Matata Project - Provisional Cost Estimates

Awatarariki Chute and Bund Options

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Awatarariki Chute and Bund Options

Prepared for

Whakatane District Council

Prepared by

AECOM New Zealand Limited
Level 1, 17 Grey Street, Tauranga Central, Tauranga 3110, PO Box 13161, Tauranga Central, Tauranga 3141, New Zealand
T +64 7 927 3080 F +64 7 927 3082 www.aecom.com

20 December 2012

60279511

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Quality Information

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Ref 60279511

Date 20 December 2012

Prepared by Geoff Morgan

Reviewed by Colin Newton

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
	01-Nov-2012	Draft for comment	Peter Hartley Technical Director Environment	
	20-Dec-2012	Final Report		

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1.0 Introduction

The Awatarariki Stream is located on the western fringe of the Matata residential area and was a major cause of damage during a 2005 storm event in the area where the stream exits the steep escarpment behind Matata. AECOM are engaged by Whakatane District Council to prepare provisional estimates for an option that discharges debris directly to the sea via a chute and for an option that protects the Matata residential area with an earth bund. The scope of the work is detailed in our proposal to Whakatane District Council dated 15 October 2012.

The chute to sea is a concept initiated by the Sustainable Matata Group and Tangihia Consultants & Associates Ltd. No hydraulic modelling, engineering design or estimating has been considered previously. This report covers initial hydraulic modelling, development of the concept and preliminary estimating of this option.

The bunded option AECOM is commissioned to update is an option previously considered by Tonkin and Taylor (T&T) in their report 'Preliminary Infrastructure and Planning Options Report, August 2005", option A7. The hydraulic and debris flow characteristics of this option have not been revisited but the alignment, and preliminary estimates are updated in this report.

2.0 Survey Data

The LiDAR survey data used in this analysis was received from the CAD file "M_Matata_Survey_Data Post 2005.dwg". The data was supplied by T&T and is understood to be based on LiDAR survey following the 2005 debris flow event. WDC has supplied LiDAR data surveyed in 2006 and this matches the T&T survey.

It appears that a channel survey of the Awatarariki Stream was completed by Harrison Grierson shortly after the 2005 event (the survey is referenced in Ontrack calculation sheets for the ECMT bridge). This survey has not been provided.

3.0 Chute to Sea

The flood diversion channel (also called the "chute-to-sea") diverts large flood and debris flow events away from the existing Awatarariki Stream and directly to the sea. The requirement is for a channel that has capacity to pass a debris event with a flood discharge of 66m^3/s, similar to the May 2005, (T&T report 2005). After the 2005 event, the rail bridge across the Awatarariki Stream between the State Highway and the escarpment was replaced with a two span structure and the central pier may obstruct flow. If this eventuates flood and debris may overflow the rail line and 'funnel' into the chute. As flow across the rail line has not been modelled or investigated in any detail the options in this report retain this dual span bridge and the cost to provide a single span rail bridge is included as sub option. Because the channel conveys large debris flows the gradient must be steep enough to maintain high velocities so that debris does not settle out of suspension within the channel, which could result in blockage. To prevent the channel from scouring while in operation it is concrete lined. The channel outlet is designed with a 45^o flare, also to reduce the potential for blockage of the outlet.

The channel is also flared at the inlet with the left wall aligned to meet the left abutment of the East Coast Main Trunk (ECMT) rail bridge. The straight section of the channel begins immediately downstream of the SH2 crossing. An alternative option is to start the straight section upstream of SH2, which may reduce the required SH2 bridge span.

3.1 Chute Alignment

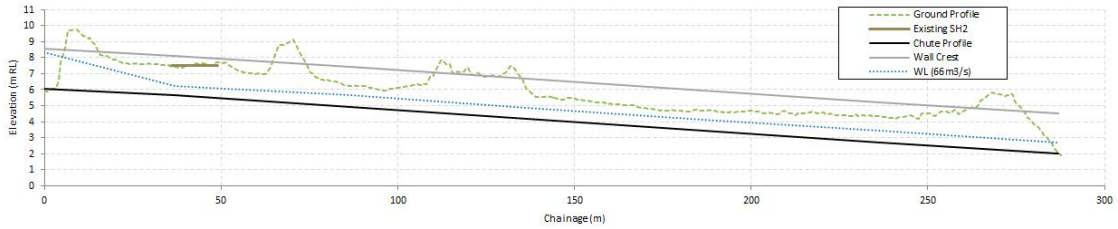
The proposed horizontal alignment is shown on drawing 60276243-0111. The horizontal alignment was selected to minimise the length of the diversion channel, minimise impacts on existing buildings and to possibly avoid a new crossing under the ECMT railway line. The chosen alignment diverts the stream on the left bank, mid-way between the existing road and rail bridge. The total length of the diversion channel is 288m.

