire can have many benefits for forest health and productivity. Benefits include selecting for oak over mesic competitors, hardwood control within loblolly pine plantations, reducing hazardous fuel loads, and creating habitat variability. Currently, the North Carolina Forest Service is burning for 35-55 $ acre$^{-1}$, which includes firebreak implementation (NCFS, 2025).

As shown in Appendix I, the terrain will make it difficult to install firebreaks along the stand edges, which are often in streamside management zones. Additionally, running a bulldozer through a SMZ defeats the purpose of the SMZ. However, the numerous ridges already have roads installed along their crests, which can easily be cleaned up for fire breaks.

The best burn plan for this site is to use the SMZs along stand edges as "soft" firebreaks. The ridgetop roads will act as hard backstops. If the fires were to jump the creeks or ephemeral drains, they would not make it across the backstop. This ensures the desired stands are burned but also allows fire to potentially feather up and down the gullies, creating favorable wildlife habitat. If the leaves are blown out of these ephemeral drains prior to burning, the fire will be less likely to breach the soft firebreak.

At a minimum, it is recommended to burn the hardwood patch clearings once oak regeneration has reached 0.75" root collar diameter. This will top kill the mesic stems and help oak outcompete. The tentative burn units are shown in Figures 26 and 27 but will need final approval by the NCFS or other burn contractors.

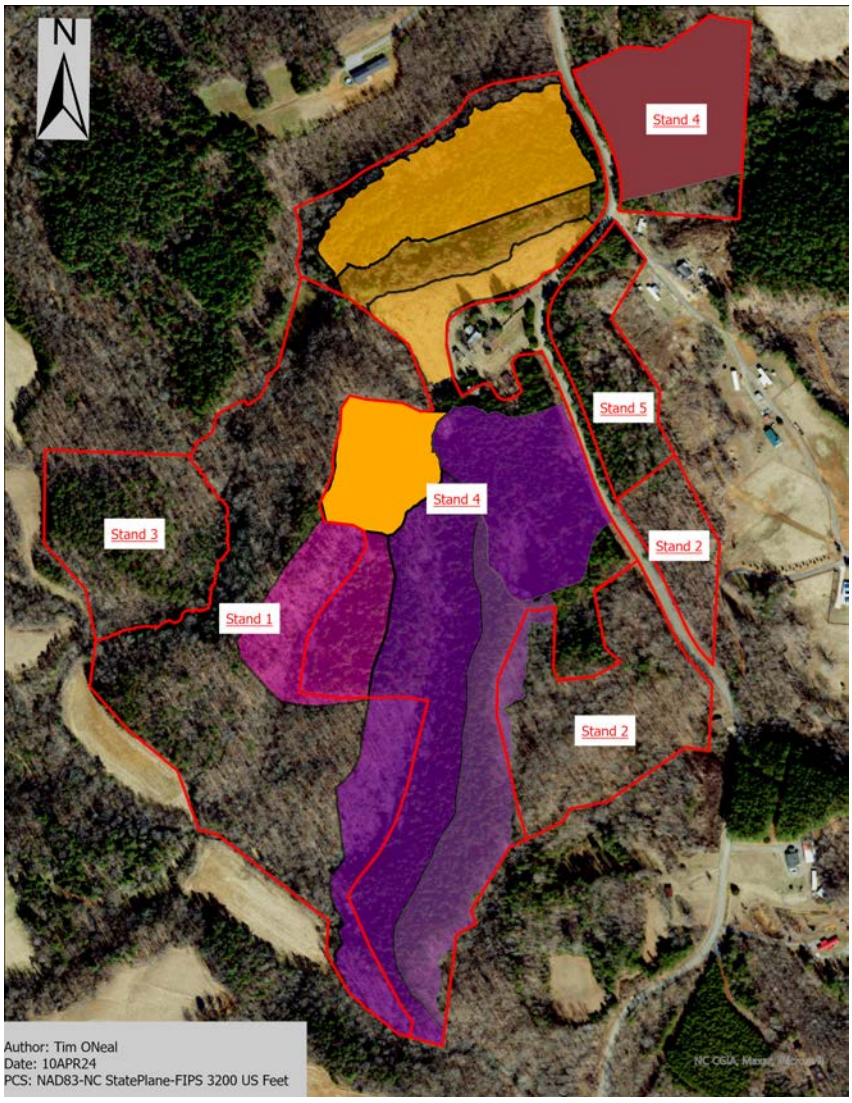


Figure 26. Hardwood burn plan (Stands 1 & 2).

