Appendix 15

RETURN TO APPENDICES LIST

Awoonga Dam Flood Capacity Assessment, correspondence 3 September 2009

(GHD Pty Ltd)

03 September 2009

Our ref: 41/21180/394765
Your ref:

Mr Richard West
Gladstone Area Water Board
147 Goondoon Street
GLADSTONE QLD 4680

Dear Richard

Awoonga Dam AFC Assessment - Option 2E
Additional Information

1 Background

GHD recently completed the Acceptable Flood Capacity Assessment for Awoonga Saddle Dam No. 3. The lowest cost option (2E) for meeting the AFC compliance is the removal of the existing Saddle Dam down to a non erodible surface along the alignment of the existing embankment and protection of the saddle using a concrete/RCC slab with a crest level of RL 45 m.

This option will result in a significantly reduced PAR because there is no sudden increase in breach flow resulting from failure of an embankment or concrete gravity section. However, this option will result in more frequent flooding through the saddle dam for which the AEP at which flow commences is about 1 in 100 compared with the other options where the crest level is greater than or equal to the present Saddle Dam level of RL 47.9 m AHD.

GAWB requested further investigation of the impact of this increased frequency of operation on the downstream. GHD submitted a proposal for this work on 31 August 2009. This letter report provides interim additional information on Option 2E as requested by GAWB to meet immediate internal reporting deadlines.

2 Scope

The scope of this letter report is:

» Comment on possible environmental, legislative and planning issues and approval costs;

» Assess land acquisition costs; and

» Consider options to minimise and prevent downstream erosion and sedimentation.

3 Interim Comment on Environmental, Legislative and Planning Issues

3.1 Option 2E (Saddle Dam No. 3 Crest Level RL 45, Overtopping Commences at 1 in 100 AEP)

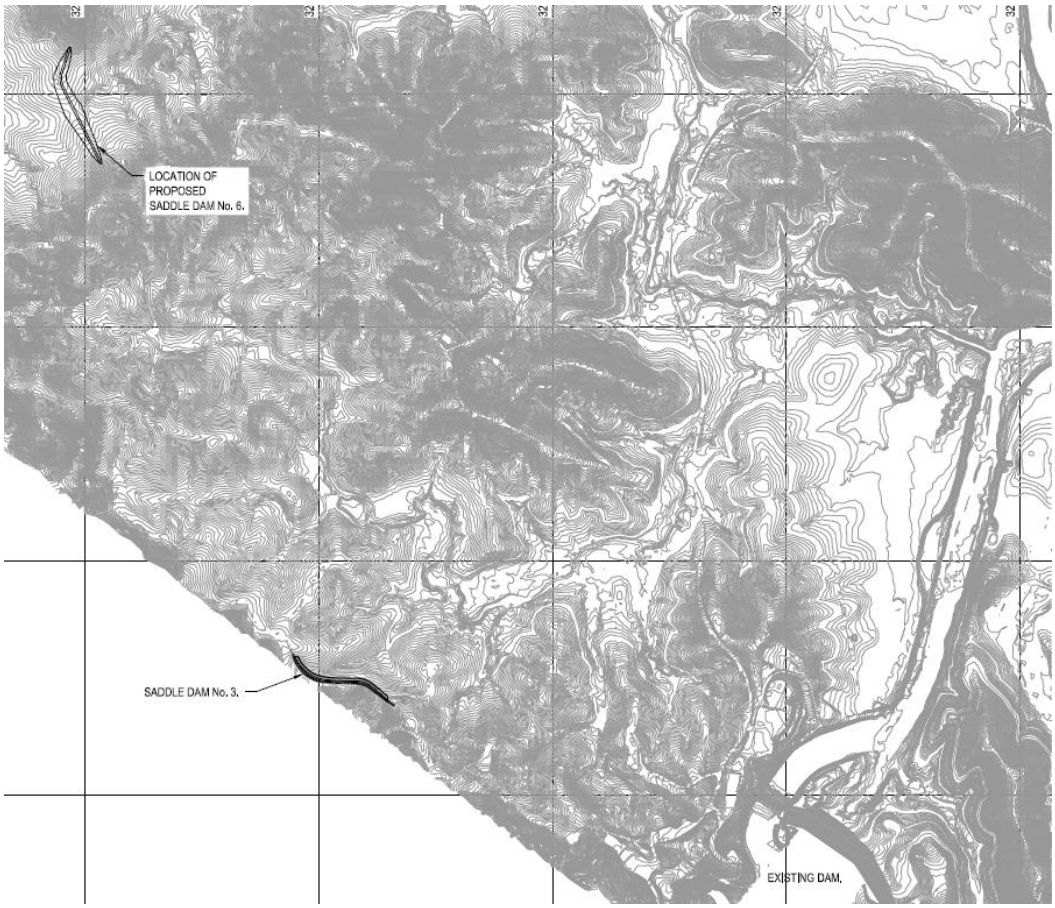
Saddle Dam Option 1 - 1:100 ARI overtopping. DERM believes that GAWB must demonstrate compliance with the general Duty of Care provisions under the Environmental Protection Act 1994 and ensure that no deliberate "serious and material environmental harm" occurs as a result of the

