Expert Witness Statement of Robert Campbell Swan – Drainage (NGGA)

Amendment C395 Geelong Planning Scheme

Prepared for

Planning Panels Victoria

6 November 2019

Cardno

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1 Name and address

Mr Robert Campbell Swan

Cardno Victoria Pty Ltd

Level 4, 501 Swanston Street

Melbourne, VIC 3000

2 Position

National Technical Lead, Water

Principal Engineer, Hydrology and Stormwater

Manager, Water Engineering

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3 Area of expertise

a. My area of expertise is hydrology and hydraulics, particularly the areas relating to the flow and characteristics of surface water and flood dynamics.

b. I have over 18 years experience in the assessment, design and development of drainage strategies and water quality treatments in urban areas.

c. My qualifications are detailed in Appendix A.

4 Glossary of Terms

Average Exceedance Probability (AEP)

The chance of a given discharge or level value being exceeded in a given year. A 1% AEP flood event has a 1% chance of occurring in any year (and is equivalent to the 1 in 100 year ARI event).

The conversion from ARI to AEP is shown in the table below

ARI (years)	AEP (%)
1	63%
2	39%
5	18% (usually approximated as the 20% AEP)
10	10%
20	5%
50	2%
100	1%

Australian Height Datum (AHD)

A common national surface level datum approximately corresponding to mean sea level.

Average Recurrence Interval (ARI)

The average or expected value of the period between exceedances of a given discharge or event. A 100-year ARI event would occur, on average, once every 100-years.

Catchment

The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.

City of Greater Geelong

The City of Geelong is the local government authority for Amendment C395

Design flood

A significant event to be considered in the design process; various works within the floodplain may have different design events. e.g. some roads may be designed to be overtopped in the 1 in 1 year or 100%AEP flood event.

DELWP

The Department of Environment, Land, Water and Planning of the Victorian Government

Difference Plot

A map showing the difference in flood depth between two flood events.

Discharge

The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.

Floodplain

Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.

Hydraulics

The term given to the study of water flow in a river, floodplain, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.

Hydrograph

A graph that shows how the discharge changes with time at any particular location.

Hydrology

The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.

Mathematical/computer models	The mathematical representation of the physical processes involved in runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. In this report, the models referred to are mainly involved with rainfall, runoff, pipe and overland stream flow and water quality.
Melbourne Water Corporation (MWC)	Melbourne Water is the regional floodplain management authority for the Melbourne Metropolitan area. Melbourne Water generally controls flooding once catchment area reaches greater than 60 hectares.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this document, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Topography	A surface which defines the ground level of a chosen area.

5 Services

My services were engaged to provide expert opinion on issues relating to the drainage and stormwater quality elements of the North and West Geelong Growth Areas Framework

My instructions were to prepare an expert report describing my views in relation to the drainage infrastructure matters associated with the Amendment. These views are to be made with specific regard to the Lee-Pratt land at:

- 330 Heales Road, Corio
- 415 Bacchus Marsh Road, Corio

6 Lee-Pratt Land

The Lee-Pratt land is shown in Figure 6-1. It is in the Northern Growth Area, Heales Road Precinct, which is projected to be the last precinct developed under the framework plan. The site location in the context of the framework plan is shown in Figure 6-2. The area is designated as a potential future employment area (subject to investigation).

