Croskell PSP Drainage Strategy

Concept Drainage Strategy Rev. D Design Report

Prepared for Melbourne Water
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Contents

Executive Summary **1**

1 Introduction **3**

1.1 Background 3

1.1.1 Project background 3

1.1.2 Croskell Precinct Structure Plan (PSP) 3

1.1.3 Ti-Tree Creek Development Services Scheme 3

1.2 Purpose of report 4

1.3 Project scope 4

1.4 Exclusions 4

2 Project Objectives **5**

3 Design Codes **6**

4 Catchment Characteristics **8**

4.1 Overview 8

4.2 Site locality 8

4.3 Topography 10

4.3.1 Western catchments 10

4.3.2 Eastern catchments 10

4.4 Existing catchment area and land use 10

4.5 Existing drainage 10

4.6 Groundwater and soil profile reporting 12

4.7 Cultural heritage values 12

4.8 Environmental values 13

4.9 Site constraints 13

4.10 Future development conditions 15

5 Design Performance Requirements **16**

5.1 Overview 16

5.2 Design Hydrology 16

5.2.1 Design requirements 16

5.2.2 Design peak flow targets based on pre-development conditions 16

5.3 Water quality 18

5.3.1 Design requirements 18

5.3.2 Targets and objectives 19

5.3.3 Total annual runoff volume at VDP cable crossing performance results 21

6 Croskell PSP Concept Drainage Strategy Rev. D **22**

6.1 Overview 22

6.2 Drawings list 25

6.3 Asset design requirements 25

6.3.1 Overview 25

6.3.2 Northwest pipe diversion 25

6.3.3 Swales 30

6.3.4 Retarding Basins and Wetlands 31
6.3.5 Sediment ponds 35
6.3.6 Ti-Tree Creek main waterway 37
6.3.7 Minor system underground drainage 41
6.4 Hydrological modelling – RORB 43
6.4.1 Overview 43
6.4.2 Modelling approach 43
6.4.3 Retarding basin design performance 44
6.4.4 Hydrological modelling results 45
6.5 Water quality and quantity modelling and improvement measures - MUSIC 46
6.5.1 Overview 46
6.5.2 Water quality and total annual runoff modelling 46
6.5.3 Total annual runoff volume at VDP cable crossing performance results 47
6.5.4 Wetlands 48
6.5.5 Sediment basins 48
6.6 Hydraulic modelling - TUFLOW 49
6.6.1 Overview 49
6.6.2 Limitations 49
6.6.3 Design flood modelling results 50
6.6.4 Findings and recommendations 59
6.7 Land requirements estimate 60
7 Recommendations 63
8 References 64

Appendices

Appendix A – Groundwater Memorandum
Appendix B – Pre-development hydrological modelling
Appendix C – Post-development hydrological modelling
Appendix D – MUSIC Contributing Catchments
Appendix E – Sediment basin sizing
Appendix F – 2025 TUFLOW modelling approach
Appendix G – Constructed Waterway Freeboard

Revision History

Revision Nº	Prepared By	Description	Date
0	Michael Di Matteo	Issue for Use	30/09/2025

Document Acceptance

Action	Name	Signed	Date
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on behalf of	Water4Good		

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Executive Summary

The Croskell Employment Precinct Structure Plan (Croskell PSP), covering approximately 318 hectares in Clyde North and Cranbourne East, is undergoing transformation from predominantly rural pasture and industrial land into a greenfield industrial, mixed use, and residential development area. The existing site includes open paddocks, an abattoir, a broiler farm, and a concrete batching plant, with drainage currently limited to an agricultural drain that conveys flows northward to constructed wetlands beyond Thompsons Road. This system provides minimal flood protection, and large areas remain vulnerable to inundation due to shallow groundwater and the absence of formal drainage infrastructure. Urbanisation will significantly increase impervious surfaces, creating a critical need for a drainage and flood mitigation strategy that manages stormwater flows and achieves Best Practice Environmental Management (BPEM) targets for Total Suspended Solids (TSS), Total Nitrogen (TN), and Total Phosphorus (TP).

The drainage strategy proposed was developed through a several-year collaborative PSP process involving the Victorian Planning Authority (VPA), City of Casey, landowners, developers and their consultants, DEECA, South East Water, Ausnet, and the Department of Transport and Planning (DTP). This process included liaison and technical workshops with stakeholders over a period of 18 months, and a Standing Advisory Committee (SAC) hearing in early 2025 to refine and optimise the design in response to stakeholder feedback and site constraints.

The proposed solution integrates a network of major and minor drainage assets to convey external catchment flows and local catchment flows generally northward to Thompsons Road, and some local catchment flows eastward to Berwick-Cranbourne Road. Major assets include the Ti-Tree Creek constructed waterway, retarding basins (SBRB2, WLRB3, WLRB4), wetlands, sediment ponds (SB1–SB3), and a 1%AEP diversion pipe, supported by trunk pipes and swales servicing catchments of 0.4 hectares or greater. This system mitigates flood risk, protects critical infrastructure within a transmission easement including the Victorian Desalination Project (VDP) high voltage cable and Ausnet transmission towers, and Melbourne Water mains, South East Water sewerage pumping station, sewer mains, and recycled water reticulation network, and demonstrates compliance with water quality objectives at the two outfalls. The outfalls are located at Thompsons Road and Berwick-Cranbourne Road (which conveys to an existing wetland retarding basin further downstream on Thompsons Road).

It should be noted that in specific locations of the constructed waterway, the freeboard target of 300mm is not achieved. In addition, there is residual afflux identified external to the PSP outside of existing drainage reserves in a climate change scenario.

The design was informed by environmental and geotechnical investigations, feature surveys, and advanced modelling using RORB for hydrology, TUFLOW for two-dimensional hydraulic performance, and MUSIC for water quality. Key assumptions included climate change projections to 2100 under ARR2019 v4.2 (SSP2-4.5), ultimate land use based on the VPA Place-Based Plan, and clearance requirements for critical services. Constraints influencing the design included minimising impacts on developable land, avoiding clashes with major utilities, and preserving ecological and cultural heritage values.

Risks for future stages include detailed design refinements, construction feasibility for deep trenching and service crossings, staging of interim works, groundwater management, and additional modelling and investigation of residual afflux downstream under climate change scenarios.

Next steps by others involve developing functional and detailed designs, securing utility approvals, updating hydraulic models with post-development landform data, and investigating mitigation options for downstream impacts.

Figure 0-1 shows proposed designed assets for Croskell PSP drainage strategy and required land footprints.

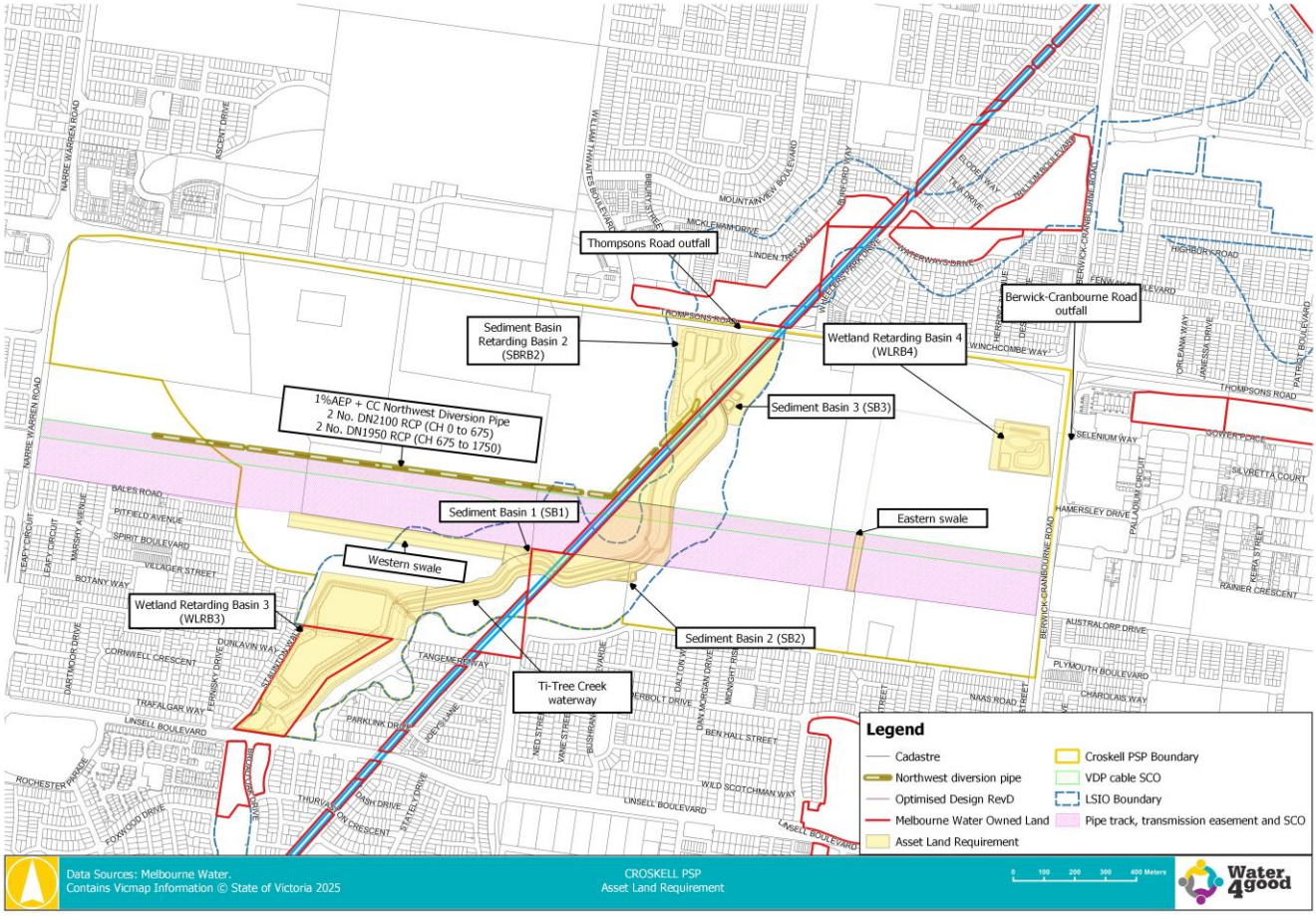


Figure 0-1: Asset land requirement in Croskell PSP strategy

1 Introduction

1.1 Background

1.1.1 Project background

Water4Good has been engaged by Melbourne Water to complete a drainage concept options assessment and concept design of major drainage assets (retarding basin, wetland and waterway) and minor assets (drainage lines) for the Croskell Precinct Structure Plan (PSP).

In June 2024 Melbourne Water exhibited for public comment the Croskell PSP Proposed Drainage Strategy - Drainage Strategy Concept Design Report ("Draft Drainage Strategy (June 2024)"; MEG250-07-TD-OT-REP-0004 Rev.0) prepared by Water4Good (2024).

In the period 11 Sep 2024 to 9 Oct 2024, the Victorian Planning Authority (VPA) held a public consultation for the Croskell Employment Precinct Structure Plan (PSP), which included a draft concept drainage strategy by Melbourne Water.

In October 2024, following assessment of public submissions on the PSP and drainage strategy, Melbourne Water recommended changes to the design basis and identified further opportunities for optimisation of the drainage strategy. Water4Good revised the concept design based to implement these recommendations.

In December 2024, the revision B of the optimised design ("Optimised Design Rev. B (Dec 2024)"; MEG250-07-TD-OT-REP-0005 Rev.B) was distributed to stakeholders and a workshop held on 11 December 2024. Following feedback from the workshop, design changes were captured in a revision C report (Optimised Design Rev. C (Feb 2025)", MEG250-07-TD-OT-REP-0005 Rev.C).

In February 2025, several changes to the drainage strategy including modifications to avoid services and asset clashes were proposed. Engagement between Melbourne Water and asset owners including South East Water, DEECA, and Ausnet continued to resolve services and asset interfaces and provide design requirements for future functional design.

From 3 March 2025 to 28 March 2025 the Standing Advisory Committee (SAC) for the Croskell (Employment) Precinct Structure Plan was held to hear from submitters and all stakeholders including on the proposed drainage strategy.

In May 2025 to August 2025, design basis changes were adopted and the final iteration of Water4Good's design is captured in this report named the "Concept Drainage Strategy Rev. D (September 2025)" and is intended to be the final design deliverable for the Croskell PSP drainage strategy.

1.1.2 Croskell Precinct Structure Plan (PSP)

The Croskell (Employment) precinct is located approximately 45km southeast of Melbourne's central business district within the City of Casey. The precinct encompasses around 318 hectares and is bounded by Thompsons Road to the north, Berwick Cranbourne Road to the east, and Narre Warren Cranbourne Road to the west. The boundary of the Croskell (Employment) precinct was expanded in January 2023 to encompass the entirety of 1450 Thompsons Road, an addition of 12.23ha. The Croskell Employment PSP is located within Ti Tree Creek Development Services Scheme (DSS 0619).

1.1.3 Ti-Tree Creek Development Services Scheme

The catchment for the Ti-Tree Creek Development Services Scheme is approximately bounded by Greaves Road and O'Shea Road to the north, Clyde North DSS to the east, Collison Road DSS to the south and Narre Warren-Cranbourne Road to the west. The scheme area discharges generally in a north-easterly and

then north-westerly direction into Greaves Road Retarding Basin before entering Hallam Valley Contour Drain.

1.2 Purpose of report

The purpose of this report is to document the design completed for the proposed Concept Drainage Strategy Rev. D (September 2025) for Croskell PSP, located within the Melbourne Water Ti-Tree Creek Drainage Services Scheme (0619). It includes water quality assessment, waterway and flood retardation assets design. Water4Good has prepared the report for use by Melbourne Water.

1.3 Project scope

Water4Good's scope of work to inform the Concept Design included:

- Environmental assessment
- Geotechnical assessment
- Feature survey
- Hydrological modelling
- Hydraulic modelling
- Water quality assessment
- Concept design of Major DSS assets (retarding basin, wetland, and waterway assets)
- Design of Minor DSS assets (trunk pipes and swales servicing minimum 0.4 ha)
- Stakeholder engagement.

1.4 Exclusions

- Detailed quantities estimate for fill volume and land requirement.
- Integrated Water Management opportunities
- Cost estimate (to be prepared by Melbourne Water separately)

2 Project Objectives

The planning and provision of new infrastructure to support greenfield development within Melbourne Water's operational boundary (waterway management district) is usually managed using a Development Services Scheme (DSS).

A development services scheme comprises a drainage strategy for an area together with a pricing arrangement that allows Melbourne Water to require developers to contribute to the cost of the construction of works by Melbourne Water in connection with a development.

The strategy ensures that planning for urban development is conducted on a catchment basis and meets appropriate standards for flood protection and environmental performance, including protection and enhancement of waterway and biodiversity values.

Furthermore, Victorian planning provisions provide requirements for stormwater management for greenfield developments under Clause 56.07-4 26/10/2018 VC154 for residential subdivisions and Clause 53.18-4 W1 03/02/2022 VC199 for non-residential subdivisions.

Key objectives for the Croskell PSP DSS include:

- Flood protection is to be provided for properties within the PSP.
- New developments are not to further exacerbate existing flooding conditions for downstream/neighbouring properties.
- New developments are to achieve appropriate Best Practice stormwater quality treatment for flows generated from their property to mitigate impacts on downstream environments.
- To optimise drainage land requirements within the existing Urban Floodway Zone area and Melbourne Water owned land.
- Propose constructed waterways to provide safe drainage and flood protection and to incorporate environmental, cultural and amenity values.
- Climate Change effects to be included in the DSS design.
- Protect/minimise impacts on existing environmental and waterway values.
- Meet critical and other agency asset operational requirements to ensure constructability (i.e. water supply mains, transmission infrastructure and Victorian Desalination Project (VDP) underground power cable).
- Achieve the principles as set out in the Melbourne Water Principles for Provision of Waterway and Drainage Services for Urban Growth.

3 Design Codes

The concept design has been reviewed against relevant Melbourne Water Standards and Specifications, and Australian and Industry Standards/Guidelines listed Table 3-1, Table 3-2, and Table 3-3.

Table 3-1: List of Standards and references

Document Title
Melbourne Water Principles for Provision of Waterway and Drainage Services for Urban Growth
Flood Mapping guidelines and technical specifications (Melbourne Water 2021)
Wetland Design Manual (Melbourne Water December 2020)
Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia (Geoscience Australia), Version 4.2, 2019.
Constructed Waterway Design Manual (Melbourne Water 2019)
Retarding Basin Design and Assessment Guideline (Melbourne Water)
Waterway Corridors – Guidelines for greenfield development areas within the Port Phillip and Westernport Region (Melbourne Water, October 2013)
Melbourne Water MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Guideline – July 2024 Update
Melbourne Water Survey Standards and Guidelines Rev 4.
Melbourne Water Survey Drafting Manual Rev 4.
ANCOLD Guidelines for the Consequence Categories for Dams (October 2012)
Australian Runoff Quality: A Guide to Water Sensitive Urban Design (2006)
ANCOLD guidelines on selection of acceptable flood capacity for dams (March 2000)
Urban Stormwater - Best Practice Environmental Management Guidelines (Victorian Stormwater Committee, 1999)

Table 3-2: Melbourne Water Standards

Document Number	Document Title
CORP AM P006	Preparation of Drawing Documents
CORP CW P062	Safety in Design
CORP GOV 002	Risk Management Policy
CORP H&S 027	HAZID (Hazard Identification)
AM STA 3600	Standards for Infrastructure Projects in Flood-Prone Areas
	Principles for Provision of Waterway and Drainage Services for Urban Growth
7251/12/001 to 7251/12/035	Retarding Basins and Sediment Pond Standard Drawings

Table 3-3: Other Applicable Codes, Standards, and Guidelines

Document Title
Precinct Structure Planning Guidelines: New Communities in Victoria (VPA October 2021)
DEECA Guidelines for Development in Flood Affected Areas (2019)
Melbourne Water Healthy Waterways Strategy 2018
City of Casey Integrated Water Management Plan
Urban Floodway Zone (UFZ) overlays
Vision for Remaining Growth Areas City of Casey
Designing, constructing, and implementing new flood mitigation infrastructure
WSAA Product specifications for products and materials
VicRoads (DTP Roads) requirements
TUFLOW Classic/HPC User Manual 2025.0.

4 Catchment Characteristics

4.1 Overview

The following sections describe the catchment characteristics, including catchment plan, locality, topography, soils, cultural, heritage and environmental assessments, ultimate development land use and constraints within the Croskell PSP catchments.

For the purposes of concept design development and reporting, the drainage strategy has been separated into two areas:

- Western catchments, including sub-catchments draining to the existing Thompsons Road culvert.
- Eastern catchments, include sub-catchments draining to the existing Berwick-Cranbourne Road culvert.

4.2 Site locality

The Precinct Structure Plans located within the Ti-Tree Creek DSS (0619) are shown in Figure 4-1. Most of the schemes have been developed around Croskell PSP scheme.

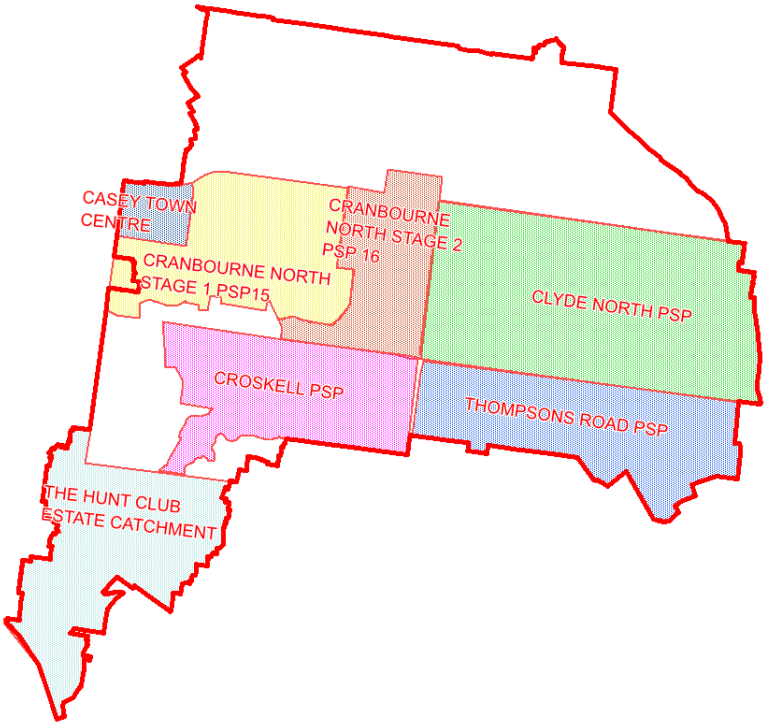


Figure 4-1: PSP boundaries within Ti-Tree Creek DSS

The Croskell PSP site locality is shown in Figure 4-2. Croskell PSP is bounded by Thompsons Road to the north, Berwick Cranbourne Road to the east, Narre Warren Road to the west and by Linsell Boulevard, Donohue Street, Brocker Street and Glenelg Street to the south.

Other adjacent DSS's include the 2371 – Collison Road DSS to the south, and 2370 – Clyde Creek DSS is to the southeast.

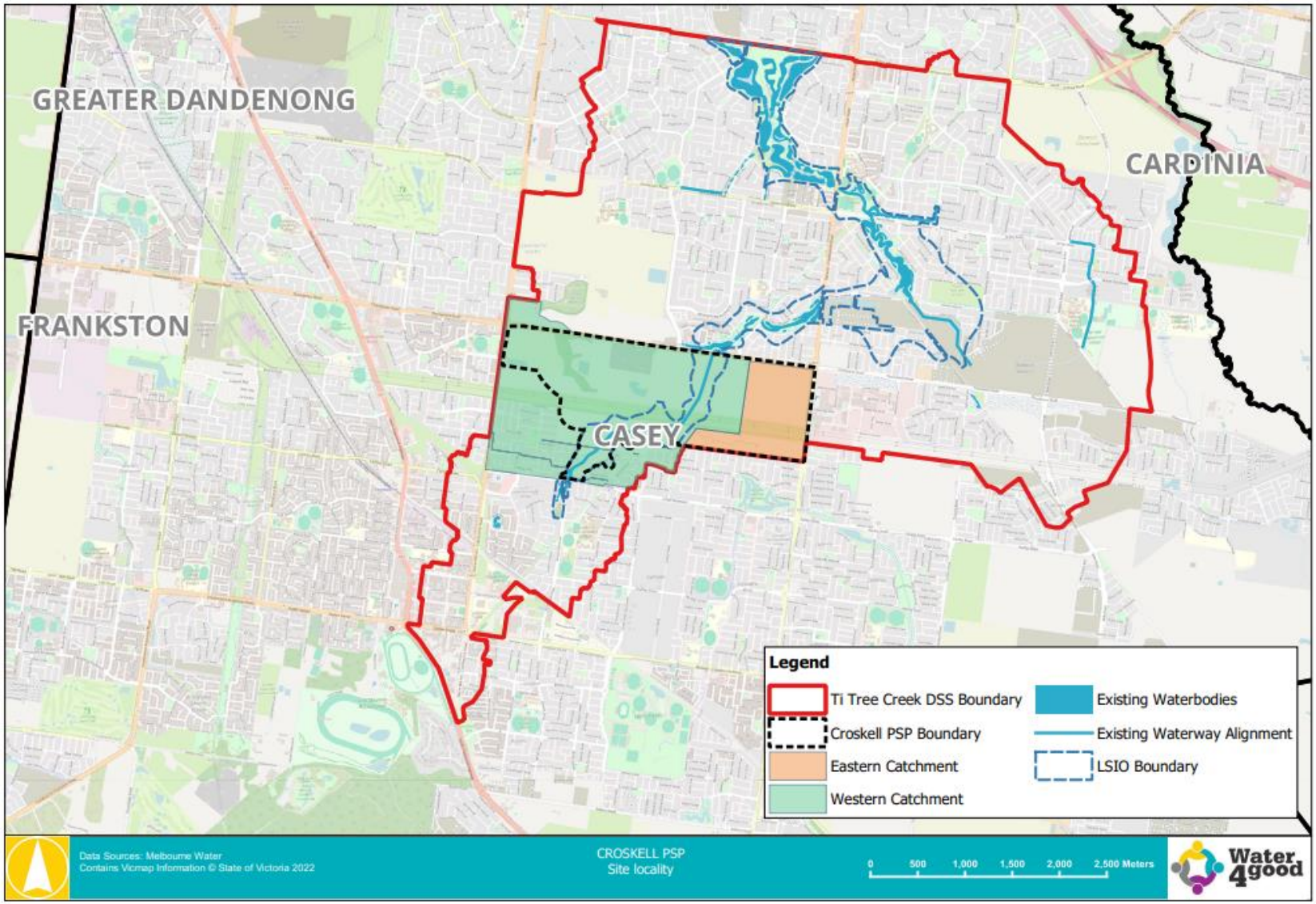


Figure 4-2: Croskell PSP site locality plan

4.3 Topography

4.3.1 Western catchments

The western catchment comprises nearly 65% of the Croskell PSP area. Elevation within the area ranges from 59 mAHD at northwest area to 31 mAHD at the northeast area.

