Madison's First Permeable Pavement Street



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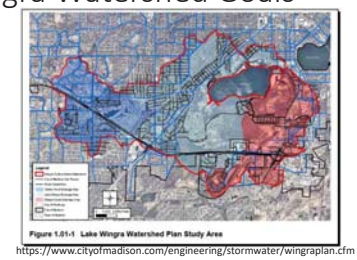
Working toward the Wingra Watershed Goals

Wingra Watershed Plan

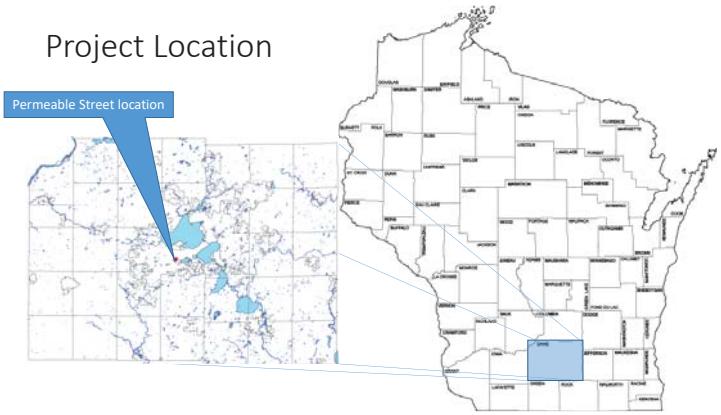
- 1,000 private rain gardens
- 4 ac of permeable pavement
- Downspout Disconnection 35%
- 1,000 Terrace Rain Gardens
- Total infiltration of ~6 Millon gallons

The Pilot study is 7 % of the watershed. An area weighted goal for the pilot area is 420,000 gallons each year.

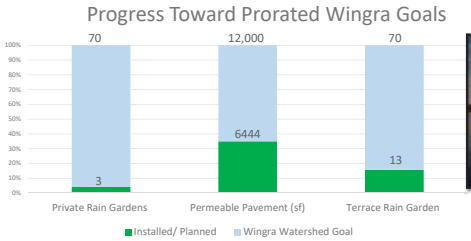


https://www.cityofmadison.com/engineering/stormwater/wingraplan.cfm

Project Location



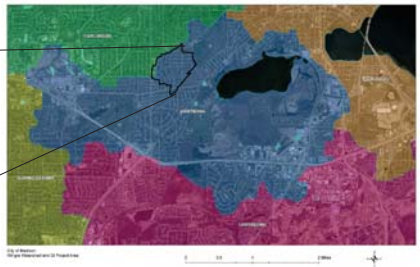
Working toward the Wingra Watershed Goals



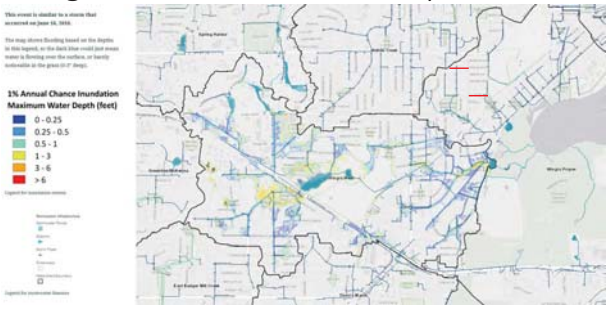
Progress within the GI Pilot Study Area

Photo credit: Richard Hurd

Project Location



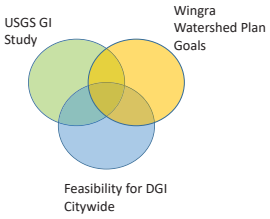
Wingra West Watershed Study



2-D Hydrologic and Hydraulic Model
One task is assessing the impact of DGI

Project Goals

- USGS GI Pilot Study
- Wingra Watershed Plan
- Distributed Green Infrastructure Evaluation
  - Citywide Watershed Studies



