I2 — SKM Stream Diversion Concept Report

Caval Ridge Site Development

STREAM DIVERSION CONCEPT REPORT

- Rev 0.
- 21 January 2009

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Contents

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1. Introduction and Background

The Caval Ridge Project is a proposed coal mine located in the Bowen Basin, Queensland just South of the township of Moranbah. Creek diversions are required as part of the proposed infrastructure design and mine staging plans. This report details the concept design for these proposed creek diversions, to support the licensing application for creek diversions.

An assessment was made of the Caval Ridge Mine Development Area by DNRW in June, 2008 to determine features within the investigation area that are considered to be watercourses as defined under the provisions of the Water Act 2000. Three locations were identified and interpreted as Horse Creek and Caval Creek as discussed above, with the coordinates of these listed in Table 1.

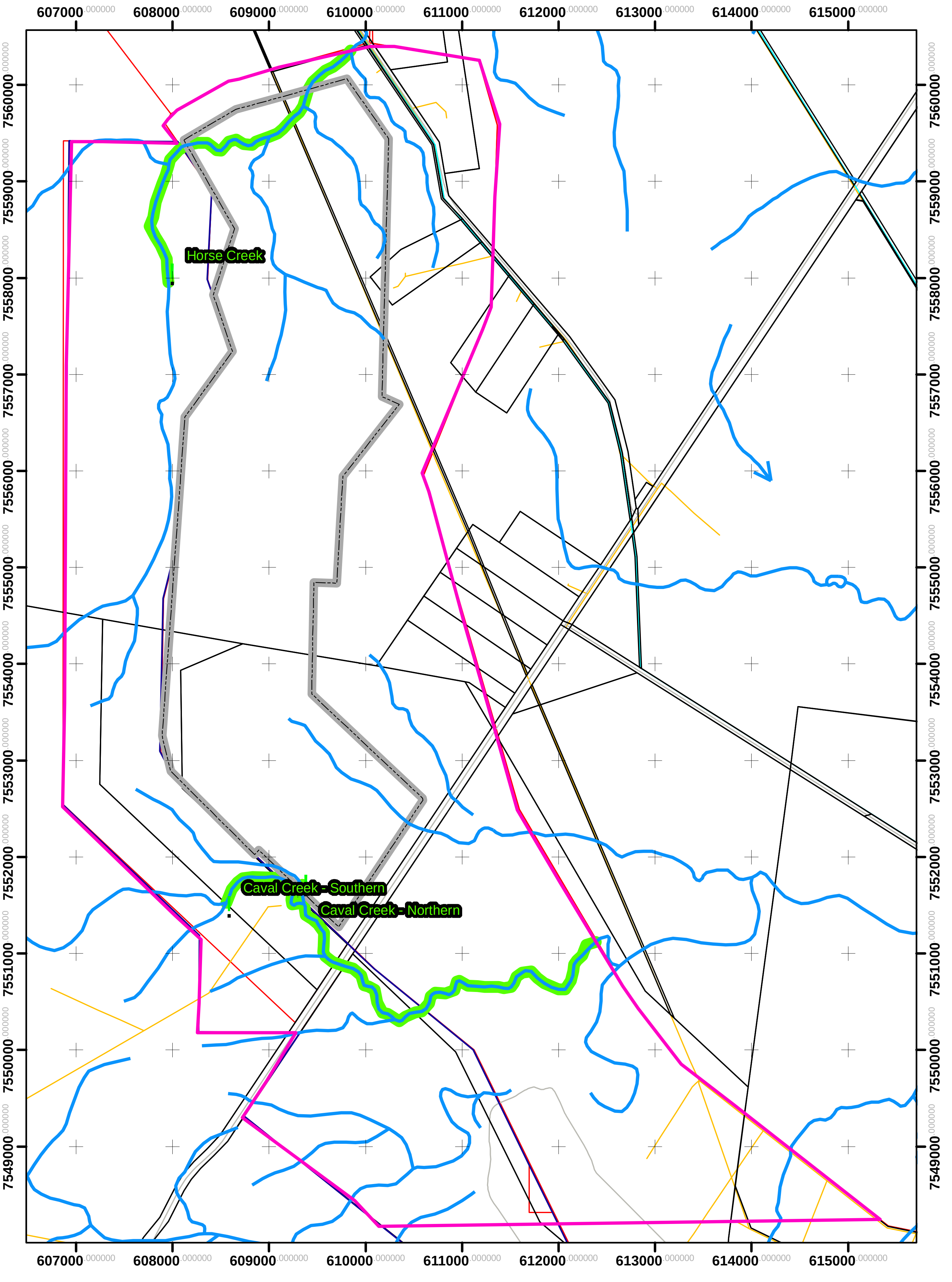
- **Table 1 Coordinates of Upstream Extent of Watercourses**

Point	Stream	Degrees South	Degrees East
1	Caval Creek – Northern Branch	22 08'00.76" S	148 03'39.08" E
2	Caval Creek – Southern Branch	22 08'07.13" S	148 03'17.55" E
3	Horse Creek	22 04'45.48" S	148 02'54.19" E

Two creeks were identified as designated watercourses as by the Department of Natural Resources and Water (DNRW) for the purposed of the Act. The creeks to be diverted are the Caval and Horse Creeks, with both creeks located north of the Peak Downs highway. The proposed Caval Creek diversion is located adjacent to the proposed coal handling and preparation plant and the proposed Horse Creek diversion is located in the northern reaches of the current mining lease.

Both Caval Creek and Horse Creek are small upper catchment streams within the Isaac River catchment. The catchments for these creeks extend to the west of the Caval Ridge mine lease boundary with the upper catchment boundary located approximately 4km west of the mine lease boundary.

The location of the points listed in Table 1 is illustrated in the context of the mine lease and proposed mine pit extent in Figure 1. Also illustrated on this figure are the reaches of creek within the mine lease that will be modified by the stream diversion.



Legend

- Mine Lease
- Watercourse Determinations
- Pit Footprint
- Stream Reach to be Diverted

0 250 500 1,000 1,500 2,000 Metres

Scale - 1:50,000

Projection: MGA Zone 56

Caval Ridge Stream Diversion Concept

Figure 1: Catchment Delineation

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2. Diversion Requirements

Reaches of both Caval Creek and Horse Creek require diversion due to their proximity to proposed mining operations. The diversion requirements for each of these creeks is discussed separately in the following two sections.

2.1. Caval Creek Diversion

The two nominated watercourse points for Caval Creek are located in close proximity to each other with both points being located within the Caval Ridge mine lease. The nominated point on the Northern Arm of Caval Creek is situated approximately 200m upstream of the confluence with the Southern Arm.

The mine lease crosses Caval Creek in the upper reaches of the catchment and as a result the catchment area to the nominated watercourse points is relatively small. The total catchment area is 825 ha for the two creeks combined with the catchment area breakdown listed in Table 2. A large proportion of this catchment area is located within the mine lease and is hence subject to change for the operational phase of the site.

The length of creek to be diverted within the mine lease is approximately 5.8km from the collective points of watercourse determination to the mine lease boundary. It is proposed that the diversion of this creek consider two diversion cases; a short term case where the upper reach of the creek is diverted, and a long term case where the full creek reach within the mine lease is diverted. Figures within this report illustrate mining operations that are consistent with the short term diversion configuration, with the proposed long term diversion option considering the expansion of these mining operations to the south and intersecting the short term diversion alignment.

The details of the short term creek diversion for Caval Creek are listed in Table 2. The length of existing creek proposed to be diverted is 2.9km (as highlighted on Figure 1) with an existing natural longitudinal grade of approximately 0.45 %.

The details of the long term creek diversion for Caval Creek are listed in Table 3. The length of existing creek proposed to be diverted is 5.8km (as highlighted on Figure 1) with an existing natural longitudinal grade of approximately 0.38 %.

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Table 2 Existing Stream Details for Caval Creek Short Term Creek Diversion

Stream	Creek Length to be Diverted	Catchment Area to Watercourse Determination
Caval Creek – Northern Arm	200m	443 ha
Caval Creek – Southern Arm	2.7km	382 ha
TOTAL	**2.9km**	**825 ha**

Table 3 Existing Stream Details for Caval Creek Long Term Creek Diversion

Stream	Creek Length to be Diverted	Catchment Area to Watercourse Determination
Caval Creek – Northern Arm	200m	443 ha
Caval Creek – Southern Arm	5.6km	382 ha
TOTAL	**5.8km**	**825 ha**

2.2. Horse Creek Diversion

The Horse Creek catchment is located along the western boundary of the mine lease and drains from South to North within the lease area. Similar to Caval Creek, the point of watercourse determination is located within the mine lease with a relatively small catchment area, however it is noted that the Horse Creek catchment is larger than the Caval Creek catchment. The approximate catchment area for Horse Creek to the point of watercourse determination is listed in Table 4. The stream reach requiring diversion is approximately 3.8km in length from the point of watercourse determination to the mine lease boundary with the existing creek having an average longitudinal grade over this reach of approximately 0.4%.

Table 4 Stream Details to Point of Watercourse Definition for Horse Creek

Stream	Creek Length to be Diverted	Catchment Area to Watercourse Determination
Horse Creek	3.8km	2,113 ha

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3. Proposed Design Concept

Both the existing creek reaches for Caval and Horse Creeks proposed to be diverted are located in the upper reaches of their respective catchments with corresponding small catchment areas. This is of particular note for the Caval Creek catchment with a catchment area of only 825 ha to the points of watercourse determination. It is noted that the catchments considered here are smaller than those typically considered for the assessment methods applied in this investigation. Both existing creeks are also relatively steep with longitudinal grades in the order of 0.4% for the creek reaches within the mine lease.

The design of the proposed stream diversions followed the following design objectives:

- The creek diversions were proposed to achieve geomorphic stability by adherence to the DNRW stream diversion guidelines as detailed in Natural Resources and Water, Watercourse Diversions – Central Queensland Mining Industry, January 2008;
- The creek diversions were to require minimal ongoing maintenance and modification, achieved through maintaining a constant diversion bed grade and utilising no flow control structures such as drop structures;
- The creek diversions have utilised a diversion bank side slope of 1:4 (V:H). This condition was adopted as a preliminary assumption based on limited geotechnical information, with the intention that these bank side slopes be refined as the design process progresses; and
- Adopting a diverted creek length that maintained bed grade below that of the existing natural creek, achieved through the adopted diversion alignment and stream meanders where appropriate.

This implementation of these design objectives for the two creek diversions is further discussed in the following sections for the two creeks.

- **Table 5 Summary of key creek diversion details**

Creek	Existing Creek Length	Diversion Length	Diversion Grade	Cut Volume; 1V:4H	Peak Cut Depth
Caval Creek	2,900 m	3,700 m [A] 5,257 m [B]	Upper reach 0.3-0.4% Lower reach 0.7%	517,000 m^3	9m
Horse Creek	3,800 m	4,590 m	0.38%	327,600 m^3	6-7m

A – proposed short term configuration

B – proposed long term configuration

3.1. Caval Creek

The interaction of Caval Creek with the proposed mining operations and infrastructure is shown in Figure 2. Two options were considered for the diversion of Caval Creek as shown in Figure 2; an option conveying flows to the east around the proposed infrastructure area, and the adopted option conveying flows to the west of the infrastructure and stockpile areas.

The option of diverting the creek to the east of the infrastructure area was removed from consideration following modelling of the proposed alignment for the following reasons:

- The proposed alignment shortened the existing natural stream, such that the creek bed grade was increased;
- The required maximum cut depth to the east of the infrastructure was prohibitively large (in the order of 15m) creating geotechnical issues with adjacent railway loop.

The adopted horizontal alignment of the creek diversion for Caval Creek is shown in further detail in Figure 3. In this figure the short term diversion length is shown in orange with the long term diversion extension shown in green.

