Technical Memorandum

Date	20 August 2024
To	Superintendent Environmental Approvals (Eastern)
From	Jacqueline Woodlock – Water Planning
CC	Ricardo Fuentes, Helen Butterworth, Johanna Richards, Iain Rea
Subject	Orebody 29/30/35 Significant Amendment – Surface Water Impact Assessment

1 Introduction

The purpose of this Technical Memorandum is to present the surface water impact assessment for the Orebody 29/30/35 Significant Amendment (the Proposal).

The scope of the Proposal includes the construction and operation of a new pipeline to distribute additional surplus water, expansion of the Orebody (OB) 29 and OB30 mine pits, increase in groundwater abstraction and surplus water discharge, additional overburden storage areas (OSAs) and a ramp. The indicative footprint for the proposal is shown in **Figure 1**. Surface water considerations for other supporting infrastructure such as roads and go-lines have not been assessed as it is standard practice for drainage infrastructure to be included in their designs.

2 Regional and local hydrology

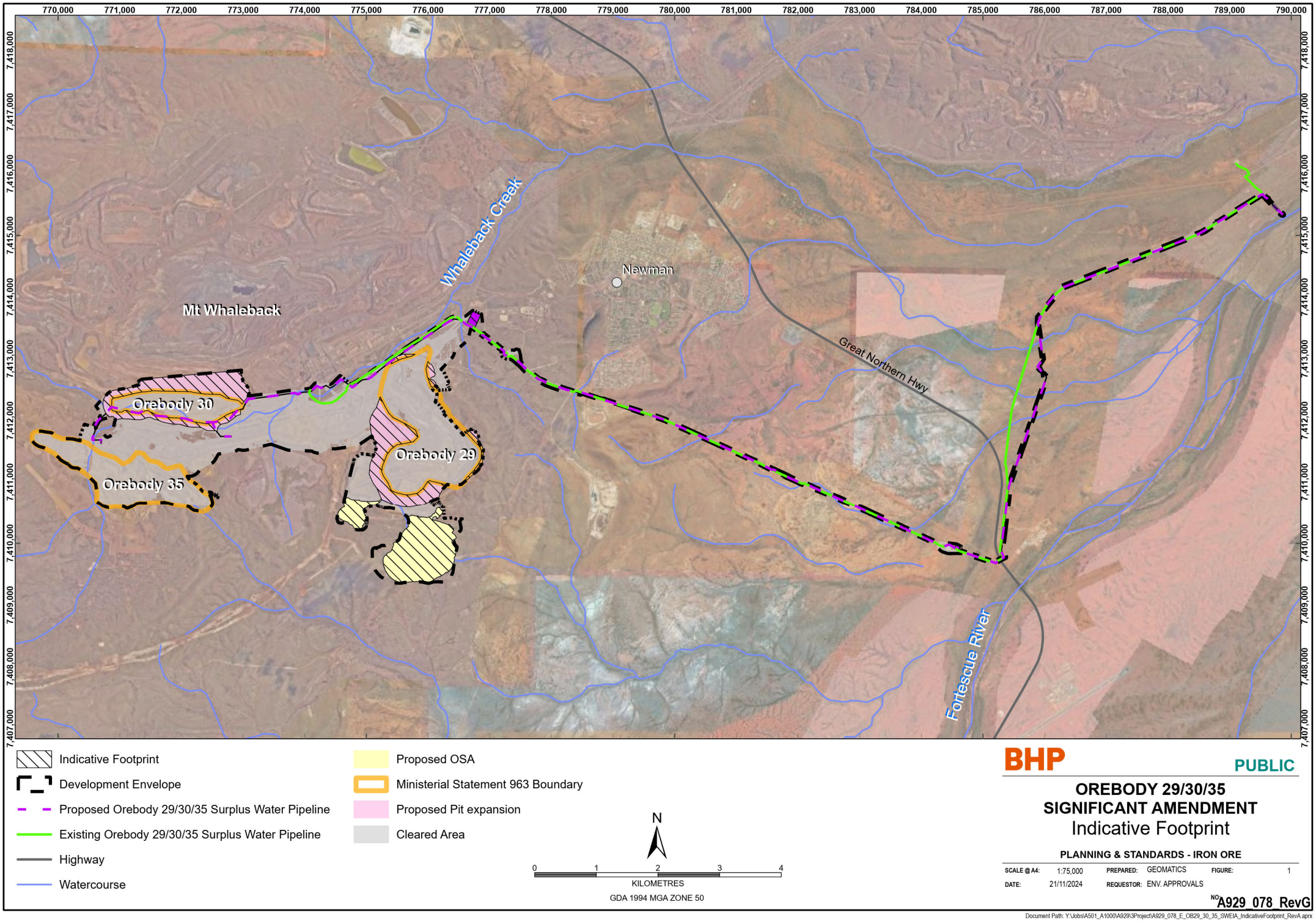
The Proposal is located within the Upper Fortescue River (DWER) catchment, which has a total catchment area of 29,757 km^2. Significant hydrological features in the Upper Fortescue River catchment include (**Figure 2**):

