



Scalable Solutions for Green Infrastructure Design

Calumet Stormwater Collaborative
November 5, 2021

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Agenda

- RISC Background
- What's New in the 2021 Guide?
- Guide Review
  - Decision Tools
  - Green Infrastructure Practices
  - Example: Naturalized Detention
- Lessons & Limitations
- Discussion

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RISC Solutions: A Team Focused on Alternative Delivery/Financing Frameworks For Climate Adaptation

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CDP DISCLOSURE INSIGHT ACTION

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AMERICAN SOCIETY OF ADAPTATION PROFESSIONALS

HIP INVESTOR Human Impact + Profit

What RISC initiative focuses on…

- **Establishing a cluster** of resiliency and sustainability professionals
- **Developing toolkits and templates** for scaling resiliency infrastructure, and driving down transaction action costs
- **Creating prioritized frameworks** for investments in resiliency infrastructure
- **Supporting transactions** around resiliency infrastructure, like environmental impact bonds, community public private partnerships, etc.

Cluster Agencies

- MWRD (Chicago)
- MMSD (Milwaukee)
- DWSD (Detroit)
- US EPA
- City of Pittsburgh, PA
- City of Detroit, MI
- City of Minneapolis, MN
- City of Ann Arbor, MI
- City of Flint, MI
- City of Kalamazoo, MI
- City of Southfield, MI
- Cuyahoga County, OH
- City of Hobart, IN
- Town of Merrillville, IN

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What's in the 2021 Guide

- Decision support tools
  - What GI practice to use?
  - Where to locate them?
  - Which techniques solve which problems?

- 11 Green Infrastructure practices
  - Basic design renderings
  - Design guidelines
  - Maintenance guidelines
  - Cost information
  - Specifications
  - Plant guidance

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Purpose of the Guide

- Assist communities in **planning, procuring GI design work**
- Does not replace need to hire a design engineer, but is intended to simplify process of competing GI projects, by helping to **establish in-house standards**
- Focus on **local governments and sewer districts,** but applicable to any property owner considering GI
- Particularly valuable to agencies with less in-house expertise

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Why We Updated the GI Designs Guide

- Need to add BMPs for low density areas (suburban and rural)
- Develop watershed-scale solutions, emphasizing both upstream and downstream BMPs
- Consolidate similar BMPs into larger categories
  - Bio-retention
  - Naturalized detention
  - Bio-filtration

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Why We Updated the GI Designs Guide

- Expand information to make it more usable (particularly around sizing and cost)
- The last decade has taught us much about what works, what doesn't and what's most important

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GI Designs Guide – Version History

1st edition

July 2015

- Introduced first 5 BMPs
- Focused heavily on urban areas and conversion of brownfield sites

2nd edition

September 2017

- Introduced 2 new BMPs
- Same focus, included heavy CSC participation

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GUIDON DESIGN
SUSTAINABLE ARCHITECTURE + ENGINEERING

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What's New - Additional BMP's

