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| **Project Number & Title:** | 307-R-0560 Narngalu Peak Planning |
| **Contractor:** | Shawmac |

## Document Information

| CBH Document Number | Contractor Document Number | Document Title: |
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| 307-R-0560-CI-RPT-0001 | 2504015-SWMP-0001 | Stormwater Management Plan |

## Revision History

| CBH Rev No | Contractor Rev No. | Description | Date | Approved By (Contractor) | Approved By (CBH) |
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| A | A | Issued for Review | 18.06.2025 | James Bridge | |

☑ 1 - APPROVED

☐ 2 - APPROVED WORK MAY PROCEED - Submit IFT / IFD / IFU / IFC Documentation

☐ 3 - APPROVED EXCEPT AS NOTED - Revise and Resubmit

☐ 4 - NOT APPROVED, WORK MAY NOT PROCEED - Revise and Resubmit

☐ 5 - INFORMATION ONLY

Signature BR Ashworth Date 30/6/2025

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# Stormwater Management Plan

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|---|---|
| Project: | Narngulu Peak Planning<br>Stormwater Management Plan |
| Client: | CBH |
| Author: | N. Baby |
| Date: | 18th June 2025 |
| Shawmac Document #: | 2504015-SWMP-001 |
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## Document Status: Client Review

| Version | Prepared By | Reviewed By | Approved By | Date |
|---|---|---|---|---|
| A | N. Baby | J. Bridge | J. Bridge | 18.06.25 |
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## Disclaimer



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## Figures



## Tables

# 1. Introduction

## 1.1. The Project

CBH are proposing to add an additional 104,800t of storage by constructing 3x new temporary open bulkheads (TBH18/19/20) at their existing Narngulu site as part of their 2025 peak planning project.

Refer to **Appendix A – CBH Concept Design** for full details of the proposal.

**Figure 1** shows the overall Narngulu CBH site and **Figure 2** shows the existing established area of the site and the location of the proposed new bulkheads.


**Figure 1: CBH Overall Site**


**Figure 2: Existing Established Site**

Shawmac have been commissioned by CBH to prepare the 30% design for the works including drainage.

## 1.2. Purpose

The purpose of this report is to document the drainage design philosophy and outcomes for the 30% design.

# 2. Existing Situation

## 2.1. Site Characteristics

The CBH site is currently occupied by permanent OBH's 01/02/03/04/05/06/07/08/09 and temporary emergency TBH's 10/11/12/13/14.

The majority of the OBH's are located in the north-eastern portion of the site. The remaining southern and south-eastern portions of the site are vacant and used for cropping.

