WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Ballarat West DCP Drainage Review

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Report on Ballarat West DCP funding review

1. Report By:

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Qualifications:

- BEnv Eng (Hons,) Monash University, 2002
- MEngSci, UNSW, 2006
- Grad Certificate River Health Management, Melbourne University, 2009

Affiliations:

- Member, Institution of Engineers Australia
- Committee Member, Stormwater Industry Association Victoria

Area of Expertise:

Key areas of expertise relevant to this report are summarised below.

- Assessment of stormwater and flooding related issues associated with residential, industrial estate and wetland development proposals.
- Hydraulic modelling of flood flows for major flood studies, including assessment of existing problems and evaluation of alternative floodplain management options.
- Water Quality investigations including hydrodynamics, nutrients and sediment transport
- Experience in formulating and calculating multiple Melbourne Water and Council Drainage Schemes

2. Statement of Expertise

With my qualifications and experience, I believe that I am well qualified to provide an expert opinion on the proposed development contributions plan for the drainage component of Ballarat West.

3. Report Contributor

Thomas Cousland
Project Engineer
Water Technology Pty Ltd
15 Business Park Drive
Notting Hill, VIC 3168

Qualifications:

- Bachelor of Engineering Civil, Monash University, 2006

Affiliations:

- Member, Institution of Engineers Australia

Area of Expertise:

Key areas of expertise relevant to this report are summarised below.

- Assessment of flooding, water quality and waterway protection
- Urban and rural river design and management
- Data collection, processing and analysis
- Application of GIS
- Former Melbourne Water employee and manager of multiple Drainage Schemes in Northern Melbourne Region (2006-2008)

4. Scope of this Report

The purpose of this report is to provide an expert opinion on the following matters:

1. Assessment of the technical models associated with the Ballarat West DCP
2. Assessment of the scheme cost distribution with respect to other schemes in our experience

5. Basis of this Report

This report is based on:

- Review of Ballarat West Growth Area reports and models accessed through the City of Ballarat's website including:
  - Engeny Water Management, February 2012, Ballarat West Growth Area PSP Drainage Report
  - Drainage Report MUSIC model "Precinct 4-1995 V2.sqz" accessed June 2013 http://www.ballarat.vic.gov.au/pbs/city-strategy/ballarat-west/ballarat-west-psp.aspx
  - Drainage Report MUSIC model "Precinct 1-1995 V4.sqz" accessed June 2013 http://www.ballarat.vic.gov.au/pbs/city-strategy/ballarat-west/ballarat-west-psp.aspx
  - Drainage Report MUSIC model "Precinct 2-1995 Test no RB9.sqz" accessed June 2013 http://www.ballarat.vic.gov.au/pbs/city-strategy/ballarat-west/ballarat-west-psp.aspx
  - Drainage Report RORB models "Ballarat_Developed V2.catg" and "Ballarat_Existing.catg" accessed June 2013 http://www.ballarat.vic.gov.au/pbs/city-strategy/ballarat-west/ballarat-west-psp.aspx
- Melbourne Water, 2007, Principles for Provision of Waterway and Drainage Services for urban Growth

6. Introduction

The Ballarat West DCP proposes to share funding of stormwater infrastructure across the three precincts within the DCP. Each precinct currently has an estimated cost per hectare for providing works within each precinct. The breakdown of these estimates is currently;

- Precinct 1 - $89,349.00
- Precinct 2 - $64,909.00
- Precinct 4 - $59,621.00

I have been asked to investigate the potential for separating Precinct 4 from cost sharing of drainage infrastructure within the Ballarat West DCP, and the possibility of Precinct 4 only funding works within the boundaries of Precinct 4.

7. Melbourne Water DSS principles

Melbourne Water's document "Principles for Provision of Waterway and Drainage Services for Urban Growth" outlines the principles used for creating drainage schemes to service urban growth. Principle number 1 relates to the size of the scheme area and states:

There shall be no formal limit on the size of the scheme area.

The appropriateness of size will vary from scheme to scheme and is governed by nexus between contributing properties and infrastructure provision. This is likely to be closely related to the drainage characteristics of the land.

The minimum sizing of the scheme should achieve a direct relationship between land in the scheme and proposed drainage works, and should have regard to practical planning and administrative requirements.

In my view the size of the precinct is large enough to ensure stormwater infrastructure can be appropriately managed and funded through the contributing properties within the precinct. Infrastructure requirements for Precinct 4 are managed within the boundaries of the precinct, and are not reliant on infrastructure elsewhere in the Ballarat West DCP.

