Residential Use of Permeable Pavements

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I. Executive Summary

The city of Oshkosh is not currency taking all options it has to manage stormwater as seriously as they should. There is an easily available addition waiting to be used that could be made to help the city's current stormwater management. That solution is an ordnance change that would allow for the residential use of permeable pavements. These residential permeable pavements would come at little expense to the city and build a partnership between the city and the citizens of Oshkosh. Oshkosh has a history of issues with stormwater management, with major storms in the past causing flooding throughout the city. Allowing for the residential use of permeable pavers can help manage the city's stormwater. Not to mention, allowing for this ordinance change would, according to our stakeholder Dr. Maureen Muldoon, help residents think more about what they put in their stormwater and where that stormwater goes.

Permeable pavements do more than help residents keep pollutants out of the city's stormwater. The methods that allow permeable pavements to help stormwater infiltrate are also able to capture a large variety of pollutants before it can make it into the soil. This is something that should interest the City of Oshkosh as this can help the city manage its ongoing problem with the eutrophication in Lake Winnebago contributing to harmful algal blooms. Permeable pavements can help to improve the city's water quality, providing the community with a safer and more enjoyable lakeshore.

Permeable pavements have actually been used in Oshkosh for several years now, just not on residential properties. The city has helped to oversee several installations of permeable pavements on both city and private property. The installations at The Senior's Center, Fire Station 16 and the YMCA Downtown have all been successful and easy to maintain, according

to the City's Public Works Director Mr. James Rabe, and have been easy to maintain. Permeable pavements do work in Oshkosh, so why not also allow for their use on residential properties?

Oshkosh should consider this proposal to change the residential surfacing ordinance to allow for the use of permeable pavements. The prior listed benefits are all described in detail throughout this report and will ultimately lead to Oshkosh seeing less flooding, reduced stormwater runoff and improved water quality in and around the city. This is a straightforward way for the city to improve both its resiliency and sustainability, creating a more climate friendly city.

II. Background/Context/Problem Identification

Permeable Pavements

The United States Environmental Protection Agency (EPA) declares permeable pavements as "a green infrastructure alternative to traditional impervious surfaces" such as concrete and asphalt (Environmental Protection Agency [EPA], 2021). Permeable pavements double as a type of surfacing material and a strategy for stormwater management. The porous surface of permeable pavements allow precipitation and melt to infiltrate into the ground, which allows for the removal or reduction of pollutants that would traditionally enter the stormwater system.

There are several types of permeable pavements available on the market today including porous asphalt, pervious concrete and permeable interlocking concrete pavement (PICP) (EPA, 2021). While the specific construction design for each permeable pavement insulation depends on the soil type present and specific stormwater management needs of the location, the Minnesota Pollution Control Agency (MPCA) states that, "all permeable pavements have a

similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer, optional underdrains, and geotextile over uncompacted soil subgrade" (Minnesota Pollution Control Agency [MPCA], 2023). *See Appendix C for permeable pavement schematic diagrams compliments of the MPCA.*

Oshkosh Algal Blooms

As Oshkosh residents, we've all had the displeasure of witnessing Lake Winnebago transform into the green waterbody that many locals know as Lake Winneseptic. This unsightly and foul smelling phenomenon is the result of prolific growth of both harmless and harmful algal varieties, including the highly toxic cyanobacteria, better known as blue-green algae. These algal blooms come with direct and indirect impacts that influence the social, economic, and environmental sustainability of the City of Oshkosh.

Businesses in the vicinity of impacted water bodies suffer when blooms are present. According to the UW Oshkosh Sustainability Institute for Regional Transformations (SIRT), "billions of dollars in economic losses to industry, recreation, and public health" result from the presence of harmful algal blooms on a global scale (Sustainability Institute for Regional Transformations [SIRT], n.d.). Restaurants that offer patio service, for example, may see fewer customers opt to eat at their establishments when blooms are present as the outdoor eating experience may be perceived as spoiled by the unpleasant sights and smells associated with the blooms. Opportunities for recreation drastically decline when blooms are present, which impact not only citizens of Oshkosh, but private businesses that offer services such as equipment rentals or tours.

In addition to economic concern, great concern should result from the risk that harmful algal blooms pose to both the biotic and abiotic components of marine and terrestrial ecosystems.

A team of students and researchers from SIRT and the Fox-Wolf Watershed Alliance are currently working on a research project funded by National Science Foundation that aims to better understand the impacts of harmful algal blooms (HABs) in the Winnebago Pool Lakes. According to SIRT, the dangerous toxins produced by HABs may make life forms both, in and around the water, sick if directly ingested. On a broader scale algal blooms wreak havoc on aquatic ecosystems by limiting the availability of vital nutrients, such as oxygen, and by blocking sunlight. When harmful algal blooms get large enough they can create dead zones where other competing vegetation are unable to acquire the nutrients necessary for survival (SIRT, n.d.).

