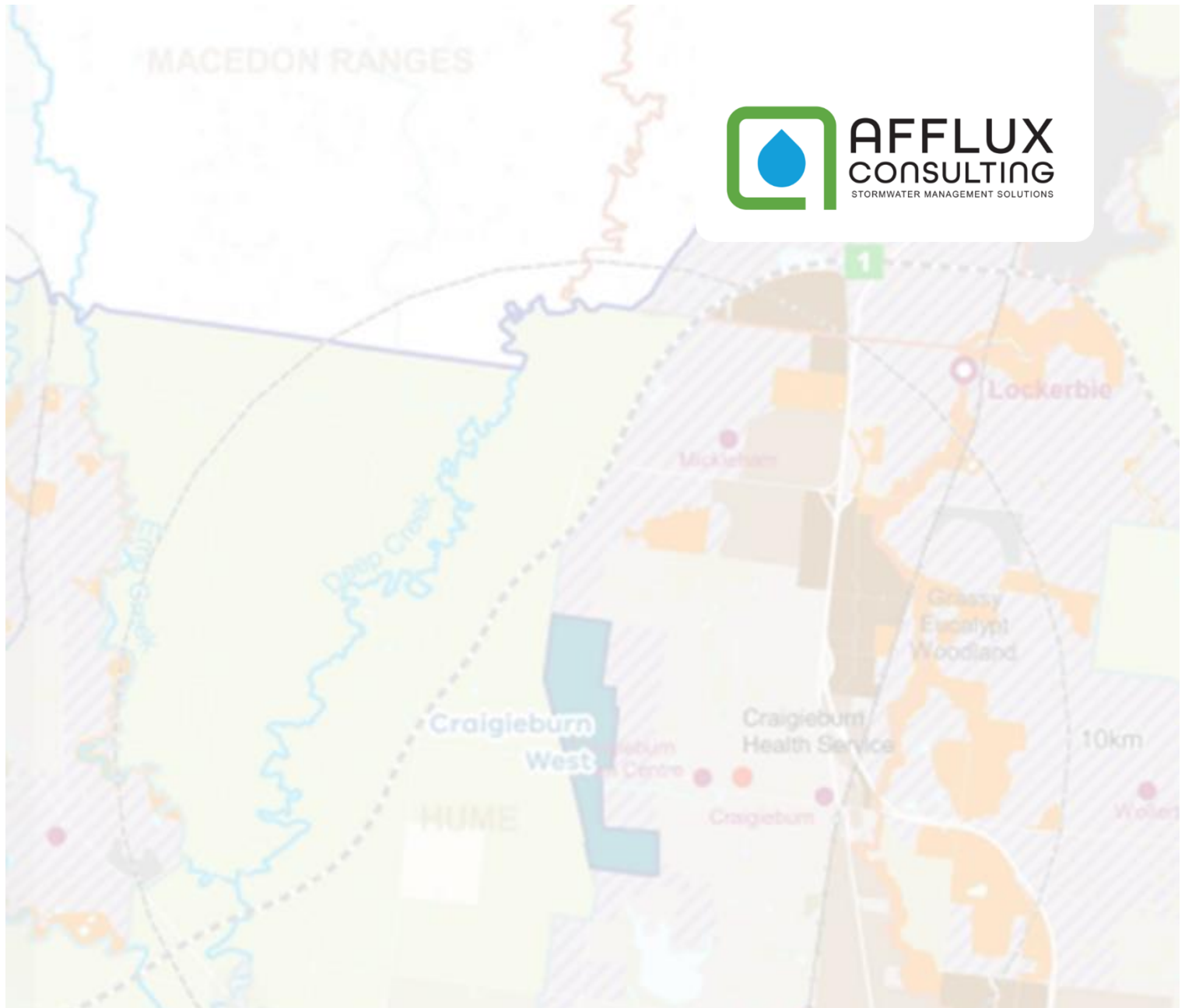


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# CRAIGIEBURN WEST PRECINCT STRUCTURE PLAN

## Expert Evidence Report

Date 16 April 2021

Prepared for Craigieburn West PSP Panel Hearing

Version Precinct Structure Plan

Author Chris Beardshaw

Client Deague Group

<b>Prepared for</b>	Craigieburn West PSP Panel Hearing
<b>Author/s</b>	Chris Beardshaw
<b>Checked</b>	CMB
<b>Approved</b>	CMB
<b>Instructed by</b>	Deague Group

## Document History

Version	Date	Description
Precinct Structure Plan	16/4/2021	Expert Evidence Report

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## Climate Change Statement

A wide range of sources, including but not limited to the IPCC, CSIRO and BoM, unanimously agree that the global climate is changing. Unless otherwise stated, the information provided in this report does not take into consideration the varying nature of climate change and its consequences on our current engineering practices. The results presented may be significantly underestimated; flood characteristics shown (e.g. flood depths, extents and hazards) are may be different once climate change is taken into account.

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# 1. Report Author

## **Christopher Mitchell Beardshaw**

Principal Engineer

Afflux Consulting Pty Ltd

Emerald, VIC 3178

### **Qualifications:**

- BEnvEng (Hons), Monash University, 2002
- MEngSci, UNSW, 2006
- Graduate Certificate River Health Management, University of Melbourne, 2009
- River Styles <sup>TM</sup>, 2019

### **Affiliations:**

- Member, Institution of Engineers Australia
- President, Stormwater Victoria Industry Association (2016-2019)

### **Area of Expertise:**

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

- Assessment of flooding, water quality and waterway protection
- Drainage and WSUD industry expert
- Urban and rural river design and management
- Data collection, processing and analysis
- Application of GIS
- 1- and 2-Dimensional Flood modelling

### **Statement of Expertise**

With my qualifications and experience, I believe that I am well qualified to provide an expert opinion of drainage issues within the land associated with the Craigieburn West PSP.

### **Scope of this Statement and associated Report**

I have been instructed in this matter by Planning and Property Partners Pty Ltd, who act on behalf of Deague Group, which are the representing the properties 7, 9, 11, and 15 within the Craigieburn West PSP.

---

## 2. Report Contributors

### **Theresa Catherine Fuhrmann**

Engineer

Afflux Consulting Pty Ltd

Emerald, VIC 3178

#### **Qualifications:**

- BEng (Hons), Swinburne University, 2020
- BBus, Swinburne University, 2020

#### **Affiliations:**

- Member, Stormwater Victoria Industry Association

#### **Area of Expertise:**

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

- Experience as Strategies Planner in Catchment Strategies and Services team, Melbourne Water Corporation
- Assessment of flood and stormwater management
- Data collection, processing and analysis
- Application of GIS

#### **Scope of contribution:**

Theresa assisted in the preparation of the report, including data review and figure preparation under my instruction and supervision.

### 3. Basis of Statement and Report

I have been requested to prepare and present drainage evidence regarding the Craigieburn West PSP (PSP 1068) and the draft urban structure plan that has been circulated. Specifically, I have been asked to address the following matters:

- i. The viability and constructability of the north-south waterway as proposed by Melbourne Water within the Aitkens Creek Drainage Services Scheme (traversing Property 14)
- ii. The proposed location of assets and their capacity to realise efficient drainage outcomes alongside urban form.
- iii. A revised drainage strategy, which may involve reconfiguration of inefficient water quality assets and removal of assets facing significant engineering constraints.

In preparing this statement I have:

- Reviewed the exhibited Precinct Structure Plan Draft for Public Consultation, November 2020 together with Craigieburn R2 Precinct Structure Plan Amendment C120 to the Hume Planning Scheme, September 2010 (Amended November 2020);
- Reviewed the Workshop Summary Diagram as presented within the Craigieburn West PSP Co-Design Workshop Outcomes report, November 2019.
- Reviewed relevant background reports commissioned by the Victorian Planning Authority for the Craigieburn West PSP.
- Reviewed submissions and public consultation documents received in respect to Craigieburn West PSP 1068
- Reviewed the supplied drainage scheme information as supplied by Melbourne Water, including the Aitkens Creek Drainage Services Scheme plan, models and background reports.
- Reviewed additional publicly available information, including but not limited to:
  - Site inspection
  - Aerial imagery
  - DEPI planning scheme and cadastral information as accessed online.
  - Relevant Design Guidelines and Guidelines for Development
  - Various Environmental Planning instruments and Planning Frameworks
  - Topographic information

#### Declaration

I have made all enquiries that I believe are desirable and appropriate. No matters of significance which I regard as relevant have to my knowledge been withheld from the Tribunal. Accordingly, I believe that the report is a complete and accurate statement of the hydraulic matters.



Chris M Beardshaw

BEnvEng (Hons), MEngSci, Grad Cert River Health

16 April 2021

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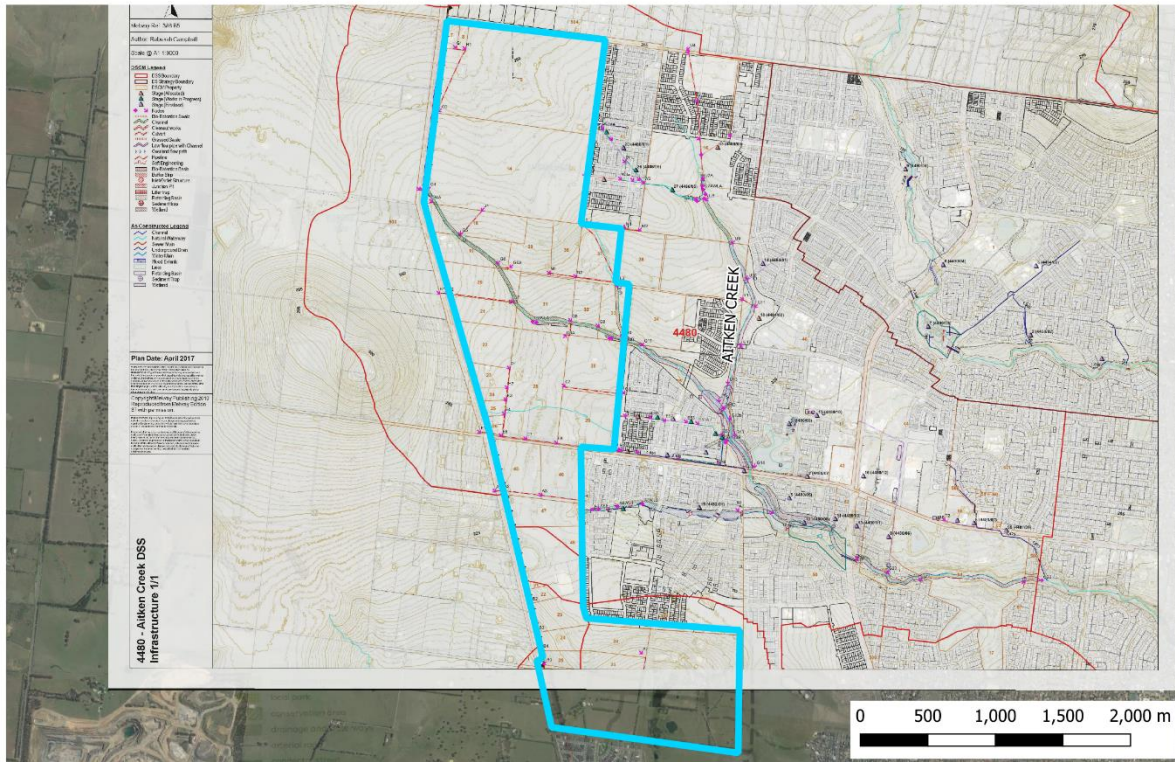
## 4. Key Report Conclusions

In relation to the stormwater drainage plan, the following conclusions have been made:

- The scheme in its current form can meet the Melbourne Water objectives, however it presents various inefficiencies and may not be possible to practically construct.
- The engineering constructability must be reconsidered to ensure ecological objectives aligns with viable outcomes, considering the topographical and geomorphological complexities.
- The proposed water quality assets represent catchment areas that are conceptually hard to drain and could be better arranged to enhance the liveability of the area and improve asset effectiveness.
- Proposing constructed assets should be considered within the greater urban form context and contribute to both liveability and ecological outcomes.
- An alternative arrangement is available and has been presented in this report. Flexibility within the PSP should be given to further pursue this arrangement.
- The proposition to accept the DSS as a conceptual outline and move assets at detailed design is not possible within the PSP framework as it stands. The PSP will need to be framed to allow significant changes to the drainage assets.

## 5. Background Review

This document details the preliminary review of the Drainage Services Schemes (DSS) associated with a number of development properties in the Craigieburn West PSP. The specific properties, or area of interest can be seen in Figure 1.



Craigieburn West PSP  
Aitkens Creek DSS

*Figure 1. Area of Interest*

The PSP crosses three DSS areas (Aitkens Creek DS, Upper Brodies Creek DS and Yuroke Creek DS). The PSP does not cover the entirety of Aitken Creek DS with several important downstream works proposed outside of the PSP boundary.

This report discusses the portion of Aitkens Creek DS encapsulated within the Craigieburn West PSP boundaries. It is understood that the scheme has undergone engineering review as a part of the PSP approval process. Therefore, the scheme is provided with the opportunity to review the intent of its assets, the generated hydrological flows at key locations, any water quality requirements and constructability of the assets proposed within the boundary.

The land allocated for drainage must represent reasonable, buildable and appropriate engineering outcomes to support development, and align with environmental values suited to Craigieburn West catchment requirements.

The DRAFT PSP layout can be seen in Figure 2.

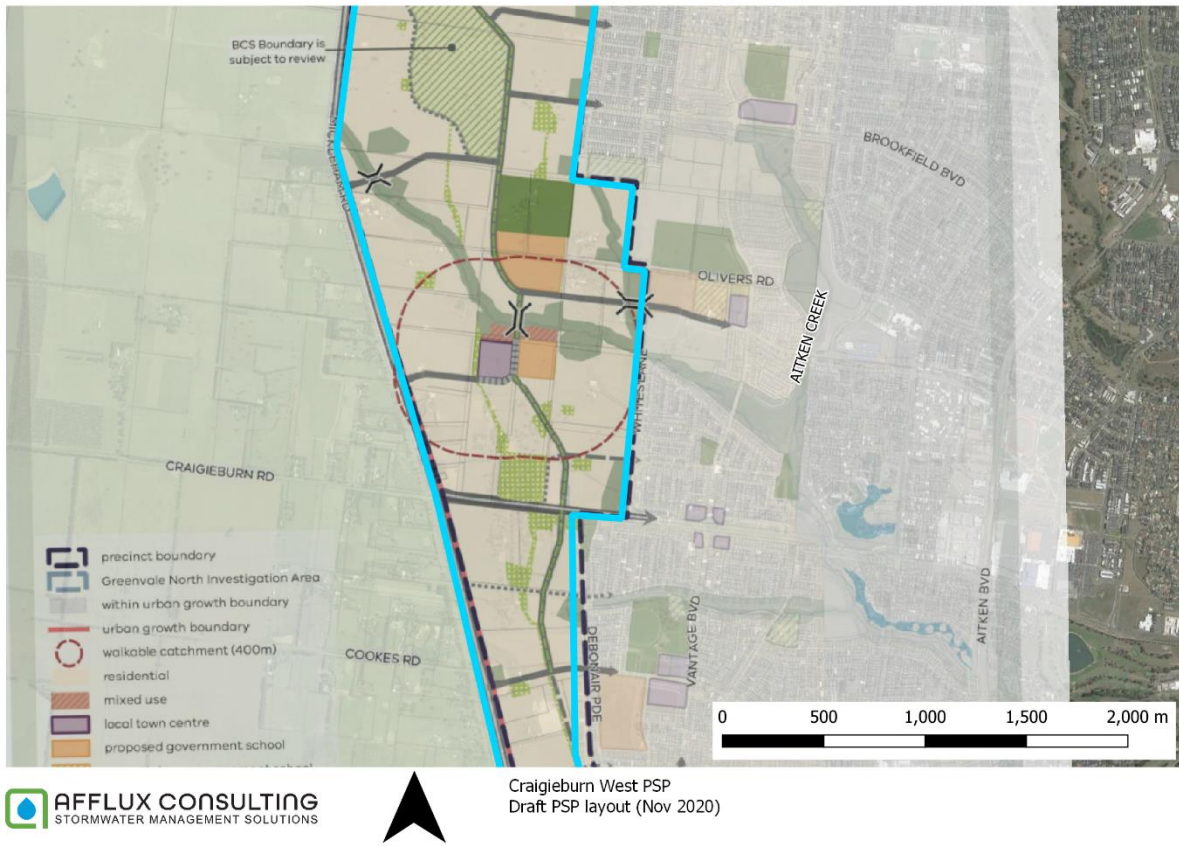


Figure 2. DRAFT PSP layout



## 6. Aitkens Creek Drainage Scheme Review

A high-level review of the Aitkens Creek Drainage Scheme Services (DSS) was undertaken to understand both the intent and the outcomes of the proposed scheme. A definition of the purposes of a scheme are noted below.

