THE EFFECTS OF LAND-USE CHANGE ON BENTHIC MACROINVERTEBRATES IN THE UPPER REACHES OF THE APIES-PIENAAR CATCHMENT

Supervisor: Matthys Dippenaar
Geology Department
Co-Supervisor: Dr Chris Weldon
Zoology Department
Progress report 2014

WATER RESEARCH COMMISSION

Introduction

- Freshwater ecosystems - most threatened
- South Africa - changes in the socio-economic climate and high levels of development and urbanisation:
  - Increase in impacts to natural water resources

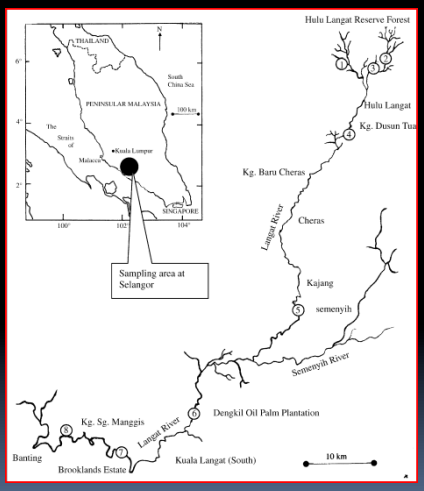
Water Quality

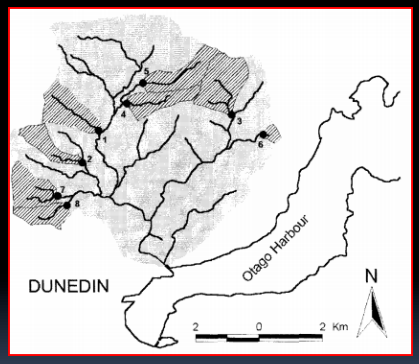
- Water quality and community structure - dictated by the natural processes
  - Alteration affect the ecological integrity of rivers
- Land use type is highly associated with changes in surface water chemical and physical quality
- There is a need for sound water and ecosystem management of catchment areas

Benthic Macroinvertebrates

- A surrogate for ecosystem health
- Responses to changes in chemical and physical water quality parameters
  - Extensively investigated
- There is a general trend

Two types of investigation





Problem

- Highly developed catchments have streams and rivers flowing through multiple land use types over relatively short distances
  - Are the changes at a fine scale sufficient to use as a diagnostic tool for water quality and ecosystem health assessments?
  - Do the same rules apply?

Aim

- To investigate and compare chemical and physical water quality parameters and aquatic macroinvertebrate species composition along a single stream with multiple land use types

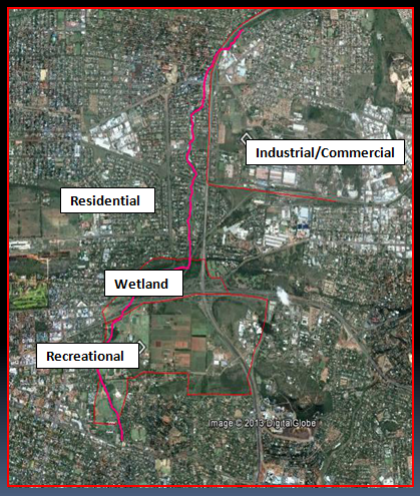
Objectives

- Water quality parameters **vs** aquatic macroinvertebrate assemblages?
- What effects macro invertebrate assemblages?
- Address urban land use variation impacts on surface water quality and ecosystem health

Site Selection

- The upper reaches of the Apies-Pienaar catchment was chosen (8,06 km)
  - Constant geology
  - Flows through multiple distinct land use types
  - Accessibility

Site Selection



Approach

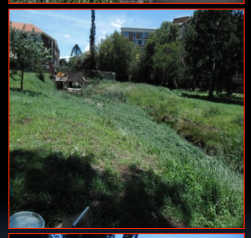
- At each site the following was do
  1. Sites described
  2. Water quality samples taken
  3. Macroinvertebrate samplers p

Site Descriptors

- Visual observations
  - Storm water drains/tributaries
  - Point sources of pollution
  - Direct human impact
- Descriptions
  - Substrate type
  - In-stream micro habitat composition
  - Riparian zone composition
  - Canopy cover
- Physical parameters
  - Depth
  - Width

