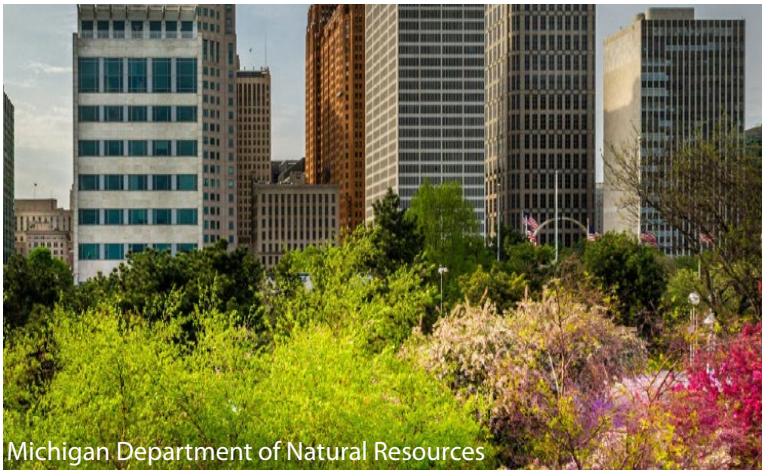
CLIMATE CHANGE VULNERABILITY OF URBAN TREES

DETROIT, MICHIGAN



Michigan Department of Natural Resources

This list was developed to aid Detroit, Michigan community forestry practitioners in selecting trees to reduce climate change vulnerability of their urban forests. It is meant to be a complement to other tree selection resources. Other factors may also need to be considered, such as aesthetics, local site conditions, wildlife value, or nursery availability. It is also important to note that some species may have climate benefits but may not be suitable for planting for other reasons, such as having invasive potential or susceptibility to pests or pathogens.

Vulnerability: Trees can be vulnerable to a variety of climate-related stressors such as intense heat, drought, flooding, and changing pest and disease patterns. Climate vulnerability is a function of the impacts of climate change on a species and its adaptive capacity. Species with negative impacts on habitat suitability and low adaptive capacity will have high vulnerability and vice versa. The following factors were used to determine climate vulnerability:

Urban adaptability: Adaptability scores were generated for each species based on literature describing its tolerance to disturbances such as drought, flooding, pests, and disease, as well as its growth requirements such as shade tolerance, soil needs, and ease of nursery propagation. Scores were assigned to species using methods developed in an urban forest vulnerability assessment for Chicago for trees planted in developed sites. A positive score indicates that a species is tolerant to a wide range of disturbances and can be planted on a variety of sites. A negative score indicates a species is highly susceptible to disturbances and/or is limited to specific planting sites.

Hardiness and heat zone suitability: Tree species ranges were recorded from government, university, and arboretum websites. Species tolerance ranges were compared to current and projected heat and hardiness zones for Detroit, Michigan using downscaled climate models under low emissions (RCP 4.5) and high emissions (RCP 8.5) scenarios for changes in greenhouse gases. Trees were considered to have suitable zone suitability if the species' tolerance was within the range of current and projected hardiness and heat zone through the end of the 21st century.

NOTE: This list was primarily created for species planted in developed sites, such as streets, yards, boulevards, and parks. If you are interested in projected changes in habitat suitability for native species in natural areas, see the Climate Change Tree Atlas at www.fs.fed.us/nrs/atlas/.

Current and projected USDA Hardiness Zones and AHS Heat Zones for Detroit, Michigan. Hardiness zone is determined by the average lowest temperature over a 30 year period. Heat zones are determined by the number of days above 86°F.

Time Period	Hardiness Zone Range		Heat Zone Range	
1980–2010	6		5	
	Low Emissions	High Emissions	Low Emissions	High Emissions
2010–2039	7	7	6	7
2040–2069	7	8	7	8
2070–2099	7	8	7	9

SOURCE: *Adaptability scores were assigned using methods developed in an urban forest vulnerability assessment for Chicago by Brandt et al. 2017 (https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs168.pdf). Future heat and hardiness zone information were provided from: https://usfs.maps.arcgis.com/apps/MapSeries/index.html?appid=96088b1c086a4b39b3a75d0fd97a4c40.*

NIACS Northern Institute of Applied Climate Science

www.forestadaptation.org

URBAN ADAPTABILITY:

- \+ ***High:*** *Species may perform better than modeled*
- • ***Medium***
- – ***Low:*** *Species may perform worse than modeled*

ZONE SUITABILITY:

- ✓ ***Suitable***
- ✗ ***Not Suitable***

VULNERABILITY:

- ▼ ***Low:*** *Suitable zone, high adaptability*
- ● ***Low-moderate:*** *Suitable zone, medium adaptability*
- ⊖ ***Moderate:*** *Suitable zone, low adaptability or zone not suitable, high adaptability*
- ○ ***Moderate- high:*** *Zone not suitable, medium adaptability*
- △ ***High:*** *Zone not suitable, low adaptability*

