Botany Aquatic Centre

Flood Impact Assessment

Prepared by Rain Consulting for

Creo Consultants

Deep Thinking for Better Water Outcomes

Document Control

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Cover Image

Bridgewater Bay – July 2023 – Rain Consulting

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52.49 kg of CO2 have been emitted in the creation of this project. In line with the 2C pathway, we have offset **2.5 times this (131.23 kg offset)**.

Contents

Tables

Figures

1 Report Author

This report has been prepared by:

Luke Cunningham – **Director and Principal Engineer of Rain Consulting** Chartered Professional Engineer CPEng, Bachelor of Environmental Engineering (Hons)**,** Graduate Diploma of Project Management.

Luke's CV is attached.

2 Introduction

Bayside City Council have planned a redevelopment of the existing Botany Aquatic Centre. The new facility will include:

- Adventure waterplay and slides;
- 50 metre outdoor competition pool and 25 metre indoor lap pool;
- Indoor learn to swim pool;
- A new building with entrance, amenities, gym space, change rooms and a kiosk;
- New grandstand; and,
- Landscaping of the open green space.

(Bayside City Council, 2024)

In 2015, the City of Botany Bay commissioned BMT WBM to complete the Botany Bay Foreshore Beach Catchment Flood Study (BMT WBM, 2015). The flood study suggested that the Botany Aquatic Centre is likely to be subjected to flooding in a 1% AEP event in existing conditions as shown in Figure 2-1.

As the new proposal includes a change of landform on the subject site, a flood impact assessment is required to show the impact of the proposed development on flooding in the 1% AEP event. The proposed works are shown in Figure 2-2.

Elevation changes vary from 600 mm reductions in levels through to up to 900 mm increases as shown in Figure 2-3. Elevation differences have been produced based on the proposed surface levels provided to Rain Consulting versus the terrain within the existing flood model. The results show a general lowering through the centre of the site with some raising on the eastern and western sides of the property. Buildings are not included in the terrain difference plots.

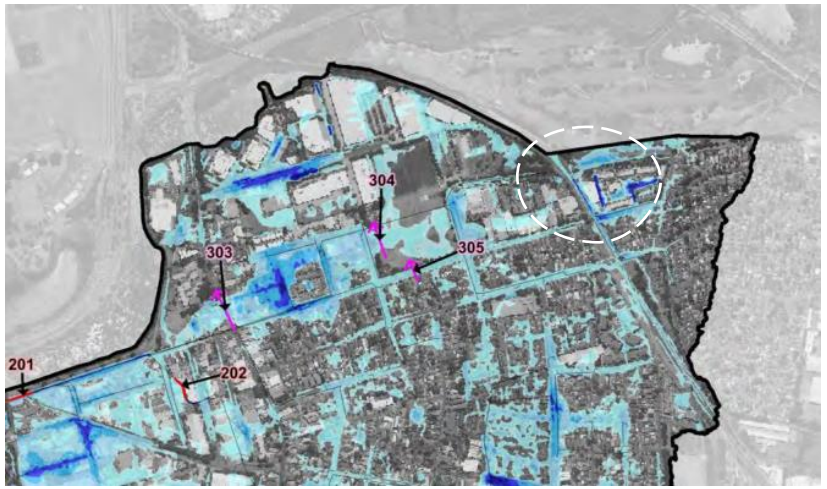

Figure 2-1 Extract of flood modelling results with site outlined (BMT WBM, 2015)

