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I work at the Udall Center for Studies in Public Policy. I work with stakeholders and community partners to answer questions related to water security, urban resilience, and environmental justice, by focusing on greenspace/green infrastructure.

I am originally from Monterrey, Mexico. I did my undergraduate studies on architecture at ITESM in Monterrey.

I hold two advanced degrees from the UArizona:

- a master of architecture degree with a concentration in design and energy conservation
- a doctoral degree in arid lands resource sciences with a minor in global change.



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Green Infrastructure for Stormwater Management in Hermosillo, Mexico: Soil Recondition and Site Design

Blanca González, Adriana Zuniga, Bo Yang, Joaquin Murrieta,
Guadalupe Peñúñuri, Eduardo Hinojosa, Kassandra Soto, Irene Pineda

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NADBank Seminar #5: Urban Green Infrastructure

December 7, 2021

Green infrastructure and urban resilience

Green infrastructure is increasingly promoted to curb the impact of urbanization and enhance resilience.¹



Houston, TX after hurricane Harvey in 2017. Paved surfaces increase flooding and heat.



Green infrastructure combines green-gray-blue infrastructures to manage stormwater and reduce flooding

1: Staddon et al. (2019). Contributions of green infrastructure to enhancing urban resilience. *Environmental Systems and Decisions*.

Challenges for the broad-scale implementation of GI include:

- Lack of **design standards** that are generalizable, yet context-specific to capture the unique properties of the site (e.g., soils).¹
- Continuous **maintenance**.

Importance of considering soils in the design of GI:

- Soil conditions affect the likelihood of plant establishment and the level of stormwater infiltration.
- Ideal soil properties facilitate **maintenance**.

1: Zuniga-Teran et al. (2019). Challenges of mainstreaming green infrastructure in built environment professions. *Journal of Environmental Planning and Management*.

To develop a landscape design methodology that considers soil properties for stormwater infiltration and soil enhancements for plant establishment to facilitate the maintenance of vegetation.

Case study of an interdisciplinary effort that integrated soil studies with landscape design for the city of Hermosillo, Mexico.

Binational project funded by CAZMEX (UArizona + CONACYT)



Hermosillo is a leader in GI-related policies:

- **Design standards** – design manual for GI.
- **Plant palette** – guidelines for native plants that do not require irrigation (less maintenance).



10 INSTRUMENTOS NORMATIVOS, TÉCNICOS Y DE PLANEACIÓN / Manuales, guías y normas técnicas



Manual de Lineamientos de Diseño de Infraestructura Verde para Municipios Mexicanos HERMOSILLO, SONORA