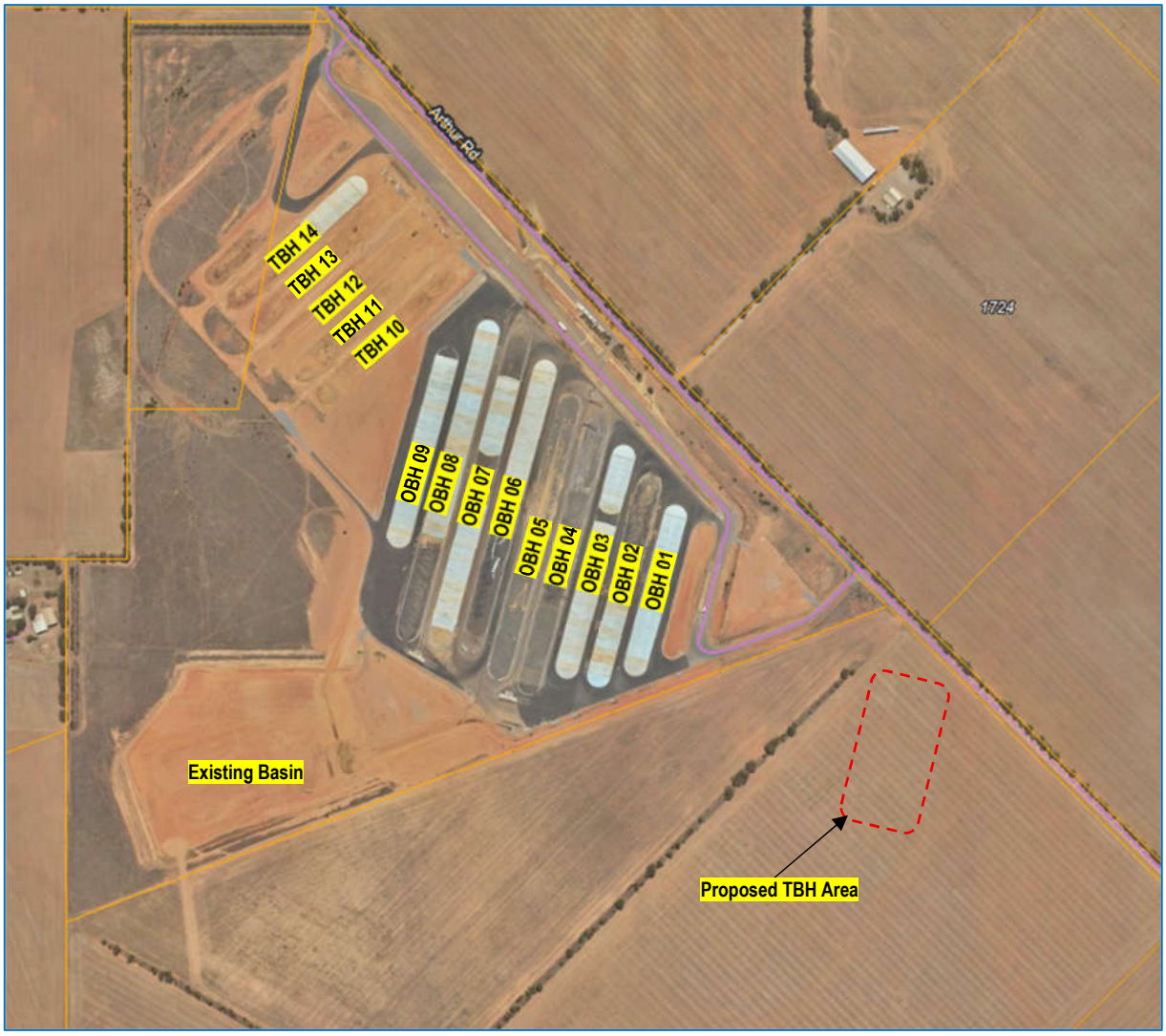



**Figure 3 : Existing Site**

## 2.2. Geotechnical

Galt Geotechnics undertook a geotechnical investigation and study of the site in June 2022 (J1801254 010 R Rev 0, 12/07/2022). Galt described the subsurface soil conditions at the undeveloped portion of the site ( Lot 14 Arthur Road, where the emergency bulkheads are proposed) were generally consisting of:

- Central and Southern Part of OBH16 to OBH19
    - Silty SAND (SM): fine to coarse grained, sub-angular to angular, pale brown to brown, approximately 15-20 % low plasticity fines, typically dry, ranging from medium dense to very dense (apparent high density due to desiccation of fines), present from ground surface and extending to depths ranging from 0.2 m to 1.2 m; overlying.
    - Clayey SAND (SC)/ Sandy CLAY (CL-CI): fine to coarse grained, sub-angular to sub-rounded, red brown becoming brown with depth, approximately 20-40 % low to medium plasticity fines, trace gravel, moist, typically medium dense to very dense or stiff to hard, extending to a depth of up to 2.5 m.
- Northern Part of OBH16 to OBH 21
    - Silty/Clayey SAND (SM-SC): fine to medium grained, sub-angular to sub-rounded, brown, approximately 15% non-plastic to low plasticity fines, trace organics typically in the upper 100 mm, typically dry, typically dense to very dense (high density due to desiccation of fines), present from surface to depths ranging from 0.2 m to0.4 m; overlying
    - Clayey SAND/Sandy CLAY (CL-CI): low to medium plasticity, red-brown, with 30-70 % fine to medium grained sand, typically moist, extending to depths to the maximum investigated depth of 2.5 m.

Groundwater was not encountered in the test pits during that investigation (mid-winter) or previous investigations (near the end of summer). The only exception was the presence of standing water across the north-eastern part of the existing basin on the southern end of Lot 15. Given that no groundwater inflow was noted in any nearby test pits, it is expected that this standing water is stormwater runoff that has perched on the silty sand/clayey sand.

