BHP Mitsubishi Alliance

Appendix E

Surface Water Resources Assessment

CAVAL RIDGE MINE

Horse Pit Extension Project

Surface Water Impact Assessment

Prepared for:
BHP
480 Queen Street
Brisbane QLD 4000 Australia

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620.13593-R01-v4.0	9 August 2021	N Bichel	H Doherty	P Smith

CONTENTS

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

PHOTOS

CONTENTS

APPENDICES

1 Introduction

The Caval Ridge Mine (CVM) is owned and operated by BM Alliance Coal Operations Pty Ltd (BMA), on behalf of the Central Queensland Coal Associates Joint Venture (CQCA JV). The CVM project was approved by the Coordinator-General under the *State Development and Public Works Organisation Act 1971* (Qld) in 2010 and has been in operation since 2014. Operations at CVM are carried out under the conditions of Environmental Authority (EA) EPML00562013, EPBC Approval (2008/4417) and Coordinator-General's imposed conditions.

The CVM mining operations are located primarily within Mining Lease (ML) 1775, with Harrow Creek acting as the southernmost boundary of CVM. Associated infrastructure for the CVM is located on ML 70403 and ML 70462. The CVM northern boundary is located approximately five (5) kilometres (km) south-west of Moranbah in the Bowen Basin, Queensland. The CVM is an open cut mining operation using dragline and truck/shovel equipment that supplies hard coking coal product for the export market. CVM produces up to 15 million tonnes per annum (Mtpa) of Run-of-Mine (ROM) coal. CVM also receives ROM coal from BMA's neighbouring Peak Downs Mine (PDM), via conveyor, for processing. The future annual transfer of ROM coal from PDM is expected to vary between 5 and 11 Mtpa.

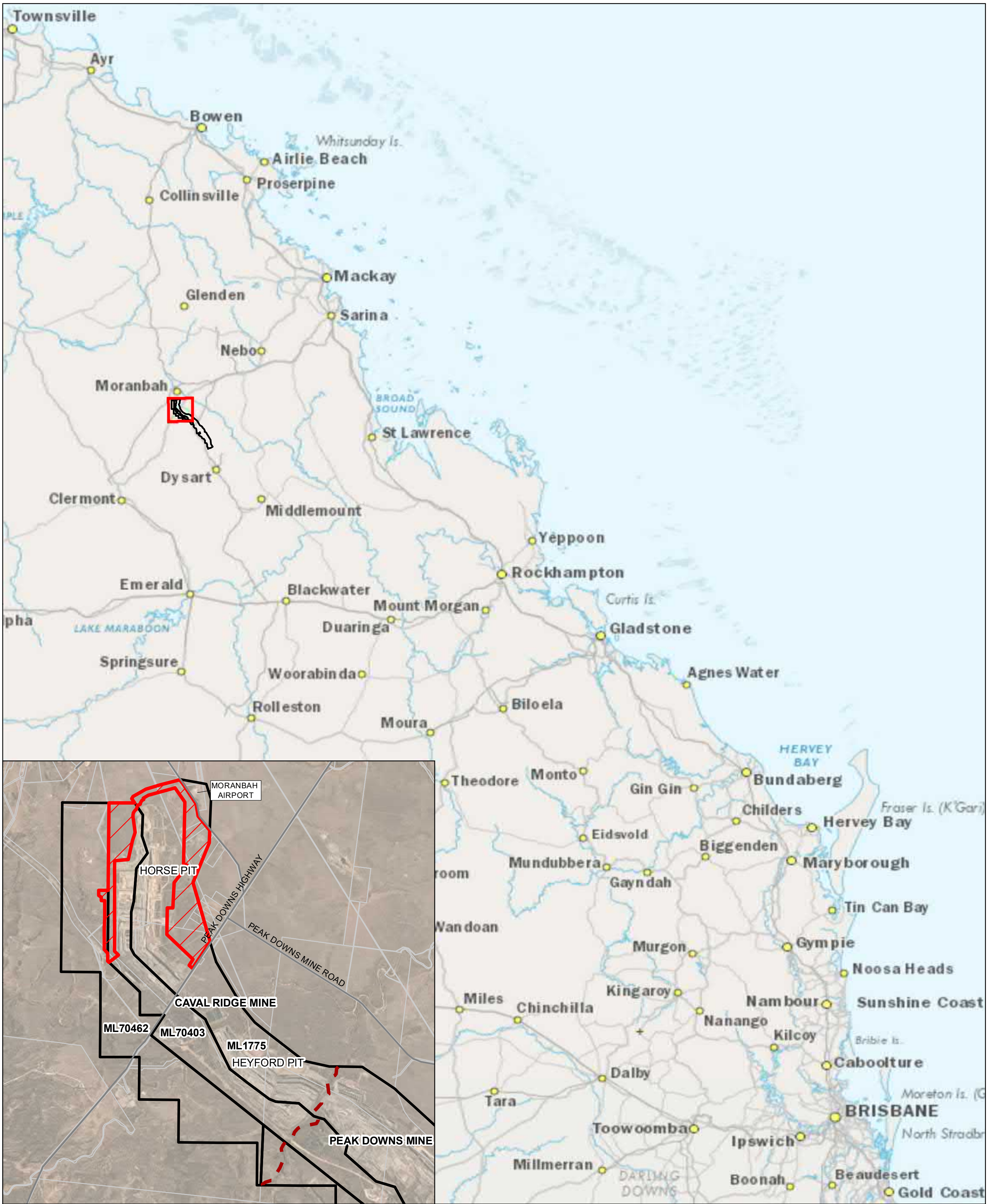
The CVM includes two pits - Horse Pit (north of Peak Downs Highway) and Heyford Pit (north of Harrow Creek) - as well as the Caval Ridge rail spur (Goonyella System), Train Load-out Facility (TLF) and coal stockpiles, Run-of-Mine (ROM) stockpiles, In Pit Spoil Dumps (IPD), Coal Handling and Processing Plant (CHPP), water management infrastructure and supporting infrastructure (i.e. roads, powerlines, laydown area, workshops and offices). The location of the CVM is presented in **Figure 1-1**.

The CVM Environmental Impact Statement (EIS) (2010) and approval was based on a 30-year mine plan across defined extents for Horse Pit and Heyford Pit. Due to changes in mine sequencing, improvements in mining efficiency and further resource definition, an extension to the approved mining footprint of Horse Pit is required to continue mining. This Chapter outlines the details of the Horse Pit Extension Project (the Project).

1.1 Project Overview

The Project proposes to extend the footprint of the existing Horse Pit at the CVM. As a result of identifying efficiencies in mine sequencing and planning, mining activities are currently scheduled to reach the limit of the approved Horse Pit extent during Financial Year (FY) 2025, with some existing site infrastructure potentially being relocated from 2023. If approved, the extension is projected to extend the mine's life from the 2030s to the 2050s, protecting jobs and royalties into the future. Exploration activities will be ongoing for the life of the mine.

The Project covers the existing MLs: ML 1775, ML 70403 and ML 70462 and will be confined north of the Peak Downs Highway. The disturbance extent is shown in **Figure 1-2**.



0 1 2 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:220,500 at A4
Project No.: 620.13593
Date: 2/12/2020
Drawn by: PM

Roads
Caval Ridge Mine and Peak Downs Mine Boundary
Horse Pit Extension Project Area
BHP Tenements
Cadastre

Horse Pit Extension Project

Regional Locality

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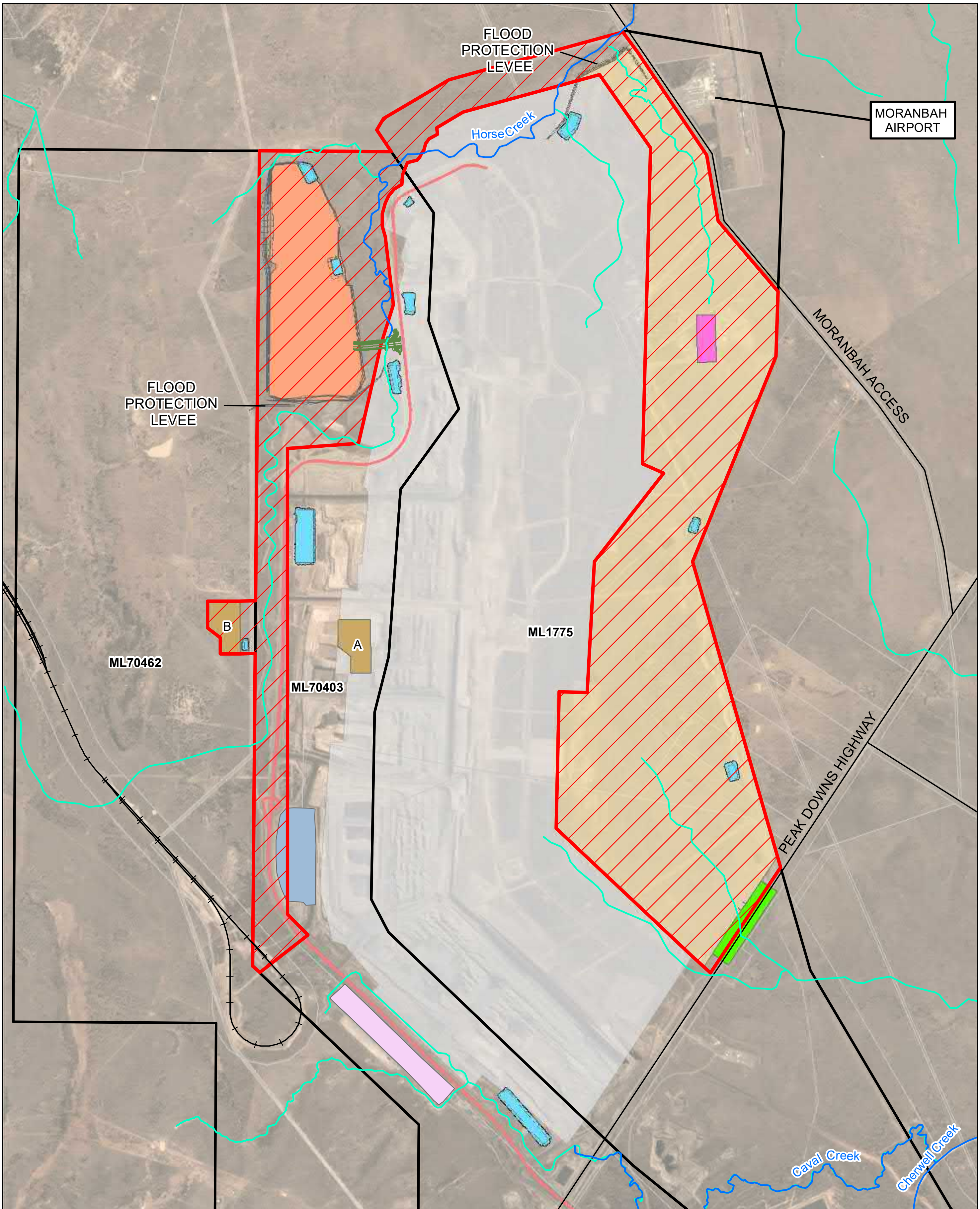
FIGURE 1-1

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\SLR62013593_GEN_ProjectLocation_002.mxd



Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 09-Aug-2021
Drawn by: PM

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- Existing Road
- Existing Rail
- Zone for Dragline Crossing
- Existing Horse ROM Stockpile
- Existing Train Load Out Stockpile
- Caval Ridge EIS Boundary (2010)
- BHP Tenements
- Cadastre
- Bridge over Horse Creek
- Haul Roads
- Watercourses (Water Act 2000)
- Drainage features
- Proposed Water Management Infrastructure
- Dams
- Proposed EME Build Pad
- Proposed Blast Compound Options
- Proposed Out of Pit Dump
- Horse Pit Extension
- Horse Pit Extension Project Area

Horse Pit Extension Project

Project Overview

FIGURE 1-2

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_ProjectOverview_002.mxd

1.1.1 Mining

The key mining elements of the Project are summarised below:

- Extension of the existing Horse Pit beyond the approved extent during FY2025, (proposed activities to not extend into Moranbah Airport and the Moranbah Access Road);
- Maximum CVM ROM coal production up to 15 Mtpa;
- Revised CVM Life of Mine (LOM) to FY2056;
- Development of an Out of Pit Dump (OOPD) in the north-west of ML 70403 (commencing in FY2028);
- Continuation of progressive rehabilitation of disturbed areas with the aim of progressing to a final landform design, including a final void of approximately 680ha in the far east of ML 1775 at the conclusion of mining;
- Continuation of current open cut mining techniques employed at CVM;
- Continuation of progressive disposal of mining waste and CHPP rejects to IPDs and to the proposed OOPD (commencing in FY2028); and
- Continued use of the existing accommodation and workforce strategy.

1.1.2 Mine Infrastructure

The key mine infrastructure elements of the Project are summarised below:

- Relocation of enabling infrastructure, including: an EME Build Pad, blasting compound (two potential relocation options), go-lines, substations, back-access roads and powerlines as required by the progress of mining;
- Extension of the haul road to provide access to the proposed OOPD in the north-west of ML 70403 including the construction of a bridge over Horse Creek;
- Construction of two flood levees: the northern levee bounds a portion of Horse Pit and the western levee is located at the south-west extent of the proposed OOPD;
- Relocation of mine water dams and pipelines as required by the progress of mining;
- Expansion of sediment dam capacities and construction of new sediment dams, clean water diversion drains and mine affected water (MAW) drains to manage runoff associated with the proposed OOPD;
- Relocation of the Peak Downs Highway dragline crossing;
- Continued use of the CHPP complex – no upgrades to the CHPP are required as a result of the Project;
- Continued disposal of dewatered tailings and rejects within spoil; and
- Continued use of the conveyor from PDM, Caval Ridge rail spur, TLF, product coal stockpiles, ROM stockpiles, IPDs, water management system and supporting infrastructure (i.e. roads, powerlines, laydown, workshops and offices).

1.1.3 Project Objectives

The key surface water objectives for the Project are:

- Maintaining the environmental values for surface water in the region and mitigating impacts of the Project on the downstream environment and downstream users;
- Management of surface water flows and flooding in particular through Horse Creek; and
- Maintaining the condition and natural functions of water bodies, and watercourses – including the stability of beds and banks of watercourses from construction through to closure.

The report structure is provided as follows:

- **Surface water context**: Describes the local, regional and legislative context for the site and existing surface water Environmental Values (EVs).
- **Surface water management:** Describes the proposed water management strategy and infrastructure for the site.
- **Surface water modelling:** Presents an assessment of the performance of the proposed infrastructure including the flood modelling and final landforms.
- **Impact assessment and mitigation:** Summarises the findings of the assessment, potential impacts and the proposed mitigation measures. This section also outlines the any proposed amendments to the surface water EA conditions.

2 Surface Water Context

2.1 Regional Catchment

The Project Site is mainly located within the Horse Creek Catchment and a small proportion is located within the Cherwell Creek catchment. Both creeks are a tributary of the Isaac River. The Isaac River Catchment is part of the Isaac-Connors sub-catchment, which is part of the Fitzroy River Basin. The Fitzroy River terminates at the Coral Sea south-east of Rockhampton, near Port Alma.

Land uses within the Fitzroy River Basin include mining, agriculture and bushland. The Project has an area of approximately 1,214 ha (12.1 square kilometers (km^2)), representing a relatively small part of the 22,000 km^2 Isaac Connor sub catchment and 140,000 km^2 greater Fitzroy Basin catchment area**. Figure 2-1** illustrates the Project Site relative to the broader Fitzroy River Basin.

2.2 Local Waterways

The Project site is located within the Horse Creek and Cherwell Creek catchments. These creeks are tributaries of the Isaac River and are described further below.

2.2.1 Horse Creek

Horse Creek is located on the western side of the existing Horse Pit. The creek flows in a northerly direction towards the boundary of ML 1775 before flowing north east towards the confluence with Grosvenor Creek. Horse Creek has previously been diverted upstream of the Project Site to allow for current mine operations whilst maintaining fluvial processes. It should be noted that Horse Creek is not defined as a watercourse and has a stream order of less than 4. As such, the existing diversion is not a regulated watercourse diversion.

Horse Creek meets with Grosvenor Creek, with the junction approximately 2.3 km downstream from the ML boundary. Horse Creek flows into Grosvenor Creek only for less frequent events due to a weir located at the downstream end of Horse Creek, just upstream of Grosvenor Creek. The catchment area of Horse Creek to the junction with Grosvenor Creek is 57 km^2 with the Project covering just over 4 km^2 of that catchment.

2.2.2 Cherwell Creek

Cherwell Creek headwaters are located to the west of the current MLs. Cherwell Creek has a total catchment area of over 700 km^2 and flows north easterly from the headwaters, through the existing MLs to the confluence with Isaac River. Major tributaries of Cherwell Creek include Caval Creek, Coalhole Creek, Harrow Creek and JB Gully. The Project site is located on a small, unnamed tributary of Cherwell Creek, located upstream of the confluence of Cherwell Creek and Harrow Creek. The Project site covers 3 km^2 of the overall 700 km^2 Cherwell Creek catchment. **Figure 2-2** illustrates the location of the Project site relative to the local waterways.

N

0 25 50 75 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:3,000,000 at A4

Project No.: 620.13593

Date: 03-Jun-2021

Drawn by: PM

Mining Lease

Regional Drainage Basin

Regional Subcatchment

River

Fitzroy River Basin

Horse Pit Extension Project

Caval Ridge Mine
Regional Surface Water Resources

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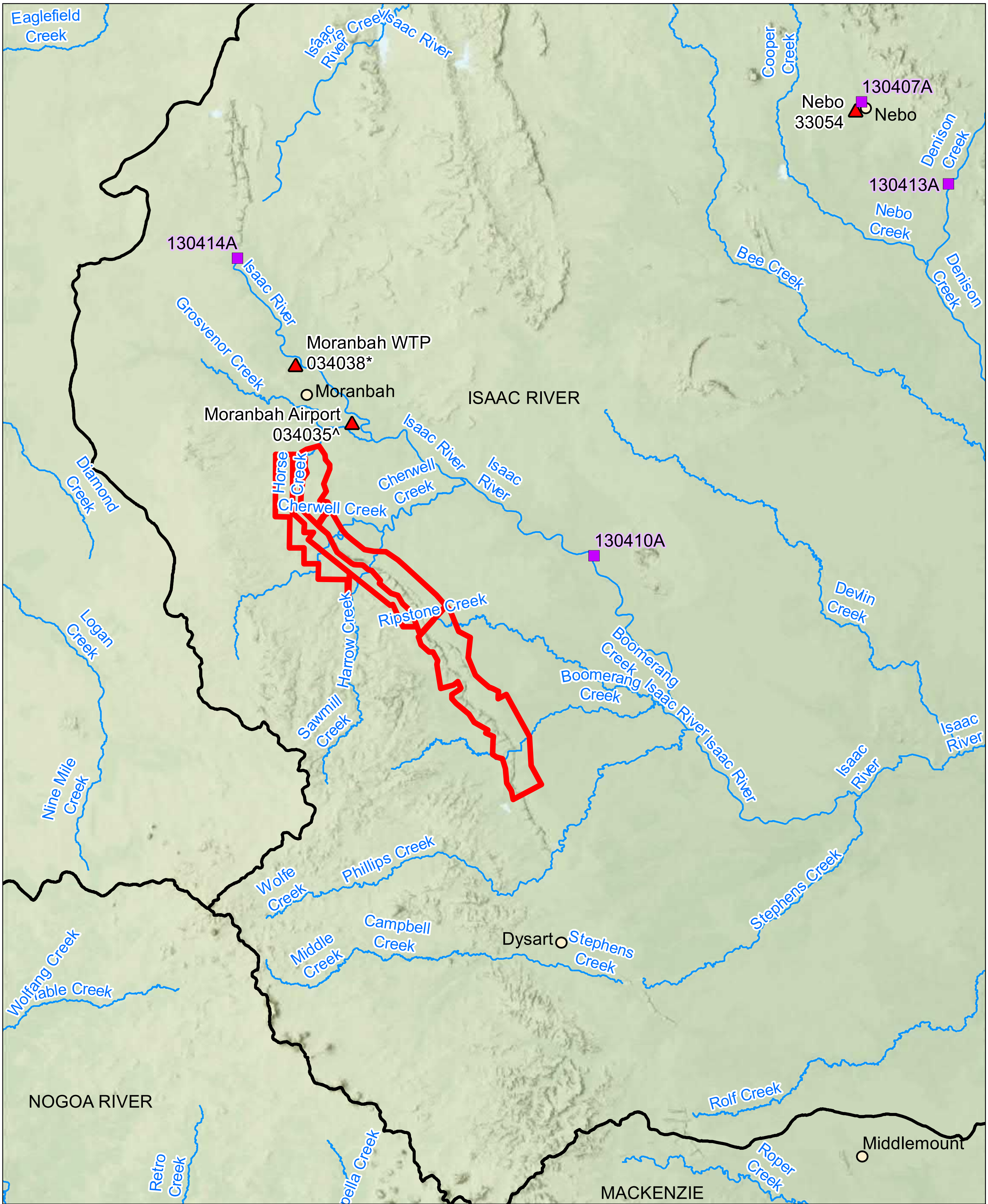
FIGURE 2-1



0 5 10 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:600,000 at A4
Project No.: 620.13593
Date: 11-Jun-2021
Drawn by: PM

- DNRM Streamflow Gauges
- Gauge Location
- Population Centre
- Mining Lease
- Waterway
- Regional Subcatchment

Horse Pit Extension Project

Caval Ridge Mine Local Waterways

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FIGURE 2-2

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\SLR62013593_GEN_Figure 2-2_LocalWaterways.mxd

2.3 Climate and Flows

2.3.1 Rainfall

The Bureau of Meteorology (BoM) operates rainfall and evaporation gauges for several locations in the vicinity of the Project Site. The historical rainfall and evaporation records for the gauge locations shown in **Table 2-1** were analysed to determine the climate at the Project Site. The locations of the gauges are illustrated in **Figure 2-3.**

Table 2-1 Rainfall and Evaporation Gauge Data

Gauge Number	BoM Name	Open - Closed	Number of Years of data & completeness	Elevation	Location (Lat/ Long)	Distance/ direction from site (km)
034014	Grosvenor Downs	1886 - 1972	86 yrs (31% complete)	Not available	-22.033, 148.083	13 NNE
034035^	Moranbah Airport	2012- Open	8 yrs (98% complete)	232.2	-22.064, 148.076	9 NNE
034038*	Moranbah Water Treatment Plant	1972 to 2012	40 yrs (96% complete)	235.7	-21.995, 148.031	17 NNW
034055	Mount Lebanon	1954 to 2005	50 yrs (98% complete)	294	-22.2211, 147.9703	13 SW

Note:
* Also Evaporation Gauge
^ Pluviograph readings are also available at BoM station 34035 Moranbah Airport (between February 2012 and February 2018)

The closest BoM station to the subject site is the Moranbah Airport, which is situated within the north-east corner of the ML boundary.

Data from the Scientific Information for Land Owners (SILO) database hosted by the Science Delivery Division of the Department of Environment and Science (DES) was also obtained for the Project. SILO provides rainfall data as both a Patched Point Data (historical data whereby missing data is infilled from interpolated estimates from surrounding gauges) and/or gridded data set, which provides an interpolated grid of 5 x 5 km over the whole of Australia. Data Drill information is also available for points derived from interpolated estimates from the gridded data set. The Data Drill for the Project site and the Patch Point Data for the closest BoM stations of Moranbah Airport / Moranbah WTP were also downloaded.

Figure 2-4 illustrates the average rainfall data from the SILO data and Moranbah Water Treatment Plant. This was considered the most appropriate gauge to use for the assessment due to its proximity to the Project site, length and completeness of the record.

The graph illustrates the dry winters and wet summers with approximately 77 per cent of the annual rainfall occurring over the wet season between November and April. It also indicates that the SILO data provides a good estimate of regional rainfall.

Annual average rainfall totals for the gauges were similar with 557 mm recorded at Moranbah WTP, 530 mm at Moranbah Airport, 546mm at Mount Lebanon and 598 mm from the SILO data set.

Project Number:	620.13593	Projection:	GCS WGS 1984
Date:	03-Jun-2021	Scale:	1:600,000 at A4
Drawn by:	PM		

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- DNRM Streamflow Gauges
- Flow Logger Gauges
- Water Quality Gauges
- BOM Rainfall Gauges
- Watercourse
- Mining Lease

Horse Pit Extension Project

Caval Ridge Mine
Local Surface Water Resources

FIGURE 2-2

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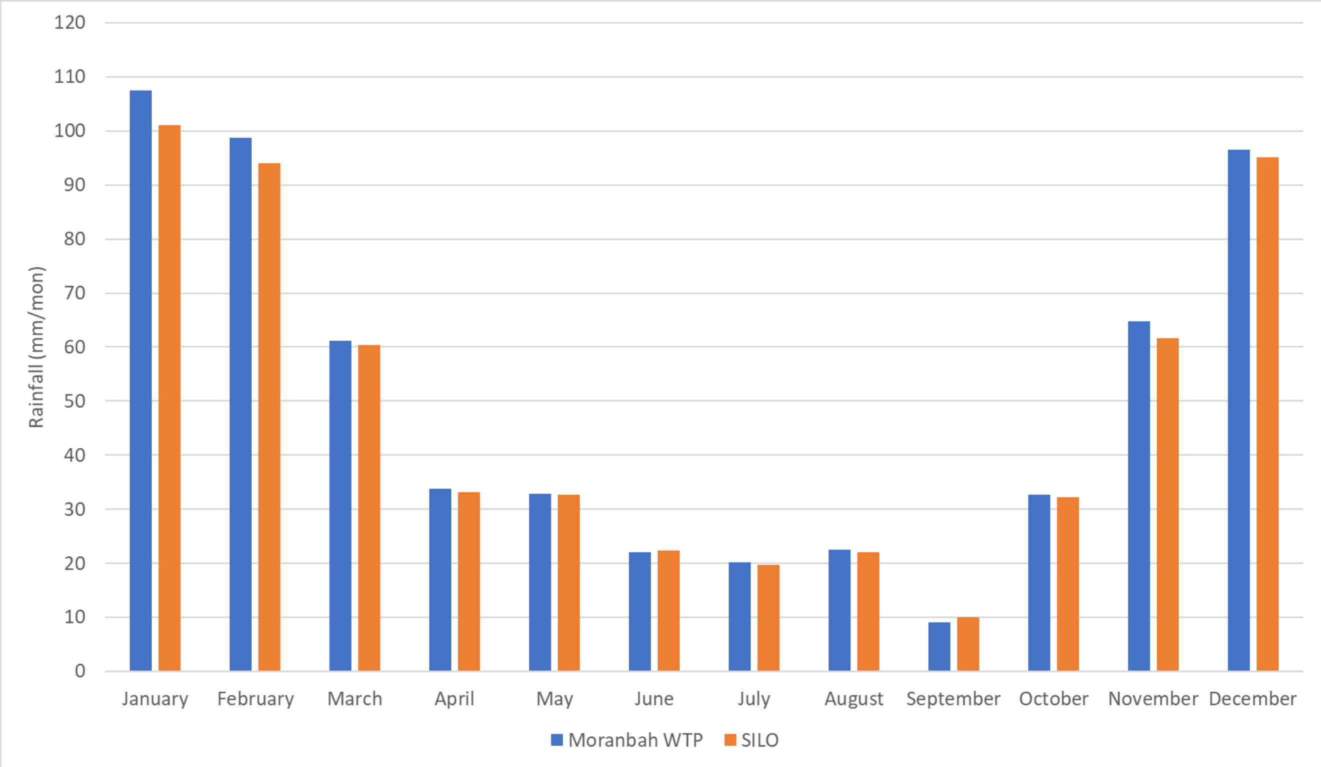


Figure 2-4 Average Monthly Rainfall

2.3.2 Evaporation

Gauged evaporation data was available from the Moranbah WTP (BoM station 034038). Daily data was available between January 1986 and March 2012 with less than 7 per cent missing data. Monthly averages from this gauge are provided in **Figure 2-5. Figure 2-5** illustrates that the highest evaporation rates occur over the wet season between October and March, and potential evaporation far exceeds rainfall over the year.

SILO evaporation data was also downloaded for this area. Prior to 1986 the SILO evaporation data is infilled with monthly average data, and as a result is up to 10 per cent less than the evaporation extremes of the daily data set.

Figure 2-5 Evaporation relative to rainfall

2.3.3 Streamflow Characteristics

The department of Regional Development, Manufacturing and Water (DRDMW) operates stream gauges within a close proximity to the Project site. **Table 2-2** outlines the stream flow gauge details. The nearest open stream flow gauge with the most significant record of 38 years is located on the Isaac River just downstream of Goonyella Mine, which is approximately 30 km upstream of the confluence of Grosvenor Creek and Isaac River. Daily streamflow data for flow and water level (minimum, mean and maximum) was downloaded for the Goonyella and Deverill gauging stations with the flow exceedance curves presented in **Figure 2-6**. This figure illustrates the ephemeral nature of all watercourses.

Table 2-2 Streamflow Gauge Details

Gauge Number	River Name	Catchment Area (km^2)	Opened - Closed	Location (Degrees South)	Location (Degrees West)
130414A	Isaac River at Goonyella	1214	1983 - 2021	-21.86	147.97
130410A	Isaac River at Deverill	4092	1968 - present	-22.17	148.38

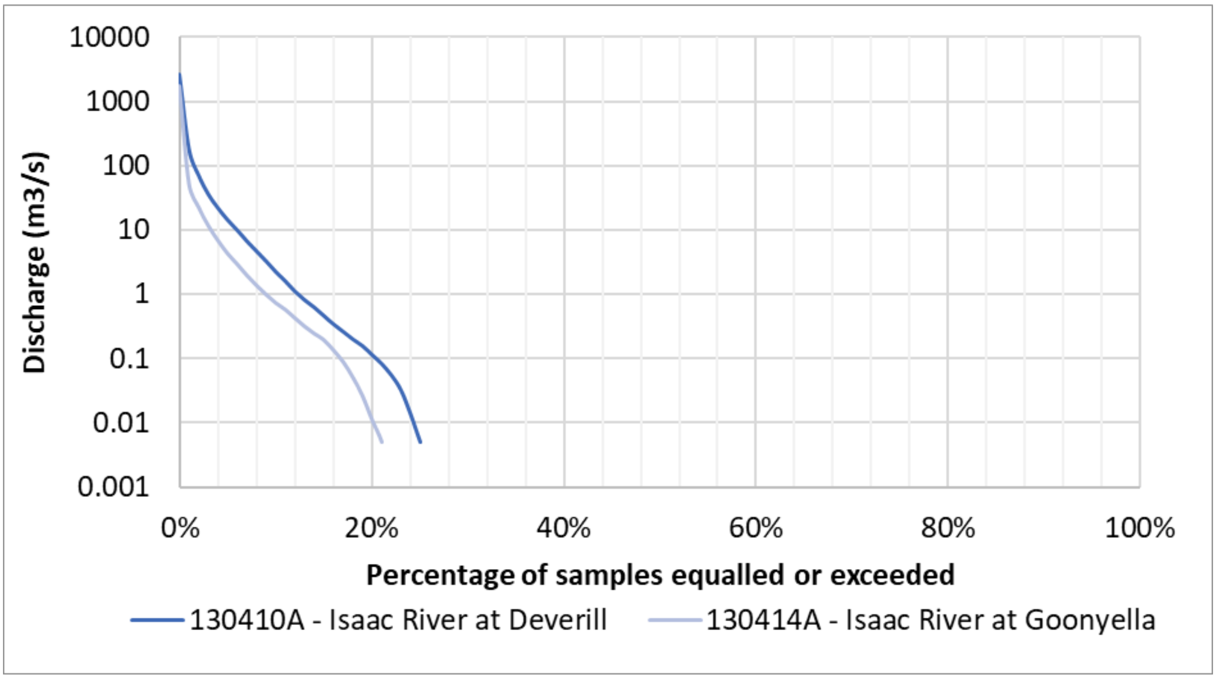


Figure 2-6 Daily Discharge Exceedance Curves

2.4 Legislative Framework

The Relevant legislation in relation to surface water resources for the Project includes:

- *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) including the water trigger;
- *Water Act 2000 (QLD)* (the Water Act);
- *Water Reform and Other Legislation Amendment Act 2014* (WROLA Act);
- Water Plan (Fitzroy Basin) 2011;
- Environmental Protection Act 1994 (the EP Act);
- Environmental Protection (Water) Policy 2009 (EPP Water);
- Environmental Protection (Water) Policy 2009 Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River) September 2011; and
- *Fisheries Act 1994.*

2.4.1 Commonwealth Legislation

The water trigger is legally relevant to the Project as it involves a coal mine development. Under the EPBC Act, an action involving a 'CSG development' or 'large coal mining development' will require approval from the Commonwealth Environment Minister if the action has, will have, or is likely to have, a significant impact on a water resource. The Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments—impacts on water resources (the Guideline) provides a self-assessment framework and exemptions to determine if a referral under the EBPC Act is required. The surface water impact assessment demonstrates that the Project will not have a significant impact on the surface water resources.

2.4.2 State Legislation

The Isaac River is a declared water course under the Water Act 2000 (the Water Act). Queensland Globe Spatial Data identifies a portion of Horse Creek and Cherwell Creek as watercourses and the unnamed tributaries of Cherwell Creek, which extend through the Project site as drainage features under the definitions of the Water Act.

Two un-mapped watercourses, which discharge to Horse Creek, are located within the Project Site. It is considered that these un-mapped features are classified as drainage features similar to the un-named tributaries of Cherwell Creek.

Under the Water Act, a Water Licence is required for taking or interfering with surface water, overland flow water or underground water. Changes to a number of provisions in the Water Act came into effect on 6 December 2016 through the Water Reform and Other Legislation Amendment Act 2014 (WROLA Act). These changes included a simplification of the water licensing process, and a number of exemptions. Under Section 97 and 98 of the Water Act, diversions associated with an EA (Section 97) or resource activity (Section 98) are approved through the EA process. The EA process applies to the extent that the water course diversion is on tenure associated with the EA. In the case of the Project, all proposed works are located within the ML and therefore exempt.

The Fitzroy Basin Water Resource Plan 2011 and Fitzroy Basin Water Resource Operations Plan (DNRM, 2016) outline the use of water within the basin under the Water Act. The plan defines the availability of water and provides a framework for sustainable management, such as targets for environmental flow objectives and regulating the taking of overland flow. The Project falls within the Isaac Connors Sub Basin area of the Fitzroy Basin Water Resources Plan, with no specific objectives set for this sub basin area in the vicinity of the Project.

The EPP (Water) outlines the objectives of the EP Act with regard to water. In particular, the EPP Water Isaac River Sub Basin Plan outlines the Environmental Values and Water Quality Objectives for the region. These are discussed further in **Section 2.5**.

2.5 Environmental Values and Water Quality

The EVs for the Project are listed in the Environmental Protection (Water) Policy 2009 for Isaac River Sub-basin Environmental Values (DES, 2011). The Project Site is located within the Isaac Western Upland and Tributaries Catchment, and in a close proximity to the Isaac River and Lower Connors River Main Channel. As any adverse impact due to the Project would affect the Isaac River, EVs from both sub-basins have been noted in this assessment. The applicable EVs are defined and outlined in **Table 2-3**.

All relevant EVs need to be considered when evaluating a water body. The level of environmental and water quality protection must be determined to maintain each of the EVs. Management goals that are established to protect the environmental values should reflect the specific problems and/or threats to the values, desired levels of protection and key attributes that must be protected (ANZECC & ARMCANZ, 2000).

Table 2-3 Environmental Values for the Project

Environmental Value	Description	Potential Impacts of the Project
Aquatic Ecosystems	Maintaining or improving the ecological condition of waterbodies and their riparian zones, with contaminant trigger values selected from the ANZECC 2000 Guidelines depending on the location within the catchment.	Applies to the Isaac River and Lower Connors River Main Channel sub-basin only. The Project has the potential to impact on aquatic ecosystems. This is further discussed in the Aquatic Ecology Chapter.
Visual Recreation	Aesthetic qualities of waters, including visual clarity and colour, surface films and debris, and nuisance organisms.	The waterways have values for visual recreation.
Stock Watering	Suitability of water supply for production of healthy livestock.	This value is relevant with surrounding land use for beef cattle grazing.
Primary Recreation	Health of humans during recreation, which involves direct contact and a high probability of water being swallowed, for example, swimming, surfing.	Due to the ephemeral nature of the watercourses and their location it is considered unlikely that waterways will be used for primary recreation.
Secondary Recreation	Health of humans during recreation, which involves indirect contact and a low probability of water being swallowed, for example, wading, boating.	As above it is considered unlikely that the waterways will be used for secondary recreation.
Aquaculture	Health of aquaculture species and humans consuming aquatic foods (such as fish, molluscs and crustaceans) from commercial ventures.	Due to the ephemeral nature of the watercourses and their location, it is considered unlikely that waterways will be used for aquaculture.
Farm water Supply/Use	Suitability of domestic farm water supply, other than drinking water, for example, water used for laundry and produce preparation.	No farm water supply users are located along Horse or Cherwell Creek, and therefore the potential impact to farm water supply is unlikely.

Environmental Value		Description	Potential Impacts of the Project
	Drinking Water	Refers to the quality of drinking water drawn from the raw surface and groundwater sources before any treatment.	Due to the ephemeral nature of the watercourses, it is considered unlikely that the environmental value for drinking water will apply. Moranbah Township is supplied town water by BMA.
	Aquatic Foods (Cooked)	Protecting water quality to produce healthy aquatic foods such as fish, crustaceans and shellfish for human consumption and aquaculture activities.	Applicable. Isaac River could be a source of aquatic foods.
	Irrigation	Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.	Applicable. Isaac River is a source of water supply for irrigation.
	Industrial Use	Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries. Industries usually treat water supplies to meet their needs.	There are no industrial water users in the vicinity of the Project site.
	Cultural and Spiritual Values	Indigenous and non-indigenous cultural heritage, for example, custodial, spiritual, cultural, and traditional heritage, lifestyles, symbols, landmarks.	The waterways hold cultural and spiritual values.

2.5.1 Guideline Values

Where more than one EV applies to receiving waters, the most stringent Water Quality Objective (WQO) is adopted to protect all identified EVs. Aquatic ecosystem WQO therefore form the basis of the WQO for this Project. **Table 2-4** outlines the guideline WQO identified for the Protection of aquatic ecosystems.

Table 2-4 Guideline Values for the Protection of Aquatic Ecosystems

Management Intent (Level of Protection)	Upper Isaac River Catchment (refer plans WQ1301, WQ1310)	
	Parameter	Water Quality Objectives
Aquatic Ecosystems, Moderately Disturbed	Ammonia N	<20 µg/L
	Oxidised N	<60 µg/L
	Organic N	<420 µg/L
	Total nitrogen	<500 µg/L
	Filterable reactive phosphorus	<20 µg/L
	Total phosphorus	<50 µg/L
	Chlorophyll a	<5.0 µg/L
	Dissolved oxygen	85%–110% saturation
	Turbidity	<50 NTU
	Suspended solids	<55 mg/L
	pH	6.5–8.5
	Conductivity (EC) baseflow	<720 µS/cm
	Conductivity (EC) high flow	<250 µS/cm
	Sulphate	<25 mg/L

Notes, N = nitrogen, EC = electrical conductivity, ND = no data, µg/ L = micrograms per litre, mg/L = milligrams per litre, NTU = Nephelometric Turbidity Units, µS/cm = microSiemens per centimetre

2.5.2 Water Quality Monitoring.

Water quality sampling was undertaken at seven monitoring locations within and downstream of the Project site as part of the annual Receiving Environment Monitoring Program (REMP). **Figure 2-7** illustrates the sample locations.

The analysis undertaken as part of the aquatic ecology assessment for this Project (Horse Pit Extension Project Aquatic Ecology Assessment, ESP 2021) found "*Overall, aquatic ecosystem values of waterways and wetlands in the vicinity of the Project were low to moderate, and were considered to be similar to and representative of ephemeral systems in the broader region. Sites on waterways with higher stream orders (i.e. Cherwell Creek and Grosvenor Creek) typically had higher ecological value than sites on waterways with low stream orders (i.e. Horse Creek, Caval Creek and unnamed tributaries). Mapped lacustrine wetlands were assessed as having moderate aquatic ecological value (particularly due to their provision of dry season refuge for aquatic flora and fauna) and palustrine wetlands were assessed as having low aquatic ecological value (as they were dry during the field surveys). The value of wetlands in the vicinity of the Project to terrestrial flora and fauna was limited to riverine wetland areas within ML 1775 and ML 70403 along Nine Mile Creek and Cherwell Creek (E2M 2020).*"

2.6 Existing Water Users

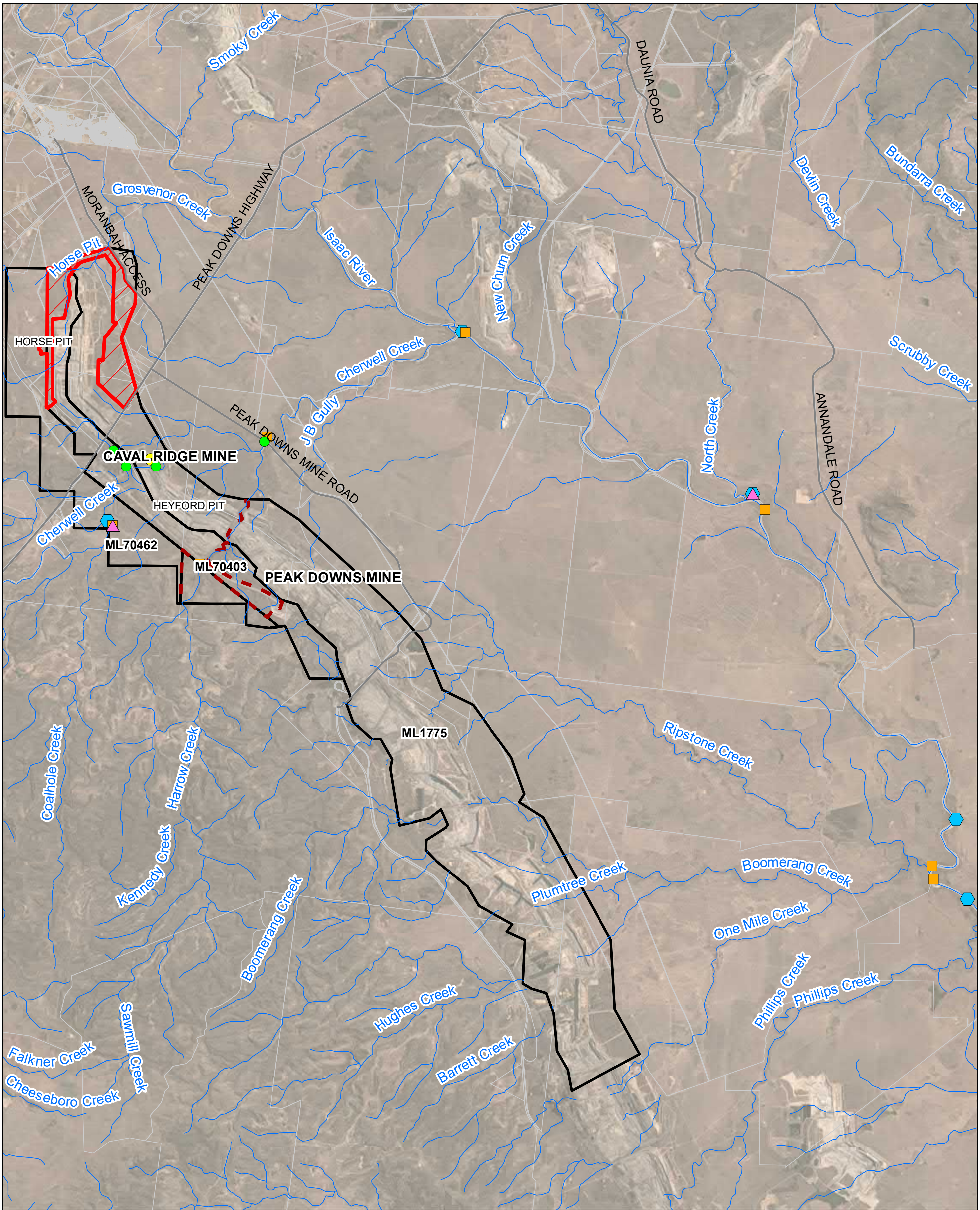
2.6.1 Licenced Water Users

A search of the Queensland Government database for licenced water users was undertaken on the 21 of March 2021. No licenced surface water users were identified within a 10 km radius[1] of the project site. That is, no downstream water users were identified between the Project and the Isaac River.

Aerial photography was also reviewed, and it was observed that a large dam exists on Horse Creek just upstream of the confluence with Grosvenor Creek. No water licence has been identified for this structure. This is potentially the most affected downstream user, with the Horse Creek Catchment area being reduced by 9 km^2, representing a 14 per cent reduction in catchment area.

Nearby water users are shown in **Figure 2-8**.

[1] In the Environmental Authority, EPML00562013 - Caval Ridge Mine, it is stated under *Obligations under the Environmental Protection Act 1994 section F20 (Water)* that "*For the purpose of the REMP, the receiving environment is the waters of the Cherwell Creek and connected or surrounding waterways within ten (10) kilometres downstream of the release.*"



0 1 2 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:250,000 at A4

Project No.: 620.13593

Date: 02-Jun-2021

Drawn by: PM

- MAW Release Point
- Overflow Release Point
- Receiving Water Point
- Release Point
- REMP Locations
- Watercourses
- Roads
- Caval Ridge Mine and Peak Downs Mine Boundary
- Horse Pit Extension Project Area
- BHP Tenements
- Cadastre

Horse Pit Extension Project

Water Quality Monitoring and Release Locations

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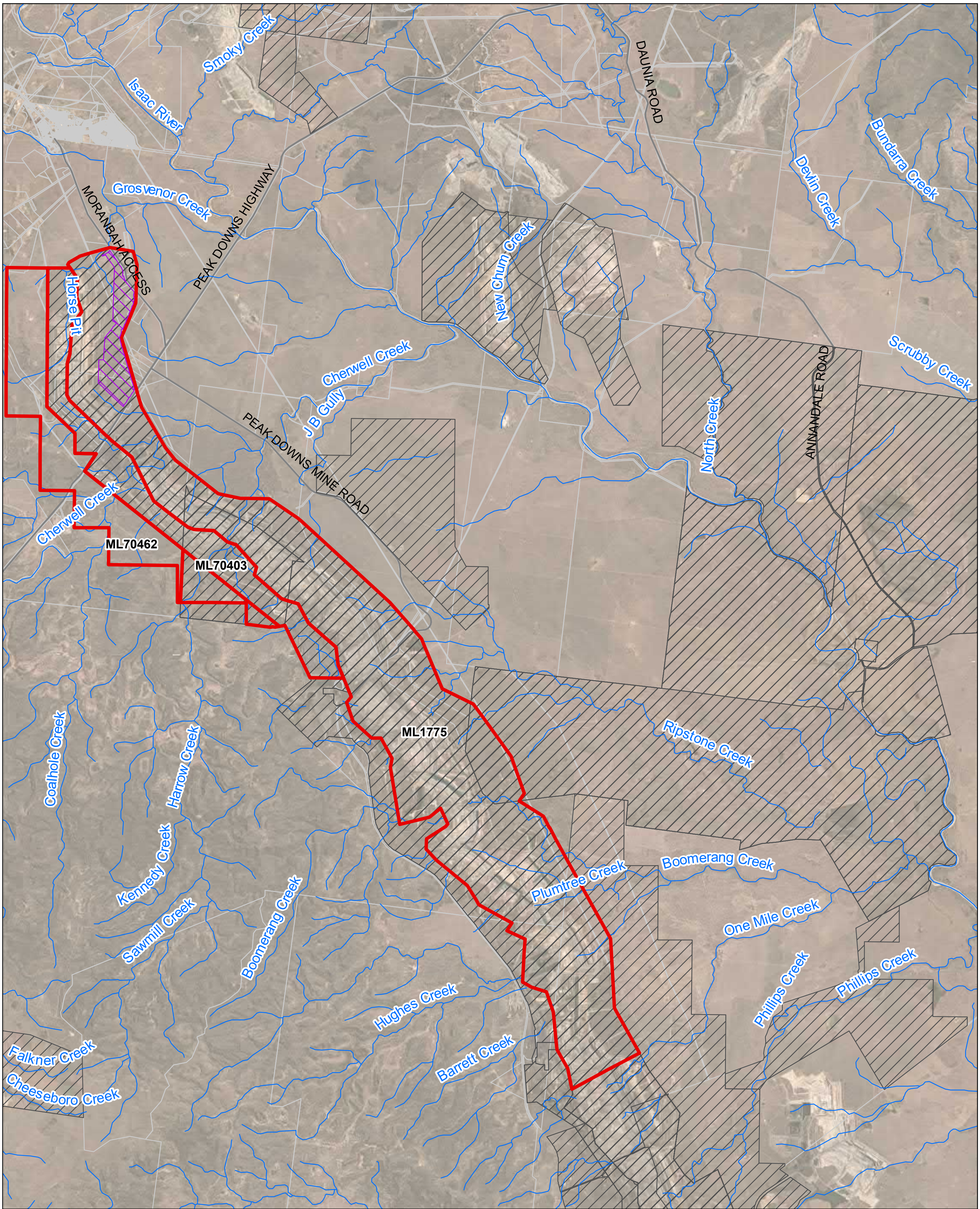
FIGURE 2-7

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Surface Water\SLR62013593_SW_MonitoringPoints_001.mxd



N

0 1 2 3 4 5 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:250,000 at A4
Project No.: 620.13593
Date: 11-Jun-2021
Drawn by: PM

- Watercourses
- Roads
- BHP Tenements
- Cadastre
- Water Users
- Horse Pit Extension Area

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Horse Pit Extension Project

Water Users

FIGURE 2-8

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2.7 Creek Geomorphology

The Project is situated in the Bowen Basin, south of the township of Moranbah in Queensland. It covers tributary streams of the Isaac River in the headwaters of the greater Fitzroy River catchment. The area is divided by a relatively indistinct ridgeline dividing two watersheds: the northern watershed includes Horse Creek and tributaries; and the southern watershed includes Nine Mile Creek, Caval Creek, Harrow Creek, Cherwell Creek and tributaries. South of the project site, Nine Mile Creek and Caval Creek joins Cherwell Creek, and Harrow Creek joins Cherwell Creek downstream of the project site, before joining the Isaac River. Horse Creek joins Grosvenor Creek (Isaac River tributary) downstream of the Project site.

The watercourses in and around the site are ephemeral, since they are dry during prolonged periods. After these dry periods, a significant rainfall event is typically required in order to restore flows in the creeks.

SLR carried out a site visit in August 2020. This assessment has been focused on Horse Creek, as this is the waterway most at risk of changes to its geomorphic characteristics from changes to hydrologic regime and construction of a levee along its bank.

2.7.1 Previous Assessments

A site inspection of Horse Creek, Cherwell Creek and their tributaries was carried out by URS in 2009 (Creek Site Visit, URS 2009) to support the Caval Ridge Environmental Impact Statement (EIS). The report noted the following

- Depth of channel averaged at 1-2 m but up to 4 m; width of low flow channel estimated at 3 m wide;
- Bank slopes 1:1 to 1:2;
- Most of the creek banks were covered in vegetation (grasses) and stable, however undermining and over bank erosion observed;
- Silty and gravel bed materials were deposited, especially around track crossings;
- Log jams present;
- Evidence of erosion more evident on downstream sites. Cattle grazing and cattle tracks evident; and
- On-stream farm dams evident on Horse Creek tributaries.

2.7.2 Geomorphic characteristics

Horse Creek has a consistent cross section and long section with an overall slope of 0.3 per cent. The river has mostly a sandy bed with vegetated banks. The flow velocity in the creek is mostly between 0.5 to 1.5 m/s and reaches a velocity of 3.5 m/s in the middle of the diversion. A geomorphic feature summary from SLR site visit (August 2020) is provided in **Table 2-5** below.

A typical cross section of Horse Creek with confined low-flow channel and high-flow channel is shown in **Figure 2-9**. Further photographs and typical cross sections are provided in **Appendix A**.

Table 2-5 Horse Creek Geomorphic Summary

Channel Characteristics	SLR 2020 Description
Length of Channel in the Study Area	3.5 km
Sinuosity Index	0.77 Slightly Sinuous
Bed Slope	Upper reaches 0.28%; Lower reaches 0.34%.
Channel Planform and Type	Single thread
Active Bed Character	Sandy bed with vegetated banking. Some weathered rocks.
Width of Bed	2 to 8 m
Flow depth in 10% AEP Flood	1 m to 3 m
Sediment Type	Sandy material
Channel Banks	Moderate to high slope banks grassed with trees. Vegetated benches present.
Bankfull Conditions	High flow channel approximately 100-200 m wide. Main channel perched through some sections. Floodplain fairly confined without significant breakouts.

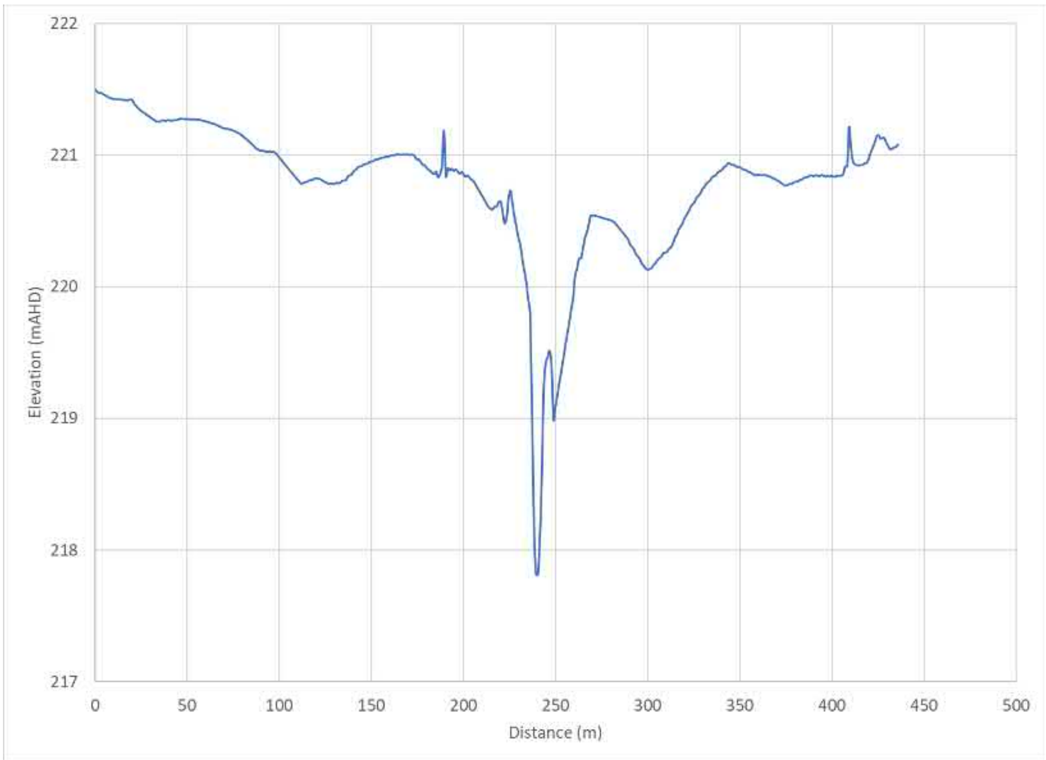


Figure 2-9 Horse Creek typical section showing confined low-flow and high-flow channel.

Photo 2-1 Horse Creek sandy bed and vegetated bench

During the site visit carried out by SLR (2020), moderate to extreme bank erosion was evident. This is illustrated in **Photo 2-2** and **Photo 2-3,** which show the erosion on the outer banks as well as aggradation of sediments on the riverbed.

Photo 2-2 Erosion on tributary of Horse Creek

Photo 2-3 Evidence of bank erosion and aggregation of sediments on the Horse Pit River

2.7.3 Summary of findings

The site inspection found that the existing waterways of Horse Creek, Cherwell Creek and other unnamed tributaries running through the Project area, were largely unchanged from the site visit carried out by URS in 2009. The waterways are prone to erosion, particularly as a result of grazing activities.

In most cases, it was apparent that a change in flow regime (such as concentration of a flow path from a dam outlet or along a cattle track) allowed gully and sheet erosion to take place due to the highly dispersive nature of the soils. The highly dispersive nature of the soils will need to be noted and managed for any proposed waterway works.

3 Surface Water Management

3.1 Overview of Surface Water Management Principles

BMA will be required to update its water management plan to incorporate the Horse Pit extension at the CVM. The current effective surface water management strategy will be applied to the new pit areas for the Project and will involve the following management actions:

- Where possible, stormwater runoff from undisturbed areas, both on and surrounding the Mine site is diverted away from disturbed areas and released directly into adjacent waterways (i.e. Horse Creek and Cherwell Creek);
- sediment laden runoff is captured in sediment dams and used for dust suppression to minimise the likelihood of offsite water discharges;
- MAW is prioritised for water demands at CHPP and dust suppression with makeup water from Burdekin pipeline; Or it is discharged off-site via the release dam that comply with the Mine's EA No. EPML00562013;
- Infrastructure and mining areas are protected from flooding from Horse Creek and Cherwell Creek using flood levees and/or bunding;
- The haul road crossing and the Horse Pit extension operate in compliance with the DNRME's Riverine Protection permit requirements;
- All significant quantities of hydrocarbon and chemical products stored on site, are stored in temporary or permanent bunding;
- Sediment transport to be reduced through progressive revegetation. For example, progressive rehabilitation is applied to areas no longer required for operational use;
- Standard Operating Procedures (SOPs) will be developed, implemented and revised as required for the main aspects of BMA's mining business, including those aspects that can adversely impact on surface water management if not properly conducted;
- The continued implementation of the BMA's Environmental Management System will ensure that roles and responsibilities for mining activities that may affect surface water are clearly defined and that appropriate management actions are developed and implemented for these mining activities to provide a commensurate level of environmental protection;
- All water management structures are designed and constructed using practical hydraulic parameters based on an appropriate risk-based rainfall event, catchment size, slopes, discharge design and soil types. The design criteria and standards are to comply with regulated or best practice standards for MAW management and Erosion and Sediment Control;
- Spill capture and retention devices are used for refuelling and similar areas;
- Runoff from oily water areas is treated using an oil-water separator; and
- Disturbance is kept to an operational minimum for safe operation to reduce the area exposed.

3.2 Activities Requiring Management

The key components of the Project with potential to impact on surface water resources include:

- Extension of the existing Horse Pit beyond the approved extent during FY2025;
- Relocation of enabling infrastructure, including: an EME Build Pad, blasting compound (two potential relocation options), go-lines, substations, back-access roads and powerlines as required by the progress of Mining;
- Extension of the haul road to access the proposed OOPD in the north-west of ML 70403, including the construction of a culvert crossing over Horse Creek;
- Construction of two flood levees: the northern levee bounds a portion of Horse Pit and the western levee is located at the south-west extent of the proposed OOPD;
- Relocation of mine water dams and pipelines as required by the progress of mining;
- Expansion of sediment dam capacities and construction of new sediment dams, clean water diversion drain and mine affected water (MAW) drains to manage runoff associated with the proposed OOPD; and
- Relocation of the Peak Downs Highway dragline crossing.

3.3 Existing Surface Water Infrastructure

3.3.1 Sediment and MAW Dams

The existing water management strategy involves the use of the sediment and MAW dams as transfer points. All sediment dam transfers are directed to the clean water cell of 12N Dam whilst MAW is directed to the MAW water cell of 12N Dam. MAW will continue to be dewatered from Horse Pit over the highwall and piped into either N1 dam or N2 dam throughout the life of the Project.

A summary of the existing water management structures is provided in **Table 3-1** and **Table 3-2**.

Table 3-1 Mine Affected Water Dam Summary

Name	Existing Volume (ML)	Location
Mine Water Dam N1	41	Horse Pit East
Mine Water Dam N2	50	Horse Pit East
Mine Water Dam MIA 1	76	MIA
Mine Water Dam MIA 2	80	MIA
Mine Water Dam MIA 4	26	MIA
Mine Water Dam MIA 5	57	MIA
Mine Water Dam 12N - MWC	1,100	Heyford Pit North
MAW Total	**1,379**	-

Table 3-2 Existing sediment dams

Name	Existing Volume (ML)	Location
Sediment Dam N1	140	Horse Pit
Sediment Dam N2	225	Horse Pit
Sediment dam N3A	24	Horse Pit North
Sediment dam N3B	14	Horse Pit North
Sediment Dam N3C	18	Horse Pit North
Sediment Dam S1	75	Heyford Pit North
Sediment Dam S2	111	Heyford Pit North
Sediment Dam S3	86	Heyford Pit North
MIA Sediment Dam 1	40	MIA
MIA Sediment Dam 2	17	MIA
12N – CWC	1,000	Heyford Pit North

3.3.2 Pipelines

Raw water is piped via the Burdekin Water Pipeline (via Western Corridor) along the western boundary of ML 70403, over the Peak Downs Highway to the raw water dam in the MIA on ML 70403, south of the Peak Downs Highway. This pipeline will not interact with any elements of the Project.

The Burdekin Water Pipeline dissects ML 1775 adjacent to the Moranbah Access Road. This pipeline corridor is within the approximately 100 m wide exclusion zone in the east of ML 1775, and as such no relocation of this pipeline is required. A minor tee-junction previously used to supply raw water to the BMA accommodation camp will be removed prior to interaction with mining at Horse Pit.

MAW pipelines are used to dewater operational pits and transfer water between dam storages. These pipelines receive MAW from operational pits and facilitate bulk transfers of MAW. The MAW pipelines will be relocated in a staged manner, as required, with the relocation of water storage dams discussed above for the progress of mining, and progressively relocated to align with the back-access roads in accordance with the mine schedule. Ultimately, the final alignment of the MAW pipeline will be within the mining exclusion zone in the far east of ML 1775.

External pipeline water is sourced via a branch off the BMA owned Burdekin pipeline. This water is sourced at the Burdekin Fall weir and is used to fill the raw water dam as well as for potable water. CVM has an internal allocation to draw a maximum of 5,260 ML per annum of raw water.

3.4 Proposed Surface Water Infrastructure

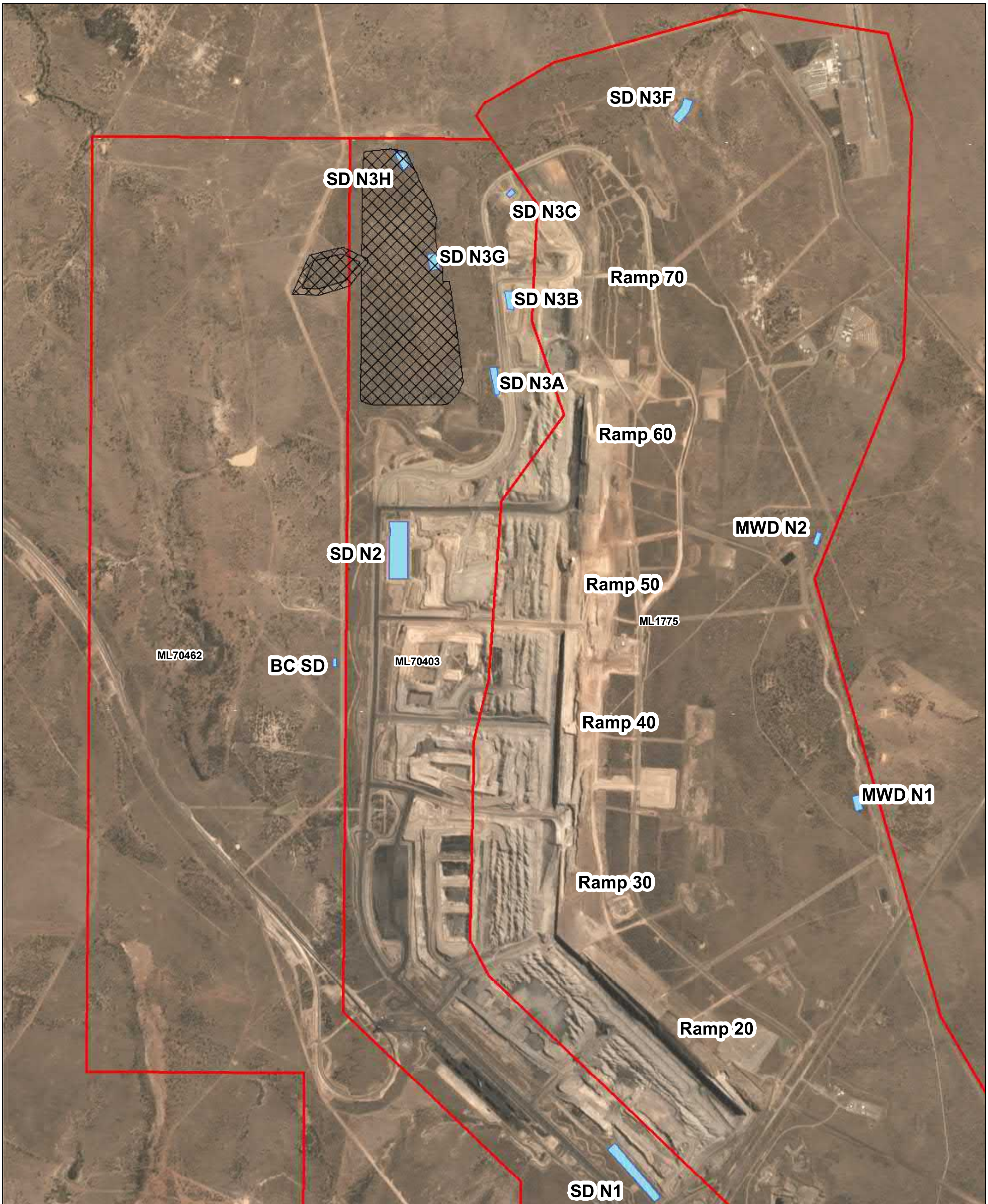
The existing water infrastructure at CVM is insufficient for the planned extension of Horse Pit. As a result, a reconfiguration of the water infrastructure is proposed, including relocation and expansion of existing infrastructure as well as construction of additional infrastructure. Details of the proposed works are outlined in the following subsections. Locations of water management infrastructure are illustrated in **Figure 3-1**.

3.4.1 Sediment and MAW Dams

The existing N1 and N2 MAW dams are currently used as staging dams for MAW including dewatered pit water and are located in the far east of ML 1775. The N1 and N2 MAW dams will be retained as separate water storage structures of 41 ML and 50 ML respectively. These dams will be relocated as close as possible to the eastern extent of ML 1775 prior to being mined through and will include the extension of pipelines to the new locations. The pipelines will be relocated in a staged manner in accordance with the progression of mining with the final alignment to be confined within the exclusions zone on the far eastern boundary of ML 1775. The proposed total length of pipeline extensions required for the relocated dams is approximately 7 km.

Four (4) new sediment dams are proposed to capture runoff from the OOPD, Blast Compound and the disturbance areas associated with the Project.

A summary of the proposed water management structures is provided in **Table 3-3.**



0 500 1,000 Meters

Projection: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project No.: 620.13593
Date: 23-Jul-2021
Drawn by: PM

Storages
BHP Tenements
OOPD and Quarry Boundary

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Horse Pit Extension Project

Water Infrastructure Locations

FIGURE 3-1

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\62013593_F3-1_Infrastruacture_Location_v6.mxd

Table 3-3 Mine Affected Water Dam Summary

Name	Existing Volume (ML)	Location
Mine Water Dam N1	41	Horse Pit East – to be relocated
Mine Water Dam N2	50	Horse Pit East – to be relocated
Mine Water Dam MIA 1	76	MIA
Mine Water Dam MIA 2	80	MIA
Mine Water Dam MIA 4	26	MIA
Mine Water Dam MIA 5	57	MIA
Mine Water Dam 12N - MWC	1,100	Heyford Pit North
Total	**1,430**	
Total Including Emergency In-Pit Storage	**216,000**	

BMA have reviewed the capacity of existing sediment dams to ensure suitable capacities are achieved for the Project. The existing sediment dams within the Project site will require upgrades to accommodate increased catchments. In addition, the following new sediment dams are proposed:

- One (1) new sediment dam (capacity of 70 ML) is required to capture the runoff in the north of ML 1775 adjacent to the proposed northern flood levee,
- Two (2) new sediment dams (combined capacity of 97 ML) are required to capture runoff from the proposed OOPD to the north-west of Horse Pit, and
- One (1) new sediment dam (capacity of 24 ML) is required to capture runoff from the proposed blast compound (for Location B only).

Each sediment dam will have a permanent pump with pipeline infrastructure to enable dewatering to the existing water management system as required and in compliance with BMA ESC & MAW Management Standard.

Details of the existing sediment dams, new sediment dams and upgrades to existing dams relevant to the Project are provided in **Table 3-4.**

Table 3-4 Sediment Dam Summary (Horse Pit only)

Name	Existing Volume (ML)	Revised Volume (ML)	Location
Sediment Dam N1	140	278	Horse Pit
Sediment Dam N2 [A]	225	225	Horse Pit
Sediment dam N3A	24	57	Horse Pit North
Sediment dam N3B	14	66	Horse Pit North
Sediment Dam N3C	18	21	Horse Pit North

Name	Existing Volume (ML)	Revised Volume (ML)	Location
Sediment Dam N3F [B]	NA	70	Horse Pit North
Sediment Dam N3G [B]	NA	42	Proposed OOPD
Sediment Dam N3H [B]	NA	55	Proposed OOPD
Blast Compound Sediment Dam [B]	NA	24	Location B Option
Total	**421**	**838**	-

[A] No expansion required. Existing sediment dam volume exceeds minimum requirements.

[B] Proposed new sediment dams.

3.4.2 Surface Water Drains

The Project will require additional surface water drains to manage clean and dirty water in addition to the existing drains at CVM.

There is one proposed clean water drain designed to convey a 1% Annual Exceedance Probability (AEP) flood and capture the clean water catchment to the west of the proposed OOPD. The clean water drain flows south to north, and parallel to the proposed OOPD in the west. The drain is approximately 2 km in length, and contains a maximum cut depth of approximately 9.0 m. This drain will direct flow to a natural drainage feature north of the proposed OOPD. The drainage feature outflows to Horse Creek approximately 1 km to the east.

There are four proposed sediment laden runoff drains that bound the outer extents of the proposed OOPD. The MAW drains are designed to convey a 10% AEP flood immunity capturing all MAW within the stockpile area. The total length of proposed MAW drains is approximately 4.6 km with a maximum cut depth of approximately 9.0 m along the outer extents of the OOPD. The drains will direct flow to two proposed sediment dams, as described above.

3.5 Flood Protection Structures

The Isaac River is the main watercourse within the region and lies 12 km to the east of ML 1775.

Two watercourses flow through the proposed mine site – Horse Creek and Cherwell Creek. These creeks are both tributaries of the Isaac River. Horse Creek flows north along the western boundary of ML 1775 before flowing north east near the northern boundary of the lease. Cherwell Creek flows north east across ML 1775 before it enters the Isaac River. Detailed descriptions of the creek locations are given in Section 2.2 and shown in Figure 2-2.

An options analysis was undertaken by Engeny as part of the BMA Caval Ridge Horse Pit Extension Water Management Concept Design Report (Engeny, 2020), to determine the most appropriate design to provide flood protection to the Horse Pit. The design considered diversions and levees as described below.

3.5.1 Diversions

There are no proposed watercourse diversions or modifications to existing watercourse diversions required to facilitate the Project. There are two existing diversions at CVM associated with Cherwell Creek and Caval Creek. Horse Creek has been realigned previously however this is not a regulated watercourse diversion as Horse Creek is not defined as a watercourse.

There are four mapped minor drainage features that traverse the Project, discharging into both Horse Creek and Cherwell Creek. These drainage lines will be mined through as Horse Pit progresses. Earthworks will be required ahead of mining to convey upslope overland flow away from Horse Pit. There is also a minor drainage line that interacts with the north-west corner of the proposed OOPD. This drainage line will be realigned around the toe of the OOPD.

3.5.2 Flood Levees

Existing flood protection at CVM is provided via the haul road running adjacent to the diversion of Horse Creek, and levees bounding various sections of the perimeter of Horse Pit. Flood immunity at CVM has been designed to prevent pit inundation up to 0.1% AEP.

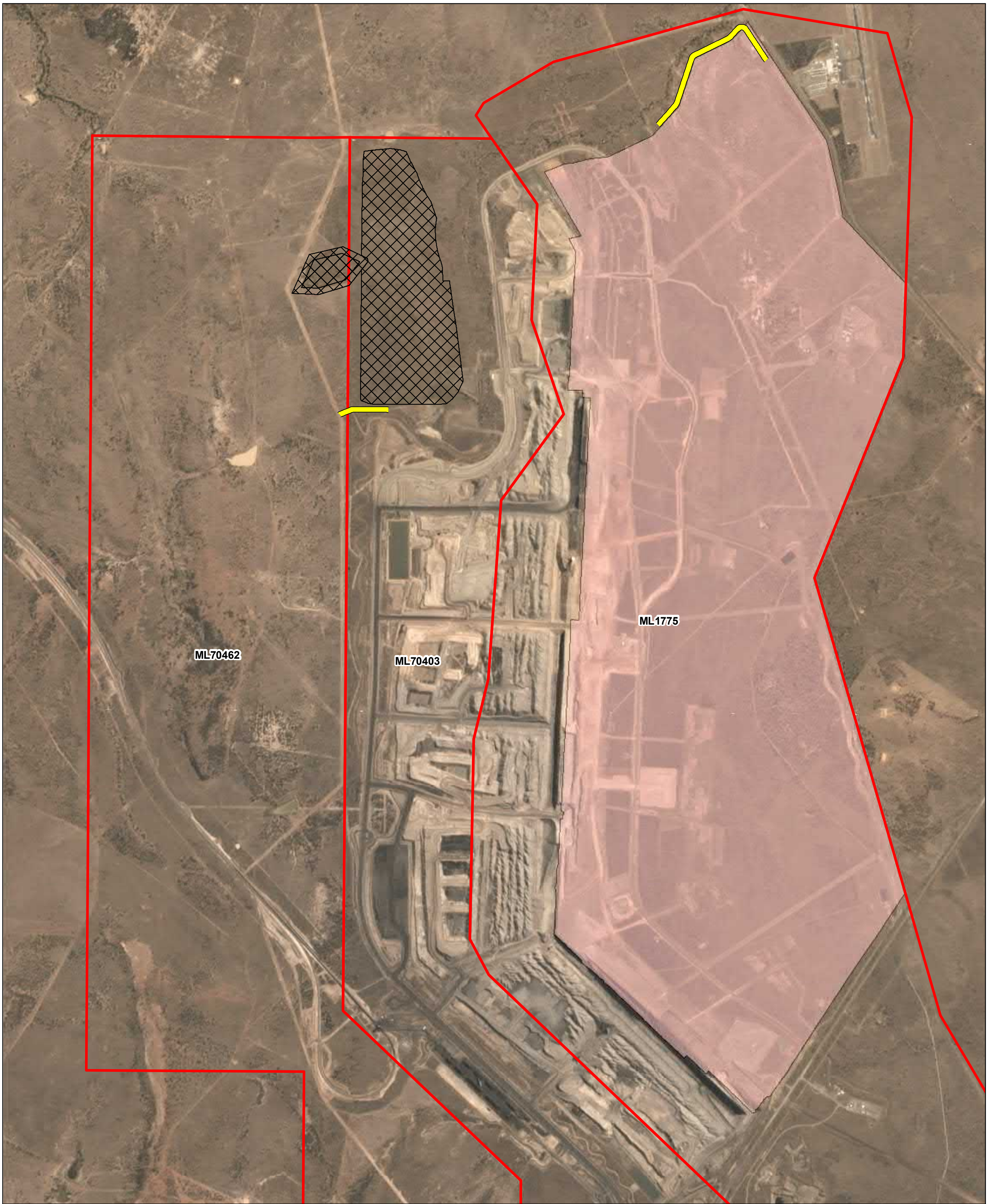
To facilitate the Project and maintain pit flood immunity at CVM up to 0.1% AEP, two additional flood levees are required. The two proposed flood levees have been designed to a concept level for the purpose of the EA Amendment for the Project. BMA has confirmed through a Consequence Category Assessment (CCA) the two levees will be regulated structures on the basis that significant volumes of clean water inflow could occur, potentially overwhelming the water management system. The proposed levee locations and extents are summarised below:

- The northern levee (Horse Pit North levee) bounds a portion of Horse Pit in the far north of ML 1775. This levee is approximately 1.4 km in length. The levee is to be constructed in a staged approach to allow free draining of the clean highwall catchment while providing pit protection.
- The western levee (Horse Pit West Levee) is located at the south-west extent of the proposed OOPD on the boundary of ML 70403 and ML 70462. This levee is approximately 400 m in length and will protect the proposed OOPD from flooding of Horse Creek to the south.

The basis of design for the levees is outlined in **Table 3-5** and the locations of the proposed flood protection levees are outlined on **Figure 3-2**.

