



ENQ: Tim Dolling  
DIRECT LINE: 08 9216 6094

**Co-operative Bulk Handling Ltd**  
ABN 29 256 604 947  
Level 6, 240 St Georges Terrace  
Perth WA 6000 Australia  
GPO Box L886  
Perth WA 6842 Australia  
Telephone  
+61 8 9327 9600  
Grower Service Centre  
1800 199 083  
**cbh.com.au**

2 July 2019

Mr Ian D'Arcy  
Chief Executive Officer  
Shire of Brookton  
PO Box 42  
Brookton WA 6306

Dear Ian

## **APPLICATION FOR DEVELOPMENT APPROVAL**

I refer to the requirement for additional grain receival, storage and truck weighing facilities at the Brookton grain receival site.

The development will be undertaken on adjoining lot 50 Sewell Street opposite the site purchased from GJ and JK Bassett.

Lot 50 was been subdivided into lots 550 comprising of 10.1817 ha and adjoining lot 552 comprising of 1.8466 ha of remnant native vegetation ceded to the State.

Proposed development includes a site entry, internal roads to and around four open bulkheads with a total capacity of 98,400 tonnes, temporary weighbridge and site exit.

The four open bulkheads will be filled with grain by portable drive-over-grid grain stackers and covered with tarpaulins once filled.

The internal roads and open bulkhead pads will be surrounded by open drains connected to a detention basin.

Please find attached the following documentation and drawings for assessment:

- ) Completed Shire of Brookton application for development approval form
- ) Conceptual Layout Option 1 (site) plan 426-ENG-CI-DES-0001\_B
- ) General arrangement drawing 942301-R1 for the portable weighbridge
- ) GA drawing S119-ENG-ST-DGA-0001-R3 for a 1.8 m high open bulkhead wall frame
- ) Stormwater design report.

If you have any enquiries, please contact me on 9216 6094, 0439 969 835 or by email at [tim.dolling@cbh.com.au](mailto:tim.dolling@cbh.com.au).

Yours sincerely

**For: Co-operative Bulk Handling Limited**

A handwritten signature in black ink, appearing to read "Tim Dolling", written over a light grey rectangular background.

**Tim Dolling**  
**Planning & Approvals Coordinator**  
Enc



SCALE 1:5000 @ A3

50 0 300

ALL DISTANCES ARE IN METRES



<b>Project Number &amp; Title:</b>	M-2608 BROOKTON EMERGENCY STORAGE
<b>Contractor:</b>	MCDOWALL AFFLECK PTY LTD

Document Information		
CBH Document Number	Contractor Document Number	Document Name
426-2608-CI-RPT-0001	16144-SDR	Stormwater Design Report

Revision History					
CBH Rev No	Contractor Rev No.	Description	Date	Approved By (Contractor)	Approved By (CBH)
A	A	Issued for Approval	1/7/2019	H. Millen	

REVISION STATUS

REV	DATE	DESCRIPTION	BY	CHECKED
A	01/07/2019	PRELIM DRAFT	MM	HM



## Table of Contents

<b>1. INTRODUCTION</b>	<b>4</b>
1.1 OBJECTIVES	4
<b>2. PRE-DEVELOPMENT ENVIRONMENT</b>	<b>4</b>
2.1 GEOTECHNICAL CONDITIONS	4
2.2 EXISTING BASINS	4
<b>3. STORMWATER MANAGEMENT PRINCIPLES</b>	<b>5</b>
3.1 RAINFALL DATA	5
3.2 PRE-DEVELOPMENT AND POST- DEVELOPMENT FLOW CALCULATION	6
<b>4. BASINS</b>	<b>6</b>
4.1 EXTERNAL CATCHMENT	6
4.2 SOUTH BASIN EXPANSION CALCULATION (BASIN 01)	7
4.3 WEST BASIN EXPANSION CALCULATION (BASIN 02)	ERROR! BOOKMARK NOT DEFINED.
<b>5. OPEN CHANNELS</b>	<b>7</b>
5.1 OPEN CHANNEL CRITERIA	7
5.2 SUMMARY	ERROR! BOOKMARK NOT DEFINED.
<b>6. CULVERTS</b>	<b>7</b>
6.1 CULVERT CRITERIA	7
6.2 SUMMARY	ERROR! BOOKMARK NOT DEFINED.
6.3 MAINTENANCE	7
<b>7. BULKHEAD INVERTED CROWN FLOW</b>	ERROR! BOOKMARK NOT DEFINED.
<b>8. KERB OPENINGS</b>	ERROR! BOOKMARK NOT DEFINED.
<b>9. SUMMARY</b>	<b>7</b>
<b>APPENDIX 1 – STORMWATER CATCHMENT PLAN</b>	<b>8</b>
<b>APPENDIX 2 - CALCULATIONS</b>	<b>9</b>



## 1. Introduction

McDowall Affleck has been appointed by CBH as Engineering Consultants for the proposed Bulk Head Expansion at Brookton.