The chute is set at a constant gradient of 1.41% from the stream channel to the beach. This option has a vertical fall of 4m and requires a new road bridge where the channel passes under SH2. The existing stream channel is retained and flood flows and debris larger than a 1 in 5 return period will pass down the new channel.

Drawing No 60276243-0111 Rev B (refer Appendix A) shows horizontal alignment of the chute. Drawing No 60276243-0112 Rev B shows a typical cross section and long sections showing the gradient and difference in elevation.

This option requires a new culvert in the Awatarariki Stream approximately 50m upstream of the existing SH2 crossing. The new culvert limits the discharge in the stream so that high flows spill into the chute. The culvert is twin 1800mm diameter pipes.

Figure 1 Long Section for Chute-to-Sea (Option 1)



3.2 Hydraulic Design

A HEC-RAS (version 4.1) one-dimensional hydraulic model of the stream and diversion channel was used for the concept hydraulic design of the diversion channel. The model was run for the vertical alignment with a constant 66m^3/s discharge, which assumes no flow continues down the existing stream channel (this is a conservative approach for but considered appropriate for this level of study).

The model was run with water only flows; no parameters were changed to allow for the effects of large volumes of suspended debris. The channel was modelled as a trapezoidal section with a 15m base width and side slopes of 1V:1.5H.

The downstream boundary condition in the model was set at a constant level of RL 2.0m, which is the downstream invert level of the channel. Review of previous Environment Bay of Plenty modelling reports indicates that the 20yr ARI tide level with storm surge could be up to RL 2.20m (including allowance for sea level rise), so the tide level is not expected to affect the performance of the diversion channel.

The ECMT rail bridge is included in the model using as-built data. No allowance was made for a debris raft on the bridge pier.

The model results show that the chute can pass the design flow with velocities around 6m/s. For the design event, flow is super-critical with water depths of 0.70m. The chute has a channel depth of 2.5m to allow sufficient freeboard for the channel to pass large boulders similar to the May 2005 event.

3.3 Impacts on Existing Infrastructure

Construction of the diversion channel requires changes to the State Highway and Kaokaoroa Street. A similar number of properties to T&T option A7 properties need to be acquired and there may also be some impact on the ECMT rail line. These issues are outlined below.

<u>State Highway 2</u>

For vertical alignment, the diversion channel passes under the State Highway at an invert level of RL 4.9m, requiring a new bridge with a minimum clearance of 3m and a 22m clear span. The minimum soffit level of the bridge is RL 8.0m to allow sufficient clearance for large debris. The road needs to be raised on both sides of the new bridge. The impact of the raised road clearance on the existing rail bridge will need investigating if the option proceeds to detail design.

The existing SH2 bridge is not upgraded for either of the new diversion channel options.

<u>ECMT Rail Bridge</u>

Hydraulic modelling results show this bridge has clearance during the 2005 design event, but during a debris flood similar to the 2005 event, debris is likely to accumulate upstream of the central bridge pier. In order to maintain a clear path for the debris flow it may be preferable to replace the existing bridge with a clear span structure.

Kaokaoroa Street Realignment

The diversion alignment crosses Kaokaoroa Street, which needs to be realigned. On the drawings, the road is relocated approximately 60m to the south-east. The proposed location is indicative only and no geometric design was undertaken. Line of sight for vehicles exiting Kaokaoroa Street onto SH2 may be an issue.