**Invasive species*

		LOW EMISSIONS ZONE		HIGH EMISSIONS ZONE	
COMMON NAME	ADAPT	SUIT	VULN	SUIT	VULN
Accolade elm	+	✓	▼	✗	⊖
Alleghany serviceberry	+	✓	▼	✓	▼
American beech	•	✓	●	✓	●
American elm	•	✓	●	✓	●
American filbert	•	✓	●	✓	●
American linden, Basswood	•	✓	●	✗	○
American mountain ash	•	✗	○	✗	○
American plum	•	✓	●	✗	○
American sycamore	•	✓	●	✓	●
Amur corktree*	•	✓	●	✗	○
Amur maackia	+	✓	▼	✗	⊖
Amur maple*	•	✓	●	✗	○
Apple serviceberry	•	✓	●	✗	○
Austrian pine	•	✓	●	✗	○
Bald cypress	+	✓	▼	✓	▼
Balsam fir	•	✗	○	✗	○
Bitternut hickory	•	✓	●	✓	●
Black alder	•	✓	●	✗	○
Black ash	–	✓	⊖	✗	△
Black cherry	–	✓	⊖	✓	⊖
Black locust	•	✓	●	✓	●
Black maple	•	✓	●	✗	○
Black oak	–	✓	⊖	✗	○
Black tupelo, Black gum	+	✓	▼	✓	▼
Black walnut	–	✓	⊖	✓	⊖
Black willow	–	✓	⊖	✓	⊖
Blue ash	•	✓	●	✗	○
Boxelder	•	✓	●	✗	○
Bur oak	+	✓	▼	✓	▼
Callery pear*	•	✓	●	✗	○
Chestnut oak	+	✓	▼	✗	⊖
Chinkapin oak	+	✓	▼	✗	⊖
Chokecherry	•	✓	●	✗	○
Cockspur hawthorn	•	✓	●	✗	○
Colorado blue spruce	•	✓	●	✗	○
Common hackberry	+	✓	▼	✓	▼
Common horsechestnut	•	✓	●	✗	○
Common persimmon	+	✓	▼	✓	▼
Cornelian cherry dogwood	•	✓	●	✗	○
Crimean linden	+	✓	▼	✗	⊖
Dawn redwood	•	✓	●	✓	●
Donald Wyman crabapple	•	✓	●	✗	⊖
Douglas-fir	–	✓	⊖	✗	△
Downy serviceberry	+	✓	▼	✓	▼
Eastern cottonwood	–	✓	⊖	✓	⊖

		LOW EMISSIONS ZONE		HIGH EMISSIONS ZONE	
COMMON NAME	ADAPT	SUIT	VULN	SUIT	VULN
Eastern hemlock	–	✓	⊖	✗	△
Eastern redbud	•	✓	●	✓	●
Eastern redcedar	+	✓	▼	✓	▼
Eastern serviceberry	•	✓	●	✗	○
Eastern white pine	–	✓	⊖	✗	△
English oak	•	✓	●	✗	○
European ash	•	✓	●	✗	○
European beech	•	✓	●	✗	○
European hornbeam	•	✓	●	✗	○
European larch	•	✗	○	✗	○
European mountain ash	•	✓	●	✗	○
Flowering dogwood	•	✓	●	✓	●
Freeman maple	•	✓	●	✗	○
Ginkgo	+	✓	▼	✓	▼
Goldenrain tree*	+	✓	▼	✓	▼
Gray birch	–	✗	△	✗	△
Green ash	•	✓	●	✓	●
Hardy rubbertree	+	✓	▼	✗	⊖
Hedge maple	•	✓	●	✗	○
Higan cherry	•	✓	●	✗	○
Honeylocust*	•	✓	●	✓	●
Ironwood	+	✓	▼	✓	▼
Japanese elm	•	✓	●	✓	●
Japanese flowering cherry	•	✓	●	✓	⊖
Japanese maple	•	✓	●	✗	○
Japanese pagoda tree	+	✓	▼	✓	▼
Japanese tree lilac	+	✓	▼	✗	⊖
Japanese white pine	•	✓	●	✓	●
Japanese zelkova	+	✓	▼	✓	▼
Katsura tree	–	✓	⊖	✗	△
Kentucky coffeetree	+	✓	▼	✓	▼
Korean mountain ash	•	✓	●	✓	●
Kousa dogwood	+	✓	▼	✗	⊖
Lacebark elm	+	✓	▼	✓	▼
Littleleaf linden	+	✓	▼	✗	⊖
London planetree	•	✓	●	✓	●
Miyabe maple	+	✓	▼	✗	⊖
Mockernut hickory	•	✓	●	✓	●
Mountain maple	+	✗	⊖	✗	⊖
Mugo pine	•	✓	●	✗	○
Musclewood	+	✓	▼	✓	▼
Northern catalpa	•	✓	●	✗	○
Northern pin oak	–	✓	⊖	✗	△
Northern red oak	•	✓	●	✓	●
Northern white cedar, Arborvitae	+	✓	▼	✗	⊖