construction and more particularly, the operation (ie overtopping) of the spillway. Currently, the construction and operation of this option would be construed as condoning deliberate "serious and material environmental harm" under the EP Act and the project would not be approved. The exception is that the project may be approved on the basis that GAWB have demonstrated consideration of environmental harm and have undertaken a detailed water course flow assessment, and implemented erosion and sediment control mechanisms that will mitigate "environmental harm". Essentially DERM would want a defined flow channel constructed, with the vegetation removed (not allowed to be deliberately washed away), banks stabilised, and flow dissipation devices installed.

Assessment and approval would also rely on the project meeting the requirements of State Planning Policy 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide, and on the EP Act Environmental Protection (Water) Policy 1997, in particular Part 5 of the policy which is the management of activities by administrating authorities (GAWB in this case). The sections in this part confer a duty on the authority to consider a range of impacts on water quality, in this case overland flow and its impacts. The implications of the Commonwealth EPBC Act haven't been looked at in detail yet, but there is a high possibility of the project needing referral to the Commonwealth under the provisions of the Act and the Commonwealth will set the likely assessment criteria for approval - which would be likely to extend to a full Public Environment Report or a high level Environmental Impact Assessment investigation.

3.2 Option 4 (New Embankment at Saddle Dam No. 3 to RL55 and Saddle Dam No. 6 Commences at 1 in 16,000 AEP)

Applications for this project must similarly consider the above, however the likelihood of occurrence is such that it could not be demonstrated that the works would result in deliberate "serious and material environmental harm". This was a difficult example to extract a firm opinion from DERM, however it was concluded that it must be shown how GAWB would consider compliance with SPP 1/03 and the EPP (Water), but that given the likelihood of occurrence, this interval of risk (1:16000 years) is not defined under these policies and possibly unable to be applied in this case. It was pointed out that many smaller dam structures are approved that may possibly be built to only a 1:500 year ARI event (farm dams and the like) and some mining water supply dams are similarly approved to much higher levels of risk (to ARI less than 1:10 000) than the proposed Option 4. It is unlikely that this option would trigger an EPBC referral as would fall outside their immediate risk category for this type of infrastructure (similar to some mining water supply dams for eg).

