Climate Change Adaptation Plan

Otter Point Woods

April 21, 2020

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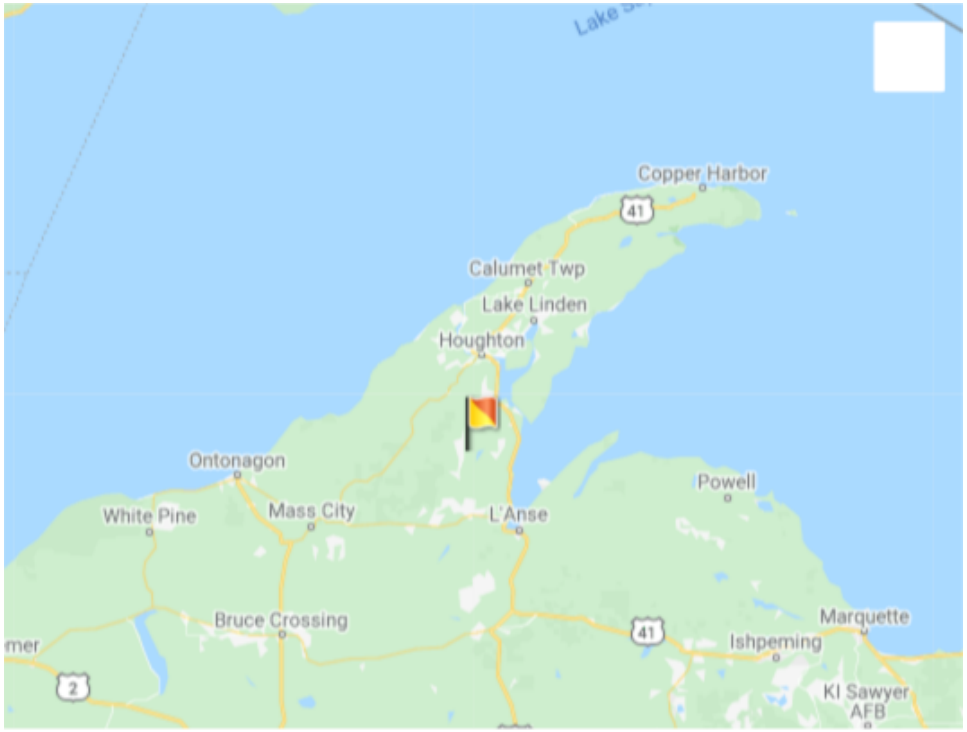
Prepared using the Adaptation Workbook - AdaptationWorkbook.org



Property details

Acres: 30

Ownership: Private Non-Industrial

Management goals and objectives capture fundamental information about the project area or property and provide a starting point for considering climate change.

1a. Lowland-riparian hardwoods: Goals and Objectives

Stands are in low-lying sites and are dominated primarily by black ash, red maple, American elm, or a mixture of these species.

Bottomland hardwoods. Composition is primarily green ash and silver maple. Early spring flooding due to snowmelt.

Goal	Objectives and Timeframes
Maintain the health of the forests, wetlands, and natural ecosystems on the property.	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)* • Reduce the dominance of green ash to less than 30% of the forest canopy in anticipation of the emerald ash borer by harvesting ash trees for firewood on approximately 10 acres. *(next 10 years)* • Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)* • Retain and promote the growth of tree species that may be suitable for future conditions, including silver maple (currently present on the property).
Protect/maintain water quality	• Maintain vegetative cover with a mix of forests and wetlands *(forever)*

1b. Tag alder wetlands: Goals and Objectives

Small patches of tag alder and shrubs distributed across the property.

Goal	Objectives and Timeframes
Protect/maintain water quality	• Maintain buffer along shorelines *(forever)*

1c. Cattail wetlands: Goals and Objectives

Small patches of tag alder and shrubs distributed across the property.

Goal	Objectives and Timeframes
Protect/maintain water quality	• Maintain buffer along shorelines *(forever)*
Maintain the health of the forests, wetlands, and natural ecosystems on the property.	

1d. Field: Goals and Objectives

Approx. 0.X-acre field.

Goal	Objectives and Timeframes
Maintain the health of the forests, wetlands, and natural ecosystems on the property.	
Provide high-quality habitat for diverse wildlife species with an emphasis on waterfowl.	• Plant diverse tree and plant species along field edges and shorelines to promote wildlife food sources *(20 years)*

1e. Orchards: Goals and Objectives

Two small orchard areas.

