Gary, IN Department of Venues, Parks and Recreation

Urban Forest Management Plan

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Section 1: Overview of Goals

The City of Gary Department of Venues, Parks and Recreation (GDVPR) in Lake County, Indiana has recently worked with Great Lakes Urban Forestry Management (GLUFM) to conduct a tree inventory on 22 park properties and the Indiana University Northwest campus which resulted in a managed tree population of 2,367 trees. Detailed tree data was collected for GDVPR's managed trees as part of a 2020 tree inventory. The data collected during this inventory was used to create this Urban Forest Management Plan (UFMP). The Plan details how the Gary Department of Venues, Parks and Recreation urban forest resources will be managed for the benefit of the community it serves for the next 30 years, with a focus which begins in 2020, and projects out to 2050. This Plan is meant to assist, as well as take direction from the community in Gary for the betterment of it's trees and it's community. It is hoped that the scope of this Plan may someday include the entire City, and not just the Parks, for a holistic Urban Forestry Plan for the City of Gary.

In terms of the condition of the Urban Forest of GDVPR, there are some strengths, along with opportunities for improvement. GDVPR has a moderately sized tree population for an entity of its size, providing many ecological benefits. However, there is evidence of a limited level of recent tree maintenance. One challenge faced by GDVPR will be to implement a robust tree maintenance program which can help to improve the overall condition of the tree population.

Additionally, the diversity of tree species at GDVPR is moderate, with 81 species represented. A greater overall diversity of the urban forest resource would put it at a lower risk of future mass tree loss due to introduced insects and diseases. GDVPR has an opportunity to improve the species diversity in their parks. Lastly, the properties of GDVPR have a lot of of open planting space and the Reforestation Plan developed as part of this UFMP will help to enhance the parks.

To improve the existing diversity, as well as to meet some of the challenges listed above, the following Urban Forest Management Plan will address each one of these challenges and create goals and milestones for each. Below is a broad view of the activities to come in the 2020-2050 period. Further detail is given in the body of the report, with separate sections detailing specific urban forestry activities, and how it is proposed they are achieved, along with standards and Best Management Practices for each.

Direct Goals

Create a Needs Analysis	**Document Policies and Procedures**	**Maintain Tree Planting Standards**
Create Annual Tree Pruning Program	**Increase Overall Diversity by 2050**	**Increase Capacity of City Staff**
Manage Tree Removals	**Maintain Accurate Tree Inventory**	**Properly Mulch New Plantings**
Incorporate BMPs into Tree Care	**Create Tree Risk Management Policy**	**Increase Urban Tree Canopy**
Create Strategic Partnerships	**Develop Tree Protection Standards**	**Consider Natural Areas in Planning**
Engage the Community	**Provide Education and Outreach**	**Climate and Stormwater Abatement**

Additional Long Term Goals

Establish an in House Nursery	**Contract Growing of Trees**	**Create Tree Donation Program**
Incentivize Private Property Tree Planting	**Plant Food Forests / Use Permaculture**	**Increase Tree Planting in Natural Areas**
Use Abandoned Spaces for Tree Planting	**Use Trees as Wildlife Habitat**	**Utilize Urban Wood From Tree Removal**

A proposed forestry program has been proposed which will achieve the greatest benefit for the community, based on the data from the inventory, as well as input from the partner committees and members of GDVPR's community. However, all plans are subject to change based on new information, budgets, or other unforeseen circumstances. For this reason, we ask all readers to consider that this plan is to be a living, breathing document, and goals and strategies will be updated to fit circumstances as needed. This Plan will be reviewed periodically, and residents, business owners, and other stakeholders will have an opportunity to provide input and help make it better during those annual reviews.

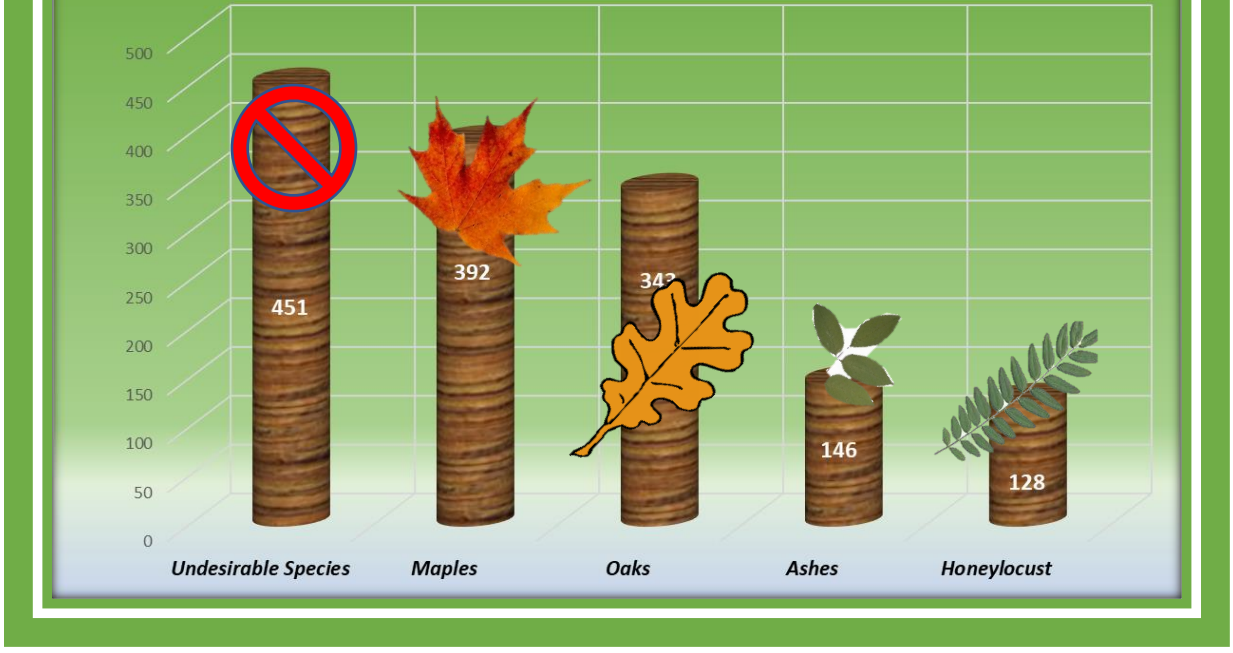
MISSION STATEMENT

It shall be the mission of this Urban Forest Management Plan to outline goals, budgets, and Arboricultural Best Management Practices for the Urban Forest in GDVPR's parks. This will provide the following benefits to the residents of the GDVPR community: Increase canopy cover, filter and reduce storm water runoff, reduce the urban heat island effect, create shade and energy savings, promote general health and wellbeing, provide a source of enjoyment and aesthetics, uptake carbon dioxide and filter pollutants, reduce crime, and increase property values.

Trees that make up this Urban Forest consist of trees on the park properties which exist for the enjoyment of the residents of Gary. This plan also seeks to outline both the short- and long-term management of the urban forest resource to maximize the environmental and aesthetic benefits of GDVPR's Urban Forest, while minimizing risks and costs. These goals and practices are designed to be financially and programmatically sustainable, as well as flexible both now and in the future as City Councils, Administrations, parks staff, and residents change with time.

Section 2: Gary's Urban Forest At A Glance

Total Number of Trees	2,367
Total Number of Species	81
Annual Benefits Provided	$130,805/yr
Standing Value	$14,043,546



Section 3: Direct Goals

Listed below are the direct goals of this Urban Forest Management Plan (herein referred to as "UFMP", or "the Plan"), as well as a brief discussion of how they shall be met. We believe these goals realistic and attainable, and do not place an undue burden on GDVPR or its resources. Instead, the goals of this UFMP are to save money and provide greater benefits over time through proactive and not reactive management. The Plan is also meant to be adaptable: New concepts, the introduction of new pests or pathogens, or changing climate (both social and meteorological) may all change the way the Urban Forest is viewed and managed. The goals of this document are subject to change based on the discovery of new knowledge, shifting budgets, or other circumstances, but generally are those with direct measurable outcomes.

The Plan is intended to be reviewed periodically by GDVPR officials and staff and any other interested stakeholders acting in the best interests of GDVPR and its community. The review process should include evaluation of progress made towards these goals. Goals may be altered after the review, as conditions warrant. This UFMP is written with the understanding that Government agencies, Administrations, and communities change over time, and therefore its goals and milestones require a large degree of flexibility. Since trees represent a long term (50-80 year) commitment, this Urban Forest Management Plan is intended to provide guidance and continuity through those changes, while also adapting to them as the need arises.

Create a Needs Analysis for the Current Tree Population Based on Strengths and Opportunities

Every urban tree population today is the result of past management decisions. As time goes on, the urban forestry industry increases its level of knowledge, skill, and efficiency in managing trees. Based on that new knowledge, often it is discovered that decisions made 20 or more years ago are having a negative effect, even though they might have seemed like good decisions at the time. For GDVPR's trees, it is the goal of this Plan to assess the current state of GDVPR's Urban Forest and examine its overall strengths and benefits, and look for opportunities for improvement.

Each aspect of the tree inventory data which was taken for GDVPR has been analyzed: How many trees, what condition they are in, how old they are, what needs do they have, and more were all examined to create strategic goals to improve the tree population for the benefit of GDVPR and its community. Specific goals in terms of planting, removals, budgets, personnel, and maintenance are all addressed in this UFMP. The strengths and opportunities of these activities will be the guiding principles for the management strategies and specific goals outlined in each section below.

Establish Goals in Order to Enhance Strengths and Realize Opportunities

To accomplish anything, goals are needed along the way to help guide organizations through the process. Establishing a robust forestry program will require a series of achievable goals to be realized. This Plan seeks to accomplish those goals within a realistic budget and achievable timespan. Goals are intended to change over time as GDVPR's capacity may increase or be reduced. The ability to adapt along the way is of great importance to this Plan.

In each section, we shall include goals which incorporate both a budget and a time frame in which those goals can be accomplished. The goals will, over time, create a fully operational and sustainable forestry program. This program will include tree planting, tree maintenance, and tree removal for GDVPR's Urban Forest, so that the tree population will be healthy, and provide the greatest benefits and least risk at an efficient price point. To learn more about the budgeting and staff capacity of GDVPR, see the goals below, or budgets in Section 17.

Increase Awareness of the Urban Forest in Gary and Engage the Community

The entire reason for the establishment of an urban forestry program at GDVPR is to improve the lives of the community and it's residents, business owners, and other stakeholders who want to see the Gary be a healthier, happier community. In a recent survey undertaken by The Nature Conservancy, it was shown that Gary residents pass through or visit parks and greenspaces quite often, with the highest category being almost daily! In addition, respondents to the survey indicated that the services trees provide, such as energy savings, clean air, mitigating climate change, providing wildlife habitat, and similar concepts were very important to them, and help to make Gary a more livable and healthy city, and combat it's perception as being overly industrial. Clearly, portions of the community are already engaged with trees!

However, to have trees and the urban forest be front and center, we will need even more partners in the community to provide support for this program. Community leaders and GDVPR staff will be reaching out to local churches, garden clubs, philanthropic organization, residents, and business owners in order to make the forestry program as innovative and hands-on as possible. In this manner, residents and business owners in the GDVPR community can take ownership of this important resource, and allow it to work for them, their families, businesses, and the good of the whole community. A sense of ownership and stewardship is of the greatest importance when creating a forestry program. For more on these innovative programs, and how you can get involved, turn to sections 4 and 5 below.

Document Arboricultural Policies and Procedures

We will work with GDVPR staff to suggest edits and improve ordinances governing trees in Gary. Tree ordinances are meant to encourage proper tree care practices as spelled out in this plan, for the benefit of the whole community. These will be very straightforward regulations, such as enforcing rules about what trees are not allowed to be plant, and defining what trees are the GDVPR's responsibility.

These measures will result in a tree population which is diverse, healthy, and improving while providing benefits to the City and its residents over the long term. This will serve to provide guidance for all future administrations, employees, and community residents, so that a level of understanding is reached that can be used in the future. Currently, the Park Board has authority over street trees as well, and we recommend this ordinance be reviewed and revised to place street tree authority with a different department. To learn more about ordinances, see the City of Gary's Municipal Code.

Increase Overall Diversity by 2050 Through Tree Planting

Tree species diversity is one of the most important concepts in Urban Forestry today. The reason pests and diseases like Emerald Ash Borer (EAB) and Dutch Elm Disease (DED) were so devastating was that there were simply too many Ash and Elm trees. When EAB arrived, many communities had 20% or more Ash trees, resulting in mass tree loss. This can be avoided by planting a greater diversity of tree species, so that when new pests or pathogens are introduced, we only lose small amounts of specific tree species. Great diversity leads to reduced costs and increased benefits over time.

An achievable "Diversity Vision" has been created for 2050 which will see the tree population become more diverse than it currently is. This Diversity Vision drives this entire plan. With a moderate diversity of tree species at current, it is believed the proposed Diversity Vision represents an attainable goal. Additionally, a Reforestation Plan has been created which helps to accomplish this goal, and will result in an exceptionally diverse tree population by 2050.

Creating this long term reforestation plan was an integral part of this process. As of this writing, the reforestation plan calls for the planting of 550 additional trees at specific locations in the parks. For this plan, trees will be planted which are underrepresented in the current population, and in a manner that selects the right tree for the right site via targeted tree planting. Ideas such as the exploration the opportunity of purchasing high quality nursery stock from a variety of growers at reasonable rates, as well as planting smaller stock will be explored. To learn more about tree planting and reforestation, turn to Section 12, and appendices A, B, C, and H

Maintain an Acceptable / Unacceptable Species List

The urban environment is a difficult place for a tree to live, but GDVPR's situation represents a unique opportunity for trees vs the urban street tree environment. Parks do not suffer from the same lack of soil, road pollutants, and other stresses that urban street trees do. This more tree-friendly environment provides the ability to plant more sensitive tree species with a higher degree of success. This makes increasing diversity a slightly easier task. That said, there are also trees which we want to limit or eliminate planting of. Trees which have very weak wood, which are known invasive species, which produce messy or foul-smelling fruits, or which create a public nuisance should also be avoided.

Acceptable species are those which are adapted to our Midwest climate, are not invasive, and do not pose high risk. Included in this Plan is an "acceptable" and an "unacceptable" species list, which will detail specific trees which may be planted on GDVPR properties. As part of annual reviews of this plan, this list will be reviewed the periodically in response to changes in species composition of the urban forest, weather events, and availability of new tree species. For more information on this, see the Acceptable Species list in Appendix A.

Manage Tree Removals

For public safety, or to prevent the spread of pests and pathogens, tree removal is an unavoidable part of urban forestry. During the inventory, 448 trees were identified as requiring removal. To keep the visitors to GDVPR properties safe, a tree removal program has been created in this Plan which budgets for the safe removal of these trees over the coming years in order to maintain public safety.

Beginning this year, the trees identified for priority removal during the tree inventory update will be scheduled to be removed. Trees identified as posing risk should be prioritized first. In addition, periodic tree inventory updates will continue to identify trees requiring removal. As mentioned throughout, it is understood that capacity is very limited right now. However, having a prioritized removal schedule is the first step in avoiding liability and increasing public safety.

Cost projections for tree removals have been made based on the number, age, and condition of trees at GDVPR for the next 30 years, so that long term budgeting projections can begin as soon as possible. Also included are ANSI and ISA safety standards, as well as suggested bid specifications to ensure GDVPR is hiring qualified contractors who will be held to the highest industry standards. For more information on GDVPR's proposed tree removal program, turn to section 11.

Increase the Capacity of the GDVPR Urban Forestry Program

As is mentioned later in this goals section, Gary currently has very limited capacity for a variety of reasons, and performing tree work in house, or even contracting it out, can be a difficult process to budget for. To that end, it is proposed, that GDVPR engage in public/private partnerships with a variety of organizations to train its staff on basic arboricultural skills. This training will give Gary's public works and parks staff the basic tools to perform basic tree care when needed, and reduce the need for large amounts of contracted labor while increasing public safety.

Propose an Annual Maintenance Program

Properly maintained trees establish faster, grow quicker, and live much longer lives than trees which are not maintained, or improperly maintained. Since large trees provide the greatest benefits to the community, maintenance is a critical part of the proposed Urban Forestry program in GDVPR. Annual maintenance for trees will include critical tasks such as cyclical pruning of all trees. Though we understand Gary's capacity is very limited at the moment, a program has been created based around needs, and this program can be managed adaptively. There were 339 trees were identified in the inventory as requiring priority pruning, with an additional 82 identified as needing pruning of a dead limb. Our goal will be to prune all 421 of these trees within the first 5 years of this plan's adoption.

As GDVPR begins to increase its capacity for maintenance through in house training, the use of grant funding, and public/private partnerships, these goals will become more achievable as the program gains momentum and benefits of maintenance are realized. For more information on tree pruning and maintenance, turn to sections 13 and 14.

Maintain an Accurate Tree Inventory

Managing an urban forest requires a clear understanding of the existing trees, their ages, conditions, and locations, so that GDVPR crews and contractors can perform maintenance work on these trees. With this concept in mind, GDVPR has taken the important step of obtaining a comprehensive inventory of its managed trees on 22 park properties. All inventories are a snapshot in time, and need to be maintained. The tree inventory should continue to be maintained at a high level of accuracy so that it does not become out of date.

To accomplish this, GDVPR has been supplied with a GIS-based tool which can be used by its employees to manage the tree population from any computer, smartphone, tablet, or other mobile device.

It is planned that as a part of this initiative, several staff members will be trained by a consultant to handle basic updates to the tree inventory, possibly working with some volunteer groups such as the Gary Green Urbanism group in order to keep the information at its most current. This will ensure that all trees are periodically assessed for DBH, risk, and maintenance needs, and that tree removals and new plantings are represented in the inventory. Maintaining tree data at a high level is vital in the execution of this Management Plan.

Proper Mulching of All New Plantings

The urban environment can be a difficult place for a tree to become established and to live a long, healthy life. Proper mulching can significantly increase a tree's ability to do this. Mulch helps to conserve water during the summer months by preventing it from evaporating from the soil. It also helps prevent weeds from growing around the tree and competing for water and nutrients, and keeps lawn equipment such as mowers and weed whips away from the trunk where they can damage the tree. All new plantings will be properly mulched at the time of planting by either the planting contractor, or in house staff as specified. Another outcome of this plan is to educate staff about proper mulching care, and notify them when poor mulching techniques are being used. Of particular concern is the practice known as "Volcano Mulching" which can kill a tree over time. For more information on proper mulching, turn to section 14.

Incorporation of Best Management Practices in Tree Care Operations

"Best Management Practices" is a term which means being on the cutting edge of your industry. All contractors and in house staff working on tree care operations for GDVPR will be in compliance with the latest industry Best Management Practices, based on the appendices in this report. The ANSI and ISA Best Management Practices shall be integral parts of any in-house tree care operations or Request for Proposal (RFP) or bid documents when seeking qualified contractors. Full text of all referenced standards shall be made available to all GDVPR employees and contractors performing tree care operations. Public outreach and education shall be performed by GDVPR, ensuring that stakeholders and community residents understand these practices as well. This UFMP will be placed in the public domain for all to use as a reference.

Creation, Utilization, and Maintenance of a Tree Risk Assessment Policy

Trees create great benefits, but during a storm or other weather event, they may also pose a great risk. Tree limb failure can have catastrophic effect on people or property, and trees need to be well-managed and healthy to avoid that risk. This is particularly pronounced in a park setting as noted above. A risk assessment policy that is not overly burdensome, but maintains public safety while avoiding undue liability, has been created for GDVPR as part of this Plan. This policy will aid in identifying, documenting, and designating for removal or mitigation trees which may pose a threat to public safety in a timely manner. This will reduce the overall level of Risk posed by trees, as well as exposure to liability from tree related incidents by reducing the frequency of those incidents. Basic risk assessment language and parameters are included in this document, and a basic Tree Risk Assessment Policy has been created in Section 16, and assessment forms are available in Appendix F

Increase Urban Tree Canopy from 23.24% to 25%

The tree canopy is important to the community because more trees provide greater benefits such as decreased heating and cooling costs, pollution reduction, and storm water uptake. Tree lined parks are more attractive to homebuyers looking in neighborhoods with parks and green space, which increases home values, home ownership, and tax revenue. All of these factors benefit the community, so we want to increase tree canopy in Gary overall. Currently, Gary has a 23.24% tree canopy coverage overall (public and private land), compared to other land cover types, such as grass, buildings, paved surfaces, and water. That said, there is always room for improvement, but that improvement must be realistic and attainable. This is a goal which will be continually reevaluated over time.

Working with GDVPR as well as private landowners, we believe that a modest increase to 25% canopy cover is a realistic goal. We would like to see a Memorandum of Understanding with other invested entities, so that canopy cover can be increased through joint ventures and grant programs. Currently, the GDVPR tree population provides $130,805 in annual benefits to the community. We aim to demonstrate that this number will be higher with increases in overall Tree Canopy. Studies have show that increases in tree canopy and greenspace have led to reductions in crime, leads to better grades and student learning, and increases health and perception of health, among other things. Trees really do have value beyond just aesthetics and monetary value, and increasing the number of trees directly increases these benefits!

We believe that 25% canopy cover is a realistic goal for Gary by 2050, though with sustained effort, certainly that number could be higher. This will be accomplished by increasing the number of trees on the park properties, as well as improving tree care allowing trees to live longer, become larger, and create more canopy cover. Tree planting on private property will also be encouraged through public-private partnerships with local organizations and businesses. We seek to enhance these plantings even more through partnerships with business owners and other stakeholders. For more information on Urban Tree Canopy, tree benefits, and other such information, turn to section 8.

Create Strategic Partnerships with Granting Organizations

Gary staff and project partners have been forthcoming about the lack of funding that the forestry program will have in the short term. This is due to the amount of capital that Gary is currently using for redevelopment and essential services. While trees are certainly essential in many ways, we understand that there are more pressing goals for the short term. To that end, applying for and receiving grants will be a crucial part of making up this budget shortfall. Limited forestry staff and administrative staff time may be well spent on seeking these grants, and partnering with some of the organizations listed in the Strategic Partnerships section below (Section 14) in order to move these initiatives forward.

Tree Protection and Preservation for Large Scale Construction Projects

There may be times when trees can become damaged by construction activities, costing the City money, and eliminating the benefit the trees had to the community. As is common in many other public organizations, a basic tree survey and assessment should be conducted prior to the onset of construction activities. A tree protection zone should be established and maintained during construction. Finally, tree removal, for trees of a certain size on the approved species list, should require prior approval by the City during site planning. Again, we understand that managing this for smaller residential lots may create an undue burden, so the focus of this program will be for larger construction projects of 1 acre or more. A strategic goal of this Urban Forest Management plan is to preserve quality trees during large-scale construction projects.

Incorporate Natural Areas Stewardship into Tree Care Operations

The GDVPR system is made up of a fair amount of land which is not managed, but instead are wooded, natural areas. The management techniques of these areas can often be vastly different from the rest of the park properties This plan aims to extend its reach into these areas, so that there is a goal aimed at ecological enhancement of these areas, particularly invasive species removal. In addition, Gary has been working with partners such as The Nature Conservancy on restoring some of these sites. Using public private partnerships, it will be possible to clear some of this unmanaged land of invasive species and open the areas up to be usable features of the parks, where residents can safely experience wooded areas. Removing thick brush can make the parks safer by not providing cover for transients and other people who often take advantage of the cover that unmaintained woods provide.

Section 4: Additional / Long Term Goals

There are no strategic timelines set forth here for these programs. As the more crucial goals of the Urban Forestry program in GDVPR are met, these are goals to be discussed by GDVPR and the Gary City Council as time and budgets become available. Nonetheless, we do believe that many of these programs represent some of the most progressive Urban Forestry policies in the current climate, and that they should all be considered for implementation.

Establishment of GDVPR Propagation Nursery

GDVPR can grow a share of its own park trees, using much smaller trees obtained from wholesale nurseries at a fraction of the cost of a full-sized tree. Small trees (“whips”) can be purchased wholesale, and then grown to maturity on GDVPR property. It represents a quality investment that results in significant cost savings over the long term. Trees can be purchased when small, and grown to plantable size (minimum of 1.75” diameter) on city-owned land.

The amount of time required for the care of young trees is minimal, and at an average cost of $250 per tree, GDVPR could save a significant amount of money in their tree nursery planting program. Though this may sound labor intensive, using community volunteers and formal groups such as the Gary Green Urbanism organization, this may be more practical than it may seem. Particularly when taken into account with the abandoned spaces goal below.

Use of Abandoned Spaces for Tree Growing / Planting

During the process of public outreach and public comment for this Management Plan, a concept that came across from the community several times was about using vacant lots or abandoned buildings to be torn down as some sort of green space. This immediately sparked interest in our team, and we believed that this was an idea worthy of consideration. Working in many economically depressed areas of some cities, we are well aware that vacant lots and buildings can be a haven for crime and homelessness. However, these same vacant lots are also usable space for green initiatives such as community gardens, or in this case, spaces for planting trees.

Individual lots could be acquired by the parks department and managed as tree nurseries to grow trees to plantable size, possibly even using local community leaders in that neighborhood to help lead volunteer efforts to maintain those trees until they can be transplanted. Or alternatively, as will be discussed below, vacant lots could be planted with fruit and nut trees, and also tended to by the local community as a source of food and community pride. It could even be imagined that fairly vast network of these small community orchards could become something that serves as a model for other cities to begin to turn their vacant areas into vibrant green spaces the community can be proud of.

Contract Growing Arrangement

One of the keys to a successful Reforestation Plan or Tree Planting Program is the availability of high-quality nursery stock from local sources. A new approved species list has been developed to that end, as well as the tree species that are prohibited on GDVPR property. Having this information is an enormous advantage for GDVPR.

This knowledge, however, does not guarantee the availability of those specific trees when the time arrives to fill a particular site. One way to assure the availability of the stock that GDVPR wants each year is to have trees contract grown by a nursery (or nurseries), and reserved specifically for GDVPR. In this manner, GDVPR will not have to compete with the commercial and residential landscape industries or retailers purchasing trees from wholesale nurseries. Trees are ordered in annual increments, typically following a "fifth year out" model. Each year, GDVPR would purchase the trees previously ordered for that year, and place an order for the "fifth year out". This gives the supplying nursery time to procure, plant, and bring the agreed upon trees to the size and branching habit specified.

Tree Donation Program

GDVPR might consider a Tree Donation program where someone can pay to have a tree planted in a park of their choosing. In addition, they have the option of purchasing a small aluminum plaque which can be hung from a low branch of the tree or mounted to the ground with any inscription they want. These trees are typically planted in memory or in honor of a loved one, or to celebrate a milestone. The Reforestation Plan portion of this project should be used as a guide in determining what the options are for a donation tree that is mutually agreed upon by both the donor and GDVPR.

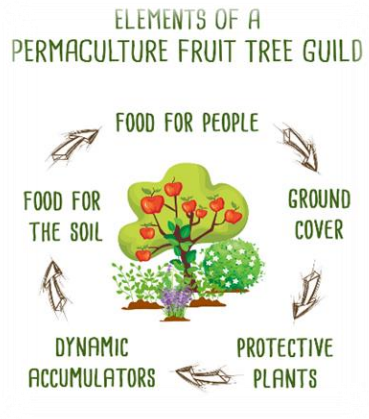
We believe that publicizing and expanding this program when practical would lead to increased tree planting and decreased costs for GDVPR. Species must be approved by GDVPR, to ensure that the species is not too large for the planting site, or otherwise a very poor fit for the site. We must also try to stay in keeping with the diversity standards that we have established earlier in the plan, hence why species selection must be controlled to some degree. We do not want to offer memorial trees of species which are already overrepresented in the tree population.

Private Property Tree Planting Incentive Programs

Tree planting on private property is a strategic outcome of this Urban Forestry Management Plan. Though the city or GDVPR has no formal jurisdiction to plant trees on private property, the benefits of tree planting on private property are substantial in terms of energy savings, storm water benefits, and other benefits. GDVPR should consider incentivizing residents and business owners to plant trees on their property.

Use of Food Forests and Permaculture Guilds in Tree Plantings and Urban Greening

Permaculture is the concept of using communities of plants that all work well ecologically or chemically together to enhance the overall area. This stands in contrast to the view of plants solely from an aesthetic standpoint. These groupings are often referred to as "guilds" and there are several well-established guilds that can be taken advantage of by GDVPR, as well as many more potential guilds that can be experimented with going forward. A simple example of a guild would be planting legumes as a soil stabilizer near fruit trees (instead of mulch) so that the legume provides nitrogen to the fruit tree, increasing its yield and making it healthier overall. This very progressive approach to planting communities of plants and trees vs just standalone plants is a very interesting concept, and one that GDVPR might opt to take advantage of.



A large part of building permaculture guilds is to have food plants as part of the guild in additional to other types of functional plants. We are starting to see an uptick in the planting of Apple, Edible Pear, Peach, and some nut producing species in parks. For a long time, such species were not traditionally planted in parks due to the fruits attracting insects and being relatively messy. However, as society has become more focused on local food production, the popularity of these "food forests" have flourished, and their popularity with residents has overcome their downsides. Parks are now doubling as mini orchards, and the fruit trees have become an attraction. There are clearly some species such as Chestnut which can have hazardous husks and should not be utilized. However, many species of fruit and nut trees are hardy to the NW Indiana area, and will increase overall species diversity, and will make for attraction to the parks.

Though the concept of permaculture and food forests will not work for every park or certainly for every tree planting, there will certainly be areas which can be used as test cases for both of these concepts. Particularly in the abandoned areas mentioned above. Integrating these concepts with community gardens in the parks or abandoned areas is another avenue that could be popular with residents. And as we will discuss below, the use of guilds as it pertains to natural areas becomes important as well, where we are building native communities instead of just installing native plants. This concept of community is a unifying thread in this effort!

Incorporate More Tree Plantings into Natural Areas, Remove Non-Native and Aggressive Trees

The district currently owns and manages approximately 38 acres of their parks where the dominant species are either invasive species (such as European Buckthorn) or very aggressive natives (such as Cottonwood and Black Locust). These area areas which have tremendous potential for enhancement through the removal of these undesirable species, and planting with native grasses, wildflowers, and of course trees. Many times, in native plantings, trees are often ignored in favor of the Indiana native prairie species which are typically planted. However, Indiana is home to many native communities other than prairie, and tree plantings can be a very important part of enhancing these areas.

Native communities such as Oak/Hickory Woodlands, Savanna, Floodplain Forest, and even some wetlands can all be enhanced through the use of native tree plantings. As GDVPR takes to the important task of eliminating these invasive and aggressive trees form their existing natural areas, care should be taken to replant desirable trees in their place. And as mentioned above in the permaculture section, we want to mimic the natural ecosystem in these areas.

Tree planting plans should include diverse canopies, with herbaceous vegetation, understory trees, and canopy trees all incorporated into the planting plan. These diverse native plantings will in turn attract diverse wildlife, including many pollinator species such as bees and butterflies which have been on the decline in recent years.

All of this said, one of the main goals in opening up this 38 acres by removing invasive and aggressive species will be to have more usable space, so overplanting of trees is not necessarily the best option as well. But using the removed material to create woodchipped trails and planting of native forbs, grasses, and trees accomplishes both goals of increasing usable space while also increasing Indiana Native species cover and tree canopy cover.

Use Trees as Wildlife Habitat (Pollinators and Birds)

Evergreen trees have always been a safe haven for birds and owls during all seasons of the year in Indiana, as are standing dead trees ("snags"). In addition, many trees provide fodder for pollinating species such as bees and butterflies. Tree species such as apples, basswood, cherries, black locust, catalpa, horse chestnut, tulip tree, and the willows are all insect pollinated, and will attract beneficial insects. As GDVPR looks to engage residents more, having beneficial wildlife becomes more important. It is also recommended that in a safe manner, certain dead trees be cut back but retained for bird nesting. There would not be opportunities to do this in the parks, but rather in the natural areas that are remote and far enough away from walking paths. These standing snags are often an integral part of native landscaping plans, though they must be monitored to ensure they do not pose a public hazard. The use of things like Bat and Owl boxes to attract these creatures can be done on larger trees.

That said, the goal should also be to attempt to reduce "nuisance" wildlife, such as excess deer, opossums, squirrels, and the like. Though these are certainly native wildlife, they can have a tendency to harm trees and desirable native species, as well as pose health hazard in some cases. The planting in natural areas of deer resistant native species may achieve this goal as well.

Wood Utilization Program

As the UFMP recommendations take effect over time, a considerable amount of material will be generated that may be suitable for use as urban timber. Urban timber is generally defined as saw logs generated from urban tree removal operations. Larger and longer logs are suitable for dimensional lumber production (such as 2x4's, etc.), and smaller material may be used to produce many other products. Forming strategic partnerships with local sawmills, woodworkers, and carpenters would be an important early goal of this program, while creating a market for the finished goods will be an ongoing goal. And of course, the generation of woodchips for mulching new plantings is important as well, however a higher use value for quality wood is always desirable.

Urban timber can be utilized to mill suitable wood into a large variety of products including pallet blanks, shipping material, dimensional lumber, fine furniture, and artisan pieces. In order to successfully upcycle urban timber into usable lumber, several steps must be followed in order to produce logs suitable for milling. Optimum urban timber production will include specifications for tree removal operations that will produce saw logs of the proper dimension and quality. Specifications for the construction of public buildings that require a specified amount of upcycled, local urban timber for either interior or exterior applications may qualify for LEED certification points, and raising awareness of the benefits of the urban forest in general, creating a saleable product that can serve as a revenue stream. A sample Urban Timber Harvesting specification in appendix L.

Section 5 - Strategic Partnerships

Partnerships have become a very effective means of getting important forestry projects funded when tax funding may present a shortfall, or when additional volunteer labor is needed. These typically involve either public-private partnerships, or partnering with other public entities. The following are groups which could be strategic partners of Gary Department of Venues, Parks and Recreation in enacting the goals of this plan.

City Department of Green Urbanism/ Sustainability & Environmental Affairs

The City of Gary's Public Works Department includes a Department of Green Urbanism / Sustainability & Environmental Affairs. Their mission is to protect and improve the health of the environment making it a valuable asset for Gary utilizing environmental services and program activities to advance the City's efforts. The Department welcomes volunteers to assist with Environmental Stewardship Programs. The GDVPR may benefit from drawing on a pool of volunteers that may help complete restoration efforts and the fostering of tree health in Gary's Public Parks.

City of Gary Stormwater Management District

The Gary Storm Water Management District is charged with the responsibility of provid ing the collection, disposal, and drainage of storm and surface water and relieving sanitary sewers of such. The District provides opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a storm water management panel. A partnership between the District and GDVPR could assist in engaging residents to understand the importance of the role of trees in helping to absorb excess stormwater.

The Nature Conservancy

The Nature Conservancy has already been a valuable advocate for GDVPR in assisting the drive for developing a strategic plan for the future of the GDVPR urban forest. Continued partnerships between The Nature Conservancy and GDVPR can help to educate residents and to promote the Conservancy's goals of tackling climate change, protecting land & water, providing food & water sustainability, and building healthy cities. The Nature Conservancy welcomes volunteers that can work with GDVPR and help in the work toward reaching these goals.

U.S. Forest Service

The U.S. Forest Service provides a variety of grant opportunities to entities which foster the health and vita lity of urban forests and natural areas throughout the United States. GDVPR would benefit greatly from additional funding in order to reach the goals set out in this Urban Forestry Management Plan. A partnership with the U.S. Forest Service could also help to create opportunities for teens and young adults to become engaged in educational programs, internships, service projects, and other activities that could help improve GDVPR's urban forest.