*Development services schemes are prepared to plan the infrastructure required to ensure new urban development meets appropriate standards for flood protection, water quality, waterway health and amenity. Infrastructure requirements are costed and used to establish contributions under the Water Act that will apply to developers to fund the provision of infrastructure.*

(Principles for Provision of Waterway and Drainage Services for Urban Growth, Melbourne Water)

*A common set of hydraulic and environmental performance criteria are incorporated into the design of development services schemes. They are:*

- *All new developments will be provided with 1-in-100 year flood protection consistent with ResCode requirement*
- *The minor drainage system shall have a capacity to cater for a 1-in-5 year storm event*
- *Water quality treatment to 'Best Practice'\* (currently 45% reduction in total nitrogen and phosphorous, 80% reduction in total suspended solids)*
- *Protection of the environmental, social (including heritage) and economic values of waterways.*

*The above criteria form the basis of the development services scheme strategy prepared for the catchment.*

(Principles for Provision of Waterway and Drainage Services for Urban Growth, Melbourne Water)

The scheme principles provide assurance that:

*Schemes should propose infrastructure to service development that is optimal in terms of cost and performance.*

(Principle 4, Principles for Provision of Waterway and Drainage Services for Urban Growth, Melbourne Water)

Catchment models and information has been provided by Melbourne Water (MW) for this area. A number of major drainage components for this area as supplied by Melbourne Water have been highlighted in Figure 3 for further review.

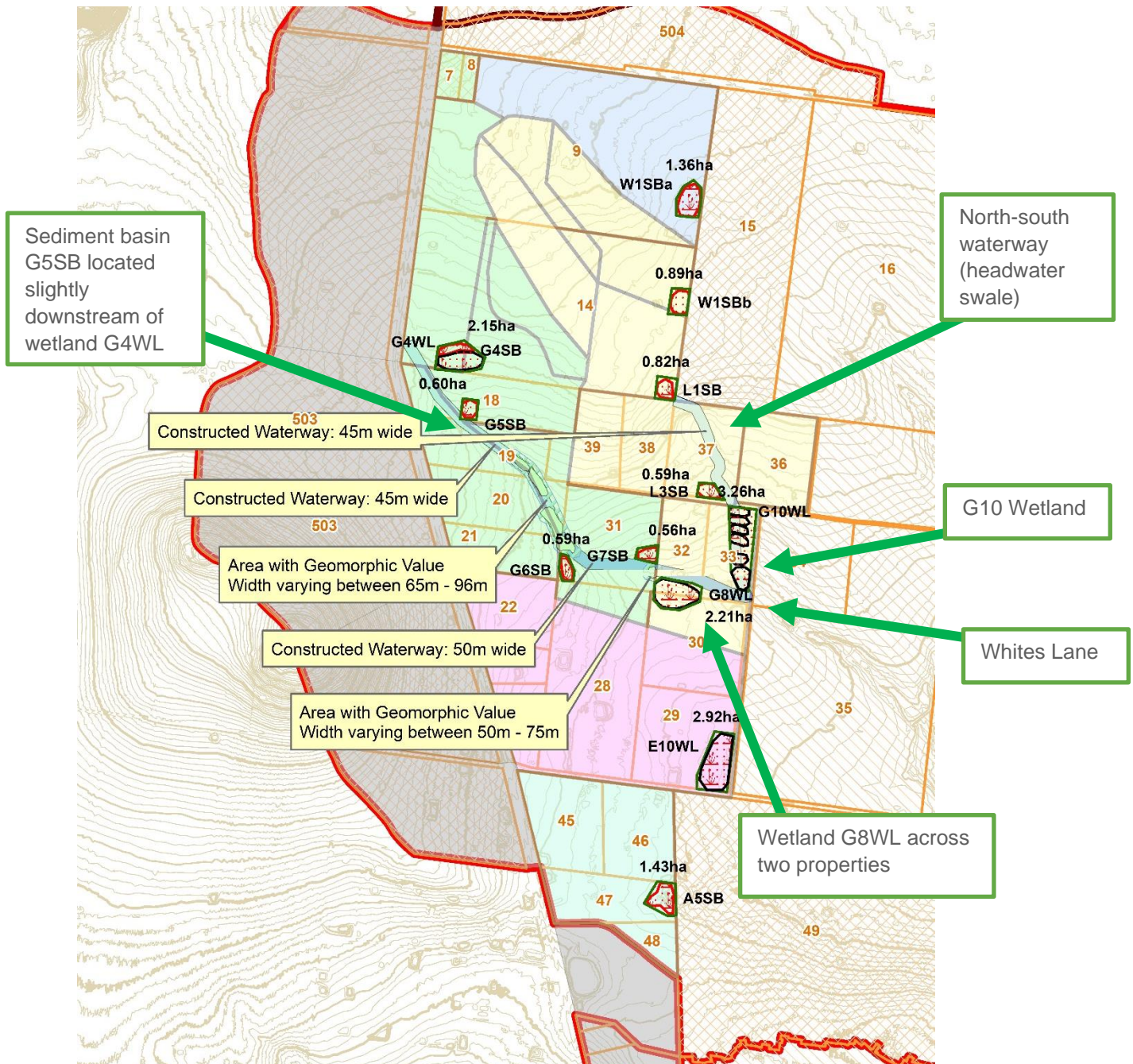


Figure 3. Scheme and Major Components

## Catchment Hydrology and Waterway Review

Melbourne Water have provided a RORB hydrological model for the catchment for review. I have reviewed the flows generated by the model but have not reviewed the model calibration or setup. The key flow rates relating to the scheme can be seen in Table 1 below, with locations relating to the node locations shown in Figure 3.

Table 1. Key Flow Rate Estimates

Q100 Flow	Aitken Ck at G4	Aitken Ck at G7	AitCk us Drn 4485 at WhitesLane
Flow Rate (m <sup>3</sup> /s)	8.8	17.0	17.6



Of particular note to the provision of this scheme, no print node (flow derivation point) was included in the model between H and I to indicate flows at top of waterway. This is particularly important as the flow magnitude at the head of a proposed waterway helps determine if a constructed waterway is required. The location at the head of the waterway is shown in Figure 5

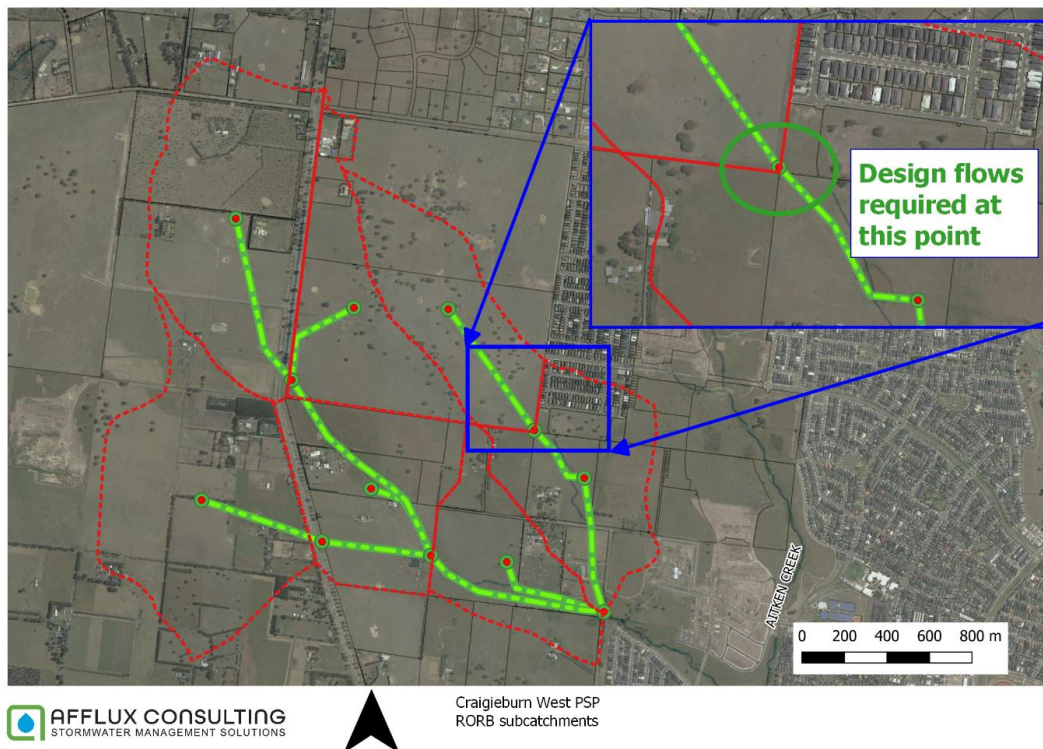


Figure 4. Flow magnitude assessment – RORB design flow review

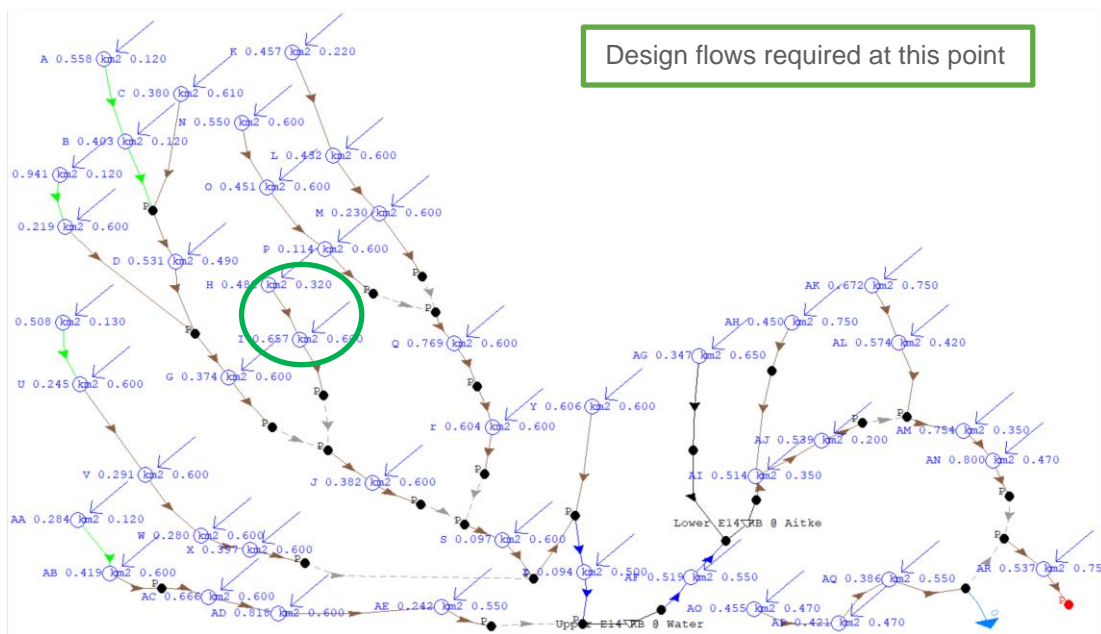


Figure 5. Melbourne Water RORB (AitkenCk\_Review\_Sep19 - ORIG .CATG)

Revising this model produces the following flows:

MED & MEAN results at Point added to model:

Peak Closest to the Median			Average Peak Values				
Storm Duration	Temporal pattern	Peak (m3/s)	Storm Duration	Average	Peak Closest to Average	Temporal pattern	Local Ranking
20 min	27	6.758	20 min	6.365	6.343	26	4

Figure 6. Revised print node Location and Flow

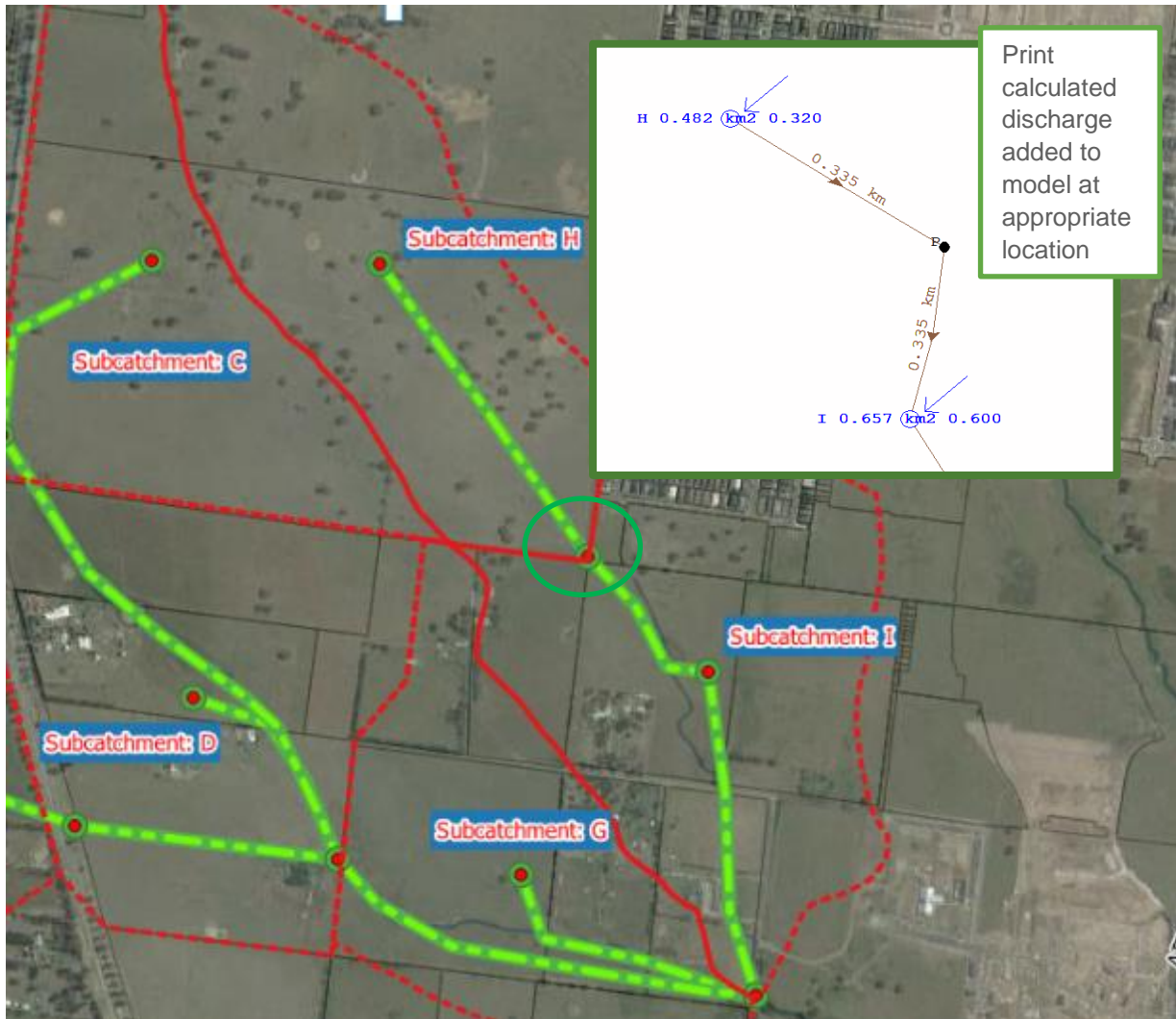


Figure 7. Altered RORB to include flow calculation point

This flow is well below the determining hydraulic width for a constructed waterway within the Melbourne Water guidelines (Waterway Corridors Guidelines for Greenfield Development). Further review of this waterway and wetland location shows particularly steep grades as can be seen in Figure 8.

