The City of White Bear Lake

Downtown Greening Program

FNRM 4501/5501 Urban Forest Management: Managing Greenspaces for People

Spring 2015

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Acknowledgements

We would like to thank White Bear Lake employee's Ellen Richter, Assistant City Manager; Brent Thompson, City Engineer; and Mark Burch, Director of Public Works, for taking the time to meet with us and providing valuable answers throughout the course of the project.

We would like to thank all of those who helped in the preparation of the presentation of this document by making suggestions and contributing in various other forms.

Executive Summary

Stormwater management is a critical issue facing cities that will only become more important as intense precipitation events continue to increase. Sitting at the confluence of three distinct watersheds, the City of White Bear Lake faces unique stormwater management challenges. To address these challenges various forms of sustainable grey and green infrastructure should be implemented.

To complete this project, research and literature review were combined with field work. The data generated by previous student projects on White Bear Lake were used to build a fuller understanding of the city's current tree canopy and stormwater management situation; most notably report two of seven by ESPM 4041W Problem Solving for Environmental Change, from the fall of 2014.

To encourage the creation of effective and sustainable infrastructure, students from the University of Minnesota worked in conjunction with the City of White Bear Lake to produce a comprehensive greening plan for a targeted area in the city's downtown core.

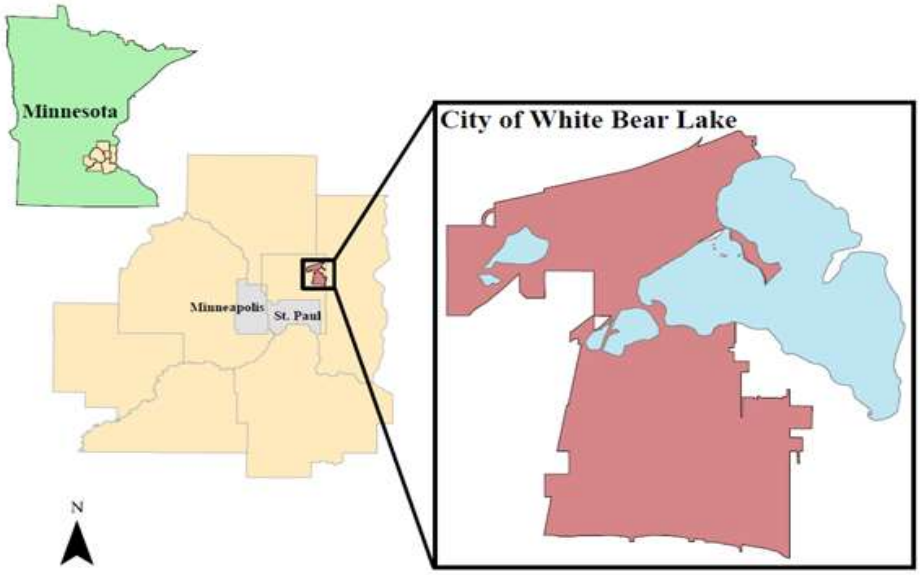
The final recommendations fell into one of four categories, as listed below:

1. A consolidated dumpster enclosure for the businesses within the project site boundaries
2. Rain and butterfly gardens
3. Green roofing
4. Suspended pavement to better support larger tree health and longevity yet still allow for normal paved surfaces

Introduction

The City of White Bear Lake (WBL) is located on the northeast corner of the most populated region in MN, the Minneapolis-St. Paul metropolitan area (Figure 1.), with an estimated population of 24,555 and approximate area of 8.66 square miles (US Census 2014). The current land use of WBL was mainly comprised of 47.3% (2558.5 acres) residential area, 18.8% (1241.9 acres) public area, 4.9% (249.9 acres) commercial area and 4.4% (208.4 acres) industrial area (City of White Bear Lake 2008). Being one of the largest lakes in the metro area, the White Bear Lake itself is in the vicinity of the city with an area of 0.64 square miles. The lake gives a unique ecological feature to the city and becomes a popular resort for visitors.

Figure 1. Location of the City of White Bear Lake



The beautiful lake and its high quality of water have huge economic, ecological, and aesthetic values to the city, and the City of White Bear Lake has been committed to preserving this high quality water through the Storm Water Pollution Prevention Program (SWPPP) to improve the quality of the stormwater runoff discharged from the City's storm sewer system (SWPPP 2015). Stormwater runoff is one of the major sources of pollution into receiving water bodies which can lead to water quality impairments and related adverse impacts on the ecology of lake and streams. Thus, the stormwater management issues have always been at the top of the city's concerns.

