2021 Urban Forestry Management Plan

City of Terre Haute

Prepared By:

Steve Lane – Urban Forestry Consultant
Certified Arborist IL-4565A - TRAQ

GREAT LAKES URBAN FORESTRY MANAGEMENT
A GRAF TREE CARE COMPANY

Introduction

Recently, the City of Terre Haute had most of its tree inventory data updated. This inventory resulted in a total count of 16,212 trees, and included critical maintenance and condition data, as outlined in the attached Executive Summary. This Management Plan will serve as an update and enhancement to the previous Management Plan from 2010. Please note that all tree population analysis in terms of composition and structure have been provided in the Executive Summary report, and so this document will strictly focus on benefits provided by the Urban Forest, some additional analyses and maps, and a plan moving forward for some critical areas of Terre Haute's Urban Forestry program. It is worthy of note here that this plan is meant to be adaptively managed. It should be reviewed periodically and edited to make sure it is building on success, or correcting failures where they have occurred. We recommend once every 2 years this plan be revisited and edited.

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 Terre Haute. This will provide the following benefits to the residents of the community: Increase canopy cover, filter and reduce storm water runoff, 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 publicly owned right of ways and other publicly managed land. 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 Terre Haute'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.

Goals Summary

The following goals shall be for the next 10 years in Terre Haute in order to maximize the benefits of its Urban Forest while minimizing risk to its residents, as well as educating the public about the importance of trees to build a coalition in order to accomplish these goals. These goals will be expanded upon further in the Management Plan after discussion of some more tree population data, but we felt it was important for the reader to look at this additional data analysis with these goals in mind first. They are listed mostly in order of importance, however there is considerable latitude in how the city chooses to approach these goals:

Complete the Remaining Tree Survey Update – While the inventory update was a monumental undertaking this year, the funding available was only able to cover updating approximately 80% of the population. The remaining trees should be assessed as soon as possible to make this update complete and have all the data available at that time for making more precise planning and decision making when it comes to future management decisions.

Revisit Cycle Pruning Program – Currently, while the city spends a good amount of money each year on forestry related activities, it has been very heavily focused on tree removals. We believe this needs to shift to proactive maintenance in the form of cycle pruning. Currently, the city has 7 zones into which its trees are divided geographically (see maps section after this), but trees are not distributed equally in these zones. We have provided a rough budget for tree pruning over the coming years but redrawing these zones and updating the pruning program will make this transition much smoother.

Focus More Budget on Tree Planting – As stated above, most money has been going to tree removals, and it is time to start redistributing some of those funds to other places, most notably tree planting. As we will mention below, overall, and with only 80% of the City's tree inventory updated, the current stocking density of Terre Haute's street tree population is right around 81%, which means there are many open planting sites in which to plant trees. Our goal here is to grow Terre Haute's street tree population by nearly 2,000 trees over the coming 10 years.

Create Local Partnerships to Attain Goals – There will be some lofty goals set here in terms of tree planting, maintenance, and public outreach. Not all these goals may be able to be accomplished using just in house or contracted staff and labor. Engaging the Community through local partnerships will be key to accomplishing some of these goals. Whether it is a volunteer tree planting, young tree pruning, engaging volunteers to water and mulch trees, or having people plant trees on their own property, the success of Urban Forestry programs often depends on partnerships.

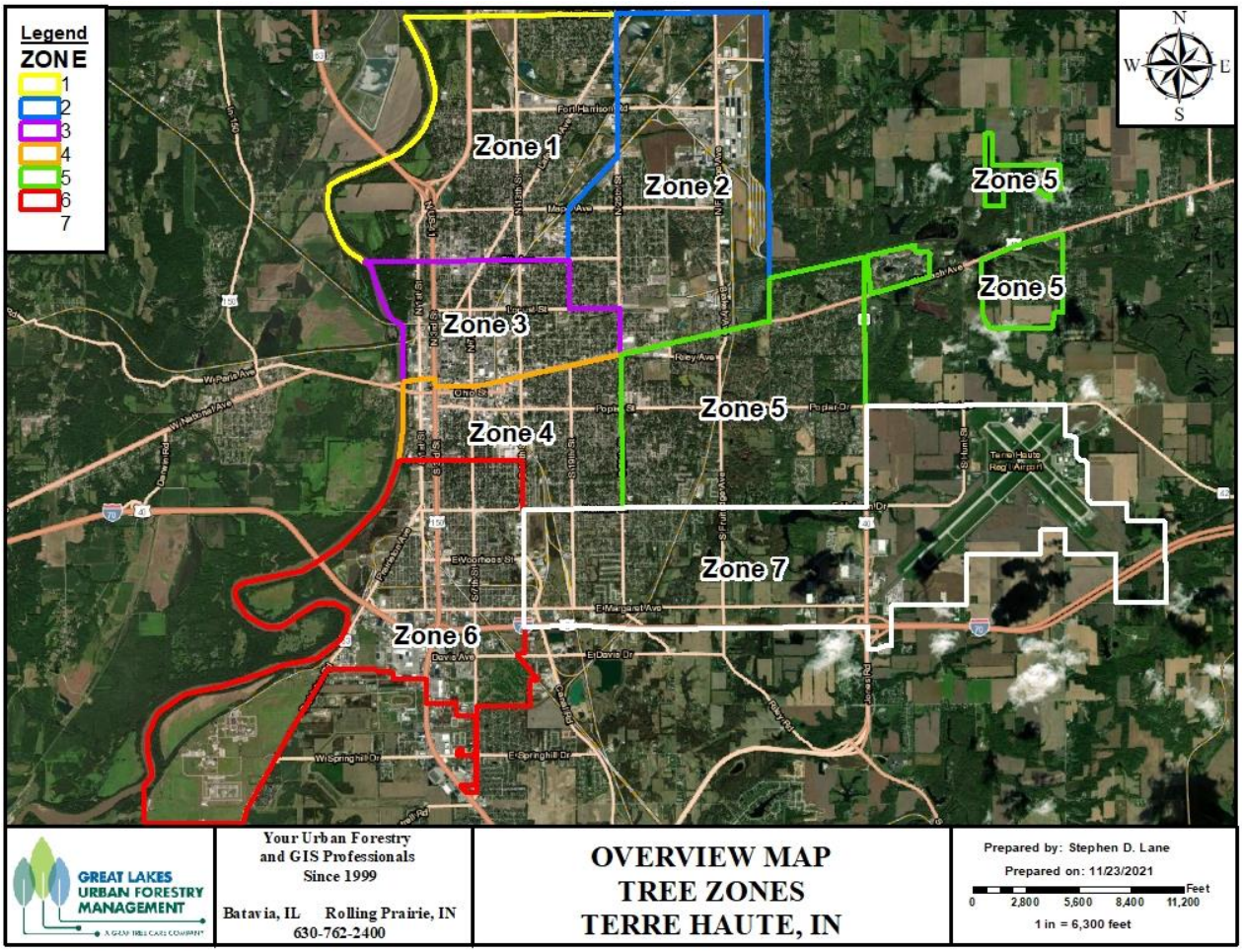
Create and Implement a Tree Risk Management Policy- Trees create great benefits, but during a storm or other weather event, they may also pose a great risk. Trees need to be well-managed and healthy to avoid that risk. A draft risk assessment policy been created for Terre Haute as part of this Plan. 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.

