HOMER ADVISORY PLANNING COMMISSION
491 E PIONEER AVENUE
HOMER, ALASKA

OCTOBER 17, 2018
6:30 PM, WEDNESDAY
COWLES COUNCIL CHAMBERS

NOTICE OF MEETING
WORKSESSION AGENDA

1. **CALL TO ORDER, 5:30 P.M.**

2. **REGULAR AGENDA**

3. **SR 18-71 Green Infrastructure**
   - **Visitor - Cook Inlet Keeper's Bob Shavelson or Sue Mauger are expected to be in attendance for the green infrastructure discussion and to answer questions.**
   - **Complete the community scoping worksheet (pgs. 17-26, "Tackling Barriers to Green Infrastructure")**
   - **Discuss the section on auditing community codes and ordinances (pgs. 27-51)**

4. **PUBLIC COMMENTS**
   The public may speak to the Planning Commission regarding matters on the work session agenda that are not scheduled for public hearing or plat consideration. (3 minute time limit).

5. **COMMISSION COMMENTS**

6. **ADJOURNMENT, 6:30 P.M.**

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 18-71

TO:	Homer Advisory Planning Commission
FROM:	Rick Abboud, City Planner
DATE:	October 17, 2018
SUBJECT:	Green Infrastructure

Introduction

The Commission has requested that green infrastructure become a priority on the worklist. Last meeting we reviewed a staff report and had a discussion about serval aspects of green infrastructure. As a result, it was determined that the commission needed more information about green infrastructure and ideas that might identify possible project(s)/actions.

Analysis

I have invited Cook Inlet Keeper to speak to the Commission about green infrastructure in Homer. I have also contacted Homer Soil & Water Conservation District for input on partners with local knowledge.

I have also reviewed Alaska Clean Water Action Grants. The grant period is two years. The next application deadline is November 5, 2018 for a grant period of approximately March 2019 through February 28, 2021. There will not be another full solicitation until fall of 2020. Grant proposals are solicited for projects that will address waterbody specific, stewardship (statewide or regional) and marine beach actions for priorities previously identified in strategic planning documents. ACWA's goal is to support projects that lead to local stewardship of waters, the recovery of polluted waterbodies, and the protection and maintenance of waterbodies at risk of degradation.

Staff Recommendation

Ask question of presenter and further review *Tackling Barriers to Green Infrastructure*.

Attachments

Wisconsin Sea Grant With Support From The NOAA Coastal Storms Program. (2013) *Tackling Barriers to Green Infrastructure;* Foreword, Background, Introduction, and What You Need to Know Before the Audit: Key Strategies and Common Barriers (pgs. 17-51). Retrieved from http://seagrant.wisc.edu/Home/Topics/CoastalCommunities/Details.aspx?PostID=2462.

HOW TO AUDIT LOCAL CODES AND ORDINANCES

There are three main steps in the local codes and ordinances audit:

1. **Community scoping** In this step, get to know how your community's experiences, attitudes and preferences can affect efforts to implement green infrastructure. You will explore your community's identity as related to aesthetics and culture and look for opportunities to build green infrastructure support as the results of the audit emerge.
2. **Audit your community's codes and ordinances** Using the audit section, assess whether specific regulations are supportive (a practice is encouraged or required), prohibitive (a practice is not allowed), ambiguous (confusing) or absent (nothing is stated, for or against) regarding the use of green infrastructure. The questions are organized by code, policy and operational topics where barriers to green infrastructure practices are commonly found. The grading system will help identify which codes and ordinances pose the biggest barriers.
3. **Prioritize recommendations and develop a strategy for adoption** Use the scoping information from step 1 along with the results of the audit to guide prioritization of recommended code revisions and amendments. This will help you develop a strategy that best fits the needs of your community and is met with greater acceptance.

Community Scoping: Get to Know Your Community

Understanding green infrastructure in the context of your community and its culture is central to making successful changes to your local regulations that will enable and promote the use of green infrastructure.

The effects of local regulations are partly a result of what is written in the code — the language itself — but also partly a function of how the community's elected and appointed officials, staff and developers interpret the code during the review process. Perceptions about and experiences with green infrastructure from any sector of your community can aid or thwart efforts to adopt code and ordinance amendments.

The background information you collect in this step is likely to indicate where you may encounter pushback and help you develop a strategy to counter it. This information will also help you identify natural allies — individuals, groups or businesses — who might be supportive in moving your community toward greater green infrastructure acceptance and implementation.

In addition, knowing your community's identity is critical to ensure that changes to local regulations will incorporate and build upon the preferences and priorities of the community. Green infrastructure can then be framed as a strategy to help the community achieve many broader goals.

The questions on the following worksheet will provide valuable background information about your community in the context of green infrastructure implementation. This worksheet will help identify obstacles, opportunities for troubleshooting and the most logical codes to prioritize for revisions.

City of Port Washington Wastewater Treatment Plant green roof

COMMUNITY SCOPING WORKSHEET

Investigating concerns about or objections to green infrastructure can help you understand why a community may be hesitant to implement green infrastructure. A dialogue about these issues can give you critical information regarding the community's experience with green infrastructure.

Community Planning

1. Has a comprehensive plan been adopted for the community?
   ☐ Yes ☐ No

   If yes, how are the community's natural resources addressed in the comprehensive plan? _____

   _____

   _____

   _____

   If yes, is there specific attention to the community's water resources in the comprehensive plan?
   ☐ Yes ☐ No

   If yes, is green infrastructure implementation listed as a key element for implementation?
   ☐ Yes ☐ No

2. Has your community taken part in the development of a watershed restoration or other similar plan?
   ☐ Yes ☐ No

3. Does the community's hazard mitigation plan identify green infrastructure as a mitigation activity?
   ☐ Yes ☐ No

Natural Assets

1. What are the natural resources of your community?
   - ☐ Rivers
   - ☐ Streams
   - ☐ Lakes
   - ☐ Public or private property with water frontage
   - ☐ Other important natural areas

2. Are those natural resources incorporated into the community's culture, such as for events?
   ☐ Yes ☐ No

   If yes, how? _____

   _____

   _____

   _____

3. Are there impaired resources, vacant lots or sites (e.g., degraded wetlands/shorelines, contaminated sites, flood-prone areas) that would be good targets for remediation or restoration?
☐ Yes ☐ No

_____

_____

_____

If yes, would green infrastructure be suitable for these sites (e.g., stormwater infiltration may NOT be feasible on a brownfield redevelopment)?
☐ Yes ☐ No

If yes, these can often be good sites to demonstrate new ideas and practices.

