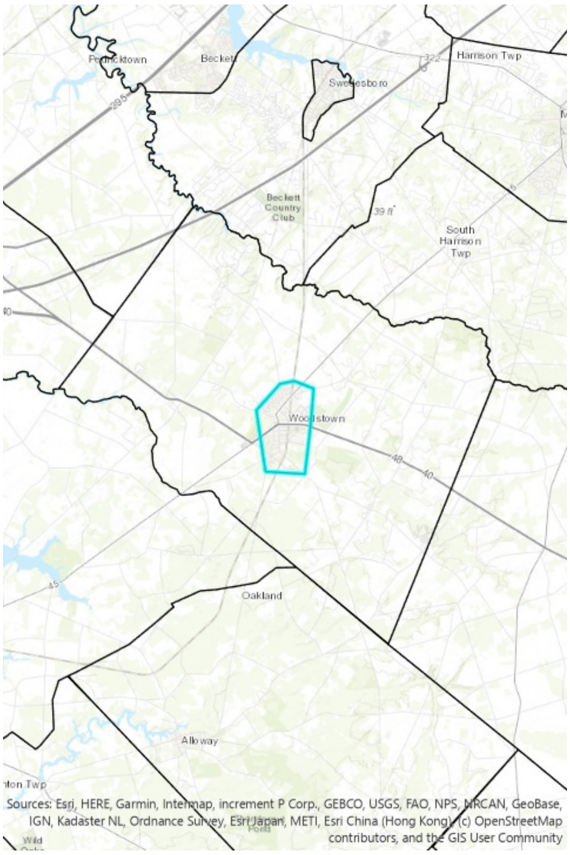
Woodstown Borough: Forest Climate Risk Snapshot

Introduction



New Jersey’s trees and forests will undoubtedly be affected by changing temperatures and precipitation patterns posed by future climate change. Warmer summers can create stress for some species that cannot tolerate high temperatures. Milder winters may allow some species to survive in the area that previously would have suffered freezing damage. Warmer springs and autumn may change the timing of leaf-out, flowering, and senescence as well extend the length of the growing season. Shifts in precipitation patterns will also affect local trees. More heavy precipitation events may increase the frequency or severity of flooding. Storms may break limbs or damage trees. Drier conditions in summer or fall coupled with warmer temperatures could cause soil moisture deficits.

One of the biggest implications of projected climate change is shifting plant hardiness and heat zones. Planting suitability for trees and other plants is determined by hardiness zones, which are based on minimum temperatures, and heat zones, which are based on the number of days above 86°F. Both heat and hardiness zones are projected to shift over the next century, changing recommendations on what should be planted to ensure maximum likelihood of longer term success. Some species will be more vulnerable to these changes than others.

The Historical and projected future (RCP4.5 & 8.5) climate maps were provided by the Northeast Regional Climate Center at Cornell University through their Applied Climate Information System (ACIS, http://rcc-acis.org). Historical or Baseline data represent average values from 1981 to 2010. These are also known as the “981-2010 Normals”. Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC, which describe different climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come. Emissions in RCP 4.5 peak around 2040, then decline. In RCP 8.5, emissions continue to rise throughout the 21st century. The climate data were extracted and summarized for each municipality (median value was used).

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Growing Degree Days

The length of the growing season for plants is often measured in Growing Degree Days. The number of growing degree days per year is used to estimate the growth and development of plants (or insects) during the growing season. Higher numbers of growing-degree days indicate longer and warmer growing conditions. As growth occurs only when temperature exceeds a species' base temperature (for example, 50°F), the number of days times the number of degrees above the base indicates the duration and magnitude of growing conditions. The higher the number, the longer the growing season.