- Fortescue River which flows into Ophthalmia Dam and continues downstream of Ophthalmia Dam
- Whaleback Creek, a tributary of the Fortescue River, which discharges into the Fortescue River upstream of Ophthalmia Dam
- Fortescue Marsh, which is the terminus of the Upper Fortescue River, approximately 128 km downstream of Ophthalmia Dam.

The Proposal is also mostly within the Priority 1 (P1) Newman Drinking Water Reserve.

For the assessment at the regional scale, the catchment area of the Fortescue River upstream of Ophthalmia Dam ('Fortescue River at Ophthalmia Dam') (**Figure 2**) is 3,072 km^2.

At the local scale, the Proposal is located wholly within the Whaleback Creek Catchment, which has an area of 195 km^2. The contributing catchment has been modified due to existing creek diversions and construction of mine infrastructure (**Figure 3**).



Indicative Footprint
Development Envelope
Proposed Orebody 29/30/35 Surplus Water Pipeline
Existing Orebody 29/30/35 Surplus Water Pipeline
Highway
Watercourse

Proposed OSA
Ministerial Statement 963 Boundary
Proposed Pit expansion
Cleared Area

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BHP

PUBLIC

OREBODY 29/30/35
SIGNIFICANT AMENDMENT
Indicative Footprint

PLANNING & STANDARDS - IRON ORE

SCALE @ A4:	1:75,000	PREPARED:	GEOMATICS	FIGURE:	1
DATE:	21/11/2024	REQUESTOR:	ENV. APPROVALS		

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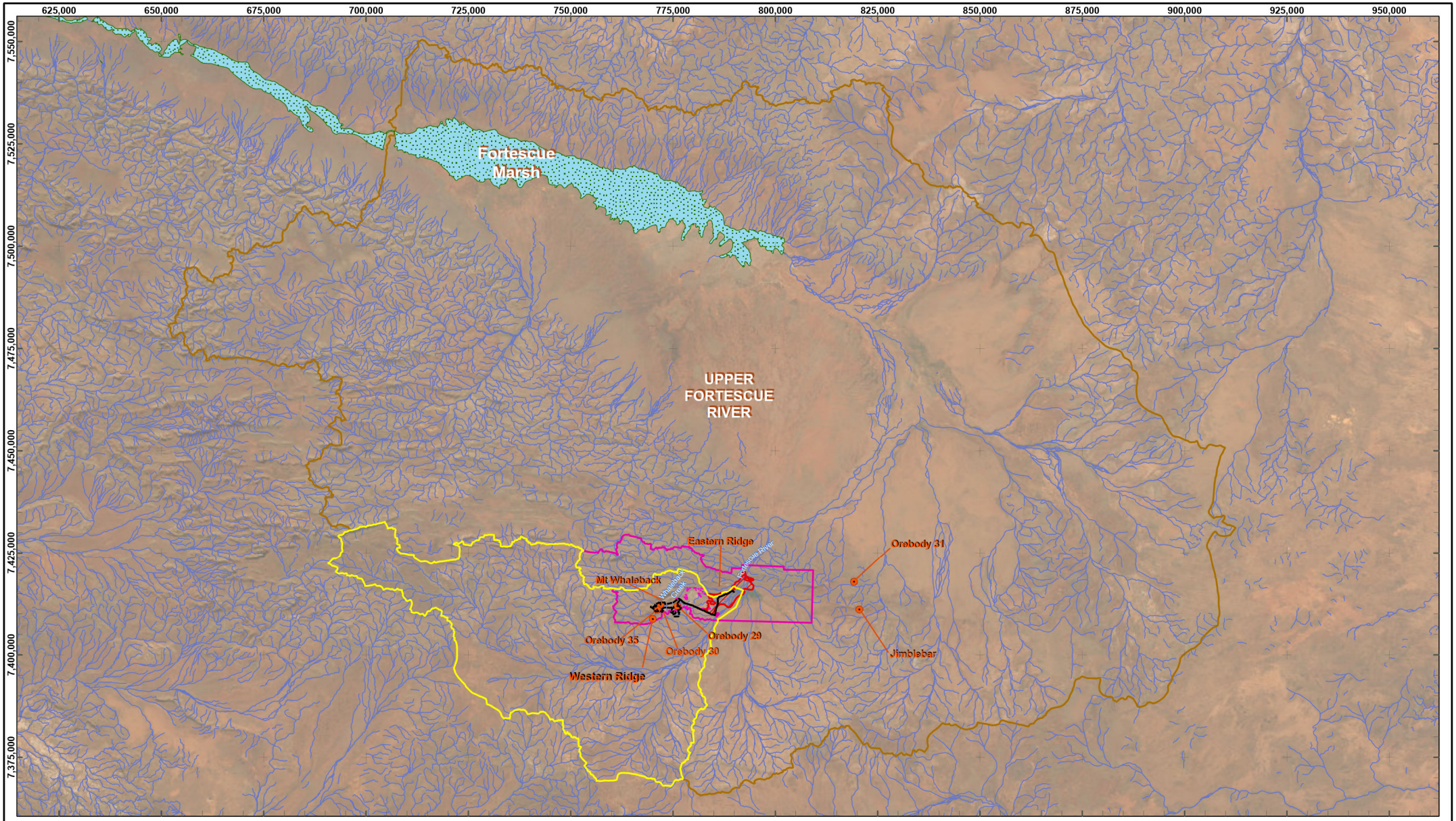

- BHP operations
- Development Envelope
- Ethel Gorge TEC
- Newman Drinking Water Reserve P1
- Newman Drinking Water Reserve P3
- Fortescue River at Ophthalmia Dam Catchment
- Upper Fortescue River Catchment
- Fortescue Marsh
- Waterways

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OREBODY 29/30/35 SIGNIFICANT AMENDMENT

