ENVIRONMENTAL
MONITORING
SOLUTIONS

- **Inundation flooding**
  - e.g. a river bursts its banks
- **Flooding other causes (FOC)**
  - e.g. bockages
- **Hydraulic incapacity**
  - the drainage network cannot convey the event

CENTAUR

Urban Flood Alleviation Using Local Network Storage Capacity

- Easy deployment, maintenance and operation
- Low cost and space efficient
- Reduce flood risk, prevent CSO spills and manage flows

CENTAUR

- What is it?
- The System
- CENTAUR Case Study
- Modelling

eawag aquatic research

VEOLIA

Steinhardt® Water Technology Systems

· U C ·
UNIVERSIDADE DE COIMBRA

Águas de Coimbra

ENVIRONMENTAL MONITORING SOLUTIONS

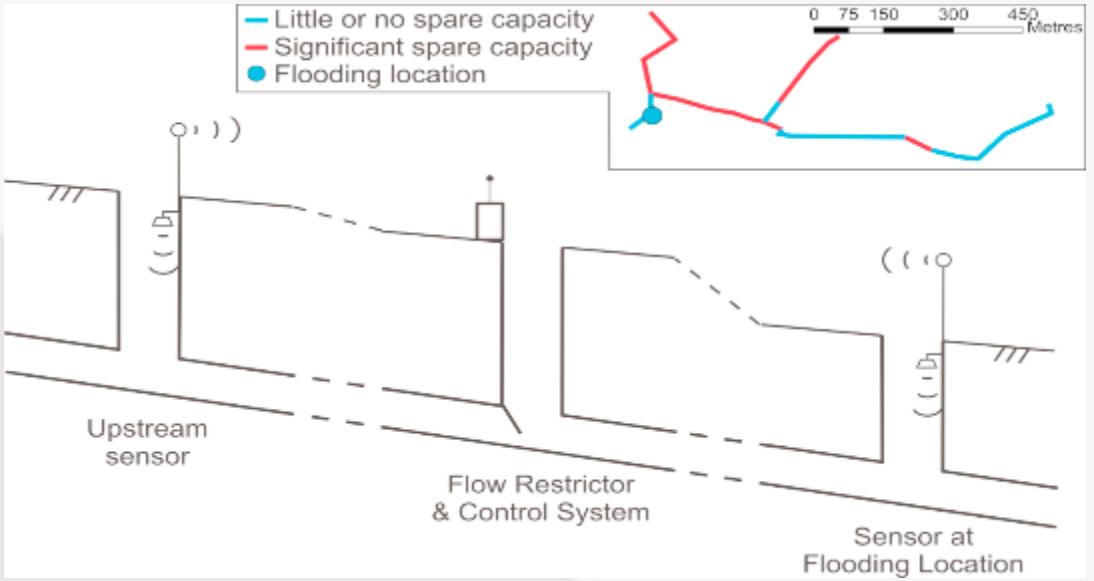
The University Of Sheffield.

