# Technical Note

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| **Title** | Darwin Green Drainage Assessment – DG2/DG3 Model Technical Note |
| **Author** | Victoria Berg-Holdo |
| **Checker** | Renuka Gunasekara |
| **Approver** | Giles Booth |


## Executive Summary

A surface water modelling study has been completed by Hyder for Barratts Homes to develop a surface water management strategy for the Darwin Green development site to the north of Cambridge. It provides further supporting evidence base for the viability of a site allocation application for the development of the Darwin Green 2 and 3 sites. The DG2 and DG3 sites are adjacent to the proposed DG1 site at the same location.

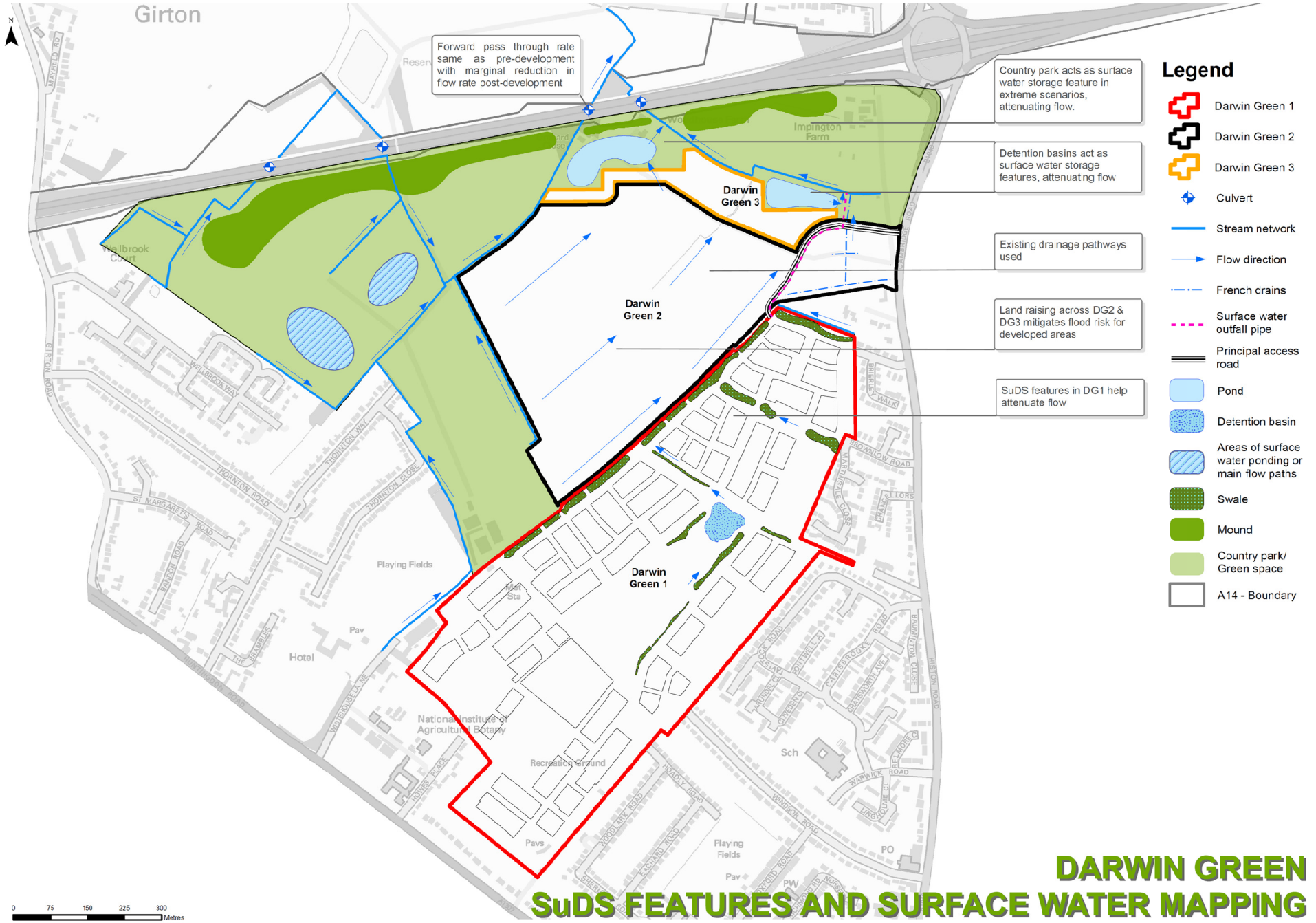
A detailed hydraulic model was created in ISIS Tuflow to simulate rainfall across the study area and surface water flow paths through the development. The hydraulic model provides the ability to simulate the water flow routes and standing water risk through amending the physical features of the development and adjusting the permeability of the ground of developed areas.

