Incorporating Green Infrastructure Into Stormwater Management

Assessing alternate strategies to address flooding in Port of Spain, Trinidad

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UBC Master Land and Water Systems 2015/16

Content

- Key Messages
- Objectives
- Study Area
- Flooding in Port of Spain
- Current Stormwater Strategy
- Incorporating Green Infrastructure into the urban landscape
- Potential opportunities for Implementation of green infrastructure
- Conclusion
- Recommendations
- Lessons Learnt
- Acknowledgements

Key messages

- Green Infrastructure can be utilized as part of a broader stormwater management plan to alleviate flooding in the City of Port of Spain.
- Port of Spain will only derive benefits if there is **legislative** & **institutional** reform along with concerted efforts at **collaboration** between and among agencies responsible for stormwater planning and management .

Objectives

- Investigate current strategies used to address flooding in POS.
- Provide recommendations to the possible establishment of a stormwater management plan.
- Determine if green infrastructure can be successfully utilized as part of a broader stormwater management plan in POS.
- Provide illustrative examples of how green infrastructure can reduce flooding in Port of Spain.

Methodology

- Primary research
  - *Interviews*
  - *Analyzed current initiatives*
- Literature review
- Illustrative designs

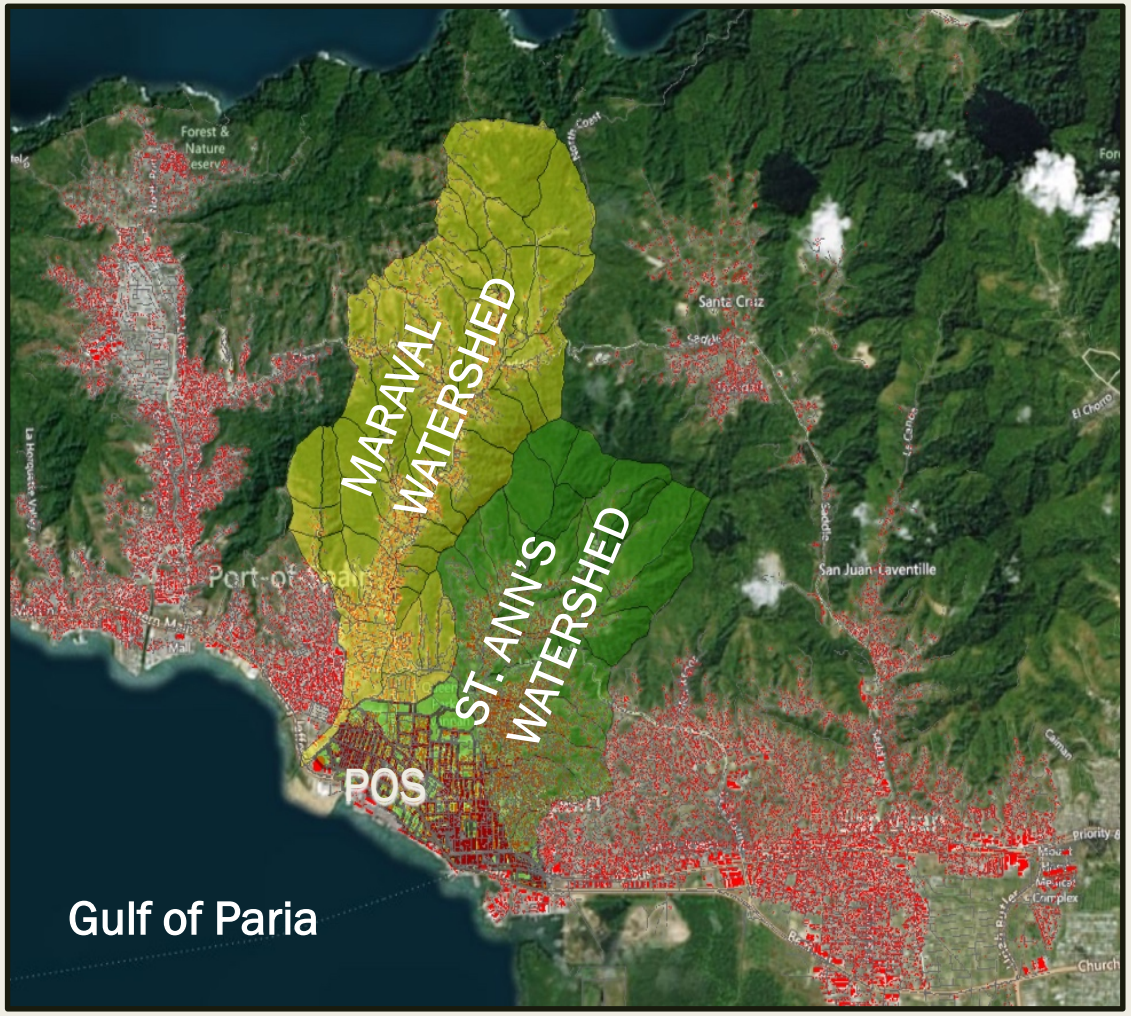
Study Area

Port of Spain

- Capital City
- Area – 502 hectares
- Municipal population – 37,074
- Transient Population – 250,000
- Large section of reclaimed land
- Grid-like city structure
- 80% imperviousness


