Hume Planning Scheme Amendments C207 and C208: Sunbury South and Lancefield Road PSPs Permit Application Nos (P18858, P18854, P18855)

Expert Witness Report

Drainage Evidence – 60 Buckland Way

REVISION B

14 August 2017

Report by: Valerie Mag, B.E. Civil (Hons), M. Eng. Sci.

Stormy Water Solutions

stormywater@optusnet.com.au

Contents

1. Statement of Evidence

1.1 Qualifications and Expertise

I am the author of this report. My name is Valerie-Joy Sally Mag. I am a Civil Engineer and Principal of Stormy Water Solutions. I practice as a consulting hydraulic and hydrologic Engineer.

My educational qualifications are as follows:

- Bachelor of Civil Engineering, Monash University (1989)
- Master of Water Resources and Environmental Engineering, Monash University (1993)

I have twenty eight years' experience and expertise in hydrologic and hydraulic engineering, particularly in the areas of:

- Preparing complex urban and rural flood plain strategies,
- Preparing Water Sensitive Urban Design Strategies,
- Major catchment analysis, including flood flow and flood level estimation,
- Planning and assessment of development within flood plain and overland flow path systems,
- Reviewing drainage strategies prepared by other consultants for Melbourne Water and various councils, and
- Regularly preparing and conducting training in drainage and WSUD for the Municipal Association of Victoria, Vic Roads, Melbourne Water, the Department of Tourism Arts and the Environment (Tasmania), ARRB Group and others.

I have had no previous involvement in the site. However, I have been involved in various projects in and around Sunbury over the last 15 years including:

- The concept and functional design of various drainage elements within the existing Jacksons Hill Estate including the involvement in the overall drainage strategies for Jacksons Hill (2002 to 2006) and concept and functional design of the existing wetland system in Holden Reserve (2005), and
- Completing an audit of **all** of Hume City Council WSUD assets in 2015 which including inspecting all WSUD assets within the Jacksons Hill Estate.

I am proficient in the application of the current Melbourne Water's "Design, construction and establishment of constructed wetlands: design manual". My company (which consists of myself and one other technical engineer) designed over 20 wetlands to the manual requirements in 2016 alone.

1.2 Instructions that Define the Scope of the Report

As requested in by Echelon Planning in a letter to me dated 4 August 2017, I have been engaged by the owners of 60 Buckland Way Sunbury to act as an expert witness on behalf of owners of 60 Buckland Way and prepare a report which address the following issues:

- Whether the drainage reserve (defined under Melbourne Water Corporation (MWC) Development Services Scheme as WL10) could be moved to another location on the creek,
- Whether the drainage reserve for WL10 can be split into two reserves, with one smaller reserve located on the site and another located elsewhere on the creek,
- If the drainage reserve for WL10 be retained on the subject site, whether it could be shifted further towards the creek and/or reduced in size,
- Whether any of the land shown as 'landscape values' is potentially developable from a drainage perspective, i.e. is it outside the Urban Floodway Zone and could drainage issues potentially be addressed, and
- Whether the proposed planning controls for the potentially developable 'landscape values' land are appropriate from a drainage engineering perspective.

1.3 Documents Reviewed

As part of the preparation for this report have reviewed the following information/documents:

1. The Exhibited Sunbury South PSP (2016).

2. Selected exhibited Planning Scheme Amendment Documents including
    - Explanatory Report,
    - Zoning maps, and
    - Schedule 9 to the Urban Growth Zone.

3. The submission to Amendment C207 by Ive, Danica, Nikola and Ljubica Kolceg and the VPA's written response to this.

4. Submission to Amendments C207 and C208 by Hume City Council in which Section 16 of the letter includes comments on integrated water management.

5. Updated draft Sunbury South DSS issued by the VPA on 29 June 2017 with instructions that it will replace the drainage infrastructure shown in the exhibited PSP.

6. Post-exhibition information issued by the VPA on 31 July 2017 regarding the 'landscape values' land including the proposed planning controls for this land.

7. Background information received from Melbourne Water on 26 July 2017:
    - 'Riparian vegetation and geomorphology in the Sunbury Growth Area' (October 2014),
    - 'Erosion Analysis Classification for Waterways around Sunbury' (February 2015),
    - 'EPI (Erosion Potential Index) and volumetric results, groups 1, 2 & 3 and additional reaches' (April to September 2015),
    - 'Assessment of stormwater management challenges around Sunbury' (June 2015).

8. A map prepared by Echelon Planning showing elements of the exhibited PSP in relation to the site.

9. A map prepared by Echelon Planning showing the post-exhibition information on the landscape values in relation to the site.

10. Planning Panels Victoria expert evidence guidelines.

11. Panel Directions and timetable version 1.

12. A memo entitled “Erosion analysis classification for waterways around Sunbury Distribution” from Alluvium to Nino Polon (Melbourne Water) dated 20 February 2015.

13. A memo entitled “Assessment of Stormwater Management Challenges around Sunbury” from Alluvium to Aaron Dowling (Melbourne Water) dated 16 June 2015.

14. A memo from Alluvium entitled “Erosion Potential Analysis for Additional Reaches around Sunbury,” to Mat Garner dated 30 September 2015.

15. A report entitled “Riparian Vegetation and Geomorphology in the Sunbury Growth Area” by Alluvium and Biosis, October 2014.

16. Various maps produced by Biosis (dated 9 September 2014) detailed vegetation classes of all affects properties (including the subject site).

17. A Melbourne Water plan labelled DSS 6815 Draft Plan, dated 30 November 2016 showing preliminary DSS requirements including of the subject site.

18. A Melbourne Water plan labelled Fox Hollow Drive DSS 6815 Preliminary Plan, dated 3 August 2017 (provided by MWC to Valerie Mag (SWS) on this date).

19. PSP 74 and 75 Sunbury South and Lancefield Road, Victorian Planning Authority, Part A submission, August 2017.

20. A Melbourne Water Plan Dated April 2017 entitled “6814 Harpers Creek DSS, Infrastructure 1/1” April 2017

1.4 Other Material Referenced

My report is also based on:

- MWC's "Waterway Corridors Guidelines for greenfield development areas within the Port Phillip and Westernport Region".

- Melbourne Waters Guideline for the use of MUSIC (MWC web site August 2017),

- Design, construction and establishment of constructed wetlands: design manual (MWC web site August 2017),

- The MUSIC model (Version 6.6.1) used to assess various catchment strategies,

- Historical and recent Near Map aerial photography of the subject site and surrounds,

- Department of Environment Land Water and Planning (DELWP) interactive map data in downloaded in AutoCAD format from their website particularly:
    - 1 metre contour information,
    - watercourse locations as defined by DELWP, and
    - road and lot boundary locations,

- 0.5 Lidar contours in the area of interest (downloaded in GIS format and converted to AutoCAD),

- A site visit with the landowners on 2 August 2017, and

- A meeting with Melbourne Water and Echelon Planning held at Melbourne Water on 2 August 2017,

1.5 Summary

All of the above form the facts, matters and all assumptions upon which the report proceeds.

A summary of my conclusions in relation to the implications of the Melbourne Water Corporation DSS proposals on the subject site are summarised below.

- I agree that the land allocated for the Harpers Creek waterway and its riparian zone is reasonable to apply in this instance, particularly given the creek erosion issues.

- I agree complete removal of classification of land identified as "landscape values" from the subject site should not occur. As such, MWC's updated August 2017 DSS plan is a reasonable representation of delineating developable which can be drained via gravity to a regional wetland system (either located on, or south east of the subject site).

- Proposed planning controls for the “potentially developable ‘landscape values’ land” within the subject site are appropriate from a drainage engineering perspective, although care in the design development of drainage pipelines servicing this area must occur to ensure the area can drain under gravity to WL10.