ENVIRONMENTAL MONITORING SOLUTIONS

CENTAUR

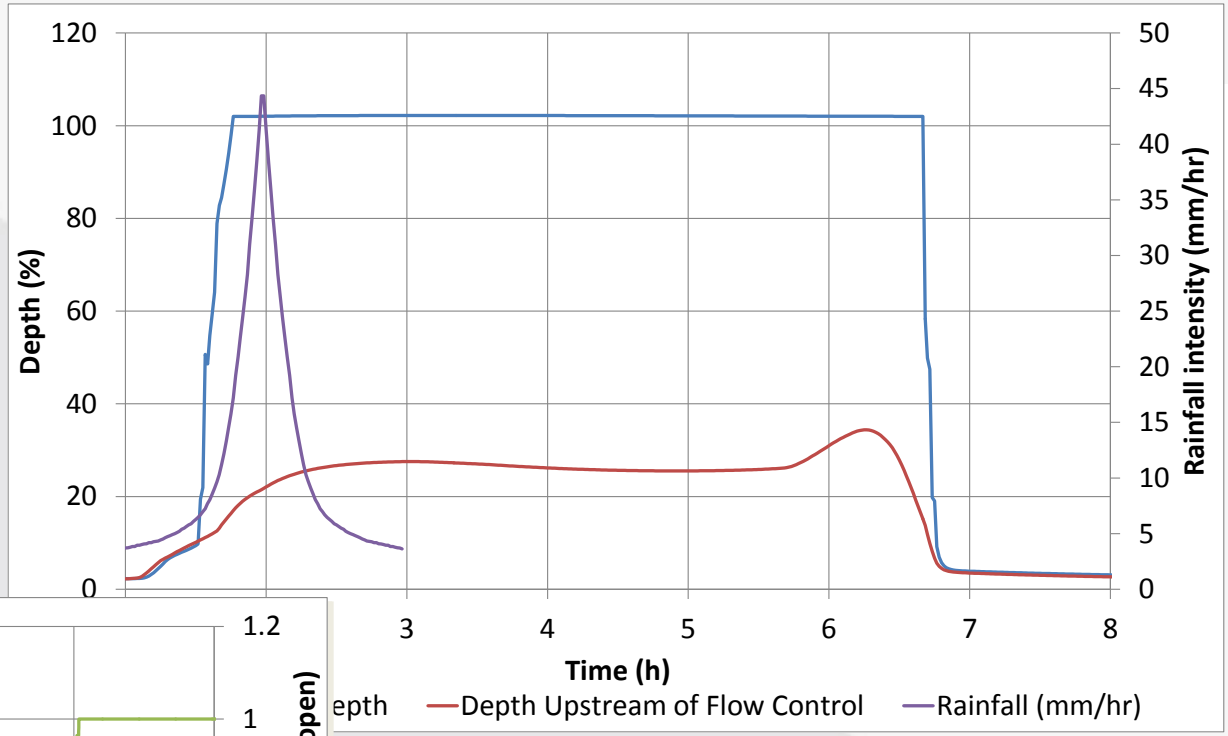
- Intelligent autonomous system for local urban flood risk reduction
  - *Utilises untapped network capacity*
  - *Controls flow based on intelligent algorithm which leverages local level data*
  - *Easily deployed, capital- and space-efficient*
- Low-cost alternative to “traditional” capital- and space-intensive solutions

