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Waterway Management Consultants

STATEMENT OF EXPERT EVIDENCE

AMENDMENT C395 TO THE GREATER GEELONG PLANNING SCHEME

SURFACE WATER MANAGEMENT STRATEGY

For: Lovely Banks Development Group

6 November 2019

Director ***Neil McKinnon Craigie*** *BE(Civil), MEngSci, MIEAust, CPEng*

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1. NAME AND ADDRESS

Neil McKinnon Craigie, 40 Jamieson Court, Cape Schanck, VIC, 3939.

2. QUALIFICATIONS AND EXPERIENCE

B.E. (Civil), Monash University 1975
Grad. Course in Engg. Hydrology, UNSW 1976
M.Eng. Sci., Monash University 1981

After 14 years professional employment with the former Dandenong Valley Authority I commenced private practice as a waterway management consultant in 1989 and have worked continuously in this role since then.

I am a recognised expert in the field of surface water management, waterway management, and stormwater quality and quantity control measures. I have advised on such issues on numerous rural, semi-urban and urban developments throughout Victoria. A Statement of Qualifications and Experience is attached as Appendix A.

I have previously completed preliminary reports on stormwater management strategies for City of Greater Geelong (CoGG) in both the Northern Geelong Growth Area (NGGA), and Western Geelong Growth Area (WGGA).

I have since continued to assist Lovely Banks Group on refining the stormwater management strategy in NGGA to suit emerging development proposals generated through multi-disciplinary team design. The issue of water reuse has played a prominent role in this work.

3. INSTRUCTIONS

This statement has been prepared on the instruction of Maddocks on behalf of the Lovely Banks Development Group (Lovely Banks Group), the majority owner of the land in the Northern Geelong Growth Area (NGGA).

I was instructed to carry out:

- A review of the Amendment documentation as relevant to my field of expertise, with a particular focus on how the Amendment deals with the Northern and Western Growth Areas;
- A review of the Settlement Strategy and the Framework Plan as relevant to my field of expertise, with a particular focus on how these documents deal with the Northern and Western Growth Areas;
- An evaluation of the Lovely Banks Group submission as relevant to my expertise, including an opinion on the changes sought by the Lovely Banks Group;
- An evaluation of the Council-adopted response to submissions; and
- Any other matters in relation to the Amendment which I consider should be highlighted or considered, as relevant to my field of expertise.

4. INFORMATION USED AND RELIED UPON

In responding to my instructions, I have relied primarily on my previous stormwater management strategy reports for Council, my ongoing work with Lovely Banks Group on refining drainage proposals, and the submissions made by Lovely Banks Group.

My prior reports are as follows:

- *Northern Geelong Growth Area (NGGA,) Conceptual Layout for Stormwater Management Strategy (SWMS)*, for City of Greater Geelong, (Draft-Version 8), 28 September 2017;

- *Western Geelong Growth Area (WGGA,) Conceptual Layout for Stormwater Management Strategy (SWMS)*, for City of Greater Geelong, (Draft-Version 7), 28 September 2017;

The submissions by Lovely Banks Group are as follows:

- Cover letter dated 29 July 2019, including Attachments 1 & 2 which outline the specific changes to the planning scheme ordinance and Framework Plan requested by Lovely Banks Group.

- Accompanying submission report containing explanatory text and plans which illustrate the changes sought by Lovely Banks Group; and

- Letter dated 23 July 2019 from Deep End Services Pty Ltd providing technical support to the submission.

I have also utilized relevant information from the Index to brief as supplied to me and repeated below, as well as site survey and aerial photography, my work in the Lara West Growth Area and the Heales Road Geelong Ring Road Employment Precinct (GREP) area, and contemporary urban stormwater best management practice documents.