Generally, catchments grade towards Ti-Tree Creek, an existing agricultural drain, which runs from Linsell Boulevard to Thompsons Road and ultimately drains into constructed wetlands located north of Thompsons Road.

4.3.2 Eastern catchments

The eastern catchments include PSP Lots 14 and Lots 20 to 24.

Lots 20 to 24 generally grade northwards into Lots 13E and Lot 14. There is a natural low point at the south-eastern boundary of Lot 14 and Lot 24, where the local gradient is very flat.

Lot 14 generally grades from maximum 32.5 mAHD to approx. 27.8 mAHD, north-eastwards toward the existing Berwick-Cranbourne Road culvert location (DSS asset ID G2-G3). Within the Lot 14 transmission easement, no defined swale crossing of the VDP power cable can be identified from the LiDAR data. The eastern part of the catchment is relatively flat (with a gradient of less than 0.5%).

4.4 Existing catchment area and land use

Croskell PSP area is approximately 318 ha and is situated in the Port Phillip catchment within the Gippsland Plain Bioregion. The majority of the area is currently being used for grazing stock and consists of large open paddocks with rows of non-native trees. An elevated section in the central-northern part of the study area consists of former quarries and now contains a concrete batching plant, broiler farm and abattoir. Existing land use within the Croskell PSP site is rural open pasture (approx. 80%) and industrial (abattoir, broiler farm, concrete batching plant).

Catchments external to the PSP include the existing residential development within the Hunt Club Estate to the south, and existing residential development to the southwest and southeast of the PSP.

Melbourne Water owns the land parcel north of Linsell Boulevard culverts and the Melbourne Water Pipe Track Reserve.

4.5 Existing drainage

The Croskell PSP site is located within the Ti-Tree Creek DSS – 0619. An agricultural drain runs from Linsell Boulevard to Thompsons Road. The waterway drains into Thompsons Road culvert which discharges into constructed wetlands north of Thompsons Rd. The existing drainage assets plan of Croskell PSP is presented in Figure 4-3.

Water4Good was provided with a flood model of the existing conditions based on the Flood Modelling Report—Ti-Tree Creek (Cardno, February 2020), showing large areas of the PSP are vulnerable to potential flooding for a 1%AEP without climate change event, with flood depths estimated to be in the range of 0.1 to 0.5 meters, particularly along the agricultural drain that runs through the centre of the precinct.

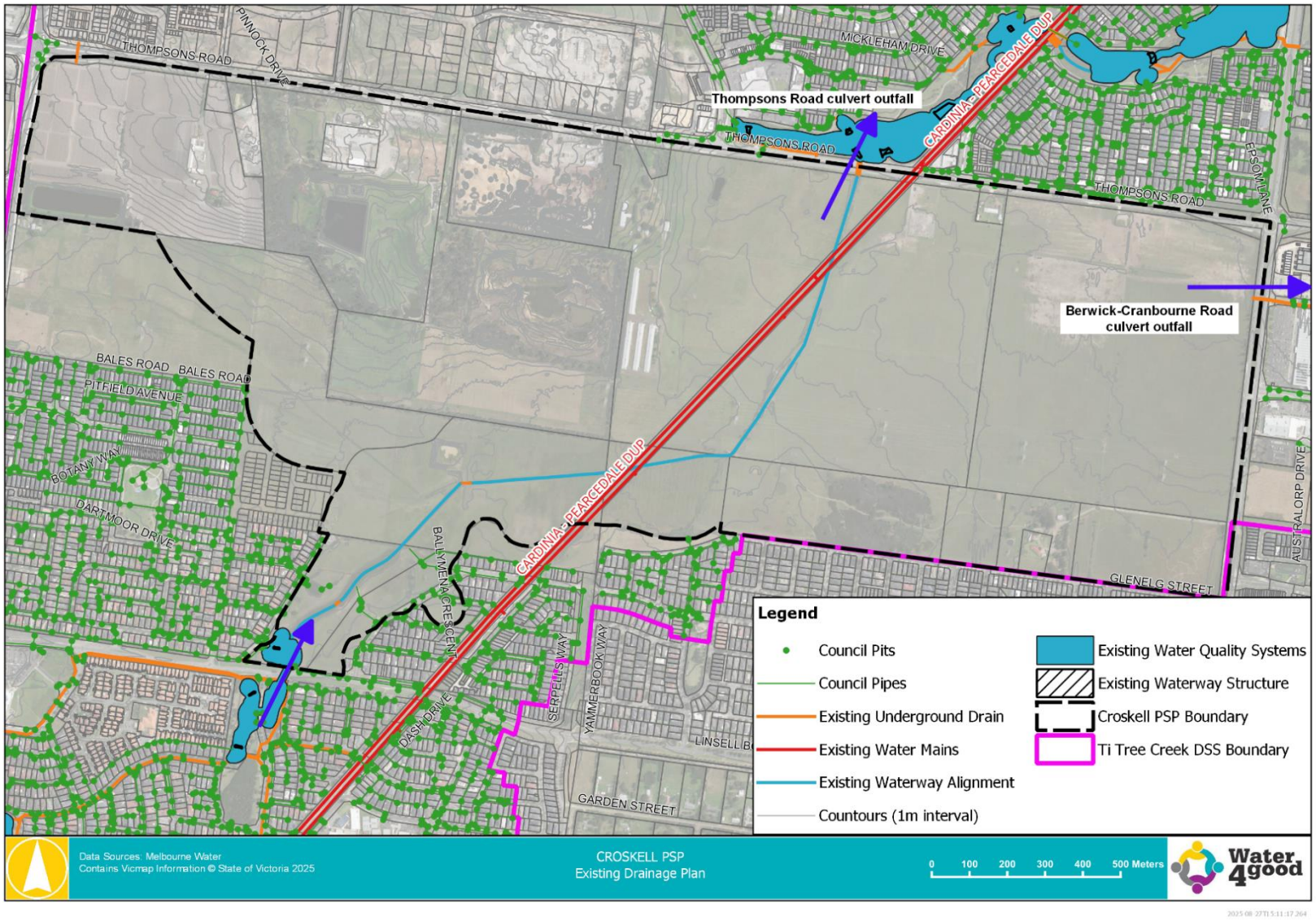


Figure 4-3: Existing drainage assets plan within the PSP (note only council pits and pipes within Ti-Tree Creek DSS are shown)

4.6 Groundwater and soil profile reporting

A preliminary geotechnical investigation by Water4Good (May 2022) was conducted during the early design stages of the project. The investigation provided an indication of the soil conditions that may be encountered along the proposed drain alignment and at basins for the proposed Croskell PSP.

Subsequently, completion of 21 boreholes and in situ testing, in addition to geotechnical and contamination sampling, was used to characterise the subsurface ground conditions (Water4Good August 2023). An additional borehole was sampled near the proposed 1%AEP pipe northwest diversion (see Section 6.3.2) alignment (Water4Good August 2025) and an additional groundwater well was drilled at WLRB4.

Geotechnically, the site is generally considered suitable for the development of the proposed wetland basin(s) and ancillary channel works; however, some issues have been identified that will require management.

The main geotechnical issues identified that have the potential to impact on the wetland design and construction activities and include:

- Dispersive soils and increased erosion potential,
- Elevated in situ soil moisture content,
- Shallow groundwater.

Silty clay was identified throughout the samples collected. Testing of this soil has confirmed the potential for dispersiveness; however, there is no trace of acid sulfate soils. Dispersive soils pose a constraint for earthworks and possible treatments to assist in reducing the dispersive potential and erosion of the clay soils have been discussed in the report.

Contamination and acid sulfate testing indicated that the soils are likely suitable for both reuse onsite or for offsite disposal as Fill Material.

The risk of acid sulfate soils being present at the site was considered low based on preliminary investigation results.

Groundwater monitoring was performed in April 2024 through August 2025. Refer Appendix A for a memorandum showing the results of the monitoring program.

4.7 Cultural heritage values

The Victorian Planning Authority (VPA) commissioned a post-contact heritage assessment for the Croskell PSP by Ecology and Heritage Partners (August 2024). One area of Aboriginal heritage significance was identified in the eastern catchments. No major drainage works (retarding basins or waterways) will be located in this area.

The Bunurong Land Council Aboriginal Corporation prepared a Cultural Heritage Interpretation Strategy for the VPA (February 2024). The recommendations from the report include retention and revitalisation of a patch of remnant vegetation identified at 37 Brocker St, Clyde North. The Croskell PSP drainage strategy is not anticipated to have a material impact on this property or the identified remnant vegetation.

The Cultural Values Interpretation Strategy (CVIS Feb 2024) and the Aboriginal Cultural Impact Assessment (ACHIA May 2024) is available to developers. Developers are required to conduct a CHMP for the areas in which they undertake and deliver drainage assets. They need to refer to the CVIS and the ACHIA prior to undertaking the CHMP and are required to conduct a CHMP regardless of the outcomes of the CVIS and ACHIA.

4.8 Environmental values

The following documents provide existing environmental values in both the western and eastern catchments of the PSP:

- Croskell PSP desktop environmental assessment (Water4Good, October 2022)
- Arboriculture assessment – Croskell PSP (ENSPEC, January 2023)
- Croskell PSP Growling Grass Frog survey report (Water4Good, April 2023)

The western catchment primarily consists of extensive open farmlands, which has led to the degradation and fragmentation of the remaining native vegetation. However, the area still has pockets of conservation significance within the area, notably the remnant woodlands and wetlands in and around the old quarry sites at 1550 and 1520 Thompsons Road. Other valuable conservation areas include the major drainage line running through the study area, a small reserve located north of Midnight Rise, and scattered trees and remnants of native and exotic vegetation within road reserves. These patches of native vegetation are essential for providing habitat to endangered wildlife species like the Southern Brown Bandicoot, Growling Grass Frog, and Dwarf Galaxias, which have been documented in nearby regions under the EPBC and FFG Act listings. The Growling Grass Frog survey did not identify presence of this species.

In the eastern catchment, there were no recordings of vulnerable species as defined under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), nor of threatened species as identified under the Flora and Fauna Guarantee Act 1988 (FFG Act). Trees of high retention value ratings were identified in Lots 22 and 23.

4.9 Site constraints

A site constraints map is presented in Figure 4-4 and Figure 4-5. The key constraints affecting the drainage strategy include:

- Existing uses within the precinct, including an abattoir, a broiler farm and a concrete batching plant, that may exist for a number of years after the planning for this precinct is completed. These uses have existing buffer requirements and have quarantined development outcomes surrounding this precinct.
- Area is prone to flooding and may require a significant amount of fill when development occurs.
- Shallow groundwater.
- The site has a gentle slope, trending from south-west to north-east and from west to east.
- Indicative alignment of future PSP connector roads.
- Thompsons Road and Berwick-Cranbourne Road intersection upgrade. Revised allotment boundaries were adopted and affect the location of WLRB4. The existing Berwick-Cranbourne Road culvert will be extended as part of the works.
- Melbourne Water water supply mains and abandoned main within the Melbourne Water Pipe Track Reserve.
- Ausnet overhead high voltage powerline and towers, and distribution poles.
- Fibre optic cable (for the WLRB4 wetland retarding basin, within the Eastern Catchment, is assumed will be relocated).
- Victorian Desalination Project (VDP) underground 220kV High Voltage Alternating Current (HVAC) power cable within a Specific Controls Overlay (SCO).
- South East Water Cranbourne East Pumping Station, pressurised sewer, gravity sewer, and recycled water mains has interfaces at WLRB3, Ti-Tree Creek waterway, and eastern swales.

Several waterway or culvert crossings are required for the VDP cable and Melbourne Water mains. The hydrological requirements for the crossings are presented in Section 5. The design requirements to address specific constraints encountered by each proposed drainage asset are provided in Section 6.3.

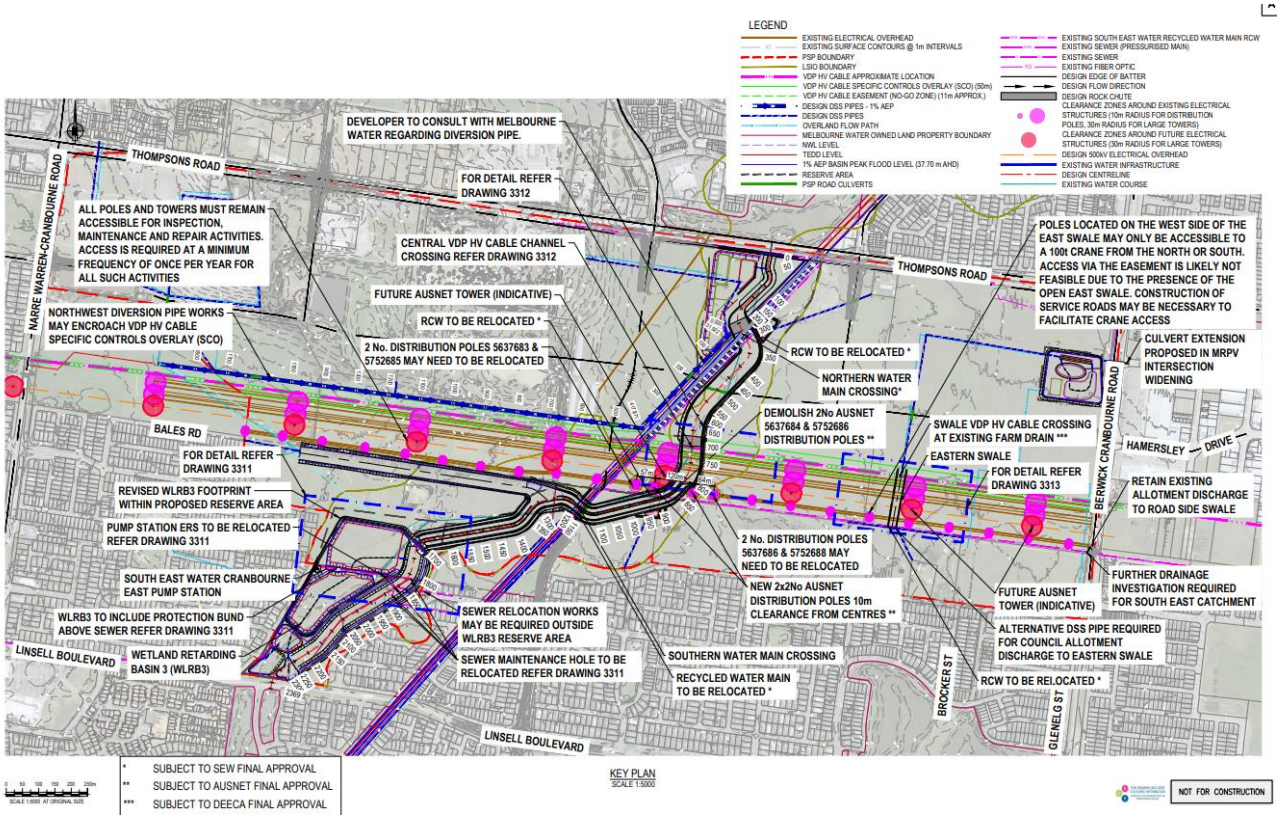


Figure 4-4: South East Water recycled water main interfaces with DSS assets (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3301)

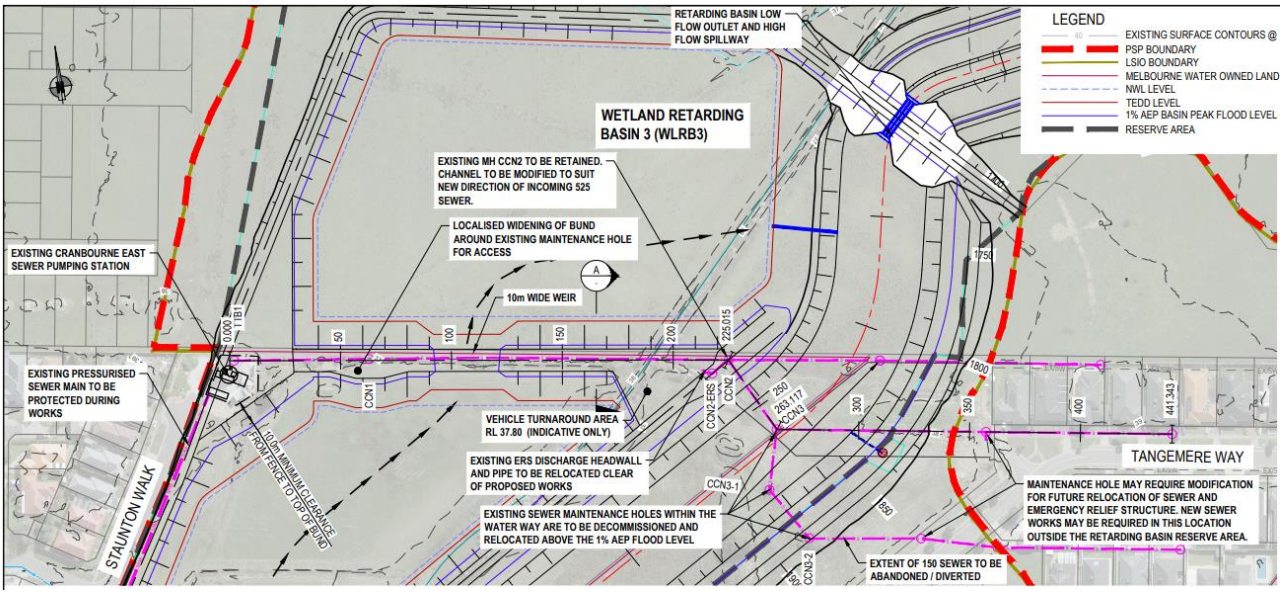


Figure 4-5: South East Water assets at WLRB3 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3311)

4.10 Future development conditions

Ultimate development land use is based on the Place Based Plan for Croskell PSP provided by the Victorian Planning Authority (VPA) (September 2024).

The following land uses are proposed for the western catchments:

- Commercial use along Thompsons Road and Narre Warren Rd.
- Industrial areas within the allotment outside of the transmission easement.
- Residential and open spaces draining to the constructed waterway from Linsell Blvd to Thompsons Rd.

The following land uses are proposed for the eastern catchments:

- For Lot 14, commercial use along Thompsons Road and business within the allotment outside the Ausnet utilities easement.
- For Lots 20 to 24, residential use and open space area is draining to Lot 14 via the western swale proposed for the Croskell PSP DSS.

The utilities easement is assumed to remain undeveloped. If future development includes development within the utilities easement (e.g. car parks or other development with impervious surfaces), DSS assets would have to be revised and potentially increased in storage size to accommodate the additional contributions to peak flow and total annual runoff volume.

5 Design Performance Requirements

5.1 Overview

This section includes the general project Development Services Scheme drainage design performance requirements agreed with Melbourne Water for post-development conditions. The design requirements were developed in accordance with drainage design requirement publications and information available on site constraints and services requirements.

5.2 Design Hydrology

5.2.1 Design requirements

Table 5-1 presents the revised design hydrology requirements for Croskell PSP for the Concept Drainage Strategy Rev. D (September 2025). The impact of development within Croskell PSP on locations downstream of the PSP should be assessed using 1%AEP with climate change for the post-development mitigation design.

The design of major assets, including retarding basins and waterways, should account for climate change and ensure that peak flow rates in the post-development condition do not exceed 2100 pre-development flows at Thompsons Road outfall culvert, Berwick Cranbourne Road culvert outfall, water main crossings (southern water main crossing located downstream of the western swale and northern water main crossing downstream of SB3), and Victorian Desalination Project (VDP) cable crossings. Freeboard should be set to 1%AEP with climate change peak flood levels. The size of major assets in the post-development scenario should allow 1%AEP 2100 climate change inflows, which should be retarded to pre-development 1%AEP 2100 climate change peak flows at target locations.

Table 5-1: Design hydrology requirements at target locations in Croskell PSP

Requirement	Pre-development target climate condition	Post-development mitigation design climate condition
Croskell PSP - Thompsons Road culvert	2100 1%AEP with climate change.	2100 1%AEP with climate change
Croskell PSP – Berwick Cranbourne Road culvert		
Croskell PSP - Water main and VDP cable crossings		
Downstream – Thompsons Road WLRB1 outlet, Pound Road, Clyde Road, Grices Road		

5.2.2 Design peak flow targets based on pre-development conditions

Pre-development RORB models for the West and the East catchments were developed for Croskell PSP by Water4Good. Table 5-2 shows the pre-development peak flow targets and durations for Croskell PSP drainage strategy using this model. The reporting locations are shown in Figure 5-1: Hydrological reporting locations.

The storage capacities of the wetlands located south of Linsell Blvd were not represented in the pre-development RORB model, as it was assumed the flow attenuation is not significant, which is an approach generally adopted for DSS.

Table 5-2: Design peak flow targets for Croskell PSP drainage strategy

Reporting location description *(RORB print statement)*	**Pre-dev. Target Event**	**Pre-dev. Peak Flow Duration**	**Pre-dev. Peak Flow Target (m^3/s)**
Croskell PSP catchment outfalls			
Thompsons Road culvert, western catchment (*THOMPSONS ROAD*)	*1% AEP with climate change*	4.5hr	25.65 (based on RORB model) 31.0 (based on Thompsons Road culvert design by Cardno)
Berwick Cranbourne Rd culvert eastern catchment (*K2*)(1)		30min	15.02 (based on RORB model) 6.60 (based on existing culvert capacity assessment with 0% blockage(2))
Croskell PSP water Main Crossings			
Waterway crossing south of utilities easement (*Croskell Water Main Cross S*)	*1% AEP with climate change*	2hr	26.46
Waterway crossing north of utilities easement (*Croskell water main cross N*)		3hr	23.64
Croskell PSP VDP cable Crossings			
Main waterway crossing of VDP cable (*Croskell VDP main cross*)	*1% AEP with climate change*	2hr	25.26
Western waterway crossing of VDP cable (*Croskell VDP Cable W*)		1.5hr	4.90
Eastern utilities easement crossing of VDP Cable east (Croskell VDP Cable EAST)(3)		45min	7.83
Downstream locations			
Thompsons Road WLRB1 outlet (*Thompsons Rd WLRB1 Outlet*) (1)	*1% AEP with climate change*	9hr	5.24
Water main crossing upstream Berwick Cranbourne Rd within Cranbourne North Stage 2 PSP *(Water Main Crossing)*		6hr	31.51

1. The eastern catchments outfall and Thompsons Road WLRB1 pre-development targets are based on historical post-development fraction imperviousness for Lot 14 (FI=0.6), and Lots 20 to 24 (FI=0.3) assumed to be the basis for design for the G2-G3 DSS culvert and downstream Thompsons Road WLRB1.

2. Based on review of the capacity of the existing G2-G4 culvert under Berwick-Cranbourne Road (refer to Draft Drainage Strategy (Water4Good, June 2024) Appendix C – Eastern Catchments Drainage Strategy Memorandum Rev.0).

3. The eastern catchment VDP cable crossing pre-development target is based on the existing land use at the site (and not the historical post-development fraction imperviousness used for the Berwick Cranbourne Rd culvert). This approach was adopted to allow the DSS to accommodate no increase in peak flows across the VDP cable in the post-development case from existing conditions.

