Cory Gallo, ASLA, LEED AP
Emily Overbey, Graduate Student
Brian Wethington, Portland BES

Portland and Progressive Stormwater Design

- Regarded as a leader in progressive and innovative stormwater management
  - Manage on-site and at-the-source
  - Small-scale, vegetated facilities
- Manage for water quantity and quality
- Even more...
  - Educate the public
  - Create visual amenity
  - Add value
  - Become art features

WHY???

- **Three possible contributors…**
  - CLIMATE
  - POLICIES
  - TOOLS

WHY PORTLAND?

Research Question...

How do Landscape Architects and Civil Engineers use Portland's unique stormwater sizing tools during the site design process?

RESEARCH QUESTION

BACKGROUND

Municipal Stormwater Management Manuals

Typically…

- Stormwater manuals recommend or require a sizing approach.
- Usually to a specific on-site stormwater model:
  - Rational
  - TR55
  - Etc.
- Basically… formulas which are left to the designer to interpret and are difficult for administrators to verify.

STORMWATER MANUALS

Municipal Stormwater Management Manuals

Philadelphia's new manual encourages small-scale bmp's but leaves the sizing of them up to designers.

Table 5.3: Acceptable Calculation Methods for Runoff Estimation

Type	Mathematical Model	Impervious Cover	Experience Modeling Soil Properties	Hand/Spreadsheet Calculations	Example Computer Programs
Empirical Methods	NRCS Curve Number method	Any	Moderate-High	Yes (smaller sites)	NRCS, TR-55, TR-20, HEC-HMS
Infiltration Loss Models	Constant Loss	Any	Moderate-High	Yes (smaller sites)	HEC-HMS
	Green-Ampt	Any	High	No	EPA SWMM, HEC-HMS
	Horton	Any	High	No	EPA SWMM

STORMWATER MANUALS

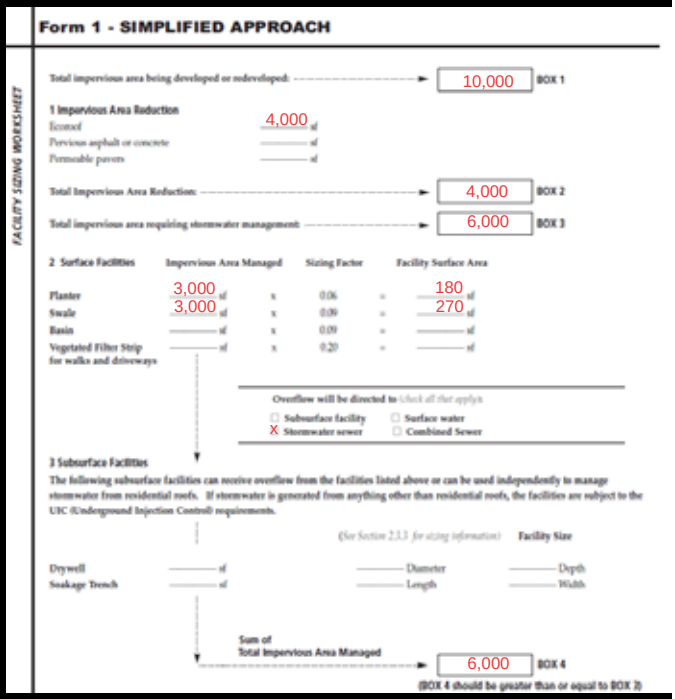
Portland's Sizing Tools

- 3 sizing methodologies:
  - **Simplified Approach**
    - sizing factor based formula
  - **Presumptive Approach**
    - Infiltration loss spreadsheet model which uses the SBUH method
  - **Performance Approach**
    - catchall which allows designers to use any model
    - hardly ever used

PORTLAND'S APPROACH

This is it…

- Designed for small, residential sites to make the process “simple”.
- Not allowable for commercial project approval.
- However, is it used as part of the design process???



Form 1 - SIMPLIFIED APPROACH

FACILITY SIZING WORKSHEET

Total impervious area being developed or redeveloped: ► 10,000 BOX 1

1 Impervious Area Reduction

Removed 4,000 sf

Pervious asphalt or concrete ____ sf

Permeable pavers ____ sf

Total Impervious Area Reduction: ► 4,000 BOX 2

Total impervious area requiring stormwater management: ► 6,000 BOX 3

2 Surface Facilities	Impervious Area Managed		Sizing Factor		Facility Surface Area
Planter	3,000 sf	x	0.06	=	180 sf
Swale	3,000 sf	x	0.09	=	270 sf
Basin	____ sf	x	0.09	=	____ sf
Vegetated Filter Strip for walks and driveways	____ sf	x	0.20	=	____ sf

Overflow will be directed to (check all that apply):

☐ Subsurface facility ☐ Surface water

X Stormwater sewer ☐ Combined Sewer

3 Subsurface Facilities

The following subsurface facilities can receive overflow from the facilities listed above or can be used independently to manage stormwater from residential roofs. If stormwater is generated from anything other than residential roofs, the facilities are subject to the UIC (Underground Injection Control) requirements.