URBAN ADAPTABILITY:

- \+ ***High:*** *Species may perform better than modeled*
- • ***Medium***
- – ***Low:*** *Species may perform worse than modeled*

ZONE SUITABILITY:

- ✓ ***Suitable***
- ✗ ***Not Suitable***

VULNERABILITY:

- ▼ ***Low:*** *Suitable zone, high adaptability*
- ● ***Low-moderate:*** *Suitable zone, medium adaptability*
- ⊖ ***Moderate:*** *Suitable zone, low adaptability or zone not suitable, high adaptability*
- ○ ***Moderate- high:*** *Zone not suitable, medium adaptability*
- △ ***High:*** *Zone not suitable, low adaptability*

**Invasive species*

		LOW EMISSIONS ZONE		HIGH EMISSIONS ZONE	
COMMON NAME	ADAPT	SUIT	VULN	SUIT	VULN
Norway maple*	+	✓	▼	✗	⊖
Norway spruce	•	✓	●	✗	○
Ohio buckeye	•	✓	●	✗	○
Okame cherry	•	✓	⊖	✗	⊖
Osage-orange	•	✓	●	✓	●
Overcup oak	+	✓	▼	✗	⊖
Pagoda dogwood	•	✓	●	✗	○
Paper birch	•	✓	●	✗	○
Paperbark maple	–	✓	⊖	✗	△
Paradise apple	•	✓	●	✓	●
Pawpaw	•	✓	●	✗	○
Peking tree lilac	+	✓	▼	✗	⊖
Persian ironwood	+	✓	▼	✗	⊖
Pignut hickory	•	✓	●	✗	○
Pin oak	+	✓	●	✗	○
Prairifire crabapple	•	✓	●	✗	○
Princeton elm	+	✓	▼	✓	▼
Quaking aspen	•	✓	●	✗	○
Red maple	•	✓	●	✓	●
Red mulberry	•	✓	●	✓	●
Red pine	–	✓	⊖	✗	△
River birch	•	✓	●	✓	●
Russian olive*	+	✓	▼	✗	⊖
Sargent cherry	•	✓	●	✓	○
Sassafras	•	✓	●	✓	○
Saucer magnolia	+	✓	▼	✓	▼
Sawtooth oak*	+	✓	▼	✗	⊖
Scarlet oak	•	✓	●	✓	●
Scots pine	•	✓	●	✗	○
Shagbark hickory	–	✓	⊖	✗	△
Shantung maple	+	✓	▼	✗	⊖
Shingle oak	+	✓	▼	✗	⊖
Shumard oak	•	✓	●	✓	●
Siberian elm*	•	✓	●	✓	●
Silver linden	•	✓	●	✓	●
Silver maple	•	✓	●	✗	○
Slippery elm	•	✓	●	✓	●
Smoketree	+	✓	▼	✓	▼
Snowdrift crabapple	•	✓	●	✗	○
Sour cherry	•	✓	●	✗	○
Star magnolia	•	✓	●	✓	●
Striped maple	•	✓	●	✗	○
Sugar maple	•	✓	●	✗	○
Sugar Tyme crabapple	•	✓	●	✗	○
Swamp bur oak	+	✓	▼	✗	⊖

		LOW EMISSIONS ZONE		HIGH EMISSIONS ZONE	
COMMON NAME	ADAPT	SUIT	VULN	SUIT	VULN
Swamp white oak	+	✓	▼	✗	⊖
Sweet birch	•	✓	●	✗	○
Sweet cherry	•	✓	●	✗	○
Sweetbay magnolia	+	✓	▼	✓	▼
Sweetgum	–	✓	⊖	✓	⊖
Tamarack	•	✗	○	✗	○
Tatarian maple	•	✓	●	✗	○
Tree of heaven*	+	✓	▼	✗	⊖
Trident maple	•	✓	●	✓	●
Triumph elm	+	✓	▼	✓	▼
Tuliptree	–	✓	⊖	✓	⊖
Turkish Hazelnut	•	✓	●	✗	○
Washington hawthorn	•	✓	●	✗	○
White ash	–	✓	⊖	✓	⊖
White fir	•	✓	●	✗	○
White fringetree	+	✓	▼	✓	▼
White mulberry*	•	✓	●	✗	○
White oak	–	✓	⊖	✗	△
White spruce	•	✓	●	✗	○
Winter king green hawthorn	•	✓	●	✗	○
Yellow birch	+	✓	▼	✗	⊖
Yellow buckeye	•	✓	●	✗	○
Yellowwood	•	✓	●	✓	●