

Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Research under University of South Australia (UNiSA)

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Global South Academic Conclave on WASH and Climate linkages

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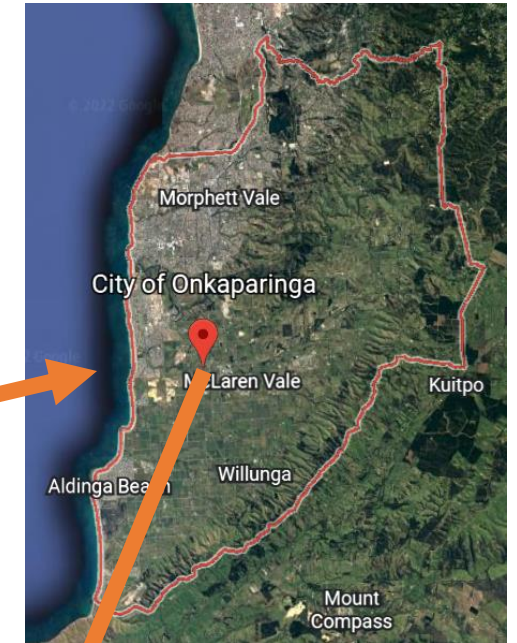
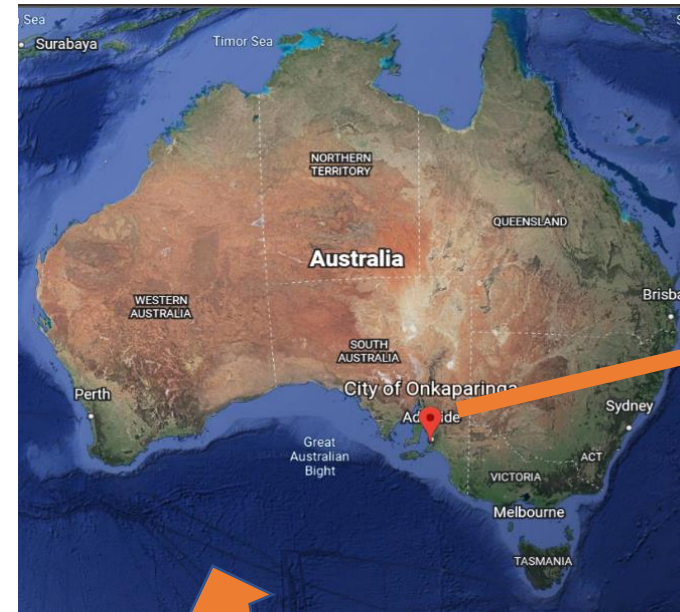
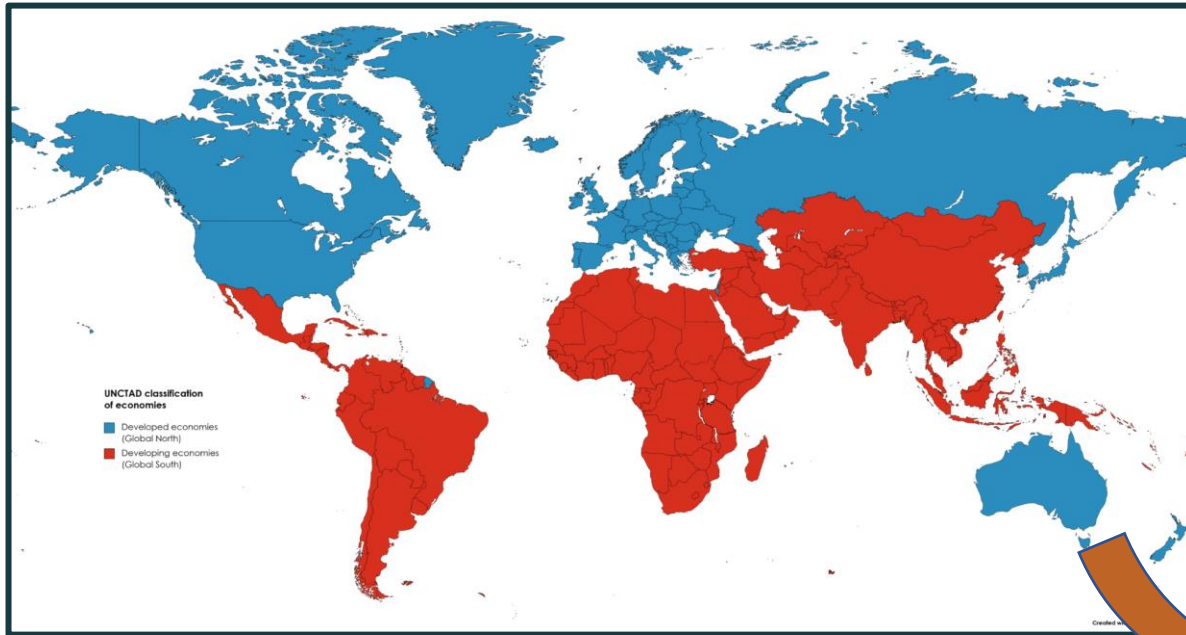
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Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Study Area

