

# **Toowoomba Bypass Summary Analysis of Design/Construction of Batter Protection at Cut 21 and Cut 26**

(Version 2.0)

## Creative Commons information

© State of Queensland (Department of Transport and Main Roads) 2015



<http://creativecommons.org/licences/by/4.0/>

This work is licensed under a Creative Commons Attribution 4.0 Licence. You are free to copy, communicate and adapt the work, as long as you attribute the authors.

The Queensland Government supports and encourages the dissemination and exchange of information. However, copyright protects this publication. The State of Queensland has no objection to this material being reproduced, made available online or electronically but only if its recognised as the owner of the copyright and this material remains unaltered.



The Queensland Government is committed to providing accessible services to Queenslanders of all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer: While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Released under RIMD/MR

# Document control options

## Departmental approvals

Refer to the appropriate Risk Assessment Tool for relevant reviewer and approver

Date	Name	Position	Action required (Review/endorse/approve)	Due
9/01/2023	Dereck Sanderson	DD(Darling Downs)	Approve	9/01/2023

## Risk level

- GACC major       GACC minor       High risk (but not GACC)       Medium risk

Prepared by	Bruce Ollason
Title	Project Director (Toowoomba Second Range Crossing)
District & Region	Darling Downs District
Branch & Division	Infrastructure Management Division
Project/program	
Project number	
Project location	
Status	
DMS ref. no.	

Released under RTI - DTMS

# Contents

1.	Overview	1
2.	Roles under a Public Private Partnership	1
3.	Design Process	1
4.	Summary of Approach to Batter Treatments	2
5.	IFC Drawings and Requirements	2
6.	Updated IFC Drawings	3
7.	As-built Drawings	3
8.	Conclusion	4

Released under RTI - DTMR

## 1. Overview

On 5 January 2023 the department received a media enquiry regarding the length and spacing of "stabilisation rods" in Cut 21 and Cut 26 which both have experienced geotechnical failures post-construction and are currently subject to significant repair works.

The purpose of this report is to give a high-level summary of the design and construction process related to cut batter treatments with particular reference to Cut 21 RHS and Cut 26 RHS.

(Note RHS is "right hand side" in the direction of chainage which is the northern side of the bypass where its alignment is running east-west.)

The two cuttings are both within the eastern section of the project which extends from the interchange with the Warrego Highway at Helidon in the east to the top of the range at the New England Highway.

This section is characterised by the steepest grades on the project, large cuts and large fills and a varied geology ranging from sections of strong and highly uniform basalt or sandstone to volcanically influenced sections with high variability of material types and strengths.

See locality map attached at Appendix 1.

This analysis has been carried out based on a review of the Issued for Construction (IFC) drawings and the As-built drawings which were produced by Nexus and reviewed and certified by the Independent Reviewer.

## 2. Roles under a Public Private Partnership

The Toowoomba Second Range Crossing (TSRC) project is a Public Private Partnership (PPP) contract (between the State and Nexus Infrastructure) underpinned by a Design and Construct sub-contract (Nexus Delivery) and an Operate and Maintain sub-contract (Nexus Operations and Maintenance).

One of the key elements of the PPP contract model is the role of the Independent Reviewer in key technical processes for the Design and Construct phase.

This role is considered a necessary mechanism to give confidence to lenders and equity investors that their interests are protected.

As a result, the role of TMR under these arrangements is different to the role it normally adopts on the majority of its contracts.

In the context of this report, the key difference of significance is that TMR does not have an approval role in the design and construction activities.

The Independent Reviewer is tasked with reviewing and certifying the design and construction activities.

## 3. Design Process

Nexus have been contracted to design and construct the TSRC in accordance with the project-specific Performance Specification which calls up TMR's various design guidelines and specifications and other design guidelines and codes, for example Austroads design guidelines.

The Performance Specification defines the design process that should be followed for the project.

The design process is an iterative one where a design at a designated level of maturity is submitted to the Independent Reviewer for review and comment.

The comments are fed back to Nexus and incorporated into the design work to take the design to the next level of maturity.

This process continues until the Issue for Construction (IFC) drawings are completed and certified by the Independent Reviewer.

During each iteration of the design the Independent Reviewer provides the design to TMR for comment.

The Independent Reviewer then includes the TMR comments it considers relevant in its list of comments and returns them to Nexus.

TMR has input to the design through its review role but is not the approver of the design.

#### **4. Summary of Approach to Batter Treatments**

The term "stabilisation rods" used in the media enquiry is not a term used on the project.

It is assumed the reference is to soil nails or bolts which is the terminology adopted in the TSRC design. These will be referred to simply as bolts for the purposes of this report.

Bolts used on cut faces were an integral part of the design elements used to protect the cut batter faces from the elements.

It should be noted these treatments are "local level" and designed to protect the cut face. They are not part of the geotechnical design to deliver large scale geotechnical stability across the cuttings.

These design elements fall into two broad categories:

- i. Slope protection where the bolts are used to essentially hold erosion control matting on the face of the cut. The matting is a plastic filament matrix that is filled with a topsoil / hydromulch mix that will facilitate vegetation growth over time.

This was the predominant treatment at Cut 21. (See details at Appendix 2)

- ii. Slope reinforcement where the bolts hold steel mesh reinforcement in place to facilitate installation of a layer shotcrete facing to the batter.

This was the predominant treatment at Cut 26. (See details at Appendix 3).

The designers had a broad understanding of the geology at each of the cuttings based on pre-tender site investigation reports which were supplemented with additional site investigations during the design phase.

Notwithstanding the availability of this information the designers recognised that the actual location and extent of the various materials can only be fully known once the cut face is excavated.

As a result, the design contains numerous references to determining final treatments on site based on either specific testing or geotechnical expert advice.

In other words, the design itself contemplated that there would be changes during the construction phase to reflect the actual site conditions encountered.

Of particular note is the schedule of "J bolts" which are designated as "to be determined on site" in the original drawings. In the case of Cut 21 the drawings advise "Spot bolting and ancillary support may be required on zones of increased weathering and fracturing.

During construction they were not required at Cut 21 and so the As-built schedule shows no "j bolts".

#### **5. IFC Drawings and Requirements**

The IFC drawings are the version that is approved at the end of the design cycle and are therefore the initial set of drawings for construction.

Relevant excerpts from the IFC drawings are attached at Appendix 4.

The bolt requirements as outlined in the IFC drawings are as follows:

i. Cut 21

Depending on batter slope and the type of material encountered the bolt requirements were 2.5 x 3 m spacing with 2 m length, 3 x 3 m spacing with 2 m length or 2.5 x 2.5 m spacing with 2.5 m length.

ii. Cut 26

The bolt requirements were 2.0 x 2.5 m with 3 m length.

## 6. Updated IFC Drawings

During construction in 2017 there was a significant geotechnical failure of Embankment 24.

This required a re-design which resulted in the motorway alignment pushing to the north from the original alignment.

Cut 26 is adjacent to Embankment 24 and so the shift in alignment made it necessary to re-design Cut 26.

The IFC drawings were updated to incorporate the changes from the re-alignment and these were then issued for construction.

Relevant excerpts from the re-issued IFC drawings are attached at Appendix 5.

The bolt requirements as outlined in the updated IFC drawings are as follows:

ii. Cut 21

The requirements for Cut 21 remained unchanged from the original IFC drawings

iii. Cut 26

The bolt requirements were 2.5 x 2.5 m staggered spacing with 3 m length except at Batter 1 which required 5 m length.

## 7. As-built Drawings

The As-built drawings are the documented record of what was constructed.

Relevant excerpts from the As-built drawings are attached at Appendix 6.

The actual spacings and lengths of bolts constructed were as follows:

iii. Cut 21

Depending on batter slope and the type of material encountered the bolt parameters of 2.5 x 3 m spacing with 2 m length, 3 x 3 m spacing with 2 m length or 2.5 x 2.5 m spacing with 2.5 m length were adopted in line with the IFC drawings.

iv. Cut 26

The bolt parameters adopted were all at 2.5 x 2.5 m staggered spacings but depending on location in the cutting the lengths were either 3m or 6 m.

## 8. Likely Geotechnical Failure Mechanisms

As mentioned in Section 4 the bolting that has been carried out on the project is part of "local level" treatments that are designed to protect the face of the cut batters from the elements over time.

Although protecting the faces of cuttings is critically important for the general stability and durability of the cuttings these protection treatments are not part of the geotechnical design to provide the large-scale stability of the cuttings.

The inference that changes in bolt spacing and lengths has led to the failures in Cut 21 and Cut 26 is misplaced.

In general terms the large-scale stability problems being encountered at these cuttings has resulted from deep seated thin lenses of poor material being weakened by the ingress of water resulting in a loss of resistance and an inability to support the material above them.

A cross-section from Cut 26 showing the geological layering and likely failure planes is attached at Appendix 7.

## 9. Conclusion

The original design contemplated adjustments to the design during construction to reflect the ground conditions exposed during excavation.

The constructed works are generally in accordance with the original design (or re-design for Cut 26) and the variations to the design have not resulted in shortening any bolts and in fact has resulted in longer bolts than originally scheduled in some sections of the design.