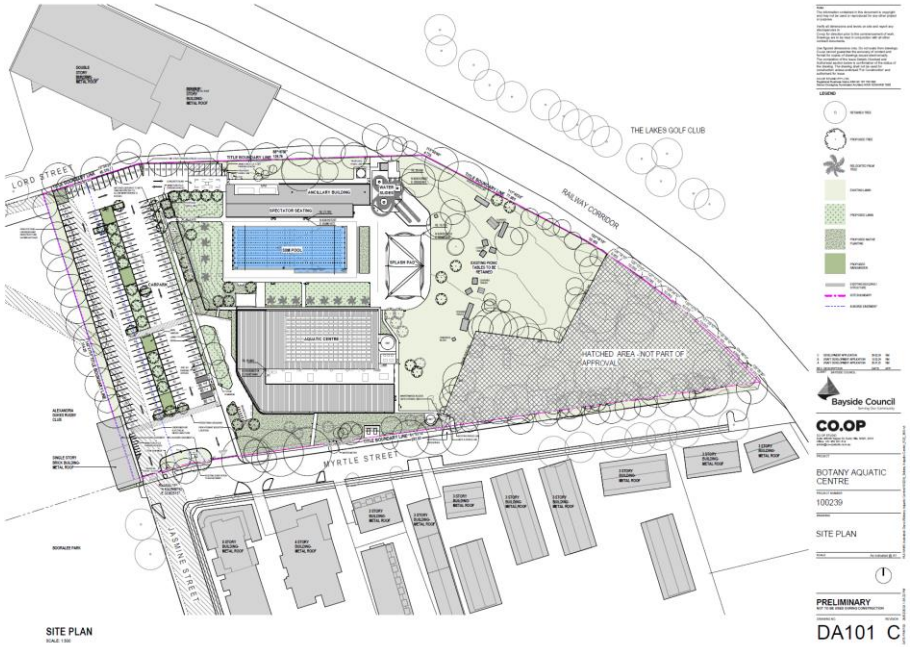

Figure 2-2 Proposed works (CO.OP Studio)

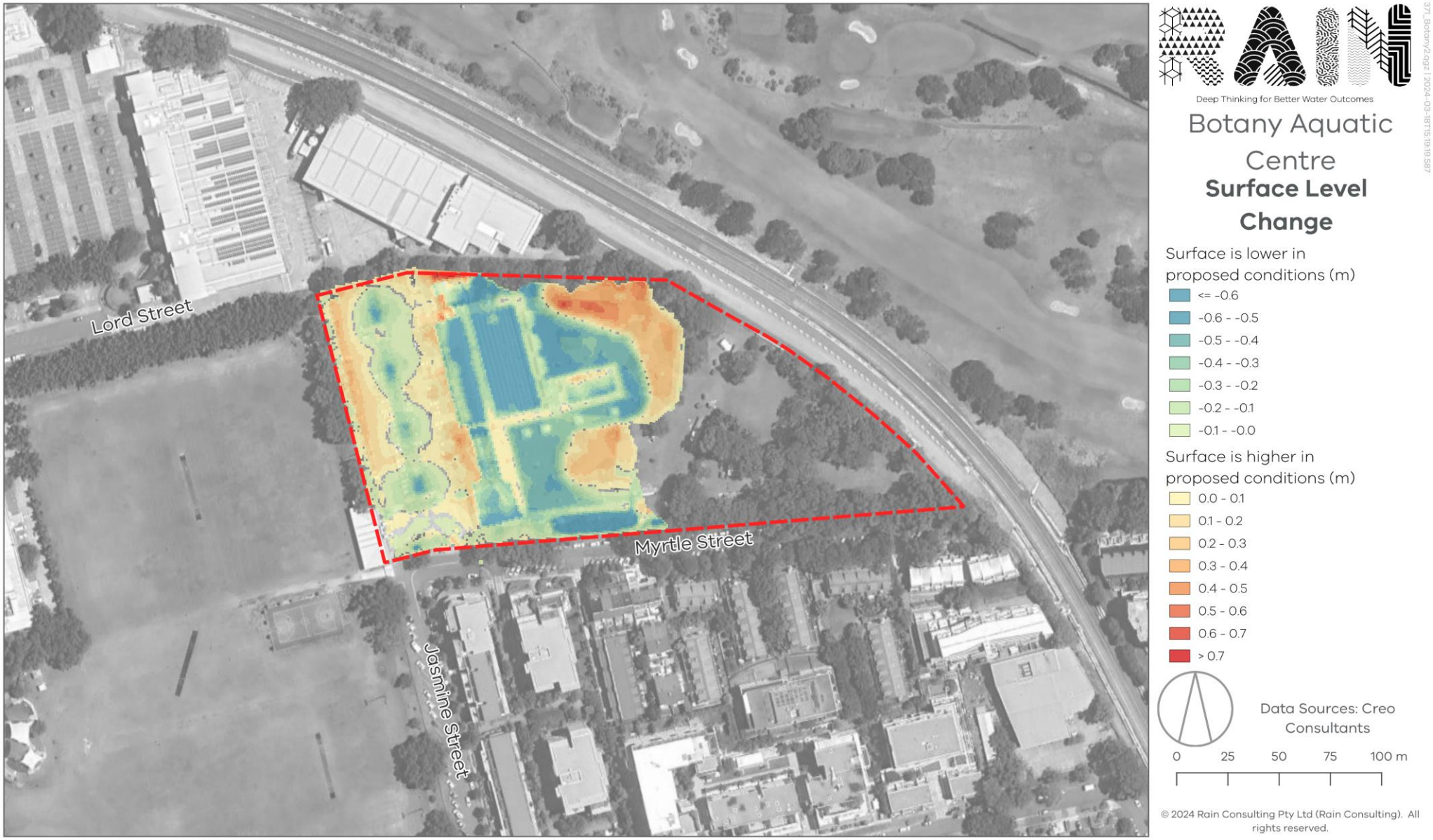

Figure 2-3 Elevation Difference – Proposed vs Existing

3 Flood Modelling

The primary method of assessing the difference in flooding in a before and after scenario is through detailed flood modelling.

