



ENVIRONMENT

APPLICATION OF USING HYDRAULIC MODELLING SOFTWARE IN ASSESSMENT OF INFLOW AND INFILTRATION IN SEWER COLLECTION SYSTEMS

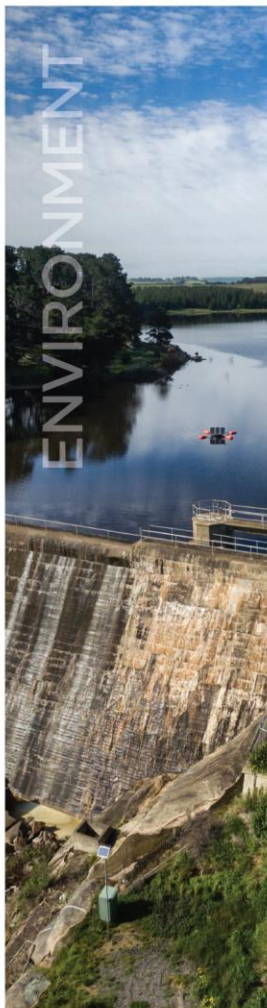


CENTRAL
HIGHLANDS
WATER

PRESENTATION OVERVIEW



- Context
- Case Study catchment
- Brief methodology
- Results
- Discussion



CONTEXT



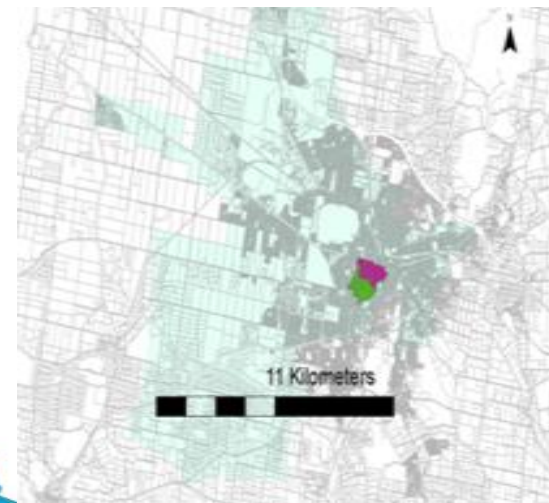
- This presentation is part of a research project undertaken by Federation University Australia and Central Highlands Water
- The aim of the research project is to “accurately estimate groundwater infiltration volume in sewer networks”

CASE STUDY CATCHMENT



- Ballarat sewer network
- Redan and Newington catchments
- Sewer flow monitoring and rain gauging - undertaken for 34 months (July 2014 – March 2017)
- Catchment details

Sub-Catchment	Newington	Redan
Area (ha)	48.34	55.34
Length of Sewer Main (m)	12,032	9,948
No. of properties 2017	870	769



