S Cumulative Surface Water Impact Assessment

Report

Cumulative Surface Water Impact Assessment

3 OCTOBER 2012

Prepared for

Hancock Galilee Pty Ltd

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42626920

URS

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Abbreviations

Abbreviation	Description
AEP	Annual Exceedance Probability
DTM	Digital Terrain Model
EIS	Environmental Impact Statement
HEC-RAS	Hydrologic Engineering Centre – River Analysis System
MLA	Mine Lease Area
PB	Parsons Brinkerhoff
SEIS	Supplementary Environmental Impact Statement
TUFLOW	Two Dimensional Unsteady Flow

Introduction

1.1 Overview

URS Australia Pty Ltd (URS) has been engaged by Hancock Galilee Pty Ltd to undertake additional hydrologic and hydraulic modelling in response to comments received on the Supplementary EIS (SEIS) prepared for the Kevin's Corner Project in relation to the potential cumulative impacts arising from the development of the proposed Kevin's Corner and Alpha Coal Mines.

The proposed Kevin's Corner Project comprises a 30 million tonnes per annum (Mtpa) open-cut pit operation and underground longwall mine operation. The Alpha Coal Project comprises an entirely open-cut pit operation which is located to the south of the Kevin's Corner Project, which is also upstream of the Kevin's Corner Project.

A Revised Surface Water Hydraulics Report was presented as Appendix K of the first issue of the SEIS. Following submission of the revised hydraulics report further comments were received in relation to the need to assess the potential impact of the Alpha Coal Mine within the Kevin's Corner MLA. This report was prepared to address specific comments raised in relation to the Revised Surface Water Hydraulics Technical Report submitted for the SEIS.

This report presents the results of the assessment undertaken to assess the cumulative impacts of the Alpha Coal and Kevin's Corner Mines within the Kevin's Corner MLA in terms of the following:

1. Impacts on Flood Immunity
2. Impacts on Sedimentation and Erosion
3. Impacts on Matters of National Environmental Significance (MNES) from Inundation.
4. Impacts on Subsided Areas

The assessment is based on the SEIS layout for the Kevin's Corner Project prepared by URS, and the SEIS layout for the Alpha Coal Mine site provided by Parsons Brinckerhoff.

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Methodology

2.1 Overview

This flood impact assessment has been carried out using a combination of desktop, field, and computational investigations. The analysis has also included examination of previous studies and relevant reports, aerial photographs, and topographic data.

Details of the methodology and results from the hydrologic and hydraulic assessments previously conducted for the Kevin's Corner EIS and SEIS are provided in the following reports:

- *Kevin's Corner Project – Flood Hydrology Study.* Report prepared by URS for Hancock Galilee Pty Ltd as Appendix M2.1 to the Kevin's Corner EIS. 19 April 2011.
- *Kevin's Corner – Revised Hydraulic Technical Report*. Report prepared by URS for Hancock Galilee Pty Ltd as Appendix K to the Kevin's Corner SEIS (superseding Appendix M2.2 of the Kevin's Corner EIS). 12 June 2012.

2.2 Cumulative Impact Assessment Methodology

The cumulative impact assessment has drawn and built on this previous work. The methodology adopted for each of four components of the assessment is described below;

1. Flood Immunity

   To understand the adequacy of the proposed flood protection measures for the Kevin's Corner Mine, a combined flood model was run for the 1:1,000 Annual Exceedance Probability (AEP) (extreme) event that included the fully developed mine plans for both the Alpha Coal and Kevin's Corner Mines. The modelling results were then assessed to determine whether flood levels within the Kevin's Corner Mine had increased and whether the flood protection measures proposed for the Kevin's Corner Mine were still adequate. Any cumulative impacts from the Alpha Coal Mine would be expected to influence the flood protection measures adjacent to the main Sandy Creek channel as this is the only watercourse within the Kevin's Corner lease that is located downstream of the Alpha Coal Project.

2. Impacts on Sedimentation and Erosion

   To assess whether the Alpha Coal Mine changes stream flow, velocity, and stream power within the Kevin's Corner MLA compared with the effect of the Kevin's Corner Mine alone, a combined hydraulic model was run for the 1:2 and 1:50 AEP (minor) events that included the fully developed mine plans for both the Alpha Coal and Kevin's Corner Mines. The stream power, velocity, and shear stress results were compared with those predicted in the EIS for the Kevin's Corner Mine alone.

3. Impacts on Matters of National Environmental Significance (MNES) from Inundation

   In order to establish whether the Alpha Coal Mine causes additional MNES impacts through increased inundation, a combined flood model was run for the 1:100 AEP event based on the fully developed mine plans for the Alpha and Kevin's Corner Mines. The model outputs were interpreted to identify any additional areas that were inundated for a period of more than four days as a consequence of the Alpha Mine. This was based on the precedent set in the Hinze Dam EIS, which determined that "Vegetation could withstand a periodic inundation of up to four days in the event of a Q100 storm, and although vegetation may suffer damage from currents and temporary flooding, it is considered likely to recover" (Hinze Dam Alliance, 2007).

In the event that any additional areas of extended inundation (four days or greater) were identified they would be compared with MNES distribution to assess whether there are additional MNES impacts as a result of consideration of the surface water impacts of the Alpha Coal Mine.

4. Impacts on subsided areas

To understand the potential for cumulative impacts to occur within subsided areas of the Kevin's Corner Mine, a combined flood model was run for the 1:1,000 AEP (extreme) event that included the fully developed mine plans for both the Alpha Coal and Kevin's Corner Mines. The modelling results were then assessed to determine whether flood extents within subsided areas of the Kevin's Corner Mine had increased.

A relatively small portion of the proposed subsided area on the Kevin's Corner Mine lease may have the potential to be affected by surface water impacts from the Alpha Coal Mine due to increases in flood extent within Little Sandy Creek. This area is located within the south-eastern portion of the Southern Underground mine. In order to avoid the potential for cumulative impacts to arise within subsided areas the southern extent of the panels on the eastern boundary of the southern underground mine will be reduced to ensure that they do not intersect with the predicted flood extent within Little Sandy Creek due to the Alpha Coal Mine.

The Interim Subsidence Management Plan (Appendix N of the SEIS) deals with minimising impacts from subsidence in areas outside the limits of the levees (regulated structures). The Rehabilitation Plan (Appendix T4.09 of the SEIS) and the Biodiversity Offset Strategy (State and Federal) (Appendix P of the SEIS) deals with the management of residual impacts post subsidence mitigation measures.

2.3 Hydraulic Modelling Methodology

2.3.1 Flood Immunity

The TUFLOW model developed for the SEIS, revised to reflect the fully developed mine plans for both mine sites, was run for the 1:1,000 AEP peak discharge to assess the adequacy of the flood protection measures proposed for the Kevin's Corner Mine. The methodology undertaken for the TUFLOW modelling was:

1. Modify the base condition topography to incorporate the planned diversion and flood protection measures based on Alpha Coal Mine SEIS and Kevin's Corner Mine Basis of Design Layout (SEIS Volume 2, Appendix M Site Water Management (Basis of Design) Report).
2. Assess the changes to water surface elevation as a result of Alpha Coal Mine development.
3. Assess the adequacy of the Kevin's Corner flood protection infrastructure.

2.3.2 Stream Hydraulic Characteristics

The HEC-RAS models, developed to simulate steady state peak flow events up to a 1:50 AEP for the Kevin's Corner EIS, were updated to the reflect the mine layout (as reflected in the Site Water Management (Basis of Design) Report, Appendix M of the SEIS) and extended to the southern, western and eastern boundaries of the Alpha MLA to incorporate stream flow effects from the Alpha Coal Mine. This consisted of delineating the pertinent streams in the Alpha MLA, extracting elevation

information for a number of stream cross-sections based on a digital terrain model (DTM) of the area, and determining the boundary conditions (channel slope, peak flow inputs) at required cross-sections.

Separate stream and flow configurations were constructed based on the Alpha baseline and developed conditions for the 1:2 AEP and 1:50 AEP flow events. These Alpha models were then combined with the Kevin's Corner models to create an integrated cumulative impacts model. The scenarios modelled are outlined in Section 2.3.4.

2.3.3 Duration of Inundation

In order to calculate the cumulative duration of inundation within the Kevin's Corner lease, a RORB hydrologic model was constructed to reflect the Kevin's Corner and Alpha Mine plans. Catchment hydrographs were extracted from the RORB model and input into TUFLOW models, which were run as dynamic hydraulic models. Separate TUFLOW models were constructed to represent the Kevin's Corner and Cumulative Impact scenarios.

