Soil hydrologic assessments:
A briefing on the Caño Martín Peña work for the Corporación del Proyecto ENLACE DEL Caño Martín Peña and Region 2 USEPA

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Overview

- We spent several months researching soils data for San Juan, then worked for a week in March 2015 to carry out our soil hydrologic assessment protocol
- What are the soils that underlay the San Juan area, and how does water move through these soils?
- This is a start toward understanding this major data gap that informs on green infrastructure applications

Overview

- We have focused on how urbanization has imprinted on soil development in each of the major soil orders
- This taxonomic and hydrologic assessment work links land use with an understanding of the urban water cycles in these cities
- Field data provide a minimum dataset for planning and implementing green infrastructure (GI)
- GI may serve as partial remedies to stormwater and combined-sewer management in US cities

Soil core sampling

We used a track-type Geoprobe unit. Due to hammer action, we lose structure as a taxonomic diagnostic feature

Or, we expose the soil profile by excavation

Hydrology

Above – tension infiltrometer, double-ring unit
Left – Amoozemeter measures sub-surface hydraulic conductivity (drainage)

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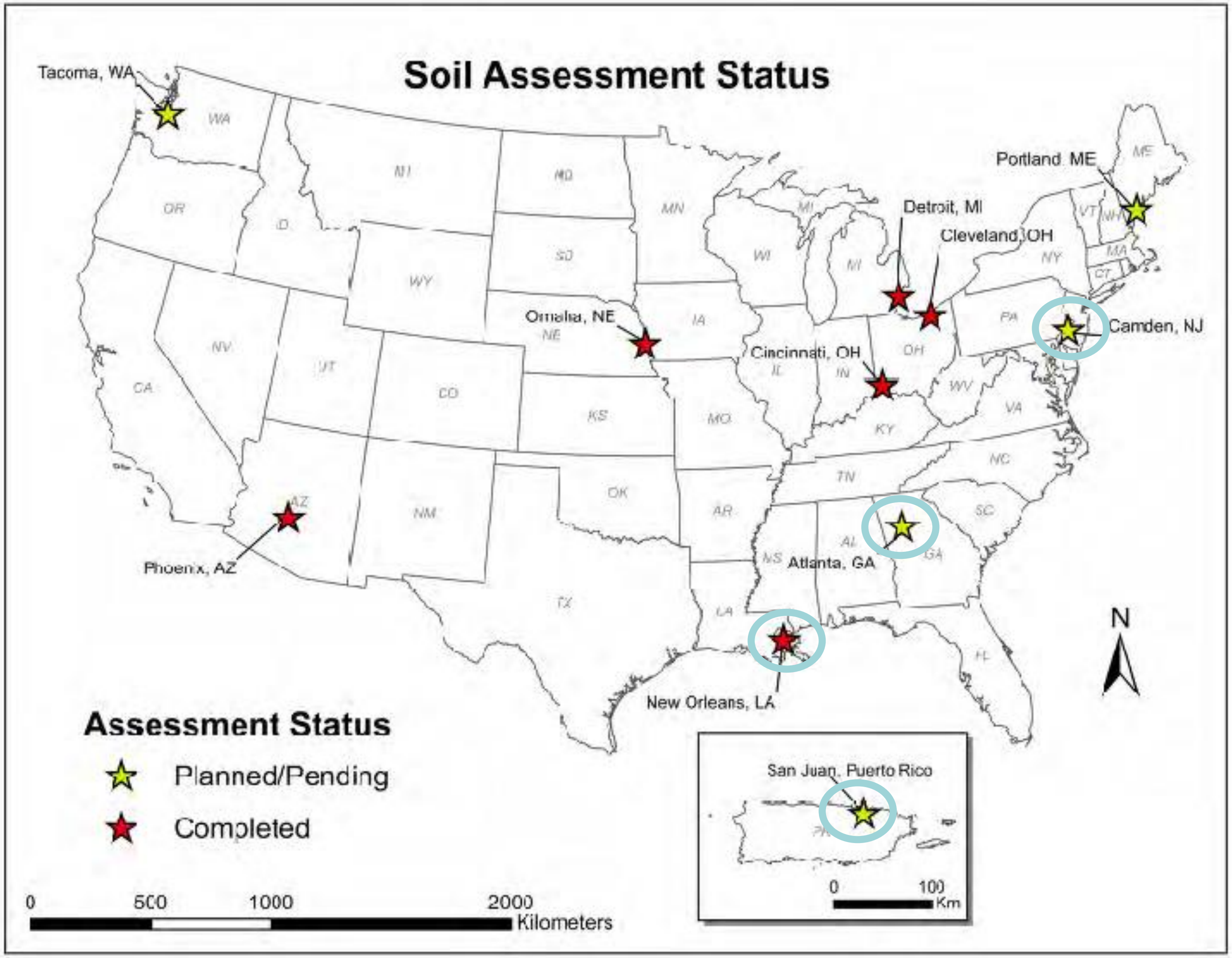
“We’re nationwide…”