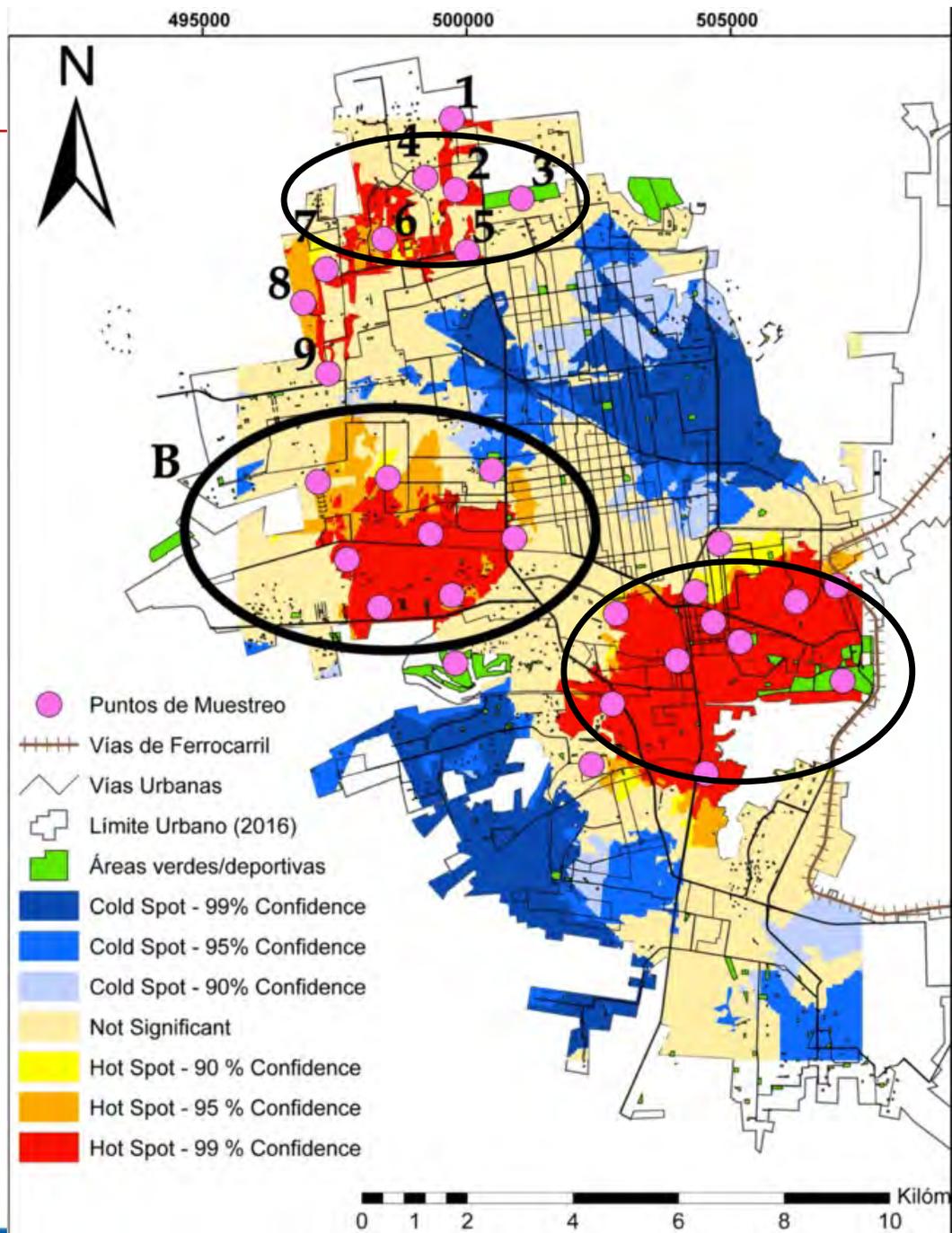
IMPLEMENTACIÓN DE INFRAESTRUCTURA VERDE EN EL DISEÑO VIAL DE CIUDAD DE MÉXICO
#CIUDADESPARALAMOVIDAD #CICLIM