Maraval River
Queens
Park
Savannah
St. Ann's
River
Previously Reclaimed land
Invaders Bay
GULF OF PARIA
1209 m
Image © 2016 DigitalGlobe
Image © 2016 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Study Area – Watershed characteristics



Map showing the configuration of the watersheds which influence the Port of Spain catchment.

Maraval watershed

- Watershed measures 2000 hectares
- Highly urbanized even on steep slopes.
- Several channels and tributaries draining into Gulf of Paria.

St. Ann's watershed

- Highly urbanized even on steep slopes.
- St. Ann's river becomes the East Dry River as it enters Port of Spain.
- The East Dry River is fully concretized.

FLOODING IN PORT OF SPAIN

- Observed locations
- Issues which affect flooding

Flooding in Port of Spain – Observed Locations

Flooding in Port of Spain – Issues affecting flooding

A dense network of impermeable cover

- Dense network of impermeable cover

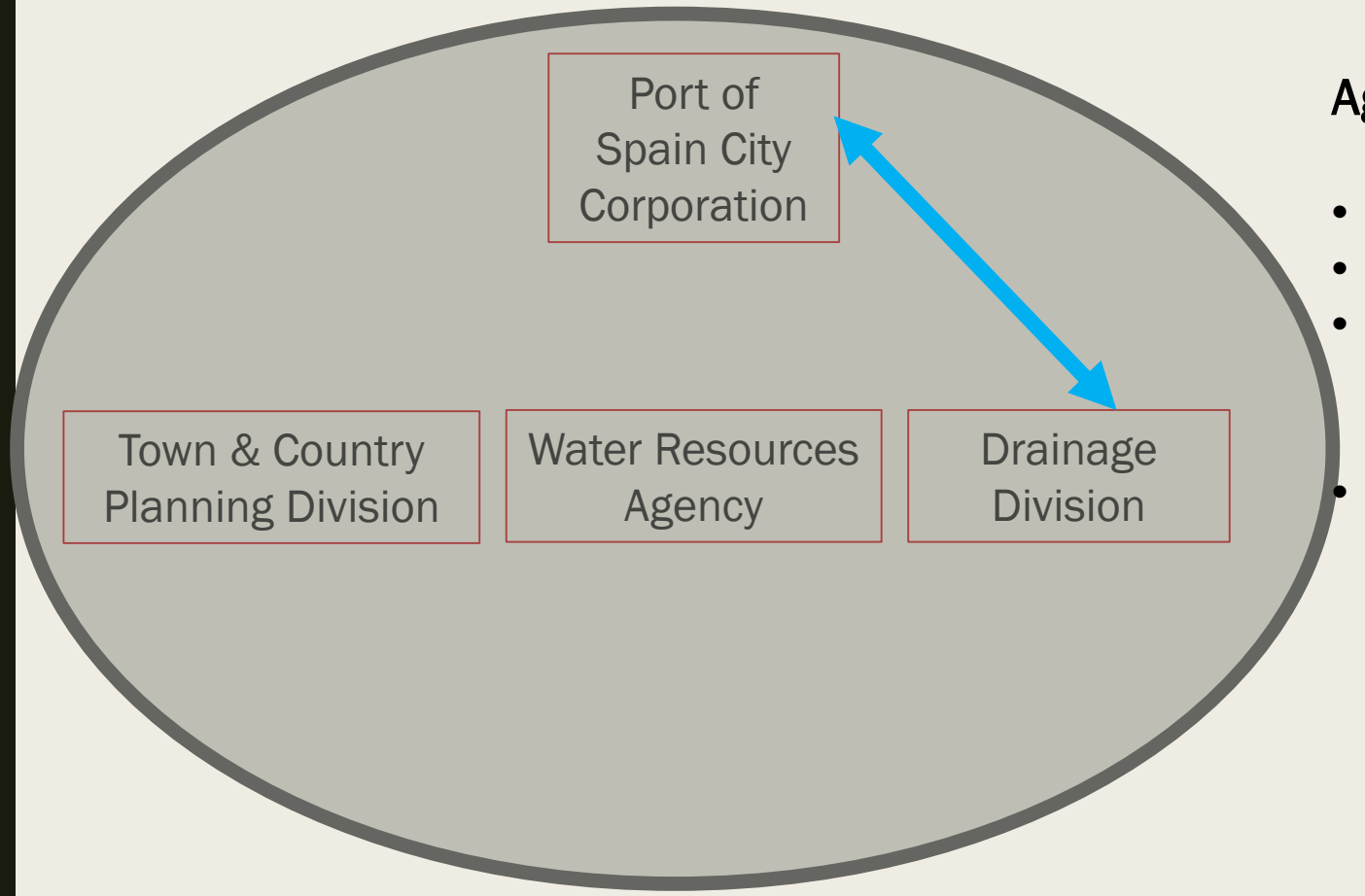
Flooding in Port of Spain – Tidal Influence