Protocol

- <u>Basic</u> - Urban soils were not (are not) investigated nor mapped
- <u>Practical</u> - We designed a protocol that assesses <u>*suitability*</u> of urban soils (GI may not be appropriate for some areas):

Taxonomy – what does the soil look like? (texture, color, full descriptions)

Hydrology – infiltration and subsurface K

Basic fertility and chemistry, shading – urban gardening applications, includes Cu and Zn

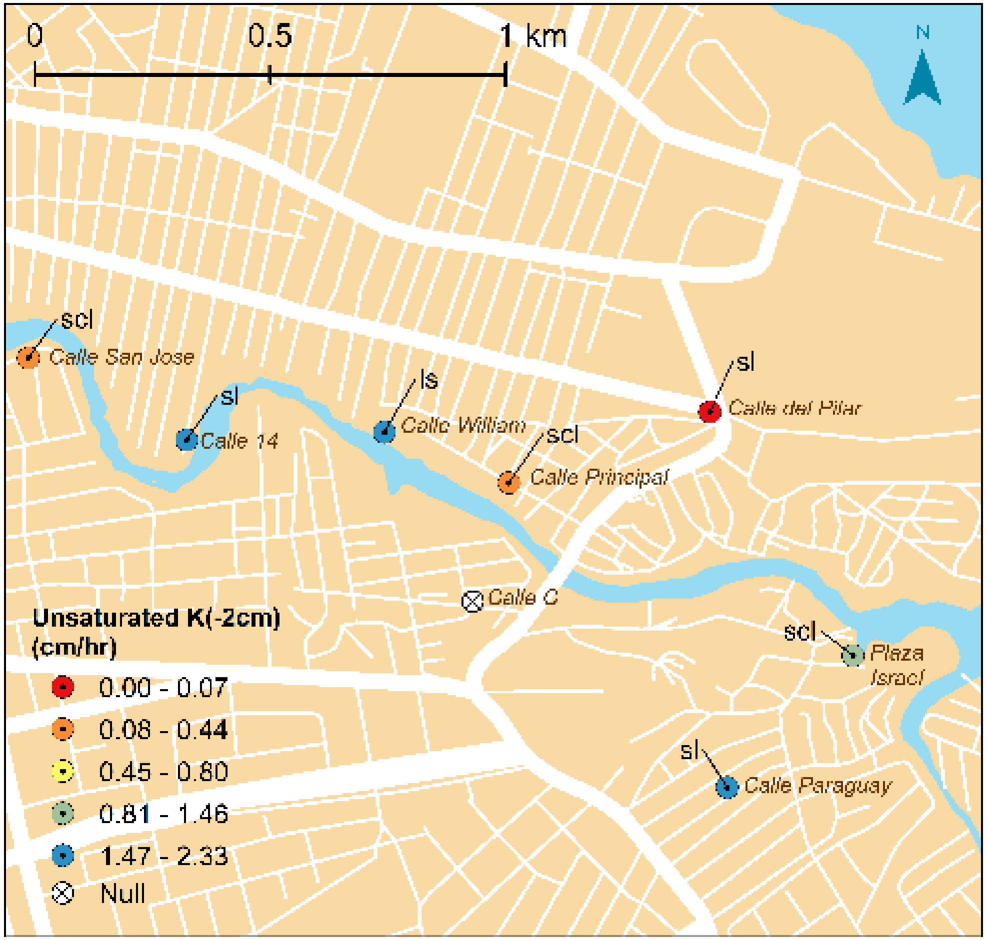
Shallow buried debris – index for quality of demolition

What we did in one week (!)