 **DESARROLLO TERRITORIAL**
SECRETARÍA DE DESARROLLO TERRITORIAL, URBANISMO Y OBRAS PÚBLICAS

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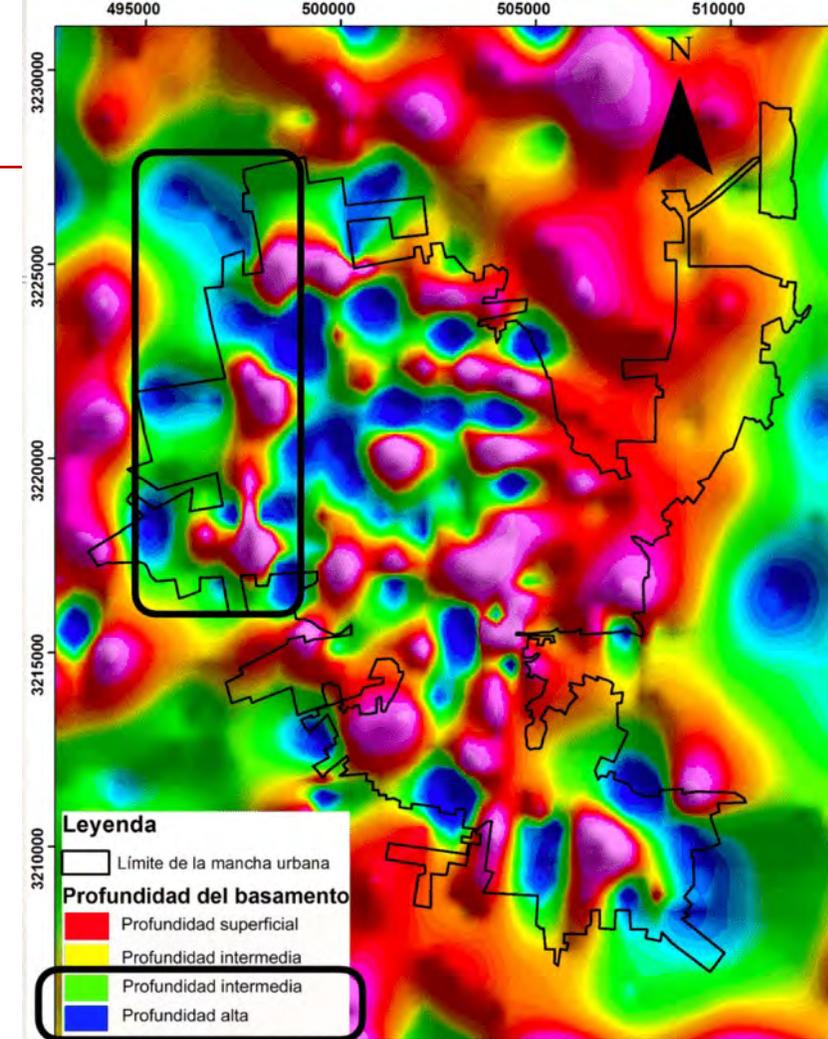
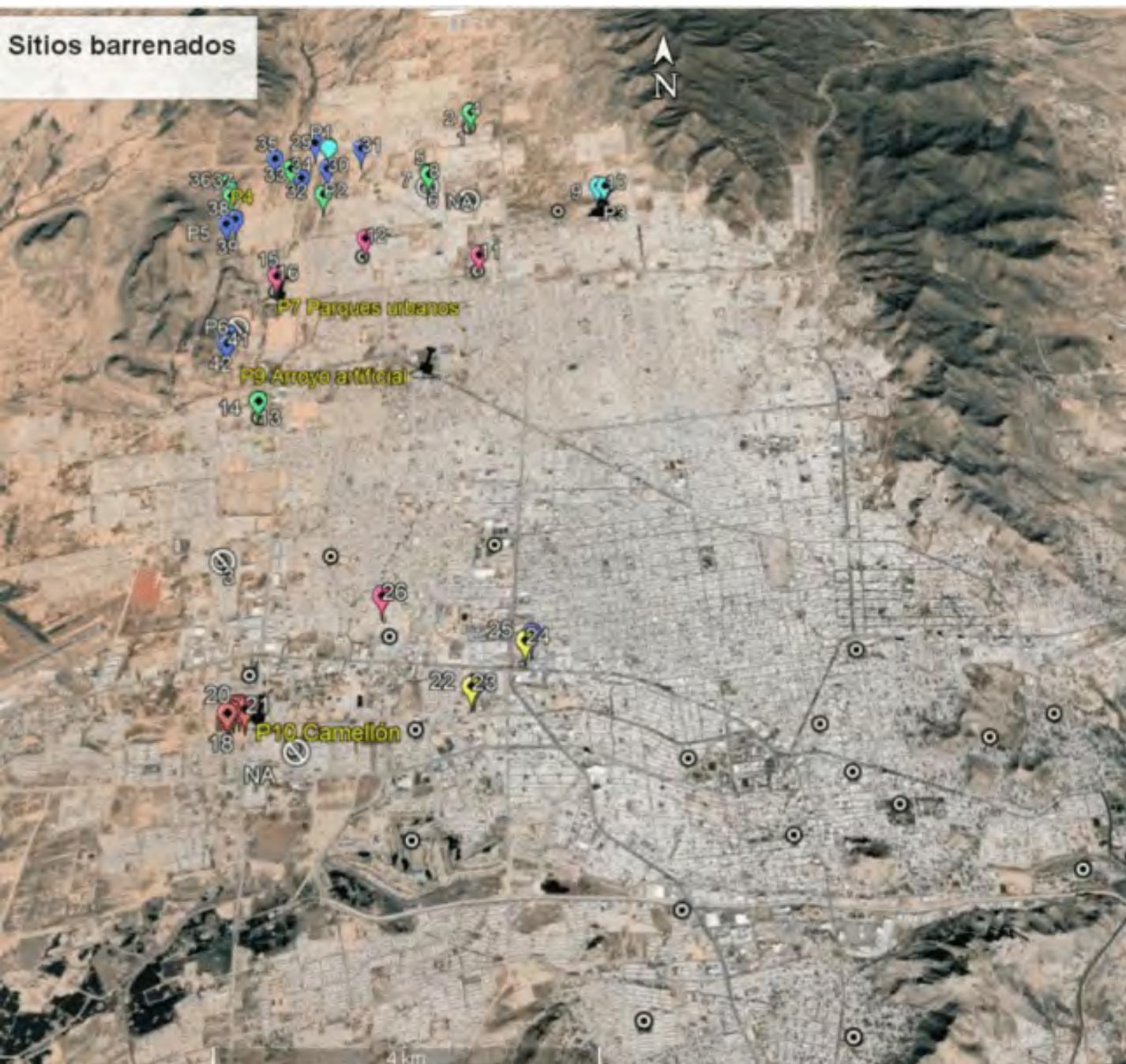
Por encargo de:
 **Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear**
de la República Federal de Alemania

Background on soil studies



A collaboration between GIZ, IMPLAN, ITSON, UNAM (2018-2019) determined the preferred location of soils with suitable soil conditions for infiltration in Hermosillo:

- Enough land area to infiltrate and redistribute stormwater.
- Good drainage conditions
- Far from urban infrastructure
- Physical and chemical soil filtration capacity



- 43 sites identified.
- 5 sites are located on the foothills of Cerro Colorado – NW of the city.

