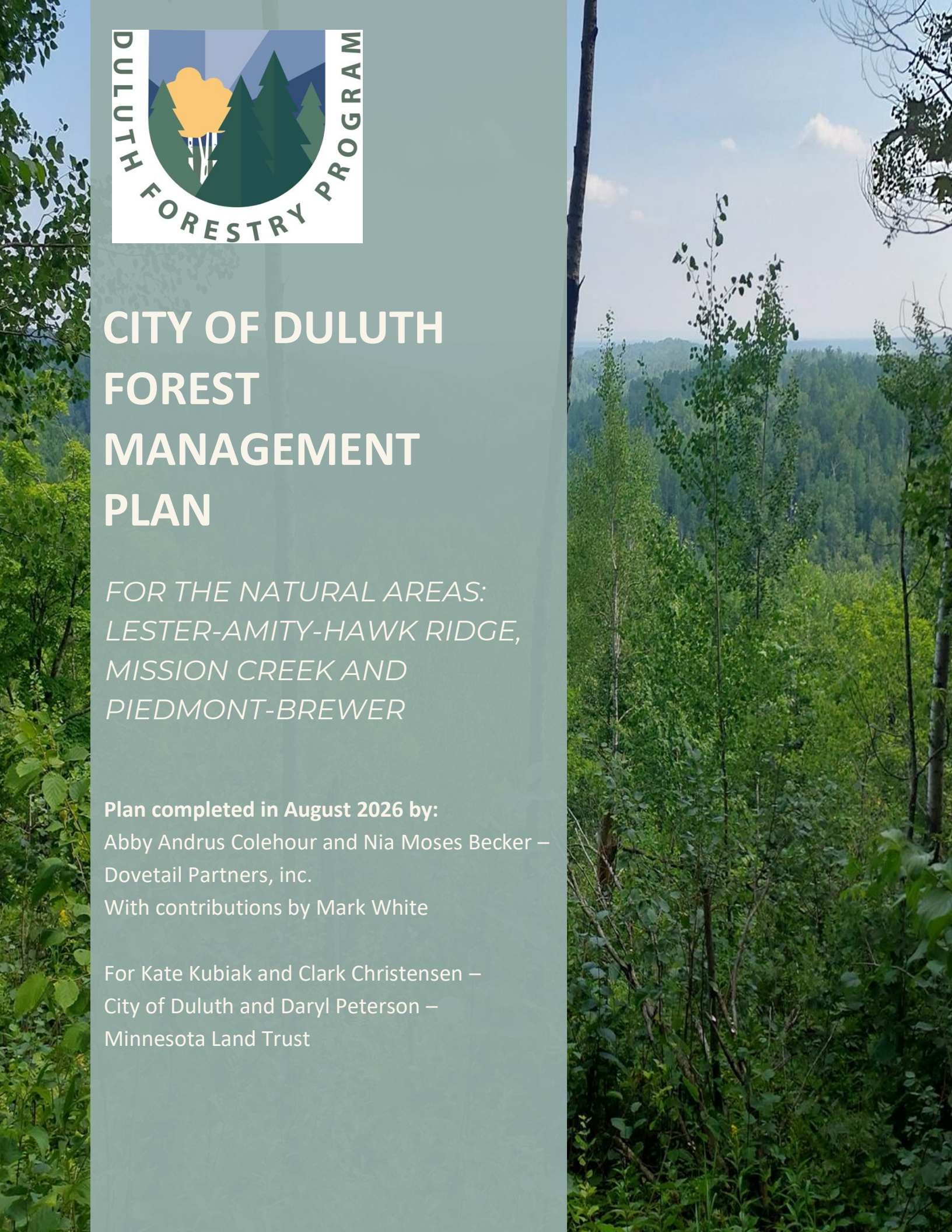


CITY OF DULUTH FOREST MANAGEMENT PLAN

FOR THE NATURAL AREAS: LESTER-AMITY-HAWK RIDGE, MISSION CREEK AND PIEDMONT-BREWER

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Table of Contents

SECTION 1: LANDSCAPE CONTEXT 5

GEOLOGY, SOILS, AND TOPOGRAPHY 5
CLIMATE AND CLIMATE CHANGE 6
FOREST TYPES 7
DISTURBANCE HISTORY 10

SECTION 2: FOREST INVENTORY METHODS AND STANDS SUMMARY 11

FOREST INVENTORY 11

SECTION 3: FOREST HEALTH AND MANAGEMENT CONSIDERATIONS 12

EMERALD ASH BORER 12
DISTURBANCE, SUCCESSION, AND TREE REGENERATION 13
CONIFER REGENERATION 14
HARDWOOD REGENERATION 15
HERBIVORY 16
NON-NATIVE EARTHWORMS 16
BUCKTHORN 16
BIRDS 17
TROUT STREAMS 19
WHITE PINE BLISTER RUST 19

SECTION 4: MANAGEMENT GOALS, STRATEGIES, AND ACTIONS 20

MANAGEMENT GOAL SUMMARY 20
GOAL 1 RECREATION 20
GOAL 2 ECOSYSTEM FUNCTION 20
GOAL 3 REGENERATION 21
GOAL 4 RESTORE/ENHANCE NATIVE PLANT COMMUNITIES 21
GOAL 5 FOREST RESILIENCE 22

SECTION 3: LESTER-AMITY-HAWK RIDGE NATURAL AREA (LESTER) 23

STAND 1 NORTHERN HARDWOODS 26
STAND 2 ASPEN (BLACK ASH, NORTHERN HARDWOODS) 30
STAND 3 ASPEN-BIRCH (RED PINE) 33
STAND 4 ASPEN-BIRCH (RED MAPLE) 37
STAND 5 ASPEN-BIRCH (PLANTATION) 41

Stand 6 Riparian 45
Stand 7 Non-Forested Field 49
Stand 8 Pine Plantation 51
Stand 9 Aspen-Birch (Red Maple) 55
Stand 10 Aspen-Birch (Balsam Fir) 59
Stand 11 Aspen-Birch 63
Stand 12 Aspen-Birch 67
Stand 13 Aspen-Birch (Riparian) 71
Stand 14 Developed/Riparian 75
Stand 15 Rocky Outcrop (Aspen-Red Oak) 79
Stand 16 Aspen-Birch (Balsam Fir) 83
Stand 17 Northern Hardwoods (Red Oak) 86

SECTION 4: MISSION CREEK NATURAL AREA (MISSION) 90

Stand 1 Mixed Hardwood Conifer 93
Stand 2 Aspen 96
Stand 3 Aspen 100
Stand 4 Mixed Hardwood Conifer 103
Stand 5 Riparian 106
Stand 6 Mixed Hardwood Conifer 110
Stand 7 Northern Hardwoods 114
Stand 8 Aspen 117
Stand 9 Cliff/Talus 120
Stand 10 Northern Hardwoods (White Pine, Red Pine) 122
Stand 11 Mixed Hardwood Conifer 125
Stand 12 Riparian 129
Stand 13 Aspen 133
Stand 14 Northern Hardwoods (Red Oak) 137
Stand 15 Northern Hardwoods (Red Oak, White Pine, Red Pine) 140
Stand 16 Mixed Hardwood Conifer 144
Stand 17 Riparian 148
Stand 18 White Pine, White Spruce, Paper Birch 152
Stand 19 Mixed Hardwood Conifer 156

SECTION 5: PIEDMONT-BREWER NATURAL AREA (PIEDMONT) 160

Stand 1 Aspen-Birch (Hardwoods) 162
Stand 2 Black Ash-Aspen-Balsam Poplar 166
Stand 3 Aspen-Birch 170
Stand 4 Aspen-Birch (Riparian) 174
Stand 5 Aspen-Birch (Hardwoods) 178
Stand 6 Aspen-Birch (Hardwoods) 182
Stand 7 Aspen-Birch (Riparian) 186
Stand 8 Aspen-Birch (Hardwoods) 190

APPENDICES 193

SPATIAL DATA (SHAPEFILES) 193

TABULAR DATA (EXCEL) 193

List of Tables

TABLE 1: PRIMARY FOREST TYPES BY PROPERTY (LANDFIRE, USDA) 8
TABLE 2: NATIVE PLANT COMMUNITIES BY PROPERTY (MN DNR) 9
TABLE 3: FOREST INVENTORY SUMMARY FOR ALL PROPERTIES 11
TABLE 4: EFFECTIVENESS OF MANAGEMENT OPTIONS FOR EMERALD ASH BORER IN BLACK ASH FORESTS 13
TABLE 5: OVERVIEW OF KEY HABITAT STRUCTURES AND IMPORTANCE FOR MINNESOTA BIRD SPECIES. 18
TABLE 6:LESTER-AMITY-HAWK RIDGE STAND ATTRIBUTES 24
TABLE 7: MISSION CREEK STAND ATTRIBUTES 91
TABLE 8: PIEDMONT STAND ATTRIBUTES TABLE 161

List of Figures

FIGURE 1: PROPERTY CONTEXT MAP 6
FIGURE 2: LESTER STANDS MAP 23
FIGURE 3: MISSION STANDS MAP 90
FIGURE 4: PIEDMONT STANDS MAP 160

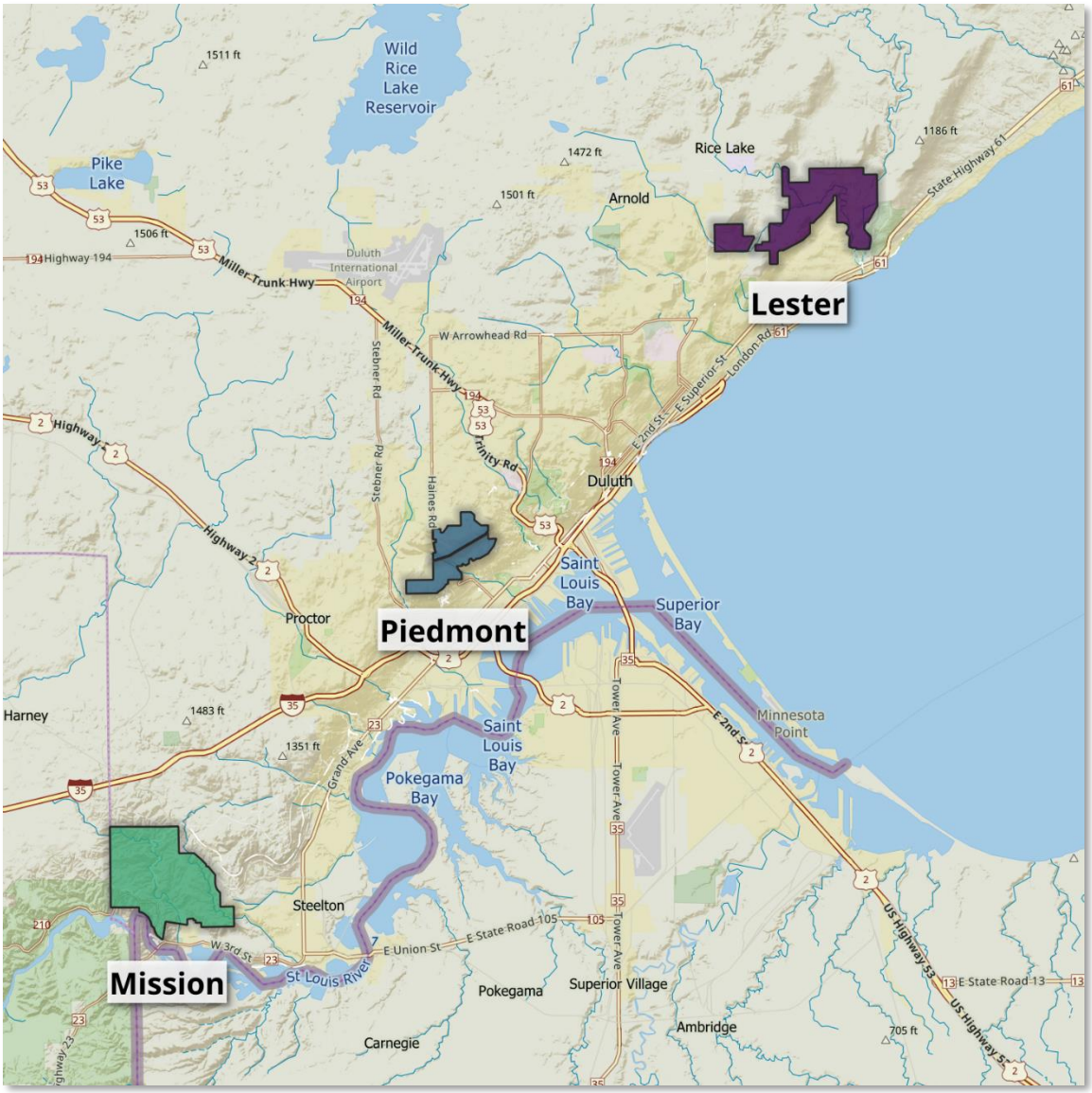
Section 1: Landscape Context

Geology, Soils, and Topography

The Piedmont-Brewer and Lester-Amity-Hawk Ridge land complexes are part of the Superior and Rainy Stony and Rocky Till Plains and Moraines Major Land Resource Area (093A). This area features a prominent northeast-oriented ridgeline that stretches across the length of Duluth and beyond. This geologic feature is composed of a diabase rock intrusion that formed during the lava flows of the Mid-Continent Rift System. Once exposed, this slow-cooling rock resisted weathering and erosion compared to surrounding volcanic rock, resulting in these extents of exposed rock outcrops tilted towards the rift axis. The remainder of the landscape in this MLRA was glaciated by numerous advances of the Superior, Rainy, and Des Moines glacial lobes during the Wisconsin glaciation as well as pre-Wisconsin glacial periods. The geomorphic surfaces are geologically very young (i.e., 10,000 to 20,000 years) and dominated by drumlin fields, moraines, small lake plains, outwash plains, and bedrock-controlled uplands. The resulting soils in this geologic context are diverse, including outcrops of bedrock at or near the surface, deeper glacial till deposits ranging from well-drained gravelly soil in creek floodplains to poorly drained, hydric clay-silt dominated soils (wetlands) in moraine depressions. Differences in plant communities are strongly influenced by this range of soil types.

Mission Creek, meanwhile, is located on the Major Land Resource Area of the Superior Lake Plain (092X). This landscape was shaped during the Late Wisconsin glacial period as glacial lobes advanced and retreated, creating moraines and deposits of lacustrine materials as glacial lakes formed and then drained. The soils at Mission Creek are over 95% of the silty-loam Udalfs-Eutrudepts complex, with the majority composed of steep slopes between 25-70% with less extreme slopes on the ridgetops and tributary drainages. Drainage for these soils is moderately well to well drained, with medium to very high runoff potential. The lower Mission Creek floodplain originates from alluvial material and is dominantly clayey with poorer drainage and more wetland associated plant communities.

Figure 1: Property Context Map



Climate and Climate Change

The average annual precipitation along Lake Superior's north shore is 26-32 inches (66 to 81 centimeters). About 65 percent of the precipitation falls as rain during the growing season (May through September) and about 21 percent falls as snow. The freeze-free period averages about 130 days and ranges from 97 to 150 days (USDA-NRCS, 2022[1]). The climate in Duluth's natural areas is strongly influenced by Lake Superior, resulting in cooler summers, warmer winters, and greater precipitation compared to more inland locations. In addition, steep slopes along the ridgeline result in downward

[1] United States Department of Agriculture (USDA), Natural Resources Conservation Service. 2022. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. USDA Handbook 296. Washington, DC.

frost movement, reducing freeze severity mid-slope. This climate supports a higher proportion of mesic hardwood forests than more inland regions.

Mean annual temperature Northeastern Minnesota increased by 3° F from 1951 – 2021 while annual precipitation increases ranged from 1% to 10% (Historical Climate Change).
While climate change presents uncertainty regarding future climate and weather patterns, significant warming over the remainder of the 21st century is inevitable, along with changes in precipitation including quantities, seasonal variability, and the frequency of extreme events. Climate modeling based on recently developed emissions scenarios estimates a 4.4° temperature increase and a precipitation decrease of 2.2 by mid-century (High Emissions Scenario for this region (CMIPS6 Climate Modeling). This scenario indicates a higher likelihood of moisture deficits where evapotranspiration exceeds precipitation leading to drought stress in tree populations. Earlier modeling efforts show greater temperature increases but show potential precipitation increases over the same period (CMIPS5 Climate Modeling).

Forest Types

Forest types in northern Minnesota can be described in multiple ways, depending on the geographic scale, emphasis on historic versus contemporary composition, compiling agency, and data sources. The primary references used in this plan were LANDFIRE[2], USDA's Ecological Site Descriptions[3], and the Minnesota DNR's Native Plant Communities classification system[4]. Each system has its own strengths and limitations. All of these sources were collated with the results of the present forest inventory to make management recommendations that align with the corresponding forest types. The summary of forest types for each property is included in Table 1. A more detailed breakdown of forest type is included for each forest stand description.

[2] LANDFIRE is a national database that was created by a collaboration of U.S. government agencies to assist land managers with decision-making related to wildfires and natural resource management. The data provided is at a coarse scale, meant for large landscape planning. https://www.landfire.gov/

[3] Ecological Site Descriptions are provided by the Natural Resource Conservation Service (NRCS) to support land managers in evaluating potential land use, response to management activities or disturbances, and long-term productivity. https://www.nrcs.usda.gov/getting-assistance/technical-assistance/ecological-sciences/ecological-site-descriptions

[4] The Minnesota DNR developed this native plant community classification system by analyzing field data https://www.dnr.state.mn.us/npc/classification.html. A separate inventory of NPCs in Duluth's natural areas was conducted by GEI Consultants in 2026 – see associated report for detailed accounting and descriptions.

Table 1: Primary Forest Types by Property (Landfire, USDA)

	LANDFIRE	USDA Ecological Site Descriptions
Lester	Biophysical setting: Boreal White Spruce-Fir-Hardwood Forest-Inland Succession Class: D (Late Development 1 – Closed) Succession Class description: Spruce-fir-cedar forest with canopy associates including quaking aspen, paper birch, white pine, bigtooth aspen, red pine, jack pine, white spruce, and eastern hemlock Maximum tree size class: Large (21-33" DBH)	F093AY013MN - Loamy uplands F093AY006MN - Depressional Wet Hardwood Forest 093AY009MN - Bedrock Controlled Upland Forest F092XY012WI - Moist Clayey Lowlands F092XY007WI - Wet Loamy or Clayey Lowlands
Piedmont	Biophysical setting: Laurentian-Acadian Northern Hardwoods Forest-Hemlock Succession class: Class E - Mid Development 2 - Closed Succession class description: Class E represents transition from fire response, early successional stands. Characteristic species are quaking aspen and paper birch in the upper canopy, sugar maple and basswood in the mid to upper canopy. Maximum tree size class: Medium (9-21” DBH)	F093AY009MN - Bedrock Controlled Upland Forest F093AY013MN - Loamy Upland
Mission Creek	Biophysical setting: Boreal White Spruce-Fir-Hardwood Forest-Inland Succession Class: D (Late Development 1 – Closed) Succession Class description: Spruce-fir-cedar forest with canopy associates including quaking aspen, paper birch, white pine, bigtooth aspen, red pine, jack pine, white spruce, and eastern hemlock Maximum tree size class: Large (21-33" DBH).	F093AY013MN - Loamy uplands F092XY015WI - Clayey Uplands

Table 2: Native Plant Communities by Property[5] (MN DNR)

Lester

NPC	Acres	Percent
FDn43b	429	29.0%
Disturbed	213	14.4%
MHn35b	179	12.1%
MHn46b	133	9.0%
MHn44a	84	5.7%
WFn55a	80	5.4%
FFn57a	69	4.7%
FDn33b	56	3.8%
ROn23a	44	3.0%
FDn43b1	43	2.9%
Developed	40	2.7%
RVx54a	32	2.2%
WFn74a	27	1.9%
RVx43a2	18	1.2%
MHn47a	13	0.9%
RVx32	8	0.5%
FDn33a1	5	0.4%
FDn43c	5	0.3%
WMn82b1	1	0.1%
FDn43a	0	0.0%
MRn93b	0	0.0%
Grand Total	**1479**	**100.0%**

Piedmont

NPC	Acres	Percent
MHn35b	296	44.4%
MHn47a	80	12.0%
WFn55a	79	11.9%
ROn23b	71	10.7%
MHn46b	52	7.8%
FDn43b2	46	6.9%
FPn73a	12	1.8%
Disturbed	11	1.7%
CTn24	10	1.5%
Developed	7	1.1%
ROn12b	2	0.2%
ROn23a	1	0.1%
Grand Total	**667**	**100.0%**

Mission

NPC	Acres	Percent
MHn35b	1116	58.9%
MHn44c	190	10.1%
MHn46b	160	8.5%
MHn44b	142	7.5%
MHn44a	62	3.3%
MHn44	39	2.1%
FFn57a	37	1.9%
RVx54a	32	1.7%
Disturbed	30	1.6%
FDn43b	18	1.0%
MHn47a	15	0.8%
RVx32	14	0.7%
MHn45b	12	0.6%
Developed	10	0.6%
WFn55a	7	0.4%
CTn11e	5	0.3%
WMn82b1	3	0.2%
CTn42d	1	0.0%
OW	1	0.0%
CTn11	0	0.0%
Grand Total	**1895**	**100.0%**

[5] Data Source: Shapefile associated with "Native Plant Community Data in the City of Duluth, MN" report by GEI Consultants, 2026.

Disturbance History

Historic Disturbance Regime

Lester and Mission: For the Boreal White Spruce-Fir-Hardwood Forest-Inland forest type[6], frequent windthrow and insect outbreaks (spruce budworm) are the most frequent disturbances. Infrequent catastrophic fires shape these forests, with fire frequency being influenced by the interaction of blowdowns, insects, and droughts. Windthrow is particularly common along lakeshore forests such as Lester and Mission Creek. Deer herbivory is noted as causing a regeneration failure of white cedar. This forest type can shift towards aspen and birch dominance following a fire event, or towards conifers (primarily white spruce, balsam fir, and white cedar, occasionally red pine and white pine) in the absence of fire.

Piedmont: For the Laurentian-Acadian Northern Hardwood Forests-Hemlock forest type[7], infrequent catastrophic windthrow from thunderstorm downdrafts or tornadoes every several generations of trees is an important disturbance shaping this forest type. Stand-replacing fire is infrequent and typically occurs after major blowdown events or periods of extreme drought. Generally, this forest type is fire-resistant and hosts fire-sensitive species. According to a research synthesis of this forest type in 2017, moderate severity wind storm events are fairly common in this forest type, occurring on roughly 2-5% of the landscape annually. Such wind events reset patches of the forest tens to a few hundred square meters in size to earlier successional stages, thereby regularly establishing new age cohorts. This type of disturbance is distinct from single-tree gap dynamics which result in very minor canopy openings enabling a few younger trees to rise to the canopy position, and from stand-replacing fires which reset the entire forest to an early successional state.

Recent Disturbance Events

Major disturbance events over the past couple hundred years are still evident on these landscapes. White pine, red pine, eastern hemlock, and other species were logged extensively by European settlers in the late 1800s and early 1900s, virtually eliminating the former dominance of these tree species, and in some cases even the seed source for future generations of these trees. Such extensive clearcutting reverted the landscape to an early successional stage characterized by aspen and birch dominance. Slash from these timber harvesting operations contributed to subsequent fire extent and severity. The Cloquet fire of 1918 burned hot and fast through much of Duluth, Cloquet, and the surrounding area, burning off not only vegetation but also much of the soil organic layer. A map that was reconstructed of the fire's perimeter shows the northern three-quarters of Lester as having burned, the southern two-thirds of Piedmont having burned, but Mission Creek left completely unscathed.

Other notable disturbances having locally specific impacts to the Duluth Area include a high wind event in 2016 that resulted in large-scale tree blowdown, particularly evident at Lester, and a historic flood event across the broader Duluth area in 2012 in which 7-10" of rain fell over the course of two days that washed out roads, culverts, and streambeds.

[6] Boreal White Spruce-Fir-Hardwood Forest – Inland. BpS Model/Description Version: Aug. 2020. Reviewed by Randy Swaty. US Forest Service Research and Development.

[7] Laurentian-Acadian Northern Hardwoods Forest - Hemlock. BpS Model/Description Version: Aug. 2020. Reviewed by Ron Deckert and Greg Nowacki, plus staff from Chequemegon-Nicholet National Forest. US Forest Service Research and Development.

Section 2: Forest Inventory Methods and Stands Summary

Forest Inventory

Plots were established at a cruise intensity of approximately one plot per 10 acres. Plot locations were established in a systematic grid, then navigated to using GPS to conduct the inventory. Plots were added as needed for smaller or heterogenous stands.

In each plot location, overstory tree characteristics were sampled using variable radius plots with 10 Basal Area Factor (BAF) prism. Metrics collected were plot number, tree species, diameter (DBH), live/dead and canopy position/crown class. For borderline trees, every other tree was recorded.

For understory characteristics, tree regeneration was sampled using 1/100th or 1/250th acre fixed radius plots, nested within the overstory plots. Trees under 6-ft tall were tallied as seedlings, with trees over 6-ft and under 5-inches DBH tallied as saplings. Using these same nested plots, a count for shrubs over and under 6-ft height and estimation of herbaceous plant cover class was obtained. Qualitative data collected included coarse woody debris amounts (Low, Medium or High), Invasive species (by species, Low, Medium or High), presence and notes of pests and disease, wildlife notes including species with excessive browse, notes on human impacts, and any other relevant management notes or observations. Data were collected between July 2025 and August 2026.

Site index

For each stand, site index was calculated for the dominant tree species and a secondary species. For dominant species, two or three specimens were collected depending on similarity of first two specimens, and one specimen was collected for secondary species. An increment borer was used to calculate number of tree rings, and a clinometer used to measure height at 50-m distance from the tree[8]. Site index was determined using site index curves from Carmean, Hahn, and Jacobs, 1989[9]. Data were collected between March and August 2026.

Table 3: Forest Inventory Summary for All Properties

Property	Total Stands	Plots	Acreage
Lester	17	165	1493
Mission	19	188	1955
Piedmont	8	69	667
Total	**44**	**422**	**4115**

[8] Huebschmann, Michael and Martin, Jeff. 1996. Lakes States Woodlands: Estimating and interpreting site index.
[9] Carmean, Willard H., Hahn, Jarold T., and Jacobs, Rodney D. 1989. GTR NC-128 Site index curves for forest tree species in the Eastern United States. USDA Forest Service, North Central Forest Experiment Station.

Section 3: Forest Health and Management Considerations

This section outlines the primary forest health concerns within the surveyed properties and a summary of current best management practices to address them.

Emerald Ash Borer

At the time of the present forest inventory (summer/fall 2025), Emerald Ash Borer (EAB) invasion is in an advanced stage at Lester and Piedmont, and in an early to mid-stage invasion at Mission. At Lester and Piedmont, significant stands of former black ash dominance have up to 80-100% mature tree mortality, and as little as 20% decline in the upper reaches of Mission Creek. Some mature trees exhibit epicormic or root crown sprouting. In general, there are still some individual living green and black ash trees, and very abundant black and green ash regeneration across all properties and stands. Emerald ash borer can infest trees as little as 1 inch in diameter, but tend to target larger diameter trees during early stages of invasion. In areas of significant tree loss at Lester and Piedmont, the loss of ash tree cover appears to be associated with an increased presence of speckled alder and buckthorn. Ash tree mortality can result in an elevated water table and possible transition from forested wetland to other wetland types. Loss of shade from forested cover can also change stream conditions (i.e. increase stream temperature) and therefore impact aquatic life.

EAB cannot be eradicated from the landscape. However, ash-dominant stands can be managed for resiliency to lessen the secondary ecological impacts. Slowing Ash Mortality (SLAM) utilizes multiple management strategies and is more effective than using individual management strategies alone. SLAM is used to slow the growth and spread of EAB during early to mid-infestation stages. Biocontrol with EAB parasitoids has shown limited potential for reducing the amount of EAB damage when used alone but can be combined with other strategies for greater impact. Insecticide injections can also suppress EAB populations and preserve seed trees, ensuring future seed sources. Ash seedlings are shade-tolerant, and ash is a prolific seed producer. Fostering the recruitment of ash seedlings that are present in the forest now can provide for future ash trees if conditions or technology changes. In addition, planting and encouraging a diverse tree species assemblage within riparian areas currently dominated by ash will ensure forest canopy and preserve wetland hydrology regardless of ash status. Leaving dead ash trees standing where they do not pose a hazard to infrastructure or trail users is recommended for wildlife habitat, coarse woody debris recruitment, and creating viable sites (tip-up mounds and nurse logs from fallen trees) for natural tree regeneration of species like yellow birch and white pine. However, if insecticides are used to preserve seed trees, it is recommended to also remove surrounding ash trees to reduce the surrounding EAB population.

Tree species to interplant in black ash swamps to maintain forested cover:

- *Priority species currently present:* Yellow birch, white spruce, white cedar, white pine
- *Additional species currently present:* Balsam poplar, basswood, red oak, sugar maple, red maple, balsam fir, quaking aspen, tamarack
- *Climate adaptation species:* Silver maple, bur oak, swamp white oak, box elder, American elm, hackberry, Eastern cottonwood
- *Historically present species:* Eastern hemlock

Table 4: Effectiveness of Management Options for Emerald Ash Borer in Black Ash Forests[10]

Management Option		Anticipated Effectiveness of Treatments to Achieve Specific Goals			
		Maintain canopy & vertical structure	Promote black ash regeneration	Directly protect black ash regeneration	Suppress EAB infestation
No intervention		Ineffective (--)	Ineffective (--)	Ineffective (--)	Ineffective (--)
Individual tree treatments	Systemic insecticide	Highly effective (+)	Highly effective (+)	Limited (-)	Highly effective (+)
	Classical biocontrol (non-native parasitoid releases)	Ineffective (--)	Ineffective (--)	Limited (-)	Limited (-)
	Ash tree removals (individual tree selection, row harvests, gap harvests)	Ineffective (--)	Highly effective (+)	Ineffective (--)	Limited (-)
Treatment combinations	Biocontrol + Systemic insecticides	Highly effective (+)	Highly effective (+)	Limited (-)	Highly effective (+)
	Tree removals + Systemic insecticides	Highly effective (+)	Extremely effective (++)	Ineffective (--)	Highly effective (+)
	Biocontrol + Tree removals	Ineffective (--)	Highly effective (+)	Limited (-)	Limited (-)
	Systemic insecticides + Biocontrol + Tree removals	Highly effective (+)	Extremely effective (++)	Limited (-)	Highly effective (+)

Ineffective (--) = unlikely to achieve goal; Limited (-) = studies have shown variable to poor results; **Highly effective (+)** = studies have consistently shown strong results; possible additive/synergistic effect; **Extremely effective (++)** = combining two highly effective treatments is likely to yield better results than a single treatment; greater additive/synergistic effect.

Source: McCullough D.G., Seigert N., Management Options for Emerald Ash Borer in Black Ash Forests. 2026

Disturbance, Succession, and Tree Regeneration

Forest types across Lester, Piedmont, and Mission vary but are nearly all in a transitional or mid-succession stage (averaging 35-75 years) with only occasional remnant or older trees. Active management can reverse or accelerate succession towards different stages. Supporting a range of successional stages provides a greater diversity of wildlife habitat niches and enables greater resilience at a landscape scale. In general, management goals in this plan recommend progression towards later successional forest stages and retention of large tracts of interior forest where possible, due to the

[10] Management options for emerald ash borer in black ash forests. Siegert, N.W. and D.G. McCullough. 2026. Michigan State University Extension. East Lansing, Michigan.

limited presence of older contiguous forests in the surrounding landscape. The following list summarizes management strategies associated with various desired successional states.

- *Early successional management* - Forest stands naturally reset to young forest conditions after a disturbance like flooding, fire, pests/disease, beaver activity, or major wind event. Young forests are typically dominated by quaking aspen, paper birch, balsam poplar, and jack pine (infrequent) in this area. Regeneration for early succession forests requires significant canopy gaps to stimulate aspen root re-sprouting, encourage growth of sun-loving seedlings, and expose bare soil for seed germination. Where appropriate, thoughtful silviculture and modern best management practices can mimic natural disturbance to create or maintain patches of young forest while minimizing negative impacts to mature forest habitats and the wildlife species that depend on them. Species that benefit from early succession stands include golden-winged warbler, American woodcock, grouse, sapsuckers, rose breasted grosbeak, snowshoe hares, deer, moose, turtles, and beaver.
- *Late successional management* - Late successional forests require longer periods of time without a canopy-altering disturbance. In these older forests, tree diameter increases while trees per acre decreases. Higher levels of coarse woody debris and snags create structural diversity and habitat niches for wildlife like porcupines, bats, woodpeckers, martens, flying squirrels, and salamanders. A greater component of the canopy composition is slow-growing, shade-tolerant species like sugar maple, white cedar, white pine, yellow birch, eastern hemlock, bur oak, red pine, white spruce and balsam fir. For these later-successional species to successfully establish on their own, a seed source must be present, and seedlings must survive into maturity. Lack of seed source due to past clear-cut logging and excessive deer herbivory make natural regeneration challenging across many of Duluth's natural areas (see Regeneration and Herbivory sections below). Active management to encourage late-succession forests include site preparation around seed trees, midstory mastication, tree planting and caging, and deer exclosures.
- *No management* – A hands-off approach allows the forest to naturally progress through succession without management intervention. This is appropriate where the stand already contains a diversity of desirable species and age classes, herbivory does not cause a major hindrance to seedling success, and invasive species do not overwhelm the midstory. Natural disturbances such as fire, flooding, insect outbreaks, and windstorms may revert a forest to an earlier successional state.

Conifer Regeneration

There is very little regeneration and recruitment of the late-successional conifer species historically present and expected in these forest types - white pine, red pine, white cedar, and eastern hemlock. Despite being some of the oldest trees on the property, there has been virtually zero white and red pine recruitment over the last ~100 years. Conifers (and other small-seeded trees) require a bare mineral soil seedbed for regeneration. Lack of disturbance and competing vegetation can prevent the establishment of seedlings, while shading from the canopy and browse by deer can prevent the recruitment of seedlings that do become established. Large, legacy conifers are present across the landscape and should be preserved as much as possible to continue to provide a natural seed source.

White spruce, and to a lesser extent balsam fir, have had success in regeneration. Both of these species are susceptible to spruce budworm and can cause elevated fire risk following mortality from spruce budworm outbreaks. However, neither of these species has become overabundant on landscape scale. Some isolated areas throughout each property have very dense stands of young white spruce or balsam

fir that should be thinned to reduce spruce budworm potential and release vigorous regenerating trees from competition. Other areas, such as slopes with northern aspects, natural white spruce regeneration could be encouraged as a deer-resistant species.

Management activities to address conifer regeneration

- Soil scarification to expose mineral soil within 700 feet of seed trees
- Prescribed surface burning to expose mineral soil within 700 feet of seed trees
- Direct seeding
- Tree planting and tree protection

Hardwood Regeneration

Black ash, green ash, and to a lesser degree quaking aspen are the most abundant species in tree regeneration layers in mesic hardwood stands across the three properties. While white-tailed deer browse on these species, the sheer numbers of seedlings may allow some to grow above browse levels. As mentioned in the EAB section, if effective EAB control methods are developed, maintaining some ash regeneration provides a source for future ash tree to access the canopy and produce seeds.

Most of the mesic hardwood stands across the three properties appear to be in young forest (0-55 years) or transition (55-95 years) where there is relatively high abundance of early successional tree species (quaking aspen, paper birch). Mid-tolerant and generally longer-lived hardwoods (red maple, red oak, yellow birch) along with species with higher shade tolerance (basswood, sugar maple) may be present in the canopy but are often poorly represented in the regeneration layers.

In Northern Mesic Hardwood Forests (MHn35), stand replacing wind and fire disturbances occurred infrequently with rotation periods greater than 1,000 years for wind and 970 years for fire. Moderate severity fire and wind that resulted in some tree mortality creating variable canopy openings occurred with a rotation period of 130 years. Silvicultural approaches that mimic these moderate severity disturbances along with browse protection and scarification treatments to increase seedling establishment could be used to increase successful establishment of mid-tolerant and shade tolerant hardwood species. Prescribed fire could also have a role in creating mineral soil seedbeds and reducing understory competition. If the objective is to establish cohorts of these species to replace existing canopy trees, then targeted planting along with brush saw release could be effective.

As many of the shade tolerant and mid-tolerant species are considered climate adaptive, managing for these species should serve to increase adaptive capacity.

Of the shade intolerant species (balsam, poplar, bigtooth aspen, quaking aspen, paper birch) (excluding ash species) quaking aspen is by far the most abundant in regeneration, subcanopy and canopy. Even-aged treatments including shelterwood and seed tree methods that create sufficient light can be used: however quaking aspen sprouting can overwhelm sites. Shelterwood systems with higher canopy cover retention (~40%) can damp down the sprouting response.

Given challenges to regeneration due to deer browse, non-native earthworms, and other factors, a long-term commitment to establishing desired species composition will be key to building resilience into these forests.

Herbivory

For stands in which a seed source is present, germination is successful, and conditions should theoretically support recruitment into sapling and mature states, herbivory may be a driving factor preventing regeneration. Controlling for deer browse is one immediate measure that can be taken to enable existing seedlings to recruit to the sapling stage where they are more likely to survive herbivory.

Management activities to address deer herbivory

- Encourage hunting - the City currently has a deer bow-hunting program. Continue the program, provide education and incentives to enable more hunters to access remote natural areas.
- Exclosures - install large fenced areas that deer cannot access. Alternatively, create natural brush deer barricades by cutting overly dense tree and shrubs in a manner that prevents deer entry. In several years, compare seedling and sapling quantities to assess effectiveness. If regeneration has not improved in exclosures, then other factors are driving regeneration problems.
- Rabbit exclosures - In a subset of exclosures, install finer mesh fencing 2' in height to exclude rabbits. Compare regeneration impacts to deer-only exclosures
- Rodent exclosures - excluding rodents will be more challenging, but if regeneration has not improved through deer and rabbit exclosures, consider experimenting with this.
- Deer repellent - scent based repellents make vegetation unpalatable or induce a fear response. This can be effective but must be reapplied multiple times a year.

Non-Native Earthworms

Non-native earthworms can cause significant changes to forest soils, inhibit the regeneration of many herbaceous, shrub, and tree species. In cases with extreme infestation, understory plant cover and tree regeneration are severely limited. By removing litter and mixing the organic layer with deeper horizons, soil bulk density can increase, resulting in reduced water holding capacity and fertility. Other impacts include increased soil temperature during the growing season along with less insulation from heat during the growing season and cold temperatures during the winter due to loss of leaf litter and duff. Impacts from earthworms are most severe for mesic hardwood forests with deeper organic soil layers, because earthworms consume and relocate the organic matter to deeper horizons. For more information see the USDA's summary on non-native earthworm impacts[11].

Buckthorn

Buckthorn is a persistent issue across Duluth's natural areas. Treatment recommendations depend on access constraints, size and extent of the population, and forest conditions. In some cases, an extensive invasive species presence can indicate an underlying issue with forest health such as past artificial disturbance (clearcut logging, soil disturbance, development activities like farming or road creation, etc), a soil nutrient imbalance (often nitrogen is too high), or forest health issue affecting native tree resilience. In addition to immediate buckthorn removal projects, underlying forest health issues should also be addressed to help reduce population rebounds and future invasion.

[11] https://www.climatehubs.usda.gov/hubs/northern-forests/topic/non-native-invasive-earthworms-midwest-and-eastern-united-states

Management activities to address buckthorn:

- Smaller Seedlings - for less established areas, hand pull to remove seedlings. Where possible, overplant a high density of native shrubs to shade out future seedlings emerging from the seedbank.
- Larger established areas of buckthorn will require mechanical, chemical, or biological treatment. Shrubs of up to a certain size can be mulched (depending on equipment capacity), with even larger trees best suited for chainsaw treatment. Pairing removal with herbicide application or goat browsing can improve the efficacy of the treatment and reduce the number of treatment entries.
- Goat browsing may be effective and is a publicly appealing alternative to herbicide treatment. It is recommended if the preservation of native plants is not a concern (goats will eat many plants), as in a buckthorn monoculture. Goat browsing tends to be most successful after an initial mastication of mature plants, and with a longer duration browsing period or repeated entries to starve out resprouting buckthorn stumps and exhaust the seed bank.
- Reduce dispersion of new plants
    - Bike trails and powerlines are systems for dispersions. High traffic trails and disturbed areas were observed to have more invasives. Monitor these areas and remove new infestations as they occur.
    - Install boot brushes and bike cleaning stations to prevent further seed dispersal and establishment.
    - Birds are a common source of seed dispersal. Monitor areas with high bird activity for new invasions and focus removal efforts here

Birds

The Duluth area has a rich bird population including Lake Superior and St. Louis River Estuary waterfowl, summer nesting birds, spring and fall migrating birds, overwintering residents, and occasional visiting boreal birds like owls from Canada. The buffering effect of Lake Superior provides suitable conditions for many birds, while the north shore ridgeline offers air currents supportive to hawk and other bird migration. Birds play many important roles in forest ecosystems, but their populations have declined by 1.2 billion birds since 1970[12] due to habitat loss, invasive species like emerald ash borer, climate change, and other factors. Of the 250 bird species in Minnesota, 150 species nest in forests[13]. While different species and life stages of birds require different habitat features, some preferring vast extents of mature interior forest and others preferring early successional or edge habitats, some key structural elements can be incorporated into forest management practices to support a diversity of bird species.

[12] North American Bird Conservation Initiative. (2019). State of the Birds 2019. stateofthebirds.org/2019

[13] Forestry for Minnesota Birds. 2025. Lead Author: Nelson, Christian with numerous other contributors. Forest Stewards Guild, American Bird Conservancy, and University of Minnesota's Natural Resources Research Institute. https://www.dovetailinc.org/portfoliodetail.php?id=68067874c2d00

Table 5: Overview of Key Habitat Structures and Importance for Minnesota Bird Species.
Source: "Forestry for Minnesota Birds" guidebook[13]

Vertical structure diversity/canopy cover	Vertical structure diversity, or differing levels of canopy cover in the over-, mid-, and understory, provides habitat to many forest breeding birds.
Horizontal structure diversity	Diversity in horizontal structure, or the arrangement of species and woody structure on a plane parallel to the ground, provides habitat to many forest breeding birds.
Canopy gaps ("gaps")	Create canopy openings that allow sunlight to penetrate down to the forest floor to help regenerate desired tree species and to diversify habitat for forest breeding birds.
Native biodiversity/ invasive species	Manage to create a diversity of native forest plants to ensure that birds have available food sources, including insects and mast. Eliminate invasive plants that may interfere with tree and shrub regeneration.
Large-diameter trees	Provides structural elements for nesting, roosting, perching, and feeding habitat for many forest breeding birds. Can become large snags, cavities, and down woody material over time.
Conifer inclusions	Retain or create clusters of conifer trees, for habitat, winter shelter, and to increase forest resilience to climate change and other stressors.
Snags or cavity trees	Provides structural elements for nesting, roosting, perching, and feeding habitat for many forest breeding birds.
Downed woody material	Provides structural elements for ground nesting birds as well as habitat for invertebrate food sources.
Leaf litter and duff	An adequate layer of duff is essential to ground-nesting birds and invertebrate populations; in oak-dominated hardwood forests, it may hinder natural oak regeneration.
Riparian and wetland forests	Water features, including seasonal ephemeral ponds, and the surrounding vegetation provide beneficial habitat elements for forest bird breeding and migrating birds.

Lester (Hawk Ridge) – According to the nomination letter to the Duluth Natural Areas Program[14], 60% of birds listed in Minnesota Birds of Greatest Conservation Need were documented during Hawk Ridge monitoring efforts. Over 200 bird species are documented annually in the natural area for nesting, foraging, and migratory habitat including raptors and passerines. Land management decisions should be made to benefit the bird populations depending on these landscapes. The extensive research and education programs at Hawk Ridge and associated publications are an asset and should be referenced as companion resources when making land management decisions.

[14] Nomination of Lester-Amity-Hawk Ridge Natural Area to the Duluth Natural Areas Program. April 2025. Hawk Ridge Bird Observatory, Minnesota Land Trust, South St. Louis County Soil and Water Conservation District, Minnesota Trout Unlimited.

Mission Creek – A bird use survey in Magney-Snively[15] - an adjacent and similar natural area to Mission Creek - found that forest interior and canopy-associated birds were the most abundant birds using the site, and that the forest was most important as early season breeding and spring migratory habitat. Canada Warbler, Golden-Winged Warbler, and Wood Thrush were species of conservation significance found on the site. The report summarized: "Management actions that prioritize retention of mature hardwood forest, maintenance of well-developed shrub and subcanopy layers, protection of riparian corridors and seasonal wetlands, and proactive adaptation of ash-dominated forested wetlands are likely to provide the greatest benefit."

Trout Streams

All three properties host designated trout streams[16], listed as such due to their cool water temperatures and presence of coarse streambed sediments. Designated trout streams are required through state regulation to have a buffer of perennial vegetation or other approved water quality management practice. Preserving shaded forest cover along seasonal waterways and tributaries, reducing erosion along streams, enhancing aquatic structural diversity and other habitat features within stream corridors, and preventing pollution will all help preserve trout stream integrity.

Lester trout streams: Lester River, Amity Creek, East Branch Amity Creek
Piedmont trout streams: Merritt Creek
Mission trout streams: Mission Creek, Sargent Creek

White Pine Blister Rust

White pine blister rust (WPBR) is caused by *Cronartium ribicola* J.C Fischer, a basidiomycete fungus. The *C. ribicola* life cycle alternates between pines of the subgenus *Strobus*, creating perennial cankers, and *Ribes* L. species (gooseberries, currants), where it produces a foliar disease. WPBR is common in northeastern Minnesota and limits regeneration by killing young white pine, and larger trees can be killed as branch dieback proceeds over time. WPBR originated in Asia and came to North America in the late 19th century.

The lack of sufficient moisture limits the distribution of WPBR. WPBR is more prevalent in areas that have either low daily maximum temperatures or long cool periods during the day. At the macroclimatic scale, WPBR tends to increase with latitude, elevation, and proximity to cold water bodies (e.g., Lake Superior) (WPBR Risk Factors).

At the mesoscale, WPBR is more prevalent at higher elevations and less common in broad river valleys. Night breezes near the Great Lakes are important as carriers of WPBR sporidia. Cool air moves off the land surface, collecting WPBR sporidia from *Ribes*. This cool air hits warmer air above the lake surface, creating a backflow over the land surface. The spores are deposited in a band from 10 to 7 mi. from the lakeshore. Night air movement patterns also match the distribution of WPBR adjacent to swamp forests. At the microscale, small canopy openings retain moisture and remain cooler longer than closed canopy or larger openings and are more susceptible to WPBR infection. Cold air moves downslope and accumulates in narrow valleys or depressions, creating favorable conditions for WPBR infection.

[15] Grinde, A., Siebers, R. 2026. Magney–Snively Natural Area: Management and Avian Monitoring Report, 2024–2025. Natural Resources Research Institute, University of Minnesota Duluth, Technical Report NRRI/TR-2026/43.
[16] https://www.dnr.state.mn.us/fishing/trout/map.html

WPBR infections primarily take place below nine feet above ground level as cool-moist conditions favorable to infection are most common in this zone. Pruning branches below nine feet is an effective way to limit infection (WPBR Pruning). Pruning eliminates branches with the highest risk of infection and branches that are already infected. Pruning should be avoided during spring when new shoot growth begins. Tree bark can also be damaged. Pruning can begin on the lowest branches when trees are 4-6 years old.

Section 4: Management Goals, Strategies, and Actions

Management Goal Summary

1. *Recreation:* Support recreational uses and enhance recreational user experience
2. *Ecosystem function:* Protect and enhance water quality, soil integrity, and wildlife habitat
3. *Regeneration:* Ensure healthy forest regeneration and accelerate forest succession towards late-stage native tree composition
4. *Restore/enhance native plant communities:* Manage for revitalization of native plant communities, remove invasive species, and reintroduce native vegetation where it is lacking
5. *Forest resilience:* Support forest resilience in the face of climate change and disturbances such as windstorms and wildfire

Goal 1 RECREATION

Support recreational uses and enhance recreational user experience

Strategy 1.1	**Maintain trail functionality**
Action 1.1.1	Cut and remove weakened or dead trees along trails
Strategy 1.2	**Manage for open or partially open ("park-like") understory conditions**
Action 1.2.1	Mulch/masticate dense shrubs
Action 1.2.2	Prescribed burning
Action 1.2.3	Prescribed grazing
Strategy 1.3	**Manage viewsheds at key viewpoints**
Action 1.3.1	Cut tall vegetation
Action 1.3.2	Remove accumulated woody debris

Goal 2 ECOSYSTEM FUNCTION

Protect and enhance water quality, soil integrity, and wildlife habitat

Strategy 2.1	**Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality**
Action 2.1.1	Systemic insecticide treatment into mature female ash trees during early-stage invasion to protect seed trees for future ash regeneration. Girdle ash trees to attract EAB in combination with systemic insecticide injection to adjacent trees
Action 2.1.3	Biocontrol of EAB through release of parasitoid wasps
Action 2.1.4	Underplanting - Plant replacement trees where ash decline and mortality is advanced
Strategy 2.2	**Stabilize erodible soil along wetland, stream and riverbanks**
Action 2.2.1	Seed fast-growing trees on eroded banks where tree cover is desired
Action 2.2.2	Seed fast-growing native grasses and forbs on eroded banks where tree cover is not deemed critical
Strategy 2.3	**Increase complexity of forest structure to encourage bird, bat, and pollinator habitat**

Action 2.3.1 Retain snags at a density of 5-10 snags/acre for wildlife habitat, particularly large diameter trees (>12" DBH) and hardwood species
Action 2.3.2 Allow aging trees to decay in place, contributing coarse woody debris and standing deadwood and cavities
Action 2.3.3 Gap selection and shelterwood treatments to improve priority nesting and foraging areas

Strategy 2.4 Encourage bird and pollinator food sources

Action 2.4.1 Plant native flowering and fruiting shrubs
Action 2.4.2 Maintain establishing vegetation through watering, pruning, mulching, etc
Action 2.4.2 Prescribed burning or coppicing to stimulate forage production

Goal 3 REGENERATION

Ensure healthy natural forest regeneration and accelerate forest succession towards late-stage native tree composition

Strategy 3.1 Create canopy openings to allow sunlight to reach forest floor

Action 3.1.1 Single tree selection
Action 3.1.2 Gap selection
Action 3.1.3 Shelterwood harvest
Action 3.1.4 Crop (seed) tree release
Action 3.1.5 Girdle trees surrounding seed producing trees of interest
Action 3.1.6 Commercial harvest

Strategy 3.2 Reduce competition in mid-story

Action 3.2.1 Mulch/masticate shrub layer
Action 3.2.2 Remove buckthorn

Strategy 3.3 Promote natural regeneration in vicinity of seed-bearing trees

Action 3.3.1 Monitor for seed producing trees of interest
Action 3.3.2 Site preparation - Prescribed burning
Action 3.3.3 Site preparation - Mechanical soil scarification

Strategy 3.4 Artificial regeneration

Action 3.4.1 Plant trees
Action 3.4.2 Disperse tree seeds

Strategy 3.5 Protect seedlings and saplings (natural or artificial regeneration)

Action 3.5.1 Cage/bud cap individual trees
Action 3.5.2 Large area deer exclosure - natural materials or fence
Action 3.5.3 Encourage deer hunting

Goal 4 RESTORE/ENHANCE NATIVE PLANT COMMUNITIES

Manage for revitalization of native plant communities, remove invasive species, and reintroduce native vegetation where it is lacking

Strategy 4.1 Buckthorn removal

Action 4.1.1 Hand pull seedlings up to 1" diameter
Action 4.1.2 Hand cut or chainsaw stems >1" diameter
Action 4.1.3 Masticate or mulch dense stands of buckthorn
Action 4.1.4 Follow-up foliar herbicide treatment after initial removal
Action 4.1.5 Prescribed grazing on resprouts after initial removal

Strategy 4.2 Prevent introductions of aggressive introduced plants

Action 4.2.1 Monitor and remove invasive plants at first detection (Early Detection Rapid Response)
Action 4.2.2 Install boot brushes at trailheads
Strategy 4.3 Re-establish native vegetation
Action 4.3.1 Seed native grasses and forbs
Action 4.3.2 Plant native shrubs and/or trees
Strategy 4.4 Restore and maintain fire-dependent plant communities
Action 4.4.1 Prescribed burning
Strategy 4.5 Transition tree plantations to native forest composition
Action 4.5.1 Thin overly stocked tree plantations, sell commercially when possible or remove offsite
Action 4.5.2 Remove non-native tree species, sell commercially when possible or remove offsite
Action 4.5.3 Interplant diverse native trees suitable to site conditions

Goal 5 FOREST RESILIENCE

Support forest resilience in the face of climate change and disturbances such as windstorms and wildfire

Strategy 5.1 Support health of retained trees
Action 5.1.2 Thin overstocked mature trees (shelterwood harvest)
Strategy 5.2 Reduce hazardous fuel load to reduce wildfire risk and severity
Action 5.2.1 Thin and remove overcrowded balsam fir or white spruce
Action 5.2.2 Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies
Action 5.2.3 Woody debris processing through biochar creation, pile burning, or off-site chipping
Action 5.2.4 Prescribed burning
Strategy 5.3 Introduce native tree species and genotypes better suited for future climate scenarios – tolerant of prolonged drought, extreme heat events, increased storm severity, heavy rainfall, increase wildfire severity, etc.)
Action 5.3.1 Plant currently occurring species whose range naturally extends further south - red oak, bur oak, white pine, yellow birch, basswood, sugar maple, red maple, silver maple
Action 5.3.2 Plant currently occurring northern conifers at the southern end of their range only in climate resilient sites (protected from extreme heat, drought, wind) - black spruce, white spruce, jack pine, tamarack, white cedar
Action 5.3.3 Select seeds of currently occurring species from slightly more southern stock
Action 5.3.4 Assisted migration - Introduce species native to adjacent regions with slightly warmer climates – white oak, swamp white oak, black cherry, American elm, bitternut hickory, eastern cottonwood, hackberry, river birch, etc.

Section 3: Lester-Amity-Hawk Ridge Natural Area (Lester)

Figure 2: Lester Stands Map

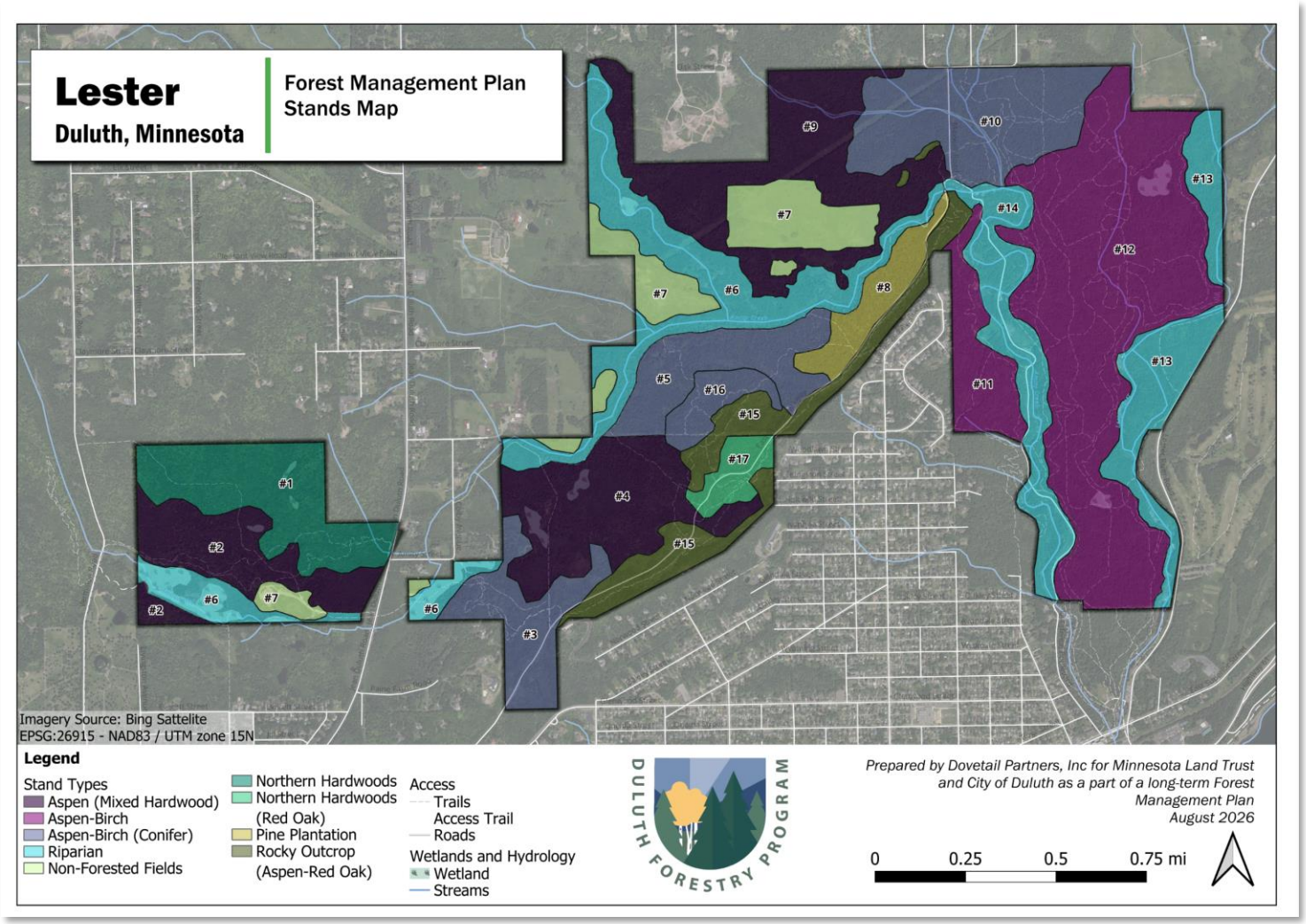
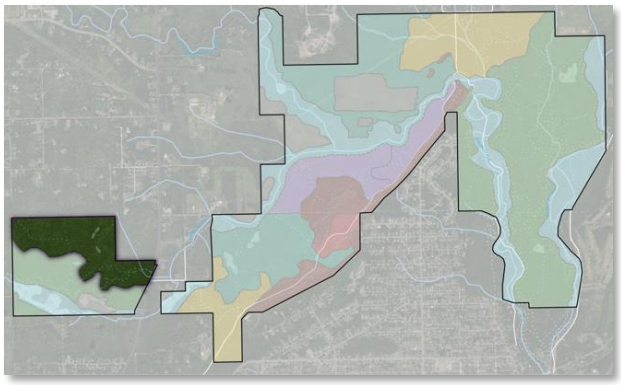


Table 6: Lester-Amity-Hawk Ridge Stand Attributes

Stand #	Forest Type	Acres	Soil Prima	NPC Primary	Avg DBH (in)	SE DBH (in)	Avg Basal Area (ft2/ac)	SE Basal Area (ft2/ac)	SiteIndex1	SiteIndex1_species	SiteIndex2	SiteIndex2_species	Total Plots
1	Northern Hardwoods	88.5	F141D	MHn35b	10.1	0.6	105	13.3	77.5	Quaking Aspen	50	Sugar Maple	10
2	Aspen (Black Ash, Northern Hardwoods)	69.5	F141D	MHn35b	9.6	0.9	110	9.5	77.5	Quaking Aspen	50	Sugar Maple	7
3	Aspen-Birch (Red Pine)	56	F147D	FDn43b	9.8	1.1	93	19.2	53.0	Quaking Aspen	52.7	Red Pine	6
4	Aspen-Birch (Red Maple)	103.6	F147D	WFn55a	8.1	0.9	56	10.1	68.5	Quaking Aspen	57	Red Maple	9
5	Aspen-Birch (Plantation)	60.3	F147D	Disturbed/ FDn43b1	8	1	129	12.8	74.0	Quaking Aspen	56.5	Red Pine	7
6	Riparian	147.9	E9E	FFn57a / MHn46b	7.4	0.5	96	10.5	71.5	Quaking Aspen	58	Paper Birch	20
7	Non-Forested Field	84	E3A	Disturbed					n/a	n/a	n/a	n/a	0
8	Pine Plantation	31.9	F147D	Disturbed	11.6	0.9	146	17.5	72.5	Quaking Aspen	51.5	Red Pine	8
9	Aspen-Birch (Red Maple)	136.7	E3A	MHn44a / MHn46b / FDn43b	8.8	0.5	98	10.8	63.0	Quaking Aspen	49	Sugar Maple	16
10	Aspen-Birch (Balsam Fir)	109.7	E23F	FDn43b	8.8	0.6	136	15.7	72.0	Quaking Aspen	62	Balsam Fir	11
11	Aspen-Birch	42.7	E15A	FDn43b / MHn44a	9.1	0.7	107	12.7	61.5	Quaking Aspen			7

12	Aspen-Birch	294.5	E3B	FDn43b	9.8	0.4	116	6.1	80.5	Quaking Aspen	62	Paper Birch	32
13	Aspen-Birch (Riparian)	75.9	E11E	FDn33b / FFn57a	9.2	0.6	110	12.6	61.0	Aspen	47	Paper Birch	5
14	Developed/Riparian	74.7	E23F	Developed / Disturbed / FDn33b	8.9	1	107	19	71.5	Quaking Aspen	58	Paper Birch	10
15	Rocky Outcrop (Aspen-Red Oak)	74.2	F160F	ROn23a	4.8	1.2	46	13.1	53.5	Red Oak	54	Jack Pine	7
16	Aspen-Birch (Balsam Fir)	21.5	F160F	FDn43b1	6	0.4	100	14.4	67.0	Quaking Aspen	65	Paper Birch	5
17	Northern Hardwoods (Red Oak)	19	F160F	MHn35b	10.1	0.6	134	14.3	44.3	Red Oak			5

Stand 1 Northern Hardwoods





Stand Characteristics

Forest Type: Northern Hardwoods

Size: 88 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	72.2	81.93%
MHn47a	7.9	8.93%
MHn46b	4.2	4.78%

Ecological Site (USDA):

- F093AY013MN - Loamy Uplands
- F093AY006MN - Depressional Wet Hardwood Forest

Dominant Soils:

- ∉ F141D (50%), F139F (37%), F140B (8%)
- ∉ Silt loam, sandy loam
- ∉ Well drained to very poorly drained depressions

Successional Stage: Young forest (0-55 years) beginning to transition to mature forest

Average Diameter (DBH): 10.1" (SE=0.6)

Average Basal Area: 105 ft^2/ac (SE=3.3)

Snags per acre: 87 medium (6-11" DBH), 1.5 large (>12"), mostly quaking aspen, bigtooth aspen, and black ash

Coarse woody debris: Medium to high

Wildfire risk: Low

Invasive Species: Moderate to high - buckthorn is established in parts of the stand

Pests & Disease: Emerald ash borer is well-established, dead and dying ash are present

Current Condition: This is a rich mixed hardwood forest on a slightly south-facing slope with black ash-dominant wet depressions occurring throughout. Red oak is the dominant canopy tree (12-26" DBH), complemented by co-dominant bigtooth aspen, quaking aspen, sugar maple, and paper birch, and black ash dominating the lower lying areas. Sugar maple is the most common intermediate tree, and is present in all levels of the canopy structure. Regeneration is dominated by black and green ash, with quaking aspen, sugar maple, and red oak also common, and less basswood, paper birch, red maple, and balsam fir. In this forest type, white pine, yellow birch, and white spruce would be expected but have not been detected likely due to lack of seed source. Buckthorn is established in the understory, along with moderately dense beaked hazel, red-osier dogwood, and guelder-rose (*Viburnum opulus*). Bluejoint, sedges, bracken fern, currant, and bush honeysuckle are common in the understory.

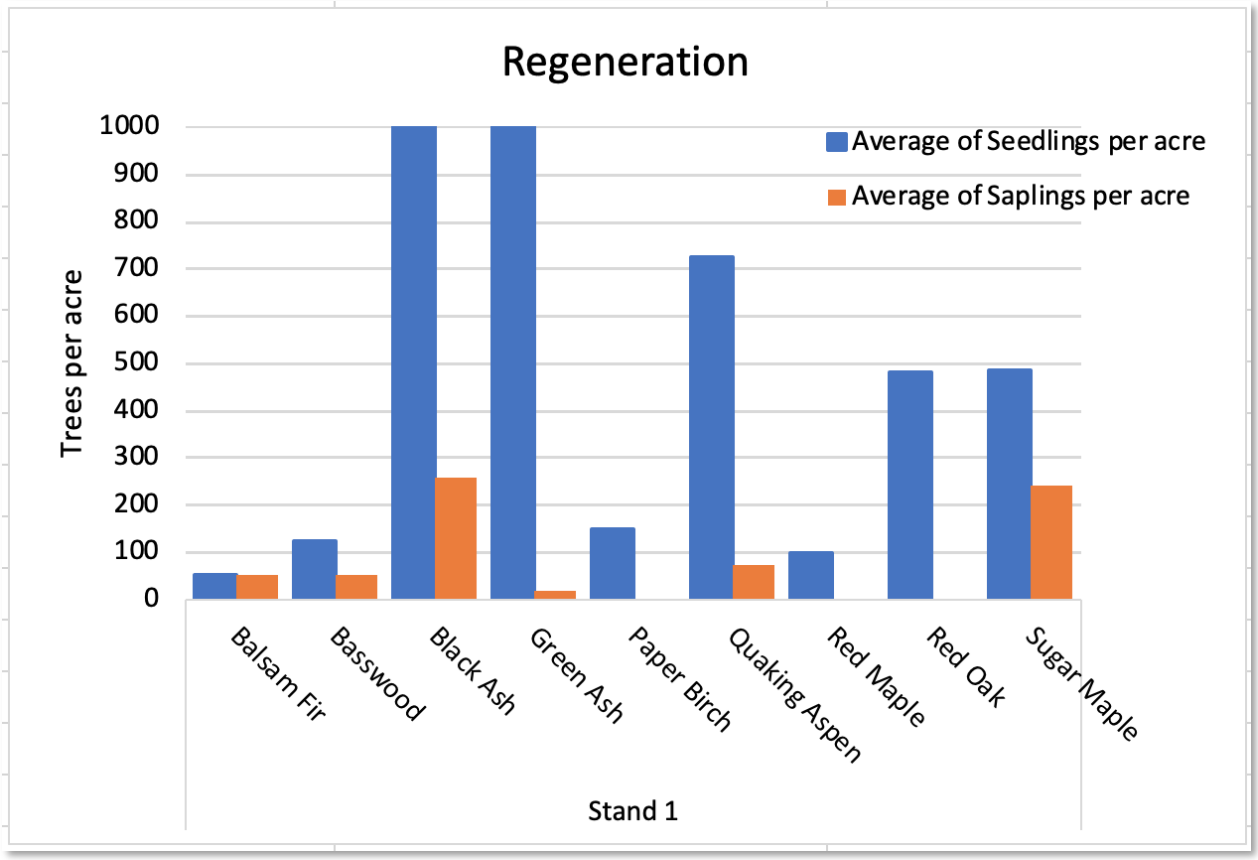
Current Recreational Uses or Management:
A snowmobile trail and hiking trail pass through the stand. Recreational activity is generally lower compared to other areas of the property.

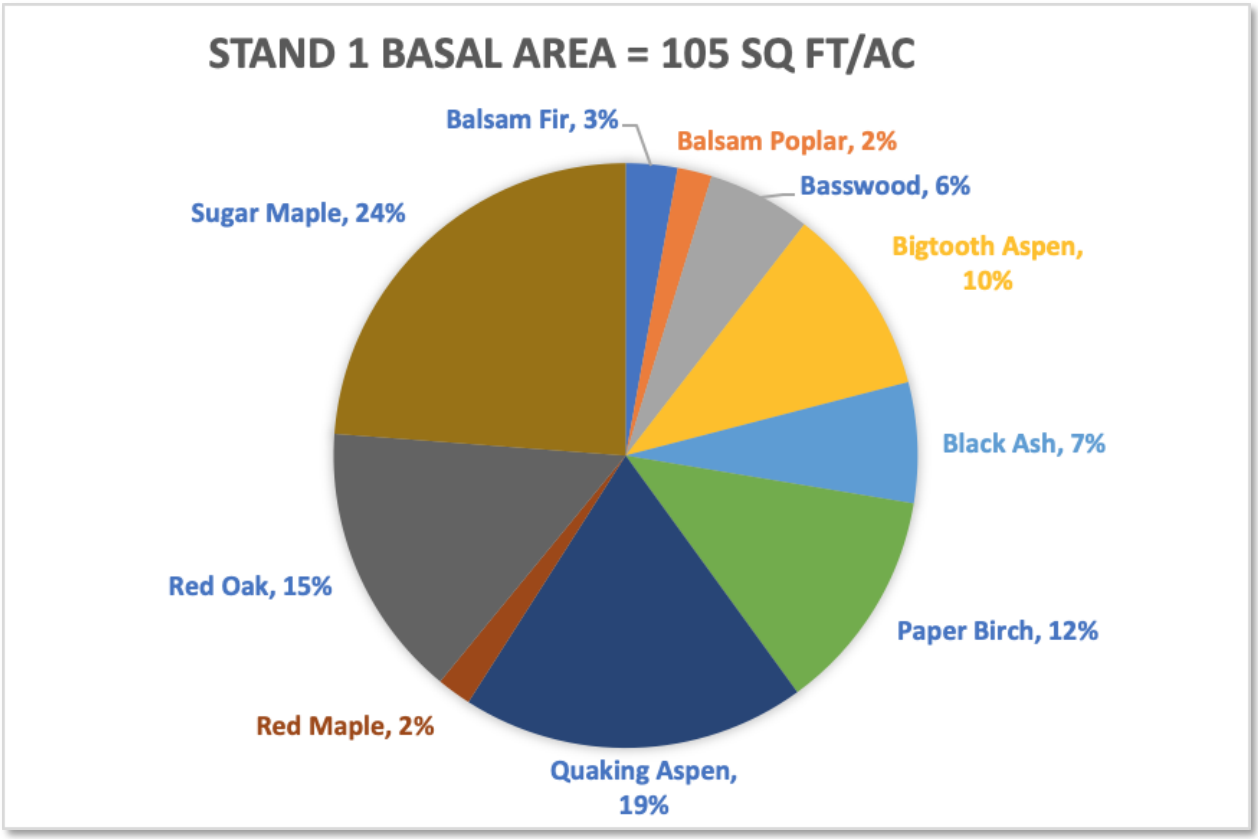
Adjacent land use concerns:
This stand borders private land on three sides

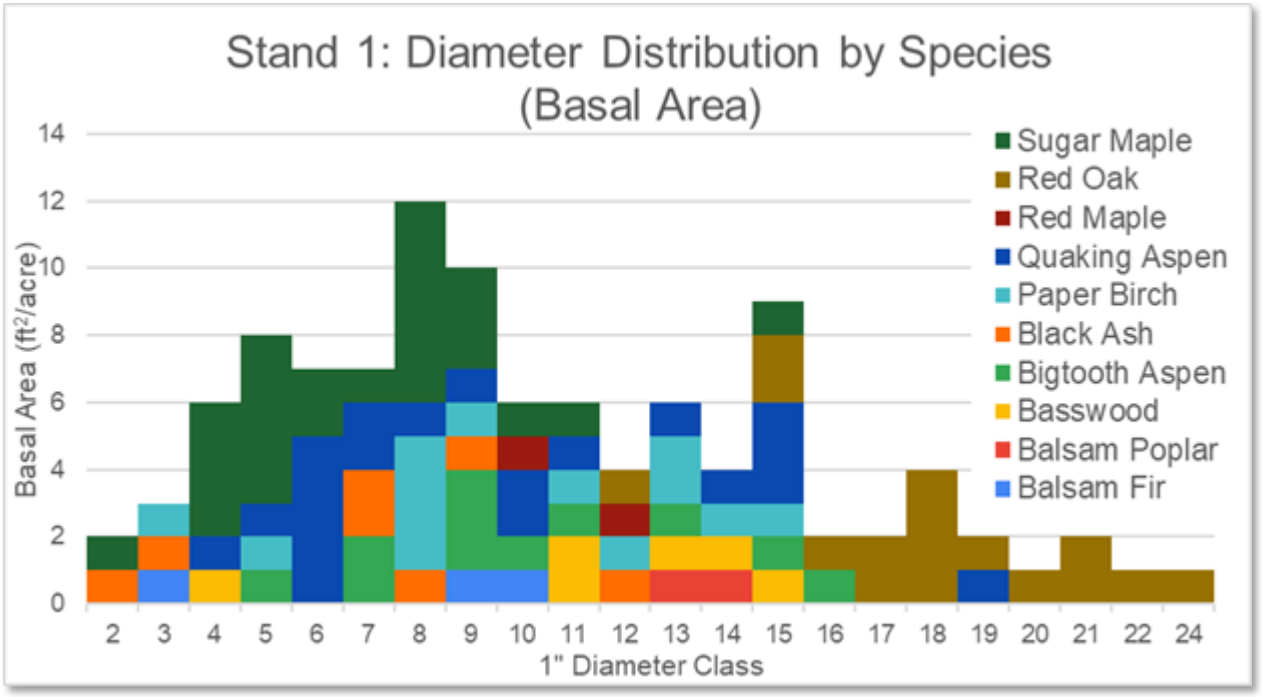
No action result (10-20 years): Buckthorn may become problematic, especially in areas with ash and eventually aspen as these species die out due to EAB or age. Depressions may transition from forested to shrubby or non-forested due to shortage of seed sources to recruit other wet forest species and flooded conditions.

Management Goals, Strategies, and Actions

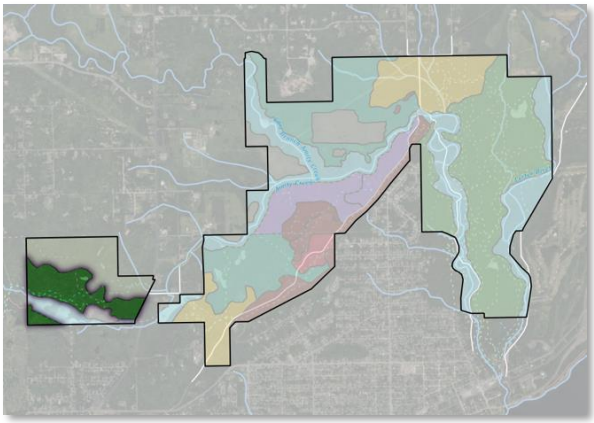
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Regeneration	Artificial regeneration	Disperse tree seeds	
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Basswood
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
Stand 1


STAND 1 BASAL AREA = 105 SQ FT/AC
Balsam Fir, 3%
Balsam Poplar, 2%
Basswood, 6%
Bigtooth Aspen, 10%
Black Ash, 7%
Paper Birch, 12%
Quaking Aspen, 19%
Red Maple, 2%
Red Oak, 15%
Sugar Maple, 24%


Stand 1: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 24
1" Diameter Class
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar
Balsam Fir

Stand 2 Aspen (Black Ash, Northern Hardwoods)





Stand Characteristics

Forest Type: Aspen (Black Ash, Northern Hardwoods)

Size: 70 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	40.9	58.78%
MHn46b	12.8	18.42%
WFn55a	6.7	9.62%
MHn47a	5.0	7.21%

Dominant Soil:

- F141D (58%): Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes. Silt loam, loam over gravelly sandy loam at 4". Well drained to moderately well drained with very poorly drained depressions (15%).
- F135A (12%): Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes. Silt loam and loam over gravelly sandy loam at 5-7". Somewhat poorly drained to very poorly drained.
- GP (7%): gravel pit

Ecological Site (USDA): F093AY013MN Loamy Uplands, F093AY006MN - Depressional Wet Hardwood Forest

Successional Stage (MDNR): Young forest (0-55 years) beginning to transition to mature forest

Average Stand Diameter (DBH): 9.6" (SE=0.9)

Average Stand Basal Area: 110 ft^2/ac (SE=9.5)

Snags per acre: 26 medium (6-11" DBH), 2 large (>12" DBH), mostly aspen

Coarse woody debris: Medium to high

Wildfire risk: Low

Invasive Species: Moderate, buckthorn and honeysuckle are present, but not well-established.

Pests & Disease: EAB present, with trees showing top dieback and epicormic sprouting

Current Condition: This stand is a similar wet-mesic forest with depressions like Stand 1, except quaking aspen (majority 3-8" DBH) and bigtooth aspen (6-11" DBH) are more dominant and oak is less prevalent. Sugar maple is common as an intermediate, subcanopy, and regenerating tree. Paper birch, red oak, basswood, balsam fir, and red maple are also components of the canopy, subcanopy, and regenerating layers. Beaked hazel and buckthorn are the dominant shrub layer species, along with dogwoods. Bush honeysuckle, bracken fern, large-leaved aster, and lady fern are common in the understory. Beaver activity was noted with dams and lodges present in the wetland adjacent to this stand.

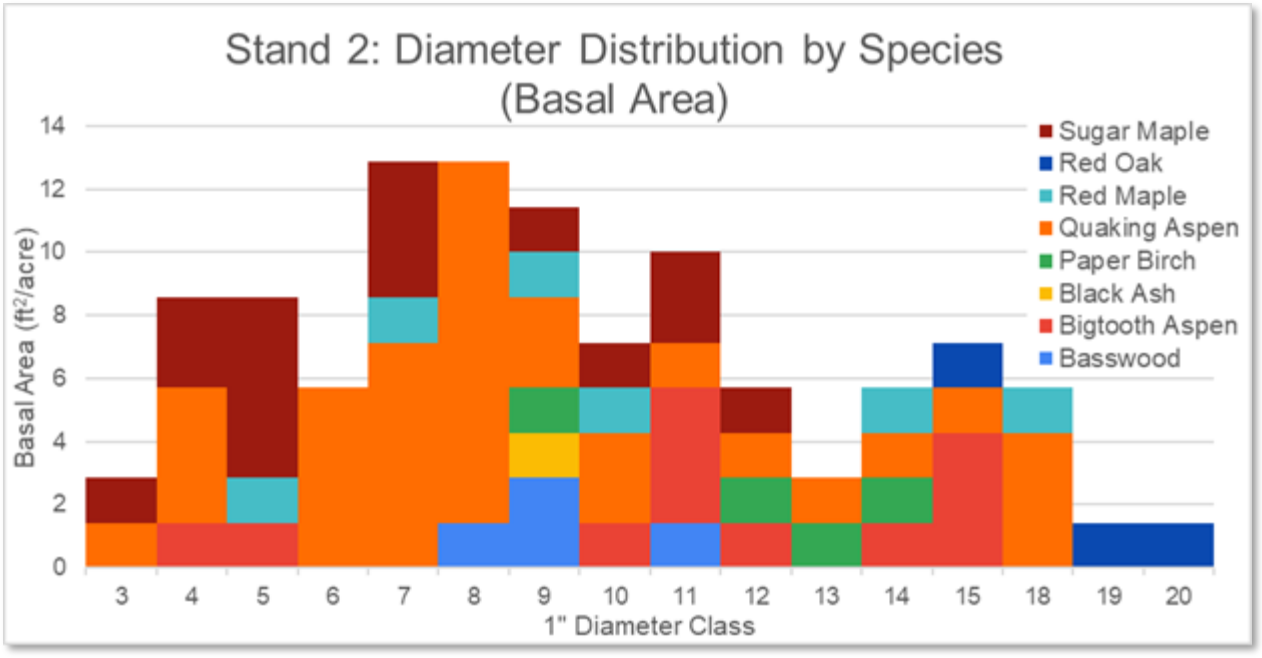
Current Recreational Uses or Management:
A snowmobile trail, mountain bike trail, and hiking trail pass through the stand. Recreational activity is generally lower compared to other areas of the property.

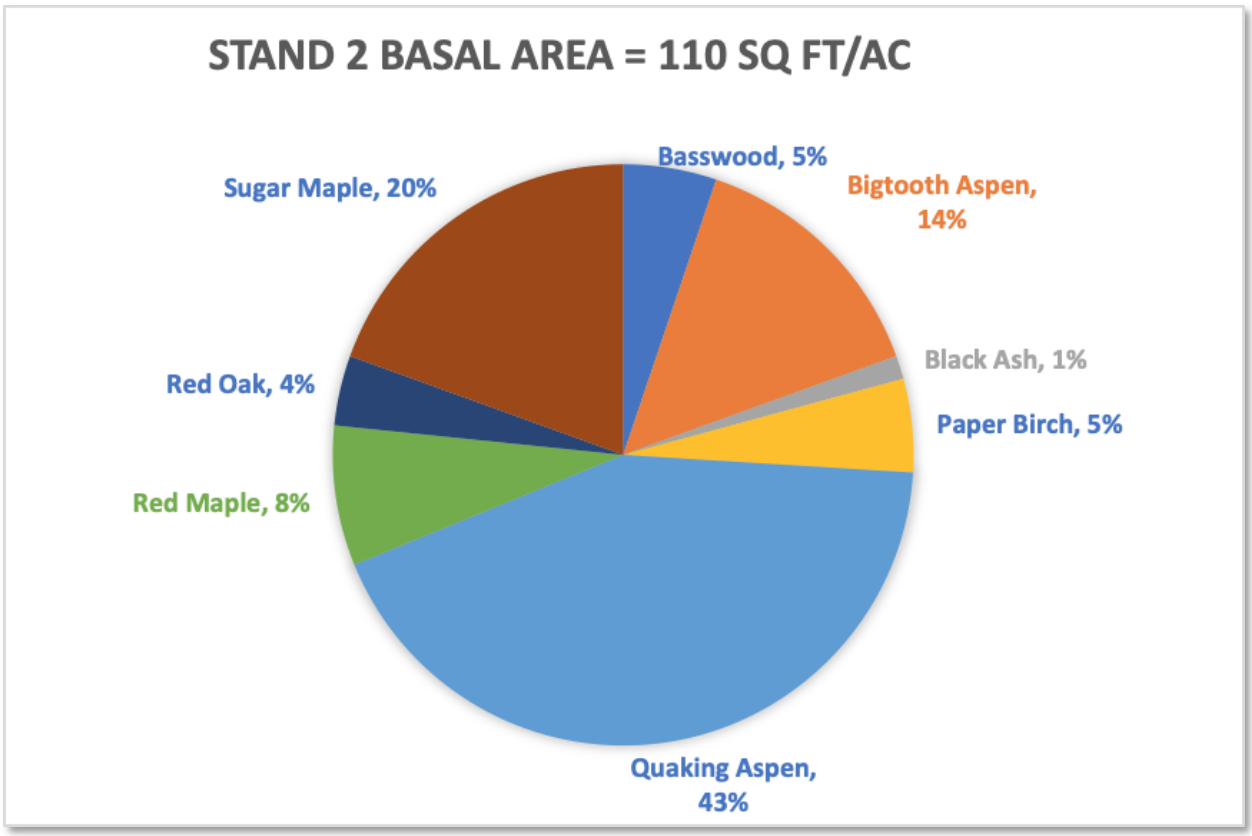
Adjacent land use concerns:
This stand borders private land to the west

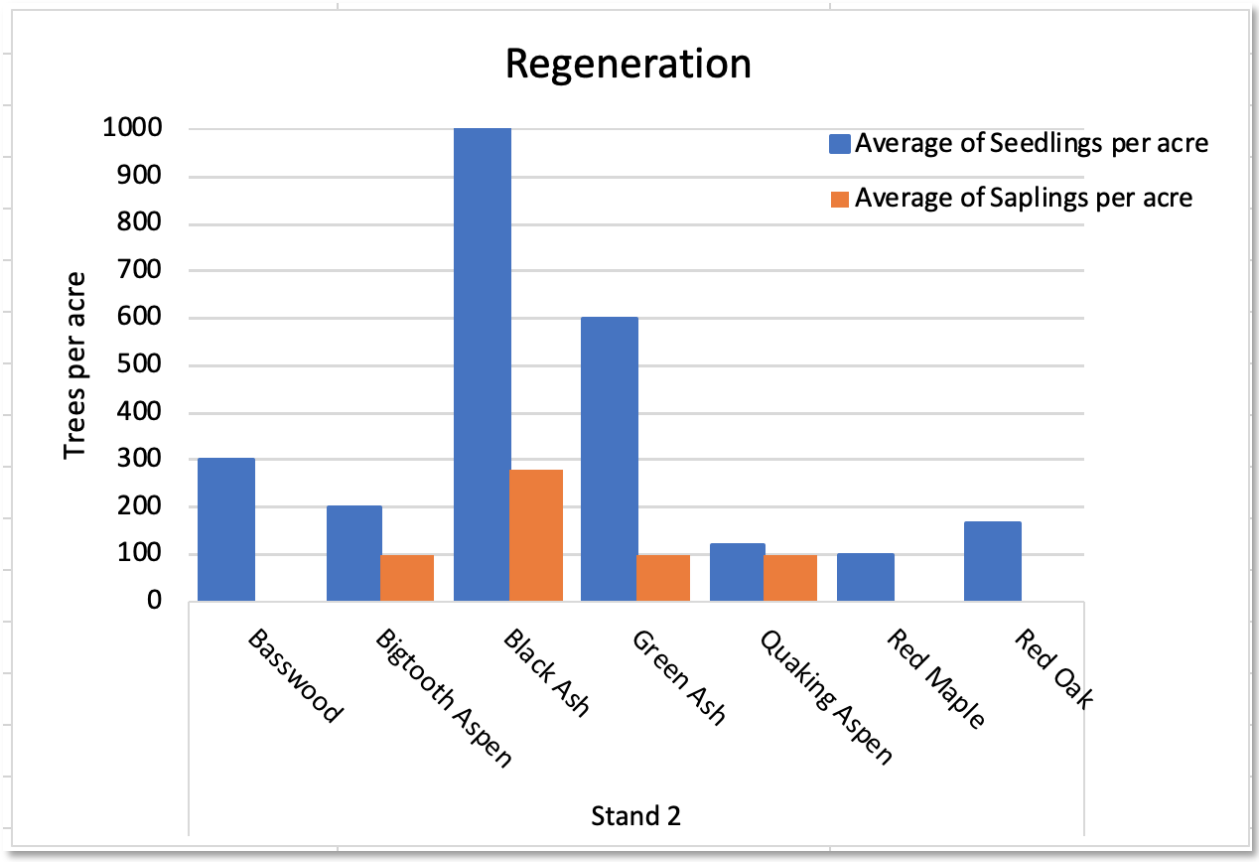
No action result (10-20 years): Buckthorn may become problematic, especially in areas with ash and eventually aspen as these species die out due to EAB or age. Depressions may transition from forested to shrubby or non-forested due to shortage of seed sources to recruit other wet forest species and flooded conditions.

Management Goals, Strategies, and Actions

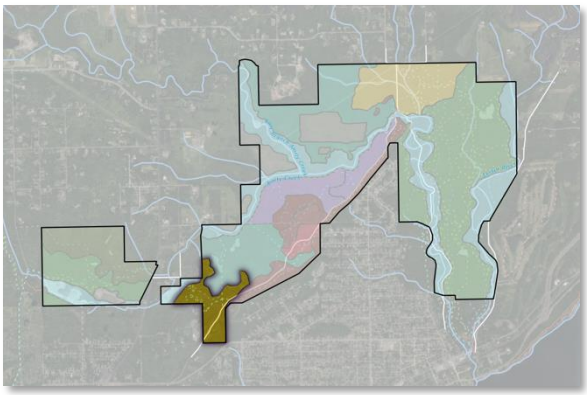
Goal	Strategy	Action	Notes
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Gap selection	Gap widths at least 1-2x height of trees; cut during dormant season. Target aspen.




STAND 2 BASAL AREA = 110 SQ FT/AC
Basswood, 5%
Bigtooth Aspen, 14%
Black Ash, 1%
Paper Birch, 5%
Quaking Aspen, 43%
Red Maple, 8%
Red Oak, 4%
Sugar Maple, 20%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Basswood
Bigtooth Aspen
Black Ash
Green Ash
Quaking Aspen
Red Maple
Red Oak
Stand 2

Stand 3 Aspen-Birch (Red Pine)





Stand Characteristics

Forest Type: Aspen-Birch (Red Pine)

Size: 54 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b	26.0	47.87%
MHn35b	12.1	22.22%
Disturbed	5.3	9.69%
WFn74a	4.1	7.52%

Dominant Soil:

- F147D (66%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.
- F160F (21%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- F112D (12%): Forbay-Augustana complex, 3 to 18 percent slopes. Loam to 79” depth. Well drained to moderately well drained.

Ecological Site (USDA): F093AY013MN Loamy Uplands, F093AY006MN - Depressional Wet Hardwood Forest, F093AY009MN - Bedrock Controlled Upland Forest

Successional Stage (MDNR): Transitional forest (35-55 years)

Average Stand Diameter (DBH): 9.8” (SE=1.1)

Average Stand Basal Area: 93 ft2/ac (SE=19.2)

Snags per acre: 3 medium (6-11” DBH), 2 large (>12” DBH)

Coarse woody debris: Medium

Wildfire risk: Moderate due to fire-dependent characteristics, Skyline parkway, and proximity to residential and research areas

Invasive Species: Buckthorn is high but in isolated patches, including a several-acre stand of mature buckthorn monoculture

Pests & Disease: Emerald ash borer has caused near total mortality of ash trees. Red pines appear stressed with possible secondary bark beetle impacts.

Current Condition: This is a diverse site spanning the entire slope of the southwestern portion of the Hawk Ridge ridgeline. The soil ranges from very deep loam to exposed bedrock, resulting in variable water and nutrient availability and therefore high stress and variable tree composition. Drier exposed portions of the site are dominated by planted red pine (average 6-14” DBH) with young quaking aspen and balsam

poplar (majority 3-5" DBH with some 6-14" DBH), occasional jack pine, paper birch, and red oak in adjacent non-planted areas. These are fire-dependent characteristic mature forests, with the understory layer mostly a diverse array of shrubs including red-osier dogwood, beaked hazel, mountain ash, nannyberry, serviceberry, *Prunus* spp., and hawthorn. In the deeper and wetter soils of this stand, dead/dying black ash and speckled alder swamps dominate along with a notable stand of very mature (4-6" DBH) monoculture of closed-canopy buckthorn with no other tree cover and little evidence of a native plant community. Alder dominance is well established in the wake of ash decline. Regeneration is strongly dominated by black and green ash seedlings with a low rate of recruitment to the sapling stage. Other species show a similar trend of high seedling establishment but low recruitment to sapling stage - paper birch, quaking aspen, red maple, red oak, and smaller amounts of red pine and balsam fir. White pine and white spruce would be expected in this forest type but are not present, likely due to lack of seed source. The legacy of human disturbances combined with the effects of a harsh environment are apparent in the stand. While the recruitment of fire-intolerant species like red maple and ash indicates succession towards hardwood, the high rate of failure and historic fire-influenced characteristics suggests that the stand may benefit from reintroduction of surface fires and management for a fire-dependent ecosystem.

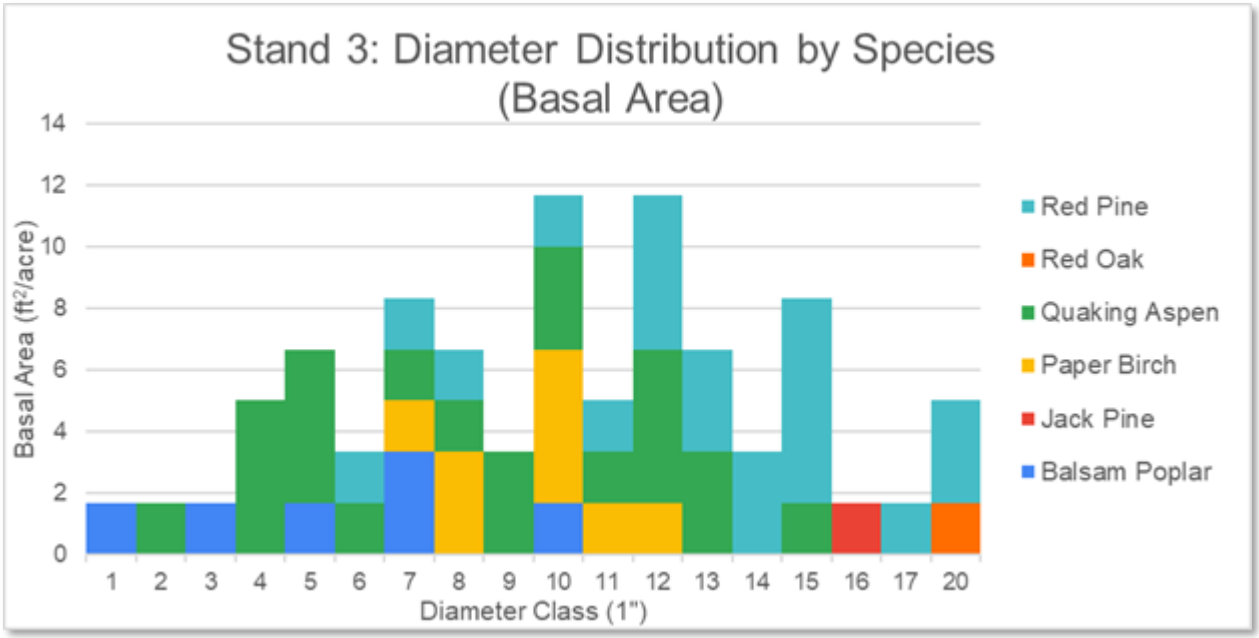
Current Recreational Uses or Management:
Skyline Parkway bisects the stand. A snowmobile trail and hiking trail passes through the stand.