The historical downtown area maintains its unique characteristic and hominess that attract many visitors and new citizens to the city each year. The quaint shops and peaceful ambiance of the downtown make for perfect weekend getaway and bring lots of traffic and shoppers. While in close proximity to the lake, the downtown also becomes a hotspot for the city's stormwater runoff issue. Thus, improving the current existing green and grey stormwater management infrastructure while maintaining the downtown's economic function and its long established intrinsic value is important. This report focuses on the downtown area and provides the city with BMPs (best management practices) that can help reduce stormwater runoff and improve water quality through increasing tree canopy, bioretention, filtration and education.

Figure 2: Aerial view of downtown White Bear Lake, Minnesota

Greening Projects

The City of White Bear Lake has been gracious enough to engage with the University of Minnesota in order to give CFANS students the opportunity to apply their knowledge in a real world setting by using the city as a classroom case study. Projects completed by previous student groups have produced a variety of inventories, surveys, and recommendations geared towards improving tree canopy and stormwater management practices. This student project builds upon the data collected and the recommendations given by these preceding groups by identifying a small area of the downtown White Bear Lake core to be targeted for an intensive greening program. While the impacts and offsets of some of these projects taken individually could be seen as marginal, when implemented together they perform a wide array of ecosystem services in a sustainable manner. Furthermore, it is hoped that once the benefits of green infrastructure programs are more readily visible to the public an expansion of greening projects would blossom throughout the city.

1. The four proposed projects are as follows:

2. A consolidated dumpster enclosure for the businesses within the project site boundaries
3. Rain and butterfly gardens
4. Green roofing
5. Suspended pavement that will better support longer tree life as well as paved surfaces

Site Description

The targeted area is the square block adjacent to Washington Square Park, 4th and 3rd Streets forming the northern and southern boundaries, bordered on the east by Banning Avenue, and Washington Square to the West. Included in the project area is the parking lot in the center of the block. This parking lot is the designated site of the dumpster enclosure, to be shared by the businesses ringing the block. For a full list of businesses and their addresses refer to the appendices.

Figure 3: Aerial view of the project site

The parking lot is currently home to five green ash trees, three of which are <10 dbh. Several flip-top dumpsters and large industrial trash cans currently handle the waste needs of the businesses around the parking lot. There are five large islands in the parking lot with some amount of grass, small trees and shrubs, one with a fire hydrant, and one with a power transformer box.

Figure 4: View of dumpsters & two large green ash trees. (left)

Figure 5: Island in parking lot covered by grass/weeds. (right)

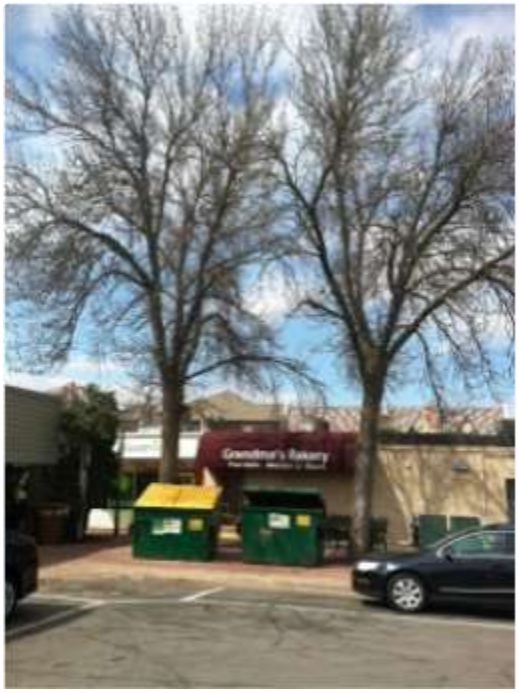


Figure 6: Island in parking lot with large green ash tree.

The lot has several mature, high value trees that already provide enormous value. Every effort to preserve them should be made during future construction. The large bur oaks and basswoods provide shade and a host other benefits, while the red cedars provide a welcome splash of green during the winter months.

Figure 7: Three large bur oaks.

Figure 8: Red cedar tree on edge of lot.

Inventory of Ash Trees

Emerald ash borer (EAB) has become a serious problem in some areas of Minnesota. Fortunately for White Bear Lake, this invasive pest has not yet been discovered within the city. Unfortunately for White Bear Lake, its proximity to neighboring areas that are infested with EAB makes it all but a forgone conclusion that this insect will make its way to White Bear Lake - if it is has not already become established, but not yet discovered. The downtown core of White Bear Lake has 141 ash trees as of the fall of 2014 (predominately green ash, *Fraxinus pennslvanica*). This represents 10.73% of downtown tree cover, which by many metrics is an acceptable number. However, having such a relatively low number of ash trees represented in the downtown canopy presents WBL with an opportunity to fully expunge this troublesome species from the landscape. This preventative measure will save on removal costs later, add biodiversity to the tree canopy, add to the already pleasing aesthetic of the downtown core, and increase resistance to common pests and pathogens.