Naturalized Detention

Stormwater Trees

Filter Strip- Level Spreader

Vegetated Swale

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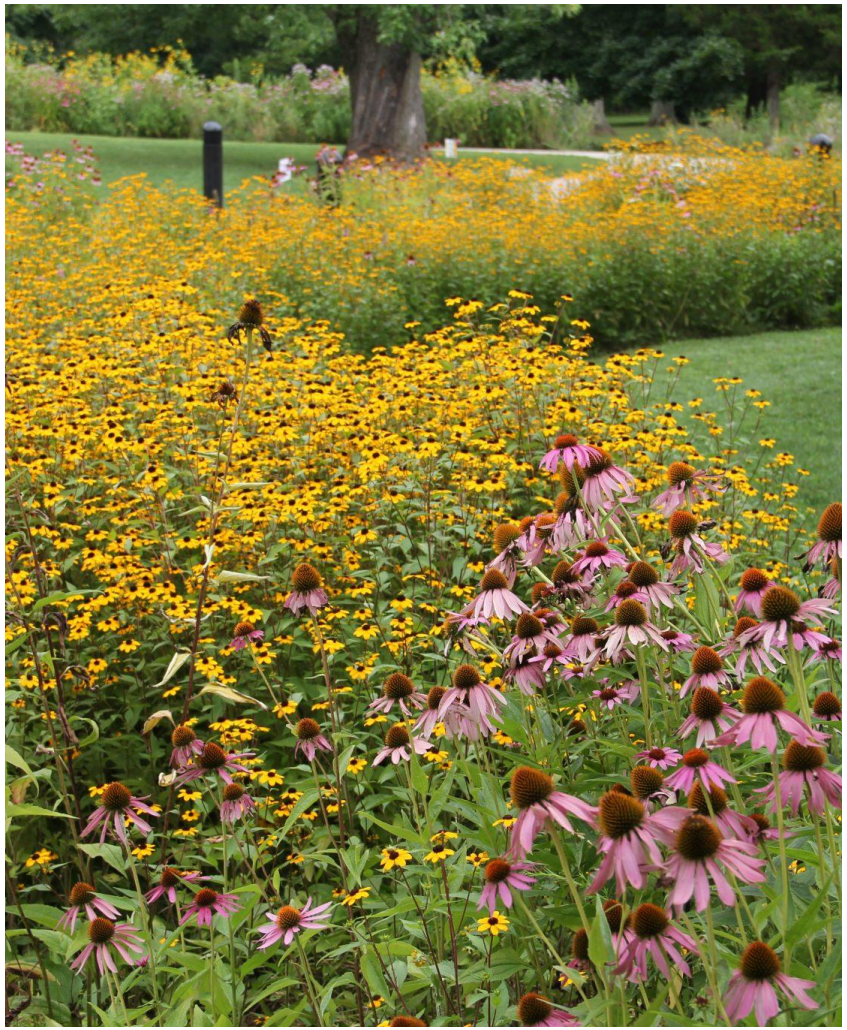
What's New – Planting Approach

- Focus on **herbaceous perennials** versus native
- Distinctions between **ornamental** and **naturalized**
- Guidance for plant selection:
  - Sun exposure, soil moisture, salt exposure, flood duration, soil pH and depth



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What's New – Conversion Tables

Units	Total	Equation	Formula	Typical Applications
Square Feet	100.00	20 x 5	Length x Width	Overall site size, seeding, sod, liner, green roof units, porous unit pavers
Cubic Feet	600.00	20 x 5 x 6	Length x Width x Height	Underground stormwater chamber, concrete curb encasement
Square Yards	11.11	(20 x 5) ÷ 9	(Length x Width) ÷ 9	Geotextile Fabric, Erosion Blanket, Grading
Cubic Yards	22.22	(20 x 5 x 6) ÷ 27	(Length x Width x Height) ÷ 27	Excavation, Hauling, Mulch, Soil, Stone, Topsoil
Linear Feet	N/A	N/A	N/A	Storm sewer, perforated piping, backfill, curb, level spreader
Each	N/A	N/A	N/A	Plants (plugs, gallons), trees, shrubs, drainage basin, splash pad, rip rap, storm sewer connection, underdrain cleanout, outlet control structure, berm check dam, grate, encasement access, driveway culvert

Units	Total	Equation	Formula	Typical Applications
Lump Sum	N/A	N/A	N/A	Mobilization, Design engineering
Ton	N/A	N/A	N/A	Gravel
Acre	N/A	N/A	N/A	Invasive species removal

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What's New – Cost Tables

	Item	Description	Unit Price	Unit
GI Technique	Stormwater planter	Design/Engineering	15% of Construction Cost	LS
		Mobilization	$10,000.00	LS
		Excavation & Haul	$45.00	CY
		Leaf Mulch	$70.00	CY
		Engineered Soil	$80.00	CY
		Open-Grade Crushed Stone	$65.00	CY
		Geotextile Fabric	$5.00	SY
		Erosion Control Blanket	$3.00	SY
Required Component	Stormwater Planter Curb	Curb, stormwater planter (6" barrier curb with 24" total height)	$50.00	LF
	Splash Pad	Cobble Splash Pad	$250.00	EA
Required Selection	Native Plantings	Plugs (12" on center)	$5.00	EA
		Gallons (36" on center)	$15.00	EA
Custom options	Trees	Varies by species and size	$400.00	EA
	Shrub	Varies by species and size	$60.00	EA
	Structured Soil	CU Structural Soil	$120.00	CY
	Outlet Control/ Overflow Structure	Outlet Control Drainage Basin (varies by size)	$2,800.00	EA
	Underdrain	4" HDPE Perforated Pipe	$20.00	LF
	Storm Sewer	12" HDPE storm sewer	$65.00	LF
	Underdrain Cleanout		$600.00	EA
	Connection to existing storm structure		$600.00	EA