For this project, the City of Bayside approved the use of and supplied the Botany Bay Foreshore Beach Catchment Flood Study (BMT WBM, 2015) flood model. The flood model is a TUFLOW model. TUFLOW is a two-dimensional model used widely in Australia for flooding and drainage studies and is considered the industry standard for flood impact analysis.

The model was largely adopted "as is" from Council. In proposed conditions, the new proposed terrain was added, as well as the proposed new pipe and pit network and the proposed 740 kL onsite detention (OSD) tank. The difference between the existing conditions and proposed conditions models are shown schematically in Figure 3-1.

Build details of the flood model used for this assessment are shown below in Table 3-1.

Table 3-1 TUFLOW model build information

Input Parameter	Data
1% Critical storm	120-minute duration, temporal pattern 6 (median). All durations were re-run to confirm this. Matched with original flood study.
Scenarios considered	Existing conditions and proposed design conditions. Both simulated for the 1% critical storm.
2d Code	The 2d code of the model was not changed from the existing Bay Foreshore Beach Catchment Flood Study (BMT WBM, 2015).
Topographic data	For existing conditions, the terrain within the original model was utilised. In proposed conditions, a DEM was created by Rain Consulting from TIN designs provided by Creo Consultants.
Z shapes	Z-shapes in the existing model were maintained. Additional z-shapes were entered in proposed conditions to represent the floor levels of buildings around the site.
Inflow Data	The original rainfall on grid boundary condition was utilised. No changes were made.
TUFLOW Model Build	2018-03-AB Double Precision with Classic Solver
Grid cell size	2 m^2 per original model
Timestep	0.5 seconds per original model
Roughness	As per Elizabeth Street flood model (Rain Consulting 2024) – no changes.
Downstream boundary	As per original model – no changes
PO Locations	As per original model – no changes
Initial Water Level (m AHD)	As per original model – no changes
1d Pipe Network	As per original model in all locations except for design conditions where proposed drainage network and OSD were added.
1d Pit Network	As per original model in all locations except for design conditions where proposed drainage network and OSD were added.
Simulation time	5 hours (2-hour duration event)
Total number of warnings prior to simulation	35 (most from original model, new warnings are acceptable and related to inverts around the OSD tank which are expected)
Total number of warnings during simulation	0
Number of negative depths	0
Volume on grid at start of simulation (m3)	40,108
Volume on grid at end of simulation (m3)	128,302
Total volume in (m3)	331,566
Total volume out (m3)	242,021
Volume error (m3)	-1,351
Final cumulative mass error	-0.25%