The models were run for a 150 hour simulation time to allow entire hydrographs generated from the 1 in 100 AEP event to drain through to the downstream boundary of the Kevin's Corner lease. The hydraulic modelling results were interpreted to identify areas that were predicted to be inundated for a period in excess of four days (96 hours) during the 1 in 100 AEP event. For the purpose of 1 in 100 AEP duration of inundation, it was assumed that no overflows from the mine water management system would occur for the duration of the simulation.

2.3.4 Modelling Scenarios

Two scenarios have been considered for the purpose of this cumulative flood impact assessment. These two scenarios are:

- Kevin's Corner developed condition / Alpha base condition [KC (Dv) / Alpha (Bs)]
- Kevin's Corner developed condition / Alpha developed condition [KC (Dv) / Alpha (Dv)]

2.3.5 Key Assumptions

The following assumptions were made in relation to the update of the HEC-RAS and TUFLOW models for this cumulative impact assessment:

- Kevin's Corner Mine layout is as per the Site Water Management (Basis of Design) Report (Appendix M of the SEIS).
- Alpha Coal Mine layout is the SEIS layout.
- Alpha channel diversions and levees were represented in the ground model as standard trapezoidal channels and 'glass wall' levees.
- Runoff from any open pit mine catchment does not contribute to stream flows.

Cumulative Impacts on Flood Immunity

3.1 Results of KC (Dv) / Alpha Coal (Bs) Scenario

The flood extent presented in the Revised Surface Water Hydraulics Report (Appendix K of the SEIS) for the 1:1,000 AEP event was reassessed to reflect the mine layout described in the Site Water Management (Basis of Design) Report (Appendix M of the SEIS). The revised maximum flood extent for the 1:1,000 AEP event is provided in Appendix A, Figure A-1.

3.2 Results of KC (Dv) / Alpha Coal (Dv) Scenario

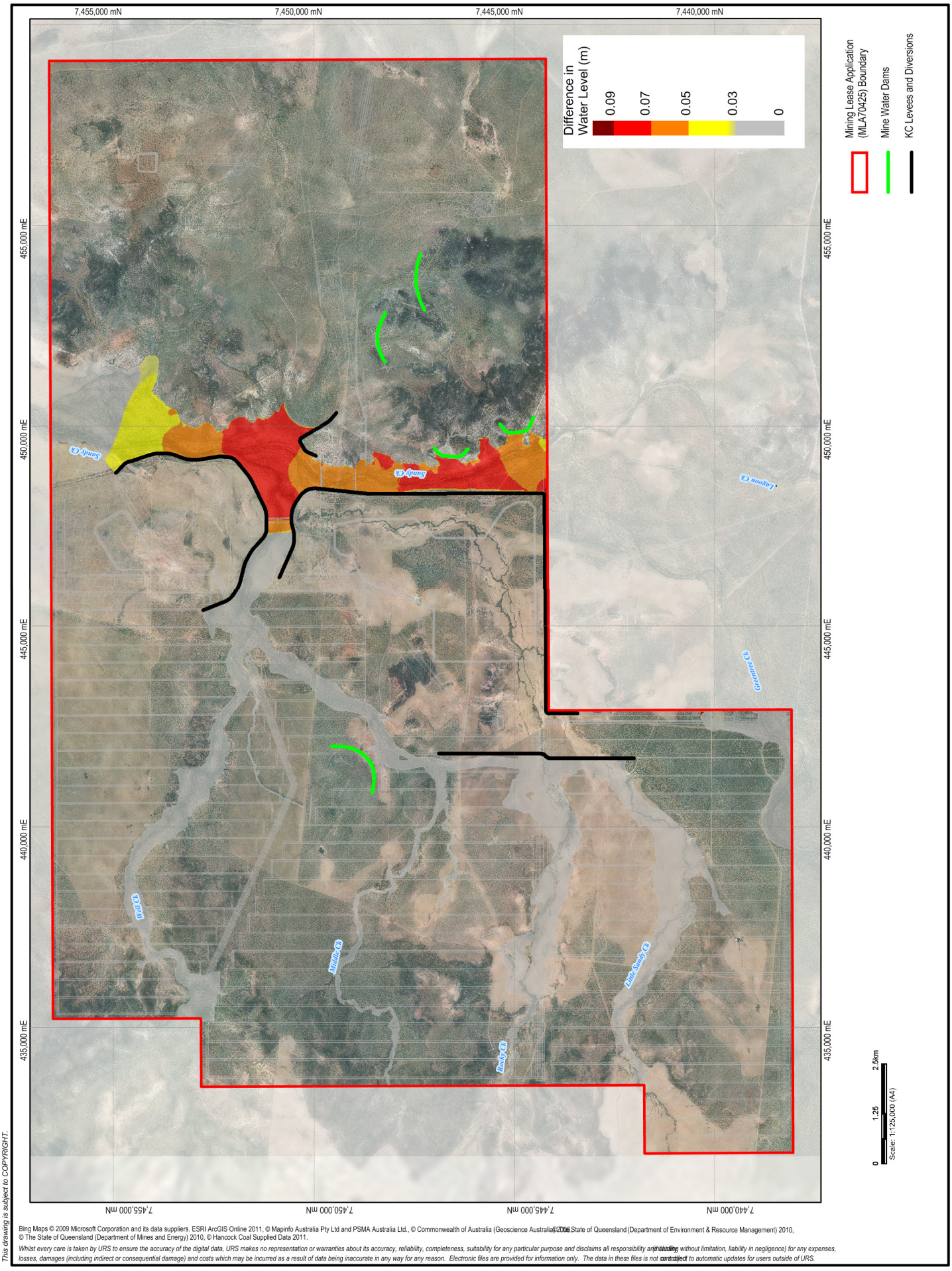
The cumulative maximum flood extent predicted within the Kevin's Corner Mine lease arising from the development of the Alpha Coal and Kevin's Corner Mines is presented in Appendix A, Figure A-2.

3.3 Comparison of Results

Figure 3-1 shows the changes in flood levels within the Kevin's Corner MDL that are predicted from the cumulative impacts of the Alpha Coal Mine and Kevin's Corner development compared to that resulting from the Kevin's Corner Project alone. The data shown in the figure indicates that the cumulative impacts of the Alpha Coal and Kevin's Corner Mines may increase flood levels within the Kevin's Corner Mine lease area by up to 90 mm and result in an equivalent increase in afflux at the upstream lease boundary. This increase is restricted to Sandy Creek with some backwater effects observed in Well Creek and extends from the Alpha Mine MDL boundary downstream to an area adjacent to the northern open-cut levee. Flood levels then decline to be equivalent to that modelled for the Kevin's Corner Project alone at the downstream lease boundary.

The flood protection infrastructure presented in the Site Water Management (Basis of Design) Report has been designed with a 1 m freeboard above the 1:1,000 AEP flood level which is adequate to prevent inundation of the site from a 90 mm increase in water levels.

A comparison of the cumulated flood extent shown in Appendix A, Figure A-2 with that predicted for the Kevin's Corner Mine alone shown in Appendix A, Figure A-1 shows that the flood extents are identical despite the increase in water level. This is due to the levees, which traverse the left bank of Sandy Creek, and the relatively steep natural topography on the right bank of the channel that spans the area of increased water level.



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CUMULATIVE IMPACTS ON FLOOD LEVELS (1:1000 AEP)

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Figure: 3-1

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Cumulative Impacts on Erosion and Sedimentation

Long section plots illustrating the 1:2 AEP and 1:50 AEP peak channel velocity, stream power and shear stress along Sandy Creek within the Kevin's Corner MLA are presented in Appendix B, Figures B-1 to B-6. All plots overlay the KC (Dv) / Alpha (Bs) Scenario with the KC (Dv) / Alpha (Dv) Scenario, as well as the baseline (no development) scenario. It should be noted that the plots have been produced only for Sandy Creek as this is the only creek system which may be impacted by the Alpha Mine site.

Table 4-1 summarises the 10^{th} to 90^{th} percentile ranges of the abovementioned parameters along the length of Sandy Creek. The modelled extent of the Greentree Creek to Well Creek reach spans the length of Sandy Creek from the upstream MLA boundary to the junction with Well Creek, whilst the 'Downstream of Well Creek' reach spans the length of Sandy Creek downstream of the junction with Well Creek to the downstream MLA boundary.