Spancrete Panels

- Tongue and groove in the street
- Tabs in the sidewalk.
- This was due to the 5.5' width requirement
- 6" thickness for sidewalk
- 8" thickness for street
- Manufactured in environmentally controlled environment

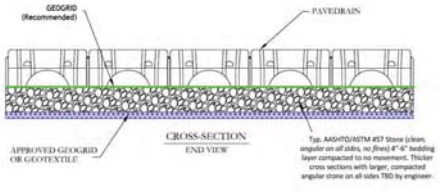
Material Selection Process

- USGS Permeable Test Site
- Considerations
  - Durability
  - Winter Maintenance
  - Finished Surface Appearance
  - Long Term Maintenance Requirements
  - Constructability

Permeable Pavement Testing Facility -East Side of Madison

https://www.usgs.gov/science/evaluating-potential-benefits-permeable-pavement-quantity-and-quality-stormwater-runoff

Pavedrain



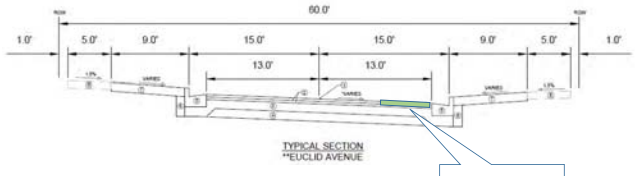
St. Clair Street Pavedrain Section

Selected Products

Spancrete Replenish

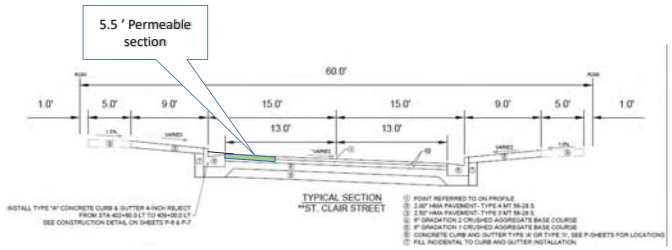
Pavedrain

Euclid Avenue Cross Section

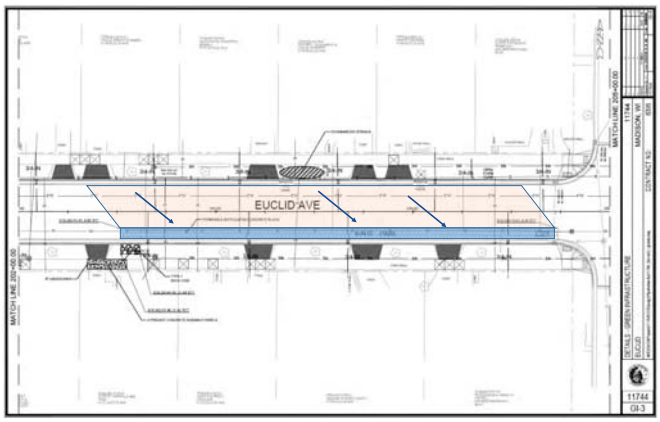


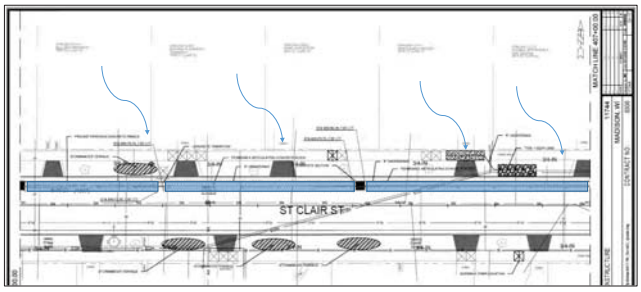
30' Face to Face width
Super Elevated Street
26' of asphalt
21.5' of Run-on to 5.5' of Permeable surface
4:1 Run on