NR



**Bruce Ollason**  
**Project Director (Toowoomba Second Range Crossing)**

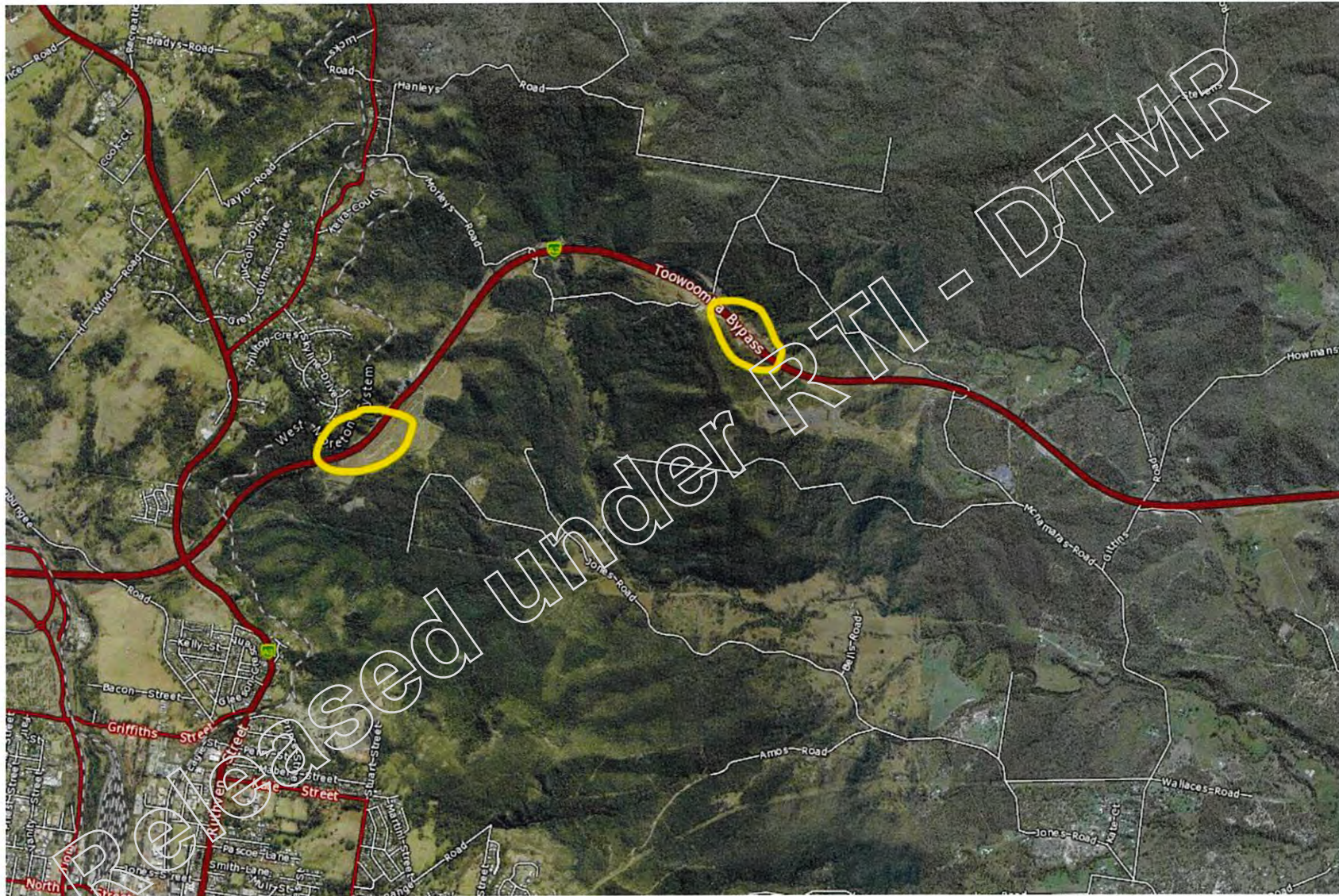
9 January 2023



Released under RTI - DTMR

Appendix 1

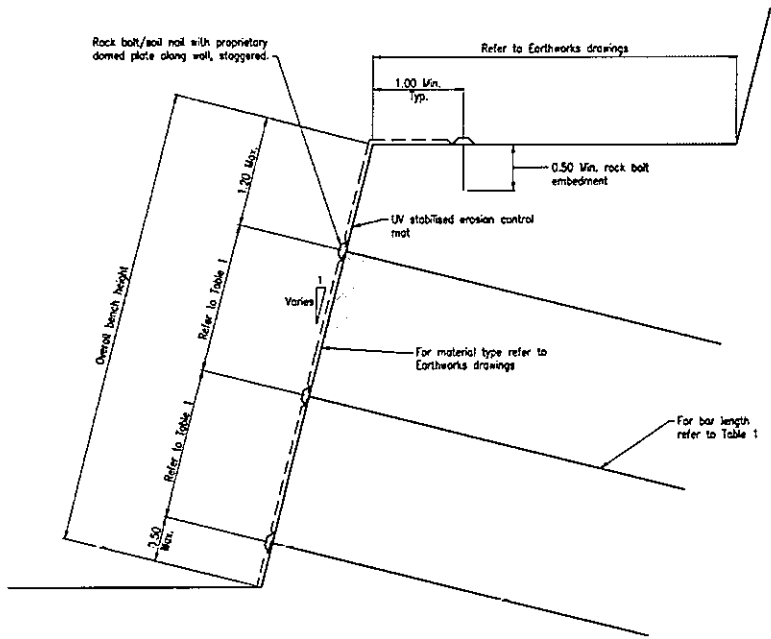
Locality Map



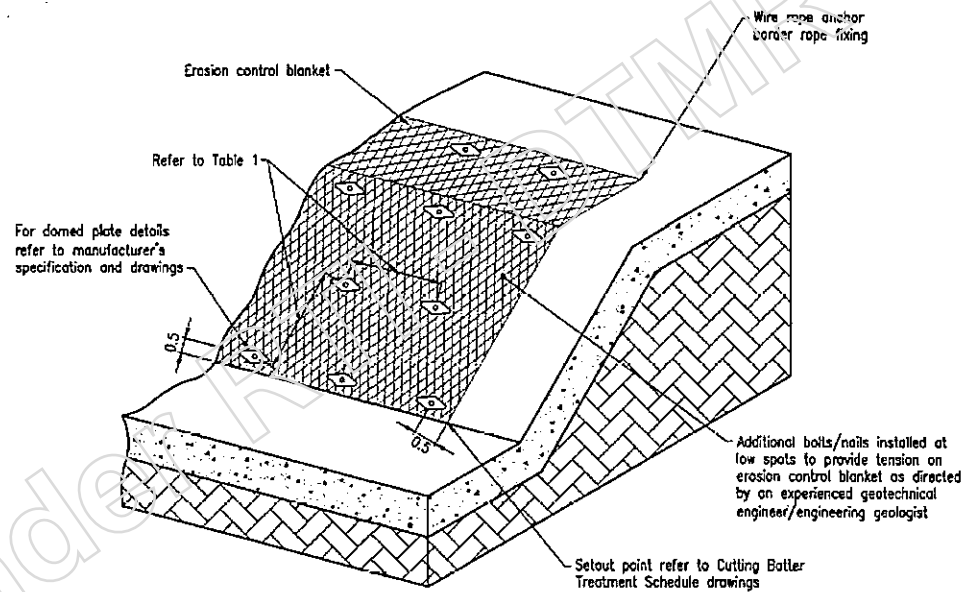
Released under RTI - DTMR

Appendix 2

Details of Slope Protection



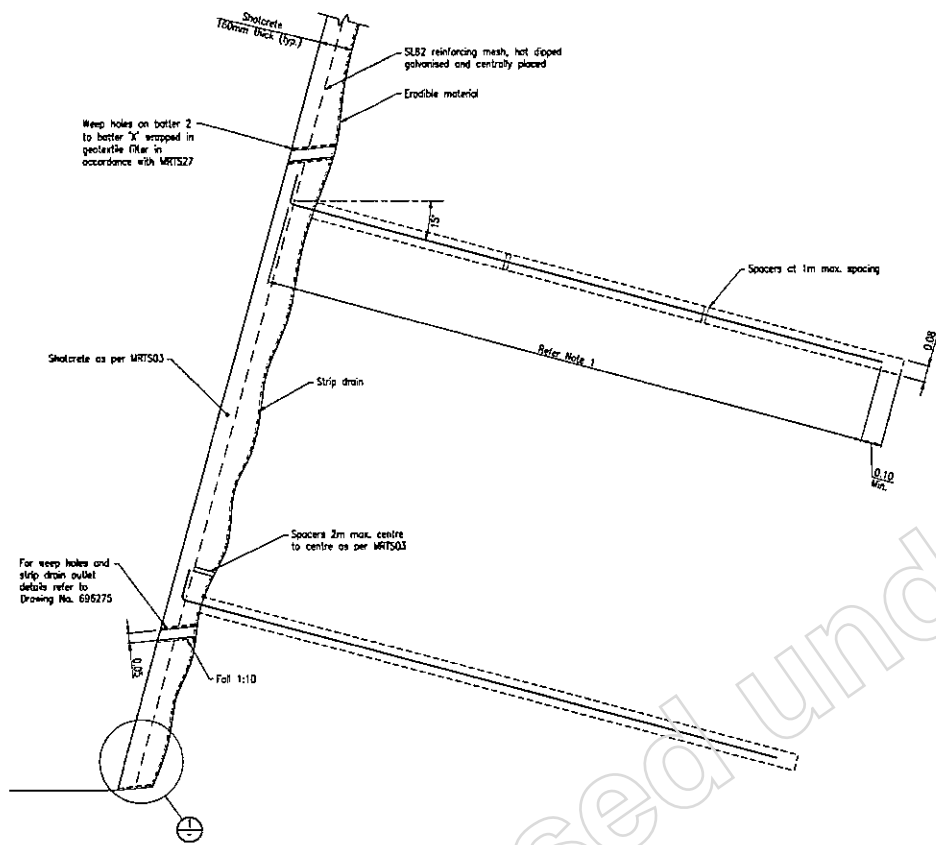
GENERAL LAYOUT OF EROSION CONTROL BLANKET  
Scale A



