



# The Benefits of Rapid Flood Modeling

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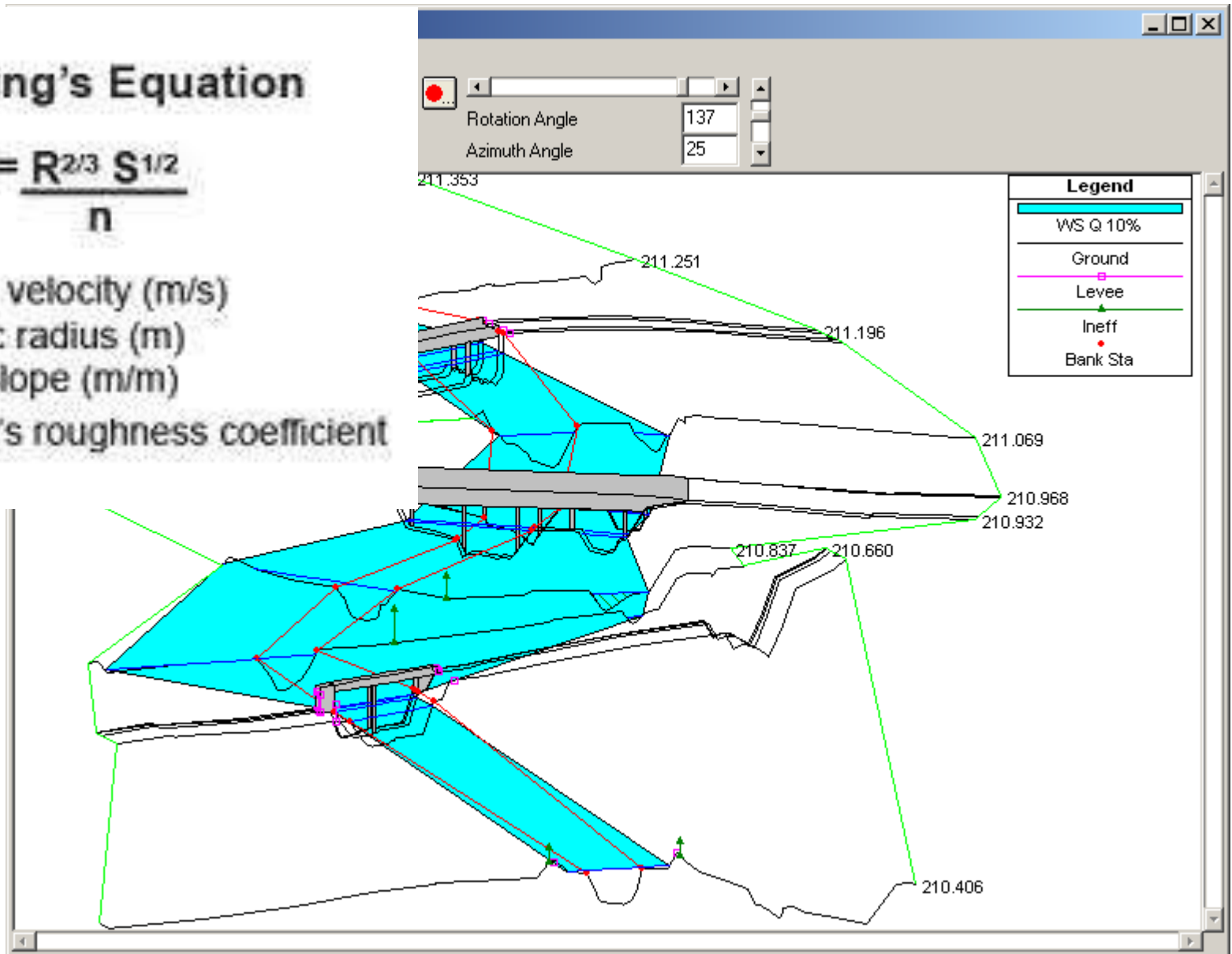
# Understanding flood risk



### Manning's Equation

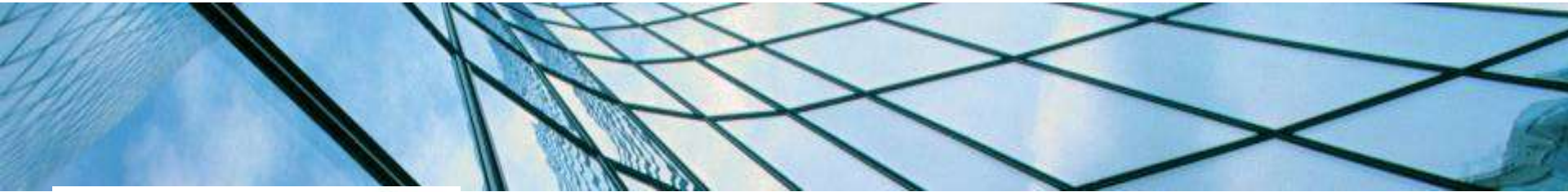
$$V = \frac{R^{2/3} S^{1/2}}{n}$$

- V is average velocity (m/s)
- R = hydraulic radius (m)
- S = energy slope (m/m)
- n = Manning's roughness coefficient





# 2D modelling



BMT 2012

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Floodwave attenuation  
Urban flooding

**MIKE**  
BY DHI 

Where Does it go?

weston200yr.avi

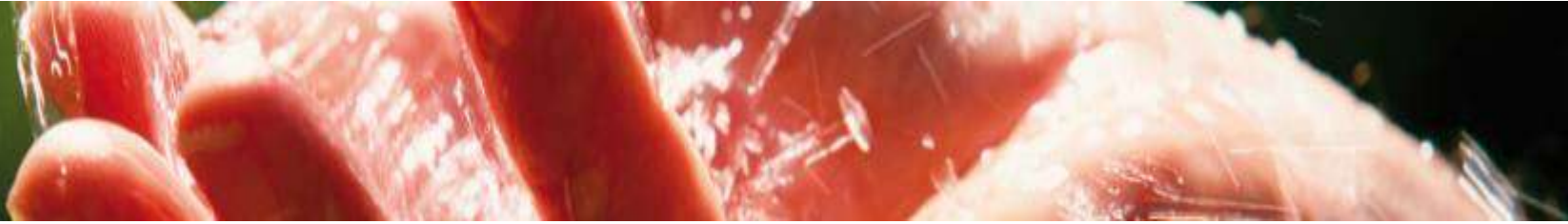
Mesh Module Dep weston002



- Nigeria
- New Orleans
- UK
- Azerbaijan
- Columbia
- Thailand
- Egypt
- Ireland



