

# 17. Cumulative environmental impact assessment

## 17.1 Introduction

This chapter assesses the cumulative environmental impacts of the Proposal. Cumulative environmental impacts are the 'successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities' (EPA 2021c). Reasonably foreseeable future activities are defined as 'third party (or proponent) activities which are already approved, are in a government approvals process, or are otherwise reasonably likely to proceed' (EPA 2021a).

The NJF IBRA subregion is selected as the system boundary for cumulative impact assessment of the Mine component of the Proposal, as it is ecologically distinct from surrounding IBRA subregions and is subject to similar threatening processes as the Mine DE.

The locality within 5 km of the Refinery has been selected as the system boundary for cumulative impact assessment of the Refinery component of the Proposal. This locality has a land use and ecological condition typical of the Pinjarra Plain within the south-east SCP IBRA subregion, and also represents the local airshed of Pinjarra townsite.

## 17.2 Huntly Mine

### 17.2.1 Past and present activities

The NJF subregion has been subject to environmental impacts from a range of past and present activities, with the key activities in order of area of disturbance as follows:

- Agriculture
- Timber harvesting
- Prescribed burning
- Bauxite and gold mining
- Plantations
- Water supply reservoirs.

Section 5.4.4.2 (Table 5.39) presents a breakdown of the current areas and estimated future areas of disturbance of each of the key activities in the NJF subregion. As presented, the most widespread activities within the NJF subregion have been historic disturbance for agriculture and timber harvesting. The combined result is that 42 per cent of the subregion has been permanently cleared of native vegetation for agriculture, with an additional 41 per cent subject to timber harvesting, with old growth forest limited to approximately 2 per cent of the subregion. Agriculture, predominantly dryland cropping and grazing, has caused approximately 87 per cent of the permanent clearing within the subregion<sup>1</sup>. Mining to date has cleared approximately 2 per cent of the subregion, of which about two thirds has been rehabilitated to varying prescriptions and practice, with Alcoa rehabilitating about 78 per cent of their bauxite mining (see Section 2.4).

Table 17.1 presents cumulative impacts of past and present activities in the NJF subregion, which are summarised as follows.

---

<sup>1</sup> <https://www.awe.gov.au/abares/aclump/catchment-scale-land-use-of-australia-update-december-2020>

Agriculture and timber harvesting have caused widespread impacts (an order of magnitude greater than mining) including:

- Loss of biodiversity and habitat from permanent clearing.
- Long term loss of mature/senescent trees and associated hollows from timber harvesting.
- Spread of *Phytophthora* dieback in forested areas from timber harvesting.
- Agricultural impacts to soils including erosion, salinity, compaction and acidification.
- Secondary salinity impacts to the Murray River and Avon River from permanent clearing.
- Conversion of natural landscape to rural character and conversion of old growth forest to juvenile to immature forest age.

Mining has caused impacts as follows:

- Short to medium term ecological and amenity impacts during operations and until rehabilitation establishes.
- Long term loss of mature/senescent trees and associated hollows, as well as long term loss of coarse woody debris (CWD) fauna habitats, both which will take over a century to accumulate to levels comparable to un-mined forest.
- Rehabilitation returning varying biodiversity, ecological integrity and landscape quality.

The ecological impact of prescribed burning is debated (see Section 5.4.4.6). Prescribed burning is undertaken to reduce the severity and extent of wildfires, which can have significant ecological, water quality and amenity impacts. However, Bradshaw *et al.* (2018) note that there are trade-offs and polarised views in fire management and that further research is required to characterise the long-term impact of 'natural' versus intensively managed fire regimes. The EPA assessment of the 2024-2033 FMP (see below in regard to biodiversity indicators) has recommended an independent scientific review of prescribed burning in order to identify contemporary science and knowledge on the impacts of prescribed burning on biodiversity.

Water supply reservoirs have caused localised loss of incised river valley landforms and vegetation (i.e. Murray vegetation complexes) and widespread disruption to aquatic fauna migrations and dispersal; however, they have created perennial waterbodies that provide refuges for aquatic fauna. The Murray River and Avon River were not dammed as their water quality was unfit for drinking due to secondary salinity from cleared agricultural upper catchments.

Inland waters are a key component of Aboriginal cultural values, with Traditional Owner life traditionally revolving around waterways and the associated food resources and social and aesthetic values. Agriculture has resulted in widespread impacts to the water quality of waterways in the NJF and SCP subregions, including salinisation of the Murray River. Water supply reservoirs along the Darling Scarp have substantially reduced flow in the Serpentine River and Dandalup River downstream. Climate change has resulted in a decline in river flows since the 1970s. The historic impact on hydrological regimes and water quality, as well as introduced aquatic fauna and weed invasion, is expected to have substantially impacted the quality of aquatic and riparian ecosystems and associated Aboriginal cultural values.

Access to country is another key component of Aboriginal cultural values, supporting Traditional Owner spiritual and physical health and enabling transfer of Aboriginal cultural knowledge. Access to country has historically been restricted through agricultural, urban and rural residential development of the NJF and SCP subregions, with Aboriginal people displaced or forcibly removed from their traditional lands. Access to country is available within publicly accessible State Forest, National Parks and recreational reserves in the NJF and SCP subregions. The Huntly and Willowdale mines necessitate the restriction of public access to the

affected areas of State Forest as mine regions have been progressively opened, and pending closure and handback to State Government.

### 17.2.2 Reasonably foreseeable future activities

Reasonably foreseeable future activities within the NJF subregion include approved and proposed mining (Figure 17-1), which is expected to increase the total disturbance from mining to approximately 3.86 per cent of the subregion as of 2045 (see Section 5.4.2.2). Jarrah forest cleared for mining is expected to be rehabilitated to varying biodiversity, ecological integrity and landscape quality, with the exception of deep voids of the Newmont Boddington Goldmine which will be left as is and form pit lakes over time (see Section 5.4.4.2).

Under the 2024-2033 FMP, timber harvesting has ceased within the NJF subregion since January 2024, except for maintaining forest health and for approved mining (CPC and DBCA 2023).

Prescribed burning is expected to continue within the subregion in accordance with the WA Government's strategy to reduce fuel loads and minimise the likelihood and severity of large scale wildfires. Other future activities within the subregion may include future urban or rural residential development in the Perth Hills (e.g. North Stoneville) and infrastructure development (e.g. East Link WA), which are expected to be relatively minor. There remains potential for future agricultural clearing to occur in the subregion, however clearing is expected to be relatively minor and subject to regulation under Part V of the EP Act.

As presented in Table 17.1, mining within the NJF subregion is not expected to cause cumulative fragmentation, hydrology, air quality or amenity impacts as the mines are sufficiently distant from each other or distributed in different catchments. Mining is highly unlikely to cause cumulative amenity impacts to Jarrahdale or Dwellingup townsites and their rural fringe, whereas impacts to the Boddington townsite are expected to be comparable to existing effects from Newmont Boddington Goldmine and Worsley Mine. Mining is not likely to cause cumulative impacts to Aboriginal cultural values associated with Inland Waters, which will remain substantially impacted by agriculture, water supply reservoirs, climate change and introduced aquatic fauna and weeds.

### 17.2.3 Cumulative impacts – flora and vegetation

Mining, fragmentation, timber harvesting, climate change, and disease and weed invasions have the potential to change floristic diversity and vegetation structure, affecting the extent and quality of associated fauna habitats. Table 5.41 presents an overview of the potential impacts on regional vegetation complexes within the NJF subregion from mining and timber harvesting.

Mining is expected to occur over differing vegetation complexes depending on the location. The Huntly and Willowdale bauxite mines predominantly occur in the high rainfall zones of the NJF and impact predominantly Dwellingup 1 and 2 and Yarragil 1 and 2 complexes. By comparison, Newmont Boddington Goldmine and Worsley mines occur further east in the semi-arid zone and lie over Coolakin, Dwellingup 4, Pindalup and Yalanbee complexes.

Mining is expected to predominantly impact vegetation complexes that are retained at above 75 per cent of pre-European extent. However, Newmont Boddington and Worsley mines lie over the rural fringe of the NJF and include Coolakin, Michibin and Williams vegetation complexes retained at 25 per cent to 40 per cent of the pre-European extent. Rehabilitation of the four mines has restored cleared native forest under varying prescriptions and practice, as discussed in Section 2.4.

Timber harvesting has occurred over a wide range of vegetation complexes reflecting the coverage of State Forest and Timber Reserves over 75 per cent of DBCA managed lands and across high rainfall and semi-arid zones. Formal reserves provide a higher representation in

scarp, valley and northern vegetation near the Perth Hills, including Darling Scarp, Helena, Murray and Yalanbee complexes.

As noted in Section 1.9.2.14, the cessation of native timber harvesting (as of 2024) means that the forest remaining in the NJF subregion is expected to mature and senesce, eventually reaching varying forms of mature and Old Growth Forest.

The partial loss of floristic diversity, ecosystem diversity and structural complexity of predominantly widespread vegetation complexes associated within the Proposal largely occurs in vegetation types that are well represented in the subregion. Cumulative impact with other mining, historic timber harvesting, climate change, fire and dieback, is not anticipated to cause a significant impact to significant vegetation in the subregion.

The Proposal is therefore unlikely to cause significant impacts on significant vegetation that result in a loss of biodiversity or ecological integrity in the NJF subregion.