- The drainage reserve (defined under Melbourne Water Corporation (MWC) Development Services Scheme as WL10) could be moved to another location on the creek as proposed in Section 4.2. I conclude that relocating WL10 to the area I have specified in Section 4.1 would be the best outcome, not only for the owners of 60 Buckland Way, but also for all land owners draining to this asset in terms of:
    - Reduced DSS costs via reduced WL10 construction costs and allowing more developable land in the DSS area, and
    - Ease of draining all developable land easily via gravity to WL10.

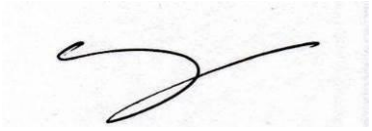
- I consider that the drainage reserve for WL10 can be split into two (or more) reserves, with one smaller reserve located on the site and others located elsewhere along the creek interface. However, I have not examined this alternative in detail given Council’s preference for one regional wetland facility to reduce maintenance requirements etc.

- If the drainage reserve for WL10 is retained on the subject site, it can be both shifted further towards the creek and reduced in size as per Section 4.1.

This report only covers drainage implications east of Harpers Creek. The design of drainage provisions west of the creek has a minor impact on the subject site and has not been considered in this report.

All issues regarding, geomorphological, ecological and environmental impact (except where addressed by incorporation of proposed drainage Water Sensitive Assets) are outside the scope of this report and my expert evidence.

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.



Valerie – Joy S Mag
B.E. Civil (Hons), M. Eng. Sci.
Principal
STORMY WATER SOLUTIONS
1.26 Jells Road
Wheelers Hill 3150
10 August 2017

2. Drainage Proposals on 20 Buckland Way

I have been engaged by the owners of 60 Buckland Way, Sunbury (the subject site) to specifically address the impact of the proposed MWC drainage infrastructure on the subject site.

Proposals are summarised below.

2.1 2016 Drainage Proposals

Of particular concern to the landowners is the area shown as encumbered for “drainage purposes” in a MWC plan labelled DSS 6815 Draft Plan, dated 30 November 2016 as detailed in Figure 1, showing preliminary DSS requirements including of the subject site

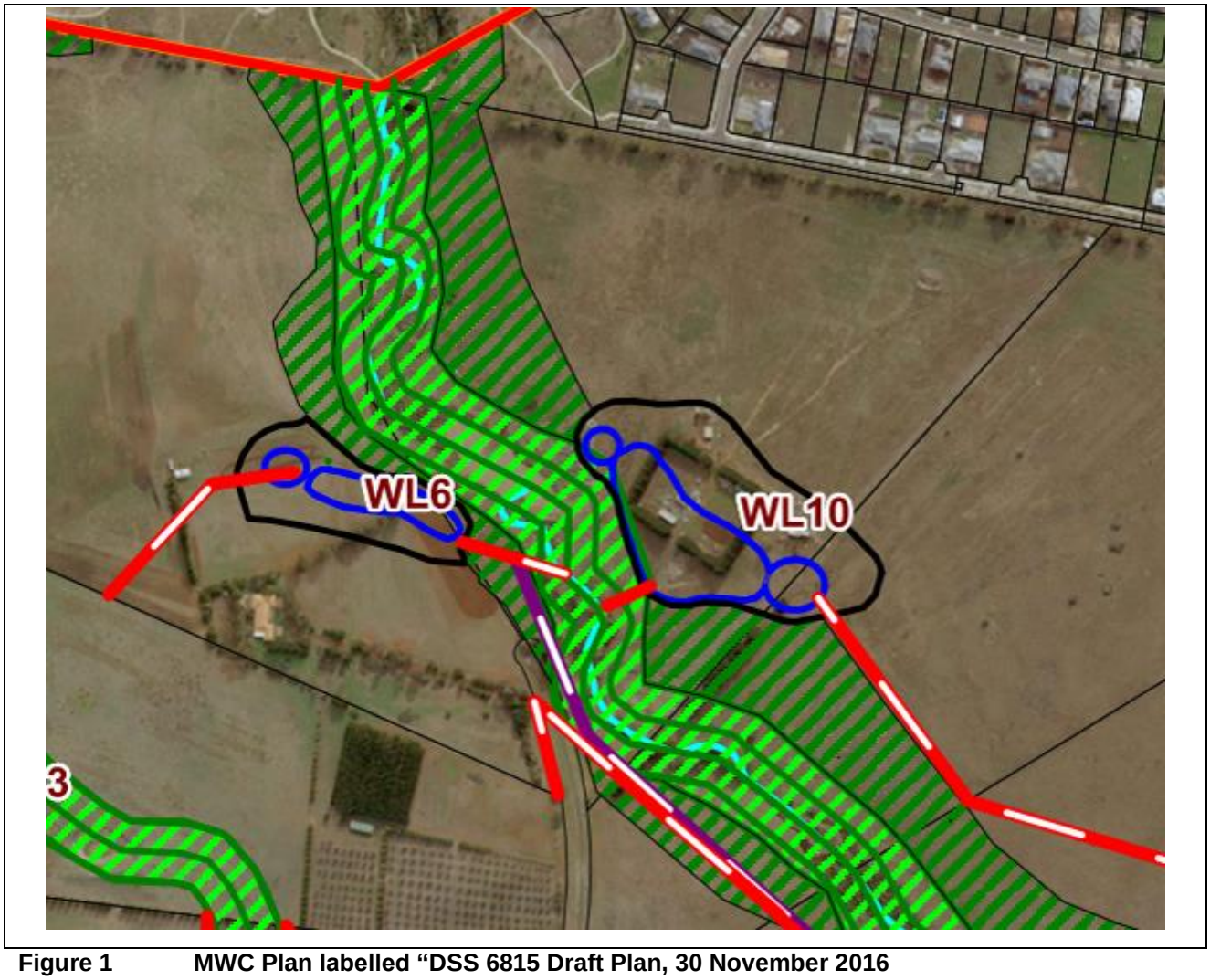


Figure 1 MWC Plan labelled “DSS 6815 Draft Plan, 30 November 2016

This report specifically addresses the above issues.

The 2016 plan shows three encumbered allocations of land in the subject site being:

- Land associated with the exiting Harpers Creek waterway and its riparian zone, including the area affected by the 1% Annual Exceedance Probability (AEP) flood event (light green hatch, Figure 1),
- Land identified as “landscape values” (dark green hatch, Figure 1), and
- Land associated with proposed wetland WL10.

Once all of the above are taken into account, the remainder of land identified as developable is in the order of 9.6 ha, representing about 49% of the subject site. This excludes any additional provision for local parks within the developable area.

Although not examined in detail, I agree that the land allocated for the Harpers Creek waterway and its riparian zone is reasonable to apply in this instance, particularly given the creek erosion issues.

Issues in regard to the areas identified as exhibiting “landscape values” and WL10 are discussed below.

2.2 August 2017 Drainage Proposals

In a meeting on 2 August 2017, MWC advised that the land allocated originally proposed above had been modified. Figure 2 details the updated plan.

The current DSS proposals increase the developable land on the subject site to in the order of 11.6 ha, representing about 59% of the subject site. This excludes any additional provision for local parks within the developable area.