The short term reach of the Caval Creek diversion is located in an area of dense mining infrastructure. The existing creek alignment intersects the proposed haul road, product stockpiles and the proposed pit extent. The proposed creek diversion of Caval Creek has sought to capture flows from upstream of these infrastructure features with the alignment options for this being either to the north of the stockpiles or to the South of the stockpiles. Figure 3 depicts the adopted configuration which utilised an alignment to the north of the stockpiles with the basis for adopting this alignment were as follows:

- The alignment to the north allowed for the inclusion of additional stream length, thereby achieving a reduced diversion stream bed grade; and
- The local terrain elevation is such that a stream diversion to the south of the stockpiles required a maximum cut depth of up to 15m which was considered to be unsustainable both from a cost and maintenance perspective.

As a result of these, a diversion alignment to the south of the stockpile area was adopted.

The diversion alignment intersects multiple small local creeks joining the diversion from the west. The diversion vertical profile was adopted so as to intersect these creeks at grade, reducing the likelihood of scour issues at these points of confluence. The vertical profile of the proposed diversion is illustrated in the design sketches in the Appendices of this report.

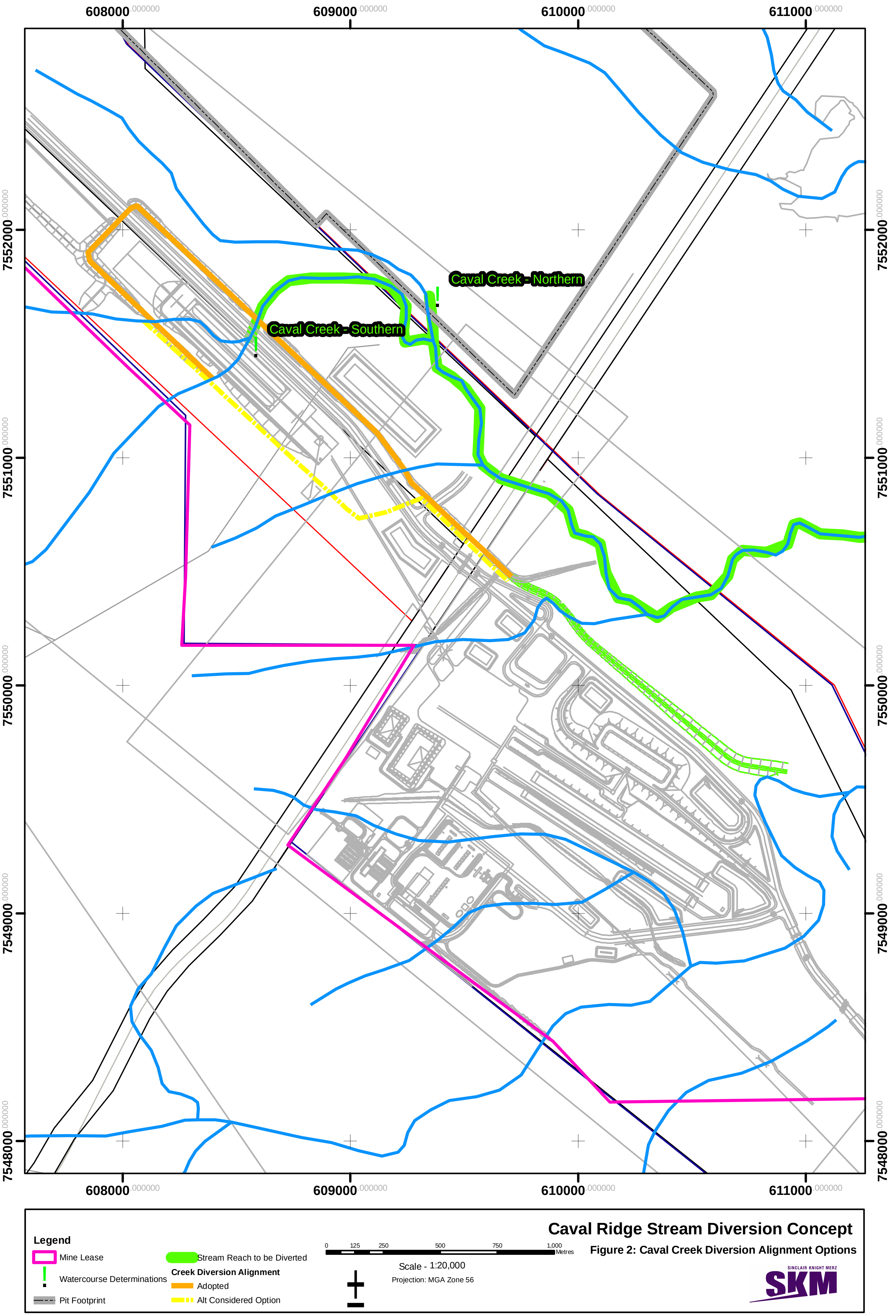
The adopted creek diversion horizontal alignment is approximately 3.8km in length from the most upstream point of diversion to the end of the short term diversion option, which is 900m longer

(30% increase in stream length) than the existing creek length for the same reach. No stream meanders were incorporated in this reach of the proposed creek diversion. Such an approach was adopted on the following basis:

- The proposed creek diversion is longer than the existing creek, hence a grade that maintains bed stability is achieved without the inclusion of a stream bed meander;
- The diversion is located within an area of intensive infrastructure with limited horizontal area in which for a stream meander to be included;
- The creek diversion is located in the very upper reaches of the catchment with a small catchment area. The estimated design discharges for this diversion reach are small and acceptable stream velocity, power and shear stress conditions can be achieved with no meander requirements.

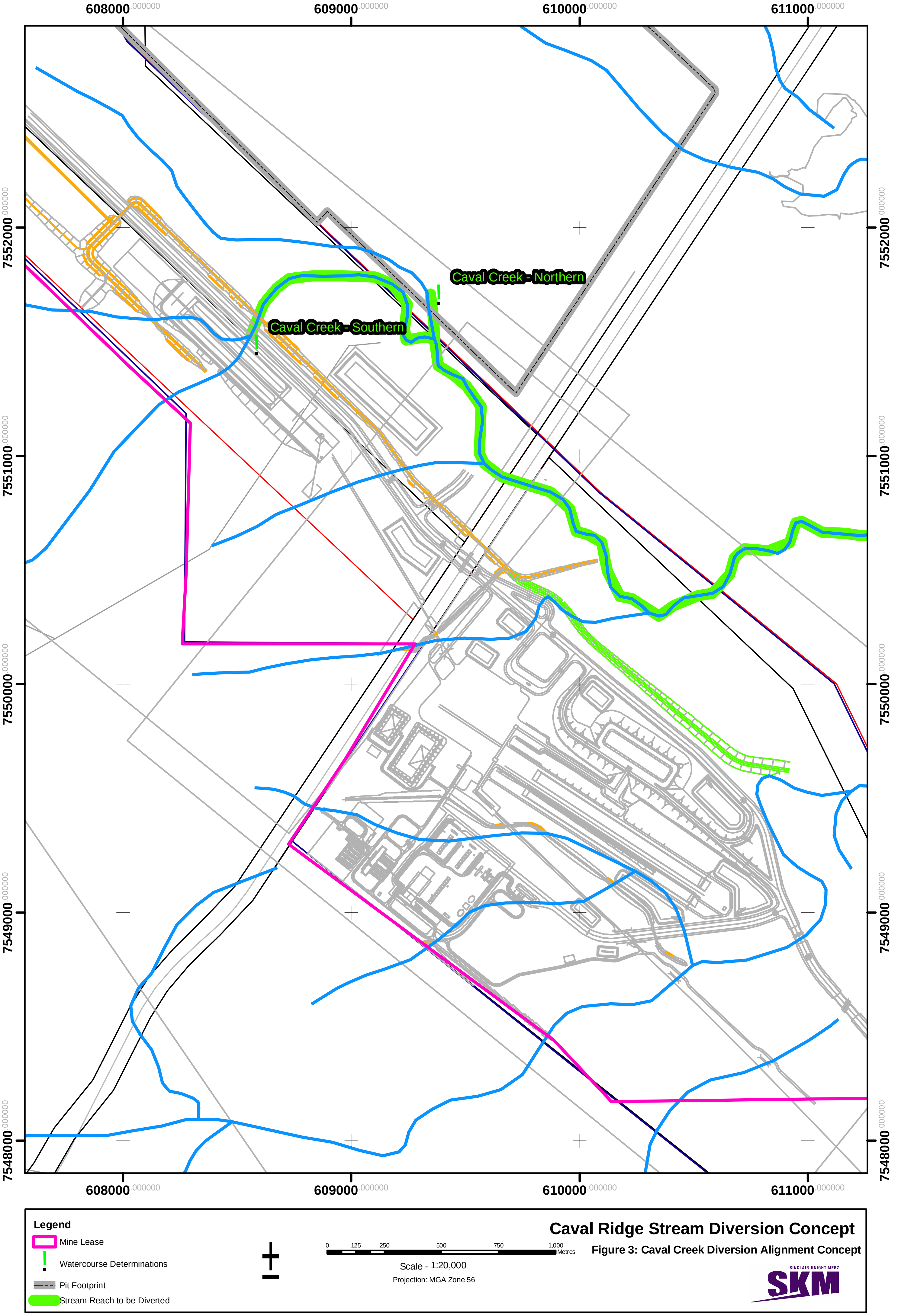
This proposed configuration does not utilise a stream meander, however there remains a 50m diversion buffer offset from the top of diversion bank to the east that can be utilised to incorporate a slight stream meander to achieve visual amenity where required. This is further discussed in Section 5.

The long term diversion is illustratively represented as a straight aligned diversion extension of the short term diversion following the northern edge of the proposed haul road. As with the proposed short term diversion, this diversion reach has been designed to achieve stable creek velocity, power and shear stress conditions utilising this alignment without meanders. However, this reach is not subject to the density of infrastructure as the upstream reach hence meanders may be incorporated into this reach where required.



Caval Ridge Stream Diversion Concept

Figure 2: Caval Creek Diversion Alignment Options



Caval Ridge Stream Diversion Concept

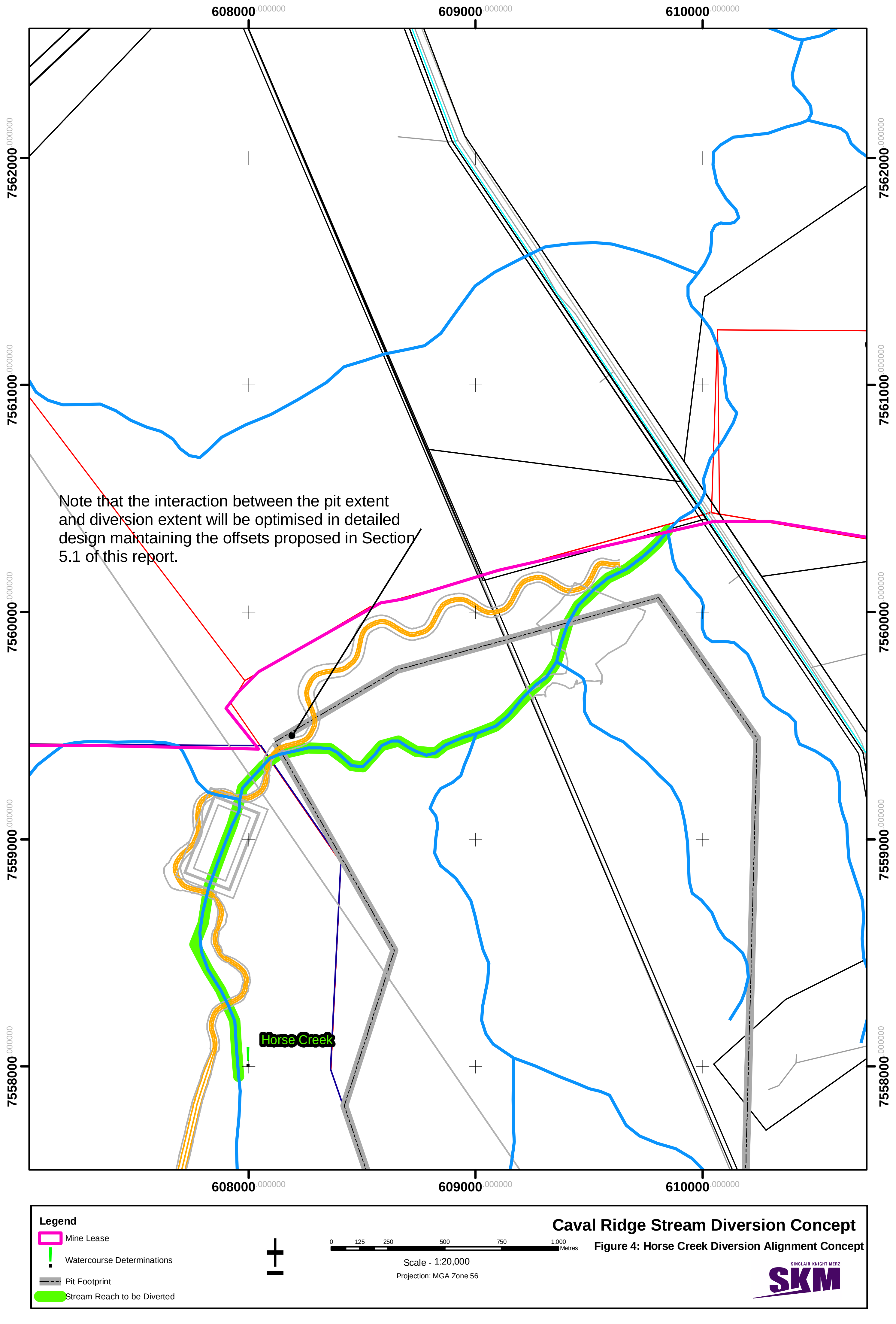
Figure 3: Caval Creek Diversion Alignment Concept