Focus on Caño Martín Peña

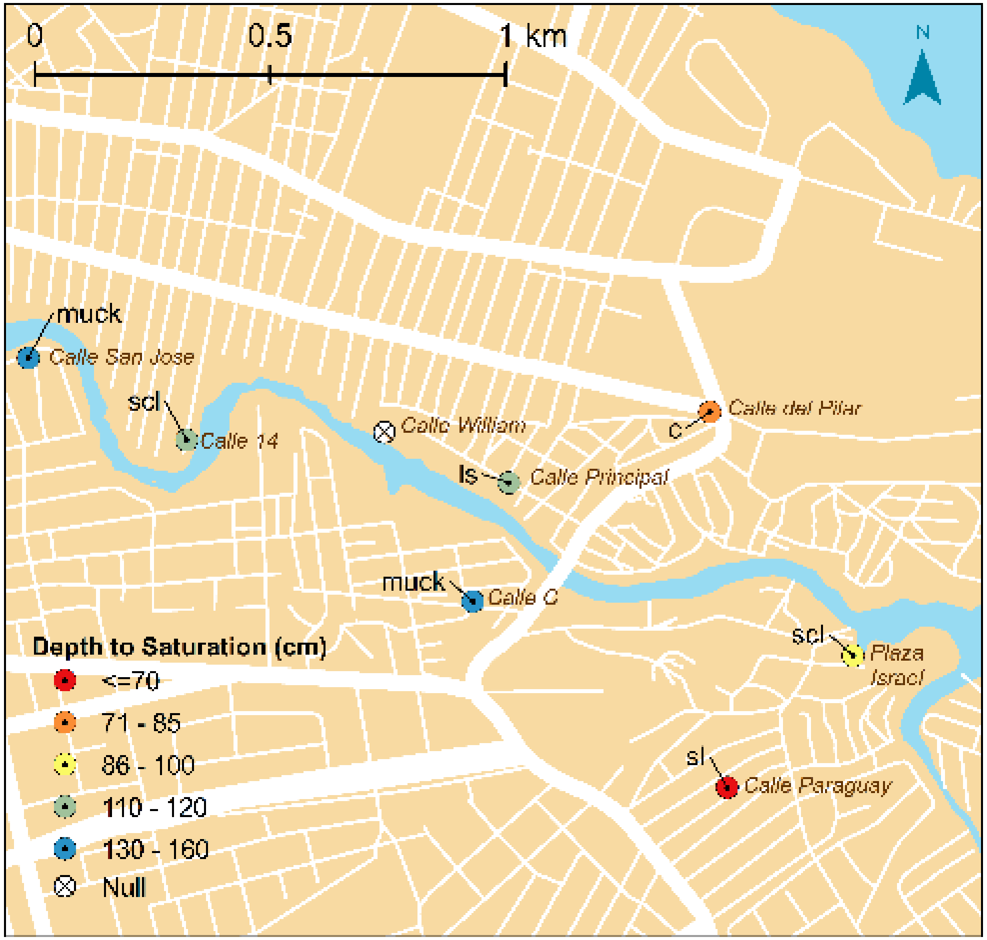
Infiltration rates (don’t connect the dots!)

These are among the higher rates we saw in San Juan… We usually look for 1 cm hr^{-1} as a reasonable infiltration rate