	(See Section 2.3.3 for sizing information)		Facility Size	
Drywell	____ sf	____ Diameter		____ Depth
Soakage Trench	____ sf	____ Length		____ Width

Sum of Total Impervious Area Managed ► 6,000 BOX 4

(BOX 4 should be greater than or equal to BOX 3)

Sizing factors...

- Sizing factors allow each facility to manage the up to Portland’s 10-year event for flow and manage water quality.
- Four small-scale BMPs with sizing factors:
  - Basin
  - Swale
  - Planter
  - Filter Strip

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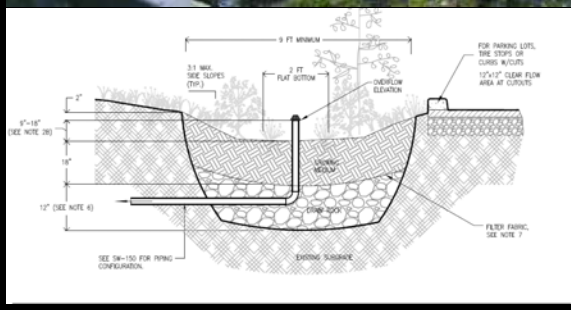
SIMPLIFIED APPROACH

	sizing factor
Basin	**0.09**
Swale	0.09
Filter Strip	0.20
Planter	0.06

Photo: City of Portland, 2008 Stormwater Management Manual

- Flat-bottomed, shallow landscaped depression used to collect and hold stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground.

- Reservoir depth = 12”
- Growing medium
  - Infiltration rate = 2.0 in/hr
  - Depth = 18”
- 12” gravel depth
- 9’ minimum width
- 3:1 max side slopes



BASIN

	sizing factor
Basin	0.09
Swale	**0.09**
Filter Strip	0.20
Planter	0.06

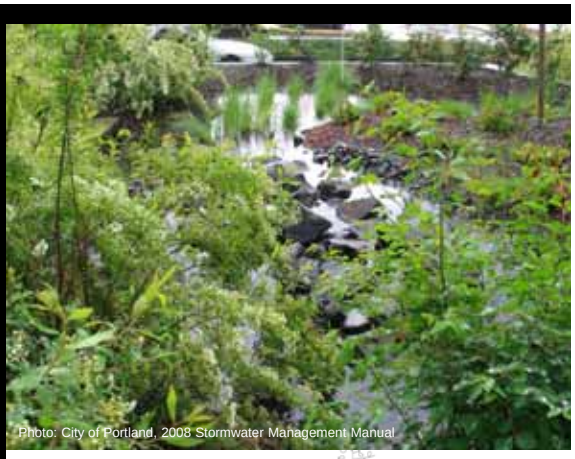
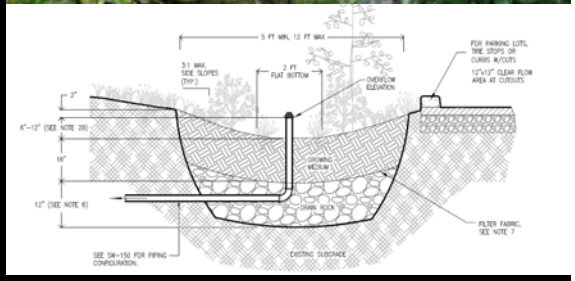


Photo: City of Portland, 2008 Stormwater Management Manual

- Long, narrow, gently sloping landscaped depressions that collect, convey, filter, and infiltrate stormwater runoff.

- Reservoir depth = 9”
- Growing medium
  - Infiltration rate = 2.0 in/hr
  - Depth = 18”
- 12” gravel depth
- 5’ min, 12’ max width
- 3:1 max side slope

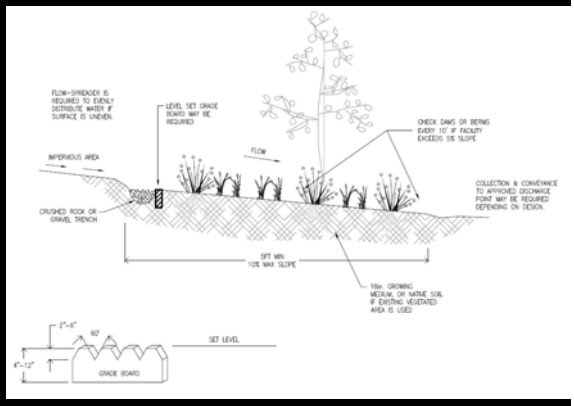


SWALE

	sizing factor
Basin	0.09
Swale	0.09
Filter Strip	**0.20**
Planter	0.06

- Gently sloped area that is designed to receive sheet flows and slow down runoff. Typically linear facilities that run parallel to the impervious surface and are commonly used to receive the runoff from walkways and driveways.