Table 4-1 Sandy Creek HEC-RAS Hydraulic Model Results

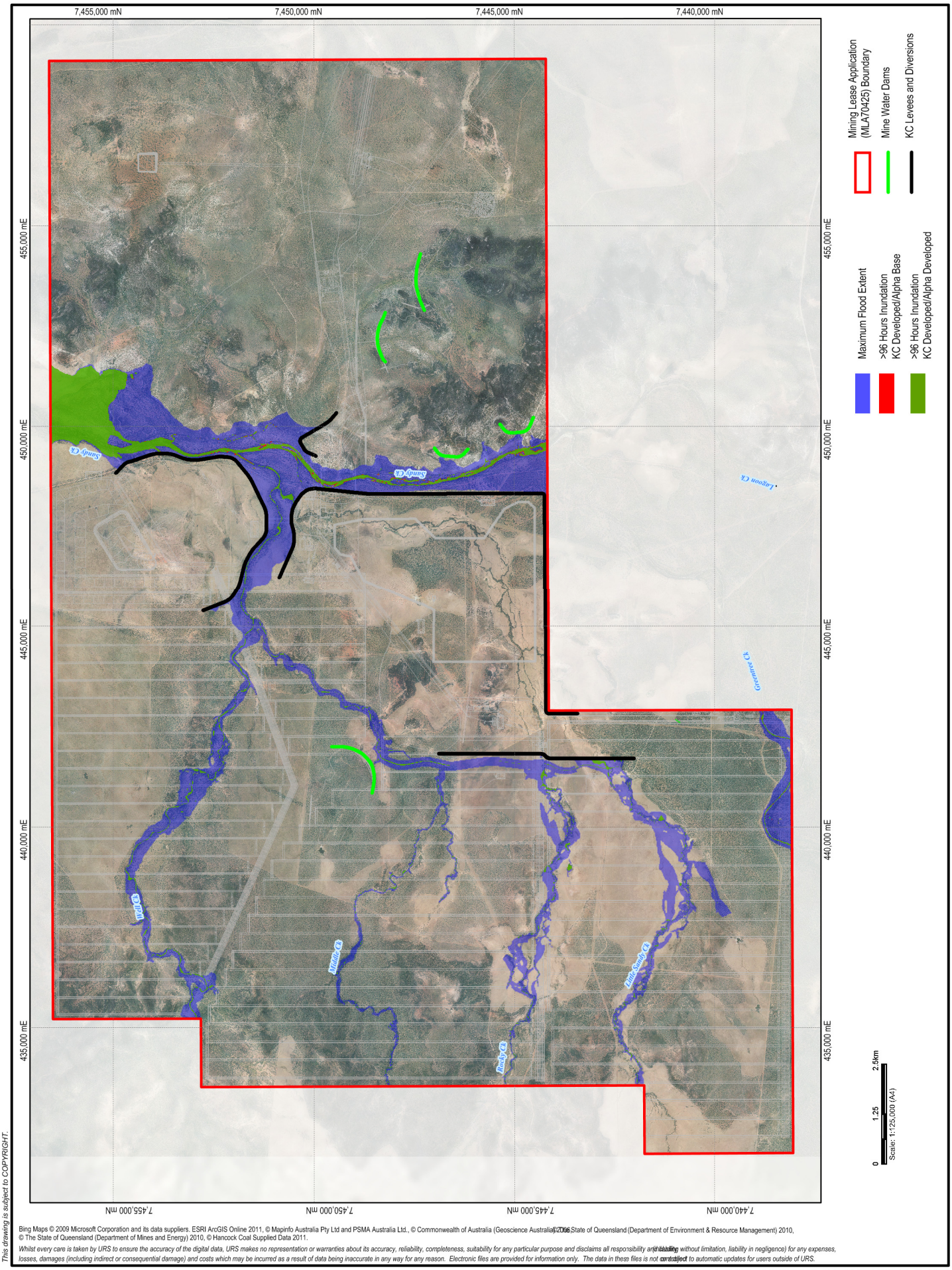
Reach	Scenario	Flow Velocity (m/s)	Stream Power (W/m^2)	Shear Stress (N/m^2)	Flow Depth (m)
1:2 AEP					
Greentree Creek to Well Creek	KC (Dv) / Alpha (Bs)	0.4 - 1.0	1.2 - 22.5	2.9 - 21.8	1.0 - 2.0
	KC (Dv) / Alpha (Dv)	0.4 - 1.1	1.2 - 23.4	2.8 - 22.5	1.0 - 1.9
Downstream of Well Creek	KC (Dv) / Alpha (Bs)	0.5 - 1.3	1.8 - 34.4	3.6 - 27.5	1.4 - 2.1
	KC (Dv) / Alpha (Dv)	0.5 - 1.2	1.7 - 34.1	3.6 - 27.4	1.3 - 2.1
1:50 AEP					
Greentree Creek to Well Creek	KC (Dv) / Alpha (Bs)	1.4 - 2.2	29.8 - 111.8	21.9 - 51.3	3.8 - 5.0
	KC (Dv) / Alpha (Dv)	1.3 - 2.1	28.1 - 107.2	21.0 - 50.0	3.8 - 5.0
Downstream of Well Creek	KC (Dv) / Alpha (Bs)	1.6 - 2.4	44.6 - 155.3	27.6 - 63.6	4.2 - 5.5
	KC (Dv) / Alpha (Dv)	1.6 - 2.4	44.3 - 152.2	27.5 - 62.9	4.2 - 5.5

The results provided in Table 4-1 show that the hydraulic parameters are very similar for the two scenarios in both reaches of Sandy Creek. This indicates that there is not predicted to be a cumulative impact on erosion and sedimentation rates within the Kevin's Corner lease.

Cumulative Impacts on the Duration of Inundation

The results of the duration of inundation simulations for the Kevin's Corner developed condition / Alpha base condition [KC (Dv) / Alpha (Bs)] and the Kevin's Corner developed / Alpha developed [KC (Dv) / Alpha (Dv)] are shown in Appendix C, Figure C-1 and Figure C-2 respectively. In each case three inundation extents are presented, these being; areas inundated for less than 24 hours, areas inundated for more than 24 and less than 96 hours, and those areas inundated for more than 96 hours.

Figure 5-1 provides a comparison of the areas inundated for 96 hours or more for the KC (Dv) / Alpha (Dv) scenario and the KC (Dv) / Alpha (Bs). The figure shows that the area inundated for more than 96 hours does not increase for the KC (Dv) / Alpha (Dv) (Cumulative Impact) scenario and is in fact less for the Kevin's Corner Cumulative Impact scenario than for the Kevin's Corner Mine alone.



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COMPARISON OF THE CUMULATIVE IMPACT ON INUNDATION EXTENT AND DURATION (1:100 AEP) WITH THAT FOR THE KEVIN'S CORNER MINE ALONE

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Figure: 5-1

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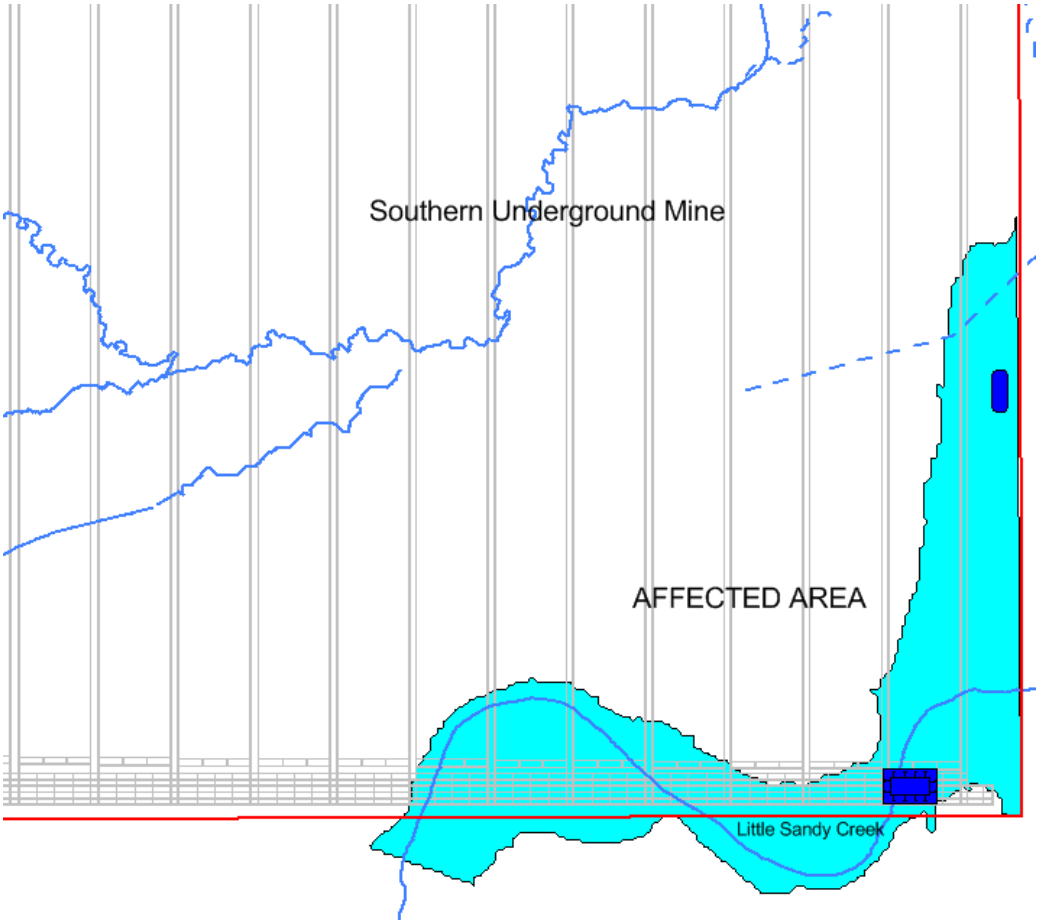
Cumulative Impacts on Subsided Areas