Table 3-5 Flood Levee Basis of Design

Component	Basis of Design
Flood Immunity	0.1% AEP with 0.5 m freeboard
Crest Width	10.0 m (as per current site levees)
Batter Slopes	1V:3H (no safety bunds)
Key Trench Width	3.0 m
Crest Treatment	100 mm gravel capping and guideposts (trafficable)
Batter Treatment	Topsoil and seed



0 500 1,000 Meters

Projection: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project No.: 620.13593
Date: 11-Jun-2021
Drawn by: PM

BHP Tenements
OOPD and Quarry Boundary
Horse Pit Extension footprint

Horse Pit Extension Project

Levee Alignment

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FIGURE 3-2

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3.6 Summary of New Water Management Infrastructure

The proposed water management infrastructure is summarised in **Table 3-6** and **Figure 3-3** below. This shows the details of changes and expansion of the water management infrastructure for the Project.

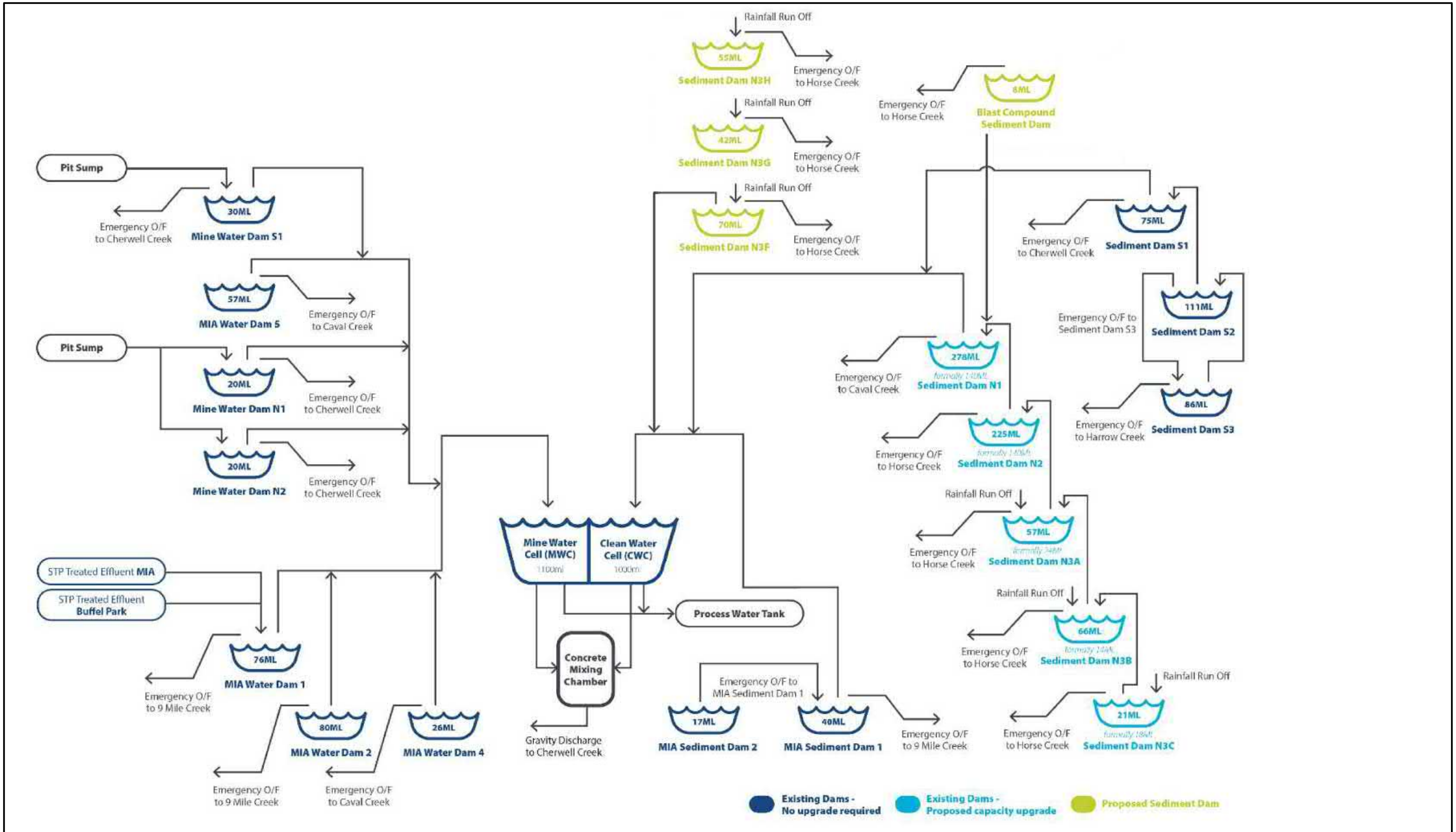
Table 3-6 Proposed Surface Water Management Infrastructure

Element	Existing Volume (ML)	Proposed Volume (ML)	Location
Sediment Dam N1	140	278	Horse Pit
Sediment Dam N2 [A]	225	225	Horse Pit
Sediment dam N3A	24	57	Horse Pit North
Sediment dam N3B	14	66	Horse Pit North
Sediment Dam N3C	18	21	Horse Pit North
Sediment Dam N3F [B]	NA	70	Horse Pit North
Sediment Dam N3G [B]	NA	42	Proposed OOPD
Sediment Dam N3H [B]	NA	55	Proposed OOPD
Blast Compound Sediment Dam [B]	NA	8	Location B Option
Sediment Dam S1	75	75	Heyford Pit North
Sediment Dam S2	111	111	Heyford Pit North
Sediment Dam S3	86	86	Heyford Pit North
MIA Sediment Dam 1	40	40	MIA
MIA Sediment Dam 2	17	17	MIA
12N - CWC	1,000	1,000	Heyford Pit North
Mine Water Dam N1[C]	41	41	Horse Pit East
Mine Water Dam N2[C]	50	50	Horse Pit East
Mine Water Dam MIA 1	76	76	MIA
Mine Water Dam MIA 2	80	80	MIA
Mine Water Dam MIA 4	26	26	MIA
Mine Water Dam MIA 5	57	57	MIA
Mine Water Dam 12N - MWC	1,100	1,100	Heyford Pit North
Horse Pit Levee North	N/A	N/A	Located to the north of Horse Pit
Horse Pit Levee West	N/A	N/A	Located to the west of Horse Pit

[A] No expansion required. Existing sediment dam volume exceeds minimum requirements.

[B] Proposed new sediment dams.

[C] Relocation required.



Project Number:	620.13593
Date:	31-May-2021
Drawn by:	PM

Horse Pit Extension Project

Proposed update to CVM Water Management System (Process Flow Diagram)

FIGURE 3-2

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4 Hydrologic and Hydraulic Modelling

Horse Pit is located within the Horse Creek catchment, with the creek realigned to run along the western and northern boundaries of the existing Horse Pit. There are also a number of tributaries located to the east of the existing Horse Pit.

As part of the original development of the mine, Horse Creek was realigned diverted to prevent ingress of flood water into the adjacent mine workings. More recently, a tributary of Horse Creek, located to the east of the mine, has been partially realigned to reduce ingress of flood water into the pit.

A flooding assessment of Horse Creek has been conducted for the 50%, 10%, 5%, 2%, 1%, 0.1% AEP and PMF events. The flood assessment has been conducted using current industry standards (Australian Rainfall and Runoff (AR&R)) for hydrology and the most up to date topographical information from 2019 as provided by BMA.

Flood modelling has been carried out to determine flood extents and depth for rare events along with stream power, bed shear stress and velocities for the 50% and 2% AEP events.

4.1 Terminology

In accordance with AR&R, this report uses the terminology AEP to define the likelihood of design flood events occurring – that is the probability of an event occurring or being exceeded within a year. Average Recurrence Interval (ARI) was a term used previously to define the probability of design flood events (IEAust, 1987), and was defined as the average period between occurrences equalling or exceeding a given value.

For clarity, the adopted and previously used terminology is both shown in **Table 4-1**.

Table 4-1 Design Flood Events Terminology

ARI*	AEP**	Terminology used in this report
2 year	~39%	50% AEP
5 year	~18%	20% AEP
10 years	10%	10% AEP
20 years	5%	5% AEP
50 years	2%	2% AEP
100 years	1%	1% AEP
1000 years	0.05%	0.1% AEP

1 **Average Recurrence Interval ** Annual Exceedance Probability.*

4.2 Modelling Updates

Previous modelling has been carried out by Engeny (2019) and was provided to SLR for this Project. The hydrologic and hydraulic modelling has been reviewed to determine whether the models were fit for purpose. Key updates to the provided models include:

- Hydrologic model (XP-Rafts)
    - Catchment extents were updated to account for recent changes in mining landform;
    - Catchment delineation was carried out for the catchments west of the mine, as the existing catchments were not reflective of the provided terrain information; and
    - Additional catchments were incorporated into the model to account for the extension of the model downstream past the Moranbah Access Road.
- Hydraulic model (TUFLOW)
    - The model was updated to the latest version of TUFLOW, incorporated 2019 LiDAR and extended 600 m downstream of the Moranbah Access Road;
    - The model was updated to utilise a 2 metre grid cell size (existing model 4 metre) to provide appropriate representation of flow paths across the site;
    - A recently constructed diversion channel and the relocated back access road (BAR) located to the east of the existing pit, were also included in the TUFLOW model. Details of the road, channel and associated works were provided by BMA as follows:
        - BAR – information sufficient to create a Digital Elevation Model (DEM) was supplied. The DEM was incorporated into the model. In addition, culverts identified in the detailed design drawings from the BAR were included in the model.
        - Diversion channel – preliminary design information was supplied. This information was used to incorporate a channel within the model. The location of the channel was based on a shape file provided by BMA. It was assumed that the channel was constructed with a constant grade from the western end to the southern end, with levels at either end matching existing ground levels. The channel was assumed to be trapezoidal in shape, consistent with the design plan and photographic evidence. Design details suggest that the channel was sized to convey the 24 hour 10% AEP event.

4.3 Hydrologic Modelling

Hydrologic modelling was undertaken by Engeny in 2019 as part of a flood study of the major waterways and drains interacting with the CVM operating area. The modelling was updated as noted in **Section 4.2**.

The hydrologic model was calibrated to the two largest recorded flow events identified in the available gauge records, being the March 2012 and February 2016 flood events (Engeny, 2019). The model calibration was carried out using the Moranbah Airport (034035) BoM gauge, and flood heights recorded on the upstream Cherwell station (331610).

The XP-RAFTS model was well calibrated to the March 2012 event, however, due to the spatial variation of the 2016 rainfall event, the model was under-estimating the peak flow estimate for the 2016 event. Timing and routing were well represented for both events (Engeny,2019).

As outlined in **Section 4.2**, SLR has reviewed this model and updated catchment extents and areas to be reflective of the current landform. Model parameters derived as part of the model calibration have been adopted and are provided below.

- Initial Loss 25 mm
- Continuing Loss 2.1 mm
- Bx factor of 0.9

The model was used to simulate the 50%, 10%, 5%, 2%, 1%, 0.1% AEP and PMF events. Analysis of the critical duration and mean temporal patterns in accordance with ARR2019 methodologies was undertaken.

The peak flow rates for Horse Creek at Moranbah Access Road are provided below.

Table 4-2 Peak Flows from XP-RAFTS model at Horse Creek (Moranbah Access Road).

AEP	Peak Flow (m^3/s)
50%	73
10%	109
5%	147
2%	199
1%	234
0.1%	450
PMF	2290

4.4 Hydraulic Modelling

Hydraulic modelling of the area was conducted using TUFLOW. TUFLOW is an industry standard one and two dimensional hydrodynamic software package. The TUFLOW modelling conducted by Engeny was updated and used to simulate a range of events. The flood model was used to demonstrate the immunity of the proposed levees to protect the extension of Horse Pit and the proposed OOPD.

4.4.1 Manning’s roughness

Manning’s roughness values adopted in the previous model were adopted as they were considered appropriate. These values are summarised below in **Table 4-3**.

Table 4-3 Manning's Roughness

Land Use	Manning's n
Open space/light vegetation	0.05
Active channel	0.035
Spoil/stockpile	0.04
Channel/riparian zone	0.07
Roads/hardstand	0.025
Waterbodies	0.015

4.4.2 Model Inflows

Inflows were taken from the RAFTS model. Inflows were applied at discrete locations throughout the model. It is noted, therefore, that the upstream end of all inundation mapping is not an indication that no inundation occurs upstream, merely that this was the limit of interest for the modelling.

4.4.3 Model boundary

The downstream boundary was modelled as normal depth based on the slope of the land at the boundary as determined using the Lidar.

4.5 Flood Mapping Results

The updated flood model was used to simulate the 50%, 10%, 5%, 2%, 1% and 0.1% AEP flood events. The flood modelling results were used to determine the extent of flooding for each of these events. Furthermore, a PMP DF event was carried out to determine the extent of flooding from Horse Creek, and any impact on the final void.

The figures contained in **Appendix B** illustrate the existing 50%, 10%, 5%, 2%, 1% AEP, 0.1% AEP and PMF event flood peak depths, water surface levels and extent. As shown in **Figure 4-1**, the recently completed drain conveys flow away from the pit for events up to the 0.1% AEP.

4.6 Existing Flood Characteristics

The flood model was used to simulate the 50%, 10%, 1% and 0.1% AEP flood events. The flood modelling results were used to determine the behaviour of Horse Creek, and its tributaries in the vicinity of the mine under existing conditions (as per current mining activities). This information provides the base case information for future assessment of potential impacts occurring as a result of the proposed pit extension.

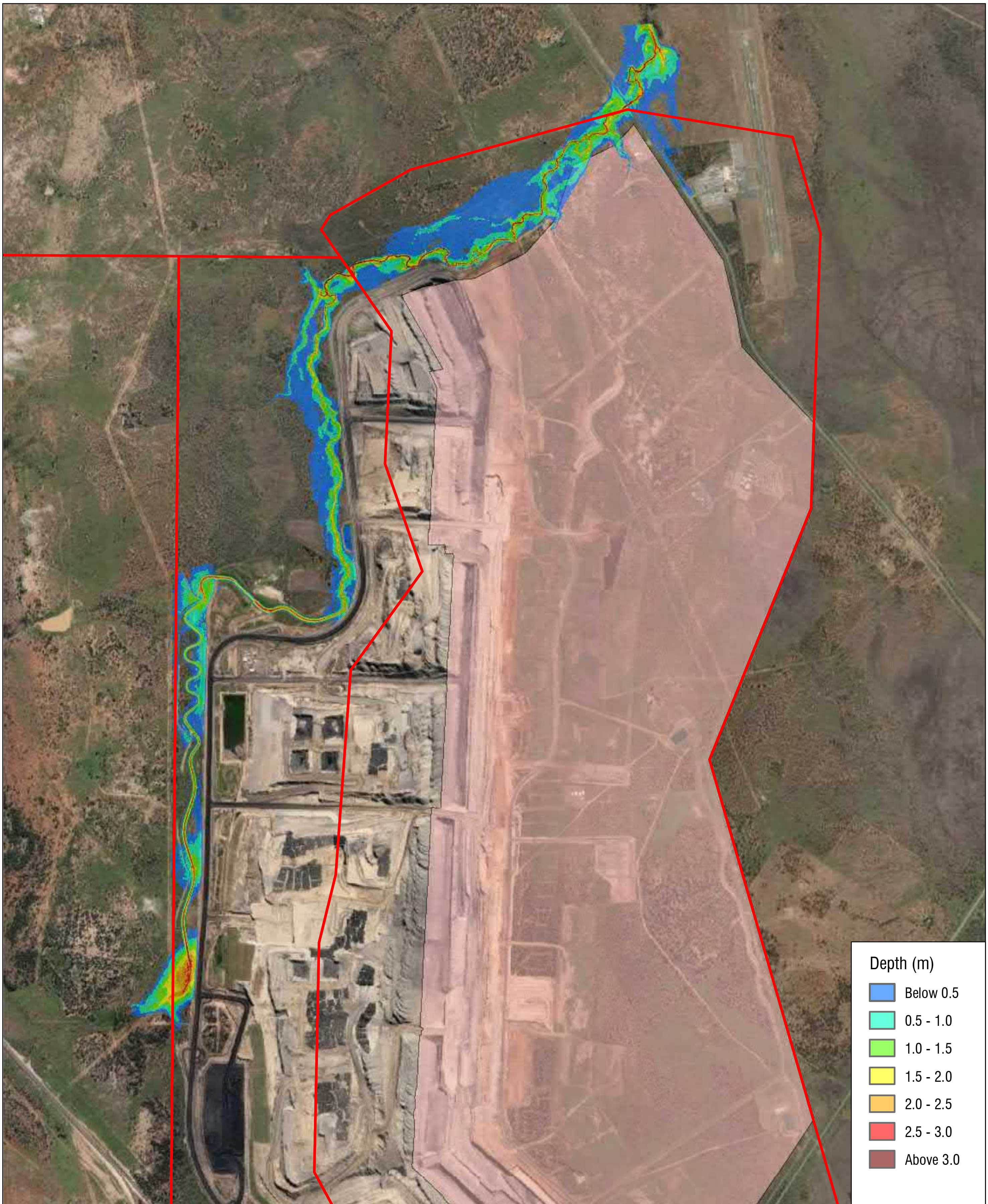
The existing 0.1% AEP event flood peak depths, water surface levels and extent are illustrated in **Appendix B**. As shown, without the proposed levees, operational areas of the project would be inundated by flooding from Horse Creek, with the existing Horse Creek flow path currently flowing directly into Horse Pit and the dump extents.

Full results for flood depths, velocities, bed shear stress and stream power are provided in **Appendix B**.

The existing flood characteristics are summarised below for Horse Creek. The flood characteristics are illustrated relative to the recommended industry standard ACARP design criteria for the design of stream diversions (ACARP, 2002), which relate to stream power, velocities and shear stresses. While these criteria relate only to diversions, comparisons to existing conditions indicate the nature of the existing flow regime. The comparison, presented in **Table 4-4**, indicates the flow behaviour for Horse Creek exceeds the ACARP design criteria. **Appendix B** provides mapping of these characteristics.

Table 4-4 ACARP diversion channel design criteria and existing flood behaviour

Scenario		ACARP Criteria	Horse Creek (west of Horse Pit)	Horse Creek Downstream of Horse Pit)
50% AEP event	Stream Power (Watts/metre^2)	**<60**	<200	<150
	Velocity (Metres/second)	**<1.5**	<1.8	0.5 to 1.5
	Shear Stress (Newtons/metre^2)	**<40**	<100	<40 (local areas of up to 100)
2% AEP event	Stream Power (Watts/metre^2)	**<150**	<220	60 to 120
	Velocity (Metres/second)	**<2.5**	<2.2	1.0 to 1.5
	Shear Stress (Newtons/metre^2)	**<80**	<100	<60 for most, <110 in low flow channel



0 0.5 1 km

Mining Leases

Horse Pit Extension footprint

Projection: GDA 1994 MGA Zone 55

Scale: 1:35,000 at A4

Project No.: 620.13593

Date: 11-Jun-2021

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Horse Pit Extension Project

Existing Scenario
Peak Flood Depths - 0.1% AEP

FIGURE 4-1

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5 Mine Water Management

The Project will utilise the existing water management system at CVM. Additional water management infrastructure and relocation of MAW dams will be required to facilitate the Project. The water management system at CVM and proposed updates to water management for the Project are outlined in the following subsections.

5.1 Mine Water Balance Modelling

The performance of the Project's water management system was assessed using the modelling software program GoldSim. GoldSim is a software package developed by the GoldSim Technology Group to model continuous systems and has the ability to track the movement of water with time-based inputs and operating rules.

The assessment was undertaken utilising the Central Regional Water Network (CRWN) Water Balance Model (WBM) (BMA, 2020). The CRWN WBM was developed by BMA and links the individual WBM's developed for the BMA mine sites of Saraji Mine (SRM), Caval Ridge (CVM), Peak Downs (PDM) and Saraji South (SSM)). The water management systems of these individual mines are connected by the CRWN Pipeline. The CRWN Pipeline is a pipeline, which extends from NPM to CVM through SRM and PDM allowing the transfer of MAW transfers between these operations. The CRWN WBM also includes representation of the receiving water catchments, including the operation of Teviot and Burton Gorge Dam to represent the likely coincident flows in the Isaac River and its tributaries.

This linked CRWN WBM was updated to detail the proposed water management infrastructure and its impact on both the CVM water management system, the connected mine sites and the receiving environment.

The CRWN WBM is a daily resolution WBM. The CRWN WBM assesses the performance of each mine's water management system against their regulatory requirements outlined in their EAs and BMAs own internal water management standards. The objectives of the CRWN Water Management System are to:

- Control and manage the separation and use of clean and mine affected water;
- Use mine affected water preferentially to meet the site's water demands for the Coal Handling and Preparation Plant (CHPP) as well as dust suppression;
- Maximise pit operability; and
- Control the release of water from the storage dam's so that releases occur in accordance with the licenced conditions in a manner that minimises impacts upon downstream users and the environment.

The current site water balance model was developed from a schematisation of the water management system and the component descriptions outlined in **Section 3.4**.

5.2 Mine Water Sources and Demands

5.2.1 Water Supply & Demands

Water demand for the Project is not expected to increase from the existing demand at CVM. The major water demand for CVM arises from coal processing and dust suppression for operations, haul roads, OOPD and to support progressive rehabilitation. The mine water system has been configured to maximise the re-use of water on site with the aim to reduce the amount of raw water consumed by the operation. The key CVM operational water requirements are summarised in **Table 5-1**

Table 5-1 Mine Water Demand

Water Use	Volume Required	Water Quality Requirements	Source
CHPP	7.0 ML/d	MAW	Mine Water Dam 12N
Dust Suppression	10.3 ML/d	MAW	Mine Water Dam 12N

The Project will not require major changes to the existing supply at CVM. The major water demands for CVM (coal processing and dust suppression) are principally met by MAW with sufficient raw water allocation as make up water source. MAW is also utilised at CVM for firefighting purposes and is pumped into on-site water storages, mechanically filtered and stored in tanks ready for use.

5.2.2 External pipeline water

CVM has an internal allocation to draw a maximum of 5,260 ML per annum of raw water. The GoldSim Water Balance Model for the CVM predicts an average of 3,200 ML of raw water will be required each year for the mine life. Raw water consumption is minimised by maximising the reuse of on-site MAW in the mining process, sharing between operations, and by employing techniques to minimise losses due to seepage and evaporation.

5.2.3 Potable Water

The quality of surface water runoff at CVM is not suitable for potable water, and therefore only treated raw water is used. Raw water for potable purposes is sourced via the BMA owned Burdekin pipeline, and treated at the on-site CVM Potable Water Treatment Plant to standards outlined in the *CVM Potable and Raw Water Management Plan* and the *Australian Drinking Water Guidelines* (2011).

5.2.4 Water Transfer Agreement

A water transfer agreement exists between CVM, PDM, SRM and NPM. In the agreement, the mine sites have made commitments to EA condition compliance, General Environmental Duty, prevention of environmental harm and keeping of rigorous monitoring records. Monthly water reports are distributed outlining Trigger Action Response Plan levels and water volumes at each site. This information is used to monitor the need for the transfer of water to and from CVM.

5.2.5 Treated Sewage Effluent

The Project will not require changes to sewage treatment management at CVM. Sewage from the Mine Infrastructure Area (MIA) and the CHPP, is collected via a system of gravity and pumped rising sewerage mains, and treated via a package sewage treatment plant (STP) within the MIA. The effluent is treated to a suitable quality to allow safe and efficient reuse on site.

5.2.6 Pit Dewatering

The existing water management strategy for pit dewatering will continue for the Project. MAW will be dewatered from the operational Horse North pits over the highwall and piped into either Mine Water Dam N1 or N2 throughout the operational life of the mine.

Modelled forecast pit dewatering volumes for the Project have been established. The results demonstrated a static or decreasing annual dewatering volume across CVM. As the pit dewatering volumes have been forecast to not increase as a result of the Project, the pumping strategy will not be modified beyond relocating dams and extending pipelines.

5.3 Climate

The climate input to the CRWN WBM is based on stochastic rainfall and average evaporation. The purpose of the stochastic rainfall is to examine a range of climate sequences based on the recorded historical rainfall data. The stochastic data still maintains the climate statistics of the historical rainfall record, but also examines the robustness of the system. This is achieved by modelling the potential for events that are statistically likely to or have the possibility of occurring (based on the historical series), but may be less than, greater than or occur in a different sequence to the historical record. The use of stochastic data allows for the presentation of the modelling results with a probability of occurring, which will help inform the management strategies and mitigation measures.

The stochastic rainfall data was generated from recorded historical data using the eWater CRC's Stochastic Climate Library (SCL). The eWater CRC is a government owned, not for profit agency, and the SCL allows for the generation of probabilistic climate data based on statistics and patterns analysed from a historical record. The SCL was used to generate 500 replicates over 20 year sequences (2020 to 2040) of daily rainfall data. This method allows assessment of a wide range of rainfall sequences, which may be experienced over the life of the Project. **Figure 5-1** illustrates how the probabilistic data compares to the historical rainfall record for annual rainfall totals. The graph indicates that the model is simulating a range greater than that provided by the historical record, but that the median or 50th percentile of the results are aligned with the historical record. The historical record is also maintained in the water balance model for future simulations or calibration if required.

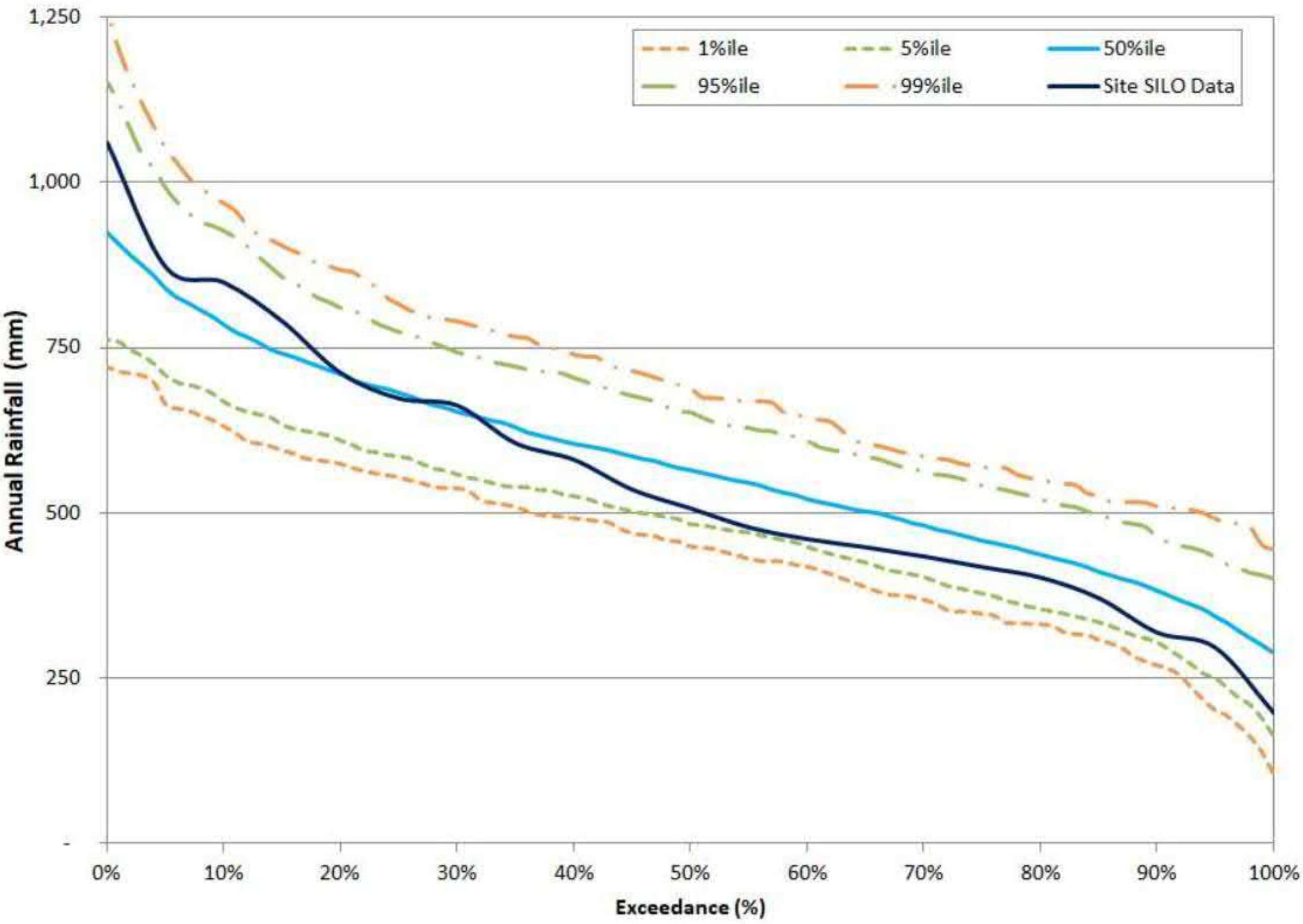


Figure 5-1 Comparison of Historical and Probabilistic Data

Evaporation from the site was determined based on monthly averages as recorded at Moranbah WTP (BoM station 034038). Monthly averages were used as the length of this data record was limited to 26 years. The extended evaporation record available in SILO was reviewed, but the infilled data consisted of data with notably lower monthly averages than the actual site record for the period prior to gauge readings. This is most likely due to the limited available data for infilling. Due to the short evaporation record and missing data, the error bounds on the generation of stochastic evaporation records were significant. As such monthly evaporation data was adopted rather than daily data for use in the GoldSim water balance model for stochastic simulations.

5.4 Contributing Catchments

The catchments contributing to runoff change as the mine pit progresses and flood levees are constructed. Catchment areas for each land use for each storage or pit were determined from the mine plans and GIS analysis, at a number of intervals over the life of mine. A description of each catchment type is provided below. Appendix C provides a table of the total areas by land use and illustrates these areas spatially.

- **Cleared** – This area represents the area that has been disturbed prior to mining through clearing of vegetation, topsoil removal and / or pre-strip. Runoff from this area must be captured in the mine water management system due to its potential to be sediment laden. Cleared areas will report to either out of pit sedimentation dams or flow back into the pit depending on the topography and the extent to which pre-stripping has occurred;
- **Mining Area** – This area represents the active mining area and mine pit floor. All runoff within this catchment reports to the respective mine pit; and
- **Spoil** – This area represents the dump of spoil overburden material. This is typically behind the active mining area and usually consists of an unconsolidated dump, which has not yet reached natural surface. The Project also includes a large out of pit spoil dump to the west of the site.
- **Rehabilitated** – three to five years after active mining the dump area will become seeded and grassed. Runoff from this area will report to either sedimentation basins or back to the pit depending on the topography and rehabilitation;
- **Haul Roads** – haul roads represent areas of compacted fill which, although not impervious, will have minimal soil water stores and result in a larger percentage conversion of rainfall to runoff.
- **Undisturbed** – Water runoff in undisturbed areas are generally diverted away from disturbed areas, and as such are not captured in the mine water management system. However, in some instances the topography and progression of the pit or the location of the flood levee is such that a proportion of the total catchment is undisturbed, and reports to the water management system.

5.5 Rainfall Runoff

The Australia Water Balance Model (AWBM) was used to relate daily rainfall and evapotranspiration to soil moisture and runoff. The AWBM parameters within the CRWN WBM have been adopted for different land use types based on calibration of the individual site WBMs, as well as AWBM parameters from similar studies in the region. The AWBM parameters adopted are provided in Table 5-2.

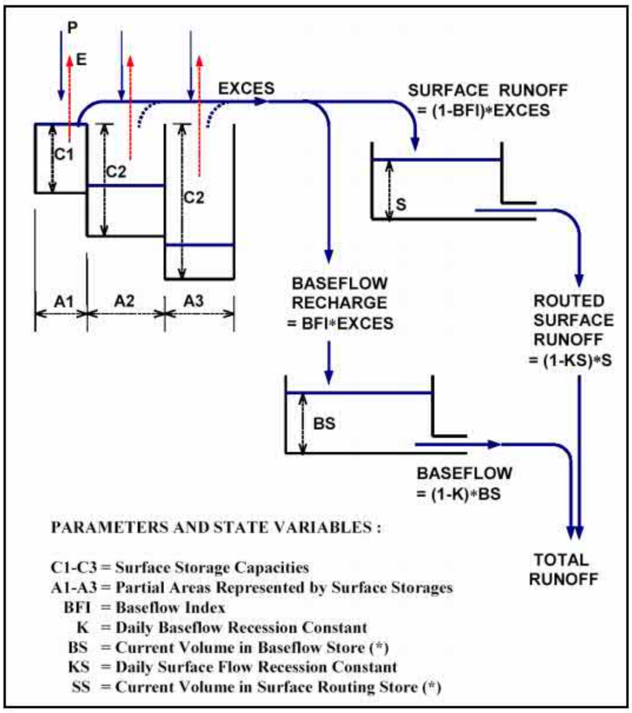


Figure 5-2 Structure of the AWBM Model (eWater CRC, 2004)

Table 5-2 Adopted AWBM Parameters

Parameter	Natural	Cleared	Mining Pit / Industrial Road	Stockpile	Spoil	Rehab	Creeks
Small storage capacity (mm)	7	10	5	20	10	5	7
Medium storage capacity (mm)	120	50	20	100	100	15	120
Large storage capacity (mm)	142	100	35	160	140	25	142
Small partial area portion	0.134	0.134	0.134	0.134	0.134	0.134	0.134
Medium partial area portion	0.433	0.433	0.433	0.433	0.433	0.433	0.433
Large partial area portion	0.433	0.433	0.433	0.433	0.433	0.433	0.433
Baseflow index	0.35	0.1	0.1	0.8	0.35	0.1	0.35
Baseflow recession	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Daily streamflow recession	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Initial soil store levels (mm)	0	0	0	0	0	0	0
Initial baseflow level	0	0	0	0	0	0	0

5.6 Groundwater

Groundwater inflow estimates for the Project were based on groundwater modelling undertaken by SLR (as outlined in the Caval Ridge Mine Groundwater Impact Assessment, 2021). The modelling estimated minimum and maximum inflow rates for each year within the simulation period. Groundwater inflows were then simulated stochastically with groundwater inflows within the nominated ranges selected by the model at random for each of the 500 replicates modelled. The minimum and maximum groundwater inflow rates for each year are provided in **Appendix D**.

5.7 Water Balance Operating Rules and Assumptions

5.8 Controlled Release Conditions

The CRWN WBM includes the representation of the EA conditions for releases at all CRWN mine sites. The WBMs release water from the sites based on:

- The flow and water quality of the Isaac River and local creeks as predicted by the WBM;
- The water quality of the release storages on site;
- The Trigger Action Response Plan (TARP) levels for stored water inventory;
- The physical release infrastructure constraints for each release storage; and
- The other water releases from release points within the CRWN sites.

As CVM, PDM and SRM all release water to the Isaac River, prioritisation has been applied on the assimilative capacity of the Isaac River and the releases from the CRWN sites. This is determined by BMA based on conditions at each site.

The controlled release conditions have been maintained in the water balance model. The current EA (EPML00562013) allows for discharge from the 12N Dam, subject to minimum flow rates being achieved in Cherwell and Isaac River. The flow triggers outlined below are based on maintaining an EC in the receiving waterway of below 2,000 µs/cm (outlined in table F5 of the EA). The modelled release conditions are presented in **Table 5-3**, **Table 5-4** and **Table 5-5** below.

Table 5-3 Release Point

Release Point (RP)	Easting (GDA94)	Northing (GDA94)	Mine Affected Water Source and Location	Monitoring Point	Receiving waters Description
RP1	612170	7550109	12N Dam	Discharge point	Cherwell Creek

Table 5-4 Release Conditions – waters released from site

<table>
<tr><th rowspan="2">Waterway</th><th rowspan="2">Flow Trigger</th><th colspan="3">Release Conditions</th></tr>
<tr><th>Released Water Quality EC Limit</th><th>Released Water Quality pH Limit</th><th>Receiving Water Flow Recording Frequency**</th></tr>
<tr><td>Cherwell Creek - Upper Cherwell Creek</td><td>> = 0.5 m^3/s</td><td rowspan="2"><10,000 µs/cm</td><td rowspan="2">6.5 (min) to 9.5 (max)</td><td>Daily during discharge</td></tr>
<tr><td>Isaac River – Isaac River Deverill</td><td>> = 3 m^3/s</td><td>Continuous (minimum daily) during discharge</td></tr>
</table>

** Low flow releases provide for releases on the tail end of a natural flow event. The low flow release window commences the moment the natural flow recedes below the flow trigger and spans a period of 28 days only.

Table 5-5 Receiving Waters Contaminant Trigger Levels

Quality Characteristic	Trigger Level	Monitoring Frequency
pH (pH units)	6.5 to 9.0 (Isaac River Seloh Nolem Downstream, or backup monitoring point)	Real time telemetry for EC and pH with grab samples at commencement, and weekly thereafter, when safe to do so and access permits. Daily grab samples if telemetry not available. (The first sample must be taken as soon as practicable following the commencement of the release influence period at the downstream monitoring point)
Electrical Conductivity (µs/cm)	2000 (Isaac River Seloh Nolem Downstream, or backup monitoring point)	
Sulphate (SO_4^{2-}) (mg/L)	1000 (Isaac River Seloh Nolem Downstream, or backup monitoring point)	Commencement of release, and thereafter weekly, during release when safe to do so and access permits. (The first sample must be taken as soon as practicable following the commencement of the release influence period at the downstream monitoring point)

5.9 Site Surface Water Quality

The water balance model was developed to include a high-level salt balance to track both the quantity and quality of water on-site. The salt balance tracks the water quality in all of the inflows to the Sediment Dams, MAW Dam and Pits and subsequent effects from evaporation and releases on the storage water quality. The water quality values are presented in **Table 5-6** . These adopted values are consistent with those adopted for other Queensland mine sites.

Table 5-6 Assumed Salinity

Source	Assumed Salinity (µs/cm)
Natural catchments / undisturbed*	300
Cleared	500
Groundwater* / Pit	3000
Spoil	1000
Tailings	3000
Rehabilitated	300

*based on average data from monitoring

The above salinity values are converted to a concentration in milligrams per litre using an average multiplication factor of 0.67 (Measuring Salinity DERM, June 2007) to quantify the mass of salt transferred in the model. The salt balance is used as an indicator of water quality. Actual releases will be made based on sampling and monitoring of a number of water quality parameters.

5.10 Mine Water Balance Results

The following provides a summary of the water management results for the Project. At the peak of mining the disturbance area captured (including freshwater catchments behind the mine area) is up to 7 km^2. The WBM results show there is always water inventory available due to the capacity of the 12N dam and Raw Water Dam and pipeline allocation, meeting all CHPP and dust suppression needs.

To assess the adequacy of the water balance to meet the Project’s operational requirements, the likelihood of pit inundation was assessed. The water balance modelling indicated that the pits would not exceed the sump capacity of 20 ML in moderate to high rainfall conditions. For high rainfall conditions, pit inundation could be on average one to two months per annum (**Table 5-7**).

Table 5-7 Pit Inundation Statistics per Annum

Climate	Average No of Days of Pit Inundation per annum					
	Ramp 20	Ramp 30	Ramp 40	Ramp 50	Ramp 60	Ramp 70
Moderate Rainfall (50% exceedance)	0	0	1	0	0	3
High Rainfall (75% exceedance)	0	1	13	0	4	14
Very High Rainfall (95% exceedance)	0	13	98	50	73	58

Figure 5-3 illustrates the total storage inventory predicted over the CVM ML updated with pit progression landforms from 2021 to 2057 with commencement of the Horse Pit extension project in 2025. The assessment for the original CRWN project was undertaken for a 40 year period (based on previously generated probabilistic rainfall data) for the Total Stored Water Inventory of the CRWN sites. This assessment shows that the most significant change in stored water inventories is predicted over the next 20 years and, after this timeframe, there is also increasing uncertainty in a number of inputs, including the mine plan. On this basis, the water balance modelling assessment period was selected to be 20 years.

The updates to the Horse Pit mine plan have been included in this assessment, which has shown no significant changes in results over this time period; therefore, the modelling assessment period has remained unchanged and the starting year for the model runs was 2021. The graph indicates there is predicted to be sufficient capacity within the designated storages (~3,627 ML for MAW dam storage and 216,000 ML including in-pit storage) to manage the climate extremes of the Project.

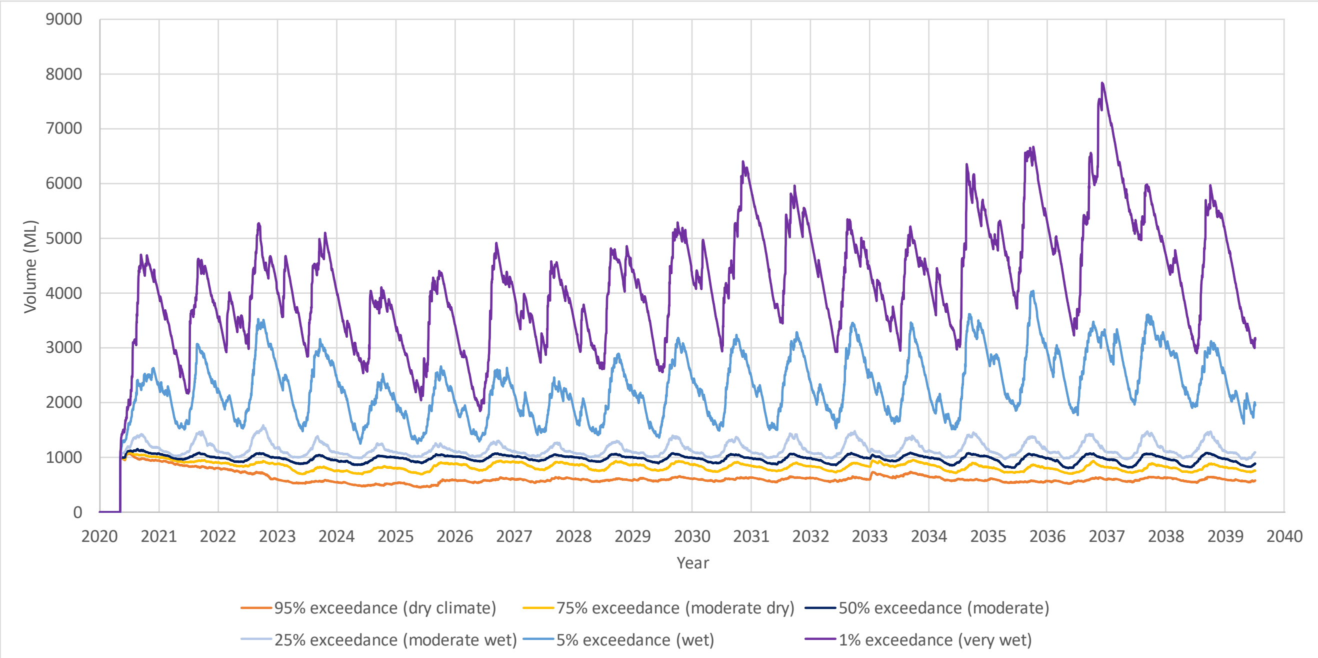


Figure 5-3 Predicted Storage Inventory and Capacity

The results of the water balance modelling illustrate the ability of the water storages to manage predictable climate extremes in rainfall. The predicted probability of uncontrolled overflows over the Project's life was based on the stochastic rainfall data (500 replicates x 20 years = 10,000 years modelled).

The average annual volume of water released to Cherwell Creek over the life of the Project was assessed and is illustrated in **Figure 5-4**. The results indicate that in a typical year, controlled releases would be in the order of 100 to 200 ML, increasing up to 2500 ML in a very wet climate with a 1% chance of exceedance. The controlled releases are made based on estimated flows in Cherwell Creek for coincident rainfall, and the predicted water quality within the storage. The modelling predicts that with releases downstream, EC in the receiving waterways will be less than 800 µS/cm and on average less than 400 µS/cm.

Figure 5-4 Predicted Annual Release Volume over Life of Mine

The release condition is considered important as it allows for good quality water to be released off site following periods of significant rainfall. This prevents good quality water increasing in salinity through evaporation and maximises the available storage within the mine site to manage climate extremes. This release of water also assists in maintaining the availability of water to downstream users at an appropriate water quality. The release condition also assists in reducing the uncontrolled releases from site. Uncontrolled releases are illustrated in **Figure 5-5**.

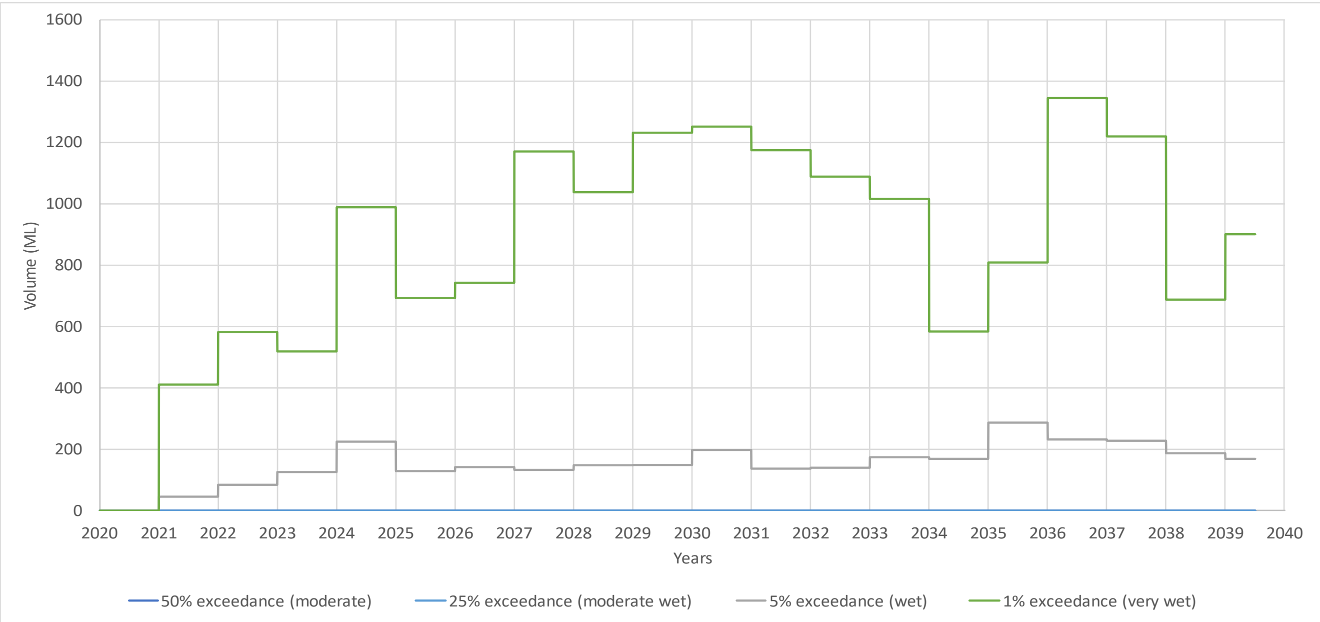


Figure 5-5 Predicted Uncontrolled Release Volume over Life of Mine

It should be noted that during the Project's operations, the Mine sites will be progressively rehabilitated. As such water quality within the storages is expected to improve.

The water balance modelling is based on conservative estimates for 500 stochastic rainfall replicates. The results predict that the Project's water management infrastructure combined with the Mine infrastructure is able to adequately manage mine water, to minimise risks to operations and adverse impacts to the downstream environment.

5.11 Sensitivity and Validation

The CRWN WBM has an internal quality assurance process to ensure the robustness of the model. The CRWN WBM calculates a mass balance for all water quantity and quality elements on a daily basis. The WBM net balance was zero for the CRWN WBM for both water quantity and quality.

The Sustainable Minerals Institute (SMI) from the University of Queensland was also engaged to provide quality assurance and review of the CRWN model development, initial model outputs and final model outcomes. Findings from their review have been incorporated in the model.

As part of the CRWN model development, sensitivity assessments were undertaken on key inputs of evaporation, AWBM parametrisation and water quality assumptions. The assessment was undertaken to determine the magnitude of the system sensitivity to the change (±20%). The assessment found that the evaporation and AWBM parameters for runoff had the most impact on the WBM outcomes, with impacts of ±30 to ±40 % on the release volumes.

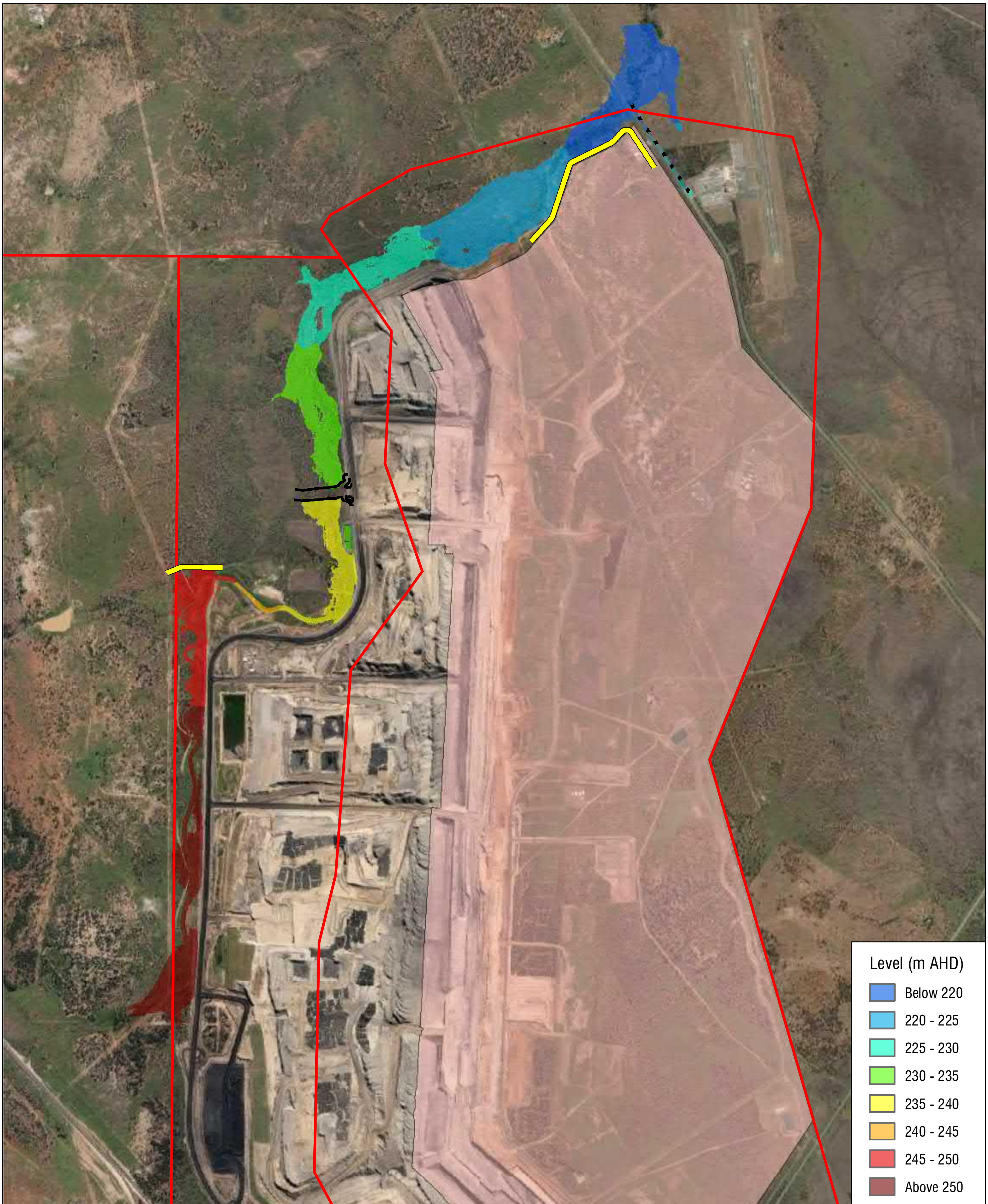
In accordance with the BMA Mine Water Standard, the proposed sediment dam and MAW dam sizing was also compared against design rainfall events from Australian Rainfall and Runoff (AR&R) 2019. This allowed for assessment of the storage against shorter duration sub-daily rainfall events. The assessment consisted of a simplified conservative calculation of runoff (using a simplified runoff coefficient) and pumping, but with no controlled releases. The assessment found that no spills would be predicted for a storm duration of less than 24 hours (less than the daily WBM).

6 Impact Assessment and Mitigation

6.1 Flooding Impact Assessment and Mitigation

As outlined in **Section 4.5,** protecting the pits from flood ingress will require the construction of the Horse Pit North and Horse Pit West levees. The flood extent for the 0.1% AEP is illustrated in **Figure 6-1,** with the impact of the works on flood behaviour illustrated in **Figure 6-2.**

The impacts of the flood mitigation structures on flooding for both Horse Pit North and Horse Pit West are discussed further below. Flood modelling results for all AEPs for both scenarios are mapped and provided in **Appendix B**.



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:35,000 at A4
Project No.: 620.13593
Date: 11-Jun-2021
Drawn by: PM

Mining Leases
Horse Pit Extension footprint
Proposed Levee
Proposed Road
Proposed Drain

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Horse Pit Extension Project

Life of Mine Flood Extent
Peak Flood Levels - 0.1% AEP

FIGURE 6-1

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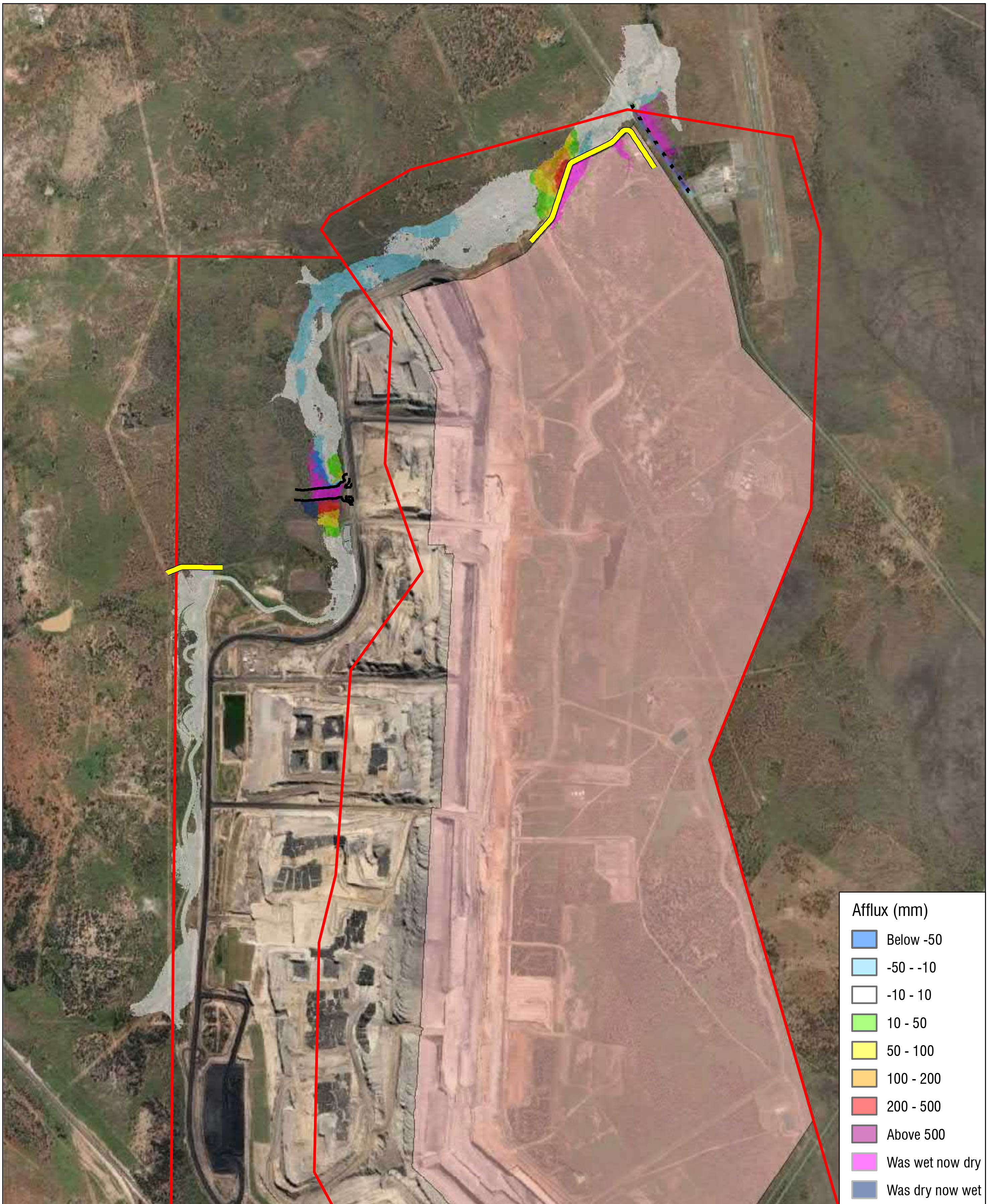

0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
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Drawn by: PM

Mining Leases
Horse Pit Extension footprint
Proposed Levee
Proposed Road
Proposed Drain

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Horse Pit Extension Project

Life of Mine Flood Extent
Peak Flood Afflux - 0.1% AEP

FIGURE 6-2

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\62013593_F6-2_LoM_Afflux_1000y.mxd

The flood model results indicate that as a result of the Horse Creek levees, flood immunity of for the Project is achieved for flood events up to and including the 0.1% AEP event. The results also indicate that a freeboard in excess of 500 mm is achieved by the proposed levees for the 0.1% AEP event. Results of the flood model indicate that the confinement of the floodplain due to the levee construction does not result in adverse impacts to Horse Creek. This is due to some reduction in retardment of flows due to the construction of the Haul Road crossing to the OOPD.

The proposed road crossing of Horse Creek to the OOPD provides a 0.1% AEP flood immunity to the Haul Road and the OOPD. Results of the flood modelling indicate the culvert crossing will cause flood affluxes upstream in the 0.1% AEP event, however, the afflux is contained within the extents of the Horse Creek floodplain, contained on the ML and has no impact on existing mine infrastructure.

Horse Pit North Levee results in some flood afflux to the north of the levee of up to 500 mm. The afflux is wholly contained within the existing flood extent of Horse Creek, with no additional flood areas observed.

The flood behaviour within the Horse Creek channel was also reviewed against the ACARP design criteria, and existing flood behaviour, with the comparison presented in **Table 6-1**. The results indicate the construction of the levee does not change the key stability criteria noted in ACARP. However, construction of the levee has the potential to increase scour and erosion, particularly given the sodic soils in the region. Erosion protection will be considered as part of the levees detailed design.

Table 6-1 ACARP Creek Diversion Criteria – Qualitative Assessment

Scenario	ACARP Criteria	Existing	Post levee construction
50% AEP event			
Stream Power (Watts/metre^2)	**<60**	<120 with isolated areas up to 150	<120 with isolated areas up to 150
Velocity (Metres/second)	**<1.5**	0.5 to 1.5	0.5 to 1.5
Shear Stress (Newtons/metre^2)	**<40**	<40 (local areas of up to 100)	<40 (local areas of up to 100)
2% AEP event			
Stream Power (Watts/metre^2)	**<150**	60-120	60 to 210
Velocity (Metres/second)	**<2.5**	1.0 to 1.5	1.0 to 1.8
Shear Stress (Newtons/metre^2)	**<80**	<60 for most, <110 in low flow channel	<60 for most, <110 in low flow channel

6.2 Mine Water Releases and Impacts Downstream

The results of the water balance modelling indicate that the Project's water management infrastructure is sufficient to manage mine affected water within the current EA conditions. The controlled release regime aims to minimise impacts to downstream water users and the environment through:

- allowing discharge of good quality water when appropriate baseflow conditions exist in Cherwell Creek and Isaac River; and
- a release regime that is based on known flow and water quality thresholds, which minimises the risk of uncontrolled releases.

The catchment area reduced by the Project is

- 7 per cent of Horse Creek;
- 0.5 per cent of Grosvenor Creek; and
- 0.4 per cent of Cherwell Creek.

The Isaac River has a catchment area of approximately 3400 km^2 at the confluence of Grosvenor Creek, and therefore, the catchment area reduced by the Project is in the order of 0.2 per cent. This represents a very small overall reduction in catchment area due to each of the watercourses.

It should be noted that predicted reduction in runoff will be less than simply the reduction in flows generated by the catchment captured. This is due to the overflows from sediment dams and controlled releases during large rainfall events.

Analysis of the potential impact of this reduced catchment on flow frequency and duration, was undertaken through scaling of the available flow record from the Burton Gorge gauge (130410A).

The daily historical flow record at the gauge 130410A was scaled relative to the catchment area of the Isaac River, just downstream of the Project site (at the confluence of Cherwell River 3400 km^2). The scaling of flows was also undertaken for this area, less the additional area captured by the surface water management system of 7 km^2. This was undertaken for flow thresholds of 0.5 m^3/s, 1 m^3/s, 3 m^3/s and 6 m^3/s. The number of days over the threshold were identified, as well as the duration of the flow over this threshold, commonly referred to as the spell duration.

Table 6-2 to **Table 6-5** illustrates the results of this assessment for flows greater than 1 m^3/s, but less than 3 m^3/s. The tables indicate that there are only very minor changes to the occurrences of higher or medium flows, and almost no change to the spell durations. This analysis is considered conservative as it does not account for controlled releases and overflows from the Projects clean water and sediment dams. As such the Project is considered unlikely to cause changes to the flow regime that would result in impacts to downstream users or the environment.

Table 6-2 Isaac River flow threshold changes

Month	Existing		With Project	
	Days of Flow	Average Flow Duration (Days)	Days of Flow	Average Flow Duration (Days)
Jan	55	2.07	54	2.07
Feb	69	2.88	69	2.88
Mar	32	2.28	32	2.28
Apr	23	5.74	23	5.74
May	24	2.50	24	2.50
Jun	11	2.27	11	2.27
Jul	2	1.50	2	1.50
Aug	4	1.25	4	1.25
Sep	4	2.00	4	2.00
Oct	12	1.25	12	1.25
Nov	40	1.55	40	1.55
Dec	33	1.27	33	1.27
Total	309	2.21	308	2.21

Table 6-3 Horse Creek flow threshold changes

Month	Existing		With Project	
	Days of Flow	Average Flow Duration (Days)	Days of Flow	Average Flow Duration (Days)
Jan	46	1.65	43	1.70
Feb	13	1.31	11	1.36
Mar	7	1.14	7	1.14
Apr	6	1.50	5	1.60
May	4	1.25	4	1.25
Jun	0	0.00	0	0.00
Jul	0	0.00	0	0.00
Aug	0	0.00	0	0.00
Sep	0	0.00	0	0.00
Oct	6	1.50	5	1.20
Nov	5	1.20	4	1.25
Dec	32	1.28	32	1.34
Total	119	0.90	111	0.90

Table 6-4 Grosvenor Creek flow threshold changes

Month	Existing		With Project	
	Days of Flow	Average Flow Duration (Days)	Days of Flow	Average Flow Duration (Days)
Jan	58	2.38	58	2.38
Feb	44	1.80	44	1.80
Mar	25	2.32	25	2.32
Apr	11	2.09	11	2.09
May	18	2.00	18	2.00
Jun	8	1.50	8	1.50
Jul	0	0.00	0	0.00
Aug	4	1.50	4	1.50
Sep	0	0.00	0	0.00
Oct	22	1.73	21	1.76
Nov	34	1.47	34	1.47
Dec	40	1.23	40	1.23
Total	264	1.50	263	1.50

Table 6-5 Cherwell Creek flow threshold changes

Month	Existing		With Project	
	Days of Flow	Average Flow Duration (Days)	Days of Flow	Average Flow Duration (Days)
Jan	59	2.24	60	2.27
Feb	44	1.91	44	1.91
Mar	24	2.33	24	2.33
Apr	11	1.91	11	1.91
May	18	2.06	19	2.26
Jun	9	1.67	9	1.67
Jul	0	0.00	0	0.00
Aug	3	1.33	3	1.33
Sep	0	0.00	0	0.00
Oct	20	1.75	20	1.75
Nov	33	1.33	33	1.33
Dec	42	1.29	42	1.29
Total	263	1.48	265	1.50

6.3 Water Quality Impacts and Mitigation Measures

The Project has the potential to impact on water quality and subsequently the downstream environment through construction and operation. Impacts on water quality and aquatic ecology are also discussed further in Horse Pit Extension Project Aquatic Ecology Assessment (ESP 2021). Changes to the flood regime, and the timing and magnitude of flows in watercourses, have the potential to impact on aquatic ecosystems by:

- influencing the success of the life cycles of aquatic species that have adapted to natural flow regimes and have evolved in response to natural variation (i.e. affecting cues for movement, migration and breeding);
- changing the diversity and structure of instream physical habitats, which can influence the composition of biotic communities;
- affecting water quality through changes to the flushing of water;
- increasing scouring and erosion of watercourses influences habitat conditions and further affects water quality;
- changing the variation in connectivity along the length of rivers and between rivers and floodplains, and
- decreasing the successful invasion of exotic and pest species.

6.3.1 Management Measures - Construction of Levees and Horse Creek Crossing

To manage the potential for decreased water quality during construction of the levees and Horse Creek Crossing, the following mitigation measures will be implemented:

- appropriate erosion and sediment control measures will be established as required to reduce the amount of runoff from disturbed areas in accordance with industry standards and guidelines;
- bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with AS1940:2004, and where practical, will be located away from any waterbodies;
- oil spill recovery equipment will be available when working adjacent to drainage channels with the ability to discharge off site. Spill kits will be located with construction crews conducting activities with the potential for significant spills. CVM existing SOP for spill management will be utilised;
- refuelling locations and handling of fuels shall be undertaken away from waterbodies;
- construction of the haul road crossing will occur over the dry season to minimise soil disturbance on adjacent waterways; and
- as soon as practical, disturbed areas will be rehabilitated to reduce the amount of exposed soils.

Additional construction mitigation measures specific to the levee construction and haul road crossings of waterways are provided in **Section 3.5**.

6.3.2 Operation Management Measures

The existing CVM controls to mitigate potential surface water impacts are considered appropriate to protect surface water quality and the downstream receiving environment.

- the existing Mine Water Management Plan (MWMP) will be amended progressively as required to incorporate modified and new water management infrastructure following construction;

- sediment dams, pit water storage and other water management structures (e.g. bunds and drains) will be designed and operated in accordance with BMA's standards and within the current framework specified in the existing site WMP;
- the Project's water management will be based on the separation and management of clean and MAW catchments;
- water capture within the Project's clean areas will be diverted around operational areas, and where practical, allowed to discharge off site as part of normal overland flow. The operation of the freshwater dam will minimise the impact of the flood levees on the natural flow regime for undisturbed and rehabilitated catchments behind the levees;
- disturbed areas within the Project site will be diverted to sediment dams for treatment, and possible reuse for dust suppression and process water requirements. This will maximise their storage capacity to reduce the risk of off-site discharges;
- the current REMP and associated water quality monitoring program will be continued. The program is designed to ensure the MWMP is effective, to demonstrate compliance with the Mine's strict discharge limits, and to ensure the downstream water quality (physico-chemical parameters, at a minimum) is not being adversely impacted;
- progressive rehabilitation will be undertaken as operational areas become available to reduce the amount of disturbed area. The freshwater dam will assist in the conveyance of runoff downstream where the flood levees are an impediment to this;
- fuel, dangerous goods and, hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements;
- the existing SOP for spills and emergency response procedures will continue to be utilised. Spill recovery and containment equipment will be available when working adjacent to sensitive drainage paths and within other areas, such as workshops; and
- The road crossing of the Horse Creek diversion will be managed in accordance with the measures outlined above for construction and operations. In addition to these, the erection of temporary waterway barriers during construction of any road crossings will include the provision to transfer flows from upstream of the works to the downstream channel without passing though the disturbed construction site.

Through implementing the above management strategies for surface water management, the risk of adverse impacts to the water quality of Horse Creek and the Isaac River downstream of the Project is insignificant.

6.3.3 Flood Levee Management Measures

The construction of the flood protection levees will be undertaken in accordance with the measures outlined above for construction and operations. In addition to this, the levees will be regulated structures and managed in accordance with the EA conditions for regulated structures. **Section 8** outlines these conditions. No changes are proposed to these conditions as part of this EA amendment.

6.3.4 Water Quality Monitoring

Water Quality monitoring will be conducted as part of the Project's EA conditions and in accordance with the REMP. As part of this EA amendment a controlled release regime is proposed as part of the Mine Water Management System, in accordance with the existing EA conditions.

6.4 Cumulative Impact Assessment

The existing approved Caval Ridge Mine has been integrated into the surface water assessment for the Project described in this report. Therefore, the cumulative impacts due to the Project and the Caval Ridge Mine have been accounted for in this assessment.

The results from this assessment indicate that the Project is able to manage surface water impacts such as flooding and mine water management in accordance with DEHP standards and guidelines. These guidelines set out conditions and thresholds such as downstream receiving water quality conditions, which are based on research undertaken into species tolerance and the potential for cumulative impacts from multiple mining releases.

The location of the weir on Horse Creek immediately downstream of the Project significantly alters the natural flow and flood regime, and restricts any impacts from propagating further downstream.

6.5 Climate Change

The Climate Change in Australia Climate Futures tool was reviewed for the Project area for the potential impacts to climate conditions over the life of mine (2045). The tool was reviewed for the RCP 8.5 emissions scenario, which represents a moderate emissions scenario. The available data indicated the majority of models (over 50%) indicated a small change to annual rainfalls (-5% to 5%), with 25% of the models predicting that conditions would become drier than current conditions (up to 15%).

The potential influence of climate change supports the Project's proposed water management system, which incorporates both a controlled release and a number of sediment dams, which allow water to overflow downstream, thereby, minimising the Project's impact on downstream users and the environment.

The probabilistic rainfall accounts for the potential uncertainty in the current climate and does not allow for climate change. However, the probabilistic modelling does indicate the ability of the system to manage climate extremes and the probability of these occurring within the life of mine based on historically observed data. The modelling indicates the robustness of the system to cope with these climate extremes, although it is acknowledged that these may become more frequent with the effects of climate change.

6.6 Impact and Mitigation Assessment Summary

The impact assessment indicates that impacts associated with the Project are expected to be insignificant and contained within the ML 1775. Management and monitoring measures are also proposed and are currently part of the Project's EA or will be conditioned as part of this EA amendment. This is discussed further in **Section 8.**

7 Rehabilitation and Final Void Assessment

7.1 Flooding

Assessment of flood behaviour for the final landform was undertaken for the 0.1% AEP event, and is illustrated in **Figure 7-1**. As shown, results of the modelling indicate that the proposed final landform will provide flood immunity for the final void in 0.1% AEP event.

Management of voids in the floodplain is legislated under the EP Act. The legislative requirement of the EP Act states

"If land the subject of the proposed PRCP schedule will contain a void situated wholly or partly in a flood plain, the schedule must provide for the rehabilitation of the land to a stable condition."

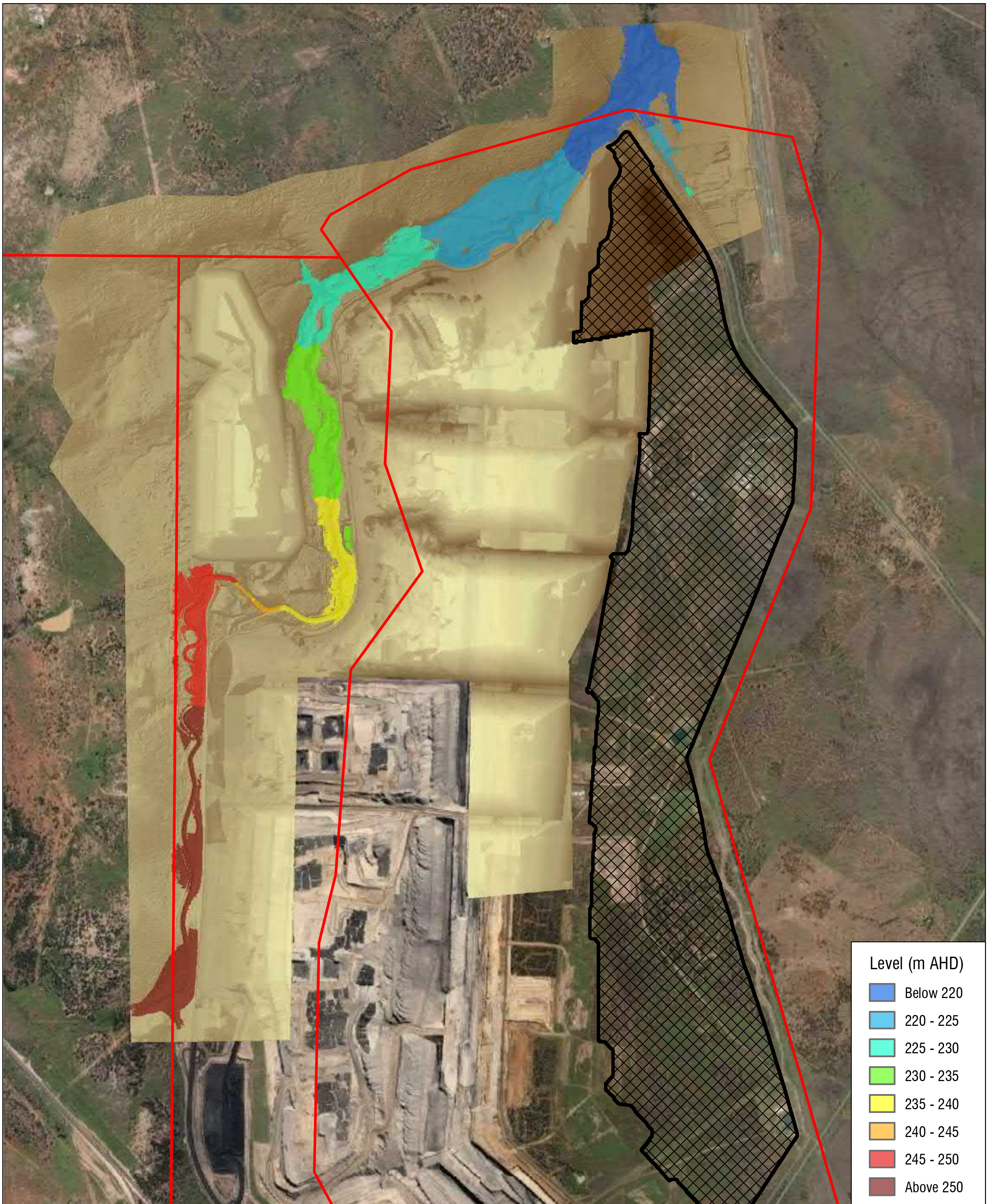
The EP Regulation 2019 (Section 41C (3) provides further details:

"The administering authority must treat the land as a flood plain to the extent the results of the flood plain modelling show that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the level modelled as the peak water level 0.1% AEP for a relevant watercourse under the ARR"

Horse Creek is identified as a Strahler Order 2/3 waterway, with Grosvenor Creek identified as an order 5 waterway. Although Horse Creek is not a Strahler Order 4 waterway, conservatively the assessment of the void with regard to the extent of the 0.1% AEP flood has been carried out.

The final landform shows the removal of the Horse Creek levees, with the final landform forming part of the Horse Creek floodplain. The final landform includes areas of raised ground, which act as bunding for the final void from the 0.1% AEP event. These bunds are very stable, rising to 10-20 min height over a length of 1 km, with top widths of approximately 50 m. These areas will be well vegetated to prevent erosion and to mitigate the potential for increased sediment load downstream.

The final landform will be assessed as part of the site closure planning. This will include assessment of the structural integrity of the bund surrounding the void, and monitoring of erosion and water quality. The mining lease will not be relinquished until the final landform and associated bunds are deemed to be stable and suitable for relinquishment.



Projection: GDA 1994 MGA Zone 55
Scale: 1:35,000 at A4

Project No.: 620.13593
Date: 11-Jun-2021
Drawn by: PM

SLR BHP
www.slrconsulting.com

Horse Pit Extension Project

Final Landform Flood Extent
Peak Flood Levels - 0.1% AEP

FIGURE 7-1

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\62013593_F7-1_Final_Landform_1000y_v3.mxd

7.2 Water Balance Modelling

Mining will continue to the east, and mined-out areas in the west will be progressively back-filled and rehabilitated when practical. A final void will remain in the far east of ML 1775 at the conclusion of mining. The final void will comprise approximately 643 ha (at the crest) to a depth of approximately 125 m.

The primary objective of the spoil dumping strategy for the Project is to backfill the void where practical to reduce the final void area remaining at end of the Project life. A new OOPD is proposed to the north-west of Horse Pit on ML 70403, which is considered to be a future elevated landform. The OOPD is required from FY2028 due to space constraints within the existing IPDs.

The modelling involved an iterative process between ground and surface water modelling. Groundwater inflows to the GoldSim void water balance model were determined from the groundwater flux curve, provided from the Groundwater Impact Study (SLR, 2021).

The model was simulated for a 100 year period and the resulting water level from the GoldSim model calculated. The groundwater model was then simulated for the resulting pit lake levels. The iterative modelling found the predicted groundwater inflow rate would be 0.18 ML/d, with a final water level of 120 m AHD, or approximately 25 m of depth in the final void.