- Growing medium
  - Infiltration rate = 2.0 in/hr
  - Depth = 18”
- 5’ minimum width
- 10% max slope



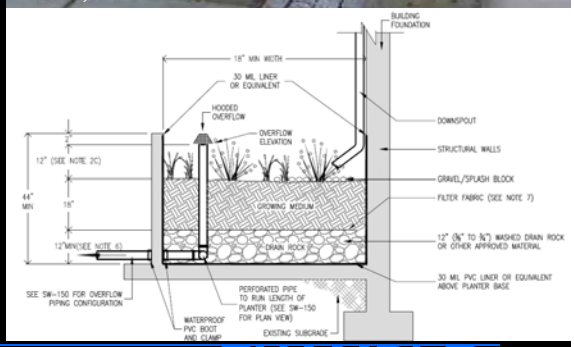
FILTER STRIP

	sizing factor
Basin	0.09
Swale	0.09
Filter Strip	0.20
Planter	**0.06**

- Structural landscape reservoirs used to collect, filter, and infiltrate stormwater, allowing pollutants to settle and filter out as the water percolates through the vegetation, growing medium, and gravel.

- Reservoir depth = 12”
- Growing medium
  - Infiltration rate = 2.0 in/hr
  - Depth = 18”

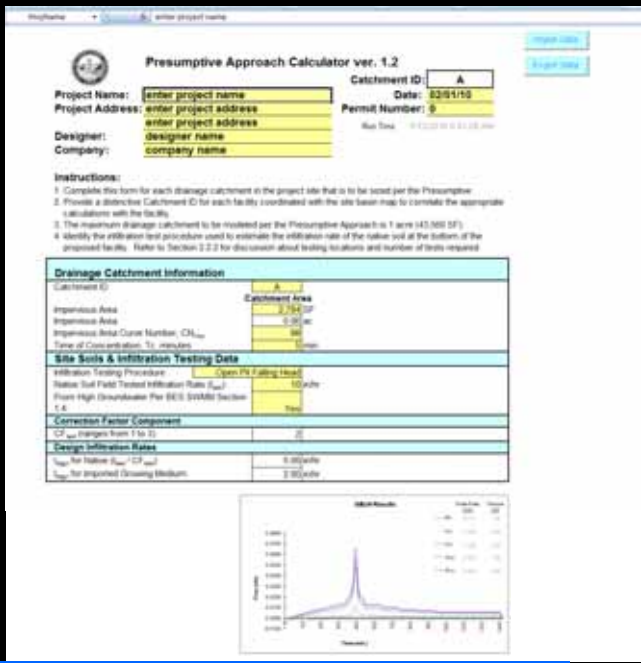

Photo: Cory Gallo



EXAMPLE

Presumptive Approach

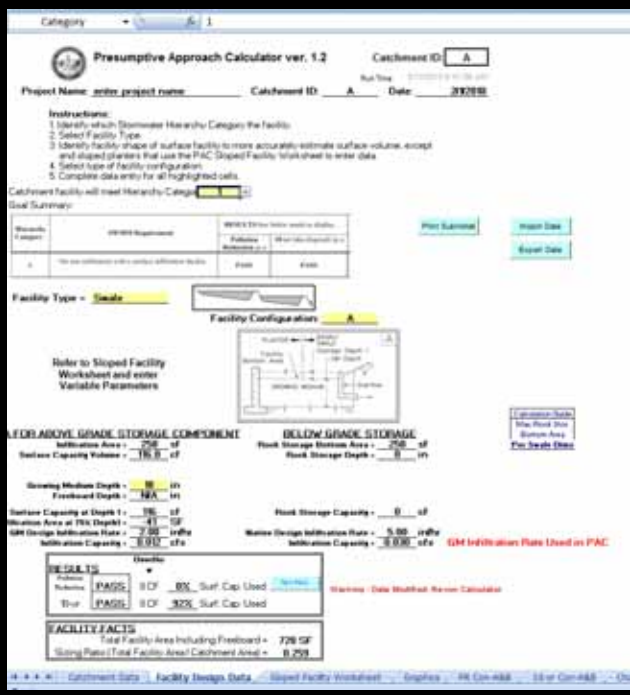
- Designed for larger, commercial sites to allow for accurate sizing of small-scaled BMPs.
- Calculates detailed specifications of BMP design including soil depth, storage depth, and drain rock depth.
- Allowable on any project type.
- Still, comparatively easy to use, but more cumbersome than simplified method.