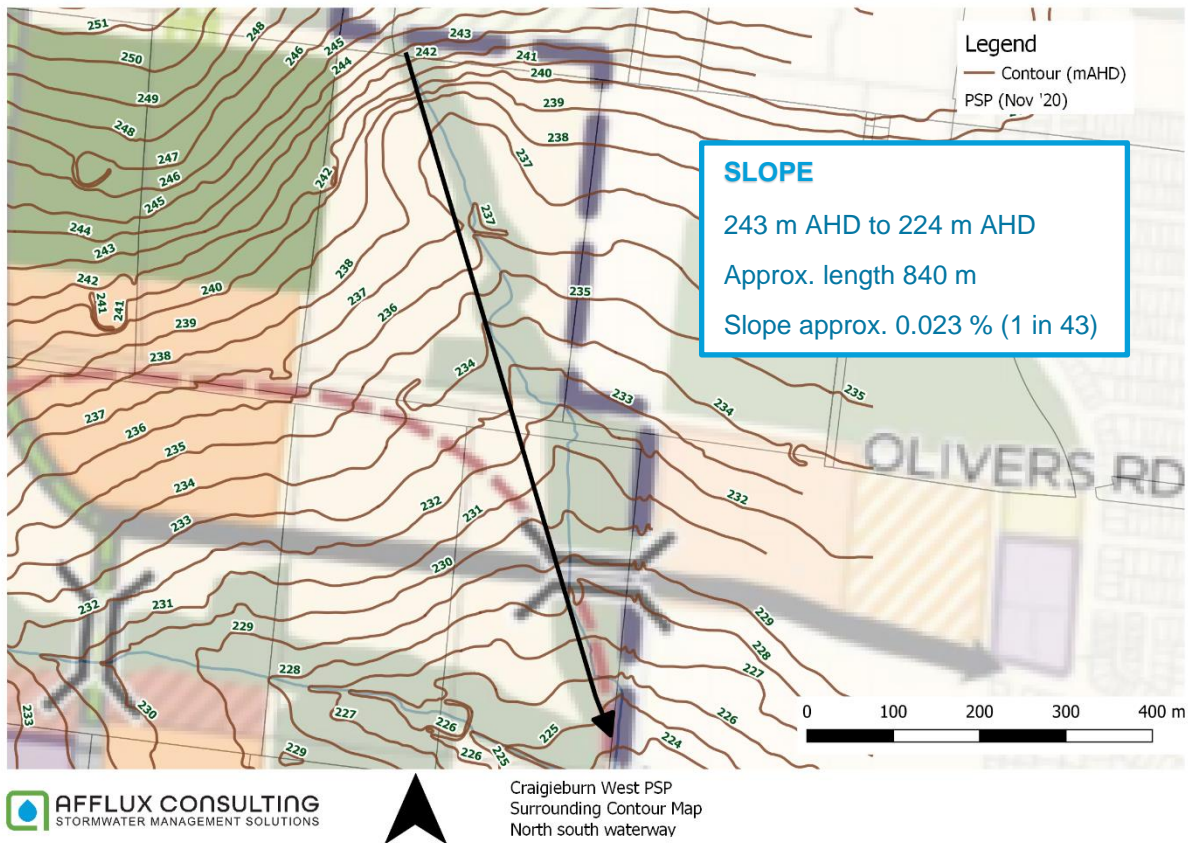


Figure 8. Proposed Northern Waterway and Wetland existing grades.

### Waterway and Flow Review Summary

The Key points from this flow analysis are:

- Flow rates along the main branch of Aitken Creek will require a constructed waterway approach.
- Low peak flow rates ~ 6 m<sup>3</sup>/s of water may not necessitate a constructed waterway along the northern branch.
- The slope of approximately 0.0233 % (1 in 43), will make construction of assets difficult and possibly prohibitory expensive for the northern arm.





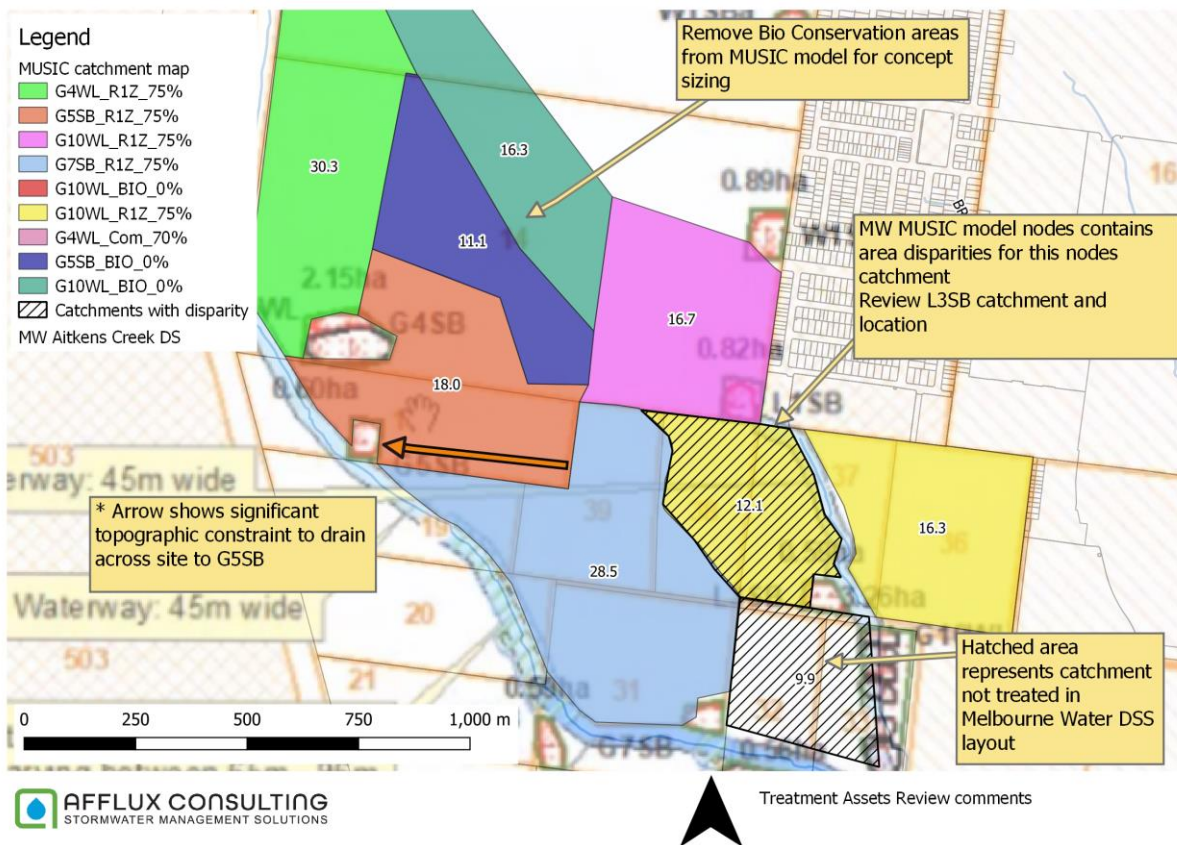


Figure 10. Review identified a number of changes for better catchment

### Water Quality Asset and Location Review Summary

The key points from asset location analysis are:

- Assets must align with urban form and final urban structure to ensure better catchment and land use.
- Catchments must consider topographic constraints present within this area (particularly G5SB)
- Catchment efficiency must consider topography, urban form, road links as major overland flow paths, catchment treatment maximisation
- Modelling for treatment size of developed areas only
- Asset orientation and location to be considered with respect to topography (particularly G10WL)

## 7. Drainage Scheme Design Processes

Drainage and waterway infrastructure is fundamental to the planning of a PSP area and in my view should be much more resolved before a draft PSP is finalised for public consultation. The presence and alignment of the waterway and location of the basins can greatly impact design responses relating to amenity and outlook, the location of facilities, and the opportunity for efficient water use to open space – these are matters that should be considered at the outset of preparing the plan. The waterway and wetland layout shown in the draft Urban Structure (Place Based Plan) is lacking in technical basis as I understand that Melbourne Water have not been able to complete its modelling and assessments to the same extent it ordinarily would to inform the preparation of a PSP. Given this, the waterway design and wetland locations and the overall approach to the drainage is unresolved and results in the draft Place Based plan creating inefficient spaces, poor interfaces and in some instances some irregular drainage outcomes as shown in the high-level review.

I appreciate that the VPA are seeking to keep the process moving and as such have released the PSP for consultation without the drainage having been resolved for the precinct. With that being the case, it is my view that the work required to analyse and resolve the drainage infrastructure for the Precinct ought to be completed by Melbourne Water in consultation with the Council and landowners as a matter of priority or an alternate mechanism for flexibility be sought by the Panel. I submit that the completion of the approval of the PSP amendment in a scheduled program should not override the detailed consideration of drainage options for the Precinct and the sites represented by Deague Group.

As presented within the VPA PSP 1068 Craigieburn West Precinct Structure Plan Part A Submission (April 2021):

*The VPA has prepared the PSP to reflect the draft revised DSS provided by Melbourne Water. The issues raised in submissions seek changes to the draft DSS rather than taking issue with features proposed through the PSP.*

*The VPA considers the content of the DSS is a matter for Melbourne Water to resolve under its own legislative framework and the PSP appropriately captures the current designs provided to the VPA by Melbourne Water. The VPA's position on this issue is consistent with that put to the Panel considering the Shenstone Park PSP, where similarly submitters sought to vary the alignment and design of drainage infrastructure through the PSP process rather than a DSS review. Having considered the issues, the Shenstone Park Panel ultimately considered the issues put in submissions could be resolved through detailed design and that changes proposed by the VPA to afford greater flexibility in drainage infrastructure delivery were appropriate.<sup>6</sup> The VPA proposes similar changes here to those recommended to the panel considering the Shenstone Park PSP. Relevantly, the revised Requirement R11 references the need for drainage infrastructure to be delivered in accordance with the relevant DSS and to the satisfaction of Melbourne Water and the Responsible Authority. The VPA submits that with these revisions, the PSP will provide appropriate flexibility to respond to detailed design changes - such as narrowing or straightening waterways (if approved by Melbourne Water and the Responsible Authority)- as is sought by submitters.*

It is expected that conceptual to detailed design stages require reasonable and practical variation between design iterations and as such there may be multitudes of minor alterations between Development Services Scheme finalisation and acceptance of as completed assets. However, conceptual design must be proposed in a way that can be realised within a detailed design, particularly where it is to be presented within the PSP. In a brief review of the Shenstone Park example, it would seem that all of the assets in that case were much more anchored to a location. Meaning that the detailed design could reasonably be expected to follow the conceptual design.

In this case, there is fundamental disagreement of the assets as proposed within the draft DSS. These are represented on the Place Based Plan and impact ultimate design scenarios. Drainage features proposed on the PSP plan include:

- Allocation of land provided for north south waterway recommended to be removed (to be replaced by green link)
- Allocation of land provided for sediment basins to be removed (and represented at more appropriate locations)
- Required land budget sizes for treatment assets to be resolved to align with more efficient configuration.
- Representation of Aitken Creek Main Channel (east west) to align with better urban form outcomes.

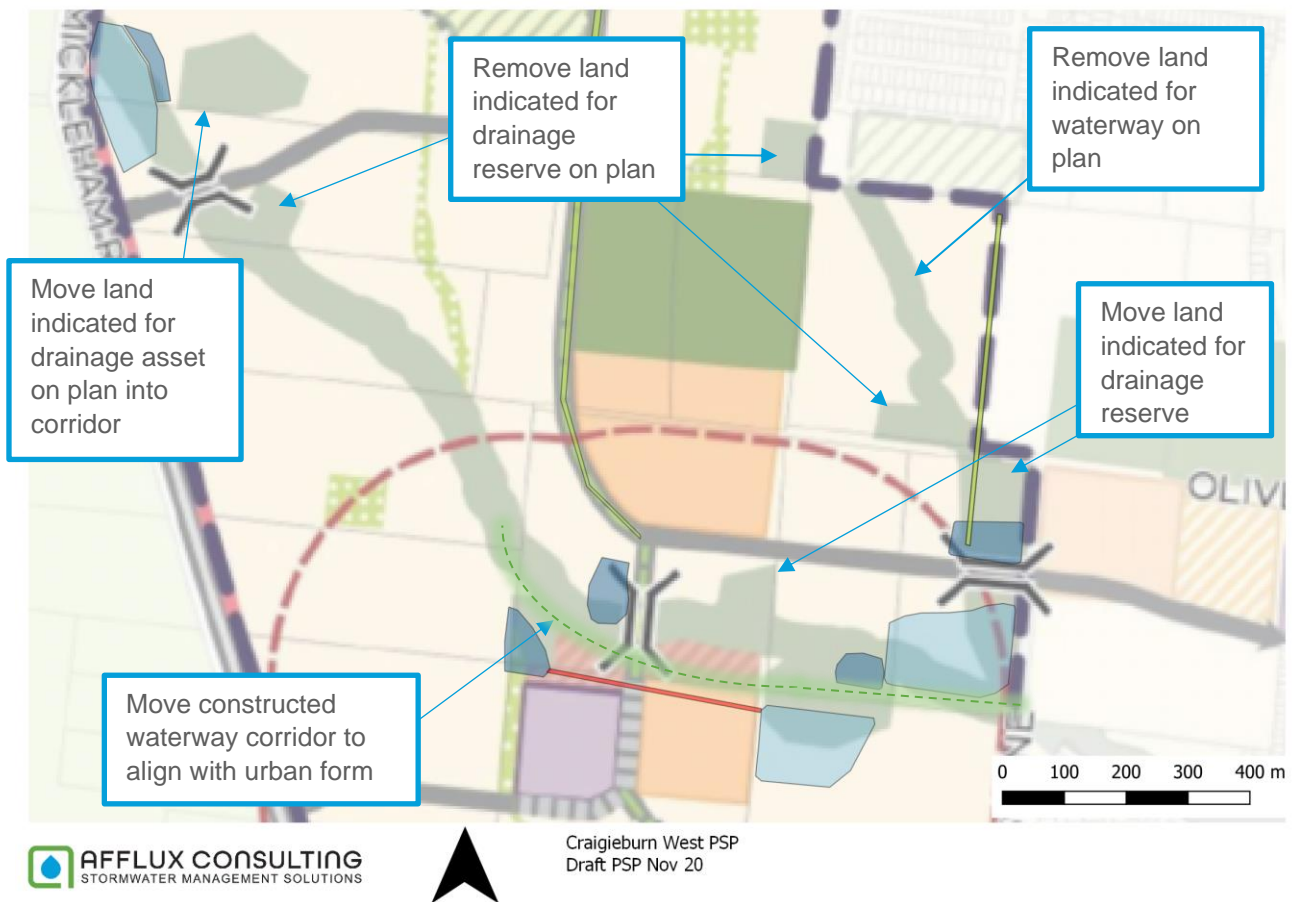


Figure 11. Major Land discrepancies in DSS affecting PSP.