Ash Tree Count by Size

DBH (tree trunk diameter at breast height, i.e, 4.5 feet above ground)	Ash Trees
>30	20
12-30	102
<12	19
Total	141

Table 1: Ash tree count by size

Ash Trees on Project Site

Location	Ash Trees	DBH Class
Washington	4	>15” (inches)
4th	3	>10”
Banning	0	-
3rd	0	-
Parking Lot	5	<10 - >22”

Table 2: Ash trees on project site

Dumpster Enclosure

Currently the dumpsters belonging to the businesses in the project zone are placed in the parking lot behind the business. Two types of trash receptacles are currently being utilized: 6 yard bin dumpsters and 32 gallon wheeled trash cans. The 6 yard bin dumpsters are crane lifted to transfer waste into front-end loader trucks. This requires the dumpster enclosure to be open above in order to not interfere with current waste pickup procedures. The overhead clearance of a front-end loader requires 18'-6" overhead clearance in order to avoid damage to nearby structures. Currently, a variation of these trash receptacles can be found scattered within and around the parking lot off of Banning Ave and 3rd Street.

One solution to this lack of uniformity would be to build a trash area, preferably one that also looks presentable and inconspicuous. The blueprint shown here would allow for two 6 yard bins and six 32 gallon wheeled trash cans. The 6 yard bins would be accessible via locked gates that would be open to a driveway for trash pickup. The wheeled trash cans are accessible via locked doors on opposite sides of the trash enclosures. By subdividing the enclosure, individual or small groups of business still have their designated trash areas but in a single organized area.

The trash enclosure would be made of 6" brick walls; depending on how the enclosure is positioned, the height of these walls would vary. The walls facing toward streets would be 6'-0" in height to reduce visibility of trash receptacles and their contents. All remaining walls would be 5'-0" in height for sightline visibility. Over the wheeled trash cans, a green roof would be installed. The simplest material to grow would be prairie grasses that would be visible from street side for a visually appeal. Steel columns would raise the roof to 10'-0" on the street side and have a slope of 2"/12". This would create visibility of the roof to showcase the uniqueness, as well as allow for debris to fall off. Optional design decisions regarding aesthetics of the dumpster enclosure can include, but is not limited to: planting of nearby trees, shrubs, vines or grasses, installation of another material on exterior walls, design of steel columns for added interest, etc.

Figure 9: Dumpster enclosure design with trees.

Figure 10: Dumpster enclosure design.

Figure 11: Diagram of enclosure design from above.

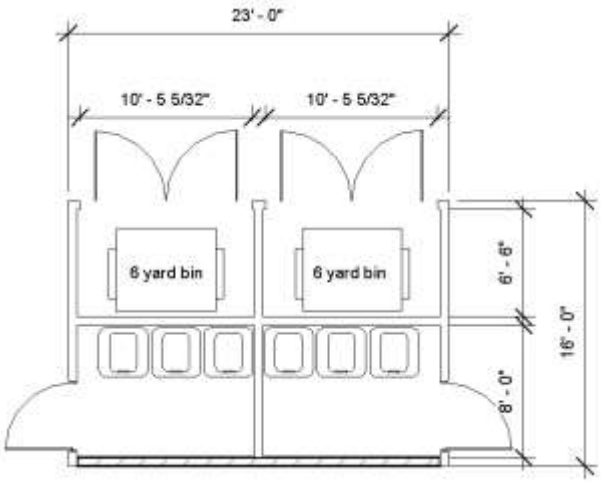


Figure 12: Rendering of green dumpster enclosure.

Rain & Butterfly Gardens

Rain gardens: help reduce pollution in lakes, rivers, and streams; help recharge groundwater; keep rainwater on the property where it naturally belongs; create native habitat for wildlife and butterflies; and beautify the landscape.

These depressed gardens are built to collect water and allow it to slowly penetrate into the ground. These gardens are good substitutes in areas where water runoff prevention is needed, however planting of trees or the use of other methods is not possible. These types of areas are near intersections where trees would block site lines, or in areas where there is not area for a tree crown.

Rain Garden Characteristics:

- A grass buffer strip around the garden that will slow the velocity of oncoming runoff.
- A mulch layer providing a medium for biological activities to occur.
- Plants that will use the runoff for moisture and nutrients.
- A soil layer where plant roots will collect moisture and nutrients.
- A ponding area of depression of the garden will provide the necessary storage needed for incoming runoff.
- A berm that is at least six inches of soil or rocks that functions as a dam to facilitate the ponding of runoff.

