MILE HIGH FLOOD DISTRICT

DATE: 2/17/2021 (Via Microsoft Teams)
PROJECT: USDCM Vol. 3 Ch. 4 Update 2020-2021
SUBJECT: Permeable Pavement

MEETING NOTES

V3Ch4 Stakeholder Meeting #7

MEETING DETAILS

Meeting Date/Time: February 17, 2021 (via Zoom)

Attendees: See Q1 in poll results

This document: Meeting details
Meeting notes
Stakeholder Poll Results

Related: Video recording – Available via www.mhfd.org (or MHFD's YouTube channel)

DISCUSSION NOTES

TOPICS (POLL ?s)	DISCUSSION NOTES & COMMENTS
Introductions/ Primary Roles	- Cross Section – all areas/parties/groups represented
Interest in Attending Today	- Lessons Learned – learn from others, real-world experience - Maintenance
How is permeable pavement encouraged by local governments?	- Maintenance – discouraged because of concerns about maintenance - Situational Uses – areas with limited space are encouraged - Concerns about traffic loading and freezing temperatures/snow removal
What prompts you to use permeable pavement over other SCMS?	- Space Constraints - Multi-Functional Space
How are permeable pavement systems maintained? By whom?	- The owners of the property typically provide the maintenance - Pre-qualified contractors would be helpful o Training for installers and contractors, Seattle GI Program, guidance document for municipal maintenance workers - ICPI resources for maintenance and reinstatement guidelines
What types of permeable pavement have you used?	- Most using PICP, concrete grid pavement was second most used
What has been effective or not worked well?	- PICP has been successful - Concrete grid better as erosion control - Pavers with turf successful in low-traffic or pedestrian settings, but do need irrigation - Basil Hamdan (City of Fort Collins) – Modular grid pavements successfully used in Fort Collins, about 5-6 installations
What wearing course(s) should be included or removed?	- Grass has irrigation requirements - Leave room for flexibility and innovation

TOPICS (POLL ?s)	DISCUSSION NOTES & COMMENTS
Should There be Design Specifications for Cell-Confinement?	- Most responses said yes
Related to Sustainability, What is Your View with Permeable Pavement?	- Most responses said depends on site characteristics or that it is/can be sustainable
What Site Characteristics or Design Parameters are Most Important to Consider?	- Subgrade is important - Adjacent land use, soils, utilities, etc. - Intended use (pedestrian vs. vehicles) - Anticipated sediment loading - Basil Hamdan (City of Fort Collins) – procuring the right stone including gradation and clean material
Any other experiences to share?	- Pine needles – use blower to get them off pavers - ADA Concerns – keep the joint size less than ½ inch wide - Sidewalks and Trails – usually flow to a vegetated area, so can use RPA
If you could change one thing about current criteria what would it be?	- ASCE-6818 – national standard with structure advice for designs
Where have you deviated from criteria for permeable pavement?	- David Smith (Interlocking Concrete Pavement Institute) – concerns about structural stability with a sand layer, prefers to use larger particles
What are other recommendations for improving criteria?	- Provide guidance for installation, construction, site control recommendations, etc. - Site considerations – run-on ratios, surrounding vegetation, road vs. parking lot

TOPICS (POLL ?s)	DISCUSSION NOTES & COMMENTS
Summarize Meeting ***(Andrew Earles, Wright Water)***	- Diverse group and perspectives - Main reasons people were attending today were maintenance and learning from others' experience - Maintenance concerns o Uncertainty, fear of maintenance, and lack of maintenance capabilities emerged as discouraging factors for using permeable pavements o Criteria for sweepers may need to be updated. Regenerative air sweepers are hard to find in Colorado. o Maintenance done by the property owner and many contract the maintenance work out, including local governments. Pre-qualified or lists of maintenance contractors could be helpful. - Winter performance and traffic loading concerns can also discourage use of permeable pavements - Main reasons to use permeable pavements: space constraints, creating multi-functional spaces, and aesthetics - Guidance document for utility workers doing work below permeable pavements would be useful - Wearing courses o Concerns with irrigation requirements with grass o Increasing stone size with depth - Lessons learned o Pine needles o Run-on and site specific concerns o Evaporation loss and wetting/drying o Installation is critical - Areas for Improvement o ASCE standard, sand layer o Joint openings o Underdrains o Full infiltration sections o Installation and site control o Materials testing and inspections