Decision Tools

GREEN UPDATES TO GRAY INFRASTRUCTURE

When incorporated into existing gray stormwater systems, **green infrastructure** can help manage water volume and velocity entering into the sewer; improve water quality in runoff, pre and post sewer conveyance; and reduce the impact on existing infrastructure, communities, and ecosystems.

Where

Sewer and drainage tile located on roads, parking lots, office buildings, farm fields, and lawns.

When

For new construction or retrofitting existing systems.

How: Green Infrastructure Techniques

Infiltration

Improve inflitration by using bioretention to reduce runoff velocity and volume, and recharge groundwater.

Benefits: Reduce CSO events, flooding, and coastal erosion.

Upstream BMPs: Bioswale, Rain Garden, Stormwater Planter, Permeable Pavement Box, Tree Filter, Filter Strip/Level Spreader, Stormwater Trees

Downstream BMPs: Semi-wet Pond

Water Treatment

Reduce non-point source pollution in runoff before it enters sewers and other water bodies.

Benefits: Remove pollutants, contaminants and nutrients in runoff.

Upstream BMPs: Bioswale, Rain Garden, Stormwater Planter, Box Tree Filter, Filter Strip/Level Spreader, Stormwater Trees, Green Roof

Downstream BMPs: Wet Pond, Semi-wet Pond

Detention

Store excess stormwater to control runoff volume and velocity before it moves downstream.

Benefits: Reduce erosion, water levels, wear on infrastructure and pollution in runoff.