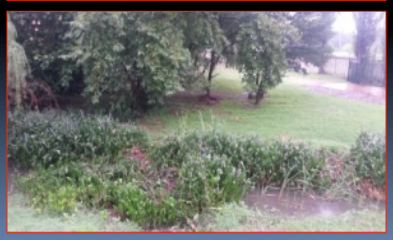
Site 1 (Source/ Residential)

- Source
- Frank Struben Bird Sanctuary
- Shallow, stagnant water
- Muddy substrate
- Extensive natural vegetation
- Low accessibility


Site 2 (Recreational)

- LC De Villiers Sports Grounds
- Vegetation upkeep
- Muddy substrate
- High canopy cover
- High accessibility

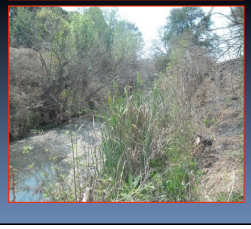



Site 3 (Wetland/Least transformed)

- After Colbyn Valley Wetland
- Deep free flowing
- High riparian vegetation
- Rock and clay substrate
- Water seemed most pristine

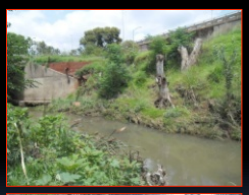
Site 4 (Residential)

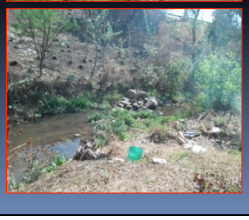
- Waverly and N1
- Rocky clay substrate
- Deep, free flowing
- Highly assessable
- Highway/drains/excrement



Site 5 (Industrial)

- East Lynn
- Shallow, free flowing
- Rocky clay substrate
- Highly assessable
- Squatters/refuse/drains





Site Description

Water Quality

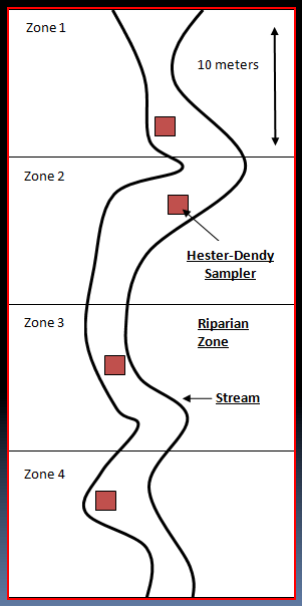
- Water quality samples are to be taken at each site for the following:
  - Physical:
    - Temperature
    - pH
    - Turbidity
    - Electrical conductivity
  - Chemical:
    - Total dissolved solids/Salinity
    - Trace metals
    - Nutrient enrichment
    - Dissolved oxygen
  - Biological:
    - Organic enrichment
    - Total petroleum hydrocarbons
    - Microbial pollution

Macroinvertebrate Samplers

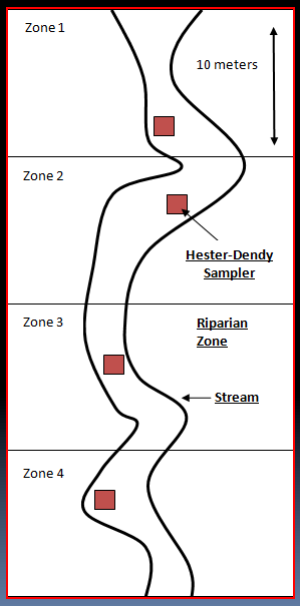
- Artificial Substrate Samplers
  - Why samplers?
    - High variation in substrate between sites, Low variation in micro habitats within sites
    - Fourteen 7,6 cm x 7,6 cm Hardboard plates
    - Varied spacers between the plates

Sampler Placement

- Macroinvertebrate samplers
  - 4 Hester-Dendy artificial samplers at each station
  - Four adjacent 10m zones
  - One sampler in each zone
    - velocity, depth and exposure to sunlight was constant.