Rain gardens can be any size and there are many variations of them. In downtown areas, rain gardens fit into the space between the street and the sidewalk. **The costs of rain gardens is between $3-$10 /square foot.** An extra cost would be labor to plant and watering during establishment. Also if wanted, a special curb can be constructed to direct water runoff to the rain garden. This curb can be constructed when the streets are redone and is not necessary to put in a rain garden.

Figure 13: Rain garden cross section.

Figure 14: Rain garden in Normal, IL.

The recharging of groundwater is one of the crucial environmental services provided by rain & butterfly gardens. This recharge process can be localized, where runoff is collected by a garden and directed downwards; or a series of rain gardens can be linked by underground infrastructure and either directed towards an open body of water, or collected in a cistern for various uses. Rain gardens not only provide an aesthetically pleasing surrounding, but they can have a positive stormwater offset effect on areas with high levels of non-permeable surfaces. The figure below depicts how rain gardens, suspended pavement, and submerged infrastructure work together in order to collect stormwater runoff and direct it or store it wherever necessary.

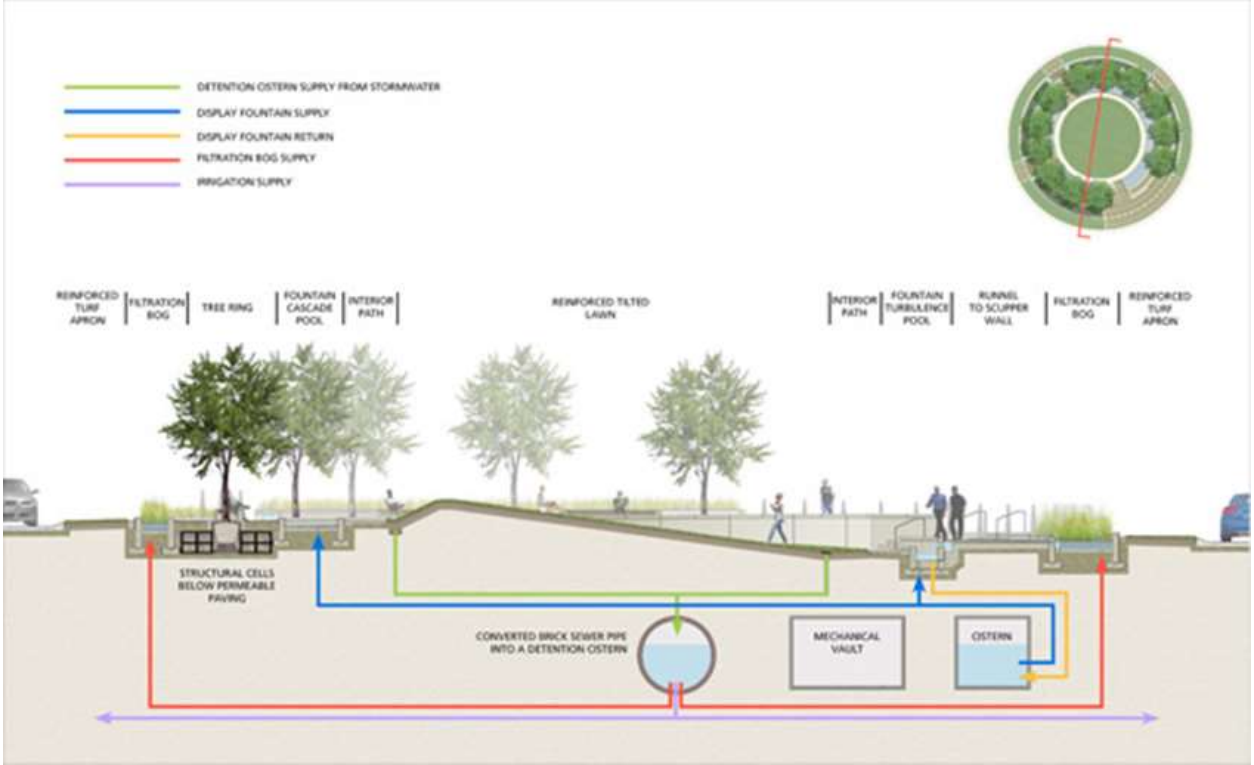


Figure 15: Rain garden collection system working in tandem with suspended pavement systems.

Figure 16: Beautiful and highly functional rain garden in Normal, IL.

Butterfly gardens can provide the same benefits as a typical rain garden, while boosting its aesthetic value and level of biotic interaction. These pollinator gardens add a vibrant splash of color to the grey infrastructure of downtown. Planting native prairie grasses and flowers will attract a host of butterfly species, adding yet another draw/interesting element to the downtown core.

In addition to effectively and sustainably managing stormwater runoff, butterfly gardens off an excellent opportunity for community engagement. Groups like Minnesota In Bloom and the Master Gardeners are often more than happy to engage in large scale community garden projects.