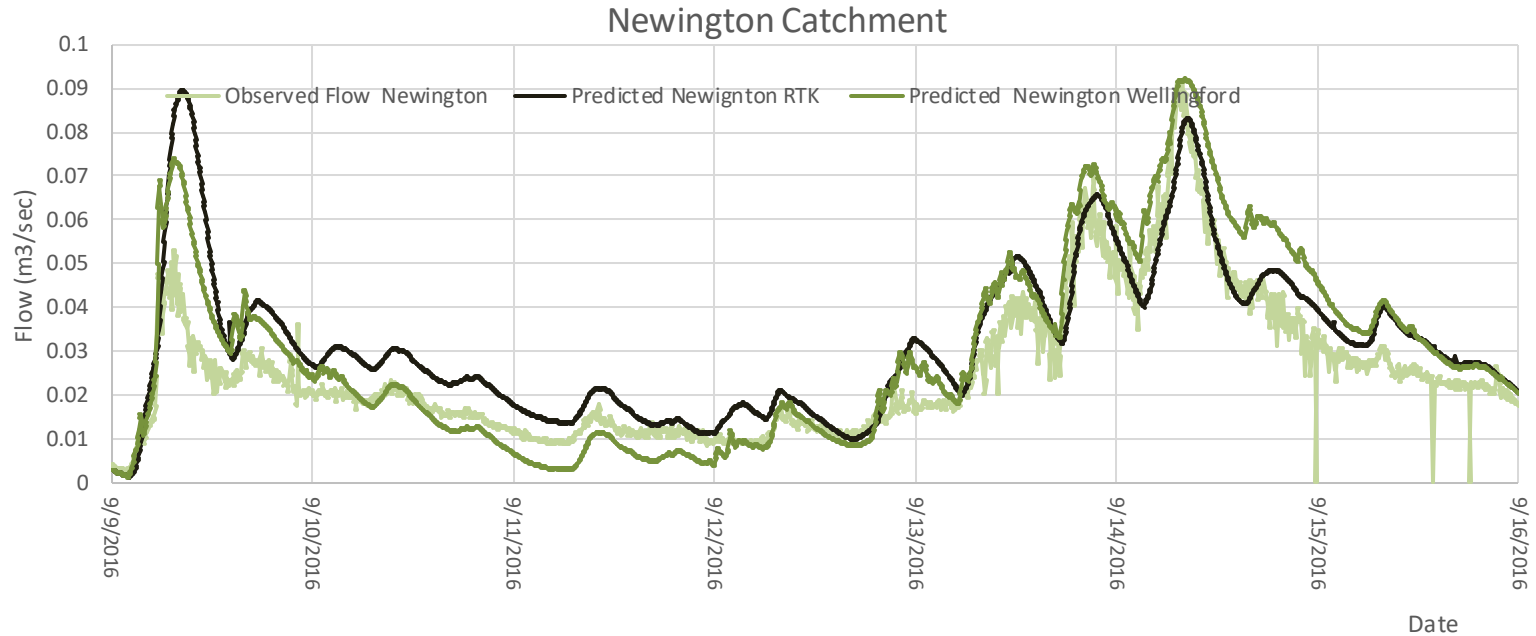
BRIEF METHODOLOGY



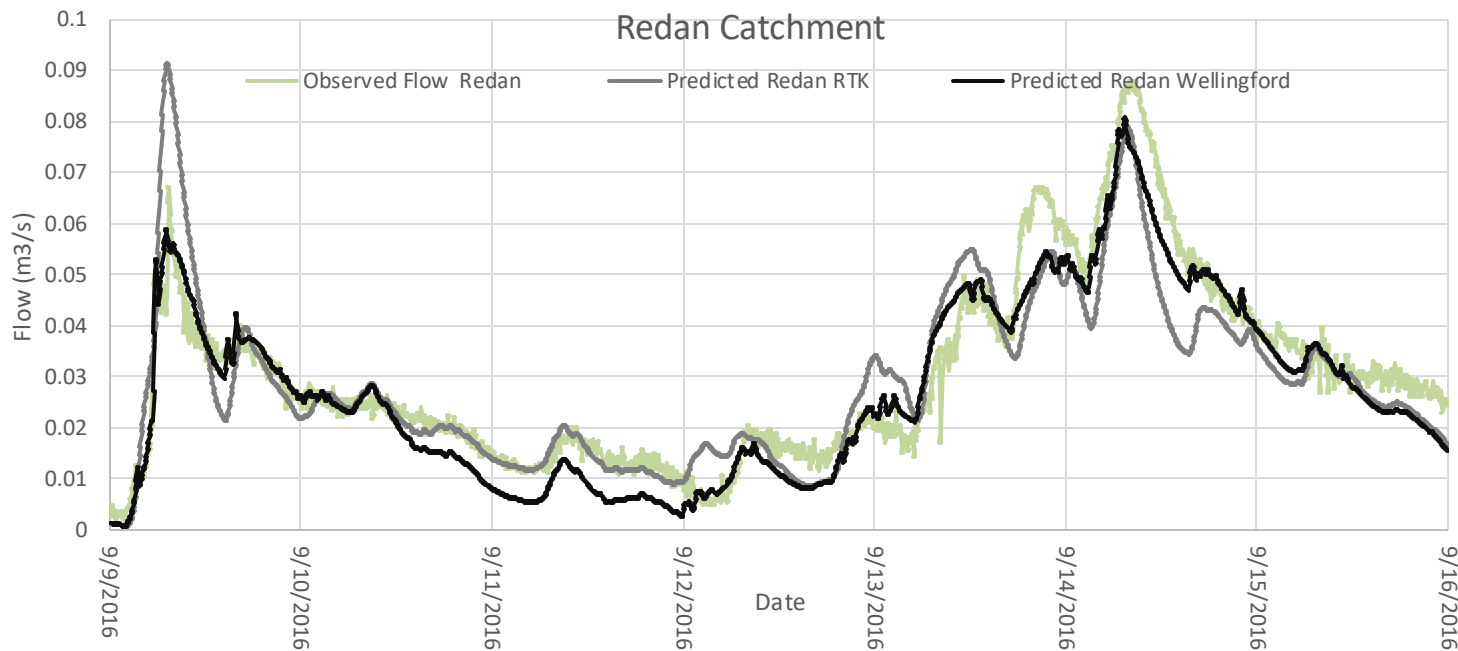
- Infoworks ICM was used
- Two hydrology methods
 - Wellingford method
 - RTK Hydrograph method
- Dry weather flow calibration
- Wet weather flow calibration to set parameters (short period)
 - Wellingford method – Fast response, slow response and GIM
 - RTK - Three respective R, T, K
- Model simulation for 34 months with wet weather flow calibration parameters
- Separation of each components
 - Fast response only – DWF = Inflow
 - Slow response only – DWF = Infiltration
 - GIM only – DWF = GWI