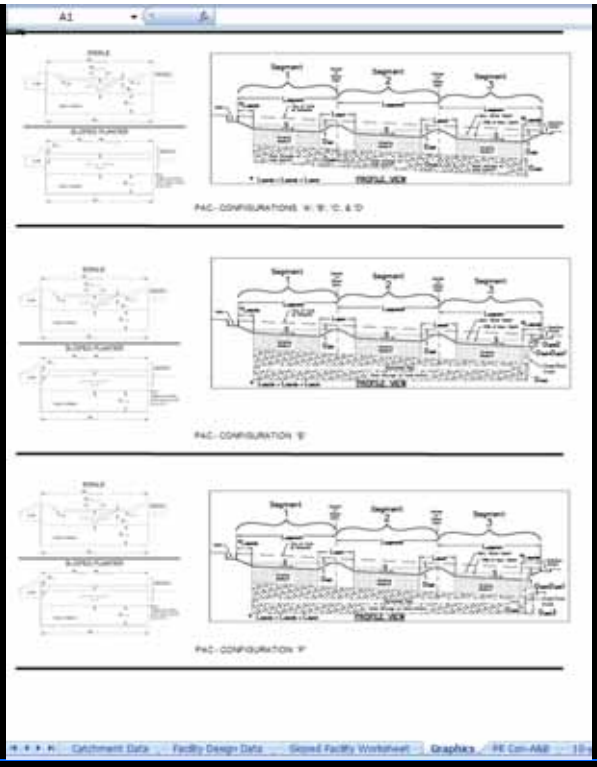


Presumptive Approach

Designers can control key features:

- Geometry
- Infiltration rate
- Reservoir depth
- Sub-surface storage
- Basically… a designer can create his/her own section and size it.
- Model includes all calculations for approval.
- Everyone's calculations are the same.





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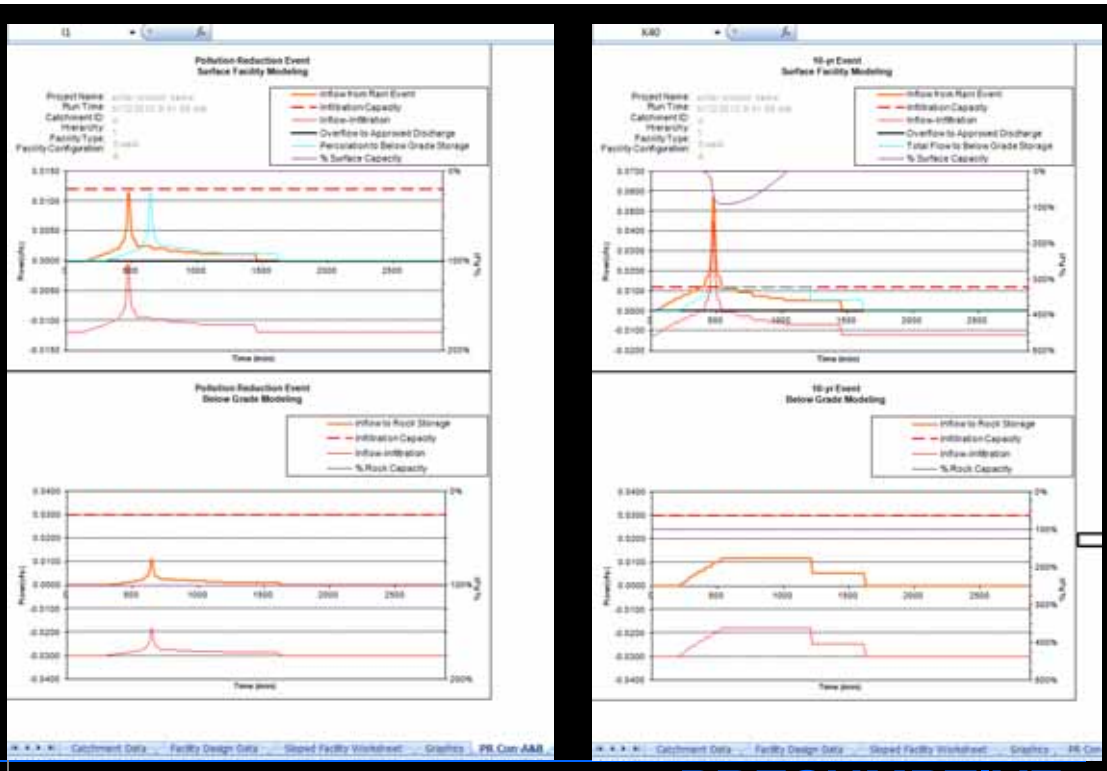