Regional Hydrology

PLANNING & STANDARDS - IRON ORE

SCALE @ A4:	1:1,250,000	PREPARED:	GEOMATICS	FIGURE:	2
DATE:	21/11/2024	REQUESTOR:	ENV. APPROVALS	NO:	A929_079_RevE
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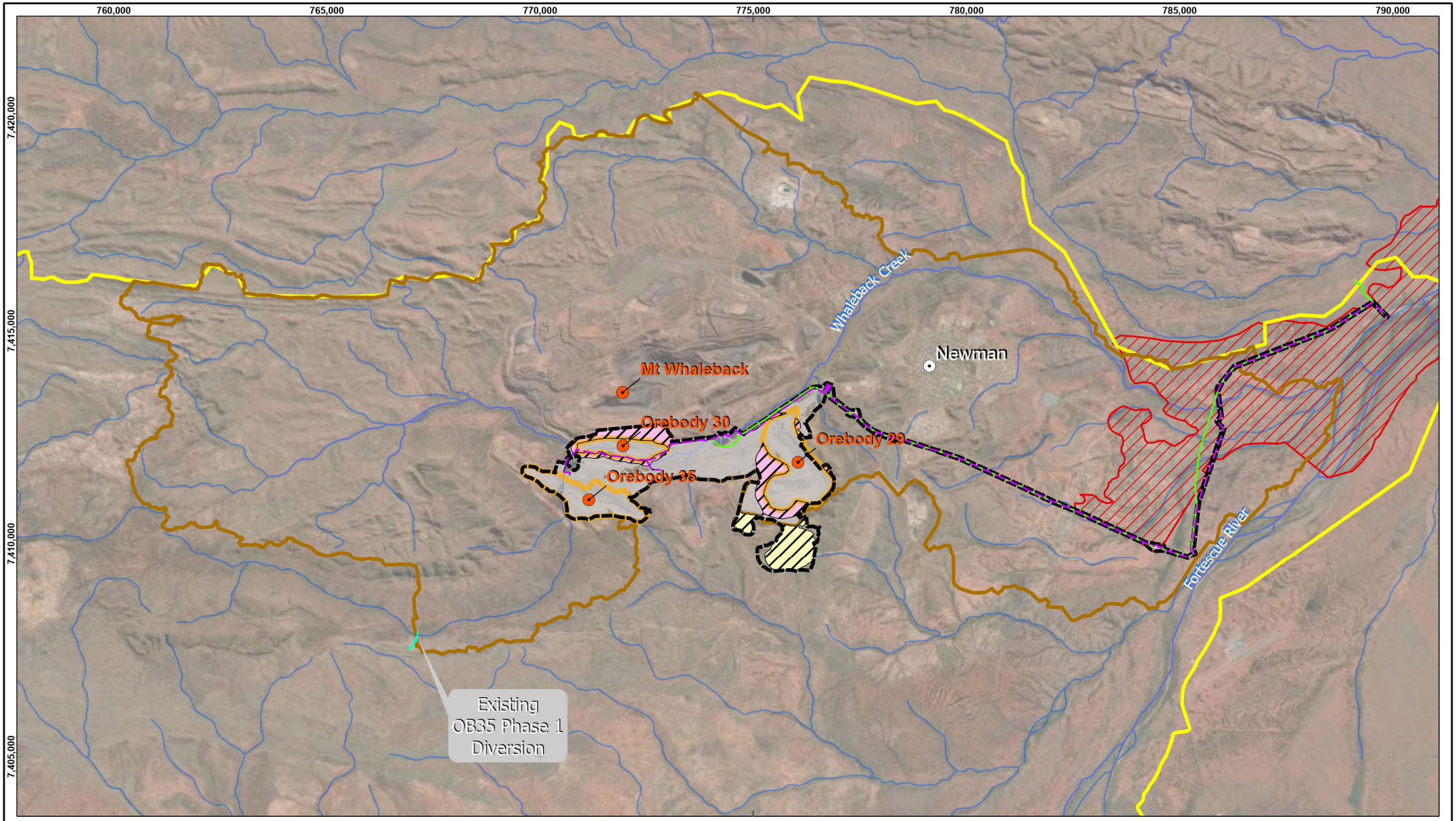

- BHP operations
- Watercourse
- Proposed Orebody 29/30/35 Surplus Water Pipeline
- Existing Orebody 29/30/35 Surplus Water Pipeline
- Indicative Footprint
- Development Envelope
- Ministerial Statement 963 Boundary
- Proposed Pit Expansion
- Ethel Gorge TEC
- Whaleback Creek Catchment
- Fortescue River at Ophthalmia Dam Catchment
- Existing Orebody 35 Phase 1 Diversion
- Proposed OSA
- Cleared Area

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OREBODY 29/30/35 SIGNIFICANT AMENDMENT