The model includes representation of the Sustainable Urban Drainage Systems (SuDS) proposed to help manage surface in the development. These include detention basins, swales, French drains and drainage ponds to help direct and attenuate the surface water on the site. These are connected and drain to the local surface water network.

The model results show that flood risk is effectively mitigated through land raising planned across the DG2 and DG3 sites. It is also demonstrates no increase in pass forward flow to downstream areas through flow effective attenuation at specially design features and the country park.

Overall, the proposed Darwin Green 2/3 development presents a unique opportunity to reduce existing flood risk issues downstream of its catchment area and take an innovative approach to surface water management, which has the potential to deliver wider environmental and water quality benefits.

A summary surface water mapping diagram is shown below.




# DARWIN GREEN
# SuDS FEATURES AND SURFACE WATER MAPPING

Drawing ref: UA007516 - Darwin Green

## Introduction

Woods Hardwick commissioned Hyder Consulting (UK) Ltd (HCL) to undertake a drainage assessment of the Darwin Green development site located to the north-west of Cambridge City centre. The Darwin Green development site is made up of three separate areas known as Darwin Green 1 (DG1), Darwin Green 2 (DG2) and Darwin Green 3 (DG3).

As part of a previous assessment in January 2014, HCL developed 1D-2D TUFLOW-ESTRY models of the 1 in 100 Annual Exceedance Probability (1% AEP) year event inclusive of a 30% increase in rainfall intensity to represent climate change impact - for both the pre and post development scenarios. In June 2014, the post development model was enhanced with a more detailed drainage network on the DG1 site. In November 2014, the post development model was revised again with modified ground levels on the DG2 site and further modifications to the drainage network on the DG1 site.

Woods Hardwick subsequently requested more detailed information on the modelled pluvial water levels across the site to inform the DG2 and DG3 site design development. Therefore, the purpose of this study has been to develop two 1D-2D TUFLOW-ESTRY models using the additional information supplied by Woods Hardwick and report the model findings. The two modelled scenarios are as follows:

- **Ring-fenced DG1 baseline Scenario** – This modelling scenario represents the existing drainage on both the DG2 and DG3 sites along with the approved drainage network and site levels on the DG1 site. This scenario is now considered as the **pre-development baseline model** in this technical note hereafter.

- **Post Combined DG2 and DG3 Development Scenario** – This modelling scenario represents the post development case on the DG1 site, DG2 site and the DG3 site. This model includes the latest topographical survey data, latest surface water plans, additional land drains to eastern edge of DG1 and land drains insertion in DG2 site to land north of Brierley Walk. This is now considered as the **post development model** in this technical note hereafter.

The purpose of this technical note is to summarise and discuss the predicted pluvial flooding impacts (both onsite and offsite) for each pre-development and post-development scenario above.

## Additional Data Provided

The following additional data was provided to enhance the Darwin Green drainage assessment models:

- CAD drawings of the proposed development on site with the proposed ground levels.
- Revised WinDes model of the proposed drainage network.
- Pdf sketch of proposed land drains at the eastern edge of DG1 and to land north of Brierley Walk through DG2 site.
- Highways Agency data for A14 corridor. This information gave us the updated information for the A14 road boundary.

**Pre-development Scenario**

A new Pre-development model was created by modifying the previous pre-development TUFLOW-ESTRY model developed for Woods Hardwick. DG1 site already benefits from the approved planning permission (including for the proposed site levels and detailed drainage design). Therefore, to represent the existing site with the DG1 approved drainage and site levels, the previous pre-development TUFLOW-ESTRY model was modified by incorporating the latest DG1 drainage network and the proposed levels within the DG1 area of the site. Figure 2 below illustrates the modelling results for the updated Pre-development scenario.