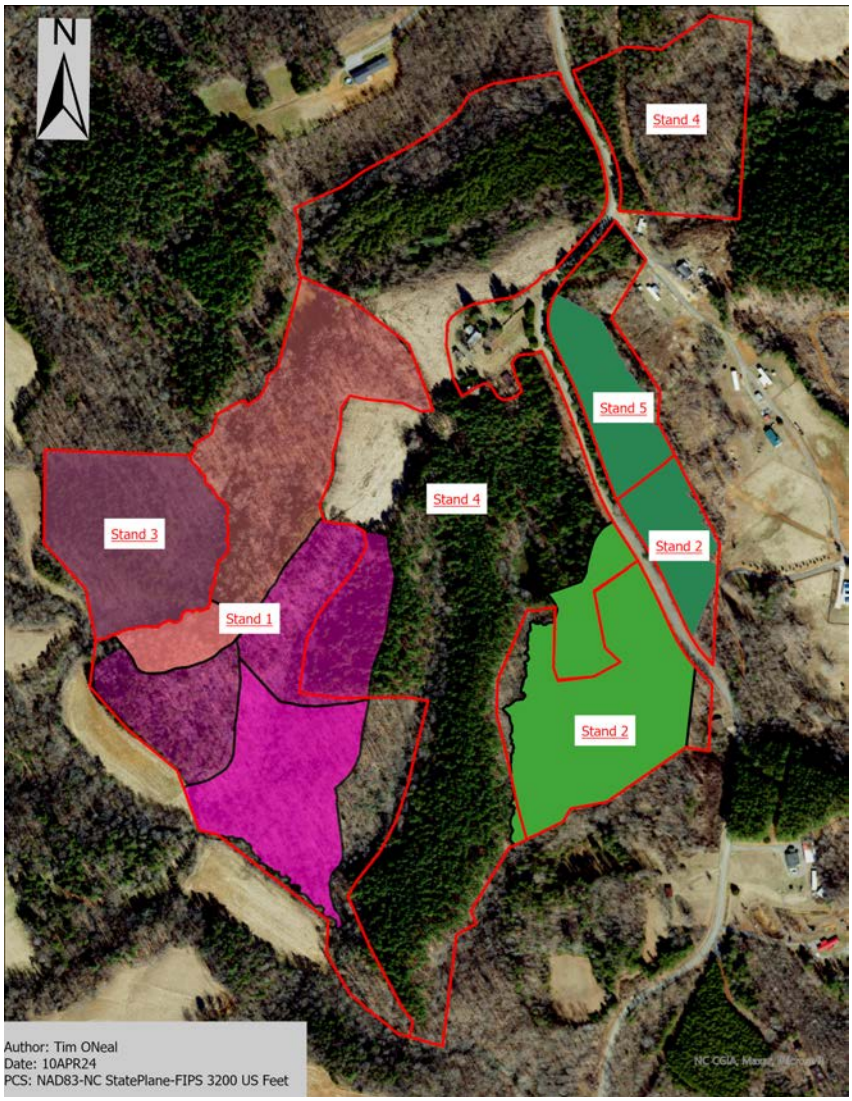

Figure 27. Pine burn plan (Stand 4).

# Appendix K-Posted Laws

In 2011, the NC General Assembly passed the NC Landowner Protection Act (G.S 14-159.6, G.S. 14-159.7(1)). This act makes it easier and less cost-prohibitive to mark boundaries so that no-trespass laws can be enforced. Previous no-trespass laws required boundaries be marked with 12in x 12in "No Trespassing" signage placed every 200 yards around the property boundary. Under the 2011 law, 8" purple paint strips placed 100 yards apart, 3-5' above the ground, carry the same legal weight as the expensive signage (NCWRC-2011).

Under the landowner protection act, any individual entering a posted property (G.S. 14-159.7) without written permission from the landowner dated within the previous 12 months can be cited on site for trespassing by law enforcement officials (NCWRC-2011).

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