Parameter	Dry Weather calibration	Wet Weather calibration
Volume of flow:	+/- 10%;	+/- 20%;
Peak hourly volume, greater of observed flow data:	+/- 10% OR specified accuracy of observed flow data;	+/- 15% OR specified accuracy of observed flow data;
Peak timing:	+/- 1 hour;	+/- 1 hour;
Shape:	representative of observed flow pattern	representative of observed flow pattern

RESULTS – WET WEATHER



RESULTS – WET WEATHER



WET WEATHER CALIBRATION – RESULTS COMPARISON



Hydrology	Catchment	Total Flow Volume (KL)			Peak Volume (m3/s)			Coefficient of Determination (r2)	Nash-Sutcliffe model efficiency coefficient
		Wet weather event		% of variation	Wet weather event		% of variation		
		Observed	Simulated		Observed	Simulated			
Wellingford Method	Newington	18,336	18,265	0%	0.088	0.092	-5%	0.9169	0.6640
	Redan	15,298	16,697	-9%	0.092	0.081	12%	0.9224	0.8990
RTK Method	Newington	18,336	19,266	-5%	0.088	0.083	6%	0.7663	0.5604
	Redan	15,298	17,569	-15%	0.092	0.08	13%	0.7671	0.7610

ENTIRE MONITORING PERIOD RESULTS COMPARISON

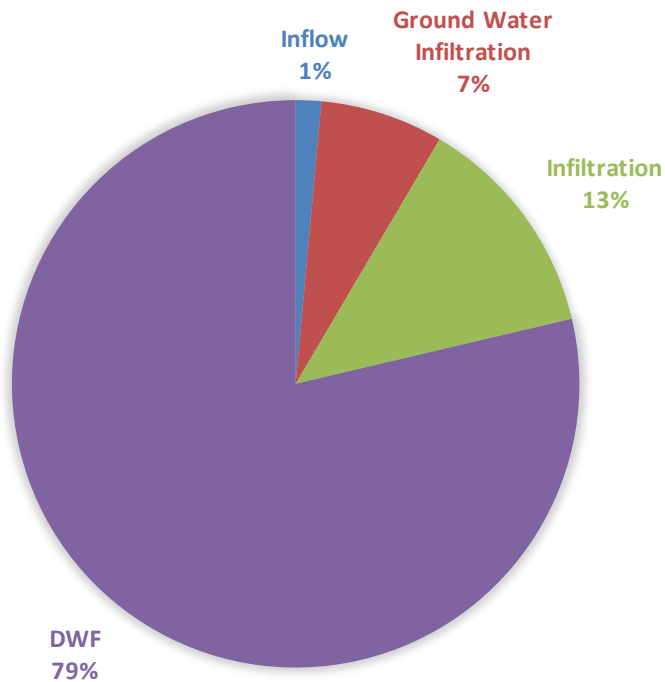


Hydrology	Catchment	Total Flow Volume (KL)			Peak Volume (m3/s)			Coefficient of Determination (r ²)	Nash-Sutcliffe model efficiency coefficient
		Wet weather event		% of variation	Wet weather event		% of variation		
		Observed	Simulated		Observed	Simulated			
Wellingford Method	Newington	593,122	551,783	7%	0.090	0.099	-10%	0.6626	0.3215
	Redan	550,633	493,351	10%	0.090	0.091	-1%	0.6344	0.5591
RTK Method	Newington	593,122	642,608	-8%	0.090	0.090	0%	0.5062	- 0.0268
	Redan	550,633	552,921	0%	0.090	0.090	0%	0.5172	0.4360