Goal	Objectives and Timeframes
Create area for fruit-production	• Replace current apple trees with new fruit-producing trees *(next 5 years)*

1f. Property-wide: Goals and Objectives

Entire 30-acre property

Goal	Objectives and Timeframes
Maintain the health of the forests, wetlands, and natural ecosystems on the property.	• Reduce and remove non-native invasive plant species. *(20 years)*
Maintain trail network for access	• Maintain the existing trail network for access. *(20 years)*
Enhance opportunities for hunting, foraging, and other forms of recreation.	

2. Climate Change Impacts and Vulnerabilities

Climate change will not affect all places in the same way. This section describes the anticipated effects of climate change within a region, and then provides additional details how specific places within the project area may be affected.

2a. Regional Climate Impacts and Vulnerabilities

Potential Climate Impact - Regional	Property or Project Area Considerations
Temperatures in northern Wisconsin and western Michigan will increase between 3 °F and 9 °F by the end of the century, with more warming during winter. (23, 27)	
Total snowfall, snow depth, and snowpack duration are all expected to decline substantially in northern Wisconsin and western Michigan by the end of the century. (23, 27)	If snowpacks decline substantially, spring flooding might not be as severe. However, lake-effect snow will likely be substantial for quite some time in the Keweenaw.
Northern Wisconsin and western Michigan will have 30-50 fewer days of frozen ground during the winter by the end of the century. (23)	
The growing season in northern Wisconsin and western Upper Michigan will increase by 20 to 70 days by the end of the century. (23, 27)	
Intense precipitation events will continue to become more frequent in in northern Wisconsin and western Upper Michigan. (23, 27)	
Soil moisture patterns in in northern Wisconsin and western Upper Michigan will change, with drier soil conditions later in the growing season. (23)	The high water table might allow plants (especially those with larger root systems) to access water during dry conditions as long as lake levels are maintained.
Many invasive species, insect pests, and pathogens in northern Wisconsin and western Upper Michigan will increase or become more damaging. (23)	
Boreal species in northern Wisconsin and western Upper Michigan will face increasing stress from climate change. (23)	There are very few northern or boreal species on the property except for a few spruce trees.
Southern or temperate species in northern Wisconsin and western Upper Michigan will be favored by climate change. (23)	Many of the current tree species (e.g., silver maple, box elder) are present much farther to the south and would not be expected to be negatively

Potential Climate Impact - Regional	Property or Project Area Considerations
Forest productivity in northern Wisconsin and western Upper Michigan will increase across the assessment area. (23)	

2b. Lowland-riparian hardwoods: Climate Impacts and Vulnerabilities

Potential Impacts: Mixed/Neutral **Adaptive Capacity:** Moderate-High **Vulnerability:** Moderate

Potential Climate Impact - Lowland-riparian hardwoods	Property or Project Area Considerations
Lowland and riparian hardwood forests may be vulnerable to future changes in hydrology. (39, 23)	The hydrological driver for this property is the level of Otter Lake and Otter River, and it is unclear whether the water level would be affected by the changing climate, particularly during the summer growing season. Lowland and riparian forests are well-adapted to seasonal fluctuations in the water table, which suggests that the system has some capacity to adapt to change. Changes in winter snowfall and snowpack and the onset of spring may lead to earlier spring flooding.
Most dominant tree species in lowland and riparian hardwood forests are expected to increase by the end of the century (American elm, black willow, eastern cottonwood, green ash, silver maple, swamp white oak, and white ash). (39, 23)	Many of the current tree species (e.g., silver maple, box elder) are present much farther to the south and would not be expected to be negatively affected by climate (in the absence of other stressors).
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). (39, 23)	These species are generally absent from the property with the exception of a few scattered black ash, northern white cedar, and white and Norway spruce.
Invasive species such as reed canarygrass, Japanese barberry, and buckthorn have the potential to increase in lowland and riparian hardwood forests under climate change. (39, 23)	Reed canarygrass is the predominant understory vegetation on the site in many areas, and could increase in areas where the forest canopy is disturbed (due to insects, wind, etc.). Few other undesirable non-native species are currently present on the property. Japanese barberry is already present and reproducing on the adjacent property. Several other invasive species (including aquatic species) could become problematic if introduced to the site.
Deer herbivory on preferred species may hinder regeneration. (40, 41)	
Insect pests and diseases could become more active and virulent in lowland and riparian hardwood forests under a warmer climate. (39, 23)	
Many tree species in lowland and riparian forests could tolerate limited increases in flooding and drought under climate change. (39, 23)	