3.4 Cost Estimates

The NZTA Feasibility phase estimate pro forma and default contingency and funding risk values for the different aspects of the work were used. A more detailed cost schedule is included in Appendix B Feasibility Estimates and is summarised in Section 6.0.Annual operation and maintenance costs are based on annual mowing of grassed areas, clearing deposited material from one minor storm each year and a larger storm every five years from the chute and clearing sand from the chute outlet twice a year. The estimated annual O&M cost is $125,300

4.0 Bund Option

4.1 Bund Alignment

This bund starts immediately east of the Awatarariki Stream at the point it leaves the escarpment and has a relatively straight alignment to a point immediately west of the westernmost house on Clem Elliott Drive. When T&T first developed this option the rail bridge across the Awatarariki Stream between the State Highway and the escarpment had not been replaced. A new rail bridge has been built in this location and AECOM have modified the bund to retain this bridge in its present location. The same uncertainty with blockage at this bridge and flow across the rail line as outlined in section 3.0applies to this option and a new single span rail bridge is included as a sub option. The modified alignment starts in the same location as option A7 but follows the stream alignment east of the rail bridge to the State Highway. From this point it runs north to the same termination point as A7. Similar to the chute options should blockage occur at this bridge flood and debris may overflow the rail line and continue flowing west of the bund.

Drawing No 60276243-0116 Rev A in Appendix A shows the concept alignment of the bund option.

4.2 Hydraulic Design

AECOM is not engaged to reconsider the hydraulic design developed by T&T for this option as it is similar to the bund options identified by them. Their work is based on the volume of material and flood flow that occurred in the 2005 event.

4.3 Impacts on Existing Infrastructure

Construction of the bund requires changes to Kaokaoroa Street. A similar number of properties to T&T option A7 need to be acquired and there may also be some impact on SH2 and the ECMT rail line. These issues are outlined below.

State Highway 2

The State Highway passes through the bund and is supported either side by reinforced earth retaining walls. No protection is provided to the highway and debris is likely to block it in an event similar to 2005. Route security for SH2 is beyond the scope of this report but intuitively the difficulty and cost of providing this security is likely to render it impractical.

The bund is a non-frangible obstacle to vehicles and although estimates allow for barrier protection a specific solution has not been designed.

ECMT Rail Bridge

Modelling results show this bridge is clear during the 2005 design event, but during a debris flood similar to the 2005 event debris would likely accumulate upstream of the central bridge pier. In order to maintain a clear path for the debris flow it may be preferable to replace the existing bridge with a clear span structure.

Kaokaoroa Street Realignment

The diversion alignment crosses Kaokaoroa Street, which needs to be realigned. On the drawings the road moves approximately 60m to the south-east. The proposed location is indicative only and no geometric design was undertaken. Line of sight for vehicles exiting Kaokaoroa Street onto SH2 may be an issue.

4.4 Cost Estimates

The NZTA Feasibility phase templates and default risk values for the different aspects of the work were used. A more detailed cost schedule is included in Appendix B Feasibility Estimates and is summarised in Section 6.0.

Operation and maintenance costs are based on annual mowing of grassed areas and clearing deposited material from one storm each year from the bunded area. They are higher than the chute options due to the larger area to maintain and bank scour but partly offset by maintenance of the chute outlet. The annual estimated O&M cost is $172,600.

5.0 Limitations

The preliminary cost estimates in this report are based on concept options that have had no detailed designs prepared. AECOM developed the chute concept proposed by Tangihia Consultants & Associates Ltd to provide enough detail to allow preliminary estimates. The bund option is a concept developed by T&T that AECOM modified slightly to allow retention of the rail bridge over the Awatarariki Stream and this report presents preliminary estimates using the T&T concept.

The report allows the Whakatane District Council to compare likely cost of the chute and bunded option and may not be relied on in any other context or for any other purpose without prior agreement by AECOM.

6.0 Option Summary

As concrete infrastructure generally has a design life of 100 years the present value of operations and maintenance is discounted over this period to compare whole of life costs. A present worth factor of 8% is used in this calculation in line with central government guidance. Property costs are not included but as all options follow a similar alignment they should be the same for all options. The table below summarises the options that AECOM are tasked with evaluating.