Figure 18 - Butterfly garden as a median strip

Green Roofing

While still a relatively new commercial industry, green roofing has a broad set of benefits for any sustainable building strategy. By replacing barren roofing with living plants part of the natural landscape is preserved while being put to work for the benefit of the structure. The many benefits of green roofing are an investment in a property, and an investment in the community. Some of these benefits include:

- Clean water
    - Rainwater running over bare roofs picks up heat and contaminants as it drains onto our streets and eventually back into lakes and streams. Green roofs hold rain, reducing excess runoff and pollution, thus reducing the need for additional stormwater treatment infrastructure.
- Longer lasting roofs
    - Green roofs are protected from some of the factors that cause roofs to fail, such as extreme summer heat and thermal swings. Typically, green roofs last longer than conventional roofs, reducing cost and waste.
- Cooler buildings, cooler streets
    - Aside from the shade they can provide, green roofs cool their buildings through evapotranspiration. If enough roofs in an area are green they combat the urban heat island effect, mitigating the excessively hot temperatures felt on sidewalks and streets in the summer months.
- Habitat
    - Green roofing creates green space in the urban environment that can provide habitat for birds and beneficial insects.

Figure 19 - Newly installed green roof on a garage in Minneapolis, MN

Figure 20 - Advanced green roof on top of St. Paul Fire Station #1, St. Paul, MN

Current pricing estimates of green roofing are between $8.00 - $15.00 per square foot; which can prove cost prohibitive for small, privately owned businesses. Regardless, the green roofing industry is becoming increasingly popular in the commercial sector with many high profile buildings installing green roofs to reap the benefits of their extensive environmental services.

Figure 21: Green roofing environmental services illustration

Figure 22 - Map of roof square footage in project area

Suspended Pavement

Permeable and suspended pavements are porous ground covers that allows runoff to filter back into the soil or gravel base, through the pavement. Permeable pavement, like pervious concrete/asphalt and interlocking pavement bricks and squares allows water to seep through/around them in order to re-enter the soil. Suspended pavement systems take this one step further by essentially aerating the soil underneath the walkable surface with concrete grids (concrete blocks with spaces inside) or reinforced plastic grids that give a high degree of structural support to the soil as well as the surface above. These suspended systems allow for maximum surface permeability, therefore recharging the maximum amount of stormwater runoff possible. In addition, they provide urban trees with spots to truly thrive in the built environment; doubling the lifespan of most planted trees. It is these suspended systems that we recommend to White Bear Lake, as they offer the most effective, and sustainable options moving forward.

Silva Cell by DeepRoot® is the premiere suspended pavement system. It consists of an underground suspension system that supports the traffic above, which protecting the soil below from compaction. This provides room for tree roots to grow into, which allows trees to reach maturity, a rare occurrence in conventional sidewalk systems where the only way for trees to expand is to buckle pavement and overlap curbs. Currently the average life of a tree in an urban setting is a projected 10-13 years. Minnesota based Kestrel Design Group calculated that White Bear Lake could save $494 per year for every tree supported by a system of 100 Silva Cells.