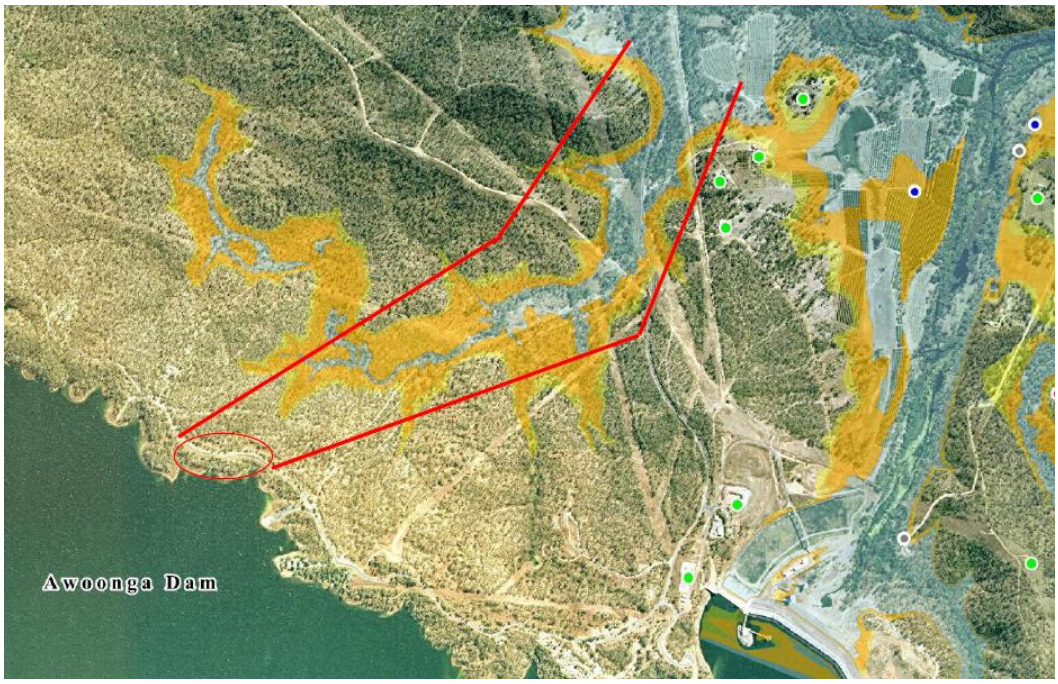


4 Land Acquisition

The area downstream of Saddle Dam No. 3 affected by overflow would possibly be purchased by GAWB. Indicative costs were obtained for recent property sales in the area. These are presented below.

Address	Sale Price	Area (Ha)	Rate per Ha
320 Wildman Rd	$468,000	50Ha?	$10,000
249B Awoonga Dam Rd	$445,000	4Ha	$111,000
91 Pikes Crossing Rd	$590,000	9.1	$65,000
Otto Rd	$479,000	50Ha	$10,000

If the affected area to be acquired is approximately 50 Ha, then assuming a rate of $50,000 /Ha, the cost to acquire the property is $2.5 million.



5 Option 2E Downstream Flow Characteristics for 1 in 200 AEP Design Event

In order to determine the flow characteristics downstream of Saddle Dam No. 3, peak water level for the 1 in 200 AEP event was derived from the Awoonga Dam Flood Frequency Level Plot (Figure 5-3 of GHD Awoonga AFC Study Report). Peak water level was taken as RL 46. The actual level would likely be slightly less than this.

Assuming a concrete sill level of RL 45, crest length of 430 m, coefficient of discharge Cd = 1.6, flow over Saddle Dam No. 3 for the 1 in 200 AEP event is approximately 700 m^3/s. Assuming a bed slope of 1%, the normal depth for a 200 wide trapezoidal channel is about 1.2 m. Actual flow characteristics down the channel will be determined in more detail at a later stage.

Refer to the long section of the downstream channel on SK08. The grade for the first kilometre or so downstream of Saddle Dam No. 3 is roughly 2%, then it flattens off to around 0.5% down to Tucker Creek.

6 Energy Dissipation and Sediment Control

To minimise erosion and sediment transport downstream of Saddle Dam No. 3 for events exceeding the 1 in 100 AEP, bed control is likely to be the most effective strategy. This would involve reducing the effective channel grade by means of head control drop structures. The drop structures could possibly be designed for the 1 in 200 AEP flow event, but may be needed to control erosion for up to the 1 in 1,200 AEP.

The drop structure would be a wall or weir built in the channel bed to transfer water from one elevation to a lower elevation, without erosion. In this application, we have assumed a mass concrete wall, 3 m high, 100 m crest length, at several locations down the channel to the convergence of Tucker Tributary and Tucker Creek. Actual dimensions will depend on the topography of the valley. Flow over 100 m wide crest structures would be approximately 3 m deep for the 1 in 200 AEP flow of 700 m^3/s.

The drop structures are intended to limit back erosion of the creek bed. A nominal 3 m vertical spacing has thus been adopted. The location and height of the drop structures will be refined to better suit the topography at a later stage if required. A concrete slab immediately downstream of the wall protects the foundation from erosion by the overflow.

Preliminary indications are that 10 drop structures will be required. We have assumed they are 3 m high, 3 m wide, 100 m long = 900 m^3 each, plus 10% extra for walls, slab etc = 1,000 m^3. Assuming \$600 /m^3 for concrete = \$600k per structure; Plus excavation, other unestimated items assume 50% = \$0.9m per structure; Ten structures = \$9m.

If 1 in 1,000 AEP event is adopted as the design flood, the drop structures will need to be more substantial. If their length increases to say 300 m, the cost roughly triples to \$27m.