Excessive algal growth on Lake Winnebago is largely due to the combination of warming temperatures and nutrient-loading from pollutant runoff. During precipitation events, pollutants like pesticides and fertilizers are either picked up by the rain to percolate into the soil, where they pose contamination risk to the groundwater supply, or they're carried to surface water bodies via stormwater runoff, where they promote nutrient loading and eutrophication of our local surface water bodies. As climate change brings about warmer temperatures and harsher climates for food production, we could see our harmful algal bloom situation worsen as local farmers do everything in their power to ensure our community is fed.

Oshkosh Flooding & Stormwater Management

Flooding has been a historically prominent issue in Oshkosh. According to a June 2018 Oshkosh Northwestern news article written by Sophie Carson, In June 2008, Oshkosh residents endured a week-long storm system that produced an estimated 10 inches of rainfall that had devastating consequences for residential and city infrastructure. More than $29 million in residential property damages resulted from this flooding event and approximately 2,400 Winnebago County residents were forced to apply for federal assistance. The Federal Emergency

Management Agency (FEMA) provided Winnebago County residents with $4.5 million in emergency grants, while the state as a whole received $56 million in FEMA grants to help alleviate flood devastation (Carson, 2018). This is just one example of how devastating and costly flooding events have been in Oshkosh. As climate change progresses and precipitation events increase, floods of this magnitude could become a regular occurrence in Oshkosh and the surrounding areas.

In response to past flooding events, and in preparation for future flooding events, the City of Oshkosh has invested significant funding and effort into stormwater infrastructure upgrades. According to a March 2023 WTAQ News Talk story, the City of Oshkosh is undertaking a 2023-2024 project to improve the city's drainage system. Oshkosh Public Works Director James Rabe reports that the first phase of this project has been completed and they have now entered the design phase. Mr. Rabe believes that effective flood issue prevention "requires a partnership between residents and the city" in which residents report existing and potential flooding issues to the city (Midwest Communications, 2023). We believe that Oshkosh residents can more actively participate in this partnership to prevent flooding issues by being granted permission to install permeable pavements in their residential driveways.

Oshkosh Water Quality

The immediate need for effective stormwater management techniques that provide pollution reduction benefits are of paramount importance to Oshkosh residents. According to the Wisconsin Department of Natural Resources [WI DNR] Draft 2024 Water Condition Lists, the Fox River, Lake Butte Des Morts, and Lake Winnebago are just three of the major water bodies in Winnebago County that are designated as impaired for the 2024-2026 cycle. The WI DNR defines impaired waters as "waters not attaining water quality standards [set by the Clean Water

Act] that do not yet have a restoration plan in place" (Wisconsin Department of Natural Resources [WI DNR], n.d.). Acute aquatic toxicity, degraded aquatic plant community (macrophytes), recreational restrictions due to pathogens, and PCBs contaminated fish tissue are amongst the impairments and observed effects for the above Winnebago County water bodies as listed in the WI DNR Draft 2024 Water Condition Lists (WI DNR, n.d.).

The City of Oshkosh Water Utility Division is responsible for providing clean drinking water for 66,000 Oshkosh residents. Their website states that they are "committed to providing high-quality water at reasonable rates while protecting public health and the environment" (City of Oshkosh, n.d.). The pending impaired water classification for Lake Winnebago should be particularly concerning to Oshkosh residents and Oshkosh Water Utility, since our drinking water is sourced from Lake Winnebago. It is clear that action needs to be taken to protect our waters from pollutants that pose risk to the environmental, social, and economic wellbeing of the City of Oshkosh.

III. Recommended Action

To help combat the issues associated with stormwater management in a sustainable fashion, our group is recommending an ordinance change to allow for the use of permeable pavements on residential properties. To best allow citizens to take advantage of pervious pavements, a change to the surfacing standards in Chapter 30–Article VII, Section 175 (R) adding pervious pavements to the the listed acceptable construction materials for off street parking as well as adding a definition of permeable pavements based on the Wisconsin DNR's 1008 technical standard for permeable pavement. The proposed code would looks something like this:

Chapter 30–Article VII, Section 175 (R):

(1) All off-street parking, loading, and traffic circulation areas shall be graded and surfaced so as to be dust-free and properly drained and shall be paved with a hard, all-weather or other surface to the satisfaction of the Director of Community Development, or designee. All driveways and parking areas shall be surfaced with approved material and constructed to be capable of carrying a wheel load of 4,000 pounds.

(a) Acceptable surfacing materials include asphalt, concrete, brick, cement pavers, permeable pavement as defined in the WI DNR 1008 Permeable Pavement Technical Standard, or similar material approved by the City and installed and maintained per industry standards.

(b) Residential drives serving single- and two-family dwellings may contain a grass or permeable center, provided that the areas on which the vehicle's wheels touch are a minimum of 12 to 18 inches in width.