The Proposal is unlikely to likely to cause a significant impact to the ecological integrity of the NJF regarding the following biodiversity indicators:

- Areas with a Protective Mechanism within the NJF within the ML1SA
- Disturbance to vegetation communities of conservation significance
- Ecological condition of native vegetation (upland vegetation)
- Ecological condition of native vegetation (stream and swamp vegetation)
- Ecological connectivity of vegetation

#### **17.2.4 Cumulative impacts – fauna**

Mining within the subregion is expected to cause a cumulative, partial loss of fauna diversity and ecological integrity over the medium to long term, primarily due to the loss of coarse woody debris and mature trees. Cumulatively, this impact will reduce the quality of habitat for conservation significant fauna species and occur in the context of past activities of timber harvesting and agriculture, which have affected approximately 98 per cent of the subregion.

The temporary loss of high quality habitat in the period between clearing and establishment of rehabilitation may cause a significant impact to local populations of threatened terrestrial fauna species, Woylie and Chuditch, but is unlikely to significantly impact State listed priority or conservation-dependent fauna species (e.g. resulting in a species becoming listed as threatened), due to the extent and diversity of habitats remaining in the NJF subregion.

For terrestrial fauna, the Proposal and other mining activities are anticipated to create temporary fragmentation, obstructing native ground fauna movements. The impact of fragmentation will occur in the context of existing fragmentation from the Myara mine region and the presence of reservoirs and public roads. Rehabilitation has been shown to restore terrestrial vertebrate fauna biodiversity in the short to medium term, indicating that fragmentation is temporary and effectively mitigated by rehabilitation.

Quokka dispersal along stream zones may be disrupted by haul road crossings and there is uncertainty as to the species use of constructed fauna crossing structures, which may also be subject to higher feral predator activity. Mammal populations impacted by fragmentation are expected to recover in the medium term following establishment of rehabilitation and removal of haul road crossings. The impact of fragmentation will occur in the context of existing fragmentation from the Myara mine region and the presence of reservoirs and public roads.

Mining in combination with past clearing for agriculture and timber harvesting is likely to cause significant cumulative impact to Black Cockatoos, through cumulative loss of foraging habitat in the medium term and loss of potential breeding habitat in the long term (though known and suitable nesting trees will be retained).

Mining is unlikely to cause fragmentation impacts to Black Cockatoos as the species are highly mobile and clearing will create gaps in habitat that are well below 4 km. Fragmentation impacts to ground mammal populations are expected to be localised to the vicinity of each mine, as the mines are relatively distant from each other, and reduce in the medium term as rehabilitation progresses and establishes.

#### 17.2.5 Cumulative impacts – other threats and processes

The Proposal may have cumulative impacts associated with threats and processes, including:

- Fire
- Feral predators and invasive species
- Weeds and disease
- Climate change

The EPA assessed fire management of the NJF as part of its assessment of the FMP 2024-2033 (EPA 2023). Currently, the FMP proposes to burn no more than 200,000 ha per year of vegetation. The EPA noted the strongly contested and opposing views in relation to the appropriateness of the WA Government's current approach to prescribed burning of the Jarrah forest. The EPA considered that prescribed burning likely has a role to play in managing forest ecosystems and conserving biological diversity and ecological integrity. However, it was contested whether the FMP's proposed targets and implementation will achieve this (EPA 2023).

The EPA's assessment of the FMP 2024-2023 recommended that the Minister commission an independent scientific review of prescribed burning to identify contemporary science and knowledge on the impacts of prescribed burning on biodiversity, particularly in the context of climate change (EPA 2023). This scientific review is expected to provide further information on the effects of fire regimes on the ecological integrity of the NJF and whether the current approach to prescribed burning requires amendment. This, in turn, is expected to guide amendments to the management of mining and rehabilitation to support the amended approach to prescribed burning of the NJF.

The EPA did not assess the impact of feral predators and invasive species in its assessment of the FMP 2024-2033 (EPA 2023). This indicates that the management measures considered for feral animals in the FMP are anticipated to minimise the widespread impact on ground fauna and are likely to maintain the ecological integrity of the NJF.

In addition, climate change has the potential to result in changes to fauna habitat types due to changes in vegetation structure caused by water stress and altered fire regimes. The combination of reduced rainfall and increased heat waves may result in greater water stress and die-off in the overstorey during droughts, and a drying and reduction in vegetation cover in swamps and streams.

The subregion has widespread *Phytophthora* dieback infestation, which is expected to continue to spread through the landscape irrespective of further anthropogenic disturbance. Mining, subject to contemporary hygiene protocols, has been demonstrated to cause limited spread of dieback (see Section 5.3.4.7), and the Proposal is unlikely to cause a significant impact to the subregion related to *Phytophthora* dieback or other diseases.

A low intensity of weeds may occur throughout the subregion due to historic timber harvesting activities. Recreational activities within the NJF may spread weeds along and downstream of tracks and campsites, however the magnitude of spread is expected to be limited due to the lack of earthmoving or drainage alteration.

Mining may result in localised introduction of weeds during construction and spread of existing weed infestations in streams or disturbed areas. However, mine rehabilitation has limited and

declining weed cover and is not expected to significantly increase the coverage of weeds in the NJF subregion.

The Proposal may potentially cause a significant impact to the ecological integrity of the NJF with regard to two biodiversity indicators:

- Inappropriate fire regimes:
  - Mining and rehabilitation are sympathetic to WA Government fire management. Widespread prescribed burning to maintain a forest fuel age of approximately six years without a fine scale mosaic of long unburnt areas, has the potential to impact some obligate seeder flora and reduce habitat for fauna populations.
- Feral predators and invasive species:
  - Expected temporal concentration of predation from feral animals (principally cats) as a result of fragmentation from mining across the region.
  - The cat population represents an ongoing pressure on Critical Weight Range mammals and other ground fauna and with no widespread treatment yet developed, the cumulative impacts is considered potentially significant.

#### 17.2.6 Cumulative impacts – social surroundings

The Willowdale, Newmont Boddington, and Worsley mines lie at least 10 km from the Mine DE and are not expected to contribute to cumulative noise, light, or dust levels at receptors in the vicinity of the Mine DE. However, mining in the Mine DE may cause audible noise levels along nearby sections of the Bibbulmun Track, which may be concurrent with noise levels near the Newmont Boddington Goldmine and Willowdale Mine. Mining is expected to cause cumulative impacts to the Bibbulmun Track as follows:

Audible noise during adverse meteorological conditions and certain operational scenarios, which may affect two to three sections of the Bibbulmun Track at the same time over the short to medium term.

- Long term visual impact to elevated viewpoints in the Monadnocks Conservation Park, White Horse Hills and Mount Wells, which may occur concurrently over the long term until rehabilitation progresses and establishes.
- Restriction to public access and informal use over large areas of State Forest between the Huntly Mine and Willowdale Mine, which may extend over the long term until the mines are rehabilitated and closed and the lease relinquished.

Mining in the Myara North DE may cause long-term visual impacts to elevated viewpoints in the Monadnocks Conservation Park, concurrent with existing visual impacts from the Myara region operations and the White Horse Hills from Newmont Boddington Goldmine. The Worsley Mine Hotham Extension and Central Extended Mining Areas may also become visible from the White Horse Hills, contributing to cumulative visual impacts along the Bibbulmun Track.

The long term restriction to public access and informal use over areas of State Forest is expected to restrict access to country for Aboriginal people, causing an impact to associated Aboriginal cultural values. This impact will occur in the context of extensive and permanent restrictions to access to country from agricultural, urban and rural residential developments in the NJF and SCP subregions.

**Table 17.1 Cumulative impacts of past, present and reasonably foreseeable future activities within the NJF IBRA subregion**

Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
<p>Flora and vegetation</p>	<p>Agriculture over approximately 36 per cent of the subregion has caused permanent loss of native vegetation, of which approximately 30 per cent comprised Jarrah-Marri forest and approximately 69 per cent comprised woodlands of Marri, Wandoo and York Gum in the north and east portions of the subregion (Section 5.3.4.1).</p> <p>Timber harvesting over approximately 56 per cent of the subregion has caused a loss of old-growth forest structure and maintenance of a juvenile to immature age forest structure (Section 5.3.4.4) with a partial loss of floristic diversity lasting up to 10 years from the last harvest (Section 5.4.4.3). Old growth forest remains in fragmented areas over approximately 1-2 per cent of the subregion (Figure 17-2).</p> <p>Introduction and spread of <i>Phytophthora</i> Dieback, predominantly from timber harvesting, has caused infestation over approximately a third of Jarrah forest (Section 5.3.4.7). Infestations are predominantly in the high rainfall zone near the Darling Scarp and in valleys (Section 5.3.4.7).</p> <p>Prescribed burning has covered an average of 7 per cent (range 1 to 16 per cent) of DBCA managed forests within the subregion each year from 2000-2020. Target burn frequencies of six years may impact obligate seeder species (Section 5.4.4.6).</p> <p>The Jarrahdale, Huntly, Willowdale, Worsley, and Newmont Boddington mines have, in combination, cleared a total of approximately 40,345 ha or 2 per cent of the subregion (3.5 per cent of remaining native vegetation). Approximately 25,403 ha or 63 per cent of the cleared area has been rehabilitated with a partial loss of biodiversity and ecological integrity compared to un-mined forest (Section 5.5.3). It is noted that biodiversity outcomes for mining rehabilitation, in terms of similarity to reference ecosystems, have improved over time. Alcoa's recent rehabilitation includes a broader range of species, including recalcitrant species, consistent with improvements in rehabilitation practice (Section 2.4.7).</p> <p>The Huntly, Willowdale and Jarrahdale mines largely occur in the high rainfall zones of the NJF and impact predominantly Dwellingup 1 and 2 and Yarragil 1 and 2 complexes. By comparison, Newmont Boddington Goldmine and Worsley mines occur further east in the semi-arid zone and lie over Coolakin, Dwellingup 4, Pindalup and Yalanbee complexes, which comprise Jarrah (subspecies <i>thalassica</i>) and Marri open forest and Wandoo woodlands. (Section 5.4.4.1). The Proposal is expected to predominantly impact vegetation complexes that are retained above 75 per cent of pre-European extent.</p> <p>Mine clearing has been in Jarrah forest and Wandoo woodlands and predominantly (&gt; 90 per cent) in widespread upland vegetation complexes such as Dwellingup and Yalanbee and the mid-slope of valley complexes such as Yarragil, Coolakin and Pindalup (Section 5.4.6.2) (see Figure 17-2). A small proportion of clearing (&lt; 10 per cent) is expected to have occurred over granite outcrops, swamps and stream zones that are potential habitats for threatened flora and potential GDEs.</p> <p>In terms of flora, Priority species impacted by the Proposal occur across the subregion, along with species occurring within the Swan Coastal Plain, Avon Wheatbelt and Southern Jarrah Forest. However, these species will continue to exist in the broader area or within their known range, including areas previously disturbed by mining and/or timber harvesting.</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity (crops, stock animals, plantations) and not be subject to substantial rehabilitation. Clearing may occur for urban and rural residential development in the Perth Hills and infrastructure development.</p> <p>No further clearing of old growth forest is expected to occur. Mapped old growth forest predominantly lie outside of existing and proposed mining regions (Figure 17-2). Within the Mine DE, a small area of Old Growth Forest is within the Avoidance Zone.</p> <p>Native Timber harvesting ceased in 2024 under the 2024-2033 FMP, with the exception of logging for maintenance of forest health (e.g. ecological thinning). Harvested forest is expected to progress to varying forms of old growth forest in the long term, under the influence of contemporary climate and fire regimes and the effects of <i>Phytophthora</i> dieback (Section 5.4.4.7).</p> <p>Prescribed burning is expected to continue in accordance with the WA Government's strategy to reduce fuel loads and minimise wildfires.</p> <p>The Huntly, Willowdale, Worsley and Newmont Boddington mines are anticipated to clear up to a further 36,665 ha as of 2045 when mining is expected to complete in the Mine DE, for a total disturbance by mining of 72,359 ha (Section 5.4.4.3). Total mining disturbance of 2045 will represent 3.9 per cent of the subregion or 6.6 per cent of the remaining native vegetation. The Proposal comprises approximately 10.4 per cent of the total clearing related to mining.</p> <p>Clearing will be in Jarrah forest and Wandoo woodlands, predominantly (&gt; 90 per cent) in widespread upland and mid-slope valley vegetation types that are retained at well above 30 per cent of the pre-European extent (Section 5.4.4.2) The Worsley Mine may clear small areas of the Lukin 2, Michibin and Williams vegetation complexes that are retained below 30 per cent of pre-European extent (Section 5.4.4.3). Cleared native vegetation will predominantly (&gt; 95 per cent) be rehabilitated, with the exception of deep mine voids of Newmont Boddington Goldmine.</p> <p>Clearing of conservation significant vegetation communities (granite outcrops and fringing vegetation, represented by R and G vegetation types) is typically limited to &lt;1 per cent of total clearing when mining for bauxite, &lt;2.5 per cent for the Newmont Boddington Goldmine, and a cumulative impact is unlikely to be significant for clearing of these communities.</p> <p>There will be some cumulative impact to conservation significant flora as a result of mining projects. However, these species will continue to exist in the broader area or within their known range.</p> <p>No Threatened species were identified as being cumulatively impacted, with <i>Hibbertia ?ambita</i> and <i>Senecio leucoglossus</i> as the only Priority flora species identified as potentially impacted by the Proposal and cumulatively by Newmont Boddington Goldmine and Worsley Mine. The projects are not expected to significantly impact these Priority flora populations locally or affect the species' conservation status at a regional level.</p> <p>In combination, the Huntly, Willowdale, Worsley and Newmont Boddington projects would cause a total disturbance of up to 72,359 ha within the NJF (Section 5.4.4.1). The areas where clearing of conservation significant flora habitat may occur is in areas associated with swamps, lower slopes, valley floors and/or granite outcrops.</p>

Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
Terrestrial fauna	<p>Agricultural activities over approximately 36 per cent of the subregion have caused permanent loss of native vegetation comprising a range of terrestrial fauna habitats, including threatened Black Cockatoos (Carnaby's, FRTBC, Baudin's), Woylie, Numbat, Chuditch, Quokka and Malleefowl.</p> <p>Timber harvesting over approximately 41 per cent of the subregion has resulted in loss of old growth forest structure and maintenance of juvenile to immature age forest structure, including loss of mature/senescent trees and associated hollows. Loss of hollows has caused widespread loss of breeding habitat for Black Cockatoos, other bird species and arboreal mammals.</p> <p>Apart from loss of hollows, timber harvesting does not appear to have substantially impacted fauna populations or other habitat features (Section 6.4.4.4). Timber harvesting may cause short term direct mortality during operations.</p> <p>Secondary salinity from widespread agricultural clearing has resulted in salinisation of Avon River and Murray River and impact to salinity sensitive aquatic fauna such as Carters Freshwater Mussel (TSSC 2018).</p> <p>Damming of the Serpentine River, Dandalup River, Canning River and Wungong Brook has permanently disrupted aquatic fauna migrations and dispersal (e.g. Pouched Lamprey). Dams have created perennial water bodies that provide refugia for aquatic species during the summer-autumn.</p> <p>Prescribed burning has covered an average of 7 per cent (range 1 to 16 per cent) each year from 2000-2020 over DBCA managed forests in the subregion. Target burn frequencies of six years may impact some fauna species that require longer burn intervals (Section 6.4.4.5).</p> <p>Mining has impacted approximately 2 per cent of the subregion, causing localised short term direct fauna mortality (Section 6.4.4.2) and medium term habitat fragmentation for ground mammals including Woylie, Chuditch and Quokka (Section 6.4.4.3) and potentially Numbat near Boddington. Clearing for the Worsley Mine may fragment fauna linkages within an existing fragmented agricultural landscape. Clearing has caused a short to medium term loss of foraging resources for Black Cockatoos, with contemporary rehabilitation prescriptions expected to improve foraging habitat values for Black Cockatoos.</p> <p>Approximately two thirds of mine areas have been rehabilitated with a partial loss of faunal diversity and habitat quality (Section 6.4.4.2). Mining has caused loss of mature/senescent trees and associated hollows as well as loss of coarse woody debris habitats (Section 6.4.4.2).</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity and not be subject to substantial rehabilitation. Minor clearing may occur for urban, rural residential and infrastructure development.</p> <p>Native Timber harvesting ceased in 2024 under the 2024-2033 FMP, with the exception of logging for maintenance of forest health (e.g. ecological thinning). Ecological thinning is expected to avoid large trees with hollows. Harvested forest is expected to progress to varying forms of old growth forest, regenerating hollows over a timeframe of several decades (for current mature age forest) to centuries (for current juvenile to immature age forest).</p> <p>Prescribed burning is expected to continue in accordance with the WA Government strategy to reduce fuel loads and minimise wildfires.</p> <p>No substantial future damming of rivers is expected to occur in the subregion.</p> <p>The total disturbance for all mining may impact up to 72,359 ha or approximately 6.6 per cent of the remaining native vegetation in the subregion (Section 5.4.4.1), of which the Proposal will comprise about 10.4 per cent. Mining will cause localised short term direct fauna mortality and medium term habitat fragmentation for ground mammals. Rehabilitation is expected to progress to varying forms of old growth forest over the long term, regenerating hollows and CWD habitat over a timeframe of centuries.</p> <p>The cumulative loss of habitats for threatened fauna until mine rehabilitation restores habitat values, in combination with historic habitat loss from agriculture and timber harvesting, may cause a significant impact to threatened fauna populations. This includes medium term loss (10-20 years) of foraging habitat and long term loss (&gt;100 years) of potential breeding habitat for Black Cockatoos; and short term loss (&lt; 10 years) of foraging habitat, medium term fragmentation (10-20 years) and long term loss (&gt; 100 years) of coarse woody debris that supports denning by Chuditch.</p>
Terrestrial environmental quality	<p>Agricultural development has occurred over approximately 36 per cent of the subregion, causing widespread land and soil impacts. Soil erosion averages approximately 10 t/ha/year (Mcfarlane et al 2000) and is a higher risk during excessive stocking on poor pastures during drought years (DAFWA 2013). Secondary salinity affects about 2 per cent of agricultural land in the subregion with a further 3 per cent at risk in valleys (DAFWA 2013). Agriculture has caused a moderate level of soil compaction, with soils mainly resilient but small areas of yellow soils at risk as cropping becomes more common (DAFWA 2013). Agriculture has also caused subsurface soil acidification through fertiliser use, crop harvesting and inadequate lime application, with deep sandy duplex soils particularly affected (DAFWA 2013).</p> <p>Timber harvesting over approximately 41 per cent of the subregion has caused soil compaction, particularly during wet ground conditions, with higher compaction in landings and extraction tracks (Whitford 2012). The impact of harvesting has been reduced over the past two decades through improved harvesting management (Whitford 2009).</p> <p>Mining over approximately 2 per cent of the subregion has caused localised disturbance to land and soils, with loss of soil structure and removal of the bauxite layer from the upper regolith (Section 7.4.2.3). Bauxite mining has occurred predominantly over widespread lateritic soils with minor disturbance to alluvial soils or granite outcrops for mine infrastructure. Bauxite mining is unlikely to have substantially disturbed acid generating materials (Section 7.4.2.2) and will cause erosion in the short to medium term until rehabilitation establishes (Section 7.4.2.3). Alcoa's mine rehabilitation has included local topsoil and overburden placement and deep and contour ripping to improve soil permeability, limit erosion and promote vegetation establishment (Section 7.4.2.3).</p> <p>The Newmont Boddington Goldmine has pit void, waste rock and tailings storage landforms extending over approximately 4,374 ha or 0.23 per cent of the subregion, which may result in long term acid mine drainage and soil erosion. The Newmont Goldmine pit void and waste landforms are regulated under the <i>Mining Act 1978</i>. Worsley Alumina Refinery has tailings storage landforms over approximately 1,300 ha or 0.07 per cent of the subregion, which</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity. Minor clearing may occur for urban, rural residential and infrastructure development.</p> <p>Agricultural activities are expected to continue to cause widespread impact to soils through salinity, erosion, compaction and acidification. Subsurface soil acidification is expected to increase with continuing fertiliser application and cropping.</p> <p>Native Timber harvesting ceased in 2024 under the 2024-2033 FMP, with the exception of logging for maintenance of forest health (e.g. ecological thinning). Soil compaction in harvested forest is expected to naturally remediate over the long term as the forest progresses into various forms of old growth forest. Some re-compaction may occur for logging activities to maintain forest health.</p> <p>Mining clearing represents 3.9 per cent of the subregion or 6.6 per cent of the remaining native vegetation. The Proposal comprises approximately 10.3 per cent of the total clearing related to mining.</p> <p>Bauxite mining will occur predominantly over lateritic soils and cause soil erosion in the short to medium term until rehabilitation establishes. The pit void, waste rock and tailings storage landforms will increase in extent at Newmont Boddington Goldmine and Worsley Alumina Refinery and remain a small proportion (approximately 0.3 per cent) of the subregion. The mine waste landforms will be operated and rehabilitated in accordance with approvals under the Mining Act and/or Part V of the EP Act.</p>

Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
	<p>may result in long term alkaline drainage and soil erosion. The Worsley Refinery tailings storage is regulated under Part V of the EP Act.</p>	
<p>Inland waters</p>	<p>Secondary salinity from widespread agricultural clearing has resulted in salinisation of Avon and Murray rivers, which has impacted their potential beneficial use for drinking water as well as aquatic ecological values within the NJF subregion and the Swan Coastal Plain downstream.</p> <p>Damming of the Serpentine, Dandalup and Canning rivers and Wungong Brook has diverted flows for the beneficial use of drinking water, which has substantially reduced environmental flows in downstream rivers with associated environmental impacts to aquatic and riparian ecosystems on the Swan Coastal Plain.</p> <p>Hydrological and water quality impacts from agriculture, damming and climate change have impacted riparian and aquatic ecosystems, which have impacted Aboriginal cultural values associated with Inland Waters.</p> <p>Mining has occurred within several catchments including regulated PDWSAs and un-regulated catchments of the Murray, Serpentine and Harvey rivers (see Figure 17-3).</p> <p>The former Jarrahdale Mine (now closed) and Huntly Mine have predominantly operated within PDWSAs, with rehabilitated areas comprising 7.6 % of the overall catchment for these PDWSAs (as at the end of 2023). Open areas associated with these mines comprise 2.3 % of the PDWSA catchments, including Serpentine (4.5 per cent of catchment), Serpentine Pipehead (2.5 per cent of catchment), North Dandalup (3.6 per cent of catchment), South Dandalup (0.5 per cent of catchment) and Conjurunup Pipehead (0.8 per cent of catchment). Mining within the PDWSAs to date has not caused a reservoir to be taken out of service due to salinity, turbidity or contaminant discharges (Section 8.4.6). Salinity and turbidity monitoring data available for Serpentine, South Dandalup and Wungong Brook PDWSAs indicates that past and existing mining has not caused elevated salinity or turbidity at offtakes (see Section 8.4.4).</p> <p>Willowdale Mine has predominantly operated in the un-regulated Murray and Harvey river catchments and the Samson Brook (8.3 per cent of catchment) and Stirling Dam (2.6 per cent of catchment) PDWSAs (see Figure 17-3). To date mining has not caused either reservoir to be taken out of service due to salinity, turbidity or contaminant discharges.</p> <p>Newmont Boddington Goldmine and Worsley Mine have operated in the catchments of the Hotham and Williams rivers, which are tributaries of the un-regulated Murray River catchment. Worsley Alumina Refinery lies in the un-regulated catchment of the Collie River.</p> <p>Mining within catchments of PDWSAs is hydrologically disconnected from downstream rivers and the Peel-Yalgorup System Ramsar wetlands, as drinking water dams either release no water downstream (e.g. Wungong, South Dandalup) or very limited releases (e.g. Serpentine, North Dandalup). Given the lack of substantial impact to reservoir water quality to date, the attenuating effects of reservoirs and the limited to no releases downstream, mining within PDWSAs is expected to have caused negligible impact to the downstream Ramsar wetlands.</p> <p>Mining in the un-regulated Serpentine, Murray and Harvey river catchments is hydrologically connected to downstream rivers that discharge into the Peel-Yalgorup Ramsar wetlands. The total area of mining and rehabilitation within the un-regulated catchments is approximately 21,000 ha, which represents about 2.3 per cent of the approximately 540,000 ha of agriculture and intensive land use within the catchment of the Ramsar wetlands<sup>2</sup>. Given that the operational area is a fraction of the total mined area, that about three quarters have been rehabilitated to date and the limited fertiliser application, mining is expected to have contributed very minor to negligible water quality impacts to the Ramsar wetlands compared to agriculture and other intensive land uses.</p> <p>Mining in the un-regulated Murray River is unlikely to have caused significant impact to the Murray River section within Lane Poole Reserve. To date, mining has not resulted in a catastrophic contaminant discharge that has affected recreational usage or amenity at Lane Poole Reserve or downstream. Contaminant spills and leaks (e.g. diesel fuel and oils) within mined areas are expected to have been remediated or otherwise remained in-situ and caused localised impacts to mine rehabilitation (see Section 8.4.8 and Section 5.4.4.3) rather than discharging into downstream rivers.</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity. Minor clearing may occur for urban, rural residential and infrastructure development.</p> <p>Cleared agricultural land is expected to continue to cause secondary salinity to the Avon and Murray Rivers.</p> <p>Dams are expected to remain in place and continue to divert water from downstream rivers with associated environmental impacts.</p> <p>Hydrological and water quality impacts from agriculture, damming and climate change are expected to continue to impact riparian and aquatic ecosystems and associated Aboriginal cultural values.</p> <p>Total disturbance from mining represents 3.9 per cent of the subregion (Section 5.4.4.1), with the Proposal comprising approximately 10.4 per cent of the total disturbance related to mining. Within PDWSAs, the Proposal in combination with historic disturbance and clearing under other approvals granted to Alcoa could result in a cumulative disturbance of up to 13,239 ha within Serpentine Dam (20.0 per cent of catchment), up to 4,300 ha within South Dandalup Dam (13.7 per cent of catchment) and up to 2,804 ha within Wungong Brook (21.4 per cent of catchment).</p> <p>The Willowdale Mine (Larego region) will operate within the Stirling Dam PDWSA as well as un-regulated Murray and Harvey river catchments (see Figure 17-3) and will not contribute cumulative impacts to the PDWSAs covered by the Huntly Mine.</p> <p>Boddington Goldmine will remain within the un-regulated Murray River catchment. Worsley Mine including the Primary Bauxite Area (PBA) and Extended Mining Areas (EMAs) will predominantly occur within the un-regulated Murray River catchment (see Figure 17-3) and not contribute cumulative impacts to the PDWSAs covered by the Huntly Mine or Willowdale Mine. The western portions of the Central and Hotham North EMA may lie in the upper catchment of the Serpentine PDWSA and contribute minor additional clearing to that PDWSA.</p> <p>Mining within catchments of PDWSAs is unlikely to cause significant impacts to drinking water quality from salinity, turbidity or other contaminants, as has been demonstrated by detailed assessments and historical monitoring data for the Serpentine Dam and South Dandalup Dam (see Section 8.4). The Huntly and Willowdale mines will operate within different PDWSAs and not contribute cumulative impact risks in any one PDWSA.</p> <p>Mining in the un-regulated Murray River catchment is highly unlikely (rare event) to result in a catastrophic contaminant discharge that results in a significant impact to recreational usage or amenity of Lane Poole Reserve or downstream. Contaminant spills and leaks within mined areas are expected to be remediated or otherwise remain in-situ and cause localised impacts to mine rehabilitation (see Section 8.4.8 and Section 5.4.4.3) rather than discharging into downstream rivers.</p> <p>Mining is unlikely to impact to hydrological regimes or water quality such that associated Aboriginal cultural values are significantly impacted.</p> <p>The pit void, waste rock and tailings storage landforms will increase in extent at Newmont Boddington Goldmine and Worsley Alumina Refinery, and remain a small proportion (approximately 0.3 per cent) of the subregion. The mine waste landforms may result in</p>