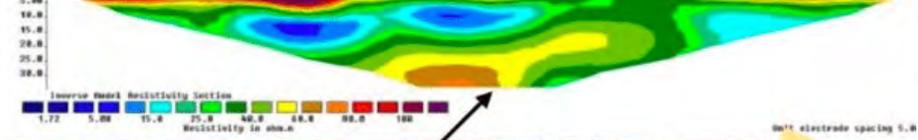
Site selection

LAND TENURE – The City owns a 22 ha parcel north of site P4. Land donated by developers (3%) for parks.

SOILS - Site has similar soil conditions (pH, CE, DA, texture) than P4 – ideal for stormwater infiltration.

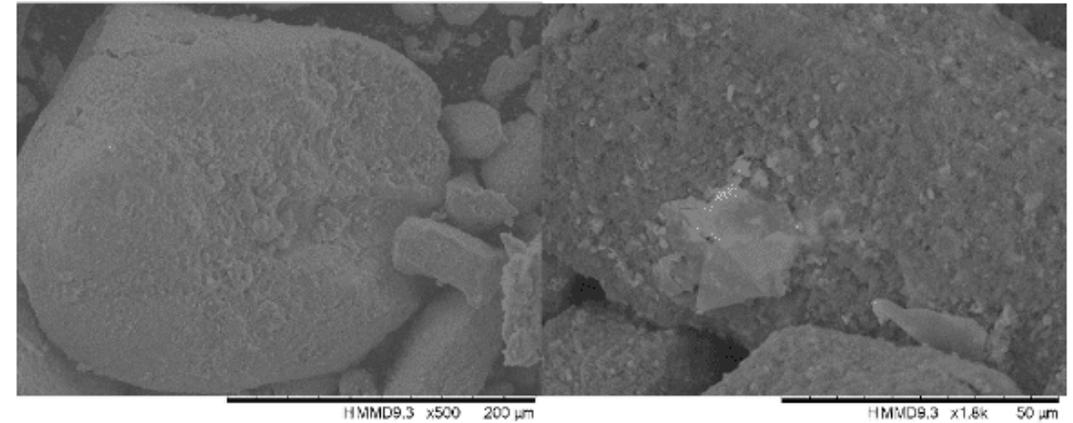
PLANNING - Part of the greenbelt planned for the City of Hermosillo.

JUSTICE - Adjacent to a low-income, peri-urban area – deprived of greenspace.



Soil experiments (UNAM)

- Lab experiments with biochar and bonechar – soil enhancements.
- Experiments to improve the moisture retention capacity of soils and filtration of pollutants.