Historical Baseline 1981-2010 (Median): 3,735

	Future Projection (Median)	Change vs. Historical Baseline (Median)
RCP 4.5 2050-2070 (Days)	4,805	1,070
RCP 4.5 2080-2090 (Days)	5,025	1,290
RCP 8.5 2050-2070 (Days)	5,245	1,510
RCP 8.5 2080-2090 (Days)	6,135	2,400

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Plant Hardiness Zones

Plant hardiness zones provide a general indication of the extent of overwinter stress experienced by plants and are based on the average annual extreme minimum temperatures. Hardiness Zones are used by horticulturists to evaluate the cold hardiness of plants. Plant hardiness zones and subzones are delineated according to the US Department of Agriculture’s definitions, which break the geography into zones by 10 °F (5.56 °C) increments of annual extreme minimum temperature. North America is divided into 11 separate planting zones; each growing zone is 10°F warmer (or colder) in an average winter than the adjacent zone. The higher the number, the longer the growing season.

Historical Baseline 1981-2010 (Median): 7

	Future Projection (Median)	Change vs. Historical Baseline (Median)
RCP 4.5 2050-2070 (Days)	8	1
RCP 4.5 2080-2090 (Days)	8	1
RCP 8.5 2050-2070 (Days)	8	1
RCP 8.5 2080-2090 (Days)	9	2

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Heat Zone Days

Heat zones map the distribution of potential heat stress for plants and animals, including humans. The heat zones are based on the number of days each year that a given region experiences “heat days” - days with a maximum daily temperature >30 °C (86 °F). The 30 °C threshold value is set primarily for agricultural production and is a general temperature threshold at which photosynthesis can be negatively impacted for C3 plants (e.g., most species including trees). The Continental US includes 12 Plant Heat Zones from Zone 1 with less than one heat day to Zone 12 with more than 210 heat days.

Historical Baseline 1981-2010 (Median): 53

	Future Projection (Median)	Change vs. Historical Baseline (Median)
RCP 4.5 2050-2070 (Days)	89	36
RCP 4.5 2080-2090 (Days)	93	40
RCP 8.5 2050-2070 (Days)	118	65
RCP 8.5 2080-2090 (Days)	142	89

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Seasonal Extreme Temperatures

Alternatively, one might be interested in the projected changes in seasonal extreme temperatures. For example, we have extracted the Number of Days with a Maximum temperature above 95°F or Number of Days with a Minimum Below 32°F.

Number of Days with a Maximum temperature above 95˚F

Historical Baseline 1981-2010 (Median): 3

	Future Projection (Median)	Change vs. Historical Baseline (Median)
RCP 4.5 2050-2070 (Days)	19	16
RCP 4.5 2080-2090 (Days)	23	20
RCP 8.5 2050-2070 (Days)	30	27
RCP 8.5 2080-2090 (Days)	56	53

Number of Days with a Minimum Below 32˚F

Historical Baseline 1981-2010 (Median): 86

	Future Projection (Median)	Change vs. Historical Baseline (Median)
RCP 4.5 2050-2070 (Days)	58	-28
RCP 4.5 2080-2090 (Days)	53	-33
RCP 8.5 2050-2070 (Days)	49	-37
RCP 8.5 2080-2090 (Days)	32	-54

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Climate Change Projections for Tree Species

The US Forest Service has assessed a number of trees species for changes in species habitat suitability from climate impacts models and heat and hardiness zones. Traits that may make species more adaptable to stress, such as resistance to pests, diseases, drought, and flooding were also considered. Their work highlights which species that may be more or less vulnerable to projected changes in the climate and other stressors in the coming decades. Species vulnerability is meant to be considered along with other management goals, such as enhancing biodiversity or providing wildlife habitat. Some vulnerable species may still be an important part of the landscape; they just may require extra care or specific planting sites.

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

MID-ATLANTIC REGION

The region's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in the Mid-Atlantic region (Butler-Leopold et al. in review). This report includes information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest types. This handout is summarized from the full assessment.

TREE SPECIES INFORMATION:

This assessment uses two climate scenarios to "bracket" a range of possible futures. These future climate projections were used with two forest impact models (Tree Atlas and LANDIS) to provide information about how individual tree species may respond to a changing climate. More information on the climate and forest impact models can be found in the assessment. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Remember that models are just tools, and they're not perfect. Model projections don't account for some factors that could be modified by climate change, like droughts, wildfire activity, and invasive species. If a species is rare or confined to a small area, Tree Atlas results may be less reliable. These factors, and others, could cause a particular species to perform better or worse than a model projects. Human choices will also continue to influence forest distribution, especially for tree species that are projected to increase. Planting programs may assist the movement of future-adapted species, but this will depend on management decisions.