4. Is there public access to local rivers, lakes and natural areas?
☐ Yes ☐ No

If yes, where and what type? _____

_____

_____

_____

Hazards

1. Is your community challenged with any of the following flooding issues?
☐ Basement backups
☐ Wet basements
☐ Street flooding
☐ Stream or river overflow
☐ Ponding in yards and green spaces
☐ Other_____

2. Have stormwater outfalls, culverts and bridges been surveyed for potential pollution issues?
☐ Yes ☐ No

3. Does your community experience beach or swimming area closures after storms due to high bacteria levels?
☐ Yes ☐ No

If yes, are the sources (or potential sources) of bacteria documented or understood?
☐ Yes ☐ No

4. If streams or rivers are within your community's boundaries, are they on the state's 303(d) list of impaired and threatened waters[7]?
☐ Yes ☐ No

5. Does your community have issues with bluff or ravine erosion?
☐ Yes ☐ No

Community Identity and Character

1. Is being "green" attractive to new people moving into your community?
   ☐ Yes ☐ No

2. Does your community have any environmental, sustainability or nature-based designations?
   ☐ Yes ☐ No

   _____

   _____

   _____

3. Is your community a sister city to a city with water issues?
   ☐ Yes ☐ No

   If yes, name of the city and list its water issues: _____

   _____

   _____

   _____

4. Have other environmental initiatives been started in your community?
   ☐ Yes ☐ No

   If yes, what is their focus? _____

   _____

   _____

   _____

5. Do residents of your community like a homogeneous appearance to their neighborhoods or are individual residents' preferences tolerated or even celebrated?

   _____

   _____

6. Is turf grass the favored lawn cover or is there a more diverse approach to residential landscaping that can include native plantings, prairies and rain gardens?

   _____

   _____

Stormwater Regulations

1. Does the community have a stormwater utility?
   ☐ Yes ☐ No

   If yes, are the rates dependent on equivalent residential units (ERUs)?
   ☐ Yes ☐ No

   If yes, does the stormwater utility incentivize green infrastructure through the reduction of ERUs and the corresponding tax rate?
   ☐ Yes ☐ No

2. Is the stormwater ordinance up-to-date in accordance with state law?
   ☐ Yes ☐ No

3. Does the stormwater ordinance include green infrastructure practices as approved methods to address stormwater runoff in new development and redevelopment projects?
   ☐ Yes ☐ No

4. What amount of development (e.g., half an acre of new or redeveloped impervious surface, any site plan, an acre or more of new development) triggers the requirement for a developer to submit a stormwater management plan?

   _____

   When a stormwater development plan is required, are reviewers knowledgeable about green infrastructure?
   ☐ Yes ☐ No

   Is green infrastructure encouraged in the review process?
   ☐ Yes ☐ No

5. Is your municipality required to have coverage under a municipal separate storm sewer system (MS4) permit?
   ☐ Yes ☐ No

6. Does your community have total maximum daily load (TMDL) allocation requirements that it must meet?
   ☐ Yes ☐ No

Current Green Infrastructure Usage

1. Have residents installed rain gardens or rain barrels?
   ☐ Yes ☐ No

2. Have any neighborhood associations or other organizations initiated green infrastructure projects such as rain gardens or stormwater tree programs?
   ☐ Yes ☐ No

   If yes, please describe_____

   _____

   _____

   _____

3. Are there community gardens?
☐ Yes ☐ No

If yes, what's the water supply for irrigation?

_____

4. Are there formal or informal efforts to ensure maintenance of subdivision ponds or other private green infrastructure features?
☐ Yes ☐ No

5. Has your community implemented a downspout or foundation drain disconnection program?
☐ Yes ☐ No

If yes, is this encouraged by the local government, or simply allowed?

_____

If yes, who would respond to questions or provide technical information on drain disconnection?

_____

6. Does your community have an issue with inflow and infiltration?
☐ Yes ☐ No

Menomonee Valley Redevelopment and Community Park, native plantings, Milwaukee

Understanding Your Community

Learning about concerns or objections to green infrastructure can help you understand why a community may be hesitant to risk failure or not be in favor of codes that promote green infrastructure. A dialogue about these issues can provide valuable insight into the cause of the failure and give you critical information regarding the community's experience with green infrastructure.

7. Are there restrictions on the application and use of lawn fertilizers and/or pesticides?

☐ Yes ☐ No

8. Are streams and rivers protected by regulated buffers?

☐ Yes ☐ No

If yes, how large a setback is required?

_____

If yes, what type of vegetation is required/allowed?

_____

_____

9. Is there awareness of coal tar sealant pollution?

☐ Yes ☐ No

10. Have any developers who have worked in your community used green infrastructure?

☐ Yes ☐ No

If yes, with what success?

_____

_____

_____

11. Do you have subdivisions/neighborhoods that incorporate conservation, low-impact development, sustainability features or green infrastructure practices?

☐ Yes ☐ No

If yes, please explain: _____

_____

_____

12. Which of the following green infrastructure practices have been implemented in your community?

- ☐ Bioretention areas, such as plantings in parking lot islands
- ☐ Green roofs
- ☐ Downspout disconnections into rain barrels, planter boxes and permeable areas
- ☐ Rain gardens
- ☐ Streets and alleys with permeable surfacing
- ☐ Bioswales
- ☐ Native plantings
- ☐ Wetland and floodplain preservation and restoration
- ☐ Conservation and protection of open lands, natural areas and green spaces
- ☐ Permeable and porous pavements and paved surfaces
- ☐ Urban tree canopy protection and restoration

Which installations have been described as successful?

_____

_____

_____

Which have been described as failed? _____

_____

_____

_____

Was there community support for the projects?
☐ Yes ☐ No

If yes, was significant outreach needed to secure community buy-in for any of the projects?
☐ Yes ☐ No

Was the community opposed to the project at the beginning or at any points in the process?
☐ Yes ☐ No

If yes, how was the opposition addressed? _____

_____

_____

13. Is there a green infrastructure initiative or project that the community incorporated into its identity?
☐ Yes ☐ No

_____

_____

_____

Knowing your community's identity is critical to ensure that changes to local regulations will incorporate and build upon the preferences and priorities of the community.

14. Is there a government entity spearheading the acceptance and/or adoption of green infrastructure (e.g., a sewerage district, mayor's office, etc.)?
☐ Yes ☐ No

_____

_____

_____

Community Acceptance

1. What community groups or associations would be natural allies for green infrastructure?
These could include a park friends group, a garden club, a Wild Ones chapter, a conservation committee, a school that has the environment or sustainability as an organizing theme, river or bay keepers, a Rotary Club, bicycling advocacy group or village beautification committee.