Cumulative modelling of the flood extent for the 1:1,000 AEP event shows that a relatively small portion of the proposed subsided area on the Kevin's Corner Mine lease may have the potential to be affected by surface water impacts from the Alpha Coal Mine. This area is located within the south-eastern portion of the Southern Underground mine and is due to increases in flood extent within Little Sandy Creek as a result of the proposed Sandy Creek diversion for the Alpha Coal Mine. The affected area is shown in Figure 6-1 below.

Figure 6-1 Cumulative Impact on Subsided Areas



In order to avoid the potential for cumulative impacts to arise within subsided areas, the southern extent of the panels on the eastern boundary of the Southern Underground mine will be reduced to ensure that they do not intersect with the predicted flood extent within Little Sandy Creek due to the Alpha Coal Mine.

Conclusion

The results of the cumulative surface water assessment show the following in relation to each of the potential areas of concern expressed in relation to cumulative impacts;

1. Impacts on Flood Immunity

The cumulative impact of the Alpha Coal and Kevin's Corner Mines results in an increase in flood levels of up to 90 mm along much of Sandy Creek. Sandy Creek is the only watercourse which would experience cumulative impacts from both mines. Flood levels return to the levels predicted for the Kevin's Corner Project alone at the downstream MLA boundary. The minor increase in flood levels has no impact on the flood immunity provided for the mine as flood protection infrastructure has been designed with a 1 m freeboard above the 1:1,000 AEP flood level. Further, the predicted increase in flood levels has no impact on the flood extent due to the levees, which traverse the left bank of Sandy Creek, and the relatively steep natural topography on the right bank of the channel, which spans the area of increased water level.

2. Impacts on Sedimentation and Erosion

The Alpha Coal Mine is not predicted to cause increased stream flow, velocity, and power within the Kevin's Corner MLA beyond that predicted for the Kevin's Corner Mine for either the 1:2 or 1:50 AEP (minor) event. This indicates that there is not predicted to be a cumulative impact on erosion and sedimentation rates within the Kevin's Corner lease.

3. Impacts on Matters of National Environmental Significance (MNES) from Inundation

The assessment has shown that there is not predicted to be an increase in the area inundated for greater than 96 hours for a 1:100 AEP event due to consideration of the Alpha Coal Mine. Therefore, there are not predicted to be any additional impacts on MNES from inundation.

4. Subsidence

The assessment identified the potential for the Alpha Coal Mine to increase the flood extent within a portion of the Southern Underground mine due to the diversion of Sandy Creek. This was the only subsided area that was found to be subjected to cumulative impacts from the Alpha Coal Mine. In order to avoid the potential for cumulative impacts to arise within subsided areas, the southern extent of the panels on the eastern boundary of the Southern Underground mine will be reduced to ensure that they do not intersect with the predicted flood extent within Little Sandy Creek due to the Alpha Coal Mine.

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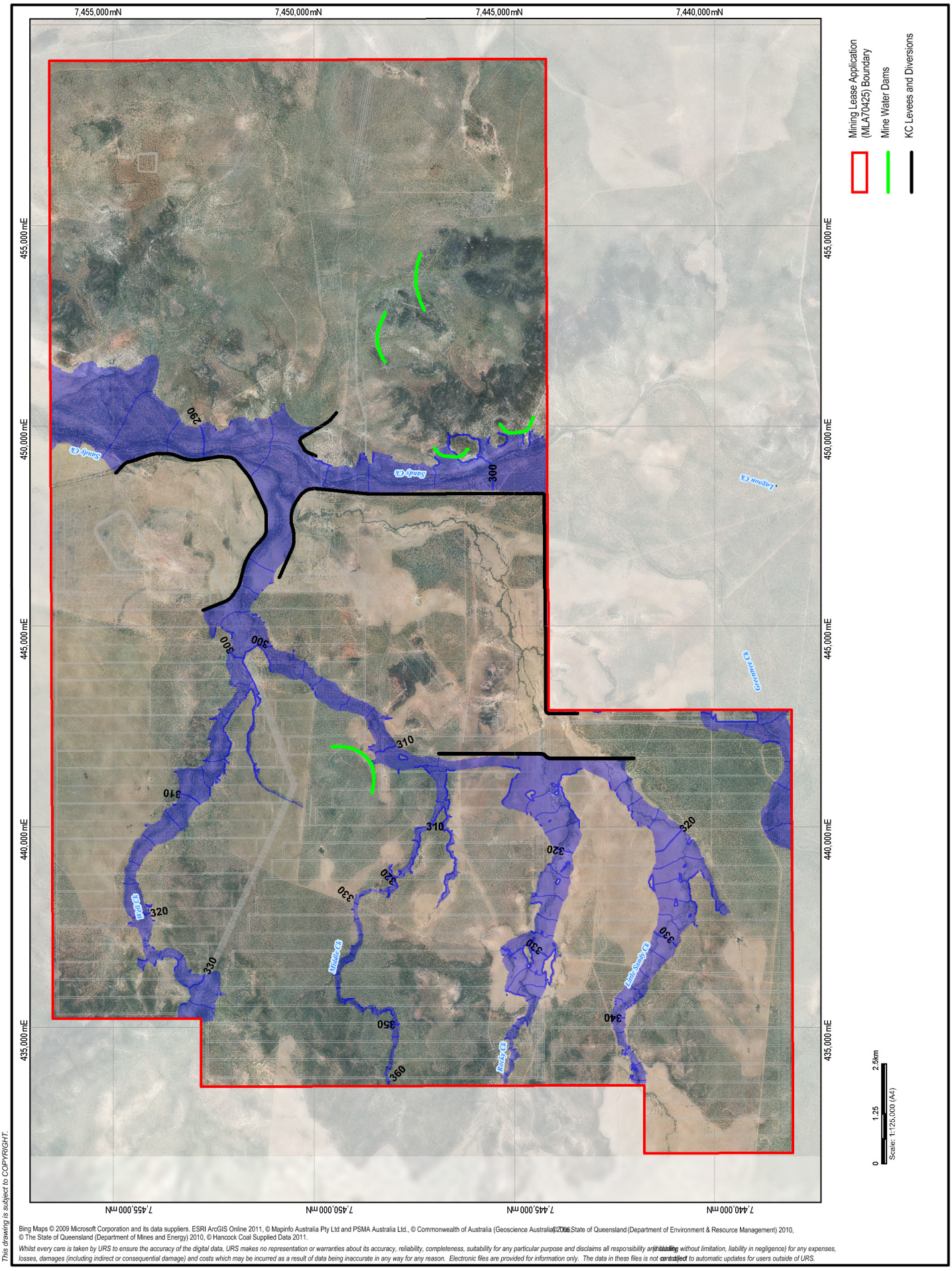
A

Appendix A Flood Extent Maps



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1:1000 AEP FLOOD EXTENT (KC (Dv)/ ALPHA COAL (Bs)