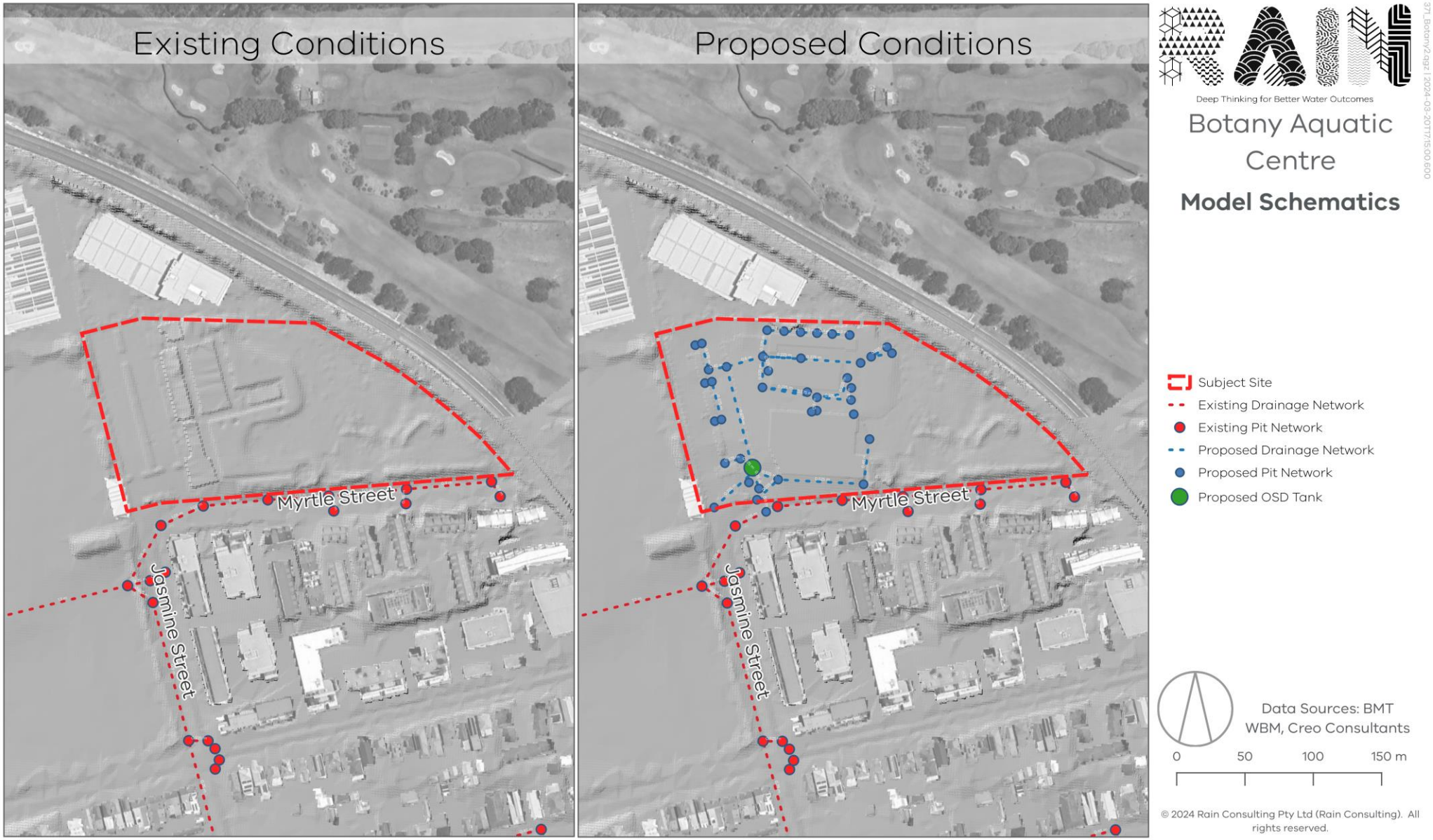

Figure 3-1 TUFLOW Model Schematisation

4 Results

Results between existing and proposed conditions are shown on the following pages.

Figure 4-1 shows the flood level afflux map. This map shows the difference in depths between what would be expected in a 1% AEP event in current conditions versus what would be expected in the same event with the proposed works in place. The results are showing that outside of the subject site, flood levels are not increased in any way. North of the subject site, large areas of flood level reduction are seen around the commercial/industrial properties off Lord Street. Reductions are up to 100 mm in areas. Within the subject site, results are a mix of decreases and increases. This is expected due to the large redesign of the site. The most significant area of increase is in the eastern portion of the site where an existing flow path is partially blocked by the proposed works. This creates a slight increase in levels in the open space area within the site, which in turn is the cause of the large reductions in levels to the north (downstream) of the site. Considering the widespread changes to the site, the results are favourable and show that the cut and fill within the site, partnered with the proposed drainage assets and OSD are effective in mitigating any offsite impacts.

Figure 4-2 further explores the depths in the critical 1% AEP event. It further demonstrates that there are no changes offsite around Myrtle and Jasmine Street and shows the reduction in depths north of the site. Within the site, there is an obvious reduction in flooding around the site, particularly around the carpark area. As described above, the depth of water increases in the eastern portion of the site, but does not exceed 300 mm in depth, resulting in a low hazard in this area. Much of the site is covered in depths of less than 20 mm (both existing and proposed) which have been filtered from the results.

Figure 4-3 shows the existing versus proposed water surface elevation (WSE) plots. Extents in the WSE plots appear greater than in the depth plots due to the depths of less than 20 mm not being filtered out. The results show that flood levels within the property vary between 7.1 m AHD and 7.9 m AHD, with some higher levels seen in the open space in the south east corner of the site. Between existing and proposed conditions, reductions in WSE can be seen in most locations, with the slight increase in levels in the eastern portion of the site seen. Again, reductions in levels within the carpark are notable.

Figure 4-4 shows how velocities change between existing and proposed conditions. Velocities through the site in both conditions are very low, and generally less than 0.2 m/s. No noteworthy changes have been observed between existing and proposed.

