GREEN INFRASTRUCTURE PLANTING PLANS
GREEN INFRASTRUCTURE PLANTING PLANS

- UNDERLYING STORMWATER PROBLEMS
- BENEFITS OF VEGETATED GREEN INFRASTRUCTURE
- CHALLENGES OF USING PLANT MATERIAL
- PLANT SELECTION TOOL
Historically, aquatic ecosystems throughout North America were predominantly formed and sustained by stable groundwater hydrology where they originated and were sustained by constant flow from seeps and springs.
Contemporary Unstable Surface Water Hydrology Patterns

Increased Runoff & Erosion

Rainfall

Very Little Recharge

Increased Runoff & Erosion

Accumulated Discharge, Sedimentation, & Flooding
WHY MANAGE STORMWATER?

PUBLIC HEALTH (CSO’S)

SOIL CONSERVATION

FLOODING / BASEMENT BACKUPS

AQUATIC ECOSYSTEMS
CONCLUSION: FOCUS ON ABATING STORMWATER RUNOFF POLLUTION

SOURCES OF POLLUTION

1975
- Rural-Agricultural Runoff: 21%
- CSO's: 49%
- Urban-Non-Agricultural Runoff: 23%
- WWTP: 5%
- SSO's: 2%

2000
- Rural-Agricultural Runoff: 21%
- CSO's: 7%
- Urban-Non-Agricultural Runoff: 68%
- WWTP: 2%
- SSO's: 2%

Greater Milwaukee Watersheds Fecal Coliform Loadings

Estimated Pollutant Reduction over 25-Year Period About 50 Percent

CONCLUSION: FOCUS ON ABATING STORMWATER RUNOFF POLLUTION
VEGETATED GREEN INFRASTRUCTURE

- HABITAT
- NUTRIENT REMOVAL
- EVAPOTRANSPIRATION
- INFILTRATION AND AQUIFER RECHARGE
ROLE OF HERBACEOUS PLANTS

- SOIL HEALTH
- DISPERSED ROOT SYSTEMS
- EROSION CONTROL
VEGETATED GREEN INFRASTRUCTURE

RAIN GARDENS

GREEN ROOFS

NATURALIZED PLANTINGS

BIORETENTION
The Botanical Law

“Plants Grow in Habitats to Which They are Adapted”
Habitat Considerations

- Flood Duration
- Soil Moisture (complete saturation to wilting point)
- Temperature
- pH
- Nutrients
- Sun exposure
- Weed competition / Beneficial associations
- Soil Health
- Flooded soils have limited oxygen
- Impeded respiration leads to a build up of carbon dioxide, methane, and nitrogen gasses
- Toxic compounds such as ethanol and hydrogen sulphide build up
Soil Moisture

(Source: Utah State University)
Soil Moisture

(Source: Utah State University)
Soil Moisture

(Source: Utah State University)
Temperature

100% moisture is lost through evaporation or transpiration

Some bacteria species start dying

15% moisture used for growth, 85% moisture lost through evaporation and transpiration

Plant growth slows

100% moisture is used for plant growth

Source: NRCS
Most cultivated plants prefer a pH of 6.2 to 7.0.

Many native Illinois plant communities prefer more alkaline conditions.

Source: Mississippi State University
Nutrients

- Major Nutrients
  - Nitrogen (N)
  - Phosphorus (P)
  - Potassium (K)

- Trace Elements
  - Iron
  - Manganese
  - Zinc
  - Copper
  - Boron
  - Molybdenum
Nutrients

FEED YOUR LAWN

FEED IT!
NUTRIENTS ARE NOT PLANT FOOD
Sun Exposure

FULL SUN
6 or more hours of direct sunlight

PART SUN
4-6 hours of direct sunlight

FULL SHADE
Less than 4 hours of direct sunlight

Weed Competition

**REED CANARY GRASS**  
*Phalaris arundinacea*

**COMMON REED**  
*Phragmites australis*

**BUCKTHORN**  
*Rhamnus spp.*

**BULL THISTLE**  
*Cirsium vulgare*
Beneficial Associations

- Grasses – Soil builders and thermal regulators
- Mycorrhizal Fungi – often symbiotic relationship – assist plants with obtaining water, phosphorus and other micronutrients
- Rhizobacteria – release plant growth compounds
- Animal associates – forage and pollination
Soil Health - Rhizosphere
VEGETATED GREEN INFRASTRUCTURE - SUCCESSES