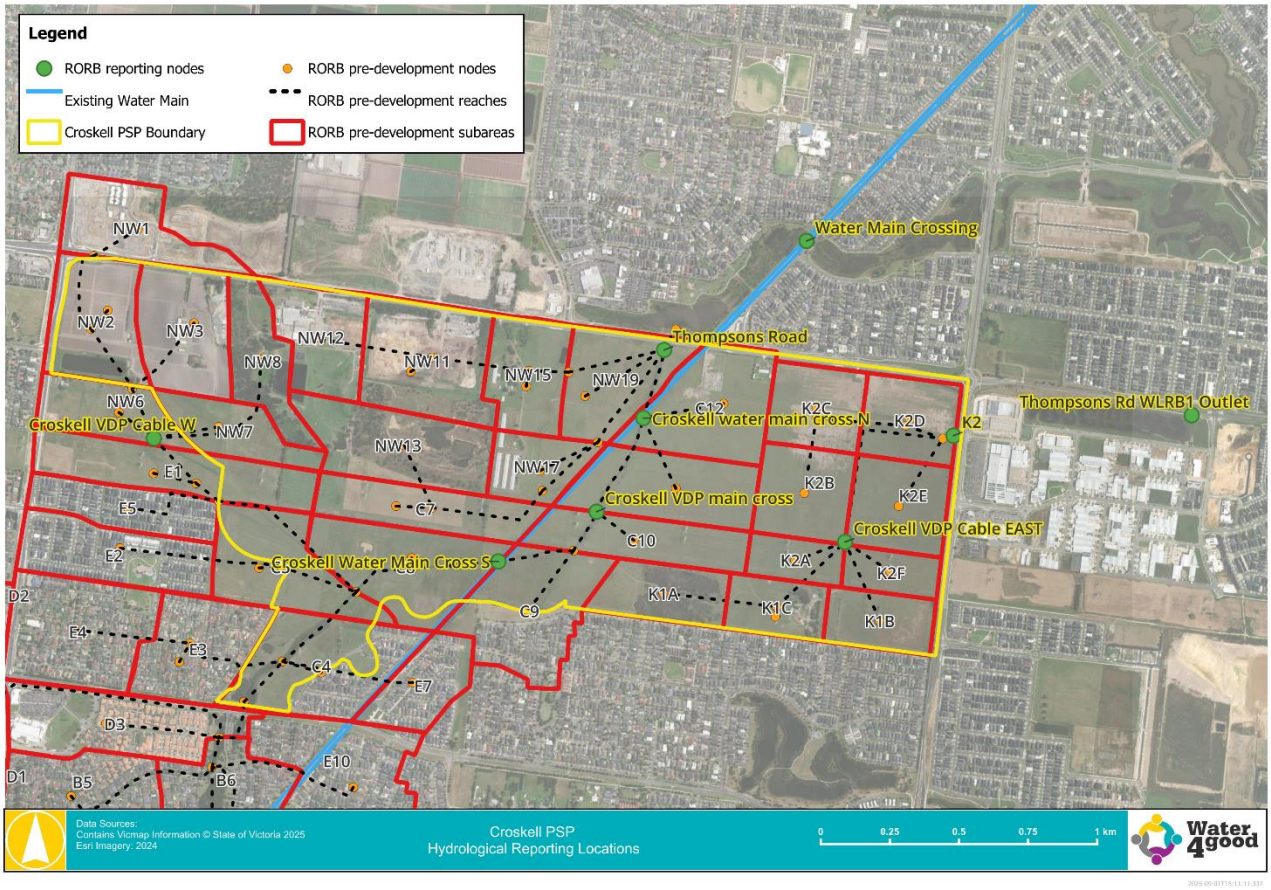


Figure 5-1: Hydrological reporting locations

5.3 Water quality

5.3.1 Design requirements

The MUSIC modelling performed was based on the MUSIC Modelling Guidelines: Guidance for urban stormwater modelling using MUSIC software (July 2024 update). The water quality design requirements are as follows:

- The design criteria proposed for the Croskell PSP development are the baseline requirements suggested by Melbourne Water to meet minimum requirements shown in Table 5-3.
- Wetland design on MUSIC software will not require consideration of potential effects from climate change (e.g. 4EY event, without climate change condition to be used as the basis for wetland design).
- For the purposes of water quality performance, the western catchment and eastern catchment should achieve targets as measured at the Thompsons Road culvert outfall and Berwick Cranbourne Road culvert outfall, respectively.
- Assessment of pollutant loading at the Ti-Tree Creek outfall is not required.
- The total annual pollutant reduction targets for Croskell PSP are based on applying the best practice reduction rates (performance objective) to the total annual pollutant loads generated in the post-development with mitigation conditions.
- Pollutant load reduction is calculated based on a pollutant load mass balance for each WSUD asset, as follows:

Pollutant Load Reduction for Croskell PSP =

(Pollutant Load Into each Wetland) - (Pollutant Load Out of each Wetland) +

(Pollutant Load Into each Sediment Pond) - (Pollutant Load Out of each Sediment Pond)

Table 5-3: Water quality design criteria

Pollutant type	Current best practice performance objective
Suspended solids (SS)	80% retention of the typical urban annual load
Total phosphorus (TP)	45% retention of the typical urban annual load
Total nitrogen (TN)	45% retention of the typical urban annual load
Litter	70% reduction of typical urban annual load

5.3.2 Targets and objectives

A lumped MUSIC catchment was used to estimate the post-development pollutant loadings for each of the western and eastern catchments.

a. Western catchments

For the purposes of water quality performance, the western catchment should achieve targets as measured at the Thompsons Road culvert outfall.

Figure 5-2 shows the western catchment delineation, including undeveloped areas contributing to Thompsons Road culvert outfall within Croskell PSP and to the north-west of Croskell PSP. Table 5-4 shows the pollutant loads used as a baseline for the western catchment pollutant load reduction estimates.

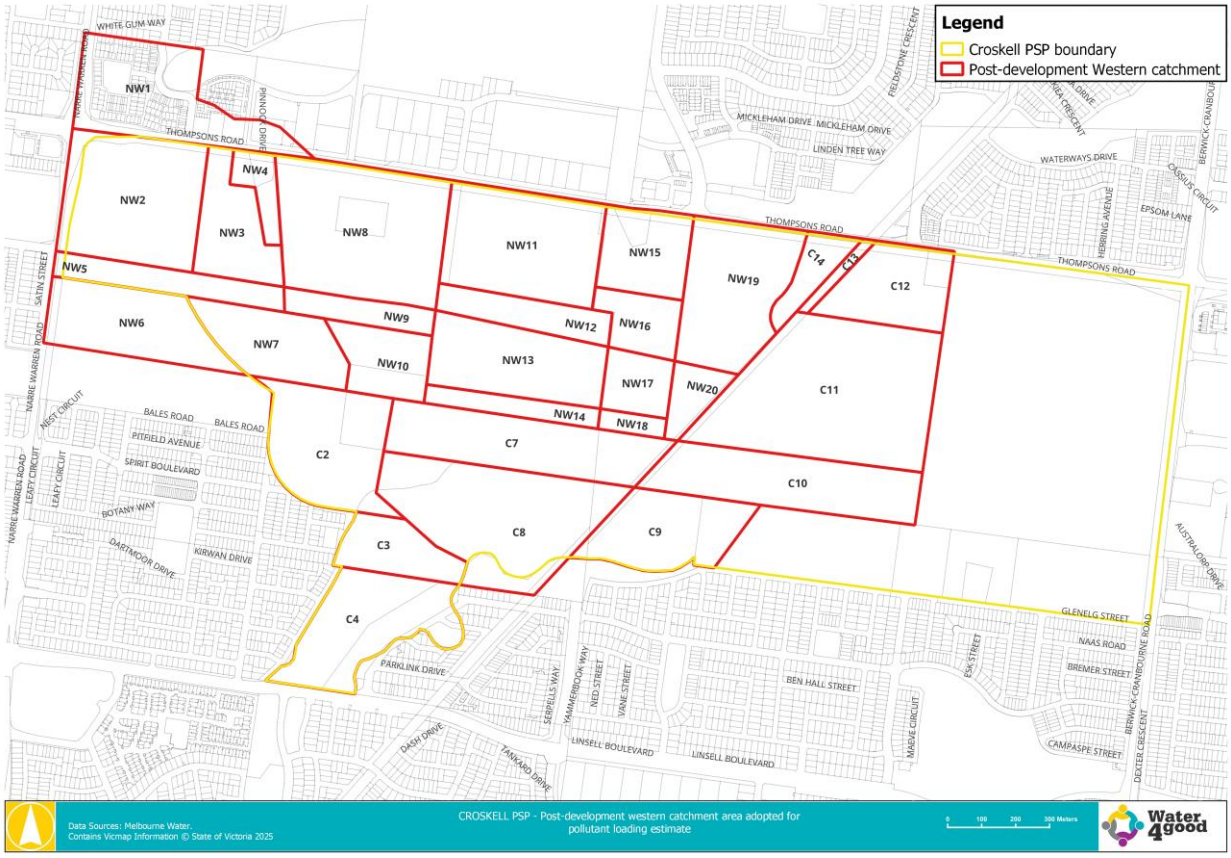


Figure 5-2: Post-development western catchment area adopted for pollutant loading estimate

Table 5-4: Western catchment MUSIC baseline post-development pollutant loading

Result	Values
Areas - Total Area (ha)	264
Total Suspended Solids (kg/yr)	212,000
Total Phosphorus (kg/yr)	452
Total Nitrogen (kg/yr)	3,310
Gross Pollutants (kg/yr)	47,700

b. Eastern catchments

The previous DSS design for existing Thompsons Road WLRB1 considers lots with residential land use as the contributing catchments. Croskell PSP proposes a change in the historically planned land use from residential to industrial, resulting in a larger impervious area contributing to the Thompsons Road outfall compared with the design impervious area adopted for design of existing Thompsons Road WLRB1.

For the purposes of water quality performance, the Croskell PSP eastern catchment should achieve pollutant reduction targets as measured at the Thompsons Road culvert outfall downstream of Thompsons Rd WLRB1.

The pollutant reduction performance of the proposed WLRB4 within Croskell PSP and the existing Thompsons Rd WLRB1 should be considered to contribute to the pollutant reduction performance.

The catchment area contributing to pollutant loadings for the eastern catchment includes catchments outside of Croskell PSP. The treatment train effectiveness is evaluated at the outfall of Thompsons Road WLRB1.

Figure 5-3 shows the eastern catchment delineation, extended to include the existing WLRB1 asset and its contributing catchment. Table 5-5 shows the pollutant loads used as a baseline for the eastern catchment pollutant load reduction estimates.

Table 5-5: Eastern catchment MUSIC baseline post-development pollutant loading

Result	Values
Areas - Total Area (ha)	190
Total Suspended Solids (kg/yr)	189,000
Total Phosphorus (kg/yr)	388
Total Nitrogen (kg/yr)	2,780
Gross Pollutants (kg/yr)	37,600

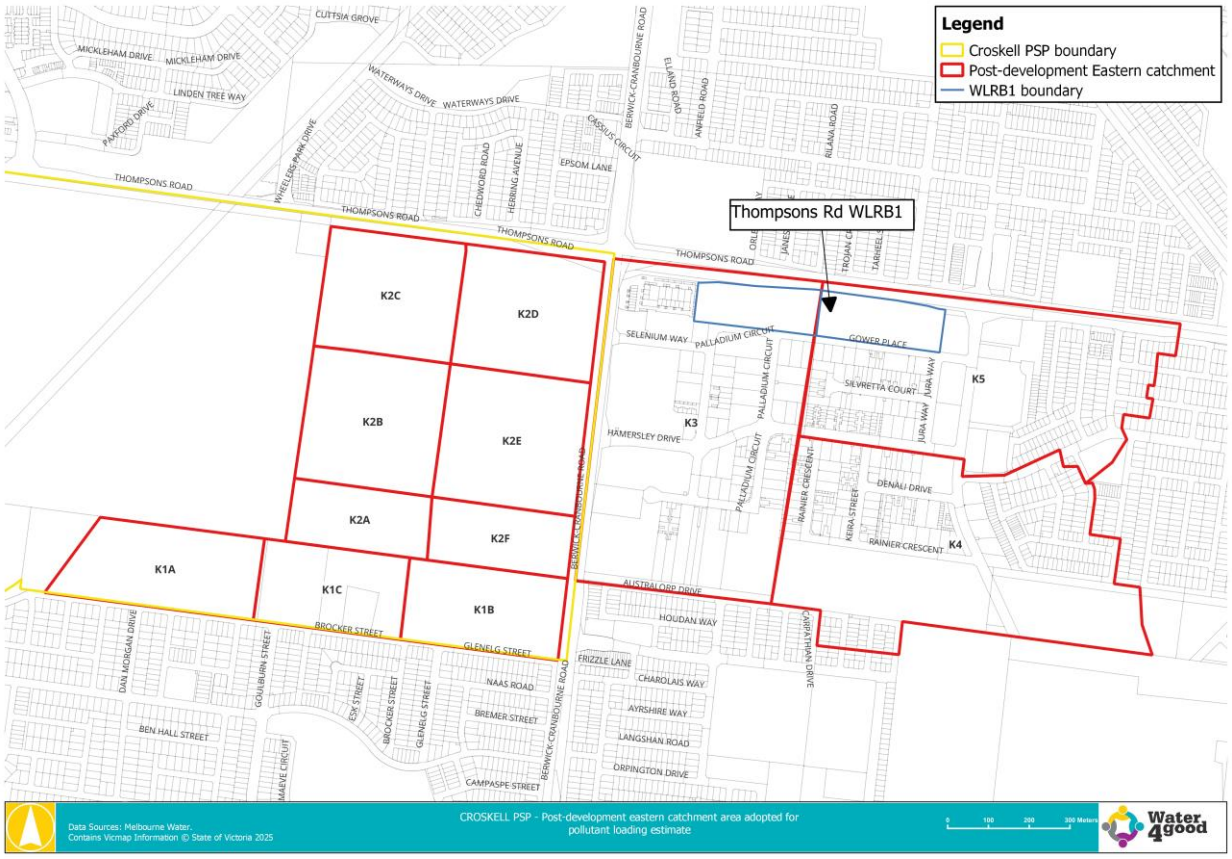


Figure 5-3: Post-development eastern catchment area adopted for pollutant loading estimate

5.3.3 Total annual runoff volume at VDP cable crossing performance results

Table 5-6 shows the estimates of the total annual volume of runoff in the pre-development conditions for Croskell PSP based on the MUSIC model. It should be noted that MUSIC estimates for baseflows may not be accurate due to the lack of calibration of the model for the Croskell PSP.

Table 5-6: Total annual runoff volume baseline at VDP cable crossings.

VDP cable crossing location	Pre-development average annual volume (ML/yr)
Western Crossing	145
Central Crossing	1,960
Eastern Crossing	61

6 Croskell PSP Concept Drainage Strategy Rev. D

6.1 Overview

A layout of the Croskell PSP Concept Drainage Strategy Rev. D (September 2025) developed by Water4Good is presented in Figure 6-1. Major DSS drainage assets in the concept design include:

- Ti-Tree Creek constructed waterway
- Western swale
- Eastern swale
- Northwest diversion pipe (1%AEP with climate change capacity)
- Sediment basin retarding basin 2 west (SBRB2)
- Wetland regarding basin 3 (WLRB3)
- Wetland retarding basin 4 (WLRB4)
- Sediment basin (SB1)
- Sediment basin (SB2)
- Sediment basin (SB3)

The asset land requirement footprints in the Croskell PSP drainage strategy are shown in . A buffer has been applied around some of the major assets because of the following critical risks:

- Shallow groundwater impacting the long-term operation of assets.
- Ensuring flows can be safely conveyed across the VDP cable and water supply pipe track and not impact on immediate downstream areas.
- Manage clash with South East water sewer assets.

The buffers that have been applied are still confined within the Urban Floodway Zone, with the exception of WLRB4 where the additional buffer is approximately 0.4ha.

The following sections describe the specific asset design requirements, modelling approach and results, and concept design considerations for individual assets for the Croskell PSP Western and Eastern catchments.

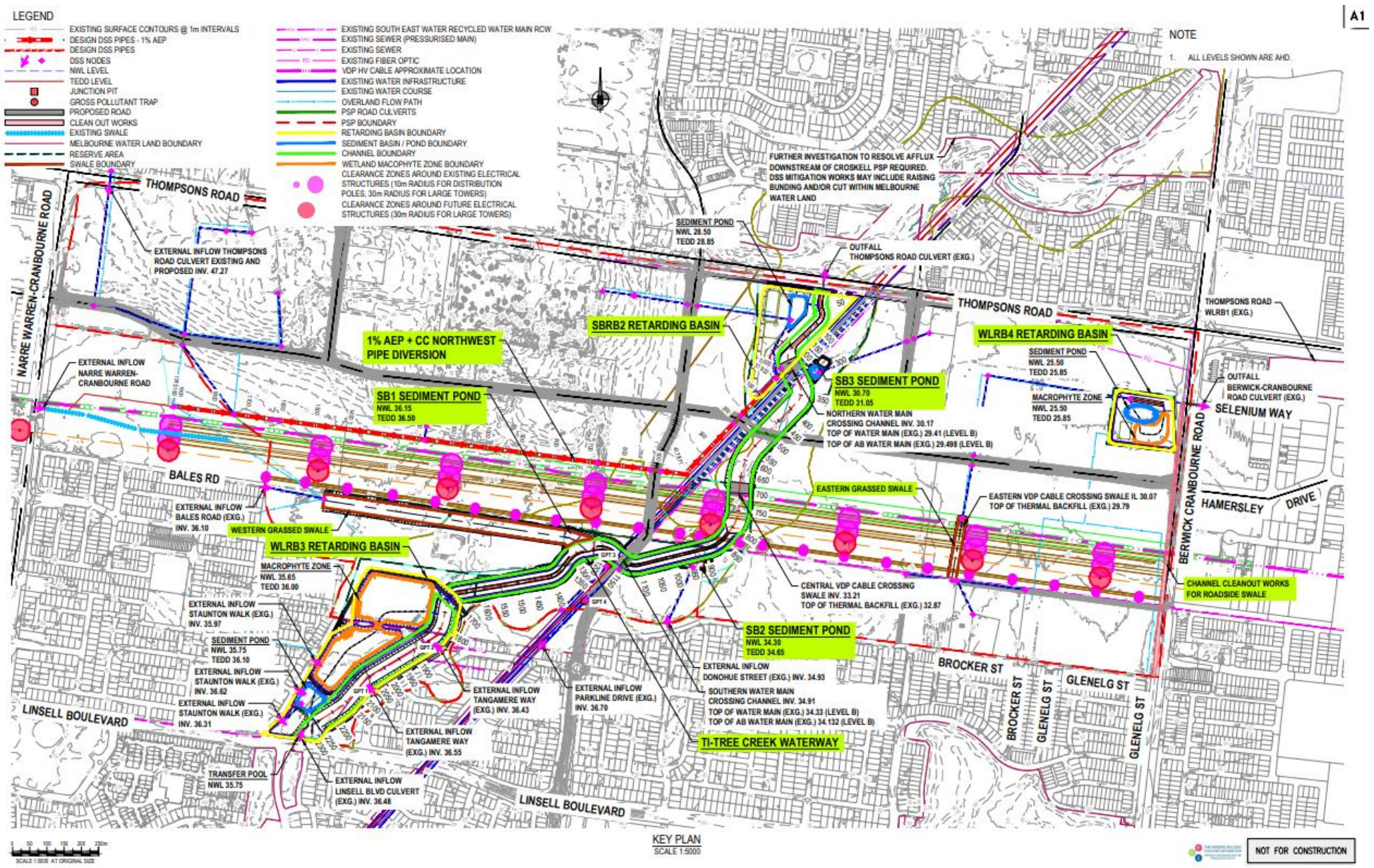


Figure 6-1: Layout Plan for the Croskell PSP Concept design Strategy (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

Thompsons Road outfall

Berwick-Cranbourne Road outfall

Sediment Basin Retarding Basin 2 (SBRB2)

Wetland Retarding Basin 4 (WLRB4)

1%AEP + CC Northwest Diversion Pipe
2 No. DN2100 RCP (CH 0 to 675)
2 No. DN1950 RCP (CH 675 to 1750)

Sediment Basin 3 (SB3)

Sediment Basin 1 (SB1)

Eastern swale

Western swale

Wetland Retarding Basin 3 (WLRB3)

Sediment Basin 2 (SB2)

Ti-Tree Creek waterway

NARRE WARREN ROAD
ASCENT DRIVE
WILLIAM THWAITES BOULEVARD
BIBURY STREET
MOUNTAINVIEW BOULEVARD
MICKLEHAM DRIVE
LINDEN TREE WAY
BURFORD WAY
ELODEA WAY
TILIA DRIVE
TRILLIUM BOULEVARD
BERWICK-CRANBOURNE ROAD
WATERWAYS DRIVE
WHEELERS PARK DRIVE
HIGHBURY ROAD
FENWAY BOULEVARD
THOMPSONS ROAD
WINCHCOMBE WAY
HERRING AVENUE
ORLEANA WAY
JANESSA DRIVE
PATRIOT BOULEVARD
GOWER PLACE
SELENIUM WAY
SILVRETTA COURT
PALLADIUM CIRCUIT
HAMERSLEY DRIVE
KEIRA STREET
RAINIER CRESCENT
AUSTRALORP DRIVE
PLYMOUTH BOULEVARD
CHAROLAIS WAY
NAAS ROAD
BALES ROAD
PITFIELD AVENUE
SPIRIT BOULEVARD
VILLAGER STREET
BOTANY WAY
LEAFY CIRCUIT
MARSHY AVENUE
DARTMOOR DRIVE
CORNWELL CRESCENT
TRAFALGAR WAY
FERNISKY DRIVE
DUNLAVIN WAY
STAUNTON WAY
LINSELL BOULEVARD
ROCHESTER PARADE
FOXWOOD DRIVE
BROADOAK DRIVE
PARKLINK DRIVE
JOEYS LANE
TANGEMERE WAY
THURVASTON CRESCENT
DASH DRIVE
STATELY DRIVE
DERBOLT DRIVE
DALTON WAY
DAN MORGAN DRIVE
MIDNIGHT RISE
NED STREET
VANE STREET
BUSHRANGER BOULEVARDE
BEN HALL STREET
WILD SCOTCHMAN WAY
LINSELL BOULEVARD

Legend

- Cadastre
- Northwest diversion pipe
- Optimised Design RevD
- Melbourne Water Owned Land
- Asset Land Requirement
- Croskell PSP Boundary
- VDP cable SCO
- LSIO Boundary
- Pipe track, transmission easement and SCO

Data Sources: Melbourne Water.
Contains Vicmap Information © State of Victoria 2025

CROSKELL PSP
Asset Land Requirement

0 100 200 300 400 Meters

Water 4good

Figure 6-2: Asset land requirement in Croskell PSP strategy

6.2 Drawings list

Table 6-1 shows the drawings list for the Croskell PSP Concept Drainage Strategy Rev. D (September 2025).

Table 6-1: Croskell PSP Drainage Strategy Concept Design drawings

Drawing title	Drawing no.	Revision
LOCALITY PLAN AND DRAWING INDEX	MEG250-07-DW-CV-SKH-3000	0
LAYOUT PLAN	MEG250-07-DW-CV-SKH-3001	0
ASSET KEY PLAN	MEG250-07-DW-CV-SKH-3100	0
WLRB4 AND EASTERN SWALE PLAN	MEG250-07-DW-CV-SKH-3101	0
WLRB3 BASIN PLAN	MEG250-07-DW-CV-SKH-3102	0
SBRB2 BASIN AND SB3 SEDIMENT BASIN PLAN	MEG250-07-DW-CV-SKH-3104	0
SB2 SEDIMENT BASIN PLAN	MEG250-07-DW-CV-SKH-3105	0
1% AEP DIVERSION PIPE LONGITUDINAL SECTION	MEG250-07-DW-CV-SKH-3201	0
MAIN CHANNEL LONGITUDINAL SECTION	MEG250-07-DW-CV-SKH-3202	0
UTILITY AUTHORITY INTERFACES PLAN	MEG250-07-DW-CV-SKH-3301	0
WLRB3 SEWER INTERFACE PLAN AND SECTION	MEG250-07-DW-CV-SKH-3311	0
WESTERN VDP CABLE CROSSING PLAN AND SECTION	MEG250-07-DW-CV-SKH-3004	0
EASTERN VDP CABLE CROSSING PLAN AND SECTION	MEG250-07-DW-CV-SKH-3005	0

6.3 Asset design requirements

6.3.1 Overview

The following subsections outline the general and asset-specific design requirements and assumptions adopted for the Croskell PSP Concept Drainage Strategy Rev. D (September 2025) for flooding and drainage.

6.3.2 Northwest pipe diversion

a. Catchment diversion

The following design assumptions have been adopted for the northwest catchment diversion:

- All flows up to (and including) the 1%AEP with climate change design flows from the catchments north of the VDP western crossing are diverted via DSS pipe to SBRB2 retarding basin. This is required for:
  - Achieve pre-development peak flow target at the western VDP cable crossing in the 1%AEP event
  - Water quality improvement.
  - To minimise the total annual volume of runoff and resultant soil-wetting at the proposed waterway crossing of the VDP cable.
- Flows exceeding the Western diversion pipe capacity will follow the natural flow path and spill southward across the VDP cable. Future development north of the VDP cable should ensure that spill flows sheet over a wide area and are not concentrated in order to minimise increased risk of scour to the VDP cable.
- It is proposed that sheet flows across the VDP cable (gap flows exceeding the 1%AEP with climate change) shall be intercepted by the proposed Western swale (refer to section 6.3.31.1).

b. Pipe sizing and alignment

The objective of the Northwest diversion pipe is to redirect all post-development flows up to and including the 1%AEP with climate change design event eastwards to SBRB2 away from the natural flow path crossing the VDP cable. The parameters used to estimate the pipe size are listed in Table 6-2.

Table 6-2: Northwest catchment pipe diversion

Pipe reference	Design flow rate Q (m3/s) for 1% AEP with climate change	Slope (1 in X)	Number of pipes	Pipe diameter (mm)
F3-FD1	2.28	250	1	1200
FD1-FD2	15.83	250	2	1950
FD3-FD4	15.83	250	2	1950
FD4-FD5	17.70	250	2	1950
FD5-FD6	20.27	250	2	2100
FD7-FD8	20.49	250	2	2100
FD9-FD10	20.98	250	2	2100
FD10-FD13	20.98	250	2	2100

Figure 6-3 shows the Northwest diversion pipe alignment and Figure 6-4 shows its long section. The pipe inlet has approximately 1 metre cover below the existing agricultural drain near the existing VDP cable crossing. There is further opportunity to optimise the pipe cover to minimise the trench depth along the pipe. Low flows will continue to be diverted to the pipe.