NIPSCO

NIPSCO supports environmental restoration and education projects throughout northern Indiana t trough funding from the Environmental Action Grant. Partnering with NIPCO and obtaining a grant could benefit GDVPR in a variety of ways as the grant could be used to fund tree canopy projects, reforestation efforts, woodland restoration projects, or other such endeavors. Additionally, NIPSCO's ecological restoration and conservation efforts is helping improve air quality throughout Northern Indiana which helps to benefit Gary as a whole.

Northwest Indiana Regional Planning Commission

Northwest Indiana Regional Planning Commission provides a forum that enables the citizens of Northwest Indiana to address regional issues relating to transportation, the environment, and economic development. NIRPC can assist GDVPR through advocacy; the identification and framing of issues of concern; the identification of potential funding sources and the pursuit of funding; project planning, plan implementation, programming, and coordination; and direct provision of technical services, data, as well as other resources.

Gary Community School Corporation

A partnership between GDVPR and Gary Community School Corporation would create a first tier opportunity for reaching out to the younger generation to show the importance of trees and green infrastructure in their lives. This is an excellent opportunity to impact young people's view of green infrastructure, and perhaps open up career paths they may otherwise not have realized, as they make important decisions about colleges and vocations. There are tremendous opportunities for local educators to bring staff into classrooms to teach, as well as school staff to bring students out into the field to learn. Trees provide amazing education opportunities in the way of biology, ecology, chemistry, social studies, mathematics, and many other disciplines. Using this to everyone's mutual advantage has the potential to create excellent outcomes for all involved.

The TREE Fund

The TREE Fund is a nonprofit research based organization which supplies grants to students and organizations involved with urban forestry, arboricultural, and other tree and environmentally oriented disciplines. Recently, TREE Fund grants have been given out to municipalities and other public entities seeking to use their data for betterment of the urban forestry community. Partnering with the TREE Fund would represent a leveraged benefit of the work done in GDVPR to date, and allow the staff compensated time to perform the actual science.

CommunitTree Indiana

The CommuniTree program is actually program administered by NIRPC, but one which also has countless private and public sector partners that make the program function. From nurseries, nonprofits, government agencies, and of course members of the community to volunteer their time. CommuniTree already has been a wild success for Gary and Northwest Indiana overall in terms of getting trees planted at minimal cost, as well as building a sense of community among it's members.

Section 6 – Personnel and Production

Below is a representation of personnel, and which tasks each is responsible for. Please note that titles are listed, and not specific staff members. This is to ensure that as staff changes, the positions are listed instead of the exact staff names.

Park Board of Commissioners

The Park Board of Commissioners is the steward of this Urban Forestry Management Plan. As representatives of the residents of GDVPR, the Board is tasked with ensuring the maintenance of the Urban Forest so that all residents can realize its benefits. The Board is composed of elected officials, and is tasked with making informed decisions affecting the Urban Forest. The Board may seek guidance from the Forestry Consultant, City Planner, Executive Director, and use its opinions and independent research to make decisions that other Board members may not have specific knowledge in. The Staff is responsible for annually updating and approving the Urban Forestry Management Plan based on new information and new Board Members. The Board is also responsible for a review of issues associated with public property trees, and perform a more detailed assessment of finances and operations that can be reported back to the Board.

Executive Director
The Executive Director is ultimately responsible for all decision making affecting finance and operations in GDVPR. High level decisions involving the Urban Forest, particularly those with significant expenditures, should involve the Executive Director, though they may be somewhat disconnected form day to day activities.

City Planner
The City Planner is responsible for the final layout of new parks and the trees that come along with it. The Planner works with all of the above positions to determine the Master Planning process, and is responsible for ensuring that new plantings are done with the best interests of the community at large. Must work in coordination with and at times direct all other parties to ensure that the goals laid out in the Plan are met.

Citizen's Advisory Urban Forest Committee
Though this committee does not actively exist at this time, City of Gary Code (Ch 44) allows for its creation ,and it has existed in the past. Based on the fact that this management plan will have many goals which require champions, such a committee would be beneficial to achieving the goals set forth. It is advised that this committee be recreated from local advocates, and involve a majority of citizens from the community, as well as several representatives of GDVPR and the City of Gary, as well as involvement form both the Forestry Consultant as well as Tree Care Contractors. While the Urban Forest Committee will not have direct power to tax and spend, they will advise those in a position to do so through advocacy and community organizing.

Forestry Consultant
The Forestry Consultant is responsible for impartially assessing the tree population as to its various needs on an annual or biannual basis, at the discretion of GDVPR staff. The Forestry Consultant communicates the needs of the trees to the Board and GDVPR staff so that individual needs in terms of tree planting, removal, and maintenance can be performed. The Forestry Consultant may also function as the Park District Arborist on a contractual basis should GDVPR decide it necessary.

Tree Care Contractors
Tree Care Contractors are responsible for performing work identified by the Park Board of Commissioners, Forestry Consultant, City Planner, and Urban Forestry Committee in a timely, safe, and expeditious manner. The Tree Care Contractor should have at least one International Society of Arboriculture Certified Arborist on site when work is being performed, and guide and participate in the performance of Tree Trimming, Pruning, Removal, and Plant Health Care operations. Other operations, such as Tree Planting, Tree Watering, and Tree Mulching do not have to be performed under the direct supervision of a Certified Arborist.

Current Status (2020) of GDVPR Forestry Production

As of this writing, GDVPR has a very limited staff capacity for forestry operations, and no dedicated full time staff. Tree work is performed mostly in a reactive fashion after storm events or tree failures, and larger more hazardous operations are performed by contractors on an as needed basis. While this may seem at first like a disadvantage, it actually provides a clean slate from which to build a forestry operation from the ground up in a sustainable manner, using the inventory data as a baseline for work to be performed, and timelines to complete.

In House Vs Contracted Vs Volunteer Labor

While we do not mean to beleaguer this point, Gary has very limited capacity for forestry operations, and in that sense, at least during the initial phases proposed by this plan, will have to pursue some unique strategies in order to get tree work done. For this reason, a slightly different approach has been taken to this section than our standard language. We have created a table below which shows the various services each of these groups can perform. As can be seen, volunteer labor has the ability to do quite a bit of this work!

Volunteers	**In-House Staff**	**Contractors**
Small Tree Pruning	Medium Tree Pruning	Large Tree Pruning
Tree Planting	Small to Medium Removals	Large Removals
Watering	Tree Inspections	Storm Damage
Mulching	Tree Planting	Training for In-House Staff
Tree Inspections (Limited)	Training Volunteers	Training Volunteers
Community Outreach	Community Outreach	Industry Outreach

Something very important to note here, and we will explore this in more detail later, is that GDVPR's tree population is rapidly going to become younger. Within the first 7 years, according to this plan, 448 generally larger trees will be removed. This represents 19% of the total tree population! During that same time, we anticipate at 100 trees planted per year, that 700 new trees will not only take the place of the 448 removed, but 250 new trees will be planted as well. Given the parks existing age structure, and all of these removals and new plantings, by 2030 it is estimated that nearly half of Gary's trees (45%) in their public parks will be 6" or less in diameter.

6" trees are those which can be effectively cared for by well trained volunteers or stewards, and maintained with only the use of simple hand tools. What this means is that well trained volunteers and stewards can be responsible for a large portion of Gary's tree population, which represents a phenomenal cost savings for the organization. During this time, GDVPR staff and contractors can be working on the remaining 55% of the trees, may of which are in good condition. This will ease the burden tremendously on getting work performed. This will be explored in following sections of the Plan.

We anticipate that In-House staff can be responsible for maintaining trees which are 7-12", and then contracted labor would be responsible for any tree over 12". It is also anticipated, per the table above, that contractors could assist in training In-House staff through a shadowing program of some sort, where non-forestry staff at GDVPR can gain useful forestry skills by working alongside contracted labor and getting some on the job training. The In House staff, in turn, could help pass this knowledge along to volunteers and stewards. This sharing of information represents a progressive approach towards in urban forestry in a community that is challenged by budgets and staff availability.

Section 7 – Environmental Concerns

Outside of their aesthetic value, trees have a great variety of environmental benefits, specifically offsetting climate change by producing a cooling effect in urban heat islands, and flood abatement by absorbing stormwater that otherwise would run off. However, there are also some concerns that City of Gary residents expressed during a survey (appended) about some of the negative effects of trees. We will address these first, followed by some analysis of the climate change and stormwater benefits that trees provide.

Resident Concerns

Tree Pollen and Allergies

While it is certainly true that tree pollen can cause allergic reactions in some people, the fraction of pollen allergies related specifically to trees is fairly small when compared to pollens produced from herbaceous species such as ragweed, goldenrod, and other flowering plants. Several authors of this document are allergy sufferers, and are sympathetic to this cause. That said, it is not advisable to not plant trees specifically due to pollen issues, but rather, there are some common sense steps that can be taken.

First, if you are an allergy sufferer living near one of the parks, and you would like to have species planted that are less allergenic, contact the City and let them know. We can help plan our landscapes better, and in general, the City will try to reduce the number of allergen producing trees it uses if you are active in the planning process. Secondly, make sure to keep up with the pollen counts in the daily weather. Chances are planted trees in the Urban landscape are the least of your worries, and naturally occurring trees in the woods or elsewhere contribute a much greater pollen load, so being aware of pollen counts is important. Finally, plan your time outside. Tree pollen season is short, and the benefits of trees far outweigh this relatively short-lived inconvenience.

Tree Roots Clogging Sewer Lines

This is certainly one of the potential side effects that having trees in an urban setting that gives trees a bad name to some degree. But while trees invading sewer lines does occur from time to time, generally it is the fault of the sewer line being broken to begin with, and not the tree itself! Trees do not "create" holes in sewer lines, rather they find areas where water and sewage (which the tree sees as nutrient) is already leaking, and sends fine roots into those cracks, which develop ionto larger roots over time. In addition, only certain trees in the landscape tend to do this, and for the most part, these are trees which we do not plant anymore such as Silver Maple, Cottonwood, and certain species of Willow. Once again, there are some common sense steps that can be taken to avoid this issue.

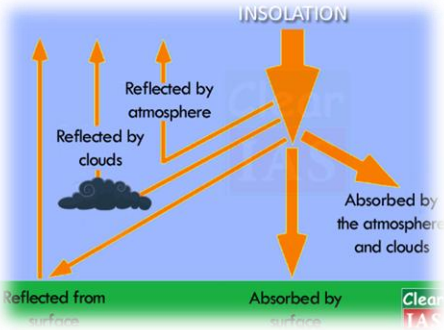
First, like any other part of your home that you maintain, have your sewer lines inspected for cracks and other damage every now and again. Leaky sewer lines are not only an invitation for tree roots to seek out cracks and worsen them, but they are also a source of soil contamination and potentially foul odors. Fixing small issues before they become large issues is a basic homeowner's first line of defense whether it's your roof, mice or ants, or any other potential problem. Secondly, make sure that the trees planted near your sewer lines isn't one of the more aggressive species mentioned above, and if it is, know that routine inspections will need to be more frequent if you are concerned. As mentioned, the City is already specifically not planting trees which interfere with sewer lines. And if a tree is scheduled to be planted at your home, and you know your sewer lines are bad, please request a sewer line friendly tree. Engaging in the process is once again very important. And ultimately, as mentioned above, if tree roots are growing into your sewer lines, it's because the sewer line itself was already compromised.

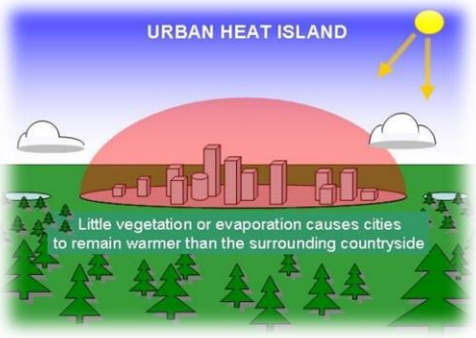
<u>Positive Tree Benefits for the Environment</u>

So now that some of the negative things have been addressed, let's move on to some of the immensely positive benefits that trees provide! Please note, a much more comprehensive analysis of tree benefits can be found in section 8 below. Here, we are focusing very narrowly on 2 topics, those being the climate change and the urban heat island effect, as well as flooding prevention and stormwater benefits, since this was one of the primary focuses of this grant, and also some of the more important benefits trees provide.

Climate Change / Urban Heat Island Mitigation

First, let's define a few terms: **Climate Change** is change in the climate, both human-induced as well as naturally occurring, that disrupts what we perceive to be the normal operation of climate. It should be noted here that climate is different than weather! Weather is the day to day meteorology such as rain on Tuesday and Sunny on Wednesday. Climate is what the long term averages are for an area, such as average June temperatures in the mid 70's with 2-3 inches of rain. The term **Global Warming** has been misapplied many times when speaking about climate change. Yes, increases in Carbon Dioxide emissions lead in general to a warmer climate, which comes with very specific problems. But the climate change we are seeing currently is one of extremes: higher highs, lower lows, more severe storms, etc. The important part is that during this process of change, year to year weather becomes more erratic and unpredictable as the climate changes to generally a warmer one.



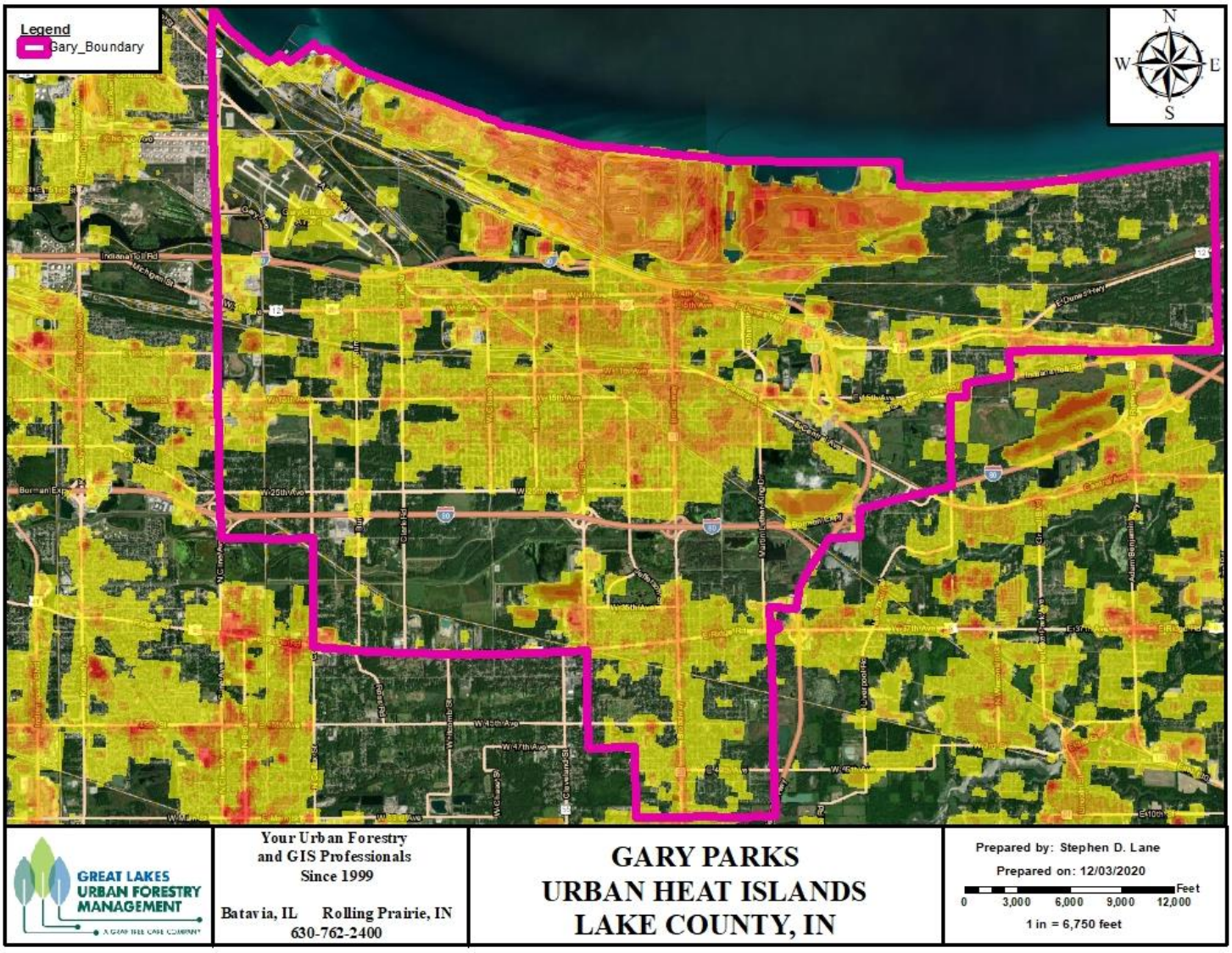


The **Urban Heat Island Effect** is a separate but related issue. Trees and other green plants contain Chlorophyll, a naturally occurring compound which is custom built by nature for absorbing the sun's energy and converting it to sugars by photosynthesis. And what an energy the sun has! The amount of energy from the sun hitting the Earth at any given time is approximately 1,350 Watts per square meter, which is a LOT of energy to absorb! When an area has fewer plants, and a lot of asphalt and other dark surfaces, this produces a lot of heat.

Think about it, if you wear a dark shirt when the sun is shining, you feel hotter than if you were wearing a white shirt. That is because different colors absorb things differently, and light colors reflect light while dark colors absorb it, and absorbing more light leads to more heat. So asphalt and other urban surfaces create local heating above normal atmospheric heating.

All of this is of course just scratching the surface of a set of very complex issues! But essentially, when we have a generally warming climate, combined with this urban heat island effect, it can dramatically raise temperatures in urban areas, leading to a variety of issues. This is where trees become a major factor in making things better! Not only do they absorb Carbon Dioxide from the atmosphere, which helps to reduce the effects of climate change, but especially in urban areas, if we can plant trees over areas of asphalt and dark surfaces, this will keep the sun from hitting those surfaces, and instead direct the sun's energy to photosynthesis in the tree's leaves. The combined effects of these things will lead to reductions in warming.

For the City of Gary, above is a map of some of the urban heat islands areas:

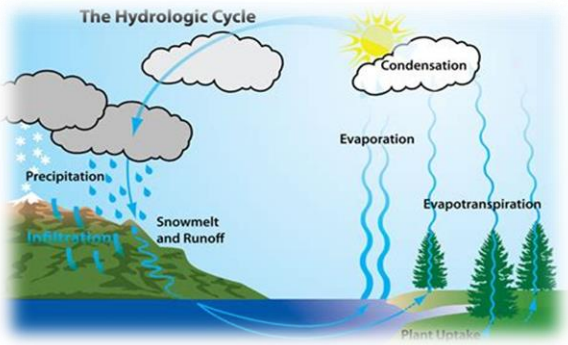


As can be seen from this map, the greatest heat island effects are along the industrial corridor to the north, with significant heat islands in the center of town as well. These are the areas where tree planting will create the greatest cooling effects through increased tree planting. And in fact, when we discuss the reforestation / tree planting plan which was created for the City later in this document, we will revisit this map. As of right now, through this project we have planned the future planting of 550 trees, and this heat island data was used to plant more trees where the heat island effect was worse.

Planting trees not just on City owned property, but also incentivizing residents and business owners to plant trees on their own property is a long term goal of this management plan, and one of the big reasons is to offset the effects of climate change the urban heat island effect. It should also be remembered that the climate is global, and there are no walls that separate cities, states, countries, etc. So when one area warms, it has effects on the whole climate system. Conversely, when an area has more trees and vegetation planted, those benefits do not just stay confined to that area, but benefit the whole planet. Trees are truly an example of acting locally and impacting globally.

Reduction in Flooding / Storm Effects

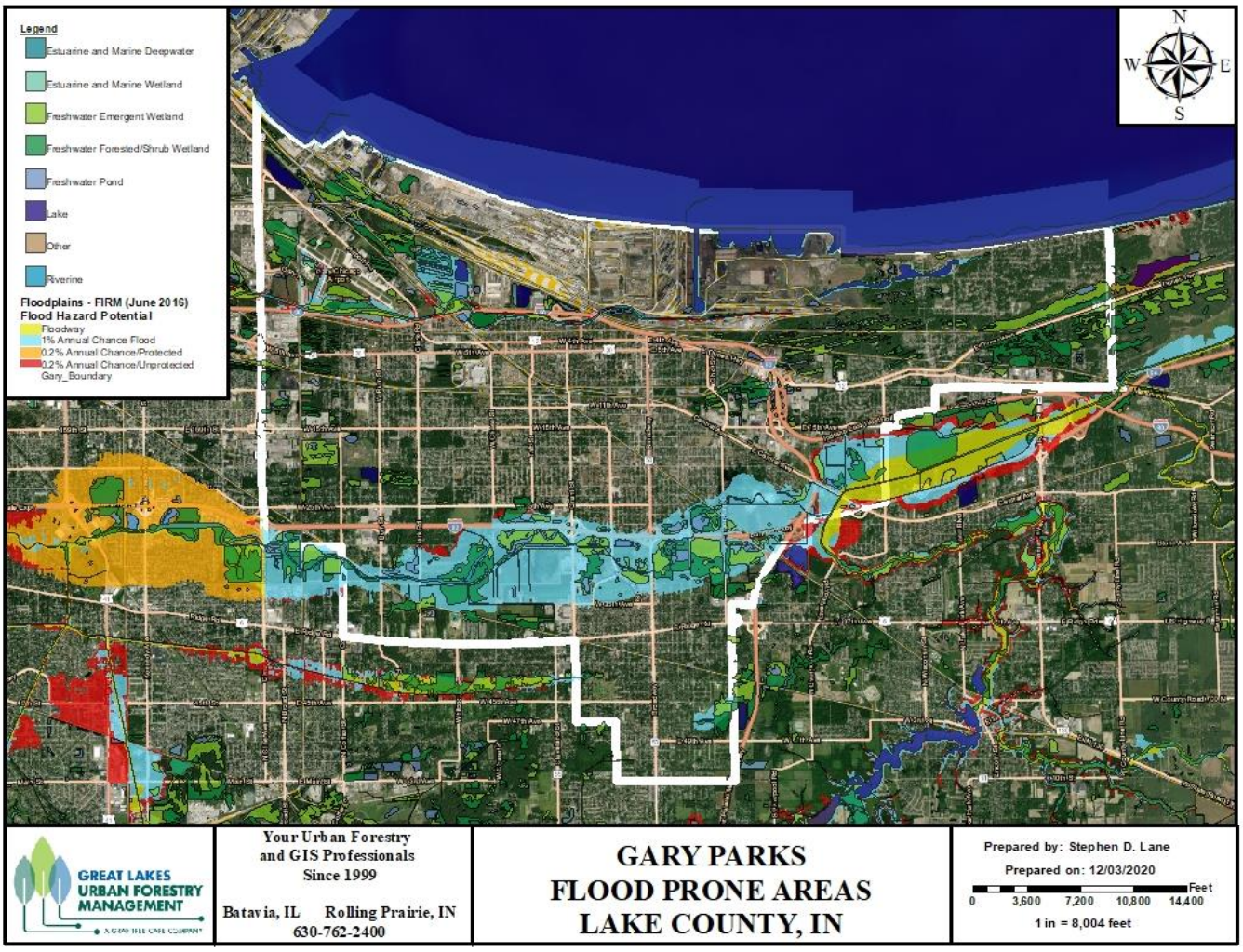
Once again, let's define a few terms here. First, the Earth has what is called a **Hydrologic Cycle**, which is pictured in a simple form to the right. All of the water that has ever existed on Earth was here when the Earth first formed around 5 billion years ago, and has simply been recycled ever since then! Water stored in the oceans and lakes evaporates into the atmosphere where it forms clouds, and then rains down, either into the ocean to start again, or over land, where things get more complicated! When rain falls over land, several different things can happen to it that determine what happens next in the cycle.



If the rain falls onto the soil surface, some of that water **percolates** (yes, like making coffee!) into the soil where it moves as groundwater (water under the soil surface). However, when there is so much rain that the soil becomes saturated like a wet sponge that cannot hold any more water, then any additional rainfall becomes **runoff**, which "runs off" over the top of the land surface. This is what we traditionally call **floodwater**.

When an area floods, the consequences can be enormous in terms of economic impact and the impact to humans and wildlife. And there is another side of this story as well. Most communities have what is called **stormwater infrastructure** to handle this water. Storm drains and are things we all see regularly which are meant to handle this water. But those systems are expensive to maintain, and the more water they handle, the more often they need repair or replacing. So what can we do to reduce this floodwater? Plant more trees!

Trees do something called **transpiration**, which effectively means that their roots soak up excess water in the soil, and they release it through their leaves back to the atmosphere. So the more trees we plant, the greater the reduction in flooding, and the less our stormwater infrastructure is taxed, and the less economic and social suffering there has to be as a result of flooding. On the following page is a map showing flood prone areas in Gary:



What is important to note from the above map is not what the exact colors mean, just know that these colors all show either known wetlands, water bodies, or flood prone areas in Gary, and as can be seen, there are quite a few of them. Tree planting along any of these locations will help to transpire extra water out of the soil and prevent flooding from occurring. In particular, there are trees which are naturally adapted to growing in wetter soils, and these trees can really move a lot of water out of the ground, especially as they age. A mature tree can move as much as 6,500 gallons of water per year out of the system! Multiply that by thousands of trees, and you can see how quickly this adds up to a big difference.

Once again, as part of the reforestation / tree planting plan effort, this flooding data was used to determine where trees would have the greatest impact on stormwater and flooding. And just like climate change is not confined to a single area, neither is stormwater and flooding. Whatever floodwater is not absorbed in one area moves downstream to another area. So by reducing runoff in Gary, it will help all downstream communities. And again, the more communities we can get to take action on this, the more flooding and runoff will be reduced!

Section 4 – State of the Urban Forest

According to the recently conducted Tree Inventory, the tree population stands at 2,367 established trees. We shall examine this in greater detail below, as well as provide a specific plan to change the species composition over time.

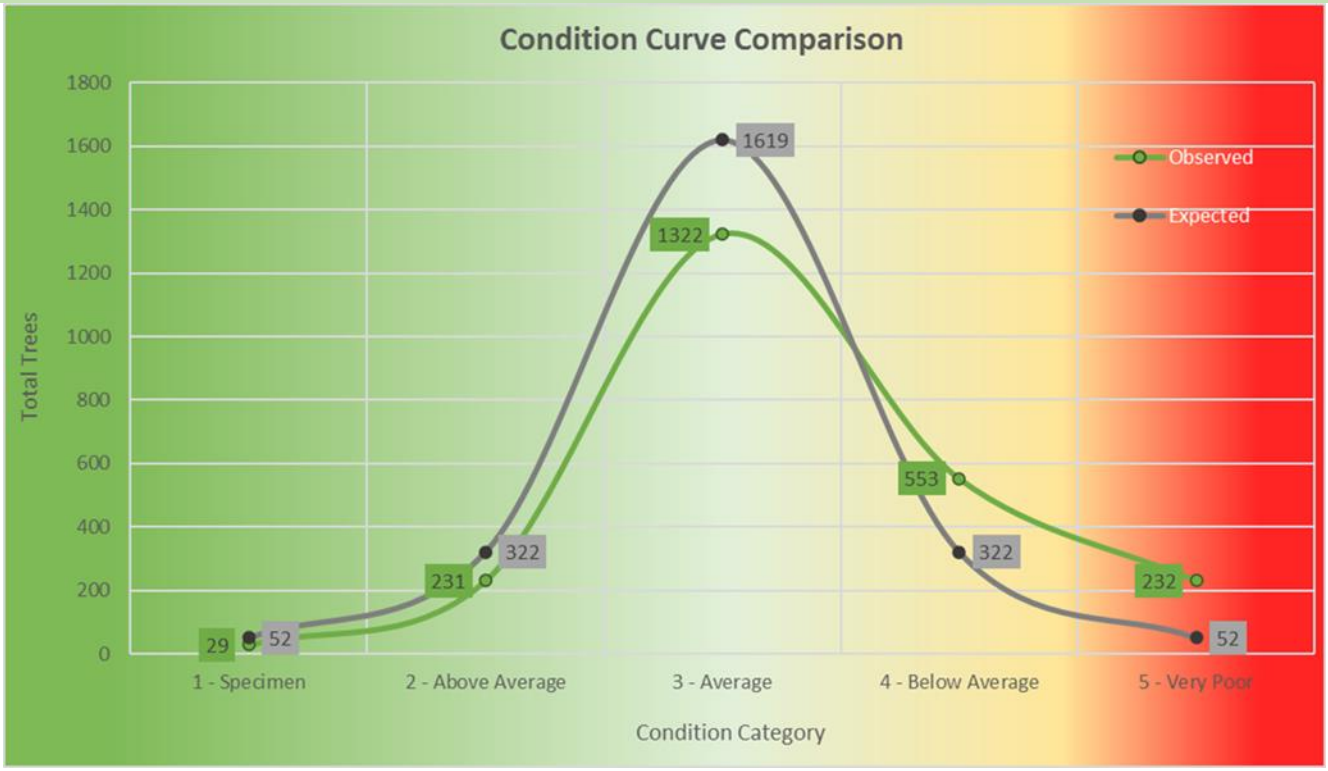
Basic Statistics – GDVPR Trees

Total Number of Trees	2,367
Number of Stumps	83
Total Number of Species	81
Total Diameter Inches	40,178"
Average Tree Diameter	16.97"
Average Tree Height (ft)	30.23
Average Crown Spread (ft)	22.05
Average Crowding (Height to Spread Ratio)	1.37
Total Canopy Volume	37,317,218 cu ft
Average Canopy Volume	15,766 cu ft
Average Tree Condition	3.31 (Well Below Average)
Average Mature (8" and up) Tree Condition	3.33 (Well Below Average)

Condition Curve

During the tree inventory, we rated the condition of each tree using a 1-5 rating system. The rating criteria is as follows:

Condition 1	**Specimen** – Tree has no observable defects, wounds, diseases, and has textbook perfect form for the species. In addition, since young trees have a tendency to be trouble free, a condition 1 tree must by definition be greater than 16" DBH. These are legacy trees, and as such are rare.
Condition 2	**Above Average** – Tree may have a small amount of deadwood, or a very limited number of nonthreatening defects. The overall form of the tree must be good, and consistent for the species in question. These trees must be larger than 8" DBH for the reason listed above. Often the difference between condition 2 and 3 is growth habit.
Condition 3	**Average** – Tree has moderate amounts if deadwood, wounds, or other deficiencies, but is generally healthy. A wide variety of forms is acceptable for this group, which is meant to define the middle ground around which better or worse trees can be defined and identified.
Condition 4	**Below Average** – Tree has defects, deadwood, wounds, disease, etc. that are in imminent danger of causing a need for removal. Very poor form or architecture can put an otherwise healthy tree in this category as well, though generally it is reserved for health defects.
Condition 5	**Very Poor** – Tree must be removed. Physical or Health defects are too far advanced for the tree to be reasonably saved. Like condition 1 trees, these are relatively rare, as generally trees approaching this level are removed before they can get there.



This curve represents the distribution of trees in each of the categories enumerated above. As stated in the collection parameters section, deviations from the expected normal standard distribution can serve as a useful tool in analyzing the overall health of a tree population, and for this reason, we have included a theoretical curve representing a normal distribution so that comparisons can readily be made. The green line with green labels represents what we observed in the field, and the grey line with grey labels is the predicted normal distribution. The condition curve for the GDVPR inventory indicates a tree population that is in overall below average condition.

The Condition 1, or specimen trees, were lower than would be predicted by the standard distribution alone, but we often expect that the specimen trees will come in lower than their statistical norm because of their rarity. A Condition 1 tree, by definition, must be at least 16" DBH (and generally much larger), have textbook perfect architecture for the species, and have no observable defects. Over 44% of GDVPR trees have a DBH less than 16" and are not eligible for the Condition 1 category. As younger trees are planted in sites with adequate growing space, and if they are properly pruned and maintained, they should develop with good structure and may mature to become Condition 2 and eventually Condition 1 trees.

The Condition 2, or above average trees, came in lower than what statistical analysis would predict. Similar to the Condition 1 category, Condition 2 trees need to have good structure that is consistent with the species in question and also be over 8" DBH. Looking toward the future, GDVPR has an opportunity to increase the number of trees in the condition 2 category in their parks. In general, if trees are properly mulched and maintained, newly installed trees are done so correctly and cared for well, and site selection for the trees is well matched to the species, trees will often mature with good form and without significant defects. These trees can eventually become Condition 2 trees.

The Condition 4 trees came in much higher than what would be statistically expected and this is primarily due to a significant number of aging trees which have developed excessive deadwood and/or structural defects. GDVPR can use the data from this inventory to locate Condition 4 trees and prioritize them for maintenance or removal.The 232 trees in the Condition 5 category are dead and some can pose a risk to park staff and patrons. The number of trees in this category far exceeds the expected norm, however GDVPR can use the inventory to prioritize them for removal.

The trees in the condition 3, or average, category are quite a bit lower than the expected norm. The reason for this is simply because trees that would normally be assigned this category are instead in the Condition 4 & 5 categories. As the condition 4 and 5 trees are pruned or removed and replaced, this condition curve will certainly shift more toward average.

Age Class Analysis

This age class analysis chart illustrates a somewhat atypical trend in the overall age spread of a tree population seen in a park district setting. Often, we see many trees being younger to middle aged and a relatively lower number of trees in the older age categories. In GDVPR, although the 6" DBH and smaller is the largest category we see that the middle-aged to mature age classes make up a sizable portion of the population as well. As shown above, 615 of GDVPR's total 2,367 trees (26%) have a DBH of 6" or less which we generally consider to be less than about 15 years old. Most trees grow on average approximately ½" per year, although that figure varies significantly depending on the species in question. Only 11.5% (273 of 2,367) of GDVPR's trees have a DBH of 7-12" which are generally considered to be about 15-25 years old. The 13-18" DBH category makes up 16.5% (391 of 2,367) of the population and is considered to be approximately 25-35 years old. The 486 trees (20.5%) in the 19-24" DBH category are generally mature trees over 35-45 years old.

The 602 remaining trees in the 25"+ DBH categories are about 45-50+ years old. Some of these are still in fair condition, however many are nearing the end of their natural life or already dead. The number of trees in the 30"+ categories are often lower due to the natural senescence and ensuing decline of trees in urban settings, though park district trees are frequently longer lived because they often have more growing space, both above and below ground. A fairly equal number of trees in each age classification is, within reason, desirable and indicative of a consistent focus on tree planting and tree maintenance in GDVPR, and shows that the right trees are being planted in the correct locations. As the younger population matures and moves into the next higher category and new trees are planted replacing older trees, GDVPR continues to have an opportunity, over time, to bring the tree age classes to a more balanced level.

This situation presents management strengths and opportunities. In terms of strengths, we are always seeking to find ways to increase the number of trees in the older age classes, because larger trees provide greater benefits. With sizable population of trees in the middle-aged classes, and with the proper care and adherence to this plan, GDVPR can expect a significant number of trees in the 25" DBH and greater ranges in 20-25 years. Additionally, there is much tree planting work to be done, as is shown in the numbers below, and this will take resources in several different areas. The Tree Planting portion of this plan will account for a large share of the overall 2020-2050 budgeting process.

Maintenance Status

In terms of Arborist Recommendations of maintenance needs in the GDVPR tree population, the statistics displayed above show a positive trend overall. The majority of trees require only Cyclical Pruning on a regular basis, which is an overall desirable trait in a tree population. It is recommended to develop a 7 year pruning cycle, ensuring every tree in the Gary Department of Venues, Parks and Recreation population is pruned every 7 years, which could help to raise some trees to the next condition level. The remaining categories were used to indicate trees in need of maintenance which should be prioritized over those in the Cyclical Prune category and will be discussed briefly below.

