

# Climate Change Adaptation Plan

## NorthWoods Stewardship Center

April 21, 2017

Prepared by Sam Perron

Prepared using the Adaptation Workbook - [AdaptationWorkbook.org](http://AdaptationWorkbook.org)



### Property details

**Acres:** 1,473

**Ownership:** Private Non-Industrial

NorthWoods owns and manages a ~1,473 acre forest. Within this forest we conduct timber and habitat management, maintain recreational trails, and provide educational materials and programming. The purpose of this Adaptation Workbook project is to revisit our 2015 forest management plan, to decide if any modifications should be made with regards to climate change adaptation. Particular attention will be given to stands that are identified as most vulnerable to climate impacts and where management work (logging, precommercial thinning, planting, invasive work, etc.) is planned. One of these areas is a ~16 acre Norway spruce plantation where ongoing small-scale harvesting is underway; this stand/management area is intended as a demonstration site for climate change adapted silviculture. Other areas with planned implementation include a 32.5 acre precommercial thinning funded by NRCS, 0.4 acres of invasive phragmites treatment, and a 228 acre young hardwood stand where pre-commercial regeneration harvesting (areas of non-commercial overstory species) is planned for 20 non-contiguous acres.

Climate Adaptation Plan	<b>NorthWoods Stewardship Center</b>
Project Details	1,473 acres Private Non-Industrial ownership

	<p>NorthWoods owns and manages a ~1,473 acre forest. Within this forest we conduct timber and habitat management, maintain recreational trails, and provide educational materials and programming. The purpose of this Adaptation Workbook project is to revisit our 2015 forest management plan, to decide if any modifications should be made with regards to climate change adaptation. Particular attention will be given to stands that are identified as most vulnerable to climate impacts and where management work (logging, precommercial thinning, planting, invasive work, etc.) is planned. One of these areas is a ~16 acre Norway spruce plantation where ongoing small-scale harvesting is underway; this stand/management area is intended as a demonstration site for climate change adapted silviculture. Other areas with planned implementation include a 32.5 acre precommercial thinning funded by NRCS, 0.4 acres of invasive phragmites treatment, and a 228 acre young hardwood stand where pre-commercial regeneration harvesting (areas of non-commercial overstory species) is planned for 20 non-contiguous acres.</p>
<p>Management area(s)</p>	<p><b>Northern hardwood</b></p> <p><b>Softwood Plantation</b></p> <p><b>Lowland and riparian forest</b></p> <p><b>Forest Roads and Trails</b></p>
<p>Regional Climate Change Impacts &amp; Property-Level Considerations</p>	<p>The following climate change impacts are regional expectations drawn from published resources. Under each regional climate change impact statement, property-level considerations describe how the general trend might be meaningful at the scale of the property.</p> <p><b>Temperatures in New England are projected to increase 3.5 to 8.5 °F by the end of the century, with the greatest warming expected to occur during winter.</b></p> <p><b>The growing season in New England and northern New York is generally expected to increase by 20 days or more by the end of the century, due to fewer days with a minimum temperatures below 32°F.</b></p> <p><b>The winter season will be shorter and milder across New England and northern New York, with less precipitation falling as snow and reduced snow cover and depth.</b></p> <p><b>Precipitation patterns will be altered, with projected increases in annual precipitation and potential for reduced growing season precipitation in New England and northern New York.</b></p> <p><b>Intense precipitation events will continue to become more frequent in New England and northern New York.</b></p> <p><b>Warmer temperatures and altered precipitation in New England and northern New York will interact to change soil moisture patterns throughout the year, with the potential for both wetter and drier conditions depending on the location and season.</b></p> <p><b>Forest vegetation in New England and northern New York may face increased risk of moisture deficit and drought during the growing season.</b></p> <p><b>Certain insect pests and pathogens will increase in occurrence or become more damaging in New England and northern New York.</b></p> <p><b>Many invasive plants will increase in extent or abundance in New England and northern New York.</b>  Property considerations: Very few invasives present on the property, but other areas within 100-200 miles have many invasive species. Invasive pressure could increase, and this is something we have not had to deal with extensively yet.</p> <p><b>Many northern and boreal tree species will face increasing stress across much of New England and northern New York.</b></p> <p><b>Habitat will become more suitable in New England and northern New York for some southern species.</b></p> <p><b>Forest composition will change across the landscape in New England and northern New York.</b></p> <p><b>Shifts in forest composition in New England and northern New York will take at least several decades to occur in the absence of major disturbance.</b></p> <p><b>Conditions affecting tree regeneration and recruitment will change in New England and northern New York.</b></p> <p><b>Forest productivity in New England and northern New York will increase during the next several decades in the absence of significant stressors.</b></p> <p><b>Low-diversity systems are at greater risk from climate change.</b></p> <p><b>Species in fragmented landscapes will have less opportunity to migrate in response to climate change.</b></p> <p><b>Systems that are limited to particular environments will have less opportunity to migrate in response to climate change.</b></p> <p><b>Systems that are more tolerant of disturbance have less risk of declining on the landscape</b></p>

### Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

<p>Plan for specific Management area</p>	<p>Northern hardwood</p> <p>Northern hardwood forest cover is found over much of the property, and northern hardwood natural</p>
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	<p>communities/variants are the expected natural community for nearly all of the 1473 acres (land use history has led to different existing cover). For this project, the northern hardwood management topic applies to timber stands (including regenerating stands) that currently have northern hardwood or similar forest cover; this includes mixed hardwood/softwood stands that include 25-65% softwood (balsam fir, red/white spruce, white pine, tamarack).</p> <p>Northern hardwood forests are widely distributed over a variety of sites with dry-mesic to wet-mesic conditions and nutrient-poor to rich soils. This forest type is generally found at low to moderate elevations. Species that are commonly dominant include sugar maple, yellow birch, American beech, eastern hemlock, and red spruce.</p>
Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective(s)	<p>Maintain 10-25% of stocking in minor species, especially species with high wildlife/non-timber value such as American beech, serviceberry, apple, basswood, mountain ash, eastern hophornbeam and others. <i>(ongoing)</i></p> <p>Re-develop old forest structure, including multiple age classes, legacy trees &gt;20" dbh, cavity trees, snags &gt;15" dbh, and varying sizes of downed wood. <i>(ongoing)</i></p>
Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective(s)	<p>Increase percentages of AGS and commercial species through pre-commercial and commercial harvests. <i>(ongoing)</i></p> <p>Harvest 20-40 cords of firewood annually for NorthWoods facilities. <i>(annual)</i></p> <p>Promote site-appropriate species with high value for timber and/or non-timber values. Preferred species (depending on site) include sugar maple, yellow birch, red spruce, black cherry, white ash, red maple, paper birch, American beech, and others. <i>(ongoing)</i></p> <p>Provide for continuous regeneration of preferred species, either through periodic harvests or open forest canopy. <i>(ongoing)</i></p>
Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective(s)	Maintain existing trails and construct additional multi-use (xc-ski, hiking, forestry access) trail(s) to connect networks on opposite sides of the forest. <i>(2020)</i>
Potential identified impacts for Northern hardwood	<p><b>Several dominant tree species are at risk of declining by the end of the century, including red spruce and balsam fir.</b></p> <p>Property considerations: Balsam fir is a large overstory component in most mixed stands; balsam fir also regenerates aggressively on much of the site. Colder areas of the property (for instance, north facing gullies) may provide habitat/refugia for northern tree species during decline.</p> <p><b>Some tree species may be more likely to persist or increase through the end of the century, such as red maple.</b></p> <p><b>Northern hardwood forests are widely distributed across a variety of sites, increasing adaptive capacity.</b></p> <p><b>High levels of diversity may increase the ability of forests to adapt to climate change.</b></p> <p><b>Insect pests and forest diseases could become more problematic in northern hardwood forests under a warmer climate.</b></p> <p><b>Invasive species such as buckthorn, honeysuckle, and garlic mustard are expected to become more problematic under climate change.</b></p> <p><b>Changes in herbivore populations may also have substantial effects on forest growth and composition in northern hardwood forests.</b></p>
Potential impact of climate change on health and function of system	Mixed/Neutral
Adaptive Capacity of system to climate change impacts or disturbances	Moderate-High
Vulnerability determination	Moderate

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective(s)	Maintain 10-25% of stocking in minor species, especially species with high wildlife/non-timber value such as

Management Objective	Maintain 10-25% of stocking in minor species, especially species with high wildlife/non-timber value such as American beech, serviceberry, apple, basswood, mountain ash, eastern hophornbeam and others. ( <i>ongoing</i> )
Challenges	Increased invasive plant pressure could reduce diversity and vigor of regeneration, and would be likely to out-compete slow growing species and/or shrubs.
Opportunities	The "minor" species identified are predicted to adapt well to climate change. In addition, species currently uncommon in northern VT, such as oaks and walnut, could become more common.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Current management promotes species diversity, and the flexibility of this objective (promoting many species, without strict percentages of each) makes it very attainable.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Promote regeneration of native, site-appropriate species that are expected to adapt well to a changing climate. Species to favor include black cherry, white pine, butternut, basswood and red maple. This should be accomplished over several cutting cycles (possibly multiple rotations) when transitioning even-aged stands to uneven-aged/irregular structures.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	By increasing the proportion of climate-change-adapted species, future stands should be more resilient to changing climate as well as other stressors such as insect pests, pathogens, variable weather conditions, etc.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