Unlike the Shenstone Park example, many of these points are fundamental to the PSP land budgeting and could not be changed at a later state as “Generally in Accordance” with the plan. As such these items need to be addressed at this Panel.

## 8. Drainage Scheme Design objectives

To justify the proposed changes, a review of the supplied Melbourne Water documents as tabled and principles has been undertaken. Melbourne Water has submitted that the assets have been located appropriately based on a number of documents including:

- Final Headwater Stream documents
- Principles for Provision of Waterway and Drainage Services for Urban Growth
- Waterway Corridors Guidelines for Greenfield Development
- Final Project Report – Aitken Creek Waterway Values Assessment

A short description of drainage asset objectives has been compiled from these various sources as below:

*Headwater streams are important in regulating the flow of water, sediments and nutrients throughout a catchment. They also contribute to local biodiversity values, often providing habitat for rare and threatened species”*

Source: Final Headwater Stream Factsheet, Melbourne Water

*The objectives for waterway corridors in greenfield development areas of the Port Phillip and Westernport are:*

- *To protect, enhance or restore river health and biodiversity*
- *To enable some complementary use of waterways for recreational purposes and infrastructure (if appropriate) while maintaining primary river health, flood protection and biodiversity functions*
- *To provide effective flood protection.*

Source: Waterway Corridors, Guidelines for greenfield development areas within the Port Phillip and Westernport Region, Melbourne Water

*The minor drainage system shall have a capacity to cater for a 1-in-5 year storm event*

*Water quality treatment to ‘Best Practice’\* (currently 45% reduction in total nitrogen and phosphorous, 80% reduction in total suspended solids)*

Source: Principles for Provision of Waterway and Drainage Services for Urban Growth, Melbourne Water

*Constructing a ‘treatment train’ using structural treatment measures involves the selection and sequential ordering of treatments to achieve optimal pollutant removal. Different treatments use different processes to remove pollutants, depending on the size range of the pollutant types. No one treatment can remove all stormwater pollutants. To achieve removal for a range of pollutants a number of treatments will be required and the selection and order in which they are constructed is a critical consideration.*

Source: Urban Stormwater: Best Practice Environmental Management Guidelines, Victoria Stormwater Committee, 1999

*Stormwater structural treatment measures can be grouped into three categories: primary, secondary and tertiary.*

### **Primary treatment**



*Physical screening or rapid sedimentation techniques. Typical retained contaminants: gross pollutants and coarse sediments.*

### **Secondary treatment**

*Finer particle sedimentation and filtration techniques. Typical retained contaminants: fine particles and attached pollutants.*

### **Tertiary treatment**

*Enhanced sedimentation and filtration, biological uptake, adsorption onto sediments. Typical retained contaminants: nutrients and heavy metals.*

Source: *Urban Stormwater: Best Practice Environmental Management Guidelines, Victoria Stormwater Committee, 1999*

*Sediment settling basins are structures designed to trap coarse sediment. These can be used in isolation in the stormwater system, or as a pre-treatment upstream of other treatment measures. The basins can take the form of a formal 'tank' (usually concrete) or a less formal pond (usually earth). Sedimentation is encouraged in the basin by enlarging the channel so that water velocities are reduced to a point where sedimentation can occur.*

Source: *Urban Stormwater: Best Practice Environmental Management Guidelines, Victoria Stormwater Committee, 1999*

*Wetlands are built to remove pollutants carried such as fine sediments and water soluble nutrients, primarily nitrogen and phosphorous. These wetlands are shallow, vegetated systems that fill and drain in a controlled manner following rain events. The design hydrological regime and vegetation configuration throughout the wetland is critical to the treatment function of the system.*

Source: *Constructed wetlands design manual – Part A1 – Introduction, Melbourne Water*

These highlighted points have been explored in more detail in relation to the proposed Aitken Creek DSS.

## **Headwater streams**

The design objectives of retaining natural drainage features must be considered, not only by asset importance, but also within the context of development and risk potential. Retention of important natural assets without consideration of the changing surrounding landscapes becomes impossible without intervention and requires considerable forethought. Melbourne Water have identified that the retention of the Northern arm waterway is required to meet this headwater streams policy (noting that this hasn't been applied on a number of other streams within the PSP).

I submit that whilst this is a worthwhile policy objective, the final engineering and conveyance of water through the catchment is a primary objective and needs to be considered within the context of this policy. There is no point allocating this land for protection if it needs to be completely re-engineered and concreted to meet the engineering constraints.

Within the Headwater Streams Technical Note (Jacobs, 2016) as provided by Melbourne Water, the protection of headwater streams within urban development is explored, as follows:

*Walsh et al. (2016) have outlined a set of five principles for how to manage stormwater for the protection of stream ecosystems are presented. These are:*

1. **Identify the ecosystems to be protected and set objectives for their management, including condition targets.** An appropriate target could be the condition of the stream before the urban development of its catchment or of analogous rural streams in the same region.
2. **Mimic the predevelopment water balance and flow regime.** The post-development water balance should mimic the predevelopment water balance. Specifically, the volumes of runoff and infiltrated water from an impervious area with stormwater control measures should be similar to those of the predevelopment state.
3. **Implement stormwater control measures that deliver filtered flows.** Stormwater control measures should be designed to deliver the volume and temporal pattern of flows that mimic, as much as possible, the dominant predevelopment hydrologic processes (e.g. dispersed stormwater harvesting and infiltration systems).
4. **Implement stormwater control measures that are able to store the rain events that would otherwise disturb and negatively impact stream biota.**
5. **Apply the storm control measures to all impervious surfaces in the catchment.** Effective implementation of the above principles requires catchment-wide application.

The key takeaways from this include the identification of ecosystems to be retained and the importance of flow control as stormwater runoff volume and frequency increases with development (Urban Stormwater: Best Practice Environmental Management Guidelines, Victoria Stormwater Committee, 1999). This presents a significant engineering consideration.

The retention of headwater streams as a function of value and unmitigated risk (i.e. risk without adequate engineering consideration and intervention) is identified within the Aitken Creek Waterway Values Assessment Final Project Report (Jacobs, December, 2020):

Table 4-2. Summary table outlining results of unmitigated risk assessment.

Name	Values		Unmitigated Risk Profile						Priority Values
	Ecology	Geomorphology	Magnitude (A)	Sensitivity (B)		Risk Rating (AxB)			
				Ecology	Geomorphology	Ecology	Geomorphology		
Aitken Creek - Main Channel	2 Medium - high	1 Insignificant	3 High	3 High	3 High	9 High	9 High	<ul style="list-style-type: none"><li>• Mature <i>Eucalyptus Camaldulensis</i> - River Red Gums</li><li>• EVC 132_61 Heavier-soils Plains Grassland (Endangered)</li><li>• EVC 125: Plains Grassy Wetland (endangered)</li></ul> Presence not confirmed: <ul style="list-style-type: none"><li>• <i>Amphibromus fluitans</i> - River Swamp Wallaby Grass</li><li>• Golden Sun Moth (<i>Synemon plana</i>) in grasslands adjacent to creek</li><li>• <i>Litoria raniformis</i> - Growling Grass Frog</li><li>• <i>Dianella amoena</i> - Matted Flax Lily</li></ul>	
Aitken Creek - Southern Tributary	2 Medium - high	1 Insignificant	3 High	3 High	3 High	9 High	9 High	<ul style="list-style-type: none"><li>• Mature <i>Eucalyptus Camaldulensis</i> - River Red Gums</li><li>• EVC 132_61 Heavier-soils Plains Grassland (Endangered)</li><li>• EVC 125: Plains Grassy Wetland (endangered)</li></ul> Presence not confirmed: <ul style="list-style-type: none"><li>• <i>Amphibromus fluitans</i> - River Swamp Wallaby Grass</li><li>• <i>Litoria raniformis</i> - Growling Grass Frog</li><li>• <i>Dianella amoena</i> - Matted Flax Lily</li></ul>	

Figure 12. Excerpt from Aitken Creek Waterway Values Assessment Final Project Report, Jacobs December 2020

This points to insignificant geomorphological values, but some (mainly grassland) ecological values. Completely changing the hydrology of the catchment, as will be the case in this PSP, is incompatible with retaining these ecological features as a waterway corridor. Furthermore, given the low geomorphological values and high waterway stresses with this changed hydrology a completely rebuilt channel form will be required, thus removing any existing vegetation.

Furthermore, the Jacobs (2016) Headwater Streams Technical Note provides an ideal recommendation for retention and incorporation of important headwater streams into the urban form:

*Headwater streams should be recognised as ecosystems worth protecting during the very first stages of planning new urban areas, and ideally they should be reserved as linear green spaces to retain their important functions (Walsh et al. 2016).*



*Linear green space incorporated within the road network.*

Source: *Headwater Streams Technical Note (Jacobs, 2016) photo credited to Melbourne Water*

Based on this, I believe that the integration of linear green spaces (swales) within road networks ensures the key values and functions associated with headwater streams are incorporated with urban development and should be considered as part of this PSP.

*Key values and functions of headwater streams include:*

- *They make up a significant proportion of the stream network and collect the majority of the runoff and dissolved nutrients from a catchment.*
- *The surface water in headwater streams infiltrates into the local groundwater system and contributes to groundwater levels, and maintains base flows in downstream waterways.*
- *They are able to retain and temporarily store water, which assists in regulating flows and reducing the risk of downstream flooding.*
- *They recycle and retain nutrients, which can significantly reduce nutrient export to downstream waterways, estuaries and bays (sometimes by more than 50%).*
- *Although the number of species occurring in one headwater stream is often relatively low, the collective contribution to regional biodiversity is high because of the large number of these types of streams in the catchment.*
- *The water quality, biodiversity and ecological health of downstream waterways and bays depend on the functions provided by headwater streams.*

(Final Headwater Stream Factsheet, Melbourne Water)

Similarly, roadway swales are designed to promote infiltration, flow regulation, nutrient retention/processing and urban amenity, etc.

Swales as overland flow path stormwater conveyance are recommended to be incorporated into major north south connector roads. The swales designed with intent of stormwater infiltration and volumetric reductions (Figure 13). Where expected yearly infiltration from swales for this catchment is approx. 2600L/ y/ meter of swale. This enables the required integrated water management options within the PSP and ensures implementation of objectives outlined within the Melbourne Water Healthy Waterways Strategy. These can be better engineered into the urban form and meet both the hydrological (flow) requirements, and the slope challenges of this waterway. Finally, an engineered solution will protect the sodic soils and high risk environments.

Typical swale sections and proposed road integration for this area can be seen in Figure 13, Figure 14 and Figure 15 below.



Figure 13. Typical vegetated swale

Source: Facility for Advancing Water Biofiltration, 2008

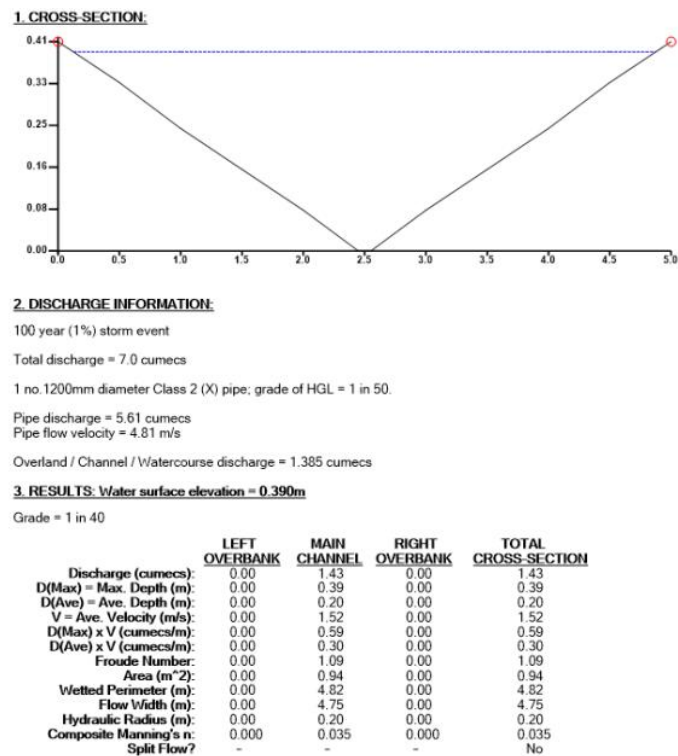


Figure 14. PC-Covey Section for proposed swale



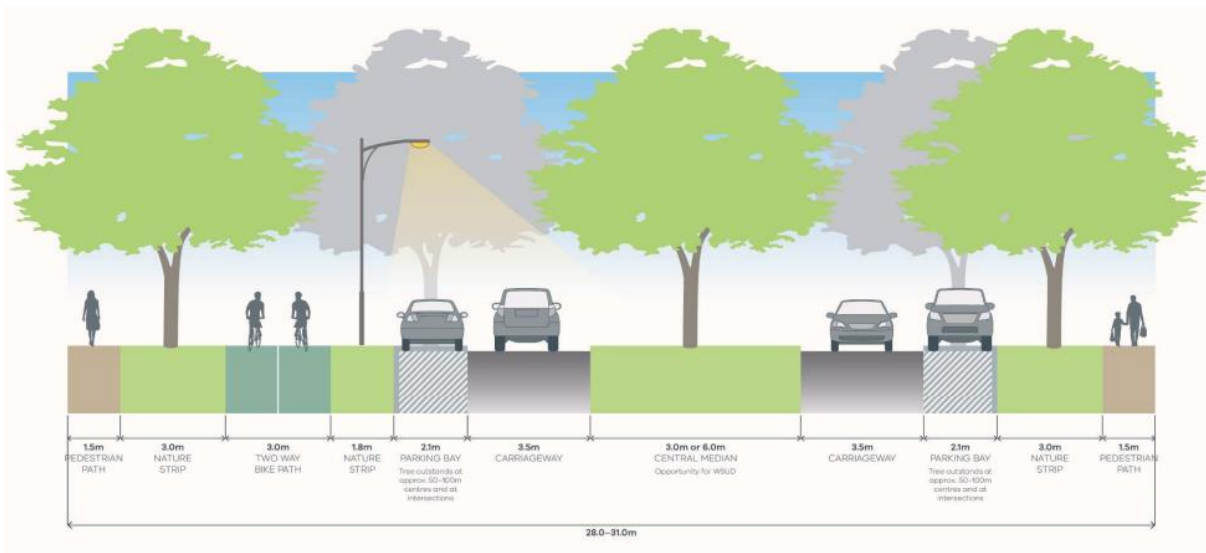


Figure 15. Connector Street Boulevard excerpt from PSP 1068 – Craigieburn West Precinct Structure Plan, Draft for Public Consultation, November 2020

The following Figure 16) was presented to Melbourne Water (November, 2020), where reference to OFP (overland flow path) conveyance is recommended as green links, subject to final urban form. (Afflux has been liaising with Melbourne Water over the past year on these design issues).