_____

_____

_____

2. Are there neighborhood associations with a strong environmental ethic and commitment to sustainability?

☐ Yes ☐ No

_____

3. Which companies or businesses (e.g., garden centers or landscaping contractors) within your community have a strong environmental ethic and commitment to sustainability?

_____

_____

_____

4. Are there individuals who are advocates for green infrastructure and green practices in your community?

☐ Yes ☐ No

List individuals and what types of practices they support:_____

_____

_____

_____

5. Are there individuals who are opposed to green infrastructure and other environmental initiatives?

☐ Yes ☐ No

If yes, what is the basis of their concern or objection?

_____

_____

_____

6. Do you have code and ordinance changes reviewed by an attorney?

☐ Yes, always
☐ Sometimes
☐ Rarely
☐ Never

If yes, is this an impediment to making change?

☐ Yes ☐ No

7. What is your community's attitude or approach towards changing regulations?

☐ Positive, willing/able to take on

☐ Neutral, not proactive, but few objections when routine change is made

☐ Challenging, changes likely to receive intense scrutiny or to lead to objections.

_____

_____

_____

Audit Your Community's Codes and Ordinances

Using the audit section of this workbook (see the tabbed section), thoroughly review the codes and ordinances to identify barriers to the use of green infrastructure for stormwater treatment and control for private and public projects.

Prioritize Recommendations and Develop a Strategy for Adoption

Prioritizing Code Amendments

The report card at the end of the audit section will help your team identify areas where critical barriers exist. The codes identified in the topic area with the most low scores are a logical starting point. There are likely to be many codes and ordinances in several topic areas needing revision. If this is the case, it may be helpful to use additional criteria or information to prioritize the next phase of work.

Knowing what development pressures your community is facing can help determine which amendments to prioritize.

Is your community built out with most development occurring as redevelopment? If so, this might lead to a prioritization of amendments that would enable shared or offsite parking and permit permeable materials for parking lot surfacing, green roofs or planter boxes for rainwater harvesting.

Does your community have large parcels available for new development? This might lead to the prioritization of regulations pertaining to the size of individual parking spaces and number required, or reducing the footprint of roads and culs-de-sac in subdivision standards. Parking lot landscaping requirements could be amended so landscaping is allowed or required to serve as stormwater management. If there is little development or redevelopment planned, a focus on enabling green infrastructure practices on residential properties could take priority.

Are there regulations or requirements affecting your community? Your municipality may have regulatory requirements in addition to a MS4 stormwater permit such as a total maximum daily load (TMDL) that requires the reduction of pollutants identified in a TDML implementation plan or combined sewer overflow problems. Removing barriers to green infrastructure practices could help mitigate specific pollutants identified in a TMDL, which would make codes relevant to that area a high priority for revision.

The scoping information will also help in developing an approach that best fits your community and in assembling a team of local allies to encourage greater use of green infrastructure. This, in turn, can inform any public outreach and education efforts that might be needed to advance the adoption of the recommended changes.

The importance of a successful green infrastructure project to the goal of advancing green infrastructure in your community cannot be overstated. A failed project can have a crippling effect on subsequent green infrastructure initiatives.

Reed Street Yards, bioswale, Milwaukee

Overcoming Other Hurdles

In addition to specific local regulations, perceptions about and experiences with green infrastructure can be significant barriers to widespread implementation of these practices. Concerns about failure, cost and maintenance will need to be addressed.

If a project has failed in the community or been poorly received, it is critical to determine the root causes of that failure. This information can help in the development of a strategy to advance recommended amendments through the approval process and address resistance to proposed changes.

Before amendments are reviewed by the planning commission or other board, **enlist the support of allies identified in the community scoping activity.** Outreach to these allies can build support for green infrastructure and potentially identify early adopters for a particular initiative. Community allies can be called on to speak in favor of green infrastructure and associated ordinance changes in your local code adoption process whether that is at public hearings, subcommittee meetings or board or commission meetings.

Residential green infrastructure practices can also present challenges. **Concerns about negative comments from neighbors can be a disincentive even if a practice is allowed in the community.** Some have found a simple permit that is easy to fill out and submit electronically for residential practices such as rain gardens, cisterns and natural yards can help manage neighbor relations proactively.

For instance, if a resident would like to install a rain garden but is concerned that neighbors would complain, he or she can submit an application for a rain garden permit. This gives residents added reassurance to move forward with rain garden plans and enables municipal staff to communicate to concerned neighbors that rain gardens are an approved form of landscaping. This simple step provides a straightforward response to a complaint call, "Yes, it is allowable and your neighbor has a permit on file to use that practice."

The **cost of green infrastructure may be a concern** among staff or elected officials. There are many well-researched studies and reports on this topic that compare green infrastructure practices to conventional gray infrastructure and stormwater management approaches. Links to several of these reports are included in the resources section of this workbook.

Local staff may also cite **maintenance of green infrastructure installations** and concerns about effectiveness. Case studies, strategies and maintenance manuals are available to help counter these concerns. Some of these are included in the resources section.

Follow Through

The complete code audit — drafting revisions and adopting recommendations — sets the stage for greater use of green infrastructure. With green infrastructure enabled, developers, contractors and communities will consider green infrastructure as a potential component of their projects. When projects incorporate green infrastructure as a result of a code amendment, use the projects as opportunities to build greater acceptance for green infrastructure.

Track projects that are associated with the revised codes through the design, public input and installation phases to ensure a successful project. Strategic outreach to inform residents about new development, redevelopment or capital improvement projects that incorporate green infrastructure is critical to their acceptance. Time invested in public outreach to educate residents about green infrastructure and its benefits can help foster greater buy-in for the project. The importance of a successful green infrastructure project to the goal of advancing green infrastructure in your community cannot be overstated. A failed project can have a crippling effect on subsequent green infrastructure initiatives.

Amending codes and ordinances to enable green infrastructure is only the start of your work. Long-term community acceptance and support for green infrastructure is built on outreach and education to officials and residents and the successful implementation of projects.

Outreach to allies builds understanding about the importance of the desired green infrastructure practice and potentially identifies early adopters for a particular initiative.

Menomonee Valley Redevelopment and Community Park, stormwater wetlands, Milwaukee

Reed Street Yards bioswale, Milwaukee

WHAT'S THE IMPACT?

The effects of local regulations on stormwater runoff management and green infrastructure implementation can be abstract and difficult to understand. Geographic information system (GIS)-based stormwater models offer an effective tool for demonstrating and communicating the impacts of green infrastructure-friendly codes and ordinances in your community.