The outlet is at the transfer pool of the SBRB2, in the high flow bypass channel. There is minimal opportunity to lower the outlet due to constraints including the existing Thompsons Road culvert invert and SBRB2 high flow bypass grade. The pipe alignment within the SBRB2 reserve area is indicative and should be refined considering hydraulic efficiencies, and interfaces with the Ti-Tree Creek waterway, drop structure and invert of the basin.

The pipe has a maximum depth to invert below existing surface level of approximately 9 metres. The ultimate development finished surface level is not known at this preliminary concept design stage. Neither a detailed hydraulic assessment nor pipe loading assessment has been undertaken. Careful consideration should be given to the pipe loading and accessibility, and works within the Specific Controls Overlay (SCO) in future design stages. Where the pipe is not located under a road, an easement would be required for construction, access and renewal of the pipe in accordance with Melbourne Water requirements.

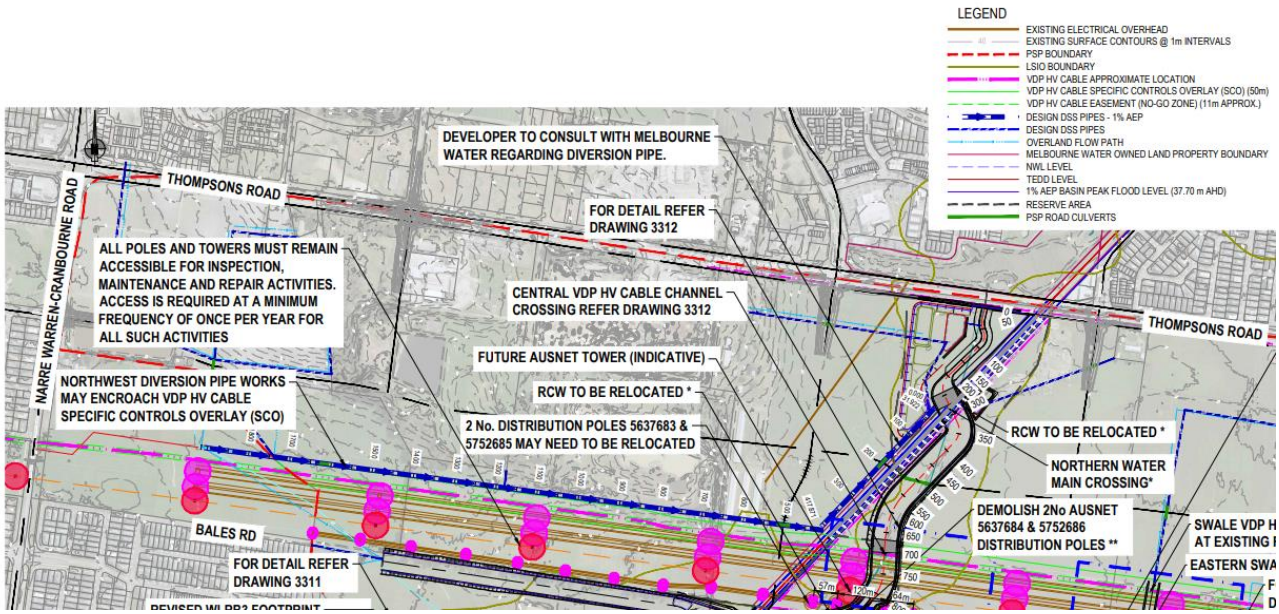


Figure 6-3: Northwest catchment diversion pipe – Concept Drainage Strategy Rev. D (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3301)

A long section of the proposed pipe diversion is shown in Figure 6-4. Further optimisation of the pipe alignment and depth to invert should be completed at functional design.

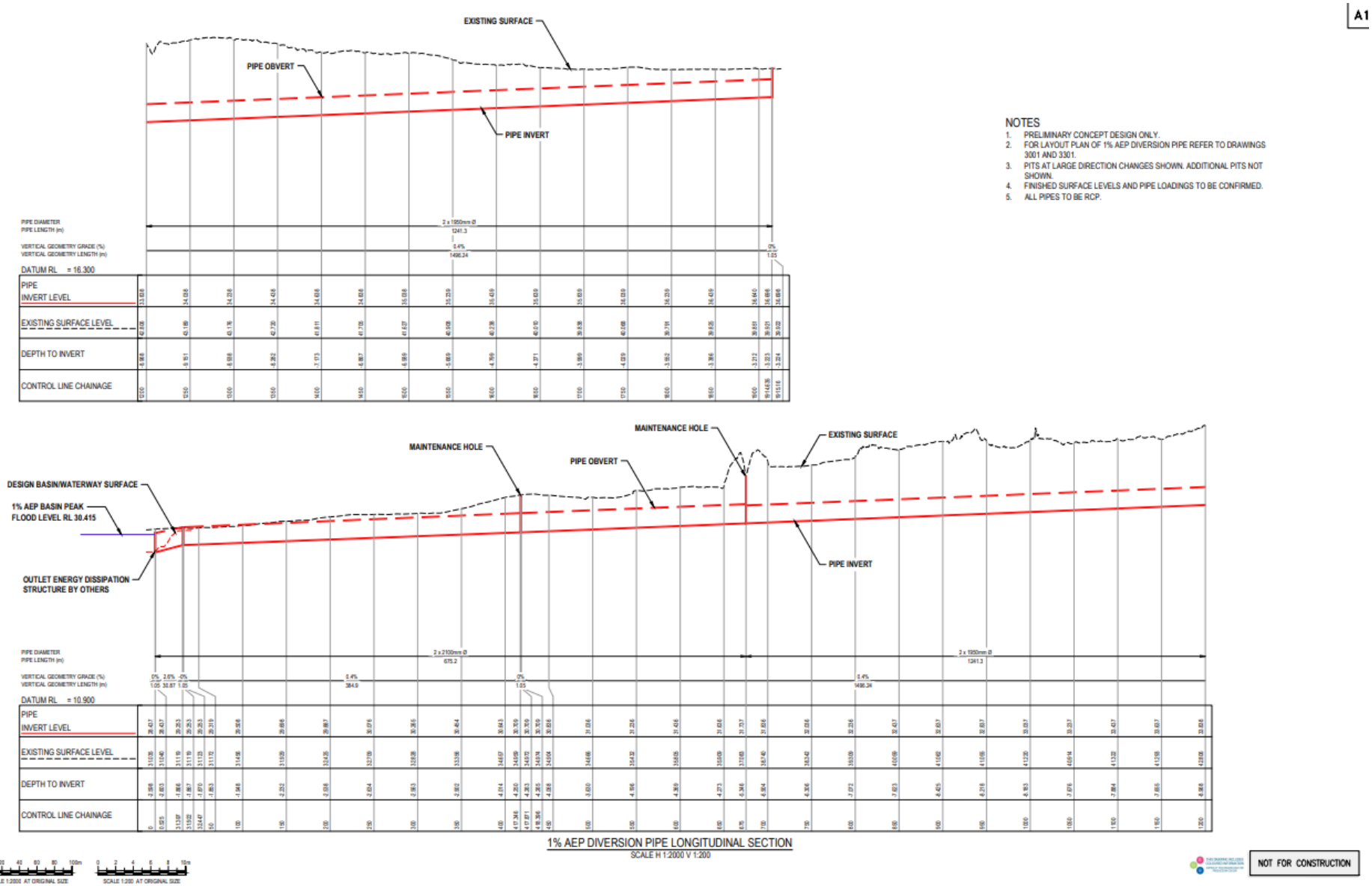


Figure 6-4: Northwest pipe diversion long section (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3201)

c. Flow diversion to inlets of Northwest diversion pipe

Water4Good have completed a preliminary assessment of the required inlets to the diversion pipe to enable overland flow up to the 1%AEP (with climate change) to be captured and redirected.

Within the Northwest diversion pipe's contributing catchment, on-grade pits are required to capture overland flow. At the pipe inlet, sag pits are required at up to three locations with a minimum ponding depth of 0.3 metres. The catchments contributing to the proposed pipe with flows to be diverted westwards are shown in Figure 6-5.

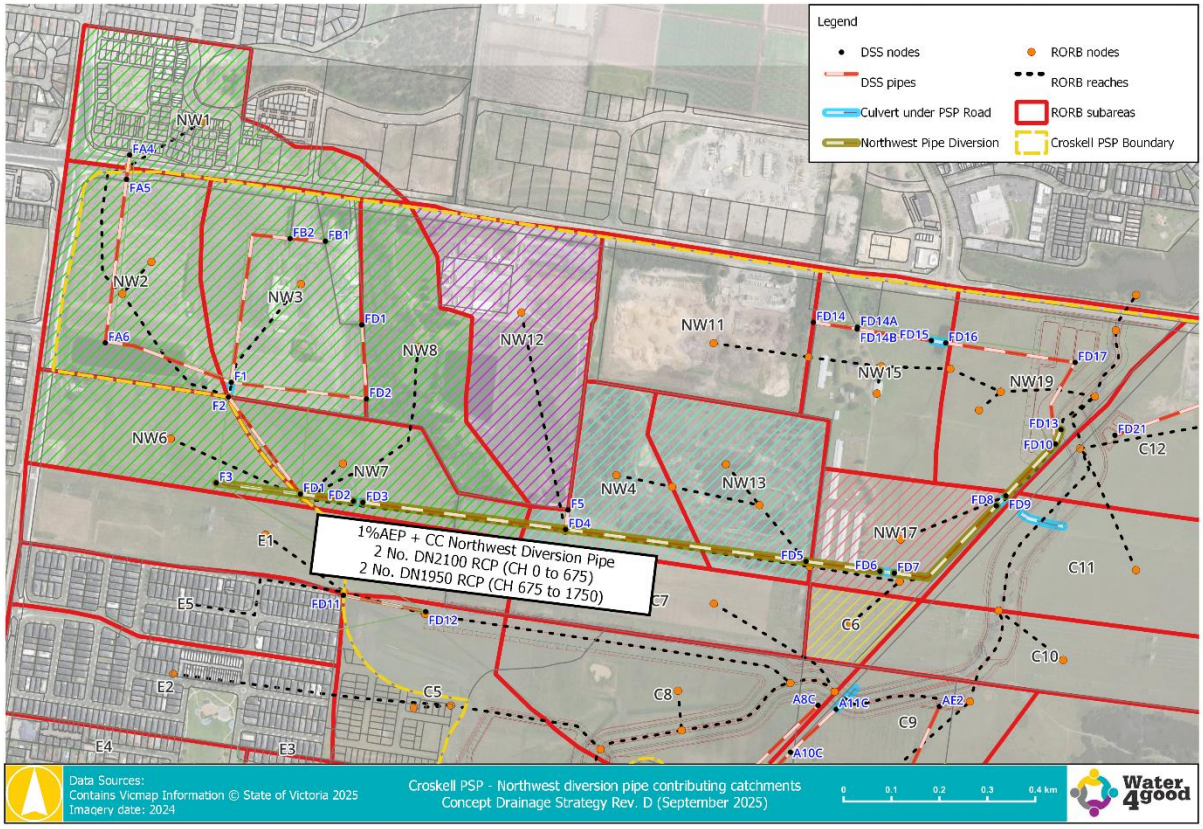


Figure 6-5: Northwest diversion pipe contributing catchments

6.3.3 Swales

a. Eastern swale

The following key design principles are applicable in managing **minor** storm event flows in the eastern catchment:

- Provide drainage for minimum 20%AEP with climate change peak discharge for Lots 20, 21, 22, 23 and 24, through Lot 14, to Berwick-Cranbourne road existing culvert (DSS pipe G2-G3).
- No pipe crossing under the VDP cable shall be provided as directed by DEECA.
- Formalise the drainage crossing of the VDP cable.

The following key design principles are applicable in managing **major** storm event flows in the eastern catchment:

- Allow gaps flows from Lots 20, 21, 22, 23 and 24 (i.e. flow rates above 20%AEP with climate change to sheet flow across the VDP cable. This is considered preferable to providing a larger crossing of the VDP cable (e.g. up to a 1% AEP - with climate change - capacity)
- Gap flows from Lots 20, 21, 22, 23 and 24 shall be managed by the developer of Lot 14.

A swale with a corridor width of 27 metres (hydraulic width of 23 metres and 4m access track) is required to convey flows from catchments from Lots 20, 21, 22, 23 and 24.

The swale design flow is 2.78 m^3/s and has a length 185 metres, upstream invert of 30.27 mAHD, and downstream invert 30.04mAHD discharging into a DSS pipe at grated inlet pit. The swale has 1(V):5(H) side slopes and 0.4 metres depth. The freeboard for the 20%AEP (with climate change) event at the upstream end is 30 mm and approximately 150 mm at the VDP crossing, which is considered adequate as the swale is designed to spill in events rarer than the 20%AEP with climate change, with minimal to no worsening upon existing conditions. Flows exceeding the capacity of the eastern swale are assumed to sheet over the VDP cable.

b. Western swale

Water4Good have assessed the hydraulic conveyance requirements for catchments within and south of the transmission easement to convey flows to Ti-Tree Creek. The assessment considered emergency scenarios where the Northwest diversion pipe capacity is exceeded (due to blockage of the pipe or in an extreme storm event exceeding its design capacity) and flows from its catchment spill across the VDP cable and transmission easement. Figure 6-6 shows the catchments and overland flow paths considered in the assessment of the swale.

A swale with a corridor width of 51 metres (hydraulic width of 46 metres and 4m access track) is required to convey flows from catchments within and south of the transmission easement to Ti-Tree Creek (see Figure 6-6). The swale design flow in the 1% AEP (with climate change) was estimated to be 6.7 m^3/s. This includes 1%AEP (with climate change) flows from catchments E1 and E5, and an assumed 20%AEP (with climate change) flow to represent pipe flow from catchment E2 at the inlet of the swale. It is noted that the Narre Warren Road catchment conveyed via an existing swale within the transmission easement to the agricultural drain to be intercepted by the Western swale has not been included in the catchment for this assessment and should be further investigated. The RORB model developed did not include this road catchment and the existing swale. Further adjustments to the model are required to account for this subarea and its reach.

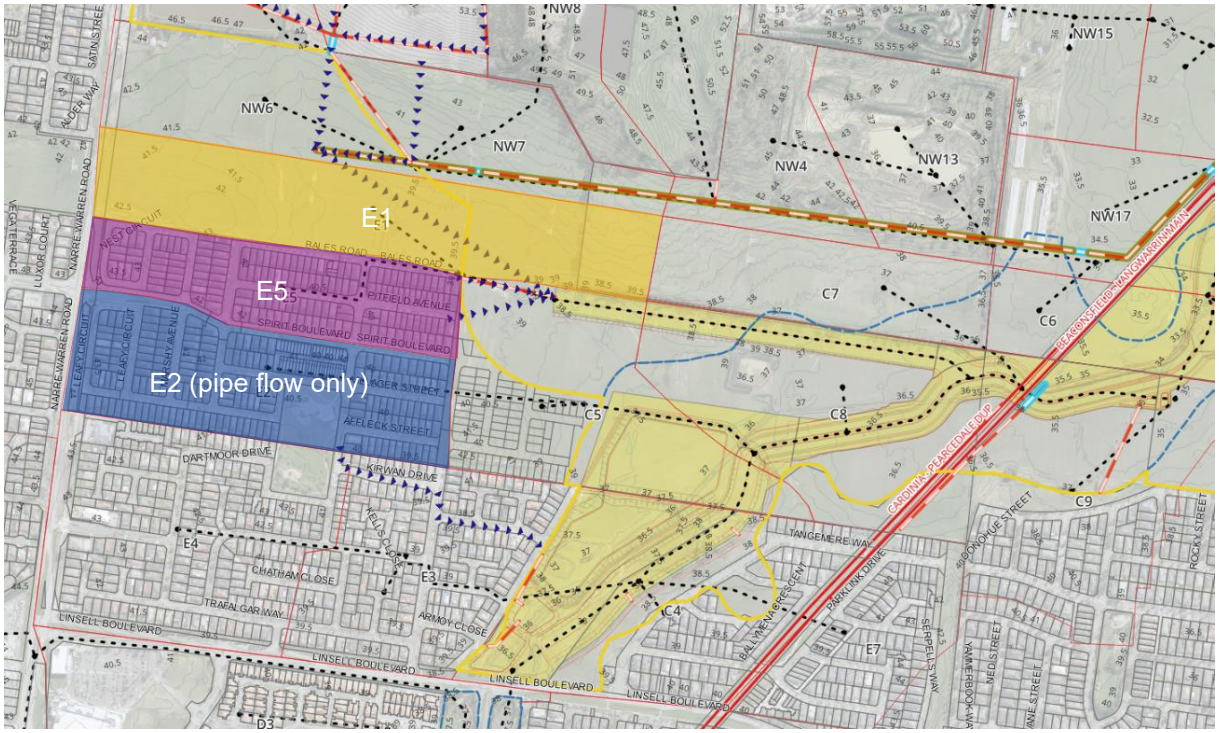


Figure 6-6: Western swale locality and catchments.

The swale has a length 750 metres, upstream invert of 35.88 mAHD, and downstream invert 35.33 mAHD discharging into the SB1 sediment basin, a base width of 40 metres, 1(V):4(H) side slopes, 0.5 metres depth, and at least 0.3 metres freeboard.

The western swale would have sufficient freeboard to convey up to the 0.5%AEP (with climate change) peak flows, with 0.2% AEP flows exceeding the capacity of the swale. Flows exceeding the capacity of the western VDP cable 1% AEP pipe diversion (with climate change allowance) are assumed to sheet over the VDP cable and be diverted along a future overland flow path to the swale.

Catchment C7 is assumed to discharge to sediment basin SB1, and not at the western swale, up to a 1% AEP (with climate change) event, however, flows higher than a 1%AEP (with climate change) design flow are assumed to sheet into the swale. The swale would have an additional benefit of providing a buffer to remnant vegetation near the southern boundary of the utilities easement.

Removal of sediment basin SB1 would enable the swale's downstream invert to match the Ti-Tree Creek main waterway channel's invert and provide additional fall across the swale. The steeper gradient would reduce hydraulic width and therefore swale corridor required.

6.3.4 Retarding Basins and Wetlands

a. Overview

In the Croskell PSP Concept Drainage Strategy Rev. D, there are three retarding basins: Sediment Basin Retarding Basin 2 (SBRB2), Wetland Retarding Basin 3 (WLRB3), and Wetland Retarding Basin 4 (WLRB4).

The following general design requirements have been adopted for the design of the retarding basins:

- Retarding basins are primarily sized to meet target pre-development 1%AEP with climate change condition peak flows at Thompsons Road culvert, and Water main and VDP cable crossings, using climate change hydrologic inflows.
- No retarding basin is to be located within the transmission easement based on previous communications with Ausnet.

- As SBRB2 and WLRB3 both contribute to reduction of peak flows at Thompsons Road culvert and downstream locations, optimisation of SBRB2 and WLRB3 should:
  - minimise the footprint of SBRB2 outside the Urban Floodway Zone (UFZ)
  - maximise the footprint of WLRB3 within Melbourne Water land
  - consider diminishing returns in flow attenuation when adding more storage to WLRB3 within the UFZ outside Melbourne Water land.
- No major drainage works (retarding basins or waterways) will be located in areas of aboriginal heritage.
- Allow for a 10% Safety Factor for the footprint of proposed retarding basin assets to accommodate potential mitigation for shallow groundwater, should be determined at functional design.
  - WLRB4 buffer (10% of design basin area) due to previously identified groundwater risks to enable e.g. steepening of batters or other groundwater mitigation works.
  - WLRB3 buffer (10% if design basin area) due to potential increase in wetland footprint from clash with South East Water sewer assets.

The following general design requirements were adopted for the wetlands:

- All wetland assets are to be offline.
- Sediment ponds are required at all wetland inlets.
- Main Ti Tree Creek waterway channel bypasses the wetland.

The following subsections outline the asset-specific design considerations adopted for SBRB2, WLRB3, WLRB4.

b. Sediment Basin Retarding Basin 2 (SBRB2)

- SBRB2 will treat new developed areas within Croskell PSP west of the water main and from the north-western pipe diversion (which includes catchments internal and external to Croskell PSP).
- Reserve area of 5.76 ha, contained within the Urban Floodway Zone (UFZ). Basin storage includes the storage within the high flow bypass.
- One standalone sediment pond that provides primary treatment prior to discharge to main waterway channel.
- The embankment for SBRB2 should be raised above existing and integrated with the propose PSP shared user path.

Figure 6-7 shows the layout of SBRB2 in the Croskell PSP Concept Drainage Strategy Rev. D.

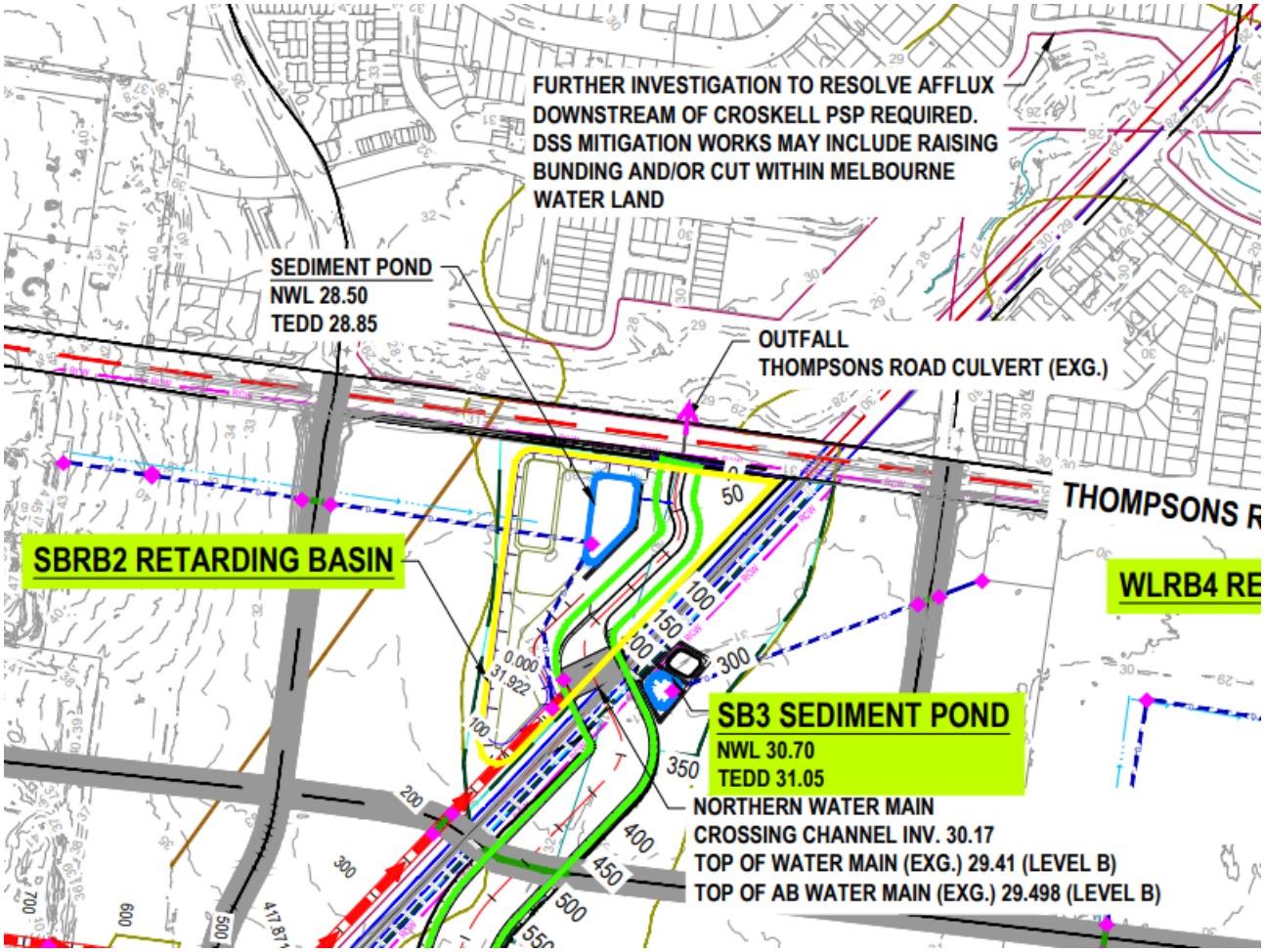


Figure 6-7: Sediment basin retarding basin 2 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001).

c. Wetland Retarding Basin 3 (WLRB3)

- The main function of the wetland retarding basin is to retard flows to meet target peak flows at Thompsons Road, the main waterway VDP cable crossing and water main crossings.
- Reserve footprint of 14.5 ha. Storage within the basin includes the Ti-Tree Creek waterway (high flow bypass) and airspace above the wetland asset.
- Wetland macrophyte area is 4.0 ha and extended detention depth of wetland is 350 mm.
- 20%AEP (with climate change) DSS pipes will redirect existing outfalls to the sediment pond within WLRB3. Overland flows from the catchment west of WLRB3 will drain directly into the wetland without high flow bypass.
- A low flow offtake from the WLRB3 transfer pool downstream of Linsell Boulevard will divert flows external to the Croskell PSP area to WLRB3 sediment basin and then wetland for treatment that contributes to the pollutant load reduction for Croskell PSP as directed by Melbourne Water. The pollutant load reduction achieved through treatment of external catchments south of Linsell Boulevard contributes to achieving the Croskell PSP BPEM targets (refer Section 5.3.1) and enables a larger wetland footprint area located within Melbourne Water land.
- The treatment of external catchments by WLRB3 enables some local PSP catchments to not have a tertiary treatment (wetland) pathway as they will discharge directly to waterways within the PSP.
- Eastern extent of main channel facilitates development adjacent Tangemere Way, and facilitates future road to access development northeast of the asset south of the main channel.
- Protection bund above sewer and offsets from pump station based on South East Water comments. For detailed requirements see drawing MEG250-07-DW-CV-SKH-3311 Rev.0.