The proposed expansion has a total impermeable area of approximately 7.9 hectares.

### 1.1 Objectives

The objective of this Stormwater Design Report (SDR) is to assess the predevelopment and post development conditions of the subject land in accordance with guidelines set by the CBH.

This SDR provides details on how stormwater will be managed to reduce the impacts of flooding from the emergency storage.

## 2. Pre-development Environment

### 2.1 Geotechnical Conditions

A Geotechnical investigation has been undertaken by Golder Associates Pty Ltd in February 2019. Based on the geotechnical test pits, the soil profile generally across the site comprises of:

- TOPSOIL: Silty SAND (SP) – fine to coarse grained, pale grey, approximately 20-30% non-plastic silt, with grain rootlets up to 1mm in diameter, with roots 1mm in diameter, dense, dry, extending to a depth of 0.1m, overlying.
- SAND / Silty SAND / Gravelly SAND (SP/SM) – not encountered in test pit BTP01, fine to coarse grained, pale grey, approximately 20-30% non-plastic silt, up to 30% fine to medium gravel, dense to very dense, dry extending to depths of between 0.3 and 1.4m, overlying
- Clayey SAND / Sandy CLAY / CLAY (SC/CL-CI) – fine to coarse grained sand, low to high plasticity clay, red, orange, yellow and brown, trace fine to medium gravel, occasionally weakly to moderately cemented, stiff to very stiff, dry extending to depths from 1.2m to the maximum depth investigated of 2.3m.

Cemented material / Weathered Granite was encountered at depths of 1.4m and 1.2m in test pits BTP01 and BTP05 respectively.

Groundwater was not encountered to the maximum depth investigated of 2.3m. However, the sand encountered in BTP06 was moist (overlying a relatively impermeable clayey sand layer). Two standpipes have been installed within test pits BTP03 and BTP06 to facilitate monitoring of groundwater variations. It is noted that shallow groundwater is likely to perch on the clayey soils after significant rainfall events. We do not expect groundwater will impact the proposed additions.

Groundwater flow has affected construction at other CBH sites, particularly where construction occurs during and following the wetter portion of the year. It is recommended that perimeter drainage be installed prior to bulk earthworks.

### 2.2 Existing Basins

There are 4 existing basins located north west of the proposed bulk heads and captures flow from the existing open bulkheads.



### 3. Stormwater Management Principles

The CBH guidelines have been used as the basis for the stormwater management design within the site. The drainage philosophy and assumptions are as follow:

- Open drain channels and culverts sized to cater for 1 in 20 Post Development ARI;
- Open drains to have a minimum of 0.4m depth, maximum 1:3 side slopes and minimum 1.5m wide base;
- The basin is to cater for the 1 in 20-year ARI for post less pre-development storage volume.
- Erosion protection to be installed where velocities are estimated to be greater than 2m/s;

#### 3.1 Rainfall Data

Design rainfall Intensity Frequency Duration (IFD) data was produced using the Bureau of Meteorology AEP software based on the co-ordinates of the proposed bulk heads.

The summary of the IFD table is shown below:

Table 1: Summary of IFD

	EY	Annual Exceedance Probability (AEP)					
Duration	1EY	50%	20%	10%	5%	2%	1%
1 min	1.28	1.47	2.1	2.59	3.11	3.88	4.53
2 min	2.21	2.51	3.52	4.3	5.14	6.39	7.47
3 min	2.97	3.37	4.76	5.83	6.98	8.68	10.1
4 min	3.6	4.1	5.82	7.14	8.56	10.7	12.4
5 min	4.13	4.71	6.73	8.27	9.92	12.4	14.4
10 min	6.01	6.89	9.92	12.2	14.7	18.3	21.4
15 min	7.24	8.29	11.9	14.7	17.7	22.1	25.8
30 min	9.55	10.9	15.6	19.2	23	28.7	33.5
1 hour	12.3	13.9	19.7	24.1	28.9	36	42.1
2 hour	15.7	17.7	24.7	30.2	36.2	45.1	52.8
3 hour	18.1	20.4	28.3	34.6	41.5	51.8	60.7
6 hour	23.1	26	36.1	44	52.8	66	77.5
12 hour	29.3	32.9	45.7	55.7	66.6	83.4	98
24 hour	36.3	40.8	56.3	68.3	81.1	101	119
48 hour	43.4	48.7	66.5	79.7	93.5	115	134
72 hour	47.7	53.4	72.1	85.6	99.3	121	140
96 hour	50.9	56.9	76.2	89.8	103	125	143



120 hour	53.7	59.9	79.8	83.5	107	128	146
144 hour	56.3	62.8	83.2	97.2	111	132	149
168 hour	58.9	65.6	86.7	101	115	136	152

### 3.2 Pre-development and Post-development Flow Calculation

After construction of the proposed bulk heads, the catchment will change as the open drain surrounding the new bulkheads will capture and direct the runoff into the proposed basin.

The rational method has been used to calculate the predevelopment and post development flow of the site with time of concentration calculated using kinematic wave equation.

The CBH design standard specifies a 20-year coefficient of runoff. ARR uses a 10-year coefficient as the basis of the calculations, therefore in accordance with ARR we have used a frequency factor to convert the 20-year coefficient to a 10-year coefficient for calculation purposes.

For predevelopment flow:

- Surface roughness coefficient  $n^* = 0.035$  for vegetated surface
- For 1 in 20 yrs,  $C_{20} = 0.2$
- For 1 in 10 yrs,  $C_{10} = 0.19$

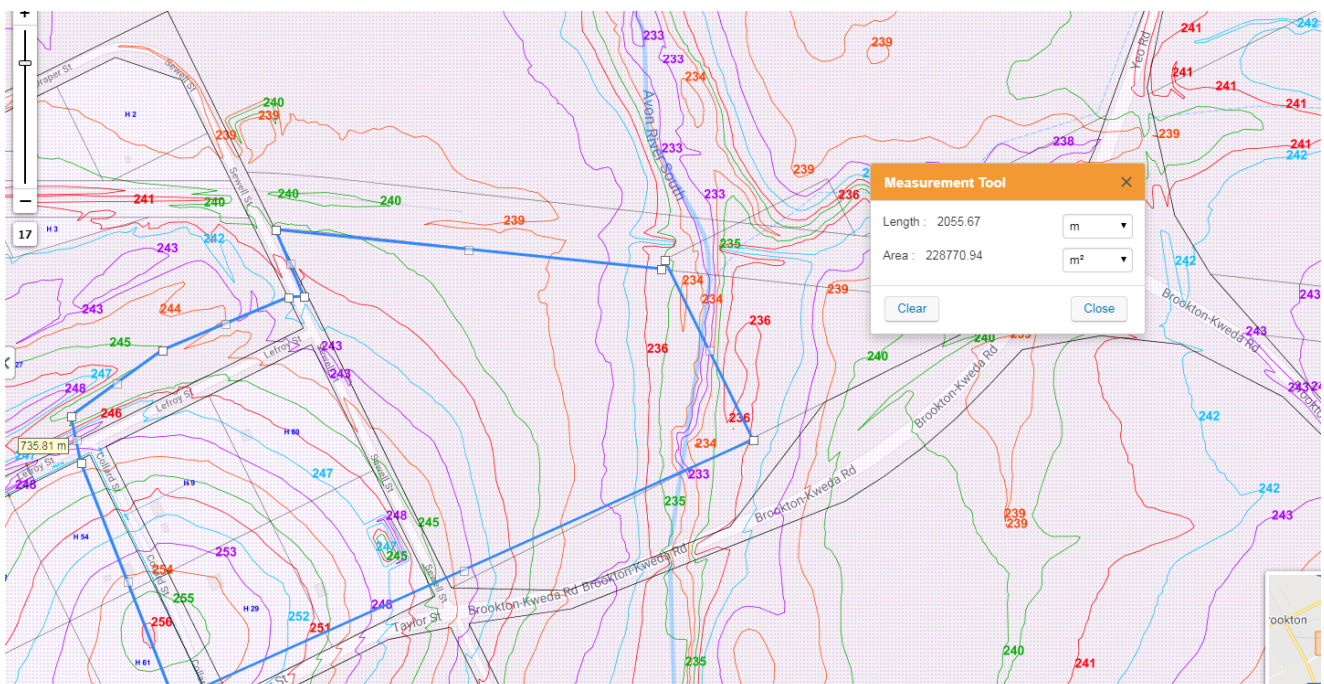
For post development flow:

