

# Flood Recovery Guide for Green Infrastructure in Communities



Photo credit: North Dakota Game and Fish Department



## NDSU

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# Section 1. Introduction

The historic floods of 2011 caused millions of dollars in damage and imposed great hardship on those affected. Low-lying areas along the Missouri and Souris rivers sustained unprecedented damage. The floods negatively impacted the trees and forests in these areas as well.

The peak inundation occurred during the week of June 27, 2011, on the Missouri River and the week of June 20, 2011, on the Mouse (Souris) River. Growing-season flooding is detrimental to trees because the lack of soil oxygen causes roots to die. Many species cannot withstand more than four to six weeks of flooding.

The standing dead trees imposed a great liability in residential areas. The loss of this green infrastructure will have long-term impacts because trees reduce summer cooling and winter heating costs and beautify our environment.

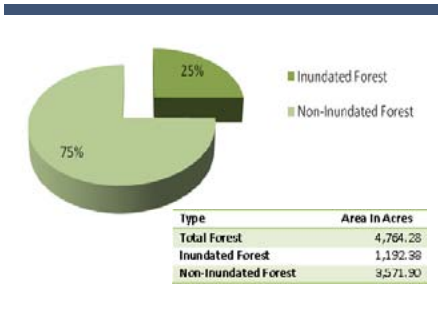
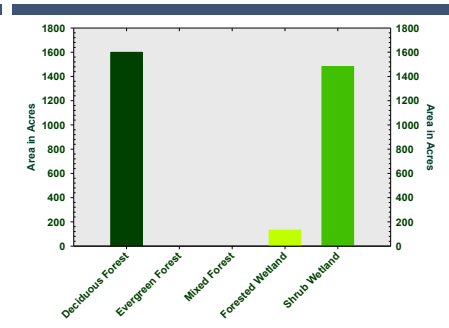
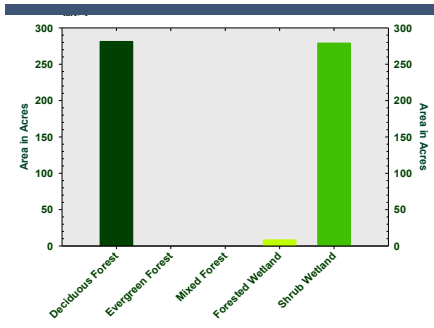
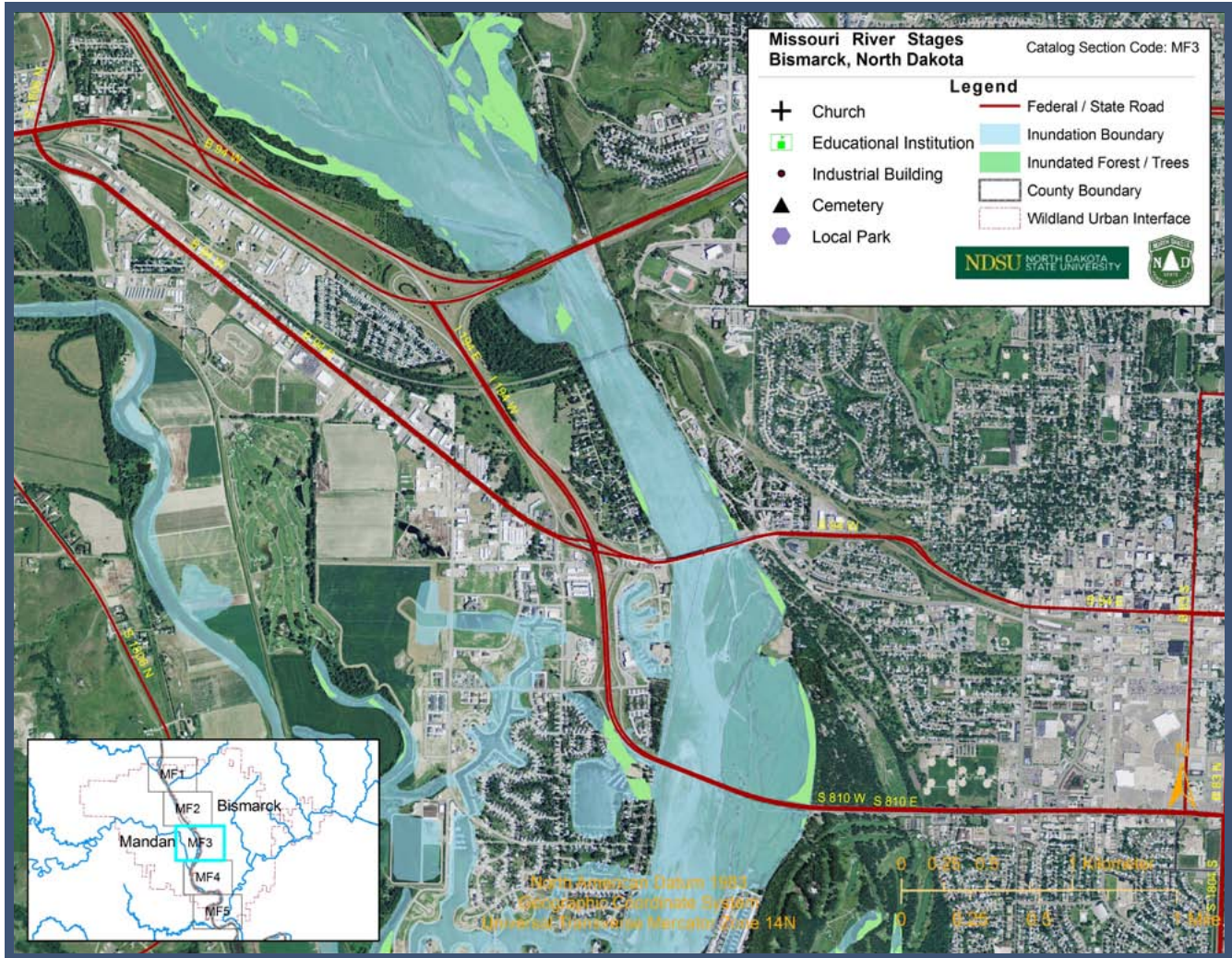
Riparian forests are among the most important of all forest types in the Great Plains. These scarce resources provide numerous key ecological services, including improving water quality, providing wildlife habitat for rare and endangered species, enhancing the botanical diversity of the region and carbon sequestration.