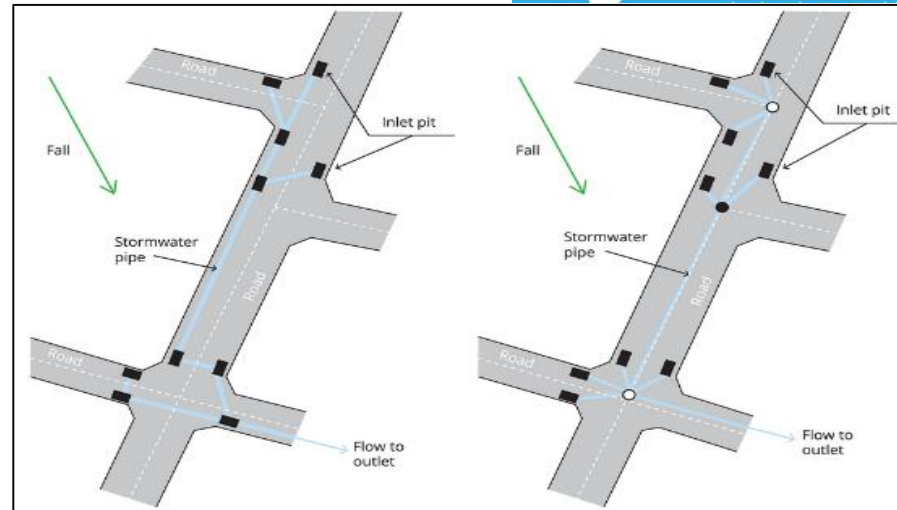
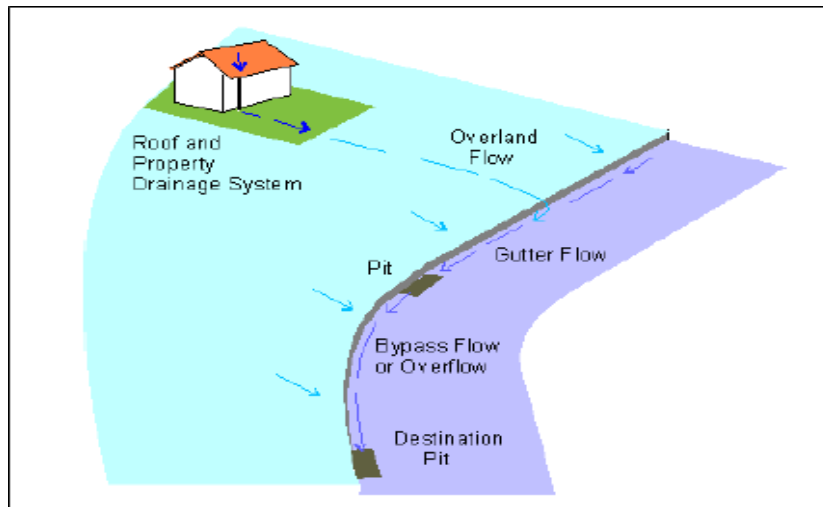
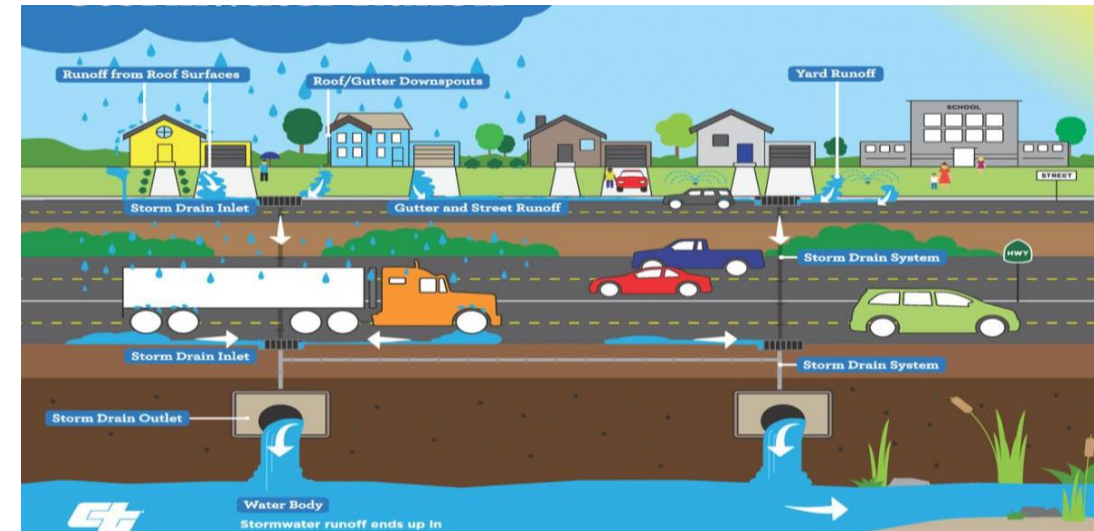


A residential allotment containing 21 plots in Village Green, Aldinga, City of Onkaparinga, South Australia

Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Background

- **Sensitivity Analysis**
- **Storm Water Drainage System**
- **Pit Characteristics**
- **Climate Projections**



Conventional storm water drainage design system
(Source: O'Loughlin, Stackand & Kus 2018)

Pit arrangement in storm water drainage system
(Source: Coombes & Roso 2019)

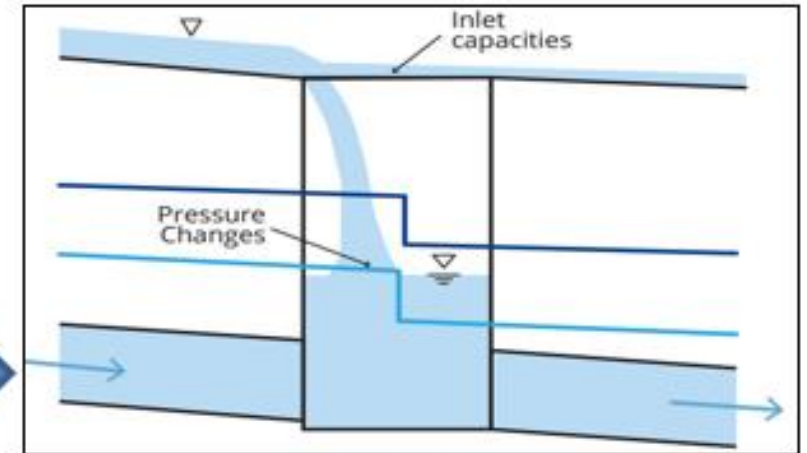
Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Pit Characteristics considered for sensitivity analysis



Pit blocking factor

Pit pressure change



Single or double size

Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Research Questions

1. What effect do various modifications in design parameters of pits have on stormwater drainage design?
2. Are the pit characteristics sensitive to the design of stormwater drainage systems as practiced in South Australia?
3. Which characteristics of pits are adequate to manage the frequent/small and rare/large storm events in South Australia?

Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Research Aim

To analyse the pit sensitivity for stormwater drainage design using numerous design criteria linked to pits for evaluating existing design process and improvement of design in the future.

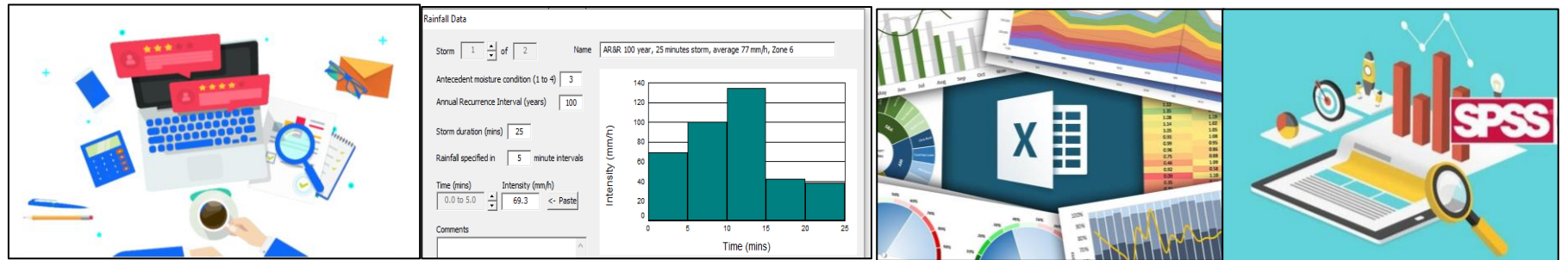
Research Objectives

1. To design an appropriate conventional stormwater drainage system in a residential area following the guidelines and standards.
2. To assess the performance of ten different models of stormwater drainage systems during major and minor storms
3. To identify which properties of the pit are sensitive to the stormwater drainage design practiced commonly in South Australia
4. To interpret the relationships among the values of Hydraulic Grade Line (HGL) in pits and maximum flow rate in pipes generated by major and minor storm analysis.

Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

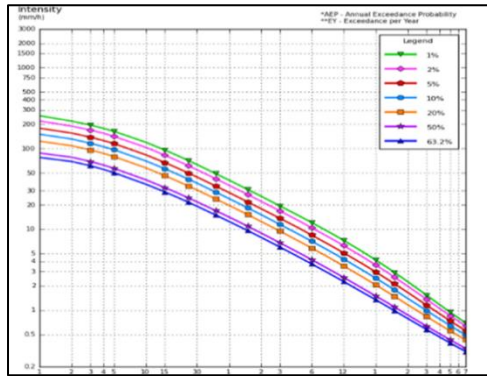
Research Methodology and Methods

Methodology	Quantitative
Approach	Case study-based modelling approach
Modelling software	DRAINS
Result comparison	<ul style="list-style-type: none"> ➤ Data visualization (Excel charts)
	<ul style="list-style-type: none"> ➤ Statistical analysis (Kruskal Wallis)

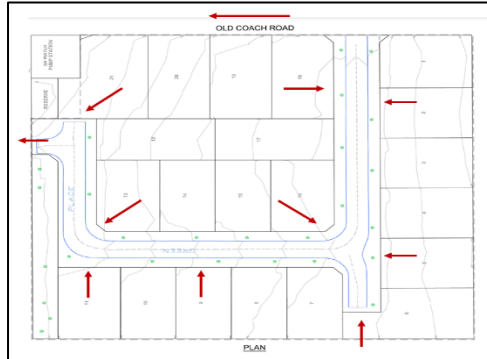


Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

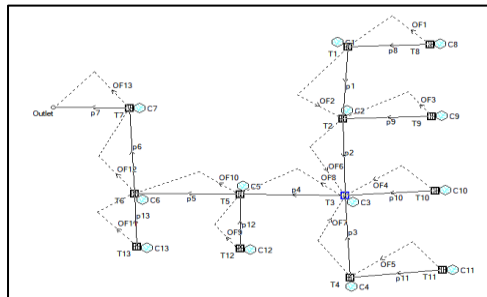
Research Method



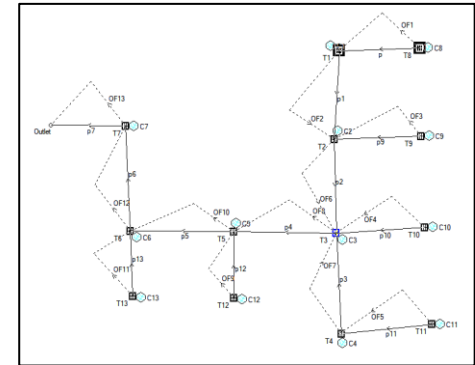
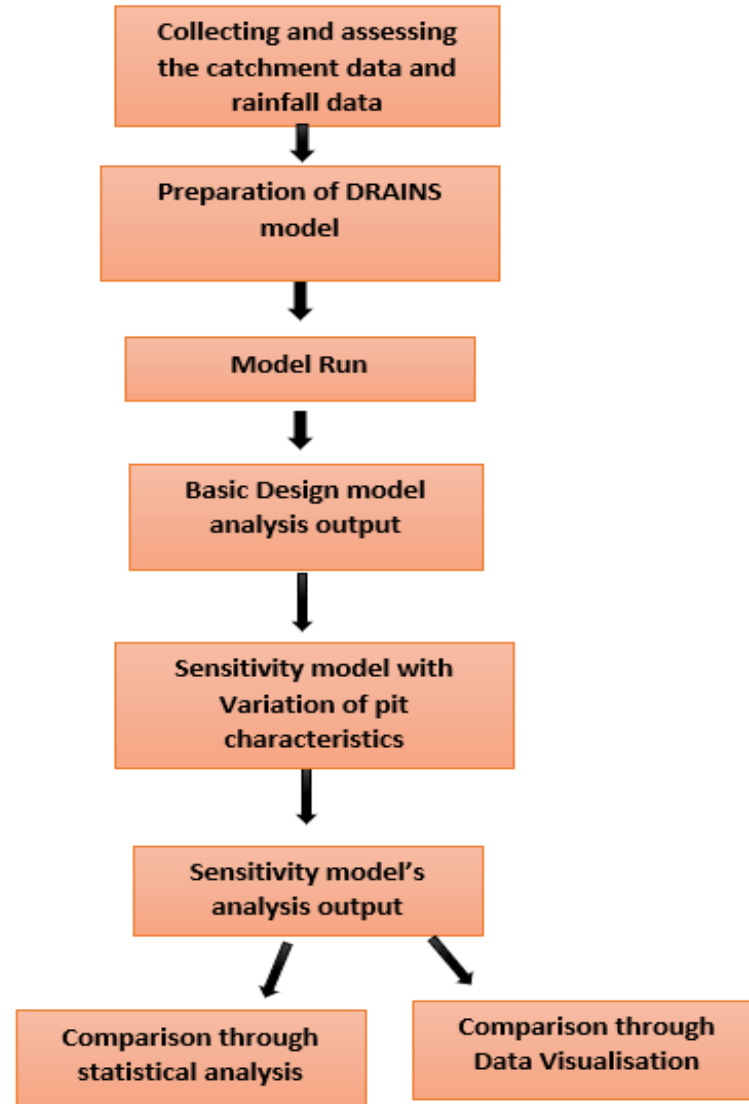
Rainfall data