Local Hydrology

PLANNING & STANDARDS - IRON ORE

SCALE @ A4:	1:120,000	PREPARED:	GEOMATICS	FIGURE:	3
DATE:	21/11/2024	REQUESTOR:	ENV. APPROVALS	NO:	929_080_RevH
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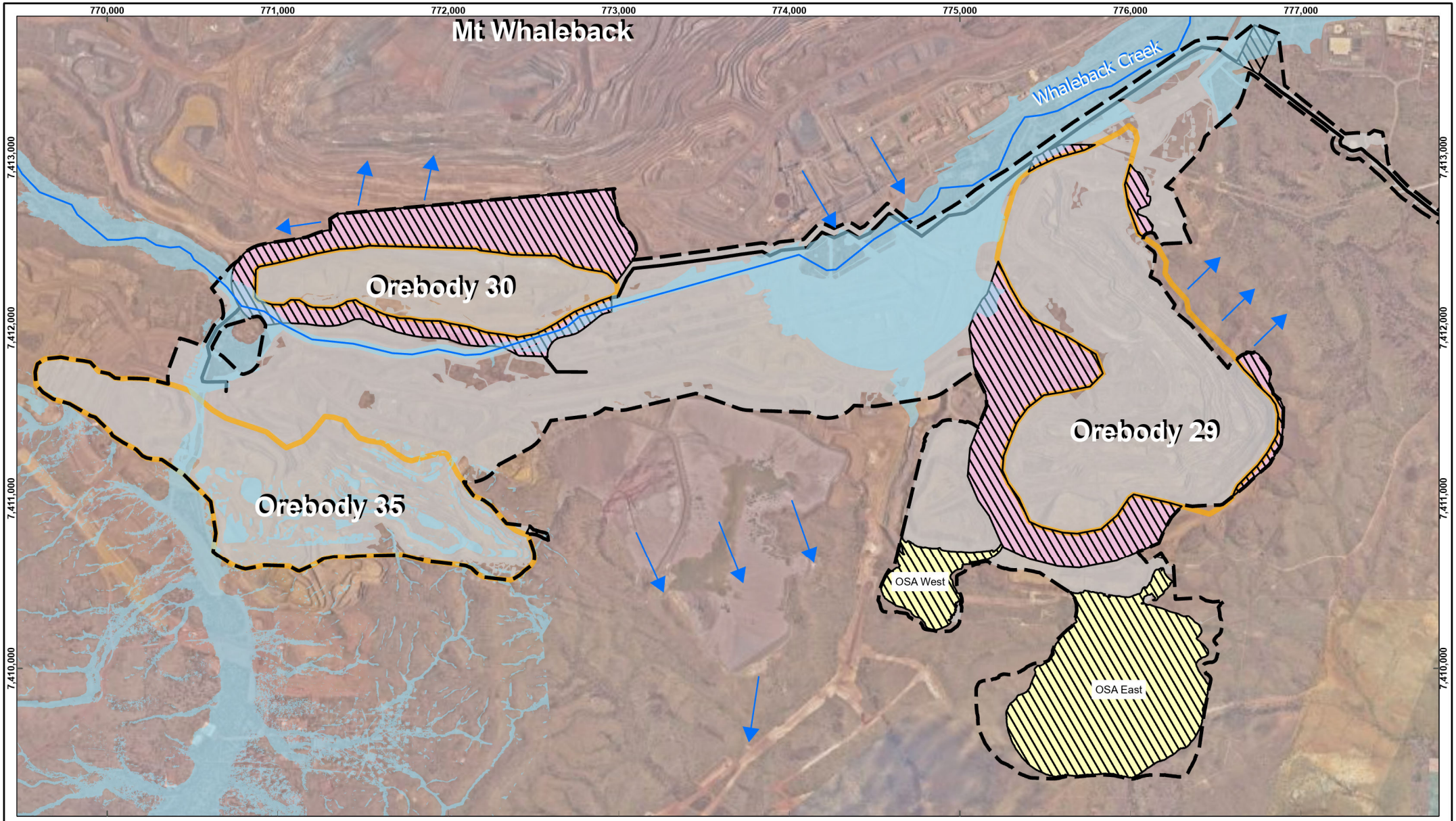
The 1 in 100-year flood extent, Whaleback Creek alignment, and direction of local flow is shown in **Figure 4**. The footprint of the OB30 proposed pit expansion encroaches on the 100-year flood extent. However, the current detail design is contained outside the 100-year flood extent.