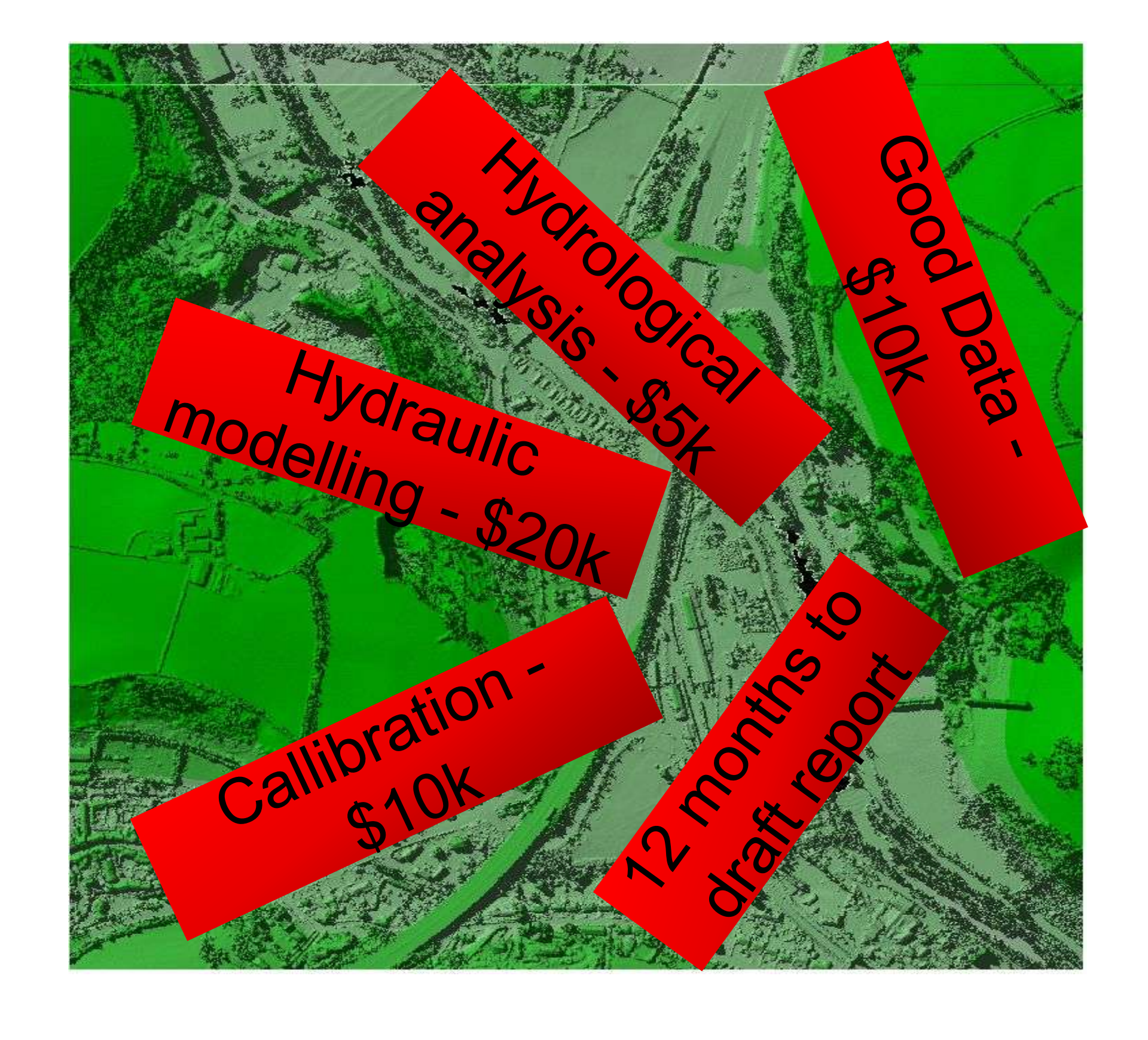




## The problems are self evident

- The risks are not well understood
- People are powerless during the event
- The economic, social and environmental impacts are enormous and long term

**Am I part of the problem?**

An aerial photograph of a river valley with a winding river and surrounding fields. Overlaid on the image are five red rectangular boxes containing white text. The text describes various stages of a project: 'Good Data - \$10k', 'Hydrological analysis - \$5k', 'Hydraulic modelling - \$20k', 'Callibration - \$10k', and '12 months to draft report'.

