Recommendations and Strategies for Green Infrastructure Improvements

Fort Atkinson, Wisconsin

May 14, 2015

Submitted by the Department of Landscape Architecture
University of Wisconsin - Madison
Madison, WI

Figure 1.00 - Fort Atkinson Picture

ACKNOWLEDGEMENTS

We would like to thank the City of Fort Atkinson and the Heart of the City group for their cooperation and for the opportunity they've allowed the Landscape Architecture department from the University of Wisconsin to brainstorm solutions to help guide Fort Atkinson's downtown development. We would also like to thank the Fort Atkinson engineering department who were kindly able to provide us documents for our analysis. It is through genuine cooperation such as this that we can hope to create positive change for the community.

PURPOSE OF DOCUMENT

This document is intended to be a guide for Fort Atkinson city planners who wish to improve the aesthetics and ecological functioning of the downtown Main Street area. We will outline some techniques and design features that we believe will be effective, give implementation recommendations, and provide sources for more detailed information.

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Figure 1.01 - Fort Atkinson Photo

Madeline Van Cleve
Area of study

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Katherine Braun
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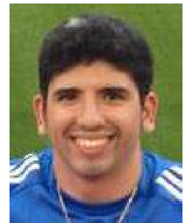


Gabriel Mena
Landscape Architecture

WHO WE ARE

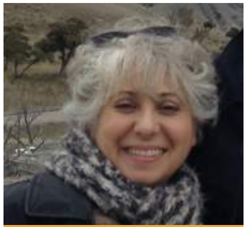
We are the students of the Urban Ecology 375 course in Landscape Architecture of the University of Wisconsin-Madison (Spring 2015 Semester). This course is being taught by Dr. John Harrington, the Landscape Architecture department chair. We are graduate and undergraduate students with a range of backgrounds, primarily in landscape design and ecology, and we have spent the semester discussing green infrastructure concepts and their applicability to Fort Atkinson.

Sarah Betzler is a second year Master's student in the Environment and Resources program. Her research thesis studies the effects of prairie restoration on small mammal communities. She anticipates a career in regional planning, protected area management, or wildlife conservation.

Maddie Van Cleve is a second year Master's student in Landscape Architecture. Her research focuses on increasing the presence of early blooming prairie forbs in prairie restorations. She hopes to remain in southern Wisconsin working in natural area restoration and management.

Nancy Chachula is in her final year to earn her undergraduate degree in Landscape Architecture. She has been practicing landscape design in her own practice for the past five years and hopes to expand her work to larger projects that imbed ecologically sustainable principles.

Brittany Murphy Brittany Murphy is a third year Master's candidate in the Conservation Biology and Sustainable



Nancy Chachula
Landscape Architecture

Peter Clark
Landscape Architecture

Figure 1.02 - Fort Atkinson Photo

Development
program with the Nelson Institute. Her interests include ecological restoration, new urbanism, and complete street design.

Elizabeth Freeze is a first year Master's student in Landscape Architecture, focusing on Urban Ecology and Environmental Education. She plans to continue working in non-profit urban agriculture or with the city metroparks.

Katherine Braun is a second year Master's candidate in Landscape Architecture. Her research focuses on heritage apple trees at the old Badger Army Ammunition Plant in Sauk County, Wisconsin.

Anthony Slusser is a fifth year undergraduate studying Landscape Architecture. He hopes to incorporate stormwater practices and energy conservation methods in his work after he graduates.

Gabriel Mena is a fourth year undergraduate student studying Landscape Architecture.

Peter Clark is a fifth year undergraduate studying Landscape Architecture with an interest in urban design and storm water management.

Professor. John Harrington is the current Department Chair of the Landscape Architecture Department and the professor of the Urban Ecology class.

PRECEDENT REVIEW - WHAT HAVE OTHER TOWNS DONE?

Figure 1.03- Hwy 42 “Main Street” Before

Figure 1.04- Hwy 42 “Main Street” After

Algoma, Wisconsin

Population: 3,126

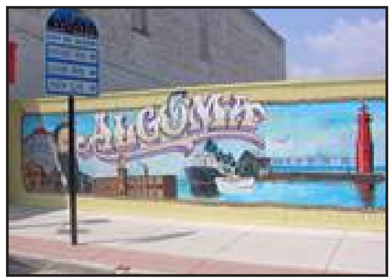
Algoma, Wisconsin is a small municipality with a rich history located on the shore of Lake Michigan. Algoma has completed many downtown improvement projects including a new visitor center, main street redevelopment and public mural event.

Award-Winning Visitors’ Center

- Built with volunteer labor and donated materials
- Staffed year-round by 40 volunteers, mostly Seniors
- Beach boardwalk constructed by volunteers

Main Street Redesign

- Addition of curb extensions, street trees and furniture
- Clearly delineates downtown entry and exit
- Increases green space and provides safer pedestrian opportunities



Walldog Wave Mural Event

- Summer event in 2007 with International artists’ group, the Walldogs
- Created and recreated traditional-style advertising murals
- Murals focus on local history, businesses and industry, people, etc.
- Murals are included in Historic Algoma Walking Tour along with historic buildings

Figure 1.05- Osceola Precedent Image

Figure 1.06- Osceola Precedent Image

Osceola, Wisconsin
Population: 2,568

Osceola, Wisconsin is a small town along the St. Croix River that worked with SEH, an engineering firm, and the WI DOT to complete a major Historic Downtown Streetscape project. Improvements include:

- New hardscaping in a variety of textures
- Perennial and grass plantings
- New site amenities, street furniture and lighting
- Complete replacement of public infrastructure
- Improved crosswalks
- Curb bumpouts
- Increased land striping and parking delineation

Figure 1.07- Osceola Precedent Image

PRECEDENT REVIEW - WHAT HAVE OTHER TOWNS DONE?

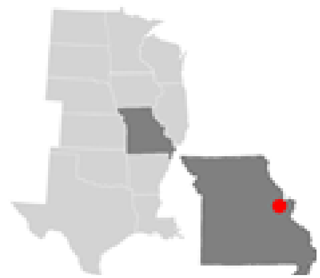
Figure 1.03a- Big Ben Bikin' Statue outside of visitor center in Sparta, WI

Sparta, Wisconsin
Population: 9,602

Sparta, WI is home to the first rails-to-trails project in the country. The city has embraced this legacy and branded themselves the "Bicycling Capital of America". Sparta created a mascot, Ben Bikin', whose image they use for place-making to boost identity and tourism throughout the city.

Figure 1.05a

Defiance, MO
Population: 3,154



Defiance is an unincorporated community about 40 miles from downtown St. Louis, Missouri. Defiance lies along the Katy Trail State Park and is home to Katy Bike Rental, the “one-stop-shop” on the Katy Trail. Services offered include:

- Bike Repairs and Rental
- Shuttle service and area tours
- Trail maps and information
- Ice cream, snacks and beverages
- Souvenirs and tourist information

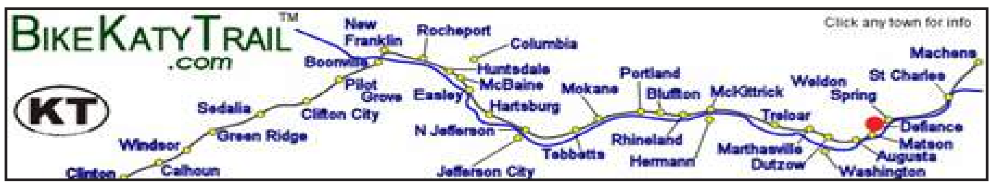


Figure 1.07a

Figure 1.08 - Fort Atkinson Photo

Figure 1.09 - Fort Atkinson Photo

PROJECT CONTEXT, BACKGROUND AND HISTORY

Fort Atkinson is located in the oak savanna/prairie region of Wisconsin. Before European settlement, this landscape consisted largely of open prairie with pockets of fire-tolerant woodland or savanna in more protected areas. River floodplains would have supported floodplain forests with more flood-tolerant tree species.

Plenty of non-native trees, shrubs, grasses, and flowers will thrive in Fort Atkinson, but it's worth considering that native species are more likely to be well-adapted to the climate and to endemic pests and diseases. They also provide useful habitat for birds, insects, and other animals, and help foster a regionally integrated sense of place. Successfully greening Fort Atkinson's Main Street will require a variety of native and non-native plants, but we would like to encourage the use of natives wherever possible.

IMPORTANCE OF GREEN INFRASTRUCTURE AND MULTIFUNCTIONALITY

'Green infrastructure' refers to urban design elements that use ecological processes to improve stormwater management, air quality, heat island effects, urban habitat, and aesthetics. Green infrastructure has existed for millennia, but recent technological advances and increasing awareness of urban environmental problems has led to a revolution in their use. Below, we have summarized the most common problems that green infrastructure can address.

Figure 1.10 - Fort Atkinson Project Boundary

Figure 1.11 - Heart of the City Logo

PROJECT GOALS AND CONCERNS

Through meeting with the "Heart of the City" group and from our understanding of urban ecology in the context of a city like Fort Atkinson, we hope to foster continued improvement of streetscape aesthetics in conjunction with goals which carry out critically needed ecological services. We would like to see the improvement of street tree and plant diversity to further enhance the streetscape to also protect the tree populations from disease, but to also encourage ecological uses by birds and other animals. Connectivity from downtown to natural areas in the surrounding countryside are vital to enable children and adults the ability to explore and escape the city without the need for a car. And very importantly, we hope these recommendations for stormwater and pollution control measures can further protect the Rock River from industrial and internal combustion engine byproducts which ever increasingly risk our natural areas. We believe that through use of many of these recommendations, these project goals can be realized for the people of Fort Atkinson.