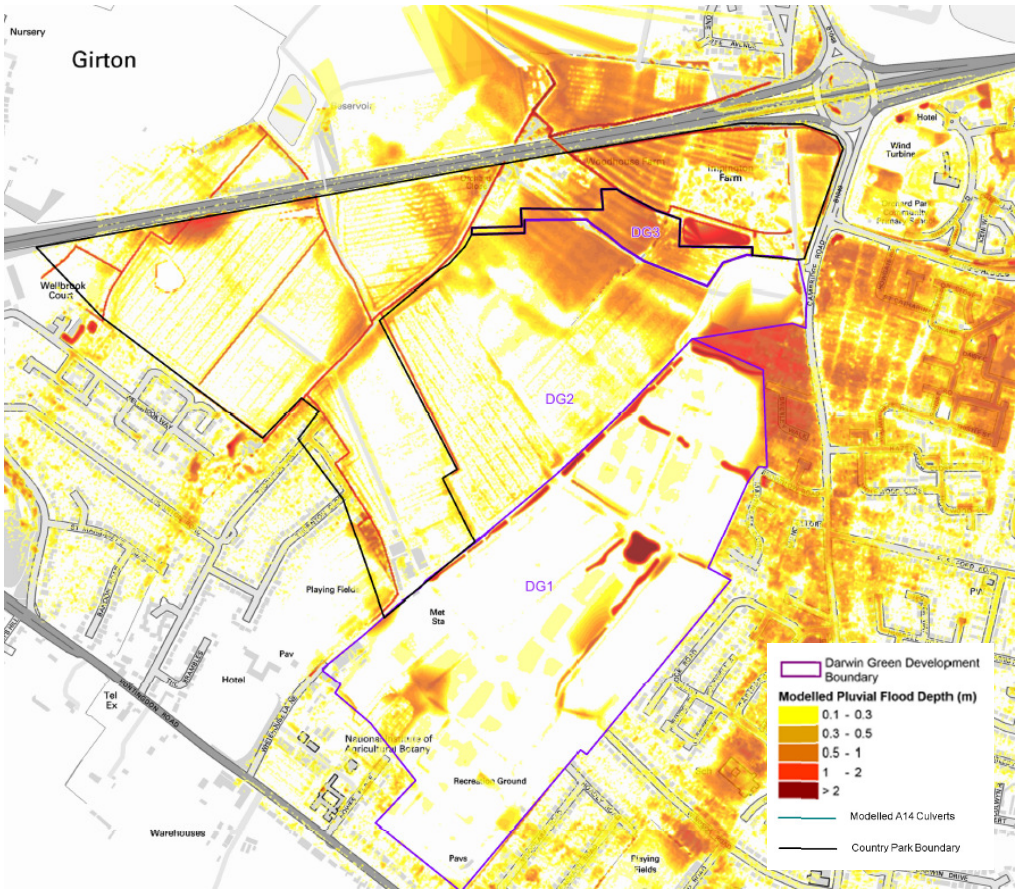



**Figure 1 – Modelled Pluvial Flood Depths in the Pre-Development Scenario (for the 1 in 100 year plus climate change event)**

**Post Development Scenario**

A post development model for the Darwin Green 2 (DG2) and Darwin Green 3 (DG3) development was created by modifying the previous post-development TUFLOW-ESTRY model that was developed for Woods Hardwick.

Woods Hardwick provided HCL with their revised WinDes model of the drainage network on Darwin Green site. The information from the WinDes model was exported out and applied to the new TUFLOW-ESTRY model. The information from the drainage network including hydrobreaks were applied to the model, the manholes were also applied to the model and storage tanks were applied to the model.

Additional proposed ground levels for the post Darwin Green development site DG2 and DG3 were provided, which also included some ground raising and re-profiling. These were incorporated into the model by creating a ground model in the form of an .asc file which stamped these points on top of the existing topographic data for the site.

The proposed ground levels in DG2 and DG3 site will ensure a gradual slope down to the proposed ponds and the Country Park area (to the north and west) to improve land drainage across the proposed

development minimising pluvial flood risk. Additional landscaped earth mounds have also been proposed at the northern edge of the Country Park along A14 and these were also represented in the 2D.