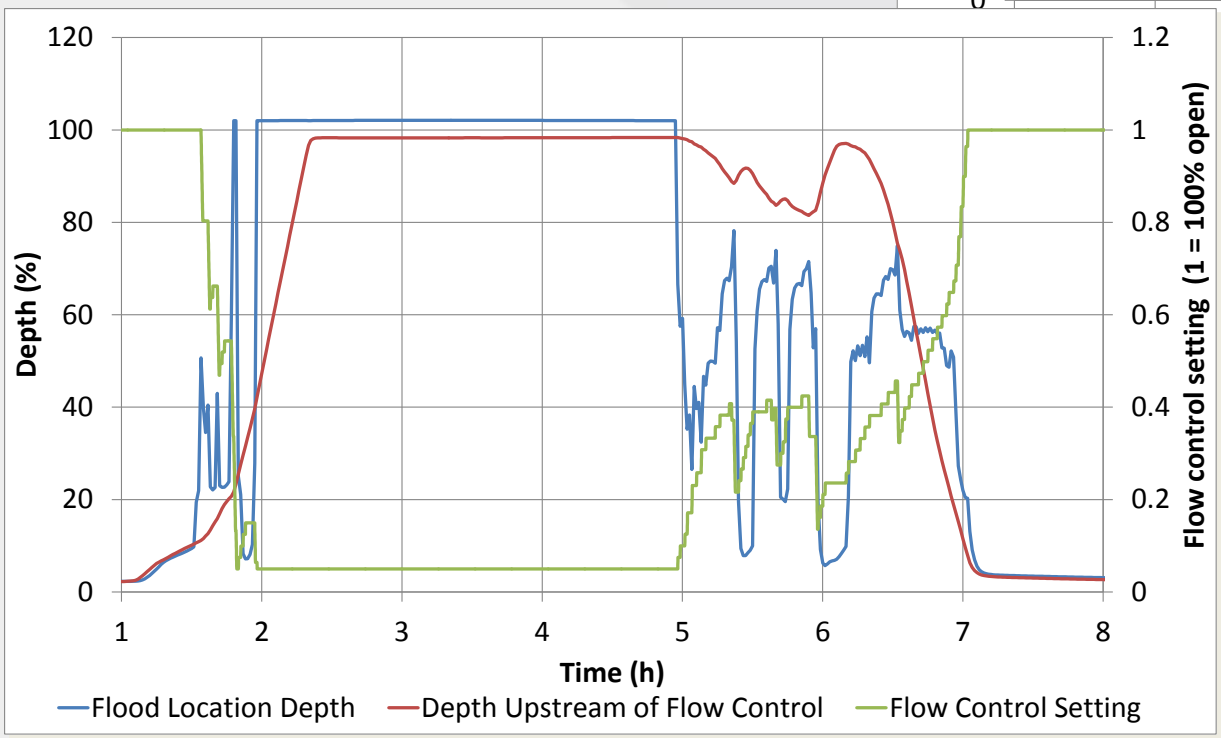
CONCEPT



Return Period (years)	Existing Flood Vol (m^3)	Residual Flood Vol (m^3) with CENTAUR	Captured Flood Volume
0.5	18	0	100%
1	45	0	100%
2	95	0	100%
5	213	0	100%
10	356	48	87%
20	559	265	53%
30	711	425	40%

CONCEPT





- 5 Yr return, 120min storm
  - 247m^3 escaped
- 54% reduction in escaped vol.

DIFFERENT USES FOR CENTAUR

- Flood protection
- Limiting CSO spills
- Regulating flows into energy intensive assets
- Complementary solution, e.g. reduce size of an intended storage tank, combine with SUDS
- Rainwater capture and sewage recycling (Singapore)

- **CENTAURS Clustered to form IWANs**
  - Intelligent Wastewater Networks

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THE SYSTEM

CENTAUR: KEY DESIGN FEATURES

- **Reliability**
  - robust, reliable comms
    - radio, not GSM (guaranteed signal, low latency for real-time control)
    - optimised radio signals (below ground, above ground)
  - sensor reliability
    - selected for reliability
    - sensor redundancy
- **Fail-safes**
  - physical overflow on gate (1/100 yr storm upstream)
  - system can be configured to disable (fully open) on reduced fidelity
- **Remote access**
  - via GSM / web
  - for visibility
  - for reconfiguration
- **Power Optimised**
  - batt (5yr), solar
- **Designed with robust Cyber-Security**
- **Easy implementation with Full Diagnositcs**

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OPTIMISED POWER

BATTERY (5YR TARGET)

SOLAR

MAINS (24V from Cab)