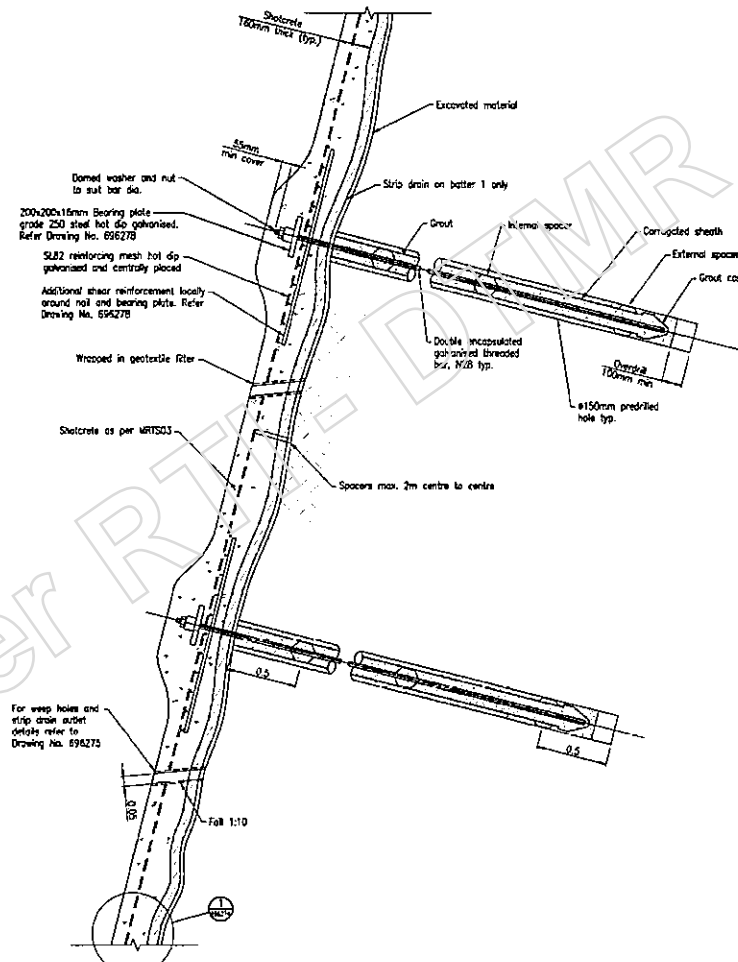
Released under RTI - DTMR

Appendix 3

Details of Slope Reinforcement



TYPICAL SHOTCRETE FACING DETAILS

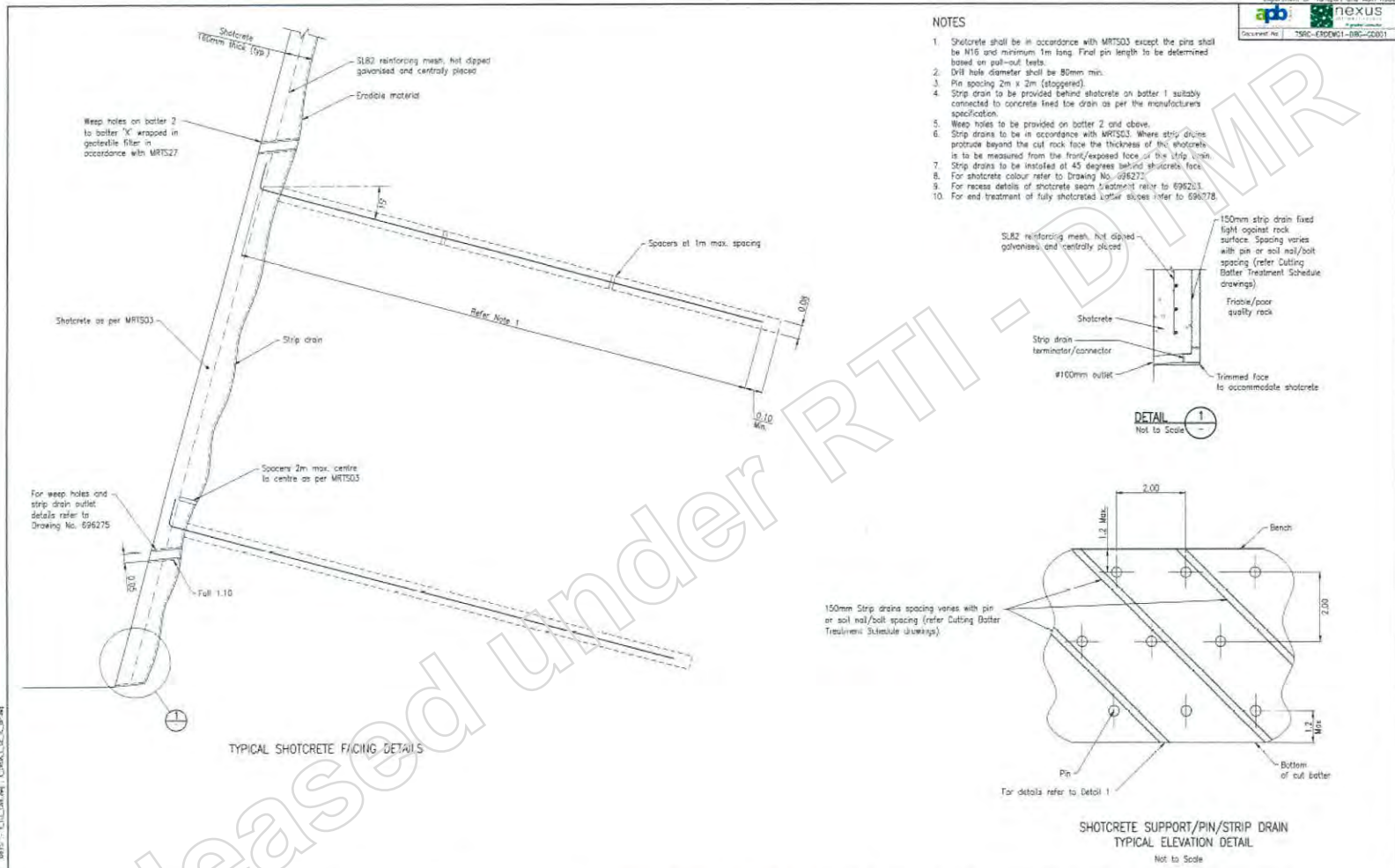


TYPICAL REINFORCED SHOTCRETE FACING DETAILS  
Not to Scale

Appendix 4

IFC Drawings

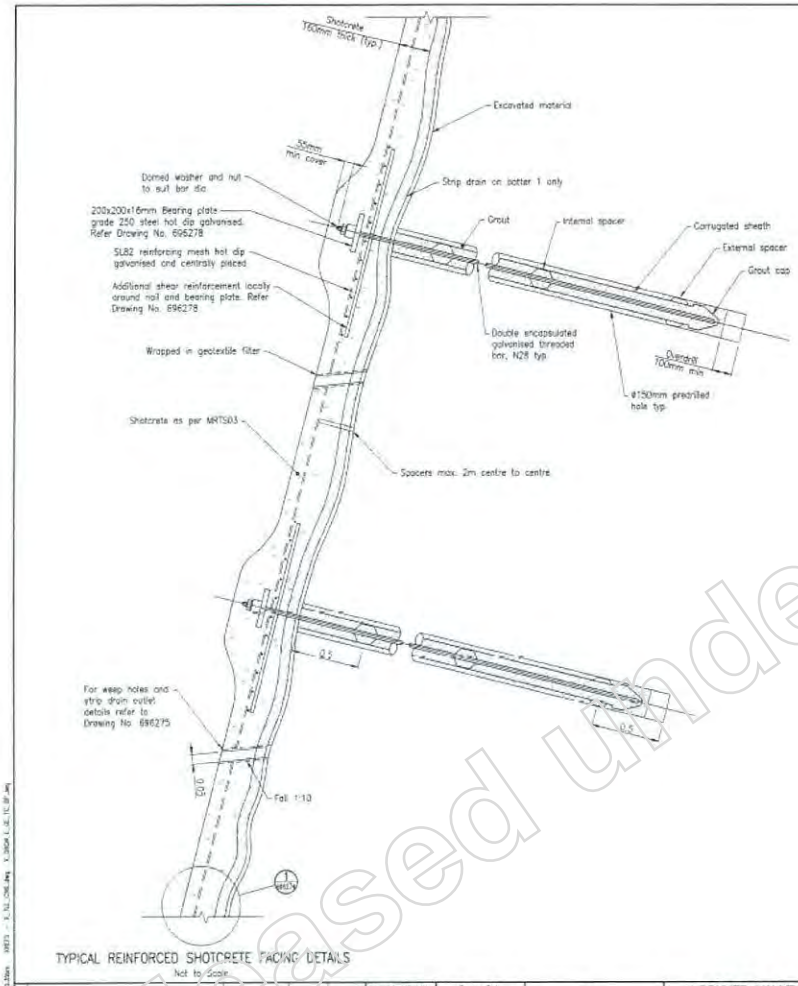
Released under RTI - DTMR



- NOTES**
- Shotcrete shall be in accordance with MRTS03 except the pins shall be M16 and minimum 1m long. Final pin length to be determined based on pull-out tests.
  - D18 hole diameter shall be 80mm min.
  - Pin spacing 2m x 2m (staggered).
  - Strip drain to be provided behind shotcrete on batter 1 suitably connected to concrete lined toe drain as per the manufacturer's specification.
  - Weep holes to be provided on batter 2 and above.
  - Strip drains to be in accordance with MRTS03. Where strip drains protrude beyond the cut rock face the thickness of the shotcrete is to be measured from the front/ exposed face of the strip drain. Strip drains to be installed at 45 degrees behind shotcrete face.
  - For shotcrete colour refer to Drawing No. 696272.
  - For recess details of shotcrete seam treatment refer to 696273.
  - For end treatment of fully shotcreted upper slopes refer to 696278.

Associated Job No.		Survey Data		LOCKYER VALLEY RC AND TOOWOOMBA RC		BATTER PROTECTION GENERAL DETAILS - CUTTING		Queensland Government	
Datum		CGDA84		WARREGO HIGHWAY - GORE HIGHWAY		SHOTCRETE FACING DETAILS - TYPE B		Job No. 265/18A/3	
Auxiliary City No.		MCA94 256		CTL CHGE 0.000 - 43100.000 (MCA00)		SLOPE PROTECTION - EAST - SHEET 1		Contract No. 696274 1A	
Height Origin		AHD Derived		Reference Points		Drawn		Series Number	
Survey Books		MR3392C		Proceeding BP		L. Brennan		NO. DATE	
Dimensions shown in metres unless otherwise stated		19A/22A		2.37		43.10		18/11/25/08/16	
Through Channels from NH 18A/314 2.37km - 45.47km		8.81		28A/B		Designed		M. Owen	

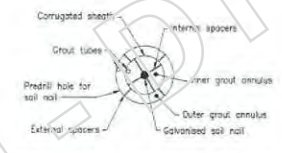




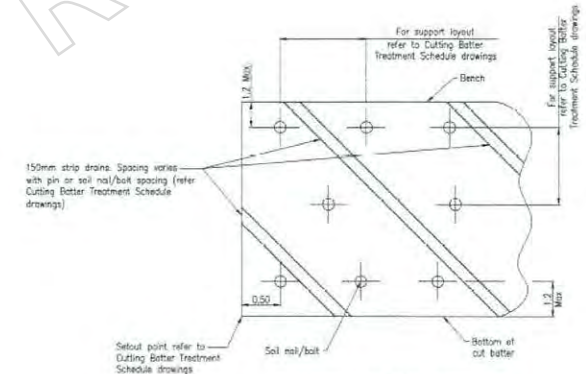
TYPICAL REINFORCED SHOTCRETE FACING DETAILS  
Not to Scale

NOTES


1. For details of cutting geometry (including cut height, batter height and angle and bench width) refer to earthworks drawings.
2. Spacing of soil nails/bolts to be staggered. Soil nails/bolts shall be Grade B500N deformed reinforcing bar in accordance with MRT503, unless specified otherwise. Soil nails/bolts to be tested in accordance with MRT503.
3. Corrugated sheath shall be in accordance with MRT503.
4. Spacers shall be provided to ensure the soil nail/bolt and sheathing are centrally located within the hole as per MRT503.
5. Strip drains shall be installed on batter 1 only and single weep hole shall be constructed to drain to surface water drain. Refer to Drainage drawings for longitudinal drainage.
6. For shotcrete colour refer Drawing No. 696273.
7. For additional shear reinforcement and base plate details refer to Drawing No. 696278.



TYPICAL SECTION THROUGH SOIL NAIL/BOLT  
Not to Scale

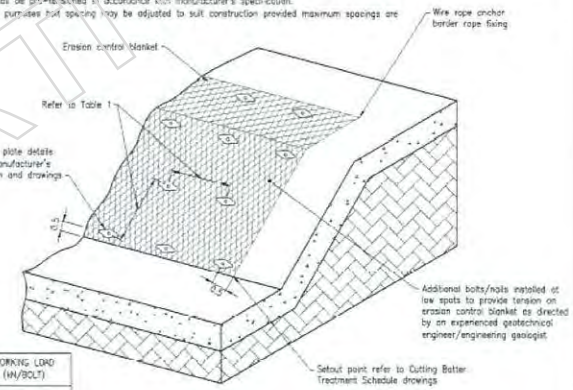
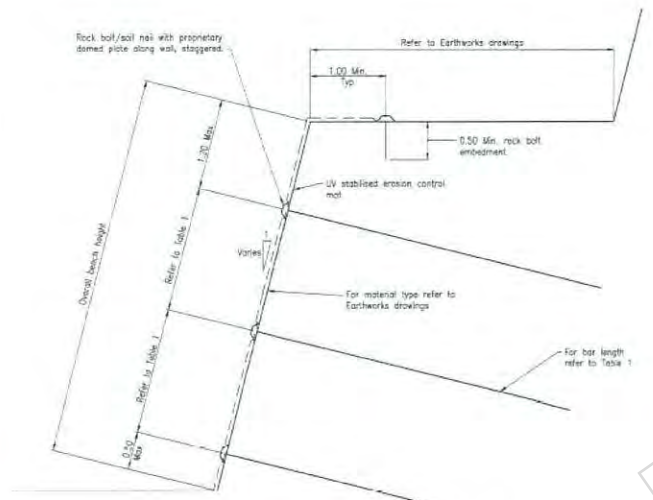


SHOTCRETE SUPPORT/PIN/STRIP DRAIN  
TYPICAL ELEVATION DETAIL  
Not to Scale

Associated Job No Datum Survey Date Scale Drawing No Date Height Design Survey Books MRS 5920 Dimensions shown in metres except where shown otherwise Through Channel Top: N: 184214 2.27m - 41.47m	Survey Date Datum Height Design Survey Books MRS 5920 Dimensions shown in metres except where shown otherwise	Scale Not to Scale	LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY CTL CHGE 0.000 - 43100.000 (MC0400)		BATTER PROTECTION GENERAL DETAILS - CUTTING SOIL NAILS/BOLTS - TYPE K1 SLOPE REINFORCEMENT EAST - SHEET 1		 Queensland Government Job No. 255/184/3 Contract No. 696277 1A Series Number CD-03 of 10 MR_Edge_2017/11
			Reference Points Pilewing BP H&M 20 2.37 43.10 4.81 29/8				

NOTES

- Erosion control blanket is to be applied based on material properties assessed during construction (refer Table 1) by an experienced geotechnical engineer/engineering geologist.
- Due consideration must be given to rock mass structures and geological variability (eg. interbedded nature, weathering, strength variations) in selection of erosion control blanket.
- Erosion control blanket to be installed in accordance with manufacturer's specifications. All components to have min 100 year design life.
- Nominal erosion control blanket is based on current durability assessments of no presence of aggressive materials on site. The experienced geotechnical engineer/engineering geologist shall be informed should the assessment be no longer valid.
- Technical requirements of erosion control blanket system:
  - Properties of steel mesh:
    - Female strength of mesh: 53N/m
    - Net spacing shown in Table 1 may be modified to suit alternative mesh specifications and shall be approved by the experienced geotechnical engineer/engineering geologist.
  - Properties of erosion control blanket:
    - UV resistance (ASTM D4355): UV stabilised
    - Colour: to match existing terrain as close as practicable
  - Properties of rock bolt/soil nail / mat / face plate:
    - Bar type: 22mm GRP
    - Drill hole diameter: 60mm
    - Ultimate tensile strength: 250kN
    - Ultimate capacity of GRP mat: 60kN
    - Load to be applied on mat: 20kN
    - Face plate: proprietary dished plate
- Distance between rock bolt/soil nail and top of batter shall be 1.2m maximum and 0.5m maximum at bottom of batter. To be reviewed on site by an experienced geotechnical engineer/engineering geologist.
- For soil nail / bolt spacing, length and material types refer to Table 1.
- Refer to Geotechnical Interpretive Report - Soil (TSPC-ERODM23-REP-DU02) for field (or making test procedure: Slake Durability Index test method to be undertaken as per AS4353.3.4.
- Landscaping to be applied as soon as practicable. Refer to Landscaping drawings for landscaping requirements.
- Soil nails/bolts shall be pre-tensioned in accordance with manufacturer's specification.
- For constructability purposes nail spacing may be adjusted to suit construction provided maximum spacings are not exceeded.



GENERAL LAYOUT OF EROSION CONTROL BLANKET  
Scale A

GENERAL NAIL ARRANGEMENT  
Net to Scale

TABLE 1 SUPPORT TYPE D – EROSION CONTROL BLANKET

EROSION CONTROL TYPE 1	BATTER SLOPE (V:H)	MATERIAL TYPE	JAR SLAKING INDEX (JSI)	SLAKE DURABILITY INDEX (SDI)	DURISON CLASS NUMBER	BOLT SPACING (m) (V:H)	BAR LENGTH (m)	WORKING LOAD (kN/BOLT)
D1	1:1	HW/MW SANDSTONE, HW/MW BASALT, INCLUDING INTERBEDDED SHALE	4	+50	J3	2.5 x 3	2	25
D2	1:1	HW/MW INTERBEDDED, HW/MW CLAYSTONE/MUDSTONE/SILTSTONE AND KW SANDSTONE				2.5 x 2.5	2.5 <sup>1</sup>	25
D3	1:1.5	HW/MW INTERBEDDED, HW/MW CLAYSTONE/MUDSTONE/SILTSTONE AND KW SANDSTONE				2 x 3	2	23


1 Type D erosion control required where JSI < 4 and/or SDI < 50 (or erosion protection required otherwise).  
 2 HW-MW amygdaloid basalt and HW massive basalt require type D1 support regardless of JSI and SDI values.  
 3 Bar length to be revised based on pull-out test in similar material as per AS1100. For details refer Drawing No. 696273. Pull-out test resistance required for 2m bar > 55 kN.

