Tree Protection Zone During Construction

ENVIRONMENTAL STUDIES 490 – SENIOR SEMINAR

FALL 2023

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Executive Summary

Currently, the City of Oshkosh does not provide any form of concrete guidelines for protecting existing urban trees. This proposal aims at addressing this discrepancy to help the City of Oshkosh meet their sustainability goals by proposing the implementation of a Tree Protection Zone (TPZ) ordinance. Provided in this proposal are the viewpoints of various stakeholders we have spoken to, including other cities' forestry managers, a sustainability director, an arborist, an engineer, and a conservation expert and resident.

In addition, provided are a few examples, both from within and outside Wisconsin, that serve as guidelines for best practices regarding urban tree protection. La Crosse is a good example of a city that prioritizes its urban forestry. Their efforts can be seen through initiatives of having a comprehensive urban tree inventory, successfully removing and replacing all ash trees to prevent the spread of the Emerald Ash Borer and providing many opportunities for community members to get involved in urban forestry practices. Another example of excellent urban forestry initiatives comes from Washington D.C. Here, the urban forest is an integral part of the city's design, boasting a tree canopy of 35%. This is made possible through their strict tree protection regulations applied to both public and private property. Likewise, Stevens Point, McFarland and Sun Prairie Wisconsin, and Minneapolis, Minnesota are all cities that have implemented tree protection ordinances into their forestry management plans and can serve as guides for TPZ policies in Oshkosh.

While the ordinance itself is void of costs, costs are accrued by the actual application of TPZ barriers which will require construction fencing, steel posts, and signs. Funding for these costs can be supplemented through grants and fines collected from non-compliers. In addition, extra time and planning will be required from all individuals involved, including the forester, city planners, and the construction companies to place barriers and conduct inspections. However, overall, investment in the protection of existing trees increases their return on investment as the benefits urban trees provide to the community increase as the trees mature. These include increases in air quality, stormwater management, critical habitat for wildlife, reducing the urban island effect, improved mental health and many more. These benefits make it crucial to protect Oshkosh's urban tree canopy with an institutionally recognized TPZ ordinance.

Background

The current standard for tree protection during construction in Oshkosh is based upon "good faith" with the various companies and departments that are involved. Protecting trees is necessary to ensure a healthy, diverse urban forest that will provide optimal benefits to the community, including stormwater infiltration, carbon sequestration and wildlife habitat. The city will face astonishing consequences if there is no action taken to protect the urban forest. Current ordinances do not provide any requirement to retain trees during different types of construction, including new development and street reconstruction, among others. This ordinance could also help increase the city's canopy cover, which is currently at 9%, whereas the average canopy cover in Wisconsin is just above 28%. Since Oshkosh is well below the state average, it is even more important to establish a TPZ.

A healthy urban forest does not only provide economic and environmental benefits but will also provide the community with many social benefits. There are numerous studies that show the positive impact that urban green spaces have on an individual's mental, physical, emotional, and spiritual health. Retaining an urban forest would create a positive interaction with nature and improve an individual's overall well-being. If the economic and environmental benefits were not sufficient, then the additional social benefits make it essential to protect the urban tree population to better the community. A community will see tremendous benefits from supporting a healthy and diverse urban forest.

Recommended Action

We recommend that the City of Oshkosh adopt a Tree Protection Zone (TPZ) ordinance that aims to ensure the protection of the existing urban tree canopy and tree roots during construction and related activities. Currently, Oshkosh does not have any set standards or guidelines outlining best practices for urban tree protection prior to, and during, development project's formation and simply operates on a "good faith" system. The creation of an ordinance of this kind will help mitigate tree loss and tree damage.

A TPZ is an area that is blocked off where no construction or related activities can occur. This includes storage of equipment, materials, excavation, and other activities. The picture below from the North Carolina Urban Forest Council shows an example of a TPZ. The inner circle is the dripline, which is where the tree canopy ends and prevents physical damage to the canopy and trunk. The outer circle is the critical root zone, which is the area roots are expected to be growing and prevents root and soil damage. The size of the TPZ is determined using a few different equations which will be included in Appendix A.

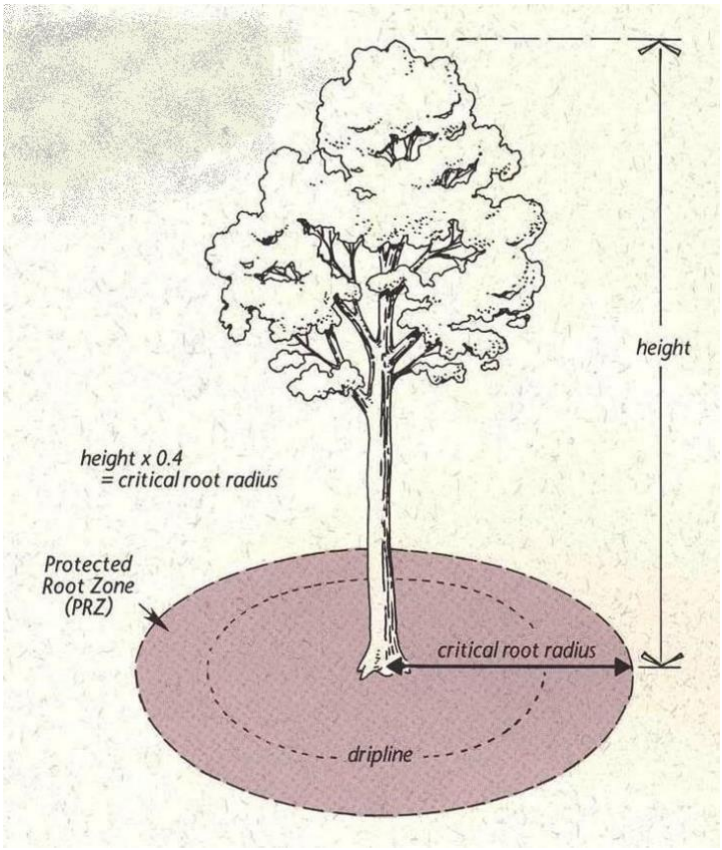

Figure 1. Example of a TPZ

The lack of specified guidelines leaves urban trees susceptible to being abused and uprooted without consideration of the impacts this will have on the overall health of the community. Urban trees provide various ecosystem services that help mitigate costs associated with increasing temperatures, rainfall, air pollution, and health issues. As a result, an ordinance, like the one being proposed, will allow Oshkosh to be more prepared with the increasing challenges posed by climate change through the protection of its existing urban tree canopy.

To achieve this, the goal is to create an ordinance that would require communication between construction companies and the city forester prior to construction to ensure protection of healthy and mature trees are not ignored in the planning process. Outlining who, when, and how to contact the pertinent departments prior to construction allows for improved collaboration between agencies and city departments. This is important to set the stage for what the expectations and standards are when working with and around public urban trees. The guidelines should include tree specific guides to protect tree limbs, trunk, and root system. Each salvageable tree, as determined by the city forester or a certified arborist, should have the appropriate specifications of the TPZ calculated. They, the city forester or a certified arborist, may also provide information on the specific tree's root handling guidelines if there's a potential risk of root damage. Having a certified tree arborist on construction sites is not part of our proposal, but it is something that we strongly suggest.

Lastly, the ordinance should include a penalty clause to allow the city to collect a monetary sum for improper handling of urban trees. For example, in any case of violation, the Forestry department holds the right to place a fine for a violation that results in damages to a public tree; the sum of the fine can be calculated in accordance with the value of the damaged tree(s) and the ecosystem services they provided. In turn, the money acquired through this method can be allocated to fund urban forestry maintenance or future projects (see Appendix G for TPZ fine example clause).

Figure 2. Bank First- 1159 N Koeller St, Oshkosh. A group of mature trees cut down to build Bank First.

Maintaining the health of existing trees increases their return on investment. Overall, research shows that economic benefits of street trees are typically correlated to tree variables like trunk diameter and canopy surface area. Presented in the pictures above is an example of what we consider a missed opportunity. The pictures show the construction site of Bank First on Koeller St, here in Oshkosh. As you can see, several mature trees were cut down on the construction site to make way for the building and extensive pavement for vehicle parking. With a TPZ ordinance in place, situations like these can be avoided and a healthy urban forest can be maintained.

Stakeholder Identification

Travis Derks – City Forester, Oshkosh

Travis Derks has been the Landscape Operations Manager and City Forester for the City of Oshkosh since April of 2022. As such, he directs, manages, and supervises all aspects dealing with public trees like planting, removal, pruning, and general maintenance. He is also entrusted with informing the public on forestry projects and providing educational material for tree care. Travis has been taking charge of proper tree maintenance and follows a 5-year pruning cycle. He is also committed to diversifying the urban tree canopy in Oshkosh; so far, he has managed to plant trees of 27 different species and 20 different genera. In addition, he is managing the spread of the Emerald Ash Borer in Oshkosh by removing any trees infected beyond repair and treating healthy Ash trees with a pesticide to protect them from infection.

Mainly, Travis identified that there is currently no true protection for public trees from being harmed or removed during construction operations. He said that even though he does encourage contractors to be mindful of tree locations when designing their plans and working near trees, essentially relying on a "good faith" system, it leaves public trees vulnerable to be negatively impacted. As a result, he believes that having a TPZ ordinance can help uplift the chances to public tree safety which will contribute to the overall health of the urban forest.