Sampler Placement



Repetition

- After 6 weeks:
  - Visual observations made (in case of changes)
  - Water quality samples taken again
  - Samplers are retrieved and replaced with fresh samplers
- Three 6 week periods

Repetition




Retrieval and Identification

- Macroinvertebrate samples were removed from sampler in the lab
- Identified to family level using dissection microscope and taxonomic keys
- Families will be counted
  - Family richness
  - Total abundance
  - Shannon-Weiner index

Retrieval and Identification




Statistical analysis

Water quality

- 2 way ANOVA
  - Time
  - Land use
- Ordination
  - PCA

Macroinvertebrates

- 2 way ANOVA
  - Family richness
  - Total abundance
  - Shannon-Weiner index
- Ordination
  - nMDS

Limitations

- Land use types not equal in length possibly causing variation in change in water quality.
- Land use types are not strictly isolated from one another thus may influence one another.
- By using artificial substrates various taxa are omitted from samples, however this is justified in the standardisation of sampling method.

Limitations





Timeline

Date	Activity
29-31 January	Take water readings, remove and replace second last batch of samplers.
1 Feb- 15 March	Sort Samplers in the lab, finalise statistical analysis.
15-17 March	Take last water readings remove last batch of samplers
18 March – April	Identify macro invertebrates present on all sampler results and analyse and compare with water quality samples.
May -June	Finalise results and write up
July	Hand in draft

Acknowledgments

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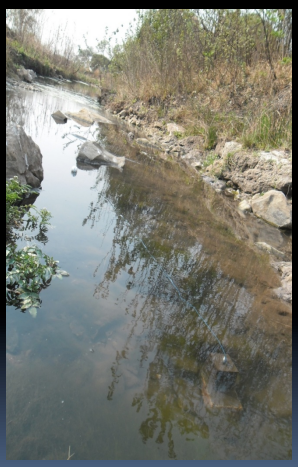
  - Water Research Commission
  - Project K5/2052- Vadose Zone Hydrology
- Access and Permission
  - City of Tshwane
  - Friends of Colbyn Valley
  - Adopt Moreletaspruit Initiative
- Enjoyment:
  - Sarah Mahlangu for helping out



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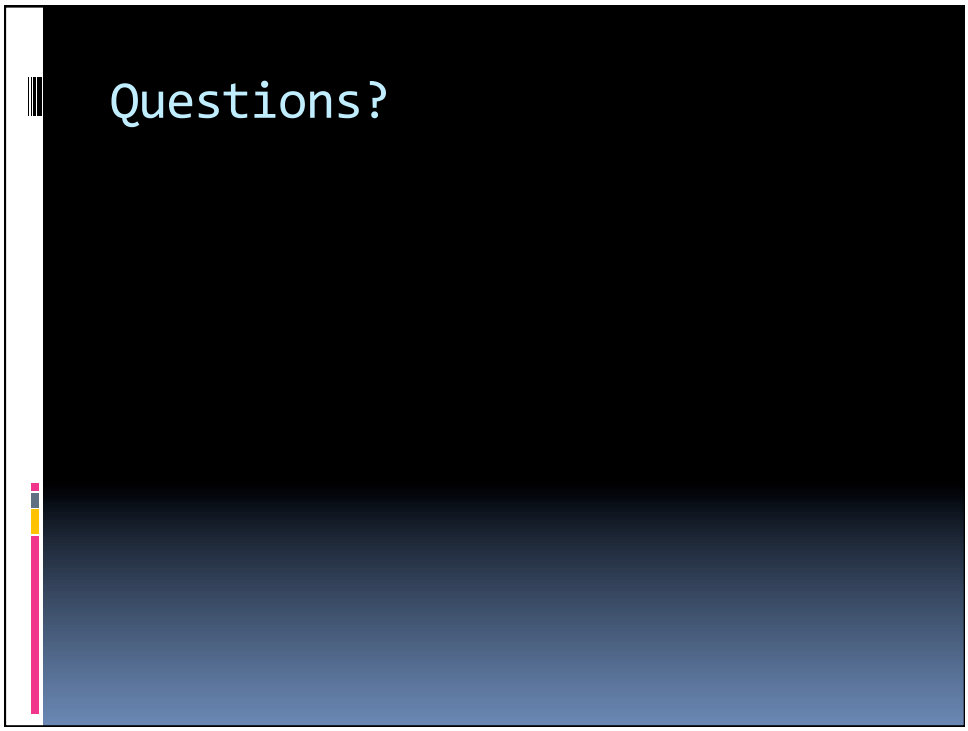
Questions?