Figure 4-1 1% AEP Event – Flood Level Afflux – Design vs. Existing

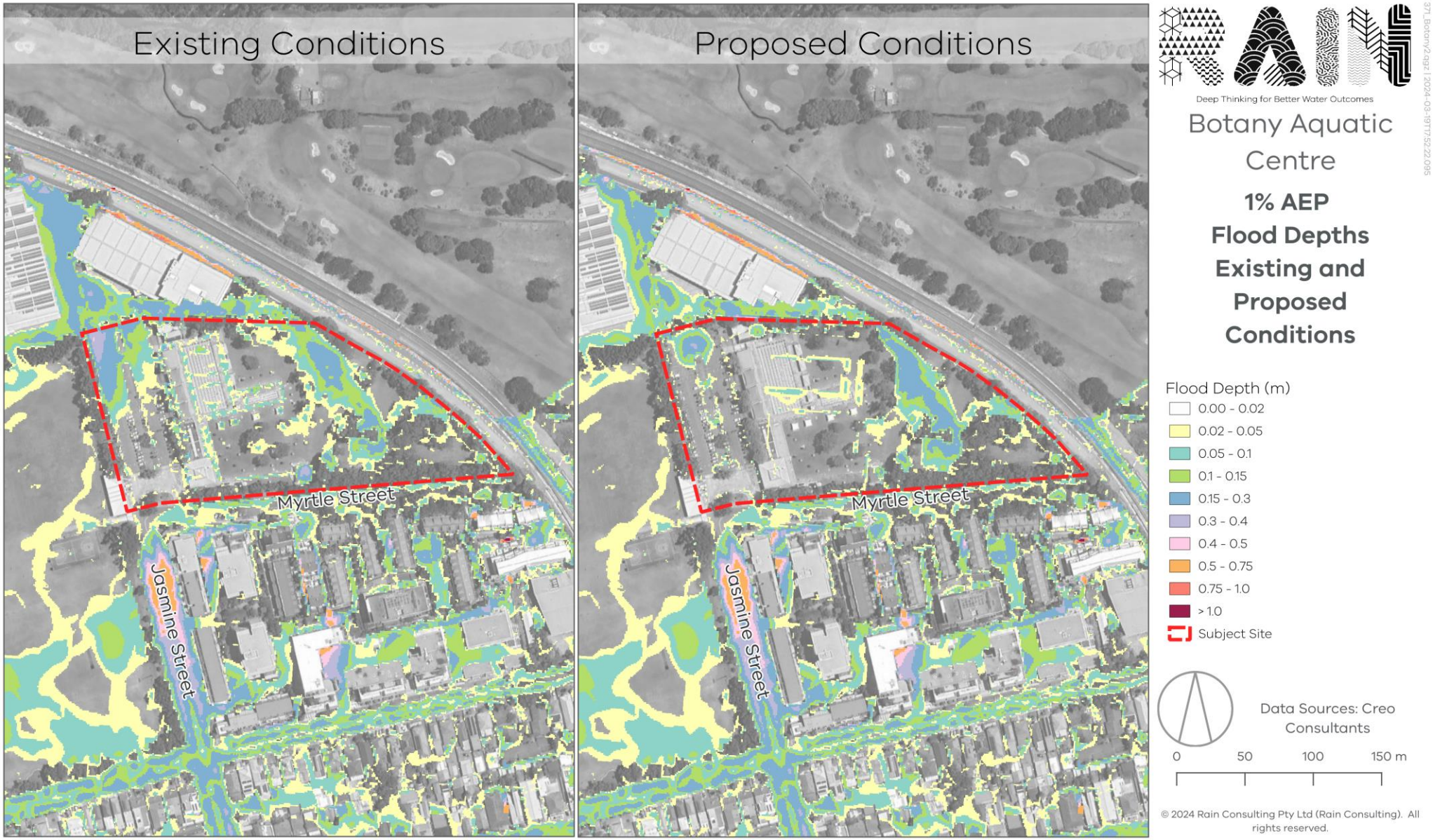

Figure 4-2 1% AEP Event – Flood Depths – Existing