RAIN GARDENS

GREEN ROOFS

NATURALIZED PLANTINGS

BIORETENTION
VEGETATED GREEN INFRASTRUCTURE - FAILS

RAIN GARDENS

GREEN ROOFS

NATURALIZED PLANTINGS

BIORETENTION
Cultural Practices

Owners have expectations with Vegetation:

“It’s a strange phenomenon: People pay so little attention to the appearance of concrete or asphalt, but when these impervious surfaces are removed and plants are installed, everyone has an opinion as to how they should look and be managed” - T. Liptan

(Source: “Sustainable Stormwater Management,” 2017)
“... naturalistic landscapes require the least oversight and upkeep of any vegetative system because informal planting designs allow for variation in arrangement” - T. Liptan

(Source: “Sustainable Stormwater Management,” 2017)
Planting Approaches

**NATURALIZED**
- LOW INSTALL COST
- HIGH HABITAT VALUE
- 3-5 YR ESTABLISHMENT

KRESGE FOUNDATION HQ

**DRIFT**
- HIGH INSTALL COST
- MED. HABITAT VALUE

LURIE GARDEN

**FORMAL/BLOCK**
- MED. INSTALL COST
- LOW HABITAT VALUE
- EASIER MAINTENANCE

JOHNSON CONTROLS HQ
Planting Approaches

PROS
- High habitat value, soil health
- Long-term maintenance savings
- Lower inputs of water, fertilizer
- Resistant to pests/diseases
- Sustainable, Self-renewing

CONS
- Works better with larger, contiguous plantings
- Higher, specialized establishment cost in year 1 through 5
- Weed competition
- Aesthetic is not for everyone
Planting Approaches

PROS
- Beauty
- Stable, consistent maintenance cost
- Easier to weed
- Easier to maintain in smaller, fragmented spaces
- Immediate establishment

CONS
- Lower habitat value
- Larger, long-term maintenance cost
- More inputs of water and fertilizer
- Less resistant to pests/diseases
- Must be replaced every 8 to 15 years
Cultural and Ecological Conditions

- Green Infrastructure Conditions
- Planting Approach (cultural expectations)
- Site Context
- Soil Depth
- Flood Duration
- Soil Moisture
- Soil Temperature
- pH
- Nutrients
- Sun exposure
- Weed competition / Beneficial associations
- Soil Health
- At least 3,149 naturally occurring vascular plants in the Chicago region

- Several thousand more cultivated plants available from nurseries
Green Infrastructure Sizing Calculator
Milwaukee Metropolitan Sewerage District

Disclaimer
Green infrastructure sizing calculator is specific to MMSD service area, results are not for final design, and not all MMSD green infrastructure strategies are included in the calculator. Refer to MMSD Chapter 13 Rules and Regulations for additional information.

Note: Please provide requested project information in blue boxes.

<table>
<thead>
<tr>
<th>Project Drainage Area</th>
<th>Project Site Dimensions</th>
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</thead>
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<tr>
<td>1.00</td>
<td>290</td>
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<tr>
<td></td>
<td>Available Project Area Length (feet)</td>
</tr>
<tr>
<td>1.00</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Available Project Area Width (feet)</td>
</tr>
<tr>
<td>C</td>
<td>19</td>
</tr>
<tr>
<td>Land Use (C = Commercial, I = Industrial, R = Residential)</td>
<td>1 Length to Width Ratio</td>
</tr>
<tr>
<td></td>
<td>4,350</td>
</tr>
<tr>
<td></td>
<td>Available Project Area (ft²)</td>
</tr>
</tbody>
</table>

Project Specific Questions

- Is the project area for the green infrastructure strategy within the right of way?
- Are the topographic slopes adjacent to the green infrastructure strategy greater than 12%?
- Is the depth to bedrock less than 6 feet?
- Is the depth to groundwater less than 6 feet?
- Is the project area within 10 feet horizontally of building foundations?
- Is the project area within 10 feet laterally from underground sanitary sewer infrastructure or other utilities?