The 231 total trees in the "Monitor-Long Term" and "Monitor-Annual" categories can be viewed as being in a transitional phase. For the most part, the tree has an indiscernible defect, or shows signs of developing issues or general decline which must be observed. These trees should be reassessed periodically and their maintenance status updated.

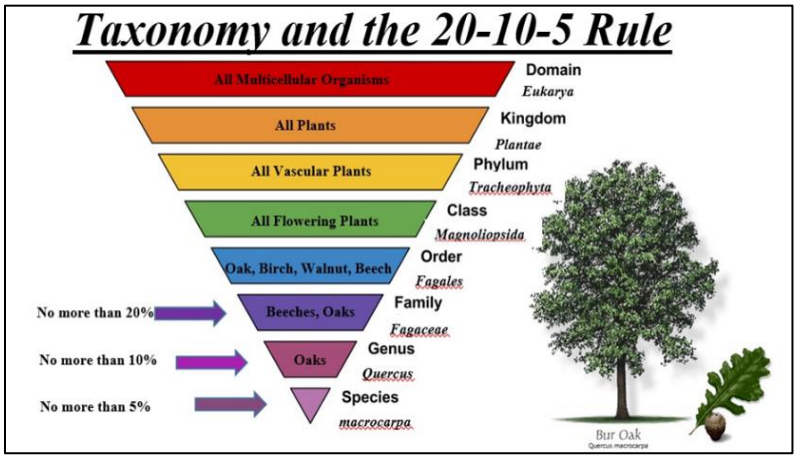
The 339 trees in the "Prune-Priority" group and the 82 trees in the "Prune- Dead Limb" are trees which are simply overgrown, or have parts which need to be removed promptly, and should have pruning prioritized over the trees in the cyclical prune set. Generally, we consider this to be a "within 1-3 years" level of pruning.

181 trees were categorized as "Prune-Train" which are typically trees smaller than 6" DBH and have structural issues or are overgrown and require selective pruning to establish better architecture in the future. Establishment pruning, or the pruning of young trees to establish proper branching habit and structure, is one of the least expensive yet most effective maintenance items that can be performed on a young tree.

The 448 trees in the "Remove" sets include a variety of tree species which have declined or developed structural defects and are beyond the point of salvaging. The 172 trees in the priority removal category should be removed promptly. The 173 standard removals should be prioritized and removed in a timely manner. The 103 low priority removals should be removed as time and budget allow.

The 7 trees which received a "Risk Assessment" status were in a location where they could pose a risk to GDVPR patrons. These are trees which have developed defects and require a more in-depth inspection and analysis to determine GDVPR's risk tolerance threshold and the need for mitigation efforts. It is recommended that a Level 2 Basic Risk Assessment or a Level 3 Advanced Risk Assessment be performed on these trees (per TRAQ or ANSI A300 Pt 9 Standards), or equivalent (ISA Tree Risk BMP methodology, Matheny and Clark, etc).

Diversity Analysis



Taxonomy is the method by which scientists classify plants, animals, and other life forms into distinct categories. A species is unique. There is only one type in that category, such as Burr Oak (*Quercus macrocarpa*), which refers to only one specific type of tree. A genus, however, is a group that may contain multiple species. All Oak trees, for instance, are in the genus *Quercus*. The further down the taxonomic ladder you go, the more similar things become. A graphic illustration of this is given here.

The more similar tree species are to each other, the higher the likelihood that an insect or pathogen is able to exploit every species of that genus. EAB is a classic example of this, as it affected every tree species in the Ash genus. The best prevention of tree loss we have is to limit the number of trees that a new pest or pathogen can affect. While diversity of species is important (such as white oak, red oak, bur oak, and pin oak), it is also important to achieve diversity on the genus and family level, so that Oaks, Hackberries, Hybrid Elm, and a large selection of trees are planted.

A "20-10-5" rule for GDVPR's future tree plantings is recommended, which stipulates no more than 20% of any one family, 10% of any one genus, and 5% of any one species shall be planted during any one planting cycle. It will also be a long-term goal of the forestry program to have the tree population as a whole in compliance with the 20-10-5 Rule, although it may not be possible by the 2050 date we have utilized. This level of taxonomic diversity is consistent with today's arboricultural industry standards (see graphic to right).

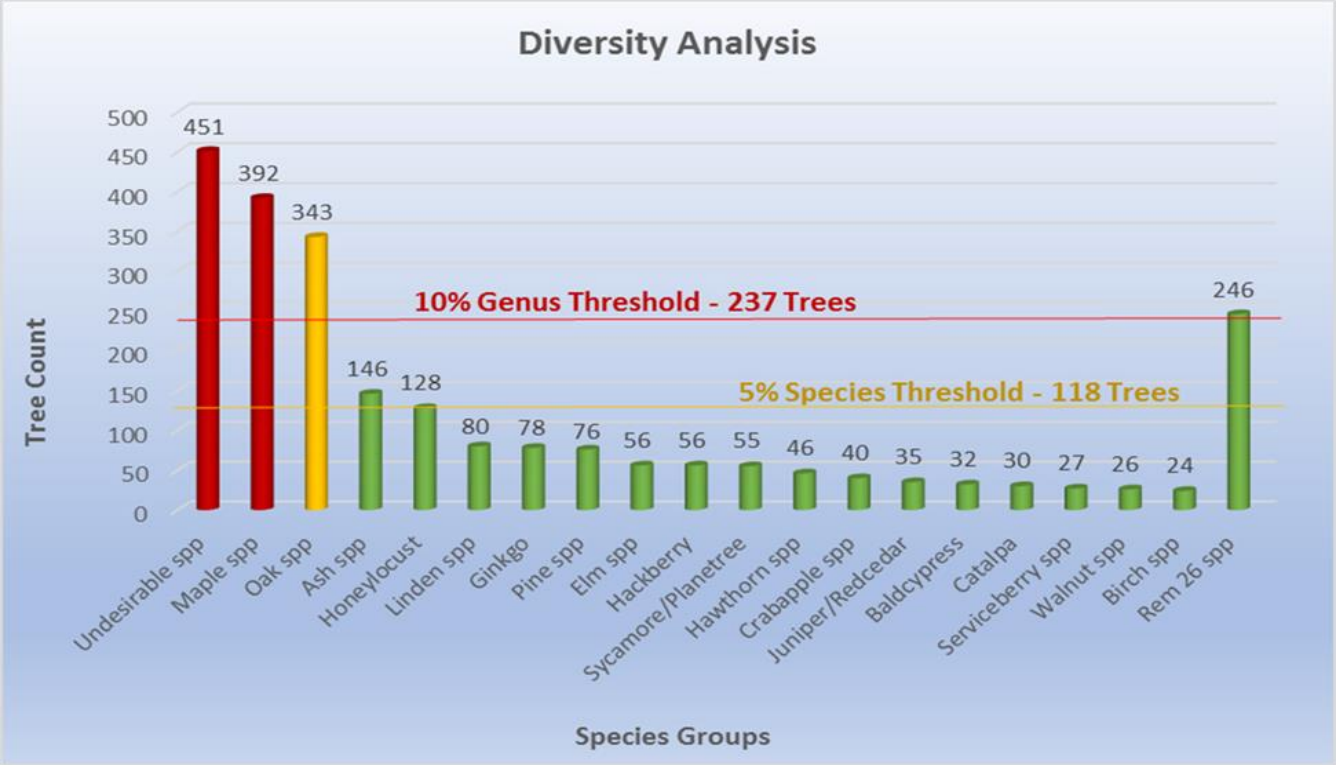
The old paradigm of urban forestry was to create tree lined streets and parks in which every tree was the same type, shape, age, and height. This was thought to produce a symmetrical and uniform appearance. Urban foresters have now learned that once a pest or pathogen is introduced into a monoculture planting such as this, an epicenter of infestation is created that may cause serious damage, both ecologically and financially. Diversity in the urban forest helps to prevent and reduce the impacts of pests and pathogens. There are three aspects of diversity in the urban forest. We will examine these in detail, below.

Current Species Composition – GDVPR

SPECIES	COUNT	% OF TOTAL	AVG DBH	AVG HEIGHT	AVG SPREAD	AVG VOL	AVG COND
MAPLE-SILVER	279	11.79%	28.16	45.81	34.00	35169.56	3.25
OAK-BLACK	178	7.52%	19.03	36.60	26.51	18719.37	3.14
MULBERRY-SPP	151	6.38%	24.21	33.41	28.87	19765.29	3.58
HONEYLOCUST	128	5.41%	21.81	42.19	35.04	40065.08	2.89
ASH-GREEN	125	5.28%	20.78	32.12	25.16	2373.18	4.80
COTTONWOOD	116	4.90%	21.15	36.38	24.09	17830.76	3.37
ELM-SIBERIAN	82	3.46%	19.85	38.35	25.12	16208.47	3.56
GINKGO	78	3.30%	13.50	25.77	15.96	5739.88	3.18
HACKBERRY	56	2.37%	23.32	43.57	32.68	30060.35	2.91
MAPLE-NORWAY	53	2.24%	16.51	31.04	24.25	12949.22	3.32
PINE-AUSTRIAN	52	2.20%	16.87	23.75	18.85	3435.47	4.08
POPLAR-SPP	52	2.20%	6.42	21.15	10.38	1750.96	3.48
LINDEN-AMERICAN	45	1.90%	14.44	23.78	15.47	11162.05	3.18
MAPLE-RED	42	1.77%	14.14	28.81	23.93	13884.44	2.62

APPLE-CRAB SPP	40	1.69%	9.60	15.13	16.20	2218.59	3.43
SYCAMORE	39	1.65%	26.26	45.51	35.13	38011.64	2.54
OAK-RED	37	1.56%	17.97	31.35	22.81	18607.16	3.35
OAK-SWAMP WHITE	36	1.52%	1.36	8.17	3.39	57.21	3.19
LINDEN-LITTLELEAF	33	1.39%	21.97	33.48	27.42	21059.57	2.97
BALDCYPRESS	32	1.35%	19.94	32.50	19.84	15854.07	2.34
OAK-BURR	31	1.31%	2.06	9.84	3.77	174.78	3.19
CATALPA	30	1.27%	18.00	28.00	20.00	9623.24	3.13
HAWTHORN-COCKSPUR	29	1.23%	3.90	8.62	7.07	695.22	3.03
SERVICEBERRY-SPP	27	1.14%	3.63	9.07	6.67	316.43	3.07
ELM-AMERICAN	26	1.10%	23.27	42.31	31.15	25437.57	3.54
WALNUT-BLACK	26	1.10%	7.19	20.19	11.73	4980.72	3.23
AMERICAN REDBUD	23	0.97%	1.39	6.09	4.61	104.54	3.43
BIRCH-RIVER	22	0.93%	16.09	25.00	19.23	23529.59	2.32
OAK-PIN	22	0.93%	16.14	33.86	23.50	22942.79	2.73
TULIPTREE	22	0.93%	3.95	14.09	6.32	2609.67	3.18
ASH-WHITE	21	0.89%	17.76	27.86	25.24	5309.79	4.52
EASTERN REDCEDAR	20	0.84%	2.80	9.85	5.10	333.06	3.00
KENTUCKY COFFEETREE	19	0.80%	3.53	12.63	6.74	2424.60	2.95
PINE-SCOTCH	19	0.80%	15.53	16.11	17.16	1717.38	4.00
AILANTHUS	18	0.76%	14.67	36.67	16.67	5654.89	3.44
CHERRY-SPP	18	0.76%	2.28	12.50	6.39	618.56	3.11
LILAC-TREE	18	0.76%	6.67	15.00	9.72	711.09	3.00
PEAR-CALLERY	18	0.76%	15.33	26.67	20.83	7872.13	3.06
ELM-SPP	17	0.72%	25.53	42.35	29.41	31846.51	3.29
OAK-WHITE	17	0.72%	10.35	24.41	15.71	10360.96	2.76
ARBOR VITAE	16	0.68%	2.13	5.31	3.13	45.40	3.00
BUCKEYE-OHIO	16	0.68%	1.94	8.00	4.69	905.05	3.00
LONDON PLANETREE	16	0.68%	2.81	13.13	6.31	1988.89	3.50
JUNIPER-COMMON	15	0.63%	4.20	14.00	5.00	274.84	3.00
ASPEN-QUAKING	14	0.59%	6.71	22.86	10.71	1633.60	3.21
BLACK LOCUST	14	0.59%	17.07	35.36	20.71	11690.41	3.57
HAWTHORN-SPP	14	0.59%	7.14	10.71	10.36	539.86	3.07
OAK-CHINQUAPIN	14	0.59%	1.36	9.14	3.29	66.41	3.21
ELM-HYBRID	11	0.46%	8.82	18.18	11.27	5854.40	3.09
HICKORY-PECAN	9	0.38%	1.56	7.78	4.11	82.63	3.00
PAWPAW	9	0.38%	1.00	5.00	3.00	10.99	3.44
WILLOW-WEEPING	9	0.38%	38.78	44.44	37.78	51237.56	3.22
MAPLE-AUTUMN BLAZE	8	0.34%	5.38	17.50	10.00	1020.83	3.00
MAPLE-SUGAR	8	0.34%	10.63	25.63	21.88	6932.29	2.75
PEACH	8	0.34%	1.00	5.00	3.00	14.13	3.00
SWEETGUM	8	0.34%	1.00	5.00	3.00	14.13	3.00
UNKNOWN	8	0.34%	19.75	15.63	8.50	3.53	4.50
DOUGLAS FIR	6	0.25%	13.83	35.00	17.50	7067.25	3.50

OAK-SHINGLE	6	0.25%	1.17	7.17	3.00	28.27	3.33
SPRUCE-SPP	6	0.25%	7.67	24.17	7.50	1455.98	3.00
WILLOW-SPP	6	0.25%	12.33	35.83	22.17	13351.61	3.00
DOGWOOD-SPP	5	0.21%	2.00	5.00	3.00	11.31	3.80
PINE-SPP	5	0.21%	4.40	12.00	11.00	887.33	3.20
AMUR CORKTREE	4	0.17%	17.00	28.75	27.50	23547.68	3.00
SPRUCE-BLUE	4	0.17%	13.00	26.25	16.25	5153.20	3.00
AMERICAN HORNBEAM	3	0.13%	2.00	5.00	3.00	35.34	3.00
EUROPEAN HORNBEAM	3	0.13%	1.00	10.00	3.00	40.05	3.33
HAWTHORN-WASHINGTON	3	0.13%	6.00	11.67	6.67	444.98	3.33
SPRUCE-NORWAY	3	0.13%	19.67	36.67	18.33	8605.03	3.00
BIRCH-SPP	2	0.08%	1.00	3.00	3.00	21.20	4.00
CHERRY-BLACK	2	0.08%	27.50	55.00	32.50	36317.81	4.00
ELM-CHINESE	2	0.08%	19.50	50.00	30.00	17668.13	3.50
LINDEN-SILVER	2	0.08%	22.00	50.00	35.00	41029.31	2.00
OAK-SPP	2	0.08%	2.00	6.50	3.00	10.60	4.50
PEAR-EDIBLE	2	0.08%	11.00	20.00	15.00	2826.90	3.00
PLUM-SPP	2	0.08%	5.50	15.00	10.00	932.48	3.50
ASPEN	1	0.04%	3.00	15.00	10.00	785.25	4.00
BOXELDER	1	0.04%	22.00	25.00	20.00	6282.00	3.00
HORSECHESTNUT	1	0.04%	17.00	40.00	25.00	14723.44	2.00
MAPLE-BLACK	1	0.04%	21.00	40.00	30.00	17668.13	2.00
MAPLE-SPP	1	0.04%	12.00	15.00	10.00	0.00	5.00



The following narratives reference the above diversity charts

Taxonomic (Species) Diversity

Why is it important to plant a diverse set of trees at the species, Genus, and Family levels? Simply put, it is to ensure that we will not fall victim to the extreme expenses of mass tree loss from pests and pathogens in the future. The reason Emerald Ash Borer was so devastating for many communities was because their tree populations were over 20% Ash trees. When these trees died and had to be removed, those communities lost 20% of their trees. This comes with the obvious expenses of having to remove these trees and replace them. But it also comes with hidden expenses as well, namely the loss of the ecological services that those trees provided: Homes cost more to heat and cool, storm water infrastructure falls under heavier pressure, and increases in pollutants and greenhouse gases may be observed. For all these reasons, a more diverse group of trees needs to be planted, such that we are never prone to losing more than 5-10% of our trees at any given time. As can be seen above, GDVPR's tree population is moderately diverse.

Oak being overrepresented is not an issue as far as we are concerned. Plantings of additional is still encouraged, as is diversifying the Oaks which are being planted by using less common species such as Chinquapin Oak, Sawtooth Oak, Chestnut Oak, English Oak, and Willow Oak. As Oak is on a general decline the Midwest, planting of Oaks in relatively high numbers is still recommended to offset losses in native Oak stands.

Maples, which are universally overplanted in the Midwest, make up for 16.6% of the overall tree population, which is exceeding the 10% Genus threshold set forth in the "20-10-5" rule. One of the goals of the Diversity Vision will be to begin targeting older and poor condition Maples for removal. That does not mean that no Maples can be planted, either. It just means that few should be planted while a larger number are removed, and the species of Maple being planted should be diversified.

Finally, there are a quite large number of undesirable species in the parks (Mulberry, Cottonwood, Siberian Elm, Ailanthus, Willow spp, Black Cherry, Poplar, and Boxelder). We label these trees as undesirable because they are ecologically threatening, have extremely weak wood or poor architecture, have very messy fruits, or otherwise undesirable in our urban forest. While these trees do trees provide benefits, they generally present more of a liability than they do a benefit. Species such as Cottonwood and Siberian Elm can grow to be 80 feet tall, with extremely weak wood that can fail and cause public safety concerns. Species such as Black Cherry and Mulberry may be native trees, but they are very aggressive, produce messy fruits, and have very poor architecture making them unsightly and potentially hazardous. As illustrated on the chart above, undesirable species make up a sizable portion of the tree population, and there should be a focus of future removal and replacement efforts, for ecological, aesthetic, and safety reasons.

In terms of recommended species for new plantings, we have provided the general guidelines below in the "Future of the Urban Forest" section, but encourage GDVPR to continually evaluate its diversity levels. In terms of strengths, the diversity of the remaining tree population, with the exception of undesirable species and Maples, is acceptable at the moment, and this comes with the benefit that few other species or genera exceed their "20-10-5 Rule" limits, and GDVPR can plant virtually any recommended tree species without concern about exceeding those limits. There is tremendous room for growth in that regard.

When it comes to challenges, they do exist, but they are not insurmountable. The primary concern will be to get GDVPR on a regular cycle of updating the tree inventory and performing maintenance and risk assessments based on that data, favoring a "needs-based" pruning cycle which will help to move the overall condition of the population toward average.

Spatial Diversity

Spatial diversity is the concept of mixing tree species evenly over the whole population to increase distance between potential host organisms. The easiest way to slow the spread of any new pest or pathogen is to increase the distance between potential host trees. Every pest or disease, such as EAB or Dutch Elm Disease (DED), has a limited area to which it can spread in a given time frame. The more difficult it is to get to the next host tree, the less of a problem the pest or pathogen becomes, and the easier quarantining these pests and pathogens becomes.

In addition to the functional benefits provided by increasing spatial diversity, communities and neighborhoods that have implemented diverse planting over the past several decades have demonstrated that such diversity yields an arboretum-like landscape that is both functional and aesthetically pleasing. At present, the Spatial Diversity at GDVPR is satisfactory, particularly given the overabundance of Maple trees in the population.

A robust tree reforestation plan planning phase has already been undertaken and part of this plan. This will ensure that new plantings are designed so that a highly spatially diverse tree population will be created, and the creation of areas of low spatial diversity (monocultures) will be avoided.

Age-Class Diversity

Age-class diversity is also an important consideration. A healthy forest has trees of many ages. Young, intermediate, and mature trees allow for regeneration, replacement, and vigor in the overall forest community. A mixture of tree species, locations, and ages will lead to the greatest diversity, which will insulate the forest against pest and pathogen outbreaks. The urban forest is no different. The outdated urban forestry paradigm promoted even-aged tree plantings, so that all trees were approximately the same size and age. However, once these trees begin to decline, most will require removal and replanting almost simultaneously. This can leave an entire community or neighborhood without shade and aesthetics for nearly a decade.

The current approach of the urban forestry community is to strategically plant trees over a longer timeframe. With this strategy, trees will grow to maturity in different stages, and decline at different times. When the dead trees are eventually removed, there will always be a variety of age classes on a block or in a neighborhood. This reduces the pressure to reforest an area immediately after removal, helping to manage costs and maintain budget cycles. A mixed age-class stand planting ensures that mature trees are always present. It also will allow for strategic planting of trees based on the existing canopy, where shade-tolerant trees can thrive in the understory, for example.

In addition, GDVPR staff should be aware of the concept of average tree lifespan. It is understood that some species of trees simply do not have a long lifespan. Crab Apples, Serviceberries, and Tree Lilacs (most of the smaller ornamentals) are examples of these trees, and this must be taken into account with a long term reforestation plan. Oaks and Hickories with lifespans of 100 years or more should not be taken into consideration on the same timeframes as these smaller ornamentals. That said, in our long term reforestation plan, we have decided to accept these lifespan issues at face value, and have not increased the total volume of planting shorter lived trees vs longer lived trees. It is understood that these trees will require replacement on a shorter scale, and the overall goal is to plant fewer of these trees in favor of larger and longer-lived species.

An additional benefit of mixed-age plantings is the ability to plant shade-loving trees as well as sun-loving trees. When a park is newly planted with trees of the same age, all the trees are essentially in full sun. This precludes the ability to plant shade loving trees, as they have a tendency to dry out in the summer sun. With mixed-age stands, shade-tolerant, medium height trees may be planted underneath the canopy of larger, mature trees. This concept of a layered tree canopy is particularly important on park properties since there is a relatively finite amount of space where trees can be planted. This calculated approach will be utilized for future tree removal and replacement, and help to create a more “staggered” urban forest, one that has mature trees, middle aged trees, and young trees in similar quantities.

Reforestation Planning Results

The reforestation planning aspect will be explored later in this Plan, but here were the preliminary results of the number of and specific species to be planted in the 550 sites the GLUFM assessed. At approximately 100 trees per year planted, it is anticipated that this group of species should all be installed by 2027. Again, this will be discussed further later in the Plan.

This is a highly diverse selection of trees mostly native to Indiana and the Midwest, with a few other species mixed in due to their urban tolerance and suitability to these sites. Please note that non-native species are a perfectly acceptable part of the built environment, so long as they are not planted where they could impact specifically designed natural areas, such as next to nature preserves or forests.

RECOMMENDED SPECIES	COUNT	RECOMMENDED SPECIES	COUNT	RECOMMENDED SPECIES	COUNT
Kentucky Coffeetree	45	Spruce, Norway	15	Oak, Shingle	6
Oak, Swamp White	41	Douglas Fir	13	Oak, Black	5
Hackberry, Common	34	Magnolia, Saucer	13	Hornbeam, American	4
Elm, Hybrid (Smaller)	29	Lilac, Japanese Ivory Silk	12	Pawpaw	3
Catalpa	28	Buckeye, Ohio (Standard)	9	Buckeye, Red	3
Elm, Hybrid (Larger)	28	Oak,Chinquapin	9	Dogwood, Cornelian	3
Baldcypress	25	Ironwood	8	Hawthorn, Winterking	3
Sweetgum	25	Buckeye, Yellow	7	Hickory, Pecan	3
Ginkgo (Standard)	22	Larch	7	Oak, English (Columnar)	3
Tuliptree	21	Persian Ironwood	7	Alder, Black/Speckled	2
Linden, Redmond	19	Zelkova	7	Oak, White	2
Linden, Greenspire	17	Blackgum	6	Beech, European (Riversii)	1
London Planetree	17	Dawn Redwood	6	Dogwood, Pagoda	1
Oak, Burr	15	Apple	6	Hackberry, Sugar	1
Oak, Red	15	Katsura	6	Serviceberry	1

iTree Streets Analysis Results

Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	24,058	(N/A)	10.16	(N/A)	0.32	(N/A)
CO2	2,762	(N/A)	1.17	(N/A)	0.04	(N/A)
Air Quality	6,195	(N/A)	2.62	(N/A)	0.08	(N/A)
Stormwater	59,998	(N/A)	25.35	(N/A)	0.80	(N/A)
Aesthetic/Other	24,262	(N/A)	10.25	(N/A)	0.32	(N/A)
Total Benefits	117,275	(N/A)	49.55	(N/A)	1.56	(N/A)

Total Standing Value of GDVPR Trees (Per 9th Guide to Plant Appraisal)

$3,428,546

iTree Eco Analysis Results – Full Tree Population Benefits

- Number of trees: 2,367
- Tree Cover: 30.28 acres
- Most common species of trees: Silver maple, Black oak, mulberry spp
- Percentage of trees less than 6" (15.2 cm) diameter: 26.0%
- Pollution Removal: 1325 pounds/year ($5.39 thousand/year)
- Carbon Storage: 2.432 thousand tons ($415 thousand)
- Carbon Sequestration: 26.46 tons ($4.51 thousand/year)
- Oxygen Production: 70.56 tons/year
- Avoided Runoff: 54.35 thousand cubic feet/year ($3.63 thousand/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Structural values: $10.2 million

Summary of iTree Streets and Eco Values:

Annual Benefits	
Benefits to Residents	$117,275
Benefits to Environment	$13,530
Total	$130,805
Standing Values	
As a Commodity	$3,428,546
As an Ecological Resource	$10,615,000
Total	$14,043,546

As can be seen from the above tables, the tree population of GDVPR currently provides approximately $130,805 in benefits every year, directly related to trees and their effective facilities, neighboring homes, businesses, and the environment. In additional, the value as a commodity and an ecological resource of the tree population is $14,043,546.

These benefits are measured as the Ecological Services these trees provide to Gary residents and the environment. These benefits can be viewed as income to Gary's residents, and so long as the trees are maintained, they will continue to provide these benefits, and more. As trees grow, they also increase their benefits. For example, a 3" diameter tree provides $7/year in benefits, whereas as 20" diameter tree can provide over $500 per year. The goal is to increase benefits of the tree population even more, to a point where the tree population even yields "profits" in terms of ecological services.

The replacement value of trees was also calculated. Currently, the standing value of all trees in GDVPR's tree population is $3,428,546. This value is calculated using the industry standard reference, the *9th Edition Guide to Tree and Landscape Appraisal*, which is published by the Council of Tree and Landscape Appraisers.

The iTree Eco data takes into account the value of the trees in the absence of effects on buildings, and looks at trees from an ecological perspective, mostly what the tree's value is in sequestering and storing Carbon as a resource. These numbers are based on peer reviewed science in both Arboriculture as well as Climatology and other disciplines. The goal in this Urban Forestry Management Plan is to create a tree population which maximizes these ecological services by increasing the number of trees on GDVPR properties, and how long they live, while minimizing costs in order to create a healthy, well maintained, and beneficial tree population.

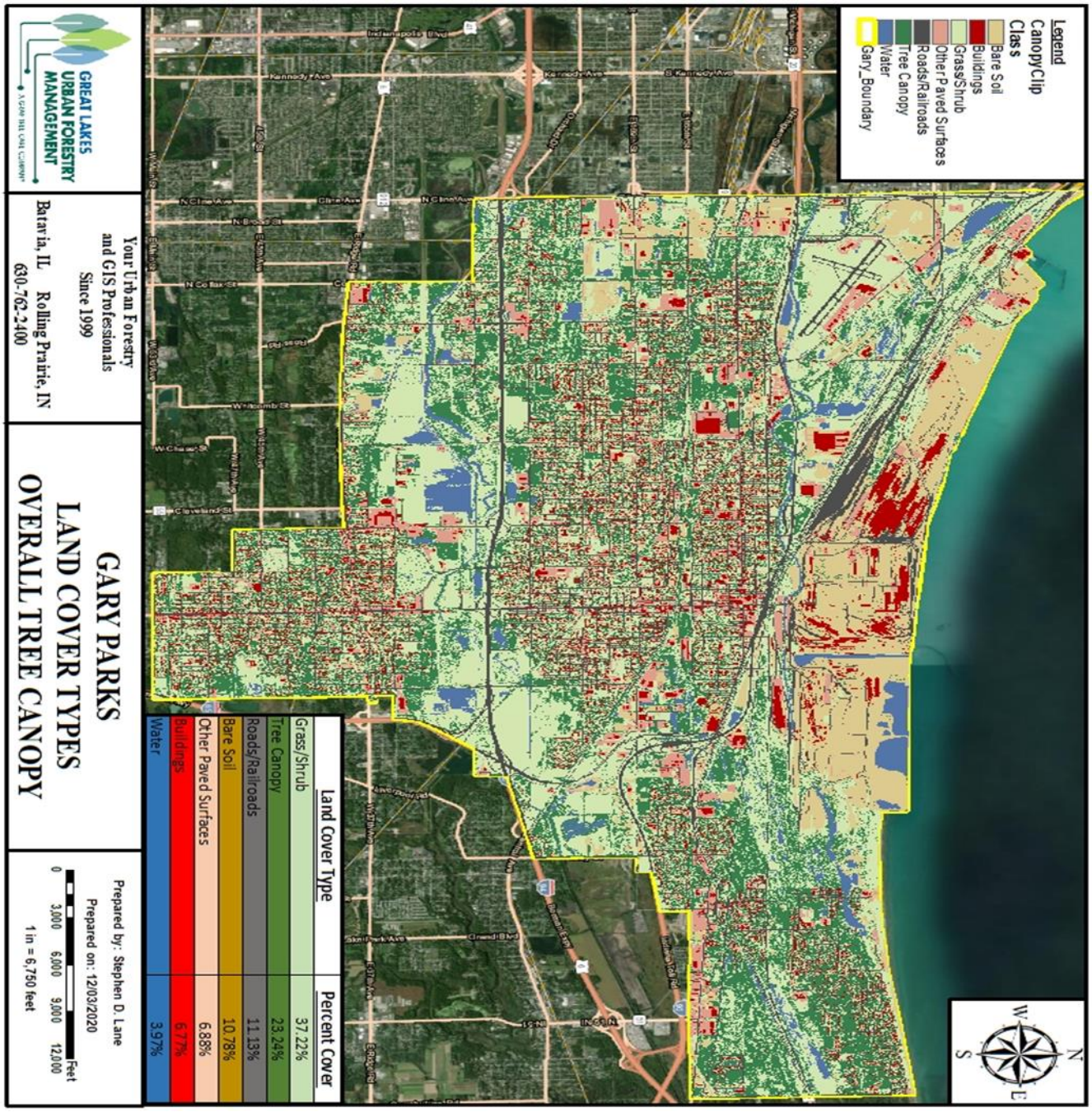
Urban Tree Canopy Assessment

Based on data from the US Forest Service and Morton Arboretum, a determination was made as to what the total Urban Tree Canopy of GDVPR is. This is expressed as the percent of GDVPR covered by tree canopy, from an aerial assessment. This assessment included 6 additional land cover types, including grass and shrub, bare soil, water, buildings, roads and railroads, and other miscellaneous paved surfaces. The result of this tree canopy assessment was that GDVPR contains 23.24% total tree canopy. The map of the canopy assessment appears on the following page.

The tree inventory itself was only conducted in GDVPR property. Detailed tree information was not recorded for trees on any other property types. However, this Urban Tree Canopy Assessment does in fact include canopy cover on private property. Aerial images were used to estimate how much tree and other land cover types were in the park district using data available from the US Forest Service working with the Chicago Region Trees Initiative (CRTI).

The goal is to increase and maintain the total tree canopy at GDVPR to 25% by 2050, working in partnership with NGO's as well as local business owners, schools, and other stakeholders. This goal has been estimated by analyzing data from many different urban tree populations in the Chicago and Northwest Indiana regions, and is based on preliminary data from the Chicago Region Trees Initiative's (CRTI) Forest Composition Workgroup. With such a high canopy cover percentage in the first place, we believe that maintaining canopy, with only slight growth, is a reasonable and attainable goal. Please remember that once this goal is achieved, it can be set higher! The goal is to succeed at a more modest goal first, and then set a higher goal based on that initial success.

This will ensure that existing trees will live longer and provide greater benefits. Tree planting and maintenance will also be encouraged on private property, by incentivizing residents and business owners to plant trees through public private partnerships, as well as attempting to provide outreach and education to residents through events such as Arbor Day and Earth Day celebrations. This goal will be monitored by using aerial imagery analysis. Every 5 to 10 years, the imagery will be reassessed, and a new canopy cover percentage will be calculated for Gary.



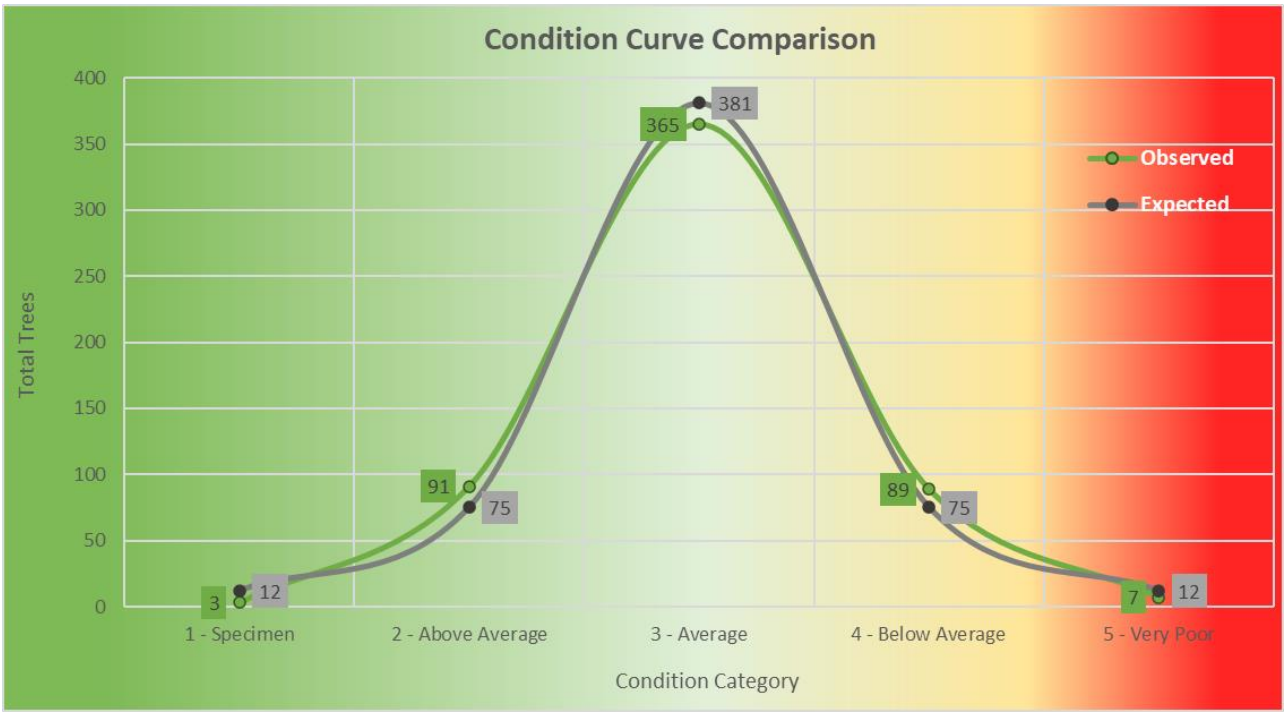
Section 9 – Indiana University Northwest Campus Trees

A special section has been created here for an inventory which was conducted for the Indiana University Northwest campus. This was a collaborative effort between IUN staff, students, The Nature Conservancy, and the IUN Office of Sustainability. Specifically, we would like to acknowledge Erin Argyilan PhD (Professor of Geosciences), and IUN interns Ben Macuga and Chris Smith for their efforts in assisting with data collection and tree locating.