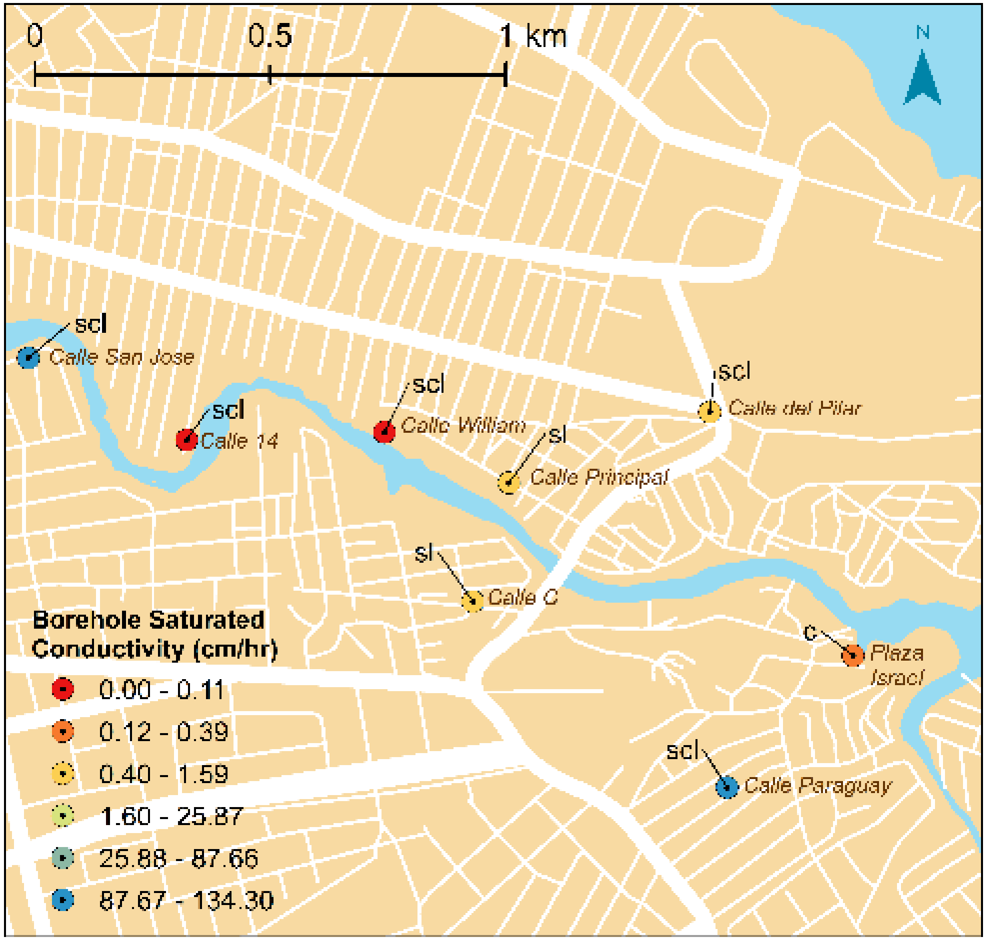
Texture Key: **ls** = *loamy sand*; **scl** = *sandy clay loam*; **sl** = *sandy loam*

Where we found the water table



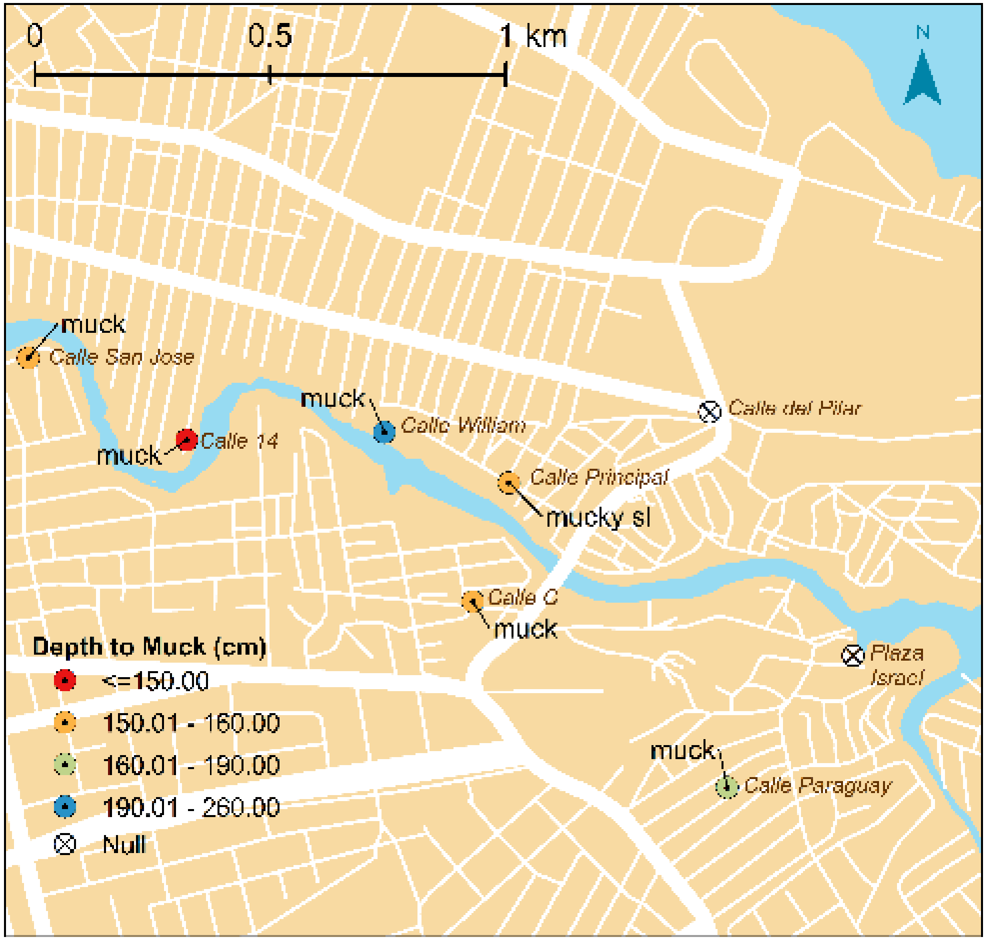
Texture Key:c = *clay*; **ls** = *loamy sand*; **muck** = *muck*; **scl** = *sandy clay loam*; **sl** = *sandy loam*