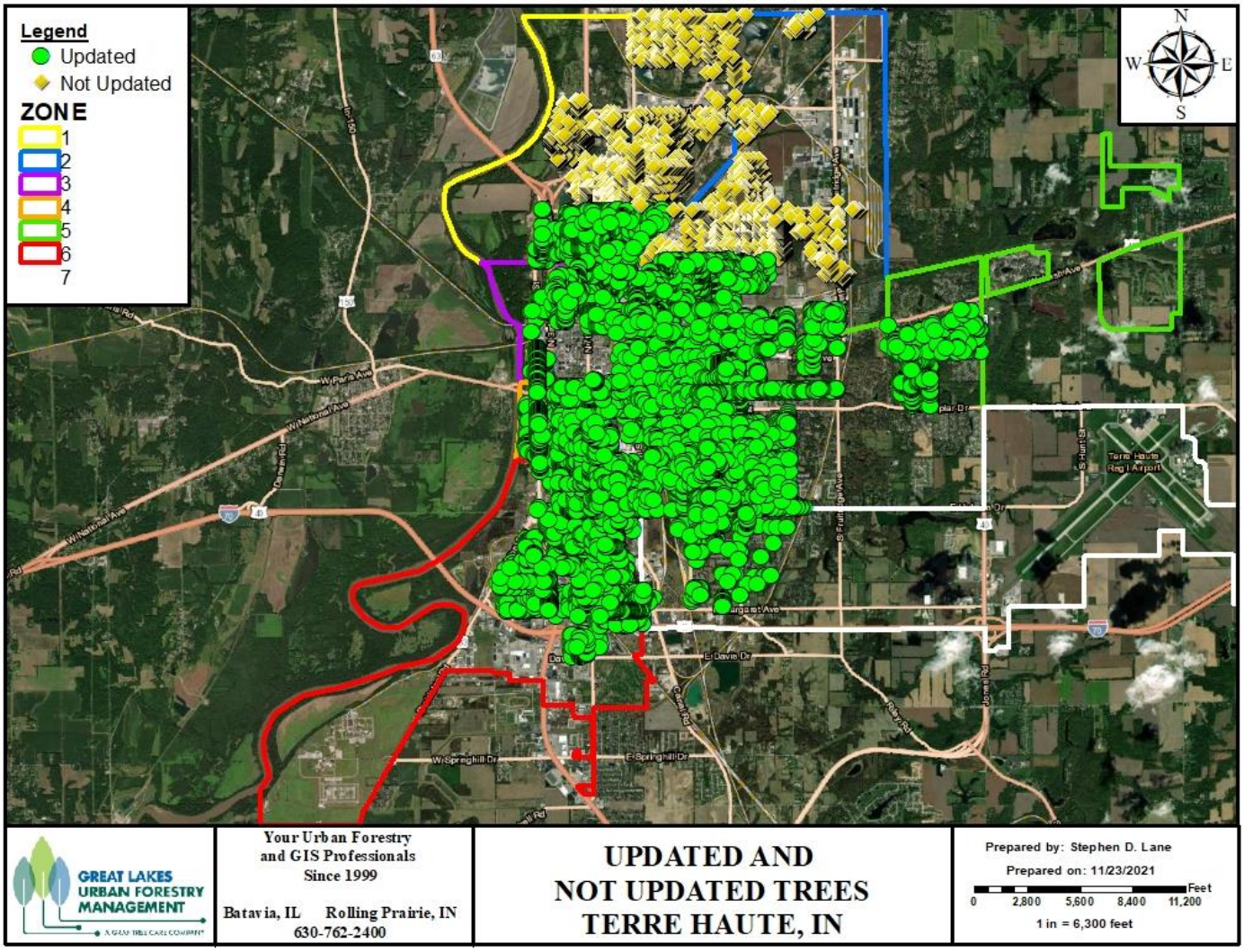
Diversify the Tree Population - This will be expanded on later, but creating a more diverse tree population with a focus on planting the right tree in the right place and avoiding overplanted species will make the tree population less susceptible to mass tree loss from pests and pathogens. This will ultimately save the city time and money as it strives to have a more diverse, resilient, and beautiful tree population! A City-wide tree planting plan which plans for the "right tree in the right site" will be an important part of this process.

Maps and Charts

The following maps and Charts have been created as an update to the 2010 plan's series of maps and charts.

Below is a map of the areas which have been completed during this update cycle and those which remain to be updated. The majority of trees still to be updated lie in zones 1 and 2;

