



Stormwater Management Plan

Project:	Broomehill Peak Planning 2026
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Date:	31 st August 2026
Shawmac Document #:	2605002-SWMP-001
CBH Document #:	TBC

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Document Status: Client Review

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File Reference: \\shawmacserver\NewData\Jobs Active 2026\CE - Roads & Drainage\CBH_Peak Planning TN & SWMP_2605002\3. Documents\3.20 SWMP\12. Broomehill\2605002-SWMP-012_A.docx



Contents

1.	Introduction	2
1.1.	The Project.....	2
1.2.	Purpose.....	2
2.	Pre Development Situation	3
2.1.	Surface Water Catchments.....	3
3.	Stormwater Management Strategy.....	5
3.1.	Strategy Overview.....	5
3.2.	Design Criteria and Modelling Assumptions	6
3.3.	Stormwater Quantity and Model Results.....	7
	Appendix A – CBH Concept Plan.....	9

Figures

Figure 1: CBH Concept Plan	2
Figure 2: Pre Development CBH Catchments	3
Figure 3: Proposed Drainage Strategy	5
Figure 4: XPStorm Modelling & Analysis	7

Tables

Table 1: Calibre 20-year ARI	4
Table 2: Basin Modelling Results 20-Year ARI.....	7
Table 3: Culvert Modelling Results 20-Year ARI	8



1. Introduction

1.1. The Project

It is understood that CBH recently constructed two (2) temporary open bulkheads (TBH 14 & 15) on vacant land to the south of their existing Broomehill site as part of their 2025 peak planning project. CBH now wish to operate these bulkheads permanently.

Refer **Appendix A – CBH Concept Plan** for CBH concept plan for the completed works and **Figure 1** for an extract of the concept.