The following examples highlight particular code revisions and amendments that would enable green infrastructure practices and reduced impervious surface at different sites in the greater Milwaukee area. The sites illustrate the potential benefits of:

- Incorporating bioretention in general landscaping requirements.
- Using native or deep-rooted plants with ample soils in place of turfgrass.
- Reducing the total impervious area associated with parking requirements.
- Allowing the use of permeable surfacing in parking lots, driveways, fire protection areas and alleys.
- Incorporating tree planting, native plants and soil amendments (use of aeration and top dressing with organic fertilizer to foster root development and increase infiltration in turfgrass).

Mequon Nature Preserve, native plantings

For each parcel, the following question was asked: If development or redevelopment of this site occurred after the recommended code change was made, incorporating green infrastructure practices, what would be the impact on water quality and the quantity of runoff?

Modeling Methodology

For each site, a hypothetical redevelopment project was modeled to determine the associated stormwater runoff volume and pollution load reductions from existing conditions. The team used WinSLAMM version 10.2.0, the source loading and management model developed by PV & Associates LLC, to model the existing development conditions and a post-code revision redevelopment scenario with green infrastructure installations in place. ESRI ArcMap software was used to measure parcel attributes, including roofs, parking lots and turfgrass areas. Design assumptions for installed practices were based on engineering standards, constraints of the site, type of best management practice (BMP) and goal of BMP (water quality, water quantity, reduced peak flow rate, etc.).

Infiltration rates were determined using soil types provided by municipal and federal GIS soil layers. If the data were insufficient for the native soil type(s) on the parcel, a silty soil type was assumed because it represents an average runoff condition as compared with sandy and clayey soil options in the model and is commonly selected as the default soil type for modeling in southeast Wisconsin.

Bioretention practices were modeled using the same geometry (height of practice, drain sizes, etc.). Assumptions used in modeling bioretention practices included:

- Modeling software requirements of one 6-inch drain tile underdrain, vertical standpipe, broad crested weir[4]
- 24 inches of engineered soil[5] (75% sand/25% compost)
- 12 inches of rock fill under engineered media[6]

Permeable pavement practices were modeled using the same geometry (material specifications, depths and underdrain sizes). Assumptions used in modeling permeable pavement included:

- Pavement thickness of 6 inches and porosity of 0.20
- Aggregate bedding thickness of 4 inches and porosity of 0.35
- Aggregate storage layer thickness of 12 inches and porosity of 0.35
- Initial infiltration rate of 100 inches/hour and surface clogging load of 0.06 pounds/square foot
- Underdrain diameter of 4 inches and elevated 4 inches from bottom of storage layer
- Subgrade seepage rate of 0.3 inches/hour
- TSS reduction rate for flow through pavement of 55%

Conversion of turfgrass to native landscaping was modeled by changing the soil type from silty to sandy soil type. This represents the increased infiltration capacity created through establishment of deep-rooted native plantings and possible soil amendments.

The Brewery, infiltration trench, Milwaukee

Mequon Nature Preserve, native plantings

WHAT'S THE IMPACT: **GREEN INFRASTRUCTURE STANDARDS FOR PARKING LOT LANDSCAPING**

Code Revision: Encouraging use of bioretention areas with curb cut inlets as parking lot landscaping

24.12.020 Perimeter Vehicular Use Area Landscaping and

24.12.030 Interior Vehicular Use Area Landscaping

The integration of depressed bioretention areas used for landscaping and stormwater management is are strongly encouraged. Where perimeter areas are designed specifically for stormwater management, the planting and dimensional requirements of **24.12.020(B)(1)** above may be varied as necessary to ensure that the area functions effectively for stormwater treatment, so long as in the judgment of the [plan commission, city engineer] an equivalent amount of landscaping, planting or screening is provided.

Site: Parking lot redevelopment (total parking area 0.46 acre)
Addition of 2,310 square feet in bioretention

Runoff volume reduction: 46%

Total suspended solids reduction: 59%

WHAT'S THE IMPACT: **SUBSTITUTING NATIVE VEGETATION FOR TURFGRASS**

Code Revision: Encourage use of natives in lawn areas and limit total percent of site in turfgrass

Chapter 122 – ZONING

Landscaping. A general description of landscaping standards, screening, and parking lot treatments. Naturalized landscaping, the use of native vegetation, preservation of existing trees and wooded area, and tree planting that will provide additional tree canopy on the site are encouraged. The use of turfgrass should be limited to those areas intended for outdoor recreation or gathering areas.

Site: Non-residential development (lawn area 1.74 acres)
Substitution of native vegetation for entire lawn area[7]

Runoff volume reduction: 74%

Total suspended solids reduction: 64%


Image Landsat

WHAT'S THE IMPACT: **REDUCING TOTAL IMPERVIOUS AREA ASSOCIATED WITH PARKING**

Code Revision: Reduce minimum parking ratio (spaces required per square foot of building area) and set a maximum number of drive-through lanes. A retrofit of the site would require the removal of two drive-through lanes to be in conformance with the ordinance.

Sec. 13-1-92 Parking Requirements.

(k) The Following Guide Specifies the Minimum Number of Parking Spaces Required.

(2) Retail Sales and Customer Service Uses; Places of Entertainment. Retail sales and customer service uses, and places of entertainment, except as specifically set forth below: one (1) space per two hundred (200) ~~one hundred fifty (150) square feet~~ of gross floor area of customer sales and service, plus one (1) space per two hundred (200) square feet of storage and/or office gross floor area, or if the use has at least eighty thousand (80,000) square feet gross floor area, one (1) space per two hundred (200) square feet of gross floor area.