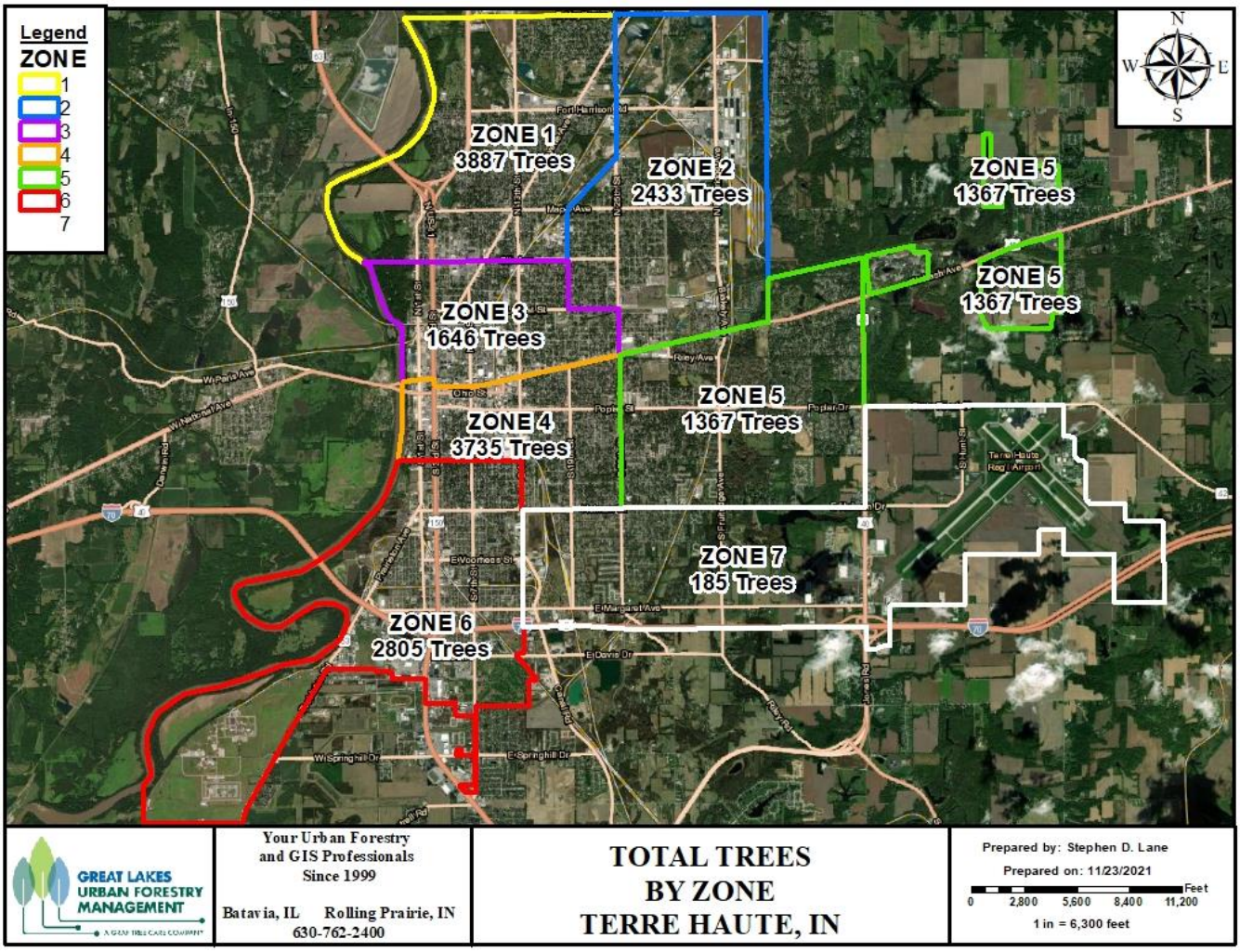




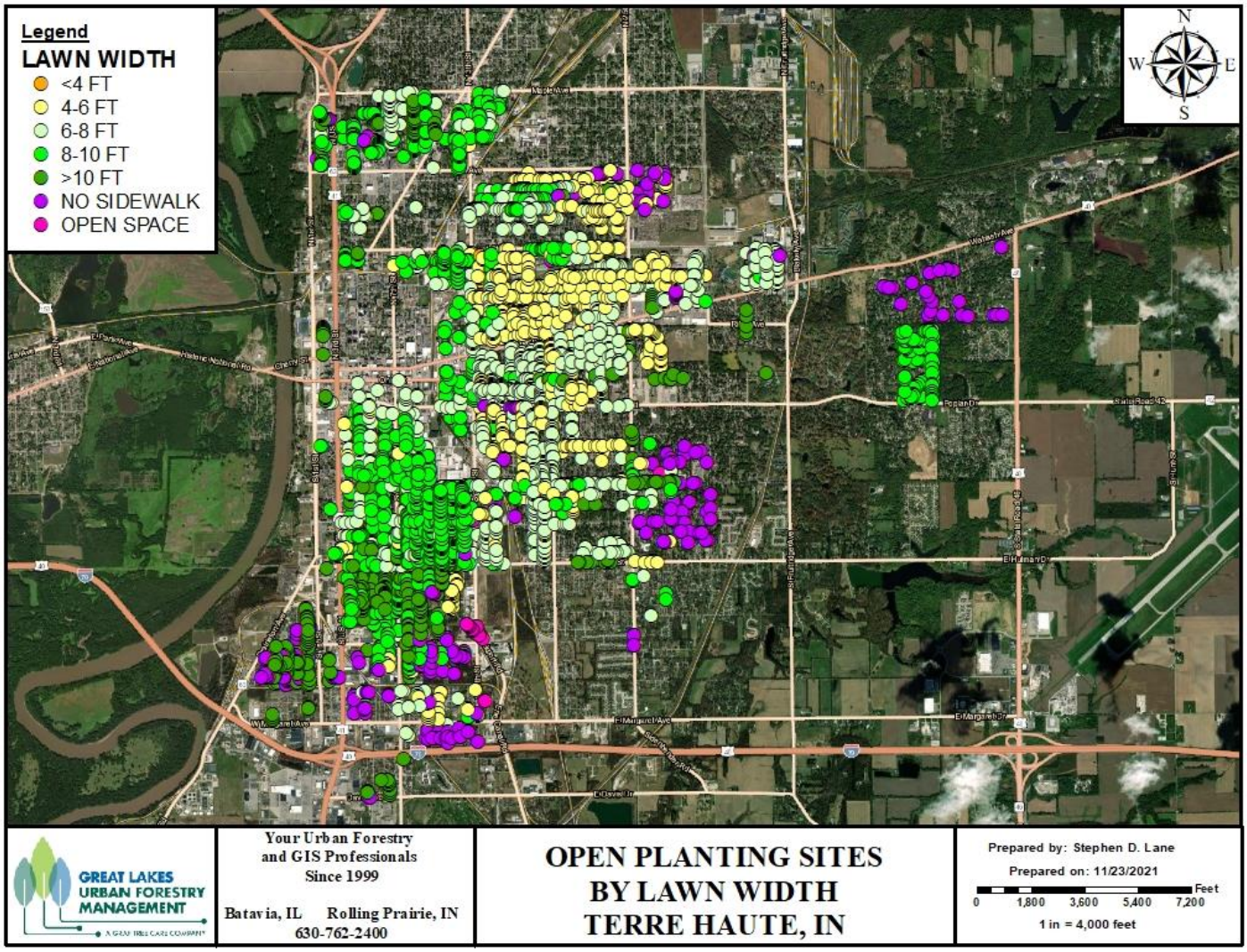
As noted above, these zones do not have a very equitable distribution of trees and planting sites. With only 80% of the total tree and planting space data updated (16,200 out of approximately 20,600), we do know at this time the final total of number of trees and planting spaces, particularly in Zones 1 and 2. Based on the data we have available from the last updates, below is a table, map, and chart of the distribution of trees and planting spaces in each zone:

Zone	Trees	Spaces	% Density
1	3887	262	93.7%
2	2433	327	88.2%
3	1646	742	68.9%
4	3735	1200	75.7%
5	1367	242	85.0%
6	2805	1186	70.3%
7	185	24	88.5%

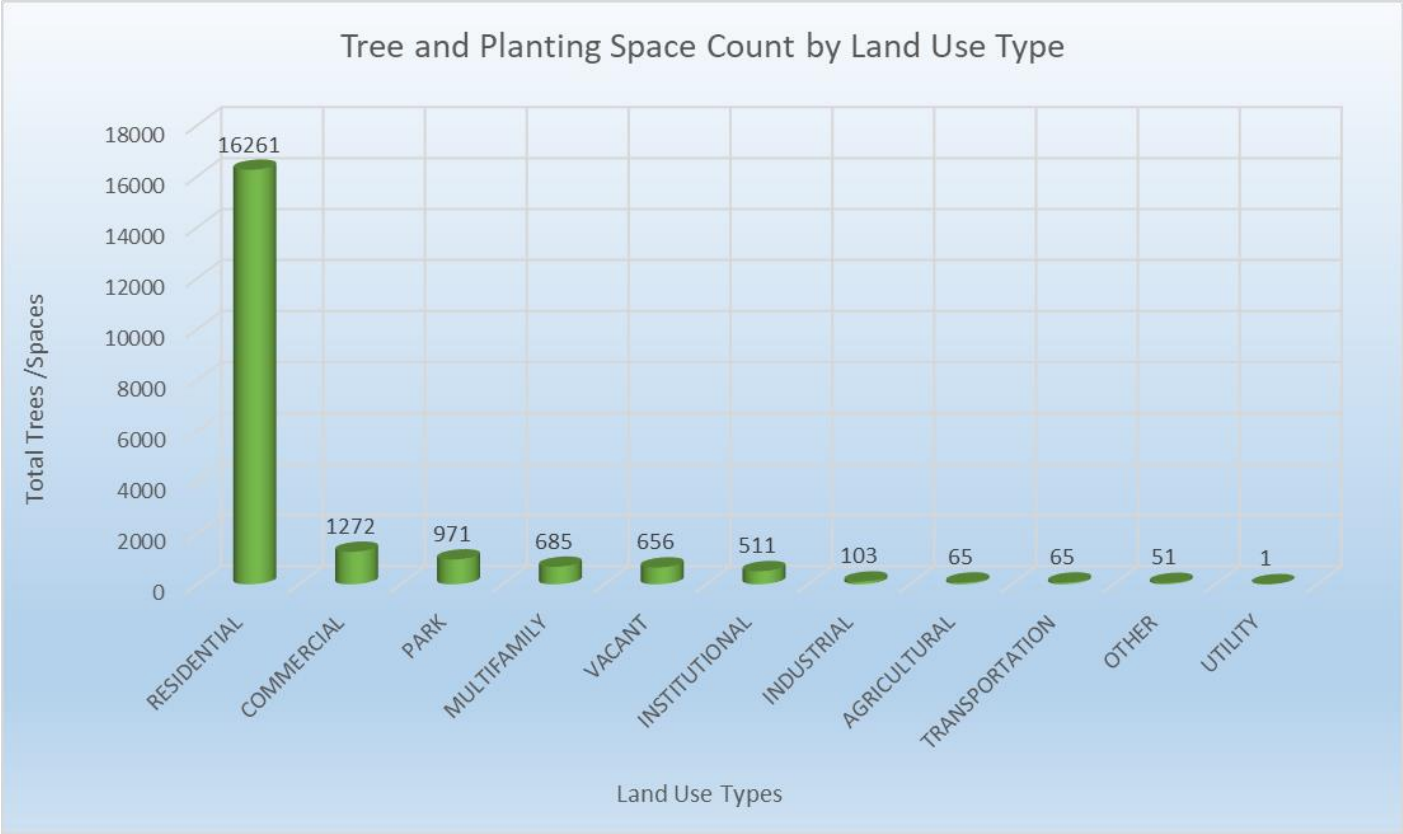

Trees and Planting Spaces by Zone
Labels Indicate Stocking Density
Total Trees
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
93.7%
88.2%
68.9%
75.7%
85.0%
70.3%
88.5%
1
2
3
4
5
6
7
Zone Number
Trees
Spaces


Legend
ZONE
1
2
3
4
5
6
7
N
W
E
S
ZONE 1
3887 Trees
ZONE 2
2433 Trees
ZONE 5
1367 Trees
ZONE 5
1367 Trees
ZONE 3
1646 Trees
ZONE 5
1367 Trees
ZONE 4
3735 Trees
ZONE 7
185 Trees
ZONE 6
2805 Trees
GREAT LAKES
URBAN FORESTRY
MANAGEMENT
Your Urban Forestry
and GIS Professionals
Since 1999
Batavia, IL Rolling Prairie, IN
630-762-2400
TOTAL TREES
BY ZONE
TERRE HAUTE, IN
Prepared by: Stephen D. Lane
Prepared on: 11/23/2021
0 2,800 5,600 8,400 11,200 Feet
1 in = 6,300 feet

Below is also a map of the distribution of open planting sites, though this is not broken out by zone, but rather by Tree Lawn width. There are many local names for these areas, but the Parkway, Tree Lawn, or Boulevard, so some popular names go, is the area of the street between the curb and sidewalk where trees are planted by the City. Sometimes there is no curb and sidewalk, and these areas are reflected here as well. Once again, this data is incomplete, particularly in zones 1 and 2, however it gives a very good feel overall for the distribution of planting sites and tree lawn widths throughout the City:



One thing worthy of note here is that the tree lawn width directly impacts which trees can be planted in which areas of town. Street trees have a difficult life to live in terms of exposure to road salts and air and waterborne pollutants; not having ample soil to grow in complicates things even more. Some tree species we are recommending for planting will do well in challenging sites, but others need a bit more soil and a "quieter" side street to live out their lives on. This data regarding location of planting sites and the amount of available soil on each will dramatically improve the ability to create a targeted reforestation plan for the City going forward, where trees are selected for planting by the sites which are best suited to them.