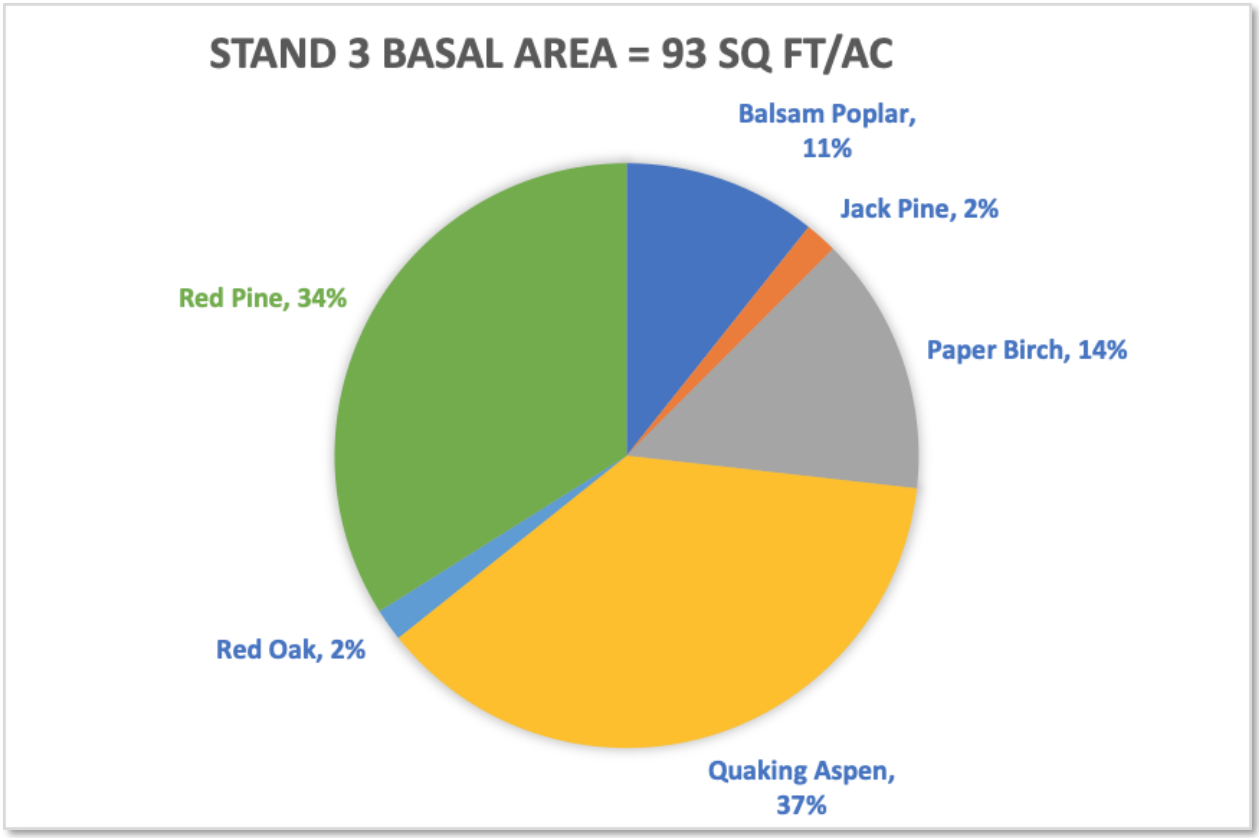
Adjacent land use concerns: Private lands on three sides of the unit, including a dense residential neighborhood to the south.

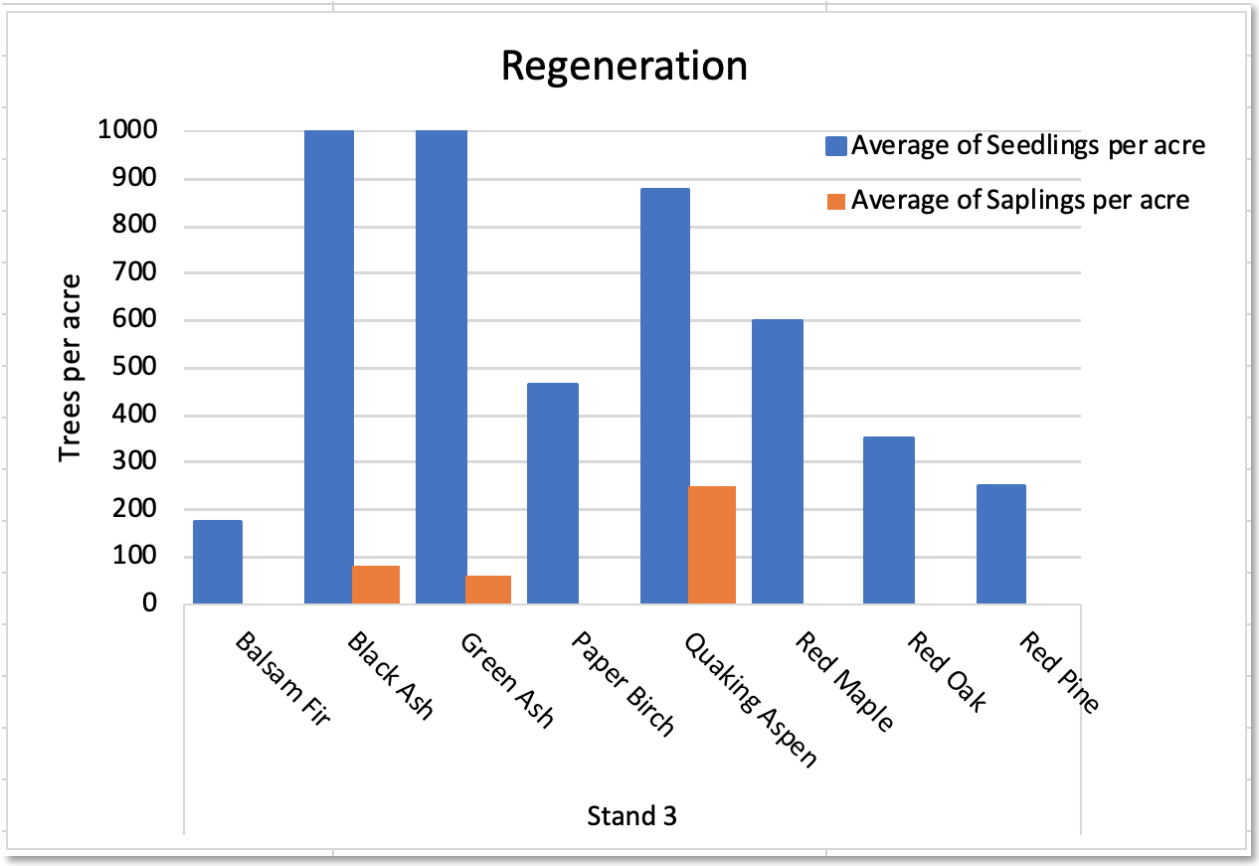
No action result (10-20 years): The stand may continue to transition toward aspen and red maple, and possibly white spruce if seeds are able to disperse from nearby mature trees. The stand is vulnerable to drought and heat stress due to thin soils over bedrock, which may make regeneration for many species challenging, leaving aspen, birch, and drought-hardy understory trees dominant. Buckthorn is likely to expand significantly at the expense of native shrubs and native tree recruitment. Ash stands will likely convert to shrub or non-forested swamps.

Management Goals, Strategies, and Actions

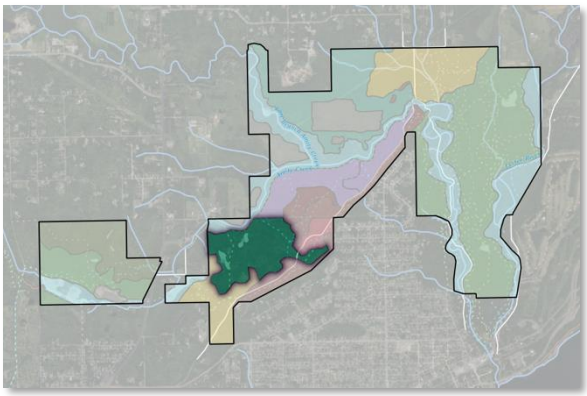
Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Regeneration	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Restore/enhance native plant communities	Restore and maintain fire-dependent plant communities	Prescribed burning	Pine patches


Stand 3: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 20
Diameter Class (1")
Red Pine
Red Oak
Quaking Aspen
Paper Birch
Jack Pine
Balsam Poplar


STAND 3 BASAL AREA = 93 SQ FT/AC
Balsam Poplar, 11%
Jack Pine, 2%
Paper Birch, 14%
Red Pine, 34%
Red Oak, 2%
Quaking Aspen, 37%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Red Pine
Stand 3

Stand 4 Aspen-Birch (Red Maple)





Stand Characteristics

Forest Type: Aspen-Birch (Red Maple)

Size: 104 acres

NPC (MDNR)	*Acres*	*% of stand*
WFn55a	40.3	38.86%
FDn43b	15.6	15.10%
WFn74a	14.0	13.53%
FDn43b1	13.2	12.71%

Dominant Soil:

- F147D (82%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.
- F160F (9%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- F135A (7%): Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes. Silt loam and loam over gravelly sandy loam at 5-7". Somewhat poorly drained to very poorly drained.

Ecological Site (USDA): F093AY013MN Loamy Uplands, F093AY006MN - Depressional Wet Hardwood Forest, F093AY009MN - Bedrock Controlled Upland Forest

Successional Stage (MDNR): Young forest (0-75 years)

Average Stand Diameter (DBH): 8.1" (SE=0.9)

Average Stand Basal Area: 56 ft2/ac (SE=10.1)

Snags per acre: 54 medium, many paper birch (6-11" DBH), 5 large (>12" DBH), mostly ash and aspen

Coarse woody debris: Medium to high

Wildfire risk: Low

Invasive Species: Moderate - buckthorn is typically present in low amounts, but high in isolated areas

Pests & Disease: EAB is established with overstory mortality present

Current Condition: This stand is similar to Stand 3 in being a mosaic of shallow bedrock soils and deeper loamy soils, with variable water retention and therefore a forest composition ranging from fire-influenced on exposed dry sites to wet forested and herbaceous swamps in depressions. Stand 4 is generally flatter, richer, and wetter than Stand 3. Young (3-11" DBH) quaking aspen and red maple (6-14" DBH) dominate

the sparse and inconsistent overstory, with paper birch (3-11" DBH) and bigtooth aspen (3-8" DBH) as co-dominants and balsam fir (3-5") emerging in the intermediate layer. Emerald ash borer has caused a near-total ash mortality in wet forested areas, leaving speckled alder as strongly dominant, making any effort at ash underplanting challenging. Black and green ash is retained as a dense regeneration layer, with some successful establishment of black ash to saplings. Quaking aspen, balsam fir, and bigtooth aspen make up the remainder of a modest sapling cohort. Quaking aspen seedlings are also very prevalent, and small amounts of paper birch, red maple, and red oak that have not recruited to the sapling age. Other than dense areas of speckled alder, the shrub layer is moderate and consists of beaked hazel, buckthorn, dogwoods, and serviceberry. Bluejoint is common in the understory, along with goldenrod and bush honeysuckle. Despite the presence of fire-dependent plant communities, returning fire to this stand may not be a priority nor practical due to prevalence of fire-intolerant species, difficulty to access with equipment, and generally swampy conditions.

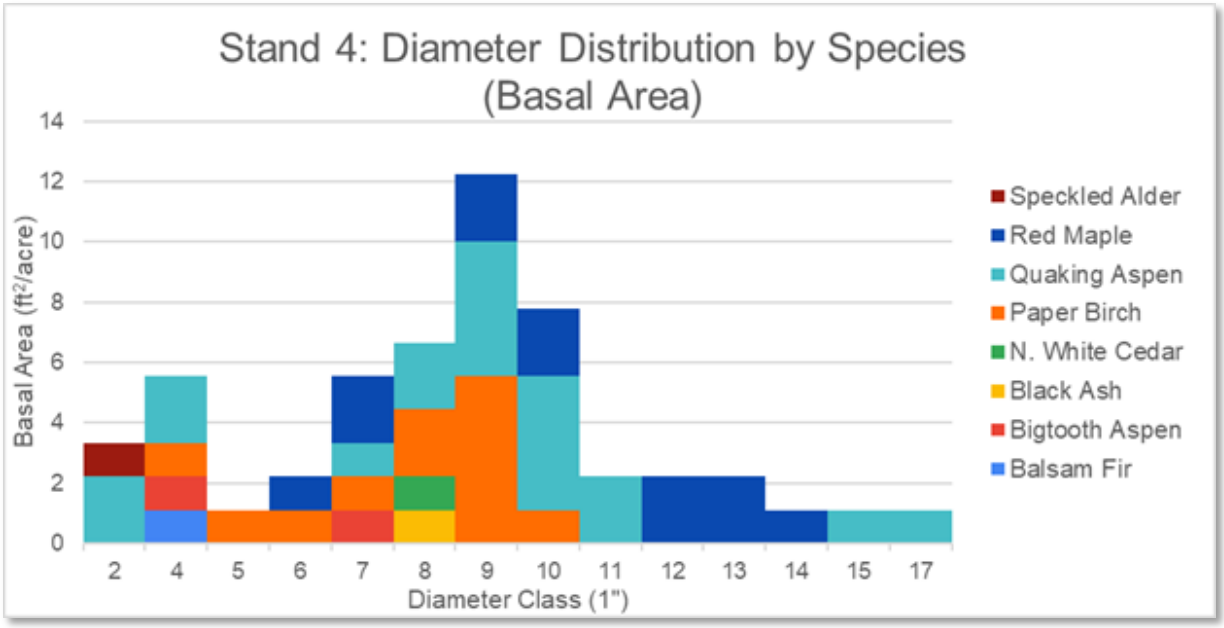
Current Recreational Uses or Management:
A snowmobile trail and a hiking trail pass through the stand. A primary hawk research facility is located in the southern section of the stand, with associated vegetation clearing surrounding it and throughout the stand.

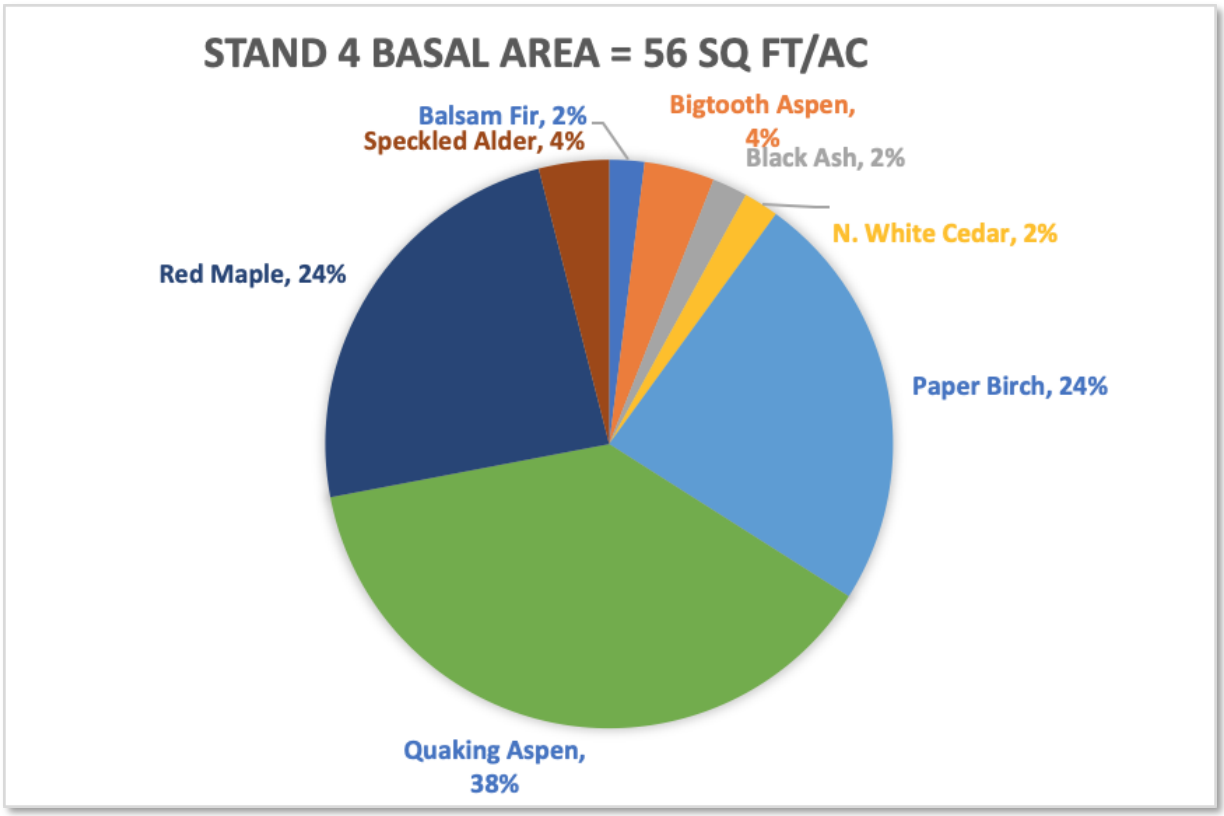
Adjacent land use concerns: N/A

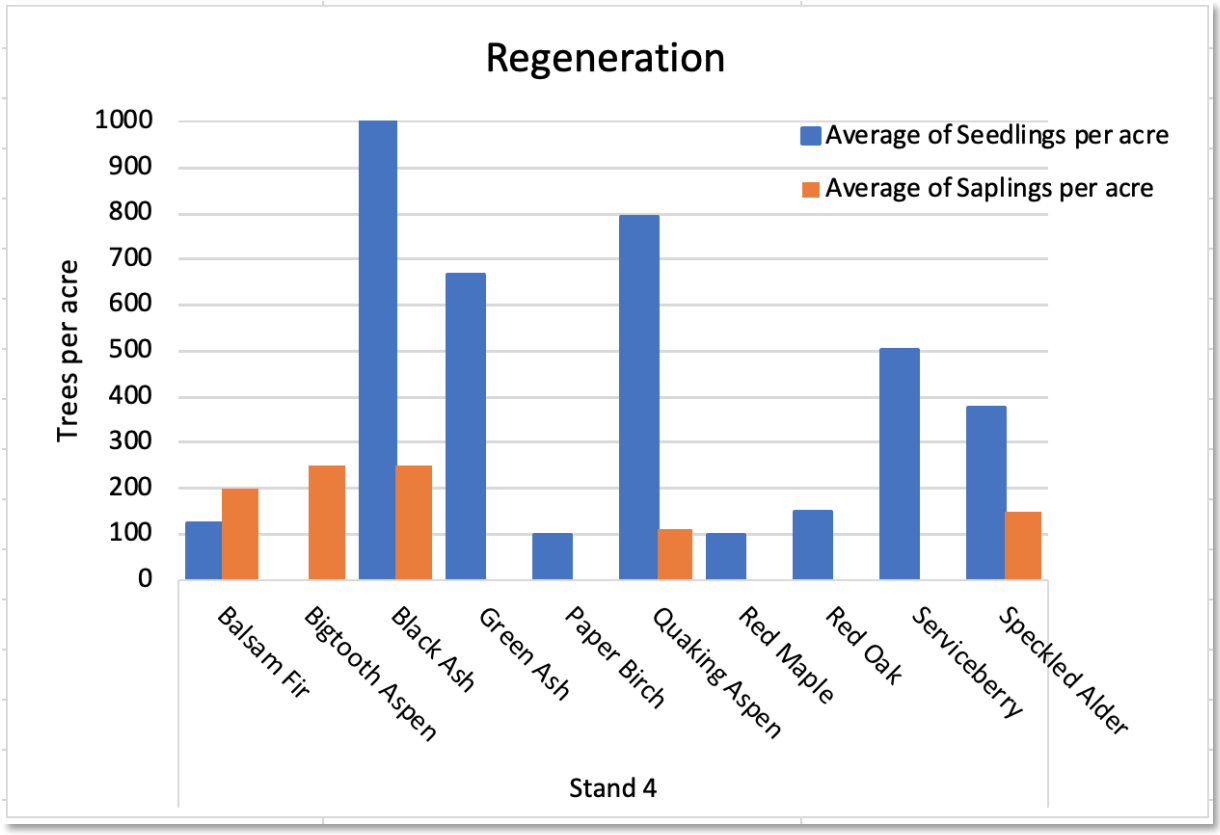
No action result (10-20 years): The stand is likely to continue to persist in a fairly consistent state. Balsam fir and red maple may become more dominant as aspen and birch age out. Due to variable water retention in the soil, flooding or drought events may cause excess and rapid tree mortality leading to dramatic changes to successional state and possibly composition. Buckthorn is likely to expand significantly at the expense of native shrubs and native tree recruitment. Ash stands will likely convert to shrub or non-forested swamps.

Management Goals, Strategies, and Actions

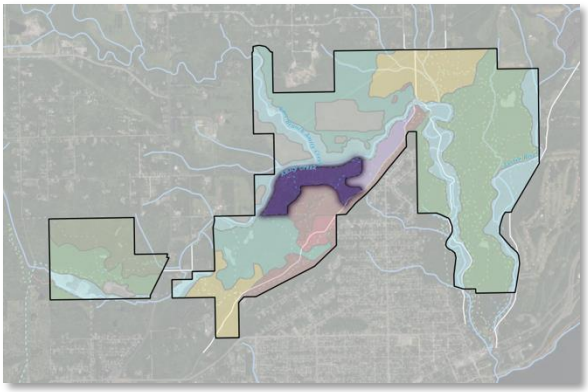
Goal	Strategy	Action	Notes
Restore/enhance native plant communities; EAB restoration	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Underplanting - Plant trees other than ash where ash decline and mortality is advanced	
Regeneration	Reduce competition in midstory	Mulch/masticate shrub layer	Mastication in strips of overabundant shrubs (up to 30% of stand at one time). Target alder, buckthorn


Stand 4: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
14
12
10
8
6
4
2
0
2 4 5 6 7 8 9 10 11 12 13 14 15 17
Diameter Class (1")
Speckled Alder
Red Maple
Quaking Aspen
Paper Birch
N. White Cedar
Black Ash
Bigtooth Aspen
Balsam Fir


STAND 4 BASAL AREA = 56 SQ FT/AC
Balsam Fir, 2%
Speckled Alder, 4%
Bigtooth Aspen, 4%
Black Ash, 2%
N. White Cedar, 2%
Red Maple, 24%
Paper Birch, 24%
Quaking Aspen, 38%



Stand 5 Aspen-Birch (Plantation)





Stand Characteristics

Forest Type: Aspen-Birch (Plantation)

Size: 60 acres

NPC (MDNR)	*Acres*	*% of stand*
Disturbed	31.7	52.60%
FDn43b1	15.9	26.38%
FDn43c	4.7	7.86%
MHn46b	4.0	6.60%

Dominant Soil:

- F147D (94%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.

Ecological Site (USDA): F093AY013MN Loamy Uplands, F093AY006MN - Depressional Wet Hardwood Forest

Successional Stage (MDNR): Modified, with characteristics of both mature (55-95 years) and transitional (35-55 years)

Average Stand Diameter (DBH): 8.0"; SE 1.0"

Average Stand Basal Area: 129 ft2/ac: SE 12.8 ft2/ac

Snags per acre: 49 medium (6-11" DBH), many conifer (black spruce) and black ash

Coarse woody debris: High

Wildfire risk: High due to fuel loading from blowdown and dense living and dead balsam fir and white spruce

Invasive Species: Low to moderate, buckthorn and honeysuckle present sporadically throughout stand

Pests & Disease: Emerald ash borer has caused significant ash mortality

Current Condition

This stand has similar topographic and soil characteristics as Stand 4, but clearly has a different management history with extensive over-mature or failed tree plantations and more modified native plant communities indicating a likely history of tilling and cultivation. Distinct stands of planted red pine (15-20" and 6-8" DBH) and black spruce (6-12") are fairly or in need of thinning. Young aspen (majority <5" but occasionally up to 20" DBH) with fewer paper birch (3-11" DBH) occur on the outskirts or within canopy gaps of planted stands. Balsam fir and white spruce (3-8" DBH) are becoming established as intermediate trees in the understory. Black ash, balsam poplar, and speckled alder are also present, although many black ash have died. The stand has many dead and downed trees from failed plantings and blowdown. Regeneration is strong, with half black ash and the remainder quaking aspen, balsam fir, and lesser amounts of balsam poplar, paper birch, red oak, and white spruce. Shrub layer is moderately dense with buckthorn, beaked hazel, and serviceberry. White and red pine are ecologically appropriate to the site but are uncommon as naturally occurring trees. The ecological history and trajectory is difficult to read but trends towards fire-dependent and may be more fully expressed through reintroduction of surface burning.

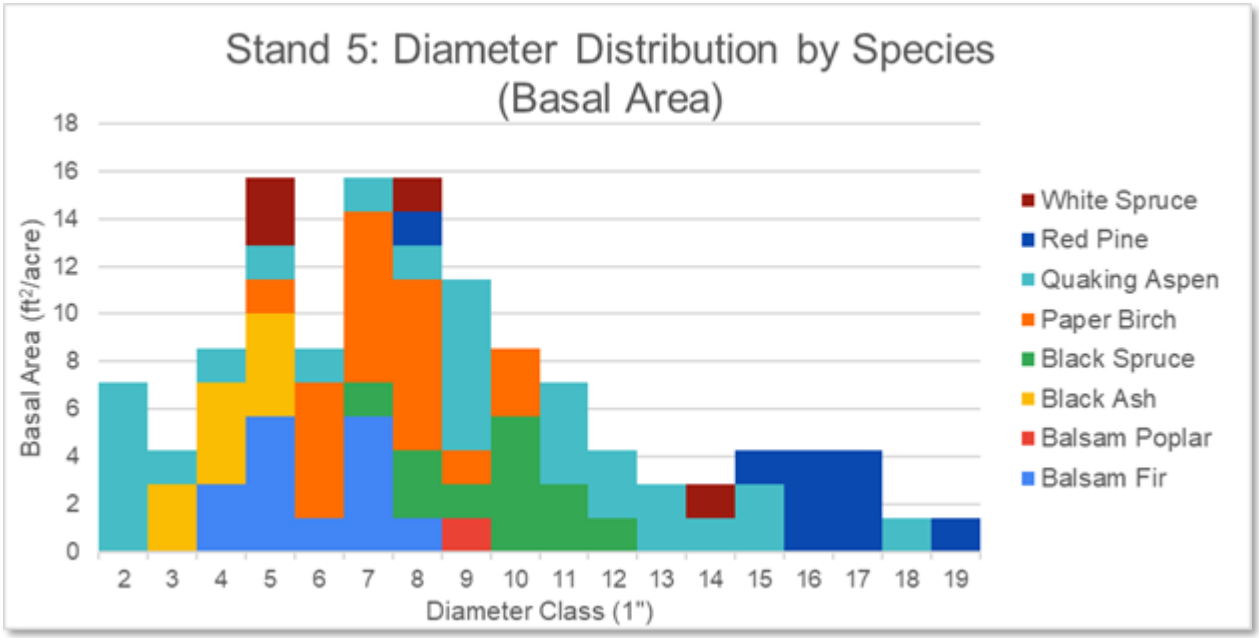
Current Recreational Uses or Management: A couple of hiking trails pass through the unit. The northern boundary of the unit is defined by the Amity Creek/Duluth Traverse trail.

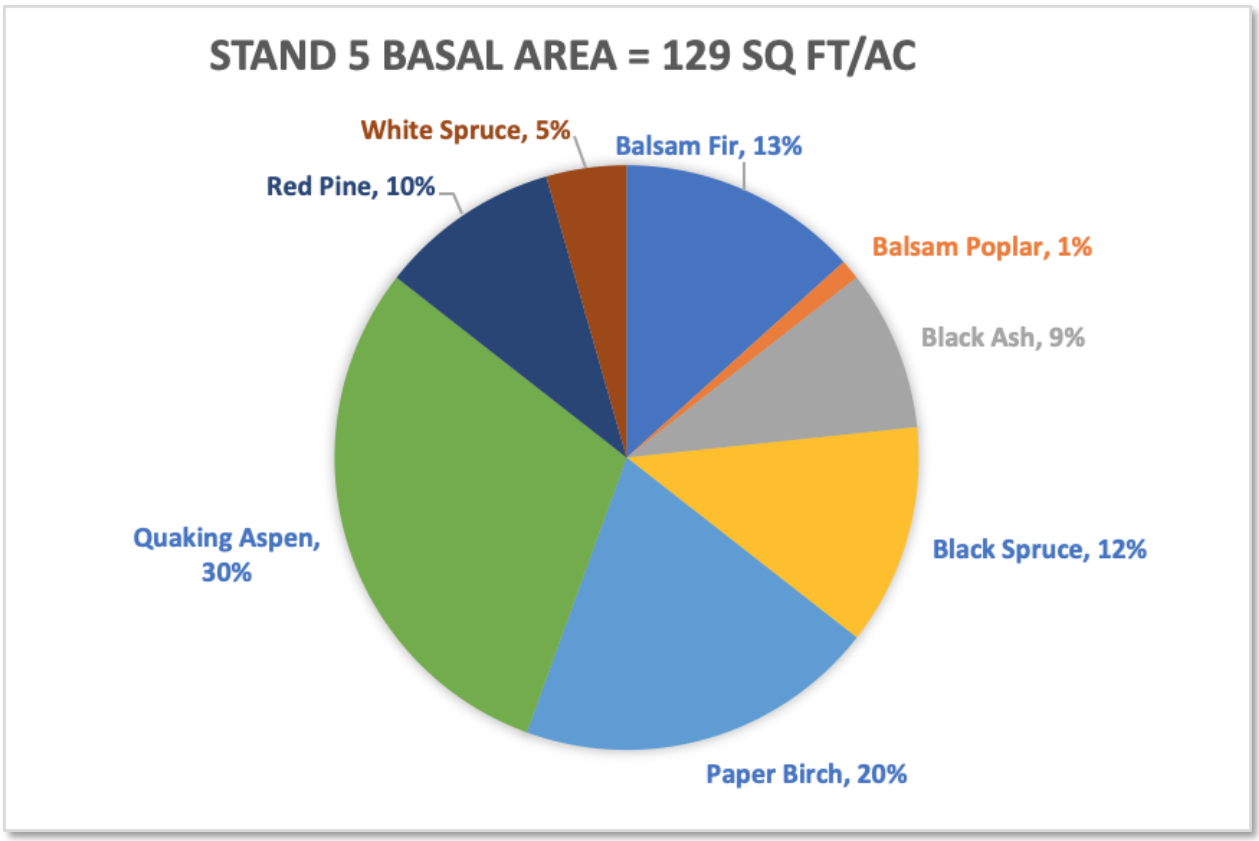
Adjacent land use concerns: Water tower is present in on the eastern boundary of this unit, as is Skyline Parkway

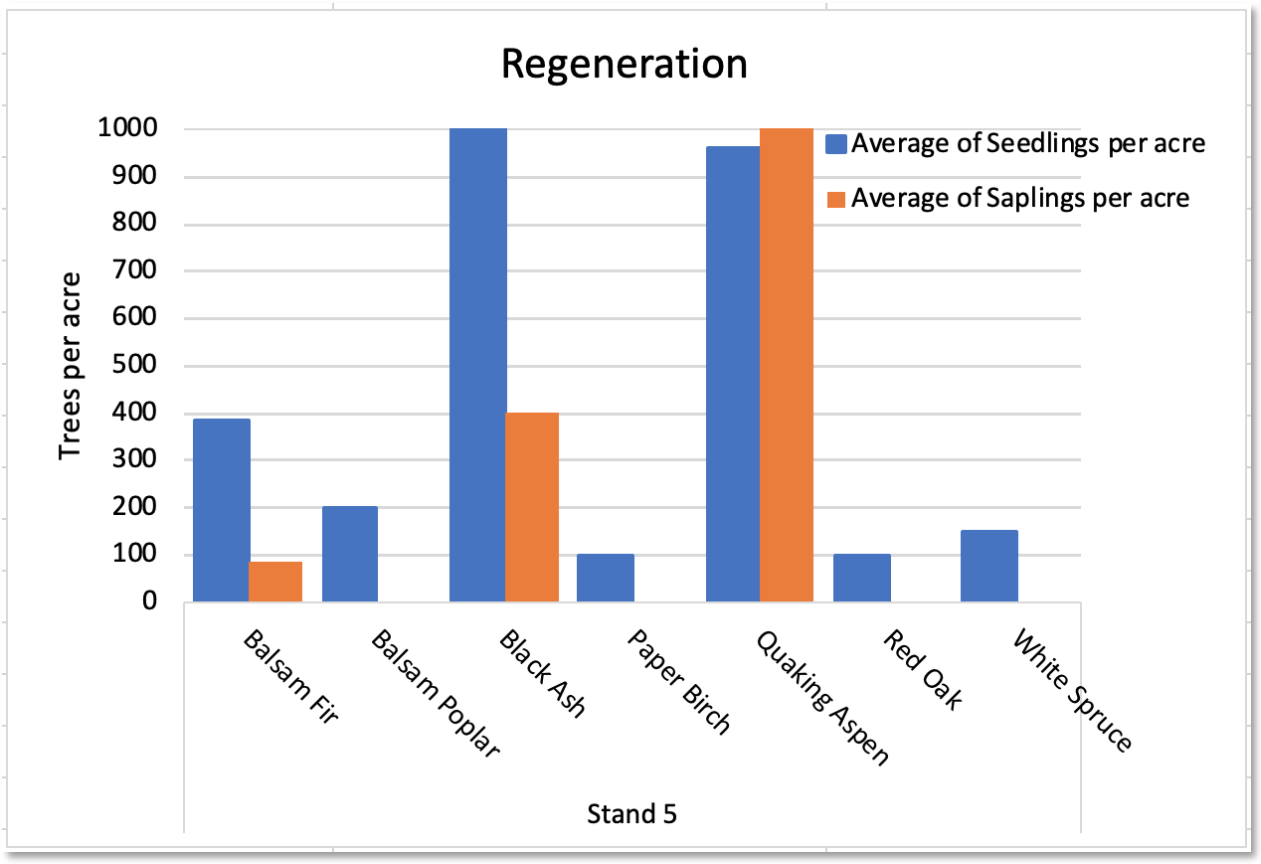
No action result (10-20 years): Some aspen will continue to recruit. Planted conifers will continue to age out and fail due to overcrowding, increasing hazardous fuel load. Black ash will continue to fail and may be replaced by white spruce and balsam poplar, or possibly wet areas will convert to speckled alder or grass-dominant wet meadows.

Management Goals, Strategies, and Actions

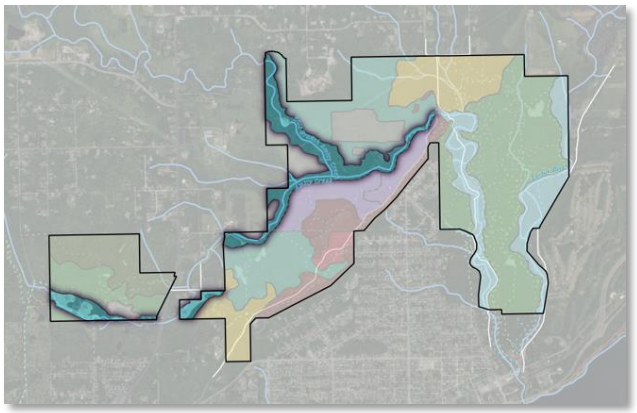
Goal	Strategy	Action	Notes
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Thin and remove overcrowded balsam fir or white spruce; Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies; Woody debris processing through biochar creation, pile burning, or off-site chipping	Slash and storm damage tree removal
Restore/enhance native plant communities; Regeneration	Restore and maintain fire-dependent plant communities	Prescribed burning	Site preparation before tree planting
Forest resilience	Support health of retained trees	Thin overstocked mature trees (shelterwood harvest)	Retain most vigorous individuals of desired species, commercial harvest where possible
Regeneration	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	
Regeneration; Restore/enhance native plant communities	Artificial regeneration	Plant trees	Plant long-lived moisture tolerant species


Stand 5: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
18
16
14
12
10
8
6
4
2
0
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Diameter Class (1")
White Spruce
Red Pine
Quaking Aspen
Paper Birch
Black Spruce
Black Ash
Balsam Poplar
Balsam Fir


STAND 5 BASAL AREA = 129 SQ FT/AC
White Spruce, 5%
Balsam Fir, 13%
Red Pine, 10%
Balsam Poplar, 1%
Black Ash, 9%
Quaking Aspen, 30%
Black Spruce, 12%
Paper Birch, 20%


Regeneration
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Average of Seedlings per acre
Average of Saplings per acre
Balsam Fir
Balsam Poplar
Black Ash
Paper Birch
Quaking Aspen
Red Oak
White Spruce
Stand 5

Stand 6 Riparian





Stand Characteristics

Forest Type: Riparian

Size: 147 acres

NPC (MDNR)	*Acres*	*% of stand*
FFn57a	48.6	33.02%
MHn46b	30.6	20.77%
Disturbed	25.6	17.41%
MHn35b	23.0	15.64%

Dominant Soil:

- E9E (23%): Miskoaki-Fluvaquents, frequently flooded, complex, 0 to 45 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.
- E8D (15%): Amnicon-Fluvaquents, frequently flooded, complex, 0 to 18 percent slopes. Silt loam, silty clay loam over clay at 13" or stratified silt loam to gravelly clay loam at 11". Well drained.
- E23F (12%): Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes. Silt loam, silty clay loam over clay at 6"; sandy loam, stratified very gravelly sandy loam. Well drained to somewhat poorly drained.
- F148F (8%): Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes. Silt loam over gravelly sandy loam at 4" or mucky silt loam over stratified silt loam to gravelly loamy coarse sand at 6" or bedrock. Well drained to poorly drained.
- E11E (7%): Miskoaki-Rock outcrop complex, 18 to 70 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.
- GP (7%): gravel pit

Ecological Site (USDA): F092XY015WI - Clayey Uplands, F092XY007WI - Wet Loamy or Clayey Lowlands, F092XY004WI - Seasonally Dry Floodplains (35%)

Successional Stage (MDNR): Young forest (0-55 years) approaching transitional forest (55-95 years)

Average Stand Diameter (DBH): 7.4”; SE 0.5”

Average Stand Basal Area: 96 ft2/ac; SE 10.5 ft2/ac

Snags per acre: 48 medium, mostly ash (6-11” DBH), 5 large (>12” DBH)

Coarse woody debris: High to medium

Wildfire risk: Low

Invasive Species: Variable, buckthorn present throughout, problematic in some areas

Pests & Disease: EAB widely established, dead and dying trees present

Current Condition: This floodplain forest with hardwood terraces spans a long stretch throughout the property encompassing banks and floodplains of Amity Creek and East Branch Amity Creek. This area is generally level, unlike the steeply eroding banks of lower Amity Creek (Stand 14). Quaking aspen, paper birch, and balsam poplar dominate the canopy, which ranges from open to closed. The majority of canopy trees are 3-5" DBH, with fewer larger trees up to 20" and occasional larger black willow. Black ash was recently an important canopy tree but has declined significantly due to emerald ash borer. Balsam fir and white spruce are establishing as intermediate trees. The regeneration layer is of the same general composition, with numerous black ash and the addition of occasional red pine, scotch pine, red maple, and red oak, and planted and caged white cedar and white pine. Speckled alder is common, along with beaked hazel, buckthorn, serviceberry, and occasional mountain maple and Prunus spp. Ostrich fern is monoculture in some locations. Bluejoint, goldenrod, and horsetail are also common. The upper reaches of both creek branches have high beaver activity including dams, felled trees, and pooled water with associated wetland communities.

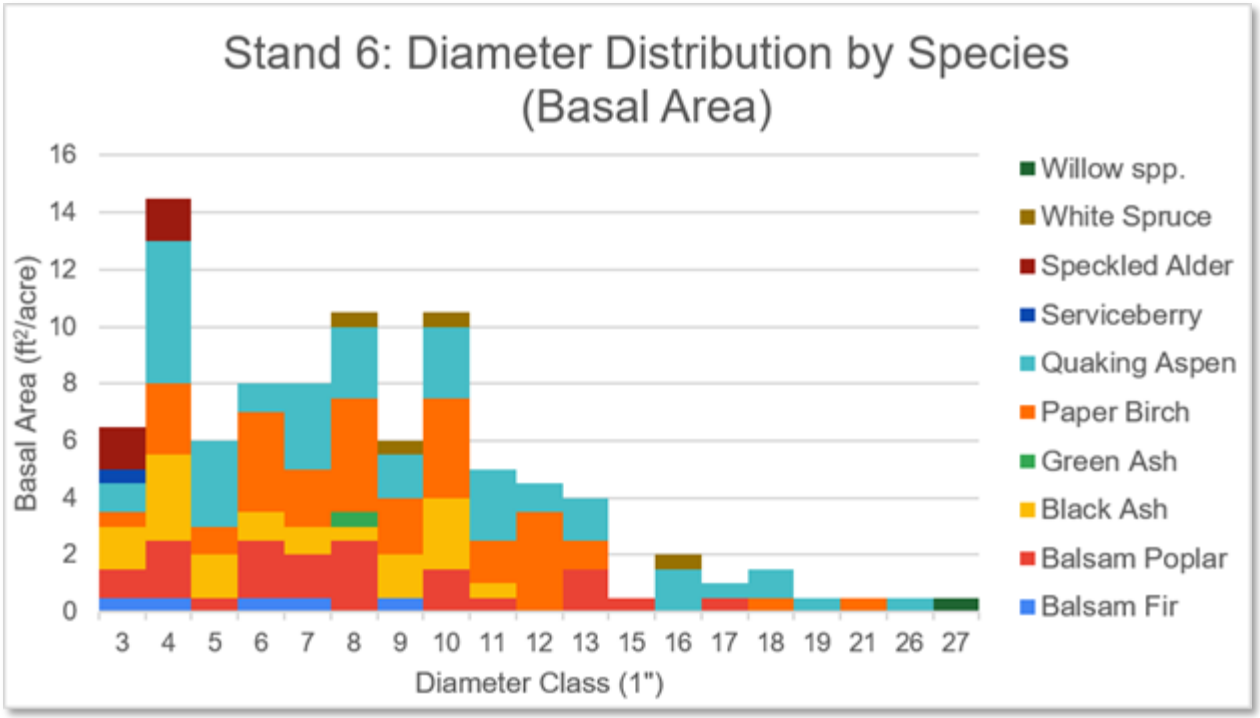
Current Recreational Uses or Management:
Recreational trail along the southern edge of stand. Sections along Amity Creek have planted and caged white pine, white cedar, and other seedlings. The far western section west of Jean Duluth Rd has been impacted through gravel extraction.

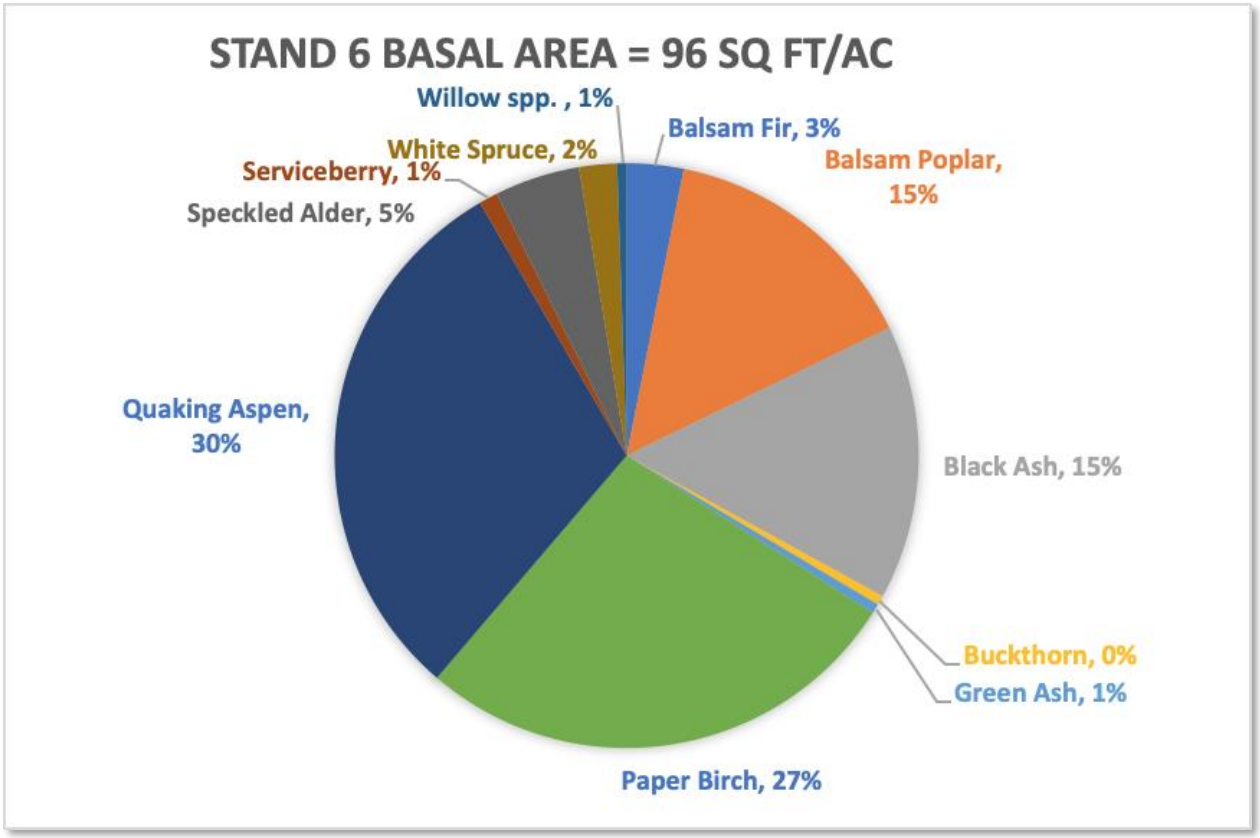
Adjacent land use concerns:
The Vermillion Road crossing upstream of beaver dams on Amity Creek may be impacted by beaver activity.

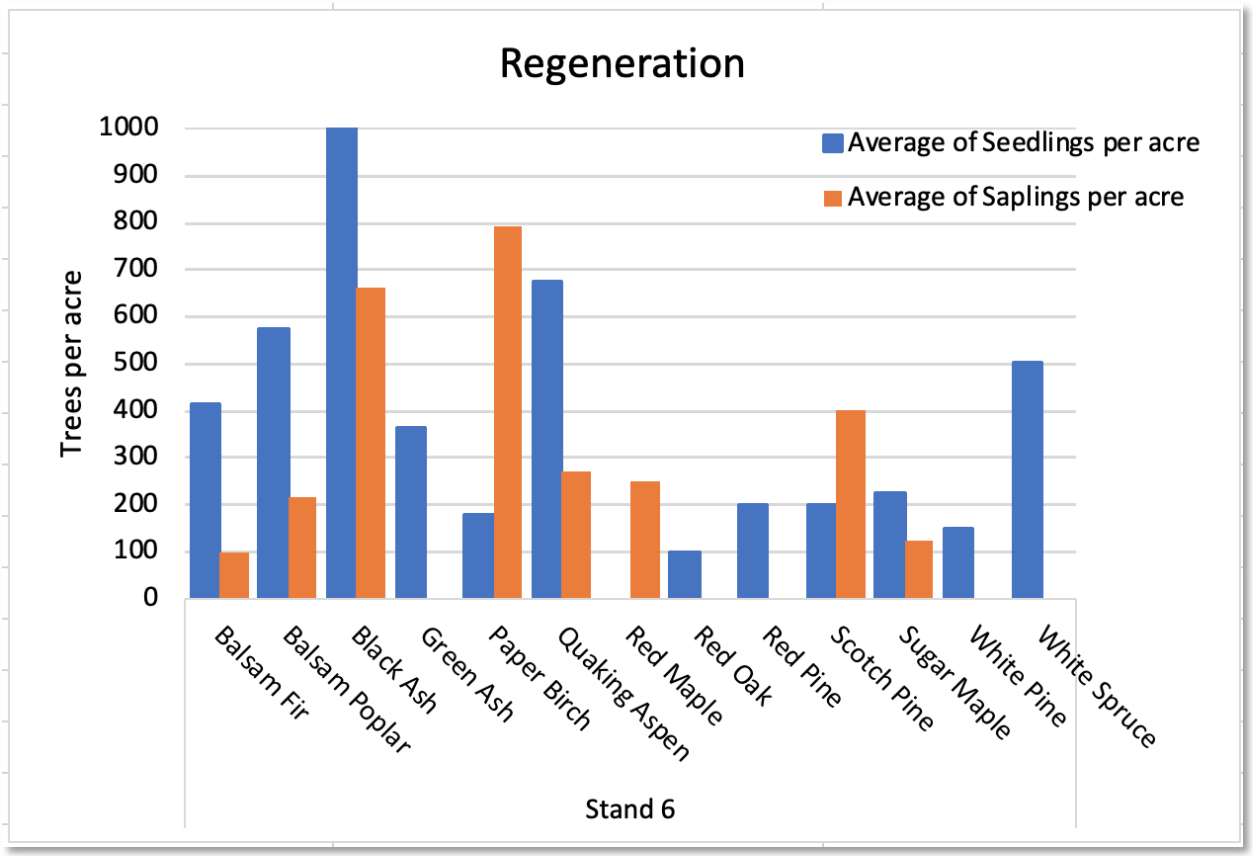
No action result (10-20 years): Emerald ash borer will continue to kill ash, causing possible transition to non-forested wetlands in some places. Balsam poplar, paper birch, and quaking aspen will continue to recruit. White spruce and balsam fir will become more established over time.

Management Goals, Strategies, and Actions

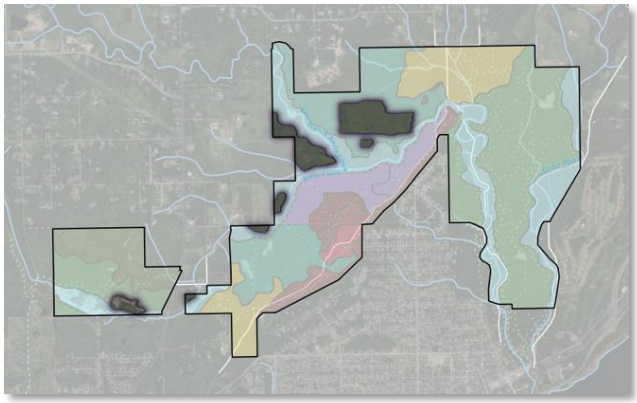
Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Ecosystem function	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Underplanting - Plant trees other than ash where ash decline and mortality is advanced	


Stand 6: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
16
14
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 15 16 17 18 19 21 26 27
Diameter Class (1")
Willow spp.
White Spruce
Speckled Alder
Serviceberry
Quaking Aspen
Paper Birch
Green Ash
Black Ash
Balsam Poplar
Balsam Fir


STAND 6 BASAL AREA = 96 SQ FT/AC
Willow spp. , 1%
Balsam Fir, 3%
White Spruce, 2%
Serviceberry, 1%
Balsam Poplar, 15%
Speckled Alder, 5%
Quaking Aspen, 30%
Black Ash, 15%
Buckthorn, 0%
Green Ash, 1%
Paper Birch, 27%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Red Pine
Scotch Pine
Sugar Maple
White Pine
White Spruce
Stand 6

Stand 7 Non-Forested Field





Stand Characteristics

Forest Type: Non-Forested Field

Size: 84 acres

NPC (MDNR)	*Acres*	*% of stand*
Disturbed	73.6	87.68%
Developed	7.6	9.09%

Dominant Soil:

- E3A (61%): Cuttre complex, 0 to 3 percent slopes. Silt loam, silty clay loam, over clay at 5-8". Somewhat poorly drained to poorly drained.
- E2B (9%): Cuttre-Fluvaquents, frequently flooded, complex, 0 to 8 percent slopes. Silt loam or silty clay loam over clay at 8" or stratified silt loam to gravelly clay loam at 11". Somewhat poorly drained to very poorly drained.
- GP (8%): gravel pit
- F111B (7%): Augustana-Hegberg complex, 1 to 8 percent slopes. Loamy and/or silty material over friable loamy till over dense loamy till. Moderately well drained to somewhat poorly drained.

Average Stand Diameter (DBH): N/A

Average Stand Basal Area: N/A

Snags per acre: N/A

Coarse woody debris: Low to none

Wildfire risk: Moderate, fine flashy fuels abundant (grass)

Invasive Species: Non-native pasture grasses and herbaceous plants

Pests & Disease: N/A

Current Condition: This stand combines six distinct areas that are non-forested and primarily non-native. This includes one active gravel pit west of Jean Duluth Rd, three maintained fields that appear to be horse pastures utilized by neighboring private landowners, and one large rectangular field with a history of tree nursery and possibly other forms of cultivation. This latter field and the edges or drainages of some of the other fields have patches of small tree and shrub cover such as willow, dogwood, young white spruce, non-native spruces, and aspen. If allowed to proceed with no management, they are likely to become afforested with aspen, spruce, and other native species. However, their current openness offers opportunities to diversify land cover or support local enterprises.

Current Recreational Uses or Management:
City use, horse pasture, potentially a solar installation. Evidence of a former tree nursery in the large rectangular field. A high-voltage electric transmission line runs through the largest field.

Adjacent land use concerns:
Neighboring private landowners utilizing boundary fields for horse pasture or horse trails.

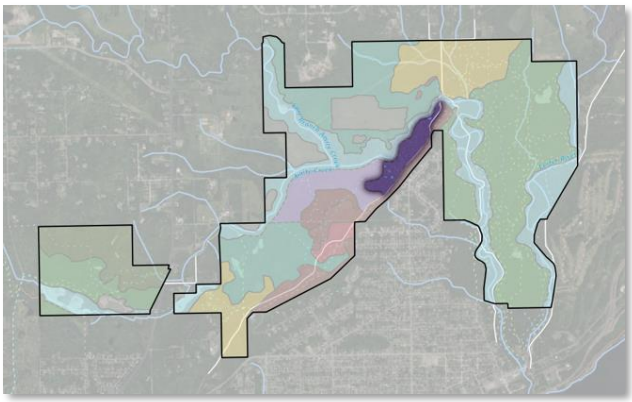
No action result (10-20 years): In northernmost two fields, succession will result in afforestation of nearby pioneer tree species (aspen, alder) or non-native seed trees already present. Horse pasture fields will likely continue to be maintained as open meadows if landowners continue activities. Gravel pit, if not managed for invasive species, may result in new populations of pioneer invasive plants entering from equipment or taking advantage of disturbed conditions.

Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Ecosystem function	Re-establish native vegetation; Encourage bird and pollinator habitat	Seed native grasses and forbs	Possibility of solar installation in portions of unit
Restore/enhance native plant communities	Restore and maintain fire-dependent plant communities	Prescribed burning	Conduct in dormant season
Restore/enhance native plant communities	Prevent introductions of aggressive introduced plants	Monitor and remove invasive plants at first detection (Early Detection Rapid Response)	City workers or volunteer stewards

No tree inventories were conducted in the non-forested units

Stand 8 Pine Plantation





Stand Characteristics

Forest Type: Pine Plantation

Size: 32 acres

NPC (MDNR)	*Acres*	*% of stand*
Disturbed	29.8	93.46%
Developed	2.0	6.25%

Dominant Soil:

- F147D (88%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.

Ecological Site (USDA): F093AY013MN Loamy uplands, F093AY006MN - Depressional Wet Hardwood Forest, 093AY009MN - Bedrock Controlled Upland Forest

Successional Stage (MDNR): Young forest (0-55 years) emerging through planted mature forest (55-95 years), characteristics of mixed stages

Average Stand Diameter (DBH): 11.6" (SE=0.9)

Average Stand Basal Area: 146 ft2/ac (SE=12.8)

Snags per acre: 68 medium (6-11" DBH), 5 large (>12" DBH)

Coarse woody debris: High to medium

Wildfire risk: Moderate due to flashy fine fuels (grass) and high fuel loading with dead, dying and overcrowded trees

Invasive Species: Scots pine highly dominant in the overstory, buckthorn presence is limited

Pests & Disease: EAB present; Red pine appear stressed due to bark beetles

Current Condition: This stand has similar topographic and soil characteristics to stands 4 and 5 in being a mix of well drained loamy hardwoods and saturated boggy soil with lowland forest characteristics. However, almost the entire stand is a planted pine stand with a mix of red pine (averaging 9-11" DBH) and Scotch pine (averaging 12-14" DBH). Quaking aspen is sparsely present at all growth stages with abundant regeneration, primarily near stand edges. Paper birch, balsam poplar, white spruce and balsam fir occur as intermediate or regenerating trees. Black ash regeneration is excessive, though mature ash is limited in number. Beaked hazel, speckled alder, mountain maple, and round-leaved dogwood are common in a moderately sparse shrub layer. Herbaceous layer in pine-dominated areas is primarily grass and thatch.

Current Recreational Uses or Management:
The stand was clearly planted for pine silviculture. Stand health ranges from decently healthy (live crown >30%) to

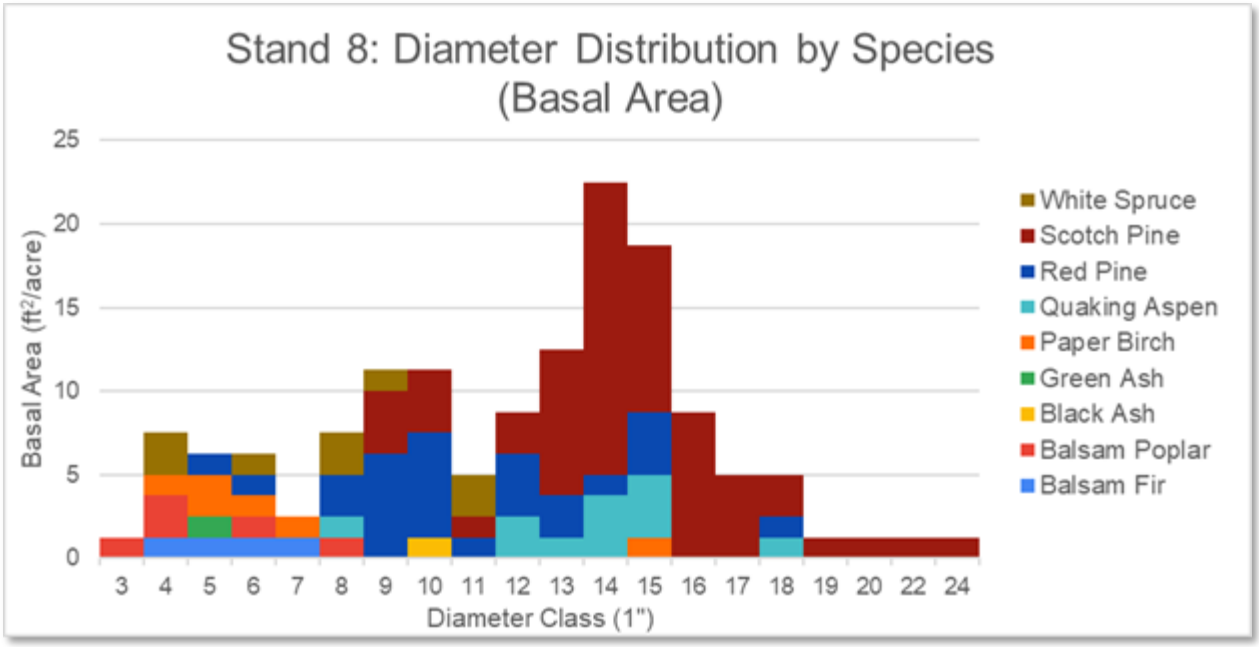
Adjacent land use concerns:
Road impacts from Skyline Parkway; high recreation use

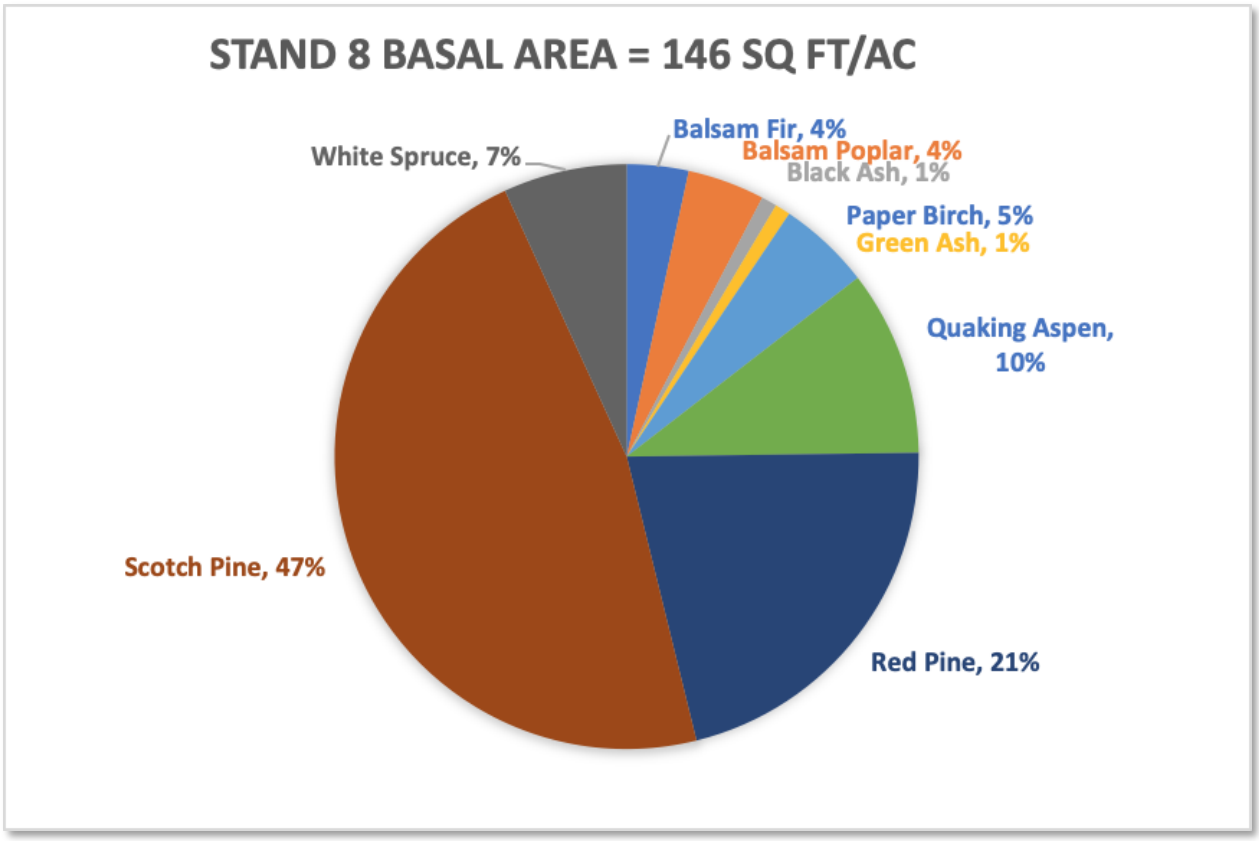
rotting. Some Scots pine have recently been girdled and the understory seeded with native species. This area has high recreational use, with easy access from Skyline Parkway and nearby trailhead.

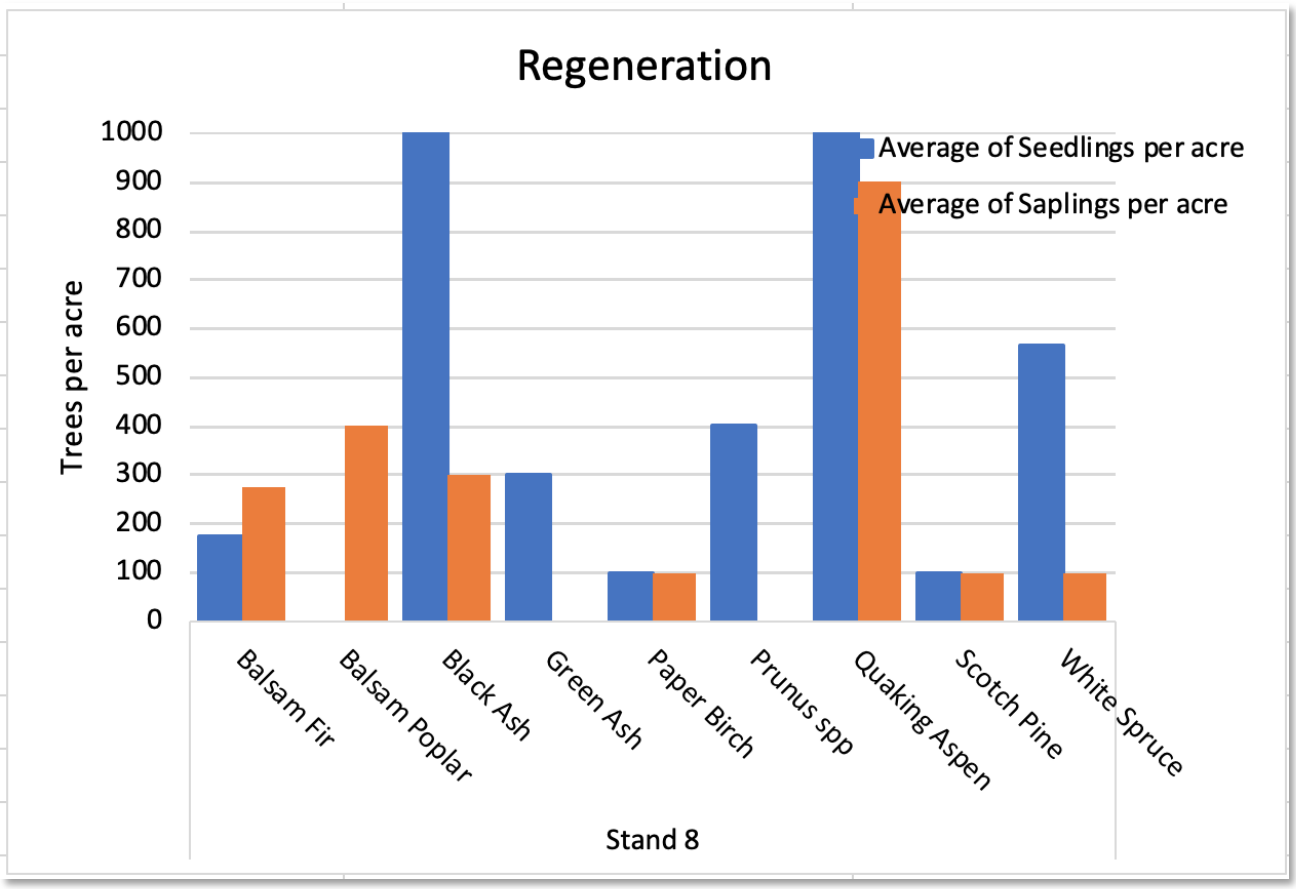
No action result (10-20 years): *Aspen* may recruit into gaps and openings, balsam fir likely to increase, fire risk likely to increase as pines age out and fall.

Management Goals, Strategies, and Actions

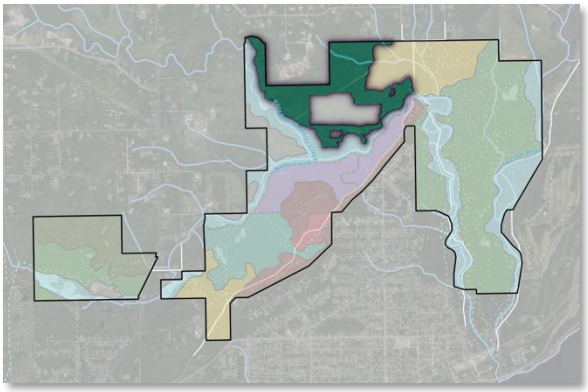
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Transition tree plantations to native forest composition	Thin overly stocked tree plantations, sell commercially when possible or remove offsite; Remove non-native tree species, sell commercially when possible or remove offsite; Interplant diverse native trees suitable to site conditions	Restore to natural red pine woodland ecosystem
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Thin and remove overcrowded balsam fir or white spruce; Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies; Woody debris processing through biochar creation, pile burning, or off-site chipping	Slash and storm damage tree removal
Regeneration; Restore/enhance native plant communities	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning	
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	
Regeneration	Artificial regeneration	Plant trees; Disperse tree seeds	


Stand 8: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
25
20
15
10
5
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 24
Diameter Class (1")
White Spruce
Scotch Pine
Red Pine
Quaking Aspen
Paper Birch
Green Ash
Black Ash
Balsam Poplar
Balsam Fir


STAND 8 BASAL AREA = 146 SQ FT/AC
Balsam Fir, 4%
Balsam Poplar, 4%
Black Ash, 1%
White Spruce, 7%
Paper Birch, 5%
Green Ash, 1%
Quaking Aspen, 10%
Scotch Pine, 47%
Red Pine, 21%


Regeneration
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Average of Seedlings per acre
Average of Saplings per acre
Balsam Fir
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Prunus spp
Quaking Aspen
Scotch Pine
White Spruce
Stand 8

Stand 9 Aspen-Birch (Red Maple)





Stand Characteristics

Forest Type: Aspen-Birch (Red Maple)

Size: 135 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44a	43.2	32.07%
MHn46b	36.4	27.03%
FDn43b	34.2	25.34%
Disturbed	10.3	7.65%
WFn55a	10.1	7.52%

Dominant Soil:

- E3A (65%): Cuttre complex, 0 to 3 percent slopes. Silt loam, silty clay loam, over clay at 5-8". Somewhat poorly drained to poorly drained.
- E8D (9%): Amnicon-Fluvaquents, frequently flooded, complex, 0 to 18 percent slopes.Silt loam, silty clay loam over clay at 13" or stratified silt loam to gravelly clay loam at 11". Well drained.
- E9E (8%): Miskoaki-Fluvaquents, frequently flooded, complex, 0 to 45 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.

Ecological Site (USDA): F092XY012WI - Moist Clayey Lowlands, F092XY007WI - Wet Loamy or Clayey Lowlands, F092XY015WI - Clayey Uplands

Successional Stage (MDNR): Young forest (0-35 years) to early transitional forest (35-95 years)

Average Stand Diameter (DBH): 8.8" (SE=0.5)

Average Stand Basal Area: 98 ft2/ac (SE=10.8)

Snags per acre: 74 medium, (6-11" DBH), 8 large (>12" DBH), mostly aspen

Coarse woody debris: High to medium

Wildfire risk: Moderate due to blowdown and possible ignition source from powerline

Invasive Species: Buckthorn is pervasive as large and small saplings, low amounts of honeysuckle present

Pests & Disease: EAB has resulted in near complete mortality of canopy trees >8" DBH

Current Condition: In this large, mixed-age yet homogenous stand, aspen is by far the dominant canopy tree at mixed size classes with about one third <5" DBH, one half between 6-14", and the remainder up to 20". Black ash is excessively abundant up to 5" DBH and regenerating seedlings and saplings, with some dead mature ash as well. Regeneration is also high for red maple and quaking aspen, with some balsam poplar, yellow birch, and balsam fir. There are occasional mature red maple, sugar maple, basswood, and

yellow birch. Buckthorn is well established as large understory trees and dense stands of young saplings, along with thick beaked hazel, speckled alder, mountain maple, and serviceberry. Dominant understory plants are bluejoint grass, lady fern, bracken fern, and strawberry. The stand exhibits fire-influenced characteristics though this may have been the aftermath of logging slash fires or other disturbance, whereas the moist soil conditions suggest species tolerant of saturated conditions may be better suited. Blowdown is evident throughout the stand, primarily of aspen. Deer activity is high in this area.

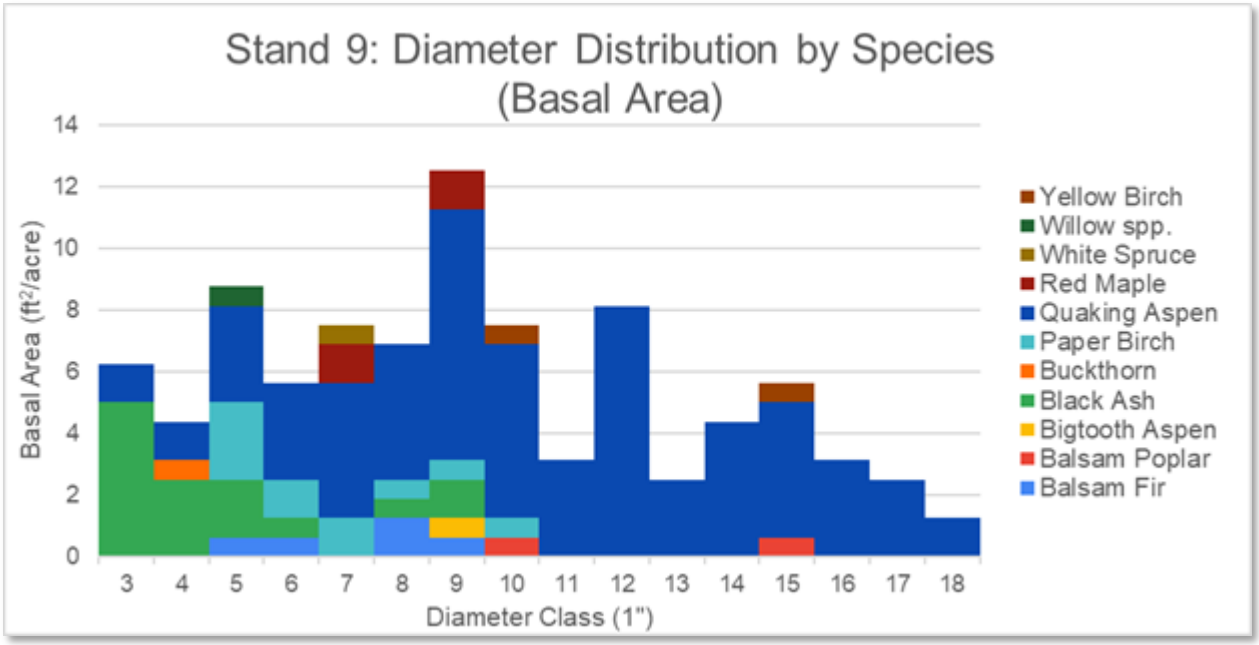
Current Recreational Uses or Management:
There are no trails through the stand, although there is access from a trailhead parking to the north on Maxwell Rd via the powerline corridor. There is evidence of hunting activity.

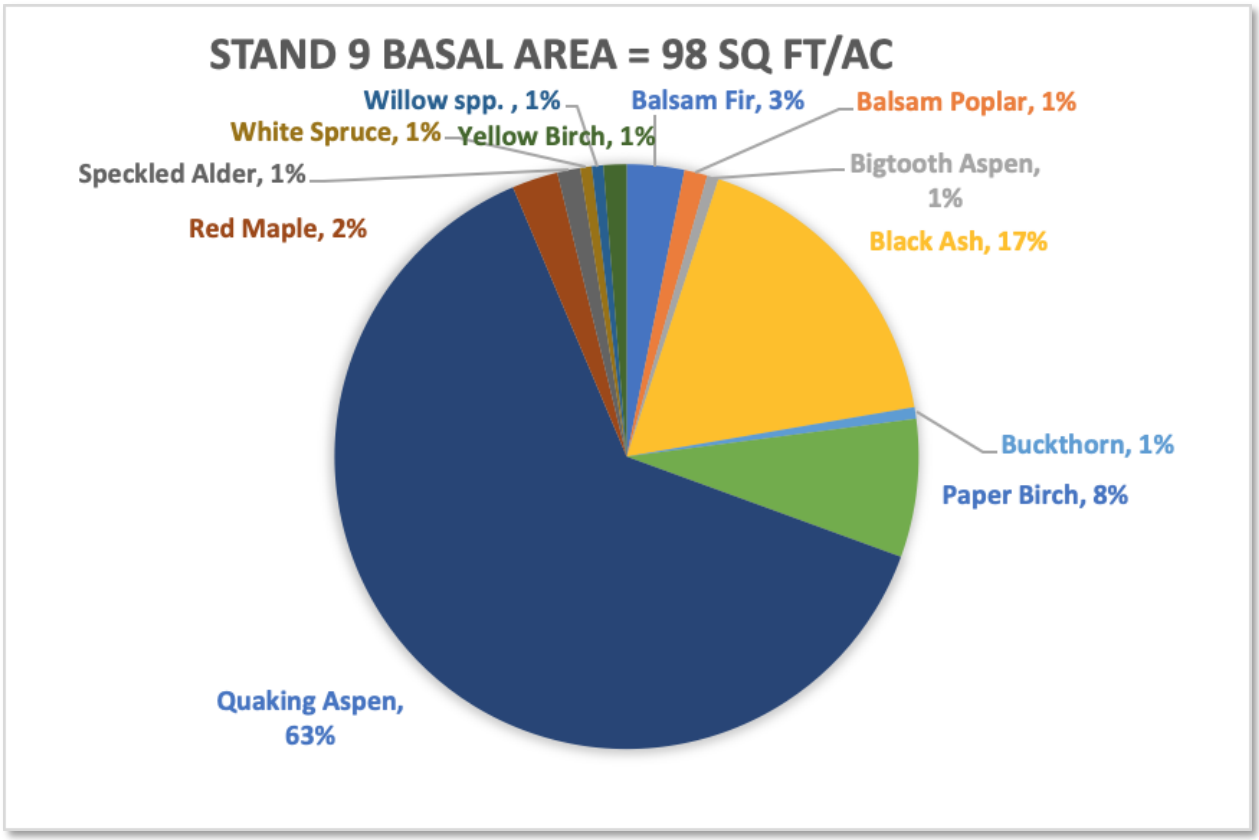
Adjacent land use concerns:
Private gravel pit to the north potentially impacting water quality/quantity feeding East branch Amity Creek. Large field in the center of the stand (stand 7) with many non-native species and edge effects.

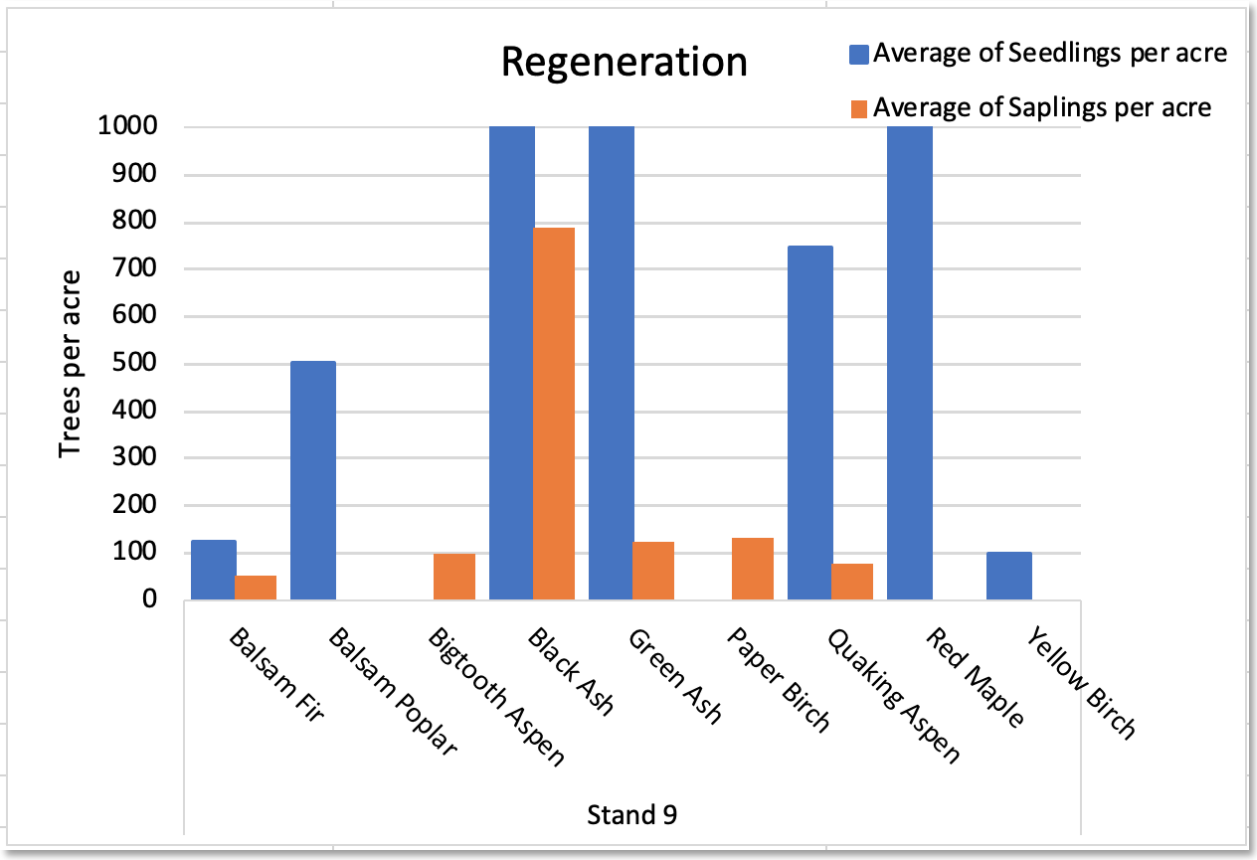
No action result (10-20 years): Mature aspen will continue to die, creating additional large snags; additional blowdown is likely to occur. Buckthorn may become increasingly problematic, especially in areas with ash and eventually aspen as these species die out due to EAB or age. The stand will continue as an aspen-red maple canopy.

Management Goals, Strategies, and Actions

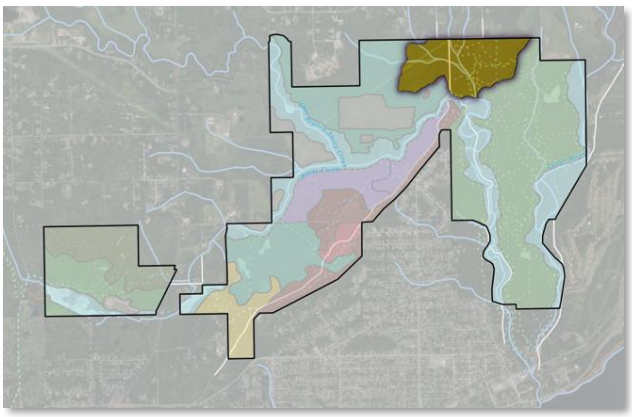
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Regeneration	Reduce competition in midstory	Mulch/masticate shrub layer	Mastication in strips of overabundant shrubs (up to 30% of stand at one time). Target alder, buckthorn
Regeneration	Artificial regeneration	Plant trees	Plant long-lived moisture tolerant hardwood species
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	


Stand 9: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
14
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Diameter Class (1")
Yellow Birch
Willow spp.
White Spruce
Red Maple
Quaking Aspen
Paper Birch
Buckthorn
Black Ash
Bigtooth Aspen
Balsam Poplar
Balsam Fir


STAND 9 BASAL AREA = 98 SQ FT/AC
Willow spp. , 1%
Balsam Fir, 3%
Balsam Poplar, 1%
White Spruce, 1%
Yellow Birch, 1%
Speckled Alder, 1%
Bigtooth Aspen, 1%
Red Maple, 2%
Black Ash, 17%
Buckthorn, 1%
Paper Birch, 8%
Quaking Aspen, 63%



Stand 10 Aspen-Birch (Balsam Fir)





Stand Characteristics

Forest Type: Aspen-Birch (Balsam Fir)

Size: 110 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b	77.6	70.80%
MHn44a	10.2	9.30%
MHn46b	8.8	8.02%
WFn55a	7.5	6.85%

Dominant Soil:

- E3B (30%): Cuttre complex, 0 to 8 percent slopes. Silt loam, silty clay loam, over clay at 5-8". Somewhat poorly drained to poorly drained.
- E23F (30%): Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes. Silt loam, silty clay loam over clay at 6"; sandy loam, stratified very gravelly sandy loam. Well drained to somewhat poorly drained.
- E3A (22%): Cuttre complex, 0 to 3 percent slopes. Silt loam, silty clay loam, over clay at 5-8". Somewhat poorly drained to poorly drained.
- E16D (9%): Amnicon-Cuttre complex, 5 to 18 percent slopes. Silt loam, silty clay loam over clay at 8-13". Moderately well drained to somewhat poorly drained.

Ecological Site (USDA): F092XY012WI - Moist Clayey Lowlands, F092XY007WI - Wet Loamy or Clayey Lowlands, F092XY015WI - Clayey Uplands, F092XY004WI - Seasonally Dry Floodplains (35%) *Successional Stage (MDNR):* Young forest (0-35 years) to early transitional forest (35-95 years)

Average Stand Diameter (DBH): 8.9" (SE=1.0)

Average Stand Basal Area: 136 ft2/ac (SE=15.7)

Snags per acre: 60 medium, (6-11" DBH), 2 large (>12" DBH), mostly aspen, red pine, ash

Coarse woody debris: Medium

Wildfire risk: High due to fuel loading, dense balsam fir and road passage through unit

Invasive Species: Medium - Buckthorn is widespread

Pests & Disease: EAB - Mature ash is completely dead where present

Current Condition: This lowland aspen-dominant stand is similar to stand 9 with the addition of paper birch and a very thick emerging intermediate and regeneration layer of balsam fir. It includes a seasonal drainage feeding Amity Creek. Quaking aspen is by far the dominant canopy tree at mixed size classes with about one third <5" DBH, one half between 6-14", and the remainder up to 20". A robust intermediate layer is dominated by balsam fir with paper birch, red maple, and buckthorn. Regeneration is very thick with balsam fir as seedlings and saplings, as well as many black ash, green ash, paper birch, and quaking aspen. Red maple, white pine, and white spruce are emerging as seedlings. This is one of few stands with white pine regeneration - unclear if natural or planted and unprotected. Buckthorn is pervasive, but coincides with mountain maple, beaked hazel, dogwoods, and a variety of native fruiting shrubs at lower densities. Understory is strongly dominated by large-leaved aster with some bush honeysuckle, bracken fern, strawberry, sarsparilla, and sedges.

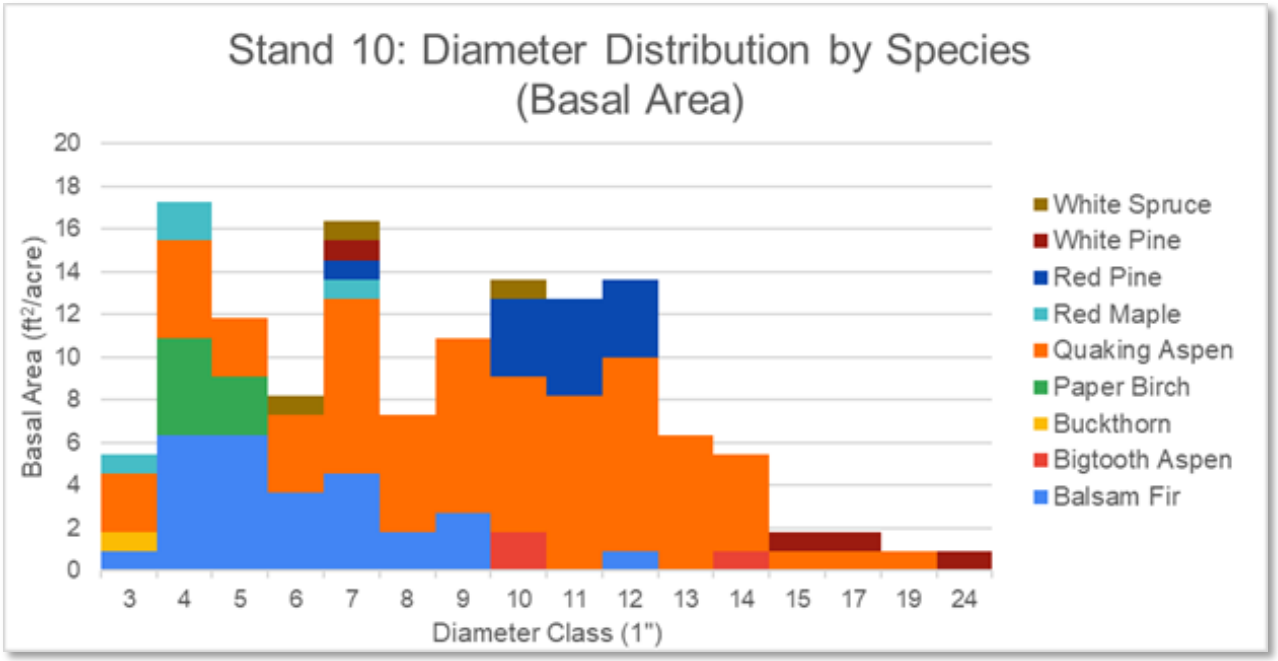
Current Recreational Uses or Management:
Several recreational trails including snowmobile, ski, hiking, and mountain biking east of Seven Bridges Road.

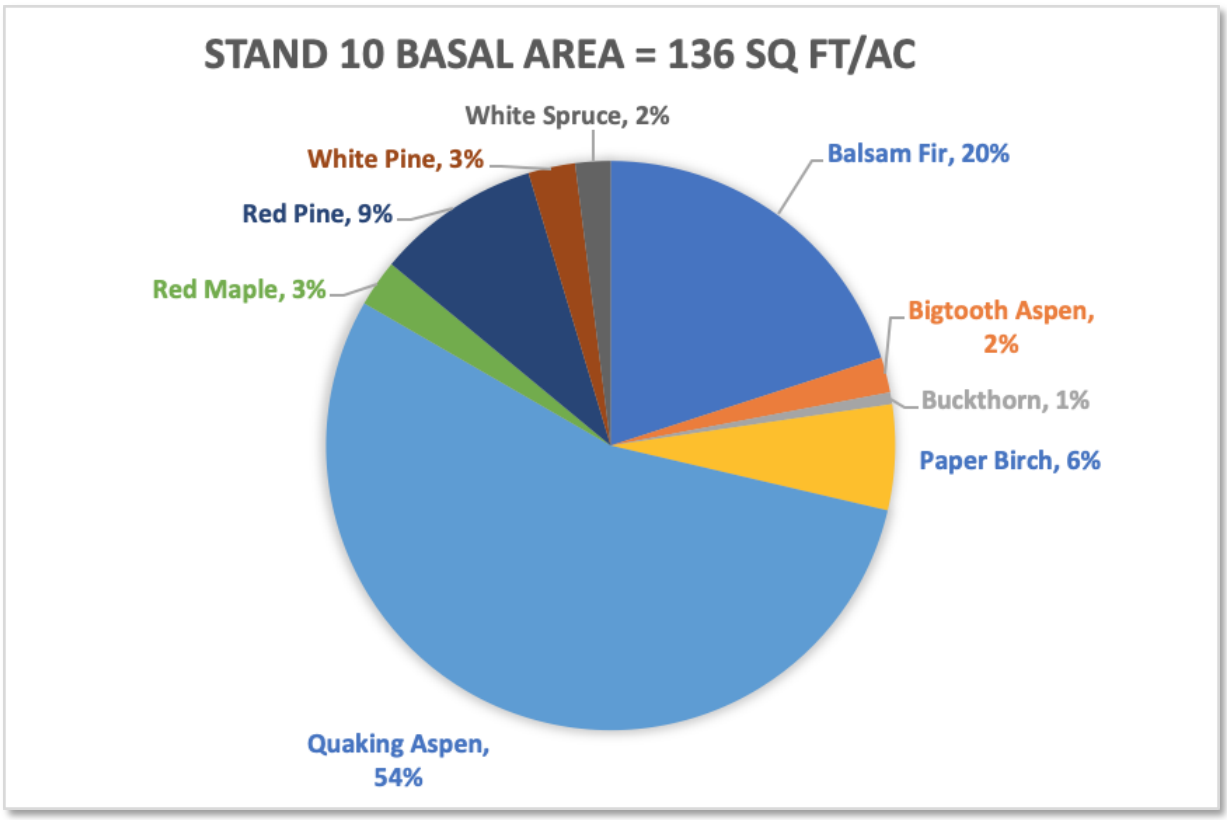
Adjacent land use concerns:
Some recreational trails and Seven Bridges Road may negatively impact wetland hydrology. Powerline corridor, residential area to the north.

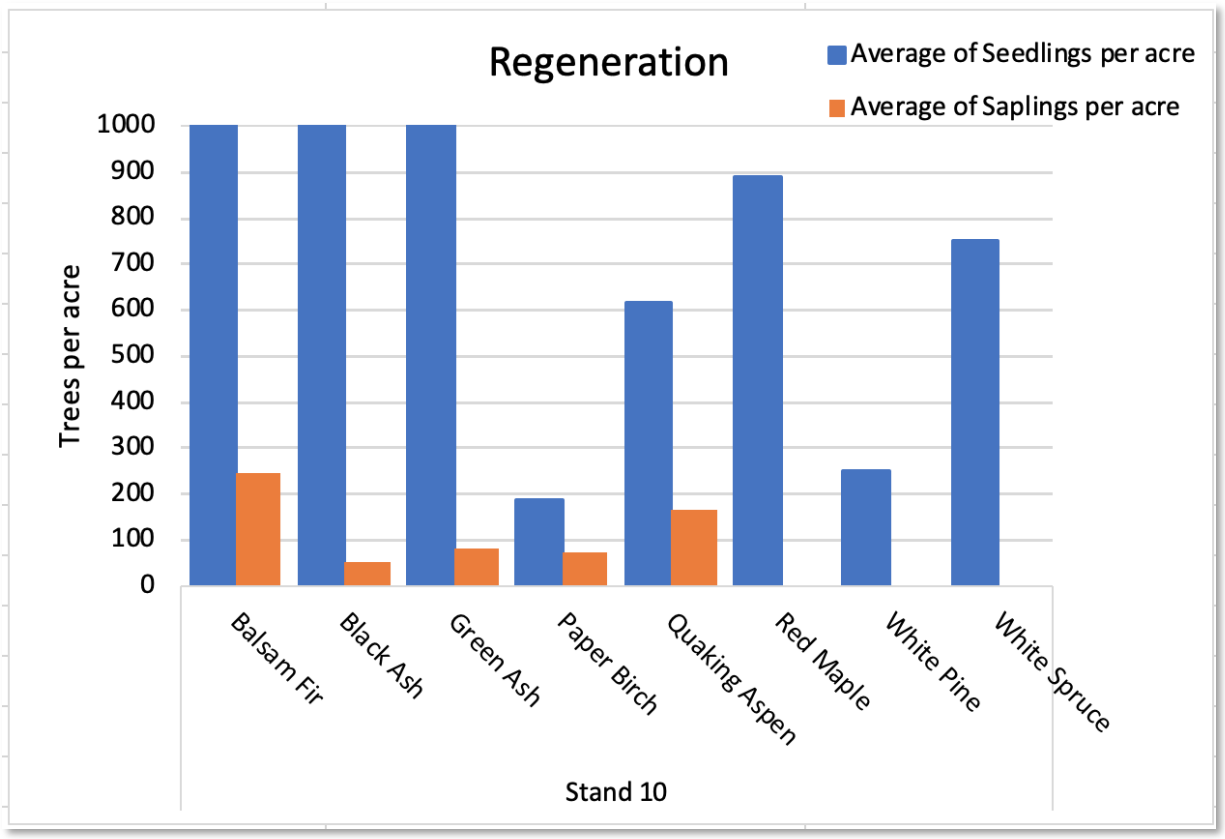
No action result (10-20 years): Increased prevalence and growth of balsam firs and red maple leading to elevated fire risk. Ash-dominant lowlands may convert to shrub-dominant wetland, especially where buckthorn is present.