7 Option 2E Concept Cost Estimate Update

The Option 2E cost estimate presented in the AFC report has been updated to take into account the anticipated environmental and planning issues, including the possible need for land acquisition and erosion control down the channel.

The cost estimate below has been developed for the purpose of comparing options only. The scope of works has not been fully defined and therefore the estimates are not warranted by GHD. Additional investigations will be required to define the extent of works and provide a preliminary cost estimate.

Item	Description		Amount
1	Option 2E Construction Cost as presented in the AFC Study report (GHD 2009)		\$3,660,250
Plus Additional Items Discussed In This Letter Report			
2	Environmental Impact Assessment		\$1,000,000
3	Land Acquisition		\$2,500,000
4	Erosion control up to 1 in 200 AEP		\$9,000,000
		Subtotal	\$16,160,250
5	20% for minor items		\$3,250,000
		Subtotal	\$19,410,250
6	Allow 10% for Design, Tender and Supervision		\$1,950,000
		Subtotal	\$21,360,250
7	20% Indirect costs		\$4,250,000
		Subtotal	\$25,610,250

8	Add 30% contingencies		$7,700,000
		TOTAL (ex GST)	**$33,310,250**

8 Option 4 – New Saddle Dam to RL 55

This option is detailed in "Report for Awoonga Saddle Dam No 3 – Acceptable Flood Capacity Assessment" (GHD, Rev 0, 1 June 2009). This option provides a new embankment dam to RL 55, flow through saddle dam no 6 for events greater than 1/16,000 AEP and with $1M allowance for a new wall on the left abutment.

Item	Description		Amount
1	Option 4 Construction Cost as presented in the AFC Study report (GHD 2009)		$9,626,250
Plus Additional Items Discussed In This Letter Report			
2	Left abutment wall		$1,000,000
		Subtotal	$10,626,250
3	20% for minor items		$2,125,250
		Subtotal	$12,751,500
4	Allow 10% for Design, Tender and Supervision		$1,275,150
		Subtotal	$14,026,650
5	20% Indirect costs		$2,805,330
		Subtotal	$16,830,980
6	Add 30% contingencies		$5,049,294
		TOTAL (ex GST)	**$21,880,274**

9 Conclusions

Compared to the current risks downstream of Saddle Dam No. 3 (crest level RL 47.9 m), Option 2E, for events from 1 in 100 AEP to 1 in 1,200 AEP event (when overtopping of Saddle Dam No. 3 commences), presents an increased flooding risk for downstream population. The extent of flooding and increased risk still needs to be determined in more detail.

To comply with the requirements of the Environmental Protections Act, and ensure that no deliberate "serious and material environmental harm" occurs as a result of the construction and more particularly, the operation (ie overtopping) of Saddle Dam No. 3, significant erosion protection works in the valley

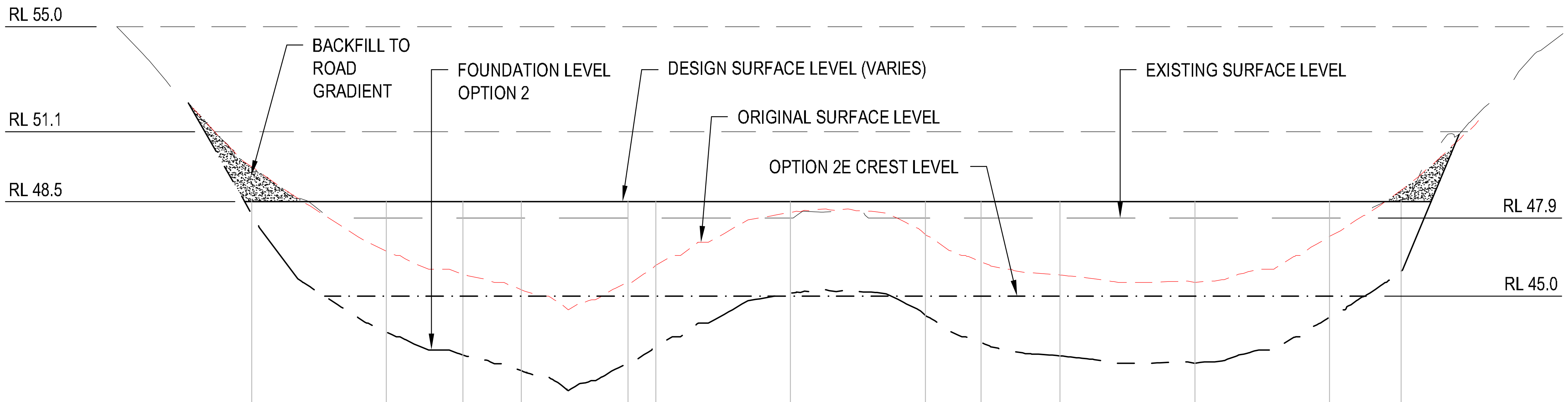
downstream of Saddle Dam No. 3 will be required. These works were roughly assessed for the purpose of comparing costs between options. The cost of minimising the impact to the downstream environment following overtopping of Saddle Dam No. 3 Option 2E for events rarer than 1 in 100 AEP results in this no longer being the lowest cost option for meeting AFC requirements, with costs possibly ranging from $33m to in excess of $60m, depending on the extent of erosion protection structures required.