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Figure: **A-1**

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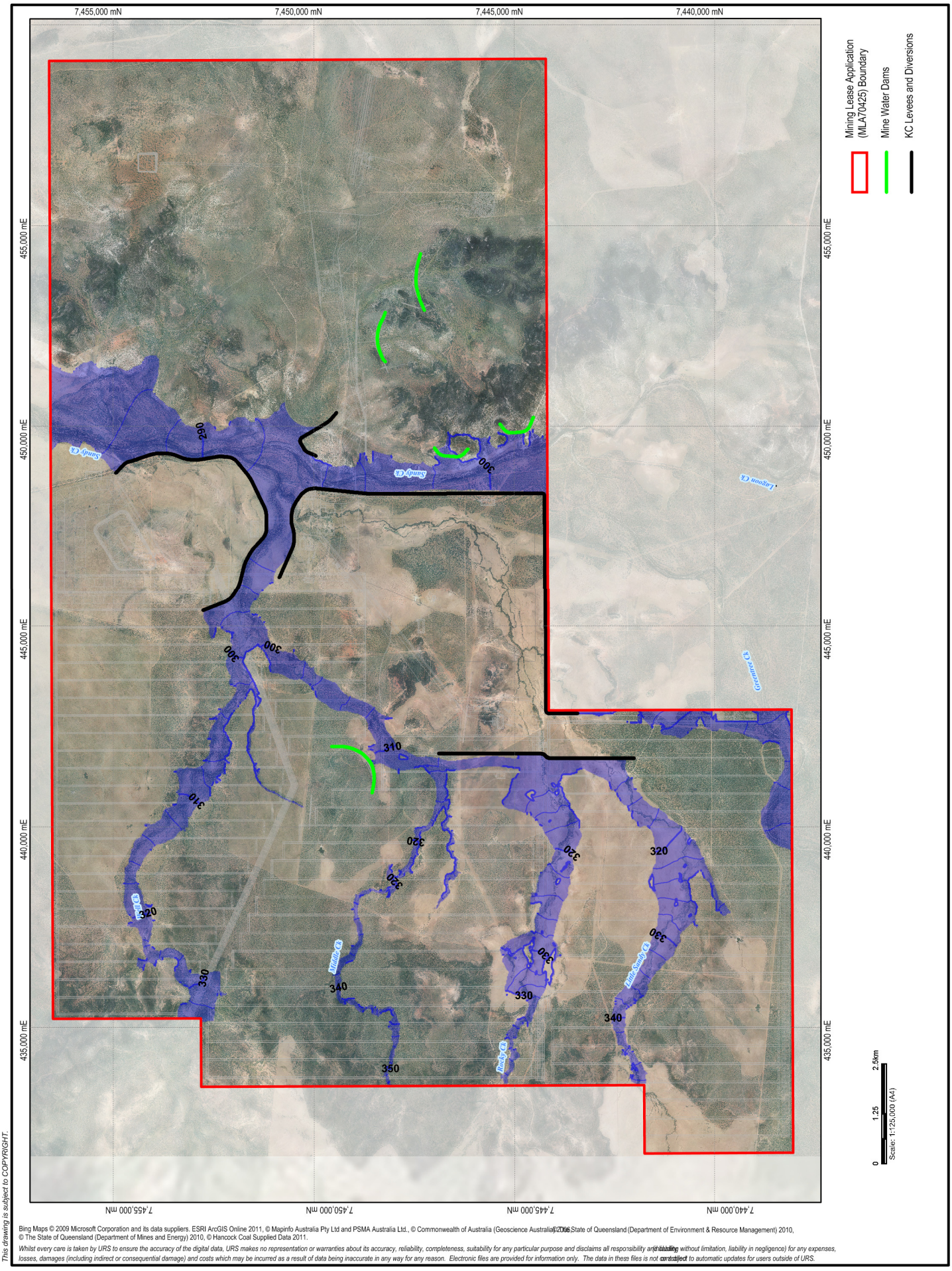

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1:1000 AEP FLOOD EXTENT (KC(Dv)/ALPHA COAL (Dv))

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Figure: A-2

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Appendix B Long Section Plots of Sandy Creek Hydraulic Characteristics