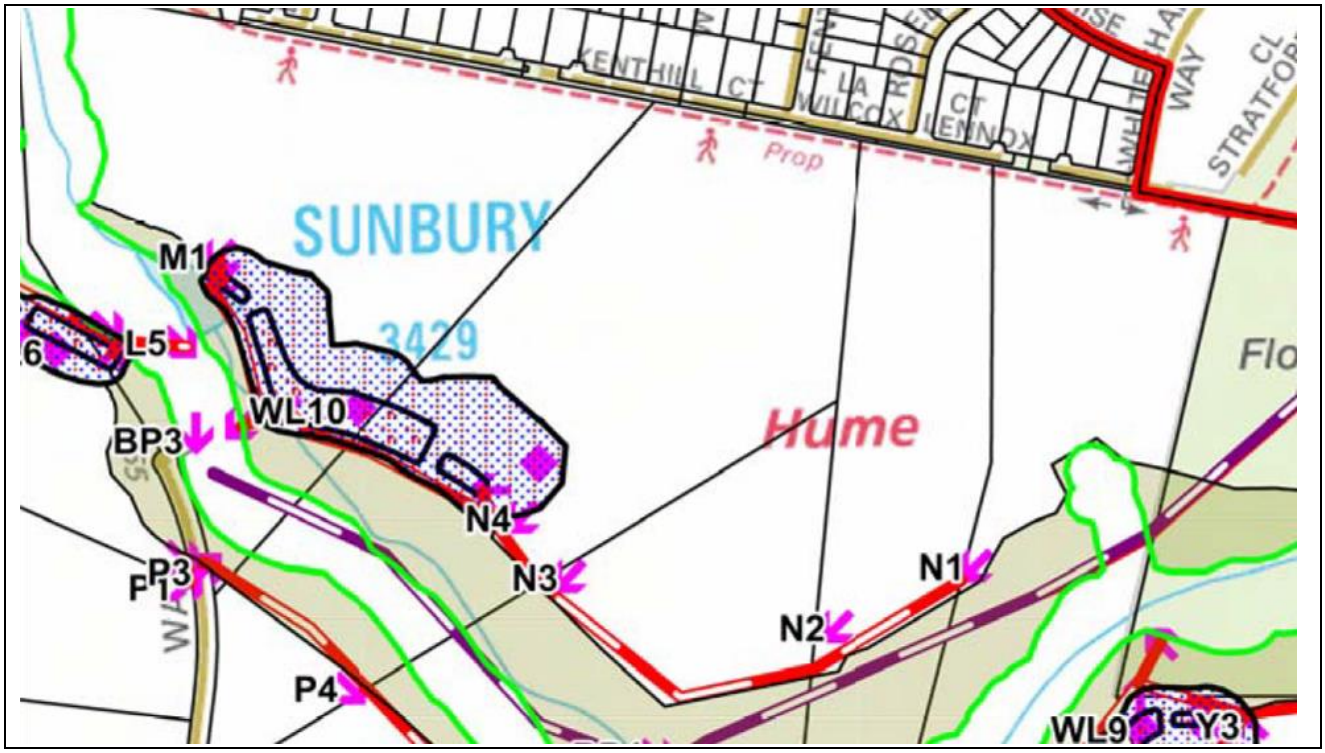


Figure 2 Extract of a MWC plan labelled “Fox Hollow Drive DSS 6815 Preliminary Plan, 3 August 2017”

In the meeting of 2 August 2017 with SWS, MWC explained that land identified as “landscape values” was largely delineated given a slope analysis of the areas adjacent to Harpers Creek. This is land that potentially could be developable subject to addressing drainage constraints. The main drainage issue (as opposed to other issues associated with building on steep slopes) is ensuring piped outfalls can discharge under gravity to allocated wetland areas.

The Landscape Values land can be defined as “potentially developable” and “undevelopable” as defined in Figure 3 below.

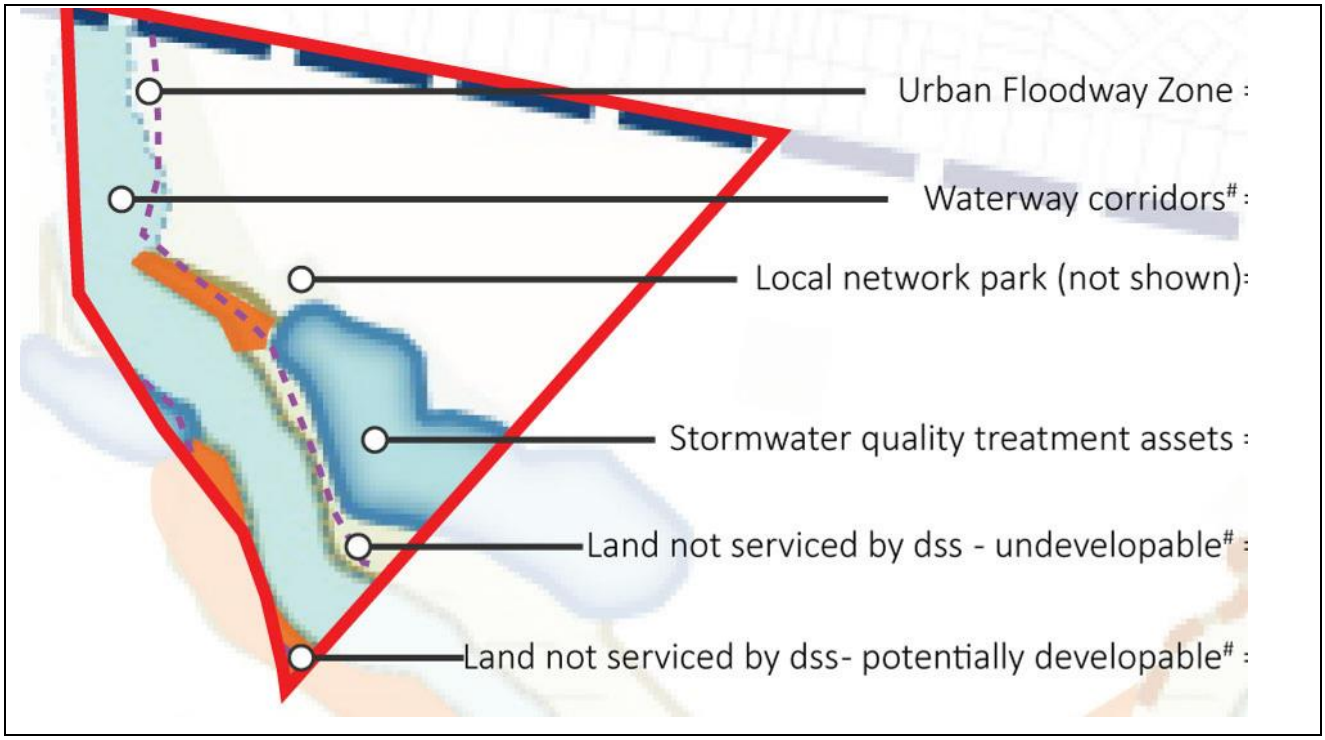


Figure 3 Echelon Planning Plan detailing current land allocation within the subject site.

As detailed in Figures 2 and 3 above, the latest DSS plan released by MWC has substantially reduced the “Landscape Values” area within the subject site. I generally agree that the remainder of the area shown, being low, steep and relatively close to the receiving body of Harpers Greek, would be difficult to drain via pipelines to a regional wetland system. I agree complete removal of classification of land identified as “landscape values” from the subject site should not occur. The updated August 2017 plan is a reasonable representation of delineating developable which can be drained via gravity to a regional wetland system (either located on, or south east of the subject site). Notwithstanding the above, it is recognised that construction of dwellings within the urban floodway zone is prohibited.

I consider that the proposed planning controls for the potentially developable ‘landscape values’ land are appropriate from a drainage engineering perspective, although care in the design development of drainage pipelines servicing this area must occur to ensure the area can drain under gravity to WL10.

I do have concerns about the delineation of the area allocated for, and the location of WL10, and these are discussed below.

3. Assessment of August 2017 Design of WL10

In a meeting on 2 August 2017 with SWS, MWC advised that the design of WL10 is required to achieve two objectives being:

- Storing water after storm events to reduce the flow volume in Harpers Creek to address ongoing erosion concerns, and
- Treating stormwater to current best practice (80% removal of Total Suspended Solids (TSS), 45% removal of Total Phosphorus (TP) and 45% removal of Total Nitrogen (TN)) from the contributing developable area prior to discharge to Harpers Creek.

SWS estimates the current MWC DSS wetland design parameters as detailed in Figure 4. This plan has been prepared by SWS bases on the August 2017 DSS provided by MWC.