3.2. Horse Creek

The diversion of Horse Creek is not subject to the density of infrastructure as the proposed Caval Creek diversion. The proposed horizontal alignment of the Horse Creek diversion is shown in Figure 4.

Figure 4 illustrates that the basis for the diversion of Horse Creek is the interaction of the existing creek alignment with the proposed mine pit configuration. The proposed stream diversion concept seeks to realign Horse Creek to the north within the mine lease, thereby maximising access to the available resource. The proposed horizontal alignment incorporates a stream meander with sinuosity equivalent to that of the existing natural creek as taken from aerial photography, with this meander used to provide sufficient stream length to achieve the required stream velocity, power and shear stress criteria. The proposed creek diversion for Horse Creek is 4.6km in length, compared to the existing natural creek length of 3.8km.

The location of the Horse Creek diversion relative to the mine pit and mine lease boundary dictated that limited opportunity existed to consider horizontal alignment options. Rather, the adopted horizontal alignment was optimised as a single design concept by the inclusion of stream meanders that replicated the natural system and established compliance with the creek diversion guidelines.



Caval Ridge Stream Diversion Concept

Figure 4: Horse Creek Diversion Alignment Concept

4. Proposed Diversion Hydraulic Assessment

The proposed creek diversion concepts discussed in Section 3 of this report were analysed hydraulically to confirm compliance of the proposed design with the appropriate guidelines.

4.1. Hydrologic and Hydraulic Analysis

The hydrologic analysis of the proposed creek diversion was undertaken based on the DNRW accepted method detailed in Appendix E of the *Bowen Basin River Diversions Design and Rehabilitation Criteria (July 2002)* report. The hydraulic analysis was undertaken utilising the Natural Resources and Water report, *Watercourse Diversions – Central Queensland Mining Industry*, January 2008. Full details of this analysis are contained in Appendix A for the hydrologic analysis and Appendix B for the hydraulic analysis.

The key creek diversion details for the adopted configurations are listed in the following two tables.

- **Table 6 Caval Creek Diversion, Key Details**

Total Channel Length	Diversion Grade	Diversion Base Width	Cut Volume; 1:4	Peak Cut Depth
5,257m	Upper reach* 0.3-0.4% Lower reach 0.7%	Upper reach approx. 4m Lower reach 10-15m	517,000m^3	9m

* reach located around mining operations

- **Table 7 Horse Creek Diversion, Key Details**

Total Channel Length	Diversion Grade	Diversion Base Width	Cut Volume; 1:4	Peak Cut Depth
4,590m[#]	0.38% (with meander)	20m constant	327,600m^3	6 – 7m

from declared water course determination point

4.2. Results of Analysis

The hydraulic modelling results presented in Appendix B of this report were assessed against the design criteria for creek diversions detailed in the Natural Resources and Water report, *Watercourse Diversions – Central Queensland Mining Industry*, January 2008. This assessment is shown in Table 8 for the proposed Caval Creek diversion and Table 9 for the proposed Horse Creek diversion.

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- **Table 8 Caval Creek Diversion – Results of Hydraulic Analysis against Design Criteria**

Scenario	Stream Power (W/m^2)	Velocity (m/s)	Shear Stress (N/m^2)
2 year ARI (no vegetation)	<35	<1.0	<40
Compliance	PASS	Criteria Exceeded	PASS
2 year ARI (vegetated)	<60	<1.5	<40
Compliance	PASS	PASS	PASS
50 year ARI	<220	<2.5	<80
Compliance	PASS	PASS	PASS

Ref: Natural Resources and Water report , *Watercourse Diversions – Central Queensland Mining Industry*, January 2008

- **Table 9 Horse Creek Diversion – Results of Hydraulic Analysis against Design Criteria**

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Compliance	PASS	PASS	PASS
50 year ARI	<220	<2.5	<80
Compliance	PASS	PASS	PASS

Ref: Natural Resources and Water report , *Watercourse Diversions – Central Queensland Mining Industry*, January 2008

The results of the above presented tables highlights that the proposed diversions are compliant with the appropriate guideline stream conditions for the 2 year ARI vegetated scenario and for the 50 year ARI condition. Both the creek diversions are not fully compliant with the criteria for the 2 year ARI non-vegetated state, with the Caval Creek diversion achieving velocities in excess of 1m/s and the Horse Creek diversion exceeding both the velocity and stream power conditions. The implication of these non-compliances and proposed management approach for these are discussed in the following Section.

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The location of the Horse Creek diversion relative to the mine pit and mine lease boundary dictated that limited opportunity existed to consider horizontal alignment options. Rather, the adopted horizontal alignment was optimised as a single design concept by the inclusion of stream meanders that replicated the natural system and established compliance with the creek diversion guidelines.

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The results of the above presented tables highlights that the proposed diversions are compliant with the appropriate guideline stream conditions for the 2 year ARI vegetated scenario and for the 50 year ARI condition. Both the creek diversions are not fully compliant with the criteria for the 2 year ARI non-vegetated state, with the Caval Creek diversion achieving velocities in excess of 1m/s and the Horse Creek diversion exceeding both the velocity and stream power conditions. The implication of these non-compliances and proposed management approach for these are discussed in the following Section.

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5. Concept Management of Proposed Diversions

This report section details some concept management conditions for the proposed creek diversions. Further details of the diversion management, including construction staging and long term monitoring are proposed to be resolved in the detailed design phase of the project implementation.

5.1. Offsets from Key Infrastructure and Operations

It is proposed that the diversions detailed in this report maintain offset distances from key infrastructure and lease boundaries. These proposed diversion offsets, applied from the top of bank of the stream diversion, are listed in Table 10 detailing the offset distance and the purpose for the separation.

Table 10 Proposed Creek Diversion Offset Requirements

Offset From	Offset Distance	Purpose
Spoil pile toe	50m	Water quality separation and landscaping
Mine Lease Boundary*	30m	Visual amenity and access

* - applicable only to Horse Creek

5.2. Management of Variations from Guidelines

5.2.1. Hydraulic Criteria

It was noted in Section 4.2 of this report that the proposed stream diversions do not achieve full compliance with the 2 year ARI non-vegetated condition, with Caval Creek not maintaining peak velocities below 1m/s and Horse Creek not complying with the peak velocity requirement and not maintaining peak stream power below 35 W/m^2.

It is proposed that measures be considered in the detailed design phase of the project for the mitigation of risks associated with these non-compliance with the guidelines. As the proposed diversions are compliant with the 2 year ARI condition for the vegetated conditions, it is the diversion immediately following construction that are exposed to this risk. Potential mitigation measures to manage this risk include the following:

- Construction of the diversions during the dry season, thereby maximising the opportunity for the establishment of vegetation prior to significant flow events;
- Development of a diversion revegetation plan;
- Construction staging that maximises the time for vegetation establishment prior to the activation of the creek diversions;

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It is proposed that measures be considered in the detailed design phase of the project for the mitigation of risks associated with these non-compliance with the guidelines. As the proposed diversions are compliant with the 2 year ARI condition for the vegetated conditions, it is the diversion immediately following construction that are exposed to this risk. Potential mitigation measures to manage this risk include the following:

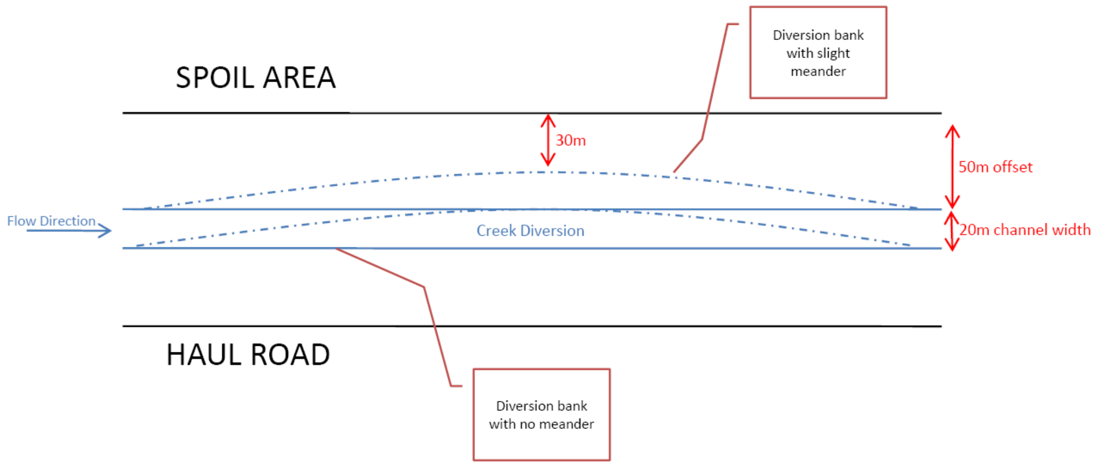
- Construction of the diversions during the dry season, thereby maximising the opportunity for the establishment of vegetation prior to significant flow events;
- Development of a diversion revegetation plan;
- Construction staging that maximises the time for vegetation establishment prior to the activation of the creek diversions;

- Development of a comprehensive diversion monitoring program with particular focus on monitoring of bed conditions following flow events.

5.2.2. Stream Plan Form

As discussed earlier in this report, the proposed Caval Creek diversion as proposed does not include stream meanders due to site constraints. It was further raised that the opportunity exists to incorporate a slight meander in the stream plan form by the utilisation of offsets, so that the constructed creek diversion is aesthetically more similar to a natural stream. This is proposed to occur where the Caval Creek diversion is located between the haul road and the spoil area between diversion chainages 1100 and 3000.

The concept for the introduction of a slight stream meander is illustrated in Figure 5. In this figure, half a cycle of a stream meander is illustrated showing a proposed configuration where the diversion channel meanders from the centreline by the equivalent width of the diversion channel.



- **Figure 5 Option for introduction of stream meander in Caval Creek diversion**

It is intended that this concept be further investigated as the design process progresses, establishing the number of meander cycles that be introduced along the diversion reach and the impact this has on hydraulic conditions. This proposed approach will increase creek diversion length and is hence anticipated to reduce flow velocity, stream power and shear stresses.

5.2.3. Cross Sectional Form

As discussed earlier in this report, the assessment to this stage in design has considered a cross-sectional form of 1V:4H, with a 5m wide horizontal bench placed at vertical intervals of 5m. This approach was adopted as a conservative horizontal plan configuration in the absence of geotechnical slope stability information. It is intended that these creek diversion side slopes be refined as the design process progresses.