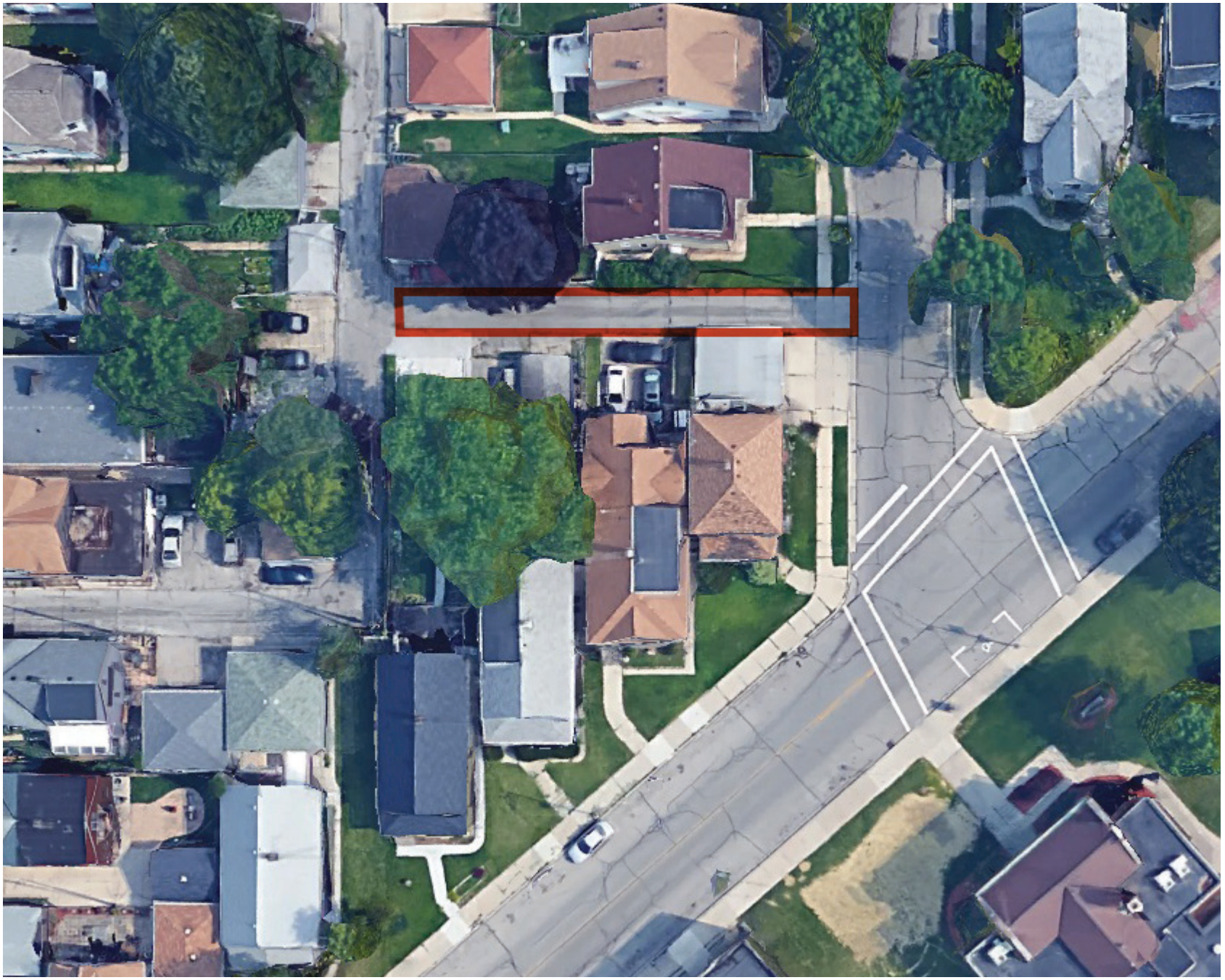
a. Financial Institutions: One (1) per two hundred (200) ~~one hundred fifty (150)~~ square feet of gross floor area of customer sales and service, plus one (1) space per employee for the work shift with the largest number of employees. Financial institutions with drive-through service facilities shall provide sufficient space for up to four (4) waiting vehicles at each drive-through service lane.

Site: Commercial bank (total drainage area 33,000 square feet)

- Remove two drive-through lanes
- Park at 5.5 spaces/1,000 square feet = 44 spaces instead of 64 spaces
- 21% impervious cover reduction (convert impervious to turf grass[8])

Runoff volume reduction: 19%

Total suspended solids reduction: 23%



WHAT'S THE IMPACT: **ALLOWING AND INSTALLING PERMEABLE ALLEYS**

Code Revision: Allow use of permeable surfacing in driveways and alleys

(3) Surfacing. All driveways shall be surfaced in accordance with village standards and specifications so as to provide a durable and dust-free surface, and shall be so graded and drained as to dispose of all surface water. Permeable surfacing may be used upon review and approval by the village engineer.

Site: Residential alleyway (total drainage area 25,000 square feet)

Replace 5,600 square feet with permeable pavement

Runoff volume reduction: 63%

Total suspended solids reduction: 63%


Image Landsat

WHAT'S THE IMPACT: **LANDSCAPING WITH NATIVE GRASSES, TREE PLANTINGS AND BIORETENTION**

Code Revision: Encourage use of bioretention as landscaping and landscape-based stormwater control

i. All yards sodded or seeded on at least 4 inches of topsoil. Rain gardens defined in the Chapter may be incorporated into lawn areas where planned and designed to receive drainage or runoff.

ii. Trees and shrubbery appropriate for the development, and according to the plan approved under subsection (a) above. The incorporation of amended soil areas, stormwater trees, and other vegetative stormwater control measures into landscaping plans is encouraged.

(c) Parking Lot Landscaping

1. Landscaping shall be provided on the perimeter and within the interior of all parking areas to provide screening, canopy cover, and stormwater treatment and control. The integration of vegetated stormwater control measures with parking lot landscaping is strongly encouraged. All landscaped areas shall be mulched or seeded in keeping with the overall landscaping plan. The Village may maintain a list of accepted species of tree and landscaping materials, including plants and trees suitable for use in vegetated stormwater control measures.

2. In parking lots, at least 5% of the interior parking area shall be landscaped with planting, and one tree of a minimum 2-inch caliper, for each 10 spaces, all as shall be submitted and approved as part of the plan provided for herein above. Planting required within the parking lot shall be in addition to, and not in lieu of, other planting requirements, such as for street trees. The planting plan may be varied to accommodate the design of vegetated stormwater control measures, so long as the total number of required trees is met within the overall parking area. The use of deciduous trees (which may function as stormwater trees, as defined in the Chapter) is encouraged to provide canopy shading within parking areas. Each interior landscaped area shall be a minimum of 75 square feet in size.

Site: Non-residential development (total area 4.12 acres)

- All parking areas drain to bioretention treatment or tree boxes (10,000 square feet)
- Rooftop drains to rain gardens in landscaped areas surrounding building
- Access drive drains through native vegetation filter strip
- All turfgrass replaced with native vegetation

Runoff volume reduction: 56%

Total suspended solids reduction: 64%

University of Wisconsin School of Freshwater Sciences permeable pavers, Milwaukee

APPENDIX 1

Sample Zoning Definitions for Green Infrastructure Practices

The following are examples of definitions of different green infrastructure practices. Providing an umbrella definition of "green infrastructure" or "vegetated stormwater management measures" is one way to enable green infrastructure in landscaped areas without the need to differentiate among such terms as "bioswale," "bioretention area," "rain garden" or "vegetated swale." **Note that these definitions should be tailored to match the language structure of your local ordinance and to reflect local or state statutes, definitions and codes.**

Green Infrastructure. Green infrastructure refers to those methods of stormwater treatment and control that use the natural capacities of soil and vegetation to prevent or reduce stormwater runoff and associated nonpoint source pollution. Green infrastructure methods often are combined with conventional or structural stormwater treatment systems, such as separators, ponds or underground systems, to create stormwater "treatment trains" that enhance stormwater treatment and water quality.