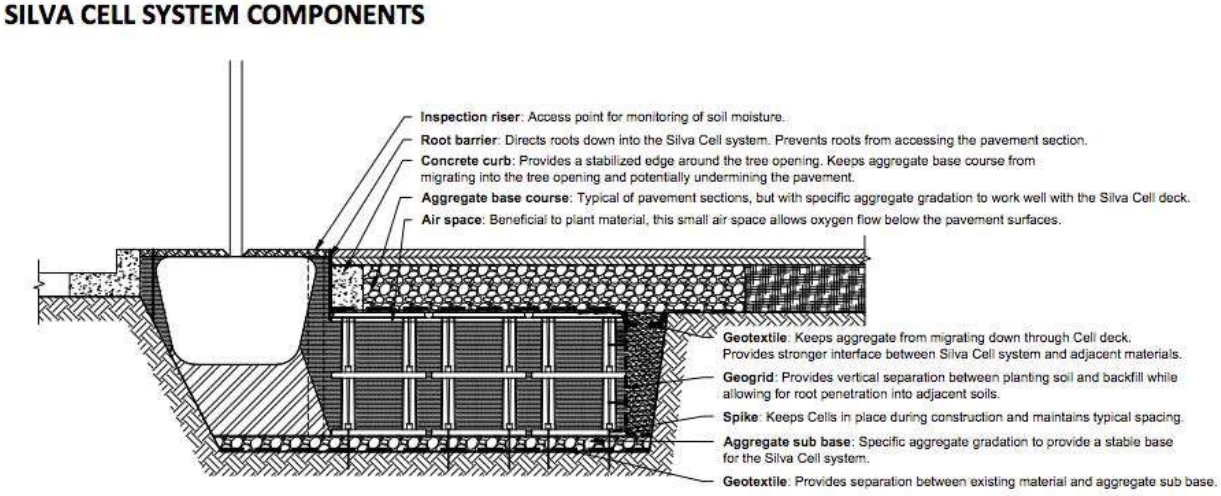


Figure 23: Silva Cell design

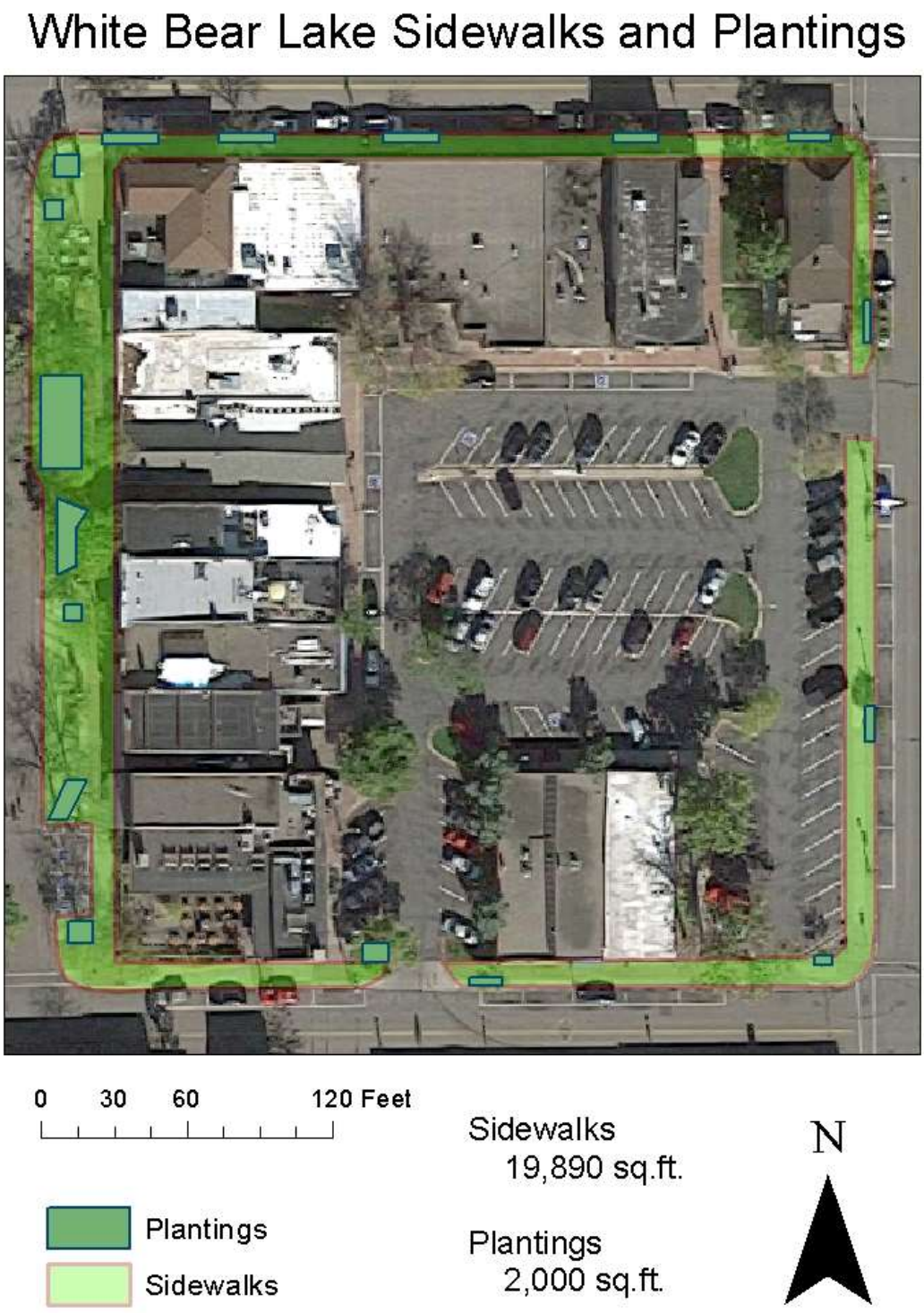


Figure 24 - Map of project site, highlighting sidewalks and planting spaces.

Lifespan of cells

DeepRoot, the manufacturer of the Silva Cell 2™, has a 20 year warranty on their product when properly installed but states that the cells should last over 100 years without maintenance. DeepRoot's website includes additional information on the quality and lifespan of the cells.