Outfalls located in the Gulf of Paria.

Flooding in Port of Spain
Inadequate drainage & Littering

Flooding in Port of Spain –

Institutional Environment



Agencies:

- Port of Spain City Corporation
- Town and Country Planning Division
- Ministry of the Environment and Water Resources
  - Drainage Division
- East Port of Spain Development Company

Flooding in Port of Spain –

Institutional Environment – Current Initiatives

Focus on drainage upgrade

- Pump and Sump strategies
- Mapping of drainage infrastructure
- IDB Flood Alleviation Program / Emerging Sustainable Cities Initiatives
  - *EPOSDC – Linear Park*
- East Port of Spain Development Company initiatives.

POWERGEN Cooling channel

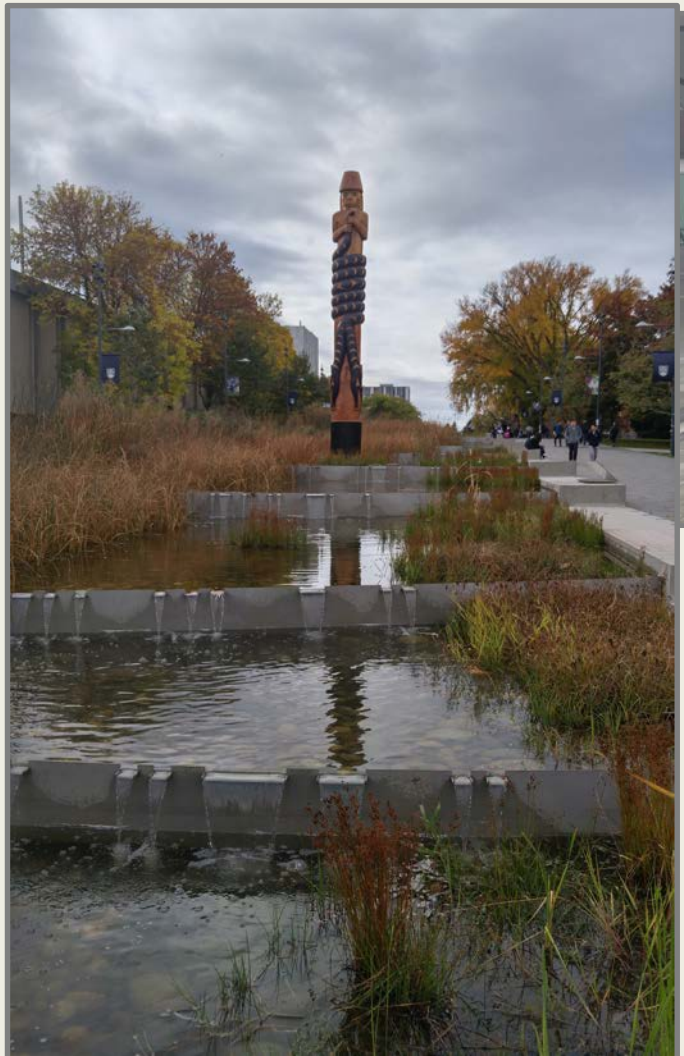
Legislative Framework

- Municipal Corporations Act (1990)
  - *Section 232, Part XII identifies Miscellaneous functions*
- Waterworks and Water Conservation Act (1944)
- Town and Country Planning Act (1960)
  - *Planning and Facilitation Act (2014) – not yet proclaimed*
- Water and Sewerage Authority Act (1965)
- Environmental Management Act (2000)
- Public Health Ordinance
- **Draft** Small building code (2004)

NO LEGISLATION WHICH DIRECTLY SPEAKS TO STORMWATER MANAGEMENT

Incorporating Green Infrastructure into the urban landscape

- Green infrastructure is a form of low-impact development.
  - *It integrates vegetation (trees, shrubs, wetland vegetation) with man-made drainage infrastructure and includes structural landscape design features which mimic natural processes to reduce runoff and therefore flooding.*
- Stormwater should no longer be considered a nuisance. It is a **resource** that can be utilized.