This proposed change to Chapter 30–Article VII, Section 175 (R) is based on a similar code used by the City of Green Bay (Sec. 44-1694 as seen in Appendix A) and, based on our benchmarking, is a good place for the City of Oshkosh to start. These changes both allow for the implementation of permeable pavements on residential properties while also setting standards for the location of said implementation and a minimum infiltration rate once installed. The WI DNR 1008 document establishes a minimum infiltration rate of at least 100 in/hr, a goal that is both achievable and productive for the city, and establishes a minimum distance of 10 feet from any foundations unless preventative measures were taken to keep water away from said foundation (Wisconsin Department of Natural Resources, 2021).

While this ordinance change alone will not be enough to see widespread adoption of pervious surfaces in the City of Oshkosh, this change will allow for the implementation of pervious surfaces on residential properties already owned by stormwater conscientious citizens or companies looking to develop housing that is more sustainable. Without giving citizens the option to have pervious pavements, it will not be possible to fully understand what steps need to be taken to effectively educate property owners of the implications of stormwater and the best management practices that are available to them.

IV. Stakeholder Identification

Mr. James Rabe - Key Stakeholder

Mr. James Rabe, Director of Public Works in the City of Oshkosh municipality, has a great deal of impact on how permeable pavements—and equivalents—can be used within the city. permeable pavements are currently used by the city in several parking lots, and they have seen a great deal of success as a best management practice (BMP) in Oshkosh. Mr. Rabe said himself that they seem to be on track to recoup the money spent on building them, and the overall maintenance has been easy and cost-effective. However, he was not in favor of changing the zoning to allow for easy use of permeable pavements on residential properties, as there is concern that they could become hydraulically connected to the basements of the residents. This potential for property damage has the ability, in his eyes, to tarnish the reputation of a BMP that can be very effective in Oshkosh when used in the right situations. Another concern of Mr. Rabe was how to effectively educate the public about the benefits of permeable pavements and how to properly implement them on their own property. The city currently has a Stormwater Credit

program that is supposed to help incentivize residents constructing rain gardens and other smaller best management practices on their own property. Mr. Rabe felt that the Stormwater Credit program was ineffective on residential properties and did not seem to think that including permeable pavements with the other stormwater management practices listed in the program would be effective in increasing resident education on permeable pavements.

While Mr. Rabe's concerns on resident education are not so easily solved, his concerns with permeable pavements becoming hydrologically connected to are. The WI DNR standard on permeable pavements explicitly states how far said systems should be kept from building foundations, and also provides information on measures that can be taken to to prevent a hydrologic connections between infiltration systems and building foundations–like applying a liner under the portions of the pavement that are within 10 feet of a foundation.

Anonymous Company - Expert and Key Stakeholder

The company has multiple locations within the state of Wisconsin and across the Midwest. Specializing in concrete construction they offer both permeable and nonpermeable pavement options. They believe that permeable pavements are a great alternative to conventional pavement, as it provides improved performance and aesthetics, especially in areas with light traffic. Their studies have found that runoff can be reduced by approximately 80%, helping communities that suffer from flood events. In winter climates their permeable pavements have shown to reduce salt use and the need to remove snow as the drainage speeds up the melting process, saving money long-term. They acknowledge that permeable pavements are not suitable for all applications but can be used with great success in many areas that see medium to light traffic. Proper installation is important to achieve long-term durability and effectiveness. It was

pointed out that maintenance is lower than traditional impervious pavements and in the instance of extreme weather events shifting is possible but at the cost of being easily fixed. The company did not want to be named and wished to remain anonymous.

Dr. Misty McPhee - Primary Stakeholder

Dr. Misty McPhee is an Associate Professor of Environmental Studies and Biology, as well as a resident of Oshkosh. She is an advocate for the implementation of permeable pavements in residential areas. Her mission is to reduce the impact she has on the environment and one way she sees fit is to substitute the usage of concrete with pervious pavement. Dr. McPhee addressed her concerns with the concrete industry as it is one of the leading producers of carbon emissions and upon installation, disrupts the infiltration of groundwater. It was due to these concerns that she contacted the company True Grid to have a project plan drawn up to install a permeable pavement system. The project was denied by the city due to concerns that permeable pavements were no different than a gravel driveway and due to the belief that they are not suitable for clay substrates. This was despite evidence provided that these pavers excelled in the presence of clay and the gravel was fully contained within the paver system. Misty is passionate about permeable pavements and looks forward to them being implemented, so residents of Oshkosh can take advantage of their benefits.