Upstream BMPs: Underground Storage, Green Roof

Downstream BMPs: Wet Pond, Semi-wet Pond

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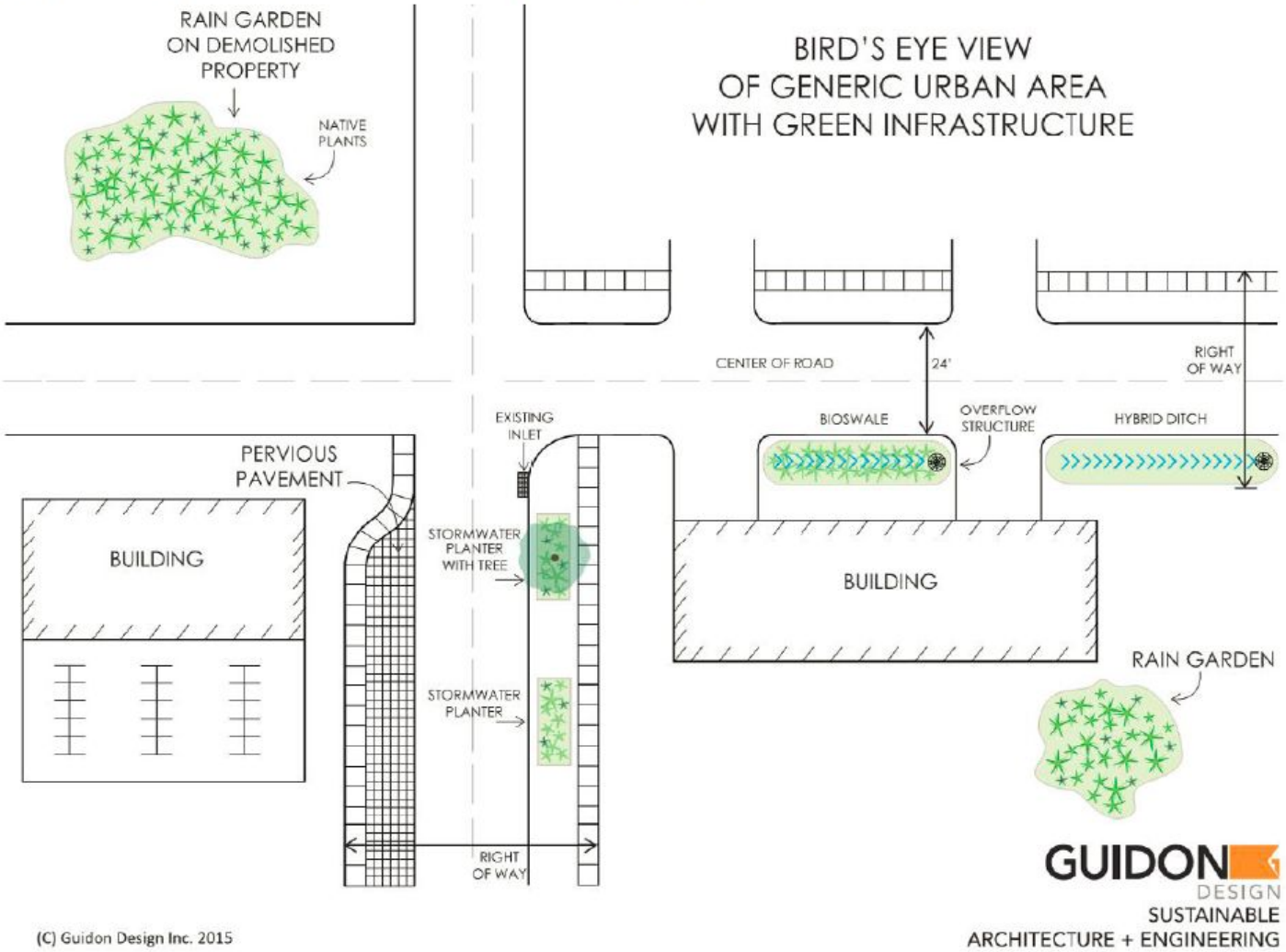
Decision Tools



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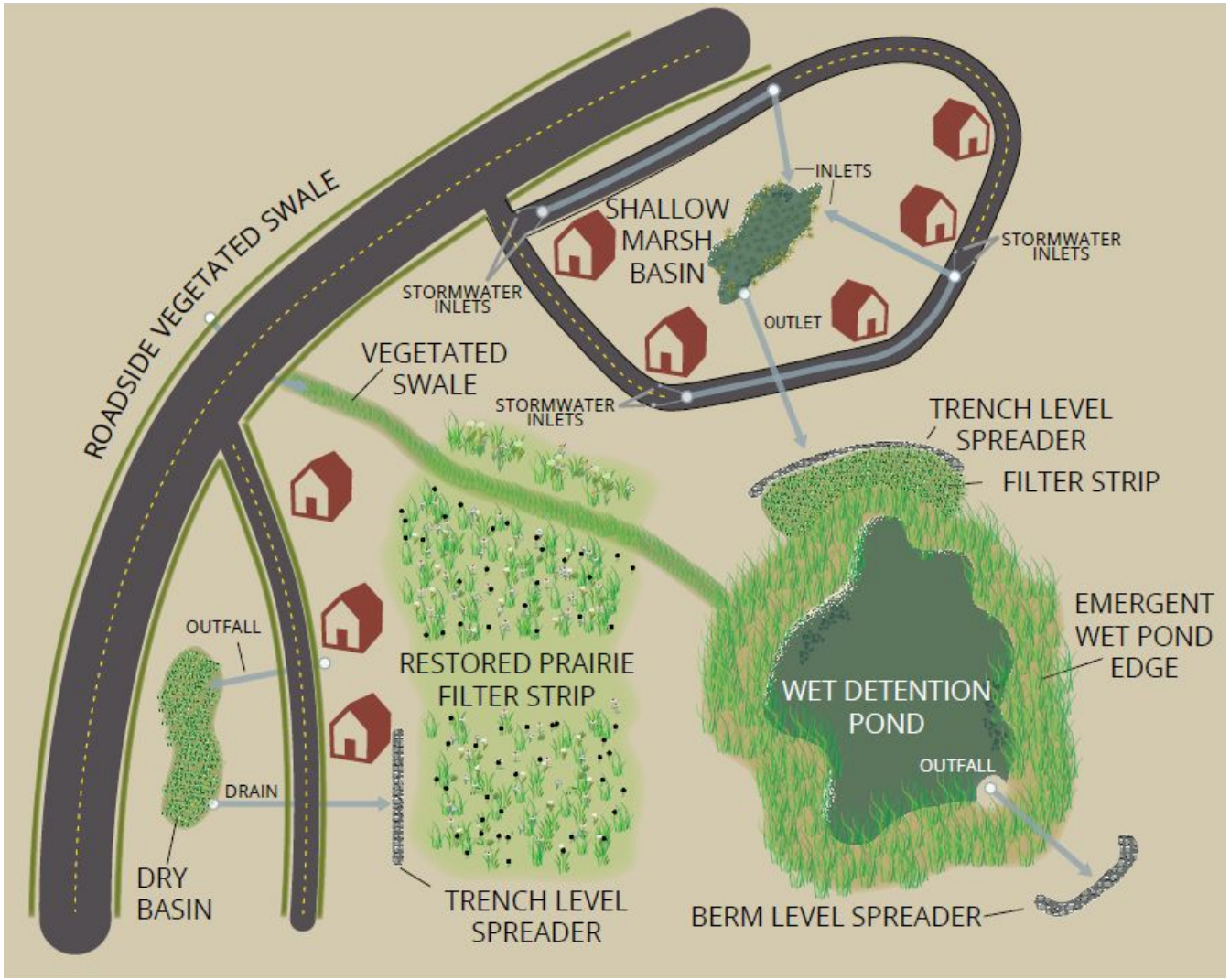
Decision Tools