Management Goals, Strategies, and Actions

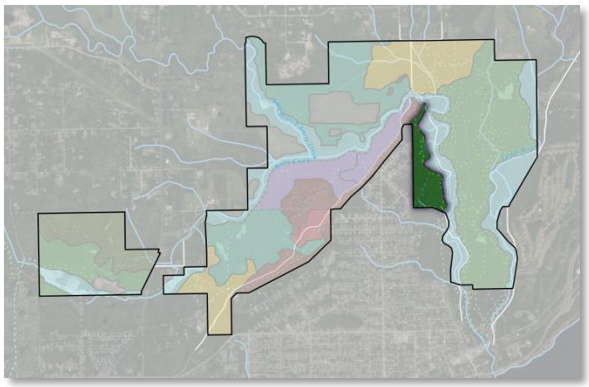
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	Initial mulching in tandem with fuels reduction, maintained through intermittent burning and grazing
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Thin and remove overcrowded balsam fir or white spruce; Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies; Woody debris processing through biochar creation, pile burning, or off-site chipping	Retain low density of vigorous balsam fir, limb up 10'
Restore/enhance native plant communities; Regeneration; Recreation	Restore and maintain fire-dependent plant communities; Manage for open or partially open (“park-like”) understory conditions	Prescribed burning; prescribed grazing	Rotate between burning and grazing as conditions/capacity allows. Ladder fuels must be reduced before burning.
Regeneration	Artificial regeneration	Plant trees	Plant long-lived fire tolerant species
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	


Stand 10: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
20
18
16
14
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 14 15 17 19 24
Diameter Class (1")
White Spruce
White Pine
Red Pine
Red Maple
Quaking Aspen
Paper Birch
Buckthorn
Bigtooth Aspen
Balsam Fir


STAND 10 BASAL AREA = 136 SQ FT/AC
White Spruce, 2%
White Pine, 3%
Red Pine, 9%
Red Maple, 3%
Balsam Fir, 20%
Bigtooth Aspen, 2%
Buckthorn, 1%
Paper Birch, 6%
Quaking Aspen, 54%



Stand 11 Aspen-Birch





Stand Characteristics

Forest Type: Aspen-Birch

Size: 43 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b	19.8	46.43%
MHn44a	17.9	41.80%
RVx54a	2.7	6.34%

Dominant Soil:

- E15A (66%): Badriver complex, 0 to 3 percent slopes. Silt loam and silty clay loam, clay at 4-5", silty clay and silty clay loam at 34-56"+. Somewhat poorly drained to poorly drained.
- F160F (16%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- E23F (8%): Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes. Silt loam, silty clay loam over clay at 6"; sandy loam, stratified very gravelly sandy loam. Well drained to somewhat poorly drained.

Ecological Site (USDA): F092XY012WI - Moist Clayey Lowlands, F092XY007WI - Wet Loamy or Clayey Lowlands, F092XY015WI - Clayey Uplands, F092XY004WI - Seasonally Dry Floodplains (35%)

Successional Stage (MDNR): Young forest (0-35 years) to early transitional forest (35-95 years)

Average Stand Diameter (DBH): 9.1" (SE=0.7)

Average Stand Basal Area: 107 ft2/ac (SE=12.7)

Snags per acre: 50 medium (6-11" DBH)

Coarse woody debris: High to Medium

Wildfire risk: Moderate due to high fuel loading on the ground, tree density, and proximity to residential areas

Invasive Species: Buckthorn prevalent throughout the stand, well-established in some areas

Pests & Disease: EAB established, ash mortality widespread

Current Condition: This stand is the upper banks grading down into lower Amity Creek with moderate slopes and eastern aspect. This is a strongly dominant young quaking aspen stand, with about half the aspen 5" DBH or less and the other half 6-15" DBH. Paper birch is the next most common species, with very occasional black ash, balsam poplar, and red maple. Black ash is an abundant seedling but interestingly no saplings were counted. Aspen was the most common seedling that was also found at the sapling stage. Paper birch and balsam poplar are also present as saplings. White spruce and red maple are also found as seedlings. Understory trees and tall shrubs are abundant, notably speckled alder, serviceberry, buckthorn, mountain maple, and dogwoods. Herbaceous layer is dominated by bush honeysuckle, bracken fern, dewberry, and isolated patches of staghorn sumac.

Current Recreational Uses or Management:
There are two hiking trails through the stand, entering from Hawk Ridge and the neighboring residential area. Social trails are common.

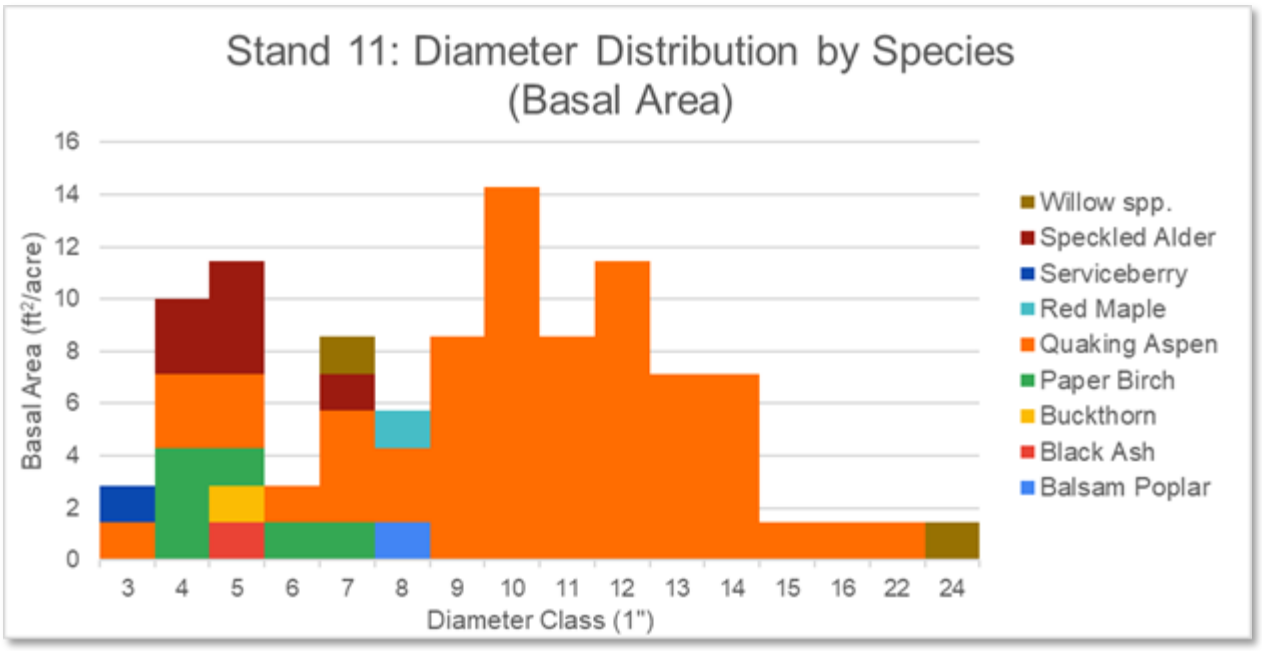
Adjacent land use concerns:
Residential area to the west of the stand

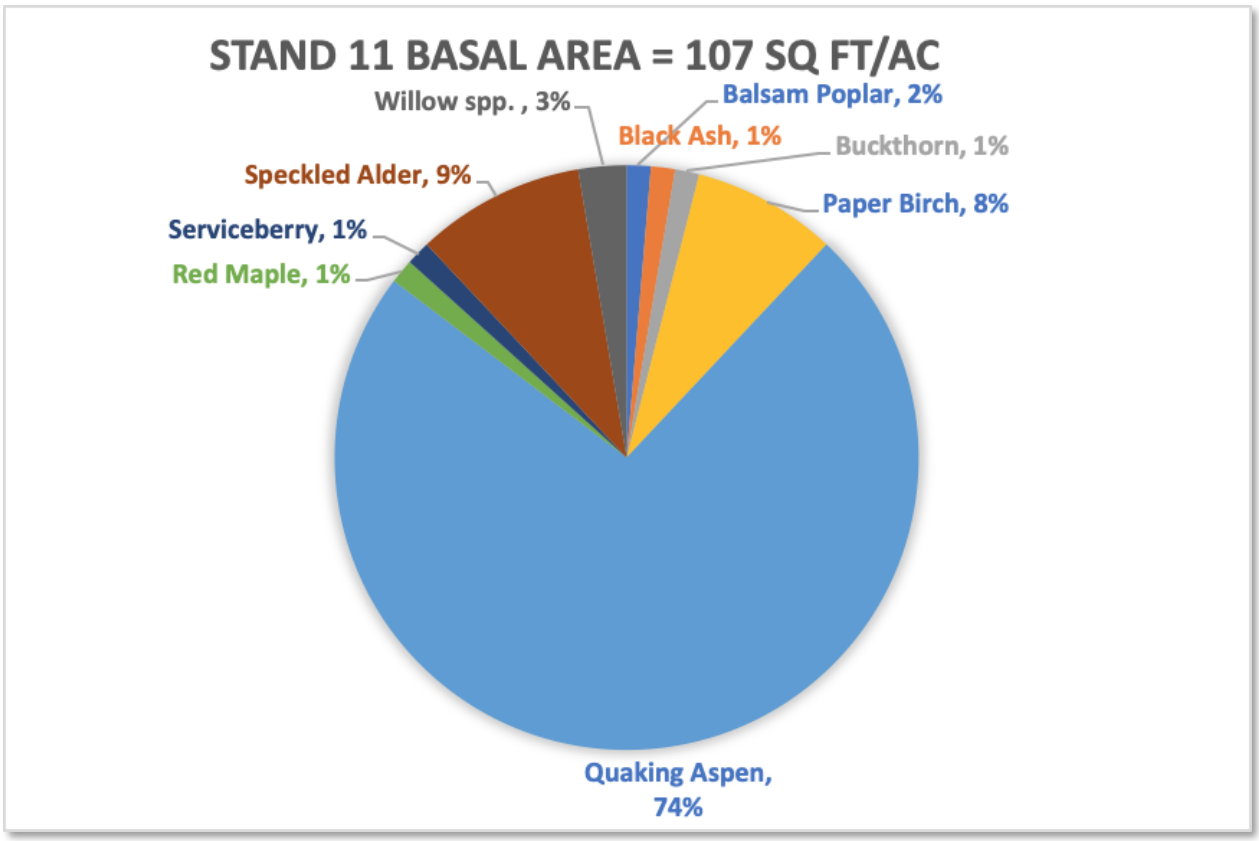
No action result (10-20 years): Buckthorn will increase and push out native understory shrub layer. Aspen and birch will continue to age and begin turning to snags, while red maple and white spruce may increase.

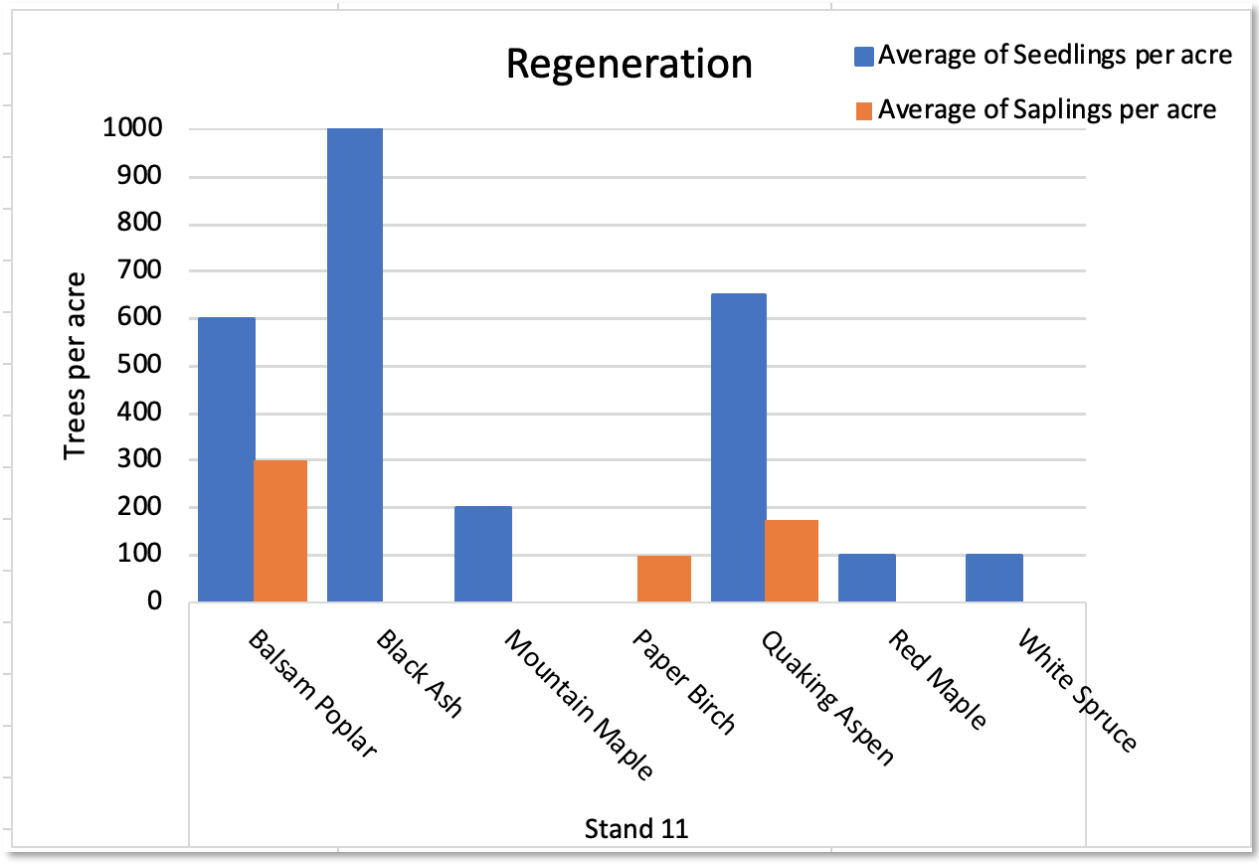
Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes

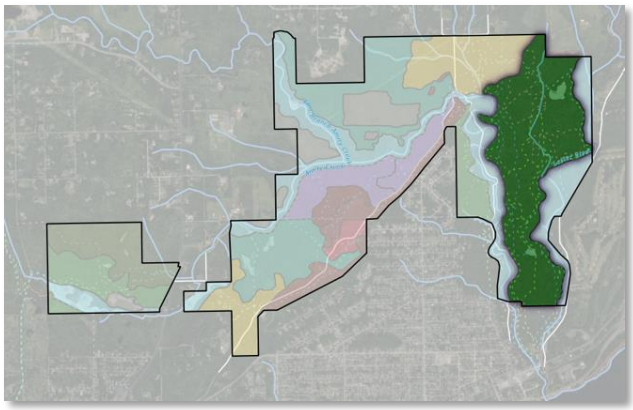
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	Followup treatment of buckthorn, prescribed grazing or herbicide treatment
Regeneration	Reduce competition in midstory	Mulch/masticate shrub layer	Mastication in strips of overabundant shrubs (up to 30% of stand at one time). Target alder, buckthorn
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Gap selection	Gap widths 0.5-2x height of trees; cut during growing season
Regeneration	Artificial regeneration	Plant trees	Plant long-lived moisture tolerant hardwood species
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Assisted migration - Introduce species native to adjacent regions with slightly warmer climates	




STAND 11 BASAL AREA = 107 SQ FT/AC
Willow spp. , 3%
Balsam Poplar, 2%
Black Ash, 1%
Buckthorn, 1%
Speckled Alder, 9%
Paper Birch, 8%
Serviceberry, 1%
Red Maple, 1%
Quaking Aspen, 74%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Mountain Maple
Paper Birch
Quaking Aspen
Red Maple
White Spruce
Stand 11

Stand 12 Aspen-Birch





Stand Characteristics

Forest Type: Aspen-Birch

Size: 295 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b	235.0	79.80%
MHn46b	20.2	6.86%
RVx54a	17.4	5.91%

Dominant Soil:

- E3B (48%): Cuttre complex, 0 to 8 percent slopes. Silt loam, silty clay loam, over clay at 5-8". Somewhat poorly drained to poorly drained.
- E16D (18%): Amnicon-Cuttre complex, 5 to 18 percent slopes. Silt loam, silty clay loam over clay at 8-13". Moderately well drained to somewhat poorly drained.
- E9E (15%): Miskoaki-Fluvaquents, frequently flooded, complex, 0 to 45 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.
- E11E (7%): Miskoaki-Rock outcrop complex, 18 to 70 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.

Ecological Site (USDA): F092XY012WI - Moist Clayey Lowlands, F092XY007WI - Wet Loamy or Clayey Lowlands

Successional Stage (MDNR): Transitional forest (35-95 years)

Average Stand Diameter (DBH): 9.8" (SE=0.4)

Average Stand Basal Area: 116 ft2/ac (SE=6.1)

Snags per acre: 177 medium (6-11" DBH), 20 large (>12" DBH)

Coarse woody debris: Medium to high

Wildfire risk: Medium to high in isolated patches of dense young balsam fir, heavy fuel loading from dense trees, blowdown, and numerous snags

Invasive Species: Buckthorn throughout the stand, more well-established in southern half of stand

Pests & Disease: EAB established with dead and dying trees present; minimal fir mortality; localized aspen and birch mortality

Current Condition: This is the largest stand in the Lester-Amity recreation area, and has a fairly similar composition throughout. Quaking aspen and paper birch by far dominate the canopy, with a geometric distribution of size classes indicating the stand has some mature characteristics (aspen 15-22" DBH) but is still maturing with majority smaller trees at 3-11" DBH. Occasional remnant conifers (white spruce, white pine, jack pine) suggest fire-influenced characteristics that could be perpetuated through active fire management. Black ash, green ash, and willow are present in lower-lying drainages, high water overflows

from Amity Creek, and wetlands. Young balsam fir is dense in isolated pockets and there is some bigtooth aspen. Black ash and green ash are strongly regenerating primarily in lowerlying areas, with quaking aspen and red maple abundant as seedlings and saplings throughout. Blowdown is apparent in patches. Buckthorn is the most common midstory species, along with serviceberry, beaked hazel, and speckled alder, and lower quantities of other native shrubs (*Prunus* spp., red-osier dogwood, mountain maple, downy arrowwood [*Viburnum opulus*], hawthorns [*Crataegus* spp.). Dominant understory plants are large-leaved aster, bush honeysuckle, dewberry, bracken fern, currant, and goldenrod.

Current Recreational Uses or Management:
This stand has a high concentration of trails for multiple recreation types, including hiking, skiing, mountain biking, and snowmobiling. It is accessible from trailheads on all sides of the property and receives high visitor use. Lester-Amity is one of the most accessible recreation areas for Duluth residents.

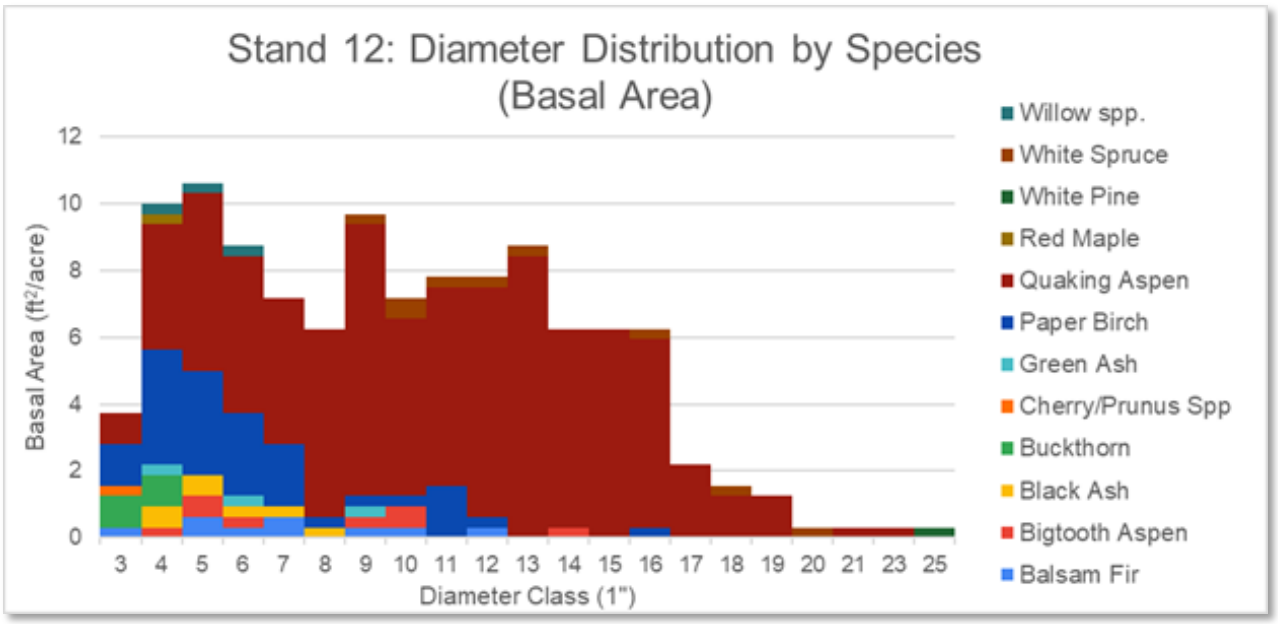
Adjacent land use concerns:
N/A

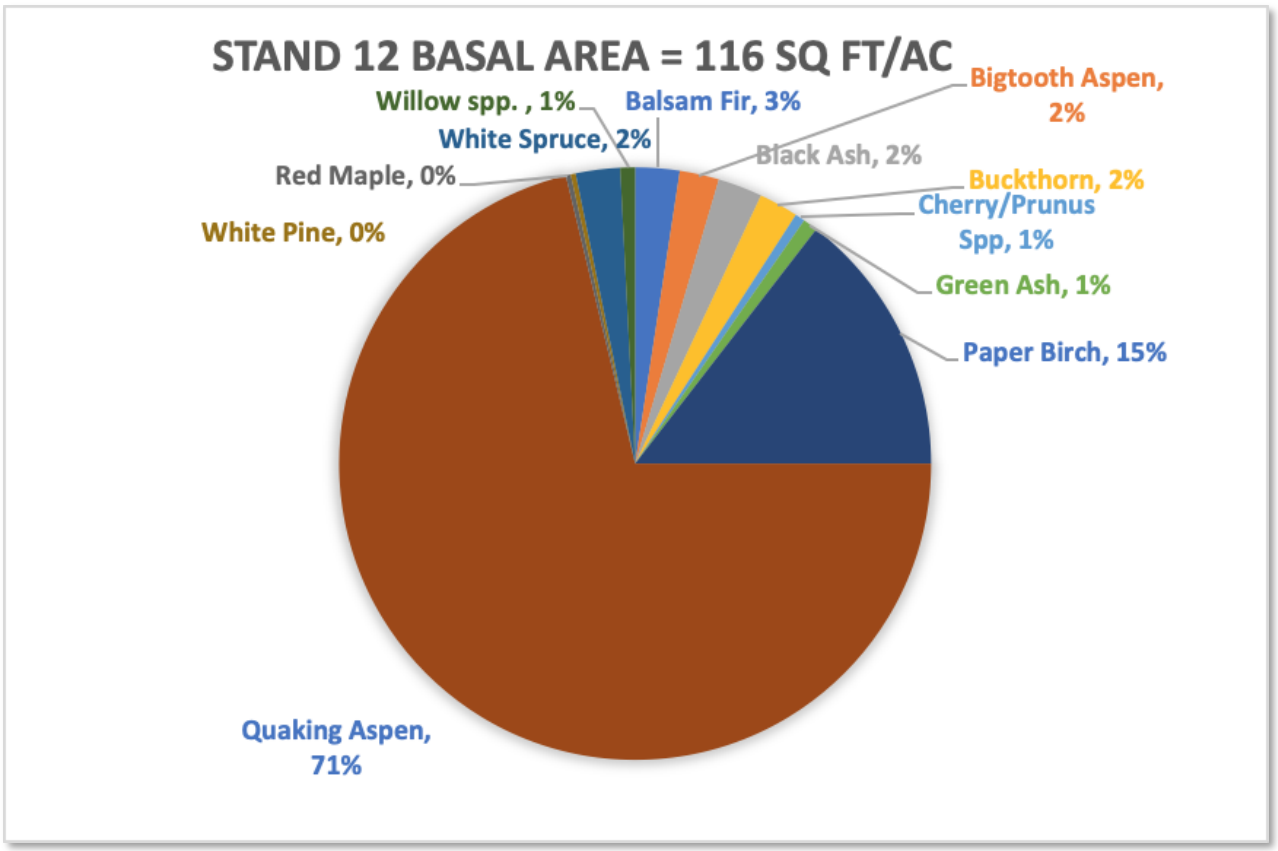
No action result (10-20 years): Fire-dependent characteristics may transition to more mesic hardwood characteristics with incursion of red maple, unless a wildfire occurs. Aspen will continue to die off as it matures. Dense aspen and birch may be vulnerable to future windthrow events and forest resilience may decline due to lack of diversity. Dense stands of balsam fir may fail from competition stress or spruce budworm increasing hazardous fuel load.

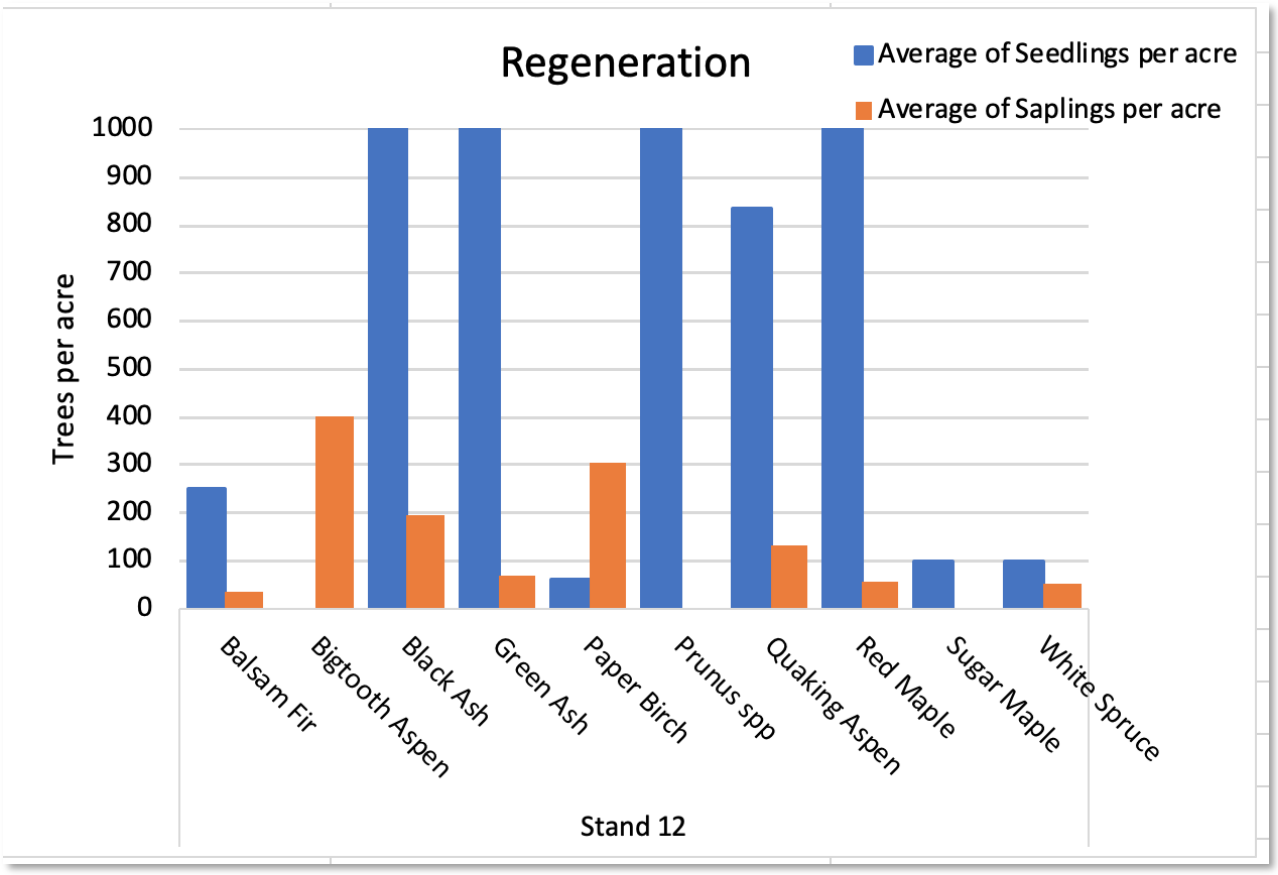
Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	Initial mulching, maintained through intermittent burning and grazing
Recreation	Maintain trail functionality	Cut and remove weakened or dead trees along trails	
Recreation; Forest resilience; Restore/enhance native plant communities	Manage for open or partially open ("park-like") understory conditions	Mulch/masticate dense shrubs	Target buckthorn and hazel
Restore/enhance native plant communities; Regeneration; Recreation	Restore and maintain fire-dependent plant communities; Manage for open or partially open ("park-like") understory conditions	Prescribed burning; prescribed grazing	Rotate between burning and grazing as conditions/capacity allows. Ladder fuels must be reduced before burning.

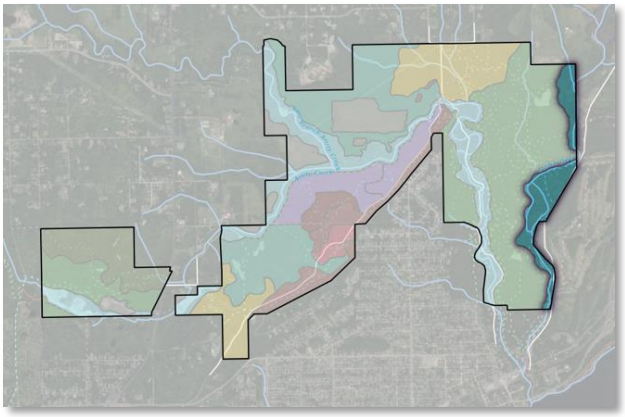
Regeneration; Forest resilience; Ecosystem function	Artificial regeneration	Plant trees	late successional, fire tolerant conifers (or direct seed), fruiting shrubs






Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Bigtooth Aspen
Black Ash
Green Ash
Paper Birch
Prunus spp
Quaking Aspen
Red Maple
Sugar Maple
White Spruce
Stand 12

Stand 13 Aspen-Birch (Riparian)





Stand Characteristics

Forest Type: Aspen-Birch (Riparian)

Size: 76 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn33b	27.3	36.07%
FFn57a	13.9	18.45%
RVx43a2	11.1	14.74%
FDn43b	6.3	8.31%
RVx54a	6.3	8.29%
MHn46b	5.9	7.82%

Dominant Soil:

- E11E (40%): Miskoaki-Rock outcrop complex, 18 to 70 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.
- E8D (25%): Amnicon-Fluvaquents, frequently flooded, complex, 0 to 18 percent slopes. Silt loam, silty clay loam over clay at 13" or stratified silt loam to gravelly clay loam at 11". Well drained.
- E13E (16%): Udifluvents, occasionally flooded-Rollins complex, 0 to 30 percent slopes. Extremely gravelly loam 0-80" or sandy loam over gravelly sandy loam at 5" at extremely gravelly sand 14-80". Moderately well drained to somewhat excessively drained.
- E24F (11%): Miskoaki-Cuttre complex, 5 to 45 percent slopes. Silt loam or silty clay loam over clay at 6-8". Well drained to somewhat poorly drained.

Ecological Site (USDA): F092XY015WI - Clayey Uplands, F092XY007WI - Wet Loamy or Clayey Lowlands, F092XY004WI - Seasonally Dry Floodplains, F092XY013WI - Sandy Uplands

Successional Stage (MDNR): Young forest (0-55 years)

Average Stand Diameter (DBH): 9.2" (SE=0.6)

Average Stand Basal Area: 110 ft^2/ac (SE=12.6)

Snags per acre: 9 large (>12" DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Moderate densities of buckthorn and occasional honeysuckle

Pests & Disease: Emerald ash borer has caused near or total mortality to ash trees

Current Condition: The Lester River floodplain includes lower lying black ash swamps with black ash up to 8" DBH highly impacted by emerald ash borer, and slopes and upper terraces featuring a mixed-age fire-dependent paper birch and quaking aspen forest with diameters ranging from 3 to 20". Canopy cover is variable with regeneration high likely due to regular canopy gaps. Black ash is the most abundant regenerating species by far, with green ash, quaking aspen next most common, and lower amounts of balsam poplar, paper birch, red maple, and balsam fir. The midstory is relatively thick with serviceberry,

beaked hazel, round-leaved dogwood, and a diversity of other native shrubs, along with buckthorn. Bluejoint is common in the floodplain forest, along with thimbleberry, large-leaved aster, currant, and raspberries and dewberries (*Rubus* spp.).

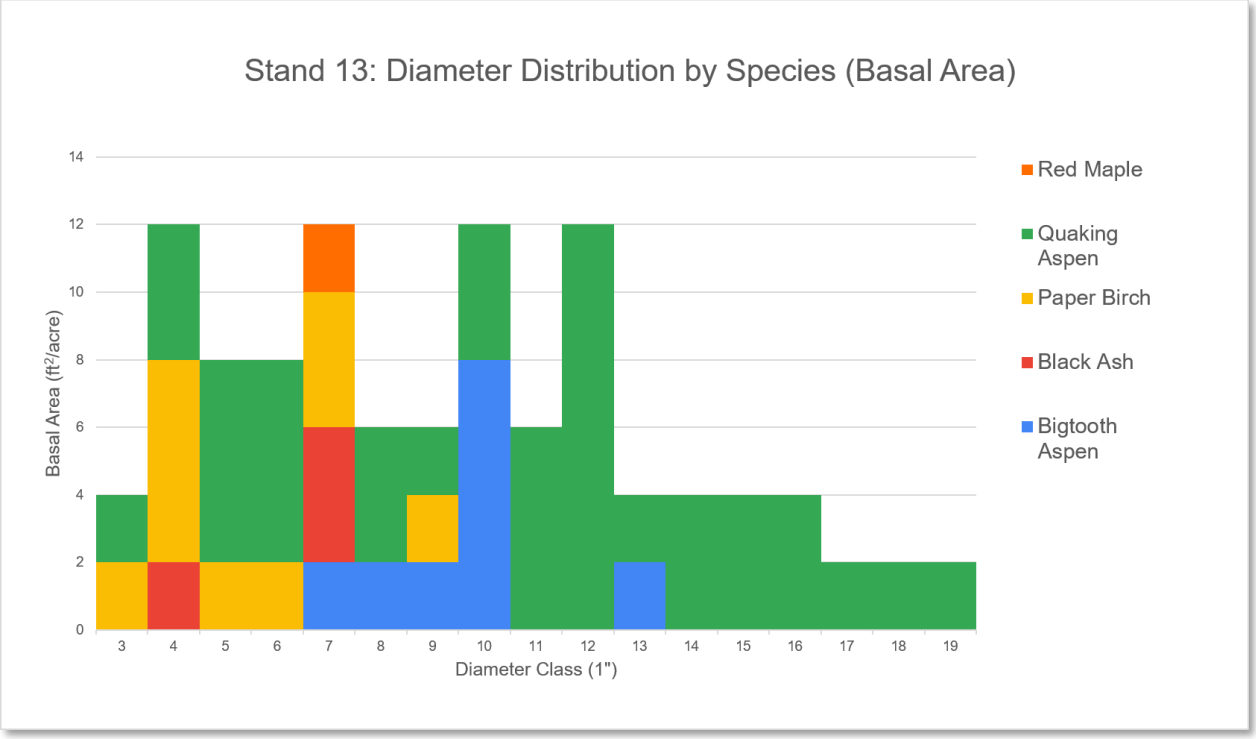
Current Recreational Uses or Management:
This stand is further from main trailheads and has only a single hiking trail through it, meaning lower recreational traffic. There were indications of high wildlife uses, including tracks, scat and browse.

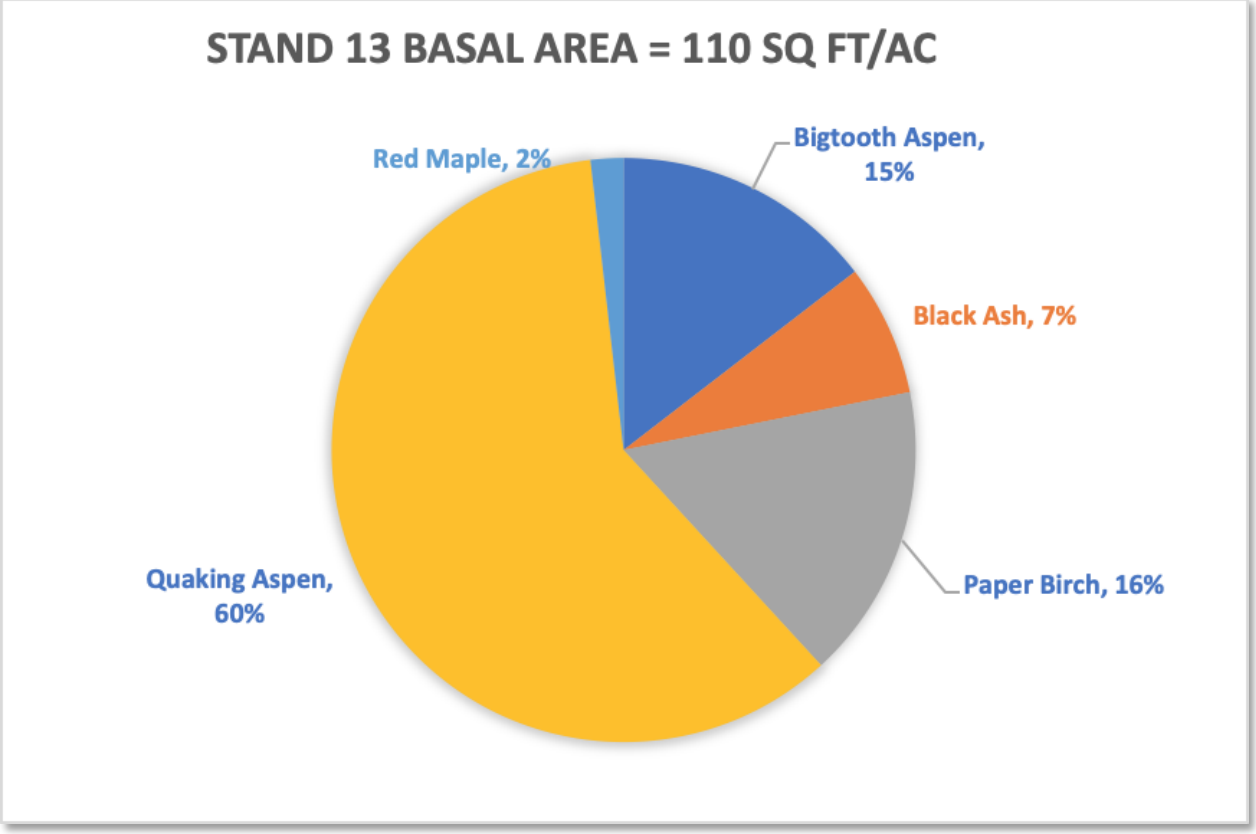
Adjacent land use concerns:
Lester River Road is uphill of the unit - concern for runoff and pollution. Residential areas upstream of this natural area may contribute runoff and pollution.

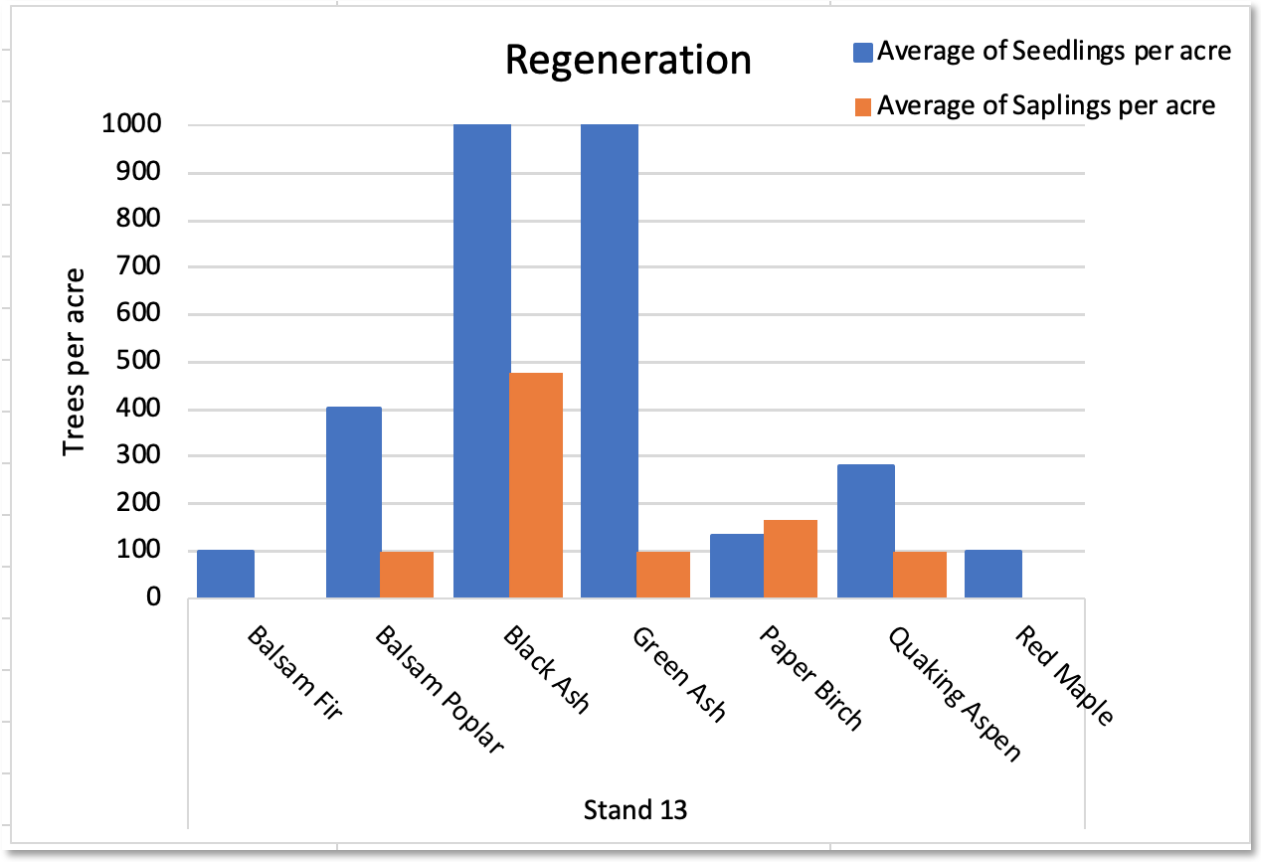
No action result (10-20 years): Birch and aspen are likely to persist. Later successional species may not establish on their own leaving a low diversity forest. A low diversity forest is less resilient to climate change-induced extreme rain, heat, drought, and storm events. Lester River aquatic habitat may be negatively impacted by loss of shade and organic matter deposition from ash trees in the wake of emerald ash borer

Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Underplanting - Plant trees other than ash where ash decline and mortality is advanced	
Restore/enhance native plant communities	Restore and maintain fire-dependent plant communities	Prescribed burning	On sandy outwash hill in south part of unit


Stand 13: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Diameter Class (1")
Red Maple
Quaking Aspen
Paper Birch
Black Ash
Bigtooth Aspen


STAND 13 BASAL AREA = 110 SQ FT/AC
Red Maple, 2%
Bigtooth Aspen, 15%
Black Ash, 7%
Quaking Aspen, 60%
Paper Birch, 16%



Stand 14 Developed/Riparian



Stand Characteristics

Forest Type: Developed/Riparian

Size: 75 acres

NPC (MDNR)	*Acres*	*% of stand*
Developed	13.9	18.61%
Disturbed	13.1	17.59%
FDn33b	9.6	12.90%
MHn44a	6.3	8.45%
FDn43b	6.2	8.29%
MHn46b	6.2	8.24%
RVx43a2	6.0	8.08%
RVx54a	5.9	7.89%
FFn57a	5.4	7.20%

Dominant Soil:

- E23F (51%): Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes. Silt loam, silty clay loam over clay at 6"; sandy loam, stratified very gravelly sandy loam. Well drained to somewhat poorly drained.
- E11E (45%): Miskoaki-Rock outcrop complex, 18 to 70 percent slopes. Silt loam, silty clay loam, clay at 6". Well drained.

Ecological Site (USDA): F092XY015WI - Clayey Uplands, F092XY004WI - Seasonally Dry Floodplains (35%)

Successional Stage (MDNR): Young forest (0-55 years) to early transitional forest (55-95 years)

Average Stand Diameter (DBH): 8.9" (SE=1.0)

Average Stand Basal Area: 107 ^{2} (SE=19.0)

Snags per acre: 55 medium (6-11" DBH), 9 large (>12" DBH)

Coarse woody debris: Medium to high

Wildfire risk: High on upper embankments due to dead, dying, and fallen planted red pines and proximity to trailheads, Seven Bridges Road, and Lester-Amity Chalet

Invasive Species: Buckthorn saplings at a low density

Pests & Disease: Cause of red pine mortality is very likely overcrowding, but insects or disease may be a contributing or secondary factor

Current Condition: This unit is a mosaic of floodplain forest and bedrock channels of Amity Creek, steep embankments of overcrowded and failing red pine plantations, and upper slopes that are either highly eroded or composed of young to maturing birch-aspen stands. The floodplain forest includes quaking aspen, white spruce, balsam poplar, black ash, green ash, and occasional black willow spanning fairly evenly across the 3-14" size class. Regeneration is healthy, with a diversity of both seedlings and sapling including balsam poplar, black ash, green ash, quaking aspen, balsam fir, white spruce, and even red and white pine (most pines were likely planted). The upper banks include older floodplain terraces of aspen and birch, and steep slopes feature multiple monoculture stands of planted red pines over 80 years old. These were likely planted densely at approximately 8-ft-on-center to prevent erosion, which was successful, but they are now overcrowded and dead, dying, or struggling with <25% live crown. The shrub layer varies from sparse to moderately dense with dominant species being mountain maple, red osier dogwood, beaked hazel, and a higher diversity of native shrubs (*Prunus* spp., mountain ash, *Amelanchier* spp., willows, and the rare buffaloberry) compared to other stands. Thimbleberry is a dominant understory species, along with large-leaved aster, hawkweed, and raspberries and dewberries (*Rubus* spp.).

Current Recreational Uses or Management:

: This stand retains valuable native plant community but also has significant areas of development, recreational impacts, and managed vegetation. The Lester Amity Chalet, Seven Bridges Road, ski trails, hiking trails, mountain biking trails, snowmobile trails, parking pullouts, and numerous "social trails" and river sit spots are amongst such infrastructure. Numerous planting

Adjacent land use concerns:

Lower Amity Creek is one of the most accessible recreation areas for Duluth residents and is a highly valued site for numerous recreational users, providing opportunities for both good land stewardship and risks of negative impacts like trampling, pollution, trash/debris, and disruption of

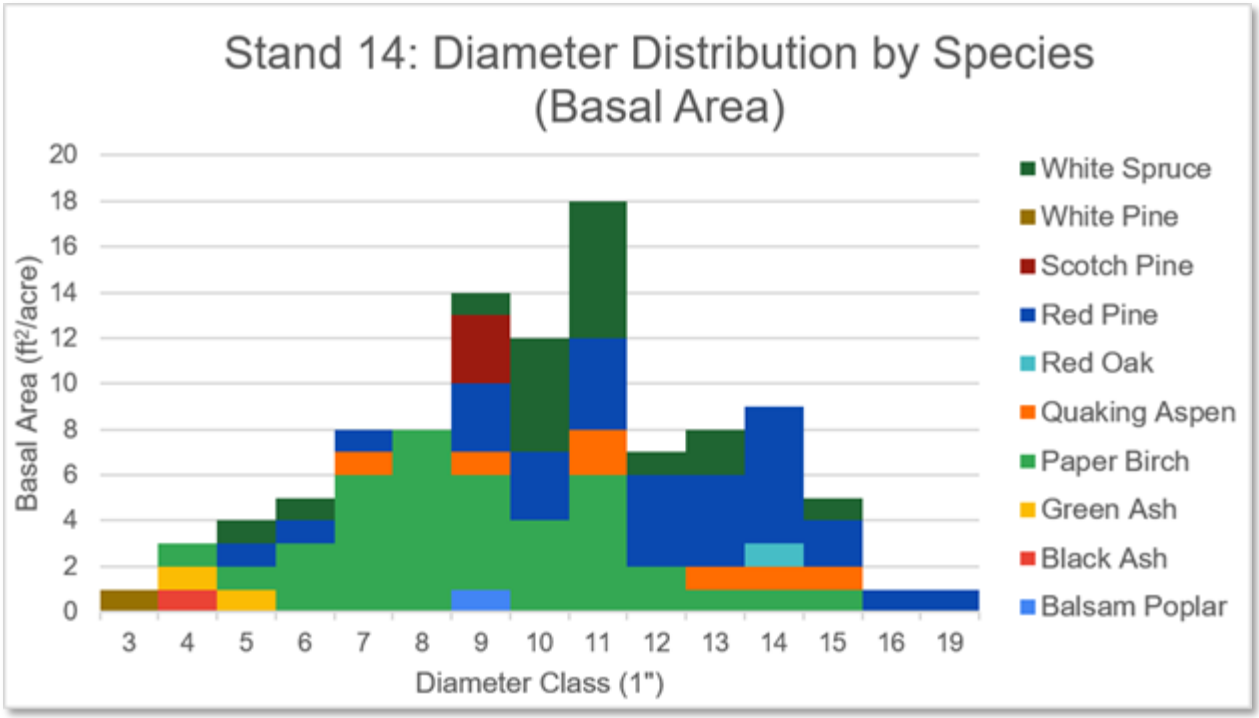
projects have been undertaken across multiple generations, as indicated by the >80 year old planted red pines along with planted and caged seedlings of white cedar, white pine, red pine, and white spruce in the floodplain terraces.

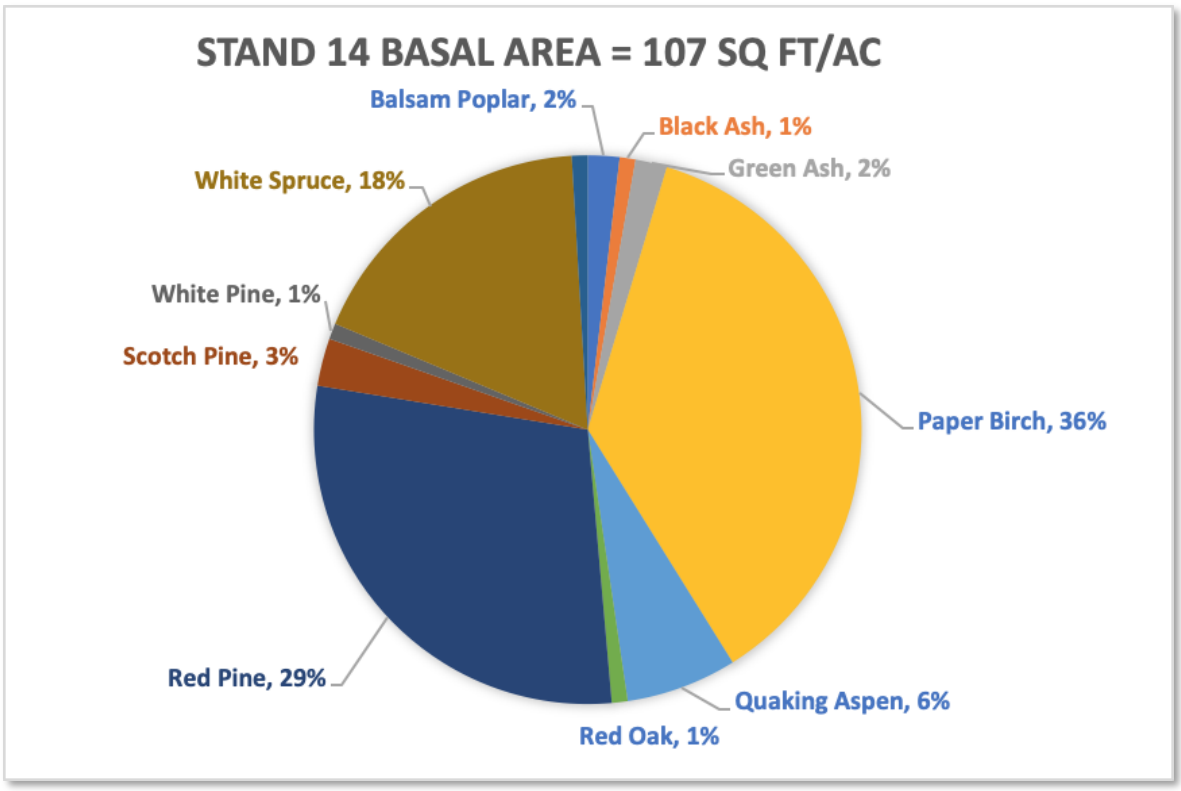
wildlife. Extremely dense stands of buckthorn occur to the south and west of the stand and are encroaching into the park.

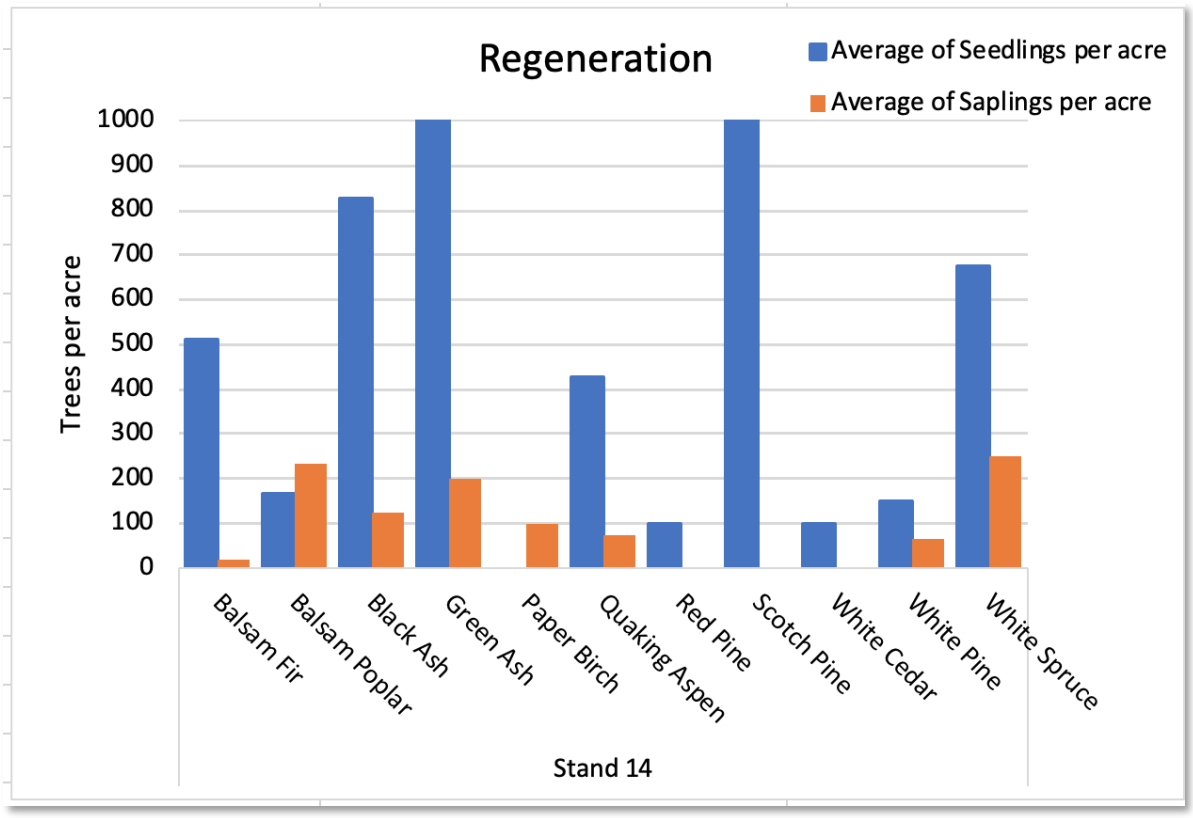
No action result (10-20 years): Red pines will continue to fail and fall over, resulting in hazards to the public, a maintenance burden, an unattractive viewshed, and increased wildfire risk. Natural tree regeneration may occur but buckthorn or native shrubs like hazel, dogwood, and mountain maple may become dominant. Floodplain forest will persist but longer-lived shade-tolerant species may not establish on their own leaving a lower diversity forest.

Management Goals, Strategies, and Actions

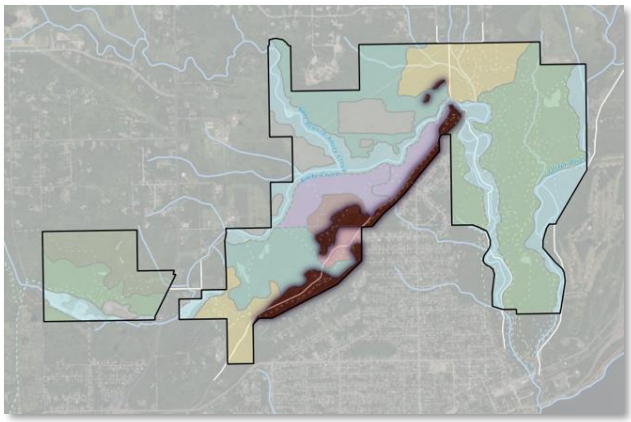
Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Ecosystem function	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	Avoid soil disturbance on slopes; avoid herbicides near wetlands and waterways
Restore/enhance native plant communities	Transition tree plantations to native forest composition	Thin overly stocked tree plantations, sell commercially when possible or remove offsite; Interplant diverse native trees suitable to site conditions	Reduce red pine competition, create canopy openings for regeneration and understory growth
Regeneration; Ecosystem function	Artificial regeneration	Plant trees	Establish riparian conifers


Stand 14: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
20
18
16
14
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 19
Diameter Class (1")
White Spruce
White Pine
Scotch Pine
Red Pine
Red Oak
Quaking Aspen
Paper Birch
Green Ash
Black Ash
Balsam Poplar


STAND 14 BASAL AREA = 107 SQ FT/AC
Balsam Poplar, 2%
Black Ash, 1%
Green Ash, 2%
White Spruce, 18%
White Pine, 1%
Scotch Pine, 3%
Paper Birch, 36%
Red Pine, 29%
Quaking Aspen, 6%
Red Oak, 1%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Pine
Scotch Pine
White Cedar
White Pine
White Spruce
Stand 14

Stand 15 Rocky Outcrop (Aspen-Red Oak)





Stand Characteristics

Forest Type: Rocky Outcrop (Aspen-Red Oak)

Size: 68 acres

NPC (MDNR)	*Acres*	*% of stand*
ROn23a	40.6	60.01%
FDn33b	12.1	17.81%
MHn35b	7.6	11.20%

Dominant Soil:

- F160F (67%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- F147D (24%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.
- F112D (7%): Forbay-Augustana complex, 3 to 18 percent slopes. Loam to 79". Well drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest, F093AY013MN Loamy uplands, F093AY006MN - Depressional Wet Hardwood Forest

Successional Stage (MDNR): N/A

Average Stand Diameter (DBH): 4.8" (SE=1.2)

Average Stand Basal Area: 46 ft2/ac (SE=13.1)

Snags per acre: 1.5 large (>12" DBH)

Coarse woody debris: Low to medium

Wildfire risk: Moderate due to dry exposed environment, some dead fir, and risk of ignition from recreational users and vehicles along Skyline Parkway

Invasive Species: Medium amount of buckthorn plants fairly well established in the tall shrub layer

Pests & Disease: Some dead fir was noted which may suggest spruce budworm, although cause of mortality was not confirmed

Current Condition: This stand makes up the highest peak of Hawk Ridge and the contiguous ridgeline extending to the northeast and southwest, a rocky outcrop of sparsely growing stunted tree growth characterized by a fire-dependent plant community. Quaking aspen is the dominant tree averaging 3-8" DBH, with fewer red oak in all size classes up to 14" DBH, red maple 3-5" DBH, and occasional paper birch. Regeneration is modest, with more saplings than seedlings, indicating healthy establishment of young trees though at a sparse density. Saplings are mostly aspen and a few red maple, with seedlings of balsam fir, paper birch, aspen, red maple, and red oak. Shrub layer is dense, composed of red-osier dogwood, serviceberry, buckthorn, beaked hazel, and chokecherry. Herbaceous layer is very dominantly bush honeysuckle with a greater diversity of plants compared to other stands.

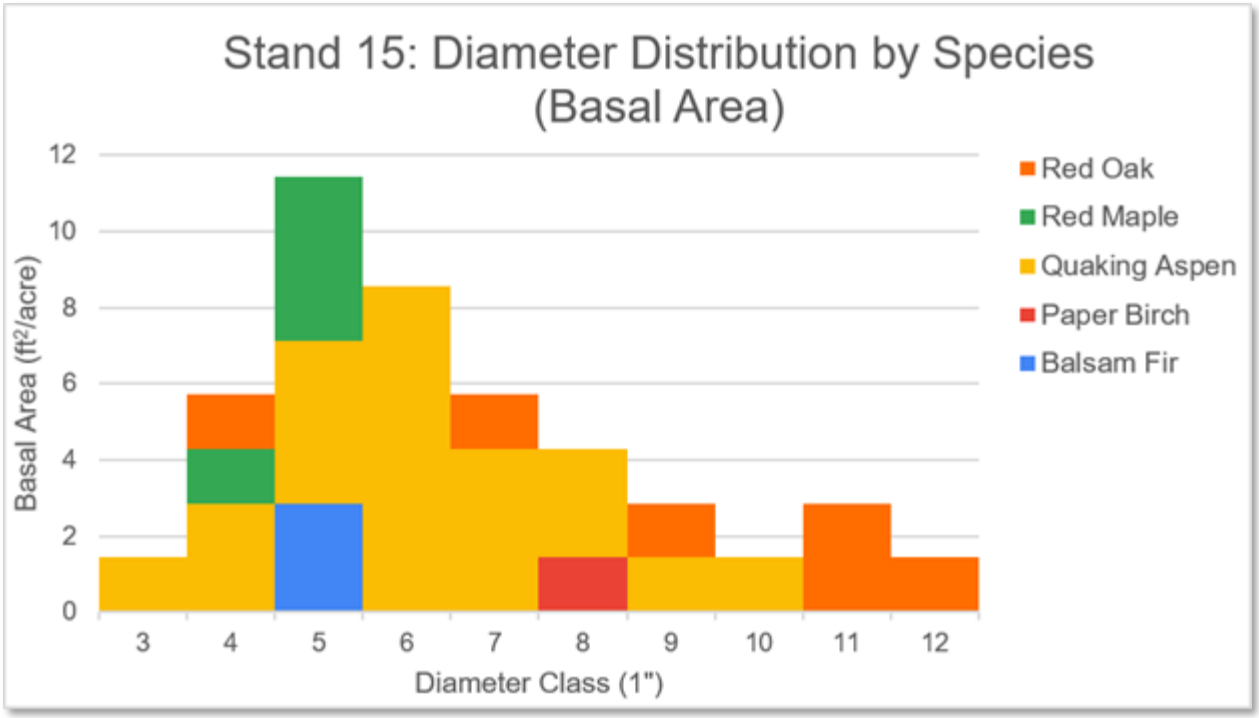
Current Recreational Uses or Management:
Several hiking trails intersect within this stand. A powerline corridor bisects the unit. Skyline Parkway follows the ridgeline through the entire length of the stand. The stand includes the central public viewing and educational activity during peak hawk migration in the spring and fall. The stand also boasts stunning views of Lake Superior that would be compromised if tree growth continues downslope.

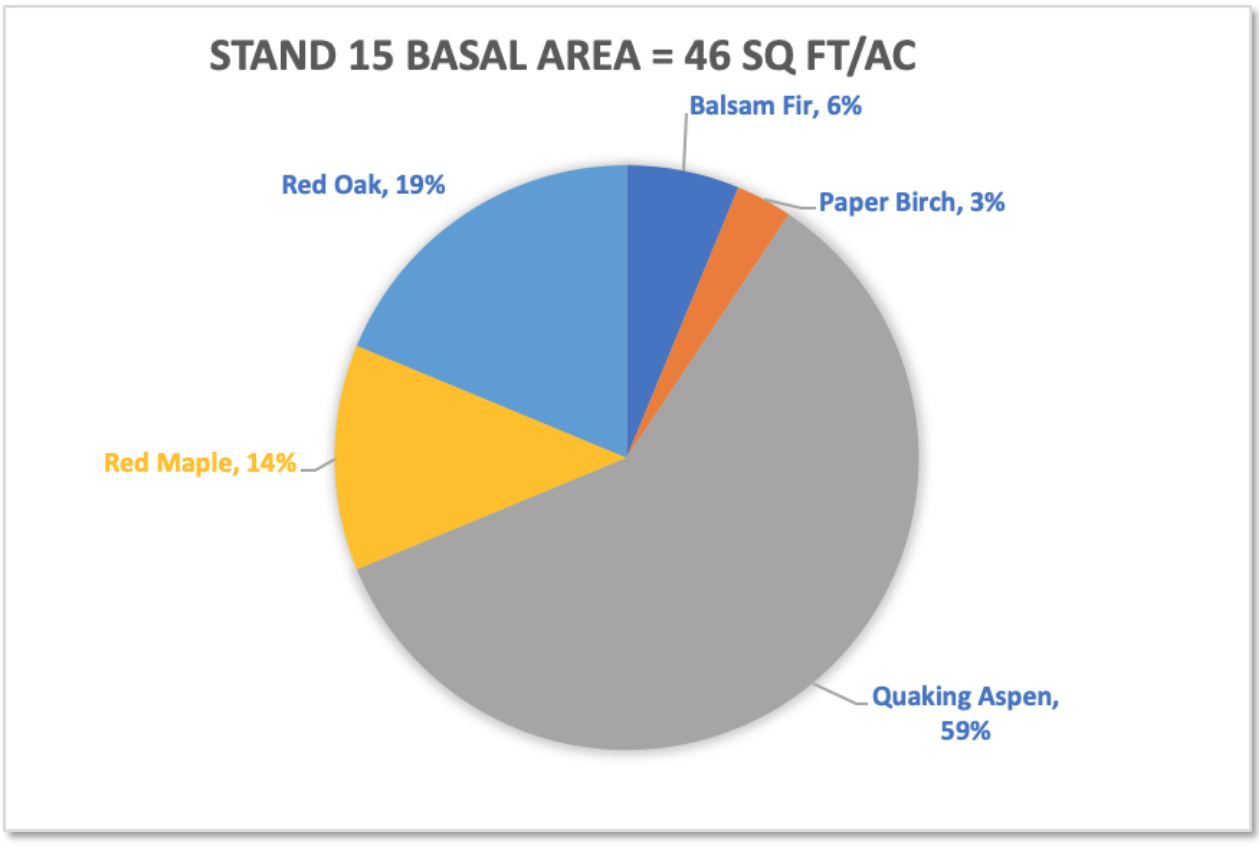
Adjacent land use concerns:
Ignition source from recreational users throughout Hawk Ridge or vehicles on Skyline Parkway. Potential for trampling and trash/debris from high visitor use.

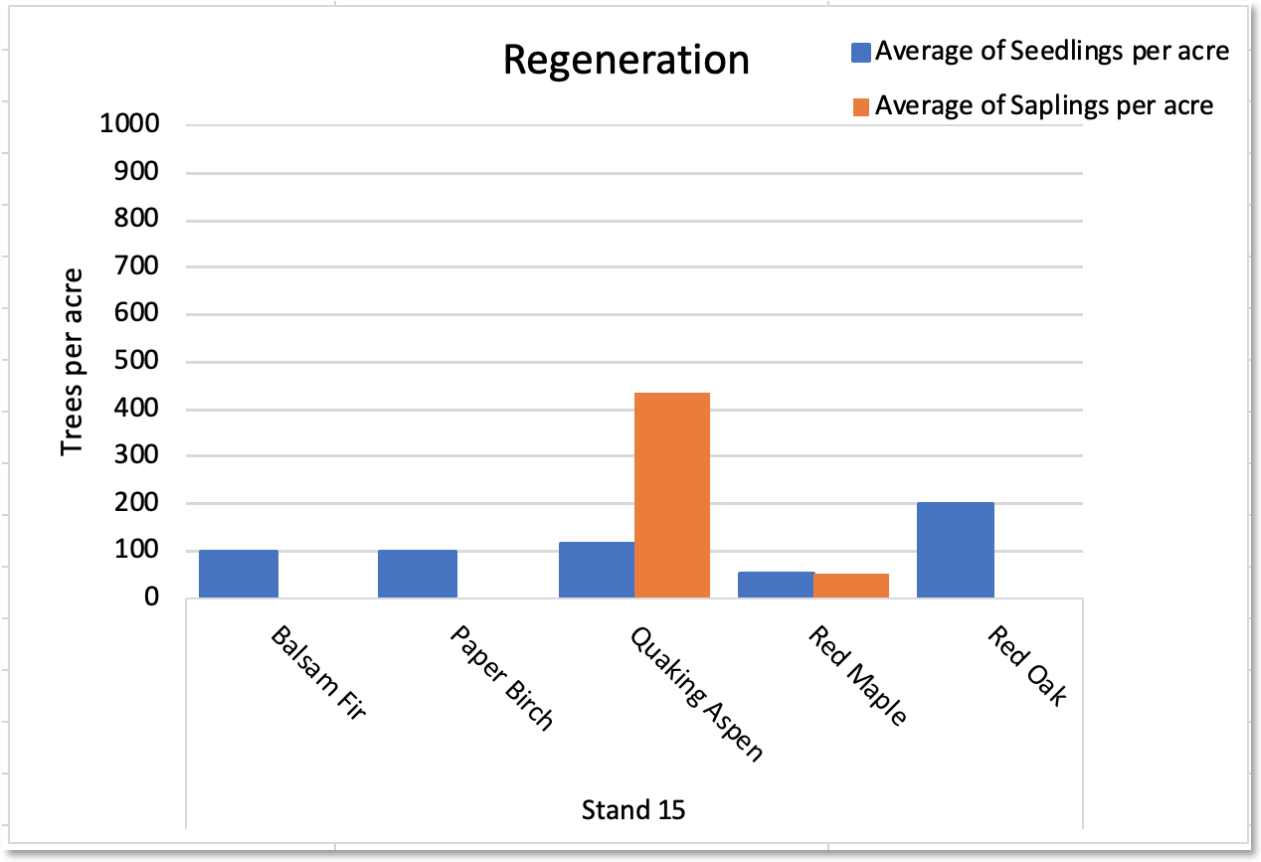
No action result (10-20 years): The stand is not likely to change much given the harsh conditions of the rocky outcrop environment and adaptation of existing plants to environmental extremes like drought, wind, and cold exposure. Greater tree mortality could occur in the event of an extreme drought or heat wave, or a wildfire.

Management Goals, Strategies, and Actions

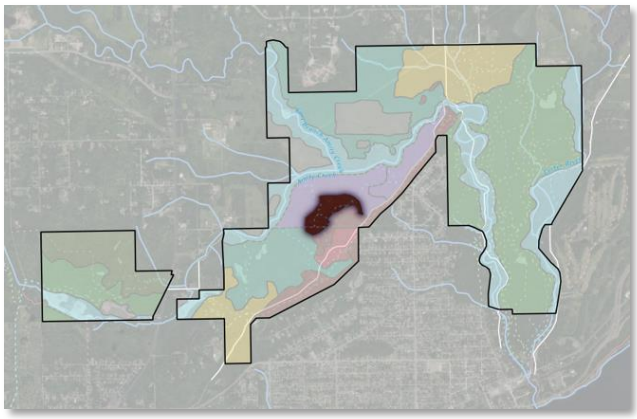
Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Recreation	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	Additional invasive species present along road
Restore/enhance native plant communities; Recreation	Restore and maintain fire-dependent plant communities	Prescribed burning	Red maple establishing in younger age classes, Buckthorn present, follow up monitor
Recreation	Manage viewsheds at key viewpoints	Cut tall vegetation; Remove accumulated woody debris	hand cut vegetation


Stand 15: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
3
4
5
6
7
8
9
10
11
12
Diameter Class (1")
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Balsam Fir


STAND 15 BASAL AREA = 46 SQ FT/AC
Balsam Fir, 6%
Paper Birch, 3%
Red Oak, 19%
Red Maple, 14%
Quaking Aspen, 59%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Stand 15

Stand 16 Aspen-Birch (Balsam Fir)





Stand Characteristics

Forest Type: Aspen-Birch (Balsam Fir)

Size: 22 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b1	11.4	52.98%
FDn33a1	5.1	23.70%
FDn33b	2.4	11.32%
FDn43b	1.3	6.01%

Dominant Soil:

- F160F (68%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- F147D (32%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest, F093AY013MN Loamy uplands

Successional Stage (MDNR): Young forest (0-35 years)

Average Stand Diameter (DBH): 6.0" (SE=0.4)

Average Stand Basal Area: 100 ft2/ac (SE=14.4)

Snags per acre: 49 medium (6-11" DBH)

Coarse woody debris: High

Wildfire risk: High due to quantity of dense living and dead balsam fir forming a fuel ladder, blowdown trees, steep slope, and high visitor traffic

Invasive Species: Buckthorn in low quantities

Pests & Disease: The presence of dead fir may suggest spruce budworm, although cause of mortality was not confirmed

Current Condition: This very rocky, steep stand is located on the northwestern-facing slope of the Hawk Ridge peak. Soil is minimal and stunted trees grow primarily out of crevices in the rock. Dominant trees are an equal mix of paper birch, quaking aspen, and balsam fir. Diameter distribution indicates a young stand with a geometric distribution of numerous <5" diameter trees, some 6-8" trees, and only occasional 9-11" trees. Regeneration is strong and of the same species composition as well as occasional red maple and black ash seedlings. Fuel loading is very high with blowdown trees, dense living balsam fir, and dead balsam fir forming a fuel ladder, posing a significant wildfire risk. Beaked hazel, mountain maple, serviceberry, and red-osier dogwood form a moderately dense shrub layer. Moss, lichens, large-leaved aster, and bush honeysuckle are the dominant herbaceous layer. Blueberry is present but not in abundance.

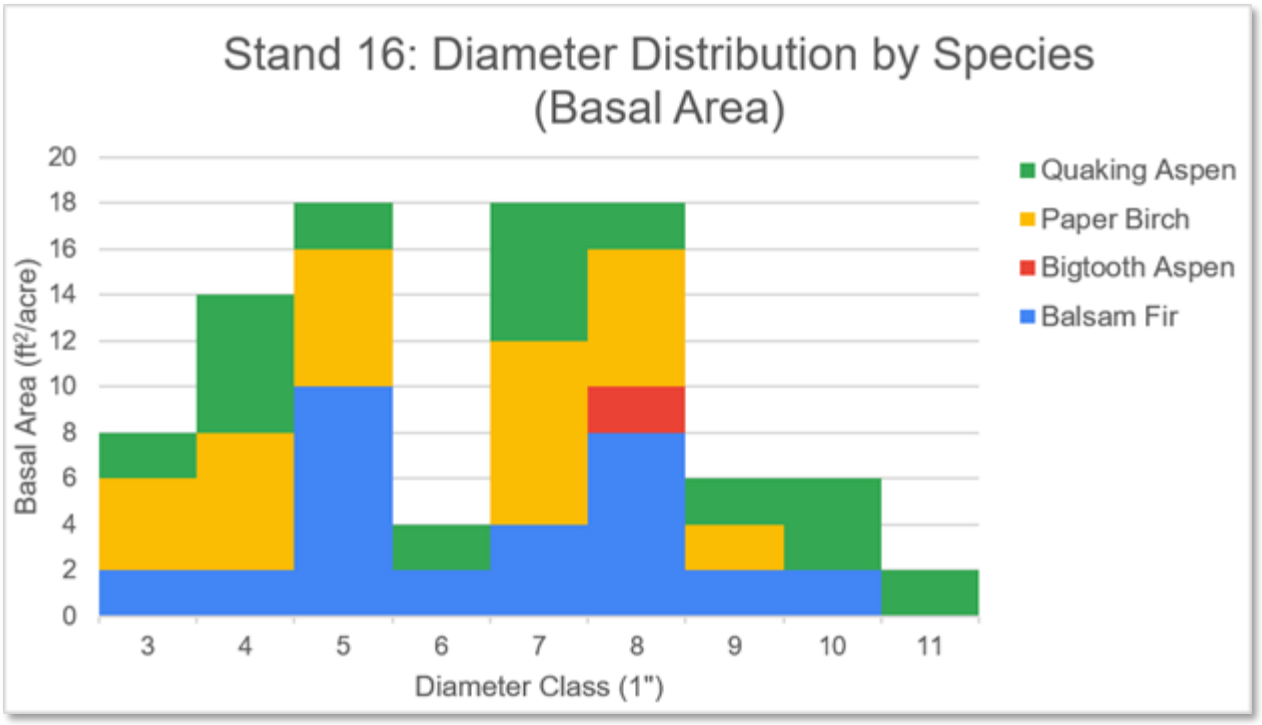
Current Recreational Uses or Management:
The Ridge Loop trail traverses down this slope. Dense buildup of downed trees and rocky steep terrain discourages off-trail use.

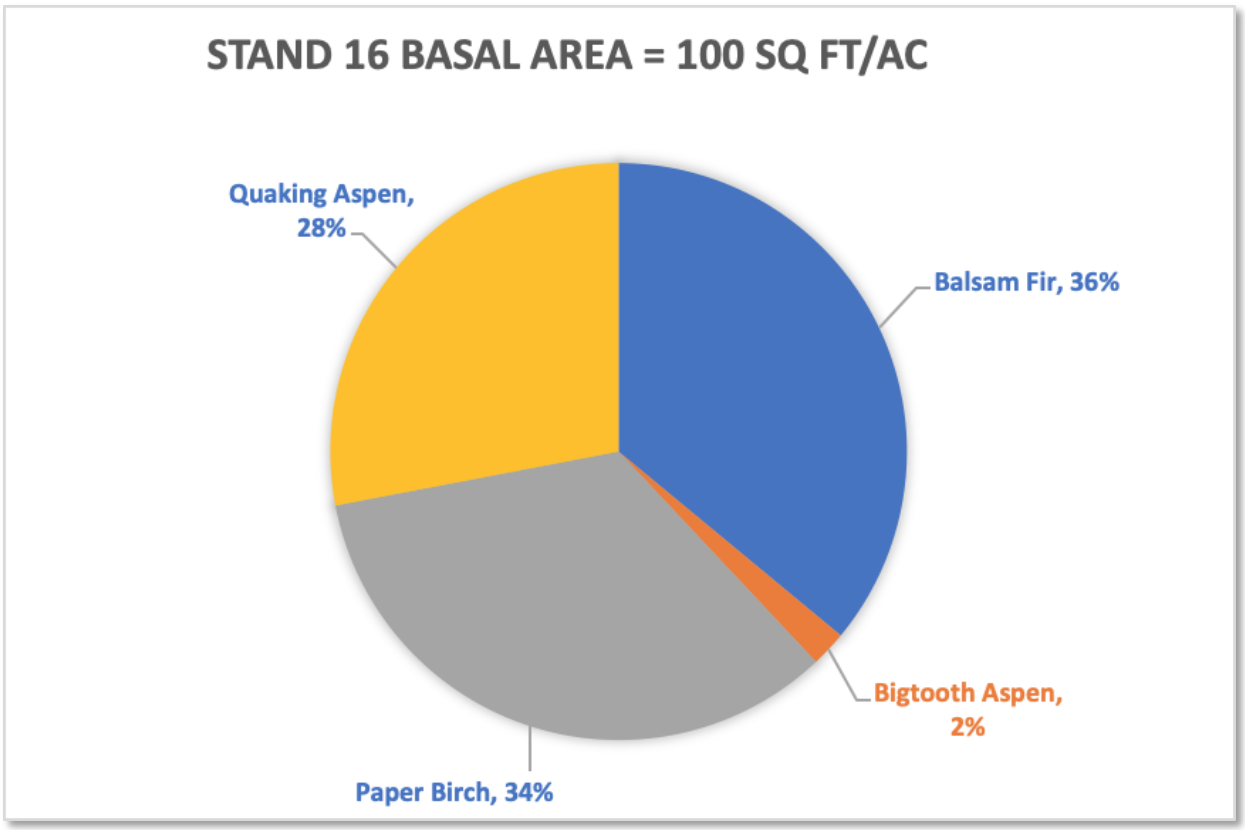
Adjacent land use concerns:
Ignition source from recreational users throughout Hawk Ridge or vehicles on Skyline Parkway.

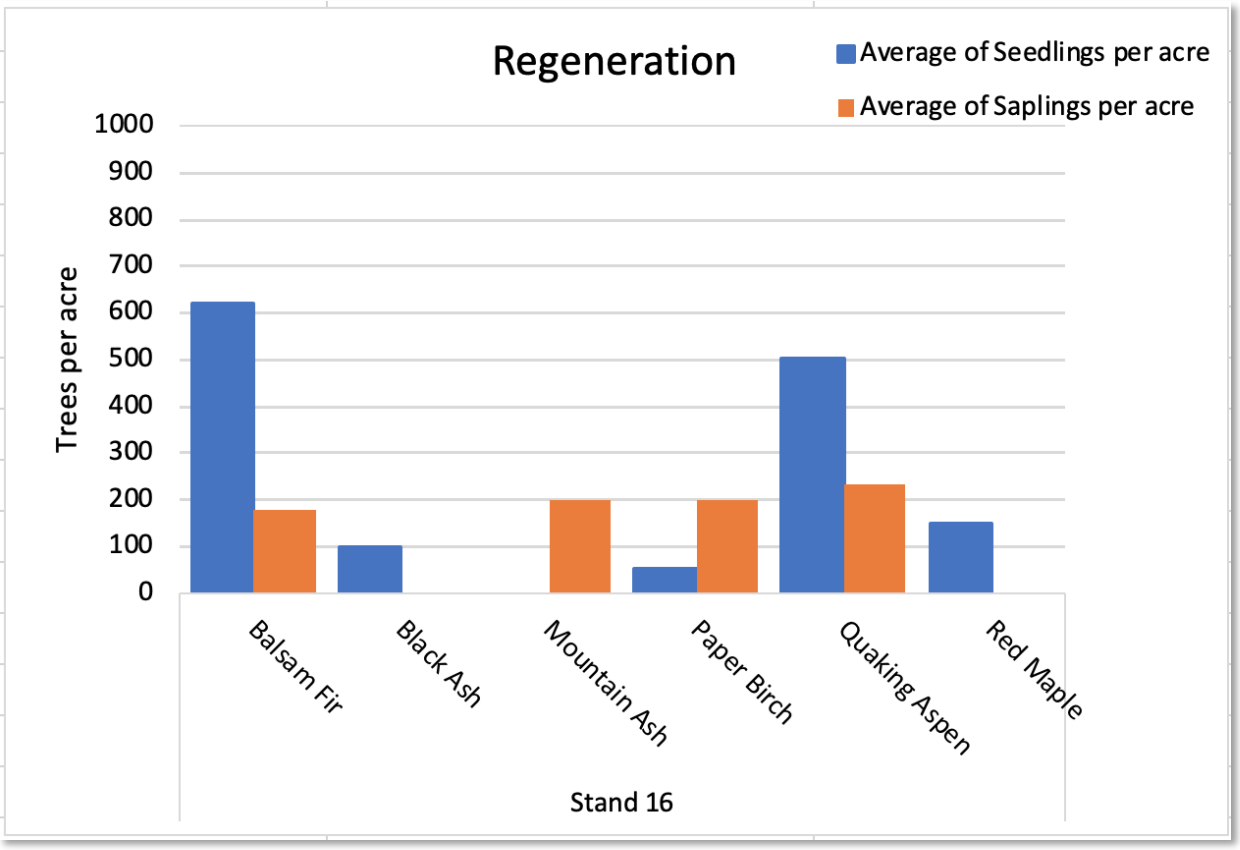
No action result (10-20 years): Balsam fir will continue to die from competition with each other and drought impacts. A fire in this stand is inevitable and would involve intense fire behavior and potentially severe fire effects setting back all vegetation for a long period. A controlled burn after mechanical removal of some fuels will reduce fire intensity and severity.

Management Goals, Strategies, and Actions

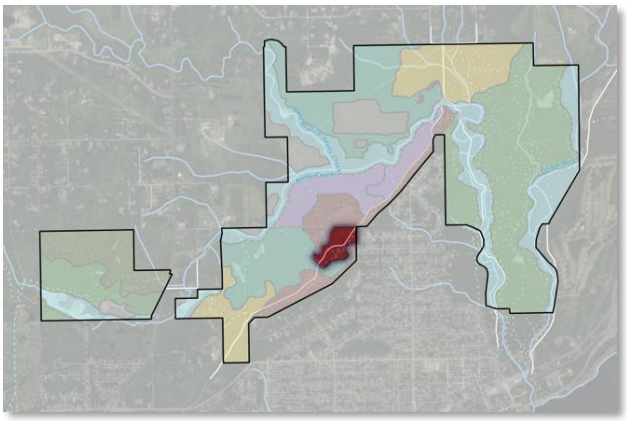
Goal	Strategy	Action	Notes
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Remove accumulated woody debris	
Forest resilience; Restore/enhance native plant communities	Restore and maintain fire-dependent plant communities	Prescribed burn	Red maple establishing in younger age classes, Buckthorn present, follow up monitor




STAND 16 BASAL AREA = 100 SQ FT/AC
Quaking Aspen, 28%
Balsam Fir, 36%
Bigtooth Aspen, 2%
Paper Birch, 34%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Black Ash
Mountain Ash
Paper Birch
Quaking Aspen
Red Maple
Stand 16

Stand 17 Northern Hardwoods (Red Oak)





Stand Characteristics

Forest Type: Northern Hardwoods (Red Oak)

Size: 19 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	13.1	69.63%
FDn33b	1.5	7.89%
FDn43b1	1.4	7.47%
Developed	1.4	7.36%

Dominant Soil:

- F160F (61%): Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes. Gravelly sand loam over bedrock between 0-28". Well drained.
- F147D (39%): Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes. Loam, silt-loam over gravelly sandy loam at 4-5". Well drained to poorly drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest, F093AY013MN Loamy uplands

Successional Stage (MDNR): Transitional forest (55-95 years)

Average Stand Diameter (DBH): 10.1”; SE 0.6”

Average Stand Basal Area: 134 ft2/ac; SE 14.3 ft2/ac

Snags per acre: 2 medium (6-11” DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Buckthorn is present throughout but in low amounts and mostly seedlings

Pests & Disease: Some dead spruce was noted which may suggest spruce budworm, although cause of mortality was not confirmed

Current Condition: This is the most hardwood-dominant forest stand at Hawk Ridge, located on the toe slope of the Hawk Ridge peak with a southeastern aspect. Red oak is by far the dominant canopy species, forming a partially-closed canopy of trees averaging 9-14” DBH. Quaking aspen, paper birch, and sugar maple are also common, averaging 6-11” DBH. Sugar maple and to a lesser extent red maple are the dominant subcanopy trees. Regeneration is generally low. Sugar maple is the primary sapling tree, and quaking aspen seedlings are abundant but there were no aspen saplings. Red oak, basswood, balsam fir, paper birch, and green ash are also present in lower amounts. Shrub layer is sparse with buckthorn and dogwood as the most common species. Thimbleberry and large-leaved aster are the dominant understory plants. The stand exhibits characteristics of both fire-dependent and mesic hardwood forest, indicating a possible transition from fire-dependent to mesic hardwood type in the absence of fire.

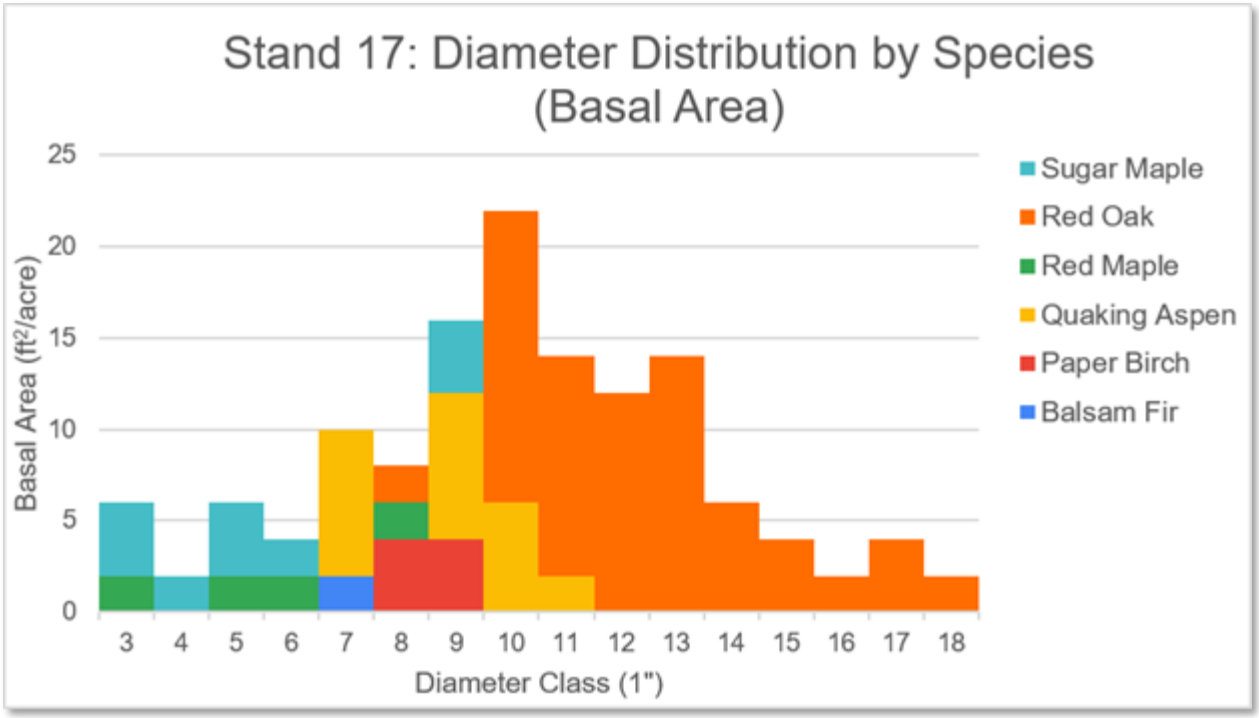
Current Recreational Uses or Management:
There are many hiking trails within the stand and some evidence of vegetation trampling in the understory. Skyline parkway bisects the unit - a source of visitors and invasive species.

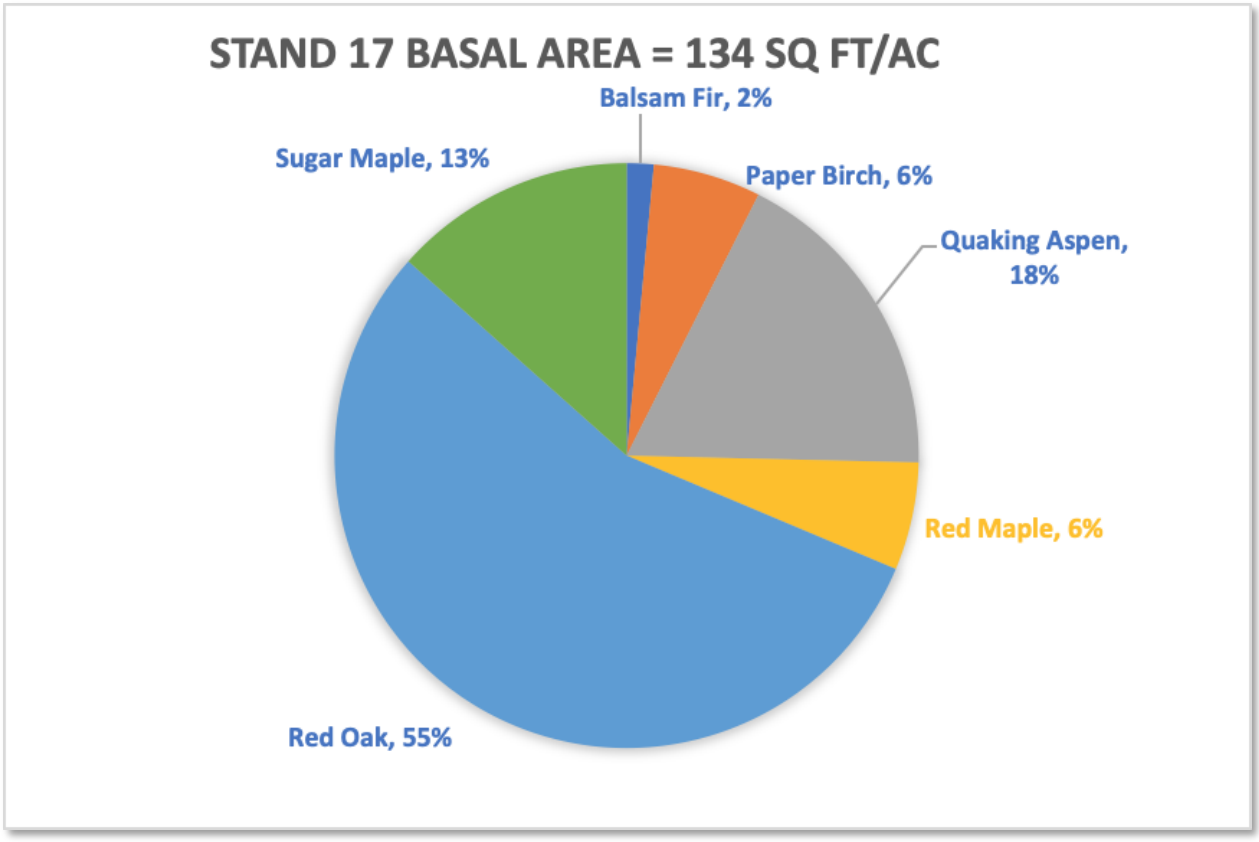
Adjacent land use concerns:
Residential area just downhill from the unit - possible source of extra foot traffic, invasive species, and trash/debris.