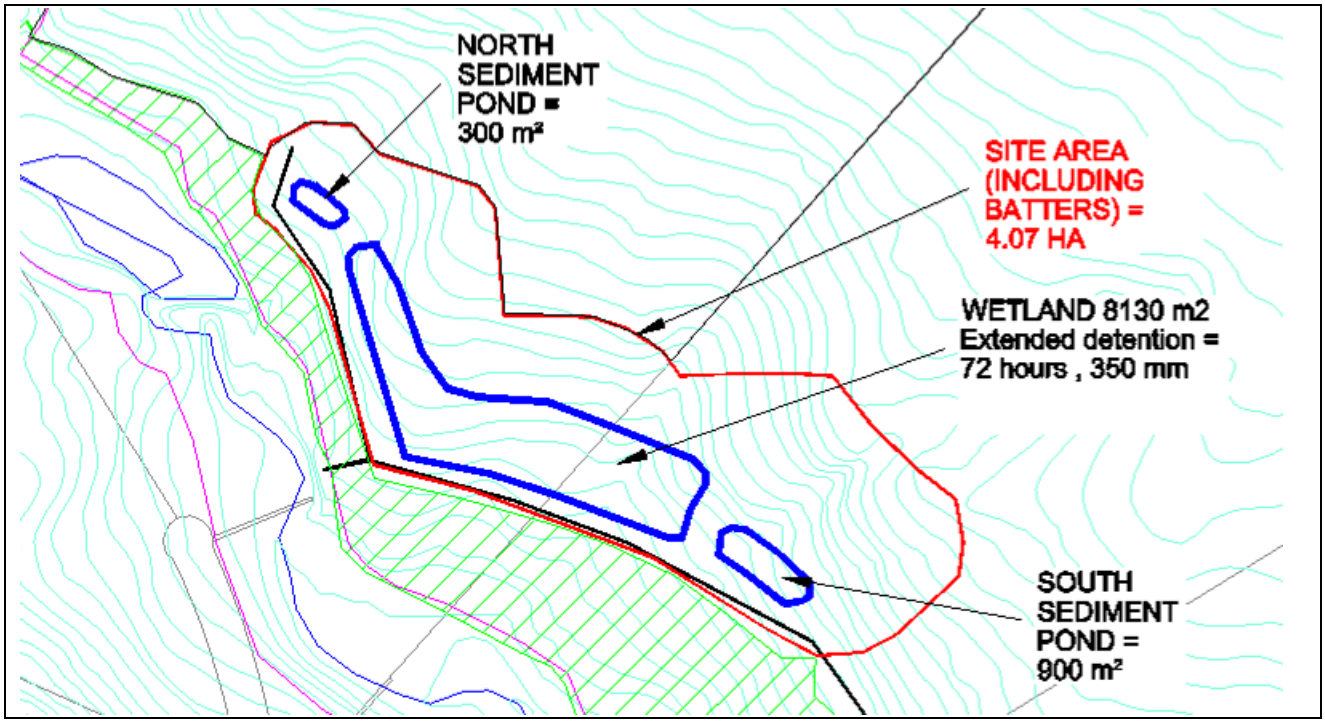


Figure 4 Assumed Sediment Pond and Wetland Characteristics Based on MWC August 2017 DSS plan

These aspects are discussed below.

3.1 Stormwater Runoff Storage

MWC have advised that flood storage is not required for the 100 Year ARI (1% AEP) event in this case. A large regional retarding basin is planned upstream of the viaduct.

In a memo entitled “Assessment of Stormwater Management Challenges around Sunbury (June 2015)” Alluvium concluded that an erosion potential analysis clearly indicated a “business as usual” drainage design approach based around specific objectives and design criteria, collectively known as best practice treatment objectives, will not manage flows sufficiently to protect waterway physical form and manage the risk to built and natural assets.

Alluvium recommended that a flow management strategy, along with optimal waterway setbacks, be developed to manage the increased risks of erosion following urban development in the growth areas around Sunbury.

The above work further expanded on in a memo entitled “Erosion analysis classification for waterways around Sunbury Distribution, Alluvium, 20 February 2015” which examined the scale of flow management required to protect the receiving waterways from increased erosion from urban runoff, and to reduce the risk of erosion to an acceptable level. Management techniques included:

- Attenuation of flows through temporary storage or detention to provide for reduced peak flows over a longer duration (as would be provided in this case by WL10), and
- Bypass or reuse of stormwater to reduce the volume and erosive power of stormwater in the receiving waterways (Harpers Creek in this case).

This work informed the “solution curves” detailed below for various tributaries of Jacksons Creek. The “solution curve” for Harpers Creek it reiterated in Annexure 1 in this report.

In memo entitled “Erosion Potential Analysis for Additional Reaches around Sunbury, Alluvium, 30 September 2015” the Erosion Potential Index (EPI) approach was described. This is a method used to identify drainage solutions that maintain the current erosion potential on the waterway. A series of drainage solutions for each waterway that met the objectives were investigated. The solution for each waterway are various combinations of storage volume (representing wetland/retarding basin storage) and bypass flows (representing either piped flows that bypass Harpers Creek to prevent erosion or stormwater harvesting). For example, one solution would be no storage and a large pipe to divert all low flows in Harpers Creek. At the other end of the spectrum would be the provision of a large storage in the contributing catchment and no bypass pipe.

The “solution curve” for Harpers Creek in the vicinity of the subject site is reproduced as Annexure 1. This Figure appears to indicate that there is ample storage available (over 2,800 m^3) in the 350 mm extended detention range of WL10 to meet the above objectives with minimal bypass flow.

As such, I consider that the design of the wetland can follow normal wetland design procedures without consideration of addition flood storage provisions in excess of the extended detention range (being 350 mm above Normal Water Level (NWL). In fact the wetland is over sized to meet the criteria described in this section.

3.2 Stormwater Pollutant Retention

WL10 is required to treating stormwater to current best practice being 80% removal of TSS and 45% removal of TN and TP from the contributing developable area prior to discharge to Harpers Creek. I used the MUSIC model (Version 6.2.1) to assess the current MWC DSS proposal.

Wetland parameters were as detailed in Figure 3 above. It was assumed that the total extended detention in the two sediment ponds and wetland was 72 hours. As there are two separate inlets to the system, the extended detention time in each system was apportioned based on system size.

The MWC web site recommend Melbourne Airport rainfall and evaporation data for 1971 to 1980 be used in the model for this area of Melbourne. As this data set has a significant gap in the data, I used Melbourne Airport data from 1981 to 1991 at 6 minute intervals. This resulted in an annual rainfall of 522 mm, which is deemed reasonable for the Sunbury region. A fraction imperviousness of 0.6 was utilised, based on MWC recommendations for development exhibiting lots between 600 – 1000 m^2. The MUSIC model is detailed in Figure 5 below.