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Practices Overview

BIO-RETENTION PRACTICES

- Bioswale/Hybrid Ditch
- Rain Garden
- Stormwater Planters
- Box Tree Filter

NATURALIZED DETENTION

- Natural detention basins
  - Wet Bottom Basins
  - Shallow Marsh Basins
  - Dry Bottom Basins

BIO-FILTRATION PRACTICES

- Vegetated Filter Strip & Level Spreaders
- Vegetated Swales

ADDITIONAL PRACTICES

- Stormwater Trees
- Green Roof
- Permeable Pavement
- Underground Storage

Bio-retention Practices

Sites that capturing stormwater runoff, filter pollutants, and promote infiltration that recharges groundwater on-site, using basin-like structure

Rain Garden

Stormwater Planter

Box Tree Filter

Bioswale

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Naturalized Detention Practices

Detention basins are constructed depressions, with discharge sufficiently restricted to store and treat stormwater, and gradually release it to the downstream drainage system.

Wet Bottom Basins

Shallow Marsh Basin

Dry Pond

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Biofiltration Practices

Practices primarily focused on treating runoff as it moves through the site, in addition to reducing its velocity (which reduces erosion and sedimentation downstream).

Filter Strip-
Level Spreader

Vegetated
Swale

Additional Practices

These various BMPs provide a mixture of benefits around treatment, storage, heat reduction, improved aesthetics, and numerous other benefits.

Permeable Pavement

Stormwater Trees

Underground Storage

Green Roof

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Naturalized Detention

Description:

- Large downstream BMP for lower density locations
- Constructed basins, with restricted discharge (to store stormwater), gradually release it downstream.
- Earliest versions were dry bottom basins, meant to only serve as overflow for flooding events

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Naturalized Detention

Description:

- Over past 20 years, more detention basins have constructed as wet ponds and marshes, to improve pollutant removal (and regulatory requirements)
- Consists of herbaceous perennials and grasses found in wetlands
- “Settling” and aquatic organisms remove pollutants

Naturalized Detention

Customization Options:

- **Potential Locations:** Subdivisions, Campuses, Parks
- **Type:** Wet Bottom, Shallow Marsh, Dry Bottom
- Exclusively or partially designated as GI
  - Partial: Dry bottom
- Standalone or part of a regional treatment system
- **Planting goals:** aesthetics, pollinators, habitat restoration
- **Sizing:** seeding or plugs
- Recreation amenities like trails