As can be seen above, the vast majority of trees are in the Single-Family Residential setting. This data also plays an important part in selecting trees for the future, as tree selection in (e.g.) an industrial area may be wildly different from those selected for a residential neighborhood. Similarly, tree adjacent to agricultural fields where they will receive higher nitrogen loading may be very different from in a commercial setting where soil nutrients are limited. We will discuss the tree planting planning in more detail below.

Benefits Provided by Tree Population

We have assessed the dollar value and ecological services provided by trees in several ways below. The first is an iTree Analysis, which looks at benefits trees provide and the dollar value that equates to. We will then also provide a general analysis of the cost benefit ratio of trees in general, to show that overall, trees have an amazing return on investment! This connection is very important to establish in order to build some of the partnerships we shall explore below. Even for people who don't understand the value of trees at first, seeing their value in hard dollars makes this an approachable topic

iTree Data Analysis

The iTree suite of tools provides a hard-dollar analysis of the benefits provided by trees on an annual basis, as well as their standing value as a commodity. These calculations are based on peer reviewed research conducted by the US Forest Service and several private partners and is generally accepted as the best available model of these values available. We conducted two separate iTree analyses using both the iTree Streets as well as the iTree Eco tools.

While Streets focuses more on energy, stormwater, and aesthetic and property values directly felt by residents and their homes or place of work on an annual basis, Eco focuses more on benefits to the environment overall, and calculates the replacement value (standing value) of trees more accurately, though both packages have overlap in some areas. We shall present the results of both below, and explore each category in slightly more detail.

iTree Streets Results

Using basic budget figures provided by the City, some information about the City such as average home values and numbers of street miles, along with the tree inventory data itself, iTree streets is able to calculate the benefits (or ecological services) provided by trees each year, and then compare the costs to the benefits provided. The results are below in a table format, and we will discuss this briefly below.

Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	124,568	(N/A)	7.64	(N/A)	2.05	(N/A)
CO2	18,579	(N/A)	1.14	(N/A)	0.31	(N/A)
Air Quality	43,288	(N/A)	2.66	(N/A)	0.71	(N/A)
Stormwater	413,816	(N/A)	25.39	(N/A)	6.81	(N/A)
Aesthetic/Other	463,919	(N/A)	28.47	(N/A)	7.63	(N/A)
Total Benefits	1,064,171	(N/A)	65.30	(N/A)	17.51	(N/A)
Costs						
Planting	51,200		3.14		0.84	
Contract Pruning	127,950		7.85		2.10	
Pest Management	2,500		0.15		0.04	
Irrigation	2,500		0.15		0.04	
Removal	218,000		13.38		3.59	
Administration	75,000		4.60		1.23	
Inspection/Service	2,500		0.15		0.04	
Infrastructure Repairs	2,500		0.15		0.04	
Litter Clean-up	2,500		0.15		0.04	
Liability/Claims	0		0.00		0.00	
Other Costs	0		0.00		0.00	
Total Costs	484,650		29.74		7.97	
Net Benefits	579,521	(N/A)	35.56	(N/A)	9.53	(N/A)
Benefit-cost ratio	2.20	(N/A)				

Per the above chart, the city spends approximately $485,650 each year on its tree population, and in return, obtains benefits from that tree population of $1,064,171 annually. This equates to a nearly 120% return on investment, which we will demonstrate below, is even better than what we generally calculate for an average tree.

But what about these ecological services that provide these benefits, what do these things really mean? It is 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.

The City of Terre Haute's trees provide $124,568 in energy savings each year. This comes in the form of reducing electricity demand by 1,309.4 Megawatt-Hours annually and reducing natural gas usage by 36,514.9 Therms annually!

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.

The City of Terre Haute's trees increase its property values by $463,919 each year!

Stormwater: 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, so the more trees, 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.

The City of Terre Haute's trees provide $413,816 in stormwater savings each year. This comes in the form or reducing stormwater by over 66.7 million gallons annually!

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.

The City of Terre Haute's trees provide $43,288 in air quality savings each year. This comes in the form of removing nearly 35,000 pounds of various pollutants annually!

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.

The City of Terre Haute's trees provide $18,579 in Carbon Dioxide savings each year. The comes in the form of removing over 5.6 million pounds of carbon from the atmosphere annually!

iTree Eco Results

The iTree Eco analysis, which as stated above looks more into the standing value of the tree population as well as the ecological services described above, resulted in the following data:

- Pollution Removal: 7.614 tons/year ($52.9 thousand/year)
- Carbon Storage: 16.06 thousand tons ($2.74 million)
- Carbon Sequestration: 227.7 tons ($38.8 thousand/year)
- Oxygen Production: 607.1 tons/year
- Avoided Runoff: 578 thousand cubic feet/year ($38.6 thousand/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Replacement values: $73.4 million

There are some subtle differences here between the 2 models on a few topics, but the important ones to note from the iTree Eco analysis are highlighted with a green outline above:

Replacement Values: Starting from the bottom up, the standing value of all trees in Terre Haute is listed as $73.4 million! This is not an annual value per se, but rather the instantaneous value at any given time of the replacement value of the trees. Replacement value is essentially the insurance value of a tree to a specific property and is calculated by a standard reference manual published periodically by the Council of Tree and Landscape Appraisers. It should be noted here that this value does change each year. More trees increase its value, as does trees living to greater ages.

Oxygen Production: These trees also provide 607.1 tons of Oxygen production each year. This is one of the obvious benefits of trees that we all too often ignore or discount. It should be noted here that an average price of $0.13/kilogram, this translates to an annual value of over $71,500 which can be added to the above benefits!

Carbon Sequestration: Finally, these trees provide over 16,000 tons of carbon storage each year. Please note that this is different from sequestration. Sequestration is how much carbon they take out of the atmosphere each year. Storage is the amount that the entire tree stores from all its years of annually sequestering carbon. This equates to an additional $2.74 million on top of the $73.4 million mentioned earlier. Since sequestration is cumulative, this value also increases as more trees are planted and existing trees live longer!

The important takeaway message here is that getting trees live longer and increasing the number of trees in Terre Haute will all increase the benefits these trees provide, and therefore their value to the community as well!

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 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 below, with the calculations on the following page.

To reiterate from earlier, this is an average value we have calculated based on standard expenses and benefits. With the city's current budget, their return on investment is actually pushing 120% overall, which is even better than the 107% expressed below. Though we should point out that it is good to see these calculations being consistent.

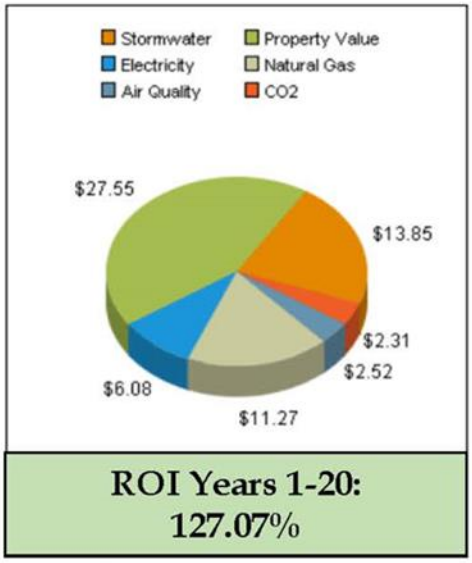
Total Investment	$4,150.00
Total Return	$8,585.00
Total ROI Over 60 Years	106.87%

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%

Goals

Here we shall provide some goals and basic budgeting where applicable to accomplish those goals. Some goals have no stated budget at this time because they are either exploratory goals or may involve volunteer labor or partnerships will costs will be minimal or are unknow at this time. We will conclude with a budget analysis projection in the final section. These are expansions of the goals listed earlier in this management plan.