Good Data -  
\$10k

Hydrological  
analysis - \$5k

Hydraulic  
modelling - \$20k

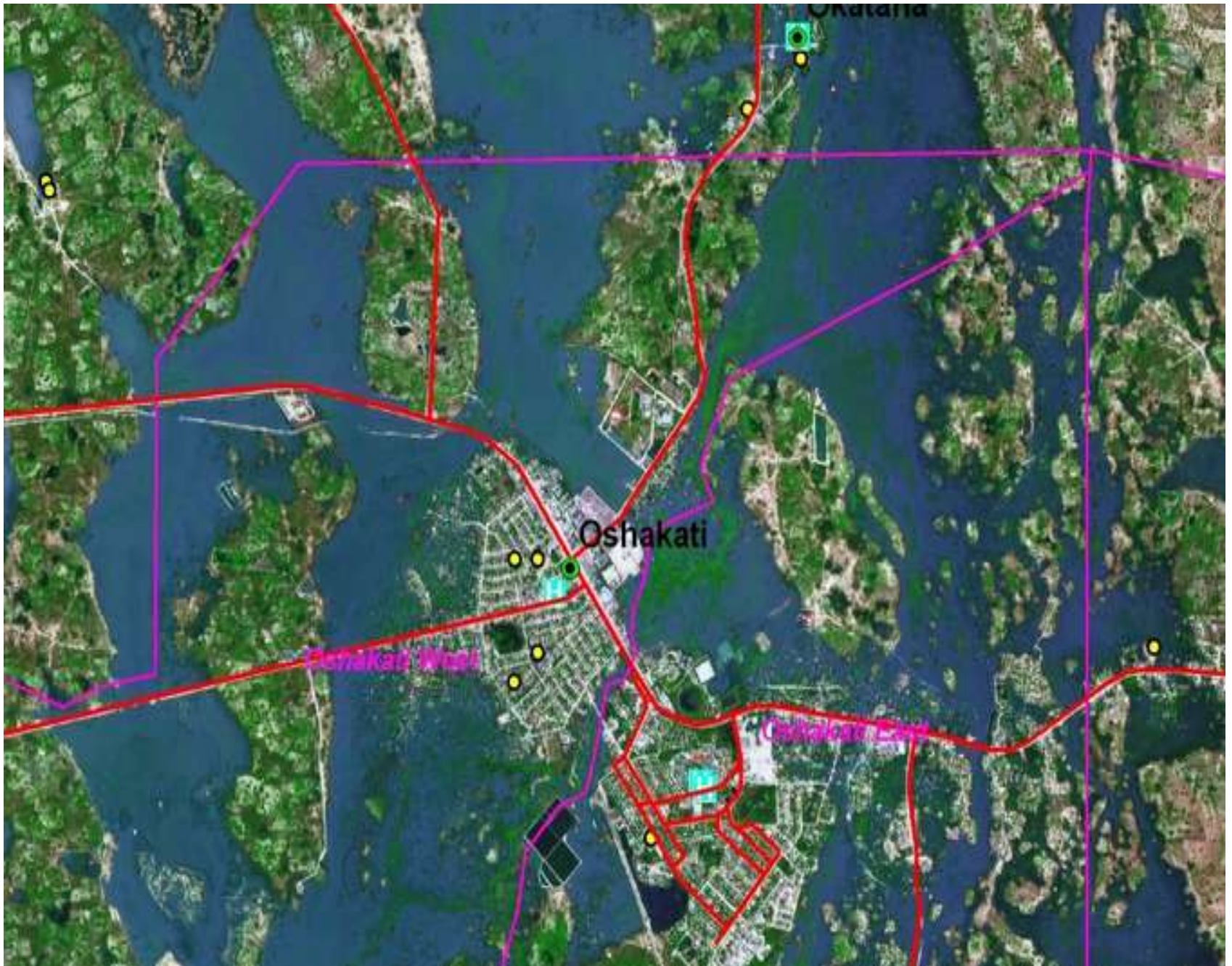
Callibration -  
\$10k

12 months to  
draft report










**Flooding in Northern Namibia  
SPOT-5 Satellite Imagery, 05 April 2011**







Why does Oshakati flood?  
What can be done to improve  
the situation?





## Shuttle Radar Topography Mission

- Home
- Mission
- About Data
- Images
- Site Map

### Mapping The World In 3 Dimensions



## Namibia Weather

Etosha Safari Lodge, Namibia

Navigation

- Home Page
- Current Weather
- Etosha Monthly Reports
- Etosha Trends
- Etosha Records
- Etosha High/Low Records
- UV Forecast
- Sun/Moon
- Almanac
- About
- Website Map

Yearly Reports: 2012 OK

Monthly Reports: March 2010 OK

Min.	Avg.	Dep From Normal	Avg Dew pt.	Avg Wet Bulb	Heating	Cooling	Sig Cond	Sun hrs	2400 LST Snow Fall	2400 LST Water Equiv	Avg Sea Level	Avg Spd
18.6	23.9	---	19.2	20.8	00.0	05.6	---	03.7	00.0	02.8	1005.4	05.8
20.9	24.7	---	20.1	21.7	00.0	06.4	---	04.5	00.0	01.3	1007.1	09.4
20.4	26.0	---	18.7	21.3	00.0	07.7	---	06.7	00.0	00.0	1006.9	08.5
18.9	25.2	---	18.7	21.0	00.0	06.8	---	04.7	00.0	00.0	1006.3	07.4
18.8	24.3	---	17.2	19.9	00.0	06.0	---	02.3	00.0	00.0	1007.4	08.5
19.9	23.7	---	17.9	20.0	00.0	05.4	---	03.5	00.0	07.6	1007.6	13.4
18.7	23.3	---	18.1	20.0	00.0	05.0	---	04.3	00.0	00.0	1010.1	14.0
20.6	22.8	---	15.8	18.4	00.0	04.3	---	08.0	00.0	00.0	1010.3	09.6
18.1	23.7	---	16.5	19.2	00.0	05.4	---	08.3	00.0	00.0	1008.9	10.4
19.5	24.1	---	17.9	20.2	00.0	05.8	---	04.0	00.0	00.5	1008.4	08.0
19.4	25.0	---	17.8	20.4	00.0	06.7	---	02.9	00.0	00.0	1008.3	09.7
19.7	24.8	---	17.3	20.0	00.0	06.3	---	06.0	00.0	00.0	1009.1	07.4
19.8	27.7	---	14.6	19.7	00.0	09.4	HOT	07.6	00.0	00.0	1007.3	08.6
19.7	27.7	---	12.8	18.9	00.0	09.4	HOT	09.3	00.0	20.3	1004.5	09.8
20.4	25.2	---	13.9	18.5	00.0	06.9	---	01.8	00.0	00.0	1006.3	10.5
20.1	25.6	---	17.1	20.3	00.0	07.3	---	06.3	00.0	00.0	1007.5	05.4
18.2	25.7	---	15.2	19.3	00.0	07.4	---	07.5	00.0	00.0	1006.0	06.8
18.9	26.4	---	12.3	18.2	00.0	08.1	HOT	09.0	00.0	00.0	1006.7	08.8
18.3	25.8	---	12.3	18.0	00.0	07.5	---	05.3	00.0	00.0	1007.8	07.3
16.9	23.8	---	13.2	17.6	00.0	05.5	HOT	06.4	00.0	01.5	1007.4	09.7
18.3	25.8	---	15.2	19.4	00.0	07.5	---	06.8	00.0	00.0	1007.4	11.8
20.4	25.7	---	16.2	19.8	00.0	07.4	---	05.8	00.0	00.0	1006.3	18.1
20.1	25.0	---	17.4	20.2	00.0	06.7	---	03.9	00.0	00.5	1004.8	07.9
18.5	24.4	---	17.1	19.8	00.0	06.1	---	04.9	00.0	00.0	1004.3	08.2
17.8	23.7	---	18.5	20.4	00.0	05.4	---	04.9	00.0	40.9	1005.8	07.0
17.4	20.1	---	18.0	18.8	00.0	01.8	---	00.4	00.0	06.8	1009.6	05.5
17.2	23.3	---	18.4	20.2	00.0	05.0	---	09.0	00.0	00.3	1010.3	06.7
18.4	22.9	---	19.2	20.5	00.0	04.6	---	03.3	00.0	16.8	1008.7	07.5