The pond and swales were modelled in the 2D. The pond and swales were then connected to the 1D drainage network by CN and SX connections. Gullies were represented in the model and allowed water to flow from the 2D surface into the 1D drainage network. A few additional land drains (i.e. filter drains) have been added to the model (as ID drainage network) at the eastern edge of DG1 and to land north of Brierley Walk through DG2 site to enhance land drainage in this area.

Figure 3 below illustrates the modelling results for the updated Post-development scenario.

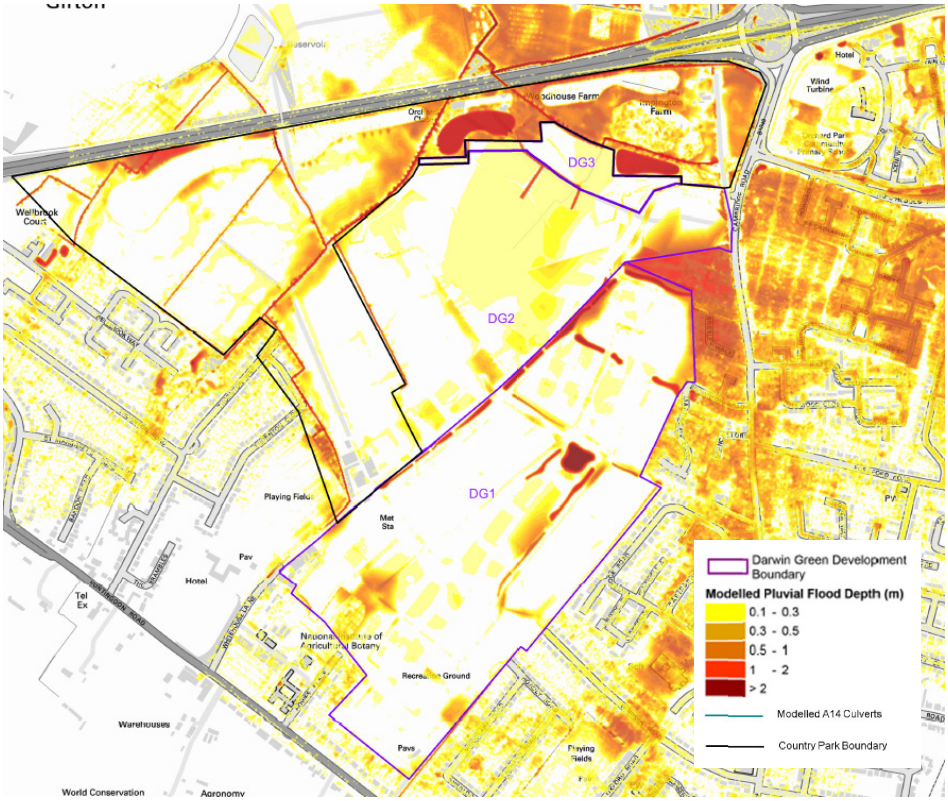



**Figure 2 – Modelled Pluvial Flood Depths in the Post Development Scenario (for 1 in 100 year plus climate change event)**

Figure 4 below outlines the depth differences between the modelled pre and post development scenarios within the model boundary.