Galt have commented that the previous field and laboratory testing using the falling head method indicates that the unsaturated hydraulic conductivity of the in-situ soils is very low, particularly when compacted. Therefore, Galt has advised that for the purposes of drainage design, the site soils are to be considered impermeable.

## 2.3. Environmental

As the surrounding land is almost completely cleared for cropping, there are no particular environmental concerns, with the exception of some trees within the site that will not be impacted by the proposed expansion.

**Figure 4** provides an excerpt of the 1:100,000 Geoscience Australia Topographic Map '*Geraldton*' and shows the environmentally features surrounding the site.

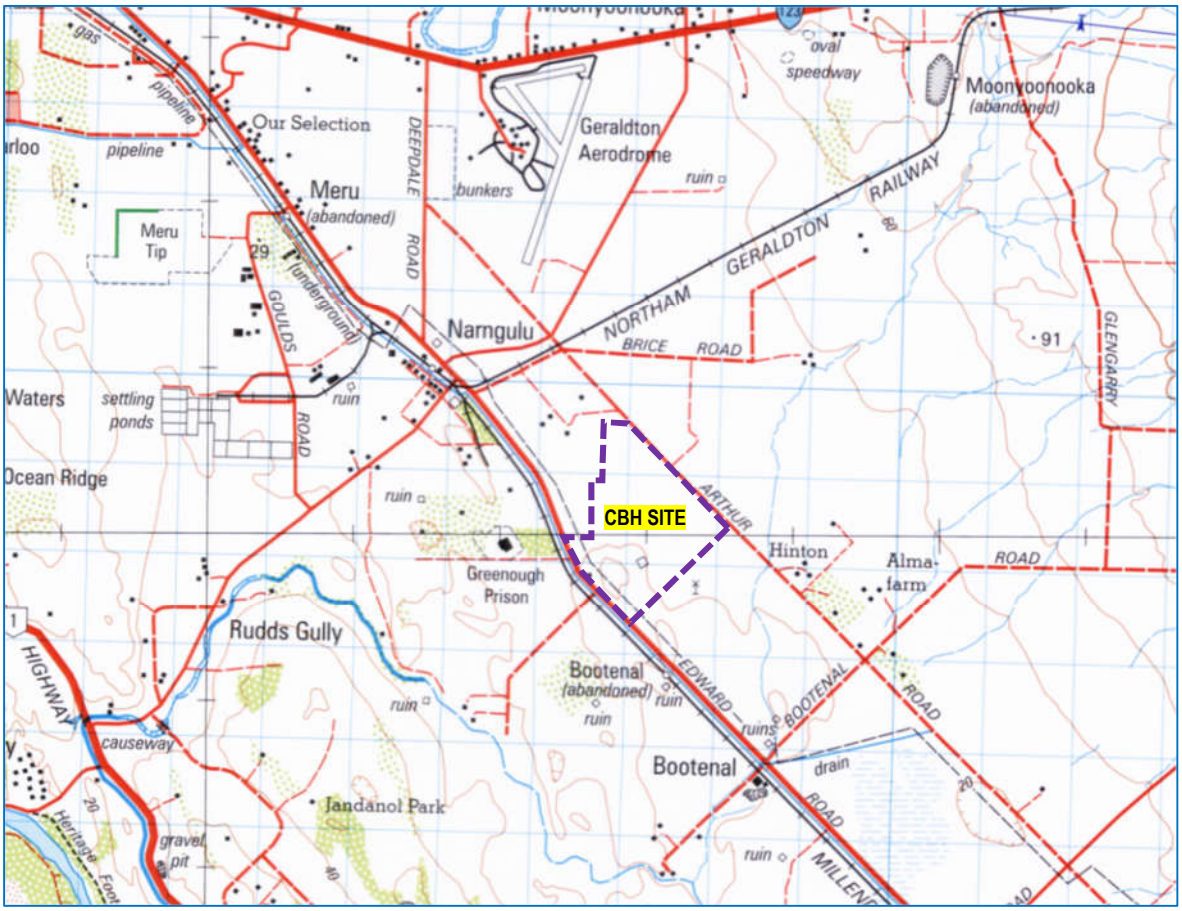



**Figure 4: 1:100,000 Geoscience Australia Topographic Map Excerpt**

## 2.4. Terrain

The natural terrain has a series of ridges grading towards isolated low spots within the CBH site at grades typically between 0.5%-3%. The CBH site falls from high points of 24m and 22m AHD along the north-west boundary and north-east boundary, respectively, to isolated low points varying from 19.5 and 20m AHD as well as 18.29m AHD at the existing basin. **Figure 5** shows the natural terrain surrounding the site (2m contours).