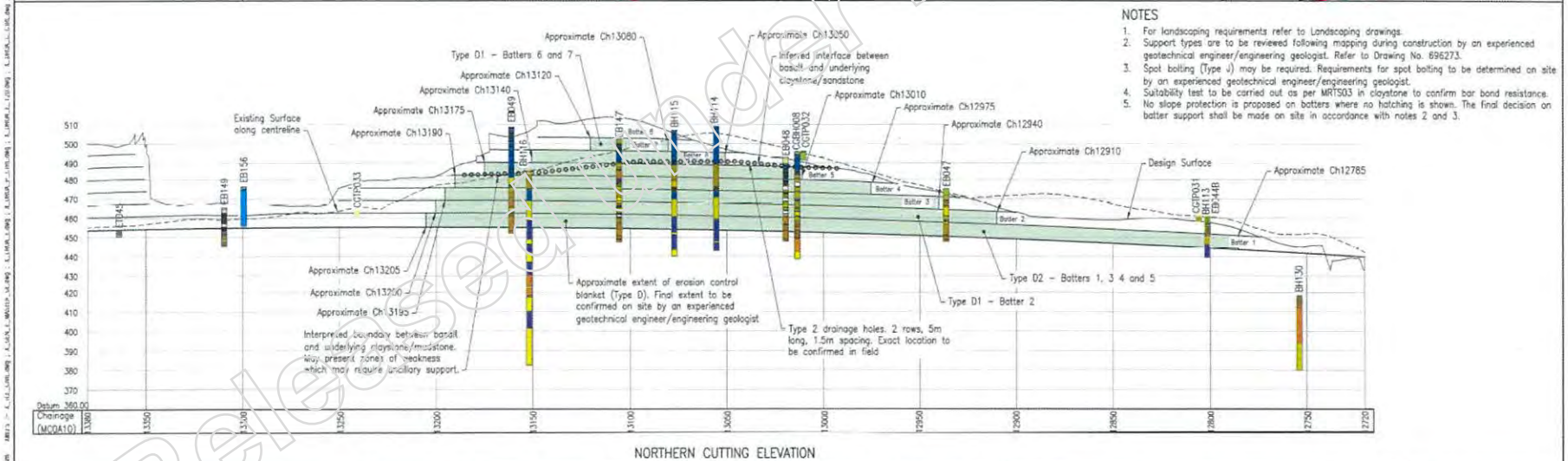
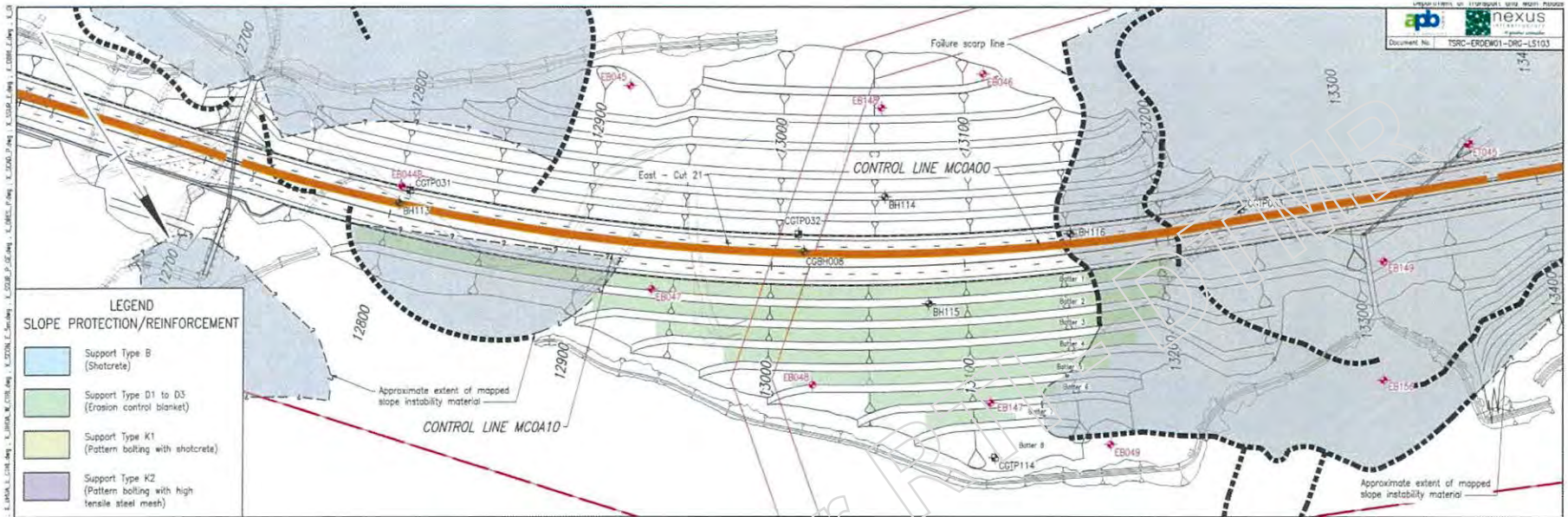
Survey Date: _____ Datum: 03494 Auxiliary Dtp No: _____ HAZ: _____ CH: _____ Height: _____ Origin: _____ Survey Book: _____	Scales: _____ <b>LOCKYER VALLEY RC AND TOowoomba RC</b> <b>WARREGO HIGHWAY – GORE HIGHWAY</b> GTL CHGE 0.000 – 43100.000 (M00400)	<b>BATTER PROTECTION GENERAL DETAILS – CUTTING</b> <b>EROSION CONTROL BLANKET DETAILS</b> <b>TYPE D SLOPE PROTECTION – EAST</b>	 <b>Queensland Government</b> Job No. 265/18A/3 Contract No. DDWD-71 Drawing No. 696276 1A Series Number 01-08 of 10 Web Code 192741
--	--	---	---

**NOTES**

- For detailed cross sections of cuts refer to Earthworks Drawings.
- For typical cutting layout and geometry refer to Earthworks drawings.
- Landslide/colluvium/scree/talus deposits identified. For excavation sequence details refer to Earthworks drawings.
- For batter protection extents refer to Batter Protection Plan and Longitudinal Section drawings.
- Extent of rock fall protection is based on geotechnical requirements only and does not consider general road design requirements. For full extent of rock fall fence refer to Road Alignment drawings.

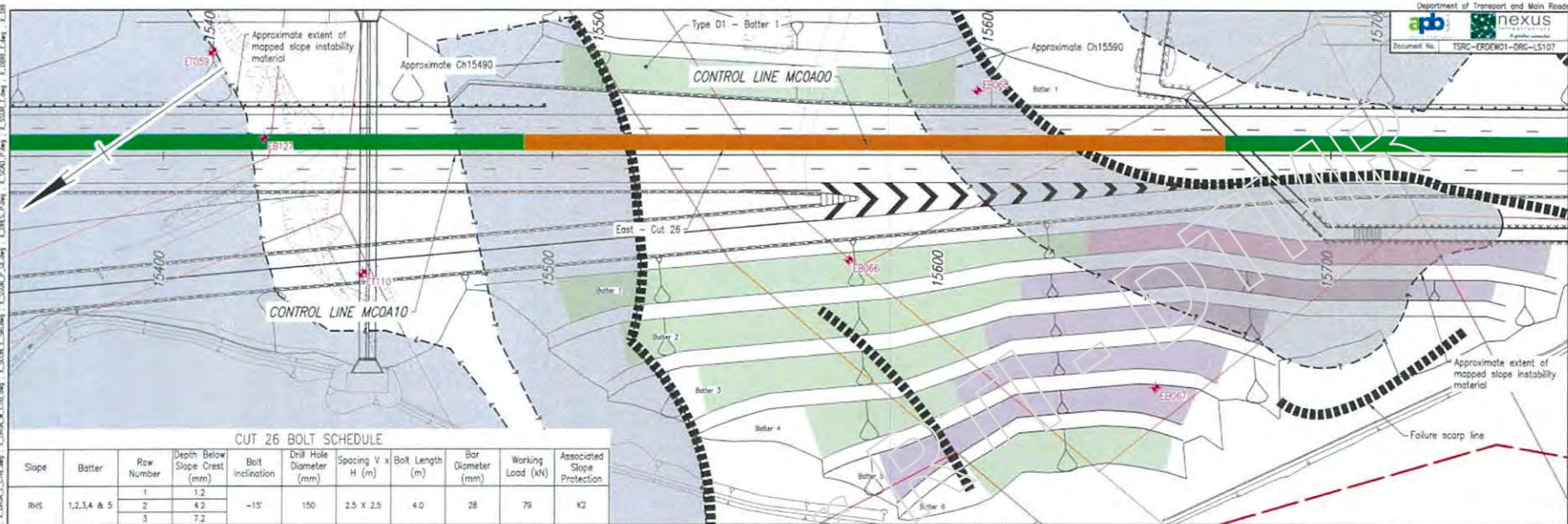
ID	CHANAGE		TYPE (BOX / SIDE LONG)	CUT HEIGHT		EXPECTED GEOLOGICAL CONDITIONS	EXPECTED GROUNDWATER CONDITIONS	SLOPE PROTECTION COVERAGE OF TOTAL CUT FACE AREA (%)				SLOPE REINFORCEMENT (REFER NOTE 4)			SUB-SURFACE DRAINAGE			ROCKFALL PROTECTION		REMARKS				
	FROM	TO		LHS	RHS			EROSION PROTECTION				TYPE K - PATTERN BOLTING (K1 WITH SHOTCRETE, K2 WITH HIGH TENSILE STEEL MESH) TYPE J - SPOT BOLTING WITH SHOTCRETE			TYPE 1 SUB-HORIZONTAL DRAINAGE			LENGTH (M)						
								TYPE B - SHOTCRETE	TYPE D1 (1V:1H HW/MW SANDSTONE, BASALT)	TYPE D2 (1V:1.5H HW/MW INTERBEDDED, CLAYSTONE/ MUDSTONE AND XW SANDSTONE)	TYPE D3 (1V:1.5H HW/MW CLAYSTONE/MUDSTONE AND HW/MW INTERBEDDED CLAYSTONE/MUDSTONE /SILTSTONE	TYPE	SPACING V x H (m)	SOIL NAIL/ROCK ANCHOR LENGTH (m)	COVERAGE OF TOTAL CUT FACE AREA %	SPACING (m)	DRAIN HOLE LENGTH (m)	TOTAL DRAIN HOLES	LHS		RHS			
CUT 20	12500	12710	Side Long	12.8	2.5	Residual: Sandstone - XW to MW	EB145 - 30.43m bgl - RL383.95m - 24/02/2016 EB146 - 33.45m bgl - RL426.95m - 24/02/2016 EB141 - 31.37m bgl - RL421.56m - 24/02/2016																	
	12710	12950	Box	45.1	14.0	Minor colluvium; Residual; Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to MW; Mudstone - XW to SW; Coal seams and Ferricrete; Basalt (massive) - XW to SW	BH115 - Moist at base 65.23m bgl - RL438.95m - 12/01/2016 BH115 - 65.58m bgl - RL438.40m - 01/02/2016 BH116 - 70.04m bgl - RL412.49m - 14/01/2015 BH116 - 66.87m bgl - RL412.56m - 01/02/2015 EB045 - 33.92m bgl - RL454.92m - 26/11/2015 EB045 - 33.92m bgl - RL454.92m - 13/01/2016 EB045 - 33.42m bgl - RL455.42m - 13/01/2016 to 01/02/2016																	
	12950	13240	Box	50.3	37.2	Colluvium (slope instability area); Basalt - MW to SW (with some extremely weathered seams and infill joints); Interbedded Sandstone/Siltstone/Mudstone - HW	EB045 - 33.92m bgl - RL454.92m - 01/02/2016 EB045 - 33.95m bgl - RL454.89m - 24/2/2016 EB045 - 33.96m bgl - RL454.88m - 22/03/2016 EB048 - 29.25m bgl - RL461.70m - 25/11/2015 EB149 - 12.90m bgl - RL449.24m - 24/02/2016 EB149 - 15.14m bgl - RL446.00m - 22/03/2016																	
CUT 24	14380	14770	Box	34.2	31.3	Residual; Interbedded Sandstone/Siltstone/Mudstone - XW to SW; Coal Seams; Basalt - HW	EB061 - 28.24m bgl - RL414.894m - 26/11/2015 EB061 - 31.93m bgl - RL409.20m - 14/1/2016 EB061 - 31.93m bgl - RL409.20m - 1/2/2016 EB061 - 31.95m bgl - RL409.18m - 24/02/2016 EB061 - 31.97m bgl - RL409.16m - 23/03/2016																	
	15100	15200	Box	8.3	26.5	Colluvium (slope instability area); Residual; Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - HW to MW	BH043 - 30.785 m bgl - RL433.035m - 04/01/16 BH043 - 30.72 m bgl - RL433.08m - 12/01/16 & 02/02/16 EB064 - 17.54 m bgl - RL449.987m - 14/01/16 EB064 - 18.44 m bgl - RL449.087m - 02/02/16 EB065 - Dry @ 19.85 m bgl - RL450.939m - 14/01/16 EB065 - Dry @ 19.89 m bgl - RL450.859m - 02/02/16																	
	15200	15340	Box	12.1	26.1																			
CUT 25	15480	15600	Box	12.3	44.3	Colluvium (rear surface); Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.45m bgl - RL448.77m - 02/02/2016 EB067 - 31.46m bgl - RL445.01m - 02/02/2016																	
	15600	15750	Box	7.2	45.8																			
	15750	16280	Box	14.7	41.7	Colluvium (rear surface); Basalt (Amygdaloid) - XW to MW; Basalt (talus) and talus; Basalt	EB043 (off alignment 50m) - Dry at 39.5m bgl - RL574.24m EB050 (off alignment 50m) - Dry at 33.5m bgl - RL518.64m																	
EMBANKMENT 25	16380	16630	Side Long	11.7	10.3	Residual (rear surface); Basalt (Amygdaloid) - XW to SW	EB073 - 10.12 m bgl - 516.01 RL - 2/2/2016																	

