RAVENSTHORPE NICKEL OPERATION

Proposal to Impact *Kunzea similis* subsp. *mediterranea* (Threatened)

Assessment of Conservation Status Against IUCN Red List Criteria

FQM NICKEL AUSTRALIA LTD

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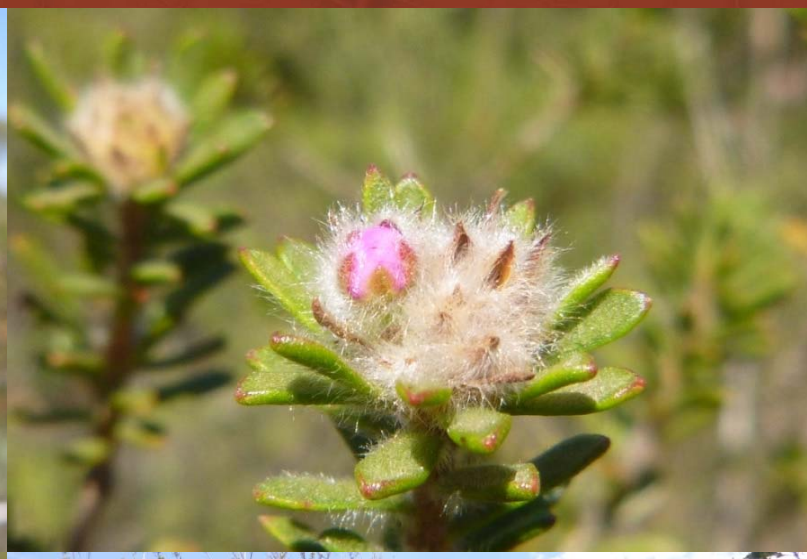
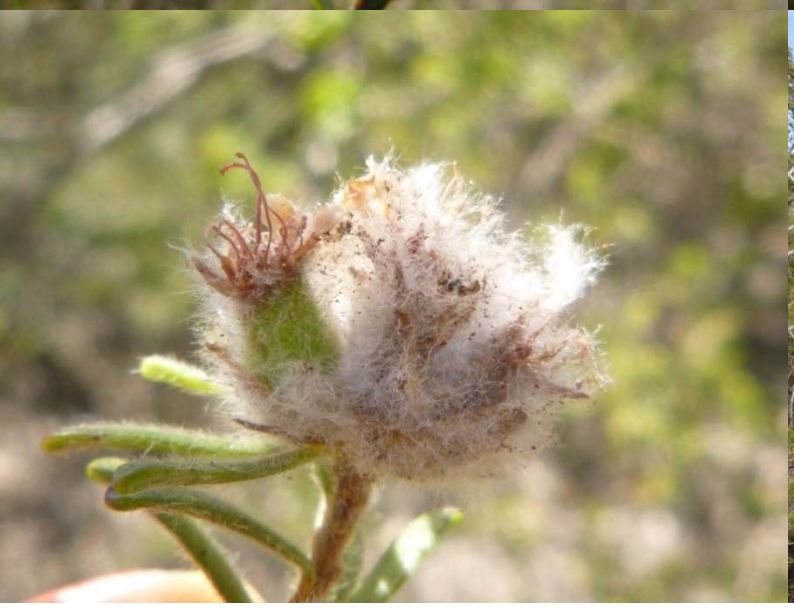


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1 INTRODUCTION

1.1 Overview

FQM Australia Nickel Pty Ltd (FQM) currently mine and process nickel laterite ore to produce a mixed nickel and cobalt hydroxide precipitate at their Ravensthorpe Nickel Operations (RNO), located approximately 35 km east of the town of Ravensthorpe, Western Australia, on Bandalup Hill. Approval was granted in 2003 under the Western Australian *Environmental Protection Act* 1986 (EP Act) for the RNO, which included mining of 3 orebodies, namely the Halleys, Hale-Bopp and Shoemaker-Levy orebodies (Government of Western Australia 2003). This included approval to impact part of the only known wild population of *Kunzea similis* subsp. *mediterranea*, a taxon currently listed as Threatened (Declared Rare Flora) under the Western Australian *Wildlife Conservation Act* 1950 (WC Act). Under International Union for Conservation of Nature (IUCN) Red List Categories and Criteria (IUCN 2012), this taxon was determined to satisfy criteria for the Endangered category by the Western Australian Threatened Species Scientific Committee (TSSC) in 2008 (Atkins 2008).

As part of the approval for the RNO, a commitment was made to conserve part of the population of *Kunzea similis* subsp. *mediterranea* on the Hale-Bopp orebody within a designated area (Government of Western Australia 2003), now termed the *Kunzea similis* subsp. *mediterranea* Community Conservation Area (CCA).