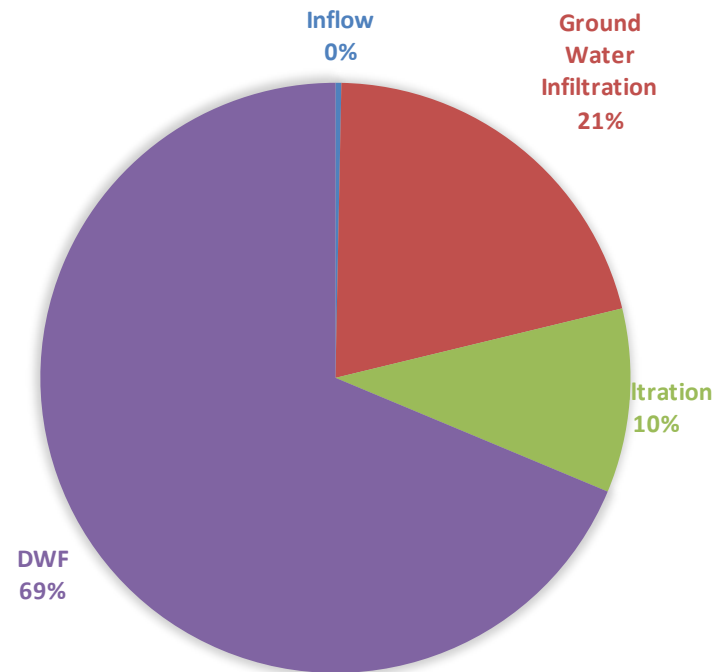
FLOW SEPARATION



NEWINGTON WELLINGFORD



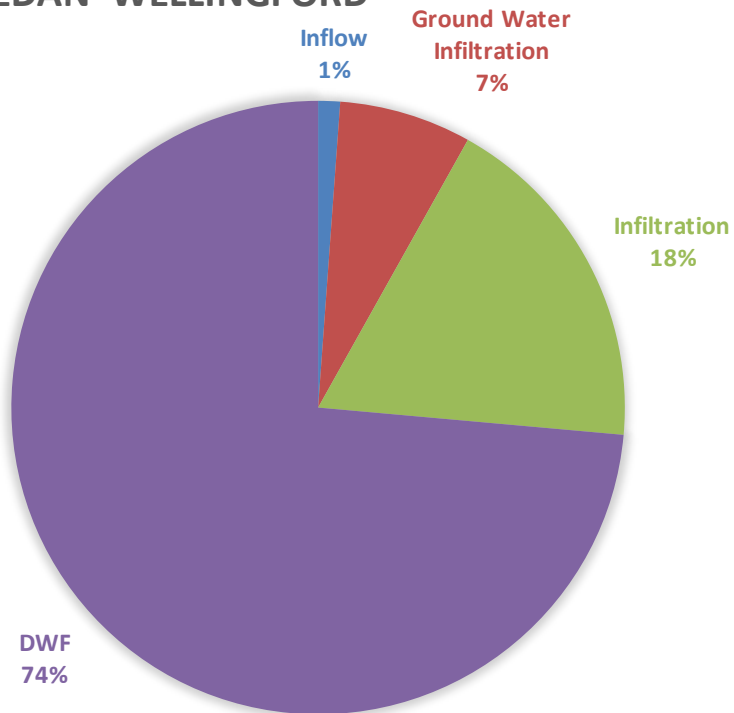
NEWINGTON RTK



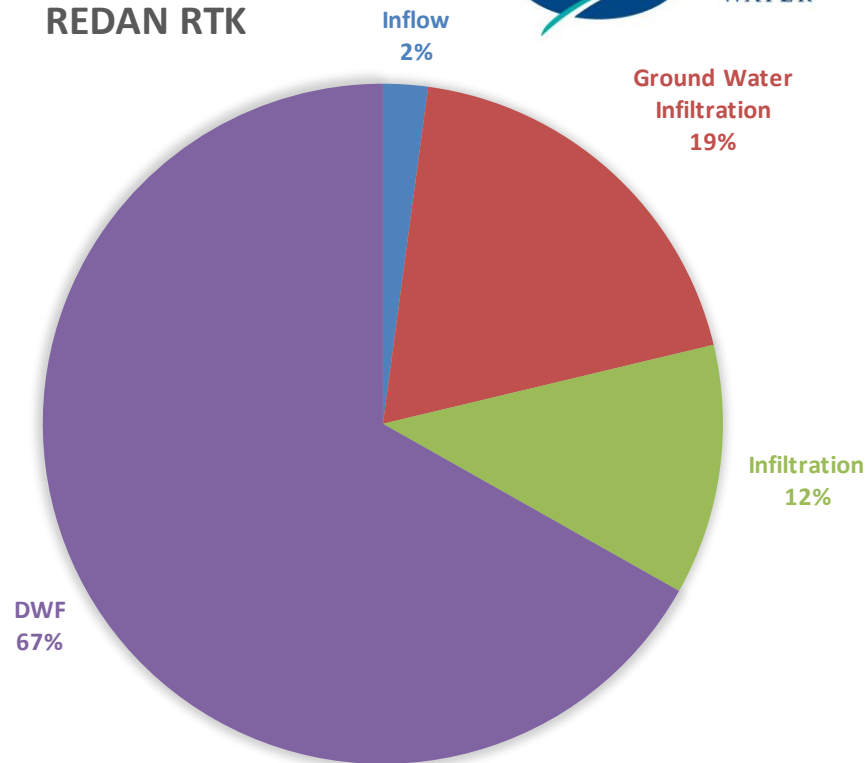
FLOW SEPARATION



REDAN WELLINGFORD



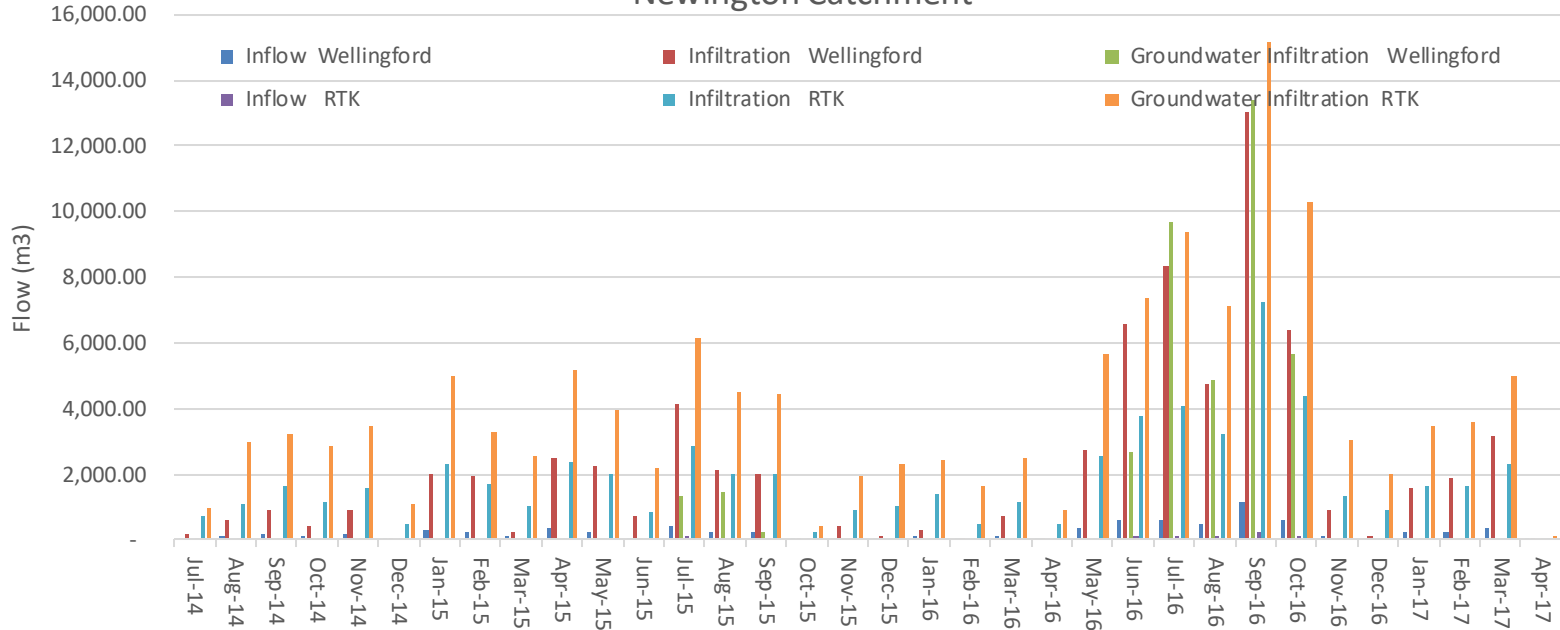
REDAN RTK



MONTHLY FLOW SEPARATION



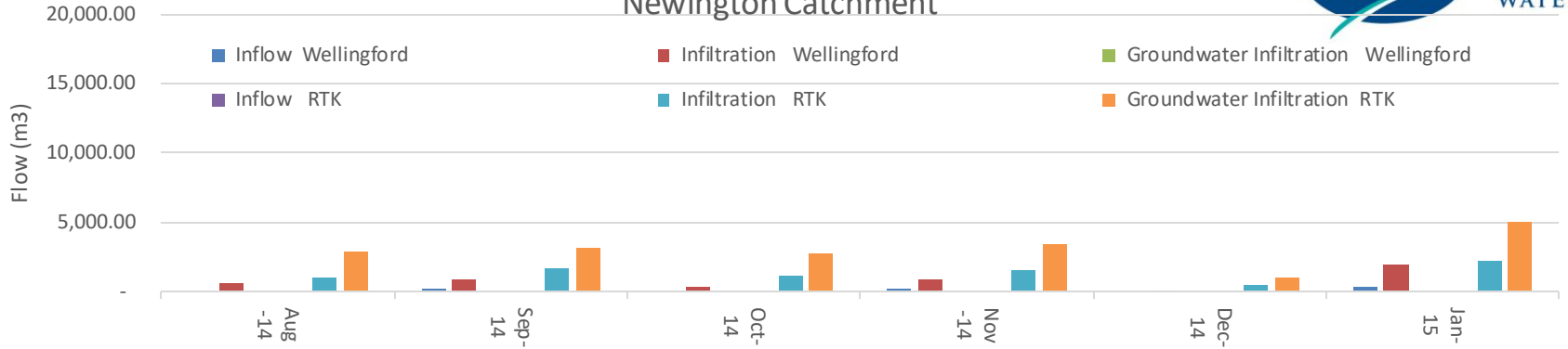