<sup>2</sup> Peel-Harvey NRM land use profile: <https://www.awe.gov.au/abares/aclump/land-use/catchment-scale-land-use-profile-nrm>

Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
	<p>Mining is unlikely to have impacted hydrological regimes or water quality such that associated Aboriginal cultural values are significantly impacted.</p> <p>The Newmont Boddington Goldmine has pit void, waste rock and tailings storage landforms that may result in long term acid mine drainage within the Hotham River catchment. The Newmont Goldmine pit void and waste landforms are regulated under the <i>Mining Act 1978</i>.</p>	<p>long term acid mine drainage in the Murray and Collie river catchments and will be operated and rehabilitated in accordance with approvals under the Mining Act and/or Part V of the EP Act.</p>
Air quality	<p>Agricultural development has occurred over approximately 36 per cent of the subregion. Dryland cropping and grazing results in removal of vegetative cover and ground disturbance in summer and potential for wind erosion with autumn pre-frontal winds<sup>3</sup> with potential for local and regional dust impacts. The subregion is at moderate risk of wind erosion, with a higher risk during excessive stocking on poor pastures during drought years (DAFWA 2013).</p> <p>Prescribed burning has occurred over an average of 7 per cent per year (during 2000-2020) of DBCA managed forest in the subregion. Prescribed burns can release large quantities of particulate matter that can cause episodic air quality impacts to urban and rural receptors across the South West region depending on meteorological conditions. Prescribed burning caused between 30 per cent and 64 per cent of Ambient Air NEPM exceedances measured in DWER's air quality monitoring network over 2015-2020<sup>4</sup>.</p> <p>Mining over approximately 2 per cent of the subregion is expected to have generated dust emissions that caused elevated dust levels and deposition in the vicinity of the mines, most of which comprises Jarrah forest and (in the case of Worsley Mine) agricultural land. Approximately two thirds of mined areas have been rehabilitated which is expected to substantially reduce dust emissions as surface disturbance ceases, a surficial crust forms and vegetation establishes. Historic burning of wood waste is expected to have contributed to the particulate emissions from prescribed burning to the regional airshed.</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity. Minor clearing may occur for urban, rural residential and infrastructure development.</p> <p>Widespread agricultural activities are expected to continue to cause wind erosion and potential episodic dust impacts to local and regional receptors.</p> <p>Prescribed burning is expected to continue in accordance with the WA Government's strategy to reduce fuel loads and minimise wildfires. Prescribed burning is expected to continue to result in episodic air quality impacts to urban and rural receptors across the South West region, including those in the vicinity of the Mine DE.</p> <p>Mining clearing represents 3.6 per cent of the subregion, with the Proposal comprising approximately 10.3 per cent of the total clearing related to mining. Mining will continue to generate dust emissions and cause elevated dust levels and deposition in the vicinity of the mines. The Willowdale, Newmont Boddington and Worsley mines will lie at least 10 km from the Mine DE and are not expected to contribute to cumulative dust levels at receptors in the vicinity of the Mine DE. Alcoa has ceased the burning of wood waste, which will eliminate the associated contribution to particulate emissions in the regional airshed.</p> <p>All mined areas, with the exception of pit voids, will be rehabilitated which is expected to substantially reduce dust emissions as surface disturbance ceases, a surficial crust forms and vegetation establishes.</p>
Social surrounds	<p>Agriculture over approximately 36 per cent of the subregion has caused permanent loss of native vegetation in the vicinity of farming towns such as Boddington, the Perth Hills as well as pockets of land in the vicinity of Jarrahdale and Dwellingup. This has caused widespread conversion of landscape character from native forests and woodlands to rural. Agricultural clearing and ground disturbance is also expected to have caused widespread loss of Aboriginal cultural heritage.</p> <p>Timber harvesting over approximately 41 per cent of the subregion has caused a widespread conversion of landscape character from old growth forest (very large trees spaced apart) to a predominantly juvenile to immature age forest (denser stands of smaller trees). Old growth forest remains in fragmented areas over approximately 1-2 per cent of the subregion, most of which lie in the east and south-east portions of forested areas, away from the historic centres of timber industry in Jarrahdale and Dwellingup (Figure 17-2).</p> <p>Timber harvesting may have caused loss of Aboriginal cultural heritage from ground disturbance, particularly when undertaken in valleys. The former timber industry has left behind European cultural heritage near Jarrahdale and Dwellingup as well as shield/reference trees scattered throughout the forest (Section 11.3.3.4).</p> <p>Timber harvesting has caused periods of localised noise emissions and heavy vehicle traffic along public roads during harvesting operations, as timber and wood products are hauled to timber mills and other premises.</p> <p>Prescribed burning has occurred over an average of 7 per cent per year (during 2000-2020) of DBCA managed forest in the subregion. Prescribed burns can cause episodic amenity impacts to urban and rural receptors across the South West region depending on meteorological conditions.</p>	<p>No substantial future agricultural development is expected in the subregion. Cleared agricultural areas are expected to be retained for primary productivity. Minor clearing may occur for urban, rural residential and infrastructure development.</p> <p>Native Timber harvesting ceased in 2024 under the 2024-2033 FMP, with the exception of logging for maintenance of forest health (e.g. ecological thinning). Ecological thinning is expected to avoid large trees with hollows. Harvested forest is expected to progress to varying forms of old growth forest, regenerating the old growth forest landscape over a timeframe of several decades (for current mature age forest) to centuries (for current juvenile to immature age forest).</p> <p>Prescribed burning is expected to continue in accordance with the WA Government's strategy to reduce fuel loads and minimise wildfires. Prescribed burning is expected to continue to result in episodic amenity impacts to urban and rural receptors across the South West region, including those in the vicinity of the Mine DE.</p> <p>Mining clearing represents 3.6 per cent of the subregion, with the Proposal comprising approximately 10.3 per cent of the total clearing related to mining</p> <p>Mining will continue to cause localised noise, light and dust emissions that cause elevated noise levels, nighttime illumination and dust deposition in the vicinity. The Willowdale, Boddington Gold and Worsley mines will lie at least 10 km from the Mine DE and are not</p>

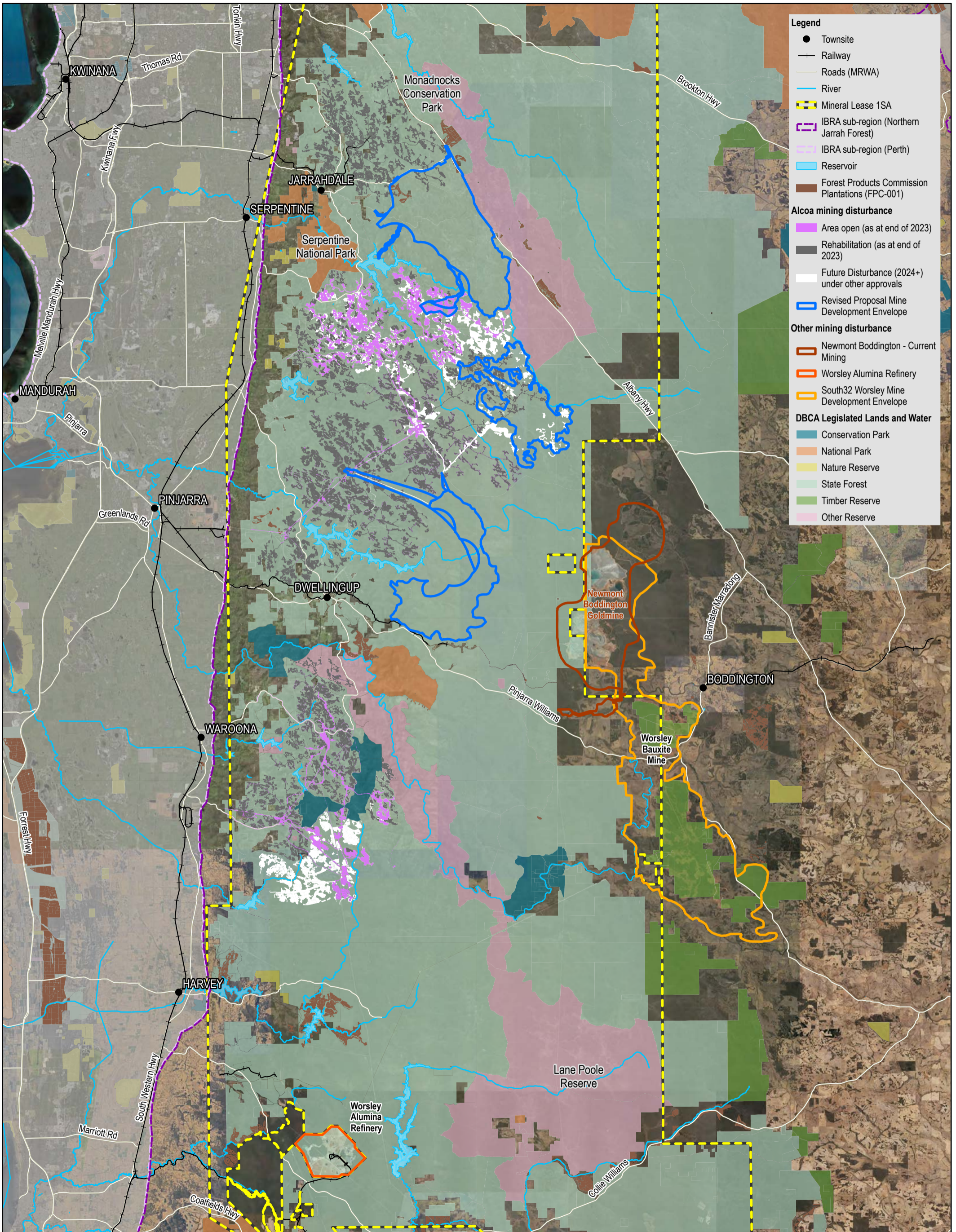
<sup>3</sup> <https://www.agric.wa.gov.au/wind-erosion/managing-wind-erosion-southern-western-australia>