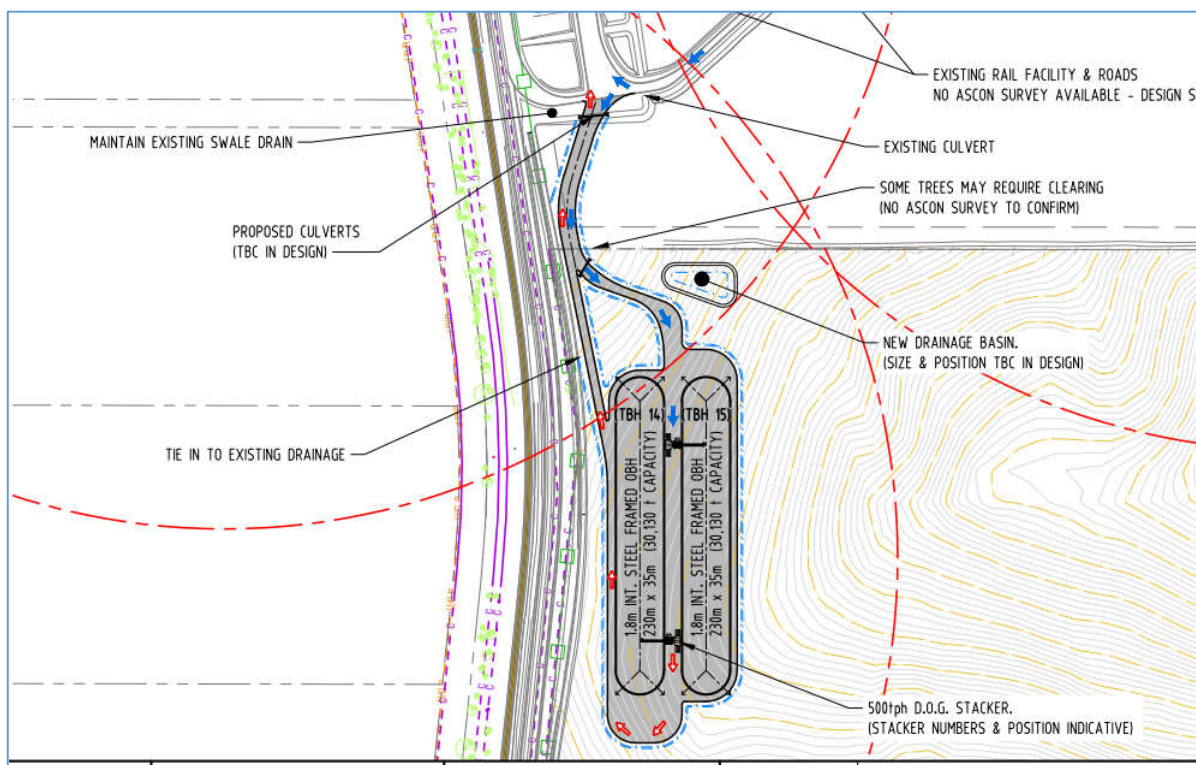


Figure 1: CBH Concept Plan

1.2. Purpose

The purpose of this report is to outline and quantify the stormwater management measures adopted for the design of the recently constructed TBH 14 and TBH 15.



2. Pre Development Situation

2.1. Surface Water Catchments

The southern portion of the CBH site comprised of two internal major catchments that directed stormwater into two non-free-draining basins (1 and 2), and one free draining basin (3). Runoff from the site is conveyed to these basins via a network of pipes and open drains. The site is predominately bounded by farmland, with Great Southern Highway and an existing railway line located along the west boundary, and Nardlah Road to the east.

Figure 2 below shows the Pre Development CBH catchments.