Figure 1.12 - Project Goals

Figure 1.13 - Project Goals

Figure 1.14 - Project Goals

Figure 1.15 - Project Goals

ANALYSIS & RECOMMENDATIONS

- CANOPY COVER
- CONNECTIVITY
- PUBLIC SPACES
- GREEN ROOFS
- STORM WATER
- STREETSCAPE

Figure 2.00 - Fort Atkinson Photo

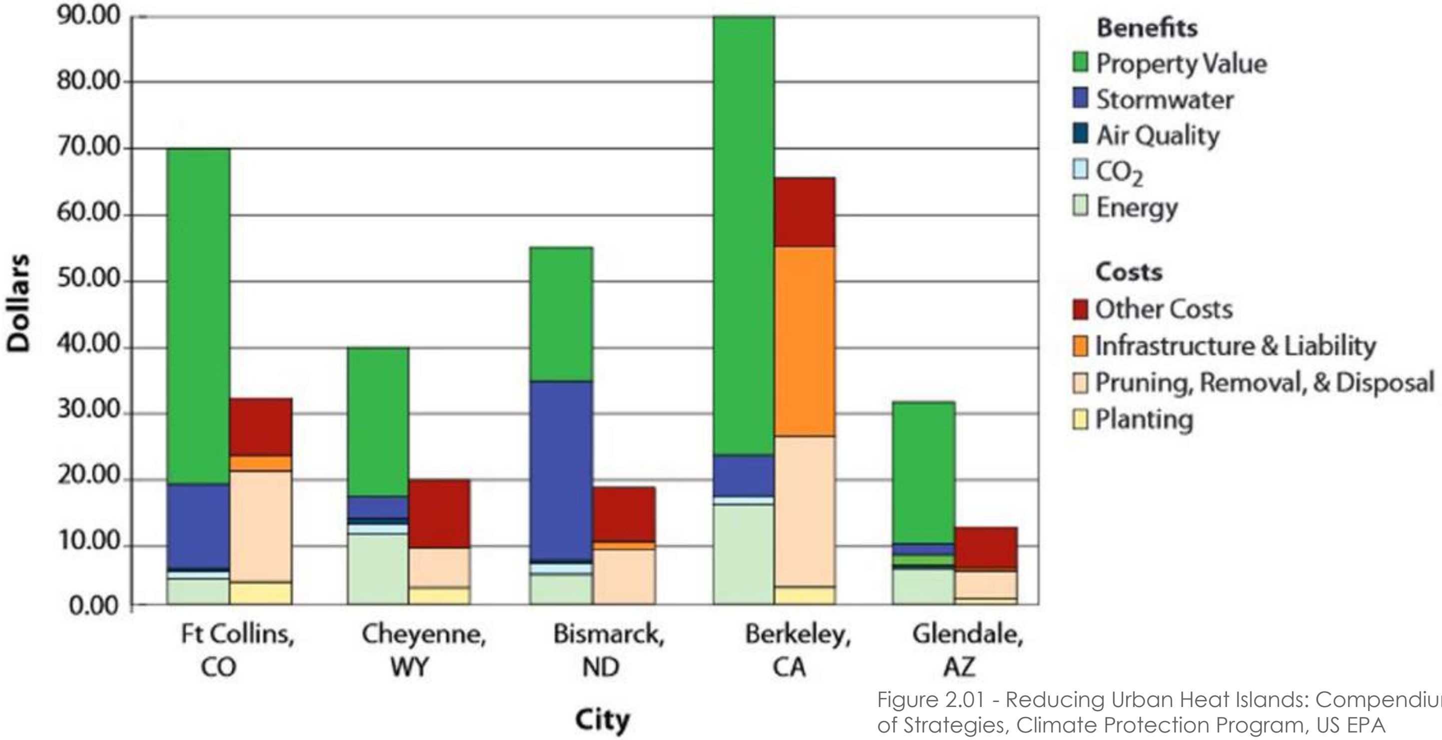


Figure 2.01 - Reducing Urban Heat Islands: Compendium of Strategies, Climate Protection Program, US EPA

CANOPY COVER: ANALYSIS

From our analysis of downtown Fort Atkinson, we quickly found that there is a severe lack of canopy cover along Hwy 12. Not only that, but parking lots and single story buildings were very exposed from what we observed. The negative effects of this are wide reaching. Urban heat island effect can be mitigated by canopy cover which shades concrete and structures. This warming of the urban environment also heats stormwater runoff which warms the Rock River, dangerously altering habitat for freshwater animals. Trees also help with the mitigation of stormwater runoff by uptaking it with their roots. The habitat that is in such crucially high demand for urban tolerant animals is also created by added canopy cover. What we found in Fort Atkinson was a lack of tree diversity, which creates less opportunities for urban wildlife.

Use of land can have positive or negative byproducts. For instance, a parking lot is an important piece of urban infrastructure, but is only partially utilized. As is, a parking lot will absorb lots of heat or cause immediate rainwater runoff. By creating a plane of trees over these hot surfaces, it can remediate both of those situations and make a more pleasant atmosphere for all involved.

Street Tree Diversity in Fort Atkinson, WI (2015)

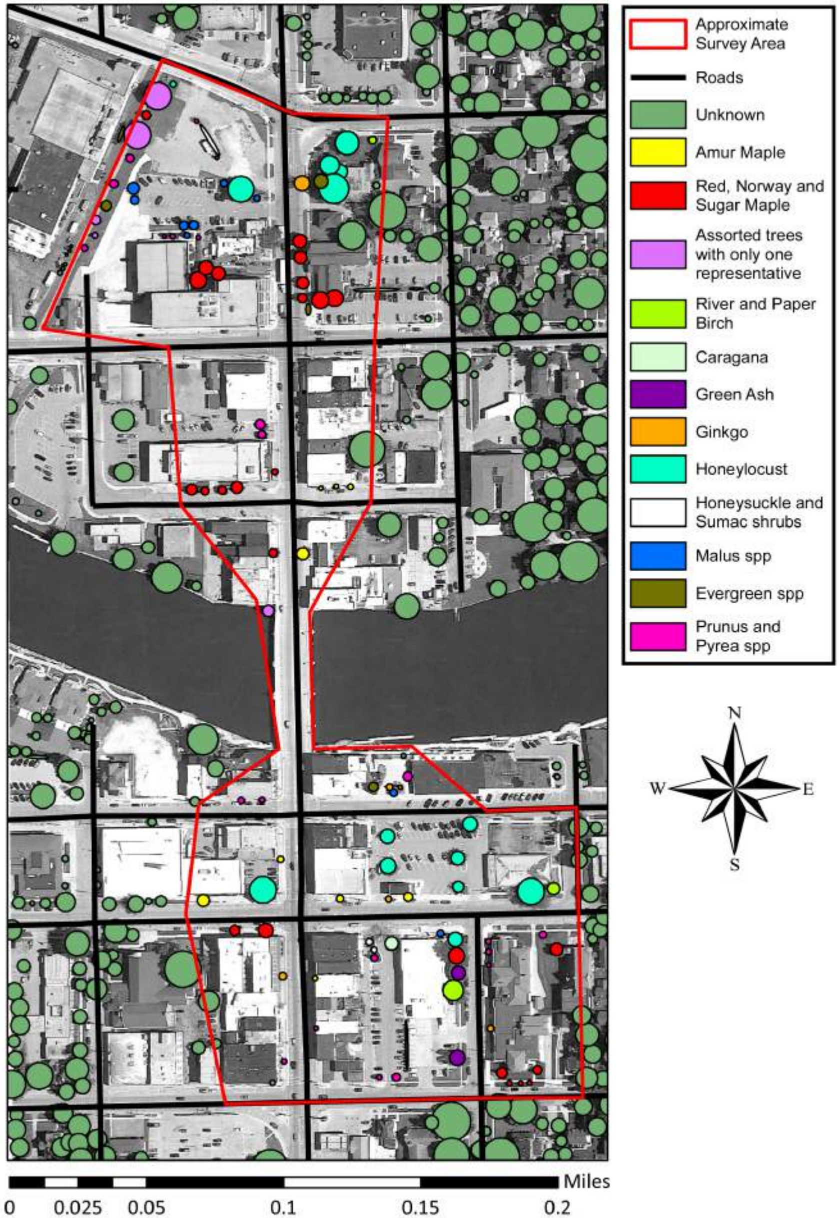


Figure 2.02 - Street Tree Diversity in Fort Atkinson, Wisconsin

Figure 2.03 - Large, healthy street trees can encourage foot traffic, tourism and economic growth. Main Street, Greenville, SC.

CANOPY COVER: RECOMMENDATIONS

The benefits of street trees to an urban community are many. Improving the urban forest may be the simplest, most effective, and most economical means of improving the ecological health of a city. Some of the benefits of a healthy urban forest include:

- Stormwater uptake
- Increased infiltration of stormwater around tree (on permeable surfaces)
- Interception of pollutants from precipitation
- Uptake of air pollution
- Reduction of air temperature
- Reduction in energy costs due to cooling benefits
- Carbon sequestration
- Erosion reduction
- Habitat for wildlife
- Fruit for human and animal use
- Noise reduction
- Aesthetic and psychological benefits
- Increased economic opportunity (foot traffic and tourism in downtown areas)

Maintaining the urban forest, however, is not as simple as planting trees in roadside terraces. In order to truly garner the benefits of street trees, trees need to be big and healthy. Large trees are exponentially more efficient at taking in stormwater and pollutants than small trees, and large trees also provide better habitat for wildlife and are aesthetically more desirable. Large trees require more space, and maintaining large healthy trees involves consideration of infrastructure and urban planning, as well as species selection.

Infrastructure Considerations:

Trees should be allotted as much ground space as possible. Trees should not be planted in areas that are wholly boxed in with pavement because soil underneath the pavement is compacted, and is therefore too low in oxygen for the growth of tree roots. Common solutions to this problem in cities are to create trenches or tree pits of unpaved soil where trees will be planted. Oftentimes these trenches or pits are too small for root growth resulting in unhealthy, stunted trees. For every square foot of crown area, trees require 2 cubic feet of soil (U.S. DOT[1]). A 16-foot crown diameter tree—a large urban tree—would therefore require 32 cubic feet of soil. Other sources recommend higher ratios.

If adequate space is already present at a potential planting site, simply refraining from paving wherever possible and allowing trees more space to grow is the best approach.

To allow for the growth of large trees in already paved areas, several new approaches to traditional pavement and concrete have been utilized:

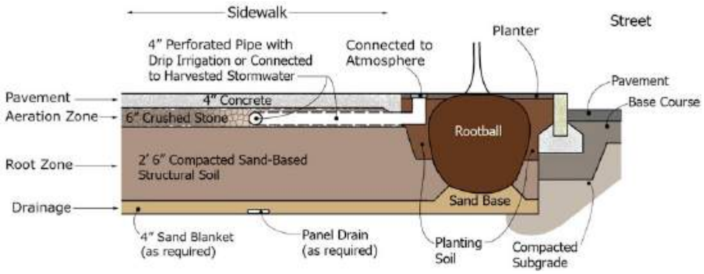


Figure 2.04 - The Sand-based Structural Soil system.

Sand Based Structural Soil (SBSS):

In this approach sidewalks are laid on top of a layer of gravel that rest on top of a layer of sand. The gravel and sand are hard enough to allow for a stable sidewalk, but porous enough to allow for root growth. Perforated pipes connect the sand layer to the surface, and can additionally serve as stormwater intake pipes, or irrigation pipes for trees during droughts.

CU-Structural Soil:

Stones of relatively even one-inch diameter are mixed with clay-loam soil and a hydrophilic gel. The compaction of the stone-soil-gel mixture can be 95% making it sufficiently stable to support heavy loads. But because the stones rest on each other in a lattice formation, the space between the stones is still penetrable by tree roots.

Suspended Pavement:

This approach uses a grid of metal or plastic posts buried under the soil to give structure to the sidewalk above. Tree roots can grow in between the posts.

In all of these approaches if permeable pavement is placed on top, stormwater can infiltrate directly into the soil and irrigate the tree.

Though some of these infrastructure changes may seem drastic, the importance of adequate space for street trees cannot be overstated. To continue to plant in inadequately sized tree pits is to continue to pour resources into a tree that will never have economical or environmental returns of equal magnitude.

Figure 2.05 - Healthy trees planted in CU Structural Soil create a pleasant atmosphere in Zuccotti Park, Lower Manhattan, NY.

Figure 2.06 - The suspended pavement system involves a tree being planted on a grid over which pavement will be laid.