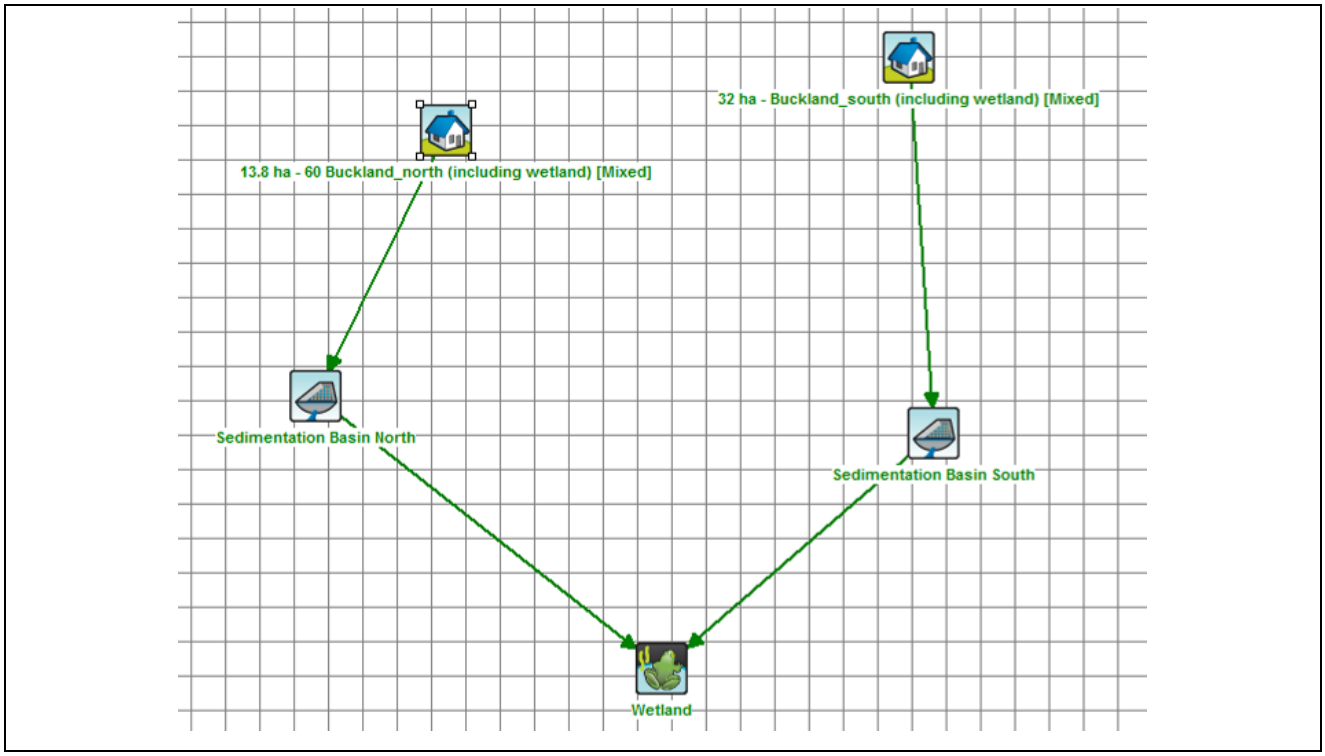


Figure 5 MUSIC Model – Assessment of August 2017 DSS Proposals

The MUSIC model predicts:

- 85.6 % removal of TSS,
- 73.8 % removal of TP, and
- 52.2 % removal of TN.

Given the above, I conclude that the current MWC DSS proposal for wetland WL10 is overdesigned to meet the stormwater pollutant retardation requirements of the DSS.

4. Possible Alternative Designs

There are many ways to meet the two major flood storage and stormwater pollutant retention objectives above. These could include distributed WSUD and stormwater management initiatives throughout the catchment. For instance, a strategy incorporating tanks for toilet flushing, distributed stormwater input to contour swales running along the edge of the "significant landscape" boundary and distributed sediment ponds would probably suffice. Alternatively, the large "regional wetland" could be split into two or three. Both of these alternatives would have the advantage of ensuring a small water feed to some of the existing primary flow paths immediately upslope of Harpers Creek. The existing DSS strategy essentially cuts all flow off from these flow paths, which must have ecological consequences.

However, it is clear from the documents reviewed, that Council would prefer one regional wetland in this area to minimise maintenance responsibilities. This is understandable considering the large amount of wetlands proposed within the whole of the Sunbury South and Lancefield Road PSP's. As such, I have not investigated distributed drainage solutions in the area of interest.

I have investigated two alternative scenarios. These are presented to show that there are other ways to achieve the objectives while reducing or removing the requirement for WL10 on the subject site.

I note that MWC are currently undertaking the functional design for WL10 which may also achieve the objective of reducing WL10 land take on the subject site. However, MWC informed me on 2 August 2017 that this functional design was not available for review at this time.

4.1 Removing WL10 from the Subject Site.

This alternative design considers removing WL10 from the subject site. The alternative solution is shown in Figure 6 below. This is the preferred design of the landowners of 60 Buckland Way.

It should be noted that I have used 0.5 metre Lidar data to set realistic normal water levels and batter requirements, in regard to the vertical constraints of the site.

The proposal as detailed in Figure 6 increases the developable land on the subject site to in the order of 13.8 ha, representing about 71% of the subject site. This excludes any additional provision for local parks within the developable area. As such, the MUSIC analysis as detailed below is conservative in regard to stormwater pollutant removal efficiencies.

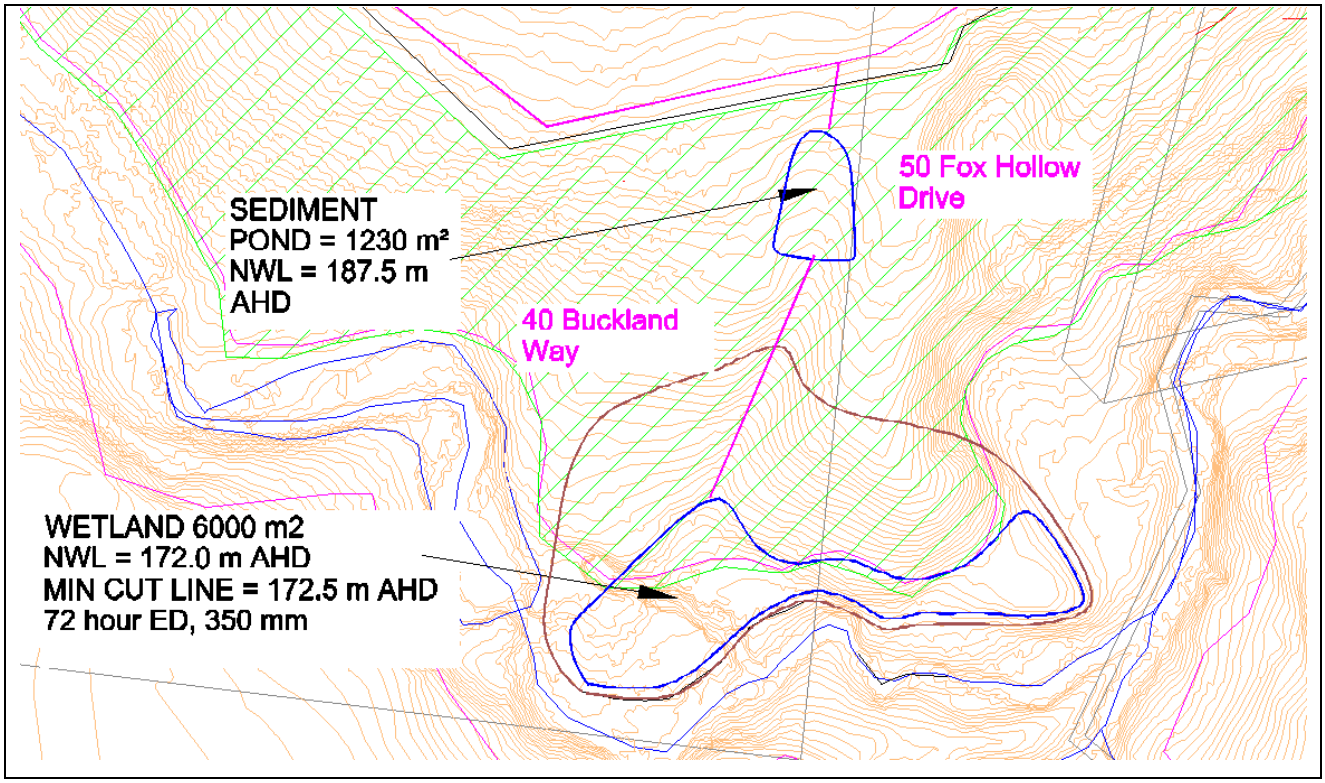


Figure 6 **Alternative Design of WL10 - Relocated to "Land Not Servied by DSS (developable and undevelopable) within 40 Buckland Way annd 50 Fox Hollow Drive**

The proposal detailed in Figure 6 has the advantage of locating both the sediment pond and wetland within the area identified within the DSS as having "landscape values". The sediment pond could be moved further south if required to enable development of 40 Buckland Way and 50 Fox Hollow Drive within the "Land Not Servied by DSS but defined as possibly developable". All land to the north of the proposed site can be drained under gravity to the sediment pond and wetland system as it is now located within the lowest area of the catchment.