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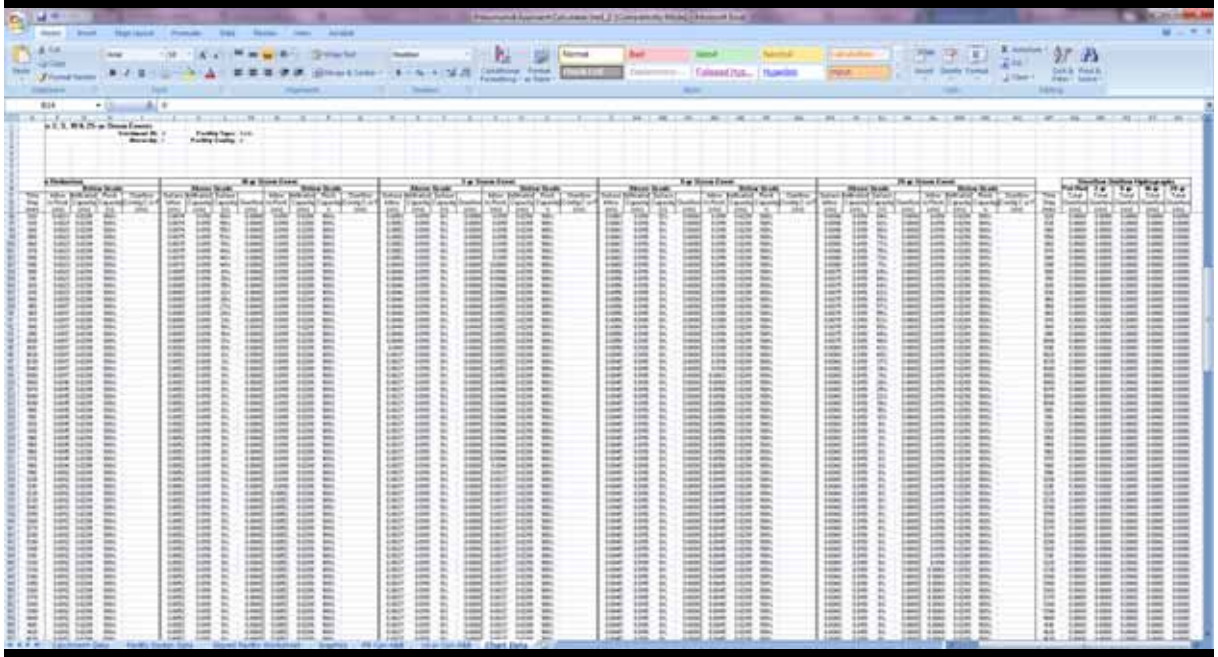

PRESUMPTIVE APPROACH

METHODS

Determining how designers use the approaches

Simplified and **Presumptive Approaches**…

- How do Landscape Architects and Civil Engineers use them?
- Which one do they use most often?
- When do they use them?

Determining how designers use the approaches

- Developed Web-based survey
- Distribution of survey by BES and Mississippi State University
- Targeted distribution to both Landscape Architects and Civil Engineers who regularly design stormwater facilities.
- Total respondents 32: 16 Landscape Architects and 16 Civil Engineers

Determining how designers use the approaches

- Survey Categories
  - Demographics
  - Work Focus
  - Stormwater Management Manual Experience
  - Stormwater Design Process
    - When facilities are sized during the design process
  - Perceptions of the Stormwater Management Manual
  - Short Answer Comments

SURVEY STRUCTURE

RESULTS

(in progress)

Use

Which Sizing Methodology do you feel best suits your professional needs and role in the design process?

LA's prefer the simplified and Engineers prefer the presumptive.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Simplified	6.3% (1)	**42.9% (6)**	20.7% (6)
Presumptive	**81.3% (13)**	28.6% (4)	**58.6% (17)**
Performance	6.3% (1)	0.0% (0)	3.4% (1)
N/A	6.3% (1)	28.6% (4)	17.2% (5)

Use

Even though it is currently not allowed for permitting, do you feel the Simplified Approach is useful for sizing stormwater facilities on commercial projects?

Both thought the simplified was useful.

