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Planning for Field-Scale Bioswale Performance Evaluation at the OSU OGSIR Facility

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Clean Water Conference 2020

Stormwater: The Urban Frontier

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- Urban landscapes:
  - ↑ impervious surfaces, ↑ peak flow, ↓ vegetation = ↑ flooding
- Sewer overflows
  - Spill untreated water from storms
- Stormwater contaminants
  - Concentrations > treated wastewater
  - Varies by rainfall, hydrology, land use
    - Highways, agriculture, industrial areas

https://www.seattletimes.com/seattle-news/weather/extreme-rainstorms-becoming-more-common-in-seattle-says-city-meteorologist/

Stormwater Management

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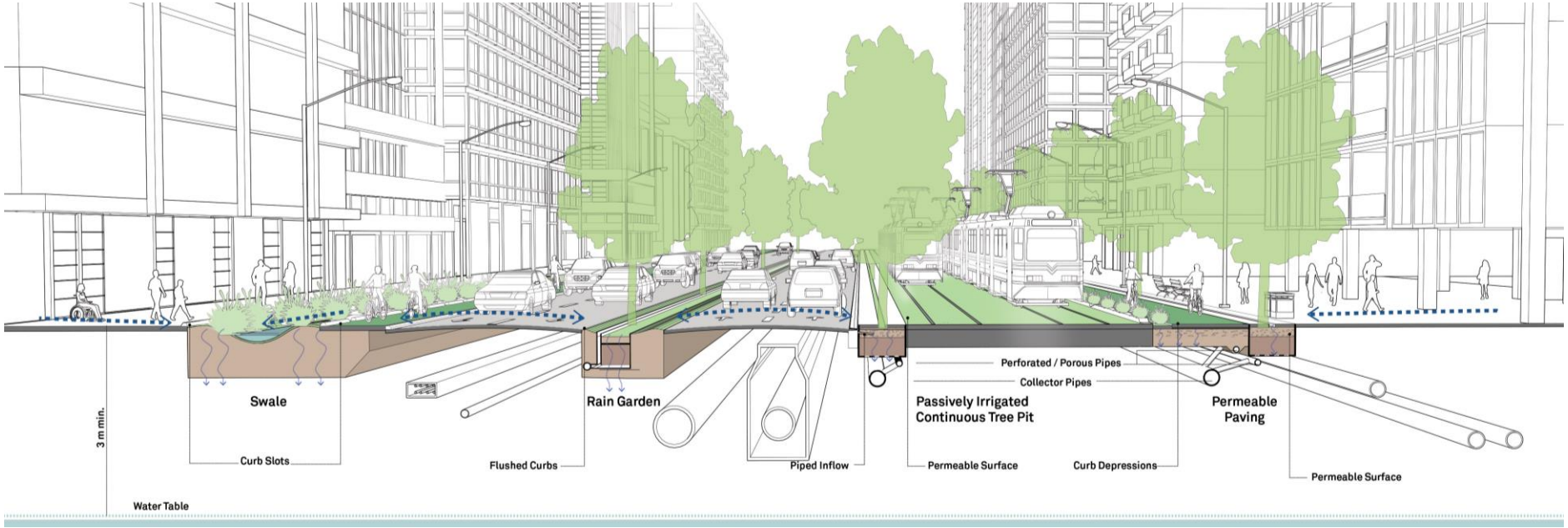
- Green stormwater infrastructure (GSI)
  - Control runoff hydrology & water quality
- Bioretention is most well studied GSI



https://globaldesigningcities.org/publication/global-street-design-guide/utilities-and-infrastructure/green-infrastructure-stormwater-management/

Bioretention - Function

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- Plant-based stormwater control
  - Flooding from sewer overflow
  - Treatment of contaminants
- Dynamic living systems
- Examples:
  - Bioswales
  - Rain gardens
  - Stormwater planters