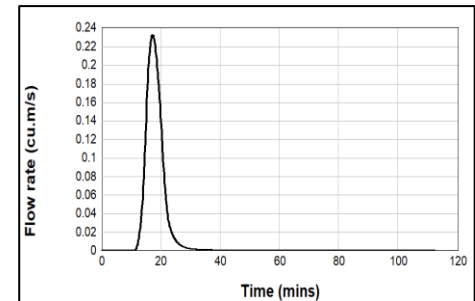
Catchment data



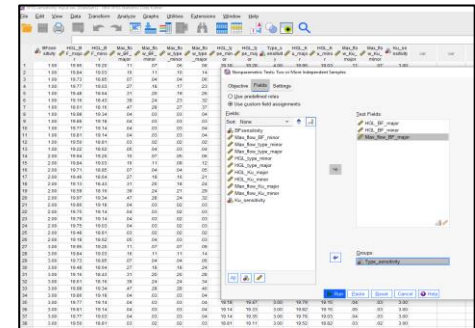
DRAINS model



Basic design model by DRAINS



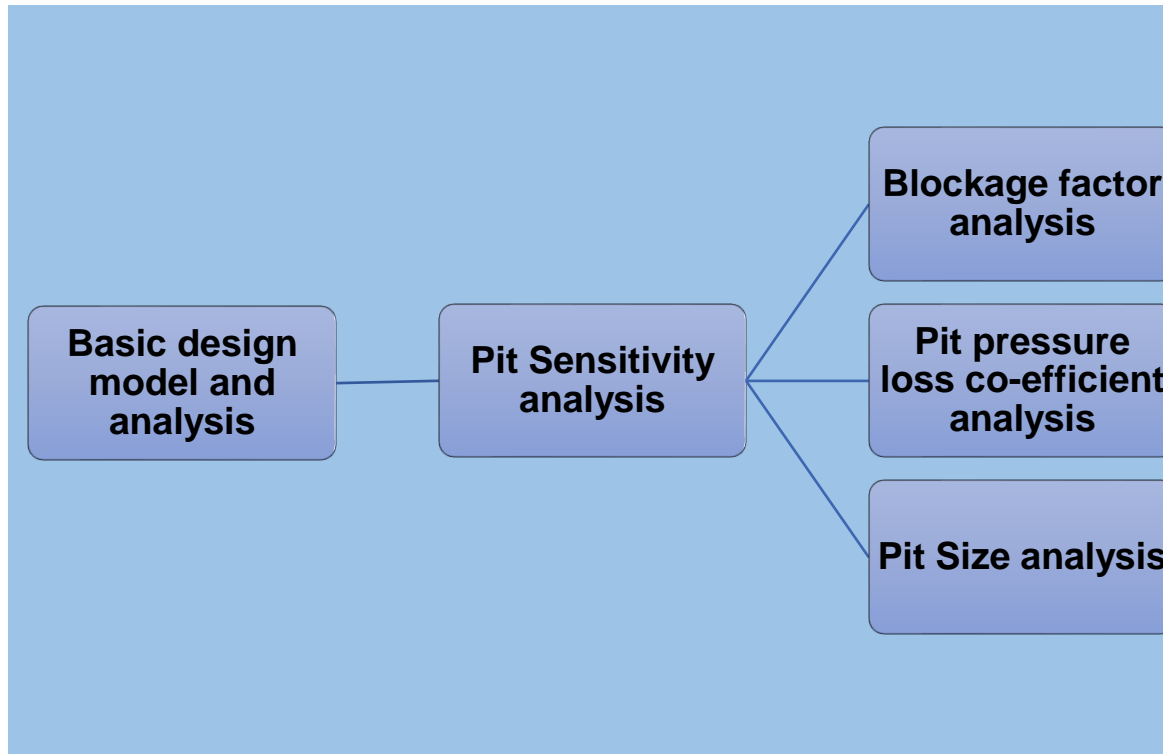
Sensitivity model analysis by DRAINS



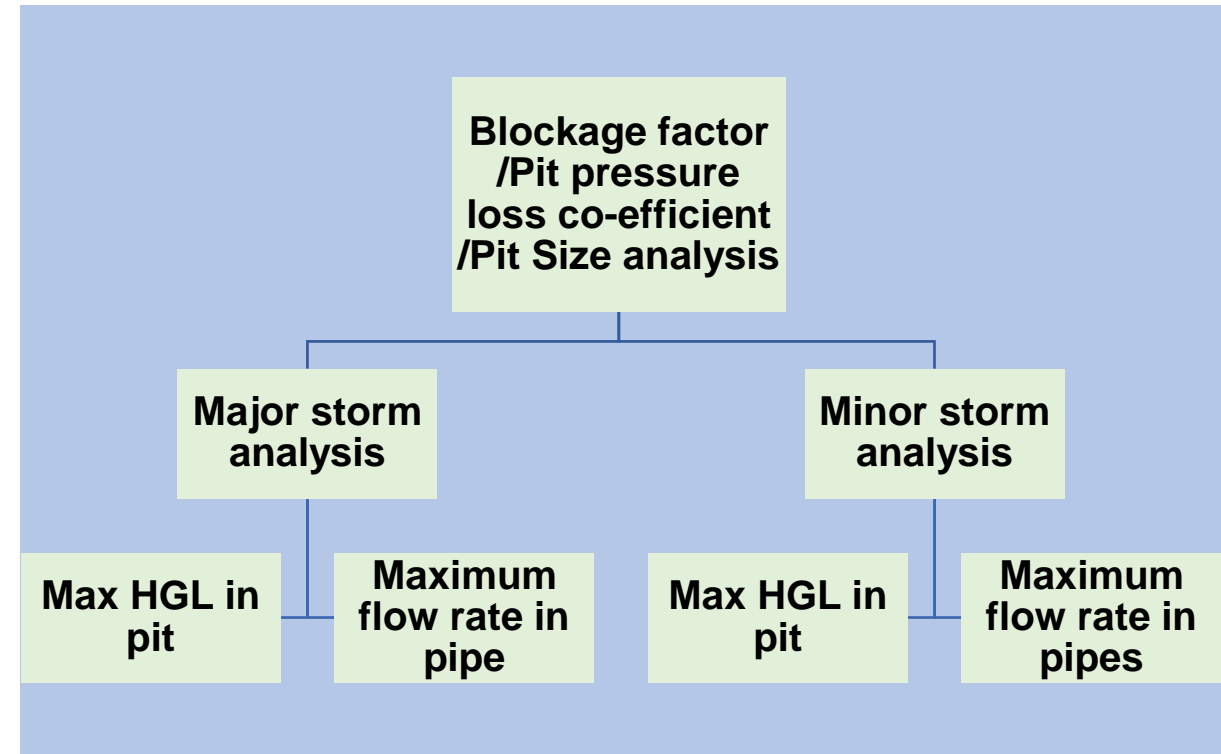
Statistical analysis by SPSS

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Research Methods: Sensitivity Analysis