6. References

- Australian Coal Association Research Program (ACARP), Bowen Basin River Diversions – Design and Rehabilitation Criteria, July 2002
- Natural Resources and Water, Watercourse Diversions – Central Queensland Mining Industry, January 2008
- Butcher, L 2008, *Determination of Watercourses and Upstream Pointsfor the Caval Ridge Mine Development Project (letter),* Department of Natural Resources and Water

Appendix A Hydrologic Analysis

A.1 Purpose

To determine the typical flows for the Caval and Horse Creeks diversions, a rainfall/runoff relationship for the surrounding catchment was derived using Australian Coal Association Research Program (ACARP) methods.

A.2 Hydrologic ACARP Approach

ACARP developed a simplified method to estimate the flow for any number of flood events for any stream in the Bowen Basin area based on catchment characteristics. This hydrological approach is detailed in Appendix E of the *Bowen Basin River Diversions Design and Rehabilitation Criteria (July 2002)* report.

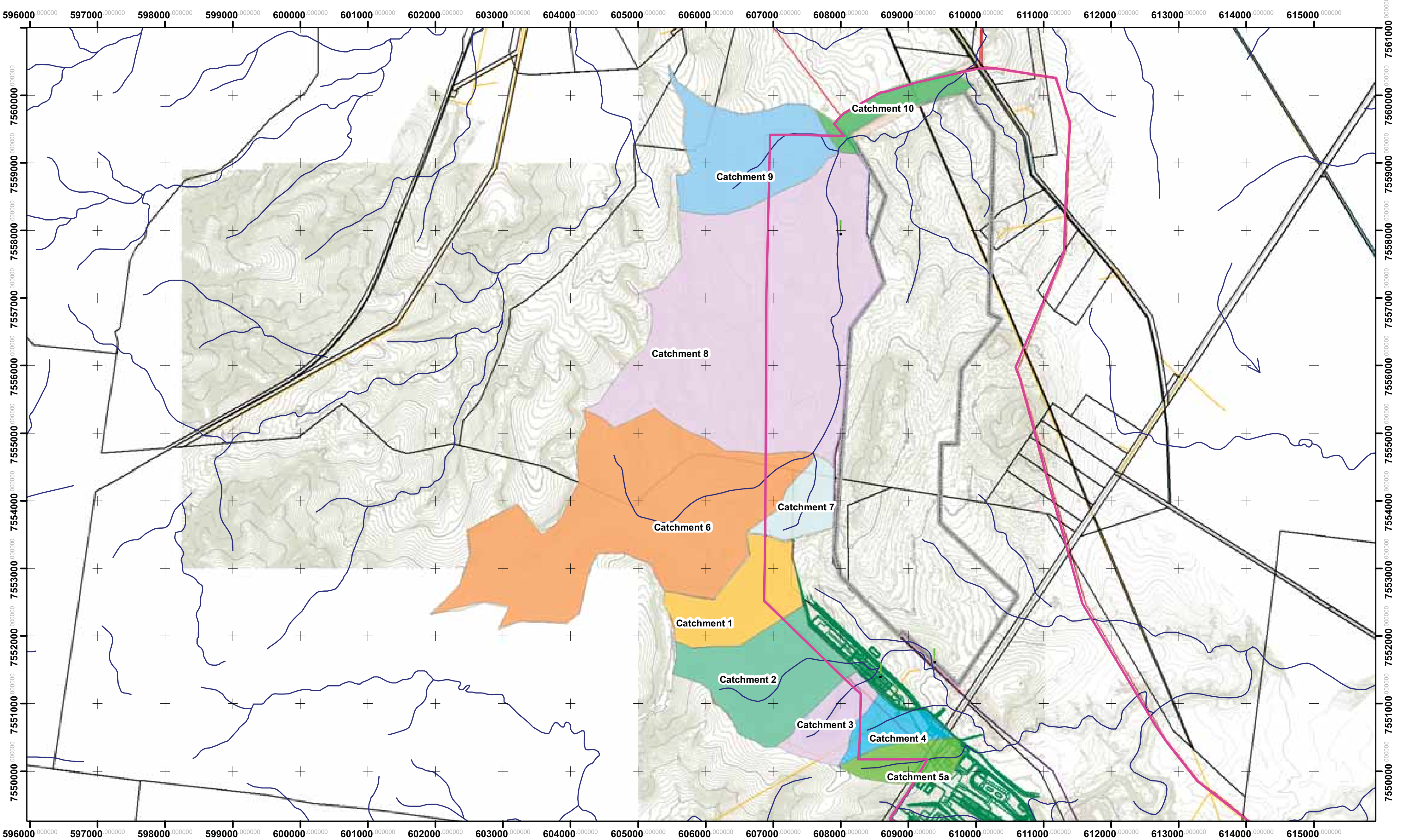
A key advantage of the ACARP modelling approach, when compared to the rational method approaches, is that it was designed specifically to derive flow estimates for any number of flood events for any stream in the Bowen Basin area based on catchment characteristics.

Due to the physical restrictions of available space for the Caval Creek diversion, the RAFTS hydrological model was used to create a typical hydrograph for the catchment area and the maximum flows generated from ACARP included. By combining these hydrological techniques and taking into account time of concentration, more accurate maximum flows through the creek diversion were obtained for the 2 year ARI. The 2 year ARI DNRW condition proved to be the limiting factor in the design of the Creeks.

A.3 Catchment Details

The contributing catchments to the defined stream reaches were delineated and split into subcatchments reflective of the location where each subcatchment will contribute to the likely stream diversion alignment. This catchment delineation is shown in Figure 6. Also shown in this figure is the location of the waterway determination points as established by DNRW with these points representing the upstream point requiring diversion design that is compliant with DNRW guidelines.

Subcatchments 1 to 5a contribute to the Caval Creek diversion, with subcatchments 6 to 10 contributing the Horse Creek diversion.



Legend

- Mine Lease
- Watercourse Determinations
- Pit Footprint

0 500 1,000 2,000 3,000 4,000 Metres

Scale - 1:50,000

Projection: MGA Zone 56

Caval Ridge Stream Diversion Concept

Figure 6: Catchment Delineation

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A.4 Results of Hydrologic Analysis

The contributing catchments to the Horse Creek diversion are significantly larger than those contributing to the Caval Creek diversion. As a result, the estimated design discharges for Horse Creek are in the order of 4 times those predicted for Caval Creek.

The estimated design discharges for the two creek diversions are listed in the following tables. Note that these are presented at chainage location, reflective of the progressive increase in design discharge as additional catchments contribute to the diversion.

- **Table 11 Estimated Caval Creek Design Discharges (m^3/s)**

Chainage	2 year ARI	50 year ARI	100 year ARI	Detail
0	3.7	4.9	6.1	Catchment 3 - start of realigned diversion
327	5.5	7.4	9.2	Pickup of Catchment 2
770	8.9	12.0	14.9	Pickup of Catchment 1 at 90deg bend
2600	9.2	12.4	15.4	Pickup of Catchment 4
3600	10.2	13.7	17.0	Pickup of Catchment 5a - Diversion Extension Reach
4600	12.7	17.2	21.3	Pickup of Catchment 5b - Diversion Extension Reach

- **Table 12 Estimated Horse Creek Design Discharges (m^3/s)**

Chainage	2 year ARI	50 year ARI	100 year ARI	Detail
300	2.7	2.8	3.5	
1200	16.6	29.0	36.1	
1600	33.2	62.6	77.6	Adopted as U/S Discharge for Declared Stream at 4900
5300	33.2	62.6	77.6	
6300	40.4	73.3	90.9	
6600	43.6	76.9	95.4	

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Appendix B Hydraulic Analysis

B.1 Hydraulic Design Parameters

Hydraulic modelling was utilised to assess the impact of the proposed Caval and Horse Creek diversion designs for the 2, and 50 year ARI rainfall events. HECRAS hydraulic modelling was created to design the creek diversion according to the specifications detailed in the Natural Resources and Water report , *Watercourse Diversions – Central Queensland Mining Industry*, January 2008.

The upper limits design criteria detailed in the NRW report are detailed in Table 13. Upon advice from BMA, the 2 year ARI (no vegetation) criteria were not used as a limiting factor in the creek diversion design as it is anticipated that the diversion will be vegetated. Consequently, the Manning's value for light brush on banks was used in the modelling to depict vegetated scenarios (Manning's n = 0.035). For comparative purposes, the "no vegetation" scenario was run for the 2 year ARI event (Manning's n = 0.028).

Table 13 DNRW Upper Limit Creek Design Threshold Criteria

Scenario	Stream Power (W/m^{2})	Velocity (m/s)	Shear Stress (N/m^{2})
2 year ARI (no vegetation)	<35	<1.0	<40
2 year ARI (vegetated)	<60	<1.5	<40
50 year ARI	<220	<2.5	<80

Ref: Natural Resources and Water report , *Watercourse Diversions – Central Queensland Mining Industry*, January 2008

B.2 Caval Creek Concept Design

The proposed Caval Creek diversion design concept was modified during the design process. Initially it was proposed for the diversion to be aligned on the eastern side of the proposed railway loop, located between the railway and the mine infrastructure area and stockyard. It was found during the concept assessment that this alignment, while workable, resulted in a very large cut volumes. In addition, large cut depths coupled with an adopted side slope configuration of 1:4 with a 5m bench at 5m resulted in a very large surface footprint to the diversion such that the infrastructure area would need to be relocated. Due to these constraints, an alternate alignment was investigated and ultimately adopted.

The adopted Caval Creek diversion has an upstream extent at Catchment 3 and runs to the North to pass around the proposed infrastructure and stockyard area. The alignment intercepts catchment 2 at grade upstream of two 90 degree bends around the extended stockyard. The diversion is then proposed to be aligned adjacent to the haul road.

The Caval Creek alignment incorporated both a short term discharge point and a potential diversion extension. The short term configuration diversion is approximately 3,750m in length and the future extension incorporated an additional 1,600m of constructed diversion. The initial diversion reach utilises two stream grades, with 0.2% adopted for the upper reach to facilitate tie in with adjacent catchments, and 0.54% to meet the downstream confluence. The future extension of this diversion has a straight line diversion grade of 0.74%.

Due to the relatively small design discharges and adopted low stream grades, the proposed diversion requires only a small base widths. Where the diversion is maintained at a bed grade of 0.2% a nominal 4m base width was adopted for constructability, while a 15m base width is required for the stream reaches of steeper bed grade.

B.3 Horse Creek Concept Design

The proposed Horse Creek diversion is located in the most northern reaches of the mine lease. The proposed diversion alignment is detailed here downstream of the 4,800m chainage as this is the chainage reflective of the declared watercourse as per DNRW. The Horse Creek diversion requires significantly less cut depth than the Caval Creek diversion with the proposed diversion alignment more closely following the natural terrain.

There is a straight line bed grade from the upstream interception point to the downstream merge with the existing creek of approximately 0.4%. This is based on a straight line diversion length of 3,4km. The combination of this grade and large design discharge dictated that very large base widths would be required to maintain DNRW stream velocity and power requirements. As a result, a meander was introduced to this stream diversion to increase effective stream length by 18% to approximately 4.6km. To achieve this a meander of maximum deviation from centreline of 50m was adopted so as to not constrain mining potential, requiring approximately 6 meander cycles within the diversion.

B.4 Results

The following tables present the key hydraulic model outputs for the proposed Caval and Horse Creek diversions.