Drainage capacity – higher values is related to buried coarse-grained, rocky debris



Texture Key: **c** = *clay;* **scl** = *sandy clay loam;* **sl** = *sandy loam*

Depth to muck (organic matter) layer. These deposits are what the community is built on. A null value means that there was no muck, just anthropogenic soil fill



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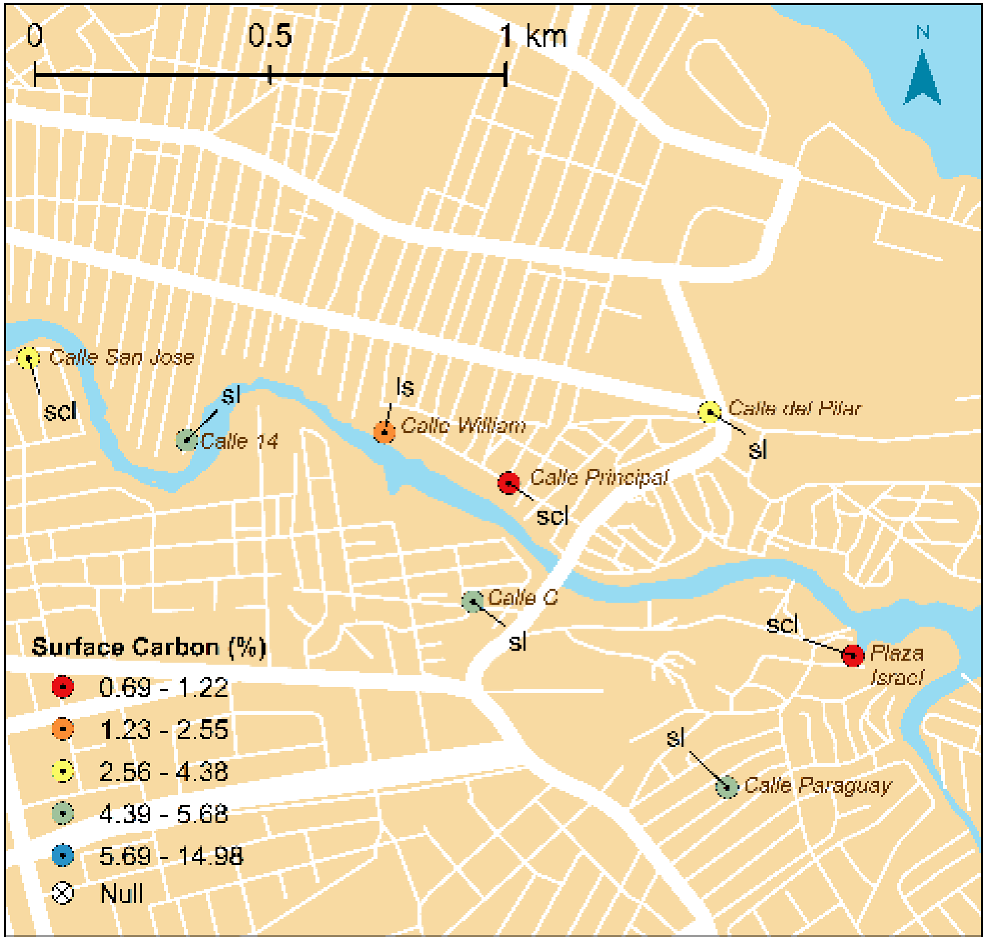
Total soil carbon includes anything that was in the sample that contains carbon. We are most interested in the organic carbon, which energizes the soil ecosystem. As it stands, this is an index of what we might have to work with in terms of carbon resources.