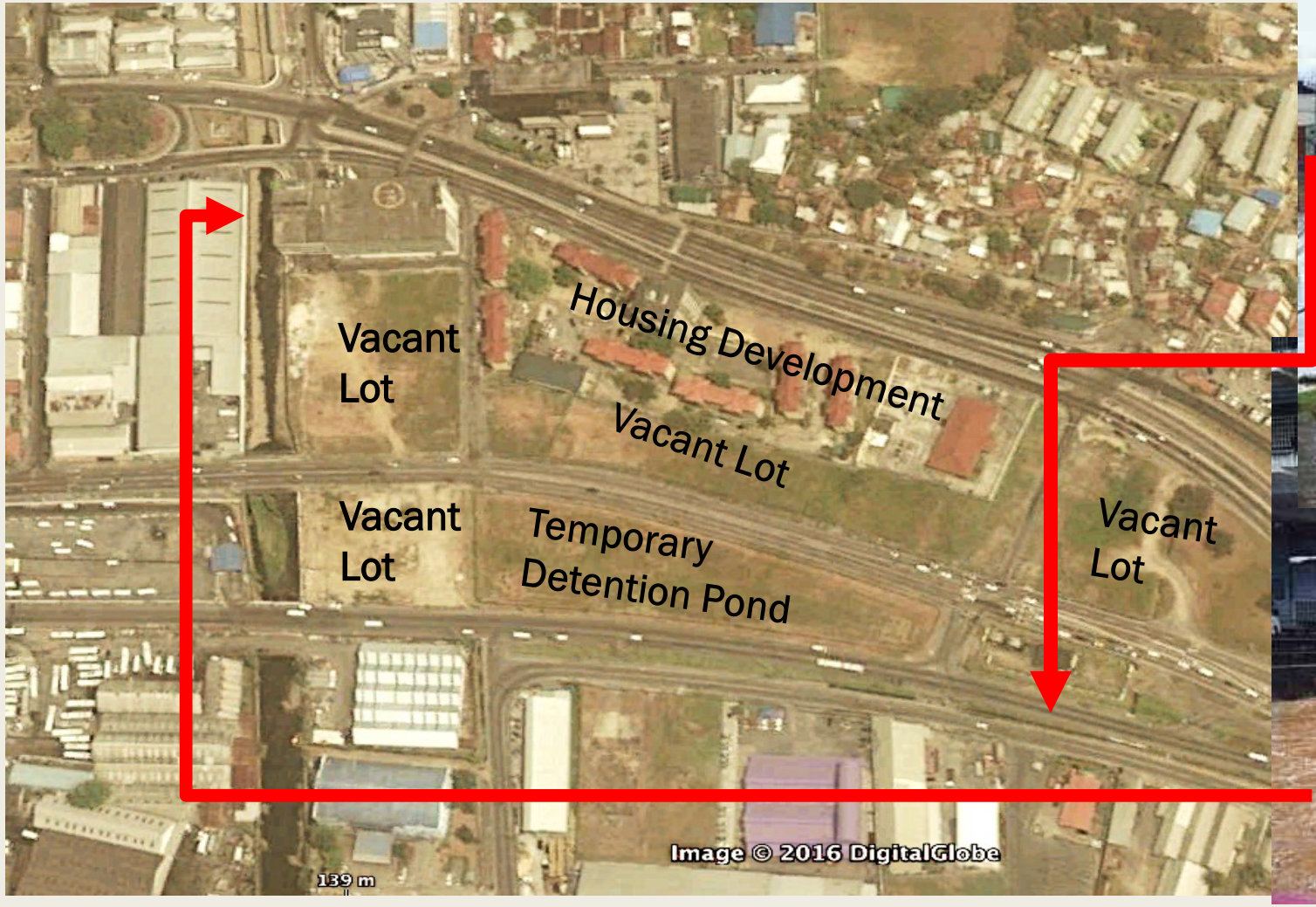
Green infrastructure feature found at "The Nest"

University Boulevard Stormwater Terraces at UBC

POTENTIAL OPPORTUNITIES

- South Quay Wetland
- Brian Lara Promenade Bioswales
- Queens Park Savannah Artificial Recharge

