Climate-resilient trees for central MN

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Umbrella magnolia fruit

Outline

- Benefits of resilient landscapes
- Threats to landscapes
- Challenges in built landscapes
- Plant selection
- Eight tree recommendations
- Questions

Activity

THINK. PAIR. SHARE.

1 minute to write your thoughts down.

1 minute to share with someone sitting near you.

2 minutes to share with the group.

What do you think of when you hear the phrase resilient landscape?

What defines a resilient landscape?

"...resilience as the capacity of social and ecological systems to return to a desired state following exposure to a stressor or disturbance."
- Pacific Northwest Research Station, U.S. Forest Service

"[Resilience is a] capacity to withstand change or recover from unexpected impacts quickly."
- National Park Service

Above: Flooding after multiple days of heavy rain at the UMN Landscape Arboretum in April 2024.

Benefits of resilient landscapes

Creating adaptive systems that resist the impacts of abiotic and biotic pressures, like climate change and invasive pests.

- Continuously bouncing back and regenerating
- Coping with ever changing “new normal”
- Improving ecological and human health

Above: Diverse and resilient landscape planting.

Ecosystem services of trees and healthy landscapes

- Conserve energy
- Mitigate extreme heat
- Provide shade
- Absorb stormwater
- Create wildlife habitat
- Filter air and water

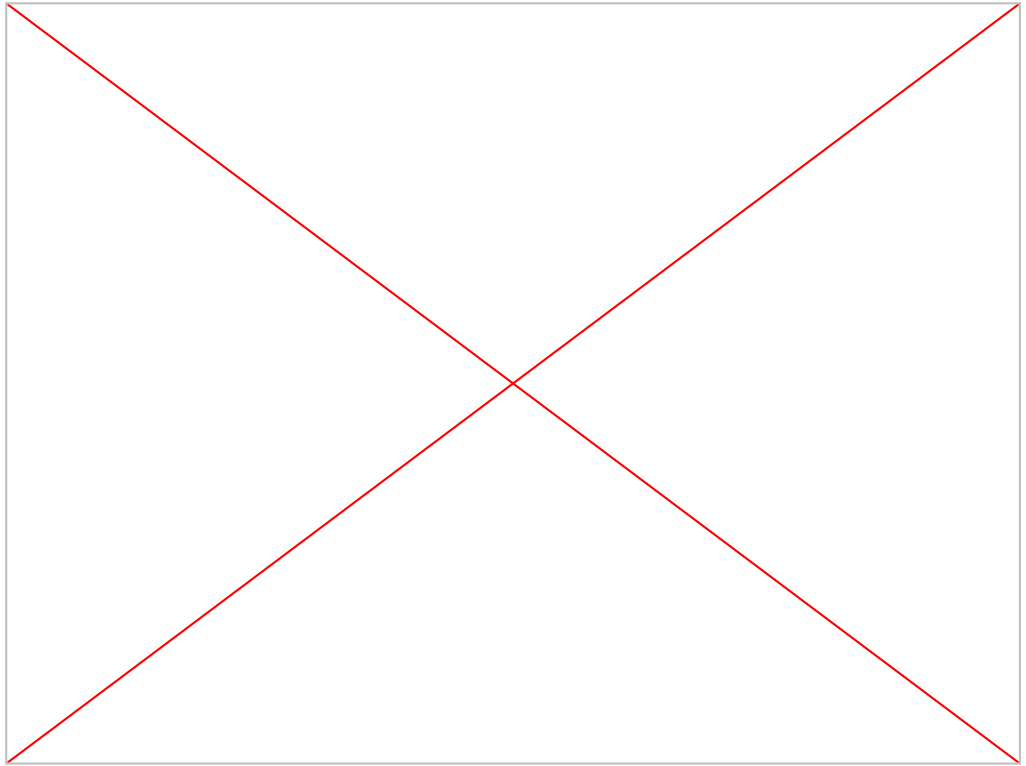
Aesculus turbinata
(Japanese horse chestnut)

Threats to landscapes

- More frequent and severe weather events
- Warmer winters
- Wetter years
- Vandalism
- Invasive pests
- New diseases