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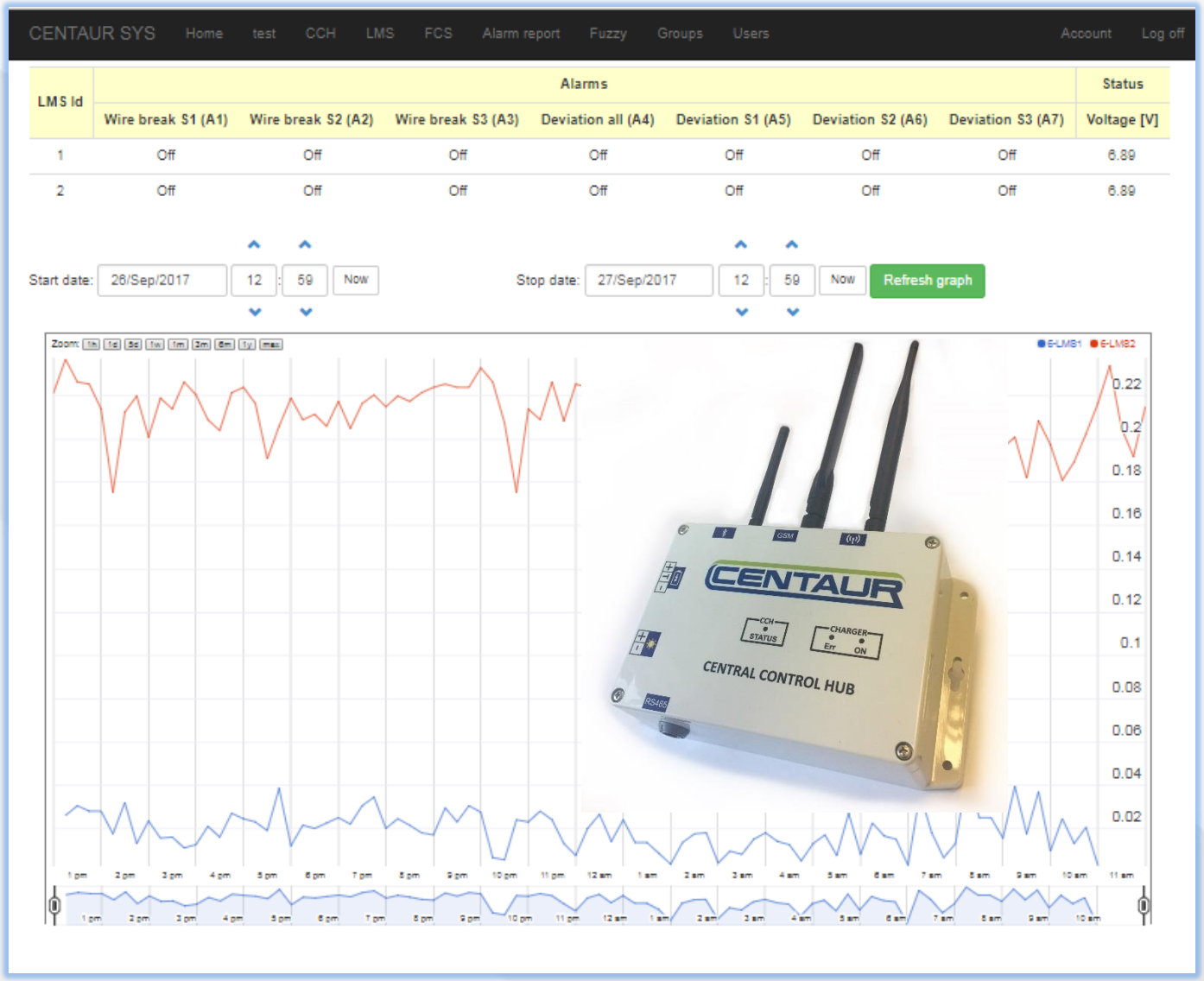
OPERATIONAL VISIBILITY