INDEX OF DOCUMENTS

TAB NO	DESCRIPTION OF DOCUMENT	DATE
EXHIBITED DOCUMENTATION		
1.	Notice Material (Instruction Sheet & Explanatory Report)	
2.	Municipal Strategic Statement: ▪ Clause 21.03 – Objectives, Strategies, Implementation ▪ Clause 21.04 - Municipal Framework Plan ▪ Clause 21.06 - Settlement and Housing ▪ Clause 21.08 Development and Community Infrastructure ▪ Clause 21.11 – Armstrong Creek Urban Growth Area ▪ Clause 21.14 – The Bellarine Peninsula ▪ Clause 21.16 - Anakie ▪ Clause 21.20 – Northern and Western Geelong Growth Areas	
3.	Clause 37.07 - Schedule 1 to the Urban Growth Zone	
4.	Clause 72.08 Schedule – Background Documents	
5.	Planning Scheme Maps	
SUBMISSIONS & COUNCIL REPORTS		
6.	Submission of Lovely Banks Development Group	29 July 2019
7.	Council Meeting Report resolving to adopt the Settlement Strategy and request that the Minister for Planning authorise the preparation of the Amendment	9 October 2018
8.	Council Meeting Report resolving to adopt the Framework Plan and request the Minister authorise the preparation of the amendment, to immediately commence preparing a PSP for the Elcho Road East precinct and to seek State Government funding for major transport infrastructure to accommodate growth	26 March 2019
9.	Council Meeting Report considering submissions received in respect of the Amendment	26 September 2019
BACKGROUND DOCUMENTS		
10.	Settlement Strategy	October 2018

TAB NO	DESCRIPTION OF DOCUMENT	DATE
11.	Discussion Papers: ▪ Paper 1 – Growth Scenarios ▪ Paper 2- Background to Projections ▪ Paper 3 – Population Trends and Drivers of Housing Demand ▪ Paper 4 – Residential Dwelling Stock – Parts 1, 2 & 3 ▪ Paper 5 – Residential Land Supply and Development ▪ Paper 6 – Land Supply and Housing Affordability	October 2018
12.	Northern and Western Geelong Growth Areas Framework Plan	March 2019
13.	Bushfire Planning Assessment prepared by Bushfire Planning	29 May 2019

5. THE AMENDMENT DOCUMENTATION

The changes proposed by Amendment 395 include:

- Minor changes to Clauses 21.03 Objectives – Strategies - Implementation, 21.11 Armstrong Creek Urban Growth Area and 21.16 Anakie to reflect the Framework Plan.

- Replace the Municipal Framework Plan at Clause 21.04 to implement the Settlement Strategy.

- Replace and amend Clauses 21.06 Settlement and Housing, 21.08 Development and Community Infrastructure and 21.14 The Bellarine Peninsula to implement the Settlement Strategy.

- A new Clause 21.20 Northern and Western Geelong Growth Areas to implement the Framework Plan.

- Rezone land in the Northern and Western Growth Areas from Rural Living, Farming, Public Park and Recreation and Industrial 1 Zones to the Urban Growth Zone.

No issues are raised in the amendment documentation in regard to matters relevant to my area of expertise in stormwater management in either growth area.

6. THE SETTLEMENT STRATEGY AND THE FRAMEWORK PLAN

No issues are raised in the Settlement Strategy in regard to matters relevant to my area of expertise in stormwater management in either growth area.

Apart from what is identified below, no issues are raised in the Framework Plan in regard to matters relevant to my area of expertise in stormwater management in the Western Growth Area.

In the Northern Growth Area the layout of drainage assets and waterways at Plan 7 of the Framework Plan (p 62) appears to generally replicate the original concept layout from my 28 September 2017 report to Council. That was prepared in advance of any potential development layout across the area and is no longer appropriate in my view. Further work has since been completed by myself and others to adjust the drainage network to better simulate emerging proposals for development and to reduce land take for drainage purposes across the Hovells Creek/Elcho Creek areas.

While Action N1.2.9 of the Framework Plan (p 65) does provide some flexibility for future adjustment, given the extent of work that has been completed already it is submitted that Plan 7 of the Framework Plan should be revised.

Further consideration of drainage layout in the NGGA follows in Sections 7, 8 and 9 of this report.

7. THE LOVELY BANKS GROUP SUBMISSION

The submissions by Lovely Banks Group are as follows:

- Cover letter dated 29 July 2019, including Attachments 1 & 2 which outline the specific changes to the planning scheme ordinance and Framework Plan requested by Lovely Banks Group.
- Accompanying submission report containing explanatory text and plans which illustrate the changes sought by Lovely Banks Group.