Figure 6-8 shows the layout of WLRB3 in the Croskell PSP Concept Drainage Strategy Rev. D.

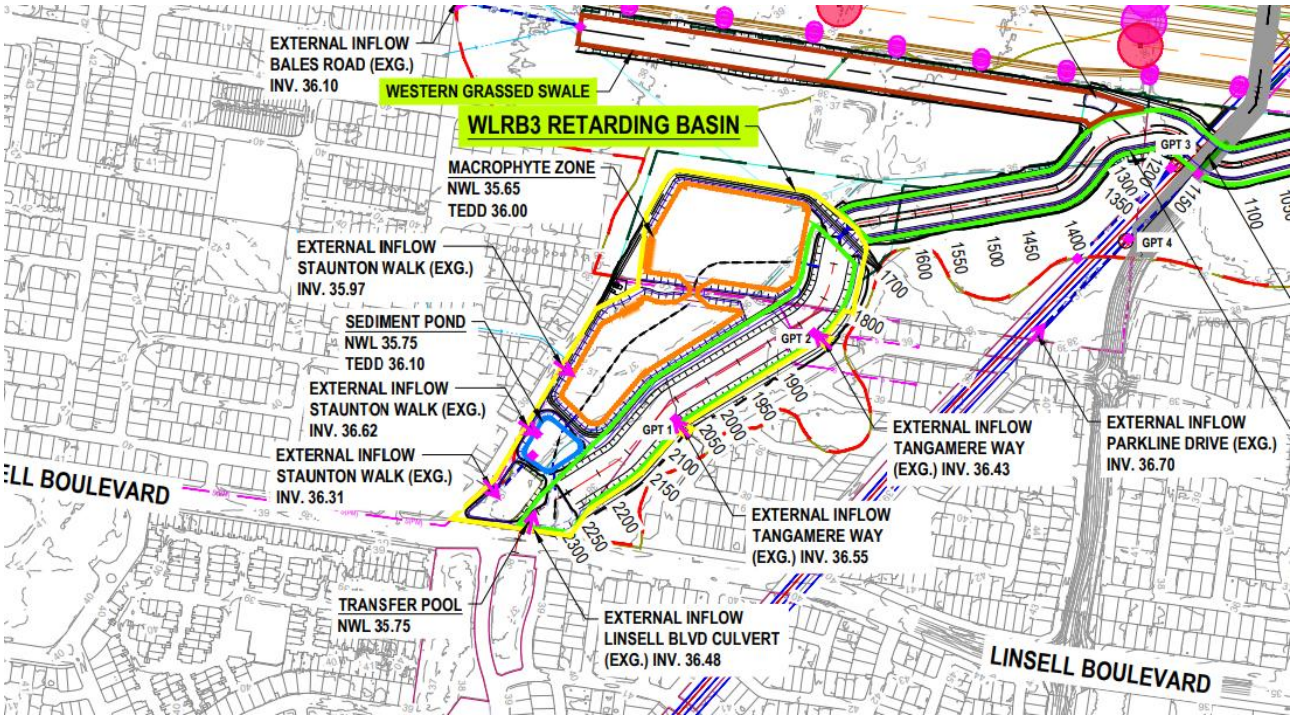


Figure 6-8: Wetland retarding basin 3 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

d. Wetland Retarding Basin 4 (WLRB4)

- Water4Good tested the capacity of Thompsons Road WLRB1 during optimisation of the WLRB4 retarding basin flood control storage. It was found that Thompsons Road Basin WLRB1 peak water levels were very sensitive to the discharge rate at the inlet to the Berwick-Cranbourne Road culvert. A wetland retarding basin (WLRB4) was required to ensure the discharge rate leaving Thompsons Road WLRB1 did not increase under a 1%AEP (with climate change). Matching the target discharge leaving Thompsons Road WLRB1 is the limiting constraint for WLRB4 basin size.
- The basin has a reserve area of 3.1 ha. The wetland macrophyte zone surface area of 0.435 ha, considering Thompsons Road WLRB1 to contributes to pollutant loading performance for Croskell PSP.

Figure 6-9 shows the layout of of WLRB4 Croskell PSP Concept Drainage Strategy Rev. D.

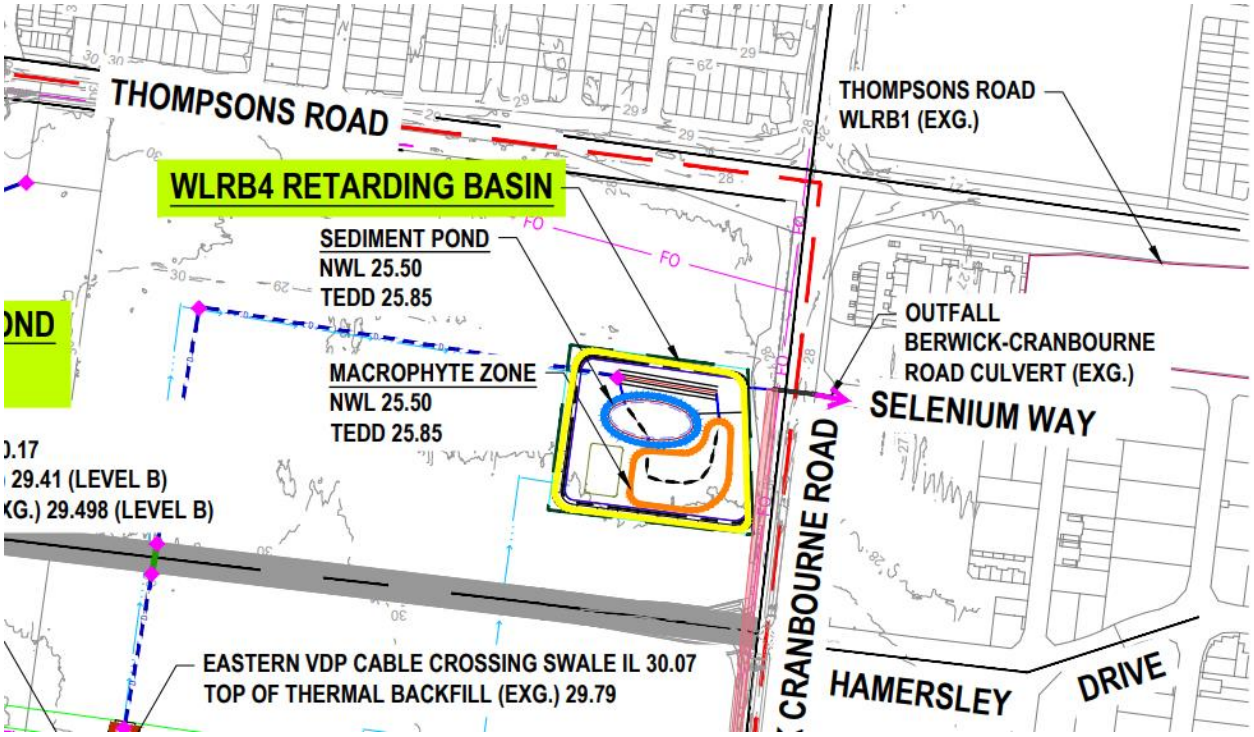


Figure 6-9: Wetland Retarding Basin 4 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

6.3.5 Sediment ponds

- Standalone sediment ponds (SB1, SB2 and SB3) are required to provide a primary treatment pathway for existing developed catchments external to Croskell PSP and new catchments within Croskell PSP upstream of the main waterway channel.
- Allow a 20% Safety Factor for the sediment pond footprint.

The following subsections outline the asset-specific design requirements adopted for SB1, SB2 and SB3.

a. Sediment Basin 1 (SB1)

SB1 provides primary treatment of catchments south of the transmission easement and west of the Ti-Tree Creek main waterway (Figure 6-10). SB1 is located within the reserve area for the Western swale and Ti-Tree Creek waterway. SB1 would be located between the Western swale and Ti-Tree Creek waterway. The drying area is proposed to be located in fill outside the northern bank of the Ti-Tree Creek waterway. Functional design should consider optimising the placement of the sediment pond and ensure a bypass is provided.

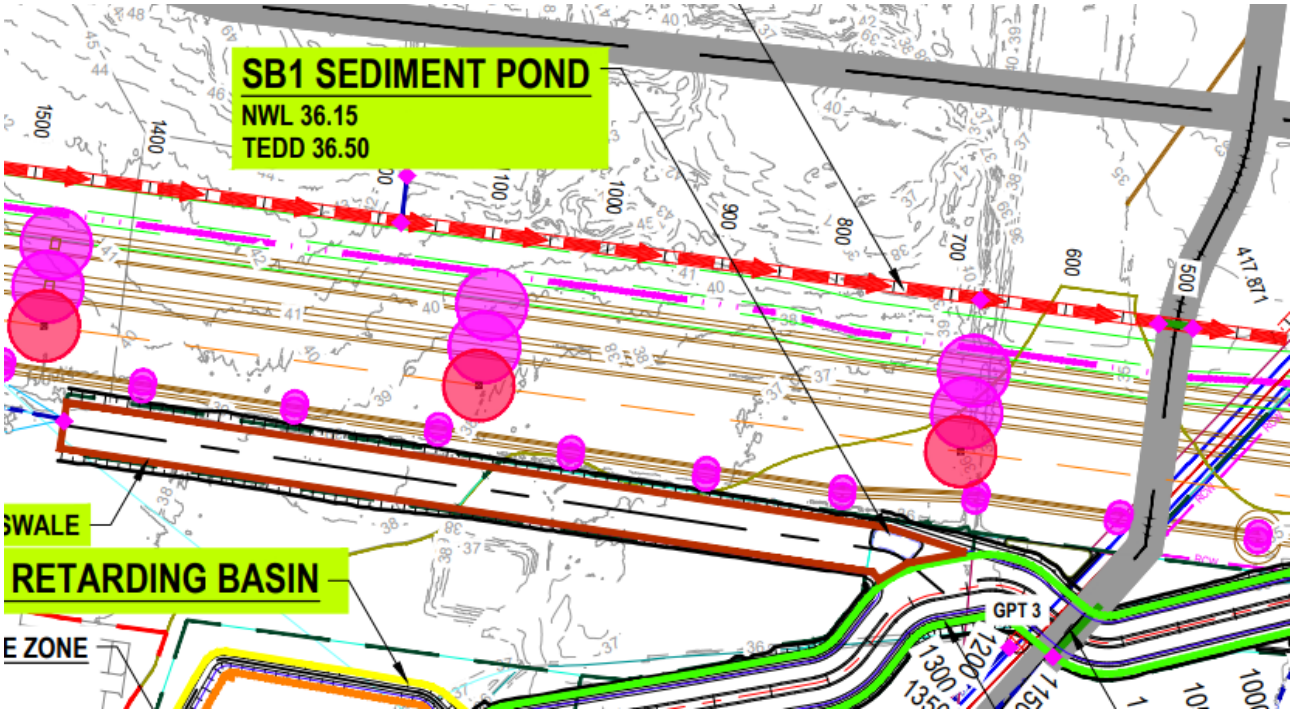


Figure 6-10: Sediment basin 1 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

b. Sediment Basin 2 (SB2)

SB2 provides primary treatment of catchments south of the transmission easement and east of the Ti-Tree Creek main waterway (Figure 6-11). The reserve area of SB2 is 0.2 ha as a buffer has been retained for this asset. SB1 pond and drying area are located on two separate allotments, which should be considered when delivering the asset.

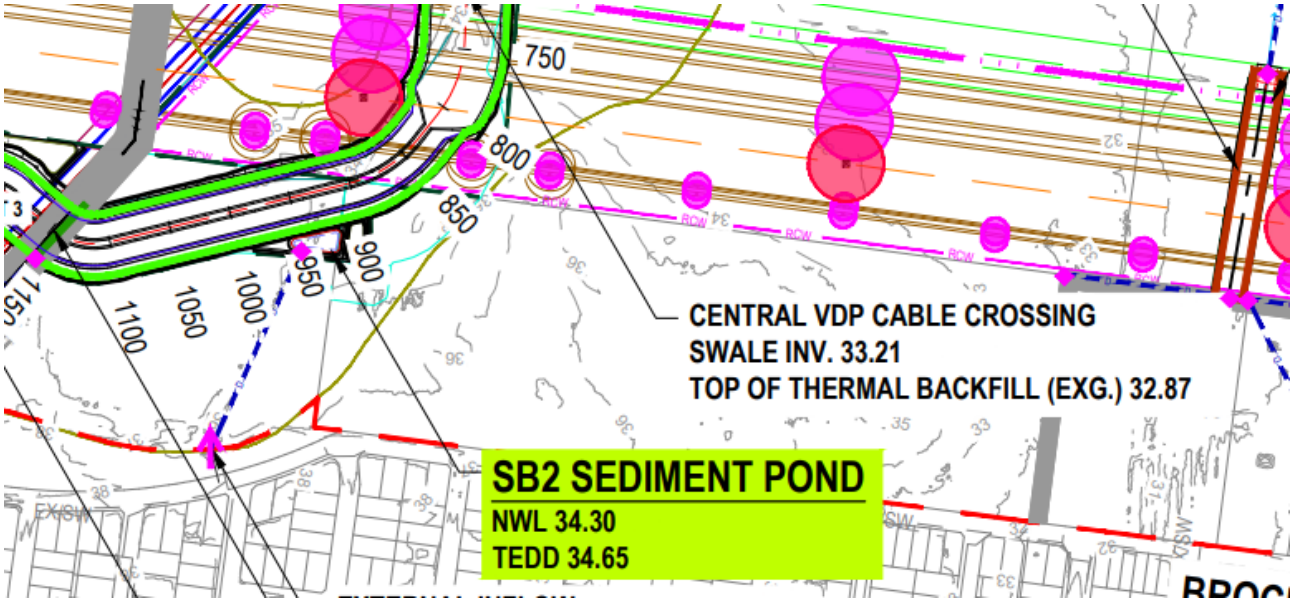


Figure 6-11: Sediment basin 2 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

c. Sediment Basin 3 (SB3)

SB3 provides primary treatment of catchments north of the transmission easement and east of the Ti-Tree Creek main waterway. SB3 has a reserve area of 2.0 ha as a reserve buffer has been retained for this asset. This buffer is located within the existing UFZ area (see Figure 6-12).

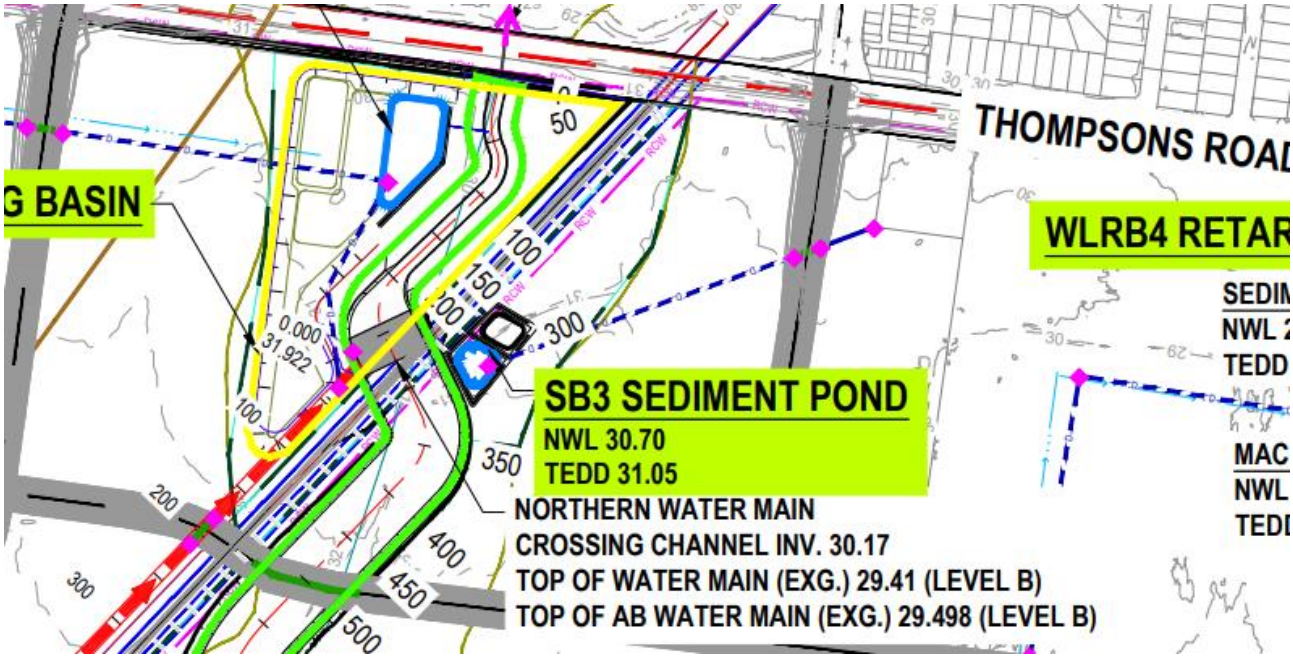


Figure 6-12: Sediment basin 3 (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

6.3.6 Ti-Tree Creek main waterway

a. Design assumptions and requirements

The following design assumptions and requirements were adopted for the Ti-Tree Creek main waterway and services crossings:

- The existing waterway is an agricultural drain that has limited environmental value.
- The concept design for the waterway takes into consideration:
  - service clearance requirements and assumptions
  - Croskell PSP place based plan
  - Existing and proposed drainage outfalls
  - Survey information
  - *Melbourne Water Constructed Waterway Design Manual* (Melbourne Water, December 2019).
- Key constraints for the waterway alignment include:
  - Victorian Desalination Project (VDP) underground 220kV High Voltage Alternating Current (HVAC) power cable.
  - Ausnet overhead high voltage powerline and towers, and distribution poles
  - Melbourne Water existing water mains
  - South East Water Recycled water mains
  - South East Water existing gravity sewer within WLRB3
  - Future PSP road crossings (Casey Fields Boulevard, Majestic Boulevard, and shared user path).
- The main waterway is designed to convey the post-development with mitigation 1%AEP (with climate change) peak flows, with the low flow channel sized to convey the post-development with mitigation 4EY without climate change peak flows.
- A freeboard level of 300 mm (above the 1%AEP (with climate change) flood level) to the top of the waterway channel has been adopted. The initial sizing of the waterway was undertaken using PC-Convey and has been checked using detailed hydraulic modelling using TUFLOW.
- The waterway corridor widths are set assuming no adjacent roads along the waterway, in line with Table 4 of the *Melbourne Water Waterway Corridor Guidelines* (Melbourne Water, 2013).
- There are no specific environmental considerations required based on completed desktop and site-based investigations.

- Feasibility of connection from existing drainage outfalls to the waterway were checked against concept design waterway invert levels.
- No major drainage works (retarding basins or waterways) will be located in areas of aboriginal heritage.
- The waterway alignment was refined to adjacent utilities easements to reduce pockets of undevelopable land.
- The waterway typology was optimised to reduce fill requirements and achieve required clearance to services crossings.

b. Crossing of the water main and VDP cable

- For detailed information on the VDP cable crossing refer Drawing MEG250-07-DW-CV-SKH-3312 Rev.0.
- The waterway alignment at the VDP and water main crossings are proposed to run roughly perpendicularly to the asset/service lines to help limit the extent of the waterway works at these crossings. In addition, a specialist design for the VDP crossing will be required by the project proponent (e.g. to consider heat dissipation).
- The design assumes formalisation of the waterways at the VDP and water main crossings, subject to DEECA's approval.
- At these crossing locations, the waterway alignments have been set so the waterway's low flow channels can cross the VDP and water main lines at roughly the same locations as the existing channels (assuming the new waterway's low flow channel is positioned at or close to the midway point of the new waterway corridor at these locations).
- At the water main and VDP cable crossings, due to the limited clearance available over the services, a waterway crossing without freeboard will be adopted. Conveyance of flows exceeding the design peak flood levels will be considered immediately downstream of the crossings.
- It is noted as an **opportunity** that if the abandoned water main at the northern crossing could be lowered, that approximately 200 mm lower waterway invert at the active water main crossing could be possible, providing opportunity to lower SB3 and reduce development fill within the lot east of the crossing.
- Main waterway channel between southern water main crossing and VDP cable runs between Ausnet towers. This alignment assumes that existing distribution poles are demolished and new poles constructed. Refer to Drawing MEG250-07-DW-CV-SKH-3301 Rev. 0 for further details.
- The reserve area immediately north and south of the VDP cable was included to address uncertainties associated with the design outcomes at the VDP cable crossing. In particular, the reserve area within the utilities easement and north of the utilities easement has been increased to allow for flood flows to be controlled and safely conveyed across the VDP cable and back into the constructed waterway without impacting on future development.
- The Ti Tree Creek main waterway channel was designed in a 3d earthworks model, taking into account minimum 500mm clearance to water mains and the VDP cable crossings exclusion zone (Thermal backfill). Water main depthing survey data undertaken by Water4Good (2023) was used. VDP cable model data provided by DEECA in 2023 was used.

The waterway design parameters along Ti-Tree Creek are shown in Table 6-3 below.

Table 6-3: Waterway design parameters for reaches along Ti-Tree Creek (refer to drawings MEG250-07-DW-CV-SKH-3100)

Parameter	Reach A	Reach B	Reach C	Reach D	Reach E	Reach F
Reach chainages (indicative) (m)	Ch 2300 to Ch 1700	Ch 1700 to Ch 1175	Ch 1175 to Ch 825	Ch 825 to Ch 275	Ch 275 to Ch 200	Ch 200 to Ch 0
Waterway type	High flow bypass	Compound(2)	Compound	Linear pool	Linear pool	High flow bypass
Longitudinal Grade (V:H)	1:2000	1:1170	1:250	1:220	1:200	N/A
1%AEP with climate change design flow (m^3/s)	32.06	11.05	12.12	12.83	13.97	N/A
Hydraulic Width (m) (1)	N/A	35	35	59	60	N/A
Corridor width adopted (m)	N/A	60	60(3)	75(4)	75(4)	N/A

1. Hydraulic width has been measured at the top of 300 mm freeboard within the channel considering the peak flood depth in a 1%AEP with climate change event from the TUFLOW modelled flows. A hydraulic width is not provided for the retarding basin high flow bypass channels. The adopted corridor widths from the previous design Rev. C have been retained, and Water4Good note that optimisation of the corridor widths may be possible at future design stages.

2. A compound waterway typically is only acceptable for longitudinal grades steeper than 1:800. A linear pool system is generally adopted for longitudinal grades flatter than 1:800. For reach B, the longitudinal grade is 1:1170. A compound channel has been adopted to minimise the width of the southern water main crossing as there is sufficient clearance for a compound channel. Further optimisation of this reach may be possible at future design stages.

3. For reach C, the waterway corridor is assumed to be less than 60m within the transmission easement. Melbourne Water may accept that buffer zones outside the hydraulic width are not required, so that the waterway can run between existing and future Ausnet tower clearance zones. Further optimisation of these reaches may be possible at future design stages.

4. DEECA advised that a concrete lined channel is required for the Ti-Tree Creek channel crossing of the VDP cable. The concrete lined channel crossing is to be designed by others. For reach D and E, a corridor width of 75 metres has been allowed for due to constraints on the depth of channel at the VDP cable crossing and water main that may result in 300 mm freeboard not being able to be achieved within these reaches. Further optimisation of these reaches may be possible at future design stages.

Figure 6-13 and Figure 6-14 show the waterway chainages from Ch 0m to 2300m.