Species Selection:

Ideally street trees would be native tree species that are adapted to the southern Wisconsin climate and wildlife. The urban environment, no matter the climate and regional context, is quite different from the historical landscape, and by planting native oak savanna/prairie species we are not suggesting that Ft. Atkinson should attempt to recreate the oak/savanna prairie community type. Rather, native species are preferable for their resilience. "Native" in this sense are species that are endemic to southern Wisconsin. Oak species (*Quercus* species) are especially beneficial to wildlife not only because of the large quantities of acorns produced, but also because of their large size at maturity, and unique form (open-grown in open settings). Ft. Atkinson was historically part of the oak savanna/prairie complex and several oak species would have been common in the area. These include:

- Bur oak (*Quercus macrocarpa*)
- Black oak (*Quercus velutina*)
- White oak (*Quercus alba*)

Other species that may have been historically present and are large at maturity include:

- Red oak (*Quercus rubra*)
- Shagbark hickory (*Carya ovata*)
- Black cherry (*Prunus serotina*)

A second consideration for species selection of street trees is their ability to withstand the stresses of the urban environment. Some of these stresses include:

- Drought
- Heat (amplified in cities by the urban heat island effect)
- Cold (leading to frost cracking)
- Pollutants in the air and water supply
- Road salt
- Lack of nutrients
- Excess nutrients (especially from lawn runoff or stormwater)
- Soil compaction
- Lack of space for root growth
- Mower/bike tree damage
- Vandalism
- Fungal/viral/bacterial infection caused by wounds created by previous two items
- Insect infestation

Figure 2.07 - Southern Wisconsin Oak Savanna
Justin Meissen. Flickr: https://www.flickr.com/photos/40855483@N00/15396252166/in/photostream/

Native species may be especially equipped to withstand some of these stresses because they are adapted to the climate and flora and fauna of southern Wisconsin. In particular native species may be best at withstanding cold, fungal/viral/bacterial infections, and insect infestations[2]. Native non-savanna/prairie trees to consider planting include:

- Basswood (*Tilia americana*)
- Sugar maple (*Acer saccharum*)
- Red maple (*Acer rubrum*)

- Hackberry (*Celtis occidentalis*)
- Kentucky coffeetree (*Gymnocladus dioicus*)
- Honey locust (*Gleditsia triacanthos*)
- Slippery elm (*Ulmus rubra*)

- Rock elm (*Ulmus thomasii*)

Figure 2.08 - “Frost crack initiation point” by Rosser1954 Roger Griffith Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Frost_crack_initiation_point.JPG#/

Figure 2.09 - Chlorosis caused by road salt

- Hawthorn (*Crataegus species*)

Counterintuitively, lowland or floodplain tree species may be especially adapted to the hotter, drier urban environment. This is because when water floods a floodplain the trees are subjected to an anoxic, or low oxygen environment. Soil compaction in the urban environment due to pavement, development, and traffic (foot or vehicular) create a similarly anoxic environment in which lowland species may, nevertheless, grow to a large mature size. Native lowland trees to consider planting include:

- Silver maple (*Acer saccharinum*)
- Cottonwood (*Populus deltoides*) (Parklands only)
- Swamp white oak (*Quercus bicolor*)
- Native willow species (*Salix* species)
- River birch (*Betula nigra*)
- Sycamore (*Platanus occidentalis*)

Some non-natives may be adapted to withstand other stresses. For example, tree species of a slightly more southern flora may be better able to withstand heat and drought. Gingko and London Plane trees may grow to a large size even with heavy soil compaction. Non-native trees to consider planting include:

- London Plane Tree (*Platanus* x *acerifolia*)
- Catalpa (*Catalpa speciosa*)
- Non-native willow species (*Salix* species)
- Liberty elm (*Ulmus americana* ‘libertas’)
- Ginkgo (*Gingko biloba*)

Sub canopy species are those that do not grow as tall as canopy species. They tend to be more shade tolerant than canopy species and because of their smaller size they may fit onto sites that are too small to support larger species, or on sites underneath power lines. Although their smaller size will prevent such species from being as environmentally or economically beneficial as many large species, the benefit of a small tree on a small site is better than no tree on a small site.

Figure 2.10 - Catalpa trees grow well in the urban environment and produce large, beautiful spring flowers.

Figure 2.11 - American plum blooming along a street.

Some sub canopy species to consider planting include:

Native species:

- Serviceberry (*Amelanchier species*)*
- Ironwood/Hop Hornbeam (*Ostrya virginiana*)
- Musclewood (*Carpinus caroliniana*)

- Blackgum (*Nyssa sylvatica*)
- American plum (*Prunus virginiana*)*
- Prairie crabapple (*Malus ioensis*)*
- Dogwood (*Cornus species*)
- Witchhazel (*Hamamelis virginiana*)

Non-native species:

- Ohio buckeye (*Aesculus glabra*)
- Horse chestnut (*Aesculus hippocastanum*)
- Persimmon (*Diospyros virginiana*)*
- Magnolia species (*Magnolia* species)

Species that were excluded from the list of recommended tree species include those that have been shown to be invasive or are potentially invasive, are aggressively colonizing plants, and/or over-represented in natural communities around Wisconsin. Some of these trees, such as Norway maples (*Acer platanoides*), and redbud (*Cercis canadensis*), are commonly planted in urban areas. Other species to avoid planting include black locust (*Robinia pseudoacacia*), prickly ash (*Zanthoxylum americanum*), red mulberry (*Morus rubra*), burning bush (*Euonymus alatus*), Japanese barberry (*Berberis thunbergii*), Russian olive (*Elaeagnus angustifolia*), autumn olive (*Elaeagnus umbellata*), amur honeysuckle (*Lonicera maackii*), Asian fly honeysuckle (*Lonicera morrowi*), Tartarian honeysuckle (*Lonicera tatarica*), hybrid honeysuckle (*Lonicera* x *bella*), Japanese knotweed (*Polygonum cuspidatum*), buckthorn (*Rhamnus cathartica*), and glossy buckthorn (*Rhamnus frangula*).

Generally, evergreen species do not make good street trees. Many evergreens are especially sensitive to salt and excessive nutrients. In addition they do not require as much water and so are less efficient at taking up pollutants. Evergreen species are also not native to the oak savanna/prairie community of southern Wisconsin. Because the urban environment is very different from the historical landscape, for the sake of biodiversity these species are not unwelcome in urban environments, however, they should not be the dominant street tree species and would be better off planted in yards or parks. An exception to this rule of thumb are the hardy evergreen shrubs arborvitae (*Thuja occidentalis*), yew (*Taxus* species), and juniper (*Juniperus* species). These species seem to do well in the urban environment and can help provide privacy and winter color.

Other Factors in Biodiversity

Biodiversity, for our purposes here, can be thought of as the variety of species and their genetic types, the variety of lifeforms, and the variety of ecological systems and communities in a given area. Biodiversity increases the resilience of the urban forest to disease and insect infestation, and increases the benefit to wildlife. Biodiversity also makes for a more interesting and beautiful city, in autumn foliage, winter form, spring flowers and summer green. In addition to species richness, factors to consider when aiming to increase biodiversity include:

Tree Form:

Trees grow in a variety of shapes and forms; tall and narrow (aspen, birch), wide and gnarled (open grown oaks), vase-like (American elm), dense bulbous foliage (maples), pyramidal (arborvitae), dainty and spreading (pagoda dogwood) and many others. Creating a planting plan with tree form in mind can help create a certain character for a block. For example, American elm trees were once coveted for their vase-like shape that created Cathedral arches over streets, and while Dutch Elm Disease still commonly prevents American elms from reaching the size where they could create such arches, there are several American elm cultivars that have the same growth form (for example, the Liberty elm). Perhaps Main Street would be better distinguished if it were planted with a row of arching elms alternating with shorter spring flowering species such as American plum, serviceberry and prairie crabapple? Side

Figure 2.12 - The tunnel of trees over this street in Minnesota lend it a distinct character and feel.

streets could be planted with shorter-statured, wide-foliage trees such as maples, with sub canopy species interspersed for variety and planting density. Mixing shorter-statured trees in with tall ones can help bring a street with tall, straight buildings down to human scale. It can transform an open, hot or windy street into a calmer, cooler street. Stands of mixed species can also fill in a space in dense and interesting ways that mimic natural communities, for example, perhaps a strip of barren lawn such as borders much of the Glacial River Trail could be planted with bur oak, white oak, black oak, black cherry and shagbark hickory to imitate southern Wisconsin oak woodland. Tree form can be used to enhance the beauty and character of a street, as well as the resilience of the urban canopy.

Tree Age:

Planting should be staggered so that the urban canopy is composed of relatively even amounts of young, middle-aged, and mature trees. Using size as a proxy for age, no more than 40% percent of all trees in a given city should be in the smallest size class (<6 inches in diameter at breast height). If the urban canopy is mostly even-aged, the city will find itself tree-less and lacking crucial ecological services when the trees reach their maximum age and begin to expire. Even-aged stands are also more likely to be wiped out if a disease, insect infestation or natural disaster strikes when they are already mature trees. The urban forest is an investment that should be kept replenished with regular planting spread across the city such that more mature trees are interspersed with young trees.

Groundcover:

A healthy diverse groundcover with a wide variety of native plantings will work in conjunction with street trees to enhance ecological services and create habitat for wildlife. A diverse groundcover is also aesthetically pleasing and can, especially in instances where natives are used, reduce the need for management by lawn mowing and chemical pesticide or fertilizer applications. The groundcover species, if taken from the native flora of southern Wisconsin, will, like the native trees, be more resilient to drought, disease, insect damage, extreme cold and heat and other stresses that are intensified in the urban environment. Because Fort Atkinson was historically part of the savanna-prairie complex, prairie grasses and forbs may be particularly appropriate for planting in terraces, strips, pocket parks, under or around street trees, or even, in the case of vines, up the side of buildings. Species to consider planting include:

Prairie Grasses and Sedges:

Prairie grasses and sedges such as little bluestem (*Schizachyrium scoparium*), june grass (*Koeleria macrantha*), prairie dropseed (*Sporobolus heterolepsis*), sideoats grama (*Bouteloua curtipendula*), purple love grass (*Eragrostis spectabilis*), and Pennsylvania sedge (*Carex pensylvanica*). These plants do well in dry, sunny conditions, and will not grow over thirty inches. They are appropriate for sunny pocket parks, unshaded terraces, parking lot strips, and empty lots.

Prairie Forbs:

Prairie forbs such as pale-purple coneflower (*Echinacea pallida*), butterfly weed (*Asclepias tuberosa*), black-eyed Susan (*Rudbeckia hirta*), leadplant (*Amorpha canescens*), bergamot (*Monarda istulosa*), showy goldenrod (*Solidago speciosa*), hoary vervain (*Verbena stricta*), spiderwort (*Tradescantia ohiensis*), blazing star (*Liatris species*), golden alexander (*Zizea aurea*), nodding onion (*Allium cernuum*), common milkweed (*Asclepias syriaca*) and many others also do well in dry, sunny conditions, and will not grow over thirty inches. They are appropriate for sunny pocket parks, unshaded terraces, parking lot strips, and empty lots.

Woodland Plants:

Woodland plants such as trillium (*Trillium species*), Jacob's ladder (*Polemonium reptans*), columbine (*Aquilegia

Figure 2.13 - A parking lot prairie garden in Minnesota.

Figure 2.14 - This telephone pole planting uses a phlox cultivar and a variegated Solomon's seal to beautify what would otherwise likely be a strip of grass. Native woodland phlox and Solomon's seal could easily be substituted for the cultivars.

Figure 2.15 - A telephone pole planting of dwarf bush honeysuckle.

canadensis), Virginia bluebells (*Mertensia virginica*), wild geranium (*Geranium maculatum*), wild ginger (*Asarum canadense*), mayapple (*Podophyllum peltatum*), woodland phlox (*Phlox divaricata*), woodland sunflower (*Helianthus divaricatus*), Solomon's seal (*Polygonatum biflorum*) , false Solomon's seal (*Maianthemum racemosum*) and others do well in moist shady conditions such as under and around trees. They are appropriate for groundcover in planters surrounding trees (especially planters elevated above street level), and in larger stips under trees.

Short Statured Shrubs:

Short statured shrubs can be used to separate planted areas from trafficked areas, to provide diversity in plant life form, and to provide food for wildlife, especially birds. Species to consider planting include New Jersey tea (*Ceanothus americanus*), bush honeysuckle (*Diervilla lonicera*), American hazelnut (*Corylus americana*), elderberry (*Sambucus canadensis*), American highbush cranberry (*Viburnum trilobum*), wild roses (*Rosa* species), Eastern wahoo, *Euonymus atropurpureus*), and the previously mentioned evergreen shrubs juniper (*Juniperus* species), arborvitae (*Thuja occidentalis*), and yew (*Taxus* species).

Figure 2.16 - Clematis cultivars growing on the front of a building. The native clematis (Virgin's bower) and other native vines will readily grow up buildings in urban environments.