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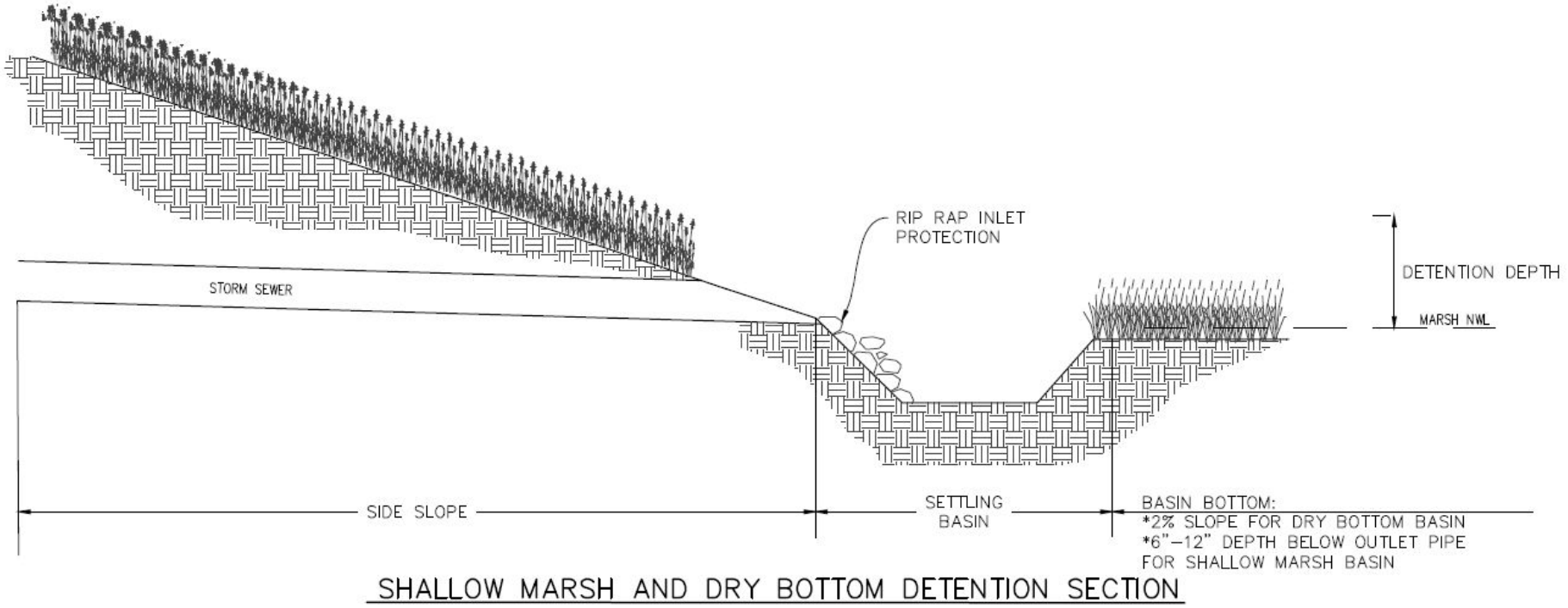
Naturalized Detention



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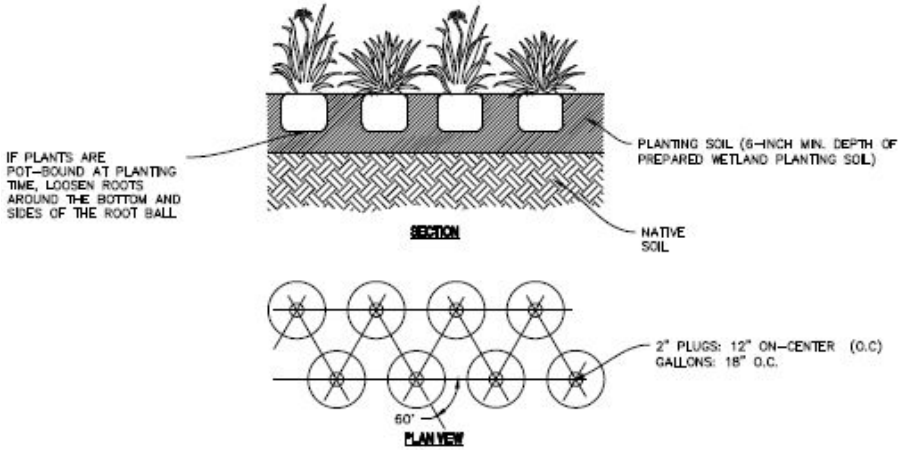
Naturalized Detention