- Level and status in real-time
- On screen alarming
- SCADA integration

REMOTE RECONFIG

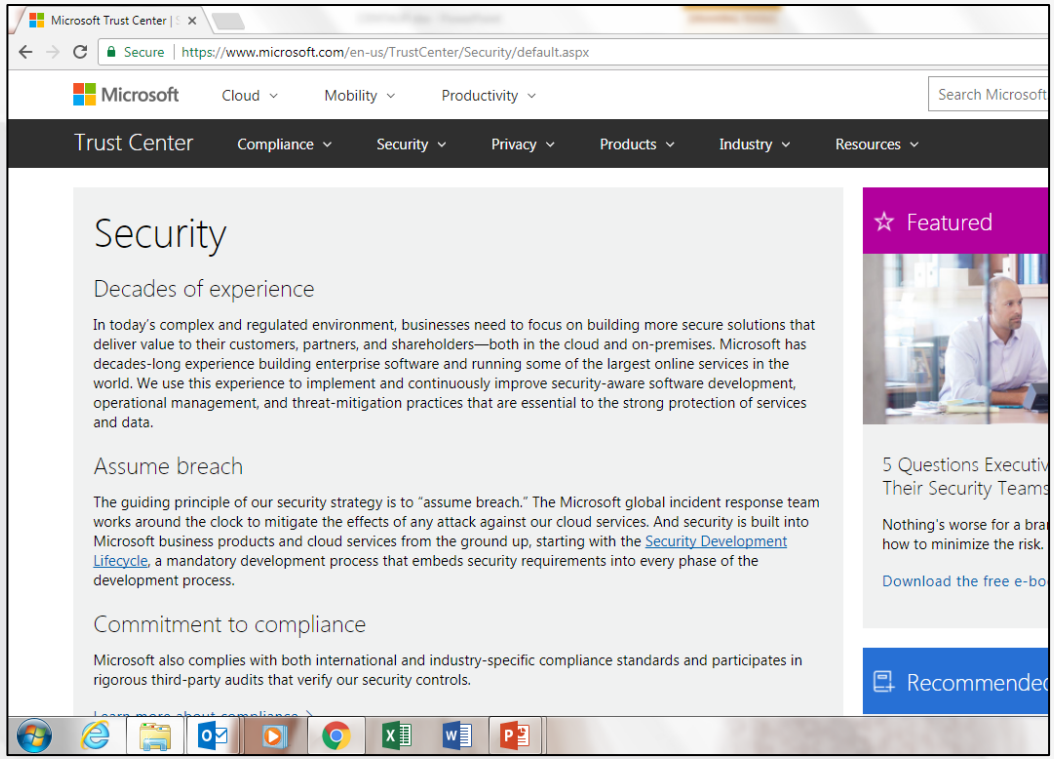
- Dashboard connected to Hub
- Pass-through to other units



online DASHBOARD

CYBER SECURITY

- Radio comms network
  - secure proprietary protocol
- Web portal based on MS Azure
- Control Hub to Portal
  - JSON (SSL security for message encryption)
- Bluetooth opened as required



PROTOTYPING AND DEVELOPMENT

- Lab deployment
  - controlled environment
- Field deployment
  - signal, power, reliability issues
  - all addressed in beta version

TRL 1	Basic principles observed and reported.	concept and modelling	2015
TRL 2	Technology concept and/or application formulated.		
TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept.		
TRL 4	Technology basic validation in a laboratory environment.	prototype development and deployment in lab	2016
TRL 5	Technology basic validation in a relevant environment.		
TRL 6	Technology model or prototype demonstration in a relevant environment.		
TRL 7	Technology prototype demonstration in an operational environment.	prototype in field	Q1/Q2 2017
TRL 8	Actual Technology completed and qualified through test and demonstration.	beta version in field	Q2/Q3 2017
TRL 9	Actual Technology qualified through successful mission operations.	market	late 2017 onwards

CASE STUDY

CASE STUDY

- Protecting a World Heritage Site in Coimbra
- Significant reduction in level at target site
- Plan to put possibly 2 more systems in (can run from same Hub)