Associated Job No.	Survey Data	Scales	LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY		BATTER PROTECTION CUTTING BATTER TREATMENT SCHEDULE EAST - SHEET 2			 Job No. 265/18A/3 Contract No. DDWD-71 Drawing No. 696285 Series Number SH-101 of 04 MRR Detail 10/1/16
Auxiliary Drg Nos.	Datum: GDA94 Horiz. Cntd: MGA84 Z56 Height Origin: AHD Derived		CTL CHGE 0.000 = 4,3100.000 (MGA00)		ENGINEERING CERTIFICATION (REG)			
Survey Books	MR93920		Reference Points		ENG. AREA: Gestic NAME: A Kemp SIGNATURE: [Signature] NO. DATE: 18116 26/02/16			



- NOTES**
1. For landscaping requirements refer to Landscaping drawings.
  2. Support types are to be reviewed following mapping during construction by an experienced geotechnical engineer/engineering geologist. Refer to Drawing No. 896273.
  3. Spot bolting (Type J) may be required. Requirements for spot bolting to be determined on site by an experienced geotechnical engineer/engineering geologist.
  4. Suitability test to be carried out as per MRTS03 in claystone to confirm bar bond resistance.
  5. No slope protection is proposed on batters where no hatching is shown. The final decision on batter support shall be made on site in accordance with notes 2 and 3.

Associated Job Nos		Survey Date		Scales		LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY CTL CHGE 0.000 - 43100.000 (MCOA00)		BATTER PROTECTION PLAN AND LONGITUDINAL SECTION EAST - CUT 21 RHS				<b>Queensland Government</b> Job No. 265/18A/3 Contract No. DDWD-71 Drawing No. 696301/A Series Number LS-103 of 26 MRR Detail 107/141	
Datum		GDA94		0 10 20 30 40m		Preceding		Drawn		ENGINEERING CERTIFICATION (EPD)		NO. DATE 16116 26/09/16	
Auxiliary Drg Nos		MG94 256				Reference Points		Signed		NAME		NO. DATE	
A Issued For Construction - (K. Oct No 196-26-01-01-02-00-01)		AHD Derived				From start to		Dwg		SIGNATURE		NO. DATE	
Revisions/Descriptions		Date		Microfiled		From end to		Dwg		NAME		NO. DATE	
MP93920						Following		Dwg		NAME		NO. DATE	



**CUT 26 BOLT SCHEDULE**

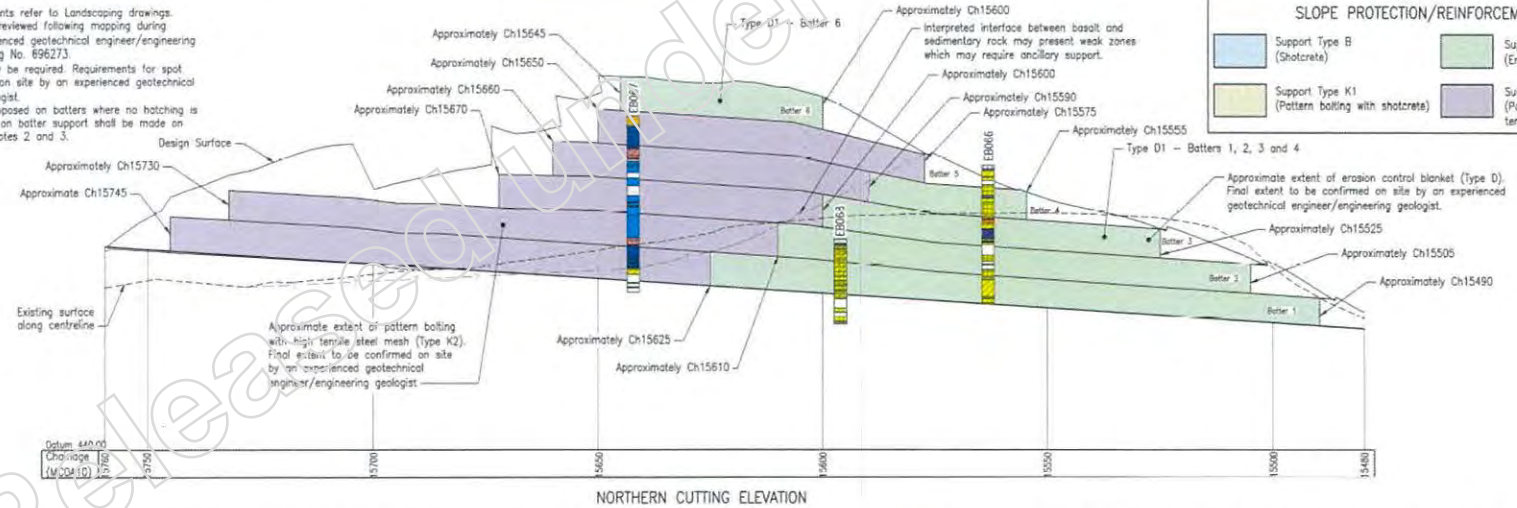
Slope	Batter	Row Number	Depth Below Slope Crest (mm)	Bolt Inclination	Drill Hole Diameter (mm)	Spacing V x H (m)	Bolt Length (m)	Bar Diameter (mm)	Working Load (kN)	Associated Slope Protection
RHS	1, 2, 3, 4 & 5	1	1.2	-15°	150	2.5 X 2.5	4.0	28	79	K2
		2	4.2							
		3	7.2							

**NOTES**

- For landscaping requirements refer to Landscaping drawings.
- Support types are to be reviewed following mapping during construction by an experienced geotechnical engineer/engineering geologist. Refer to Drawing No. 696273.
- Spot bolting (Type J) may be required. Requirements for spot bolting to be determined on site by an experienced geotechnical engineer/engineering geologist.
- No slope protection is proposed on batters where no hatching is shown. The final decision on batter support shall be made on site in accordance with notes 2 and 3.

**LEGEND**  
**SLOPE PROTECTION/REINFORCEMENT**

Support Type B (Shotcrete)	Support Type D1 to D3 (Erosion control blanket)
Support Type K1 (Pattern bolting with shotcrete)	Support Type K2 (Pattern bolting with high tensile steel mesh)



NORTHERN CUTTING ELEVATION

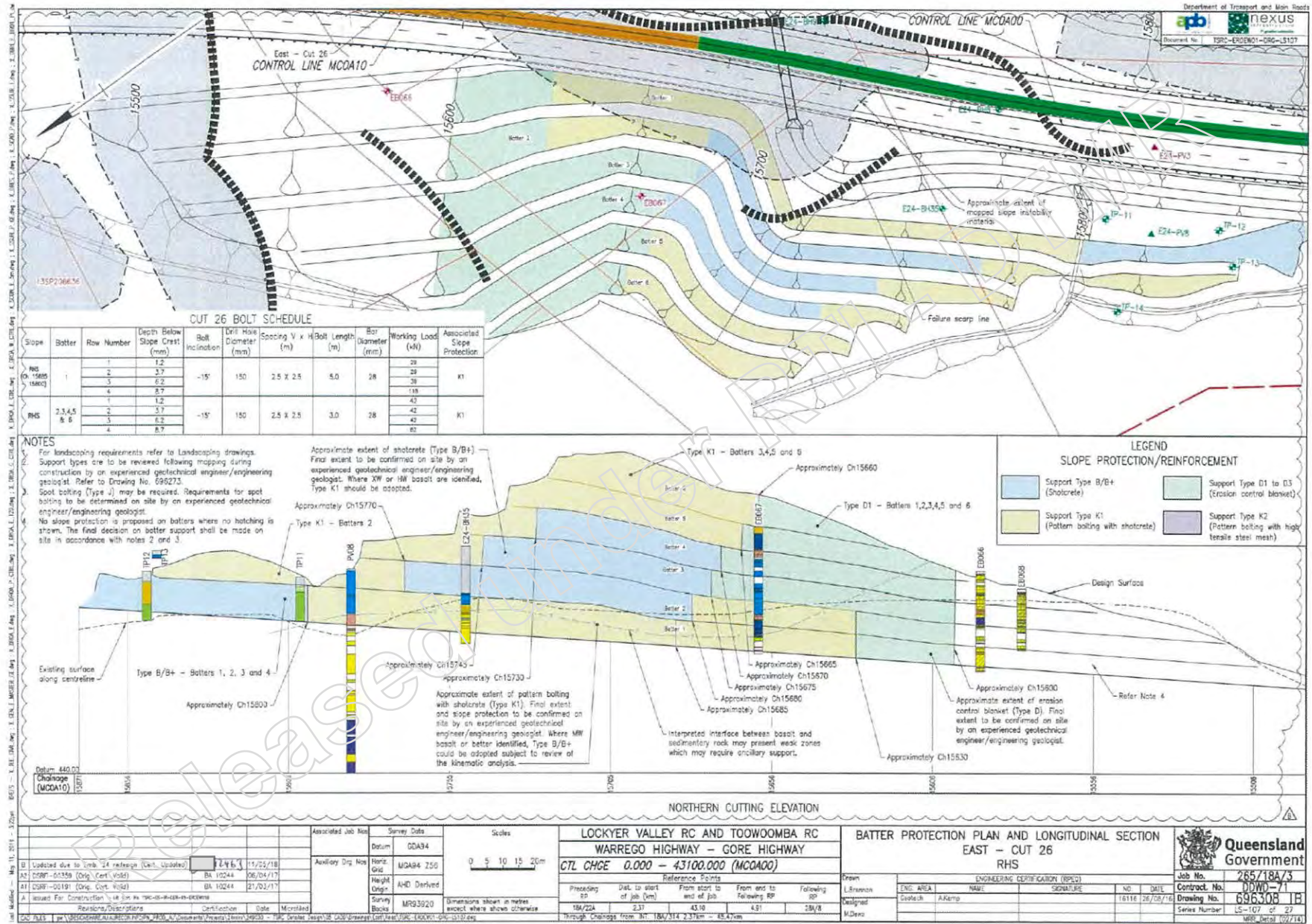
Associated Job No.	Survey Date	Scales		LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY		BATTER PROTECTION PLAN AND LONGITUDINAL SECTION EAST - CUT 26		Queensland Government	
Drawn	GDAG4	0 5 10 15 20m		CTL CHGE 0.000 - 43100.000 (MCOA00)		EAST - CUT 26		Job No. 265/18A/3	
Auxiliary Dwg No.	MGAG4 256			Reference Points		RHS		Contract No. DDWD-71	
Height Origin	AHD Derived			Preparation		From start to		Drawing No. 696308	
Survey Book	MR93920			Dist. to start		From end to		Series Number LS-107 of 26	
Dimension	incept. w			Following		Drawn		MPR Detail (02/116)	
Revisions/Descriptions	Certification	Date		98.9%		ENG. AREA			
						NAME			
						SIGNATURE			
						NO.		16116 26/06/16	
						DATE			