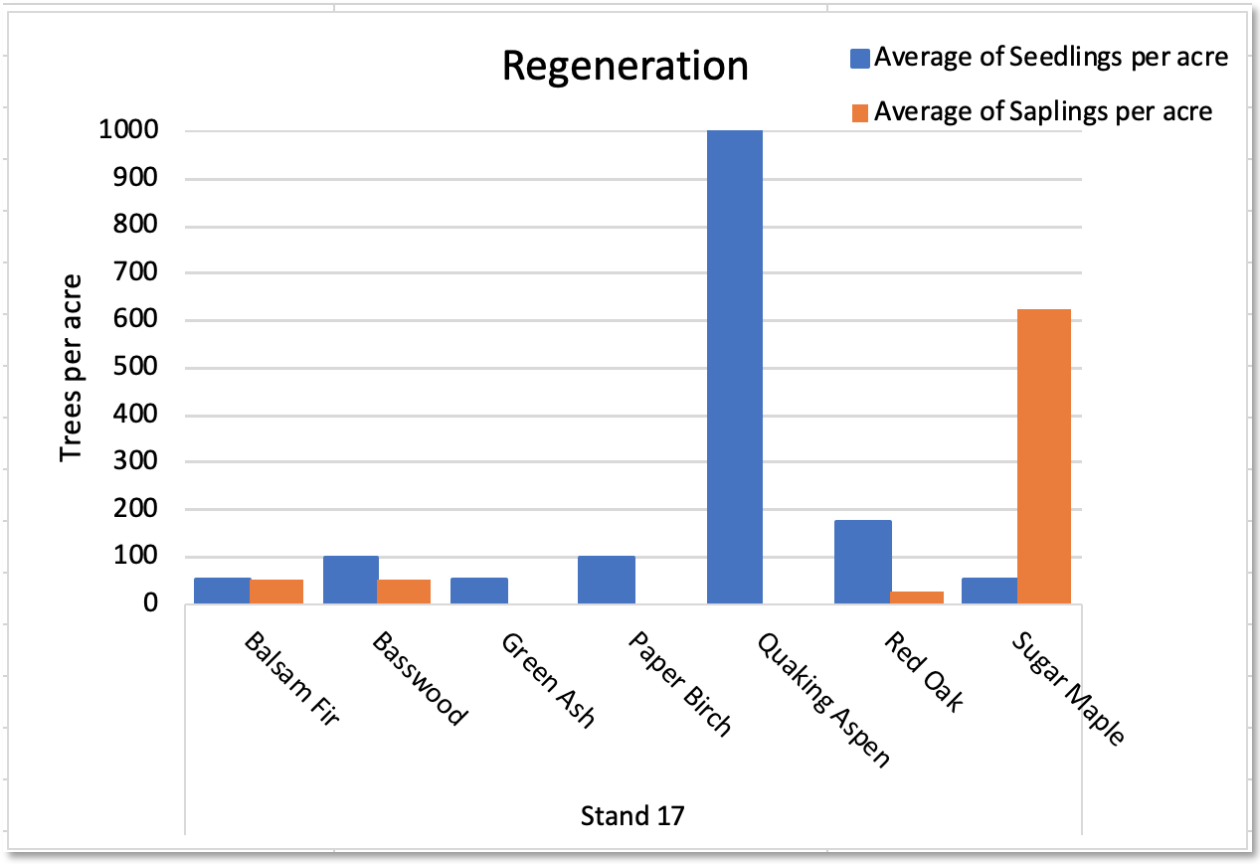
No action result (10-20 years): The stand may transition more completely to a mesic hardwood forest type, unless a severe drought limits establishment of hardwoods in favor of drought-hardy species present in the stand such as red oak.

Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities; Regeneration	Restore and maintain fire-dependent plant communities	Prescribed burning	Understory is quite bare, use fire under oak stand to stimulate tree and fire-dependent herbaceous plant germination. Avoid areas of sugar maple dominance
Regeneration	Artificial regeneration	Plant trees	Supplemental if needed
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	Understory is quite bare, use deer exclosure to protect naturally regenerating trees


Stand 17: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
25
20
15
10
5
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Diameter Class (1")
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Balsam Fir


STAND 17 BASAL AREA = 134 SQ FT/AC
Balsam Fir, 2%
Sugar Maple, 13%
Paper Birch, 6%
Quaking Aspen, 18%
Red Maple, 6%
Red Oak, 55%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Basswood
Green Ash
Paper Birch
Quaking Aspen
Red Oak
Sugar Maple
Stand 17

Section 4: Mission Creek Natural Area (Mission)

Figure 3: Mission Stands Map

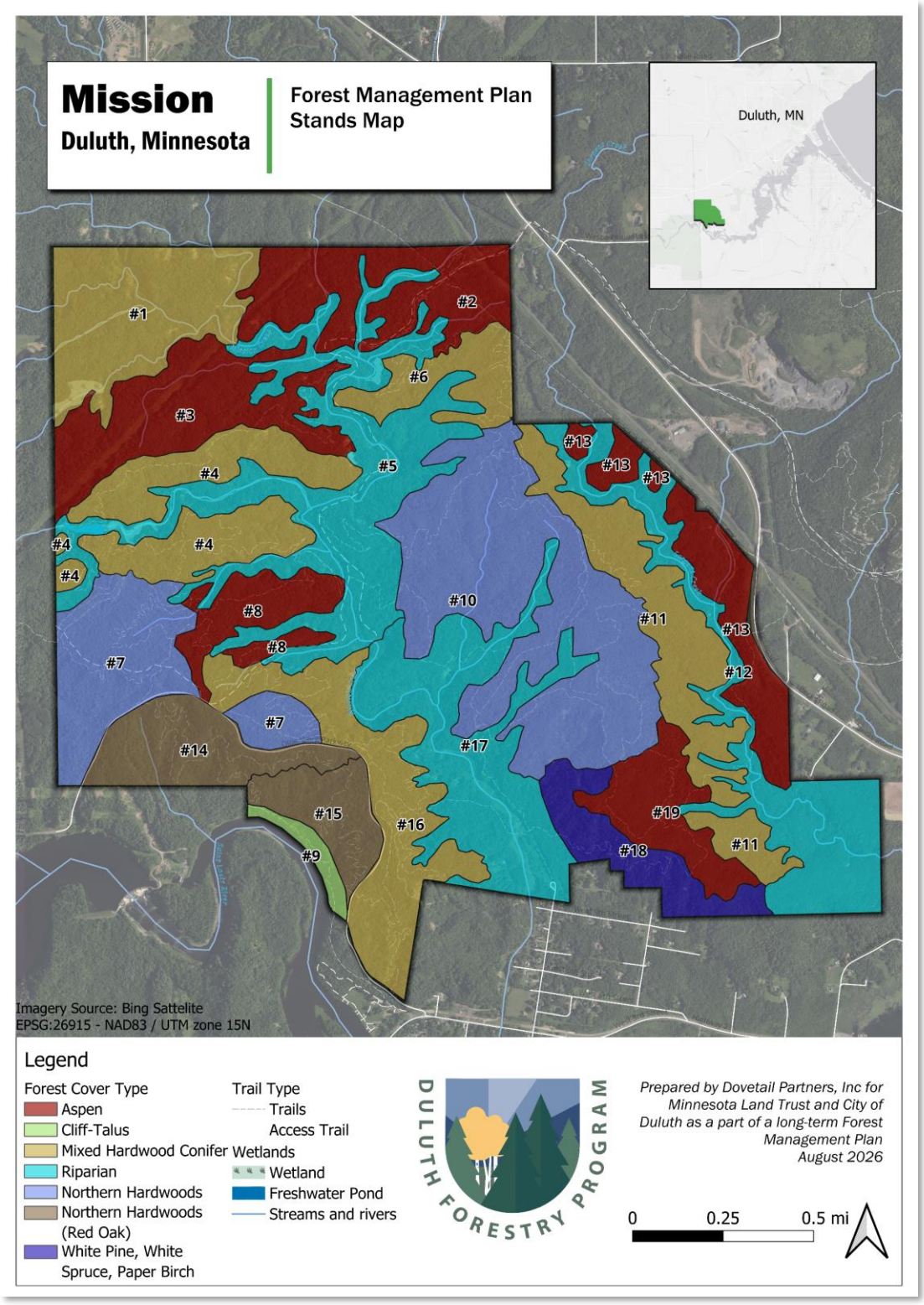
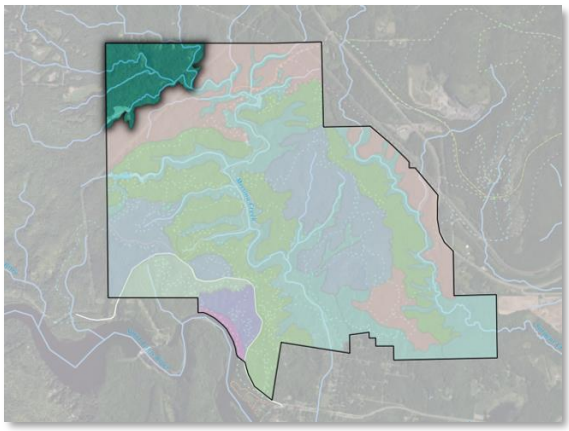


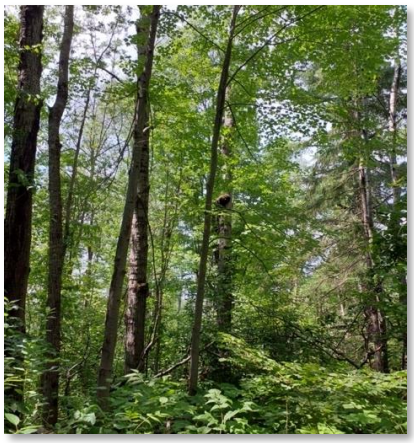
Table 7: Mission Creek Stand Attributes

Stand #	Forest Typ	Acres	Soil Prima	NPC Primary	Avg DBH (in)	SE DBH (in)	Avg Basal Area (ft2/ac)	SE Basal Area (ft2/ac)	SiteIndex1	SiteIndex1_species	SiteIndex2	SiteIndex2_species	Total Plots
1	Mixed Hardwood Conifer	120.3	F155G	MHn35b	9.1	0.9	105	10.4	73.7	Quaking Aspen			11
2	Aspen	100.2	F155G	MHn35b	10.4	0.5	137	12.2	73.7	Quaking Aspen			12
3	Aspen	108.7	F155B	MHn35b	8.3	0.6	128	10.7	73.7	Quaking Aspen			13
4	Mixed Hardwood Conifer	115	F155G	MHn35b	9.6	0.4	119	13	68.3	Quaking Aspen	40	White Spruce	9
5	Riparian	222.9	F155G	MHn44c	8.8	0.4	113.3	8.1	85.0	Quaking Aspen	57	White Spruce	15
6	Mixed Hardwood Conifer	44.7	F155G	MHn35b	11.7	0.9	138	9.8	73.7	Quaking Aspen			6
7	Northern Hardwoods	111.1	F155G	MHn35b	10.1	0.7	109	10	68.3	Quaking Aspen	40	White Spruce	12
8	Aspen	48.9	F155G	MHn35b	8.6	0.5	118	13.1	68.3	Quaking Aspen	46	Red Oak	5
9	Cliff/Talus	12	F155G	MHn44b / CTn11e					n/a	n/a	n/a	n/a	1
10	Northern Hardwoods (White Pine, Red Pine)	254.3	F155G	MHn35b	10.4	0.3	119.6	7.2	74.3	Quaking Aspen	40	Sugar Maple	23
11	Mixed Hardwood Conifer	116.6	F155B	MHn35b	10.6	0.5	155	13.4	74.3	Quaking Aspen	40	Sugar Maple	10

12	Riparian	128.3	F155G	MHn44b / MHn35b	9.8	0.7	115	14.6	85.0	Quaking Aspen	57	White Spruce	15
13	Aspen	72.2	F155G	MHn35b	9.3	0.5	127	13.7	73.7	Quaking Aspen			6
14	Northern Hardwoods (Red Oak)	69.5	F155G	MHn35b	10.6	0.6	118	11.1	76.0	Quaking Aspen	48	Red Oak	8
15	Northern Hardwoods (Red Oak, White Pine, Red Pine)	44.7	F155G	MHn35b	11.3	1.2	118	13.9	76.0	Quaking Aspen	48	Red Oak	5
16	Mixed Hardwood Conifer	119.8	F155G	MHn35b	9.4	0.5	128	17.6	50.0	Red Oak	63	White Spruce	12
17	Riparian	160.4	F155G	MHn44b / MHn44c	11.2	0.8	123.1	9.7	85.0	Quaking Aspen	57	White Spruce	16
18	White Pine, White Spruce, Paper Birch	52.8	F155G	MHn44b	11.8	1.8	125	21.9	52.0	White Spruce	60	Red Oak	4
19	Mixed Hardwood Conifer	56.4	F155B	MHn35b	9.2	0.5	142	15.8	67.0	Quaking Aspen	53	White Spruce	5

Stand 1 Mixed Hardwood Conifer





Stand Characteristics

Forest Type: Mixed Hardwood Conifer

Size: 120 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	35.1	29%
MHn44c	22.7	19%
FDn43b	18.4	15%
MHn46b	17.2	14%
RVx54a	14.1	12%

Ecological Site (USDA): F092XY014WI - Loamy Uplands F092XY015WI - Clayey Uplands

Dominant Soils: F155G, F155B. Udalfs-Eutrudepts complex, slopes ranging from 0-8% on ridgetops (F155B) to 25-70% slopes (F155G) on tributary drainages

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 9.1" (SE=0.89)

Average Stand Basal Area: 105 ft2/ac (SE=10.4)

Snags per acre: 12 medium (6-11" DBH), 3 Large (>12"DBH)

Coarse woody debris: Medium to High

Wildfire risk: Low

Invasive Species: Low - Buckthorn was observed rarely, and at low amounts

Pests & Disease: Emerald ash borer is present in the mature ash trees with partial mortality and top-kill.

Current Condition: This maturing mesic hardwood-conifer forest is located at the northwest corner of the Mission Creek property and consists of numerous steep slopes and headwater drainages that converge to form the Mission Creek tributaries. Wildlife activity and in particular beaver activity is high in the lowlands with frequent beaver-felled trees and ponding behind dams with speckled alder and herbaceous wetlands. Canopy is moderately filled in with a dense midstory of hazel and thimbleberry. The oldest age class of trees are the occasional remnant white pine (23-38" DBH), uncommon sugar maple and yellow birch (not documented in inventory), and white spruce (11-16" DBH). A maturing cohort of 5-10" DBH paper birch, aspen, and occasional red maple occur on the upper slopes with balsam poplar, black ash, and occasional basswood in lower lying areas. Red oak and balsam fir of the 5-7" size class are present in low density in drier portions of the stand. Black ash vastly dominates the regeneration layer (<5" DBH), with green ash, balsam poplar, paper birch, quaking aspen, and basswood also present in reasonable abundance. Tall shrubs include occasional speckled alder in the lowlands, and hazel on upper slopes. Dominant understory plants include dewberry, gooseberry, lady fern, large-leaved aster, raspberry, thimbleberry, bush honeysuckle, and fly honeysuckle.

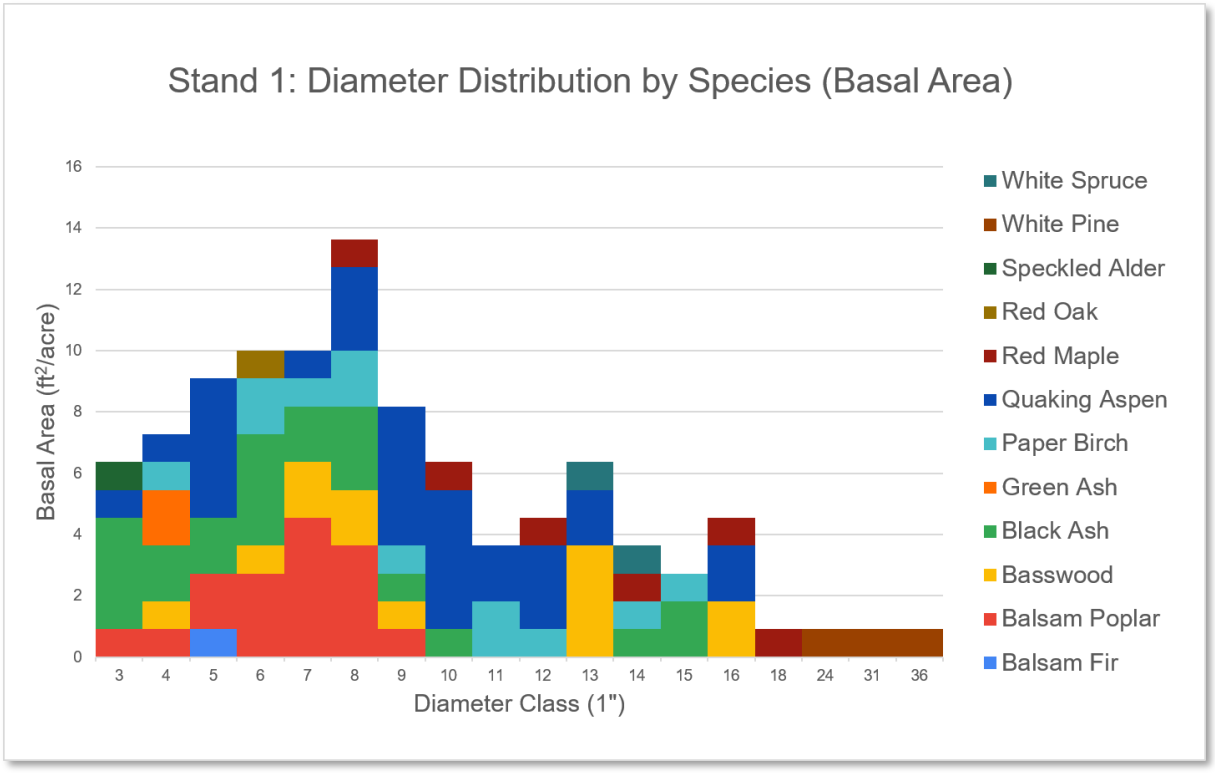
Current Recreational Uses or Management:
Recreational use of this stand is limited due to the lack of trails and difficult access.

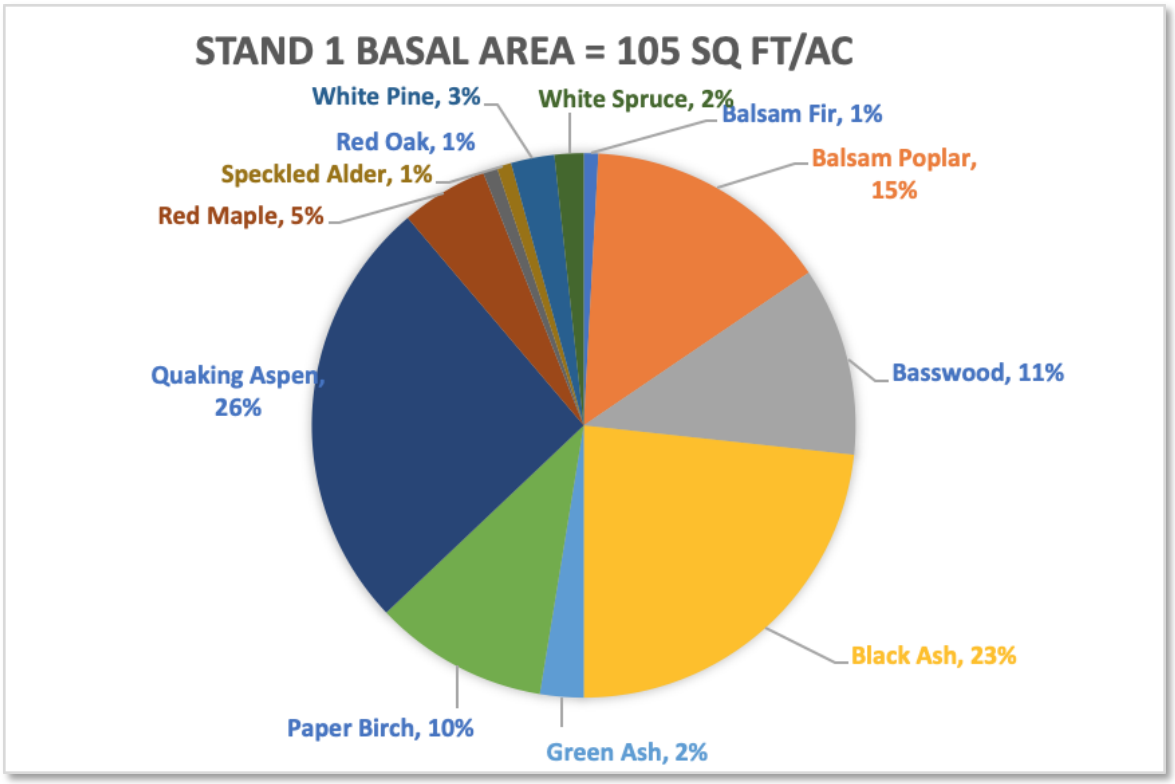
Adjacent land use concerns:
Private property borders the north and west sides of the stand and may cause impacts from runoff into the Mission Creek headwaters, invasive species incursion, or social trails.

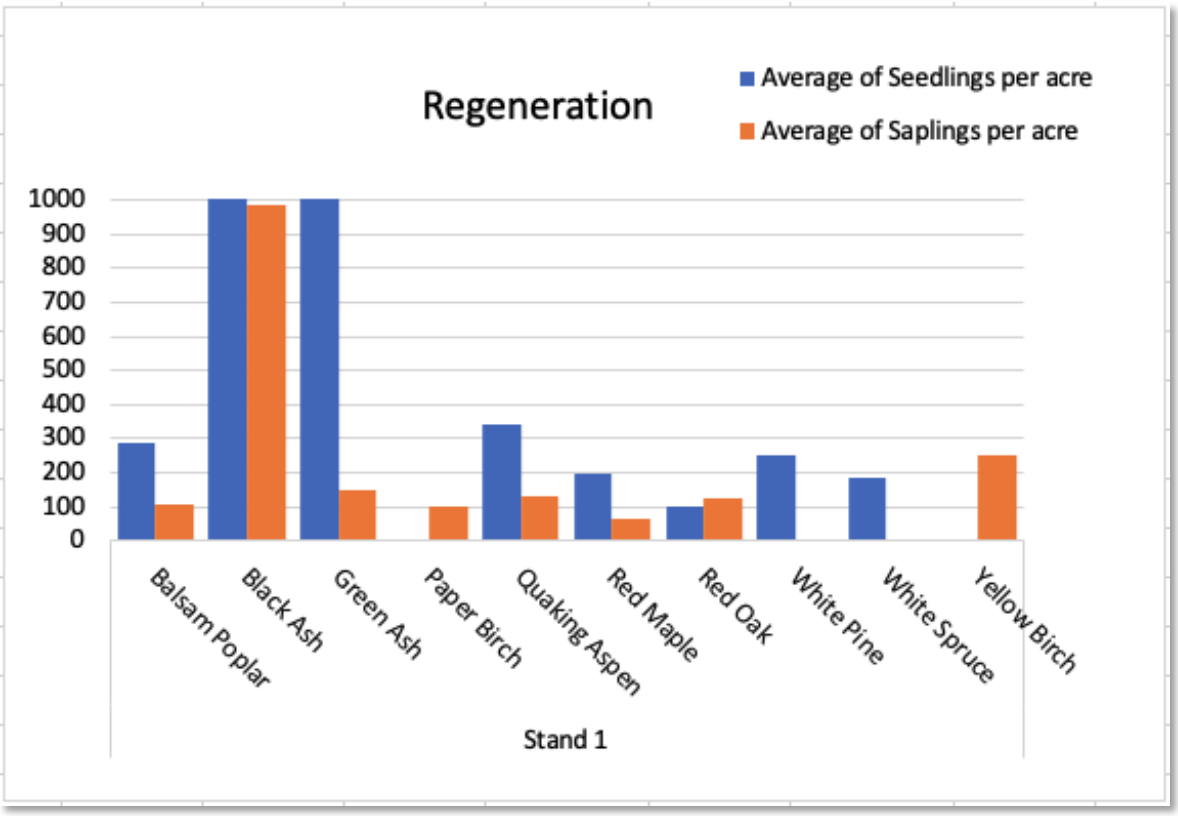
No action result (10-20 years): The ash mortality from EAB will continue and Mission Creek headwater floodplains may become more herbaceous or shrub dominant.

Management Goals, Strategies, and Actions

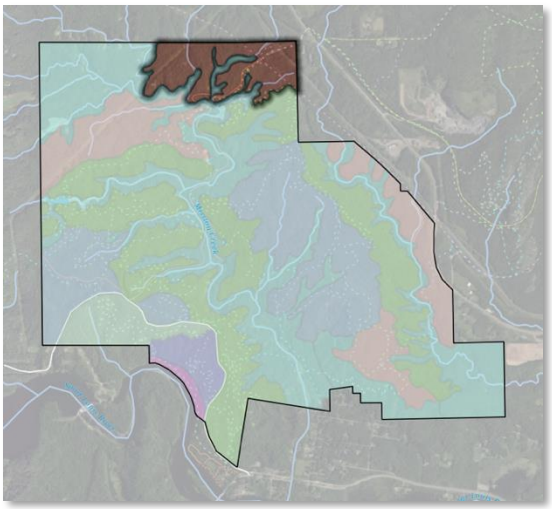
Goal	Strategy	Action	Notes
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Systemic herbicide injection annually into mature female trees during early-stage invasion to serve as seed crops for future ash regeneration; Girdle ash trees to attract EAB in combination with systemic herbicide injection to adjacent trees; Underplanting - Plant trees other than ash where ash decline and mortality is advanced	Access limited

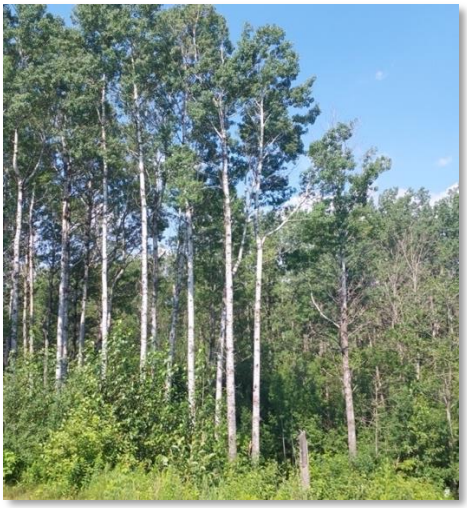



STAND 1 BASAL AREA = 105 SQ FT/AC
White Pine, 3%
White Spruce, 2%
Balsam Fir, 1%
Red Oak, 1%
Balsam Poplar, 15%
Speckled Alder, 1%
Red Maple, 5%
Quaking Aspen, 26%
Basswood, 11%
Black Ash, 23%
Paper Birch, 10%
Green Ash, 2%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
White Pine
White Spruce
Yellow Birch
Stand 1

Stand 2 Aspen





Stand Characteristics

Forest Type: Aspen

Size: 100 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	55.9	72%
Disturbed	8.7	11%
MHn44c	5.5	7%

Ecological Site (USDA):

Dominant Soils: F155G (83%), F155B (17%) Udalfs-Eutrudepts complex, slopes ranging from 0-8% on ridgetops (F155B) to 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Moderately well to well drained.

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 10.4" (SE=0.89)

Average Stand Basal Area: 137ft2/ac (SE=12.2ft2/ac)

Snags per acre: 31 medium (6-11" DBH), 2 Large (>12"DBH)

Coarse woody debris: Medium/High to High

Wildfire risk: Low. A portion of this unit is adjacent to railroad tracks, which can be a source of wildfire ignitions

Invasive Species: Low, with some buckthorn saplings dispersed throughout the stand

Pests & Disease: Minimal aspen mortality and some evidence of EAB

Current Condition: This mature aspen stand is located at the northeast portion of the property with trailhead frontage on Becks Rd/Highway 3. The overstory is well-stocked and dominated by quaking aspen throughout most size classes. There is some paper birch in the 5-12" size classes. Quaking aspen, red maple, paper birch, and white spruce compose the majority of the 2-7" size class. Black ash is present in the overstory and overrepresented (along with green ash) in the seedling size classes. A few remnant white pine (up to 31" DBH) and occasional red pine are scattered along the slopes. There is some recruitment of paper birch into sapling size classes, while quaking aspen is recruiting but not establishing well into the sapling stage, possibly due to canopy closure. The midstory is dense and dominated by beaked hazel, roundleaf dogwood, serviceberry, native *Prunus* species, and downy arrowwood. The understory is dominated by bush honeysuckle, goldenrod, large-leaved aster, oak fern, and thimbleberry.

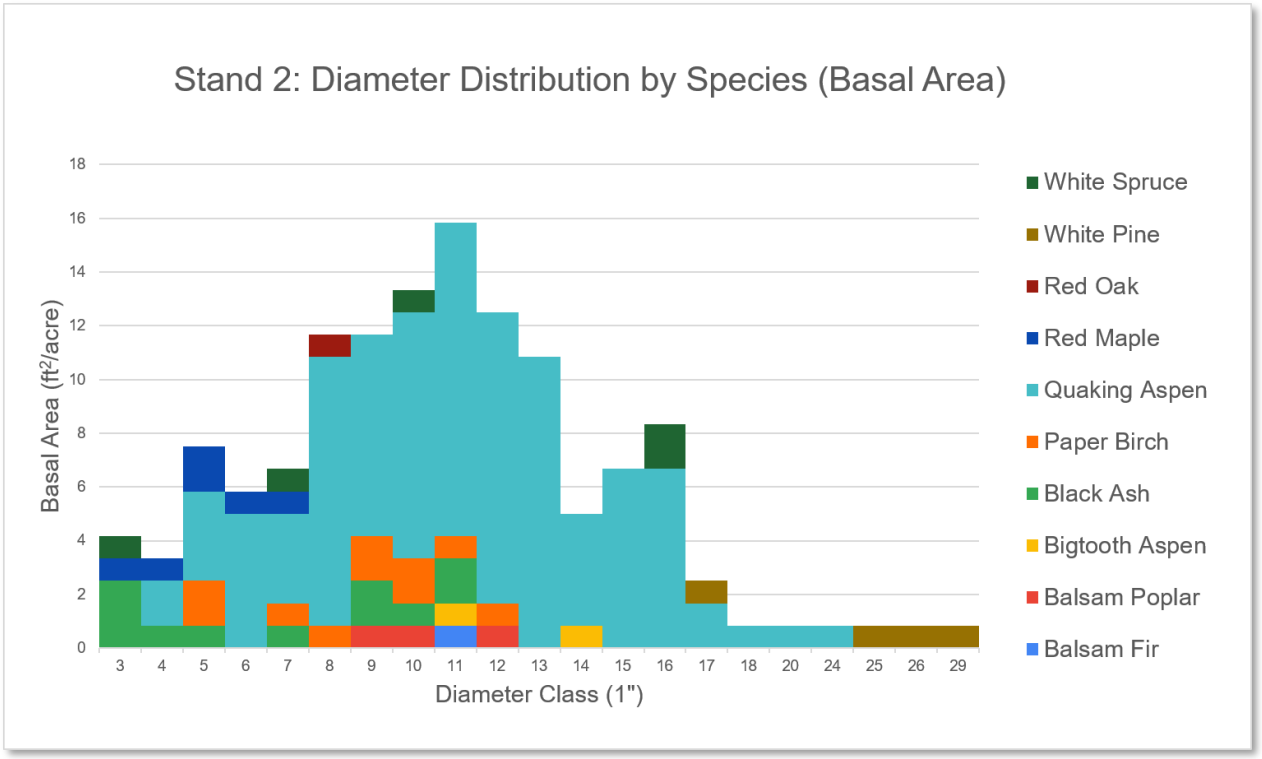
Current Recreational Uses or Management:
The Mission Creek Parkway, Willard Munger State Trail and additional trails are located through a portion of this stand as well as the Becks Rd Trailhead.

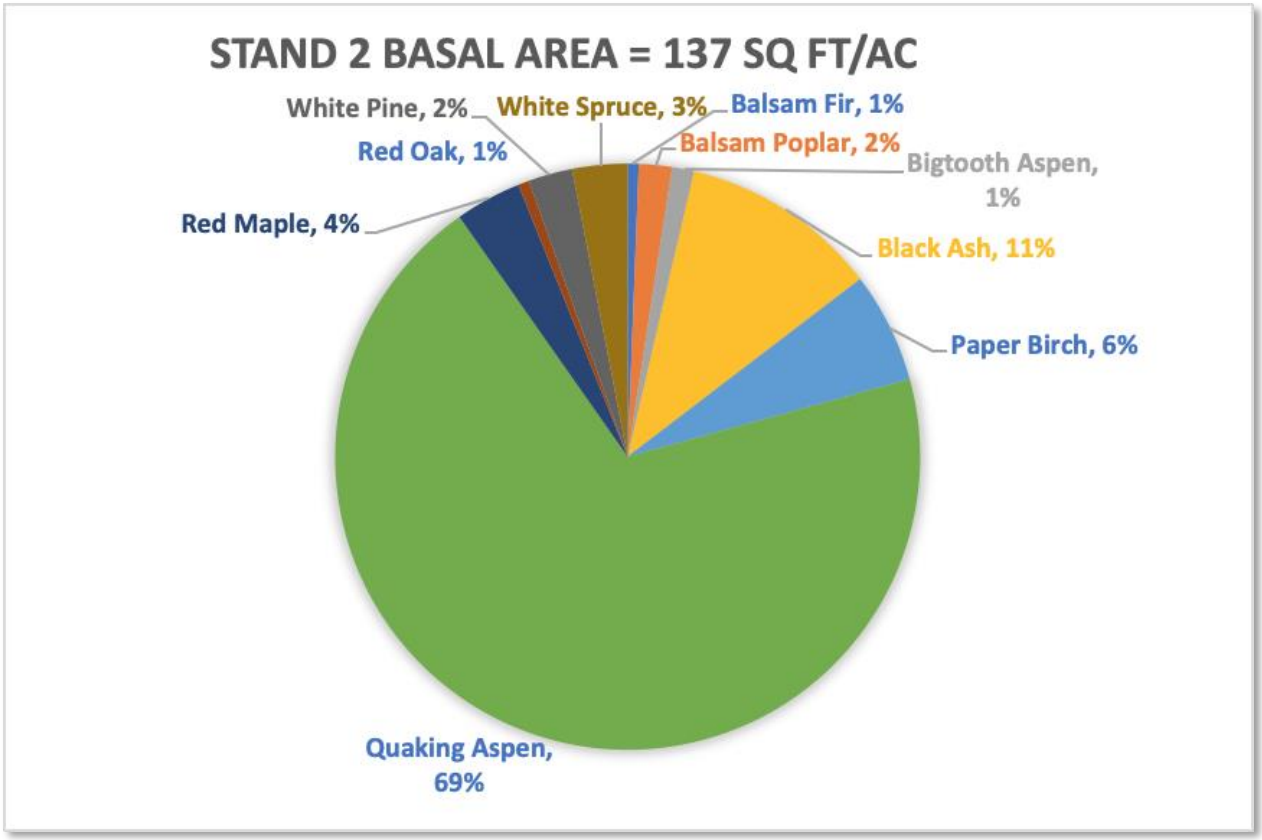
Adjacent land use concerns:
Trailhead parking lot, numerous multi-use trails, active railroad, and powerline corridor present in this stand pose risks of ongoing impacts such as soil compaction, vegetation trampling, pollution runoff into Mission Creek tributaries, and introduction of invasive species from recreational users, train traffic, and trail/railway maintenance operations.

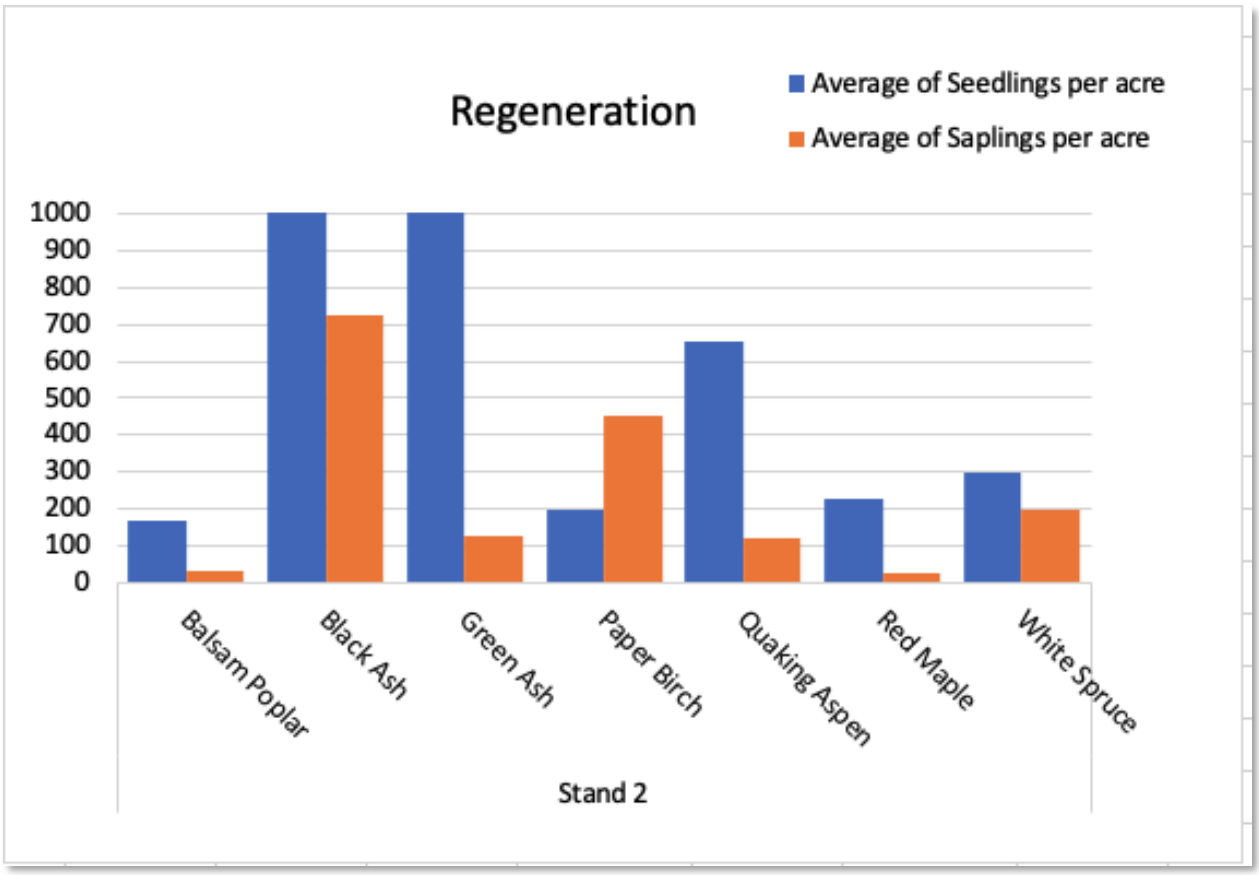
No action result (10-20 years): This stand is dominated by quaking aspen, a relatively short-lived early successional species that is generally unable to regenerate under its own canopy in the absence of disturbance. Over the next 10-20 years, these trees would become increasingly mature, with individual tree mortality creating small gaps. Black and green ash regeneration is abundant and likely to recruit in these gaps. This stand has a limited non-ash hardwood seed source. Sugar maple, white spruce, and basswood would be expected to emerge as the next successional species in this forest type, but few saplings of these species were observed.

Management Goals, Strategies, and Actions

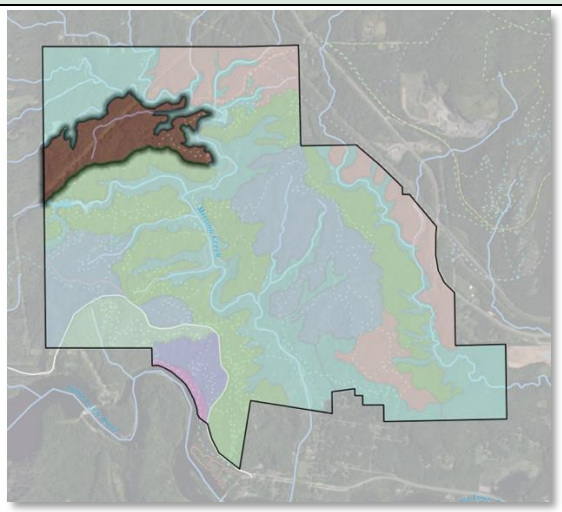
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.

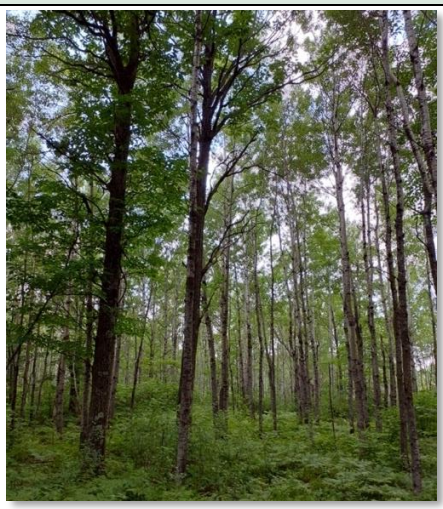

Stand 2: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
16
18
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 24 25 26 29
Diameter Class (1")
White Spruce
White Pine
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Black Ash
Bigtooth Aspen
Balsam Poplar
Balsam Fir


STAND 2 BASAL AREA = 137 SQ FT/AC
White Pine, 2%
White Spruce, 3%
Balsam Fir, 1%
Red Oak, 1%
Balsam Poplar, 2%
Bigtooth Aspen, 1%
Red Maple, 4%
Black Ash, 11%
Paper Birch, 6%
Quaking Aspen, 69%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
White Spruce
Stand 2

Stand 3 Aspen





Stand Characteristics

Forest Type: Aspen

Size: 109 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	77.6	71%
Disturbed	20.1	18%
MHn44c	10.2	9%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands
F092XY015WI - Clayey Uplands

Dominant Soils: F155B (51%), F155G (49%) Udalfs-Eutrudepts complex, slopes ranging from 0-8% on ridgetops (F155B) to 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Somewhat poorly drained to well drained.

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 8.3" (SE=0.64)

Average Stand Basal Area: 128 ft^2/ac (SE=10.7)

Snags per acre: 16 medium (6-11" DBH), 2 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low - Occasional large buckthorn saplings throughout unit

Pests & Disease: Deer browse present, limiting seedling recruitment

Current Condition: This stand consists of uplands dominated by aspen with birch and a mix of white spruce and northern hardwood species. A high-voltage powerline splits the stand. The average tree diameter is smaller compared to other stands on the property. Balsam poplar and paper birch are the second and third, most common tree species, respectively, in this unit. Overall, this unit is dominated by early-successional species, with few longer-lived hardwood species such as red oak, red maple, and sugar maple present. Ash regeneration is the most abundant compared to other species in this stand, but less abundant overall compared to similar stands. Aside from ash regeneration, balsam poplar had the most recruitment into the sapling size classes, with quaking aspen and red oak most abundant in the seedling size classes. The midstory is composed of a mix of beaked hazel, mountain maple, roundleaved dogwood, speckled alder, native *Prunus* species, and serviceberry. Mature, established beaked hazel is prevalent in the understory. Dominant understory plants are bracken fern, bush honeysuckle, goldenrod, lady fern, large-leaved aster, pyrola, raspberry, and thimbleberry.

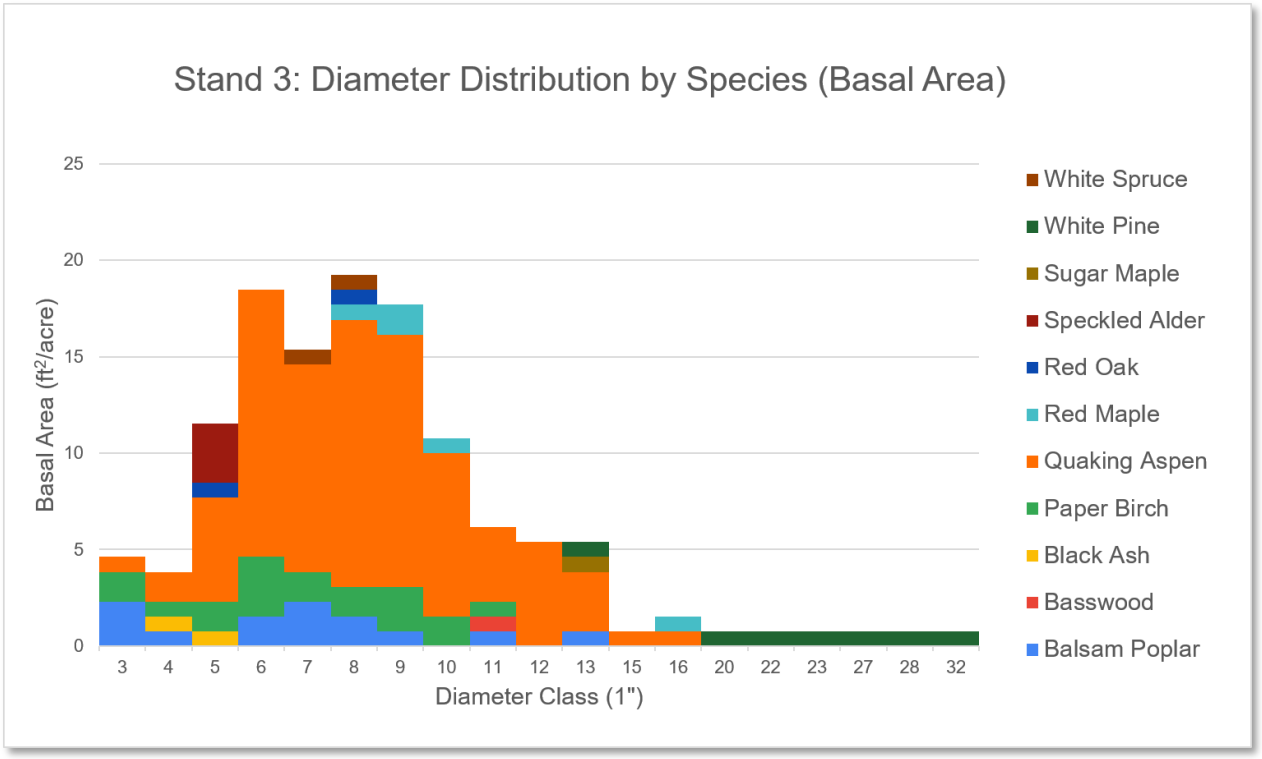
Current Recreational Uses or Management:
Limited trails are present in this unit, though the powerline corridor provides some foot or potentially all-terrain vehicle access through herbaceous vegetation.

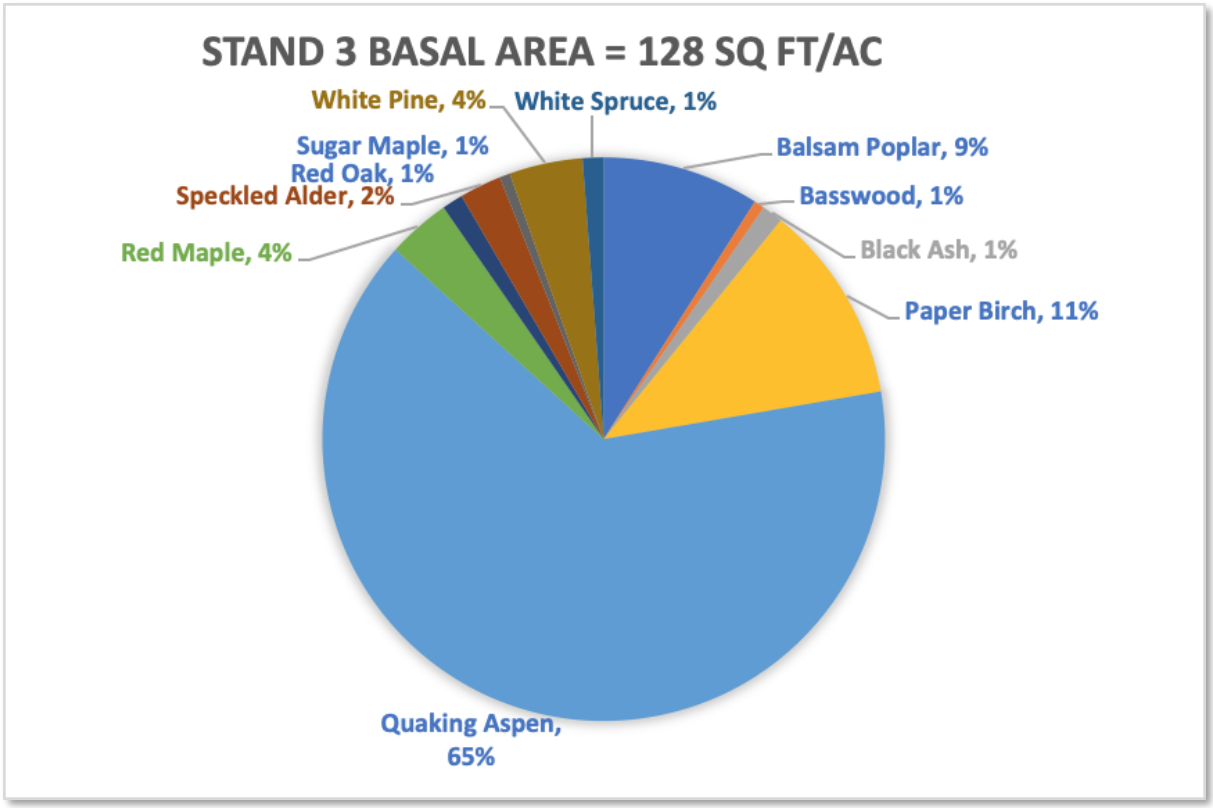
Adjacent land use concerns:
Private property borders the west side of the stand and may cause impacts from runoff into the Mission Creek headwaters, invasive species incursion, or social trails.

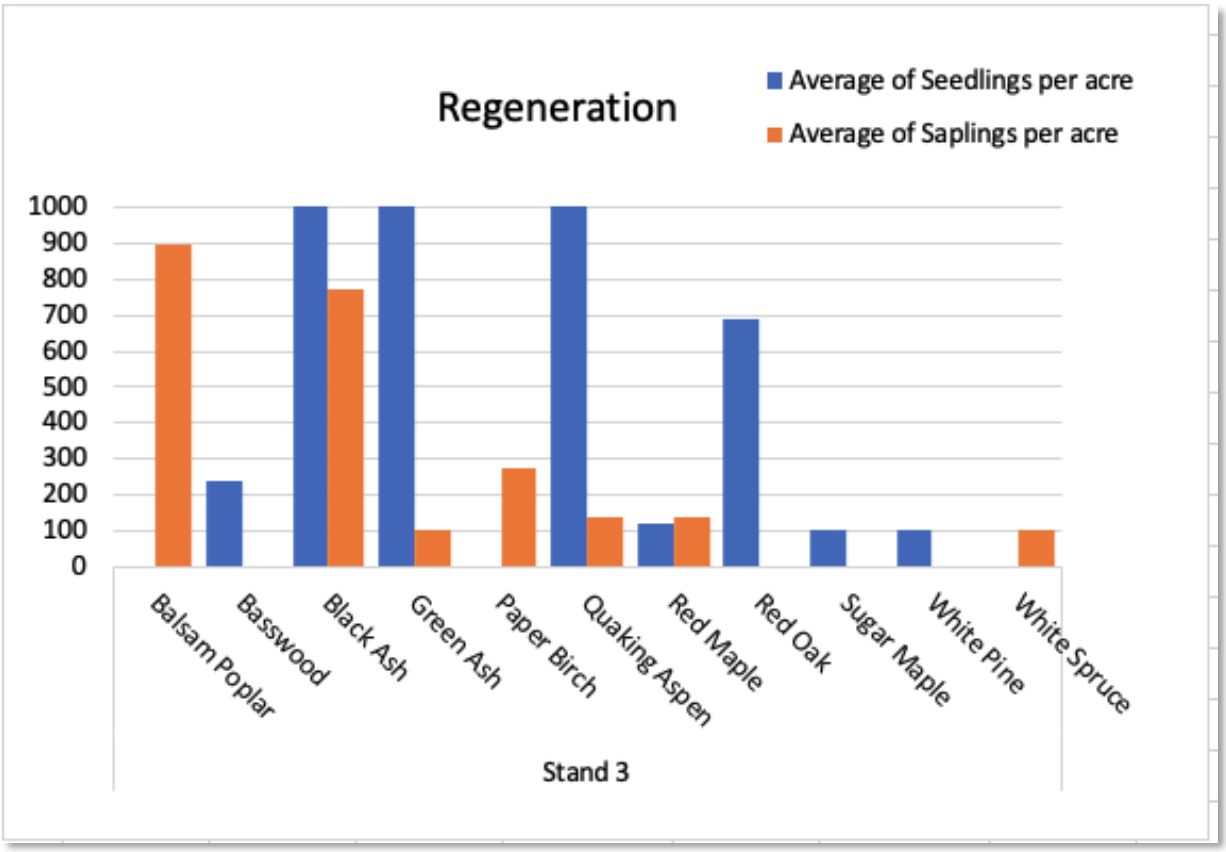
No action result (10-20 years): This stand is dominated by quaking aspen, a relatively short-lived early successional species that is generally unable to regenerate under its own canopy in the absence of disturbance. Over the next 10-20 years, these trees would become increasingly mature, with individual tree mortality creating small gaps. Hazel shrubs are highly abundant in this stand, and are likely to further establish in gaps and compete with tree seedlings. This stand has a limited non-ash hardwood seed source, but some balsam poplar, red maple and paper birch are recruiting to saplings.

Management Goals, Strategies, and Actions

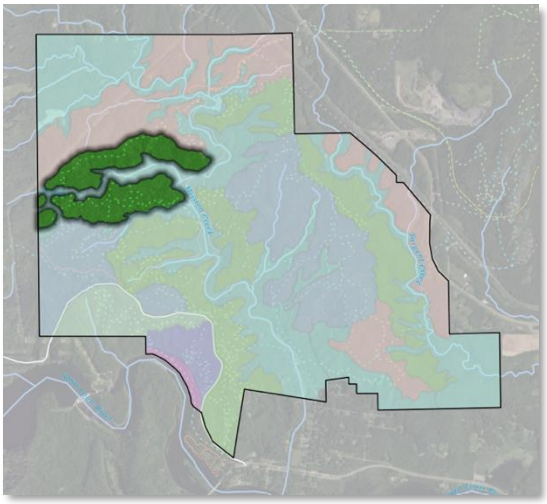
Goal	Strategy	Action	Notes
Regeneration; Restore/enhance native plant communities	Reduce competition in midstory	Mulch/masticate shrub layer	Target hazel




STAND 3 BASAL AREA = 128 SQ FT/AC
White Pine, 4%
White Spruce, 1%
Sugar Maple, 1%
Red Oak, 1%
Speckled Alder, 2%
Balsam Poplar, 9%
Basswood, 1%
Black Ash, 1%
Red Maple, 4%
Paper Birch, 11%
Quaking Aspen, 65%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 3

Stand 4 Mixed Hardwood Conifer





Stand Characteristics
Forest Type: Mixed Hardwood Conifer
Size: 115 acres
NPC

MHn35b	103.2	90%
MHn44c	10.8	9%
(MDNR)	*Acres*	*% of stand*

Ecological Site (USDA):
F092XY014WI - Loamy Uplands
F092XY015WI - Clayey Uplands
Dominant Soils: F155G (69%), F155B (31%)
Udalfs-Eutrudepts complex, slopes ranging from 0-8% on ridgetops (F155B) to 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature (55-95 years)
Average Stand Diameter (DBH): 9.6" (SE=0.42)
Average Stand Basal Area: 119 ft^2/ac (SE=13)
Snags per acre: 21 medium (6-11" DBH), primarily aspen
Coarse woody debris: Medium
Wildfire risk: Low
Invasive Species: Low amounts of scattered buckthorn
Pests & Disease: None noted

Current Condition: This transitional aspen-hardwood stand follows along a south-facing slope in the upper portion of Mission Creek. Quaking aspen is the most abundant overstory tree species present (ranging mostly from 5-16" DBH). Sugar maple, paper birch, basswood, and to a lesser extent red maple and white spruce are abundant in the 4-10" DBH range, indicating the stand is transitioning naturally into the mature form of this mesic hardwood forest type. Ironwood (primarily of the 2" size class) is also prevalent in the understory. Despite the diverse seedling regeneration, few trees (aside from some ash) are currently recruiting into the sapling age classes. Canopy is dense in places but with sizeable openings, in which beaked hazel is quite dense. The midstory also includes ironwood, native *Prunus* species, round-leafed dogwood, and serviceberry. Dominant understory plants include bush honeysuckle, Pennsylvania sedge, lady fern, large-leaved aster, and a diversity of other ferns.

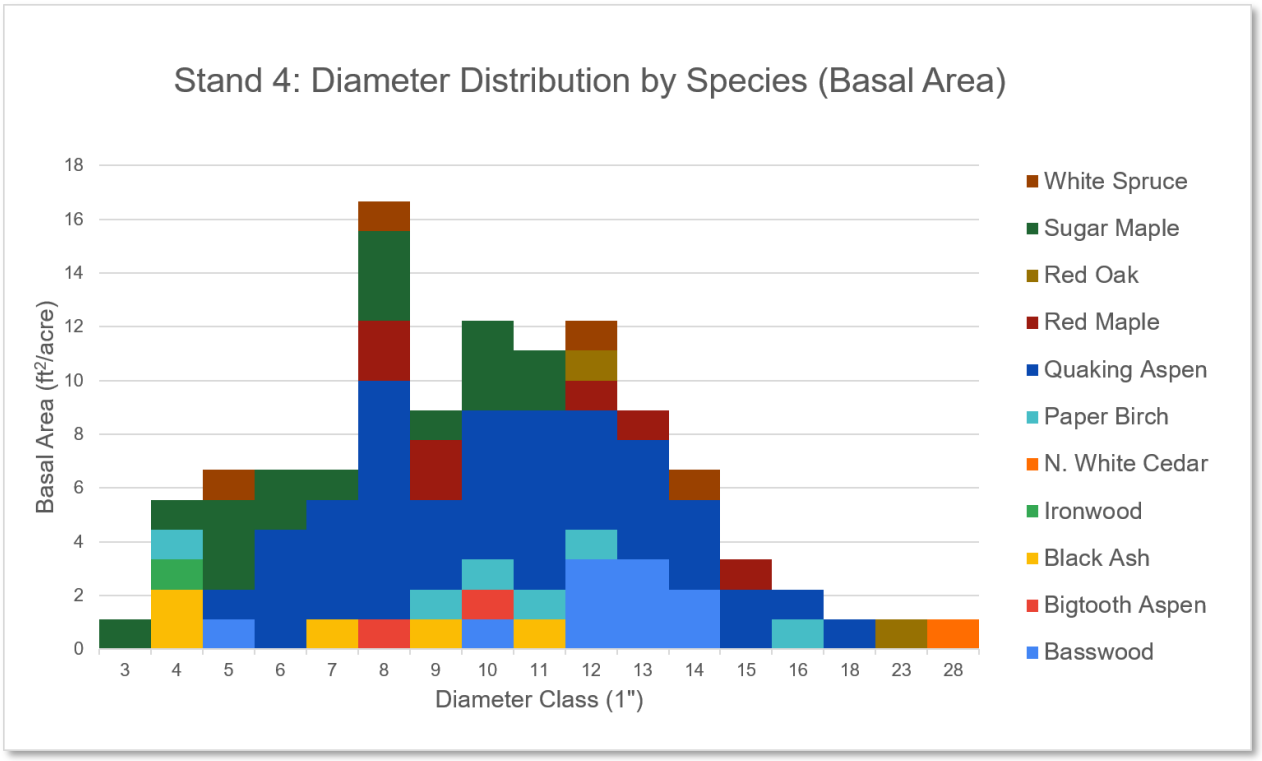
Current Recreational Uses or Management:
The Duluth Traverse hiking/mountain biking trail runs cross-slope through this unit.

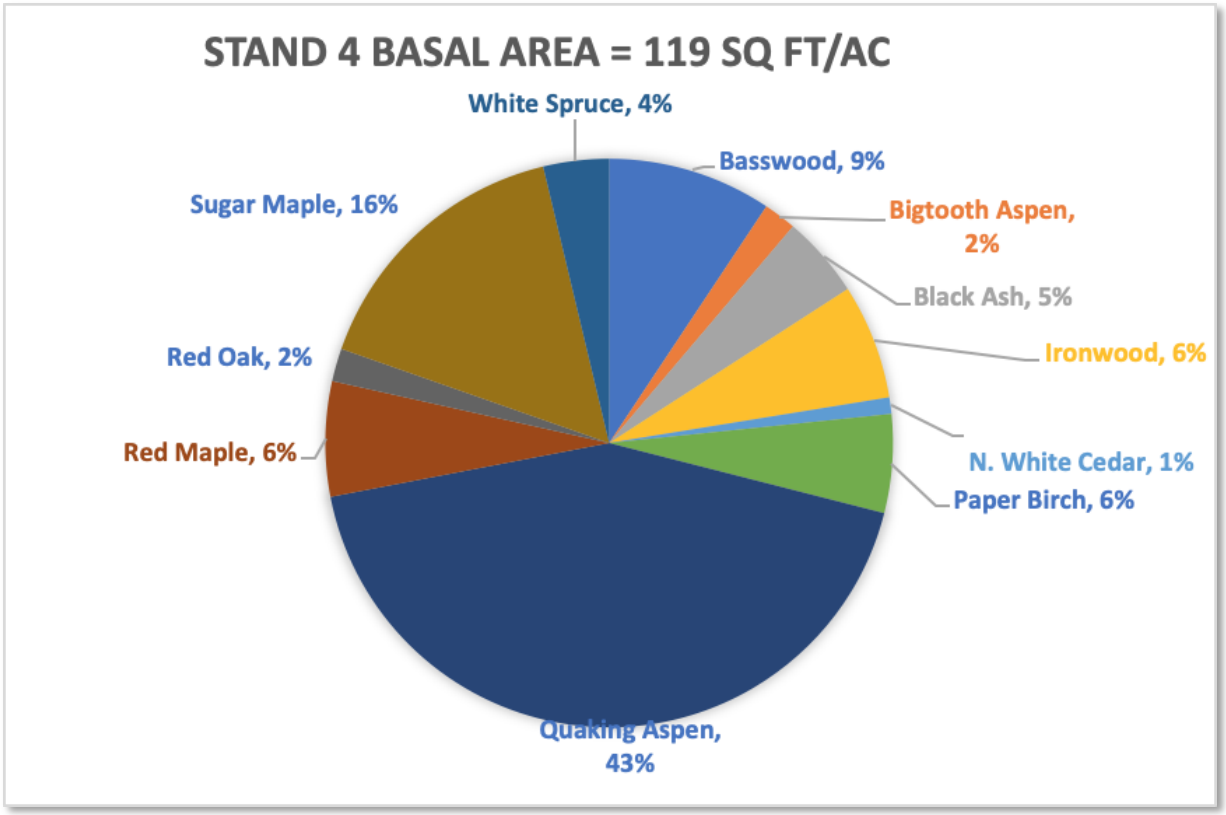
Adjacent land use concerns:
To the west of this unit is Jay Cooke State Park, potentially bringing higher numbers of visitors via connected hiking trails.

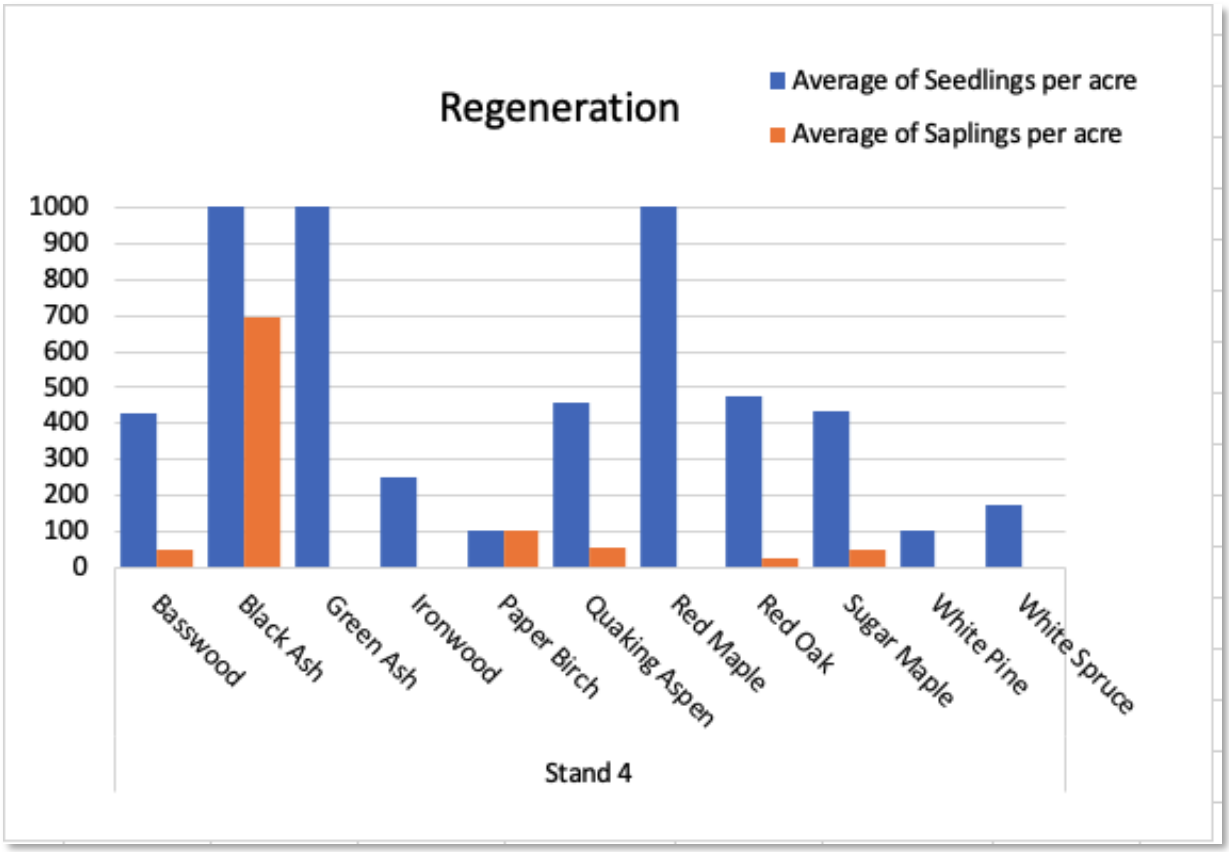
No action result (10-20 years): Due to the closed canopy conditions, this stand would be expected to transition to shade tolerant tree species such as maples, basswood, and ironwood. Mature aspen will continue to age out and naturally turn to snags or fall over, contributing to coarse woody debris and forest complexity. Hardwoods may continue to successfully establish into maturity; however, if deer browse continues at high pressure, stand density may decline in favor of dense hazel thickets.

Management Goals, Strategies, and Actions

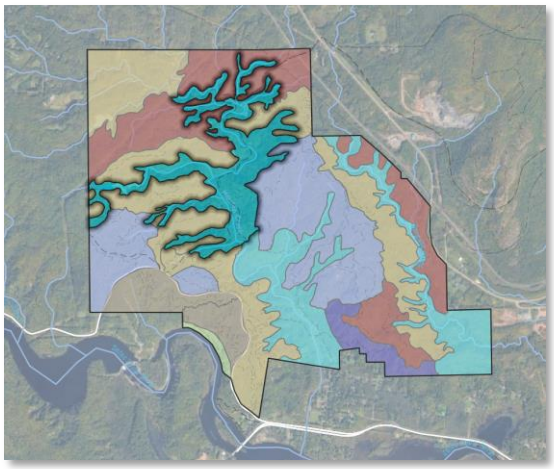
Goal	Strategy	Action	Notes
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	




STAND 4 BASAL AREA = 119 SQ FT/AC
White Spruce, 4%
Basswood, 9%
Bigtooth Aspen, 2%
Black Ash, 5%
Ironwood, 6%
N. White Cedar, 1%
Paper Birch, 6%
Quaking Aspen, 43%
Red Maple, 6%
Red Oak, 2%
Sugar Maple, 16%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Basswood
Black Ash
Green Ash
Ironwood
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 4

Stand 5 Riparian





Stand Characteristics
Forest Type: Riparian
Size: 223 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44c	78.3	35%
MHn44	33.9	15%
MHn46b	31.0	14%
MHn35b	26.8	12%
MHn44a	17.3	8%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands
Dominant Soils: F155G (93%), F155B (7%)
Udalfs-Eutrudepts complex, 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature (35-95 years)
Average Stand Diameter (DBH): 8.8" (SE=0.4)
Average Stand Basal Area: 113.3ft^2/ac (SE=8.1)
Snags per acre: 13 medium (6-11" DBH), 2 large (>12"DBH)
Coarse woody debris: Medium to High
Wildfire risk: Low
Invasive Species: Low - Occasional buckthorn
Pests & Disease: EAB is present in this stand but does not appear to have caused widespread mortality. Symptoms of early-stage infestation associated decline are present such as slight canopy decline and epicormic sprouting

Current Condition: This unit encompasses the riparian areas and adjacent slopes between the Mission Creek headwaters and lower portion of Mission Creek. The variable aspects, elevations, and slopes provide many terrestrial microhabitats in addition to the aquatic habitat in the streams themselves. North-facing slopes feature mature white cedar, yellow birch, and white spruce. Many slopes are actively eroding, exposing bare mineral soil and supporting white pine and white cedar regeneration. Exposed slopes also provide uncommon early seral habitat in an otherwise mature forest and support higher concentrations of balsam poplar and serviceberry. Overall, the overstory tree species distribution in this stand is young and relatively even. While black ash, quaking aspen, and balsam poplar are the most common species in this unit, they are not overrepresented in most size classes, especially the larger size classes of trees. White spruce is the primary conifer component of this stand, with the majority of white spruce in the 2-10" size classes and less frequent legacy sizes (28"+). The midstory supports beaked hazel, mountain maple, native *Prunus* species, roundleafed dogwood, and serviceberry. Dominant understory plants include ostrich fern, horsetail, lady fern, thimbleberry, and gooseberry.

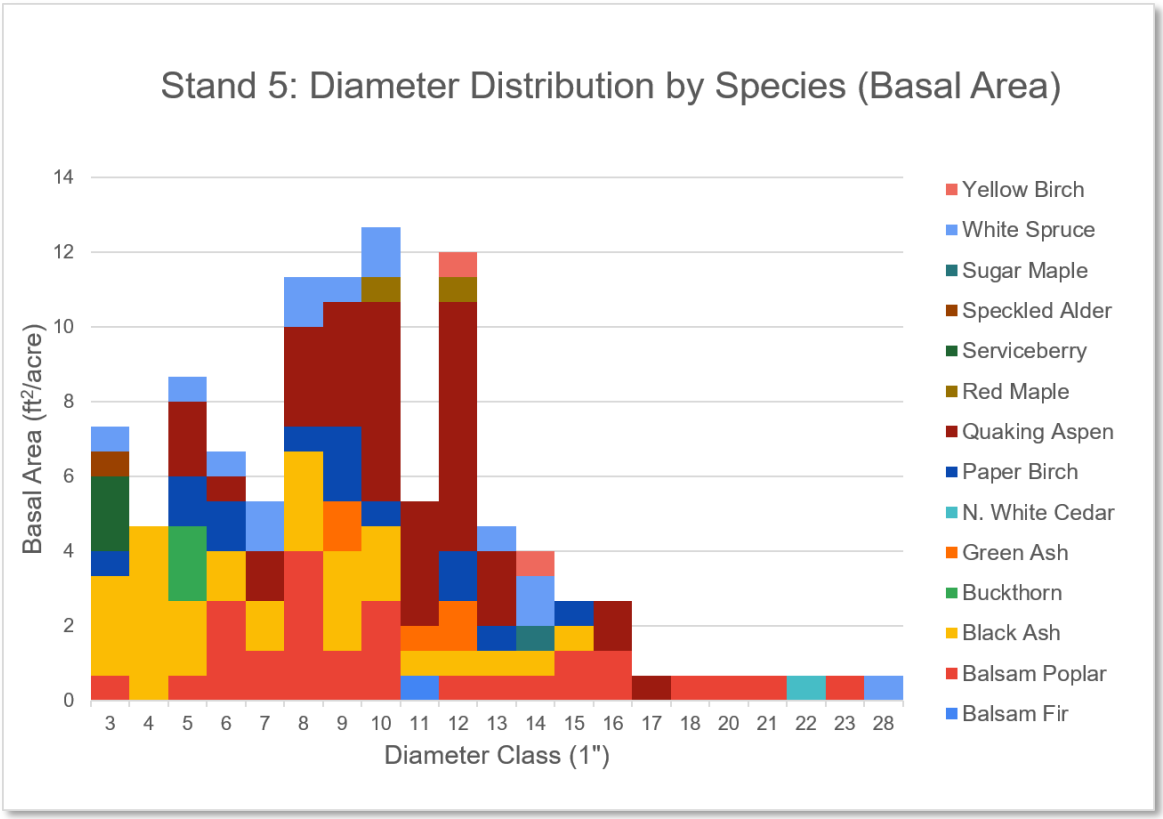
Current Recreational Uses or Management:
Multiple trails are present within this unit, including the Mission Creek Parkway and its associated stone bridges.

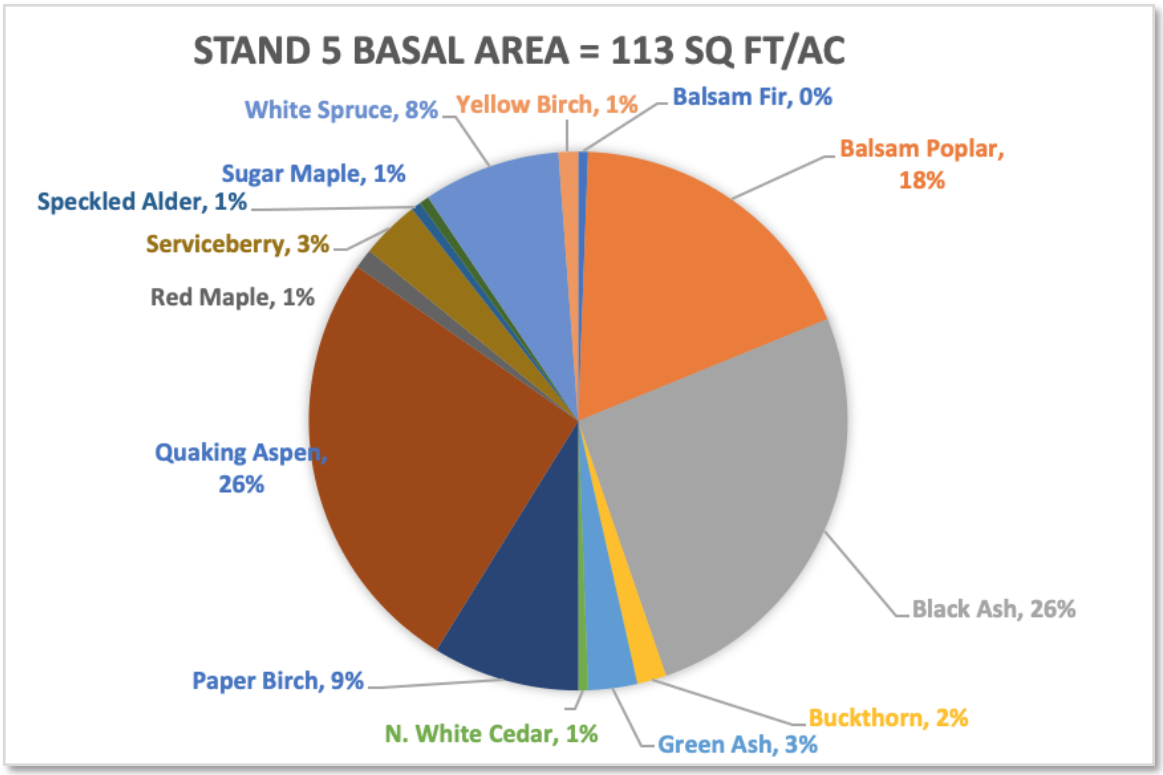
Adjacent land use concerns:
Possible pollution from adjacent private properties entering the Mission Creek watershed

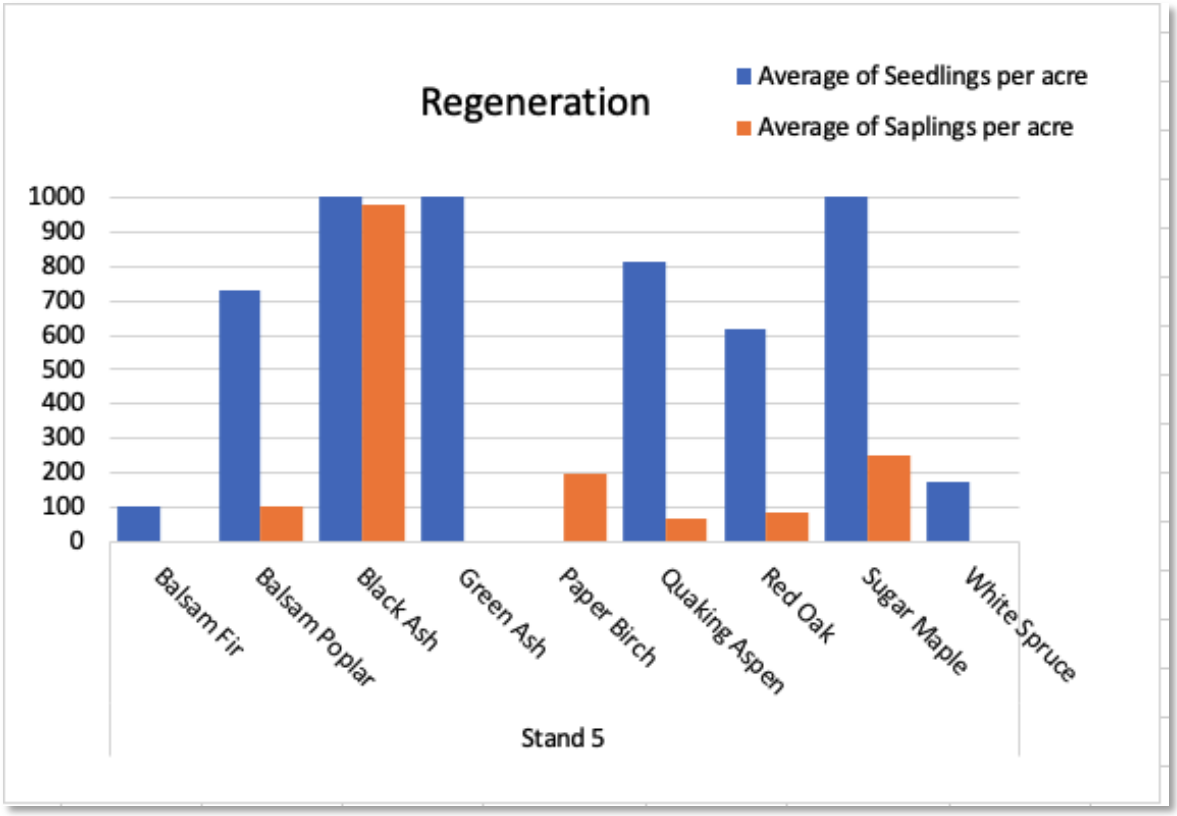
No action result (10-20 years): Slopes will likely continue to erode especially during high rainfall or snowmelt conditions, perhaps hindering regeneration. Where stable periods of time pass, naturally regenerating trees, particularly characteristic of the mature form of this forest type may establish, particularly white spruce if other species succumb to deer browse. Black ash regeneration is abundant, but its longevity and ability to become established as an overstory tree is limited by EAB. Alternatively, shrubs may become dominant where trees are unsuccessful in their establishment.

Management Goals, Strategies, and Actions

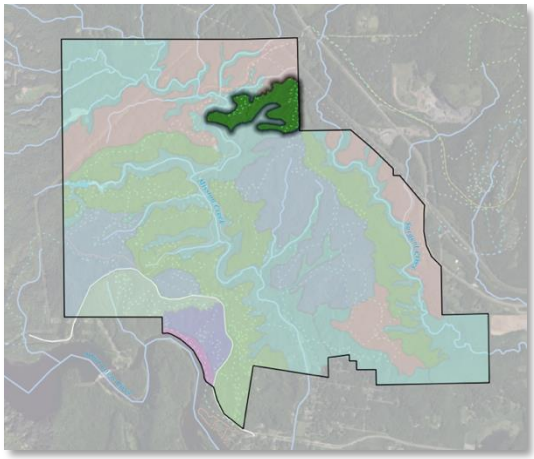
Goal	Strategy	Action	Notes
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Systemic herbicide injection annually into mature female trees during early-stage invasion to serve as seed crops for future ash regeneration; Girdle ash trees to attract EAB in combination with systemic herbicide injection to adjacent trees; Underplanting - Plant trees other than ash where ash decline and mortality is advanced	


Stand 5: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 21 22 23 28
Diameter Class (1")
Yellow Birch
White Spruce
Sugar Maple
Speckled Alder
Serviceberry
Red Maple
Quaking Aspen
Paper Birch
N. White Cedar
Green Ash
Buckthorn
Black Ash
Balsam Poplar
Balsam Fir


STAND 5 BASAL AREA = 113 SQ FT/AC
White Spruce, 8%
Yellow Birch, 1%
Balsam Fir, 0%
Balsam Poplar, 18%
Sugar Maple, 1%
Speckled Alder, 1%
Serviceberry, 3%
Red Maple, 1%
Quaking Aspen, 26%
Black Ash, 26%
Paper Birch, 9%
N. White Cedar, 1%
Green Ash, 3%
Buckthorn, 2%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Oak
Sugar Maple
White Spruce
Stand 5

Stand 6 Mixed Hardwood Conifer





Stand Characteristics

Forest Type: Mixed Hardwood Conifer

Size: 45 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	32.6	76%
MHn44	4.9	11%
MHn46b	4.7	11%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands

Dominant Soils: F115G (84%), F155B (16%)
Udalfs-Eutrudepts complex, 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 11.7" (SE 0.9)

Average Stand Basal Area: 138 ft^2/ac (SE 9.8)

Snags per acre: 25 medium (6-11" DBH), 3 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low - buckthorn and honeysuckle present but occasional, with existing buckthorn large and established

Pests & Disease: Ash trees in this stand show signs of initial infestation by EAB such as slight canopy decline and damage to foliage caused by adult feeding

Current Condition: This mature stand is located on the slopes and uplands above upper Mission Creek in the northeast portion of the property. A dense stand of remnant white pines in the 22" to 34" size range occurs on the south-facing slope. Quaking aspen is most dominant in the 8" to 13" size classes, but not as overly abundant outside of these size classes. In the smaller, pulp and poletimber size classes, paper birch and black ash were most common, with aspen also present but less prevalent. In addition, the 4" to 7" size classes had fewer trees per acre than the immediately larger size classes, indicating the stand is in a later successional stage or an occurrence of a regeneration bottleneck. Mesic hardwood species (sugar maple, red oak) are present as mature trees in low quantity but with a notable lack of regeneration. Black and green ash dominate the seedling and sapling age classes, with quaking aspen and red maple are the next most prevalent seedling species. Other than ash, seedling recruitment into the sapling layer is limited, likely due to lack of light (closed canopy forest condition) and deer browse. The midstory is well-developed and is composed of beaked hazel, mountain maple, pagoda dogwood, round-leaved dogwood, and serviceberry. Dominant understory plants are thimbleberry, bush honeysuckle, largeleaved aster, and bracken fern.

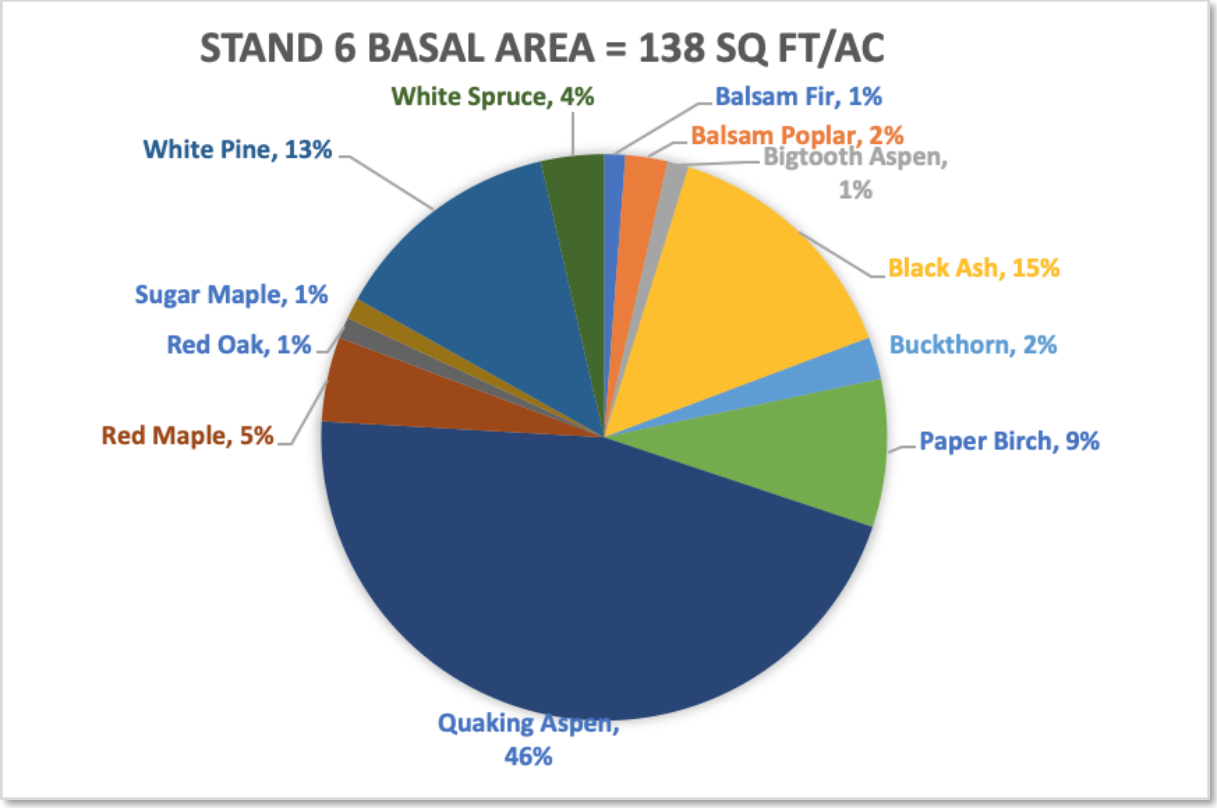
Current Recreational Uses or Management:
A very windy hiking trail meanders along contour through this unit.

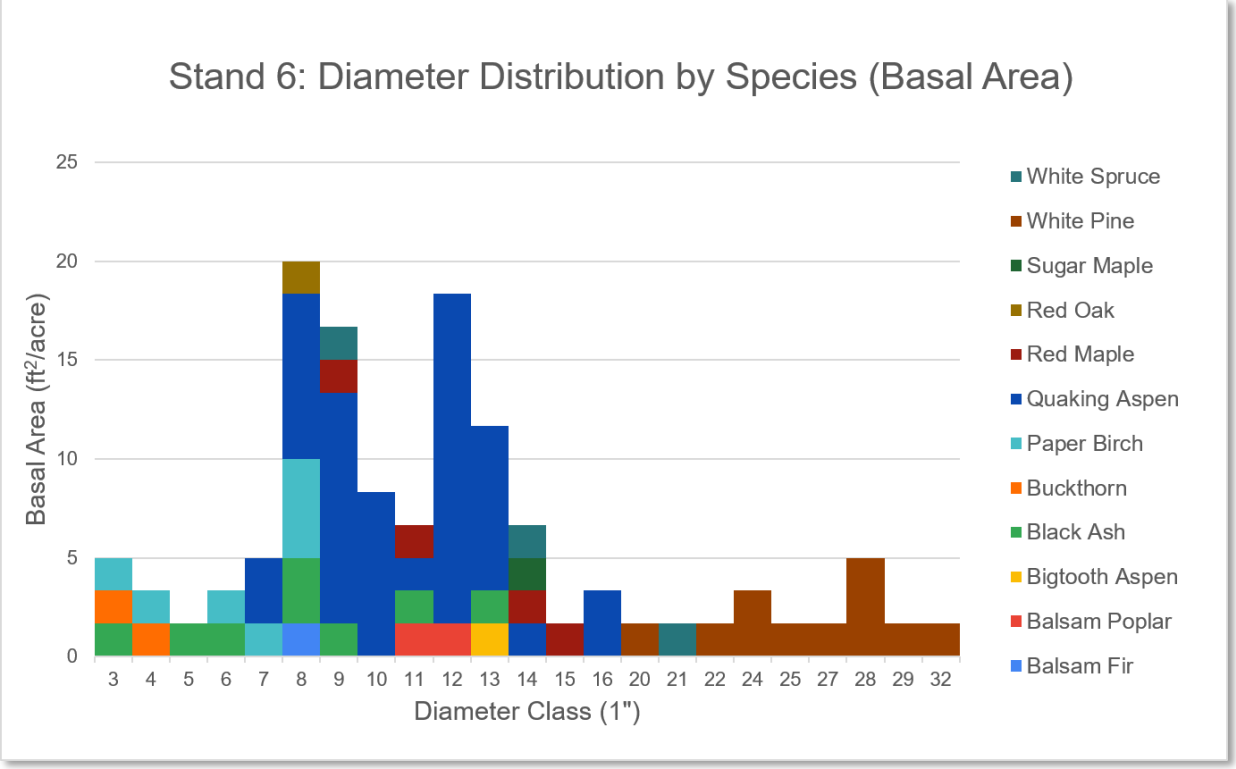
Adjacent land use concerns:
Private property abuts the east side of the unit.

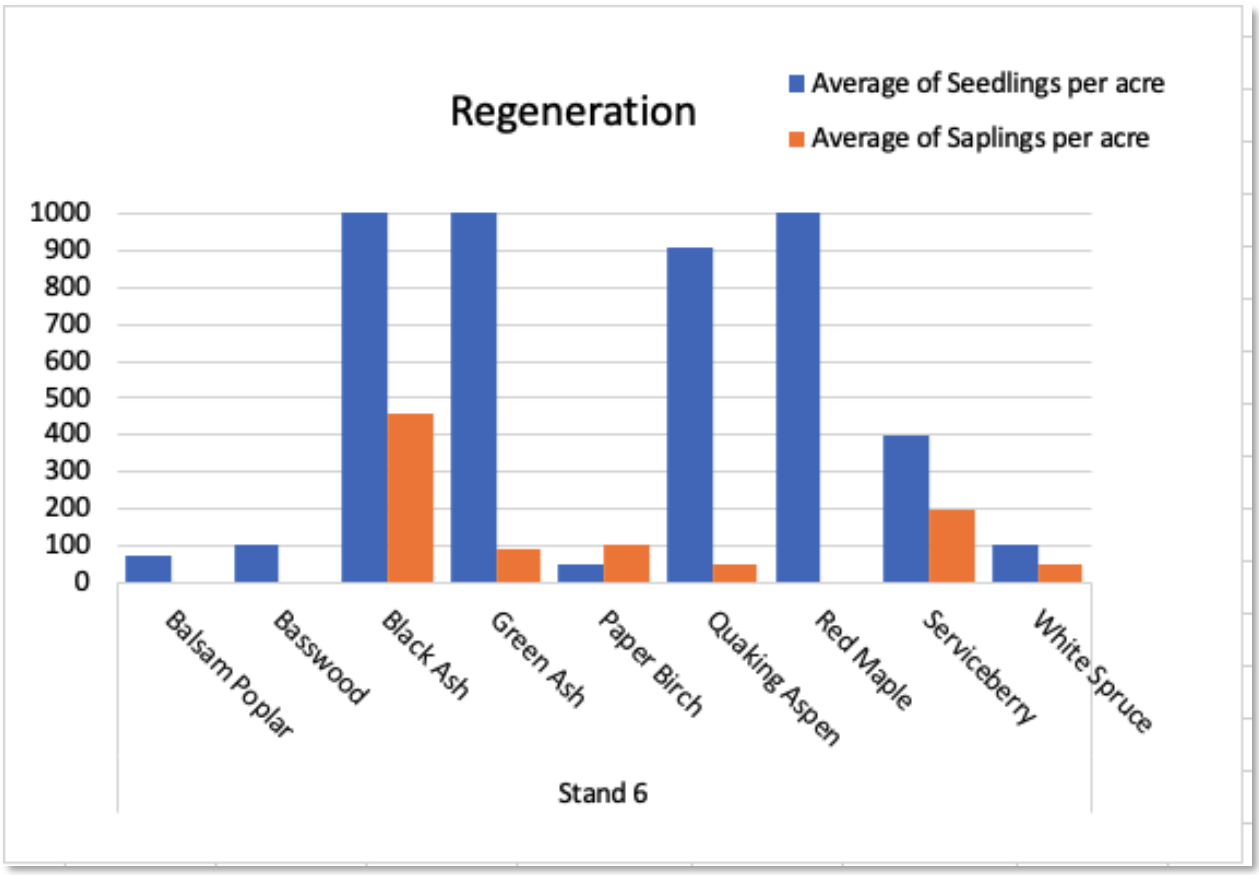
No action result (10-20 years): Old white pines will eventually age out and become snags. Aspen and birch are likely to become dominant in areas with little competition from shrubs or buckthorn.