Base Statics

Total Number of Trees Located	920
Total Number of Trees Assessed	555*
Assessment %	60.33%
Total Number of Species	62*
Total Diameter Inches	4,436"*
Average Tree Diameter	7.99"*
Average Tree Height (ft)	18.77
Average Crown Spread (ft)	13.36
Average Crowding (Height to Spread Ratio)	1.40
Total Canopy Volume (cubic feet)	2,222,933.60
Average Canopy Volume (cubic feet)	4,005.29
Average Tree Condition	3.01 (Average)
Average Mature (8" and up) Tree Condition	2.83 (Well Above Average)

IUN Students used a handheld, submeter accuracy GPS unit to locate 920 trees and large shrubs throughout the campus as part of an ongoing Environmental Sciences course they are taking. Great Lakes staff then went into the field and performed the arboricultural assessments on approximately 60% of those trees, leaving the remaining 40% for the students to assess as part of their coursework. This type of educational outreach really embodies the spirit of this management plan, and also provides and avenue for students to get directly involved with arboriculture and some professions that rely on science in the green industry. Their data was used to prepare the following charts.

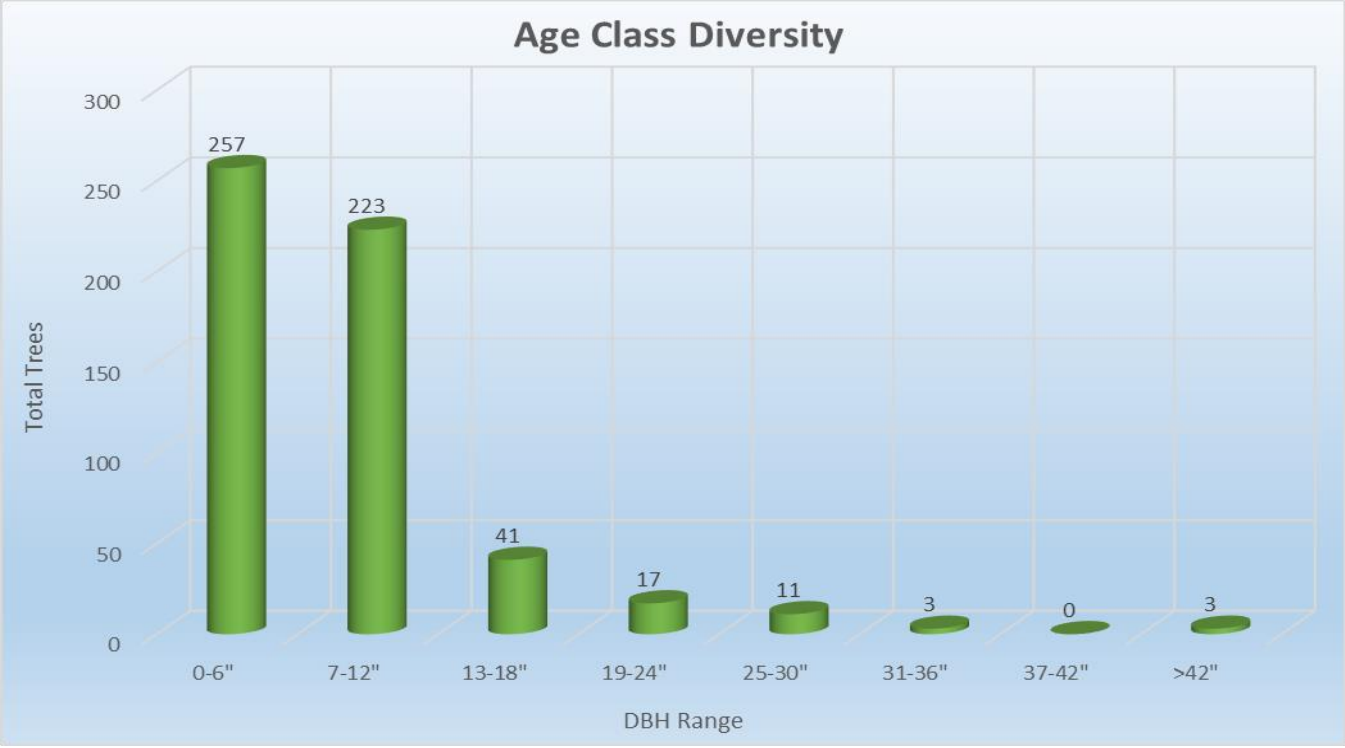


Overall, the trees at the IUN campus were in well above average condition. The number of above average trees was higher than predicted, as was the number of below average trees. However, there were more above average than below average, hence the overall better than average condition rating.

The number of average trees was actually lower than would be expected, which is interesting. Typically we see the number of trees in the "average" category skew higher due to the fact that trees smaller than 8" generally wind up in this category if they are in decent condition (see condition rating table above). However, because the trees at the IUN campus are for the most part mature trees larger than 8", this generally caused there to be fewer trees in the average status than normal. This conclusion is also borne out in the following DBH chart.

In terms of the specimen and very poor condition trees, the very poor condition trees were above the expected norm. This was primarily due to drought stress on several evergreens on site, as well as the loss of several newly planted trees which simply did not survive their first season. This elevated number is statistically insignificant overall. The number of specimen trees was below the expected norm. Mostly this was due to the 16" diameter size requirement we use as a threshold for being rated as specimen. As these trees continue to age and grow in size, we expect even more trees to move into this category.

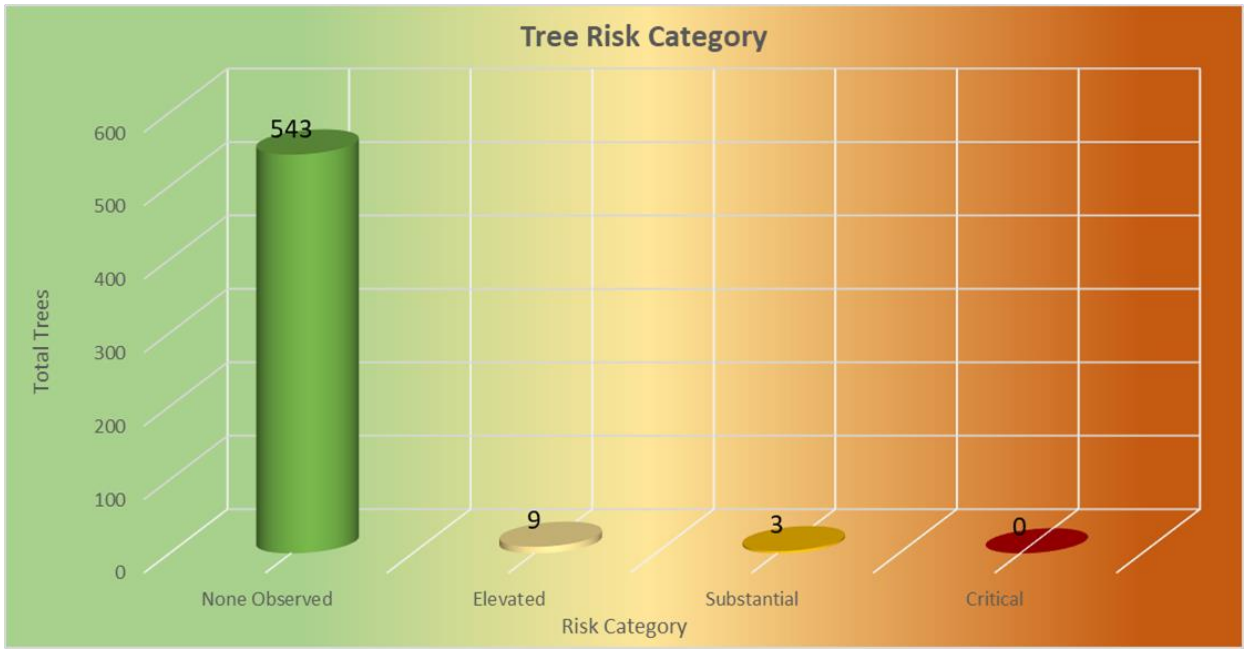
Overall, this curve is indicative of a high standard of care, and a tree population which will only continue to improve in condition as trees grow and become eligible to move into higher condition rating categories.



As mentioned above, the larger sizes of many trees at the IUN campus allowed them to move into different categories than "average". While this chart does not show a majority of larger trees, it does show that quite a few are above 8", which is when they become eligible for higher condition status. And by and large, because of the level of care they are receiving, they do in fact make that transition readily. Please note that as a 60% sample, this chart is somewhat skewed. There was a large population of London Planetrees, assorted evergreens, and other random trees which are not represented here due to not having been evaluated by the consultant's staff. We always look for gradual decline in numbers of trees with increasing diameter, and the reality for the entire campus is that transition is more gradual than what appears here.

When it comes to the maintenance recommendations given to each tree by the consultant, this chart displays a very positive trend. 394 out of the 555 trees surveyed (71%) simply required a standard cycle pruning on a regular schedule. And additional 68 trees (12%) simply required a training pruning. This means that 83% of the trees have no special maintenance requirements to speak of.

Of the remaining 17%, the majority of trees (51, or 9%) required only annual or long term monitoring. As noted above, monitoring typically means the tree didn't fall into any other category, and was in a state of change, and so we place it in this category when a final determination cannot be made yet as to whether to (e.g.) prune a defect or possibly removal a tree. The final 8% were a mix of priority and dead limb pruning, various priority levels of removal, and in several cases, cabling or bracing was recommended for trees with some structural issues (3 total trees). All things told, this is once again indicative of a high standard of care.

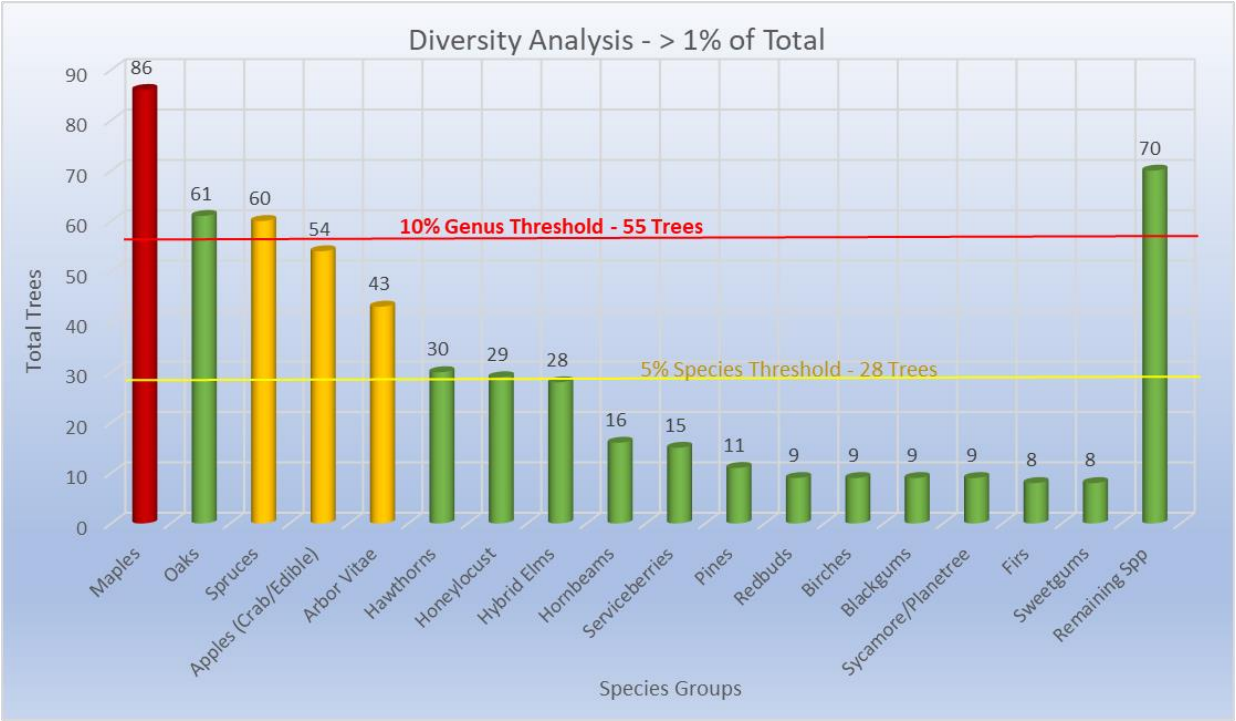


When it comes to managing the risk posed by trees, we have a clearly delineated process known as TRAQ (Tree Risk Assessment Qualification). We will examine this in more detail later in the plan when we look at risk management. The takeaway message for the IUN trees here is simple, these trees pose very little risk overall. The "elevated" category is generally still very low risk, and it is not until the Substantial or Critical ratings that trees need a more formal Risk Assessment than the time we were afforded with each tree would allow for. Only 3 trees on campus might be considered for additional risk assessments using more thorough documentation and methodology. This may actually make an interesting exercise for students to learn more advanced techniques for tree risk and stability assessments.

Tree Diversity

SPECIES	COUNT	% OF TOTAL	AVG DBH	AVG CONDITION	AVG HEIGHT	AVG SPREAD	AVG CANOPY VOL.
APPLE-CRAB SPP	53	9.55%	7.34	3.04	14.43	14.08	1594.74
ARBOR VITAE	43	7.75%	3.88	3.33	14.07	5.63	455.96
HONEYLOCUST	29	5.23%	10.55	3.14	24.48	19.07	7252.46
ELM-HYBRID	28	5.05%	8.86	2.96	20.89	14.82	3207.61
OAK-RED	27	4.86%	7.22	2.63	21.48	15.00	3399.11
MAPLE-SUGAR	26	4.68%	9.62	2.73	21.35	16.35	5296.66
HAWTHORN-SPP	24	4.32%	7.25	2.83	15.00	17.29	2642.04
SPRUCE-BLUE	24	4.32%	9.79	3.42	26.88	13.96	4424.39
MAPLE-AUTUMN BLAZE	23	4.14%	10.04	2.96	29.57	18.48	6416.00
SPRUCE-NORWAY	21	3.78%	7.10	2.67	22.38	11.90	3085.85
MAPLE-RED	17	3.06%	11.29	3.12	22.06	16.76	4030.18
AMERICAN HORNBEAM	16	2.88%	3.94	2.88	9.38	8.31	1573.74
OAK-CHINQUAPIN	15	2.70%	2.79	3.00	11.67	5.20	528.42
SERVICEBERRY-SPP	15	2.70%	6.27	3.13	8.87	7.73	295.62
SPRUCE-SPP	15	2.70%	5.60	2.93	18.33	11.00	2392.40
MAPLE-SILVER	13	2.34%	30.77	3.54	40.77	30.77	23414.04
UNKNOWN	10	1.80%	7.00	3.20	20.50	17.50	4422.92
AMERICAN REDBUD	9	1.62%	4.67	2.89	9.22	9.00	581.96
BLACKGUM	9	1.62%	5.33	2.89	16.11	12.56	1814.36
FIR-CONCOLOR	8	1.44%	9.63	2.63	25.00	11.88	2944.69
SWEETGUM	8	1.44%	18.63	2.75	38.13	27.50	19054.58
BIRCH-RIVER	7	1.26%	4.29	3.00	14.29	9.14	5469.04
CHERRY-SPP	6	1.08%	6.00	3.00	10.83	8.33	451.52
MAPLE-NORWAY	6	1.08%	13.00	2.83	25.83	22.50	7230.84
BALDCYPRESS	5	0.90%	6.00	2.60	18.20	13.20	4657.16
GINKGO	5	0.90%	5.00	3.40	15.00	10.00	1060.09
HAWTHORN-COCKSPUR	5	0.90%	11.40	3.20	17.00	20.00	3710.31
SYCAMORE	5	0.90%	1.40	3.40	6.60	3.40	51.51
BUCKEYE-RED	4	0.72%	1.00	3.00	3.00	3.00	21.20
DOGWOOD-SPP	4	0.72%	6.00	3.25	11.25	11.25	692.00
LONDON PLANETREE	4	0.72%	1.75	3.75	10.00	4.50	130.16
OAK-BURR	4	0.72%	1.25	3.00	6.25	3.50	44.96
OAK-PIN	4	0.72%	20.75	2.75	43.75	33.75	39728.74
OAK-SWAMP WHITE	4	0.72%	2.75	3.00	11.25	6.00	678.46
PINE-AUSTRIAN	4	0.72%	12.75	3.00	22.50	15.00	3091.92

PINE-WHITE	4	0.72%	19.25	2.25	42.50	21.25	14198.30
HICKORY-PECAN	3	0.54%	1.00	3.00	5.00	3.00	14.13
LINDEN-AMERICAN	3	0.54%	1.00	3.33	10.00	3.67	78.79
LINDEN-LITTLELEAF	3	0.54%	5.33	3.00	15.00	7.67	945.70
MAGNOLIA-SPP	3	0.54%	1.67	3.33	4.33	3.00	30.62
OAK-SHINGLE	3	0.54%	1.00	3.33	6.67	5.00	91.61
OAK-WHITE	3	0.54%	3.00	3.00	10.00	5.33	271.17
PERSIMMON	3	0.54%	1.00	3.00	5.00	3.67	22.51
PINE-RED	3	0.54%	18.67	3.00	26.67	15.00	2944.69
TULIPTREE	3	0.54%	1.67	3.33	8.33	4.33	70.15
BIRCH-YELLOW	2	0.36%	1.00	3.00	10.00	3.00	49.47
BUCKEYE-OHIO	2	0.36%	3.50	3.00	10.00	6.50	410.29
COTTONWOOD	2	0.36%	40.00	3.00	50.00	45.00	40244.06
EASTERN REDCEDAR	2	0.36%	4.00	3.00	15.00	5.00	294.47
KENTUCKY COFFEETREE	2	0.36%	6.50	2.50	25.00	16.50	12385.36
LILAC-TREE	2	0.36%	5.00	3.00	10.00	7.50	245.39
PEAR-CALLERY	2	0.36%	9.00	3.00	15.00	15.00	2522.62
APPLE-EDIBLE	1	0.18%	12.00	2.00	15.00	15.00	1766.81
BEECH-AMERICAN	1	0.18%	9.00	2.00	20.00	20.00	4711.50
BEECH-SPP	1	0.18%	9.00	2.00	15.00	20.00	4711.50
CATALPA	1	0.18%	1.00	3.00	10.00	3.00	35.34
HACKBERRY	1	0.18%	15.00	2.00	30.00	30.00	14134.50
HAWTHORN-GREEN	1	0.18%	3.00	3.00	10.00	5.00	137.42
HEMLOCK-EASTERN	1	0.18%	5.00	5.00	10.00	10.00	785.25
MAPLE-JAPANESE	1	0.18%	1.00	3.00	10.00	5.00	196.31
OAK-SHUMARD	1	0.18%	1.00	3.00	5.00	3.00	14.13
PEAR-EDIBLE	1	0.18%	9.00	3.00	15.00	10.00	785.25



As can be seen from the above chart and table, at the genus level, Maples are by far the most overrepresented species at IUN. This is the case nearly everywhere in the Midwest region, since our climate has a difficult winter which can kill many zone 5 trees with a bad cold snap, and people like the aesthetics of Maples. As discussed above for the GDVPR tree population, a strategic goal for IUN should be to reduce maple plantings while increasing plantings of some of the lesser represented species such as Sweetgum, Blackgum, Sweetbay Magnolia, and others.

Spruce, Crab Apple, and Arborvitae were also overrepresented. Once again, this is very typical of an area like a college campus, where evergreens are used to screen buildings, and trees like crab apples are used to provide flowering ornamental value. There are a variety of different trees which can fill these roles however, particularly when it comes to flowering trees. Hawthorns, Magnolias, Dogwoods, Redbuds, and even ornamental Cherries are all options. And for evergreeens, Concolor Fir, Eastern Redcedar, and a variety of other species can be used in place of the typical Pine and Spruce.

Oaks appear at first to be overrepresented, and by strict adherence to the "20-10-5 Rule", they are. That said, Oak ecosystems are disappearing at an alarming rate in our native Oak woodlands, and Oaks themselves are not regenerating as well as they used to due to competition from invasive species. For these reasons and more, we never flag Oaks as being too high in number, since ultimately the populations in the built environment may act as a surrogate for trees in native ecosystems when it comes to species dispersal.

The one other very strong point we would like to point out here is the "remining species" bar to the far right. All of the other bars on this chart are those genera which represent 1% or greater of the assessed tree population. The "remaining species" bar is everything less than 1% taken in aggregate. Having the bar sitting as high as it is means that there is actually a great diversity of other species which are just lesser represented in the population.

Overall, diversifying the tree population by using species which are less represented in the tree population overall will be a primary mechanism by which the trees population can become more diverse on the IUN campus.

The Future of IUN's Urban Forest

Though we will not go into too much detail here, in communications with IUN staff, they have been working with the Geosciences department, The Nature Conservancy, and NIRPC's CommuniTree program in order to have volunteer / student planting days where members of the community can come out and plant trees on the IUN campus. And they are doing this with the ecology of the area in mind. A recent planting from Spring of 2021 planted trees in a low-lying area which are hydrophytic (water loving) trees such as Yellow Buckeye, Baldcypress, and Swamp White Oak.

There has also been discussion of setting up some study plots with some of these new trees, so that things like soil moisture can be quantified and recorded in order to produce hard scientific data about soil management in urban areas. Very few people around the country are doing work like this right now, and the prospect of having research plots in the area that also support ecological goals is very exciting, and once again embodies the spirit of this plan.

And far from stopping there, apparently there has also been discussion about installing native herbaceous plants instead of turfgrass around some of these areas, particularly the low lying basin which was planted in Spring of 2021, to create a more native ecosystem. There has been a trend towards more mimicry of natural systems in the build environment over the past several decades, and IUN intends to not only carry this tradition on, but carry it further based on scientific study and the generation of new knowledge.

We commend IUN for all of it's efforts and those of its staff, students, and partners, and look forward to what the future holds for IUN as an institution embracing Urban Forestry at both an operational as well as educational level.

Section 10– The Future of the GDVPR Urban Forest

In this next section, a vision of what the tree population of GDVPR could become by 2050 was created, and compared and contrasted with the current population. Using the existing data, and then long-term vision based on best management practices and tree biology, we will then define exactly how GDVPR can move from where it is now to where it should be, by creating a customized Forestry program.

This first table below contrasts each species in the GDVPR system, with the count of each species now in 2020, and then what we have projected for 2050. The color of each highlighted region corresponds to whether that species will be increasing or decreasing in number, according to the legend below the table.

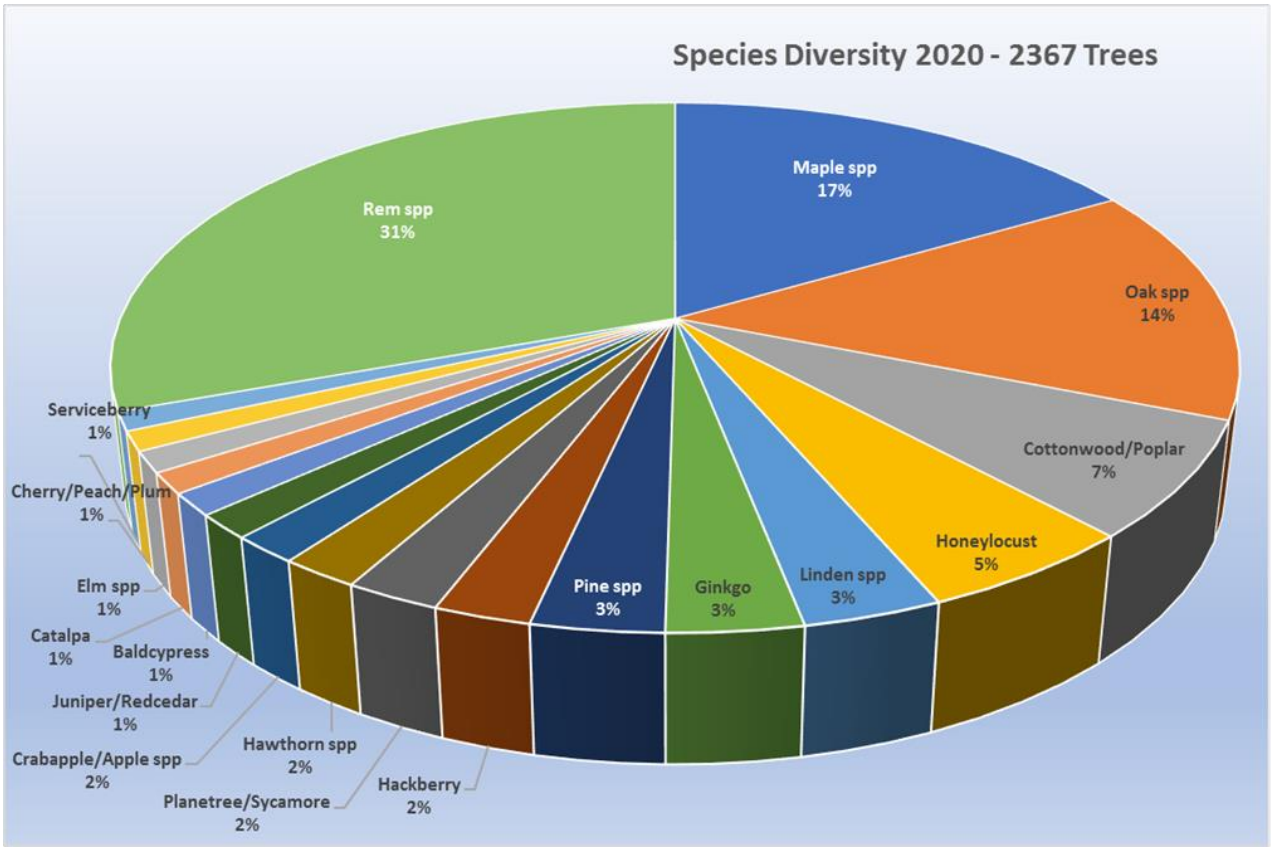
SPECIES	COUNT 2020	COUNT 2050
MAPLE-SILVER	279	25
OAK-BLACK	178	100
MULBERRY-SPP	151	20
HONEYLOCUST	128	75
ASH-GREEN	125	10
COTTONWOOD	116	25
ELM-SIBERIAN	82	10
GINKGO	78	80
HACKBERRY	56	75
MAPLE-NORWAY	53	20
PINE-AUSTRIAN	52	60
POPLAR-SPP	52	25
LINDEN-AMERICAN	45	80
MAPLE-RED	42	50
APPLE-CRAB SPP	40	70
SYCAMORE	39	10
OAK-RED	37	60
OAK-SWAMP WHITE	36	60
LINDEN-LITTLELEAF	33	60
BALDCYPRESS	32	60
OAK-BURR	31	60
CATALPA	30	60
HAWTHORN-COCKSPUR	29	60
SERVICEBERRY-SPP	27	60
ELM-AMERICAN	26	5
WALNUT-BLACK	26	5
AMERICAN REDBUD	23	50
BIRCH-RIVER	22	50
OAK-PIN	22	50
TULIPTREE	22	50
ASH-WHITE	21	10
EASTERN REDCEDAR	20	50
KENTUCKY COFFEETREE	19	50
PINE-SCOTCH	19	50
AILANTHUS	18	0
CHERRY-SPP	18	20
LILAC-TREE	18	50
PEAR-CALLERY	18	5

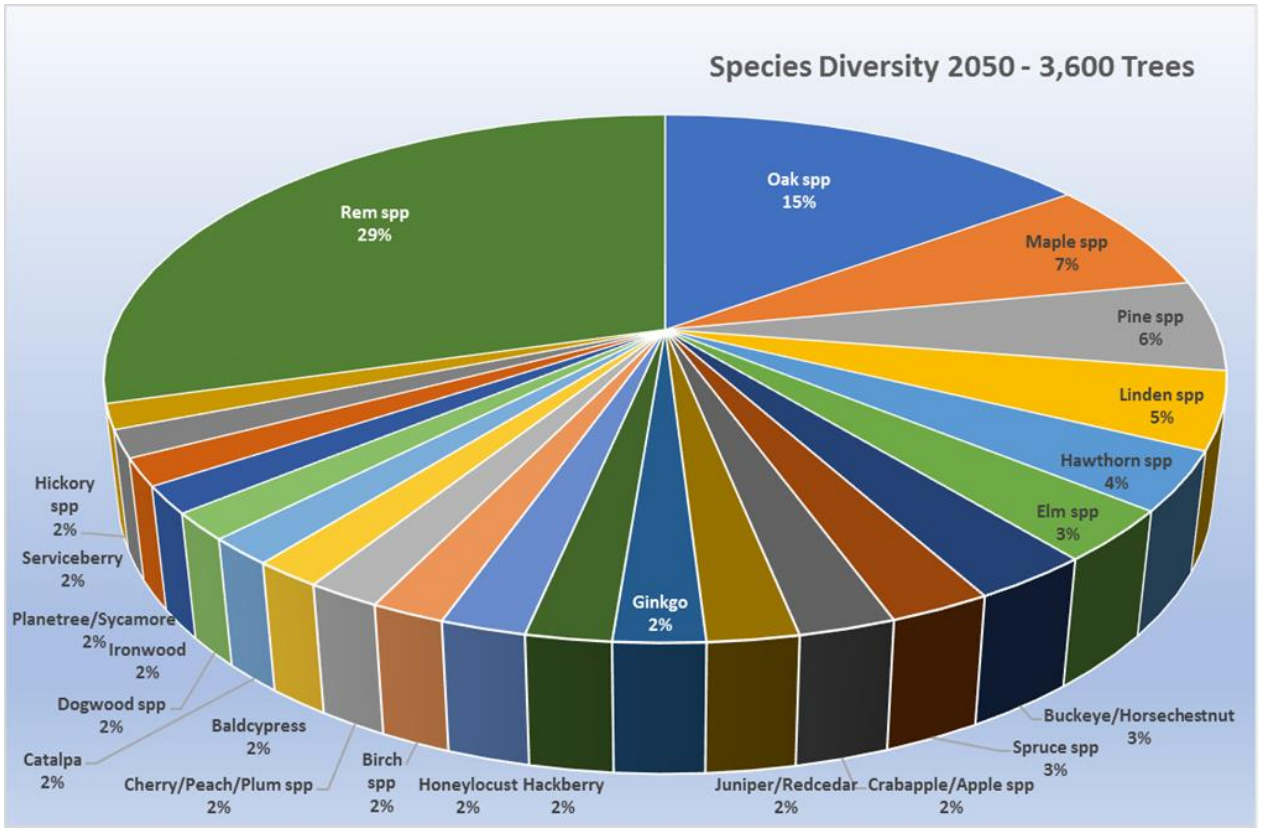
SPECIES	COUNT 2020	COUNT 2050
ELM-SPP	17	25
OAK-WHITE	17	50
ARBOR VITAE	16	30
BUCKEYE-OHIO	16	30
LONDON PLANETREE	16	50
JUNIPER-COMMON	15	30
ASPEN-QUAKING	14	20
BLACK LOCUST	14	30
HAWTHORN-SPP	14	40
OAK-CHINQUAPIN	14	40
ELM-HYBRID	11	75
HICKORY-PECAN	9	25
PAWPAW	9	40
WILLOW-WEEPING	9	0
MAPLE-AUTUMN BLAZE	8	40
MAPLE-SUGAR	8	40
PEACH	8	15
SWEETGUM	8	40
UNKNOWN	8	0
DOUGLAS FIR	6	30
OAK-SHINGLE	6	30
SPRUCE-SPP	6	30
WILLOW-SPP	6	0
DOGWOOD-SPP	5	60
PINE-SPP	5	30
AMUR CORKTREE	4	5
SPRUCE-BLUE	4	30
AMERICAN HORNBEAM	3	30
EUROPEAN HORNBEAM	3	20
HAWTHORN-WASHINGTON	3	30
SPRUCE-NORWAY	3	30
BIRCH-SPP	2	15
CHERRY-BLACK	2	0
ELM-CHINESE	2	15
LINDEN-SILVER	2	30
OAK-SPP	2	30
PEAR-EDIBLE	2	15
PLUM-SPP	2	15

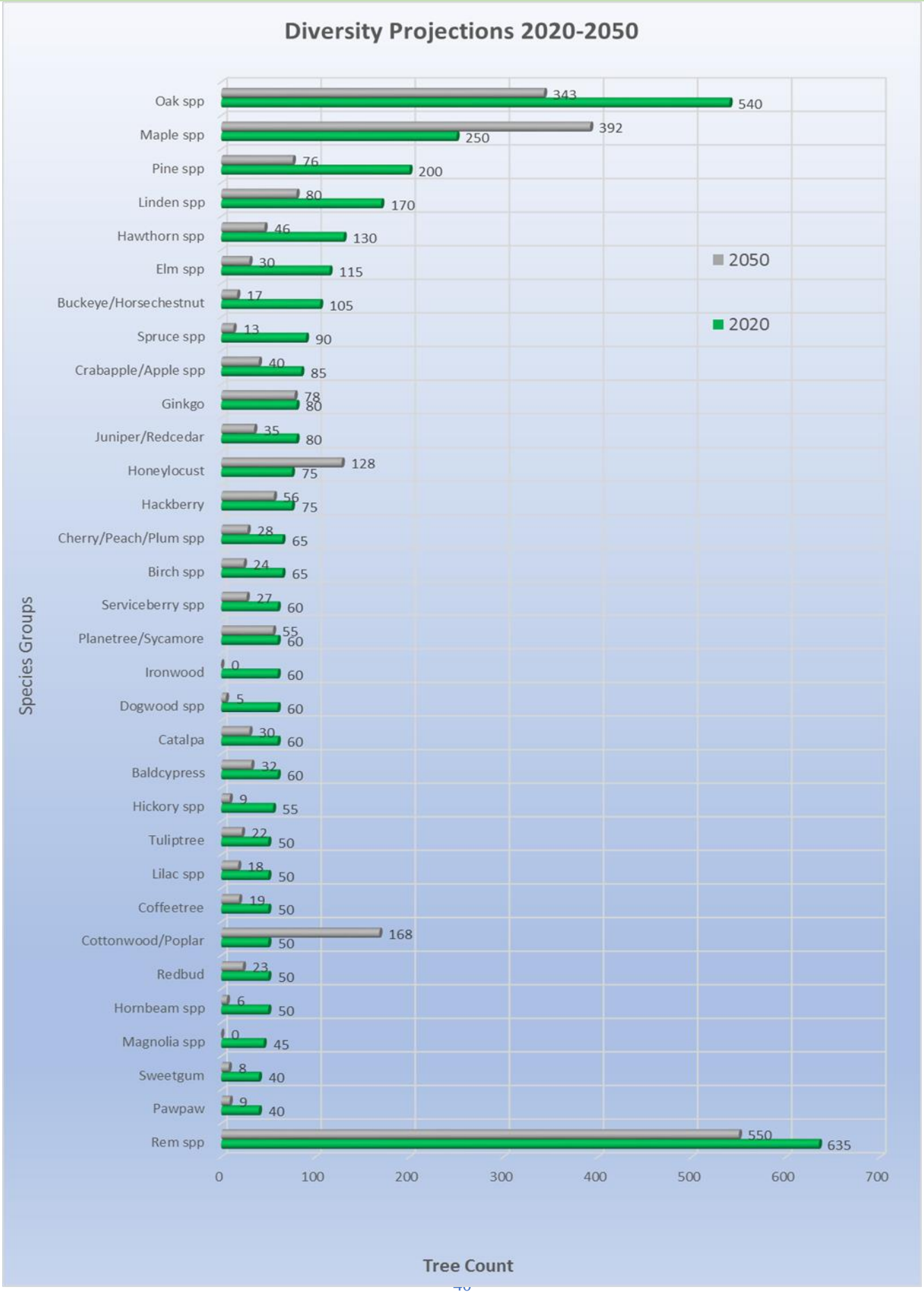
SPECIES	COUNT 2020	COUNT 2050
ASPEN	1	15
BOXELDER	1	0
HORSECHESTNUT	1	30
MAPLE-BLACK	1	30
MAPLE-SPP	1	15
ALDER-SPP	0	30
AMUR MAACKIA	0	15
APPLE-EDIBLE	0	15
BEECH-AMERICAN	0	15
BEECH-EUROPEAN	0	15
BLACKGUM	0	30
BUCKEYE-BOTTLEBRUSH	0	30
BUCKEYE-YELLOW	0	15
CAROLINA SILVERBELL	0	15
CHERRY-EDIBLE	0	15
CHESTNUT-CHINESE	0	15
DAWN REDWOOD	0	5
FIR-SPP	0	30
FRINGETREE	0	15
HEMLOCK-EASTERN	0	30
HICKORY-SPP	0	30
IRONWOOD	0	60
KATSURA	0	15
LARCH	0	30
MAGNOLIA-CUCUMBER	0	15
MAGNOLIA-SAUCER	0	15
MAGNOLIA-STAR	0	15
MAPLE-PAPERBARK	0	30
OAK-ENGLISH	0	30
OAK-SAWTOOTH	0	30
PERSIAN IRONWOOD	0	15
PERSIMMON	0	15
PINE-LIMBER	0	30
PINE-WHITE	0	30
SASSAFRASS	0	30
WALNUT-WHITE	0	15
WITCH HAZEL	0	30
YELLOWWOOD	0	30
ZELKOVA	0	30

	Actively Remove
	Maintain Current Population
	Plant in Limited Quantities
	Plant in Abundance

Change in Species Composition 2020 – 2050






Diversity Projections 2020-2050
Species Groups
Tree Count
2050
2020
Oak spp 343 540
Maple spp 392 250
Pine spp 76 200
Linden spp 80 170
Hawthorn spp 46 130
Elm spp 30 115
Buckeye/Horsechestnut 17 105
Spruce spp 13 90
Crabapple/Apple spp 40 85
Ginkgo 78 80
Juniper/Redcedar 35 80
Honeylocust 128 75
Hackberry 56 75
Cherry/Peach/Plum spp 28 65
Birch spp 24 65
Serviceberry spp 27 60
Planetree/Sycamore 55 60
Ironwood 0 60
Dogwood spp 5 60
Catalpa 30 60
Baldcypress 32 60
Hickory spp 9 55
Tuliptree 22 50
Lilac spp 18 50
Coffeetree 19 50
Cottonwood/Poplar 168 50
Redbud 23 50
Hornbeam spp 6 50
Magnolia spp 0 45
Sweetgum 8 40
Pawpaw 9 40
Rem spp 550 635
0 100 200 300 400 500 600 700

As can be seen from the above tables and chart, compared with the current species breakdown, the 2050 population will be more diverse and balanced than the current population. The Oak population will be increased from 343 to 540 which represents an increase of 197 net Oaks. Although this increase keeps the Oak genus above the 10% genus threshold, the ultimate goal will be to diversify Oaks at the species level. It is important to note that as Oaks are disappearing in our native Midwest communities, this effort to keep Oaks well represented in the GDVPR population has more to do with balancing the Oaks across the taxonomic, age class, and spatial diversity as a whole. Yes, this will leave the number of Oaks above the 20-10-5 Rule limit, but they will be planted taking into account species and spatial diversity.