Bradley Spanbauer – Director of Sustainability, UW Oshkosh

Bradley Spanbauer is the current Director of Sustainability at the University of Wisconsin-Oshkosh as well as an active member of the City of Oshkosh Sustainability Advisory Board member. When asked about the state of urban forestry here in Oshkosh, he had a lot to say. Spanbauer stated that the city has many well-developed neighborhoods with healthy mature trees, however, he noted multiple areas of possible improvement as well. He noted that tree species diversity can always be improved, as this is important in creating a successful and resilient urban forest which can serve as a habitat for birds and other native species. In addition, Spanbauer urged the importance of emphasizing the implementation of native species as much as possible as opposed to non-native species.

Bradley Spanbauer also believes that public education is a huge factor that also needs improvement. He stated that often, citizens are not aware of the importance of various native tree species, and the benefits they can provide the urban forest and the community overall as opposed to these non-native alternatives. Education of the public as well as incentives for citizens planting native terrace trees could be successful and beneficial to improving Oshkosh's urban forests. Spanbauer noted that the city of Oshkosh should investigate possibly obtaining native species to plant for cheap rates, or possibly applying for grants to obtain funding for these trees. He mentioned that there are many available grant options for urban forestry projects such as this, including ones of the Wisconsin DNR for up to $25,000 per year. These grant opportunities are discussed below.

Additionally, Spanbauer pointed out that the city of Oshkosh forestry website page includes articles and data that is incredibly out of date, with the most recent being a Street Tree and Urban Tree Canopy Report completed in 2012. This report is now, for the most part, not relevant to the current state of Oshkosh's urban forest. There are also links to Wisconsin urban tree articles from 2007, which are also not relevant anymore. Spanbauer explained that a possible urban tree inventory analysis would be a good place for the city to start in terms of gathering accurate, up-to-date information that the public can have easy access to. Also, including sections

on their website which discuss the importance of native tree species would be beneficial. Lastly, Spanbauer noted an area of concern for Oshkosh's urban forest being tree protection during road and sidewalk construction. He explained that terrace trees are often overlooked and are never accounted for in the construction planning process. 200-year-old healthy and fully mature trees are uprooted and removed. Spanbauer emphasized that this is unacceptable, and a policy or ordinance to enforce tree protection during construction would be beneficial in this regard.

Troy Heiman – Forestry Superintendent, West Allis, WI

Relevant Ordinance is included in Appendix B.

Troy Heiman is the forestry superintendent in West Allis. West Allis is a suburb of Milwaukee with a population of about 60,000 people. As the superintendent, Troy oversees the arborists that maintain the 22,000 street trees that the city has. Troy was recently promoted to the position when the former superintendent, Mike Rushmer, retired in September. Troy worked closely with Mike throughout the years allowing him to learn about the best management practices for urban forestry. Although Troy doesn't have a direct relationship with the city of Oshkosh, his expertise can still benefit the city.

One thing that Troy talked about was the importance of pruning, especially in areas with construction. Pruning is done for safety reasons and to benefit trees directly by enhancing growth and structure. If trees are not pruned in construction sites, there is a higher chance that construction equipment will tear up the branches which can lead to harming the tree later in life. Pruning trees will also help construction crews perform their jobs more efficiently. Another factor in maintaining a healthy urban forest that Troy stressed was having a more diverse forest. They did a study in 2020 to see how diverse their forest was. They found that they needed to decrease some tree species and increase others. Overall, more diversity within their urban forest will increase the health of it. Troy also talked about what West Allis is doing for protecting trees during construction. He mentioned that it is important to plan before and during construction projects to prevent damage or loss of trees. One policy that the city has that needs to be enforced is the root protection zone. This zone is five feet on each side of the centerline of the tree. No excavation can occur within this zone and construction equipment and materials cannot be placed there.

Troy's perspective is valuable to our project because he has the same goals that we are pursuing in maintaining a healthy urban forest and preventing tree damage from construction. The reason he emphasizes diversity is because of his familiarity with invasive species. He has seen Dutch elm disease destroy the elm population in the city as well as a decline in ash trees due to the emerald ash borer. His perspective on urban forestry has also been influenced by his years of experience working under the former forestry superintendent.

Dylan Wenker – City Arborist, Menasha, WI

Dylan Wenker is an expert stakeholder whose knowledge about the practice of urban forestry could prove useful. Dylan is the City Arborist for Menasha. He also emphasizes the importance of having a diversity of trees. Menasha tries to follow the Wisconsin DNR standard of having no more than ten percent of the forest be one species. There are multiple actions that the city is doing to maintain a healthy urban forest. One action is a one-to-one replacement of trees per every removal. Whenever they have to remove a tree, they replace it. The replacement tree is carefully selected with increasing diversity in mind. There is currently not a pruning cycle

but there are hopes to start a four-cycle in the future. The emerald ash borer is also impacting Menasha. To account for this invasive species, Dylan is treating the Ash tree population with a chemical injection.

Another important facet of urban forestry that Dylan mentioned is community education and outreach. Educating the public on the benefits of trees is important in keeping a positive attitude towards urban forests. Dylan has had prior experience working in forestry in the City of Madison. He has noticed a difference in people's mindsets towards trees between Madison and Menasha which has influenced how people react to new plantings and other forestry related work. This shows how important it is to understand what the local community thinks about how urban forests are managed. It is also crucial to talk with council members and residents about their concerns and ideas. Two ways that Menasha keeps their residents informed is through the city website and Arbor Day events. They also use a GIS software called the Wisconsin Community Tree Map to keep an inventory of their trees to help them make planting decisions and inform residents on those decisions.

Currently, Menasha has one ordinance in place for tree protection. The ordinance demands that there must be protective measures put into place with any excavation or construction near public trees. No excavation can occur within a ten-foot radius of any public tree without a permit from the City Forester. Dylan said that it is great to have ordinances, but the best policies always start in planning and design. The best chance to protect a tree is during the design phase of a construction project. This is why it is important for arborists to be in the early design and planning meeting to talk with engineers and construction managers.

Brandon Hellenbrand – City Forester, Sun Prairie, WI

Brandon Hellenbrand is considered an expert stakeholder as he has been in the industry nearly twenty years. He was recently appointed the City Forester of Sun Prairie in February of 2022, which was the beginning of a standalone Forestry Division for the city. Brandon's focus is managing and maintaining the public trees to receive optimal benefits from the urban forest. This includes routine pruning and pest management. Since his arrival, he has initiated the development of a Hybrid Urban Forestry Management Plan through a 2023 WI DNR Urban Forestry Grant. It is still currently being created but will include long-term and short-term goals for sustainability and management. His experience in the industry provides key insight to the importance of urban forestry. Brandon was also delighted to share with me that Sun Prairie has an ordinance pertaining to tree protection during construction. This was one of the first cities we found across the state that had an ordinance related to this and provided a valuable baseline when planning a recommendation.

Sayer Larson – Parks Superintendent, McFarland, WI

Sayer Larson is considered an expert stakeholder with experience in a wide variety of topics before taking on the role as Parks Superintendent for the Village of McFarland. Sayer has experience in landscaping and ecological restoration in both the public and private sectors giving him a unique perspective in how to properly manage an urban forest. He says that the Village is in the process of developing an Urban Forestry Management Plan, which is important for their long-term management goals. Currently, Sayer and the other Village staff do perform pruning, removals, and plantings, but a plan would create a routine in these actions. Additionally, they have begun to use the standard 20-10-5 in their new plantings to diversify their urban forest to

better withstand diseases/pests. Sayer mentioned that there are a few ordinances that relate to tree protection, but not necessarily one specific to construction.

Mike Stanonik – City Forester, Appleton, WI

Mike Stanonik is considered an expert stakeholder with twenty years of experience as an arborist. He was appointed City Forester of Appleton in May 2023, and is still working to understand the practices that were put forth by the previous forester. Appleton's current focus is responding to emerald ash borer through treatment and removal. They also maintain a seven-year pruning cycle. When asked about a construction ordinance, Mike saw the potential for one in the future, but needed to first understand the current construction practices throughout the city. He also said he collaborates with the city engineer to discuss street reconstruction plans prior to them occurring.

Dan Traas – Owner, Ranger Services Inc.

Dan Traas is the owner of Ranger Services Inc., which has been in business for over thirty years and is based out of Appleton. Dan is considered an expert and primary stakeholder because he has extensive knowledge about the relationship between urban trees and construction, and he works in the Fox Valley area. He agreed that trees are too quickly removed when they could be saved during a construction process and shared with us the importance of retaining urban trees. In his opinion, trees are as much of a city's infrastructure as anything else and should be treated like it because they can provide valuable benefits to the community. Dan thought the first step to tree protection during construction was to require a qualified arborist on the team for all reconstruction projects and establish that tree protection is desired. It is important that trees are put into the initial projects plans to ensure that tree protection is as much of a requirement as any other area in the project. He also recommended investigating Milwaukee's plan as it covers both reconstruction and new construction and is mostly based on street reconstruction.

Justin Gierach – Engineering Division Manager/City Engineer, City of Oshkosh

Detailed email included in Appendix C.

Justin Gierach is a Professional Engineer with the City of Oshkosh. He saw the benefit to maintaining as many large trees as possible because they provide more benefits than young/newly planted trees. However, he had several concerns about the implementation of an ordinance of this kind. One concern was the required maintenance of existing utilities that are within the public right-of-way. This means that anything in the way of maintaining their utilities area at risk of being removed or replaced. An additional concern was the difficulty to enforce the avoidance of the critical root zone in all construction projects (public and private). In general, the Department of Public Works would not support an ordinance of this kind because of these two concerns stated. He did state that they look at each project individually and try to save as many trees as possible within the construction limits.