Climate change trends

- Warmer winters
- Wetter years
- More frequent and severe weather events



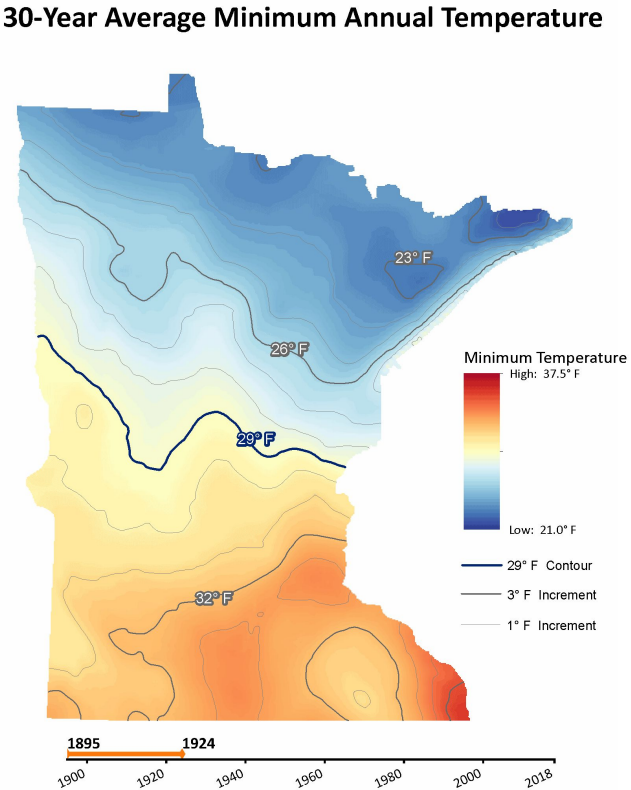
Above: Rain overflowing downspout in St. Paul in 2021.

Warmer winters

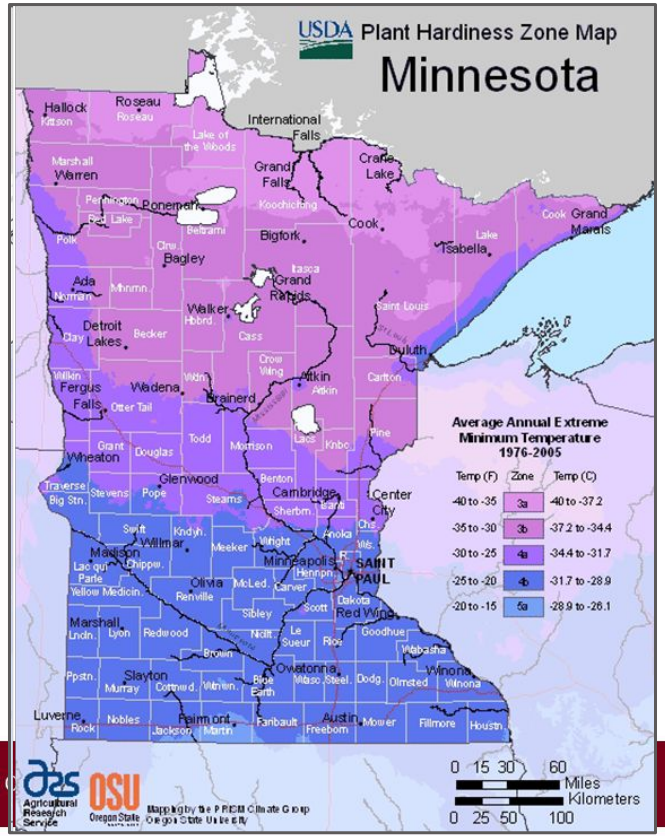
What does that mean?

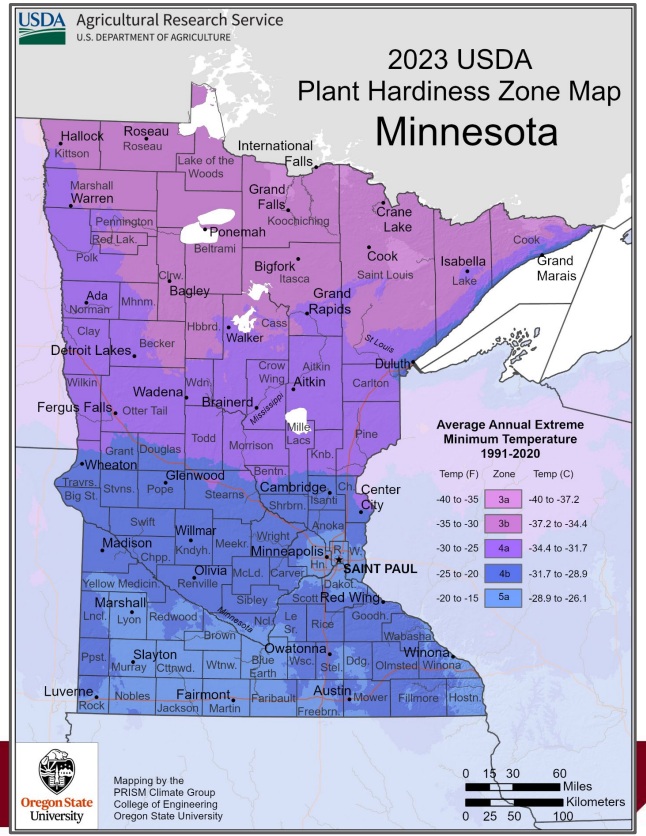
- Average winter lows are higher.

