The Implementation of Low Impact Development (LID) Practices along the South Carolina Coast

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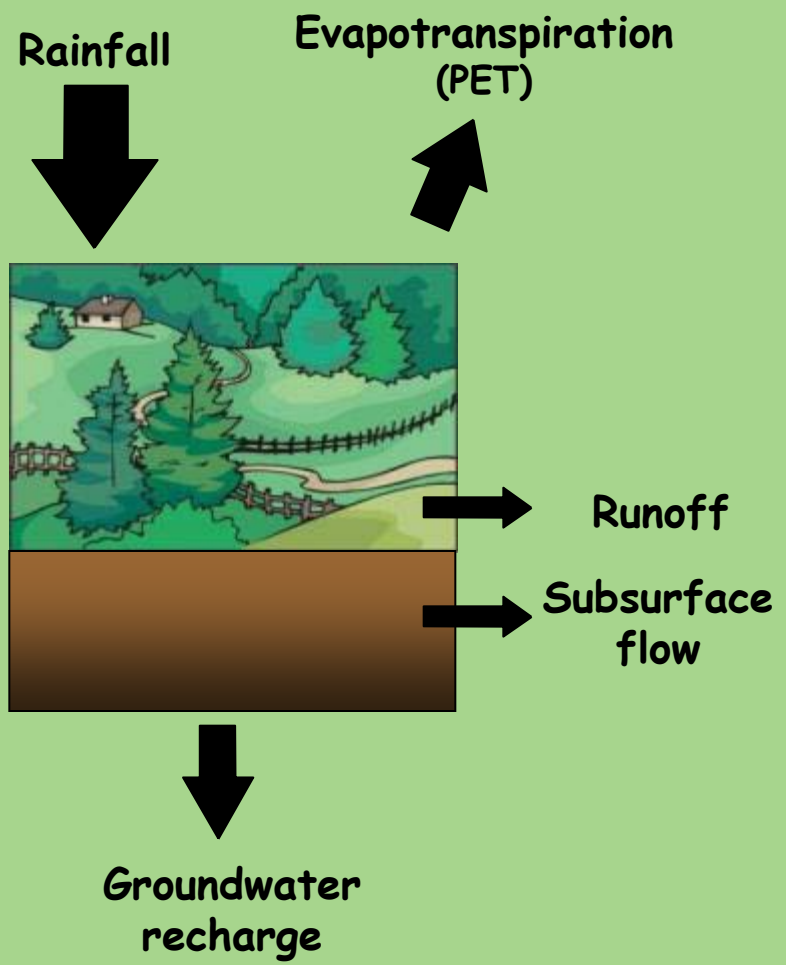
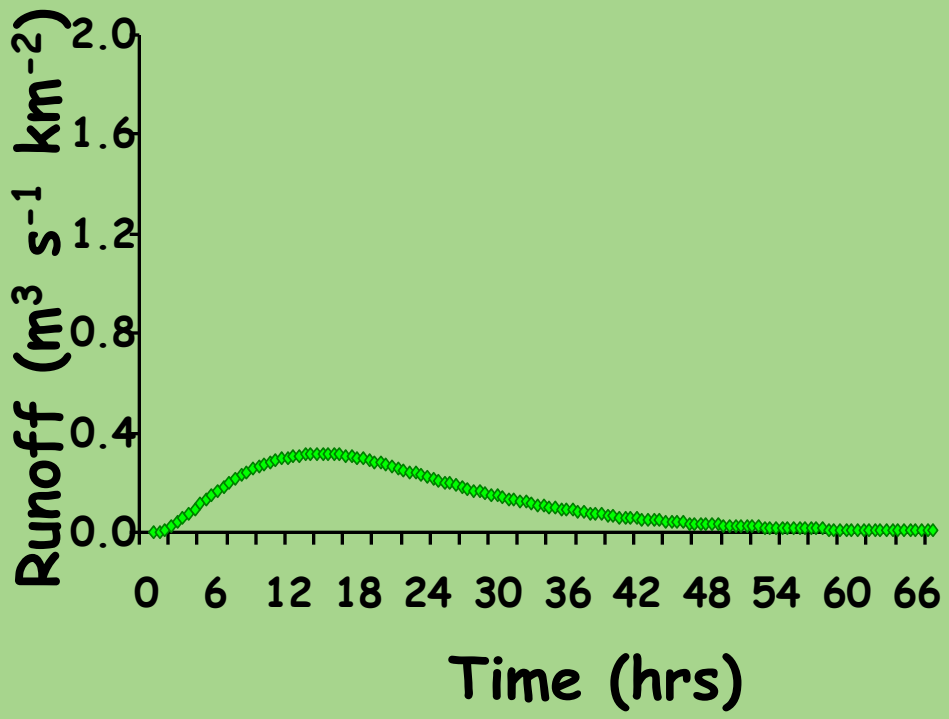
Hydrology of a Forested Watershed