<http://srtm.usgs.gov/index.php>







<http://weather.namsearch.com/etosha/wxclimate.php?date=climatedataout32010>



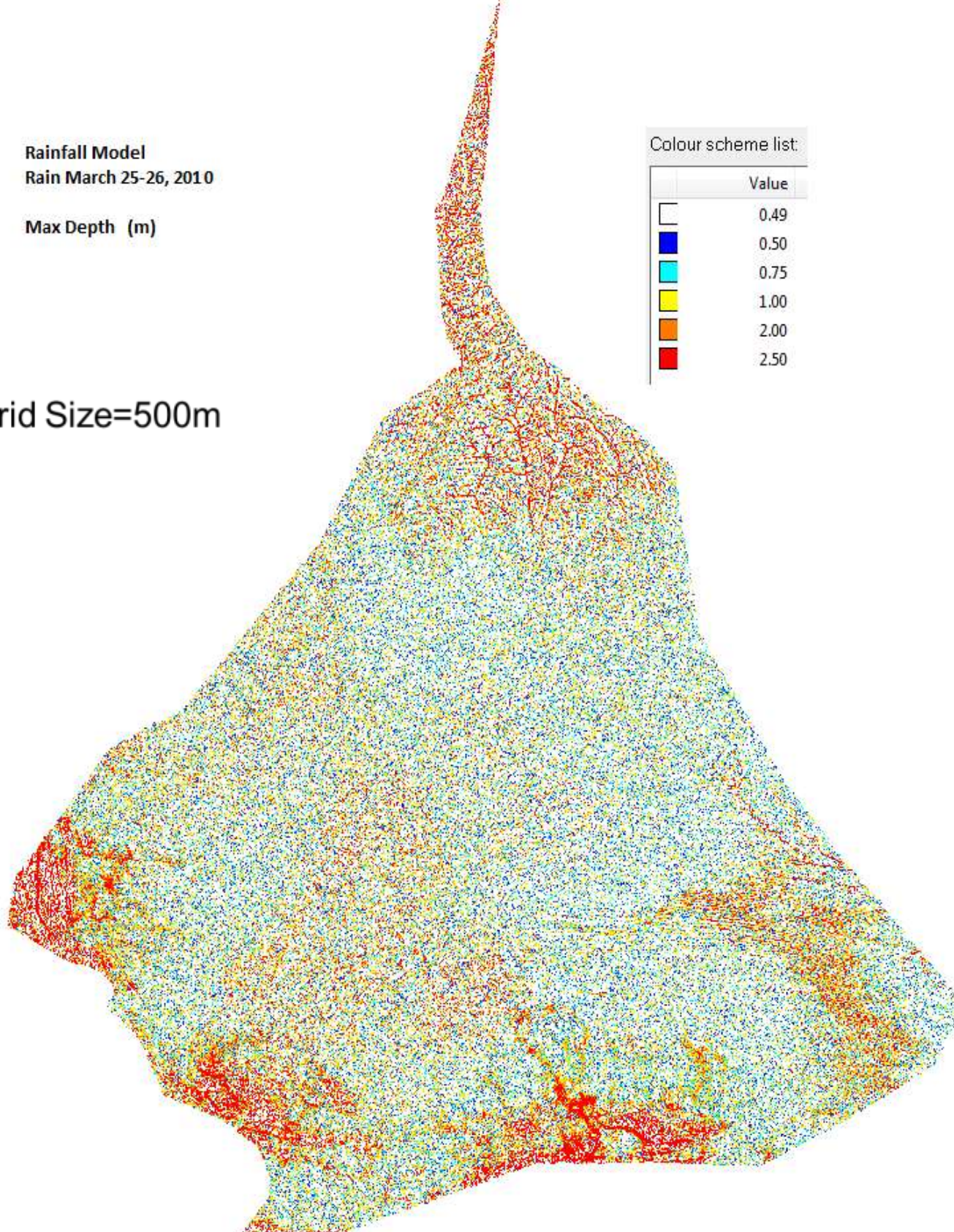
Rainfall Model  
Rain March 25-26, 2010

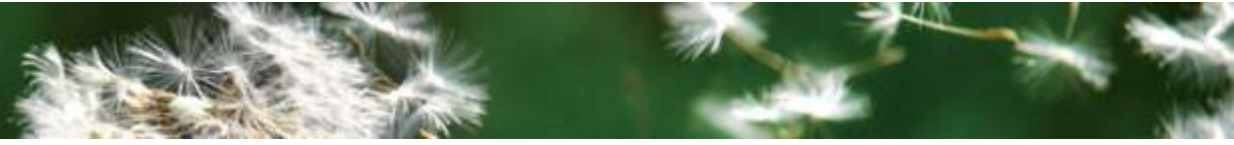
Max Depth (m)

Colour scheme list:

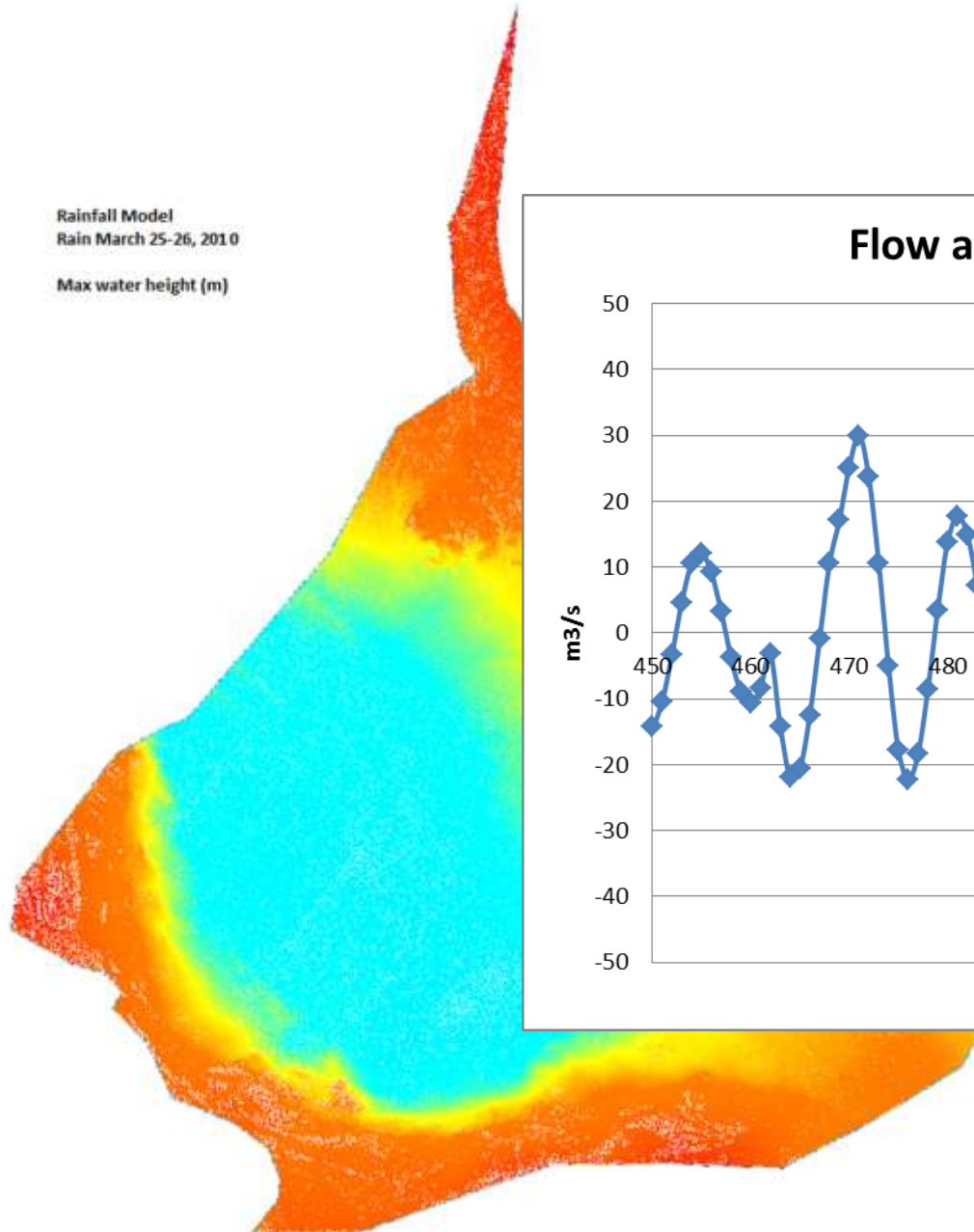
	Value
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	0.50
	0.75
	1.00
	2.00
	2.50