The salinity of the final void was also modelled to examine the impacts of the effects of evaporation and groundwater inflows on void water quality. The salinity of the final void is predicted to increase significantly post closure due to the constant inflow from highly saline groundwater at 11000 µs/cm. The predicted salinity values increase in excess of 35,000 µs/cm over 100 years post closure. The CVM Progressive Rehabilitation Closure Plan (PRCP) will incorporate management measures to reduce the impacts of the final void water quality on the environment and any potential water users.

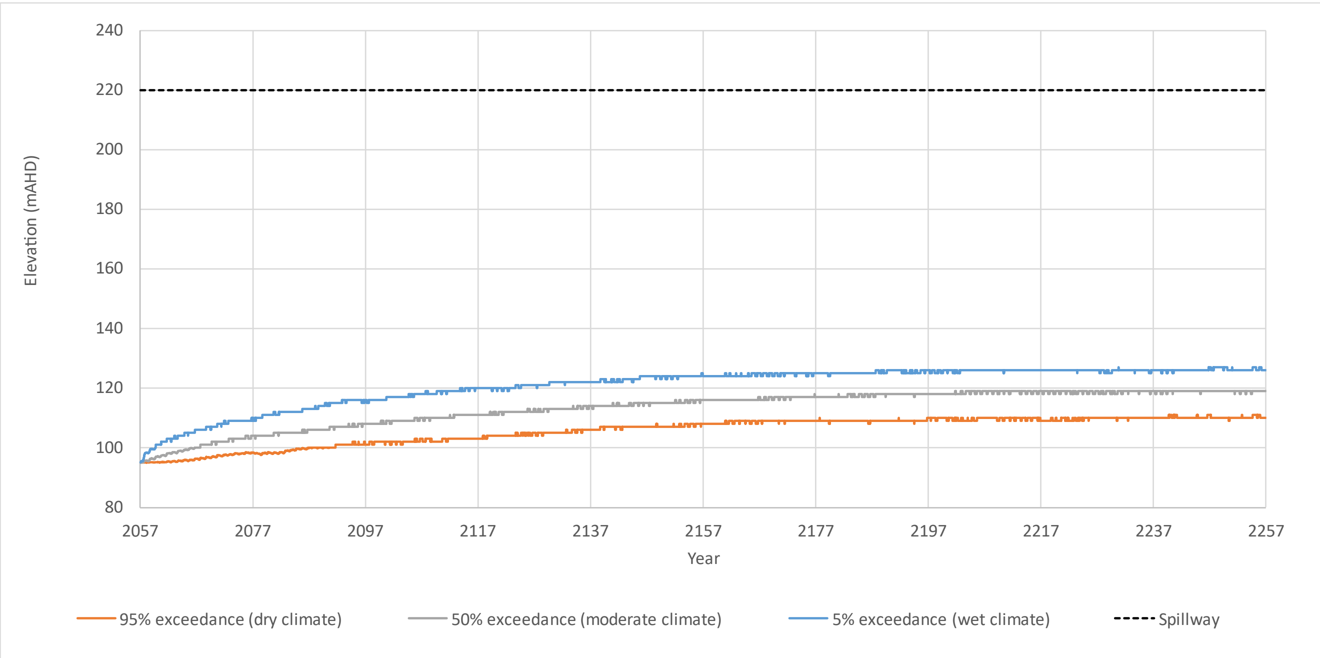


Figure 7-2 Final void water level

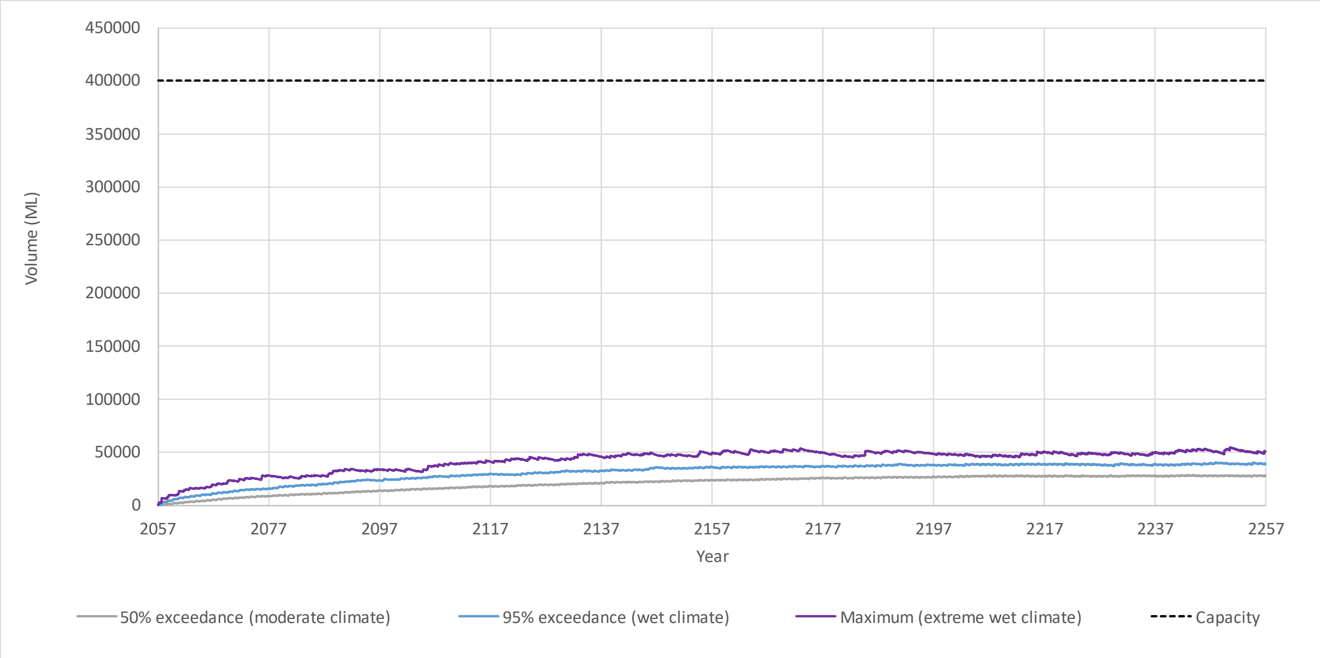


Figure 7-3 Final void volume

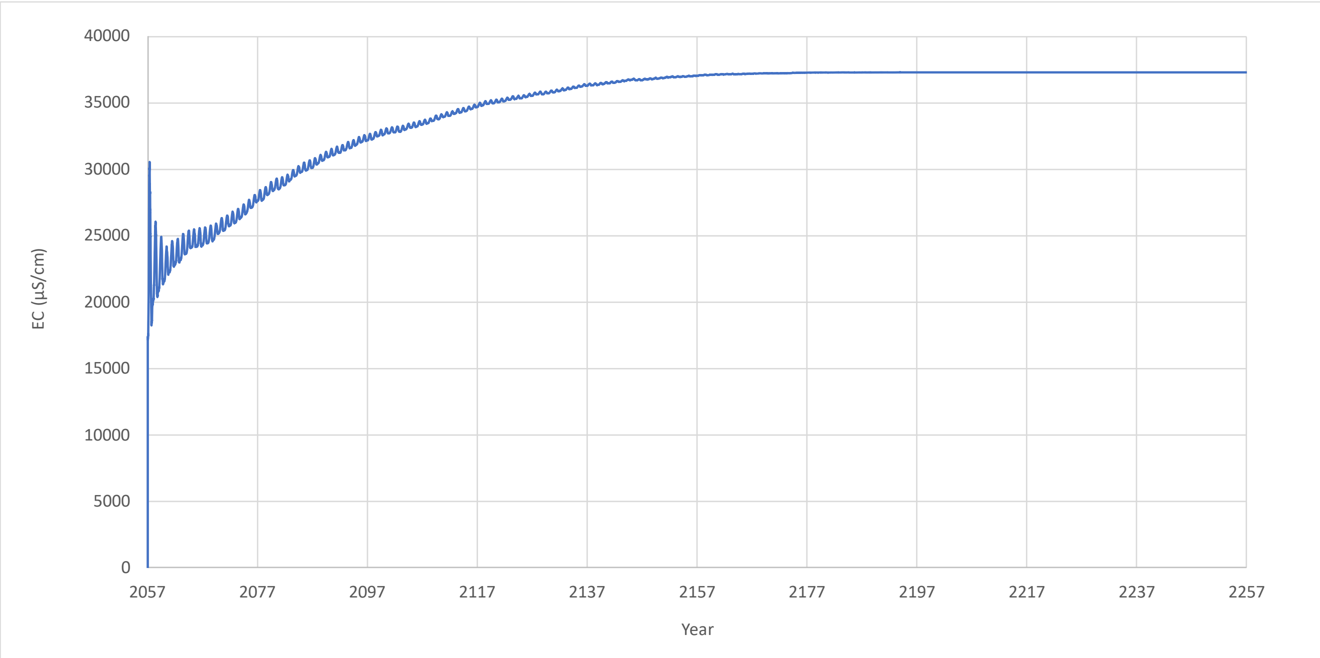


Figure 7-4 Final void water quality

8 Surface Water Resources Summary

The key surface water issues for the Project are the potential impacts on:

- flooding, flows and water quality through the construction and operation of the Horse Pit North and Horse Pit West levees to protect the pit from the ingress of water from Horse Creek during a flood event;
- receiving water quality through the capture, use and release of water captured within the mining lease as part of the site water management system; and
- flooding and flows from the proposed final landform.

The surface water impact assessment identified the following:

- the proposed infrastructure achieves the 0.1% AEP flood immunity as required by industry guidelines through the use of two (2) flood levees for Horse Creek. This flood immunity is able to be achieved with minimal impacts on flood behaviour. Impacts are limited to the immediate project vicinity;
- the results of the water balance modelling demonstrate the ability of the Project’s proposed water management infrastructure to manage mine water. The results indicate the water management system’s ability to manage water in accordance with the current EA conditions as well as support the Project’s water requirements; and
- the final landform is free draining and designed to be a stable landform in a PMFDF flood event.

The existing CVM surface water management measures are suitable to mitigate potential water quality impacts. Some specific management measures have been identified for the construction of the levees and Horse Creek Crossing. The management and mitigation measures are conditioned in the existing CVM EA through elements such as the Water Management Plan, REMP, Sediment and Erosion Control Plans and Regulated Structures Design and Inspection Conditions.

The Project does not require amendments to the conditions outlined in Schedule F – Water EA conditions (EPML00562013) and Schedule G – Structures.

9 References

ACARP. 2002. *Bowen Basin River Diversions Design and Rehabilitation Criteria*, Appendix E - Bowen Basin Hydrology Report. Australian Coal Association Research Program, Project No. 9068.

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian Water Association. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

Boughton, W. C., 2004, The Australian water balance model.

Boughton, W. C., 2009, Selecting parameter values for the AWBM daily rainfall-runoff model for use on ungauged catchments.

Bureau of Meteorology (BOM) (2019a), Climate Data Online, available from: <http://www.bom.gov.au>, accessed November 2020.

BOM, (2019b). Rainfall Intensity-Frequency-Duration Data System. Available from < <http://www.bom.gov.au/water/designRainfalls/revised-ifd/>accessed November 2020.

Department of Environment and Heritage Protection (DEHP) 2019 Structures which are dams or levees constructed as part of environmentally relevant activities, ESR/2016/1934 Version 9.00 Effective: 01 April 2019

DEHP (2016) Manual for Assessing Hazard Categories and Hydraulic Performance of Dams EM635 Version 5, DEHP, March 2016.

DEHP. 2014. Stormwater Guideline: Environmentally Relevant Activities. Brisbane: Department of Environment and Heritage Protection Government

DEHP (2013a) Model water conditions for coal mines in the Fitzroy basin ESR/2015/1561 Version 3.01 Effective: 31 March 2013

DEHP (2013b), Queensland Water Quality Guidelines 2009

Department of Environment and Science (DES) (2019a) Environmental Authority No. EPML00562013 – Caval Ridge Mine.

Department of Environment and Science (DES) (2011) Environmental Protection (Water) Policy 2009 Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part) including all waters of the Isaac River Sub-basin (including Connors River), Queensland Government, Brisbane.

DES (2009) Environmental Protection (Water) Policy 2009 (EPP (Water))

Department of Natural Resources, Mines and Energy (DNRME) Water Monitoring Information Portal (WMIP) Streamflow Data <https://water-monitoring.information.qld.gov.au/>, available from, accessed November 2020

DNRME (2019) Guideline: Works that interfere with water in a watercourse for a resource activity—watercourse diversions authorised under the Water Act 2000 OSW/2019/4599 Version 2.00 05/02/2019

Department of Science, Information Technology and Innovation (DSITI) (2019), SILO Data Drill, Queensland Government. Retrieved from https://www.longpaddock.qld.gov.au/silo/ November 2020.

Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) (2018), Information guidelines for proponents preparing coal seam gas and large coal mining development proposals, Commonwealth of Australia, Canberra.

International Erosion Control Association (Australasia), November 2008, Best Practice Erosion and Sediment Control.

Nanson G.C & JC Crook 1992 A generic classification of floodplains Geomorphology 4: 459-489

Queensland Government, 2017. Water entitlements – Attributes for active water licences, and Attributes for active water permits, accessed September 2019

Queensland Government Mineral, Water and Other Legislation Amendment (MWOLA) Act 2018

Queensland Government, 2000. Water Act 2000, current as at 3 July 2017 – revised version

Queensland Government, 1994. Environmental Protection Act 1994 (EP Act)

Rahman, A. et. al (2009). Australian Rainfall and Runoff - Revision Projects - Project 5: Regional Flood Methods. P5/S1/003. University of Western Sydney, Sydney, NSW

APPENDIX A

Horse Creek Cross-sections and Photographs

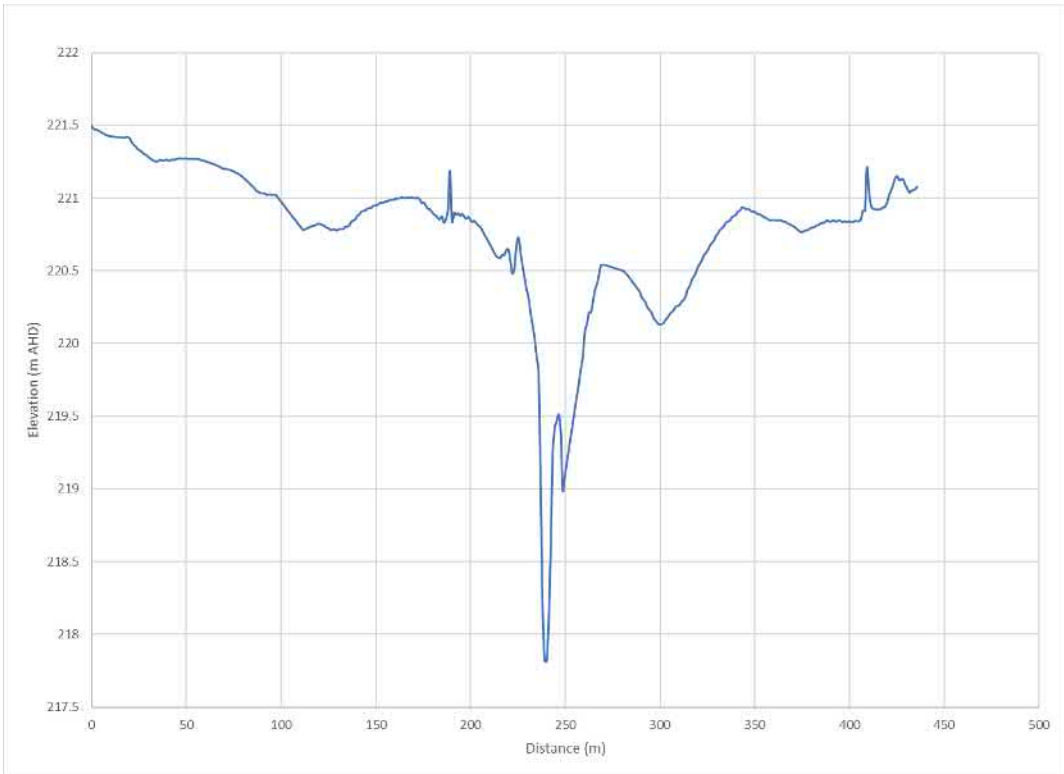


Figure A1 Horse Creek (upstream)

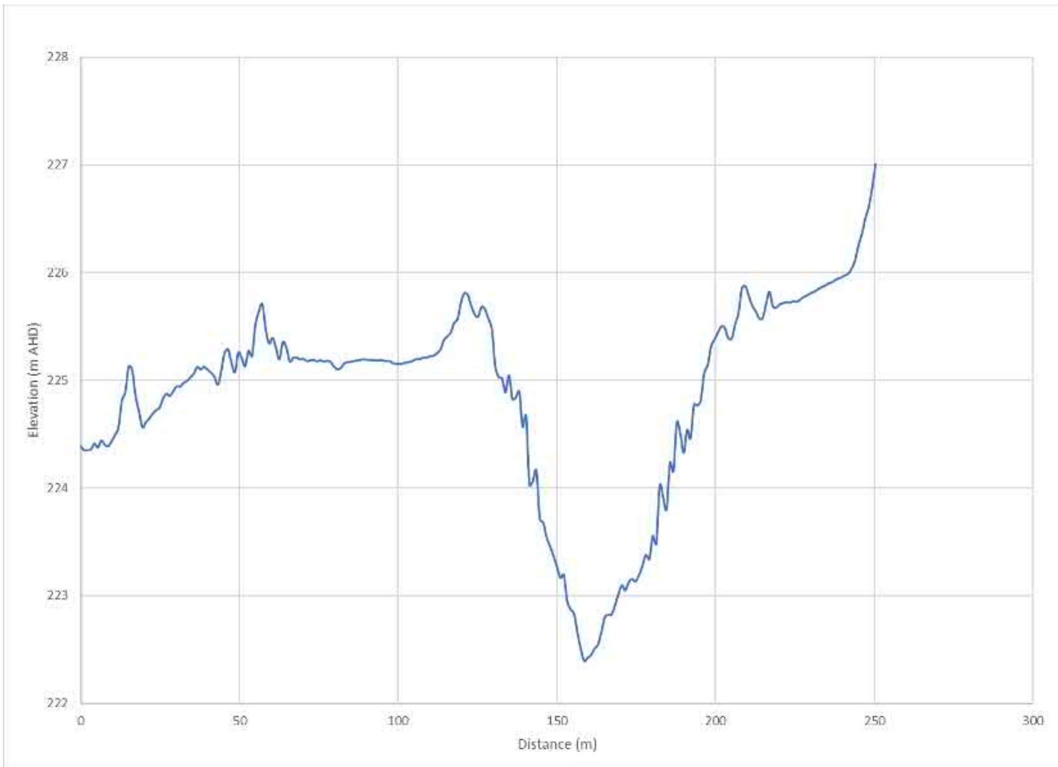


Figure 2 Horse Creek (north of existing pit)

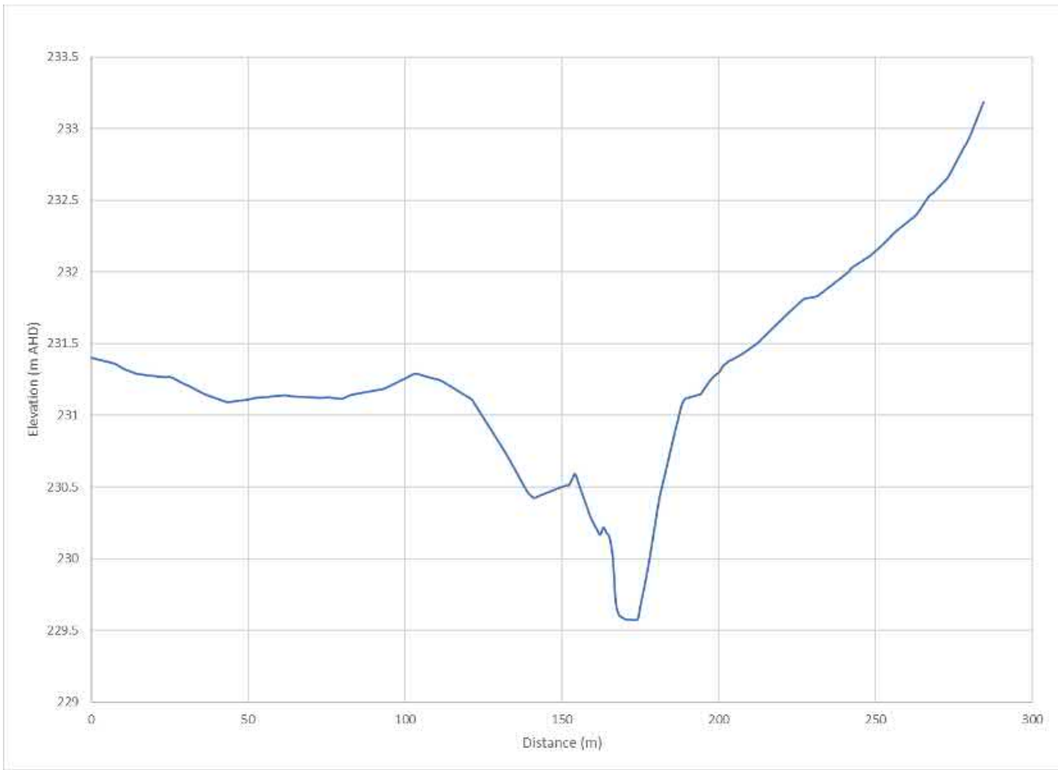


Figure 3 Horse Creek – (north of existing pit)

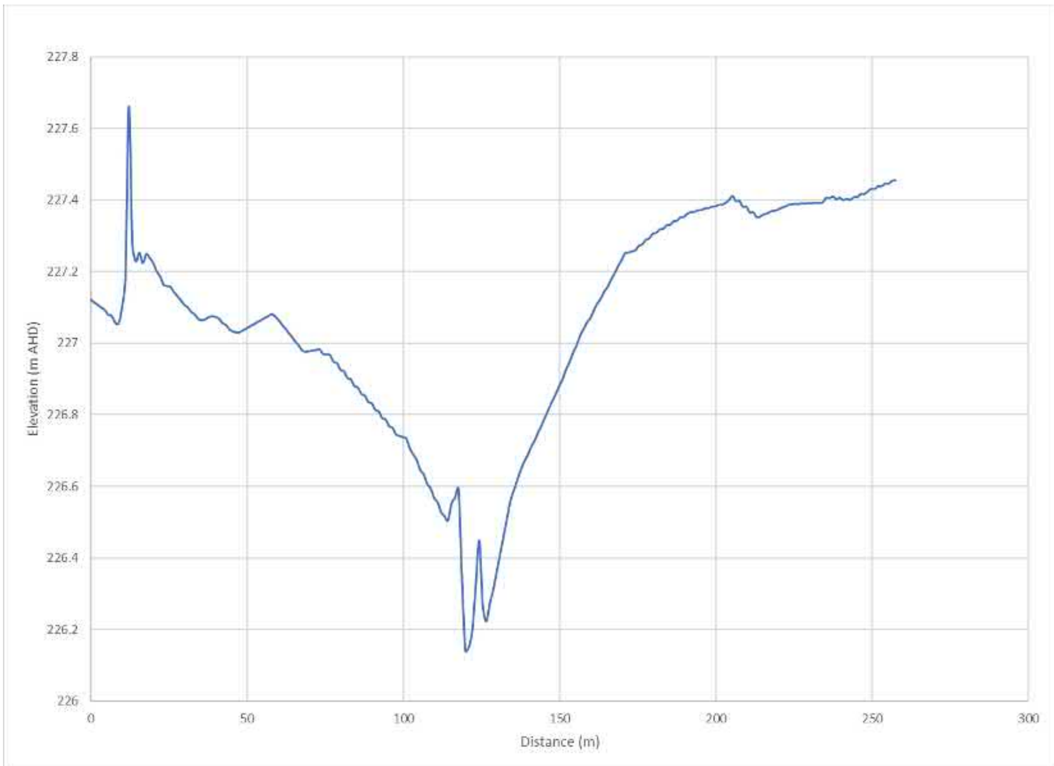


Figure 4 Tributary of Horse Creek

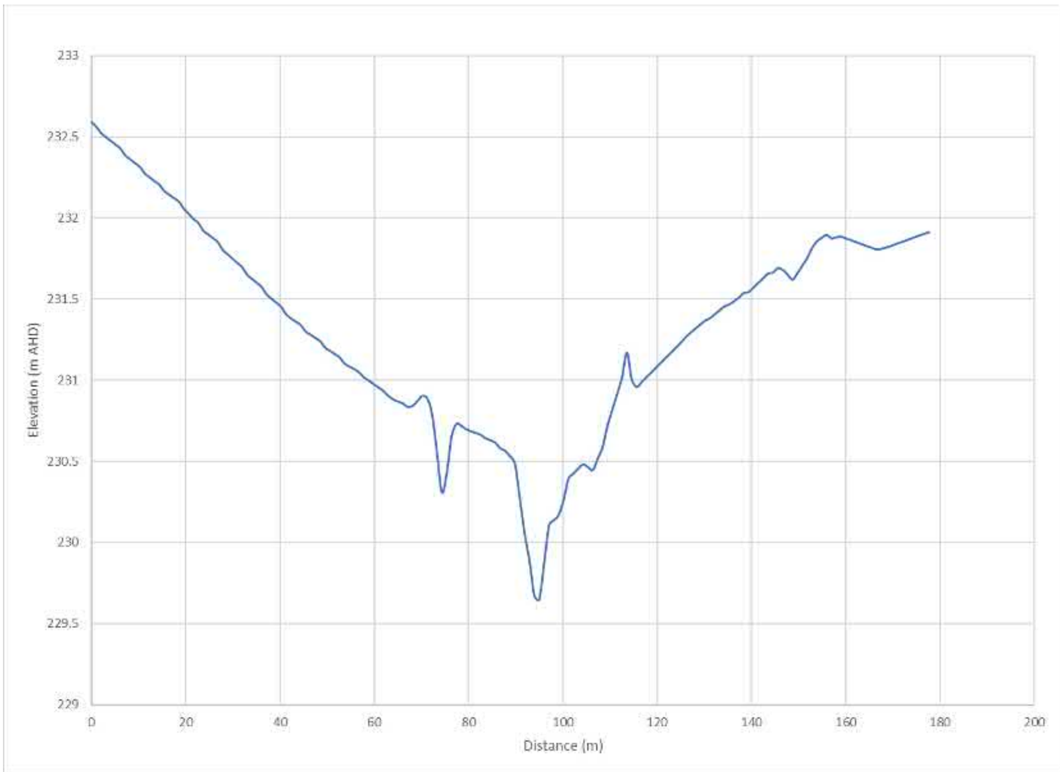


Figure 5 Tributary of Horse Creek

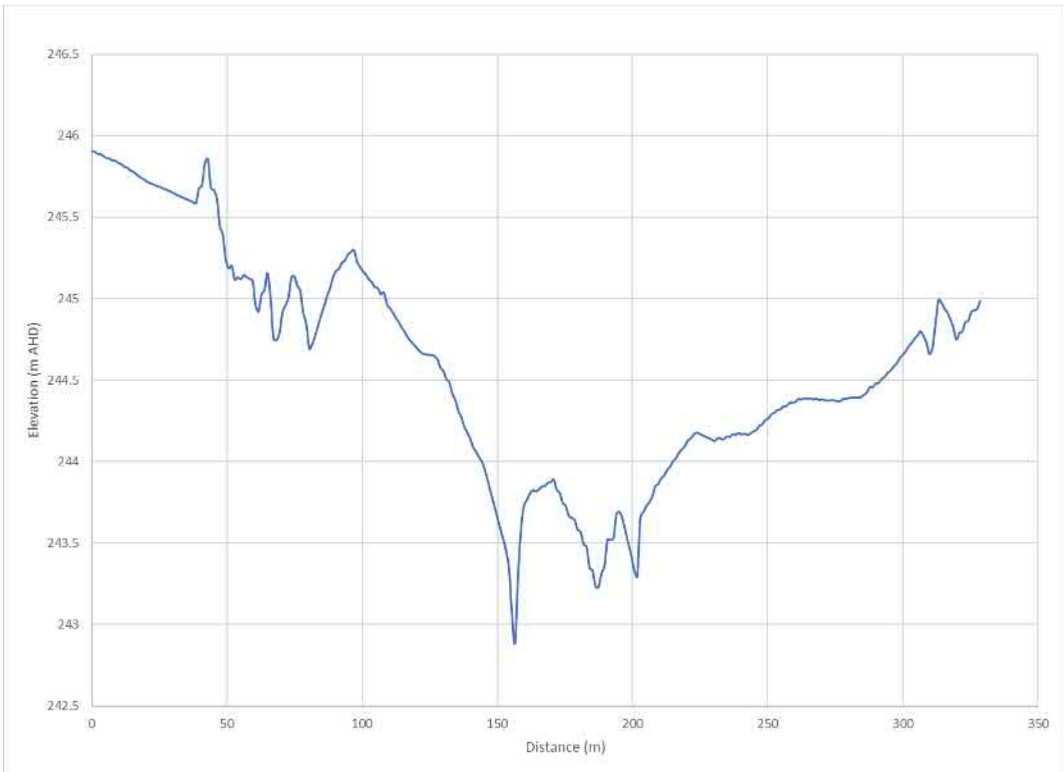


Figure 6 Tributary of Cherwell Creek

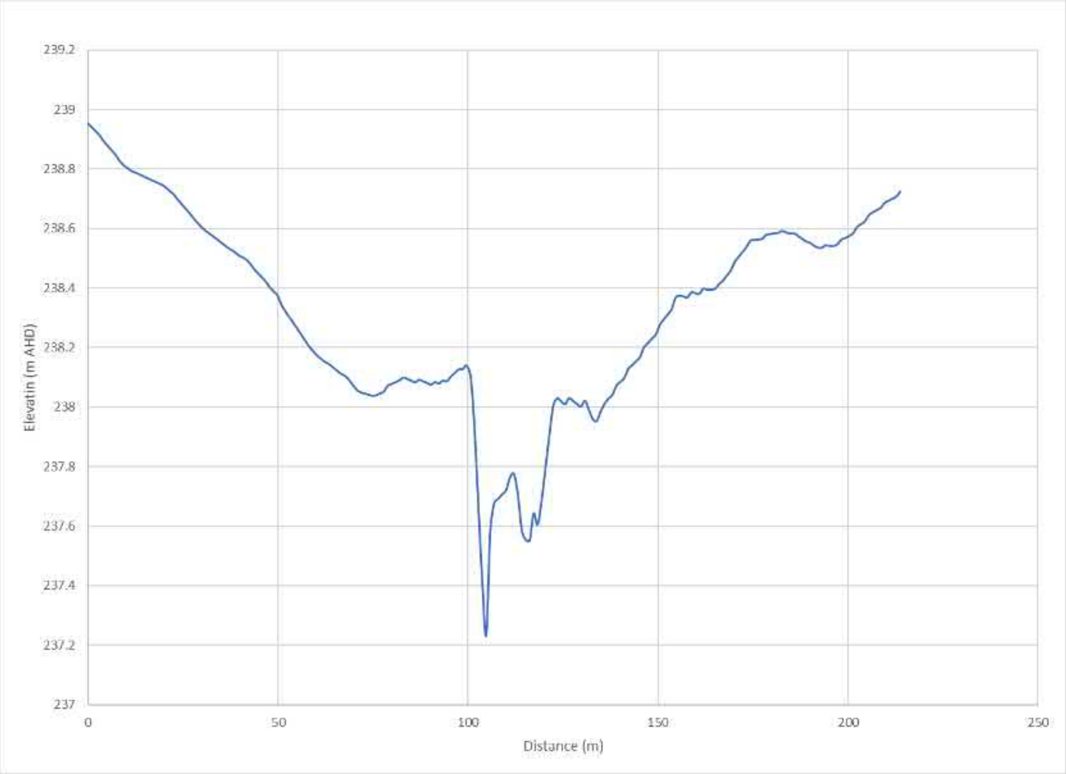


Figure 7 Tributary of Cherwell Creek

Photo 1 SW01 – Upstream

Photo 2 SW01 – Downstream

Photo 3 SW01 – Left Bank

Photo 4 SW01 – Right Bank

Photo 5 SW01 – Low Flow Channel

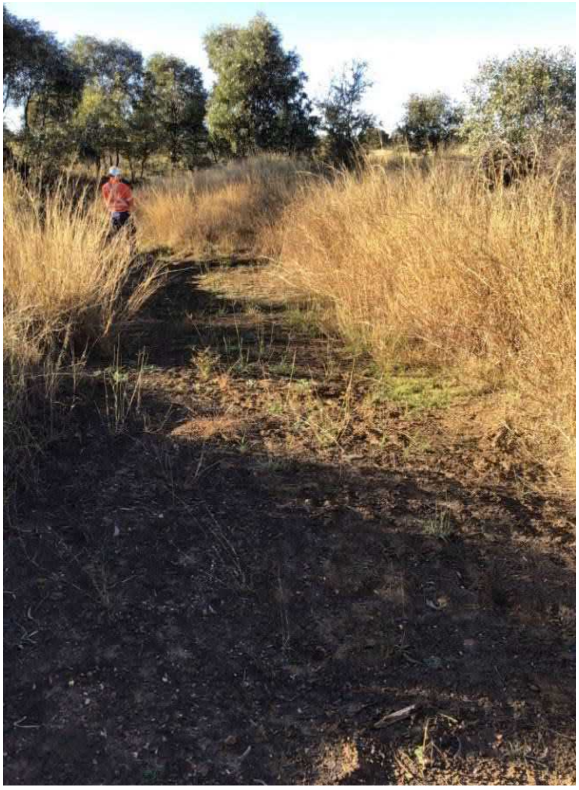


Photo 6 SW02 – Upstream

Photo 7 SW02 – Downstream

Photo 8 SW02 – Left Bank

Photo 9 SW02 – Right Bank

Photo 10 SW02 – Low Flow Channel

Photo 11 SW03 – Upstream

Photo 12 SW03 – Downstream

Photo 13 SW03 – Left Bank

Photo 14 SW03 – Right Bank

Photo 15 SW03 – Low Flow Channel

Photo 16 SW04 – Upstream

Photo 17 SW04 – Downstream

Photo 18 SW04 – Left Bank

Photo 19 SW04 – Right Bank

Photo 20 SW04 – Low Flow Channel

Photo 21 SW05 – Upstream

Photo 22 SW05 – Downstream

Photo 23 SW05 – Left Bank

Photo 24 SW05 – Right Bank

Photo 25 SW05 – Low Flow Channel

Photo 26 SW06 – Upstream

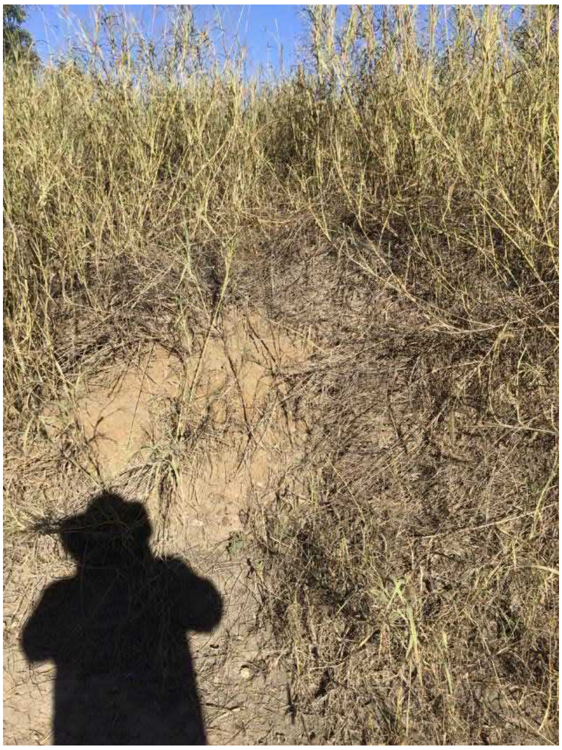


Photo 27 SW06 – Downstream

Photo 28 SW06 – Left Bank

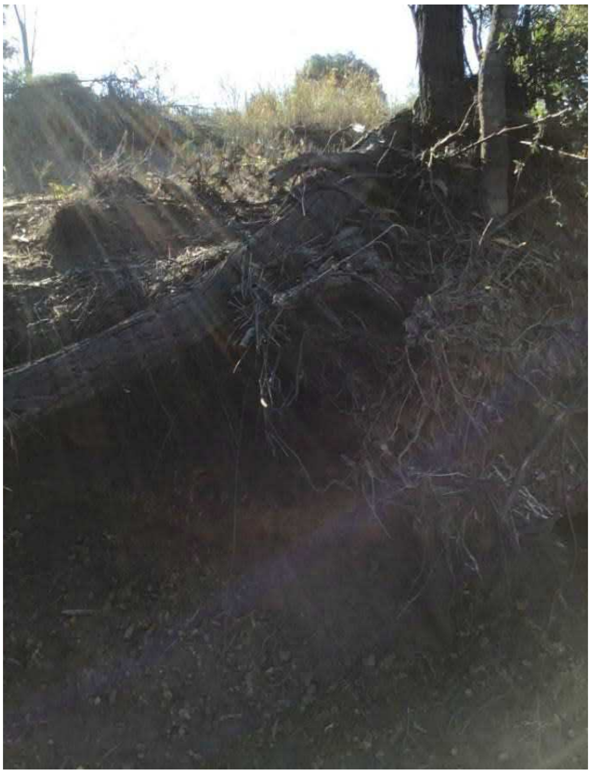


Photo 29 SW06 – Right Bank

Photo 30 SW06 – Low Flow Channel

Photo 31 SW07 – Upstream

Photo 32 SW07 – Downstream

Photo 33 SW07 – Left Bank

Photo 34 SW07 – right Bank

Photo 35 SW07 – Low Flow Channel

Photo 36 SW08 – Upstream

Photo 37 SW08 – Downstream

Photo 38 SW08 – Left Bank

Photo 39 SW08 – Right Bank

Photo 40 SW08 – Low Flow Channel

Photo 41 SW09 – Upstream

Photo 42 SW09 – Downstream

Photo 43 SW09 – Left Bank

Photo 44 SW09 – Right Bank

Photo 45 SW09 – Low Flow Channel

Photo 46 SW10 – Upstream

Photo 47 SW10 – Downstream

Photo 48 SW10 – Left Bank

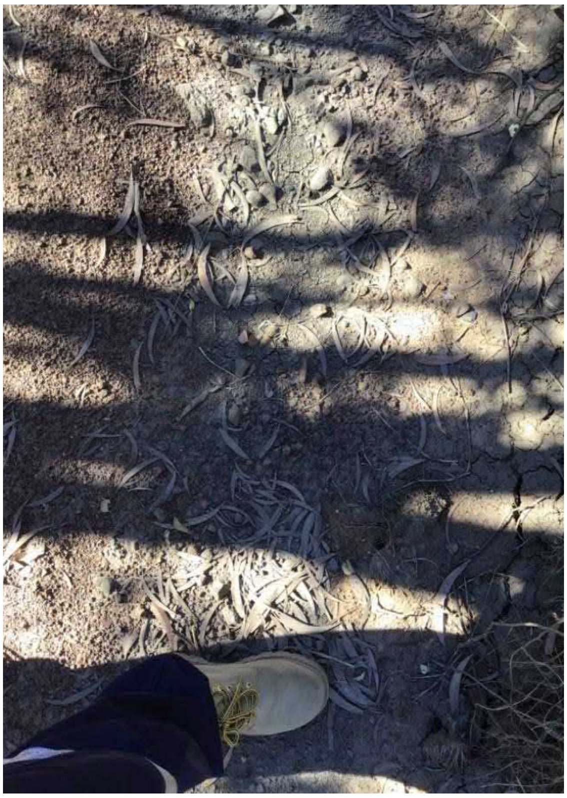


Photo 49 SW10 – Right Bank

Photo 50 SW10 – Low Flow Channel

Photo 51 SW11 – Upstream

Photo 52 SW11 – Downstream

Photo 53 SW11 – Left Bank

Photo 54 SW11 – Right Bank

Photo 55 SW11 – Low Flow Channel

Photo 56 SW12 – Upstream

Photo 57 SW12 – Downstream

Photo 58 SW12 – Left Bank

Photo 59 SW12 – Right Bank

Photo 60 SW12 – Low Flow Channel

Photo 61 SW13 – Upstream

Photo 62 SW13 – Downstream

Photo 63 SW13 – Left Bank

Photo 64 SW13 – Right Bank

Photo 65 SW13 – Low Flow Channel

Photo 66 SW14 – Upstream

Photo 67 SW14 – Downstream

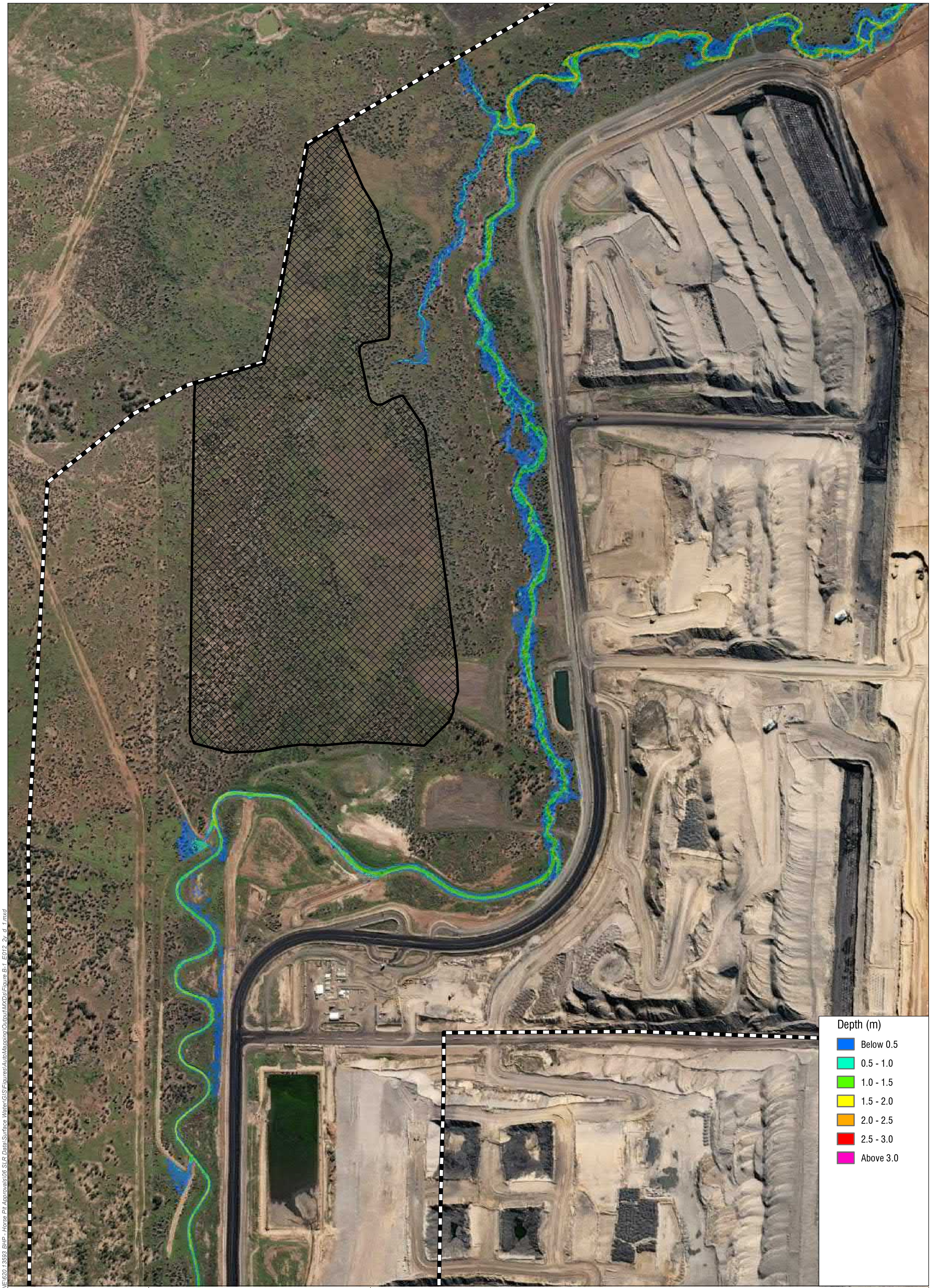
Photo 68 SW14 – Left Bank

Photo 69 SW14 – Right Bank

Photo 70 SW14 – Low Flow Channel

APPENDIX B

Flood Model Results



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Legend

Proposed Waste Rock Dump

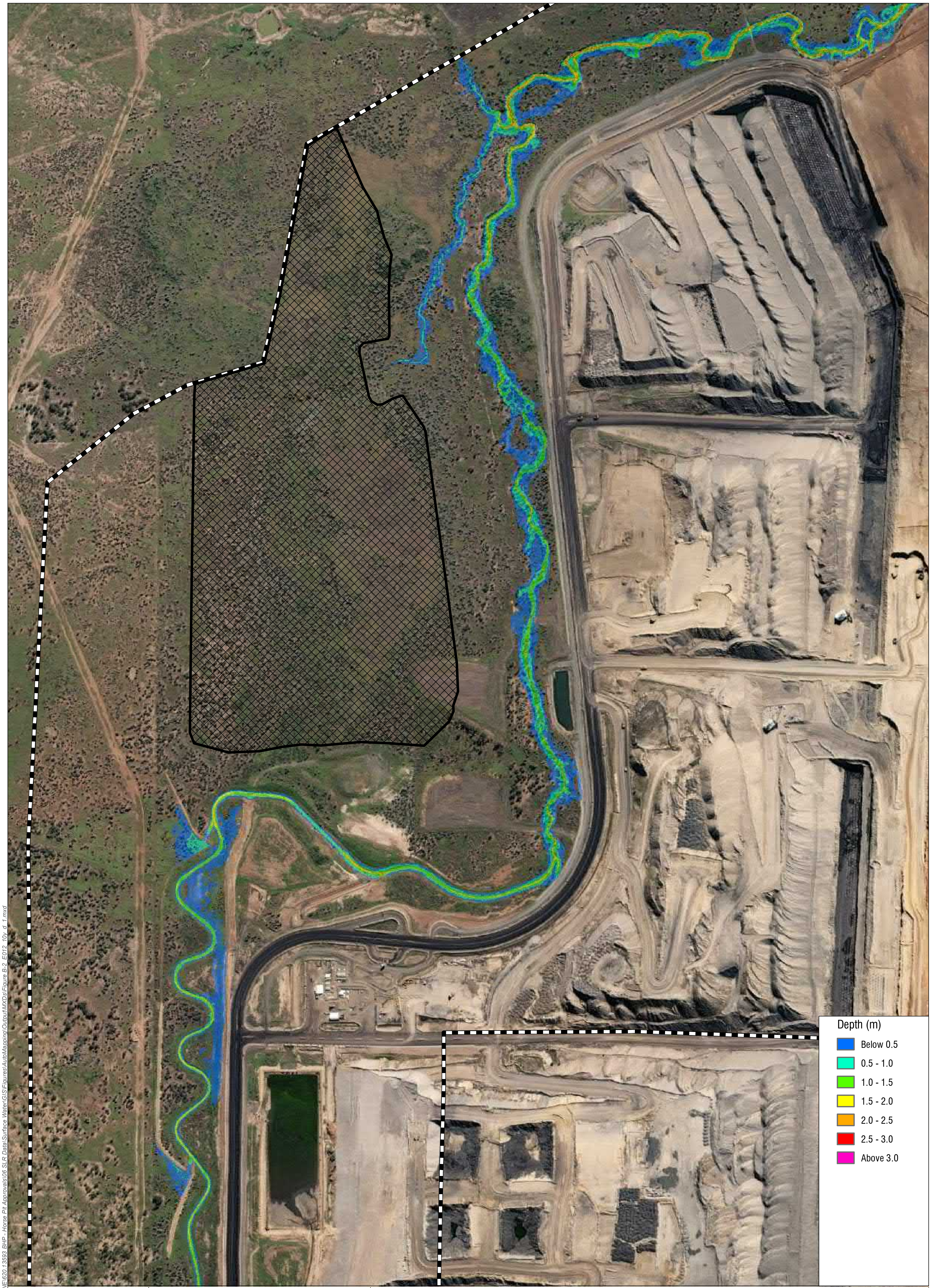
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 50% AEP

Figure B-1

SLR



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Legend

Proposed Waste Rock Dump

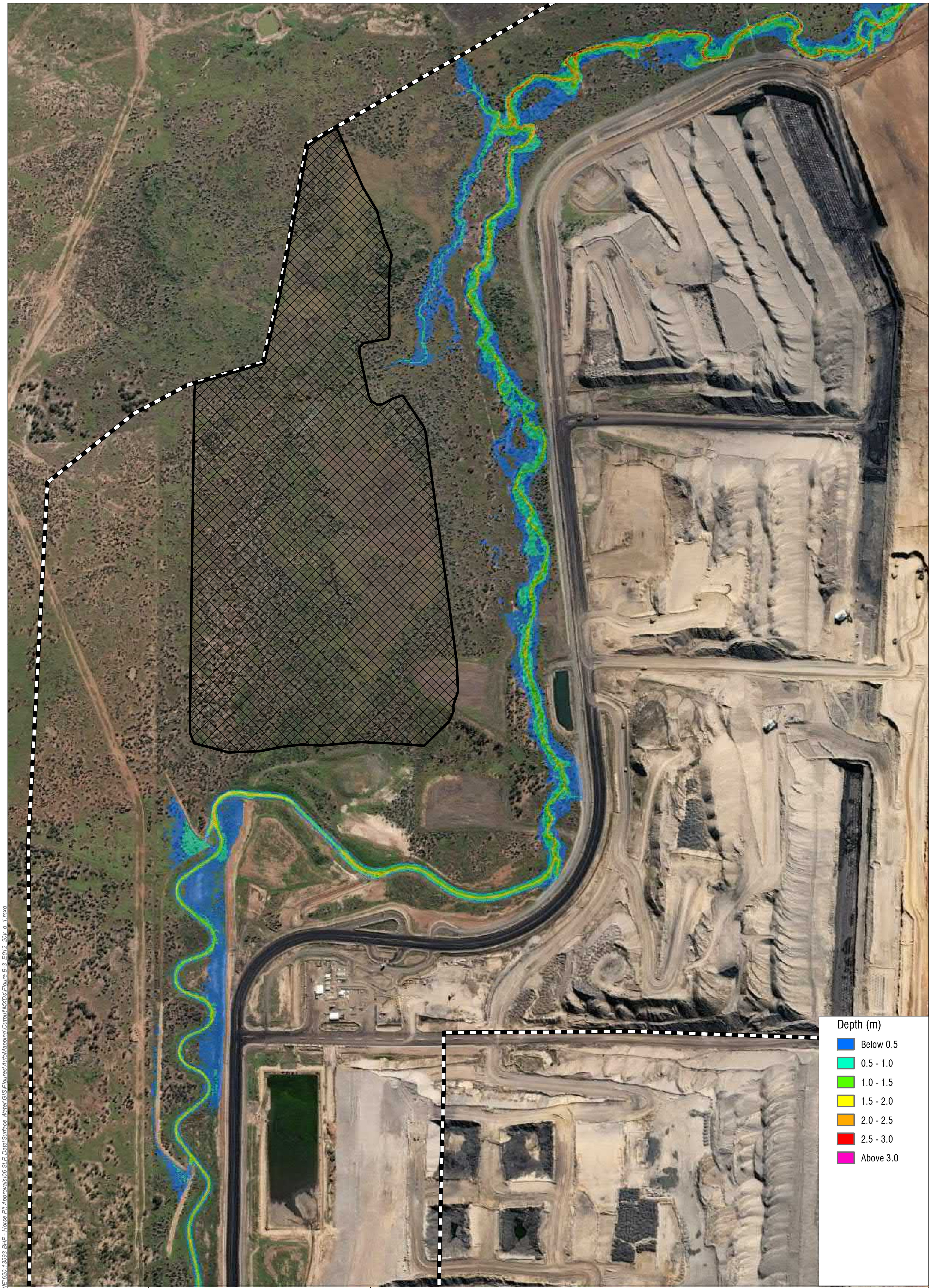
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 10% AEP

Figure B-2

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-2_E012_10y_d_1.mxd



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Legend

Proposed Waste Rock Dump

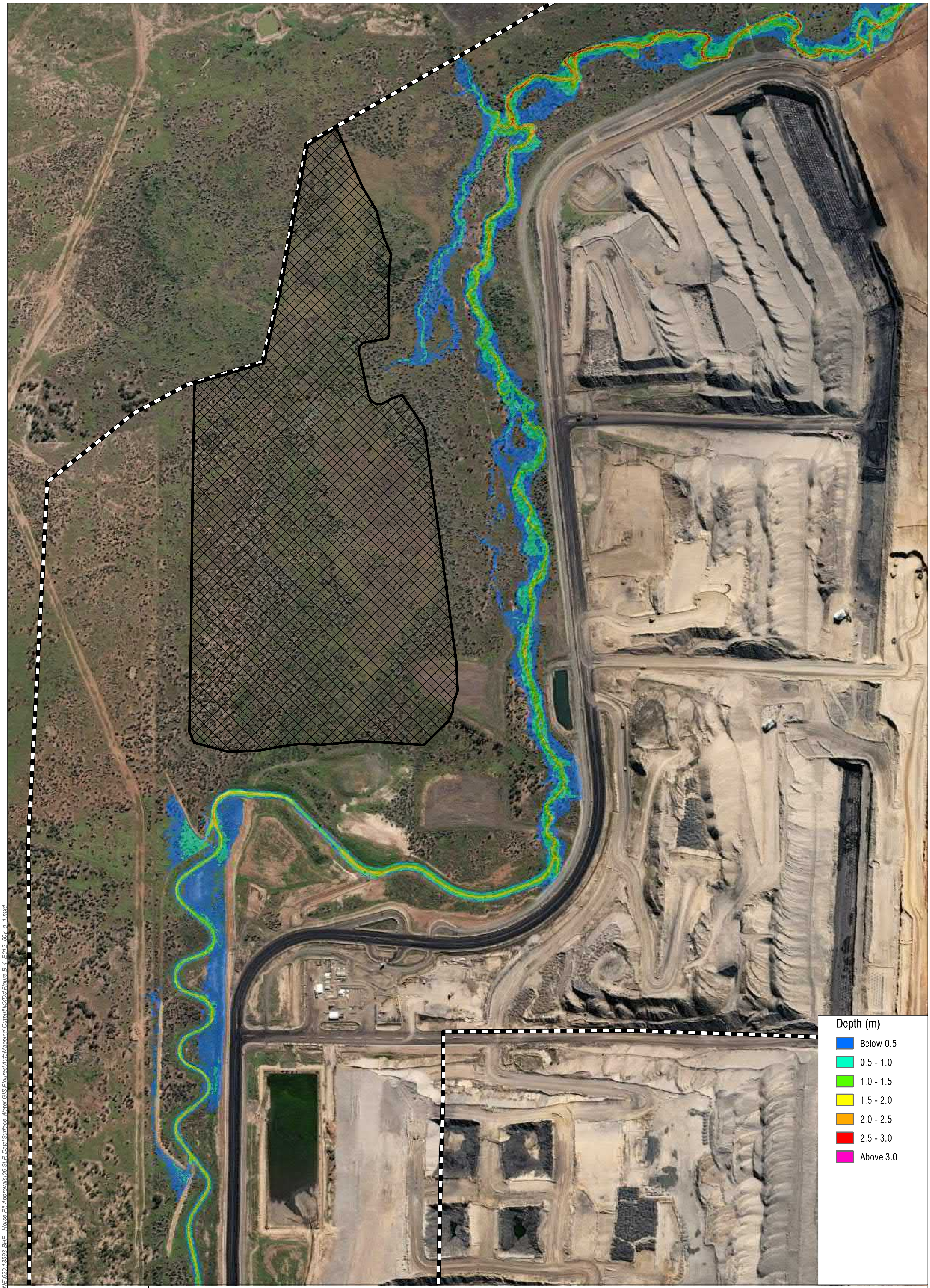
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 5% AEP

Figure B-3

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-3_E012_20y_d_1.mxd



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Proposed Waste Rock Dump

TUFLOW Model Extent

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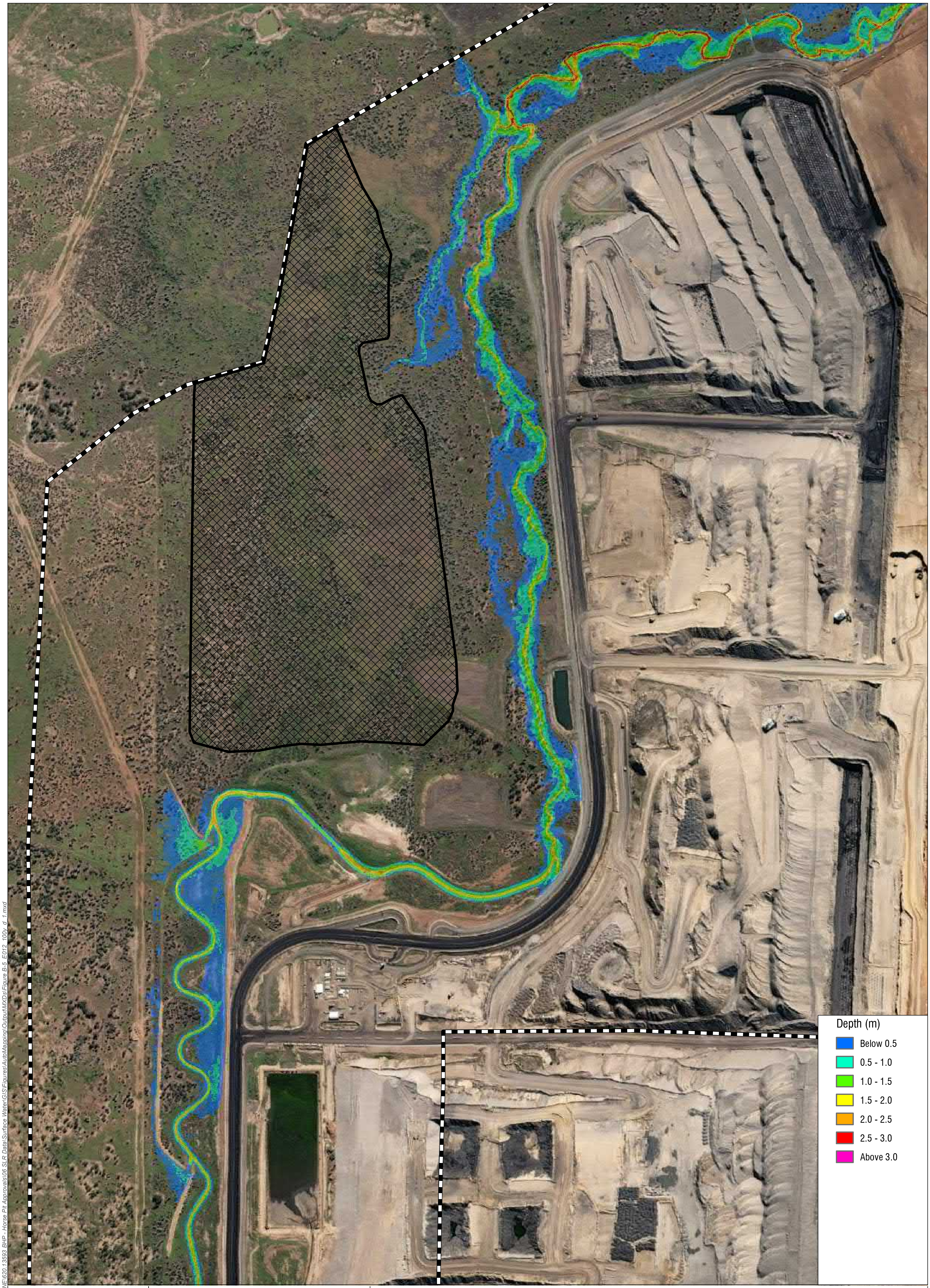
Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 2% AEP

Figure B-4



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Legend

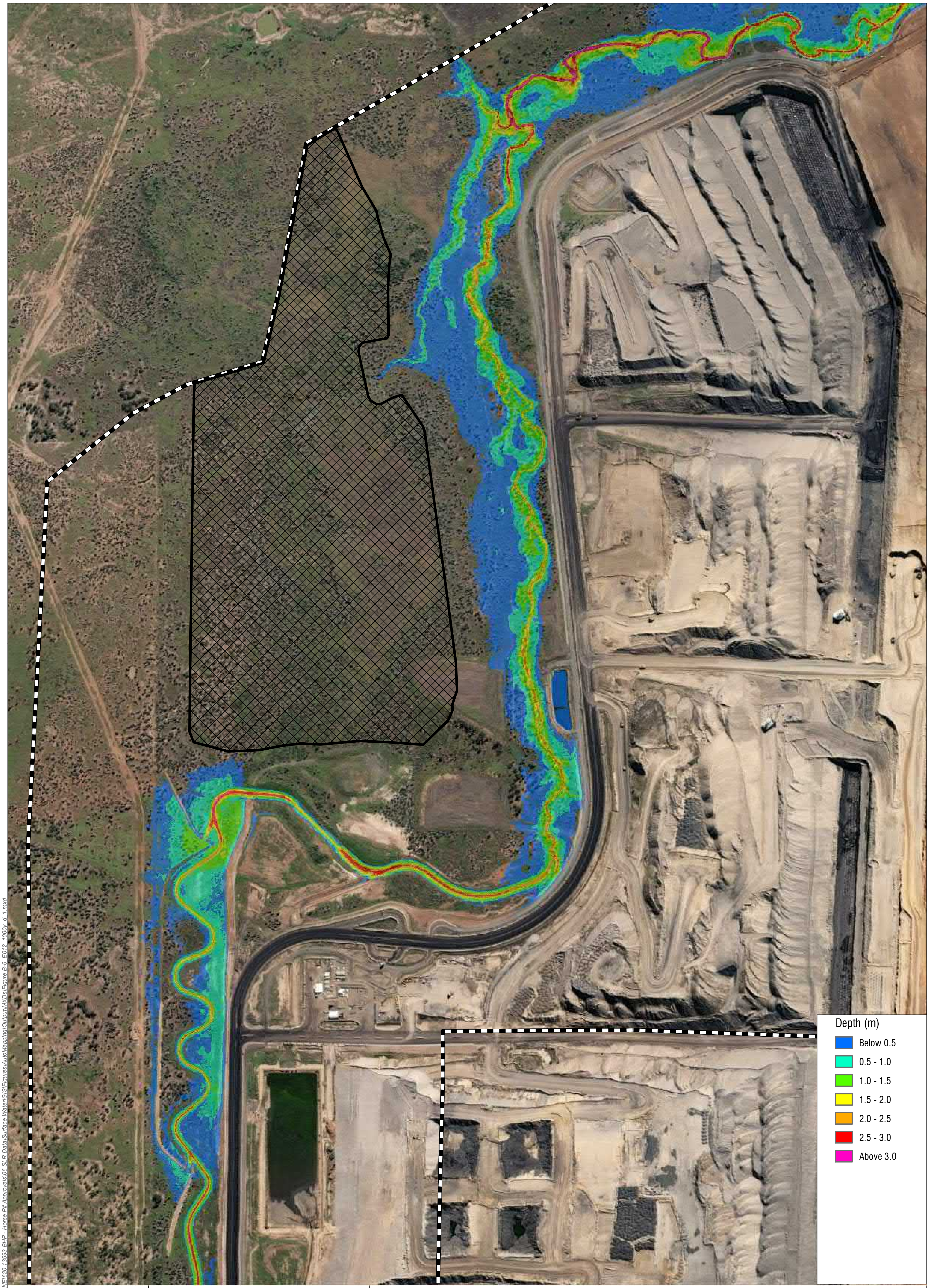
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 1% AEP

Figure B-5



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Legend

Proposed Waste Rock Dump

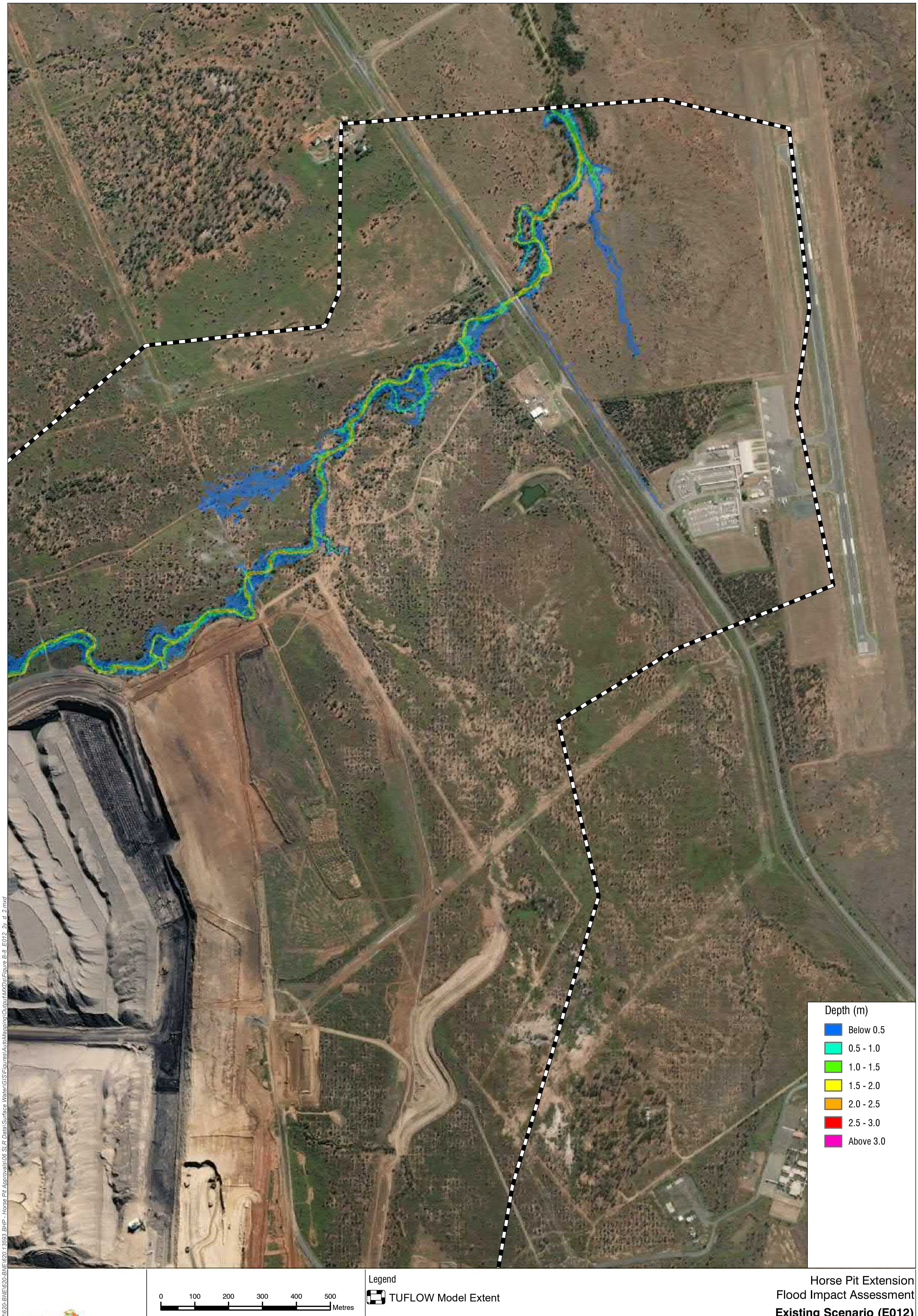
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 0.1% AEP

Figure B-6

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-6_E012_1000y_d_1.mxd



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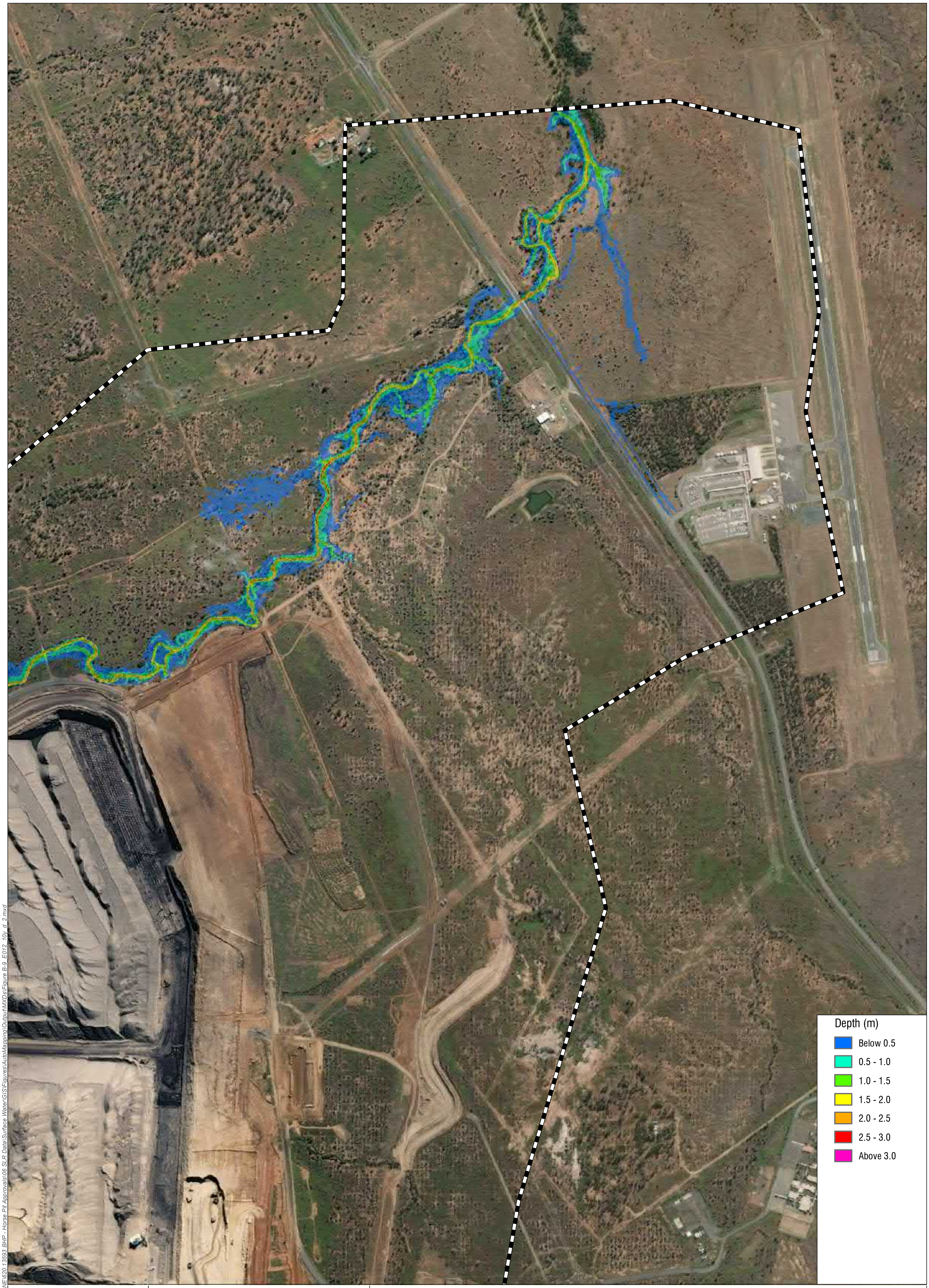
Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 50% AEP

Figure B-8



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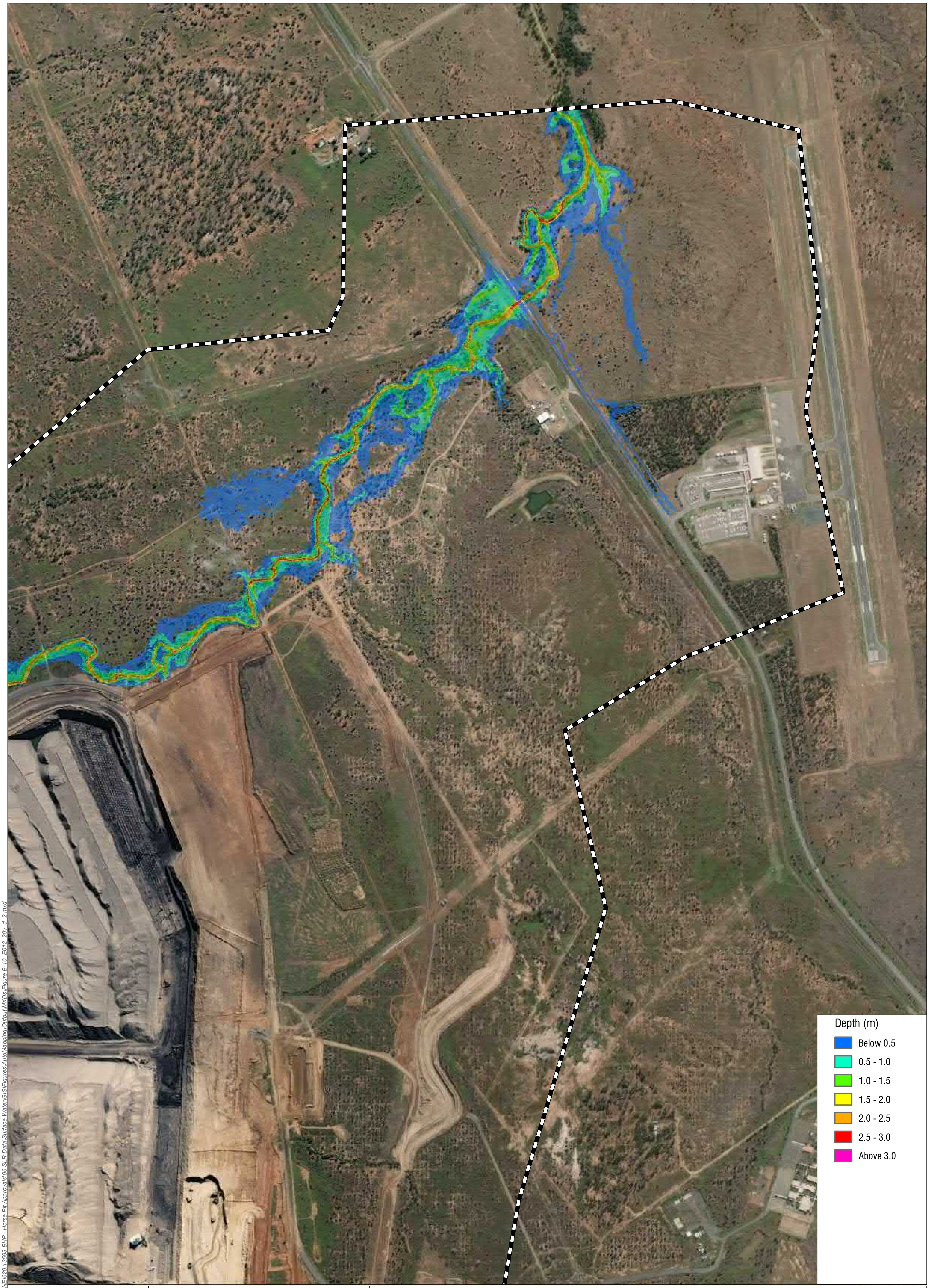
Legend
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 10% AEP