Complete and Manage Tree Inventory Updates

Goal

As noted several times above, the inventory update only covered 80% of the existing tree population, leaving approximately 20% of the City's tree and planting site population without current data. It should be noted here that older data for these areas exists, and we used this older data to fill in gaps when necessary for our analyses above. But having all data current will be very useful to the city in refining this plan going forward.

In addition, the city should budget annually to update the inventory data in each zone ahead of its scheduled pruning cycle on annual basis. This means with 7 zones, the City's tree inventory will never be more than 7 years out of date. These large-scale updates will likely be performed by an outside Forestry Consultant, and include detailed data updates such as DBH, condition, and maintenance needs. The city should also prioritize the maintenance of the entire inventory with its in house resources for annual removals and plantings across the whole population, to make sure that at least what is or is not out on city streets is accounted for. This will minimize data errors between 7-year updates.

Timeline

Timeline	Task
Jan 2022-March 2022	Budgeting process for remaining inventory updates to be completed by forestry consultant
April-August 2022	Complete remaining inventory updates
September-December 2022	Update goals and management plan to reflect fully updated data
2023	In house staff updates removals and additions, revamps cycle pruning program (see below)
Ongoing	Forestry Consultant updates 1 zone per year, in house staff updates annual removals and plantings throughout the city

Budget

The estimated annual cost for these programs averages out to around $10,000 per year in perpetuity.

Revisit and Enhance Cycle Pruning Program

Goal

As seen in the tables and charts on pages 4-5, trees are not equally distributed in each of Terre Haute's zones. Therefore, these zones do not make the best subdivisions for creating or enhancing a cycle pruning program. We would advise that the zones be reexamined so that they contain a fairly equal number of trees in each. This keeps the budgeting for cycle pruning mush easier to accomplish with less unpredictability.

As briefly mentioned above, and we will revisit several times throughout the remainder of this plan, Terre Haute has been very concerned in terms of budget with tree removals recently, many of those due to Emerald Ash Borer removals as well as an aging population of Silver Maples. Based on the inventory, we believe it is time to begin to shift that budget money so there is more emphasis on proactive cyclical maintenance rather than a more reactive strategy.

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. 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.

The goal is to prune the trees identified as being in the greatest need of pruning, regardless of zone, first. Then, use the revamped tree zones to begin or enhance the cycle pruning program so that no tree goes without pruning longer than 7 years.

Timeline

Timeline	Task
January 2022-August 2022	Revisit cycle pruning program, evaluate for opportunities and strengthen BMP language
September-December 2022	Review completed tree inventory data, recreate new tree zones.
December 2022-March 2023	Prune high priority trees from around entire City, regardless of zone.
April 2023-August 2023	Finalize new zones and RFP language, bid first cycle prune under new zones
September 2023-March 2024	Perform first new cycle prune, evaluate success, make changes as necessary
Ongoing	7 year cycle pruning program is budgeted for, performed, and improved as necessary

Budget

Milestones	2022	2023	2024	2025	2026	2027-2032
Trees Pruned	1300	1750	2000	2200	2425	2600/year avg
Notes	All High and Medium Priority Prunings	Cycle Pruning, Lowest Tree Count Area First	Increase Cycle Pruning Capacity	Increase Cycle Pruning Capacity	Increase Cycle Pruning Capacity	Approximately 2600 Cycle Prunes / year in perpetuity
Cost (2022)	$100,000	$140,000	$160,750	$175,000	$188,500	$196,275
Cost (CPI)	$100,000	$140,000	$160,750	$175,000	$188,500	$225,716

Please note the budget here assumes that the tree population will grow from approximately 16,200 trees in 2022 to 18,000 trees in 2032. This is a tentative goal for now and will be reevaluated on an annual basis. In addition, the following costs were used for estimating, and are based on real world values seen in the Midwest market today:

Tree Type/Size	Cost/Tree
Evergreen	$20
Large (>24")	$150
Medium (13-24")	$75
Small (1-12")	$40

One final note here is that we have provided a budget for continued tree removals in our "final" budget table, even though we are deemphasizing it in these overarching goals. Tree removal is still a very important part of a functional urban forestry program, we just believe that more money should be spent on planting and maintenance activities.

Increase Tree Plantings and Stocking Density

Goal

As seen in the graphics on pages 5-6 and previous discussion, Terre Haute has room for many more new trees, up to a total of around 20,500 total sites if all were planted with a tree! According to the current data, only approximately 80% of those are filled. While maintaining 100% stocking density is likely not a realistic or even desirable goal, increasing tree cover should be!

Currently the City of Terre Haute spends approximately $50,000 on tree planting and aftercare each year, which we anticipate meaning that approximately 150 trees are getting planted each year. The goal will be to increase that number of the next 10 years to $75,000 per year or more, so that the city is planting a minimum of 250 trees per year.

Please see the "Diversify Tree Population" and "Build local Partnerships to Attain Goals" sections below for more details on building not only capacity but diversity as well. We chose to separate these into separate sections, but they are very much related when it comes to tree planting!

Timeline

Timeline	Task
January 2022-March 2022	Reevaluate planting program and budget, find strategic partners to assist in increasing capacity
March 2022-December 2022	Perform Spring and fall plantings in 2022, reevaluate budgets, partners, and program
January 2022-March 2022	Implement and begin tree planting planning program (detailed below)
Ongoing	Increase planting budget annually, continue to build partnerships

Budget

Milestones	2022	2023	2024	2025	2026	2027-2032
Trees Planted	125	150	175	200	225	250/year avg
Planting Cost (2022)	$37,500	$45,000	$52,500	$60,000	$67,500	$75,000
Planting Cost (CPI)	$37,500	$45,000	$52,500	$60,000	$67,500	$86,250

Please note here that an average cost of $300 per tree (installed) has been utilized. There are many avenues to reduce this cost even further, such as working with partner organizations to get trees donated, trees planted by volunteers, or using smaller nursery stock such as 5-gallon containerized stock instead of 2-2.5" balled and burlapped stock.

Build Local Partnerships to Attain Goals

Goal

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. Partners may be able to provide materials, such partnering with the IDNR or a local nursery to provide trees, or they may be able to provide capacity in terms of labor items like planting, mulching or watering trees. Depending on the City's view of such things, volunteers could even take care of pruning young trees if they are properly trained to do so!

There are no strategic timelines or budgets for establishing these relationships, only a general note that doing so will likely drive costs for budget items downward as materials and capacity concerns are assisted with by partner organizations. The following are groups which could be strategic partners of Terre Haute in enacting the goals of this plan, in no particular order:

The Nature Conservancy

The Nature Conservancy has already been a valuable advocate for Terre Haute in assisting the drive for developing a strategic plan for the future of the urban forest. Partnerships between The Nature Conservancy and Terre Haute 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 Terre Haute 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 vitality of urban forests and natural areas throughout the United States. Terre Haute would benefit greatly from 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 Terre Haute's urban forest.

Vigo County School Corporation

A partnership between Terre Haute and Vigo County 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.

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 Terre Haute to date, and allow the staff compensated time to perform the actual science.

CommuniTree 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 its members.

Indiana Department of Natural Resources

The Indiana Department of Natural Resources (IDNR) Community and Urban Forestry program provides guidance and grants to communities for development and caretaking of urban forests. Every year, they have grant money available for tree inventory, tree purchase and planting, and other such activities. They are also a vital partner when it comes to providing community outreach and education throughout the entire state, and have a phenomenal staff to assist communities, particularly those with limited resources to devote to forestry funding. Grant programs and technical assistance from IDNR would be very valuable to their program.

Indiana Community Tree Stewards

The Indiana Community Tree Stewards (ICTS) program is a joint venture of the US Forest Service, Indiana Department of Natural Resources, and Indiana Urban Forest Council. Participants take an 18-hour course in the basics of tree care and maintenance. Participants who complete the course are asked to donate 15 hours of volunteer service to their community or state urban forestry programs. These hours can include tree planting, maintenance and care, advocacy for the urban forest, presentations on tree planting, care, or engaging and involving citizens in urban forestry. We have found this program to be tremendously helpful in not only assisting the city in performing basic maintenance on young trees such as watering and mulching, but also increasing the level of knowledge and awareness of the Urban Forest.