Adaptation Tactic	<b>Monitor for invasive plant species and reduce/eliminate them before large populations establish. Property-wide monitoring should be conducted every 10 years (during forest management plan updates) with more frequent monitoring on disturbed sites. Control measures may be manual or chemical and should be completed at appropriate intervals, typically annually.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	By controlling invasives before they are deeply entrenched, cost and ecological repercussions should be minimized.
Drawbacks and barriers of this tactic	In the event of a large invasive species influx, cost of treatment/control may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>

... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Use pre-commercial thinnings and commercial harvests to release/favor species predicted to adapt well to climate change. Species include black cherry, white pine, red maple and others.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Forest stand improvement work increases stand value and individual tree vigor, as well as selecting for desirable species. Selecting for these species where they already exist will provide seed source for future regeneration.
Drawbacks and barriers of this tactic	Cost of pre-commercial thinning may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

### Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Invasive species
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	90% removal of existing phragmites patches. 90-100% removal of new invasive populations, if feasible.
Implementing monitoring efforts (frequency, time of year, etc)	Existing invasives, to be treated in 2017 as part of NRCS cost share, will be monitored annually (during June-August) for 5 years after treatment. 1/1000 acre plots will be use to evaluate invasive cover. The entire property will be monitored for new invasives an a 10 year cycle, coinciding with FMP update inventory.
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Species composition
Monitoring Variable 2	
Threshold or Criteria for Evaluation of adaptation tactic	Increase in proportion (% basal area) of future climate adapted species such as black cherry, white pine, red maple and others. Minor/non-commercial species up to 25% total.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. Variable radius plots used for inventory.
Monitoring variables used to	Regeneration

evaluate if tactic is achieving desired management objective(s)	
Monitoring Variable 3	
Threshold or Criteria for Evaluation of adaptation tactic	Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Re-develop old forest structure, including multiple age classes, legacy trees >20" dbh, cavity trees, snags >15" dbh, and varying sizes of downed wood. <i>(ongoing)</i>
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Management of forest structure is not likely to be affected much by climate change impacts.

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Increase percentages of AGS and commercial species through pre-commercial and commercial harvests. <i>(ongoing)</i>
Challenges	Some commercial species (sugar maple, spruce, balsam fir, yellow birch) are predicted to decline. Under current management, balsam fir regenerates vigorously on many sites, so it may be challenging to secure climate change adapted commercial species in future rotations. Increased storm intensity (ice, wind, etc) may cause damage to high-quality trees, especially those in thinned, small diameter stands.
Opportunities	Some current species (black cherry) are predicted to increase with climate change, and additional high-value species currently absent from the property (red oak, black walnut) may have increasingly suitable habitat.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Current management promotes high quality, commercial growing stock of various species; management for high quality stems is unlikely to be impacted by climate change, although species selection/proportions may change.

### Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Promote regeneration of native, site-appropriate species that are expected to adapt well to a changing climate. Species to favor include black cherry, white pine, butternut, basswood and red maple. This should be accomplished over several cutting cycles (possibly multiple rotations) when transitioning even-aged stands to uneven-aged/irregular structures.</b>
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Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	By increasing the proportion of climate-change-adapted species, future stands should be more resilient to changing climate as well as other stressors such as insect pests, pathogens, variable weather conditions, etc.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Monitor for invasive plant species and reduce/eliminate them before large populations establish. Property-wide monitoring should be conducted every 10 years (during forest management plan updates) with more frequent monitoring on disturbed sites. Control measures may be manual or chemical and should be completed at appropriate intervals, typically annually.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	By controlling invasives before they are deeply entrenched, cost and ecological repercussions should be minimized.
Drawbacks and barriers of this tactic	In the event of a large invasive species influx, cost of treatment/control may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Use pre-commercial thinnings and commercial harvests to release/favor species predicted to adapt well to climate change. Species include black cherry, white pine, red maple and others.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Forest stand improvement work increases stand value and individual tree vigor, as well as selecting for desirable species. Selecting for these species where they already exist will provide seed source for future regeneration.
Drawbacks and barriers of this tactic	Cost of pre-commercial thinning may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>