The OSAs within the Development Envelope are outside the 100-year flood extent and are in the upper reaches of the catchment.

Any flows to the north of the OB30 pit will drain predominately north, with only the north-western perimeter draining south-west into Whaleback Creek. Any flows along the eastern perimeter of OB29 will drain north-east towards the unnamed tributary and flows along the western perimeter will drains north-east towards Whaleback Creek.

Runoff from OSA East will drain eastwards via minor tributaries towards Fortescue River. Runoff from the OSA West will drain south via minor tributaries towards Fortescue River.



- Development Envelope
- Indicative Footprint
- Ministerial Statement 963 Boundary
- Proposed Pit expansion
- Flood Extents 1 in 100 Years
- Whaleback Creek Alignment
- Cleared Area
- Proposed OSA
- Surface Water Flow Direction

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OREBODY 29/30/35 SIGNIFICANT AMENDMENT

Flood extents and direction of local flow

PLANNING & STANDARDS - IRON ORE

SCALE @ A4:	1:30,000	PREPARED:	GEOMATICS	FIGURE:	4
DATE:	25/11/2024	REQUESTOR:	ENV. APPROVALS		

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3 Catchment area loss

The Proposal will reduce the catchment area contributing to runoff. This is mainly due to the footprints of the expanded pits and OSAs, as well as any upstream catchment areas which are intercepted by this infrastructure. The proposed pipeline within the mine area of the Development Envelope will be above-ground, however any upstream catchment areas intercepted by the infrastructure would only be partially restricted to a depth less than 0.10 m (as flow would be flowing both over and under the pipeline) and would therefore have a negligible effect on catchment areas. Outside of the mine area, the proposed pipeline is to be below ground, and as such will have no impact on catchment areas.

The catchment loss calculations have been determined under closure conditions, as this represents the long-term impact of the proposed expansion. This assumed partially backfilled pit footprints for OB29 and OB35 and a pit lake footprint for OB30, in addition to the rehabilitated OSA footprints, to determine the catchment loss. A catchment reduction factor of 0.7 was assumed for the rehabilitated OSAs, as they will be mostly internally draining. A catchment reduction factor of 1.0 was assumed for the partially backfilled pit footprints and pit lake footprints, as even a partially backfilled pit will capture the runoff and cause filling combined with seepage within the pit, removing the runoff from the catchment.

Table 1 shows the estimated catchment areas occupied and intercepted by the Orebody 29/30/35 pits and OSAs for the existing Orebody 29/30/35 mine, the Proposal and the combined effect (existing mine and the Proposal).

Table 1 Catchment Area Loss for Orebody 29/30/35 Significant Amendment

	Footprint Area (km^2)			Reduction in Contributing Catchment (1) (km^2)		
Landform	**Existing**	**Proposal**	**Combined (Existing + Proposal)**	**Existing**	**Proposal**	**Combined (Existing + Proposal)**
Pits	4.6	2.2	6.8	4.6	2.2	6.8
OSAs	-	1.3	1.3	-	0.9	0.9
Blocked Catchment	0.8	-	0.8	0.8	-	0.8
Total	***5.4***	***3.5***	***8.9***	***5.4***	***3.1***	***8.5***

(1) Catchment reduction factor of 0.7 applied to OSAs; catchment reduction factor of 1.0 applied to partially backfilled pits and pit lakes.