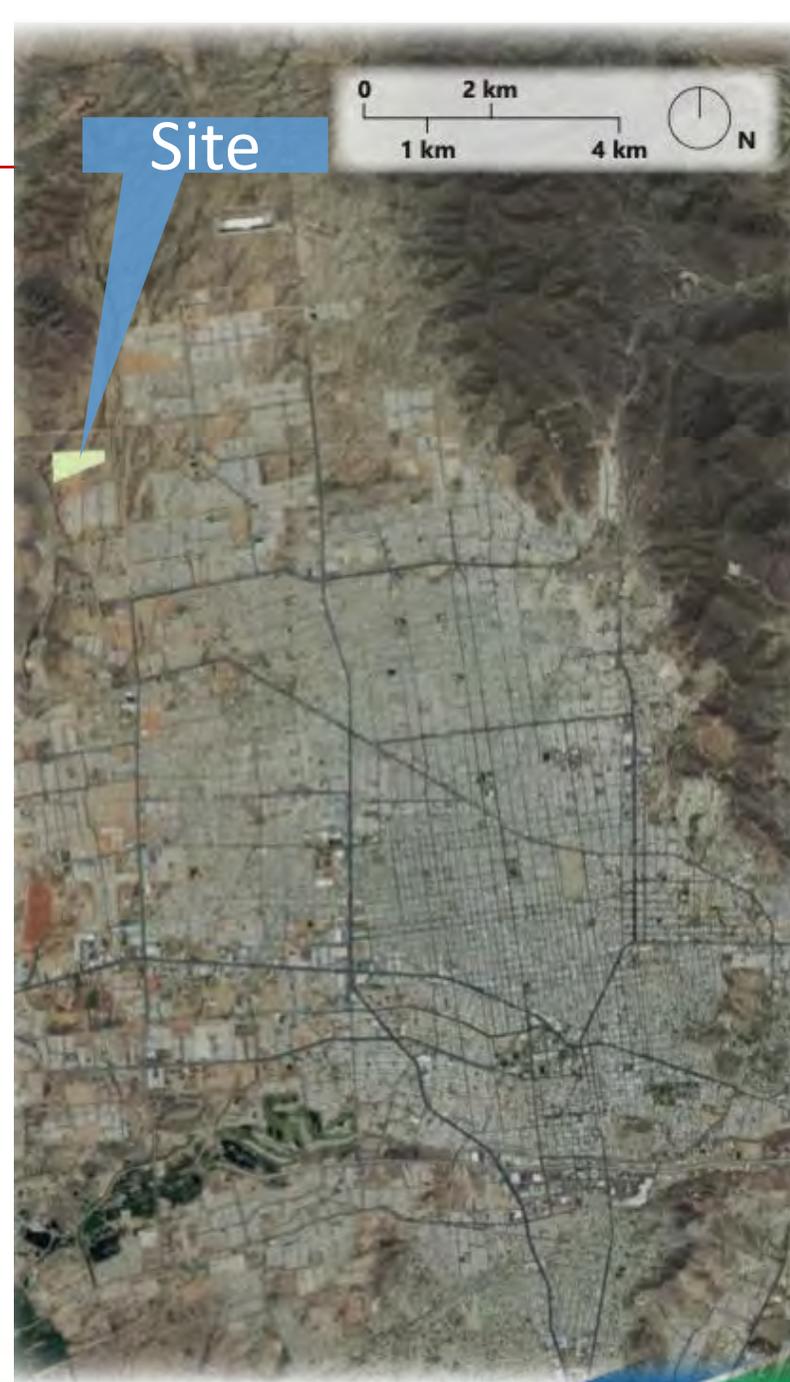


Landscape design methodology (UArizona)

UArizona's Landscape design studio class worked on the design of a park for stormwater management.



Cerro Colorado, Hermosillo, Sonora



Landscape design methodology (UArizona)

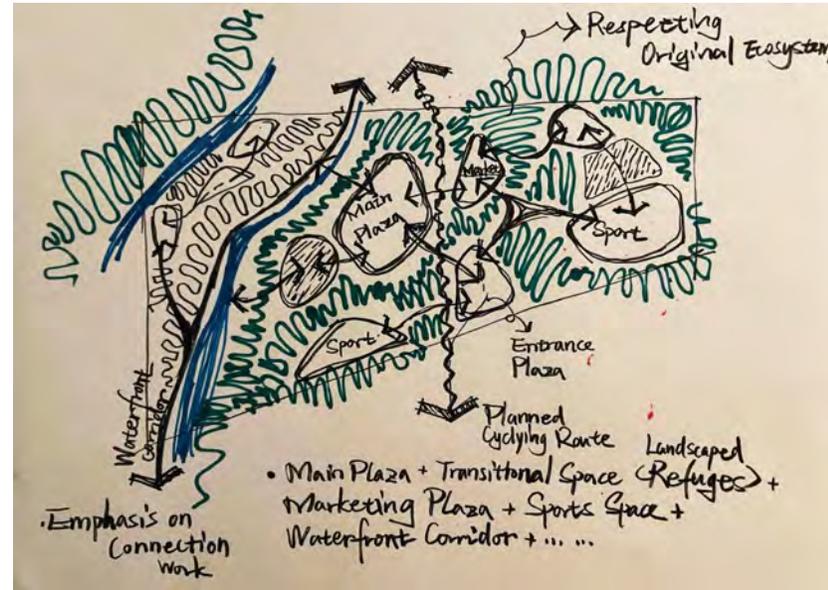
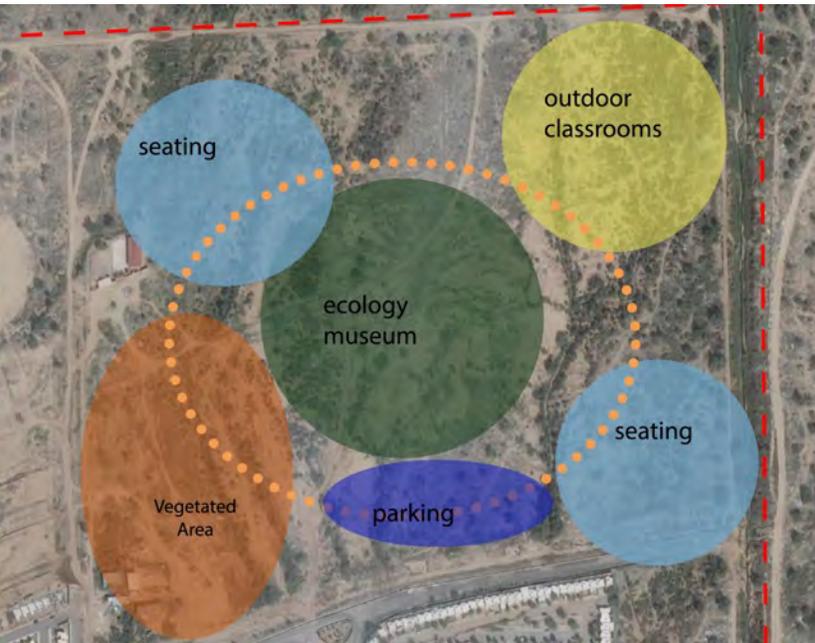
- 4 groups of MLA graduate students worked on the design of the park during the spring semester of 2021, directed by Prof. Bo Yang.
- Stakeholders reviewed the projects virtually (Zoom) – providing input for the programming of the park project (needs, uses, soil conditions).