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Table 14 Caval Creek Diversion, Power and Shear Stress

		2 year					50 year					100 year				
River Sta	Min Ch El (m)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Total (N/m s)	Shear Total (N/m2)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Total (N/m s)	Shear Total (N/m2)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Tot (N/m s)	Shear Total (N/m2)
0	248.07	3.7	248.7	1.3	32.5	25.8	5.0	248.8	1.4	39.5	29.0	6.1	248.9	1.4	45.2	31.4
-81.782*	247.56	3.7	248.2	1.2	28.8	23.8	5.0	248.3	1.3	34.6	26.5	6.1	248.4	1.4	39.8	28.8
-163.56*	247.04	3.7	247.7	1.3	37.1	28.3	5.0	247.8	1.4	47.1	32.8	6.1	247.8	1.5	54.3	35.7
-245.34*	246.52	3.7	247.2	1.1	20.7	19.0	5.0	247.4	1.1	20.1	18.3	6.1	247.5	1.1	19.9	17.9
-327.131	246	5.5	247.0	0.9	9.8	11.1	7.4	247.2	0.9	11.6	12.2	9.2	247.3	1.0	12.9	13.0
-421.70*	245.81	5.5	246.9	0.9	9.1	10.6	7.4	247.0	0.9	10.5	11.5	9.2	247.1	1.0	11.6	12.1
-516.27*	245.63	5.5	246.7	0.8	7.8	9.5	7.4	246.9	0.9	8.8	10.1	9.2	247.0	0.9	9.6	10.6
-610.85*	245.44	5.5	246.6	0.8	5.8	7.8	7.4	246.7	0.8	6.6	8.3	9.2	246.9	0.8	7.2	8.7
-705.42*	245.25	5.5	246.5	0.7	3.7	5.7	7.4	246.7	0.7	4.3	6.3	9.2	246.8	0.7	4.9	6.7
-800	245.07	8.9	246.3	1.0	14.0	13.8	12.0	246.5	1.1	17.0	15.5	14.9	246.6	1.2	19.4	16.8
-897.07*	244.87	8.9	246.1	1.0	14.0	13.8	12.0	246.3	1.1	16.9	15.5	14.9	246.4	1.2	19.4	16.8
-994.14*	244.68	8.9	245.9	1.0	14.0	13.8	12.0	246.1	1.1	16.9	15.5	14.9	246.3	1.2	19.4	16.8
-1091.2*	244.49	8.9	245.7	1.0	14.0	13.8	12.0	245.9	1.1	17.0	15.5	14.9	246.1	1.2	19.5	16.8
-1188.2*	244.3	8.9	245.6	1.0	14.0	13.8	12.0	245.7	1.1	17.0	15.5	14.9	245.9	1.2	19.5	16.9
-1285.3*	244.11	8.9	245.4	1.0	14.0	13.8	12.0	245.5	1.1	17.0	15.5	14.9	245.7	1.2	19.5	16.9
-1382.4*	243.92	8.9	245.2	1.0	14.0	13.8	12.0	245.3	1.1	17.0	15.6	14.9	245.5	1.2	19.6	16.9
-1479.5*	243.72	8.9	245.0	1.0	14.0	13.8	12.0	245.2	1.1	17.1	15.6	14.9	245.3	1.2	19.7	17.0
-1576.5*	243.53	8.9	244.8	1.0	14.1	13.9	12.0	245.0	1.1	17.3	15.7	14.9	245.1	1.2	20.0	17.2
-1673.6*	243.34	8.9	244.6	1.0	14.3	14.0	12.0	244.8	1.1	17.8	16.0	14.9	244.9	1.2	20.8	17.6
-1770.7*	243.15	8.9	244.4	1.0	14.8	14.3	12.0	244.6	1.1	18.9	16.7	14.9	244.7	1.2	22.6	18.7
-1867.81	242.96	8.9	243.7	1.5	25.8	22.5	12.0	243.9	1.4	41.2	31.2	14.9	244.0	1.5	42.4	32.1
-1877	242.96	8.9	243.4	1.2	25.7	22.0	12.0	243.5	1.3	33.0	25.6	14.9	243.6	1.4	39.4	28.4
-1967.3*	242.46	8.9	242.9	1.2	25.2	21.8	12.0	243.0	1.3	33.4	25.8	14.9	243.1	1.4	40.1	28.8
-2057.7*	241.97	8.9	242.4	1.2	25.5	21.9	12.0	242.5	1.3	33.1	25.6	14.9	242.6	1.4	39.4	28.4
-2148.1*	241.47	8.9	241.9	1.2	25.1	21.7	12.0	242.0	1.3	33.1	25.6	14.9	242.1	1.4	40.2	28.8
-2238.5*	240.98	8.9	241.4	1.2	25.6	22.0	12.0	241.5	1.3	33.3	25.7	14.9	241.6	1.4	39.6	28.5
-2328.8*	240.48	8.9	240.9	1.2	25.2	21.7	12.0	241.0	1.3	32.9	25.5	14.9	241.1	1.4	39.9	28.7
-2419.2*	239.99	8.9	240.4	1.2	25.8	22.1	12.0	240.5	1.3	33.6	25.9	14.9	240.6	1.4	40.4	28.9
-2509.6*	239.5	8.9	240.0	1.2	24.6	21.4	12.0	240.0	1.3	32.0	25.1	14.9	240.1	1.4	38.3	27.9
-2600	239	9.2	239.5	1.2	26.0	22.1	12.4	239.6	1.3	33.7	25.9	15.4	239.6	1.4	40.6	28.9
-2697.4*	238.47	9.2	238.9	1.2	25.5	21.9	12.4	239.0	1.3	33.6	25.8	15.4	239.1	1.4	40.5	28.9
-2794.8*	237.95	9.2	238.4	1.2	26.0	22.1	12.4	238.5	1.3	33.5	25.8	15.4	238.6	1.4	40.5	28.9
-2892.2*	237.42	9.2	237.9	1.2	25.6	21.9	12.4	238.0	1.3	33.7	25.9	15.4	238.1	1.4	40.5	28.9
-2989.6*	236.9	9.2	237.4	1.2	26.0	22.2	12.4	237.5	1.3	33.3	25.7	15.4	237.5	1.4	40.4	28.9
-3087.0*	236.37	9.2	236.8	1.2	25.7	22.0	12.4	236.9	1.3	33.8	25.9	15.4	237.0	1.4	40.5	28.9
-3184.4*	235.84	9.2	236.3	1.2	25.7	22.0	12.4	236.4	1.3	33.8	26.0	15.4	236.5	1.4	40.4	28.9
-3281.8*	235.32	9.2	235.8	1.2	25.9	22.1	12.4	235.9	1.3	33.3	25.7	15.4	236.0	1.4	40.1	28.7
-3379.3*	234.79	9.2	235.3	1.2	25.8	22.1	12.4	235.3	1.3	33.9	26.0	15.4	235.4	1.4	40.7	29.0
-3476.7*	234.27	9.2	234.7	1.2	25.8	22.1	12.4	234.8	1.3	33.5	25.8	15.4	234.9	1.4	40.3	28.8
-3574.1*	233.74	9.2	234.2	1.2	26.0	22.2	12.4	234.3	1.3	33.7	25.9	15.4	234.4	1.4	40.3	28.8
-3671.5*	233.21	9.2	233.7	1.2	25.8	22.1	12.4	233.8	1.3	33.5	25.8	15.4	233.8	1.4	40.7	29.0
-3768.96	232.69	9.2	233.2	1.2	25.8	22.0	12.4	233.2	1.3	33.6	25.8	15.4	233.3	1.4	40.4	28.9

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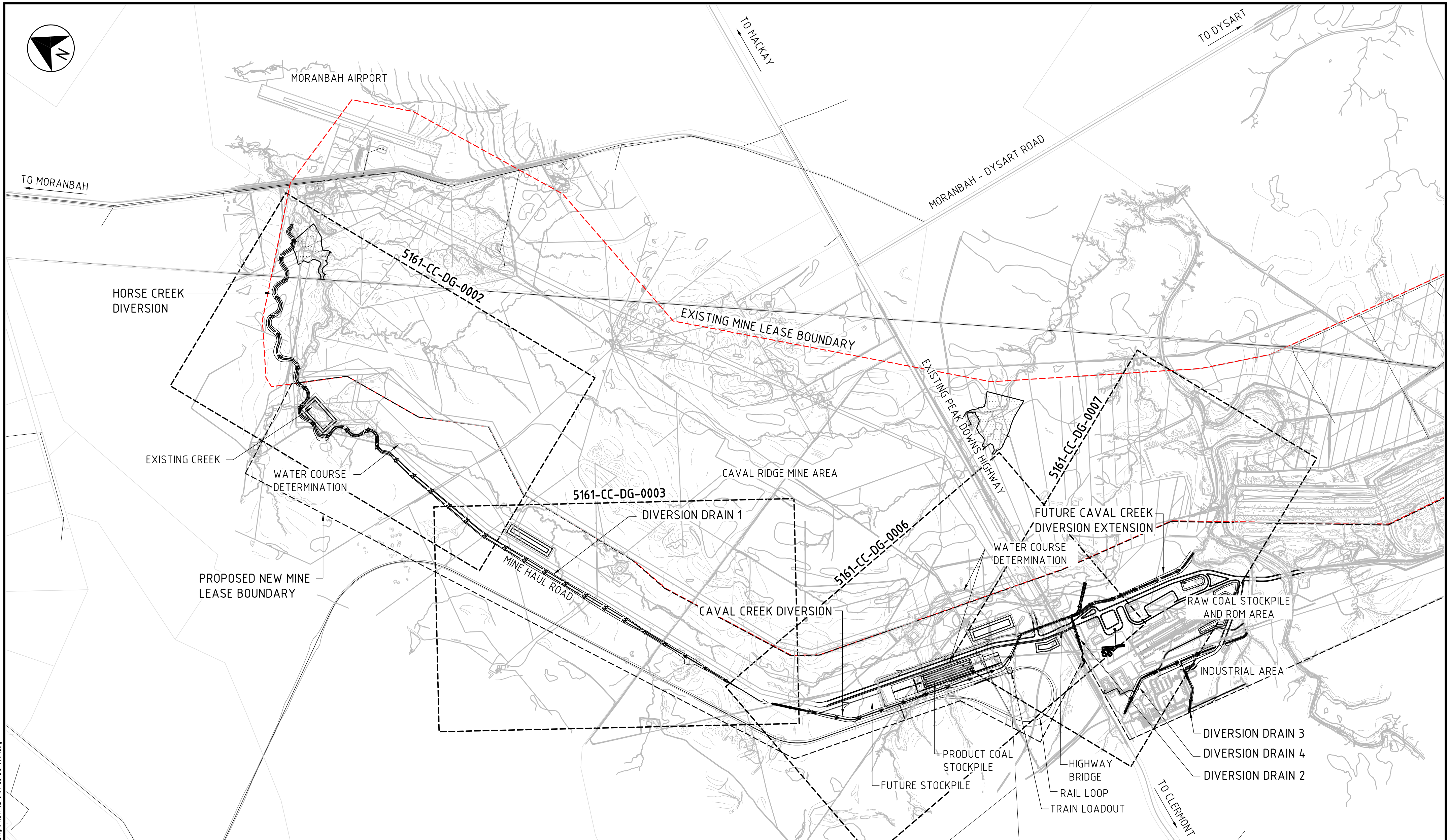
Table 15 Horse Creek Diversion, Power and Shear Stress