Purdue University Extension Office

The Purdue University Extension Office (PUEO) has one of the best Horticultural and Agricultural knowledge bases in the Midwest, and many staff are very knowledgeable about trees as well and are active in the Indiana Arborist Association. This vast network of expertise, active in all 92 of Indiana's counties, could be invaluable to Terre Haute as it continues to develop its Urban Forestry program. In addition, in partnering with local schools and Purdue could provide a pipeline for local students to get involved with Arboriculture and other Green Industry professions as a college degreed career path.

Indiana Arborist Association

The Indiana Arborist Association is the local state chapter of the International Society of Arboriculture, which is also a vast network of professionals, academics, and others working in the field of Arboriculture. They have many local and state level events where Terre Haute staff could attend to learn more about Arboriculture, even if it is not their primary profession with the City. In addition, Terre Haute staff could begin the process of becoming a Certified Arborist by attending events and beginning down that path. Many staff in municipalities who manage trees will get their Certified Arborist license even if that is not their primary job duty is, and it is not necessarily a difficult license to get, but one that can open the door to a lifetime of learning about trees and their benefits to the community,

Create and Implement a Risk Management Policy

Goal

Trees provide ecosystem and aesthetic benefits. But whether they are healthy or not, 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, Terre Haute always must assume some degree of risk. It is up to Terre Haute 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.

As can be seen in the Executive Summary tree population breakdown, there are a fairly substantial number of trees in Terre Haute which are in elevated risk Categories. The goal here will be to create a functional Tree Risk Management Policy that seeks to maximize public safety through creation of a policy which is reasonable and practicable, and also one that the City's forestry staff, legal team, and other internal staff approve of.

This will be a process best guided by a Forestry Consultant with experience in writing such plans, in order to avoid common mistakes in attempting to write plans such as this for the first time. But it must be a team effort, and everyone who will interact with this policy needs to have some time to review and approve it before it becomes official policy. This will include the city attorney, forestry staff and supervisors, code enforcement and zoning personnel, and other people who may interact with this policy at any stage of the process. This is important to ensure that everyone understands and approves of the process, and it can reasonably be executed.

Timeline

Timeline	Task
January 2022-March 2022	Begin initial review of internal policies and employees, past litigation, meet with consultant
March 2022-August 2022	Craft initial policy with consultant and staff, review and finalize in draft form
August 2022-December 2023	Conduct 1 year trial period of draft policy in action before codifying, adjust as necessary
January 2024	Adopt Tree Risk Assessment Policy formally

Budget

A small budget of approximately $1,500 should be planned for consulting time in developing this policy.

Please note several appendices have been included in this document, one of them is a sample risk assessment policy to use to get the process started in terms of some standard ideas used in other communities.

Diversify Tree Population

Goal

The tree population in Terre Haute, particularly among the younger trees planted in the past 10-15 years (see data in Executive Summary), is diverse. However, it is still dominated by a handful of species, most of them Maples (38%). In addition, as mentioned several times, there is ample stocking room available, with nearly 4,000 open planting sites on the tree lawns and parkways throughout the city. Therefore, this goal is 2-pronged, with a focus on increasing tree numbers, while also increasing the diversity of those plantings overall.

One of the reasons we find ourselves with many overplanted species is because the urban environment is a difficult one to live in, and we have a history of planting only "tough" trees like Maples, Honey locust, Lindens, etc. So, we need to diversify, but how do we plant more sensitive species for higher diversity while ensuring their survival at the same time? The answer is all in matching the right tree to the right site by way of creating a tree planting plan that considers which species thrive in which environments.

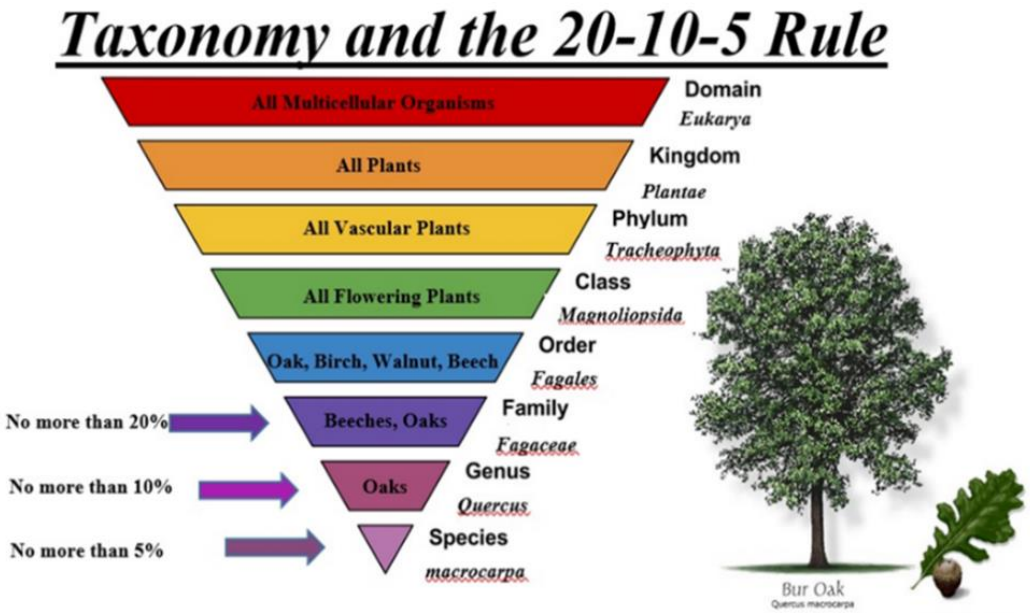
Just like data is taken on trees for a tree inventory, a tree planting plan involves assessing and recording each planting site's characteristics in much the same way we would assess a tree. Once this data is collected, planting sites are matched with trees which are well suited to those sites, so that the City would then have a suggested species for each open planting space on its parkways and tree lawns. These trees are chosen specifically to thrive in these sites, so that they will establish faster, grow more vigorously, live longer, and provide far greater benefits than if trees had been selected at random for these sites.

Some data that could be collected for each planting site would include:

1. **Available Above Ground Growing Space** – What size mature tree will the site support? A large (80 foot+) tree, or maybe there are utility lines and only a smaller tree (<15 feet) will be possible
2. **Soil Volume** – As mentioned earlier, the width of the tree lawn plays a great effect in what kinds of trees can survive in an area. Wider lawns can support more sensitive trees
3. **Soil Moisture** – While urban soils are not the same as natural soils, there are certainly wetter and drier areas of town, even on a micro scale. Selecting trees for their tolerance to drought or wet soils is important.
4. **Nutrient or Salt Loading** – Some sites may be heavily urbanized where a lot of road salt is used, and only certain species can be used. Or some sites may receive a high nutrient load, like detention basins or near agricultural fields or golf courses.
5. **Shade and Light Levels** – This is a basic but often overlooked selection criteria! Some trees do not perform well in full sun or in a lot of shade.

Trees would then be selected for planting in each site based on how well they would be likely to survive and thrive based on criteria such as these. This is often half the cost of a watering bag to do these assessments and plans, while being twice as effective!

We recommend a "triple bottom line" diversity standard where the taxonomic, spatial, and age class diversity principles are all considered. For taxonomic diversity, we want to be planting a lot of species so that we avoid future pest and pathogen issues like EAB and DED. But we also want to be planting them in mixed stands (not just one or a few species in an area, but many), as well as taking into account the average age of trees in an area, so that we have a mixed age stand as well. The "20-10-5 Rule" of species diversity is shown graphically below and is an excellent standard to attempt to shoot for.



Timeline

Timeline	Task
January 2022-March 2022	Discuss merits of creating planting plan, perform tasks in Tree Planting above
March 2022-August 2022	Consider creating planting plan as part of final tree inventory update s for 2022
August 2022-December 2022	Conduct tree planting assessments if approved, if not send back for approval
Ongoing	Perform tree planting plan and implement as annual policy

Budget

This project of creating a tree planting plan can be an annual pursuit where a set number of sites are assessed each year, or it can be a comprehensive plan where all 4,000 planting sites are assessed and a long term 10-year plan created right from the start. Or it could be some combination of the above. Assuming the City landed somewhere in the middle, where a 3-year plan which assessed 1,000 sites every 3 years, the average cost over that approximately 12 year period would be $1,750 per year.