Note: After providing requested project information, green infrastructure strategies which are not recommended based on characteristics for the specific project will not be selectable. Please select an appropriate green infrastructure strategy to begin design and develop costs and quantities.

Green Infrastructure Strategies

- Bioswale / Bioretention
- Porous Pavement
- Rain Garden

Note: If none of the green infrastructure strategies displayed above can be selected based on the specific site suitability parameters, other green infrastructure strategies may be viable and should be considered, including stormwater trees, native landscaping, and soil amendments. See below for links to typical details and specifications.

Additional Green Infrastructure Strategies (Not Included in Sizing Calculator)

- Stormwater Tree
- Native Landscaping
- Soil Amendments

Stormwater Runoff Capture Goal
Stormwater Runoff Generated from Impervious Surfaces During a 0.5-inch Rainfall Event: 13,600 gallons
Inclusion Criteria

- Hardy in Milwaukee Climate
- Generally long-lived
- Suitable for Large-scale Landscape Applications
- Not known to be invasive
- Not overly aggressive, especially if not native
- Commercially available
Planting Groupings

- **Deciduous Trees**
- **Conifer Trees**
- **Ornamental Trees**
- **Deciduous Shrubs**
- **Evergreen Shrubs**
- **Broadleaf Evergreens**
- **Vines**
- **Flowering Perennials**
- **Grasses, Sedges, Rushes**
- **Bulbs**
- **Ferns**
Green Infrastructure Plant Selection Spreadsheet
Milwaukee Metropolitan Sewerage District

Introduction

Disclaimer
1. This tool is intended to be a starting point for the successful use of plants in green infrastructure applications. It is the responsibility of the local municipality or designer to understand the conditions specific to their site and the requirements for planting. It is recommended that planting plans be developed and reviewed by a licensed landscape architect or landscape designer as well.

1. Application
1. The Milwaukee Metropolitan Sewerage District (District) has created this tool to help project partners and interested residents with the selection of plants for green infrastructure applications.

1. Green Infrastructure is one piece of the multifaceted approach to meeting the District's 2050 vision for clean water, healthy communities, and improved water quality. Strategic green infrastructure is an important part in achieving the vision by storing stormwater. This infrastructure helps to reduce peak flows, reduce pollutants, and protect drinking water sources.

2. The District recognizes the importance role that plants play in this infrastructure, but also understands that the conditions the plants must survive can be challenging. This website provides a selection of some well-adapted and proven plants to create the area most suited to their particular site.

2. Steps to Complete
1. Design a situation with us and you're in the next step.
2. Next, fill in information about your project with the options below to create a customized plant list.
3. Green buttons will provide supplemental information.

Step One

Choose Planting Style

1. Ornamental or Naturalized

1. The first choice this tool requires you to make is to select the type of planting approach that will be used. The two choices offered are, ornamental or naturalized.

1. An ornamental landscape is one that most people are familiar with. It is the one of the most common approaches in the U.S. for the last half-century. Ornamental landscapes rely on the use of plants whose roles are carefully selected by growers to be showy, fragrant, and visually pleasing or novel. These plants are typically native to a specific region having been originally imported from all over the world. Because of this selection of plants tends to produce hardGeneric Styles of Green Infrastructure plant listema with a need for regular maintenance.

1. Naturalized landscapes are beginning to gain popularity. The naturalized approach utilizes local native plants in arrangements that attempt to mimic a common regional plant community like a prairie. The placement of these plants is more natural and diverse than in an ornamental landscape. Unlike the typical cultivated approach, the naturalized landscape is designed to self-perpetuate through natural regeneration.
Choose Planting Style

Ornamental
- Ornamental Pros/Cons
- Cost Considerations

Naturalized
- Naturalized Pros/Cons
- Cost Considerations
**Green Infrastructure Plant Selection Spreadsheet**

**Milwaukee Metropolitan Sewerage District**

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**Step Two**

**Select Site Conditions (Ornamental)**

### 1. Application

1. This page will allow you to enter the conditions on your site that will determine the appropriate plant material to choose from. You can customize your settings by going directly to 4D and choosing from a range of conditions, or you can select a series of default conditions for typical green infrastructure practices under 4D. Once you are happy with your selections, hit the “Submit Data and Create Plant List” button under 4.