The details contained in this interim additional information letter report need to be confirmed by means of more detailed investigations and analysis. However, it has become evident that the more frequent occurrence of downstream flooding requires channel works rendering this option unlikely to be the lowest cost option for meeting AFC requirements.

Option 4 provides the most environmentally sound and lowest risk method of upgrading Saddle Dam 3 to the AFC requirements. The estimated cost of this option is $22m (excl GST) which is the lowest capital cost option when Option 2E is upgraded to reflect channel control works required by the EPA.

Yours sincerely

Jonathan Jensen
Dams Engineer
(07) 3316 4209



DATUM RL. 34.00

VERTICAL ALIGNMENT: L=515.68m, G=0%

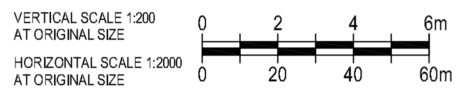
HORIZONTAL ALIGNMENT: L=128.38m | L=61.22m R=-100.00m | L=131.13m | L=155.90m R=150.00m | L=63.68m

CHAINAGE	DAM FOUNDATION OPTN2	ORIGINAL SURFACE LEVEL	DESIGN SURFACE LEVEL	EXISTING SURFACE LEVEL
50.00				55.00
100.00		49.80		49.74
150.00	43.66	46.66	48.500	47.90
178.38	42.81	45.81	48.500	47.90
200.00	42.24	45.24	48.500	47.90
239.60	42.50	45.50	48.500	47.90
250.00	43.14	46.14	48.500	47.90
300.00	45.11	48.11	48.500	47.90
350.00	44.29	47.29	48.500	47.90
370.73	43.28	46.28	48.500	47.90
400.00	42.78	45.78	48.500	47.90
450.00	42.51	45.51	48.500	47.90
500.00	44.21	47.22	48.500	47.90
526.63	45.93	48.93		48.57
550.00		51.00		51.23

