Technical Memorandum

Date	15 December 2023
To	Superintendent Environmental Approvals (Eastern)
From	Johanna Richards – Water Planning
CC	Anthony Pollifrone, Mike McMullen, Kate Mead, Iain Rea
Subject	Jimblebar East: Updated Surface Water Impact Assessment

1 Introduction

The Jimblebar East project area is located east of the existing Jimblebar mine site. The deposit will sustain Jimblebar production from FY25 via haulage to PC3. The project includes deposit development, pre-strip, an HV haul road, LV access road, dewatering infrastructure and HV standpipe. A general arrangement of the project is shown in Figure 1.

The purpose of this Technical Memo is to present the surface water impact assessment for the Jimblebar East pits and Overburden Storage Areas (OSAs) to support the project approvals application (see OSA and pit footprints in Figure 2). 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.

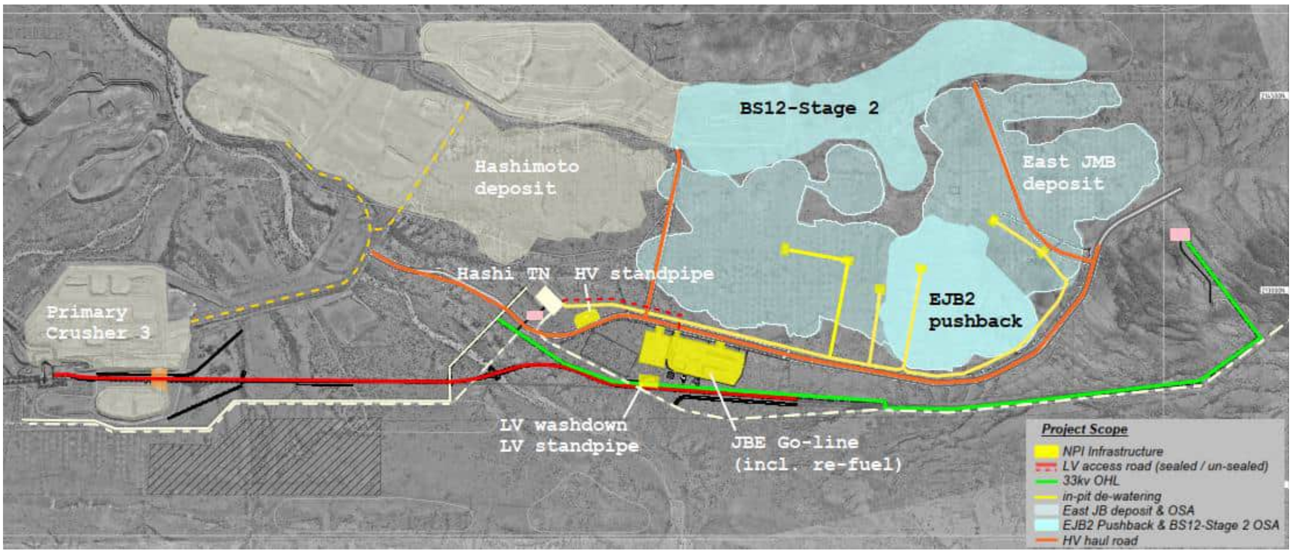

Figure 1: Jimblebar East Deposit General Arrangement

2 Regional and Local Hydrology

The Jimblebar East development is located within the Jimblebar Creek surface water catchment (Figure 2). Jimblebar Creek forms part of the larger Upper Fortescue River which flows into Fortescue Marsh. Other major tributaries into the Fortescue River include Caramulla and Jigalong Creeks. The total catchment area of the Upper Fortescue River at the Fortescue Marsh is about 29,750km^2 (Figure 3).

Jimblebar Creek consists of two main tributaries, the east branch and west branch, which merge just upstream of the Hashimoto ridgeline. Immediately downstream of the ridgeline and adjacent to the Jimblebar East development is Innawally Pool. The pool is a natural large erosion pool, about 1000m long at its fullest (following streamflow from rainfall events). It is a perched water feature and has environmental and heritage value. Jimblebar Creek has a catchment area of about 340km^2 upstream of Innawally Pool.