Figure B-9



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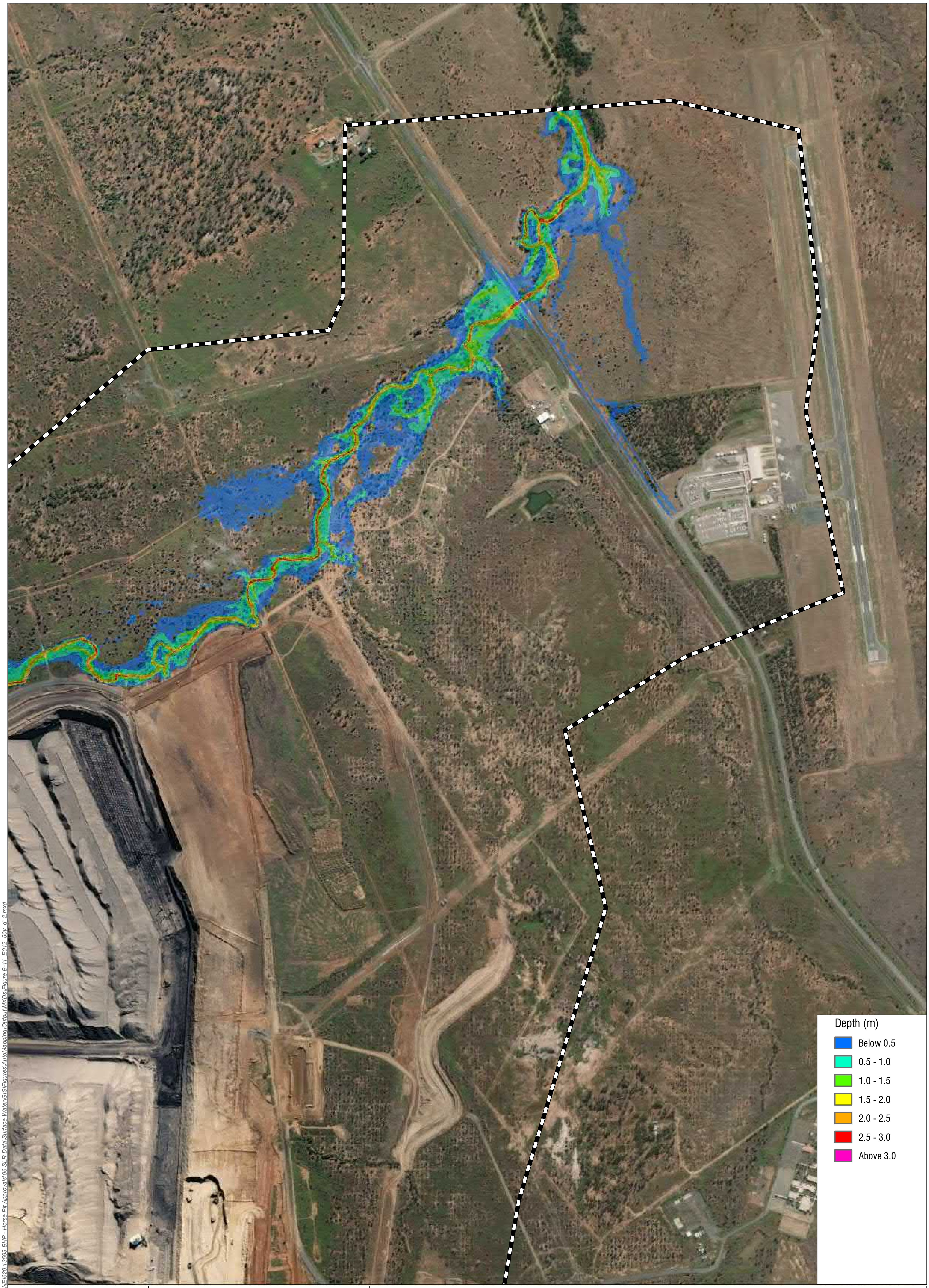
Legend
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment
Existing Scenario (E012)
Peak Flood Depths - 5% AEP

Figure B-10



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Legend

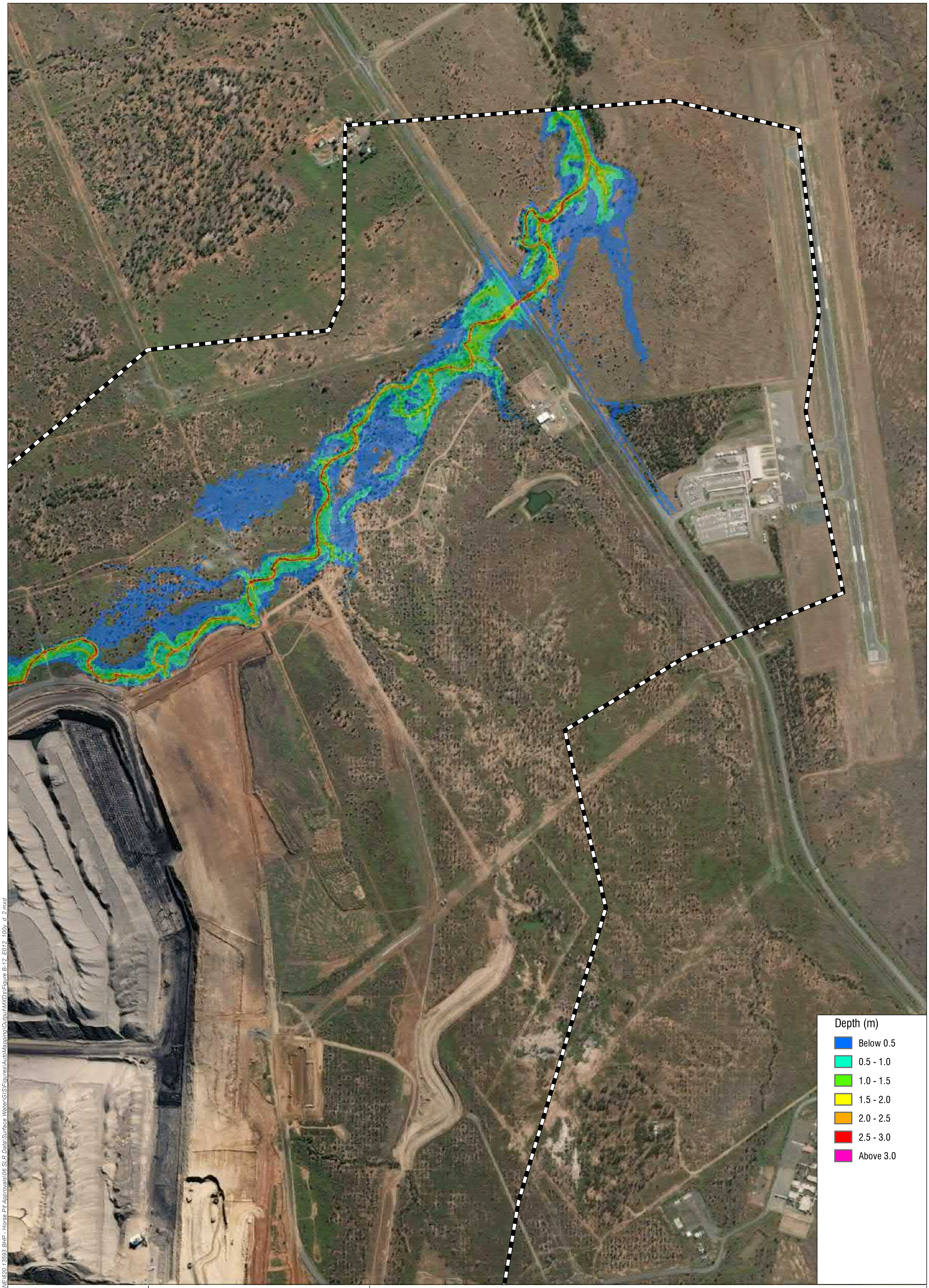
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 2% AEP

Figure B-11

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-11_E012_50y_d_2.mxd



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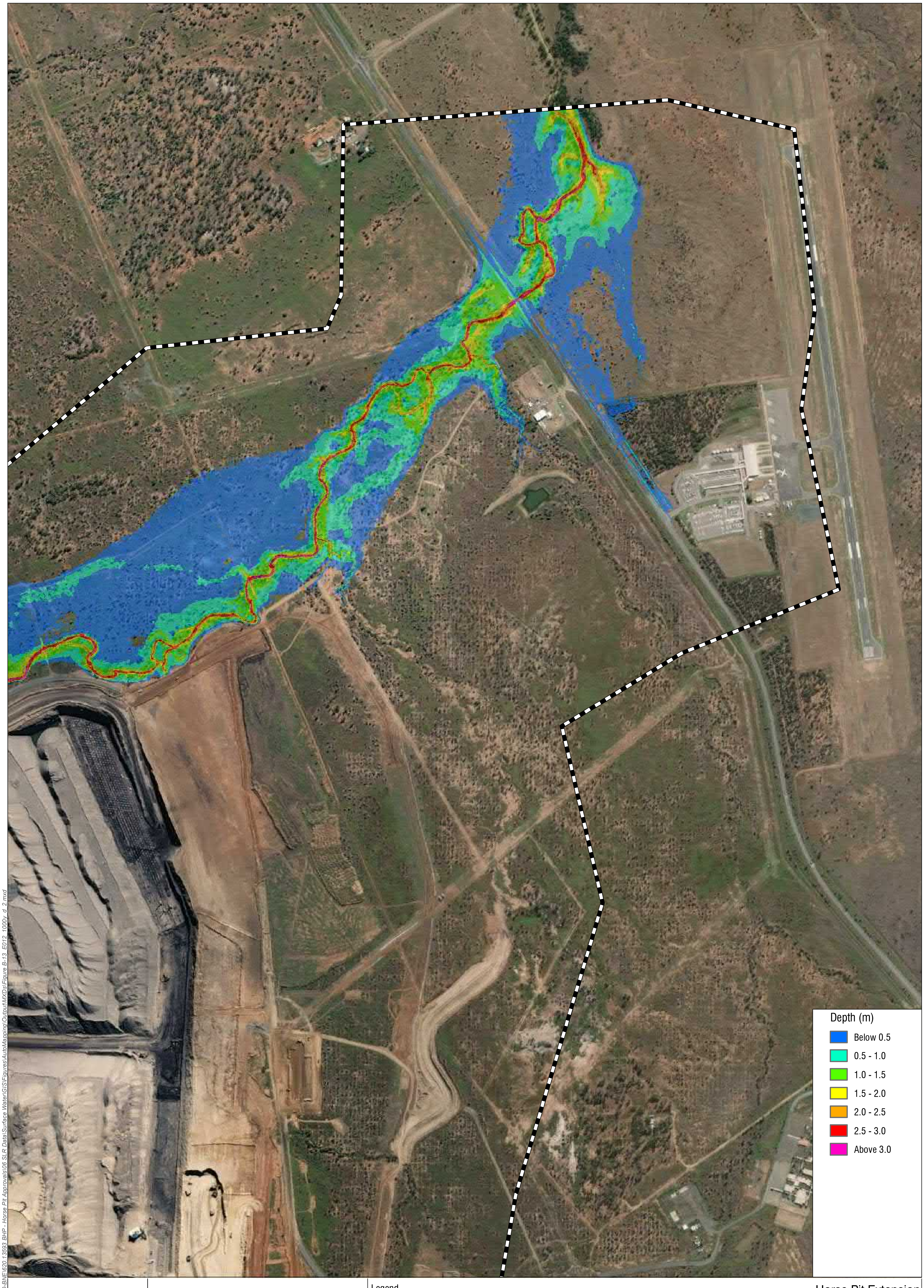
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 1% AEP

Figure B-12



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Depths - 0.1% AEP

Figure B-13

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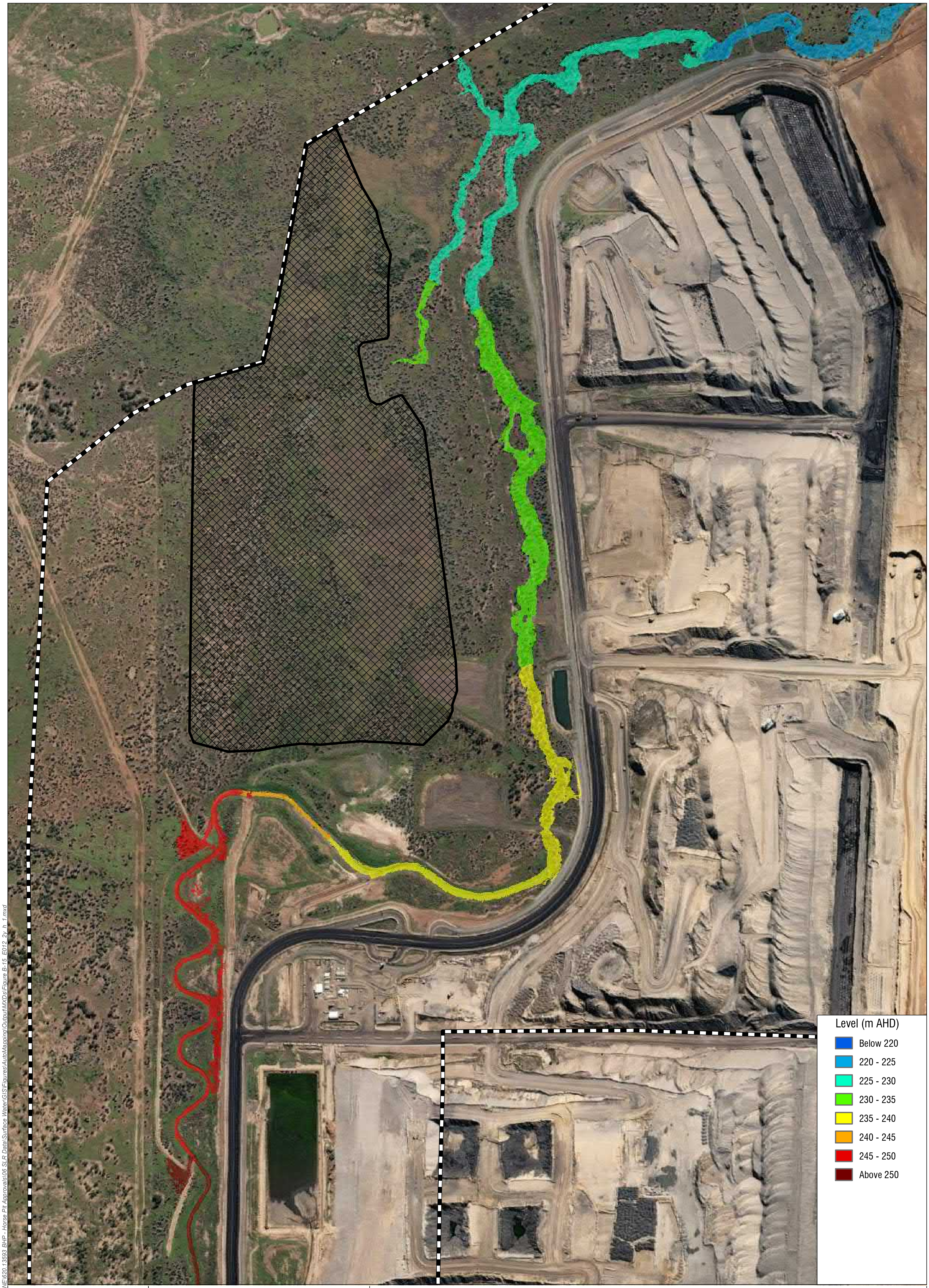

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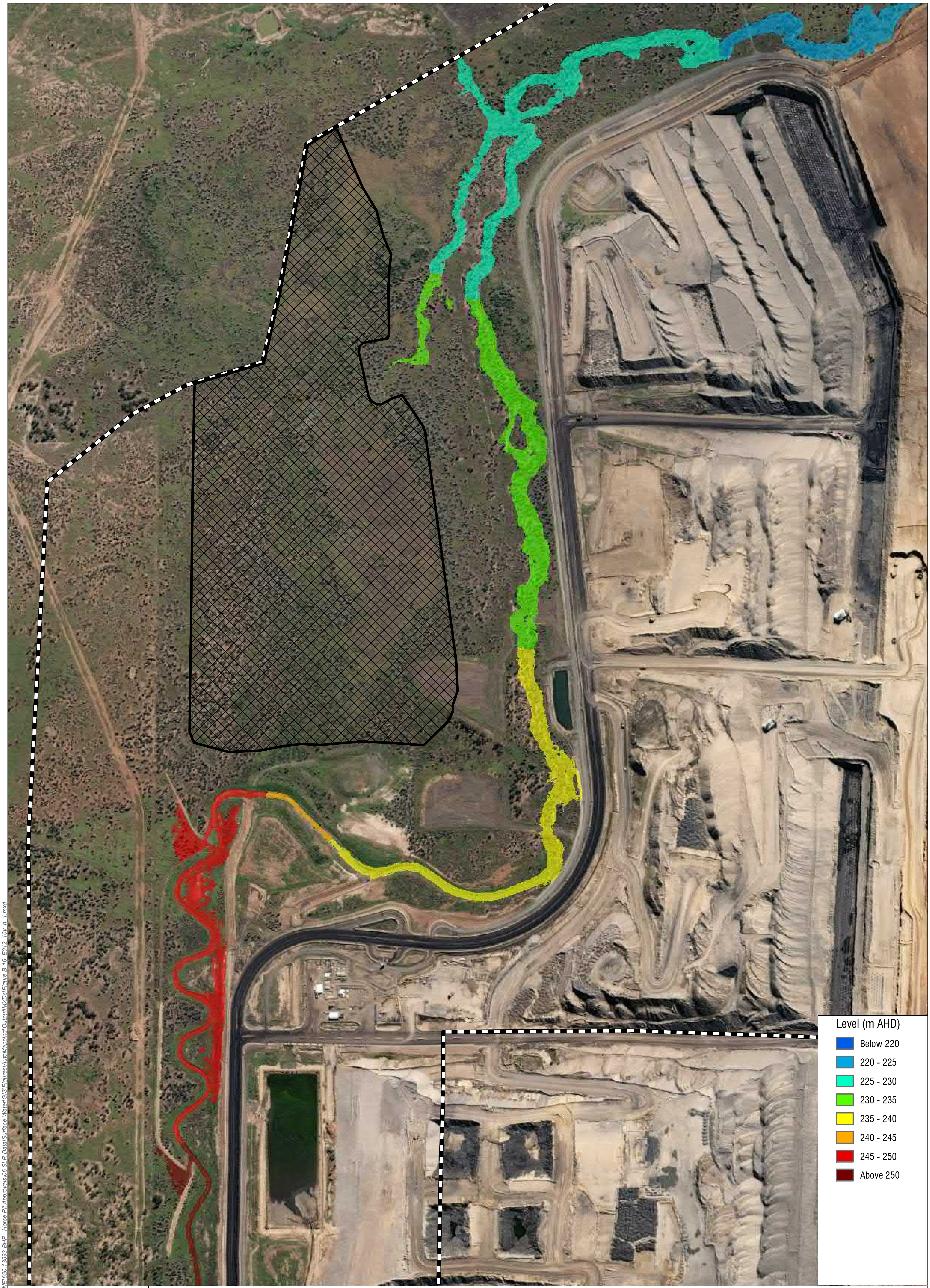
Legend
Proposed Waste Rock Dump
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment
Existing Scenario (E012)
Peak Flood Levels - 50% AEP

Figure B-15



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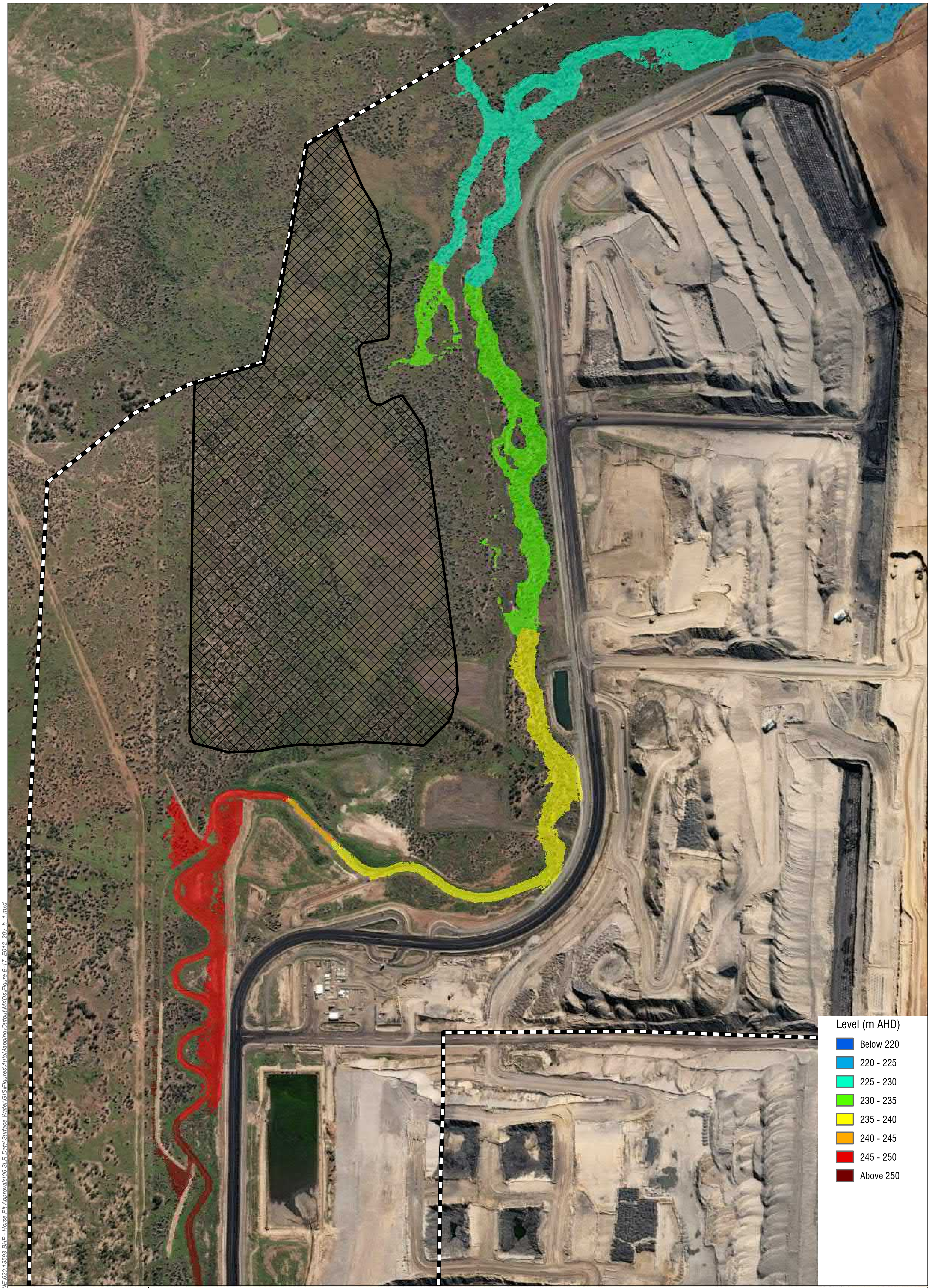
Legend
Proposed Waste Rock Dump
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 10% AEP

Figure B-16



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Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

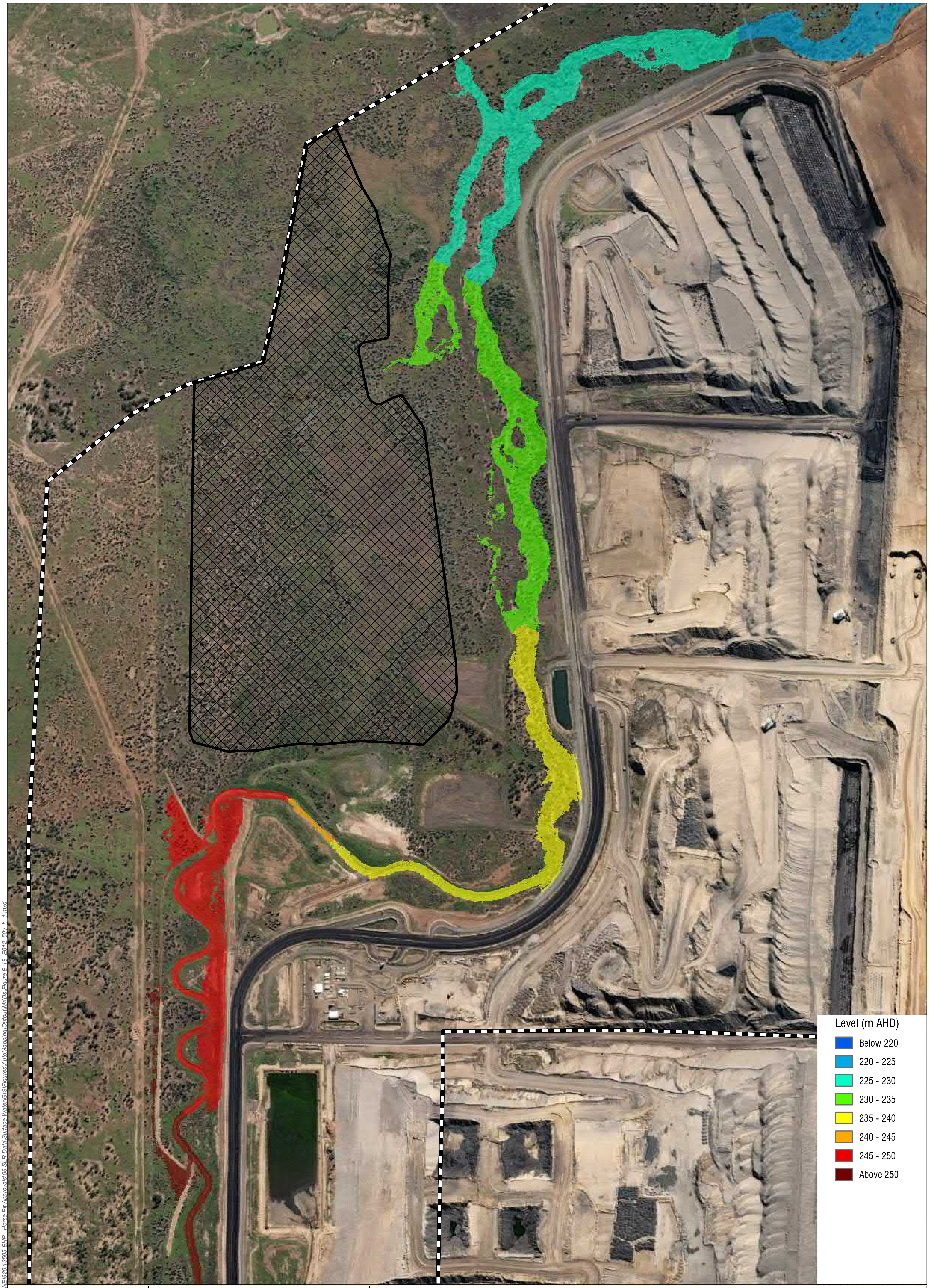
Horse Pit Extension

Flood Impact Assessment

Existing Scenario (E012)

Peak Flood Levels - 5% AEP

Figure B-17



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Legend

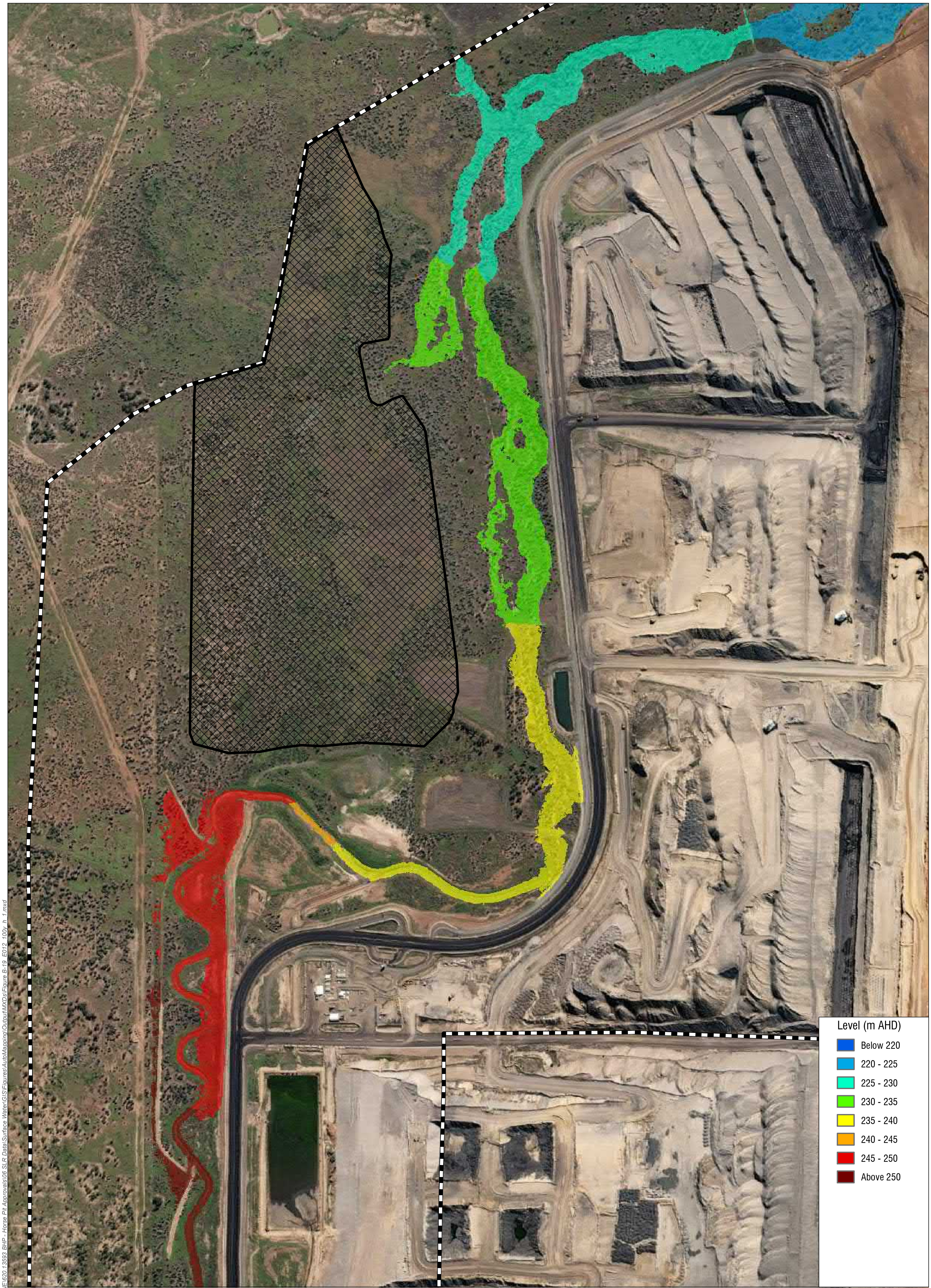
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 2% AEP

Figure B-18



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Legend

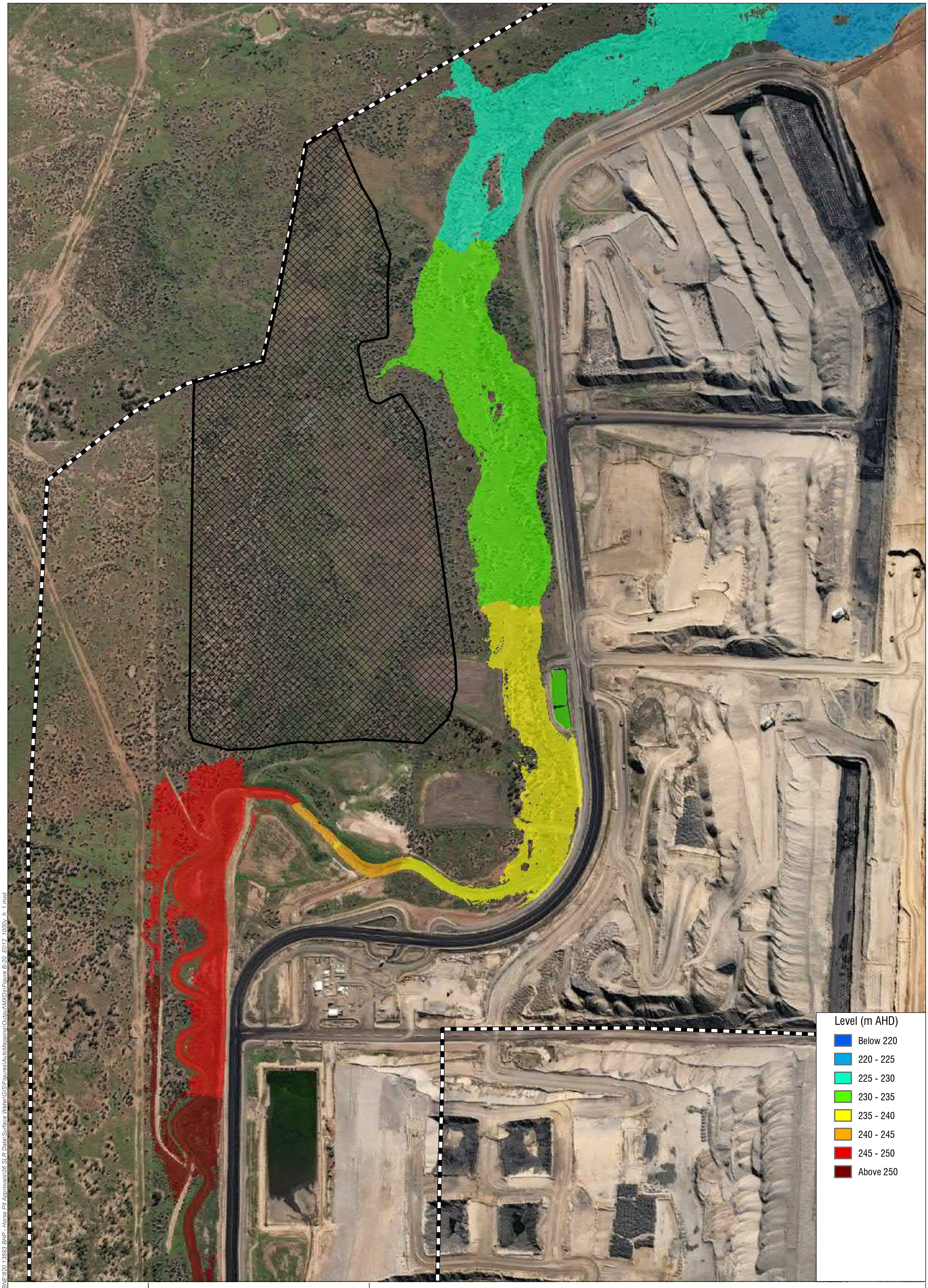
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 1% AEP

Figure B-19



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Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

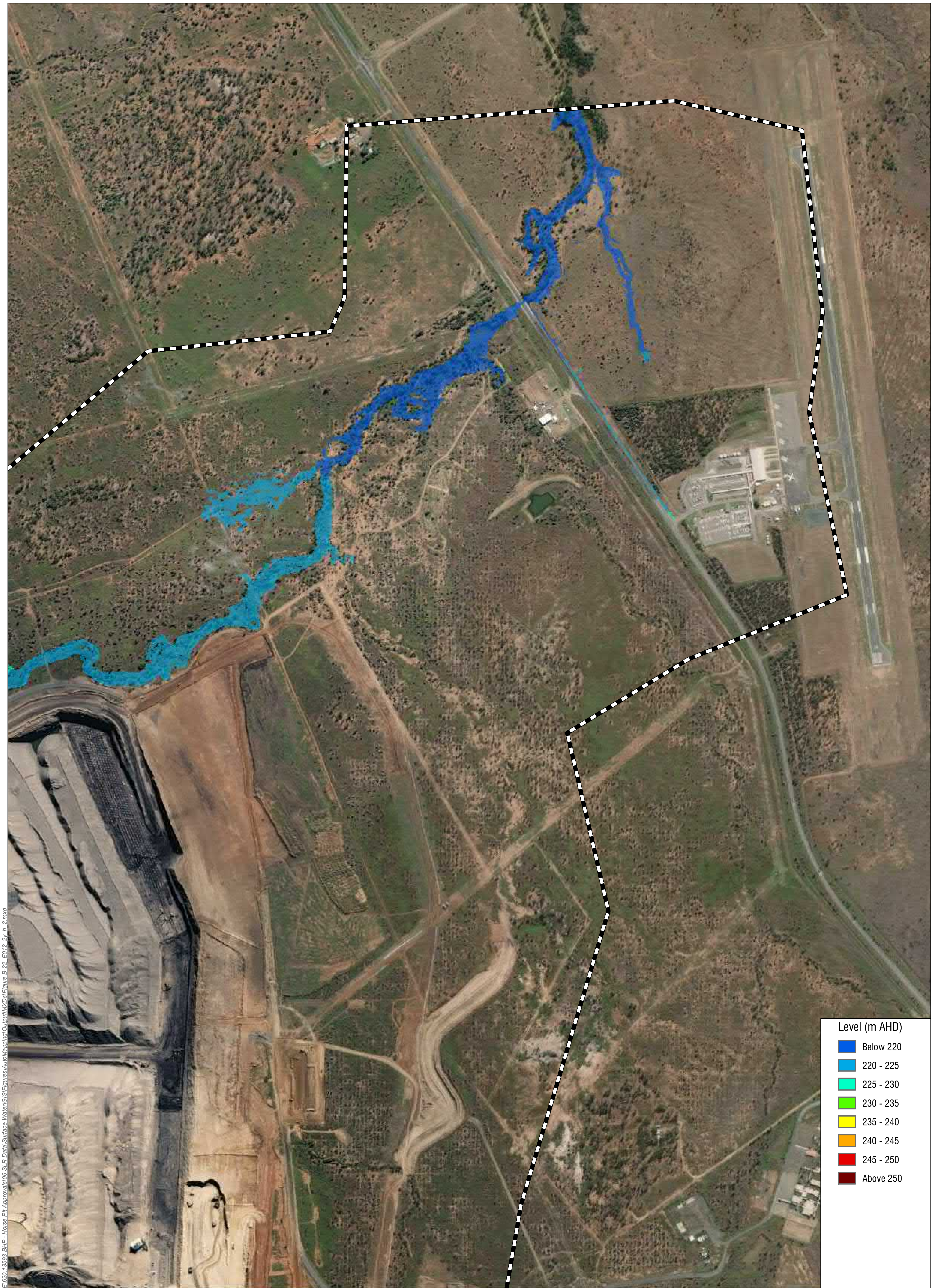
Horse Pit Extension

Flood Impact Assessment

Existing Scenario (E012)

Peak Flood Levels - 0.1% AEP

Figure B-20



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Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 50% AEP

Figure B-22

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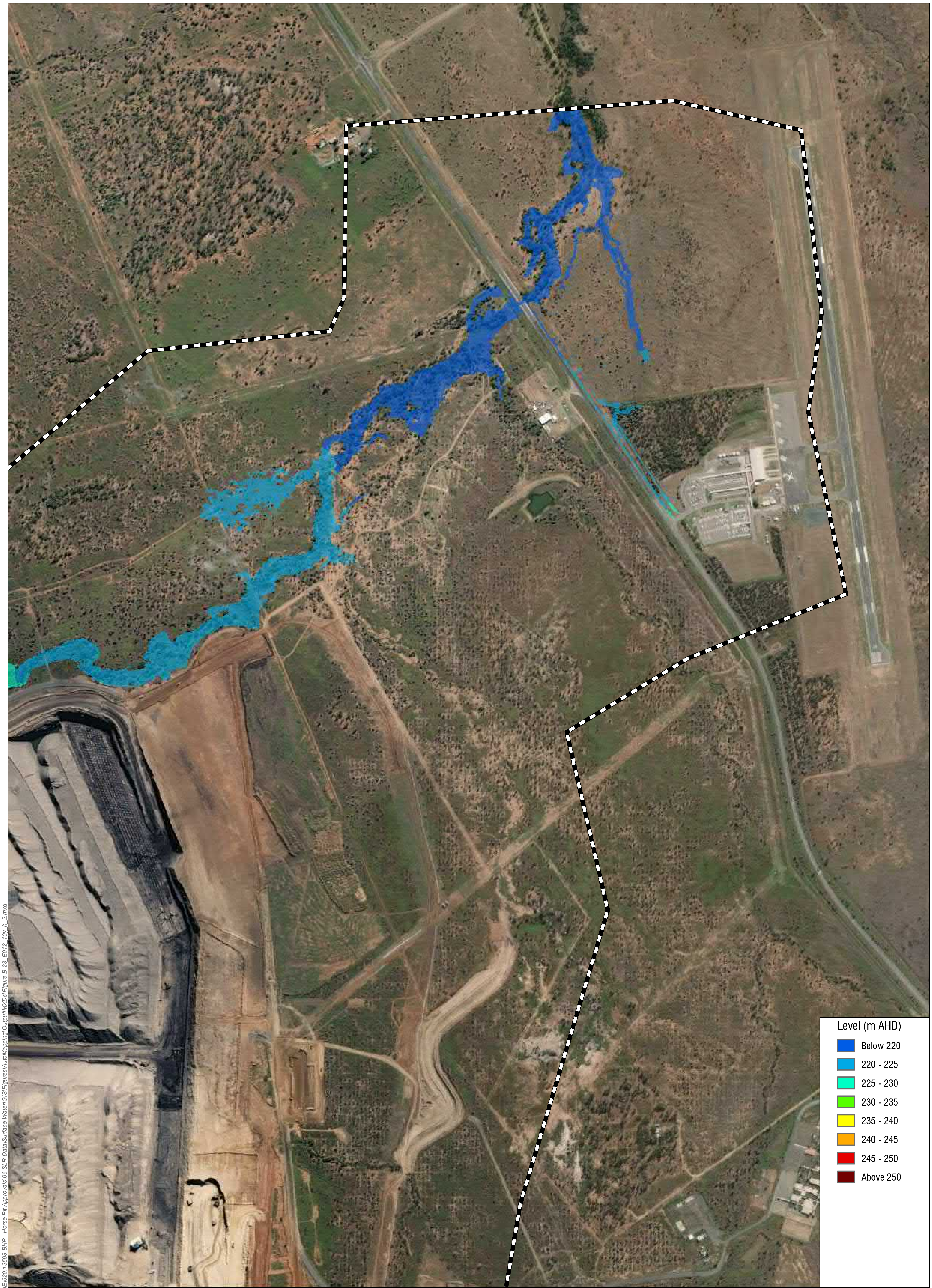

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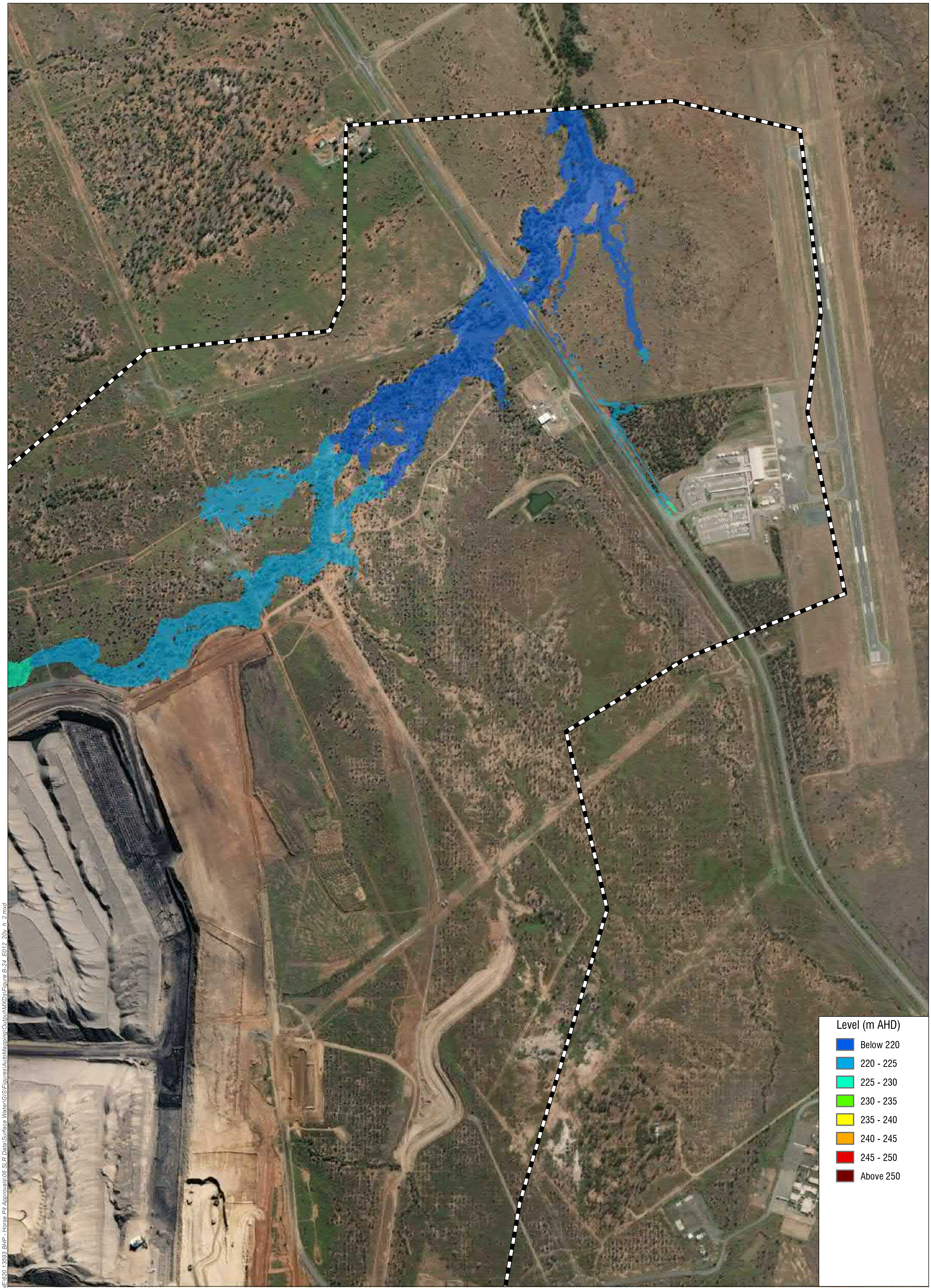
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 10% AEP

Figure B-23



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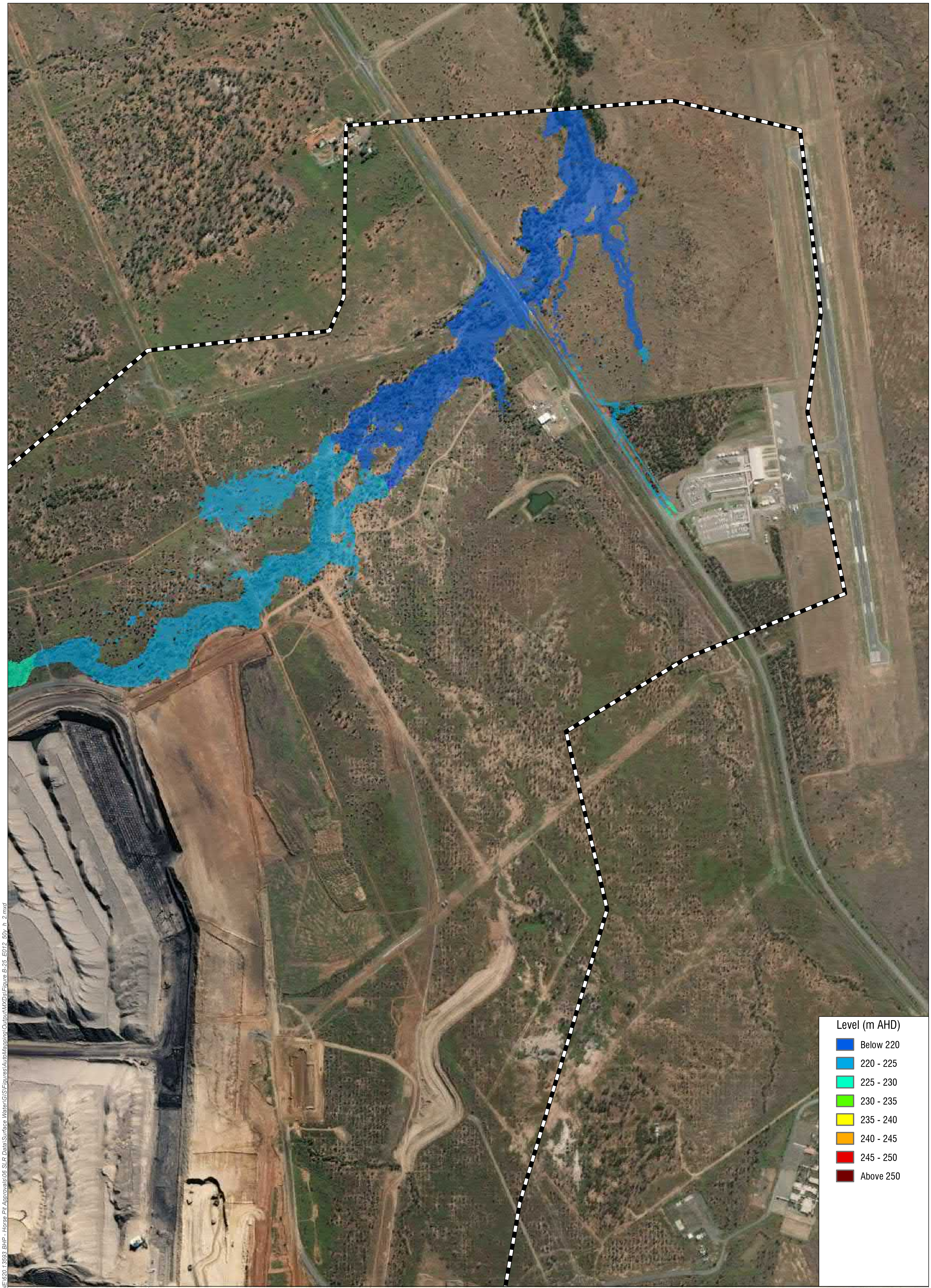
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 5% AEP

Figure B-24



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Legend

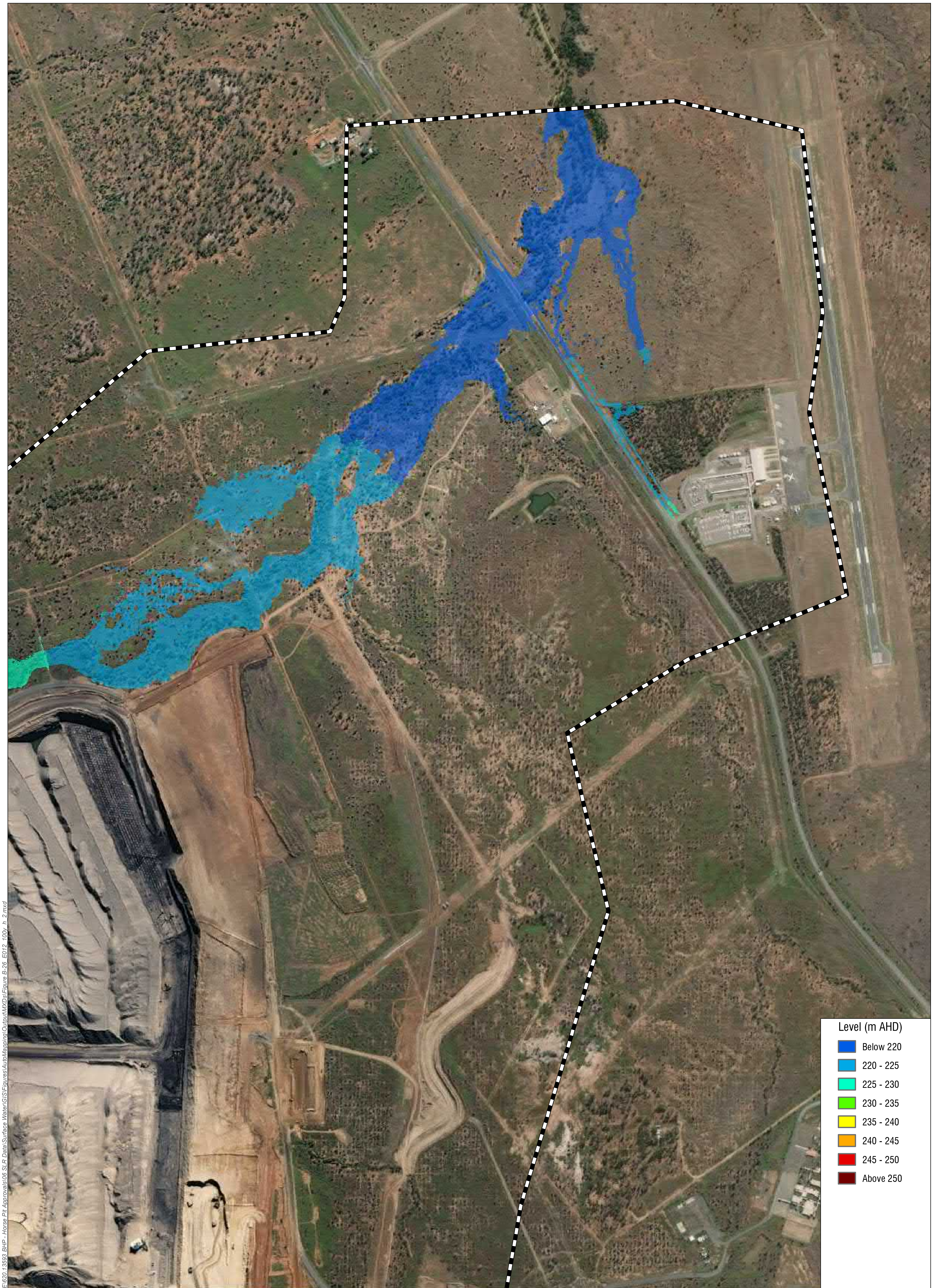
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 2% AEP

Figure B-25

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-25_E012_50y_h_2.mxd



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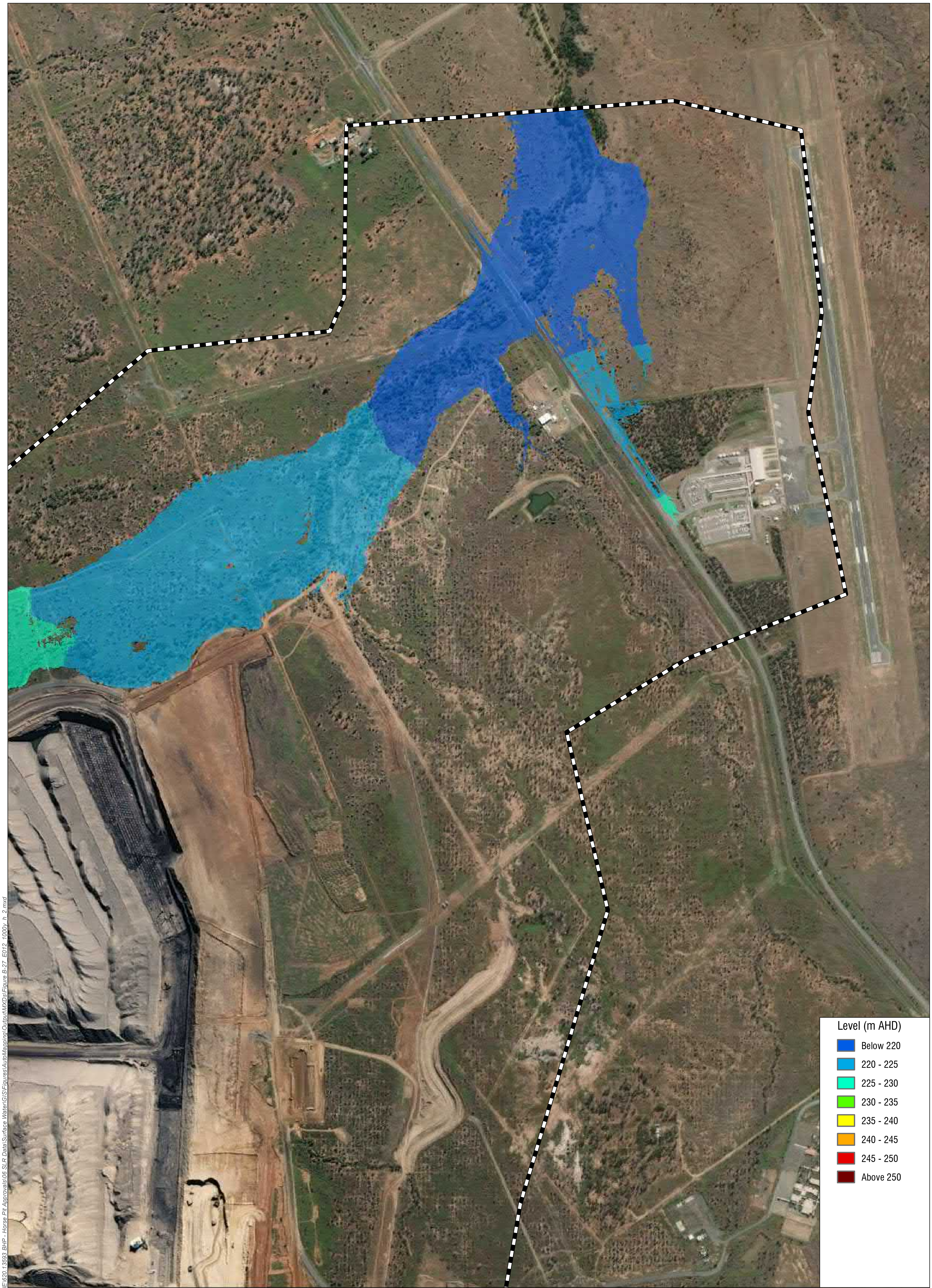
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 1% AEP

Figure B-26



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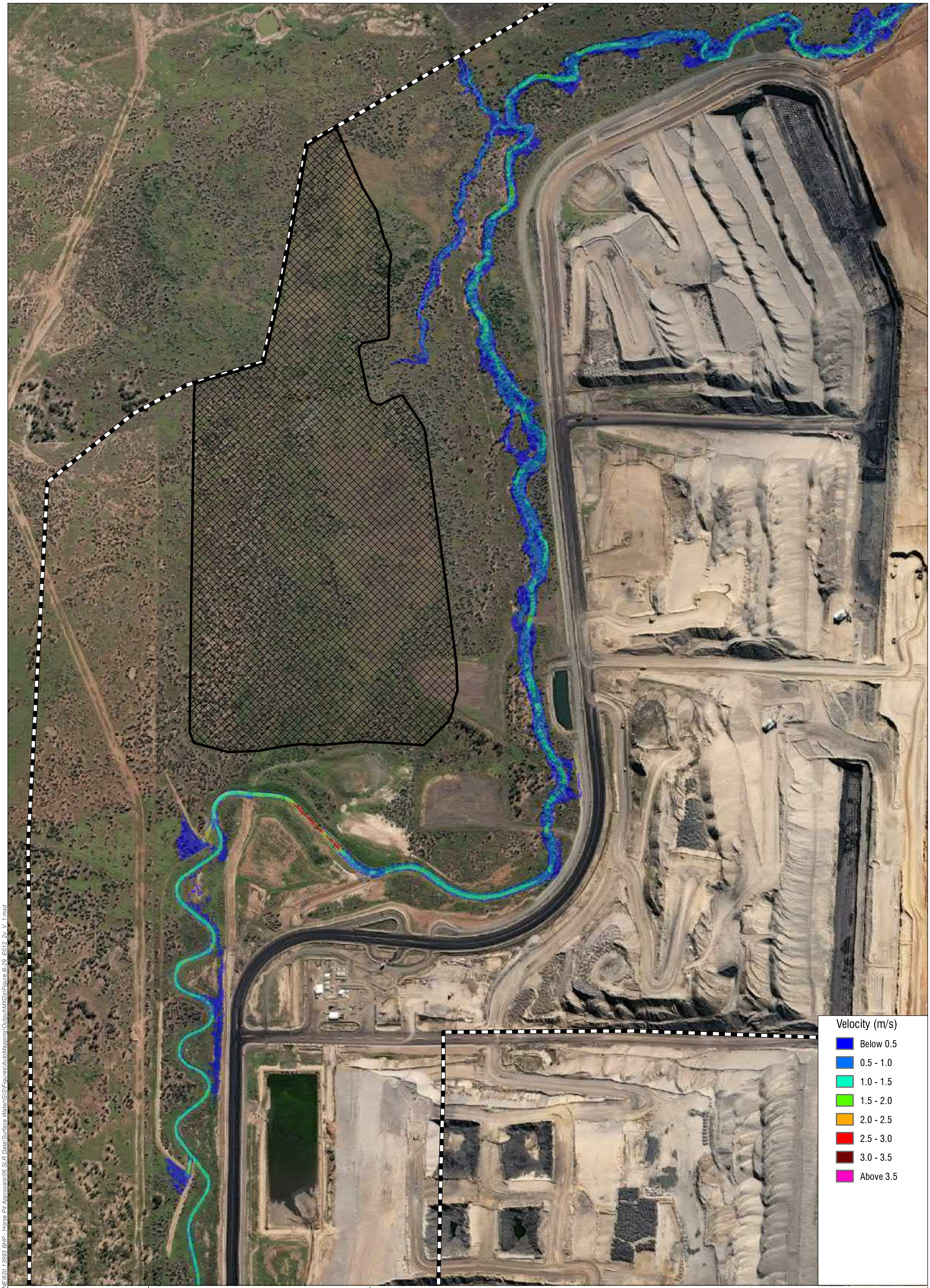
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Levels - 0.1% AEP

Figure B-27



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

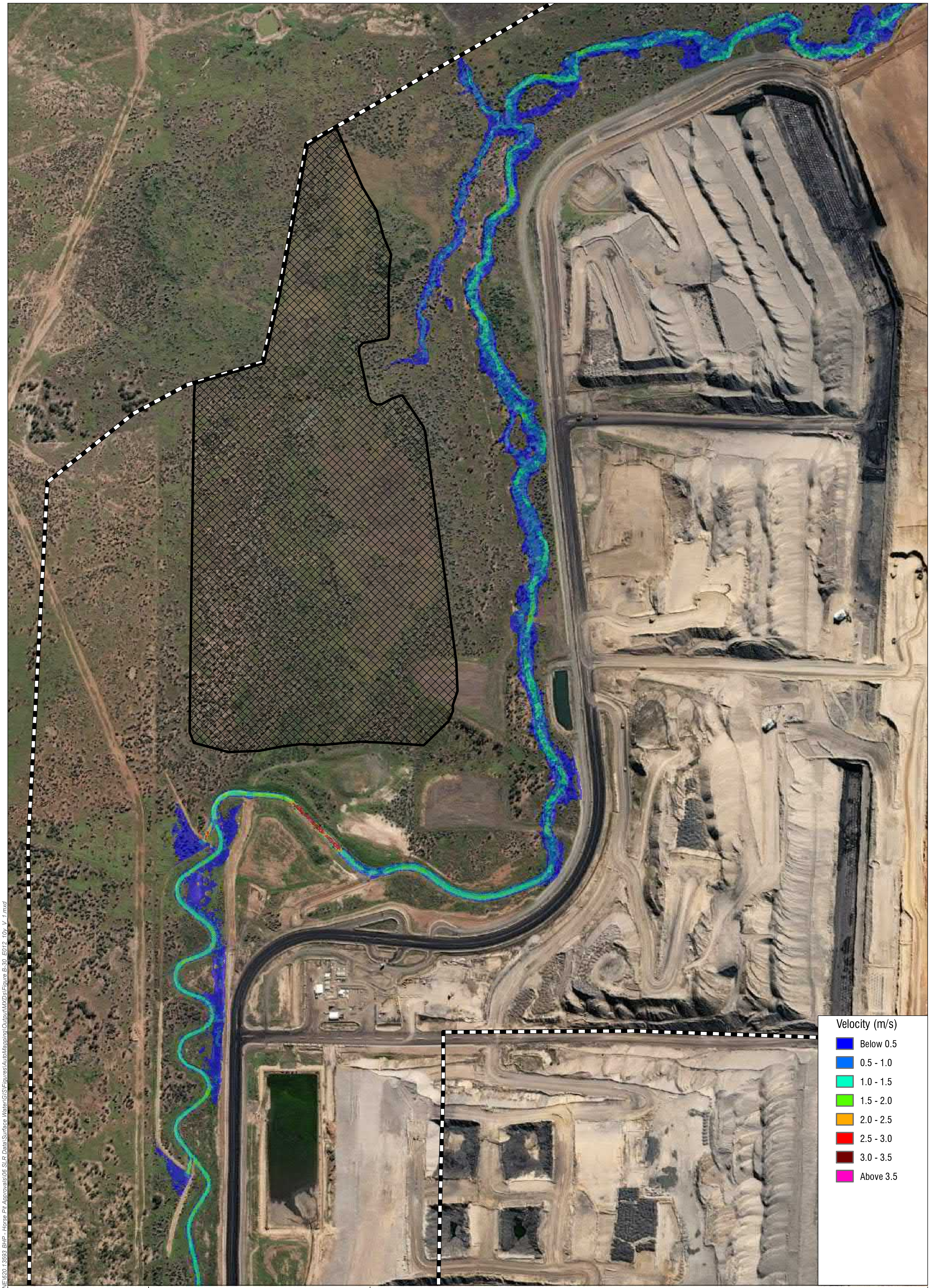
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 50% AEP

Figure B-29



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Waste Rock Dump

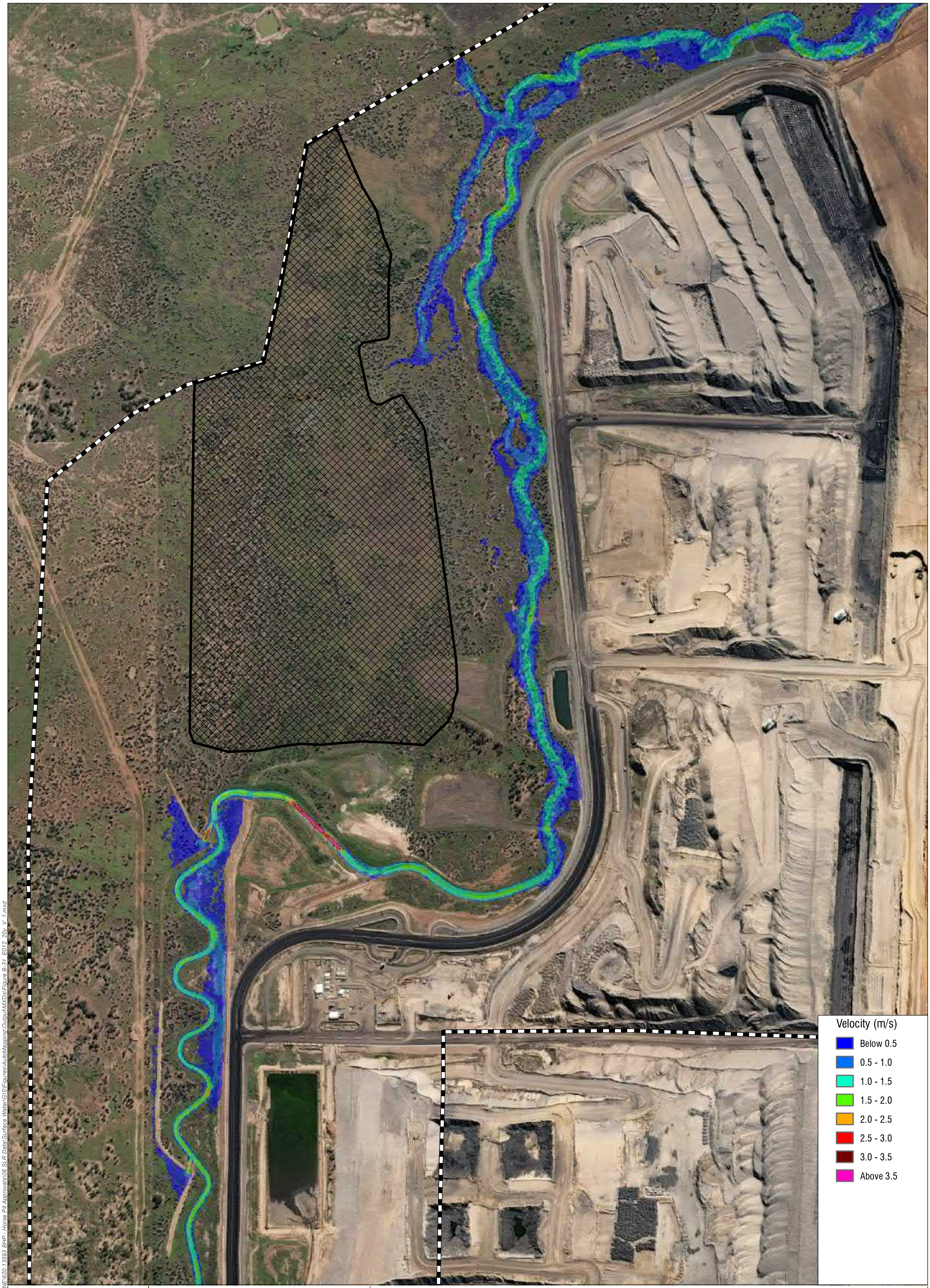
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 10% AEP

Figure B-30

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-30_E012_10y_V_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

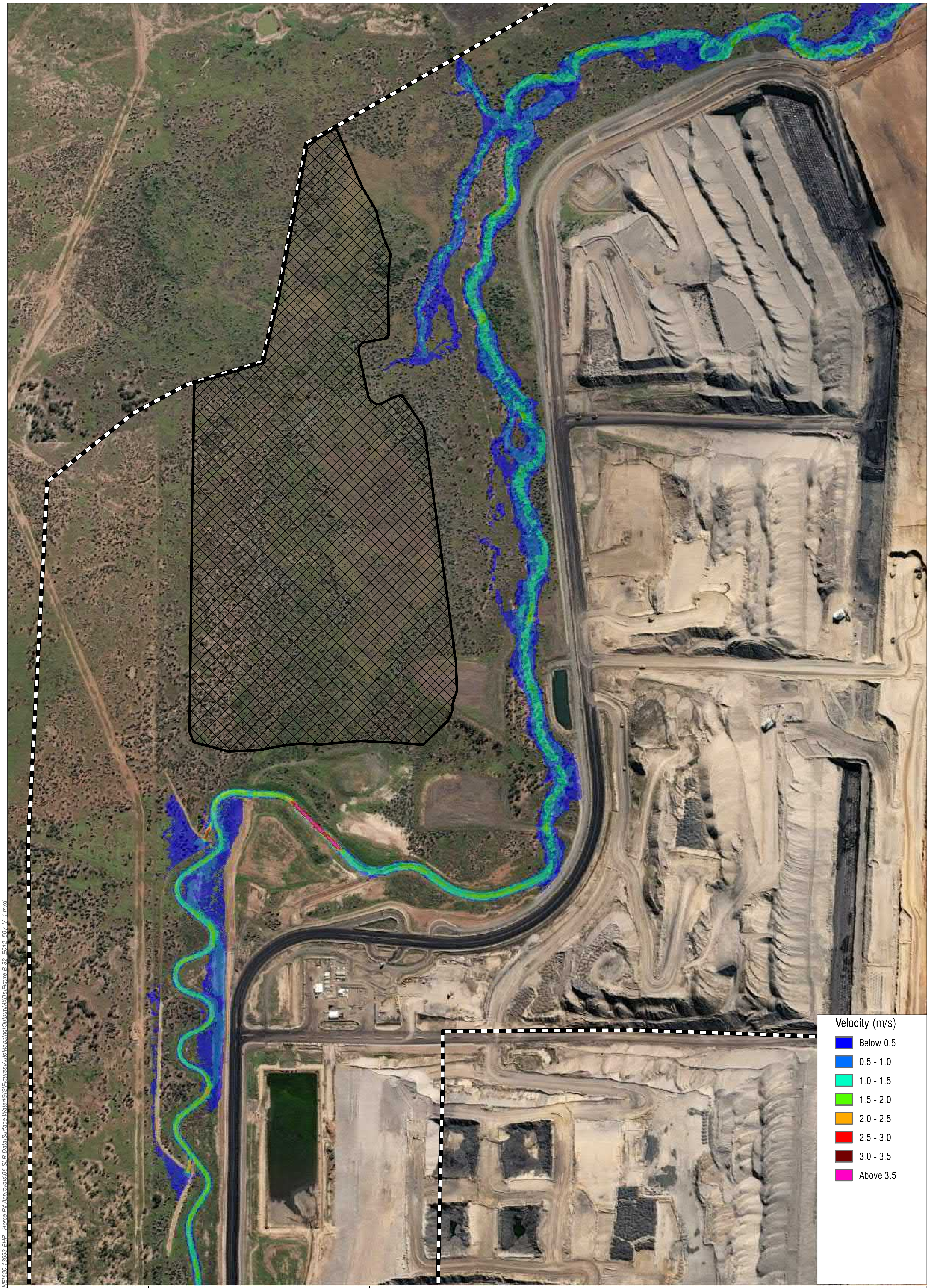
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 5% AEP

Figure B-31



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Waste Rock Dump

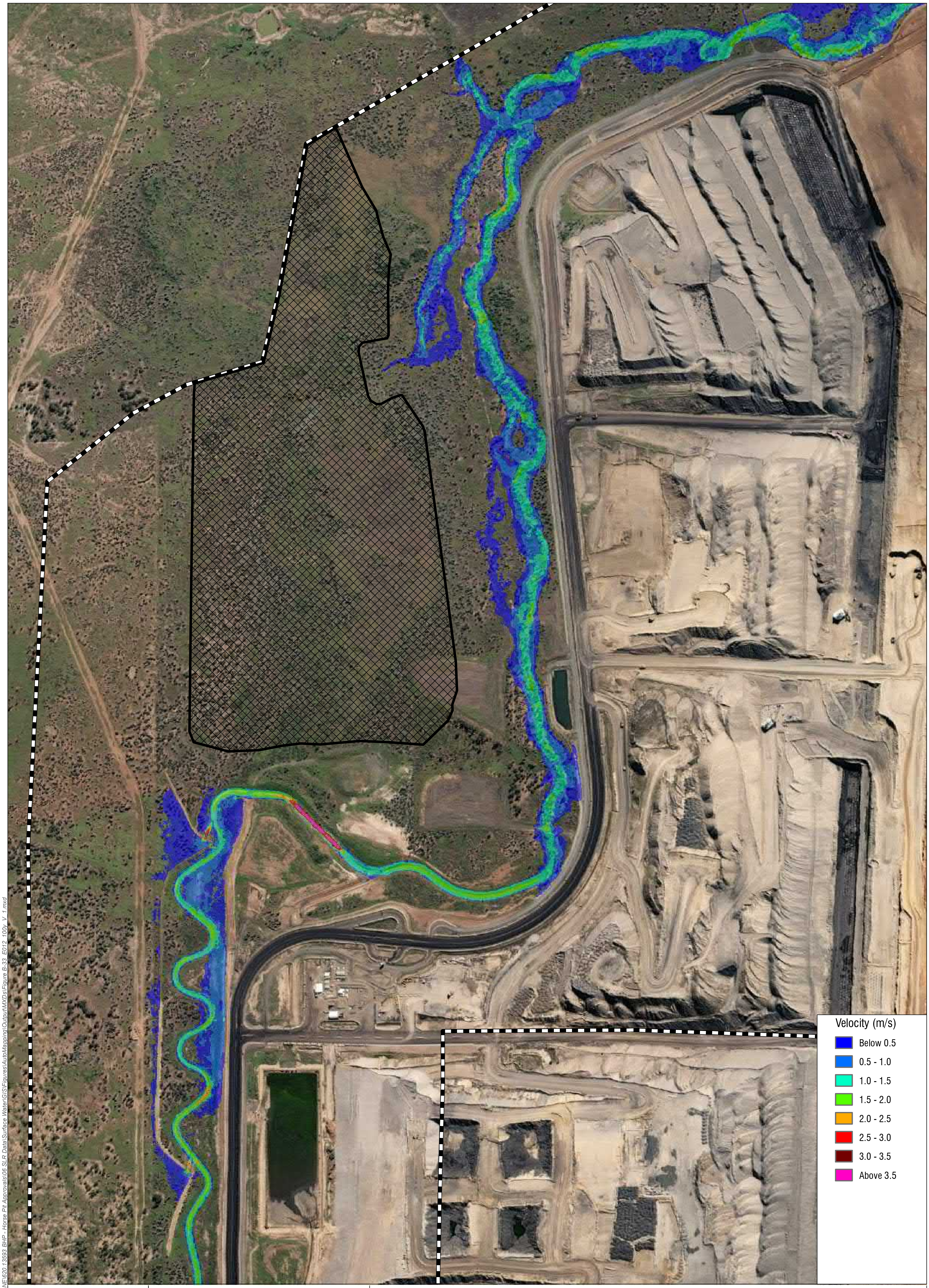
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 2% AEP

Figure B-32

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-32_E012_50y_V_1.mxd



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Legend

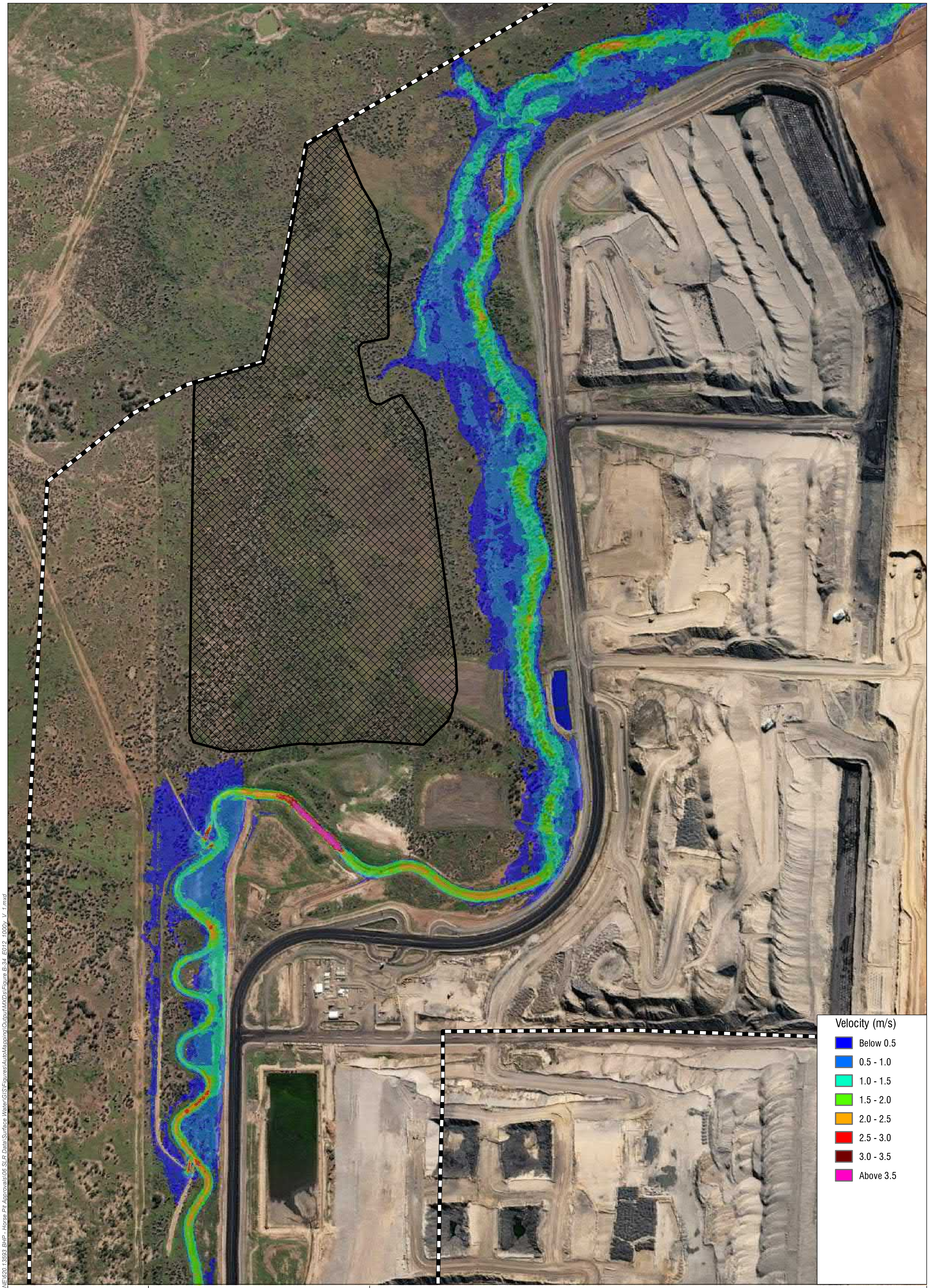
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 1% AEP