Despite these limits, models provide useful information about future expectations. It's perhaps best to think of these projections as indicators of possibility and potential change. The model results presented here were combined with information from published reports and local management expertise to draw conclusions about potential risk and change in the region's forests.

SPECIES	ADDITIONAL CONSIDERATIONS - 30 MOST COMMON SPECIES
MAY DECREASE	
American basswood	Tolerates shade, susceptible to fire
American beech	Susceptible to beech bark disease, very shade tolerant
Bigtooth aspen	Early-successional colonizer, susceptible to drought
Black cherry	Susceptible to insects and fire, mildly drought-tolerant
Eastern hemlock	Hemlock woolly adelgid causes mortality
Eastern white pine	Good disperser, but susceptible to drought and insects
Quaking aspen	Early-successional colonizer, susceptible to heat & drought
Serviceberry	Competitive colonizer, susceptible to drought
Striped maple	Shade tolerant, easily established, susceptible to drought
Sugar maple	Grows across a variety of sites, tolerates shade
Sweet birch	Susceptible to drought, fire topkill, and insects
Yellow birch	Good disperser, susceptible to fire, insects, and disease
NO CHANGE	
American hornbeam	Tolerates shade, susceptible to fire and drought
Eastern hophornbeam	Grows across a variety of sites, tolerates shade
Pitch pine	Early-successional colonizer, susceptible to insect pests

SPECIES	ADDITIONAL CONSIDERATIONS - 30 MOST COMMON SPECIES
MIXED MODEL RESULTS	
Chestnut oak	Establishes from seed or sprout, adapted to fire
Red maple	Competitive colonizer, tolerant of disturbance
Scarlet oak	Seeds and sprouts, susceptible to fire and disease
Tulip tree	Competitive colonizer tolerant of diverse sites
White ash	Emerald ash borer causes mortality
MAY INCREASE	
American elm	Susceptible to Dutch elm disease
Black locust	Early-successional colonizer, susceptible to insect pests
Black oak	Drought tolerant, susceptible to insect pests & diseases
Blackgum	Shade tolerant, fire adapted
Flowering dogwood	Shade tolerant
Northern red oak	Susceptible to insect pests
Pignut hickory	Susceptible to insect pests and drought
Sassafras	Early-successional colonizer, susceptible to fire topkill
Sweetgum	Seeds and sprouts,susceptible to fire and drought
White oak	Fire-adapted, grows on a variety of sites

NIACS Northern Institute of Applied Climate Science

www.forestadaptation.org

FUTURE PROJECTIONS

Data for the end of the century are summarized for two forest impact models under two climate change scenarios. The Climate Change Tree Atlas (www.fs.fed.us/nrs/atlas) models future suitable habitat, while LANDIS models changes in forest growth over time (future tree density presented in this table; additional data are available in the assessment).

▲ **INCREASE**
Projected increase of >20% by 2100

● **NO CHANGE**
Little change (<20%) projected by 2100

▼ **DECREASE**
Projected decrease of >20% by 2100

★ **NEW HABITAT**
Tree Atlas projects new habitat for species not currently present

ADAPTABILITY

Factors not included in the Tree Atlas model, such as the ability to respond favorably to disturbance, may make a species more or less able to adapt to future stressors (see reverse page for considerations for the 30 most common species).