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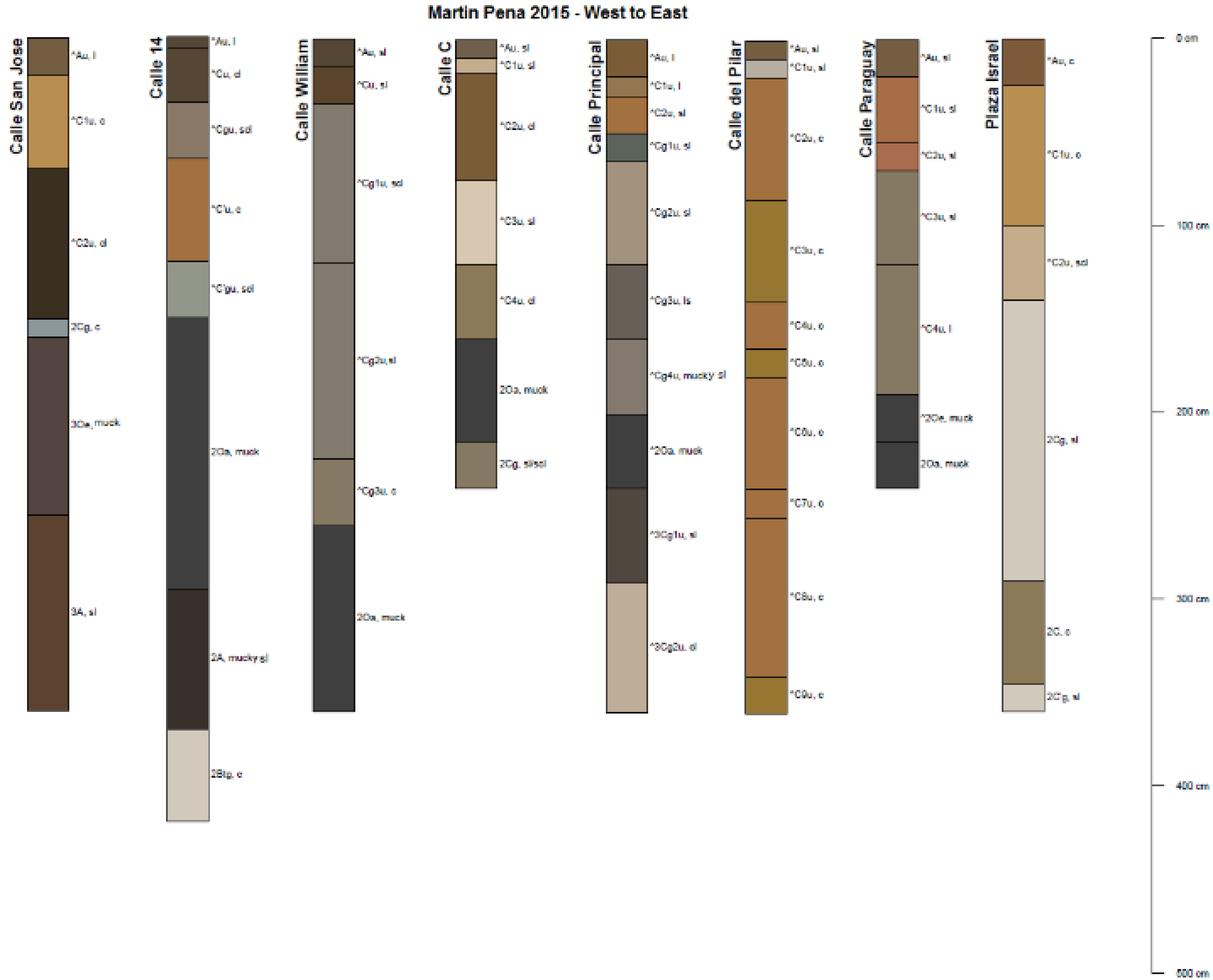
Color, texture of soils are interactive with hydrology