Extracts of the submission which relate at least in part to stormwater management are discussed below.

Amend Clause 21.20 as follows:

- *"Develop precinct structure plans that implement the intent of the Northern Geelong Growth Area Framework Plan Summary and the Western Geelong Growth Area Framework Plan Summary.*
- *Have regard to the Northern and Western Growth Area Framework Plan when preparing precinct structure plans and infrastructure contribution plans."*
- *"Develop precinct structure plans for each growth area that address the intent of the sequencing set out in the Northern and Western Geelong Growth Areas Framework Plan".*

Although generally peripheral to stormwater management the third dot point is of significance. There is a practical imperative to develop the land in sequences that minimise the extent of required drainage works (upfront cost of development) and impacts on downstream receiving waterways and landowners.

In the Elcho Creek valley this manifests itself with development likely moving west up the valley in advance of the southward extension towards Heales Road. Impacts downslope in Elcho Creek will be managed effectively with development of the first PSP area. No additional threats will arise with westwards extension.

Lovely Banks Group have requested the area in the Heales Road East PSP be dealt with in two parts so as to allow the Lovely Banks Group owned lands upstream of the RLZ areas to proceed earlier than the likely timing of the redevelopment of the RLZ zoned areas. This is supported from a drainage perspective because solutions are at hand to allow this area owned by Lovely Banks Group to develop without need for works outside existing road reserves in the RLZ area. Accordingly, there are no drainage constraints to earlier development.

Adjust the Elcho Road alignment to be more site responsive as shown in the accompanying plans.

Make consequential adjustment to the Clever and Creative Corridor as a result of the relocated centres and the road realignment as shown on the accompanying plans.

The existing angled alignment and steep approach/departure slopes of Elcho Road are unsuited to the creation of waterbodies on the upstream side as correctly illustrated in Plan 07. An alignment as shown by Lovely Banks Group in its submission simplifies issues of waterbody development and allows the road to pass over the valley as a bridge rather than as a massive high fill. Preliminary design work has shown the necessary online wetland/retarding basins can be created upstream of the new Elcho Road crossing (with views from Elcho Road), with another further downstream in conjunction with the lower level crossing for the Clever and Creative Corridor (CCC) abutting the activity centre.

Adjust the drainage proposals to reduce excessive land take and to reflect framework planning and not more detailed outcomes that will be resolved through precinct structure planning as shown in the accompanying plans.

Sufficient preliminary design work has been completed to confirm that the required water management assets can be generally consolidated with stream reserves

(sometimes with local widening of those reserves) and existing road reserves. With the exception of those fronting Bacchus Marsh Road, there is no need to specify locations and areas of offline waterbodies on the Framework Plan as identified in Plan 07 and infer a larger land take. In fact experience shows that trying to relocate/remove such assets at the PSP stage may generate difficulties. The simpler the Framework Plan the easier it is to maximise drainage efficiency and ease of implementation.

Amend the documents by adding in the following heading and text probably around p 63 to describe the role of integrated water management and the expectation that precinct structure plans will evolve the detail of waterways and drainage assets as follows:

"Integrated water management

The Framework Plan reflects initial work on flooding and water management. A holistic approach to integrated water management is being explored with Barwon Water as part of the precinct structure planning process. A full range of options are being considered that can best achieve integrated objectives relating to liveability, blue green infrastructure, water sensitive design, stormwater harvesting for public space greening and tree health and methods to restore ecological function in waterways. In the Northern Growth Area, options for a more self-sufficient water cycle that retains more runoff on the plateau and in the Elcho valleys and reduces the need for new infrastructure through rural living areas will be considered through precinct structure planning."

Preliminary work on reuse of roofwater and treated stormwater in lieu of provision of 3rd pipe recycle supply, and maximising application of passive irrigation of parkland areas with stormwater runoff, has shown significant savings are achievable in the size of water quality treatment assets, reduction in potable supply needs and mitigation of impacts on downstream receiving hydrology.