Site analysis – flows, connectivity, vegetation



Design concepts



Landscape designs



One final landscape design

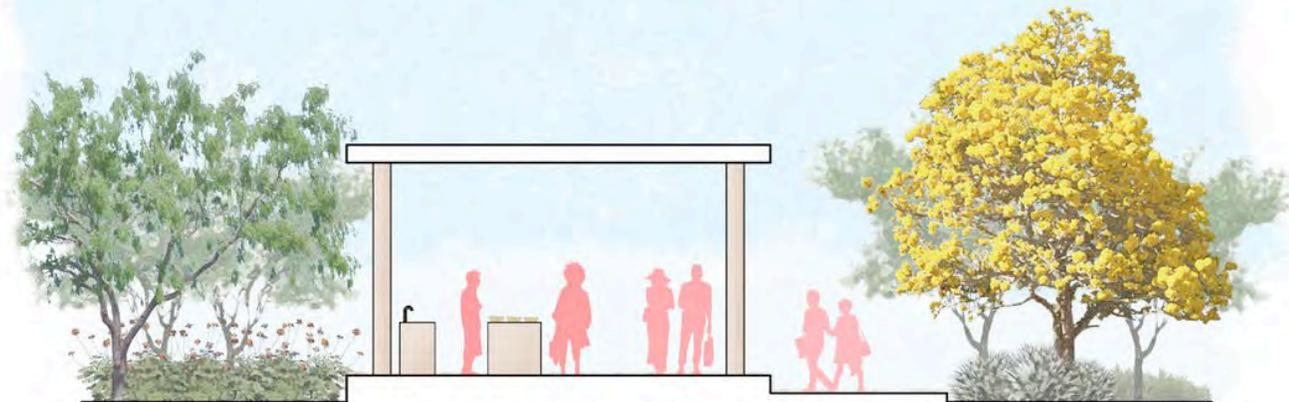
During the fall 2021 semester, graduate student, Irene Pineda, worked on the combination of 4 designs to produce one final landscape design, with the input of stakeholders.



One final landscape design – El Mercado



El Mercado



Cooking areas for vendors

One final landscape design



Relaxing areas



Stormwater terraces



Bird-watching areas

One final landscape design



Bike & pedestrian paths with an outdoor sculpture museum



A Monarch butterfly sanctuary

Visit to the site – a new reality

- Marketing interests drove developers to implement informal sport fields by clearing up the landscape.
- They bulldozed the site, destroying the desert landscape and compacting the soils, regardless of the natural drainage systems or soil properties.