Grid Size=500m

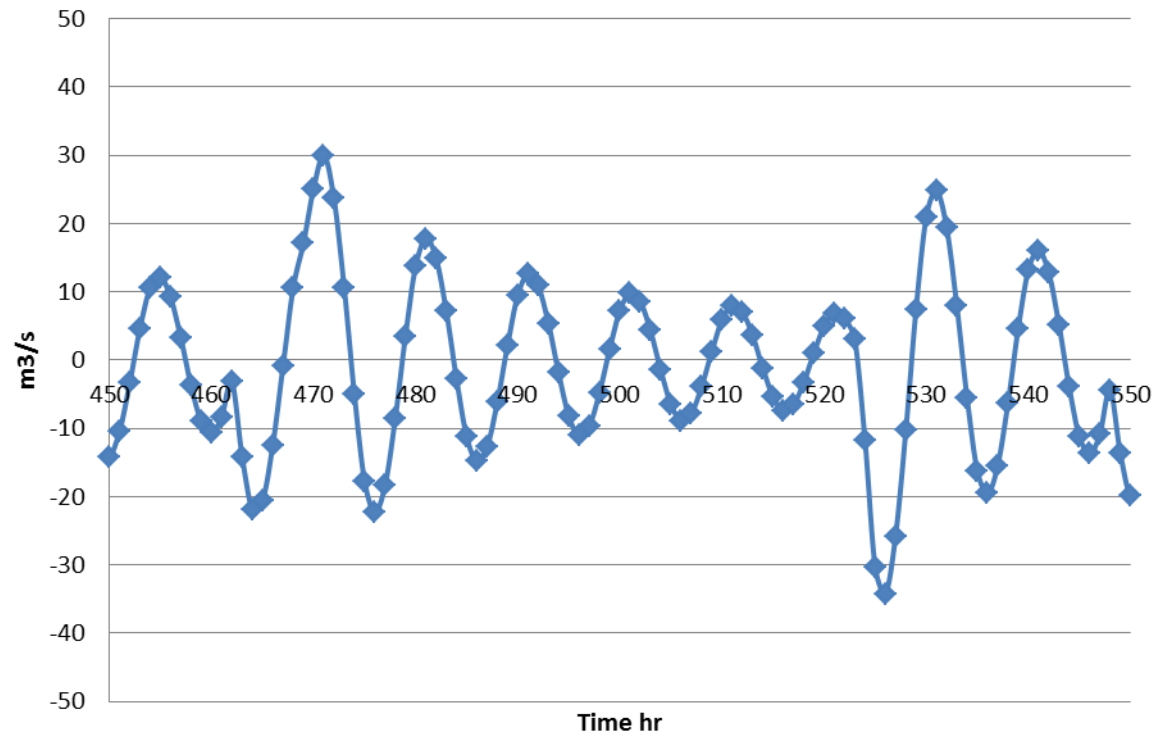




Rainfall Model  
Rain March 25-26, 2010  
Max water height (m)