WATER BUDGET



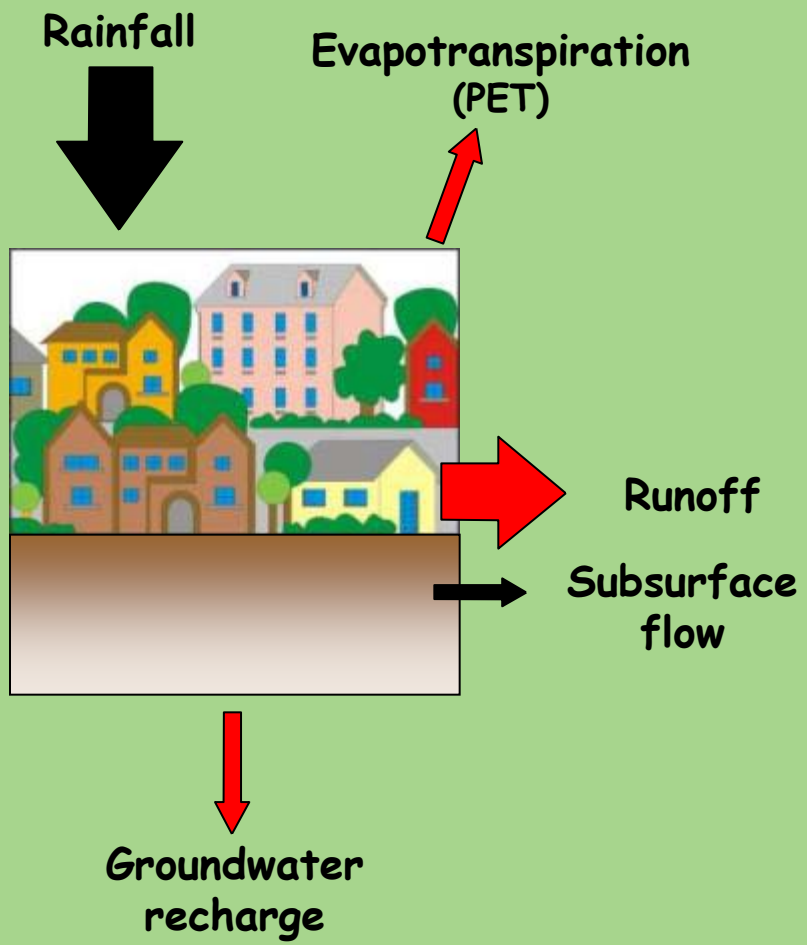
HYDROGRAPH



**Rainfall = 4.5 in/24hr*

Hydrology of a Developed Watershed

WATER BUDGET



HYDROGRAPH

**Rainfall = 4.5 in/24hr*

Stormwater Regulations

Suggest use of stormwater Best Management Practices (BMPs)