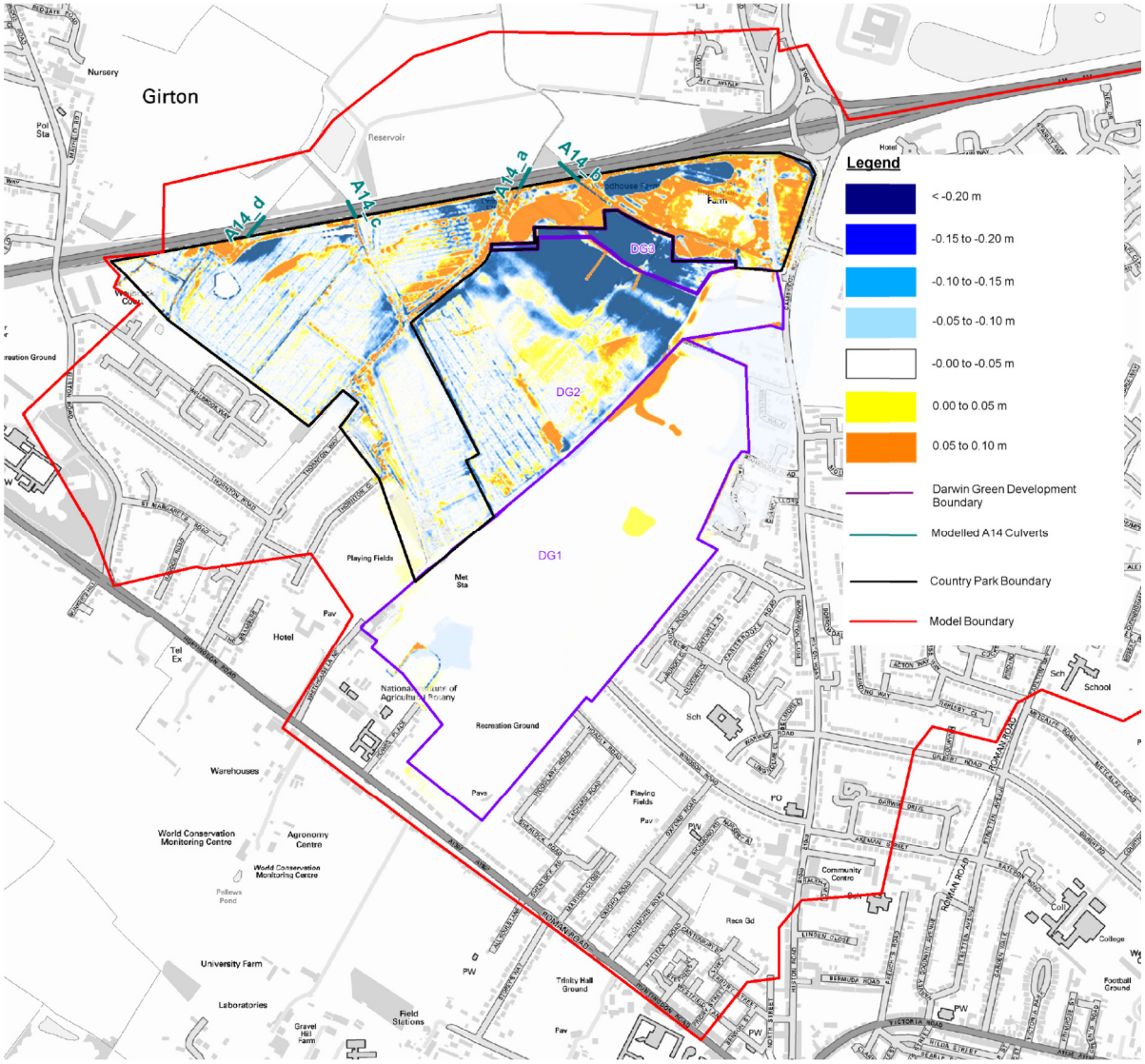
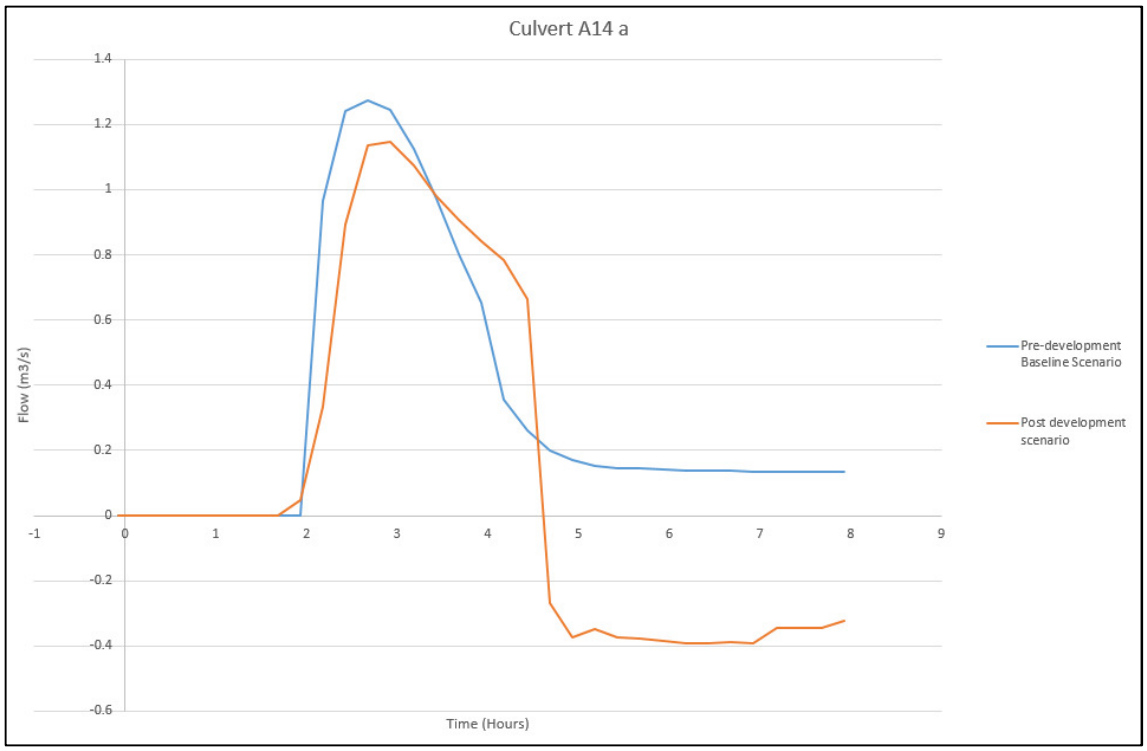