Potential Opportunity – **South Quay Wetland**



Potential Opportunity – South Quay Wetland

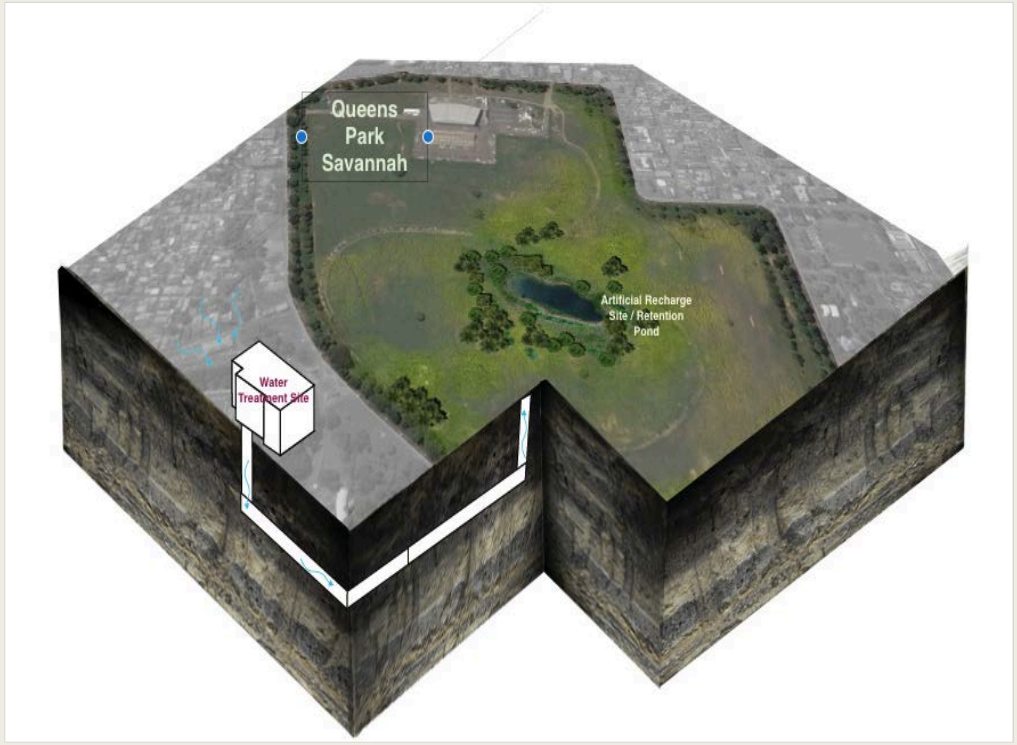
- Detention pond extended by 20 ft. towards the river channel.
- Designed to increase infiltration rates
- Elevated platforms over wetland and causeway.
- Bioswales, rain gardens, rainwater harvesting imperative in future development plans

Potential Opportunity – <u>Brian Lara Promenade Bioswales</u>

- Interlocking pavers which do not readily support infiltration.
- Green spaces are not very well maintained.

- Bioswales on both sides of path
  - Plants adapted to salt and fresh water
  - Bioswales connected to roadway
- Tree cover increased
- Permeable concrete used for walkway

Potential Opportunity – Queens Park Savannah



Current Use:

- Cultural space for carnival
- Recreation site used for jogging, kite flying & other activities.
- Ground water aquifer and well field.

Proposed Use:

- Utilize small section, 10 hectares as a wetland.
- Aquifer Storage and recovery facility
- Pre-treat stormwater at a site outside of Savannah and pipe treated water to infiltration wells/wetland

Conclusion

- Flood management in Port of Spain requires a detailed STORMWATER MANAGEMENT plan.
- Planning and development decisions have exacerbated flooding BUT can .
- Climate change requires re-assessment of current approach to flood management.
- Green infrastructure techniques can be beneficial in Port of Spain but requires institutional & legislative support to be effective.
- There is growing interest and support among a wide cross-section of citizens for innovative solutions to the problem of flooding in Trinidad.

Recommendations - Institutional Strengthening

- Close the knowledge gap within institutions on best management techniques for stormwater management
- Development of an integrated stormwater management plan for the city of Port of Spain.
- Institutions responsible for stormwater management **MUST** collaborate. Stop working in silos.
- Include green infrastructure into Comprehensive Development Plan for the City of Port of Spain.
- Incentivise residents and businesses that incorporate green infrastructure into their property development (as part of ISWMP).

Recommendations – Legislative Framework

- POSCC to seek support from the administrative and legislative arms of government to
  - *update and enforce legislation*
  - *institutional strengthening to establish a stormwater management and planning unit*
- Town and Country Planning Division must enforce current regulations and include stormwater management within their proposed Comprehensive Development Plans.

THANK YOU

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