Amend Action N1.2.2 to read as follows:

"Flooding and stormwater management will seek to reduce impacts on predevelopment hydrology of the area and minimise downstream impacts."

I strongly support this suggested redrafting.

It is not wise to imply it is possible to maintain and enhance the pre-development hydrology of land downstream of any new urban development. This is simply not practically achievable, especially where external recycle supply is provided.

While retarding basins can be used to maintain peak flow limits, it is only possible to reasonably mitigate downstream impacts of any change on volumes and frequency of runoff. Significant reuse of roofwater and stormwater is required to achieve this outcome.

8. THE COUNCIL-ADOPTED RESPONSE TO SUBMISSIONS

I have received a copy of the officers' report to the 24 September 2019 Council meeting, which addressed all submissions and provided responses.

In relation to integrated water management, the key issues raised by Lovely Banks Group and other submitters, the officers' responses, and my responses are summarised as follows:

Submission Theme	Officer Response	My Response
Concern over how much land take is implied for drainage and waterways on Plan 7. Adjust drainage proposals to reduce extent of waterways and to reduce excessive landtake. Need changes to plan 7 of the framework plan outlining stormwater land requirements. Some waterways can be removed and others reduced in scale. Allow flexibility of waterway extent and design at PSP stage Changes needed to framework plan wording on waterways and stormwater management	Not supported. PSP process will include detailed design of waterways. Waterways shown in the Framework Plan are based on detailed technical studies relating to stormwater management. However, it is recognised and expected that detailed stormwater drainage design at PSP stage will refine and in many cases reduce the extent of waterways shown on the Framework Plan. This is consistent with the metropolitan experience. Changes to the maps and wording in the Framework Plan are not needed to address this issue. The Framework Plan is intended to inform detailed planning of PSPs. For clarity, a brief introductory section will be added to the Framework Plan to explain the role of the Framework Plan in providing high level guidance that will be refined by detailed planning at PSP stage.	Past experience has shown that it is harder to remove and/or reduce implied land take at later stages of the process. Where more detailed information is already readily available (as is the case here with both the Lovely Banks Group submission and the SMEC Australia reports for CoGG), it just makes sense to use it.

Submission Theme	Officer Response	My Response
Impact of stormwater proposals on rural living areas. Objection to a waterway identified along the rear of rural living properties in Heales Road in the NGGA. Remove proposed stormwater detention basin from land in vicinity of Heales and Bacchus Marsh Roads	Stormwater management in areas of rural living will be subject to detailed investigation including consideration of alternative solutions as part of the relevant PSP and will seek to minimise impacts on individual properties, where practicable.	My further review concludes that constructed waterways and basins in the RLZ areas are not required to facilitate proposed new urban development upslope-they are only required to service redevelopment of the RLZ areas. Works in the RLZ areas to service upstream areas can be limited to new pipelines in existing road reserves.
Concern about practicalities of adopting a standard of no detrimental impact on pre-development hydrology. Action N1.2.2: change "maintain and enhance the" to "seek to reduce impacts on"	Not supported. PSP process will include detailed design of waterways. Actions in the Framework Plan outline that flooding and stormwater management will maintain and enhance the predevelopment hydrology of the areas and minimise downstream impacts.	It is not wise to imply it is possible to maintain and enhance the pre-development hydrology of land downstream of any new urban development. This is simply not practically achievable, especially where external recycle supply is provided. While retarding basins can be used to maintain peak flow limits, it is only possible to reasonably mitigate downstream impacts of any change on volumes and frequency of runoff. Significant reuse of roofwater and stormwater is required to achieve this.

9. OTHER RELEVANT MATTERS

Although they are supporting technical documents, the stormwater management reports by SMEC Australia are worthy of comment at this time given they may influence how the Framework Plan is viewed by the community at large. I consider there are some conflicts between what the SMEC Australia reports recommended and what is reflected in the Framework Plan.

I commend the modelling approach taken by SMEC Australia and in particular I support their decision to continue application of Australian Rainfall and Runoff 1987 (ARR87) rainfall and loss methods in lieu of the more up-to-date 2016/2019 version (ARR).