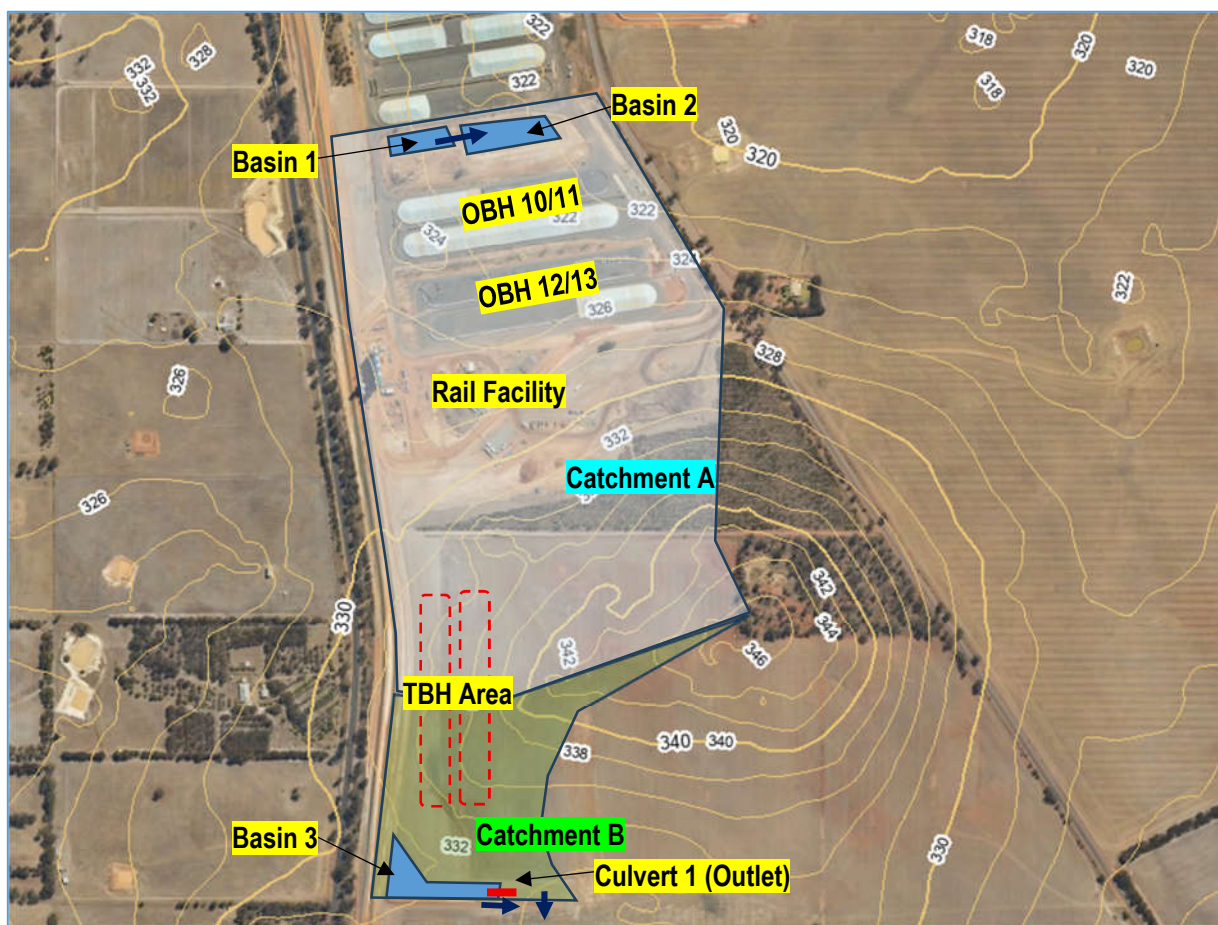


Figure 2: Pre Development CBH Catchments

Runoff from Catchment A is directed towards internal Basins 1 and 2, which acts as a sump. The Southern portion of Catchment A, along with Catchment B, are to directed to the north and south by an existing drain that protects the rail line to the west from runoff. Catchment B was largely vacant, directing runoff towards Basin 3. Basin 3 has a 300 RCP Outlet (Culvert 1), dispersing runoff towards vacant farmland south of Catchment B.



As per Calibre report COPP21005-REP-C-001 (Rev 0), Calibre previously estimated the 20-year ARI pre-development flow of Culvert 1 as part of the design of the Rail Facility, as shown in **Table 1**.

Table 1: Calibre 20-year ARI

Item	20-year ARI Flow
Pre-development Culvert 1	0.13m ³ /s



3. Stormwater Management Strategy

3.1. Strategy Overview

In general, the adopted stormwater management strategy consisted of preserving the existing catchments where possible, by constructing a levee along the eastern edge of the TBH area, preventing external flow from entering the new drains. External flow follows the levee along the edges, entering the existing drainage infrastructure after the TBH area. Internal flow from the TBH area, Catchment C, was directed towards Basin 3 to the south through a new network of open drains and ultimately discharged to the south through the existing 300RCP culvert.

The bulkheads and basins were designed to accommodate runoff from a 5% AEP event (20 year ARI event), and the flow at Culvert 1 was limited to the previously estimated pre-development flow rate of $0.13\text{m}^3/\text{s}$. Basin 3 was deepened to ensure the outflow was limited.

Figure 3 shows the proposed drainage strategy.