Another goal is to have the majority of the 451 trees considered as undesirable species removed by 2050 as well. The presence of undesirable species is a common issue in many tree populations, and comes with existing trees such as Mulberry, Cottonwood, Siberian Elm, Poplar, Black Cherry, Ailanthus, Willow, And Boxelder. We will also reduce the numbers of Maple, American Elm, Honeylocust, Callery Pear, Black Walnut, Sycamore, Green Ash, and White Ash to open up room for significant diversification.

Increases in nearly every other species across the population have also been projected. Among the notable increases in number will be in the "less than 1% representation" group, which will jump from its current status of 26 species to 35 species. What this means effectively is that the greatest species diversity will exist in trees genera and species with less than approximately 36 members in the 2050 GDVPR population, and only around 30 species or genera will be heavily represented in GDVPR.

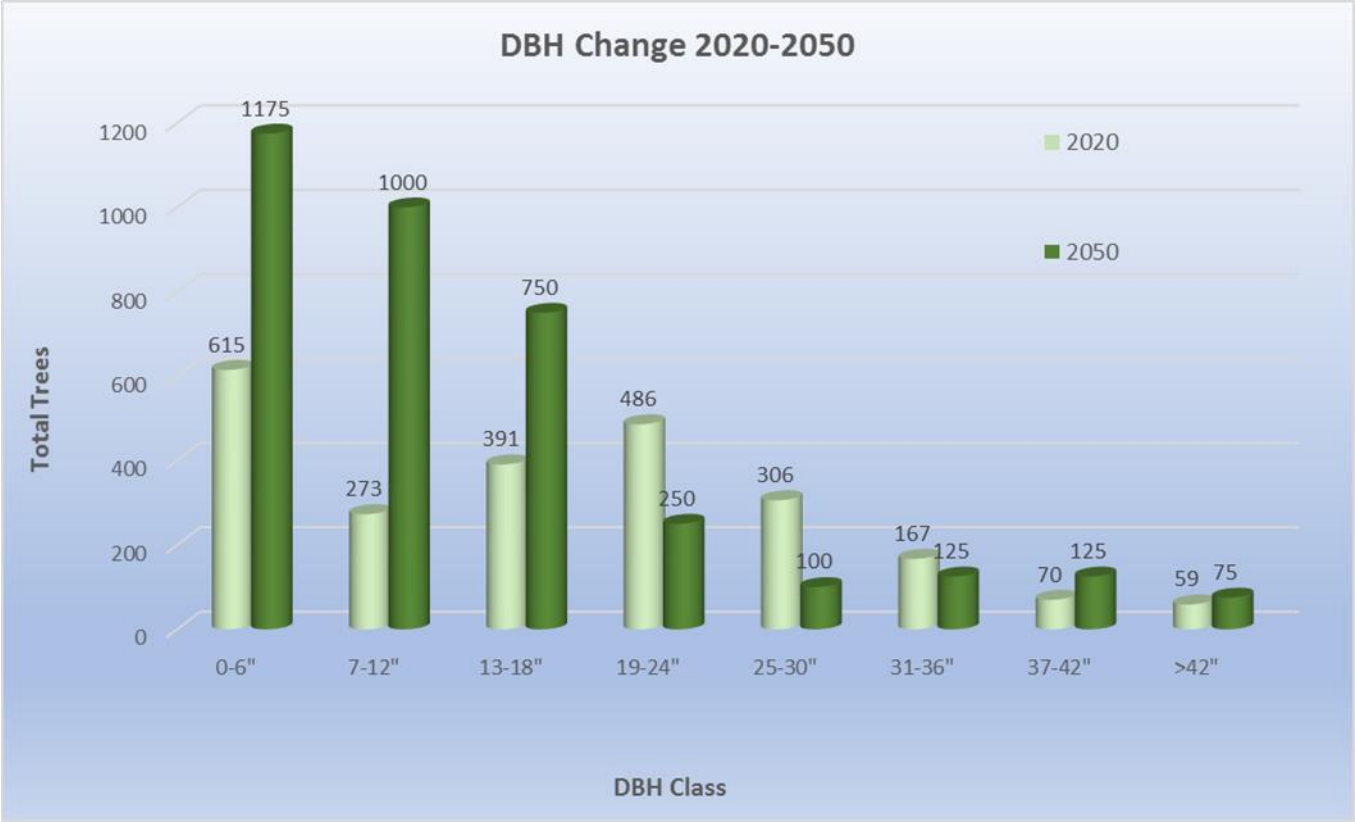
In order to arrive at these figures, the existing tree population was analyzed first for how many of each tree species would require removal based on the inventory, plus natural aging and decline over the coming 30 years. After this, we estimated how many of each species would be required to replace these removed trees, fill open planting spaces, and even factored a 15% new planting failure rate into our projections, so that our species composition projections and tree removal estimates account for failure of new plantings.

All told, we expect the managed tree population of GDVPR to increase form its current number of 2,367 trees to nearly 3,600 trees by 2050. This represents an increase of about 34% in the total numbers of trees in the GDVPR population. We believe this is an attainable goal, and will further examine the stocking density of the tree population below.

The Benefits of Larger, Healthier Trees

As expressed above, larger trees provide greater benefits to the community. They create more shade to reduce cooling costs, absorb more storm water to defray infrastructure improvement costs, create greater buffers against cool winter winds to reduce heating costs, and absorb and sequester more carbon than smaller trees do. For the 2050 vision of the tree population, we utilized a variety of methods to arrive at the proper age-class distribution. We utilized the current population structure, as listed above, and then anticipated high rates of survival based on new planting practices which would involve a "right tree/right site" approach (as detailed in the Reforestation Plan section below), as well as increased survivorship of existing trees due to improved management and care practices. Predicted growth, survivorship, and eventual tree losses were based on current species composition and future plantings and removals. This allowed the creation of a GIS File of what the tree population, including species and size, will look like 30 years from now, and generated the below chart of predicted age class distribution.

	2020	2030	2040	2050	Survival %
0-6"	615	1030	1160	1175	100.0%
7-12"	273	500	900	1000	86.2%
13-18"	391	200	350	750	72.8%
19-24"	486	300	125	250	40.7%
25-30"	306	350	200	100	36.6%
31-36"	167	150	225	125	32.0%
37-42"	70	100	100	125	25.7%
>42"	59	40	60	75	24.5%
TOTALS	2367	2670	3120	3600	



As illustrated in the above chart, the existing tree population (pale bars) has the trait of having the largest percentage of trees in the 1-6" DBH ranges, with fewer trees in the 7-12" DBH range, a slight surge in the numbers of trees in the 13-18" DBH and 19-24" DBH categories, and with incrementally fewer trees in the larger diameter ranges. As can be seen from our projections, it is that goal of this plan to begin a policy of increased new tree plantings, not just to replace trees being lost to old age or disease, but also to increase stocking density overall by filling in areas currently devoid of trees.

These estimates were done based on the assumption that increased levels of care for existing trees would enable them to survive longer. We have also factored in the shorter lived trees to these estimates, though it may not be obvious at first. It is assumed there will be a steep drop off after the 13-18" age class as these shorter lived trees turn over. Newly planted trees are also predicted to show decreased mortality, as they will be planted using detailed information matching planting site condition to specific species requirements. The numbers themselves were projected by hand, based on our prior experience, and the methods detailed below.

For projections of future age classes of trees, a ½" per year growth rate was roughly estimated by assuming that it would take an average tree 10 years to go from one age class to the next (6" = appx 10 years growth). Also utilized were the number of trees to be planted and removed annually, as calculated below in the Tree Planting and Tree Removal sections below. Based on all of this, as well as our best professional opinion, these were the numbers arrived at. It should be mentioned as well that as time goes by, these projections will change. These are simply rough estimates for the purposes of this Plan, and will be adaptively managed through time.

Ecological Services Provided by Trees

It is often easy to view the ecological services provided by trees as being strictly theoretical, and not a provider of actual hard dollars. However, the value provided by trees is concrete and actually very easy to conceptualize:

Energy Savings: During the summertime when temperatures are warm, large trees create shade. As we all know, temperatures are cooler in the shade. Cooler temperatures cause air conditioners to have to work less, which reduces the amount of energy a household utilizes. During the winter when temperatures are cold, winter winds cool your home and rob it of heat. Trees act as windbreaks and reduce winds by up to 30%, causing heating systems to use less natural gas, saving energy and money. For an entity such as GDVPR, this benefit is not always maximized due to many trees being far from residential homes, but in the cases where they provide these services to GDVPR buildings and other infrastructure, there is a recognizable benefit.

Carbon Dioxide (CO2): The amount of CO2 which is put into the atmosphere each year has a direct correlation with global climate change. That change causes more severe storms, greater drought conditions, loss of species, and many other costly outcomes. In short, reducing CO2 from our atmosphere lessens these effects. Since trees uptake CO2 and act as a sink, putting carbon into long term storage in its woody tissues, they remove it from our atmosphere, creating a net benefit to society, and saving money.

Air Quality: Many industrial processes and vehicle emissions put harmful chemicals into our air. These chemicals can cause or worsen poor health conditions such as heart disease, asthma, and lung disease. In addition, these airborne pollutants can mix with water in the atmosphere and create nitric and sulfuric acid, causing acid rain, which can destroy fisheries and contaminate water supplies. Trees absorb these compounds with their leaves and other tissues, and prevent them from remaining ambient in the atmosphere. Reductions in these chemicals results in overall better health, reducing the cost of healthcare to society, and saving communities money.

Storm Water: We often take our water systems in our municipalities for granted. The cost of delivering fresh water to homes, as well as removing and treating wastewater and storm water is immense. One of the greatest costs comes when either these systems are overwhelmed, such as during flooding, which can cause millions of dollars of damage to homes and vehicles, or when these systems need to be replaced from years of handling large volumes of water. Fortunately, trees take water from the soil and put it back into the atmosphere through the process of Transpiration, so the more trees we have, the less flooding we see, and the less strain is put on our storm water infrastructure, resulting in fewer repairs and replacements. In addition, tree canopy slows down rainfall's effects on flooding by "intercepting" it with leaves and branches, delaying how quickly rainfall can become runoff and floodwater. All this adds up to savings for a community.

Aesthetic/Other: Up to 15% of the value of a property can be attributed to its trees and other landscaping. Tree lined streets are much more appealing to homebuyers than streets devoid of trees, resulting in increased home sales, and therefore increased tax revenue, or increased tax revenue with which to fund initiatives relating to trees, attract new businesses, etc.

Return on Investment

It should also be mentioned here that the Return On Investment (ROI) for an individual tree is strongly favorable over the life of a tree in terms of investment in planting, care, and removal vs the benefits the tree provides. As we strive to justify the expenditures on trees and tree care, it is important that GDVPR stakeholders are aware of this.

On the following page, we have provided an ROI calculation sheet. This sheet breaks the tree's lifetime down into three phases, based on the anticipated costs of pruning in the budgets section(s) below. These phases are the young (3-12" DBH), mature (13-24" DBH), and full grown (25-36") ranges shown below.

Data was taken from the iTree algorithm, and applied towards the average benefits provided by a tree at each of these life stages, and multiplies it out over the 20 year period each phase accounts for. We also looked at costs for planting, watering, routine maintenance, emergency maintenance, and eventual removal of that tree over 60 years. The results are pictured to the right, with the calculations below.

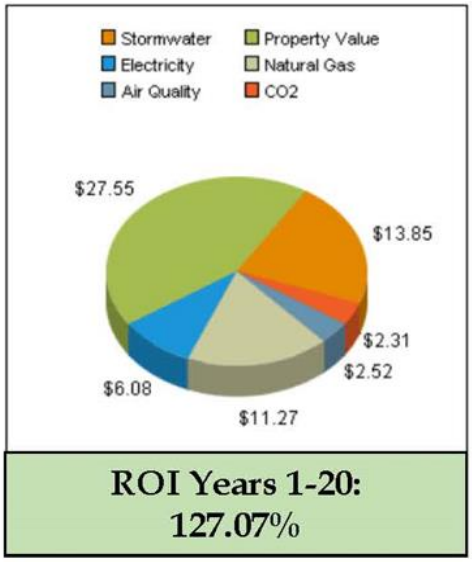
Total Investment	$4,150.00
Total Return	$8,585.00
Total ROI Over 60 Years	106.87%

Return on Investment: Years 1-20 (3-12" Diameter)

Costs

Initial Purchase and Installation	$300.00
Watering for 2 Years	$100.00
Pruning - 4x @ $40/prune	$160.00
TOTAL INVESTMENT	**$560.00**

Benefits	Avg/Year	Over 20 Years
Electricty	$6.08	$121.60
Natural Gas	$11.27	$225.40
Property Value	$27.55	$551.00
Stormwater	$13.85	$277.00
Air Quality	$2.52	$50.40
CO2 Reduction	$2.31	$46.20
TOTAL RETURN		**$1,271.60**



ROI Years 1-20: 127.07%

Return on Investment: Years 21-40 (13-24" Diameter)

Costs

Pruning - 4x @ $75/prune	$300.00
Emergency Maintenance (2x)	$500.00
TOTAL INVESTMENT	**$800.00**

Benefits	Avg/Year	Over 20 Years
Electricty	$18.87	$377.40
Natural Gas	$31.90	$638.00
Property Value	$55.97	$1,119.40
Stormwater	$54.96	$1,099.20
Air Quality	$8.36	$167.20
CO2 Reduction	$7.02	$140.40
TOTAL RETURN		**$3,541.60**

ROI Years 21-40: 342.70%

Return on Investment: Years 41-60 (25-36" Diameter)

Costs

Pruning - 4x @ $150/prune	$600.00
Emergency Maintenance (2x)	$650.00
Eventual Cost of Removal	$1,000.00
TOTAL INVESTMENT	**$2,250.00**

Benefits	Avg/Year	Over 20 Years
Electricty	$27.20	$544.00
Natural Gas	$49.26	$985.20
Property Value	$71.46	$1,429.20
Stormwater	$127.82	$2,556.40
Air Quality	$14.06	$281.20
CO2 Reduction	$10.52	$210.40
TOTAL RETURN		**$6,006.40**

ROI Years 41-60: 166.95%

Section 6 - Tree Removals

Milestones	2021	2022	2023	2024	2025	2026-2030	2031-2040	2041-2050
Trees Removed	86	86	86	87	75	75/year	75/year	75/year
Diameter Inches	1892	1892	2103	1785	1200	1200	1200	1200
Notes	First half of priority removals	Second half of priority removals	First 3/4 of standard removals	Second 1/4 of standard + first 1/2 low priority	Complete low priority + begin annual update removals	Update Inventory for New Removals	Update Inventory for New Removals	Update Inventory for New Removals
Removal Cost (2020)	$37,830	$37,830	$42,060	$35,700	$24,000	$24,000	$24,000	$24,000
Removal Cost (CPI)	$37,830	$37,830	$42,060	$35,700	$24,000	$27,600	$31,740	$36,501

The first step towards attaining GDVPR's forestry goals will be to remove trees which are diseased, dying, or present a hazard. At present, there are 448 trees which have been called for removal during the inventory. Of these, 172 are listed as Priority Removals, and are recommended to be taken down over the 2 year period from 2021-2022 to prevent potential public safety issues from arising. A goal of this Urban Forestry Management Plan is to have all identified trees marked as Priority Removals be removed by the end of 2022, or within 2 years of adoption of this plan. For 2023 and part of 2024, the focus will be on the "standard" removals. A goal of removing the Low Priority Removals should be set for 2025.

After the priority, standard, and low priority removals are taken care of, in order to attain the goals set forth in the Diversity Standards, the number of trees removed each year will actually fall slightly. This is due to the fact that most remaining poor condition or dead trees are on the 448 tree removal list. This is where, going forward, it is important to stay vigilant about maintaining the tree inventory to periodically identify trees requiring removal. Starting around 2026, we anticipate that the background rate of tree removal will be approximately 75 trees per year.

Continual reevaluation of the tree population on an annual or semiannual basis by the GDVPR staff or a Forestry Consultant will specify which trees require removal. These numbers, detailed above, are meant to be placeholders for budget calculations and diversity standards. It cannot be stressed enough that this does not require that 75 trees be removed each year, and in fact removal totals will vary from year to year. We anticipate they will likely be lower than 75 in most years. Each year, as GDVPR builds its program, trees should be evaluated on a case by case basis.

For purposes of projection, costs have been estimated using real rates of in house and contracted services for tree removal and stump grinding, based on $20 per diameter inch, which is fairly standard. Rates could certainly be found lower than this in a competitive bid process or by using in house labor. As is the case with all cost projections for this Plan, no cost increase is assumed for the first 5 years, and a 3% annual cost increase is assumed thereafter. Once again, this is a very conservative estimate based loosely on Consumer Price Index, and actual costs are likely to be lower than projected. In addition, for trees in 2026 and beyond, these are anticipated averages of trees to be removed on an annual basis.

Exact numbers of trees to be removed may be significantly more or less, as can be seen from the annual removals table above. These numbers were calculated for budget forecasting only. One of the most important goals for the program is to be able to allocate resources where they are most needed. Pruning, as we will mention below, is a maintenance item that the more you perform it early, the less it needs to be performed later in life when the tree is larger and more difficult and expensive to manage. This will be particularly important for GDVPR as they implement the tree planting plan.

Tree Removal Activities

Safe Removal of a Tree to an Appropriate Flush Cut

Tree removal can be a very dangerous activity which puts people, property, and workers in harm's way. Thus, all tree removal activities on GDVPR's property should be performed under the guidance of a Certified Arborist or Arborist Trainee. This may be the supervision of a Forestry Consultant or a Certified Arborist with the contractor who has been hired to remove the tree. The safe removal of a tree involves the removal and safe lowering of all portions of the secondary branches, scaffold branches, and finally the trunk of a tree by either a tree climber or a bucket truck operator. The stump must be flush cut such that the highest portion of the cut is no greater than two inches from the highest part of the ground surface to prevent a tripping hazard GDVPR property.

Stump Grinding

Within a reasonable amount of time following the removal, stumps and roots shall be removed using an approved stump grinding machine, such that the stump is ground to a minimum depth of 6 inches, and no surface roots are visible to the naked eye. If the site is to be planted with a new tree, that depth shall be increased to 12 inches below the soil surface. This will ensure that a new tree may be successfully planted near the site of the removed tree, and that no re-sprouting will occur from the old stump. The depths to which the stump must be ground may be altered by GDVPR depending on individual management needs for specific circumstances or contracts. Until such time as the planting space be fully restored, the stump hole will be filled and compacted to ground level using the debris resulting from the stump removal.

Planting Site Restoration

Once the tree has been safely removed and the stump has been ground out, the open planting space must be fully restored if a tree is not scheduled to be planted in or adjacent to the old hole within six weeks. Site restoration consists of removing a portion of the stump chips from the hole, mixing with a quality mineral topsoil, tamping down to match the surrounding grade, spreading grass seed over the top of the topsoil, and securing green turf blanket over the topsoil. This will ensure that grass grows back to restore the aesthetics and function of GDVPR, and prevent tripping hazards from the removal scar. It should be noted here that given the nature of GDVPR, it is not always recommended nor feasible to put a tree back where one was removed, and often a better site can be selected for a new plant than one which was removed. That said, restoration of the removal site to either turfgrass or native vegetation cover is of great importance.

Reasons for Tree Removal

Removal of trees on public spaces is never taken lightly, but it is an unavoidable reality of managing large tree populations. When the trunk, branches or roots fail, a standing tree can cause personal injury or even fatality, and even small dead trees can be an eyesore, and increase risk to visitors of GDVPR. Old trees can hold great sentimental value, and many people become attached to these community icons. However, there are times when their presence creates a public hazard, and it is at those times that action must be taken to ensure public safety. It is also important to remember that the removal of a tree today is the promise of a new tree for tomorrow!

Removal of trees on GDVPR property shall always be at the discretion of the GDVPR staff and/or a Forestry Consultant. Trees will never be removed without sound reason from the GDVPR staff or Forestry Consultant, and likewise will never be removed with no evidence of a need for removal. Trees with higher programmatic need for removal based on public safety will always hold a higher priority.

Dead or Dying

If a tree is biologically dead or nearly dead, it will require removal. Trees which are standing dead, have approximately 70 percent dead crown or greater (as determined by ocular estimate), or have less than approximately 40 percent sound wood in the cross-section of the trunk shall be removed as expediently as practical. The exact determinations of these quantities shall be at the discretion of GDVPR staff or a Forestry Consultant.

Diseased or Infested

Diseases are caused by viral, fungal, or bacterial pathogens. Infestations are caused by insects or other small animals. Dutch Elm Disease and Oak Wilt, for example, are fungal diseases that kill Elm and Oak trees when they are infected. Emerald Ash Borer is an insect which kills Ash trees by infesting them. The prompt removal of diseased or infested trees limits the exposure of other nearby trees. The removal of one tree may save dozens of others. Trees deemed to be diseased or infested by GDVPR staff or Forestry Consultant shall be removed as expediently as possible to slow the spread of insects and diseases.

High Risk

"Tree Risk" is the potential of a tree or tree part to impact a nearby person or piece of property and cause damage, injury, or fatality. This topic is of great interest in Arboriculture today, and the insurance industry is becoming increasingly involved in the business of assessing and managing the risk posed by trees. Litigation involving trees is also on the rise. Trees identified as being in elevated risk categories will be subject to mitigation or removal to maintain public safety. If such risk can only be safely mitigated by tree removal, as opposed to pruning or other measures, then their timely removal is critical because high risk trees expose the public or property to potential harm. This is particularly pronounced in a park setting, where park visitors maybe close to potentially hazardous trees.

GDVPR staff, a Forestry Consultant, or any other TRAQ Qualified Risk Assessor must assess the tree and prepare a Tree Risk Assessment Report which will document the details of the situation, prior to removal. Often, risk can be mitigated by removing a portion of the tree, restricting access to the tree, or other corrective measures, if the tree is a very high value tree in a high location value area. If the entire tree is deemed to be at high or extreme risk of failure, however, the entire tree shall be removed as a means of reducing its residual risk to zero.

Emergency / Storm Damage Removals

A tree shall be removed if it has been severely damaged and/or compromised by lightning, wind, or another such natural disaster. "Severely storm-damaged" shall be generally defined as a tree which has lost 33% or more of its crown due to wind damage, has a large crack or other wound in the trunk resulting from high winds, has a lean of greater than ten degrees from vertical, or has sustained a lightning strike. GDVPR staff or a Forestry Consultant shall determine the need for removal of a tree based on storm damage, although in an emergency situation such as a tree impacting a person, vehicle, building, power lines, or other such emergency, GDVPR reserves the right to perform any actions necessary to abate public hazards so long as they are in compliance with all relevant Arboricultural standards and practices.

Damage from Construction or Vehicle Strike

GDVPR staff or a Forestry Consultant shall assess trees that have been impacted by a vehicle strike or large piece of construction equipment. If the tree has suffered physical damage or extreme root compaction and is likely to decline and become high risk, it will be brought to the attention of the Grounds Superintendent for approval before being scheduled for removal. The decision will be based on the best professional judgement of GDVPR staff or a Forestry Consultant.

Reasonable Resident Request

If a tree bordering or overhanging a neighboring residential property has non-terminal pest or pathogen issues, moderately poor structure or is in somewhat poor condition, a resident may inquire about the removal of the tree. Such requests will be reviewed by GDVPR staff and/or Forestry Consultant, and evaluated on a case-by-case basis. If the tree shows significant potential to decline or pose a threat in the near term, GDVPR may agree to the removal within the next five years. Note that young and/or healthy trees will generally not be considered eligible for this program. Priority will always be given to trees in danger of threatening public safety.

Overplanted and Underperforming

No healthy tree shall be removed for the sole reason of having been overplanted. With the new Forestry program, GDVPR will be adopting industry best management practices for diversity in the urban forest with the goal of building a diverse urban forest. Overplanted species listed as being in "poor condition" during their most recent visual assessment will be reviewed to assess further decline or recovery. Those trees in noticeable decline shall be removed at the discretion of GDVPR staff and/or Forestry Consultant. This will only be used as a preventative measure so that these trees do not continue to decline to a point where they become hazardous, and not used as a reason to remove an otherwise healthy tree.

Tree Removal Requirements and Standards – Full Text in Appendix G

All of the following requirements and standards shall be met during tree removal activities:

Gary Department of Venues, Parks and Recreation

1. All personnel directly involved with process of chainsaw operation, climbing, bucket truck operation, and rigging limbs shall be provided with sufficient training and experience to perform such duties while employed by GDVPR, as either Grounds and Forestry staff, or performing work as a contractor employed by GDVPR.

2. Only qualified utility arborists may perform tree removal operations within ten feet of an electric utility line. GDVPR employees or contractors may complete the process of trunk removal and stump grinding only if the remaining portion of the tree is greater than ten feet from a transmission line. When higher voltage lines are encountered, please reference the ANSI Z133 standard for minimum approach distance.

3. GDVPR will not remove healthy trees to meet diversity goals unless the tree poses a risk to persons or property.

4. GDVPR shall not perform, or assist with the removal of trees on private property. Public/Private tree ownership is defined by Ordinance as having 51% or greater of its trunk diameter on private property. GDVPR does reserve the right to prune overhanging limbs from private property back to the property line.

5. GDVPR Will not be responsible for serving notice or enforcing removal of trees on private property

Section 12 – Tree Planting

Milestones	2021	2022	2023	2024	2025	2026-2030	2031-2040	2041-2050
Trees Planted	100	100	100	100	100	115/year	115/year	115/year
Planting Cost (2020)	$5,000	$6,000	$7,000	$8,000	$9,000	$23,000	$23,000	$23,000
Planting Cost (CPI)	$5,000	$6,000	$7,000	$8,000	$9,000	$26,450	$30,418	$34,980

Simply removing trees will not fulfill our vision, however. Planting of new trees must happen to increase the diversity and canopy cover. At present, GDVPR has a significant amount of space for new plantings on its properties, and Great Lakes Urban Forestry Management has created a reforestation plan to add approximately 550 trees to the gross population figure. And by 2050, the total number of trees added is projected to be over 1,200 total.

For the costs of planting, we have used $400 per tree, installed. This is a conservative estimate, and likely GDVPR may be able to find less expensive material. Particularly if volunteer labor is employed, grants procured, and smaller trees planted, these costs could reduce by 50% or greater. However, to present a fully contracted, maximum price figure, it was decided to use a market price for purchase and installation. This cost also includes the cost of watering the tree for 2 years, of which the importance cannot be overstated.

As a means of attaining the goals of increasing canopy cover to 25%, and increasing overall diversity significantly, this plan calls for the addition of 1,200+ trees over the coming 30 years. Some of these will be replacements for existing trees which are expected to be removed during that time period. Others will fill sites never occupied by trees before. We also did build a 10-15% failure rate into these calculations as well, typical of most new tree plantings. These trees will be planted by GDVPR staff, contractors, and even volunteers who have been properly trained. The Plan has specifically been formulated to plant trees where they will have the best chances to establish based on their planting sites and species requirements.

For the goals and milestones shown above, the program began with planting the approximately 100 donated trees which GDVPR typically plants using volunteer labor each year as part of its normal operations for the first 5 years. Each year thereafter, a gradual increase is called for in new plantings, until by 2026 the parks department is planting 115 trees per year. As seen in the above table, GDVPR has historically planted between 100 trees each year using volunteer labor and donated trees, with plantings increasing recently as Ash tree removals have subsided. In this respect, we find these goals to be attainable.

It should also be noted here that beginning in 2026, the costs rise significantly. The costs for volunteer tree planting for the first 5 years assume basic costs associated with holding a volunteer event: Food, staff time, portable toilets, etc. For the period beginning in 2026, we have made the assumption that GDVPR will have it's forestry program to a point where half of the trees being planted each year are planted by volunteers, with the other half being planted by traditional nurserymen and plantsmen.

Reforestation Planning

A Long-Term Reforestation Planting Plan for GDVPR, created as part of this UFMP, is be a noteworthy investment in the future so that GDVPR can plan its tree plantings over the coming decades. Open planting spaces were identified and GPS locations added where Great Lakes Urban Forestry Management saw a need for a tree.

GLUFM staff evaluated areas which needed shade primarily, such as near sports fields, benches, etc. After these needs were met, focusing on aesthetic plantings, such as near entrances or other high location value areas was done. After that, screening from nearby residences was considered, and finally, strictly aesthetic trees were planned for. Another goal of this project was to maximize the use value of the trees while also matching the right tree to the correct site, and to increase diversity throughout GDVPR, with consideration given to species diversity, spatial diversity, and age class diversity as mentioned above. GDVPR can use this plan as a template for new plantings, while also adjusting annually.

A large part of this was also evaluating tree planting to offset the Urban Heat Island effect. Using geospatial data showing where the Urban Heat Island effect was greatest, we concentrated plantings in parks where that effect was the most notable. Tree plantings in these areas will help to alleviate this effect. We also paid special attention to soil hydrology so that stormwater interception and transpiration could have the greatest effect. Planting of hydric (wet) soil tolerant trees in (e.g.) low lying areas will help to reduce ponding and overland flooding, thus reducing the burden on stormwater infrastructure.

Each planting site had a variety of data collected on it per the below specifications. Trees were generally not selected in the field, but rather from the office. Species which best meet the criteria spelled out below were selected for each site. It should be mentioned here that to grow the tree population to the approximately 3,600 trees from the current population size of 2,367 we must plant many more trees than we remove. We anticipate that reforestation planting should take place on a periodic timetable over the coming decades as trees are removed, and GDVPR properties can be reevaluated for need as things develop.

Reforestation Data Collection

The following were the data which was collected during the reforestation planning process:

Soil Volume

Soil volume is an approximate measure of the below ground growing space at the planting site.

Small	Soil volume less than approximately 25ft^3
Medium	Soil volume between approximately 25 ft^3 and 500 ft^3
Large	Soil volume greater than approximately 500 ft^3
Prohibitive	Soil volume is insufficient to support tree planting

Growspace

Growspace was evaluated based on the proximity of the planting site to structures, other trees, power lines, and other such potential obstacles. An attempt was made to determine what the site conditions might be as the tree matures.

Small	Tree has (or will have) 40 feet or less of available growspace
Medium	Tree has (or will have) 40 – 60 feet of available growspace
Large	Tree had 60 feet or more (unlimited) growspace
Prohibitive	Site did not have enough growspace to justify a new planting

Light Level

Light level was based on the amount of sun or shade that a planting site was currently experiencing, or was anticipated to experience in the future. Site conditions have to be relatively constant to make this determination, and are subject to future storm damage, construction, tree removals, etc.

Full Sun	Tree has access to abundant sunshine
Partial Shade	Tree is (or will soon be) in shade for at least 25-50% or more of the daylight hours
Full Shade	Tree was in full shade for at least 75% of the daylight hours

Soil Moisture

Soils will be evaluated by use of GIS data layers of Hydric Soils, FEMA Floodplain, and NWI Wetlands data, as well as firsthand observation. In areas where the soils had been heavily modified since the GIS data was last updated, staff ignored GIS data and record the soil type based on best professional judgment, and in rare occasions, basic sampling.

Dry	Soils are in a high elevation area on the landscape or far from water sources
Mesic	Soils are of moderate moisture during an average growing season
Hydric	Soils are wetter throughout most of the year during an average growing season
Poor	Soils are rocky, compacted, or otherwise of very low quality
Prohibitive	Soils are not adequate to support a viable root system

Loading

Loading of either salt pollutants or nutrients was assessed. High salt areas were generally along major roadways, in plowed and salted parking lots, near low spots in the terrain, near retention basins, or near intersections. High nutrient areas were generally near facilities such as sports fields that require frequent fertilization, stormwater retention ponds, or near floodplains.