Released under RTI - DTMR

Appendix 5

Updated IFC Drawings

NOTES										Department of Transport and Main Roads		mexus																	
1. For notes refer to Drawing No. 695284										Project No. T58C-E60001-080-B101		Drawing No. 695284-1																	
ID	CHANNAGE		CUT HEIGHT		EXPECTED GEOLOGICAL CONDITIONS	EXPECTED GROUNDWATER CONDITIONS	SLOPE PROTECTION COVERAGE OF TOTAL CUT FACE AREA (%)				SLOPE REINFORCEMENT (REFER NOTE 4)			SUB-SURFACE DRAINAGE			ROCK PROTECTION		REMARKS										
	FROM	TO	TYPE (BOX / SIDE / LONG)	LHS			RHS	EROSION PROTECTION				TYPE K - PATTERN BOLTING (K1 WITH SHOTCRETE, K2 WITH HIGH TENSILE STEEL MESH)			TYPE I SUB-HORIZONTAL DRAINAGE			LENGTH (M)											
								TYPE B/B+ SHOTCRETE	TYPE D1 (1/1.5H HW/MW SANDSTONE, BASALT)	TYPE D2 (1/1.5H HW/MW INTERBEDDED CLAYSTONE/MUDSTONE AND XW SANDSTONE)	TYPE D3 (1/1.5H HW/MW CLAYSTONE/MUDSTONE AND HW/MW INTERBEDDED CLAYSTONE/MUDSTONE /SILTSTONE)	TYPE	SPACING V x H (m)	SOIL NAIL/ROCK ANCHOR LENGTH (m)	COVERAGE OF TOTAL CUT FACE AREA %	SPACING (m)	DRAIN HOLE LENGTH (m)	TOTAL DRAIN HOLES		U/S	R/S								
CUT 20	12500	12710	Slope Long	12.8	2.5	Residual Sandstone - XW to MW	EB145 - 33.4m bgl - RL393.85m - 24/02/2016 EB146 - 32.45m bgl - RL428.05m - 24/02/2016 EB141 - 31.37m bgl - RL421.05m - 24/02/2016	△																					
	12710	12900	Box	15.1	24.0	Minor colluvium, Residual Sandstone - XW to SW, Interbedded Sandstone/Siltstone/Mudstone - SW to MW, Mudstone - XW to SW, Coal seams and Ferruginous Besselt (massive) - XW to SW	BH115 - 65.50m bgl - RL438.40m - 01/02/2016 BH116 - 70.04m bgl - RL412.48m - 14/01/2015 BH118 - 69.97m bgl - RL415.56m - 01/02/2015 EB045 - 33.92m bgl - RL454.92m - 28/11/2015 EB045 - 33.92m bgl - RL454.92m - 13/01/2016 EB045 - 33.42m bgl - RL455.42m - 13/01/2016 to 01/02/2016 EB045 - 33.92m bgl - RL454.92m - 01/02/2016 EB045 - 33.95m bgl - RL454.85m - 24/02/2016 EB045 - 33.95m bgl - RL454.85m - 22/03/2016 EB048 - 29.25m bgl - RL491.70m - 25/11/2015 EB148 - 13.85m bgl - RL448.24m - 24/02/2016 EB148 - 15.14m bgl - RL446.00m - 22/03/2016																						
	12950	13240	Box	50.3	57.2	Colluvium (slope instability area), Basalt - MW to SW (with some extremely weathered seams and infill joints), Interbedded Sandstone/Siltstone/Mudstone - XW	EB045 - 33.92m bgl - RL454.92m - 28/11/2015 EB045 - 33.42m bgl - RL455.42m - 13/01/2016 to 01/02/2016 EB045 - 33.92m bgl - RL454.92m - 01/02/2016 EB045 - 33.95m bgl - RL454.85m - 24/02/2016 EB045 - 33.95m bgl - RL454.85m - 22/03/2016 EB048 - 29.25m bgl - RL491.70m - 25/11/2015 EB148 - 13.85m bgl - RL448.24m - 24/02/2016 EB148 - 15.14m bgl - RL446.00m - 22/03/2016																						
	13240	13340	Box	6.0	23.2	Colluvium (slope instability area), Basalt - MW to SW (with some extremely weathered seams and infill joints), Interbedded Sandstone/Siltstone/Mudstone - XW	EB045 - 33.92m bgl - RL454.92m - 28/11/2015 EB045 - 33.42m bgl - RL455.42m - 13/01/2016 to 01/02/2016 EB045 - 33.92m bgl - RL454.92m - 01/02/2016 EB045 - 33.95m bgl - RL454.85m - 24/02/2016 EB045 - 33.95m bgl - RL454.85m - 22/03/2016 EB048 - 29.25m bgl - RL491.70m - 25/11/2015 EB148 - 13.85m bgl - RL448.24m - 24/02/2016 EB148 - 15.14m bgl - RL446.00m - 22/03/2016																						
CUT 24	14380	14770	Box	34.2	31.3	Residual, Interbedded Sandstone/Siltstone/Mudstone - XW to SW, Coal Seams, Basalt - XW	EB051 - 28.25m bgl - RL414.894m - 26/11/2015 EB061 - 31.03m bgl - RL409.20m - 14/7/2016 EB061 - 31.03m bgl - RL409.20m - 1/2/2016 EB061 - 31.25m bgl - RL409.18m - 24/02/2016 EB061 - 31.97m bgl - RL409.18m - 23/02/2016 BH043 - 30.705 m bgl - RL433.035m - 04/01/16 BH043 - 30.72 m bgl - RL433.06m - 12/01/16 & 02/02/16 EB064 - 17.54 m bgl - RL449.957m - 14/01/16 EB064 - 18.44 m bgl - RL448.057m - 02/02/16 EB065 - Dry @ 19.65 m bgl - RL451.059m - 04/01/16 EB065 - Dry @ 19.65 m bgl - RL450.959m - 14/01/16 EB065 - Dry @ 19.69 m bgl - RL450.859m - 02/02/16																						
	15100	15200	Box	8.1	26.5	Colluvium (slope instability area), Residual Sandstone - XW to SW, Interbedded Sandstone/Siltstone/Mudstone - HW to MW	EB061 - 31.03m bgl - RL409.20m - 14/7/2016 EB061 - 31.03m bgl - RL409.20m - 1/2/2016 EB061 - 31.25m bgl - RL409.18m - 24/02/2016 EB061 - 31.97m bgl - RL409.18m - 23/02/2016 BH043 - 30.705 m bgl - RL433.035m - 04/01/16 BH043 - 30.72 m bgl - RL433.06m - 12/01/16 & 02/02/16 EB064 - 17.54 m bgl - RL449.957m - 14/01/16 EB064 - 18.44 m bgl - RL448.057m - 02/02/16 EB065 - Dry @ 19.65 m bgl - RL451.059m - 04/01/16 EB065 - Dry @ 19.65 m bgl - RL450.959m - 14/01/16 EB065 - Dry @ 19.69 m bgl - RL450.859m - 02/02/16																						
	15400	15400	Box	11.1	33.1	Colluvium, Sandstone - XW to SW, Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.40m bgl - RL460.77m - 02/02/2016 EB067a - 30.78m bgl - RL475.11m - 02/02/2016																						
	15600	15680	Box	11.1	53.6	Colluvium, Sandstone - XW to SW, Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.40m bgl - RL460.77m - 02/02/2016 EB067a - 30.78m bgl - RL475.11m - 02/02/2016																						
	15680	15850	Slope Long	9.8	59.3	Colluvium, Sandstone - XW to SW, Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.40m bgl - RL460.77m - 02/02/2016 EB067a - 30.78m bgl - RL475.11m - 02/02/2016																						
EMBANKMENT 24	15710	16230	Slope Long	0.0	10.2	Colluvium, Argillaceous Basalt - XW to SW																							
	16230	16380	Slope	12.8	42.0	Colluvium, Basalt (argillaceous) - XW to MW, some full and subsoil blocks	BH548 (off alignment 50m) - Dry at 38.2m bgl - RL54.24m BH400 (off alignment 50m) - Dry at 33.5m bgl - RL51.84m																						
EMBANKMENT 25	16380	16590	Slope Long	11.7	20.1	Basalt (near surface), Basalt (Argillaceous) - XW to SW	EB071 - 19.12 m bgl - 516.61 RL - 2/2/2016																						

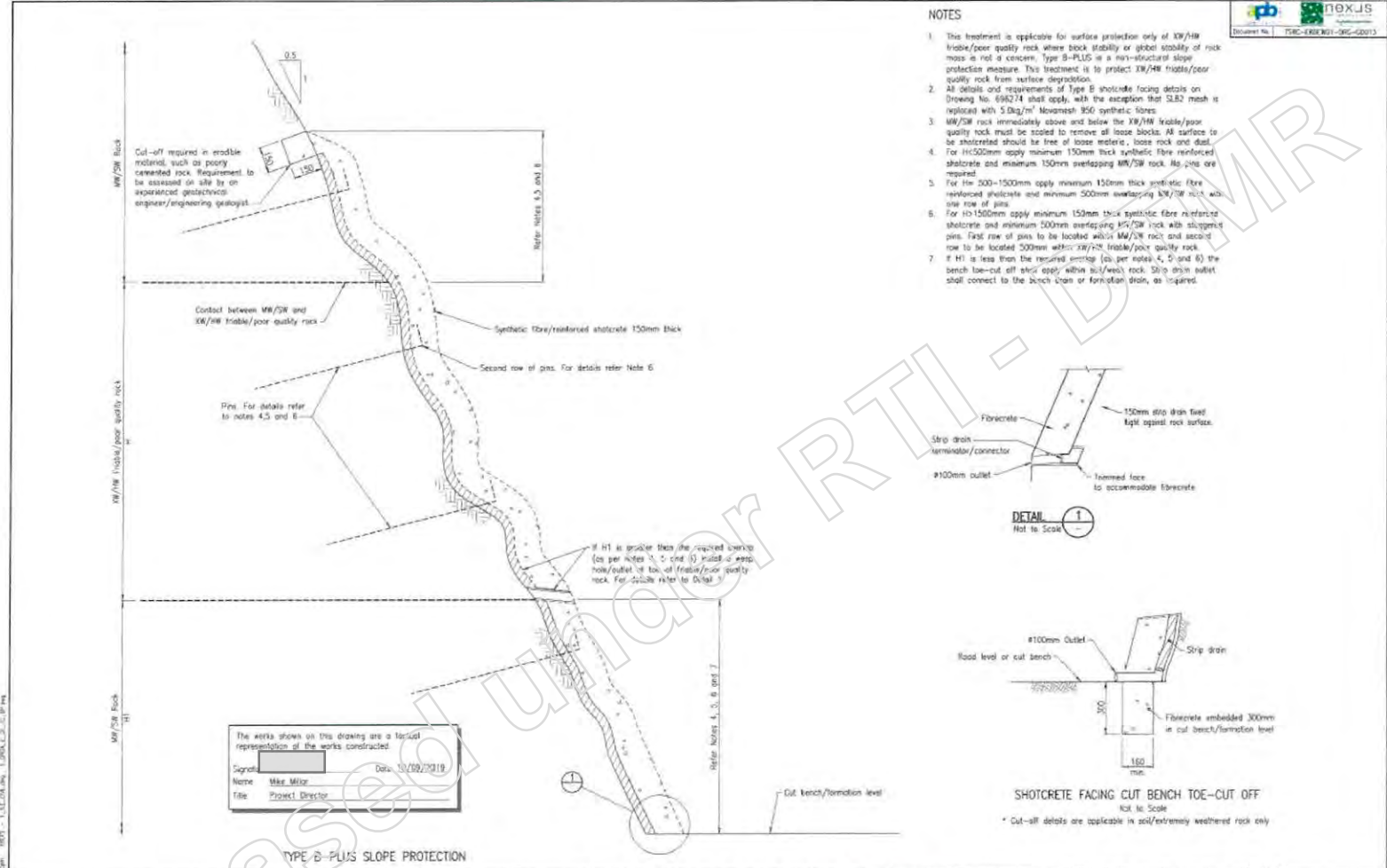




Released under RTI - DTMR


Appendix 6

As-built Drawings



- NOTES**
- This treatment is applicable for surface protection only of M/SW friable/poor quality rock where back stability or global stability of rock mass is not a concern. Type B-PLUS is a non-structural slope protection measure. This treatment is to protect M/HW friable/poor quality rock from surface degradation.
  - All details and requirements of Type B shotcrete facing details on Drawing No. 696274 shall apply, with the exception that SLB2 mesh is replaced with 5.0kg/m<sup>2</sup> Newmesh 950 synthetic fibres.
  - M/SW rock immediately above and below the M/HW friable/poor quality rock must be rooted to remove all loose blocks. All surface to be shotcreted should be free of loose material, loose rock and dust.
  - For H<500mm apply minimum 150mm thick synthetic fibre reinforced shotcrete and minimum 150mm overlapping M/SW rock. No pins are required.
  - For H=500-1500mm apply minimum 150mm thick synthetic fibre reinforced shotcrete and minimum 500mm overlapping M/SW rock with one row of pins.
  - For H>1500mm apply minimum 150mm thick synthetic fibre reinforced shotcrete and minimum 500mm overlapping M/SW rock with staggered pins. First row of pins to be located within M/SW rock and second row to be located 500mm within M/HW friable/poor quality rock. If H1 is less than the required spacing (as per notes 4, 5 and 6) the bench toe-cut off strip apply within M/SW rock. Strip drain outlet shall connect to the bench drain or formation drain, as required.

The works shown on this drawing are a logical representation of the works constructed.