<sup>4</sup> <https://www.der.wa.gov.au/your-environment/air/203-air-quality-publications>

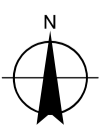
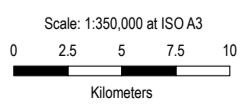
Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
	<p>Mining over approximately 2 per cent of the subregion has caused localised noise, light and dust emissions that have caused elevated noise, nighttime illumination and dust deposition in the vicinity, most of which comprises Jarrah forest and (in the case of Worsley Mine) agricultural land. Mining has occurred in the vicinity of Boddington townsite, to sections of the Bibbulmun Track and Munda Bididi Trail as well as Lane Poole Reserve (see Figure 17-4).</p> <p>Huntly Mine operations have occurred more than 5 km away from the Bibbulmun Track, which lies to the east, and within 1 km of sections of the Munda Bididi Trail to the west.</p> <p>Willowdale Mine operations have occurred within 2 km of sections of the Bibbulmun Track and Munda Bididi Trail within Lane Poole Reserve. Willowdale Mine has transitioned into the Larego mine region, which lies outside of Lane Poole Reserve and incorporates a realignment of the Munda Bididi Trail.</p> <p>Newmont Boddington Goldmine lies within 2 km of a section of the Bibbulmun Track near Mount Wells (see Figure 17-4) and has caused audible noise along the track, including at the White Horse Hills, Mount Wells and Chadoora campsites<sup>5</sup>. The Newmont Boddington Goldmine has incorporated a realignment of the Bibbulmun Track.</p> <p>Public access to the Bibbulmun Track and Munda Bididi Trail has been maintained throughout mining, with trail realignments undertaken where sections of the trails have been directly impacted.</p> <p>Mining has caused visual impacts through the loss of predominantly juvenile to immature age forest until rehabilitation restores the forest canopy. Older rehabilitation prescriptions created exotic forest and denser tree stands that have a different landscape character to un-mined forest. Survey of recreational users (Rosa et al 2019) indicated that bushwalkers have usually avoided the rehabilitated areas while mountain bikers have not and that the recreationists' perception of rehabilitated areas has been '<i>largely shaped by the absence of large and old trees and natural landforms</i>'. Mine rehabilitation under contemporary prescriptions is expected to have a less dense canopy and understorey that is closer to un-mined forest, however these areas are yet to be opened to recreational users.</p> <p>Views into mined areas are generally screened by topography and surrounding un-mined forest but are visible from some elevated viewpoints as well as where mine infrastructure (e.g. conveyors and haul roads) crosses public roads. Haul road crossings of public roads have occurred for the Huntly Mine (Kingsbury Drive), Willowdale Mine (Nanga Road) and Worsley Mine (Pinjarra-Williams Road).</p> <p>The Bibbulmun Track provides access to several elevated viewpoints within the Monadnocks Conservation Park and the White Horse Hills to the south.</p> <p>Existing Huntly Mine (Myara region) operations are visible from Mount Vincent and Mount Cooke in the Monadnocks Conservation Park, which lie approximately 8.2 km north-east and 8.7 km east from mined areas, respectively. Mount Cook also have views of plantations that lie about 1 km west of the hill, along Albany Highway.</p> <p>Past Huntly Mine (McCoy and O'Neil) region operations may have been visible from Kimberling Hill and Boonerring Hill which lie approximately 5.4 km and 8 km to the east of mined areas, respectively. Rehabilitation of the two regions is expected to be reducing the visual impact to these two viewpoints. Boonerring Hill has views of plantations (about 7,000 ha in extent) and the North Bannister Resource Recovery Facility, which occupy land within 1 km of the hill and extending east to Albany Highway.</p> <p>Newmont Boddington Goldmine operations are visible from Mount Wells, lying within 1 km of the viewpoint, as well as Boonerring Hill which lies about 10 km to the north, respectively. Kimberling Hill has forest vegetation that screens views to the south.</p> <p>Willowdale Mine operations are unlikely to be visible from highpoints due to the distance from the White Horse Hills (&gt; 30 km from Mount Wells) and that the Bibbulmun Track section that runs east of the mine follows the Murray River valley rather than hills.</p> <p>Worsley Mine operations may potentially be visible from Mount Wells and Boonerring Hill, however they are unlikely to cause a high visual impact, due to the distance from the hills (&gt; 10 km) and the surrounding context of cleared agricultural land around Boddington.</p>	<p>expected to contribute to cumulative noise, light or dust levels at receptors in the vicinity of the Mine DE.</p> <p>Mining in the Myara North or Holyoake regions may cause audible noise levels in the short to medium term along nearby sections of the Bibbulmun Track, during adverse meteorological conditions and certain operational scenarios (see Section 12.4.2.1). The audible noise levels along these sections may be concurrent with audible noise levels along the section near the Boddington Gold mine and potentially the section near Willowdale Mine. Mining may therefore create audible noise levels along two or three track sections at the same time, causing a cumulative impact to the Bibbulmun Track over the short to medium term.</p> <p>Mining in the Myara North region may cause long term visual impact to elevated viewpoints in the Monadnocks Conservation Park. The visual impacts are expected to occur concurrent with the existing visual impact to the Monadnocks viewpoints from the Myara region operations, and the visual impacts to Boonerring Hill and Mount Wells from Boddington Goldmine. The Worsley Mine Hotham Extension and Central EMAs may become visible from Boonerring Hill, their western boundaries about 4 km and 7 km east of the hill, respectively. Visual impacts to the Boonerring Hill are expected to occur in the context of existing visual impacts from plantations and the North Bannister Resource Recovery Facility that lie east of the hill.</p> <p>Mining may therefore cause a cumulative visual impact to the elevated lookouts along the Bibbulmun Track over the long term.</p> <p>Huntly Mine and Willowdale Mine will progress to restrict public access to additional areas of State Forest that may be used by some residents and visitors for informal recreation outside of defined trails and facilities that are managed and promoted. The restriction to public access will continue until mine regions are sufficiently rehabilitated and handed back to the government, at which point the areas will revert to State Forest. Boddington Goldmine and Worsley Mine lie predominantly over private land and are not expected to substantially restrict public access.</p> <p>The long-term restriction to public access over areas of State Forest is expected to restrict access to country for Aboriginal people, causing an impact to associated Aboriginal cultural values. This impact will occur in the context of extensive and permanent restrictions to access to country from agricultural, urban and rural residential developments in the NJF and SCP subregions. Alcoa will negotiate access arrangements with Traditional Owners to mitigate impacts arising from loss of access to Aboriginal cultural heritage values.</p>

<sup>5</sup> <https://www.bibbulmuntrack.org.au/trip-planner/track-sections/the-darling-range/s-realignments/>

Key Environmental Factor	Impact of past and present activities	Impact of reasonably foreseeable future activities
	<p>Huntly Mine and Willowdale Mine have restricted public access to large areas of State Forest that may be used by some local residents and visitors for informal recreation outside of defined trails and facilities that are managed and promoted. Newmont Boddington Goldmine and Worsley Mine lie predominantly over private land and are not expected to have substantially restricted public access. Mining historically may have caused some loss of Aboriginal cultural heritage due to disturbance of archaeological sites and materials, however the disturbance to valleys (where most heritage sites are expected to occur) is limited to the mine infrastructure crossings. Contemporary mining has been subject to Aboriginal heritage site survey, avoidance and management and is not expected to have caused significant heritage impacts.</p> <p>Inland Waters is a key component of Aboriginal cultural values, with Aboriginal life traditionally revolving around waterways and the associated food resources and social and aesthetic values. Agriculture has resulted in widespread impacts to the water quality of waterways in the NJF and SCP subregions, including salinisation of the Murray River. Water supply reservoirs along the Darling Scarp have disrupted aquatic fauna migration and substantially reduced flow in the Serpentine and Dandalup rivers downstream. Climate change has resulted in a decline in river flows since the 1970s. The historic impact to hydrological regimes and water quality, as well as introduced aquatic fauna and weed invasion, is expected to have substantially impacted on the quality of aquatic and riparian ecosystems and the associated Aboriginal cultural values.</p> <p>Aboriginal access to country has historically been restricted through agricultural, urban and rural residential development of the NJF and SCP subregions, with Aboriginal people displaced or forcibly removed from their traditional lands. Access to country has been available within publicly accessible State Forest, National Parks and recreational reserves in the NJF and SCP subregions. The Huntly and Willowdale mines have increasingly restricted public access to State Forest as mine regions have been progressively opened, and pending closure and handback of rehabilitated areas to the State Government.</p>	