Management Goals, Strategies, and Actions

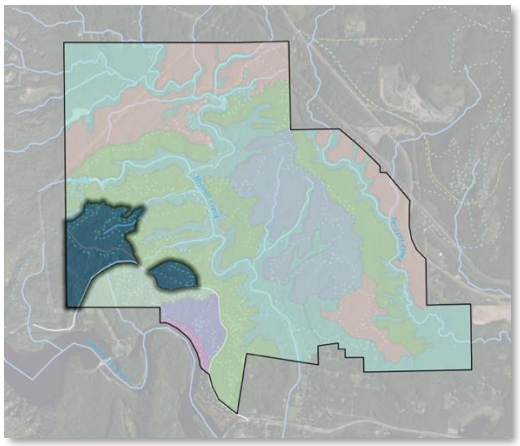
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.


STAND 6 BASAL AREA = 138 SQ FT/AC
White Spruce, 4%
Balsam Fir, 1%
Balsam Poplar, 2%
Bigtooth Aspen, 1%
White Pine, 13%
Black Ash, 15%
Sugar Maple, 1%
Red Oak, 1%
Buckthorn, 2%
Red Maple, 5%
Paper Birch, 9%
Quaking Aspen, 46%


Stand 6: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
25
20
15
10
5
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 20 21 22 24 25 27 28 29 32
Diameter Class (1")
White Spruce
White Pine
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Buckthorn
Black Ash
Bigtooth Aspen
Balsam Poplar
Balsam Fir


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Serviceberry
White Spruce
Stand 6

Stand 7 Northern Hardwoods





Stand Characteristics

Forest Type: Northern Hardwoods

Size: 111 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	92.4	83%
MHn46b	12.4	11%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands
F092XY015WI - Clayey Uplands

Dominant Soils: Dominant Soil: F155G (55%), F155B (45%)
Udalfs-Eutrudepts complex, 25-70% slopes (F155G) on tributary drainages. Very fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 10.1" (SE=0.7)

Average Stand Basal Area: 109 ft^2/ac (SE=10)

Snags per acre: 19 medium (6-11" DBH), 3 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low, minimal buckthorn observed

Pests & Disease: Signs of early EAB are present, including slight canopy decline of ash trees

Current Condition: This diverse hardwood stand is located on the west-southwest portion of the property adjacent to highway 210. It contains some slopes and hills characteristic of the rest of the property but is comparatively flat. Unlike adjacent stands, aspen is a minor component of a mixed forest composition. Aside from remnant (23"-31") white, the largest trees are red oak, quaking aspen, basswood, red maple, and paper birch, with red oak being the most abundant (14"-25" DBH). The majority of seedlings and saplings are green and black ash. Quaking aspen, red oak, sugar maple, and red maple are the most numerous non-ash seedling species present. While there is some non-ash recruitment into the sapling size classes, no red oak or red maple saplings were observed despite their relative abundance as seedlings, whereas aspen, basswood, sugar maple, and ironwood have greater sapling abundance. There are more than typical number of white pine seedlings present, but they are not surviving to sapling size. The midstory is relatively open and is composed of mostly beaked hazel with some roundleafed dogwood. Dominant understory plants include Pennsylvania sedge, largeleaved aster, bracken fern, lady fern, and Canada mayflower.

Current Recreational Uses or Management:
Several hiking trails including the North Country/Duluth Traverse and Superior Hiking Trail, and mountain bike

Adjacent land use concerns:
Several pullouts and trailhead parking areas are present along highway 210, which are

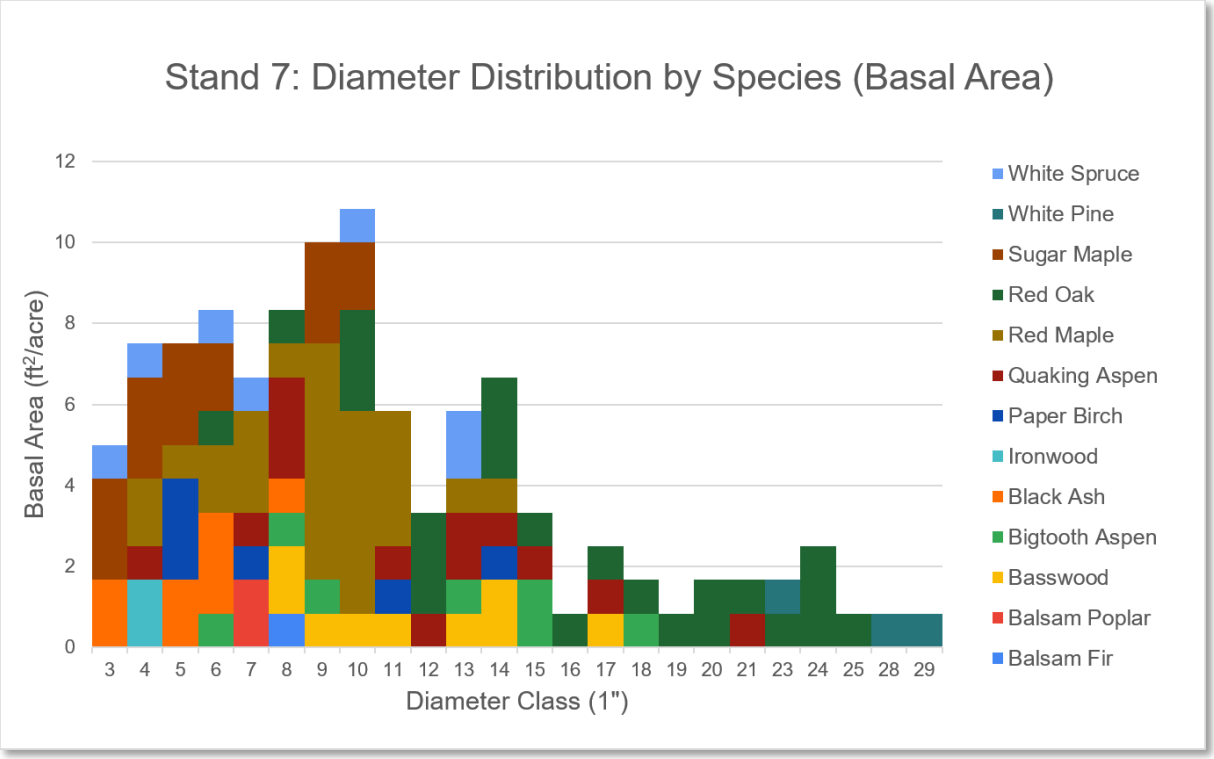
trails criss-cross the unit. A couple recently overgrown road grades and an access gate suggest recent management activity. A two-track road allowing motorized access from Highway 210 is present in the southwest portion of the stand, near the property line.

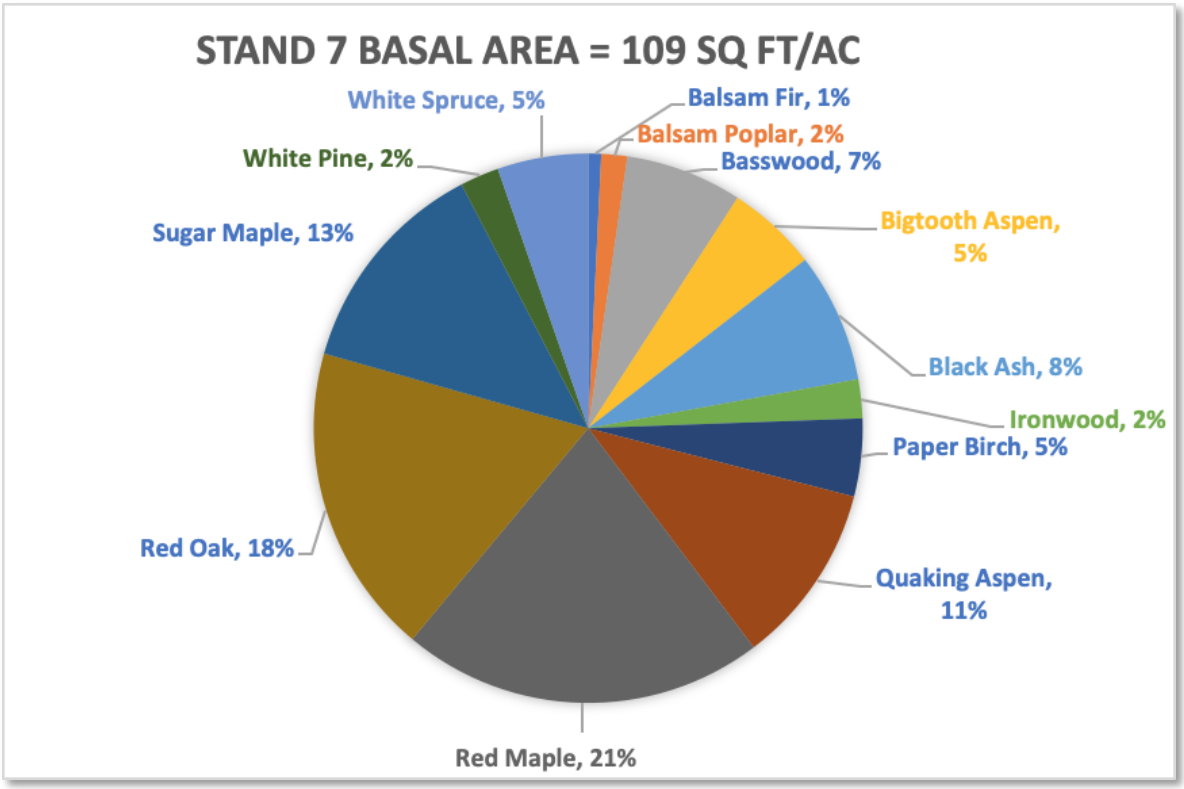
sources of higher concentration of trail uses. To the west of this unit is Jay Cooke State Park, potentially bringing higher numbers of visitors via connected hiking trails.

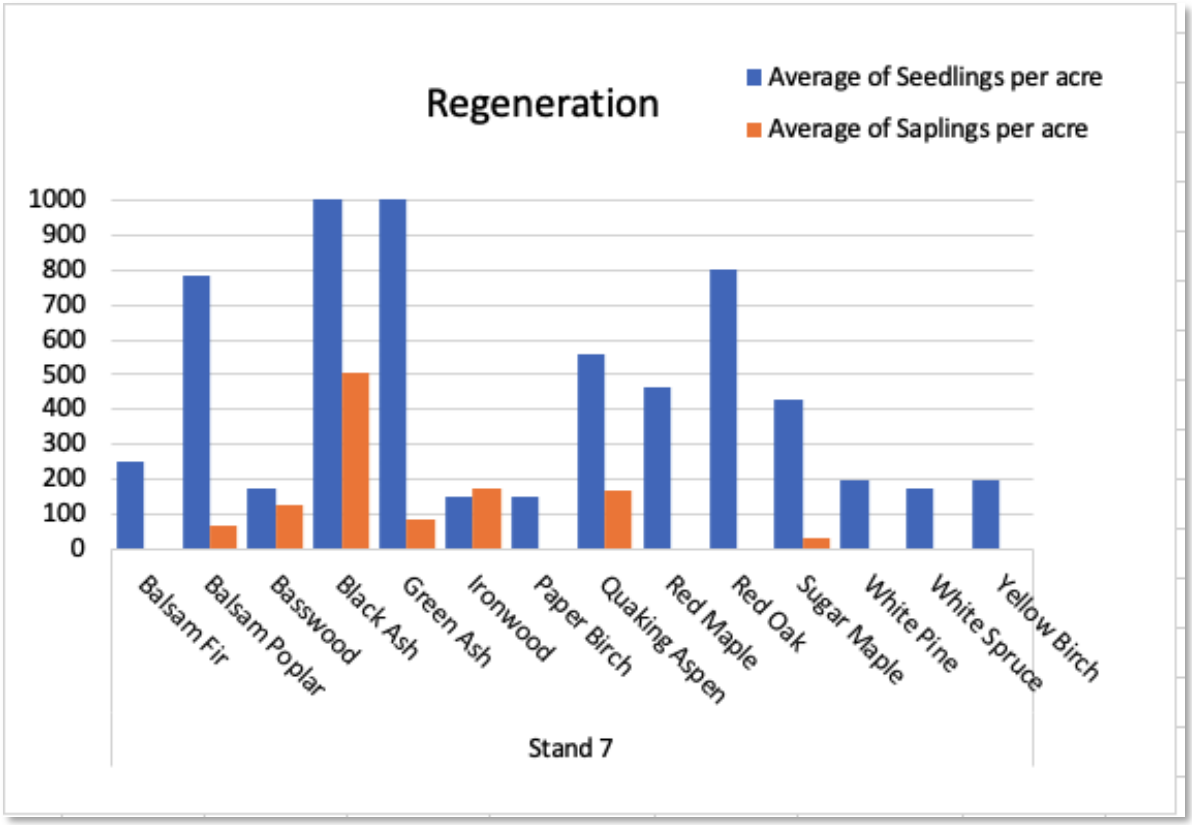
No action result (10-20 years): The stand has diverse and moderate regeneration, but closed canopy conditions and high deer abundance will favor shade tolerant species, such as red maple and ironwood, or species less palatable to deer such as white spruce. Ash regeneration is abundant, but its longevity and ability to become established as an overstory tree is limited by EAB. Alternatively, shrubs may become dominant where trees are unsuccessful in their establishment. Red maple in the 5-11" age classes will continue to grow and become more dominant in the overstory.

Management Goals, Strategies, and Actions

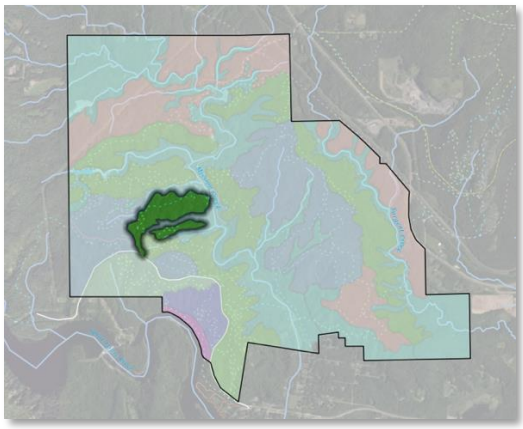
Goal	Strategy	Action	Notes
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	




STAND 7 BASAL AREA = 109 SQ FT/AC
White Spruce, 5%
Balsam Fir, 1%
Balsam Poplar, 2%
White Pine, 2%
Basswood, 7%
Sugar Maple, 13%
Bigtooth Aspen, 5%
Black Ash, 8%
Ironwood, 2%
Paper Birch, 5%
Red Oak, 18%
Quaking Aspen, 11%
Red Maple, 21%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Basswood
Black Ash
Green Ash
Ironwood
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Yellow Birch
Stand 7

Stand 8 Aspen





Stand Characteristics

Forest Type: Aspen

Size: 49 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	40.5	83%
MHn44c	6.6	13%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands
F092XY015WI - Clayey Uplands

Dominant Soils: F155G (59%), F155B (42%)
Udalfs-Eutrudepts complex, 0-8% and 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Young forest (0-55 years)

Average Stand Diameter (DBH): 8.6" (SE=0.4)

Average Stand Basal Area: 118 ft^2/ac (SE=13)

Snags per acre: 29 medium (6-11" DBH), Paper birch

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low, occasional buckthorn present in stand

Pests & Disease: None observed

Current Condition: This mid-aged aspen-dominant stand is located on the flat ridgetops and east-facing slopes that lead down to Mission Creek. Canopy is primarily composed of trees under 10" DBH, majority quaking aspen with components of sugar maple, red oak, paper birch, red oak, and white spruce. Regeneration is strongly black ash, likely to fail due to EAB, with healthy amounts of quaking aspen and some white spruce, paper birch, and red maple. The midstory is a mix of open and dense and is composed mostly of beaked hazel with some serviceberry and buckthorn. Dominant understory plants include bracken fern, bush honeysuckle, bunchberry, and largeleafed aster.

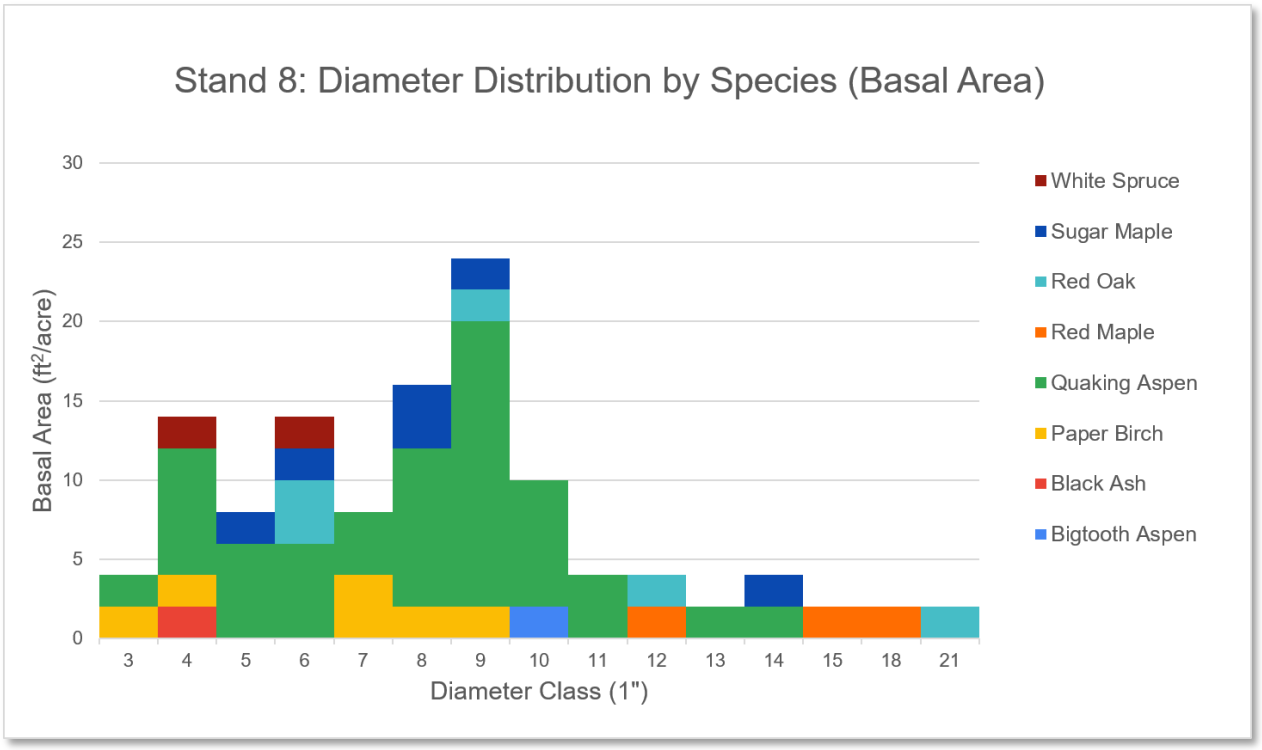
Current Recreational Uses or Management:
The Superior Hiking Trail stretches across the flatter uplands in the northern portion of this stand before routing downslope to cross Mission Creek. The southern portion of the stand hosts several crisscrossing mountain bike trails, which have a trailhead along Highway 210.

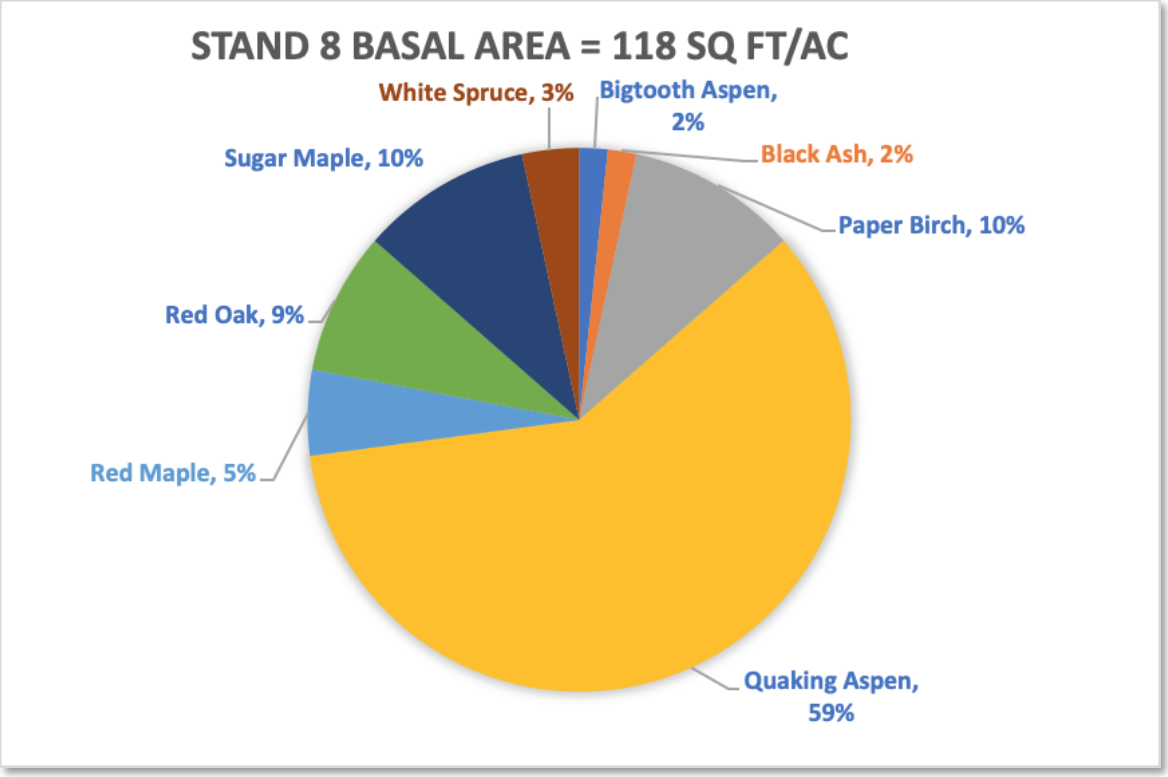
Adjacent land use concerns:
The trailhead along highway 210 is a source of higher concentration of trail users.

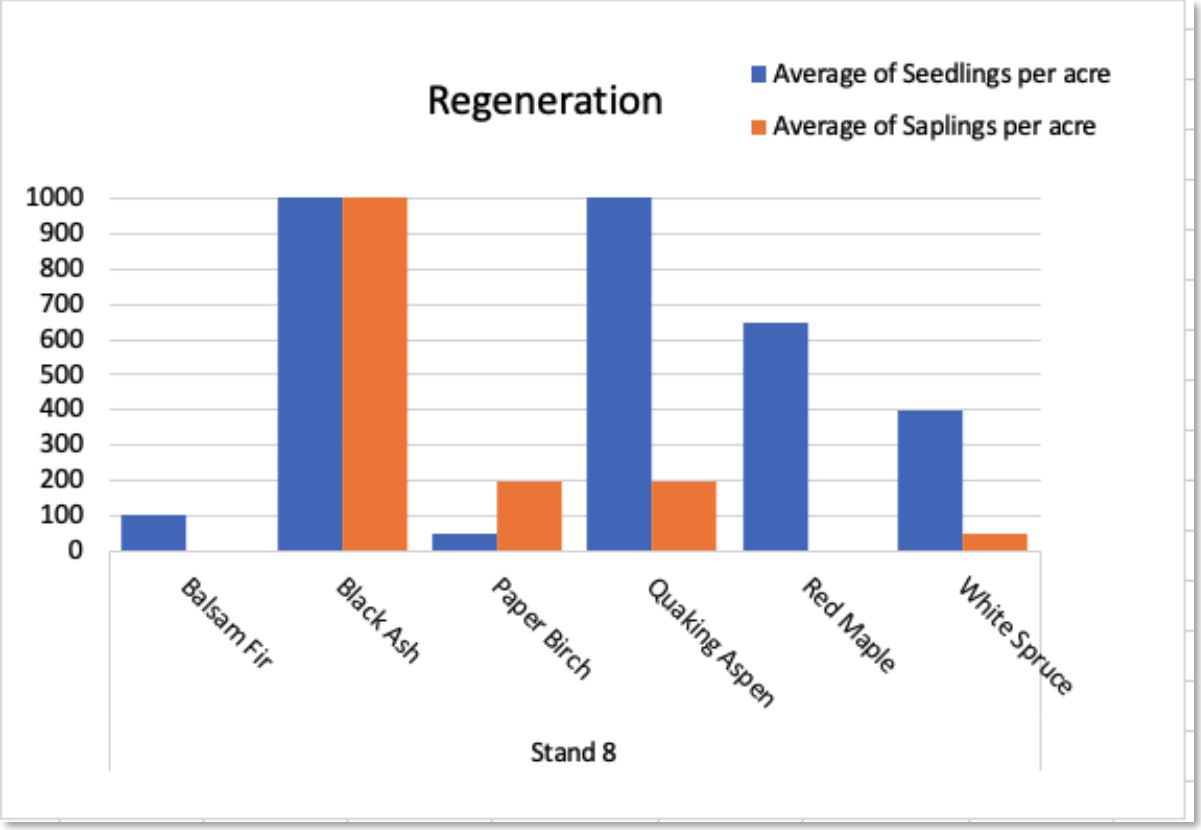
No action result (10-20 years): Quaking aspen will continue to grow and move into the larger size classes. Buckthorn may begin to become an midstory competitor.

Management Goals, Strategies, and Actions

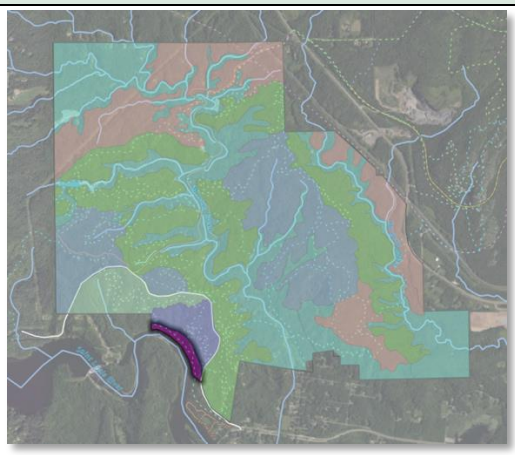
Goal	Strategy	Action	Notes
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Gap selection	Gap widths 0.5-2x height of trees; cut during growing season




STAND 8 BASAL AREA = 118 SQ FT/AC
White Spruce, 3%
Bigtooth Aspen, 2%
Black Ash, 2%
Paper Birch, 10%
Quaking Aspen, 59%
Red Maple, 5%
Red Oak, 9%
Sugar Maple, 10%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Black Ash
Paper Birch
Quaking Aspen
Red Maple
White Spruce
Stand 8

Stand 9 Cliff/Talus





Stand Characteristics

Forest Type: Cliff/Talus

Size: 12 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44b	4.6	38%
CTn11e	4.2	35%
MHn35b	1.8	15%
CTn42d	0.8	7%

Ecological Site (USDA):
F092XY014WI - Loamy Uplands

Dominant Soils: Dominant Soil: F155G (96%)
Udalfs-Eutrudepts complex, 0-8% and 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Young forest/non-forested

Average Stand Diameter (DBH): N/A

Average Stand Basal Area: N/A

Coarse woody debris: Low

Wildfire risk: Low due to extensive mineral soil on sloughing banks and proximity to river

Invasive Species: None noted

Pests & Disease: None noted

Current Condition: This small, southwest-facing unit consists of the steep slopes along the St Louis river. Portions of it are non-forested and a full forest inventory was not possible due to lack of tree cover and inaccessibility. Due to erosion and the sloughing of slopes, the forest here overall is young, brushy, and dominated by early successional species such as balsam poplar. Young white spruce, green ash, red oak, and bigtooth aspen are also present. Shrubs are abundant and robust, especially roundleaved dogwood and speckled alder. Understory plants are diverse and dominated by wild grape, poison ivy, and a variety of grasses, as well as numerous early-successional forbs.

Current Recreational Uses or Management:
A trail runs along the length of the upper contour of this unit. The lowest contour of this unit grades into the banks of the St. Louis river.

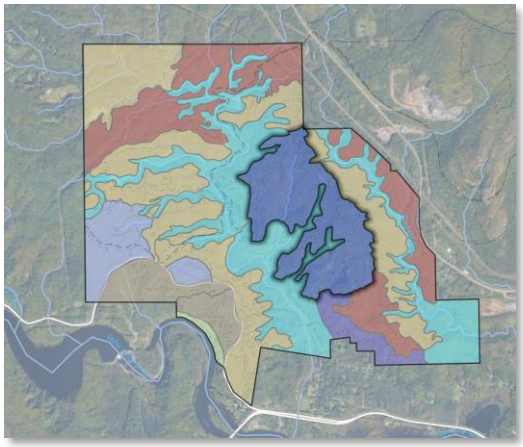
Adjacent land use concerns:
A dam restricts water flow just upstream of this unit, likely impacting the native plant community and ecological function of the lowest elevation portion of this unit.

No action result (10-20 years): Continued sloughing of these extremely steep slopes is expected to occur especially during extreme rain events. Natural recruitment and replacement of early successional forest is likely to happen across much of the unit where seedlings have enough time to establish themselves between extreme weather events.

Management Goals, Strategies, and Actions

Manage in alignment with St. Louis River Estuary restoration plans in support of cliff-talus plant communities.

Stand 10 Northern Hardwoods (White Pine, Red Pine)





Stand Characteristics

Forest Type: Northern Hardwoods (White Pine, Red Pine)

Size: 254 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	217.9	86%

Ecological Site (USDA): F092XY014WI - Loamy Uplands F092XY015WI - Clayey Uplands

Dominant Soils: F155G, F155B Udalfs-Eutrudepts complex, 0-8% and 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 10.4" (SE=0.3)

Average Stand Basal Area: 120 ft^2/ac (SE=7.2)

Snags per acre: 17 medium (6-11" DBH), 2 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low - Buckthorn and honeysuckle are occasionally present

Pests & Disease: EAB is present in the stand with healthy trees or minimal dieback noted in some areas while mortality is occurring in others. Deer browse was noted on aspen and ash.

Current Condition: This mixed-age stand is located on the higher terrain between Mission Creek and Sargent Creek, draining into Mission Creek. The stand contains a series of ridges providing varying microclimates and ephemeral streams which support diverse overstory trees and herbaceous plant species. With an average stand basal area of 120 ft^2 per acre, the overstory is well-stocked. The oldest age class of trees are remnant white pines in the 23-31" size classes, with paper birch, sugar maple, and quaking aspen as co-dominants. A diverse suite of hardwood species are present in the seedling layer, with around as many sugar maple, red maple, and red oak seedlings present as quaking aspen seedlings. Similar to most stands, ash is the most numerous seedling and sapling species. The midstory is variable with some areas completely open under closed birch canopy and other areas dense with hazel in canopy gaps, or very crowded sapling white spruce. Roundleaf dogwood, buckthorn, serviceberry, and mountain maple are also common shrub components. Dominant understory plants are thimbleberry, Pennsylvania sedge, bracken fern, largeleaved aster, and bunchberry, with a high diversity of other herbaceous species.

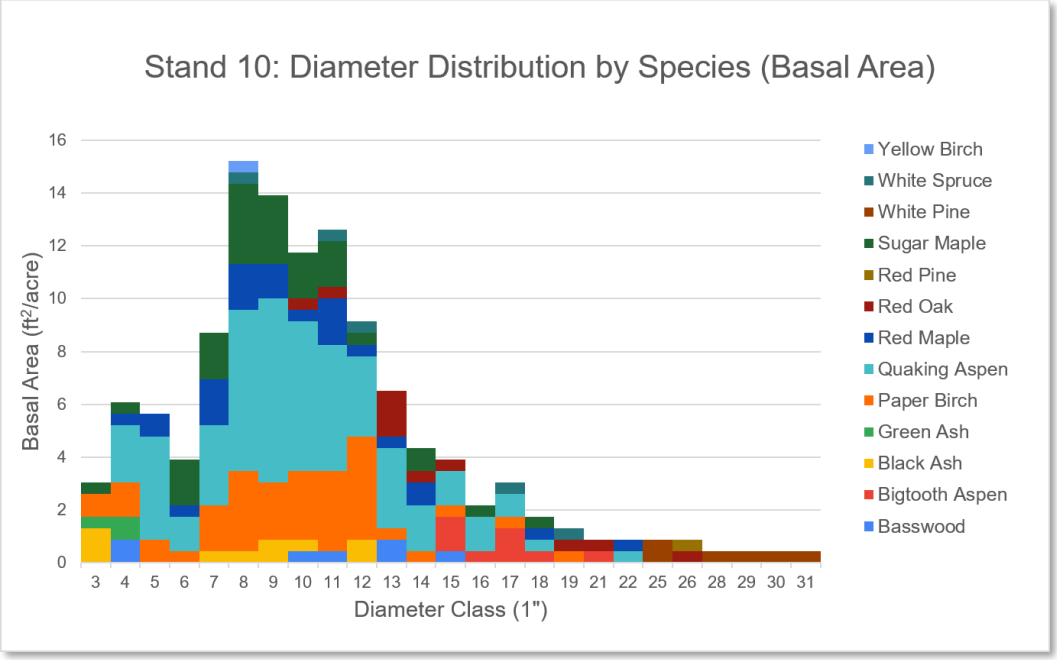
Current Recreational Uses or Management:
Several hiking and mountain bike trails cross through the stand.

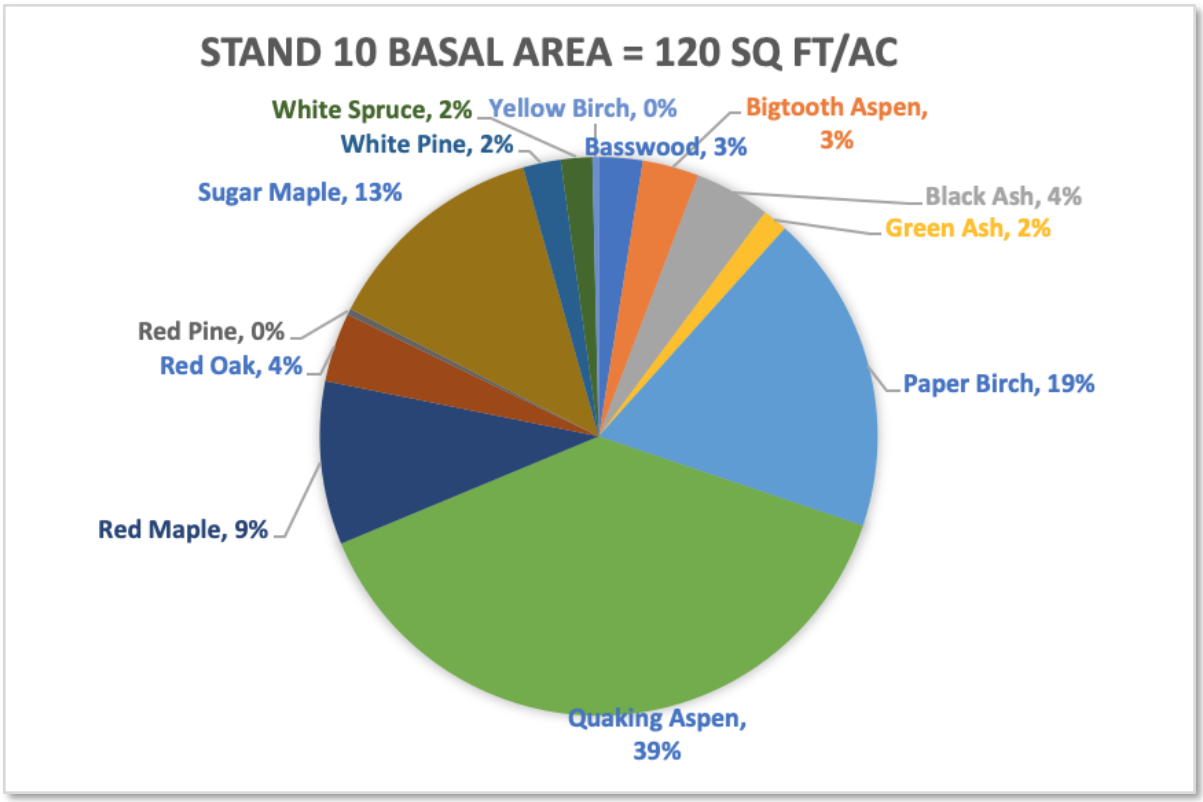
Adjacent land use concerns:
None.

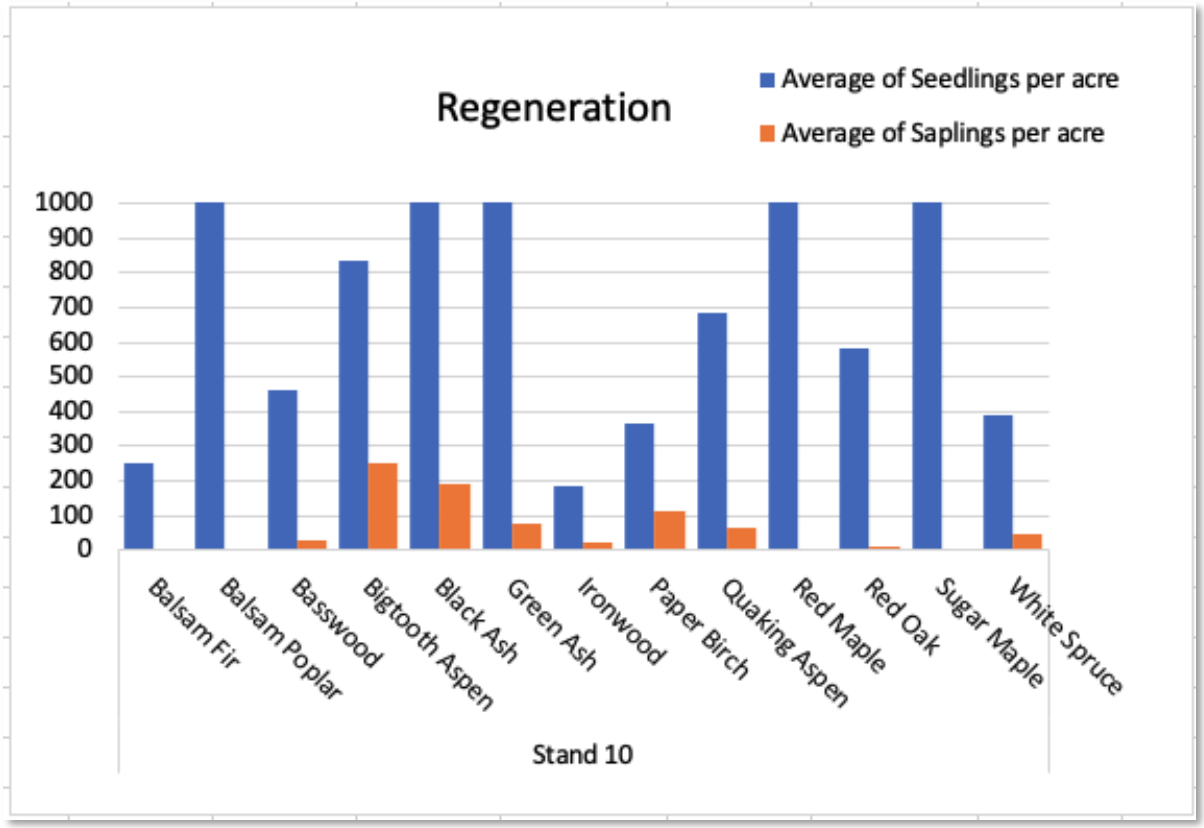
No action result (10-20 years): Sugar maple may become more dominant if canopy openings occur from individual falling trees and seedlings are able to persist through sapling stage without deer herbivory. If sugar maple is not able to recruit and grow into the canopy, white spruce may become more dominant as a deer-resistant species. White pine would typically establish in this forest type but may not due to lack of regeneration or establishment.

Management Goals, Strategies, and Actions

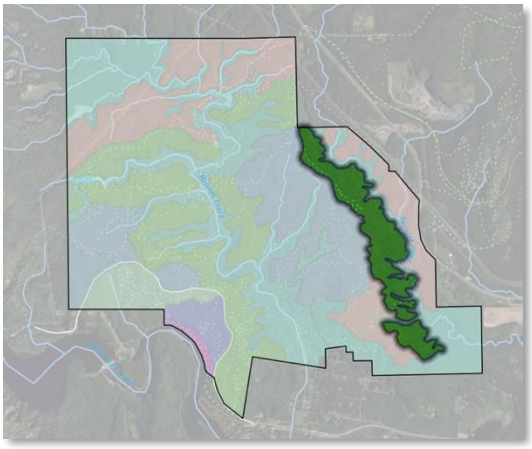
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.




STAND 10 BASAL AREA = 120 SQ FT/AC
White Spruce, 2%
Yellow Birch, 0%
Bigtooth Aspen, 3%
White Pine, 2%
Basswood, 3%
Sugar Maple, 13%
Black Ash, 4%
Green Ash, 2%
Red Pine, 0%
Red Oak, 4%
Paper Birch, 19%
Red Maple, 9%
Quaking Aspen, 39%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Basswood
Bigtooth Aspen
Black Ash
Green Ash
Ironwood
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Spruce
Stand 10

Stand 11 Mixed Hardwood Conifer





Stand Characteristics

Forest Type: Mixed Hardwood Conifer

Size: 117 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	96.0	82%
MHn44a	8.8	8%

Ecological Site (USDA): F092XY014WI - Loamy Uplands F092XY015WI - Clayey Uplands

Dominant Soils: F155G (50%), F155B (50%) Udalfs-Eutrudepts complex, 0-8% and 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Young forest (0-55 years) and transitional between young and mature (55-95 years)

Average Stand Diameter (DBH): 10.6" (SE=0.5)

Average Stand Basal Area: 155 ft^2/ac (SE=13)

Snags per acre: 30 medium (6-11" DBH), 3 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low to medium amounts of buckthorn scattered throughout stand

Pests & Disease: Aspen shoot blight (Shepards crook) observed on aspen seedlings

Current Condition: This stand spans the ridgetops and east-facing slopes of Sargent creek. It contains a broad spectrum of age classes of aspen-birch forest. In some sections, larger paper birch (10-16" diameter) exhibit broad canopies with very open understories and limited regeneration. In other places, younger birch and aspen (diameters 5-10") grow more densely or have more prevalent sugar maple-basswood-ironwood-red oak components. Shade-tolerant red maple, sugar maple, ironwood and white spruce are most common under closed canopies. Compared to the adjacent stand 10, stand 11 has fewer sugar maples but more trees per acre overall (especially in 5-7" size classes). Conifer regeneration is overall poor with more hardwood dominance. Aspen regeneration was present but noted to be growing poorly due to aspen shoot blight (Shepards crook). The midstory is variably dense and is composed of beaked hazel, roundleafed dogwood, serviceberry, downy arrowwood, speckled alder, buckthorn, and mountain maple. Dominant understory plants are thimbleberry, Pennsylvania sedge, bracken fern, and largeleaved aster.

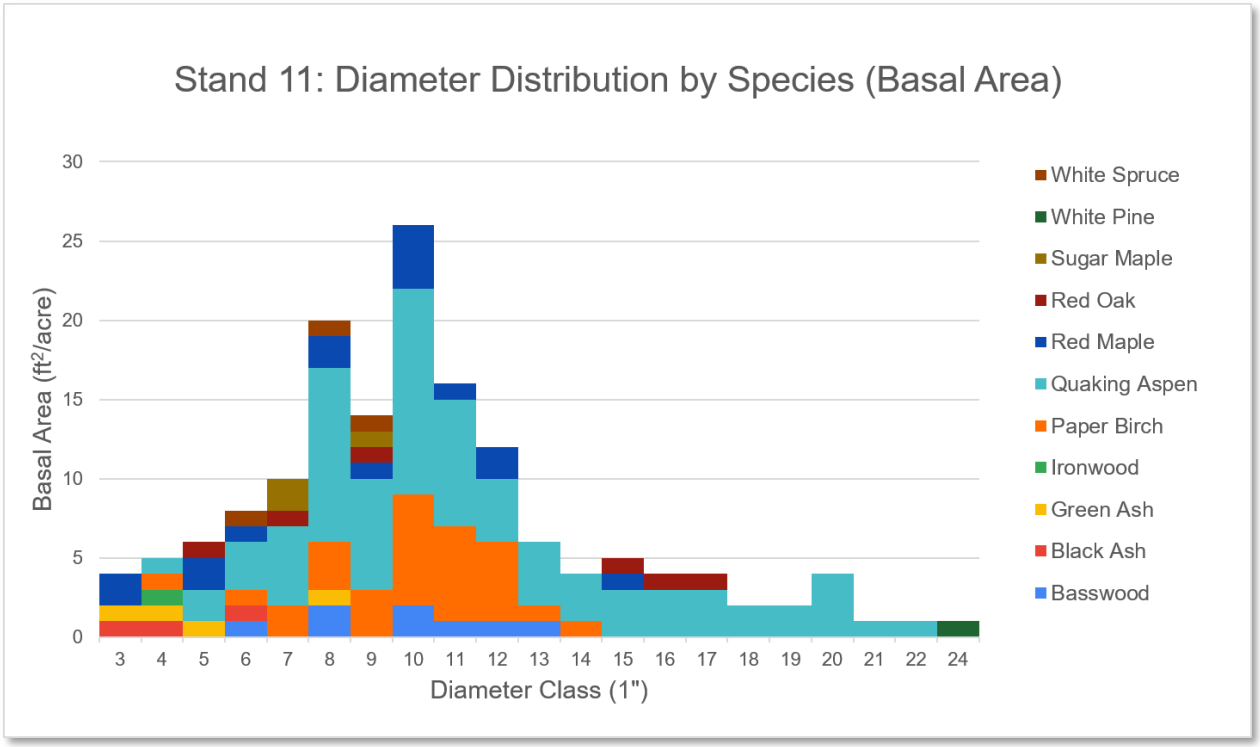
Current Recreational Uses or Management:
This unit has only occasional hiking or mountain biking trails with user-generated trails suggesting evidence of hunters. Browse height and flattened vegetation indicate large animal presence such as moose.

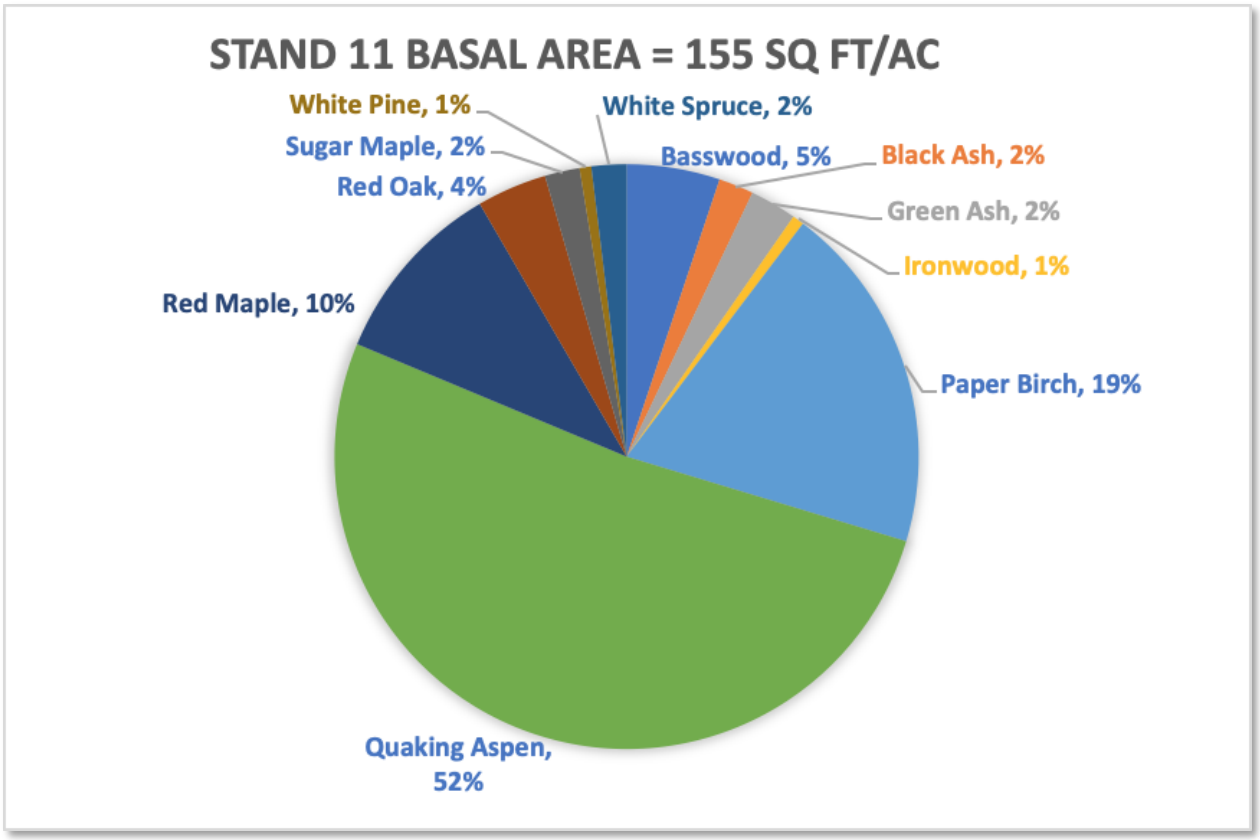
Adjacent land use concerns:
None.

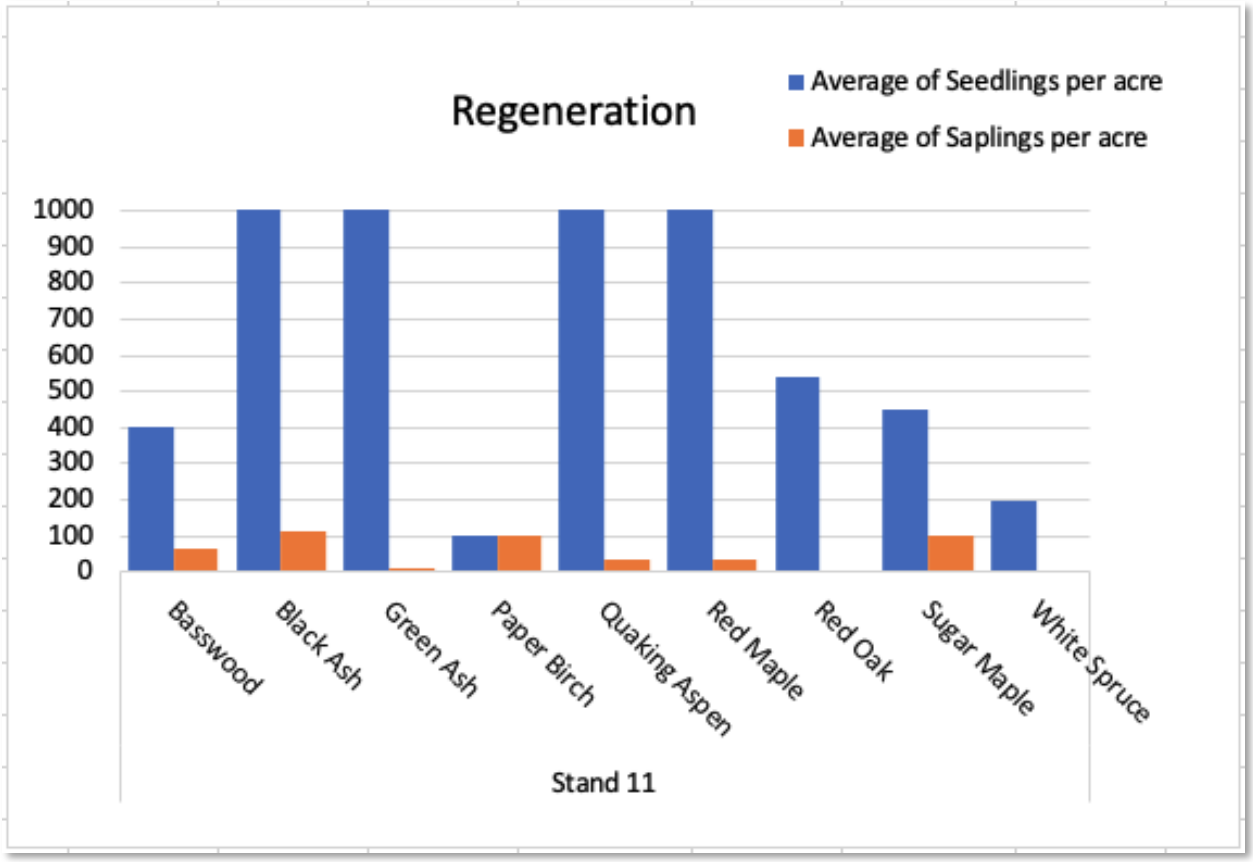
No action result (10-20 years): Aspen and birch will age out, creating large cavity trees for wildlife. Black ash regeneration will eventually fail due to EAB. If hardwoods such as red maple, sugar maple, and red oak are able to become established the stand may turn into a mature hardwood dominant stand. However, if herbivory pressure continues to be heavy, the stand may revert to a more open-canopy stand with shrub-dominance or possibly early-successional aspen clones. White pines will eventually die out and not be replaced.

Management Goals, Strategies, and Actions

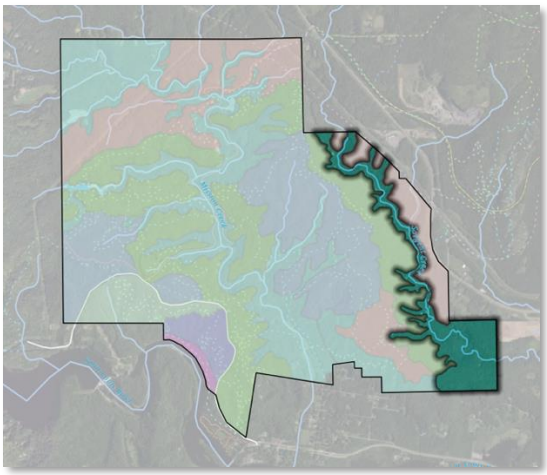
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.


Stand 11: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
30
25
20
15
10
5
0
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 24
Diameter Class (1")
White Spruce
White Pine
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Ironwood
Green Ash
Black Ash
Basswood


STAND 11 BASAL AREA = 155 SQ FT/AC
White Pine, 1%
White Spruce, 2%
Sugar Maple, 2%
Basswood, 5%
Black Ash, 2%
Red Oak, 4%
Green Ash, 2%
Ironwood, 1%
Red Maple, 10%
Paper Birch, 19%
Quaking Aspen, 52%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Basswood
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Spruce
Stand 11

Stand 12 Riparian





Stand Characteristics

Forest Type: Riparian

Size: 128 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44b	40.7	32%
MHn35b	38.1	30%
MHn46b	25.1	20%
FFn57a	14.3	11%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (71%), F155B (13%), E3B (7%), E24F (6%), E2B (2%), F111B (1%) Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitional between young and mature forest (35-95 years)

Average Stand Diameter (DBH): 9.8" (SE=0.7)

Average Stand Basal Area: 115 ft^2/ac (SE=14.6)

Snags per acre: 18 medium (6-11" DBH), 4 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low to medium presence of buckthorn, occasional invasive honeysuckle

Pests & Disease: EAB was present and well established throughout this stand with dead, dying, declining and minimally affected trees present. Blash ash is a significant component of this stand.

Current Condition: This is a maturing riparian corridor and lowland forest in the farthest southeast part of the property is bisected by Sargent Creek. The overstory is composed of 17-25" DBH white spruce, quaking aspen, and paper birch with occasional balsam poplar, white cedar, and yellow birch on low slopes, and black ash in the floodplain. A mixture of other conifer and hardwood species are also present. Regeneration is dominantly black ash, with aspen, white spruce, and balsam fir, and small numbers of other hardwood species, most of which are not recruiting to the sapling stage. The midstory is moderately dense, especially along stream edges, and is composed of beaked hazel, mountain maple, roundleafed dogwood, speckled alder, and to a lesser extent serviceberry. Thimbleberry is the dominant understory plant, along with large-leaved aster, lady fern, horsetails, bush honeysuckle, bunchberry, and bracken fern. The abundance of these (especially thimbleberry) limits the establishment of tree seedlings. Wildlife use is high in this remote stand including signs of moose.

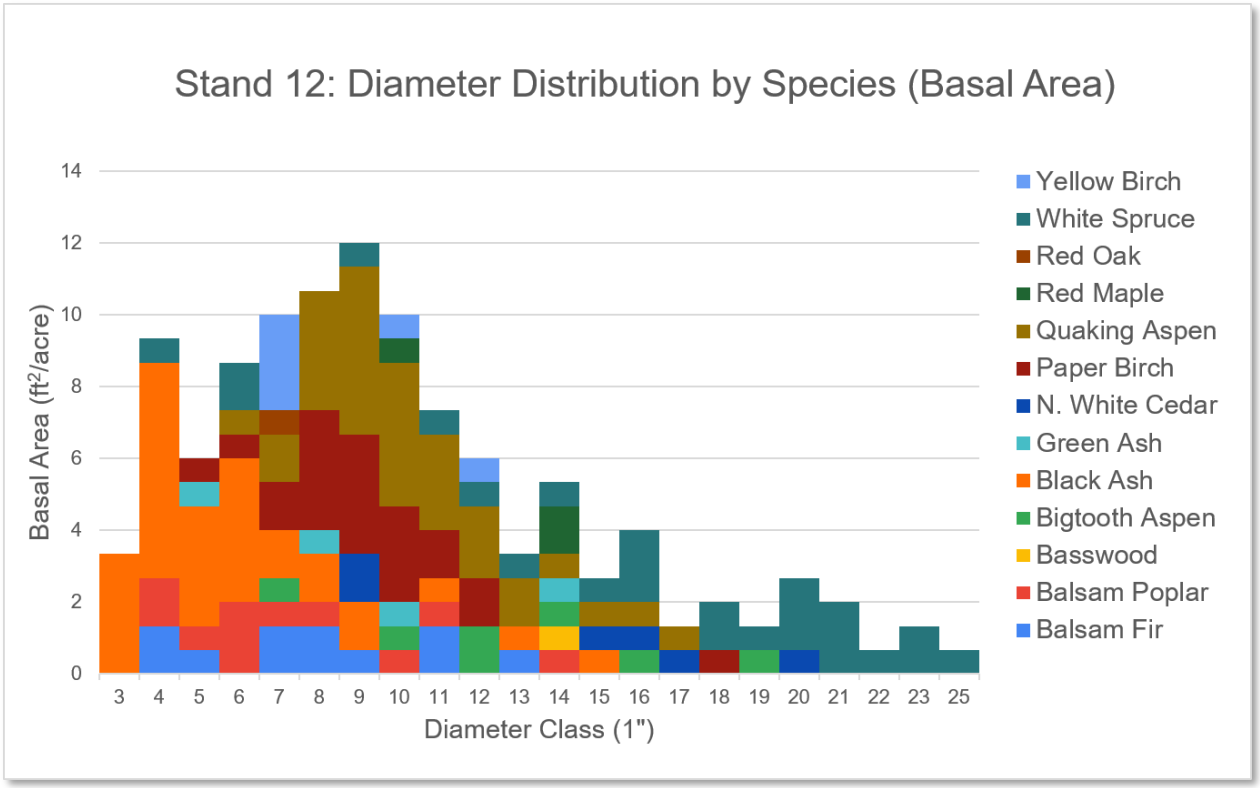
Current Recreational Uses or Management:
This stand is challenging to access due to very steep terrain and remoteness from trailheads, with only one trail crossing the Sargent creek valley. There is some evidence of social trails from adjacent residential areas in this stand. Log and rock sediment traps have previously been installed in the creek presumably to improve aquatic habitat.

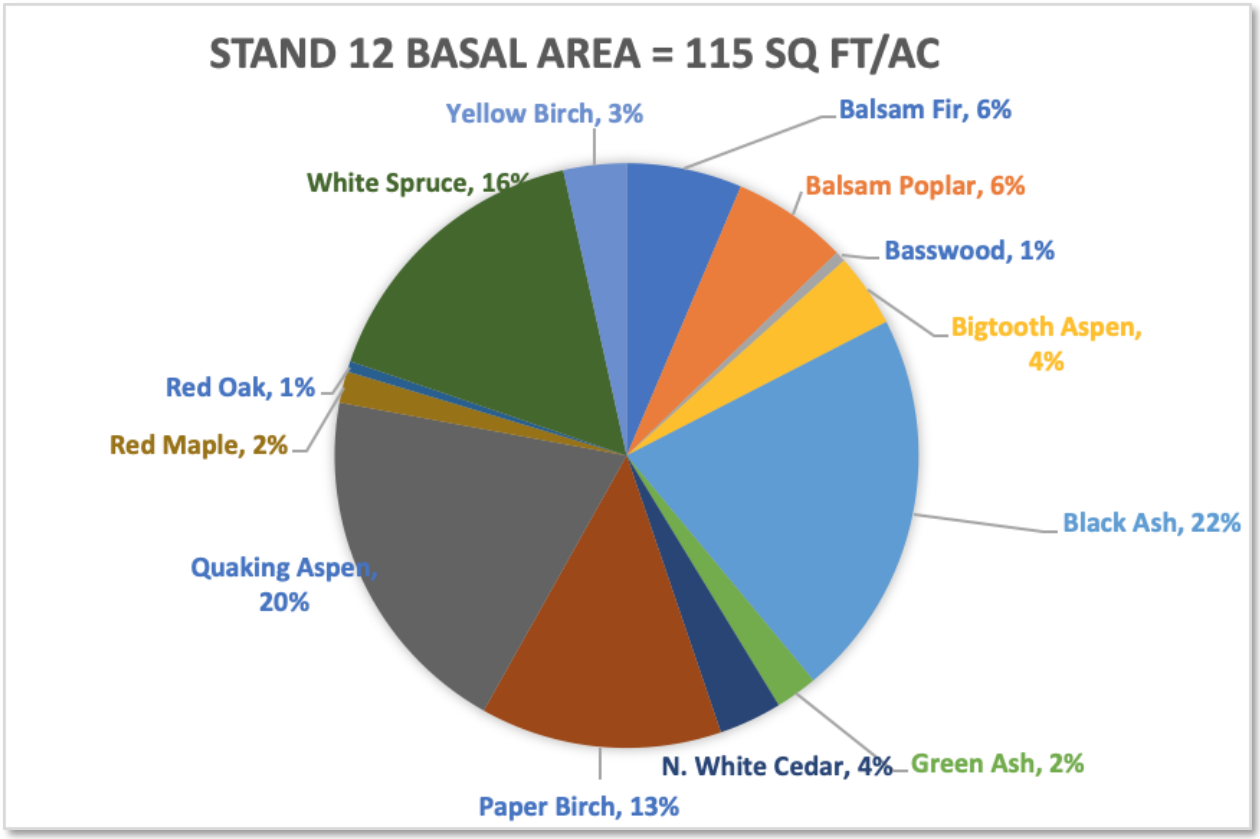
Adjacent land use concerns:
Private property, a railroad, and Becks Road to the north.

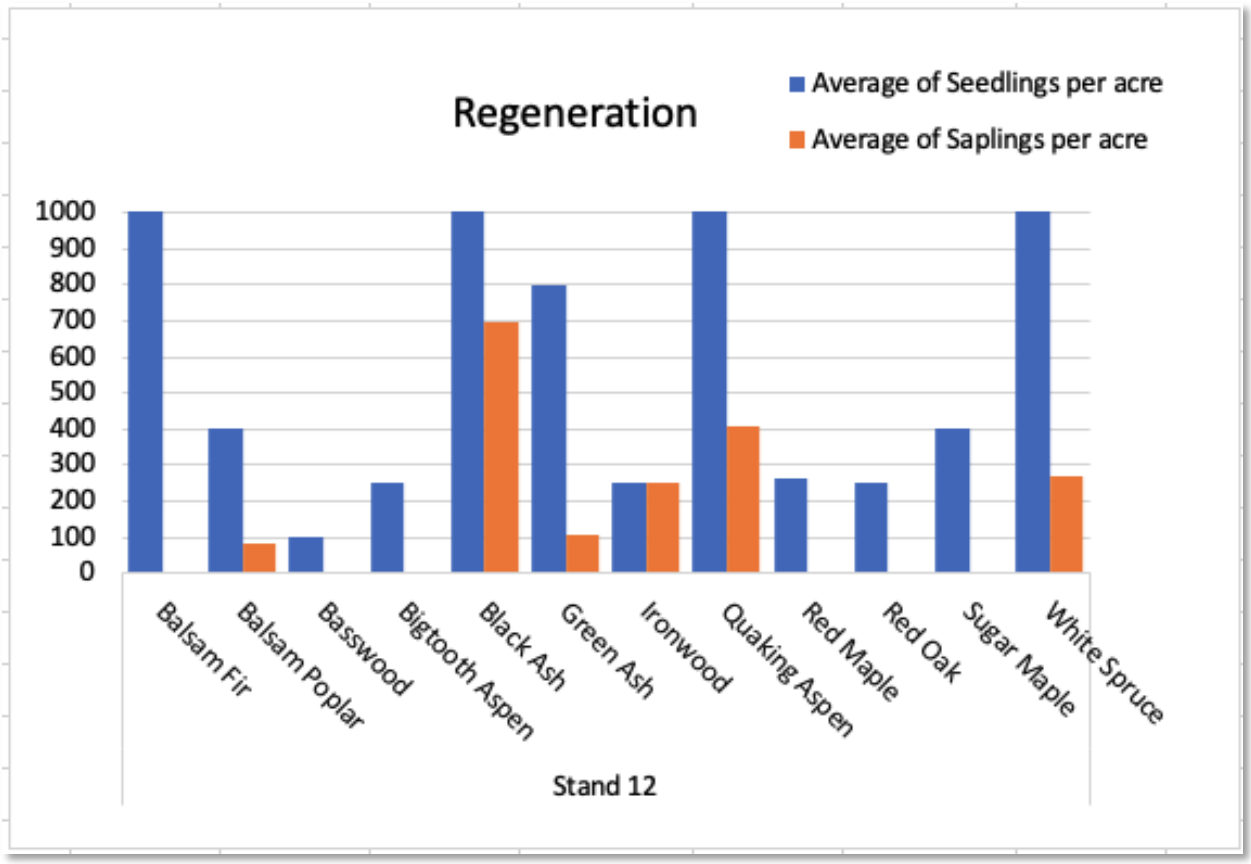
No action result (10-20 years): Complete ash mortality and resulting degradation of lowland forest habitat quality and possible buckthorn and other shrub takeover. White spruce, balsam fir, and balsam poplar is likely to become dominant in place of ash where sunlight is sufficient and competing vegetation is lower.

Management Goals, Strategies, and Actions

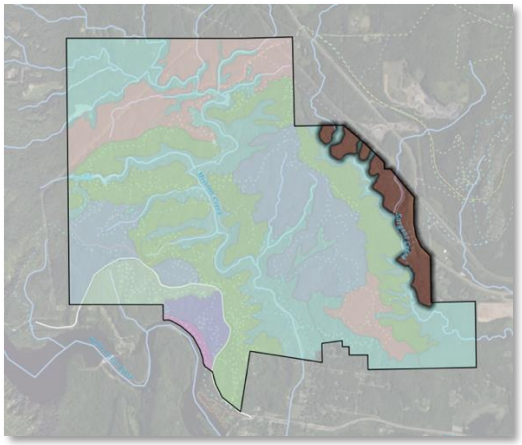
Goal	Strategy	Action	Notes
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Systemic herbicide injection annually into mature female trees during early-stage invasion to serve as seed crops for future ash regeneration; Girdle ash trees to attract EAB in combination with systemic herbicide injection to adjacent trees; Underplanting - Plant trees other than ash where ash decline and mortality is advanced	Prioritize trunk injections for seed trees with less than 30% canopy loss


Stand 12: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 25
Diameter Class (1")
Yellow Birch
White Spruce
Red Oak
Red Maple
Quaking Aspen
Paper Birch
N. White Cedar
Green Ash
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar
Balsam Fir


STAND 12 BASAL AREA = 115 SQ FT/AC
Yellow Birch, 3%
Balsam Fir, 6%
White Spruce, 16%
Balsam Poplar, 6%
Basswood, 1%
Bigtooth Aspen, 4%
Red Oak, 1%
Red Maple, 2%
Black Ash, 22%
Quaking Aspen, 20%
N. White Cedar, 4%
Green Ash, 2%
Paper Birch, 13%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Basswood
Bigtooth Aspen
Black Ash
Green Ash
Ironwood
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Spruce
Stand 12

Stand 13 Aspen





Stand Characteristics

Forest Type: Aspen

Size: 72 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	47.1	84%
MHn46b	4.6	8%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (82%), F111B (13%), E3A (3%), F155B (2%)
Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Young (0 to 55 years) and transitioning between young and mature forest (55 to 95 years)

Average Stand Diameter (DBH): 9.3" (SE=0.5)

Average Stand Basal Area: 127 ft^2/ac (SE=14)

Snags per acre: 40 medium (6-11" DBH), aspen

Coarse woody debris: Low/Medium

Wildfire risk: Low. However, a portion of this unit is adjacent to Becks Rd and railroad tracks, which can be wildfire ignition sources

Invasive Species: Medium - buckthorn was present throughout the stand, heavy in a few areas, including the aspen plantation

Pests & Disease: Initial stages of EAB infestation is present, with trees showing some decline but without widespread mortality

Current Condition: This maturing aspen-dominant stand is located at the eastern edge of the property, adjacent to railroad tracks and Becks Rd. The stand is relatively flat next to the road and drops off steeply with a western aspect down to Sargent Creek. The southeastern part of the unit is a distinct patch of plantation aspen (possibly a hybrid variety). Aspen is by far the dominant tree in both the natural and plantation sections of this stand, with the majority of trees in the 5-10" size class and some larger trees. The regeneration in this stand, primarily aspen and ash, is limited, but where there are canopy openings or edge habitat it is more prevalent. The midstory is moderately to very dense with notable semi-managed meadow openings and is composed of beaked hazel, buckthorn, mountain maple, roundleafed dogwood, serviceberry, and downy arrowwood. Dominant understory plants include largeleafed aster and thimbleberry.

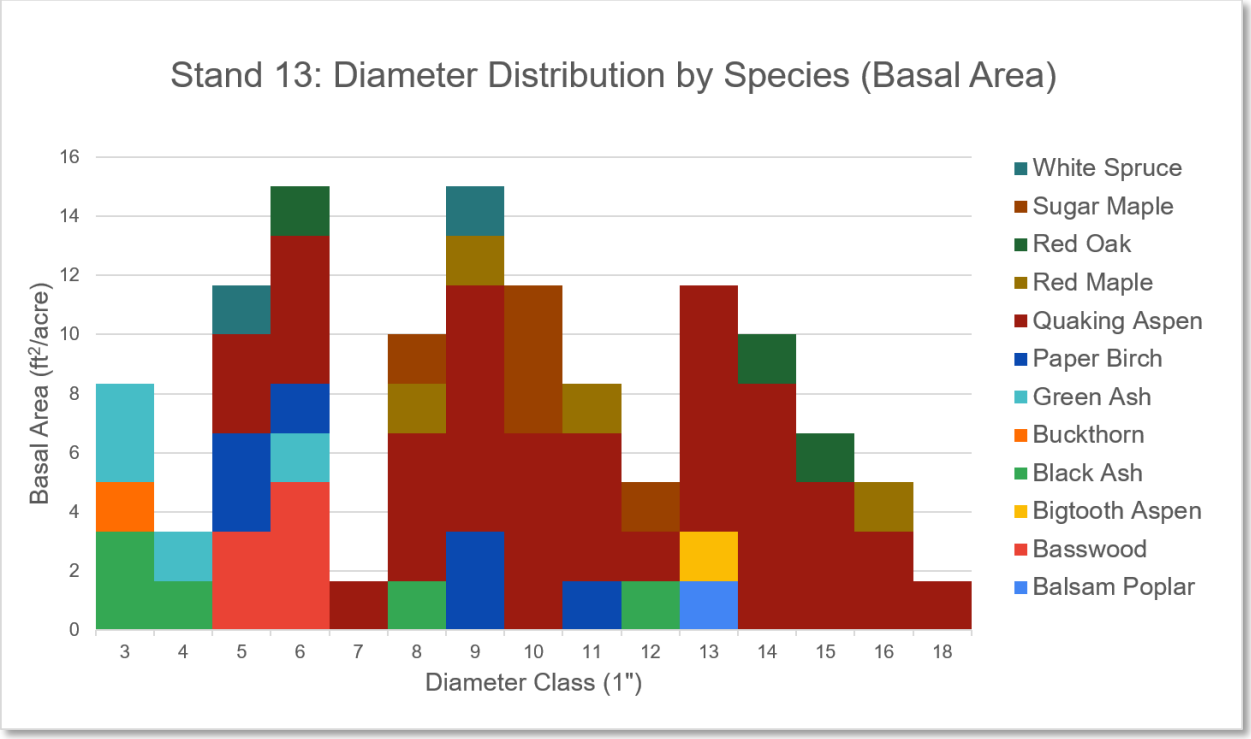
Current Recreational Uses or Management:
This stand is on the far (east) side of Sargent Creek and accessible only through the Munger Trail Trailhead on the other side of Becks Road. A <5 acre section of this stand is an actively managed quaking aspen plantation with mowed two-track roads and dense buckthorn understory.

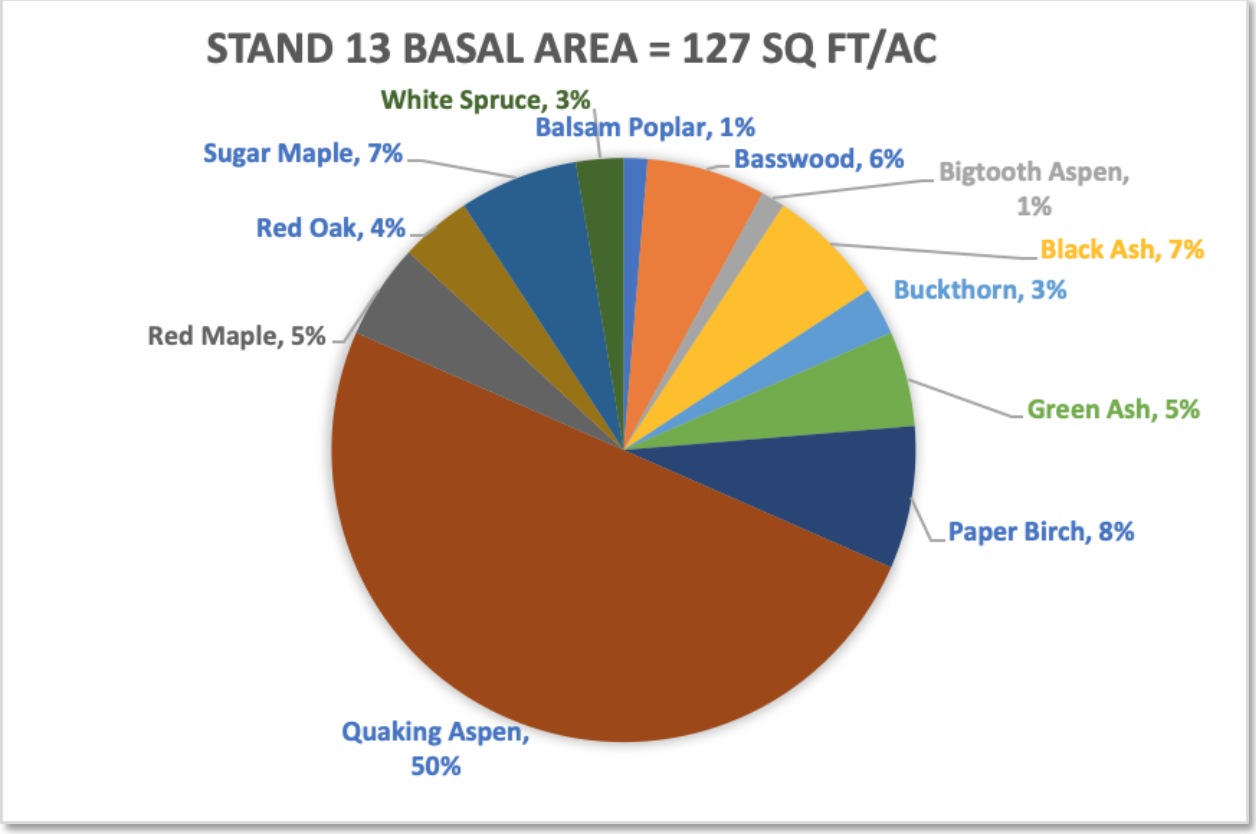
Adjacent land use concerns:
The actively managed plantation has roads that lead to an abutting private residence. Railroad contribute noise, pollution runoff into Sargent Creek tributaries, and possible source of non-native introductions.

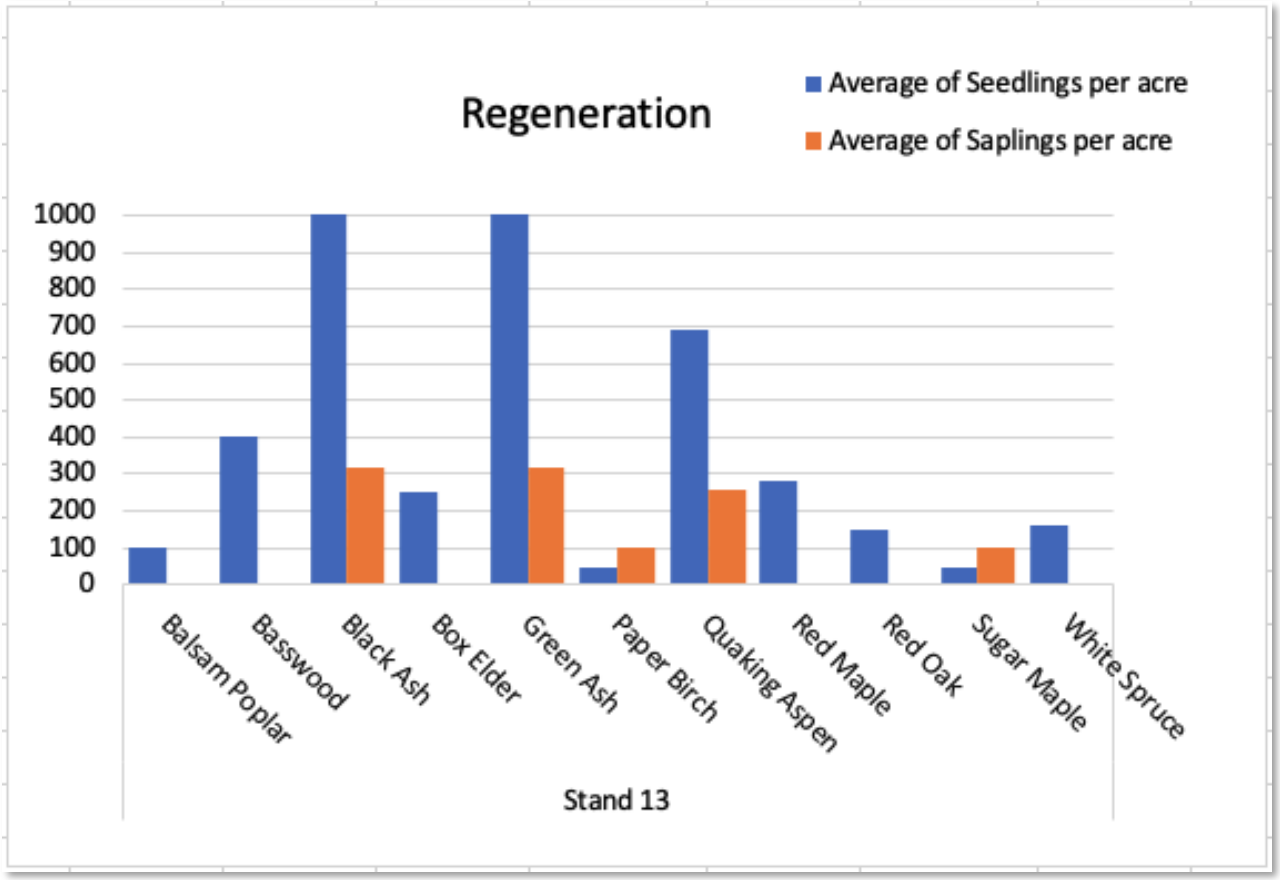
No action result (10-20 years): Aspen will mature and the stand will be subject to small gap dynamics from single tree mortality or possibly a larger stand-replacing windthrow event. Snags and coarse woody debris will increase as aspen trees decline and die of old age. Aspen or sugar maple will remain dominant depending on level of disturbance. Buckthorn will continue to spread and fill in a dense midstory, choking out native shrubs, understory trees, and herbaceous plants. Natural regeneration of other tree species will be challenging due to aspen dominance and midstory density.

Management Goals, Strategies, and Actions

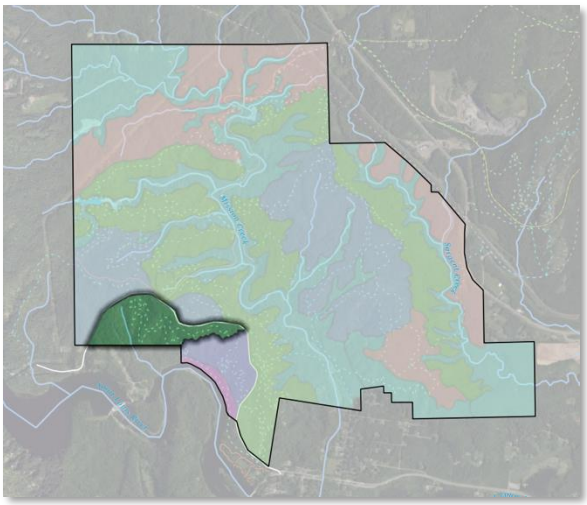
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter	
Restore/enhance native plant communities	Transition tree plantations to native forest composition	Thin overly stocked tree plantations, sell commercially when possible or remove offsite; Remove non-native tree species, sell commercially when possible or remove offsite; Interplant diverse native trees suitable to site conditions	Aspen plantation may not be a native variety - consider clearcutting and full replacement
Regeneration; Restore/enhance native plant communities	Reduce competition in midstory	Mulch/masticate shrub layer	

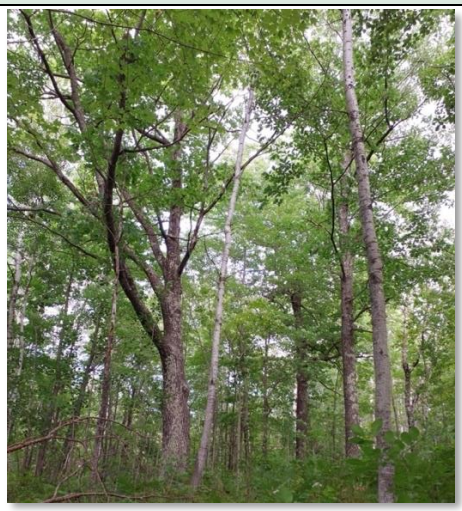

Stand 13: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
16
3
4
5
6
7
8
9
10
11
12
13
14
15
16
18
Diameter Class (1")
White Spruce
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Green Ash
Buckthorn
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar


STAND 13 BASAL AREA = 127 SQ FT/AC
White Spruce, 3%
Balsam Poplar, 1%
Sugar Maple, 7%
Basswood, 6%
Bigtooth Aspen, 1%
Red Oak, 4%
Black Ash, 7%
Buckthorn, 3%
Red Maple, 5%
Green Ash, 5%
Paper Birch, 8%
Quaking Aspen, 50%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Black Ash
Box Elder
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Spruce
Stand 13

Stand 14 Northern Hardwoods (Red Oak)





Stand Characteristics

Forest Type: Northern Hardwoods (Red Oak)

Size: 69 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	54.2	78%
MHn44c	6.4	9%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (90%), F155B (10%) Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitioning from young to mature forest (55 to 95 years)

Average Stand Diameter (DBH): 10.6" (SE=0.6)

Average Stand Basal Area: 118 ft^2/ac (SE=11)

Snags per acre: 26 medium (6-11" DBH), 1 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Moderate due to ignition risk from highway 210 and dam service road, and presence of fire-prone plant community.

Invasive Species: Buckthorn is very abundant in this stand, some of the highest on the property.

Pests & Disease: Ash is not abundant in this stand but EAB evidence was observed on mature ash where it occurs

Current Condition: This mid-successional stand is in the southwest corner of the property. The area slopes down towards the St. Louis river with some flat areas atop ridges near Highway 210 and along a service drive to the Fond du Lac dam. This is the most oak-dominant stand on the property. Sugar maple and red maple are common in the 5-7" DBH range. Due to the generally closed canopy conditions, few tree seedlings are recruiting into the sapling size classes. After ash, red oak seedlings were the most numerous seedling species. The midstory is fairly open with occasional patches of beaked hazel, roundleafed dogwood, and serviceberry. Dominant understory plants include Pennsylvania sedge, lady fern, thimbleberry, bunchberry, and bracken fern.

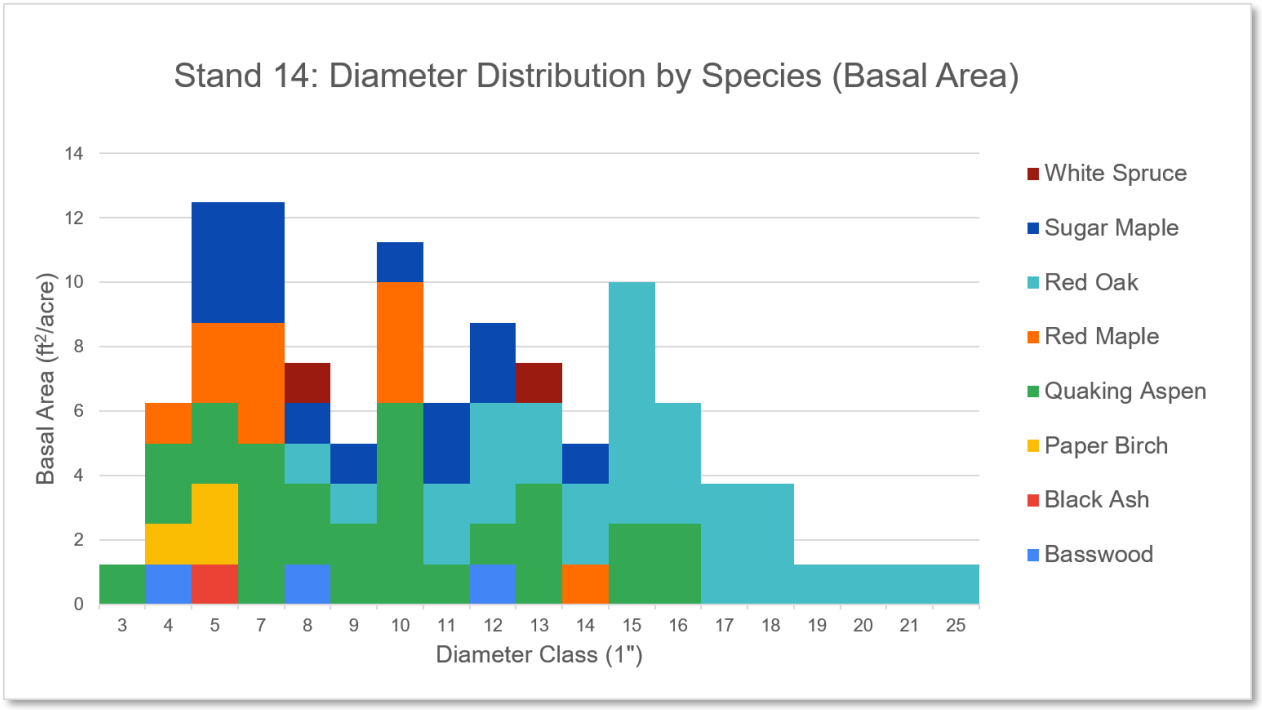
Current Recreational Uses or Management:
This is an accessible stand. Evidence of hunting, fishing or other off-trail recreation. Some trash was found on the hill below the service drive.

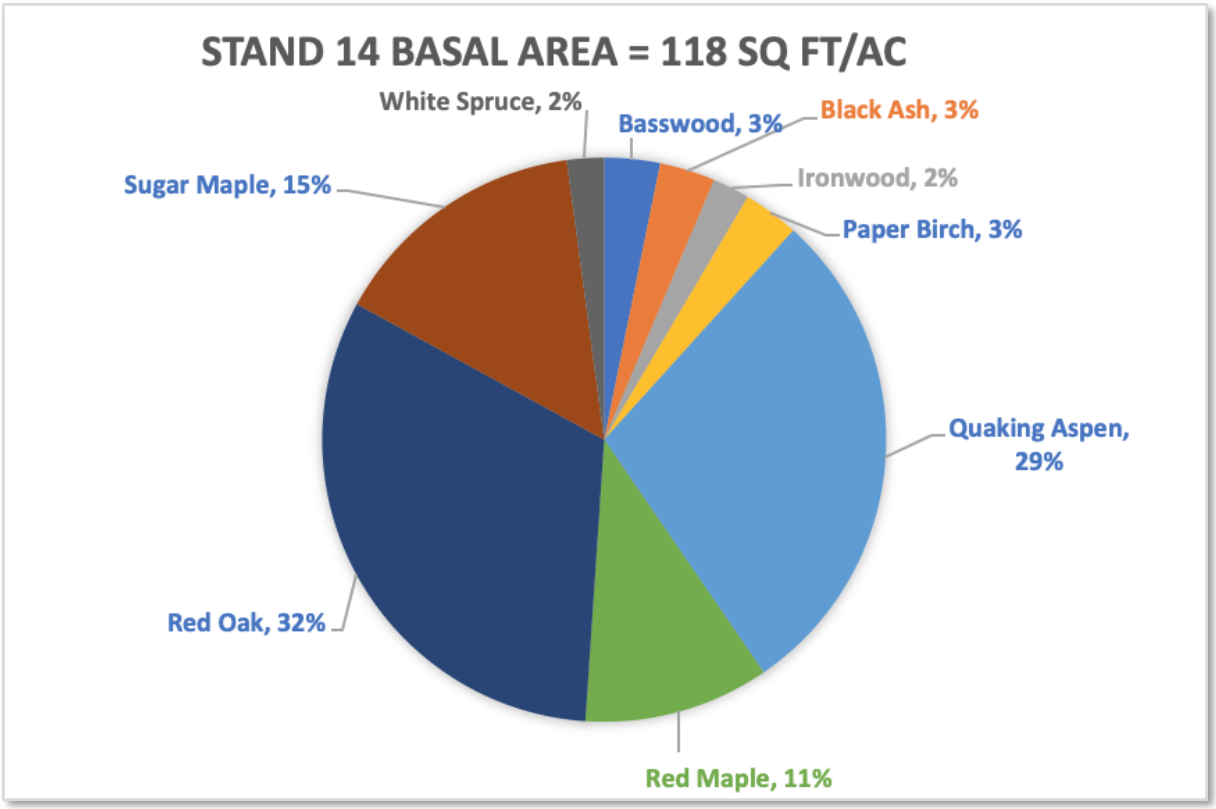
Adjacent land use concerns:
The nearby Fond du Lac Dam is considered critical infrastructure. Highway 210 may be a source of pollution, trash/debris, and invasive species.

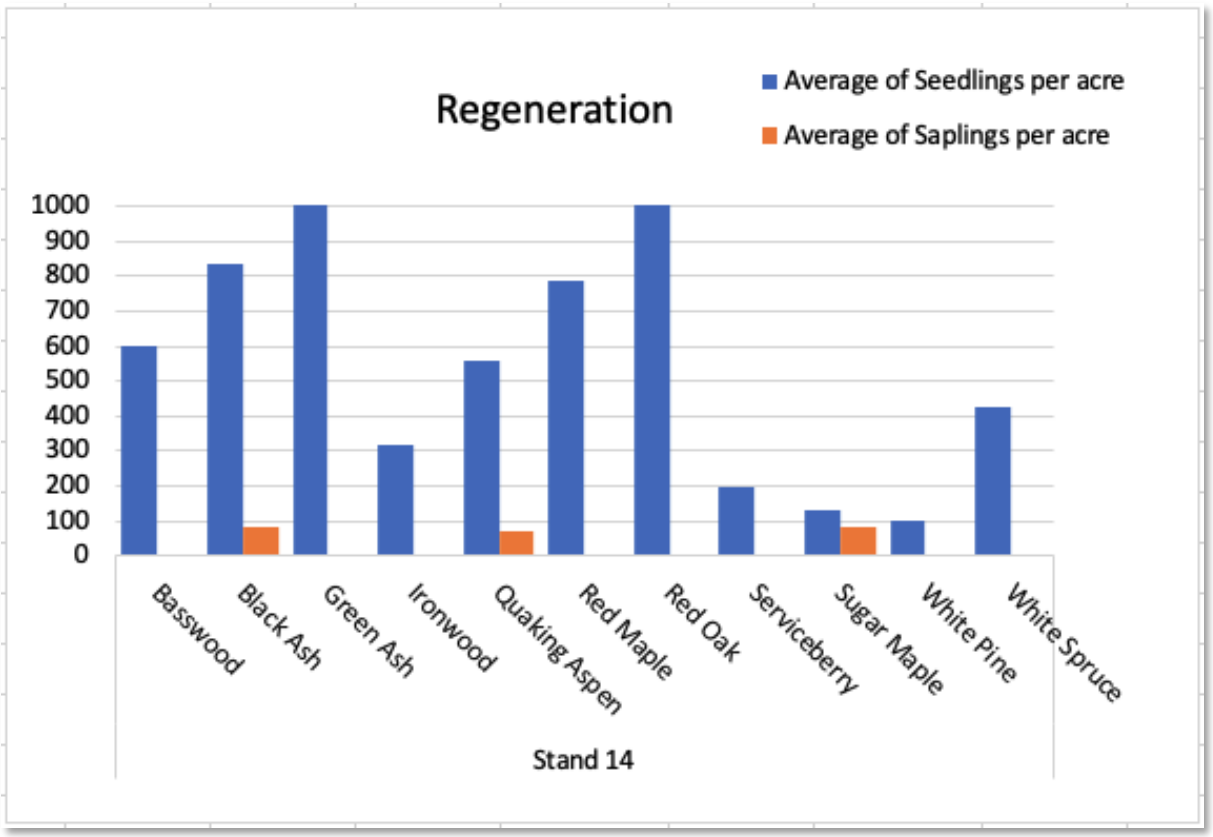
No action result (10-20 years): Conversion to shade tolerant species, closed canopy conditions will favor maples and white spruce if seeds where seed sources are present. Buckthorn abundance is likely to increase, especially in canopy gaps. Red oak regeneration is unlikely to recruit without moderately scaled disturbance, and mesophication and lack of fire may gradually shift the stand towards a more fire-intolerant hardwood plant community type.