Figure 6-1 Location of Lee-Pratt Land

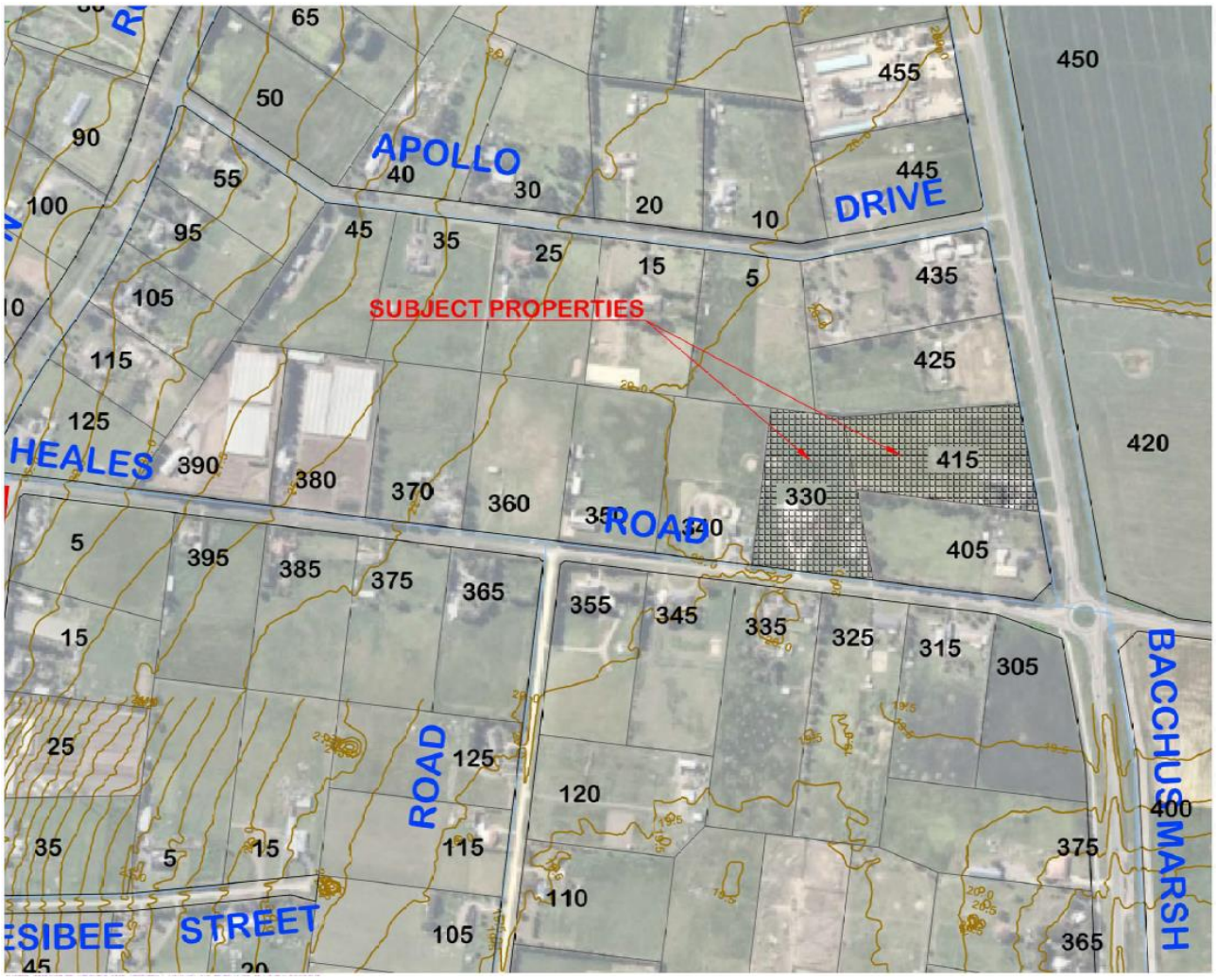
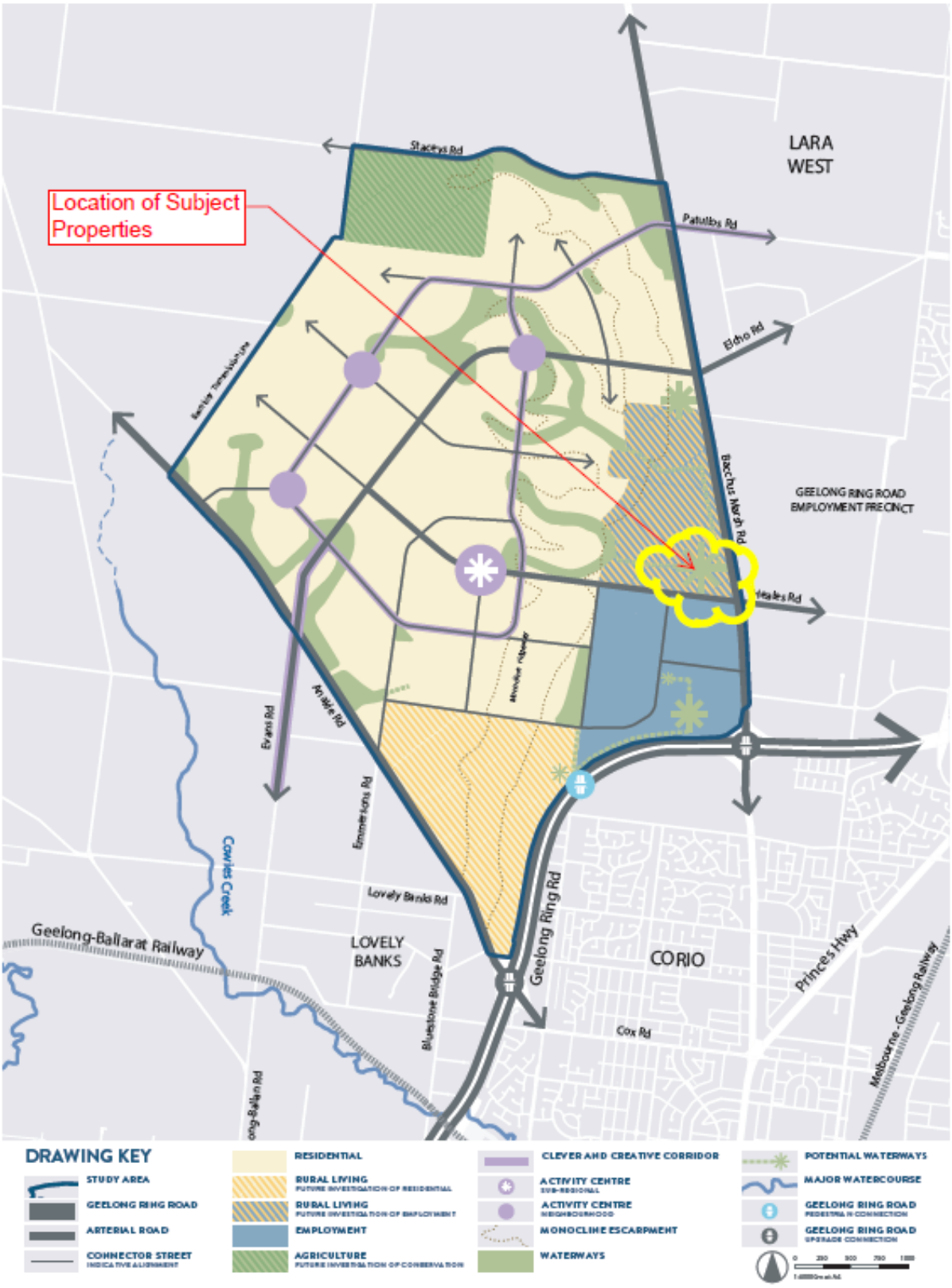