I do have some concerns over post-development modelling layout and assumptions used by SMEC Australia which are now discussed. I also highlight where conflicts are perceived to exist between what SMEC Australia have reported and what has appeared in the Framework Plan.

ARR87 vs ARR16/ARR19

As stated in Section 5.1 of SMEC Australia's First Report (Flood Impact Assessment, September 2018) it is recognised that there is little direct evidence of peak stormwater or flood flows recorded within the CoGG region being included in the ARR16/19 data analyses. It is considered that this lack of data represents the greatest limitation to improving the accuracy of rainfall runoff process simulations. It is judged that any alteration in the rainfall runoff modelling approach nominated in the new version of Australian Rainfall and Runoff is unlikely to improve the confidence in any rainfall runoff modelling outcomes until such a time as it can be corroborated by measured flow data in the local area.

There have been no recent improvements in extent of recorded rainfall-runoff data in the CoGG region. The ARR Data Hub outputs have been derived from larger catchments outside the local region.

A very recent study of the Lara West Growth Area has considered the impacts of changing from ARR87 to the more recent ARR19. The report claims a direct comparison between runoff peaks calculated by the RORB hydrologic model as applied by myself in 2012 using the ARR87 and ARR19 data.

According to the report authors the only changes made to the RORB model were to include ARR2019 IFD data, temporal patterns and loss rates. The routing parameters, subarea and reach structure and imperviousness values were all retained as in 2012.

At Bacchus Marsh Road the ARR19 data showed a peak 1%AEP flow rate of 4.3 m^3/s compared with the 14.6 m^3/s obtained with the ARR87 data. This represents a reduction of 70%, solely due to use of ARR19 data over ARR87. A reduction of this scale doesn't meet the pub test in my view and it underlines my significant concern that ARR19 data is very much unrepresentative of conditions in the CoGG region.

The SMEC Australia modelling using new RORB and Tuflow models and ARR87 rainfall and loss data has produced results consistent with the 2012 Lara West study and these are supported.

Post Development Drainage Layout For Hovells and Elcho Creeks

The work completed by myself and others since my original 2017 report for the Northern Growth Area has shown clearly that there will be benefits associated with diversion of urban flows from Elcho Creek along the gas main easement and into the Lara West Growth Area drainage system and then to Hovells Creek:

- A constructed open waterway drainage system will be available to convey all flows east of Bacchus Marsh Road, without the need for upgrade.

- The diversion can offset most of the impacts of altered hydrology along Elcho Creek downstream in the RLZ and east of Bacchus Marsh Road.

- In conjunction with a small pipe in McNeills Court, the existing RLZ area downslope along Elcho Creek can be completely protected without works in private lots.

- The diversion reduces the size of water quantity and quality treatment measures required for the proposed Elcho town centre precinct.

- The diversion provides an early opportunity for capture of water for irrigation of the first AOS area.

- The diversion will allow full development upstream in the Elcho Creek catchment to be completed earlier in the process in conjunction with WLRB's integrated with the stream reserves.

Despite this work and the recommendation for the diversion to be included as set out in my 2017 report, SMEC Australia has deleted it from their post-development analysis. The report shows a constructed waterway downstream through the RLZ area and this is reflected in the current Framework Plan. This constructed waterway is not required in my view and it will likely provoke concern and objections from those residents and also difficulties in implementation.

The clear intention of our recent design work is that wetland/retarding storage systems on the Bacchus Marsh Road frontage and constructed waterways through the RLZ area will only be needed when redevelopment of the RLZ lands occurs.

Similar arguments can apply to the remaining smaller monocline tributaries south of the main activity centre down to Heales Road. In conjunction with online assets around the top of the monocline and strategic pipe diversions within the Lovely Banks Group lands, small pipelines in existing road reserves downstream of the monocline can offset residual impacts on existing RLZ development.

Plan 07 of the Framework Plan should be amended to:

- Show piped drains in McNeill Court and other roads to the south in the RLZ area as depicted on the Lovely Banks Group submission plans.