Dr. Elsbeth (Misty) McPhee – Associate Professor of Environmental Studies, UW Oshkosh

Dr. Elsbeth McPhee is an associate professor of environmental studies and biology at the University of Wisconsin Oshkosh, and a resident of Oshkosh. Her specific research interests are in endangered species, conservation biology, and animal behavior. Dr. McPhee's expertise on

environmental conservation and her association with the city as an involved member of her community makes her an important stakeholder. Changes in the urban tree canopy can potentially impact her quality of life as well as her community's.

When asked for her views on urban forestry, she stated that she believes that trees in urban settings are essential for mitigating issues that are exacerbated by climate change, like helping with stormwater runoff, carbon sequestration, reducing the urban heat island effect, and addressing social justice issues. Being aware of the unequal tree distributions within communities, she states how trees are especially important for people in underserved neighborhoods. This is because these communities, who typically tend to be in areas where there is a prevalence of health issues, stand to benefit the most from green projects.

Dr. McPhee's main concern is tree removal and unreliable tree replacement efforts, so she is a strong proponent of increasing the urban tree canopy within Oshkosh and protecting the canopy that is already in place. Dr. McPhee draws on her expertise to reiterate the importance of having and maintaining a healthy tree canopy in urban areas for the various ecosystem services they provide.

Craig Pinkalla – Forestry Preservation Coordinator, Minneapolis Park & Recreation Board

Craig Pinkalla is the Forestry Preservation Coordinator for the Minneapolis Park & Recreation Board (MPRB) in Minneapolis, MN. Looking through their various websites, it is evident that much work and dedication has gone into the health of their urban forest. He was able to provide some information on how their TPZ policies are helping Minneapolis meet their urban tree canopy goals. Craig Pinkalla can be considered an expert stakeholder; he will not be impacted by any changes regarding TPZ's in Oshkosh, but his stake is attributed to his valuable experience and expertise in dealing with TPZ regulations. As the Forestry Preservation Coordinator, he has experience with what works and does not regarding tree protection. He believes that requiring protection at an institutional level limit the impacts on tree root systems and the health of trees during and after construction activities. It also creates an awareness over time that trees are important, and that protection is just part of doing business. He further elaborated that their tree protections specifications are intentionally not part of but referenced by [their] policies to allow annual review and update of specifications without the involved process of amending ordinance or revising policies. This has proven an effective way to adjust to changes in industry technology or best management practice.

Also, as part of the MPRB, one of his responsibilities is to conduct tree inspections for project plans, this cost is covered by the MPRB department. When thinking about Oshkosh, perhaps it would be beneficial to consider collaborating with the parks department, a collaboration can help lessen the workload brought on by having to conduct tree inspections on construction sites. Other valuable information he provided was on various challenges faced with such regulation. He said that initially they had no standard specifications for tree protection, so there was not a standard to hold projects accountable to. However, now, their requirements are part of the City of Minneapolis Standard Specifications and therefore are enforceable on all work that touches the public way. And, even though compliance in practice continues to be an issue, the procedural nature of the requirement allows for enforceable actions to correct, mitigate, or assess for damage as appropriate. Having tree protection requirements clearly shown on plan sets has reduced the frequency of non-compliance. There is, however, no substitute for inspection during construction. The other primary challenge he talked about is thoughtful design; just because you circle a tree on a plan and call out tree protection, it doesn't ensure that it is a tree

that can or should be protected. As a result, they are piloting a Tree Protection Priority Report that describes each tree in the scope of work for large projects and assigns a Preservation Priority to guide the design. A lot of the information he provided can be used to guide how we approach presenting TPZ's in Oshkosh. Craig Pinkalla provided good ideas on how to mitigate challenges associated with tree protection, like allowing the regulation to be flexible to meet situational challenges or having a prioritization analysis done to mitigate construction/tree conflict.

Benchmarking

La Crosse, WI

When looking within Wisconsin, the City of La Crosse is a great example of a community that prioritizes their urban forest. The population of La Crosse totals 52,680 people with a poverty rate of 22.1%. Their urban forests are resilient and successful, and this is due to their constant commitment to improving their practices. The City of La Crosse has been named a Tree City USA since 1989 because of their dedication to urban forestry. Tree City USA recognizes green communities across America, and since their birth in 1976, they have recognized 3,559 cities, invested $1,569,831,172 in urban forestry, and been responsible for the planting of 1,002,569 trees. In order to receive the annual Tree City recognition, cities must follow the four overarching standards which are: (1) maintaining a tree board or department, (2) having a community tree ordinance, (3) spending at least $2 per capita on urban forestry, and (4) celebrate Arbor Day. The City of La Crosse has achieved all four of these standards for 34 years straight, emphasizing and displaying their commitment to their urban forest.

La Crosse is home to over 20,000 urban trees with a tree canopy coverage of 16.6%, compared to Oshkosh's 9.2%. Their urban trees assist with controlling storm water run-off, improving air quality, reducing utility prices, increasing property values through aesthetics, as well as providing viable habitats for native wildlife. Recently, in the summer of 2021, the City of La Crosse completed a tree inventory which accounted for every urban tree to help their forestry department better manage their urban forest. To fund their various urban forestry projects, La Crosse relies on various grants. For the past few years, they have received a grant from the Wisconsin DNR in the amount of $25,000, as well as $25,000 grants from both the Community Development Block Grant and the Paul E Stry Foundation.

Emerald Ash Borer (EAB) has been a threat to countless urban trees across the United States, and La Crosse has does nothing short but be quick to address and irradicate the threat of EAB in their city. The beetle first reached La Crosse in 2012. That same year, the city had devised and published an EAB Management Plan Resolution which included irradicating the ash tree population to stop the spread of the invasive insect. By 2020, all ash trees in the City of La Crosse were successfully removed and replaced which now signifies the successful completion of the EAB Management Plan. The way La Crosse handled the Emerald Ash Borer issue in their community is a great example of their commitment to the resilience of their urban forests.

Involving community members in their urban forestry practices is also a priority of the City of La Crosse. Citizens can add to the City's urban forest by requesting the planting of boulevard trees. They are given a list of approved tree species and locations, and the city forester goes through the requests that are submitted and completes them. In addition, citizens can get involved through the "Beautify La Crosse" program. This program assists individuals, businesses, clubs, and neighborhood groups in adopting an area within a neighborhood and completing different urban forestry projects. Project ideas include planting a micro prairie or pollinator garden, establishing a rain garden, adopting a planet box at a local park, or planting native plants in traffic circles. This is a great example of a way to implement education of the importance of diverse urban forests for the community.

Looking forward, La Crosse plans to prioritize urban tree inventory assessments to help them further the development of their urban forests and obtain future funding through grants. La Crosse is a prime Wisconsin example of a community committed to excellence of their urban forests that Oshkosh could use as a benchmark to track their own progress.

Washington D.C.

One place that is known for its urban forests is Washington D.C. Urban forestry has been a key part of the city since 1791, which was the year that the L'Enfant plan was drafted. This plan was the urban plan for Washington which reserved space in the public right of way specifically for trees, making forests an integral part of the design for the city. There are a total of about 1.9 million trees throughout the city, but only about 175,000 of them are public street trees which the urban forestry division manages. The district currently has an urban tree canopy of 35% but has a goal to have 40% of the district covered with a healthy tree canopy by 2032. This would put the city among the top-ranking cities in the country in terms of tree canopy cover. To meet this goal, the urban forestry division prunes, plants, and removes thousands of trees each year.

The district also has strict laws and regulations that work to protect trees. The Urban Forest Preservation Act and Tree Canopy Protection Act save trees from any excavation or construction activities. They regulate the removal and protection of mature trees on private property. Arborists often inspect construction sites to make sure laws are being followed. A couple of tree protection measures that are used are fencing, signage, root protection matting, and root pruning. Once construction has taken place, treatments including irrigation, organic mulch, pest management, and soil amendments are used to combat any possible stressors. The city also has a list of tree species that are intolerant to construction disturbance, so special management is needed with these trees.

Washington D.C. also has a permit system for residents and contractors that want to plant, prune, or remove a tree that is within the public right of way. The permit system ensures that the city's trees are being carefully managed. A problem that many cities face today is the invasion of exotic insects. To try and prevent the spread of these invasives, the district uses the Early Detection Rapid Response Program provided by the US Forest Service. This program attempts to detect exotic bark and beetles before they are fully established. According to the non-profit organization, American Forests, the total value of Washington D. C's urban forests is estimated to be 3.6 billion dollars. This was calculated by measuring how many pollutants were removed by trees, how much carbon was stored and sequestered, and how much building energy was reduced. The functions of urban forests have a significant economic impact on the city.

Stevens Point, WI

Relevant ordinance and specifications include in Appendix D.

Stevens Point is an excellent example of a city that recognizes the importance of protecting trees during various forms of construction. In addition to a chapter in their municipal code dedicated to forestry and requirements, they have a separate document labeled "Forestry Specifications for Construction on Public Lands." Included in this is different tree protection efforts that are necessary for underground and above groundwork. If these specifications are not followed, there can be fines associated with it. Stevens Point's ordinance provides Oshkosh with many different starting points to adopt a similar ordinance.