- Legend**
- Townsite
  - Railway
  - Roads (MRWA)
  - River
  - ▭ Mineral Lease 1SA
  - ▭ IBRA sub-region (Northern Jarrah Forest)
  - ▭ IBRA sub-region (Perth)
  - ▭ Reservoir
  - ▭ Forest Products Commission Plantations (FPC-001)
- Alcoa mining disturbance**
- ▭ Area open (as at end of 2023)
  - ▭ Rehabilitation (as at end of 2023)
  - ▭ Future Disturbance (2024+) under other approvals
  - ▭ Revised Proposal Mine Development Envelope
- Other mining disturbance**
- ▭ Newmont Boddington - Current Mining
  - ▭ Worsley Alumina Refinery
  - ▭ South32 Worsley Mine Development Envelope
- DBCA Legislated Lands and Water**
- ▭ Conservation Park
  - ▭ National Park
  - ▭ Nature Reserve
  - ▭ State Forest
  - ▭ Timber Reserve
  - ▭ Other Reserve



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

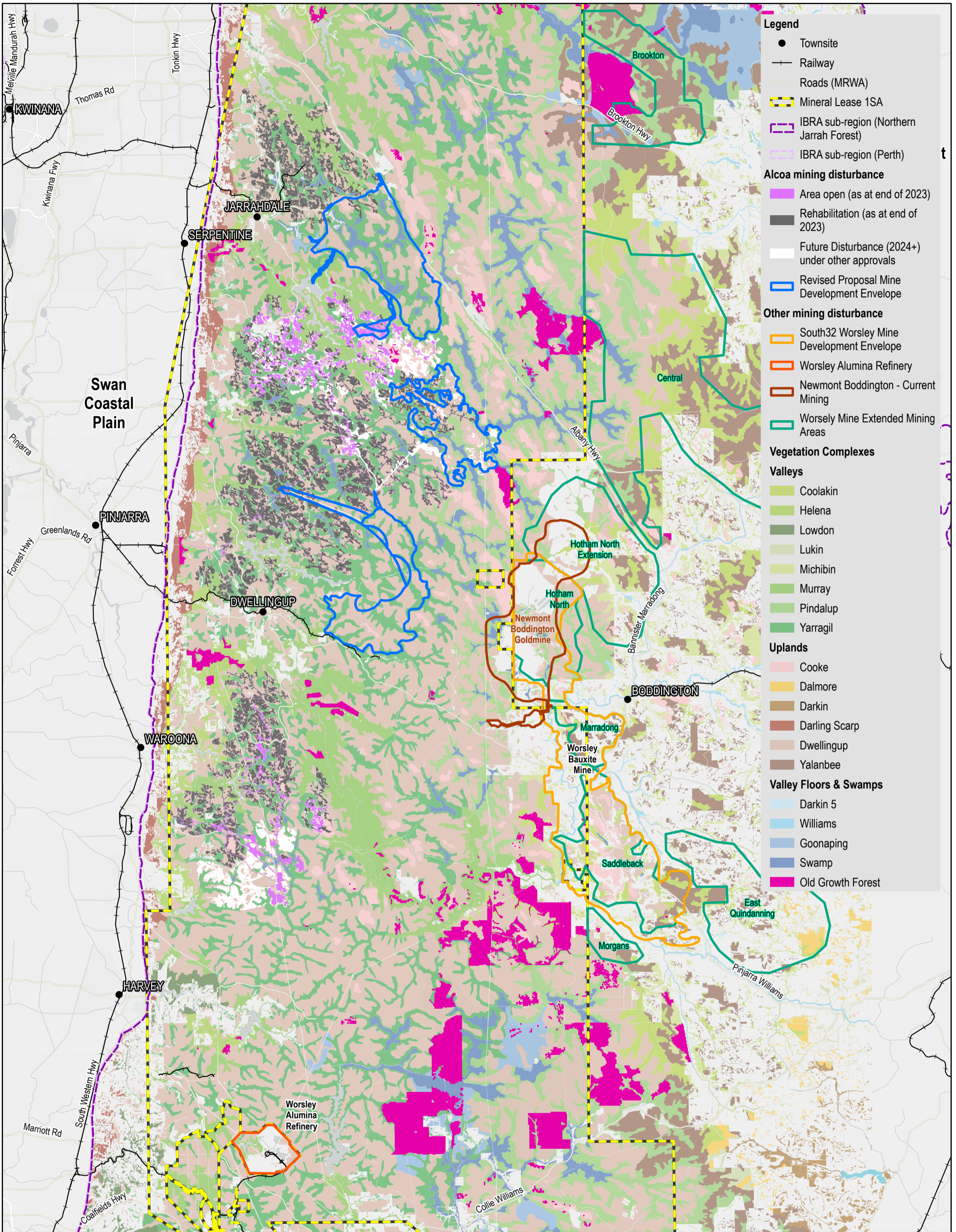
Alcoa of Australia Limited  
 Pinjarra Refinery Revised Proposal -  
 Environmental Review Document

Project No. 1263192  
 Revision No. 3  
 Date 10/03/2025

**Reasonably Foreseeable Activities -  
 Northern Jarrah Forest**

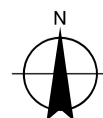
**FIGURE 17-1**

Data source: WAnow; Landgate / SLIP  
 Light Gray Base: Esri, TomTom, Garmin, Foursquare, FAO, MET/NASA, USGS.



Scale: 1:360,900 at ISO A3  
 0 2.5 5 7.5 10  
 Kilometers

Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50



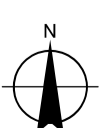
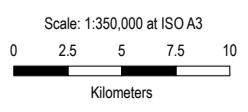
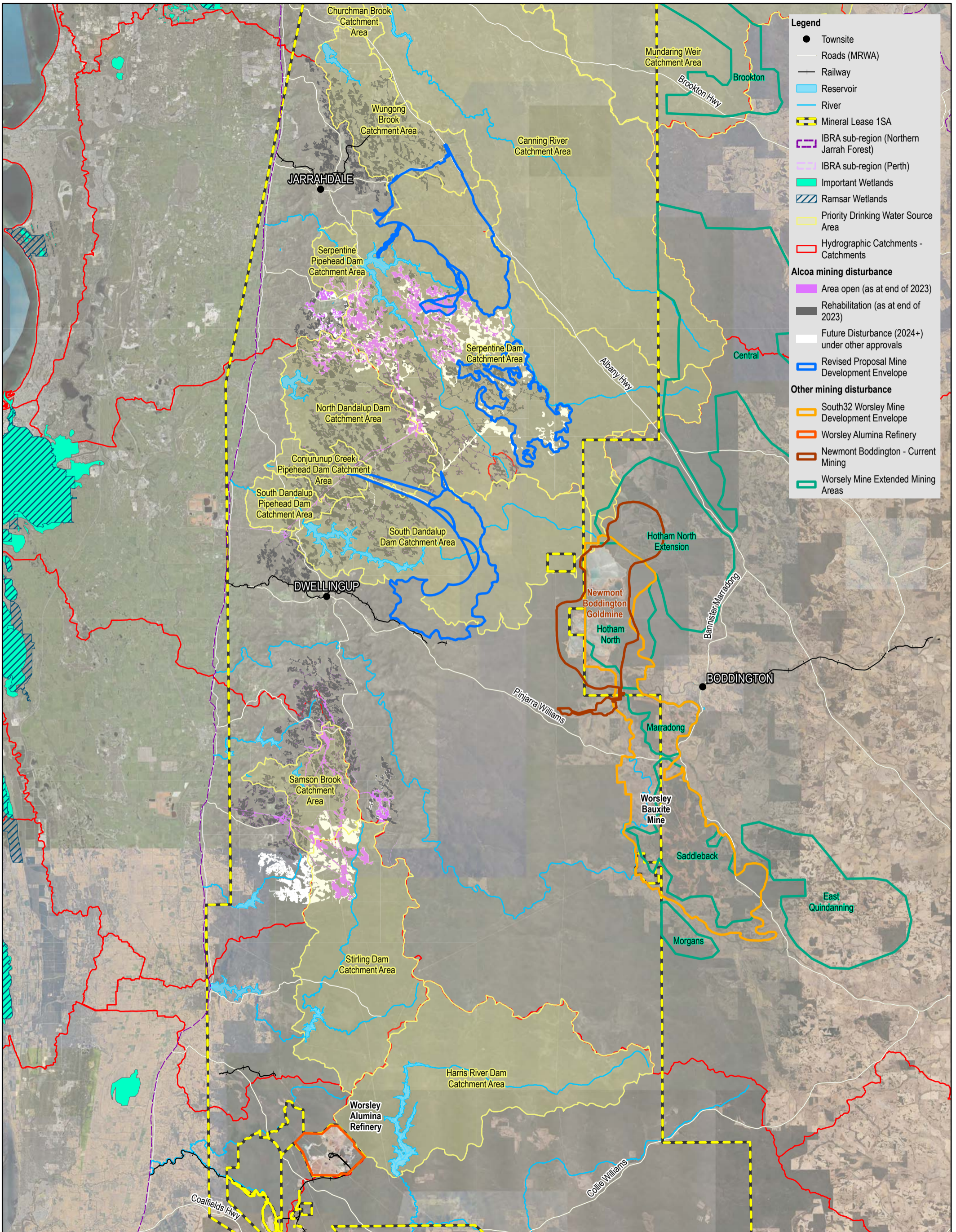
Alcoa of Australia Limited  
 Pinjarra Refinery Revised Proposal -  
 Environmental Review Document

**Cumulative Impacts to  
 Terrestrial Ecology -  
 Northern Jarrah Forest**

Project No. 12633192  
 Revision No. 3  
 Date 10/03/2025

**FIGURE 17-2**

Data source: Light Gray Base: Esri, TomTom, Garmin, Foursquare, FAO, METINASA, USGS.