The site proposed for the wetland is largely within a flat area of land located north of the existing creek line. Near Map information indicates the land is relatively clear of vegetation. Placement of a wetland in this location offers the opportunity to substantially increase the ecological diversity in the large flat area immediately adjacent to the creek line. This is a simular concept to the existing wetland servicing the eastern catchment of the Jacksons Hill Estate immediately north of 60 Buckland Way.

As at least part of the wetland detailed as Alternative 1 is probably within the defined 1% AEP flood extent of Harpers Creek, the design development will be required to ensure the following (in addition to the usual MWC requirements):

- That an access path can be located around the wetlland to MWC maintenance requirements above the 10 year ARI (10% AEP) flood level in Harpers Creek, and
- That the 100 year ARI (1% AEP) velocity from the creek over the wetlaand in less than 0.5 m/s

However, preliminary investigations (Mannings formula) indicate that the above criteria can be met.

Given the “over treatment” in the current DSS proposal, I have reduced the normal water level area of the wetland to 6000 m^2.

The MUSIC model used to assess this alternative is detailed in Figure 7.

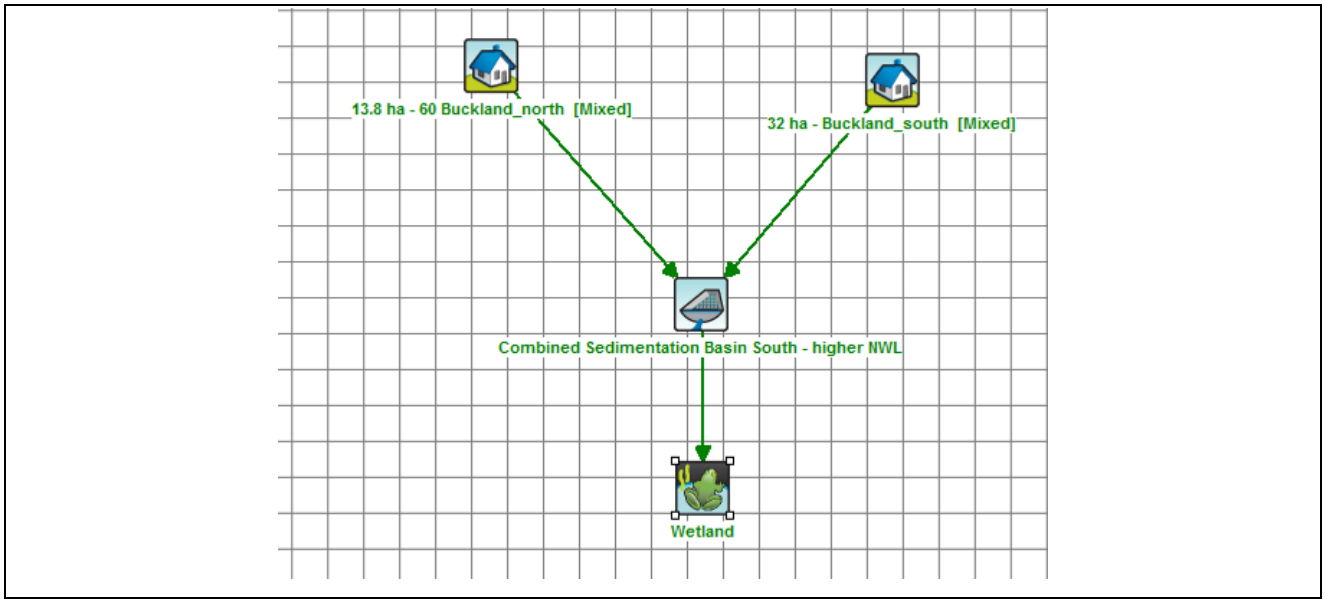


Figure 7 MUSIC Model – Wetland Alternative 1

The results of the MUSIC modelling for Alternative 1 are detailed below. As shown, this the alternative design can meet best practice in regard to stormwater pollutant retention.

- 80.8 % removal of TSS,
- 67.7 % removal of TP, and
- 45.8 % removal of TN.

In addition, the alternative design of the wetland can follow normal wetland design procedures without consideration of addition flood storage provisions in excess of the extended detention range (being 350 mm above Normal Water Level (NWL)). The wetland detailed as Alternative 1 is over sized to meet the criteria of providing storage to mitigate against increased erosion potential in Harpers Creek.

4.2 Reducing the Area of WL10 within the Subject Site.

This alternative design considers reducing the area of WL10 both within the subject site, and the neighbour to the east. The alternative solution is shown in Figure 8 below.

The proposal as detailed in Figure 8 increases the developable land on the subject site to in the order of 12.7 ha, representing about 65% of the subject site. This excludes any additional provision for local parks within the developable area. As such, the MUSIC analysis as detailed below is conservative in regard to stormwater pollutant removal efficiencies.

The reduction is achieved via three mechanisms as discussed below. Again I have used 0.5 metre Lidar data to set realistic normal water levels and batter requirements, in regard to the vertical constraints of the site.

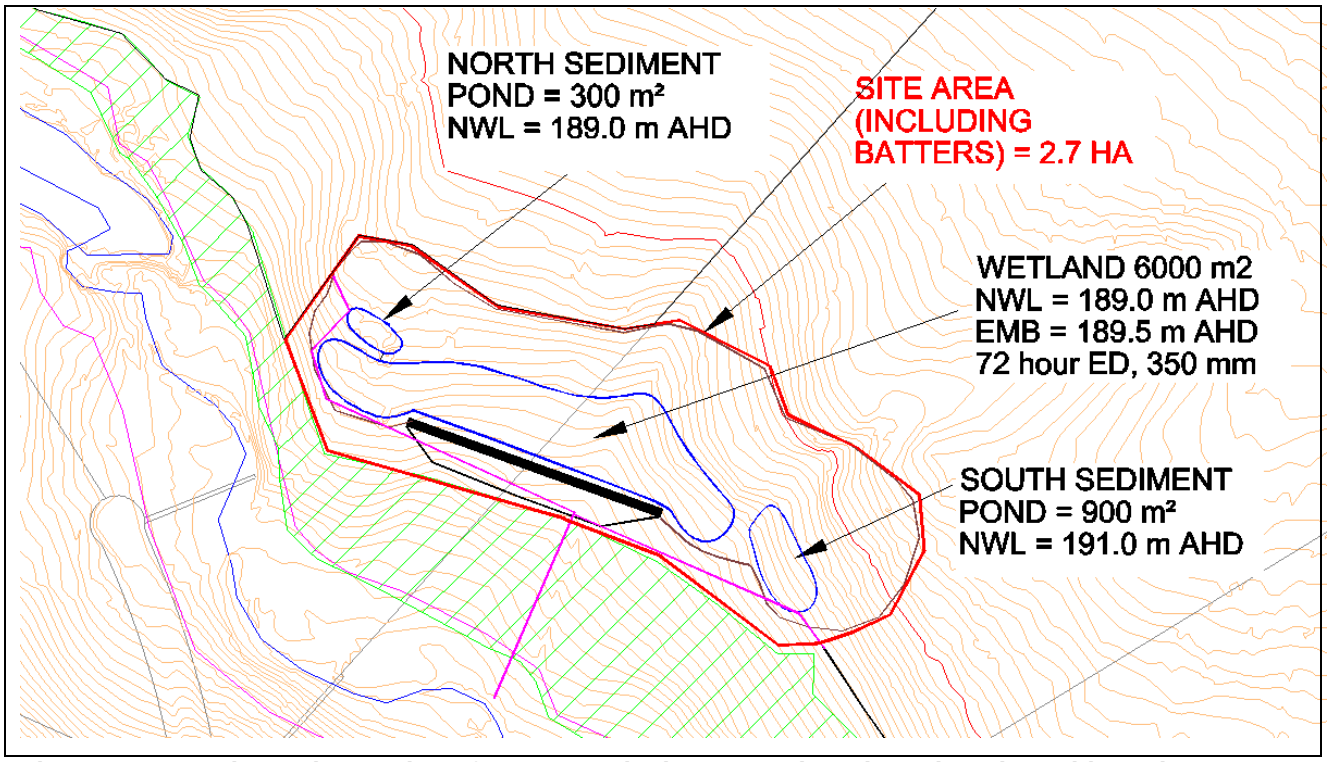


Figure 8 **Alternative Design of WL10 - Reducing Encumbered Land on the Subject Site. (NWL = normal water level, EMB = Embankment Crest Level)**