Low Impact Development (LID) Practices

Green roof,
Bowens Island

Constructed wetland,
SCDOT Rivers Avenue

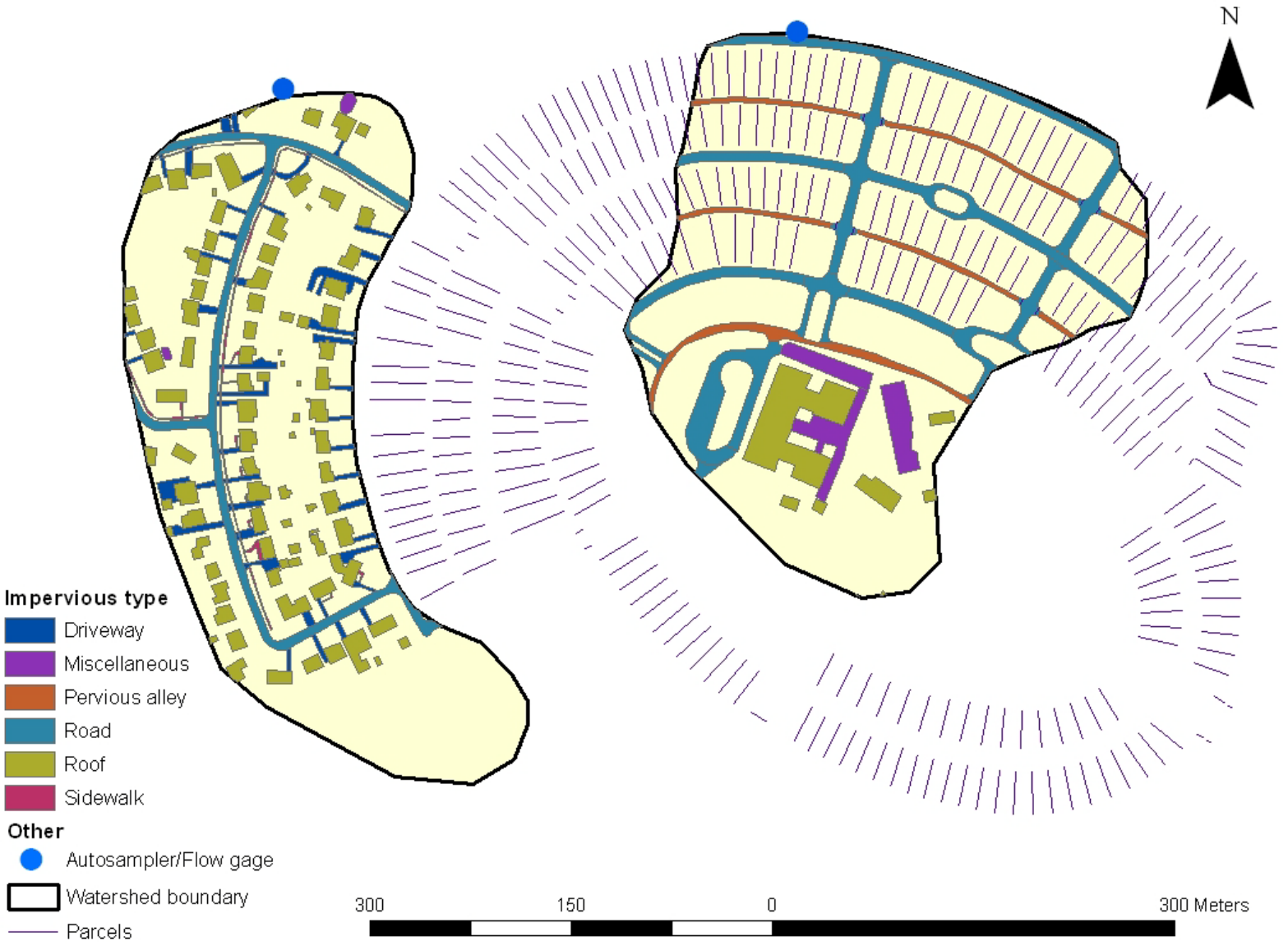
Carolina Yard,
Ladson Exchange Park

- LID is a stormwater management approach that integrates the use of a network of Best Management Practices (BMPs) to disperse stormwater throughout the site.
- Designed to promote infiltration, recharge groundwater sources, and mimic pre-development hydrologic conditions