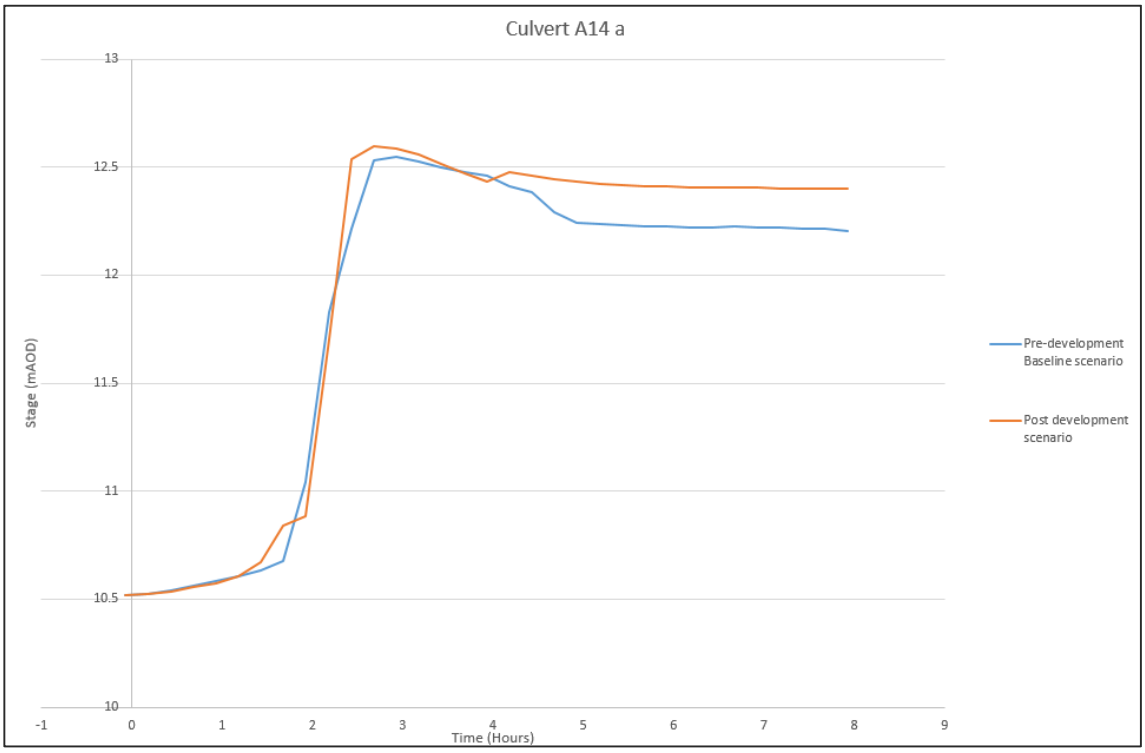

**Figure 4 – Depth differences in metres between the modelled Pre-development scenario and Post Development Scenario (for 1 in 100 year plus climate change event)**