NATIVE PLANTINGS PLUG DETAIL

MIX	BOTANICAL NAME	COMMON NAME	RECOMMENDED PLANTING METHOD	NATIVE TO MIDWEST	MOISTURE
2/3	GRASSES, SEDGES, RUSHES				
	Carex annectens (Carex brachyglossa)	Yellowfruit Sedge, Small Yellow Fox Sedge	PLUG	YES	MESIC - 6" EMERGENT
	Carex comosa	Bristly Sedge, Bottlebrush Sedge	PLUG	YES	WET - 6" EMERGENT
	Carex cristatella	Crested Oval Sedge	PLUG	YES	MESIC - 6" EMERGENT
	Carex hystericina	Bottlebrush Sedge, Porcupine Sedge	PLUG	YES	MESIC - 6" EMERGENT
	Carex vulpinoidea	Brown Fox Sedge	PLUG	YES	MESIC - 6" EMERGENT
	Glyceria grandis	American Manna Grass, Reed Manna Grass	PLUG	YES	WET - 6" EMERGENT
	Juncus effusus	Soft Rush	PLUG	YES	WET - 6" EMERGENT
	Juncus torreyi	Torrey's Rush	PLUG	YES	MESIC - 6" EMERGENT
	Leersia oryzoides	Rice Cut Grass	PLUG	YES	WET - 6" EMERGENT
	Schoenoplectus tabernaemontani	Soft-stem Bulrush	PLUG	YES	WET - 12" EMERGENT
	Scirpus atrovirens	Dark Green Bulrush	PLUG	YES	WET - 12" EMERGENT
	Scirpus cyperinus	Wool Grass	PLUG	YES	WET - 6" EMERGENT
1/3	FORBS	Common Water Plantain	BARE ROOT	YES	
	Alisma subcordatum	Common Water Plantain	BARE ROOT	YES	0" - 12" EMERGENT
	Iris virginica var. shrevii	Blue Flag Iris	BARE ROOT	YES	WET - 6" EMERGENT
	Pontederia cordata	Pickerel Weed	BARE ROOT	YES	0" - 6" EMERGENT

SUGGESTED NATIVE PLANTING SPECIES AND MIX[1,2]

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Naturalized Detention

	Item	Description	Unit Price	Unit
GI Technique	Naturalized Detention Basin	Design/Engineering	15% of Construction Cost	LS
		Mobilization	$10,000.00	LS
		Excavation & Haul	$45.00	CY
		Grading	$12.00	SY
		Topsoil (6")	$25.00	CY
		Erosion Blanket	$3.00	SY
Required Component	Native Plantings	Seeding	$0.50	SF
		Plugs (12" on center)	$5.00	EA
		Gallons (36" on center)	$15.00	EA
	Inlet Protection	Rip Rap	$500.00	EA
	Outlet Control Structure	48" Manhole with Outlet Control	$3,500.00	EA
	Storm Sewer	12" HDPE storm Sewer	$65.00	LF
	Sewer connection	Connection to existing manhole	$600.00	EA

Naturalized Detention

Construction Specifications

- 2 - Clearing and Grubbing
- 5 - Pollution Control
- 6 - Seeding, Sprigging and Mulching
- 7 - Construction Surveys
- 8 - Mobilization and Demobilization
- 21 - Excavation
- 23 - Earthfill
- 25 - Rockfill
- 26 - Topsoiling
- 44 - Corrugated Polyethylene Tubing