The second principle in the Melbourne Water document discusses how the boundaries of drainage schemes are to be set and states:

The boundary of a scheme will be determined by the drainage characteristics of the land.

The best boundary for a scheme is the natural drainage topography of the sub-catchment itself. This consists of ridgelines which direct run-off into separate catchments on either side of the ridge and waterways that receive stormwater run-off.

Selecting the natural boundary may be rendered impractical by pre-existing modifications to the topography of the land. These include:

- *Railway lines*
- *Raised roads*
- *Levee banks*
- *Other engineering works that redirect drainage flows.*

The modifications described above form "constructed boundaries" that may be adopted as a logical alternative to natural boundaries to determine the scheme boundary.

There are also other influences on boundary lines including urban development zones and property titles straddling catchment boundaries.

With respect to Precinct 4, no drainage lines leaving Precinct 4 directly enter other precincts of the Ballarat DCP. The boundary of precinct 4 also approximately follows the existing topographical catchment boundaries for the designated waterways exiting the precinct.

8. Current Drainage Scheme

The critical elements of a drainage scheme and the performance of Precinct 4 against those elements are discussed in this section. The drainage elements proposed are shown Figure 1 below, as taken from the DCP drainage report.

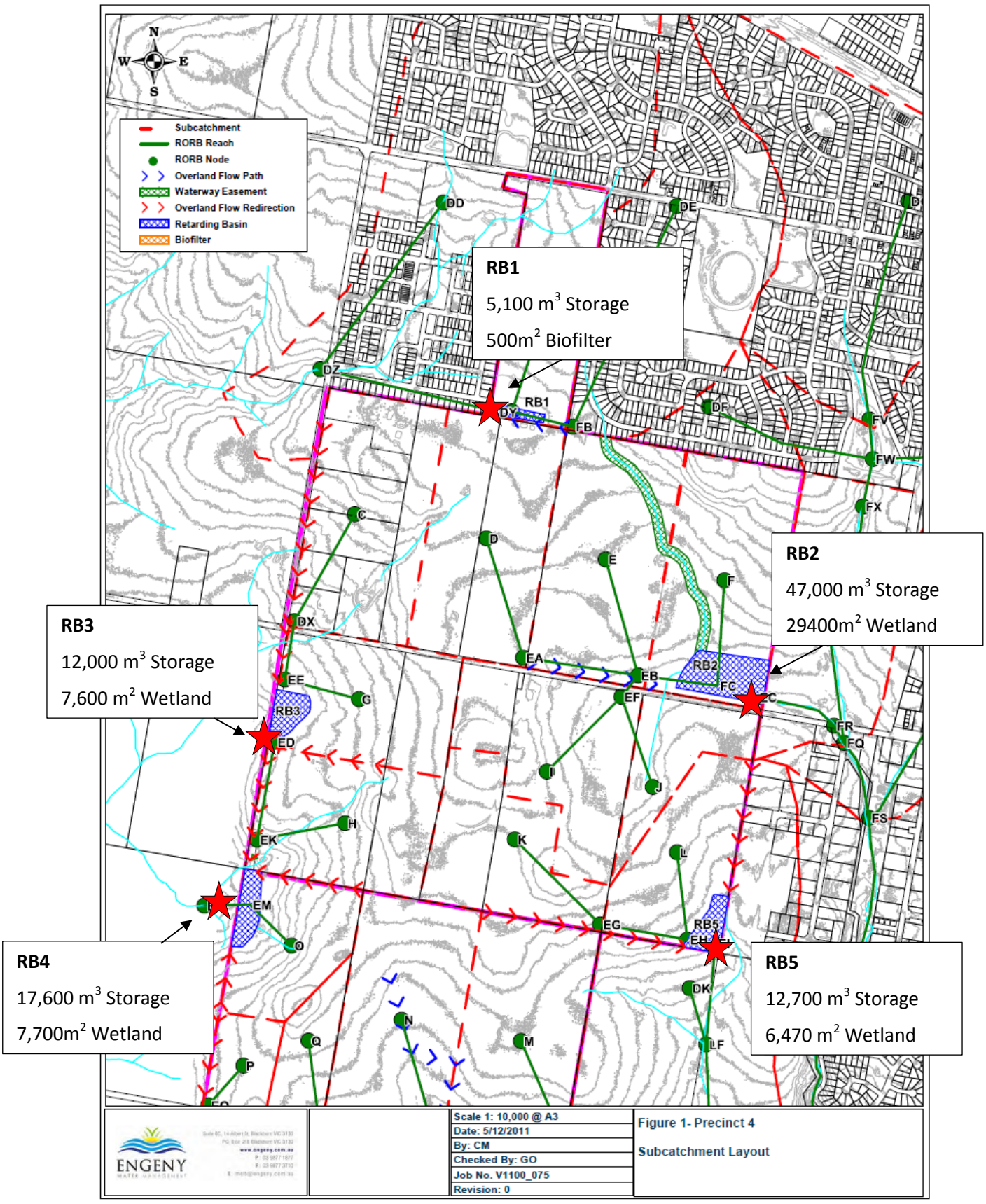


Figure 1 **Current Engeny Drainage Scheme for Precinct 4**

8.1 Water Quality Treatment performance of Precinct 4

The current scheme water quality performance for Precinct 4 is shown below Table 1. The table shows that reductions in Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) meet Best Practice Guidelines (EPA, 1999) of 80%, 45%, 45% respectively. It is noted that due to an unusual layout of elements TSS has become the key contaminant that drives the scheme.

Importantly, this scheme meets its water quality requirements at the boundary of the scheme.

Table 1 Current drainage MUSIC modelling results

	Sources	Residual Load	% Reduction
Flow (ML/yr)	1.22E3	1.14E3	6.7
Peak Flow (m3/s)	2.74	4.62	-68.8
Total Suspended Solids (kg/yr)	227E3	43.8E3	80.7