2. For more information on standard green infrastructure practices visit www.freshcoastinitiative.com.

### 2. Default Selection for Green Infrastructure

- Bio-Dome
- Rain Garden
- Extensive Green Roof
- Semi-Intensive Green Roof

### 3. Custom Selection for Green Infrastructure

#### 3.1 Sun Exposure

- Full Sun
- Part Sun
- Full Shade

#### 3.2 Soil Moisture

- Dry
- Moist
- Wet
- Emergent Type 1
- Emergent Type 2

#### 3.3 Soil Exposure

- Low
- Medium
- High

#### 3.4 Flood Duration

- Short
- Medium
- Long

#### 3.5 Soil PH

- Medically Alkaline
- Neutral
- Medically Acidic

#### 3.6 Planting Soil Depth

- 0" to 3"
- 6" to 12"
- 18" to 24"
- 24" to 36"

#### 3.7 Clear Selection

- Select All

---

**Submit Data and Create Plant List**

**Back to Step One**
2. Default Selection for Green Infrastructure

- Bio-Swale
- Rain Garden
- Extensive Green Roof
- Semi-Intensive Green Roof

3. Custom Selection for Green Infrastructure

- Sun Exposure:
  - Full Sun
  - Part Sun
  - Full Shade

- Soil Moisture:
  - Dry
  - Mesic
  - Wet
  - Emergent Type 1
  - Emergent Type 2

- Salt Exposure:
  - Low
  - Medium
  - High

- Flood Duration:
  - Short
  - Medium
  - Long

- Soil pH:
  - Mildly Acidic
  - Neutral
  - Mildly Alkaline

- Planting Soil Depth:
  - 3" to 5"
  - 6" to 17"
  - 16" to 29"
  - 230"

Clear Selection
Select All

4. Submit Data and Create Plant List
# Green Infrastructure Plant Selection Spreadsheet

**Milwaukee Metropolitan Sewerage District**

## STEP THREE YOUR CUSTOMIZED ORNAMENTAL PLANT LIST

* Minnesota is defined as the states of Minnesota, Wisconsin, Iowa, Nebraska, Illinois, Indiana, Michigan, and Ohio.

**See green vendor's list for plants suppliers.

<table>
<thead>
<tr>
<th>Deciduous Trees</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Spacing</th>
<th>Comments</th>
<th>NOT NATIVE</th>
<th>NORTHEAST</th>
<th>SOUTH WISC</th>
<th>DEER</th>
<th>RABBIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER saccharinum</td>
<td>Sugar Maple</td>
<td>Sugar Maple</td>
<td>NA</td>
<td>Tolerant heavy shade, good fall color, uncommon pest problems</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ACER saccharinum</td>
<td>Sugar Maple</td>
<td>Sugar Maple</td>
<td>NA</td>
<td>A sugar maple variety with tolerance to urban conditions</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>A. MACROPHYLLA</td>
<td>Red Maple</td>
<td>Red Maple</td>
<td>NA</td>
<td>Marginal for colder areas, beautiful autumn color and seeds</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. NORTHERN</td>
<td>Red Maple</td>
<td>Red Maple</td>
<td>NA</td>
<td>Leaves for colder areas, beautiful autumn color and seeds</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>BASSIA coccinea</td>
<td>Common Rose</td>
<td>Common Rose</td>
<td>NA</td>
<td>A beautiful rose that is tolerant of urban conditions</td>
<td>X</td>
<td></td>
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<td></td>
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<tr>
<td>B. ALBA</td>
<td>Common Rose</td>
<td>Common Rose</td>
<td>NA</td>
<td>A beautiful rose that is tolerant of urban conditions</td>
<td>X</td>
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<tr>
<td>B. SRUBENS</td>
<td>Common Rose</td>
<td>Common Rose</td>
<td>NA</td>
<td>A beautiful rose that is tolerant of urban conditions</td>
<td>X</td>
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<tr>
<td>B. VRUGENS</td>
<td>Common Rose</td>
<td>Common Rose</td>
<td>NA</td>
<td>A beautiful rose that is tolerant of urban conditions</td>
<td>X</td>
<td></td>
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<tr>
<td>CHESNUTIA castanea</td>
<td>Chestnut</td>
<td>Chestnut</td>
<td>NA</td>
<td>A beautiful chestnut that is tolerant of urban conditions</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C. NIGRA</td>
<td>Chestnut</td>
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<td>NA</td>
<td>A beautiful chestnut that is tolerant of urban conditions</td>
<td>X</td>
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<tr>
<td>C. VRUGENS</td>
<td>Chestnut</td>
<td>Chestnut</td>
<td>NA</td>
<td>A beautiful chestnut that is tolerant of urban conditions</td>
<td>X</td>
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<td>C. VRUGENS</td>
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## Ornamental Shrubs