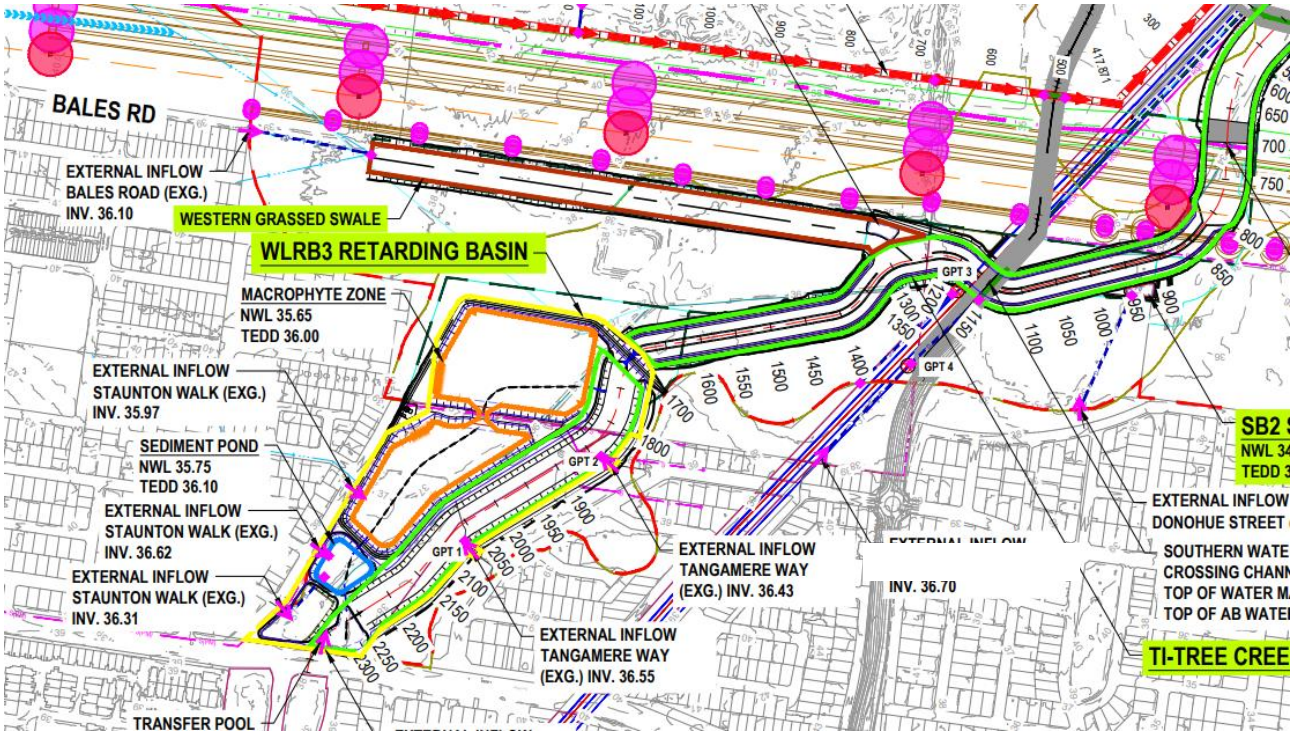


Figure 6-13: Ti-Tree Creek main waterway Ch 800m to 2300m (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001)

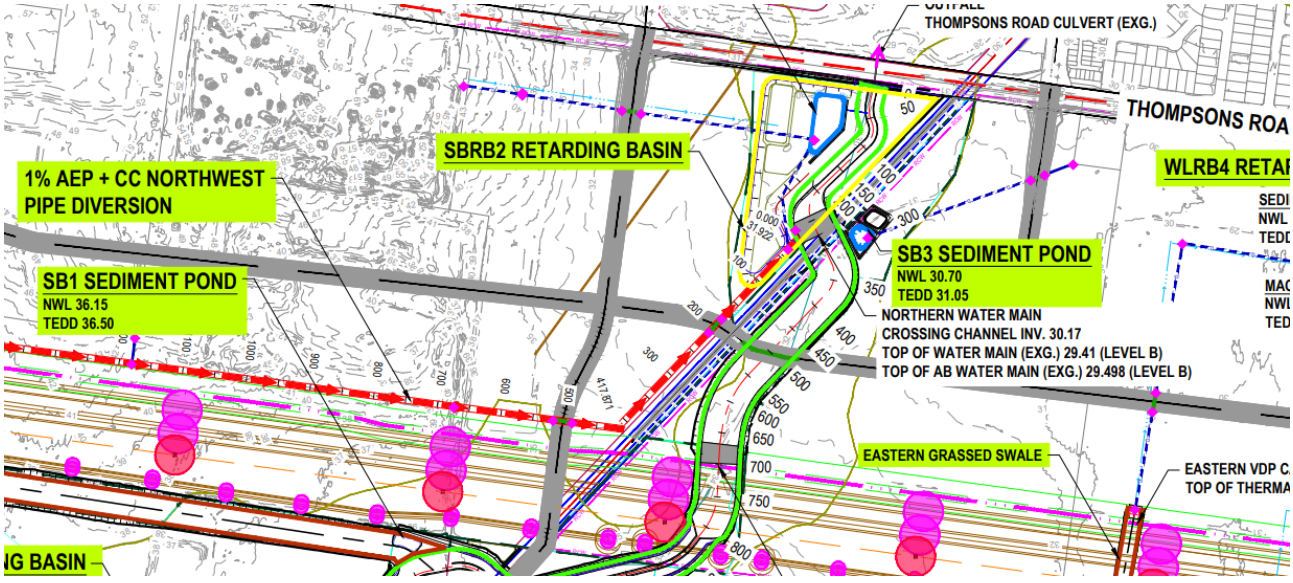


Figure 6-14: Ti-Tree Creek main waterway Ch 0m to 800m (indicative, excerpt Drawing MEG250-07-DW-CV-SKH-3001).

c. Main waterway within WLRB3 retarding basin:

- The high flow bypass within WLRB3 retarding basin shall have a 2%AEP (with climate change) peak flow capacity, as directed by Melbourne Water, such that the wetland asset remains offline of the main channel high velocity flows.
- The design intent is for the WLRB3 retarding basin outlet to throttle flows within the basin and cause the waterway to spill into the wetland via the wetland overflow weir. This approach has been adopted following Melbourne Water direction. The frequency of inundation of the wetland will be more frequent than 2%AEP.

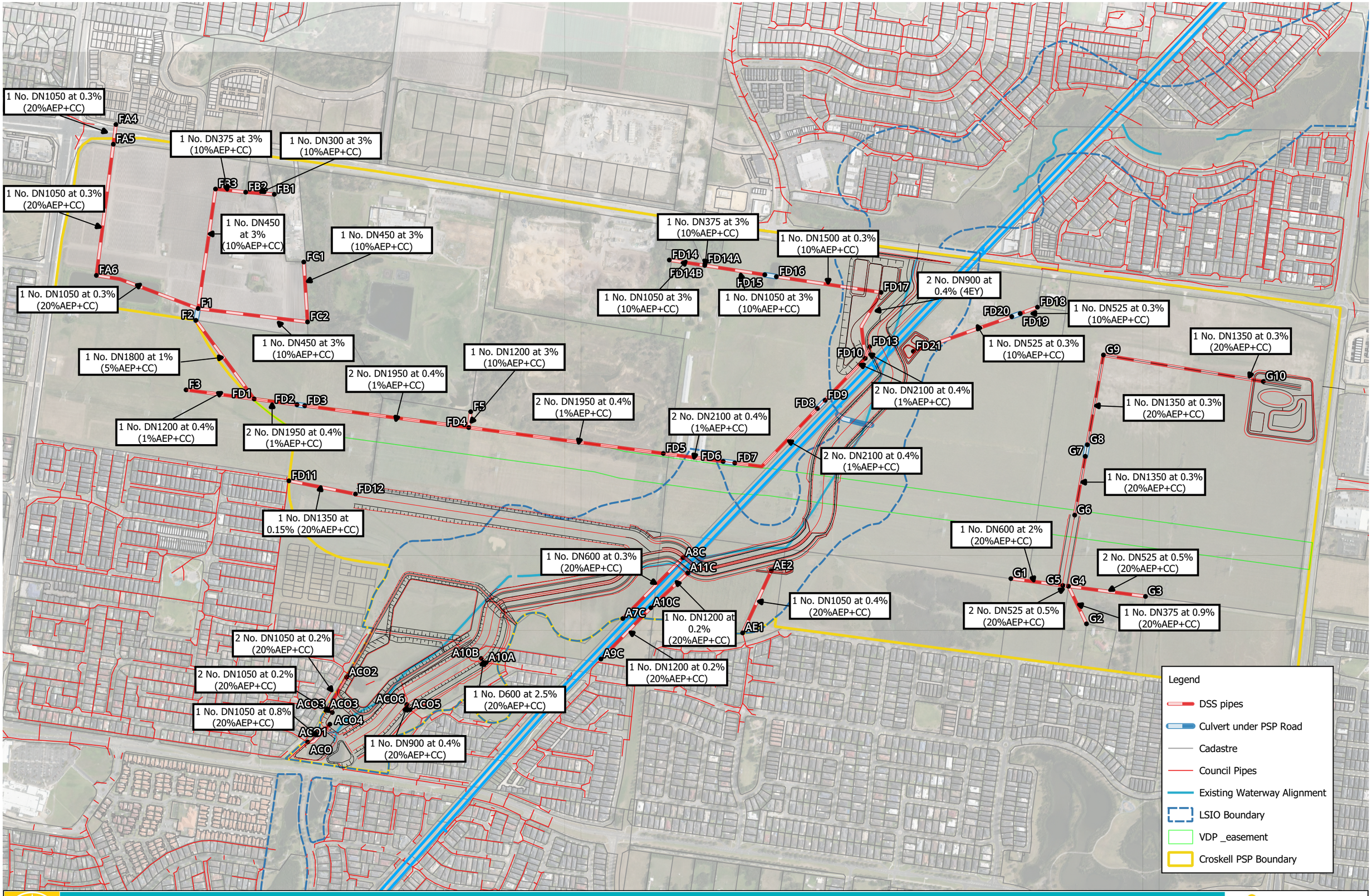
6.3.7 Minor system underground drainage

A layout of the minor DSS gravity drainage system concept design is shown in . The underground drainage with 10%AEP or more frequent design flow was sized using the rational method using 2100 climate change rainfall intensity based on ARRv4.2 guidelines.

Drainage pipes servicing residential land uses were sized for a 20% AEP (with climate change) capacity, whilst industrial/commercial land uses were sized for a 10% AEP (with climate change) capacity.

It is assumed throughout the PSP that gap flows are able to be safely conveyed through the planned network of PSP and subdivision roads. An overland flow assessment should be undertaken on a lot by lot basis to confirm this assumption.

Figure 6-15: DSS pipe and Northwest diversion system concept design



Data Sources: Melbourne Water.
Contains Vicmap Information © State of Victoria 2025

CROSKELL PSP
DSS pipes - Concept Drainage Strategy Rev. D (September 2025)

0 100 200 300 Meters

Water 4good

6.4 Hydrological modelling – RORB

6.4.1 Overview

Water4Good developed RORB models for the Western and Eastern catchments to assess flows within the Croskell PSP development. The layout of the RORB models, catchment delineation, reaches and nodes are shown in Appendix B and Appendix C. Refer to Draft Drainage Strategy (Water4Good, July 2024) Appendix B – Pre-development hydrological modelling, for the information on the pre-development RORB model calibration.

The modelling approach, design flow rates, retarding basin design parameters and hydrological modelling results are provided in the following sections.

6.4.2 Modelling approach

The following is a summary of key design approaches for the RORB modelling:

- Reach type:
  - for the post-development model, except for reaches representing the pipe diversion, reach type 2 was adopted as this is more closely representative of 1%AEP (with climate change) overland flow along road reserves.
  - for the pre-development model, reach type 1 (natural) was maintained where overland flow does not follow defined channels or road reserves. All remaining reaches are type 2.
- Storages: The storage capacities of the wetlands located south of Linsell Blvd (0619-45 and 0619-16) were represented in the pre-development RORB model as storage nodes.
- Fraction Impervious (FI): Updates to sub-catchment FI based on changes to proposed Melbourne Water reserve footprints. For areas no longer covered by a reserve, the adjacent VPA land use was used as basis for assigning post-development FI.
- RORB parameters (see Table 6-4):
  - adjustments to kc value considering updated dav values as per West and East models. The ratio kc/dav=2 was maintained per historic Ti Tree Creek model.
  - catchment areas upstream of the Thompsons Road and WLRB1 at Berwick Rd nodes were used as basis for ARF calculation for the West and East models respectively.
  - simulations were performed using the updated Climate Change guidelines from ARR2019 v4.2 for the 1% AEP event, Year 2100, considering the SSP 2-4.5.
  - the analysis was conducted using Storm Injector v 1.4, with the following version 4.2 based settings applied:
    - a median rainfall depth adjustment
    - a median rate of rise in temperature
    - a median change (increase) in initial and continuing loss.
  - MW supplied initial and continuing losses from the regional Ti Tree Creek RORB model were kept as basis for the climate change derived parameters (e.g. changes in losses due to climate change were applied on the MW prescribed losses).

Table 6-4: Hydrological model parameters

Parameter	West post-development value	East post-development value
Kc	5.9	2.4
Kc/dav	2	2
dav	2.95	1.2
IL impervious	1	1
CL impervious	0	0

Parameter	West post-development value	East post-development value
IL (pervious)	As per ARR2019 data hub v4.2	As per ARR2019 data hub v4.2
CL (pervious)	As per ARR2019 data hub v4.2	As per ARR2019 data hub v4.2
ARFs	As per ARR2019 data hub v4.2	As per ARR2019 data hub v4.2
IFD	As per ARR2019 data hub v4.2	As per ARR2019 data hub v4.2
Initial loss adjustment	Global initial Loss minus Median pre-burst depth	Global initial Loss minus Median pre-burst depth
Climate change condition	Year 2100 1% Annual Exceedance Probability (AEP)	Year 2100 1% Annual Exceedance Probability (AEP)
Climate change factor	SSP2 -4.5 factor	SSP2 -4.5 factor

The following approach was adopted for determining the design flow rates for the drainage strategy:

- The following spillway settings applied:
  - WLRB4 spillway was set at the same level as the road crest of Berwick-Cranbourne (28.2 mAHD).
  - WLRB3 spillway level was set at 37.46 mAHD based on the peak flood elevation for WLRB3 in 2025 TUFLOW model.
  - SBRB2 spillway was set at 30.4 mAHD representing the road crest of Thompsons Road at SBR2 West (value sampled from LiDAR).
- The following pipe outlet settings applied:
  - SBRB2 outlet capacity will be lower than the existing culvert capacity. An outlet structure (e.g. high flow outlet chamber fitted to culvert) shall be required at functional design.

6.4.3 Retarding basin design performance

Table 6-5 to Table 6-8 show the revised retarding basin design parameters and results for ARR2019 v4.2 SSP 2-4.5 for the year 2100. For each retarding basin, the initial and continuing loss is reported for critical durations (duration shown in brackets) for the 10% and 1% AEP (with climate change). Peak volume excludes airspace below the wetland and sediment pond Top of Extended Detention Depth (TEDD) but includes storage within the high flow bypass.

Table 6-5: SBRB2 storage design

Parameter	SBRB2	
	10% AEP (with climate change)	1% AEP (with climate change)
Base Level (mAHD)	29.2	29.2
Peak Outflow (m^3/s)	12.25	20.61
Peak Volume (m^3)	30,300	58,800
Flood Level (mAHD)	29.66	30.34

Table 6-6: WLRB3 storage design

Parameter	WLRB3	
	10% AEP (with climate change)	1% AEP (with climate change)
Base Level (mAHD)	36.0	36.0
Peak Outflow (m^3/s)	6.72	9.53
Peak Volume (m^3)	71900	130,000
Flood Level (mAHD)	36.79	37.4

Table 6-7: WLRB4 storage design

Parameter	WLRB4	
	10% AEP (with climate change)	1% AEP (with climate change)
Base Level (mAHD)	25.85	25.85
Peak Outflow (m^3/s)	1.62	2.39
Peak Volume (m^3)	21,900	34,200
Flood Level (mAHD)	27.30	27.87
1% AEP (with climate change) freeboard to adjacent road (m)	0.3 (Berwick-Cranbourne Road)	

In the RORB model, the WLRB3 outlet pipes had a loss factor (Ke) of value 1 applied. The configuration of WLRB3's outlet may vary in future design stages. For the purposes of the concept design, the Ke equal to 1 was used to simulate pipe outflows from the RORB model to be similar to the outflows simulated in the 2025 TUFLOW model.

Table 6-8: Existing Thompsons Road WLRB1 storage results

Parameter	Existing WLRB1	
	10% AEP (with climate change)	1% AEP (with climate change)
Base Level (mAHD)	25.8 (540 min)	25.8
Peak Outflow (m3/s)	2.06	3.61
Peak Volume (m3)	61,600	90,500
Flood Level (mAHD)	25.07	25.58
1% AEP (with climate change) freeboard to adjacent road (m)	0.42 (Thompsons Road at existing WLRB1)	

6.4.4 Hydrological modelling results

This section includes hydrological results for the post-development with mitigation conditions at key locations within the Ti-Tree Creek RORB models and comparison with the target flow rates outlined in Section 5.2.

Table 6-9 and Table 6-10 show that post-development flows do not exceed pre-development flows in the western catchment across all print locations. Similarly, at key locations in the east, post-development flows do not exceed pre-development flows. All basins have been designed to contain the 1% AEP (with climate change) with a freeboard of 0.3 metres between flood level and spillway.

Table 6-9: Western catchment pre-development and post-development with mitigation peak flow (SSP2-4.5 2100)

Location (West model)	Pre-development 1% AEP with climate change (m^3/s)	Post-development 1% AEP with climate change (m^3/s)
Croskell PSP water wain crossings		
Waterway crossing south of utilities easement (Croskell Water Main Cross S)	26.46	12.12
Waterway crossing north of utilities easement (Croskell water Main Cross N)	23.64	13.97
Thompsons Road culvert, western catchment (THOMPSONS ROAD)	25.65	20.51
Croskell PSP VDP cable crossing		

Location (West model)	Pre-development 1% AEP with climate change (m^3/s)	Post-development 1% AEP with climate change (m^3/s)
Main waterway crossing of VDP cable (Croskell VDP main cross)	25.26	12.83
Western waterway crossing of VDP cable (Croskell VDP Cable W)	4.9	0(1)

1. The northwest pipe diversion diverts all flows up to 1%AEP with climate change design flow rate 15.83 m^3/s away from the VDP cable crossing west. Flows in excess of the capacity of the pipe may spill over the VDP cable.

Table 6-10: Eastern catchment pre-development and post-development with mitigation peak flow (SSP2-4.5 2100)

Location (East model)	Pre-development 1% with climate change (m^3/s)	Post-development 1% AEP with climate change (m^3/s)
Berwick Cranbourne Rd culvert eastern catchment (Croskell Berwick Cranbourne R)	15.06	2.39
Thompsons Road at WLRB1 (Thompsons Rd WLRB1 P)	5.24	3.61
Eastern utilities easement crossing of VDP Cable east ('Croskell VDP Cable EAST' for the pre-development model and 'ESDS(After Crossing)' for the post-development model)	7.83	7.79(1)

1. The eastern swale conveys 20%AEP with climate change flows across the VDP cable via a swale with concrete lining above the cable crossing, as a result, the residual erosion risk of the sheeting flow is expected to be significant less than the pre-development scenario.

6.5 Water quality and quantity modelling and improvement measures - MUSIC

6.5.1 Overview

Water4Good developed a new MUSIC model for the catchments contributing to Croskell PSP to model the post-development with mitigation conditions, and best practice pollutant reduction and total annual volumes across the VDP cable. The Melbourne Water MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Guideline July 2024 version was adopted for design.

The following sections include the MUSIC modelling results, and wetland and sediment pond design.

6.5.2 Water quality and total annual runoff modelling

Water quality and total annual runoff volume modelling has been completed using MUSIC. Water Quality modelling results indicate wetland performance meets the water quality design criteria in the western catchments through a combination of sedimentation ponds and a 4.0 hectare wetland (WLRB3). The indicative location of this asset is shown in Appendix D.

The contributing area assigned to each asset is shown in Appendix D and it should be noted that gross pollutant traps (GPT) were represented as junction nodes with no treatment effects in the MUSIC model. Table 6-11 and Table 6-12 show the MUSIC model results for the Western and Eastern catchments, respectively.

Table 6-11: Western catchments total annual pollutant loading reduction performance

	Pollutant loading (kg/yr)	Target loading reduction (%)	Target loading reduction (kg/yr)	Actual pollutant loading reduction (kg/yr)	Target met? (Yes/No)	Actual pollutant loading reduction (%)
Total Suspended Solids (kg/yr)	212,000	80	169,600	219, 860	Yes	103.7
Total Phosphorus (kg/yr)	452.0	45	203.4	386.0	Yes	85.4
Total Nitrogen (kg/yr)	3,310	45	1,489.5	1,500	Yes	45.3
Gross Pollutants (kg/yr)	47,700	70	33,390	59,062	Yes	123.8

1. Values exceeding 100% for the Actual pollutant reduction (%) are possible based on the method adopted for calculating the baseline pollutant loadings (see Section 5.3.2) and the treatment of external catchments contributing to pollutant reduction for Croskell PSP.

Table 6-12: Eastern catchments total annual pollutant loading reduction performance

	Pollutant loading (kg/yr)	Target loading reduction %	Target loading reduction (kg/yr)	Actual pollutant loading reduction (kg/yr)	Target met? (Yes/No)	Actual pollutant loading reduction (%)
Total Suspended Solids (kg/yr)	189,000	80	151,200	151,011	Yes	80.0
Total Phosphorus (kg/yr)	390	45	175.5	265.2	Yes	68.0
Total Nitrogen (kg/yr)	2,780	45	1,251	1,262.1	Yes	45.4
Gross Pollutants (kg/yr)	37,600	70	26,320	37,600	Yes	100.0

6.5.3 Total annual runoff volume at VDP cable crossing performance results

Table 6-13 shows the comparison in total runoff volume between the pre-development and post-development with mitigation volume reduction at the proposed VDP cable crossing based on outcomes of the MUSIC modelling.

Water4Good recommends that mitigation measures for soil wetting be considered in future design phases. The reductions in total annual runoff volumes at the Western crossing and Central crossing are primarily a result of the northwestern catchment diversion, including a diversion of flows up to the design flow for the pipe (1%AEP with climate change flow rate). In addition to the pipe diversion, the Central crossing reduction is also influenced by evapotranspiration losses. Although total annual volumes of runoff increase in the Eastern crossing, the impact of mitigation measures including the concrete protection slab along the Eastern swale above the VDP cable should be considered.

Table 6-13: Comparison of total annual runoff volume at VDP cable crossings between pre-development and post-development with mitigation.

VDP cable crossing location	Pre-development average annual volume (ML/yr)	Post-development average annual volume (ML/yr)	Target met?
Western Crossing	145	0	Yes(1)
Central Crossing	1,960	1,920	Yes(1)
Eastern Crossing	61	99.0	No(2)

1. Although the west and central crossing locations align with the existing agricultural drain crossing location, and the existing drain is expected to convey low flows from very frequent events, the actual existing flow paths and drain capacity are not well understood. Verification of the total annual volume reductions should be completed at future design stages.

2. At the eastern crossing, an increase in total annual runoff volumes is expected based on the current concept design proposal. The increase in imperviousness in the catchment south of the VDP cable is minimal compared to the other sites, and appropriate mitigation measures for reducing soil wetting at the cable crossing or for reducing total annual runoff volumes through integrated water management measures should be considered.

6.5.4 Wetlands

Table 6-14 shows the wetland design parameters applied in the MUSIC model which met the best practice targets.

Table 6-14: Wetland MUSIC model design parameters

Wetland	WLRB3	WLRB4
Macrophyte zone Area (ha)	4.0	0.435
EDD (mm)	350	250
High flow bypass rate (m3/s)	1.0	1.33
Permanent Pool Volume (m3)	16,000	1,740

6.5.5 Sediment basins

This section describes the sediment pond size estimates used for the MUSIC model in the Croskell PSP Drainage Scheme. Key parameters applied to the sediment basin's sizing include:

- The turbulence parameter based on the hydraulic efficiency, which depends on the shape of the sediment pond. Considering Persson et al. (1999), SBRB2 and WLRB4 sedimentation pond shapes indicates a lamda value or hydraulic efficiency of 0.26 which gives n (turbulence parameter) of 1.35. The remaining sedimentation ponds' shapes (SB1, SB2 and SB3) are assumed to match Shape H, with 0.11 for hydraulic efficiency and hydraulic efficiency of 1.12.
- The extended detention depth of all sedimentation ponds was set at 0.35m.
- Standalone sedimentation ponds have k value set to zero.

A fraction imperviousness of 100% was applied to subarea nodes that represent sedimentation ponds and wetlands' areas, connected directly to the water sensitive urban design assets. Table 6-15 summarizes the inputs applied in the West MUSIC model for the sediment ponds. Detailed information on the calculations for the sediment pond sizing are in Appendix E.