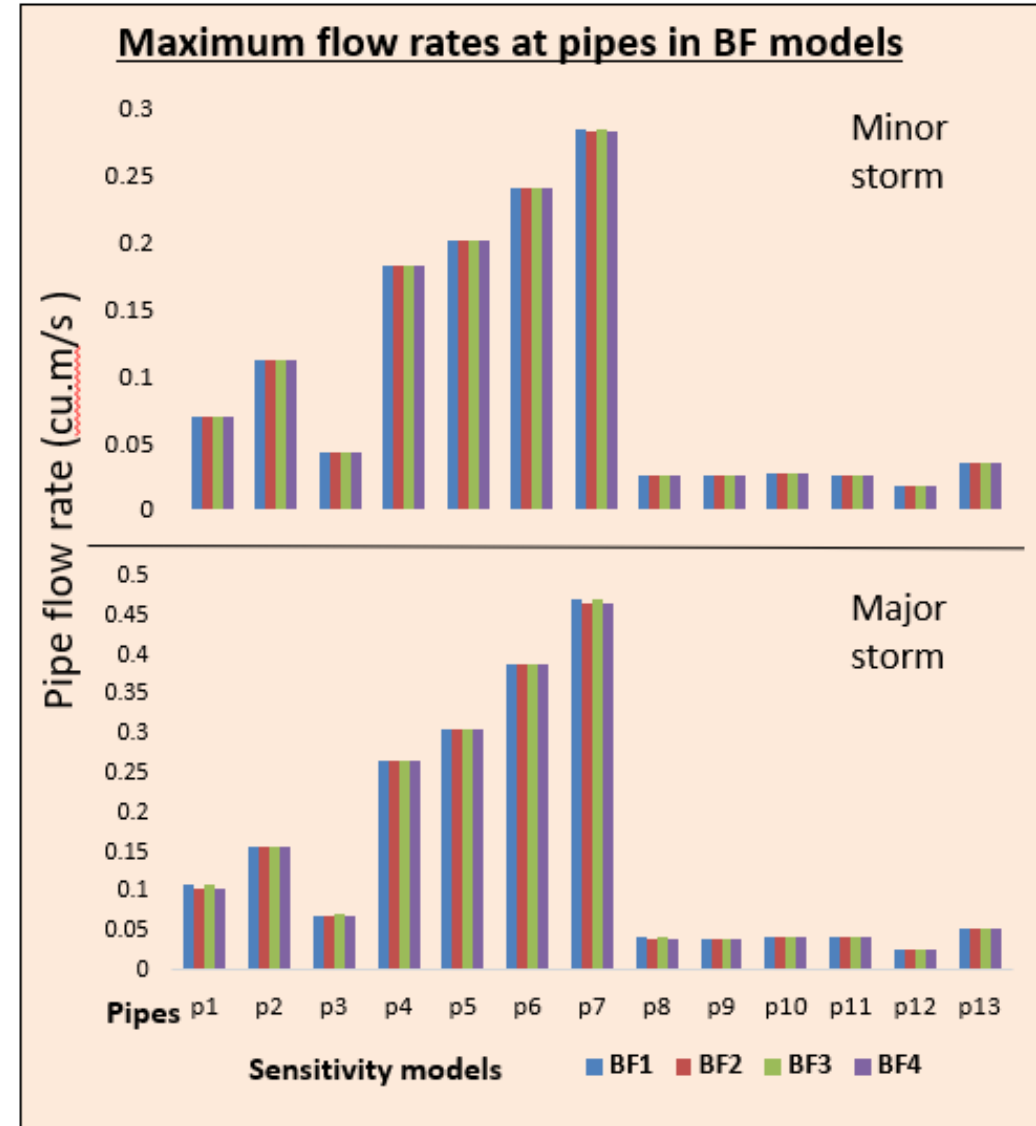
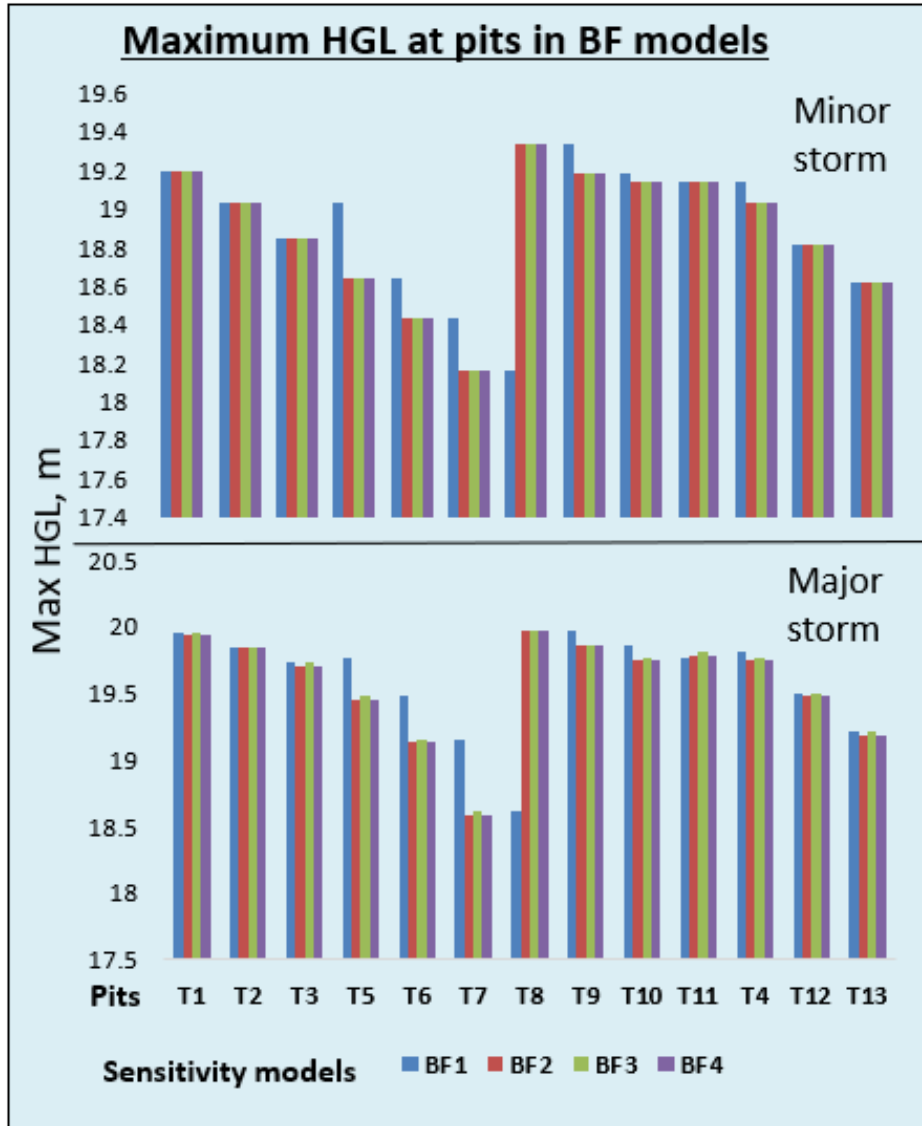
DRAINS models