Figure B-33



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Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 0.1% AEP

Figure B-34

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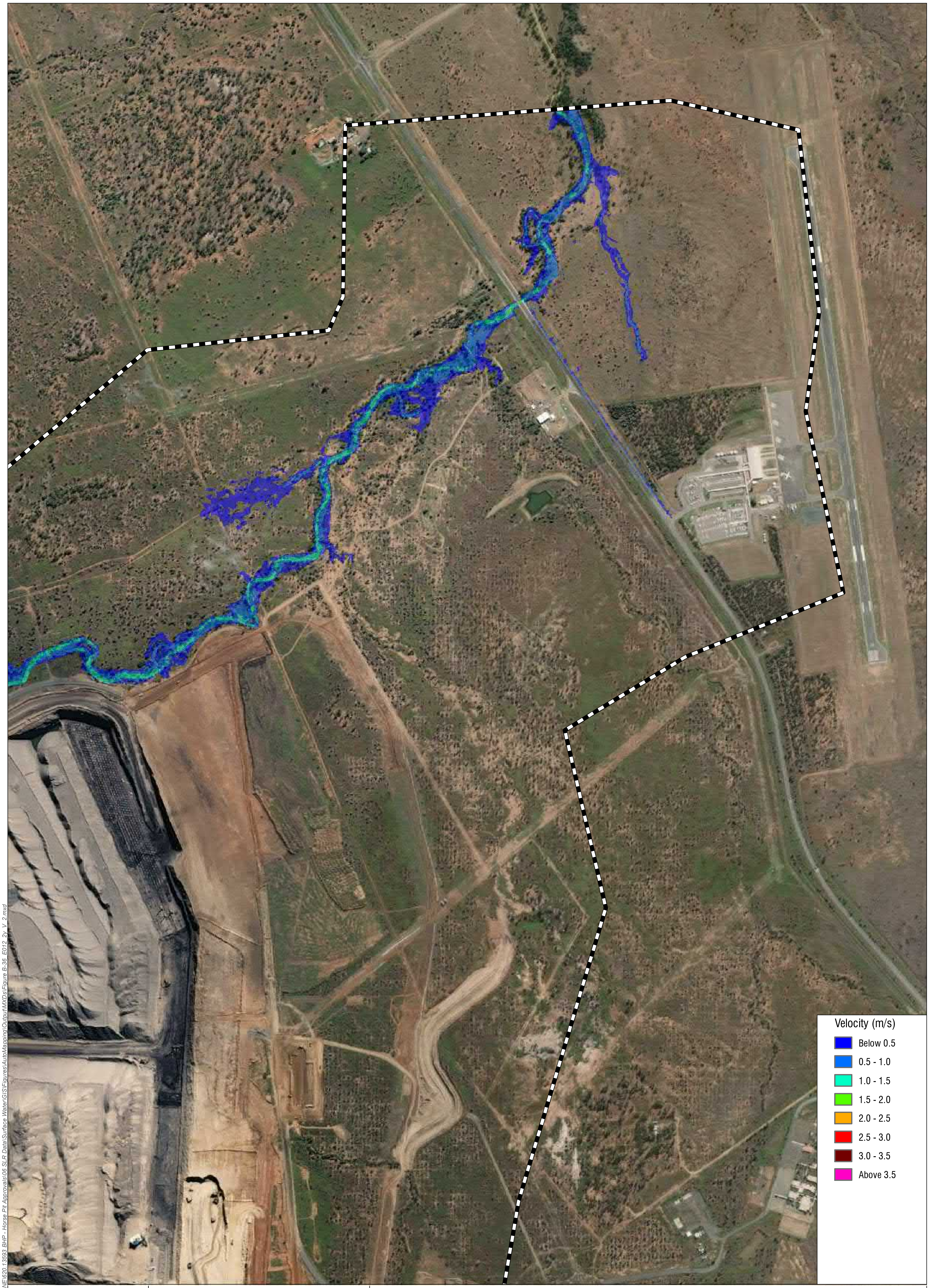

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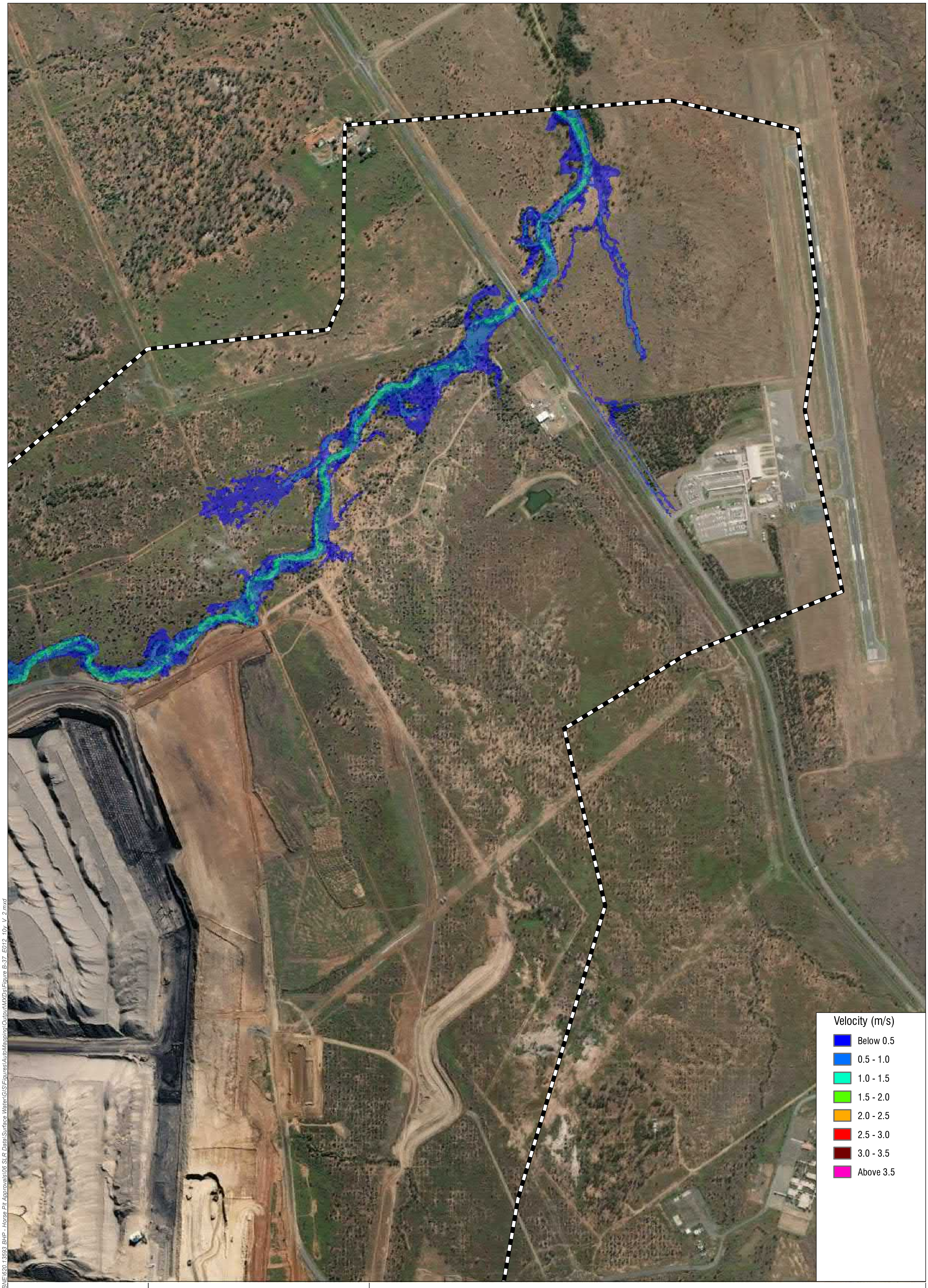
Legend
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 50% AEP

Figure B-36



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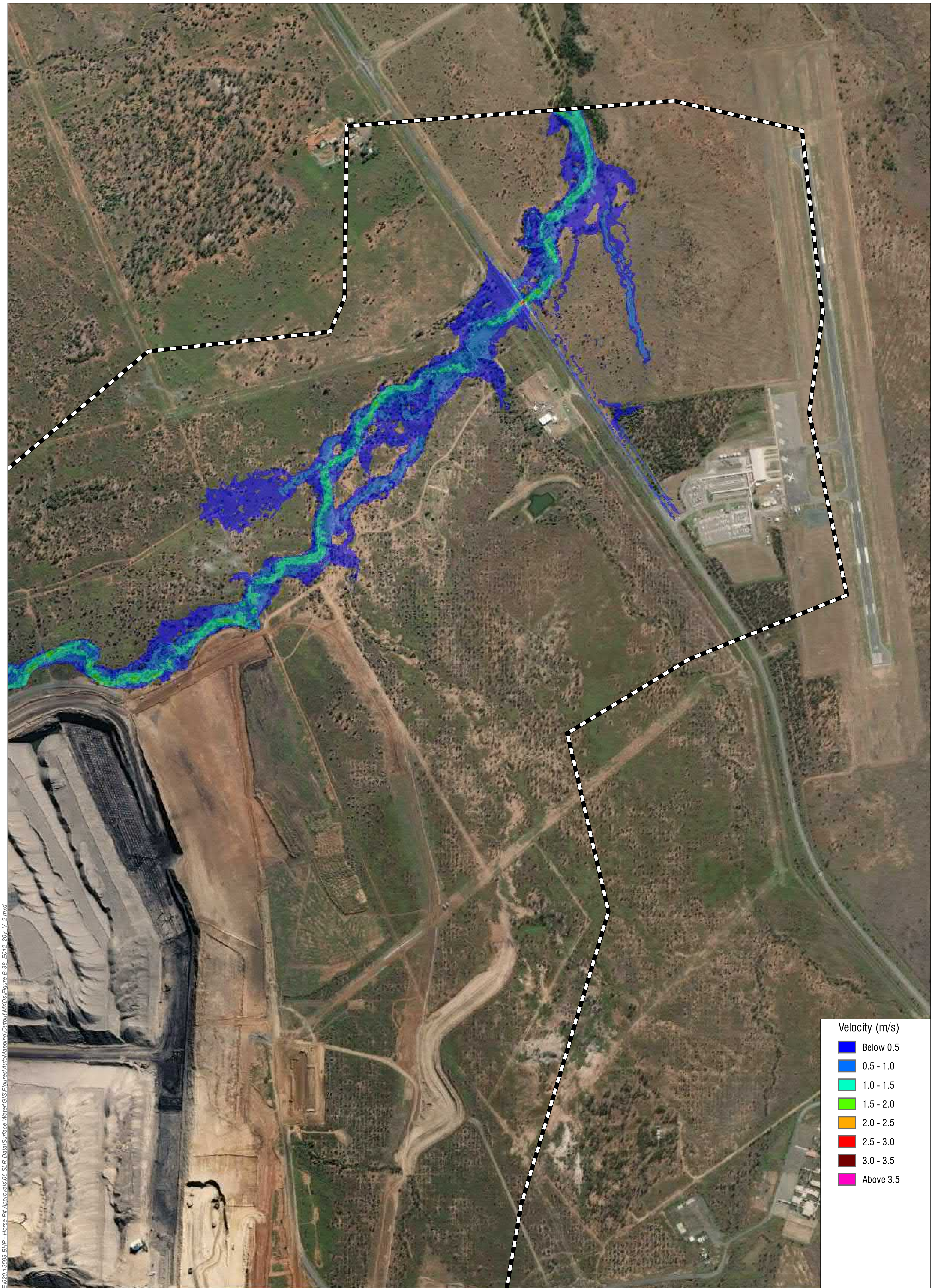
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 10% AEP

Figure B-37



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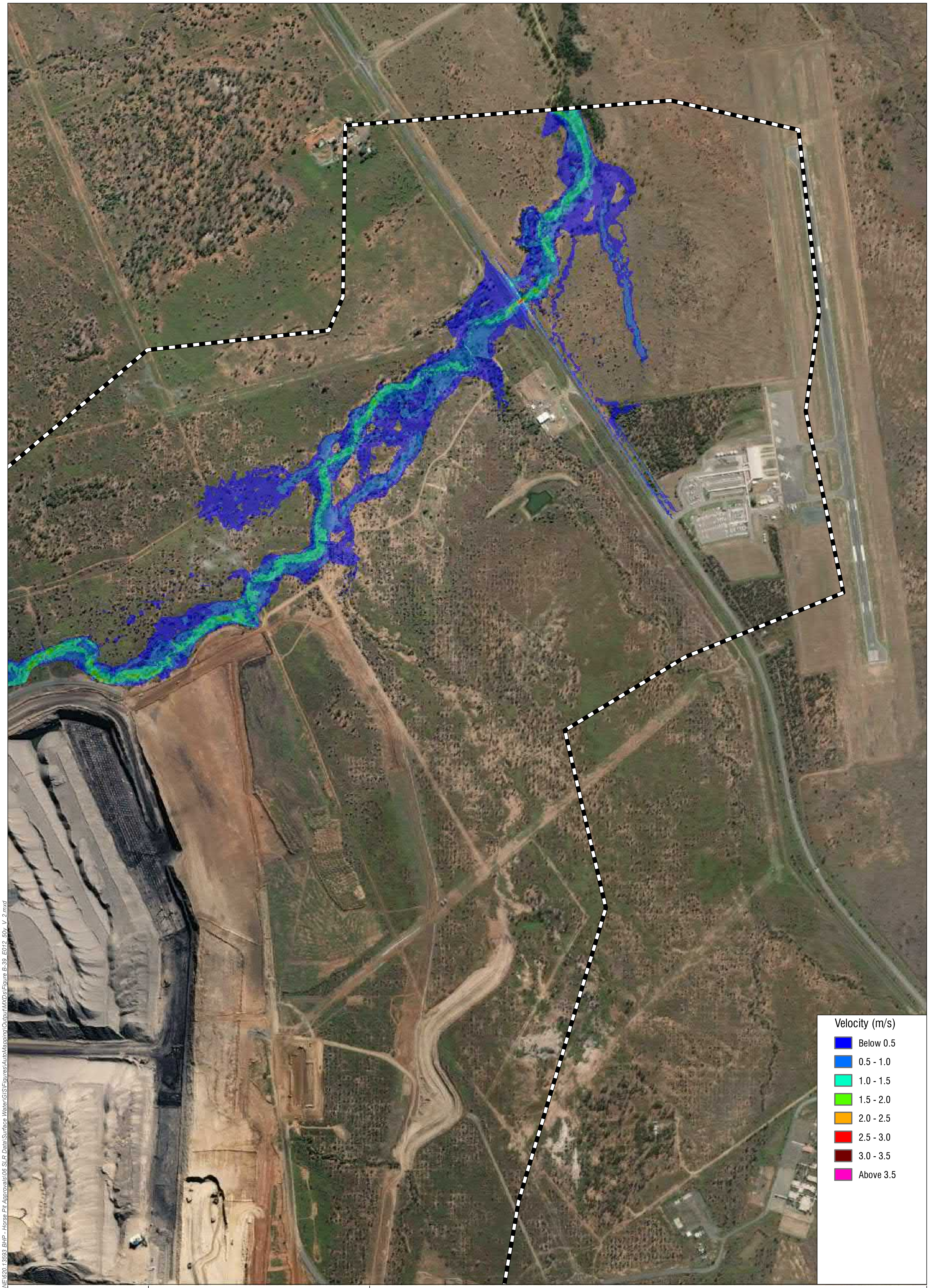
Legend
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 5% AEP

Figure B-38



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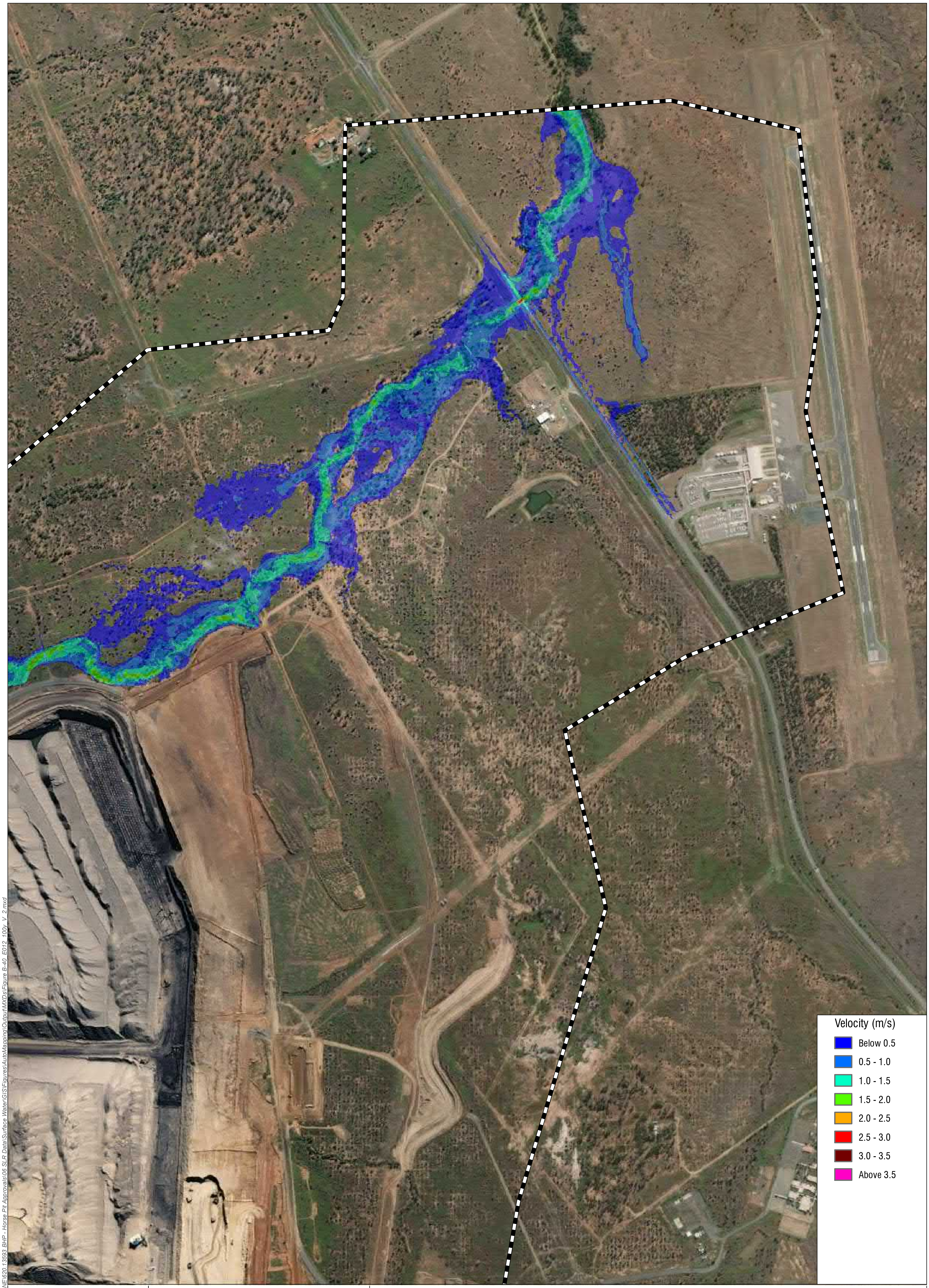
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 2% AEP

Figure B-39



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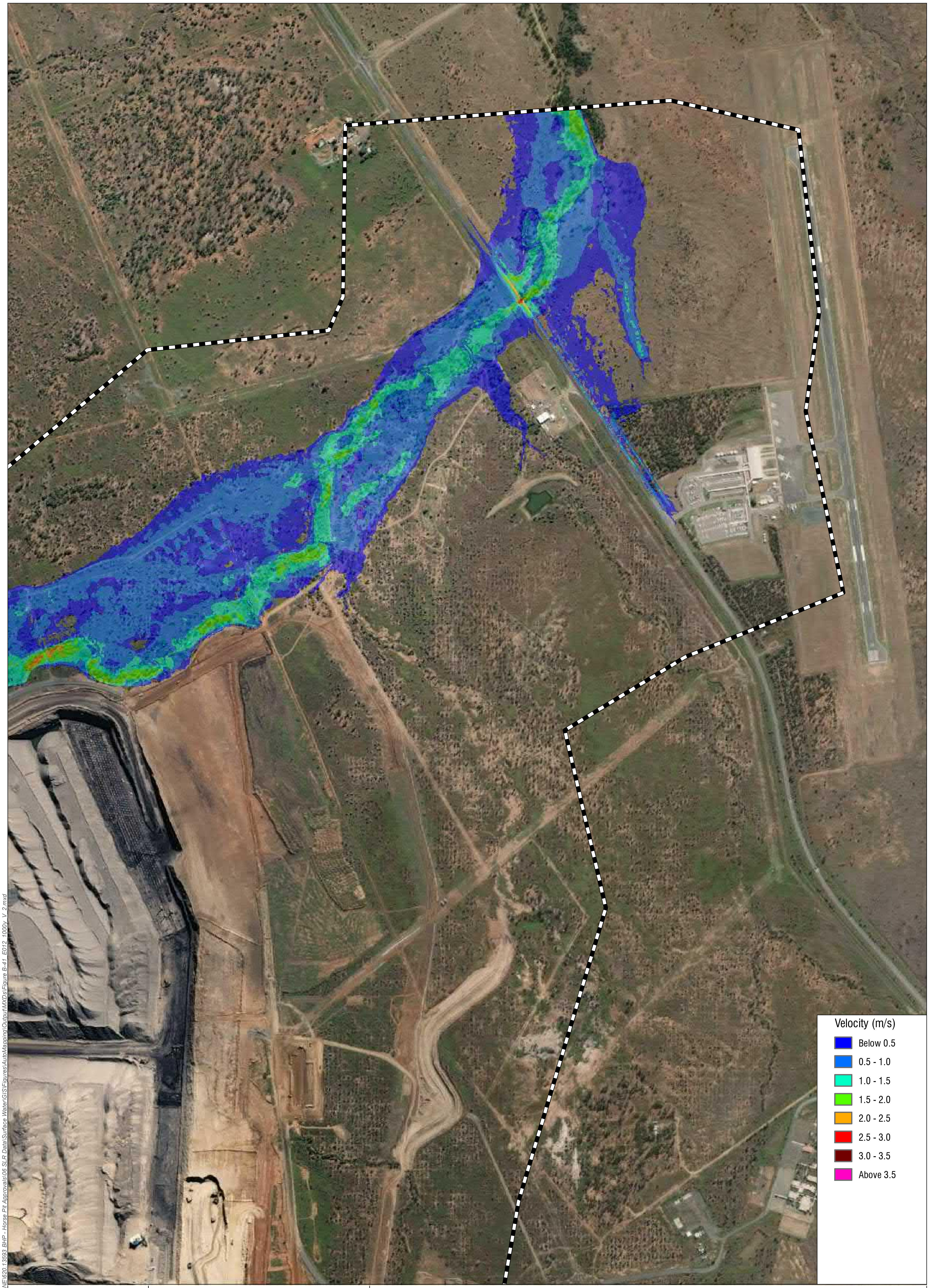
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 1% AEP

Figure B-40



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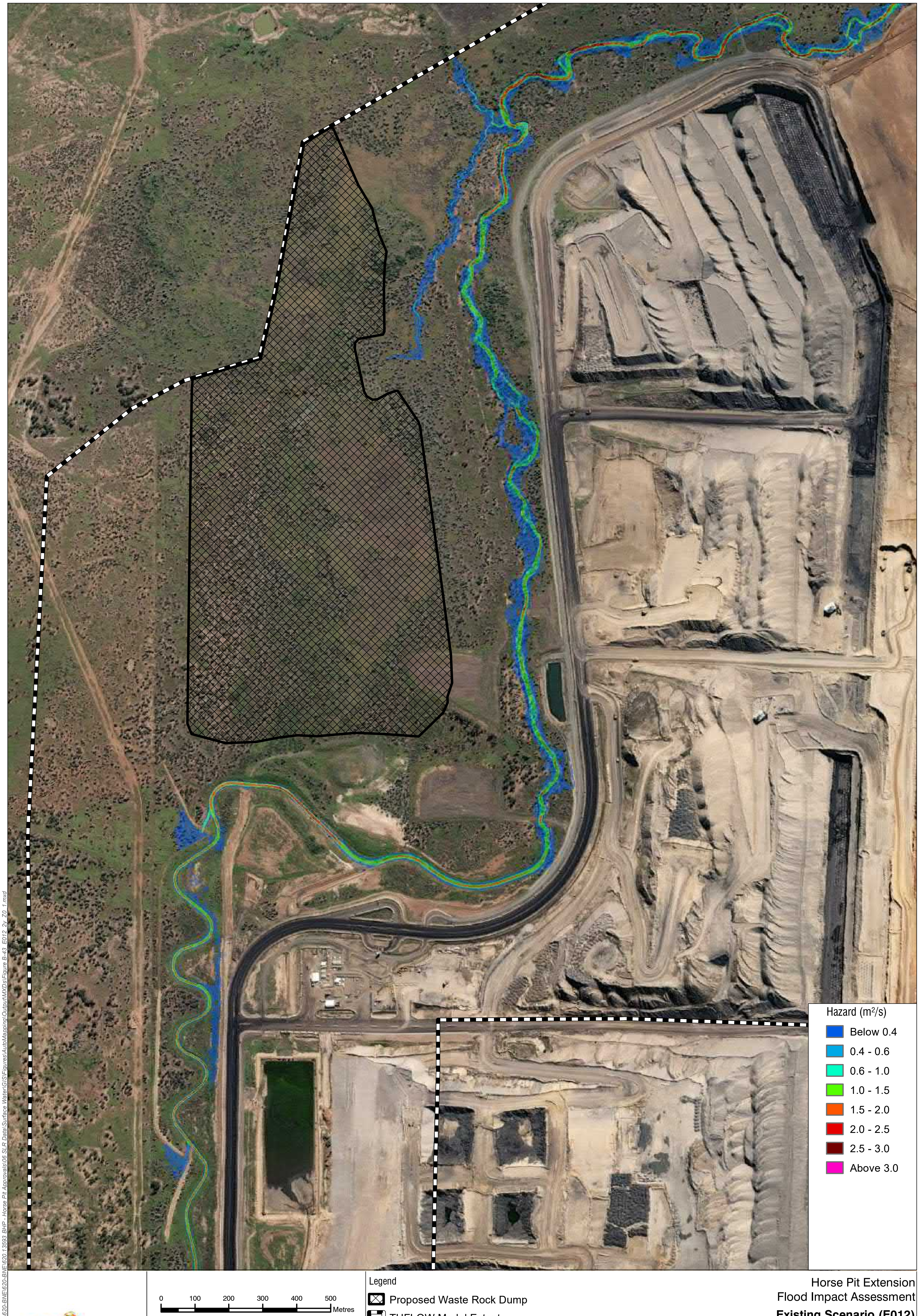
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Velocities - 0.1% AEP

Figure B-41



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Waste Rock Dump

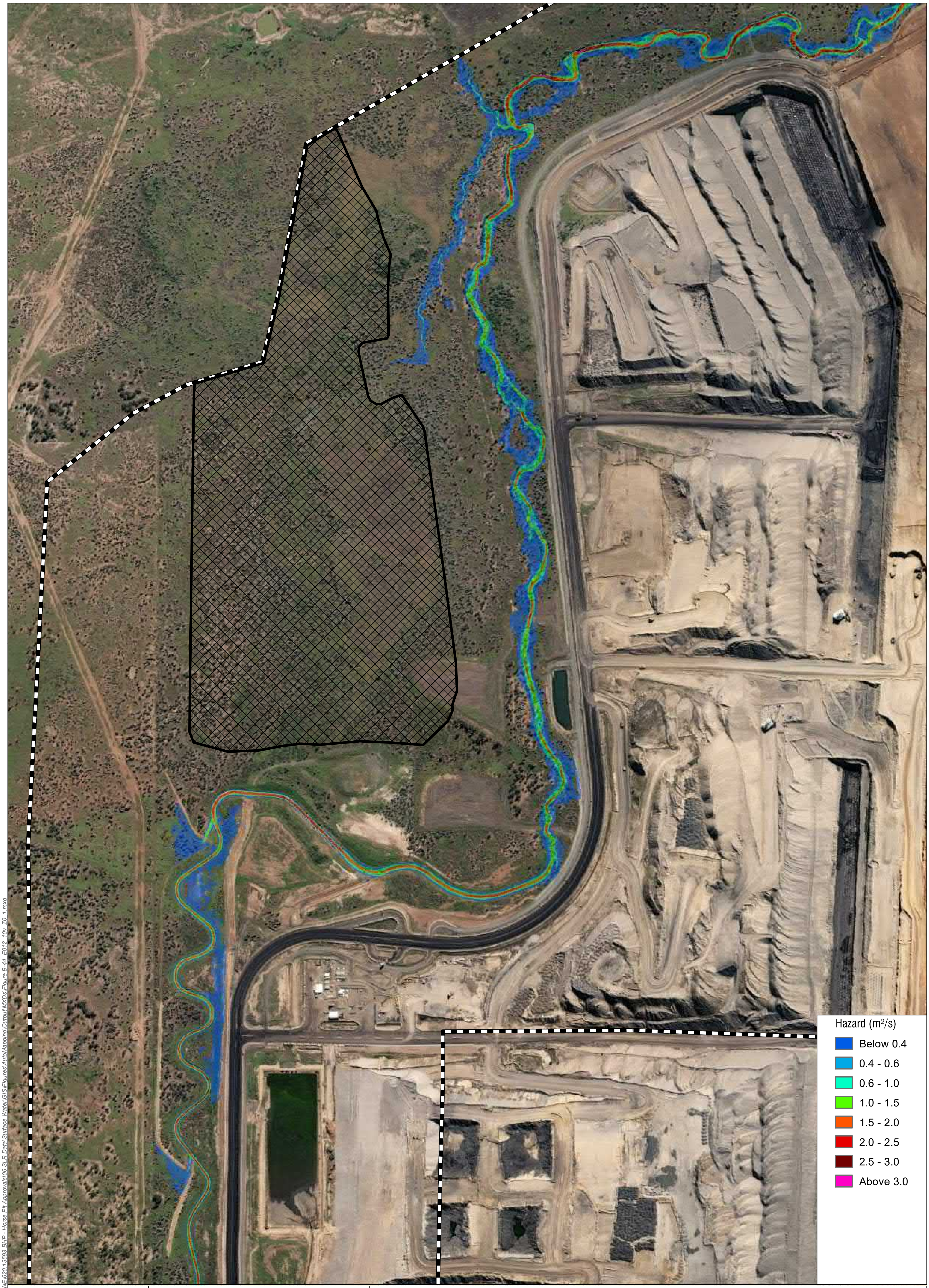
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 50% AEP

Figure B-43

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-43_E012_2y_Z0_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

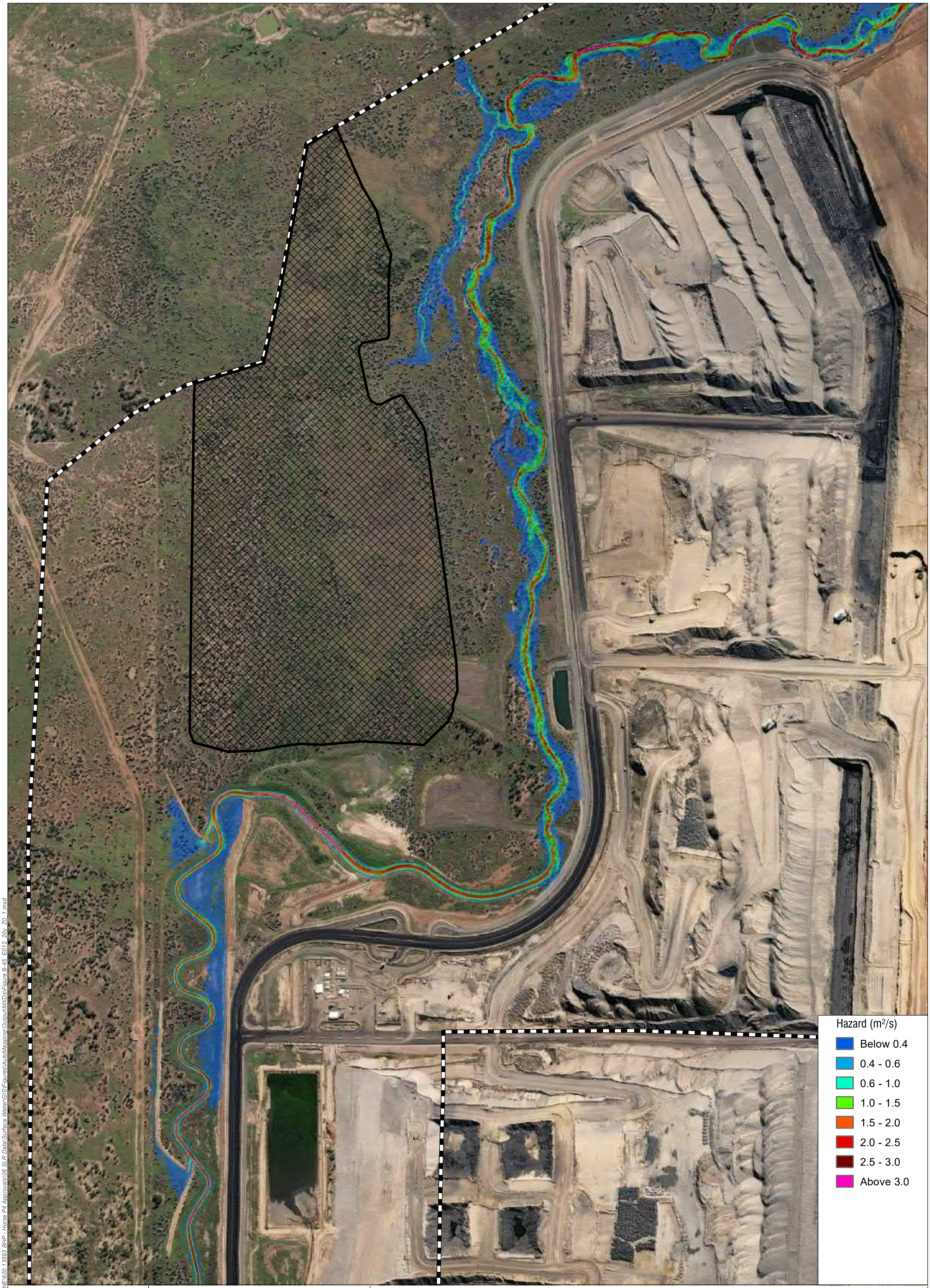
Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 10% AEP

Figure B-44



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Waste Rock Dump

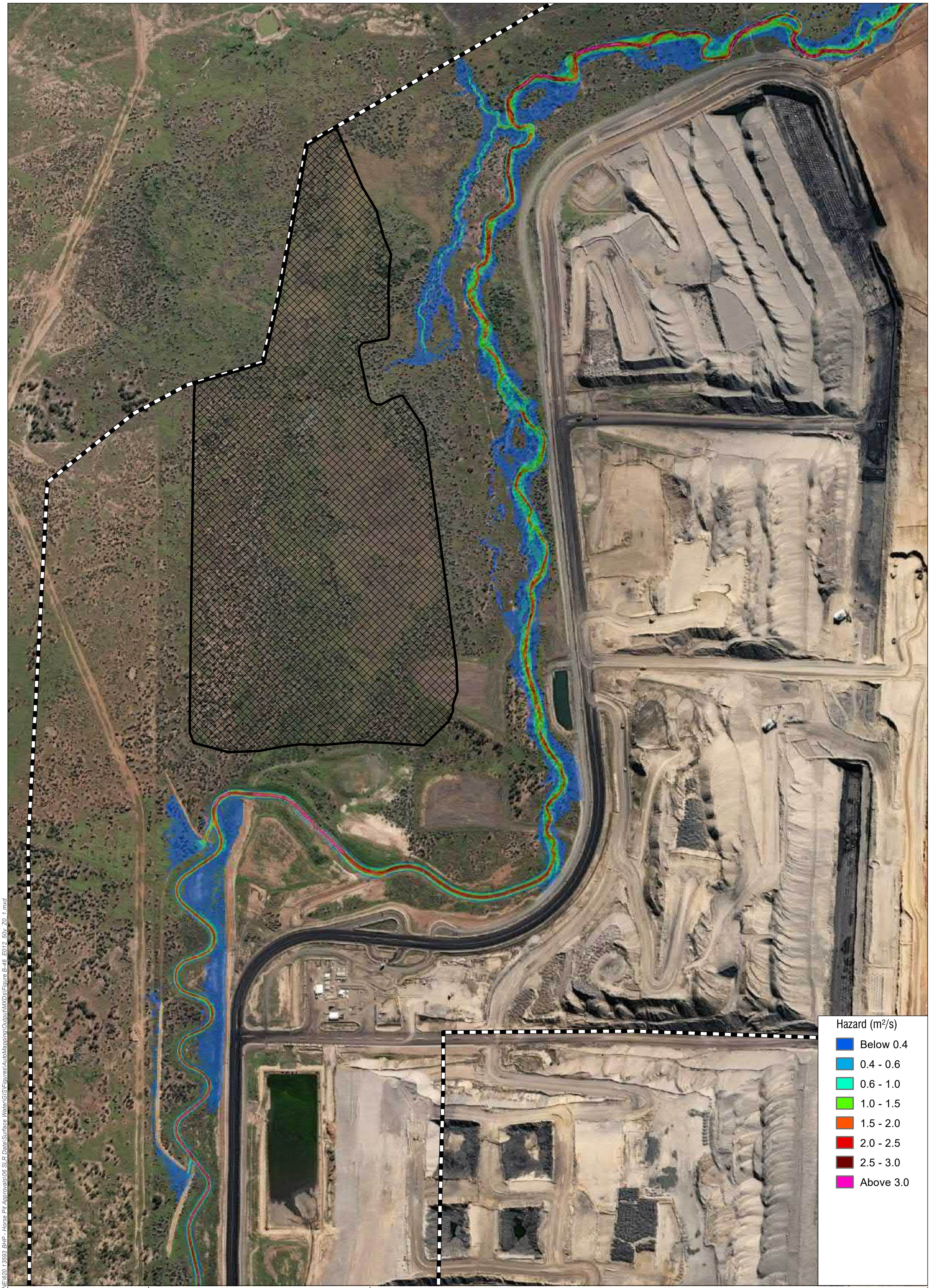
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 5% AEP

Figure B-45

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-45_E012_20y_Z0_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 2% AEP

Figure B-46

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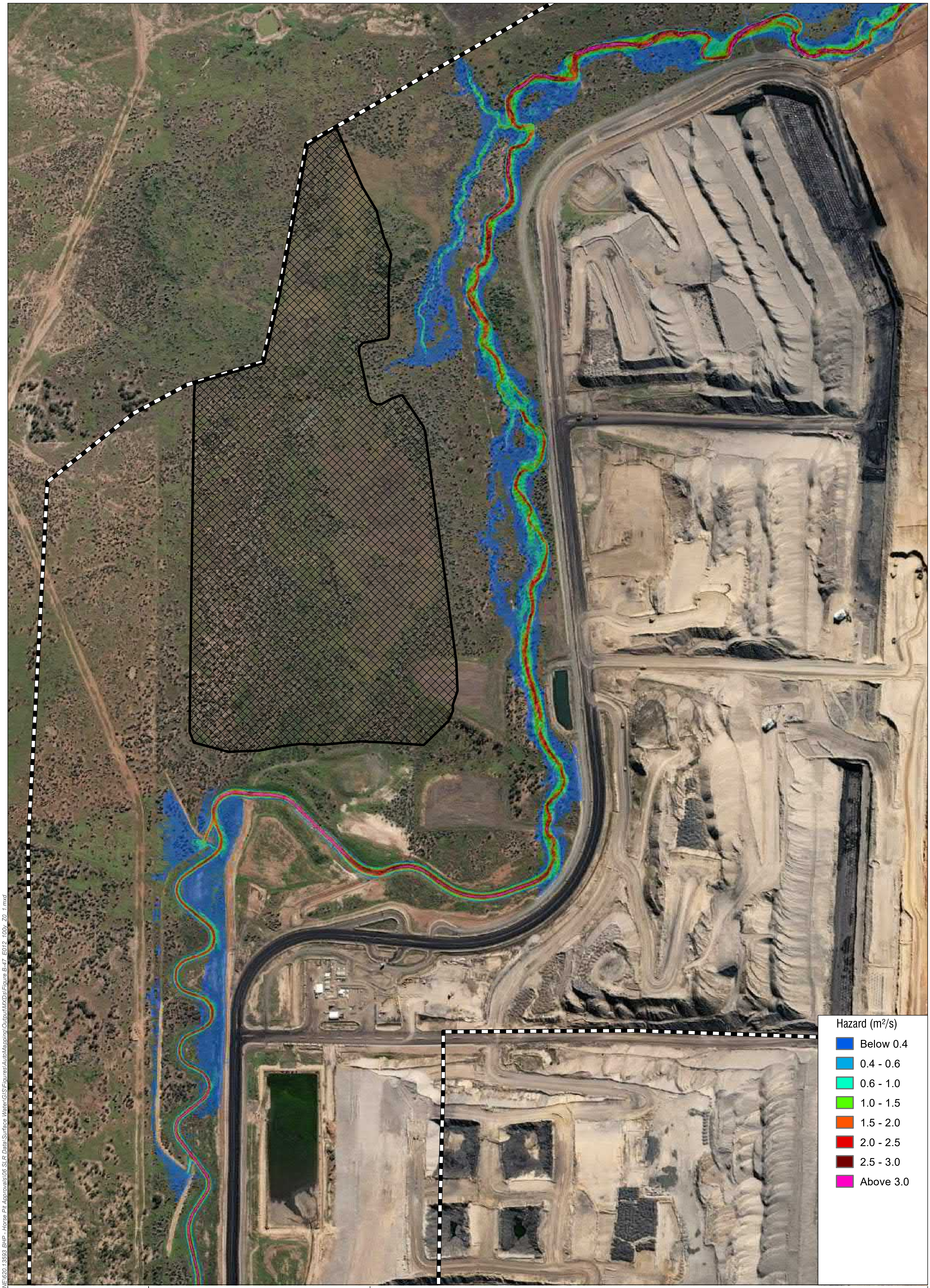

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Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

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Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 1% AEP

Figure B-47

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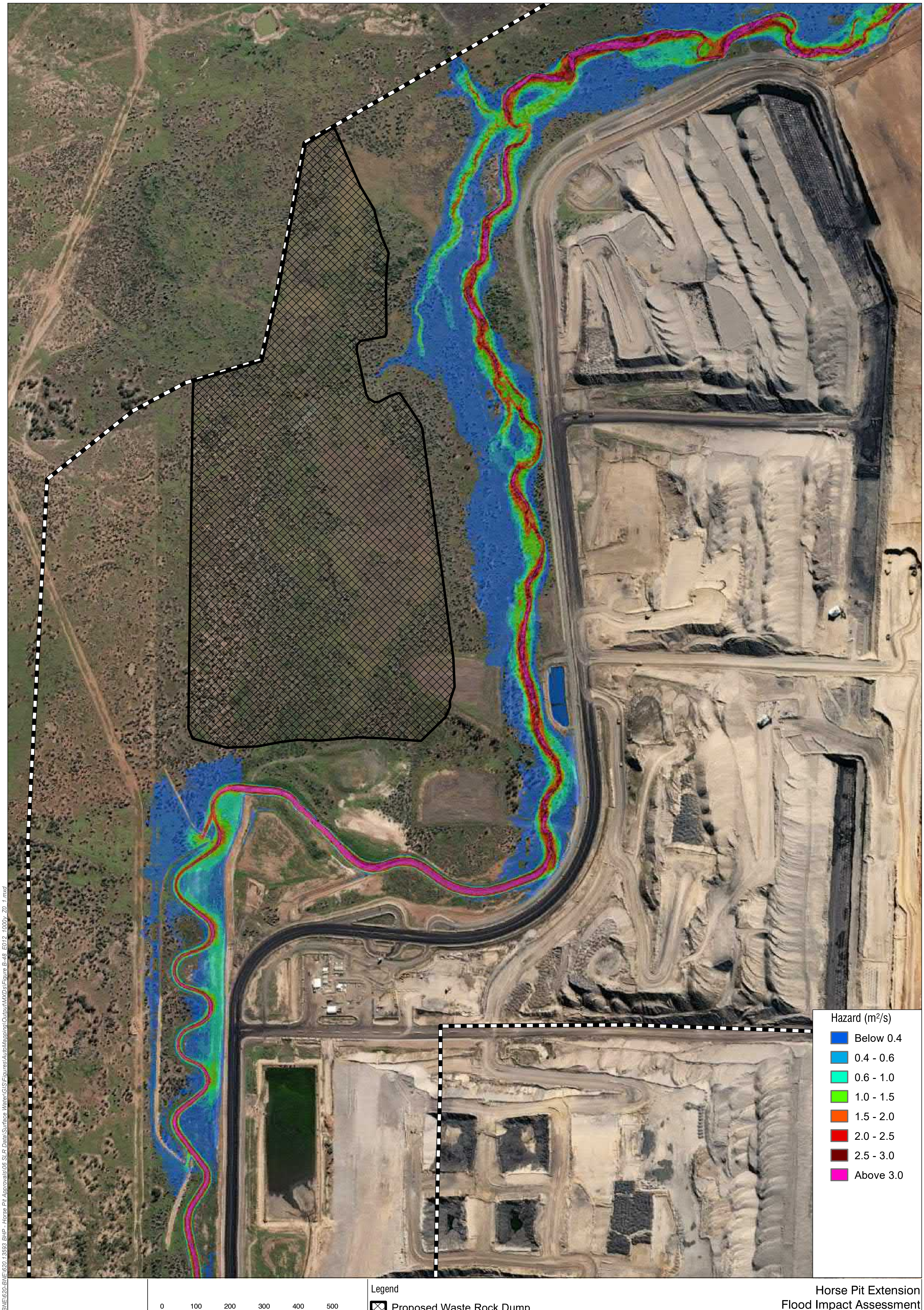

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Legend

Proposed Waste Rock Dump

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 0.1% AEP

Figure B-48

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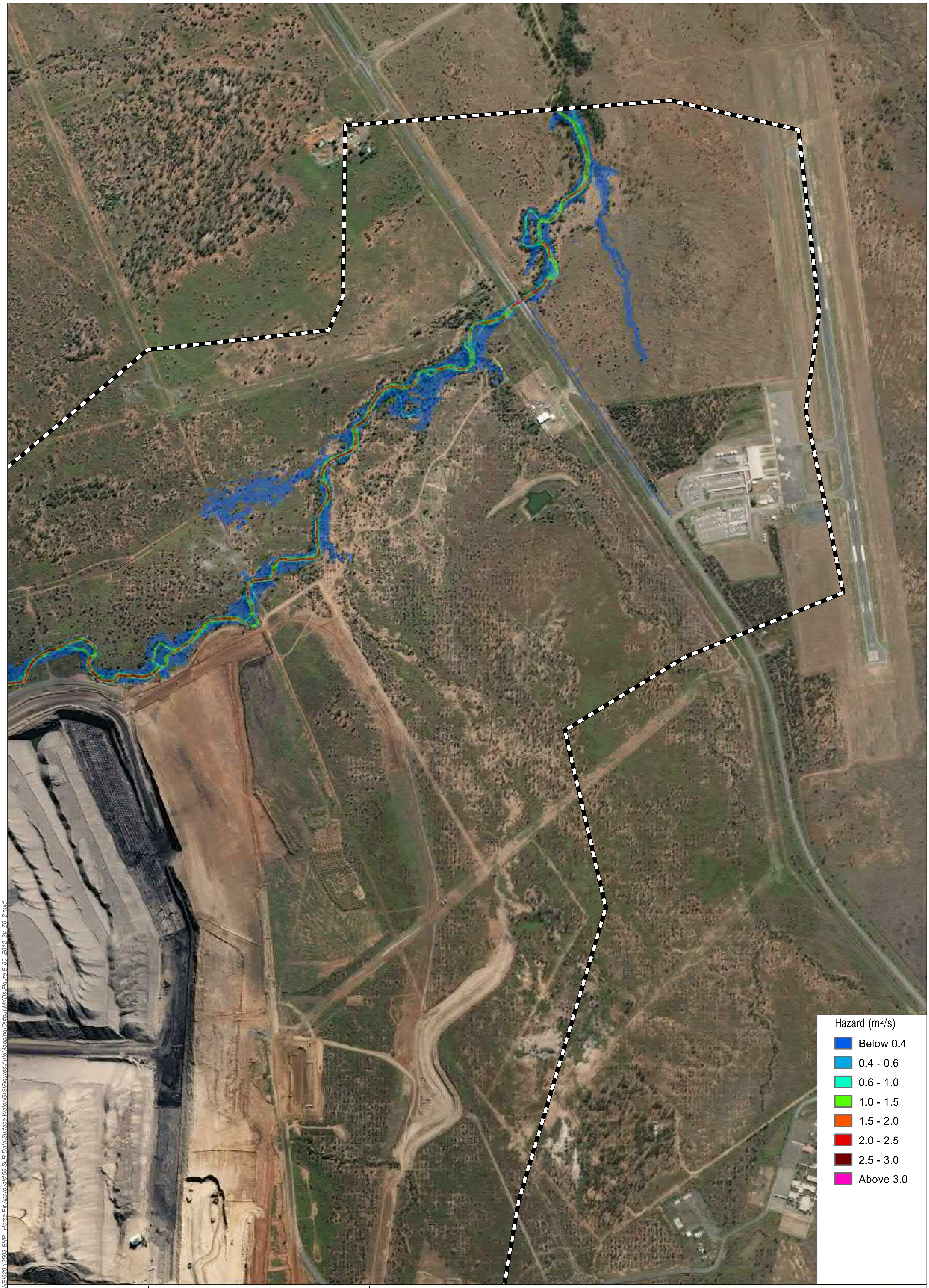

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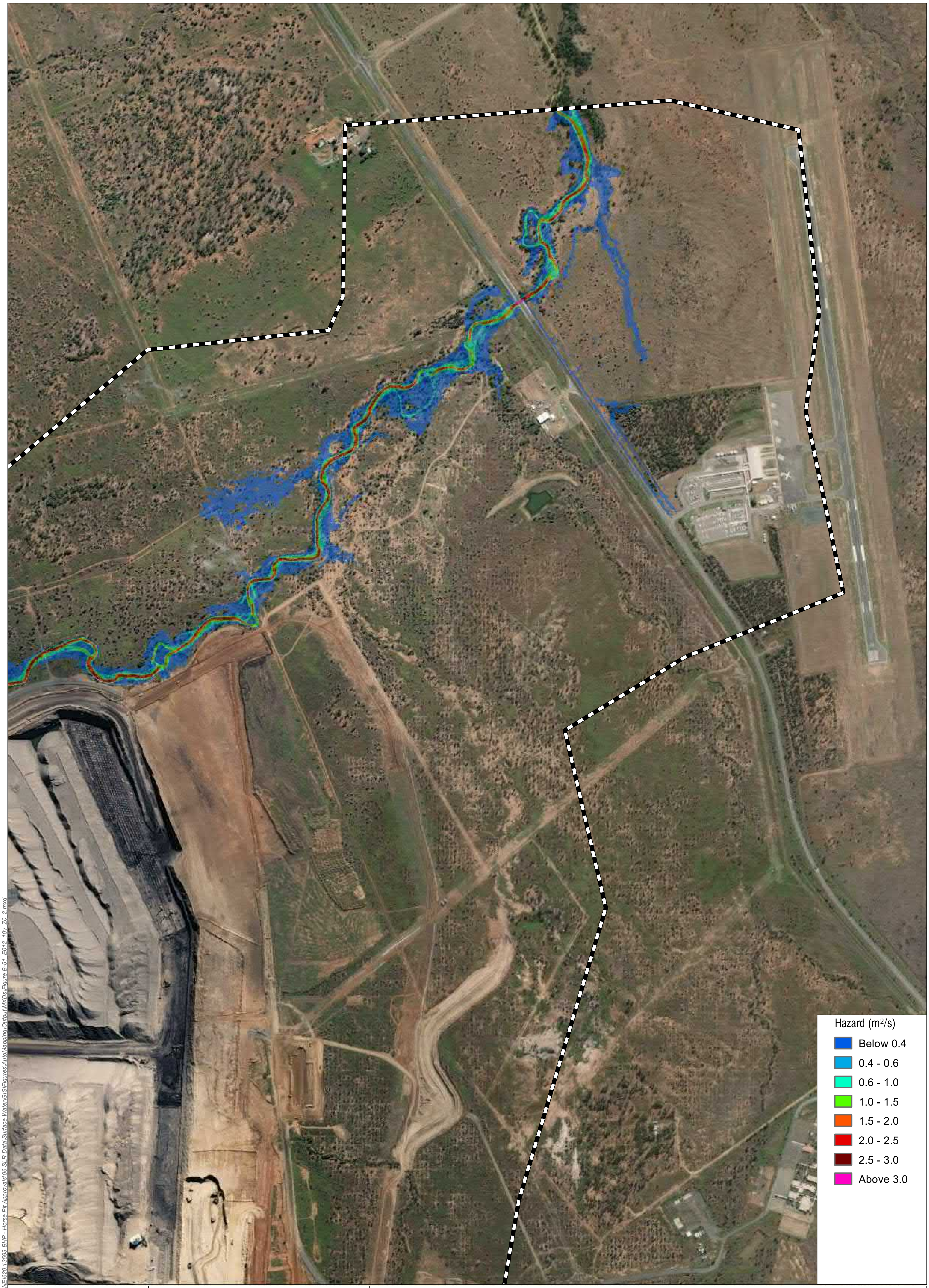
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 50% AEP

Figure B-50



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

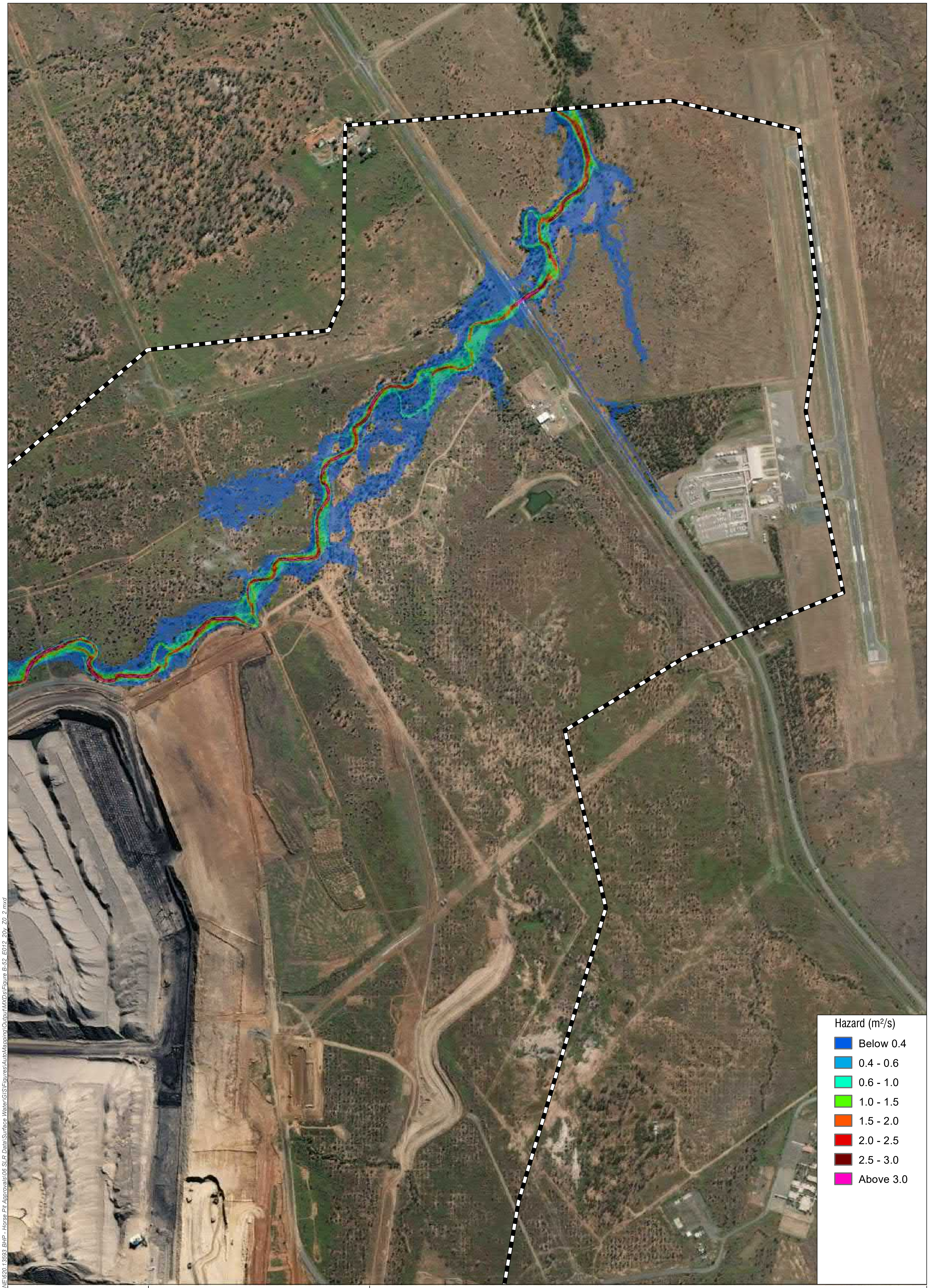
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 10% AEP

Figure B-51



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

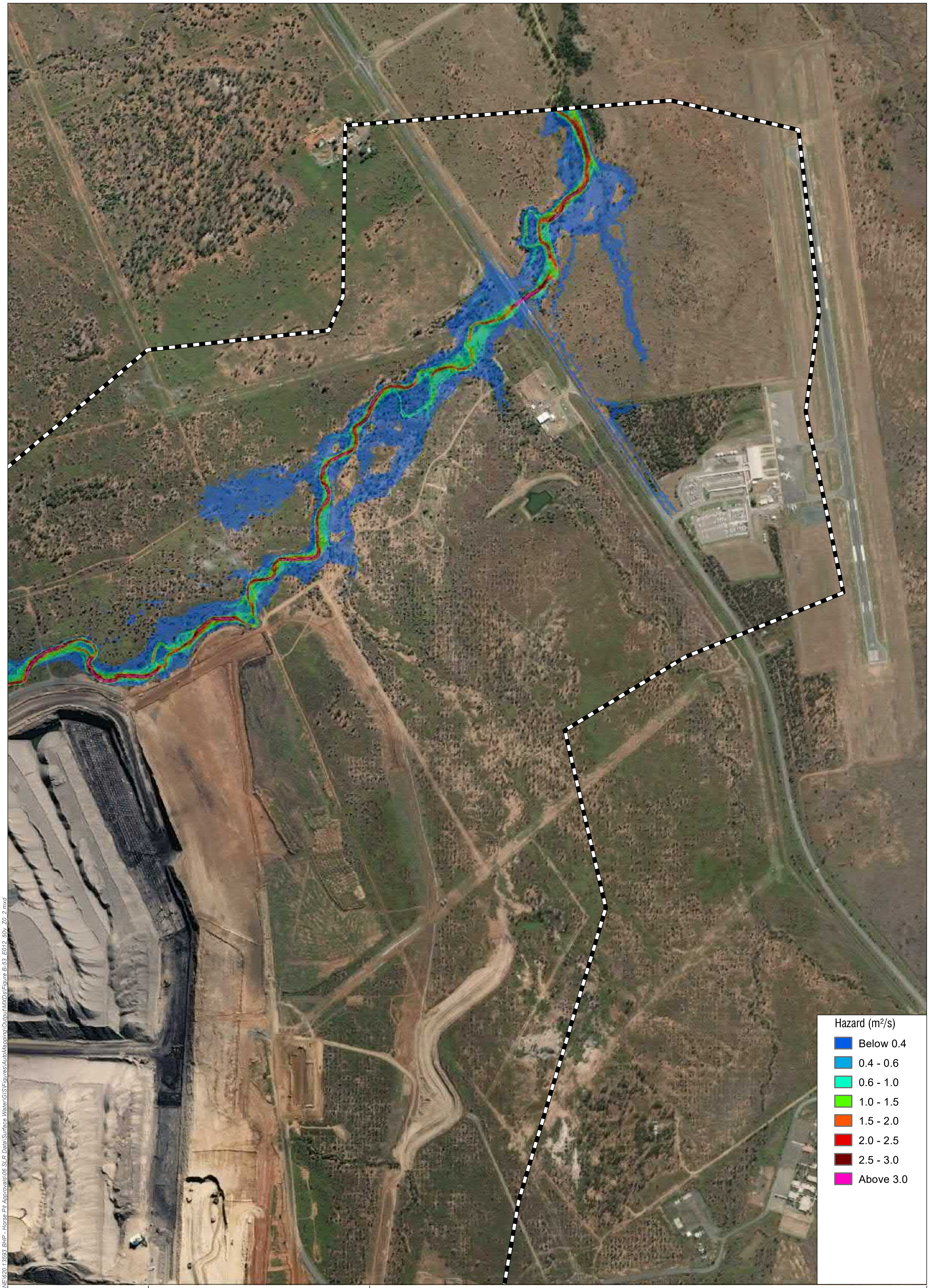
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 5% AEP

Figure B-52



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Sheet Size : A3 GDA 1994 MGA Zone 55

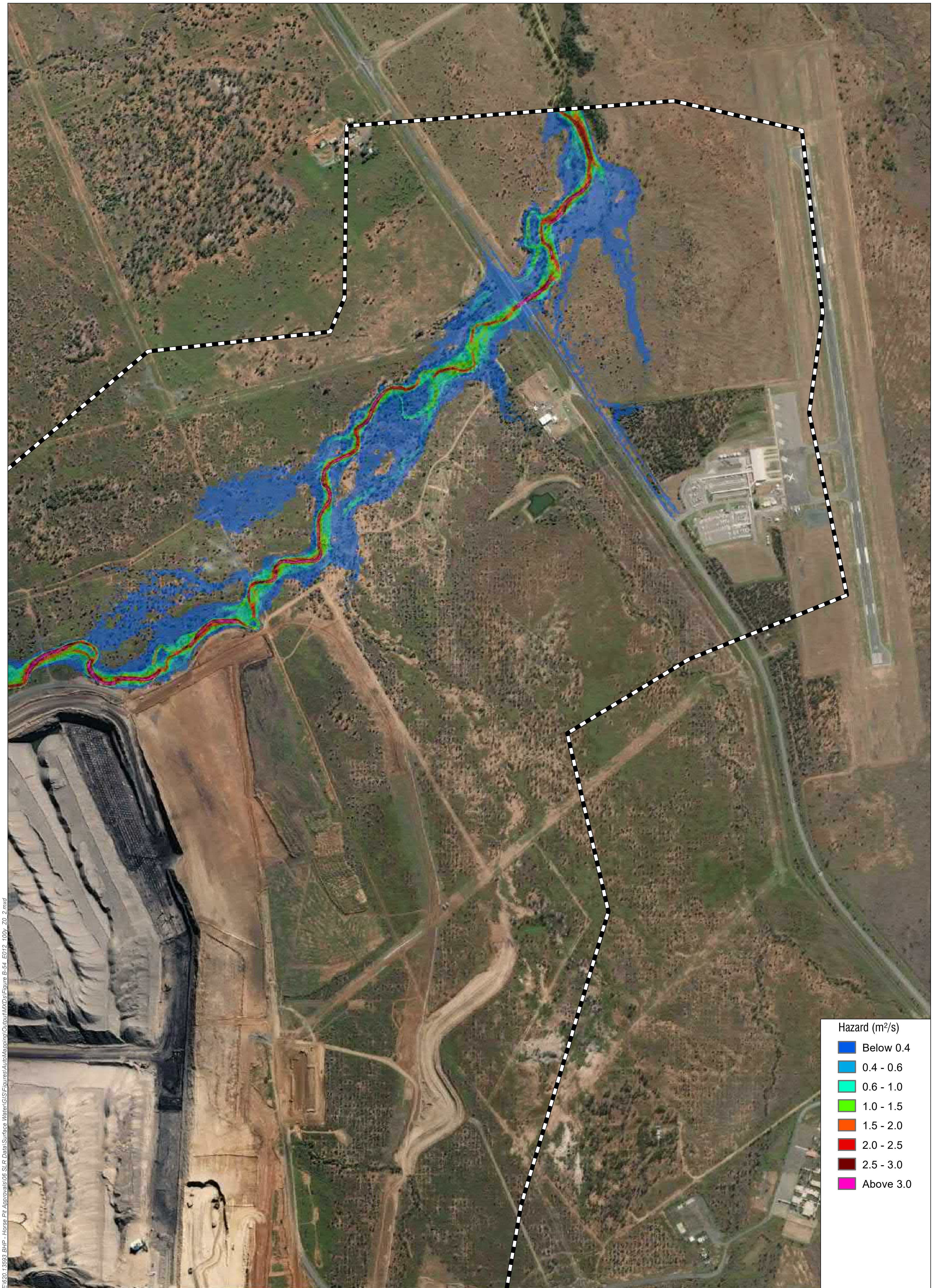
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 2% AEP

Figure B-53



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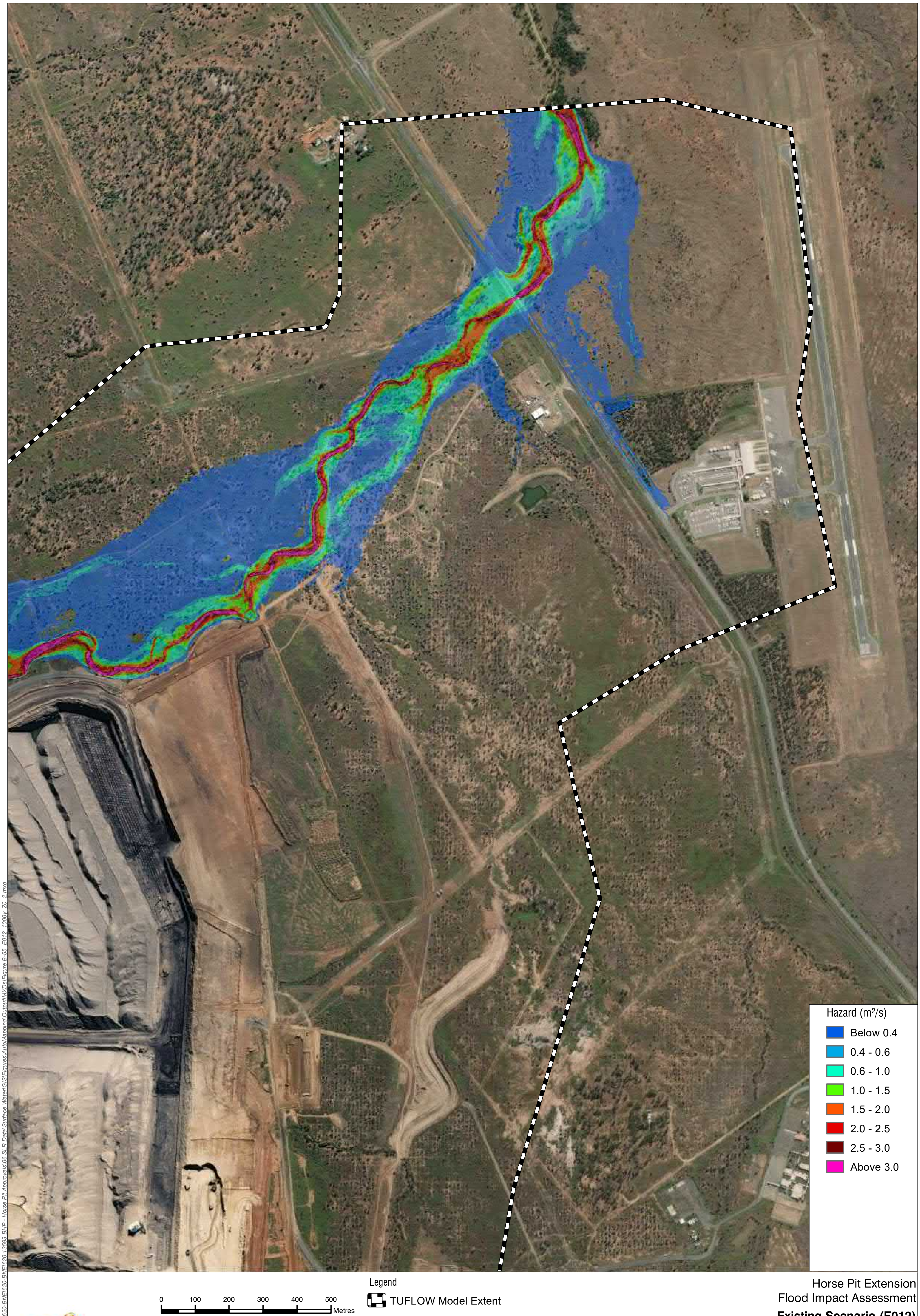
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 1% AEP

Figure B-54



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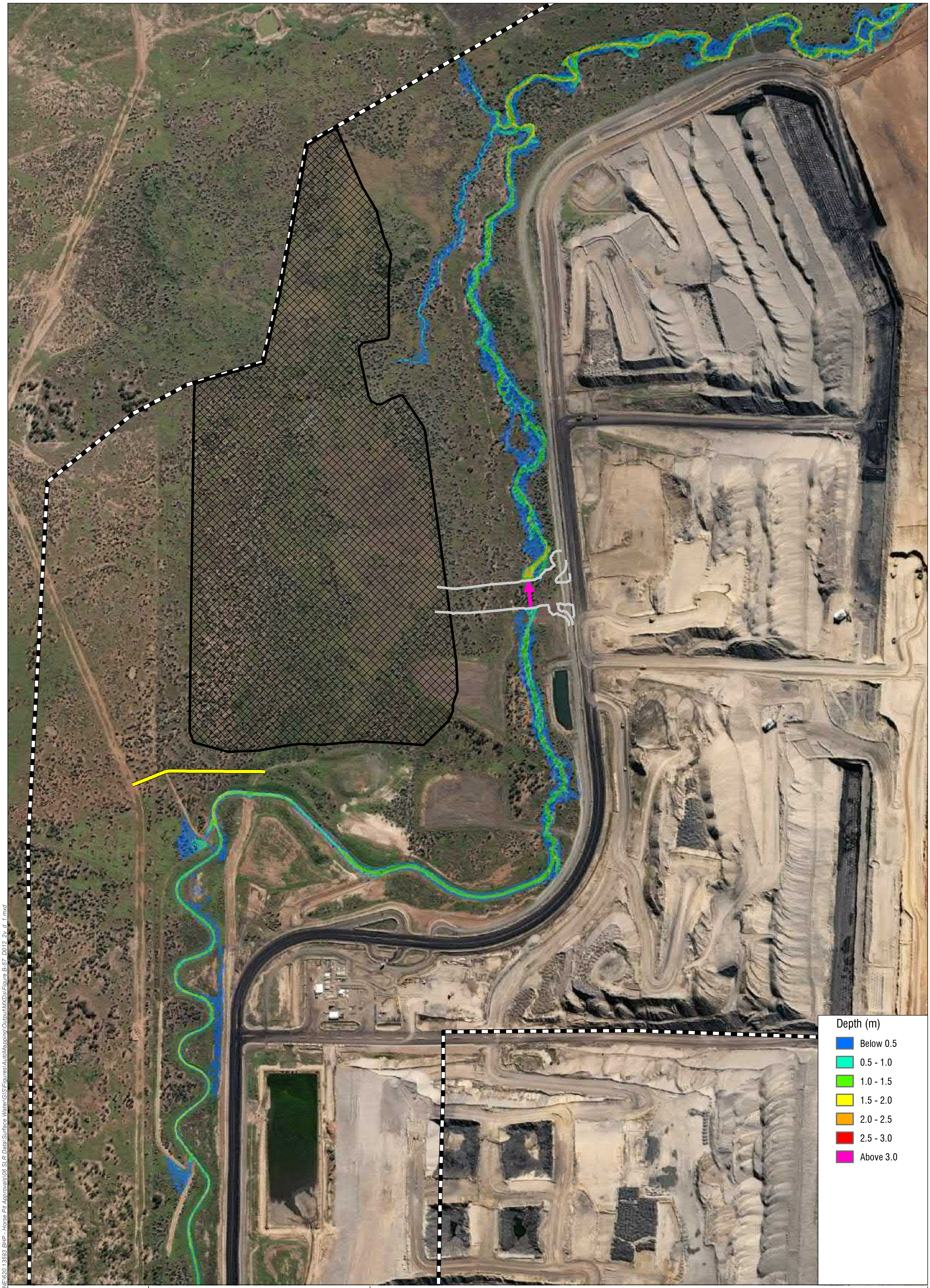
Legend

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Existing Scenario (E012)
Peak Flood Hazard - 0.1% AEP

Figure B-55



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Sheet Size : A3 GDA 1994 MGA Zone 55

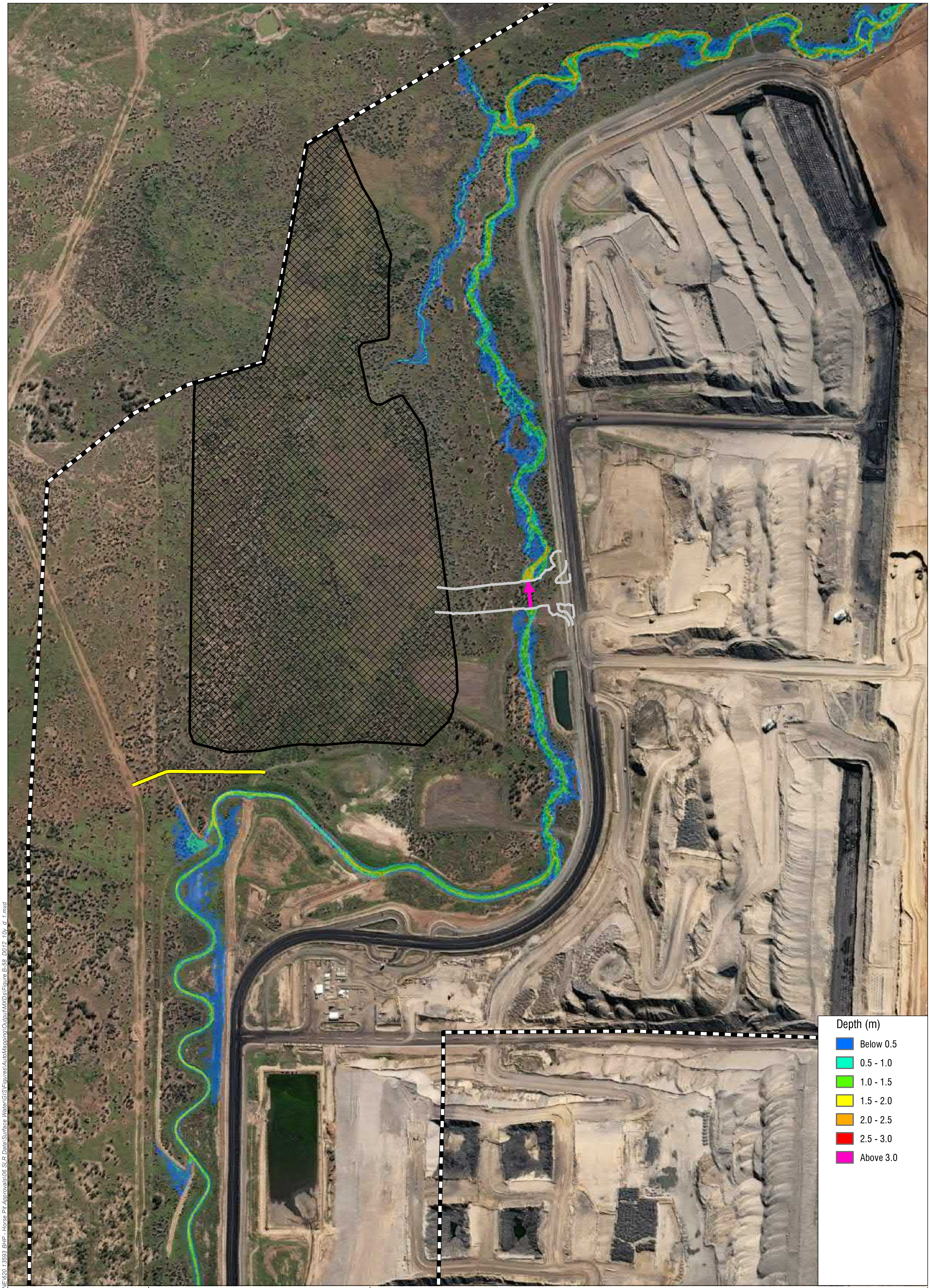
Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 50% AEP