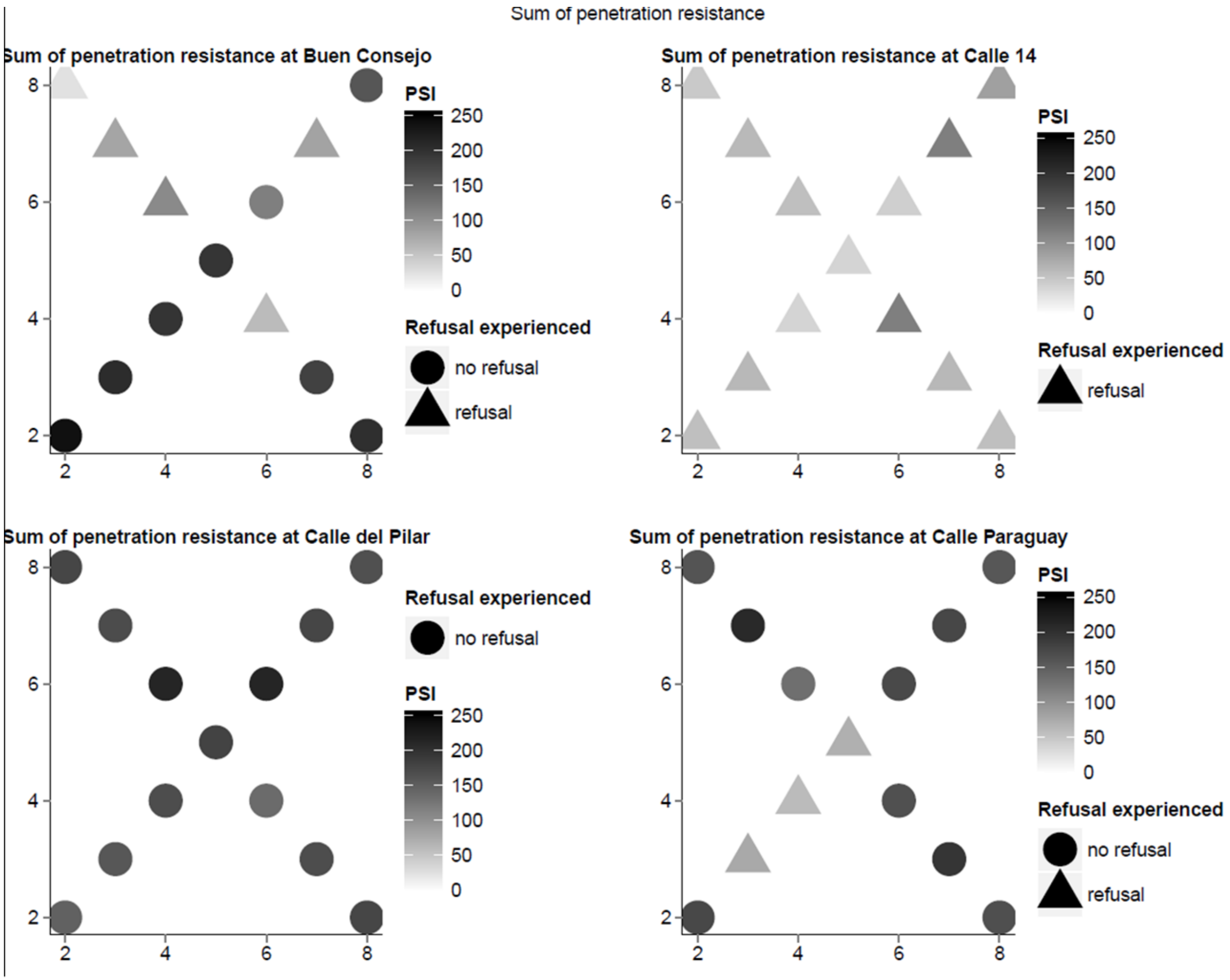
Buried Debris

- We determined percent buried debris in each horizon
- Ranged from 5 to 95%
- Gravelly, range: dusty to more massive cobble
- Materials included: brick, tile, shells, concrete, crushed rock and concrete material, wood, slag, charcoal, bituminous
- See master data sheet

Site	Depth range of redox (cm)	Depth range of saturation (cm)	Depth range of anthropogenic material (cm)	Type of anthropogenic material
Calle 14	35-120	120-420	0-150	Concrete, charcoal
Calle William	120-360	-	0-360	concrete, building gravel, brick, tile
Calle del Pilar	-	85-360	0-360	concrete, building gravel
Calle Principal	-	120-360	0-360	building rock, brick, wood, plastic
Plaza Israel	0-25	100-360	0-140	concrete, building rocks, slag
Calle Paraguay	-	70-240	0-215	concrete, building rock, brick, tile, wood
Calle C	-	160-240	0-160	concrete, building rock
Calle San Jose	-	160-360	0-150	concrete, building rock