Rain garden in Washington D.C., USA

https://www.chesapeakequarterly.net/V15N1/main1/

Bioretention - Contaminants

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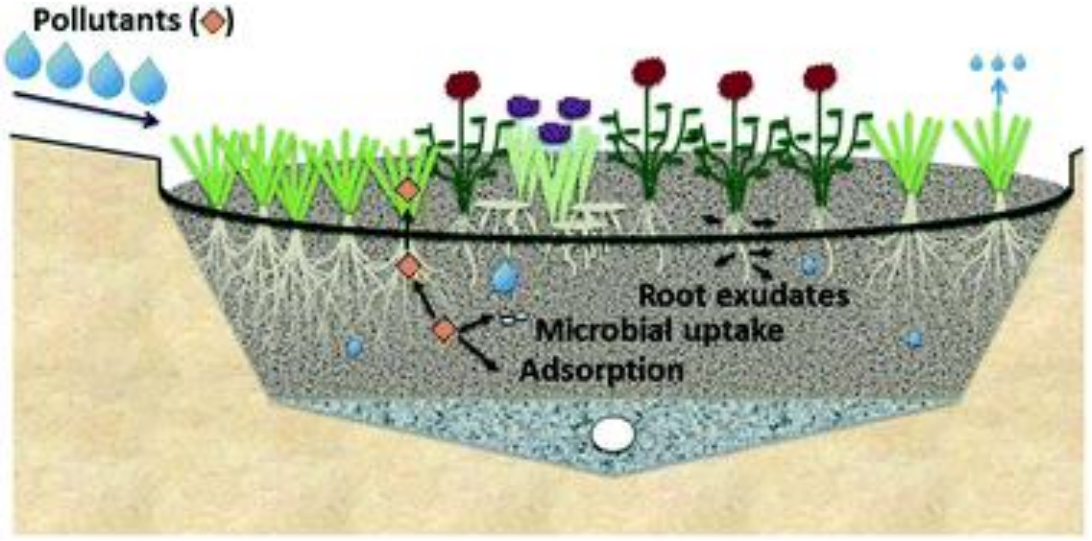
- Maximize time within system
- Particulate bound
  - Suspended solids
    - → Sedimentation
- Dissolved
  - Nutrients, heavy metals
    - → Adsorption or biodegradation
- Temperature mitigation



Muerdter, C.; Wong, C. K.; LeFevre, G. H. Emerging Investigator Series: The Role of Vegetation in Bioretention for Stormwater Treatment in the Built Environment: Pollutant Removal, Hydrologic Function, and Ancillary Benefits; 2018. https://doi.org/10.1039/C7EW00511C.

Typical Bioswale Design

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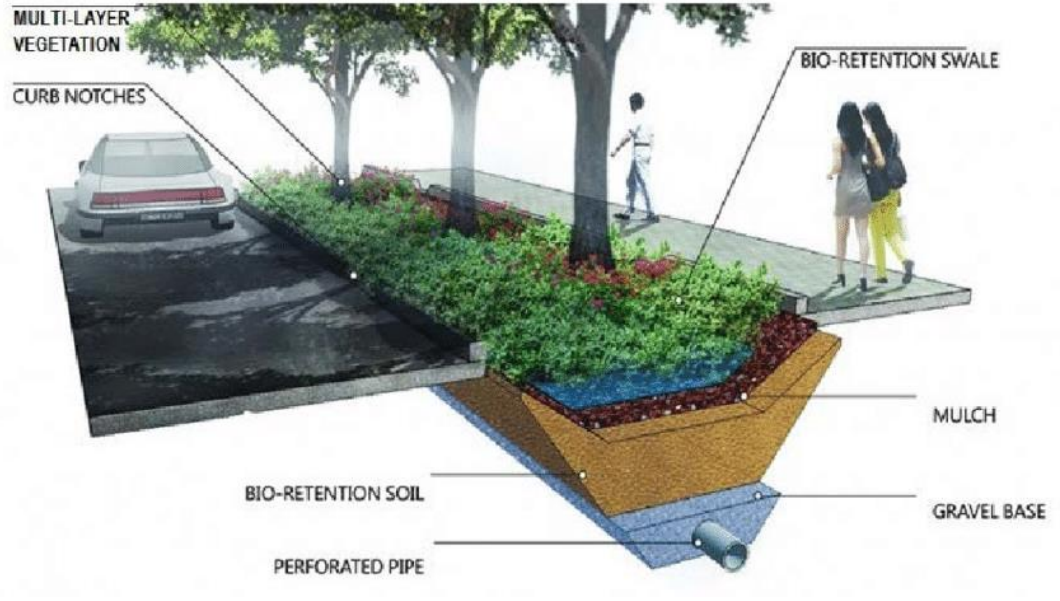
"Landscaped depression that receives runoff from up gradient impervious surfaces, and consists of several layers of filter media, vegetation, an overflow weir, and an optional underdrain."

- Goal: Dirty, fast water in
  → Cleaner, slower water out
- Engineered soil mixture
- Waterproof liners or barriers
- Use diverse native vegetation
- Apply in medians, cul-de-sacs



Dinic Brankovic, M.; Mitković, P.; Bogdanovic Protic, I.; Igić, M.; Đekić, J. Bioswales as Elements of Green Infrastructure – Foreign Practice and Possibilities of Use in the District of the City of Nis, Serbia; 2019.