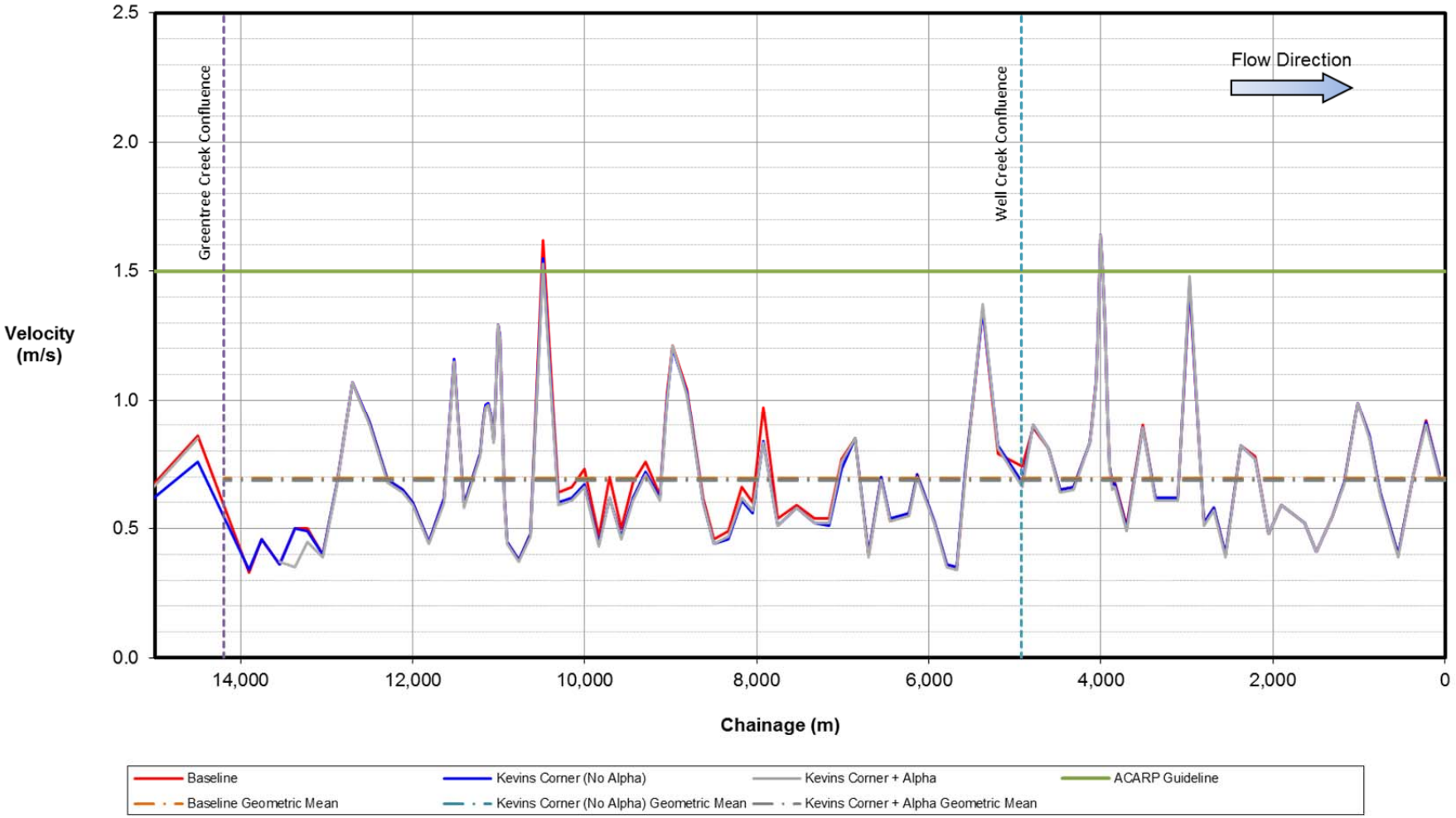

Figure B-1 Channel Velocity – 1:2 AEP

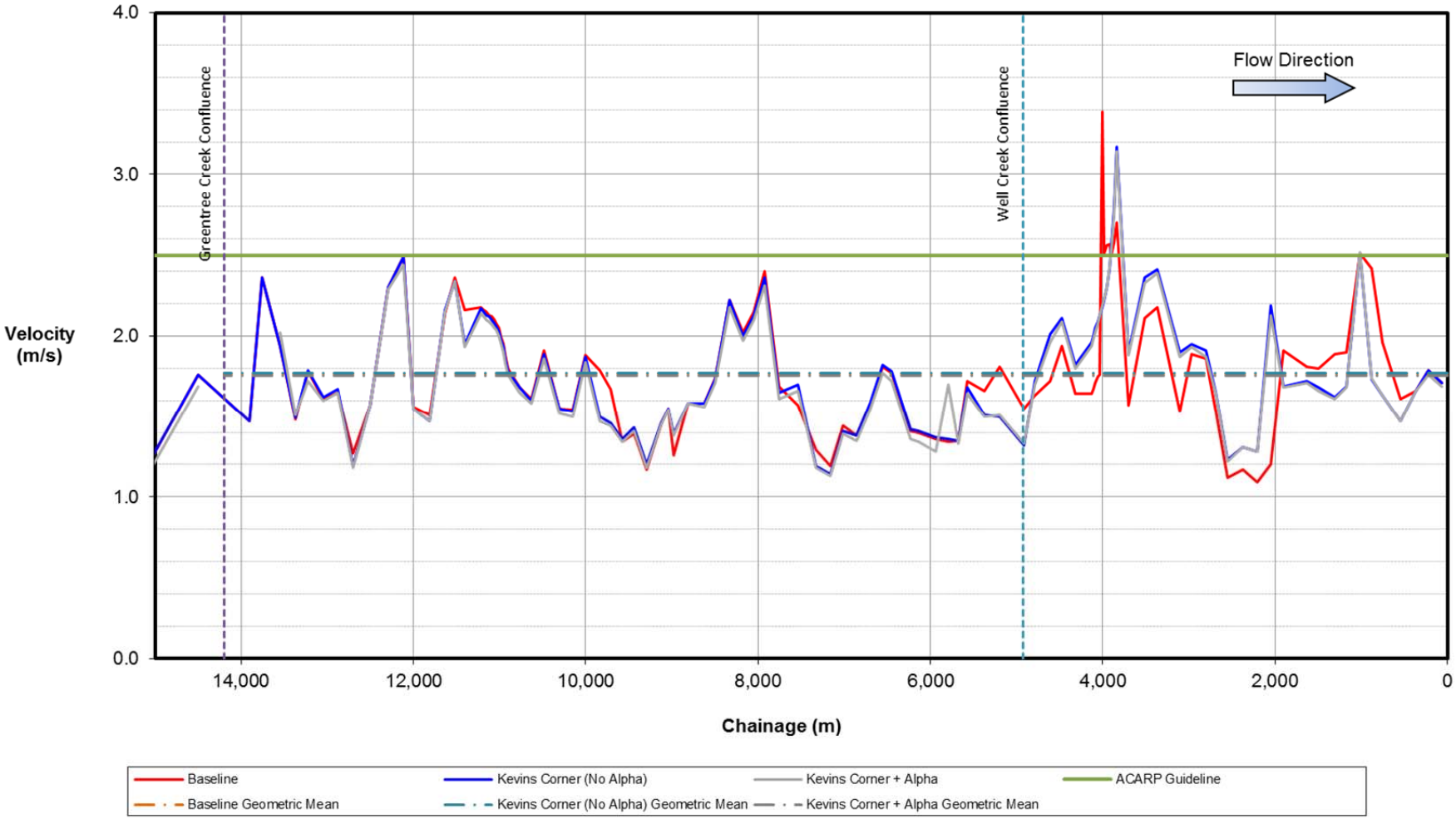

Figure B-2 Channel Velocity – 1:50 AEP

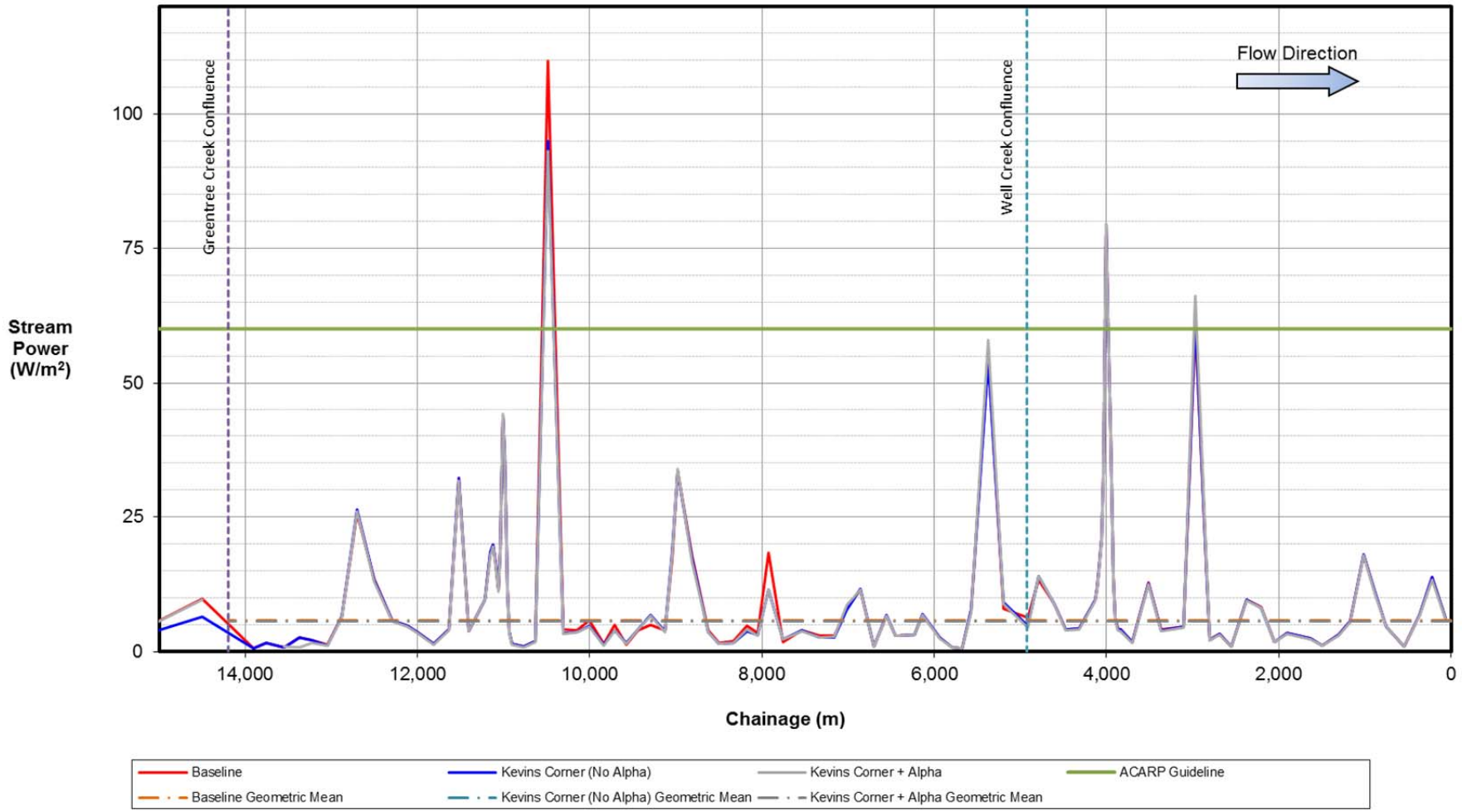

Figure B-3 Stream Power – 1:2 AEP

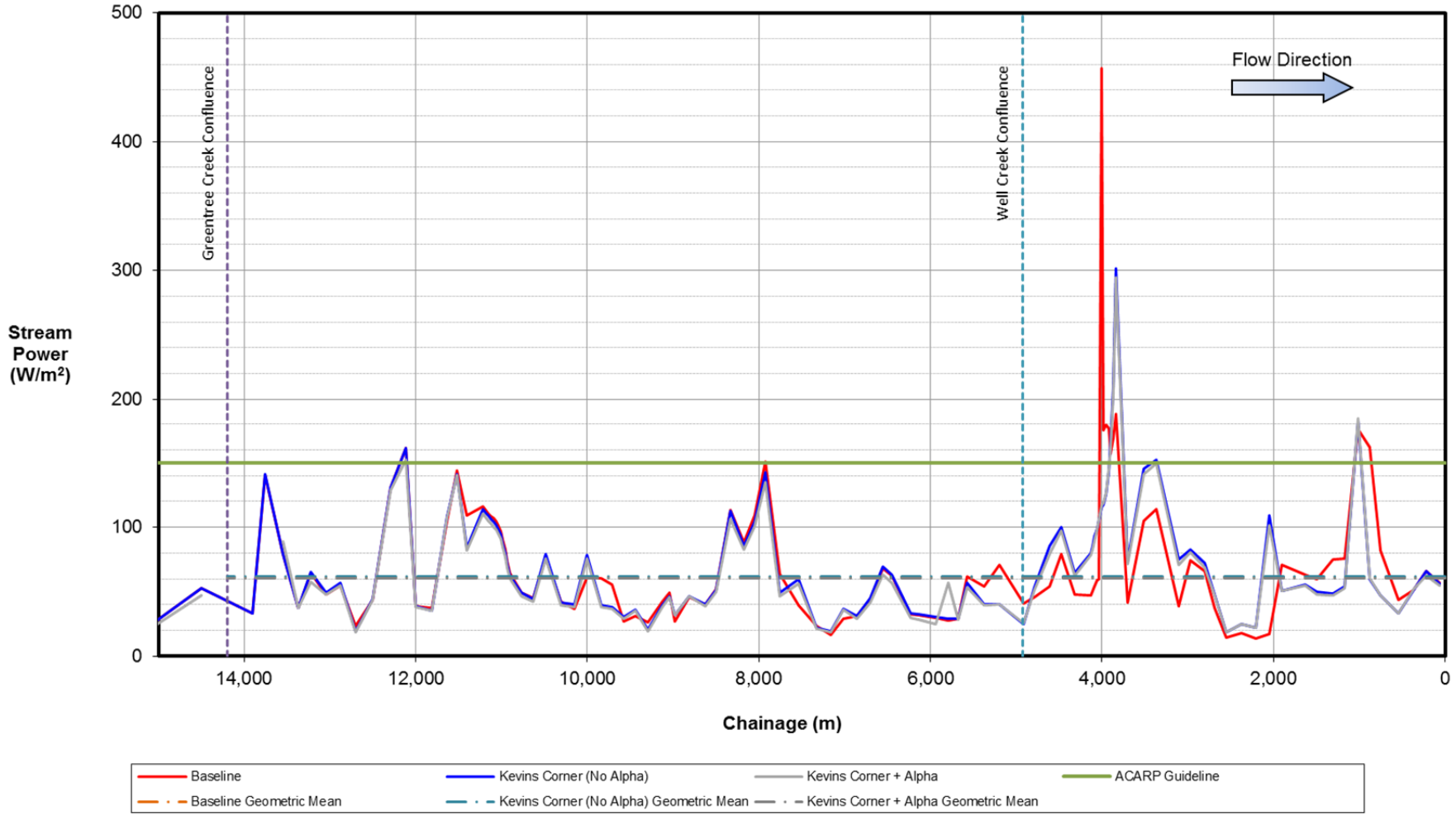

Figure B-4 Stream Power – 1:50 AEP

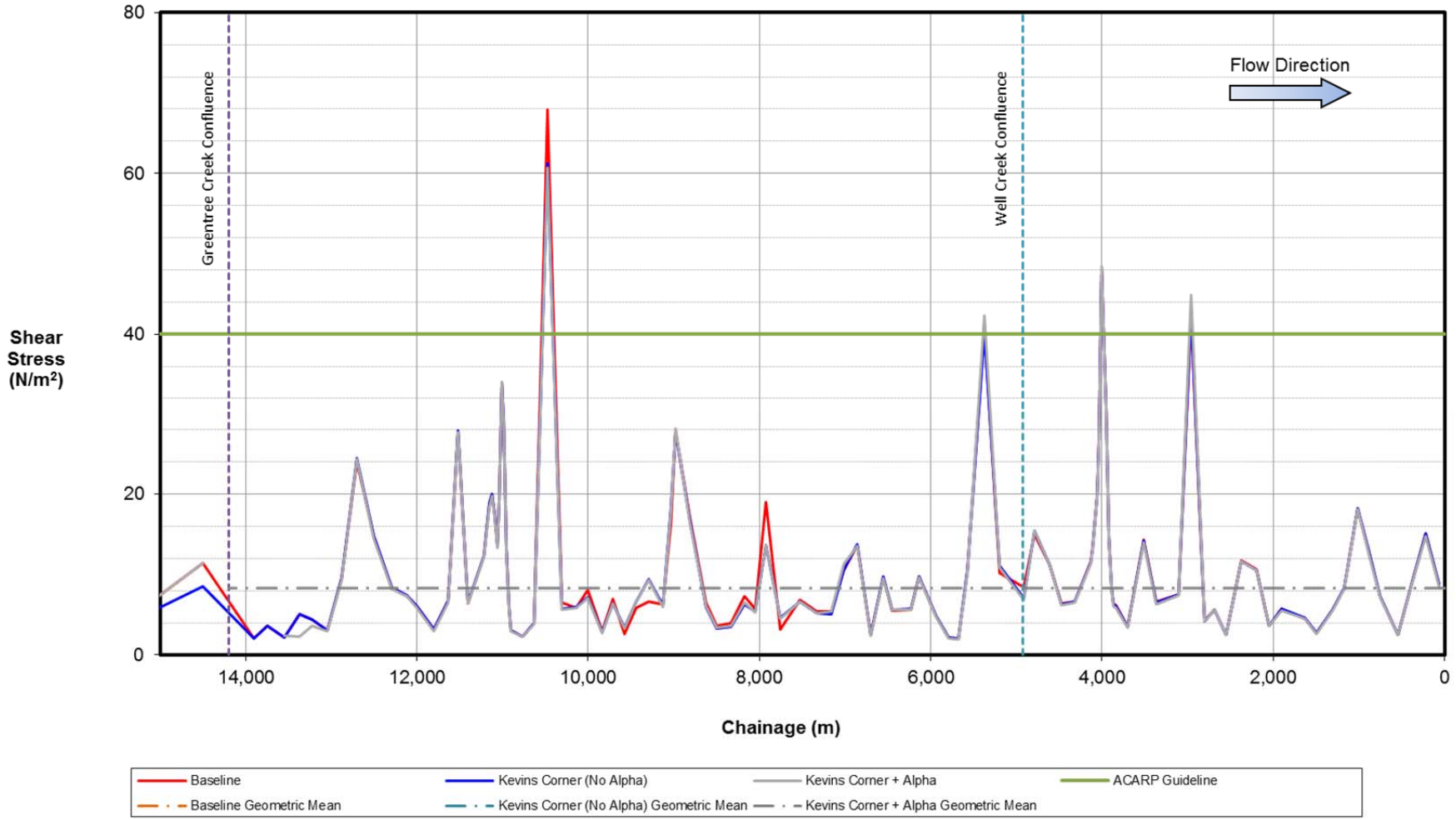