Implementation	recess.
... recommend tactic?	Yes

### Monitoring adaptation actions

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<p>Monitoring variables used to evaluate if tactic is achieving desired management objective(s)</p> <p>Monitoring Variable 1</p> <p>Threshold or Criteria for Evaluation of adaptation tactic</p> <p>Implementing monitoring efforts (frequency, time of year, etc)</p>	<p>Invasive species</p> <p>90% removal of existing phragmites patches. 90-100% removal of new invasive populations, if feasible.</p> <p>Existing invasives, to be treated in 2017 as part of NRCS cost share, will be monitored annually (during June-August) for 5 years after treatment. 1/1000 acre plots will be use to evaluate invasive cover. The entire property will be monitored for new invasives an a 10 year cycle, coinciding with FMP update inventory.</p>
<p>Monitoring variables used to evaluate if tactic is achieving desired management objective(s)</p> <p>Monitoring Variable 2</p> <p>Threshold or Criteria for Evaluation of adaptation tactic</p> <p>Implementing monitoring efforts (frequency, time of year, etc)</p>	<p>Species composition</p> <p>Increase in proportion (% basal area) of future climate adapted species such as black cherry, white pine, red maple and others. Minor/non-commercial species up to 25% total.</p> <p>Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. Variable radius plots used for inventory.</p>
<p>Monitoring variables used to evaluate if tactic is achieving desired management objective(s)</p> <p>Monitoring Variable 3</p> <p>Threshold or Criteria for Evaluation of adaptation tactic</p> <p>Implementing monitoring efforts (frequency, time of year, etc)</p>	<p>Regeneration</p> <p>Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.</p> <p>Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.</p>

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Harvest 20-40 cords of firewood annually for NorthWoods facilities. <i>(annual)</i>
Challenges	Shorter, warmer, and less predictable winters may hinder access to wet sites for harvesting.
Opportunities	Longer growing seasons may increase productivity.
Feasibility Rating	High



Feasibility of meeting objectives after evaluation of climate impacts on system

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Comments: Climate change is unlikely to impact forest productivity, especially when species and quality are of less concern. Our current harvest system uses small equipment and staff who can adapt schedules to weather conditions.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Use pre-commercial thinnings and commercial harvests to release/favor species predicted to adapt well to climate change. Species include black cherry, white pine, red maple and others.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Forest stand improvement work increases stand value and individual tree vigor, as well as selecting for desirable species. Selecting for these species where they already exist will provide seed source for future regeneration.
Drawbacks and barriers of this tactic	Cost of pre-commercial thinning may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
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## Monitoring adaptation actions

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Monitoring variables used to evaluate if tactic is achieving

Species composition

<p>desired management objective(s)</p> <p>Monitoring Variable 1</p> <p>Threshold or Criteria for Evaluation of adaptation tactic</p> <p>Implementing monitoring efforts (frequency, time of year, etc)</p>	<p>Increase in proportion (% basal area) of future climate adapted species such as black cherry, white pine, red maple and others. Minor/non-commercial species up to 25% total.</p> <p>Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. Variable radius plots used for inventory.</p>
<p>Monitoring variables used to evaluate if tactic is achieving desired management objective(s)</p> <p>Monitoring Variable 2</p> <p>Threshold or Criteria for Evaluation of adaptation tactic</p> <p>Implementing monitoring efforts (frequency, time of year, etc)</p>	<p>Regeneration</p> <p>Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.</p> <p>Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.</p>

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Promote site-appropriate species with high value for timber and/or non-timber values. Preferred species (depending on site) include sugar maple, yellow birch, red spruce, black cherry, white ash, red maple, paper birch, American beech, and others. <i>(ongoing)</i>
Challenges	Some species (sugar maple, yellow birch, paper birch) are predicted to decline as a result of climate change, and additional species (white ash) are threatened by forest pest outbreaks.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	

### Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Use pre-commercial thinnings and commercial harvests to release/favor species predicted to adapt well to climate change. Species include black cherry, white pine, red maple and others.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Forest stand improvement work increases stand value and individual tree vigor, as well as selecting for desirable species. Selecting for these species where they already exist will provide seed source for future regeneration.
Drawbacks and barriers of this tactic	Cost of pre-commercial thinning may be prohibitive.

Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant seedlings of species (red oak, possibly others) that are currently absent from the site, but are predicted to have suitable habitat AND are native to nearby/surrounding areas.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Introduce species that are expected to be adapted to future conditions
Benefits of this tactic	By introducing species earlier rather than later, they will have a chance to establish and grow to seed-producing age to establish natural regeneration in the future. Early introduction will also provide opportunity to test different sites/conditions to determine suitable habitat.
Drawbacks and barriers of this tactic	Cost of planting (rather than allowing natural regeneration) may be prohibitive. Introduction of species may have unintended impacts on ecosystem function (wildlife habitat, etc.)
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Provide for continuous regeneration of preferred species, either through periodic harvests or open forest canopy. <i>(ongoing)</i>
Challenges	Increased storm intensity/frequency may cause greater damage to fragile regeneration.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Management of forest structure is unlikely to be impacted by climate change, although species may shift and storm damage may be an increasing concern.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
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Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant seedlings of species (red oak, possibly others) that are currently absent from the site, but are predicted to have suitable habitat AND are native to nearby/surrounding areas.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Introduce species that are expected to be adapted to future conditions
Benefits of this tactic	By introducing species earlier rather than later, they will have a chance to establish and grow to seed-producing age to establish natural regeneration in the future. Early introduction will also provide opportunity to test different sites/conditions to determine suitable habitat.
Drawbacks and barriers of this tactic	Cost of planting (rather than allowing natural regeneration) may be prohibitive. Introduction of species may have unintended impacts on ecosystem function (wildlife habitat, etc.)
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective	Maintain existing trails and construct additional multi-use (xc-ski, hiking, forestry access) trail(s) to connect networks on opposite sides of the forest. (2020)
Challenges	Increased storm intensity may require more robust trails, increasing cost and/or limiting 4-season trail accessibility.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

Plan for specific Management area	<p><b>Softwood Plantation</b></p> <p>Various softwood plantations are established throughout the property. These stands are typically even-aged (45-75 years old); species include Norway spruce, white pine, red pine, Scots pine, and occasional naturally-regenerated trees of other species. Regeneration varies greatly in density and species, but balsam fir is a common seedling/sapling species, and overall regeneration in plantations is sparse.</p> <p>Plantations of even-aged Norway spruce, red pine and white pine, generally on northern hardwood sites with agricultural history.</p>
Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective(s)	<p>Transition to site appropriate species, based on natural community type (typically northern hardwood). Promote species with high value for timber and/or non-timber value, such as sugar maple, yellow birch, red spruce, black cherry, white ash, red maple, paper birch, American beech, and others. <i>(ongoing)</i></p> <p>Limit residual stand damage, including basal scarring, broken branches/tops and root exposure/compaction to 5% or less of residual trees. <i>(ongoing)</i></p> <p>Re-develop old forest structure, including multiple age classes, legacy trees &gt;20" dbh, cavity trees, snags &gt;15" dbh, and varying sizes of downed wood. <i>(ongoing)</i></p>
Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective(s)	<p>Transition to uneven-aged/irregular forest structure. <i>(ongoing)</i></p> <p>Conduct timber harvests to provide periodic income (preferably annually, but at least every 3-5 years). <i>(annual/ongoing)</i></p> <p>Provide for continuous regeneration of preferred species, either through periodic harvests or open forest canopy. <i>(ongoing)</i></p>
Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective(s)	
Potential identified impacts for Softwood Plantation	<p><b>Species such as Norway spruce may decline over the coming century.</b> Norway spruce is a major component of some softwood plantations.</p> <p><b>Forests lacking species/structure/age diversity may be less resilient to changing disturbance regimes.</b> Softwood plantations are generally characterized by a single strata, single age class and 1-3 species.</p> <p>Creating and Maintaining Resilient Forests in Vermont: Adapting Forests to Climate Change. Vermont Department of Forests, Parks and Recreation 2015 (<a href="http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/The_Forest_Ecosystem/Library/Climate%20change%20report_final_v6-18-15a.pdf">http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/The_Forest_Ecosystem/Library/Climate%20change%20report_final_v6-18-15a.pdf</a>)</p> <p><b>Lack of regeneration in even-aged stands reduces adaptive capacity.</b> Softwood plantations generally have little or no regeneration; where regeneration is present, balsam fir is common.</p>
Potential impact of climate change on health and function of system	Disruptive
Adaptive Capacity of system to climate change impacts or disturbances	Low-Moderate
Vulnerability determination	High

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate

includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Transition to site appropriate species, based on natural community type (typically northern hardwood). Promote species with high value for timber and/or non-timber value, such as sugar maple, yellow birch, red spruce, black cherry, white ash, red maple, paper birch, American beech, and others. <i>(ongoing)</i>
Challenges	Climate change may make it difficult to know which species will be best suited to the site by the end of the next rotation (80-100+ years in the future). Current regeneration includes high proportions of balsam fir, a species predicted to decline in the future.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Promote regeneration of native, site-appropriate species that are expected to adapt well to a changing climate. Species to favor include black cherry, white pine, butternut, basswood and red maple. This should be accomplished over several cutting cycles (possibly multiple rotations) when transitioning even-aged stands to uneven-aged/irregular structures.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	By increasing the proportion of climate-change-adapted species, future stands should be more resilient to changing climate as well as other stressors such as insect pests, pathogens, variable weather conditions, etc.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