Management Goals, Strategies, and Actions

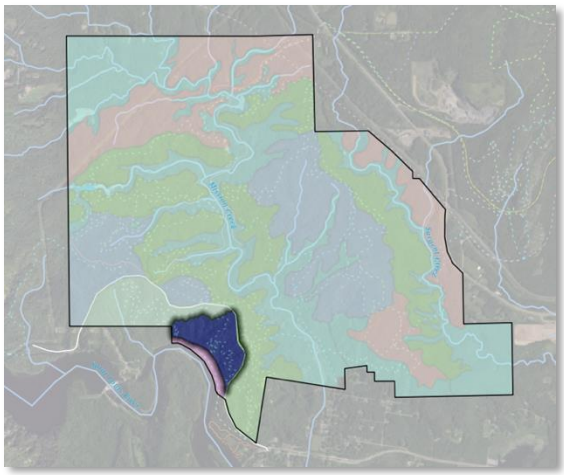
Goal	Strategy	Action	Notes
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest	establish oak cohort




STAND 14 BASAL AREA = 118 SQ FT/AC
White Spruce, 2%
Basswood, 3%
Black Ash, 3%
Ironwood, 2%
Paper Birch, 3%
Sugar Maple, 15%
Quaking Aspen, 29%
Red Oak, 32%
Red Maple, 11%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Basswood
Black Ash
Green Ash
Ironwood
Quaking Aspen
Red Maple
Red Oak
Serviceberry
Sugar Maple
White Pine
White Spruce
Stand 14

Stand 15 Northern Hardwoods (Red Oak, White Pine, Red Pine)





Stand Characteristics

Forest Type: Northern Hardwoods (Red Oak, White Pine, Red Pine)

Size: 45 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	34.2	77%
MHn44b	8.5	19%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (99%), F155B (1%) Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitioning from young to mature forest (55 to 95 years)

Average Stand Diameter (DBH): 11.3" (SE=1.2)

Average Stand Basal Area: 118 ft^2/ac (SE=14)

Snags per acre: 13 medium (6-11" DBH), 4 large (>12"DBH)

Coarse woody debris: Medium

Wildfire risk: Medium

Invasive Species: Low, Buckthorn observed occasionally and not established.

Pests & Disease: Some decline was noted on the ash trees in this stand, indicating presence of EAB

Current Condition: This closed-canopy white pine, red pine, red oak stand is located east of Stand 14 in the southwest to south-central portion of the property. It occupies the slopes and flatter ridgetops that drop down below Highway 210 and feed directly into the St. Louis river downstream of the Fond du Lac dam. The oldest and largest age class of trees are red and white pines with the largest white pine inventoried being 35" DBH. Presence of large conifer snags further indicates former pine dominance. The overstory in the rest of this stand is dominated by red oak (14-22" DBH) with paper birch, white spruce, and black ash codominant. Numerous surrounding seed sources allow for abundant regeneration of aspen, ash, and mixed hardwood species, but almost no saplings have been able to establish due to closed canopy conditions. The addition of hardwoods in the understory but lack of hardwoods in the canopy suggest this stand may have been a fire-dependent forest type that is transitioning to fire-intolerant species if fire continues to be excluded. The midstory is quite open with occasional beaked hazel and roundleaf dogwood patches. Pennsylvania sedge dominates the understory layer, along with bracken fern and thimbleberry.

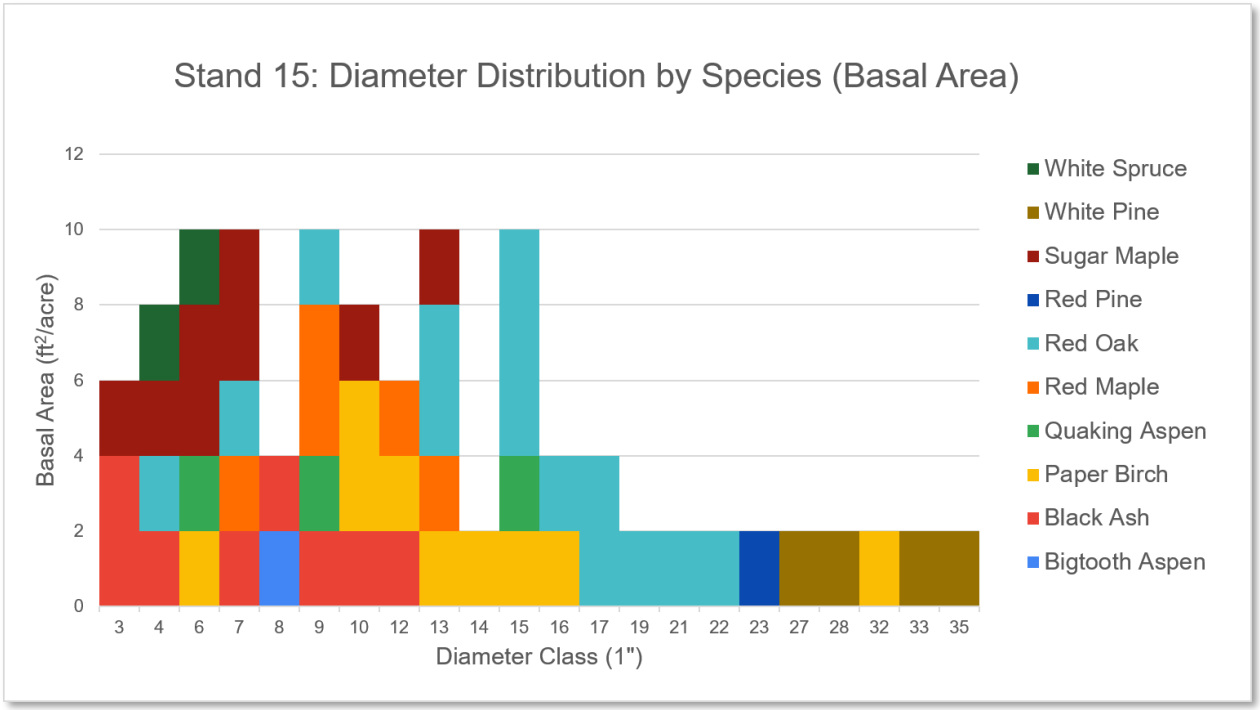
Current Recreational Uses or Management:
A mountain bike trail switchbacks throughout the stand. A trail enters the stand from Chambers Grove Park.

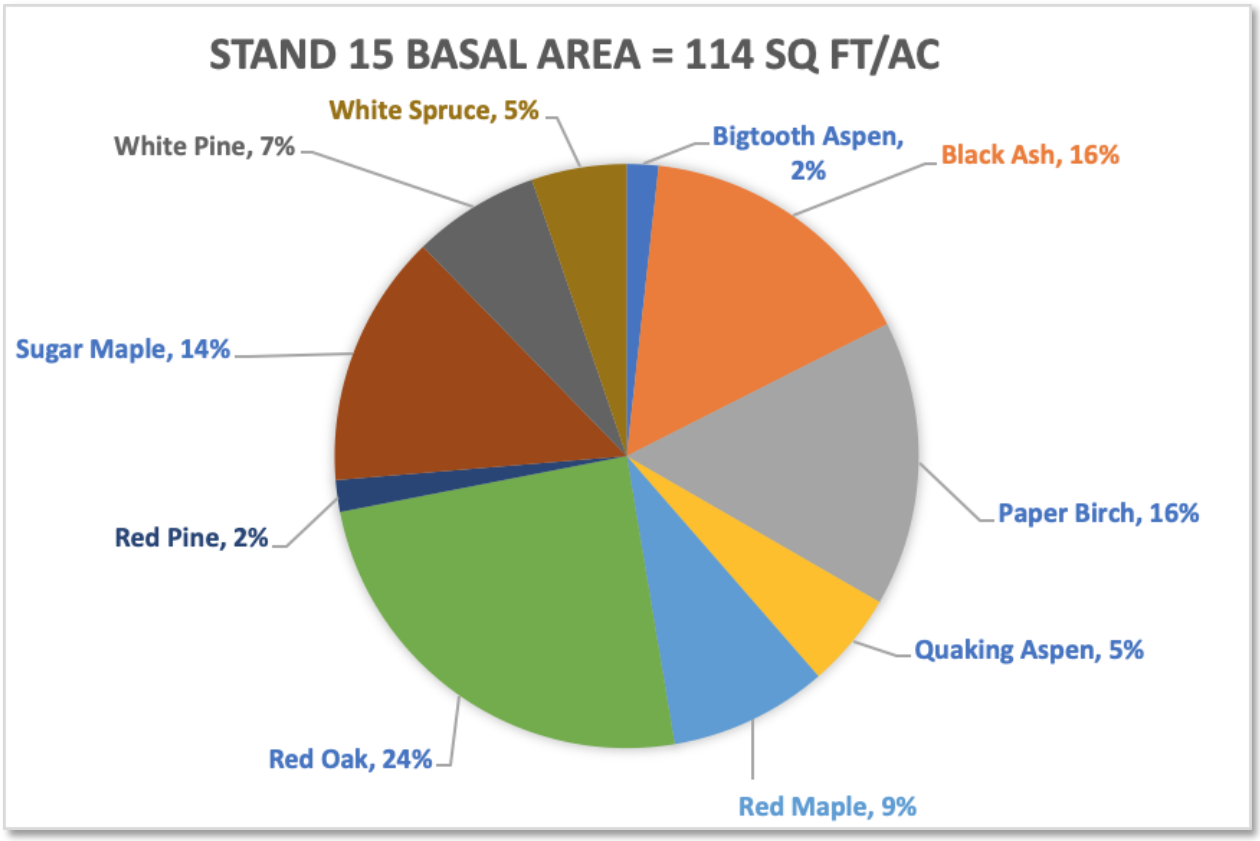
Adjacent land use concerns:
Highway 210 forms the eastern border of the stand and may be a source of pollution, trash/debris, and invasive species. Visitor density may be high due to proximity to Chambers Grove Park.

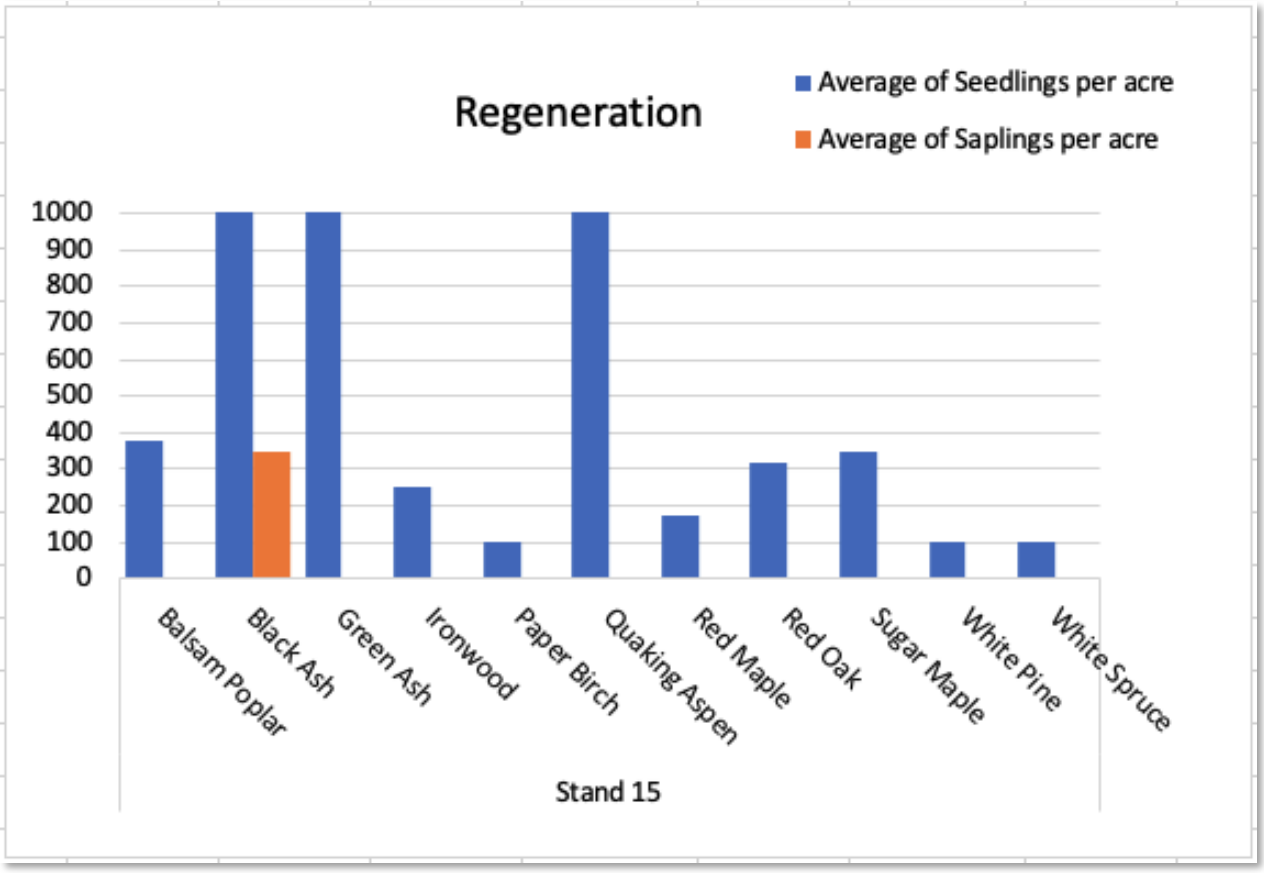
No action result (10-20 years): Over time, white and red pines will die out and be replaced by aspen and birch with some hardwood component - composition influenced by level of herbivory pressure. Mesophication and lack of fire may gradually shift the stand towards a more fire-intolerant hardwood plant community type. If herbivory pressure continues to prevent survival and establishment of saplings, the stand may shift to a more shrub-dominant community.

Management Goals, Strategies, and Actions

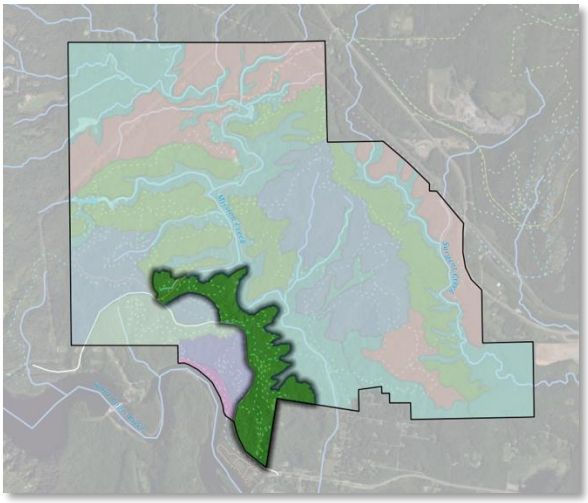
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.

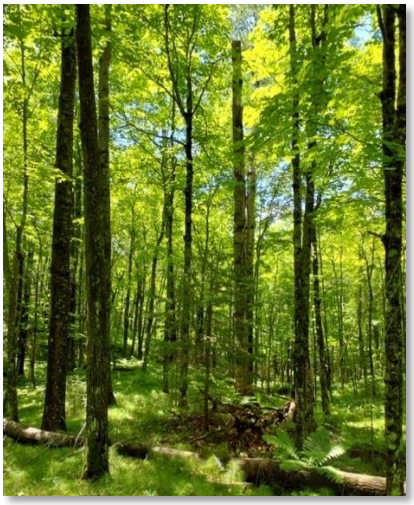

Stand 15: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
3 4 6 7 8 9 10 12 13 14 15 16 17 19 21 22 23 27 28 32 33 35
Diameter Class (1")
White Spruce
White Pine
Sugar Maple
Red Pine
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Black Ash
Bigtooth Aspen


STAND 15 BASAL AREA = 114 SQ FT/AC
White Spruce, 5%
White Pine, 7%
Bigtooth Aspen, 2%
Black Ash, 16%
Sugar Maple, 14%
Paper Birch, 16%
Red Pine, 2%
Quaking Aspen, 5%
Red Oak, 24%
Red Maple, 9%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Green Ash
Ironwood
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 15

Stand 16 Mixed Hardwood Conifer





Stand Characteristics

Forest Type: Mixed Hardwood Conifer

Size: 120 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	85.1	71%
MHn47a	13.7	11%
MHn44c	8.1	7%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (68%), F155B (32%) Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitioning from young to mature forest (55 to 95 years)

Average Stand Diameter (DBH): 9.4" (SE=0.5)

Average Stand Basal Area: 128 ft^2/ac (SE=17)

Snags per acre: 17 medium (6-11" DBH)

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low - Buckthorn was present but not noted in abundance

Pests & Disease: EAB is likely present, but ash is a minor component of this stand

Current Condition: This mid-successional mixed conifer-hardwood stand is located at the southern recreational access point adjacent to Chambers Grove Park. It spans the east side of Highway 210 north to the Mission Creek Parkway, hosting the western upper banks of lower Mission Creek. It is primarily sloped or rolling terrain, with some flatter areas along Highway 210. The overstory is dominated by red oak and quaking aspen with white spruce, red maple and sugar maple prevalent in the smaller size classes (2-4" and 5-7"). The oldest age class of trees are white pine (32-34" DBH) and the aspen in this stand are mostly in the 5-10" DBH range. Ash seedlings are prolific with quaking aspen the next most common seedling species. However, there is little sapling recruitment, and what is present is limited to a select species, including ash, quaking aspen, and white spruce. The shrub midstory is relatively open and is composed of serviceberry, round-leaved dogwood, speckled alder and some beaked hazel. The most dominant understory plants include sedge (Pennsylvania Sedge), lady fern, horsetail, bush honeysuckle, Canada mayflower, and bunchberry, with Pennsylvania sedge becoming dominant in some areas.

Current Recreational Uses or Management:
This stand borders Chambers Grove Park and is a recreational access point with several trails.

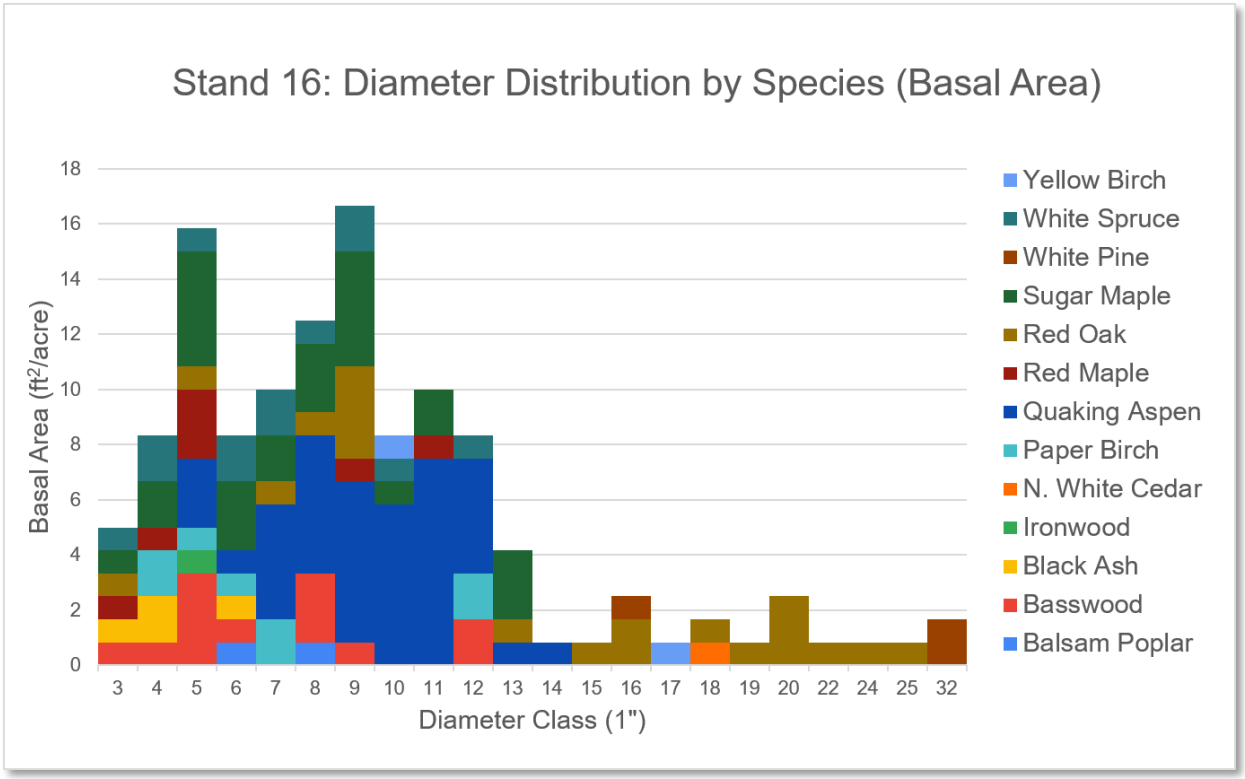
Adjacent land use concerns:
Highway 210 forms the western border of the stand and may be a source of pollution, trash/debris, and invasive species. Visitor density

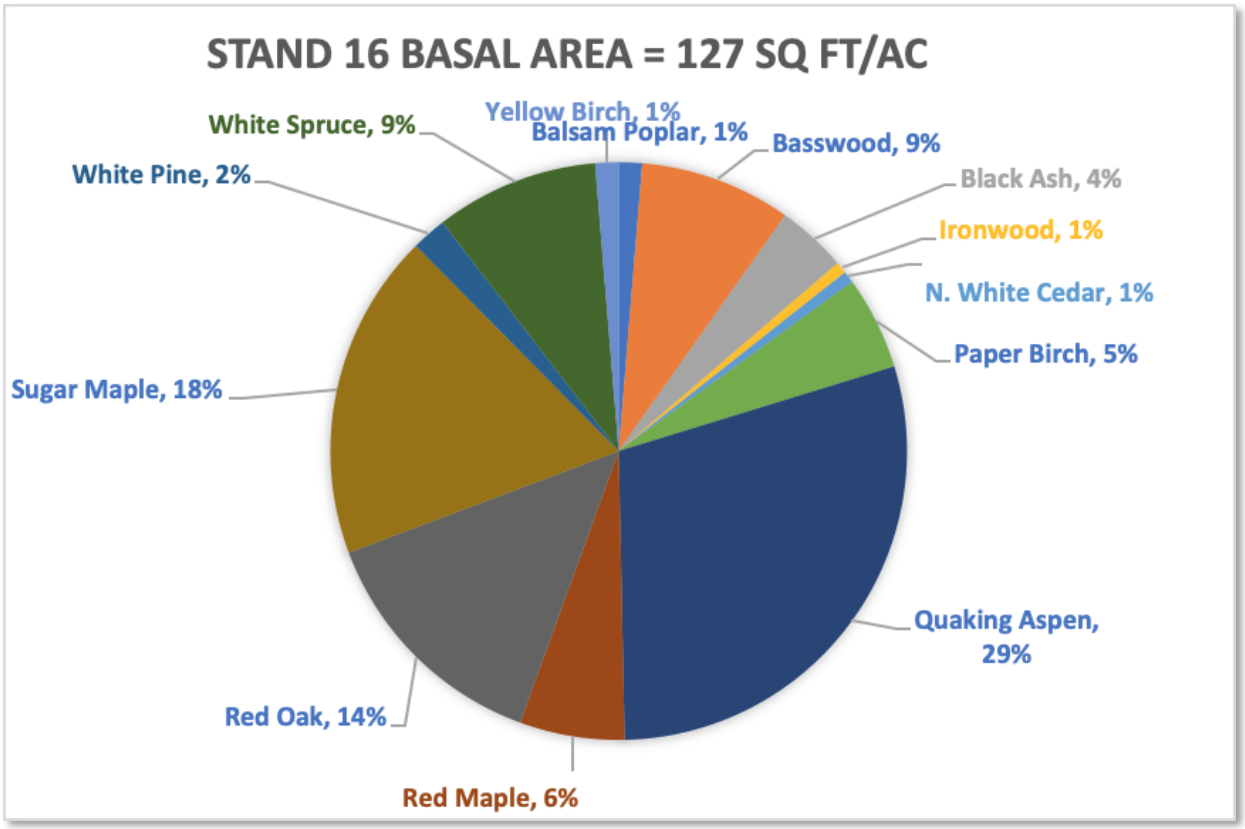
may be high due to proximity to Chambers Grove Park.

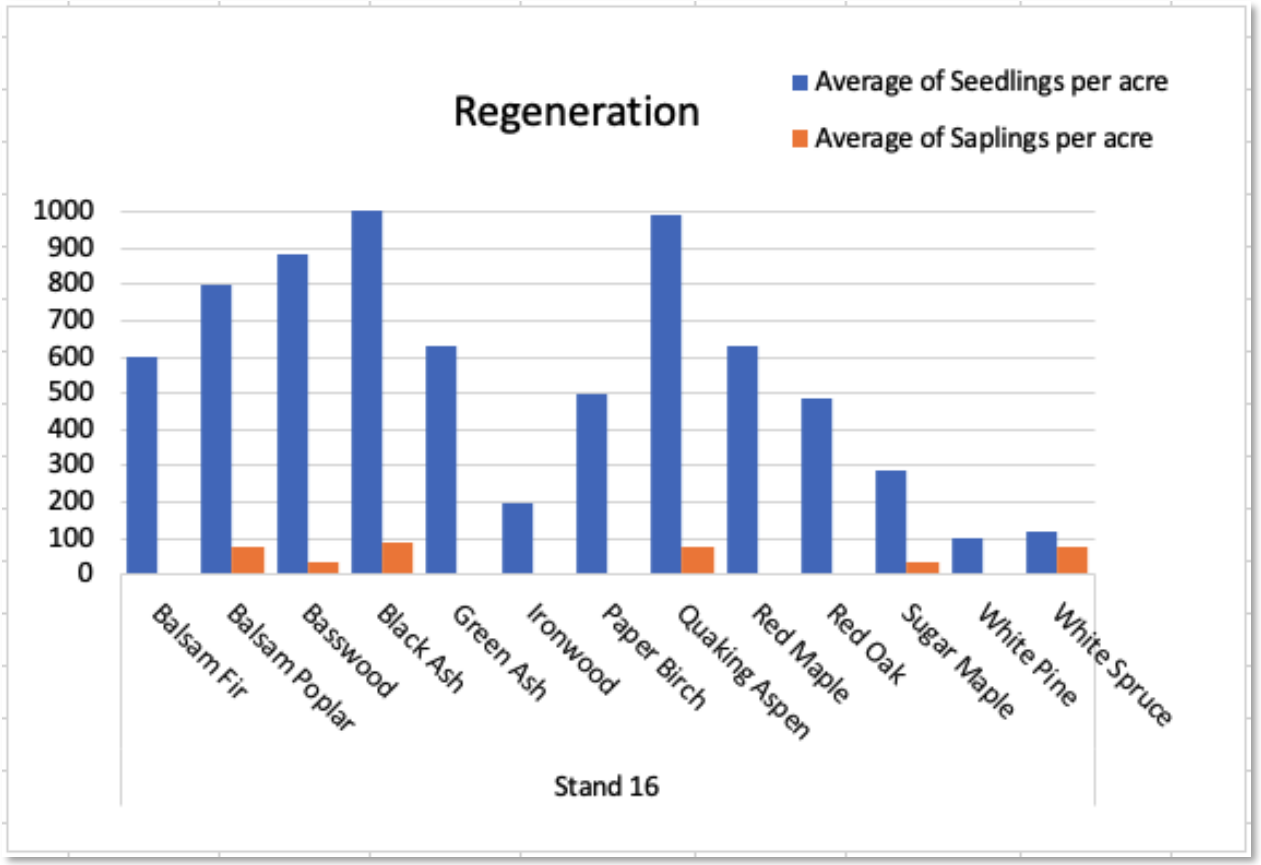
No action result (10-20 years): Mature aspen will continue to age out and naturally turn to snags or fall over, contributing to coarse woody debris and forest complexity. Hardwoods may continue to successfully establish into maturity; however, if deer browse continues at high pressure, stand density may decline in favor of dense shrub thickets or tree diversity will reduce to favor white spruce. Ash regeneration is abundant and well-positioned to take advantage of gaps, but its longevity is questionable due to EAB. Flood events may wash out patches of establishing riparian forest or introduce seeds of novel species from upstream runoff.

Management Goals, Strategies, and Actions

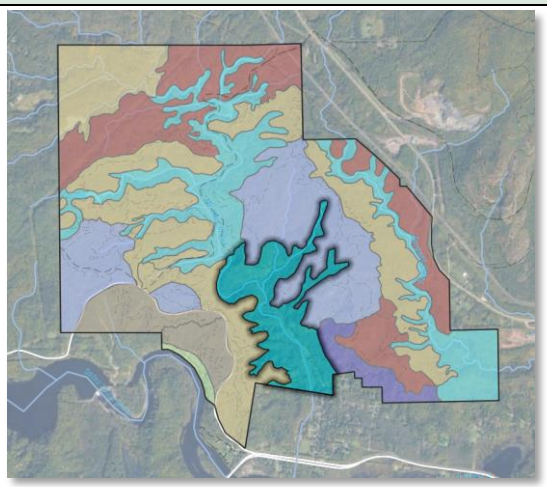
Goal	Strategy	Action	Notes
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	site prep before cones drop
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort. Target red maple, aspen.
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	

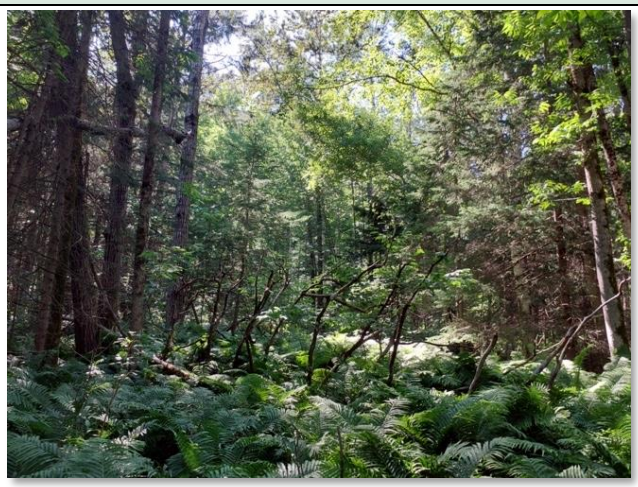

Stand 16: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
16
18
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 24 25 32
Diameter Class (1")
Yellow Birch
White Spruce
White Pine
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
N. White Cedar
Ironwood
Black Ash
Basswood
Balsam Poplar


STAND 16 BASAL AREA = 127 SQ FT/AC
White Spruce, 9%
Yellow Birch, 1%
Balsam Poplar, 1%
Basswood, 9%
White Pine, 2%
Black Ash, 4%
Ironwood, 1%
N. White Cedar, 1%
Paper Birch, 5%
Sugar Maple, 18%
Quaking Aspen, 29%
Red Oak, 14%
Red Maple, 6%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Basswood
Black Ash
Green Ash
Ironwood
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 16

Stand 17 Riparian





Stand Characteristics

Forest Type: Riparian

Size: 160 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44b	32.1	23%
MHn44c	29.5	21%
MHn46b	20.3	15%
MHn35b	18.2	13%
FFn57a	13.5	10%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (65%), E12A (21%), F155B (3%)
Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Transitioning from young to mature forest (35 to 95 years)

Average Stand Diameter (DBH): 11.2" (SE=0.8)

Average Stand Basal Area: 123 ft^2/ac (SE=9.7)

Snags per acre: 22 medium (6-11" DBH), 4 large (>12"DBH)

Coarse woody debris: Medium-High

Wildfire risk: Low

Invasive Species: Low - Buckthorn was observed at low levels in a few places, with tansy, and reed canary grass observed infrequently at medium levels

Pests & Disease: EAB is present and appears to be somewhat established, with some areas exhibiting mortality in mature trees, but only canopy decline in other areas.

Current Condition: This riparian forest is the riverine bottomlands, floodplains, and adjacent slopes of the lower reaches of Mission Creek and its tributary streams. The tree species composition is overall diverse and includes a distinct pocket on the lowest-lying floodplain of mature black ash, white cedar, yellow birch, white spruce, and balsam poplar swamp. A patch of planted red pines is located near the trailhead, along with a disturbed and very open field with evidence of past development and non-native trees. Large remnant white pine, white cedar, and occasional red pine occur on steep primarily north-facing slopes. White spruce was present throughout the stand, as it is mid-tolerant of shade and less impacted by deer browse. As in other stands, early successional species such as quaking aspen, paper birch, and balsam poplar were most numerous by total trees per acre. Shade tolerant red and sugar maple were mostly present in the smaller (2-4" DBH size classes), with some larger red maple present. There was a wide array of regeneration present in the seedling class, but minimal diversity in the sapling age class as quaking aspen and black ash made up approximately 70% of saplings tallies. Seedlings of species that are highly palatable to deer, such as white cedar and white pine, were observed, but primarily in areas that were harder for deer to access, such as steep slopes. The midstory is open to dense, and is composed of

mountain maple, beaked hazel, and speckled alder. Ostrich fern and Pennsylvania sedge tended to dominate the groundlayer where it was found. Other dominant understory plants include thimbleberry, lady fern, sedges, and horsetail.

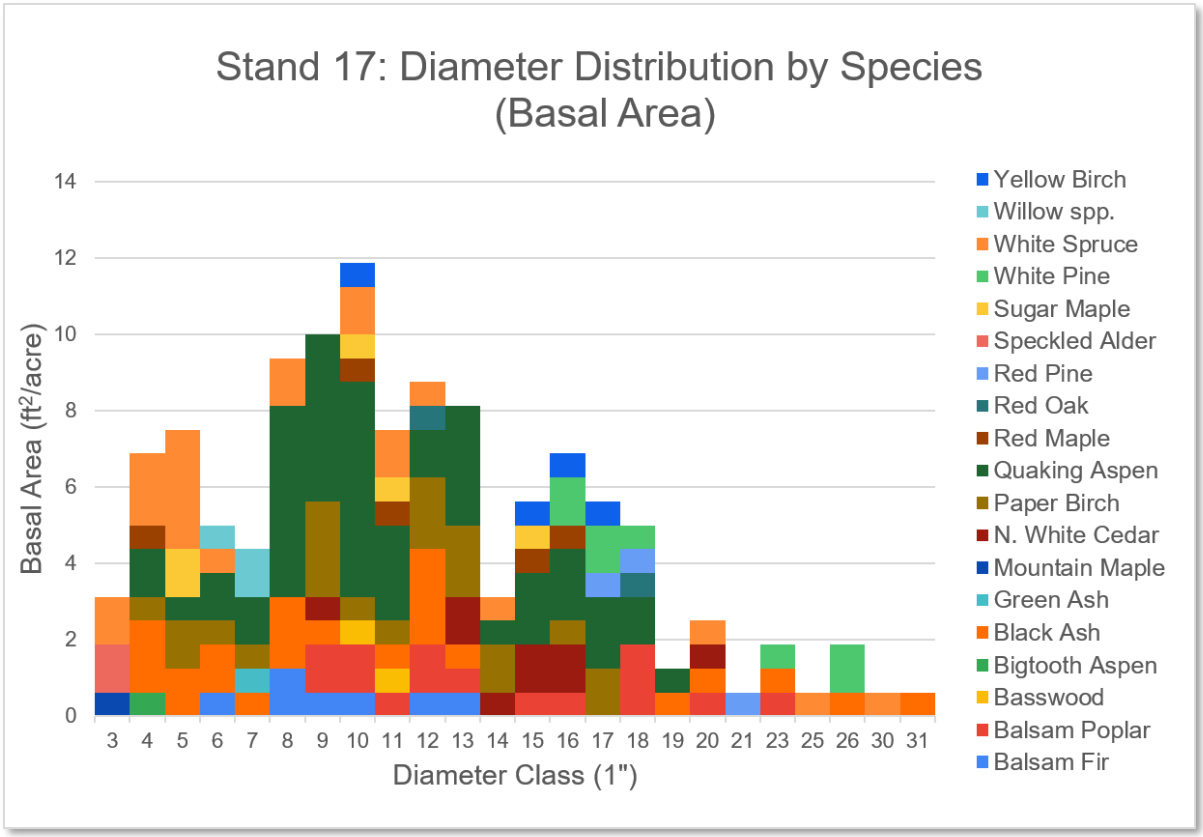
Current Recreational Uses or Management:
Past stream restoration and tree planting has been conducted in this unit. There are some recreational trails in this unit, including recreational access and parking through a residential area off 131st Ave W.

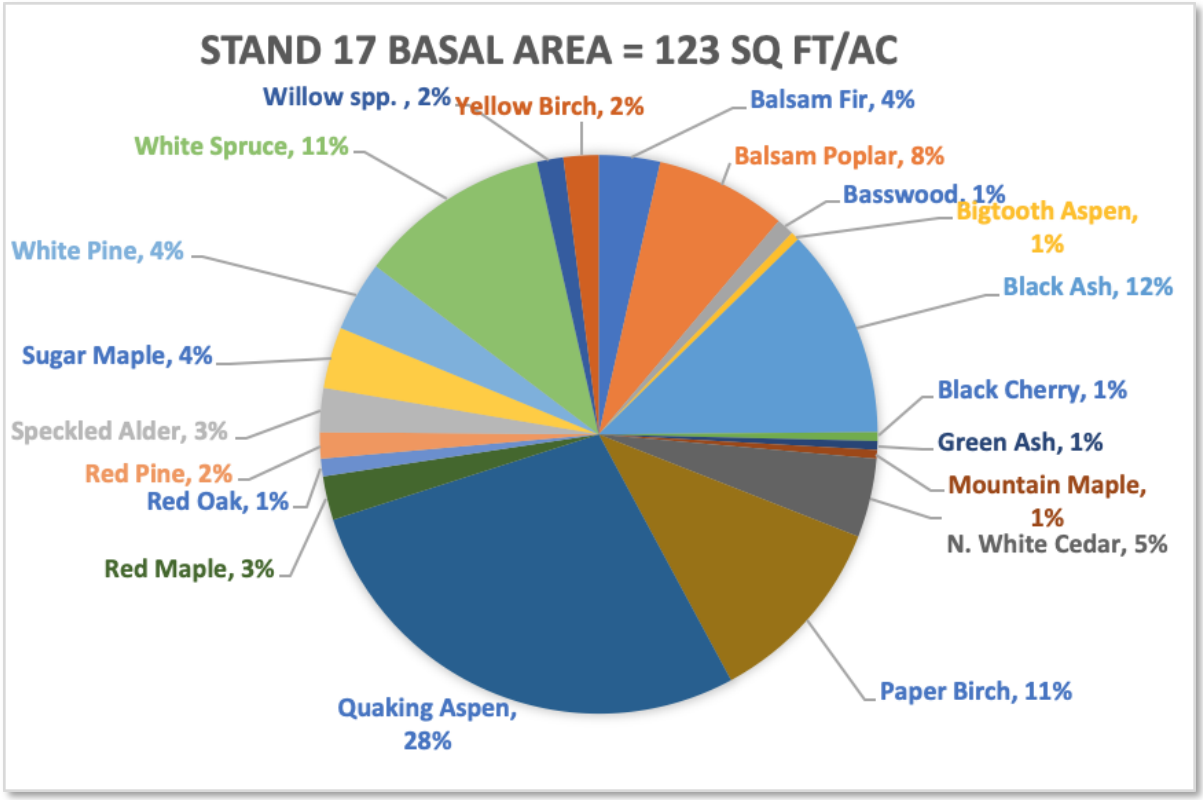
Adjacent land use concerns:
A low-lying residential area is located south of this stand adjacent to Mission Creek.

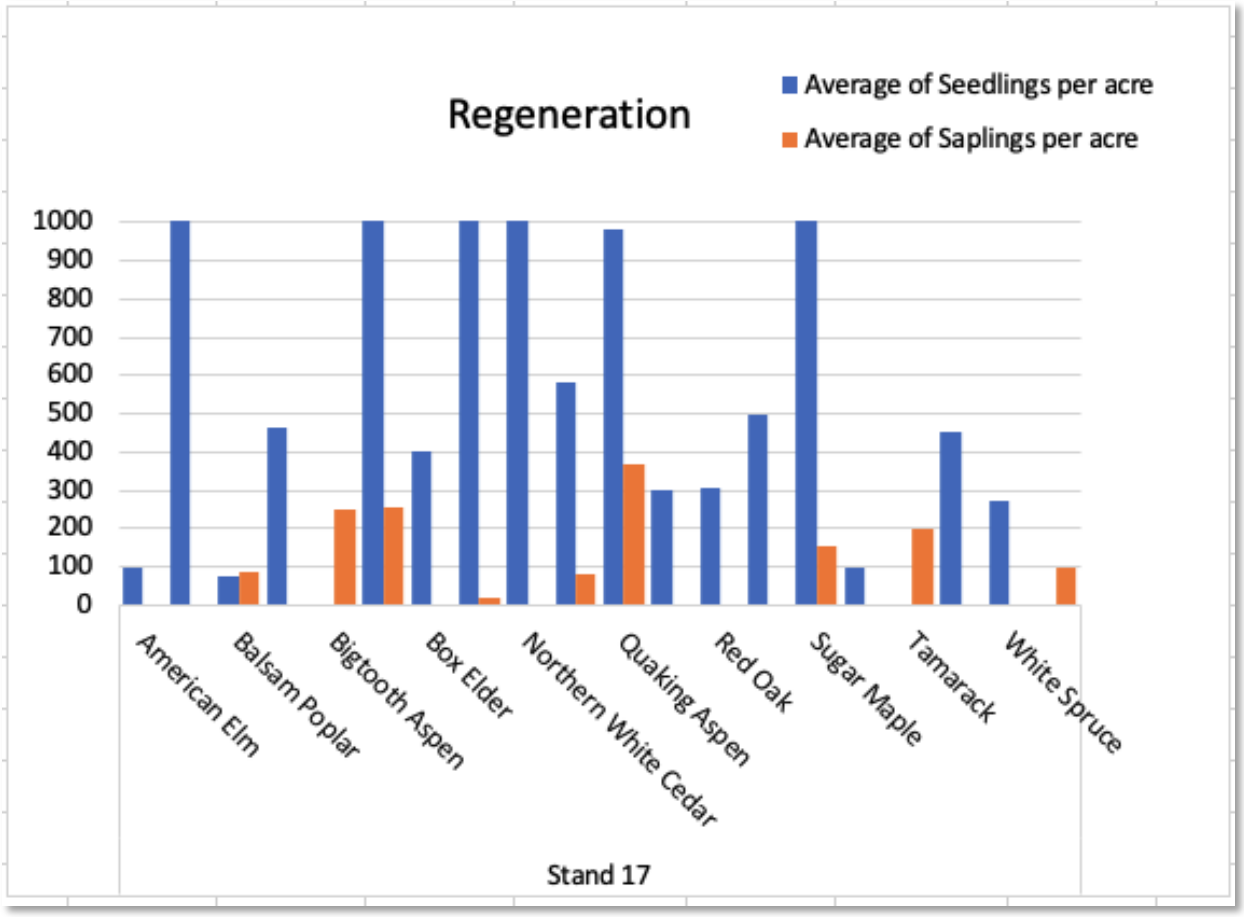
No action result (10-20 years): White spruce is present throughout all age classes and appears to be regenerating with current forest conditions. It is likely to remain the dominant conifer species. Black ash mortality will continue, with shrubs or ostrich fern likely to fill in the midstory and ground level vegetation, especially in black ash dominated areas.

Management Goals, Strategies, and Actions

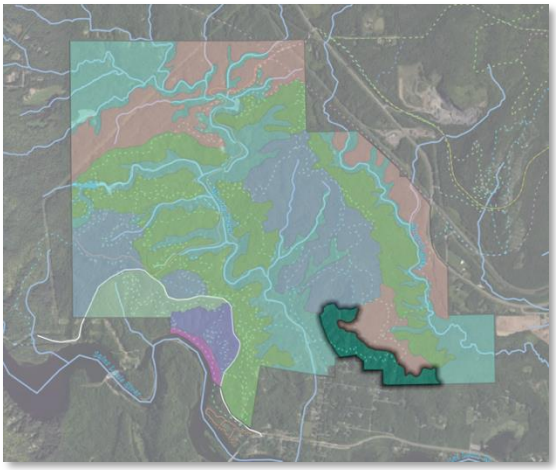
Goal	Strategy	Action	Notes
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Systemic herbicide injection annually into mature female trees during early-stage invasion to serve as seed crops for future ash regeneration; Girdle ash trees to attract EAB in combination with systemic herbicide injection to adjacent trees; Underplanting - Plant trees other than ash where ash decline and mortality is advanced	Easy Access, high visibility; Prioritize trunk injections for seed trees with less than 30% canopy loss
Ecosystem function	Stabilize soil along erodible stream and river banks	Seed fast-growing native grasses and forbs on eroded banks where tree cover is not deemed critical	


Stand 17: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 25 26 30 31
Diameter Class (1")
Yellow Birch
Willow spp.
White Spruce
White Pine
Sugar Maple
Speckled Alder
Red Pine
Red Oak
Red Maple
Quaking Aspen
Paper Birch
N. White Cedar
Mountain Maple
Green Ash
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar
Balsam Fir


STAND 17 BASAL AREA = 123 SQ FT/AC
Willow spp. , 2%
Yellow Birch, 2%
Balsam Fir, 4%
White Spruce, 11%
Balsam Poplar, 8%
Basswood, 1%
Bigtooth Aspen, 1%
White Pine, 4%
Black Ash, 12%
Sugar Maple, 4%
Black Cherry, 1%
Speckled Alder, 3%
Green Ash, 1%
Red Pine, 2%
Mountain Maple, 1%
Red Oak, 1%
N. White Cedar, 5%
Red Maple, 3%
Paper Birch, 11%
Quaking Aspen, 28%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
American Elm
Balsam Poplar
Bigtooth Aspen
Box Elder
Northern White Cedar
Quaking Aspen
Red Oak
Sugar Maple
Tamarack
White Spruce
Stand 17

Stand 18 White Pine, White Spruce, Paper Birch





Stand Characteristics

Forest Type: White Pine, White Spruce, Paper Birch

Size: 53 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn44b	26.4	50%
MHn35b	23.3	44%

Ecological Site (USDA): F092XY014WI - Loamy Uplands

Dominant Soils: F155G (95%), F155B (4%) Udalfs-Eutrudepts complex, 25-70% slopes. Fine sandy loam and silt loam. Moderately well drained to well drained.

Successional Stage: Mature forest (95-195 years)

Average Stand Diameter (DBH): 11.8" (SE=1.8)

Average Stand Basal Area: 125 ft^2/ac (SE=22)

Snags per acre: 24 medium (6-11" DBH), 1 large (>12"DBH)

Coarse woody debris: Medium to high

Wildfire risk: High due to fuel loading and proximity to residential area

Invasive Species: Moderate - buckthorn was noted throughout the stand, mostly at low levels but very dense in localized patches

Pests & Disease: None

Current Condition: This mature to old-growth forest is located on steep, south-facing steep slopes north of the residential area off Veterans Evergreen Memorial Drive in the south-central portion of the property. Large, remnant white pines are present throughout the stand, with paper birch, quaking aspen, red oak and white spruce the primary codominant species. A diverse array of other seedling species are present, but ash and sugar maple make up approximately 75% of seedlings tallied. Sapling recruitment is limited, due to the closed canopy conditions and limited sunlight. This may have been a fire-dependent forest type that is trending towards fire-intolerant species like maples due to lack of fire. Buckthorn and roundleaved dogwood are the primary midstory components. Pennsylvania sedge dominates the understory.

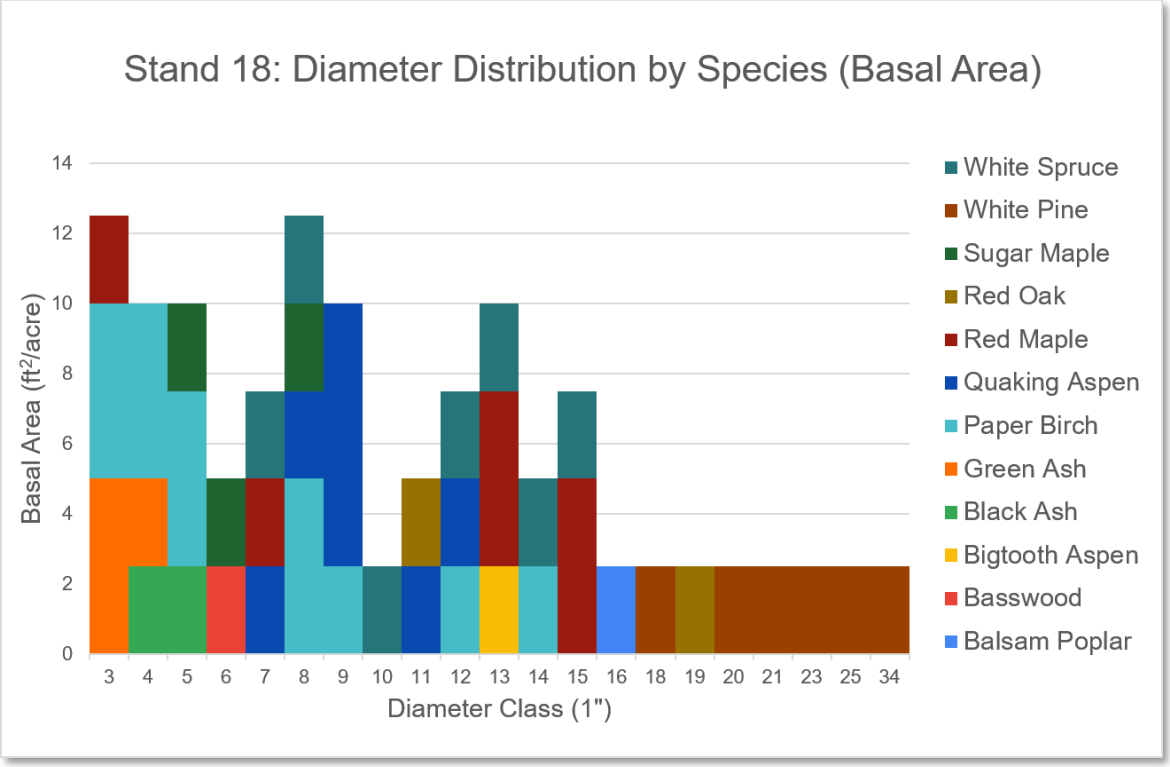
Current Recreational Uses or Management:
One trail is present through a portion of the stand. Very steep slopes deter off-trail uses.

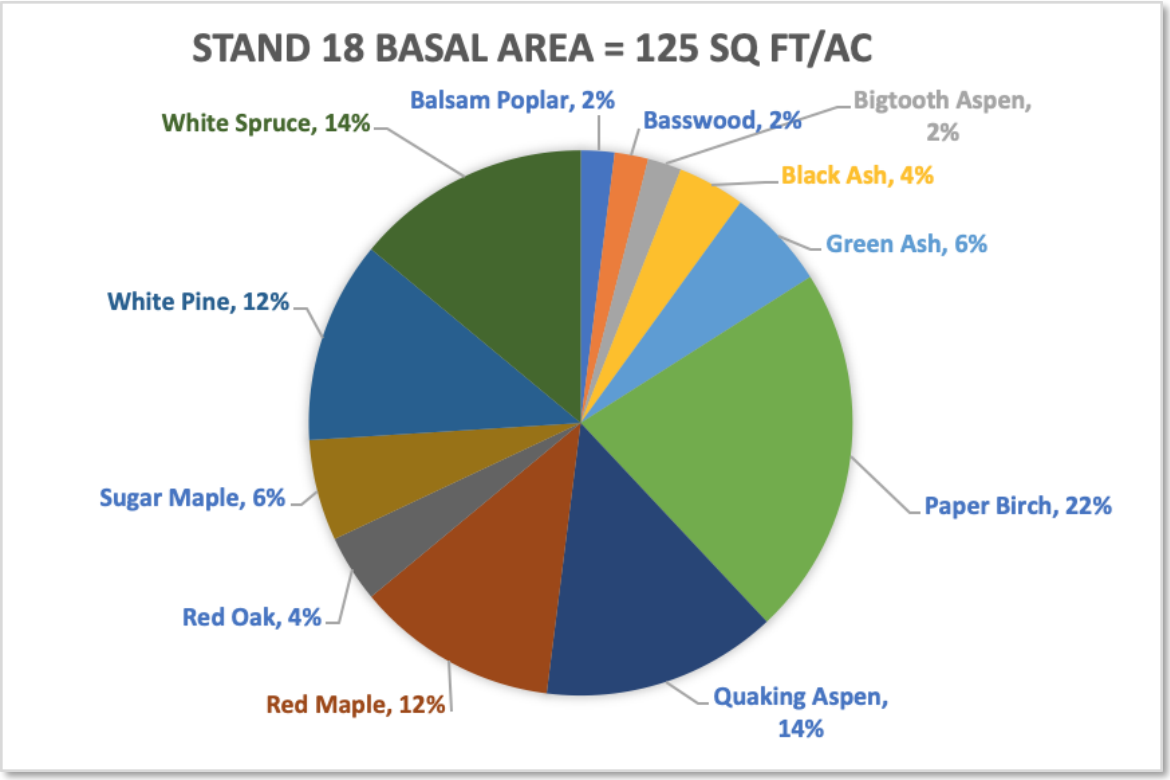
Adjacent land use concerns:
A residential area is adjacent to this unit. Potential wildfire ignition source or public safety concern in the event of a wildfire.

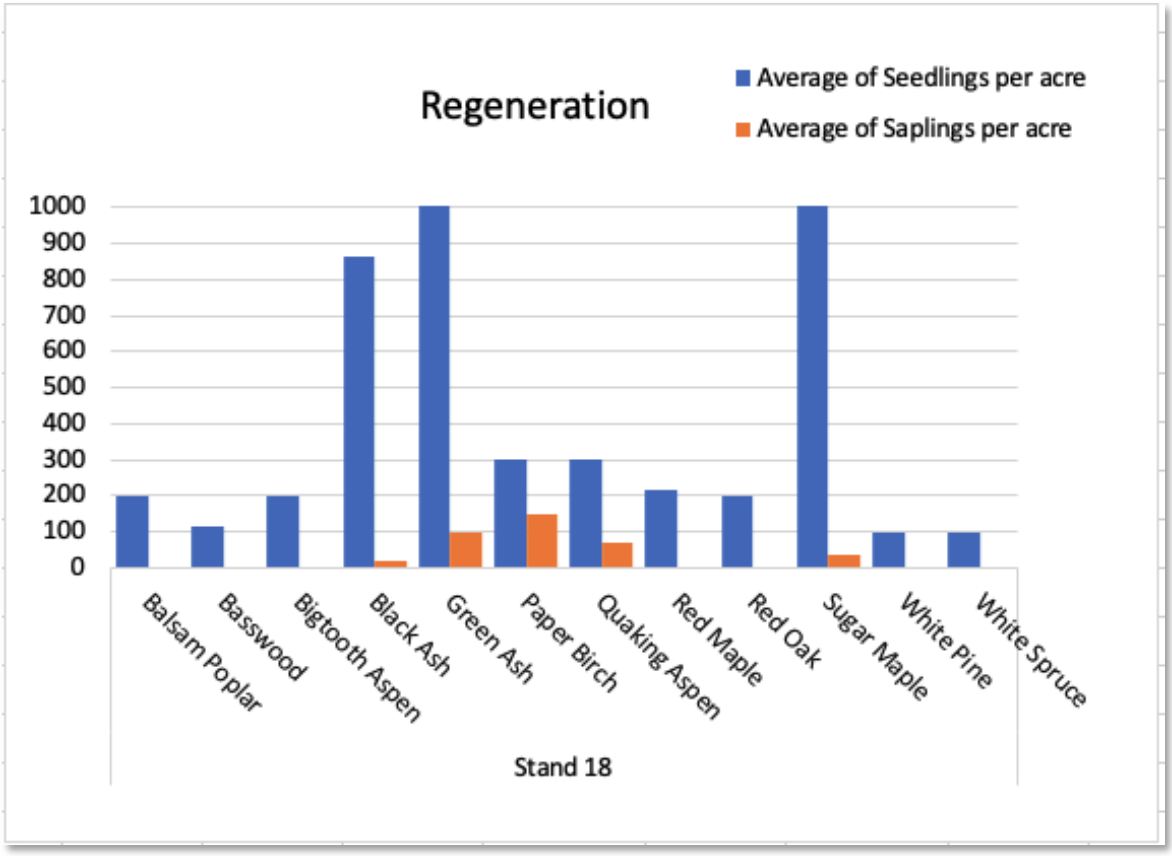
No action result (10-20 years): The white pine in this stand is mature and this species component will be reduced if a new cohort is not established. Mesophication, the transition from fire-dependent to fire-intolerant plant community is likely to occur. Black ash in the mid canopy will die, favoring shade tolerant trees (especially sugar maple) and shrubs.

Management Goals, Strategies, and Actions

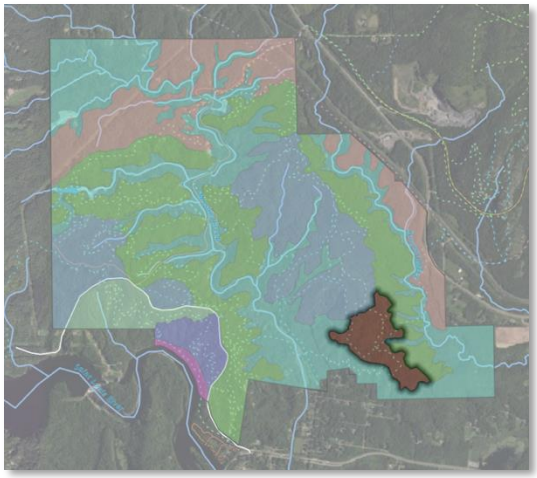
Goal	Strategy	Action	Notes
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Thin and remove overcrowded balsam fir or white spruce; Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies; Woody debris processing through biochar creation, pile burning, or off-site chipping	
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Monitor for seed producing trees of interest	White pine, red pine, white cedar, white spruce
Regeneration	Promote natural regeneration in vicinity of seed-bearing trees	Site preparation - Prescribed burning OR Site preparation - Mechanical soil scarification	Site prep through surface burning or scarification before cones drop.
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Shelterwood harvest OR Girdle trees surrounding seed producing trees of interest	Thin canopy to 40-60% cover 1-5 years in advance of conifer regen effort.


Stand 18: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 23 25 34
Diameter Class (1")
White Spruce
White Pine
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Green Ash
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar


STAND 18 BASAL AREA = 125 SQ FT/AC
Balsam Poplar, 2%
Basswood, 2%
Bigtooth Aspen, 2%
White Spruce, 14%
Black Ash, 4%
Green Ash, 6%
White Pine, 12%
Paper Birch, 22%
Sugar Maple, 6%
Red Oak, 4%
Red Maple, 12%
Quaking Aspen, 14%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Bigtooth Aspen
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 18

Stand 19 Mixed Hardwood Conifer





Stand Characteristics

Forest Type: Mixed Hardwood Conifer

Size: 56 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	35.7	63%
MHn46b	20.6	36%

Ecological Site (USDA): F092XY014WI - Loamy Uplands F092XY015WI - Clayey Uplands

Dominant Soils: F155B (76%), F155G (24%) Udalfs-Eutrudepts complex, 0-8% slopes. Fine sandy loam and silt loam. Somewhat poorly drained to well drained.

Successional Stage: Transitioning from young to mature forest (55-95 years)

Dominant Soil: F155B (76%), F155G (24%)

Average Stand Diameter (DBH): 9.2" (SE=0.5)

Average Stand Basal Area: 142 ft2/ac (SE=16)

Snags per acre: 77 medium (6-11" DBH), majority aspen

Coarse woody debris: Medium

Wildfire risk: Moderate in localized areas (spruce)

Invasive Species: Low, buckthorn was noted throughout, but as seedlings in low quantities

Pests & Disease: Dead quaking aspen regeneration was indicated due to the shady conditions

Current Condition: This mid-successional hardwood forest is located in the southeast portion of the property, on the gently rolling to relatively flat areas north of Stand 18 and the adjacent residential neighborhood. Canopy is overall dense, creating shady conditions that limit the regeneration and development of the understory. The oldest size class of trees are red oak (17-25" DBH). Quaking aspen is dominant in the 5-16" size class. Smaller trees under 7" are a mix of hardwoods and conifers including green ash, basswood, white spruce, and sugar maple, indicating the stand is moving from aspen dominance towards a mixed hardwood-white spruce stage. Tree seedlings are abundant, with green and black ash being the most abundant seedling species, and basswood and white spruce also prevalent. The midstory is very open, with tree and shrub recruitment limited. The dominant shrubs in this stand are beaked hazel, speckled alder, serviceberry, and downy arrowwood, with only speckled alder reaching the 6-ft size class. Buckthorn was also recorded in the shrub layer, but only in the under 6ft size class. Dominant understory plants include lady fern, hawkweed, dewberry, pyrola, and sedges, including Pennsylvania sedge.

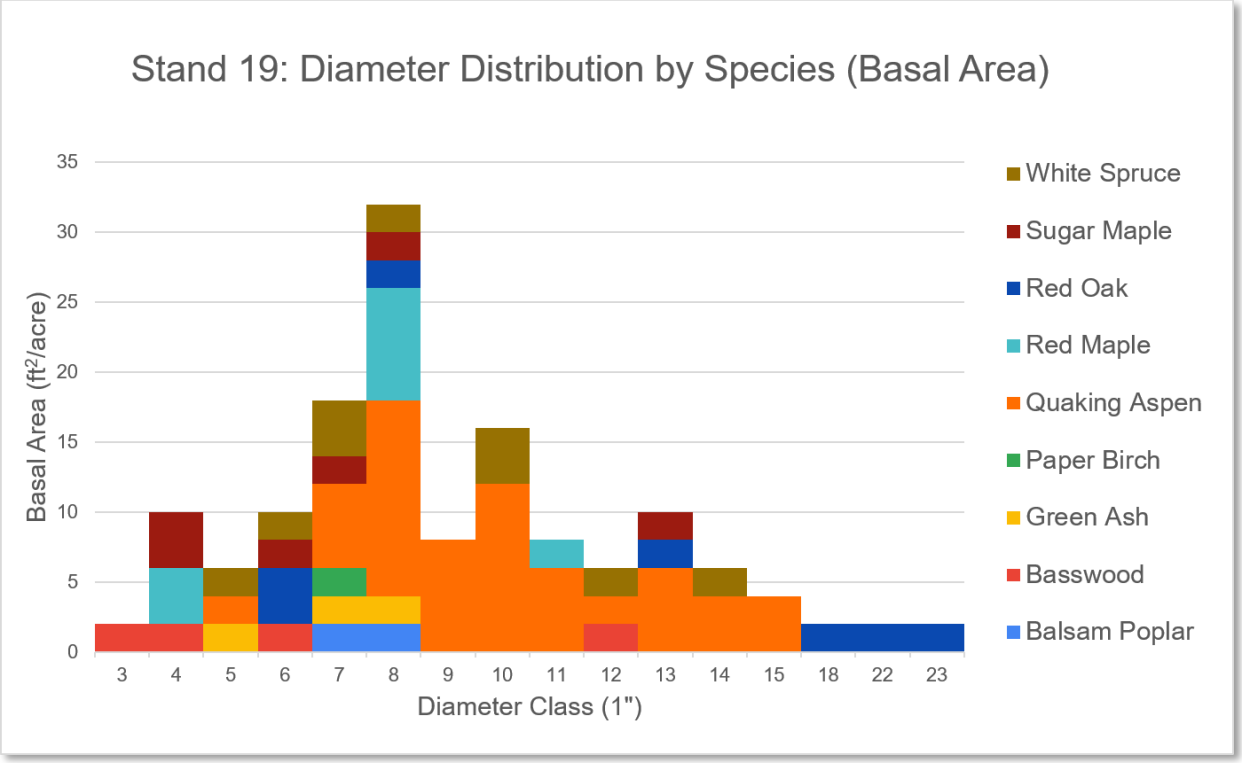
Current Recreational Uses or Management:
This stand receives moderate recreational use with two trails looping throughout the stand, though is relatively far away from trailheads.

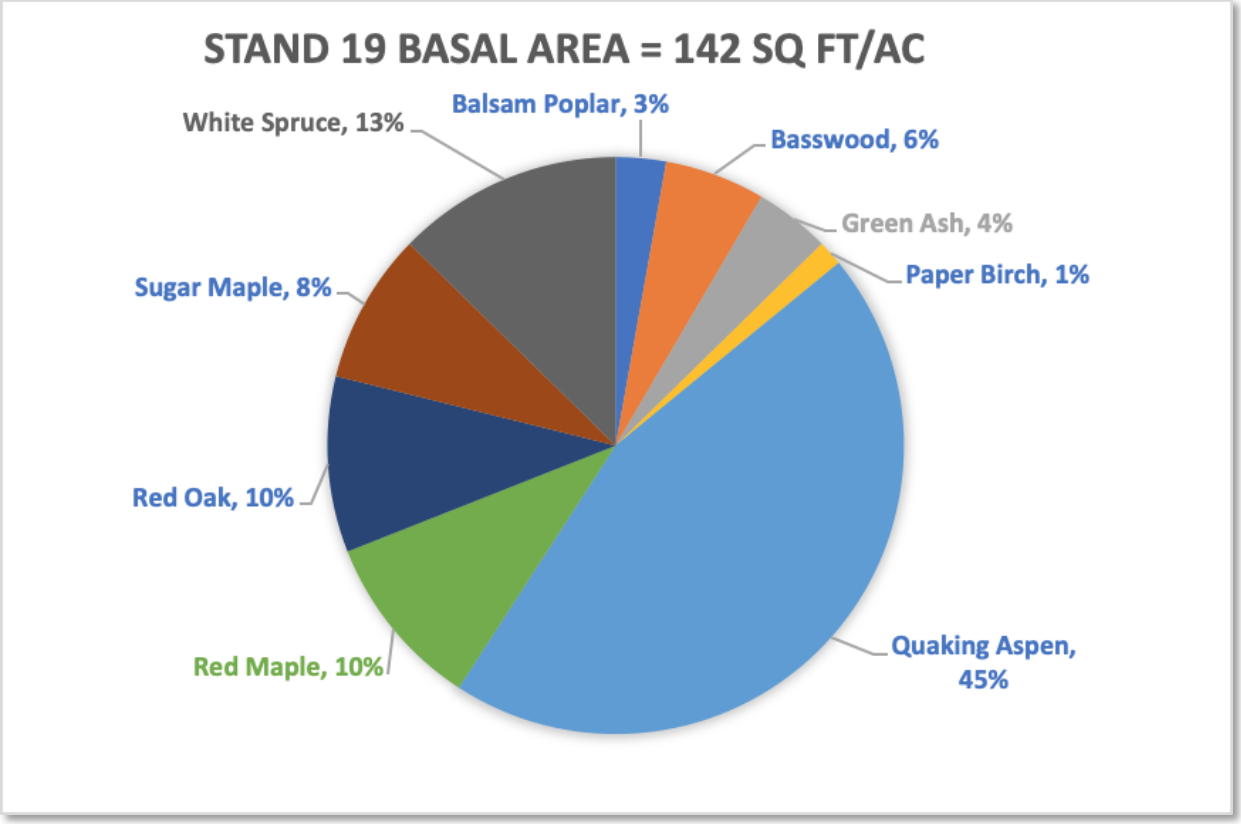
Adjacent land use concerns:
None noted.

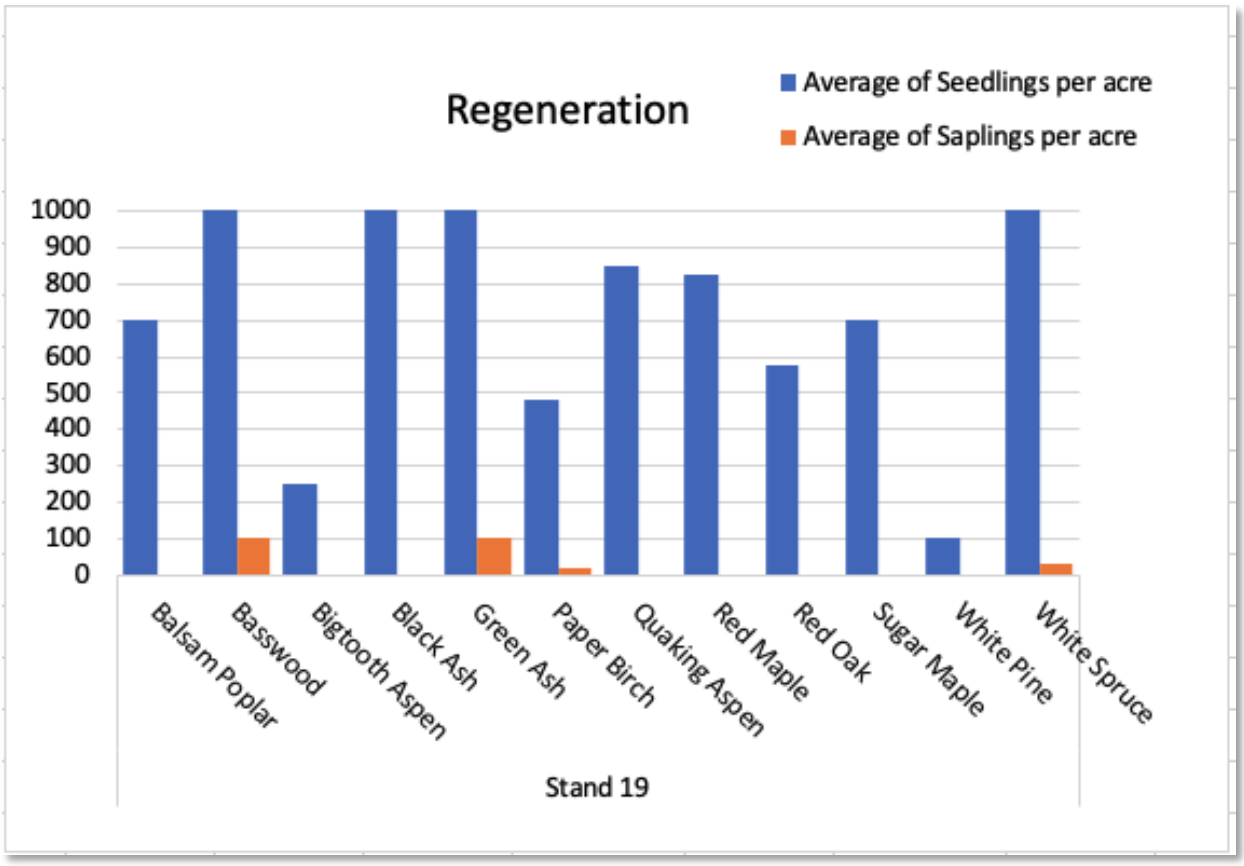
No action result (10-20 years): Aspen mortality due to age will continue, which will favor conversion to shade tolerant mixed hardwood condition and create wildlife-desired larger snags. If herbivory is too high, plant species composition will favor less palatable species.

Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Regeneration	Create canopy openings to allow sunlight to reach forest floor	Single tree selection	Cut aspen to release sugar maple saplings
Forest resilience	Reduce hazardous fuel load to reduce wildfire risk and severity	Thin and remove overcrowded balsam fir or white spruce; Thin and remove above ground dead/down woody debris (lacking soil contact) that creates a fuel ladder into tree canopies; Woody debris processing through biochar creation, pile burning, or off-site chipping	


Stand 19: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
35
30
25
20
15
10
5
0
3
4
5
6
7
8
9
10
11
12
13
14
15
18
22
23
Diameter Class (1")
White Spruce
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Green Ash
Basswood
Balsam Poplar


STAND 19 BASAL AREA = 142 SQ FT/AC
White Spruce, 13%
Balsam Poplar, 3%
Basswood, 6%
Green Ash, 4%
Paper Birch, 1%
Sugar Maple, 8%
Red Oak, 10%
Red Maple, 10%
Quaking Aspen, 45%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Bigtooth Aspen
Black Ash
Green Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
White Pine
White Spruce
Stand 19

Section 5: Piedmont-Brewer Natural Area (Piedmont)

Figure 4: Piedmont Stands Map

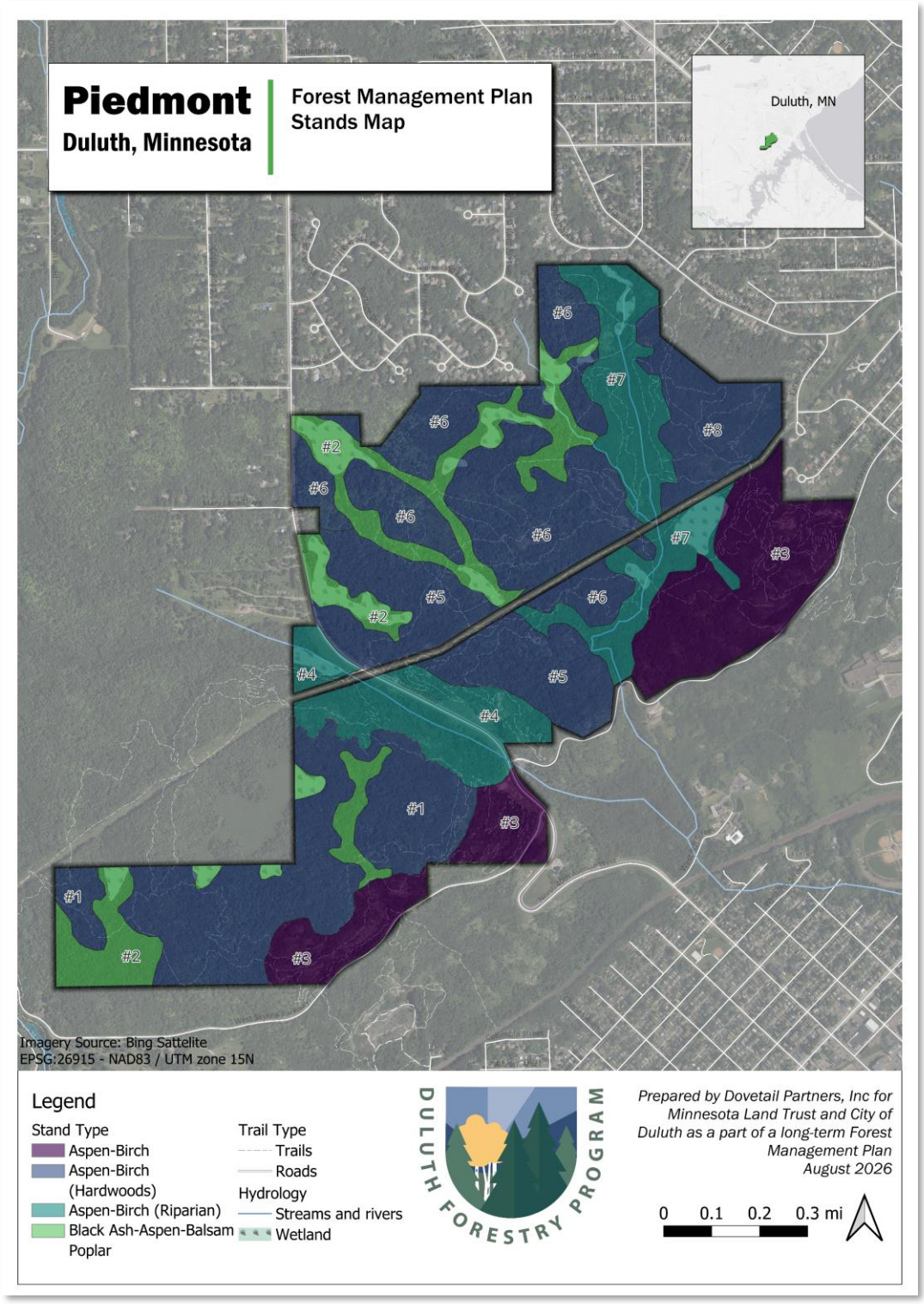
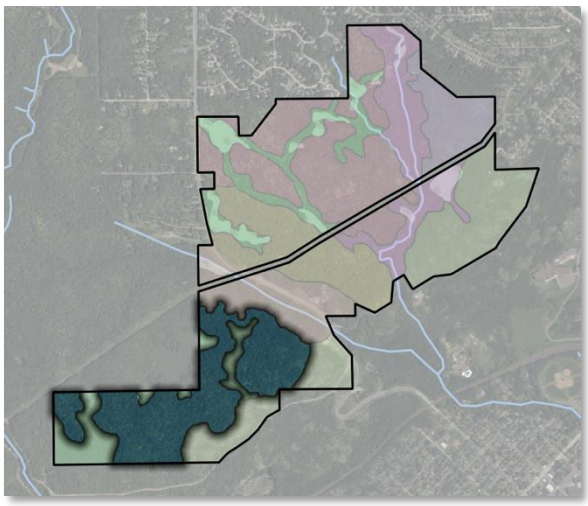


Table 8: Piedmont Stand Attributes Table

Stand #	Forest Typ	Acres	Soil Prima	NPC Primary	Avg DBH (in)	SE DBH (in)	Avg Basal Area (ft2/ac)	SE Basal Area (ft2/ac)	SiteIndex1	SiteIndex1_species	SiteIndex2	SiteIndex2_species	Total Plots
1	Aspen-Birch (Hardwoods)	113.2	F156D	MHn35b	8.5	0.5	87.3	9.1	68.0	Quaking Aspen	55	Yellow Birch	11
2	Black Ash-Aspen-Balsam Poplar	86.7	F134A	WFn55a	8.3	1.2	66.7	12.5	68.0	Quaking Aspen	55	Yellow Birch	9
3	Aspen-Birch	109.3	F160F	FDn43b2 / ROn23b	6.8	0.7	78.2	9.1	67.0	Quaking Aspen	64	Red Oak	11
4	Aspen-Birch (Riparian)	53	F148F	ROn23b / MHn46b	7.6	1.2	50	10.3	77.0	Quaking Aspen	42	Paper Birch	6
5	Aspen-Birch (Hardwoods)	71.8	F156D	MHn35b	10	1.4	65	15.1	82.5	Quaking Aspen	53	Sugar Maple	8
6	Aspen-Birch (Hardwoods)	126.6	F156D	MHn47a	8.7	0.4	102	12.5	82.0	Quaking Aspen	42	Sugar Maple	10
7	Aspen-Birch (Riparian)	69.4	F148F	MHn35b	8	1.3	50	15.5	55.0	Quaking Aspen			7
8	Aspen-Birch (Hardwoods)	36.8	F156D	MHn35b	7.5	0.7	71.4	14.9	56.5	Aspen	55	Sugar Maple	7

Stand 1 Aspen-Birch (Hardwoods)





Stand Characteristics

Forest Type: Aspen-Birch (Hardwoods)

Size: 113 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	105.4	93%

Dominant Soils:

- F156D (83%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.
- F160F (14%): Rock outcrop-Mesaba-Barto complex, 18 to 60% slopes. 0-40" to lithic bedrock; gravelly sandy loam. Well drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest, F093AY013MN - Loamy Upland

Successional Stage (MDNR): Mix of young forest (0-55 years) and transitional maturing forest (55-95 years)

Average Stand Diameter (DBH): 8.5" (SE=0.5)

Average Stand Basal Area: 87 ft^2/acre (SE=9.1)

Snags per acre: 48 medium (6-11" DBH), aspen

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Low to medium amounts of buckthorn were noted throughout the stand, some saplings well established

Pests & Disease: Emerald ash borer ubiquitous where ash is present

Current Condition: This forested stand is dominated by quaking aspen with a component of paper birch, lesser amount of basswood, and less frequent hardwoods like yellow birch, sugar maple, red maple, and red oak. Shallow, well-drained soil over bedrock makes growing conditions difficult, resulting in low basal area and low tree diversity with an overabundance of disturbance-tolerant species (aspen and birch). A moderate abundance of aspen snags indicates the stand has received recent disturbances (likely windstorms) that largely prevent it from maturing beyond the aspen-birch dominant stage. White pine and yellow birch are the longer-lived species that would be expected in this forest type - white pine is not currently present. Bur oak may also be successful if introduced. Beaked hazel forms a dense understory in some places in this stand, where other areas exhibited more open understory. Overall there was a low diversity of native midstory trees and shrubs. Bracken fern, bush honeysuckle, large-leaved aster, and lady fern are the most common understory plants.

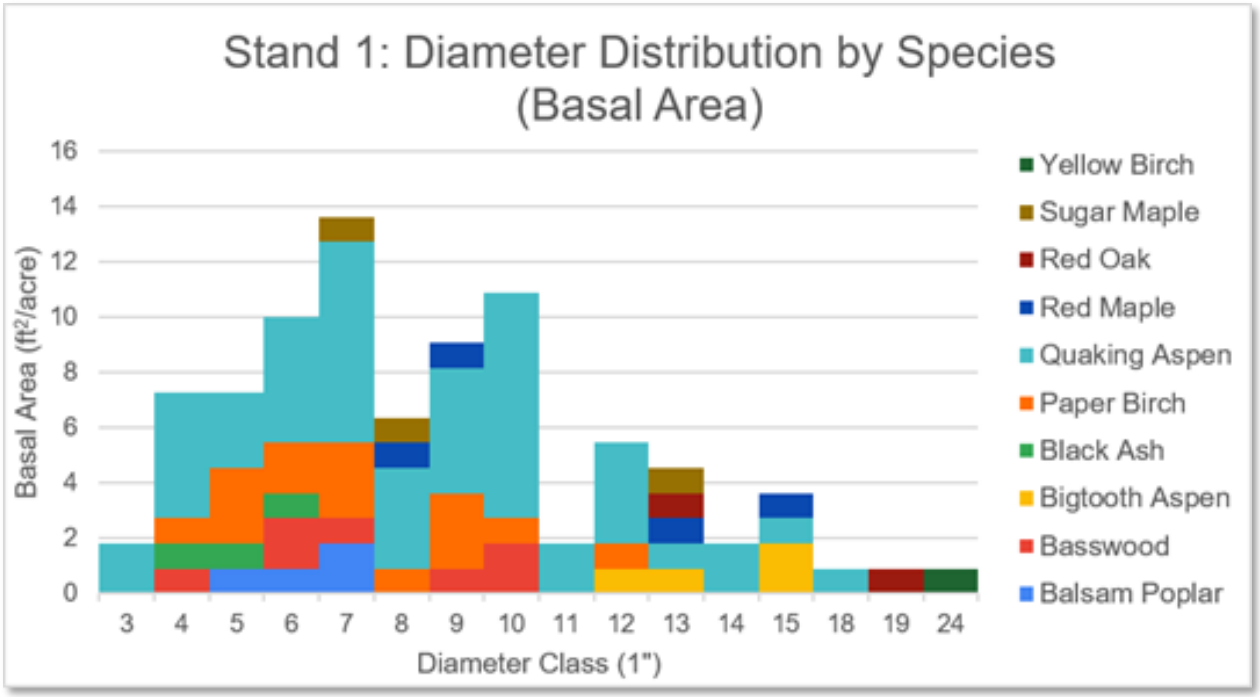
Current Recreational Uses or Management:
Brewer Park is accessed via a trailhead on Skyline Parkway near the intersection of St. Louis River Rd. The Superior Hiking Trail and a mountain bike trail traverse through this stand.

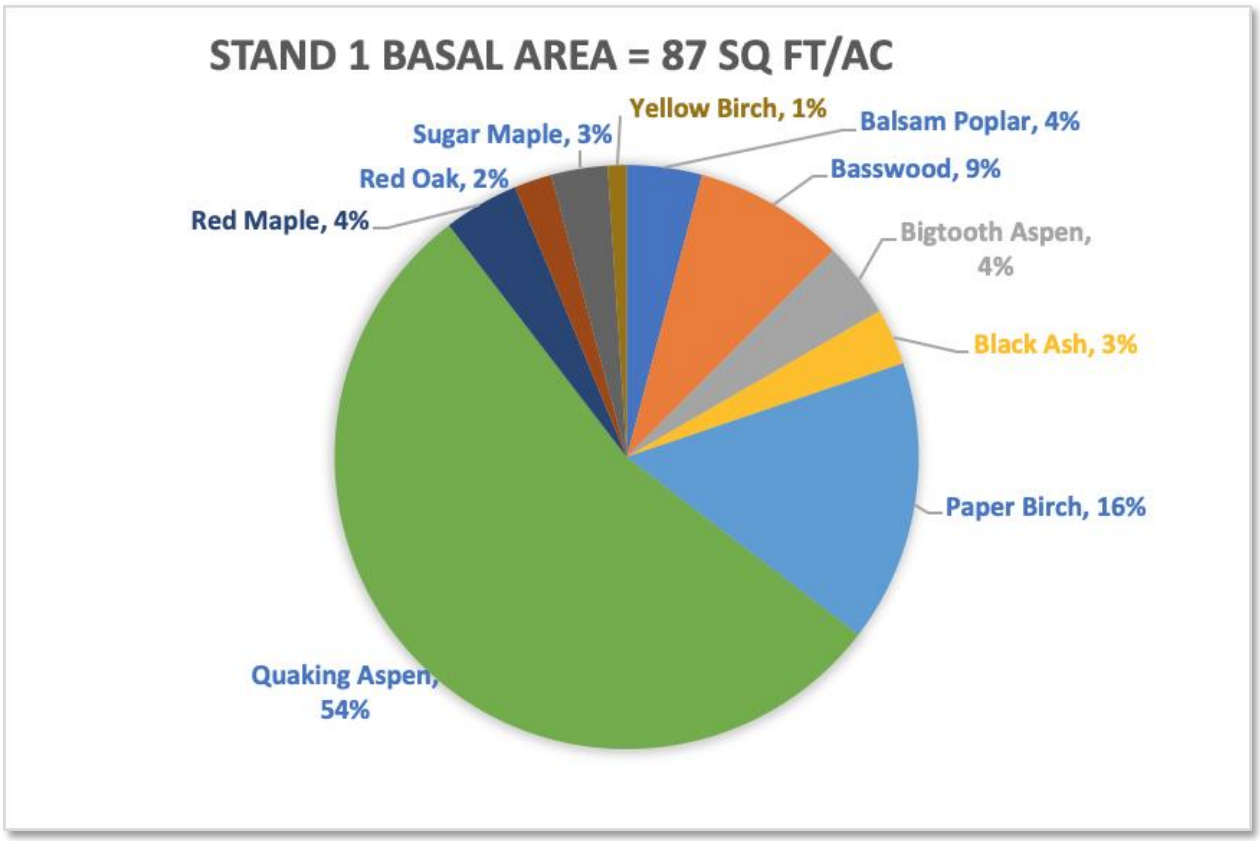
Adjacent land use concerns:
There is a cemetery to the south. The remainder of the stand is bordered by state lands also utilized for recreation.

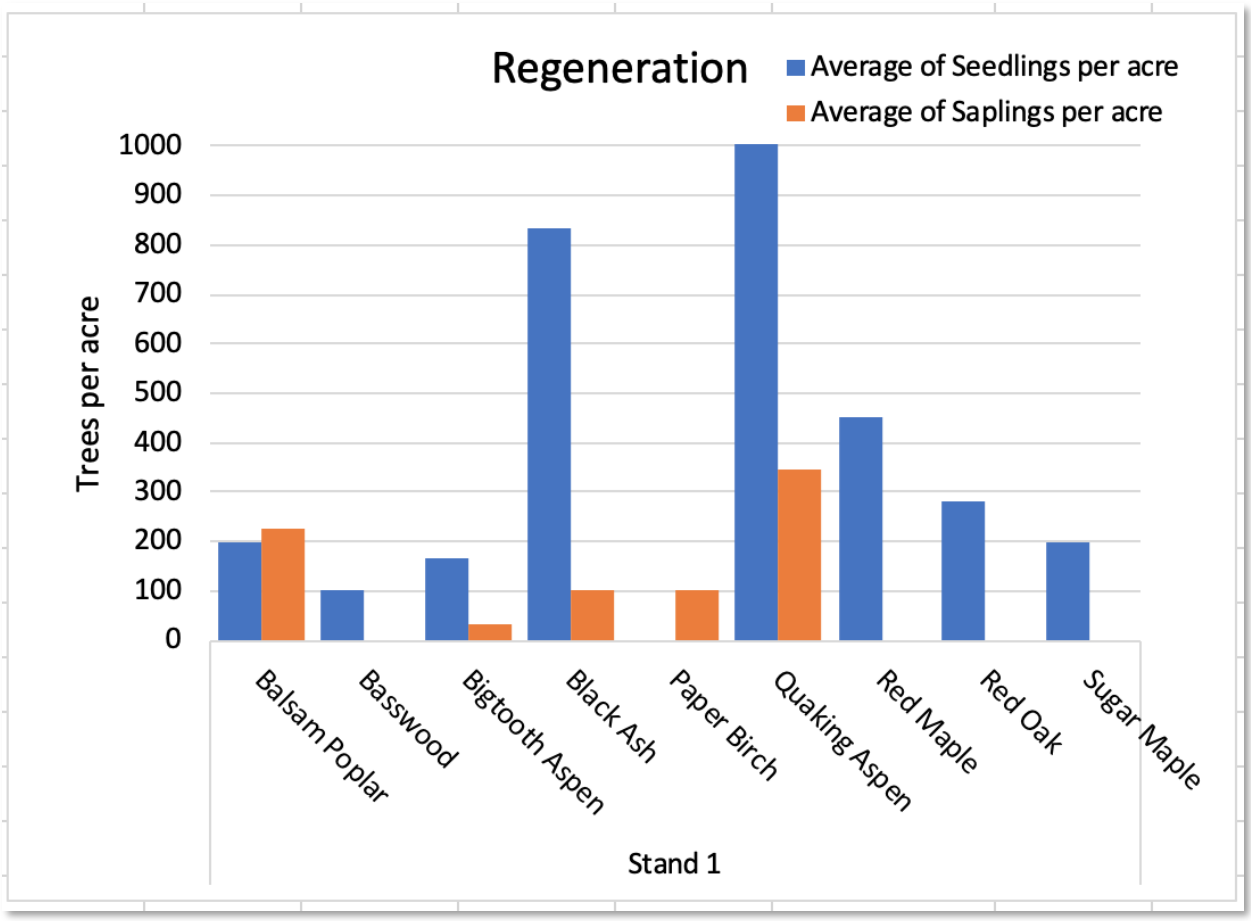
No action result (10-20 years): The stand will continue to fill with buckthorn in the midstory and crowd out the native shrub and herbaceous layer. Aspen is likely to replace itself with occasional other hardwood species. Conifers are likely to remain absent from the forest due to lack of seed source and tendency of this poor-quality ecological site type to remain in early- to mid-successional stages.

Management Goals, Strategies, and Actions

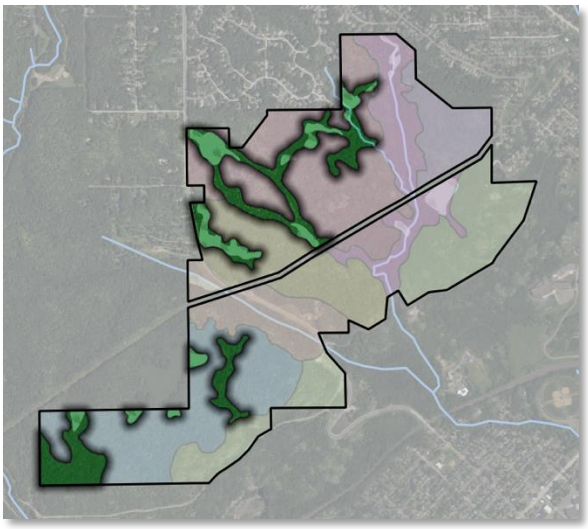
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	
Regeneration; Restore/enhance native plant communities	Reduce competition in midstory	Mulch/masticate shrub layer	Mastication in strips of overabundant shrubs (up to 30% of stand at one time). Target alder, buckthorn
Regeneration	Artificial regeneration	Plant trees	Hardwoods
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Select seeds of currently occurring species from slightly more southern stock	


Stand 1: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
16
14
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 14 15 18 19 24
Diameter Class (1")
Yellow Birch
Sugar Maple
Red Oak
Red Maple
Quaking Aspen
Paper Birch
Black Ash
Bigtooth Aspen
Basswood
Balsam Poplar


STAND 1 BASAL AREA = 87 SQ FT/AC
Yellow Birch, 1%
Balsam Poplar, 4%
Sugar Maple, 3%
Basswood, 9%
Red Oak, 2%
Red Maple, 4%
Bigtooth Aspen, 4%
Black Ash, 3%
Paper Birch, 16%
Quaking Aspen, 54%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Bigtooth Aspen
Black Ash
Paper Birch
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
Stand 1

Stand 2 Black Ash-Aspen-Balsam Poplar





Stand Characteristics

Forest Type: Black Ash-Aspen-Balsam Poplar

Size: 87 acres

NPC (MDNR)	*Acres*	*% of stand*
WFn55a	46.6	54%
MHn35b	16.5	19%
MHn47a	11.6	13%
MHn46b	6.8	8%

Dominant Soils:

- F134A (40%): Giese muck, depressional, 0 to 1 percent slopes. Muck to 1", silt loam to 11" over gravelly sandy loam. Very poorly drained.
- F156D (22%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.