Figure B-57

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-57_D012_2y_d_1.mxd



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

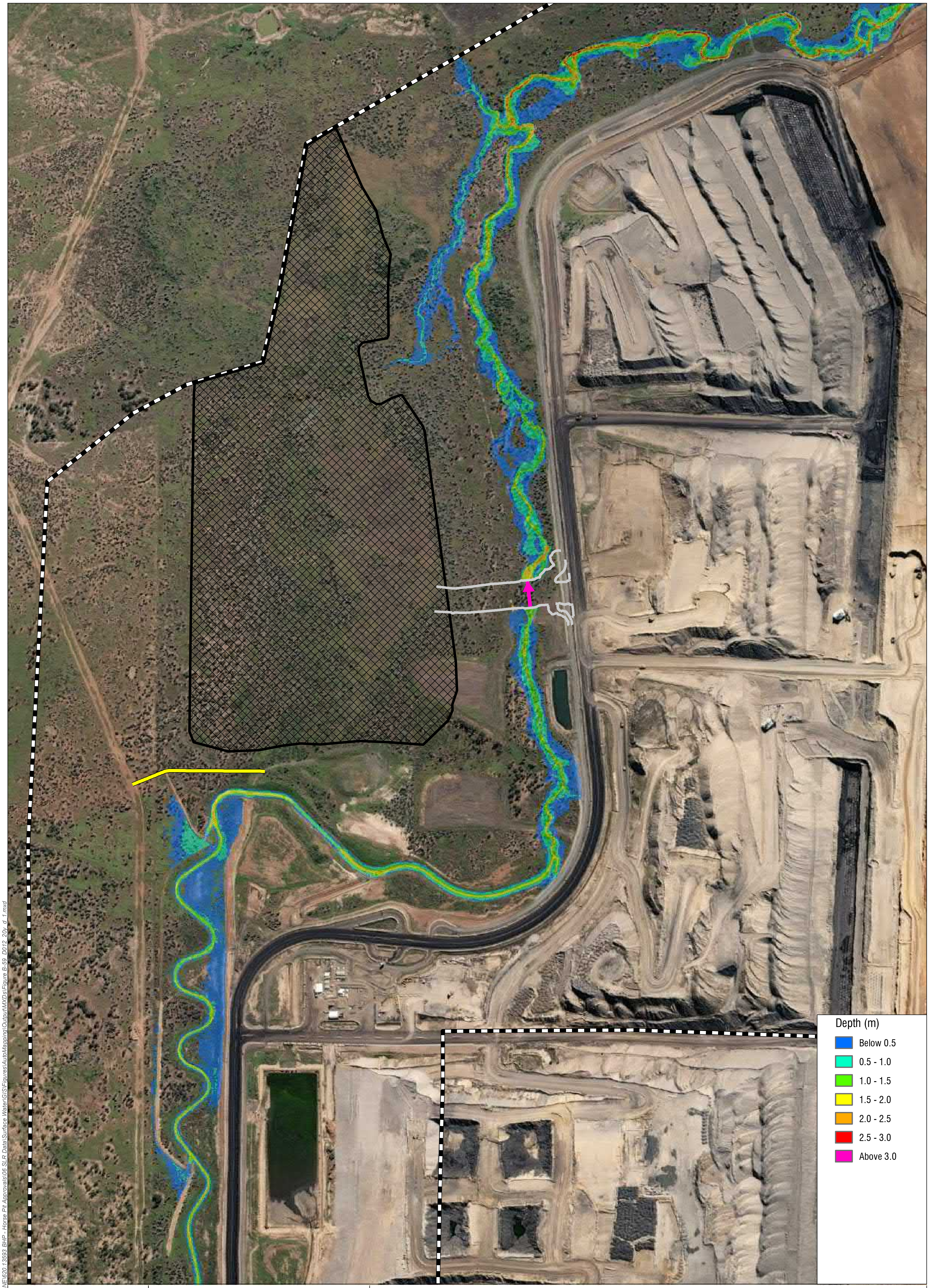
Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 10% AEP

Figure B-58



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

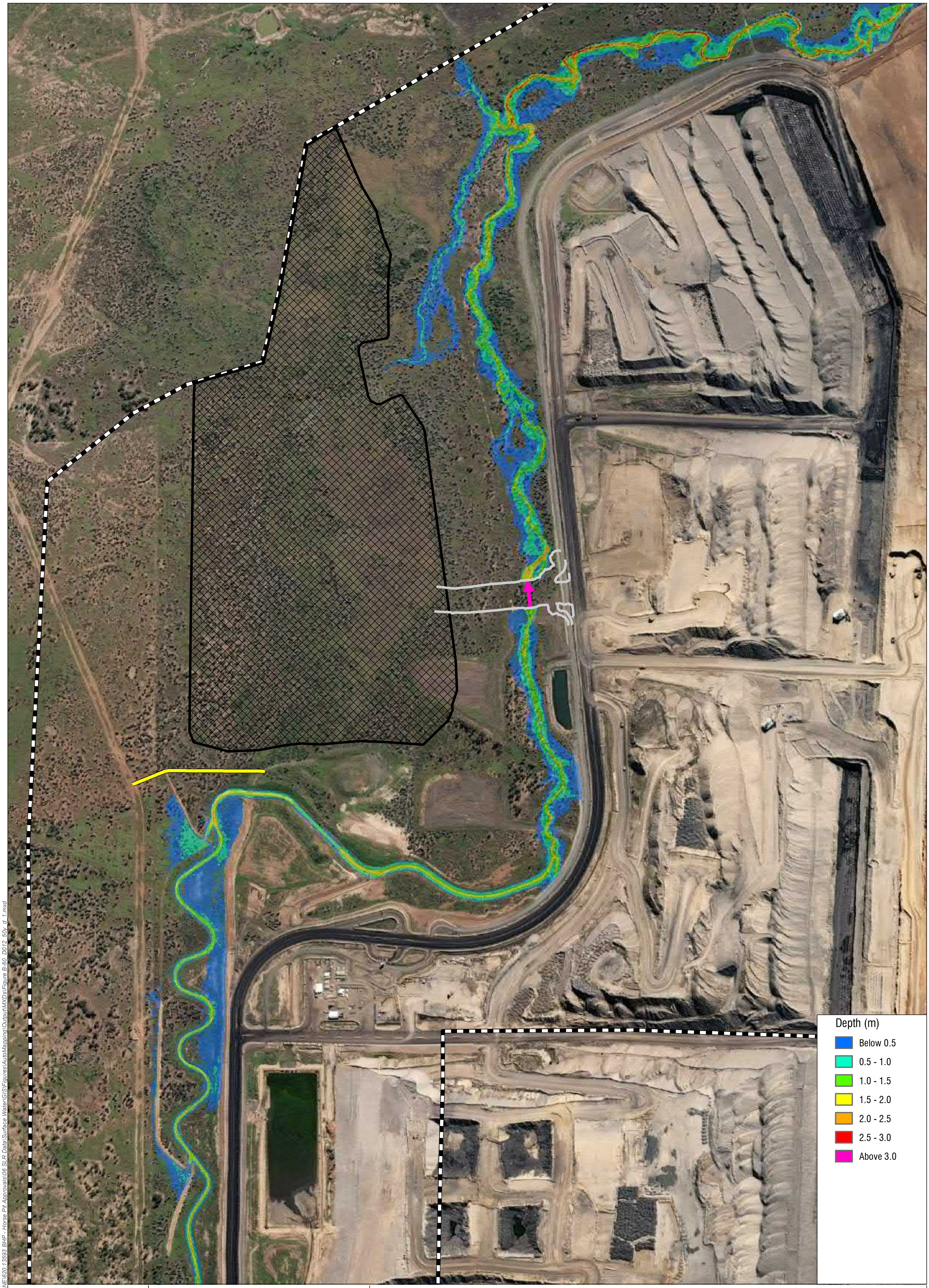
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 5% AEP

Figure B-59

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-59_D012_20y_d_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

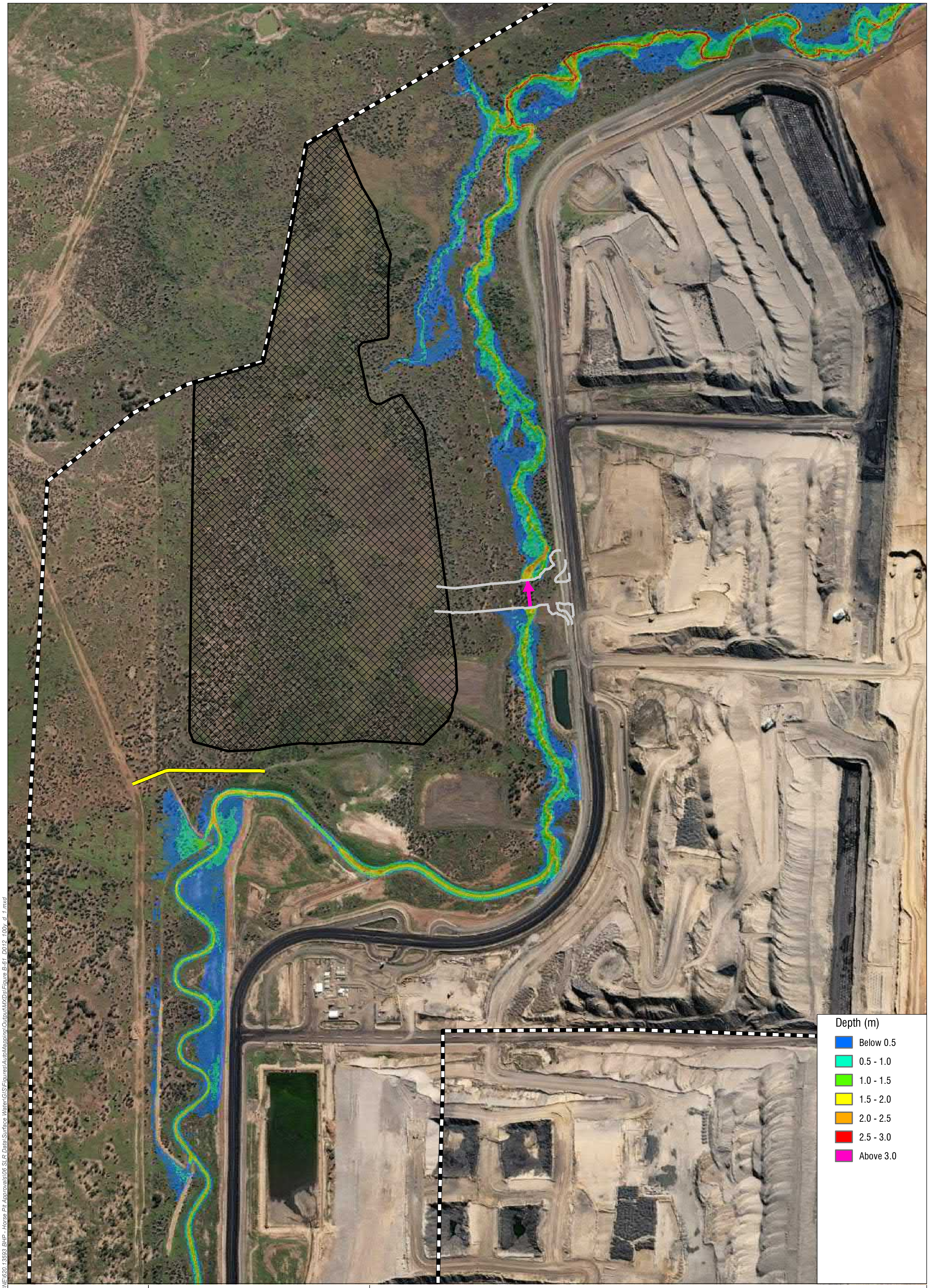
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 2% AEP

Figure B-60



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

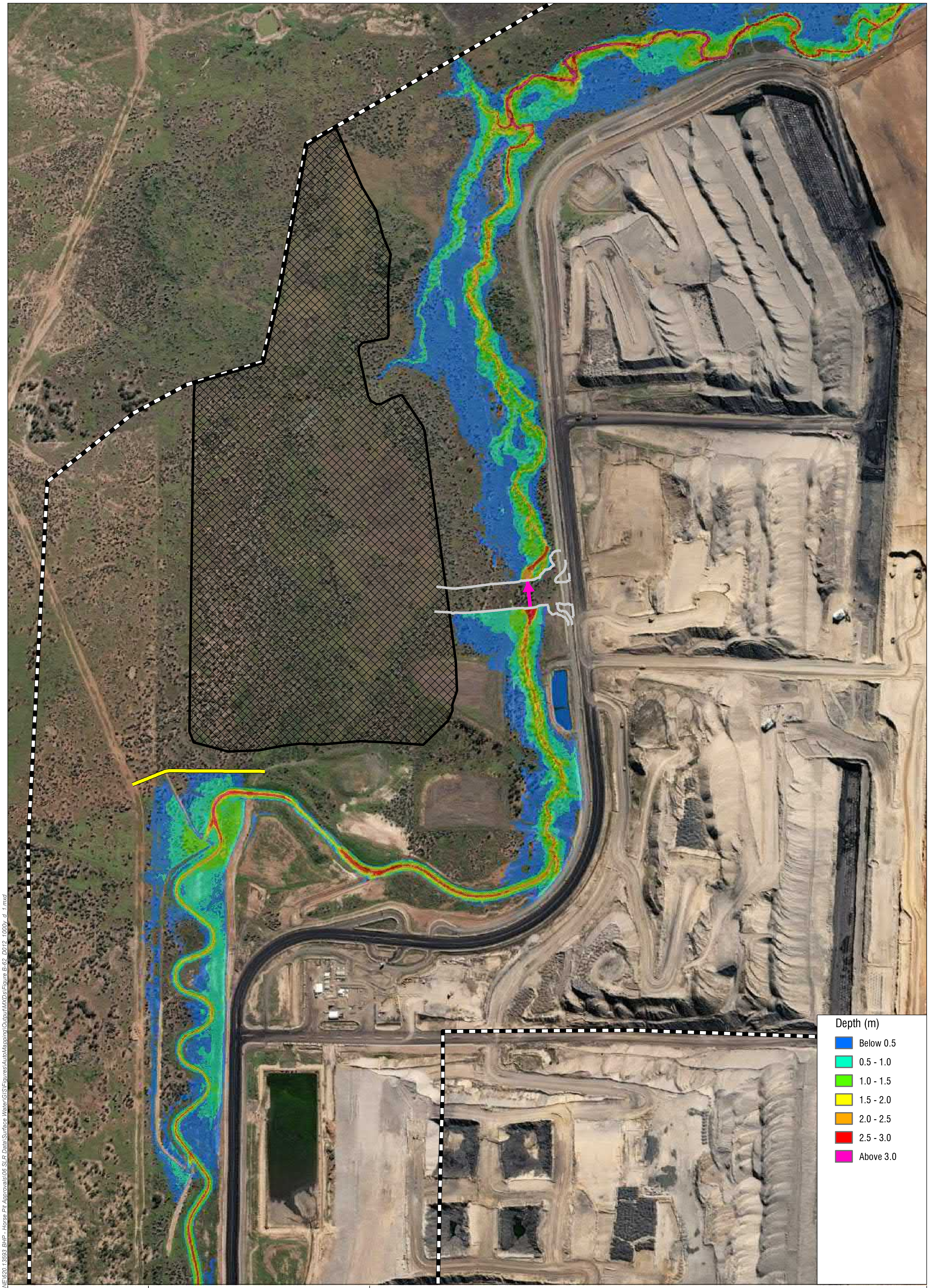
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 1% AEP

Figure B-61

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-61_D012_100y_d_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

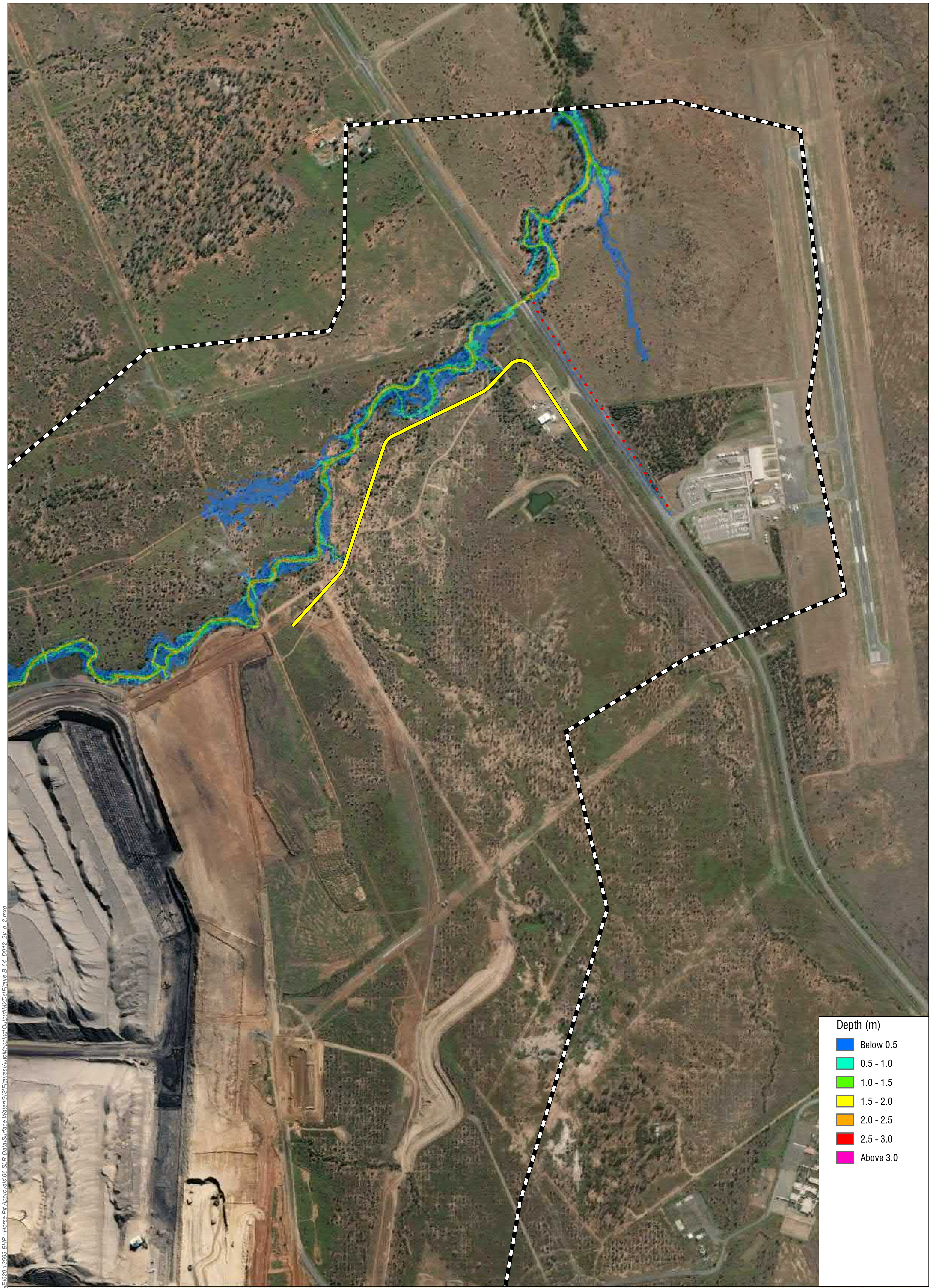
Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 0.1% AEP

Figure B-62



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

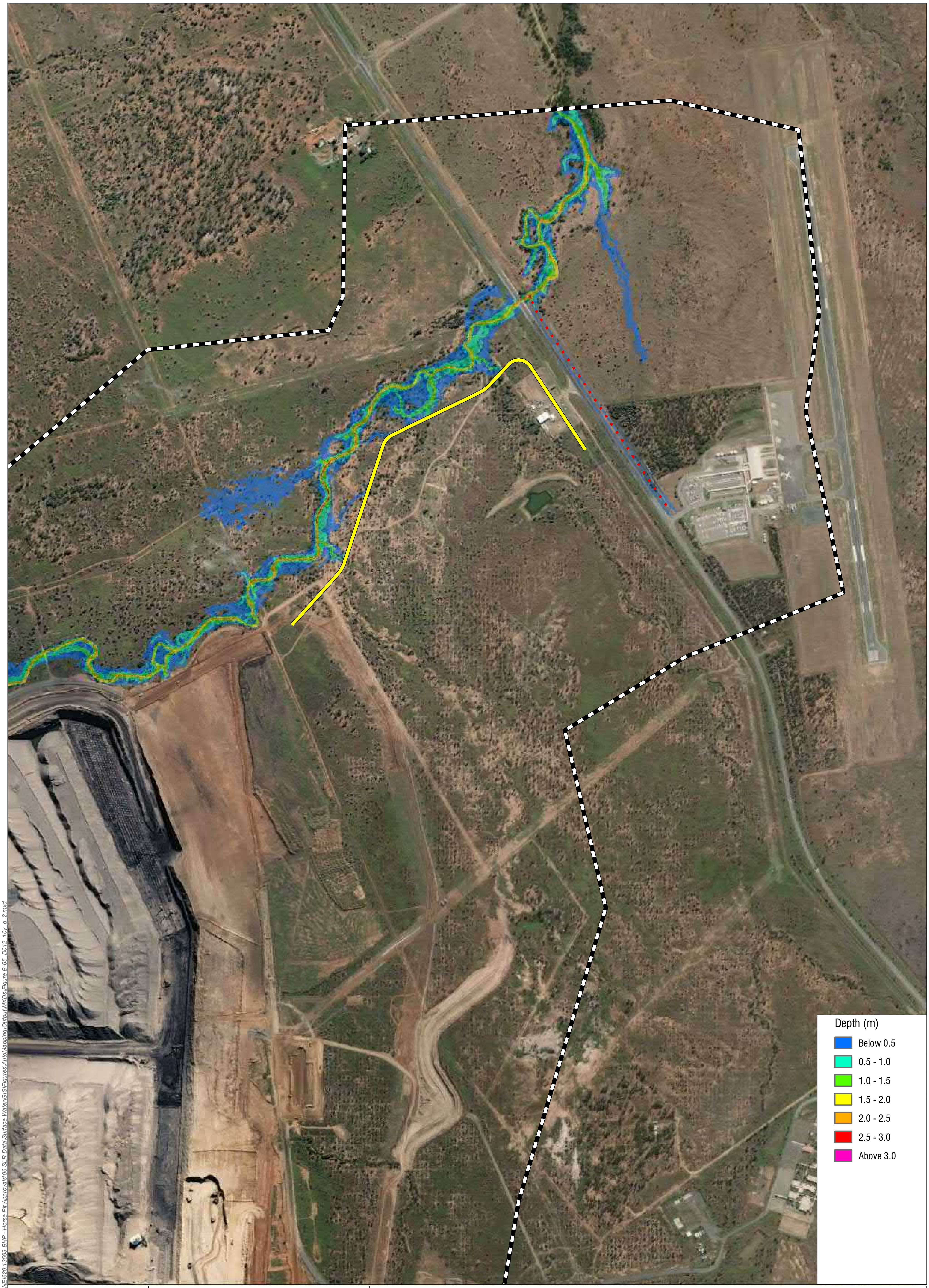
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 50% AEP

Figure B-64



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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

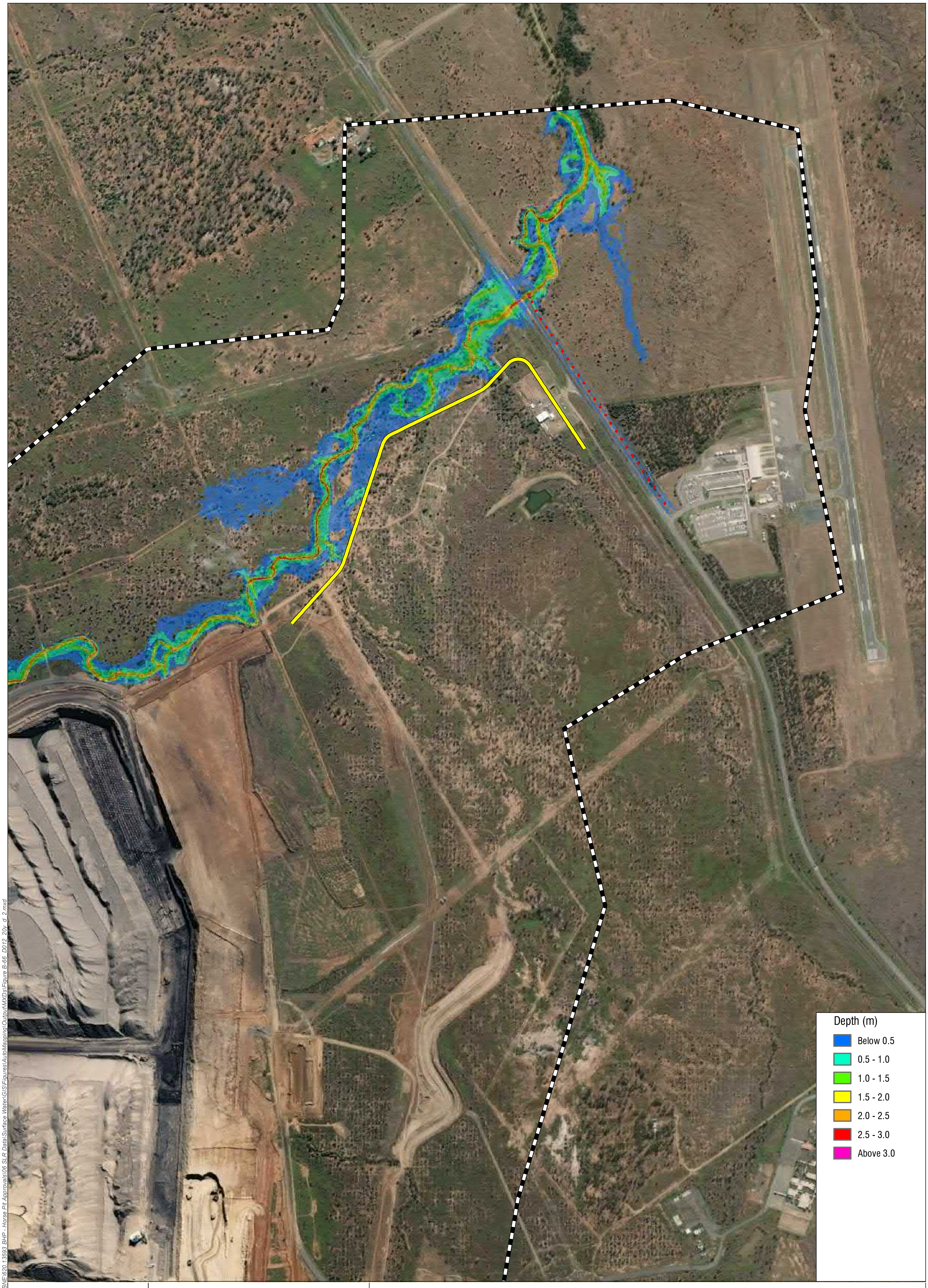
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 10% AEP

Figure B-65

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-65_D012_10y_d_2.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

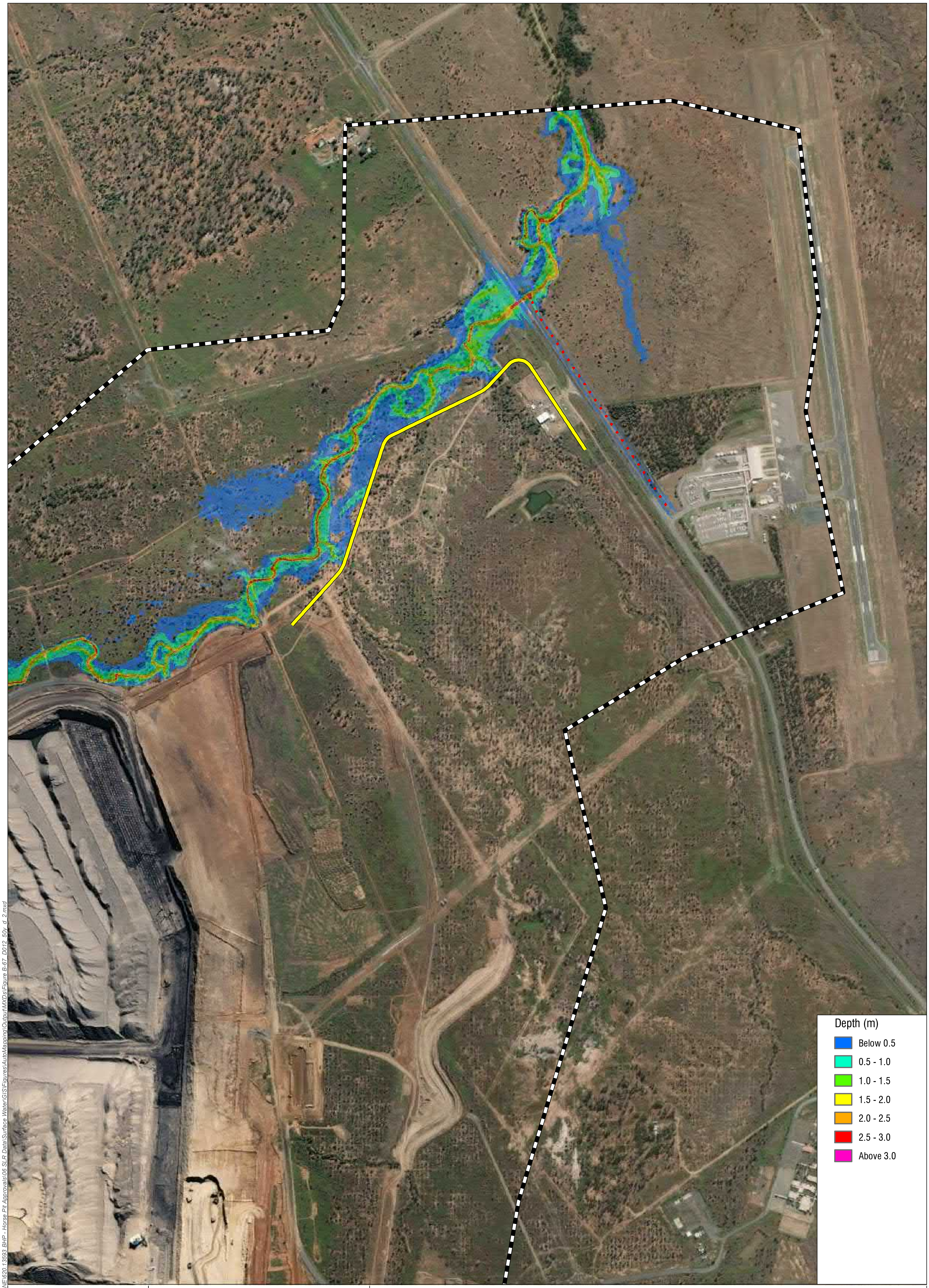
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 5% AEP

Figure B-66



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Legend

Proposed Drain

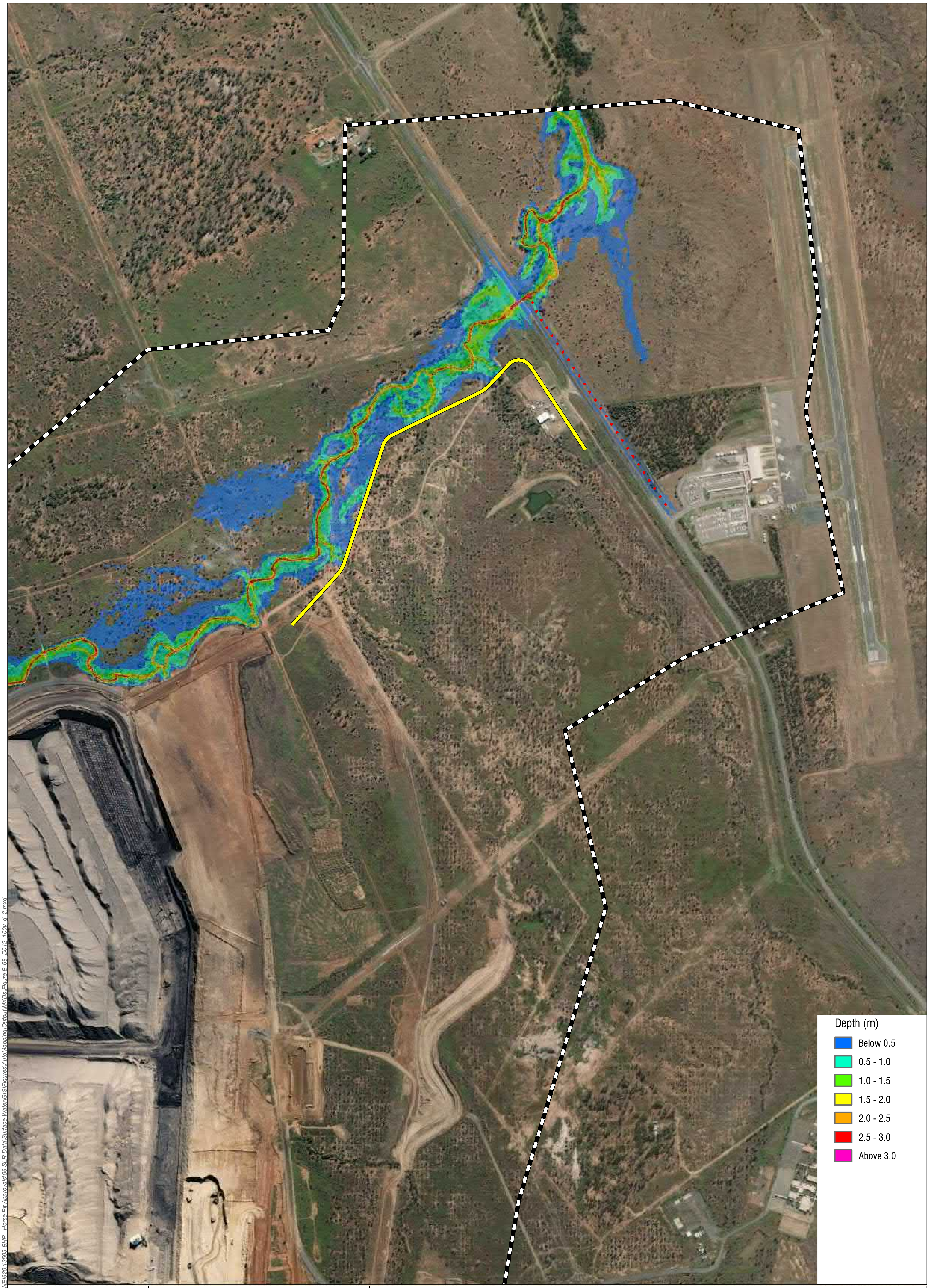
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 2% AEP

Figure B-67



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Legend

Proposed Drain

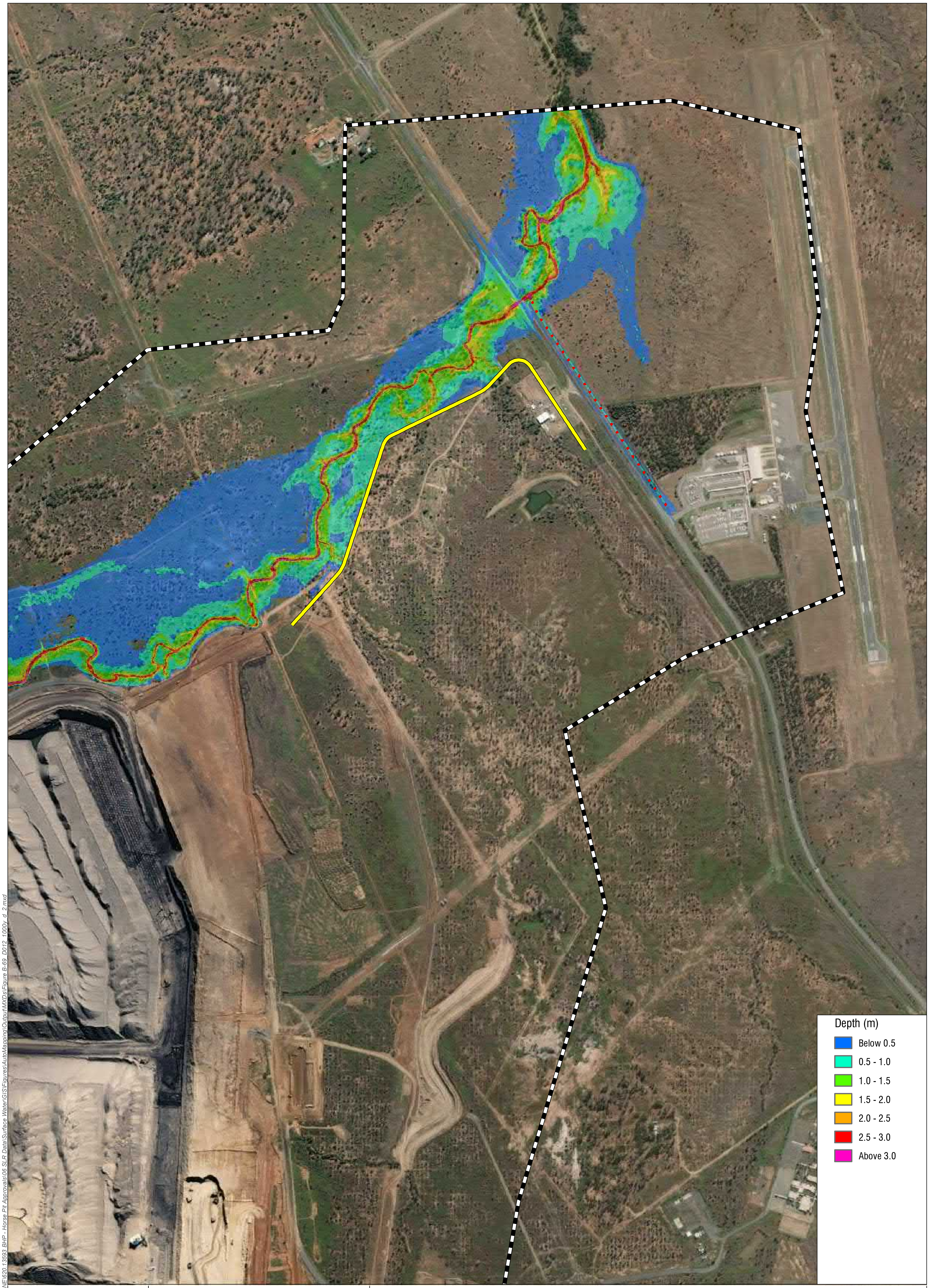
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 1% AEP

Figure B-68



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Legend

Proposed Drain

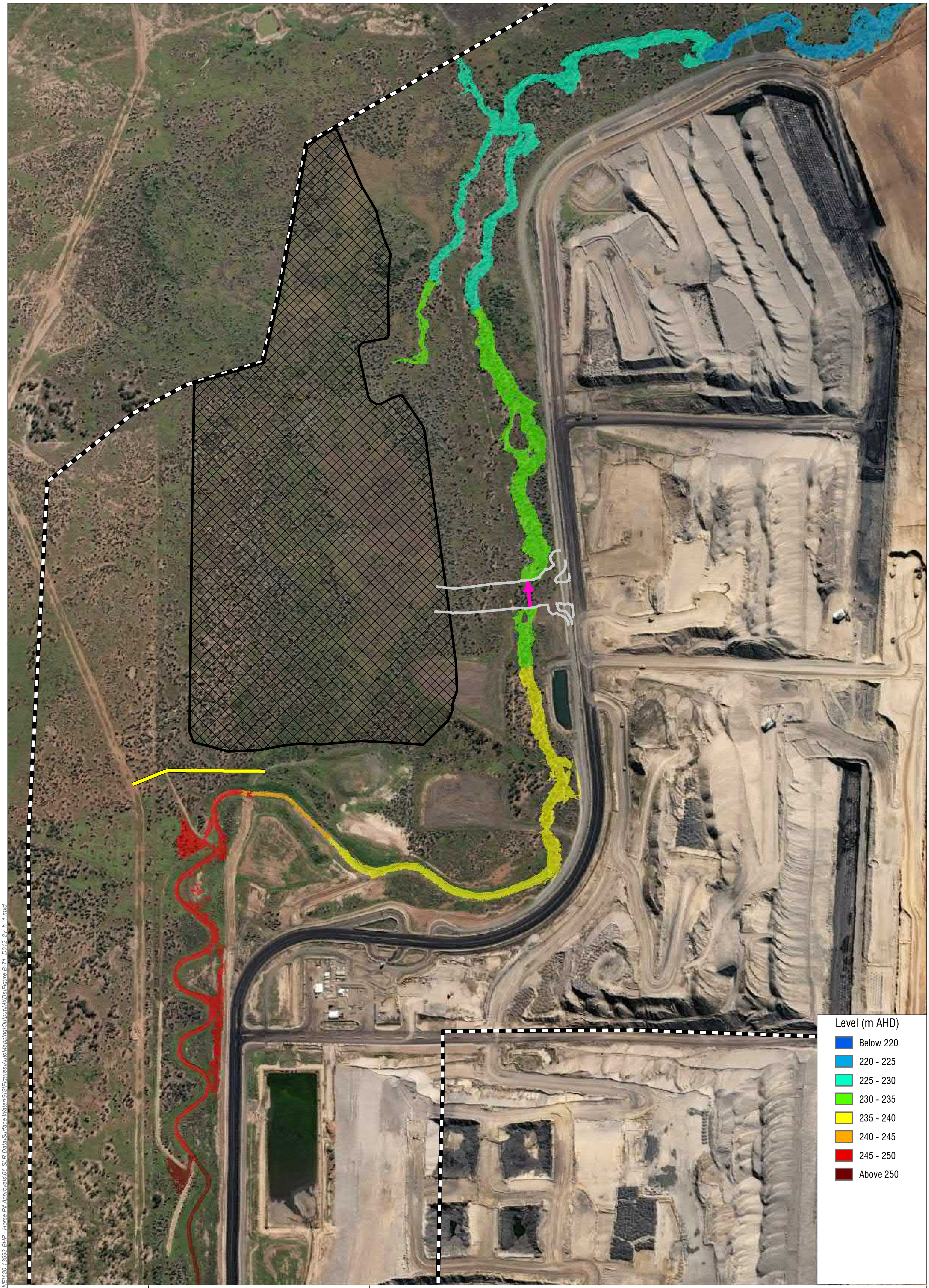
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Depths - 0.1% AEP

Figure B-69



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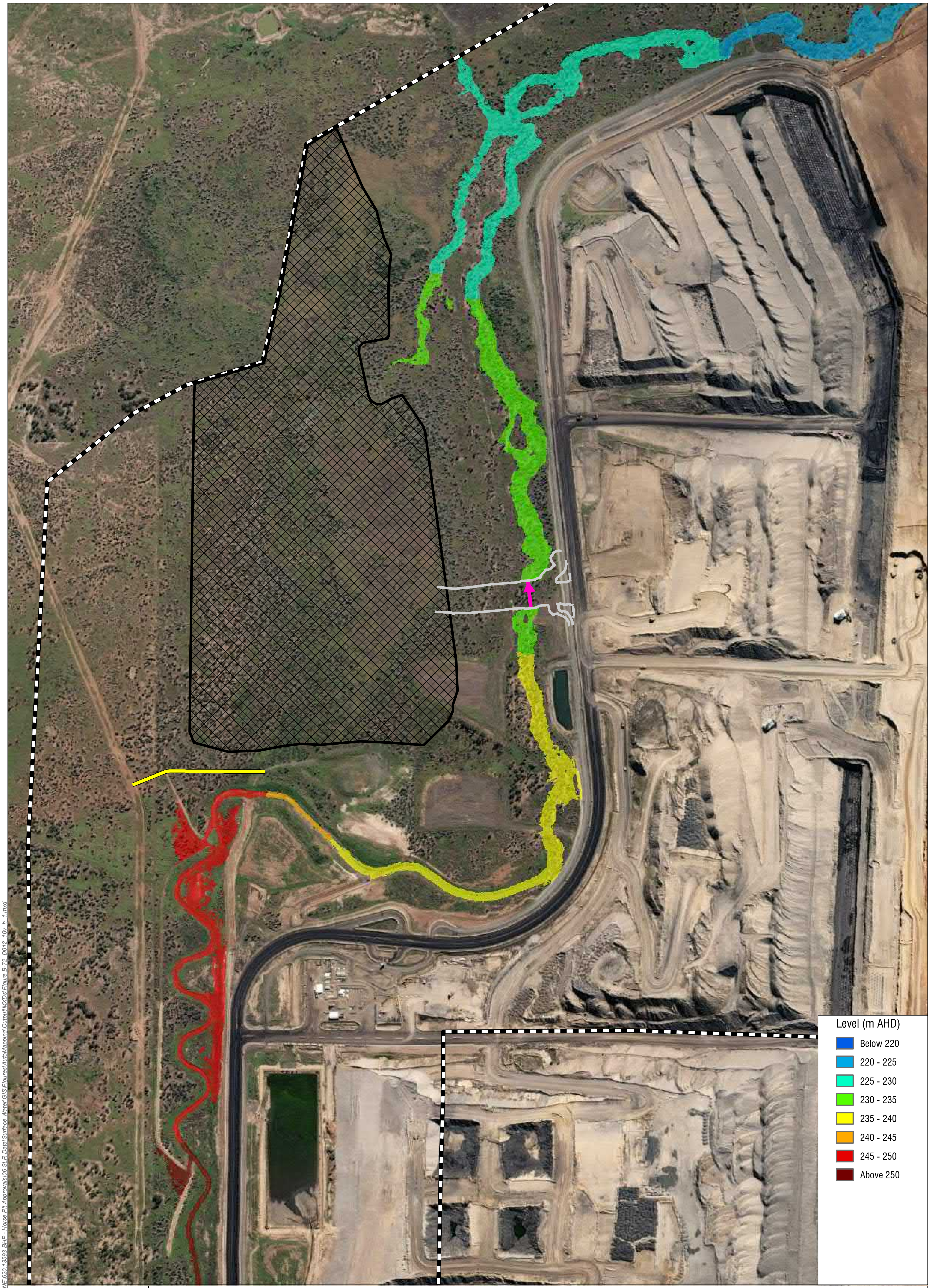
Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 50% AEP

Figure B-71



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Sheet Size : A3 GDA 1994 MGA Zone 55

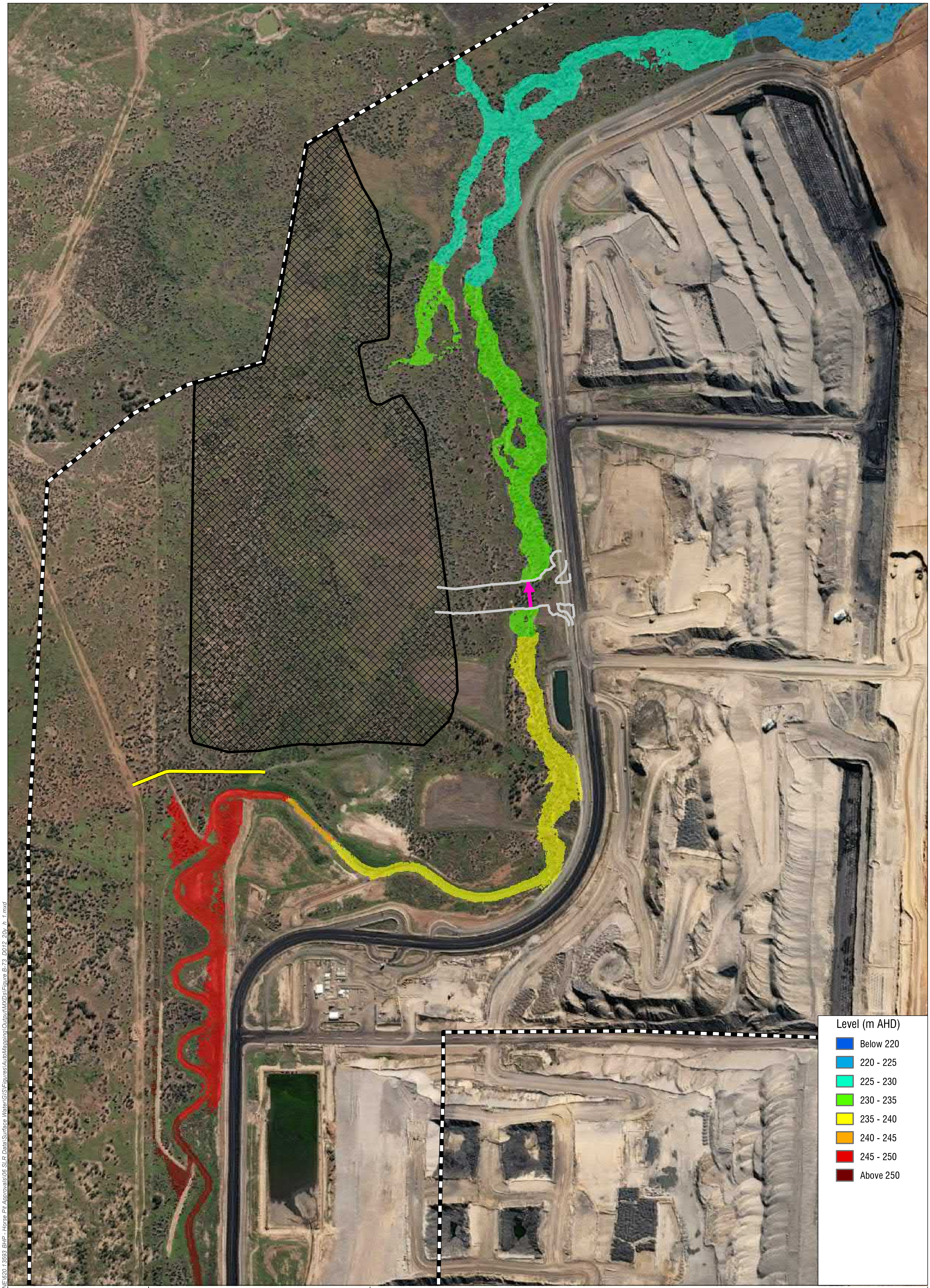
Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 10% AEP

Figure B-72

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-72_D012_10y_h_1.mxd



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Legend

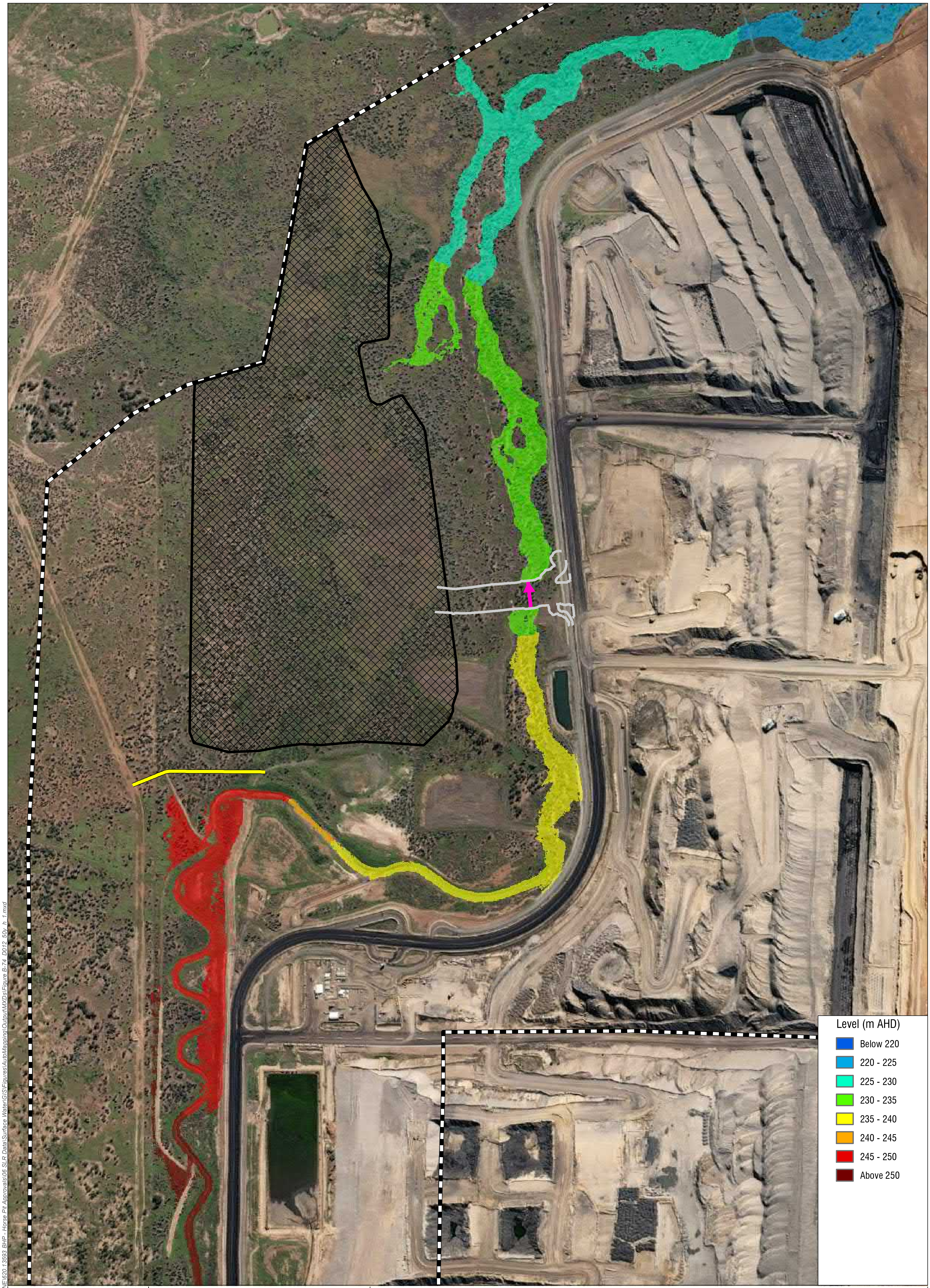
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 5% AEP

Figure B-73

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-73_D012_20y_h_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

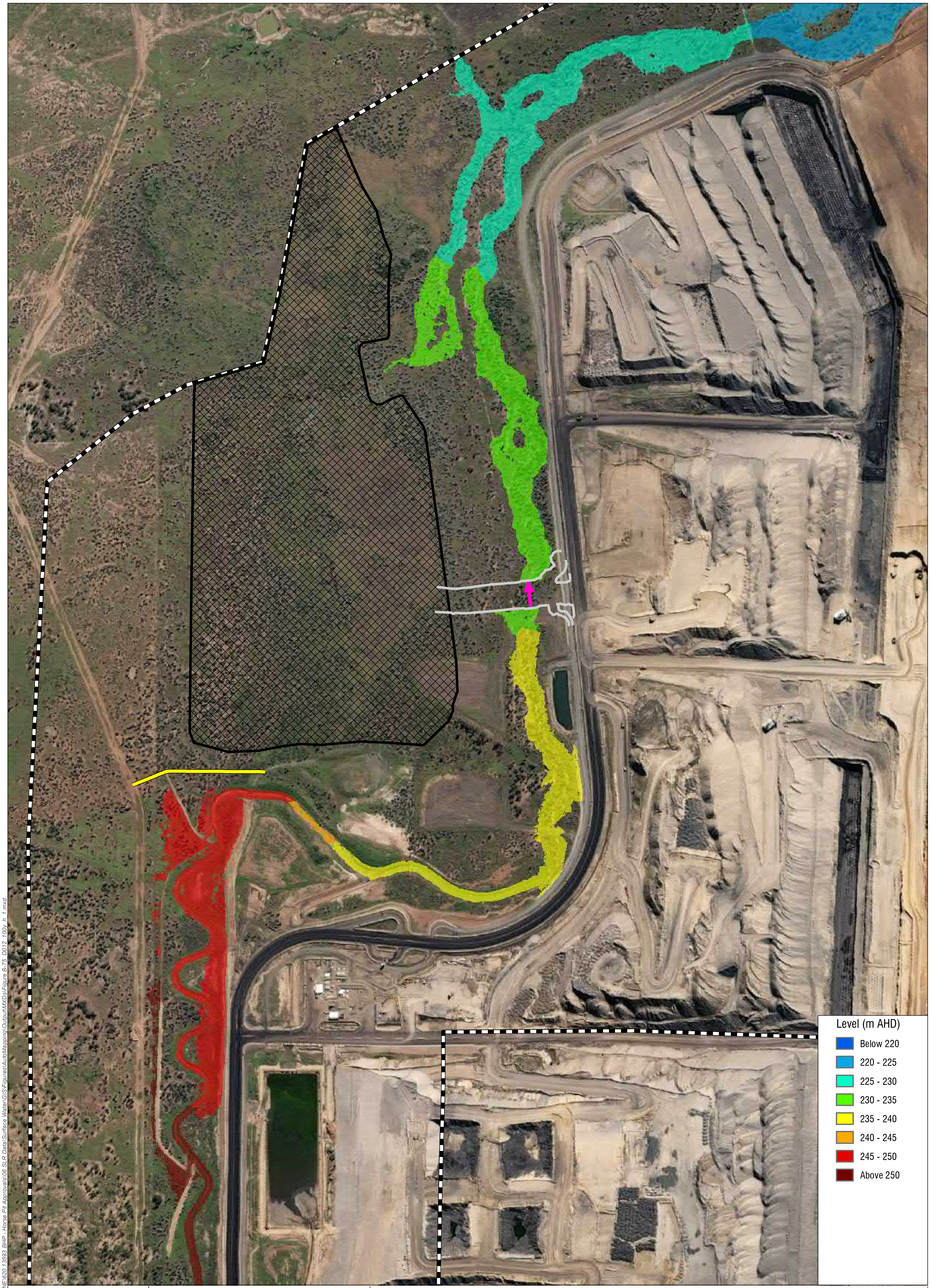
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 2% AEP

Figure B-74



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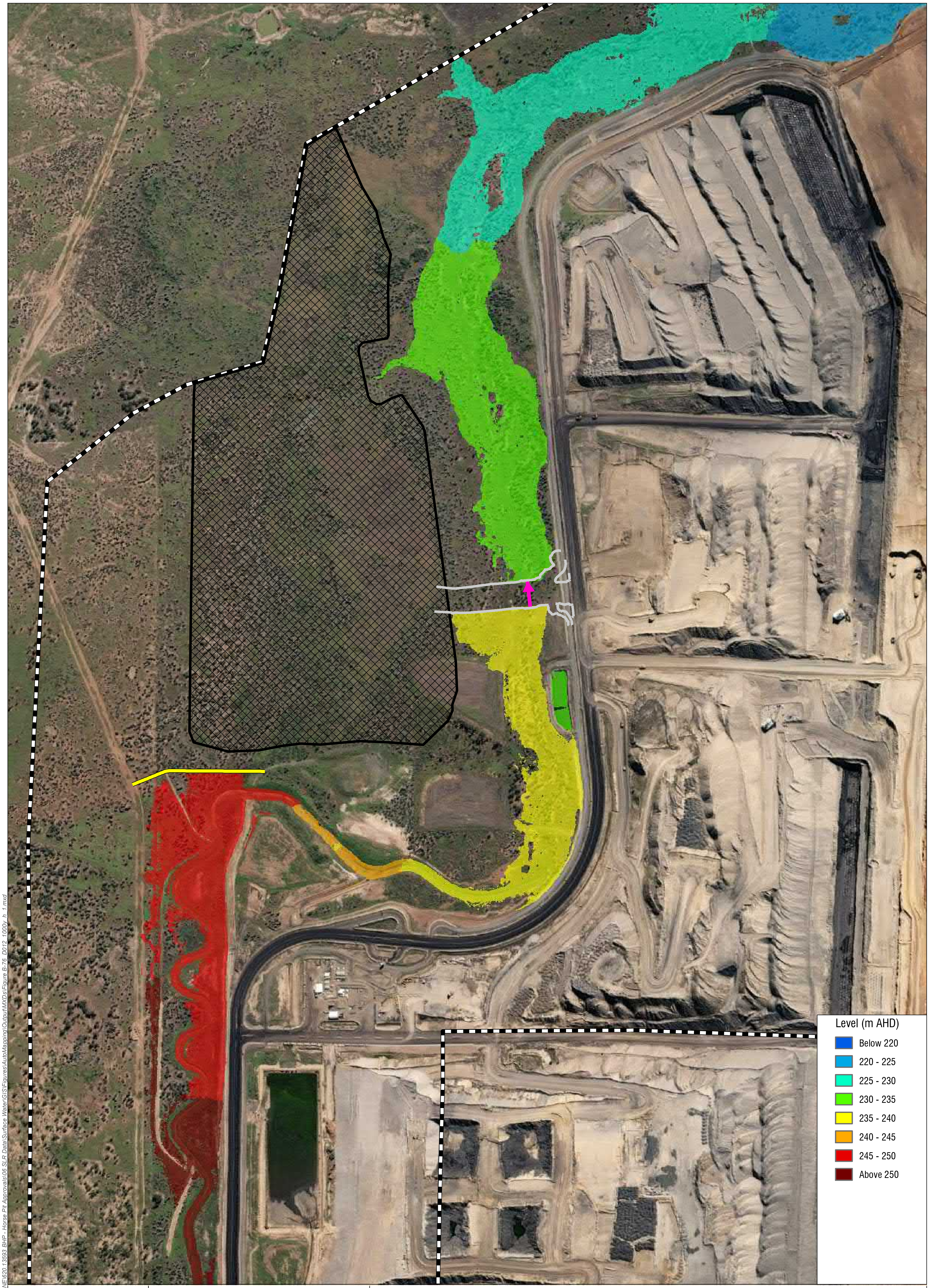
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 1% AEP

Figure B-75



Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

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Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 0.1% AEP

Figure B-76

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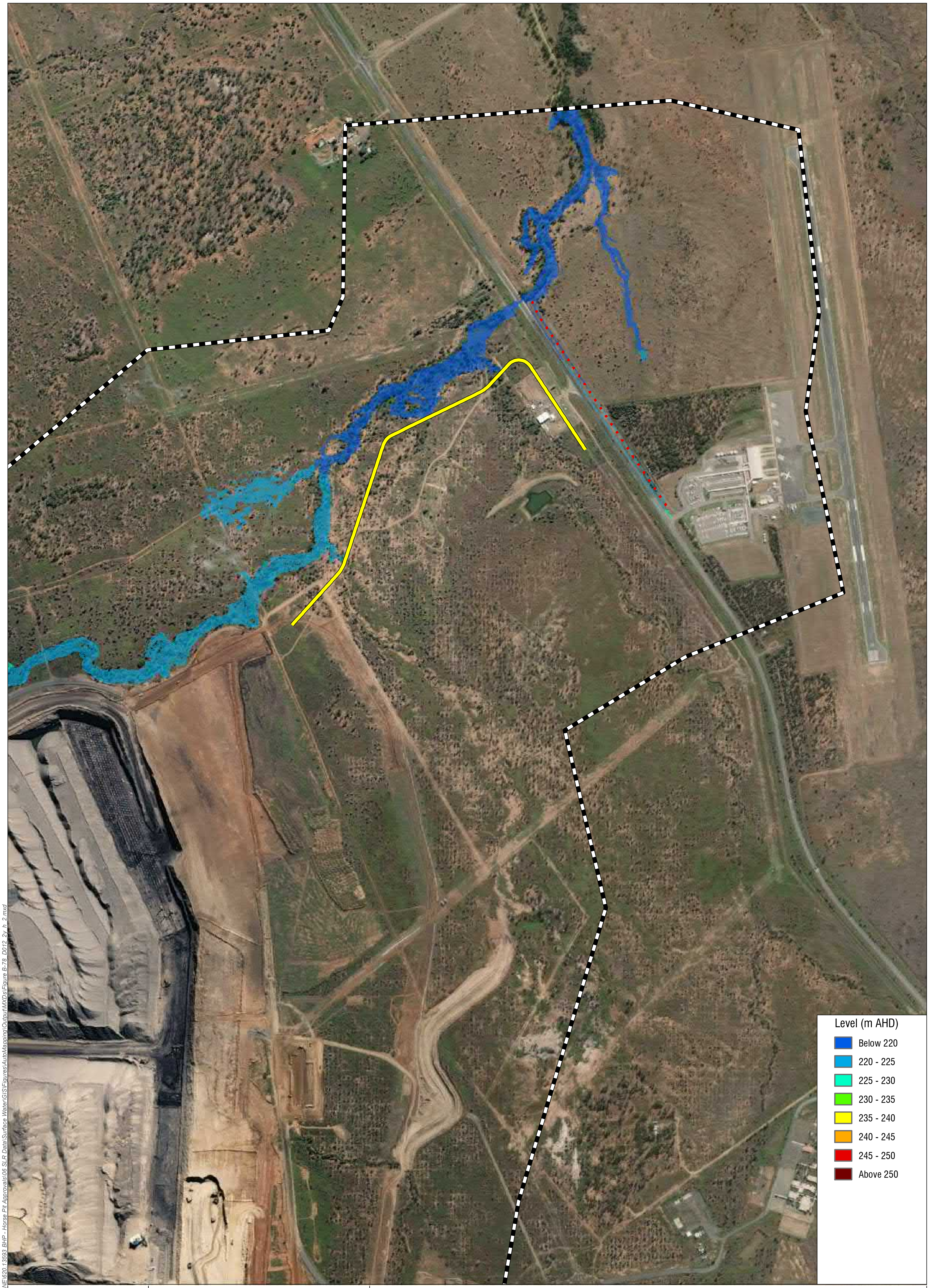

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Legend

Proposed Drain

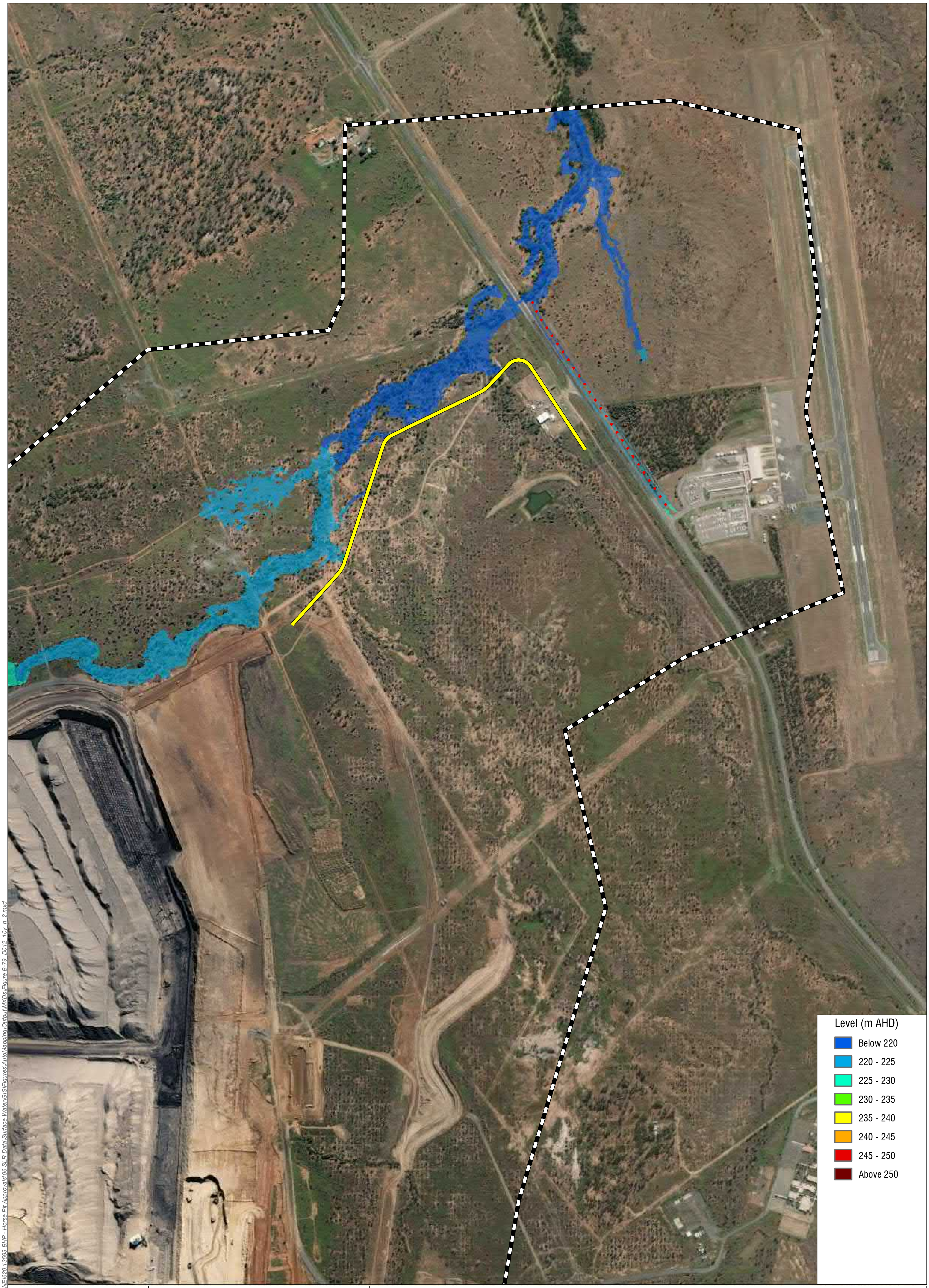
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 50% AEP

Figure B-78



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

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Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 10% AEP

Figure B-79

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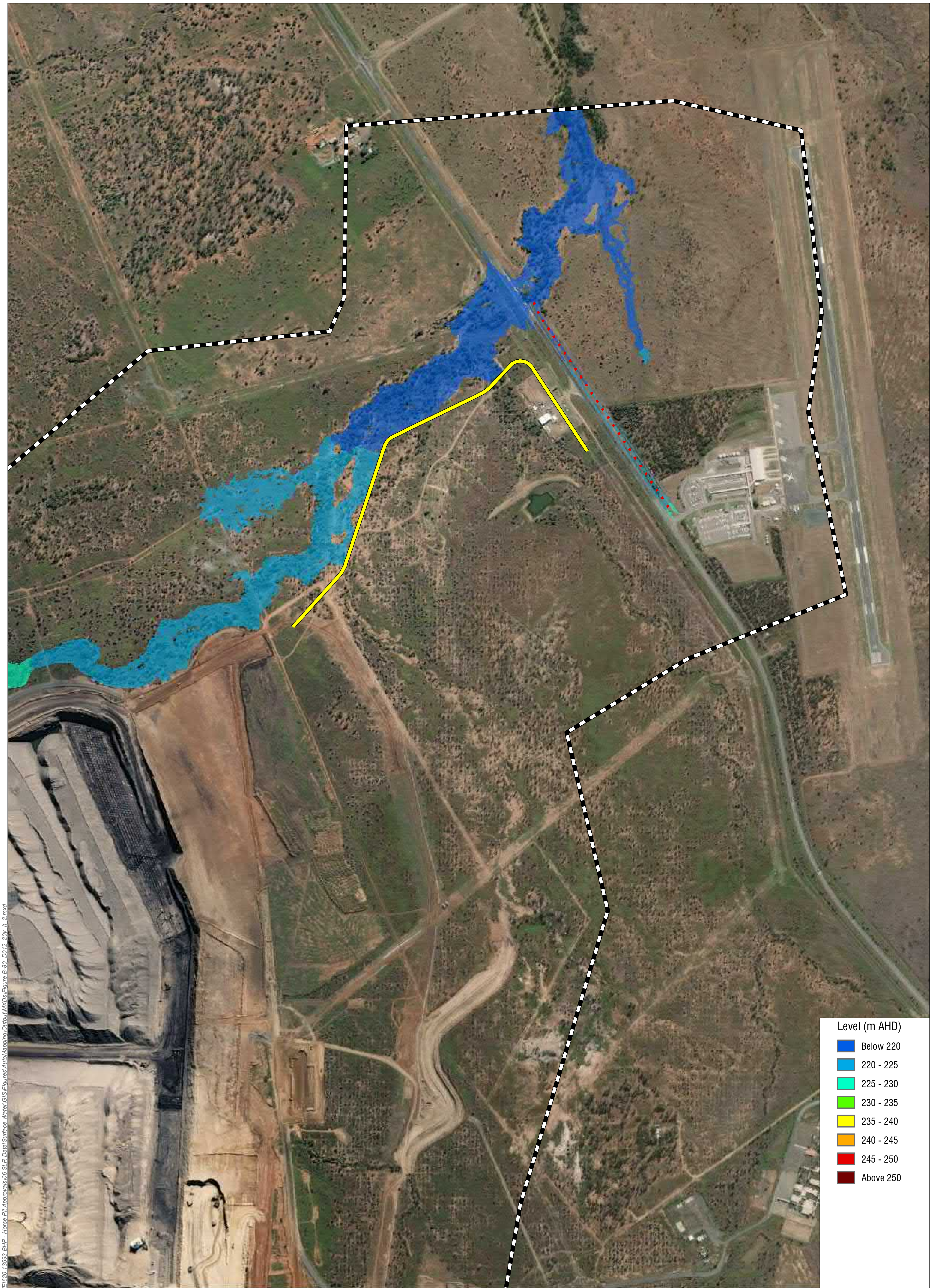

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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

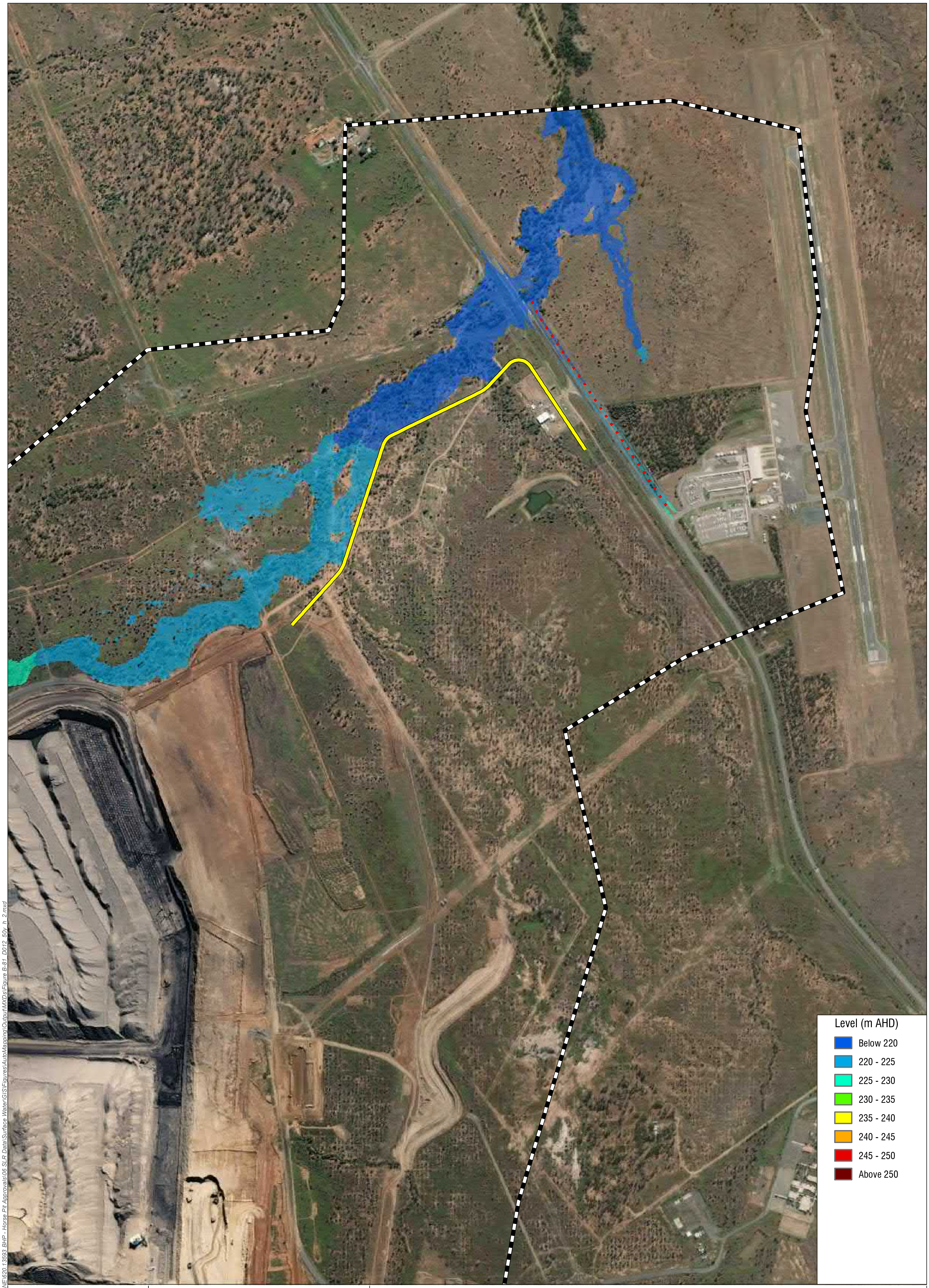
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 5% AEP