Dr. Maureen Muldoon - Expert Stakeholder

Dr. Maureen Muldoon has a doctorate in Hydrogeology, and she once taught at Oshkosh herself and is still currently a guest lecturer for the University of Wisconsin system. Dr. Muldoon was also a member of the city's stormwater utility board for a period of time. When asked about whether residents should be allowed to install permeable pavement systems on their own

property, she was in favor of the idea. A large part of the reason that green infrastructure BMPs should not only be allowed but encouraged, according to Dr. Muldoon, is because they help educate the public about how their daily choices can impact the quality of Oshkosh's water. Most people do not think about where their water goes and allowing them to become involved with the city's stormwater management, according to Dr. Muldoon, will force them to think about where their water is going and what is in it. According to Dr. Muldoon there is little debate on the effectiveness of permeable pavement systems in Oshkosh, but the implications of the city's road salting practices–and potential changes to said practices–should be taken into consideration before allowing for the widespread use of permeable pavement systems.

Jamie Fuller - Expert Stakeholder

Jamie Fuller, a retired landscaper and owner of a landscaping company, is an expert stakeholder as he has over 20 years of experience and knowledge relating to the focus of our project, permeable pavements. Based on his professional experience, Jamie believes that the installation of permeable pavement in residential areas has the potential to improve stormwater management systems, as sustainable alternatives are ideal for the changing climate. He addresses the practicality and maintenance of the pavement system as well; while he acknowledges the hindrance of snow and ice removal in northern climates, he expresses that "seasonal low-traffic access roads, whether private, public, or municipal, are great applications for permeable pavement". Furthermore, Jamie suggests that residential installations provide far less risk to the integrity of the paver system, but there is room for structural improvements in which the surface material, subsurface, and base installation are sufficiently considered; for instance, if the base material is not properly installed, the permeability of the system is compromised. As a landscaper, he is able to recognize the potential of sustainable alternatives to improve stormwater

systems, but as a resident, can acknowledge the social challenges surrounding the potential for change as well. Overall, he agrees with the fact that permeable pavement has great potential to have a meaningful impact on stormwater systems in residential areas.

Brad Spanbauer - Key Stakeholder

Brad Spanbauer is the Campus Sustainability Director and a key stakeholder for the implementation of permeable pavement in local residential areas. When asked about the significance for sustainability of permeable pavement, he explained that much of the city lies in the floodplain of the Fox River, which means that Oshkosh is vulnerable to inundation, so the implementation of permeable pavement would be an effective way to improve Oshkosh's stormwater management system and mitigate the effects of stormwater runoff. Furthermore, he recommended that should the city of Oshkosh invest in such a system, it would be in their best interest to compare permeable pavement to conventional surface applications, such as blacktop or concrete, as holistically as possible. Overall, as an advocate for sustainability, he asserts his support for efficient alternatives like permeable pavement to address local issues and improve the stormwater management of the city as a whole; not only are there appealing environmental benefits, but significant benefits for the community as well.

IV. Benchmarking

Shoreview, MN

In 2009 the city of Shoreview, Minnesota undertook one of the largest permeable pavement projects in North America at the time. The project took place in Shoreview's Woodbridge neighborhood and involved replacing 9,000 square feet of asphalt roads with

permeable concrete in an effort to reduce and treat stormwater runoff into nearby Lake Owasso. Previously stormwater runoff in the Woodbridge neighborhood had been exclusively managed through the use of culverts and other hydraulic structures. A 7-year study was conducted by the Minnesota Department of Transportation (MnDOT) and Minnesota Local Road Research Board (LBBR) to evaluate how effectively the permeable concrete performed over time; life-cycle cost analysis was also performed. Results from the study showed that some raveling and spalling had occurred in curved areas where deicing salt had to be applied unexpectedly in December 2009 due to a rain event immediately followed by a cold snap. The study also showed that the hydraulic conductivity of the Woodbridge permeable concrete had decreased slightly over time due to pore clogging. Life cycle cost analysis showed that, when regular maintenance was performed to prevent irreversible clogging, permeable concrete is more cost effective than impermeable alternatives. MnDOT & LRRB researchers concluded that permeable concrete pavements proved to be a successful alternative to culverts in the Woodbridge neighborhood (Izevbekhai et al., 2017).

Benefits derived from the minimization of direct pollution to Owasso Lake were not measured or included in the 7-year study evaluation, but according to Shoreview Public Works Director Tom Wesolowski, residents of the Woodbridge neighborhood have reported seeing a decreased quantity of weeds and algal blooms; they feel that water quality has improved since the permeable concrete was installed. Mr. Wesolowski reported that the permeable concrete's ability to prevent pooling and refreezing of snow melt in most cases, was a pleasant surprise. Shorewood doesn’t have an ordinance in place that explicitly permits permeable pavement installation in residential capacities, and while the City of Shoreview doesn’t encourage permeable pavements for residential driveways, reports Mr. Wesolowski, they do allow them.

When asked about his personal feelings towards permeable pavements, Mr. Wesolowski proclaimed, “I’m a big believer, I think it’s a great way to address certain issues in certain areas.” He went on to emphasize that permeable pavements aren’t the best stormwater management practice for every situation, so installation should be considered on a case-by-case basis. According to Mr. Wesolowski, the fact that Shorewood has continued to do permeable pavement projects from 2009-2021 is testament that they work really well under the right circumstances to solve water quality issues.