2c. Tag alder wetlands: Climate Impacts and Vulnerabilities

Potential Impacts: Disruptive **Adaptive Capacity:** Moderate **Vulnerability:** Moderate

Potential Climate Impact - Tag alder wetlands	Property or Project Area Considerations
Shoreline systems may be vulnerable to future changes in hydrology.	The hydrological driver for this property is the level of Otter Lake and Otter River, and it is unclear whether the water level would be affected by the changing climate, particularly during the summer growing season. Changes in the lake level (due to climate or other factors) would influence the distribution of these areas.
Tag alder may be susceptible to climate change.	Tag alder is a northerly-distributed species and model projections from the Canadian Forest Service indicate that the species will have reduced habitat under the climate conditions expected at the end of the century. Decline of tag alder may allow for several shrub species (native and invasive) to increase in abundance.

2d. Cattail wetlands: Climate Impacts and Vulnerabilities

Potential Impacts: Supportive **Adaptive Capacity:** Moderate-High **Vulnerability:** Low

Potential Climate Impact - Cattail wetlands	Property or Project Area Considerations
Shoreline systems may be vulnerable to changes in hydrology.	The hydrological driver for this property is the level of Otter Lake and Otter River, and it is unclear whether the water level would be affected by the changing climate, particularly during the summer growing season. Changes in the lake level (due to climate or other factors) would influence the distribution of these areas.

2e. Field: Climate Impacts and Vulnerabilities

Potential Impacts: Supportive **Adaptive Capacity:** High **Vulnerability:** Low

Potential Climate Impact - Field	Property or Project Area Considerations

2f. Orchards: Climate Impacts and Vulnerabilities

Potential Impacts: Supportive **Adaptive Capacity:** Moderate-High **Vulnerability:** Low

Potential Climate Impact - Orchards	Property or Project Area Considerations

2g. Property-wide: Climate Impacts and Vulnerabilities

Potential Impacts: Mixed/Neutral **Adaptive Capacity:** Moderate **Vulnerability:** Moderate

Potential Climate Impact - Property-wide	Property or Project Area Considerations

3. Evaluation of Management 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.

3a. Lowland-riparian hardwoods: Evaluation of Management Objectives

Management Goal: Maintain the health of the forests, wetlands, and natural ecosystems on the property.

Management Objective	Challenges and Opportunities	Feasibility
Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)*	**Challenges:** • The removal or decline of ash species may combine with more favorable conditions for reed canarygrass, increasing the prevalence or vitality of this species. This would reduce diversity and create additional challenges to establishing other species on the property. • Some northern wildlife species, such as ruffed grouse, may have reduced habitat in the future. **Opportunities:** • Site suitability for several desirable plant species may increase.	**Feasibility:** High **Feasibility Comment:** The site is likely to provide habitat for some desireable species, regardless of forest composition or condition. **Other Considerations:** No other considerations
Reduce the dominance of green ash to less than 30% of the forest canopy in anticipation of the emerald ash borer by harvesting ash trees for firewood on approximately 10 acres. *(next 10 years)*	**Challenges:** • Conditions may become more suitable for reed canarygrass, particularly where forests are disturbed, and control may become even more challenging. **Opportunities:** •	**Feasibility:** Medium **Feasibility Comment:** It is unclear what the current feasibility is of controlling reed canarygrass on the property (independent of climate change). More investigation is needed. **Other Considerations:** No other considerations

Management Goal: Maintain the health of the forests, wetlands, and natural ecosystems on the property.