- Show WLRB's on the Bacchus Marsh Road frontage south of Elcho Road and constructed waterways in the RLZ lands depicted as assets required for redevelopment of the RLZ lands and not areas upslope.

Implied Stream Reserve Corridors and Waterway Forms

The Monocline drainage lines in the NGGA are very much atypical of the stream forms covered in guideline documents such as those produced by Melbourne Water.

A key feature is the comparatively small catchments that prevail for most of the tributary gullies which are confined by the erosional topography down the steep monocline reach segments. Stream corridor reserve widths are effectively pre-determined by the existing topography and cannot realistically be set at wider values just to match published guidelines.

Plan 07 of the Framework Plan infers reserve widths of 80-100 m are to be created down all of the gullies north of Heales Road, seemingly irrespective of catchment size or topography. This conflicts with both the existing topography and the recommendations in the SMEC V2 post-development report which nominates widths typically around 30-40 m.

Plan 07 of the Framework Plan also infers 80+m reserve widths linking basins in the Cowies Creek catchments to those at Anakie Road. This again conflicts with the recommendations in the SMEC V2 post-development report which nominates widths typically around 30-40 m.

I have consistently advised CoGG that while reference to guidelines such as those produced by Melbourne Water provides a valuable information source, at all times locally appropriate adjustments should be made, recognising catchment area, surface and subsoil characteristics, geology and topography, vegetation and hydrologic regime.

It is therefore recommended that Action N1.2.1 be reworded generally as follows with appropriate changes to Plan 7 and following through into other Plans in the Framework Plan:

Waterways will be designed and constructed to accord with physical site conditions and constraints. Natural characteristics should be reinforced wherever feasible. The structural design should support the establishment of viable aquatic and riparian vegetation that improves habitat and water quality.

Natural and constructed waterways are critical to the amenity of neighbourhoods and provide key linkages for biodiversity and passive recreation. Waterways should be delivered having regard to available information sources such as the Melbourne Water Constructed Waterways in Urban Developments Guidelines. However locally appropriate adjustments should be made, recognising catchment area, surface and subsoil characteristics, geology and topography, vegetation and hydrologic regime.

10. SUMMARY

Apart from my comments in this report, no issues are raised in the amendment documentation in regard to matters relevant to my area of expertise in stormwater management in either growth area.

No issues are raised in the Settlement Strategy in regard to matters relevant to my area of expertise in stormwater management in either growth area.

No issues are raised in the Framework Plan in regard to matters relevant to my area of expertise in stormwater management in the Western Growth Area.

In regard to stormwater management in the NGGA Framework Plan I generally support and commend the proposals. However I do have several concerns.

- The existing angled alignment and steep approach/departure slopes of Elcho Road are unsuited to the creation of waterbodies on the upstream side. An alignment as shown by Lovely Banks Group in its submission simplifies issues of waterbody development and allows the road to pass over the valley as a bridge rather than as a massive high fill. I support that proposed alignment.

- Lovely Banks Group have requested that planning for the area in the Heales Road PSP be split into two parts so as to allow the Lovely Banks Group owned lands upstream of the RLZ areas to proceed earlier. This is supported as well because solutions are at hand to allow this development to occur without need for works outside existing road reserves in the RLZ area.

- The drainage proposals shown on Plan 7 imply excessive land take for waterways and management assets.

- Plan 7 infers 80+m reserve widths linking basins in the Cowies Creek catchments to those at Anakie Road, and in the Elcho Creek/monocline valleys. This conflicts with the recommendations in the SMEC V2 post-development report which nominates widths typically around 30-40 m.

- Sufficient preliminary design work has been completed to confirm that the required water management assets can be generally consolidated with stream reserves (sometimes with local widening of those reserves) and existing road reserves. With the exception of those fronting Bacchus Marsh Road, there is no need to specify locations and areas of offline waterbodies on the Framework Plan and infer a larger land take. In fact experience shows that trying to relocate/remove such assets at the PSP stage may generate difficulties. The simpler the Framework Plan the easier it is to maximise drainage efficiency and ease of implementation.