**Figure 5: Existing Site Contours**

## 2.5. Surface Water Catchments

The CBH site consists of several catchments that direct stormwater to isolated low points and existing basins within the site. There are also existing earth bunds that limit the flow from external catchments.

Stormwater from the existing emergency bulkheads is predominantly directed to an existing low point to the south that acts as a natural retention basin.

Stormwater from the existing permanent bulkheads, a small portion of the existing emergency bulkheads, and a portion of the proposed TBH area is directed to an existing constructed basin in the southwest of the site.

The majority of the undeveloped catchments including the proposed TBH area naturally flow to isolated low points within or off site and is not captured within the existing basins.

**Figure 6** below shows the existing internal and external catchments impacting the site.

As the existing catchments, including the proposed expansion catchment, are directed to isolated low points within the site that are not free draining, the pre-development flow rates have not been estimated as there is no requirement to discharge stormwater off site.

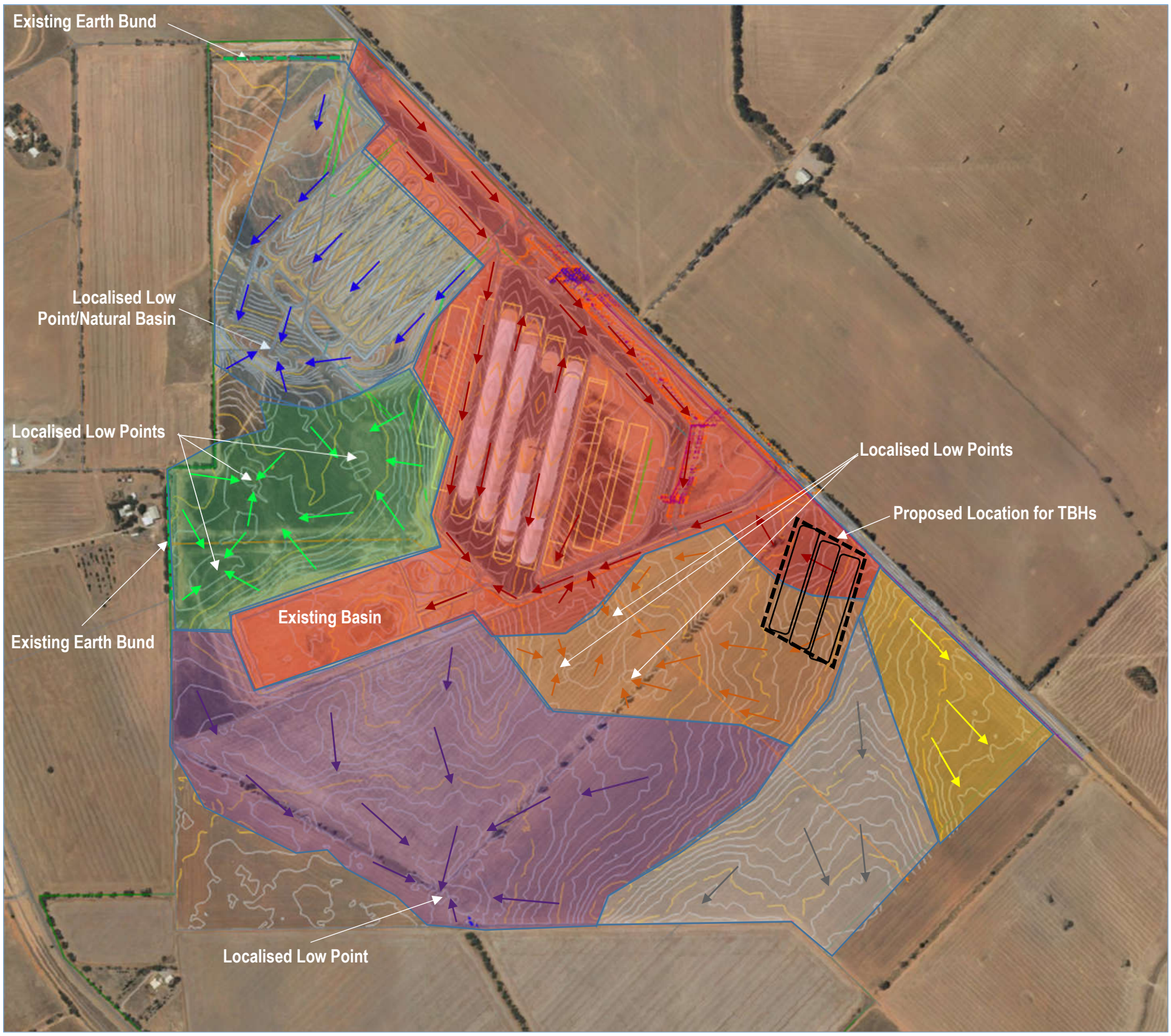



**Figure 6: Existing Catchments**

# 3. Stormwater Management Strategy

## 3.1. Strategy Overview

The general stormwater management strategy is to maintain the current drainage arrangement, which has been developed to accommodate both permanent and emergency OBHs and adapt it to suit the proposed emergency bulkhead expansion.

Several stormwater management options were assessed to manage runoff from the proposed TBH areas. These included the following:

- Option 1 involved directing stormwater to the existing basin located in the south-western portion of the site. The capacity of this basin was assessed for both the 5-year and 20-year ARI events. The assessment confirmed that the existing basin is large enough to accommodate the additional runoff generated by the proposed expansion under both events.
- Option 2A considered the construction of a new free-draining basin at the natural low point to the south west of the proposed TBHs. Modelling indicated that a basin with a capacity of approximately 10,469 $m^3$, including a 300 mm outlet with a maximum outflow of 0.078 $m^3/s$, would be required to manage runoff for a 5-year ARI event.
- Option 2B proposed a similar basin at the same location as in option 2A, but without free draining. In this scenario, a basin capacity of approximately 19,602 $m^3$ would be required to manage the 5-year ARI event runoff.