and Design Conditions

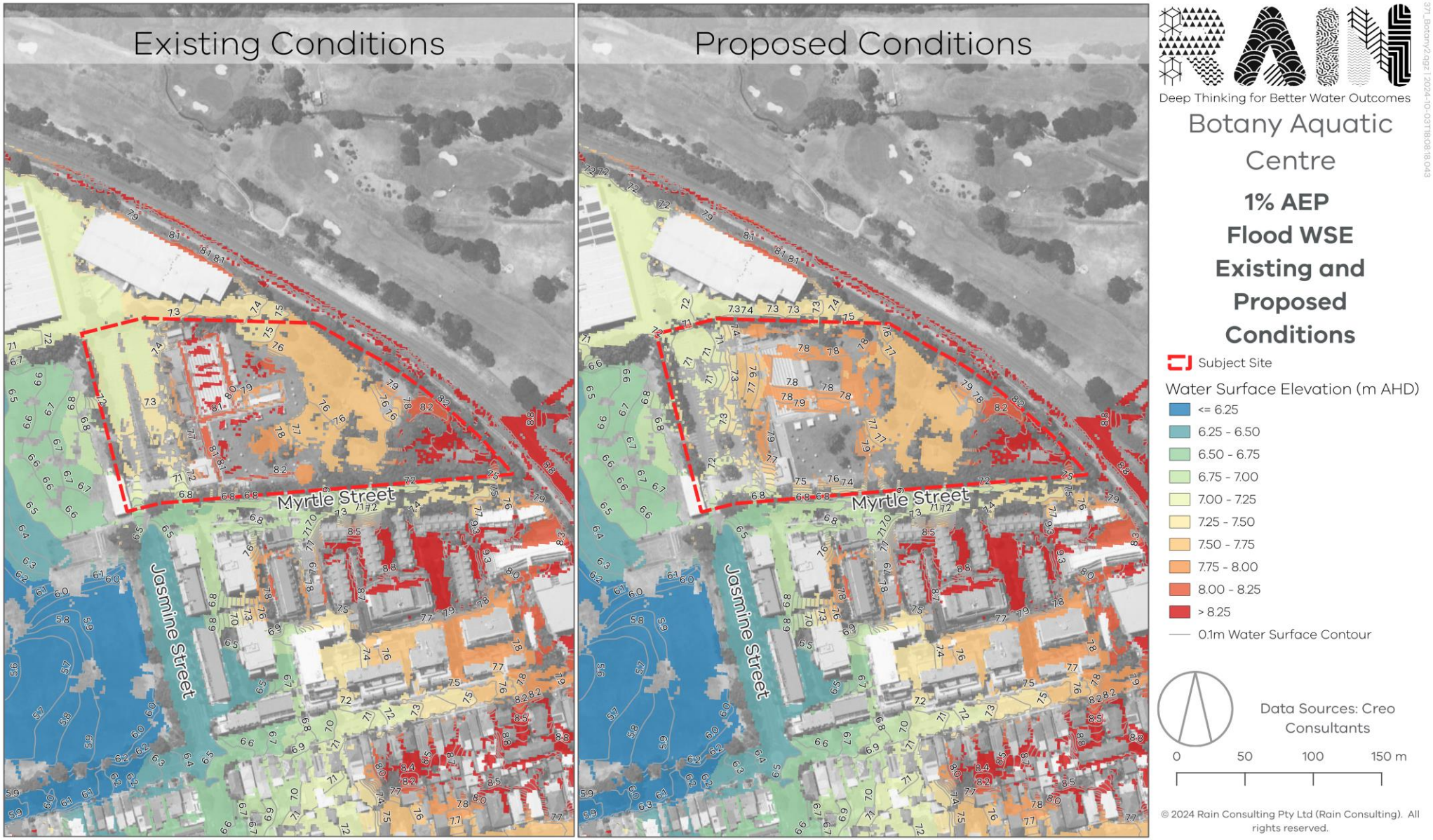

Figure 4-3 1% AEP Event – Water Surface Elevations – Existing and Design Conditions