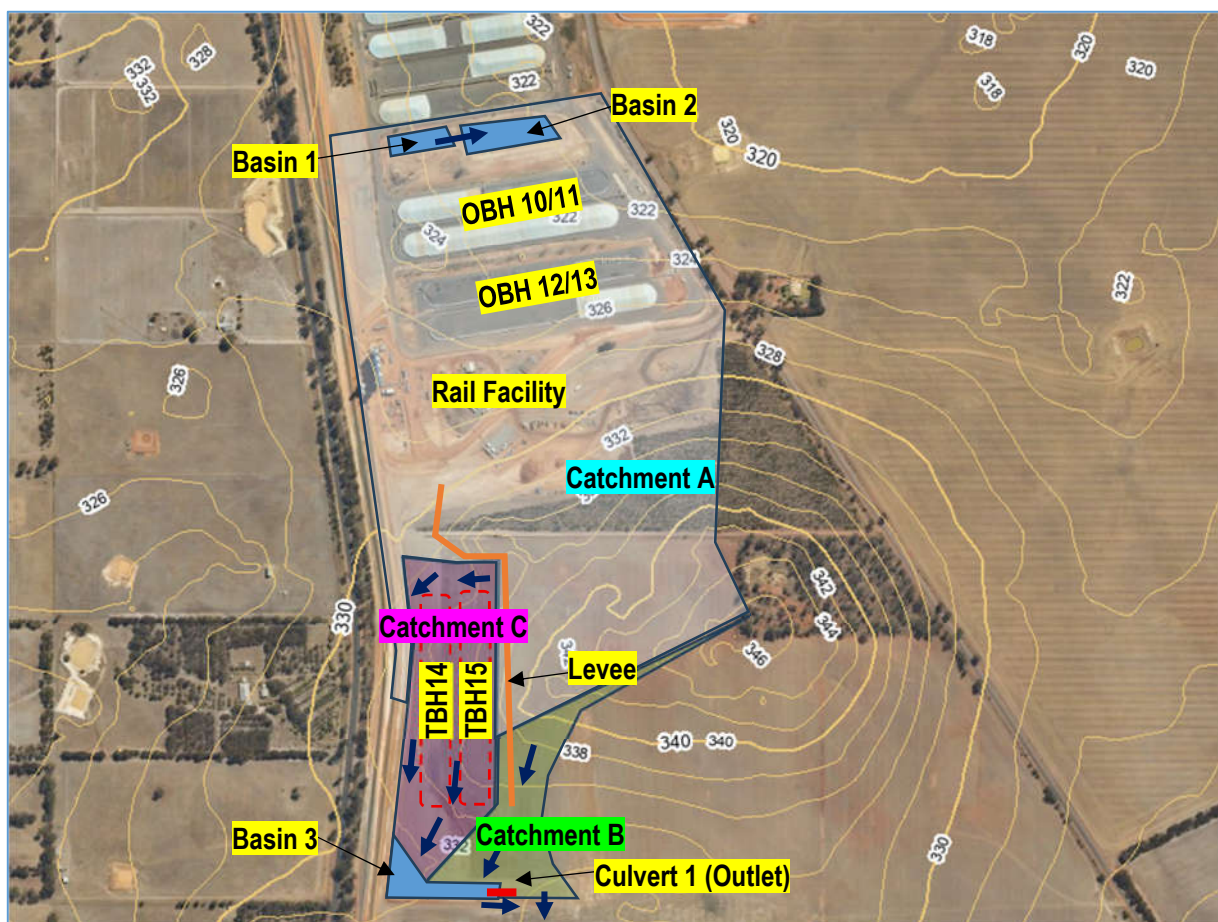


Figure 3: Proposed Drainage Strategy



3.2. Design Criteria and Modelling Assumptions

Based on the adopted strategy and CBH's design specifications, the key stormwater management design criteria and assumptions are summarised as follows:

- Adequately protect the site from inundation and flooding both from internal catchments and external upstream catchments.
- TBHs are designed for the 5% AEP event.
- Manage, control and convey the design ARI event post development event with a freeboard of 300mm. (Consideration may be given to a reduction to 150mm when flooding does not present a risk to infrastructure and operations).
- Open drains were be set at a minimum 300mm deep below the bottom of pavement, or 600mm below surface where no pavement is to be installed.
- As per CBH Peak Planning Specification, no scour protection or road kerb to be implemented.
- Culverts may have a minimum cover of 400mm (RCP Class 4) or 600mm (HDPE).
- Minimum culvert size of 450mm diameter (except at basin outlets).
- Minimum drain fall of 0.3%.

An XPSTORM model was built for the works as shown in **Figure 4**. The following key assumptions were adopted:

- Design rainfalls and temporal patterns are based on ARR 2019.
- Infiltration losses have been taken based on Calibre's report as follows:
 - Pervious areas – 5mm initial loss, 1mm continuing loss.
 - Impervious areas (e.g. new/existing pavements) – nil losses.
 - Basins – nil losses
- Model outcomes reflect the median event from the hydraulic model.
- Culvert entry/exit loss coefficients are assumed as 0.5/1.0 respectively.
- Mannings 'n' values assumed as follows:
 - Open drains – 0.014
 - Concrete Culverts – 0.014