Lowest minimum temperature
Washington County:
11.3˚F increase since 1951
1.6˚F increase per decade



Hardiness zone change

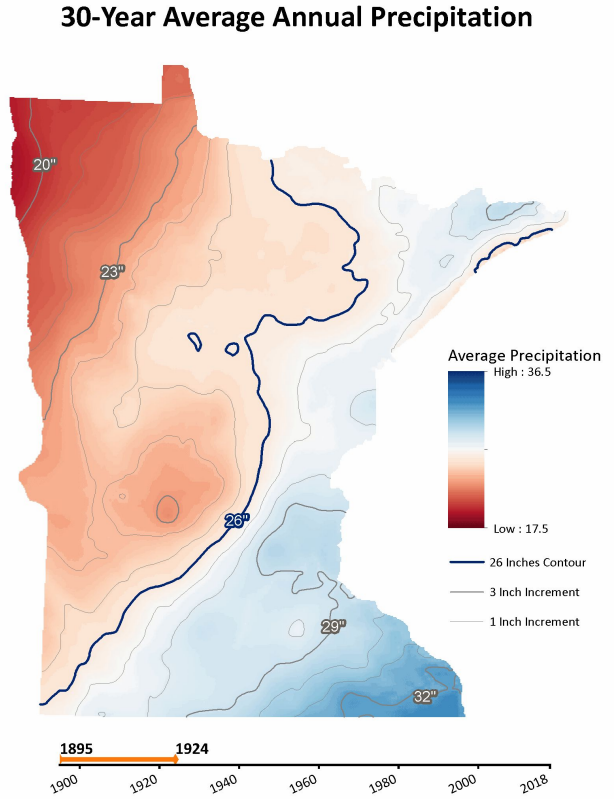




Wetter

What does that mean?

- Overall average precipitation ⬆️
- Average rainfall per event ⬆️
- Rainfall event frequency ⬇️



Wetter

What does that mean?

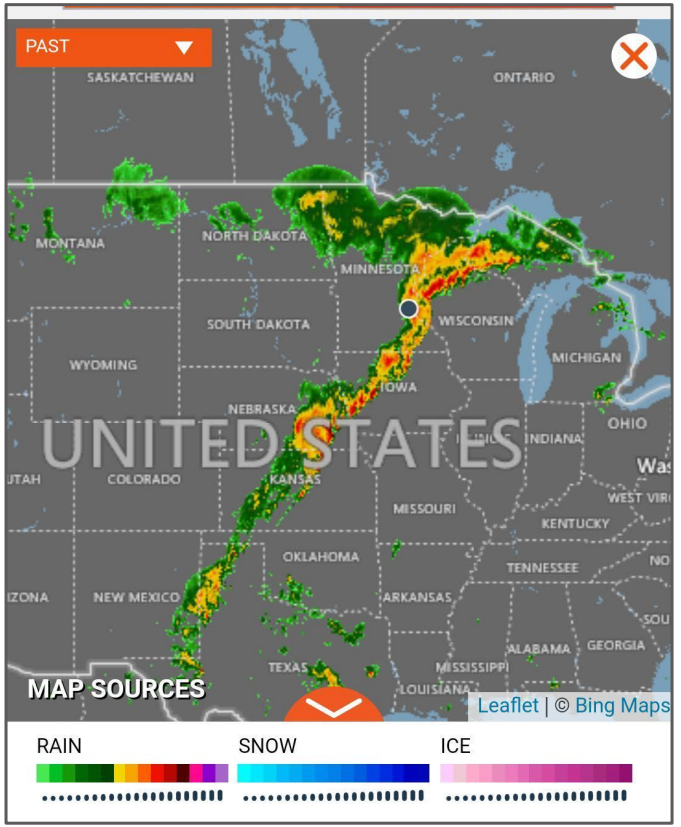
- Overall average precipitation ⬆️
- Average rainfall per event ⬆️
- Rainfall event frequency ⬇️

Above: Flooded landscape at the Arboretum after 2 inches of rain in 24 hours.

Wetter

What does that mean?

- Overall average precipitation ⬆️
- Average rainfall per event ⬆️
- Rainfall event frequency ⬇️



Right: Storm system moving through Minnesota that produced tornadoes in 2024.

More intense storms

What does that mean?

- Wind gusts ⬆️
- Average rainfall per event ⬆️

Above: Maple that came down in high winds at the Arboretum.