Management Objective	Challenges and Opportunities	Feasibility
Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)*	**Challenges:** • Ash mortality from emerald ash borer will almost certainly occur at some point in the future, although the timing is uncertain. • Ash mortality may increase opportunities for reed canarygrass and other undesirable species. **Opportunities:** • The site can be managed in advance of EAB arrival to reduce the impact and establish other desirable species.	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations
Retain and promote the growth of tree species that may be suitable for future conditions, including silver maple (currently present on the property).	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations

Management Goal: Protect/maintain water quality

Management Objective	Challenges and Opportunities	Feasibility
Maintain vegetative cover with a mix of forests and wetlands *(forever)*	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** High **Feasibility Comment:** It seems likely that some mix of forests and wetlands will always be present. **Other Considerations:** No other considerations

3b. Tag alder wetlands: Evaluation of Management Objectives

Management Goal: Protect/maintain water quality

Management Objective	Challenges and Opportunities	Feasibility
Maintain buffer along shorelines *(forever)*	**Challenges:** • If tag alder declines in the long term, it may create a niche for undesirable shrubs (like buckthorn, if introduced) or grass (especially reed canarygrass). **Opportunities:** • If tag alder declines in the long term, other shrub species may provide better wildlife habitat.	**Feasibility:** High **Feasibility Comment:** No comments **Other Considerations:** No other considerations

3c. Cattail wetlands: Evaluation of Management Objectives

Management Goal: Protect/maintain water quality

Management Objective	Challenges and Opportunities	Feasibility
Maintain buffer along shorelines *(forever)*	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** High **Feasibility Comment:** No comments **Other Considerations:** No other considerations

Management Goal: Maintain the health of the forests, wetlands, and natural ecosystems on the property.

Management Objective	Challenges and Opportunities	Feasibility

3d. Field: Evaluation of Management Objectives

Management Goal: Maintain the health of the forests, wetlands, and natural ecosystems on the property.

Management Objective	Challenges and Opportunities	Feasibility

Management Goal: Provide high-quality habitat for diverse wildlife species with an emphasis on waterfowl.

Management Objective	Challenges and Opportunities	Feasibility
Plant diverse tree and plant species along field edges and shorelines to promote wildlife food sources *(20 years)*	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations

3e. Orchards: Evaluation of Management Objectives

Management Goal: Create area for fruit-production

Management Objective	Challenges and Opportunities	Feasibility
Replace current apple trees with new fruit-producing trees *(next 5 years)*	**Challenges:** None identified **Opportunities:** • Site suitability for several desirable plant species may increase.	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations

3f. Property-wide: Evaluation of Management Objectives

Management Goal: Maintain the health of the forests, wetlands, and natural ecosystems on the property.

Management Objective	Challenges and Opportunities	Feasibility
Reduce and remove non-native invasive plant species. *(20 years)*	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations

Management Goal: Maintain trail network for access

Management Objective	Challenges and Opportunities	Feasibility
Maintain the existing trail network for access. *(20 years)*	**Challenges:** None identified **Opportunities:** None identified	**Feasibility:** Not specified **Feasibility Comment:** No comments **Other Considerations:** No other considerations

Management Goal: Enhance opportunities for hunting, foraging, and other forms of recreation.

Management Objective	Challenges and Opportunities	Feasibility

4. Adaptation Tactics

After considering the challenges and opportunities climate change might present for this management objective, these actions were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, which provide connections to more general concepts related to forest management and conservation. Tactics that are recommended can be implemented or explored further.

4a. Lowland-riparian hardwoods: Adaptation Tactics

Tactic: Create patch cuts in parts of the forest that are primarily ash (1 patch per year). Remove wood from site (firewood). Plant a variety of species on the site that are expected to be better-adapted to future conditions and provide benefits for waterfowl and other wildlife. Protect seedlings from deer. *(next 10 years)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Maintain and enhance species and structural diversity • Promote diverse age classes **Facilitate community adjustments through species transitions.** • Introduce species that are expected to be adapted to future conditions • Protect future-adapted seedlings and saplings	**Benefits:** Begins a transition away from ash in advance of EAB; Increases species diversity; Provides opportunities to increase oaks and other species valuable to wildlife. **Drawbacks and Barriers:** Unclear how problematic reed canarygrass and deer will be for planted seedlings.	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)* • Reduce the dominance of green ash to less than 30% of the forest canopy in anticipation of the emerald ash borer by harvesting ash trees for firewood on approximately 10 acres. *(next 10 years)* • Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)* • Maintain vegetative cover with a mix of forests and wetlands *(forever)*