Figure B-80



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Legend

Proposed Drain

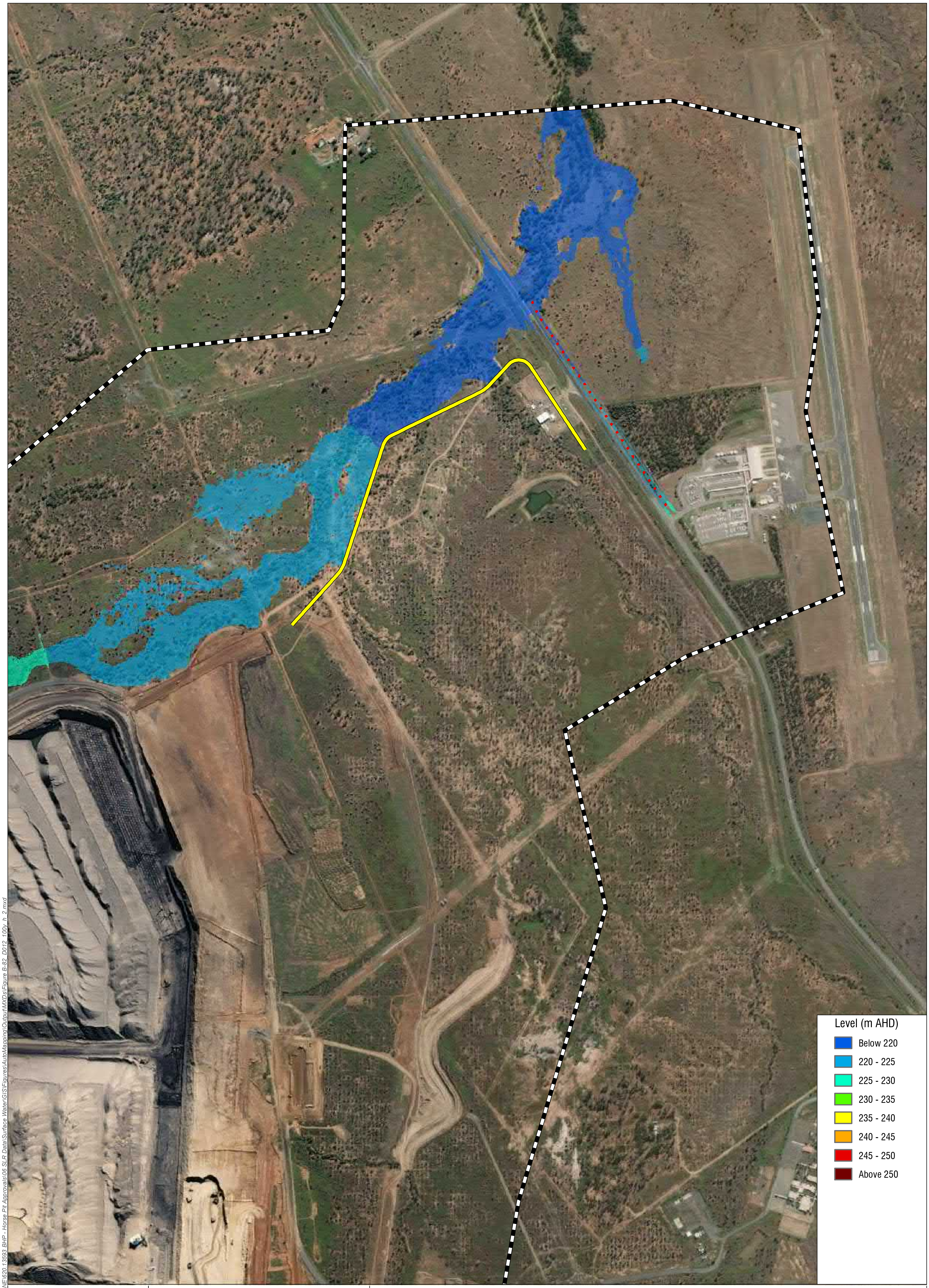
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 2% AEP

Figure B-81



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

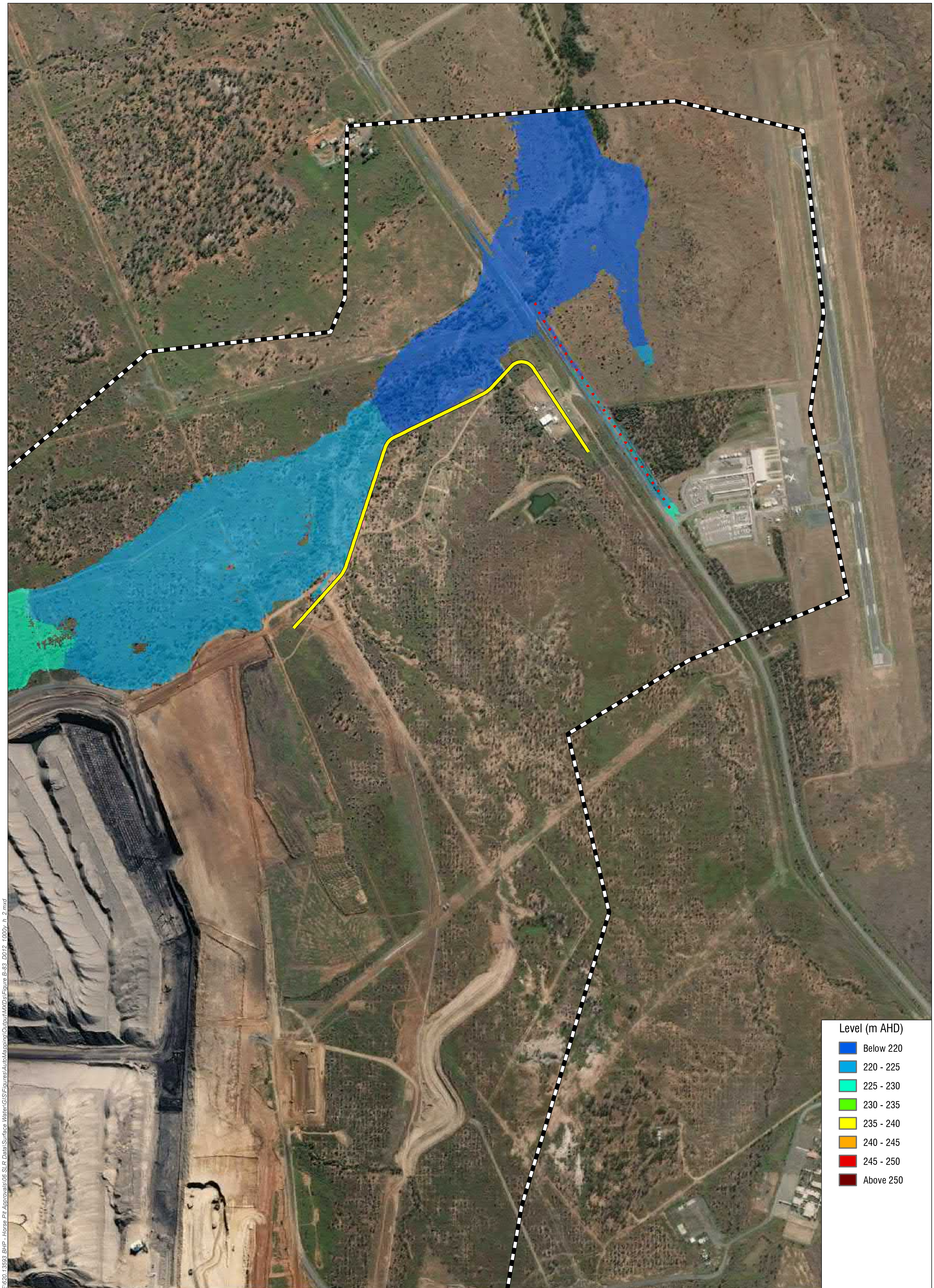
Horse Pit Extension

Flood Impact Assessment

Developed Scenario (D012)

Peak Flood Levels - 1% AEP

Figure B-82



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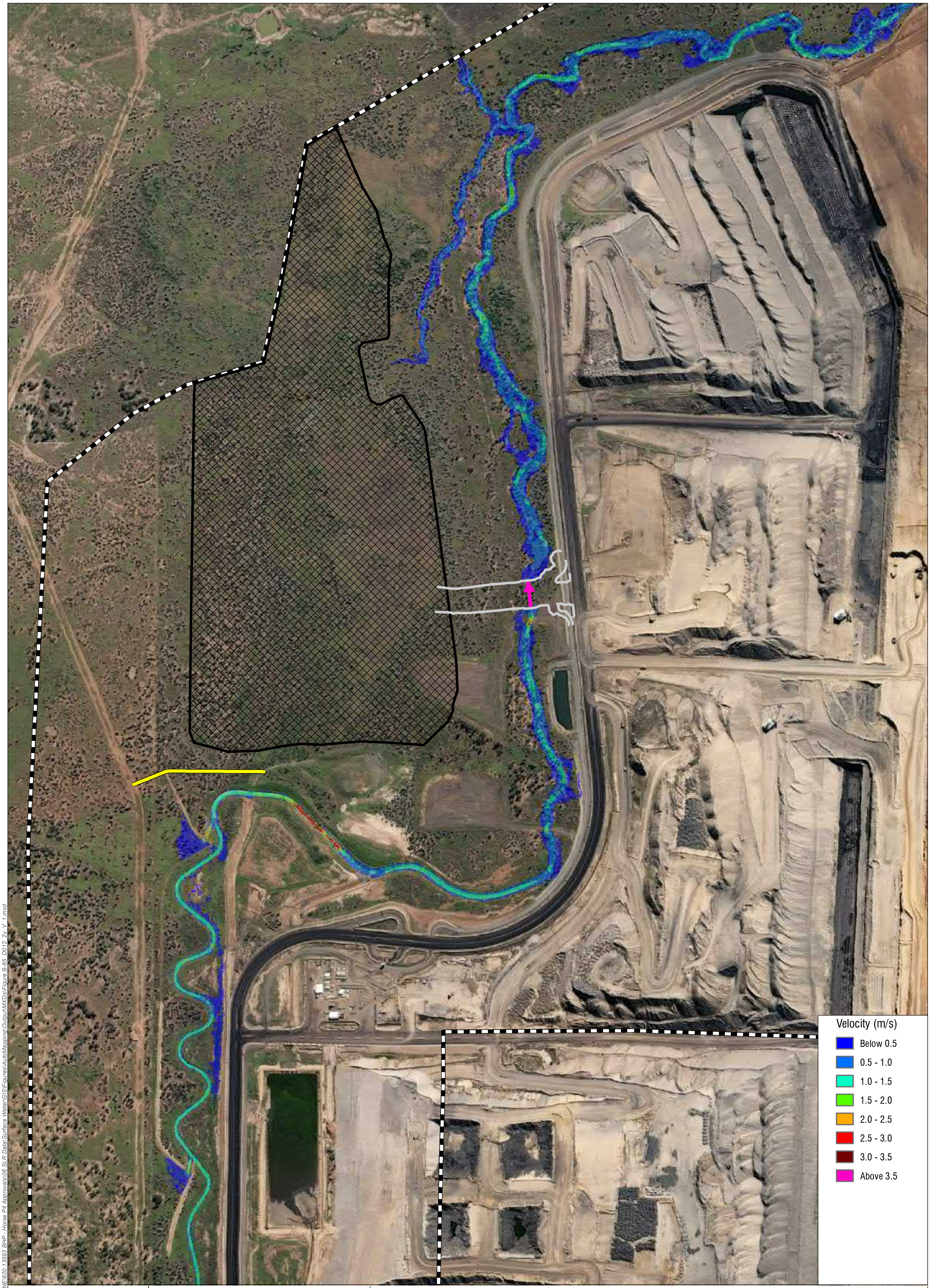
Sheet Size : A3 GDA 1994 MGA Zone 55

Legend
Proposed Drain
Proposed Levee
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Levels - 0.1% AEP

Figure B-83



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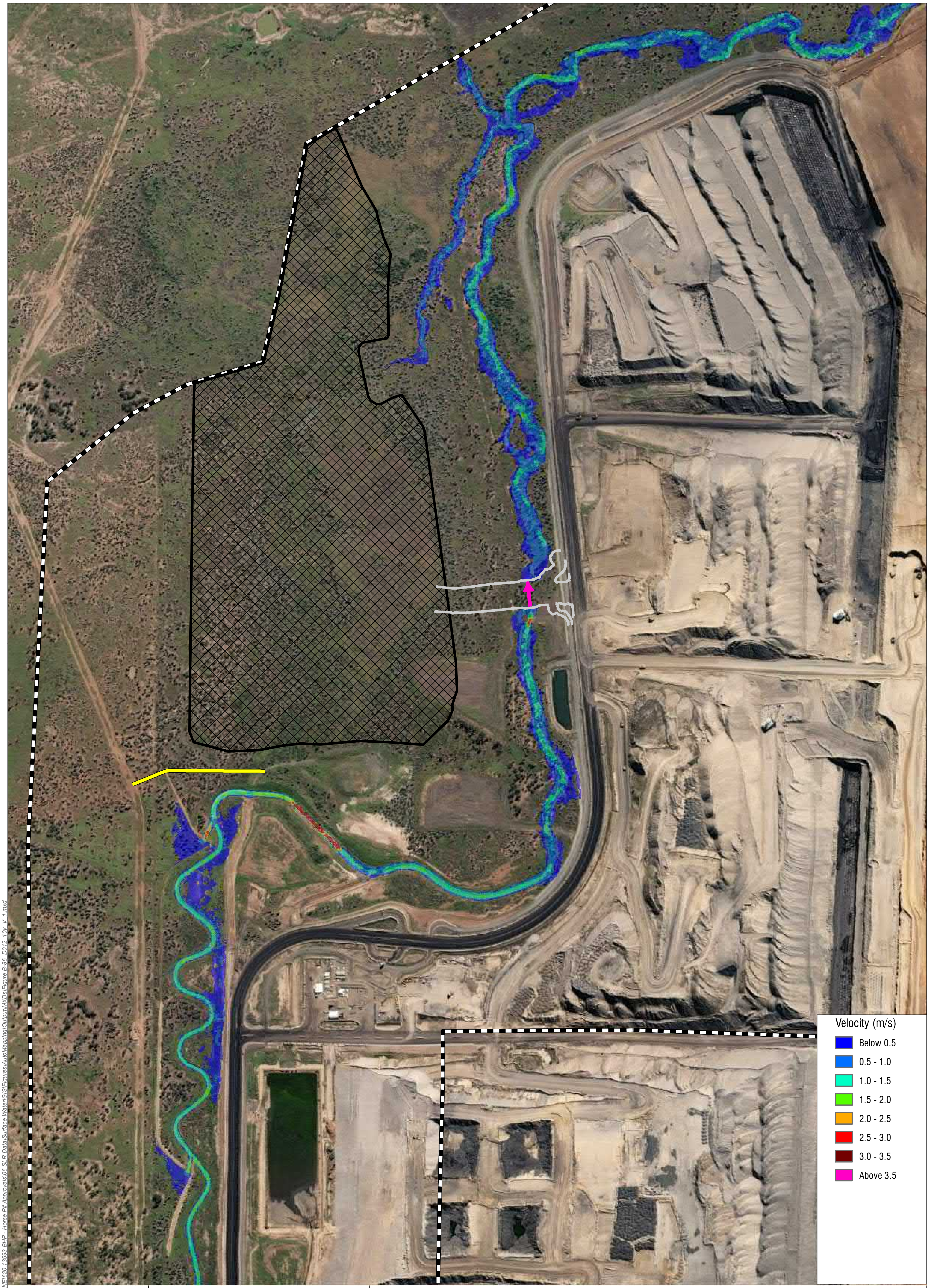
Sheet Size : A3 GDA 1994 MGA Zone 55

Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 50% AEP

Figure B-85



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

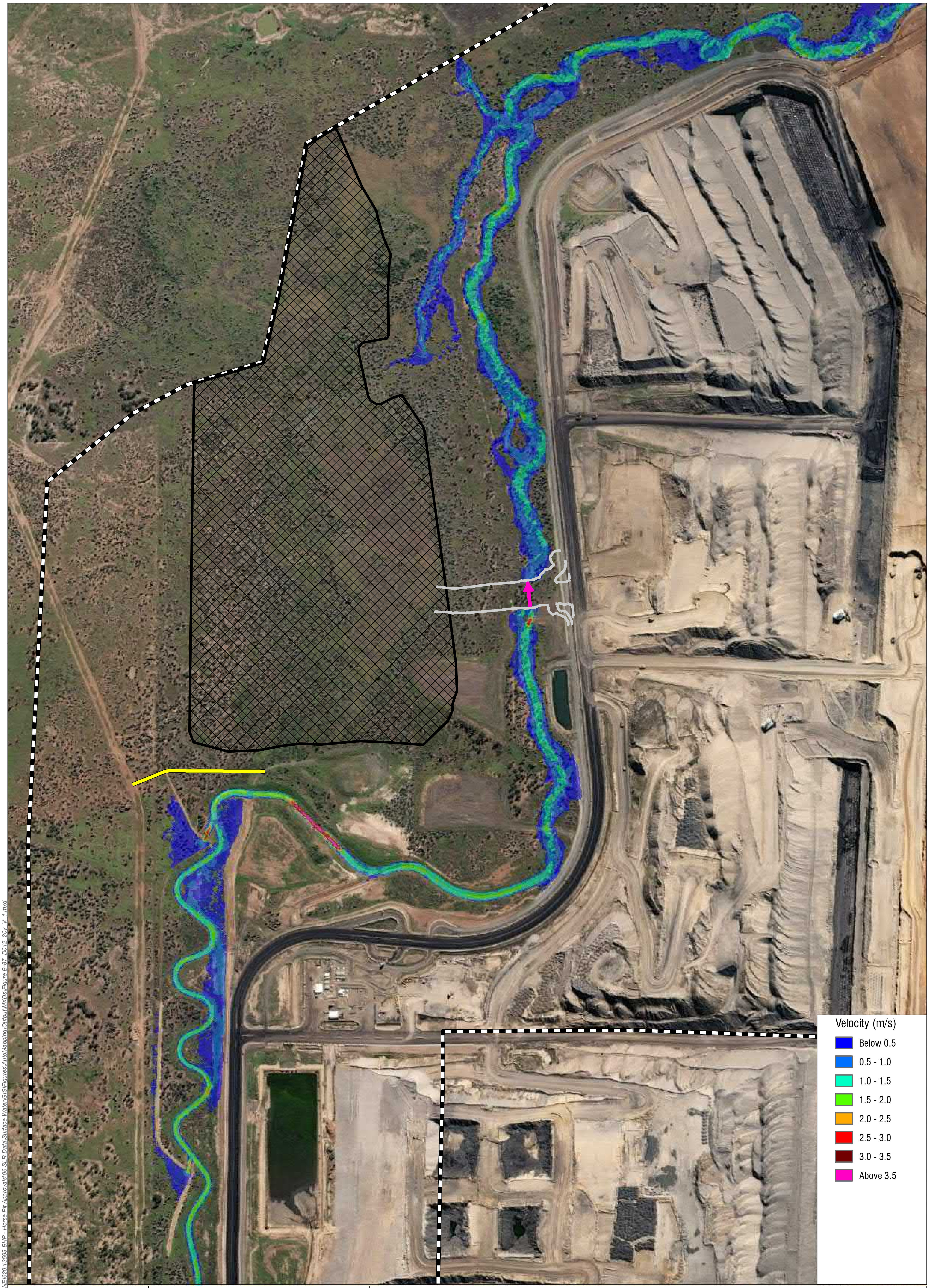
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 10% AEP

Figure B-86



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

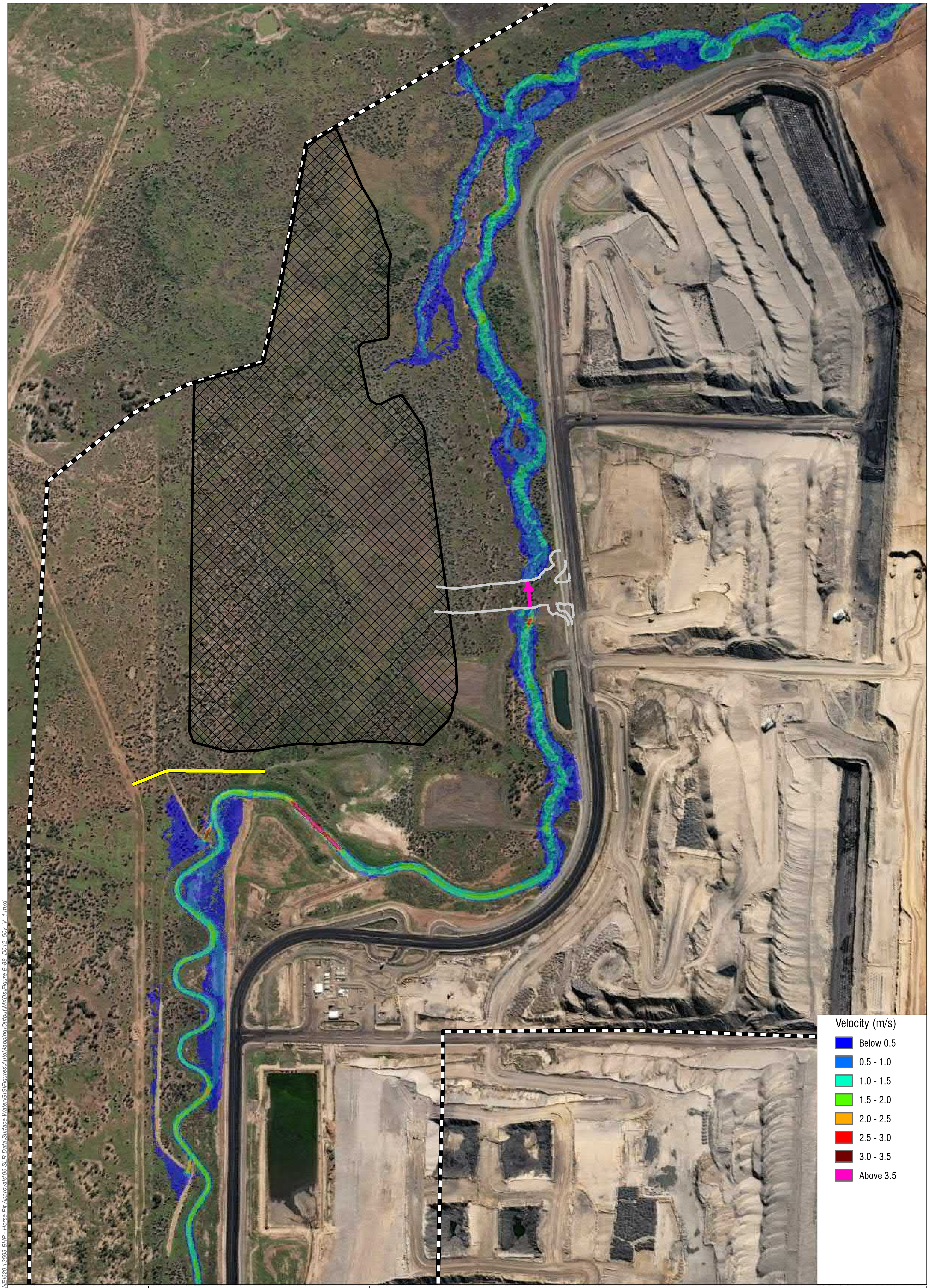
Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 5% AEP

Figure B-87

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-87_D012_20y_V_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

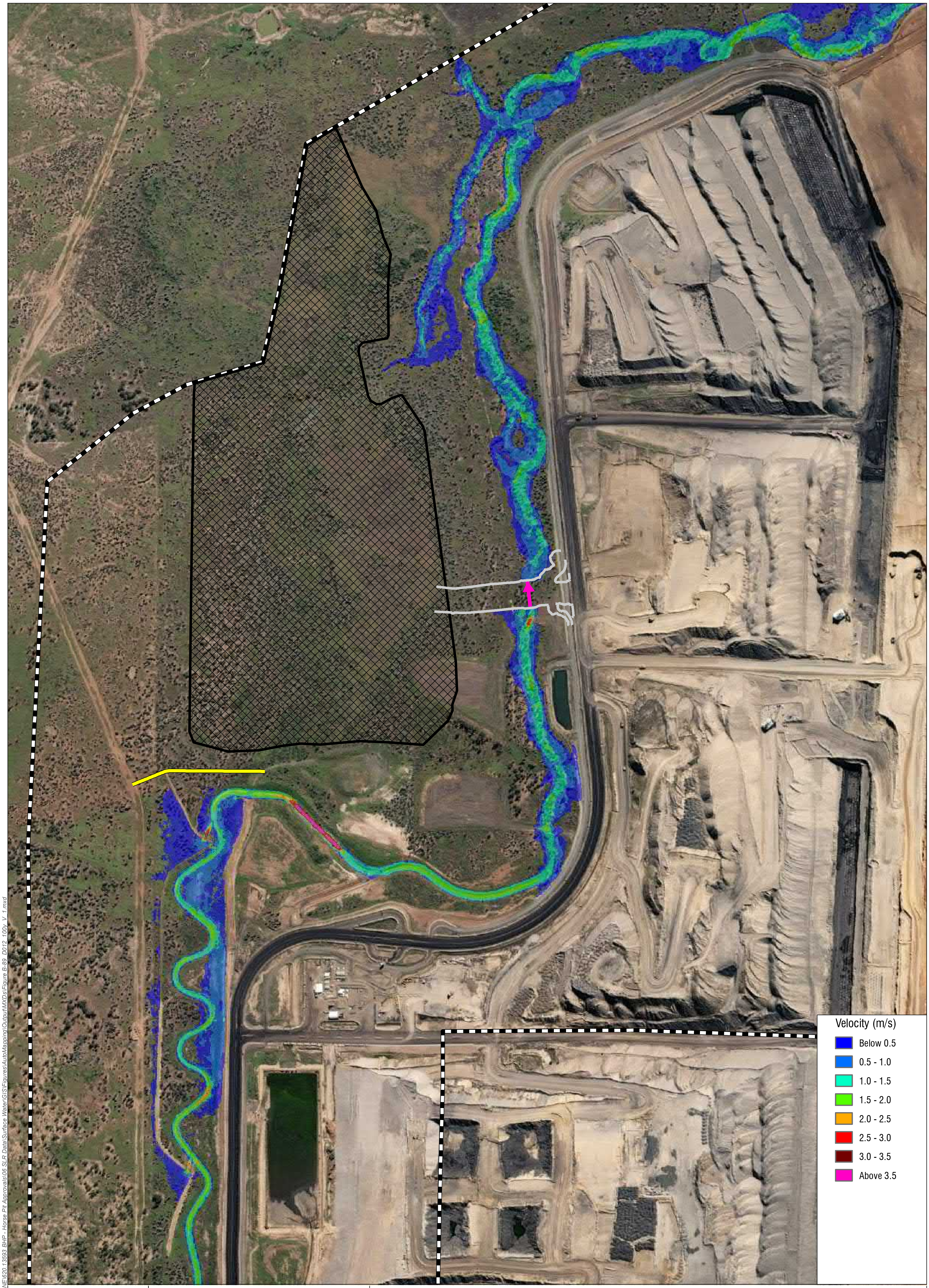
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 2% AEP

Figure B-88

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-88_D012_50y_V_1.mxd



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 1% AEP

Figure B-89

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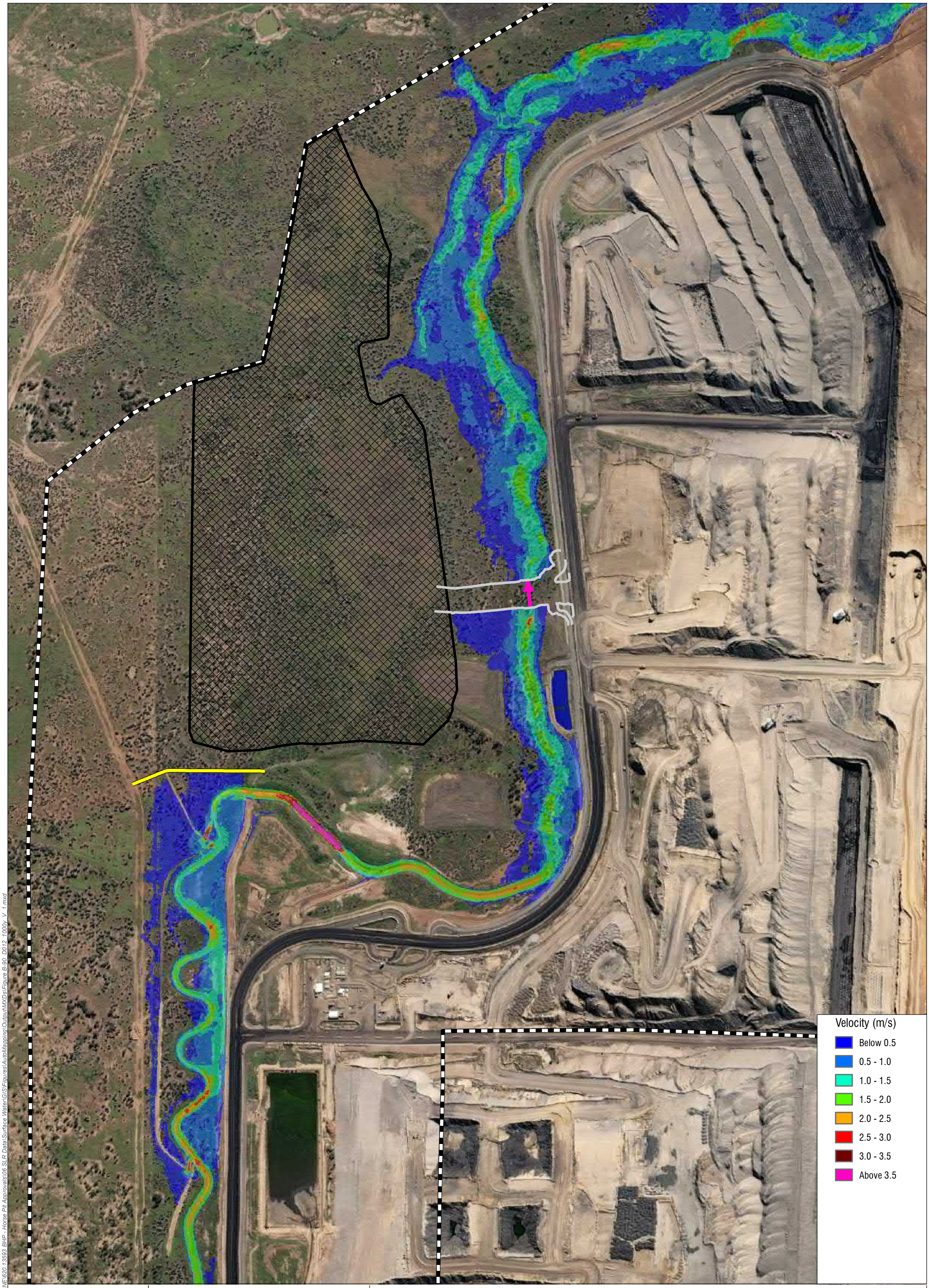

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Sheet Size : A3 GDA 1994 MGA Zone 55

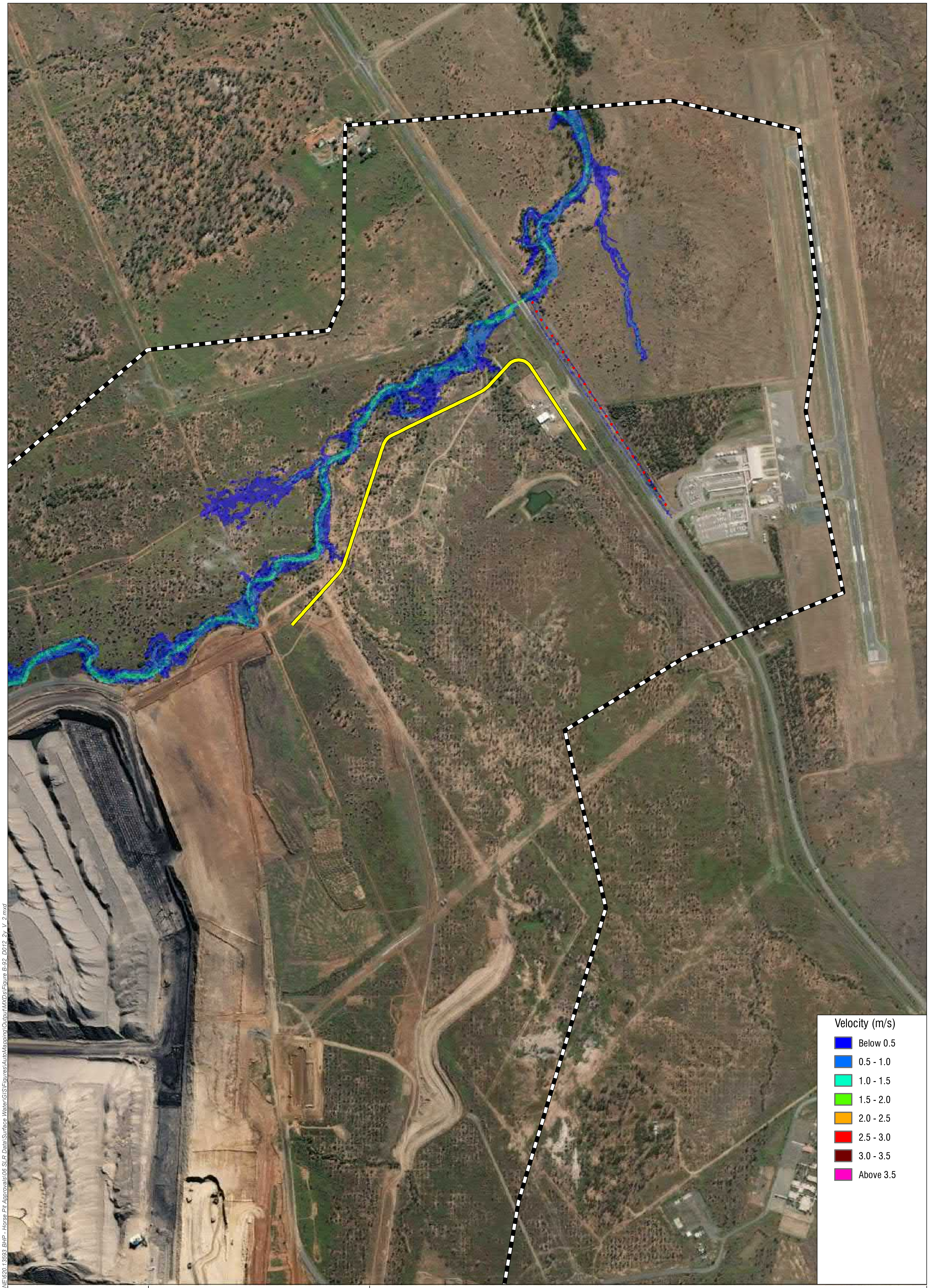
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 0.1% AEP

Figure B-90



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Legend

Proposed Drain

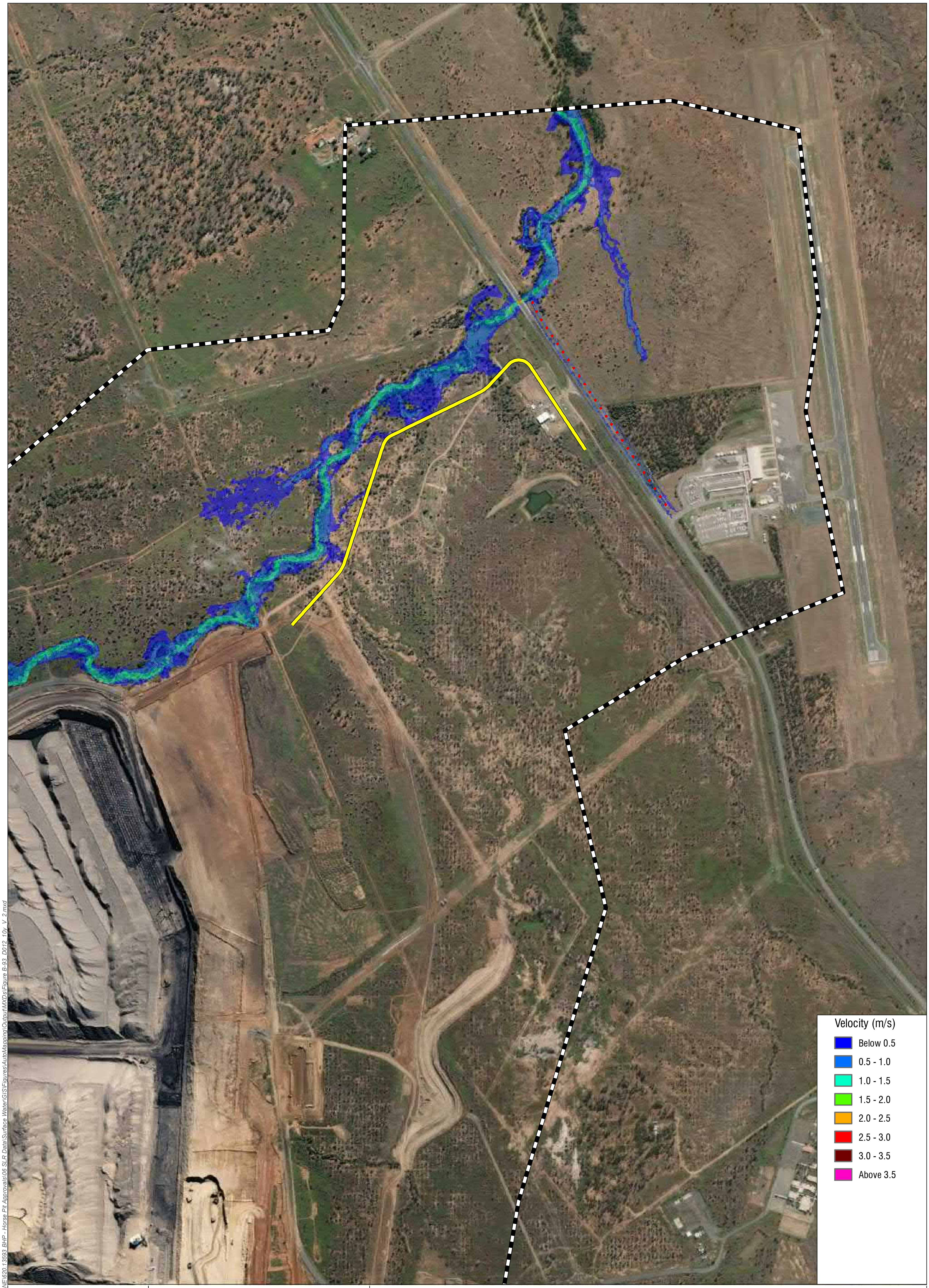
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 50% AEP

Figure B-92



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Legend

Proposed Drain

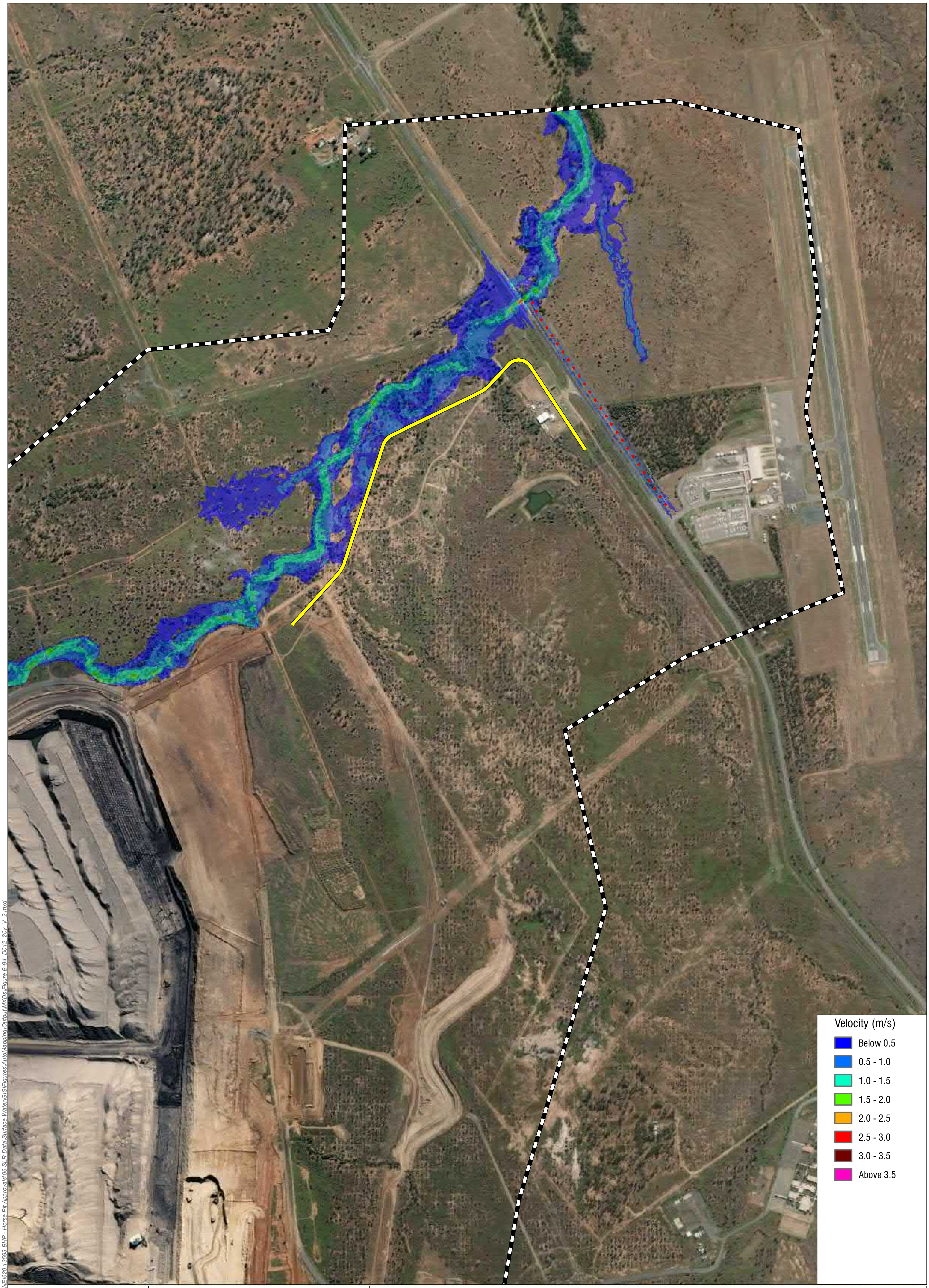
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 10% AEP

Figure B-93



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

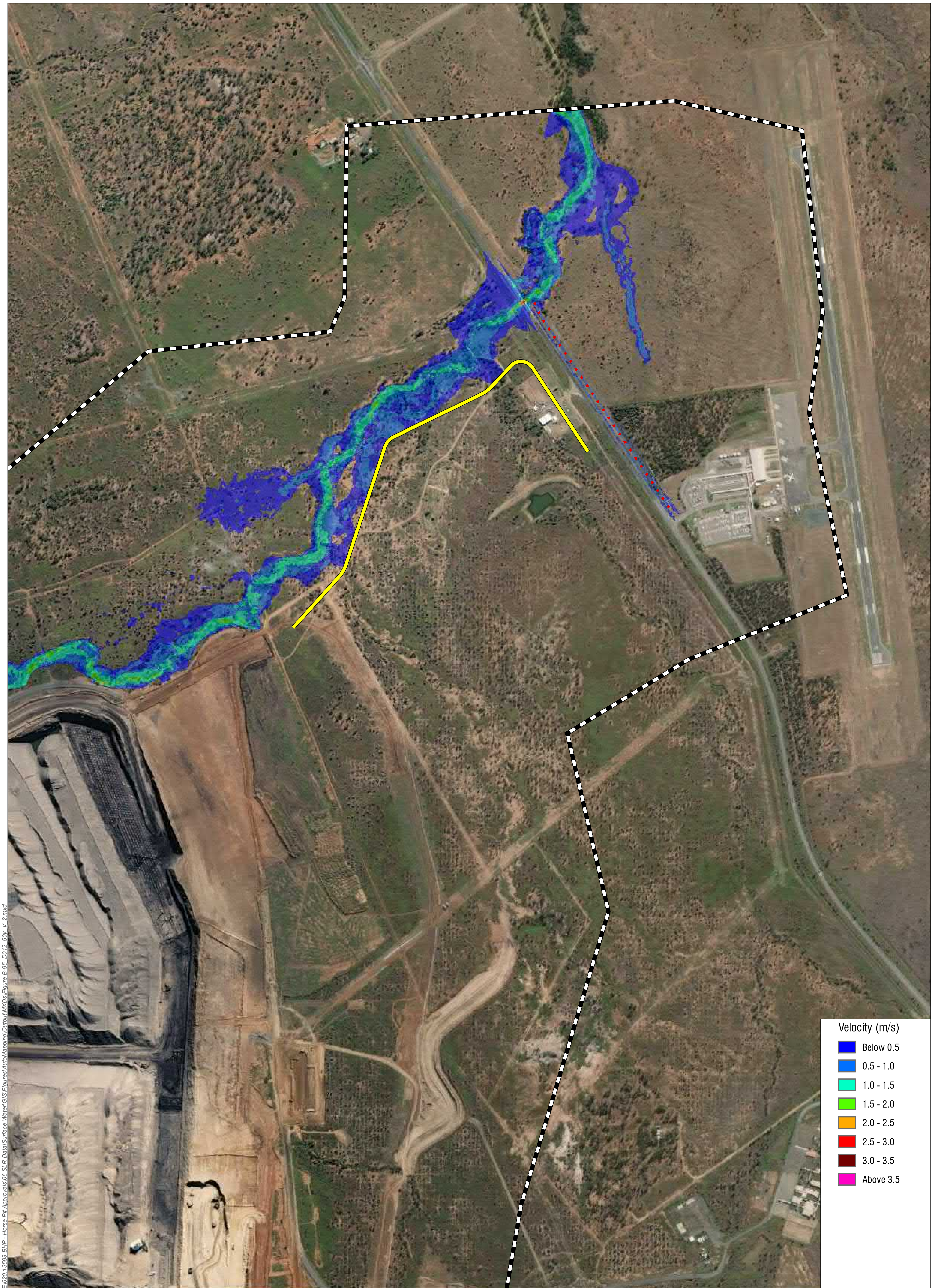
Legend
Proposed Drain
Proposed Levee
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 5% AEP

Figure B-94

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-94_D012_20y_V_2.mxd



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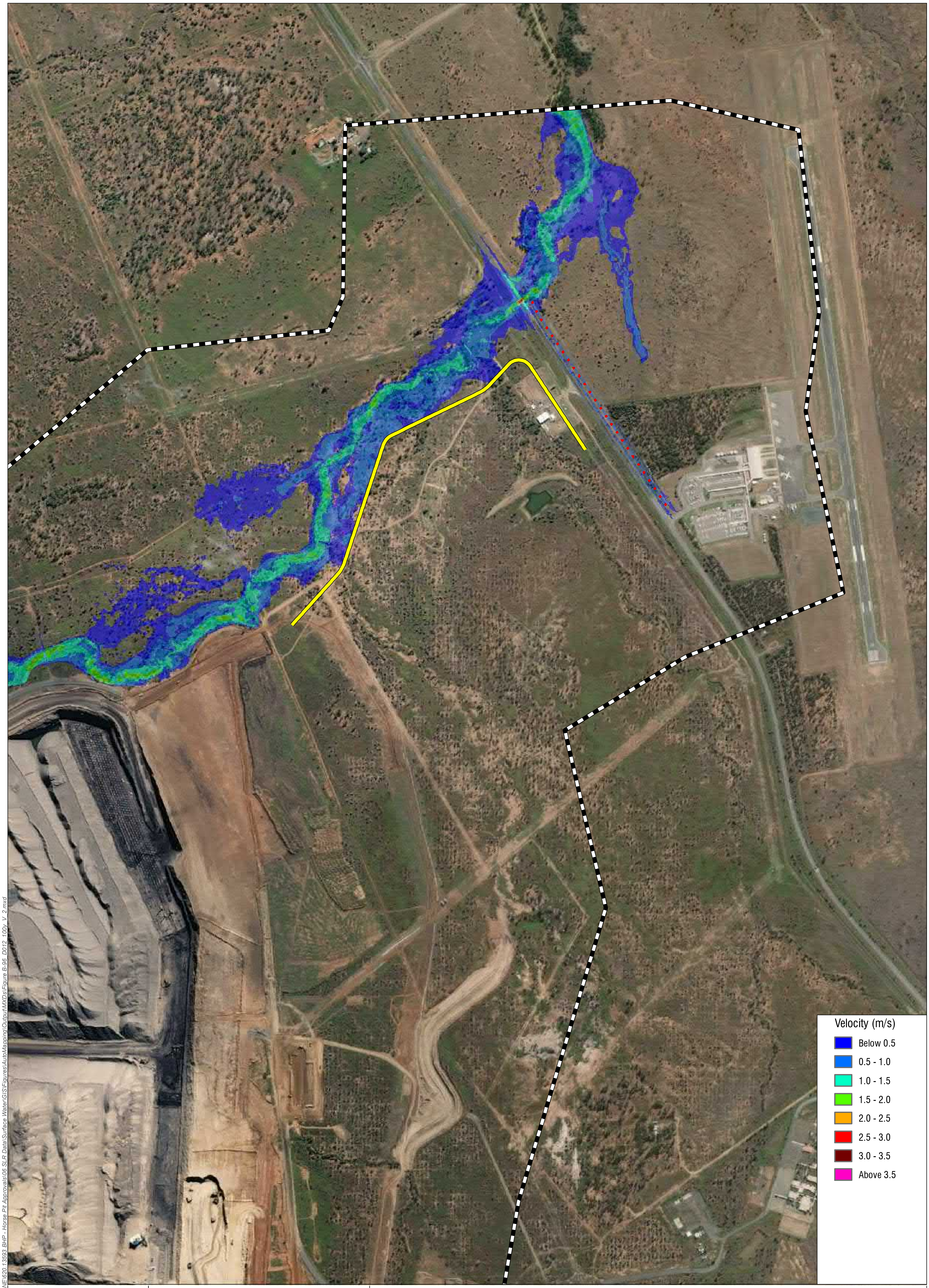
Sheet Size : A3 GDA 1994 MGA Zone 55

Legend
Proposed Drain
Proposed Levee
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 2% AEP

Figure B-95



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

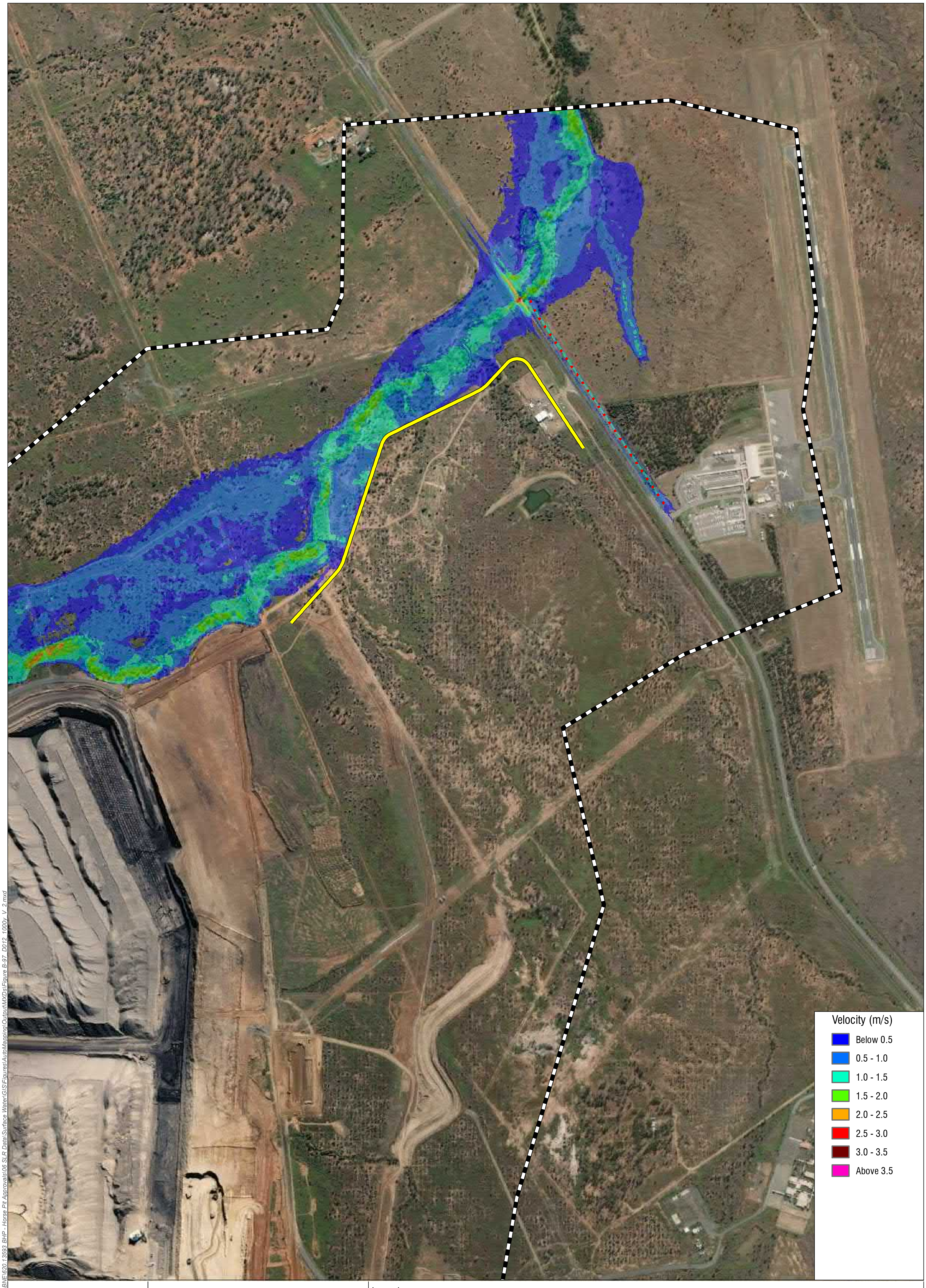
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 1% AEP

Figure B-96



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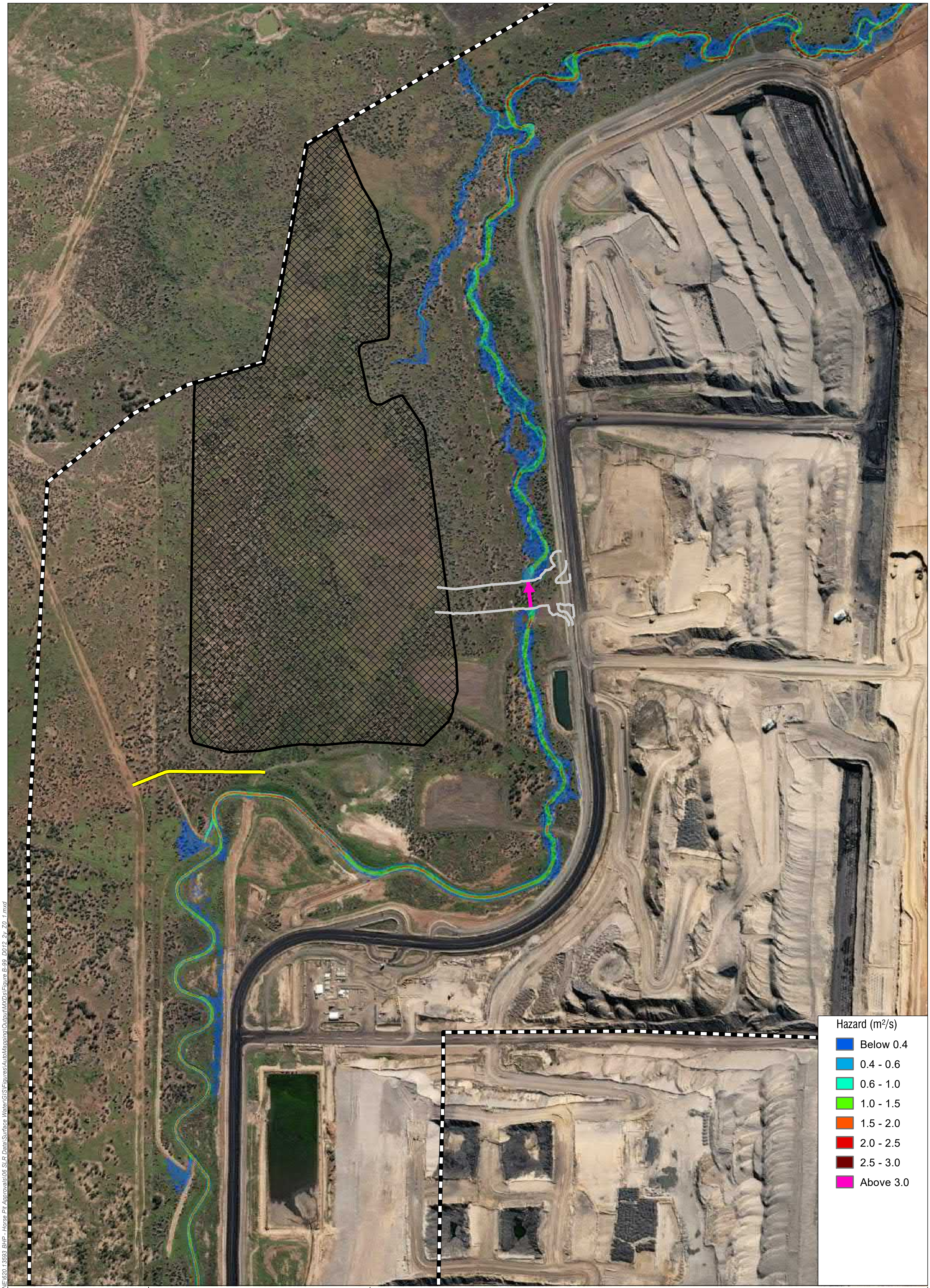
Legend

- Proposed Drain
- Proposed Levee
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Velocities - 0.1% AEP

Figure B-97



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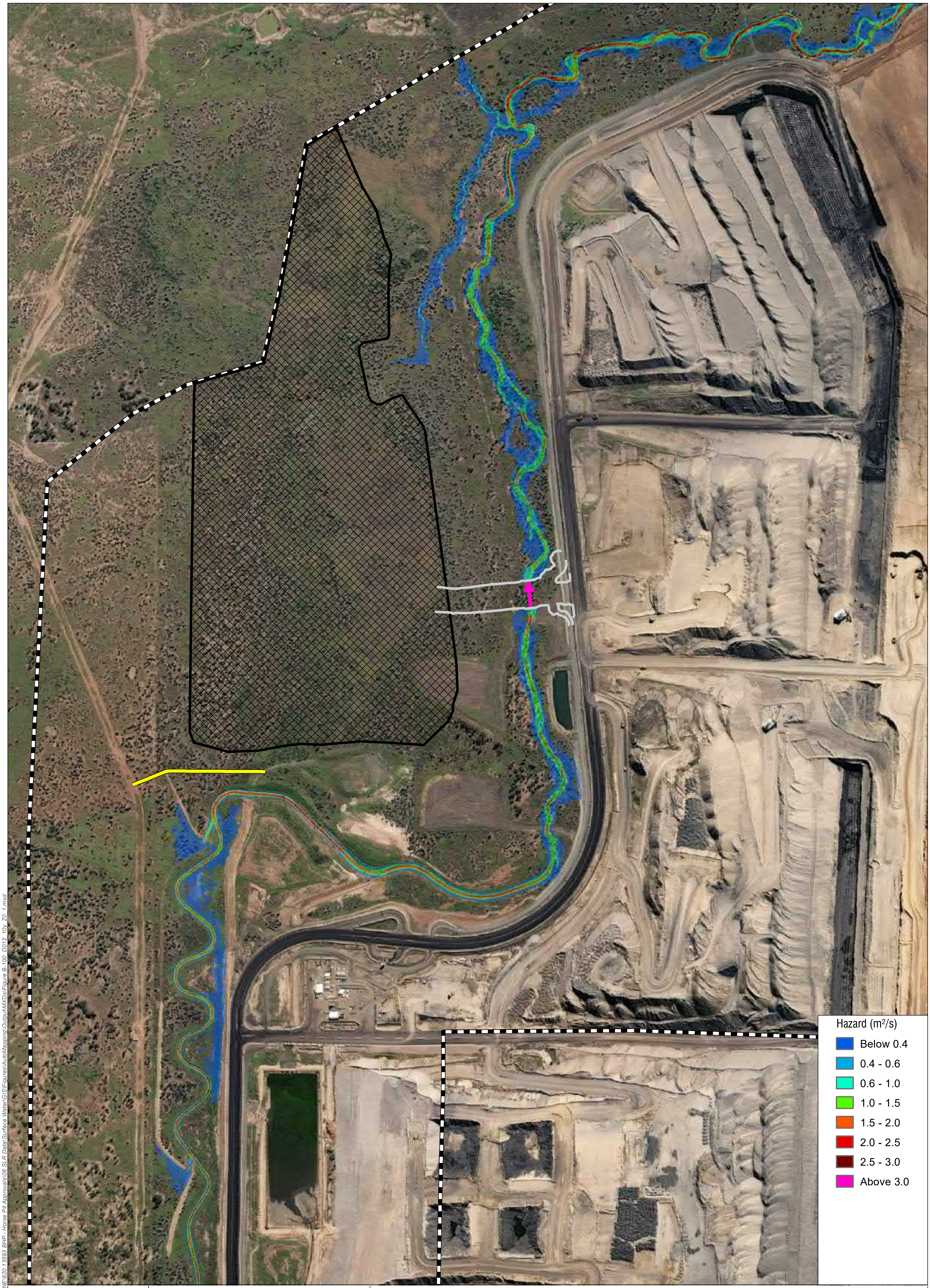
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 50% AEP

Figure B-99



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Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 10% AEP

Figure B-100

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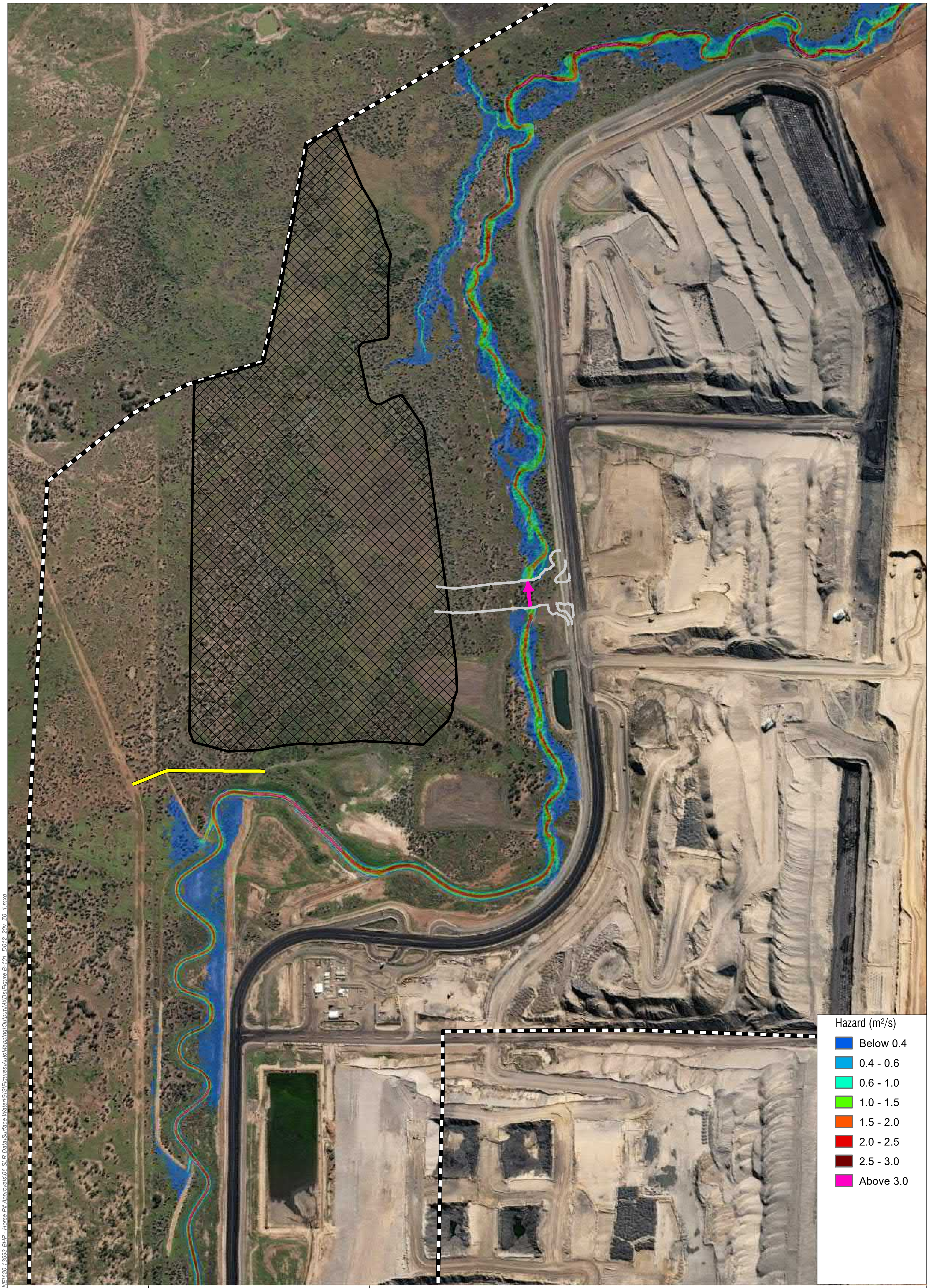
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-100_D012_10y_Z0_1.mxd



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

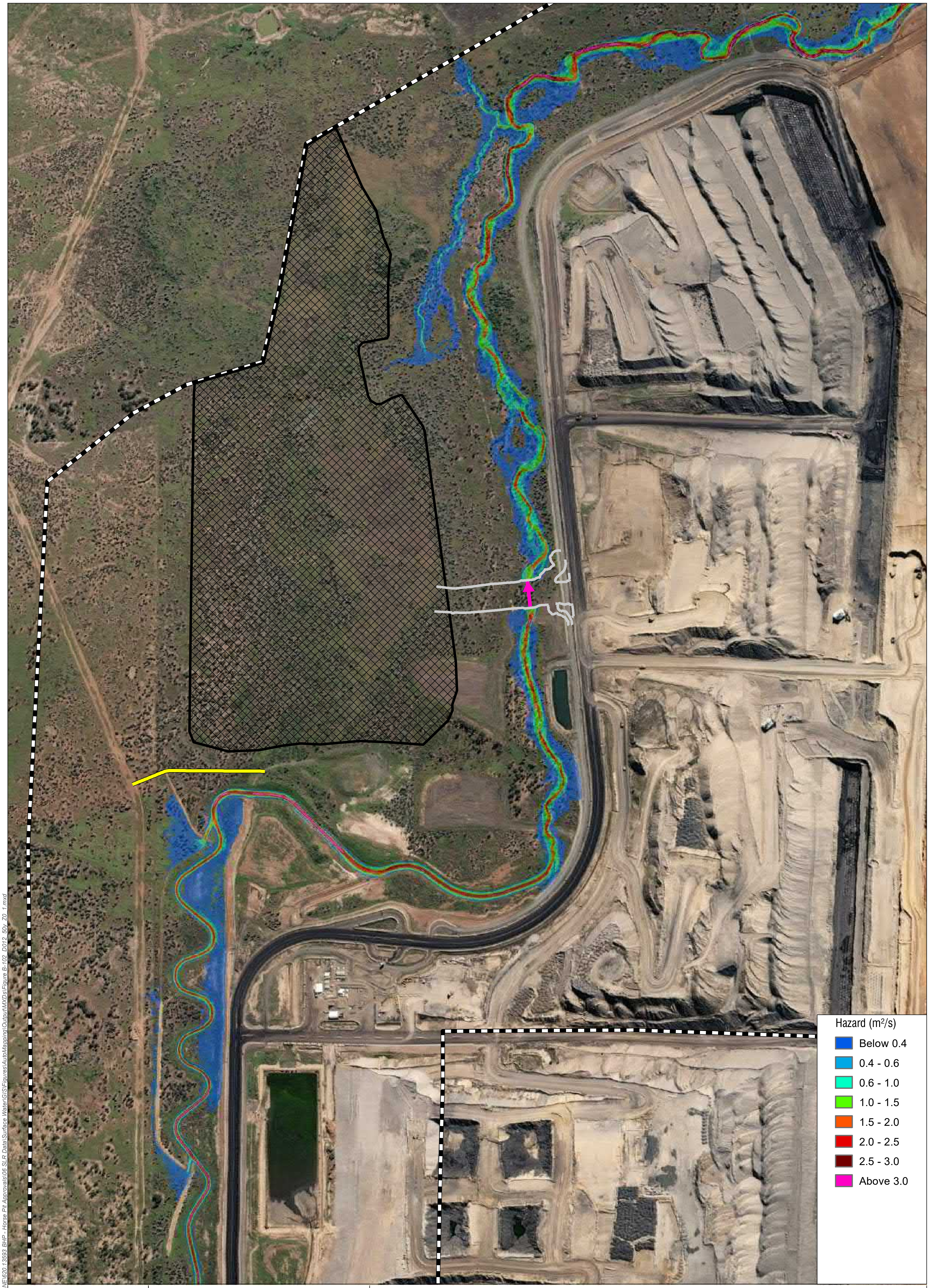
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 5% AEP

Figure B-101

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-101_D012_20y_20_1.mxd



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04-Jun-2021 Scale: 1:10,000

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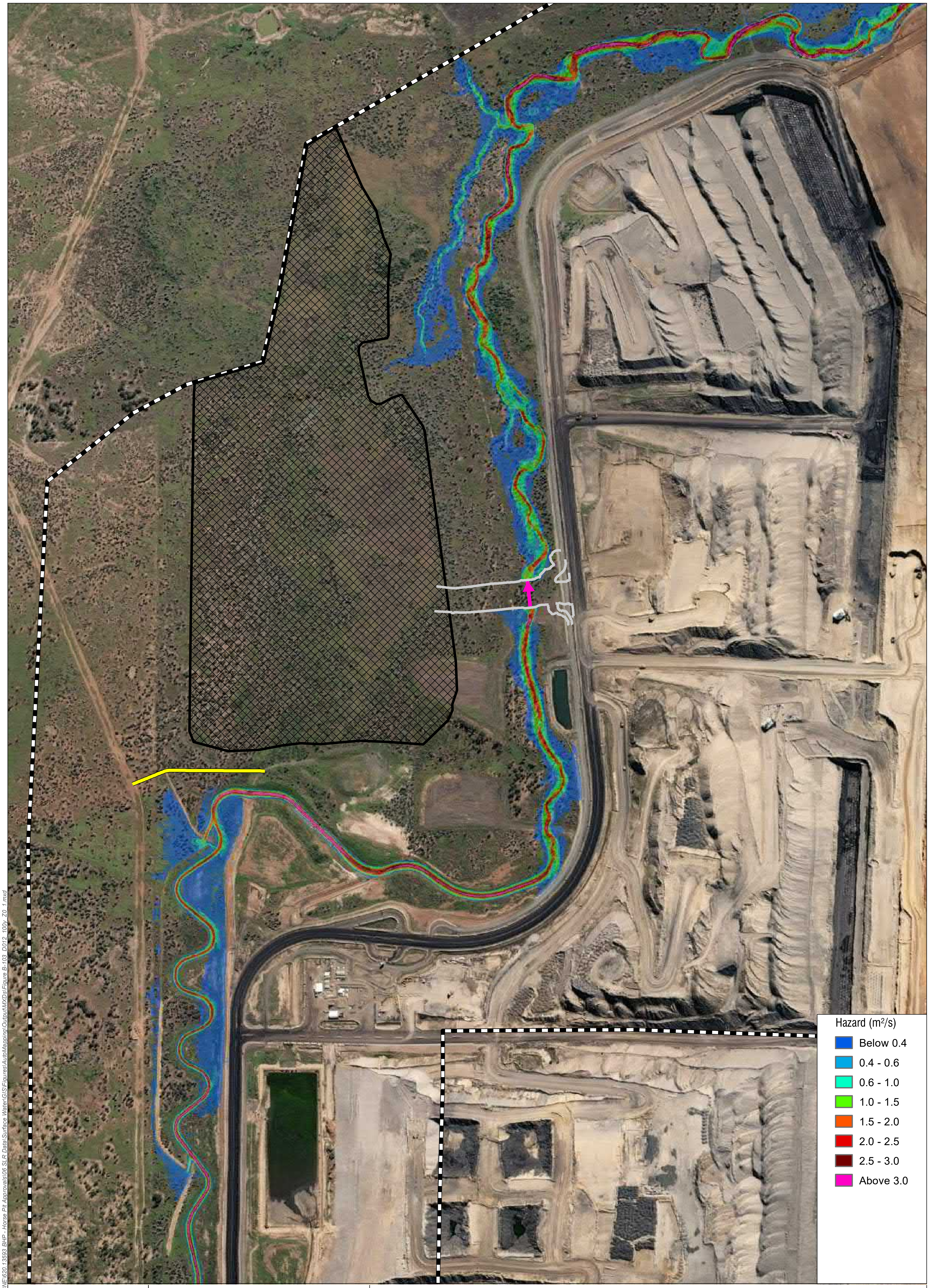
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 2% AEP

Figure B-102



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

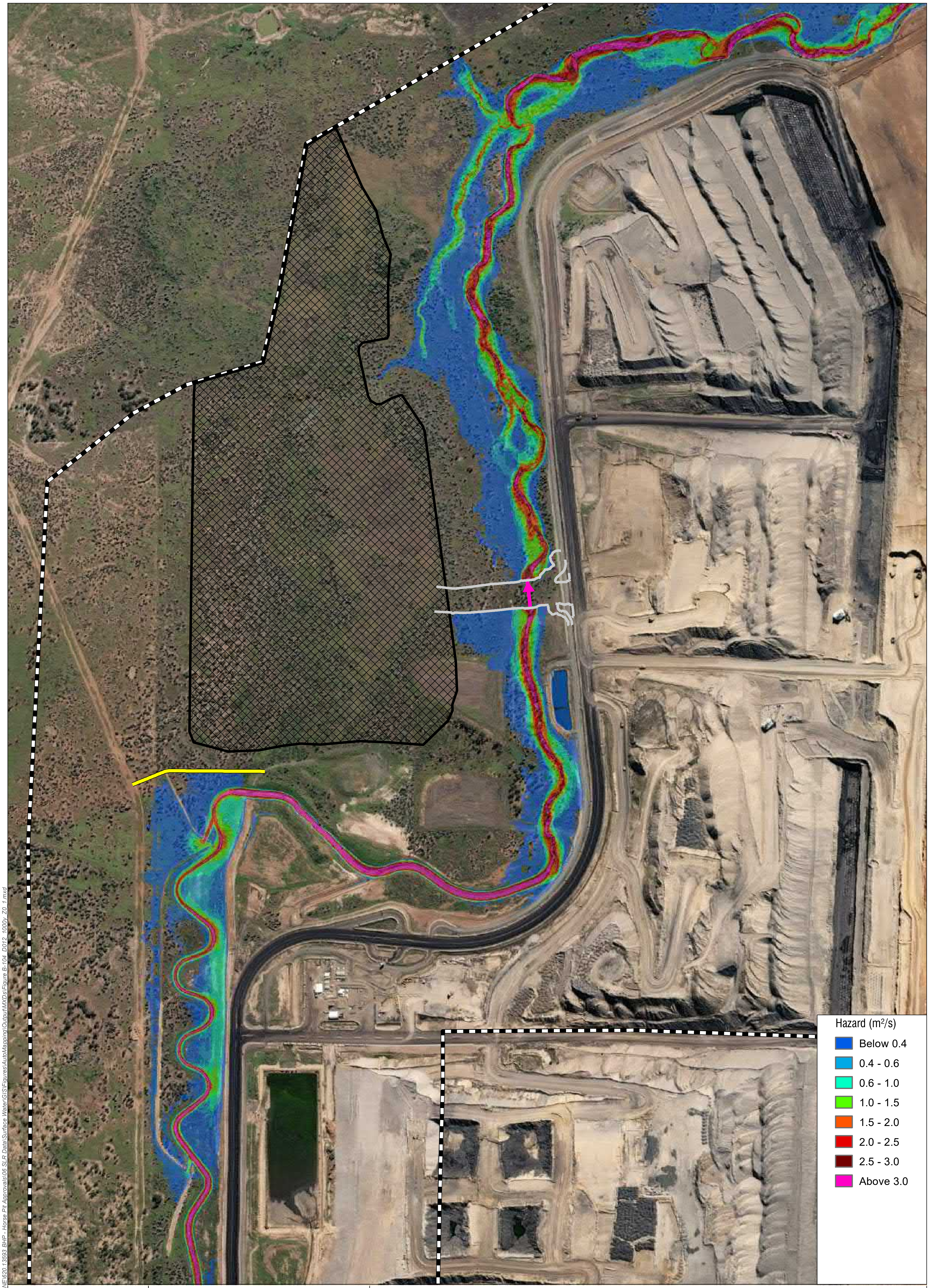
Legend

- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 1% AEP

Figure B-103



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

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Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