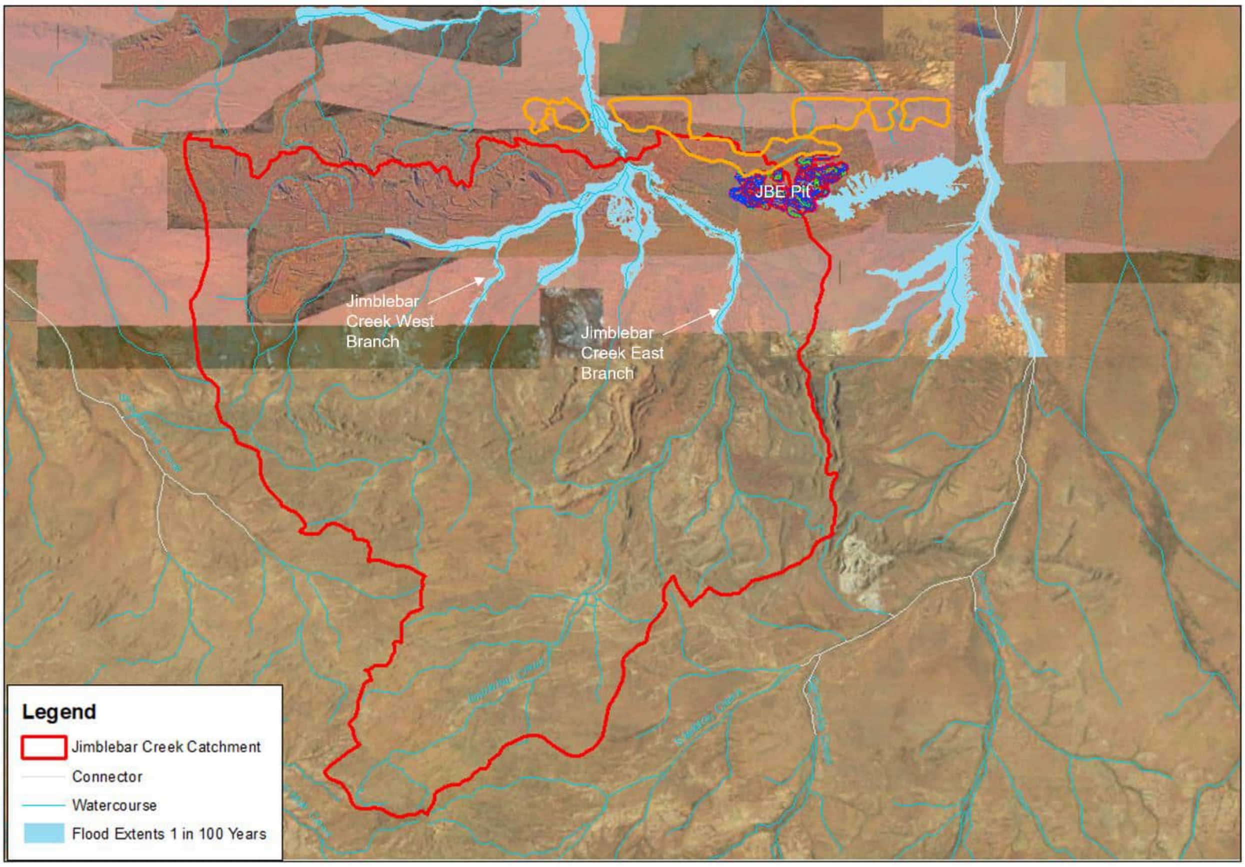

Figure 2: Jimblebar Creek Surface Water Catchment Area (Upstream of Innawally Pool)