Amended soil areas. Amended soil areas are landscaped portions of a site where decomposed organic material has been incorporated into the soil to improve its performance for infiltration and growing vegetation, enabling the area to function as a vegetated control measure.[9]

Best management practice, or BMP. Best management practice, or BMP, means structural or nonstructural measures, practices, techniques or devices employed to reduce peak flows and minimize sediment or pollutants carried in runoff.

Bioswale. Bioswale means a vegetated, mulched or xeriscaped channel that provides treatment and retention as it moves stormwater from one place to another.

Bioretention area or rain garden. A bioretention area or rain garden is an excavated area that is back-filled with a prepared or amended soil mixture, covered with a mulch layer and planted with a diversity of woody or herbaceous vegetation to which stormwater is directed to promote infiltration and evapotranspiration.[10]

Cistern. A roof runoff collection system that detains water in above-ground or underground storage tanks with a capacity of at least 100 gallons.[11]

Connected imperviousness. Connected imperviousness means an impervious surface that is directly connected to a separate storm sewer or water of the state via an impervious flow path.

Critical time. Critical time means the period starting at the time of peak rainfall intensity with a duration equal to the time of concentration of the watershed.

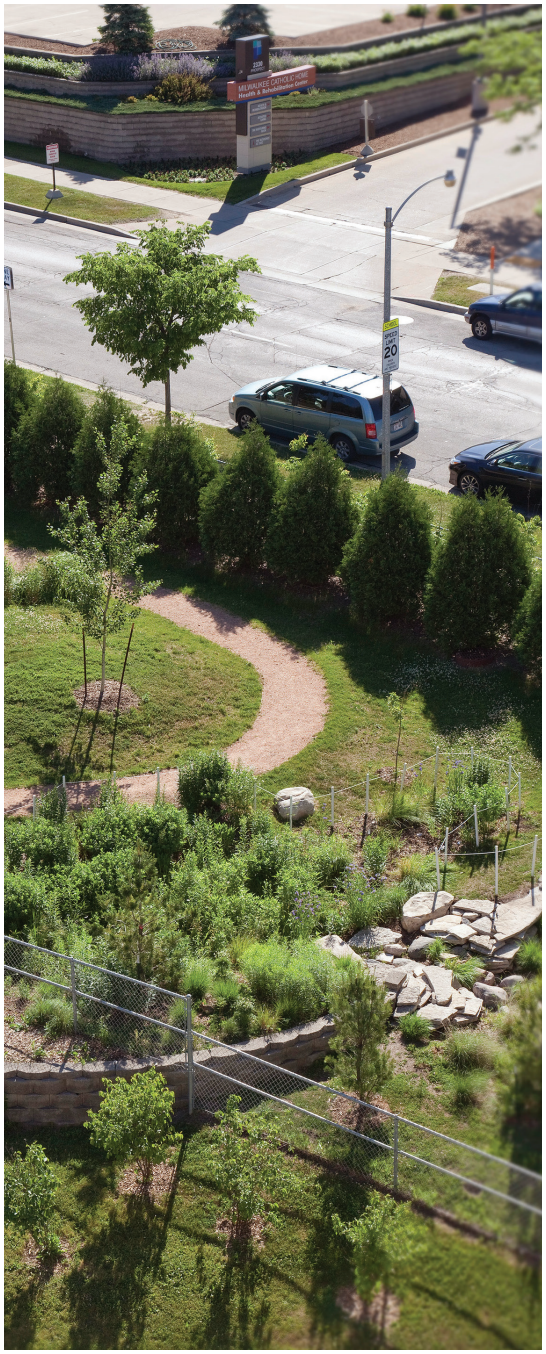
Downspout disconnection. Downspout disconnection means the rerouting of rooftop drainage pipes that are connected to storm sewers or that drain to impervious areas in order to drain rainwater to rain barrels, cisterns or permeable areas.

Green roof. An engineered roofing system that includes vegetation planted in a growing medium above an underlying waterproof membrane material designed to reduce the volume of stormwater runoff from building roofs.[12]

Green wall. The use of a supporting structure or wall panel that enables plants to grow vertically along the façade of a building or structure to provide air and water quality functions as well as aesthetic enhancement.

Impervious surface. Any pavement or structural element that prevents rain, surface water runoff or melting snow from infiltrating into the ground, including, but not limited to roofs and paved roads, driveways and parking lots.[13]

Permeable surfacing. A material or materials and accompanying subsurface treatments designed and installed specifically to allow stormwater to penetrate into it, reducing the volume of stormwater runoff



from the surfaced area. Permeable surfacing may include paver blocks, grassy pavers or similar structural support materials and permeable concrete or asphalt.

Planter box. Planter box means a structure with vertical walls and an open or closed bottom that may be attached to a building or structure and is planted with a soil medium and vegetation intended to collect, absorb and treat runoff from impervious surfaces.

Pocket wetlands. Pocket wetlands are small (typically under 1,000 square feet) constructed wetlands designed to reduce peak flows and runoff volumes, and remove pollutants via settling and bio-uptake.[14]

Rain barrels. Rain barrels are structures for the collection of roof runoff in containers, typically ranging from 50 to 100 gallons, with subsequent release to landscaped areas.[15]

Stormwater trees. Stormwater trees are trees selected and installed (either with or without an engineered box or structure) as integral components of a stormwater management plan, at points or sites where the tree(s) will have the effect of increasing the coverage of tree canopies to provide stormwater interception and evapotranspiration, stormwater uptake and increased infiltration.

Structural soil. A medium containing a mixture of crushed stone, soils and other materials that can be compacted sufficiently to support the installation of pavement or other surfacing, while permitting root growth for trees or other vegetation.

Vegetated control measures. The term "vegetated control measures" refers to vegetated swales, bioretention areas, rain gardens, amended soil landscape areas, pocket wetlands, stormwater trees or similar plantings that are designed and intended to provide stormwater treatment and control, and to promote evapotranspiration and infiltration of stormwater.

Vegetated swales. Vegetated swales are stormwater conveyance systems routing stormwater flows through vegetated areas in a natural elongated depression or a constructed channel. A vegetated infiltration swale differs from a conventional drainage channel or ditch because it is constructed specifically to promote infiltration.