Figure B-5 Shear Stress – 1:2 AEP

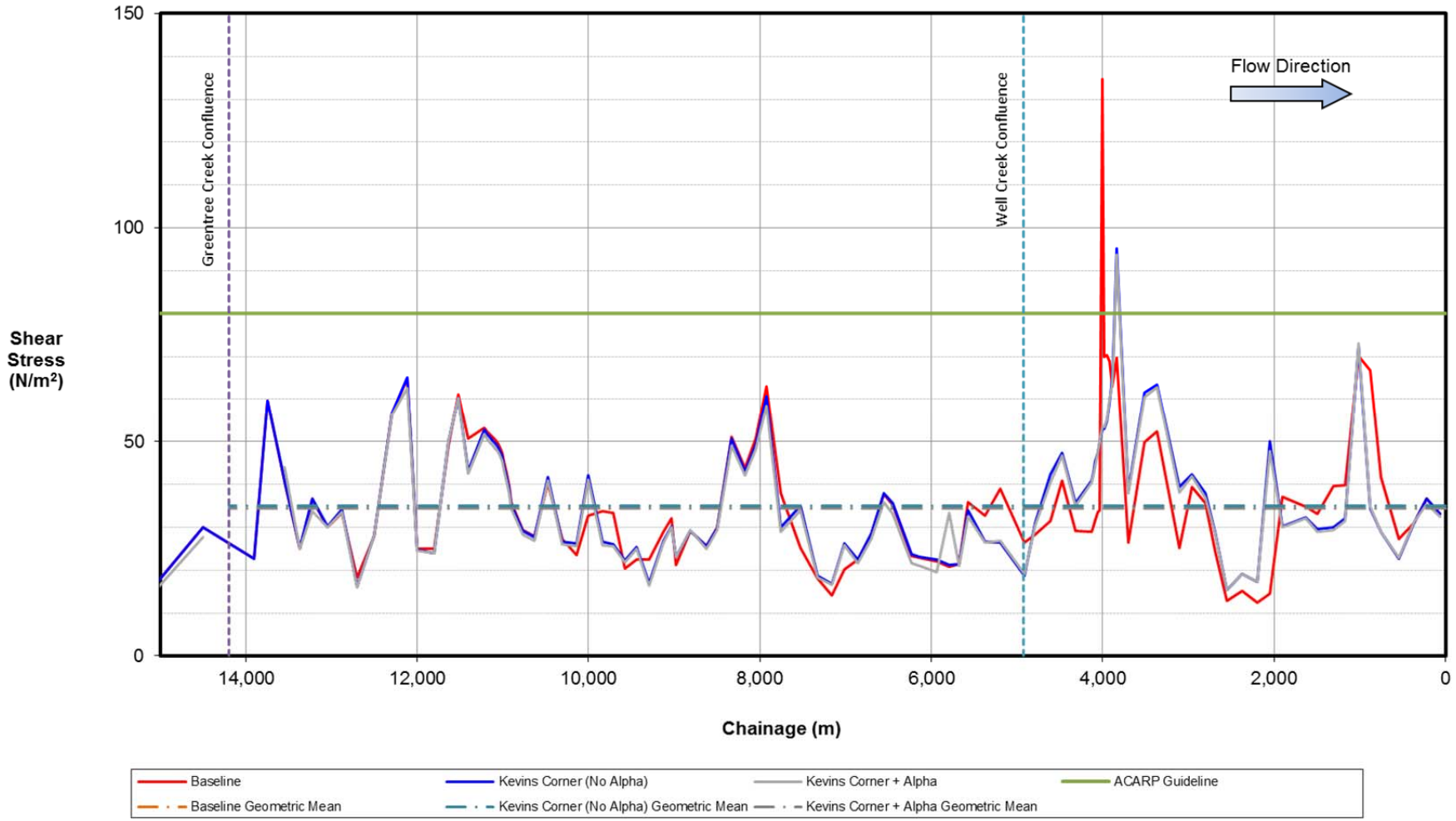

Figure B-6 Shear Stress – 1:50 AEP

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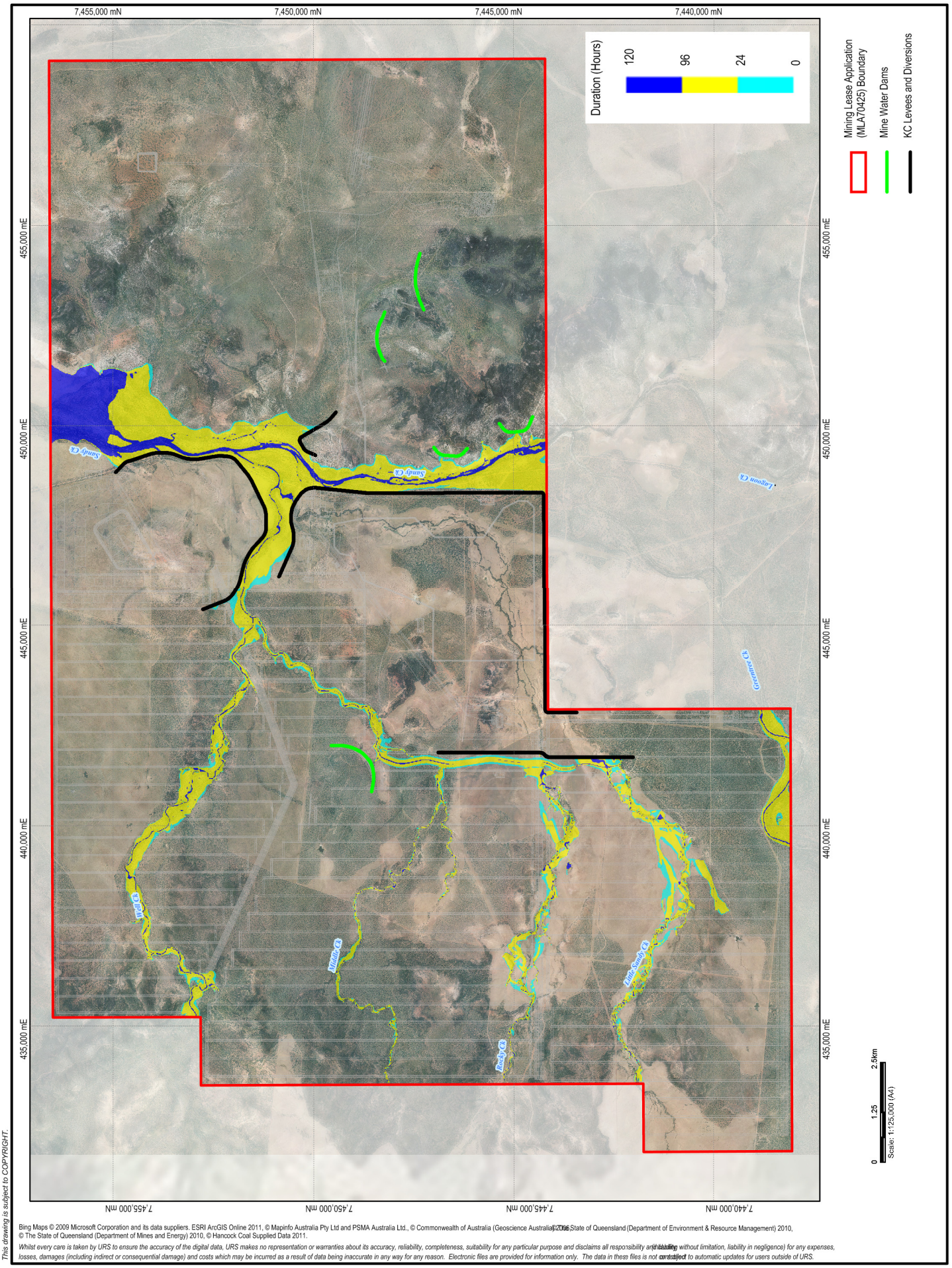
Appendix C Duration of Inundation Maps



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DURATION OF INUNDATION
KC DEVELOPED, ALPHA BASE