### Flow at the US of Oshakati





# Bare Earth Model

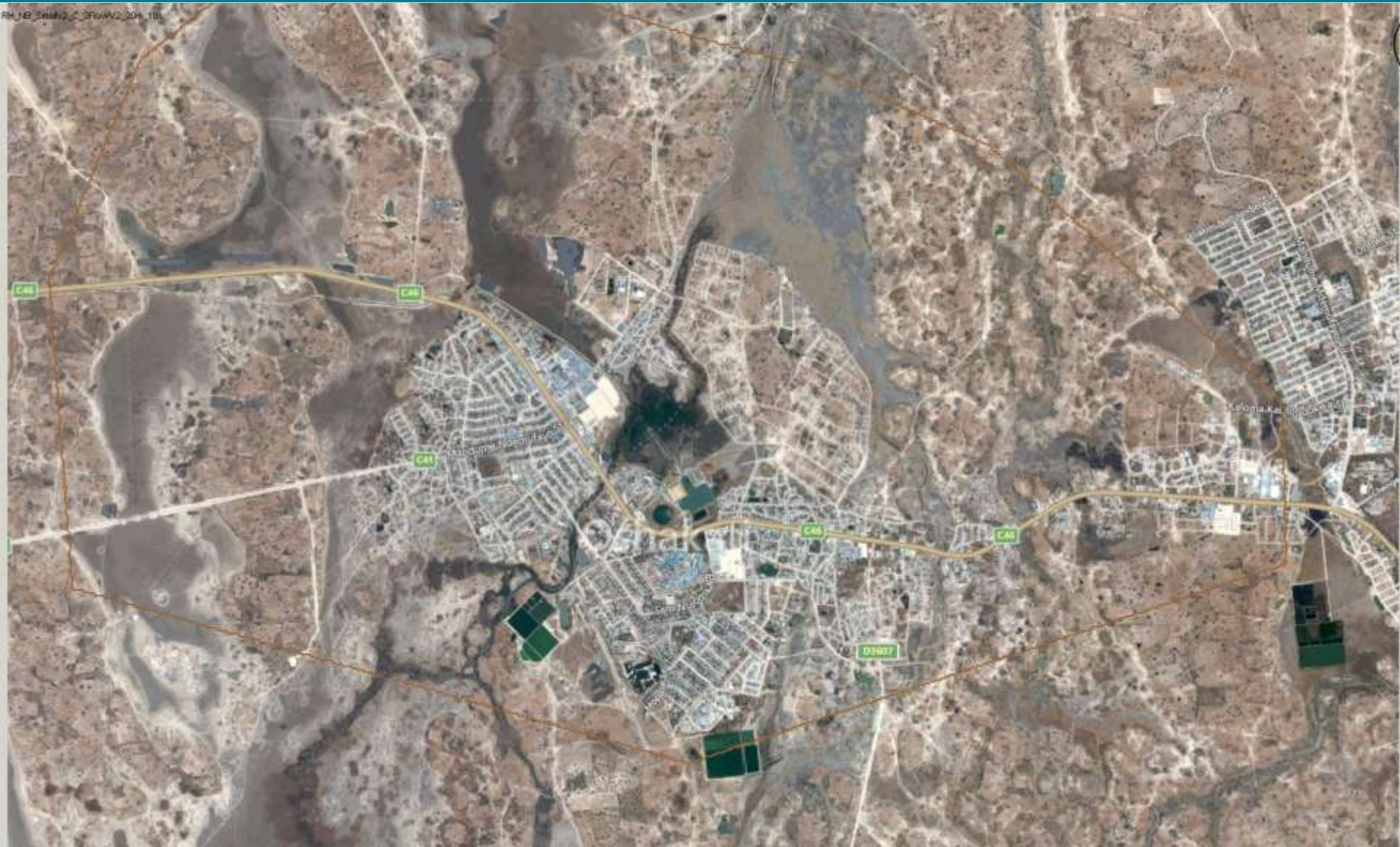




# Hydraulics

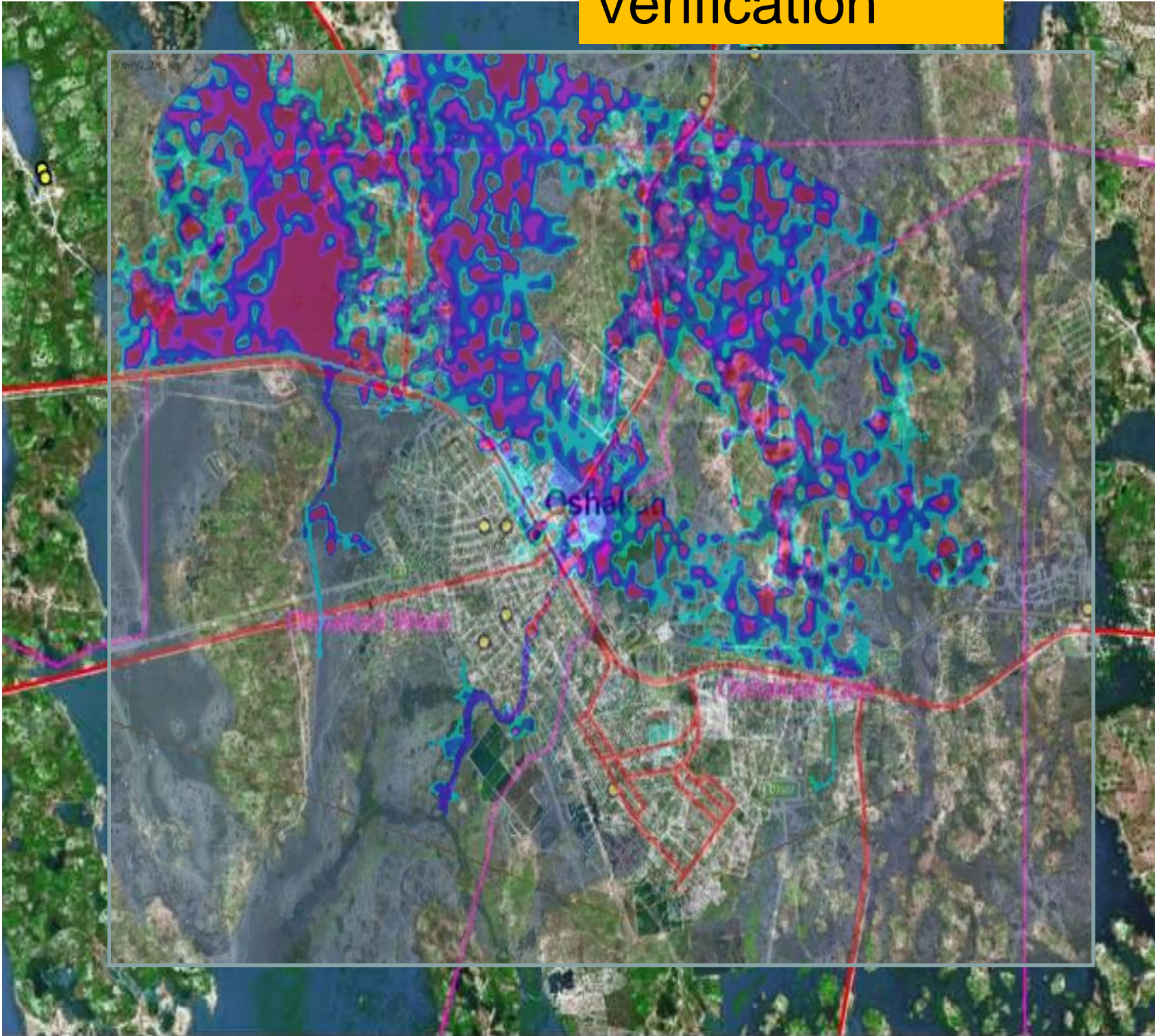






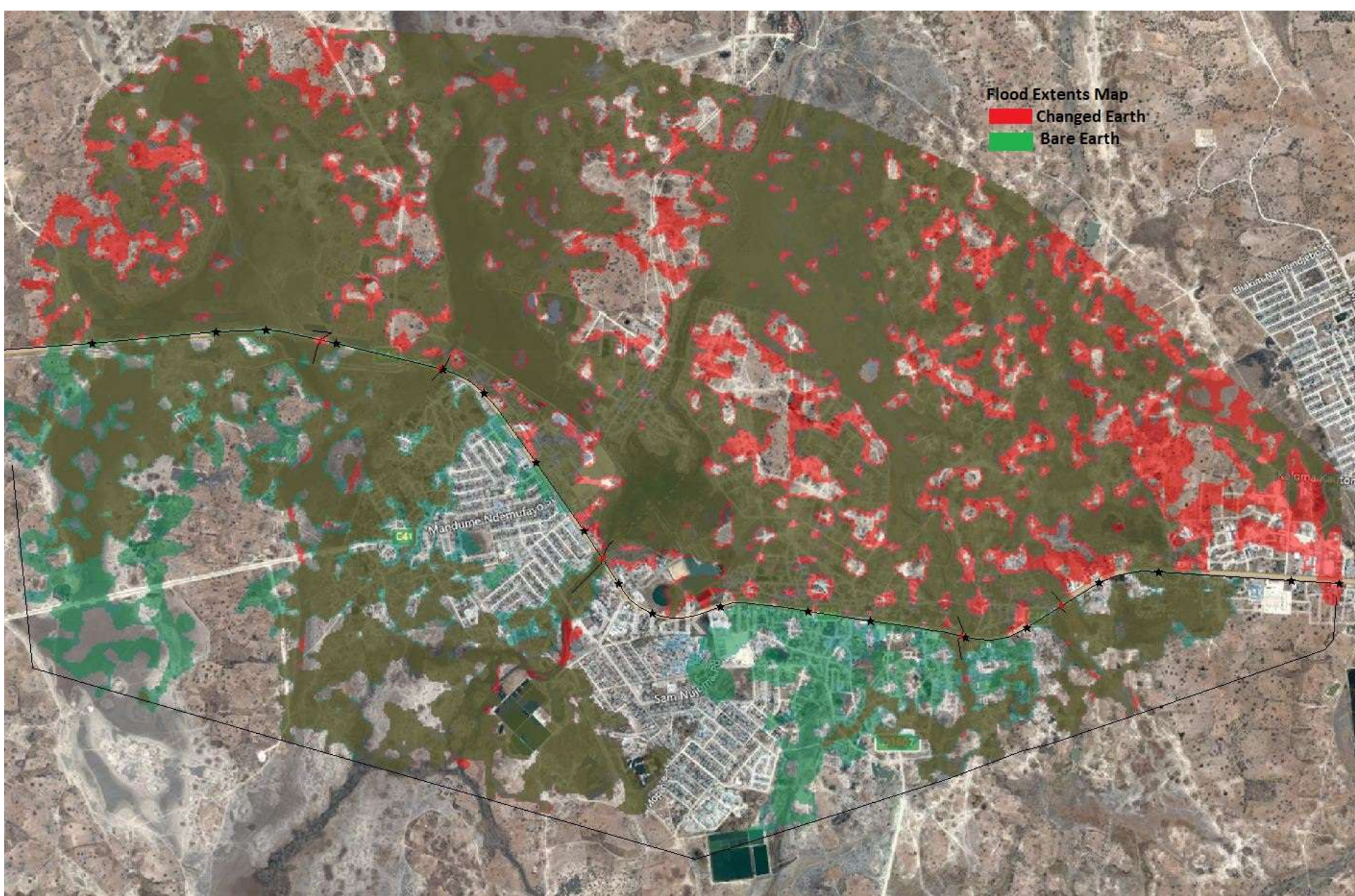


# Verification





# Differences







**Figure 7: Typical dyke section with dual carriageway**



# Adaptation & Resilience



# Strategic Planning





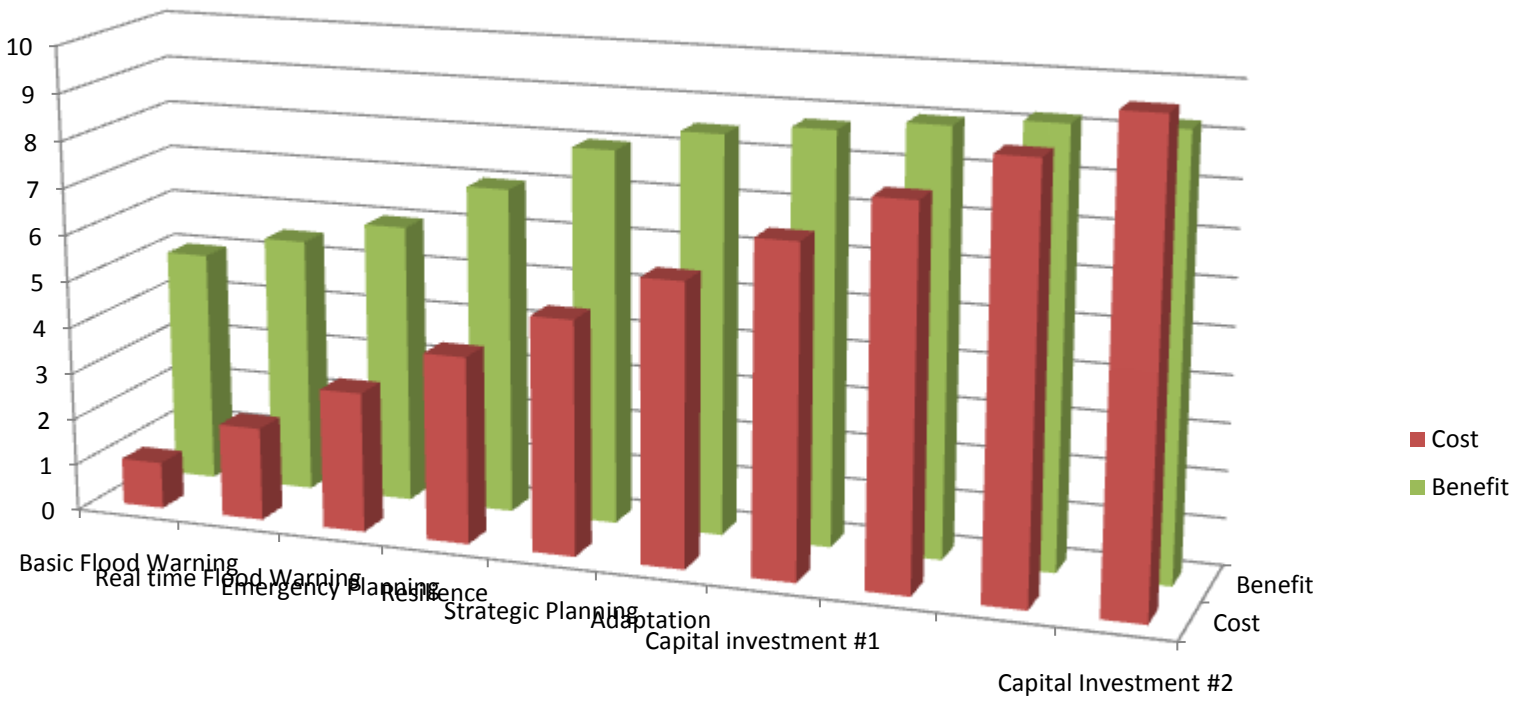
# Emergency Planning



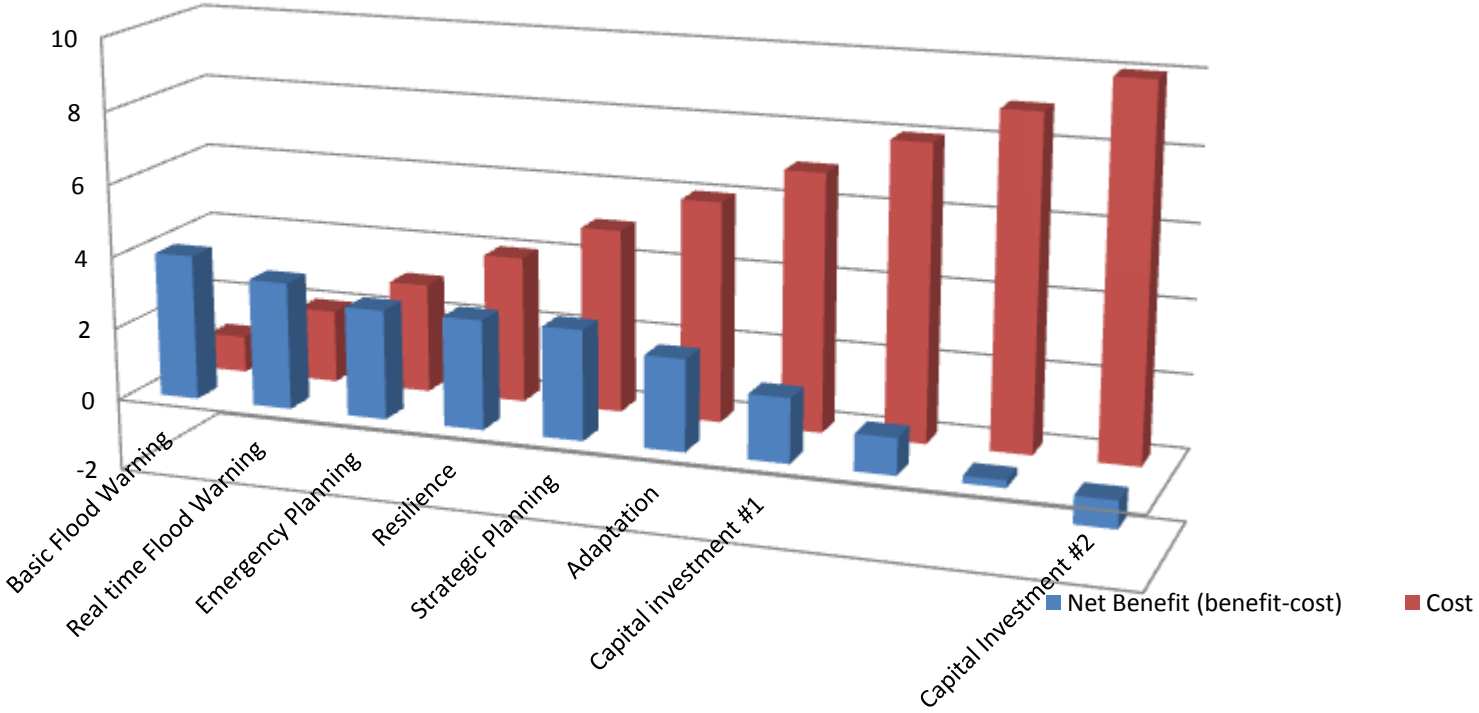