Table 1 Summary of Preliminary Estimates

Option	Description	Drawing No refer appendix A	Feasibility Capital Estimate	100 year Life Estimate
Chute Retains Rail bridge	Concrete lined chute with SH2	0111 & 0112	$8.30M	$9.55M
Chute new Rail Bridge	Concrete lined chute with SH2 bridge over the chute and rail bridge replace by a single span.	0111 & 0112	$9.8M	$11.05M
Modified T&T option A7 Retains Rail bridge	Earth bund similar to T&T A7 but diverted east of the rail bridge.	0116	$4.08M	$5.80M
Modified T&T option A7 New Rail Bridge	Earth bund similar to T&T A7 but diverted east of the rail bridge, which is replaced by a single span bridge.	0116	$5.58M	$7.30M

Appendix A

Concept Drawings

Last saved: Tue, 13 Nov 2012 09:36 am

6361800 mN

6362000 mN

2839600 mE

20

10

Awatariki Stream

Stream to be bunded upstream of railway

Riprap armoring on bund indicative extent shown for cost estimate only

Flood protection bund on right bank

Awatariki Stream to be culverted through debris bund

SH2 vertical alignment to be modified around chute – Indicative extent shown

Option 1: SH2 to be bridged over debris chute. Bridge length 22m with 3m clearance.
Option 2: Chute to ford over SH2 with road at current level. Refer drawing 60276243-0112

CH 0+100

CH 0+200

Concrete lined debris chute. 15m base width, 290m long, 2.5m deep internal slope 1V:1.5H

Extent of fill slope

Chute outlet to be flared at 45° to prevent deposited debris blocking chute

Kaokaoroa Street to be realigned. Indicative location shown

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NOT FOR CONSTRUCTION

CAD Ref: I:\Projects\Tauranga\60276243 TEEP MISC\073 Matata Debris\5. CAD\5.3 Working\DRG\ 60276243-0111.dwg

This drawing is confidential and shall only be used for the purposes of this project.

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
B	KC	13.11.12	Bunds realigned	GM
A	NGW	02.11.12	ISSUED FOR CLIENT REVIEW	CJN

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001-2000

DESIGNED	PJC	CHECKED	GM
DRAWN	NGW	CHECKED	PJC
APPROVED	CJN	DATE	Oct-12

SCALES:

SCALE B 0 10 20 25m

1 : 1000 (A3) 1 : 500 (A1)

AECOM

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CLIENT:

WHAKATANE DISTRICT COUNCIL

MATATA DEBRIS FLOW CHUTE ALIGNMENT OPTION PLAN

A1

STATUS: REVIEW

DRAWING NO. 60276243-0111

REV: B

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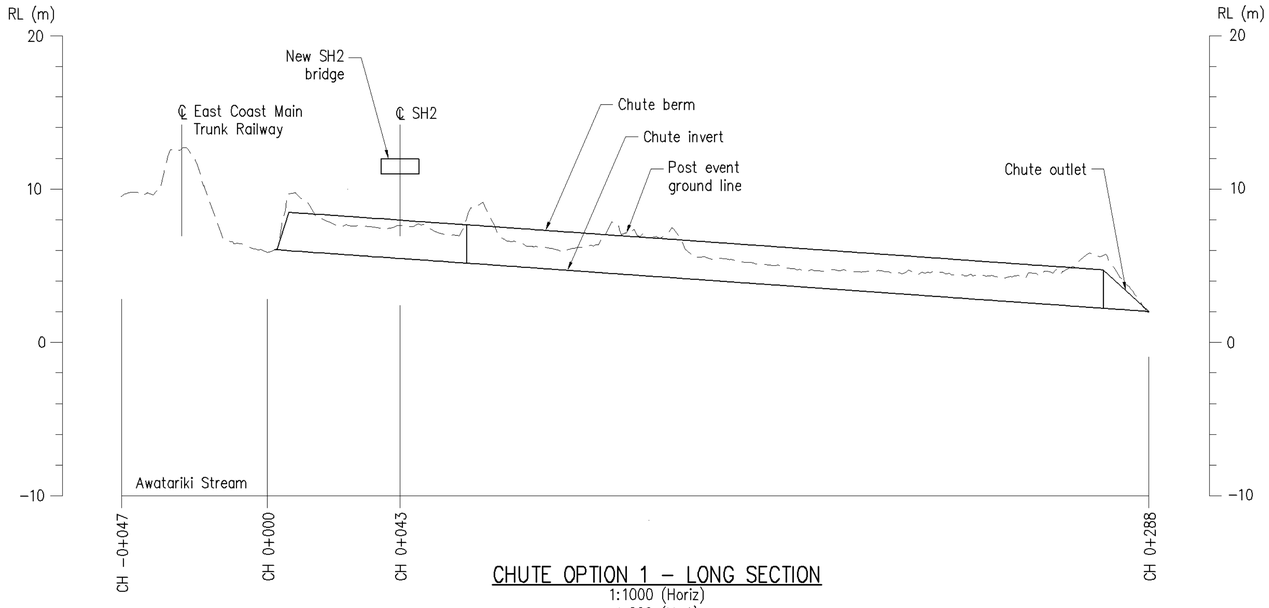
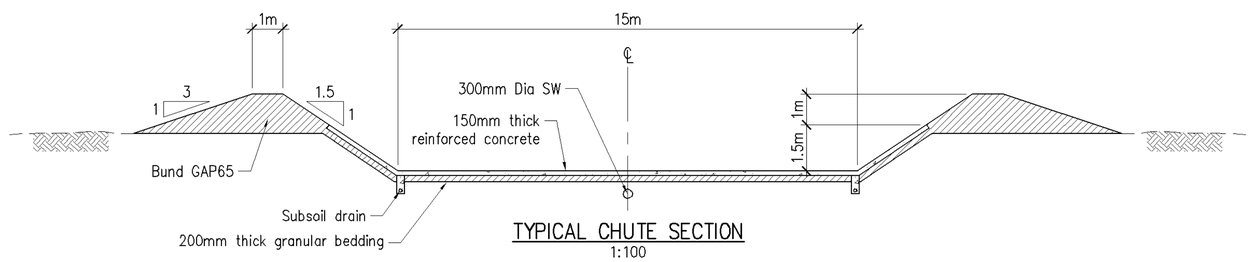