Storm in Beltrami 2025

100 mph wind gusts

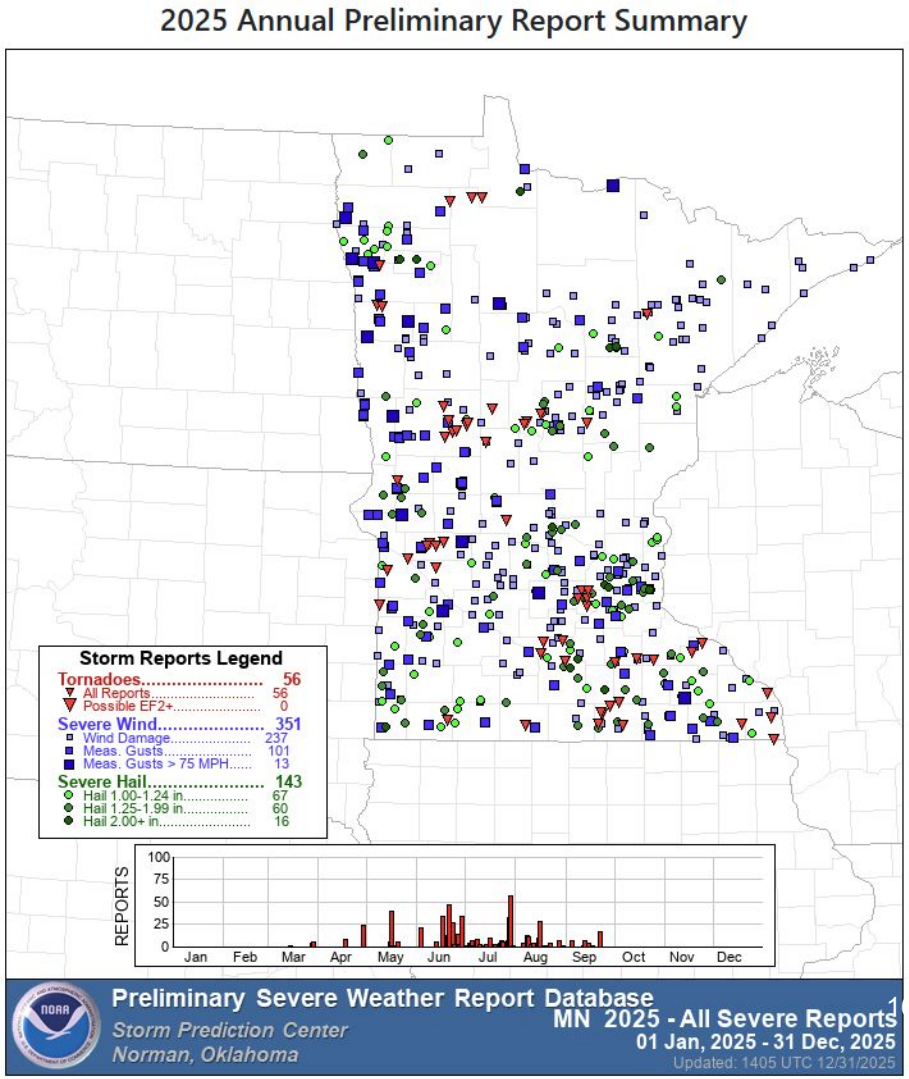
Nearly $9 million dollars in damage

Beltrami County Emergency Management/via Grand Forks NWS

Weather events

These are the extreme weather events from 2025 in Minnesota.

- Tornadoes
- Severe wind
- Severe hail



Severe weather impacts on the landscape

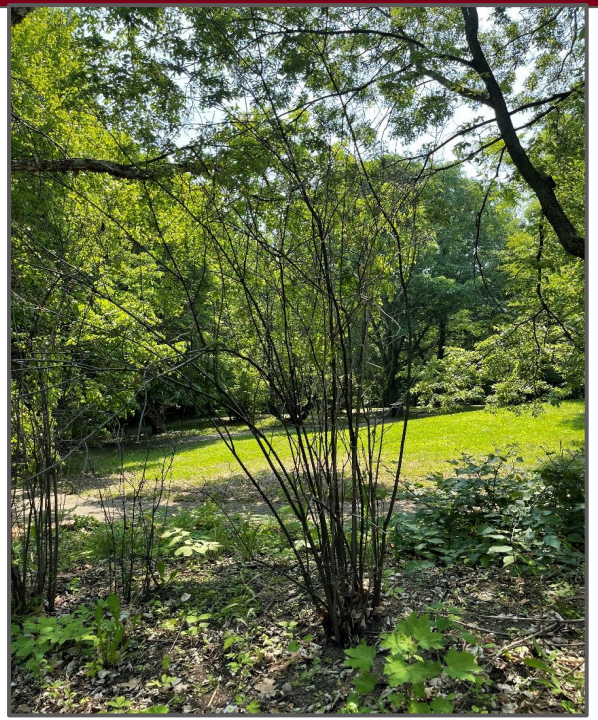
- Extreme swings in soil moisture from dry to overly wet
  - Oxygen deprivation kills roots of species intolerant of flooding
  - Walking on wet soils destroys soil structure
  - Drought can lead to death of establishing and mature trees and increased susceptibility to pests and pathogens e.g. Two-lined chestnut borer
- High winds can topple trees
- Physical damage e.g. hail at critical points in plant development
- Decreased productivity of edible plants due to drought and/or flooding, temperature swings, increased wind damage, etc.