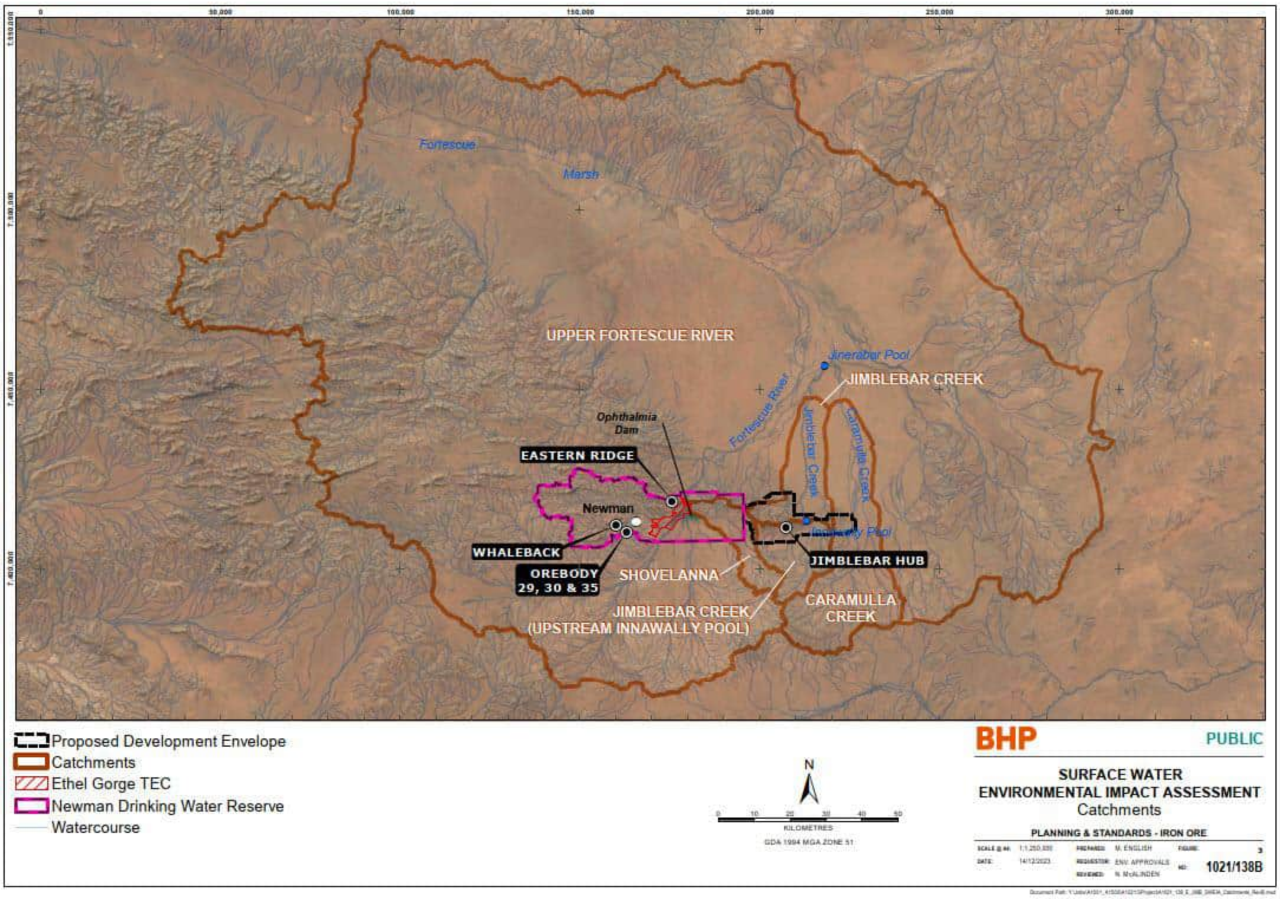

Figure 3: Regional catchments

The Jimblebar East pits and OSA's generally straddle a catchment divide and are outside the 100 year Jimblebar Creek floodplain. The 100 year flood extent and direction of local flow is shown in Figure 4.

Runoff drains away from the southern perimeter of the pits towards Jimblebar Creek East Branch. The eastern pit perimeter also drains away to the northeast into some minor tributaries which join the main Jimblebar Creek further north / downstream.

Similarly, runoff from the eastern OSA will drain southwards towards Jimblebar Creek East Branch but will be intercepted by the Hashimoto 2 pit. The eastern portion of the OSA will drain northwards to Jimblebar Creek.

The western OSA is located closest to Jimblebar Creek, although any runoff from this OSA is downstream of Innawally Pool.