Native Vines:

Native vines can be trained to climb up pergolas or buildings to add beauty and diversity to urban spaces. Vines that cover sunny building sides have the added benefit of cooling the building in the summer months. Vines provide food and shelter to wildlife, especially birds. Vine species to consider include virgin's bower (*Clematis virginiana*), trumpet honeysuckle (*Lonicera sempervirens*), and American bittersweet (*Celastrus scandens*).

[1] http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037/chap6.cfm

[2] Ash species (*Fraxinus* species) are a topical exception to the potential resistance of native trees to insect infestations. The emerald ash borer is a non-native insect. Since we cannot usually predict such infestations and the benefits of planting native trees greatly outweighs the likelihood of an epidemic of likewise proportions, we still recommend planting native species over non-natives whenever possible. For the moment, however, we do not recommend planting ash species (*Fraxinus* species) in Ft. Atkinson.

* Species that bear edible fruit.

Figure 2.17 - Google street view of Sherman Ave. where it crosses the Glacial River Trail. Bike lanes connect to downtown.

Figure 2.18 - Google street view of Madison Ave. where it crosses the Glacial River Trail. Bikes are protected from cars by yield signs, but there is little to invite them to downtown

CONNECTIVITY: ANALYSIS

Fort Atkinson can encourage foot traffic in their downtown and promote a healthier community by providing more resources for bicyclists. Fort is fortunate to have the Glacial River Trail running through it, connecting downtown Fort to the towns of Jefferson, to the north, and Milton, to the south, a stretch of over 17 miles. Providing Fort residents with safe and easy access to this trail and the rest of the town could help stimulate local businesses, reduce carbon emissions, and promote a healthier community.

Communities that support bicycle users can see many economic benefits. Easy and accessible biking through a town can increase out-of-town visitors, boost foot traffic through their shopping districts, and reduce health costs. Making biking easy and safe in Fort Atkinson may encourage more families to spend evenings and weekends downtown, socializing with neighbors and patronizing restaurants and shops.

As bikes replace cars as a means of transportation, the negative impacts of car traffic (emissions, pollution, noise, congestion, safety hazards etc.) can be reduced. Bikeable and walkable downtowns are a good way to encourage human-scale movement through town, which can improve social relationships between residents.

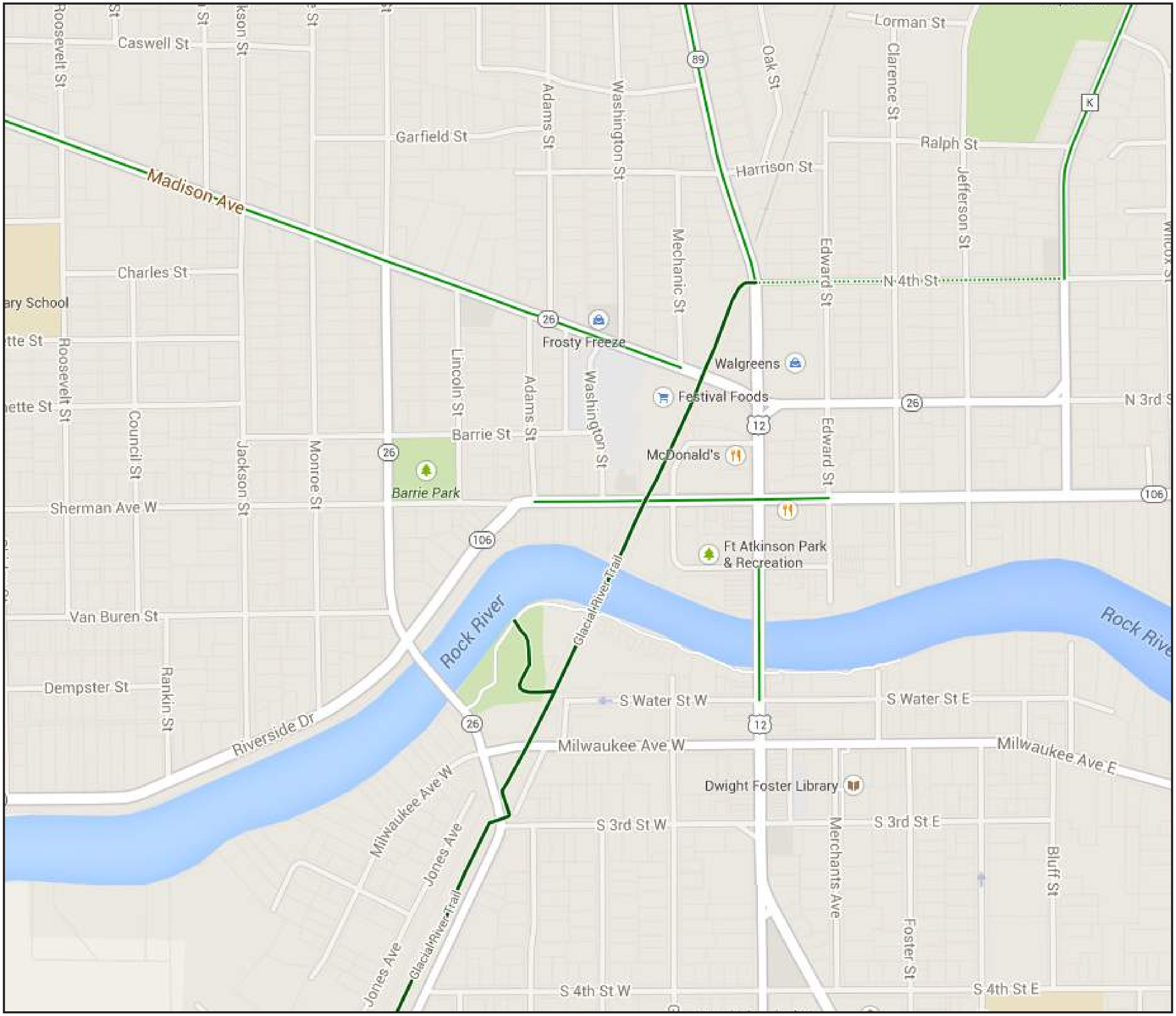


Figure 2.19 - Google Maps view of bike friendly streets in Fort Atkinson
Dark Green: Trails | Light green: Dedicated Bike Lane | Dotted: Bike Friendly road

Figure 2.20 - Simple bike lane, using only paint to separate car and bicycle traffic

Figure 2.21 - bike boxes provide a safe place for bicycles to use an intersection

CONNECTIVITY: RECOMMENDATIONS

Safe and Accessible Bike Lanes:

Creating designated bike lanes will help cyclists be safer and more visible on the road. Increasing bike lane visibility with colored paint or a different material can help both cyclists and motorist know whose lane is whose. Ideally, the bike lane would be placed on the right side of the on-street parking, to reduce door collisions (see example). Bike lanes can come in a variety of designs, from simple and easy to install, to very elaborate. One simple, yet effective way of making clear, highly visible bicycle lanes is using brightly colored paint (see figure). To provide bikes with an even safer travel route, the bicycle lane can be separated from the car traffic using a physical barrier.

Care should be taken to ensure that bike lanes provide continuous connection between destinations (bike parking, trails, the library, etc.). Forcing bikers to leave a safe zone to for even short distances can deter use.

Bike Racks:

Installing convenient and visible bike racks will allow cyclers to leave their bikes to walk around downtown Fort to shop or dine. An abundance of bike racks may help encourage people to ride their bicycles for day trips into town, because they know they will find a safe and legal place to park their bike. Signage should be placed close to the Glacial River Trail to tell riders that bike racks are available in town.

Figure 2.22- Example of an urban bike rack.

Figure 2.23 - Example of a self service bike repair station.

Self-Service Bike Repair Stations:

A self-service bike repair station is a great amenity to provide for Fort residents or out of town visitors. Being able to make quick, simple repairs to their own bikes may increase the number of people choosing to ride bikes through Fort Atkinson, because they know that quick, convenient repairs are available to them at no cost.

Figure 2.24 - from BicycleDutch's youtube video "Junction design the Dutch - cycle friendly – way" illustrating an intersection that is safe for bikes and pedestrians

Figure 2.24 - Example of woodland storybook pocket park for library lot

PUBLIC SPACE: ANALYSIS & RECOMMENDATIONS

Potential for Pocket Parks or Community Event Spaces:

In addition to several small spaces along Fort's main strip of Highway 12, there are two unused lots within our project zone that could serve as wonderful community spaces. The lot next to the library and the large open lot at the corner of Madison Avenue and Highway 12 could serve as semi-permanent to temporary community zones to offer more green amenities to the people of Fort Atkinson.

POCKET PARKS: FORT'S HIGHWAY 12 AND LIBRARY LOT:

Pocket parks are a great way to utilize small empty lots within the city. They can serve as a variety of things depending on what needs exist—a tiny urban forest, an

Figure 2.25 - this sitting space allows for playing chess or eating lunch, could be used in front of city hall could be used in front of city hall or other small seating areas along Hwy 12

urban garden, a reflection garden, a place to sit while waiting for a ride or during lunch hour. They can be permanent or temporary. They provide outdoor space for neighbors to run into each other and interact.

The green lot next to the library (above, left) could serve as both a community garden and a storybook garden. Putting in elements that could be related to nature-centric children's literature could make it a place useable for library activities, whether it be a read-aloud space or a place to reenact stories they've just read. Books such as Charlotte's Web, The Tiny Seed, The Very Hungry Caterpillar, Where the Wild Things Are, etc, could come to life in a small, whimsical space like that. On a wider community scale, it could be a place to creatively grow vegetables, fruit trees and cut flowers for citizen use, as it is a rather sunny spot. Or it could be filled with native species that could serve as an

Figure 2.26- A drive-in space would afford community events and performances

educational natural zone for the town.

Community Multi-Use Space: Hwy 12 and Madison Avenue

Being the entrance to the city, the lot on the corner of Hwy 12 and Madison Avenue could serve as a statement to tourists and residents of what exciting things are happening in town. It could be a multi-use space, especially since it is partially paved. Since it will hopefully be developed in the near future, its use should be minimally invasive. However, since it does contain green strips along the perimeter, it could serve as a location for increasing tree diversity in the city and planting some large native trees.

Urban Agriculture:

Urban agriculture can take many forms. Because of the temporary nature of the space and its multi-use functionality potential, gardens on wheels would work well. Many urban dwellers are taking to this technique to track the sun's rays, but movability has several positives. They can be rearranged for events. Raised beds are best for greyfield (paved) sites to avoid contaminants and to use the types of soils you want. The boards used to build them can be

Figure 2.27 - Movable gardens would provide food and aesthetically pleasing, flexible event space

designed and decorated as a community art project or be "sponsored" by local businesses that can advertise on them. The use of raised garden beds on a flat paved surface make them highly handicapped accessible. Plus, the food or flowers grown can be used for community events, given to local food banks, or be free for the public. It would be eye-catching from the people driving by and also a good platform for activity for residents and tourists.

Farmer's Market:

If the farmer's market currently being held on Milwaukee were to grow, this would be a perfect space for it. It would allow for more vendors, could support a stage for entertainment and would be easier to find for those who don't live in the Fort or draw in those just driving through on Hwy 12.

Drive-in Event Space:

It could also serve as a drive-in movie space or outdoor concert space that could be constructed and taken down with minimal effort. Trees planted along the perimeter would help make this more of a defined area.