Invasive pests

Lycorma delicatula
(spotted lanternfly)

Damage from ***Agrilus planipennis***
(emerald ash borer)

Viburnum Leaf Beetle



Viburnum Leaf Beetle (VLB)

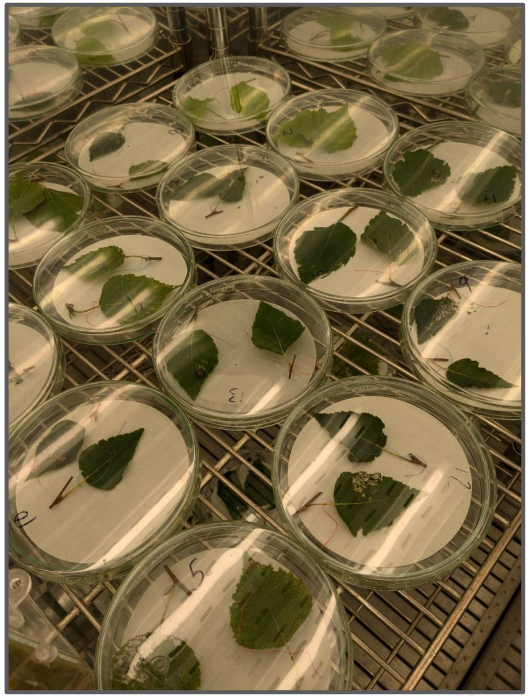
Above: feeding damage on leaves of European cranberrybush viburnum (left) and arrowwood viburnum (right).

Discovered in Hennepin Co. in 2019.

Feed on all species of *Viburnum*, and all state natives are considered exceptionally susceptible.

Observations: plants grown in shady areas are preferred by VLB over plants in full sun.

Harnessing Host Plant Resistance to Japanese Beetles



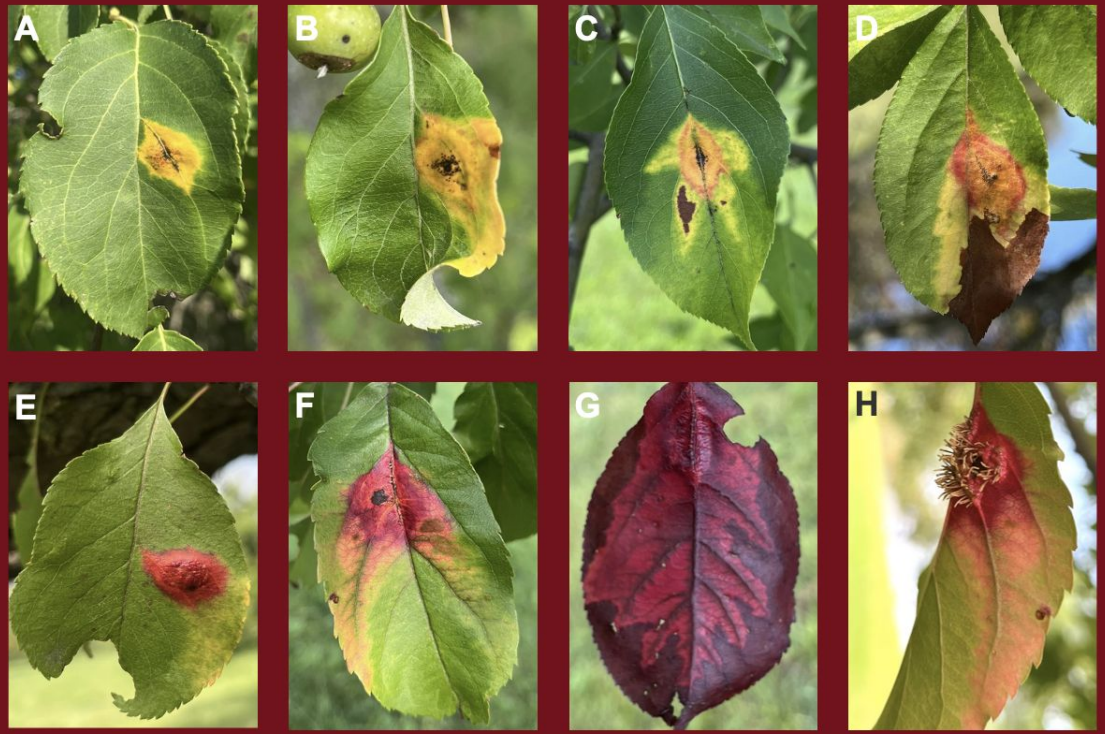


Fig. 1. Red star rust lesions caused by *Gymnosporangium yamadae* on adaxial flowering crabapple (*Malus* spp.) leaf surfaces. Note characteristic irregular lesion shape and color difference in various cultivars (**A** = 'Red Jade'; **B** = 'David'; **C** = 'Jeflite' Starlite®; **D** = 'Sentinel'; **E** = 'Makamik'; **F** = 'Purple Prince'; **G** = 'Cardinal'). *Gymnosporangium yamadae* bristle-like peridia (fungal spore structures) on abaxial leaf surface of 'Purple Prince' (**H**)

What can you do?