Total Phosphorus (kg/yr)	477	148	68.9
Total Nitrogen (kg/yr)	3.44E3	1.78E3	48.4
Gross Pollutants (kg/yr)	47.3E3	0.00	100.0

Note that wetland 4 is located within Precinct 2. To contain these works within Precinct 4, a modification of the drainage arrangement at the south-west corner of the Precinct 4 is discussed in Section 8.3 and 8.4.

8.2 Hydrological Performance of Precinct 4

The pre and post development RORB models have been analysed to determine the peak flows leaving Precinct 4 and how they compare to the existing flow targets. The results of this flow comparison are shown below in Table 2.

Table 2 Current RORB modelling Results at precinct outlets

	Pre Development Peak Flow (m3/s)	Post Development Peak Flow (m3/s)
RB1	3.4	3.25
RB2	6.3	4.88
RB4	1.93	1.69
RB5	4.1	3.78

8.3 Precinct 4 Target Summary

From a review of the models associated with Precinct 4 it has been found that the precinct meets and in many cases significantly exceeds storm water quality and quantity requirements. It is noted however that there is a small sub-catchment at the south west corner of the precinct that relies on drainage infrastructure within Precinct 2 to meet requirements. This sub-catchment can be easily

included within Precinct 4 with some minor relocations and extensions of proposed works. These modifications are discussed below.

8.4 Proposed modifications to existing scheme

Due to the location of RB4 within Precinct 2, a preliminary re-working of the MUSIC model and RORB model has been undertaken to determine the size of infrastructure required to ensure stormwater targets can be met with the Precinct 4 boundaries. Only the south west corner of Precinct 4 has been altered.

RB3 and its associated wetland has been moved to the South West corner of Precinct 4 with sub-catchments H and G now connected to the altered RB/WL. Through an iterative process to meet the best practice target of 45% reduction in Nitrogen, the wetland and associated sediment pond have been sized at 12,000m^2 and 1500m^2 respectively.

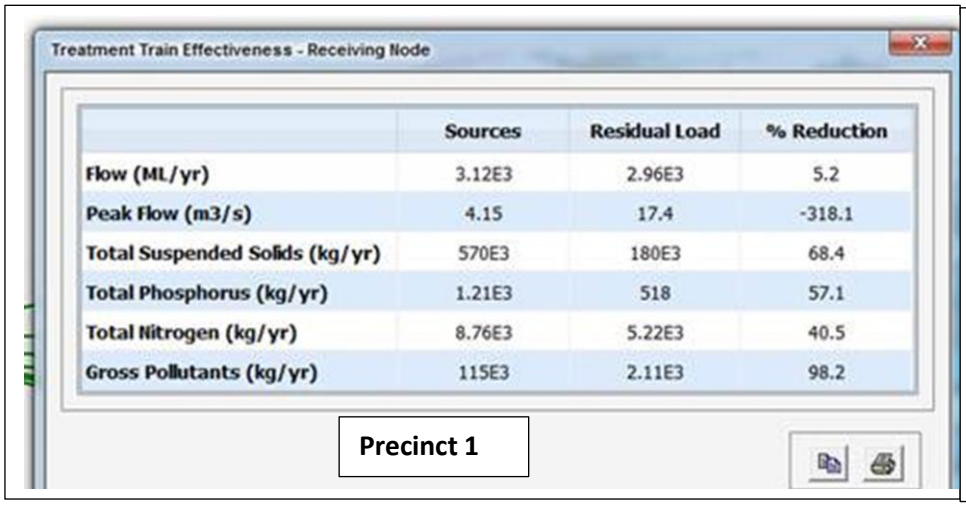
The RORB model has been re-run with the modification to RB3. The resultant storage requirement to ensure the peak flow is attenuated back to pre-development conditions is 17,200m^3. Note this relocation will reduce works in Precinct 2.