# Flood Warning

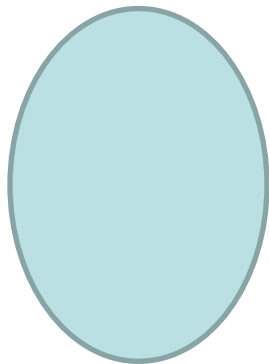
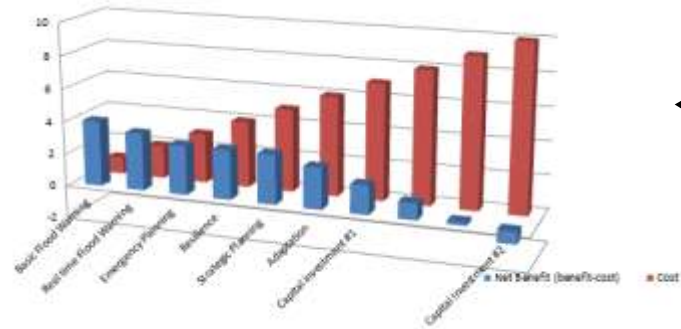




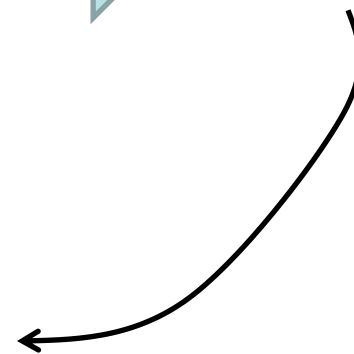
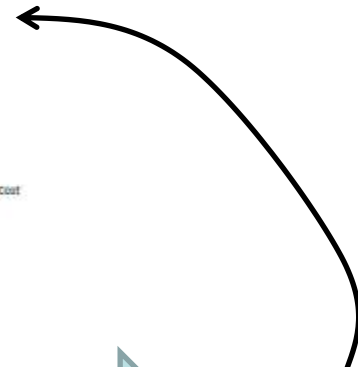




# Where next?



Cost of modelling will reduce dramatically





# Where next?





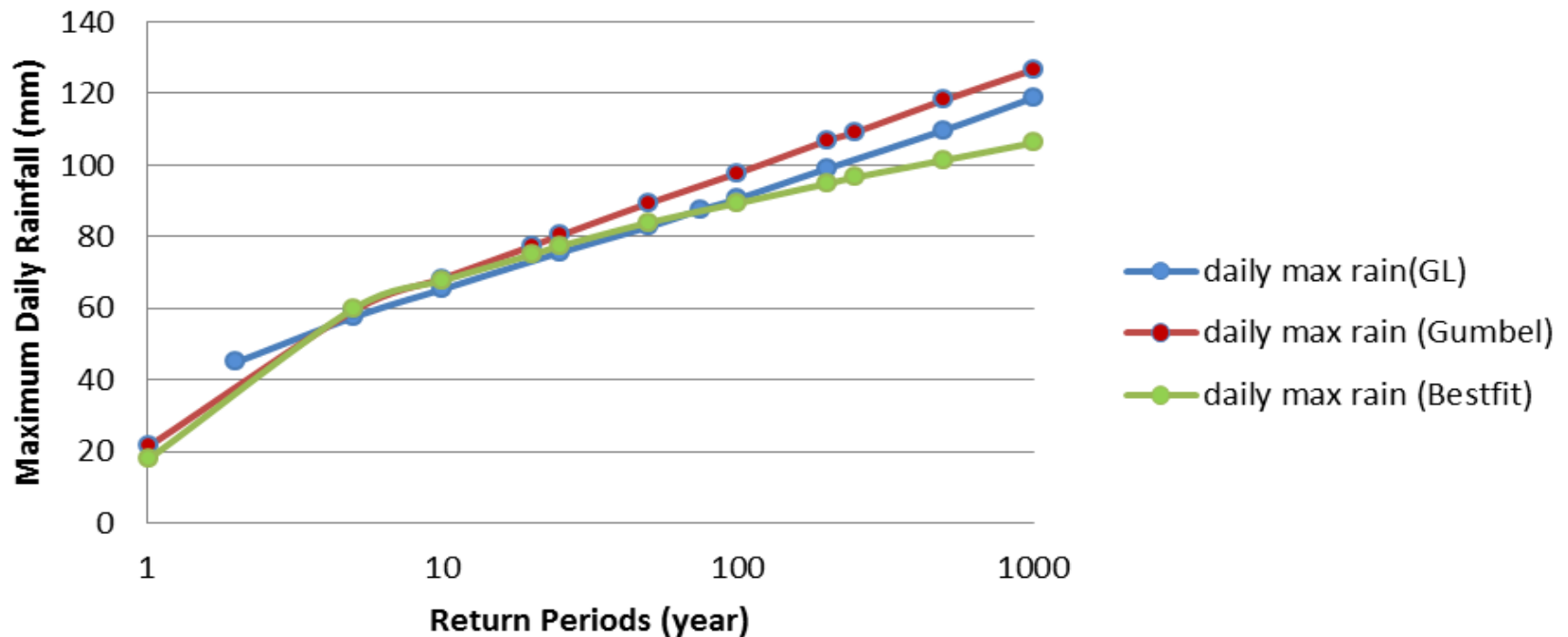
# Thank you

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## Maximum Daily Rainfall (mm) Kunene Station



**Statistical analysis of rainfall at Kunene using Generalised Logistic (GL), Gumbel and best fit method.**

- Namibia Weather site  
<http://weather.namsearch.com/etosha/wxclimate.php?date=climatedataout32010>
- Global Information and Early Warning System of Food and Agricultural Organisation of the United Nations (FAO/GIEWS) ([http://www.fao.org/giews/english/ierf/list\\_cross.asp?code=172](http://www.fao.org/giews/english/ierf/list_cross.asp?code=172))