Programs such as this have been instituted through the Midwest and the rest of the country, and they are highly successful programs which yield rich diversity as well as increased overall survivorship and an arboretum-like setting on city tree lawns and parkways.

Additional Goals

The following are some additional recommended goals based on the results of the tree inventory, discussions with Terre Haute staff, and past observations of other similar communities. This is certainly not an exhaustive list, but rather a few things to bear in mind moving forward.

Tree Removals – Though we did not discuss this in the main goals section above, it is clearly important that Terre Haute continue to monitor the tree population for tree removals each year. That said, due to the high expenditures and high success over the past years removing Ash trees and aging Silver Maples, we believe that money can begin to be shifted from removals over to cycle pruning and tree planting. It is also important to note here that tree removal and the inspections and timing of those removals will play an important role in the Risk Policy discussed above.

Contract Growing Program – As the City seeks to buy trees that are more diverse than what the local nurseries are willing to offer, considering entering into a contract growing agreement with one of them may make a lot of programmatic sense. Contract growing is where the client (the city, in this case) provides a list of what trees they are looking to plant over the next 3-10 years, and a local nursery goes and buys the small seedlings or saplings and grows then to plantable size. They then sell the trees to the client at an agreed upon rate. This ensures the availability of the trees the city will be looking to plant, without needing to make substitutions in the form of overplanted trees like Honeylocusts and Maples. Such programs are becoming more and more commonplace.

Community Outreach and Volunteerism Program – Aside from more formal programs like the Tree Stewards program, building a homegrown network of Urban Forestry advocates will be critical to the functioning of this plan. This is a low cost, high yield process, and can be done in a variety of ways, such as holding seasonal educational sessions about urban forestry at city hall or the public works office, or having staff be active in community groups throughout Terre Haute. This shows the importance of urban forestry to the community and helps build partnerships.

In-House Liner Nursery for Tree Growing - If the city so chooses, in order to reduce its planting costs even further, it could consider growing a few trees itself on land that it owns. Small bare root trees could be purchased from liner nurseries and grown to plantable size on land in Terre Haute. Trees could even be cared for and maintained in the in-house nursery by volunteers from the community, or students from local high schools or even University students.

Projected Budget: 2022-2032

As discussed earlier, these budgets figures are just projections. However, they give a good idea of what some of the initiatives mentioned above will cost on an annual basis. With only modest increases in budget, and a change in how those funds are allocated to various activities, the City of Terre Haute will be able to enhance its urban forest even further than it already is. Like all things in this plan, this budget is meant to be adaptively managed, so that new data or new headwinds can be used to update these budgets and make the plan better every year.

	Milestones	2022	2023	2024	2025	2026	2027-2032
REMOVALS	Trees Removed	193	287	471	150	45	100/year avg
	Diameter Inches	6,746"	6,106"	3,961"	4,000"	855"	800"
	Notes	All Removals 28" and larger	All Removals between 16 and 27"	All Removals Less than 16"	Update Remaining Inventory to Locate Additional Removals	Update Remaining Inventory to Locate Additional Removals	Update Remaining Inventory to Locate Additional Removals
	Removal Cost (2022)	$168,650	$152,650	$99,025	$100,000	$100,000	$100,000
	Removal Cost (CPI)	$168,650	$152,650	$99,025	$100,000	$100,000	$115,000

	Milestones	2022	2023	2024	2025	2026	2027-2032
PLANTINGS	Trees Planted	125	150	175	200	225	250/year avg
	Planting Cost (2022)	$37,500	$45,000	$52,500	$60,000	$67,500	$75,000
	Planting Cost (CPI)	$37,500	$45,000	$52,500	$60,000	$67,500	$86,250

	Milestones	2022	2023	2024	2025	2026	2027-2032
PRUNING	Trees Pruned	1300	1750	2000	2200	2425	2600/year avg
	Notes	All High and Medium Priority Prunings	Cycle Pruning, Lowest Tree Count Area First	Increase Cycle Pruning Capacity	Increase Cycle Pruning Capacity	Increase Cycle Pruning Capacity	Approximately 2600 Cycle Prunes / year in perpetuity
	Cost (2022)	$100,000	$140,000	$160,750	$175,000	$188,500	$196,275
	Cost (CPI)	$100,000	$140,000	$160,750	$175,000	$188,500	$225,716

	Milestones	2022	2023	2024	2025	2026	2027-2032
FORESTRY CONSULTANT	Notes	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 (2022)	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	Cost (CPI)	$10,000	$10,000	$10,000	$10,000	$10,000	$11,500

	Milestones	2022	2023	2024	2025	2026	2027-2032
STAFF / EXECUTIVE COSTS	C ost (2022)	$75,000	$77,500	$80,000	$82,500	$85,000	$87,500

TOTALS	**TOTALS - 2021 $**	**$391,150**	**$425,150**	**$402,275**	**$427,500**	**$451,000**	**$468,775**
	TOTALS - CPI 3%	**$391,150**	**$425,150**	**$402,275**	**$427,500**	**$451,000**	**$525,966**

Conclusion

The City of Terre Haute has a large and vibrant urban forest. As discussed in the Executive Summary section and throughout this report, the diversity of the trees in Terre Haute is quite high, with 147 unique species and countless cultivars and subspecies. The level of care for these trees overall is very good, with a relatively low level of trees in poor condition or requiring emergency maintenance of any kind.

It is just this type of level of care which has resulted in a tree population which is worth over $75 million dollars in standing value, with annual ecological service benefits totaling over $1 million dollars each year! These benefits come from energy savings, carbon sequestration and storage, increasing home values and curb appeal, stormwater savings, oxygen production, air pollution reduction, and many more. These values are only going to increase as the City strives to plant more trees and increase the level of proactive care provided to each tree. This will help all existing trees to live longer and provide greater benefits to the community.

The following goals have been established for the next 10 years in this plan:

1. Complete tree inventory updates so all data is up to date, and plan for maintaining that data annually
2. Rework the cycle pruning system, and direct more annual funding towards proactive maintenance
3. Redirect more budget towards tree planting
4. Create and implement a tree risk management policy
5. Diversify the tree population by using innovative tree planting planning strategies
6. Engage the community and its stakeholder to help promote and accomplish these goals

These are all goals which, as they are undertaken, will help strengthen the urban forestry program in Terre Haute, maximizing the benefits that trees provide to the community and minimizing cost and risk. There are many local partners we have suggested, as well as many yet to be discovered, who can help along the way and actually can become promoters of the urban forestry program in Terre Haute! The more public support and engagement this program receives, the better it will be equipped to tackle difficult situations in the future.

Certainly, none of this can be done without funding streams and innovative thinking along the way. As the basic budget and iTree reporting demonstrates, the return on investment for the forestry program in Terre Haute is currently closing in on 120%, which is a bet any Wall Street trader would take any day of the week! As we bring information like this to light, that the forestry program yields dividends and doesn't just cost money, the more people will become interested and engaged in promoting these efforts.