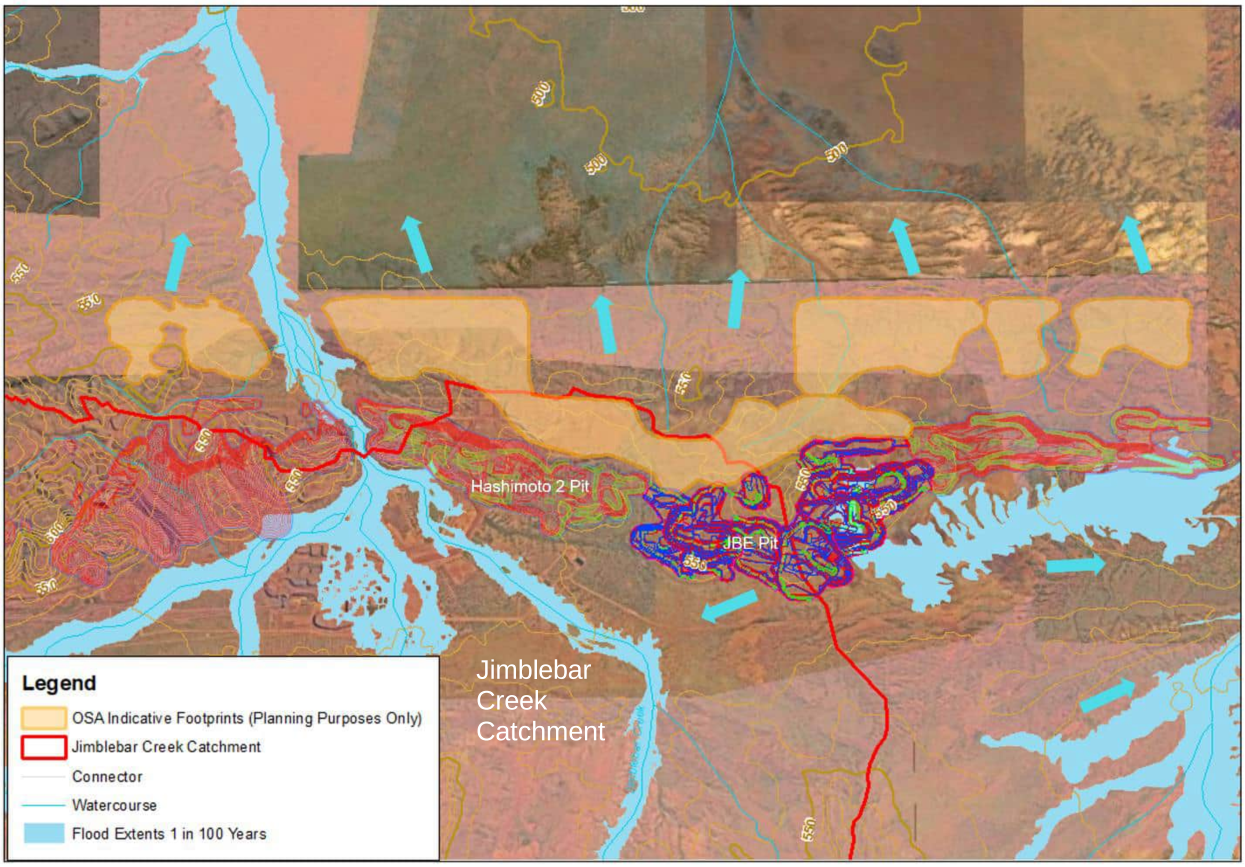

Figure 4: Direction of Local Flow

3 Catchment Area Loss

Jimblebar East development

The Jimblebar East development will have an impact on surface water availability by reducing the catchment area contributing to runoff. This is mainly due to the footprints of the pits and OSAs themselves, as well as any upstream catchment areas which are intercepted by this infrastructure.

The catchment loss calculations have been determined under closure conditions, as this represents the long-term impact of the development. As such, the backfilled pit footprints, in addition to the rehabilitated OSA footprint, were taken into account 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 0.5 was assumed for the backfilled pit footprints, as even though the backfilled surfaces will be sloped to allow contribution to the receiving drainage lines, the porosity of this material would reduce the runoff as compared to undisturbed surfaces.

Tables 1 to 4 show the estimated catchment areas occupied and intercepted by the East Jimblebar pits and OSAs for (i) Jimblebar Creek upstream of Innawally Pool, (ii) Jimblebar Creek upstream of Fortescue River confluence (iii) Caramulla Creek and (iv) Fortescue River. These impacts are further summarized in Table 5.