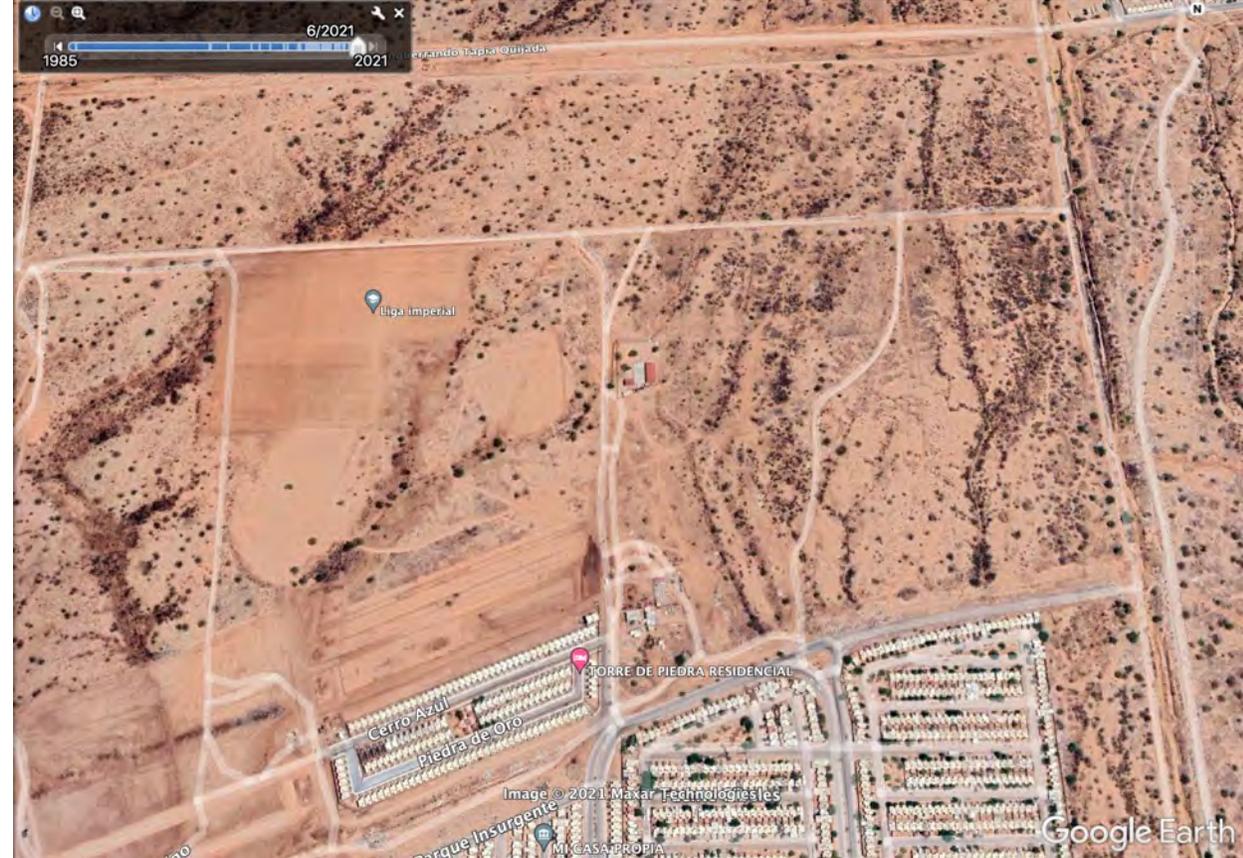
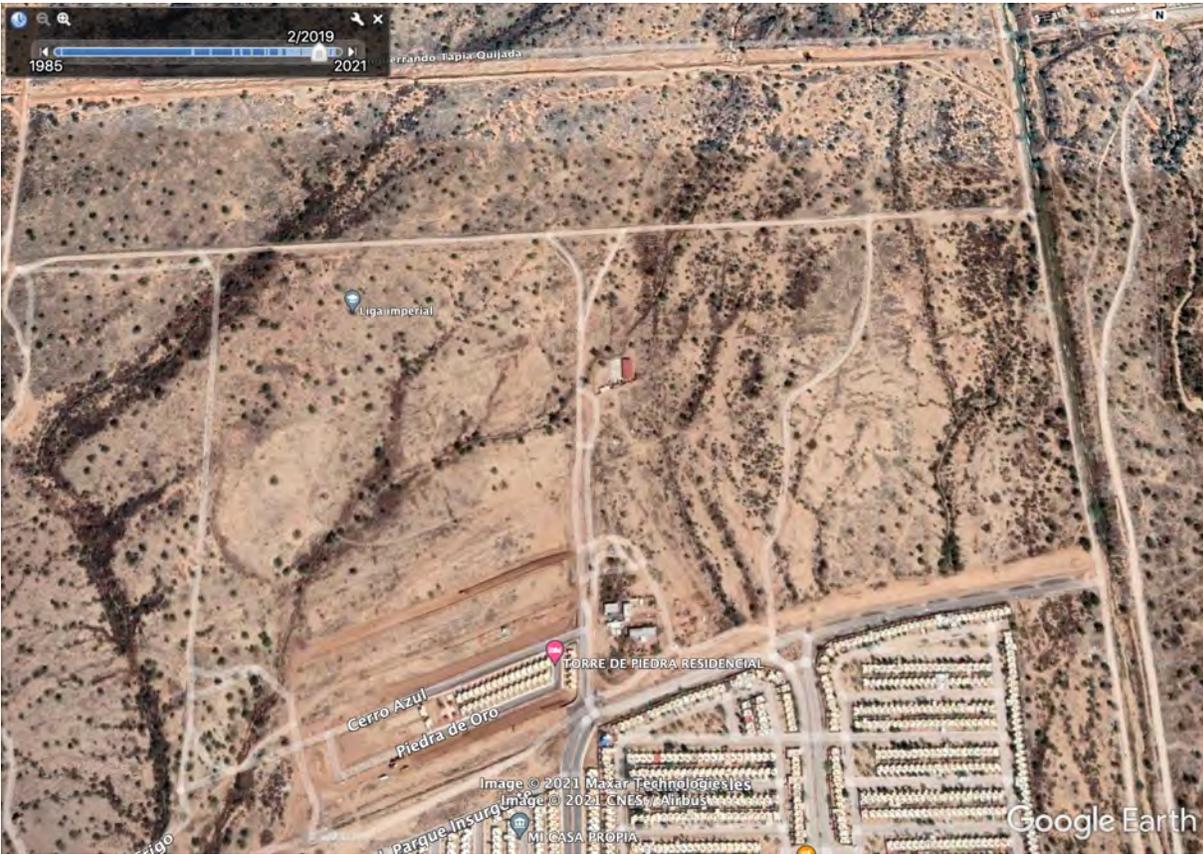
Visit to the site – a new reality