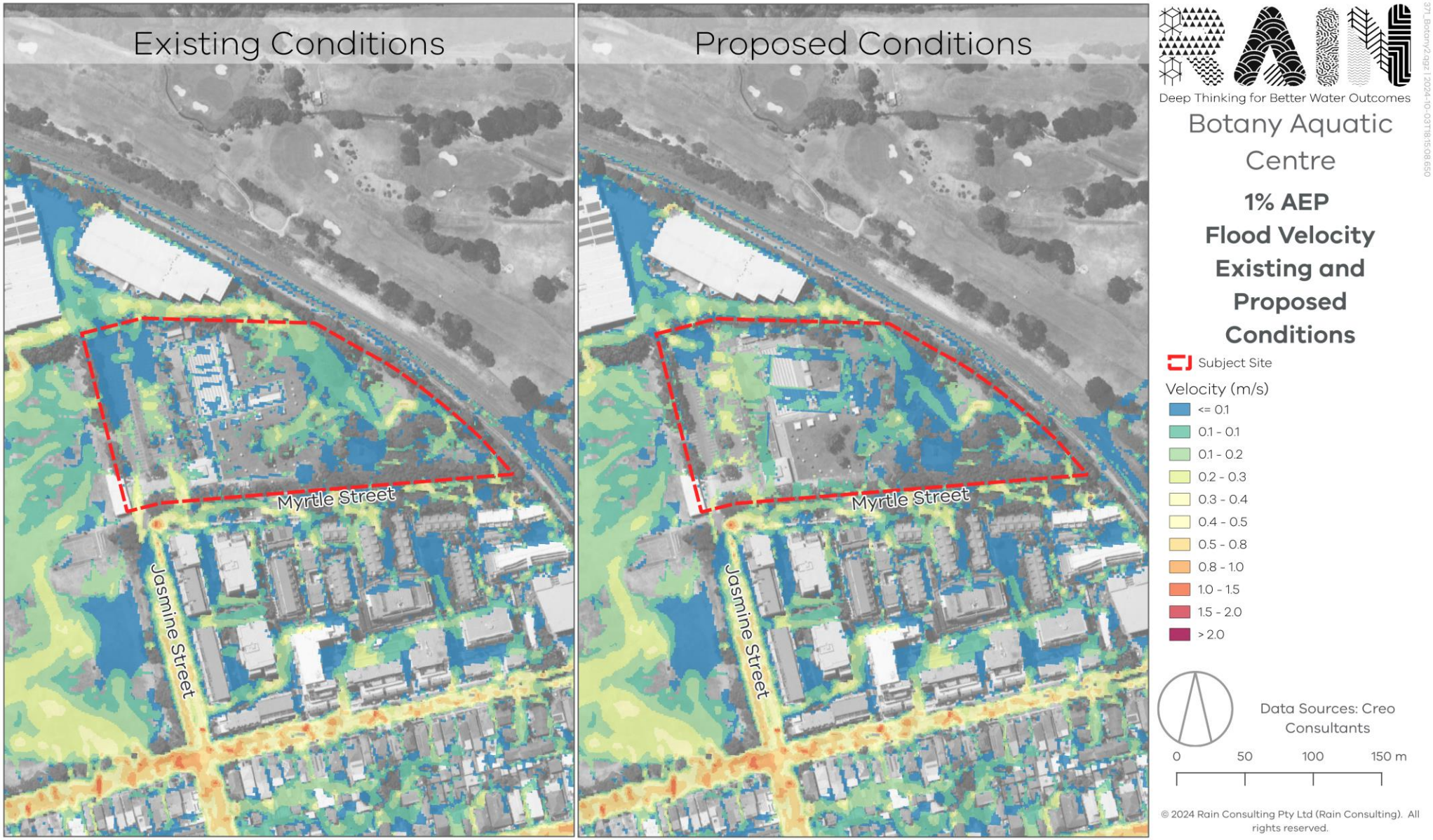

Figure 4-4 1% AEP Event – Velocity – Existing and Design Conditions

5 Conclusion

This flood impact assessment report has shown that the proposed works at the Botany Aquatic Centre have not caused any detrimental impacts on flooding outside of the subject site. Flooding has not been worsened outside of the site, and in some areas, particularly north of the site, reductions in flood depths are seen. Within the subject site, the extent of flooding has generally been reduced. This is seen mainly within the carpark area and is likely due to the proposed cut and fill, as well as the proposed drainage network and OSD tank discharging towards Myrtle Street. Increases in depths are seen in the open space within the site (eastern portion of the site) where an existing overland flow path has been constricted. This has raised flood levels locally, but depths remain below 300 mm and are hence of low hazard. This in turn has provided the flood depth reductions outside of the site.

Flood models, logs and results are available to Council on request.

6 References

Bayside City Council. (2024, 3 18). *Botany Aquatic Centre redevelopment*. Retrieved from Botany Aquatic Centre redevelopment: https://www.bayside.nsw.gov.au/your-council/city-projects/botany-aquatic-centre-redevelopment

BMT WBM. (2015). *Botany Bay Foreshore Beach Catchment Flood Study*.

Appendix A. CVs

LUKE CUNNINGHAM

Principal Engineer & Director
Bachelor Environmental Engineering (Honours), Diploma Project Management, Chartered Engineer, Registered Engineer Victoria and Queensland

ABOUT LUKE

Luke is well renowned within the stormwater industry as a flood and integrated water management specialist. He is a Chartered Professional Engineer who enjoys challenging the norms and combining engineering and creative thinking to find the best options for managing our urban water environment.