Proposed Culverts

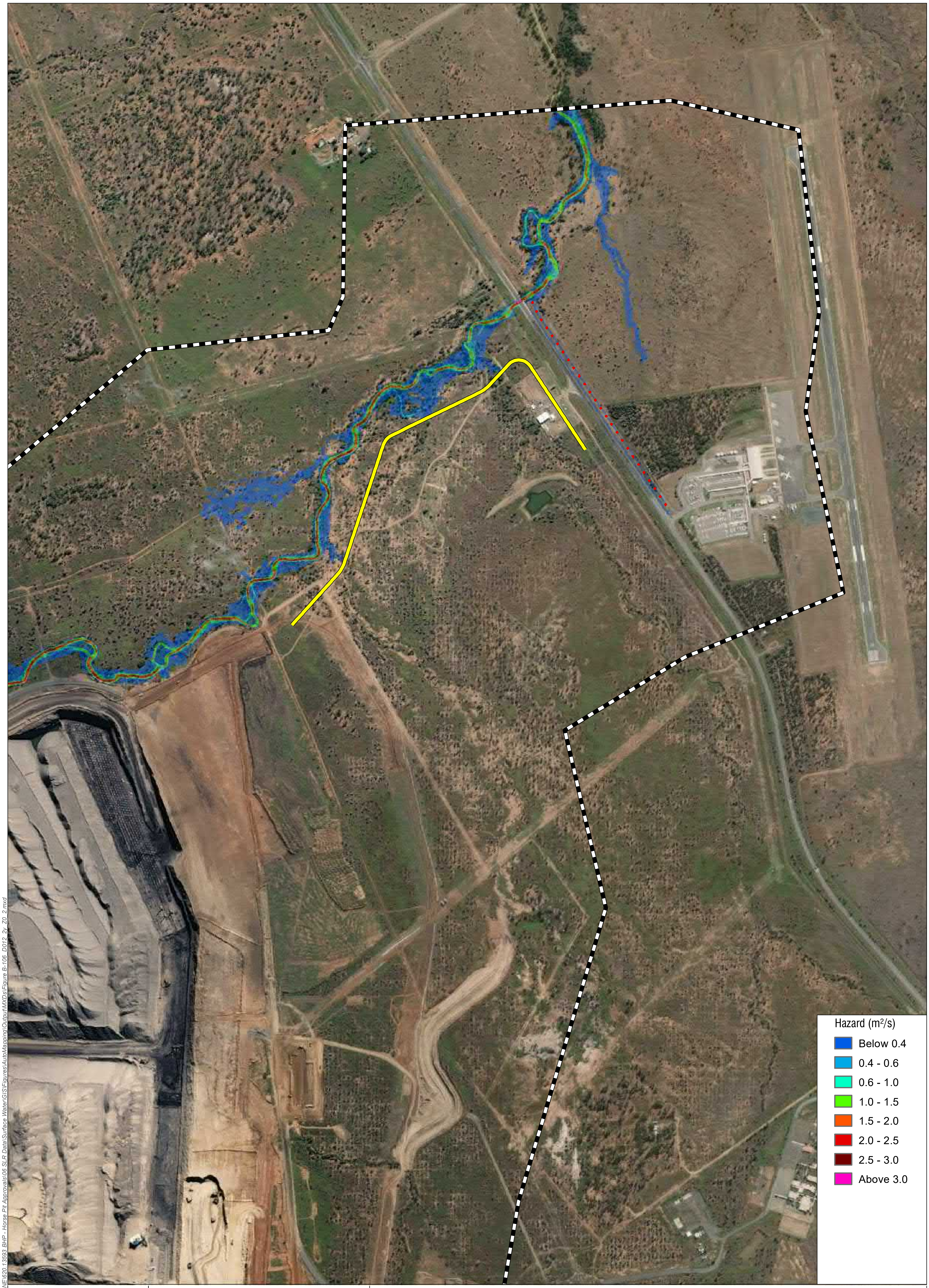
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 0.1% AEP

Figure B-104

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-104_D012_1000y_Z0_1.mxd



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

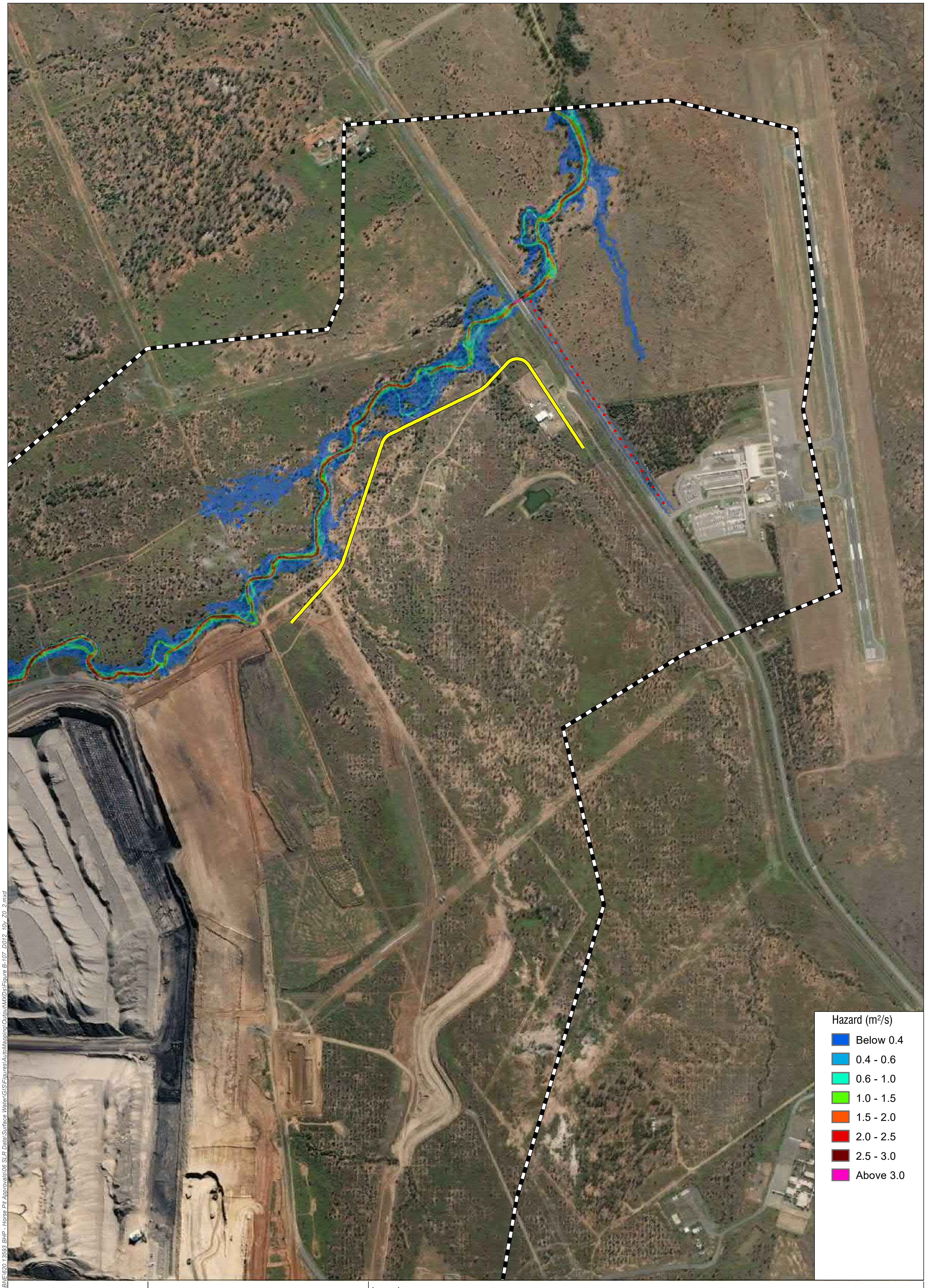
Horse Pit Extension

Flood Impact Assessment

Developed Scenario (D012)

Peak Flood Hazard - 50% AEP

Figure B-106



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

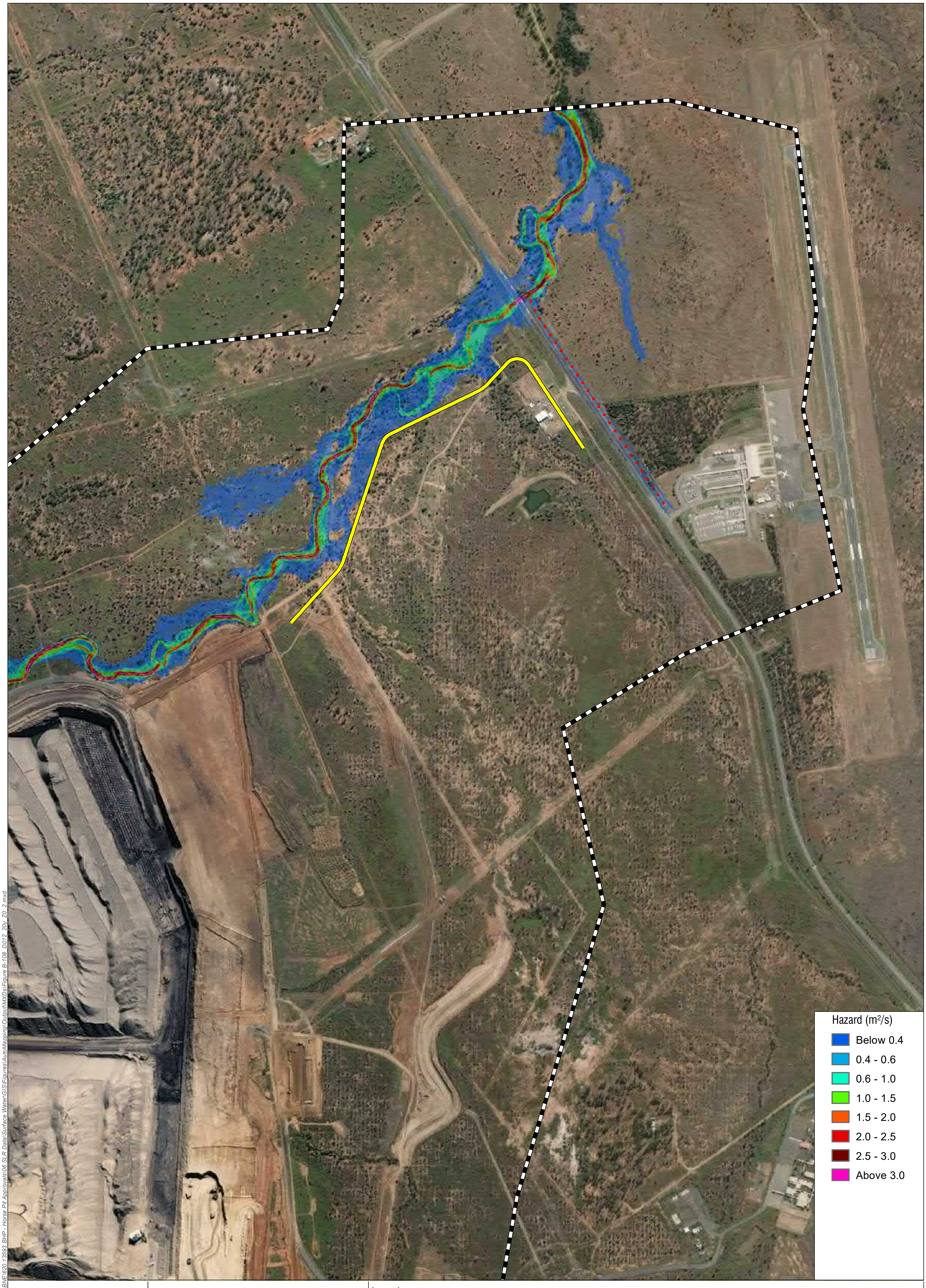
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 10% AEP

Figure B-107



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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

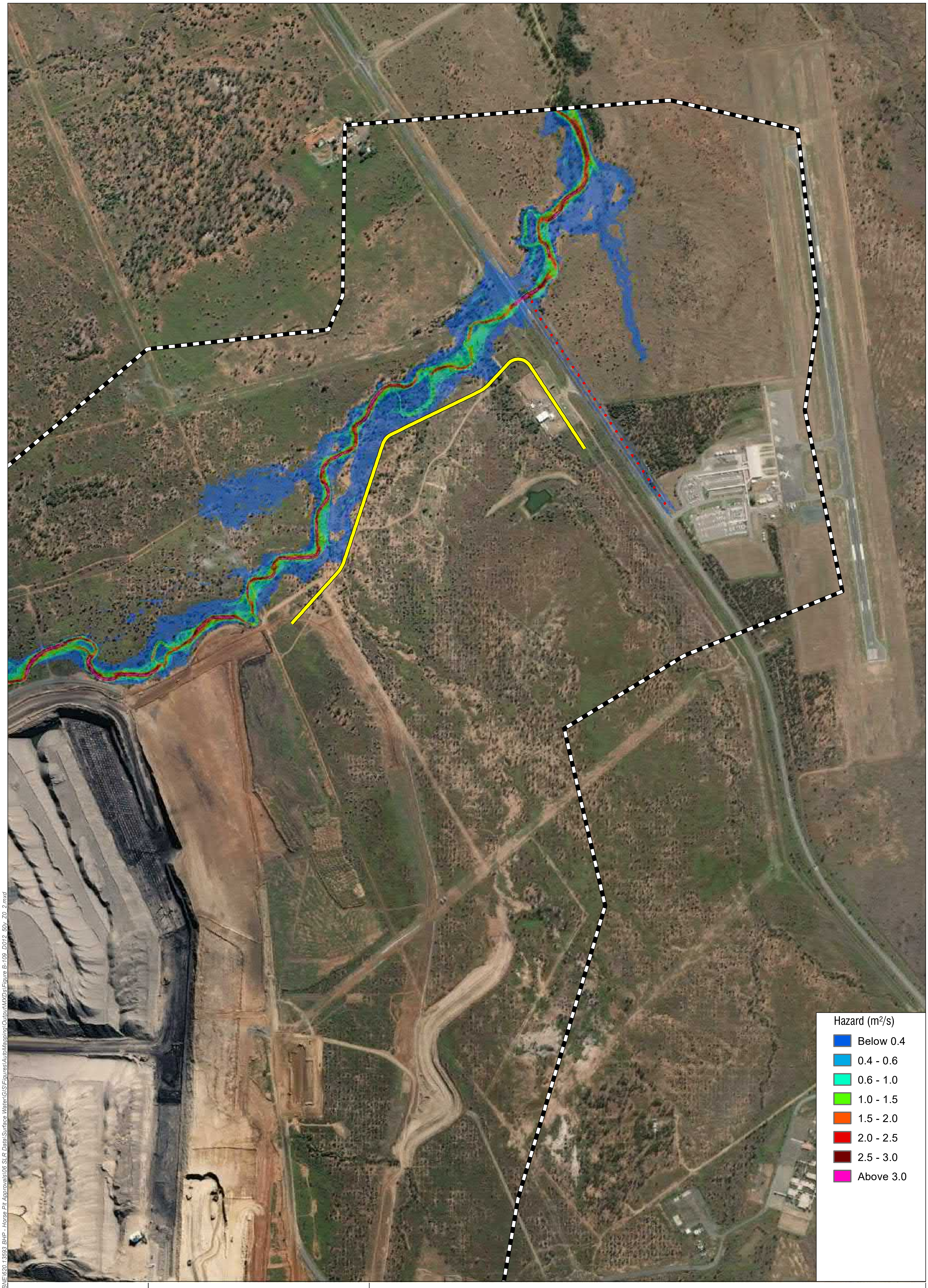
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 5% AEP

Figure B-108



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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

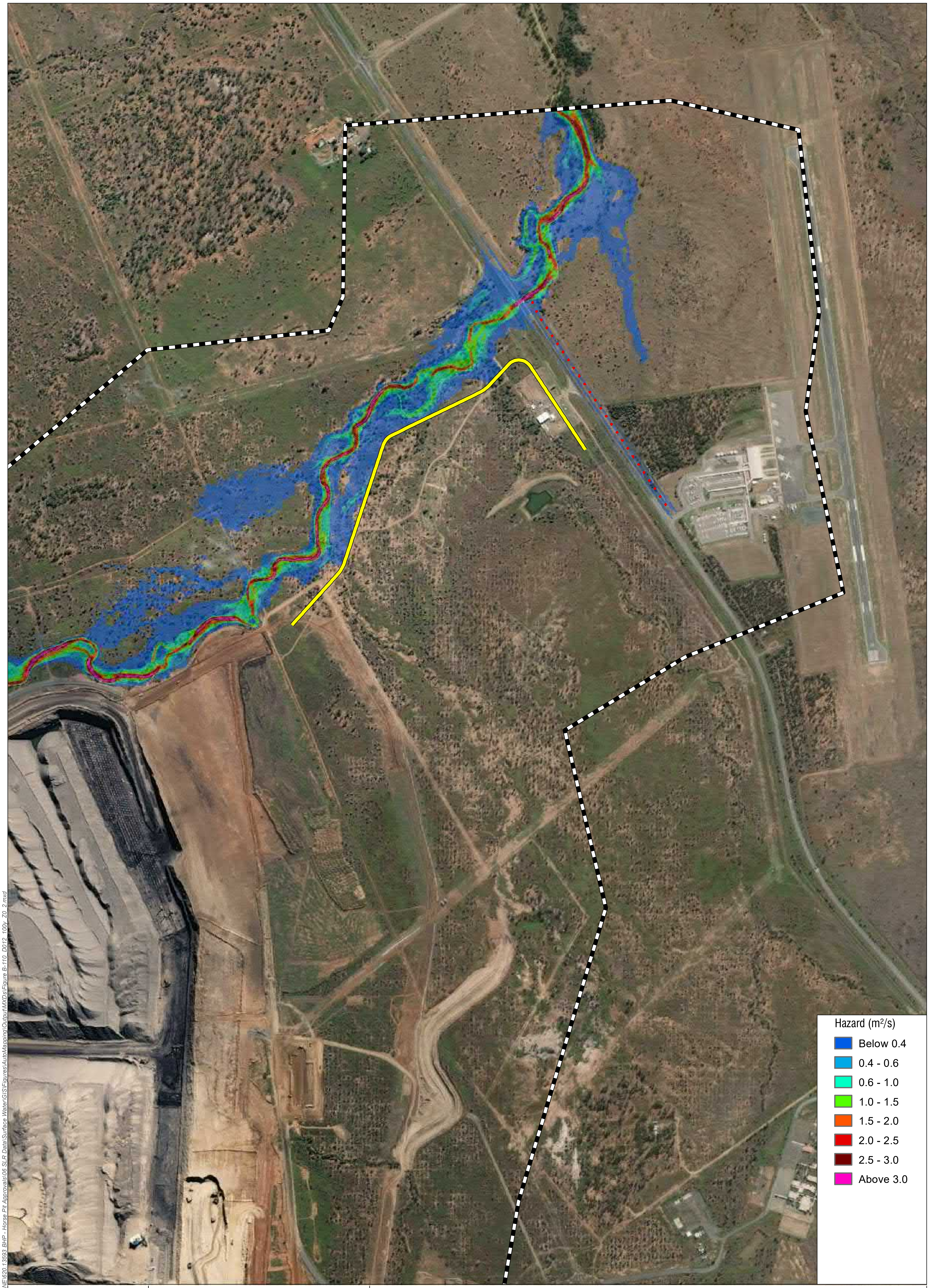
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 2% AEP

Figure B-109



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-110_D012_100y_Z0_2.mxd

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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

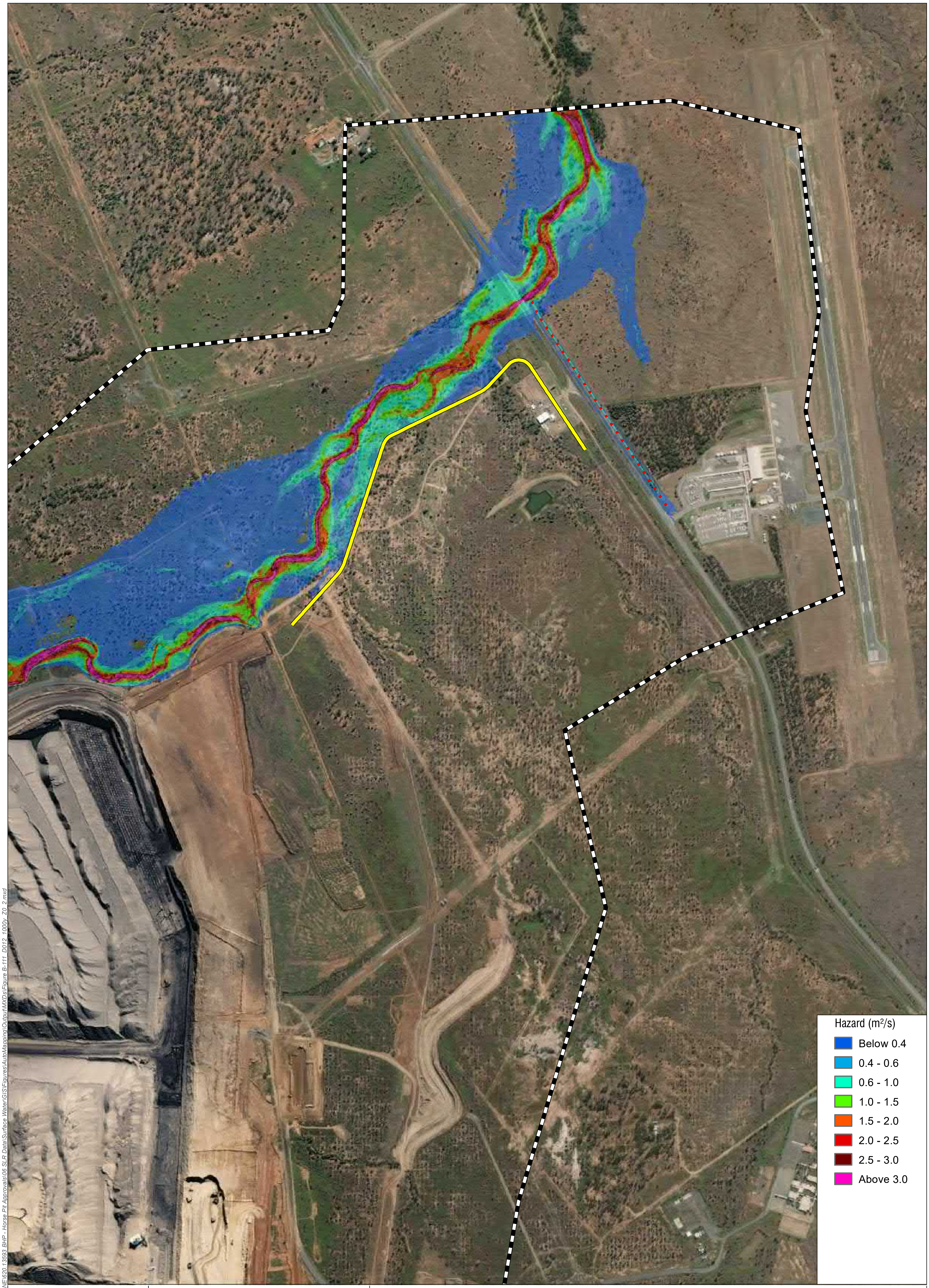
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 1% AEP

Figure B-110



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-111_D012_1000y_Z0_2.mxd

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04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

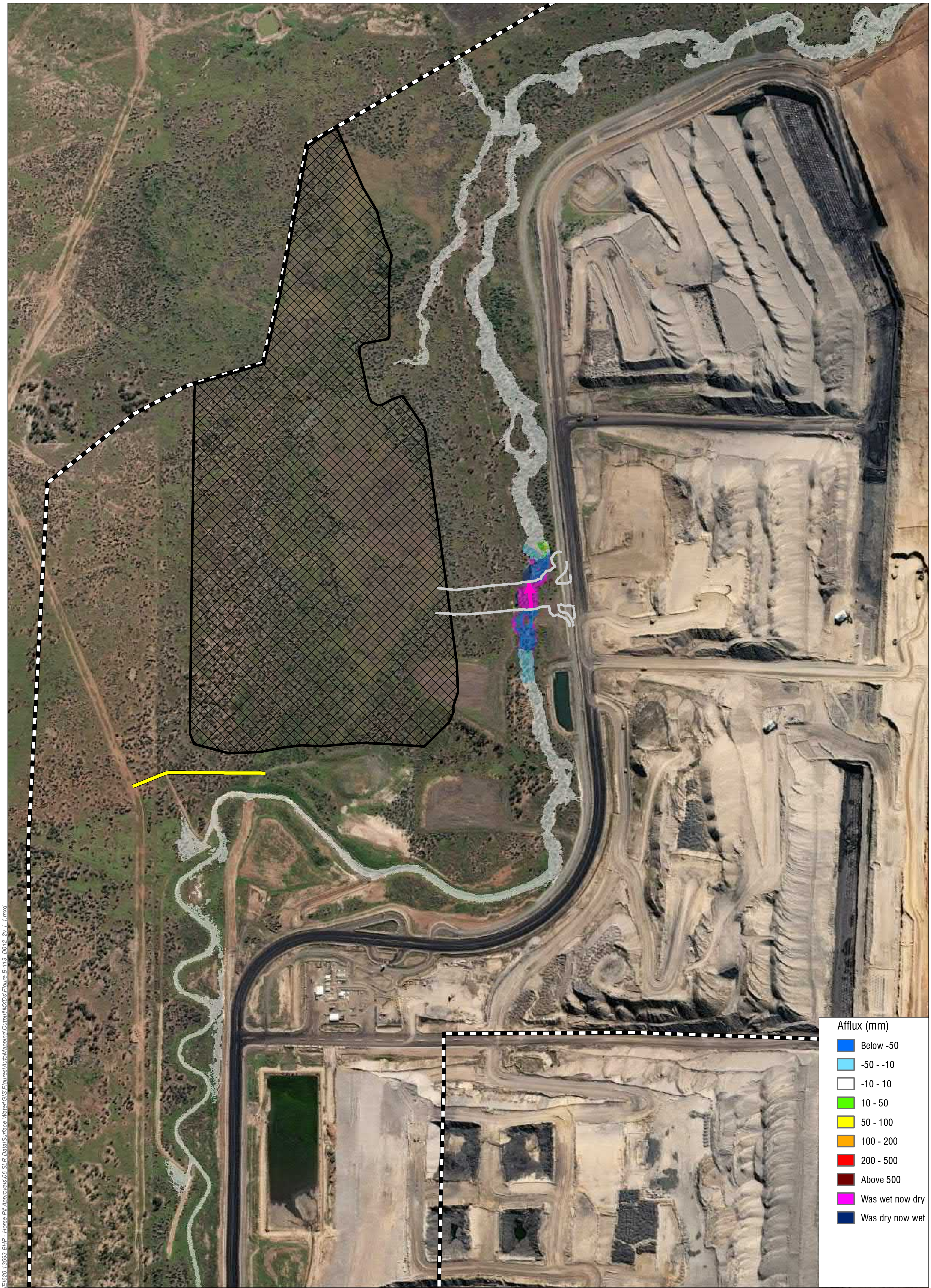
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012)
Peak Flood Hazard - 0.1% AEP

Figure B-111



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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000
Sheet Size : A3 GDA 1994 MGA Zone 55

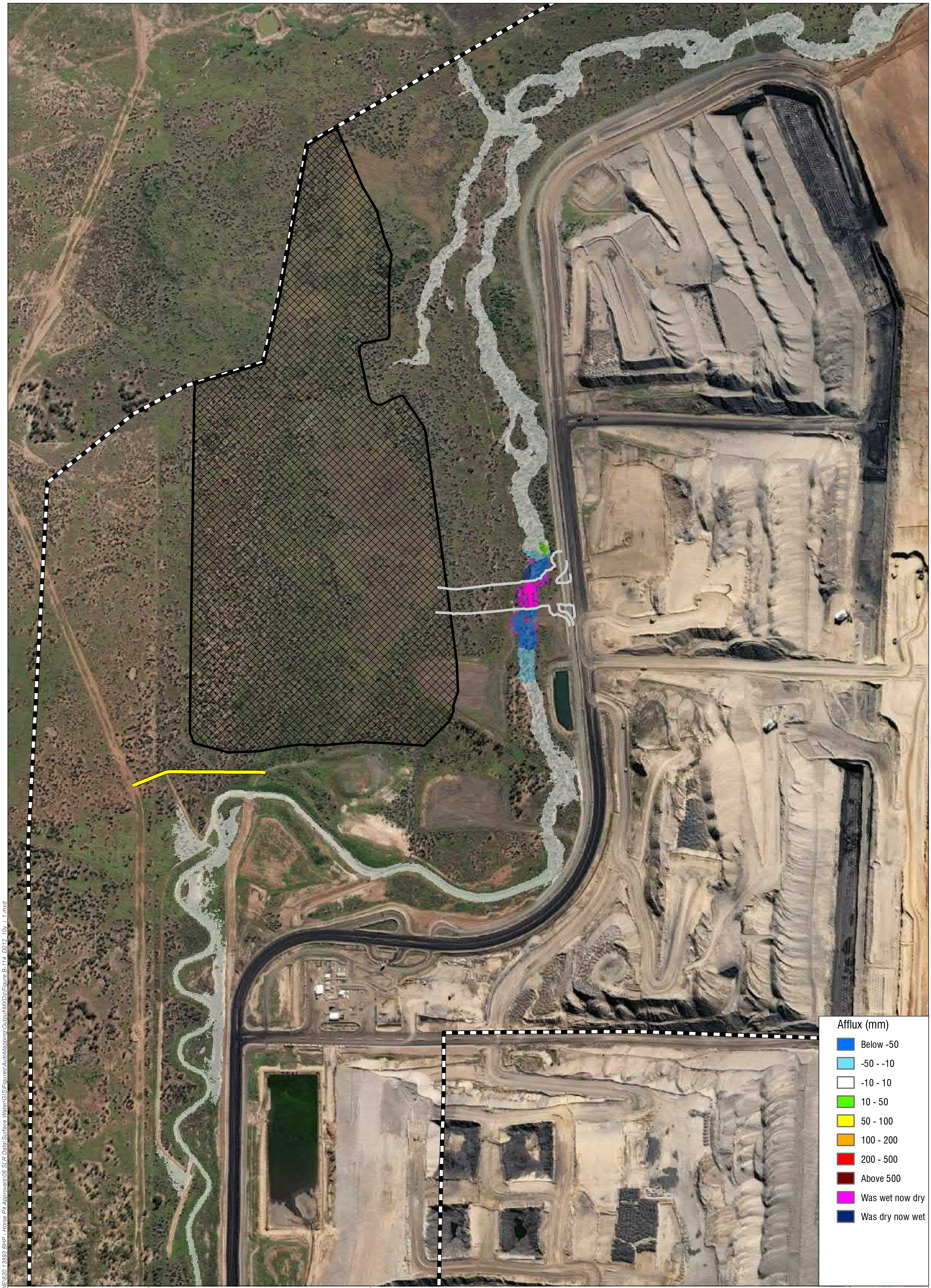
Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 50% AEP

Figure B-113

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-113_D012_2y_i_1.mxd



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-114_D012_10y_1.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

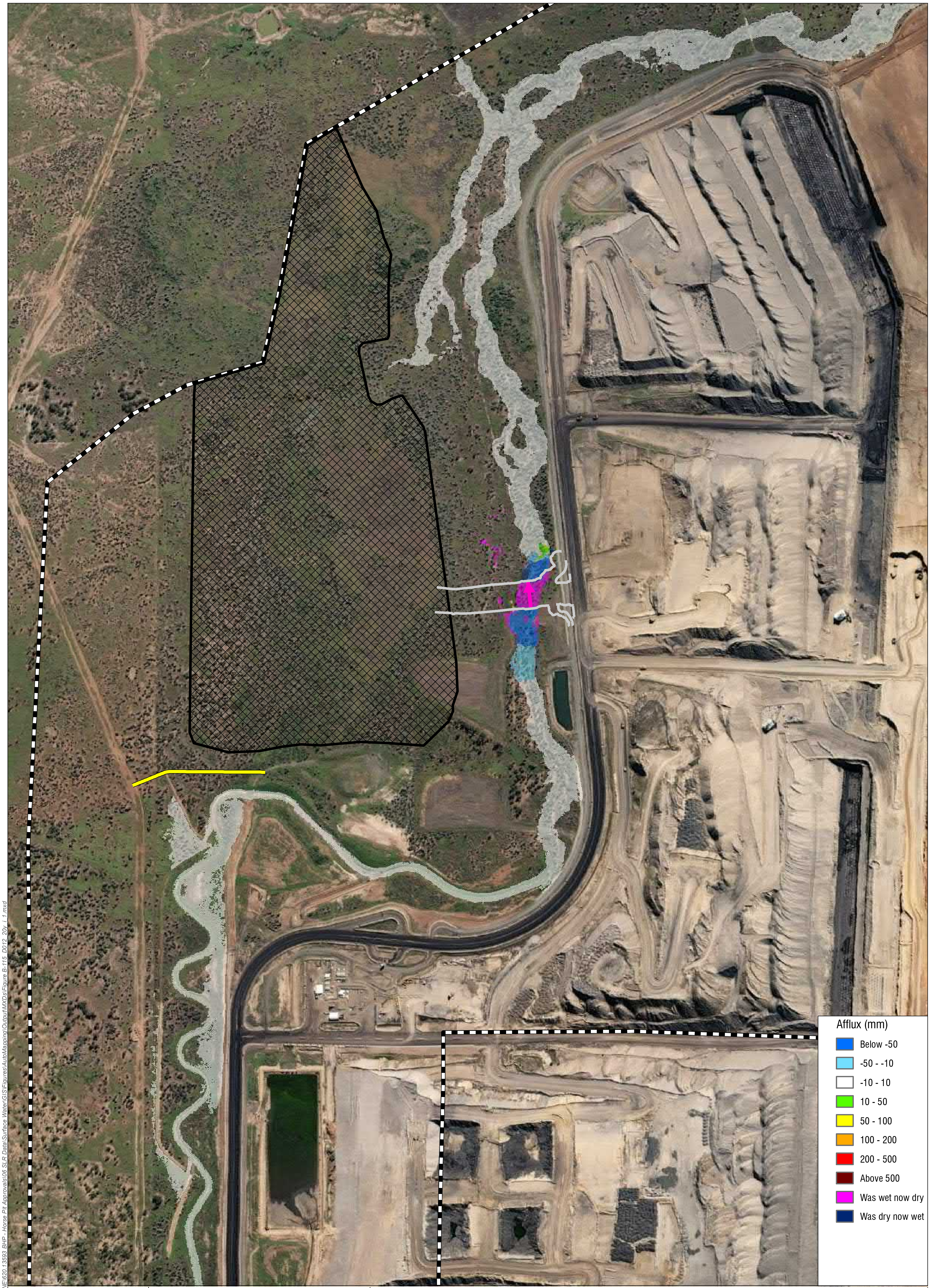
Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 10% AEP

Figure B-114



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-115_D012_20y_i_1.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

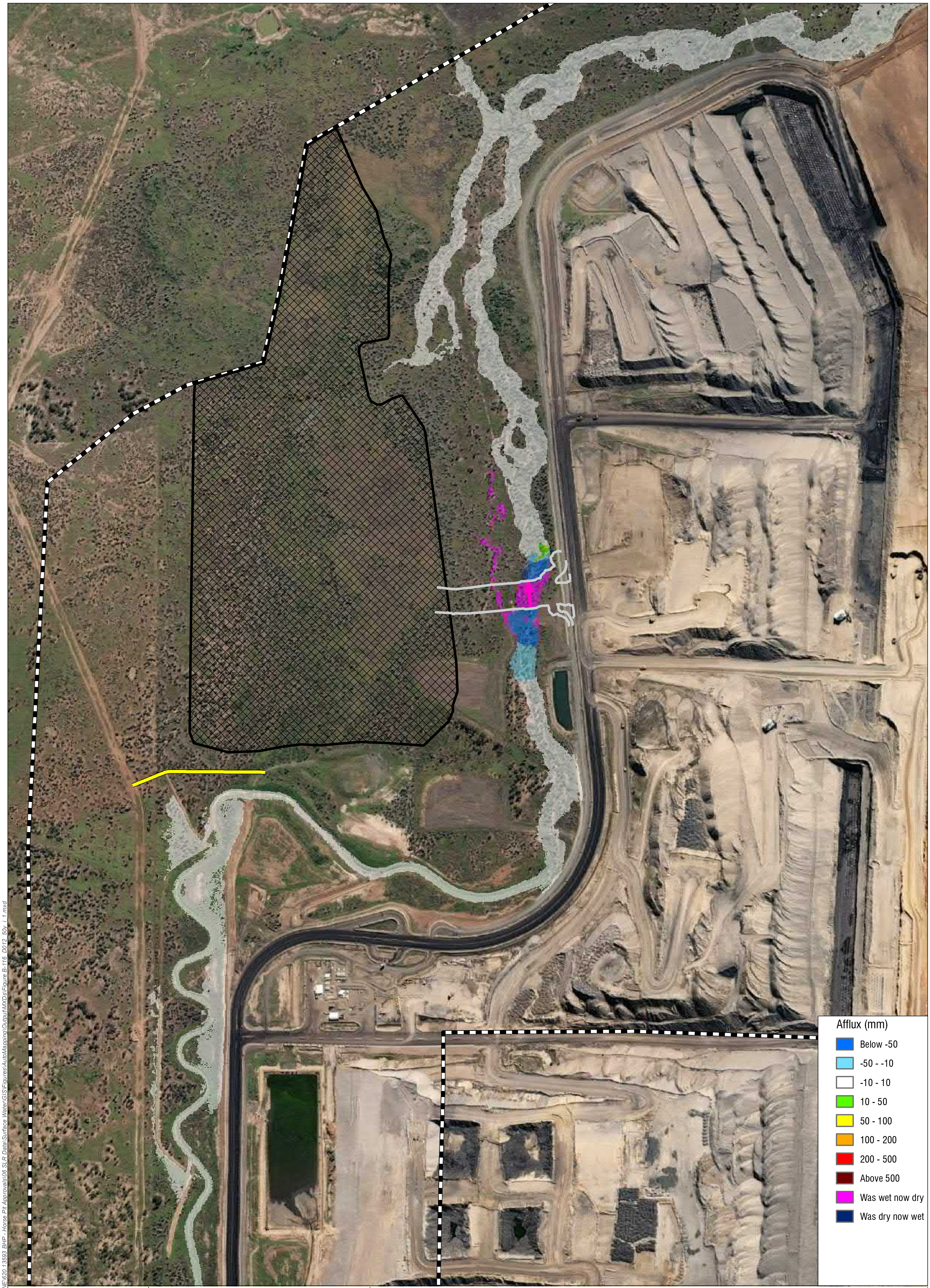
Sheet Size : A3 GDA 1994 MGA Zone 55

Legend
- Proposed Road
- Proposed Levee
- Proposed Waste Rock Dump
- Proposed Culverts
- TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 5% AEP

Figure B-115



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-116_D012_50y_i_1.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

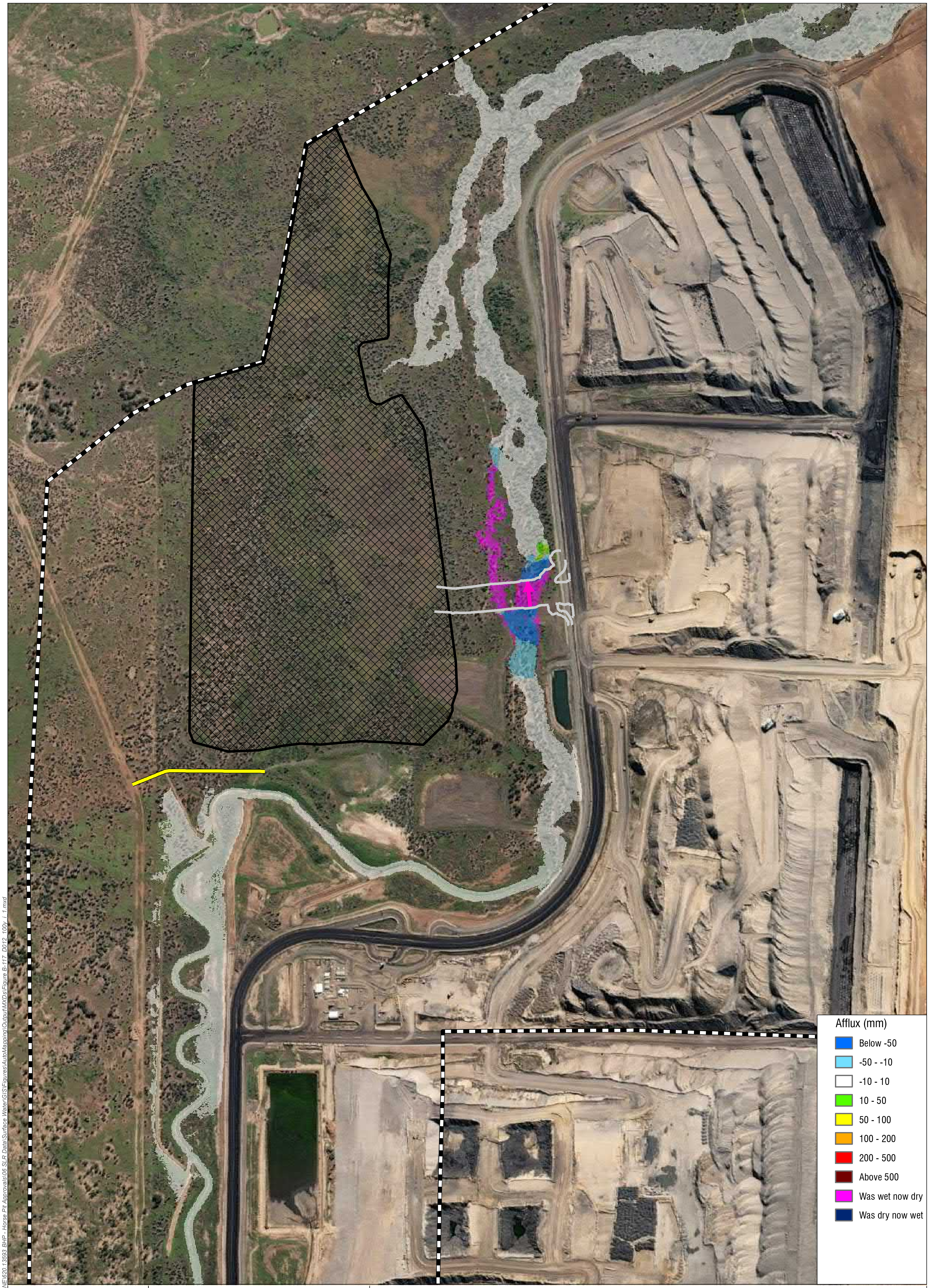
Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 2% AEP

Figure B-116



0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

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Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

Proposed Culverts

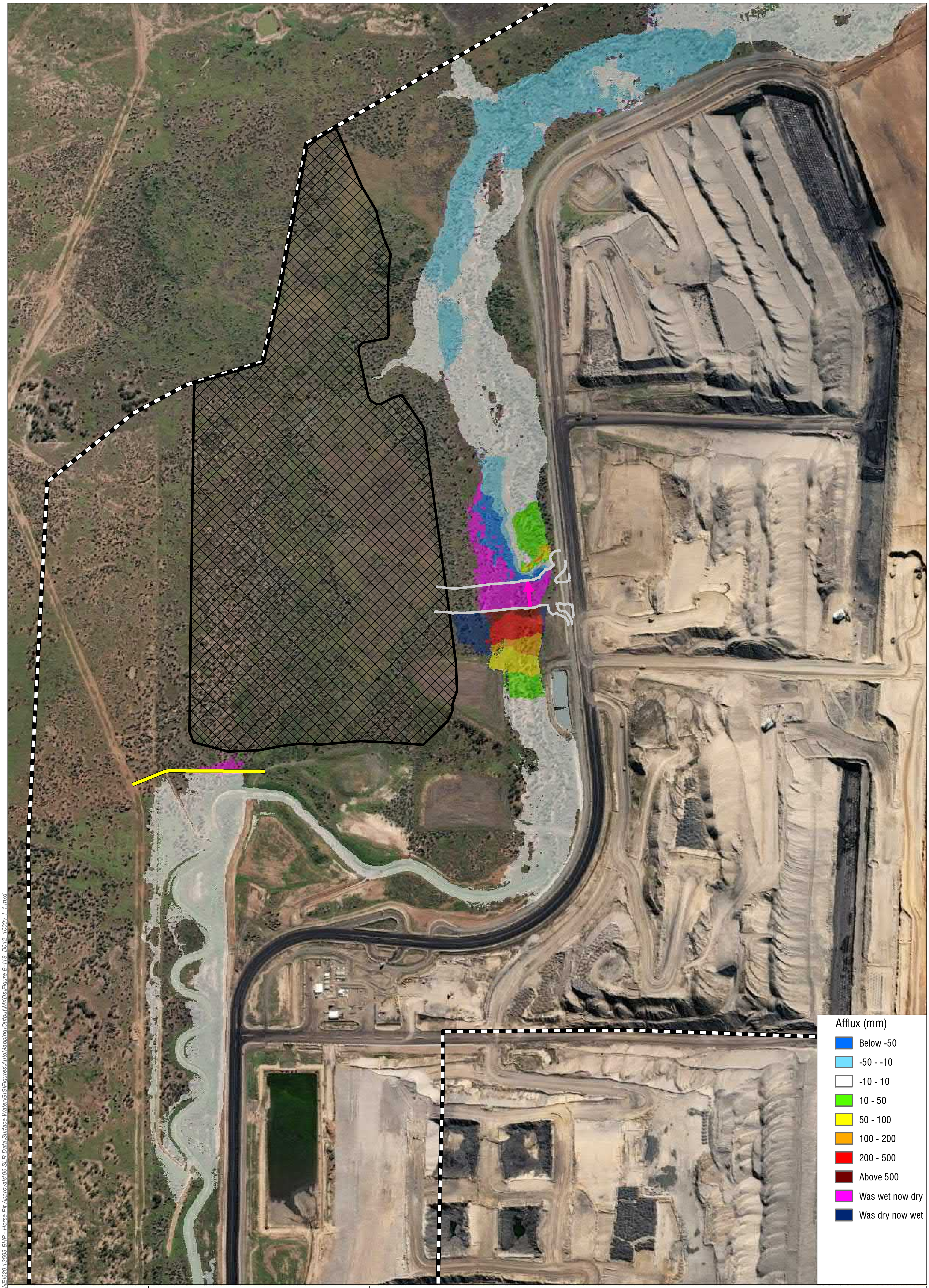
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 1% AEP

Figure B-117

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-117_D012_100y_i_1.mxd



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-118_D012_1000y_1.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Road

Proposed Levee

Proposed Waste Rock Dump

Proposed Culverts

TUFLOW Model Extent

Horse Pit Extension

Flood Impact Assessment

Developed Scenario (D012 Vs. E012)

Peak Flood Afflux - 0.1% AEP

Figure B-118

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

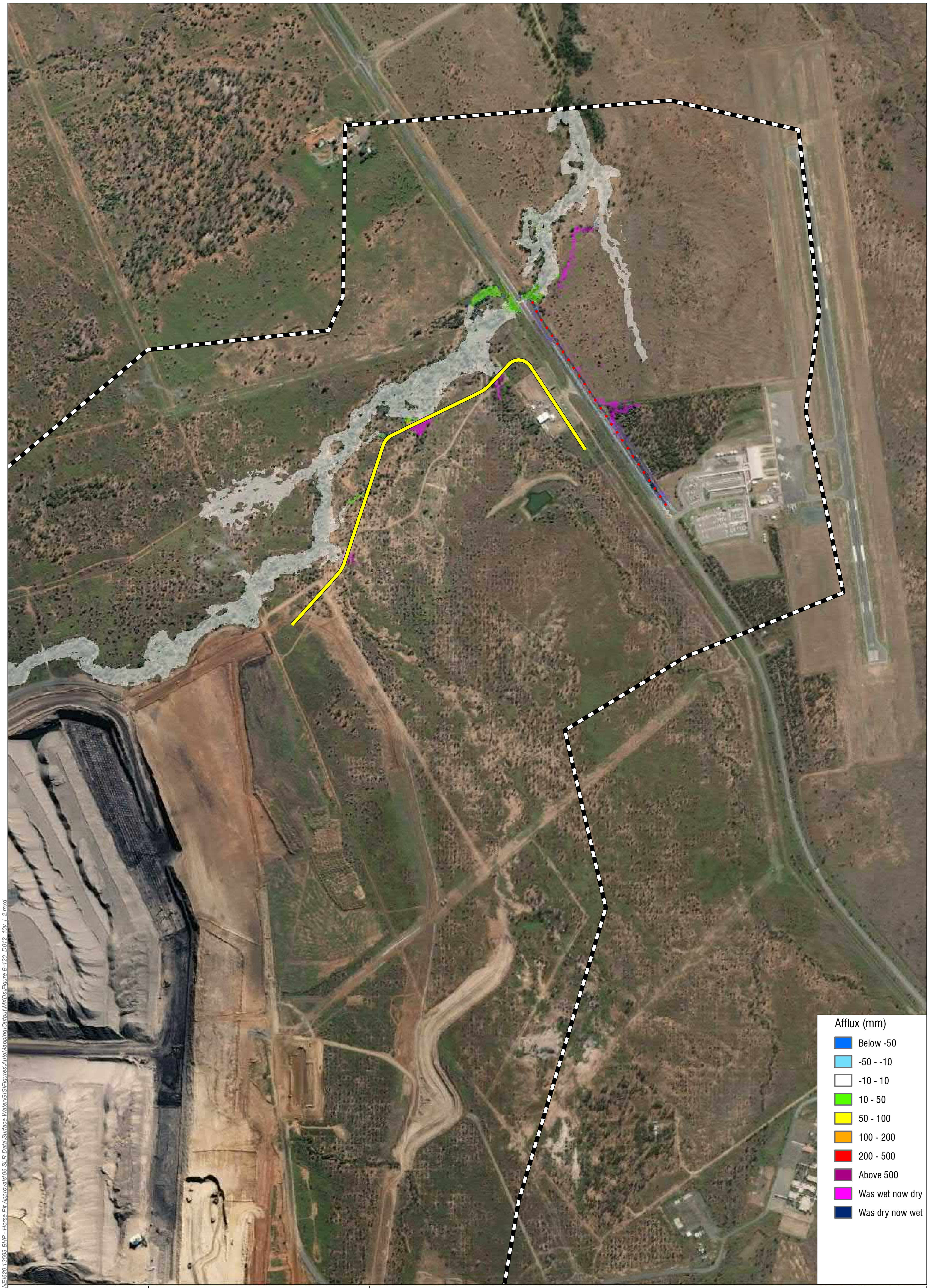
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 50% AEP

Figure B-119



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-120_D012_10y_1_2.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

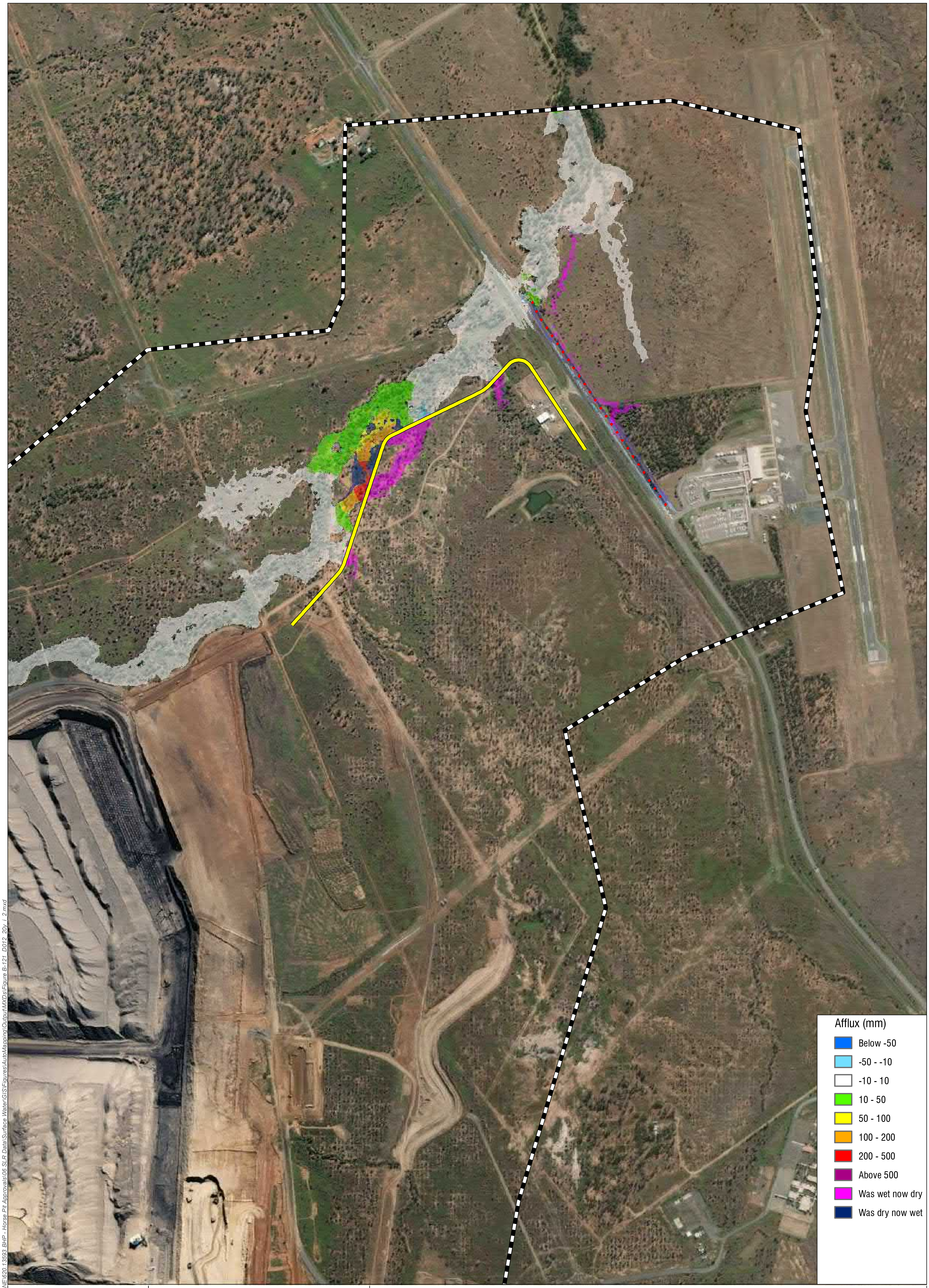
Horse Pit Extension

Flood Impact Assessment

Developed Scenario (D012 Vs. E012)

Peak Flood Afflux - 10% AEP

Figure B-120



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-121_D012_20y_I_2.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

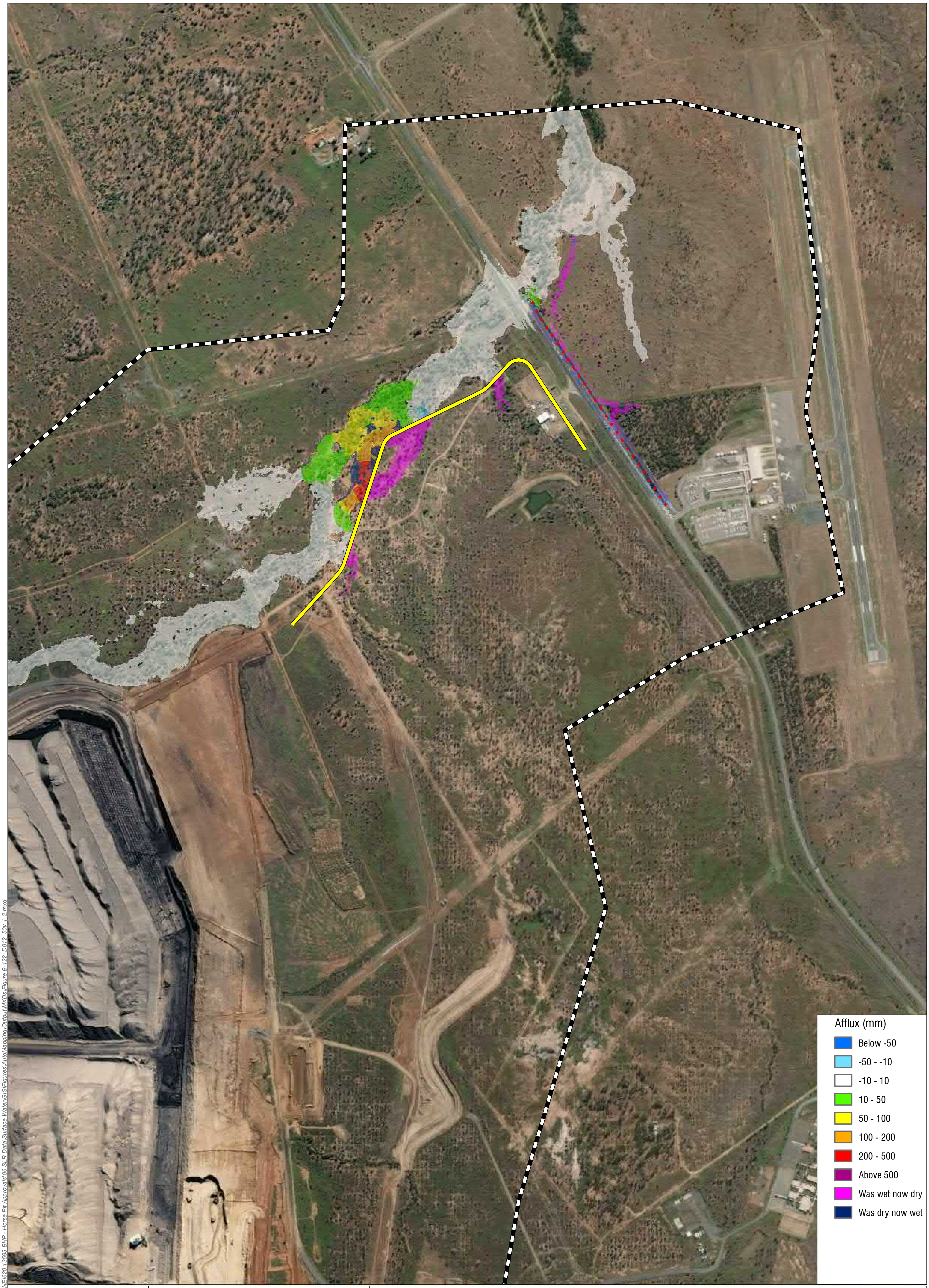
Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 5% AEP

Figure B-121



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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

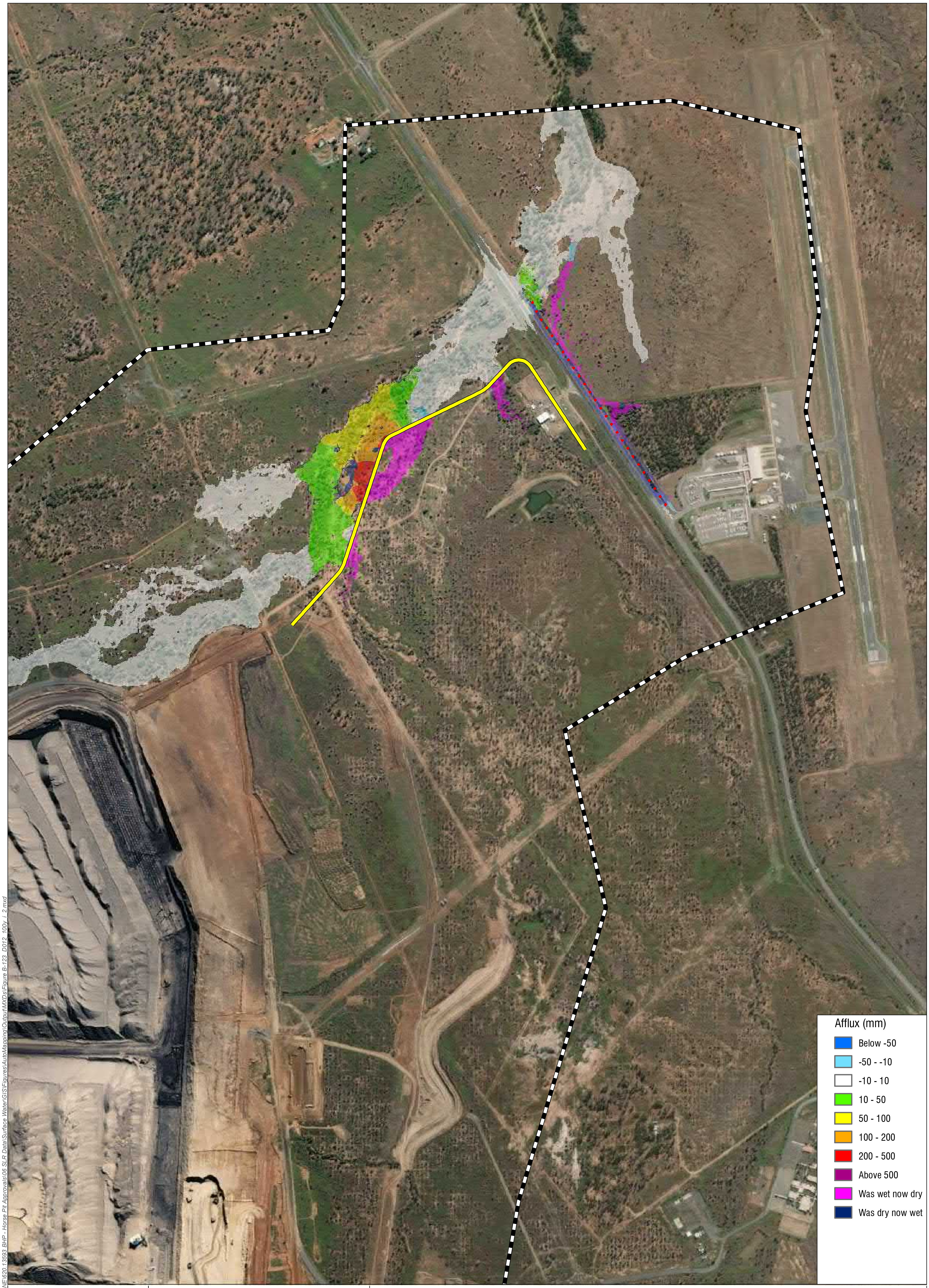
TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 2% AEP

Figure B-122

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-122_D012_50y_1_2.mxd



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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

Horse Pit Extension

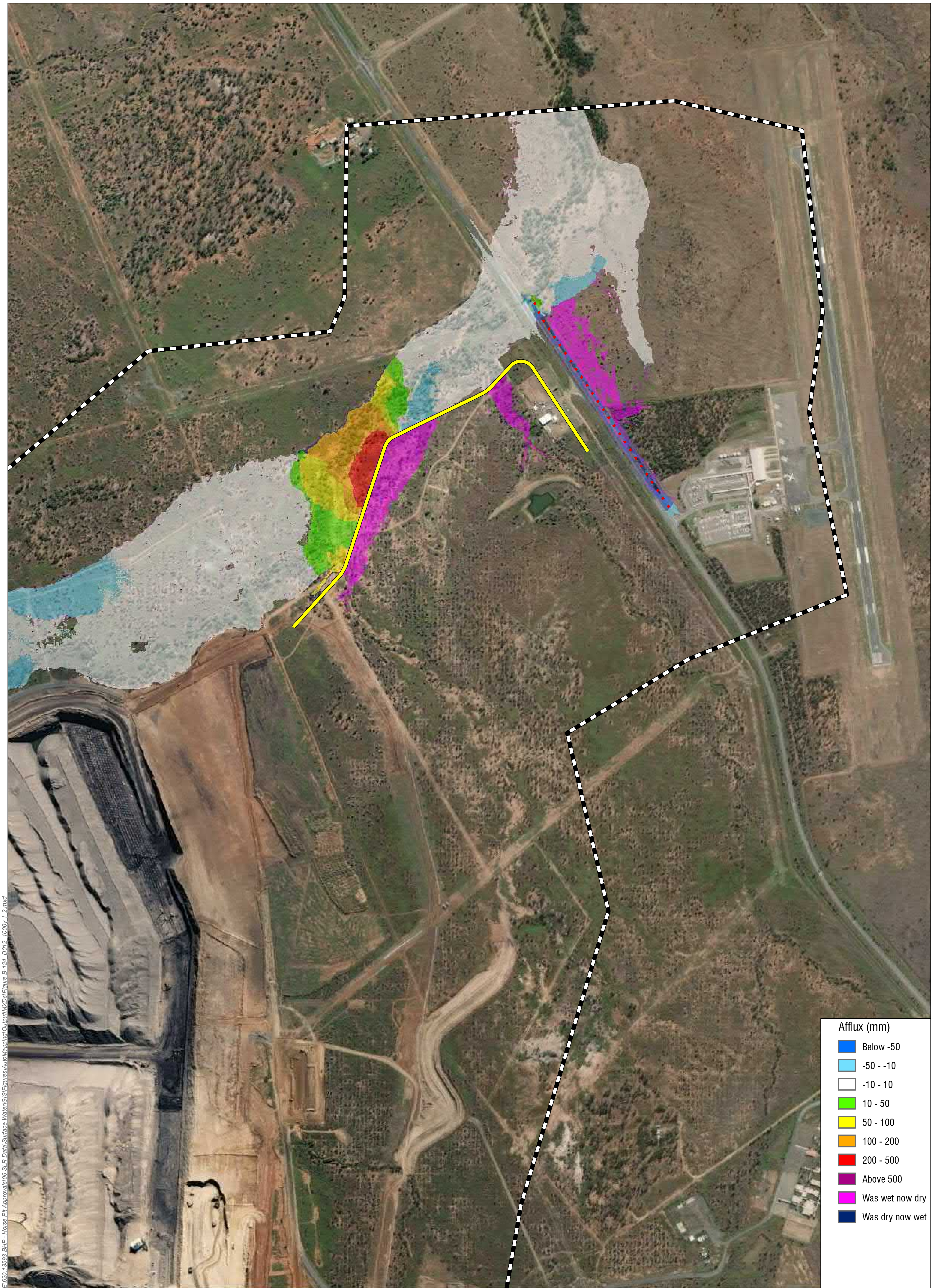
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)

Peak Flood Afflux - 1% AEP

Figure B-123

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-123_D012_100y_i_2.mxd



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\06 SLR Data\Surface Water\GIS\Figures\AutoMapping\Output\MXDs\Figure B-124_D012_1000y_l_2.mxd

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0 100 200 300 400 500 Metres

04-Jun-2021 Scale: 1:10,000

Sheet Size : A3 GDA 1994 MGA Zone 55

Legend

Proposed Drain

Proposed Levee

TUFLOW Model Extent

Horse Pit Extension
Flood Impact Assessment

Developed Scenario (D012 Vs. E012)
Peak Flood Afflux - 0.1% AEP

Figure B-124

APPENDIX C

Water Balance Model

Land Use Areas

Table 1 Land Use 2021

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	2.5	0.0	0.0	0.0	1.6	0.0	4.1
MWD N2	3.7	0.0	0.0	0.0	1.0	0.0	4.7
R20	118.9	55.4	71.2	0.0	7.2	0.0	252.8
R30	8.6	84.5	57.5	0.0	0.0	0.0	150.7
R40	62.7	59.7	48.7	0.0	3.8	0.0	174.9
R50	83.8	14.1	30.7	0.0	11.0	0.0	139.6
R60	37.6	53.3	49.1	0.0	15.8	0.0	155.7
R70	72.4	60.0	68.9	0.0	17.8	0.0	219.1
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	200.3	0.0	0.0	99.6	0.0	302.9
SD N2	18.7	168.4	0.0	0.0	101.8	0.0	288.8
SD N3A	0.0	8.8	0.0	0.0	45.4	23.2	77.5
SD N3B	0.0	9.0	0.0	0.0	8.5	3.4	20.9
SD N3C	1.5	12.9	0.0	0.0	4.0	0.0	18.5
SD N3F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	413.2	857.6	326.2	0.0	380.2	26.7	2003.9

Table 2 Land Use 2025

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	2.3	0.0	0.0	0.0	1.6	0.0	3.9
MWD N2	3.7	0.0	0.0	0.0	1.0	0.0	4.7
R20	17.2	125.5	28.9	0.0	16.1	0.0	187.7
R30	27.7	90.9	25.4	0.0	15.3	0.0	159.3
R40	46.8	104.5	32.0	0.0	13.8	0.0	197.1
R50	40.1	44.6	13.6	0.0	7.2	0.0	105.4
R60	5.8	90.3	11.7	0.0	0.0	26.6	134.5
R70	48.8	117.3	30.6	0.0	15.1	21.3	233.2
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	90.3	0.0	0.0	90.4	183.3	367.0
SD N2	19.9	84.2	0.0	0.0	101.9	91.0	296.9
SD N3A	0.0	0.0	0.0	0.0	41.7	37.8	79.5
SD N3B	0.0	1.7	0.0	0.0	9.5	10.8	22.0
SD N3C	1.2	3.0	0.0	0.0	5.3	8.5	18.1
SD N3F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	216.4	883.5	142.2	0.0	381.6	379.3	2003.1

Table 3 Land Use 2030

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	2.3	0.0	0.0	0.0	1.6	0.0	3.9
MWD N2	3.7	0.0	0.0	0.0	1.0	0.0	4.7
R20	191.9	33.1	31.1	0.0	7.5	148.7	412.4
R30	6.3	21.9	22.6	0.0	4.4	99.8	155.0
R40	44.5	38.2	40.2	0.0	10.2	117.7	250.8
R50	19.5	19.8	9.2	0.0	3.0	51.9	103.5
R60	8.5	22.1	15.8	0.0	7.1	147.9	201.5
R70	145.1	43.8	36.8	0.0	13.3	137.5	376.6
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.4	285.9	379.3
SD N2	19.9	0.0	0.0	0.0	101.9	137.3	259.1
SD N3A	0.0	0.0	0.0	0.0	41.7	49.4	91.1
SD N3B	0.0	0.0	0.0	0.0	13.0	16.5	29.5
SD N3C	1.2	0.0	0.0	0.0	5.6	11.6	18.3
SD N3F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	446.0	310.1	155.8	0.0	363.5	1204.2	2479.6

Table 4 Land Use 2035

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	2.3	0.0	0.0	0.0	1.6	0.0	3.9
MWD N2	3.7	0.0	0.0	0.0	1.0	0.0	4.7
R20	90.2	37.7	21.1	0.0	7.0	189.7	345.7
R30	5.4	23.8	9.8	0.0	4.0	129.6	172.6
R40	46.7	53.1	35.2	0.0	10.2	146.4	291.5
R50	17.3	19.6	18.6	0.0	6.0	65.2	126.7
R60	8.9	22.0	15.6	0.0	7.9	158.3	212.7
R70	459.4	56.7	44.9	0.0	15.4	198.3	774.7
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.5	286.7	380.2
SD N2	19.9	0.0	0.0	0.0	102.0	179.1	301.0
SD N3A	0.0	0.0	0.0	0.0	41.7	52.2	93.9
SD N3B	0.0	0.0	0.0	0.0	13.0	16.5	29.4
SD N3C	1.2	0.0	0.0	0.0	5.3	10.3	16.8
SD N3F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	657.9	344.2	145.1	0.0	368.3	1432.3	2947.8

Table 5 Land Use 2040

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	2.3	0.0	0.0	0.0	1.6	0.0	3.9
MWD N2	2.5	0.0	0.0	0.0	1.6	0.0	4.0
R20	61.7	35.0	11.7	0.0	3.1	225.0	336.5
R30	1.3	12.7	3.6	0.0	0.0	157.0	174.6
R40	24.2	45.2	20.3	0.0	0.0	213.3	303.0
R50	2.8	24.3	11.6	0.0	1.1	80.8	120.6
R60	2.5	23.1	15.6	0.0	7.5	196.0	244.7
R70	376.9	51.5	35.8	0.0	22.3	268.3	754.8
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.5	286.7	380.2
SD N2	19.9	0.0	0.0	0.0	102.0	179.1	301.0
SD N3A	0.0	0.0	0.0	0.0	41.7	57.9	99.5
SD N3B	0.0	0.0	0.0	0.0	13.0	21.7	34.6
SD N3C	1.2	0.0	0.0	0.0	5.3	10.3	16.8
SD N3F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	498.0	323.0	98.6	0.0	352.4	1696.1	2968.2

Table 6 Land Use 2045

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	1.5	0.0	0.0	0.0	1.6	0.0	3.1
MWD N2	0.0	0.0	0.0	0.0	1.0	0.0	1.0
R20	17.3	19.3	16.4	0.0	5.8	261.3	320.2
R30	0.0	5.0	0.3	0.0	0.0	188.5	193.7
R40	18.3	31.1	29.9	0.0	8.5	265.5	353.3
R50	2.2	18.7	15.0	0.0	0.0	85.9	121.7
R60	35.9	20.9	22.0	0.0	6.7	238.8	324.3
R70	233.9	41.0	47.3	0.0	15.1	245.7	582.9
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.5	275.6	369.1
SD N2	19.9	0.0	0.0	0.0	102.0	174.1	296.0
SD N3A	0.0	0.0	0.0	0.0	41.7	61.5	103.1
SD N3B	0.0	0.0	0.0	0.0	13.0	25.6	38.6
SD N3C	1.2	0.0	0.0	0.0	5.3	10.3	16.8
SD N3F	0.0	0.0	0.0	0.0	4.8	78.6	83.4
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	333.0	267.1	130.8	0.0	358.7	1911.4	3001.1

Table 7 Land Use 2050

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	0.0	0.0	0.0	0.0	1.6	0.0	1.6
MWD N2	0.0	0.0	0.0	0.0	1.0	0.0	1.0
R20	12.3	12.6	1.6	0.0	3.0	218.8	248.3
R30	0.0	2.9	0.0	0.0	0.0	257.1	260.0
R40	3.0	36.3	14.1	0.0	0.0	302.4	355.7
R50	2.0	8.2	0.0	0.0	0.0	104.2	114.5
R60	27.1	13.1	0.0	0.0	2.6	271.9	314.6
R70	145.5	82.8	32.9	0.0	20.3	225.7	507.2
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.5	280.4	373.9
SD N2	19.9	0.0	0.0	0.0	102.0	185.9	307.8
SD N3A	0.0	0.0	0.0	0.0	41.7	61.5	103.1
SD N3B	0.0	0.0	0.0	0.0	13.0	87.4	100.4
SD N3C	1.2	0.0	0.0	0.0	5.3	9.5	16.0
SD N3F	0.0	0.0	0.0	0.0	4.8	88.9	93.7
SD N3G	0.0	58.1	0.0	0.0	1.5	0.0	59.6
SD N3H	0.0	73.0	0.0	0.0	1.5	0.0	74.5
Total	214.0	287.0	48.6	0.0	348.5	2093.6	2991.6

Table 8 Land Use 2057

Storage	Natural	Spoil	Pit	Tailings	Disturbed	Rehab	Total
MWD N1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MWD N2	1.4	0.0	0.0	0.0	1.0	0.0	2.4
R20	11.6	1.7	0.0	0.0	3.0	231.2	247.6
R30	0.0	0.0	0.0	0.0	0.0	259.5	259.5
R40	3.9	16.3	0.0	0.0	0.0	339.3	359.5
R50	3.0	0.0	0.0	0.0	0.0	111.0	114.0
R60	30.7	8.0	0.0	0.0	0.0	302.3	341.0
R70	125.3	43.9	14.3	0.0	0.0	316.7	500.1
SD BCSD	0.0	0.0	0.0	0.0	59.8	0.0	59.8
SD N1	3.0	0.0	0.0	0.0	90.5	280.4	373.9
SD N2	19.9	0.0	0.0	0.0	102.0	185.9	307.8
SD N3A	0.0	0.0	0.0	0.0	41.7	61.5	103.1
SD N3B	0.0	0.0	0.0	0.0	13.0	87.4	100.4
SD N3C	1.2	0.0	0.0	0.0	5.3	9.5	16.0
SD N3F	0.0	0.0	0.0	0.0	4.8	88.9	93.7
SD N3G	0.0	0.0	0.0	0.0	1.5	58.1	59.6
SD N3H	0.0	0.0	0.0	0.0	1.5	73.0	74.5
Total	199.8	69.9	14.3	0.0	324.1	2404.6	3012.7

APPENDIX D

Groundwater Flux Curves

Groundwater Flux	
RL	Inflow (ML/d)
95	0.28
115	0.2
120	0.18
125	0.17
130	0.15
135	0.13
140	0.12
145	0.1
150	0.08
155	0.07
160	0.05
165	0.03
170	0.01
175	0
180	-0.02
185	-0.04
190	-0.06
195	-0.09
200	-0.11
220	-0.16

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