		2 year					50 year					100 year				
River Sta	Min Ch El (m)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Total (N/m s)	Shear Total (N/m2)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Total (N/m s)	Shear Total (N/m2)	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Power Tot (N/m s)	Shear Total (N/m2)
-4900	248.07	33.2	231.2	1.5	39.8	27.3	62.6	231.6	1.8	66.8	37.3	77.6	231.8	1.9	78.8	41.1
-5000.*	247.56	33.2	230.9	1.5	39.9	27.3	62.6	231.3	1.8	66.3	37.1	77.6	231.4	1.9	77.9	40.8
-5100.*	247.04	33.2	230.5	1.5	39.4	27.1	62.6	230.9	1.8	64.1	36.2	77.6	231.1	1.9	74.7	39.6
-5200.*	246.52	33.2	230.2	1.4	36.6	25.8	62.6	230.6	1.7	58.5	34.0	77.6	230.8	1.8	67.5	37.0
-5300.*	246	33.2	229.9	1.3	27.1	20.9	62.6	230.4	1.6	46.6	29.0	77.6	230.6	1.7	54.1	31.7
-5400.*	245.81	40.4	229.6	1.5	47.0	30.2	73.3	230.0	1.9	76.0	40.3	90.9	230.2	2.0	89.9	44.5
-5500.*	245.63	40.4	229.3	1.5	46.9	30.1	73.3	229.7	1.9	75.8	40.2	90.9	229.9	2.0	89.7	44.5
-5600.*	245.44	40.4	228.9	1.5	46.9	30.1	73.3	229.3	1.9	75.9	40.2	90.9	229.5	2.0	89.8	44.5
-5700.*	245.25	40.4	228.6	1.5	47.0	30.2	73.3	229.0	1.9	76.0	40.3	90.9	229.2	2.0	89.9	44.5
-5800.*	245.07	40.4	228.2	1.5	46.9	30.1	73.3	228.7	1.9	75.9	40.2	90.9	228.8	2.0	89.8	44.5
-5900.*	244.87	40.4	227.9	1.5	47.0	30.2	73.3	228.3	1.9	76.0	40.3	90.9	228.5	2.0	89.9	44.5
-6000.*	244.68	40.4	227.5	1.5	46.9	30.1	73.3	228.0	1.9	75.9	40.2	90.9	228.2	2.0	89.8	44.5
-6100.*	244.49	40.4	227.2	1.5	47.1	30.2	73.3	227.6	1.9	76.0	40.3	90.9	227.8	2.0	89.9	44.5
-6200.*	244.3	40.4	226.9	1.5	46.9	30.1	73.3	227.3	1.9	75.8	40.2	90.9	227.5	2.0	89.6	44.4
-6300.*	244.11	40.4	226.5	1.5	46.9	30.1	73.3	227.0	1.9	75.9	40.2	90.9	227.1	2.0	89.7	44.5
-6400.*	243.92	40.4	226.2	1.5	47.0	30.2	73.3	226.6	1.9	76.0	40.3	90.9	226.8	2.0	89.8	44.5
-6500.*	243.72	40.4	225.8	1.5	46.9	30.1	73.3	226.3	1.9	75.7	40.2	90.9	226.5	2.0	89.2	44.3
-6600.*	243.53	40.4	225.5	1.5	46.7	30.1	73.3	225.9	1.9	75.1	39.9	90.9	226.1	2.0	88.3	44.0
-6700.*	243.34	40.4	225.2	1.5	45.4	29.5	73.3	225.6	1.9	73.0	39.1	90.9	225.8	2.0	85.6	43.1
-6800.*	243.15	40.4	224.9	1.5	40.3	27.2	73.3	225.3	1.8	67.8	37.2	90.9	225.5	1.9	79.7	41.0
-6900.*	242.96	43.6	224.5	1.5	50.0	31.3	76.9	224.9	1.9	78.7	41.1	95.4	225.1	2.1	93.1	45.5
-7000.*	242.96	43.6	224.2	1.5	49.9	31.3	76.9	224.6	1.9	78.7	41.1	95.4	224.8	2.1	93.1	45.5
-7100.*	242.46	43.6	223.8	1.5	50.1	31.4	76.9	224.3	1.9	78.9	41.2	95.4	224.5	2.1	93.3	45.5
-7200.*	241.97	43.6	223.5	1.5	49.9	31.3	76.9	223.9	1.9	78.8	41.1	95.4	224.1	2.1	93.2	45.5
-7300.*	241.47	43.6	223.2	1.5	50.1	31.4	76.9	223.6	1.9	78.9	41.2	95.4	223.8	2.1	93.3	45.5
-7400.*	240.98	43.6	222.8	1.5	50.0	31.3	76.9	223.2	1.9	78.8	41.1	95.4	223.4	2.1	93.1	45.5
-7500.*	240.48	43.6	222.5	1.5	49.9	31.3	76.9	222.9	1.9	78.8	41.1	95.4	223.1	2.1	93.2	45.5
-7600.*	239.99	43.6	222.1	1.5	50.1	31.4	76.9	222.6	1.9	78.9	41.2	95.4	222.7	2.1	93.3	45.5
-7700.*	239.5	43.6	221.8	1.5	49.9	31.3	76.9	222.2	1.9	78.8	41.1	95.4	222.4	2.1	93.2	45.5
-7800.*	239	43.6	221.5	1.5	50.1	31.4	76.9	221.9	1.9	78.9	41.2	95.4	222.1	2.1	93.3	45.5
-7900.*	238.47	43.6	221.1	1.5	49.9	31.3	76.9	221.5	1.9	78.7	41.1	95.4	221.7	2.1	93.1	45.5
-8000.*	237.95	43.6	220.8	1.5	50.1	31.4	76.9	221.2	1.9	78.9	41.2	95.4	221.4	2.1	93.3	45.5
-8100.*	237.42	43.6	220.4	1.5	50.0	31.3	76.9	220.8	1.9	78.7	41.1	95.4	221.0	2.1	93.1	45.5
-8200.*	236.9	43.6	220.1	1.5	49.9	31.3	76.9	220.5	1.9	78.8	41.1	95.4	220.7	2.1	93.2	45.5
-8300.*	236.37	43.6	219.7	1.5	50.1	31.4	76.9	220.2	1.9	78.9	41.2	95.4	220.4	2.1	93.3	45.5
-8400.*	235.84	43.6	219.4	1.5	49.9	31.3	76.9	219.8	1.9	78.8	41.1	95.4	220.0	2.1	93.1	45.5
-8500.*	235.32	43.6	219.1	1.5	50.1	31.4	76.9	219.5	1.9	78.9	41.2	95.4	219.7	2.1	93.2	45.5
-8600.*	234.79	43.6	218.7	1.5	49.9	31.3	76.9	219.1	1.9	78.6	41.1	95.4	219.3	2.0	92.7	45.3
-8700.*	234.27	43.6	218.4	1.5	49.9	31.3	76.9	218.8	1.9	78.0	40.9	95.4	219.0	2.0	91.8	45.0
-8800.*	233.74	43.6	218.0	1.5	49.0	30.9	76.9	218.5	1.9	75.9	40.1	95.4	218.7	2.0	89.2	44.1
-8900	233.21	43.6	217.7	1.5	45.6	29.4	76.9	218.2	1.9	71.1	38.3	95.4	218.4	2.0	83.7	42.2
-8935	232.69	43.6	217.6	1.5	43.4	28.4	76.9	218.1	1.8	68.4	37.3	95.4	218.3	2.0	80.8	41.2

Appendix C Design Concept Sketches

DATE: 23/10/2008 4:46:17 PM LOGIN NAME: HOUGHTON, STEVEN (SKM)
LOCATION: I:\QRES\Projects\QR10095\Deliverables\Drawings\Civil\Dwg\PHCVR02-5161-CC-DG-0001.dwg



PRELIMINARY

1:20000 400 200 0 400 800 1200 1600 2000m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

DESIGNED	DESIGNED CHECKED	DRAFTING CHECKED	ENGINEER MANAGER	REVISION CHECKED	REVISION APPROVED

DOC NUMBER	DOCUMENT TITLE

REFERENCE DOCUMENTS

CONSULTANTS

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REV	DESCRIPTION	BY	CHKD	APP	DATE
A	ISSUED FOR INFORMATION	JH			09.09.08

REVISIONS, ISSUES AND APPROVALS

SCALE	AS SHOWN	DATE
DESIGNED		
DESIGN CHECKED		
DRAWN	H.PRICE	
DRAFTING CHECK		
ENGINEER MANAGER		
ACAD FILE		

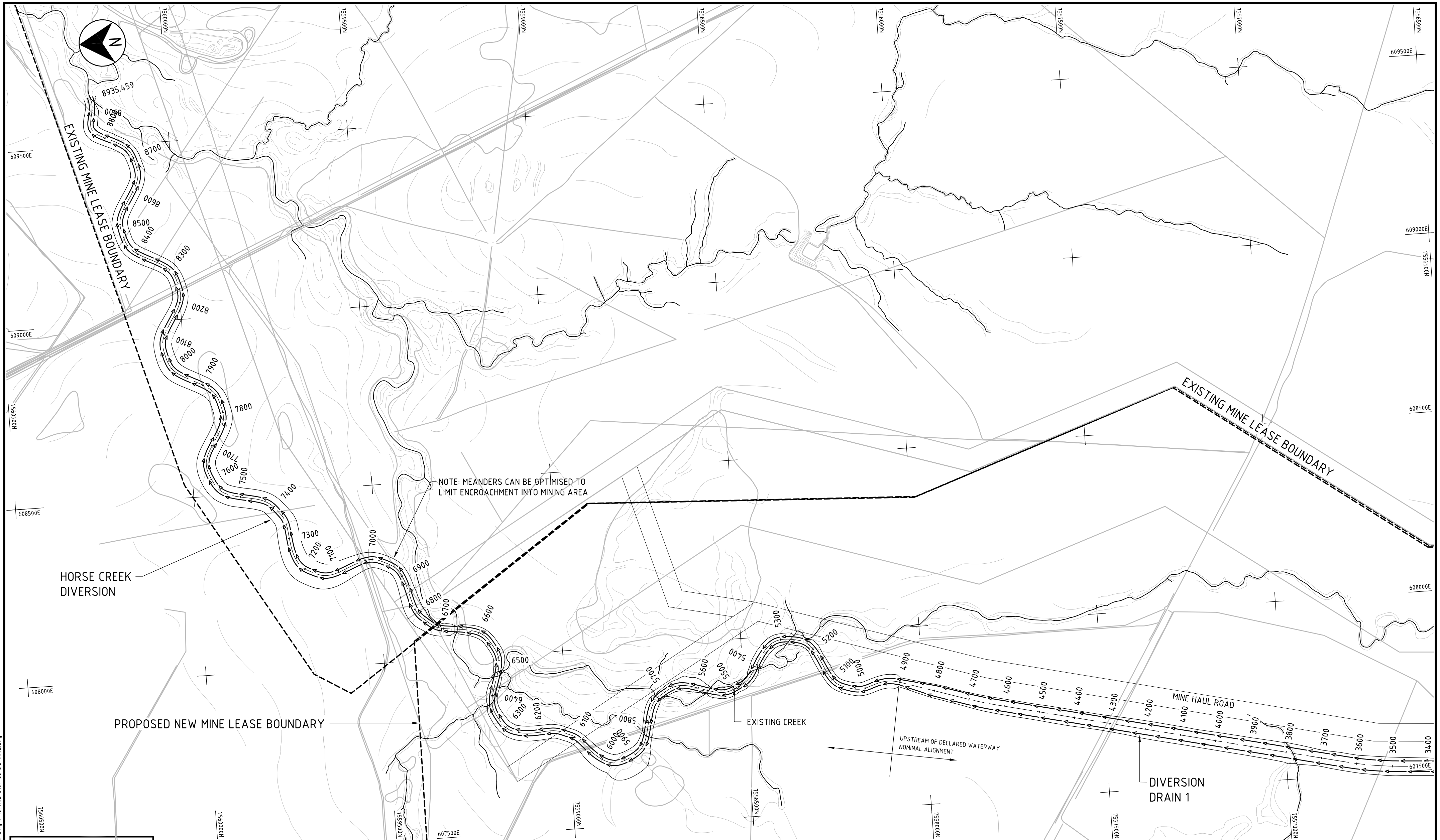
BMA
BHP Billiton Mitsubishi Alliance

APPROVAL 1
APPROVAL 2

CAVAL RIDGE MINE

DIVERSION DRAINS OVERALL PLAN

DRAWING NUMBER: PHCVR02-5161-CC-DG-0001 A1 REV. A



PRELIMINARY

1:5000 — 100 50 0 100 200 300 400 500m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

DATE: 23/10/2008 4:49:59 PM LOGIN NAME: HOUGHTON, STEVEN (SKM)
LOCATION: I:\QRES\Projects\QR10095\Deliverables\Drawings\Civil\Dwg\PHCVR02-5161-CC-DG-0002.dwg