KEY TECHNICAL SKILLS

Hydrology and hydraulics expert in TUFLOW & RORB. Very competent in MIKE by DHI, HEC-RAS, SWMM, MUSIC. GIS expert in QGIS & MapInfo. Very competent in ArcMap

KEY PROJECTS

Stormwater Expert: Melbourne Urban Stormwater Institutional Arrangements (DELWP, MAV, Melbourne Water, 2020-2023)

Flood Expert: Merri-Bek, Glen Eira IWM Plans (Councils, 2021-2022)

Westernport Growth Area IWM Strategy (Councils, Melbourne Water, DELWP, 2020-2021)

Flood Expert: Planning Scheme Amendment (for City of Melbourne, 2019-2022)

Consultant: Melbourne Water Flood Risk Reduction Team (for Melbourne Water, 2019-2020)

Flood Expert: Arden and Macaulay and Fishermans Bend Urban Design Sprint (for City of Melbourne, 2020)

EDUCATION

BACHELOR OF ENVIRONMENTAL ENGINEERING (HONOURS)
Monash University | 2002 – 2006

DIPLOMA OF PROJECT MANAGEMENT Project Management Development International | 2013

WORK EXPERIENCE

PRINCIPAL ENGINEER AND DIRECTOR
Rain Consulting | Nov 2018 – Present

FLOOD SPECIALIST
City of Melbourne | Nov 2018 – Aug 2019

PRINCIPAL ENGINEER AND GROUP MANAGER – INTEGRATED STORMWATER MANAGEMENT
Water Technology | Nov 2008 – Nov 2018

PROJECT ENGINEER – FLOOD MAPPING AND MITIGATION
Melbourne Water | May 2005 – Nov 2008

CAREER HIGHLIGHTS

- In 2017 Luke was invited to Kunshan, China with the Victorian Government to present on Water Sensitive City design in Australia.
- Luke was the lead for stormwater, water quality and flooding for the Integrated Climate Adaptation Model project for City of Melbourne. Luke presented to the C40 Cities partners, delegates from Obama's administration and the project was a finalist (of three) in the UN Climate Change awards in 2015.
- Rianda and Luke have recently been providing expert flood advice to the City of Melbourne, leading the technical reviews of their flood modelling and facilitating liaison between Melbourne Water and the City of Melbourne throughout the project, to assist with a large Planning Scheme Amendment.
- Rianda and Luke were recently invited to be guest lecturers and panellists for Master of Urban Planning students at the University of Melbourne, discussing development in Arden.
- Recently developed the City of Melbourne's Flood Modelling and Mapping Guidelines.
- Involvement in the Arden Macaulay and Fishermans Bend Design Sprint, providing flood expertise as a member of the core working group – 2020.
- 2024 Stormwater Australia Awards Winner for Policy and Education for Rain Consulting and Melbourne Water's work on the Flood Capacity Building training courses delivered to all Melbourne metropolitan councils.
- Leading the Elizabeth Street catchment (Melbourne CBD) flood modelling and redefining of methods to analyse flood risk in CBD environments.

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Deep Thinking for Better Water Outcomes

LUKE CUNNINGHAM

Principal Engineer & Director
Bachelor Environmental Engineering (Honours), Diploma Project Management, Chartered Engineer, Registered Engineer Victoria and Queensland

KEY PUBLICATIONS

Characterising rainfall spatial variability within Melbourne CBD using opportunistic sensing. Geophysical Research Abstracts. 2019, Vol. 21, p1-1. 1p. · Dec 11, 2019
Author(s): Pudashine, Jayaram; Guyot, Adrien; Pauwels, Valentin RN; Cunningham, Luke; Vijlenhoet, Remko; Seed, Alan; Prakash, Mahesh; Walker, Jeffrey

A cellular automata fast flood evaluation (CA-ffé) model Water Resources Research Vol 55, June 2019
Author(s): Behzad Jamali, Luke Cunningham, Peter M. Bach, Ana Deletic

Is green infrastructure a viable strategy for managing urban flooding? Journal of Landscape and Urban Planning · Jun 1, 2018
Author(s): J.L.Webber, T.D. Fletcher, L. Cunningham, G. Fu, D. Butler & M.J. Burns

A spatially explicit framework for climate adaptation Urban Water Journal · Jan 18, 2018
Author(s): Joshphar Kunapo, Tim Fletcher, Anthony Ladson, Luke Cunningham, Matthew Burns

A Web-GIS Based Integrated Climate Adaptation Model Conference: 9th International Conference NOVATECH Lyon, France
Author(s): Joshphar Kunapo, Tim Fletcher, Anthony Ladson, Luke Cunningham, Matthew Burns

RORB - Monte Carlo Applications in Metropolitan Melbourne Catchments IAHR 34th Biennial Congress Including the 33rd Hydrology and Water Resources Symposium - 10th Hydraulics in Water Engineering. Brisbane 2011 · Jul 1, 2011
Author(s): Luke Cunningham, Steven Muncaster

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