A large amount of the site allocation is due to batter requirements (1 in 5 assumed to current MWC standards). Battering into a steep slope can result in over 60 metres of site allocation away from the wetland just for the batter. Incorporating an embankment on the downslope of the system will help reduce battering requirements by allowing a higher Normal Water Level (NWL) in the system. The embankment I have detailed in Figure 8 would be 750 mm above the NWL. This type of design is as incorporated in the existing Holder Reserve wetland located on the eastern edge of the existing Jacksons Hill Estate (2005 concept and functional design by Ecological Engineering and Stormy Water Solutions).

To further reduce battering requirements I have incorporated a design where the south sediment pond has a normal water level 2 metres higher than the wetland and north sediment pond. Preliminary analysis indicates that pipe outfalls from the south east can still be achieved with this higher normal water level. The normal water level of the north sediment pond is the same as the wetland to ensure adequate pipe outfall provisions from the subject site.

Lastly I have reduced the normal water level area of the wetland to 6000 m^2. The sediment pond areas remain as per the current DSS proposals. The MUSIC model as detailed above predict the following stormwater pollutant reductions if this wetland reduction is accounted for:

- 80.1 % removal of TSS,
- 67.6 % removal of TP, and
- 45.8 % removal of TN.

As detailed, the alternative design can meet best practice in regard to stormwater pollutant retention.

In addition, the alternative design of the wetland can follow normal wetland design procedures without consideration of addition flood storage provisions in excess of the extended detention range (being 350 mm above Normal Water Level (NWL)). The wetland detailed as Alternative 2 is over sized to meet the criteria of providing storage to mitigate against increased erosion potential in Harpers Creek.

4.3 MWC Proposals Detailing no Provision for WL10 on the Subject Site.

The alternative of not locating WL10 on the subject site has also been considered by MWC as recently as April 2017. Figure 9 below reproduces part of a MWC plan dated April 2017 and entitled "Harpers Creek DSS, Infrastructure 1/1, April 2017". Property 29 is the subject site located in the adjacent Fox Hollow Drive DSS.

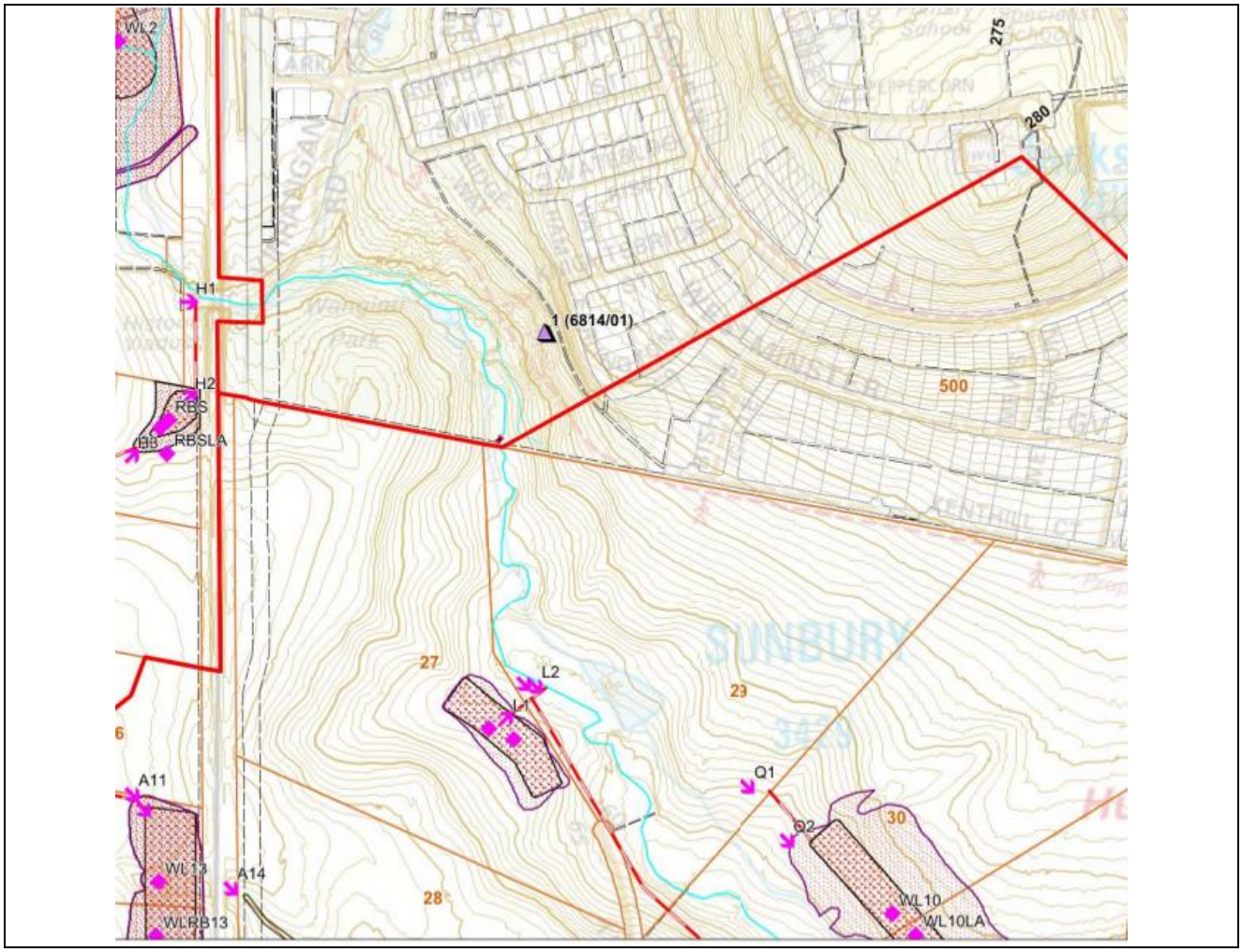


Figure 9 MWC plan dated April 2017 and entitled "Harpers Creek DSS

As detailed in Figure 9, as recently as April 2017 MWC were considering locating WL10 outside the subject site. It is understood that the MWC DSS wetland proposal was recently moved to within the subject site due to PSP proposed road interface constraints. I would suggest that the better place to have moved WL10 would be to the low point in the area as defined in Section 4.1 above, rather than higher in the catchment as defined by the location of WL10 within the subject site.

5. Conclusions

A summary of my conclusions in relation to the implications of the Melbourne Water Corporation DSS proposals on the subject site are summarised below.

- I agree that the land allocated for the Harpers Creek waterway and its riparian zone is reasonable to apply in this instance, particularly given the creek erosion issues.

- I agree complete removal of classification of land identified as “landscape values” from the subject site should not occur. As such, MWC’s updated August 2017 DSS plan is a reasonable representation of delineating developable which can be drained via gravity to a regional wetland system (either located on, or south east of the subject site).

- Proposed planning controls for the “potentially developable ‘landscape values’ land” within the subject site are appropriate from a drainage engineering perspective, although care in the design development of drainage pipelines servicing this area must occur to ensure the area can drain under gravity to WL10.