Table 1: Catchment Area Loss for Jimblebar Creek Catchment (upstream of Innawally Pool)

Landform	Footprint Area (km^2)	Reduction in Contributing Catchment (km^2) (1)
Pits	2.3	1.1
OSA's	1.7	1.2
Blocked Catchment	1.2	1.2
Total	5.1	3.5
% of Jimblebar Creek Catchment (340km^2)	1.5%	1.0%

(1) A catchment reduction of 0.7 applied to OSAs; 0.5 catchment reduction factor applied to backfilled pits

Table 2: Catchment Area Loss for Jimblebar Creek Upstream of the Fortescue River Confluence

Landform	Footprint Area (km^2)	Reduction in Contributing Catchment (km^2) (1)
Pits	4.4	2.2
OSA's	8.6	6.0
Blocked Catchment	2.4	2.4
Total	15.4	10.6
% of Jimblebar Creek Catchment [upstream Fortescue River confluence] (761km^2)	2.0%	1.4%

(1) A catchment reduction of 0.7 applied to OSAs; 0.5 catchment reduction factor applied to backfilled pits

Table 3: Catchment Area Loss for Caramulla Creek catchment

Landform	Footprint Area (km^2)	Reduction in Contributing Catchment (km^2) (1)
Pits	0.17	0.1
OSA's	3.85	2.7
Blocked Catchment	0.1	0.1
Total	4.1	2.9
% of Caramulla Creek Catchment (1,130km^2)	0.4%	0.3%

(1) A catchment reduction of 0.7 applied to OSAs; 0.5 catchment reduction factor applied to backfilled pits

Table 4: Catchment Area Loss for Upper Fortescue River catchment

Landform	Footprint Area (km^2)	Reduction in Contributing Catchment (km^2) [(1)]
Pits	4.59	2.3
OSA's	14.1	9.8
Blocked Catchment	3.7	3.7
Total	19.5	13.5
% of Upper Fortescue River catchment (29,750km^2)	0.1%	0.05%

[(1)] A catchment reduction of 0.7 applied to OSAs; 0.5 catchment reduction factor applied to backfilled pits

Table 5: Jimblebar East catchment area loss summary

Catchment[1]	Catchment area (km^2)	Reduction in Contributing Catchment (km^2) (km^2)	Reduction in catchment (%)
Jimblebar Creek (upstream of Innawally Pool)	340	3.5	1.0%
Jimblebar Creek (upstream of Fortescue River confluence)	761	10.6 [(1)]	1.4%
Caramulla Creek	1,130	2.9	0.3%
Upper Fortescue River	**29,750**	**13.5**	**0.05%**

[(1)] Includes the reduction in contributing catchment indicated for Jimblebar Creek upstream of Innawally Pool

The proposed development is estimated to reduce the Jimblebar Creek catchment (upstream of Innawally Pool) by 1%, Jimblebar Creek (upstream of the Fortescue River) confluence by 1.4%, the Caramulla Creek catchment area by 0.4%, and the Upper Fortescue River catchment area by 0.05%.

Although there will be a slight (1%) reduction in the catchment area to the Innawally Pool, no impact to the pool levels is anticipated, as the volume of runoff from the entire contributing catchment would be sufficient to fill the pool and allow flows to continue downstream.

Jimblebar Hub

The impact of changes to surface water availability during closure for the existing mines (approved proposals) in the Jimblebar Hub (Jimblebar, Orebody 31 and Orebody 17/18) have also been assessed. The loss of contributing catchment area contributing runoff to Jimblebar Creek (above the confluence with Fortescue River) from the existing mines (Jimblebar, OB31 and OB17/18) during closure is estimated to be 34 km^2 corresponding to approximately 4.5% of the Jimblebar Creek above the confluence with the Fortescue River. The cumulative loss of contributing catchment area to Creek (above the confluence with Fortescue River) from the approved proposals and the East Jimblebar proposal is 5.9%.

4 Sediment Loading

The Jimblebar East development 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 OSA's, particularly given their close proximity to Jimblebar Creek and Innawally Pool. 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 Jimblebar East development 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 1km^2. Catchment areas 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 0.2km^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 Jimblebar East development.

6 Additional 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. The 10,000 year flood extent is shown in Figure 5.

The western pit perimeter is shown to intercept some of the flood extent, however, this is a tributary of Jimblebar Creek and not the main drainage line. In addition, a large portion of the upstream catchment area draining to this tributary will be occupied by the pit and would no longer contribute to creek flow. Therefore, no additional bunding is considered to be required at this location for closure.