Dubuque, Iowa

With a population of approximately 60,000 people, Dubuque is located on the west side of the Mississippi River. Over the span of 12 years the City of Dubuque experienced six floods that were declared as a Presidential Disaster, totaling approximately $70 million dollars in damage. To help alleviate pressures a plan was put into place to replace impervious pavements in alley ways with a permeable surface. Their construction allows water to drain into the ground with any remaining water being directed into the city’s stormwater system. It is expected to result in up to an 80% runoff reduction. In addition, this system has proven to be capable of increasing the timeframe for some seasonal access alleyways by decreasing the buildup of snow and ice. The increased efficiency and aesthetics has resulted in increased support from a community excited to see the project move forward.

Green Bay, Wisconsin

The City of Green Bay has similar demographics and environmental conditions to that of Oshkosh. Their code allows for the installation of permeable pavements in residential areas and was written in conjunction with a stormwater consultant, AQUALIS (see Appendix A). To help fund permeable pavement projects a program was created called the ‘Residential Green

Stormwater Infrastructure Revolving Loan Fund' and it provides low interest loans with a set payback term making costs more manageable for citizens (see Appendix B). This loan is funded by the stormwater utility fees charged to the residents of Green Bay. The city's goal is to become more resilient to changing weather conditions and improve environmental quality. Introducing permeable pavement is seen as a great way to increase resident stormwater participation and reduce land usage, while meeting stormwater requirements.

La Crosse, Wisconsin

Through the advancement of their sustainability goals and consideration of the potential for green infrastructure to improve stormwater management, the city of La Crosse is committed to the implementation of the Green Streets Program, which will aid in the evaluation of the impact green infrastructure has on localized flooding in the Johnson Street Basin. In addition, the EPA's commitment to green infrastructure and community partnership is exemplified through the "Strategic Agenda to Protect Waters and Build More Livable Communities through Green Infrastructure", in which they collaborated with the city of La Crosse to implement a Storm Water Management Model with the intent to evaluate the cost effectiveness and the flood reduction effectiveness of permeable pavement at various levels of implementation along the Johnson Street Basin. Through the EPA's model, the implementation of permeable pavements in La Crosse, WI proves to be the most effective system for reducing the extent and duration of flooding following a large storm event. Due to the proximity of these cities, La Crosse is a strong benchmark for the city of Oshkosh; climatic and geographic similarities suggest the compatibility of permeable pavement systems in Oshkosh as the city often experiences flooding events that overwhelm the stormwater system, resulting in increased runoff and effects on the surrounding environment and community.

V. Costs

Cost is an important factor to consider when looking at the implementation of permeable pavements. Fortunately, the upfront cost and lifetime maintenance would be the responsibility of the homeowner. TrueGrid, a manufacturer of permeable pavements, estimates the cost of permeable pavement to be $4 to $16 per square foot, while the national average for an impervious driveway ranges from $5 to $18 per square foot. This places the upfront costs for both options close to one another and may encourage the use of residential permeable pavements.

Over time annual maintenance is necessary to retain the optimal performance of permeable pavement. The costs of maintenance is variable dependent on the size and type of permeable pavement that is used. A study conducted by the University of New Hampshire Stormwater Center found that annually one hectare of porous asphalt yielded no emergency maintenance due to simple, periodic maintenance being completed (Houle et al., 2013). This results in lower annual costs than conventional stormwater best management practices. In environments with clay soils, pollutants have a higher collection capacity but lower water infiltration rate than other soil types. Permeable pavement in areas with clay soils therefore require more consistent maintenance measures.

In the winter months permeable pavement requires minimal time-consuming maintenance as it provides temporary storage for salt, releasing it into adjacent areas over time rather than all at once. This means a savings in both time and money. To sustain such results, it is important to maintain proper annual upkeep to ensure its efficiency, since permeable pavement is susceptible to clogged pores (University of Wisconsin Oshkosh, 2018).

In order to allow the implementation of permeable pavers residentially, the code will need to be updated resulting in a cost to the city. To complete this project other cities have sought the assistance of a consultant specializing in stormwater management. This has proven beneficial as it provides an unbiased, expert viewpoint to construct a code that best fits the city's needs. Cities locally have utilized available funding, such as the Great Lakes Emerging Champions Mini-Grant Program, which can fully cover the expenses of a code audit, alleviating all costs to the city.

To increase resident participation the City of Green Bay created various stormwater funding initiatives. Using stormwater utility fees, a revolving loan fund called the 'Residential Green Stormwater Infrastructure Revolving Loan Fund' was created allowing residents to borrow up to $10,000 dollars, over a set loan term, to install permeable pavement driveways (see Appendix B). The loans and projects are approved by the public works department to ensure they are suitable for the building site. Large scale projects can apply for the Stormwater Improvement Grant that was created to help at-risk communities. Its goal is to improve environmental quality while increasing the property values in the area.