Foresters estimate 33,518 acres of riparian forests on the Missouri and Mouse rivers and 3,028 acres of community forests were impacted by these floods. Thousands of dead and toppled trees have been inventoried in public lands along the Missouri. Many North Dakota communities are adjacent to watercourses and, therefore, may be subject to flooding at some point.

The purpose of this guide is to help communities prepare for, respond to and recover from flood events impacting their forest resources. Natural disasters, including floods, are unpredictable, so planning for such events must incorporate flexibility.

Although the challenges posed by natural disasters can be quite variable, some common components must be accounted for in green infrastructure when such events occur. These include ensuring public safety; assessing damage; removing, disposing of and using wood waste; interagency coordination; and replanting efforts.

Communities along the Souris and Missouri Rivers were impacted by the 2011 floods as illustrated in the NDFS GIS Peak Inundation Assessment.



Summary of Inundated Forest/ Trees along Missouri River for Catalog Section Code MF3.

Summary of Inundated Forest/ Trees along Missouri River in the Bismarck Wildland Urban Interface.

Summary of the Inundated and Non-inundated Forests for Bismarck Wildland Urban Interface.

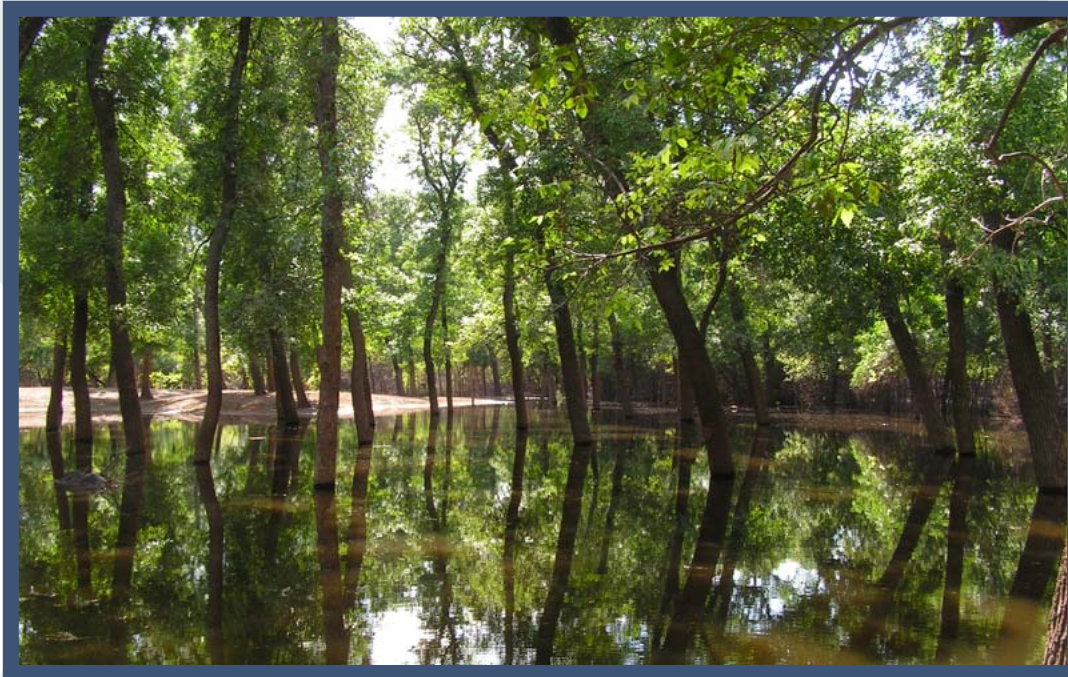
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## Section 2. Ensuring Public Safety

Human health and safety is the first and highest priority following any natural disaster. Public use areas should be closed to the public until damage assessments can be made and hazardous trees are removed.

Coordination with city officials is critical to ensure the public is informed of hazardous situations. Good communication is critical for fast response times, crew scheduling, and notifying staff and the public of hazardous situations. All municipal vehicles should be equipped with two-way radios or cell phones.

Response and cleanup activities may warrant coordination with other entities that do not use public works radios, such as fire, police, contractors and utility crews. Efforts should be made to identify mechanisms to enhance communication with these groups.



**Public use areas with standing dead trees and areas inundated with water need to be closed to the public for safety.**

In addition, homeowners may be inclined to begin clearing debris on their property. Develop written or videotaped public service announcements that can be modified easily and distributed before, during and after a natural disaster. Topics may include:

- Chain saw safety
- Safety hazards when clearing debris
- Debris disposal options
- Selecting a qualified arborist or tree-care professional
- How to identify trees worth saving
- How to care for trees after a flood event

## Section 3. Flood Damage Assessment Considerations for Trees

Conducting a systematic tree mortality/hazard assessment is critical to accurately estimate financial costs, the scale of work to be completed and wood waste volume; prioritize removals; and determine replanting needs.

The type of assessment will depend upon the area affected. Residential areas will require street and property inspections in which each tree will be inspected visually. Naturalized areas such as riparian forests will require an approach that relies on a randomized survey because visual inspections of every tree in a forested area will be overly cumbersome and time-consuming. Parks and public recreation areas (golf courses, picnic areas) may require an assessment that combines random sampling and individual tree inspections.

How trees are affected by flooding depends on numerous factors: season of flooding (spring vs. summer), species age, and health of the tree prior to flooding.

Spring flooding resulting from snowmelt is a common occurrence in North Dakota. Such floods typically do not result in significant tree mortality because most species are in a state of dormancy during the peak inundation periods. Conversely, summer or growing-season flooding can be far more detrimental to trees and shrubs.