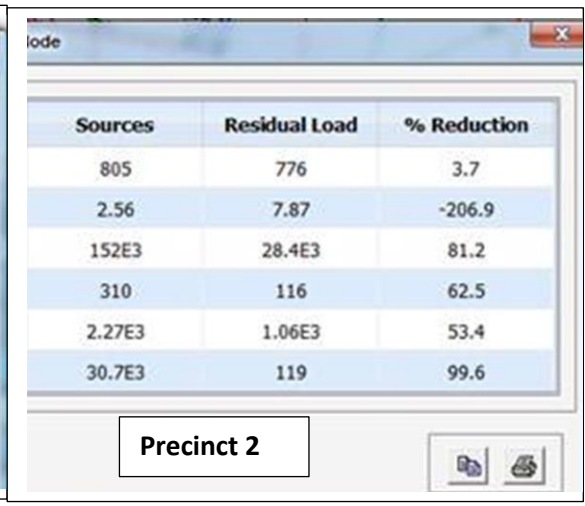
8.5 Other Precincts

Water Quality

Precincts 1 and Precinct 2 have been checked for compliance with Best Practice requirements at each of their boundaries. As can be seen in the tables below, Precinct 2 meets and exceeds its requirements at the precinct boundary. Precinct 1 is significantly under performing with respect to water quality targets. There is a note in the Engeny report stating that Precinct 1 does meet water quality requirements, though the final numbers are diluted by existing catchments upstream of Precinct 1. This does offer a potential explanation of the numbers below, though this is hard to check. If this is taken at face value, the scheme has been set up to meet water quality targets at each of the precinct boundaries.

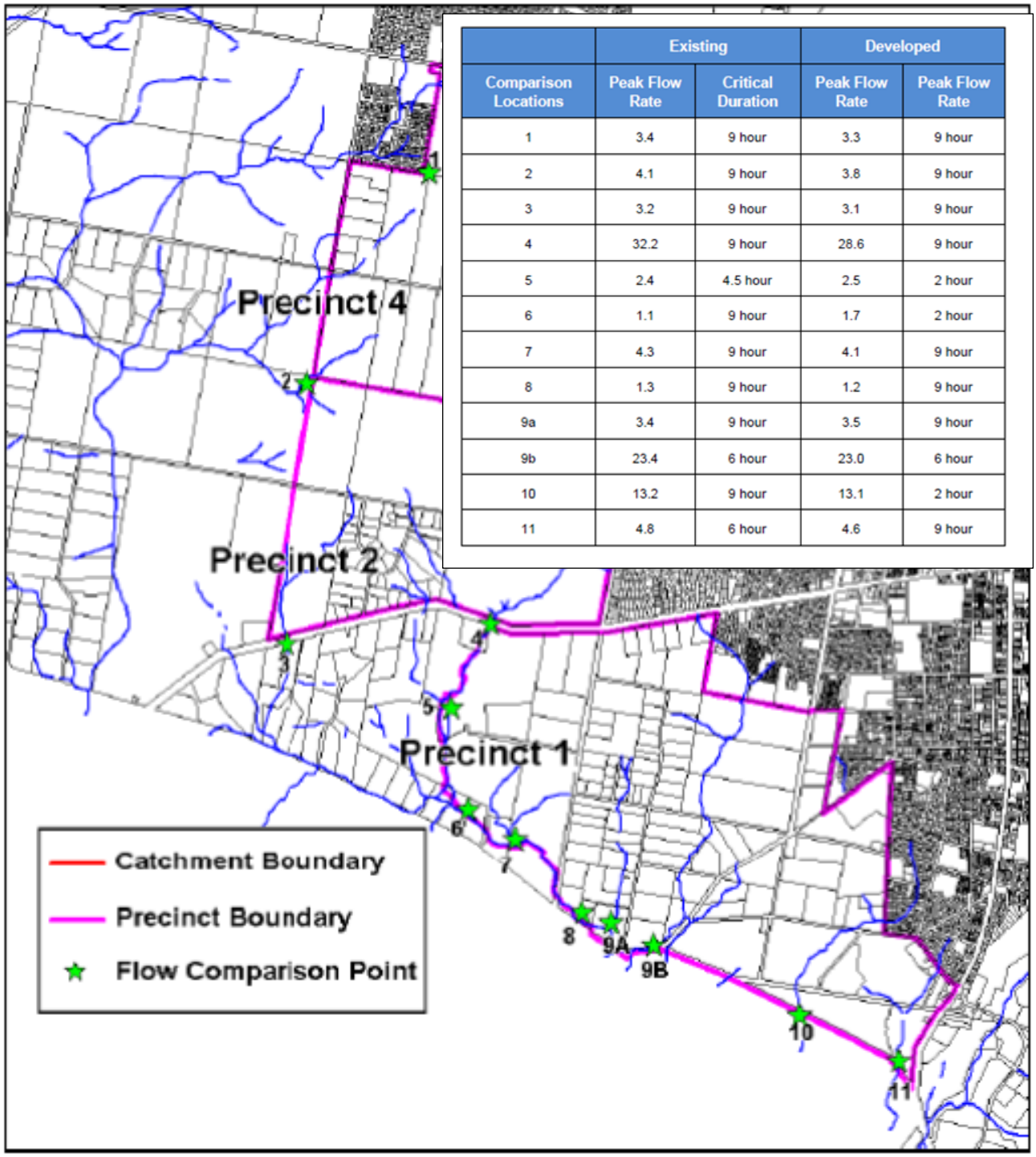
Table 3 Precinct 1 and Precinct 2 Water Quality results