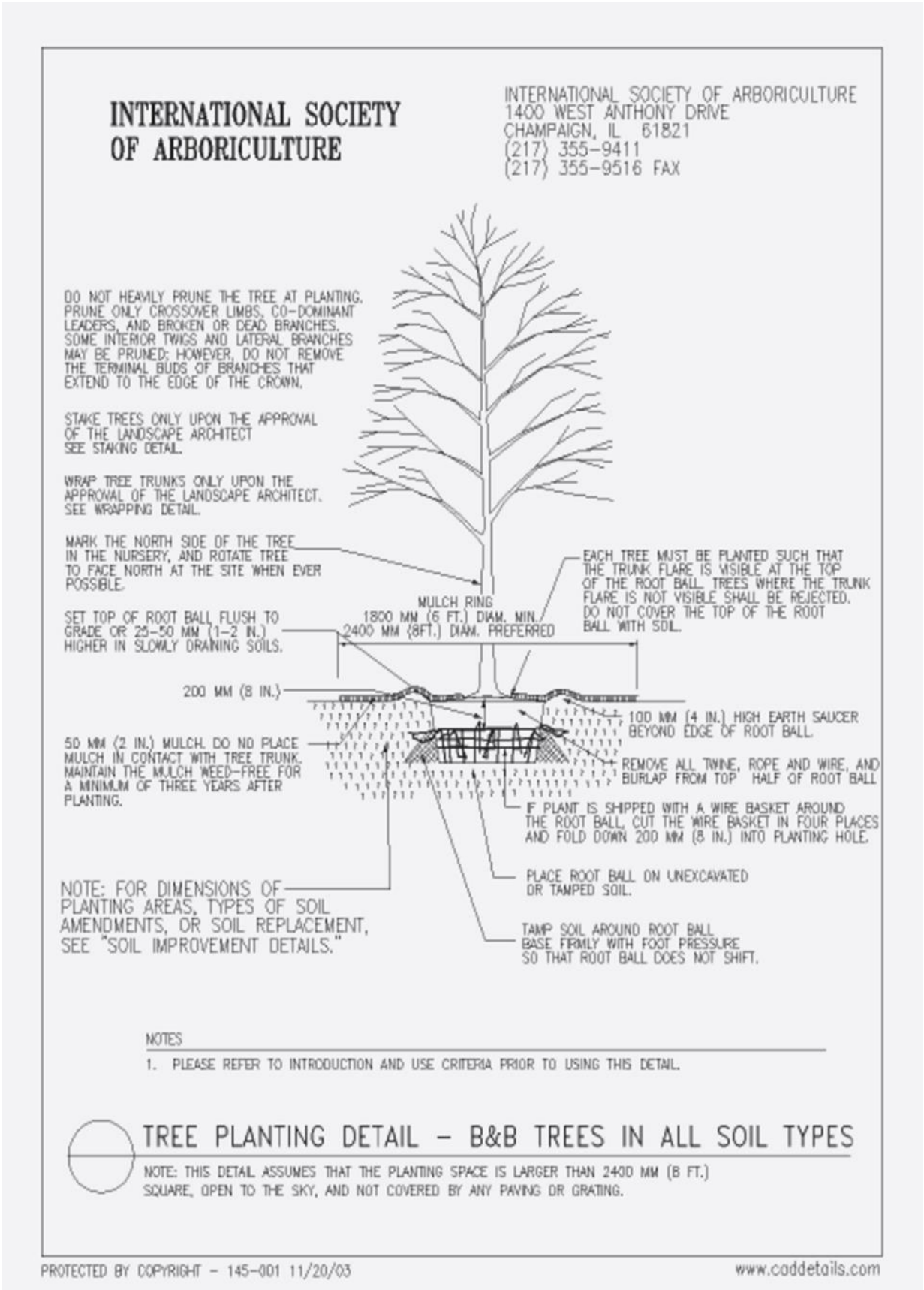
Great Lakes Urban Forestry Management thanks the City of Terre Haute, its residents, stakeholders, and the grant funding organizations which have made this endeavor possible. It has been a pleasure to work with the City on this inventory update, and to update the Urban Forestry Management Plan. We all look forward to continuing to assist the City in making it a leader in urban forestry in Indiana and throughout the country.

Appendix A – Approved and Unapproved Trees

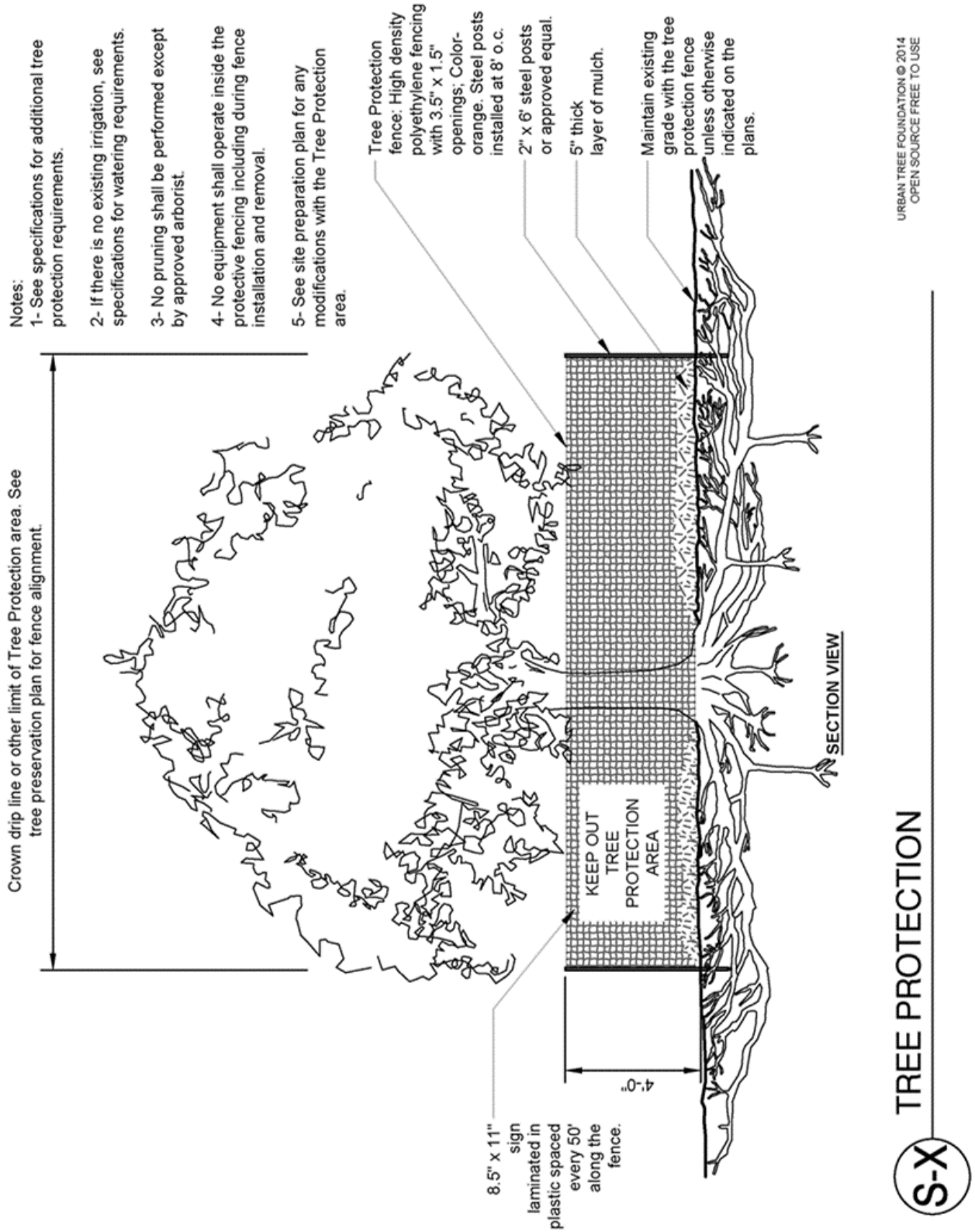
NOT APPROVED	APPROVED SPECIES			
Any Size	Large Trees	Medium Trees	Small Trees	Evergreens
AILANTHUS	BALDCYPRESS	ALDER	AMERICAN REDBUD	ARBOR VITAE
AMUR CORKTREE	BEECH-AMERICAN	AMUR MAACKIA	APPLE-CRAB	DOUGLAS FIR
ASH-EUROPEAN	BEECH-EUROPEAN	BIRCH-RIVER	APPLE-EDIBLE	EASTERN REDCEDAR
ASH-GREEN	BUCKEYE-OHIO	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			

Please note this list is not exhaustive, and new trees become available all the time,. The final decision to plant or nto plant a tree lies with the City's forestry staff and their forestry consulting team.

Appendix B – Planting Detail



Appendix C: Tree Protection Detail



Appendix D: SAMPLE Tree Risk Assessment Policy

1. ORGANIZATION 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 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 or shall be mitigated as soon as practical following the assessment.

2. During subsequent years, ORGANIZATION 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, 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 to ORGANIZATION of a concern about a potentially elevated risk tree, an Arborist and/or Urban Forestry Consultant shall perform a Level 2 or Level 3 Risk Assessment within (XX) 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 ORGANIZATION staff and/or Forestry Consultant as to what the appropriate mitigation measures are, if any.

4. All trees deemed to require mitigating actions (removal, pruning, etc.) shall be documented in writing or in a digital tree inventory by ORGANIZATION staff and/or the Urban Forestry Consultant. The documentation shall include at a minimum the date the assessment was performed, the species, size, and condition of the tree, and a brief narrative detailing things such as 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.

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 ORGANIZATION.