McFarland, WI

Relevant ordinances included in Appendix E.

McFarland is a suburb of Madison that also resides on a lake and river like Oshkosh. They are in the process of developing an urban forestry management plan, but already have

various ordinances in place that protect trees during excavation and development. They have worked towards increased biodiversity within the city and hope to expand ordinances specific to tree protection during construction in the future. McFarland has two distinct ordinances that address two different areas of construction and is a valuable example for Oshkosh.

Sun Prairie, WI

Relevant ordinance included in Appendix F.

Sun Prairie is a suburb of Madison that has a relatively new standalone Forestry Department that was established in February 2022. They are developing their first "Hybrid Urban Forestry Management Plan," however, they already have an ordinance pertaining to tree protection during construction. In Chapter 12, under "Prohibited Acts," Section B highlights what actions cannot be taken during excavations and construction to protect tree canopy and roots. This ordinance is brief, but powerful for the future of trees as it gives the necessary protection for them to mature. Sun Prairie provides a great example of what Oshkosh could also implement.

Minneapolis, MN

Relevant ordinance included in Appendix G.

Minneapolis, Minnesota is a prime example of best practices implementation regarding urban tree canopy. They pride themselves with a tree canopy of 29.8% (Trees & the Urban Forest - Minneapolis Park & Recreation Board, n.d.), compared to Oshkosh's 9%. One of the reasons Minneapolis is meeting their urban canopy goals is due to their extensive guidance on how to maintain, protect, and manage the Minneapolis urban forest, which is laid out in the Minneapolis Urban Forest Policy guidelines. The specific area of interest, relevant to this proposal, are the policy sections pertaining to tree protection.

Section 5.6 of the Minneapolis Urban Forestry defines a TPZ as "an identified area where activities are restricted surrounding existing trees within a construction zone with the primary functions: (1) to avoid physical damage from contact by equipment, materials, and activities; and (2) to preserve roots and soil conditions in an intact and non-compacted state." In addition to clearly defining the goal of the TPZ policy, they provide guides on proper coordination between project developers, Forestry Preservation Coordinator (FPC), and the appropriate city staff prior to construction to avoid damage to trees and their root systems. The Minneapolis Park and Recreation Board of Commissioners created the position of Forestry Preservation Coordinator (FPC), their role is to make tree related recommendations regarding construction practices, utility work, permitting, development review, and plan design for both Public Works and the MPRB. Additionally, the FPC serves as field representatives to mitigate impacts to trees for any construction and repair conflicts. Their extensive guidelines provide information on tree protection for various scenarios involving land development processes, construction, conduit boring, management, and any other project that has the potential of impacting existing trees. The comprehensive nature of these TPZ policies increases Minneapolis' chance of preserving long established trees and aids them in advancing towards their goal of increased tree canopy cover which makes them a good example of best practices.

Costs

The creation of an ordinance would pose minimal costs to the City of Oshkosh. In our proposal, we are suggesting that street reconstruction projects implement tree protection and retainment throughout the process. Specifically, we recommend mandating a Tree Protection Zone (TPZ) during projects. Implementing an ordinance in this regard would require extra time in the planning and design phase to ensure urban trees will be protected during construction. Prior to any construction, the TPZ barrier would need to be in place and inspected to confirm it was installed correctly. This would add an additional labor cost to install the barrier and to have a qualified arborist perform the inspection.

Our project would require a barrier to block off the designated TPZ. To do this, fencing would need to be purchased. We would recommend using orange construction fencing that comes in 4ft x 100ft rolls, with prices ranging from $20-45 depending on where it is bought. We would also need steel fence posts, which would be less than $20 per post. This fencing can be reused from project to project until it is severely damaged. Another consideration would be signage designating the tree protection area. These would cost around $10 each depending on where they are bought from but can be reused long-term from site to site as they will face minimal damage. The amount of fencing needed depends on the size of the tree, so the total price per tree would vary. Although reusing the fencing, posts, and signs would be ideal, we recognize that this may not be possible long-term practice. The only additional maintenance cost would be for repurchasing materials when they are severely damaged, or more material is needed.

This ordinance would provide other financial benefits to the city too. Maintaining the health of existing trees increases their return on investment. Overall, research shows that economic benefits of street trees are typically correlated to tree variables like trunk diameter and canopy surface area. In a study conducted by Mullaney et al., researchers found that on average, a single tree can provide: an energy savings cost of $2.16 to $64, reduced stormwater runoff costs by $2.78 to $47.85, and mitigate air pollution with a savings ranging from $1.52 to $34.50 (2015). Another study found that carbon sequestration benefits range between $0.34 to $13.38 and urban trees can increase property values anywhere between $7 to $165 (X.P. Song et al.). To reiterate, the benefits of trees are linked to the size and height of the tree, meaning that benefits are maximized from mature trees as opposed to relying on new tree plantings. This calls for the prioritization of protecting established trees through implementing a TPZ.

Funding Opportunities

Wisconsin Department of Natural Resources Regular Forestry Grant

There are a variety of grant opportunities available to use for urban forestry projects at the city level. The Wisconsin Department of Natural Resources offers the Regular Forestry Grant. This grant is a cost-share grant which ranges from $1,000 all the way up to $25,000. The Wisconsin DNR describes the intended use of this grant as being “to support new, innovative projects that will develop sustainable urban and community forestry programs, not to subsidize routine forestry activities” (WDNR). These grants are of the 50-50 match type, meaning the project sponsor would initially fund the project in full. Following, the project sponsor would apply for the grant to be reimbursed for 50% of the project cost, meaning that the project sponsor would be responsible for covering half. Applications for this grant are open and will be accepted between June 30th and October 2nd of the year before they are given out. Eligible projects should relate to community tree management, maintenance, or education within Wisconsin cities.

The Wisconsin DNR lists possible eligible project topics as tree inventory or canopy assessments, public outreach, and tree ordinance development and revision.

Inflation Reduction Act

Another source which allocates funding for urban and community forestry grants yearly is the United States Forest Service under the U.S. Department of Agriculture. They feel that healthy urban forests are unimaginably valuable to their communities. In an interview, Assistant Director for Urban and Community Forestry, Beattra Wilson, stated, “Urban trees are the hardest working trees in America. Having more trees and more access to green space is critical for our communities”. Thanks to the inflation reduction act, $1.5 billion was invested to increase urban tree cover across the nation. The U.S. Forestry Service is responsible for dividing and allocating these funds in the form of grants. For Wisconsin specifically, they have allocated $13.5 million dollars to the award. At the time of this research, there are minimal funds available for urban forestry projects. As a result, the City of Oshkosh could greatly benefit from the use of these grants in terms of advancing their own urban forestry practices.

Barriers

One possible barrier to this proposal is public perception. If the residents of Oshkosh aren't aware of the benefits that trees in urban areas bring, then people might not care to protect them. To overcome this barrier, public education and outreach is necessary so that citizens are more informed. Informed citizens would more likely than not want to protect trees and could help in making sure that potential ordinances or policies are enforced.

Another impediment to this project could come from the construction companies themselves. The main cost of protecting trees during construction would be paid for by these companies, so there could be conflict here. These companies might not want to pay the extra cost of buying the necessary barriers. Protecting trees will also be another piece to add in the planning phase. Construction projects may be prolonged when having to deal with public trees and figuring out how to protect them. There is also the problem of enforcing the ordinance. Construction crews could ignore it and just do business as usual. If this project is to work, these barriers need to be addressed. This project can work if the community and construction companies are educated, and the ordinance is enforced.

A third barrier is faced in the support from the City's Engineering Division and Public Works Department. One concern they have is the enforcement of the ordinance. They also worry that the ordinance would be hard to follow when maintenance on existing utilities needs to be done. These should be heard and would require the collaboration of the Sustainability Advisory Board and the DPW to reach a solution to the concerns. Appendix B includes the detailed email regarding concerns of the implementation of this ordinance.

Significance for Sustainability

There are many benefits that come with maintaining a healthy urban forest. These benefits can contribute to the sustainability goals of the city of Oshkosh and can offset other problems that the city faces. Maintaining a healthy urban forest by protecting trees during construction has environmental, social, and economic implications.

Environment

One environmental impact that urban forests have is the ability to remove carbon dioxide from the atmosphere. This is known as carbon sequestration. Cities are the areas that produce the most carbon emissions, so maintaining the health of mature trees could prove valuable in lessening carbon dioxide in the atmosphere which will also aid in mitigating climate change. According to Nowak and Crane, urban forests in the United States currently store 700 million metric tons of carbon with the opportunity to store much more (2002). They also mention that the southeast, north central, northeast, and Pacific northwest regions have the greatest capacity for carbon storage. Oshkosh, belonging to the north central region in this study, should try to maximize the amount of carbon that can be captured. Another study showed that trees located closer to larger bodies of water have higher contribution rates than trees that are away from water (Zheng et al., 2013). Oshkosh is located between Lake Butte des Morts and Lake Winnebago with the Fox River running right through the middle of the city. According to the studies listed above, Oshkosh is a city that can make a significant impact in lessening the amount of carbon in the atmosphere by keeping a healthy urban forest.