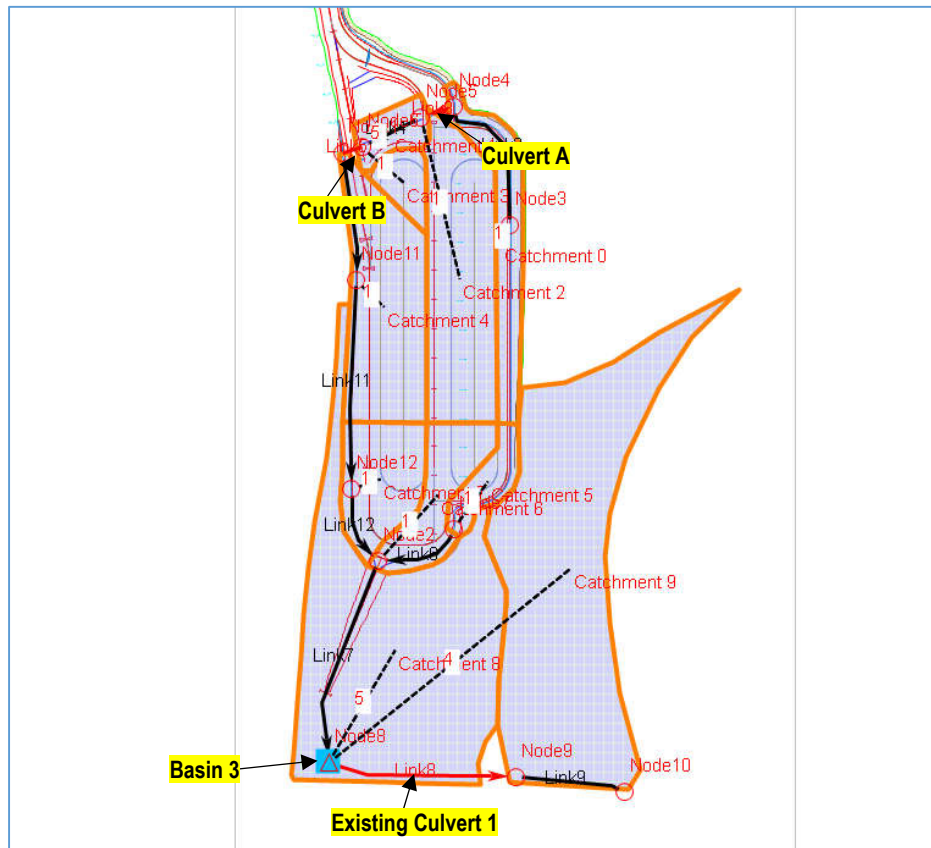


Figure 4: XPS Storm Modelling & Analysis

3.3. Stormwater Quantity and Model Results

Table 2 and Table 3 provide a summary of the stormwater modelling results for the basins and culverts, respectively.

Table 2: Basin Modelling Results 20-Year ARI

Description	Basin 3
Basin Base Level (m AHD)	330.50
Basin Base Area (m ²)	1580
Base Top Level (m AHD)	331.96
Basin Top Area (m ²)	2340
Basin TWL (m AHD)	331.82
Max Stored Volume (m ³)	2515
Total Basin Capacity (m ³)	2862
Freeboard to Top of Bund	0.48
Critical Event	9hr



Table 3: Culvert Modelling Results 20-Year ARI

Culvert	Description	Type	U/S Shoulder Level (m AHD)	HW Level (m AHD)	Freeboard to shoulder Level (m)	Max Flow (m³/s)	Max Velocity (m³/s)
Culvert A	Under Eastern Access Road North of TBH15	1x450RCP	333.65	332.36	1.29	0.040	0.818
Culvert B	Under Western Access Road North of TBH14	2x450RCP	332.88	331.97	0.91	0.162	0.808
Existing Culvert 1	Basin 3 Outlet	1x300RCP	332.30	331.82	0.48*	0.083	1.257

*Freeboard is to top of bund

As shown, the post-development outflow at Culvert 1 into the adjacent property is less than the predevelopment outflow.



Appendix A – CBH Concept Plan