None	No significant salt or nutrient loading was observed
High Salt	Significant amount of road salt (or similar) was observed or inferred
High Nutrient	Significant amounts of Nitrogen, Phosphate, etc were inferred
High Salt and Nutrient	Significant Salt and Nutrient loads were observed or inferred
Low Nutrient	Site was in a location where access to nutrient would be very limited

Sheltered

The degree of which a tree will be protected from prevailing winds, snow, and other cold-weather elements.

None	Planting site is 0-10% sheltered
Low	Planting site is 10-25% sheltered
Moderate	Planting site is 25-50% sheltered
High	Planting site is 50-75% sheltered
Very High	Planting site is 75-100% sheltered

Recommended Form

Recommended form is based upon general terms describing the shape and habit of mature tree species' canopies. Oftentimes, there are certain situations in which particular tree forms would be better suited to complement the existing landscape and/or hardscape, such as columnar trees in narrow parkways, or spreading trees in wide parkways.

Any	Any tree form would be suitable for the site
Globose	Large, regular and rounded canopy, resembling a globe
Spreading	Horizontal branching resulting in a large and wide canopy
Columnar	Column shaped canopy where horizontal growspace is less than 20'
Vaselike	Higher branching form where branches grow at sharp angles from the trunk, flaring outward
Pyramidal	Broad, cone-shaped or triangular canopy
Small	Small mature height (<30')

Planting Site Assessment

Species diversity, spatial diversity, and age-class diversity were all taken into account for the Reforestation Plan, but diversity standards should be reviewed periodically to monitor GDVPR's compliance with the 20-10-5 Rule. Strategic goals to increase that ability to meet that criteria shall continually be set. These benchmarks can be monitored with each passing season. The success of a tree depends on where and how it is planted. GDVPR staff or an Urban Forestry Consultant shall assess planting sites not included in the Reforestation Plan before trees are purchased and installed, to ensure the correct tree is being planted for the correct site. Each tree planted represents a 25-75 year commitment or more, and due diligence shall be performed before making that commitment. A list of acceptable species to be planted for all land use types appears as Appendix A at the end of this report.

Nursery Stock Procurement

Nursery stock quality is also a key to a tree's long-term success. No amount of planning can help a tree which was purchased in poor health. GDVPR staff or an Urban Forestry Consultant shall visually inspect and select every tree which is to be planted on GDVPR property, in order to minimize the possibility of installing poor quality nursery stock. As a cost saving measure, specifications should be for material no smaller than 1.75" caliper, with good form for the species, planted as either balled and burlapped, or minimum 5-gallon containerized stock. Currently, there is a shortage of good nursery stock available from growers due to the high numbers of trees being sought to replace Ash trees lost to Emerald Ash Borer. For this reason, we strongly recommend that GDVPR inspect all stock, and not to accept substitutions in their requested species.

Tree Transport and Planting

Proper transport and planting procedures determine a tree's success after planting. During transport from the nursery to the planting site, trees should be covered by a landscape tarp to avoid them desiccating during the drive. Additional, anti-transpirant sprays can be used which perform much the same function and keep the tree from drying out.

During planting, trees planted too deeply will suffer from root compaction and trunk decay. Trees planted without properly dug holes may suffer from stunting. Trees planted without proper removal of packaging materials may develop girdling roots. Trees planted too high may have surface root desiccation. Trees improperly staked or with improper trunk protection may suffer from trunk wounds or girdling of the entire trunk. The standards and Best Management Practices for tree transport and planting are detailed later in this section. Trees may be planted by a local volunteer work force so long as the workers have been adequately trained by an Arborist or Forestry Consultant prior to planting trees.

Tree Spacing and Visibility Requirements

Minimum tree spacing between Large/Medium/Small sized deciduous shade trees should take into account maximum canopy size at maturity, as well as shade tolerance. This will allow trees to grow to their full potential without heavy competition for water and nutrients with neighboring trees, and without limited space for crown growth. In addition, no tree shall be planted within 10 feet of a driveway, intersection, traffic control device, or known below ground utility. Trees may be planted under aboveground powerlines, but must be from the "Small" selections listed in the Acceptable Species list below. Evergreens are acceptable for parks, schools, municipal campuses, and waterways, but should be avoided when adjacent to a road due to visibility issues.

In certain circumstances, such as creating screening or establishing permaculture guilds, these spacing guidelines may be fluid, since the objective of these specific things requires that trees be planted closer together. And in fact there is research showing that close spacing is beneficial in some cases. These specific circumstances will be evaluated on a case by case basis by the Arborist or Forestry Consultant.

Watering

Watering of trees is absolutely essential to their establishment, growth, and survival, particularly during the first 2 years of their lives. One of the reasons for the $400 per tree cost, which is higher than retail costs for the tree alone, is that we have built the cost of watering into the budget figures. We highly recommend that when a tree site is selected for planting, that it is also planned for a 2 year watering program to avoid the tree desiccating before it is able to properly establish. We anticipate that watering will be performed by volunteers, as detailed above. This will help save costs while getting essential work done. The reforestation plan has also built site hydrology in, so that water usage can be moderated by proper species selection. That said, GDVPR should monitor how many trees it can water, so that tree planting does not exceed ability to water new stock.

Challenges of Urban Plantings

Sometimes urban planting sites are a difficult environment for a tree to thrive in, and thus it can be expected that approximately 15% of new plantings fail each planting cycle. GDVPR's contracts for tree planting should include a 1-2 year replacement warranty for any new trees that fail to thrive in their new environment. For trees grown in-house at a liner nursery, the same failure rate should also be expected. It should be understood that urban tree plantings can pose an uphill battle in many ways, due to limited soil volume, salt runoff, airborne pollutants, and other factors. With park property, this is less of a factor. Nonetheless, some new planting mortality is to be expected.

Tree Planting Requirements and Standards – Full Text in Appendix H

Gary Department of Venues, Parks and Recreation

1. Planting sites shall be determined and monitored using partner, consultant, and staff input.

2. Acceptable and unacceptable species for planting may be amended by GDVPR staff, partners, or consultants as necessary based on good scientific data and / or new species availability

3. New planting sites shall be ideally ten feet away from utility structures and a minimum of six feet from manholes and utility structures, driveways and hardscapes.

4. Choice of species for planting over the next 30 years shall be done so according to GDVPR's existing taxonomic, spatial, and age-class diversity goals. A diverse and resilient urban forest shall be created, such that it minimizes exposure to financial, environmental, and health risks while maximizing aesthetics, environmental benefits, and ecosystem services to its residents.

5. All planting stock shall be grown within 250 miles of the planting site.

6. Acceptable nursery stock shall conform to the following standards:
   - **A.** Minimum of 1.75-inch caliper, measured at six inches from the trunk flare
   - **B.** Root ball conforms to ANSI Z60.1 Standards for Nursery Stock
   - **C.** Less than 10% deadwood in the crown
   - **D.** Architecture consistent for the species, cultivar, or variety in question
   - **E.** No included bark or other such narrow branch attachments, unless consistent with species or variety
   - **F.** Free of pests or pathogens
   - **G.** Approved species list for GDVPR

7. Planting and digging of certain species shall only occur at certain times of year, in accordance with nursery industry best management practices and professional judgement. These times are subject to the professional opinions of both GDVPR and its approved contractors.

8. Indiana 811 shall be contacted, and all utilities located a minimum of 3 days before planting is scheduled to begin.

9. A minimum of a one-year replacement guarantee shall be extended from approved nurseries and plantsmen for all new contracted (not in house) plantings rated to hardiness zone five or lower.

Section 13 – Tree Pruning

Average Cost of Eventual 7 Year Cycle Prune, Based on Projections and Species Composition

Milestones	2021	2022	2023	2024	2025	2026-2030	2031-2040	2041-2050
Trees Pruned	339	263	338	340	340	380/year avg	415/year avg	515/year avg
Notes	Dead limb pruning + Appx 1/2 of Priority Prunes	Remaining priority prunes + Training pruning	Begin 7 year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune
Cost (2019)	$43,893	$34,052	$43,763	$43,763	$43,763	$49,200	$57,617	$66,681
Cost (CPI)	$43,893	$34,052	$43,763	$43,763	$43,763	$56,580	$66,260	$76,683

When maintaining a tree for its greatest benefits and lowest risk, tree pruning is one of the most cost-effective activities to be performed on a young tree, but sadly is often the most overlooked! Pruning accomplishes several very important things for a tree. It reduces the risk of failure, provides clearance for utilities or other structures, reduces wind resistance and wind damage, maintains overall tree health, and improves overall aesthetics. And the more pruning a tree gets, the less it needs over the long term, making pruning something that winds up decreasing in cost over the long term.

For the goals and milestones, once again we began with the most critical needs GDVPR has right now, those being the trees identified as higher Priority Prunes in the inventory. For the next 5 years, the number of trees pruned each year will fluctuate based on need for pruning. After this point, a final increase to the capacity of approximately 515 trees per year will allow GDVPR to prune all of its trees on a 7-year cycle. Please note that there are increases every 10 years, but this is due to the changing size of the tree population from 2,367 to 3,600. Tables for these changes are provided below:

2020: 340 Trees Pruned/Year – 2,367 Trees on a 7 Year Cycle

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year
Evergreen	146	6.17%	$25	21	$ 522.75
Large (>24")	1926	81.37%	$150	276	$ 41,376.05
Medium (13-24")	122	5.15%	$100	17	$ 1,747.28
Small (1-12")	173	7.31%	$10	25	$ 247.77
					$ 43,893.84

2030: 380 Trees Pruned/Year – 2,670 Trees on a 7 Year Cycle

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year
Evergreen	250	9.36%	$25	36	$ 889.51
Large (>24")	1800	67.42%	$150	256	$ 38,426.97
Medium (13-24")	200	7.49%	$100	28	$ 2,846.44
Small (1-12")	400	14.98%	$10	57	$ 569.29
					$ 42,732.21

2040: 445 Trees Pruned/Year – 3,115 Trees on a 7 Year Cycle

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year	
Evergreen	300	9.63%	$25	43	$ 1,071.08	445
Large (>24")	1800	57.77%	$150	257	$ 38,559.05	445
Medium (13-24")	450	14.44%	$100	64	$ 6,426.51	445
Small (1-12")	600	19.26%	$10	86	$ 856.87	445
					$ 46,913.51	

2050: 515 Trees Pruned/Year – 3,600 Trees on a 7 Year Cycle

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year	
Evergreen	400	11.11%	25	57	$ 1,430.56	515
Large (>24")	1800	50.00%	150	258	$ 38,625.00	515
Medium (13-24")	600	16.67%	100	86	$ 8,583.33	515
Small (1-12")	800	22.22%	10	114	$ 1,144.44	515
					$ 49,783.33	

Pruning Activities

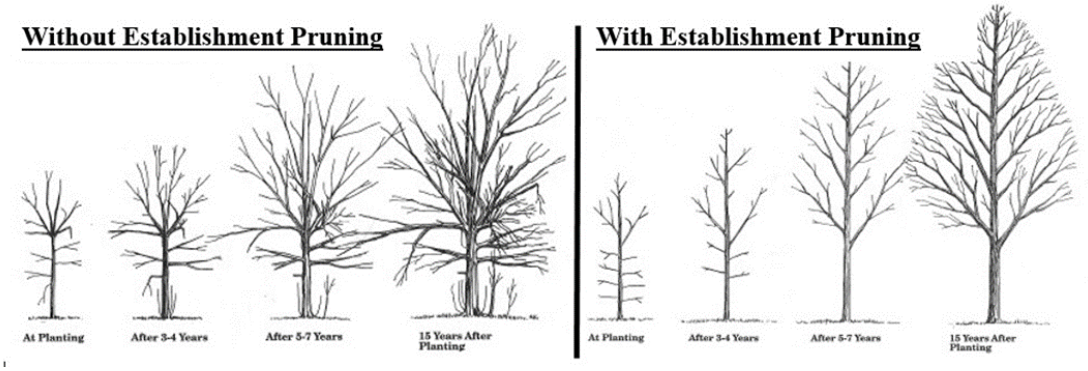
Refining of Pruning Cycle

Currently, GDVPR does not have a cycle pruning program due to budget limitations. However, as of 2021 GDVPR has been attempting to jump start a forestry program overall. Currently the, GDVPR prune trees on a needs-based basis. Though we are recommending a 7-year cycle pruning program, this number will likely fluctuate based around the results of the inventory updates. The cost to update the inventory annually will be significantly offset the tree maintenance activities.

It is very important to note here that the Forestry Consultant will help to refine the pruning activities to be performed, and that costs will be significantly lower than those listed due to a targeted approach. All too often in municipal and park district circumstances, we wind up pruning trees which do not need to be pruned based on geography. The cost to keep the inventory data up to date will more than be offset by the reductions in necessary pruning.

Pruning of Young Trees

For the purposes for this Plan, a young tree will be considered to be 12" DBH or younger. Young trees are still trying to acclimate to their sites. The pruning of young trees has different goals and outcomes than the pruning of larger, mature trees. The standard nursery stock has been meticulously pruned for four to ten years to have a single trunk, and the specific branching patterns which are considered common to the various tree species. Without proper establishment pruning, these trees might have multiple trunks, poor branch structure, and overall poor form and architecture.



Pruning of young trees to establish proper form is one of the most cost-effective maintenance activities. It is an inexpensive task that does not require a great amount of staff or volunteer time, and saves thousands of dollars in pruning and maintenance costs later in the tree's life. As mentioned above, due to not having to climb trees or use dangerous equipment, young trees may be pruned by GDVPR staff, or even well-trained local residents, with proper training from the Forestry Consultant, the relationship with the CommuniTrees program, or other qualified partner organizations.

Pruning of Mature Trees

A mature tree, for the purposes of this Plan, are considered to be greater than 12 inches in diameter. Mature trees are established in and acclimated to their sites. The pressure these trees face from their environment generally comes from above-ground factors such as pests, pathogens, man-made structures, other trees, windstorms, or lightning strikes. Pruning is performed to mitigate these above-ground issues. Natural aging and/or death are also reasons these trees are pruned. Pruning of mature trees may mitigate a short-term risk, such as after a storm; or pruning may be done to maintain a tree's long-term health and structure. In the wild, trees loose limbs to wind and disease frequently. Allowing trees to self-prune over time is not advisable in an urban setting. Safety factors may arise, and the process of self-pruning may bring up aesthetic issues in an urban environment. Mature public trees should only be pruned by professional Certified Arborists.

Private Property Trees

The park district shall not be responsible for the pruning of trees located on private property, or notifying residents of a need to prune trees. Per the proposed policy, this would mean that trees with 51% or greater of their trunk diameter on private property would be considered privately owned trees. GDVPR reserves the right to prune portions of trees overhanging public property, but is under no obligation to do so, and will perform such pruning at the discretion of the Park District Staff or Forestry Consultant.

Reasons for Pruning

Establishment Pruning

Establishment pruning is the single most cost-saving measure in tree care as it establishes good form and branch structure for the life of the tree. Establishment pruning of newly planted trees should be performed a minimum of one time prior to the tree reaching six inches in diameter. Once established, the tree will only require periodic cycle pruning to maintain an appropriate form for the urban forest. As mentioned above, because establishment pruning can be done without the use of dangerous equipment, the use of well-trained volunteers can be an effective means of pruning these young trees. GDVPR has considered the option of using the Indiana Tree Stewards program to assist in the pruning of young trees. As mentioned throughout this plan, the use of similar volunteer organizations is strongly encouraged.

Cycle Pruning

As noted above, trees should be pruned on a cyclical basis as preventative maintenance. In order to minimize the budget allocated to this task, we have used volunteer labor in our calculations for all trees 12" or less. Contracted labor or in house labor will be needed to handle larger trees, but we are anticipating that volunteers will take care of many of the smaller trees.

Emergency / Storm Damage Pruning

Emergency pruning is nearly always necessary in order to mitigate severe risk, such as limbs which have fallen and present an imminent hazard, have impacted a structure, are interfering with a utility, or are hanging and in imminent danger of doing any of the above. Emergency and Storm Damage Pruning shall be conducted at the discretion of GDVPR, with the best interests of the public in mind. This is the one occasion on which the tenets of this Plan may be left to interpretation. When life or property are in imminent danger due to conditions associated with a downed tree or tree part, GDVPR may take whatever remedial action is practical and reasonable to mitigate such imminent risk.

Sanitation Pruning

When a tree has been diagnosed as having been diseased or infested, sanitation pruning may be employed to maintain the tree while removing the diseased or infested portions. Such a technique is only effective when the host tree is infected/infested with certain pests and pathogens. Generally, removal will be the most cost-effective and safest option to avoid endangering other nearby trees. Diseases such as Black Knot fungus, Dutch Elm Disease, and Fire Blight are just a sampling of maladies which may be aided by sanitation pruning. See the appendix M for a more formal discussion of pests and pathogens.

Removal of High Risk Limbs

At times, a tree may not pose a high risk, but a single limb may have defects that make it hazardous. At these times, the removal of such limbs or parts may render the tree as low risk again, without causing permanent damage to the tree. This may also be considered when a private tree is overreaching GDVPR property. In this circumstance, the at risk limbs may be pruned back to the property line.

Pest or Pathogen Outbreak

The response to a tree becoming diseased or infested will generally be to remove the tree, or possibly prune the diseased or infested parts of the tree out. These are simply less expensive measures than attempting chemical treatment. Pest or Pathogen outbreak may be a reason for a number of the aforementioned activities, including tree pruning.

Tree Pruning Requirements and Standards – See Full Text in Appendix I

Gary Department of Venues, Parks and Recreation

1. All activities directly related to the operation of a chainsaw, bucket truck, limb rigging, or tree climbing shall be performed by a qualified employee, or under the supervision of a certified arborist or arborist trainee.

2. No pruning or maintenance activity that takes place within ten feet of a power transmission line shall be accomplished by a GDVPR employee unless they are a qualified Utility Arborist.

3. No cabling, bracing, or other such support systems should be installed GDVPR trees, either by the GDVPR, its community residents, or any contractors. Exception may be made by obtaining prior written approval of the City, or by GDVPR Staff if the tree has historic or ecological value

4. No heading, pollarding or espalier pruning shall be conducted on GDVPR trees, and no wound dressings shall be used under any circumstances, without a permit and prior written approval of GDVPR.

5. The need for pruning and maintenance of individual trees shall be at the discretion of GDVPR and its contractors.

6. GDVPR shall maintain a contracted Certified Arborist or Certified Arborist Trainee, and preference shall be given to in house, qualified labor for tree pruning activities

Section 14 – Other General Maintenance

Maintenance Activities

Retaining a Consultant

The task of updating an urban forestry program presents new challenges and learning curves, contracts to negotiate, bids to put out, resident concerns expressed, and many other experiences which will require the assistance of a professional. It is highly recommended that GDVPR retain a professional Urban Forestry consultant who can assist in navigating this territory, and help to advise GDVPR staff in their roles as Urban Forest stewards.

The forestry consultant should ideally be involved in sourcing contractors and vendors for tree pruning, removal, and planting operations, assisting in maintaining the tree inventory, coaching staff on tree health and risk assessments, assisting in explaining policies to residents and new council members, preparing contract and bid specifications, and teaching community residents how to help GDVPR in caring for their trees. The importance of this early relationship cannot be overstated, particularly because of the role that residents may play in caring for new trees.

Plant Health Care Applications

Trees, like people, sometimes contract pests and pathogens. Often these pests and pathogens can be controlled with a simple spray or injection, just as illnesses in humans can be controlled with medication. This practice is referred to as Plant Health Care. When financially practical, chemical control for common pests or pathogens may be utilized as a preventative or curative method for such ailments and increase the aesthetics and benefits of the tree population.

At present, Plant Health Care applications are a low priority for GDVPR. In the future, GDVPR may opt to be more proactive about its Plant Health Care program, including using Mycorrhizae and organic materials such as BioChar in order to be giving trees proper access to nutrients and water. Ultimately, making more informed selections through the reforestation planning process is the best tool we have, but some budget must always be allocated for reactive treatments as well. We have included a Plant Health Care appendix in this plan detailing some major pests, and our approach to them.

No resident of Gary shall be allowed to chemically treat any trees within the GDVPR system, and treatment shall be at the discretion of GDVPR alone. Treatments must be performed by a Certified Arborist who holds an Indiana Pesticide Applicators license. Additionally, trees being treated may still be removed at the discretion of GDVPR.

Water Management

The importance of water in the establishment, growth, and survivorship of trees cannot be overstated. Most trees adapted to our climate zone (USDA Hardiness Zone 5b) are also adapted to the amount of moisture we have in an average year. However, younger trees with less expansive root systems are susceptible to prolonged drought. Young trees often need additional watering, which is an essential maintenance activity and can increase the likelihood of the survival of newly planted or younger trees on the parkway. As we anticipate over 1,200 additional trees over the course of the next 30 years, this concept becomes very important. As recommended above, a watering program implemented by GDVPR should be an integral part of the tree planting program, and costs have been added to the estimates based on such watering. It is also recommended that as part of GDVPR's watering program, local volunteers from the partners section below be engaged.

Mulch

Proper applications of mulch are necessary and cost-effective maintenance activities. Mulch has many benefits, including eliminating weed growth in the root zone, protecting the tree trunk and root flare from lawn maintenance equipment, allowing water to percolate into the soil thereby reducing evaporation rates and drought stress, and creating a naturally acidic and fertile soil environment. Turf grass that we often see competes for resources such as water and nutrients, and mulch eliminates this competition. But not all mulching is beneficial. The practice known as "Volcano Mulching" is the poor practice of piling mulch against the trunk of the tree in excess of 3" deep. This causes moisture build up against the trunk, which is not adapted to wet environments, and can cause severe decay of the trunk tissue, and ultimately death. Material such as crushed limestone, red volcanic rock, or rubber pellets can alter the soil chemistry in an undesirable way, and cause dieback or tree death.

Fortunately, mulch is a commodity many entities can get for free so long as they are pruning and removing a fair number of trees each year. It is recommended that GDVPR establish a marshalling yard within City limits where pruning and removal contractors can dump wood chips. These chips can be made available for free to the Parks Department or the local community. This arrangement works very well for all parties involved: Pruning and removal contractors do not have to pay crew time to continually dump chips and pay for disposal, residents get free woodchips, and the planting contractor doesn't have to upcharge GDVPR for mulch when new trees are planted. All newly planted trees should have mulch applied appropriately. A longer term goal for GDVPR should be to mulch all trees 12" DBH and smaller, but for now, mulch for all newly planted trees, and preventing volcano mulching should be the 2 primary concerns.

Section 15 - Tree Preservation and Management During Construction

In many municipalities, ordinances exist to protect trees and shrubs from construction activities. The intent of such ordinances is to protect the benefits those trees and shrubs provide to the community. Since GDVPR does not deal with tree protection in a standard sense, we have included some recommendations below. Trees and shrubs are community resources that provide many benefits including the enjoyment of nearby property owners, as storm water benefits, energy savings, carbon sequestration and increased property values. We do believe that GDVPR should dovetail with the City's ordinance, and be able to use parks as overflow mitigation planting space for tree ordinance violations on City owned property. Likewise, trees impacted by large construction projects on GDVPR land should require mitigation to make up for the lost trees.

Therefore, tree and shrub protection and preservation during construction activities on GDVPR property represents an investment in the community. Ensuring the protection and preservation of these assets while minimizing burdens to GDVPR is essential. The requirements and standards set forth here are consistent with similar Midwest communities.

Tree protection and preservation during periods of construction involves protecting trees from damage caused by construction activities. This damage includes physical and chemical damage to the trunk, branches, and roots. Damage may be caused by equipment such as backhoes, skid steers, or other appendage-type equipment.

Tree Preservation Requirements and Standards – Full Text in Appendix J

Gary Department of Venues, Parks and Recreation

1. A tree survey shall be performed by a qualified individual prior to the beginning of any development activities on GDVPR land. The survey shall detail the size, species, and condition of each tree six inches DBH and greater OR managed landscape tree (intentionally planted, non-volunteer tree) of any size.

2. The Tree Survey and a Tree Protection Plan shall be submitted to GDVPR and all relevant architects, engineers, and workers, detailing the following:
   A. Trees to be removed
   B. Trees to be preserved
   C. Location and size of the Tree Protection Zone (TPZ) for each tree

3. The Tree Protection Zones for each tree shall be visibly delineated by the site engineer, using orange snow fencing or other high visibility exclusion material. When such a delineation is not possible, all workers on site shall be made aware of the TPZ verbally.

4. Trees lost to construction should be replaced on a 1:1 basis in terms of tree diameter. If replacement trees cannot be planted at the site address, other parks may be used as a mitigation planting site for additional tree planting.

Section 16 - Tree Risk Assessment Policy

Trees provide ecosystem and aesthetic benefits. Whether they are healthy, unhealthy, structurally sound, or in imminent danger of failing, all trees pose some degree of risk. Determining the acceptable level of risk, along with effectively managing that risk, is a key priority for forestry operations. As a tree manager, GDVPR always must assume some degree of risk. It is up to GDVPR to track that risk to ultimately decide how to take steps to mitigate trees which pose such risk in a manner which is responsible both economically as well as in the interest of public safety.

The chart below summarizes the risk observations made during the recent inventory. This is the equivalent of a Level 1 Limited Visual Risk Assessment and denotes a condition observed by the Arborist that would appear, in their judgement at the time of the inventory, to pose possible risk to people or property. We cannot stress enough that these were Rapid Assessments, and not full risk Assessments, and as such, are meant to indicate a need for further study, and do not represent a legal description of these trees risk levels.

These assessments are not legally binding, and are not intended to be utilized as evidence in a court of law. They serve primarily as a means of locating trees which require more detailed study before making a final decision as to management strategy. Any trees that fall into the substantial risk level category should receive a minimum Level 2 Risk Assessment and/or mitigating action. Any tree found to pose an elevated risk level should be monitored and/or inspected by GDVPR and a threshold of risk tolerance be established. Some of elevated risk level trees may also be considered for a Level 2 Risk Assessment and/or mitigating action. The levels of risk assessment are defined below.

Levels of Risk Assessment

These Risk Assessment Levels are based on the International Society of Arboriculture (ISA) Tree Risk Assessment Qualification (TRAQ) protocols, as well as the ANSI A300 Part 9 (Tree Risk Assessment) Standards. These levels are general guidelines, and may be open to a certain degree of interpretation. The TRAQ forms can be found in Appendix F. As mentioned previously, all trees in GDVPR were assessed for risk during the inventory, however these assessments were rapid assessments and not based on the TRAQ protocols, and as such do not represent any formal level of TRAQ risk assessment, and are not legally binding descriptions of risk. They are instead intended to provide GDVPR with data showing a need for a more detailed assessment on trees assessed to have an elevated, substantial, or critical risk level. Below are descriptions of TRAQ protocol assessments.

Level 1 Assessment

Also called a “limited visual assessment”, which is the typical “tree inventory” assessment, whereby a tree has a basic analysis of obvious physical defects and condition. The assessor walks to or drives by the tree, assesses it for defects, evaluates the risk posed by the subject tree, and reports the results of the assessment to the tree owner. Often, prior to a recommendation, a more detailed (Level 2 or Level 3) assessment will be required to gather additional data.

Level 2 Assessment

A Level 2 Assessment, also called a “basic assessment”, is a synthesis of the information collected during a detailed visual inspection of the tree and the surrounding site. Such an inspection requires a 360 degree walk around, and may include the use of simple tools, such as binoculars, magnifying lenses, mallets, probes, and trowels, or shovels. The goal is to get a more complete picture of the tree in its environment.

Level 3 Assessment
A Level 3 Assessment, also called an "advanced assessment", provides detailed information about specific tree parts, targets, and risk associated with each potential interaction. It typically requires specialized training and equipment, such as bucket trucks, resistographs, tomographs, and other equipment. This is the most detailed type of assessment.

Considerations in Assessing Risk

Likelihood of Tree Failure Impacting a Target
A large part of determining the likelihood of a tree failure impacting a target is determining the occupancy rate, or the amount of time that targets are within the Target Zone with the potential to be impacted by a tree failure. A large tree in the middle of a field could fail with little impact, but that same tree in a playground will have significant impact. In many roadways, motor traffic is present day and night. Some of GDVPR's 2,367 trees are located in proximity to playgrounds, picnic areas, buildings, parking lots, sports fields, or other areas where people may congregate. This makes the likelihood of a failed tree impacting a person relatively high. Though GDVPR properties are generally vacant at night and in inclement weather, the level of occupancy may be quite high when the properties are in use.

Consequences of a Tree Failure Impacting a Target
The potential consequences of the tree failure impacting a target are a cumulative function of both the value of the target and the characteristics of the tree and the type of failure it is likely to experience. Whereas the previous step was concerned with occupancy rates of an impact area, this step examines the consequences of the impact on a target and assumes that the target is always present, and Occupancy Rate is not considered. To follow with the above example, it is assumed that if a parkway tree were to fail, that a car, utility line, and person (anything that likely could be there) are all underneath it at the time of failure, and the consequences to those targets is evaluated. Consequences are generally considered to be "minor" for targets that can be easily replaced or repaired, such as outbuildings, tool sheds, and other similar targets. When a tree failure can cause injury, fatality, power outage, or other such outcomes, the consequences are considered to be "significant" or "severe" (see the table below).

It should be noted that for the consequences of failure to be considered as part of this risk assessment system, specific to GDVPR, the branch must have a minimum of a 3-inch diameter at the base. A smaller requirement would present an unrealistic and burdensome standard for inspection.

Weather
Every tree, no matter how healthy, can fail from wind velocity or other impacts such as lightning damage, ice loading or soil saturation. Weather events generally cause tree or tree part failures for trees which have preexisting defects. Extreme weather events, by contrast, can cause the failure of healthy trees. For all Tree Risk Assessments, Risk shall be assessed assuming "normal" weather conditions. It should be noted that "normal" weather conditions for northwestern Indiana include gusty winds, thunderstorms, tornadoes, heavy snow, and even an occasional ice storm. It is the extremes of these events that should be considered abnormal.

Gary Department of Venues, Parks and Recreation Tree Risk Assessment Policy

It is proposed that the Gary Department of Venues, Parks and Recreation is adopt the following risk assessment protocols, pending approval of their legal department. The implementation of these protocols requires the exercise of judgment and discretion by the staff assigned, including but not limited to the exercise of judgment and discretion as to the priority of actions to be taken, interim steps, and other risk management activities:

1. Gary Department of Venues, Parks and Recreation maintains a tree inventory detailing the species, size, and condition of all trees on its property, as well as a risk rating assigned after a rapid assessment at the time of the inventory which is not based on the TRAQ protocol. This UFMP recommends that the trees listed as receiving an elevated, substantial, or critical risk rating during the initial inventory be audited on a prioritized basis. During these audits, an Arborist and/or Forestry Consultant shall inspect these trees and shall identify trees potentially posing an unacceptable level of risk. Such trees identified shall either be scheduled for a more detailed risk assessment (Level 2 or 3), or shall be mitigated as soon as practical following the assessment.

2. During subsequent years, GDVPR staff shall perform limited visual assessments on an ad hoc basis by inspecting trees during the normal course of daily operations. Trees which may appear to present an elevated risk level shall be scheduled for a more detailed risk assessment (Level 2 or 3), or shall be mitigated, either by pruning, bracing, or removal, as soon as practical following the assessment.

3. Upon notification from a resident, staff, or visitor of GDVPR of a concern about a potentially high-risk tree, an Arborist and/or Urban Forestry Consultant shall perform a Level 2 or Level 3 Risk Assessment within (10) business days of the notification. If the tree is determined to have a risk rating above "Moderate" (as determined by TRAQ and ANSI A300 pt 9 Standards), a decision shall be made by GDVPR staff and/or Forestry Consultant as to what the appropriate mitigation measures are, if any.

4. All trees deemed to be in need of mitigating actions (removal, pruning, etc.) shall be documented in writing by GDVPR staff and/or Urban Forestry Consultant. The documentation shall include the date the assessment was performed, the species, size, and condition of the tree, and a brief narrative detailing which parts of the tree are likely to fail, the likelihood of failure, the likelihood of impacting a target, the consequences of tree or tree part failure, and the overall tree risk rating, per the ISA's TRAQ system of risk assessment.

5. A minimum branch diameter of three inches, by ocular estimate, shall be the standard to which this risk assessment policy applies. Assessing all branches smaller than three inches represents an undue burden to the GDVPR.

TRAQ Forms can be found in Appendix F at the end of this report.

TRAQ Tree Risk Assessment Matrices

Likelihood of Tree Failure Impacting Target

Likelihood of Tree Failure	**Likelihood of Impacting Target**			
	Very Low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat Likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat Likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat Likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Risk Rating Matrix

Likelihood of Failure and Impact	**Consequences**			
	Negligible	**Minor**	**Significant**	**Severe**
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

These 2 Tables are used to calculate risk in the following manner:

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Section 17 - Projected Budget

REMOVALS	**Milestones**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2030**	**2031-2040**	**2041-2050**
	Trees Removed	86	86	86	87	75	75/year	75/year	75/year
	Notes	First half of priority removals	Second half of priority removals	First 3/4 of standard removals	Second 1/4 of standard + first 1/2 low priority	Complete low priority + begin annual update removals	Update Inventory for New Removals	Update Inventory for New Removals	Update Inventory for New Removals
	Removal Cost (2020)	$37,830	$37,830	$42,060	$35,700	$24,000	$24,000	$24,000	$24,000
	Removal Cost (CPI)	$37,830	$37,830	$42,060	$35,700	$24,000	$27,600	$31,740	$36,501

PLANTINGS	**Milestones**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2030**	**2031-2040**	**2041-2050**
	Trees Planted	100	100	100	100	100	115/year	115/year	115/year
	Planting Cost (2020)	$5,000	$6,000	$7,000	$8,000	$9,000	$23,000	$23,000	$23,000
	Planting Cost (CPI)	$5,000	$6,000	$7,000	$8,000	$9,000	$26,450	$30,418	$34,980

PRUNING	**Milestones**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2030**	**2031-2040**	**2041-2050**
	Trees Pruned	339	263	338	340	340	380/year avg	415/year avg	515/year avg
	Notes	Dead limb pruning + Appx 1/2 of Priority Prunes	Remaining priority prunes + Training pruning	Begin 7 year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune	7 Year Cycle Prune
	Cost (2019)	$43,893	$34,052	$43,763	$43,763	$43,763	$49,200	$57,617	$66,681
	Cost (CPI)	$43,893	$34,052	$43,763	$43,763	$43,763	$56,580	$66,260	$76,683

FORESTRY CONSULTANT	**Milestones**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2030**	**2031-2040**	**2041-2050**
	Notes	UFMP / Inv Updates	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management
	Cost (2020)	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
	Cost (CPI)	$2,000	$2,000	$2,000	$2,000	$2,000	$2,300	$2,645	$3,050

Plant Health Care (PHC)	**Milestones**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2030**	**2031-2040**	**2041-2050**
	Notes	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care	Random Plant Health Care
	Cost (2020)	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
	Cost (CPI)	$2,000	$2,000	$2,000	$2,000	$2,000	$2,300	$2,645	$3,050

TOTALS	**TOTALS - 2019 $**	**$90,723**	**$81,882**	**$96,823**	**$91,463**	**$80,763**	**$100,200**	**$108,617**	**$117,681**
	TOTALS - CPI 3%	**$90,723**	**$81,882**	**$96,823**	**$91,463**	**$80,763**	**$115,230**	**$133,707**	**$154,264**

Section 18- Summary / Conclusion

The Gary Department of Venues, Parks, and Recreation (GDVPR) currently manages 2,367 trees across its 22 parks, representing 81 total distinct species. This data was collected by staff from Great Lakes Urban Forestry Management during the Spring of 2020, and used to prepare this Urban Forestry Management Plan. This project was made possible by a grant from the National Oceanic and Atmospheric Administration and the Indiana Department of Natural Resources, Lake Michigan Coastal Program.