> *" ...a part that sees a very small load (as compared to failure stress) will have a relatively long lifespan. The same part under a high load (as compared to failure stress) will have a short life span."*

This excerpt from the DeepRoot website explains that the lifespan of their product is very dependent on the loads that it will experience day to day.

Replacement for utilities

One issue to keep in mind when considering the installation of silva cells would be the additional time needed for the maintenance of utilities under the sidewalks where the cells have been installed. The manufacturer of the cells stresses the ease with which the cells can be moved for utility access Extra care will have to be taken when working around portions of sidewalk that have the cells installed to avoid any damage and possible need for replacement.

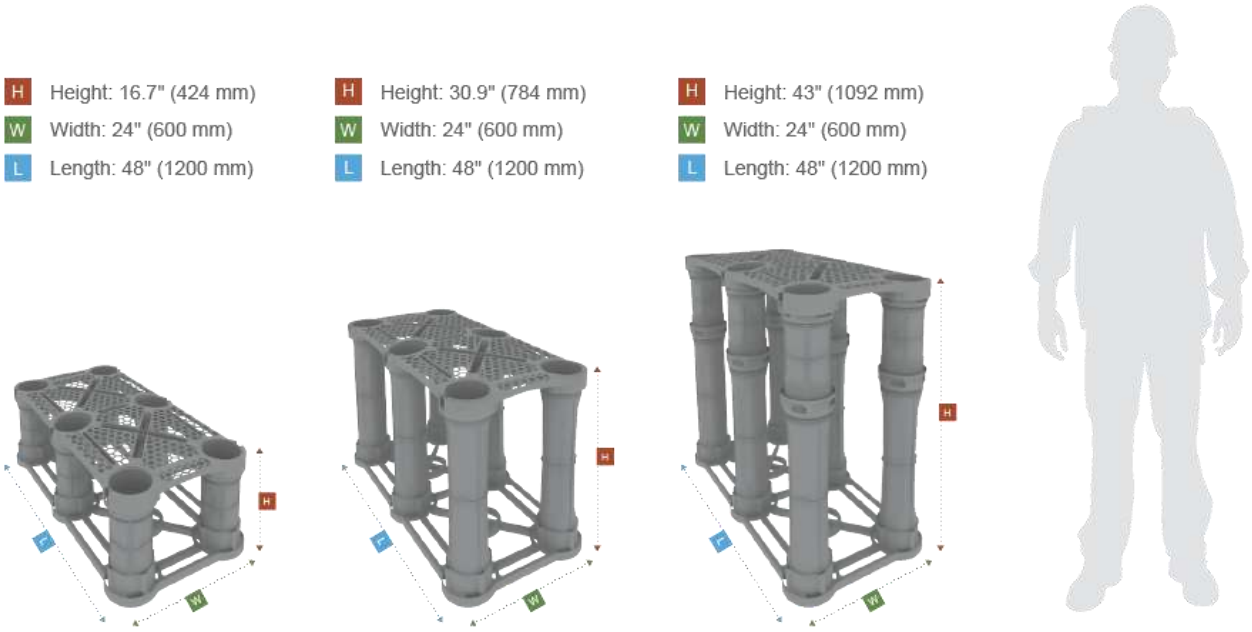


Figure 25 - SilvaCell designs

Tree Recommendations

Redesigning streets, even if suspended pavement is not implemented, provides a great opportunity to enhance the quality of the canopy by installing trees that are best suited for the urban landscape. Four tree species were selected for downtown White Bear Lake. To determine the most suitable trees, many factors were considered including: cold hardiness, resistance to pests and pathogens, height and crown spread at maturity, presence of messy seeds or fruits, wildlife/pollinator considerations, aesthetic qualities, and tolerance to salt sprays/compacted soils. The four trees that were selected based on these metrics are: the hardy rubber tree (*Eucommia ulmoides*), Kentucky coffeetree (*Gymnoclaudus dioicus*), New Horizon elm (*Ulmus* 'new horizon'), 'Northern Acclaim' honeylocust, thornless (*Gelditsia tricanthos* var. inermis).

- The hardy rubber tree (Eucommia ulmoides)
    - An ornamental species appreciated for its bright, glossy foliage and ample shade, that is rapidly gaining popularity as an all-purpose urban street tree. The hardy rubber tree tolerates drought, compacted soils, salt sprays, poor drainage, air pollution, and is free of any known pests or pathogens.

Figure 26 - Hardy rubber tree planting

- Kentucky coffeetree (*Gymnoclaudus dioicus*)
    - A tough, fast growing tree, this species is well suited to the built landscape. It easily tolerates compaction and drought. It is also free of pest and pathogen problems. Its unique branching structure provides an interesting aesthetic during the winter months. Free of messy seed pods if male trees are selected.

