Surface Water Management Strategy for Cranfield University

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1. Introduction

On June 2016 Cranfield University campus experienced an intense rainfall of about 60 mm within one hour. This led to surface water flooding of some campus buildings and airport hangars.

People working on campus could not remember a similar event in Cranfield University regarding surface water flooding due to intense rainfall.

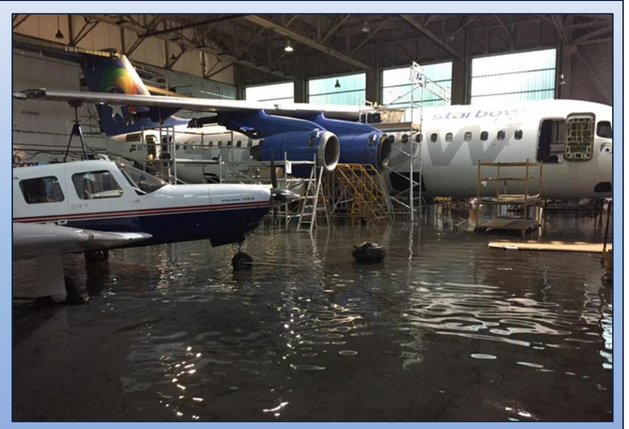

Figure 1. Picture of a flooded hangar at Cranfield Airport

2. Objectives

The target of this project was to propose a Surface Water Management Strategy (SWMS) for Cranfield University. Its achievement depended on the following objectives:

A. Understanding and definition of the current status of the drainage system in the campus.

B. Identification of the main challenges affecting the surface water at Cranfield University.

C. Identification of the most vulnerable areas within the campus.

D. Proposal of alternatives for the SWMS to solve the main problems identified.

E. Integration of water quality and biodiversity enhancement measures in the proposed solutions.

3. Methodology

Collection of Digital Data → **Catchment Definition** → **Understanding of Current Situation** → **Drainage System Status** → **Interviews and Field Data Collection**

- Aerial Images
- Digital Elevation Models
- Soil Digital Data
- Land Cover Digital Data
- Campus Buildings Digital Data

Identification of Problems

Research of SuDS techniques

Proposal of Solutions

- Study Area Field Survey
- Focus Group Discussions
- Drainage Network Information
- Affected Buildings Information
- Gatwick Airport and ACO Visit

4. Identification of Problems

The main problems identified as causes of flooding are:

A. Constricted outlet point of the catchment.

B. Low capacity and poor status of drainage system.

C. High percentage of impermeable surfaces.

D. Underlying clay soil in all the catchment.

Pollution during runoff events has also been identified and will be tackled in the proposal of solutions.

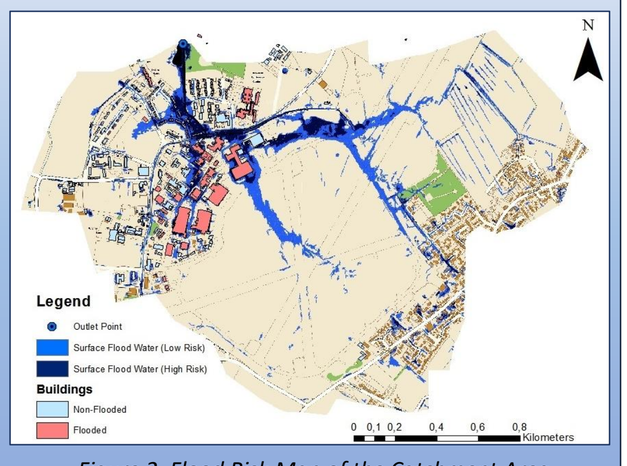

Figure 2. Flood Risk Map of the Catchment Area

5. Proposed Solutions

Features	Present	Alternative1	Alternative2
Geocellular Systems	-	4	1
Rain Gardens	-	-	9
Swales	-	-	2
Detention Basins	-	-	1
Peak Flow	25.6 m^3/s	7.3 m^3/s	16.0 m^3/s
Hydrograph Duration	7 h	33 h	33 h
Biodiversity	✖	✖	✓
Pollution Removal	✖	✓	✓
Estimated Cost	-	£4M	£2M

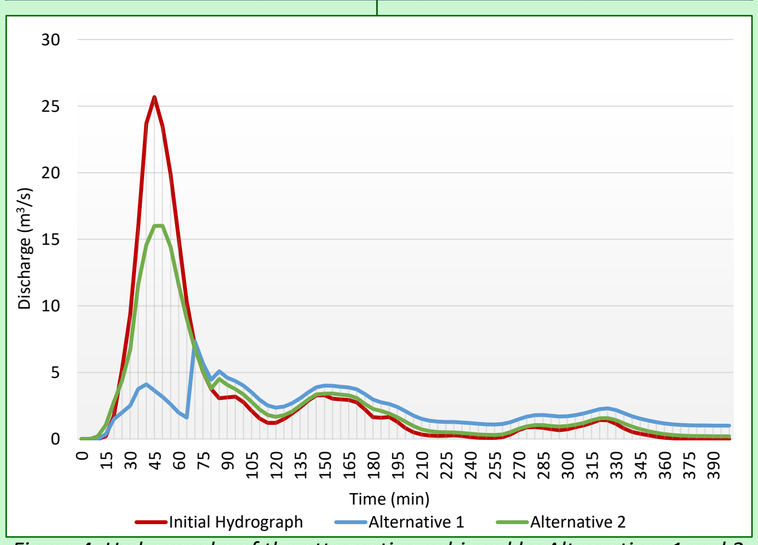

Figure 4. Hydrographs of the attenuation achieved by Alternatives 1 and 2.