Ecological Site (USDA): F093AY006MN - Depressional Wet Hardwood Forest, F093AY004MN - Peatland (35%)

Successional Stage (MDNR): Young forest (0-75 years)

Average Stand Diameter (DBH): 8.2" (SE=1.2)

Average Stand Basal Area: 67 ft^2/ac (SE=12.5)

Snags per acre: 31 medium (6-11"), 7 large (12"+), black ash and aspen

Coarse woody debris: Medium to high

Wildfire risk: Low

Invasive Species: Buckthorn and honeysuckle are common at moderate to high density in this stand

Pests & Disease: Emerald ash borer has caused canopy decline and epicormic sprouting, but not complete mortality of ash trees in this stand

Current Condition: This stand encompasses the wet forests and wetlands meandering throughout the flatter areas of aspen-hardwood forests across the northern and western portions of the property. Soils contain patches of peat characteristics, and are otherwise poorly drained. Black ash would have been the dominant tree but due to EAB mortality, basal area of mature trees is low with a balance of declining black ash, quaking aspen, balsam poplar, yellow birch, and occasional sugar maple. Regeneration is moderate for seedlings and poor for saplings, with black ash being by far the dominant establishing sapling. Other

regenerating species are balsam poplar, quaking aspen, red oak, and red maple. Speckled alder and buckthorn have become very thick under the canopy of some dead or dying ash trees. Red-osier dogwood is also common in the midstory. The understory exhibits wetland characteristics with a mix of grasses, brambles (*Rubus* spp.), lady fern, ostrich fern, bracken fern, sedges, and occasional sphagnum moss (peat).

Current Recreational Uses or Management:
These wetlands span multiple areas throughout the property with numerous intersecting trails.

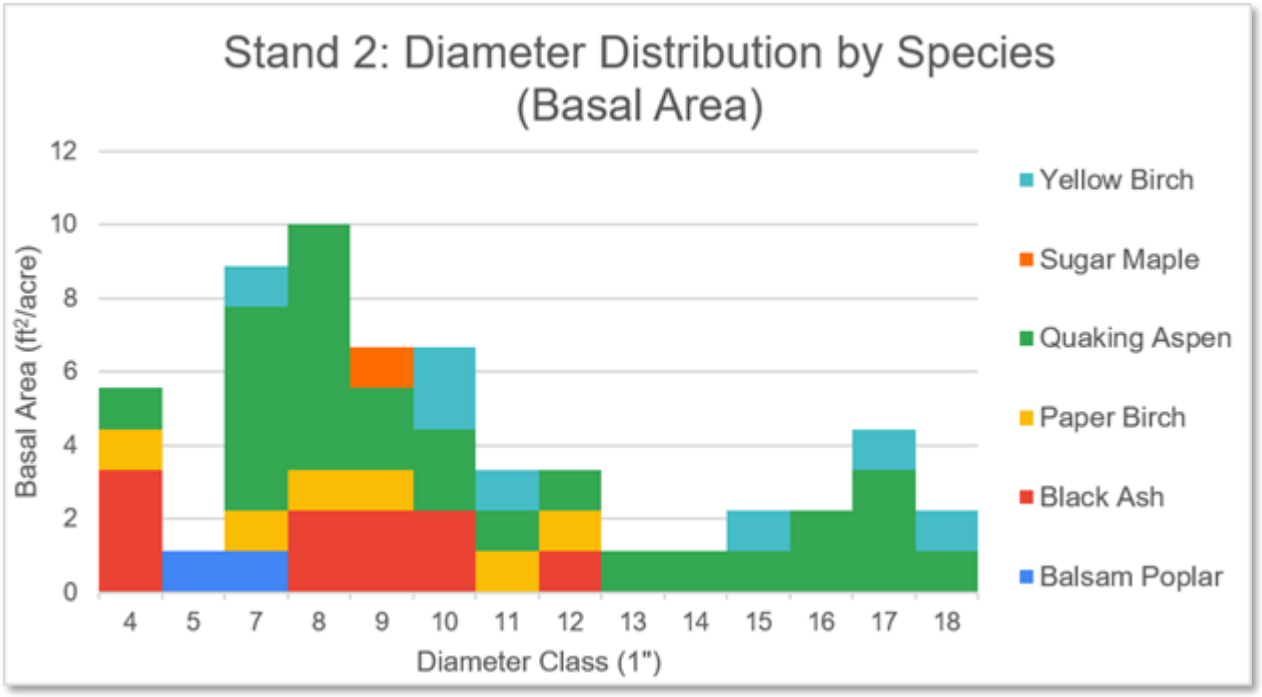
Adjacent land use concerns:
Residential areas and roads to the north and east of the property may contribute pollution, runoff, trash/debris, and invasive species to the wetlands. Natural wetland hydrology may be adversely modified from roadways and residential development. The powerline corridor in the northern half of the property may be impacting wetland hydrology.

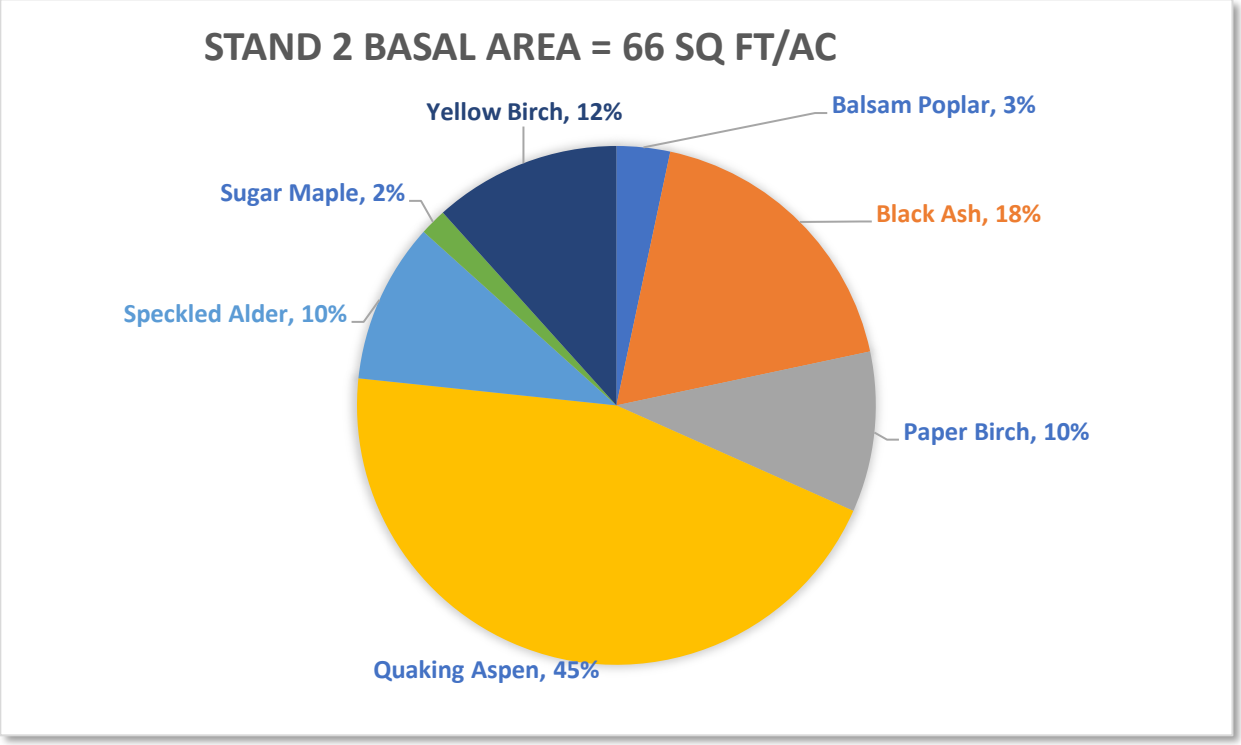
No action result (10-20 years): Black ash swamps may convert to speckled alder-dominant shrubby swamp. Buckthorn will expand. Tree species diversity may remain low and dominated by quaking aspen, balsam poplar, and occasional hardwoods.

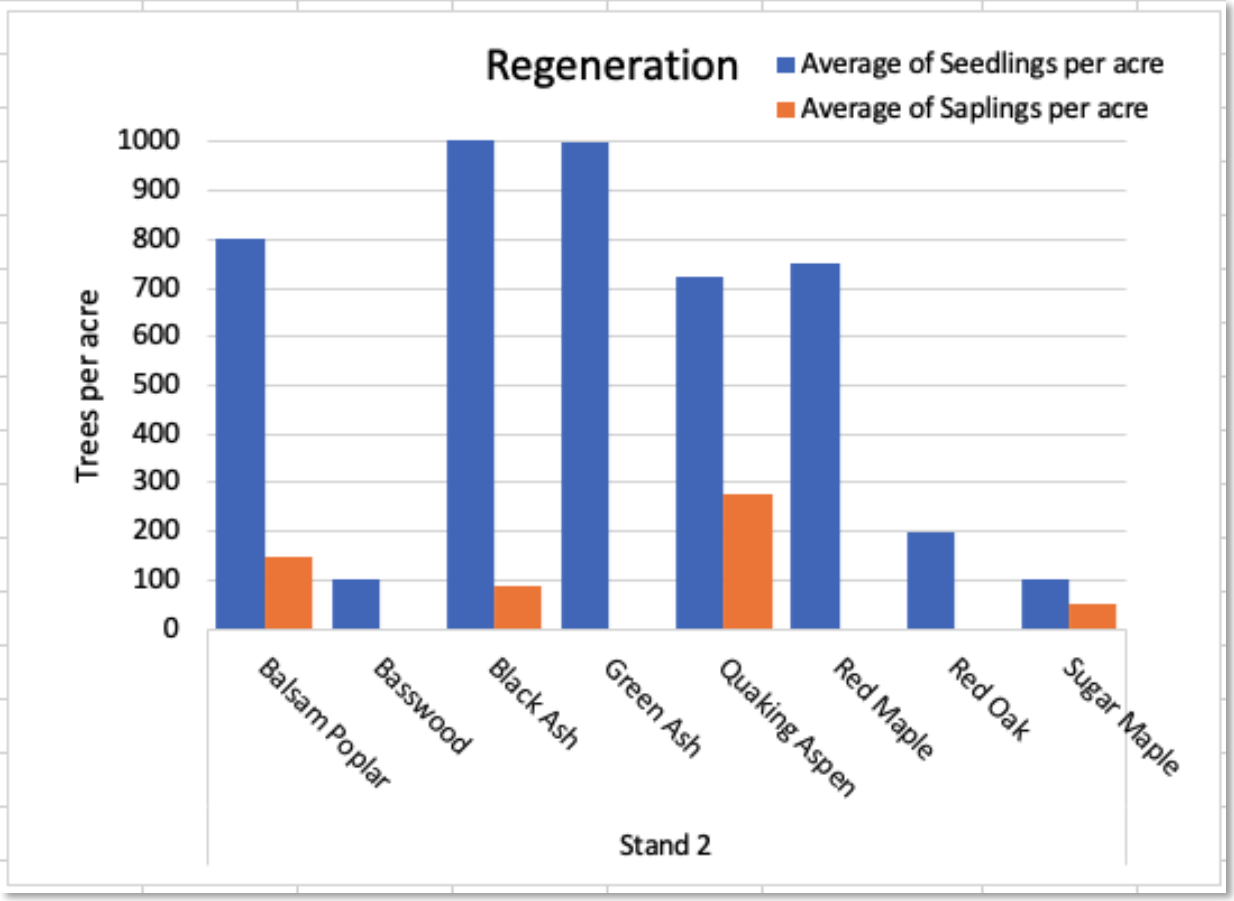
Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Masticate or mulch dense stands of buckthorn; Follow-up foliar herbicide treatment after initial removal OR Prescribed grazing on resprouts after initial removal	worst infestation in southwest corner of property
Ecosystem function	Retain or replace forested cover in the wake of emerald ash borer tree decline and mortality	Systemic herbicide injection annually into mature female trees during early-stage invasion to serve as seed crops for future ash regeneration; Girdle ash trees to attract EAB in combination with systemic herbicide injection to adjacent trees; Underplanting - Plant trees other than ash where ash decline and mortality is advanced	Prioritize trunk injections for seed trees with less than 30% canopy loss
Regeneration; Restore/enhance native plant communities	Reduce competition in midstory	Mulch/masticate shrub layer	Mastication in strips of overabundant shrubs (up to 30% of stand at one time)

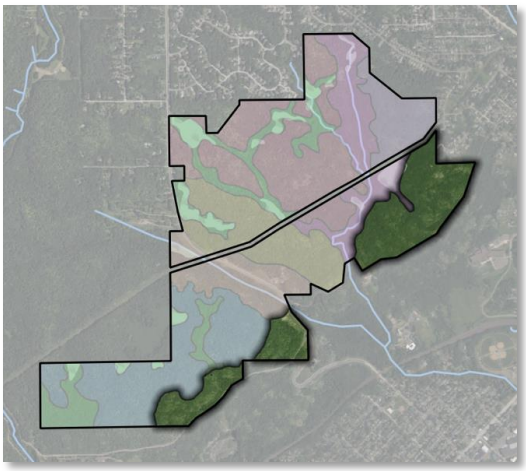
Regeneration	Artificial regeneration	Plant trees	Plant moisture tolerant trees, mix of hardwood and conifer (white pine, white cedar, yellow birch, eastern hemlock, tamarack, bur oak)
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Select seeds of currently occurring species from slightly more southern stock	




STAND 2 BASAL AREA = 66 SQ FT/AC
Yellow Birch, 12%
Balsam Poplar, 3%
Sugar Maple, 2%
Black Ash, 18%
Speckled Alder, 10%
Paper Birch, 10%
Quaking Aspen, 45%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Basswood
Black Ash
Green Ash
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
Stand 2

Stand 3 Aspen-Birch





Stand Characteristics

Forest Type: Aspen-Birch

Size: 109 acres

NPC (MDNR)	*Acres*	*% of stand*
FDn43b2	38.8	36%
ROn23b	33.1	30%
MHn35b	25.7	24%

Dominant Soil:

- F160F (80%): Rock outcrop-Mesaba-Barto complex, 18 to 60% slopes. 0-40" to lithic bedrock; gravelly sandy loam. Well drained.
- F156D (17%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest

Successional Stage (MDNR): N/A for rocky outcrop

Average Stand Diameter (DBH): 6.8" DBH (SE=0.7)

Average Stand Basal Area: 78 ft2/ac (SE=9.1)

Snags per acre: 23 medium (6-11" DBH), aspen

Coarse woody debris: Low to medium

Wildfire risk: Moderate due to dry exposed environment and risk of ignition from recreational users and vehicles along Skyline Parkway

Invasive Species: Buckthorn and honeysuckle are abundant throughout the stand

Pests & Disease: None observed

Current Condition: This young stand features expanses of exposed bedrock openings with forest and shrubs occurring in cracks or in patches of deeper well-drained soil. This bedrock-controlled, fire-prone, drought-prone forest type is poor quality (short trees characterized by rot and deformities) due to the southeastern exposure and variable moisture availability in the shallow soils. Bigtooth aspen up to 10" DBH is notably dominant here more than any other stand on the property. Quaking aspen and paper birch of the same size are also common. Mountain ash and serviceberry up to 5" DBH hold space as canopy species in bedrock-dominated openings where other trees are absent. There are occasional 10-17" sugar maple and red oak growing in very open conditions. Because of the open canopy of the stand, the midstory layer is robust in some places with buckthorn, red-osier dogwood, round-leaved dogwood, serviceberry, and a diversity of other native shrubs/midstory trees. In other places, there are notable extents of limited plant growth due to exposed bedrock and lack of soil. Bush honeysuckle, large-leaved aster, and bracken fern as the most common understory plants. The stand is unique in hosting sun/disturbance-loving plants like velvet-leaf blueberry, yarrow, valerian, and St. John's wort.

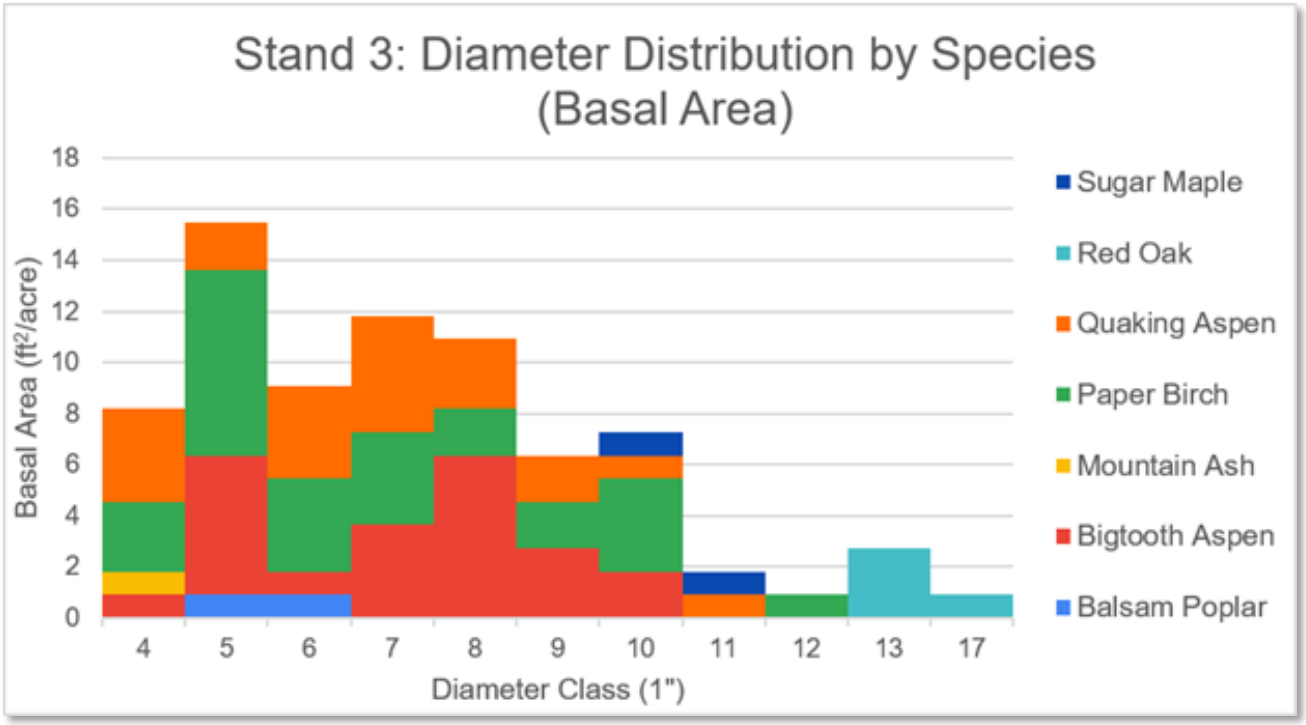
Current Recreational Uses or Management:
The stand features a high concentration of recreation trails including scenic overlooks that are somewhat trampled from foot traffic.

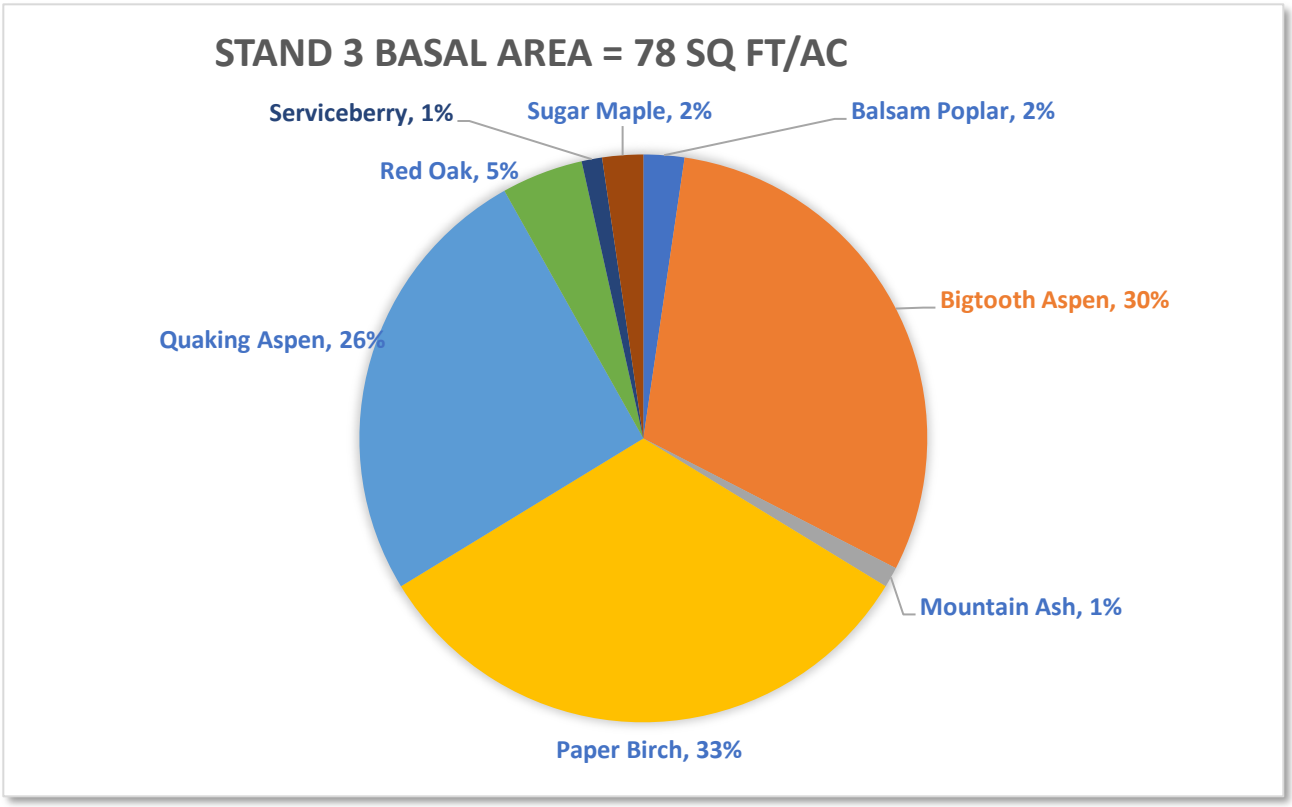
Adjacent land use concerns:
Skyline Parkway forms the southeastern boundary of this unit - access into the unit is limited due to steep and rocky slopes. Potential ignition from trail users or Skyline Parkway.

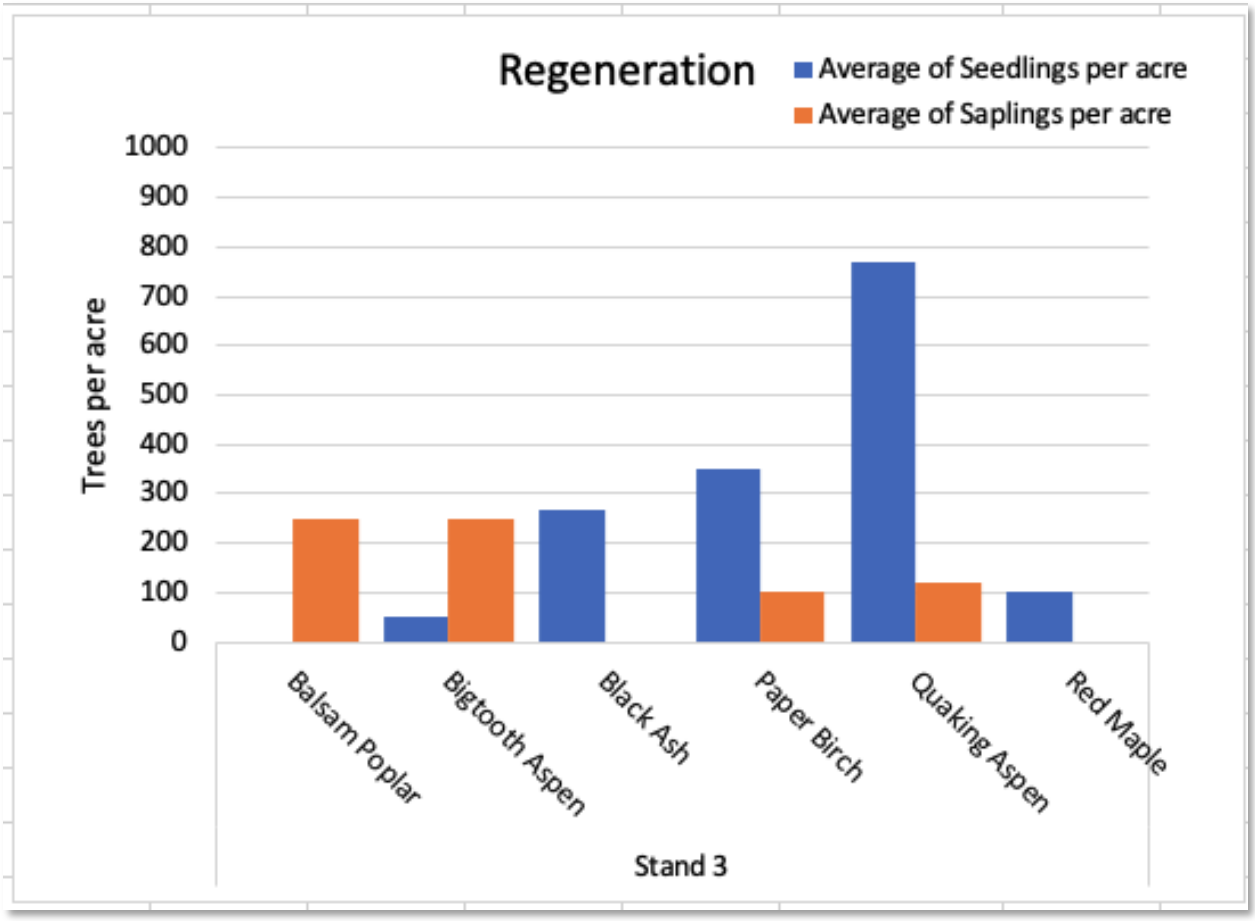
No action result (10-20 years): The stand is not likely to change much given the harsh conditions of the rocky outcrop environment and adaptation of existing plants to environmental extremes like drought, wind, and cold exposure. Greater tree mortality could occur in the event of an extreme drought or heat wave, or a wildfire with quaking aspen as the primary regenerating species. Hardwoods (sugar maple, red oak) may regenerate if temperature and precipitation patterns are mild with low occurrence of disturbances. Invasive species could be introduced from trail users.

Management Goals, Strategies, and Actions

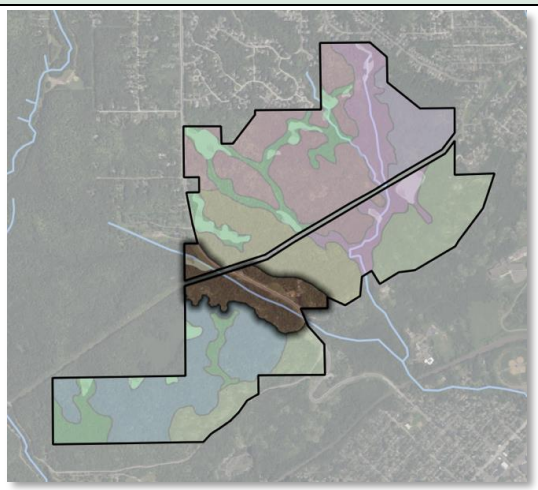
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter	Supplemental to burning
Recreation	Manage viewsheds at key viewpoints	Cut tall vegetation; Remove accumulated woody debris	Supplemental to burning; Hand cut tall vegetation in viewpoint areas
Restore/enhance native plant communities; Recreation	Restore and maintain fire-dependent plant communities	Prescribed burning	Rocky outcrops only, patch burns


Stand 3: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
18
16
14
12
10
8
6
4
2
0
4
5
6
7
8
9
10
11
12
13
17
Diameter Class (1")
Sugar Maple
Red Oak
Quaking Aspen
Paper Birch
Mountain Ash
Bigtooth Aspen
Balsam Poplar


STAND 3 BASAL AREA = 78 SQ FT/AC
Serviceberry, 1%
Sugar Maple, 2%
Balsam Poplar, 2%
Red Oak, 5%
Bigtooth Aspen, 30%
Quaking Aspen, 26%
Mountain Ash, 1%
Paper Birch, 33%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
1000
900
800
700
600
500
400
300
200
100
0
Trees per acre
Balsam Poplar
Bigtooth Aspen
Black Ash
Paper Birch
Quaking Aspen
Red Maple
Stand 3

Stand 4 Aspen-Birch (Riparian)





Stand Characteristics

Forest Type: Aspen-Birch (Riparian)

Size: 53 acres

NPC (MDNR)	*Acres*	*% of stand*
ROn23b	14.1	27%
MHn46b	11.3	21%
Disturbed	6.8	13%
CTn24	6.7	13%
MHn35b	5.6	11%

Dominant Soil:

- F148F (77%): Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes. Silt loam or mucky silt loam to 4-6" over gravelly sandy loam or stratified silt loam to gravelly loamy coarse sand. Well drained to poorly drained.
- F156D (22%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.

Ecological Site (USDA): F093AY013MN - Loamy Upland, F093AY009MN - Bedrock Controlled Upland Forest, F093AY005MN - Wet Floodplain

Successional Stage (MDNR): N/A for rocky outcrop; transitional (35-95 years) in creek floodplain

Average Stand Diameter (DBH): 7.6" DBH (SE=1.2)

Average Stand Basal Area: 50 ft2/ac (SE=10.3)

Snags per acre: 8 medium (6-11" DBH), 2 large (12"+), some black ash

Coarse woody debris: Low to medium

Wildfire risk: Medium due to vulnerability to drought and ignition risk from proximity to road

Invasive Species: Low quantities of buckthorn and honeysuckle

Pests & Disease: Emerald ash borer has caused canopy decline and some mortality where ash is present

Current Condition: This is one of the steepest and sparsest stands at Piedmont-Brewer, forming a ravine that includes the narrow floodplain of the west branch of Merritt Creek and its dramatic north- and south-facing embankments. This is a rare stand on the property in hosting a supercanopy of occasional large white pines (22-26" DBH). Quaking aspen and paper birch are the dominant canopy species, with balsam poplar abundant along the creek. On the harsh rocky embankments, mountain ash achieves canopy status in the absence of other mature trees with diameters up to 7". The only conifer saplings detected on the

property are found here - white pine, white spruce, occasional balsam fir, and even white cedar. Aspen is the most common regenerating tree, with balsam poplar and black ash common in the creekbed. Beaked hazel, mountain maple, mountain ash, buckthorn, and red-osier dogwood form a sparse shrub layer. Thimbleberry, goldenrod, bush honeysuckle, grasses, rock polypody, and rock-dwelling lichens characterize the herbaceous layer.

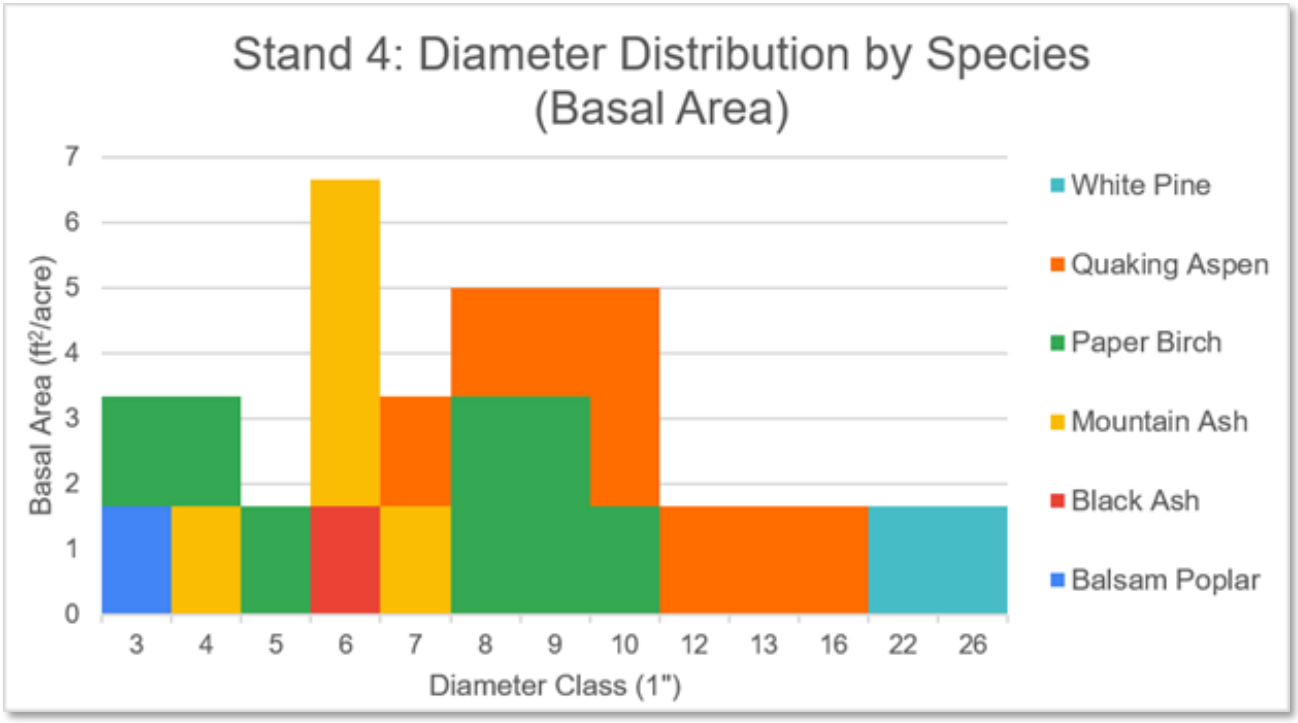
Current Recreational Uses or Management:
Haines Road runs parallel to the creek between the two steep embankments. There is a single trail crossing across Merritt Creek. Some trees were previously planted in the road right of way but have died or are not thriving.

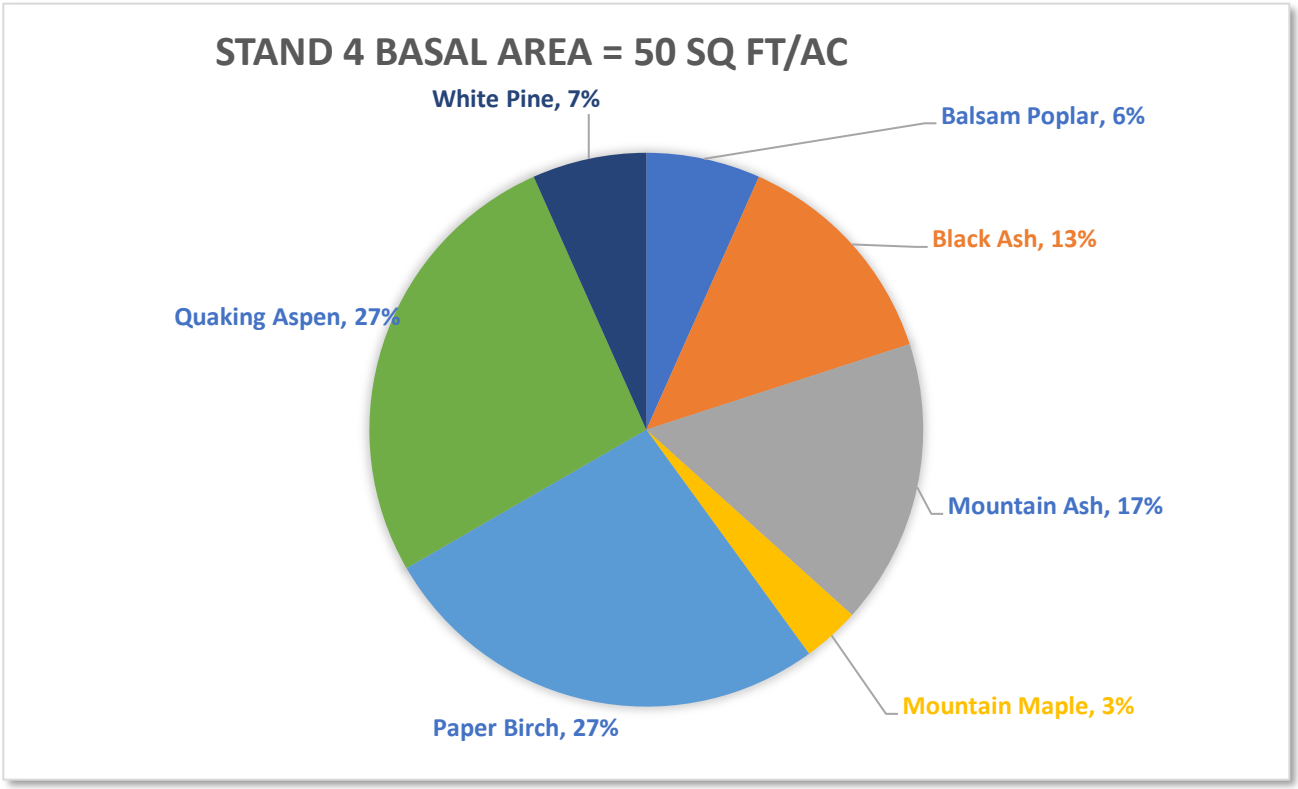
Adjacent land use concerns:
Haines Road and residential areas to the northwest may contribute runoff, pollution, trash/debris, and invasive species to the Merritt Creek watershed. The road right of way has a high concentration of non-native plants which may spread through the Merritt Creek watershed.

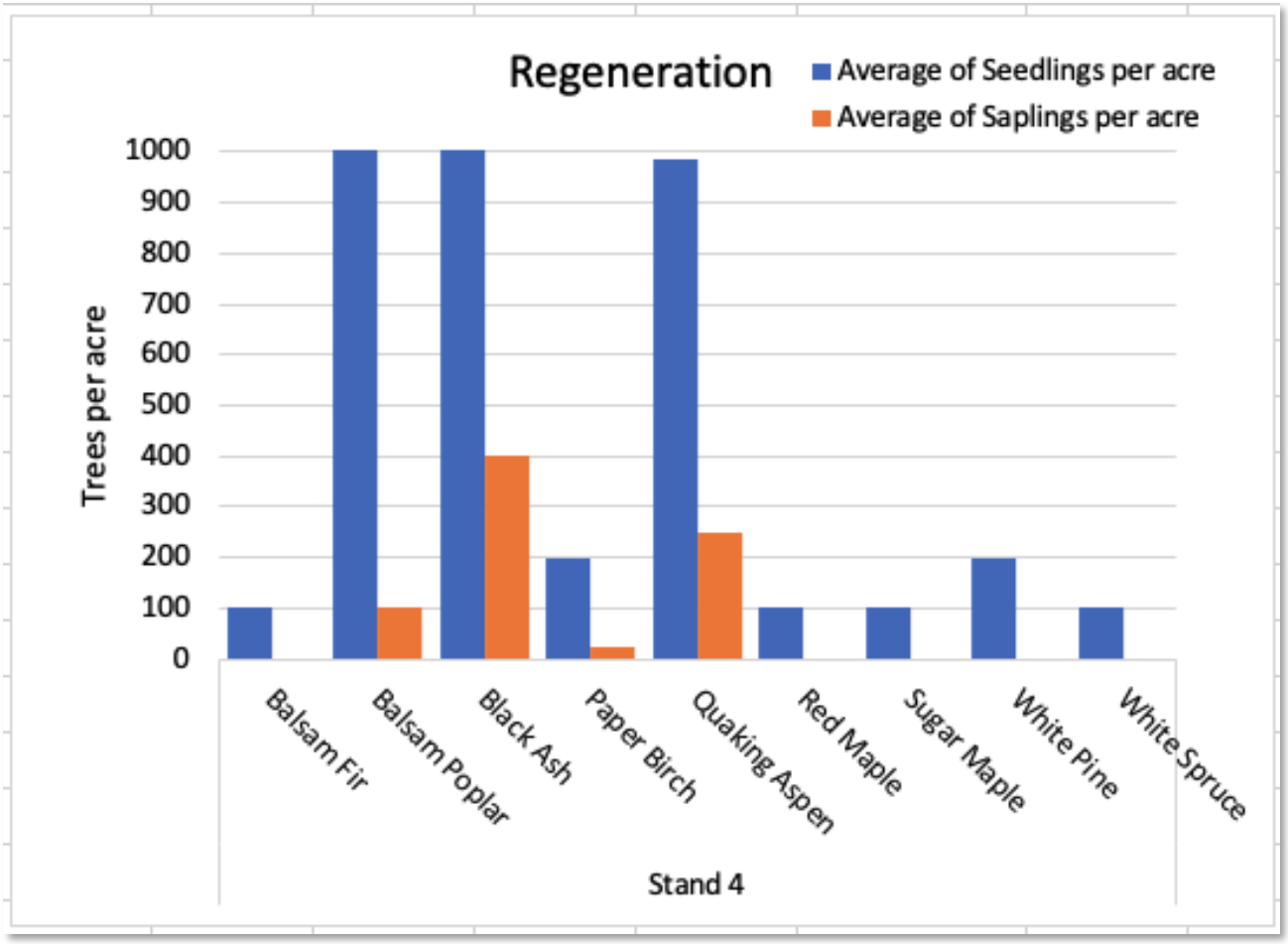
No action result (10-20 years): The stand is not likely to change much given the harsh conditions of the rocky outcrop environment and adaptation of existing plants to environmental extremes like drought, wind, and cold exposure. Greater tree mortality could occur in the event of an extreme drought or heat wave, or a wildfire with quaking aspen and paper birch as the primary regenerating species. Longer-lived conifers currently present as seedlings may achieve maturity if left undisturbed and form the next

Management Goals, Strategies, and Actions

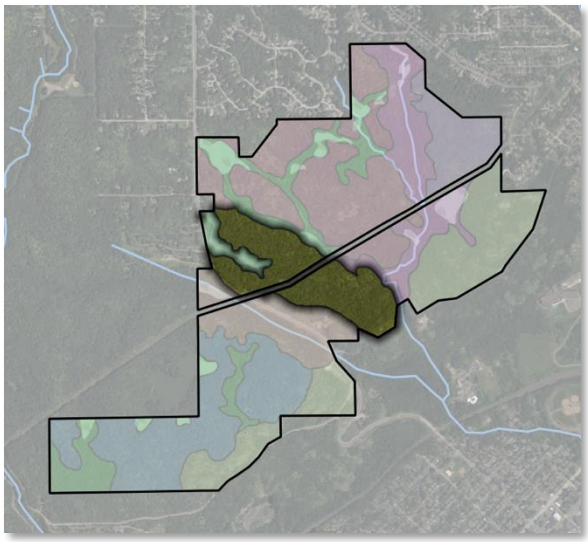
Goal	Strategy	Action	Notes
Ecosystem function; Restore/enhance native plant communities	Encourage bird and pollinator habitat	Maintain establishing vegetation through watering, pruning, mulching, etc	Recently planted trees in road right of way need maintenance

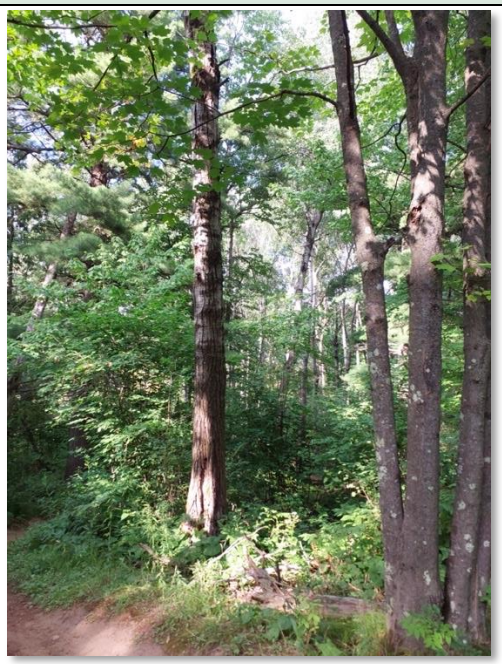

Stand 4: Diameter Distribution by Species
(Basal Area)
Basal Area (ft²/acre)
0
1
2
3
4
5
6
7
3
4
5
6
7
8
9
10
12
13
16
22
26
Diameter Class (1")
White Pine
Quaking Aspen
Paper Birch
Mountain Ash
Black Ash
Balsam Poplar


STAND 4 BASAL AREA = 50 SQ FT/AC
White Pine, 7%
Balsam Poplar, 6%
Black Ash, 13%
Quaking Aspen, 27%
Mountain Ash, 17%
Mountain Maple, 3%
Paper Birch, 27%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Black Ash
Paper Birch
Quaking Aspen
Red Maple
Sugar Maple
White Pine
White Spruce
Stand 4

Stand 5 Aspen-Birch (Hardwoods)





Stand Characteristics

Forest Type: Aspen-Birch (Hardwoods)

Size: 72 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	46.9	65%
MHn46b	14.5	20%
MHn47a	4.3	6%

Dominant Soil:

- F156D (68%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.
- F148F (19%): Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes. Silt loam or mucky silt loam to 4-6" over gravelly sandy loam or stratified silt loam to gravelly loamy coarse sand. Well drained to poorly drained.
- F141D (8%): Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes. Silt loam to 4" over gravelly sandy loam and some mucky silt loam to 40". Well drained to very poorly drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest; F093AY013MN - Loamy Upland

Successional Stage (MDNR): Mature forest (75-195 years, MHn47) with patches of young forest (0-55 years)

Average Stand Diameter (DBH): 10" DBH (SE=1.4)

Average Stand Basal Area: 65 ft2/ac (SE=15.1)

Snags per acre: 19 medium (6-11" DBH), 4 large (12"+), black ash and aspen

Coarse woody debris: Low

Wildfire risk: Low

Invasive Species: Buckthorn is present in low quantities with occasional denser patches concentrated around powerline corridor

Pests & Disease: Emerald ash borer is present where ash occurs

Current Condition: This rich mesic forest hosts a unique mature stand of yellow birch (8-23" DBH) and white cedar (averaging 15" DBH) alongside quaking aspen and a supercanopy of white pine (over 30" DBH). Paper birch, bigtooth aspen, and sugar maple are also found as mature trees. Eastern hemlock historically was also characteristic of this forest type but none are currently present. The average tree diameter is the highest of all stands on the property, but tree density is overall low - characteristic of this forest type. Regeneration is generally low and dominated by black ash, quaking aspen, with some red maple, balsam poplar, and red oak. Beaked hazel is dense in canopy openings. Serviceberry, red-osier dogwood, *Prunus* spp., and buckthorn are also common in the midstory. Ferns are abundant in the understory including bracken fern, lady fern, interrupted fern, and oak fern, as well as bush honeysuckle, goldenrod, large-leaved aster, and *Rubus* spp.

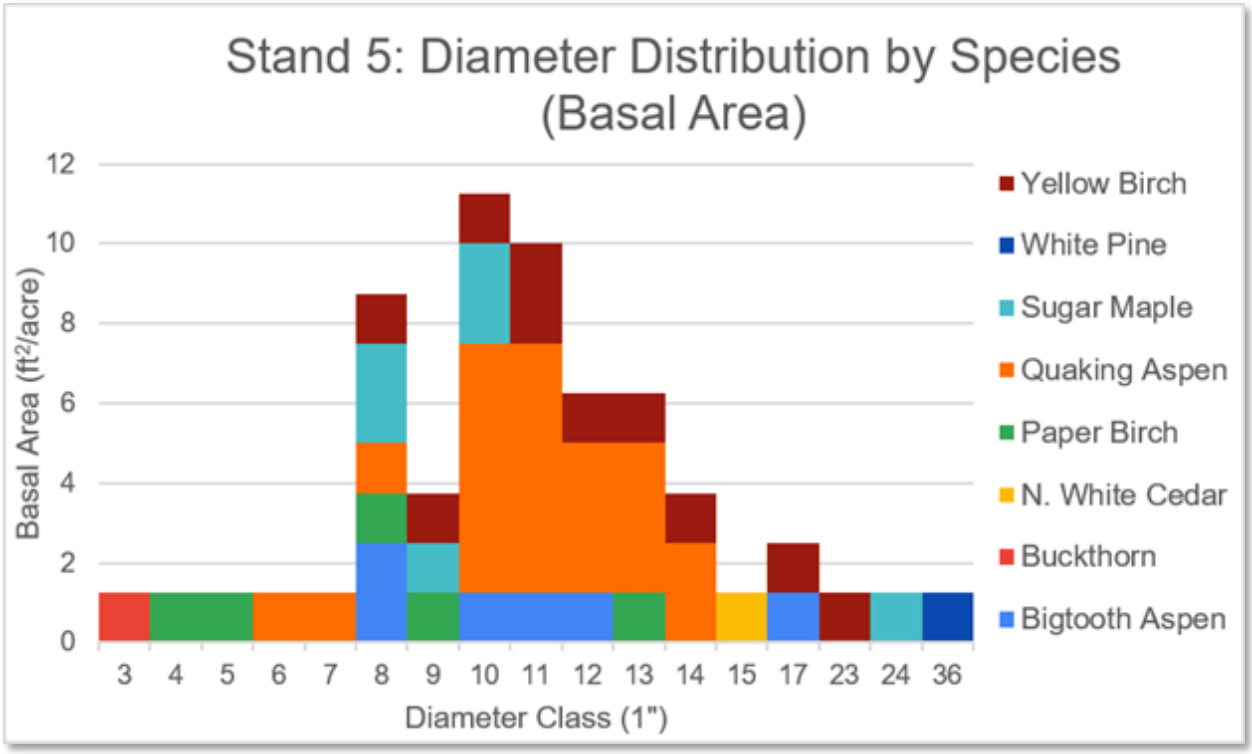
Current Recreational Uses or Management:
Several recreation trails cross through the stand, although this stand has lower trail density and larger areas between trails compared to the majority of the property.

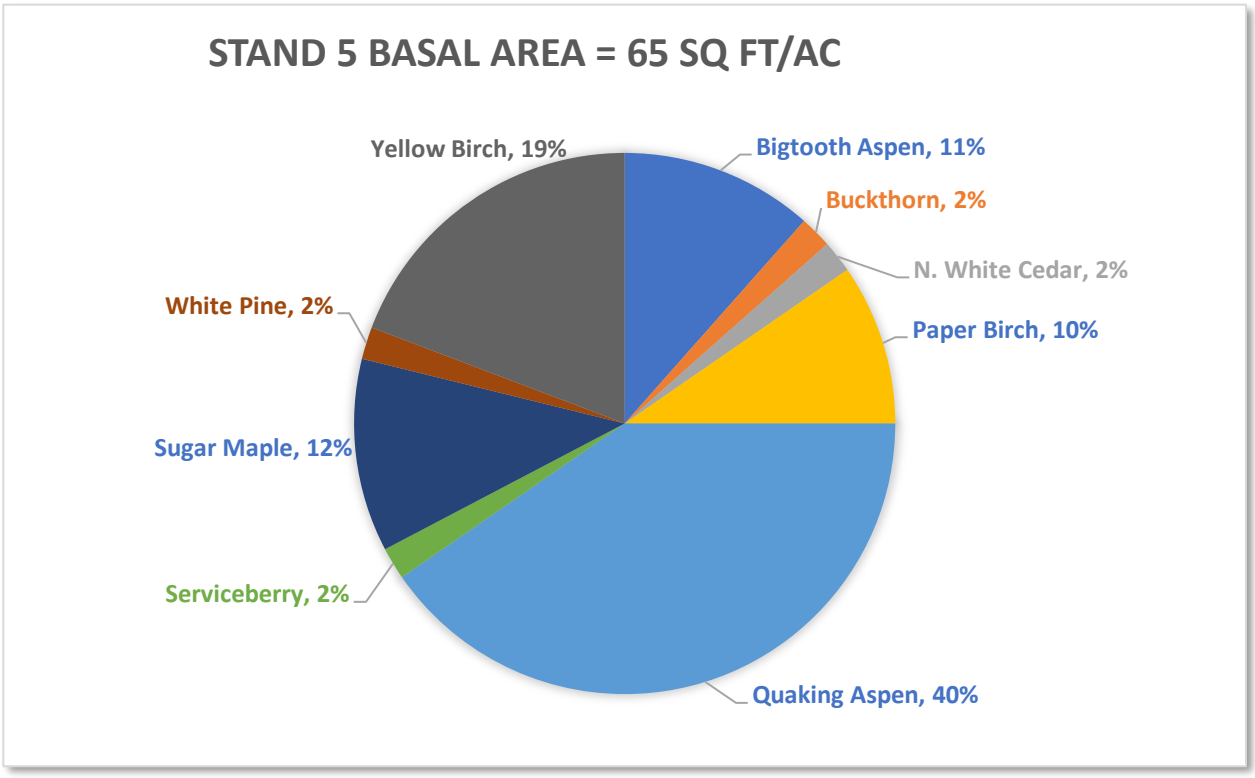
Adjacent land use concerns:
A powerline corridor bisects the unit and interrupts the mature forest characteristics with disturbance characteristics and high amounts of buckthorn.

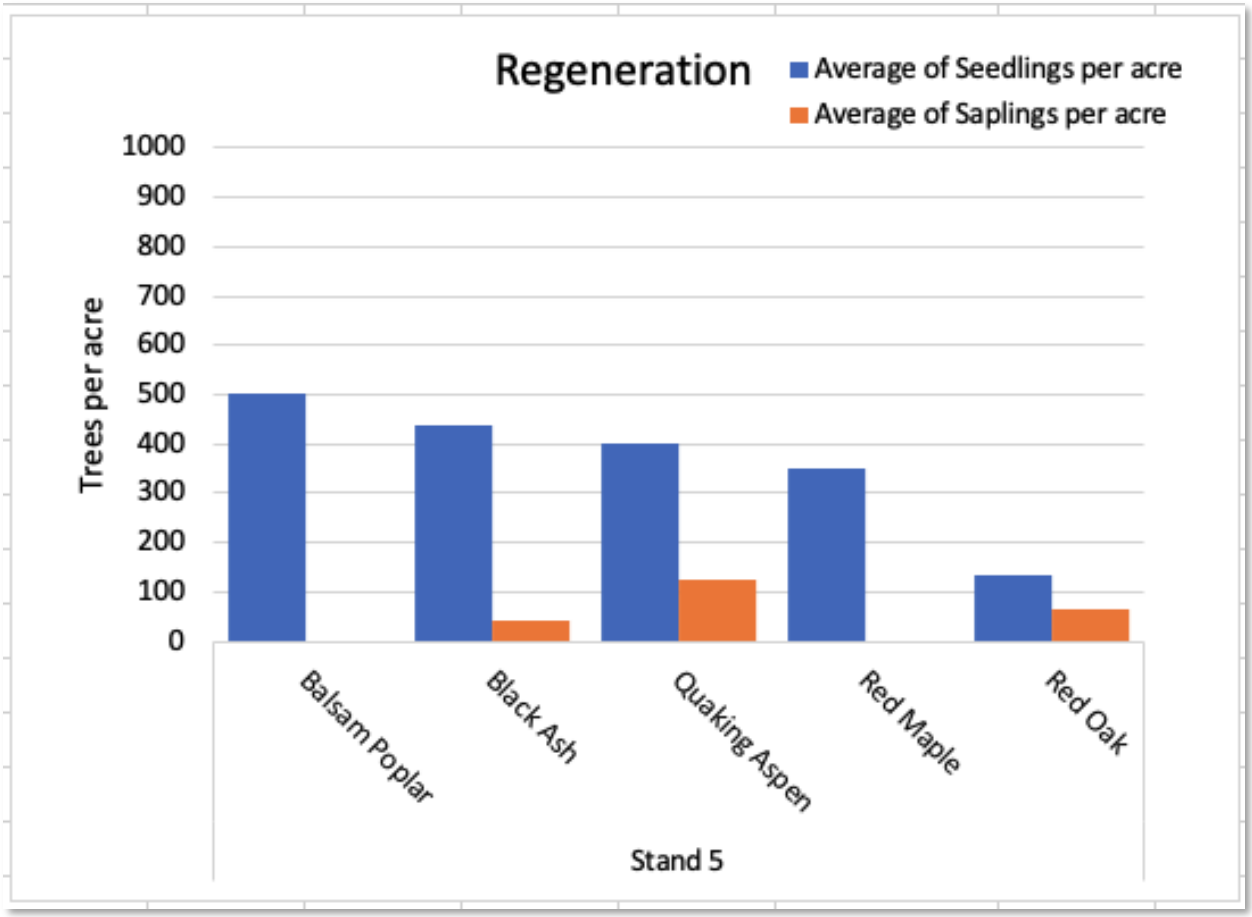
No action result (10-20 years): Yellow birch, quaking aspen, white cedar, and white pine will gradually age out and contribute coarse woody debris and snags to the forest, but are unlikely to regenerate due to deer browse and dense hazel growth. Sugar maple may become more abundant if able to establish. Quaking aspen, red oak, and red maple may become more dominant.

Management Goals, Strategies, and Actions

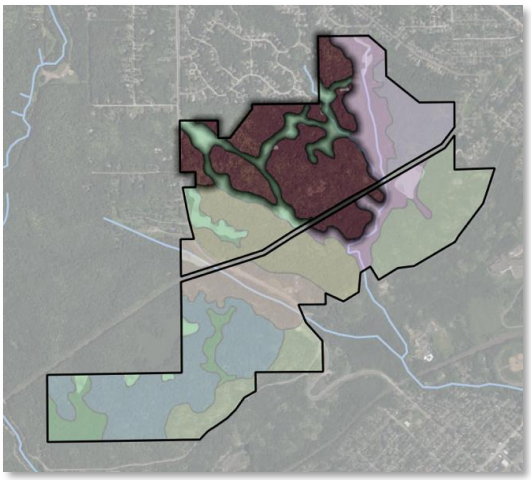
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal	along powerline and roadway
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	Prioritize areas with at least 50% sun


Stand 5: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
12
10
8
6
4
2
0
3 4 5 6 7 8 9 10 11 12 13 14 15 17 23 24 36
Diameter Class (1")
Yellow Birch
White Pine
Sugar Maple
Quaking Aspen
Paper Birch
N. White Cedar
Buckthorn
Bigtooth Aspen


STAND 5 BASAL AREA = 65 SQ FT/AC
Yellow Birch, 19%
Bigtooth Aspen, 11%
Buckthorn, 2%
N. White Cedar, 2%
Paper Birch, 10%
White Pine, 2%
Sugar Maple, 12%
Serviceberry, 2%
Quaking Aspen, 40%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Quaking Aspen
Red Maple
Red Oak
Stand 5

Stand 6 Aspen-Birch (Hardwoods)





Stand Characteristics

Forest Type: Aspen-Birch (Hardwoods)

Size: 127 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn47a	59.9	47%
MHn35b	43.3	34%
WFn55a	11.9	9%

Dominant Soil:

- F156D (51%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.
- F141D (32%): Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes. Silt loam to 4" over gravelly sandy loam and some mucky silt loam to 40". Well drained to very poorly drained.
- F135A (14%): Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes. Silt loam to 5-11" over gravelly sandy loam. Somewhat poorly drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest; F093AY013MN - Loamy Upland; F093AY006MN - Depressional Wet Hardwood Forest

Successional Stage (MDNR): Mature forest (75-195 years)

Average Stand Diameter (DBH): 8.7" DBH; SE 0.4"

Average Stand Basal Area: 102 ft2/ac, SE 12.5 ft2/ac

Snags per acre: 31 medium (6-11" DBH), aspen

Coarse woody debris: Low to medium

Wildfire risk: Low

Invasive Species: Low quantities of buckthorn and honeysuckle with isolated denser pockets

Pests & Disease: Emerald Ash Borer has caused significant ash mortality

Current Condition: This rich mesic hardwood stand is dominated by quaking aspen (average 5-10", up to 16" DBH) with paper birch and sugar maple as co-dominants. Yellow birch (11-15"), red maple, basswood, and ironwood are also present. Basal area is highest for this stand compared to any others on the property, though the stand is still relatively open, likely due to variable moisture from bedrock-controlled soils. The hardwood dominance of this stand is similar to Stand 4, but Stand 6 has fewer yellow birch and no (inventoried) white cedar or white pine. Quaking aspen, black ash, and a mix of rich hardwoods (birch, basswood, red maple, sugar maple, and red oak) form a modest regenerating cohort. Beaked hazel is thick in open canopy areas, with buckthorn, serviceberry, red-osier dogwood, and speckled alder also common

in the midstory. Grasses, bracken fern, large-leaved aster, strawberry, and goldenrod are common in the understory.

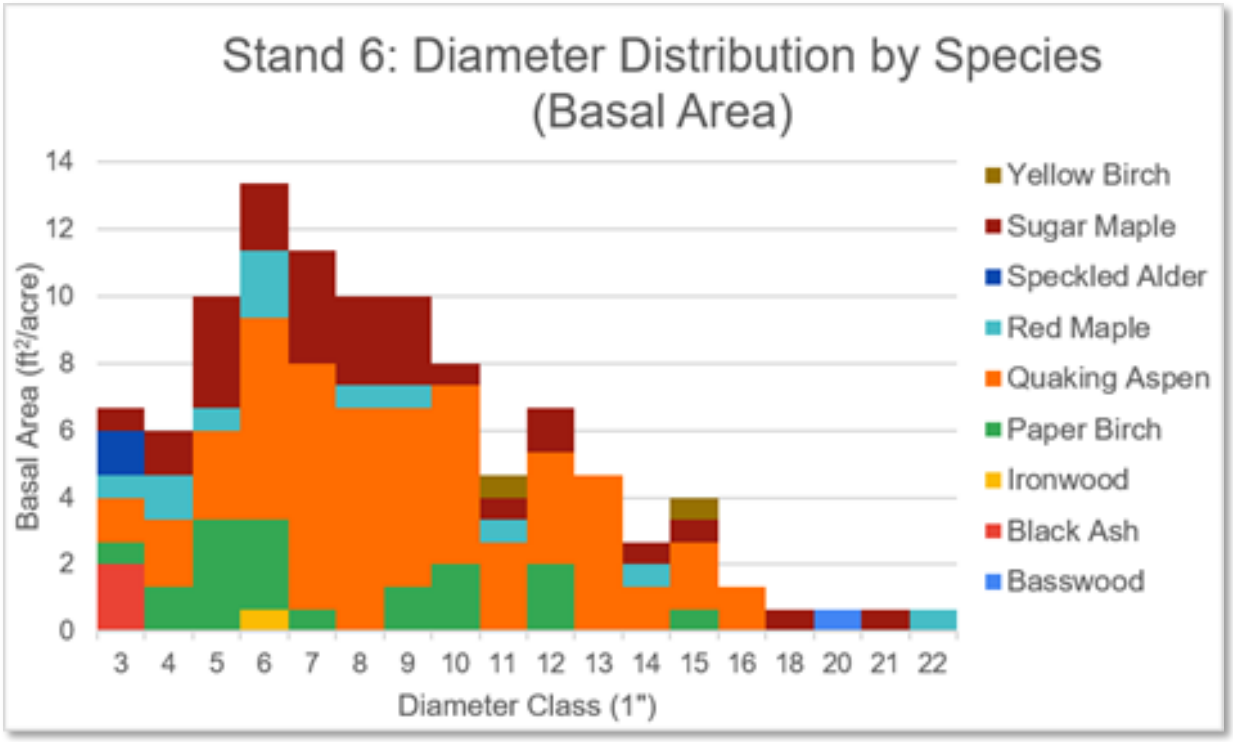
Current Recreational Uses or Management:
Several recreation trails cross through the stand.

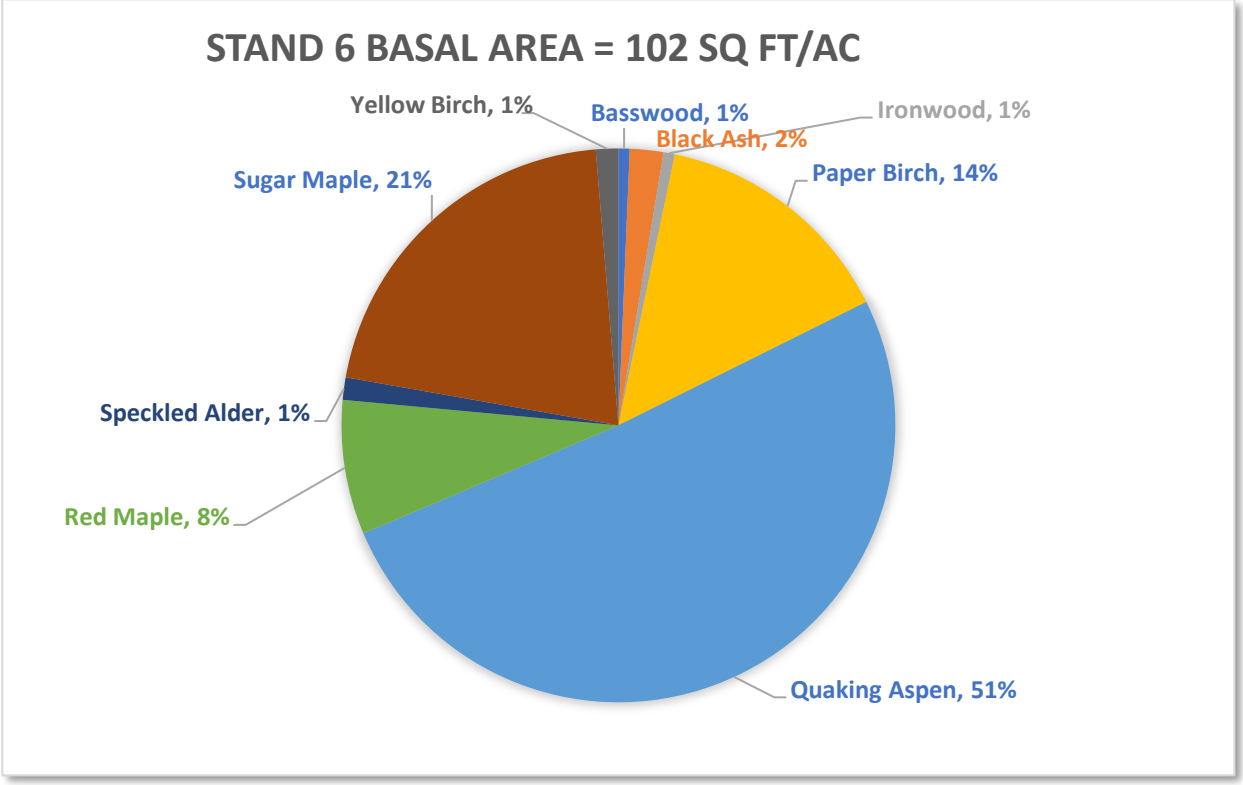
Adjacent land use concerns:
A powerline corridor bisects the unit and interrupts the mature forest characteristics with disturbance characteristics and high amounts of buckthorn.

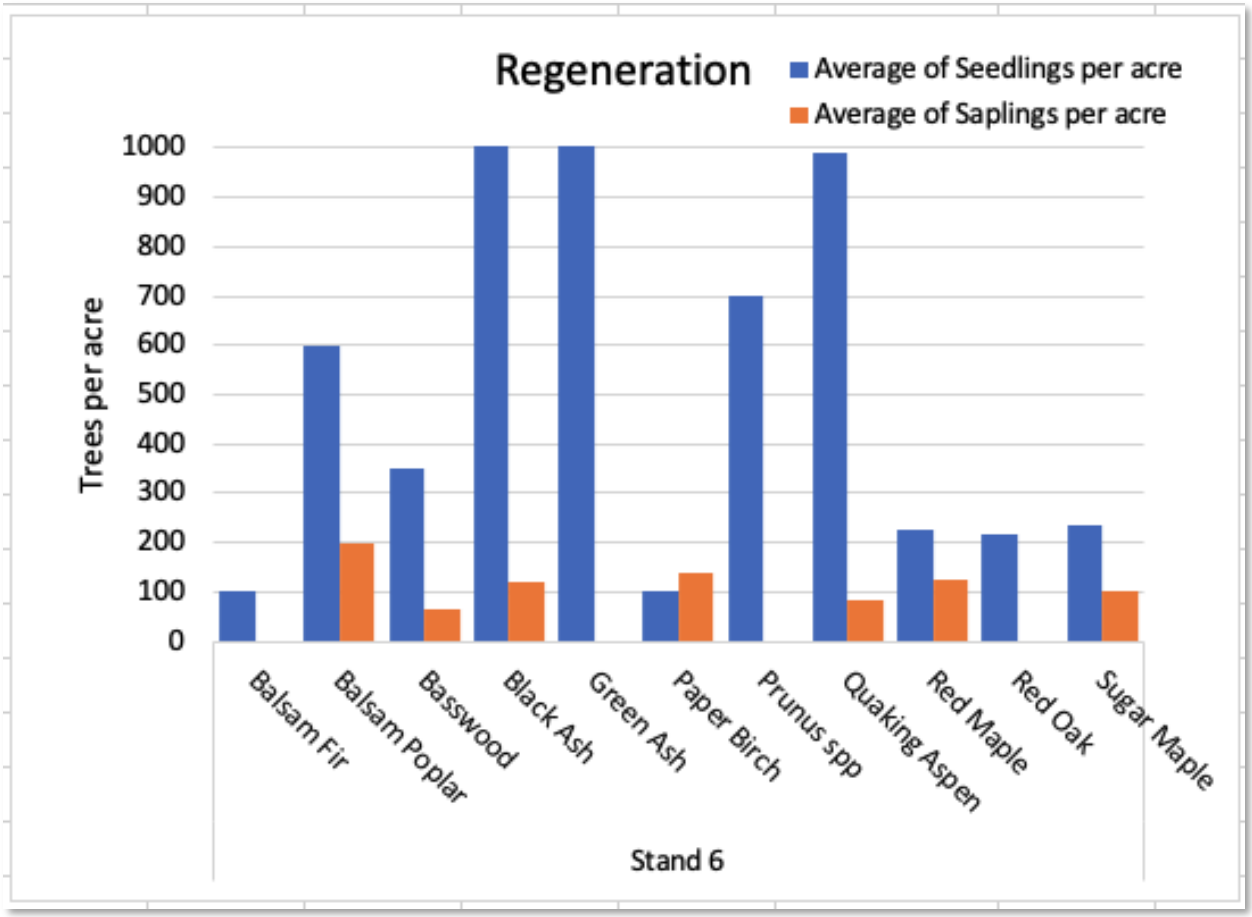
No action result (10-20 years): Hardwoods may successfully regenerate if cohorts are robust/abundant enough to withstand deer browse pressure and cold exposure in the relatively open conditions of the stand. Bedrock-controlled site conditions make the stand vulnerable to drought, so the stand may remain sparse and retain early- to mid-successional characteristics (aspen, birch, sugar maple, and basswood dominance).

Management Goals, Strategies, and Actions

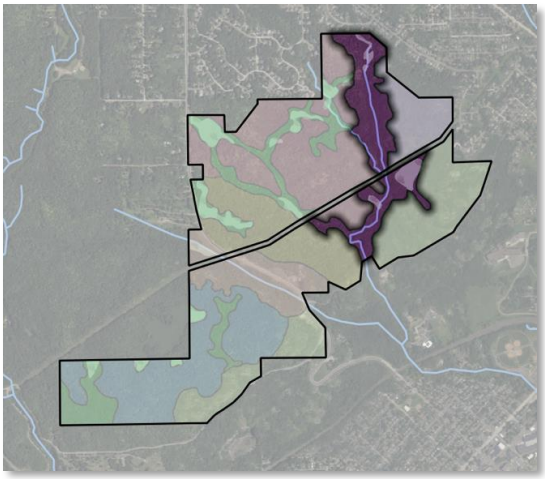
Goal	Strategy	Action	Notes
Forest resilience	Introduce tree species and genotypes well suited for future climate scenarios	Plant currently occurring species whose range naturally extends further south; Select seeds of currently occurring species from slightly more southern stock	
Regeneration	Artificial regeneration	Plant trees	Plant late successional conifers, yellow birch
Regeneration	Protect seedlings and saplings (natural or artificial regeneration)	Large area deer exclosure - natural materials or fence	Prioritize areas with at least 50% sun


Stand 6: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
0
2
4
6
8
10
12
14
3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 20 21 22
Diameter Class (1")
Yellow Birch
Sugar Maple
Speckled Alder
Red Maple
Quaking Aspen
Paper Birch
Ironwood
Black Ash
Basswood


STAND 6 BASAL AREA = 102 SQ FT/AC
Yellow Birch, 1%
Basswood, 1%
Ironwood, 1%
Black Ash, 2%
Paper Birch, 14%
Sugar Maple, 21%
Speckled Alder, 1%
Red Maple, 8%
Quaking Aspen, 51%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Fir
Balsam Poplar
Basswood
Black Ash
Green Ash
Paper Birch
Prunus spp
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
Stand 6

Stand 7 Aspen-Birch (Riparian)





Stand Characteristics

Forest Type: Aspen-Birch (Riparian)

Size: 69 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	30.7	44%
MHn46b	13.8	20%
WFn55a	9.9	14%
FPn73a	5.8	8%

Dominant Soil:

- F148F (46%): Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes. Silt loam or mucky silt loam to 4-6" over gravelly sandy loam or stratified silt loam to gravelly loamy coarse sand. Well drained to poorly drained.
- F156D (30%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.
- F134A (14%): Giese muck, depressional, 0 to 1 percent slopes. Muck to 1", silt loam to 11" over gravelly sandy loam. Very poorly drained.
- F33A (10%): Cathro muck, depressional, dense substratum, 0 to 1 percent slopes. Muck to 36" over mucky silt loam and stratified sandy loam. Very poorly drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest; F093AY013MN - Loamy Upland; F093AY004MN - Peatland

Successional Stage (MDNR): Young forest (0-55 years)

Average Stand Diameter (DBH): 8.0” DBH (SE=1.3)

Average Stand Basal Area: 50 ft2/ac (SE=15.5)

Snags per acre: 58 medium (6-11” DBH), 2 large (12”+), black ash and aspen

Coarse woody debris: Medium

Wildfire risk: Low

Invasive Species: Medium amounts of buckthorn and occasional honeysuckle, isolated pockets of thick buckthorn seedlings

Pests & Disease: Emerald ash borer where ash are present in creekbed

Current Condition: The east branch of Merritt Creek, similar to its west branch (Stand 4), is narrow with very steep and rocky embankments on both sides in its middle reaches, with flatter wetland-fed tributaries at the far north headwaters and south of the powerline corridor. The stand is overall sparse with low basal area. The creekbed and wetlands feature black ash, yellow birch (8-21" DBH), and balsam poplar (up to 14" DBH), with quaking aspen strongly dominant throughout all areas (3-11" DBH) and paper birch (6-9" DBH) present on drier embankments. The regeneration cohort is strongly quaking aspen, with smaller quantities of black ash, red maple, white spruce, and balsam poplar. Midstory is sparse to moderate with *Prunus* spp., serviceberry, mountain ash, sumac, and hawthorn on exposed slopes and beaked hazel, red-osier dogwood, willows, and pockets of thick buckthorn seedlings in deeper wetter soils. The steep ravines feature exposed bedrock and open-exposed plant communities of mosses and lichens, grasses, goldenrod, and yarrow, while surrounding mesic forests feature bush honeysuckle, lady fern, large-leaf aster, and bracken fern.

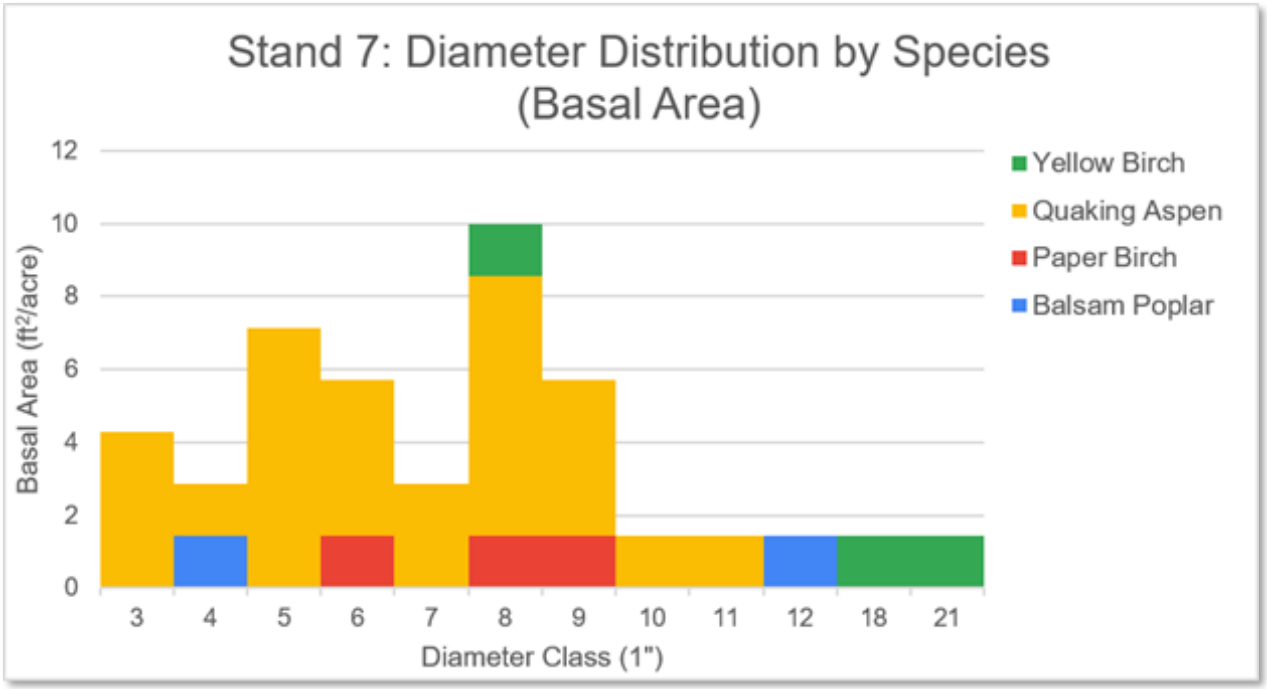
Current Recreational Uses or Management:
Several trails cross through the unit There is a trailhead at the north end of the stand. A powerline corridor crosses through the unit at the juncture of two creek tributaries and a wetland.

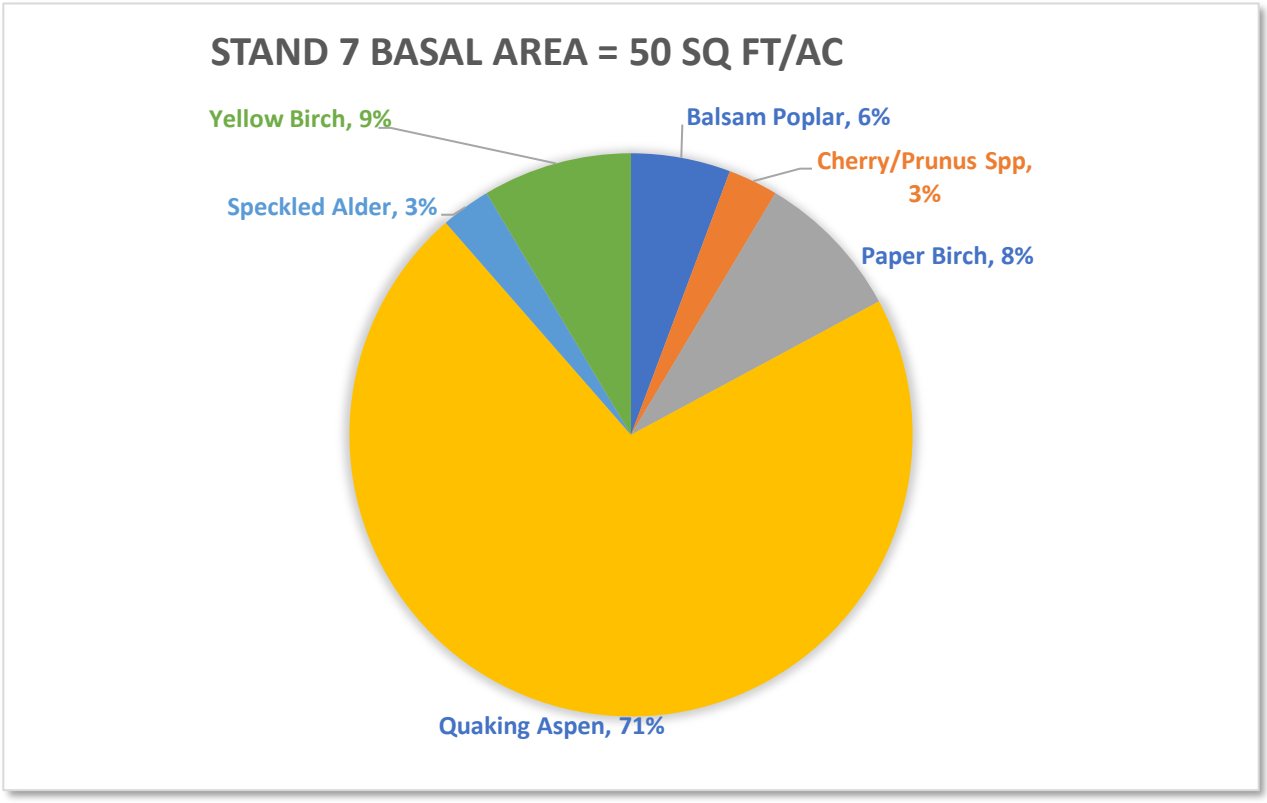
Adjacent land use concerns:
Moderately dense residential area and a trailhead at the headwaters of Merritt Creek to the north may contribute runoff, pollution, trash/debris, and invasive species to Merritt Creek. The powerline corridor may be impacting stream and wetland hydrology.

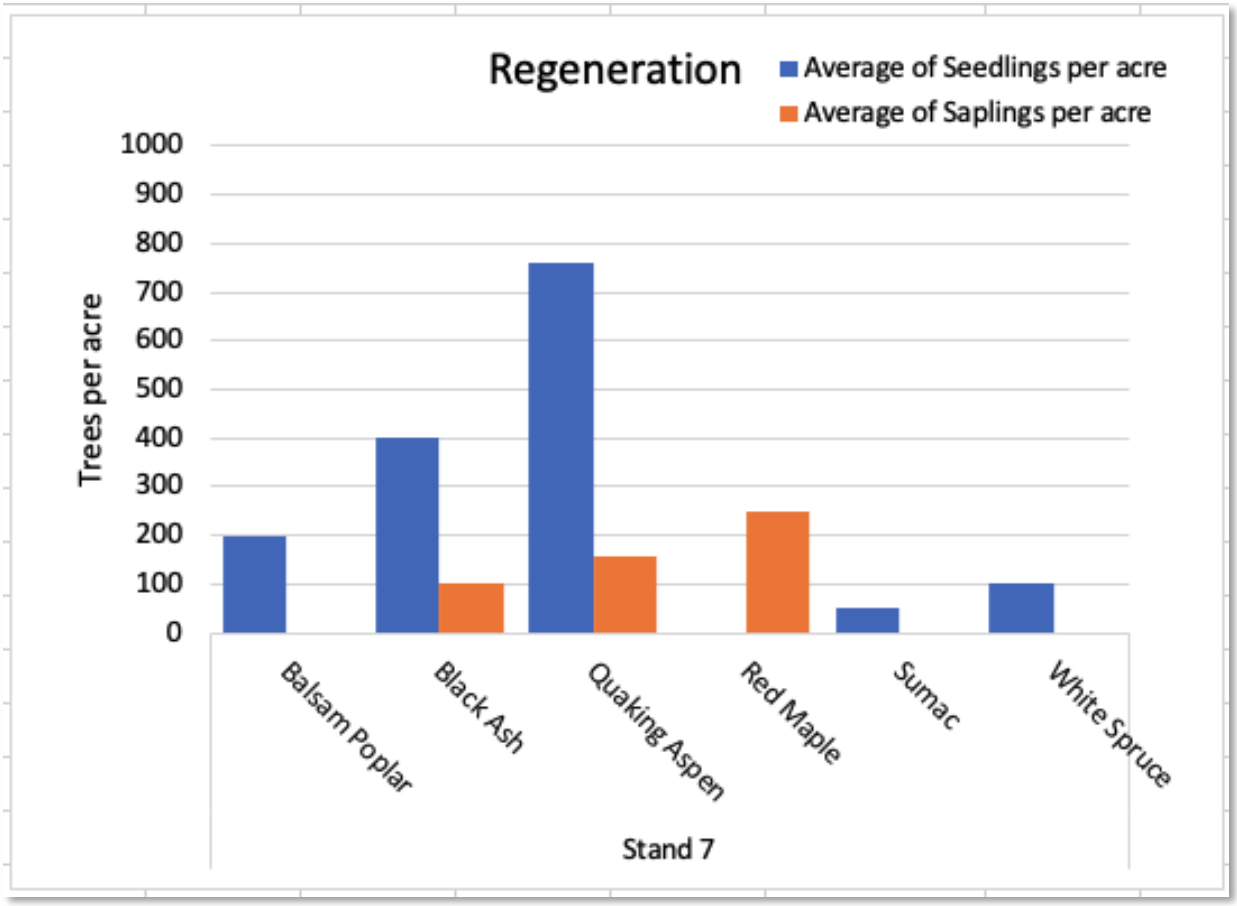
No action result (10-20 years): The tree composition is likely to remain low diversity and aspen dominated due to poor bedrock-controlled site conditions. Buckthorn may expand and become more dominant in wetland and floodplain areas, or balsam poplar and white spruce may eventually replace black ash as the dominant trees.

Management Goals, Strategies, and Actions

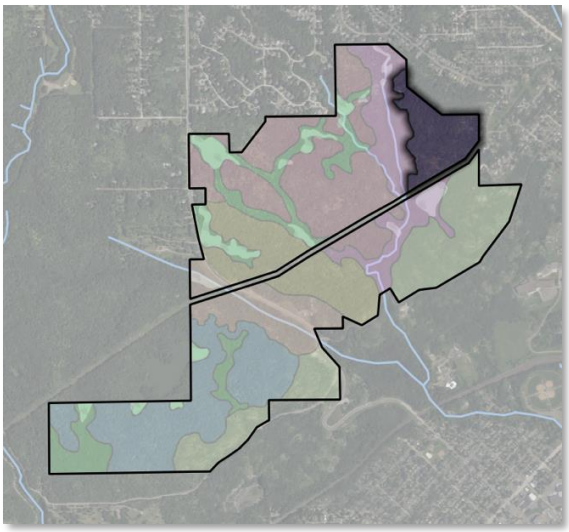
Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal	

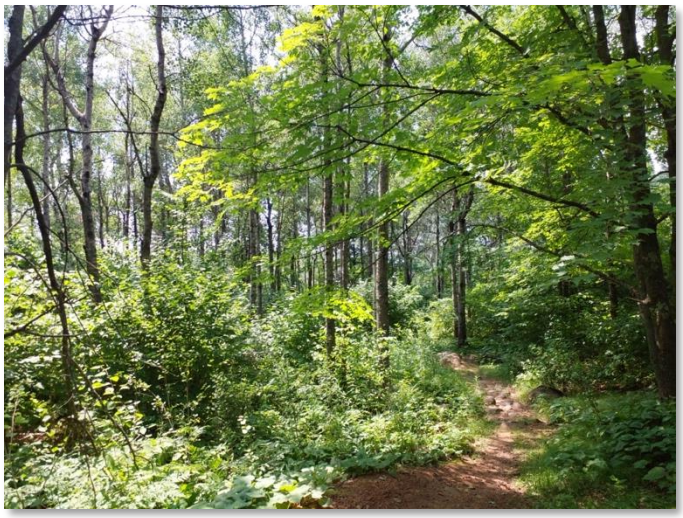

Stand 7: Diameter Distribution by Species (Basal Area)
Basal Area (ft²/acre)
12
10
8
6
4
2
0
3
4
5
6
7
8
9
10
11
12
18
21
Diameter Class (1")
Yellow Birch
Quaking Aspen
Paper Birch
Balsam Poplar


STAND 7 BASAL AREA = 50 SQ FT/AC
Yellow Birch, 9%
Balsam Poplar, 6%
Cherry/Prunus Spp, 3%
Speckled Alder, 3%
Paper Birch, 8%
Quaking Aspen, 71%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Balsam Poplar
Black Ash
Quaking Aspen
Red Maple
Sumac
White Spruce
Stand 7

Stand 8 Aspen-Birch (Hardwoods)





Stand Characteristics

Forest Type: Aspen-Birch (Hardwoods)

Size: 37 acres

NPC (MDNR)	*Acres*	*% of stand*
MHn35b	21.6	59%
ROn23b	8.6	23%
MHn47a	4.2	12%

Dominant Soil:

- F156D (86%): Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes. 0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places. Well drained.
- F160F (11%): Rock outcrop-Mesaba-Barto complex, 18 to 60% slopes. 0-40" to lithic bedrock; gravelly sandy loam. Well drained.

Ecological Site (USDA): F093AY009MN - Bedrock Controlled Upland Forest

Successional Stage (MDNR): Young forest (0-55 years)

Average Stand Diameter (DBH): 7.5" DBH (SE=0.7)

Average Stand Basal Area: 71 ft2/ac (SE=14.9)

Snags per acre: 5 medium (6-11" DBH), aspen

Coarse woody debris: Variable amounts

Wildfire risk: Low

Invasive Species: Variable amounts of buckthorn

Pests & Disease: N/A

Current Condition: This is a poor-quality bedrock-controlled quaking aspen and paper birch forest on a ridgetop with small, sparsely-growing trees up to 9" DBH. Mountain ash, red maple, and occasional red oak are also able to persist in the rocky and exposed conditions. Quaking aspen, paper birch, and red maple were the only regenerating trees recorded, with strong aspen dominance. Staghorn sumac, serviceberry, beaked hazel, red-osier dogwood, hawthorn, and buckthorn form a moderate to dense midstory layer. Bush honeysuckle, large-leaved aster, and hardy disturbance tolerant plants like goldenrod, yarrow, and St. John's wort characterize the understory.

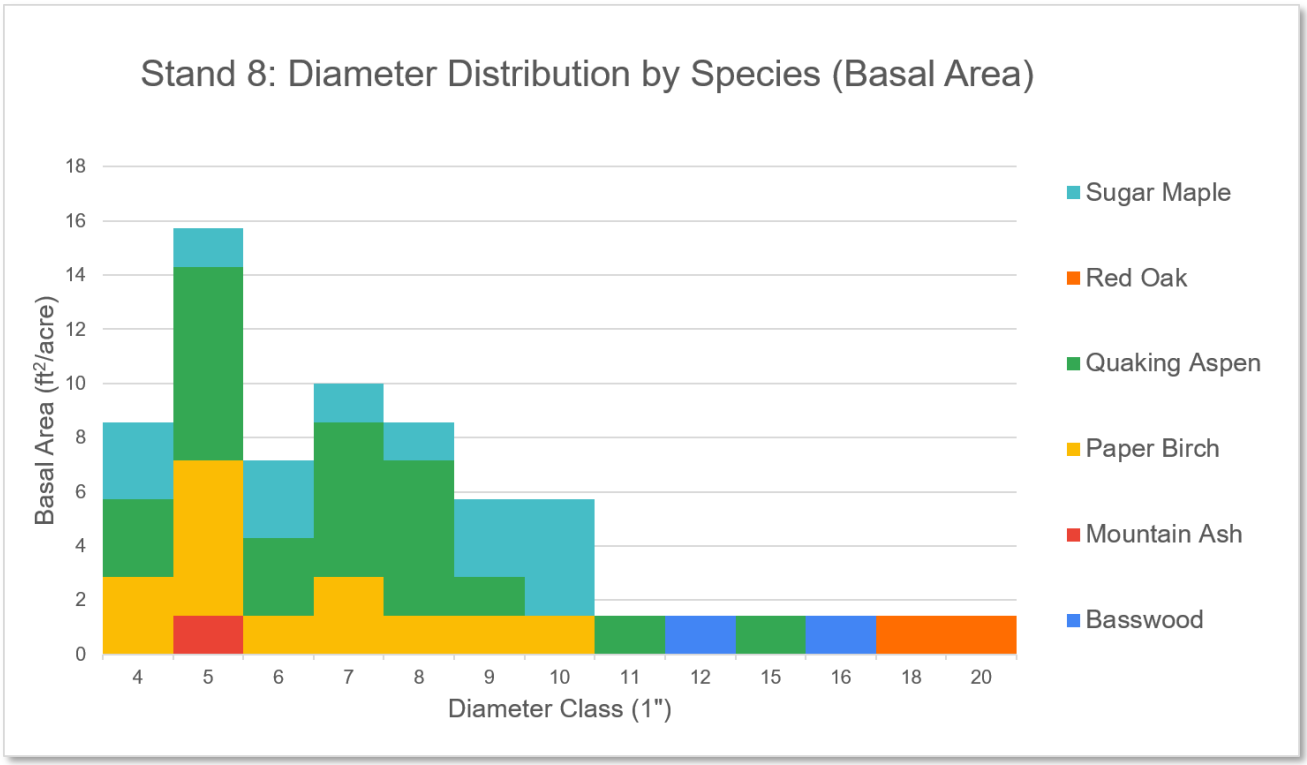
Current Recreational Uses or Management:
Several trails cross through the unit.