St Clair Street



Euclid Ave Looking West - Pavedrain





Permeable section placed on the high side of the street
This was due to a conflict with the water utility on the low side
Due to the tight schedule we did not have time to address concerns so we moved

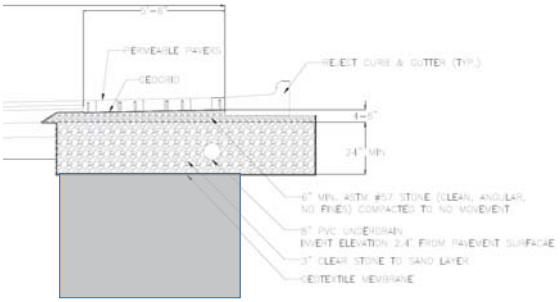
Euclid Ave looking East - Replenish

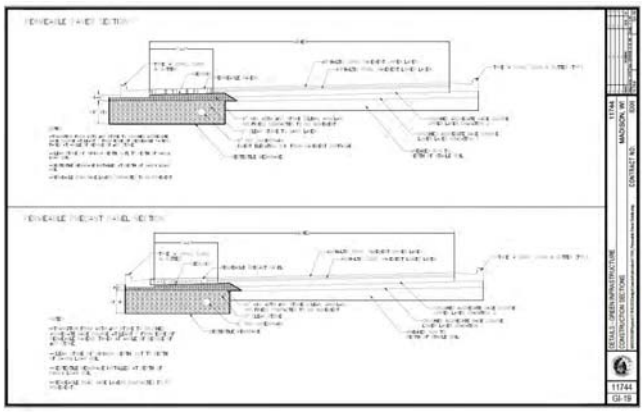
St Clair
Looking East
Pavedrain

Moving the Permeable pavement on the high side and changing the curb type changes the loading ratio.

Went from 4:1 to 6:1 for Pavedrain and 5:1 for Replenish (only accounting for directly connected impervious)

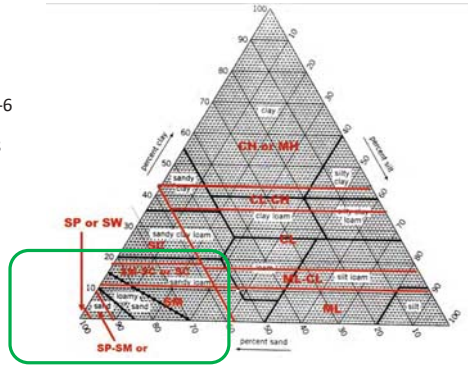
St. Clair Cross Section



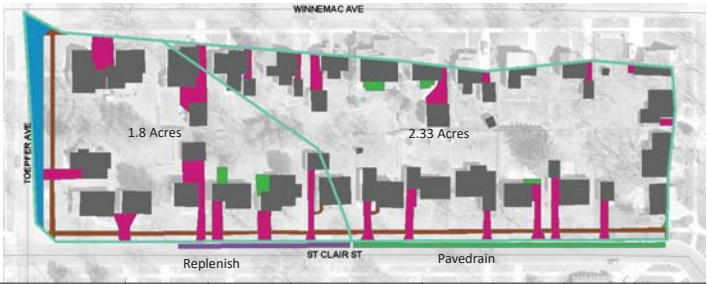


Soils

- Each Street had 3 soil boring
  - Euclid Sandy Layer at 3-6 feet Deep
  - St. Clair Sandy Layer 4-8 feet Deep
- Loamy Sand to Sandy Loam
  - 1.63 – 0.5 inches per hour
  - 3" clear stone
    - 3' – 8 '
    - @ 0.5 "/hr 64 hours full drawdown



Geogrid protects rolled surface



Location	Runon (cf)	Runoff (cf)	Volume Reduction	TSS	lb Reduced	TP	lb TP Reduced
St. Clair Precast	34,305	6,861	80%	92%	374	85%	1.389
St Clair Pavedrain	35,181	1,407	96%	92%	286	85%	1.54
Euclid Precast	16,210	162	99%	99%	17	99%	0.12
Euclid Pavedrain	10,122	101	99%	99%	17	99%	0.12
Total	95,818	8,531	91%		694		3.169