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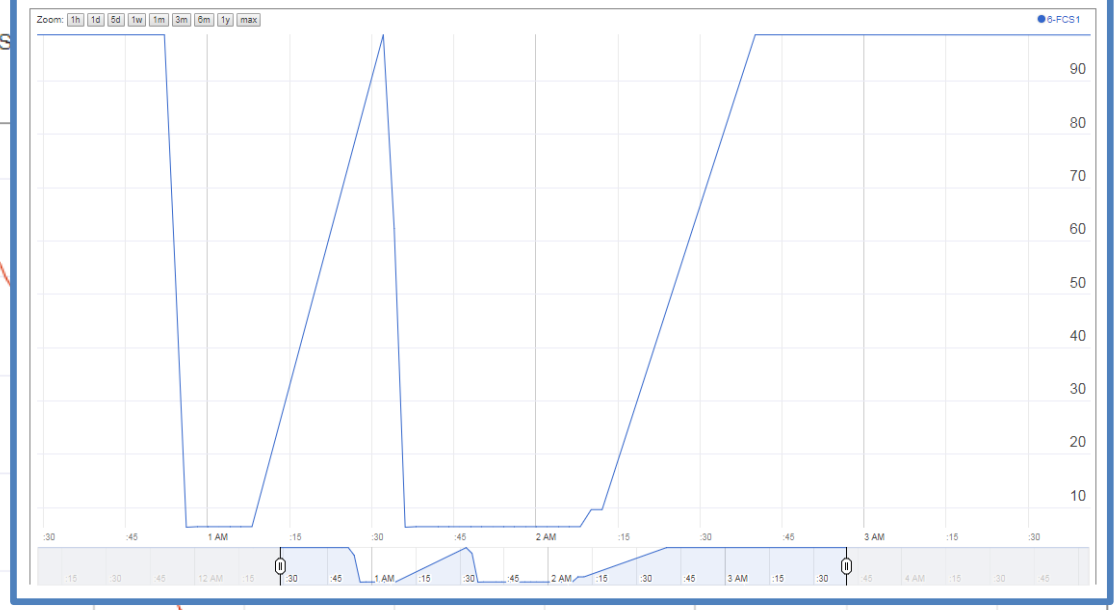
LMS Id	Alarms							Status
	Wire break S1 (A1)	Wire break S2 (A2)	Wire break S3 (A3)	Deviation all (A4)	Deviation S1 (A5)	Deviation S2 (A6)	Deviation S3 (A7)	Voltage [V]
1	Off	Off	Off	Off	Off	Off	Off	6.84
2	Off	Off	Off					

Start date: 16/Oct/2017 07 : 38 Now

FCS Id	Alarms								Status	
	Gate error (A1)	Manual mode (A2)	Communication error (A3)	Gate blocked (A4)	Motor failure (A5)	Sensor failure (A6)	Mechanical failure (A7)	Electrical failure (A8)	FCS Available	Fuzzy ON
1	Off	Off	Off	Off	Off	Off	Off	Off	ON	Off



- reducing the peak (level) at the flooding site by ~30% for significant storms

- flawless autonomous operation

MODELLING

MODELLING TOOLS & TECHNIQUES DEVELOPED BY THE PROJECT

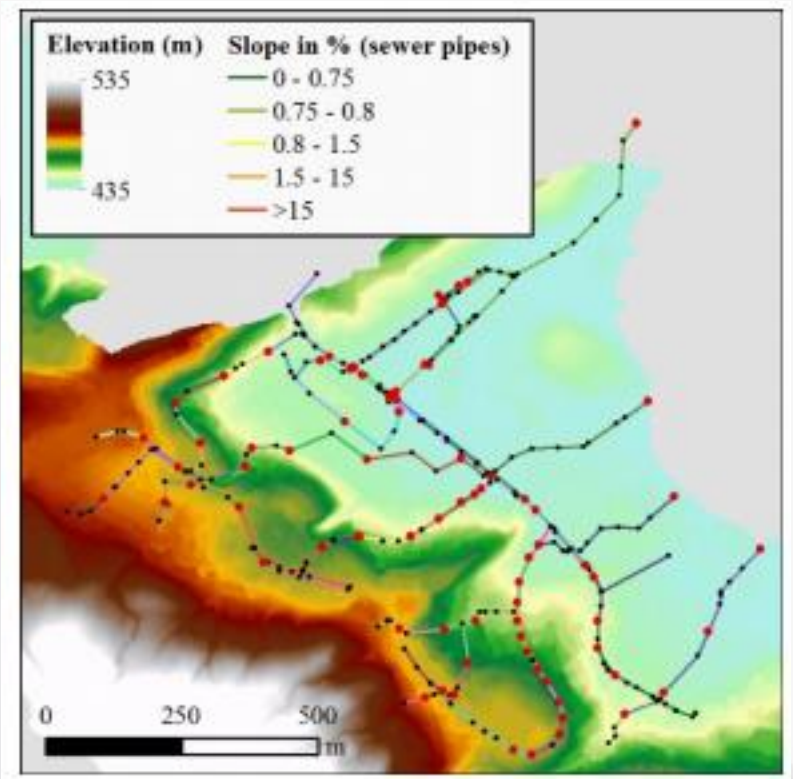
- How do we decide where to put CENTAUR?