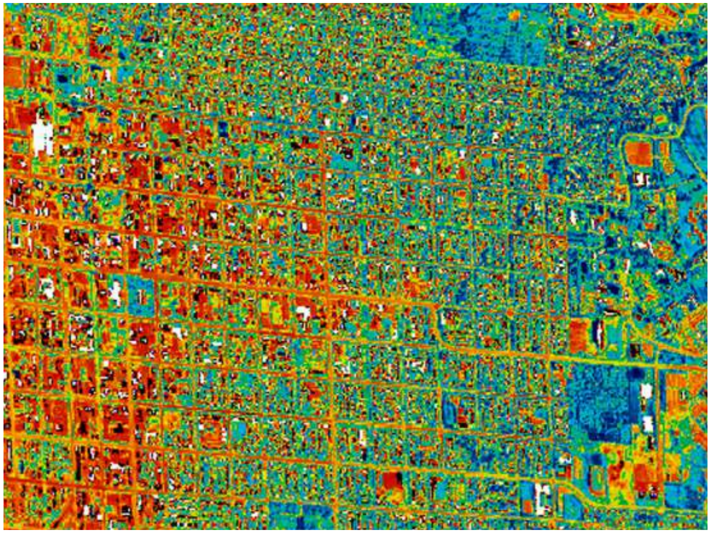


Figure 2.28 - Aerial image illustrating the Urban Heat Island effect in Salt Lake City, Utah. White areas are approximately 160°F. Blue and green areas (mostly mountains, rivers, and urban parks) are cooler, around 85-96°F.

Figure 2.29 - Illustration of the Heat Island Effect of pavement. The color ramp on the right shows the temperatures that correspond to the different temperatures.

GREEN ROOFS & URBAN HEAT ISLANDS

Heat Island Effects

The Urban Heat Island effect is a complicated but well-documented phenomenon. It occurs when urban or suburban areas become hotter than the surrounding countryside: dark-colored pavements and roofs increase temperatures, tall buildings prevent wind from carrying the heat away, and heat vented from air conditioners and restaurants is concentrated.

Once again, street trees can have a positive effect on this problem. Plants help cool their surroundings in two ways: by shading surfaces below them and by evapotranspiration (basically, sweating). All plants – grasses, flowers, shrubs, and trees – cool their surroundings using evapotranspiration. However, shading provides a much larger cooling effect, and only large trees can cool significant areas this way. Often, any Green Infrastructure that increases permeability will also reduce summer temperatures: permeable surfaces hold moisture, which will help cool the air when it evaporates on hot days. Using light-colored pavements and roofs can also help by reflecting more incoming heat, but they don't have the multifunctionality of other methods.

High summer temperatures can be a health concern, and they can discourage people from spending time outdoors. Summer heat also contributes significantly to energy consumption: peak summer energy use can increase by 1.5 to 2% with every 1° of temperature increase.

A smaller town like Fort Atkinson may seldom experience a noticeable heat island effect, but any Green Infrastructure touted as alleviating this condition will also help reduce summertime highs.

Figure 2.30 - extensive green roof on the Education Building at the University of Wisconsin-Madison.

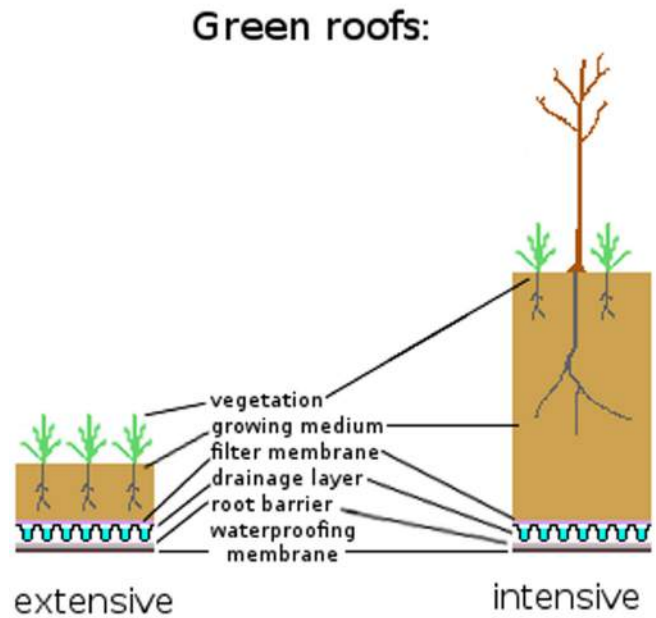


Figure 2.31 - comparison of Intensive and Extensive Green Roof construction.

Green Roofs

A ‘green roof’ is simply a roof with plants growing on it. There are many different types: green roofs can be flat or sloped; they can be ‘intensive’ (with deeper soils or planters and taller plants) or ‘extensive’ (with very shallow soil and low-growing plants); they can be aesthetic or utilitarian; publically accessible or not; and they can even be used to grow food. Green roofs can be installed on private homes, apartment buildings, or large flat roofs, and while intensive roofs often require specialized architecture to support the extra weight, lighter extensive roofs can often be retrofitted onto buildings that were not built for them. The initial and ongoing cost of a green roof will vary, but some types of installations can pay for themselves by extending the life of the underlying roof membrane. They can also be combined with solar panels.

Green roofs can reduce the urban heat island effect by replacing dark, dry roofs with lighter, moist vegetation; they also help insulate buildings, and can filter and slow stormwater runoff. For pollinators and birds, green roofs can be essential urban habitats, especially if they use native plants, and even utilitarian green roofs will improve the aesthetics of a cityscape. Specific green roof recommendations are beyond the scope of this document, but Fort Atkinson would benefit from encouraging their installation on public and private buildings.

Figure 2.32 - Impervious surfaces.

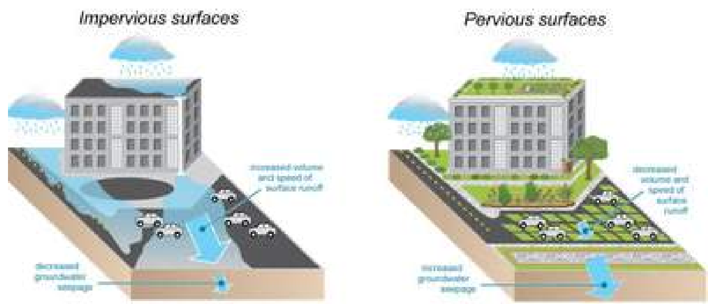


Figure 2.32 - Impervious surfaces graphic.

ANALYSIS - STORMWATER

Current Issue:

In our analysis of downtown Fort Atkinson, it was largely apparent that the proportion of impervious surfaces to permeable ones was greatly skewed towards the former. While this may not seem like an issue from certain perspectives, in the case of stormwater management, this is cause for concern.

Large amounts of impervious surfaces in the urban environment are, by and large, a detriment to the surrounding ecosystem and potentially hazardous for public health and safety. Impervious surfaces, as their name implies, are incapable of allowing substances to penetrate into the underlying soil. This means that all stormwater immediately becomes runoff, traveling down slopes, picking up pollutants and eroding unstructured soil surfaces.

The area's lack of vegetation only helps to compound the problem. With vegetation replaced by concrete surfaces, stormwater runoff flows unencumbered, surging and increasing the rate at which it picks up pollutants and erodes natural surfaces. These pollutants and suspended sediment eventually make their way into local water bodies, which negatively impact the ecosystem.

This introduction of pollutants and excess sediment may go unnoticed at first, but over time, the effects show themselves. Aquatic fauna populations die off, soils become compromised, and local resources, like Rock River, lose their value and habitability. It is this outcome that we hope to prevent with our design goals recommendations.

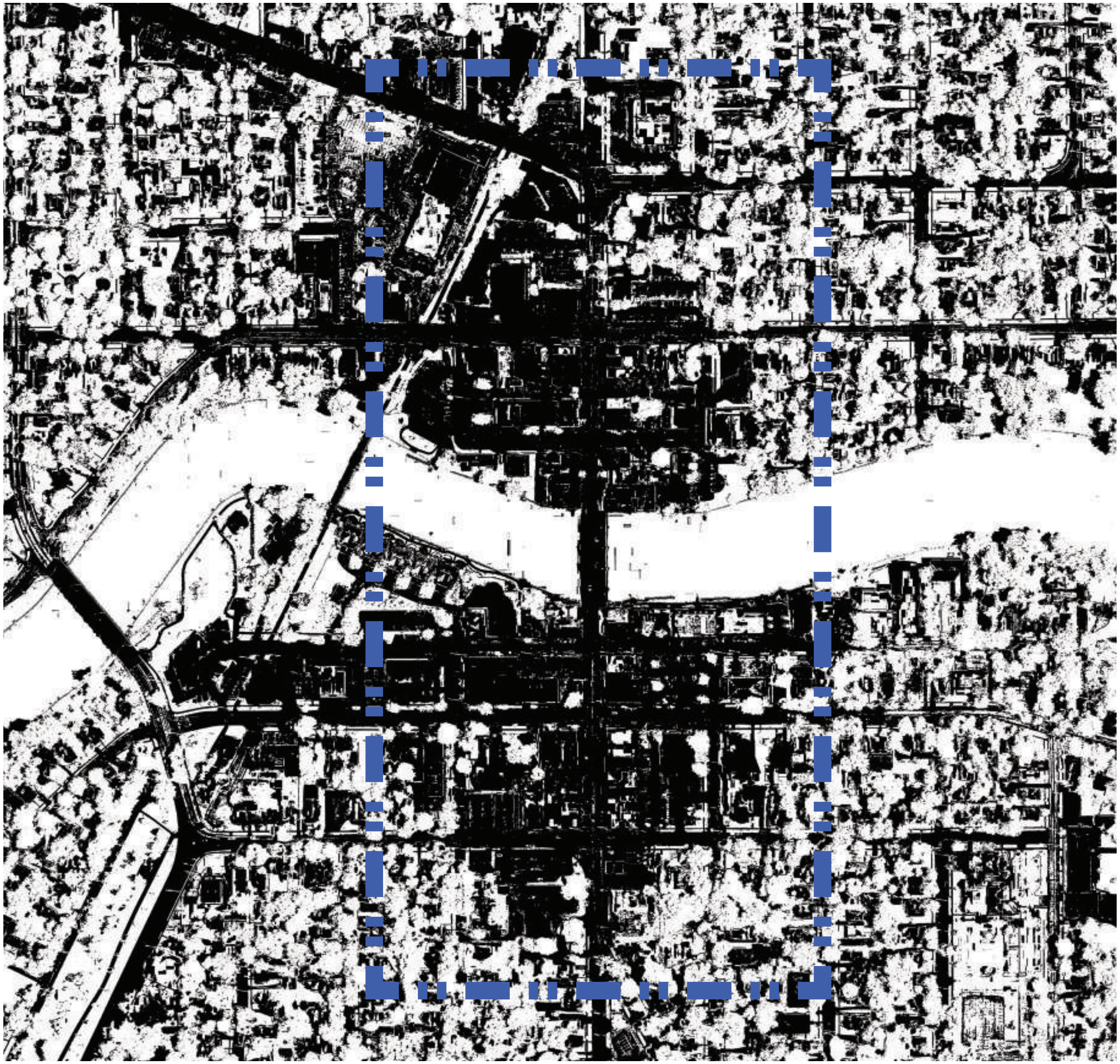


Figure 2.33 - Impervious Surfaces Map

Approximate Impervious Surface Cover, Fort Atkinson:

White on this map indicates vegetation cover in downtown Fort Atkinson. This is useful to know because groundwater infiltration is much higher for vegetated groundcovers. Knowing this, we can predict that darker areas - areas which are mostly paved - infiltrate much lower amounts of stormwater, contributing to stormwater problems.

Figure 2.34 - Bioretention curb cut for a parking lot.

Figure 2.35 - Example of a semi-intensive green roof.