CHUTE OPTION 1 – LONG SECTION

1:1000 (Horiz)
1:200 (Vert)



TYPICAL CHUTE SECTION

1:100

NOTE:

The post event ground lines shown on this drawing are from 0.5m contour data. No stream survey has been supplied

REVISION IN PROGRESS

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REVISIONS					
No.	BY	DATE	DESCRIPTION	APPD
B	KC	13.11.12	Chute option 2 section removed	GM
A	NGW	02.11.12	ISSUED FOR CLIENT REVIEW	CJN

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DESIGNED	PJC	CHECKED	GM
DRAWN	NGW	CHECKED	PJC
APPROVED	CJN	DATE	Oct-12

SCALES:

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

SCALE E 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

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CLIENT: WHAKATANE DISTRICT COUNCIL

MATATA DEBRIS FLOW
CHUTE ALIGNMENT OPTION
SECTION

A1	STATUS: REVIEW	DRAWING NO. 60276243-0112	REV: B

CAD Ref: I:\Projects\Tauranga\60276243 TEEP MISC073 Matata Debris\5 CAD\5.3 Working\DRG\ 60276243-0112.dwg

Last saved: Thu, 1 Nov 2012 04:31 pm

6361600 mN

6361800 mN

6362000 mN

2839600 mE

2839800 mE

N

Awatariki Stream

Mechanically stabilised earth walls at SH2 and Railway

Debris deposition area

Debris flow bunds

Debris flood channel

Awatariki Stream to be culverted through debris bund

Riprap armoring on bund indicative extent shown for cost estimate only

Debris flow bund

Kaokaoroa Street to be realigned. Indicative location shown

East Coast Main Trunk Railway

SH2

20

10

70

60

50

40

30

20

10

NOTE:

This drawing shows a channel and bund alignment based on previous work by other consultants. AECOM have not done any design work for this option.

NOT FOR CONSTRUCTION

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CAD Ref: \\Nzhamtfp001\environs\Projects\Tauranga\60276243 TEEP MISC\073 Matata Debris\5. CADD\5.3 Working\DRG\ 60276243-0116.dwg

This drawing is confidential and shall only be used for the purposes of this project.