- Surface roughness coefficient  $n^* = 0.022$  for open channels
- For 1 in 20 yrs,  $C_{20} = 0.9$  for paved surface
- For 1 in 10 yrs,  $C_{10} = 0.86$

## 4. Basins

### 4.1 External Catchment

The external catchment contributing to the basin's storage requirements is detailed below.







## 4.2 Proposed Basin Storage Calculation

The proposed basin storage has been sized to store the 1 in 20-year ARI event with a minimum 300mm freeboard and a controlled discharge equal to or less than the predevelopment flow rate.

The catchment contributing to the basin consists of a predevelopment area estimated at 228,770m<sup>2</sup>, over which 64,150m<sup>2</sup> of impervious area is being developed.

Storage volumes are calculated using the Modified Copas equation and is shown in Appendix 2.

Basis of design and assumptions are described as follows:

- Basin side slope is 1 in 3;
- Infiltration rate into ground used 0.6 m/day based on geotechnical investigations.
- Total Storage Required for the proposed bulkheads and external catchment is 478m<sup>3</sup>.

## 5. Open Channels

### 5.1 Open Channel Criteria

Drains will be sized to carry the 20-year ARI with the top water level 100mm below the bottom of the pavement sub-base. Calculations are contained in Appendix 2 for specific drain locations, drain locations are documented on the stormwater concept plan in Appendix 1.

## 6. Culverts

### 6.1 Culvert Criteria

Culverts will be required beneath pavements to convey storm flow from the bulkheads and overland flow. The Criteria for culverts is to convey the 20-year ARI.

### 6.2 Maintenance

It is recommended that CBH undertakes regular maintenance of the proposed trapezoidal drains to prevent reduced flow capacity caused by sedimentation in the drains.

## 7. Summary

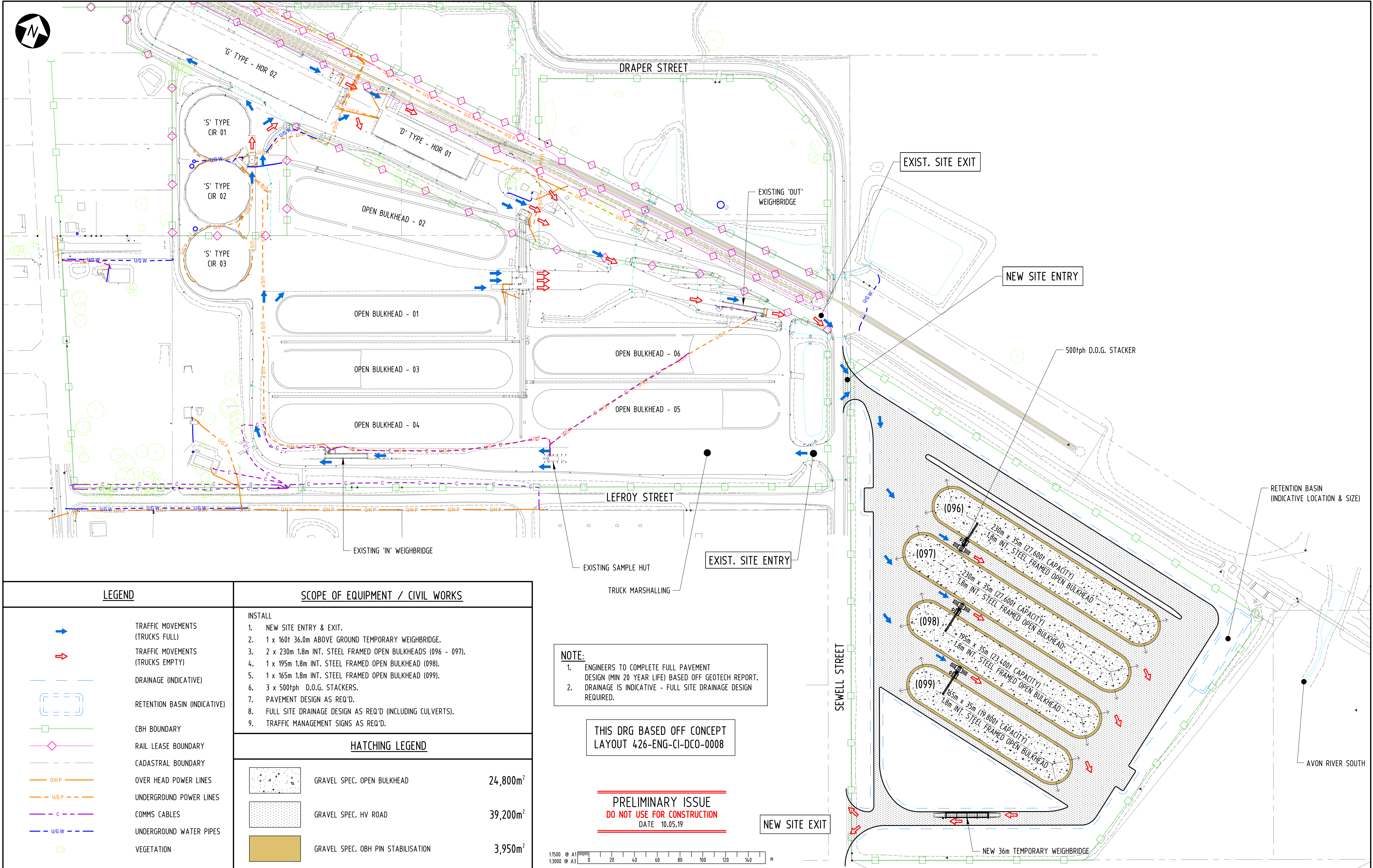
The stormwater basin design is in accordance with CBH specifications, being the 20-year ARI for the post development impervious surface with predevelopment flow discharge.