- Do not remove thriving plants (invasive species excluded…)
- Soil test and site amendments, as needed (and appropriate)
- Follow principles of “right plant, right place”
- Properly establish new plants
- Follow best practices for routine tree care (e.g. mulching with 333)
- Water established plants deeply and infrequently during prolonged dry periods




Limitations of the built environment

- Limited soil volumes
- Soil compaction
- High soil pH
- Extreme temperature fluctuations
- Extreme soil moisture fluctuations

Site restrictions

- Soil characteristics
- Expected management regimen and inputs
- Causes of plant stress
- Weather and climate impact
- **Site evaluation**

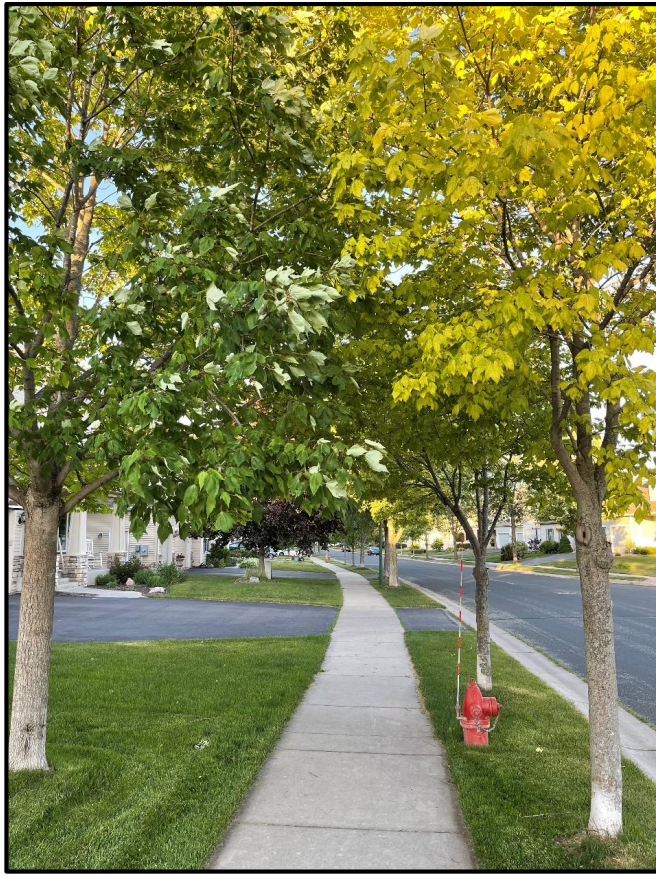
Right: Vibrant urban planting in Tokyo, Japan.

Site restrictions

- Climate constraints
- Hardiness, microclimate, sunlight, and irrigation
- Soil factors
- pH, texture, compaction level, and drainage
- Structural factors
- Limitations above/below ground
- Visual assessment of site and conditions
- Noticeable existing issues