Another environmental benefit that urban forestry brings is a reduction in air pollution. As cities become more populated, more and more pollutants are released. Trees remove pollutants from the atmosphere just as well as they remove carbon dioxide. Douglas, Irga, and Torpy did a study to see how well trees do at removing pollutants using variables such as land cover use, traffic density and industrial air pollutant emissions. They found that air pollutants were negatively correlated with tree canopy cover and positively correlated with population density (2019). There is a statistically significant relationship between urban forestry and a reduction in air pollution. An important factor to consider is the pattern of green space when trying to reduce air pollutants. The spatial patterns of green space have implications for not only air pollution but also life satisfaction. Wu and Chen showed that the fragmentation of green space is negatively associated with air pollution (2023). In other words, more divided green space will lead to less air pollution. This is contrary to the pattern of green space needed to enhance life satisfaction. Densely distributed small green spaces is related to higher life satisfaction (Wu & Chen, 2023). This piece of information is important for policymakers to keep in mind when protecting trees during construction and when thinking about the areas that urban forestry needs to be prioritized. Air pollution removal positively affects human health. According to Tan, damage to city forests can lead to excess deaths up to 1.8% (2022). A decline in tree numbers has led to an increase in air pollutants which has also increased cardiovascular and respiratory disease. Even if air quality improvements are low, human health can still be heavily impacted.

Additionally, urban trees can provide valuable habitat for various organisms and provide a crucial role in urban biodiversity. Although many organisms designate urban trees as their home, birds are one of the most common animals to utilize trees every day. Trees give birds necessary shelter, food, and breeding locations. With Oshkosh located along the Fox River and Lake Winnebago, it is an important stop on migration routes for many birds and urban trees can

give these birds somewhere to rest and feed before they continue their journey north or south. Non-migratory birds can also use these same resources that trees provide. Communities with urban trees will see a much higher percentage of birds than those without. Trees can provide habitat for other organisms as well, like insects and squirrels. As urbanization increases, these organisms will lose their familiar habitats and will have to learn to adjust, but protecting urban trees can give them necessary habitat to survive.

Lastly, urban forests can play a vital role in the biodiversity crisis. Biodiversity is the species richness and abundance of a given area. In many cities, there is very little biodiversity in trees which can make them more susceptible to pests and less resilient. For an urban forest to be resilient, it needs to have a variety of species planted so one is not more prominent than others. If one species is to face a pest or disease disturbance and are forced to be removed, there will still be other trees left in the urban space for habitat. Biodiverse urban forests can also host numerous organisms that may rely on specific species or specific tree sizes. Mature trees can have more benefits for bigger organisms where smaller trees can help smaller organisms. It is essential that there is variety in species and size of trees to be a resilient urban forest.

Society

Urban forests and green spaces can provide immense social benefits to their communities and Oshkosh is no exception to this. These green spaces serve as a prominent tool to increase human quality of life in urban settings. Individual benefits received by urban green spaces include those to mental, physical, emotional, and spiritual health. Culturally, urban green spaces provide a place for social engagement and for connections which can lead to long term relationships. In an urban setting, people often overlook and underestimate their relationship with nature. Lisa de Kleyn and her colleagues state in their article, “From green spaces to vital places: connections and expression in urban greening that allow people develop relationships with nature through their understanding of their place in nature, values, current and past interactions, and associated cultural understandings and social relationships which influence behavior” (2020). Groups of people that use urban green spaces on a regular basis to build strong social connections often tend to also value themselves in relation to nature. De Kleyn and her colleagues describe that there is a concrete feedback loop between urban green spaces and their qualities, human practices, and human response. The opportunity of cashing in the social benefits that urban green spaces have to offer is determined by how humans interact with them. This connects to the idea that urban green spaces must be successfully planned and implemented in ways that optimize these opportunities for all groups of people.

Ultimately, health deficits of the community are a social issue. Things that can improve the overall health of the community, both mentally and physically, should be a priority to communities. Urban forests have been shown to have immense positive effects on community health. A.C.K. Lee discusses these benefits in his academic article “The health benefits of urban green spaces: a review of the evidence”. Between 2000 and 2050, the percentage of the global population that will live in an urban setting is expected to rise from 46.6% to 69.6% which increases the urgency of developing resilient urban forests. Urban forests and green spaces provide opportunities for urban populations to engage in outdoor physical activity on a regular basis in places that they otherwise would not have. Benefits from outdoor physical activity includes reduced of risk of cardiovascular disease, diabetes, various types of cancer, and so on. Additionally, mental health benefits provided from urban forests are abundant. Spending

valuable and routine time in nature can decrease the risk of depression, anxiety, and overall confidence and mental well-being.

Economy

The monetization of ecosystem services has become a way to put a price value on natural systems so that 'saving' them, and promoting them, does not feel as burdensome. With the undeniable evidence of climate change, both the frequency and intensity of weather events is increasing. There is no escaping climate change, but there are things communities can do to increase their resiliency to better withstand these coming changes. One way to increase resilience in urban communities is by increasing their green infrastructure and protecting the existing vegetation within the highly impervious urban environment.

Urban areas experience a phenomenon known as the urban heat island effect. This is when cities replace natural vegetated surfaces with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. These alterations to the vegetated environment led to increases in energy use and higher air pollution levels. Protecting existing trees can be an effective way to reduce energy demand through cooling and warming effects (Ko, 2013). Urban trees help moderate the urban heat island effect by reducing the temperature of the air and ground surfaces, thus, reducing the need for air conditioning. Likewise, in the winter, urban trees serve as protection against cold winds to buildings which help lower heating costs. A study conducted in Toronto, Ontario, found that residents benefited by a savings of up to 20% in heating costs (Ko, 2018). However, improper tree species selection, location, and lack of consideration of the regional climate can lead to creating a "heat penalty" effect. Nevertheless, it was found that energy savings averaged at $2.16 to $64 per tree per year (Mullaney et al., 2014). Research shows that economic benefits of street trees are typically correlated to tree variables like trunk diameter and canopy surface area, making the protection of existing trees important for obtaining the most effective form for mitigating energy costs.

Similarly, urban trees aid in the management of stormwater. Stormwater management is an urgent 21st century urban challenge. Street trees can lower stormwater runoff by intercepting large volumes of water over impervious surfaces which can reduce downstream pollution levels, reduce costs for stormwater drainage infrastructure, and minimize the need for costly stormwater treatment systems. Urbanization often comes at a cost to green spaces; the expansion of impermeable surfaces leads to an increase in soil erosion. Soil erosion causes disruptions to the surrounding watersheds by altering drainage patterns, water quality, and altering ecosystems. It is important to recognize and appreciate the ecosystem service urban trees provide by the reduction in stormwater runoff. It is estimated that a single urban tree can reduce stormwater runoff by 3.2 kL (1kiloliter= 1,000 liters) to 11.3kL; the assigned financial annual value varies from $2.78 to $47.85 per tree (Mullaney et al., 2014). Additionally, urban trees can also mitigate air pollution, with an economic savings ranging from $1.52 to $34.50, and sequester carbon which has cost savings range of $0.34 to $13.38 per tree (X.P. Song et al.). Again, it is important to understand that the most benefits are derived from well-established trees which tend to have a larger canopy and extensive root system. Both canopy and root dimensions, in regard to stormwater mitigation, are important to gain the most benefits.

Additional economic benefits associated with urban trees are that they can increase property value. Mullaney et al. found that trees influence choice of residence, and that home values are higher in areas that have a 20-30% tree cover, next to, or near the property. They also found that income for businesses can increase up to 20%. This is due to consumer perceptions of

a more positive atmosphere, increased comfort level, and the experience of a more favorable environment when shopping when there is a decent tree canopy.

In contrast, there are several areas of concern for planners and residents regarding urban forestry. Some concerns are potential damage to urban facilities, pavement, and plumbing from tree roots. Tree roots pose a hazard for pedestrians that have trouble walking and end up tripping on roots and getting hurt. As you can imagine, repair costs, litigation costs, and maintenance costs can end up cutting into city budgets. Another area of concern regards resident perception and preferences. Some residents, particularly in lower income neighborhoods, are cautious of supporting green infrastructure projects because they often overlook how the increases to property values impact rent prices, which can lead to the displacement of already marginalized communities (Salm et al., 2023); a process known as green gentrification. Limited awareness of possible issues and consequences of urban forestry can raise program costs. Many of these unintended and unplanned consequences for costs can be prevented, or mitigated, through preventative measures which include but are not limited to: public education, knowledge has the potential to shape attitudes and intention; and prior research, figure out what areas can most benefit from the project and tailor education and communication campaigns to best suit all stakeholders (Jim et al., 2021). In general, proper planning, management, and maintenance of the urban forest can help prevent unnecessary costs.

Given these points, maintaining the health of existing trees increases their return on investment. Research shows that economic benefits of street trees are typically correlated to tree variables like trunk diameter and canopy surface area. Overall, if all preventative measures are taken, it is estimated that on average, the net monetary benefit is $50 per tree per year. To reiterate, the benefits of trees are linked to the trunk size, root diameter, and height of the tree. This means that the maximum benefits are derived from mature trees; as a result, this calls for the prioritization of protecting established trees through the implementation of a TPZ.