In addition, through generous additional funding from the partner organizations, an inventory of trees at the Indiana University Northwest campus was also performed, totaling 960 trees, of which 555 were evaluated by our staff, and the remainder will be evaluated by students. Additionally, a tree planting / reforestation plan for the entire parks department was completed, detailing the locations and specific species to be planted of 550 trees over the next 10 years. This planting plan will help diversify the tree population over time and make it much more resilient against future pest and pathogen outbreaks.

Currently, the tree population is not in the best shape, and has some significant maintenance needs. 448 trees require removal, 421 trees are in need of prioritized pruning, and the condition of the trees is below average overall. There are also some trees that require hazard mitigation. That said, the most important part of creating a diverse and resilient urban forest are to recognize the issues, prioritize them, and then start to tackle them one step at a time. And that is exactly what this plan is intended to do on a basic level.

On a more important level, however, is engaging the community, its leaders, businesses owners, and other stakeholders to help with the effort! One of the best things about planting and caring for trees is that it is a long term goal that the community can rally around. We have already put out a survey that shows the community in Gary is very interested in trees, and they have contributed amazing ideas such as creating fruit orchards in some of the parks, or using vacant lots and abandoned spaces as places to grow trees. Now we need to use this management plan to catalyze this effort.

This is a call to action to get the community involved in the Urban Forest and have a sense of pride and ownership in their green spaces!

Trees and green spaces have been shown to reduce crime rates, have benefits for climate change, reduce flooding and stormwater effects, benefit learning and memory, and bring health benefits. And in fact just the trees in the Gary parks system have a standing value of over $14 million, and bring $130,000 in benefits tot the community each year. And that's just the parks! Imagine if we were able to expand this program to include all of the street and boulevard trees into the equation and look at that value to the community!

And the community ultimately is what this plan is about. It is not meant to dictate what needs to be done and exactly how it is to be done, but rather to show what we have found, and hopefully raise awareness and have that awareness lead to action. Trees are something that most people can universally get behind. Sure, they have some issues, as people in the survey had pointed out. Allergies and sewer line issues can certainly be an issue from time to time, but we believe the benefits of a vibrant tree population to the community far outweigh any drawbacks, and that the community itself can help to drive what needs to be done. As mentioned already, several survey respondents thought that vacant lots and abandoned spaces can be used for trees, and this is exactly the type of initiative and creative thinking that will transform Gary's Urban Forest into a sense of pride for the community and a nationwide example of what can be done.

Greta Lakes Urban Forestry Management would like to thank the City of Gary, the Venue, Parks, and Recreation Department, The Nature Conservancy, the Indiana Department of Natural Resources, Indiana University Northwest, The US Forest Service, the National Oceanic and Atmospheric Association, all of the other partner organizations and staff, and most importantly the citizens of Gary Indiana for all of their feedback and assistance in making this plan a reality. We look forward to partnering with all of you in the future as we make Gary's Urban Forest a shining example of what a community can do with its trees.

Glossary of Terms

Aerial Device: Any piece of equipment expressly intended to elevate a human worker above the level at which they typically stand with their feet on the ground surface. Can include but is not limited to bucket trucks, scissor lifts, etc

Aggressive: A floral or faunal organism which is native (endemic) to the United States or Indiana, but which is known to outcompete other more desirable organisms

Arborist: An individual engaged in the profession of arboriculture who is educated, trained, and licensed to provide for or supervise the management of trees and other woody plants

Arborist Trainee: Any person working under the direct supervision of an Arborist or Certified Arborist

Balled and Burlapped: A tree, shrub, or other plant prepared for transplanting by allowing the roots to remain covered by a ball of soil around which canvas or burlap is tied and secured with a basket.

Bare Root: Harvested plants from which the soil or growing medium has been removed

Best Management Practices (BMP): Methods or techniques found to be the most effective and practical means in achieving an objective while making the optimum use of resources

Caliper: Standard nurseryman's measure of tree diameter (size). Caliper measurement of the trunk shall be taken six inches above the ground up to and including four-inch caliper size. If the caliper at six inches above the ground exceeds four inches, the caliper should be measured at 12 inches above the ground.

Certified Arborist: An individual who has sufficient experience in the field of Arboriculture, and has been certified by the International Society of Arboriculture as being a Certified Arborist

Border Trees: Trees whose trunks, when measured at DBH, are situated on both public and private property

Branch Collar: The branch collar is the point where a branch joins the trunk or another branch. This is the area the arborist chooses to make a proper cut.

Climbing Line: Any rope or other such material explicitly intended for bearing the weight of a human being

Collected Plants: Trees or shrubs which have been sourced from private property for the intent of transplanting elsewhere

Compacted Soil: A high-density soil lacking structure and porosity, characterized by restricted water infiltration and percolation (drainage), and limited root penetration

Consumer Price Index: An index of the variation in prices paid by typical consumers for retail goods and other items

Containerized: A tree, shrub, or other plant prepared for transplanting, or grown in, a solid-walled container such as a plastic pots or wooden boxes

Contracted Staff: People working for an entity as part of an independently owned and operated private company which performs work for the entity, but who are not directly employed by the entity

Controlling Authority: An agency, organization, or corporate entity with the legal authority and/or obligation to manage individual trees or tree populations

Crew Leader: Any personal who has by direction or implication been chosen to lead a team of In-House or Contracted Staff

Crown: The upper part of a tree, measured from the lowest branch, including all branches and foliage

Critical Root Zone (CRZ): The minimum volume of roots necessary for a tree to have health and stability

Cycle Pruning: The process of routine maintenance pruning of trees, not related to storm damage or other hazard or emergency related-pruning, that occurs on a set and predictable time scale set forth by the City

Deadwood: Wood on a tree or shrub which is no longer biologically living and becomes brittle or prone to failure

Decline/Declining: Trees or shrubs which are experiencing symptoms of a general decline of health due to age, pest, or pathogen related issues

Desirable: A tree or other plant whose characteristics are sought after due to ecology, aesthetics, or public safety

Diameter or DBH: Diameter at Breast Height. A standard forestry measure of tree diameter (size), measured at 4.5' above ground level on the uphill side of a tree using a Diameter Tape or Biltmore Stick

Digging Machine(s): Any piece of mechanical equipment whose express purpose is to remove soil and plants from their current locations

Diseased: The status of a tree which has been negatively impacted by a pathogen, bacterial, fungal, viral, or similar lower life forms

Drip Line: The soil surface delineated by the branch spread of a single plant or group of plants

Drought: A period of two weeks or greater, during which there is less than one inch of rainfall, when the average daytime temperature during that same period exceeds 75 degrees Fahrenheit

Dutch Elm Disease: A fungal pathogen which causes the decline and death of specific species of Elm trees.

Dying: A tree which is in the process of biological death due to senescence, disease, infestation, or other such malady from which there is very little to no hope of long-term survival

EAB: Emerald Ash Borer. An invasive beetle pest which affects all Ash trees

Establishment Pruning: The pruning of a young tree in order to establish proper form and branching habit

Established Trees: Those trees which have been permanently planted for a period of no less than 6 months, and which have permanent roots established in the soil

Failure (tree failure): Breakage of stem or branches, or loss of mechanical support in the root system

Feeder Root: Any portion of the below ground portions of the tree whose purpose is to absorb water and nutrients

Floodplain: Land which has been determined to be periodically inundated with water from a nearby moving or static water body, such as a lake or river. Determined by the Federal Emergency Management Agency

Flush Cut: Either a pruning cut or final cut to remove a stump, for which the maximum acceptable distance from the ground or the branch bark ridge shall be no greater than 2 inches.

Full-Time: An employee who has regular employment through an entity and whose work hours exceed 36 hours in a week, and who is employed year-round

Fungal: Any of a group of spore-producing organisms feeding on organic matter, including molds, yeast, mushrooms, and toadstools

Grade: The level or pitch of a certain piece of land, as defined by the trees or shrubs which inhabit it

Hardscape: The nonliving or man-made fixtures of a planned outdoor area, such as sidewalks, retaining walls, streetlamps, etc.

Hazard: A known and documented state of imperiling public safety

Healthy Tree: Any tree which is successfully adapting to its environment, and shows no signs of disease, pests, pathogens, or other such maladies, as determined by the tree manager

Host: An organism which is susceptible to a known pest or pathogen

Indiana 811: Indiana's underground utility locating service

Infested: The status of a tree which has been negatively impacted by pests

In-House Staff: Staff directly employed by an entity, on either a Full-Time or Part-Time Basis

Invasive: A floral or faunal organism which is not native (endemic) to the United States or Indiana

Job Site: Any geographic location where a person or persons will be performing activities related to the care and maintenance of an entity's property

Liner Nursery: A privately owned plant propagation facility which specializes in the growth of small trees which are intended to be planted for growth into a full form

Managed: A tree or shrub which is in an area which is routinely mowed and managed. Not a wild forest grown tree or shrub, or area containing such trees and shrubs

Manufacturer's Recommendations: Any expressly written instruction manual for a given piece of equipment that details how said equipment is supposed to be managed or maintained

Mineral Soil: Any substrate which is composed of a variety of rocks and minerals in various states of decomposition, leading to the development of a substance on which living plants may live

Mitigation: The process of diminishing risk

Monoculture: A population of trees in close proximity to one another which is comprised of 3 species or less of trees and shrubs which is prone to pest or pathogen outbreak

Natural Resources: Flora, fauna, and other such living and non-living parts of the environment which an entity maintains

Nursery Stock: Woody Perennials which are of a "Tree Form" growth habit and are supplied by a nursery contractor for planting. Not established trees

Parkway Tree: Any woody plant within a Publicly-Owned right-of-way

Part-Time: An employee who has regular employment through an entity and whose work hours are less than 36 hours in a week, and who is employed year-round

Pathogen: A fungus, virus, or other such microscopic organism which causes decline or death of trees

Pest: An insect or other macrofaunal organism which causes decline or death of trees

Private Property: Land which, by deed or title, does not belong to a public entity

Public Safety: The welfare and protection of the general public

Reforestation: The process by which trees are planted to replace trees which have been removed

Rigging Line: Any rope or other such material explicitly intended for bearing the weight of a tree limb. Not to be used for supporting a human being

Right-of-Way (ROW): The publicly-owned land on which a road, drainage ditch, trail, or other public access is built

Risk: A situation involving potential exposure to danger or endangering public safety

Root Protection Zone (RPZ): The area on the ground surrounding a tree in which excavation, compaction, and other construction-related activities should be avoided or mitigated

Saddle: A piece of equipment expressly intended to hold a human being above ground level with the assistance of a rope or other such device

Sanitation Pruning: The removal of tree limbs that have become diseased or infested, in order to prevent the spread of disease or infestation from spreading throughout the rest of the tree e.g., Dutch Elm Disease, Black Knot Fungus, etc.

Seasonal Employees: Those employees retained by an entity for less than 6 months out of the calendar or budget year

Shrub: Any woody perennial which has a multi-stemmed growth habit not consistent with being considered a tree. Can be subject to interpretation

Sound Wood: Structurally sound, non-decayed, non-compromised wood in the trunk or Scaffold Branches

Staff: Those employees retained by an entity on a full-time basis with benefits provided

Structural Root: Any portion of the below ground portions of the tree whose purpose is to stabilize the plant against the forces of wind and gravity

TRAQ: Tree Risk Assessment Qualification. The International Society of Arboriculture's formal status of an individual who is qualified to assess the risk that trees may pose risk to the general public

Tree Protection Zone (TPZ): The area surrounding a tree in which excavation and other construction-related activities should be avoided

Tree Risk: The likelihood and consequences of failure of a tree or tree parts

Tree Risk Assessment: A systematic process used to identify, analyze, and evaluate tree risk

Underperforming: Trees which have systematic health and vigor issues resulting in poor health, architecture, or other such maladies as determined by the tree manager

Undesirable: A tree which is not desired in the landscape due to ecological, aesthetic, or public safety reasons, as determined by the tree manager

Unmanaged: A tree or shrub which is in an area which is not routinely mowed and managed. A wild forest grown tree or shrub, or area containing such trees and shrubs.

Urban Wood: Any tree or other woody perennial material which has been harvested for the sole purpose of long term storage in the form of furniture, recreational material, etc. Differentiated from "Reclaimed Wood"

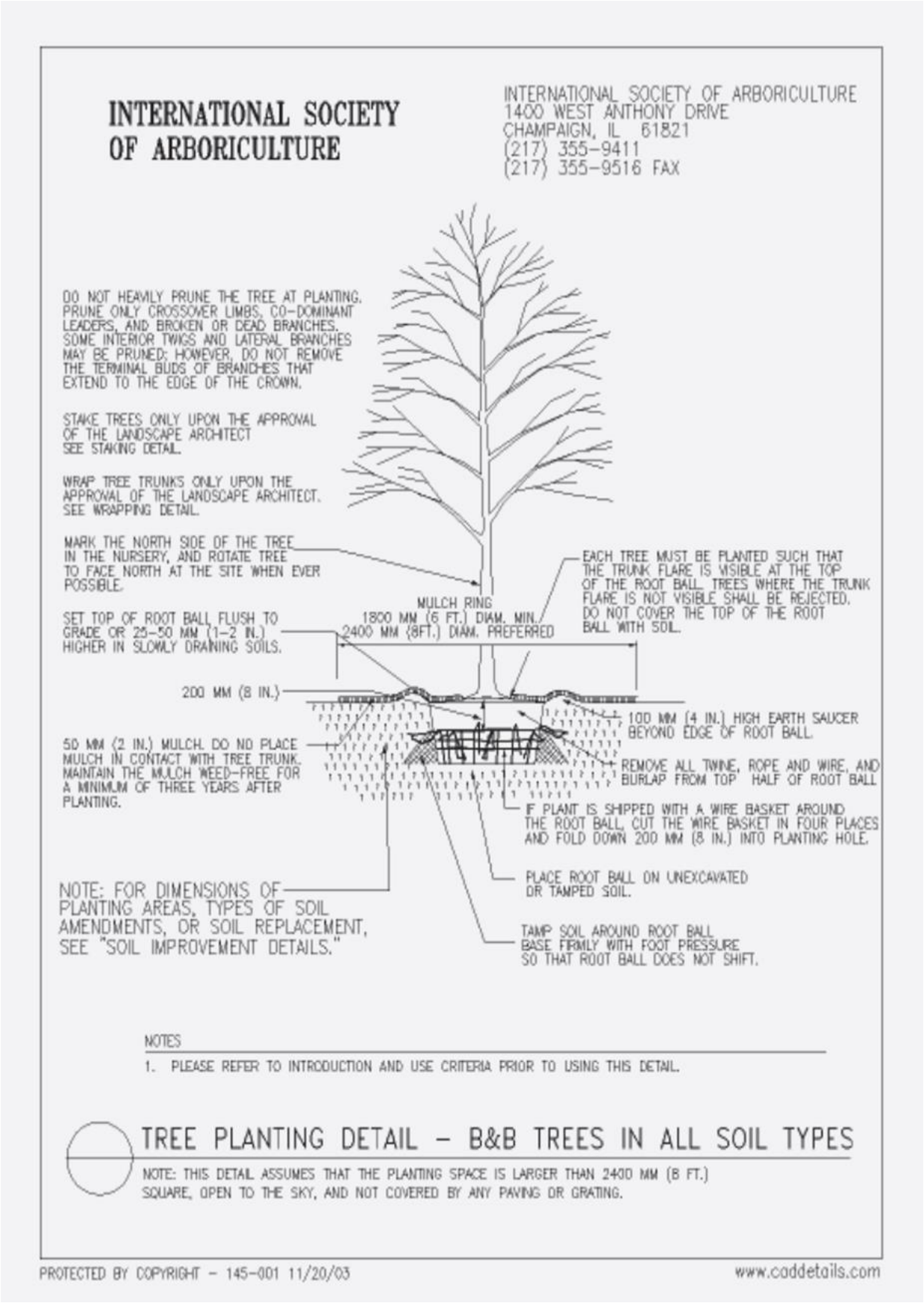
Utility Arborist: A person explicitly trained in the management of trees and other plants in relation to energized power lines. Someone who is licensed to work with conflicts between trees and such energized power lines

Appendix A: Approved / Unapproved Species

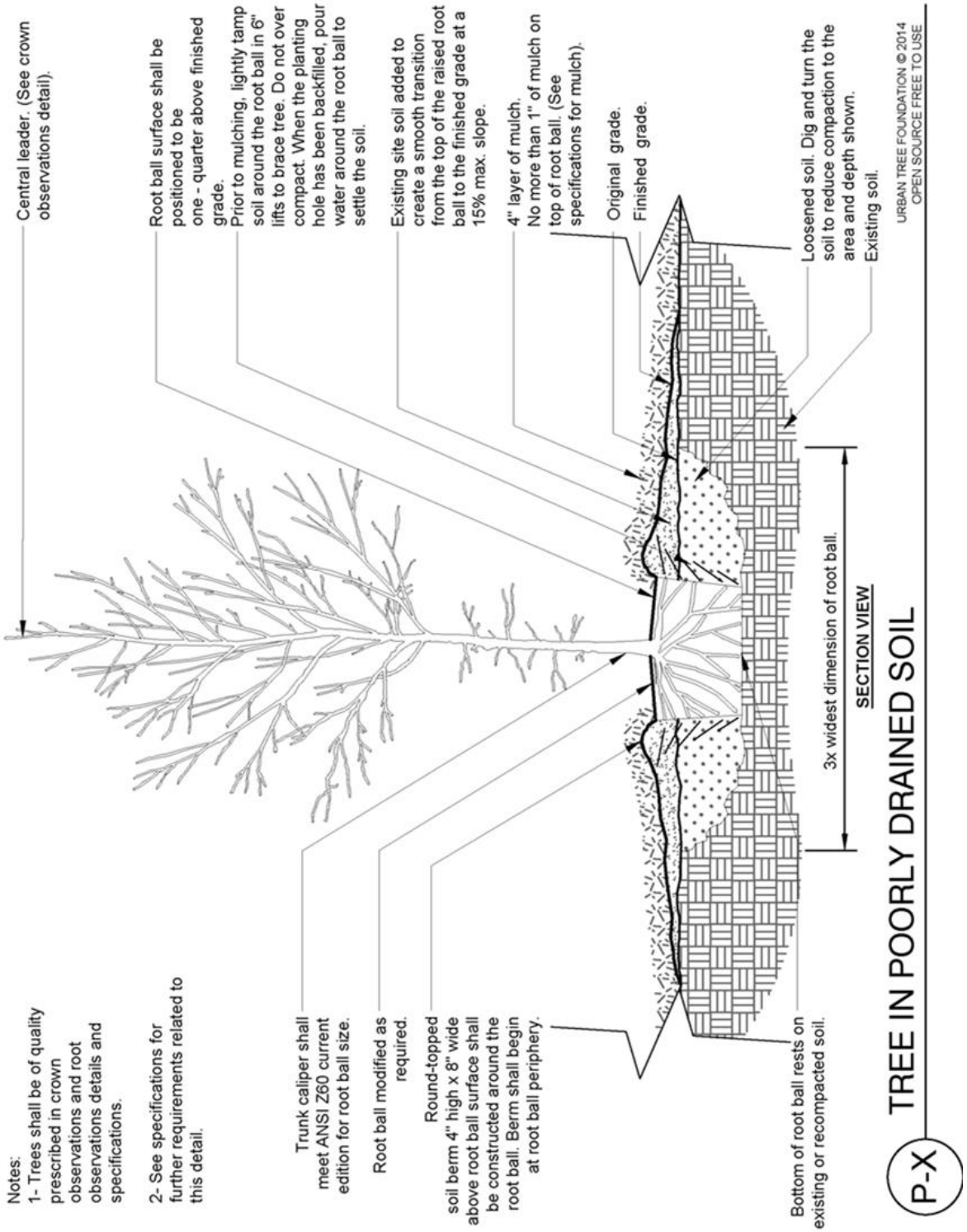
This list is subject to updating or amending by GDVPR, it's staff, partners, or consultants

NOT APPROVED	APPROVED SPECIES			
Any Size	Large Trees	Medium Trees	Small Trees	Evergreens
AILANTHUS	BALDCYPRESS	ALDER	AMERICAN REDBUD	ARBOR VITAE
AMUR CORKTREE	BEECH-AMERICAN	AMUR MAACKIA	APPLE-CRAB	DOUGLAS FIR
ASH-EUROPEAN	BEECH-EUROPEAN	BIRCH-RIVER	APPLE-EDIBLE	EASTERN REDCEDAR
ASH-GREEN	BUCKEYE-OHIO	BIRCH-WHITE	BUCKEYE-RED	FIR-CONCOLOR
ASH-WHITE	BUCKEYE-YELLOW	BLACKGUM	CHERRY-ORNAMENTAL	HEMLOCK-SPP
BOXELDER	CATALPA	ELM-CHINESE	DOGWOOD-SPP	JUNIPER-COMMON
BUCKTHORN	CHESTNUT-CHINESE	HARDY RUBBER TREE	HAWTHORN-COCKSPUR	PINE-AUSTRIAN
BURNING BUSH	DAWN REDWOOD	HAZELNUT-TURKISH	HAWTHORN-SPP	PINE-MUGO
CHERRY-BLACK/PIN	ELM-HYBRID	HORNBEAM-AMERICAN	HYDRANGEA-PEEGEE	PINE-WHITE
COTTONWOOD	GINKGO*	HORNBEAM-EUROPEAN	LILAC-SHRUB	SPRUCE-BLUE
ELM-AMERICAN	HACKBERRY	IRONWOOD	LILAC-TREE	SPRUCE-NORWAY
ELM-SIBERIAN	HICKORY-SPP	KATSURA	MAGNOLIA-SAUCER	SPRUCE-SPP
HONEYSUCKLE	HONEYLOCUST	MAPLE-HEDGE	MAPLE-AMUR	YEW
MAPLE-NORWAY	HORSECHESTNUT	MAPLE-MIYABEI	MAPLE-JAPANESE	
MAPLE-SILVER	KENTUCKY COFFEETREE*	MAPLE-PAPERBARK	PEACH/NECTARINE	
MULBERRY-SPP	LARCH	MAPLE-SHANTUNG	PLUM-SPP	
PEAR-CALLERY	LINDEN-AMERICAN	MAPLE-TRIFLORUM	ROSE OF SHARON	
POPLAR-SPP	LINDEN-LITTLELEAF	OAK-CHINKQUAPIN	SERVICEBERRY-SPP	
POPLAR-WHITE	LONDON PLANETREE	OAK-ENGLISH	SMOKETREE	
PRINCESS TREE	MAGNOLIA-CUCUMBER	OAK-SHINGLE	WITCH HAZEL	
RUSSIAN OLIVE	MAPLE-SUGAR	PERSIAN IRONWOOD		
WALNUT-ANY	OAK-BLACK	YELLOWWOOD		
	OAK-BURR	GOLDEN RAINTREE		
	OAK-PIN	MOUNTAIN ASH		
	OAK-RED	PEAR-EDIBLE		
	OAK-SWAMP WHITE	SASSAFRASS		
	OAK-WHITE	SEVENTH SON FLOWER		
	PAGODATREE			
	PERSIMMON			
	SWEETGUM			
	SYCAMORE			
	TULIPTREE	* - Male Only		
	ZELKOVA			

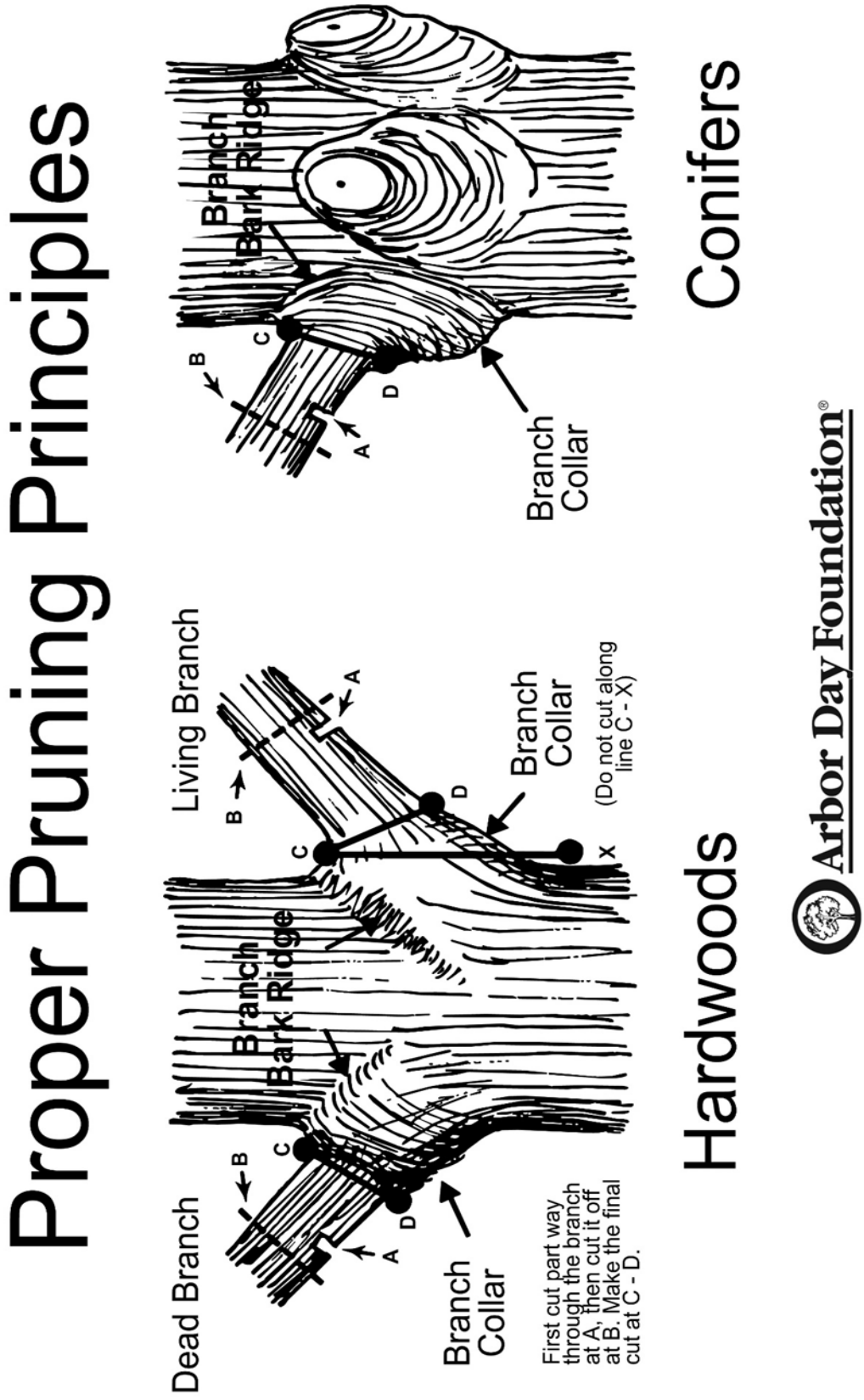
Appendix B: Balled and Burlapped Planting Detail



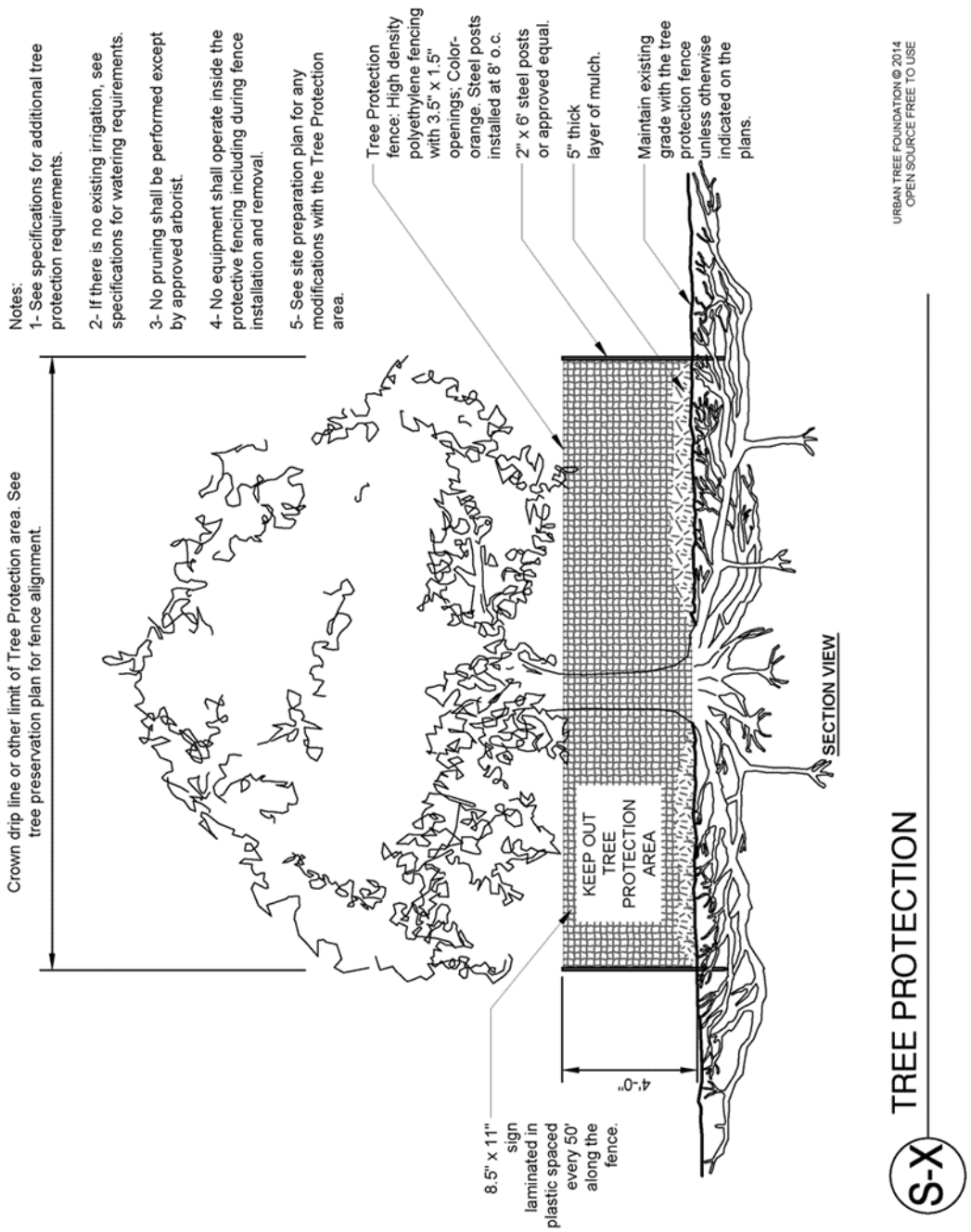
Appendix C: Container Planting Detail



Appendix D: Tree Pruning Detail



Appendix E: Tree Protection Detail



Appendix F: ISA TRAQ Form

ISA Basic Tree Risk Assessment Form

Client _____ Date _____ Time _____
Address/Tree location _____ Tree no. _____ Sheet _____ of _____
Tree species _____ dbh _____ Height _____ Crown spread dia. _____
Assessor(s) _____ Time frame _____ Tools used _____

Target Assessment

Target number	Target description	Target zone: Target within drip line	Target zone: Target within 1 x Ht.	Target zone: Target within 1.5 x Ht.	Occupancy rate (1–rare, 2 – occasional, 3 – frequent, 4 – constant)	Practical to move target?	Restriction practical?
1							
2							
3							
4							

Site Factors

History of failures _____ **Topography** Flat ☐ Slope ☐ _____% **Aspect** _____
Site changes None ☐ Grade change ☐ Site clearing ☐ Changed soil hydrology ☐ Root cuts ☐ Describe _____
Soil conditions Limited volume ☐ Saturated ☐ Shallow ☐ Compacted ☐ Pavement over roots ☐ _____% Describe _____
Prevailing wind direction _____ **Common weather** Strong winds ☐ Ice ☐ Snow ☐ Heavy rain ☐ Describe _____

Tree Health and Species Profile

Vigor Low ☐ Normal ☐ High ☐ **Foliage** None (seasonal) ☐ None (dead) ☐ Normal _____% Chlorotic _____% Necrotic _____%
Pests _____ **Abiotic** _____
Species failure profile Branches ☐ Trunk ☐ Roots ☐ Describe _____

Load Factors

Wind exposure Protected ☐ Partial ☐ Full ☐ Wind funneling ☐ _____ **Relative crown size** Small ☐ Medium ☐ Large ☐
Crown density Sparse ☐ Normal ☐ Dense ☐ **Interior branches** Few ☐ Normal ☐ Dense ☐ **Vines/Mistletoe/Moss** ☐ _____
Recent or planned change in load factors _____

Tree Defects and Conditions Affecting the Likelihood of Failure

— Crown and Branches —

Unbalanced crown ☐ LCR _____%
Dead twigs/branches ☐ ____% overall Max. dia. _____
Broken/Hangers Number _____ Max. dia. _____
Over-extended branches ☐
Pruning history
Crown cleaned ☐ Thinned ☐ Raised ☐
Reduced ☐ Topped ☐ Lion-tailed ☐
Flush cuts ☐ Other _____

Cracks ☐ _____ Lightning damage ☐
Codominant ☐ _____ Included bark ☐
Weak attachments ☐ _____ Cavity/Nest hole ____% circ.
Previous branch failures ☐ _____ Similar branches present ☐
Dead/Missing bark ☐ Cankers/Galls/Burls ☐ Sapwood damage/decay ☐
Conks ☐ Heartwood decay ☐ _____
Response growth _____

Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐ _____
Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐ _____

— Trunk —

Dead/Missing bark ☐ Abnormal bark texture/color ☐
Codominant stems ☐ Included bark ☐ Cracks ☐
Sapwood damage/decay ☐ Cankers/Galls/Burls ☐ Sap ooze ☐
Lightning damage ☐ Heartwood decay ☐ Conks/Mushrooms ☐
Cavity/Nest hole _____% circ. Depth _____ Poor taper ☐
Lean _____° Corrected? _____
Response growth _____
Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
Likelihood of failure
Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

— Roots and Root Collar —

Collar buried/Not visible ☐ Depth _____ Stem girdling ☐
Dead ☐ Decay ☐ Conks/Mushrooms ☐
Ooze ☐ Cavity ☐ _____% circ.
Cracks ☐ Cut/Damaged roots ☐ Distance from trunk _____
Root plate lifting ☐ Soil weakness ☐
Response growth _____
Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
Likelihood of failure
Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

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Risk Categorization

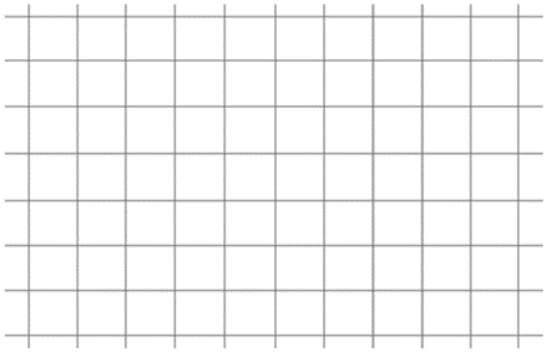
Condition number	Tree part	Conditions of concern	Part size	Fall distance	Target number	Target protection	Likelihood: Failure: Improbable	Likelihood: Failure: Possible	Likelihood: Failure: Probable	Likelihood: Failure: Imminent	Likelihood: Impact: Very low	Likelihood: Impact: Low	Likelihood: Impact: Medium	Likelihood: Impact: High	Likelihood: Failure & Impact (from Matrix 1): Unlikely	Likelihood: Failure & Impact (from Matrix 1): Somewhat	Likelihood: Failure & Impact (from Matrix 1): Likely	Likelihood: Failure & Impact (from Matrix 1): Very likely	Consequences: Negligible	Consequences: Minor	Consequences: Significant	Consequences: Severe	Risk rating of part (from Matrix 2)
1																							
2																							
3																							
4																							

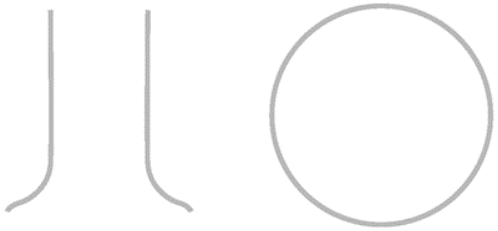
Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low





Notes, explanations, descriptions _____

_____

_____

_____

_____

Mitigation options _____ **Residual risk** _____

_____ **Residual risk** _____

_____ **Residual risk** _____

_____ **Residual risk** _____

Overall tree risk rating Low ☐ Moderate ☐ High ☐ Extreme ☐ **Work priority** 1 ☐ 2 ☐ 3 ☐ 4 ☐

Overall residual risk Low ☐ Moderate ☐ High ☐ Extreme ☐ **Recommended inspection interval** _____

Data ☐Final ☐Preliminary **Advanced assessment needed** ☐No ☐Yes-Type/Reason _____

Inspection limitations ☐None ☐Visibility ☐Access ☐Vines ☐Root collar buried Describe _____

This datasheet was produced by the International Society of Arboriculture (ISA) and is intended for use by Tree Risk Assessment Qualified (TRAQ) arborists – 2013

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Appendix G: ANSI Z133.1 Standards – Applies to All Sections

All of the ANSI Z133.1 safety standards shall apply to all tree care operations outlined in the Urban Forestry Management Plan. Listed below is a basic overview of the standard, and it is not verbatim. A full text of this manual will be made available to all GDVPR employees and contractors involved with tree care operations.