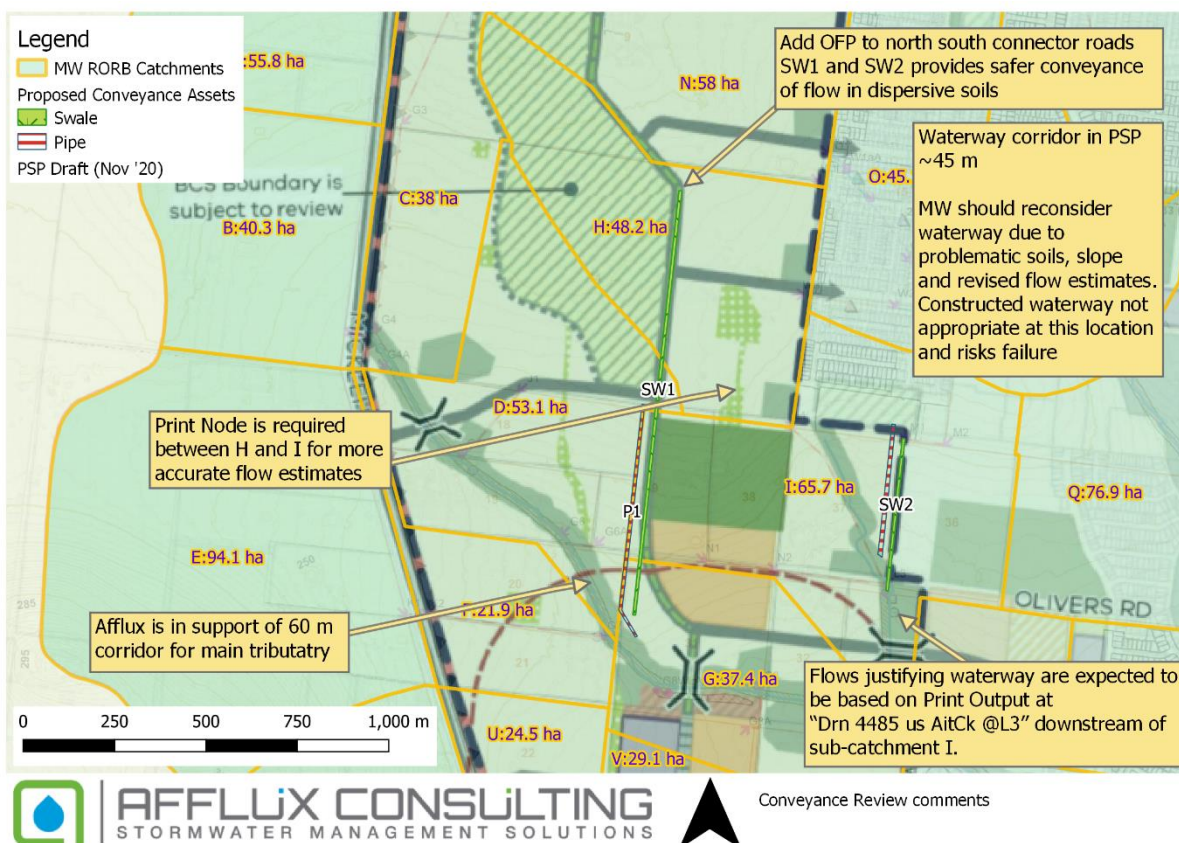


Figure 16. Flow conveyance review as presented to Melbourne Water November 2020

Additionally, the Deague Group Submission to Craigieburn West PSP Amendment (December 2020) contains the following recommendations:

**Remove the north-south Waterway tributary** – The north south tributary construction is a high risk engineering proposal, that does not meet with MW's own sodic soil recommendations. The flows from this catchment have been incorrectly calculated and do not meet the hydraulic criteria for a waterway. Understanding the MW strategic objectives for headwater streams, this leaves a stark choice. Either remove all development proposals from this catchment, and maintain the headwater stream. Or accept a piped or highly engineered waterway through this area. The 45m corridor does not provide for either option and either should be reduced in scope or completely removed and a piped option considered.

- **Swales** - the use of swales and green roads ought to be considered as a viable alternative to overland flow conveyance given the lower flows found in the RORB review (~6 m<sup>3</sup>/s split over two swales and pipes). In my view, the flows here do not justify a 40-45m waterway and particularly one which has high risk sub-surface soils with high risk for future failure such as this (as per Jacobs' report findings, source: MW email 21/11/2020). Moreover, swales require less cut (as compared to constructed waterways) and therefore reduce possibility of soil failure expected in locations with steep slope that would provide a safe alternative for overland flow conveyance.

As a result, the adjacent water quality assets should be reconfigured to align with overland flow path and waterway conveyance review.

## Proposed Water quality assets

The location of the basins can greatly impact design responses relating to amenity and outlook, the location of facilities, and the opportunity for efficient water use to open space. The current draft Place Based plan incorporating these basins creates inefficient spaces, poor interfaces and in some instances some irregular drainage outcomes.

I recommend some a number of improvements to be made to the water treatment assets to create improved drainage outcomes but also which could influence and improve the structure of the precinct:

- **G4 sediment basin and wetland** - should be relocated (west) to the Mickleham Road interface at the head of the waterway. There is no level change associated with this and it provides a more logical urban form. It will also meet the principal of discharging pipe into wetland and then into waterway.
- **G5SB** - is recommended to move further south depending on final Urban Structure to ensure it collects the full catchment and creates a better relationship with the urban form. The current location has very little catchment with potentially only 18 hectares of residential land draining into it, shifting it south would improve its catchment. Ideally this basin is moved far enough south to collect flows from the proposed north south collector road and/or combining with G7SB \*Noted that MW have agreed to this point.
- **G7SB** - Combine with G5SB.

Relocate this combined asset to the end of the North-South connector road. This road link is assumed to be a major overland flow path and represents a significant topographic consideration when selecting sediment basin location. The catchment for G7SB is indicated in the Melbourne Water MUSIC to collect 29.859 ha (RES). However, I have reviewed the model and expects that this catchment may have already been counted for treatment in G5SB catchment or L3SB (if Pipe N1 drains east toward L3SB). The proposed catchment and relocation will provide for better drainage outcomes due to topography and represents a much more logical asset positioning.

- **G8WL** – move south of geomorphic feature and abutting recreation fields. Placing a wetland across two land parcels creates future conflicts and delivery issues. The waterway should sit on MW parcel 32, and the wetland on parcel 30.

- **L1SB** – Shift to south and combine into the G10WL for better catchment efficiency. As with G5SB the sediment pond catchments should be maximised to reduce Council/MW assets. If the north south waterway is removed, there is no need for this basin here and it would be better placed with the wetland system.
- **L3SB** - reconfigure to align with overland flow path and consider its relocation in conjunction with RORB and waterway conveyance review.
- **G10WL** – Wetland configuration requires review noting that This asset does not collect flows from DFWS property 32 or 33, leaving those flows untreated. The wetland is located on area of high grade and will be of high engineering risk. A more east west alignment, rather than north south would be a better arrangement.

G10WL is a significant asset; location of this asset at the Craigieburn West PSP outlet should be considered with respect to topography. I recommend the wetland is re-oriented to minimise the fall and orientated as shown in Figure 17. This alignment is reinforced by the location of the connector street alignment identified in the Craigieburn West PSP workshop summary diagram (November 2019). Reduction of wetland slope represents significant engineering improvements and urban form improvements whilst reducing the engineering risk.



Figure 17. Proposed Asset relocations

A number of additional points should be considered as a more holistic view:

- The water quality assets should be better integrated with urban form to allow both minor and major drainage input in this area.
- The wetland G8WL should be better integrated with reuse and development capacity with the town centre. Alignment of the channel should be considered in this context and with the above points.
- The possibility of Volumetric control limits as part of the proposed EPA BPWM revisions should be viewed in this context. Opportunities to provide Integrated Water solutions should be considered, especially in the context of the oval watering.





Figure 18. Overall Asset location Changes

I have reviewed the overall asset sizing using the proposed assets in Figure 18. This results in a net reduction in water area, whilst still meeting the relevant requirements (Table 2).

Table 2. Revised treatment areas

Asset	Afflux Treatment Area (m <sup>2</sup> )	MW Treatment Area (m <sup>2</sup> )
G4SB	1,500	1,600
G4WL	6,000	6,000
G5SB	2,000	1,600
G7SB	NA	1,600
G10WL	11,000	7,000
L1SB	2,000	2,000
L3SB	2,000	2,000
W1SBa	2,100	6,000
W1SBb	800	3,500
G6SB	1,600	1,600
G8WL	6,000	5,000
SB_E10WL (Inlet Pond to E10WL)	3,300	5,000
E10WL	6,400	10,000
A5SB	1,700	5,000
<b>Total Treatment Area</b>	<b>46,400</b>	<b>57,900</b>



## Waterway realignment

The east west waterway will be the main overland flow path conveyance channel.

*The approach to calculating the waterway corridor width at a particular location depends on whether the waterway is an existing waterway or an artificial waterway that will be constructed as part of urban development, as well as considering any site specific factors such as environmental values, recreation uses or landscape characteristics*

Source: (Waterway Corridors, Guidelines for greenfield development areas within the Port Phillip and Westernport Region, Melbourne Water)

Similarly, the specific location depends on whether the waterway is to be constructed as part of an urban development. Additionally, the waterway design priority is represented as a function of values and risk. Where Melbourne Water has presented justification for retaining current waterway alignment due to geomorphic values which were categorised as being “Insignificant” in the Jacobs Aitken Creek Waterway Values Assessment Final Project Report (December 2020).

Additionally, the stream represents a “High” risk rating:

*These waterways are generally considered to be stable under existing conditions, however increased runoff arising from development has the potential to scour the channel. The soils in the study area are sodosols (Beveridge Williams, 2018) and as such are considered highly susceptible to erosion. With development there is a concern that traditional stormwater management (drainage and outfalls to creek) would result in increased flows along the waterways, potentially leading to scour and ongoing problems of erosion.*

(Jacobs Aitken Creek Waterway Values Assessment Final Project Report, December 2020).

**Table 4-2. Summary table outlining results of unmitigated risk assessment.**

Name	Values				Unmitigated Risk Profile						Priority Values		
	Ecology		Geomorphology	Magnitude (A)	Sensitivity (B)		Risk Rating (AxB)						
					Ecology	Geomorphology	Ecology	Geomorphology					
Aitken Creek - Main Channel	2	Medium-high	1	Insignificant	3	High	3	High	9	High	9	High	<ul style="list-style-type: none"><li>▪ Mature <i>Eucalyptus Camaldulensis</i> - River Red Gums</li><li>▪ EVC 132_61 Heavier-soils Plains Grassland (Endangered)</li><li>▪ EVC 125: Plains Grassy Wetland (endangered)</li></ul> Presence not confirmed: <ul style="list-style-type: none"><li>▪ <i>Amphibromus fluitans</i> -River Swamp Wallaby Grass</li><li>▪ Golden Sun Moth (<i>Synemon plana</i>) in grasslands adjacent to creek</li><li>▪ <i>Litoria raniformis</i> - Growling Grass Frog</li><li>▪ <i>Dianella amoena</i> - Matted Flax Lily</li></ul>
Aitken Creek – Southern Tributary	2	Medium-high	1	Insignificant	3	High	3	High	9	High	9	High	<ul style="list-style-type: none"><li>▪ Mature <i>Eucalyptus Camaldulensis</i> - River Red Gums</li><li>▪ EVC 132_61 Heavier-soils Plains Grassland (Endangered)</li><li>▪ EVC 125: Plains Grassy Wetland (endangered)</li></ul> Presence not confirmed: <ul style="list-style-type: none"><li>▪ <i>Amphibromus fluitans</i> -River Swamp Wallaby Grass</li><li>▪ <i>Litoria raniformis</i> - Growling Grass Frog</li><li>▪ <i>Dianella amoena</i> - Matted Flax Lily</li></ul>

**Figure 19. Excerpt from Aitken Creek Waterway Values Assessment Final Project Report (Jacobs, December 2020)**

Based on this, and the reality that the waterway will need to be constructed, I have recommended that the waterway be considered in the greater urban form and aligned to form a buffer to Mickleham Road. Working with Verve Projects (given the time constraints I was instructed to work with Verve), a proposed waterway form has been included as an appendice to this report. Whilst a high level design only, this meets the waterway grade and function with consideration of the urban form.

## 9. Conclusions

The current drainage scheme, whilst meeting Melbourne Waters requirements is:

- conceptually difficult to drain,
- does not take account of urban form or topographical constraints,
- does not consider the hydrological changes associated with headwater streams, providing no guidance on how these are to be managed.
- does not consider the engineering risks associated with the sodic soils.
- results in significant duplication of assets.

The proposal by the VPA to accept the DSS in its draft form and allow for the management of future changes through detailed design is not viable in this case due to the fundamental disagreement of asset locations and function. Put simply, the basic engineering work has not been undertaken or fully considered at this stage.

A rearrangement of the drainage can meet the same objectives, including green connectivity whilst providing additional redundancy and meeting safety criteria. The proposed rearrangement will:

- Satisfy the sediment basin and retardation requirements at Whites Lane.
- Apply green link connectivity through the subdivision whilst meeting safety requirements through the development (swales and connectivity)
- Apply better urban form and ecological objectives through the more detailed analysis of waterways.
- Be able to meet the water quality requirements within a smaller allocated area whilst providing a number of improved amenity outcomes.

This arrangement should be able to be further explored via flexibility in the PSP to advance the design.

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# Appendix A – Proposed Design Drawings



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## 10. References

Aitken Creek Waterway Values Assessment Final Project Report, Jacobs, December 2020

Constructed wetlands design manual – Part A1 – Introduction, Melbourne Water

Engineers Australia, “Australian Rainfall and Runoff” (2019), Engineers Australia.

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Principles for Provision of Waterway and Drainage Services for Urban Growth, Melbourne Water

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Victoria Stormwater Committee, 1999, Urban Stormwater, Best Practice Environmental Management Guidelines

Waterway Corridors, Guidelines for Greenfield development areas within the Port Phillip and Westernport Region, Melbourne Water