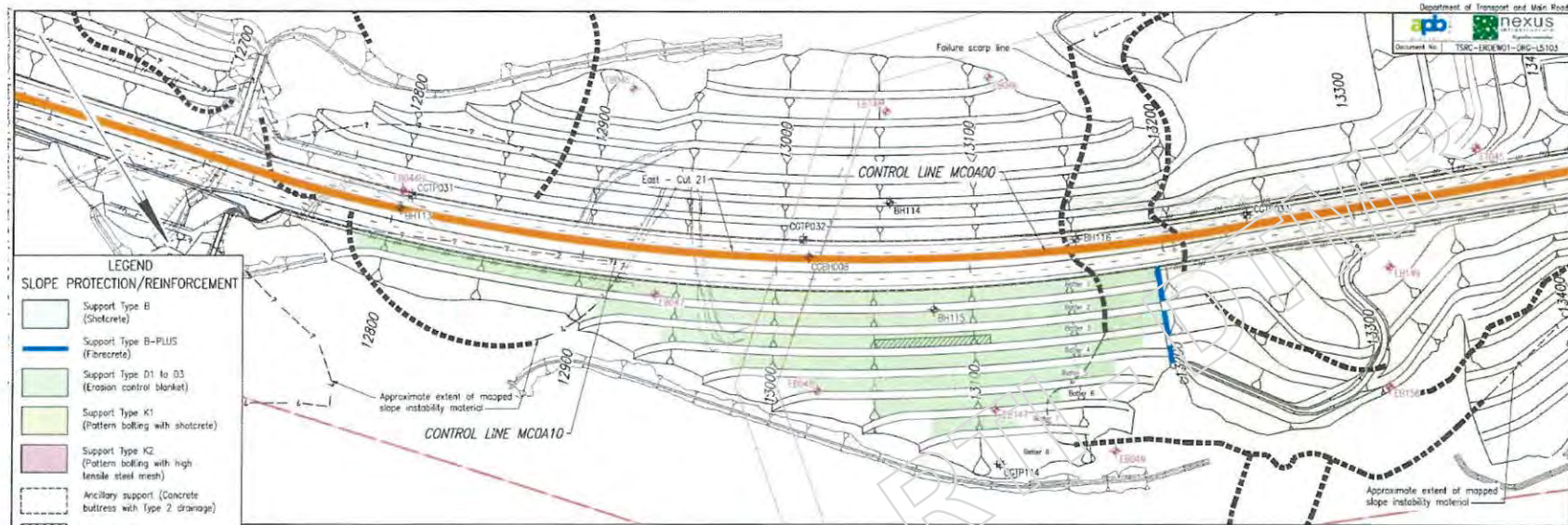
Signature:  Date: 10/09/2019  
 Name: Mike Miller  
 Title: Project Director

**TYPE B-PLUS SLOPE PROTECTION**

<p>Authorised Job No: [ ] Survey Date: [ ]</p> <p>Station: [ ]</p> <p>Project: <b>LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY</b></p> <p>Contract: <b>CU CHRF (0.000 - 43100.000) (M00400)</b></p>		<p><b>BATTER PROTECTION GENERAL DETAILS - CUTTING STEEL FIBRE REINFORCED SHOTCRETE - TYPE B-PLUS SLOPE PROTECTION - EAST</b></p> <p>ENGINEERING CERTIFICATION IMPLIED</p> <p>Scale: [ ]</p>		<p><b>Queensland Government</b></p> <p>Job No: 265/18/3</p> <p>Contract No: 00010-71</p> <p>Drawing No: 700708-1B</p> <p>Scale: GD-13 of 14</p>									
<p>Authorised by: [ ]</p> <p>Checked by: [ ]</p> <p>Drawn by: [ ]</p> <p>Scale: [ ]</p>	<p>Revision:</p> <table border="1"> <tr> <th>No.</th> <th>Description</th> <th>Date</th> <th>Checked</th> </tr> <tr> <td>1</td> <td>As Issued</td> <td>10/09/19</td> <td>[ ]</td> </tr> </table>	No.	Description	Date	Checked	1	As Issued	10/09/19	[ ]	<p>Scale: [ ]</p>	<p>Scale: [ ]</p>	<p>Scale: [ ]</p>	<p>Scale: [ ]</p>
No.	Description	Date	Checked										
1	As Issued	10/09/19	[ ]										

ID	CHARAGE		TYPE (BOX / SIDE LONG)	CUT HEIGHT		EXPECTED GEOLOGICAL CONDITIONS	EXPECTED GROUNDWATER CONDITIONS	SLOPE PROTECTION COVERAGE OF TOTAL CUT FACE AREA (%)				SLOPE REINFORCEMENT (REFER NOTE 4)				SUB-SURFACE DRAINAGE			ROCK PROTECTION		REMARKS		
	FROM	TO		LHS	RHS			EROSION PROTECTION				TYPE K - PATTERN BOLTING (K1 WITH SHOTCRETE, K2 WITH HIGH TENSILE STEEL MESH) TYPE J - SPOT BOLTING WITH SHOTCRETE				TYPE I OR TYPE II SUB-HORIZONTAL DRAINAGE			LENGTH (M)				
				TYPE B-PLUS FIBRECRETE	TYPE D1 (V.1H HW/MW SANDSTONE, BASALT)			TYPE D2 (1H.1H HW/MW INTERBEDDED CLAYSTONE/MUDSTONE AND XW SANDSTONE)	TYPE D3 (1V.1.5H HW/MW CLAYSTONE/MUDSTONE AND HW/MW INTERBEDDED CLAYSTONE/MUDSTONE /SILTSTONE)	TYPE	SPACING V x H (m)	SOIL NAIL/ROCK ANCHOR LENGTH (m)	COVERAGE OF TOTAL CUT FACE AREA %	SPACING (m)	DRAIN HOLE LENGTH (m)	TOTAL DRAIN HOLDS	LHS	RHS					
CUT 20	12500	12710	Side Long	12.6	2.5	Residual Sandstone - XW to MW	EB145 - 30.43m bgl - RL393.85m - 24/02/2016 EB146 - 33.45m bgl - RL426.95m - 24/02/2016 EB141 - 31.37m bgl - RL421.68m - 24/02/2016														The works shown on this drawing are a factual representation of the works constructed. Signature: _____ Date 10/09/2019 Name: Mike Miller Title: Project Director		
	12710	12950	Box	45.1	24.0	Minor colluvium, Residual Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to MW; Mudstone - XW to SW; Coal seams and Ferruginous Siltstone (massive) - XW to SW; Undifferentiated Tertiary Sediments (UTS)	BH115 - Most of base 65.03m bgl - RL438.95m - 12/01/2016 BH115 - 65.58m bgl - RL435.40m - 01/02/2016 BH116 - 70.04m bgl - RL412.45m - 14/01/2015 BH116 - 69.97m bgl - RL412.56m - 01/02/2015 EB045 - 33.92m bgl - RL454.92m - 26/11/2015 E3045 - 33.92m bgl - RL454.92m - 13/01/2016 E2045 - 33.42m bgl - RL455.42m - 13/01/2016 to 01/02/2016 EB045 - 33.92m bgl - RL454.92m - 01/02/2016 E3045 - 33.92m bgl - RL454.92m - 24/02/2016 EB045 - 33.95m bgl - RL454.89m - 22/03/2016 EB048 - 29.25m bgl - RL461.70m - 25/11/2015 E3149 - 12.90m bgl - RL448.24m - 24/02/2016 EB149 - 15.14m bgl - RL445.00m - 22/03/2016	RHS - 50	RHS - 20	LHS - 60 RHS - 40	LHS - 25			2	5	133			Ancillary support (concrete buttress with Type 2 drainage) between CH12975 - CH13070 - RIG - Batter 4, between CH13070 - CH13090 LHS - Batter 4.				
	12950	13240	Box	50.3	57.2	Colluvium (slope instability area), Basalt - MW to SW (with some extremely weathered seams and in-fill joints); Interbedded Sandstone/Siltstone/Mudstone - HW; Undifferentiated Tertiary Sediments (UTS)	E3045 - 33.92m bgl - RL454.92m - 26/11/2015 E3149 - 12.90m bgl - RL448.24m - 24/02/2016 EB149 - 15.14m bgl - RL445.00m - 22/03/2016	RHS - 1 (applied locally between Cut 21/22 transition and Cut 21)	RHS - 20	LHS - 60 RHS - 40	LHS - 25												
	13240	13340	Box	6.0	23.2	Colluvium (slope instability area), Basalt - MW to SW (with some extremely weathered seams and in-fill joints); Interbedded Sandstone/Siltstone/Mudstone - HW; Undifferentiated Tertiary Sediments (UTS)	EB045 - 33.92m bgl - RL454.92m - 01/02/2016 E3045 - 33.92m bgl - RL454.92m - 24/02/2016 EB045 - 33.95m bgl - RL454.89m - 22/03/2016 EB048 - 29.25m bgl - RL461.70m - 25/11/2015 E3149 - 12.90m bgl - RL448.24m - 24/02/2016 EB149 - 15.14m bgl - RL445.00m - 22/03/2016																
CUT 24	14380	14770	Box	34.2	31.3	Residual, Interbedded Sandstone/Mudstone - XW to SW; Coal Seams; Basalt - HW	BH119 - 29.445m bgl - RL412.46m - 12/01/16 BH119 - 30.44m bgl - RL411.46m - 01/02/16 EB060 - 29.28m bgl - RL413.67m - 27/11/2015 EB061 - 28.24m bgl - RL414.894m - 26/11/2015 EB061 - 31.83m bgl - RL409.20m - 14/1/2016 EB061 - 31.83m bgl - RL409.20m - 1/2/2016 EB061 - 31.95m bgl - RL409.18m - 24/02/2016 EB061 - 31.97m bgl - RL409.16m - 23/03/2016																Ancillary support (concrete buttress with Type 2 drainage) between CH14610 - CH14625 RIG - Batter 3.
	15180	15200	Box	8.3	26.5	Colluvium (slope instability area), Residual Sandstone - HW to SW; Interbedded Sandstone/Siltstone/Mudstone - HW to MW	BH043 - 30.765 m bgl - RL433.035m - 04/01/16 BH043 - 30.72 m bgl - RL433.038m - 12/01/16 & 02/02/16 EB064 - 17.54 m bgl - RL449.967m - 14/01/16 EB064 - 18.44 m bgl - RL449.087m - 02/02/16 EB065 - Dry @ 19.50 m bgl - RL451.059m - 04/01/16 EB065 - Dry @ 19.65 m bgl - RL450.909m - 14/01/16 EB065 - Dry @ 19.69 m bgl - RL450.869m - 02/02/16																
	15200	15340	Box	12.1	26.1	Colluvium (slope instability area), Residual Sandstone - HW to SW; Interbedded Sandstone/Siltstone/Mudstone - HW to MW	BH043 - 30.765 m bgl - RL433.035m - 04/01/16 BH043 - 30.72 m bgl - RL433.038m - 12/01/16 & 02/02/16 EB064 - 17.54 m bgl - RL449.967m - 14/01/16 EB064 - 18.44 m bgl - RL449.087m - 02/02/16 EB065 - Dry @ 19.50 m bgl - RL451.059m - 04/01/16 EB065 - Dry @ 19.65 m bgl - RL450.909m - 14/01/16 EB065 - Dry @ 19.69 m bgl - RL450.869m - 02/02/16																
	15480	15600	Box	11.1	33.3	Colluvium Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.10m bgl - RL468.77m - 02/02/2016 EB067a - 38.40m bgl - RL475.01m - 02/02/2016																
	15600	15660	Box	11.1	53.6	Colluvium Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.10m bgl - RL468.77m - 02/02/2016 EB067a - 38.40m bgl - RL475.01m - 02/02/2016																
	15680	15850	Side Long	0.0	56.3	Colluvium Sandstone - XW to SW; Interbedded Sandstone/Siltstone/Mudstone - XW to SW	EB066 - 31.10m bgl - RL468.77m - 02/02/2016 EB067a - 38.40m bgl - RL475.01m - 02/02/2016																
EMBANKMENT 24	15710	16230	Side Long	0.0	10.2	Colluvium; Amorphoidal Basalt - XW to SW																	
CUT 27	16230	16380	Box	12.9	42.0	Colluvium; Basalt (Amorphoidal) - XW to MW; Basalt and basaltic sands	BH049 (off alignment 50m) - Dry at 39.5m bgl - RL524.24m BH050 (off alignment 50m) - Dry at 33.5m bgl - RL518.64m																
EMBANKMENT 25	16380	16592	Side Long	11.7	20.3	Residual (near surface), Basalt (Amorphoidal) - XW to SW	EB073 - 10.12 m bgl - 516.01 RL - 2/2/2016	Type B RHS - 15															