FQM are currently exploring the feasibility of mining high-grade nickel laterite ore within the *Kunzea similis* subsp. *mediterranea* CCA. Because of the location of the nickel laterite ore within the *Kunzea similis* subsp. *mediterranea* CCA, *Kunzea similis* subsp. *mediterranea* will be impacted by the proposed mining. Such impacts may affect the conservation status of this taxon with regard to the IUCN Red List Categories and Criteria; specifically, there is the potential for this taxon to move to the Critically Endangered category. To this end, FQM have requested that Woodman Environmental Consulting Pty Ltd (Woodman Environmental) conduct an assessment of the conservation status of *Kunzea similis* subsp. *mediterranea* with regard to the IUCN Red List Categories and Criteria, based on a preliminary proposed impact area for future mining.

1.2 Aim and Objectives

The aim of this report is to provide FQM with an assessment of potential change to the conservation status of the Threatened flora taxon *Kunzea similis* subsp. *mediterranea* with regard to the IUCN Red List Categories and Criteria, considering the impact of the proposed mining to this taxon.

The objectives of the desktop review include:

- To determine whether the proposed mining will affect the conservation status of *Kunzea similis* subsp. *mediterranea* with regard to the IUCN Red List Categories and Criteria;

- Provide recommendations for mitigation and management measures (if required) relevant to the conservation status of this taxon.

2 BACKGROUND

2.1 IUCN Red List Categories and Criteria

The IUCN Red List Categories and Criteria are used by the Western Australian TSSC to rank Threatened flora and fauna species, for endorsement by the Minister for Environment (Western Australia). They are also used by the Commonwealth Government to rank Threatened Species listed under the Commonwealth *Environment Protection and Biodiversity Protection Act* 1999 (EPBC Act), and are used by other jurisdictions throughout the world. Appendix A presents the IUCN categories and criteria.

2.2 Current Conservation Status of *Kunzea similis* subsp. *mediterranea*

Initial flora surveys for the RNO recorded *Kunzea similis* (then classified as a Priority 2 flora taxon) on Bandalup Hill. *Kunzea similis* was subsequently listed as Threatened (Declared Rare Flora) in 2006, and was determined to satisfy IUCN Red List Criteria for the Vulnerable category by the TSSC (Atkins 2006). A taxonomic review of material of *Kunzea similis* resulted in this species being segregated into 2 subspecies in 2007 (Toelken & Craig 2007), with the name *Kunzea similis* subsp. *mediterranea* raised to accommodate the individuals of *Kunzea similis* on Bandalup Hill. *Kunzea similis* subsp. *mediterranea* was subsequently listed as Threatened (Declared Rare Flora) in 2008, and was determined to satisfy IUCN Red List Criteria for the Endangered category by the TSSC (Atkins 2008). Despite a number of surveys in the general vicinity of Bandalup Hill, *Kunzea similis* subsp. *mediterranea* has not been discovered anywhere else (Woodman Environmental 2015a). However, an introduced sub-population exists, located approximately 4 km north north-west of Bandalup Hill. There are also a small number of immature individuals that have recently been planted in a rehabilitated area on Bandalup Hill.

Kunzea similis subsp. *mediterranea* is noted in Smith (2012), and in subsequent Threatened (Declared Rare) and Priority Flora Lists (including the current list (Jones 2015)), as belonging to the Endangered category, under IUCN Red List Criterion A3. This criterion is defined as:

> **A population size reduction of ≥ 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b) to (e) under A1 (IUCN 2012).**

The assessment by the TSSC determined that *Kunzea similis* subsp. *mediterranea* specified reduction bases (c) and (e) under A3:

> (c): A decline in area of occupancy, extent of occurrence and/or quality of habitat; and

(e): The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

The conservation threat ranking for this taxon is therefore currently listed as EN A3ce, as per IUCN (2012).

This taxon is not currently listed as a Threatened Species under the EPBC Act.

Figure 1 shows the original and current extent of the single known wild population of *Kunzea similis* subsp. *mediterranea*, and the proposed mining impact area as currently defined. The location of the introduced sub-population is also shown.