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DOC NUMBER	DOCUMENT TITLE

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REV	DESCRIPTION	BY	CHKD	APP	DATE
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APPROVAL 2

CAVAL RIDGE MINE

HORSE CREEK DIVERSION
PLAN AND SECTIONS
SHEET 1

DRAWING NUMBER: PHCVR02-5161-CC-DG-0002 — A1 — REV. A

DATE: 23/10/2008 4:51:16 PM LOGIN NAME: HOUGHTON, STEVEN (SKM)
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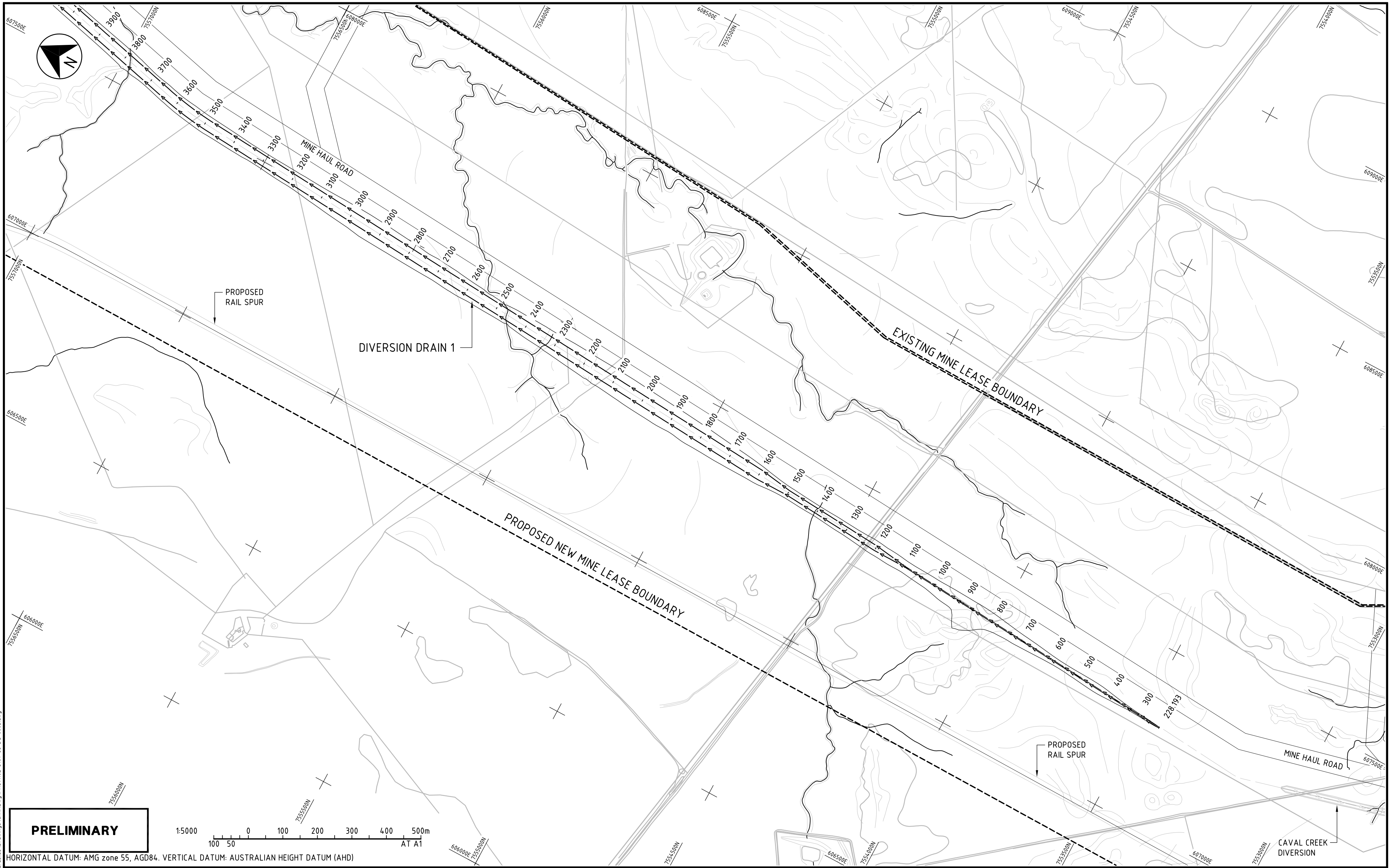

PRELIMINARY

1:5000 — 100 50 0 100 200 300 400 500m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

DESIGNED	DESIGNED CHECKED	DRAFTING CHECKED	ENGINEER MANAGER	REVISION CHECKED	REVISION APPROVED

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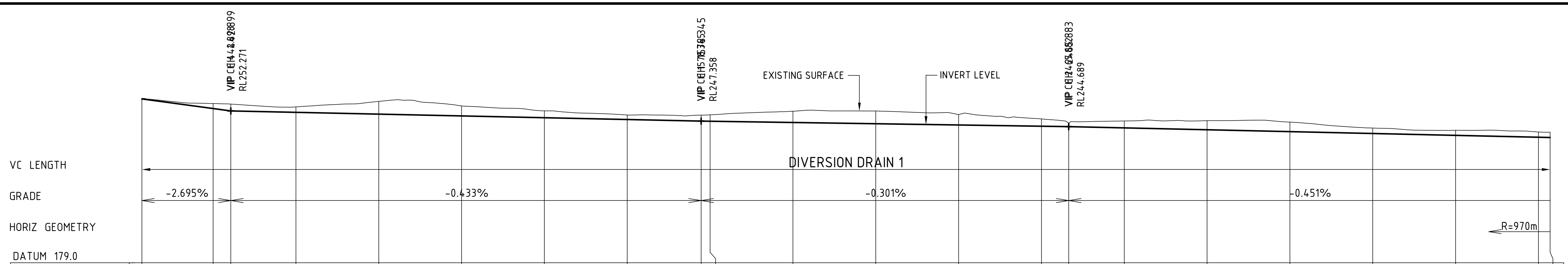
APPROVAL 1
APPROVAL 2

CAVAL RIDGE MINE

HORSE CREEK DIVERSION
PLAN AND SECTIONS
SHEET 2

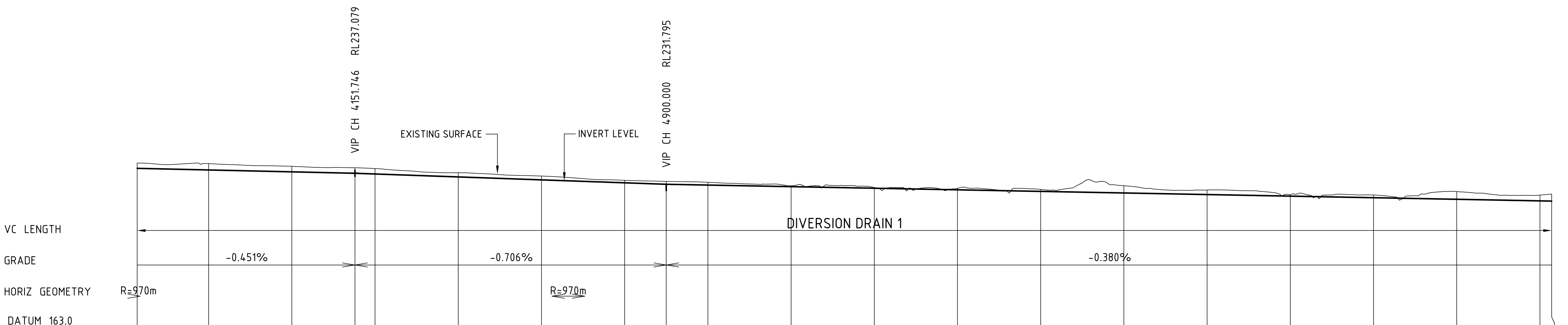
DRAWING NUMBER: PHCVR02-5161-CC-DG-0003 | A1 | REV. A



CHAINAGE	EXISTING SURFACE	DESIGN DIVERSION CL LEVELS
228.194	258.058	258.058
400.000	255.827	253.428
442.899	255.581	252.271
600.000	254.228	251.592
800.000	256.896	250.726
1000.000	254.665	249.861
1200.000	252.335	248.995
1400.000	250.321	248.130
1578.345	250.258	247.358
1600.000	250.376	247.293
1800.000	252.118	246.691
2000.000	252.239	246.090
2200.000	250.550	245.488
2400.000	248.415	244.887
2465.883	246.389	244.689
2600.000	247.418	244.083
2800.000	247.591	243.181
3000.000	246.891	242.278
3200.000	244.001	241.375
3400.000	242.906	240.472
3600.000	242.107	239.570
3628.194	241.971	239.442

LONGITUDINAL SECTION NORTHERN DRAIN CENTRE

SCALE 1:5000 HORIZONTAL
SCALE 1:1000 VERTICAL



CHAINAGE	EXISTING SURFACE	DESIGN DIVERSION CL LEVELS
3628.194	241.971	239.442
3800.000	241.732	238.667
4000.000	240.419	237.764
4151.746	239.732	237.079
4200.000	239.370	236.739
4400.000	237.367	235.326
4600.000	235.753	233.914
4800.000	233.701	232.501
4900.000	233.168	231.795
5000.000	232.742	231.415
5200.000	231.092	230.654
5400.000	230.244	229.894
5600.000	229.808	229.134
5800.000	229.312	228.374
6000.000	231.111	227.613
6200.000	229.061	226.853
6400.000	226.851	226.093
6600.000	226.677	225.333
6800.000	228.292	224.572
7000.000	226.593	223.812
7028.194	227.121	223.705

LONGITUDINAL SECTION NORTHERN DRAIN CENTRE

SCALE 1:5000 HORIZONTAL
SCALE 1:1000 VERTICAL

PRELIMINARY

1:5000 — 100 50 0 100 200 300 400 500m AT A1
1:1000 — 20 10 0 20 40 60 80 100m AT A1
1:200 — 4 3 2 1 0 4 8 12 16 20m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

DESIGNED	DESIGNED CHECKED	DRAFTING CHECKED	ENGINEER MANAGER	REVISION CHECKED	REVISION APPROVED

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DRAWN	H.PRICE	
DRAFTING CHECK		
ENGINEER MANAGER		
ACAD FILE		

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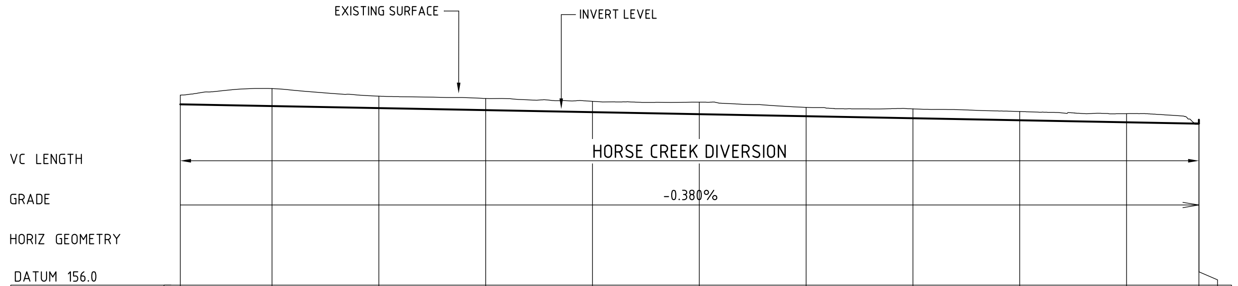
APPROVAL 1
APPROVAL 2

CAVAL RIDGE MINE
HORSE CREEK DIVERSION
PLAN AND SECTIONS
SHEET 3

DRAWING NUMBER: PHCVR02-5161-CC-DG-0004 | A1 | REV. A

DATE: 23/10/2008 4:52:23 PM LOGIN NAME: HOUGHTON, STEVEN (SKM)
LOCATION: I:\QRES\Projects\QR10095\Deliverables\Drawings\Civil\Dwg\PHCVR02-5161-CC-DG-0004.dwg