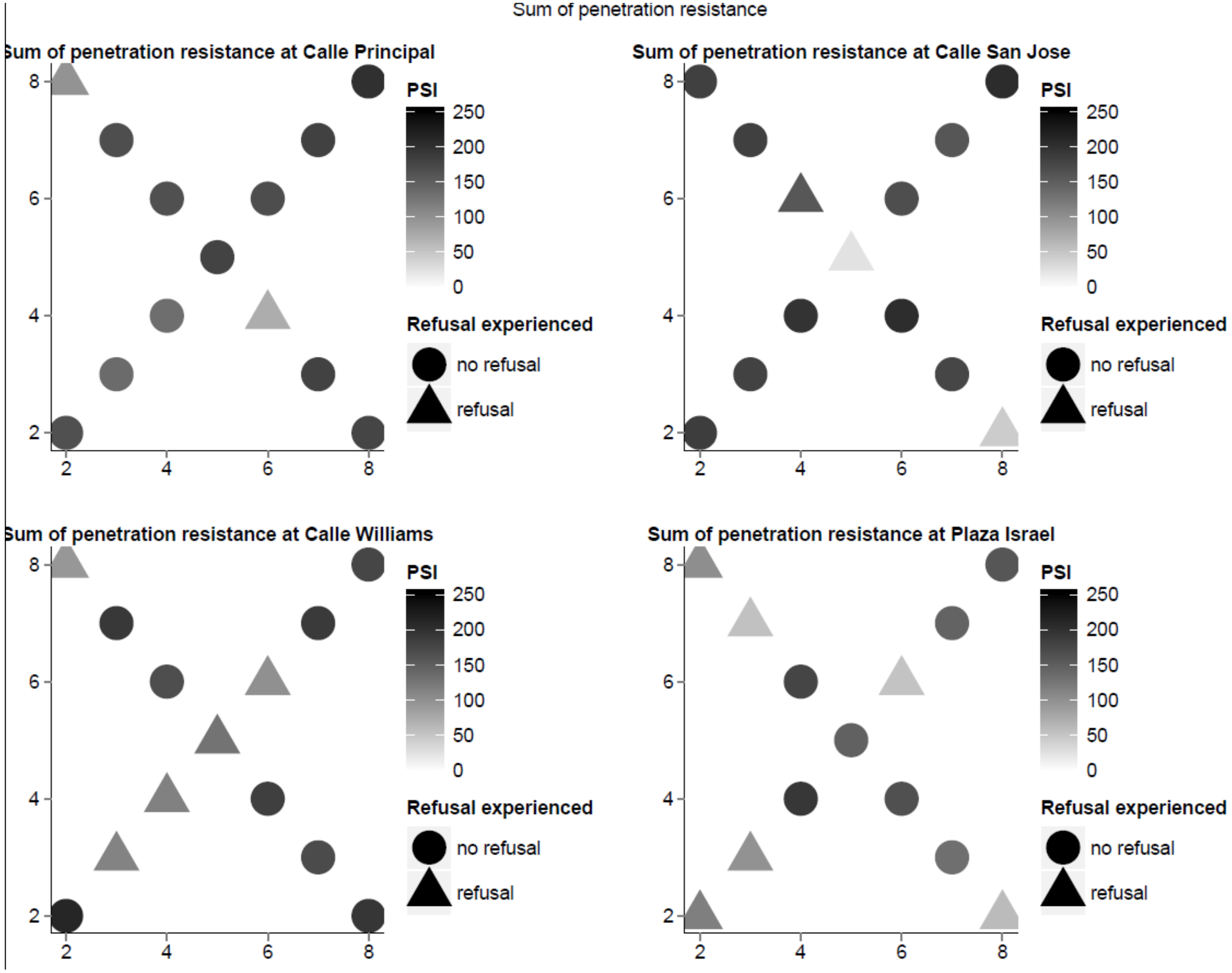
Buried Debris

- We also measured how much force it took to get a pin into the soil (penetration resistance)



Buried Debris

- Penetration resistance surveys for other CMP sites



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Images of the ENLACE area

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Interesting spaces

Conclusions

- We are asking urban soils to do more – it is important to assess these soils as we have in the past with agricultural soils
- Use actual field data to manage risk in the planning and design process preceding GI implementation
- Assess soils (fill depth, etc.)
- Work with existing geotechnical contractors and consulting soil scientists to get the full picture
- Monitor end product GI – no design is perfect, no installation is right on spec, make sure it works and use monitoring data to guide operation and modification

References

- Residential demolition and its impact on vacant lot hydrology: implications for the management of stormwater and sewer system overflows. 2014. WD Shuster, S Dadio, P Drohan, R Losco, and J Shaffer. Landscape and Urban Planning. http://dx.doi.org/10.1016/j.landurbplan.2014.02.003

- An application of field hydropedology to characterize the potential for parcel-level infiltration in a semi-arid urban ecosystem. William D. Shuster* Stephen D. Dadio, Caitlin E. Burkman, Stevan R. Earl, and Sharon J. Hall. Soil Sci. Soc. Am. J., doi:10.2136/sssaj2014.05.0200

Thank you for your time

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