LONGITUDINAL SECTION - CTRL DAM03

HORZ 1:2000 VERT 1:200

NOTE:
CHAINAGES ARE SELECTED TO CONFORM AS CLOSELY AS POSSIBLE WITH DRAWING N°. SD1702



PRELIMINARY

rev	description	app'd	date
B	REVISED ISSUE		
A	INITIAL ISSUE	MBB	29.05.09

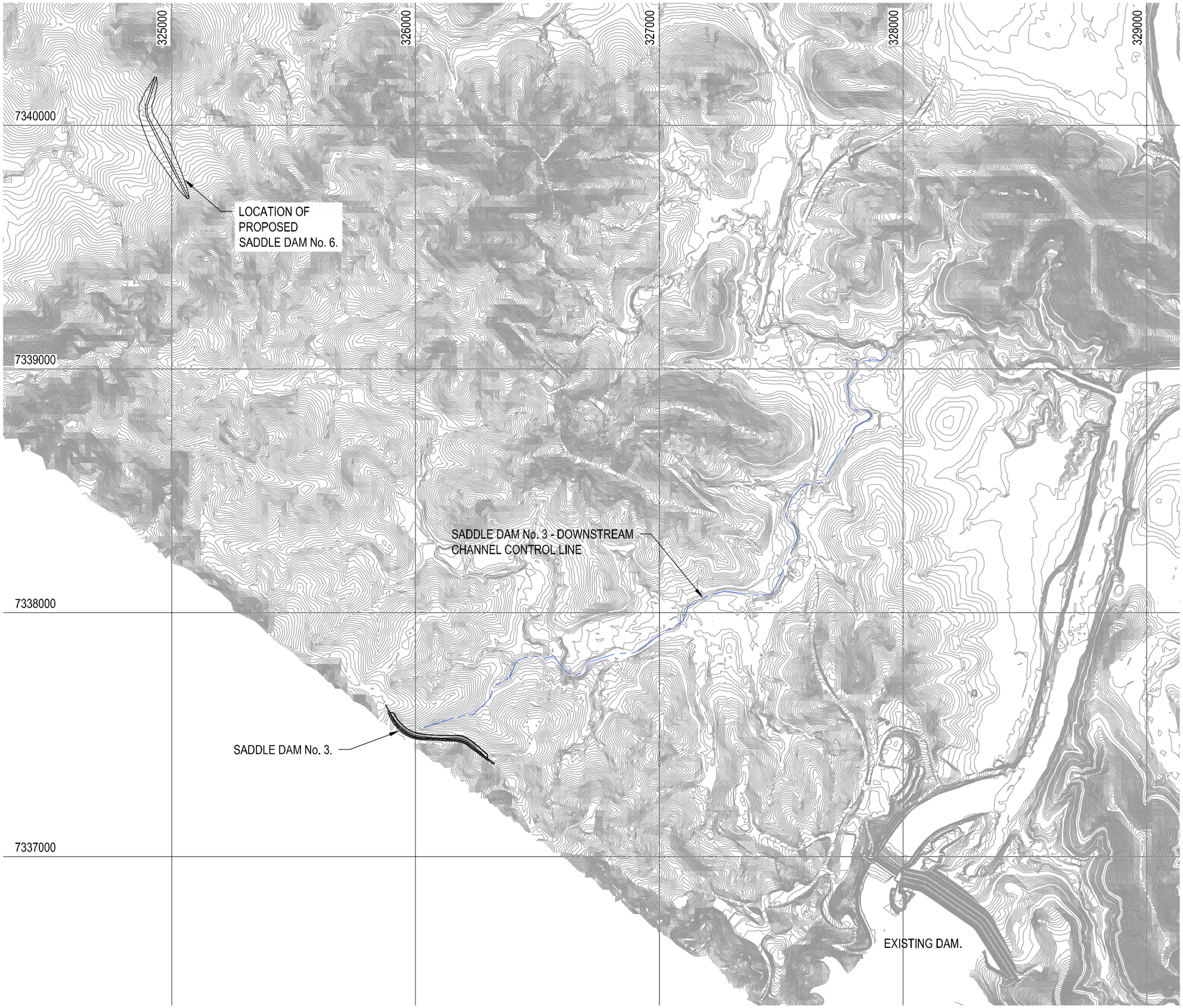
GLADSTONE AREA WATER BOARD
ACCEPTABLE FLOOD CAPACITY ASSESSMENT
AWOONGA SADDLE DAM NO. 3
LONGITUDINAL SECTION

GHD CLIENTS | PEOPLE | PERFORMANCE

4-6 Innovation Parkway
Kawana Business Village, Birtinya QLD 4575 Australia
PO Box 1540 Buddina QLD 4575
T 61 7 5413 8100 F 61 7 5413 8199
E bta1mail@ghd.com.au W www.ghd.com.au

scale AS SHOWN for A3 | job no. 41-20176
date MAY 2009 | rev no. B

approved SK05



0 200 300 450m
SCALE 1:15,000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date
B	D/S CONTROL LINE ADDED		
A	INITIAL ISSUE	MBB	29.05.09