Genetic potential

Environmental reality

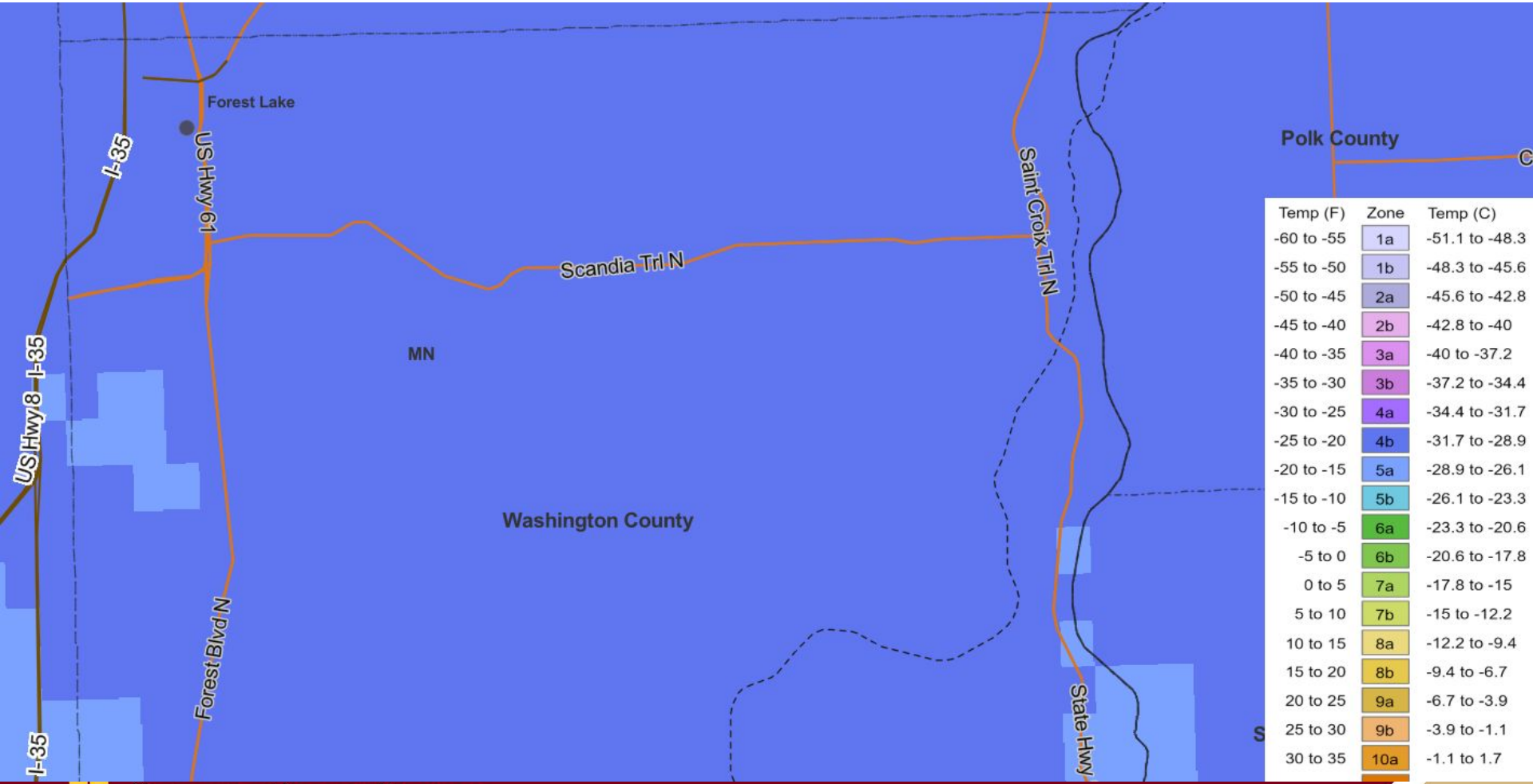


Plant selection limits

Insects/diseases	Yes
Size	Yes
Heat/Cold	Yes
Poor Drainage	Yes
Dry Soils	Yes (up to a point)
pH	Yes
Salt	Somewhat
Soil Compaction (physical impedance)	NO

Plant selection criteria

- Pest-resistant plants adapted to site conditions
- Non-invasive, highly diverse
- Meets design/functional objectives
- Matches management limitations



Zone 4 hardy trees

1. *Acer triflorum* (three-flower maple)
2. *Betula alleghaniensis* (yellow birch)
3. *Carya cordiformis* (bitternut hickory)
4. *Diospyros virginiana* (American persimmon)
5. *Magnolia tripetala* (umbrella magnolia)
6. *Nyssa sylvatica* (black gum)
7. *Pinus cembra* (Swiss stone pine)
8. *Quercus muehlenbergii* (chinkapin oak)

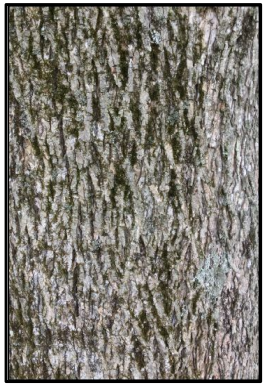
Acer triflorum (three-flower maple)

- Tree; deciduous
- Belongs to maple family (Aceraceae)
- USDA zones (3)4-7
- Full sun
- 20-30’ tall; similar width
- Dark green foliage (trifoliate leaves)
- Bark exfoliates with age
- Great yellow-orange fall color
- Excellent specimen tree
- Slow rate of growth
- Endemic to Manchuria, China, and Korea

Betula alleghaniensis (yellow birch)

- Tree; deciduous
- Patchy distribution in Midwest and Eastern U.S.
- Belongs to birch family (Betulaceae)
- USDA zones 3-7
- Full sun to part shade
- 80'+ tall; 60' wide
- Associated with moist sites, but is adaptable
- Outstanding exfoliating bark
- Great yellow fall color
- Purportedly resistant to bronze birch borer

Carya cordiformis (bitternut hickory)



- Native to Eastern U.S.
- Belongs to walnut family (Juglandaceae)
- USDA zones (3b)4-8
- Full sun
- Taller than wide; 50-80' tall
- Very adaptable
- 7 (sometimes 5 or 9) leaflets, always with a terminal leaflet
- Bark smooth to ridged with age; near diamond shaped ridges
- Outstanding yellow fall color

Diospyros virginiana (American persimmon)

American persimmon. John Ruter, University of Georgia, Bugwood.org

- Tree; deciduous
- Belongs to the ebony family (Ebenaceae)
- USDA zones 4-8
- ~60' tall and 35' wide
- Full sun
- Tolerates drought and high soil pH
- Bloom time May to June, fragrant flowers
- Edible fruit, attractive to wildlife
- Native to the Eastern and central U.S.

Rebekah D. Wallace, University of Georgia, Bugwood.org

Magnolia tripetala (umbrella magnolia)

- Tree; deciduous
- Belongs to the magnolia family (Magnoliaceae)
- USDA zones 4-8
- ~30’ tall and wide
- Full sun to part shade
- 24” long leaves
- Requires consistent moisture; performs on soils with high organic matter
- Blooms May to June
- Large white tepals
- Native to the Eastern U.S.