The basin size under detailed design will accommodate a minimum of 478m<sup>3</sup>.

Open drains and culverts have been designed to convey the 20-year ARI, with the top water level 100mm lower than the sub-base of the pavement structure.

APPENDIX 1 – SITE CONCEPT PLAN



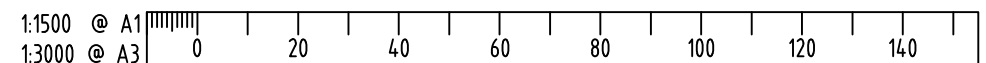


LEGEND		SCOPE OF EQUIPMENT / CIVIL WORKS	
	TRAFFIC MOVEMENTS (TRUCKS FULL)	<b>INSTALL</b> 1. NEW SITE ENTRY & EXIT. 2. 1 x 160t 36.0m ABOVE GROUND TEMPORARY WEIGHBRIDGE. 3. 2 x 230m 1.8m INT. STEEL FRAMED OPEN BULKHEADS (096 - 097). 4. 1 x 195m 1.8m INT. STEEL FRAMED OPEN BULKHEAD (098). 5. 1 x 165m 1.8m INT. STEEL FRAMED OPEN BULKHEAD (099). 6. 3 x 500tph D.O.G. STACKERS. 7. PAVEMENT DESIGN AS REQ'D. 8. FULL SITE DRAINAGE DESIGN AS REQ'D (INCLUDING CULVERTS). 9. TRAFFIC MANAGEMENT SIGNS AS REQ'D.	
	TRAFFIC MOVEMENTS (TRUCKS EMPTY)		
	DRAINAGE (INDICATIVE)		
	RETENTION BASIN (INDICATIVE)		
	CBH BOUNDARY		
	RAIL LEASE BOUNDARY		
	CADASTRAL BOUNDARY		
	OVER HEAD POWER LINES		
	UNDERGROUND POWER LINES		
	COMMS CABLES	<b>HATCHING LEGEND</b>	
	UNDERGROUND WATER PIPES		
	VEGETATION		
	GRAVEL SPEC. OPEN BULKHEAD	24,800m <sup>2</sup>	
	GRAVEL SPEC. HV ROAD	39,200m <sup>2</sup>	
	GRAVEL SPEC. OBH PIN STABILISATION	3,950m <sup>2</sup>	

**NOTE:**  
1. ENGINEERS TO COMPLETE FULL PAVEMENT DESIGN (MIN 20 YEAR LIFE) BASED OFF GEOTECH REPORT.  
2. DRAINAGE IS INDICATIVE - FULL SITE DRAINAGE DESIGN REQUIRED.