3 METHODS

3.1 Sources of Information

1. The IUCN Categories and Criteria have been sourced from IUCN (2012), with Guidelines for Using the IUCN Red List Categories and Criteria sourced from IUCN Standards and Petitions Subcommittee (2016).
2. The current category listing under the WC Act of *Kunzea similis* subsp. *mediterranea* has been obtained from Strijk (2015), Jones (2015), and Department of Parks and Wildlife (2016).
3. The current and proposed pit location and extents were received in GIS format from FQM.
4. The total original wild area of occupancy (i.e. before any mining) of *Kunzea similis* subsp. *mediterranea* (*Kunzea similis* subsp. *mediterranea* habitat) mapped has been sourced from the summation of polygons mapped by 2 studies, being:
   - Landcare Services Pty Ltd (2001a) - area of occupancy of *Kunzea similis* subsp. *mediterranea* which has previously been cleared for mining; and
   - Woodman Environmental (2015b) – extant area of occupancy of *Kunzea similis* subsp. *mediterranea*.
5. The total original number of wild *Kunzea similis* subsp. *mediterranea* individuals (i.e. before any mining) has been sourced from the summation of the number of individuals estimated by 2 studies, being:
   - Western Botanical (2005) (Table A) – the number of *Kunzea similis* subsp. *mediterrenea* individuals which have previously been cleared for mining; and
   - Woodman Environmental (2015b) – the extant number of *Kunzea similis* subsp. *mediterranea* individuals.
6. The number of *Kunzea similis* subsp. *mediterranea* individuals within an introduced sub-population, located to the north north-west of Bandalup Hill, has been sourced from Woodman Environmental (2015b).
7. The number of individuals estimated to be impacted by the proposed mining has been calculated using the area of occupancy polygons and plant density values presented in Woodman Environmental (2015b). Note that the plant density values in Woodman

Environmental (2015b) were rounded for display purposes; the actual unrounded values have been used for the calculation in this assessment

3.2 Assessment Against the Criteria

This assessment of the conservation status of *Kunzea similis* subsp. *mediterranea* has been undertaken assuming that the potential impacts from the proposed mining in its current form have already occurred; that is, the assessment assumes the hypothetical scenario that the population size has already been reduced by the proposed mining. This is relevant when assigning a taxon to Criterion A, which covers a reduction in population size both in the past and in the future.

This assessment also considers all criteria, not just those previously used to assign *Kunzea similis* subsp. *mediterranea* to Endangered. This is in line with the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2016), which note that a taxon should be assessed against as many criteria as available data permit.

This assessment only considers the extant wild population of *Kunzea similis* subsp. *mediterranea*. An additional, introduced sub-population exists, located approximately 4 km north north-west of the wild population, and numbers approximately 1,354 mature individuals. This introduction took the form of an establishment trial, and was undertaken in 2002 (Western Botanical 2003) within several small, un-rehabilitated gravel pits. This trial had the ultimate aim of determining whether a viable sub-population of this taxon could be established in an area free from the threat of mining-related disturbance (Landcare Services Pty Ltd 2001b), and as such, was not an establishment of a translocated sub-population in the strict sense. This sub-population was subsequently monitored to assess survival and condition, most recently in 2014 (Woodman Environmental 2015d).

The Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2016) note that the categorisation process should consider sub-populations introduced outside the taxon's natural range, such as the sub-population detailed above, provided four conditions (A-D) are met. It is considered that Conditions B (introduction geographically close to the natural range of the taxon) and D (at least 5 years have passed since the introduction) have been met. However, there is some uncertainty as to whether Conditions A (intent of introduction to reduce extinction risk) and C (introduction has produced viable offspring) has been met. Small immature individuals have been observed within the introduced sub-population and are likely to have been the result of reproduction by introduced individuals. However, it is unclear at this stage as to whether such individuals are offspring of the original introduced individuals, or the result of latent germination of introduced seed. Additionally, this introduction was undertaken with the primary intent of determining whether a viable sub-population could be established, rather than actually establishing a viable sub-population; with regard to this, it is considered that a more appropriate site would likely be chosen to establish a viable sub-population (e.g. natural area with established biological processes in secure tenure).

It is therefore considered that it is appropriate to conduct this assessment without including the introduced sub-population. However, the implications of including the introduced sub-population in such an assessment are discussed in Section 5.

The Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2016) also note that the categorisation process should consider self-sustaining introduced sub-populations inside the taxon's natural range. It is known that a small sub-population of *Kunzea similis* subsp. *mediterranea* exists in a recently rehabilitated area within the natural range of this taxon on Bandalup Hill. However, as per the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2016), as this sub-population is currently immature and is therefore not known to be self-sustaining, it is not included in this assessment.

3.3 Calculations

Calculations of the additional impacts to the original wild area of occupancy and number of individuals of *Kunzea similis* subsp. *mediterranea* have been performed in a GIS environment using ArcGIS, and Microsoft Excel.