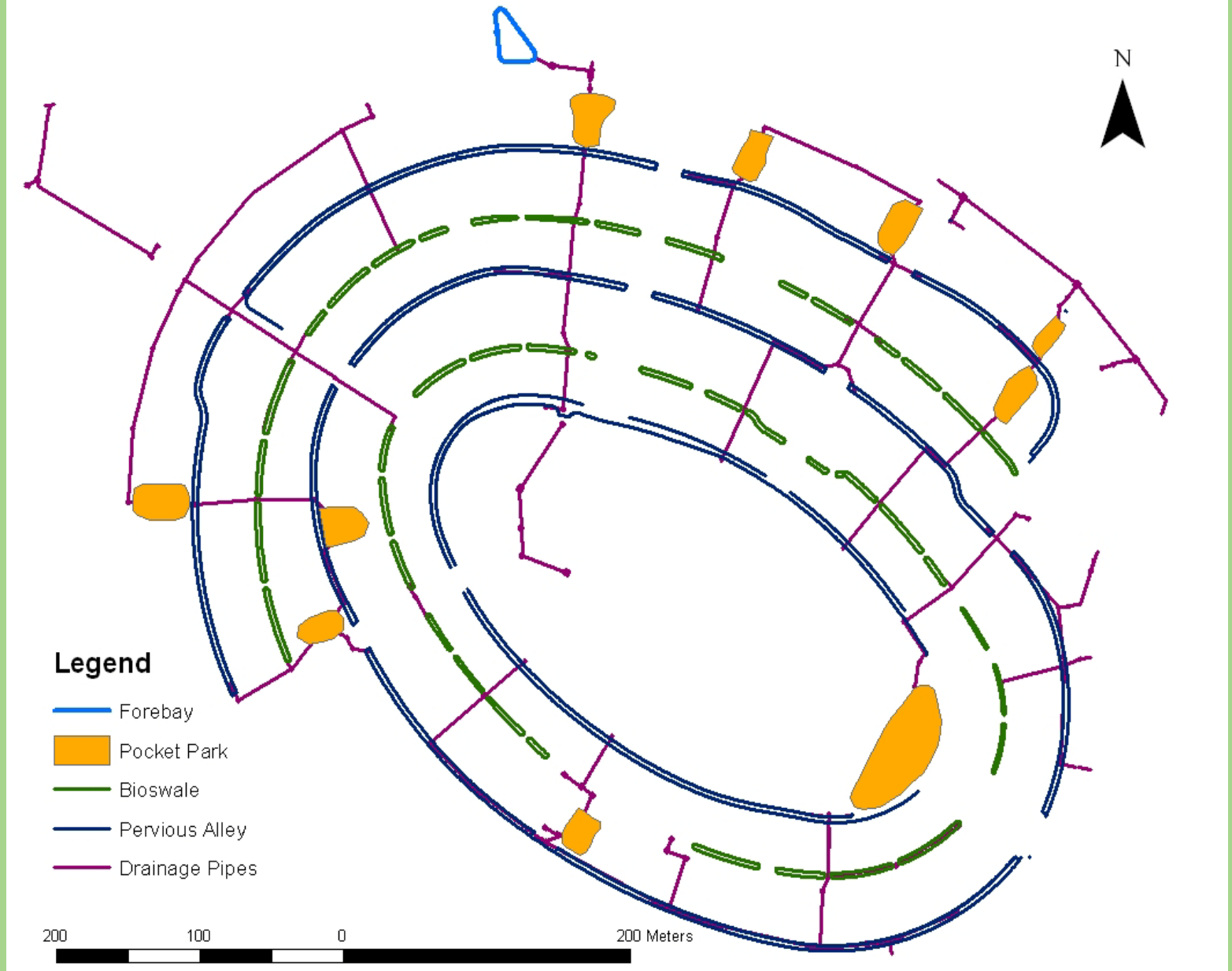
Oak Terrace Preserve: A Case Study

- LID implementation obstacles and options
- Information gaps:
  - **LID comparative performance and efficiency**
  - Cost comparison
  - LID design and installation guidelines
  - Homeowner perceptions and educational needs