		Civil/Environmental Engineering	Landscape Architecture	Response Totals
Rating	Not at all	18.8% (3)	7.7% (1)	
		12.5% (2)	7.7% (1)	
	Somewhat	**31.3% (5)**	**30.8% (4)**	
		18.8% (3)	23.1% (3)	
	Definitely	18.8% (3)	**30.8% (4)**	

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SURVEY QUESTIONS

Understanding

Which stormwater facility types do you feel you are technically capable of properly sizing to meet the city's requirements?

Engineers have a greater understanding of facility sizing.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
None of them	0.0% (0)	**29.4% (5)**	15.6% (5)
Those on the Simplified Approach	0.0% (0)	23.5% (4)	12.5% (4)
Those on the Simplified and Presumptive Approaches	6.3% (1)	**29.4% (5)**	18.8% (6)
All of the approved facilities	**93.8% (15)**	17.6% (3)	**53.1% (17)**

Understanding

Which Sizing Methodology do you think is most accurate in terms of site engineering?

Engineers have a greater understanding of facility sizing.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Simplified	0.0% (0)	7.1% (1)	3.4% (1)
Presumptive (for private and streets)	**50.0% (8)**	7.1% (1)	**31.0% (9)**
Performance	18.8% (3)	14.3% (2)	17.2% (5)
Don't Know	18.8% (3)	**42.9% (6)**	**31.0% (9)**
They're all about the same	12.5% (2)	28.6% (4)	17.2% (5)

Design Process

At what stage of the site design process do you typically begin sizing stormwater facilities?

Both groups start sizing early.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Programming (space needs assessments)	12.5% (2)	12.5% (2)	12.9% (4)
Conceptual Design (loose drawings on trace paper)	**43.8% (7)**	**50.0% (8)**	**45.2% (14)**
Schematic Design (more refined drawings, but not detailed	37.5% (6)	31.3% (5)	35.5% (11)
Design Development (CAD documents being refined into construction documents)	6.3% (1)	6.3% (1)	6.5% (2)
Construction Documentation	0.0% (0)	0.0% (0)	0.0% (0)

Design Process

Do you typically explore multiple locations for stormwater facilities **early** in the design process (programming or conceptual design)?

Both explore multiple locations (how creative?)

		Civil/Environmental Engineering	Landscape Architecture
Ratings	None of the Time	0.0% (0)	0.0% (0)
		6.3% (1)	0.0% (0)
	Some of the Time	25.0% (4)	12.5% (2)
		31.3% (5)	37.5% (6)
	All of the Time	**37.5% (6)**	**50.0% (8)**

Design Process

If stormwater facilities are sized **early** in the design process (programming or conceptual design), which approach is typically used on your projects?

LA's use the simplified when they size them early on.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Simplified	31.3% (5)	**43.8% (7)**	**38.7% (12)**
Presumptive	**43.8% (7)**	18.8% (3)	32.3% (10)
Performance	6.3% (1)	0.0% (0)	3.2% (1)
N/A	18.8% (3)	37.5% (6)	25.8% (8)

SURVEY QUESTIONS

Design Process

If stormwater facilities are sized **early** in the design process (programming or conceptual design), who typically sizes them on your projects?

BUT… still rely on Engineers most of the time even early on.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Civil/Environmental Engineer (PE)	**93.8% (15)**	**68.8% (11)**	**83.9% (26)**
Landscape Architect (RLA)	6.3% (1)	31.3% (5)	16.1% (5)
Architect (RA)	0.0% (0)	0.0% (0)	0.0% (0)
Other (please specify)	0 replies	2 replies	2

SURVEY QUESTIONS

Design Process

Who typically sizes stormwater facilities for **permitting** your projects?

Engineers size facilities for permitting.

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Civil/Environmental Engineer (PE)	**100.0% (16)**	**93.8% (15)**	**96.8% (30)**
Landscape Architect (RLA)	0.0% (0)	6.3% (1)	3.2% (1)
Architect (RA)	0.0% (0)	0.0% (0)	0.0% (0)
Other (please specify)	0 replies	1 reply	1