The OSAs are also located outside the Jimblebar Creek 10,000 year flood extent and will be suitable to remain for closure.

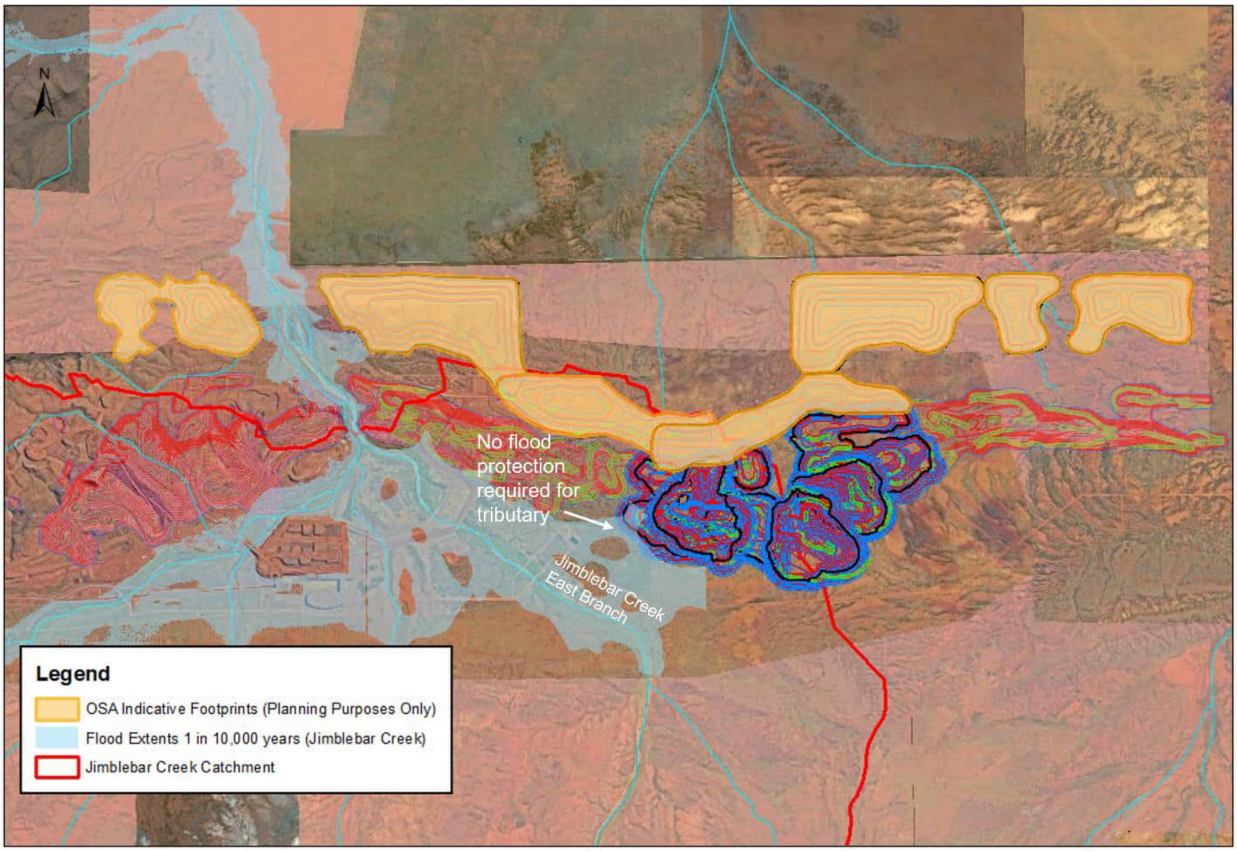

Figure 5: Jimblebar Creek 10,000 Year Flood Extent

7 Conclusion

The pits and OSAs associated with the Jimblebar East development are considered to have minimal impact on surface water availability based on estimated catchment area loss (1% of Jimblebar Creek at Innawally Pool and 0.05% of the Upper Fortescue River at Fortescue Marsh). No flood protection bunds or diversions are proposed to be required.

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

The locations of the pits and OSAs are outside the 10,000 year flood extent of Jimblebar Creek and considered suitable for closure without any additional flood protection required.