Figure 6-2 Location of Lee-Pratt Land (Framework Plan)



7 Documents Reviewed

I have reviewed the following documents with regard to the drainage of the Lee-Pratt land:

- Northern and Western Geelong Growth Areas Framework Plan, City of Greater Geelong, 2019
- Waterway Corridors, Guidelines for greenfield development areas within the Port Phillip and Westernport Region, Melbourne Water Corporation, 2013
- Northern Geelong Growth Area, Flood Impact Assessment and Stormwater Management Strategy, Volume 2, SMEC, May 2019
- Maps from the Lara Flood Study (accessed online)
- Aerial Photography, sourced from NearMap.

8 Drainage Considerations

The Lee-Pratt land has been identified as subject to flooding as part of the Lara Flood Study and contains natural drainage depressions associated with the natural landform. The SWMS identifies the land as being in the Elcho Drain catchment which discharges through Lara. There are a number of overland flow crossings of Bacchus Marsh Road, including one at the Lee-Pratt land.

8.1 Proposed Drainage Response

The framework plan and the stormwater management strategy indicate that there is a very large proposed retarding basin the covers the Lee-Pratt land. This is identified as the green star on the Framework Plan and as RB F in the Stormwater Management Strategy (SWMS). The basin controls a large area of the upstream catchment and is the major flood detention feature for the Elcho Drain catchment as part of the Growth area plan.

The SWMS notes that there are significant issues with the development of the Elcho Drain with regard to drainage infrastructure. These are:

- RB-F is the main flow control for large portions of the Elcho road catchment. As it is part of the last proposed development stages, the ability for this infrastructure to be constructed as part of the strategy is compromised.
- The SWMS identifies that there are other constraints that control the acceptable flood behaviour downstream of Bacchus Marsh Road. This includes the capacity of drainage through the GREP area. Upgrades to the capacity of the downstream drains would reduce the size of RB F
- Until RB F is constructed there is no formalised outfall for the drainage from the Elcho Drain catchment.

The SWMS also provides for alternative drainage options to be considered which would reduce the size of RB F. It is understood that these have not been fully assessed as part of the SWMS. The SWMS correctly implies that significant additional work on the drainage layout needs to completed as part of the PSP for the area.

In my view, the downstream landholders in the Heales Road precinct could be unfairly burdened by the proposed drainage infrastructure, especially as the upstream catchment areas develop. In my opinion, each precinct should be able to meet the objectives independent of development in the other precinct areas.

The SWMS does not align with the proposed precinct plans. This discrepancy is partially covered by the proposed alternative options presented in the SWMS. However, the overall impact in the short term, prior to development of the Heales Road precinct is that the Pratt -Lee land is likely to be subject to additional inundation as the upstream catchment develops.