Maryland Avenue Montessori School rain garden, Milwaukee

APPENDIX 2

Green Infrastructure Resources

Wisconsin Regulations

Wisconsin Department of Natural Resources Chapter NR 151 — Runoff Management
bit.ly/RunoffManagement

Wisconsin Department of Natural Resources Conservation Practice Standard 1008 — Permeable Pavement
bit.ly/PermeablePavement

Wisconsin Department of Natural Resources Conservation Practice Standard 1004 — Bioretention for Infiltration
bit.ly/Bioretention

Wisconsin Department of Natural Resources Conservation Practice Standard 1002 — Site Evaluation for Stormwater Infiltration
bit.ly/StormwaterInfiltration

Wisconsin Department of Natural Resources Non-Agricultural Revisions to Chapter NR 151, Runoff Management Rule
bit.ly/RunoffManagementRule

Valuing Green Infrastructure

Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide. American Rivers, American Society of Landscape Architects, ECONorthwest and Water Environment Federation, 2012.
Explores economic impacts of stormwater and how green infrastructure can help offset these costs.
bit.ly/BankingGreen

Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs. U.S. Environmental Protection Agency, 2013.
Uses 13 case studies from across the United States using various economic methods to determine cost-benefit analysis of green infrastructure and low-impact development projects.
bit.ly/EPAStudies

Green Infrastructure for Climate Resiliency. U.S. Environmental Protection Agency, 2014.
Identifies how green infrastructure can help communities build climate resiliency.
bit.ly/2ehcGQN

The Value of Green Infrastructure: Guide to Recognizing Its Economic, Environmental and Social Benefits. American Rivers and Center for Neighborhood Technology, 2010.
Outlines the multiple economic, environmental and social benefits of green infrastructure and how to assess these diverse benefits to guide decision making.
bit.ly/GreenInfrastructureBenefits

The Value of Green Infrastructure for Urban Climate Adaptation. Center for Clean Air Policy, 2011.
Identifies benefits of green infrastructure to communities to manage extremes in precipitation and temperature.
bit.ly/UrbanClimateAdapt

Financing and Implementation of Green Infrastructure

Getting to Green: Paying for Green Infrastructure: Financing Options and Resources for Local Decision-Makers. U.S. Environmental Protection Agency, 2014.
Helps municipalities develop financial strategies and identify funding opportunities for green infrastructure.
bit.ly/PayingforGreen

Green Infrastructure Opportunities that Arise During Municipal Operations. U.S. Environmental Protection Agency, 2015.
Uses case studies to demonstrate how green infrastructure can be integrated into public works projects and includes discussion of cost and benefits, review plans and maintenance.
bit.ly/EPANEP

Managing Stormwater in Redevelopment and Greenfield Development Projects Using Green Infrastructure Economic Factors that Influence Developers' Decisions. ECONorthwest, 2011.
Covers stormwater management regulations and their impact on greenfield and redevelopment projects from the point of view of the developer.
bit.ly/ManagingStormwater

Reducing Stormwater Costs through Low Impact Design Strategies and Practices. U.S. Environmental Protection Agency, 2007.
Includes 17 case studies of developments that incorporated low-impact development, reduced project costs and improved environmental performance.
bit.ly/ReducingStormwaterCosts

Maintenance

Elements of a Green Infrastructure Maintenance Business Plan
U.S. Environmental Protection Agency, 2015.
This U.S. EPA report reflects findings from Milwaukee Metropolitan Sewerage District and local stakeholders regarding the suitability of different business models for conducting maintenance for developing a regional green infrastructure maintenance program.
bit.ly/MaintenanceBusinessPlan

Green City, Clean Waters: Green Infrastructure Maintenance Manual Development Process Plan. Philadelphia Water Department, 2012.
This plan outlines the process of developing a green infrastructure maintenance manual, including evaluating maintenance protocols, developing protocols, checklists and schedules; maintenance contract agreements; program evaluation; and budget development.
bit.ly/GreenCityCleanWaters

Staying Green: Strategies to Improve Operations and Maintenance of Green Infrastructure in the Chesapeake Bay Watershed. American Rivers.
This report examines some of the major barriers to effective operations and maintenance of green infrastructure practices in the Chesapeake Bay region and identifies strategies and best practices that local governments, practitioners and other groups are using to develop and improve maintenance practices.
bit.ly/StayingGreen

Green Stormwater Operations and Maintenance Manual. Seattle Public Utilities, 2009.
This Seattle Public Utilities manual summarizes routine maintenance activities for the design of Natural Drainage System (NDS) Projects and includes a chart for scheduling and performing maintenance activities and images and descriptions for vegetation, hardscape, infrastructure and infiltration rates.
bit.ly/GreenStormwater

The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure. U.S. Environmental Protection Agency, 2013.
This report examines the operation and maintenance practices of 22 green infrastructure and highlights opportunities and challenges associated with green infrastructure O&M.
bit.ly/LongTermSuccess

REFERENCES

Demuzere et al., 2014. Mitigating and Adapting to Climate Change: Multi-functional and Multi-scale Assessment of Green Urban Infrastructure. Journal of Environmental Management 146:107-115.

Lee and Maheswaran, 2011. The Health Benefits of Urban Green Spaces: A Review of the Evidence. Journal of Public Health 33(2):212 –222.

Lee et al., 2014. Mitigation of Urban Heat Island Effect and Greenroofs. Indoor and Built Environment 23(1): 62–69.

Martin Jaffe et al., 2010. The Illinois Green Infrastructure Study. Illinois Environmental Protection Agency.

Milwaukee Metropolitan Sewerage District, 2005. Surface and Stormwater Rules Guidance Manual, Appendix L: Low Impact Development Documentation.

Milwaukee Metropolitan Sewerage District, 2012. Determining the Potential of Green Infrastructure to Reduce Overflows in Milwaukee.

Milwaukee Metropolitan Sewerage District, 2012. Sustainable Water Reclamation.

Milwaukee Metropolitan Sewerage District, 2014. Rules and Regulations, Chapter 13: Surface Water and Storm Water. Milwaukee

National Recreation and Park Association, 2010. Air Quality Effects of Urban Trees and Parks.

New York State Energy Research and Development Authority, 2006. Mitigating New York City's Heat Island With Urban Forestry, Living Roofs, and Light Surfaces. Final Report.

Philadelphia Water Department, 2011. Green City Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control Program Summary (amended).

Sands and Chapman, 2011. Why Green Infrastructure and I/I Control Go Hand in Hand, WaterWorld. Retrieved from bit.ly/WhyGreenInfrastructure.