VI. Barriers

Best Management Practice

The effective performance ability and material longevity of permeable pavement installations vary due to several factors including environmental conditions (soil type, precipitation patterns, tree canopy cover, etc.), degree of utilization, surrounding area infrastructure, and frequency of performed maintenance. Installation approval for residential applications should be granted on a case-by-case basis, and design plans should be verified by

Engineers to ensure that the proposed permeable pavement installation is an adequate management practice for addressing the given issue. Engineers should ensure that permeable pavement designs and specific layer thicknesses are adjusted according to the local soil type, soil infiltration ability, and specific reserve needs for melt/runoff interception. Due to their sensitivity to deicing salt, permeable pavements shouldn't be utilized on curved stretches of road or next to high-speed and/or high-traffic areas, which require salt application for safe travel conditions. Additionally, permeable pavements should be avoided in areas with significant tree canopy cover, as solar heat is unable to warm the pavement surface which increases the risk of melt pooling and refreezing which would require deicing salt application.

Education and Outreach

One of the barriers to our proposed changes has to do with actually informing the community about both the option to install as well as the benefits of permeable pavements on their property. A place the city could start is by providing a fact sheet that both discusses benefits and methods of implementation for residents. Another key piece of information the city could provide on siad fact sheet is the city's own experiences with permeable pavements. There are several successful installations around the city that would work to help show residents the effectiveness of permeable pavement systems and how they can be constructed here in Oshkosh. It would also be helpful if said fact sheet provided information on how installing permeable surfaces on their property would reduce how much residents have to pay on their property taxes. Starting small with education and outreach may not seem immediately effective, but if enough residents take it upon themselves to install permeable pavement on their own properties word will spread. Their neighbors will ask them why and how they chose to install permeable pavement instead of a traditional driveway. Once the ball gets rolling, more and more residents

will become aware of permeable pavement, they just need to have the option available to them to start.

VII. Significance for Sustainability

The amendment of the City of Oshkosh Zoning Ordinance Chapter 30–Article VII, Section 175(R) to allow for the installation of permeable pavements in residential driveways is a small change that can promote greater sustainability in the City of Oshkosh. The city of Oshkosh would benefit greatly from the sustainable qualities of permeable pavements. Enhancing residential areas with this form of green infrastructure would encourage both a personal and collective effort to improve both the quality and management of local water resources.

The implementation of permeable pavement in residential areas promotes sustainable and environmental objectives such as improved stormwater management, hydrologic cycle, winter preparedness, and the minimization of the effects of stormwater runoff and the changing climate. These objectives are consequential to the adaptability and resilience of Oshkosh, as much of Wisconsin is expected to become a climate haven for those who have been displaced while enduring the effects of climate change as well, with warmer temperatures and decreased precipitation rates. Furthermore, such implementation would promote economic benefits, as the amount of weathering on local infrastructure decreases greatly with permeable pavement systems due to their porous nature and ability to act as a thermal insulator. The threat of poor water quality is also reduced as a result of improved stormwater management; this is conducive for improved human health, as much of the population receives drinking water from local sources.

The implementation of permeable pavement improves freeze-thaw responses and winter preparedness. The EPA finds that permeable pavement has a higher frictional resistance than

conventional pavement, therefore, they require little to no deicing material application and do not compromise the efficiency of snow plows under winter conditions. In Wisconsin, porous asphalt can reduce the amount of salt used in the wintertime because it does not allow for standing water to form black ice (University of Wisconsin Oshkosh, 2018). Furthermore, permeable pavements can trap air, storing heat and releasing it to the surface which promotes the melting process of snow and ice. The city of Oshkosh endures cold winter months as well as snow, therefore the city must use adequate response methods to maintain safe roadways and walkways, most importantly in residential areas; eliminating extensive maintenance during winter months through the implementation of permeable pavement is both cost effective and would reduce environmental implications of such maintenance. The use of permeable pavement systems in residential areas would be especially beneficial during the wintertime.

In addition to this, according to USGS, permeable pavements help to reestablish a more natural hydrological balance by slowly releasing water into the ground rather than allowing it to flow directly into drains and out to receiving waterways. Permeable pavements improve water drainage and infiltration by allowing water to enter into a drainage system below the concrete surface, in which the water is dispersed into the gravel base layer (University of Wisconsin Oshkosh, 2018). They also help to reduce discharge peak rates by preventing large surges of precipitation through stormwater systems. Controlling runoff at the source through the use of permeable pavements reduces the need for additional BMPs such as detention ponds, which ultimately saves money and effort (USGS, 2019). This addresses local concerns of urbanization and its impact on the environment as poor infiltration and capacity for water resources exacerbates the effects of stormwater runoff; impervious surfaces promote runoff and flooding, as well as erosion and weathering. Permeable pavement can alleviate these drawbacks and

support a water conscious and climate resilient community as the circumstances in which Oshkosh will be impacted by climate change are unprecedented.