STAKEHOLDER SURVEY – POLL EVERYWHERE RESPONSES

Q 1: Introduce Yourself (Name, Organization/Place of Work)

- Paul Thomas, Stream Landscape Architecture
- Chris French, Bio Clean Environmental
- Rich Borchardt, R2R Engineers, CCBWQA
- Basil Hamdan, City of Fort Collins Utilities
- Curtis Kostecki, Creative Civil Solutions
- Scott Struck, Geosyntec Consultants
- Laraine Sanfilippo, Oldcastle
- Jim Wulliman, Muller
- Heather Otterstetter, City of Westminster
- Dustin Glist with TRUEGRID Permeable Paver, Manufacturer of Plastic Permeable Pavers
- Jessica Thrasher, Colorado Stormwater Center, CSU
- Robert Bowers, Director of Engineering, Interlocking Concrete Pavement Institute
- Jim Watt, MHFD
- Laura Hinds, MHFD
- Candice Owen - City of Boulder
- Tiffany Clark - SEMSWA
- Sam Miller - City of Aurora
- Jane Clary, Wright Water Engineers
- Brian Wethington - CCD
- Jake Moyer, City of Westminster
- Tracy Bolger, Muller Engineering
- Cassie Kaslon, Valerian

[Q2] What is your primary role?

Response	Count
A - Designer	6
B - Policy & Regulation	7
C - Reviewer	7
D - Construction/Contractor	1
E - Manufacturer	1
F - Research/Academia	1
Total	23

[Q3] What is your interest/reason for attending today's meeting on Permeable Pavement?

- Learn how to implement in projects
- I love stormwater
- Provide insight to MHFD criteria from real-world installation experience
- Learn about latest UDFCD direction with permeable pavement.
- Find out what has worked for others
- Influencing better design and installation
- Because you all are so nice and asked :)
- Maintenance
- Hear stakeholder perspectives and learn from them--

- Allow for flexible designs
- To share my experience and improve on future regulations
- Get the latest skinny
- Lessons learned, maintenance

[Q4] How is permeable pavement encouraged/discouraged by local governments (regional/state/national)?

- New maintenance equipment research published in 2020 by university of Toronto and USGS Madison that provides equipment performance. Looks at several devices beside regen.
- Often maintenance requirements misunderstood
- Traffic loading and maintenance concerns - specifically will pavers be impacted by plows
- Maintenance requirements don't fit into their existing practices
- Concerns about maintenance of utilities below BMP and who will bear costs to reconstruct BMP section.
- Freezing temperatures
- Concerns about winter performance
- PWD maintenance resistance in roadways
- a viable stormwater management tool with uncertain maintenance costs/processes
- Encouraged for sites with limited space or sites that are smaller. Fire Dept has concerns about ability to stand up to truck weight and pressure points.
- We have an LID manual and Impervious Area credits for permeable pavements - but its been up to the designers and we aren't seeing many come through.
- Encouraged - space constraints, parking lots installations, Discouraged - Maintenance, City ROW
- Tax incentives are growing.
- Through regulations, allowing it, providing additional LID credit for PP
- Encouraged in theory only but quickly discouraged because of price and maintenance
- Fear of maintenance requirements

[Q5] What prompts you to consider permeable pavement as a SCM over an alternative SCM (e.g. rain garden, EDB)?