Trees and shrubs completely inundated during the growing season will sustain significant damage, particularly if trees are inundated for a period of weeks or more. Flooding decreases available oxygen in the soil, which may damage root systems.

Generally, conifers (evergreens) are not tolerant of growing-season flooding. The impacts to conifers will be apparent within days or weeks after flooding. Many riparian species such as ash, willow and cottonwood will tolerate growing-season flooding for several weeks or more. Such deciduous trees may shed leaves due to growing-season flooding and experience stress for a short duration. Often these trees will recover and show few signs of injury in the following year.

Trees that have a significant portion of their canopy above the floodwaters likely will survive with little or no damage. Trees that are stressed prior to flooding will be more susceptible to damage imposed by flooding.



Conifers are intolerant of flooding that occurs during the growing season.

When conducting post-flood assessments, you have several factors to consider:

**Sedimentation/Erosion:** Floods can result in large quantities of soil being washed away or deposited. Erosion and sedimentation can have negative effects on trees. Roots exposed from soil erosion can die, and the tree will become susceptible to windthrow. A thick layer of sediment deposited over the area where trees are growing can have longer-term negative effects because the roots can be suffocated under a heavy layer of soil sitting atop the original soil layer.

**Saturated soils:** Soils saturated by floodwaters can become extremely soft. The shallow root systems of trees growing in poorly aerated (flooded) soils often make them prone to windthrow. Low-lying areas where soils may remain saturated for an extended period of time should be closed to the public because a sudden wind gust/storm can cause large trees to uproot.

**Proximity to structures** is important to note as well. Leaning and damaged trees hanging over structures or in high-use areas should be given special consideration.

**Trees close to power lines** should be noted because the cost of limbing the trees to allow for safe removal can add significant costs.

**Tree dimensions** such as diameter and height are important to help assess removal costs and equipment needs.



Large trees standing in saturated soils for an extended period of time can become prone to windthrow.



Sediment deposited can suffocate roots and lead to long term health problems of trees.

## Section 4. Removal, Disposal and Utilization

Safety, cost and capacity are primary considerations for the removal process. Standing dead and leaning trees present hazards to workers, residents and structures. Post-flood surveys should document such hazardous trees as high priority removals. Post-flood assessments also should document the scale of work to be completed.

Community managers must evaluate their capacity to carry out such work. Smaller communities may need to contract with arborists or tree-care companies to fulfill this role. When determining capacity needs, managers must consider whether existing staff and equipment can handle the damaged trees, the number and size of trees to remove, the urgency of removing trees based on prioritization and the costs involved.

When prioritizing tree removals, all life-threatening situations should be given highest priority. Supervisors should make an on-site visit to determine the severity of the damage in the event of multiple-hazard situations. Crews should remedy the situation to a point where it no longer is life-threatening before proceeding to the next location. Final cleanup should wait until all life-threatening situations are resolved and all streets have been cleared.

A listing of public works department equipment and vehicles available for tree cleanup work should be developed and kept current. The list may include wood chippers, aerial bucket trucks, refuse packers, prentice loaders, supervisory vehicles, chain saws, barricade and lighting equipment, hand saws and pole pruners.

When necessary, the managers may authorize the rental of additional equipment for tree cleanup work. A list of potential vendors and tree contractors authorized to work in the community to supplement municipal crews should be developed and kept current.