- The drainage reserve (defined under Melbourne Water Corporation (MWC) Development Services Scheme as WL10) could be moved to another location on the creek as proposed in Section 4.2. I conclude that relocating WL10 to the area I have specified in Section 4.1 would be the best outcome, not only for the owners of 60 Buckland Way, but also for all land owners draining to this asset in terms of:
    - Reduced DSS costs via reduced WL10 construction costs and allowing more developable land in the DSS area, and
    - Ease of draining all developable land easily via gravity to WL10.

- I consider that the drainage reserve for WL10 can be split into two (or more) reserves, with one smaller reserve located on the site and others located elsewhere along the creek interface. However, I have not examined this alternative in detail given Council’s preference for one regional wetland facility to reduce maintenance requirements etc.

- If the drainage reserve for WL10 is retained on the subject site, it can be both shifted further towards the creek and reduced in size as per Section 4.1.

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.

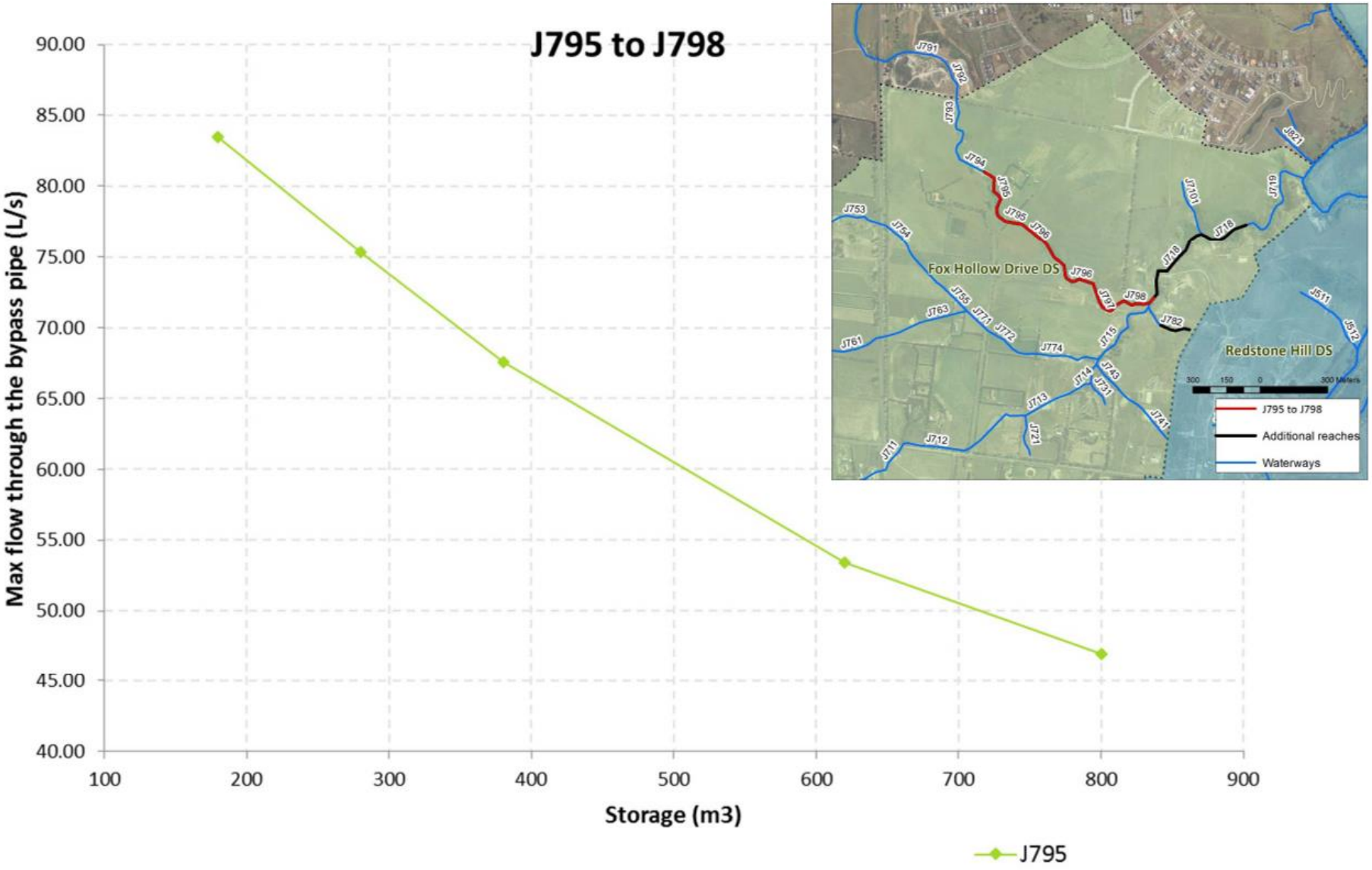
6. Abbreviations

Table 1 lists some common abbreviations and drainage system descriptions and their definitions which are referred to in this report.

Table 1 Common Drainage Abbreviations

Abbreviation Descriptions	Definition
AHD - Australian Height Datum	Common base for all survey levels in Australia. Height in metres above mean sea level.
AEP – Annual Exceedance Probability	The probability of an event being exceeded per year. i.e. 1% AEP = 100 Year ARI event.
ARI - Average Recurrence Interval.	The average length of time in years between two floods of at least a given size. A 100 Year ARI event has a 1% chance of occurring in any one year.
DSS	Development Services Scheme – catchment drainage strategies developed, implemented and run by MWC.
EY – Exceedances per Year	Magnitude of event that is expected to be exceeded X times per year. i.e. 4 EY = 3-month ARI event.
Grassed Swale	A small shallow grassed drainage line designed to convey stormwater discharge. A complementary function to the flood conveyance task is its WSUD role (where the vegetation in the base acts as a treatment swale).
Hectare (ha)	10,000 square metres
Kilometre (km)	1000 metres
m^3/s -cubic metre/second	Unit of discharge usually referring to a design flood flow along a stormwater conveyance system
Megalitre (ML) (1000 cubic metres)	1,000,000 litres = 1000 cubic metres Often a unit of water body (e.g. pond) size
MUSIC	Hydrologic computer program used to calculate stormwater pollutant generation in a catchment and the amount of treatment which can be attributed to the WSUD elements placed in that catchment
MWC	Melbourne Water Corporation
Retarding basin	A flood storage dam which is normally empty. May contain a lake or wetland in its base
Normal Water Level (NWL)	Water level of a wetland or pond defined by the lowest invert level of the outlet structure
Sedimentation basin (Sediment pond)	A pond that is used to remove coarse sediments from inflowing water mainly by Settlement processes.
Surface water	All water stored or flowing above the ground surface level
TSS	Total Suspended Solids – a term for a particular stormwater pollutant parameter
TP	Total Phosphorus – a term for a particular stormwater pollutant parameter
TN	Total Nitrogen – a term for a particular stormwater pollutant parameter
Extended Detention	Range of water level rise above normal water level where stormwater is temporarily stored for treatment for a certain detention period (usually 48 – 72 hours in a wetland system)
WSUD - Water Sensitive Urban Design	Term used to describe the design of drainage systems used to o Convey stormwater safely o Retain stormwater pollutants o Enhance local ecology o Enhance the local landscape and social amenity of built areas
Wetland	WSUD elements which are used to collect TSS, TP and TN. Usually incorporated at normal water level (NWL) below which the system is designed as shallow marsh, marsh, deep marsh and open water areas.

Annexure 1 – Extract from a memo from Alluvium entitled "Erosion potential analysis for additional reaches around Sunbury," to Mat Garner dated 30 September 2015.


J795 to J798
Max flow through the bypass pipe (L/s)
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
100
200
300
400
500
600
700
800
900
Storage (m3)
J795
Fox Hollow Drive DS
Redstone Hill DS
J795 to J798
Additional reaches
Waterways