Tactic: Cut box elder trees along edge of field. Plant species on the site that are expected to be better-adapted to future conditions and provide benefits for waterfowl and other wildlife, such as swamp white oak. Protect from deer. *(next 1 year)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Sustain fundamental ecological functions • Maintain or restore riparian areas **Facilitate community adjustments through species transitions.** • Introduce species that are expected to be adapted to future conditions	**Benefits:** Oaks will improve waterfowl and wildlife habitat over the long-term. **Drawbacks and Barriers:** It is unclear how problematic reed canarygrass and deer may be for seedlings.	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)*

Tactic: Establish various trees and shrubs across the property, emphasizing native species that have benefits to wildlife as well as cultivars and species from other areas that are edible or have other desirable characteristics. Possibilities include: (1) maple-leaved viburnum and nanny berry (not present on the property but locally abundant) along the shoreline; (2) Blackberries or other brambles along the road ditch in the field; (3) Grapes or brambles in the yard near the cottage; (4) Apple or other fruit trees in the orchard *(next 25 years)*

Practicability: Medium

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Facilitate community adjustments through species transitions. • Establish or encourage new mixes of native species • Introduce species that are expected to be adapted to future conditions	**Benefits:** Adds diversity to site; Provides many types of food and cover for wildlife **Drawbacks and Barriers:** Unclear how problematic reed canarygrass and deer will be on any plantings. Plantings will be limited by time and cost.	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)* • Reduce the dominance of green ash to less than 30% of the forest canopy in anticipation of the emerald ash borer by harvesting ash trees for firewood on approximately 10 acres. *(next 10 years)* • Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)* • Maintain vegetative cover with a mix of forests and wetlands *(forever)*

Tactic: Plant sycamore and tuliptree and swamp white oak in riparian area along river edge. *(5 years)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Sustain fundamental ecological functions • Maintain or restore riparian areas **Facilitate community adjustments through species transitions.** • Introduce species that are expected to be adapted to future conditions	**Benefits:** Creates a riparian forest that protects land **Drawbacks and Barriers:** Cost of planting	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)*

Tactic: Minimize cover of reed canarygrass where possible. *(next 25 years)*

Practicability: Medium

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Sustain fundamental ecological functions • Reduce competition for moisture, nutrients, and light	**Benefits:** Increases diversity across the property; reduces competition on plantings **Drawbacks and Barriers:** Control of these species is likely limited to areas that are treated intensively through herbicide, fire, or other means; Disturbances that open the canopy are likely to increase the grass; Control will be costly in terms of time, effort, and money; More research is needed	• Reduce the dominance of green ash to less than 30% of the forest canopy in anticipation of the emerald ash borer by harvesting ash trees for firewood on approximately 10 acres. *(next 10 years)*

Tactic: Cut small patches of tag alder to encourage new, young growth. *(next 5 years)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Maintain and enhance species and structural diversity • Promote diverse age classes	**Benefits:** Not specified **Drawbacks and Barriers:** Not specified	• Maintain vegetative cover with a mix of forests and wetlands *(forever)*

4b. Tag alder wetlands: Adaptation Tactics

Tactic: Cut small patches of tag alder to encourage new, young growth. *(next 5 years)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Maintain and enhance species and structural diversity • Promote diverse age classes	**Benefits:** Not specified **Drawbacks and Barriers:** Not specified	• Maintain buffer along shorelines *(forever)*

Tactic: Establish various trees and shrubs across the property, emphasizing native species that have benefits to wildlife as well as cultivars and species from other areas that are edible or have other desirable characteristics. Possibilities include: (1) maple-leaved viburnum and nanny berry (not present on the property but locally abundant) along the shoreline; (2) Blackberries or other brambles along the road ditch in the field; (3) Grapes or brambles in the yard near the cottage; (4) Apple or other fruit trees in the orchard *(next 25 years)*

Practicability: Medium

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Facilitate community adjustments through species transitions. • Establish or encourage new mixes of native species • Introduce species that are expected to be adapted to future conditions	**Benefits:** Adds diversity to site; Provides many types of food and cover for wildlife **Drawbacks and Barriers:** Unclear how problematic reed canarygrass and deer will be on any plantings. Plantings will be limited by time and cost.	• Maintain buffer along shorelines *(forever)*

4c. Cattail wetlands: Adaptation Tactics

Tactic: Minimize disturbance to cattail areas and other wetlands. *(next 25 years)*

