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.

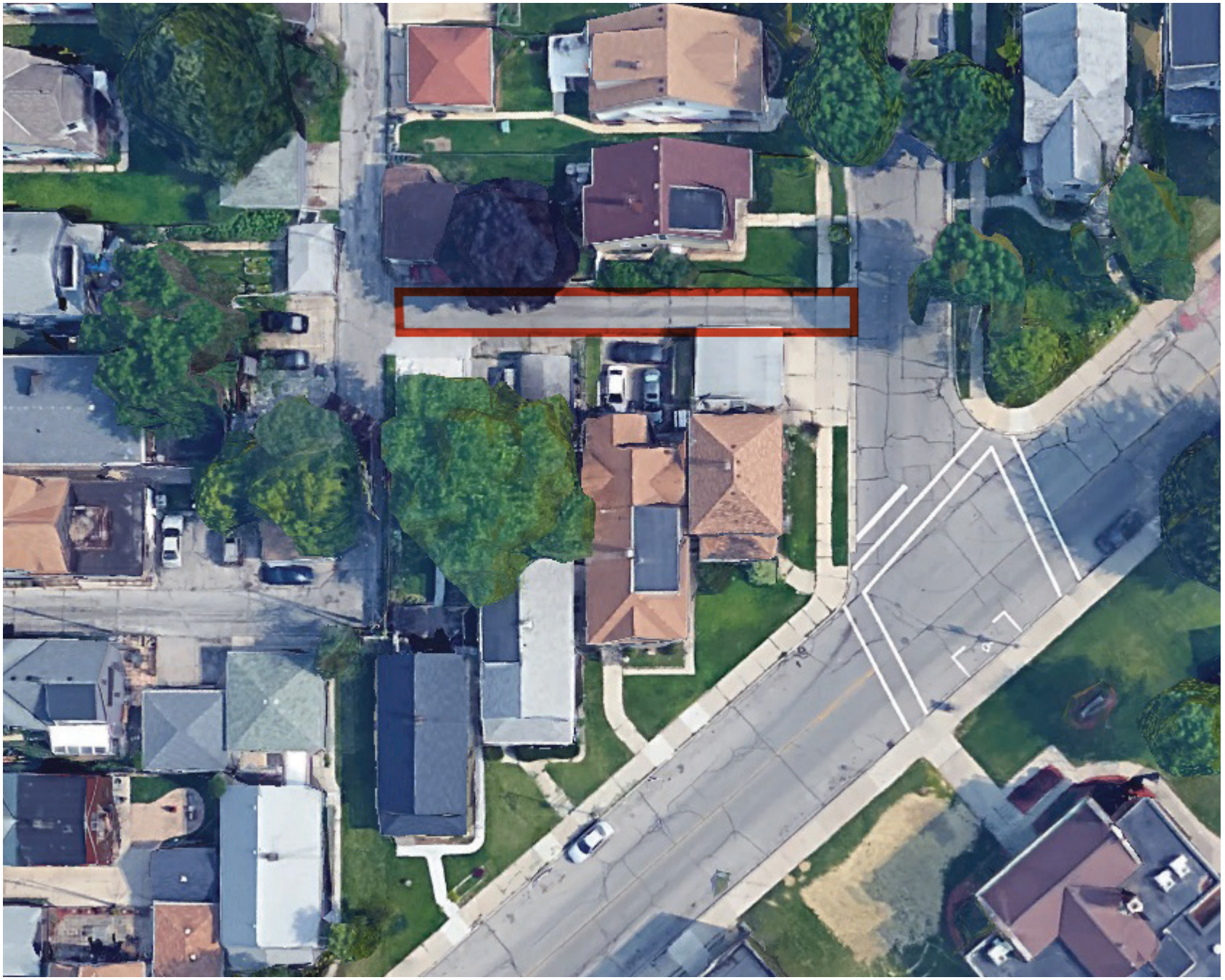
a. Financial Institutions: One (1) per two hundred (200) ~~one hundred fifty (150)~~ square feet of gross floor area of customer sales and service, plus one (1) space per employee for the work shift with the largest number of employees. Financial institutions with drive-through service facilities shall 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%