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Figure: C-1

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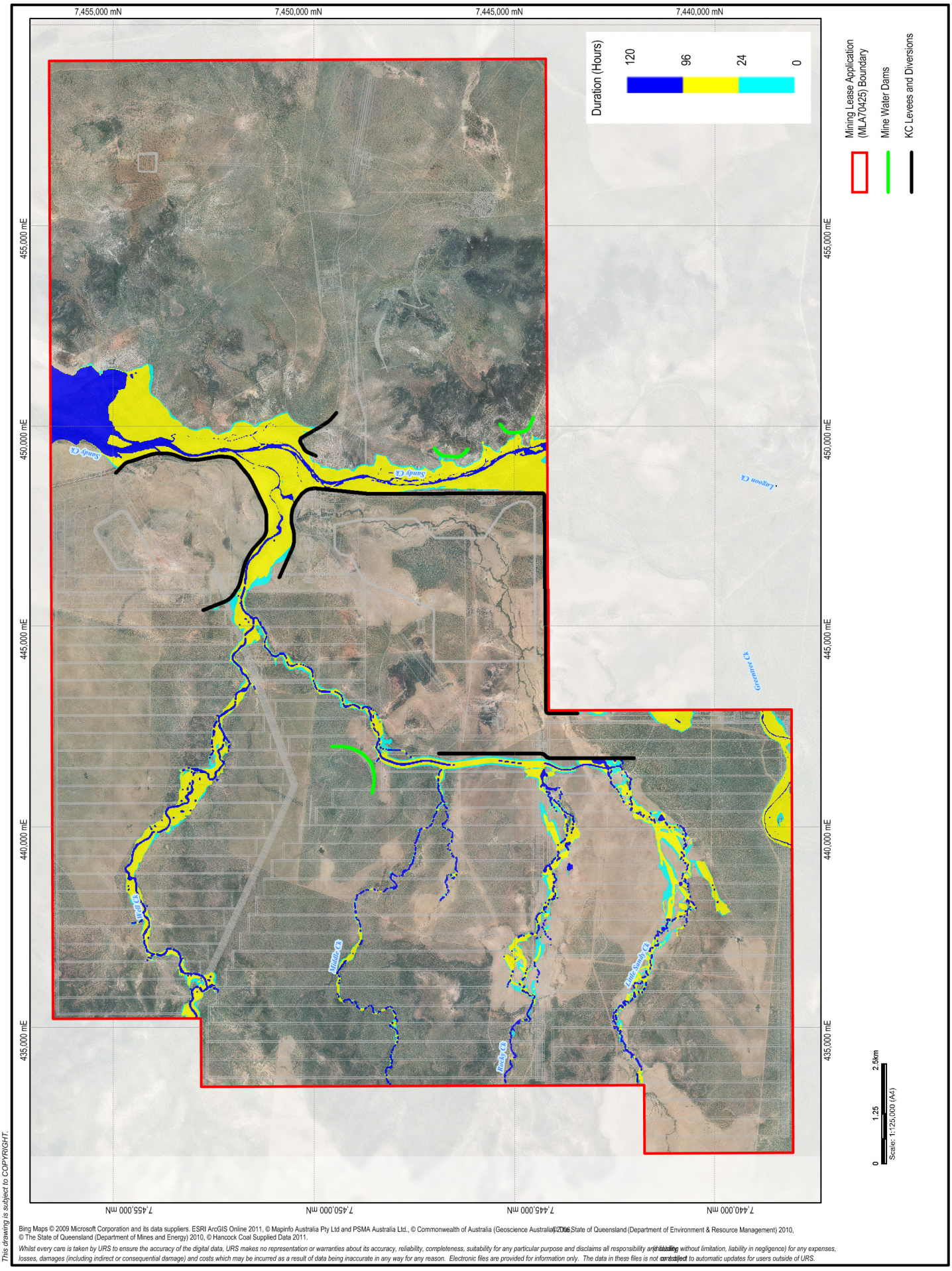

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DURATION OF INUNDATION
KC DEVELOPED, ALPHA DEVELOPED

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Figure: C-2

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