RECOMMENDATIONS - STORMWATER

Design Goals:

These design goals consist of:

•Increasing the permeable to impervious surface ratio

•Detaining stormwater surges to reduce and prevent erosion and increase the effectiveness of management systems; and

•Increasing the biological activity throughout the runoff path and collection sites to encourage breakdown of harmful pollutants

Increasing the Permeable Surfaces:

One of the first courses of action that can be made is increasing the amount of permeable surfaces downtown. By increasing the amount of permeable surfacing in Fort Atkinson's downtown center, stormwater now has the potential to penetrate into the underlying soil, decreasing the chances of stormwater surges which pick up pollutants and erode unstructured soil surfaces.

Detaining Stormwater Surges:

Even with permeable surfaces, stormwater can only penetrate into the soil so fast. Implementing areas of detention, such as swales and basins, allows stormwater to collect and stops it from moving further down slopes. Here in these detention points, any eroded soil in suspension can settle and be dealt with accordingly. Furthermore, pollutants in suspension are kept from making it into larger bodies of water, preventing greater ecological harm and providing ample time for biological systems to remediate them.

Figure 2.36 - Water passing through porous pavement.

Figure 2.37 - Stormwater managment practices can be a center piece of the streetscape aesthetic.

Increase Biological Activity:

While many solutions involve a fair amount of engineering, one crucial solution to stormwater management practices is the introduction of biological activity in the form of vegetation and soil microbes. Vegetation plays a big role in preventing stormwater surging and the consequent soil erosion, providing both a buffer to slow down stormwater as it flows down slopes and structure to soils with their roots. Certain plant species are also extremely effective at remediating pollutants, taking them up from the soil and trapping them within their mass.

Soil microbes also play a significant role in remediation. Several species are known for breaking down pollutants into non-harmful by-products. So diesel, pesticides, and herbicides collected in detention basins or percolating through the soil may be broken down rather than remain.

Technological Implementations:

Considering the concerns of the site and the goals we would like to accomplish, we considered three technologies that could be implemented. First is the use of curbside biologically active swales. As we have discussed, these swales will serve to slow down and detain stormwater surges throughout downtown Fort Atkinson. These swales will utilize specifically chosen plants and microbes to filter and break down pollutants before they have a chance to reach Rock River. These swales will have the added effect of creating new and interesting aesthetics, the vegetation adding a new form and texture to the urban environment that will help to soften the existing hardscape and architecture.

Next would be the installation of infiltration trenches in strategic points downtown. These trenches are constructed using coarse stone and recycled concrete, most of which may come from redevelopment from the city. Giving low resistance to stormwater, infiltration trenches, as their name implies, provide points of entry for runoff to infiltrate into the soil. This would allow for considerable soil erosion and movement of pollutants.

Finally, the implementation of green roofs and green spaces throughout the city would allow for infiltration of stormwater at the source while simultaneously creating interesting spaces for human usage that increase the interest of the urban center.

Figure 2.38 - Street View Main Street & Sherman Avenue.

Figure 2.39 - Street View Main Street & Water Street.

ANALYSIS - STREETSCAPE

Hwy 12, also known as Main Street, is the main circulation route that connects downtown Fort Atkinson to Interstate 26. This analysis study will focus on the stretch of road between North Third Street and South Third Street East.

More of an emphasis is placed on catering to vehicular traffic than pedestrians. Wide driving lanes, on-street parking, and long crosswalk intersections that accommodate multiple turn lanes are all street characteristics that help to circulate traffic effectively. However, these street characteristics don't make for an inviting pedestrian environment.

An analysis of the adjacent Main Street streetscapes, which consist of the sidewalks and street terraces, conclude that they lack important elements that help to create pedestrian friendly environments.

The existing commercial, office and retail buildings along Main Street serve a great deal of economic significance to the Fort Atkinson Community. Enhancing the streetscape adjacent to these buildings will help to create more pedestrian friendly spaces, which will in turn attract more people to the downtown area and increase economic activity.

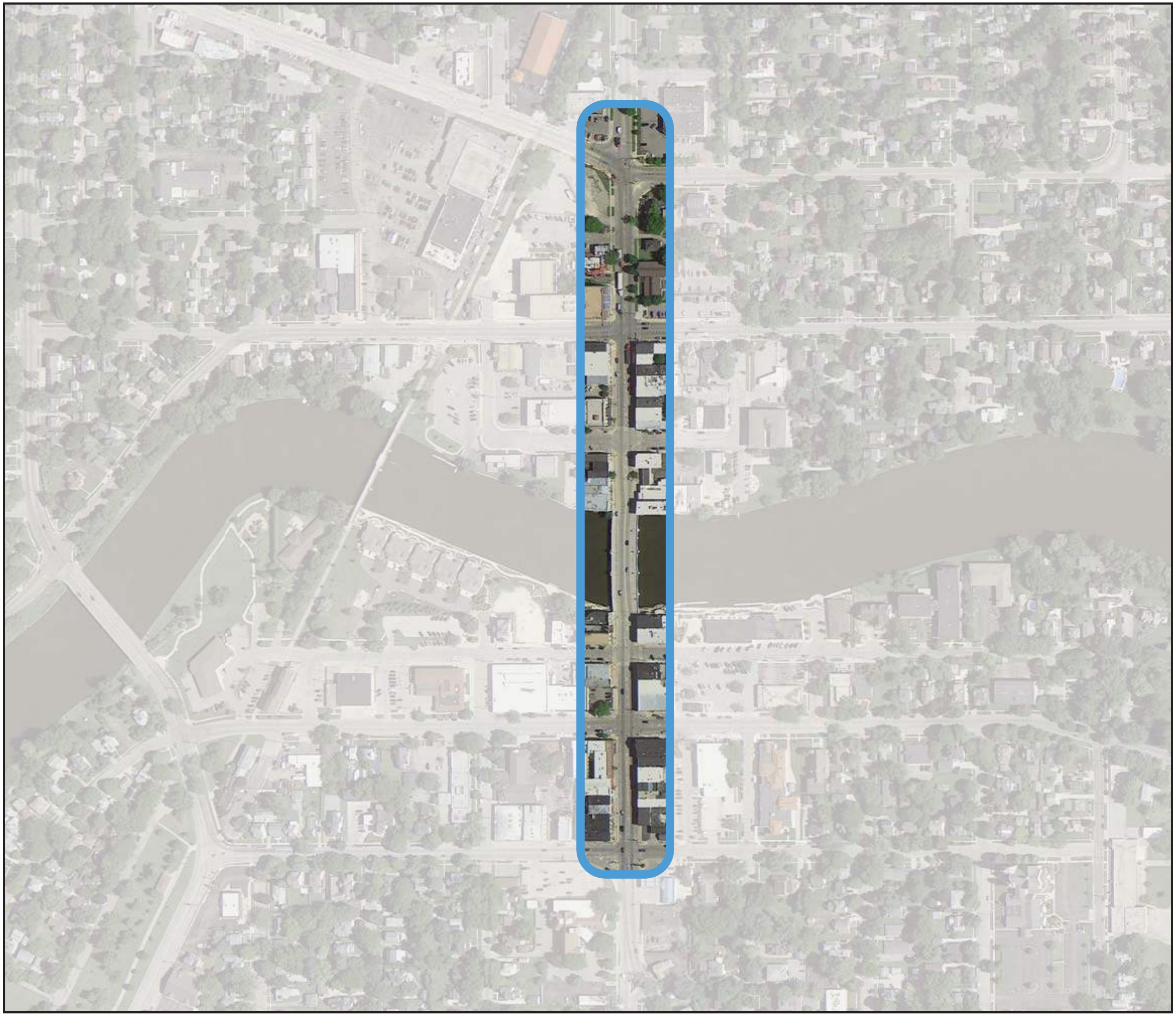


Figure 2.40 - Main Street Context Map

Figure 2.41- Site amenities.

Figure 2.42 - Bump outs.

RECOMMENDATIONS - STREETSCAPE

Recommendations for this particular section of Main Street focus on making the street more pedestrian friendly through the addition of varying streetscape and planning elements.

Site amenities such as benches, bike racks, trash receptacles, paving patters and constistent lighting features add an intricate site detail to the street and provides a cohesive street identity.

Bump outs along the street and at the street corners help to create more space for on street seating, shorten distances between crosswalks and also help to retain and filter storm water.

Canopy trees may be the most effective yet simple element to a strong streetscape design. Street trees allow for shade, help to define outdoor spaces and also provide a much needed natural aesthetic to the urban context..

Parklets could be used to replace potential on-street parking stalls. These are great spaces for people to socialize, work and eat. The best feature of parkelts are their ability to be moved. As seasons change, demand for parking changes as well, and during the coldest months, these parklets can be removed for extra parking.

On street seating creates a vibrant and active atmosphere, fostering community interaction. It also encourages people to stop for a coffee or get a bite to eat when heading through town. This is a low cost addition to a street scape that sees huge benefits in return.

Public art livens up an urban space. It creates interest as well a landmark element to make the space memorable and familiar. Again, this is a very low cost solution that makes a place, a place.

Figure 2.42 - Street trees.

Figure 2.43 - Parklet.

Figure 2.44 - On street seating.

Figure 2.45 - Public art.

CONCLUSION

- PATTERNS FOR URBAN ECOLOGY SOLUTIONS

Figure 3.00 - Fort Atkinson Photo

Figure 2.46 - Example of urban ecology typologies based on land-use.

PATTERNS FOR URBAN ECOLOGY SOLUTIONS

Urban ecology patterns refer to planned areas within an urban context where trees and other vegetation can be placed to increase ecological value on the site. It includes an integration of three elements: Fitness, Function and Space, which, when combined, create a visual schematic for communities to consider and employ to enhance urban spaces.

The following suggestions are best utilized as an ecological pattern book for planning purposes. The first step is to determine which urban spaces are to be examined.

Example of Urban People Spaces

- Buildings
- Roofs
- Parking lots
- Medians
- Bump-outs
- Sidewalks
- Parks
- Waterfronts
- Plazas