4 RESULTS

4.1 Criterion A

Criterion A considers reductions in the size of the population of a taxon, with a reduction required to specify at least 1 of 5 reduction bases (a-e) (IUCN 2012). It is considered that relatively accurate estimates of the size of the original population (i.e. prior to any mining) of *Kunzea similis* subsp. *mediterranea* in terms of number of individuals are available, with methods for calculating these estimates presented in Landcare Services Pty Ltd (2001a) and Woodman Environmental (2015b). To determine the total number of individuals within the original population, the estimate of the number of individuals in previously cleared areas (from Western Botanical 2005), and the number of extant individuals (from Woodman Environmental 2015b) have been used. It is considered that the method of estimation used in Woodman Environmental (2015b) is more accurate (although both methods returned similar results), and hence this estimate is used for extant individuals, however the estimate of individuals that occurred in previously cleared areas must be sourced from Western Botanical (2005). Although the estimate of the number of extant individuals (Woodman Environmental 2015b) was made subsequent to mining commencing on Bandalup Hill, it is considered that this estimate reflects the number of individuals present pre-mining, as *Kunzea similis* subsp. *mediterranea* appears to be relatively long-lived, and no evidence of population decline or health since mining commenced has been noted (Woodman Environmental 2015c).

It is therefore considered that assessing the taxon under Criterion A using the direct observation (a) reduction base is the most appropriate method of assessment; this is in line

with the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee 2016). As per the Guidelines for Using the IUCN Red List Categories and Criteria, the remaining applicable bases for reduction (i.e. (b)-(e)) should also be considered; however, (b) and (d) are not considered further in this assessment. Reduction base (b) (index of abundance) is not considered relevant as it is more appropriate to use (a) in this case; reduction base (d) is relevant to taxa that have been commercially exploited and therefore not relevant to this assessment.

Table 1 presents the calculation of cumulative impact to the original wild number of mature individuals of *Kunzea similis* subsp. *mediterranea* from previous mining and the proposed mining. The proposed mining will result in a population reduction of 79.57 % of the original population – this reduction is considered to be within the last 3 generations of the taxon as per the IUCN Red List Categories and Criteria (IUCN 2012).

Table 1: Cumulative Quantification of Impact to Individuals of *Kunzea similis* subsp. *mediterranea*

Factor	Value
Estimated Number of Extant Wild Individuals (from Woodman Environmental 2015b)	326,304
Estimated Number of Individuals Previously Cleared (Western Botanical 2005)	545,241
Estimated Total Population Size – Pre-Mining (Individuals)	871,545
Number of Individuals to be Impacted by Proposed Mining	148,230
Number of Extant Individuals to Remain	178,074
Reduction in Pre-Mining Population Size (%)	79.57

The assessment of the conservation status of *Kunzea similis* subsp. *mediterranea* against Criterion A with regard to the proposed mining is detailed below.

Criterion A1

Criterion A1 is not considered relevant to this assessment – this criterion requires an observed, estimated, inferred or suspected population size reduction over the last 10 years or three generations, whichever is the longer, with the causes of the reduction to be clearly reversible AND understood AND ceased (IUCN 2012). In the case of the population reduction related to the proposed mining, the cause of the reduction (mining-related removal of individuals and habitat) is not considered to be clearly reversible.

Criterion A2

Criterion A2 is considered relevant to this assessment. To satisfy the requirements of the Critically Endangered category for this criterion, there must be an observed, estimated, inferred or suspected population size reduction of ≥80 % over the last 10 years or three generations, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible.

The relevant reduction bases under Criterion A are considered below for A2:

(a) As the proposed population reduction is 79.57 % based on a direct observation of individual numbers, it is considered that the direct observation reduction base (a) has not been satisfied for the Critically Endangered category.

(c) Because of the relatively accurate mapping of the area of occupancy of *Kunzea similis* subsp. *mediterranea*, in the context of this reduction base, extent of occurrence is not considered, as it would represent a larger area than the area of occupancy, and is therefore less appropriate to use in this assessment.

The proposed mining will impact 10.33 ha of the 50.1 ha pre-mining area of occupancy; when combined with the area of occupancy impacted by previous mining (24.94 ha), the proposed mining will result in a 70.40 % reduction in the pre-mining area of occupancy. However, as *Kunzea similis* subsp. *mediterranea* occurs at differing densities across the area of occupancy, with large areas of high densities of individuals, the impact of the proposed mining on the area of occupancy is such that the proposed population reduction is 79.57 % of known individuals. It is considered that the associated decline in area of occupancy would therefore result in reduction base (c) not being satisfied for the Critically Endangered category.