Hydrological Check

Each Precinct was checked for its hydrological performance at each of the precinct boundaries. In this case the RORB model was not re-run rather the results as reported in the Engeny, 2012 report were reviewed. As can be seen in Figure 2 the flows at all comparison points (typically boundary locations) are less than the pre-developed flow. As such it can be said that each Precinct boundary meets its own water quantity requirements.



	Existing		Developed	
Comparison Locations	Peak Flow Rate	Critical Duration	Peak Flow Rate	Peak Flow Rate
1	3.4	9 hour	3.3	9 hour
2	4.1	9 hour	3.8	9 hour
3	3.2	9 hour	3.1	9 hour
4	32.2	9 hour	28.6	9 hour
5	2.4	4.5 hour	2.5	2 hour
6	1.1	9 hour	1.7	2 hour
7	4.3	9 hour	4.1	9 hour
8	1.3	9 hour	1.2	9 hour
9a	3.4	9 hour	3.5	9 hour
9b	23.4	6 hour	23.0	6 hour
10	13.2	9 hour	13.1	2 hour
11	4.8	6 hour	4.6	9 hour

Figure 2 Flow comparison points (Engeny, 2012)

9. Discussion

The proposed drainage scheme for the Ballarat West DCP provides cost sharing for the development of residential lands within three precincts. This document has reviewed Precinct 4 in particular and the provision of drainage infrastructure within it.

Drainage schemes generally provide for a more efficient use of both land, and funds to deliver a drainage solution for an area. Melbourne Water has successfully delivered schemes for well over 20 years, along with many other Councils and other drainage authorities. The key principle in any drainage scheme is that the participants in the scheme including the authorities have a perceived equity in the solution. Without this, both the scheme itself, and the drainage solution could be classified as a failure.

The proposed Ballarat West DCP provides the basis for a drainage scheme within the area. This scheme has been reviewed and found that each of the Precincts, and in particular Precinct 4, meets the basic requirements at its scheme boundary. As such, based on the principles outlined in Section 2, from a drainage perspective each precinct can operate on its own.

Each of the Precincts reviewed has a number of different land holder sizes, topographical differences, and catchment characteristics. It follows that due to these differences there will be both land development timing differences, and differential costs in the development of each of the Precincts. Precinct 4 in particular:

- Is located at the top of the catchment,
- Does not immediately drain into any other precinct,
- Is dominated by large land holdings and therefore expected to develop quicker than other Precincts
- Is easier to drain and treat than the other precincts
- Does not have large existing developments draining into it

These reasons, coupled with the scheme meeting (or able to meet) its requirements at the precinct boundary, results in an inequitable solution under the current proposal. As such, in my opinion it would not meet the requirements of Melbourne Water, or any other scheme proposal that Water Technology has been involved in.

10. Conclusions

Due to the size of Precinct 4, the natural topography of the precinct and the proposed works within the precinct, I see no reason, from a hydrological and water quality treatment perspective, why Precinct 4 could not be separated from the funding of the drainage component of the Ballarat West DCP.

11. Declaration

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

Chris M Beardshaw

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13 June 2013