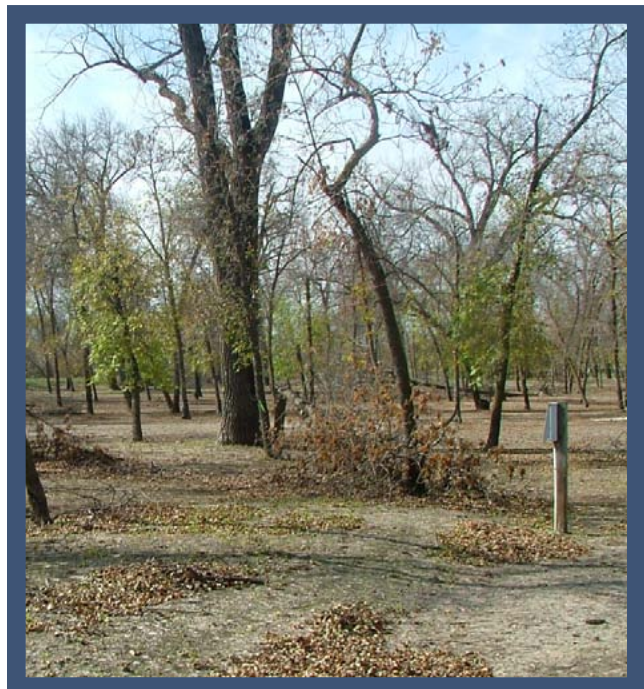
Depending on the area flooded, nearby municipalities may not have been affected by flooding. Establish a process to coordinate with these communities in the event that they could send staff and equipment for cleanup efforts.

All divisions that are involved with tree cleanup should keep accurate and detailed records on equipment and staff hours. Their records will provide important information in the event of financial reimbursement from federal or state agencies, or in case of questions or confusion regarding the use of staff, equipment or funds.

In addition, homeowners may want to begin clearing debris on their property. Develop written or videotaped public service announcements that can be modified easily and distributed before, during and after a natural disaster. Topics may include:

- Chain saw safety
- Safety hazards when clearing debris
- Debris disposal options
- Equitable vendor prices
- Selecting a qualified arborist or tree-care professional
- Selecting high-quality nursery stock
- Benefits of trees, and the advantage of a healthy and safe urban forest
- How to identify trees worth saving
- How to care for trees after a flood event

**Managers must determine the number and sizes of trees to be removed.**



## Section 5. Resources Available to City Foresters/Public Works Managers

Several state and federal agencies may be available to assist with the recovery and reclamation efforts following floods. Some of these include the North Dakota Health and Emergency Services departments, North Dakota Forest Service (technical assistance and financial assistance for replanting), U.S. Army Corps of Engineers and Federal Emergency Management Agency (FEMA).

The following chart summarizes the various programs available, the services they provide and the agencies responsible for their administration.

<b>Name</b>	<b>Description</b>	<b>Managing Agencies</b>
Community Assistance Program (CAP) Commission	Provides funding to states to assist communities in complying with National Flood Insurance Program requirements	FEMA N.D. State Water
Dam Safety Program	Provides funding to the state to promote dam safety through emergency action plans and exercises	FEMA N.D. State Water Commission
Flood Mitigation Assistance Program (FMA)	Provides pre-disaster funding for repetitive flood loss property reduction	FEMA N.D. Department of Emergency Services
Hazard Mitigation Grant Program (HMGP)	Provides post-disaster mitigation funding	FEMA N.D. Department of Emergency Services
Map Modernization Program/Risk MAP	Provides funding to establish or update floodplain mapping	FEMA N.D. State Water Commission
Pre-Disaster Mitigation Program	Provides grants through a competitive process for specific mitigation projects, including planning	FEMA N.D. Department of Emergency Services
State Water Commission Cost-Share Program	Provides cost-share assistance for flood control, water supply, recreation, snagging and clearing, studies, irrigation, bank stabilization and technical assistance projects	N.D. State Water Commission
Clean Water Act Section 319 Grants	Provides grants for a wide variety of activities related to nonpoint source pollution runoff mitigation	U.S. Environmental Protection Agency
Community Development Block Grant (CDBG)	Provides funding for sustainable community development, including disaster mitigation projects	U.S. Housing and Urban Development
Economic Development Administration (EDA) Grants and Investments	Invests and provides grants for community construction projects, including mitigation activities	U.S. Economic Development Administration
Emergency Management Performance Grants (EMPG)	Enhances and sustains all-hazard emergency management capabilities, including mitigation	N.D. Department of Emergency Services FEMA