Conclusion

Maintaining a healthy urban forest provides many benefits. These include environmental benefits such as carbon sequestration and protecting wildlife habitat, social benefits like increased like satisfaction and mental health, and economic benefits like a reduction in energy usage by municipal and residential buildings. These benefits will be enhanced if mature trees are thought of during the planning phase of construction projects and are protected from injury or removal from construction. Cities across the country and even right here in Wisconsin value their city trees over new infrastructural developments so that they can keep their trees in good condition. Looking into what these cities are doing is important so that Oshkosh can compare their practices to cities that have prominent urban forests. There are some barriers that may interfere with this proposal. The citizens of Oshkosh and construction companies might not be in favor of or follow the proposed ordinance. The most important action that can be taken to prevent these barriers is to educate the community about the significance of urban forests. The proposed ordinance has the potential to further advance the City of Oshkosh's sustainability goals.

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Appendix A

Various Equations for TPZ Specifications

Below details the various equations that can be used for TPZ and Critical Root Zone (CRZ) calculations.

North Carolina Urban Forest Council:

There are two ways of finding the size of a CRZ:

1. A legal CRZ area is determined by using a formula based on a tree's trunk diameter, as defined in municipal codes. Most municipalities define a legal CRZ as a circle with a 1, 1.25- or 1.5-foot radius for each inch diameter of the trunk.
    - To find the size of the CRZ circle when the ratio is 1:1.5, measure the trunk 4.5 feet above the ground, called diameter at breast height (DBH). Then measure outwards from the trunk 1.5 feet for every inch DBH. This will give you the legal CRZ. For example, if the legal CRZ is 1.5 foot for every 1 inch DBH, a 20-inch diameter tree would require a 30-foot radius circle of protection around the tree to meet the legal CRZ standard. Generally, municipalities require that the legal CRZ have a minimum of a 6-foot radius regardless of tree diameter, although this varies from place to place.
2. A biological CRZ area is determined by an arborist through analyzing tree characteristics, site factors, and anticipated construction impacts. In other words, the biological CRZ is defined as the area needed to preserve the roots necessary for the tree to survive construction. For most trees growing in an open setting, the biological CRZ spans from the trunk to the edge of the canopy, or the "dripline." For older trees, sensitive species, or trees growing in poor sites, the biological CRZ many actually be much larger than the dripline. Conversely, younger trees, resilient species, or trees on good sites may have a biological CRZ smaller than their driplines.

   For trees growing in a forest setting or with small crown sizes relative to their trunk size, the dripline may not capture all the roots needed for survival. In this case, the size of the biological CRZ may be found by using a DBH ratio calculation similar to what is done for the legal CRZ. An arborist can help determine what the ratio should be by evaluating tree factors (such as size, age, condition, and species sensitivity) and site characteristics (such as soil quality, water availability, and exposure).

   For young, healthy trees growing in good sites, the ratio could be as small as 1:2. So a 10-inch DBH sweetgum would need a circle with a 20-foot radius. For older, sensitive trees growing on poor sites, the ratio could be 1:4 or more. At a 1:4 ratio, a 24-inch DBH white oak would need a 96-foot radius circle of protection.

While both the legal and biological CRZ varies from place to place and tree to tree, it is essential that we make the effort to preserve as many roots as possible. Trees provide many services to your site, and smart investment in protection pays dividends in results. We recommend creating a tree protection plan prior to any construction project, which identifies protection areas for trees remaining on site.

Tree Protection Guidelines:

Trunk Diameter	Good Protection	Better Protection	Best Protection
8 inches	10 feet	12 feet	20 feet
12 inches	15 feet	18 feet	30 feet
16 inches	20 feet	24 feet	40 feet
20 inches	25 feet	30 feet	50 feet

Portland, Oregon Specifications

- 1 foot per inch of DBH (diameter at breast height)

West Allis Specifications

Sun Prairie Specifications

- 10 ft radius around tree

Appendix B

West Allis Tree Protection Practices

4. 2.2.4 BORROW EXCAVATION.
   Borrow excavation shall consist of furnishing, placing, and compacting approved soil behind the curb in areas where sod is to be installed and other areas as needed prior to placing topsoil and sod.
5. 2.2.5 TREES.
   1. (a) CLEARING AND GRUBBING.

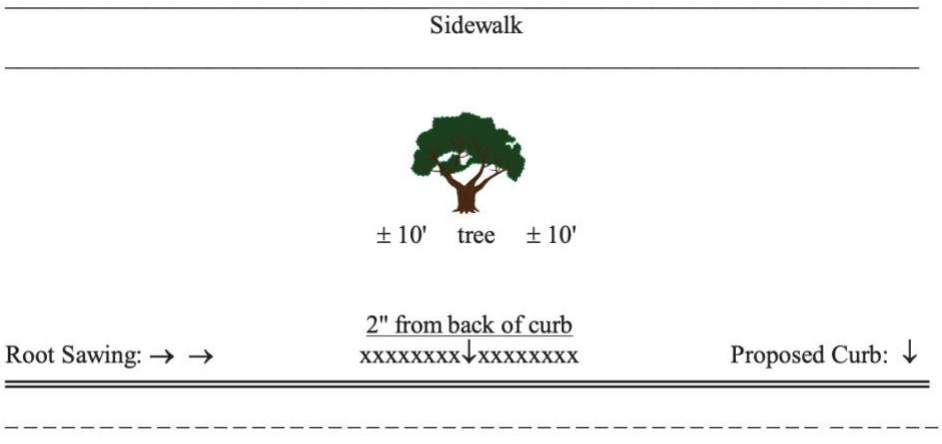
      The Contractor shall clear the ground, remove and dispose of designated trees, as well as stumps, roots, rubbish or other refuse found within the limits of the work. The price bid for grading shall include the removal of trees and stumps smaller than four (4) inches in diameter.

      Separate payment will be made for clearing and grubbing trees and stumps four (4) inches in diameter and larger.

      Stumps and roots shall be ground by an approved mechanical grinding machine to a depth of eighteen (18) inches below the proposed ground elevation. Other methods of grubbing may be used only with the approval of the Engineer.

      All grubbing holes shall be cleaned of chips and grindings and filled with approved compacted fill. The top three (3) inches shall be topsoil.

   2. (b) ROOT SAWING.
      This item of work shall consist of sawing the roots two (2) inches behind the back of the proposed curb, approximately ten (10) feet either side of each tree, and to a depth of eighteen (18) inches, as directed by the Engineer and as shown below. This may require the concrete curb and gutter to be constructed by steel or wood forms, i.e. "hand" methods, at some tree locations if conventional slip form machinery cannot be used. The cost of this additional work shall be included in the contract unit price bid per lineal foot of "31" Concrete Curb & Gutter." All street lighting cable will be de-energized and replaced after new curb installation.



      The Contractor shall take all necessary precautions to protect trees at the work site. An approved mechanical root cutter shall be used to saw the tree roots which interfere with the proposed curb and gutter construction, except in those situations where hand implement usage is adequate.

When tree roots are sawed, the following provisions shall apply:

ROOTS SHALL BE SAWED ON ONLY ONE SIDE OF A TREE.

The root system shall not be sawed deeper than eighteen (18) inches below the proposed elevation of the new curb and not more than two (2) inches from the back of the proposed curb.

Caution shall be used during root sawing operations, so as not to cause unnecessary damage to the tree or its root system.

All debris from the root sawing operation shall be used to fill root sawing trenches before the end of the workday.

Root foundations for all trees must remain adequate to withstand heavy windstorms.

All exposed and severed tree roots shall be immediately covered with a mulch and watered to prevent drying until such time that the concrete work is complete, the form removed and the area between the tree and concrete work backfilled with approved topsoil. The time duration for completion of the backfilling operations shall not exceed five (5) days from the time the concrete was placed.

"Root Sawing" shall be measured and paid for at the unit price bid per lineal foot of actual root sawing at each tree location.

(c) TREE PROTECTION.
Effective planning before and during an excavation or construction project can often prevent damage to or loss of trees. The Contractor shall take all necessary precautions to protect trees at the work site. Where a contractor perceives, that even with reasonable care, damage may occur during construction, the Forestry Division shall be contacted at (414) 302-8811 to request a preconstruction meeting on site.

(1) ROOT PROTECTION ZONE.
Root foundations must remain adequate to withstand heavy windstorms.

To protect the immediate portion of the tree roots, a Root Protection Zone will be

maintained. This Zone area is five feet (5') on each side of the centerline of the tree

trunk parallel with the street and from the backside of the curb to the backside of the walk. No construction equipment or materials, sand, soil, gravel, block or pipe shall be placed, parked or stored within this area. No chemicals, rinsates or petroleum products shall be deposited within this area. (See Figure 14.)

All cutting for the removal of sod and soil in order to establish a finished grade within this Zone must be done manually.

No excavation shall occur within this Zone.

Tree roots interfering with the work shall be completely severed with a clean sharp tool; i.e., axe, pulaski, chain saw, etc., and removed with an approved machine or other approved methods. An approved mechanical root cutter shall be used to saw the roots which interfere with the proposed sidewalk construction, except in those situations where hand implement usage is specified.

When tree roots are cut, the following provisions shall apply:

[a] CONCRETE WALK. The root system on the walk side of the tree shall not be cut by means of mechanical root cutting machines. If root removal is essential to concrete walk replacement, interfering roots shall be manually cut with hand implements.

Roots below the proposed walk shall be removed only to a depth of nine (9) inches below the proposed elevation of the new five-inch (5") concrete walk.

When replacement walk is two feet (2') or less from the surface of a City tree trunk, the walk will be narrowed one foot (1'). All old walk should be removed prior to any root cutting in narrowed area. If the root system is to be cut, the cut must be within two inches (2") of the edge of the proposed new walk and not more than nine inches (9") below the proposed elevation of the new walk. (See Figure 14.)