OSU OGSIR Facility

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- Field-scale experiments for GSI
- Runoff from 100,000 ft^2 catchment
- Contaminant sources:
  - Fuel spills, raw asphalt, parking lot chemicals, road fill sediment, etc.
- Three 100 ft "cells" for testing different technologies

OGSIR Facility in August 2020

OSU OGSIR Design

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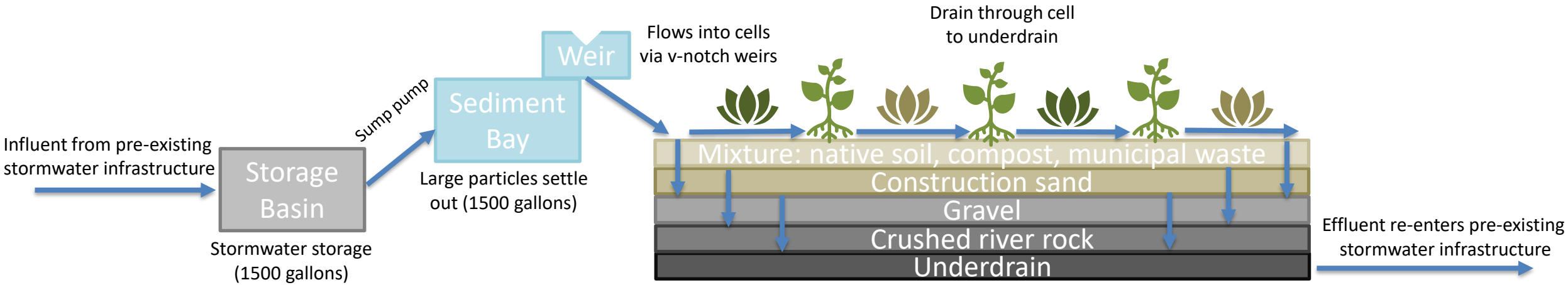
Treatment Train (side view)



Monitored Parameters

- Water flow rates
- Precipitation & wind speed
- Relative humidity
- Soil moisture & water pressure
- Pump usage
- Solar radiation
- Atmospheric temperature
- Barometric pressure

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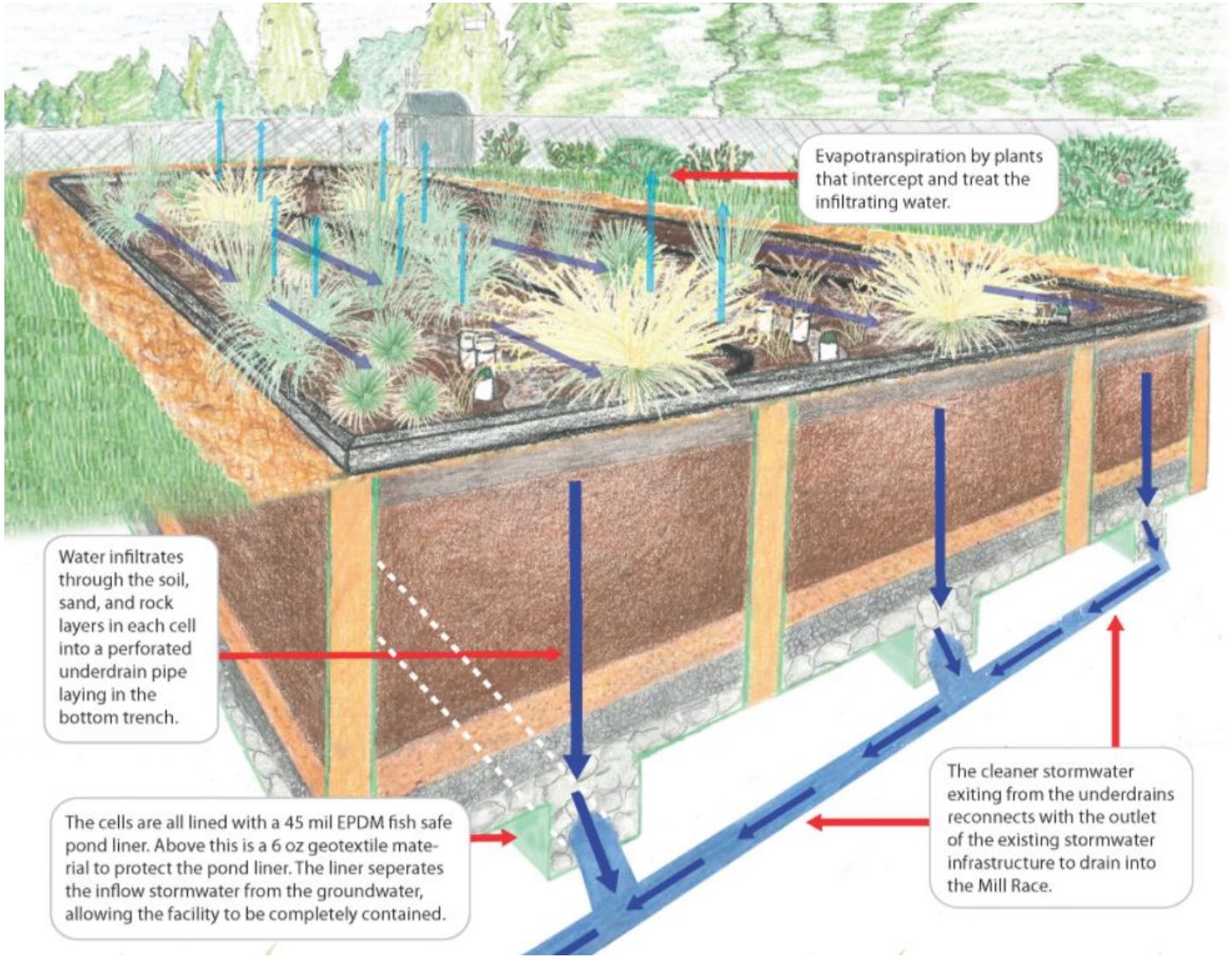