- It is not wise to imply it is possible to maintain and enhance the pre-development hydrology of land downstream of any new urban development. This is simply not practically achievable, especially where external recycle supply is provided. It is recommended that Action N1.2.2 be amended as follows:

  "Flooding and stormwater management will seek to reduce impacts on predevelopment hydrology of the area and minimise downstream impacts."

- I commend the modelling approach taken by SMEC Australia and in particular I support their decision to continue application of Australian Rainfall and Runoff 1987 (ARR87) rainfall and loss methods in lieu of the more up-to-date 2016/2019 version (ARR).

- The SMEC Australia V2 post-development report has deleted the original proposal for Elcho Creek to be diverted in part along the gas main to Hovells Creek outfall. This has resulted in a constructed waterway now being shown downstream through the RLZ area and this is reflected in the current

Framework Plan. This constructed waterway is not required in my view and it will likely provoke concern and objections from those residents and difficulties for implementation.

- The Elcho Creek diversion proposal should be embedded in future detail design of the first PSP.

- Wetland/retarding storage systems on the Bacchus Marsh Road frontage and constructed waterways through the RLZ area will only be needed when redevelopment of the RLZ lands occurs.

In my opinion Plan 7 should be amended to:

- Show piped drains in McNeill Court and other roads to the south in the RLZ area as depicted on the Lovely Banks Group submission plans.

- Show WLRB's on the Bacchus Marsh Road frontage south of Elcho Road and constructed waterways in the RLZ lands depicted as assets required for redevelopment of the RLZ lands and not areas upslope.

While reference to waterway corridor and design guidelines such as those produced by Melbourne Water provides a valuable information source, at all times locally appropriate adjustments should be made, recognising catchment area, surface and subsoil characteristics, geology and topography, vegetation and hydrologic regime. Conditions in the NGGA monocline gullies are very much atypical of those generalised in the Melbourne Water guidelines.

- It is recommended that Action N1.2.1 be reworded generally as follows with appropriate changes to Plan 7 and following through into other Plans in the Framework Plan:

Waterways will be designed and constructed to accord with physical site conditions and constraints. Natural characteristics should be reinforced wherever feasible. The structural

design should support the establishment of viable aquatic and riparian vegetation that improves habitat and water quality.

Natural and constructed waterways are critical to the amenity of neighbourhoods and provide key linkages for biodiversity and passive recreation. Waterways should be delivered having regard to available information sources such as the Melbourne Water Constructed Waterways in Urban Developments Guidelines. However locally appropriate adjustments should be made, recognising catchment area, surface and subsoil characteristics, geology and topography, vegetation and hydrologic regime.

11. DECLARATION

In preparing this statement I have made all the enquiries that I believe to be desirable and appropriate, and that no matters of significance that I regard as relevant have to my knowledge been withheld from the Panel.

Neil M Craigie

BE Civil, MEngSci, MIEAust, CPEng (Ret)

6 November 2019

Appendix A Statement Of Qualifications And Experience

Name: Neil McKinnon Craigie

Address: 40 Jamieson Court, Cape Schanck, VIC 3939

Business Phone: 0427 510 053 **Email**: nmcraigie@bigpond.com

Professional Qualifications:

B.E. (Civil), Monash University 1975
Grad. Course in Engg. Hydrology, UNSW 1976
M.Eng. Sci., Monash University 1981

Professional Background:

1974 Joined Dandenong Valley Authority (DVA)
1980 Appointed as Design Engineer
1984 Appointed as Design and Investigation Engineer controlling hydrologic and hydraulic investigations, project design and engineering consultancy services
1989 Commenced private practice as a waterway management consultant.

Current Occupation: Waterways Management Consultant
trading as Neil M Craigie Pty Ltd

Affiliations: Member, Institution of Engineers Australia (MIEAust, CPEng (Ret))

Experience:
I have extensive experience in:

- river basin management,
- assessment and design of restoration works for degraded and/or unstable natural waterway systems,
- assessment and design of mitigation works to address the effects of urbanisation on waterway systems,
- investigation and design of drainage and flood management schemes of all forms and sizes in both urban and rural settings,
- troubleshooting and remedial design in urban drainage systems.
- investigation, design and ongoing management of wetland, lake and tidal waterway systems

Whilst with the DVA, I directed all hydrologic and hydraulic investigations, project design and consultancy services. I led the preparation of standards for stream restoration work and developed innovative techniques for evaluation and appraisal of waterway management problems. I have further refined and applied these techniques since commencing private practice, in major studies throughout Victoria and in Far North and South-East Queensland.