Cost

Bid Prices

Surface	Unit Cost (sf)	Quantity	Total Cost Low	Total Cost High	Project Cost
Pavedrain	$24.30 - $33.5	3,284	$79,801	$110,014	$79,801
Spancrete	$30.62 - $43.65	3,163	$96,851	$138,065	$99,635
Totals		6,447	$176,652	$248,079	$179,436

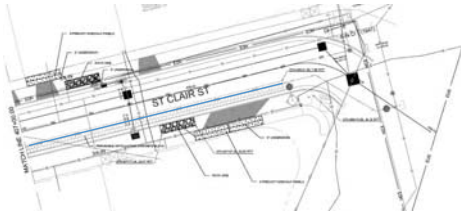
Change Orders

Description	Quantity	Unit	Unit Price	Total
Stone for Pervious Undercut	1200	Tons	16.4	$19,680
Polymeric Sand to fill gap	1200	LF	4	$4,800
Concrete Sealant (Pavedrain Only)	3300	sf	1.25	$4,125
Clean Gap	600	LF	$3.00	$1,800
				$30,405

Total Cost	$209,841

Utility conflicts

- Permeable surfaces have unknown future risk for other utilities
  - Emergency repairs
    - How and who fixes the problem?
    - What do we do with the geogrid and geotextile?
  - Risk led to re-design of water supply line on Euclid Ave and of the permeable sections St. Clair



Financial Considerations

Are you counting permeable pavement as an asset?

What is an appropriate depreciation rate?

20 years?

Work to develop a process for tracking installations for both maintenance and financial records.

#BUILTbyBONDS

vs

How we addressed access structures and Material transition

Lessons Learned

Expect a lot of questions and site visits during your first project.

Inspectors, Contractors, and Designers all need practice.

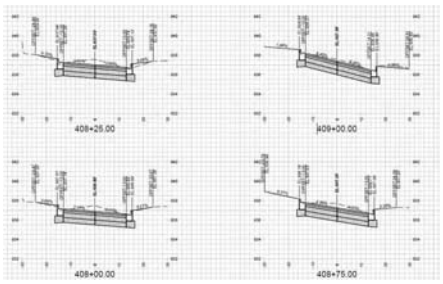
Lesson Learned: Curb Machine Wobble

Polymeric Sand vs Granite Chip

- Polymeric Sand is pricey
- Polymeric Sand is not permeable
- Polymeric Sand stays in place

- Chips are less expensive up front
- Chips are permeable
- Chips need to be replaced after each vacuum

Keep Cross Slopes Consistent



Transitions in cross slope are difficult for the precast panels.

Only use in areas with the same cross slope.

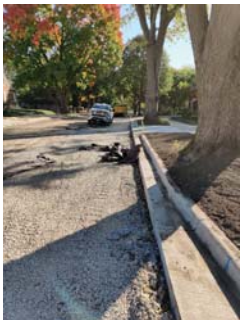
Can I settle a block?

Block ¾ - 1 " above curb
Specification required max deviation of ½ inch.

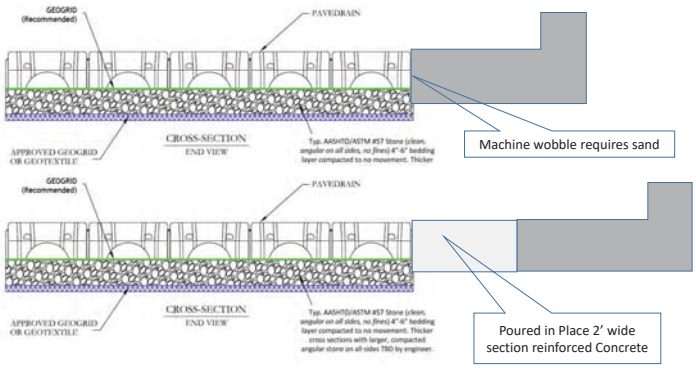
Three Options Discussed:

- Vibratory plate on front end loader load spreading log
- Remove high blocks, remove #57 stone, compact, replace block
- Grind down lip

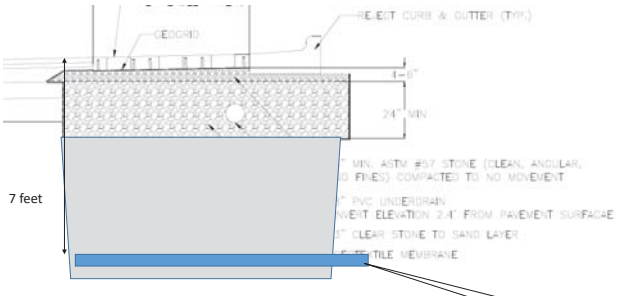
Need to protect the clear stone



Avoiding the Gap

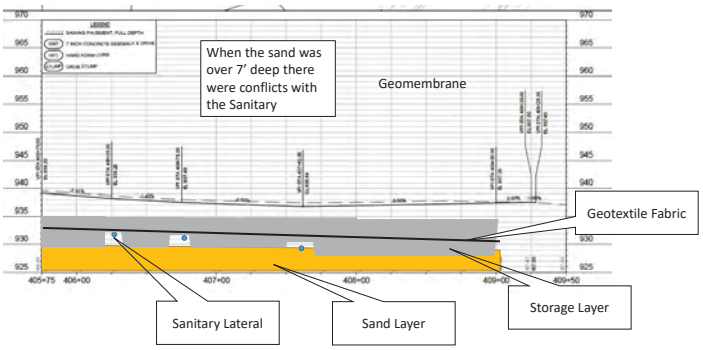


Sanitary Sewer Conflicts.



Sanitary Laterals can be in the way of the trench if you need to dig more that 7' to get to the infiltration layer.

Sanitary Sewer Conflict



Pavedrain can be sealed

- We added Sealant to our pavedrain pavers to protect against salt.
  - Tracking from cars
- It provides long-lasting protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion.
- Pervious concrete can not be sealed

Protect the curb and the block with the asphalt

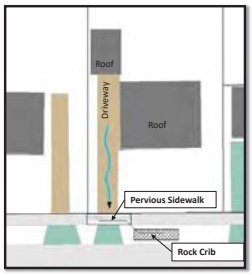
Maintenance Plan

- Spring and Fall Vacuum Sweeper
- Vac truck / Hydroexcavator if clogging evident
- Monitor through monitoring wells.
- Annual inspection for heaving and wear.

Impact of asphalt lip on snowplow effectiveness

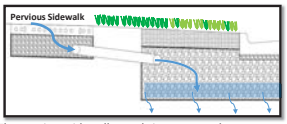
- The First snow this winter showed:
- Plow leaving a fair amount of snow over pervious surface
- No evidence of preferential melting
- Residential street
- No Salt
- Sand if icing occurs

Pervious Sidewalk with Rock Cribs



Water flows from the driveway, through the pervious sidewalk and is then routed to the rock crib in the terrace. Overflow water is directed to the storm sewer.

Comparison of Traditional and Pervious Sidewalk



The pervious sidewalk panels intercept and route water to a buried rock crib where it soaks into the ground.

Rock Crib in Terrace

Precast Pervious Panels across driveway

Summary

Next time

- Sand layer within 6 feet **max**
- Soil borings every 150’
- Discuss with utilities **ahead** of time
- Only on the downstream side
- Poured concrete transition strip between curb and permeable pavement
  - This might expand the over permeable foot print to avoid seam under wheel path.

Questions?

- Contact Information

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