Analysis output

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Results: Sensitivity Analysis (Blockage Factor)

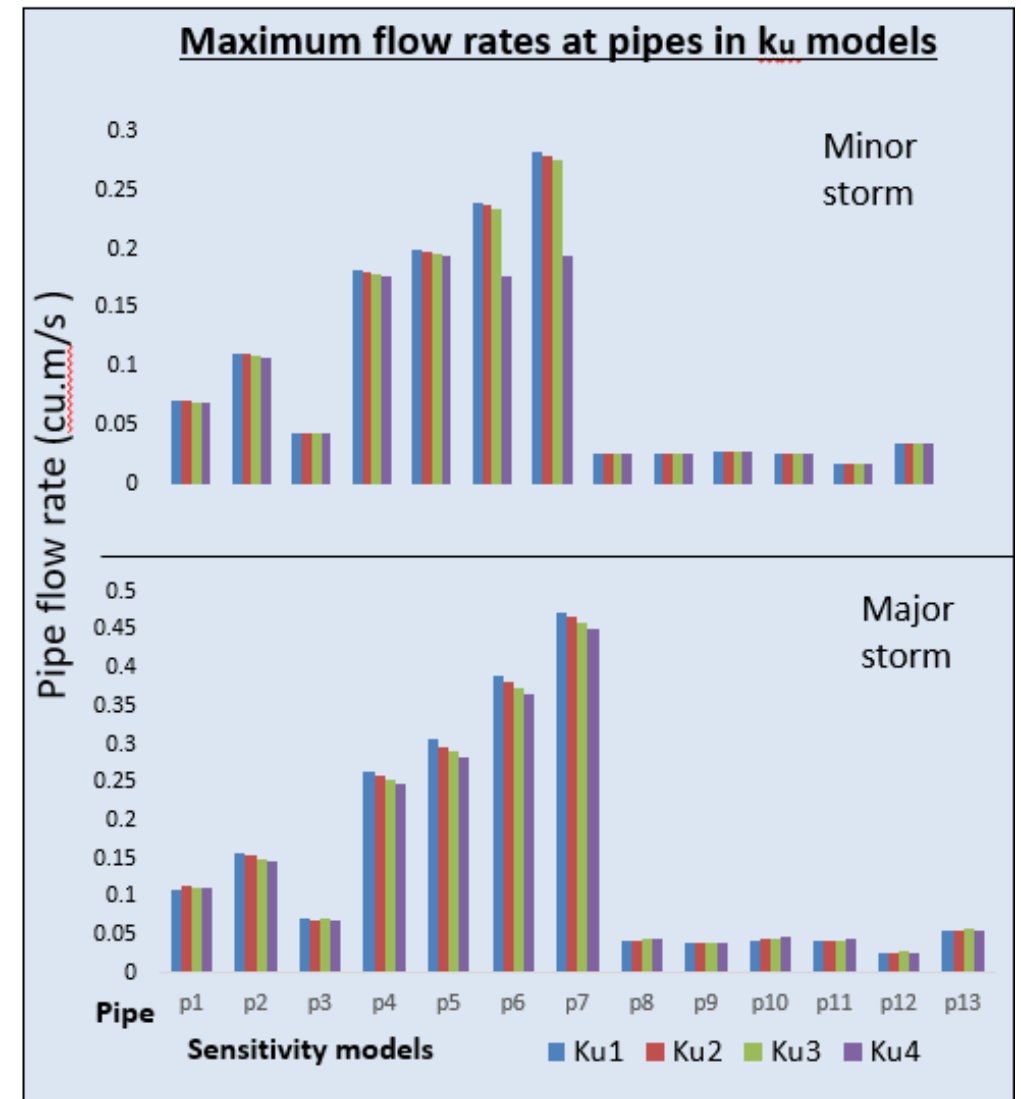
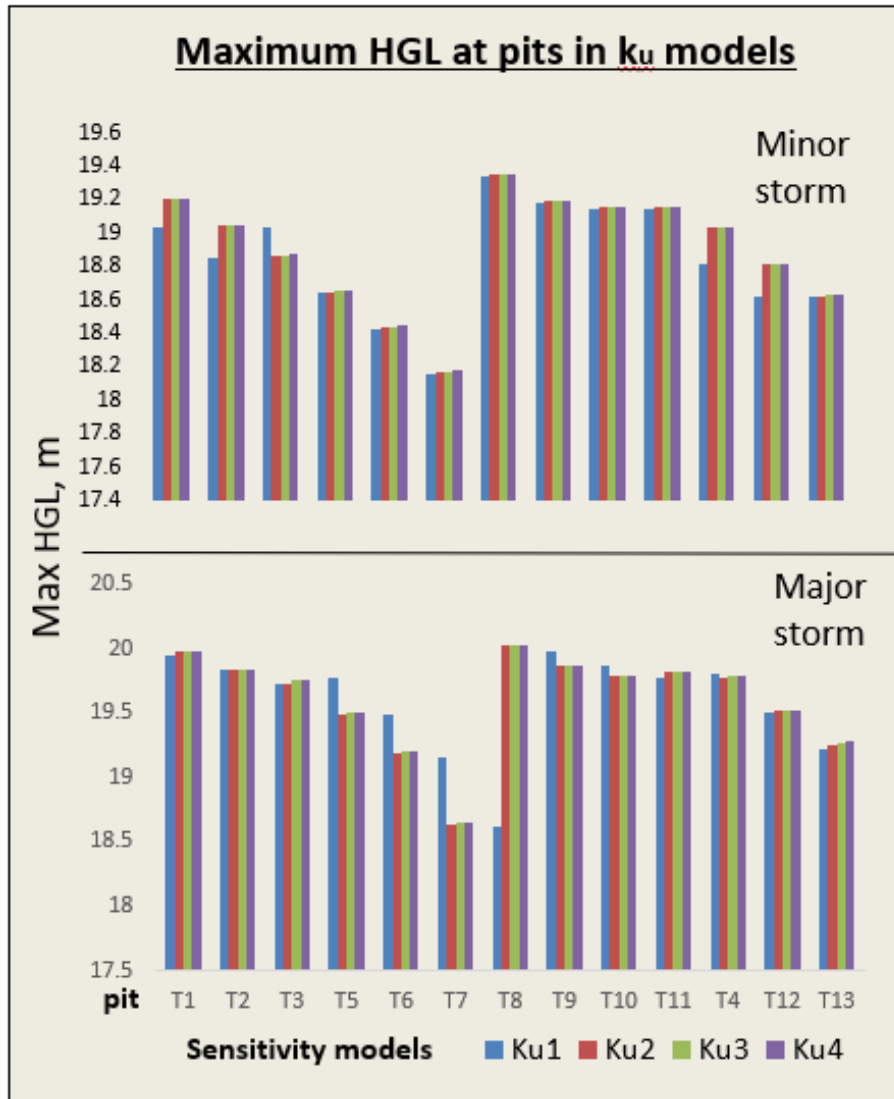


Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Result:

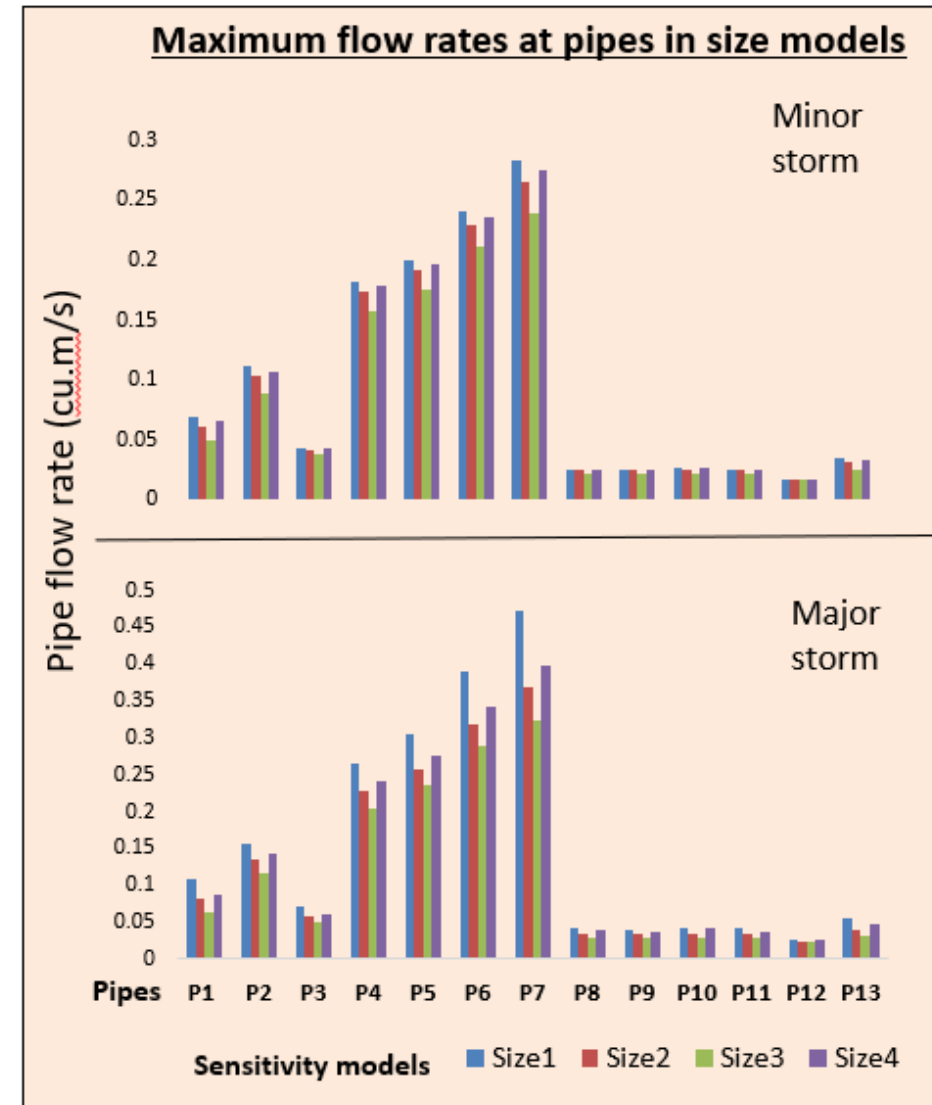
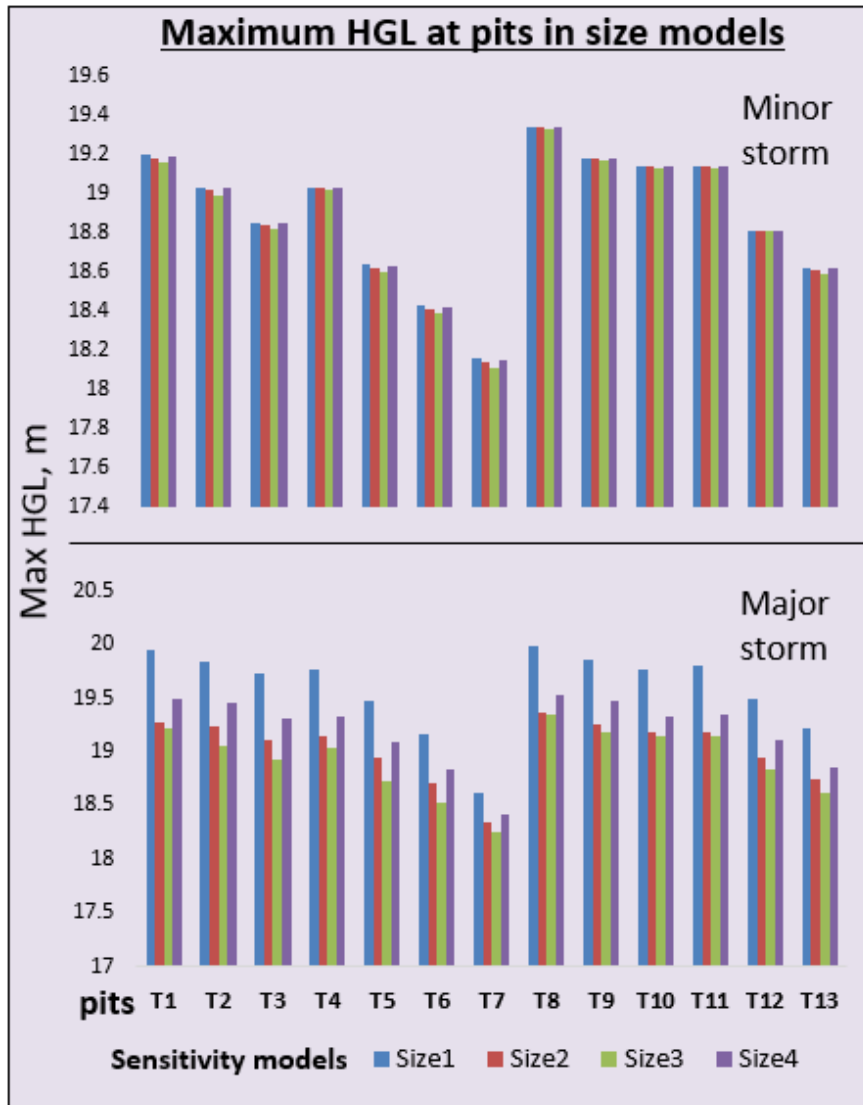
Sensitivity Analysis

