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Modelling of stormwater drainage systems using RCP 8.5 climate change scenario

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Abstract: The aim of the study was to understand the flood control efficacy of existing drainage system for RCP 8.5 climate change scenario up to 2090 in South Australian catchments. The guidelines of Australia Rainfall Runoff (ARR 2016) were used to understand the climate change impacts on rainfall intensities and CSIRO's Climate Futures Exploration Tool (CFET) was used to predict the future climatic conditions of South Australia for RCP 8.5 scenario. The modelling outputs of CFET resulted three possible maximum temperature increases of 1^0C, 2.25^0C and 3^0C in 2030, 2060 and 2090 respectively. These predicted increased temperatures may alter the rainfall patterns of South Australia and rainfall intensities could be increased as 5%, 11.6% and 15.8% in 2030, 2060 and 2090 respectively.

Three study areas of South Australia were considered. Drainage systems using ARR 2016 were designed for the selected catchments using DRAINS model. AS/NZS 3500.3 design code was followed for selecting the concrete pipe sizes and pit dimensions. The optimum drainage systems design was adopted by examining the hydraulic grade lines at various pit locations of the selected pipes. Thereafter, the projected rainfall intensities due to RCP 8.5 climate change scenarios were entered into the DRAINS model for major and minor storm events. The performance of drainage systems for RCP 8.5 scenario was evaluated by considering several aspects including critical flow at pipe, up welling water at pit, adequacy of free board, flow at overflow route, hydraulic grade line (HGL), longitudinal slope and pipe size.

The results showed that the properly designed, constructed and maintained existing drainage system may be able to cope with ARR 2016 rainfall events. However, this performance was revealed to be highly sensitive to the projected future changes in rainfall intensities for the years 2060 and 2090 (Figure 1). It also revealed from the long sections analysis of the pipe that the HGL in several segments of the network went beyond the allowable limit in major storms, implying more risks of overflows and flooding. Observed hydrographs (Figure 2) showed that the RCP 8.5 scenarios had greater maximum flow rates thus a greater volume of runoff to the system. Freeboard analysis indicated that the freeboard levels in certain important sections of the network declined, which rendered inadequate margin between the HGL, and water surface levels especially as estimated with 2090 scenario.

In conclusions, the existing drainage systems in South Australia will be unable to cope with major rainfall events at RCP 8.5 climate change scenario and appropriate adaptation options using water sensitive urban design technologies may widely utilised to get better techno-environmental benefits.