VIII. Summary/Conclusion

Allowing for the installation of permeable pavement in residential applications represents a forward-thinking and sustainable approach to the stormwater management issues that the city need not face alone. Oshkosh already has a history of struggles with water pollution and eutrophication as well as flooding. By allowing the community to more closely interact with stormwater management, residents will be able to become more aware of the impacts of the runoff leaving their property while also helping to improve the city's stormwater management and reducing pollutants in our water. To prolong the porosity and efficiency of permeable pavement, proper maintenance is necessary, but convenient as it is less demanding than conventional materials. While cost and education are both barriers to the proper implementation of permeable pavement on residential properties, once these barriers are mitigated, permeable pavement can help to take a proactive stance against the negative impacts of impermeable surfaces and help the city prepare for the future.

We urge the City of Oshkosh to consider the far-reaching positive impacts this simple ordinance change can bring and to embrace a sustainable future for our community. Together, we can take a significant step toward a more resilient, environmentally friendly, and water-conscious community.

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Appendix A - Example of Surfacing Municipal Code from Green Bay, WI

The following is a section of Green Bay's municipal code that establishes surfacing standards for the city. This implementation is a good example of surfacing code allowing for pervious pavement and is comparable to the existing surfacing code already used by the City of Oshkosh.

Green Bay Code: **Sec. 44-1694. - Surfacing.**

(a) All off-street parking facilities and driveways leading to such parking facilities, and all other areas upon which motor vehicles may traverse or be parked shall be graded and surfaced with a dust-free all-weather hard surface material capable of carrying a wheel load of 4,000 pounds.

    (1) Acceptable surfacing materials include asphalt, concrete, brick, cement pavers, permeable pavement as defined in Section 44-249, or similar material approved by the City and installed and maintained per industry standards.

(b) Residential drives serving single- and two-family dwellings may contain a grass or permeable center, provided that the areas on which the vehicle's wheels touch are a minimum of 12 to 18 inches in width.

Appendix B - Green Bay, Wisconsin: ‘Residential Green Stormwater Infrastructure Revolving Loan Fund’

The following is the information regarding Green Bay's Green Stormwater Revolving Loan Fund. Additional documents regarding the loans procedures and application are linked below but can also be obtained through the City of Green Bay’s website. The implementation of this loan would allow residents a financing option to install permeable pavements and increase participation in their usage.

The Green Stormwater Revolving Loan Fund will provide low-interest loans to residential property owners to install green stormwater infrastructure (GSI) on their property. GSI helps soak up stormwater runoff close to where the rain and snow falls. Overtime, GSI practices distributed across the city will help build resiliency to changing weather patterns and intense storm events.

In addition to proven water quality benefits, GSI can provide many important benefits to our community, including lessen nuisance flooding, provide shade, improve air quality and public health, and reduce costs associated with traditional “gray” stormwater infrastructure.

Eligible Work Includes:

- Permeable surfacing for driveways and sidewalks
- Rain gardens
- Stormwater planter boxes
- All projects and products must be approved by the Public Works Department

Loan Terms:

- Maximum repayment is 10 years, payable in equal consecutive monthly installments.

- 2% interest rate
- Loan amount is $10,000
- Loans greater than $10,000 shall be considered on a case-by-case basis

Interested applicants are strongly encouraged to make an appointment with Public Works staff to discuss proposed project(s) prior to submitting a loan application.

Email questions to GreenBayPublicWorks@greenbaywi.gov or call 920-448-3040.

Green Stormwater Infrastructure Revolving Loan Fund Application Checklist:

https://greenbaywi.gov/DocumentCenter/View/10550/GSIRLF-Application-Checklist-2023-PDF?bidId=

Residential Green Stormwater Infrastructure Revolving Loan Fund Application Form:

https://greenbaywi.gov/DocumentCenter/View/10549/GSI-Revolving-Loan-Application-PDF?bidId=

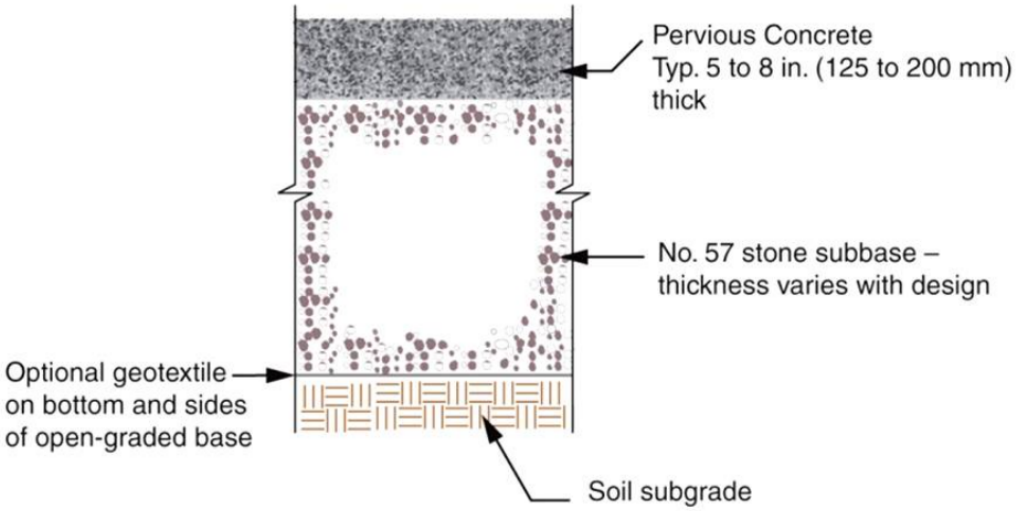
Residential Green Stormwater Infrastructure Revolving Loan Fund Program:

https://greenbaywi.gov/DocumentCenter/View/10575/GSIRLF-Procedures-Manual-PDF?bidId=

Appendix C- Permeable Pavement Schematic Diagrams

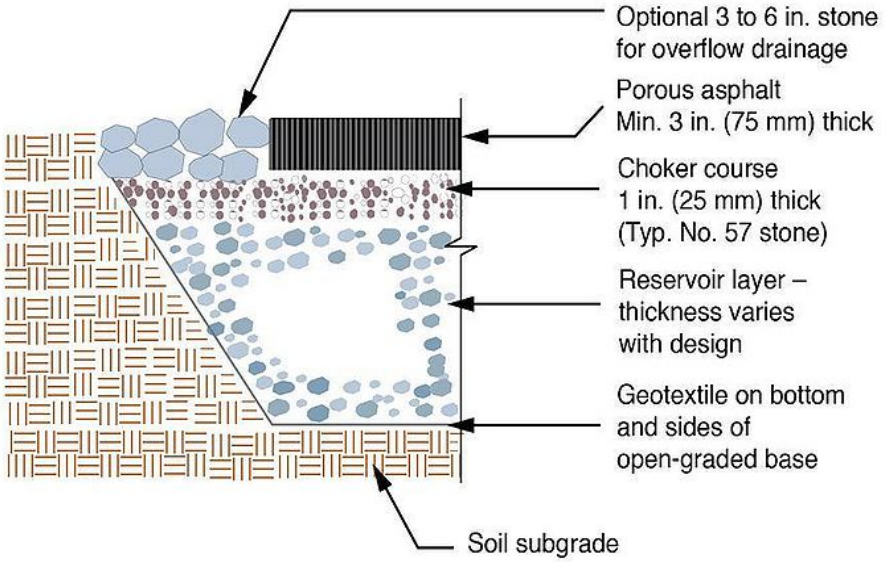
Source: Minnesota Pollution Control Agency. (2022, December). *Design criteria for Permeable Pavement*. Minnesota Stormwater Manual. https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_permeable_pavement

Diagram 1: Pervious Concrete



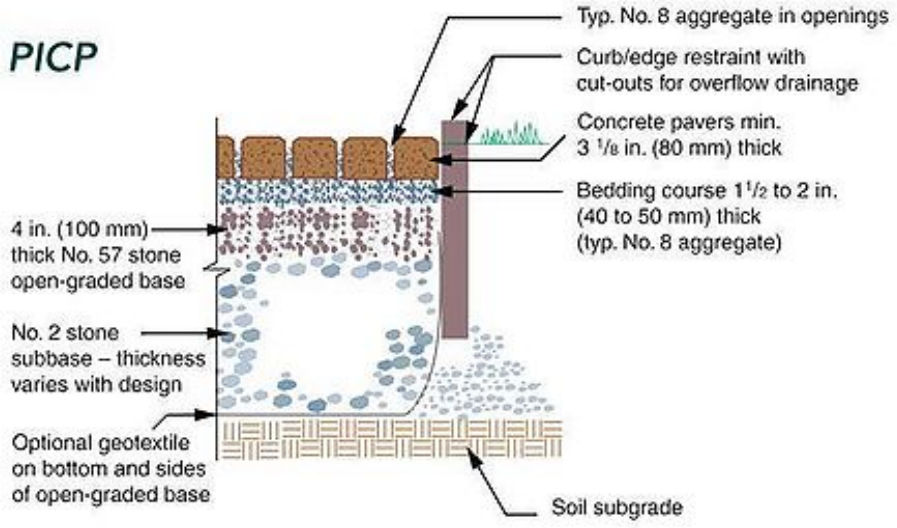
Schematic illustrating typical pervious concrete cross section and basic components of a pervious concrete system.

Diagram 2: Porous Asphalt



Schematic illustrating typical porous asphalt cross section and basic components of a pervious concrete system.

Diagram 3: Permeable Interlocking Concrete Pavement (PICP)



Schematic illustrating typical permeable interlocking concrete pavement cross section and basic components of a pervious concrete system.