Paired Catchment Study



Oak Terrace Preserve



Bioretention swale

Pervious alley

Pocket Park

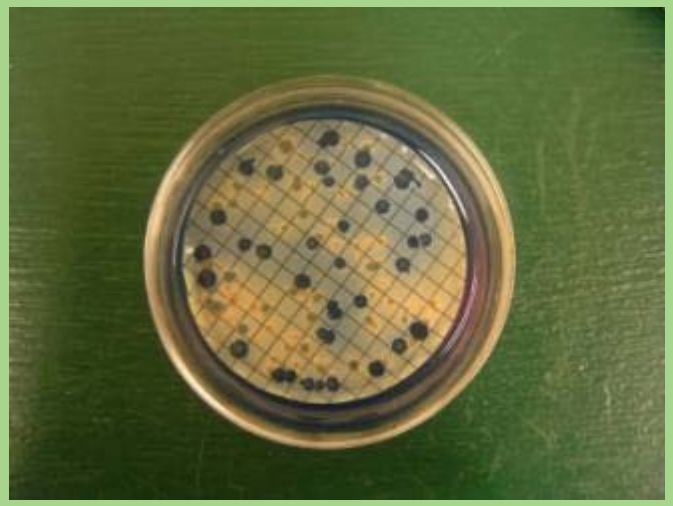
Forebay

Method: Data collection

RAIN EVENT: ≥ 13 MM WITH < 0.3 MM PREVIOUS 72 HOURS

- **Rain volume & intensity**
  - Rain gage
- **Runoff volume**
  - Flow gages
  - SCS Curve Number Method (NRCS, 2001)
- **Runoff Samples**
  - 12 bottle autosampler

Methods: Sample Processing



- TDN and TDP
  - USC Baruch Institute
- **Fecal Coliform**
  - CCEHBR Microbiology Lab, mFC method
- Atrazine and 2,4-D
  - CCEHBR Ecotoxicology Lab, RaPID Assay Kits
- **TSS**
  - SCDNR MRRI