Keywords: *Climate change impacts, RCP 8.5, drainage systems, DRAINS model.*

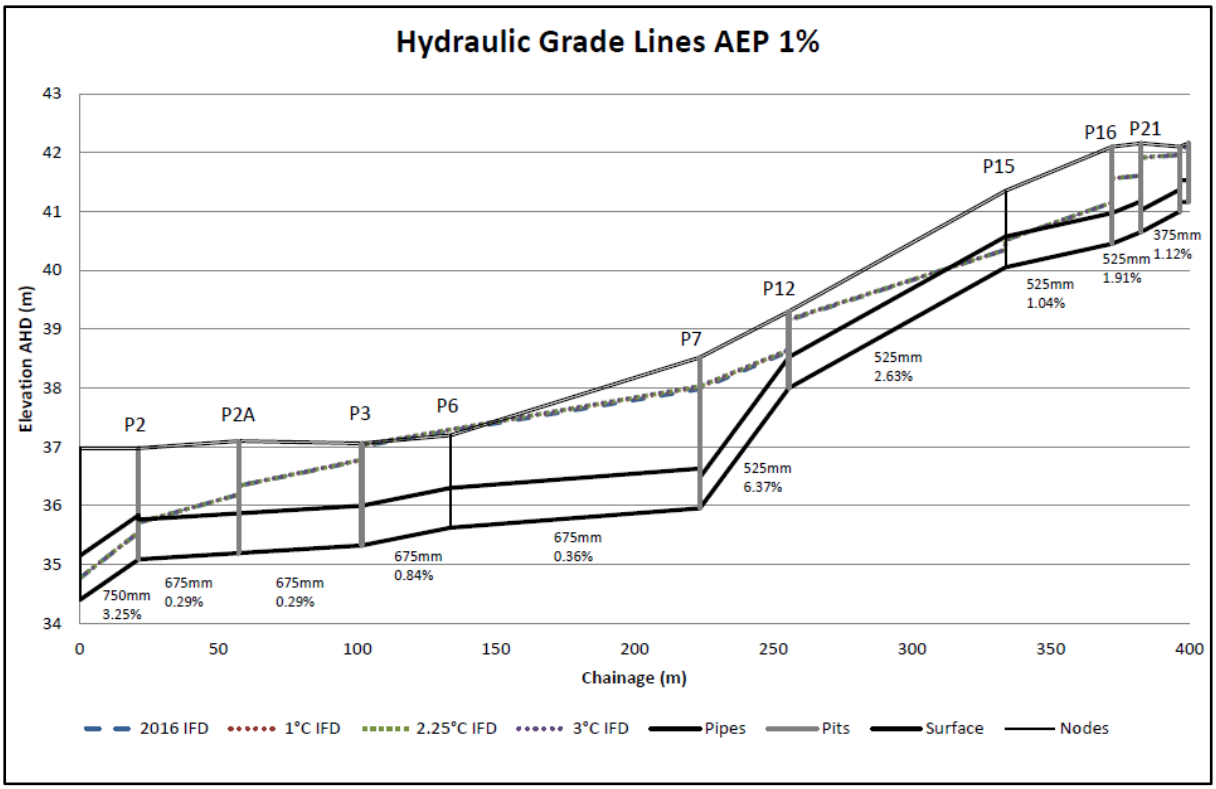

Figure 1: Hydraulic grade lines of drainage pipes.

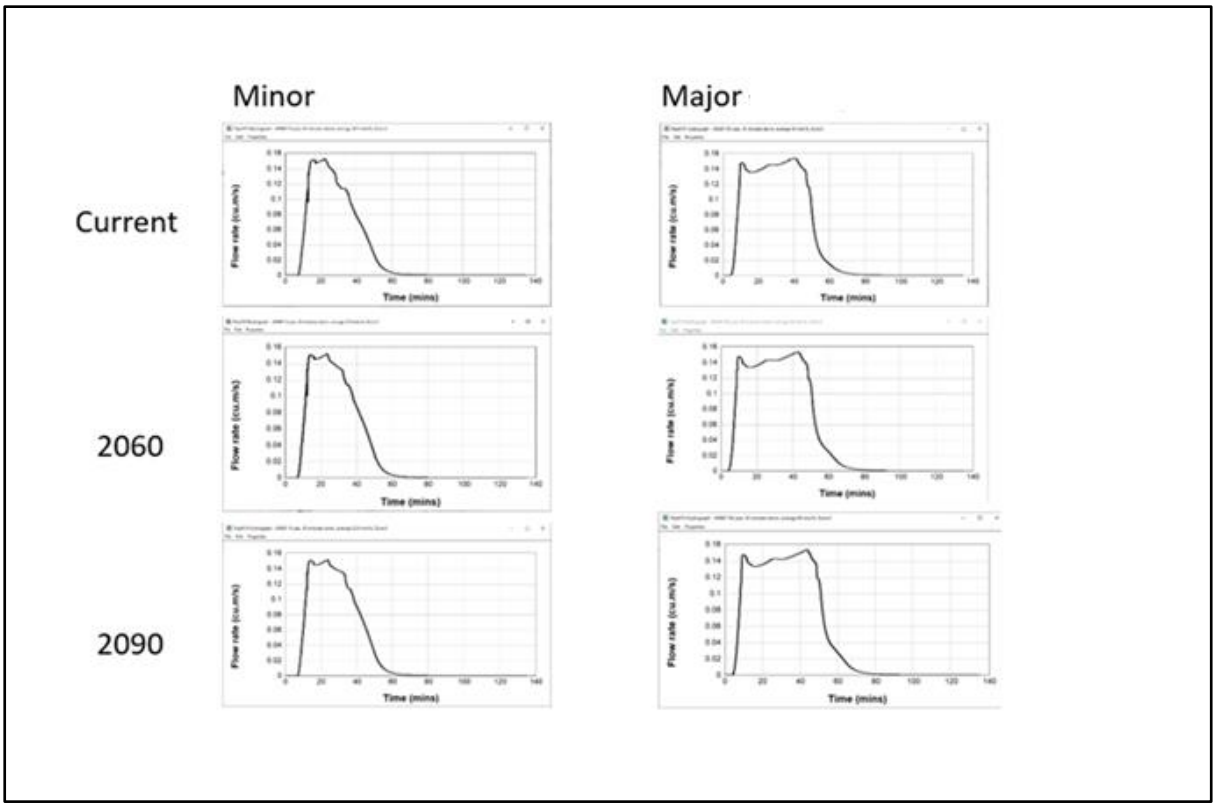

Figure 2: Hydrographs for a particular section of a drainage pipe using RCP 8.5 scenario.