<b>Name</b>	<b>Description</b>	<b>Managing Agencies</b>
Emergency Watershed Protection	Provides funding and technical assistance for emergency measures such as floodplain easements in impaired watersheds	U.S. Natural Resources Conservation Service
Environmental Quality Incentives Program	Provides funding and technical assistance to farmers and ranchers to promote agricultural production and environmental quality as compatible goals	U.S. Natural Resources Conservation Service
National Wildlife Wetland Refuge System	Provides funding for the acquisition of lands for the federal wildlife refuge system	U.S. Fish and Wildlife Service
North American Wetland Conservation Fund	Provides funding for wetland conservation projects	U.S. Fish and Wildlife Service
Natural Resources Conservation Service Conservation Programs	Provides funding through programs for the conservation of natural resources	U.S. Natural Resources Conservation Service
Partners for Fish and Wildlife	Provides financial and technical assistance to landowners for wetland restoration projects in “focus areas” of the state	U.S. Fish and Wildlife Service



## Section 6. Replanting

Communities must recognize that replanting efforts will not and should not be immediate. Following cleanup efforts, impacted areas should be surveyed for available planting spaces on public lands. Trees that are selected to remain in the landscape following a flood event should be monitored for several years. Replanting efforts should be planned during an extended period of years to avoid creating an even-aged stand of trees.

Tree planting, greening and special events such as Arbor Day ceremonies may be welcome activities after a natural disaster. Residents may see these activities as a sign of hope for the community during the process of recovery.

Educating the public on choosing the “right tree for the right place” is crucial during the recovery phase. This is an opportunity for the community to avoid future problems resulting from poor species selection and improper planting techniques. In addition, information on caring for trees that have sustained the flood should be made available.

### Community Forestry Grants

The North Dakota Forest Service offers grants for tree planting and program development projects on public property. Three grant programs are available: Community Family Forest (CFF), America the Beautiful (ATB) Tree Planting and ATB Program Development.

### Eligible Applicants

All projects must be on publicly owned or controlled property, such as boulevards, parks or school lands. Projects related to community forestry flood recovery needs will be given special consideration. Eligible applicants include counties, townships, cities, towns, park districts, school districts or tribal equivalents.

### Funds Availability

All grants require a match from the community. The community’s match may be in the form of cash and/or in-kind (volunteer labor, services, donated supplies or use of equipment) that is directly related to the grant project. The match for Community Family Forest grants is 80:20; the match for America the Beautiful grants is 50:50. Applications are funded on a competitive basis, subject to the discretion of the North Dakota Forest Service Community Forestry Council.



### Community Family Forest (CFF)

CFF grants are funded by the North Dakota Trees Trust Fund. The purpose of these grants is to honor families in the state by planting trees in communities and strengthening the tradition of annual tree planting. The maximum award for this tree planting grant is \$2,000 for communities certified as a Tree City USA. Other communities are eligible for grants up to \$1,500. Only one grant application will be accepted per community.

### America the Beautiful (ATB) Tree Planting

This tree planting grant is co-sponsored by the U.S. Forest Service and is intended to stimulate the development of innovative and effective tree planting projects in communities. The maximum grant award is \$10,000. Multiple entities in the same community can apply for this grant.

### America the Beautiful (ATB) Program Development

This grant is made available through the U.S. Forest Service and is intended to stimulate the development of innovative and effective community forestry projects other than tree planting.

The maximum grant award is \$10,000. Program Development projects include:

- Inventories, risk tree assessments or tree removals, especially projects related to community forestry flood recovery needs
- Removals of ash trees as part of an Emerald ash borer community action plan
- Development of a community forestry action plan, including a planting plan, to increase species diversity in preparation for EAB
- Educational outreach to expand awareness of community forestry in the community

## **Diversifying the Community Forest**

Emerald ash borer (EAB) is a highly invasive, non-native beetle that attacks and kills all species of ash (*Fraxinus* spp.) trees. Ash is one of the most common trees planted and found in North Dakota communities. The loss of these trees would be devastating from an ecological and economic standpoint.