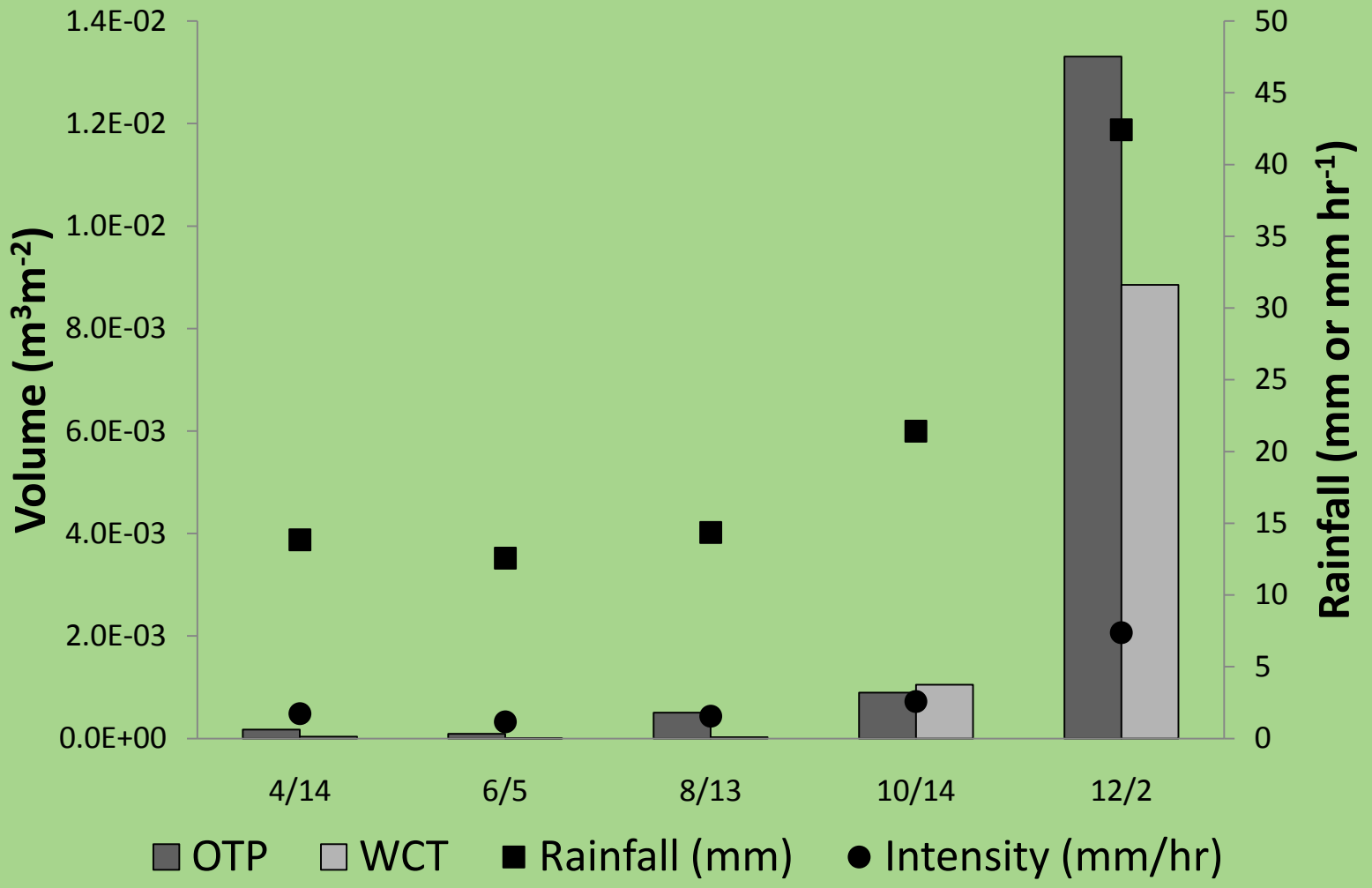
Methods: Data analyses

Predictor Variables	Response Variables
Catchment (treatment, reference)	Runoff Volume (m^3m^{-2})
Date	First flush concentration (mass per unit volume)
	Average event concentrations (mass per unit volume)
	Yield (mass per area)