- aesthetic value, durability
- Space, locations when shallow storm sewers provides alternate to tank and pumps.
- High Land Cost
- Easy access to maintain and confirm performance
- Multi-functional space
- Multiple benefits - i.e. manage stormwater with additional benefits of traffic calming, better aesthetics, reduced heat island, etc.
- lack of available space, ability to use the parking area as a multi purpose area
- High density sites with little landscape area.
- space constraints, water conservation
- Space
- Dual function - pavement and scm
- Space constraint
- Space constraints, aesthetics, educational opportunities

[Q6] How are permeable pavement systems maintained? By whom?

- If used for CM for a private development - the owner
- End user typically. If placed in ROW, Denver makes owner take full responsibility.
- We have one installation on City property maintained by the City... No other proposals have been made.
- Use contractors for city-owned
- by owner or HOA when on private property, by the City when in the ROW
- Whoever owns the property is held responsible.
- Commercial management company
- The owner ;)

[Q7] What types of permeable pavement have you used? ***See video for Q7 discussion/responses.***

- A - Permeable-interlocking concrete pavers (PICP)
- B - Concrete grid pavement
- C - Porous gravel
- D - Reinforced grass
- E - Other (type in chat)

[Q8] What has been effective and what has not worked well?

- Plastic Pavers with turf works well if the area is irrigated and the base material is done well.
- permeable concrete has not been very durable, due to unraveling at the joints
- "grasscrete" has worked well in low-traffic or pedestrian environments
- Well designed and constructed PICP has worked well.
- Worked well
- PICP with 1/4" to 1/2" joints. 5-15% surface opening. Concrete grid and ACB better as erosion control revetments
- PICP and TrueGrid have been successful so far.
- PICP with routine maintenance

[Q9] What wearing course(s) (e.g. grass, gravel) should be included/removed?

- Anything should be on the table if it is appropriate to the context AND can be maintained/sustained.
- Consider including gravel reinforced paver as a separate category from porous gravel.
- Use choking layers of stone increasing in size with depth, sand can be a good filter material but affects structural stability
- Wondering if grass should be discouraged due to irrigation requirements

[Q10] For porous gravel options, should there be design specifications for cell-confinement?

Response	Count
A – Yes	12
B – No	0
C – Not sure	2
Total	14

[Q11] Related to sustainability, what is your view with permeable pavement?

Response	Count
A – I believe it is a sustainable SCM.	4
B – I believe it can be sustainable.	2
C – Depends on the site characteristics, construction, and maintenance	11
D – I do not think permeable pavement is sustainable.	0
E – Not sure.	0
F – Other (type in chat)	0
Total	17

[Q12] - What site characteristics or design parameters are most important to consider for permeable pavement?

- Watch submittals vs. delivered product. There are "Pavers" and "Permeable Pavers".. Joint spacing.
- Joint width: Not too narrow, not too wide (1/4" to 1/2")
- sediment clean waters draining onto pavers
- Building run-on vs. parking lot run on
- Hydraulic Loading Rate: good studies by Bill Selbig, USGS
- Plastic Cellular confinement deforms or curls up on edges
- anticipated sediment loading (high sediment loads clog more quickly if run ratios are high)
- Active running vehicles in parking lot
- full-time pedestrian vs. shared use vs. primarily vehicular traffic
- North facing properties? Don't get much sunlight
- loading, subgrade strength and permeability, tracked on sediment potential, stabilized surrounding area
- Configuration (i.e. harringbone pattern)
- Controlled aggregate gradations during construction are important
- Underground utilities
- slopes on site and nearby adjacent properties (in excess of X%)
- proximity to adjacent structures, soil swell and permeability
- Surrounding landscape area, sub grade,
- Amount of sediment loading at the site
- Urban/architectural/experiential context
- Well draining subgrade
- Existing subgrade
- Sub grade permeability

[Q13] - Are there any other experience or lessons learned that you would like to share with the group?

- subdrain can be installed deeper and tied to a shallower storm drain with an inverted elbow
- protect paver field during construction if needed to be constructed early for access
- Keep construction sources of sediment out of installed pavers-- phase the work or control sediment.