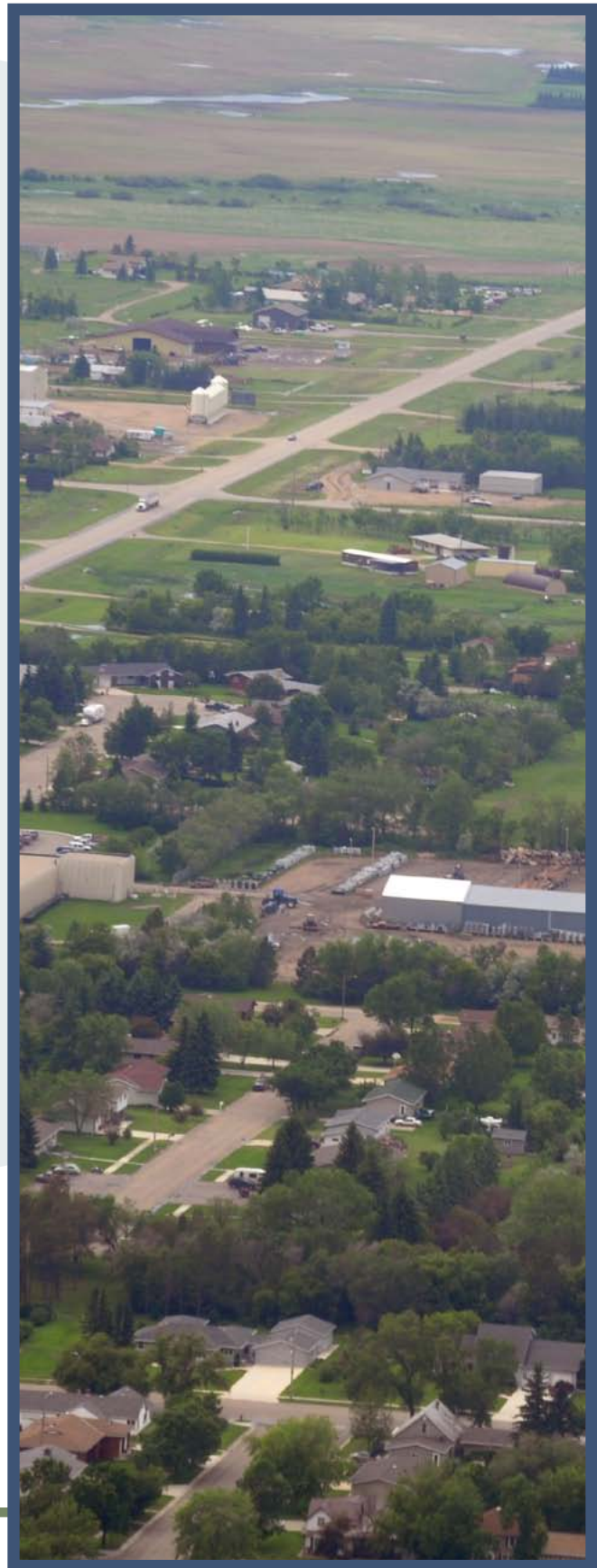
Given this threat and potential threats of future invasive insects or diseases increasing the genetic diversity of the trees we plant is in the long-term interest of communities. This can be done by planting multiple genera and species within these genera.

Recent street tree inventories of communities throughout North Dakota reveal populations of green ash ranging from 16 to nearly 80 percent, with an average street tree population consisting of 38 percent green ash.

As a rule, no single tree species should represent more than 10 percent of any community's tree resource (See Santamour, Frank. *Trees for Urban Planting: Diversity, Uniformity, and Common Sense*. U.S. National Arboretum; Agricultural Research Service, USDA, Washington, D.C. METRIA: The Metropolitan Tree Improvement Alliance, METRIA 7 Conference. June 11-12, 1990. Pg. 57.) When tree species exceed this 10 percent threshold, it can signify low species diversity, which can increase the potential impact of insect or disease issues on the community's trees.

For more information, contact the North Dakota Forest Service:

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