Adaptation Tactic	<b>Monitor for invasive plant species and reduce/eliminate them before large populations establish. Property-wide monitoring should be conducted every 10 years (during forest management plan updates) with more frequent monitoring on disturbed sites. Control measures may be manual or chemical and should be completed at appropriate intervals, typically annually.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	By controlling invasives before they are deeply entrenched, cost and ecological repercussions should be minimized.
Drawbacks and barriers of this tactic	In the event of a large invasive species influx, cost of treatment/control may be prohibitive.
Timeframe to implement	ongoing

Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant seedlings of species (red oak, possibly others) that are currently absent from the site, but are predicted to have suitable habitat AND are native to nearby/surrounding areas.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Introduce species that are expected to be adapted to future conditions
Benefits of this tactic	By introducing species earlier rather than later, they will have a chance to establish and grow to seed-producing age to establish natural regeneration in the future. Early introduction will also provide opportunity to test different sites/conditions to determine suitable habitat.
Drawbacks and barriers of this tactic	Cost of planting (rather than allowing natural regeneration) may be prohibitive. Introduction of species may have unintended impacts on ecosystem function (wildlife habitat, etc.)
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

### Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Invasive species
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	90% removal of existing phragmites patches. 90-100% removal of new invasive populations, if feasible.
Implementing monitoring efforts (frequency, time of year, etc)	Existing invasives, to be treated in 2017 as part of NRCS cost share, will be monitored annually (during June-August) for 5 years after treatment. 1/1000 acre plots will be use to evaluate invasive cover. The entire property will be monitored for new invasives an a 10 year cycle, coinciding with FMP update inventory.
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Species composition
Monitoring Variable 2	
Threshold or Criteria for Evaluation of adaptation tactic	Increase in proportion (% basal area) of future climate adapted species such as black cherry, white pine, red maple and others. Minor/non-commercial species up to 25% total.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. Variable radius plots used for inventory.



etc)	
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Regeneration
Monitoring Variable 3	
Threshold or Criteria for Evaluation of adaptation tactic	Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Limit residual stand damage, including basal scarring, broken branches/tops and root exposure/compaction to 5% or less of residual trees. ( <i>ongoing</i> )
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: This operational objective is currently being met, and is unlikely to be impacted by climate change.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Re-develop old forest structure, including multiple age classes, legacy trees >20" dbh, cavity trees, snags >15" dbh, and varying sizes of downed wood. <i>(ongoing)</i>
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Management of forest structure is unlikely to be impacted by climate change.

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Transition to uneven-aged/irregular forest structure. <i>(ongoing)</i>
Challenges	Future forest pest outbreaks in single-species stands could require early salvage harvesting, resulting in another even-aged stand.
Opportunities	Natural disturbance from increased storm intensity could help create irregular forest structure.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Although forest dynamics may change in a changing climate, the general disturbance regime of small gap dynamics is likely to continue.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Promote regeneration of native, site-appropriate species that are expected to adapt well to a changing climate. Species to favor include black cherry, white pine, butternut, basswood and red maple. This should be accomplished over several cutting cycles (possibly multiple rotations) when transitioning even-aged stands to uneven-aged/irregular structures.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	By increasing the proportion of climate-change-adapted species, future stands should be more resilient to changing climate as well as other stressors such as insect pests, pathogens, variable weather conditions, etc.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High

... practicability of tactic?	Yes
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant seedlings of species (red oak, possibly others) that are currently absent from the site, but are predicted to have suitable habitat AND are native to nearby/surrounding areas.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Introduce species that are expected to be adapted to future conditions
Benefits of this tactic	By introducing species earlier rather than later, they will have a chance to establish and grow to seed-producing age to establish natural regeneration in the future. Early introduction will also provide opportunity to test different sites/conditions to determine suitable habitat.
Drawbacks and barriers of this tactic	Cost of planting (rather than allowing natural regeneration) may be prohibitive. Introduction of species may have unintended impacts on ecosystem function (wildlife habitat, etc.)
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

### Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Regeneration
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Monitoring variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Conduct timber harvests to provide periodic income (preferably annually, but at least every 3-5 years). <i>(annual/ongoing)</i>
Challenges	Increased invasive pressure, especially in regeneration cuts, may require control tactics that will cut into timber harvesting profit.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Monitor for invasive plant species and reduce/eliminate them before large populations establish. Property-wide monitoring should be conducted every 10 years (during forest management plan updates) with more frequent monitoring on disturbed sites. Control measures may be manual or chemical and should be completed at appropriate intervals, typically annually.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	By controlling invasives before they are deeply entrenched, cost and ecological repercussions should be minimized.
Drawbacks and barriers of this tactic	In the event of a large invasive species influx, cost of treatment/control may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>

Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

### Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Regeneration
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Regeneration harvests should have at least 350 stems/ac of vigorous seedlings/saplings of desired species within 5 years after harvesting.
Implementing monitoring efforts (frequency, time of year, etc)	Forest inventory will be conducted on 10 year intervals, coinciding with FMP updates. 1/1000th acre plots used to evaluate seedling/sapling density and species composition.

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Provide for continuous regeneration of preferred species, either through periodic harvests or open forest canopy. <i>(ongoing)</i>
Challenges	Increased storm intensity/frequency may cause greater damage to fragile regeneration.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Management of forest structure is unlikely to be impacted by climate change, although species may shift and storm damage may be an increasing concern.

### Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

Plan for specific Management area	<p>Lowland and riparian forest</p> <p>Includes forested wetlands, nonproductive forest, and other areas not suitable/desired for timber management.</p> <p>Diverse forested wetlands are found in depressions and low-lying areas, along waterways, and in floodplains. Dominant species may include ash, red or silver maple, swamp white oak, sycamore, American elm, and river birch.</p>
Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective(s)	<p>Maintain 75% or greater canopy cover in riparian areas. <i>(ongoing)</i></p> <p>Leave at least 50% of harvested material as downed woody material.</p>
Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective(s)	Maintain trails to reduce/eliminate soil disturbance; trail improvements may include drainage, hardening, limited use (ie frozen-ground-only equipment access) or bridging. <i>(ongoing)</i>
Potential identified impacts for Lowland and riparian forest	<p><b>Lowland and riparian forests may have limited tolerance to changes in precipitation and water tables.</b></p> <p><b>Many tree species could tolerate limited increases in flooding and drought under climate change.</b></p> <p><b>Many of the dominant tree species are projected to have similar or increased habitat, including American elm, eastern cottonwood, and silver maple.</b></p> <p>Property considerations: Lowland and riparian forests on this site tend to have species less adapted to climate change, such as tamarack, balsam fir, black ash, eastern hemlock and northern white cedar.</p> <p><b>Some tree species in lowland and riparian hardwood forests are expected to decline by the end of the century (northern white-cedar, black ash, balsam fir, yellow birch, and paper birch).</b></p> <p>Property considerations: These species make up a large percentage of lowland/riparian forests on this site.</p> <p><b>Invasive species such as Japanese stiltgrass and buckthorn are expected to become more problematic under climate change.</b></p> <p><b>Insect pests and forest diseases could become more problematic these forests under a warmer climate.</b></p>
Potential impact of climate	Disruptive

change on health and function of system	
Adaptive Capacity of system to climate change impacts or disturbances	Moderate-High
Vulnerability determination	Moderate

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Maintain 75% or greater canopy cover in riparian areas. <i>(ongoing)</i>
Challenges	Some species in riparian areas (balsam fir, eastern hemlock, black ash, yellow birch) are likely to decline.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain at least 75% canopy cover, and retain downed woody material near streams, wetlands and lakeshores. Limit equipment access and soil disturbance in these areas.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Maintain or restore riparian areas
Benefits of this tactic	Protecting riparian areas should provide resilience to future increased flow from storms.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna
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Management Objective	Leave at least 50% of harvested material as downed woody material.
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: This objective is met by current management, and is unlikely to be impacted by climate change.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain at least 75% canopy cover, and retain downed woody material near streams, wetlands and lakeshores. Limit equipment access and soil disturbance in these areas.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Maintain or restore riparian areas
Benefits of this tactic	Protecting riparian areas should provide resilience to future increased flow from storms.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective	Maintain trails to reduce/eliminate soil disturbance; trail improvements may include drainage, hardening, limited use (ie frozen-ground-only equipment access) or bridging. <i>(ongoing)</i>
Challenges	Warmer winters may limit access for winter recreation/equipment access on hydric soils. Year-round trails may need substantial improvements to withstand more intense rainfall events.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the



Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

Plan for specific Management area	<p><b>Forest Roads and Trails</b></p> <p>Includes trails used for non-motorized recreation (cross country skiing, hiking, wildlife observation, etc.) and forestry equipment access.</p>
Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective(s)	<p>Minimize erosion, rutting, off-trail soil disturbance, and stream impacts from roads and trails. <i>(ongoing)</i></p> <p>Ensure that roads and trails do not create barriers to wildlife movement or habitat use; site trails to avoid sensitive habitats and riparian areas. <i>(ongoing)</i></p>
Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective(s)	Develop permanent access roads/trails for harvesting equipment. These trails will be used frequently for uneven-aged/irregular harvesting and intermediate treatments, and must be located and designed to withstand equipment use with minimal "closeout" repair after harvests. <i>(ongoing)</i>
Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective(s)	Maintain and enhance aesthetic values of trails, including large trailside trees, wildlife viewing areas, historic sites, and interpretive signage. <i>(ongoing)</i>
Potential identified impacts for Forest Roads and Trails	<p><b>The winter season will be shorter and milder across New England and northern New York, with less precipitation falling as snow and reduced snow cover and depth.</b></p> <p>Reliance on winter harvest conditions may become inadequate for protecting soils while still maintaining harvest productivity.</p> <p>M. Notaro, D. Lorenz, and others. 2014. 21st century projections of snowfall and winter severity across central-eastern North America. <i>Journal of Climate</i>. (<a href="http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-13-00520.1">http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-13-00520.1</a>)</p> <p><b>Intense precipitation events will continue to become more frequent in New England and northern New York.</b></p> <p>Current drainage, erosion control and stream crossing structures may be insufficient for protecting trail and environmental integrity.</p> <p>D. Lorenz and M. Notaro. 2014. LCC Statistical Downscaling. Nelson Center for Climatic Research - University of Wisconsin-Madison. (<a href="http://nelson.wisc.edu/ccr/index.php">http://nelson.wisc.edu/ccr/index.php</a>)</p>
Potential impact of climate change on health and function of system	Disruptive
Adaptive Capacity of system to climate change impacts or disturbances	Low-Moderate
Vulnerability determination	High

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Minimize erosion, rutting, off-trail soil disturbance, and stream impacts from roads and trails. <i>(ongoing)</i>
Challenges	Increased frequency/intensity of precipitation events may lead to increased erosion potential and times when trails are inaccessible. Warmer, shorter winters may limit frozen conditions on trails that are too wet/soft for non-frozen equipment access.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Low Comments: Trail resilience is currently marginal, and often dependent on dry/frozen conditions.

### Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

### Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To promote forest health, including intact natural communities and wildlife habitat values that support a diverse native flora and fauna.
Management Objective	Ensure that roads and trails do not create barriers to wildlife movement or habitat use; site trails to avoid sensitive habitats and riparian areas. <i>(ongoing)</i>
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Current trail structures do not create major habitat impacts or wildlife barriers; this is unlikely to be impacted directly by climate change.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
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Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To cultivate a variety of forest products while improving long-term timber value and forest productivity and modeling sustainable forestry practices.
Management Objective	Develop permanent access roads/trails for harvesting equipment. These trails will be used frequently for uneven-aged/irregular harvesting and intermediate treatments, and must be located and designed to withstand equipment use with minimal "closeout" repair after harvests. ( <i>ongoing</i> )
Challenges	Increased frequency/intensity of precipitation events may lead to increased erosion potential and times when trails are inaccessible. Warmer, shorter winters may limit frozen conditions on trails that are too wet/soft for non-frozen equipment access.
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	Low Comments: Many sites are too wet for non-frozen equipment access, and current trail building guidelines (Acceptable Management Practices) may be insufficient for protecting trails/water quality under future climate conditions.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>

Strategy	Reduce the risk and long-term impacts of severe disturbances
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

## Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	To create and maintain outdoor education and recreation values that serve as a community resource and best support the NorthWoods mission.
Management Objective	Maintain and enhance aesthetic values of trails, including large trailside trees, wildlife viewing areas, historic sites, and interpretive signage. <i>(ongoing)</i>
Challenges	N/A
Opportunities	N/A
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Trail and forest appearance may change with climatic changes, but aesthetics would likely be unaffected.

## Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	<b>Maintain, improve and/or construct new trails to withstand more intense rainfall events, and plan wherever possible for non-frozen equipment access.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Benefits of this tactic	Improved permanent trails will allow us to meet silvicultural/management objectives by carrying out planned harvests on-schedule while minimizing residual damage.
Drawbacks and barriers of this tactic	Cost of improving/building new trails, bridges, etc may be prohibitive.
Timeframe to implement	ongoing
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other</i>

implementation

factors.

... recommend tactic?

Yes

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