Nyssa sylvatica (black gum)

- Tree; deciduous
- Eastern U.S.
- Nyssaceae
- USDA zones (3)4-9
- Full sun
- 30-50’ tall; 30-40’ wide
- “Pin oak” branch habit
- Orange, red, or purple fall color
- Glossy leaves
- Tolerates some drought, occasionally saturated soil, and some salt exposure

Nyssa sylvatica (black gum)



Pinus cembra (Swiss stone pine)

- Pinaceae
- Zones 3-7
- 30-40’ tall
- ~25’ wide
- Full sun (part shade)
- Five-needled pine
- Tolerates: high pH, dry sites, occasional drought
- Narrow/pyramidal habit
- Slow growth
- Endemic to Europe and Asia

Quercus muehlenbergii (chinkapin oak)

Images obtained through the Cornell University woody plant database

- Tree; deciduous
- Native through Central and Eastern U.S.
- Oak/beech family (Fagaceae)
- USDA zones 4b-7
- Full sun
- 40-50' tall; 35-50' wide
- Medium to slow growth rate
- Flaky bark texture
- Tolerant of high pH soil, drought, and some salt exposure
- Great urban tree, useful for boulevards

What should you do?

Take an inventory of the trees and other plant species around you.

Look for species in different families that meet the needs of your landscape.

Wrap-up

We do better when we work together!

Stay curious.

Stay active.

Keep gardening.

Plant more trees.

Tree	Scientific Name	Size	Height	Width	Zone	Native	Attributes	Tolerances
American hornbeam	*Carpinus caroliniana*	S, M	20-30	20-30	3-9	MN		
American persimmon	*Diospyros virginiana*	M, L	35-60	20-35	4-9	NA		
American smoketree	*Cotinus obovatus*	S, M	20-30	10-20	4-8	NA		
Bald cypress	*Taxodium distichum*	L	50-70	20-30	4-11	NA		
Bitternut hickory	*Carya cordiformis*	L	50-70	40-50	4-9	MN		
Black tupelo	*Nyssa sylvatica*	M, L	30-50	20-30	4-9	NA		
Chinese fringe tree*	*Chionanthus retusus*	S	15-25	15-25	5-8	N		
Chinkapin oak	*Quercus muehlenbergii*	L	40-50	50-60	5-7	MN		
Cucumber magnolia	*Magnolia acuminata*	L	50-80	50-80	4-8	NA		
European hornbeam	*Carpinus betulus*	M, L	40-60	30-40	4-8	N		
European horsechestnut	*Aesculus hippocastanum*	L	50-75	40-65	3-7	N		
European larch	*Larix decidua*	L	70-75	25-30	3-6	N		
EXCLAMATION!™ London planetree	*Platanus ×acerifolia* 'Morton Circle'	L	55-65	40-50	4-8	N		
Fragrant snowbell*	*Styrax obassia*	S, M	20-30	15-25	5-8	N		
Fringe tree	*Chionanthus virginicus*	S	12-20	12-20	4-9	NA		
Golden Glory cornelian cherry dogwood	*Cornus mas* 'Golden Glory'	S	15-20	15-20	4-8	N		
Goldenraintree*	*Koelreuteria paniculata*	M	30-40	30-40	5-8	N		
Japanese white pine	*Pinus parviflora*	M, L	25-50	25-50	4-7	N		
Katsuratree	*Cercidiphyllum japonicum*	L	40-60	20-30	4-8	N		
Kousa dogwood*	*Cornus kousa*	S, M	20-30	20-30	5-8	N		
Lacebark pine*	*Pinus bungeana*	M, L	30-50	20-35	4-7	N		
Manchurian maple	*Acer mandschuricum*	S	20-30	15-25	4-7	N		
Northern catalpa	*Catalpa speciosa*	L	40-60	20-40	4-8	NA		
Northern pecan	*Carya illinoinensis*	L	70-100	40-75	4-9	NA		
Pawpaw	*Asimina triloba*	S	15-20	15-20	5-8	NA		
Sargent cherry	*Prunus sargentii*	S, M	20-30	20-30	4-7	N		
Scholar tree	*Styphnolobium japonicum*	L	50-75	50-75	4-7	N		
Serbian spruce	*Picea omorika*	L	50-60	20-25	4-7	N		
Shagbark hickory	*Carya ovata*	L	60-80	30-50	4-9	MN		
Shellbark hickory	*Carya laciniosa*	L	60-80	40-60	4-9	NA		
Shingle oak	*Quercus imbricaria*	L	50-60	50-60	4-8	NA		

Resources

1. SCIPP tool for county-level temperature data: https://cmintemp.scipp.lsu.edu/
2. MN DNR climate data (including maps): https://www.dnr.state.mn.us/climate/historical/annual.html
3. NOAA extreme weather events: https://www.spc.noaa.gov/climo/summary/
4. MN DNR June 2024 72-hr precip map: https://www.dnr.state.mn.us/climate/journal/extreme-rain-flooding-southern-minnesota-june-20-22.html
5. USDA Plant Hardiness Zone Map https://planthardiness.ars.usda.gov/
6. UMN Extension Plant Elements of Design tool: https://plantsearch.extension.umn.edu/home/list

Questions??