The figure above shows that in the post development scenario there is a depth reduction of up to 0.2m at the northern parts of the DG2 site and across the entire DG3 site. The figure also shows that there is some increase in water levels of 0.1m to the north of the DG2 and DG3 sites (for 1% AEP plus climate change event) within the proposed Country Park area south of A14 but this is unlikely to have a significant impact on the proposed amenity land use as western part of the Country Park is mainly dry and unaffected.

The following four graphs show both the pre and post development flow and stage through the two culverts (A14_a and A14_b) under the A14 located to the north of the Darwin Green development site.




**Graph 1 – Flow through culvert A14_a in both the Pre Development scenario and Post Development scenario**

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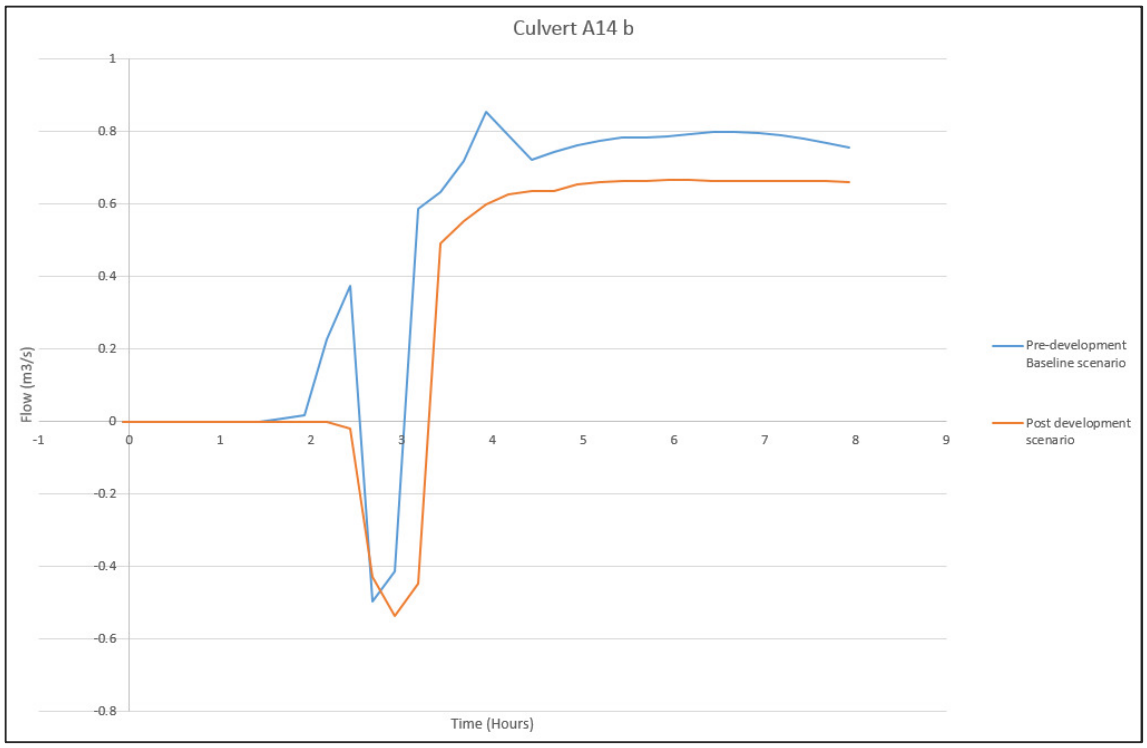
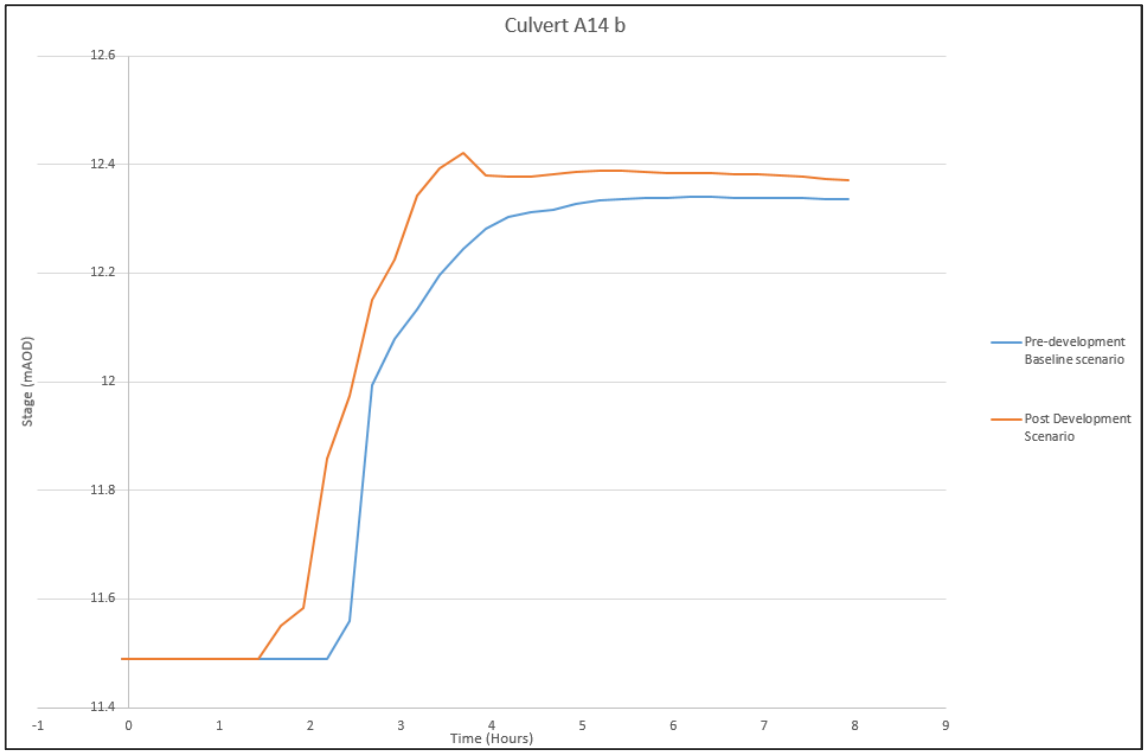
**Graph 2 – Water level at culvert A14_a in both the Pre Development scenario and the Post Development scenario**