C. All Constructed BH 0291-01298 (Orig. Cont. Vols) - 10/09/19 BH 0291-01298 (Orig. Cont. Vols) - 19/06/19 B Updated due to Emb. 24 (realign) (Cont. Updated) - 11/05/18 A2 0291-03415 (Orig. Cont. Vols) - 11/05/18 A3 0291-03415 (Orig. Cont. Vols) - 22/06/17 A4 0291-03415 (Orig. Cont. Vols) - 13/04/17		Associated Job Nos Survey Data Datum: GDA94 Horizontal: MGA84 Z56 Height: AHD Derived Survey: MR03920 Dimensions: as marked	Scales LOCKYER VALLEY RC AND TOowoomba RC WARREGO HIGHWAY - GORE HIGHWAY CTL CHGE 0.000 - 43100.000 (MCA00)	BATTER PROTECTION CUTTING BATTER TREATMENT SCHEDULE EAST - SHEET 2	Job No: 265/18A/3 Contract No: DDWD-71 Drawing No: 696204 IC Series Number: SH-101 of 04 MRB Date: 03/10
--	--	---	--	--	--



**LEGEND**  
**SLOPE PROTECTION/REINFORCEMENT**

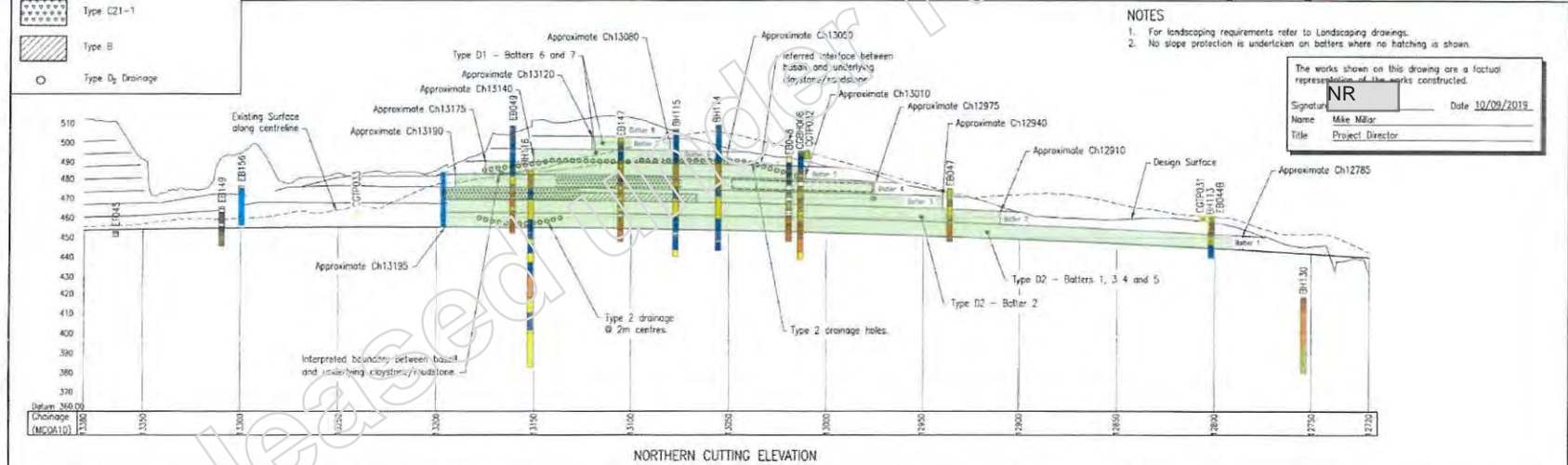
	Support Type B (Shotcrete)
	Support Type B-PLUS (Fibrecrete)
	Support Type D1 to D3 (Erosion control blanket)
	Support Type K1 (Pattern bolting with shotcrete)
	Support Type K2 (Pattern bolting with high tensile steel mesh)
	Ancillary support (Concrete buttress with Type 2 drainage)
	Type C21-1
	Type B
	Type D2 Drainage

**NOTES**

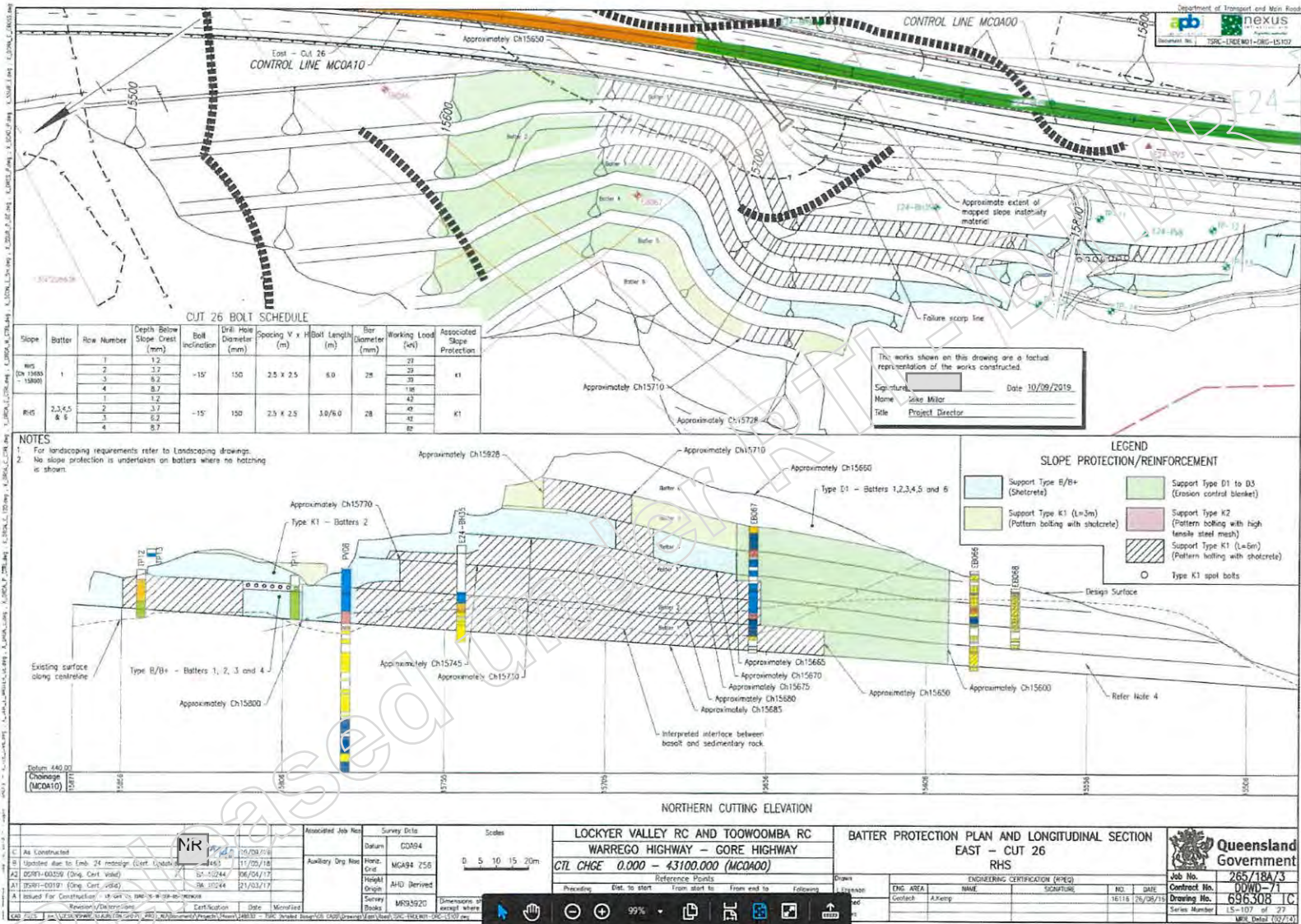
- For landscaping requirements refer to Landscaping drawings.
- No slope protection is undertaken on batters where no hatching is shown.

The works shown on this drawing are a factual representation of the works constructed.

Signature: **NR** Date: 10/09/2019  
Name: Mike Millar  
Title: Project Director



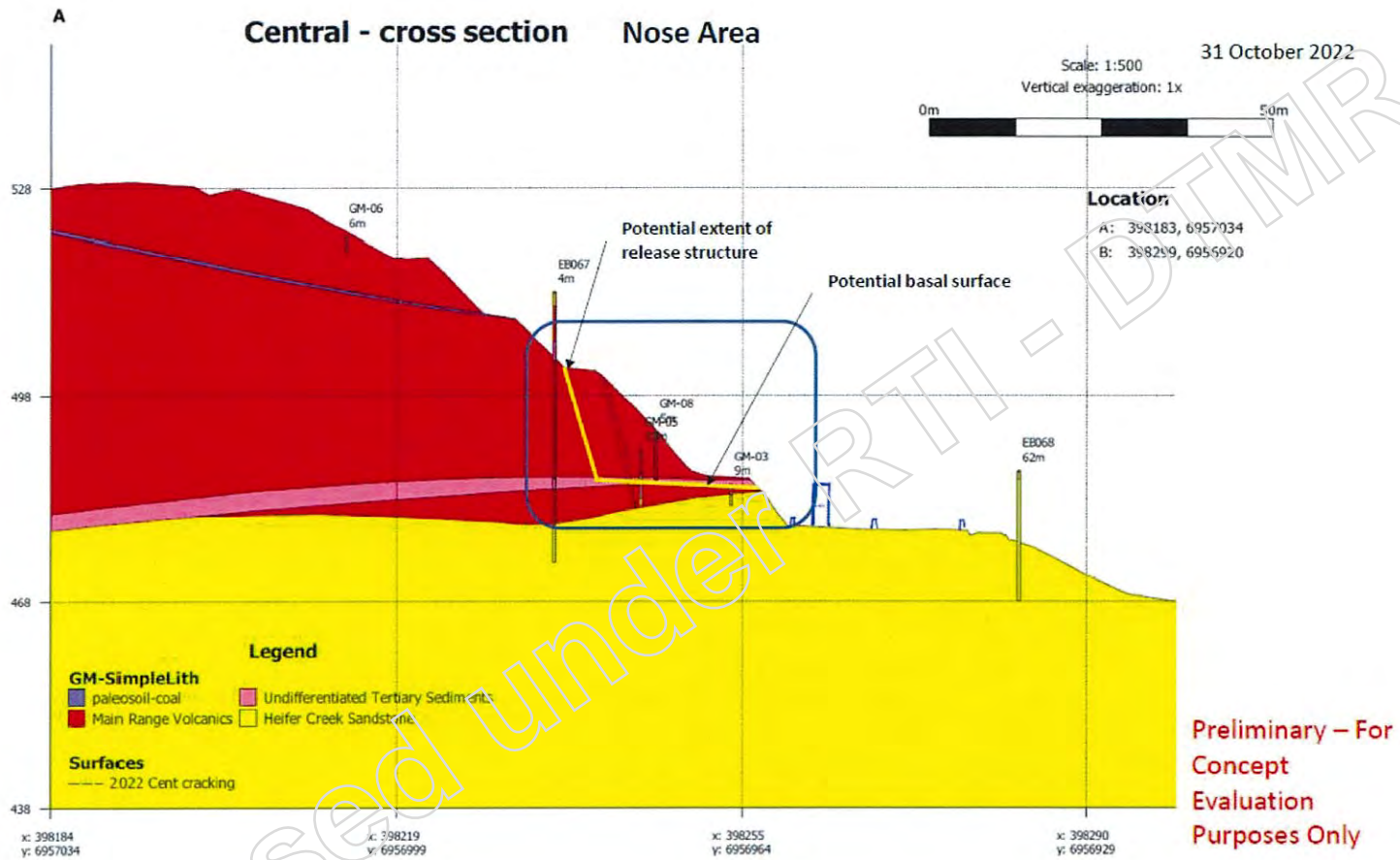
Associated Job No.		Survey Date		Scales		LOCKYER VALLEY RC AND TOOWOOMBA RC WARREGO HIGHWAY - GORE HIGHWAY CTL CHGE 0.000 - 43100.000 (MCOA00)		BATTER PROTECTION PLAN AND LONGITUDINAL SECTION EAST - CUT 21 RHS		Queensland Government	
Datum: CG2014		Datum: CG2014		0 10 20 30 40m		Reference Points		ENGINEERING CERTIFICATION (RPEQ)		Job No. 265/18A/3	
Auxiliary Eng. No.		MGA94 256				Preceding		NO. DATE		Contract No. DW0-71	
Survey (Block)		MR91920		Simensions of sheet where		From start to		18116 26/05/16		Drawing No. 6963011B	
Certification		Date		Microfilm		From end to				Series Number 15-103 of 27	



Released under RTI - DTMR

Appendix 7

Diagram of Likely Geotechnical Failure Mechanism at Cut 26



Released under RTI - DTMR