\+ high
Species may perform better than modeled

· medium

– low
Species may perform worse than modeled

SPECIES	LOW CLIMATE CHANGE (PCM B1) TREE ATLAS	LOW CLIMATE CHANGE (PCM B1) LANDIS	HIGH CLIMATE CHANGE (GFDL A1FI) TREE ATLAS	HIGH CLIMATE CHANGE (GFDL A1FI) LANDIS	ADAPT
American basswood	●		▼		·
American beech	▼	●	▼	▼	·
American chestnut	●		●		·
American elm	●		▲		·
American holly	●		▼		·
American hornbeam	●		●		·
Balsam fir	▼	▼	▼	▼	–
Balsam poplar	▼		▼		·
Bigtooth aspen	●		▼		·
Black ash	▼		▼		–
Black cherry	●	●	▼	●	–
Black oak	●	●	▲	●	·
Black spruce	▼	▼	▼	▼	·
Black walnut	▲		▲		·
Blackgum	▲		▲		+
Blackjack oak	●		▲		+
Boxelder	●		▲		+
Bur oak	●		▲		+
Chestnut oak	●	▼	●	▲	+
Cucumbertree	▲		▼		·
Eastern hemlock	▼	●	▼	▼	–
Eastern hophornbeam	●		●		+
Eastern red cedar	▲		▲		·
Eastern redbud	●		▲		·
Eastern white pine	▼	●	▼	▼	·
Flowering dogwood	▲		▲		·
Gray birch	▼		▼		·
Green ash	●		▲		·
Hackberry	▲		▲		+
Jack pine	▼		▼		·
Loblolly pine	▲	●	▲	●	·
Longleaf pine	★		★		·
Mockernut hickory	●		▲		+
Mountain maple	▼		▼		+
Northern red oak	●	●	●	▲	+
Northern white-cedar	▼	▼	▼	▼	·
Osage-orange	●		▲		+
Paper birch	▼		▼		·
Persimmon	▲		▲		+
Pignut hickory	●	●	▲	●	·
Pin cherry	▼		▼		·
Pin oak	▲		▲		–
Pitch pine	●	●	●	●	·
Pond pine	▲		▲		–
Post oak	▲		▲		+
Quaking aspen	▼	▼	▼	▼	·
Red maple	●	●	▼	▲	+
Red pine	▼		▼		·
Red spruce	▼	▼	▼	▼	–
Redbay	★				+
Sassafras	▲		▲		·
Scarlet oak	▲	●	▲	▼	·
Serviceberry	●		▼		·
Shagbark hickory	▲	●	▲	●	·
Shingle oak	●		▲		·
Shortleaf pine	●		▲		·
Silver maple	▼		▲		+
Slippery elm	●		▲		·
Sourwood	▲		●		+
Southern red oak	▲		▲		+
Striped maple	●		▼		·
Sugar maple	●	●	▼	▼	+
Swamp chestnut oak	●		●		·
Swamp tupelo	▲		▲		–
Sweet birch	●		▼		–
Sweetbay	●		●		·
Sweetgum	▲		▲		·
Sycamore	▲		▲		·
Tamarack	▼		▼		–
Tulip tree	▲	●	▼	▲	+
Turkey oak	★		★		+
Virginia pine	●	●	●	▼	·
Water oak	●		▲		·
Water tupelo	●		●		–
White ash	●	●	▼	▲	–
White oak	●	●	▲	▲	+
White spruce	▼		▼		·
Willow oak	●		▲		·
Yellow birch	●	●	▼	▼	·
Yellow buckeye	●		●		–

SOURCE: Butler-Leopold et al. (in review). Mid-Atlantic forest ecosystem vulnerability assessment and synthesis: a report from the Mid-Atlantic Climate Change Response Framework, Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.
www.forestadaptation.org/mid-atlantic/vulnerability-assessment

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For Additional Area Specific Recommendations, Go To:

New York City Region

https://forestadaptation.org/sites/default/files/New%20york%20vulnerability%20list.pdf

Mid-Atlantic Region

https://forestadaptation.org/sites/default/files/Mid-Atlantic_tree_species_Entire%20Mid-Atlantic%20Region.pdf

Coastal Plains

https://forestadaptation.org/sites/default/files/MidAtlantic_tree_species_Coastal%20Plains.pdf

Piedmont

https://forestadaptation.org/sites/default/files/MidAtlantic_tree_species_Piedmont.pdf

Ridge and Valley

https://forestadaptation.org/sites/default/files/MidAtlantic_tree_species_Ridge%20and%20Valley.pdf