- Option 2C assessed a basin configuration similar in size and layout to that proposed in CBH's concept design, assuming a non-free draining condition. The analysis indicated that a basin with a surface area of approximately 8,300 $m^2$ and a depth of 2.0 m, with 1 in 3 side slopes, would be sufficient to capture runoff from the proposed TBH area for a 5-year ARI event.

Among the options explored, the final stormwater management strategy involves directing runoff to the existing low spot west of the proposed TBHs. From there, stormwater would overtop into the existing drain and ultimately discharge into the existing basin located in the southwest portion of the site. Option 1 assessment indicates that the existing basin has sufficient capacity to accommodate the full runoff volume generated by the 5-year ARI event. Additionally, if further excavation is required as part of site filling operations, it is recommended that CBH consider undertaking this excavation at the identified low point west of the proposed TBHs to further increase stormwater storage capacity.

With the exception of the downstream culverts (3x525 RCP), all other culvert sizes and drains are indicative and to be confirmed at later design phases.

It is also noted that box culverts were adopted at the access road tie ins on the west side (south access road)

within the existing drain to not impede the permanent expansion 20-year ARI.

## 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 a 5-year ARI event.
- Manage, control and convey the design ARI event post development event with a free-board of 300mm. (Consideration may be given to a reduction to 150mm when flooding does not present a risk to infrastructure and operations).
- Open drains are to 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).
- Minimum culvert size of 450mm diameter.
- Minimum drain fall of 0.3%.

An XPSTORM model was built for the assessment options based on the following assumptions:

- Design rainfalls and temporal patterns are based on ARR 2019.
- Infiltration losses have been assumed as follows:
    - Pervious areas – 15mm initial loss, 0mm continuing loss.
    - Impervious areas (e.g. new/existing pavements) – nil losses (assumed).
- 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:
    - Pavement drains – 0.016
    - Table/open drains – 0.025
    - Concrete culverts – 0.014

## 3.3. Stormwater Quantity and Model Outcomes

**Table 1** and **Table 2** provides a summary of the modelling outcomes for the existing basin and downstream culvert, accounting for the full runoff from the proposed TBH areas.