GLADSTONE AREA WATER BOARD
ACCEPTABLE FLOOD CAPACITY ASSESSMENT

AWOONGA SADDLE DAM NO. 3
LOCALITY PLAN

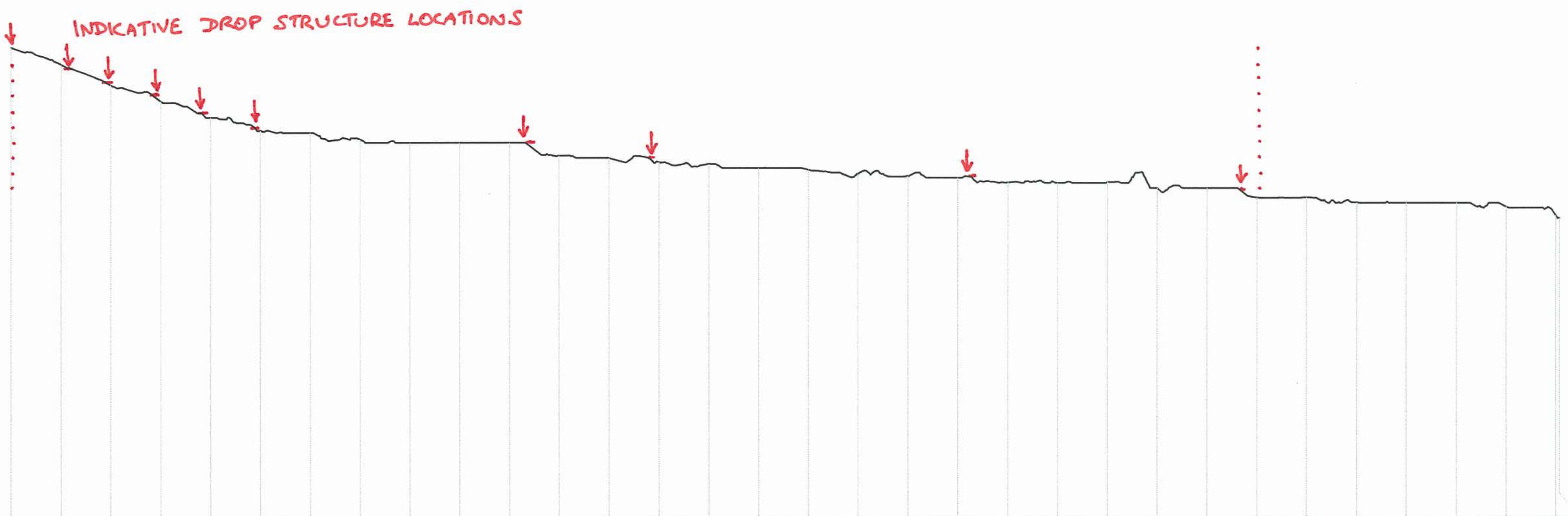
GHD CLIENTS | PEOPLE | PERFORMANCE

Level 4, 201 Charlotte St Brisbane QLD 4000 Australia
GPO Box 668 Brisbane QLD 4001
T 61 7 3316 3000 **F** 61 7 3316 3333
E bnemail@ghd.com.au **W** www.ghd.com.au

scale	1:15000 for A3	job no.	41-20176
date	MAY 2009	rev no.	B

approved SK07

Plot Date: 3 September 2009 - 4:07 PM Plotted by: Jonathan Jensen , #### Cad File No: G:\41\20176\CADD\Drawings\41-20176-SK07.dwg



DATUM RL. -54.0

CHAINAGE	EXISTING SURFACE LEVEL
0	40
100	36.623
200	32.526
300	29.339
400	26
500	23.433
600	23
700	21.65
800	21
900	21
1000	21
1100	18.446
1200	17.921
1300	17.128
1400	16.754
1500	16
1600	15.623
1700	14.756
1800	14.328
1900	14
2000	13.058
2100	13
2200	13.133
2300	11.997
2400	12
2500	10.104
2600	10.123
2700	9.097
2800	9
2900	9
3000	8.225
3100	6.504
3107.159	6

SADDLE DAM No. 3 - DOWNSTREAM CHANNEL LONGSECTION

HORIZONTAL SCALE 1:10000 VERTICAL SCALE 1:1000

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

GLADSTONE AREA WATER BOARD
ACCEPTABLE FLOOD CAPACITY ASSESSMENT

SADDLE DAM No. 3 - DOWNSTREAM CHANNEL

GHD CLIENTS | PEOPLE | PERFORMANCE

4-6 Innovation Parkway
Kawana Business Village, Birtinya QLD 4575 Australia
PO Box 1540 Buddina QLD 4575
T 61 7 5413 8100 F 61 7 5413 8199
E bta1mail@ghd.com.au W www.ghd.com.au

VERTICAL SCALE 1:1000 AT ORIGINAL SIZE 0 10 20 30m
HORIZONTAL SCALE 1:10000 AT ORIGINAL SIZE 0 100 200 300m

scale	AS SHOWN for A3	job no.	41-20176
date	SEPT 2009	rev no.	A

approved SK08

Plot Date: 3 September 2009 - 3:45 PM Plotted by: Lachlan J. Darr, Birtinya Cad File No: C:\JOBS\41-20176\CADD\41-20176-SK08.dwg