Naturalized Detention

Maintenance Guidance

- Focused on vegetative management, erosion repair, and sediment and debris removal.
- Most intensive during the first 1-3 years
- Inspect and outlet structures for debris, and inlet structures and shoreline for erosion
- Erosion is greatest concern prior to vegetation establishment
- **Year 1:** Monthly inspection and after significant rainfall (annual inspection after year 1)
- Intensive landscape maintenance should occur in first 3 years (herbicide and re-seeding)
- Seeded landscapes may take up to 5 years to establish
- Annual maintenance afterward
- Prescribed burns for landscapes preferred, mowing an alternative

Lessons & Limitations

Scalability:

- The site-specific, custom-nature of green infrastructure projects makes it hard to create transferrable guidelines

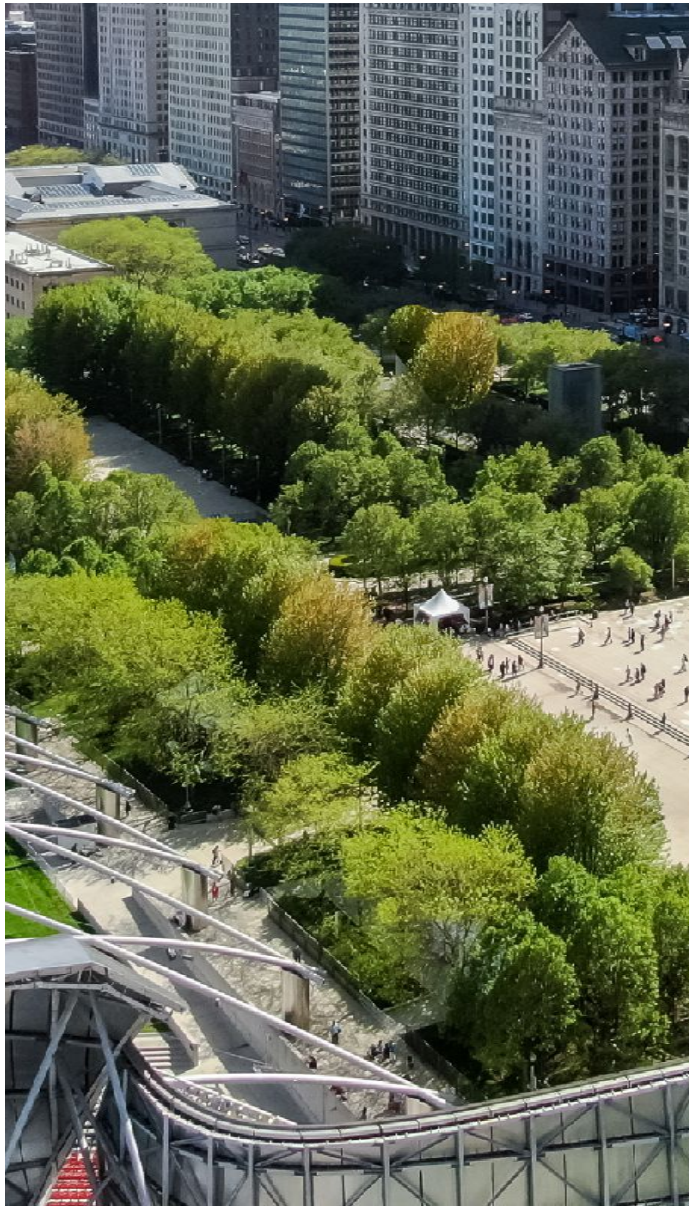
Cost:

- Much of the important information that will dictate construction cost is identified during design
  - Example: Can you use the soil on-site?
- Project characteristics and when the project is bid out in the calendar year tend to dictate pricing more than the regional factors

Lessons & Limitations

Blending BMP's

- Originally intended to incorporate agriculture BMP's in this guide as well, but it became clear that that topic was too large to fit in with the existing content
- In practice, BMP's don't always conform to strict types, and oftentimes specific projects are a blend of different BMP's



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How to Access the Guide

RISC Solutions

https://www.risc.solutions/toolkits-and-reports/

Delta Institute

https://delta-institute.org/program-area/green-infrastructure/

In addition to report, CAD files will be made available on project pages.

Questions

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