Appendix E Design Flows - t_C

The travel time of the overland flow path (t_c)can be estimated using either the Bransby Williams formula for time of concentration or by the overland kinematic wave equation as presented in Australian Rainfall and Runoff (2003).

Each method has advantages and disadvantages. The Kinematic Wave equation is the most accurate method of calculating t_c and is generally suited to most catchments. As the equation requires the designer to solve for t and $I^{0.4}$ simultaneously, an iterative approach must be undertaken (or use a previously prepared relationship table for $I^{0.4}$ for the study area). The Bransby Williams formula is well suited to situations where no actual relationships for t_c have been calculated based on observed data, and it does not require an iterative process to reach a solution making it attractive to designers new to these theories or in areas where little catchment response data exists.

It should be noted, however, that where a system is being designed to incorporate detention/retention for downstream flood control t_c should be replaced with $T_{c\text{-critical}}$, ie the time of concentration for the critical point of the total downstream catchment (the point at which unacceptable flooding is most likely to occur).

Kinematic wave equation	Bransby Williams formula for t_c
$t = \frac{6.94(L \cdot n*)^{0.6}}{I^{0.4} \cdot S^{0.3}}$	$t_c = \frac{91 \times L}{A^{0.1} \times S_e^{\ 0.2}}$
Where: **t** is the overland travel time (minutes) **L** is the overland flow path length (m) **N*** is the surface roughness (concrete or asphalt ~ 0.013) **I** is the design rainfall intensity (mm/hr) **S** is the slope	Where: **t_c** is the time of concentration (minutes) **L** is the main stream length measured to the catchment divide (km) **A** is the catchment area (Ha) **S_e** is the grade of the main stream (m/km)

EquationE.1 and Equation E.2