Statistics: (1) Two-way ANOVA and (2) Wilcoxon ranked-sum test

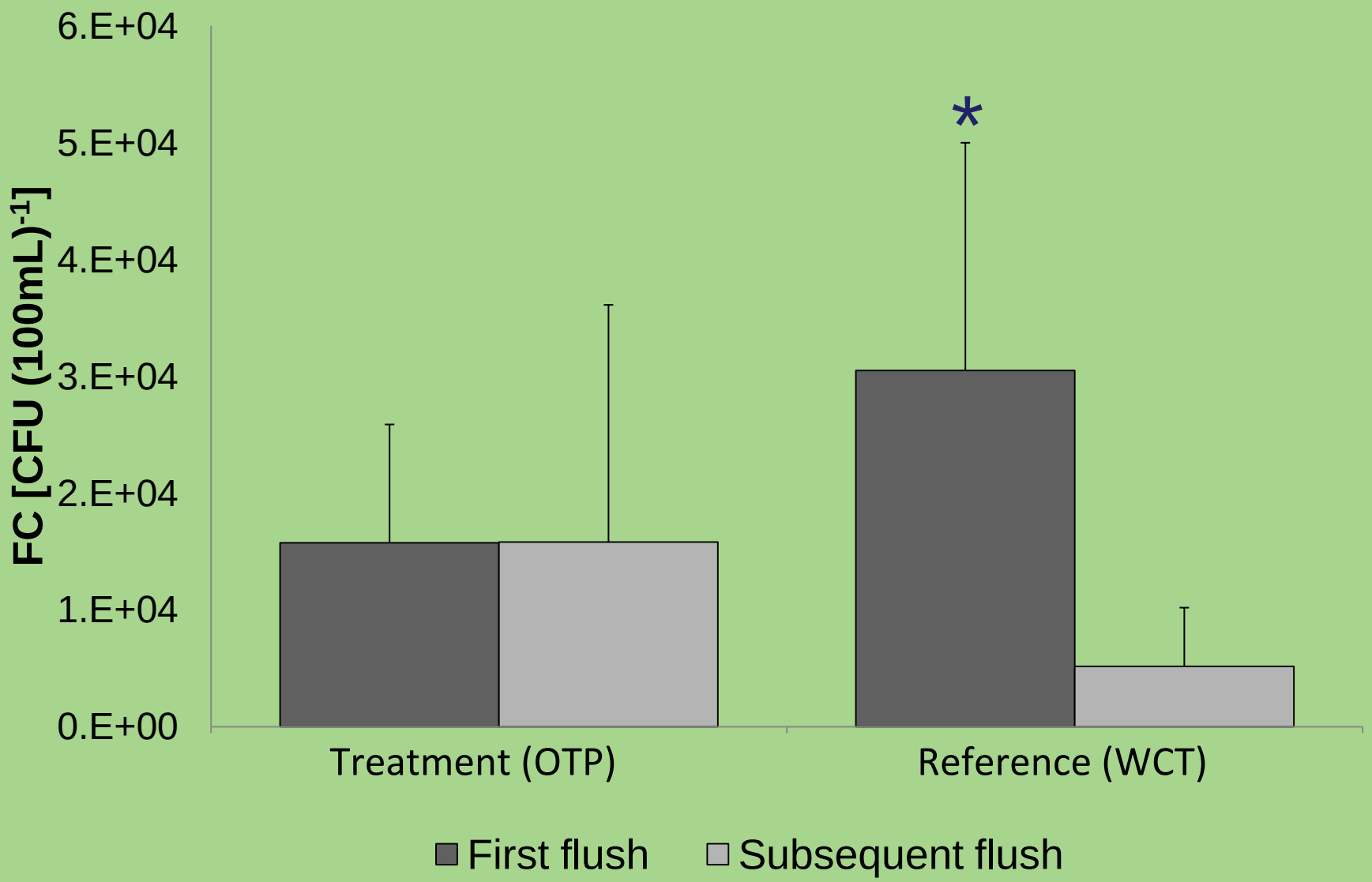
Runoff Volume

NO DIFFERENCE IN VOLUME BETWEEN CATCHMENTS



Suspended Sediment Concentrations

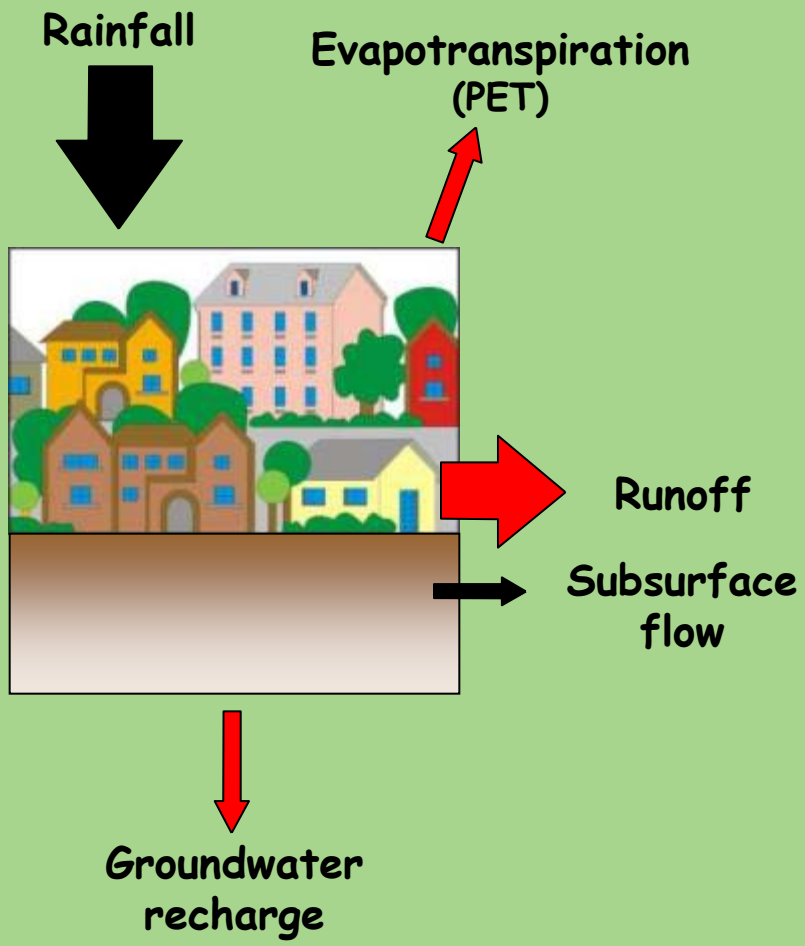
Fecal Coliform Concentrations



Pollutant Yields

Catchment	2009 Date	Runoff volume (m^3m^{-2})	TDN (kg m^{-2})	TDP (kg m^{-2})	FC (CFU m^{-2})	TSS (kg m^{-2})	Atrazine (kg m^{-2})	2,4-D (kg m^{-2})
Treatment (OTP)	4/14	1.7×10^{-4}	2.1×10^{-9}	4.2×10^{-10}	1.9×10^{4}	1.4×10^{-5}	1.7×10^{-10}	4.8×10^{-9}
	6/5	9.3×10^{-5}	1.0×10^{-9}	8.6×10^{-11}	2.3×10^{4}	7.1×10^{-6}	5.6×10^{-12}	4.6×10^{-11}
	8/13	5.1×10^{-4}	6.5×10^{-9}	3.3×10^{-10}	2.6×10^{4}	4.1×10^{-5}	0	0
	10/14	8.9×10^{-4}	5.3×10^{-7}	9.8×10^{-8}	1.7×10^{5}	6.8×10^{-5}	4.2×10^{-11}	0
	12/2	**1.3×10^{-2}**	**7.2×10^{-6}**	**1.7×10^{-6}**	**1.4×10^{6}**	**1.0×10^{-3}**	**2.7×10^{-10}**	0
Reference (WCT)	4/14	3.8×10^{-5}	5.5×10^{-10}	3.5×10^{-10}	2.9×10^{3}	1.7×10^{-6}	1.3×10^{-11}	0
	6/5	4.1×10^{-8}	8.1×10^{-13}	4.0×10^{-13}	9.4	1.2×10^{-9}	1.3×10^{-14}	0
	8/13	2.7×10^{-5}	3.1×10^{-10}	2.6×10^{-10}	4.0×10^{3}	4.2×10^{-7}	5.9×10^{-13}	0
	10/14	1.0×10^{-3}	6.4×10^{-7}	3.3×10^{-7}	1.9×10^{5}	2.8×10^{-5}	1.7×10^{-9}	0
	12/2	**8.9×10^{-3}**	**5.6×10^{-6}**	**5.7×10^{-6}**	**1.0×10^{6}**	**3.0×10^{-4}**	**7.0×10^{-9}**	0
p-value		**0.31**	**0.44**	**0.81**	**0.44**	**0.06**	**0.63**	**0.37***

Conclusion



Regulatory apprehension of LID implementation

- Dampening of first flush concentrations of TSS and FC