2. [b] CARRIAGE WALK. The edge of the new walk closest to a City tree shall be at least six feet (6') from the centerline of the tree. (See Figure 14.) All old walk should be removed prior to any root cutting. Roots shall not be cut by means of mechanical root cutting machines. If root removal is essential to carriage walk replacement, interfering roots shall be manually cut with hand implements. If the root system is to be cut, the cut must be within two inches (2") of the edge of the proposed new walk and not more than nine inches (9") below the proposed elevation of the new walk. (See Figure 14.)
3. [c] DRIVEWAYS. All old concrete should be removed prior to any root cutting. Roots shall not be cut by means of mechanical root cutting machines. If root removal is essential to driveway replacement, interfering roots shall be manually cut with hand implements. If the root system is to be cut, the cut must be within two inches (2") of the edge of the proposed new concrete and not more than nine inches (9") below the proposed elevation of the new concrete. (See Figure 14.)

Caution shall be used during root cutting operations, so as not to cause unnecessary damage to the tree or its root system.

All debris from the root sawing operations shall be removed from the sidewalk area and root sawing trenches must be filled with approved topsoil before the end of the workday.

Root foundations for all trees must remain adequate to withstand heavy windstorms.

All exposed and severed tree roots shall be immediately covered with a mulch and watered to prevent drying until such time that the concrete work is complete, the form removed and the area between the tree and concrete work backfilled with approved topsoil. The time duration for completion of the backfilling operations shall not exceed twenty-four (24) hours from the time the concrete was placed.

(2) CREDITS AND CHARGES FOR DAMAGE.
Damage to trees caused by construction work ranges both above and below ground. Root systems can suffer both mechanical and chemical damage. Tree trunks and crowns are subject to various degrees of mechanical damage. Through their short-term and long-term effects on tree health, these types of damage can be quite serious.

The most serious construction damage to a tree is usually done to the unseen portion of that tree. Overlooked and misunderstood, tree roots often suffer extensive, if unintended, injury and loss as a result of construction work happening around them.

Mechanical destruction of roots or chemical contamination of soil in the root zone is the main cause of construction damage below ground.
The soil at a construction site can suffer compaction damage by general construction, traffic, operation of heavy equipment and by the storage of construction materials. Compaction of the soil changes soil structure and increases bulk density. This leads to either drying or water-logging of soils surrounding tree roots.

Excessive root loss may also occur when no concern is given to root systems during trenching and excavating activities by trenching machines, backhoes and bulldozers.

Roots can be severed, torn away or crushed causing serious wounding and oftentimes loss of normal structural stability. This can lead to direct tree mortality and/or uprooting.

Leaking fuel, lubricants or hydraulic oils and spills or dumping of masonry rinsates, paints, acids, solvents, etc. may kill roots or impede their functions. This can adversely affect the tree health or cause direct tree mortality.

Many construction activities cause aboveground damage to street trees. This damage includes broken, split and scarred branches and/or tree trunks. Small broken branch-ends may be unavoidable and of little consequence to overall tree health. However, when large branches are torn away, damage is substantial. Total leaf area is also reduced by leaf scorch and twig death caused by hot exhaust gases venting from construction equipment operating beneath tree crowns.

Trunk wounding can range from minor outer bark damage to total structural failure of the main stem. These wounds provide entrance for decay fungi. The spread of decay in the main trunk may become so extensive as to compromise structural stability. Severe impacts can crack or split the main stem. Structural damage this extensive is usually obvious. The danger of such trees to people and property requires immediate action.

Effective planning before and during an excavation or construction project can often avert the damage to, or loss of trees. Sometimes trees must be removed to accommodate construction. Charges for any or all of the following may be levied: the appraised value of the tree, cost of removal and the cost of replacement planting.

Caution should be used during the construction process to avoid damage to the roots, trunk and branches of all street trees. Damage caused to any street tree will be repaired only by the City Forestry Division. The costs of repair, rejuvenation and/or value lost will be billed to the contractor or credited against the contract, at the option of the City.

At locations where the contractor has not complied with the City of West Allis Standard Specifications for Street Construction, and the minimum clearance was not maintained, a minimum credit to the City of fifty dollars ($50.00) per location will be taken. The credit will increase in proportion to the variance beyond the allowable minimum. The credit will be fifty dollars ($50.00) for each two-inch (2”) increment or part thereof in excess of the allowable minimum. If, in the opinion of the Forestry Division, the tree has been damaged to the point that it warrants removal, the credit that will be taken will be equal to one hundred dollars ($100.00) per inch diameter of the tree. A field measurement will be taken at four and one-half feet (4.5’) above ground to determine the tree diameter.

If required, Forestry personnel can perform clearance pruning to raise the crowns of the trees on the site. This pruning eliminates overhead conflicts without overpruning or deforming the trees.

If you have any questions or concerns regarding the trees on your construction site, please contact the Forestry Division of the City of West Allis at (414) 302-8811.

(c) ROOT CUTTING.
The Contractor shall take all necessary precautions to protect trees at the work site which are not to be removed. Tree roots interfering with the work shall be completely severed with a clean sharp tool; i.e., axe, pulaski, chain saw, etc., and removed with an approved machine or other approved methods so that no portion of the root is within two (2) inches of new concrete. An approved mechanical root cutter shall be used to saw the roots which interfere with the proposed sidewalk construction, except in those situations where hand implement usage is specified.

When tree roots are cut, the following provisions shall apply:

1. (1) CONCRETE WALK. The root system on the walk side of the tree shall not be cut deeper than nine (9) inches below the proposed elevation of the new five inch (5") concrete walk and not more than five inches (5") from the edge of the proposed walk.

   Roots below the proposed walk shall be removed only to a depth of nine (9) inches below the proposed elevation of the new five inch (5") concrete walk.

2. (2) CARRIAGE WALK. Roots shall not be cut by means of mechanical root cutting machines. If root removal is essential to carriage walk replacement, interfering roots shall be manually cut with hand implements.
3. (3) CURB AND GUTTER. The root system on the curb side of the tree shall not be cut deeper than eighteen inches (18") below the proposed elevation of the new curb and not more than eight inches (8") from the back of the proposed curb.
4. (4) DRIVEWAYS. Roots shall not be cut by means of mechanical root cutting machines. If root removal is essential to driveway replacement, interfering roots shall be manually cut with hand implements.

Caution shall be used during root cutting operations, so as not to cause unnecessary damage to the tree or its root system.

All debris from the root sawing operations shall be removed from the sidewalk area and root sawing trenches must be filled with approved topsoil before the end of the work day.

Root foundations for all trees must remain adequate to withstand heavy windstorms.

All exposed and severed tree roots shall be immediately covered with a mulch and watered to prevent drying until such time that the concrete work is complete, the form removed and the area between the tree and concrete work backfilled with approved topsoil. The time duration for completion of the backfilling operations shall not exceed twenty-four (24) hours from the time the concrete was placed.

6. 2.2.6 CULVERTS.
   New culverts shall be placed at such locations and elevations as shown on the Plans or as directed in the field. Culverts shall be supported their entire length by a well compacted subgrade.

   The Contractor must use reasonable caution in removing existing culverts within the right-of-way. The cost of this removal is to be included in the price bid for "Excavation." The culverts thus removed shall be deposited on the right-of-way for removal by City crews. When, in the opinion of the Inspector, the culverts have no salvage value for the City, said culverts shall become the property of the Contractor and are to be disposed of at his discretion.

7. 2.2.7 CONCRETE SAWING.

Appendix C

Email from Engineering Division Regarding Potential Ordinance

"I have heard back from the Forestry Division of Parks as well as several Divisions within the Department of Public Works (DPW).

The City of Oshkosh sees the benefit to maintaining as many large trees as possible. As I am sure you know, larger trees provide more benefits than young/newly planted tress.

Every situation may be different, but to put this type of ordinance in practice would be difficult for several reasons.

1. The public Right of Way has existing utilities already installed which are required to maintained by their respective owners (public and private).
    a. Public infrastructure already installed in the Right of Way. All public utility owners have the responsibility to protect the public health and safety of the citizens they serve. Meaning that anything (streets, sidewalks, terraces, trees, etc…) in the way of maintaining their facilities are at risk of being removed or replaced.

        i. Maintained by the City of Oshkosh.

        1. Storm
        2. Sanitary
        3. Water
        4. Electric
        5. Streets (concrete or asphalt, curb and gutter sections, etc…)

        ii. Maintained by other public entities (i.e. WPS, Spectrum, AT&T)

        1. Gas
        2. Electric
        3. Telecommunications facilities
        4. Fiberoptic facilities

    b. Private infrastructure that may be installed in the Right of Way

        i. Storm laterals

        ii. Sanitary laterals

        iii. Water laterals

        iv. Sidewalks

v. Telecommunications infrastructure

1. It can be very difficult/impossible to police all construction (public and private) to ensure that the work avoids the critical root zone.
2. Would this be for just work in the Public Right of Way or would it include all lands public and private?
3. Outside of the policing of this ordinance, what type of fines/penalties would be enforced for not following the ordinance.

In general, DPW does not support creating an ordinance prohibiting any construction within the protection zone of a tree. As stated above, it would be almost impossible to police as well as will be difficult to follow the ordinance to construct/maintain the facilities that already installed within the Public Right of Way. However, DPW does look at each project and tries to save as many trees as possible within our construction limits.