- Inspect the grade after construction.
- Proper installation is critical, inspection program is very necessary
- ADA unloading stalls with ramps can force settling of bricks beyond ADA conformance
- If the paver field is not close to building may not need to be lined and would reduce pollutant load downstream
- We find people are more easily convinced when they can see an actual installation, and have associated stats about costs, maintenance, performance, etc. over time
- joint material can washout at point discharge areas
- can have a added benefit of parking space lines not having to be repainted as frequently. Paint sticks better to pavers.
- Appropriate protection for installed pavers during construction
- Smaller ShopVac's work surprisingly well in small, concentrated areas...
- The 2020 BMP Database Report has updated performance information.
- Evaporation losses from pavers can be a significant factor especially on smaller storms

[Q14] If you could change one thing about the current criteria for permeable pavement, what would it be?

- provide better guidance on subdrain installation, encourage full infiltration sections where appropriate

[Q15] When and where have you deviated from criteria for permeable pavement (e.g. ICPI)?

- When the depth does not allow, we have used a shallower reservoir section
- Blended filter media blended with large aggregate vs. MHFD filter material only.

[Q16] What are other recommendations for improving criteria or specifications of permeable pavement?

- More post installation guidelines and owner education for long term maintenance and performance success
- Site considerations (surrounding vegetation, run-on ratios), guidance for road vs. parking lot installations, pictures
- Consider testing gradations of design gradations from various suppliers to get sense for consistency and compliance in industry.
- Sort of mentioned already, but just in case: characterize run-on ratios for different applications (vehicular areas vs building roof-tops).
- Provide better guidance on installation, compaction, site control during construction

Relevant Comments from Zoom Chat (*Attendees were added to list in #1)

0:12:54	David Smith:	David R. Smith
0:13:11	David Smith:	Interlocking Concrete Pavement Institute
0:13:22	Kevin Earley:	Kevin Earley, Oldcastle
0:13:28	Will Wilhelm at Kimley-Horn:	Will Wilhelm, Kimley-Horn
0:15:23	David Smith:	Encourage conformance to ASCE 68-18 on PICP as MHFD participated on the committee that wrote it.
0:16:59	David Smith:	Plus: Less cost than detention ponds and CSO
0:17:11	David Smith:	Negative: maintenance
0:25:05	Jonathan and Sonia Diller:	I was having trouble logging onto the poll at first. I am Jonathan Diller, with SMITH Environmental and Engineer
0:25:11	Jonathan and Sonia Diller:	Engineering
0:25:12	Heather Otterstetter:	https://www.mdpi.com/2073-4441/12/6/1563/pdf
0:25:19	Heather Otterstetter:	article link
0:26:22	David Smith:	Is the most efficient in reducing volumes, if that is needed beyond pollutant reductions.
0:27:52	David Smith:	Aesthetic value? Asphalt and concrete is basically ugly!
0:32:37	Jane Clary:	Jake, I think that is a good idea.
0:48:40	Will Wilhelm at Kimley-Horn:	b
0:51:54	Will Wilhelm at Kimley-Horn:	loading / high use/delivery / bad in heavy truck traffic areas where turning occurs
0:54:37	Brian Wethington:	Run-on ratio for buildings can be somewhat higher
0:54:59	Brian Wethington:	not just clogging, but also types of pollutants
0:58:39	Richard Borchardt:	Have permeable pavements been used in sidewalk or trail applications? Any Examples? Differing details?
1:17:32	Jane Clary:	Great comments!
1:35:41	Richard Borchardt:	Thanks all! Great discussion.
1:35:42	CassieKaslon:	Thank you all, great conversation.
1:35:48	Ryan Taylor:	Thank you all.
1:35:50	Jessica Thrasher, Colorado Stormwater Center:	Thank you!
1:35:56	Jesse Clark:	thanks!