Table 2 shows the reduction in catchment area as a percentage for the local and regional catchments for the existing Orebody 29/30/35 mine, the Proposal and the combined effect (existing mine and the Proposal).

Table 2: Potential reduction in catchment area

Catchment	Catchment area (km^2)	Reduction in catchment area				
		Existing (km^2)	Proposal (km^2)	Proposal (%)	Combined (Existing + Proposal) (km^2)	Combined (Existing + Proposal (%)
Whaleback Creek(1)	193	5.4	2.2	1.14%	7.6	3.94%
Fortescue River at Ophthalmia Dam	**3,072**	5.4	3.1	0.10%	8.5	0.28%
Upper Fortescue River	**29,757**			**0.01%**		**0.03%**

(1) Updated catchment as per existing topography

At the local scale, the loss of contributing catchment area contributing runoff to Whaleback Creek is estimated to be 1.14% for the Proposal only and 3.94% for the combined effect of the Proposal and the existing mine. The loss of contributing catchment area contributing runoff to Fortescue River at Ophthalmia Dam is 0.10% for the Proposal only and 0.28% for the combined effect of the Proposal and the existing mine.

4 Sediment loading

The Proposal may increase the risk of sediment loading to downstream drainage lines due to ground disturbance. One of the main sources of potential increased sediment is runoff from the OSAs, particularly given their close proximity to Fortescue River. To limit the potential for erosion, OSAs are designed to remain outside at least the 100-year floodplain of major drainage lines during operations, and where possible also outside the 10,000-year floodplain so the OSA may be suitable for closure without the need for additional flood protection measures.

Increased erosion from infrastructure which increase flow velocities above natural conditions may be another potential source of sediment. Examples include culverts or spoon drains, however, it is standard practice that these infrastructure are installed with rip rap (or other energy dissipation structures) to reduce flow velocities and erosion potential.

Note that the OSAs are designed to be internally draining, and so minimal sediment loading is anticipated from the OSAs.

5 Mitigation strategies

Mitigation strategies to manage the risks of catchment area loss and increased sediment loading are considered below.

5.1 Diversions to mitigate catchment area loss

While the reduction in local and regional catchment area due to the Proposal is not considered significant, it is best practice to minimise catchment loss where practical. The most common mitigation strategy is to construct diversions around infrastructure to enable any intercepted upstream catchments to continue draining downstream. Factors to consider include the size of the upstream catchment compared to the volume of earthworks that would be required to divert the catchment.

The largest individual catchment area intercepted by an OSA is 0.47 km^2. Catchment areas of this size are not expected to cause excessive pooling at the OSA toes as any runoff generated would quickly infiltrate.

The largest individual catchment area intercepted by a pit is 0.25 km^2. This is a relatively small area, and it is common practice at BHP's WAIO sites for catchment areas this size to drain into the pit and managed via in-pit stormwater pumping. As such, no diversions are planned for the Proposal.

6 Closure considerations

For closure, the pit and OSA footprints are typically compared to the 10,000-year flood extent to assess the risk of creek capture and for the design of safe and stable flood protection infrastructure if required.

Further assessment and modelling will be undertaken at the detailed design phase to determine the extent of diversion upgrade works to ensure the pits and OSAs do not intercept with the 10,000-year flood extent, and if bunding is warranted.

7 Conclusion

The pits and OSAs associated with the Proposal and the existing mine are considered to have minimal impact on surface water availability based on the estimated area loss (0.03% of Upper Fortescue River catchment, 0.28% of Fortescue River at Ophthalmia Dam catchment, and 3.94% of Whaleback Creek catchment). No flood protection bunds or diversions are proposed to be required for the 100-year flood assessment.

The increased risk of sediment loading to Whaleback Creek is also considered low provided perimeter bunding and sediment traps are installed around the OSA perimeter closest to the creek.

Further assessment and modelling are required to determine the extent of diversion upgrade works to ensure the pits and OSAs do not intercept with the 10,000-year flood extent, and if bunding is warranted.