Practicability: High

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Sustain fundamental ecological functions • Maintain or restore riparian areas	**Benefits:** Not specified **Drawbacks and Barriers:** Not specified	• Maintain buffer along shorelines *(forever)*

4d. Field: Adaptation Tactics

4e. Orchards: Adaptation Tactics

Tactic: Establish various trees and shrubs across the property, emphasizing native species that have benefits to wildlife as well as cultivars and species from other areas that are edible or have other desirable characteristics. Possibilities include: (1) maple-leaved viburnum and nanny berry (not present on the property but locally abundant) along the shoreline; (2) Blackberries or other brambles along the road ditch in the field; (3) Grapes or brambles in the yard near the cottage; (4) Apple or other fruit trees in the orchard *(next 25 years)*

Practicability: Medium

Adaptation Strategies and Approaches	Benefits, Drawbacks and Barriers	Associated Management Objectives
Facilitate community adjustments through species transitions. • Establish or encourage new mixes of native species • Introduce species that are expected to be adapted to future conditions	**Benefits:** Adds diversity to site; Provides many types of food and cover for wildlife **Drawbacks and Barriers:** Unclear how problematic reed canarygrass and deer will be on any plantings. Plantings will be limited by time and cost.	• Replace current apple trees with new fruit-producing trees *(next 5 years)*

4f. Property-wide: Adaptation Tactics

5. Monitoring Plan

Monitoring is critical for understanding if management actions are e·ective 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.

5a. Lowland-riparian hardwoods: Monitoring Plan

Monitoring Variable: Success of plantings

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Rate of success by species and planting time	Tending throughout the season; annual records	• Plant diverse tree and plant species in harvested areas (up to 5 acres) to supplement forest regeneration, emphasizing areas where ash is currently most abundant. *(next 10 years)*

Monitoring Variable: Problematic invasive plants

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Potentially problematic invasive plants (such as buckthorn, barberry, and non-native honeysuckle) will be absent or limited to small areas that are actively being controlled. Reed canarygrass is not included here.	Periodic walks of the property, especially during early spring and late fall when many non-native plants display leaves earlier/later in the season that native plants.	• Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)* • Maintain vegetative cover with a mix of forests and wetlands *(forever)*

Monitoring Variable: Emerald ash borer presence

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Evidence of galleries under bark	Periodic walks of the property, especially during mid-summer to evaluate health of ash crowns; Looking under bark when ash trees are cut; Inspection of stressed, dying, or dead ash trees	• Maintain forested conditions (avoid forest loss) across the 17 acres of bottomland forests by proactively addressing impending ash mortality from the emerald ash borer. *(next 10 years)*

5b. Tag alder wetlands: Monitoring Plan

Monitoring Variable: Problematic invasive plants

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Potentially problematic invasive plants (such as buckthorn, barberry, and non-native honeysuckle) will be absent or limited to small areas that are actively being controlled. Reed canarygrass is not included here.	Periodic walks of the property, especially during early spring and late fall when many non-native plants display leaves earlier/later in the season that native plants.	• Maintain buffer along shorelines *(forever)*

5c. Cattail wetlands: Monitoring Plan

Monitoring Variable: Problematic invasive plants

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Potentially problematic invasive plants (such as buckthorn, barberry, and non-native honeysuckle) will be absent or limited to small areas that are actively being controlled. Reed canarygrass is not included here.	Periodic walks of the property, especially during early spring and late fall when many non-native plants display leaves earlier/later in the season that native plants.	• Maintain buffer along shorelines *(forever)*

5d. Field: Monitoring Plan

5e. Orchards: Monitoring Plan

Monitoring Variable: Success of plantings

Criteria for Evaluation	Plans for Implementation	Associated Management Objectives
Rate of success by species and planting time	Tending throughout the season; annual records	• Replace current apple trees with new fruit-producing trees *(next 5 years)*

5f. Property-wide: Monitoring Plan

6. References

This adaptation plan was developed using the Adaptation Workbook (www.adaptationworkbook.org (https://www.adaptationworkbook.org)) and Adaptation Strategies and Approaches developed by the Northern Institute of Applied Climate Science. View the Adaptation Strategies and Approaches at: www.adaptationworkbook.org/strategies (https://www.adaptationworkbook.org/strategies).

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