Although it is likely that there will be some requirement for flow control at the Lee-Pratt land, alternate drainage strategies may limit the impost. In my view, it is too early in the process to specify any sizing of infrastructure or location of storages in the future investigations area.

9 Findings

With regard to the proposed drainage and stormwater infrastructure proposed for the Lee-Pratt land in the Framework Plan. it is my opinion that:

- The SWMS correctly identifies that there is a need for detailed analysis as part of the PSP process to further assess and define the required infrastructure.
- In the short and medium term, prior to development of the Heales Road Precinct, there is likely to be additional drainage flow directed toward the Lee-Pratt land under the proposed SMWS.
- The proposed retarding basin at the Lee-Pratt land (RB F) appears to be oversized in the SWMS, as evidenced by the significant reductions in downstream flood levels, east of Bacchus Marsh Road.
- The SWMS prepared for the Elcho Drain catchment area does not necessarily provide the best stormwater solution for the area. Alternate options should be assessed as part of the PSP.
- Each precinct area should aim to meet the overall requirements of the Framework plan, with regard to drainage, as independently as possible from the others. This approach allows development to be staged without adversely impacting downstream landholders.
- The adoption of the SWMS at this stage, prior to detailed assessment under the PSP, is premature. Although it is likely there will be some stormwater infrastructure required on the Lee-Pratt land, it is too early in the process to be prescriptive about the size and location of the infrastructure.

10 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Robert Campbell Swan

6 November 2019

APPENDIX

A

CV OF ROBERT CAMPBEL SWAN

Robert Swan

Current Position
National Technical Lead, Water

Principal, Hydrology and Hydraulics

Manager – Water Engineering

Profession
Engineer

Years' Experience
18

Joined Cardno
January 2003

Education
Bachelor of Engineering

Diploma of Project Management

Summary of Experience

Robert is Cardno's National Technical Lead for Water, a Principal Engineer and leads the Victorian Water Engineering team. He has over eighteen years' experience in the areas of hydrology and hydraulics, flood analysis, water quality and environmental assessment. He has significant project management experience and has worked on a number of large multi-disciplinary projects.

Rob is an expert in floodplain management and the simulation and modelling of large flood events. He is a member of the Victorian State Emergency Service Expert Hydrologist Panel and has performed in an operational capacity in emergency flood response. Rob has significant experience in the intersection of the planning system and flood analysis and their interaction to provide community benefit and appropriate management of natural assets.

Rob has authored papers and presented at multiple national and international conferences. Key areas of experience include:

> One and two-dimensional numerical model development and application for the study of flooding and water quality
> Flood Emergency Response and Planning
> Drainage Scheme Development and Application
> Planning Scheme Amendments
> Hydraulic and hydrologic investigations of urban and rural floodplains
> Water quality investigations of shallow lakes and Water Sensitive Urban Design
> Floodplain management and planning
> Environmental and geomorphological assessment
> Project Management
> Expert Witness Services and Planning Panels

Significant Projects

> Moorabool Flood Studies Peer Review - Rob was the expert independent reviewer for the Moorabool Shire Council in the development of planning scheme amendments for the Shire. Rob reviewed models developed by Melbourne Water and other Consultants and provided advice and opinion on their adequacy for use.
> Flood Lead, Western Distributor Tender Design - Rob was the design lead for flooding for the Western Distributor Tender Design. The project is a 5.5 Billion tunnel and freeway upgrade and included crossings of 4 major waterways. The analysis of a new bridge crossing of the Maribyrnong River included consideration of PMP and climate change flooding and the navigational requirements of commercial and recreational craft on the river.
> City of Manningham Flood Modelling and Planning Scheme Amendments - Rob represented the City of Manningham and Melbourne Water at the planning panel to implement the changes to the Manningham Special Building Overlay. This followed the successful delivery of 5 major flood models in the municipality