Tzoulas et al., 2007. Promoting Ecosystem and Human Health in Urban Areas Using Green Infrastructure: A Literature Review. Landscape and Urban Planning 81:167–178.

U.S. EPA, 2002. National Water Quality Inventory, 2000 report. EPA-841-R-02-001.

U.S. EPA, 2010. Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater With Green Infrastructure.

U.S. EPA, 2014. Greening CSO Plans: Planning and Modeling Green Infrastructure for Combined Sewer Overflow (CSO) Control.

U.S. EPA. Implementing Clean Water Act Section 303(D): Impaired Waters and Total Maximum Daily Loads (TMDLs). US EPA. Retrieved December 1, 2015, from www.epa.gov/tmdl.

U.S. EPA, 2008. Incorporating Green Infrastructure Concepts Into Total Maximum Daily Loads (TMDLs).

U.S. EPA. Stormwater Runoff - Effective vs. Total Imperviousness, CADDIS: Sources, Stressors & Responses. Retrieved December 1, 2015, from bit.ly/CADDIS.

Wisconsin Department of Natural Resources, 2014, 2004. Storm Water Post-construction Technical Standards, Conservation Practice Standard 1004, Bioretention for Infiltration; Conservation Practice Standard 1003, Infiltration Basin.

Reed Street Yards eco-industrial zone, Milwaukee

FOOTNOTES

[1] Systems include shared parking formulas, sample agreements and recording documents. These can ensure that as shared or off-site parking plans are developed they will be consistent with what is already acceptable to the municipal attorney and the burden is not on the applicants to develop these documents, which can make the cost and uncertainty go up significantly.

[2] State regulatory agencies, such as the Wisconsin Department of Natural Resources, provide technical standards and guidance for permeable surfacing. See Appendix 2. Green Infrastructure Resources.

[3] Vegetated swales are graded, open and shallow engineered channels that help reduce peak stormwater discharge flow volumes and rates. The design of swales promotes the conveyance of stormwater at a slower, controlled rate and allows them to act as a filter medium, removing pollutants and allowing stormwater infiltration. Swales must be carefully designed and maintained to function properly. The vegetation is typically made up of flood-tolerant, erosion-resistant plants, such as thick grass.

[4] The underdrain, standpipe and weir are filtration design parameters that ensure sufficient rapid drawdown of water within the bioretention practice if it were to become clogged or blocked. This safeguards against flooding, and subsequently, the possible death of the plants within the bioretention practice.

[5] The engineered soil is the growing medium for plants in the bioretention practice. Sand and compost were specified to provide well-drained nutrient-enriched soil. Engineered soil infiltration rate was assumed to be 3.6 inches per hour with a void ratio of 0.27.

[6] Rock is placed under the engineered soil to serve as a storage area for stormwater to reduce peak flows, store the water to allow infiltration and allow for the filtration of solids. Void ratio in stone storage was assumed to be 0.33.

[7] Landscaped areas represent 26% of the total office park source area.

[8] The addition of 5,700 square feet of bioretention in place of turf grass results in further reductions in runoff volume and total suspended solids (48% and 60.4%, respectively).

[9] Adapted from Milwaukee Metropolitan Sewerage District Surface & Storm Water Rules Guidance Manual, Appendix L: Low Impact Development Documentation (24).

[10] Adapted from Wisconsin Department of Natural Resources Conservation Practice Standard 1004, Bioretention for Infiltration; Conservation Practice Standard 1003, Infiltration Basin (25).

[11] Adapted from Milwaukee Metropolitan Sewerage District Surface & Storm Water Rules Guidance Manual, Appendix L: Low Impact Development Documentation (24).

[12] Adapted from Milwaukee Metropolitan Sewerage District Surface & Storm Water Rules Guidance Manual, Appendix L: Low Impact Development Documentation (24).

[13] Adapted from Milwaukee Metropolitan Sewerage District Rules and Regulations, Chapter 13: Surface Water and Storm Water (26).

[14] Adapted from Milwaukee Metropolitan Sewerage District Surface & Storm Water Rules Guidance Manual, Appendix L: Low Impact Development Documentation (24).

[15] Adapted from Milwaukee Metropolitan Sewerage District Surface & Storm Water Rules Guidance Manual, Appendix L: Low Impact Development Documentation (24).

ACKNOWLEDGMENTS

This workbook would not have been possible without the dedicated work and expertise of Kate Morgan (formerly 1000 Friends of Wisconsin) and Juli Beth Hinds (Orion Planning and Design). Kate's vision of engaging and working one-on-one with communities to implement green infrastructure is a central part of what makes this project a success. In addition to Juli Beth's extensive knowledge of water resources and planning, she created an audit tool that is relevant and helps communities to navigate the complex landscape of local code and ordinances.

We would also like to recognize contributions from Timothy Detzer (Milwaukee County) and Bryan Hartsook (Wisconsin Department of Natural Resources) who were instrumental in the production of the "What's the Impact?" section. In addition, we would like to acknowledge the members of the Technical Advisory Review Team who provided their time and invaluable feedback on this workbook.

The University of Wisconsin Sea Grant Institute offers gratitude to the partners involved in creating this workbook.

Tackling Barriers to Green Infrastructure: An Audit of Municipal Codes and Ordinances project team included:

Julia Noordyk, University of Wisconsin Sea Grant Institute, project manager, co-editor

Kate Morgan, formerly, 1000 Friends of Wisconsin, principal author

Juli Beth Hinds, Orion Planning and Design, Code Audit Tool author, co-editor

Timothy Detzer, Milwaukee County Department of Transportation and Public Works, SWAT modeling

Steve Hiniker, retired, 1000 Friends of Wisconsin, foreword, technical review

Benjamin Benninghoff, Bryan Hartsook and Mark Riedel, Wisconsin Department of Natural Resources, technical review

Bre Plier and Karen Sands, Milwaukee Metropolitan Sewerage District, technical review

Jeffrey Nettesheim, Village of Menomonee Falls, technical review

Matthew Maederer, Village of Brown Deer, technical review

Moira Harrington, Elizabeth White and Marie Zhuikov, University of Wisconsin Sea Grant Institute, editors

Yael Gen, University of Wisconsin Sea Grant Institute, design

Kevin J. Miyazaki, photography

Production of this workbook was funded by the National Oceanic and Atmospheric Administration Coastal Storms Program and University of Wisconsin Sea Grant Institute in partnership with 1000 Friends of Wisconsin, Orion Planning and Design and Milwaukee Metropolitan Sewerage District.