Appendix D

Stevens Point Municipal Code and Specifications

Chapter 11 – City Forester and Forestry:
https://stevenspoint.com/DocumentCenter/View/93/Chapter-11---Forestry

Forestry Specifications for Construction on Public Lands:

https://stevenspoint.com/DocumentCenter/View/728/Forestry---Construction-on-Public-Lands?bidId=

Appendix E

McFarland Municipal Code

59-29 Removal Of Trees And Stumps

1. *Dangerous, obstructive and infected trees.* In the normal course of business, it is not the duty of the Village Forester to routinely inspect or be responsible for trees on private property. Any tree or part thereof, whether alive or dead, which the Village Forester shall find to be infected, hazardous or a nuisance so as to endanger the public or other trees, plants or shrubs growing within the Village, or to be injurious to sewers, sidewalks or other public improvements whether growing upon public or private premises, shall be removed, trimmed or treated by the owner of the property upon or adjacent to which such tree or part thereof is located. The Village Forester shall give written notice to said owner to remedy the situation, which shall be served personally or posted upon the affected tree. Such notice shall specify a reasonable period of time within which the action must be taken as determined by the Village Forester on the basis of the seriousness of the condition of the tree or danger to the public. If the owner shall fail to remove, treat or trim said tree within the time limit, the Village Forester shall cause the tree to be removed, treated or trimmed and shall thereupon enter such cost as a special charge against the property pursuant to Wis. Stats. § 66.0627.
2. *Removal standards.* In cutting down trees located in public and terrace areas, the tree must be removed with the stump and emergent roots grubbed out, or ground out to a depth of at least nine inches below grade measured in a straight line with the normal grade of sidewalk to top of nine inches below grade measured as a straight line, normal grade of sidewalk to top of curb. All wood and debris must be removed from the street prior to the end of each working day and all holes shall be filled to normal grade level with topsoil. Backfilling should be done by the end of the workday in which the stump is removed. If it is not possible to fill in the hole by the end of the workday, the hole should be staked-off and marked with high visibility paint or flagging to avert accidents.
3. *Private removal.* No person, firm, organization or corporation shall plant, injure, trim, remove or destroy any tree or shrub located in or upon any public place, until a permit shall have been issued by the Village Forester. Such permit shall be issued only when the removal, trimming or cutting of the tree or shrub is necessary, as determined by the Village Forester, because of a public nuisance and/or location, or its location is such that substantial detriment is done to the property upon which the tree or shrub stands, or property abutting the same. Such permit shall expressly state the premises upon which the tree or shrub stands and the location of the tree thereon. The Village Forester may require submission of professional credentials and evidence of adequate liability insurance coverage.
4. *Tree preservation.* In the development of commercial property involving previously undeveloped land, the developer will, as part of its development plan identify which trees are to be removed to install the infrastructure for the development. The developer will also provide a plan specifying methods of protecting trees not approved for removal. The developer must ensure that protective structures shall remain in place until on-site construction is complete. The Village Forester, shall review and recommend a tree preservation plan to the Plan Commission. In the development of a new Subdivision involving previously undeveloped land, the developer, as part of the Preliminary Plat, will

identify which trees are to be removed to install infrastructure for the development. The developer will also provide a plan specifying methods of protecting trees not approved for removal. The developer must ensure that protective structures shall remain in place until on-site construction is complete. The Committee, after consultation with the Village Forester, shall review and approve a Preliminary Plat tree preservation plan to the Plan Commission.

(Code 1998, § 6-4-11; Ord. No. 2007-09, § 1(6-4-11), 10-22-2007)

HISTORY
Amended by Ord. 2022-02 § 59 on 2/28/2022

59-30 Prohibited Acts

1. *Damage to municipal trees.* No person shall, without written permits from Village Forester in the case of a terrace-area tree, public tree or shrub, perform or cause to be performed by others any of the following acts:
    1. Secure, fasten or run any rope, wire sign, electrical installation or other device or material to, around or through a tree or shrub.
    2. Break, injure, mutilate, deface, kill or destroy any tree or shrub or permit any fire to burn where it will injure any tree or shrub.
    3. Damage tree roots, through compaction or excavation of the soil, so extensively so as destabilize, make hazardous, damage the health of or necessitate the removal of such a tree.
    4. Permit any toxic chemical, gas, smoke, oil or other injurious substance to seep, drain or be emptied upon or about any tree or shrub.
    5. Deposit, place or store upon any public place of the Village any stone, brick, dirt, soil, concrete or other materials that may impede the free passage of water, air or nutrients to the roots of any tree on said property, except by written permit by the Village Forester.
    6. Remove any guard, stake or other device or material intended for the protection of a public tree or shrub, or close or obstruct any open space about the base of a public tree or shrub designed to permit access of air, water and fertilizer.
    7. Attach any sign, poster, notice or other object on any tree, or fasten any guy wire, cable, rope, nails, screws or other device to any tree; except that the Village may tie temporary "no parking" signs to trees when necessary in conjunction with street improvement work, tree maintenance work or parades.
    8. Erect, alter, repair or demolish any building or structure without placing suitable guards around all nearby public trees or shrubs that may be injured by such operations.
2. *Excavations and operation of heavy equipment near public trees.* No person shall excavate any ditches, tunnels or trenches, drive vehicles, or install pavement within a radius of 15 feet of the outer limit of the canopy of any public tree without a permit from the Village Forester. All trees on any parkway or other publicly owned property near any excavation or construction of any building structure or street work shall be sufficiently guarded and

protected by those responsible for such work as to prevent any injury to said trees. No person shall excavate any ditches, tunnels or trenches, or install pavement within a radius of 15 feet from any public tree without a permit from the Village Forester. Any publicly owned trees near any excavation site or site of construction of any building, structure, or street work, shall be guarded with a substantial fence not less than four feet high and eight feet square with the protected tree sited in the center of said fence; or at a distance in feet from the tree equal to the diameter of the trunk in inches at breast height, whichever is greater.

1. The Village Forester may grant an exemption to any public utility corporation to augur under a public tree or shrub and excavate within five feet of any public tree or shrub, but such public utility shall be liable for any injury or damage caused to any public tree or shrub, and if any public tree or shrub is permanently damaged due to the acts of a public utility corporation, it shall be removed, including the stump, and shall be replaced by a tree at least ten feet tall, or as otherwise approved by the Village Forester, all at the expense of the utility.
2. The Village Forester may grant an exemption to municipal employees performing their assigned duties and using all due diligence. Utility companies may apply for a written exemption after the fact in the event of responding to an emergency.

(Code 1998, § 6-4-12; Ord. No. 2007-09, § 1(6-4-12), 10-22-2007)

Appendix F

Sun Prairie Municipal Code

Chapter 12.40 – Trees and Shrubs:
https://library.municode.com/wi/sun_prairie/codes/code_of_ordinances?nodeId=TIT12STSIPUPL_CH12.40TRSH

12.40.120 Prohibited acts.

A. Damage to Public Trees. No person shall, without written permits from the city forester in the case of a terrace tree or public tree cause to be done by others any of the following acts:

1. Secure, fasten or run any rope, wire sign, unprotected electrical installation or other device or material to, around, or through a tree or shrub;
2. Break, injure, mutilate, deface, kill, remove or destroy any tree or shrub or permit any fire to burn where it will injure any tree or shrub;
3. Permit any toxic chemical, gas, smoke, oil or other injurious substance to seep, drain, or be emptied upon or about any tree or shrub, or place cement or other solid substance around the base of the same;
4. Remove any guard, stake or other device or material intended for the protection of a public tree or shrub, or close or obstruct any open space about the base of a public tree or shrub designed to permit access of air, water and fertilizer.

B. Excavations and Construction Tree Protection. All trees on any terrace or public property near any excavation or construction of any building structure or street work, when work will be performed within the dripline of a tree, shall be sufficiently guarded and protected by those responsible for such work as to prevent any injury to such trees. Such barricades shall be installed at the dripline perimeter around the tree at the contractor's expense. No person shall excavate any ditches, tunnels or trenches, or install pavement within a radius of ten (10) feet from any public tree without a permit from the city forester.

C. Replacement. The penalty for damaging a tree through a prohibited act described in this section shall be to replace the damaged tree with a tree of equal caliper or a number of trees which together equal the caliper total of the diameter of the tree damaged. The forester shall determine which replacement alternative shall be required. Failure to replace the damaged trees shall result in the city replacing the tree and billing the expense to the person who damaged the tree.

D. Interference with Forester.

1. It is unlawful to interfere with or prevent any act of the forester or his or her agents or employees while they are engaged in the performance of duties imposed by this section.
2. No person shall refuse to permit the forester or his or her duly authorized representative to enter upon his or her premises at reasonable times to exercise the duties imposed by this chapter.

E. Refusal to Abate Nuisance. A property owner shall not permit any public nuisance to remain on any premises owned or controlled by him or her when ordered by the forester to abate such nuisance.

(Ord. No. 825 , § 1, 9-15-2020; Ord. 264 § 1 (part), 1993; prior code § 6-4-12)

Appendix G

Minneapolis Urban Forest Policy

https://www.minneapolisparks.org/wp-content/uploads/2018/11/Urban-Forest-Policy.pdf

Standard Specifications Forestry 2022 MPRB Forestry

Standard Specifications Forestry 2022_MPRB_Forestry.pdf