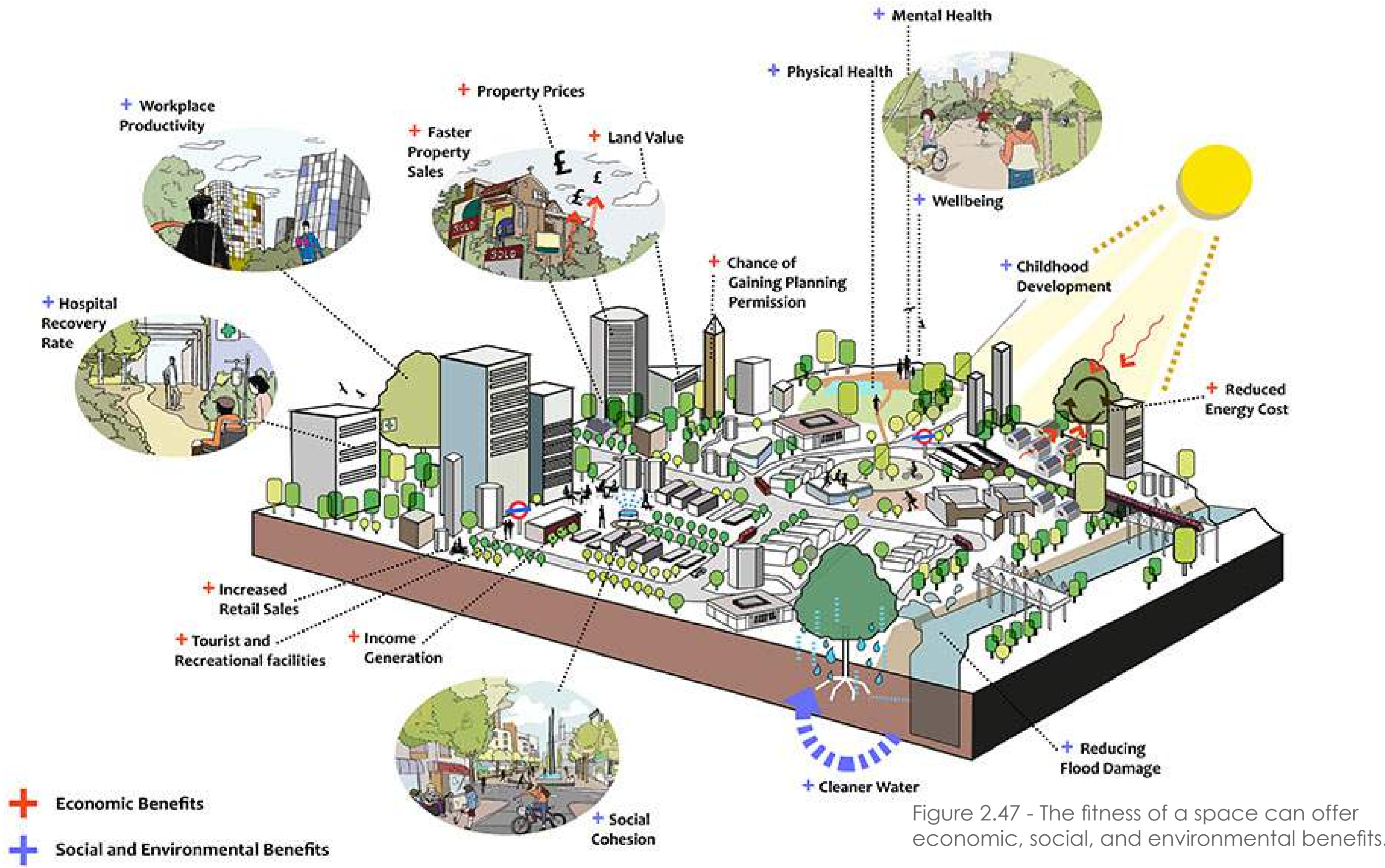


Figure 2.47 - The fitness of a space can offer economic, social, and environmental benefits.

Fitness

The fitness of an area relates to its ability to offer ecological, social and even economic benefits to its surroundings.

System fitness, for ecological purposes, takes into consideration and utilizes soil, water, air and biota, and the natural systems which they are associated with to collectively effect positive and enhanced benefits for humans and wildlife.

System fitness creates enriched habitats and resiliency for plant and animal species through offering ecosystem services. It includes increased food vitality for all species, including humans (such as urban agriculture). System fitness utilizes a combination of approaches to increase the health of: soils; atmosphere; nutrients; climate conditions; water and biota. It utilizes regenerative design to promote health & resiliency.

Four system fitness approaches are described and expanded upon, on the following pages, that aide the reader in determining which approach is best suited for their area of concern. These include, climate conditioning, loading & cycling, water amelioration, and resource cultivating.

Benefit	Reduces Stormwater Runoff											Improves Community Livability						
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture	Improves Habitat	Cultivates Public Education Opportunities
Practice																		
Green Roofs	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Maybe	Maybe	Yes	Yes
Tree Planting	Yes	Yes	Yes	Yes	No	Maybe	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Yes
Bioretention & Infiltration	Yes	Yes	Yes	Yes	Maybe	Maybe	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Maybe	No	Yes	Yes
Permeable Pavement	Yes	Yes	Yes	Yes	No	Maybe	Yes	Maybe	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes
Water Harvesting	Yes	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Maybe	Maybe	No	No	No	No	No	No	No	Yes

Yes   Maybe   No

Figure 2.48 - The benefits of green infrastructure.

Climate Conditioning

Climate conditioning includes strategies to reduce heat island effects. These include the capture, conveyance, or creation of cooling effects on site, such as:

- Shading from large canopy trees
- Evapotranspiration from large trees and vegetation
- Evaporation of pooling surface water
- Storage of water by increasing permeability of pavements and amending soils
- Cooling materials that reflect light
- Green roofs by offering coverage, water storage and evapotranspiration to cool the surrounding atmosphere

Loading & Cycling

Loading and cycling includes strategies to improve the health of soils, the atmosphere and biota. It includes:

Soil & Biota Health

- Nutrient loading by adding organic matter back into the soil
- Increasing porosity of soils through macro organisms and roots
- Providing structure through vegetation
- Infiltrating water with native vegetation with expansive root systems

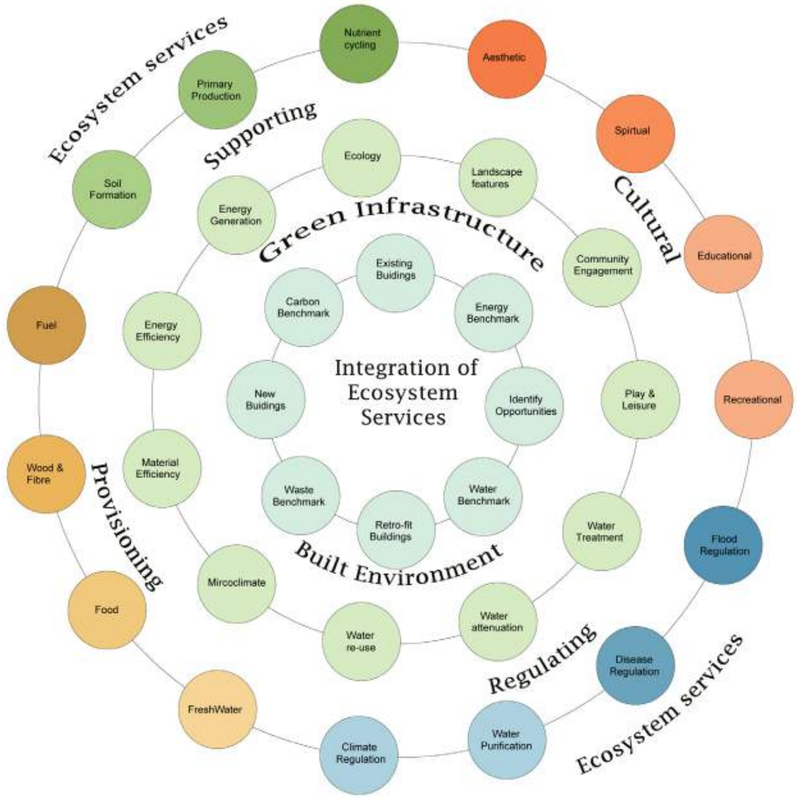


Figure 2.49 - Sustainable design through the integration of eco-system services are realized through green and blue infrastructure applications

- Removing dangerous substances and toxins through phyto-remediation

Atmosphere Health

- Mitigating toxic gases through phyto-remediation
- Providing clean air through non-petoleum based paving systems and natural landscaping of native vegetation

Water Amelioration

Water amelioration is utilized to improve, correct or enhance the flow and quality of water for use and benefit. It includes:

- Bio-retention areas to infiltrate and decrease peak flow volumes of storm water
- Bio-swales that convey water from highly sensitive areas and slowly infiltrate into the ground
- Street trees with subsurface systems that encourage root growth and health to store water.
- Green roofs that can re-use storm water and decrease peak flow volumes on site

Figure 2.50 - Example of approaches to reduce peak water volumes and increases infiltration.

Water Amelioration

Water amelioration is utilized to improve, correct or enhance the flow and quality of water for use and benefit. It includes:

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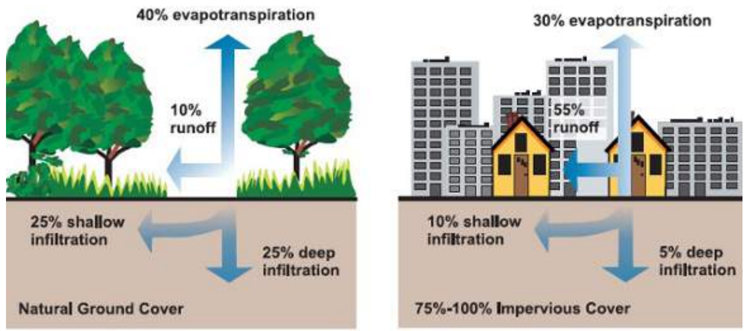

Figure 2.51 - Natural versus impervious water cycling.

Figure 2.52 - Design solutions that promote social, ecological, and cultural space.

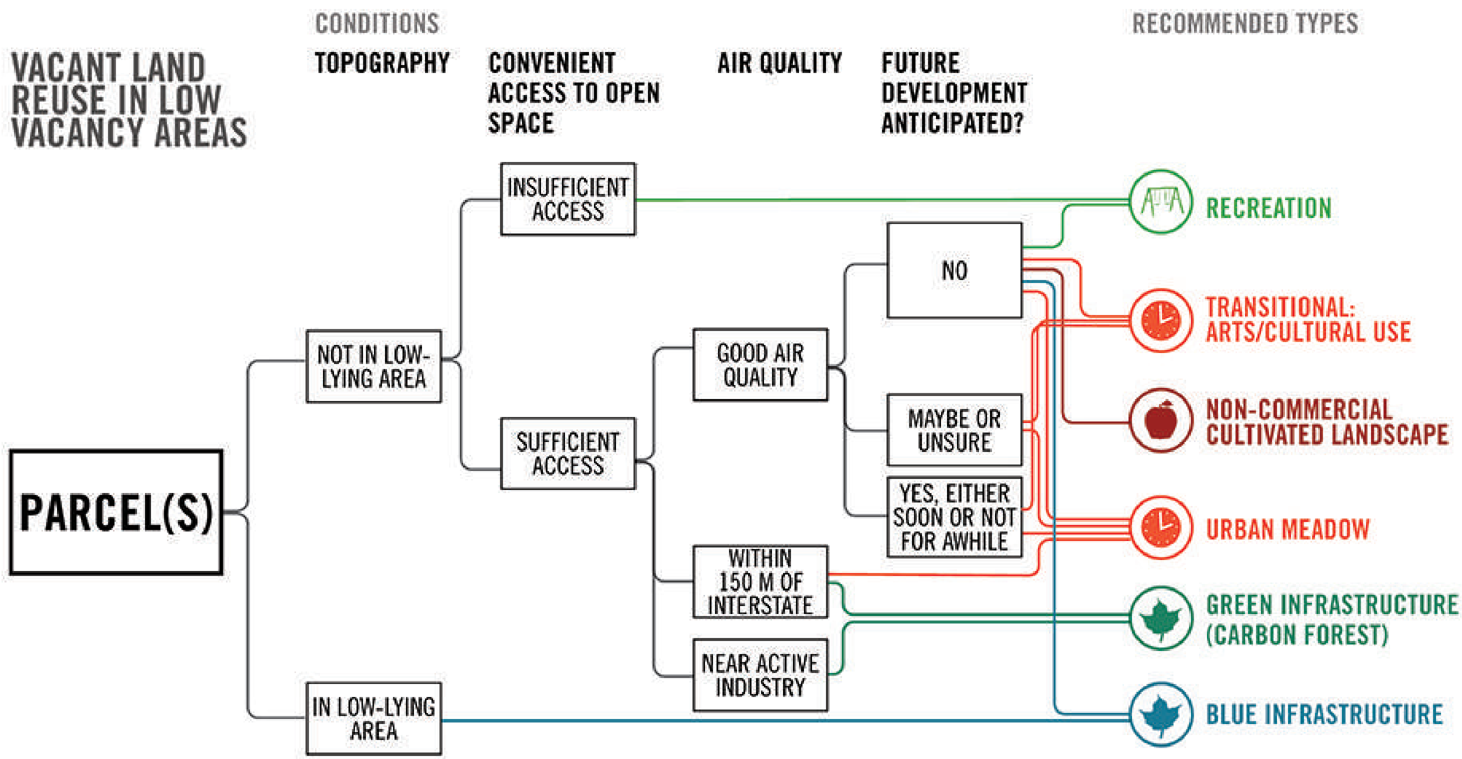

Figure 2.53 - An example of a systems approach to utilizing urban ecology

Resource Cultivating

Resource cultivating increases the natural resources on site for benefits of food, health, and materials. It includes:

- Urban agriculture systems that provide food for communities
- Large trees, such as Oaks which provide for habitat, food and other resources for wildlife
- Native plants that attract pollinators

Function

The function of a space is dependent upon its use. Design considerations that enhance the function of the space are often missed by planners. By providing for fitness and function, urban planners can apply design solutions, rooted in urban ecology, and based upon the expectations and goals for the site.