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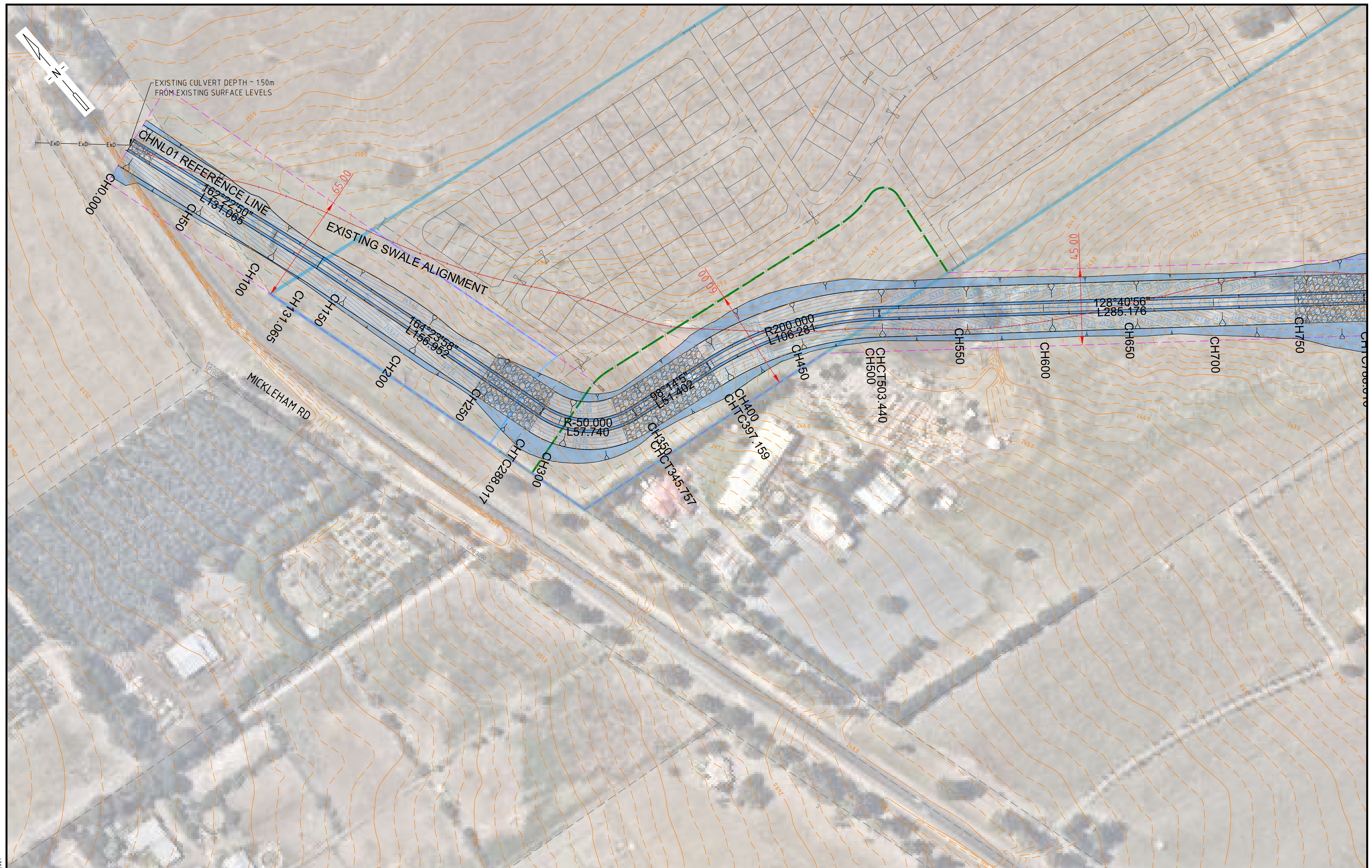
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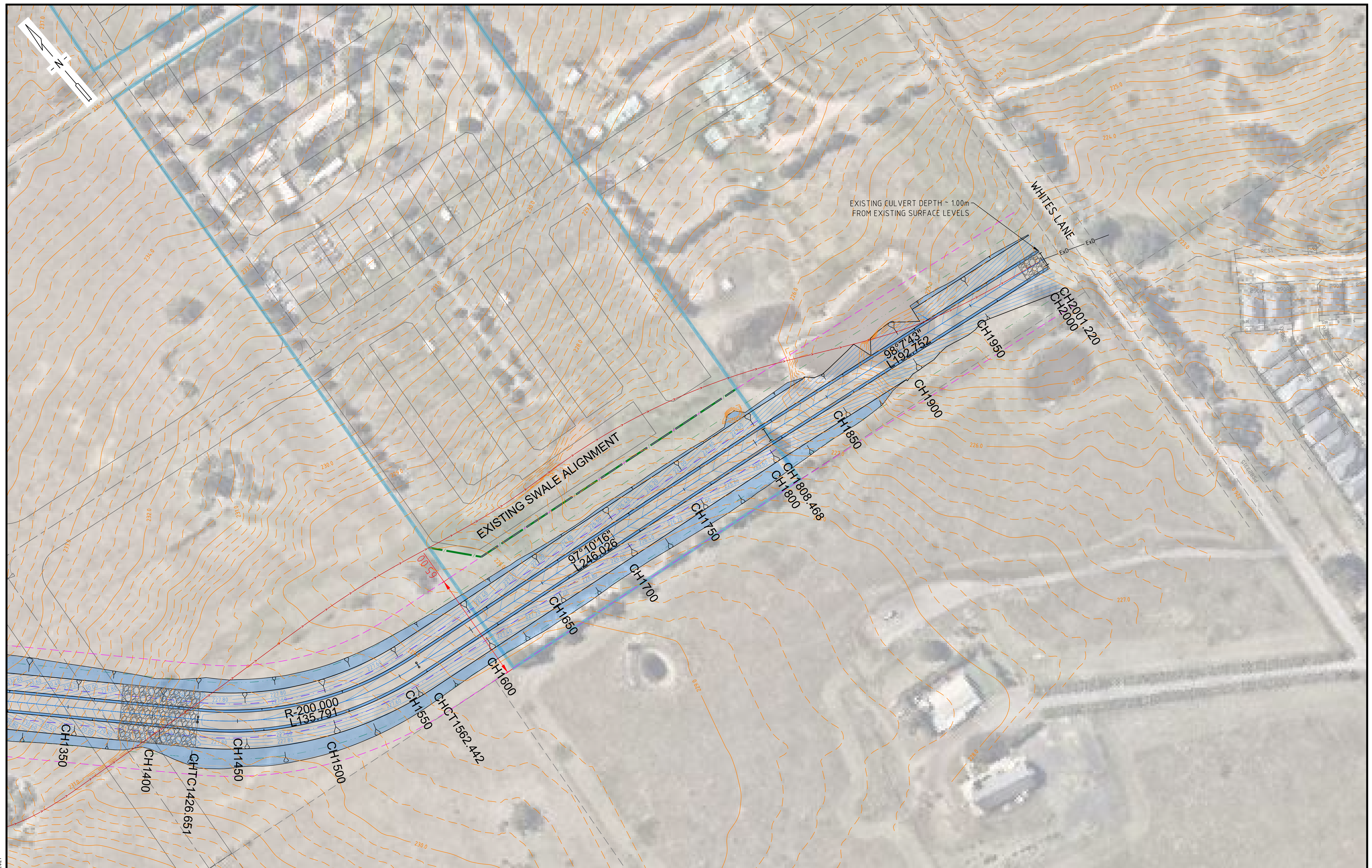


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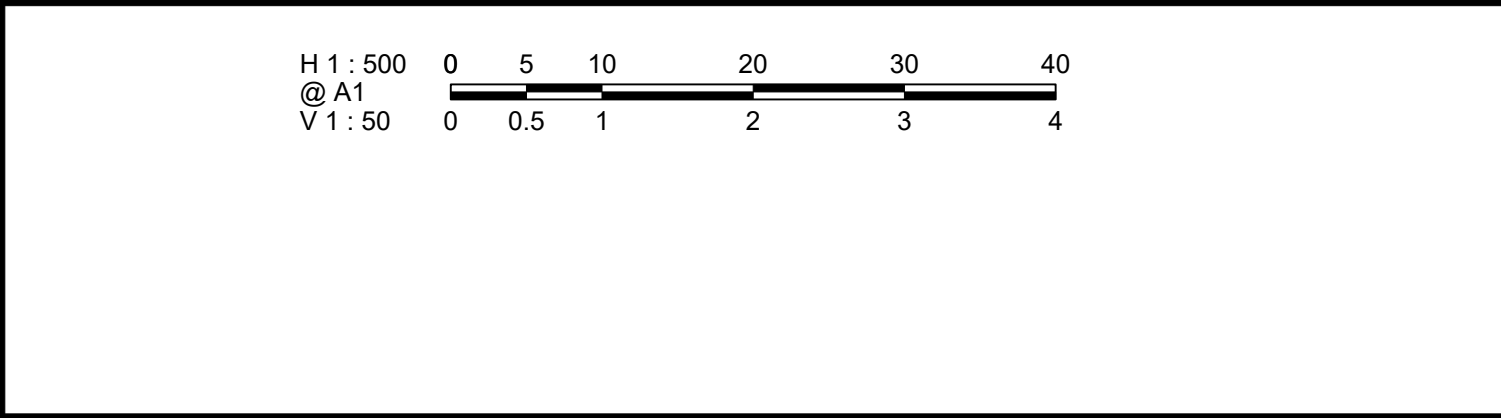






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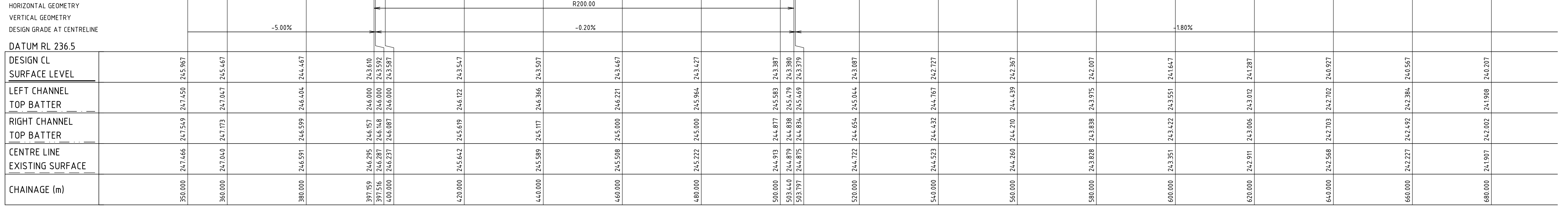




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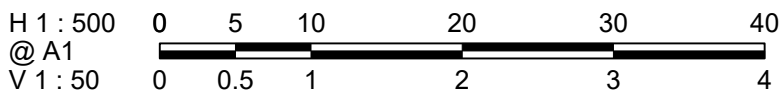


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# CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT

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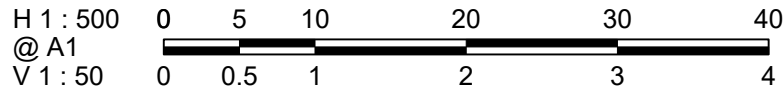
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CH01 - LONGITUDINAL SECTION


DRAWN:	EC
DESIGNED:	EC
APPROVED:	
DD MM YY	
APPROVED	DATE



CLIENT:



Ground Floor, 207-213 Waverley Road,  
Malvern East VIC 3145  
TEL : 03 8573 1500 [verveprojects.com](http://verveprojects.com)



COUNCIL:  
HUME CITY COUNCIL

PROJECT:

AITKEN CREEK  
1720 MICKLEHAM RD  
MICKLEHAM

TITLE:

CRAIGIEBURN WEST PSP  
AITKEN CREEK  
WATERWAY ALIGNMENT

ISSUE:

**PRELIMINARY**

MELWAY REF:

285 H3

PROJECT No:

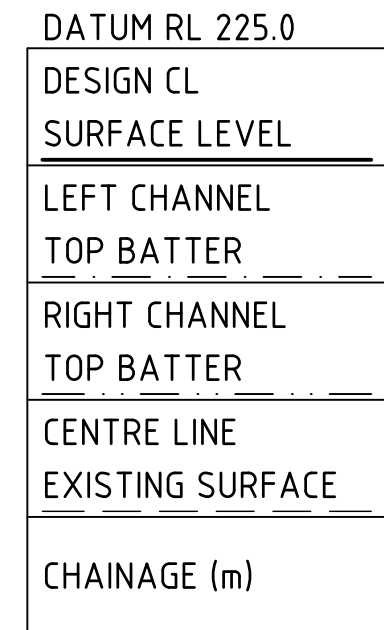
18032-00

DWG No:

SK403

REVISION:

A



CH01 - LONGITUDINAL SECTION

				DRAWN:				<div><div>H 1 : 500 @ A1 V 1 : 50</div><div><div>0510203040</div><div>00.51234</div></div></div>				CLIENT:				<div><div><div><div></div><div></div></div><div><div>verve</div><div>Ground Floor, 207-213 Waverley Road, Malvern East VIC 3145 TEL : 03 8573 1500    <a href="http://verveprojects.com">verveprojects.com</a></div></div></div><div><div><div></div><div></div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>030001</div></div><div><div>030001</div><div>0300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PLOT DATE: Wed Apr 14 01:25:20 2021

HORIZONTAL GEOMETRY  
VERTICAL GEOMETRY  
DESIGN GRADE AT CENTRELINE

DATUM RL 219.5

DESIGN CL SURFACE LEVEL	225.202	225.102	224.902	224.702	224.618	224.502	224.302	224.102	223.902	223.702	223.502	223.302	223.102	222.902	222.702	222.690
LEFT CHANNEL TOP BATTER	226.607	226.472	226.153	226.942	226.000	226.000	225.669	225.000	225.009	224.768	225.027	224.782	224.447	224.327	223.866	
RIGHT CHANNEL TOP BATTER	228.059	228.017	227.797	227.426	227.263	227.047	226.627	225.416	225.583	224.720	224.418	224.225	224.000	224.000	223.695	
CENTRE LINE EXISTING SURFACE	227.716	227.082	226.959	226.695	226.636	226.332	225.738	225.504	224.960	224.235	224.045	224.000	224.076	224.050	223.695	223.653
CHAINAGE (m)	1750.000	1760.000	1780.000	1800.000	1808.468	1820.000	1840.000	1860.000	1880.000	1900.000	1920.000	1940.000	1960.000	1980.000	2000.000	2001.220

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CH01 - LONGITUDINAL SECTION

DRAWN:

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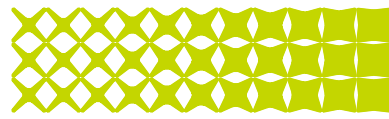
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V 1 : 50

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CLIENT:



Ground Floor, 207-213 Waverley Road,  
Malvern East VIC 3145  
TEL : 03 8573 1500 [verveprojects.com](http://verveprojects.com)



COUNCIL:

HUME CITY COUNCIL

PROJECT:

AITKEN CREEK  
1720 MICKLEHAM RD  
MICKLEHAM

TITLE:

CRAIGIEBURN WEST PSP  
AITKEN CREEK  
WATERWAY ALIGNMENT

ISSUE:

PRELIMINARY

MELWAY REF:

285 H3

PROJECT No:

18032-00

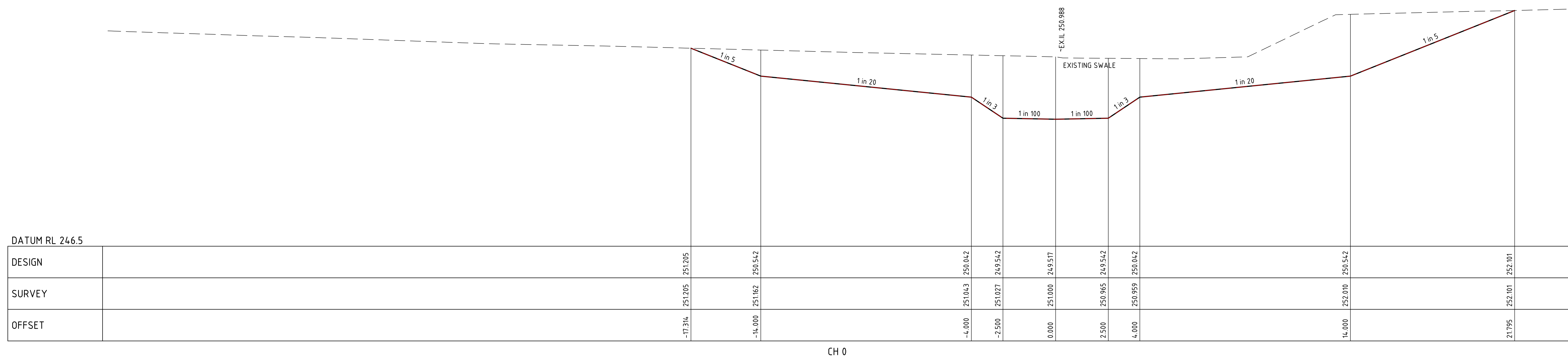
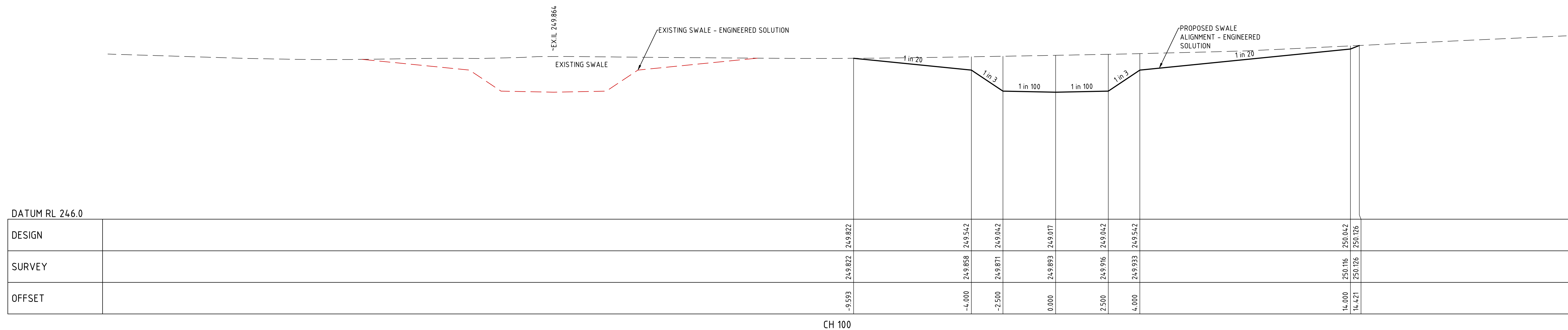
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REVISION:

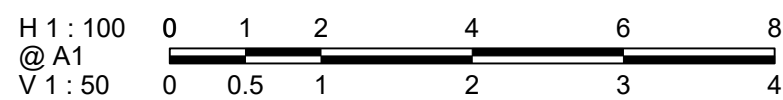
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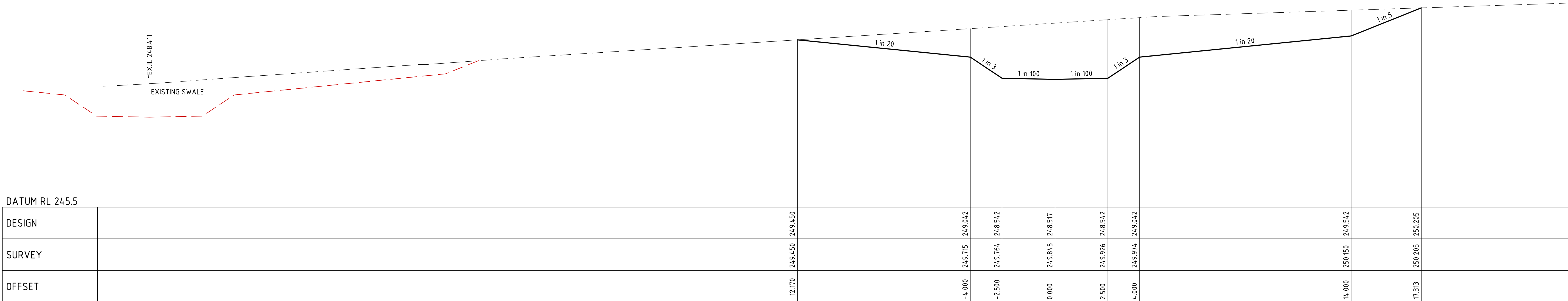
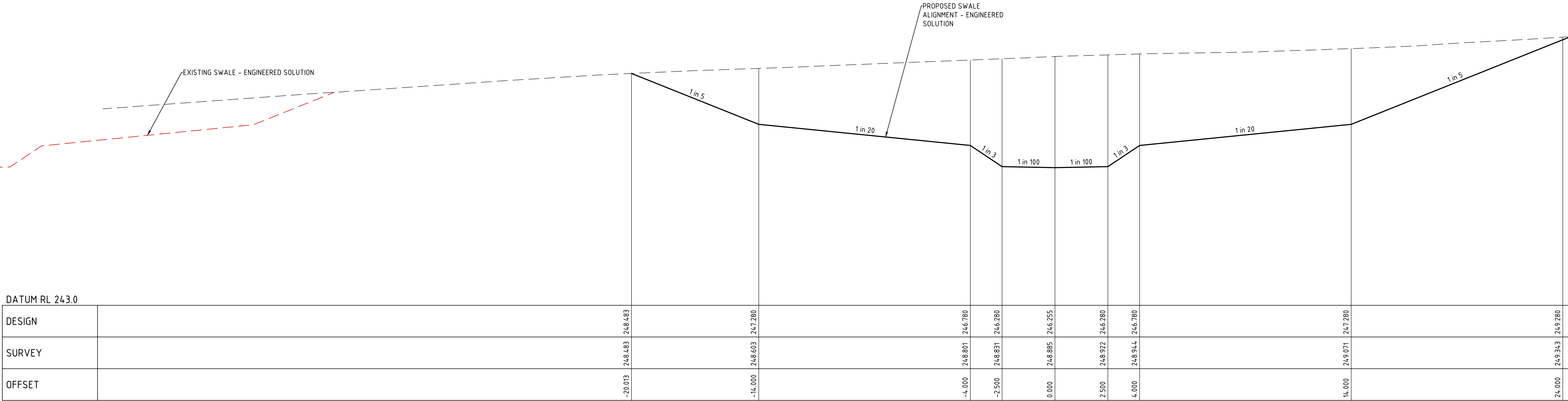
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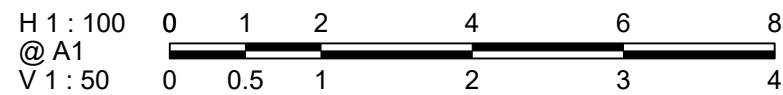
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 <small>This drawing has been printed by          Hume City Council          © Hume City Council          © Vector Pty Ltd</small>	COUNCIL: HUME CITY COUNCIL				
	PROJECT: AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM		TITLE: CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT		
ISSUE:	PRELIMINARY	MELWAY REF: 285 H3	PROJECT No: 18032-00	DWG No: SK501	REVISION: A



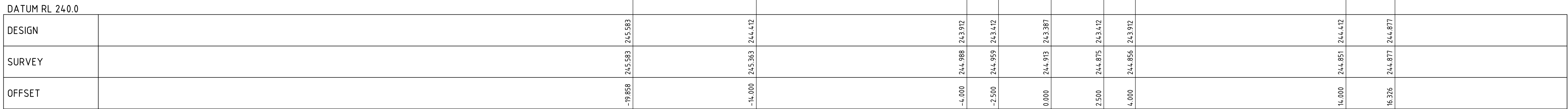
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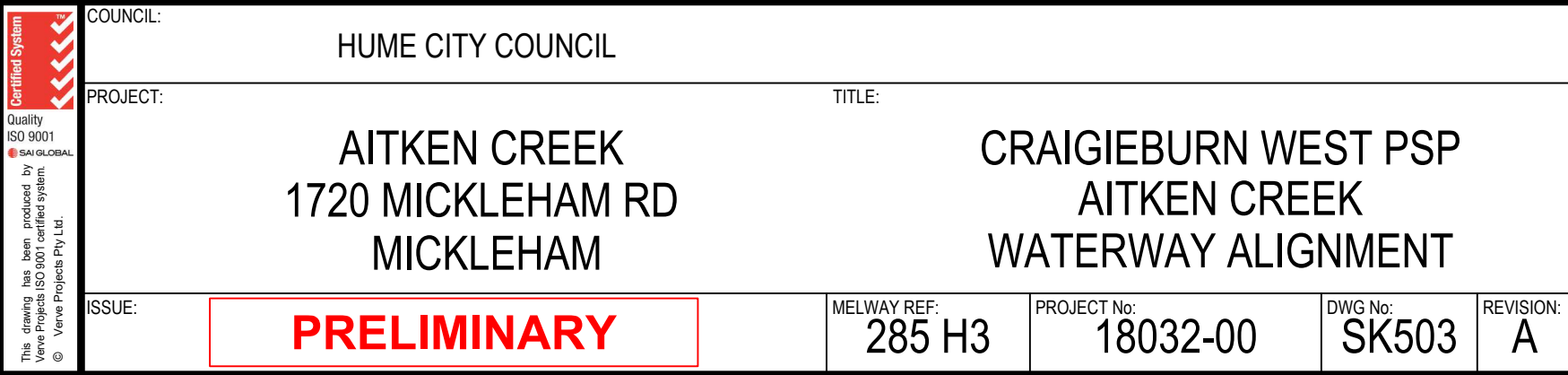
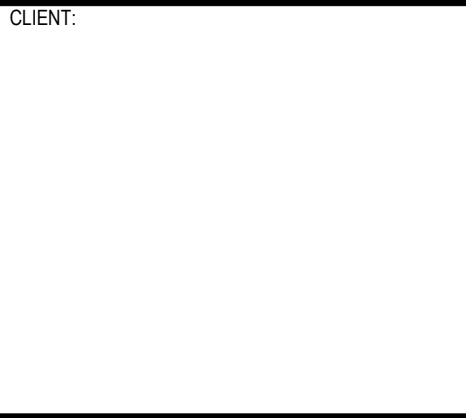
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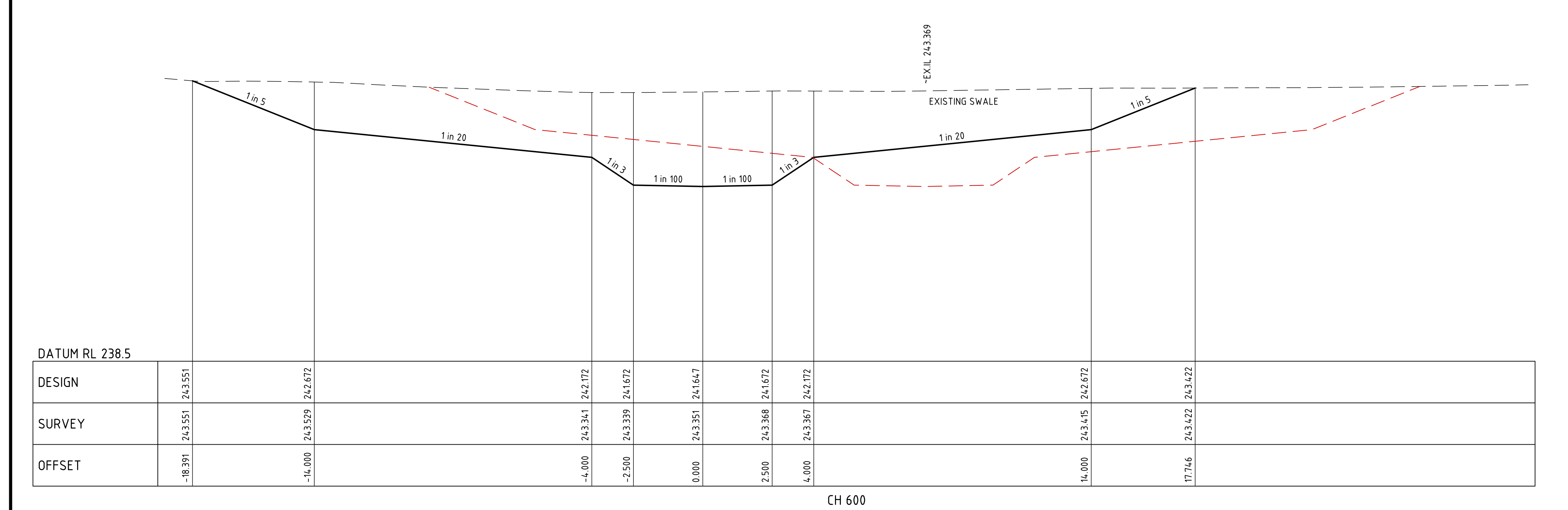


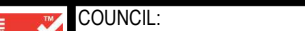


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PROJECT:		TITLE:			
AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM		CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT			
ISSUE:	PRELIMINARY	MELWAY REF: 285 H3	PROJECT No: 18032-00	DWG No: SK502	REVISION: A

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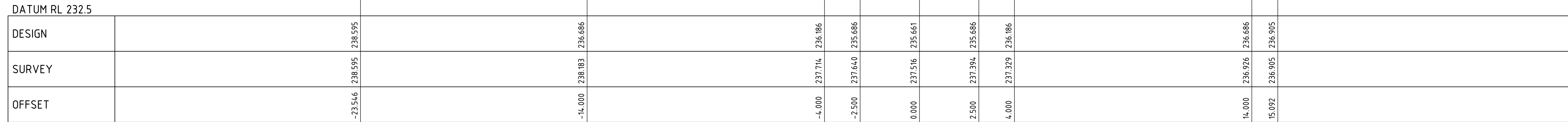
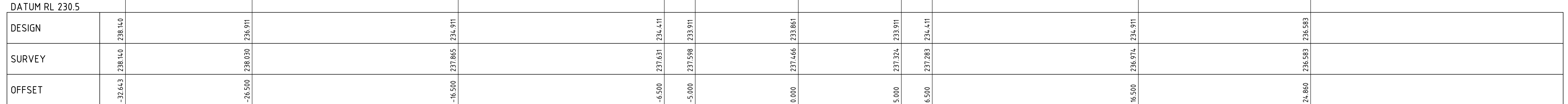


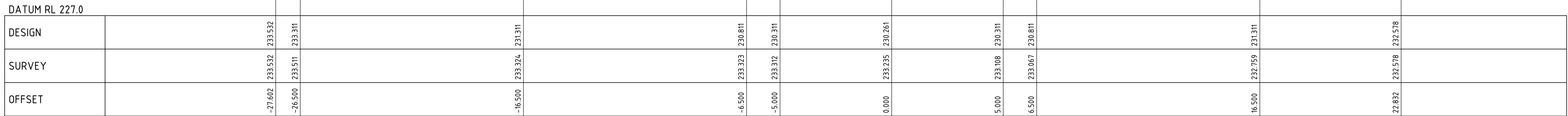


<div> <div>  <p><b>verve</b> Ground Floor, 207-213 Waverley Road, Malvern East VIC 3145 TEL : 03 8573 1500    <a href="http://verveprojects.com">verveprojects.com</a></p> </div> <div>  <p><b>COUNCIL:</b> HUME CITY COUNCIL</p> </div> </div>		<div> <div>  <p>H 1 : 100 @ A1 V 1 : 50</p> </div> <div> <p>0 1 2 4 6 8 0 0.5 1 2 3 4</p> </div> </div>		<div> <div> <p><b>CLIENT:</b></p> </div> <div> <p><b>PROJECT:</b></p> </div> </div>		<div> <div> <p><b>TITLE:</b></p> </div> <div> <p>AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM</p> </div> </div>		<div> <div> <p><b>ISSUE:</b></p> </div> <div> <p><b>PRELIMINARY</b></p> </div> </div>		<div> <div> <p><b>MELWAY REF:</b></p> </div> <div> <p>285 H3</p> </div> </div>		<div> <div> <p><b>PROJECT No:</b></p> </div> <div> <p>18032-00</p> </div> </div>		<div> <div> <p><b>DWG No:</b></p> </div> <div> <p>SK504</p> </div> </div>		<div> <div> <p><b>REVISION:</b></p> </div> <div> <p>A</p> </div> </div>	
<div> <div> <p><b>DRAWN:</b></p> </div> <div> <p>EC</p> </div> </div>		<div> <div> <p><b>DESIGNED:</b></p> </div> <div> <p>EC</p> </div> </div>		<div> <div> <p><b>APPROVED:</b></p> </div> <div> <p></p> </div> </div>		<div> <div> <p><b>DATE:</b></p> </div> <div> <p></p> </div> </div>		<div> <div> <p><b>REV</b></p> </div> <div> <p><b>DESCRIPTION</b></p> </div> </div>		<div> <div> <p><b>APPROVED</b></p> </div> <div> <p><b>DATE</b></p> </div> </div>		<div> <div> <p><b>DD.MM.YY</b></p> </div> <div> <p></p> </div> </div>		<div> <div> <p><b>DATE:</b></p> </div> <div> <p></p> </div> </div>		<div> <div> <p><b>DATE:</b></p> </div> <div> <p></p> </div> </div>	