- But…underdrains conveyed similar volume of stormwater
- Resulting in similar pollutant yields
- It's the volume of stormwater that matters!

Implications for Climate Change

- **Projected increases in the frequency and intensity of large rain events. For this study, a 40 to 43 mm event produced:**
  - 32 times more runoff volume
  - 32 to 70 times more nutrient yields (TDN & TDP)
  - 21 to 40 times more particulate pollutants (TSS & FC)
  - 0 to 16 times more herbicides (Atrazine & 2,4-D)

Comprehensive Stormwater Management Strategies

- **Reduce stormwater volume at the source**
  - Reduce impervious cover
  - Rainwater harvesting
- **Reduce stormwater velocity**
  - Temporary stormwater retention and peak flow reduction
- **Improve stormwater quality**
  - Education to reduce pollutant loads at the source
  - Pollutant filtration, sorption, settling, transformation, decay, uptake

Mitigating Impacts of Coastal Development

- **Reduce urban sprawl through better land planning policies and decisions for coastal watersheds to (1) reduce impervious cover and (2) maximize conservation of open space and riparian buffers**
  - Impervious cover thresholds for watersheds
  - Land preservation and conservation easements
  - Urban growth boundaries
  - Incentives for redevelopment and clustered development

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debra hernandez & company

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Questions?