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
A	NGW	02.11.12	ISSUED FOR CLIENT REVIEW	CJN

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DESIGNED		CHECKED	
DRAWN	NGW	CHECKED	PJC
APPROVED	CJN	DATE	Oct-12

SCALES:

SCALE 0 15 30

1:1500 (A3) 1:750 (A1)

AECOM

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CLIENT:

WHAKATANE DISTRICT LIVING WITH THE SUN

WHAKATANE DISTRICT COUNCIL

MATATA DEBRIS FLOW
DEBRIS FLOW BUND AND FLOOD CHANNEL PLAN

A1	STATUS: REVIEW	DRAWING NO. 60276243-0116	REV: A

Appendix B

Feasibility Estimate Schedules

Chute to Sea - Retain Rail Bridge

FE

Feasibility Estimate

Item	Description	Base Estimate	Expected Estimate	95%ile Estimate
A	**Project Property Cost**	0	0	0
B	**Investigation and Reporting**	277,453	332,943	424,503
C	**D&PD & Client Managed Costs**	270,910	325,090	414,490
	Construction:			
	MSQA, Client Managed Costs, & Consent Monitoring Fees	177,981		
	Physical Works ($4,582,040)			
D1	Preliminary And General	597,700		
D2	Traffic Management & Temporary Works	142,500		
D3	Fencing	11,500		
D4	Site Clearance & Earthworks	522,455		
D5	Ground Improvement Works	79,600		
D6	Drainage	1,563,880		
D7	Kerb, Channel, Traffic Islands, Footpaths, Crossings	5,400		
D8	Retaining Structures	270,000		
D9	Bridges	1,080,000		
D10	Pavement Layer Construction	168,170		
D11	Pavement Surfacing	17,985		
D12	Pavement Markings And Signs	22,820		
D13	Safety Barriers	27,000		
D14	Landscaping	32,660		
D15	Relocation Of Services	40,370		
D16	(blank)			
D17	(blank)			
D18	(blank)			
D19	(blank)			
D20	(blank)			
D21	(blank)			
D22	(blank)			
D23	(blank)			
D	**Total Construction & MSQA**	4,760,021	5,778,567	7,463,007
Total Base Estimate		5,308,384		
Note: These estimates are exclusive of escalation and GST.				
E	Assessed / Analysed Contingency	1,128,216		
Expected Estimate			6,436,600	
F	Assessed / Analysed Funding Risk		1,865,400	
95th Percentile Estimate				8,302,000

Note: These estimates are exclusive of escalation and GST.

Base Date of Estimate	31 Oct 2012	**Cost Index**
Estimate prepared by:	**Dawie Maritz**	**Signed**
Estimate internal peer review by:	**Geoff Morgan**	**Signed**
Estimate external peer review by:		**Signed**
Estimate approved by Client Project Mgr:		**Signed**

Bund Option (Similar to T&T Option A7) Retain Rail Bridge

FE

Feasibility Estimate

Item	Description	Base Estimate	Expected Estimate	95%ile Estimate
A	**Project Property Cost**	0	0	0
B	**Investigation and Reporting**	161,584	193,904	247,224
C	**D&PD & Client Managed Costs**	137,105	164,525	209,765
	Construction:			
	MSQA, Client Managed Costs, & Consent Monitoring Fees	94,939		
	Physical Works ($2,073,790)			
D1	Preliminary And General	270,500		
D2	Traffic Management & Temporary Works	50,000		
D3	Fencing	11,500		
D4	Site Clearance & Earthworks	729,725		
D5	Ground Improvement Works	84,850		
D6	Drainage	277,880		
D7	Kerb, Channel, Traffic Islands, Footpaths, Crossings	5,400		
D8	Retaining Structures	351,180		
D9	Pavement Layer Construction	151,920		
D10	Pavement Surfacing	17,985		
D11	Pavement Markings And Signs	22,820		
D12	Safety Barriers	27,000		
D13	Landscaping	32,660		
D14	Relocation Of Services	40,370		
D15	(blank)			
D16	(blank)			
D17	(blank)			
D18	(blank)			
D19	(blank)			
D20	(blank)			
D21	(blank)			
D22	(blank)			
D23	(blank)			
D	**Total Construction & MSQA**	2,168,729	2,715,471	3,624,011
Total Base Estimate		2,467,418		
Note: These estimates are exclusive of escalation and GST.				
E	Assessed / Analysed Contingency	606,482		
Expected Estimate			3,073,900	
F	Assessed / Analysed Funding Risk		1,007,100	
95th Percentile Estimate				4,081,000

Note: These estimates are exclusive of escalation and GST.

Base Date of Estimate		31 Oct 2012	**Cost Index**
Estimate prepared by:	**Dawie Maritz**		**Signed**
Estimate internal peer review by:	**Geoff Morgan**		**Signed**
Estimate external peer review by:			**Signed**
Estimate approved by Client Project Mgr:			**Signed**