Bulleted below are a number of potential expectations that actively suggest movement, space and volume.

- Expand - lengthening a space by utilizing rhythm and

repetition, such as street trees adjacent to roads
- Close - ending or narrowing a space by placing a focal point at the end point, such as a large tree, or tall native grasses
- Permit - permitting entry by utilizing gateways, such as symmetric vegetation or built structures within bio-retentive areas, and linear elements at ground plane or wall plane, such as bio-swales or permeable pavers that lead users into the space
- Restrict - restricting entry by creating screens, such as, tall grasses placed in front of fences or restricted areas
- Cover - closing a space in from the ceiling plane by using large canopy trees
- Open - opening a space up for legibility by utilizing low vegetation or permeable pavers
- View - creating and holding user views through creative placement of specimen trees and creative pruning that creates windows for viewing
- Hide - hiding or screening views, such as tall grasses
- Move - spaces for transitioning, such as linear elements in vegetation or permeable pavers
- Stop - spaces that encourage long stays by providing for interest and density through a combination of trees, vegetation, and seating that offer refuge and prospect
- Delay - spaces that encourage temporary stays by providing seating with no backs, and linear elements

Figure 2.54 - A large tree canopy creates a ceiling plane for coverage
Credit: Nancy Chachula

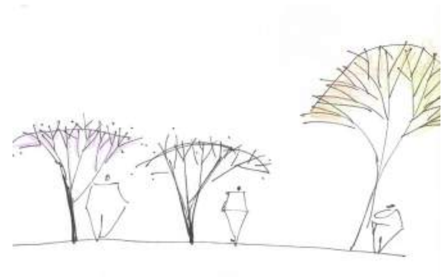

Figure 2.55 - The shape and structure of trees can provide for coverage, openess, or repetition and rhythm
Credit: Nancy Chachula

Figure 2.56 - Trees can become gateways welcoming users to a space
Credit: Nancy Chachula

Figure 2.57 - Trees and vegetation placed alongside sidewalks can lengthen, screen or create transition while also capturing stormwater
Credit: Nancy Chachula

Figure 2.58 - Trees can optimize views by offering a frame for viewers
Credit: Nancy Chachula

Figure 2.59 - Trees can add interest and density for urban environments
Credit: Nancy Chachula

APPENDIX

- STREET TREE INVENTORY
- FIGURE NUMBERS

Figure 3.00

Street Tree Inventory: Ft. Atkinson
Total Inventory

Tree Species	Street	Planting Method
Thuja occidentalis	Glacial River Bike Trail (N)	Ground
Gleditsia triacanthos	GRBT & Madison Ave (S)	Ground
Ulmus americana	GRBT (S)	Ground
Acer rubrum	GRBT (S)	Ground
Juglans nigra	GRBT (S)	Ground
Prunus	Empty lot (McDonald's)	Strip
Prunus	Empty lot (McDonald's)	Strip
Lonicera X bella	Empty lot (McDonald's)	Strip
Prunus cerasifera 'Newportii'	GRBT (S)	Ground
Pyrus calleryana 'Autumn Blaze'	GRBT (S)	Ground
Pinus nigra	GRBT (S)	Ground
Aesculus glabra	GRBT (S)	Ground
Tilia americana 'Redmond'	GRBT (S)	Ground
Prunus nigra 'Princess Kay'	GRBT (S)	Ground
Pyrus calleryana 'Autumn Blaze'	Back entrance to Vymac	Ground
Pyrus calleryana 'Autumn Blaze'	Back entrance to Vymac	Ground
Pyrus calleryana 'Autumn Blaze'	Back entrance to Vymac	Ground
Malus 1	Behind McDonald's	Strip
Malus 1	Behind McDonald's	Strip
Malus 1	Behind McDonald's	Strip
Malus 2 (big fruit)	North of McDonald's	Strip
Gleditsia triacanthos	North of McDonald's	Strip
Malus 1	North of McDonald's	Strip
Acer platanoides	South of McDonald's	Ground
Acer platanoides	South of McDonald's	Ground
Acer platanoides	South of McDonald's	Ground
Ginkgo biloba	N 3rd St and Main	Ground
Betula nigra	N 3rd St (S)	Ground
Gleditsia triacanthos	N 3rd St (S)	Ground
Gleditsia triacanthos	N 3rd St lot	Strip
Gleditsia triacanthos	N 3rd St lot	Strip
Gleditsia triacanthos	N 3rd St lot	Strip
Acer rubrum	Main St (E)	Terrace
Acer rubrum	Main St (E)	Terrace
Acer rubrum	Main St (E)	Terrace
Acer rubrum	Main St (E)	Terrace
Thuja occidentalis	Main St (E) & Sherman Ave E (N)	Ground
Acer rubrum	Main St (E) & Sherman Ave E (N) Lot	Strip
Acer rubrum	Main St (E) & Sherman Ave	Strip

	E (N) Lot	
Prunus	Main St (E)	Sidewalk Pit
Acer ginnala	N Water St E (N)	Terrace
Acer ginnala	N Water St E (N)	Terrace
Acer ginnala	N Water St E (N)	Terrace
Acer ginnala	Main St (E)	Sidewalk Pit
Prunus	Main St Pocket Park (W)	Pocket Park
Prunus	Main St Pocket Park (W)	Pocket Park
Acer platanoides	Main St (W) Municipal Bld	Sidewalk Pit
Acer platanoides	N Water St W (N)	Terrace
Acer platanoides	N Water St W (N)	Terrace
Acer platanoides	N Water St W (N)	Terrace
Acer platanoides	Main St (W)	Sidewalk Pit
Populus deltoides	In NW corner of bridge	Riverbank, volunteer
Populus deltoides	In NW corner of bridge	Riverbank, volunteer
Populus deltoides	In NW corner of bridge	Riverbank, volunteer
Evergreen Shrub	S of bridge, E riverwalk	Surrounded by Pavement
Thuja occidentalis	S Water St E (N)	Surrounded by Pavement
Gingko biloba	S Water St E (N)	Pocket Park
Gingko biloba	S Water St E (N)	Pocket Park
Malus 3	S Water St E (N)	Pocket Park
Prunus	S Water St E (N)	Near Building
Gleditsia triacanthos	Parking Lot between S Water St E & Milwaukee Ave E	Surrounded by Pavement
Gleditsia triacanthos	Parking Lot between S Water St E & Milwaukee Ave E	Surrounded by Pavement
Gleditsia triacanthos	Parking Lot between S Water St E & Milwaukee Ave E	Surrounded by Pavement
Gleditsia triacanthos	Parking Lot between S Water St E & Milwaukee Ave E	Surrounded by Pavement
Gleditsia triacanthos	Parking Lot between S Water St E & Milwaukee Ave E	Surrounded by Pavement/Pocket Park "Love Where you Live"
Acer ginnala	Milwaukee Ave E & Main St	Sidewalk Pit
Ginkgo biloba	Milwaukee Ave E (N)	Sidewalk Pit
Acer ginnala	Milwaukee Ave E (N)	Sidewalk Pit
Gleditsia triacanthos	Milwaukee Ave E (N) in front of Assoc. Bank	Ground
Betula nigra	Milwaukee Ave E (N) in front of Assoc. Bank	Ground
Caragana arborescens 'Pendula'	Milwaukee Ave E (S)	Surrounded by Pavement
Caragana arborescens 'Pendula'	Milwaukee Ave E (S)	Planter to W of Post Office Door
Rhus typhina	Milwaukee Ave E (S) behind 1st *Salix*	Strip
Pyrus calleryana 'Autumn	Milwaukee Ave E (S) behind	Strip

Blaze’	*Rhus*	
Pyrus calleryana ‘Autumn Blaze’	Milwaukee Ave E (S)	Planter to E of Post Office Door
Gleditsia triacanthos	Milwaukee Ave E (S) & Merchant Ave	Ground
Acer platanoides	Milwaukee Ave E (S) & Merchant Ave	Ground
Fraxinus pennsylvanica	Milwaukee Ave E (S) & Merchant Ave	Ground
Betula papyrifera	Milwaukee Ave E (S) & Merchant Ave	Ground
Fraxinus pennsylvanica	Milwaukee Ave E (S) & Merchant Ave	Ground
Thuja occidentalis	N-S axis behind Post Office Parking lot N of S 3rd St	Strip
Pyrus calleryana ‘Autumn Blaze’	S 3rd St (N)	Surrounded by Pavement
Pyrus calleryana ‘Autumn Blaze’	S 3rd St (N)	Surrounded by Pavement
Prunus	Main St (E)	Sidewalk Pit
Acer ginnala	Main St (E)	Sidewalk Pit
Prunus	Merchant Ave (E) Library	Ground
Pyrus calleryana ‘Autumn Blaze’	Merchant Ave (E) Library	Ground
Prunus	Merchant Ave (E) Library	Ground
Ginkgo biloba	Merchant Ave (E) Library	Ground
Acer rubrum	Merchant Ave (E) Library	Ground

Acer saccharum	S 3rd St E (N) Library	Terrace
Acer saccharum	S 3rd St E (N) Library	Terrace
Acer saccharum	S 3rd St E (N) Library	Terrace
Acer rubrum	S 3rd St E (N) Library	Ground
Prunus	Milwaukee Ave E (S) Old Church	Ground
Acer rubrum	Milwaukee Ave E (S) Old Church	Ground
Prunus	Main St (W)	Sidewalk Pit
Gingko biloba	Main St (W)	Sidewalk Pit
Acer platanoides	Milwaukee Ave W (S)	Build up Square Planter in Sidewalk
Acer platanoides	Milwaukee Ave W (S)	Build up Square Planter in Sidewalk
Acer ginnala	Milwaukee Ave W (N)	Terrace
Gleditsia triacanthos	Milwaukee Ave W (N) & Main St (W)	Planter/Pocket Park in Union Bld Parking lot
Acer ginnala	Main St (W) in front of Hallmark	Sidewalk Pit
Prunus	S Water St W (N) Near Carpe Cafe	Sidewalk Pit
Prunus	S Water St W (N) Near Carpe Cafe	Sidewalk Pit

Fort Atkinson Tree Inventory; Total Species Present

	Tree Species	Number Present
1	*Acer ginnala*	9
2	*Acer platanoides*	11
3	*Acer rubrum*	10
4	*Acer saccharum*	3
5	*Aesculus glabra*	1
6	*Betula nigra*	2
7	*Betula papyrifera*	1
8	*Caragana arborescens* 'Pendula'	2
9	*Fraxinus pennsylvanica*	2
10	*Gingko biloba*	6
11	*Gleditsia triacanthos*	14
12	*Juglans nigra*	1
13	*Malus* 1	4
14	*Malus* 2	1
15	*Malus* 3	1
16	*Pinus nigra*	1
17	*Populus deltoides*	3
18	*Prunus*	15
19	*Prunus nigra* 'Princess Kay'	1
20	*Pyrus calleryana* 'Autumn Blaze'	9
21	*Rhus typhina*	1
22	*Thuja occidentalis*	4
23	*Tilia americana* 'Redmond'	1
24	*Ulmus americana*	1
25	*Prunus cerasifera* 'Newportii'	1

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