SURVEY QUESTIONS

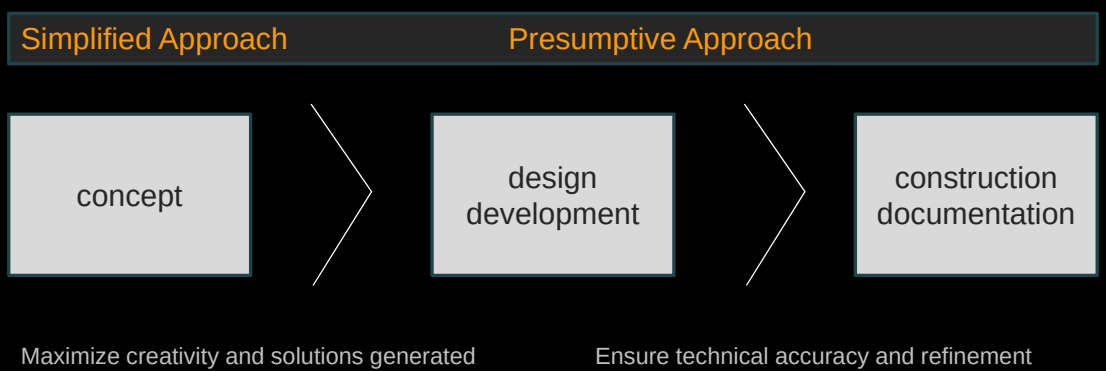
DISCUSSION & CONCLUSION

Preliminary Conclusions

- Sustainable stormwater management requires new tools.
- Both tools are helpful to encourage the design and implementation of small-scale BMP's.
- **Civil Engineers VS Landscape Architects:**
  - All designers explore multiple locations and start sizing early on.
  - Civil Engineers have a better command and understanding of the tools.
  - Civil Engineers prefer the more complex Presumptive Approach.
  - Landscape Architects prefer the simpler Simplified Approach.
  - Landscape Architects typically rely on Civil Engineers to finalize facilities.

Preliminary Conclusions

- Recommendations for Portland:
  - Encourage the use of both tools.
  - Simplified early in process to encourage creativity.
  - Presumptive later in the process to ensure accuracy.



What's Next

- More responses?
- Statistical Analysis
- Recommendations to Portland
- Comparison to other similar models?

- Thank you…

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Cory Gallo, ASLA, LEED AP
Assistant Professor
Department of Landscape Architecture
Mississippi State University

cgallo@lalc.msstate.edu

QUESTIONS

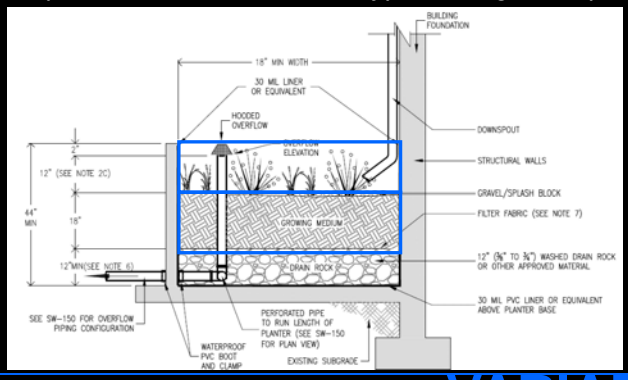
Respondents

- Majority of respondents are landscape architects and civil engineers
- Majority of respondents have at least 5 years of experience
- Majority have worked in both private and public practice
- Landscape Architects tend to design smaller projects (up to 5 acres)
- Civil Engineers tend to design larger projects (5 acres or larger)

SURVEY QUESTIONS

Variables to modify...

- Reservoir depth (or storage depth)
  - 12” (specified)
  - 18”-24” (more volume, more detention, less surface area)
- Infiltration rate (of growing medium)
  - 2.0 in/hr (specified – sand/loam/compost)
  - 8.0 in/hr (sand, still allows for some types of vegetation)



VARIABLES TO MODIFY

Design Process

At which stage of the site design process do you feel stormwater facilities on your projects are finalized or close to finalized in terms of their size and location?

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Programming (space needs assessments)	0.0% (0)	0.0% (0)	0.0% (0)
Conceptual Design (loose drawings on trace paper)	6.3% (1)	0.0% (0)	3.2% (1)
Schematic Design (more refined drawings, but not detailed)	12.5% (2)	18.8% (3)	12.9% (4)
Design Development (CAD documents being refined into construction documents)	**56.3% (9)**	**68.8% (11)**	**64.5% (20)**
Construction Documentation	25.0% (4)	12.5% (2)	19.4% (6)

Design Process

At what stage of the site design process do you feel stormwater facilities on your projects are finalized or close to finalized in terms of their technical design (underdrain or not, drain rock depth, etc)?

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Programming (space needs assessments)	0.0% (0)	0.0% (0)	0.0% (0)
Conceptual Design (loose drawings on trace paper)	0.0% (0)	0.0% (0)	0.0% (0)
Schematic Design (more refined drawings, but not detailed)	18.8% (3)	12.5% (2)	12.9% (4)
Design Development (CAD documents being refined into construction drawings)	**43.8% (7)**	31.3% (5)	38.7% (12)
Construction Documentation	37.5% (6)	**56.3% (9)**	**48.4% (15)**

Design Process

What approach is typically used to size stormwater facilities for **permitting** your projects?