Table 6-15: MUSIC inputs for sediment ponds – East and West catchments

Parameter	Unit	SB1	SB2	SB3	SBRB2	WLRB3 Sed Pond	WLRB4 Sed Pond
Sediment pond surface area	m^2	762.9	397.0	547.4	1932.4	3047.3	1431.8
Sediment pond Permanent Pool Volume	m^3	599.2	224.7	379.9	1664.7	2397.1	1200.0
Sediment pond high flow bypass	m^3/s	0.6	0.4	0.6	2.3	3.0	1.35
Drying area	m^2	900.9	273.0	525.9	2823.9	4184.7	1477.2

Table 6-16 summarises the gross pollutant traps inputs and its description.

Table 6-16: Gross pollutant traps

ID	Description	Design flow rate (m3/s) – 4EY	Contributing Area (ha)
GPT1	South-east of WLRB3	To be provided in Rev 0 report.	6.2
GPT2	East of WLRB3	To be provided in Rev 0 report.	4.5
GPT3	South of Ti-Tree Creek, west of southern water mains crossing	To be provided in Rev 0 report.	4.8
GPT4	South of Ti-Tree Creek, south of transmission easement crossing	To be provided in Rev 0 report.	10.5

6.6 Hydraulic modelling - TUFLOW

6.6.1 Overview

Water4Good prepared a two-dimensional hydraulic model using TUFLOW software (2025.0.2 iDP-w64) to simulate flood behaviour for the pre-and post-development conditions of the Croskell PSP precinct and the areas immediately downstream (referred in this report as *2025 TUFLOW model*). A Melbourne Water regional TUFLOW model for Ti Tree Creek (Cardno,2020) was used as a base to develop the 2025 TUFLOW model. The Croskell PSP Concept Drainage Strategy Rev. D (September 2025) assets were represented in the TUFLOW model surface using data exported from 12D model and the underlying model topography was predominantly sampled from the high-resolution surveyed LiDAR.

The scope of the hydraulic model included:

- Assess the pre- and post- development scenarios considering the climate change effects (ARRv4.2, 2100-year SSP2-4.5) and without climate change.
- Evaluate the flood storage capacity of the assets in Concept Drainage Strategy Rev.D (September 2025) ensuring their effectiveness in managing flood risks for the 1% AEP with climate change, fulfilling a key design criteria.
- Validate that the post-development with mitigation peak flow rates (1%AEP with climate change) at the Croskell PSP outfalls match the pre-development peak flow rates (1%AEP with climate change).
- Verify if peak flood levels within existing developments immediately downstream of Croskell PSP are not increased in a Croskell PSP 1% AEP with climate change, and without climate change, post-development scenario.

The outgoing peak flow target results set for Croskell PSP drainage strategy assets were achieved, fulfilling the design criteria. However, downstream of Croskell PSP precinct, peak flood level conditions in post-development increased above pre-development scenarios, as discussed in Section 6.6.3.

6.6.2 Limitations

This flood study limitations are:

- Calibration of the TUFLOW model to historical events was not performed.
- Flood level reporting shown downstream of Croskell PSP area are indicative only and should not be relied upon for extracting accurate flood level information.
- Inflows applied are based on pre and post-development critical durations and temporal patterns derived from Croskell PSP RORB modelling.
- Post-development conditions earthworks and landform were not represented in the TUFLOW models.
- Minor drainage assets (pipes and channels servicing allotments) were not represented in the TUFLOW model.

- Details on the internal pipes and inlet/outlet structures within/to/from basins were excluded. Outlet structures were optimised within TUFLOW, however further refinement of those structures should be performed at a later design stage.
- The total inflow of catchments contributing to areas downstream of Croskell PSP is represented as 2d_sa polygons for both pre and post-development scenarios.

The TUFLOW modelling approach is summarised in Appendix F. The following sections discuss the TUFLOW findings and recommendations.

6.6.3 Design flood modelling results

The TUFLOW model results show that generally the drainage assets modelled (SBRB2, WLRB3, WLRB4, Ti-Tree Creek main waterway and Western swale) are able to contain the 1%AEP (with climate change) flows while still allowing sufficient freeboard between flood level and its spillways and site constraints. However, in specific locations of the constructed waterway, the freeboard target of 0.3m is not achieved (See item 6.6.3a).

Also, downstream of the Croskell PSP precinct, afflux is present. Further assessment on appropriate outlet configuration for SBRB2 should be performed at functional design. A preliminary sensitivity analysis of different outlet configurations for SBRB2 was undertaken (See 6.6.3b)

a. Constructed waterway freeboard

In specific locations of the constructed waterway, the freeboard target of 0.3m is not achieved. The ‘Constructed Waterway Freeboard’ map below shows the locations which were checked (for freeboard) using the QGIS profile tool. Within the transmission easement, at locations 8, 9, 10 and 11, in particular, a freeboard of 0.3 m is not achievable without the introduction of fill within the easement (which is not permitted).

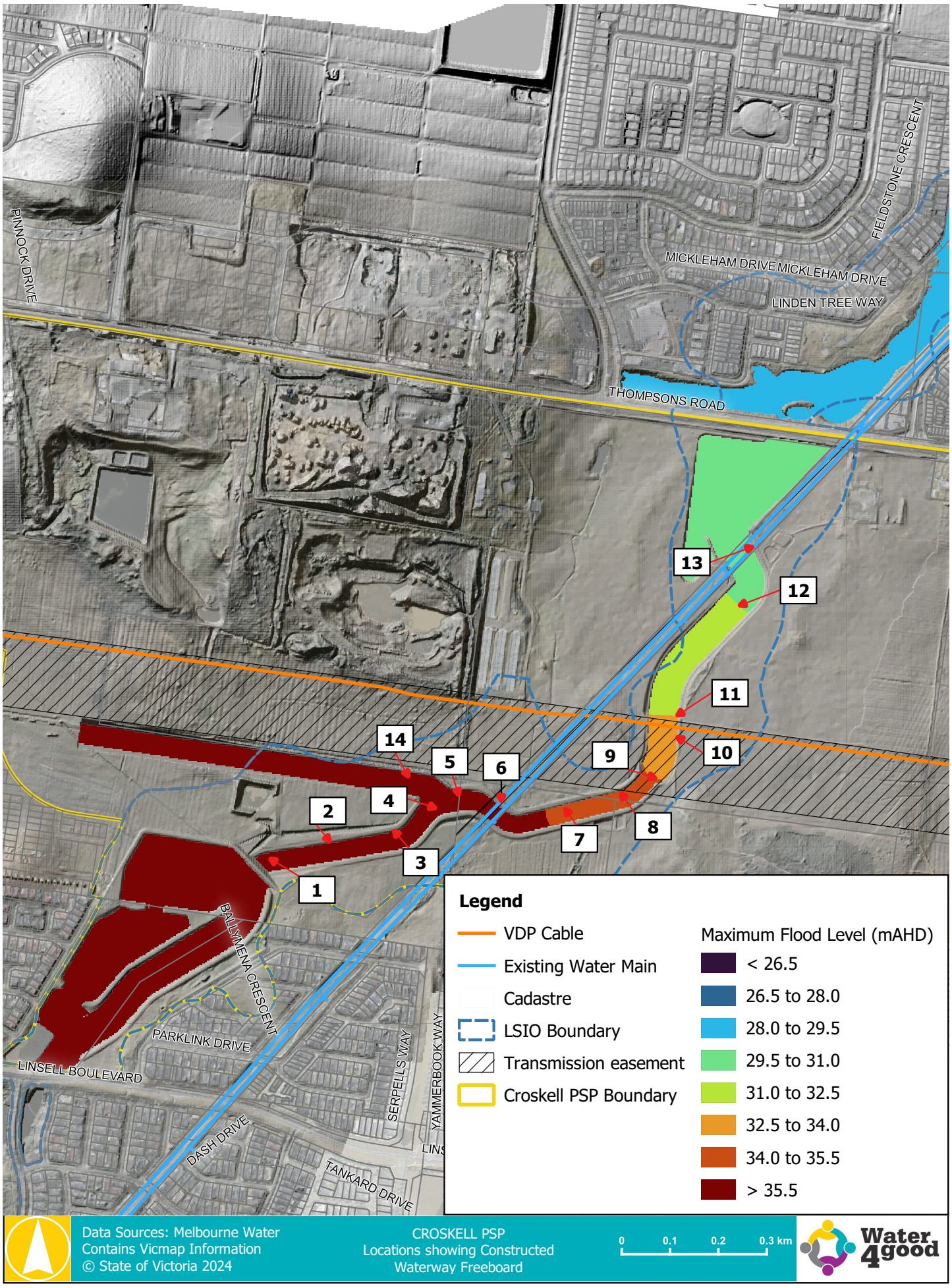
Similarly, the 0.3 m freeboard target is not achievable within the pipe track (profile 6), as filling of the area is not permitted. It is recommended that the waterway be widened within the transmission easement and pipe track to accommodate some freeboard (and Melbourne Water to consider a reduced freeboard requirement, if appropriate). It is noted that the VDP HV cable constrains the waterway invert level and therefore it may not be possible to lower the waterway to provide the required freeboard.

Details on the profile of each location can be found in Appendix G. The summary of the available freeboard is shown in Table 6-17 at the selected locations (see Figure 6-16).

Table 6-17: Freeboard at Ti-Tree Creek waterway

Profile	Water level at 1%AEP with climate change	Embankment (mAHD)	Freeboard (m)
1	36.5	37.0	0.5
2	36.3	36.8	0.5
3	36.2	36.7	0.5
4	36.1	36.6	0.5
5	36.1	36.6	0.5
6	35.9	36.3	0.4
7	35.4	35.7	0.3
8	35.0	35.3	0.3
9	34.5	35.0	0.5
10	33.6	33.9	0.3
11	33.4	33.8	0.4
12	31.1	31.5	0.4
13	30.5	30.8	0.3
14	36.1	36.5	0.4

Figure 6-16: Locations showing constructed waterway freeboard.



Data Sources: Melbourne Water
Contains Vicmap Information
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CROSKELL PSP
Locations showing Constructed Waterway Freeboard

0 0.1 0.2 0.3 km

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b. Sensitivity assessment of Weir on Thompsons Road culvert

A sensitivity analysis was undertaken using the 2025 TUFLOW model to assess the impact of a weir structure, which partially obstructs two of the outlet barrels at the outlet of the SBRB2 retarding basin, located upstream of the Thompsons Road culvert. The primary objective was to evaluate how varying weir configurations influence upstream flood levels within the basin and the afflux downstream of the Thompsons Road existing culvert. Three weir scenarios were simulated, including:

- Baseline: No weir
- A: Weir with 29.2 mAHD as crest elevation at the 2 rectangular barrels of 1.8 m (W) x 1.5m (H).
- B (adopted): Weir with 29.3 mAHD as crest elevation at the 2 rectangular barrels of 1.8 m (W) x 1.5m (H)
- C: Weir with 29.1 mAHD as crest elevation at the 2 rectangular barrels of 1.8 m (W) x 1.5m (H).

This setup was designed to represent a potential modification aimed at improving flow control and mitigating downstream flood risk. The scenario where no weir was applied is referenced as ‘baseline’ case.

The weir elevations tested were 29.1 mAHD, 29.2 mAHD and 29.3 mAHD, each obstructing two outlet barrels (1.8 m x 1.5 m) at the outlet of the SBRB2 retarding basin. To evaluate the flood levels downstream of the Thompsons Road culvert, six locations downstream of the existing Thompsons Road culvert were identified, as shown in Figure 6-17.

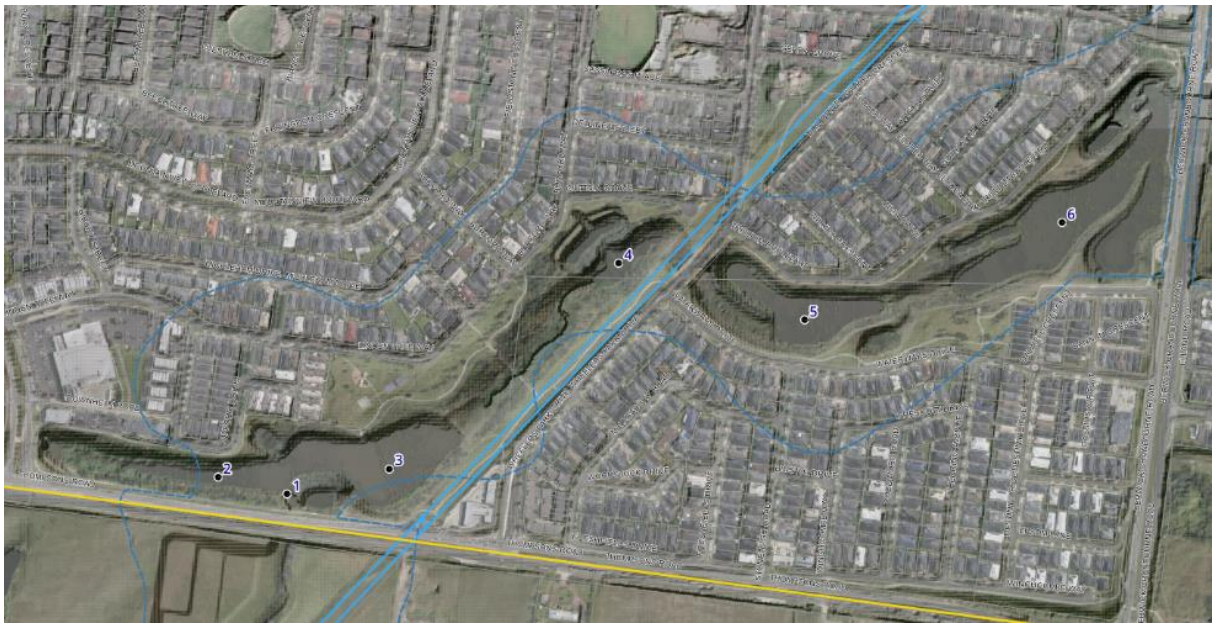


Figure 6-17: Locations downstream of Thompsons Road existing culvert

Table 6-18 shows the peak flood elevation at SBRB2 for each case scenario. The 29.2 mAHD crest elevation was selected as the preferred option due to site constraints and its acceptable peak flood elevation of 30.43 mAHD at SBRB2.

Afflux analysis downstream of the culvert showed a consistent reduction in afflux with increasing weir elevation. The scenario with a weir elevation of 29.2 mAHD provided a balanced outcome, reducing downstream afflux while keeping upstream flood level at SBRB2 with sufficient freeboard relative to the Thompsons Road crest level.

Figure 6-18 below shows the relative performance of each weir scenario across all six downstream locations. These findings highlight the importance of balancing weir design to optimise flood mitigation benefits while minimizing adverse impacts on downstream areas, an exercise that should be carried out in more detail at functional design.

Table 6-18: Peak flood elevation at SBRB2 for sensitivity test scenarios

	Baseline	A	B (adopted)	C
SBRB2 peak flood elevation (mAHD)	30.07	30.39	30.43	30.46

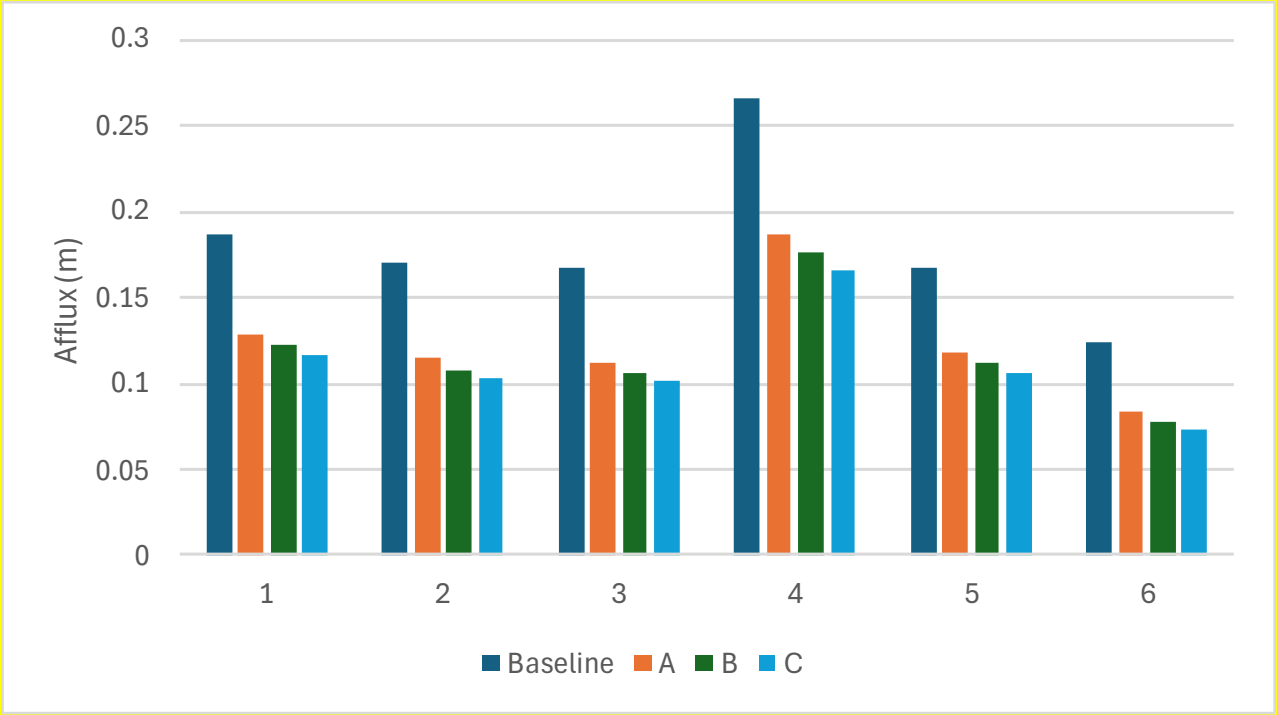


Figure 6-18: SBRB2 weir sensitivity test for 6 locations downstream of Croskell PSP.

c. Peak flow rate results

A comparison of the peak outflows simulated by both the TUFLOW hydraulic model and the RORB hydrologic model at the three retarding basins (SBRB2, WLRB3 and WLRB4) was undertaken. The purpose of this comparison is to ensure consistency between the two modelling approaches and to identify any notable discrepancies that may warrant further investigation. The comparison shown in Table 6-19 indicates that both models produce consistent peak outflow estimates, with differences within an acceptable range. For detailed design, the hydraulic model (TUFLOW) provides a more robust representation of flow dynamics and should be considered the preferred tool for final design verification.

Table 6-19: TUFLOW 1%AEP (with climate change) simulated outflows compared to target outflow from RORB

Retarding Basins	2025 TUFLOW Peak Outflow (m^3/s)	Peak Outflow (m^3/s) from RORB model
SBRB2	20.52	20.61
WLRB3	9.05	9.53
WLRB4	2.44	2.39

d. Flood level impact assessment

For the 1%AEP with climate change event, the TUFLOW and RORB models simulated similar flood levels in the retarding basins (Table 6-20). The retarding basins are able to accommodate the peak flood levels allowing a freeboard greater than 0.3m. However, it is important to note that the TUFLOW model DEM

representation of the embankments of the retarding basins are indicative only and the top of embankment should be set at the peak flood level plus 300 mm at functional design.

Table 6-20: TUFLOW 1%AEP (with climate change) simulated flood levels compared to target flood level from RORB.

Retarding Basins	TUFLOW Simulated flood level (mAHD)	Target flood level from RORB models (mAHD)
SBRB2	30.43	30.34
WLRB3	37.46	37.40
WLRB4	27.91	27.87

The flood level impact map presented in this section compares post- and pre-development scenarios for the 1% AEP with climate change event and the 1%AEP without climate change (see Flood Level Impact Maps). Downstream of the Croskell PSP precinct (north of Thompsons Road), post-development flood levels are exceeding pre-development levels in both with climate change and without climate change scenarios.

A notable afflux of approximately 116 mm is observed in the climate change scenario, and recommended future investigations to mitigate this impact are outlined in section 6.6.4. Afflux immediately downstream of the existing Thompsons Road culvert is observed during the 45-minute storm event (TP 5942). Further north, afflux is associated with the 90-minute event (TP 6002) and the 120-minute (TP 6033).

At the Thompsons Road culvert, outflow volumes were assessed under both pre-development and post-development conditions. For the 45-minute event (TP 5942), 90-minute event (TP 6002) and 120 (TP 6033) on the 1%AEP (with climate change) scenario, the post-development outflow volume increased by approximately 30%-34% compared to the pre-development 1%AEP (with climate change) scenario. This increase is likely contributing to the observed afflux downstream of Thompsons Road.

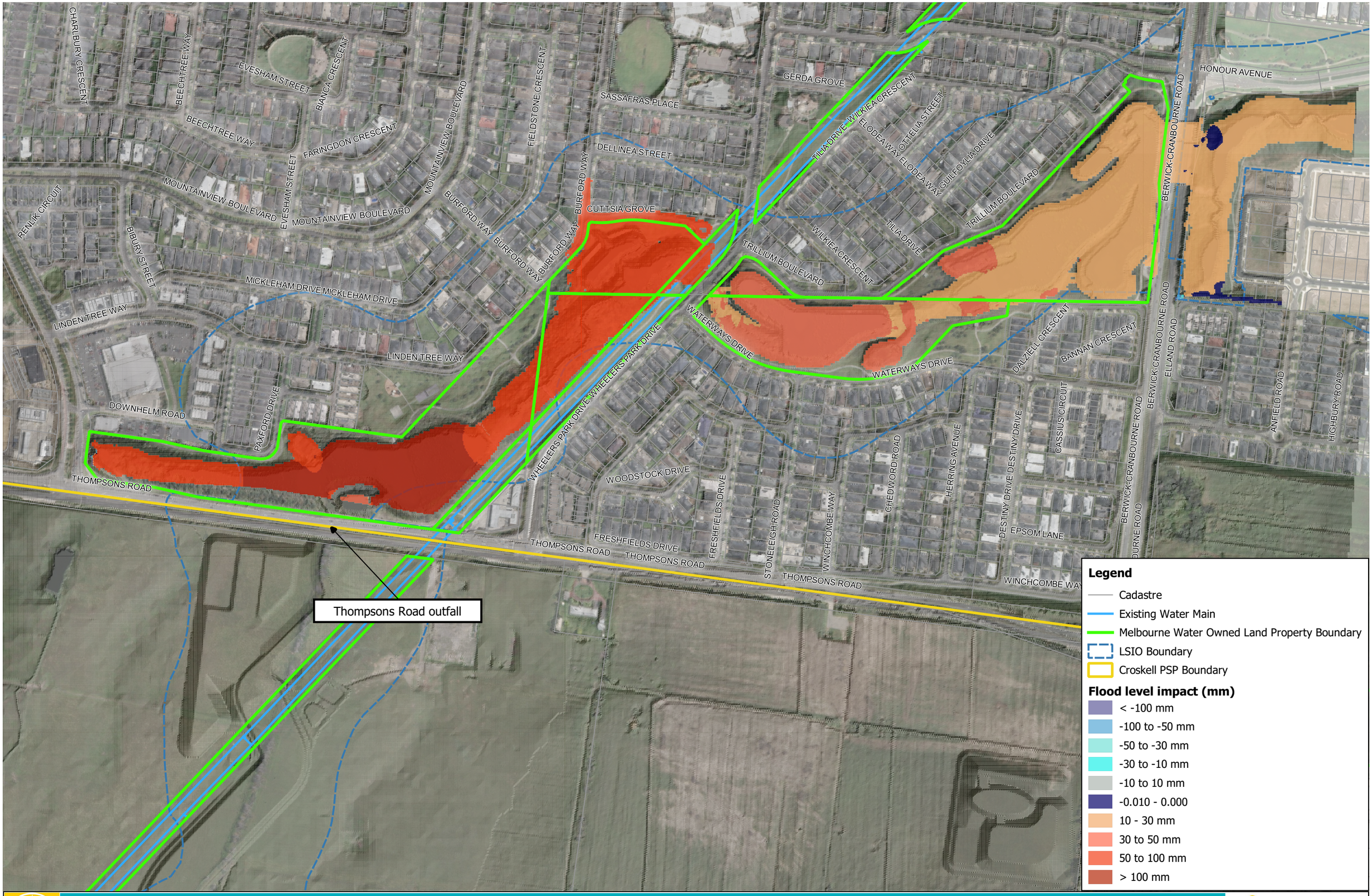
In the post-development scenario, peak outflows from the Thompsons Road culverts are simulated to be lower than in the pre-development scenario. However, in the post-development scenario, the timing of the peak flows from Thompson Road culverts has also changed and now coincides with the timing of the peak flows from the catchment downstream of the culverts. The change in peak flow timing has resulted in higher combined peak flows in the post-development scenario than in the pre-development scenario, resulting in the higher flood levels simulated further downstream of the culverts.

It is important to note that the modelling approach applied inflows directly to the retarding basins and the Ti-Tree Creek waterway. This method may overestimate flow volumes, as it does not account for the attenuating effects of post-development landform features such as buildings, roofs, and roads. Incorporating these elements into the 2025 TUFLOW model is expected to reduce the volume of outflow from Croskell PSP and alter the timing of peak outflows.