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<tr>
<th>Deciduous Shrubs</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Spacing</th>
<th>Comments</th>
<th>NOT NATIVE</th>
<th>NORTHEAST</th>
<th>SOUTH WISC</th>
<th>DEER</th>
<th>RABBIT</th>
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</thead>
<tbody>
<tr>
<td>C.icornus</td>
<td>Common Ilex</td>
<td>Common Ilex</td>
<td>NA</td>
<td>A beautiful ilex that is tolerant of urban conditions</td>
<td>X</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>C. NIGRA</td>
<td>Common Ilex</td>
<td>Common Ilex</td>
<td>NA</td>
<td>A beautiful ilex that is tolerant of urban conditions</td>
<td>X</td>
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<tr>
<td>C. NIGRA</td>
<td>Common Ilex</td>
<td>Common Ilex</td>
<td>NA</td>
<td>A beautiful ilex that is tolerant of urban conditions</td>
<td>X</td>
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</tr>
<tr>
<td>C. NIGRA</td>
<td>Common Ilex</td>
<td>Common Ilex</td>
<td>NA</td>
<td>A beautiful ilex that is tolerant of urban conditions</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Tolerant To

- **NOT NATIVE**
- **NORTHEAST**
- **SOUTH WISC**
- **DEER**
- **RABBIT**
**BIOSWALE - ADVANCED**

*9'x12' PLOT (100 S.F.) • 39-43 PLANTS • 15” TO 18” SPACING*

**FULL SUN**

**Remarks:** The plants in this mix offer a variety of leaf structure and flower displays throughout the year. Cape Breeze Switchgrass provides the backbone to the display with an upright and compact form. The Sideoats Grama is distinct for its arrangement of oak-like seed spikes which hang from one side of the stem. The three flowering perennials in the mix will ensure that something is always in bloom from May through August.

**QTY|PERENNIALS**

<table>
<thead>
<tr>
<th>QTY</th>
<th>Species</th>
<th>Description</th>
<th>Percentage of Mix</th>
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</thead>
<tbody>
<tr>
<td>7</td>
<td>Penstemon Digitalis 'Husker's Red'</td>
<td>Foxglove Beardtongue</td>
<td>15%</td>
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<tr>
<td>9</td>
<td>Nepeta x faassenii 'Junior Walker'</td>
<td>Walker's Low Creeping</td>
<td>20%</td>
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<tr>
<td>8</td>
<td>Helipterum curassavicum 'Prairie Sunset'</td>
<td>False Sunflower</td>
<td>13%</td>
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**GRASSES**

<table>
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<tr>
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<th>Species</th>
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<tbody>
<tr>
<td>16</td>
<td>Bouteloua curtipendula</td>
<td>Sideoats Grama</td>
<td>25%</td>
</tr>
<tr>
<td>8</td>
<td>Panicum virgatum 'Cape Breeze'</td>
<td>Cape Breeze Switchgrass</td>
<td>17%</td>
</tr>
</tbody>
</table>
GREEN INFRASTRUCTURE PLANTING PLANS

www.freshcoastguardians.com