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
Simplified	12.5% (2)	18.8% (3)	16.1% (5)
Presumptive	**68.8% (11)**	**37.5% (6)**	**54.8% (17)**
Performance	12.5% (2)	18.8% (3)	16.1% (5)
N/A	6.3% (1)	25.0% (4)	12.9% (4)

Understanding

Which revision of the SWMM do you feel was most easily understood and applicable?

	Civil/Environmental Engineering	Landscape Architecture	Response Totals
1999	0.0% (0)	0.0% (0)	0.0% (0)
2000	0.0% (0)	0.0% (0)	0.0% (0)
2002	6.3% (1)	7.7% (1)	3.6% (1)
2004	6.3% (1)	15.4% (2)	10.7% (3)
2008	**87.5% (14)**	**76.9% (10)**	**85.7% (24)**

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SURVEY QUESTIONS

Tools

- 3 sizing methodologies:
    - **Simplified Approach**
    - **Presumptive Approach**
    - **Performance Approach**

PORTLAND'S APPROACH

Presumptive Approach

- Detailed design characteristics based on site-specific conditions including:
    - Storage depth
    - Soil media
    - Underdrain
    - Storage rock
    - Geometry
- The model includes all calculations required for approval.
- Everyone's calculations are the same.

PRESUMPTIVE APPROACH

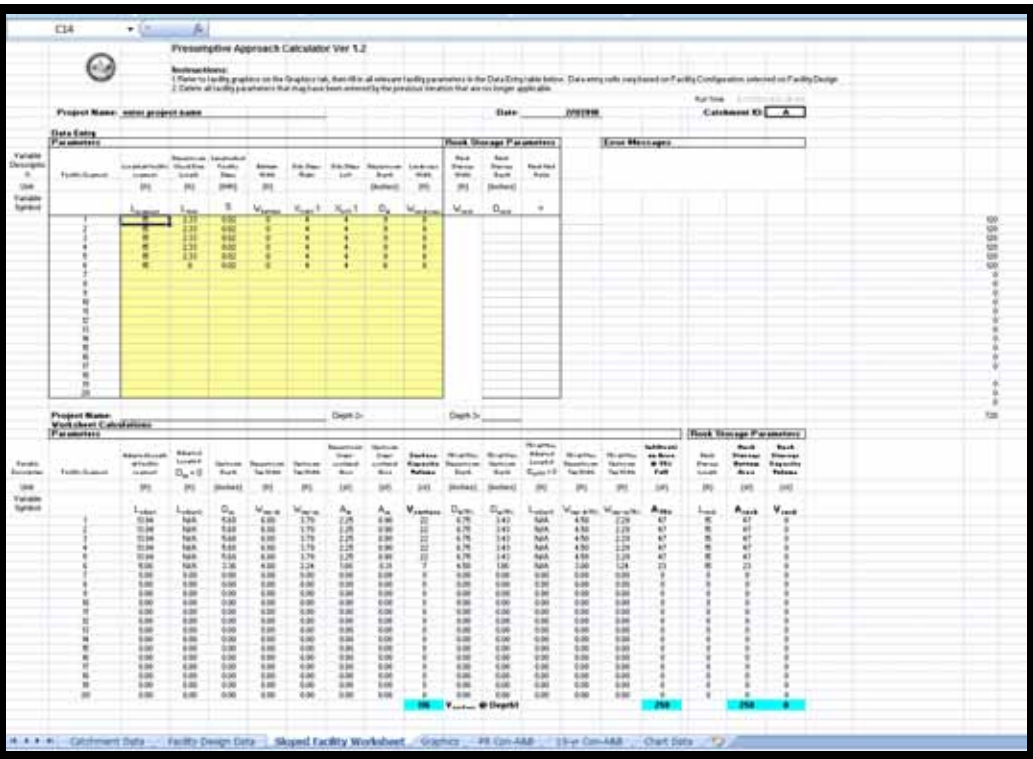
Use

How often do you use each approach?

LA's use the simplified more often then Engineers.

	Civil/Environmental Engineering	Landscape Architecture	Response Sum	Response Totals
Simplified	15 replies (20.33)	**11 replies (63.64)**	1,005	40.20 (25)
Presumptive (for private and streets)	**15 replies (65.87)**	9 replies (48.67)	**1,426**	**62.00 (23)**

SURVEY QUESTIONS



PRESUMPTIVE APPROACH