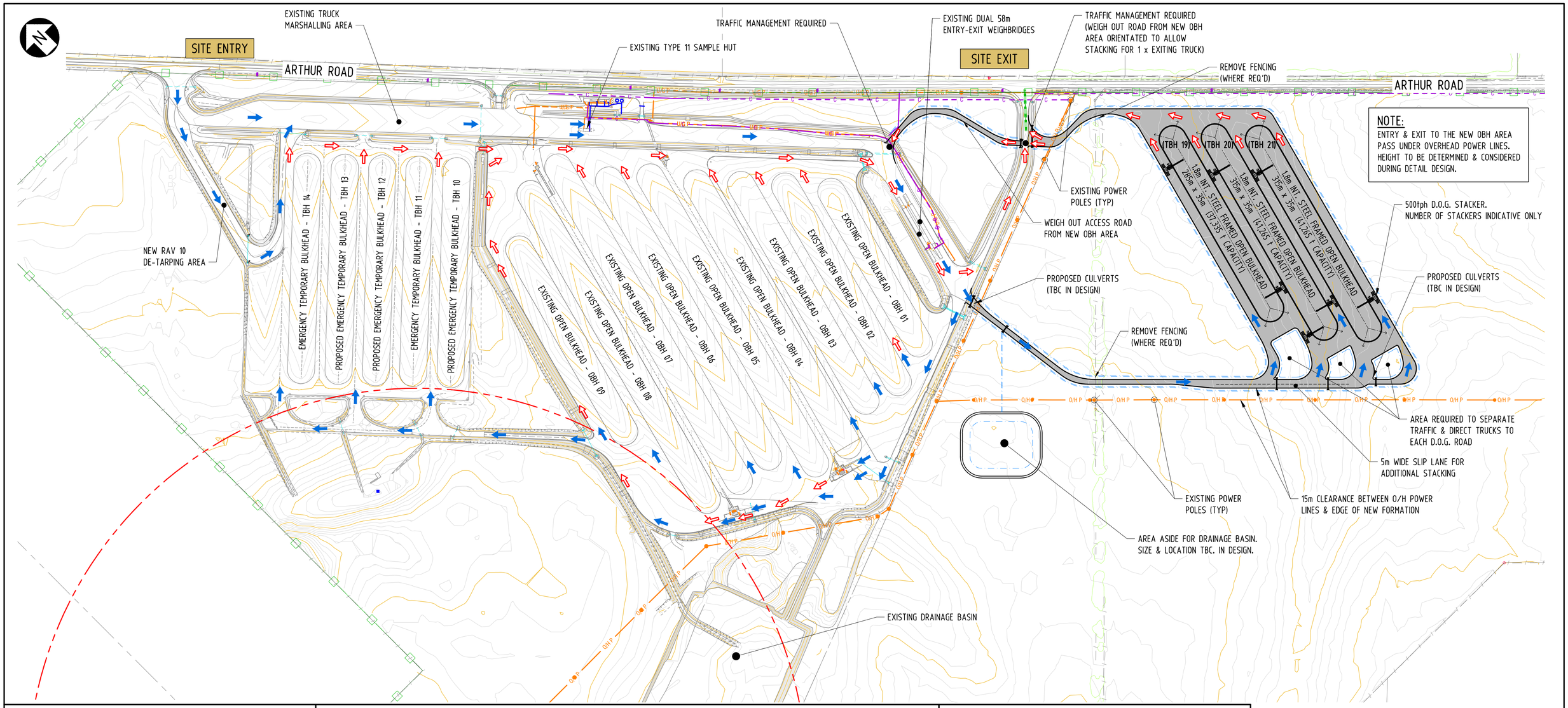
**Table 1: Basin Design Outcomes– 5-year ARI**

| Item | Basin A |
|---|---|
| Base Level (m AHD) | 18.29 |
| Base Area ($m^2$) | 1,584 |
| Top Level (m AHD)<br>Min Upstream Shoulder Level | 20.2 |
| Top Area ($m^2$) | 49,700 |
| Max Volume ($m^3$) | 51,700 |
| TWL (m AHD) | 19.17 |
| Max Stored Volume ($m^3$) | 10,662 |
| Freeboard (m) to drain outlet | 0.83 |
| Freeboard (m) to Min Upstream Shoulder Level | 1.03 |