In recent years, I have undertaken work in the field of environmental flows, providing hydraulic and waterway management input to multi-disciplinary teams. I was a team member for the Environmental Flow Assessment for the Lower Thomson and Macalister Rivers in Victoria (CRC Freshwater Ecology, 1999). Since 2000, I have assisted Dr Sandra Brizga on the environmental flow studies carried out for the Water Allocation and Management Plans (WAMPs) on the Pioneer and Logan Rivers, for the Water Resource Plans (WRP's) on the Mary and Maroochy Rivers in Queensland, and the River Processes Study on the Mary River. Each of these studies is a major multidisciplinary undertaking involving specialists from a range of disciplines, including hydrology, hydraulics, geomorphology, water quality, and ecology (aquatic and riparian vegetation, macroinvertebrates, fish, and other vertebrates such as turtles, platypus and dugong).

I have carried out and/or directed numerous hydrologic and hydraulic studies, utilising computer based models. I have particular expertise in retarding/retention basin design, several examples of which have featured novel outlet works designed to counteract high debris loads, mitigate sediment discharge, provide water quality treatment, and dissipate very high flow velocities.

In the field of management of natural waterway and floodplain systems, I and my associates have collaborated on a series of complex hydro-geomorphological investigations. These studies involved integration of unsteady-state two dimensional hydraulic modelling and fluvial geomorphology analyses to develop waterway management plans which recognise and address the governing physical processes (for example, the Tambo River at Bruthen, Badger Creek through Healesville Sanctuary, and Glenelg River sand transport studies).

In the urban areas I have been closely involved in the development and preparation of municipal/agency stormwater management plans across the greater Melbourne area.

I and my associates are continuing to play leading roles in conceptual planning and design of stormwater quantity and quality management systems involving open waterways, wetlands and lakes in many of the large residential estates being developed in greater Melbourne since the late 1990's (for example, Caroline Springs, The Waterways Estate, Tenterfield Estate, The Boardwalk Estate, Berwick Springs Estate, Beaumont Waters Estate, Torquay Sands, Lakeside at Pakenham, Pt Cook Gardens Estate, Lincoln Heath Estate, Marriott Waters, Martha Cove, Highlands Estate).

I am also active at the regional level with similar water management system planning (for example; Paynesville, Port Fairy, Warrnambool, Bendigo, Geelong/Bellarine Peninsula, Mornington Peninsula, Phillip Island/San Remo, Castlemaine, Traralgon, Warragul, Ballarat).

In conjunction with associates in the field of stormwater and wastewater quality treatment and aquatic biology, I have developed innovative approaches to design of stormwater quality management systems and all aspects of water sensitive urban design, and have applied these in a variety of urban, semi-urban and rural settings.

In the rural areas I have jointly carried out investigations into redesign opportunities for irrigation drainage systems to mitigate sediment and nutrient loads, for Goulburn-Murray Water. This work culminated in the design and construction of a major artificial wetland system serving the Muckatah Depression Drainage Scheme in Northern Victoria. This project has since won the IEAust Engineering Excellence Award.

In conjunction with my associates, I have won UDIA Awards for Excellence for Water Sensitive Urban Design and Residential Development in 2000, 2002, 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2012, 2017 and 2018, the SIAV Award for Stormwater Innovation in 2004 and 2005 (2) and the Stormwater Victoria Award for Excellence in Integrated Stormwater Design (2015). I was the recipient of the ALDE Recognition Award in 2012.

Since commencing private practice in 1989 I have also gained considerable experience as an expert witness, preparing and presenting numerous submissions to VCAT and various Planning Panels on drainage, waterway and floodplain management implications of proposed development projects throughout Victoria.

Neil M Craigie