THIS DRG BASED OFF CONCEPT LAYOUT 426-ENG-CI-DCO-0008

**PRELIMINARY ISSUE**  
DO NOT USE FOR CONSTRUCTION  
DATE 10.05.19



COPYRIGHT ©  
THIS DRAWING AND THE CONTENTS DEPICTED OR WRITTEN THEREON, WHETHER IN WHOLE OR IN PART, IS THE EXCLUSIVE INTELLECTUAL PROPERTY OF CBH GROUP AND SHOULD NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE PRIOR WRITTEN APPROVAL OF CBH GROUP.



**CBH GROUP**  
30 DELHI STREET  
WEST PERTH  
W.A. 6005  
PH (08) 9237 9600  
FAX (08) 9322 3942

REF DRAWING No.	REFERENCE DRAWING TITLE	REV	DATE	REVISION DESCRIPTION	BY	CHK'D	APP'D
		B	10.05.19	LAND BOUNDARY ADJUSTED. DRG REVISED & RE-ISSUED FOR REVIEW	JB		
		A	09.05.19	ISSUED AS CHECK PRINT AND FOR REVIEW	JB		

SCALE	1:1500	DRAWN	J. Butlingham	09.05.19	TITLE	BROOKTON PRE FEASIBILITY STUDY 98.4 kL ADDITIONAL UNSEALED STORAGE ESTIMATING PLAN No. 1		
SHEET	A1	CHECKED			DRG No	426-ENG-CI-DES-0001	SHEET	1 OF 1
PROJECT	M-2608	DESIGNED			REV.	B		
CONTRACT No		DESIGN APPR						
		PROJECT APPR						



APPENDIX 2 - CALCULATIONS

Modified Copas Equation				Job No.		16144	
				Rev		A	
Project		16144-CBH Brookton		Date		1/07/2019	
				Calcs By		MM	
IFD Location 32.375S 117.025E							
Catchment Area BASIN SIZING							
The Kinematic Wave Equation has been used to calculate overland flow times (AR&R 1987 Volume 1)							
PARAMETERS							
Pre Development				Post Development			
Total Area (m <sup>2</sup> )		228,770		Total Area (m <sup>2</sup> )		228,770	
Coeff of Runoff C <sub>10</sub>		0.19		Area of Pervious (m <sup>2</sup> )		149,770	
Slope (m/m)		0.027		Area of Impervious (m <sup>2</sup> )		79,000	
n*		0.035		Slope (m/m)		0.010	
Length (m)		450		n*		0.028	
Constant Inflow Rate (l/s) =		0		Length (m)		450	
Duration (min) =		0		C <sub>10</sub> of Impervious		0.86	
				C <sub>10</sub> of Pervious		0.19	
				Ave Coeff of Runoff C <sub>10</sub>		0.42	
				Limit Post Development Outflow		Yes	
				Limit Post Development Outflow To 1 in X		20	
				Pipe Outflow Rate (l/s)			
				Infiltration Rate (m/d)			
				Area of Infiltration (m <sup>2</sup> )			
				Infiltration Rate (l/s)		0.0	
				Total Outflow or Infiltration Rate (l/s)		0.0	
RESULTS							
Storm Event (Yr)	Pre Development		Post Development				
	T <sub>c</sub> (min)	Predev Flow Rate (l/s)	T <sub>s</sub> (min)	T <sub>c</sub> (min)	PostDev flow Rate (l/s)	PostDev Outflow Rate (l/s)	Storage Required (m <sup>3</sup> )
1	34.7	172	10	43.6	336	732	-86.2
2	32.1	203	15	40.6	372	732	-67.9
5	26.4	392	30	33.2	750	732	-3.2
10	23.6	548	30	29.4	1031	732	146.0
20	21.3	732	30	26.7	1406	732	478.0
50	19.0	1087	30	23.7	2083	732	1,214.0
100	17.6	1410	30	21.7	2666	732	1,877.0

<b>Modified Copas Equation</b>		<b>Job No.</b>	16144
		<b>Rev</b>	A
<b>Project</b>	16144-CBH Brookton	<b>Date</b>	1/07/2019
		<b>Calcs By</b>	MM