**Table 2: Downstream Culvert Design Outcome**

| Culvert | Type | U/S Shoulder (m AHD) | HW Level (m AHD) | Freeboard to shoulder (m) | Max Flow ($m^3/s$) | Max Velocity ($m^3/s$) |
|---|---|---|---|---|---|---|
| C002(Downstream culvert) | 3x525 RCP | 21.50 | 21.16 | 0.34 | 1.0 | 1.54 |

# Appendix A – CBH Concept Design




## DRAWING LEGEND

- TRAFFIC MOVEMENTS - TRUCKS FULL
- TRAFFIC MOVEMENTS - TRUCKS EMPTY
- LOT BOUNDARIES
- CBH SITE BOUNDARY
- O/H P — OVERHEAD POWER LINES
- U/G P — UNDERGROUND POWER LINES
- U/G W — UNDERGROUND WATER PIPES
- C — UNDERGROUND COMMS LINE
- EPA INDUSTRIAL/SENSITIVE LAND USE SEPARATION DISTANCE - 500m RADIUS
- PROPOSED OPEN DRAINAGE
- PROPOSED CULVERTS

## STORAGE CAPACITIES

| EXISTING SITE STORAGE | | |
|---|---|---|
| INT. STEEL FRAME OBH | (01) | 34,060t |
| INT. STEEL FRAME OBH | (02) | 42,575t |
| INT. STEEL FRAME OBH | (03) | 46,050t |
| INT. STEEL FRAME OBH | (04) | 53,710t |
| INT. STEEL FRAME OBH | (05) | 60,915t |
| INT. STEEL FRAME OBH | (06) | 55,675t |
| INT. STEEL FRAME OBH | (07) | 58,950t |
| INT. STEEL FRAME OBH | (08) | 68,120t |
| INT. STEEL FRAME OBH | (09) | 39,955t |
| INT. STEEL FRAME OBH | (TBH 10) | 36,025t |
| INT. STEEL FRAME OBH | (TBH 11) | 36,025t |
| INT. STEEL FRAME OBH | (TBH 12) | 36,025t |
| INT. STEEL FRAME OBH | (TBH 13) | 36,025t |
| INT. STEEL FRAME OBH | (TBH 14) | 36,025t |
| TOTAL EXISTING STORAGE | | 640,135t |

| PROPOSED STORAGE | | |
|---|---|---|
| INT. STEEL FRAME OBH (TEMPORARY) | (TBH 19) | 37,335t |
| INT. STEEL FRAME OBH (TEMPORARY) | (TBH 20) | 41,265t |
| INT. STEEL FRAME OBH (TEMPORARY) | (TBH 21) | 41,265t |
| TOTAL PROPOSED STORAGE | | 119,865t |

| | |
|---|---|
| TOTAL PERMANENT STORAGE | 460,010t |
| TOTAL TEMPORARY STORAGE | 299,990t |
| TOTAL SITE STORAGE | 760,000t |

## HATCHING LEGEND

AREA OF NEW WORKS — 66,175m²

PRELIMINARY ISSUE
DO NOT USE FOR CONSTRUCTION
DATE 14.04.25

1:2500 @ A1
1:5000 @ A3
0 40 80 120 160 200 240 m



CBHGROUP
ABN 29 256 604 947
CBH GROUP
LEVEL 6
240 ST GEORGE'S TERRACE
PERTH W.A. 6000
PH (08) 9237 9600
FAX (08) 9322 3942

| REF DRAWING No. | REFERENCE DRAWING TITLE | REV | DATE | REVISION DESCRIPTION | BY | CHK'D | APP'D |
|---|---|---|---|---|---|---|---|
| - | - | A | 14.04.25 | ISSUED AS CHECK PRINT AND FOR REVIEW | JB | | |

SCALE 1:2500
SHEET A1
PROJECT
CO-ORDINATE SYSTEM GCG94

| | | |
|---|---|---|
| DRAWN | J. Bullingham | 14.04.25 |
| CHECKED | | |
| DESIGNED | | |
| DESIGN APPR | | |
| PROJECT APPR | | |

TITLE
NARNGULU
2025 PEAK PLANNING
3 x ADDITIONAL OPEN BULKHEADS
CONCEPTUAL LAYOUT No. 6

DRG No 307-ENG-CI-DCO-0022
SHEET 1 OF 1
REV. A