- The open space has become an illegal dump site, posing a health hazard to the adjacent communities and to the ecological systems.



Visit to the site – a new reality

- Time series of site conditions from 2019 to 2021



Visit to the site – a new reality

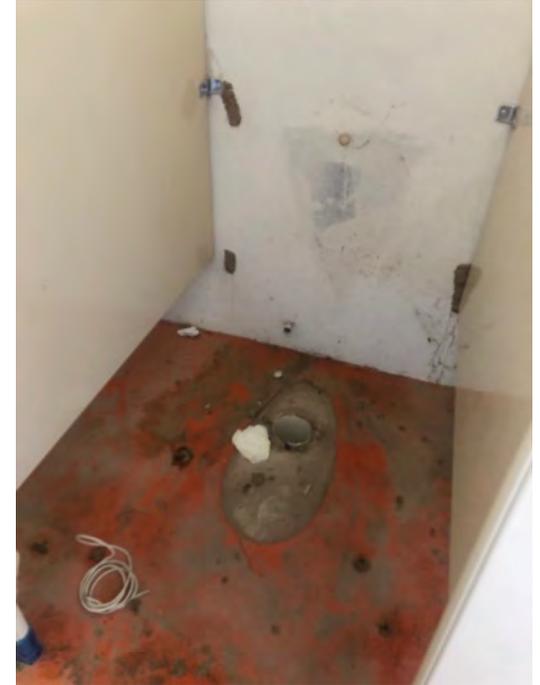
- Ecoparque visit – lack of maintenance, safety concerns, and increased vandalism.



Shade structures have been stolen



Isolated bikeway lacking maintenance



Toilets have been stolen

- Landscape design, planning for GI, and its implementation must be expedited in periurban areas of rapidly growing cities (greenbelt concept).
- There is a need for constructions plans – be ready for funding opportunities.
- Partnering with the private sector (e.g., developers), becomes critical to coordinate efforts that can result in more resilient and sustainable outcomes.
- Engaging the adjacent communities in the planning of GI may prevent vandalism, illegal dumping, destruction of desert landscape - may act as guardians of the site. We propose employment of neighbors in the maintenance and stewardship of parks.

Urban Science Theory – Urban environment

”The urban environment that humans are so busily creating is many things:

- a **biological** environment,
- a **social** environment,
- a **built** environment,
- a **marketing** environment,
- a **business** environment,
- a **political** environment.

Paul Romer, 2013¹



1: Romer, P. (2013). *The City as the Unit of Analysis*. Paul Romer Blog, 2013.

Conclusion

Greening initiatives must consider **all types of environments** within the urban environment.

Resources are needed to engage all stakeholders in greening efforts, including adjacent communities.

Urban planning in Hermosillo (and other rapidly growing cities) must **expedite engagement** efforts.



¡Muchas gracias!

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