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

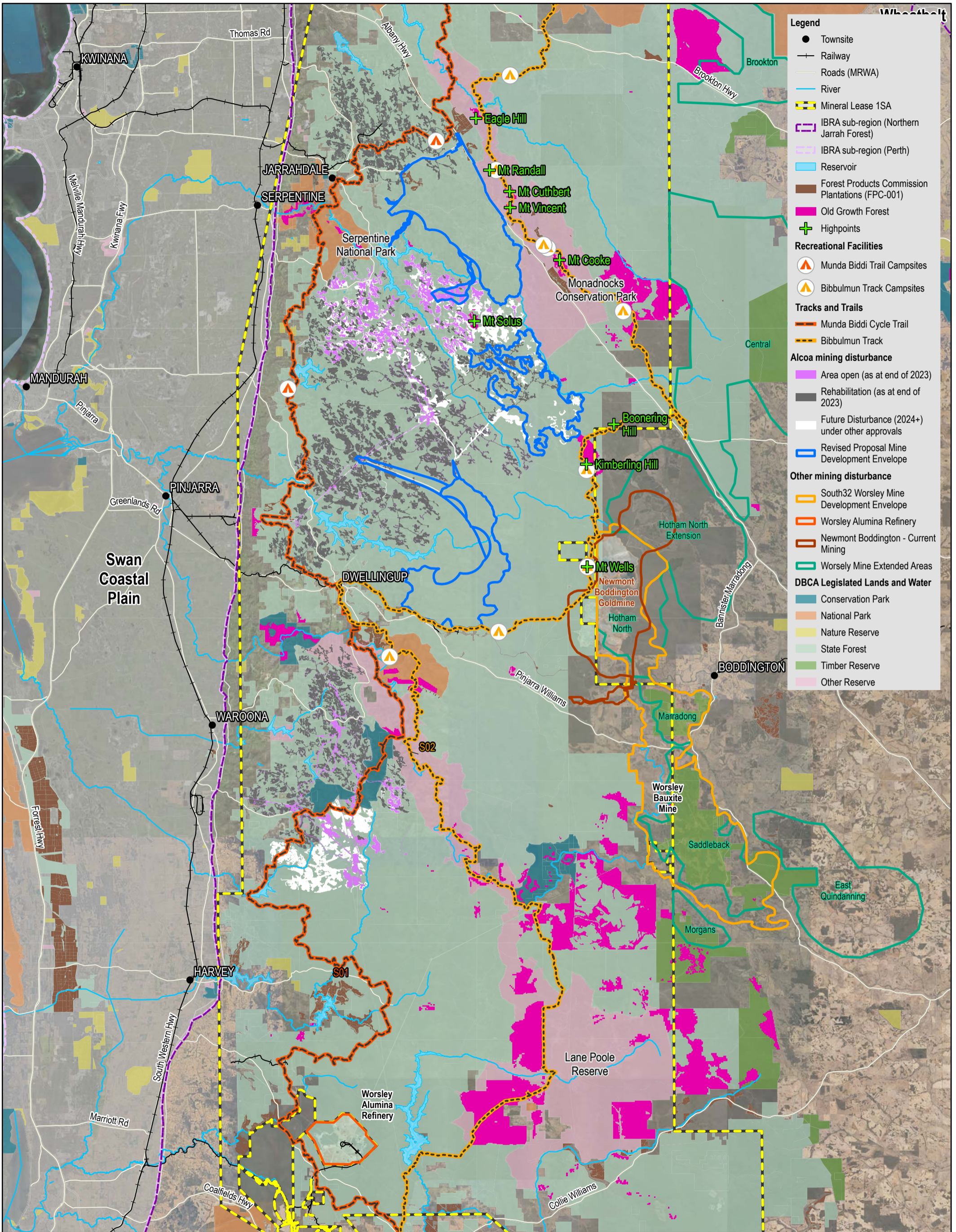
Alcoa of Australia Limited  
 Pinjarra Refinery Revised Proposal -  
 Environmental Review Document

Project No. 12663192  
 Revision No. 3  
 Date 10/03/2025

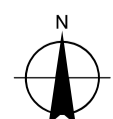
**Cumulative Impacts to Inland Waters  
 - Northern Jarrah Forest**

**FIGURE 17-3**

Data source: WAnow; Landgate / SLIP.



Scale: 1:350,000 at ISO A3  
 0 2.5 5 7.5 10  
 Kilometers  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50



Alcoa of Australia Limited  
 Pinjarra Refinery Revised Proposal -  
 Environmental Review Document

Project No. 12633192  
 Revision No. 3  
 Date 10/03/2025

Cumulative Impact to Social Surrounds -  
 Northern Jarrah Forest

FIGURE 17-4

Data source: WANow; Landgate / SLIP  
 Light Gray Base: Esri, TomTom, Garmin, Foursquare, FAO, MET/NASA, USGS.

## 17.3 Pinjarra Refinery

### 17.3.1 Past and present activities

The locality within 5 km of the Refinery has been subject to environmental impacts from a range of past and present activities, with the key activities as follows:

- Agriculture (SCP region)
- Timber harvesting (NJF subregion)
- Urban development
- Refinery operations

The combined effect of development is that approximately 66 per cent of the locality has been cleared of native vegetation, most of which has occurred on the Swan Coastal Plain (SCP) for agriculture.

Land use in the locality of the Refinery is predominantly agricultural on the SCP and State Forest on the NJF (see Section 1.12). Agricultural development has been extensive in the locality and the wider Pinjarra Plain, reflecting the presence of heavier soils (see Section 7.3.1.3) which are distinctive to the sandier landforms (e.g. Bassendean, Spearwood and Quindalup dunes) that cover the western and northern portions of the SCP. Apart from clearing, the widespread extent of agriculture has also caused cumulative phosphorus loading and eutrophication to the Peel-Yalgorup System, representing a key threatening process for the Ramsar wetlands (Hale and Butcher 2007).

Timber harvesting has occurred over most of the remaining Jarrah forest in the locality east of the Refinery, which is predominantly a mix of immature and mature age forest. However, an approximately 117 ha patch of old growth forest lies within the locality, adjacent to the Refinery DE (see Section 5.3.4.4).

Urban development comprises Pinjarra townsite established in the 1840s following the Pinjarra massacre, an event that precipitated European settlement of the region (Section 11.3.3.4). Pinjarra townsite has grown to incorporate residential and industrial areas west of the Murray River and the North Pinjarra (Carcoola) residential area to the east of the Murray River. The South Western Highway is a key transport link connecting Pinjarra townsite to Perth and the South West Region.

The Refinery was established in 1972 over predominantly cleared agricultural land and has progressively developed to its current footprint within the Refinery DE. Within the Refinery DE, Alcoa has established a vegetated screening perimeter and areas of plantations comprising a mix of exotic and native Eucalyptus species.

### 17.3.2 Reasonably foreseeable future activities

Table 17.2 presents an assessment of cumulative impacts in the locality of the Refinery.

**Table 17.2 Cumulative impacts related to the Pinjarra Refinery**

Key Environmental Factor	Cumulative impacts
Air quality	<p>There are no other heavy industry sources in the local airshed that result in substantial cumulative concentrations of atmospheric pollutants at the identified sensitive receptors near the Refinery (Section 9.3.3). Industries within 10 km of the Refinery that report under the National Pollutant Inventory (NPI) are GrainCorp Oil Seeds (5.5 km west of the residue area) and Dampier Bunbury Natural Gas Pipeline Pinjarra town metering station (5 km north of the residue area). Both of these industries report emissions that are about two orders of magnitude smaller than the Refinery.</p> <p>Local air emission sources in the airshed are expected to comprise urban and rural sources such as vehicles, wood fire stoves, service industries, stock animals and agricultural burn off. Given the small size of the population and lack of intensive agriculture, the urban and rural emissions are expected to be limited and/or diffuse and not result in substantial cumulative concentrations of atmospheric pollutants at the identified sensitive receptors near the Refinery (Section 9.3.3).</p> <p>Potential for emissions to cause acute or chronic non-carcinogenic health effects is low and acceptable. The results of the health risk screening assessment indicate that the potential for emissions to contribute to the incidence of cancer in the exposed population is so low as to be almost negligible.</p>
Social surroundings	<p>The increase in Refinery production to 5.25 Mtpa will be designed such that there is no net increase in the baseline LA10 noise levels at the at the nearest noise sensitive receivers west of the Refinery (Section 12.4.2.2). Subject to the approval of Alcoa's Regulation 17 application, the Refinery will operate in compliance with the <i>Environmental Protection (Noise) Regulations 1997</i>.</p> <p>Land development, e.g. for residential properties, in the locality of the Refinery DE may cause localised noise emissions and traffic during the construction phase and is not expected to cause significant cumulative amenity impacts with the Proposal.</p> <p>No State Heritage Register sites or Local Heritage Survey Places lie within the Refinery DE.</p> <p>Land zoned for potential future development in the locality of the Refinery DE lies over registered Aboriginal heritage sites, including the Pinjarra massacre registered Aboriginal Heritage site that lies over parts of Pinjarra townsite and the proposed Pinjarra bypass. Development of land over the Aboriginal heritage sites will require Aboriginal heritage survey and management to meet the requirements of the AH Act.</p>