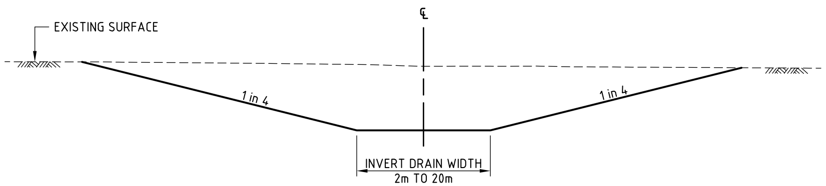
DATE: 23/10/2008 4:56:48 PM LOGIN NAME: HOUGHTON, STEVEN (SKM)
LOCATION: I:\QRES\Projects\QR10095\Deliverables\Drawings\Civil\Dwg\PHCVR02-5161-CC-DG-0005.dwg



CHAINAGE	EXISTING SURFACE	DESIGN DIVERSION CL LEVELS
7028.194	227.121	223.705
7200.000	229.618	223.052
7400.000	226.744	222.292
7600.000	225.856	221.531
7800.000	224.813	220.771
8000.000	224.495	220.011
8200.000	222.526	219.251
8400.000	221.989	218.490
8600.000	220.993	217.730
8800.000	220.198	216.970
8935.459	216.455	216.455
8935.459	216.455	216.455

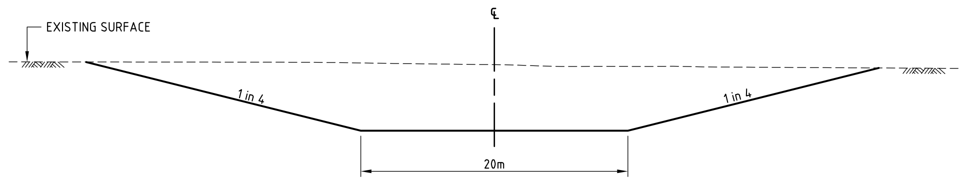
LONGITUDINAL SECTION NORTHERN DRAIN CENTRE

SCALE 1:5000 HORIZONTAL
SCALE 1:1000 VERTICAL



DIVERSION DRAIN 1

SCALE 1:200



HORSE CREEK DIVERSION

SCALE 1:200

DIVERSION DRAIN 1
WIDTH DIMENSIONS SETOUT

CHAINAGE	INVERT DRAIN WIDTH
300 -1100	2m
1100-1500	10m
1500-5200	20m

PRELIMINARY

1:5000 — 100 50 0 100 200 300 400 500m AT A1
1:1000 — 20 10 0 20 40 60 80 100m AT A1
1:200 — 4 3 2 1 0 4 8 12 16 20m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

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DRAFTING CHECK		
ENGINEER MANAGER		
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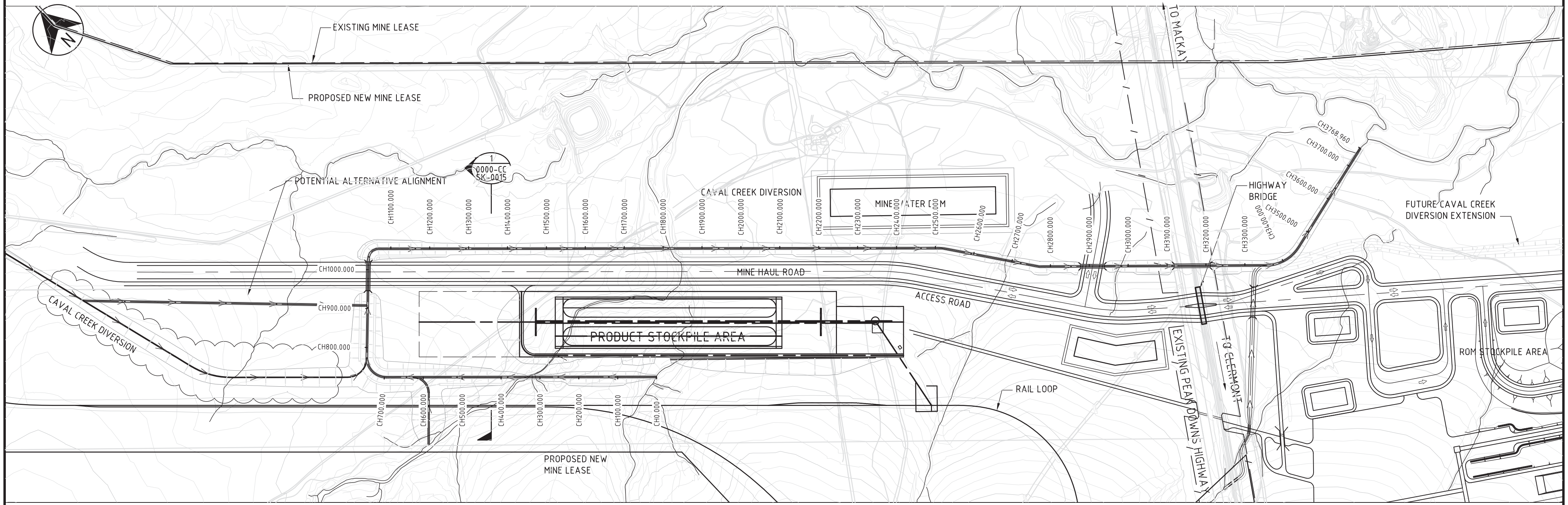
APPROVAL 1
APPROVAL 2

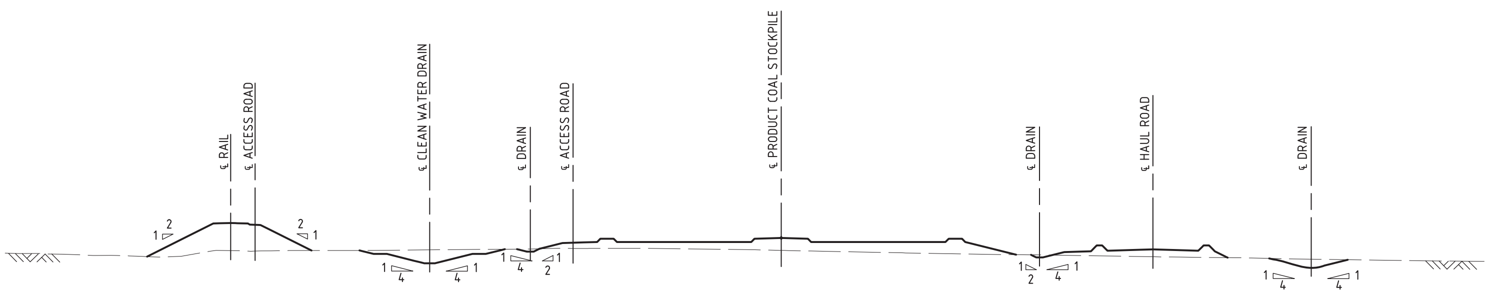
CAVAL RIDGE MINE

HORSE CREEK DIVERSION
PLAN AND SECTIONS
SHEET 4

DRAWING NUMBER A1 REV.
PHCVR02-5161-CC-DG-0005 A



PLAN
SCALE 1:10000



SECTION 1
SCALE 1:1000

PRELIMINARY

1:10000 — 200 100 0 200 400 600 800 1000m AT A1

1:1000 — 20 10 0 20 40 60 80 100m AT A1

HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

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REV	DESCRIPTION	BY	CHKD	APP	DATE
PA	PRELIMINARY				

REVISIONS, ISSUES AND APPROVALS

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DESIGN CHECKED		
DRAWN	H.PRICE	29.09.08
DRAFTING CHECK		
ENGINEER MANAGER		
ACAD FILE		

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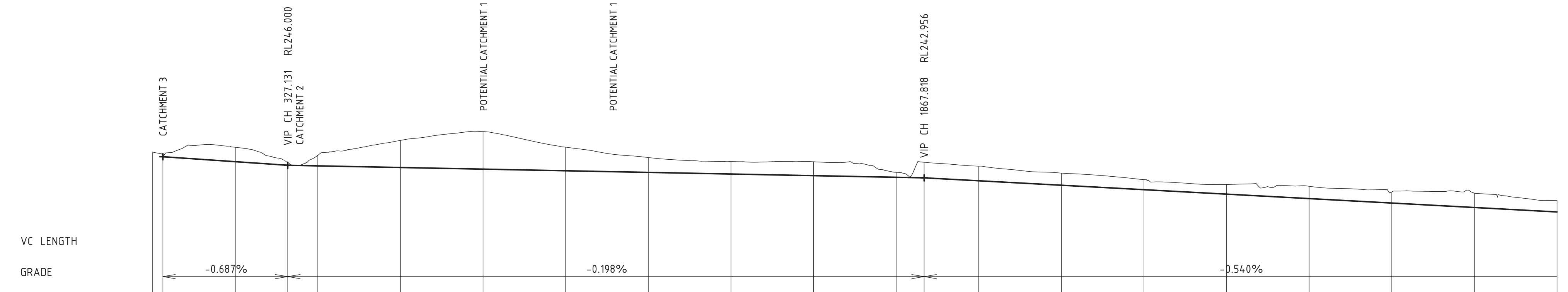
APPROVAL 1
APPROVAL 2

CAVAL RIDGE MINE

PRODUCT STOCKPILE DIVERSION DRAIN CONCEPT PLAN AND CROSS SECTION

DRAWING NUMBER	A1	REV.
PHCVR02-0000-CC-SK-0015		PA



VC LENGTH

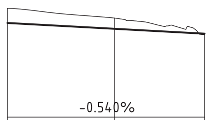
GRADE: -0.687% | -0.198% | -0.540%

HORIZ GEOMETRY: R=50m, R=50m, R=25m, R=-100m

DATUM 204.0

CHAINAGE	EXISTING SURFACE	DESIGN DIVERSION CL LEVELS
0.000	249.246	
24.918	248.376	248.075
200.000	250.371	246.873
327.131	246.676	246.000
400.000	248.431	245.856
600.000	252.042	245.461
800.000	254.177	245.066
1000.000	250.389	244.671
1200.000	247.886	244.275
1400.000	246.920	243.880
1600.000	246.869	243.485
1800.000	244.303	243.090
1867.818	246.737	242.956
2000.000	245.814	242.242
2200.000	244.096	241.162
2400.000	242.571	240.081
2600.000	241.342	239.001
2800.000	240.914	237.921
3000.000	239.554	236.840
3200.000	239.250	235.760
3400.000	237.439	234.679

LONGITUDINAL SECTION DRAIN DIVERSION 1D CENTRE
SCALE 1:5000 HORIZONTAL
SCALE 1:500 VERTICAL



VC LENGTH

GRADE: -0.540%

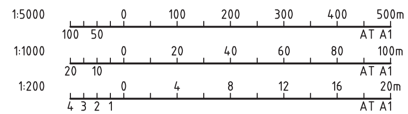
HORIZ GEOMETRY: R=-100m

DATUM 202.0

CHAINAGE	EXISTING SURFACE	DESIGN DIVERSION CL LEVELS
3400.000	237.439	234.679
3600.000	235.618	233.599
3768.960	232.469	232.686

LONGITUDINAL SECTION DRAIN DIVERSION 1D CENTRE
SCALE 1:5000 HORIZONTAL
SCALE 1:500 VERTICAL

PRELIMINARY



HORIZONTAL DATUM: AMG zone 55, AGD84. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD)

DESIGNED	DESIGNED CHECKED	DRAFTING CHECKED	ENGINEER MANAGER	REVISION CHECKED	REVISION APPROVED

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DESIGN CHECKED		
DRAWN	J.HURLSTONE	09.09.08
DRAFTING CHECK		
ENGINEER MANAGER		
ACAD FILE		

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APPROVAL 1
APPROVAL 2

CAVAL RIDGE MINE

CAVAL CREEK DIVERSION
LONGITUDINAL SECTION

DRAWING NUMBER: PHCVR02-5161-CC-SK-0017 | A1 | REV. PB