1. All tools and equipment utilized during tree care operations, including those not specifically mentioned below, shall be inspected and maintained by qualified personnel in accordance with the manufacturer's care instructions.

2. All staff shall be trained in the proper use, inspection, and maintenance of said equipment.

3. Certified arborists or arborist trainees shall conduct job briefings daily prior to tree care operations of any kind and the information shall be communicated to all workers.

4. All activities performed on any job site for any activity outlined in this Urban Forestry Management Plan shall comply with all applicable OSHA guidelines and standards.

5. Traffic and pedestrian control shall be established around the job site prior to the beginning of tree care operations.

6. Emergency contact information and a safety kit conforming to the ANSI Z308.1 standards shall be made available to all workers. All employees shall have basic instruction on the use of CPR and First Aid.

7. Personal Protective Equipment (PPE) shall be required when there is a reasonable probability of injury or illness on the job site. Such a determination will be made by the Certified Arborist or Arborist Trainee prior to the beginning of tree care operations each day, and PPE shall be made available. PPE shall be well-maintained in accordance with the manufacturer's requirements.

8. Head protection shall conform to ANSI Z89.1, face and eye protection shall conform to ANSI Z87.1, respiratory protection shall comply with ANSI Z88.2, and leg protection shall always be worn when using a chainsaw.

9. Flammable liquids shall be kept a minimum of ten feet from open sources of flame or high heat and shall be stored in approved containers.

10. All GDVPR Staff and contractors working near electrical hazards shall be qualified to do so and shall be educated in the full ANSI standards for Electrical Hazards and Line Clearance.

11. Vehicles and mobile equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements and shall be equipped with all standard safety devices, decals, and instructions, and shall be operated within all federal, state, and local motor vehicle codes and ordinances.

12. Aerial devices shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.

13. Aerial devices shall be stabilized by wheel chocks, outriggers, or stabilizers as necessary for the device, and shall never be used to lift, hoist, or lower logs or equipment unless specifically designed to do so.

14. Aerial devices shall be equipped with fall protection devices and permanent load ratings, both in accordance with ANSI/SIA 92.2 or 92.5, as applicable to the specific aerial device.

15. No aerial device shall be allowed to make contact with electrical conductors, and minimum approach distances shall be maintained in accordance with the ANSIZ133.1 Standard.

16. All brush chippers shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.

17. Sprayers and related plant health care equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions

18. Sprayer tanks or other similar enclosed spaces shall not be entered unless performed through a confined-space entry plan in accordance with OSHA 1910.46 Requirements, including air-quality testing, training, and PPE.

19. Chain saws and other similar portable power tools shall not be operated unless the manufacturer's safety devices are in proper working order. Such safety devices shall not be removed or modified.

20. Forestry staff shall have a minimum of two points of attachment to the tree or aerial device while operating a chainsaw at all times, unless the hazard posed by the second point of attachment poses a greater hazard than utilizing one point of attachment.

21. A visual hazard assessment, including a root collar inspection, shall be performed by a certified arborist or arborist trainee prior to climbing, entering, or performing work in or on any tree, and a second crew member shall be within visual or voice communication at all times during arboricultural operations that are in excess of 12 feet from the ground surface.

22. All ropes, saddles, carabiners, and other similar climbing equipment shall be: a) approved for use in the tree care industry by the manufacturer, b) have a minimum breaking strength or load capacity of 5,000 lbs., c) be inspected before each use, d) Equipment shall be removed from service when it shows signs of excessive wear or deterioration.

23. All pruning, removal, and rigging operations shall have a designated drop zone where limbs, trunks, and tools can be dropped from aloft without impacting pedestrians or passersby. A visual or verbal communication system between the employee aloft and the employee(s) on the ground shall be established to determine when the employee aloft will safely drop tree parts or tools.

24. Any tree parts which cannot be safely dropped or controlled from aloft shall have a separate rigging line tied to them to help control their fall. The tree shall be inspected for structural stability prior to the establishment of a rigging system in the tree. When trees appear to have defects that could jeopardize the ability to safely use a rigging system to drop or control a limb, an alternate plan shall be implemented.

25. All equipment utilized in rigging shall meet the load ratings for the limb being rigged, and a qualified employee, trained in proper rigging procedure shall determine the rigging procedure and equipment to be utilized. Any equipment which has been damaged or overloaded shall be removed from service.

26. When felling (removing) a tree, a crew leader shall make the determination of what equipment is necessary, and how many crew members are to be directly involved in drop zone operations. A well-established escape route shall be planned for involved workers prior to the beginning of felling operations. Any non-involved workers shall be beyond twice the height of the trunk or tree being removed during felling operations.

27. Notches shall be used on all trees and trunks greater than five inches in diameter during felling operations, and should conform to the standards set forth in the ANSIZ133.1 Standard.

28. Loose clothing, ropes, lanyards, and saddles shall not be worn during any tree care activity where the risk of entanglement with tools or machinery is possible, particularly with brush chippers.

Appendix H: Tree Planting Standards

ANSI Z60.1

1. All root ball and container sizes for all balled and burlapped stock shall conform to the Z60.1 standards for width and depth, such that they encompass enough of the fibrous root system as necessary for the full recovery of the plant upon installation.

2. All bare root stock shall conform to ANSI Z60.1 standards for minimum root spread.

3. All containerized stock shall conform to ANSI Z60.1 standards for plant and container size, as specified by GDVPR, and shall be healthy, vigorous, well-rooted and established in the container in which it is growing. The root system shall reach the sides of the container, but shall not have excessive growth encircling the inside of the container.

4. All collected plants (those grown on unmanaged land) shall be so designated, and shall be considered to be nursery-grown stock when they have been successfully reestablished in a nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons.

5. The trunk or stem of the plant shall be in the center of the ball or container, with a 10% overall variance in location.

6. The use of digging machines in both the packaging and installation of trees is considered an acceptable nursery practice.

ANSI A300 – Part 6

1. Planting sites and work sites shall be inspected for hazards by GDVPR or its contractors prior to the beginning of work each day. If portions of the work site are outside of the original scope of work, the controlling authority shall be notified immediately.

2. Location of utilities, obstructions, and other such hazards above and below ground shall be taken into account prior to planting and transplanting operations. These include, but are not limited to, gas, electric, sewer, communication, drainage, and signage.

3. The following shall be taken into consideration prior to transport and planting: Requirements of individual trees, compass orientation of field-grown trees, site feasibility assessments, soil assessment, and drainage assessment.

4. Tools for planting and transplanting shall be properly labelled or purchased for their intended use, and be maintained in accordance with the manufacturer's recommendations

5. The system used to move and store the plant shall minimize desiccation and other damage to the crown, trunk or rootball, and the health and vigor of the plant shall be maintained during these periods.

6. The hole to be dug for all new plantings shall be a minimum of 150% larger than the rootball or container diameter, as deep as the root flare of the tree to be planted, and shall have soil loosened in order to aid in root penetration.

7. For balled and burlapped trees, all rootball supporting materials shall be removed from the upper third of the rootball, and removed from the planting hole prior to final backfilling.

8. Prior to planting, container root balls shall be managed by approved methods such as, shaving the root ball, slicing the root ball, and redirecting or removing encircling roots.

9. Backfill shall comprise of either the same soil created when the hole was excavated, or a similarly amended mixture to meet a specific objective, and shall be applied in a layered fashion to reduce future settling and prevent air pockets.

10. Mulch shall be applied at a depth of two to three inches, near - but not touching - the trunk of the tree, and extending to the perimeter of the planting.

11. Support systems such as guy-wires or stakes shall not be installed except where needed, and shall be removed when no longer required for stability in the hole.

ISA BMP Manual – Tree Planting

1. Timing of planting shall be determined based on the species, and the best professional opinion of the employees of or contractors working for GDVPR.

2. All employees and contractors employed by or working for GDVPR shall be familiar with the following types of planting types, and when it is appropriate to use each:
   - **A. Bare-Root:** Field-grown, and dug without soil during the dormant season
   - **B. Balled and Burlapped:** Field grown and packaged with a soil ball, using burlap, twine, and a retaining basket of some kind
   - **C. Tree Spade:** Transplanted using a mechanical tree spade to hold the soil ball during transport
   - **D. In-Ground Fabric Bag:** Field grown with the root mass contained in a semi-permeable fabric bag
   - **E. Container Grown:** Grown above ground in containers of various shapes, sizes, and materials

3. Trees packaged with root balls must have their first structural root within two inches of the soil surface. Trees with deeper structural roots will not perform well when transplanted, and should be avoided when selecting nursery stock.

4. Trees with root balls shall be handled by the ball, not the stem, to ensure no damage occurs to the root-soil interface or to the stem itself**.**

5. Trees with leaves shall be transported with a fabric tarp to minimize desiccation, and have had their root balls wetted prior to transport.

6. Sites shall be tested for drainage, nutrient levels, and pH prior to planting (or prior to species selection, if possible).

7. Container stock shall be removed from its container. For balled and burlapped trees, wrappings shall be left on until the tree is in the hole; wrapping shall then be removed from the 1/3 to 1/4 of the wire basket and burlap from the top of the ball. For all types, ensure any encircling (girdling) roots are removed, and root ball is shaved as necessary.

8. As soil is added, wet and tamp each layer down to ensure good moisture and reduction of air bubbles.

9. Do not prune trees at time of planting, unless to remove dead, dying, diseased, or cracked branches, as it may take away from root development to have the tree attempt to heal these above-ground wounds.

10. The use of trunk wrap may be considered in areas with harsh winters, specifically on trees with thin bark, such as London Planetree and certain Maple species.

Appendix I: Tree Pruning Standards

ANSI A300 - Part 1

1. A designated Arborist or Arborist Trainee shall visually inspect each tree before beginning work. If any condition is observed above and beyond the original scope of work, said condition shall be reported to the controlling authority before any work begins.

2. Pruning cuts which remove a branch at its point of origin shall be made close to the trunk or parent branch without cutting into the branch-bark collar or leaving a stub.

3. Pruning cuts made to reduce the length of a limb or parent stem shall be made at a slight angle relative to the remaining stem, and not damage the remaining stem. If pruning to a lateral branch, the lateral should be large enough to assume the terminal role.

4. Final cuts shall be made such that the result is a flat surface, with the adjacent bark firmly attached.

5. Not more than 25% of the foliage shall be removed during an annual growing season, depending on the tree species, size, age, and condition. If more frequent pruning due to utilities, vistas, or health considerations is necessary, removal of the tree should be considered as an alternative to pruning.

ISA BMP Manual

1. All employees or contractors directly involved with the pruning of trees shall be familiar with the following pruning types and how they are to be used in conjunction with one another:

    1. **Pruning to Clean**: Selective removal of dead, diseased, detached, cracked, and broken branches
    2. **Pruning to Thin:** Selective removal of small live branches to reduce crown density
    3. **Pruning to Raise:** Selective removal of branches to provide vertical clearance
    4. **Pruning to Reduce:** Selective removal of branches and stems to decrease the height or spread of a tree or shrub
    5. **Structural Pruning:** Selective removal of live branches and stems to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems
    6. **Pruning to Restore:** Selective removal of branches, sprouts, and stubs from trees and shrubs which have been topped, severely headed, vandalized, lion-tailed, storm damaged, or otherwise damaged

2. Every effort shall be made to time pruning of individual tree species to be done in accordance with best management practices for the tree species in question. All pruning work shall be done so at the discretion of GDVPR and its approved contractors.

Appendix J: Tree Protection Standards

ANSI A300 – Part 5

1. Tree management plans and specifications for tree management shall be written and administered by a certified arborist qualified in the management of trees and shrubs during site planning, development, and construction. Such activities may include, but are not limited to: demolition, grading, building construction, walkway or roadway construction, excavation, trenching and boring, or other such activity which has the potential to negatively impact trees.

2. The management of trees and shrubs shall be incorporated into the following phases of the site development process:
   A. Planning
   B. Design
   C. Pre-Construction
   D. Construction
   E. Landscape
   F. Post-Construction

3. During the Planning phase, an assessment of tree and shrub resources on the site shall be performed by a certified arborist. The assessment shall identify the species, condition, and size of each tree and shall be incorporated into the site design. Trees to be retained or protected shall appear on site design maps. Trees on neighboring property which could also be impacted should also be considered.

4. During the design phase, a tree management report shall be developed for trees to be conserved on the site, and shall be included in the construction plans and specifications, which may include, but are not limited to:
   A. Trees to be retained
   B. Tree and Root Protection Zones
   C. Tree Protection Zone barriers
   D. Tree Protection plans
   E. Soil erosion control
   F. Soil compaction controls
   G. Staging and storage areas
   H. Other relevant on-site activities

5. Grading and demolition plans shall include all trees to be retained and removed, as well as the tree protection plans for working around trees to be retained. Plans shall also include equipment routes for avoiding the TPZ. Consequences for non-compliance shall be specified.

6. During the pre-construction phase, all tree protection plans shall be effectively communicated to all parties involved with the site development, and tree protection zone barriers shall be in place prior to the beginning of any construction activities.

7. The TPZ shall be delineated around all trees to be protected during construction, and shall be based on the size, species, and condition of the tree and its root system. Six to 18 times the diameter of the tree is generally considered to be acceptable. Deviations from this diameter may be made at the discretion of a certified arborist. Activities which could damage tree roots or compact soil should be avoided in the TPZ

8. Fencing or other visible barriers to the TPZ shall be installed prior to site clearing, grading, and demolition, and maintained throughout the construction and landscaping phase. When this is not feasible, alternate methods may be considered.

9. During the construction phase, compliance with tree protection plans shall be monitored by a certified arborist, and any damage to tree barriers or trees, or non-compliance shall be reported to the project manager or owner, or other controlling authority.

10. When removing vegetation or pavement during demolition, equipment used adjacent to the TPZ shall be specified to avoid damage to the tree and the surrounding soil, and soil protection measures shall be in place prior to vehicle or heavy traffic in or near the TPZ.

11. Storage or disposal of construction materials or hazardous materials shall not occur in the TPZ.

12. Fill within the TPZ shall not be permitted without mitigation to allow for proper air and water availability to existing roots. If fill cannot be avoided in the TPZ, compaction of fill shall be avoided, and consideration shall be given to a permanent well installation to protect the tree and its roots.

13. During the landscape, irrigation, and lighting phase, levels of compliance shall be documented and reported by a certified arborist. Non-compliance shall be reported to the project manager.

14. During the post-construction phase, a remedial and long-term maintenance plan shall be specified for existing and new landscaping, to ensure success of preservation efforts and newly planted landscaping.

15. Pruning shall be considered to reduce wind sail when necessary. It should not be considered to compensate for root loss.

16. Mulch shall be applied to as much of the tree protection zone as possible, in order to create a favorable soil environment for root recovery after construction activities.

ISA BMP Manual

1. A cost-benefit analysis shall be conducted during the planning phase. In some cases, money may be better invested in tree planting post-construction.

2. The species and age of tree shall be evaluated by a certified arborist, so that trees in good condition with desirable characteristics are preserved, but those in poor condition or with undesirable characteristics are not.

3. A tree inventory and tree management report shall be conducted during the planning phase, and a certified arborist shall work closely with developers to ensure best management practices are being met for both parties.

4. Effort shall be made to retain groups of trees, such that there is a wind and solar buffer around the highest quality trees if possible.

5. The Critical Root Zone (CRZ) is the area around the tree trunk where roots essential for tree health and stability are located. A Tree Protection Zone (TPZ) is an arborist-defined area around the tree which should include the CRZ, as well as additional area to ensure future stability and growth. The TPZ is subject to the professional opinion of the certified arborist.

6. An attempt shall also be made to preserve native soil for landscape planting as native soil with horizons and development is preferred over fill or black dirt.

7. If a sufficient TPZ cannot be established, a 6-12” layer of hardwood mulch, 3/4-inch plywood mat over a four-inch layer of hardwood mulch, or other such measures shall be temporarily installed over the CRZ in order to prevent root and soil compaction.

8. Trunk protection shall be installed on trees very close to construction activities, and should consist of 2x4 or 2x6 planks, strapped snugly to the tree trunk with wire or other strapping, preferably with a closed-cell foam between the trunk and the planks.

9. When roots over one inch cannot be avoided, they shall be pruned, not left torn or crushed. Acceptable methods of pruning are:
   A. Excavation using supersonic air tools, pressurized water, or hand tools, followed by selective root cutting
   B. Cutting through the soil along a predetermined line with a tool specifically designed to cut roots
   C. Mechanically excavating the soil (backhoe or similar) and selectively pruning remaining roots.

10. Wells, tree islands, retaining walls, and other such structures or strategies shall be considered as alternatives to any cut/fill work in the CRZ or TPZ.

11. Monitoring shall take place during construction and post-construction phases, and any non-compliance should be reported to the proper controlling authority right away, so that timely remediation or mitigation efforts may be undertaken.

Appendix K: Contract Formulation

Tree Maintenance Contract Formulation

As large-scale tree maintenance tasks will primarily be accomplished by use of a Tree Care Contractor as defined above, the following are guidelines for developing the most efficient and cost-effective contracts for park property tree trimming, tree removal, and stump removal contracts. As part of the bidding process, minimum requirements and capacities for contractors, equipment, and employee qualifications will be established as part of the bid documents for the various tasks, and addressed by specific contract language. Sample contracts are attached.

Tree Pruning

Contracts for pruning tree populations that have not been maintained on a regular basis should concentrate on that segment of the population that poses the most potential risk, and/or that segment that will benefit most from pruning operations. Those populations have been defined as part of this UFMP, and will be addressed as a priority. Once those situations have been resolved, a cycle-pruning program should be established to improve and maintain the urban forest. Most effective pruning cycles range in length from four to seven years. As we have noted many times above, however, we believe that a zone-based approach is not proper for GDVPR. We believe that updating of the inventory on a cyclical basis will identify the trees for which maintenance is needed most, and that maintenance can be carried out in any given year it is identified. This approach will stretch GDVPR's budget much further than pruning each tree every 4-7 years whether it needs it or not. The cost of the inventory updates will more than be offset by the reduction in maintenance costs.

Contract Timing

While many tree species may be safely pruned at any time during the year, all trees may be safely pruned during the dormant season. Dormant season pruning is usually defined as December 1st through the end of March. Dormant season pruning reduces the amount of material generated, minimizes the potential spread of communicable disease, and allows superior access to trees by equipment and workers. Contract completion may be extended or reduced depending on weather conditions and response of trees to weather patterns.

Contract Length

Contracts may be let on an annual or multi-year basis. While annual contracts may be able to take advantage of short-term economies, multi-year contracts enable prospective bidders to take advantage of economies of scale, commit resources and manpower over longer periods, and schedule activities far in advance. As such, long-term contracts offer the potential of lower cost, increased efficiency, and allow beneficial relationships to develop over time by eliminating the need to regularly apprise new contractors of standard adherence and performance expectations. When developing multi-year contracts, the first year of the contract is awarded to the lowest responsible bidder, and subsequent year's work awarded based on satisfactory completion of the previous year's work. In this manner, acceptable contracts may be extended, while agreements with contractors who perform poorly are avoided. Typical contact length is three years – the initial year plus two renewal years. The time frame may be extended beyond that point by mutual agreement between the City and the Contractor. Pricing for subsequent year's work will be in accordance with a specific, agreed upon Consumer Price Index (CPI). Increases in unit pricing for subsequent years will be capped at a maximum of 5%, regardless of the CPI increase. If the agreed upon CPI decreases, the previous year's unit prices will be applied to the extension year.

Contract Specifications

As specified elsewhere in the UFMP, all pruning shall follow the *ANSI A300 (Part 1) - 2008 Pruning* Standard and the ISA's *Best Management Practices: Tree Pruning (2008)* for the purpose of crown cleaning, crown thinning, crown raising, and structure development, or as amended. Contractors will be supplied with lists of trees to be pruned based on information generated by the inventory data. Minimum numbers of trees pruned in given time frames, size class definition, and overall completion dates will be addressed by specific contract language.

Tree Removal

Many of the principles that apply to the development of tree pruning contracts apply to tree removal contract preparation as well, with the exception of timing. Trees that pose the highest risk to GDVPR,staff, and visitors, and its property should be addressed as a priority. Those trees have been identified elsewhere as part of this UFMP.

Budget
As part of the inventory data collection process, trees requiring immediate removal have been identified and quantified. Those trees posing the most potential risk to GDVPR, staff, and visitors, and its property should be removed as a priority. As those trees are removed, trees requiring removal for other reasons documented as part of this UFMP may be scheduled. At a minimum, sufficient funds should be allocated to accomplish the removal of those trees initially identified as potential high-risk.

Contract Timing
All trees identified as potential high-risk by the inventory data should be removed immediately. A typical time frame for completion of a given list of tree removals usually specifies completion within ten business days of the receipt of the list. Specific time frames for completion of removals will be determined by explicit contract language. Trees that have been identified for removal but do not pose significant potential risk may be scheduled separately as time or budgets allow. Alternatively, lower priority removals may be grouped into a separate contract for dormant-season removal at alternative, off-season pricing.

Contract Length
Contracts may be let on an annual or multi-year basis. While annual contracts may be able to take advantage of short-term economies, multi-year contracts enable prospective bidders to take advantage of economies of scale, commit resources and manpower over longer periods, and schedule activities far in advance. As such, long-term contracts offer the potential of lower cost, increased efficiency, and allow beneficial relationships to develop over time by eliminating the need to regularly apprise new contractors of standard adherence and performance expectations. When developing multi-year contracts, the first year of the contract is awarded to the lowest responsible bidder, and subsequent years awarded based on satisfactory completion of the previous year's work. In this manner, satisfactory contracts may be extended, while agreements with contractors who perform poorly are avoided. Typical contact length is three years – the initial year plus two renewal years. That time frame may be extended by mutual agreement between the City and the Contractor. Pricing for subsequent year's work will be in accordance with a specific, agreed upon Consumer Price Index (CPI). Increases in unit pricing for subsequent years will be capped at a maximum of 5%, regardless of the CPI increase. If the agreed upon CPI decreases, the previous year's unit prices will be applied to the extension year.

Contract Specifications - As specified elsewhere in this UFMP, all equipment to be used and all work to be performed shall be in full compliance with the most current revision of the *ANSI Z133.1-2012 Safety Requirements for Arboricultural Operations*, or as amended. Minimum numbers of trees to be removed, specific time frames, and overall completion dates will be quantified, and addressed by specific contract language.

Stump Removal
Many of the principles that apply to the development of tree pruning and removal contracts apply to stump removal and restoration contract formulation as well, again with the exception of timing. Stump removal and restoration should occur as close to the date of removal of the tree as possible.

Budget - As part of the inventory data collection process, existing parkway stumps have been identified and quantified. As trees are removed through completion of the Tree Removal Contract, inventory updates will produce a list of stumps to be removed and restored. At a minimum, sufficient funds should be allocated to accomplish the removal and restoration of existing stumps and those resulting from the first year's removal contract. The Contract will specify the removal all tree stumps and buttress roots to a point eight inches (8") below the adjacent ground level. and removal of all surface and sufficient subsurface roots as may be necessary to eliminate "humps" in the parkway adjacent to the stump. The area then shall be restored with topsoil to the level of the adjoining grade and seeded.

Contract Timing – Existing stumps should be removed as soon as possible, and those generated by the removal contract be ground and restored as the removal contract progresses. A typical timeframe for stump removal and restoration is within twenty (20) workdays of receipt of the stump removal list. Specific time frames for removal and restoration completion will be determined by explicit contract language.

Contract Length – Contracts may be let on an annual or multi-year basis. The stump removal and restoration contract may be let in conjunction with, or separate from, the removal contract. If a single contractor submits the low quote on both operations, that contractor may be awarded both contracts. While annual contracts may be able to take advantage of short-term economies, multi-year contracts enable prospective bidders to take advantage of economies of scale, commit resources and manpower over longer periods, and schedule activities far in advance.

As such, long-term contracts offer the potential of lower cost, increased efficiency, and allow beneficial relationships to develop over time by eliminating the need to regularly apprise new contractors of standard adherence and performance expectations. When developing multi-year contracts, the first year of the contract is awarded to the lowest responsible bidder, and subsequent years awarded based on satisfactory completion of the previous year's work. In this manner, satisfactory contracts may be extended, while agreements with contractors who perform poorly are avoided.

Typical contact length is three years – the initial year plus two renewal years. That time frame may be extended by mutual agreement between the City and the Contractor. Pricing for subsequent year's work will be in accordance with a specific, agreed upon Consumer Price Index (CPI). Increases in unit pricing for subsequent years will be capped at a maximum of 5%, regardless of the CPI increase. If the agreed upon CPI decreases, the previous year's unit prices will be applied to the extension year.

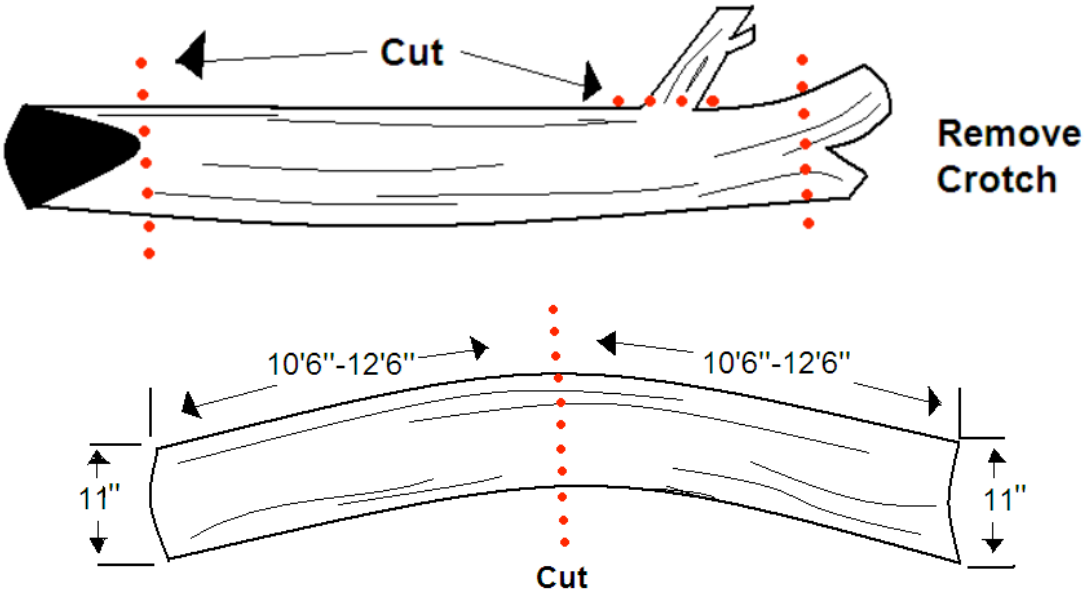
Contract Specifications - As specified elsewhere in this UFMP, all equipment to be used and all work to be performed shall be in full compliance with the most current revision of the *ANSI Z133.1-2012 Safety Requirements for Arboricultural Operations*, or as amended. Site appearance, disposal of grindings, backfilling, and seeding specifications will be addressed by specific contract language.

APPENDIX L: Urban Timber Harvesting

Log Removal Specification for Urban Timber Harvesting

This tree removal standard shall not take precedence over applicable industry safe work practices and shall be implemented by a qualified arborist, urban forest manager, and /or practitioner who, through related training or on-the-job experience, or both, are familiar with the standards, practices and hazards of recovering urban forest products and the equipment used in such operations. Additionally:

- Logs shall be felled to obtain minimum 8', 10', or 12' lengths with an additional 6" of trim on each log to a minimum diameter of 11" inside the bark. Maximum log length shall be 20'6".
- If a tree must be removed in sections, every effort should be made to retain the lowest log, at the longest possible length that can be safely felled.
- Branches should be trimmed flush with the bole/trunk, root flares should be trimmed flush with the bole/trunk, and the ends of the log should be square.
- Logs shall be flush cut with no crotches or splits. All obvious defects such as decay, large holes, and rot shall be removed.
- Logs with significant sweep shall be cut in order to eliminate as much sweep as possible while yielding the longest possible straight logs to ensure logs are flush for proper milling.



APPENDIX M: PLANT HEALTH CARE APPLICATIONS AND SAFETY

Pests and Applications

Gary Department of Venues, Parks and Recreation may recognize the following pests and pathogens to be among those which may warrant treatment during the course of the growing season in order to maintain trees health, aesthetics, and benefits provide to the community:

Emerald Ash Borer (EAB) – EAB is an insect pest which affects all species of the Ash tree genus (*Fraxinus*) in the United States. It kills the tree by having insects chew through the cambium tissue and effectively girdle the tree, causing it to not be able to get nutrients and water up to its leaves. This results in tree death several years after infestation.

Treatment for Emerald Ash Borer involves either a direct trunk injection of insecticide concentrate, or a soil drench (root application) with insecticide and fertilizers, or at times a combination of both. This insecticide in combination with fertilizer both kills the larval stage beetles, as well as provides the tree with additional nutrients to be able to heal the beetle damage.

Zimmerman Pine Moth - Zimmerman Pine Moth (ZPM) attacks most Pine species, but Austrian and Scotch Pines are particularly susceptible. The female ZPM lays eggs in midsummer near the edges of previous wounds. The larvae overwinter and begin feeding the following spring. They first feed on the bark and then bore into the cambium. The tunneling girdles the branches and causes dieback. After several years of damage, the trunk may weaken and break off. Signs of infestation include large masses of frass and resin in the branch whorl area on the trunk. These masses are often off-white or yellowish (see photo).

To control ZPM, apply an insecticide to the trunk and branches in early spring during larval activity and again in midsummer during egg-laying. Remove dead trees promptly, as they can serve as hosts and a center of infestation.

Diplodia Tip Blight - Many Pine species can be infected by Diplodia Tip Blight (DTB), but in our region Austrian and Scotch Pine are the most susceptible. DTB is more likely to occur when trees are stressed and near infected susceptible species. The disease first appears as browning of needles at the tips of shoots (see photo). Needles are often shorter than normal, and sometimes droplets exude from infected needles. Small black fruiting bodies of the fungus can be seen at the base of needles. Fruiting bodies also form on scales of seed cones and on bark of infected shoots. Often the damage appears in the lower part of the tree, but shoots throughout the tree may show damage. Repeated infection of branch tips results in deformed tree growth and loss of vitality. The fungus can also cause cankers, with excessive and obvious sap exudate.

Management of DTB includes not planting susceptible trees near mature infected Pines. On infected trees, remove any dead or cankered wood and cones. Mulch and water as needed to reduce stress. Fungicide spray requires three timely applications: 1) when buds begin to elongate/swell 2) just before the new needles begin to emerge from the fascicle sheath, and 3) 10 to 14 days later. Lastly, consider avoiding the use of the most susceptible Pines in landscape plantings.

Apple Scab – Apple Scab is a complex fungus which affects most species of Crab Apples, as well as some Serviceberries, Hawthorns, and Pears. It is often found alongside a very similar and related fungus called Cedar Apple Rust. This fungus infects the leaves and fruits of these trees, and often they lose their leaves and become entirely defoliated by the early summer. Though rarely if ever fatal, our parks contain a great number of all of these species, and it results in a very poor aesthetic when there are many small ornamental trees which appear nearly dead in the middle of August.

Control of Apple Scab is very similar for control of Diplodia Tip Blight, and involves 3 applications of fungicide: 1) Right when buds begin to break in spring 2) 2 Weeks later when tree has half of its leaf emerged 3) 2 weeks after that just before or during flowering. Cultural treatments are also effective such as raking up dead leaves so spores have nowhere to live.

Other Potential Pests and Disorders May Include

PEST/PATHOGEN	AFFECTED SPECIES	TREATMENT
Dutch Elm Disease	American Elm	Fungicide infusion at the root flare with large water volume
Thousand Cankers Disease	Walnut Species	None known yet, possible fungicide injection
Japanese Beetle	Linden, Birch, Others	Leaf spray of diluted insecticide during flight season
Iron / Manganese Chlorosis	Maples, Birches, Others	Soil or trunk injection of Iron and Manganese
Scale Insect	Many	Spray or trunk injection with insecticide
Bur Oak Blight	Burr Oak	Fungicide injection in trunk
Oak Wilt	Red Oak Family	Root trenching / fungicide injection

Pesticide Safety

When applying any Plant Health Care application to any public site, Gary Department of Venues, Parks and Recreation shall observe the following:

1. Marking of the site to be sprayed or applied to with white flags or other signage clearly allowing park patrons to know what is being applied.

2. Chemicals shall only be applied by a licensed Indiana Applicator, who is wearing the appropriate Personal Protective Equipment based on the label of what is being applied to the site.

3. Chemicals shall be applied at the label rate for the pest or pathogen being controlled, and in keeping with the manufacturer's instructions, and shall be stored in accordance with the manufacturer's instructions.

4. Aerial sprays shall not be applied when the wind speed or wind gusts exceed 15 miles per hour during the course of the day, in order to avoid overspray

5. No chemical applications shall be performed when temperatures exceed 85 degrees Fahrenheit, in order to avoid volatilization of chemicals resulting in non-target organisms being affected.

6. All Personal Protective Equipment and Application Equipment shall be maintained in accordance with the manufacturer's instructions and applicable ANSI standards for such equipment.

7. Tanks shall be triple rinsed when switching between applications and only approved tank mixes shall be acceptable when multiple chemicals are being mixed together.

8. Care shall be taken by all employees to wash hands and clothes as needed to avoid unnecessary exposure to any chemicals.