http://research.engr.oregonstate.edu/hydroinformatics/avery/other-resources

New Bioswale Design

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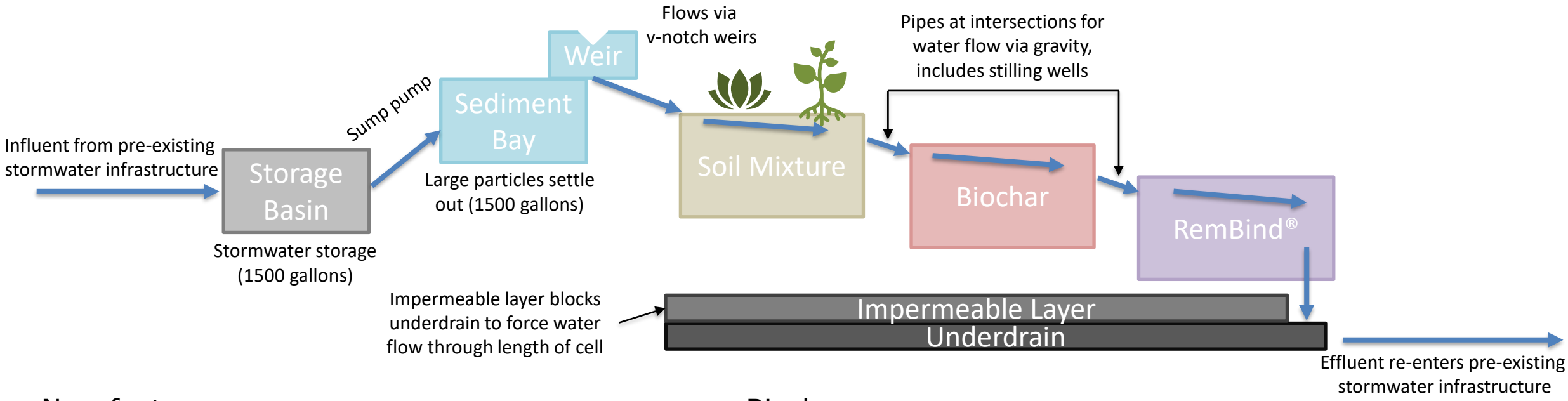

New features:

- In same cell, include different sections of soil or sorbent media
- Block underdrain for water flow through entire length of cell
- Stilling wells for water sampling at each media intersection

Biochar:

- Natural sorbent (thermochemical converted biomass)
- Contaminants: organic (PAHs, VOCs, pesticides) & inorganic (heavy metals, NH_3, NO_3)

RemBind®:

- Blend of natural sorbents (aluminum hydroxide, clays)
- Contaminants: organic (PFAS, PAHs, herbicides)

Research Plan for Thesis

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- Conduct sediment tracer studies
  - Track sediment movement in bioswale
- Build new bioswale design in Cell 1
- Collect samples for water quality tests
  - Heavy metals, nutrients, PFAS (maybe)
- Compare data with Cells 2 & 3 for performance evaluation

Cell 1 at OGSIR Facility, August 2020

Collaborating Partners

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References

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