Alternative 1. Geocellular Storage Systems

In Alternative 1, Geocellular Storage System was selected as the most effective solution in terms of flood peak attenuation needed for this catchment:

- Geocellular Storage Systems are modular systems which provide a high void ratio for storage of surface water to manage it effectively during high flow events.
- Four systems are proposed to be implemented in four key locations on campus (shown in *Figure 3*) to tackle the main surface water routes.
- Outflow from these tanks will be regulated by the installation of control mechanisms.

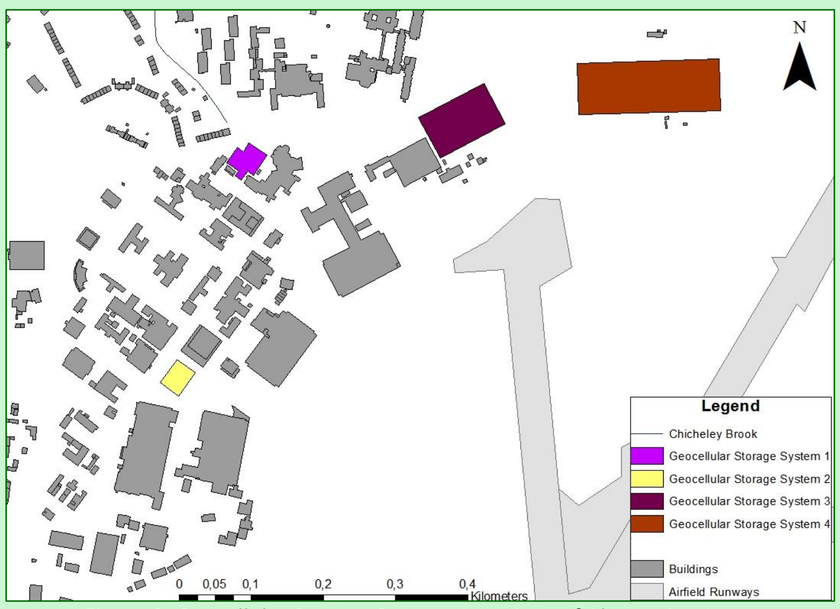

Figure 3. Geocellular Storage Systems Locations of Alternative 1.

Alternative 2. Green Infrastructure

Alternative 2 offers a cost-effective approach based on the combination of:

- Rain gardens on different locations around main campus (shown in *Figure 5*), to increase infiltration rates of surface water.
- Swales to attenuate and filter surface water, in place of the current ditches connected with the outlet point.
- A detention basin to attenuate and filtrate water surface runoff intercept the runoff.
- One of the designed Geocellular Storage Tanks from Alternative 1.

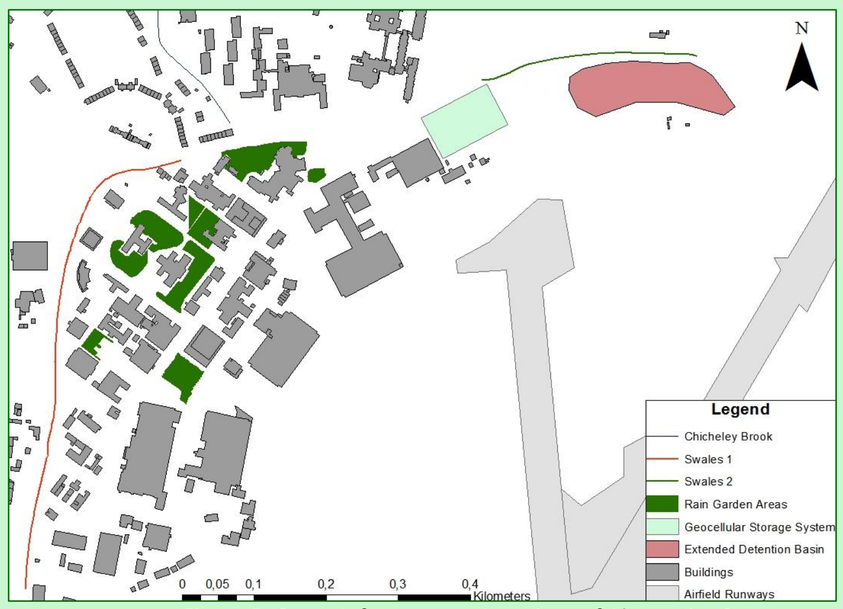

Figure 5. Green Infrastructure Locations of Alternative 2.

6. Conclusions

The main outputs of the hydrological understanding of Cranfield University campus are:

- The Digital Terrain Model, which allows the definition of the study area.
- The culvert discharge capacity, as the most constraining factor of the surface water drainage from the campus.
- The hydrological model of the catchment, simulating the surface water generation during the flooding event of 2016.

After the analysis of these generated outputs, it was concluded that the implementation of different attenuation systems was necessary for Cranfield University SWMS.

The main outputs of the proposal of solutions for the SWMS are:

- The key locations to implement attenuation systems, considering the current drainage network and the available areas.
- The hydrological and hydraulic models to analyse the performance of different scenarios.
- Two alternatives based on different SuDS approaches, including a cost estimation for each one of them.

Both alternatives are designed to be effective during extreme rainfall events, hence its elevated cost.