**Graph 3 – Flow through culvert A14_b in both the Pre Development scenario and the DG2 and Post Development scenario**




**Graph 4 – Water level at culvert A14_b in both the Pre Development scenario and the Post Development scenario**

The principal flows in the DG2 / DG3 post development scenario are from culvert A14_a where back flow was observed through culvert A14_b as a result of the flat gradient of the channel. However, the post development scenario reduces the rate of water flowing through these culverts.

## Conclusions

It can be concluded that the DG2 and DG3 post development scenario gives the greatest reduction in flooding across the DG2 and DG3 sites as well as downstream areas to the north of A14.

Forward pass through rate same as pre-development with marginal reduction in flow rate post-development

Country park acts as surface water storage feature in extreme scenarios, attenuating flow.

Detention basins act as surface water storage features, attenuating flow

Existing drainage pathways used

Land raising across DG2 & DG3 mitigates flood risk for developed areas

SuDS features in DG1 help attenuate flow

Darwin Green 1

Darwin Green 2

Darwin Green 3

Impington Farm

Wellbrook Court

Playing Fields

Hotel

National Institute of Agricultural Botany

Recreation Ground

Sch

PO

Pav

Pavs

PW

Mast Sta

Girton

## Legend

- Darwin Green 1
- Darwin Green 2
- Darwin Green 3
- Culvert
- Stream network
- Flow direction
- French drains
- Surface water outfall pipe
- Principal access road
- Pond
- Detention basin
- Areas of surface water ponding or main flow paths
- Swale
- Mound
- Country park/ Green space
- A14 - Boundary

0 75 150 225 300 Metres

1:6,500

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