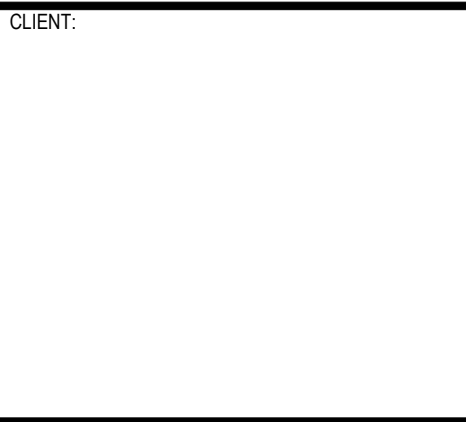
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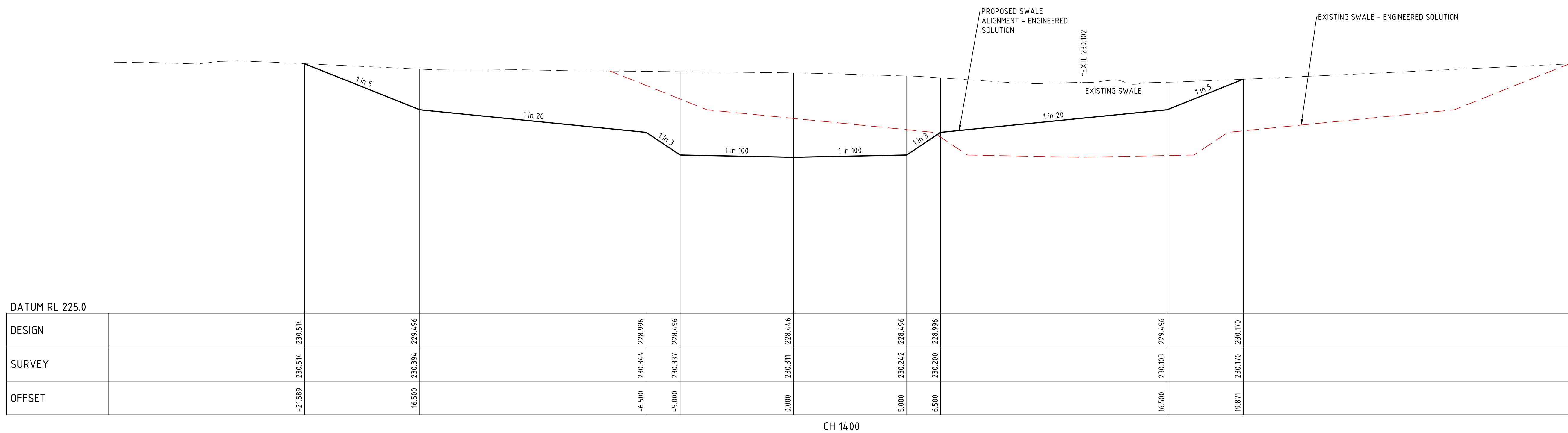
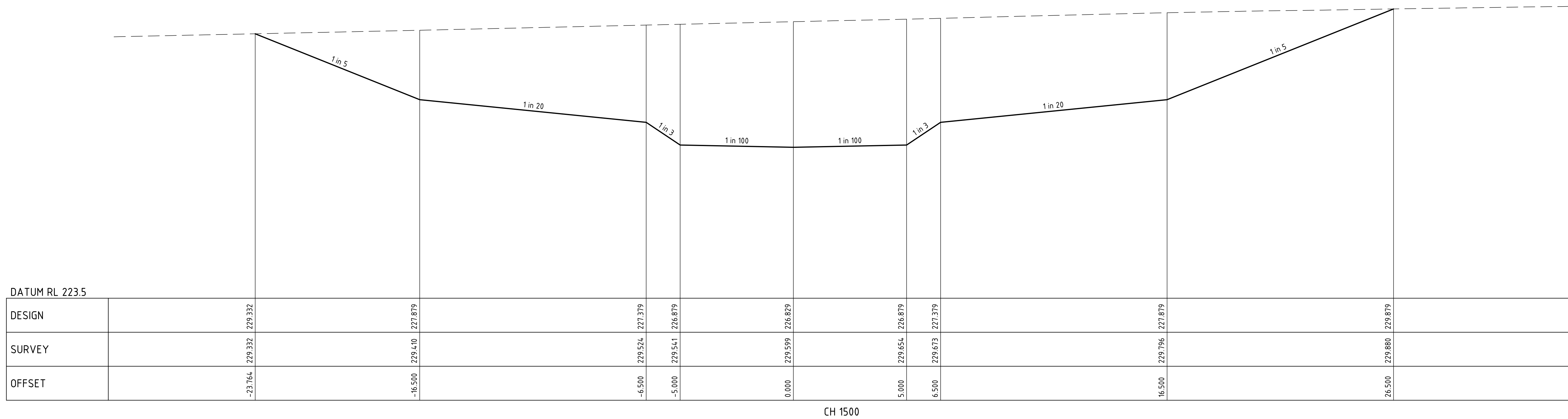
The diagram illustrates a road cross-section with a 1 in 5 downward slope on the left, a 1 in 20 horizontal section in the middle, and a 1 in 5 upward slope on the right. The road is defined by vertical lines, and the ground surface is indicated by a dashed line.

DATUM RL 229.0					
DESIGN		236.099	236.099	235.111	
SURVEY		236.099	236.067	235.111	
OFFSET	-3'14.36	236.500	236.500	235.834	-6.500
				235.815	-5.000
				235.757	0.000
				235.706	6.500
				235.638	16.500
				235.448	26.500
				235.402	27.953

						DRAWN:
						EC
						DESIGNED:
						EC
						APPROVED:
-					DD.MM.YY	
REV	DESCRIPTION			APPROVED	DATE	



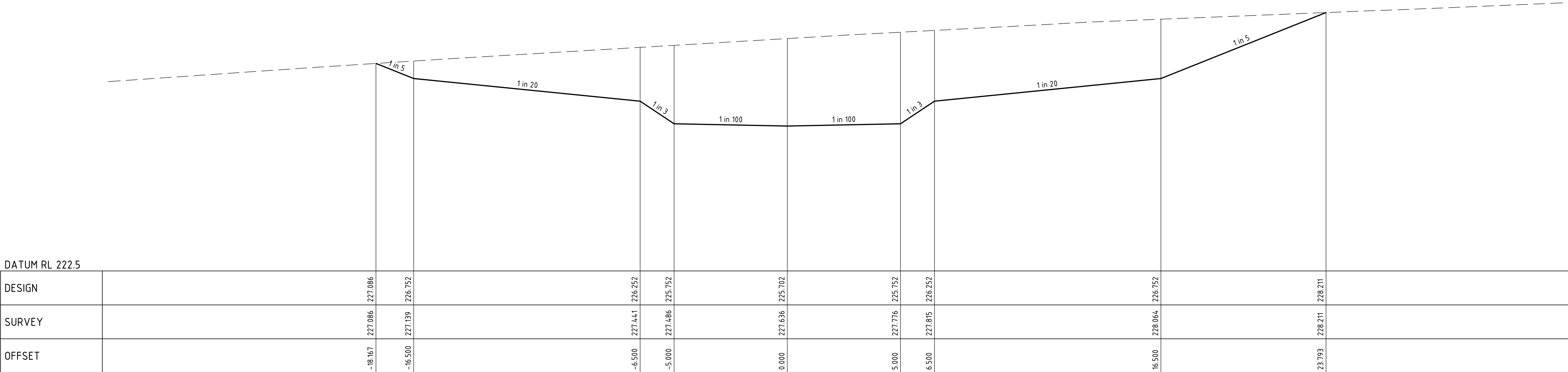
COUNCIL: HUME CITY COUNCIL					
PROJECT: AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM			TITLE: CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT		
ISSUE:	PRELIMINARY	MELWAY REF: 285 H3	PROJECT No: 18032-00	DWG No: SK507	REVISION: A



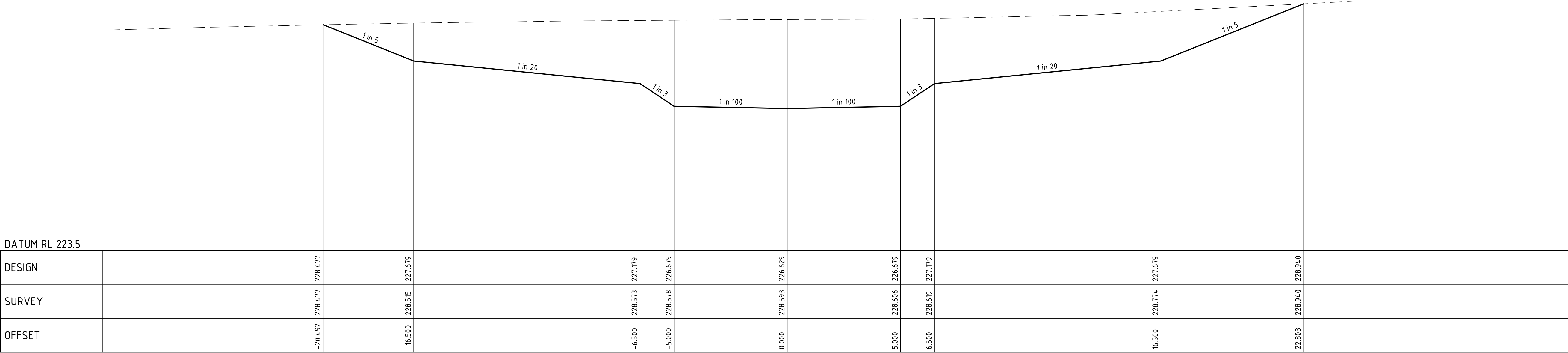
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CAD FILE: D:\V2DSYNERGY\_DATA\TEMP\V2DSYNERGY\SERVERSERVICE\3272\A4D5A481-8ED0-4D8E-A2AE-5C099D487EC\18032-00-SK509-SK511.DWG  
PLOT DATE: Wed Apr 16 01:25:43 2021



CH 1700



CH 1600

					DRAWN:
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					APPROVED:
				DD MM YY	
REV	DESCRIPTION	APPROVED	DATE		

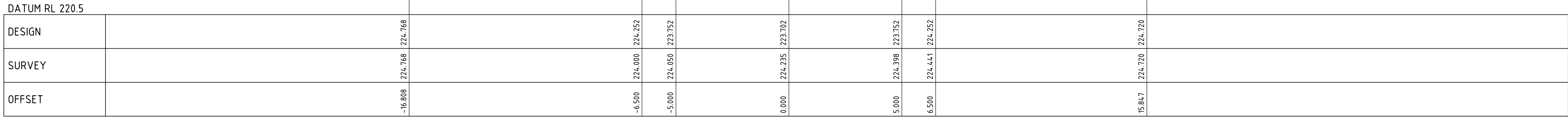


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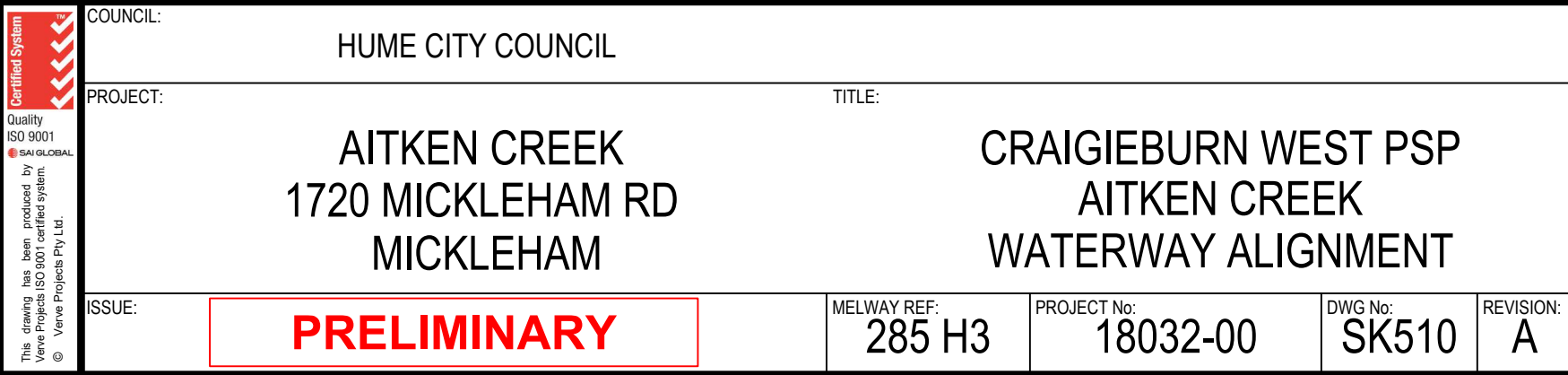
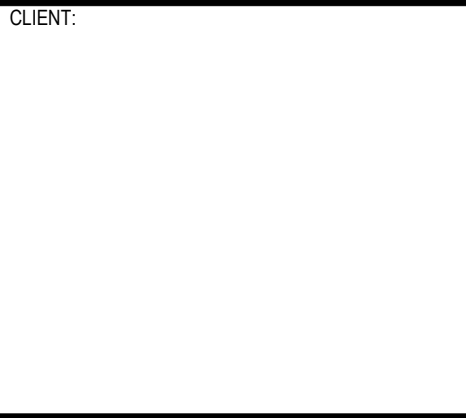
Ground Floor, 207-213 Waverley Road,  
Malvern East VIC 3145  
TEL : 03 8573 1500 [verveprojects.com](http://verveprojects.com)

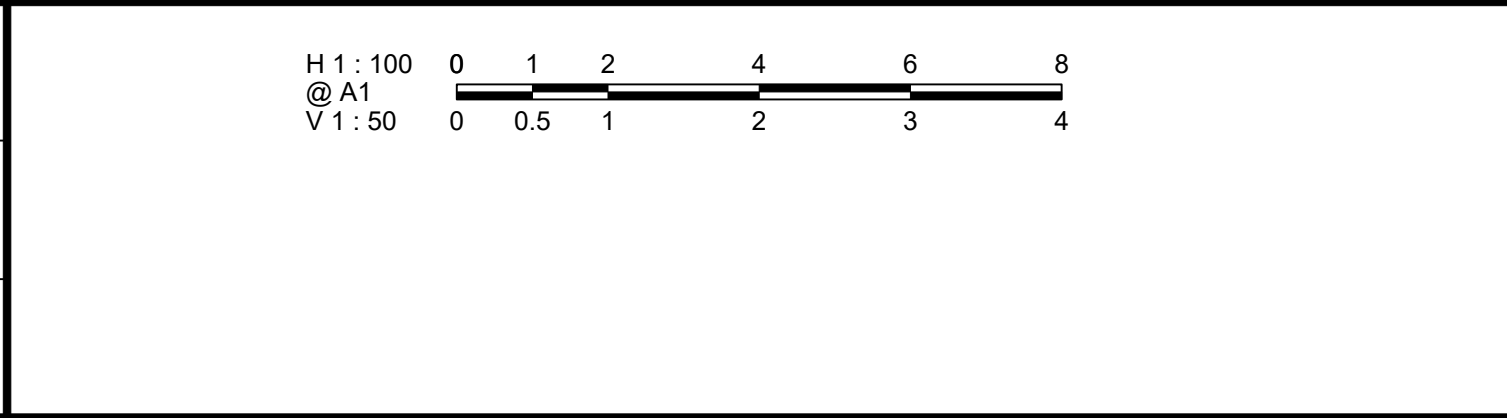
COUNCIL:	HUME CITY COUNCIL	TITLE:	
PROJECT:	AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM		CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT
ISSUE:	PRELIMINARY	MELWAY REF:	285 H3
		PROJECT No:	18032-00
		DWG No:	SK509
		REVISION:	A



DATUM RL 221.5					
DESIGN		-22.4+9	228.942	225.942	
SURVEY			228.403	225.752	
OFFSET			-16.500	226.340	225.252
				226.420	224.752
				0.000	226.695
				5.000	226.974
				6.500	227.035
				16.500	227.312
				24.868	227.426


						DRAWN:
						EC
						DESIGNED:
						EC
						APPROVED:
-					DD.MM.YY	
REV	DESCRIPTION			APPROVED	DATE	





CLIENT:



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	PROJECT:		TITLE:	
	AITKEN CREEK 1720 MICKLEHAM RD MICKLEHAM		CRAIGIEBURN WEST PSP AITKEN CREEK WATERWAY ALIGNMENT	
	ISSUE:	PRELIMINARY	MELWAY REF: 285 H3	PROJECT No: 18032-00
				DWG No: SK511
				REVISION: A