- How do we know CENTAUR will work?

HOW DO WE DECIDE WHERE TO PUT CENTAUR?

- **CENTAUR_SST** **S**ite **S**election **T**ool

- Specialist tool from EAWAG
  - import asset (geometric) data
  - identifies sites with greatest potential to reduce risk at target site
- can run different algorithms incorporating, for example:
  - available storage volume, contributing area
- ***Leitão et al (2016), CCWI, Zenodo***
- ***Leitão et al (2018), Journal of Hydrology***



freeware (download from Github)

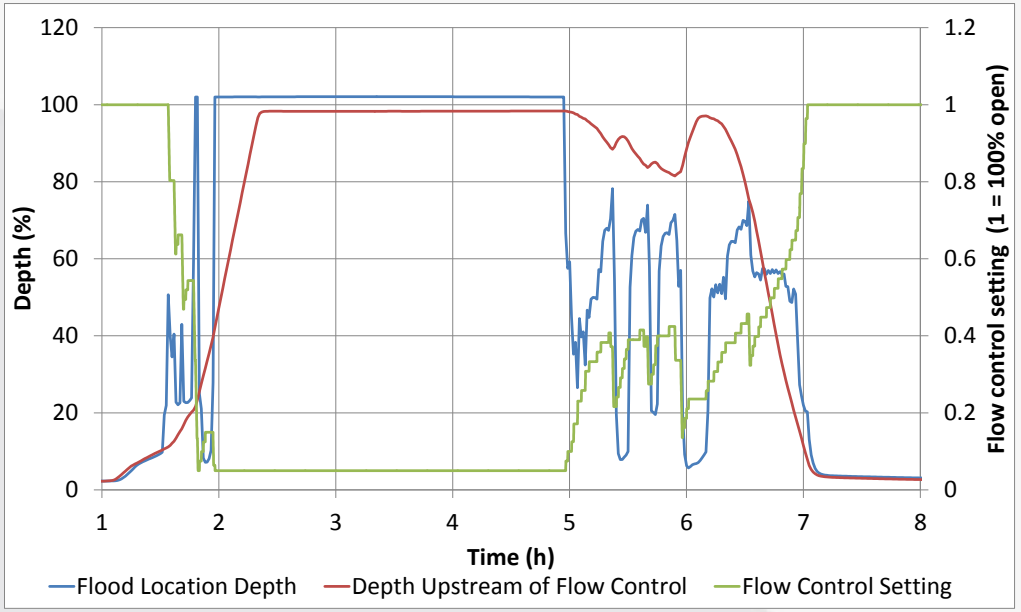
https://github.com/ldesousa/centaur.loc

search "**centaur.loc**"

HOW DO WE KNOW CENTAUR WILL WORK?

- **CENTAUR_DMT** **D**ynamic **M**odelling **T**ool

- Universitry of Sheffield
- simulates real-time response
- integration of SWMM and MATLAB



- ***Shepherd et al (2016), CIWEM Autumn UDG, Zenodo***
- ***Ostojin et al (2017), CIWEM Autumn UDG, Zenodo***

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