(Pressure Change Coefficient, k_u)



Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Results: Sensitivity Analysis (Pit size)



Sensitivity Analysis of Pit Characteristics for Storm Water Drainage Design in South Australia

Research Methods: Statistical Analysis

Kruskal Wallis test

Null Hypothesis

The pit characteristic will have no effect on storm analysis output.



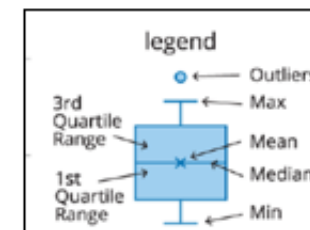
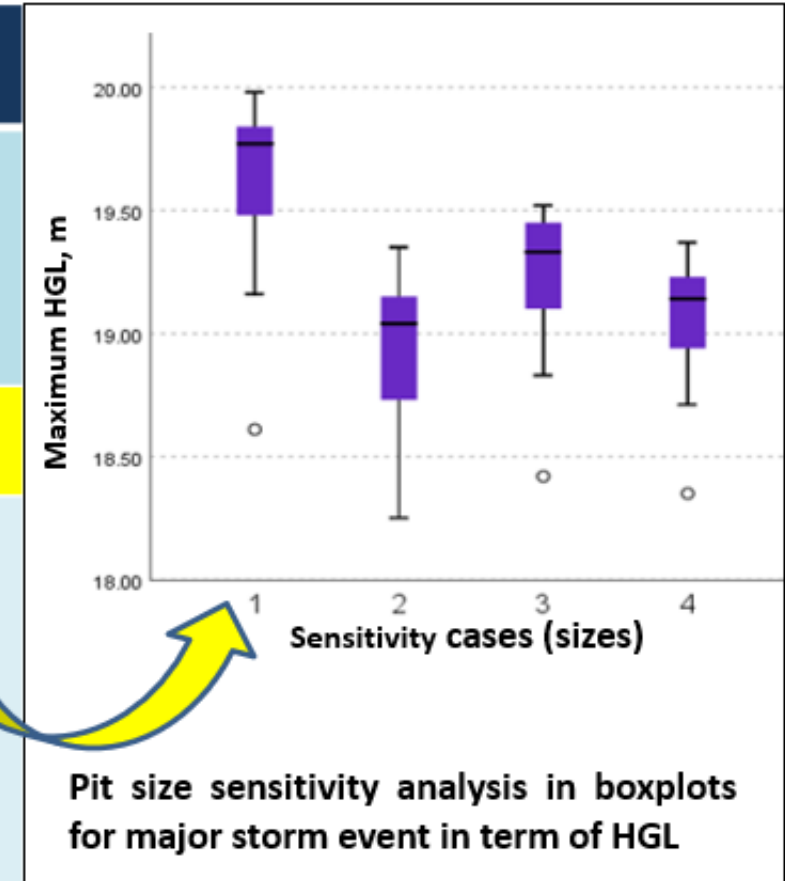
Alternative Hypothesis

The pit characteristic will have effect on storm analysis output.

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Results:
Statistical Analysis

Sensitivity parameter	Flood event	Analysis output	Result from the hypothesis test
Blockage Factor	Major storm	HGL	The distribution is same across the BF sensitivity cases.
		Maximum flowrate in pipes	
	Minor storm	HGL	
		Maximum flowrate in pipes	
Pit size	Major storm	HGL	The distribution is not same across the size sensitivity cases.
		Maximum flowrate in pipes	
	Minor	HGL	
		Maximum flowrate in pipes	
pressure loss coefficient,	Major storm	HGL	The distribution is same across the size sensitivity cases.
		Maximum flowrate in pipes	
	Minor storm	HGL	
		Maximum flowrate in pipes	



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Research findings

The pit characteristics currently practised for storm water drainage design in the city of Onkaparinga are adequate.

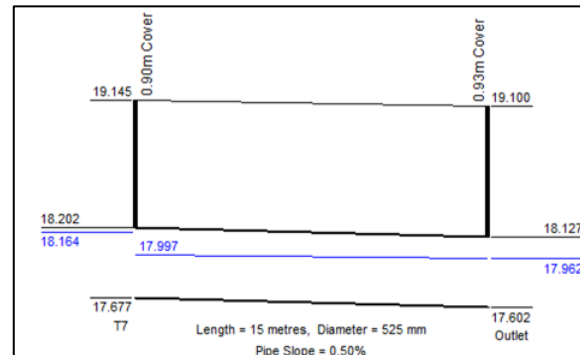
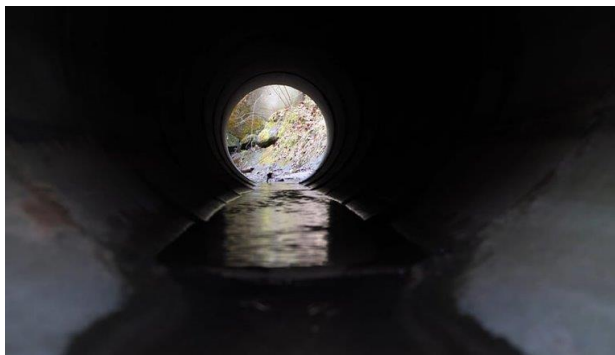
Blockage factor and k_u of pits are not sensitive to design.

Size could be the sensitive parameter of pits in design for large storms.

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Research Limitations and Recommendations for Future Study

- **Limitation of pressure co-efficient sensitivity: Partial flow has been developed in pipes. But DRAINS incorporates full pipe flow. The study should be conducted in high rainfall area.**
- **Other characteristics of pit can be included in future sensitivity studies.**
- **Other components of the system should be analysed.**
- **The study should be conducted in several cities/areas.**



Thank You

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