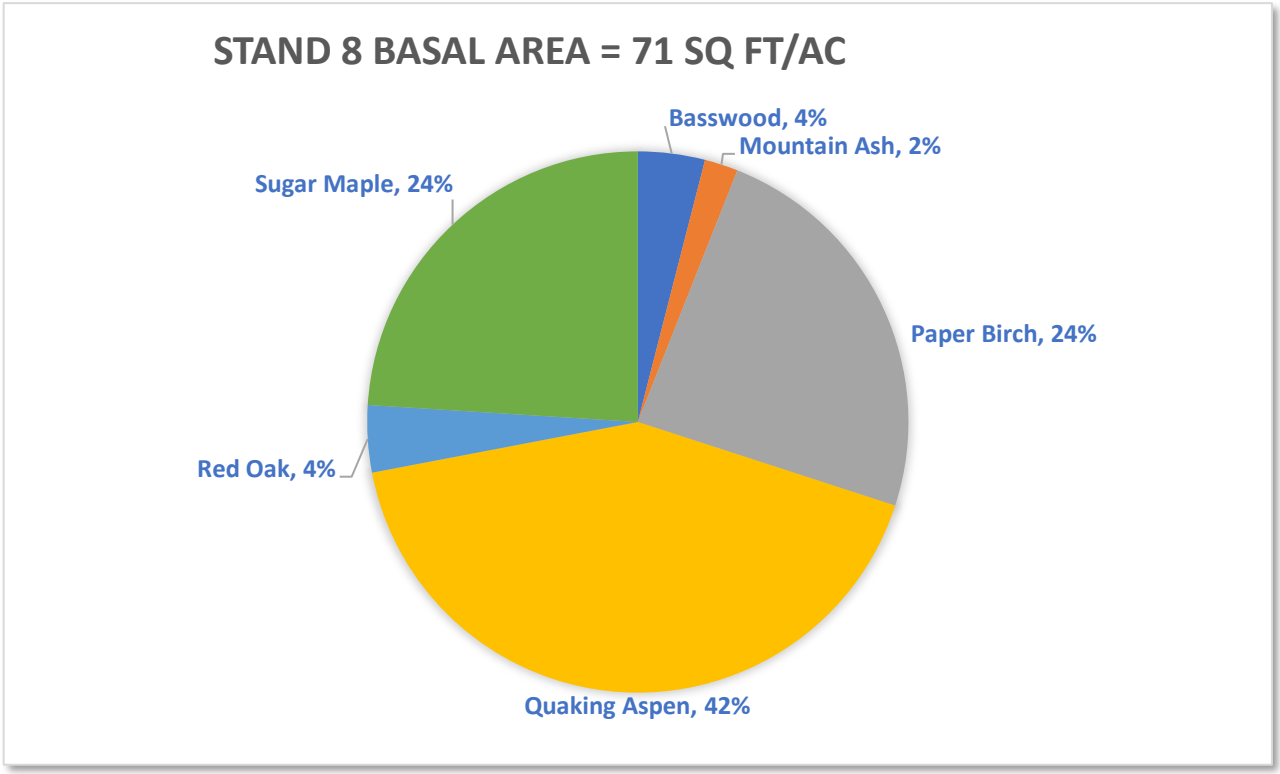
Adjacent land use concerns:
Residential areas to the north and east may be a source of off-trail visitors

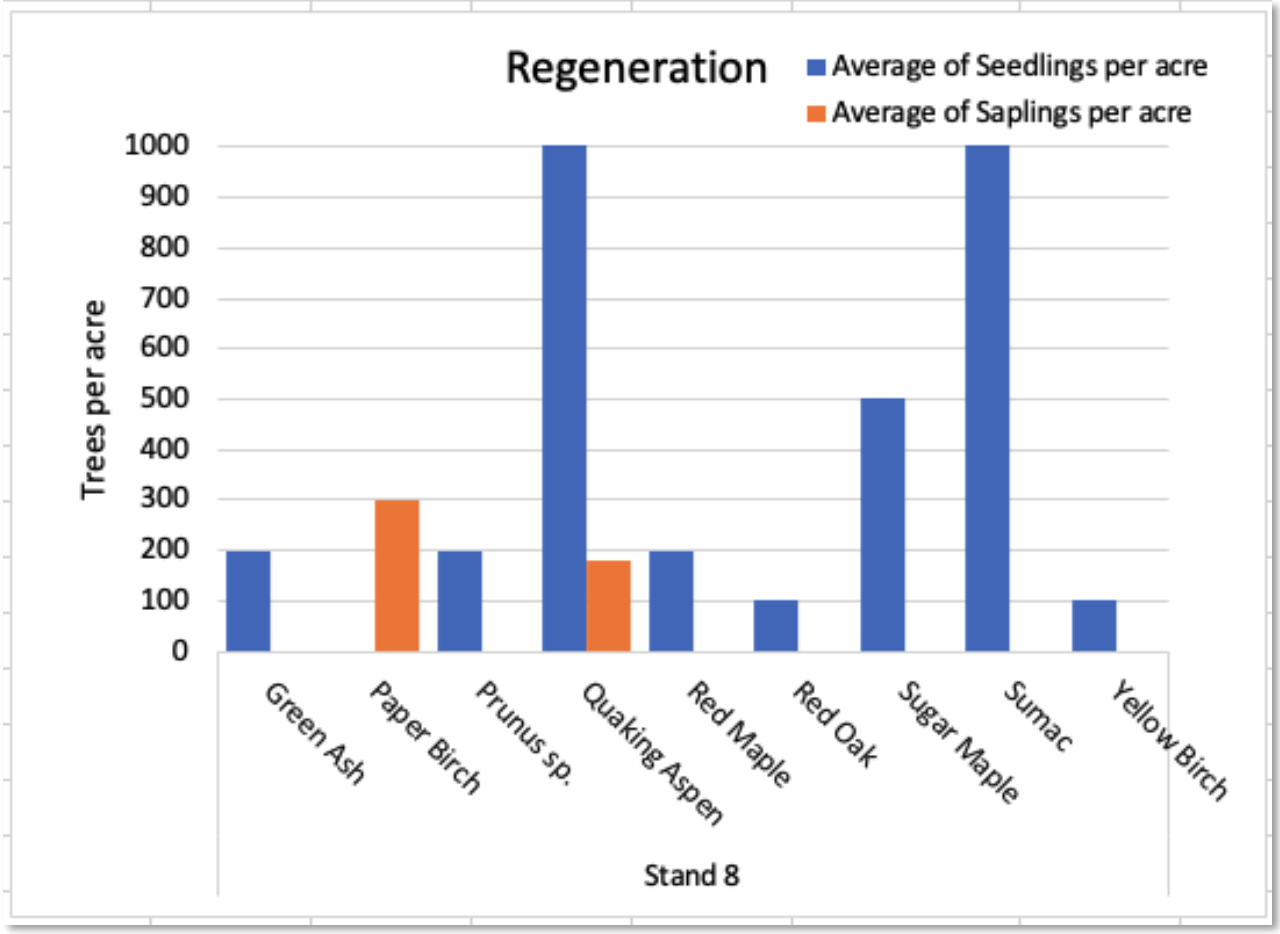
No action result (10-20 years): The stand is not likely to change much given the harsh conditions of the rocky outcrop environment and adaptation of existing plants to environmental extremes like drought, wind, and cold exposure. Greater tree mortality could occur in the event of an extreme drought or heat wave, or a wildfire with quaking aspen and paper birch as the primary regenerating species.

Management Goals, Strategies, and Actions

Goal	Strategy	Action	Notes
Restore/enhance native plant communities	Buckthorn Removal	Hand pull seedlings up to 1" diameter; Hand cut or chainsaw stems >1" diameter; Follow-up foliar herbicide treatment after initial removal	Supplement to burning in rocky outcrop areas; Cut stumps and herbicide treatment; hand pull seedlings
Restore/enhance native plant communities; Recreation	Restore and maintain fire-dependent plant communities	Prescribed burning	Rocky outcrops only, patch burns




STAND 8 BASAL AREA = 71 SQ FT/AC
Basswood, 4%
Mountain Ash, 2%
Sugar Maple, 24%
Paper Birch, 24%
Red Oak, 4%
Quaking Aspen, 42%


Regeneration
Average of Seedlings per acre
Average of Saplings per acre
Trees per acre
1000
900
800
700
600
500
400
300
200
100
0
Green Ash
Paper Birch
Prunus sp.
Quaking Aspen
Red Maple
Red Oak
Sugar Maple
Sumac
Yellow Birch
Stand 8

Appendices

A. Soil Maps
B. Soils Description Charts
C. Native Plant Communities by Property and Stands
D. Stands Maps
E. Management Maps
F. Basal Area Summary Chart
G. Regeneration Summary Chart

Spatial Data (Shapefiles)

A. Stand boundaries and attributes
B. Management activities with stand attributes
C. Inventory plot locations

Tabular Data (Excel)

A. Inventory data
B. Site index data

Appendices

for the

CITY OF DULUTH FOREST MANAGEMENT PLAN

FOR THE NATURAL AREAS: LESTER-AMITY-HAWK RIDGE, MISSION CREEK AND PIEDMONT-BREWER

Plan completed in August 2026 by:
Abby Andrus Colehour and Nia Moses Becker – Dovetail Partners, inc.
With contributions by Mark White

For Kate Kubiak and Clark Christensen – City of Duluth and Daryl Peterson – Minnesota Land Trust



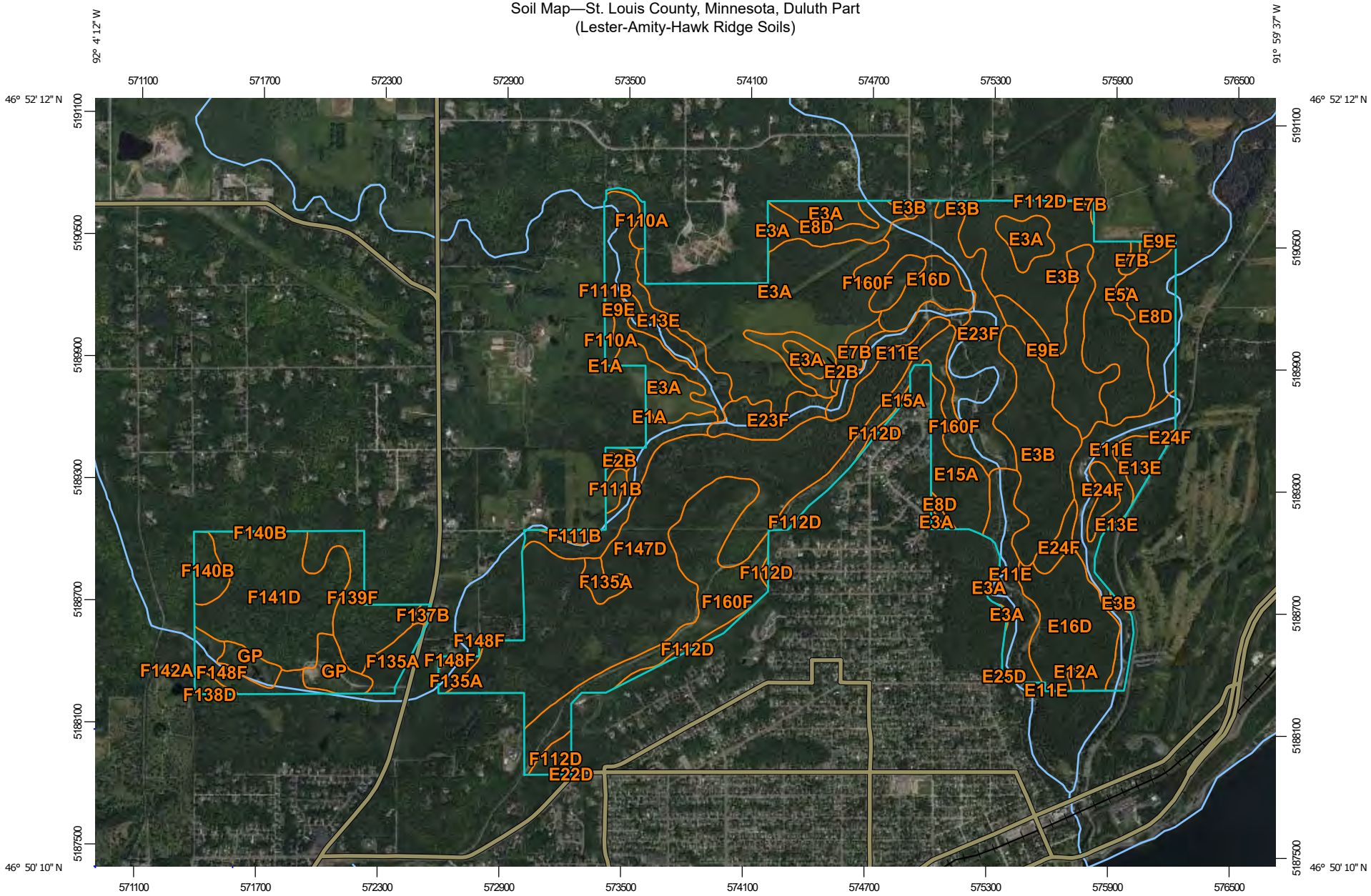
Table of Contents

Appendices

A. Soil Maps
B. Soils Description Charts
C. Native Plant Communities by Property and Stands
D. Stands Maps
E. Management Maps
F. Basal Area Summary Chart
G. Regeneration Summary Chart

Appendix A: Soil Maps

Soil Map—St. Louis County, Minnesota, Duluth Part
(Lester-Amity-Hawk Ridge Soils)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Louis County, Minnesota, Duluth Part
Survey Area Data: Version 23, Sep 10, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 30, 2020—Jul 1, 2022

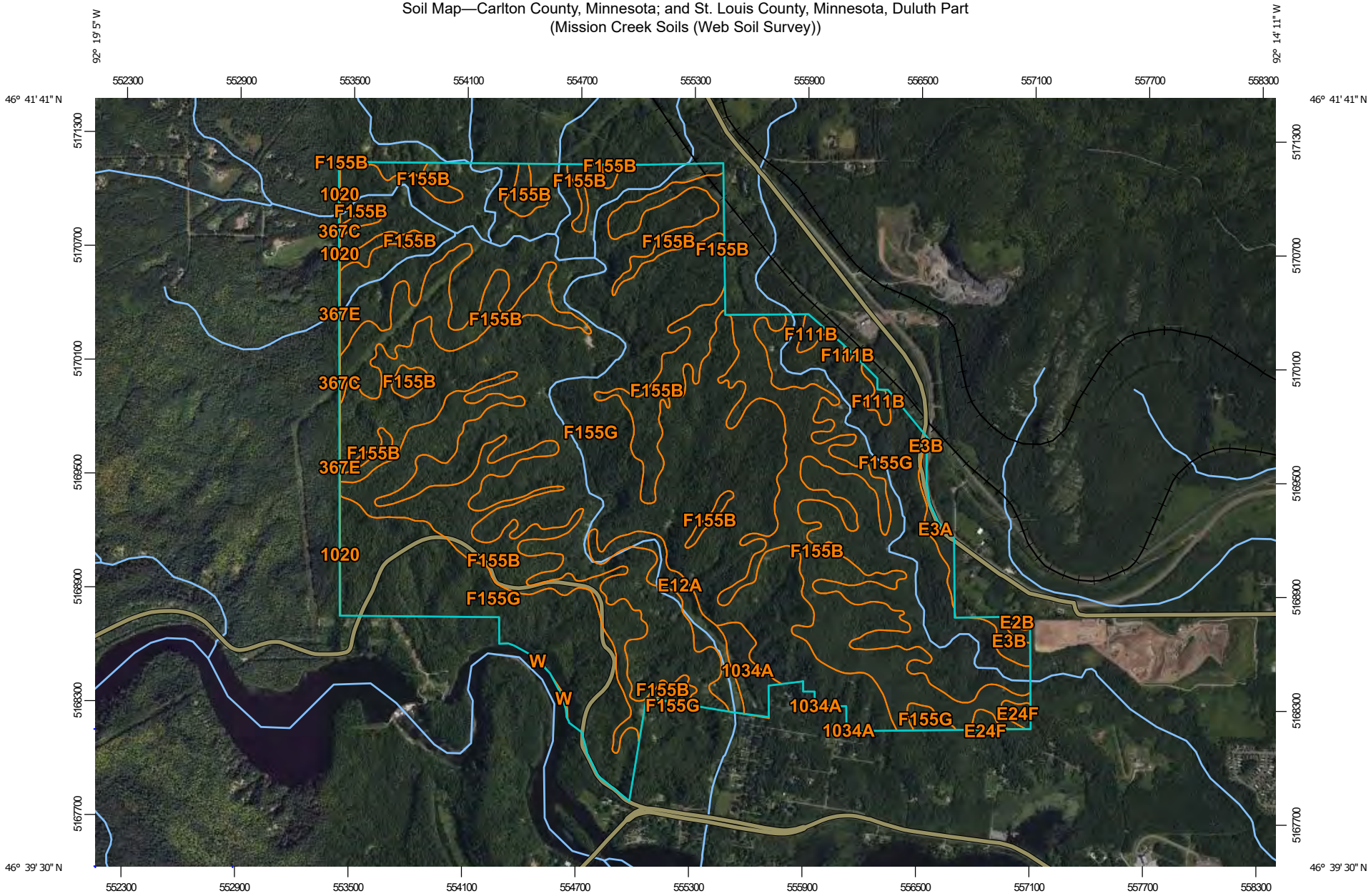
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
E1A	Fluvaquents, clayey, 0 to 1 percent slopes, frequently flooded	0.5	0.0%
E2B	Cuttre-Fluvaquents, frequently flooded, complex, 0 to 8 percent slopes	15.2	1.0%
E3A	Cuttre complex, 0 to 3 percent slopes	173.2	11.6%
E3B	Cuttre complex, 0 to 8 percent slopes	173.9	11.7%
E5A	Palmers, depressional-Cuttre complex, 0 to 1 percent slopes	3.1	0.2%
E7B	Cuttre silt loam, 3 to 8 percent slopes	10.3	0.7%
E8D	Amnicon-Fluvaquents, frequently flooded, complex, 0 to 18 percent slopes	79.5	5.3%
E9E	Miskoaki-Fluvaquents, frequently flooded, complex, 0 to 45 percent slopes	91.1	6.1%
E11E	Miskoaki-Rock outcrop complex, 18 to 70 percent slopes	101.7	6.8%
E12A	Udifluvents complex, 0 to 3 percent slopes, flooded	1.6	0.1%
E13E	Udifluvents, occasionally flooded-Rollins complex, 0 to 30 percent slopes	21.1	1.4%
E15A	Badriver complex, 0 to 3 percent slopes	29.2	2.0%
E16D	Amnicon-Cuttre complex, 5 to 18 percent slopes	76.3	5.1%
E22D	Sanborg-Badriver complex, 3 to 18 percent slopes	0.0	0.0%
E23F	Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes	104.3	7.0%
E24F	Miskoaki-Cuttre complex, 5 to 45 percent slopes	15.5	1.0%
E25D	Urban land-Amnicon-Rock outcrop complex, 0 to 18 percent slopes	0.0	0.0%
F110A	Hegberg-Eldes complex, 0 to 3 percent slopes	7.4	0.5%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
F111B	Augustana-Hegberg complex, 1 to 8 percent slopes	7.1	0.5%
F112D	Forbay-Augustana complex, 3 to 18 percent slopes	12.3	0.8%
F135A	Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes	24.8	1.7%
F137B	Normanna-Canosia-Hermantown complex, 0 to 8 percent slopes	1.6	0.1%
F138D	Ahmeek-Normanna-Canosia complex, 0 to 18 percent slopes	3.5	0.2%
F139F	Ahmeek-Canosia complex, 0 to 45 percent slopes	38.1	2.6%
F140B	Normanna-Giese, depressional, complex, pitted, 0 to 8 percent slopes	11.2	0.8%
F141D	Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes	87.8	5.9%
F142A	Canosia loam, 0 to 2 percent slopes	0.1	0.0%
F147D	Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes	247.4	16.6%
F148F	Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes	17.1	1.1%
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes	115.4	7.7%
GP	Pits, gravel-Udipsamments complex	22.2	1.5%
Totals for Area of Interest		**1,492.4**	**100.0%**

Soil Map—Carlton County, Minnesota; and St. Louis County, Minnesota, Duluth Part
(Mission Creek Soils (Web Soil Survey))



Map Scale: 1:28,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carlton County, Minnesota
Survey Area Data: Version 24, Sep 9, 2025

Soil Survey Area: St. Louis County, Minnesota, Duluth Part
Survey Area Data: Version 23, Sep 10, 2025

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 30, 2020—Jul 1, 2022

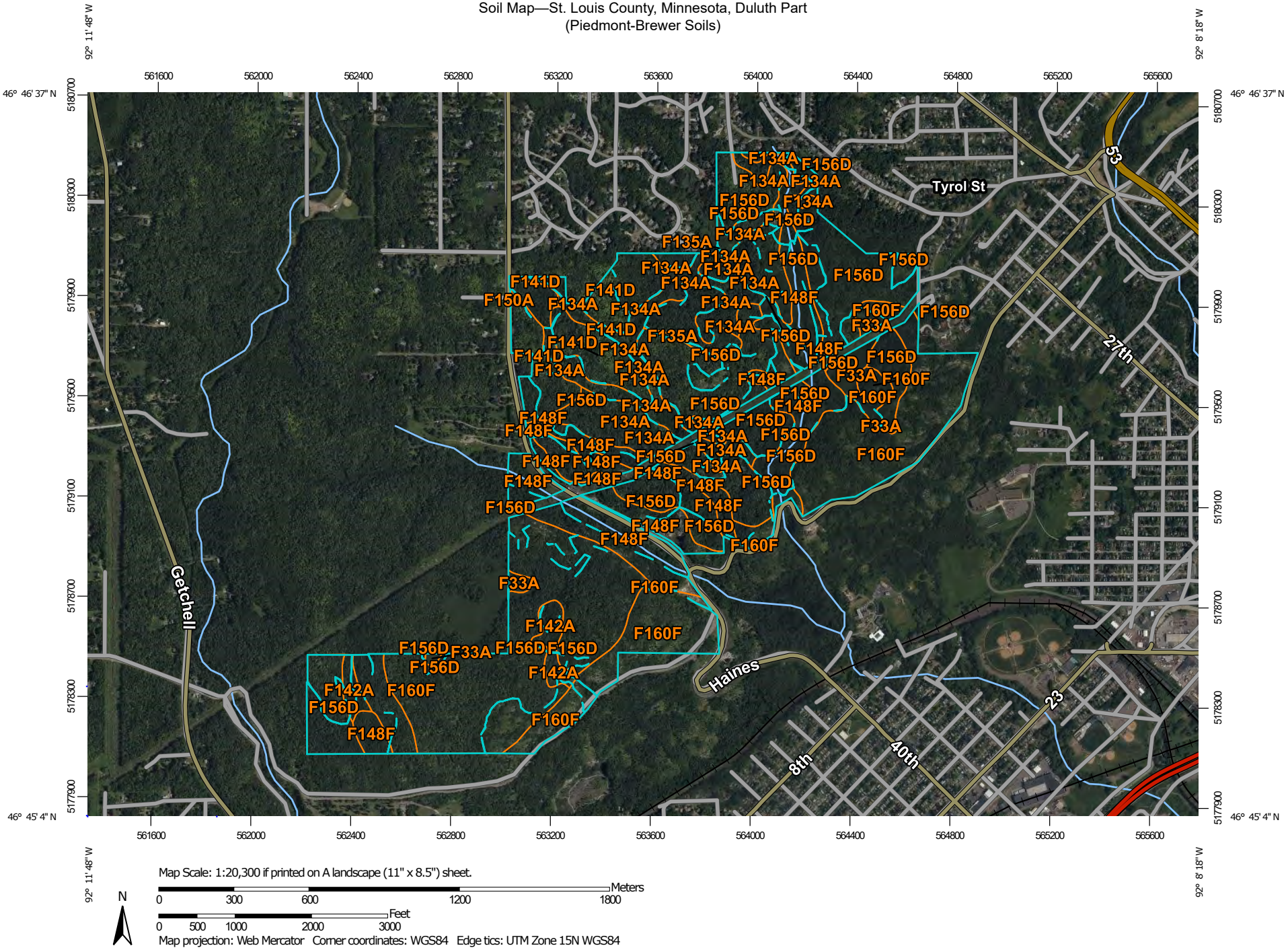
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
367C	Campia silt loam, 2 to 12 percent slopes	0.2	0.0%
367E	Campia silt loam, 12 to 25 percent slopes	0.9	0.0%
1020	Udorthents	1.3	0.1%
Subtotals for Soil Survey Area		**2.5**	**0.1%**
Totals for Area of Interest		**1,964.5**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1034A	Udifluvents and Fluvaquents, loamy, 0 to 2 percent slopes, rarely flooded	17.9	0.9%
E2B	Cuttre-Fluvaquents, frequently flooded, complex, 0 to 8 percent slopes	2.1	0.1%
E3A	Cuttre complex, 0 to 3 percent slopes	9.4	0.5%
E3B	Cuttre complex, 0 to 8 percent slopes	8.9	0.5%
E12A	Udifluvents complex, 0 to 3 percent slopes, flooded	31.8	1.6%
E24F	Miskoaki-Cuttre complex, 5 to 45 percent slopes	7.3	0.4%
F111B	Augustana-Hegberg complex, 1 to 8 percent slopes	9.9	0.5%
F155B	Udalfs-Eutrudepts complex, 0 to 8 percent slopes	497.8	25.3%
F155G	Udalfs-Eutrudepts complex, 25 to 70 percent slopes	1,376.2	70.1%
W	Water	0.5	0.0%
Subtotals for Soil Survey Area		**1,962.1**	**99.9%**
Totals for Area of Interest		**1,964.5**	**100.0%**

Soil Map—St. Louis County, Minnesota, Duluth Part
(Piedmont-Brewer Soils)



Map Scale: 1:20,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Louis County, Minnesota, Duluth Part
Survey Area Data: Version 23, Sep 10, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2022—Jul 1, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
F33A	Cathro muck, depressional, dense substratum, 0 to 1 percent slopes	9.7	1.5%
F134A	Giese muck, depressional, 0 to 1 percent slopes	46.4	7.1%
F135A	Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes	17.9	2.7%
F141D	Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes	49.3	7.5%
F142A	Canosia loam, 0 to 2 percent slopes	10.8	1.6%
F148F	Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes	96.6	14.7%
F150A	Twig-Tacoosh-Giese complex, depressional, 0 to 1 percent slopes	5.2	0.8%
F156D	Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18 percent slopes	306.7	46.8%
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes	112.7	17.2%
Totals for Area of Interest		**655.9**	**100.0%**

Appendix B: Soil Description Charts

Lester - Soils Description

Soil Code	Soil Name	Acres	Percent of property	Landform	Parent material	Soil texture	Eco Site	Drainage	Hydric	Location
F147D	Ahmeek-Canosia-Rock outcrop complex, 0 to 25 percent slopes	247.4	16.6%	Moraines	Loamy material over dense loamy till	loam, silt-loam over gravelly sandy loam at 4-5"	F093AY013MN Loamy uplands (48%), F093AY006MN - Depressional Wet Hardwood Forest (15%), 093AY009MN - Bedrock Controlled Upland Forest (7%)	Well drained to poorly drained	No, Yes (15%)	Lowland forest at Hawk Ridge
E3B	Cuttre complex, 0 to 8 percent slopes	173.9	11.7%	Tillplains	Clayey till	silt loam, silty clay loam, over clay at 5-8"	F092XY012WI - Moist Clayey Lowlands (75%), F092XY007WI - Wet Loamy or Clayey Lowlands (18%)	Somewhat poorly drained to poorly drained	No, Yes (18%)	Main lowland aspen-birch forest east of Amity Creek
E3A	Cuttre complex, 0 to 3 percent slopes	173.2	11.6%	Tillplains	Clayey till	silt loam, silty clay loam, over clay at 5-8"	F092XY012WI - Moist Clayey Lowlands (50%), F092XY007WI - Wet Loamy or Clayey Lowlands (45%)	Somewhat poorly drained to poorly drained	No, Yes (45%)	Old fields and young lowland aspen-birch forest around Amity Creek
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60 percent slopes	115.4	7.7%	Moraines	Bedrock	gravelly sand loam over bedrock between 0-28"	F093AY009MN - Bedrock Controlled Upland Forest	Well drained	No	South-facing outcrops at Hawk Ridge
E23F	Miskoaki-Udifluvents, flooded, complex, 1 to 45 percent slopes	104.3	7.0%	Tillplains	Clayey till, alluvium	Silt loam, silty clay loam over clay at 6"; sandy loam, stratified very gravelly sandy loam	F092XY015WI - Clayey Uplands (60%), F092XY004WI - Seasonally Dry Floodplains (35%)	Well drained to somewhat poorly drained	No, Yes (20%)	Upper Amity Creek and floodplains
E11E	Miskoaki-Rock outcrop complex, 18 to 70 percent slopes	101.7	6.8%	Tillplains; bedrock escarpments on tillplalin drainageways	Clayey till, bedrock escarpment and channel	silt loam, silty clay loam, clay at 6"	F092XY015WI - Clayey Uplands	Well drained	No	Lower Amity Creek and Lester River
E9E	Miskoaki-Fluvaquents, frequently flooded, complex, 0 to 45 percent slopes	91.1	6.1%	Tillplains; flats on floodplains	Clayey till; alluvium	silt loam, silty clay loam, clay at 6"	F092XY015WI - Clayey Uplands (60%), F092XY007WI - Wet Loamy or Clayey Lowlands (35%)	Well drained	No, Yes (35%)	Amity-Lester spillway
F141D	Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes	87.8	5.9%	Moraines; Depressions on moraines	Loamy material over dense loamy till	silt loam, loam over gravelly sandy loam at 4"	F093AY013MN - Loamy Upland (70%), F093AY004MN - Peatland (15%)	Well drained to moderately well drained with very poorly drained depressions (15%)	No, Yes (15%)	West side of Jean Duluth Rd
E8D	Amnicon-Fluvaquents, frequently flooded, complex, 0 to 18 percent slopes	79.5	5.3%	Tillplains; flats on floodplains	Clayey till; alluvium	silt loam, silty clay loam over clay at 13" or stratified silt loam to gravelly clay loam at 11"	F092XY015WI - Clayey Uplands (64%), F092XY007WI - Wet Loamy or Clayey Lowlands (35%)	Moderately well drained to very poorly drained	No, Yes (30%)	Upper Amity Creek tributaries
E16D	Amnicon-Cuttre complex, 5 to 18 percent slopes	76.3	5.1%	Tillplains	Clayey till	silt loam, silty clay loam over clay at 8-13"	F092XY015WI - Clayey Uplands (60%), F092XY012WI - Moist Clayey Lowlands (35%), F092XY007WI - Wet Loamy or Clayey Lowlands (5%)	Moderately well drained to somewhat poorly drained	No, Yes (5%)	Lower Amity creek floodplains/lowland forest
F139F	Ahmeek-Canosia complex, 0 to 45 percent slopes	38.1	2.6%	Moraine tillplains	Coarse-loamy ablation till over dense coarse-loamy lodgment till	silt loam over gravelly sandy loam at 4-5"	F090AY016WI - Loamy Upland (83%), F090AY006WI - Wet Loamy Lowland (17%)	Well drained to poorly drained	No, Yes (17%)	West side of Jean Duluth Rd
E15A	Badriver complex, 0 to 3 percent slopes	29.2	2.0%	Slight rises, flats, and slight depressions on tillplains	Clayey till	silt loam and silty clay loam, clay at 4-5", silty clay and silty clay loam at 34-56"+	F092XY012WI - Moist Clayey Lowlands (50%), F092XY007WI - Wet Loamy or Clayey Lowlands (50%)	Somewhat poorly drained to poorly drained	No, Yes (50%)	Upper terrace west/south of Amity Creek
F135A	Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes	24.8	1.7%	Flats, slight rises, and depressions on moraines	Loamy material over dense loamy till	silt loam and loam over gravelly sandy loam at 5-7"	F093AY013MN - Loamy Upland (50%), F093AY006MN - Depressional Wet Hardwood Forest (50%)	Somewhat poorly drained to very poorly drained	No, Yes (55%)	Wetland/lowland forest at Hawk Ridge
GP	Pits, gravel-Udipsamments complex	22.2	1.5%	Stream terraces, outwash plains, moraines	sandy and gravelly outwash	N/A	Unranked (80%), F093AY011MN - Dry Sandy Upland Forest (20%)	Well drained	Unranked (80%), No (20%)	Gravel pit west of Jean Duluth Rd
E13E	Udifluvents, occasionally flooded-Rollins complex, 0 to 30 percent slopes	21.1	1.4%	Terraces and levees on floodplains	Alluvium, loamy material over gravelly outwash	extremely gravelly loam 0-80" or sandy loam over gravelly sandy loam at 5" at extremely gravelly sand 14-80"	F092XY004WI - Seasonally Dry Floodplains (60%), F092XY013WI - Sandy Uplands (30%)	Moderately well drained to somewhat excessively drained	No, Yes (5%)	Lester River floodplains
F148F	Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes	17.1	1.1%	Moraines, moraines on floodplains	Loamy material over dense loamy till; alluvium; bedrock	silt loam over gravelly sandy loam at 4" or mucky silt loam over stratified silt loam to gravelly loamy coarse sand at 6" or bedrock	F093AY013MN - Loamy Upland (80%), F093AY005MN - Wet Floodplain (10%), F093AY009MN - Bedrock Controlled Upland Forest (10%)	Well drained to poorly drained	No, Yes (10%)	Upper Amity Creek banks
E24F	Miskoaki-Cuttre complex, 5 to 45 percent slopes	15.5	1.0%	Tillplains	Clayey till	silt loam or silty clay loam over clay at 6-8"	F092XY015WI - Clayey Uplands (70%), F092XY012WI - Moist Clayey Lowlands (30%)	Well drained to somewhat poorly drained	No	Forested hill in Lester River floodplain
E2B	Cuttre-Fluvaquents, frequently flooded, complex, 0 to 8 percent slopes	15.2	1.0%	Tillplains; flats on floodplains	Clayey till; alluvium	silt loam or silty clay loam over clay at 8" or stratified silt loam to gravelly clay loam at 11"	F092XY012WI - Moist Clayey Lowlands (80%), F092XY007WI - Wet Loamy or Clayey Lowlands (20%)	Somewhat poorly drained to very poorly drained	No, Yes (20%)	Upper Amity Creek floodplain
F112D	Forbay-Augustana complex, 3 to 18 percent slopes	12.3	0.8%	Moraines	Loamy and/or silty material over friable loamy till over dense loamy till	Loam to 79"	F093AY013MN - Loamy Upland	Well drained to moderately well drained	No	Mid-slope of southeastern aspect of Hawk Ridge; terraces of East Branch Amity Creek

F140B	Normanna-Giese, depressional, complex, pitted, 0 to 8 percent slopes	11.2	0.8%	Moraines; Depressions on moraines	Loamy material over dense loamy till	loam or silt loam over gravelly sandy loam at 4-11"; up to 1" muck in depressions	F093AY013MN - Loamy Upland (50%), F093AY006MN - Depressional Wet Hardwood Forest (50%)	Moderately well drained to very poorly drained	No, Yes (50%)	
E7B	Cuttre silt loam, 3 to 8 percent slopes	10.3	0.7%							
F110A	Hegberg-Eldes complex, 0 to 3 percent slopes	7.4	0.5%							
F111B	Augustana-Hegberg complex, 1 to 8 percent slopes	7.1	0.5%	Moraines	Loamy and/or silty material over friable loamy till over dense loamy till	silt loam, very fine sandy loam, loam	F093AY013MN - Loamy Upland	Moderately well drained to somewhat poorly drained	No	
F138D	Ahmeek-Normanna-Canosia complex, 0 to 18 percent slopes	3.5	0.2%							
E5A	Palmers, depressional-Cuttre complex, 0 to 1 percent slopes	3.1	0.2%							
E12A	Udifluvents complex, 0 to 3 percent slopes, flooded	1.6	0.1%							
F137B	Normanna-Canosia-Hermantown complex, 0 to 8 percent slopes	1.6	0.1%							
E1A	Fluvaquents, clayey, 0 to 1 percent slopes, frequently flooded	0.5	0.0%							
F142A	Canosia loam, 0 to 2 percent slopes	0.1	0.0%							
E22D	Sanborg-Badriver complex, 3 to 18 percent slopes	0	0.0%							
E25D	Urban land-Amnicon-Rock outcrop complex, 0 to 18 percent slopes	0	0.0%							
Totals for Property		**1492.4**	**100.0%**							

Piedmont - Soils Description

Soil Code	Soil Name	Acres	Percent of property	Landform	Parent material	Soil texture	Eco Site	Drainage	Hydric
F156D	Rock outcrop-Ahmeek, bedrock substratum-Barto complex, 4 to 18% slopes	306.7	46.8%	Moraines	Bedrock; Loamy material over dense loamy till over bedrock	0-65" to lithic bedrock; gravelly sandy loam with some silt loam on top in places	F093AY009MN - Bedrock Controlled Upland Forest (70%); F093AY013MN - Loamy Upland (30%)	Well drained	No
F148F	Ahmeek-Rock outcrop-Fluvaquents, frequently flooded, complex, 0 to 50 percent slopes	96.6	14.7%	Moraines, moraines on floodplains	Loamy material over dense loamy till; alluvium; bedrock	silt loam over gravelly sandy loam at 4" or mucky silt loam over stratified silt loam to gravelly loamy coarse sand at 6" or bedrock	F093AY013MN - Loamy Upland (80%), F093AY005MN - Wet Floodplain (10%), F093AY009MN - Bedrock Controlled Upland Forest (10%)	Well drained to poorly drained	No, Yes (10%)
F160F	Rock outcrop-Mesaba-Barto complex, 18 to 60% slopes	112.7	17.2%	Moraines	Bedrock; Loamy material over bedrock	0-40" to lithic bedrock; gravelly sandy loam	F093AY009MN - Bedrock Controlled Upland Forest	Well drained	No
F141D	Ahmeek-Normanna-Cathro, depressional, complex, pitted, 0 to 25 percent slopes	49.3	7.50%	Moraines	Loamy material over dense loamy till	silt loam to 4" over gravelly sandy loam and some mucky silt loam to 40"	F093AY013MN - Loamy Upland, F093AY004MN - Peatland (15%)	Well drained to very poorly drained	No; Yes (15%)
F134A	Giese muck, depressional, 0 to 1 percent slopes	46.4	7.1%	Depressions on moraines	Loamy material over dense loamy till	muck to 1", silt loam to 11" over gravelly sandy loam	F093AY006MN - Depressional Wet Hardwood Forest	Very poorly drained	Yes
F135A	Hermantown-Canosia-Giese, depressional, complex, 0 to 3 percent slopes	17.9	2.70%	Flats, slight rises, or slight depressions on moraines	Loamy material over dense loamy till	silt loam to 5-11" over gravelly sandy loam	F093AY006MN - Depressional Wet Hardwood Forest, F093AY013MN - Loamy Upland	Somewhat poorly drained	No; Yes (50%)
F142A	Canosia loam, 0 to 2% slopes	10.8	1.67%	Broad flats and slight depressions on moraines	Loamy material over dense loamy till	loam to 5" over gravelly sandy loam	F093AY006MN - Depressional Wet Hardwood Forest	Poorly drained	Yes
F33A	Cathro muck, depressional, dense substratum, 0 to 1 percent slopes	9.7	1.50%	Swamps on interdrumlins, swamps on moraines	Organic material over dense loamy till	muck to 36" over mucky silt loam and stratified sandy loam	F093AY004MN - Peatland	Very poorly drained	Yes
F150A	Twig-Tacoosh-Giese complex, depressional, 0 to 1 percent slopes	5.2	0.80%	Depressions on moraines	Organic material over loamy material over dense loamy till	mucky peat over silt loam over gravelly sandy loam	F093AY006MN - Depressional Wet Hardwood Forest, F093AY004MN - Peatland (35%)	Very poorly drained	Yes
Totals for Property		**655.3**	**100.0%**						

Mission - Soils Description

Soil Code	Soil Name	Acres	Percent of property	Landform	Parent material	Soil texture	Eco Site	Drainage	Hydric
F155G	Udalfs-Eutrudepts complex, 25 to 70 percent slopes	1376.2	70.1%	Glacial lakes (relict)	Stratified lacustrine	very fine sandy loam and silt loam	F092XY014WI - Loamy Uplands	Moderately well drained to well drained	No
F155B	Udalfs-Eutrudepts complex, 0 to 8 percent slopes	497.8	25.3%	Glacial lakes (relict)	Stratified lacustrine	silt loam, very fine sandy loam and fine sandy loam	F092XY014WI - Loamy Uplands; F092XY015WI - Clayey Uplands	Somewhat poorly drained to well drained	No
E12A	Udifluvents complex, 0 to 3 percent slopes, flooded	31.8	1.6%						
1034A	Udifluvents and Fluvaquents, loamy, 0 to 2 percent slopes, rarely flooded	17.9	0.9%						
F111B	Augustana-Hegberg complex, 1 to 8 percent slopes	9.9	0.5%						
E3A	Cuttre complex, 0 to 3 percent slopes	9.4	0.5%						
E3B	Cuttre complex, 0 to 8 percent slopes	8.9	0.5%						
E24F	Miskoaki-Cuttre complex, 5 to 45% slopes	7.3	0.4%						
E2B	Cuttre-Fluvaquents, frequently flooded, complex, 0 to 8 percent slopes	2.1	0.1%						
1020	Udorthents	1.3	0.1%						
367E	Campia silt loam, 12 to 25 percent slopes	0.9	0.0%						
W	Water	0.5	0.0%						
367C	Campia silt loam, 2 to 12 percent slopes	0.2	0.0%						
Totals for property		**0**	**0.0%**						

Appendix C: Native Plant Communities by Property and Stands

Final NPC Breakdown 8/5/26 Updated NPC

Lester

Row Labels	Stand Acres	Percent of Stand
FDn43b	429	29.0%
Disturbed	213	14.4%
MHn35b	179	12.1%
MHn46b	133	9.0%
MHn44a	84	5.7%
WFn55a	80	5.4%
FFn57a	69	4.7%
FDn33b	56	3.8%
ROn23a	44	3.0%
FDn43b1	43	2.9%
Developed	40	2.7%
RVx54a	32	2.2%
WFn74a	27	1.9%
RVx43a2	18	1.2%
MHn47a	13	0.9%
RVx32	8	0.5%
FDn33a1	5	0.4%
FDn43c	5	0.3%
WMn82b1	1	0.1%
FDn43a	0	0.0%
MRn93b	0	0.0%
Grand Total	**1479**	**100.0%**

Piedmont

Row Labels	Stand Acres	Percent of Stand
MHn35b	296	44.4%
MHn47a	80	12.0%
WFn55a	79	11.9%
ROn23b	71	10.7%
MHn46b	52	7.8%
FDn43b2	46	6.9%
FPn73a	12	1.8%
Disturbed	11	1.7%
CTn24	10	1.5%
Developed	7	1.1%
ROn12b	2	0.2%
ROn23a	1	0.1%
Grand Total	**667**	**100.0%**

Mission

Updated_NP	Stand Acres	Percent of Stand
MHn35b	1116	58.9%
MHn44c	190	10.1%
MHn46b	160	8.5%
MHn44b	142	7.5%
MHn44a	62	3.3%
MHn44	39	2.1%
FFn57a	37	1.9%
RVx54a	32	1.7%
Disturbed	30	1.6%
FDn43b	18	1.0%
MHn47a	15	0.8%
RVx32	14	0.7%
MHn45b	12	0.6%
Developed	10	0.6%
WFn55a	7	0.4%
CTn11e	5	0.3%
WMn82b1	3	0.2%
CTn42d	1	0.0%
OW	1	0.0%
CTn11	0	0.0%
Grand Total	**1895**	**100.0%**

Final NPC Breakdown 8/5/26 Updated NPC

Lester

Row Labels	Stand Acres	Percent of Stand
1	**88**	**6.0%**
MHn35b	72	81.9%
MHn47a	8	8.9%
MHn46b	4	4.8%
WFn55a	3	3.1%
Disturbed	1	1.3%
2	**70**	**4.7%**
MHn35b	41	58.8%
MHn46b	13	18.4%
WFn55a	7	9.6%
MHn47a	5	7.2%
Disturbed	3	4.4%
Developed	1	1.5%
3	**54**	**3.7%**
FDn43b	26	47.9%
MHn35b	12	22.2%
Disturbed	5	9.7%
WFn74a	4	7.5%
Developed	2	3.5%
MHn46b	2	2.9%
WFn55a	1	2.5%
FDn33b	1	2.1%
ROn23a	1	1.0%
FDn43b1	0	0.7%
4	**104**	**7.0%**
WFn55a	40	38.9%
FDn43b	16	15.1%
WFn74a	14	13.5%
FDn43b1	13	12.7%
Disturbed	8	7.7%
MHn35b	7	7.1%
MHn46b	2	2.0%
ROn23a	1	1.3%
WMn82b1	1	0.9%
Developed	1	0.5%
FDn43c	0	0.2%
FDn33b	0	0.1%
5	**60**	**4.1%**
Disturbed	32	52.6%
FDn43b1	16	26.4%
FDn43c	5	7.9%
MHn46b	4	6.6%
Developed	2	3.3%
FDn33b	1	1.6%
MHn35b	1	1.4%
ROn23a	0	0.3%
WFn55a	0	0.0%
6	**147**	**9.9%**
FFn57a	49	33.0%

Piedmont

Row Labels	Stand Acres	Percent of Stand
1	**113**	**17.0%**
MHn35b	105	93.1%
ROn23b	3	3.0%
WFn55a	3	2.8%
FPn73a	1	0.6%
ROn23a	1	0.5%
2	**87**	**13.0%**
WFn55a	47	53.7%
MHn35b	16	19.0%
MHn47a	12	13.4%
MHn46b	7	7.9%
FPn73a	3	3.9%
Disturbed	1	1.3%
Developed	1	0.8%
ROn23b	0	0.1%
3	**109**	**16.4%**
FDn43b2	39	35.5%
ROn23b	33	30.3%
MHn35b	26	23.6%
WFn55a	5	4.2%
Developed	2	1.8%
CTn24	2	1.5%
ROn12b	2	1.4%
FPn73a	1	1.3%
Disturbed	0	0.4%
MHn46b	0	0.0%
4	**53**	**7.9%**
ROn23b	14	26.6%
MHn46b	11	21.4%
Disturbed	7	12.8%
CTn24	7	12.7%
MHn35b	6	10.5%
Developed	3	6.2%
WFn55a	3	4.9%
FDn43b2	2	4.7%
ROn12b	0	0.1%
5	**72**	**10.8%**
MHn35b	47	65.3%
MHn46b	14	20.1%
MHn47a	4	6.0%
Disturbed	2	2.3%
ROn23b	2	2.2%
CTn24	1	1.8%
Developed	1	0.9%
WFn55a	1	0.8%
FDn43b2	0	0.6%
6	**127**	**19.0%**
MHn47a	60	47.3%
MHn35b	43	34.2%

Mission

StandID	Updated_NP	Stand Acres	Percent of Stand
1	MHn35b	35	29.1%
	MHn44c	23	18.8%
	FDn43b	18	15.3%
	MHn46b	17	14.3%
	RVx54a	14	11.7%
	MHn44a	7	6.0%
	RVx32	5	4.2%
	Disturbed	1	0.5%
1 Total		**120**	**6.3%**
2	MHn35b	56	72.3%
	Disturbed	9	11.3%
	MHn44c	6	7.1%
	MHn46b	5	6.4%
	MHn44b	2	2.5%
	RVx54a	0	0.2%
	RVx32	0	0.2%
2 Total		**77**	**4.1%**
3	MHn35b	78	71.4%
	Disturbed	20	18.5%
	MHn44c	10	9.4%
	RVx54a	1	0.7%
3 Total		**109**	**5.7%**
4	MHn35b	103	89.7%
	MHn44c	11	9.4%
	RVx54a	1	0.5%
	MHn44a	0	0.2%
	Disturbed	0	0.1%
	MHn46b	0	0.0%
	MHn45b	0	0.0%
	WMn82b1	0	0.0%
4 Total		**115**	**6.1%**
5	MHn44c	78	35.1%
	MHn44	34	15.2%
	MHn46b	31	13.9%
	MHn35b	27	12.0%
	MHn44a	17	7.8%
	MHn44b	14	6.4%
	RVx54a	7	3.4%
	FFn57a	5	2.3%
	RVx32	4	1.6%
	WMn82b1	3	1.5%
	MHn45b	2	0.8%
	Disturbed	0	0.0%
5 Total		**223**	**11.8%**
6	MHn35b	33	76.5%
	MHn44	5	11.4%
	MHn46b	5	11.0%
	MHn44b	0	1.1%
6 Total		**43**	**2.2%**

MHn46b	31	20.8%
Disturbed	26	17.4%
MHn35b	23	15.6%
RVx32	6	4.2%
FDn43b	4	2.8%
WFn74a	4	2.5%
WFn55a	4	2.5%
Developed	2	1.2%
MRn93b	0	0.0%
FDn43b1	0	0.0%
FDn43c	0	0.0%
7	**84**	**5.7%**
Disturbed	74	87.7%
Developed	8	9.1%
MHn35b	1	1.3%
MHn44a	1	0.8%
FDn43b	1	0.7%
MHn46b	0	0.3%
WFn55a	0	0.1%
WFn74a	0	0.0%
8	**32**	**2.2%**
Disturbed	30	93.5%
Developed	2	6.2%
FDn33b	0	0.2%
MHn46b	0	0.1%
ROn23a	0	0.0%
RVx43a2	0	0.0%
9	**135**	**9.1%**
MHn44a	43	32.1%
MHn46b	36	27.0%
FDn43b	34	25.3%
Disturbed	10	7.6%
WFn55a	10	7.5%
FFn57a	0	0.3%
Developed	0	0.0%
ROn23a	0	0.0%
10	**110**	**7.4%**
FDn43b	78	70.8%
MHn44a	10	9.3%
MHn46b	9	8.0%
WFn55a	8	6.9%
Disturbed	4	3.7%
Developed	1	1.2%
ROn23a	0	0.1%
RVx54a	0	0.0%
11	**43**	**2.9%**
FDn43b	20	46.4%
MHn44a	18	41.8%
RVx54a	3	6.3%
Disturbed	1	3.4%
ROn23a	0	0.9%
FDn33b	0	0.8%
Developed	0	0.2%
RVx43a2	0	0.0%

WFn55a	12	9.4%
ROn23b	6	4.7%
MHn46b	4	3.2%
Disturbed	1	0.7%
Developed	1	0.5%
7	**69**	**10.4%**
MHn35b	31	44.3%
MHn46b	14	20.0%
WFn55a	10	14.3%
FPn73a	6	8.4%
ROn23b	4	6.4%
FDn43b2	4	6.2%
Disturbed	0	0.3%
MHn47a	0	0.2%
8	**37**	**5.5%**
MHn35b	22	58.7%
ROn23b	9	23.4%
MHn47a	4	11.5%
MHn46b	2	4.1%
FPn73a	0	1.2%
Disturbed	0	1.0%
Grand Total	**667**	**100.0%**

7	MHn35b	92	83.1%
	MHn46b	12	11.2%
	WFn55a	4	3.3%
	Developed	2	1.7%
	MHn44c	1	0.5%
	MHn44a	0	0.2%
7 Total		**111**	**5.9%**
8	MHn35b	41	82.8%
	MHn44c	7	13.5%
	MHn46b	1	2.2%
	RVx54a	1	1.2%
	Developed	0	0.2%
	RVx32	0	0.0%
8 Total		**49**	**2.6%**
9	MHn44b	5	38.1%
	CTn11e	4	35.1%
	MHn35b	2	15.2%
	CTn42d	1	6.7%
	OW	1	4.5%
	Developed	0	0.3%
9 Total		**12**	**0.6%**
10	MHn35b	218	85.7%
	MHn44a	13	5.0%
	MHn46b	10	4.0%
	MHn44c	7	2.9%
	MHn44b	4	1.7%
	RVx54a	1	0.3%
	WFn55a	1	0.3%
	MHn44	0	0.1%
10 Total		**254**	**13.4%**
11	MHn35b	96	82.3%
	MHn44a	9	7.6%
	MHn46b	7	5.6%
	MHn44b	4	3.8%
	MHn44c	1	0.7%
	RVx32	0	0.0%
	FFn57a	0	0.0%
	MHn45b	0	0.0%
11 Total		**117**	**6.2%**
12	MHn44b	41	32.0%
	MHn35b	38	29.9%
	MHn46b	25	19.7%
	FFn57a	14	11.2%
	MHn44c	4	2.9%
	RVx32	3	2.6%
	MHn44a	2	1.5%
	MHn45b	0	0.3%
12 Total		**127**	**6.7%**
13	MHn35b	47	84.4%
	MHn46b	5	8.3%
	FFn57a	3	5.3%
	MHn44b	1	1.9%
	RVx32	0	0.1%
13 Total		**56**	**2.9%**

12	**295**	**19.9%**
FDn43b	235	79.8%
MHn46b	20	6.9%
RVx54a	17	5.9%
WFn55a	6	2.0%
MHn44a	6	2.0%
WFn74a	6	1.9%
Disturbed	3	1.0%
FFn57a	1	0.3%
RVx43a2	0	0.2%
Developed	0	0.1%
FDn43a	0	0.0%
13	**76**	**5.1%**
FDn33b	27	36.1%
FFn57a	14	18.4%
RVx43a2	11	14.7%
FDn43b	6	8.3%
RVx54a	6	8.3%
MHn46b	6	7.8%
Developed	3	4.4%
RVx32	1	1.9%
WFn74a	0	0.0%
Disturbed	0	0.0%
14	**75**	**5.1%**
Developed	14	18.6%
Disturbed	13	17.6%
FDn33b	10	12.9%
MHn44a	6	8.4%
FDn43b	6	8.3%
MHn46b	6	8.2%
RVx43a2	6	8.1%
RVx54a	6	7.9%
FFn57a	5	7.2%
WFn55a	2	2.8%
15	**68**	**4.6%**
ROn23a	41	60.0%
FDn33b	12	17.8%
MHn35b	8	11.2%
Developed	3	4.4%
Disturbed	2	2.8%
FDn43b	2	2.4%
FDn43b1	1	0.9%
FDn33a1	0	0.6%
RVx43a2	0	0.0%
WFn55a	0	0.0%
16	**22**	**1.5%**
FDn43b1	11	53.0%
FDn33a1	5	23.7%
FDn33b	2	11.3%
FDn43b	1	6.0%
Disturbed	1	3.1%
MHn35b	0	2.1%
ROn23a	0	0.8%
17	**19**	**1.3%**

14	MHn35b	54	78.1%
	MHn44c	6	9.2%
	MHn44a	4	6.1%
	Developed	4	5.5%
	MHn46b	1	1.0%
14 Total		**69**	**3.7%**
15	MHn35b	34	76.6%
	MHn44b	8	18.9%
	Developed	1	2.4%
	CTn11e	1	2.0%
	CTn11	0	0.1%
15 Total		**45**	**2.4%**
16	MHn35b	85	71.1%
	MHn47a	14	11.4%
	MHn44c	8	6.7%
	Developed	4	3.0%
	MHn44b	3	2.9%
	MHn45b	3	2.7%
	RVx54a	3	2.3%
16 Total		**120**	**6.3%**
17	MHn44b	32	23.0%
	MHn44c	30	21.1%
	MHn46b	20	14.5%
	MHn35b	18	13.0%
	FFn57a	14	9.7%
	MHn44a	9	6.4%
	MHn45b	7	4.9%
	RVx54a	5	3.7%
	WFn55a	3	2.0%
	RVx32	1	1.1%
	MHn47a	1	0.6%
17 Total		**140**	**7.4%**
18	MHn44b	26	50.2%
	MHn35b	23	44.3%
	MHn46b	1	2.3%
	MHn44a	1	1.9%
	FFn57a	1	1.3%
18 Total		**53**	**2.8%**
19	MHn35b	36	63.3%
	MHn46b	21	36.5%
	MHn44b	0	0.3%
19 Total		**56**	**3.0%**
Grand Total		**1895**	**100.0%**

MHn35b	13	69.6%
FDn33b	1	7.9%
FDn43b1	1	7.5%
Developed	1	7.4%
FDn43b	1	4.7%
ROn23a	0	2.4%
WFn55a	0	0.5%
Grand Total	**1479**	**100.0%**

Appendix D: Stands Maps

Lester

Duluth, Minnesota

Forest Management Plan Stands Map

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Stand Types
- Aspen (Mixed Hardwood)
- Aspen-Birch
- Aspen-Birch (Conifer)
- Riparian
- Non-Forested Fields
- Northern Hardwoods
- Northern Hardwoods (Red Oak)
- Pine Plantation
- Rocky Outcrop (Aspen-Red Oak)

Access
- Trails
- Access Trail
- Roads

Wetlands and Hydrology
- Wetland
- Streams

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 0.75 mi

Mission

Duluth, Minnesota

Forest Management Plan Stands Map



#1
#2
#3
#4
#5
#6
#7
#8
#10
#11
#12
#13
#14
#15
#16
#17
#18
#19

Mission Creek
Sargent Creek
Saint Louis River
Becks Road
Halie Road
West Skyline Park
Oldenberg Parkway
West 9th Street
West 6th Street
West 5th Street
West 3rd Street
Drava Court
Beach Lake Drive
Highway 23

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Forest Cover Type
- Aspen
- Cliff-Talus
- Mixed Hardwood Conifer
- Riparian
- Northern Hardwoods
- Northern Hardwoods (Red Oak)
- White Pine, White Spruce, Paper Birch

Trail Type
- Trails
- Access Trail

Wetlands
- Wetland
- Freshwater Pond
- Streams and rivers

DULUTH FORESTRY PROGRAM

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August 2026

0 0.25 0.5 mi

Piedmont

Duluth, Minnesota

Forest Management Plan Stands Map



Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Stand Type
- Aspen-Birch
- Aspen-Birch (Hardwoods)
- Aspen-Birch (Riparian)
- Black Ash-Aspen-Balsam Poplar

Trail Type
- Trails
- Roads

Hyrology
- Streams and rivers
- Wetland

DULUTH FORESTRY PROGRAM

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August 2026

0 0.1 0.2 0.3 mi

Appendix E: Management Maps

Lester

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Emerald Ash Borer Mitigation



Stand #13
High Priority

Stand #6
High Priority

Stand #4
Medium Priority

Stand #6
High Priority

Stand #6
High Priority

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- EAB Mitigation - Underplant

Wetlands and Hydrology
- Wetland
- Streams

Access
- Trails
- Access Trail
- Roads

DULUTH FORESTRY PROGRAM

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August 2026

0 0.25 0.5 0.75 mi

Lester

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Invasive Species (Buckthorn) Removal



Imagery Source: Bing Sattelite
Fire Extent Source: Tom Hollenhorst
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- Invasive Species Removal - Hand
- Invasive Species Removal - Mechanical

Buckthorn Abundance
- Extreme
- High
- Medium
- Low

Access
- Trails
- Access Trail
- Roads

Wetlands and Hydrology
- Wetland
- Streams

DULUTH FORESTRY PROGRAM

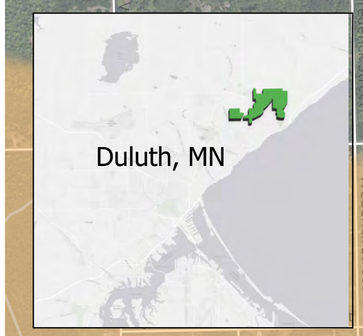
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August 2026

0 0.25 0.5 0.75 mi

Lester

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Prescribed Fire and Fuels



Imagery Source: Bing Sattelite
Fire Extent Source: Tom Hollenhorst
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- Fuels Reduction
- Prescribed Burn

Access
- Trails
- Access Trail
- Roads

Wetlands and Hydrology
- Wetland
- Streams

Historical Data
- 1918 Cloquet-Duluth Fire Extent

DULUTH FORESTRY PROGRAM

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August 2026

0 0.25 0.5 0.75 mi

Lester

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Regeneration



#1
#2
#4
#5
#8
#9
#10
#11
#12
#14
#17

Amity Creek
Lester River
Pleasant View Road
Claymore Street
Kingston Street
Idlewild Street
Ivanhoe Street
Glendale Street
Oakley Street
Norwood Street
Wyoming Street
Paine Farm Road
Everett Street
Highway 61

0 0.25 0.5 0.75 mi

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

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August 2026

DULUTH FORESTRY PROGRAM

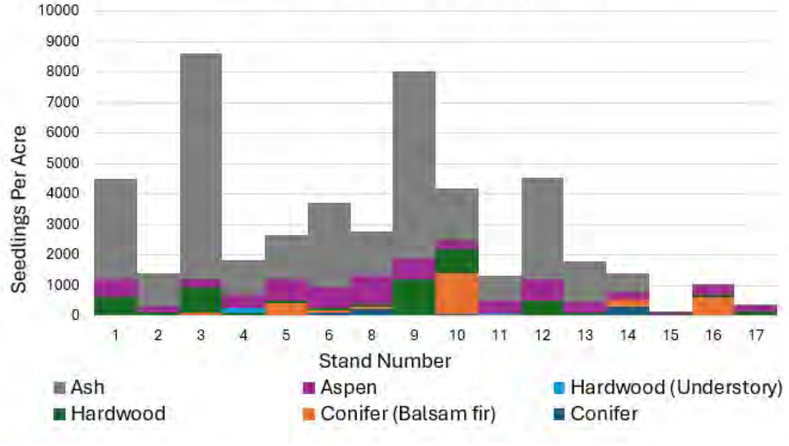
Legend

Management Activities
- Silvicultural Thinning
- Tree Planting
- Deer Exclosure
- Site Preparation

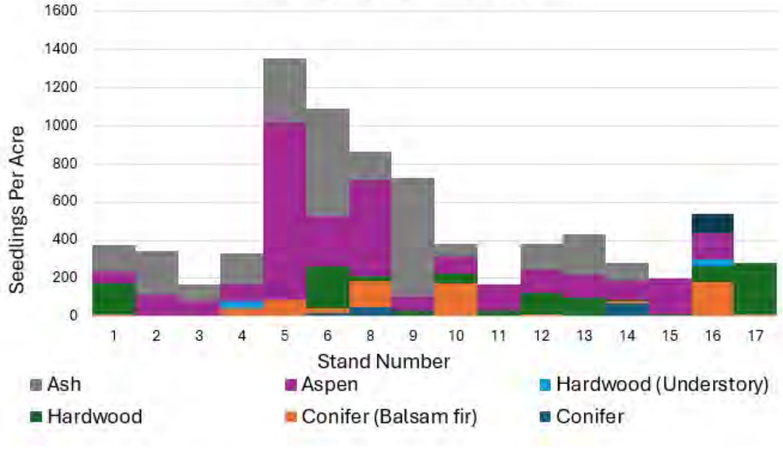
Access
- Trails
- Access Trail
- Roads

Wetlands and Hydrology
- Wetland
- Streams

Seedlings per Acre by Stand



Saplings per Acre by Stand



Mission

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Buckthorn Removal and Emerald Ash Borer Mitigation



Stand #1
Low Priority

Stand #5
High Priority

Stand #13
High Priority

Stand #17
High Priority

Stand #12
High Priority

Mission Creek

Sargent Creek

Saint Louis River

Becks Road

West Skyline Parkway

West 9th Street

West 6th Street

West 5th Street

West 3rd Street

Highway 23

Imagery Source: Google Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- Buckthorn Removal - Hand
- EAB Mitigation - SLAM

Access
- Trails
- Access Trail

Hyrdology & Wetlands
- Wetland
- Freshwater Pond
- Streams and rivers

DULUTH FORESTRY PROGRAM

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August 2026

0 0.25 0.5 mi

***SLAM (Slowing Ash Mortality) is a term that refers to an integrated strategy incorporating multiple tactics to slow EAB population growth and protect ash trees in early to mid-invasion stages. Refer to Management options for emerald ash borer in black ash forests. Siegert, N.W. and D.G. McCullough. 2026. Michigan State University Extension for more detailed information.**

Mission

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Fuels and Prescribed Fire



#19

#18

Imagery Source: Bing Sattelite
Fire Extent Source: Tom Hollenhurst
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- Fuels Reduction

Access
- Trails
- Access Trail
- 1918 Cloquet Fire Extent

Hyrdology & Wetlands
- Wetland
- Freshwater Pond
- Streams and rivers

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 0.75 mi

Mission

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Regeneration and Tree Planting



Imagery Source: Bing Sattelite
Fire Extent Source: Tom Hollenhurst
EPSG:26915 - NAD83 / UTM zone 15N

Legend

Management Activities
- Silvicultural Thinning
- Tree Planting
- Deer Exclosure
- Site Preparation

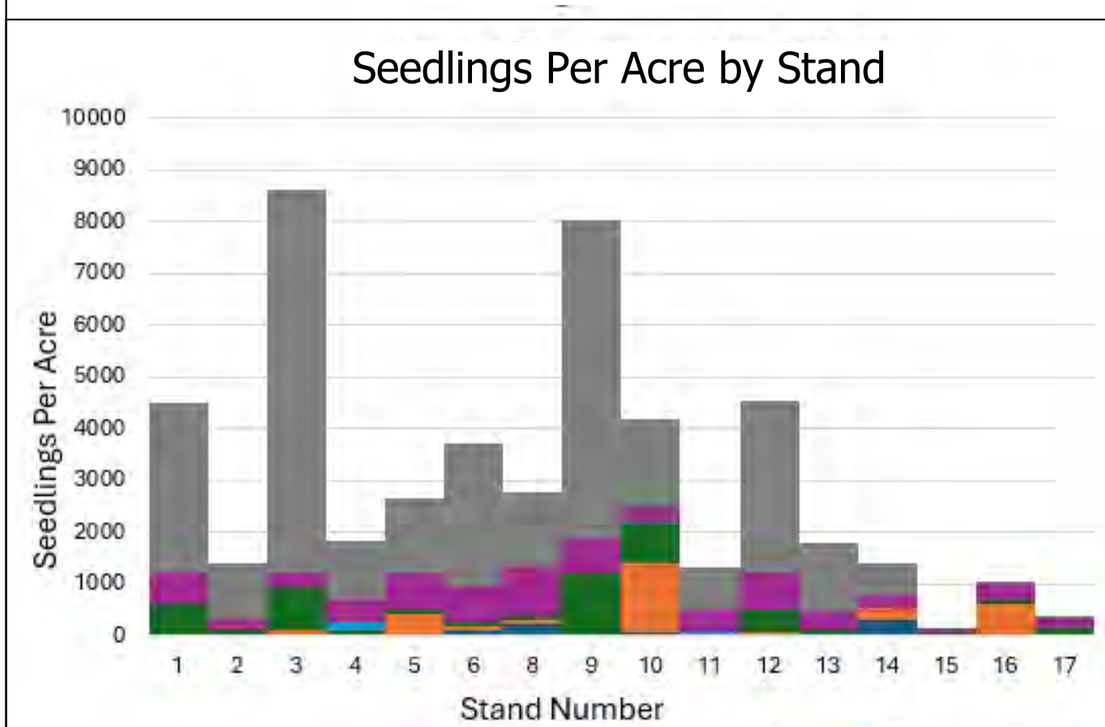
Access
- Trails
- Access Trail

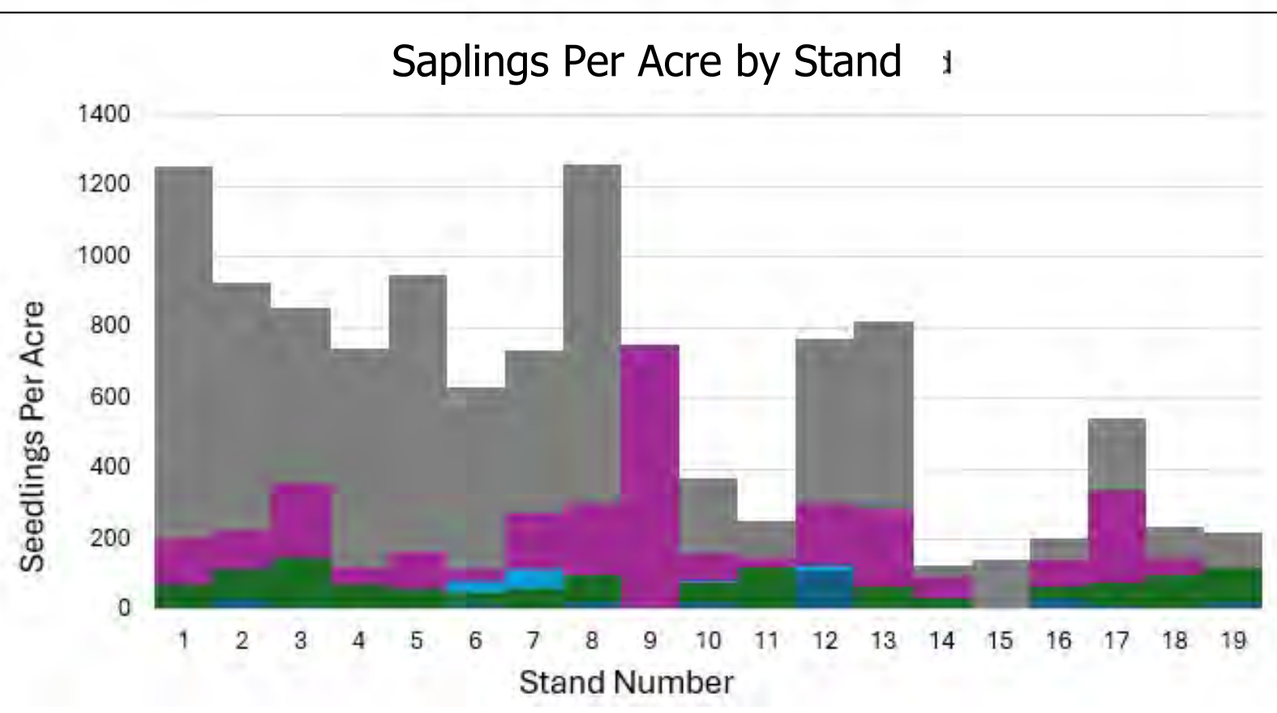
Hyrdology & Wetlands
- Wetland
- Freshwater Pond
- Streams and rivers

DULUTH FORESTRY PROGRAM

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August 2026

0 0.25 0.5 mi





Ash Aspen Midstory Hardwood Conifer (Balsam fir) Conifer

Piedmont

Duluth, Minnesota

Forest Management Plan Management Activities Map

Emerald Ash Borer Mitigation



Stand #2
High Priority

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

- EAB Mitigation - SLAM
- Trails
- Roads
- Streams
- Wetland

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 mi

***SLAM (Slowing Ash Mortality) is a term that refers to an integrated strategy incorporating multiple tactics to slow EAB population growth and protect ash trees in early to mid-invasion stages. Refer to Management options for emerald ash borer in black ash forests. Siegert, N.W. and D.G. McCullough. 2026. Michigan State University Extension for more detailed information.**

Piedmont

Duluth, Minnesota

Forest Management Plan Management Activities Map

Invasive Species (Buckthorn) Removal



#7
#8
#2
#7
#3
#5
#5
#2
#1
#3
#2
#2
#1
#2
#3

Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N

Legend

- Invasive Species Removal - Hand
- Invasive Species Removal - Mechanical

Buckthorn Abundance

- High
- Medium
- Low

- Trails
- Roads
- Streams
- Wetland

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 mi

Piedmont

Duluth, Minnesota

Forest Management Plan
Management Activities Map
Prescribed Fire and Fuels



#8
#3
#3
#3

Imagery Source: Bing Sattelite
Fire Extent Source: Tom Hollenhorst
EPSG:26915 - NAD83 / UTM zone 15N

Legend

- Prescribed Burn
- Trails
- Roads
- Streams and rivers
- Wetland
- 1918 Cloquet Fire Extent

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 mi

Piedmont

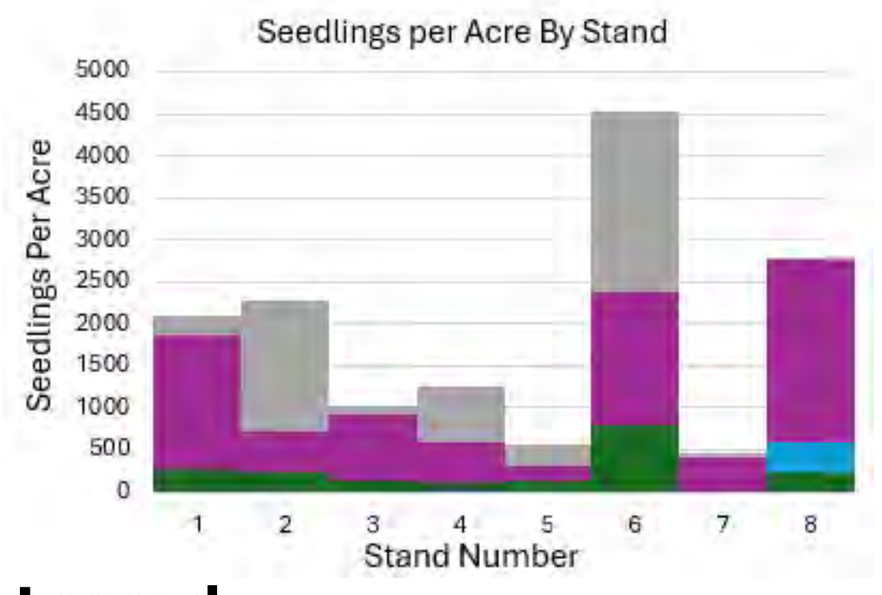
Duluth, Minnesota

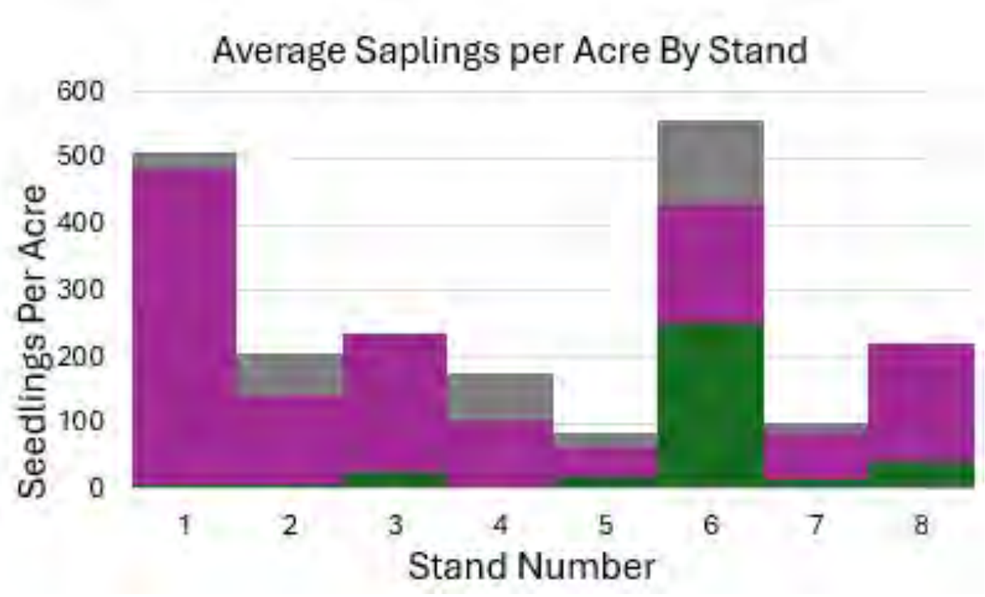
Forest Management Plan Management Activities Map

Regeneration and Tree Planting



Imagery Source: Bing Sattelite
EPSG:26915 - NAD83 / UTM zone 15N





Legend

- Tree Planting
- Deer Exclosure
- Site Preparation
- Trails
- Roads
- Streams
- Wetland

DULUTH FORESTRY PROGRAM

Prepared by Dovetail Partners, Inc for Minnesota Land Trust and City of Duluth as a part of a long-term Forest Management Plan
August 2026

0 0.25 0.5 mi

Appendix F: Basal Area Summary Chart

BASAL AREA BY SPECIES AND STAND

Sum of Average per Acre BA (Species)	Column Labels																													
Row Labels	Balsam Fir	Balsam Poplar	Basswood	Bigtooth Aspen	Black Ash	Black Cherry	Black Spruce	Buckthorn	Cherry/Prunus Spp	Green Ash	Ironwood	Jack Pine	Mountain Ash	Mountain Maple	N. White Cedar	Paper Birch	Quaking Aspen	Red Maple	Red Oak	Red Pine	Scotch Pine	Serviceberry	Speckled Alder	Sugar Maple	White Pine	White Spruce	Willow spp.	Yellow Birch	(blank)	Grand Total
Lester-Amity-Hawk Ridge	**103.3**	**38.4**	**11.7**	**52.8**	**66.8**		**15.7**	**6.0**	**0.6**	**4.7**		**1.7**			**1.1**	**246.2**	**655.8**	**47.5**	**105.5**	**119.5**	**71.8**	**2.4**	**18.0**	**64.4**	**4.9**	**42.9**	**4.9**	**1.3**	**1.0**	**1688.8**
1	3.0	2.0	6.0	11.0	7.0											13.0	20.0	2.0	16.0					25.0						105.0
2			5.7	15.7	1.4											5.7	47.1	8.6	4.3					21.4						110.0
3		10.0										1.7				13.3	35.0		1.7	31.7										93.3
4	1.1			2.2	1.1										1.1	13.3	21.1	13.3					2.2							55.6
5	17.1	1.4			11.4		15.7									25.7	38.6			12.9						5.7				128.6
6	3.0	14.0			14.5			0.5		0.5						26.0	29.0					1.0	4.5			2.0	0.5			95.5
8	5.0	6.3			1.3					1.3						7.5	15.0			31.3	68.8					10.0				146.3
9	3.1	1.3		0.6	16.9			0.6								7.5	61.9	2.5					1.3			0.6	0.6	1.3		98.1
10	27.3			2.7				0.9								8.2	74.5	3.6		12.7					3.6	2.7				136.4
11		1.4			1.4			1.4								8.6	78.6	1.4				1.4	10.0				2.9			107.1
12	2.8			2.5	2.8			2.5	0.6	0.9						16.9	82.8	0.3							0.3	2.8	0.9			116.3
13				16.0	8.0											18.0	66.0	2.0												110.0
14		2.0			1.0					2.0						39.0	7.0		1.0	31.0	3.0				1.0	19.0			1.0	107.0
15	2.9															1.4	27.1	5.7	8.6											45.7
16	36.0			2.0												34.0	28.0													100.0
17	2.0															8.0	24.0	8.0	74.0					18.0						134.0
Mission Creek	**16.6**	**101.7**	**77.6**	**28.8**	**194.3**	**0.6**		**8.7**		**35.3**	**14.6**			**0.6**	**12.2**	**228.4**	**835.2**	**158.3**	**156.9**	**4.3**		**4.0**	**7.8**	**155.9**	**66.4**	**132.7**	**1.9**	**9.9**		**2252.6**
1	0.9	15.5	11.8		24.5					2.7						10.9	27.3	5.5	0.9				0.9		2.7	1.8				105.5
2	0.8	2.5		1.7	15.0											8.3	95.0	5.0	0.8						3.3	4.2				136.7
3		11.5	0.8		1.5											14.6	82.3	4.6	1.5				3.1	0.8	5.4	1.5				127.7
4			11.1	2.2	5.6						7.8				1.1	6.7	51.1	7.8	2.2					18.9		4.4				118.9
5	0.7	20.7			29.3			2.0		3.3					0.7	10.0	29.3	1.3				4.0	0.7	0.7		9.3		1.3		113.3
6	1.7	3.3		1.7	20.0			3.3								11.7	63.3	6.7	1.7					1.7	18.3	5.0				138.3
7	0.8	1.7	7.5	5.8	8.3						2.5					5.0	11.7	23.3	20.0					14.2	2.5	5.8				109.2
8				2.0	2.0											12.0	70.0	6.0	10.0					12.0		4.0				118.0
10			3.0	3.9	5.2					1.7						22.2	46.1	11.3	4.8	0.4				15.7	2.6	2.2		0.4		119.6
11			8.0		3.0					4.0	1.0					30.0	80.0	16.0	6.0					3.0	1.0	3.0				155.0
12	7.3	7.3	0.7	4.7	24.7					2.7					4.0	15.3	22.7	2.0	0.7							18.7		4.0		114.7
13		1.7	8.3	1.7	8.3			3.3		6.7						10.0	63.3	6.7	5.0					8.3		3.3				126.7
14			3.8		3.8						2.5					3.8	33.8	12.5	37.5					17.5		2.5				117.5
15				2.0	18.0											18.0	6.0	10.0	28.0	2.0				16.0	8.0	6.0				114.0
16		1.7	10.8		5.0						0.8				0.8	6.7	37.5	7.5	17.5					23.3	2.5	11.7		1.7		127.5
17	4.4	9.4	1.3	0.6	15.0	0.6				0.6				0.6	5.6	13.8	34.4	3.1	1.3	1.9			3.1	4.4	5.0	13.8	1.9	2.5		123.1
18		2.5	2.5	2.5	5.0					7.5						27.5	17.5	15.0	5.0					7.5	15.0	17.5				125.0
19		4.0	8.0							6.0						2.0	64.0	14.0	14.0					12.0		18.0				142.0
20		20.0																												20.0
Piedmont Brewer		**13.9**	**10.8**	**34.8**	**23.6**			**1.3**	**1.4**		**0.7**		**10.7**	**1.7**	**1.3**	**101.4**	**254.6**	**11.6**	**8.3**			**2.2**	**9.4**	**51.6**	**4.6**			**26.8**		**570.5**
1		3.6	7.3	3.6	2.7											13.6	47.3	3.6	1.8					2.7				0.9		87.3
2		2.2			12.2											6.7	30.0						6.7	1.1				7.8		66.7
3		1.8		23.6									0.9			25.5	20.0		3.6			0.9		1.8						78.2
4		3.3			6.7								8.3	1.7		13.3	13.3								3.3					50.0
5				7.5				1.3							1.3	6.3	26.3					1.3		7.5	1.3			12.5		65.0
6			0.7		2.0						0.7					14.7	52.0	8.0					1.3	21.3				1.3		102.0
7		2.9							1.4							4.3	35.7						1.4					4.3		50.0
8			2.9										1.4			17.1	30.0		2.9					17.1						71.4
Grand Total	**119.9**	**153.9**	**100.1**	**116.3**	**284.7**	**0.6**	**15.7**	**15.9**	**2.1**	**39.9**	**15.3**	**1.7**	**10.7**	**2.3**	**14.6**	**576.0**	**1745.6**	**217.4**	**270.7**	**123.8**	**71.8**	**8.6**	**35.2**	**271.9**	**75.9**	**175.6**	**6.8**	**38.0**	**1.0**	**4511.9**

Appendix G: Regeneration Summary Chart

REGENERATION TABLES BY PROPERTY AND STAND

LESTER

Row Labels	Average of Seedlings per acre	Average of Saplings per acre
Stand 1	**1187**	**99**
Balsam Fir	50	50
Basswood	125	50
Black Ash	1860	260
Green Ash	4740	20
Paper Birch	150	0
Quaking Aspen	725	75
Red Maple	100	0
Red Oak	480	0
Sugar Maple	483	242
Stand 2	**490**	**120**
Basswood	300	0
Bigtooth Aspen	200	100
Black Ash	1300	280
Green Ash	600	100
Quaking Aspen	120	100
Red Maple	100	0
Red Oak	167	0
Stand 3	**2355**	**45**
Balsam Fir	175	0
Black Ash	7050	83
Green Ash	5838	63
Paper Birch	463	0
Quaking Aspen	875	250
Red Maple	600	0
Red Oak	350	0
Red Pine	250	0
Stand 4	**633**	**115**
Balsam Fir	125	200
Bigtooth Aspen	0	250
Black Ash	1375	250
Green Ash	667	0
Paper Birch	100	0
Quaking Aspen	790	110
Red Maple	100	0
Red Oak	150	0
Serviceberry	500	0
Speckled Alder	375	150
Stand 5	**715**	**365**
Balsam Fir	386	86
Balsam Poplar	200	0
Black Ash	1683	400
Paper Birch	100	0

PIEDMONT

Row Labels	Average of Seedlings per acre	Average of Saplings per acre
Stand 1	**719**	**168**
Balsam Poplar	200	225
Basswood	100	0
Bigtooth Aspen	167	33
Black Ash	833	100
Paper Birch	0	100
Quaking Aspen	1445	345
Red Maple	450	0
Red Oak	280	0
Sugar Maple	200	0
Stand 2	**1057**	**96**
Balsam Poplar	800	150
Basswood	100	0
Black Ash	2063	88
Green Ash	1000	0
Quaking Aspen	725	275
Red Maple	750	0
Red Oak	200	0
Sugar Maple	100	50
Stand 3	**442**	**106**
Balsam Poplar	0	250
Bigtooth Aspen	50	250
Black Ash	267	0
Paper Birch	350	100
Quaking Aspen	769	119
Red Maple	100	0
Stand 4	**954**	**139**
Balsam Fir	100	0
Balsam Poplar	1200	100
Black Ash	3600	400
Paper Birch	200	25
Quaking Aspen	988	250
Red Maple	100	0
Sugar Maple	100	0
White Pine	200	0
White Spruce	100	0
Stand 5	**360**	**60**
Balsam Poplar	500	0
Black Ash	440	40
Quaking Aspen	400	125
Red Maple	350	0
Red Oak	133	67
Stand 6	**738**	**87**

MISSION

Row Labels	Average of Seedlings per acre	Average of Saplings per acre
Stand 1	**1233**	**355**
Balsam Poplar	290	110
Black Ash	3059	986
Green Ash	1800	150
Paper Birch	0	100
Quaking Aspen	343	129
Red Maple	200	67
Red Oak	100	125
White Pine	250	0
White Spruce	183	0
Yellow Birch	0	250
Stand 10	**1103**	**65**
Balsam Fir	250	0
Balsam Poplar	1067	0
Basswood	464	29
Bigtooth Aspen	833	250
Black Ash	1988	194
Green Ash	2252	79
Ironwood	188	25
Paper Birch	364	114
Quaking Aspen	684	66
Red Maple	1125	0
Red Oak	581	11
Sugar Maple	1025	7
White Spruce	390	45
Stand 11	**1163**	**48**
Basswood	400	67
Black Ash	1494	113
Green Ash	2094	13
Paper Birch	100	100
Quaking Aspen	1081	38
Red Maple	1644	33
Red Oak	543	0
Sugar Maple	450	100
White Spruce	200	0
Stand 12	**1140**	**257**
Balsam Fir	2125	0
Balsam Poplar	400	83
Basswood	100	0
Bigtooth Aspen	250	0
Black Ash	2694	694
Green Ash	800	107
Ironwood	250	250

Quaking Aspen	960	1300
Red Oak	100	0
White Spruce	150	0
Stand 6	**1160**	**341**
Balsam Fir	413	100
Balsam Poplar	575	216.66667
Black Ash	3159	662
Green Ash	363	0
Paper Birch	180	790
Quaking Aspen	675	270
Red Maple	0	250
Red Oak	100	0
Red Pine	200	0
Scotch Pine	200	400
Sugar Maple	225	125
White Pine	150	0
White Spruce	500	0
Stand 8	**1009**	**314**
Balsam Fir	175	275
Balsam Poplar	0	400
Black Ash	2775	300
Green Ash	300	0
Paper Birch	100	100
Prunus spp	400	0
Quaking Aspen	1850	900
Scotch Pine	100	100
White Spruce	566.66667	100
Stand 9	**2677**	**243**
Balsam Fir	125	50
Balsam Poplar	500	0
Bigtooth Aspen	0	100
Black Ash	6288	788
Green Ash	5688	125
Paper Birch	0	133
Quaking Aspen	746	79
Red Maple	1900	0
Yellow Birch	100	0
Stand 10	**1102**	**100**
Balsam Fir	1825	244
Black Ash	1000	50
Green Ash	2267	83
Paper Birch	186	71
Quaking Aspen	617	167
Red Maple	888	0
White Pine	250	0
White Spruce	750	0
Stand 11	**657**	**86**
Balsam Poplar	600	300
Black Ash	1400	0
Mountain Maple	200	0
Paper Birch	0	100
Quaking Aspen	650	175
Red Maple	100	0
White Spruce	100	0
Stand 12	**1561**	**131**
Balsam Fir	250	33
Bigtooth Aspen	0	400
Balsam Fir	100	0
Balsam Poplar	600	200
Basswood	350	67
Black Ash	1170	120
Green Ash	3650	0
Paper Birch	100	140
Prunus spp	700	0
Quaking Aspen	992	83
Red Maple	225	125
Red Oak	217	0
Sugar Maple	233	100
Stand 7	**482**	**118**
Balsam Poplar	200	0
Black Ash	400	100
Quaking Aspen	758	158
Red Maple	0	250
Sumac	50	0
White Spruce	100	0
Stand 8	**1219**	**97**
Green Ash	200	0
Paper Birch	0	300
Prunus sp.	200	0
Quaking Aspen	2171	179
Red Maple	200	0
Red Oak	100	0
Sugar Maple	500	0
Sumac	2500	0
Yellow Birch	100	0
Grand Total	**758**	**108**

Quaking Aspen	1025	408
Red Maple	263	0
Red Oak	250	0
Sugar Maple	400	0
White Spruce	1058	267
Stand 13	**1039**	**153**
Balsam Poplar	100	0
Basswood	400	0
Black Ash	1510	320
Box Elder	250	0
Green Ash	3870	320
Paper Birch	50	100
Quaking Aspen	690	260
Red Maple	283	0
Red Oak	150	0
Sugar Maple	50	100
White Spruce	163	0
Stand 14	**815**	**24**
Basswood	600	0
Black Ash	833	83
Green Ash	1629	0
Ironwood	320	0
Quaking Aspen	557	71
Red Maple	790	0
Red Oak	1250	0
Serviceberry	200	0
Sugar Maple	133	83
White Pine	100	0
White Spruce	425	0
Stand 15	**865**	**35**
Balsam Poplar	375	0
Black Ash	2300	350
Green Ash	2200	0
Ironwood	250	0
Paper Birch	100	0
Quaking Aspen	1400	0
Red Maple	175	0
Red Oak	317	0
Sugar Maple	350	0
White Pine	100	0
White Spruce	100	0
Stand 16	**2175**	**43**
Balsam Fir	600	0
Balsam Poplar	800	75
Basswood	883	33
Black Ash	11925	88
Green Ash	633	0
Ironwood	200	0
Paper Birch	500	0
Quaking Aspen	994	75
Red Maple	633	0
Red Oak	489	0
Sugar Maple	288	38
White Pine	100	0
White Spruce	120	80
Stand 17	**1094**	**120**
American Elm	100	0

Black Ash	4247	193
Green Ash	2138	70
Paper Birch	60	305
Prunus spp	1700	0
Quaking Aspen	835	133
Red Maple	1205	55
Sugar Maple	100	0
White Spruce	100	50
Stand 13	**646**	**154**
Balsam Fir	100	0
Balsam Poplar	400	100
Black Ash	2625	475
Green Ash	1400	100
Paper Birch	133	167
Quaking Aspen	280	100
Red Maple	100	0
Stand 14	**520**	**104**
Balsam Fir	510	20
Balsam Poplar	166.66667	233.33333
Black Ash	825	125
Green Ash	1500	200
Paper Birch	0	100
Quaking Aspen	425	75
Red Pine	100	0
Scotch Pine	1000	0
White Cedar	100	0
White Pine	150	66.666667
White Spruce	675	250
Stand 15	**106**	**156**
Balsam Fir	100	0
Paper Birch	100	0
Quaking Aspen	117	433
Red Maple	50	50
Red Oak	200	0
Stand 16	**347**	**147**
Balsam Fir	620	180
Black Ash	100	0
Mountain Ash	0	200
Paper Birch	50	200
Quaking Aspen	500	233
Red Maple	150	0
Stand 17	**206**	**156**
Balsam Fir	50	50
Basswood	100	50
Green Ash	50	0
Paper Birch	100	0
Quaking Aspen	1100	0
Red Oak	175	25
Sugar Maple	50	625
Grand Total	**1224**	**179**

Balsam Fir	1367	0
Balsam Poplar	75	88
Basswood	467	0
Bigtooth Aspen	0	250
Black Ash	1992	254
Box Elder	400	0
Green Ash	2085	20
Northern White Cedar	3875	0
Paper Birch	583	83
Quaking Aspen	980	370
Red Maple	300	0
Red Oak	304	0
Serviceberry	500	0
Sugar Maple	1025	156
Swamp White Oak	100	0
Tamarack	0	200
White Pine	450	0
White Spruce	270	0
Yellow Birch	0	100
Stand 18	**519**	**35**
Balsam Poplar	200	0
Basswood	117	0
Bigtooth Aspen	200	0
Black Ash	867	17
Green Ash	1317	100
Paper Birch	300	150
Quaking Aspen	300	67
Red Maple	217	0
Red Oak	200	0
Sugar Maple	1283	33
White Pine	100	0
White Spruce	100	0
Stand 19	**1533**	**31**
Balsam Poplar	700	0
Basswood	1125	100
Bigtooth Aspen	250	0
Black Ash	2850	0
Green Ash	4510	100
Paper Birch	480	20
Quaking Aspen	850	0
Red Maple	825	0
Red Oak	580	0
Sugar Maple	700	0
White Pine	100	0
White Spruce	1600	33
Stand 2	**2081**	**310**
Balsam Poplar	167	33
Black Ash	4450	723
Green Ash	4250	125
Paper Birch	200	450
Quaking Aspen	655	120
Red Maple	225	25
White Spruce	300	200
Stand 3	**817**	**236**
Balsam Poplar	0	900
Basswood	238	0
Black Ash	1738	775
Green Ash	1350	100
Paper Birch	0	275
Quaking Aspen	1179	136
Red Maple	120	140
Red Oak	690	0
Sugar Maple	100	0

White Pine	100	0
White Spruce	0	100
Stand 4	**1145**	**158**
Basswood	430	50
Black Ash	3519	694
Green Ash	1500	0
Ironwood	250	0
Paper Birch	100	100
Quaking Aspen	456	56
Red Maple	1117	0
Red Oak	475	25
Sugar Maple	438	50
White Pine	100	0
White Spruce	175	0
Stand 5	**2160**	**331**
Balsam Fir	100	0
Balsam Poplar	730	100
Black Ash	5517	979
Green Ash	2833	0
Paper Birch	0	200
Quaking Aspen	817	67
Red Oak	617	83
Sugar Maple	1250	250
White Spruce	175	0
Stand 6	**1326**	**165**
Balsam Poplar	75	0
Basswood	100	0
Black Ash	1150	458
Green Ash	4225	88
Paper Birch	50	100
Quaking Aspen	913	50
Red Maple	2100	0
Serviceberry	400	200
White Spruce	100	50
Stand 7	**974**	**134**
Balsam Fir	250	0
Balsam Poplar	783	67
Basswood	175	125
Black Ash	2150	505
Green Ash	3375	83
Ironwood	150	175
Paper Birch	150	0
Quaking Aspen	560	170
Red Maple	464	0
Red Oak	800	0
Sugar Maple	429	29
White Pine	200	0
White Spruce	175	0
Yellow Birch	200	0
Stand 8	**1453**	**420**
Balsam Fir	100	0
Black Ash	4367	1600
Paper Birch	50	200
Quaking Aspen	1280	200
Red Maple	650	0
White Spruce	400	50
Stand 9	**313**	**188**
Balsam Poplar	0	750
Green Ash	500	0
Red Oak	250	0
White Spruce	500	0
Grand Total	**1245**	**143**