Figure 27 - Kentucky coffeetree planting

- New Horizon elm (*Ulmus* 'New Horizon')
    - This relatively new elm cultivar was developed to have maximum resistance to Dutch elm disease; it is among the most resistant cultivars. The New Horizon also tolerates compacted soils, and its extreme cold hardiness makes it ideal for Northern climates. This is a smaller elm cultivar, which means it will fit on the majority of streets without any problems.

Figure 28: 'New Horizon' elm planting

- ‘Northern Acclaim’ Honeylocust, thornless (*Gelditsia tricanthos* var. inermis)
    - White Bear Lake already appreciates the value of this incredibly hardy street tree. It is the perfect species for parking lot islands and the narrowest of sidewalk plantings. It tolerates extreme compaction and drought. Cultivars without thorns and fruit are widely available. Brilliant yellow fall color is an added aesthetic value.

Figure 29 - Honeylocust planting

Additionally, there are some tree species this group qualified as ‘problem trees,’ and advise against planting.

- All ash species (*Fraxinus*) should be avoided because of their susceptibility to EAB.
- Maple species (*Acer*)
    - Overused in the urban landscape to the point where they have become ubiquitous.

- Prone to winter sunscald, preventing this is possible but requires active management that is unnecessary in many other species.
- Prone to infection by canker-causing pathogens.
- Current maple plantings on the project site are mere saplings and yet are already afflicted by cankers and other fungal infections that have already progressed to the fruiting stage - these will cause tree mortality by an inciting event (usually weather related) and could pose possible danger to surrounding targets.

➢ Hackberry (*Celtis occidentalis*)

- Widely renowned as a hardy street tree tolerant to the rigors of the urban landscape. The majority of the hackberry plantings on the project site are stunted and sickly looking. This is most likely the result of the stocks progeny not being from the upper Midwest, and thus not hardy to harsh winters.
- It is crucial that trees planted in Minnesota be the offspring of trees able to withstand our USDA hardiness zone classification (4a-4b).

Figure - Canker on maple sapling

Figure - Fungal infection on maple sapling .

Conclusion

In an effort to further beautify downtown White Bear Lake by improving its stormwater management potential, this project has provided a short, but detailed and site specific plan. This plan calls for utilizing green infrastructure in various forms to mitigate the adverse effects of stormwater runoff and provide a sustainable tree canopy for downtown White Bear Lake.

Again, we would like to thank Ellen Richter, and all the employees of White Bear Lake city government for their assistance throughout this project.

References

Donoian, Jessica. Ebert, Bryan. Fuerst, Nathen. Helgager, Grace. Lemaniak, Maranda. "Complete Streets: Stormwater and Tree Canopy." ESPM 4041W. (2/7) Fall 2014. The University of Minnesota.

United States. Census Bureau. 2014. GOP, Washington, D.C. Accessed April 26, 2015. http://www.census.gov/

City of White Bear Lake. 2008. Land Use. City of White Bear Lake 2030 Comprehensive Plan. Accessed April 26, 2015

Bachmans Nursery, 'Green Roofing FAQ.' 2015. http://www.bachmans.com/

Minnesota Green Roofs Council. 'Case Studies.' 2015. http://www.mngreenroofs.org/

City of White Bear Lake. n.d. Storm Water Pollution Prevention Program (SWPPP). Accessed April 28, 2015. http://www.whitebearlake.org/index.asp?Type=B_BASIC&SEC=%7B76599C18-116E-48FF-AC88-51BD4DA7A707%7D

DeepRoot Designs. 'Average Tree Life Span.' 2015. http://www.deeproot.com/blog/blog-entries/is-average-tree-lifespan-a-meaningful-number

Kestrel Design Group, Inc. . Advantages of using permeable pavers above cells. DeepRoot.2013http://www.deeproot.com/silvapdfs/resources/articles/Advantages%20of%20Using%20Permeable%20Pavers%20Above%20Silva%20Cells.pdf.

Kestrel Design Group, Inc. 2011. Investment vs. returns for healthy urban trees: lifecycle cost analysis. DeepRoot. http://www.deeproot.com/silvapdfs/resources/articles/LifecycleCostAnalysis.pdf.

Iowa Department of Agriculture. 2008. Iowa Rain Garden Design and Installation Manual. http://www.iowaagriculture.gov/press/pdfs/RainGardenManual.pdf

Missouri Botanical Garden. 'Plant finder - hardy rubber tree, new horizon elm, http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a864#AllImages

http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d471

USDA. 'Plant guides - Kentucky coffee tree, honeylocust.'

http://plants.usda.gov/plantguide/pdf/cs_gydi.pdf

http://plants.usda.gov/factsheet/pdf/fs_gltr.pdf

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Tree photographs were obtained from the USDA Plant Image Database.