See and for the flood level impact maps between the post and pre-development scenario for 1%AEP without climate change and for the 1%AEP with climate change, respectively.

Figure 6-19: Flood level impact map (Post and pre-development scenario for 1%AEP with climate change, SSP2 - 4.5)

Figure 6-20: Flood level impact map (Post and pre-development scenario for 1%AEP without climate change)

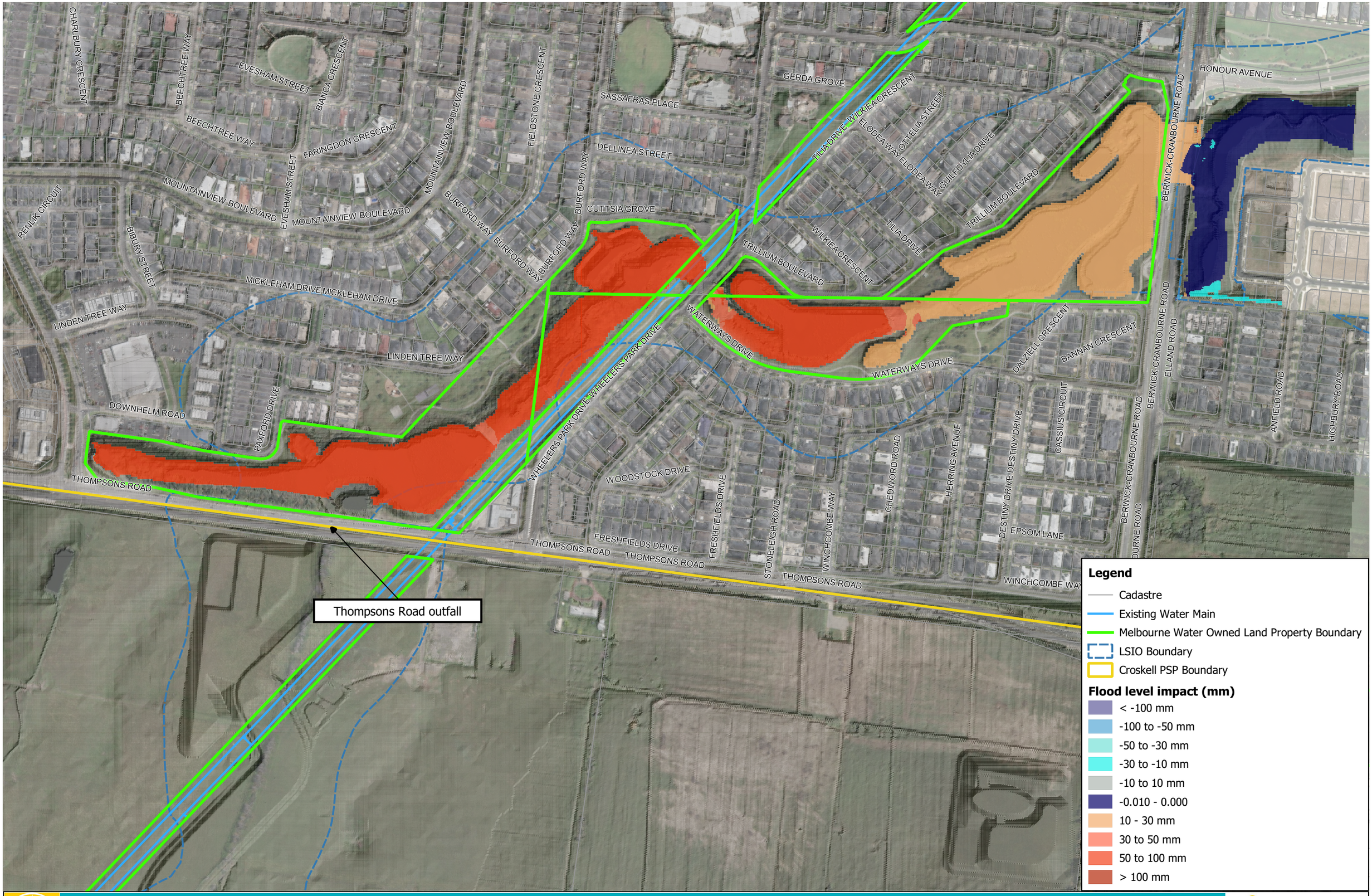


Data Sources: Melbourne Water.
Contains Vicmap Information © State of Victoria 2025, © Esri 2024

CROSKELL PSP - Concept Drainage Strategy Rev. D (September 2025)
Flood level impact map
Post and pre-development scenario for 1% AEP with climate change (SSP2 - 4.5)

0 0.1 0.2 0.3 km

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Data Sources: Melbourne Water.
Contains Vicmap Information © State of Victoria 2025, © Esri 2024

CROSKELL PSP - Concept Drainage Strategy Rev. D (September 2025)
Flood level impact map
Post and pre-development scenario for 1% AEP without climate change

0 0.1 0.2 0.3 km

Water 4good

Although results confirmed the design in post-development conditions worsened the peak flood levels downstream of Croskell PSP precinct in 1% AEP with climate change, it did not result in material increases outside MW owned land in the 1%AEP without climate change event (see Figure 6-21 where Melbourne Water owned land is represented by the red line contour).

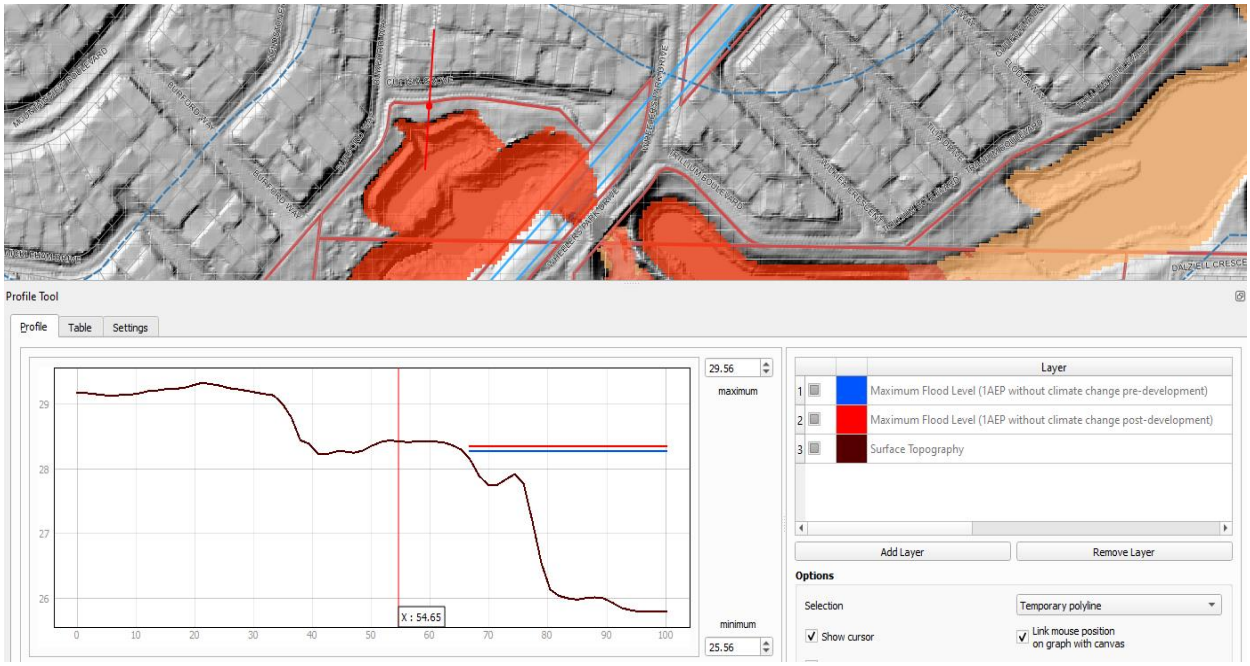


Figure 6-21: Profile plot of afflux impact north of Croskell PSP in 1%AEP without climate change event cross-section at Cuttisa Road.

For the 1%AEP (with climate change) event at Burford Way and Cuttsia Road, the flood conditions worsened outside Melbourne Water owned land, although, the increased afflux is mainly contained within the road reserve (see Figure 6-22 and Figure 6-23).

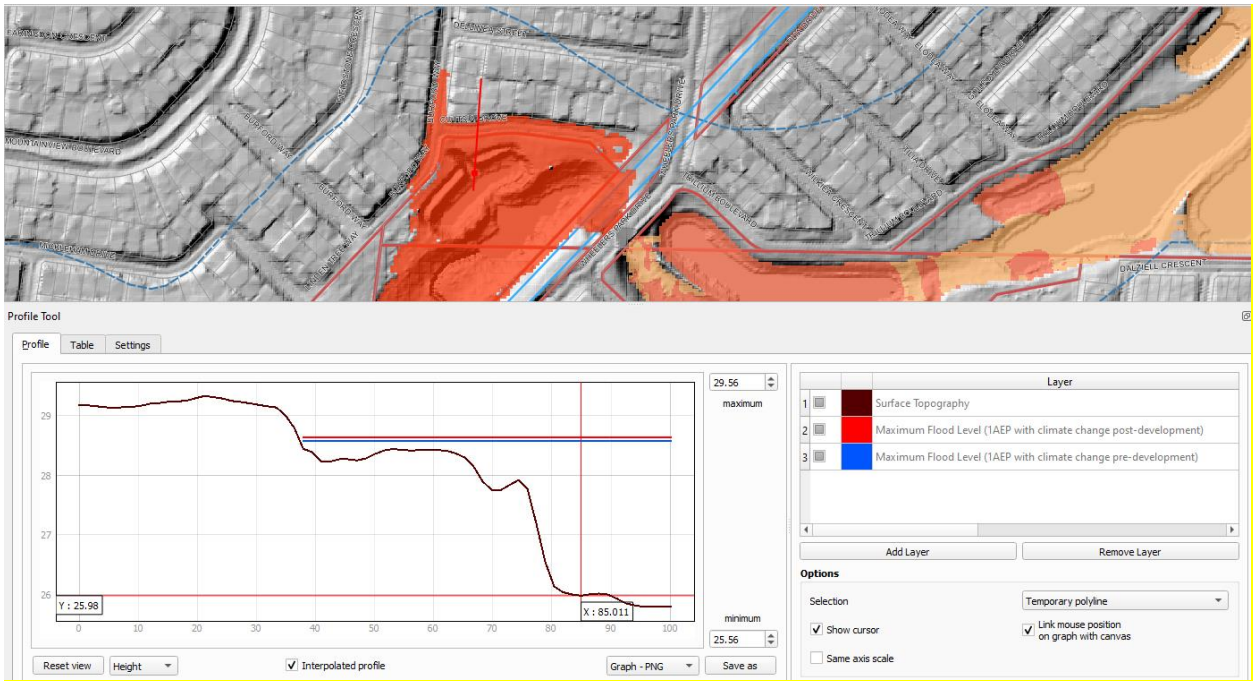


Figure 6-22: Profile plot of afflux impact north of Croskell PSP in 1%AEP (with climate change) event cross-section at Cuttisa Road

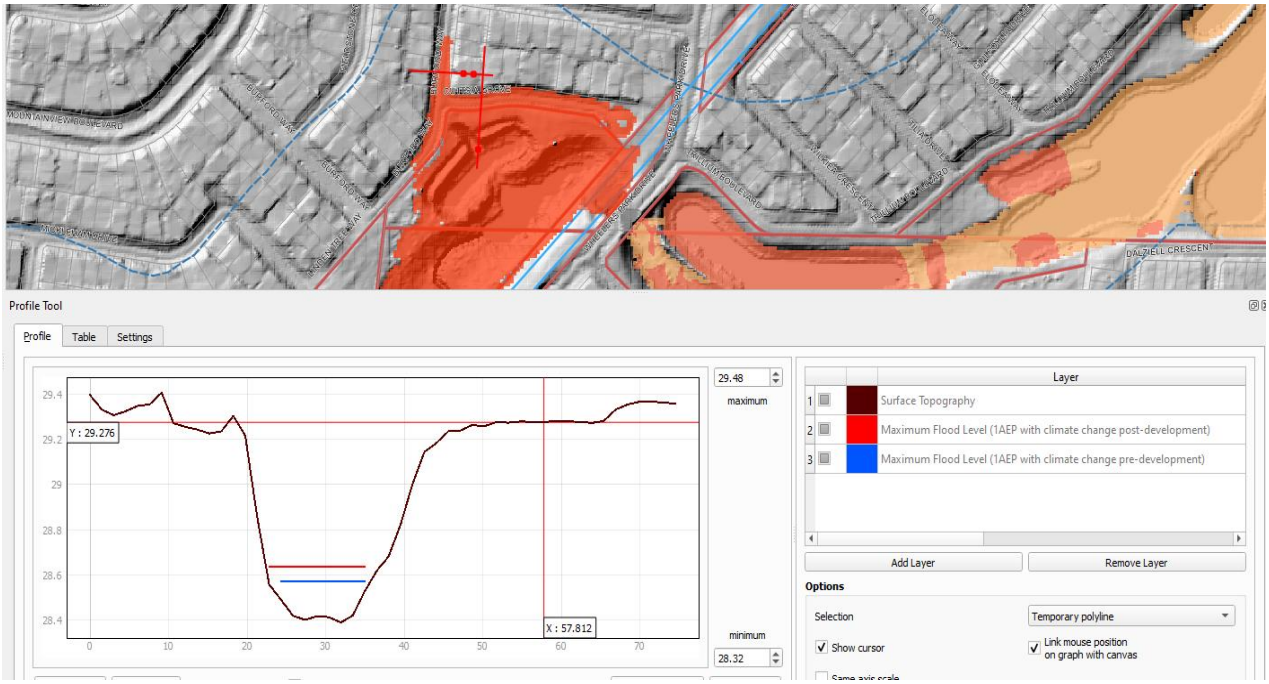


Figure 6-23: Profile plot of afflux impact north of Croskell PSP in 1%AEP (with climate change) event cross-section at Burford Way

In the post-development scenario, inflows were applied directly to the retarding basins, waterways, and diversion pipe and, as such, overland flow over the post-development developed site was not simulated in the TUFLOW model. This was a conservative approach of assessing whether the basins had sufficient flood storage. Once the post-development landform, pipes and roads are included in the models, overland flows and time of concentration may alter the current model results.

6.6.4 Findings and recommendations

The following are key findings and recommendations from TUFLOW modelling:

- The results of the hydraulic modelling show that the post -development conditions result in increased flood levels (increased afflux) to existing development downstream of Croskell PSP in the 1%AEP (with climate change) scenario. Although, there was increases in flood levels in the 1%AEP without climate change event it did not result in material increases outside Melbourne Water owned land (although it is noted the local drainage network was not modelled).
- The increased afflux would likely to increase further if the Climate Change SSP3 scenario were adopted.
- The retarding basins designed are capable of accommodating the flows in a 1%AEP (with climate change) design event, allowing sufficient freeboard within Croskell PSP.
- Ti-Tree Creek waterway freeboard of 0.3m is not achieved in at several locations including the Melbourne Water Pipe Track Reserve and the transmission easement.
- The post-development peak discharge rate for the 1% AEP (with climate change) design event does not exceed the pre-development peak discharge rate for the 1% AEP (with climate change) design event.
- A risk-based assessment of residual afflux should be undertaken following future modelling to inform whether additional mitigation works are warranted to resolve any residual afflux.
- The increased afflux downstream of the Croskell PSP precinct may be reduced or removed if additional storage is provided, some potential opportunities include:
  - within the Croskell PSP precinct utilising the full reserve/buffer area for WLRB4.
  - within the Croskell PSP precinct incorporating additional storage within the buffer area of the SB3 site
  - north of the Croskell PSP within Melbourne Water owned land, additional cut and/or levees to mitigate residual afflux outside Melbourne Water land.

- The increased afflux downstream of the Croskell PSP precinct may be reduced if the SBRB2 weir is further optimised.

The following items are suggested to be undertaken at subsequent design stages:

- A full suite of events assessment – durations and AEPs – in TUFLOW should be undertaken at functional or detailed design stage, following availability of post-development landform information. The manning's factors should be reviewed to represent accurately the landform in future stages.
- The post-development scenario inflows should be applied over the whole extent of the landform, not directly into the drainage's assets to account for overland flowpaths and additional storages.

This will allow:

- More reliable routing to be undertaken in the TUFLOW hydraulic model within the PSP region where this is not currently the case in the post-development scenario.
- The undertaking of a TUFLOW based temporal pattern and critical duration assessment to compare more holistically with the RORB results.
- In the current TUFLOW model, the outlet structures were based on the RORB models' configurations. Details on the internal pipes and inlet/outlet structures within/to/from basins should be included at later design stage.
- Refinement of storage capacity of the pits for the northwest diversion pipe to simulate the flow surcharge from the 1D pipe network to the 2D domain. The current TUFLOW modelling assumes all inflows are being captured by the diversion pipe, with no allowance for flow surcharges.

In summary, although there is residual afflux outside the PSP, there are likely to be opportunities to undertake risk-based assessment on appropriate treatment of any residual afflux, resolve the afflux at future design stages with more progressed modelling and storage within the PSP or Melbourne Water land

6.7 Land requirements estimate

Table 6-21 shows an estimate of the proposed reserve areas for the retarding basin and sediment pond assets for the Concept Drainage Strategy Rev. D (September 2025). The estimate includes buffer areas around assets.

Table 6-22 and Figure 6-24 show results of an estimate of land requirement and net developable area impact of the proposed Concept Drainage Strategy Rev. D (September 2025). Land within the existing Land Subject to Inundation Overlay (LSIO) that is currently not developable but expected to be developable with the proposed post-development drainage strategy in place has been labelled 'Was LSIO Now developable'. Land outside the LSIO that is required for waterway, retarding basin, wetland, or DSS swale assets or otherwise considered not developable due to limited access (e.g., due to having to cross a waterway) has been labelled 'Was Outside LSIO non-developable'. Areas within the transmission easement have not been included in the assessment as it is assumed there is no change in developability within the easement post-development.

The Western catchment Concept Drainage Strategy Rev. D (September 2025) is estimated to have an *increase* in Net Developable Area of 17.1 ha. The increase is due to areas within the LSIO becoming developable primarily due to treatment and retardation of flows from the external catchment with WLRB3 and containment of flood flows within waterways in an ARRv4.2 SSP2-4.5 scenario.

The eastern catchment Concept Drainage Strategy Rev. D (September 2025) is estimated to have a *decrease* in Net Developable Area of 3.1 ha. The decrease is primarily due to the footprint of WLRB4, which is required for treatment of the proposed industrial land use, and flood control of future development runoff prior to leaving the Berwick-Cranbourne Road culvert outfall in an ARRv4.2 SSP2-4.5 scenario.

Table 6-21: Summary of reserve footprints for Croskell PSP

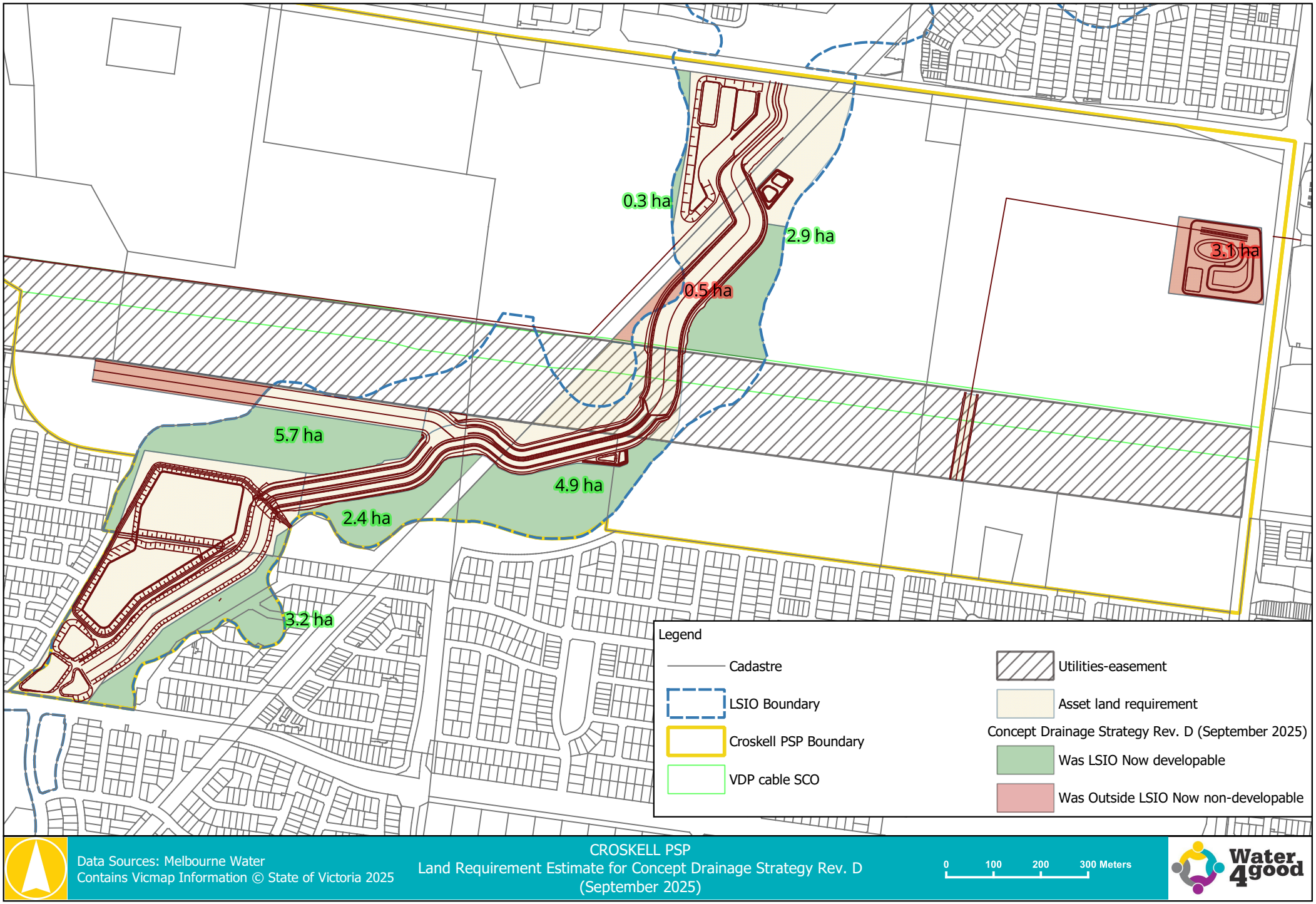
Major drainage asset	Concept Drainage Strategy Rev. D (September 2025) reserve Area (ha)
WLRB3	14.5
WLRB4	3.1
SB1	0.3
SB2	0.2
SB3	2.0
SBRB2	5.8

Table 6-22: Land requirement estimate for Croskell PSP Concept Drainage Strategy Rev. D (June 2025)

Location	Concept Drainage Strategy Rev. D (September 2025) reserve Area (ha)
Existing Land Subject to Inundation Overlay (LSIO)	
Area of existing LSIO within Croskell PSP	64.9
Western Catchment	
Was LSIO Now Developable	19.4
Was Outside LSIO Now Non-developable	2.3
Net Developable Area	*17.1*
Eastern Catchment	
Was LSIO Now Developable	0
Was Outside LSIO Now Non-developable	3.1
Net Developable Area	*-3.1*

2. Rev D Western catchment 'Was Outside LSIO Now Non-developable' revised to exclude diversion pipe easement.

Figure 6-24: Land requirement estimate Concept Drainage Strategy Rev. D (September 2025)


0.3 ha
2.9 ha
3.1 ha
0.5 ha
5.7 ha
4.9 ha
2.4 ha
3.2 ha
Legend
Cadastre
LSIO Boundary
Croskell PSP Boundary
VDP cable SCO
Utilities-easement
Asset land requirement
Concept Drainage Strategy Rev. D (September 2025)
Was LSIO Now developable
Was Outside LSIO Now non-developable
Data Sources: Melbourne Water
Contains Vicmap Information © State of Victoria 2025
CROSKELL PSP
Land Requirement Estimate for Concept Drainage Strategy Rev. D
(September 2025)
0
100
200
300 Meters
Water 4good

7 Recommendations

Water4Good recommends the following actions to progress the Croskell PSP Drainage Strategy Concept Design:

- Melbourne Water to review mitigation options for afflux impacts downstream of Croskell PSP.
- Proponents to seek approval from Ausnet for works within transmission reserve.
- Proponents to seek approval from DEECA for works within VDP cable reserve.
- Proponents to seek approval from South East Water for works within WLRB3 and other interfaces.
- Proponents to seek any relevant groundwater licenses from Southern Rural Water.
- Investigate opportunity to lower abandoned main in northern waterway crossing to potentially lower waterway further 200mm to clear active mains.
- Review of risks for future stages include detailed design refinements, construction feasibility for deep trenching and service crossings, staging of interim works, groundwater management, and additional modelling and investigation of residual afflux downstream under climate change scenarios.

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