- SES Expert Hydrologist 2012 Broken Creek Flood Event - Rob was one of two external experts brought in to provide hydrological and hydraulic analysis as part of the incident response to flooding on the Broken Creek. His work included public meetings and liaison, flood impact prediction, hydrological assessment and flood impact assessment.
- Echuca Bridge Crossing - Rob has provided design and technical advice to VicRoads on the required bridge and culvert requirements for the proposed second crossing of the Murray and Campaspe Rivers at Echuca. This advice included flood impact assessment, mitigation sizing, preliminary costing, water quality and quantity assessment and community consultation.
- Swan Hill Bridge Crossing - Rob was the project manager and technical expert for the Swan Hill Bridge Planning Study. This project included analysis of the hydrology and hydraulics of the Murray River at Swan Hill to inform and plan the replacement road and bridge crossing of the Murray River. Rob prepared the technical reports and provided expert advice to the Planning Panel considering the application.
- Warrnambool Drainage Analysis - Provided advice and assistance to the City of Warrnambool in the development of a number of drainage strategies for developing areas in Warrnambool, including Dennington, the Warrnambool North-East activity precinct and the Warrnambool Eastern Activity Precinct. The strategies included the specification of drainage works, their type and location, cost estimates and the specification of water quality treatments to protect downstream waterways. These strategies have been adopted by the City and now form part of the overall drainage plan for these areas.
- Glenelg Flood Investigations - Flood modelling and assessment of flood extents for three towns in the Glenelg Shire: Portland, Casterton and Heywood. The study provided council with updated inundation and risk mapping to inform planning decision making and included the assessment of floodway areas. The projects outputs were an order of magnitude more accurate than the previous extents used by Council and the information provided could be used for emergency response purposes in the future.
- Benalla Rural City Flood Information - Rob was the lead for the Rural City of Benalla for a number of projects, including the detailed investigation of large scale flood mitigation options. This included presenting to three community forums with over 300 total attendees and providing summary documents to Council for distribution to residents. The outcome of this work was the Benalla Flood Information Portal, which provides advice on flood risk to all residents of Benalla. Rob led this follow up project and launched the portal alongside Council and VicSES in late 2017.
- Melbourne Water Flood Mapping and Analysis - Rob has variously been the lead technical engineer, project manager and project director for approximately 20 Melbourne Water Flood Mapping projects, including those in the developing areas of Pakenham, Hallam and Koo Wee Rup. This work provides a detailed understanding of floodplain modelling and how it can be used to support flood mitigation works and development advice.
- Tooleybuc Bridge Analysis, Roads and Maritime Services, NSW - Rob was the project director and technical adviser for the Tooleybuc Bridge Crossing project. This project included analysis of the hydrology of the Murray River at Tooleybuc and the dynamics of flows through the proposed road and bridge upgrades.

Publications

May 2018

ARR 2016 – Adopting a Practical Methodology for Catchment Scale Urban Flood Mapping Projects

Swan, R, Guest, R, Sommerville, H, and Haywood, J

Proceedings of the 2018 Floodplain Management Australia National Conference, May 29 to June 1, 2018

September 2016

Adaptive Floodplain Planning - from modelling to implementation

Veldema, A, and Swan, R.

Proceedings of the 4th National Conference of Stormwater Australia, August-September 2016

December 2015

Transforming Flood Mapping Outputs to Decision Making Inputs

Veldema, A, and Swan, R.

Proceedings of the 36th National Hydrology and Water Resources Symposium

December 2015

Ocean Inundation, climate change and policy planning – is the Flood approach suitable?

Swan, R, Provis, D and Bicknell, P.

Proceedings of the 36th National Hydrology Water Resources Symposium

Feb 2013

Representing flood mechanisms in the Koo Wee Rup Flood Protection District

Swan, R and Thompson A

Presented at the 8th Victorian Flood Conference, February 2013

Feb 2013

Flood Mapping without Drainage Asset Data

Thompson A and Swan, R

Presented at the 8th Victorian Flood Conference, February 2013

Jun 2011

Direct Rainfall - Verifying the technique across two States

Swan, R and Thomson R

Proceedings of the 34th IAHR World Congress and the 33rd National Hydrology and Water Resources Symposium and the 10th National Conference on Hydraulics in Water Engineering

Oct 2010

Direct Rainfall - Loss Modelling Approaches

Swan, R.

Presented at the 7th Victorian Floodplain Management Conference

Oct 2010

Ocean versus River - Coastal Interfaces, Climate Change and Flood Analysis

Swan, R. and Provis, D.

Presented at the 7th Victorian Floodplain Management Conference

Oct 2007

Dealing with Hydrological Uncertainty: A New Modelling Approach

Swan, R.

Presented at the 5th Victorian Floodplain Management Conference

Oct 2005

Flood Studies and Extreme Events - Modelling, Mitigation and Assessment at Fairfield, Victoria

Swan, R.

Presented at the 5th Victorian Floodplain Management Conference.

Dec 2004

Application of Australian Runoff Quality Draft Chapter 6 - A 'model' approach?

Swan, R.

6th International Conference on WSUD - Cities as Catchments (WSUD 2004)

Jul 2004

Integrated High Order Water Quality and Hydrodynamic Analysis - An Essential Tool for Lake Management

Swan, R.

8th National Conference on Hydraulics in Water Engineering (2004).