Newington Catchment



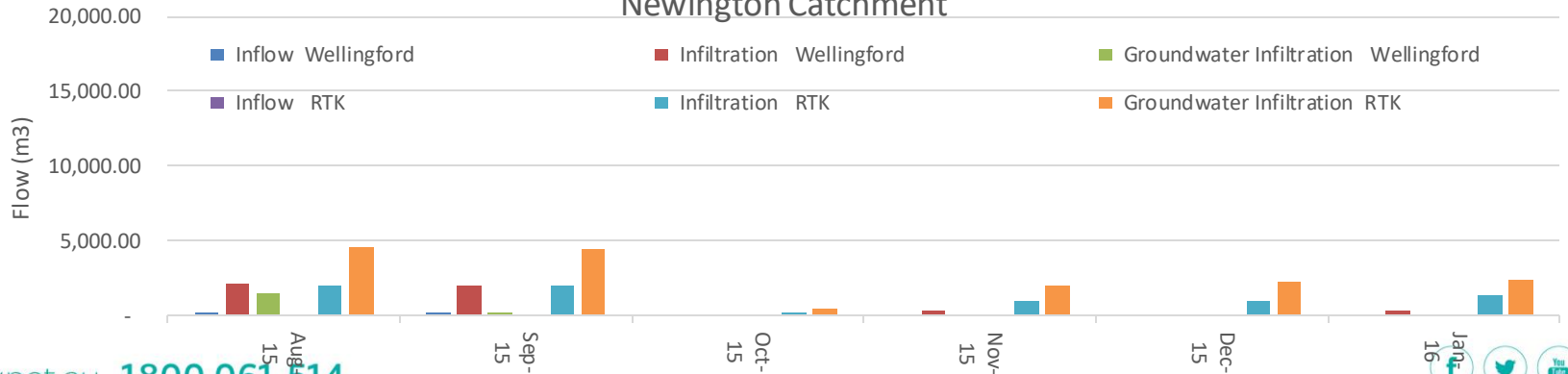
SEASONAL FLOW SEPARATION



Newington Catchment



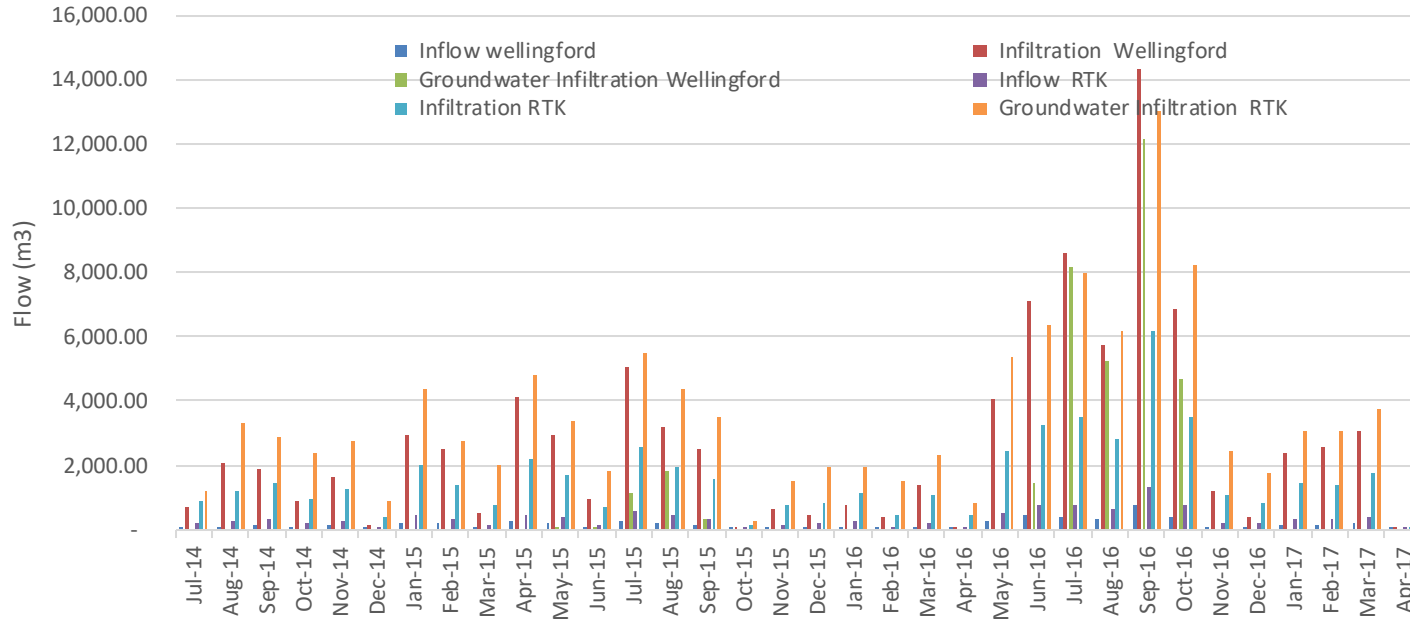
Newington Catchment



MONTHLY FLOW SEPARATION



Redan Catchment



DISCUSSION



- Dry weather flow – variation – are we capturing and presenting in the model well?
- Model parameters used in calibration is not applicable for entire monitoring period
- Dynamic changes of the parameters – are we capturing it well?
- Wellingford method – no early GWI, where as RTK assumes GWI since the early periods
- Both methods separate the hydrographs, however, results are not comparatively similar
- Calibration to see the best fit for the observed data
- Software is very powerful to provide results, but the level of confidence of the results needs independent verification – way forward !
- New tools need to be investigated – AI, ANN, Etc.

ACKNOWLEDGMENTS



- Prof. Andrew Barton – Federation University
- John Frdelja – Central Highlands Water
- Orlando Guzman – Innovyze

QUESTIONS?