Recent surveys (Woodman Environmental 2015b) of the extant area of occupancy of *Kunzea similis* subsp. *mediterranea* have indicated that the area of occupancy and number of individuals is similar to that recorded prior to mining occurring in the vicinity of the individuals, and there has been no obvious decline in quality of habitat. Although there is the potential for the proposed mining to result in a population reduction based on decline in the quality of habitat, it is considered that, as for previous mining, the proposed mining can be appropriately managed to ensure that there is not a decline in the quality of habitat of *Kunzea similis* subsp. *mediterranea*. It is considered that the reduction base (c) is therefore not satisfied for the Critically Endangered category, specifically regarding a decline in quality of habitat.

(e) Recent surveys (Woodman Environmental 2015b) of the extant area of occupancy of *Kunzea similis* subsp. *mediterranea* have indicated that the area of occupancy and number of individuals is similar to that recorded prior to mining occurring in the vicinity of the individuals, and that there is no evidence of plant pathogens or parasites (including *Phytophthora cinnamomi*), introduced taxa (also the most likely competitor organisms), hybridisation (considered unlikely to occur as it is considered that there are no closely related species within the area of occupancy) or pollutants within the extant area of occupancy. Therefore, although there is the potential for the proposed mining to result in a population reduction based on the effects of such factors, it is considered that, as for previous mining, such factors can be appropriately managed to ensure they are not introduced to the area of occupancy of *Kunzea similis* subsp. *mediterranea*, including through relevant management plans (this is discussed further in Section 5). It is therefore considered that reduction base (e) is not satisfied for this criterion for the Critically Endangered category.

The reduction of the population of *Kunzea similis* subsp. *mediterranea* by proposed mining will therefore not satisfy Criterion A2 for the Critically Endangered category.

Criterion A3

Criterion A3 is considered relevant to this assessment. To satisfy the requirements of the Critically Endangered category for this criterion, there must be a projected or suspected population size reduction of ≥80 % within the next 10 years or three generations. As reduction base (a) cannot be used under this criterion (IUCN 2012), only reduction bases (c) and (e) are relevant to this assessment.

Based on available data, it is considered unlikely that there will be a population size reduction of ≥80 % within the next 10 years or three generations, based on either (c) or (e). The current area of occupancy, extent of occurrence and quality of habitat of *Kunzea similis* subsp. *mediterranea* is similar to that recorded prior to mining occurring in the vicinity, and there is no evidence of plant pathogens or parasites (including *Phytophthora cinnamomi*), introduced taxa or pollutants within the area of occupancy (Woodman Environmental 2015b). As for previous mining, it is considered that the proposed mining can be conducted in a fashion that will not result in a future population size reduction (projected or suspected) based on area of occupancy, extent of occurrence and quality of habitat (reduction base (c)), or the effects of plant pathogens or parasites (including *Phytophthora cinnamomi*), introduced taxa or pollutants (reduction base (e)). This is discussed further in Section 5.

It is therefore considered that the proposed mining will not result in Criterion A3 being satisfied for the Critically Endangered category.

Criterion A4

Criterion A4 is not considered relevant to this assessment. To satisfy the requirements of the Critically Endangered category for this criterion, there must be an observed, estimated, inferred, projected or suspected population size reduction of ≥80 % over any 10 year or three generation period, where the time period must include both the past and the future. As detailed under Criterion A3, it is considered that the proposed mining will not result in a future population size reduction (projected or suspected). Therefore, this criterion is not considered further.

4.2 Criterion B

Criterion B considers geographic range, in the form of extent of occurrence (B1) or area of occupancy (B2). Initially, to satisfy Criterion B for the Critically Endangered category, the extent of occurrence of the taxon must be less than 100 km^2 (B1), and the area of occupancy less than 10 km^2 (B2). As detailed above under Criterion A, the original area of occupancy of *Kunzea similis* subsp. *mediterranea* was 50.1 ha (0.501 km^2); this therefore satisfies B2. Although the extent of occurrence has not been accurately calculated, *Kunzea similis* subsp. *mediterranea* has only been recorded over a linear distance of approximately 3 km, with the breadth of its area of occupancy across this distance generally being less than

1 km, it is considered that B1 is also satisfied. B1 and B2 are therefore discussed collectively below.

In addition to satisfying the extent of occurrence and area of occupancy thresholds, the taxon must satisfy two of the three options listed for Criterion B. Option A (severely fragmented or known from a single location) is satisfied for *Kunzea similis* subsp. *mediterranea*. Option C (extreme fluctuations in extent of occurrence, area of occupancy, number of locations or number of individuals) is not considered to be satisfied for *Kunzea similis* subsp. *mediterranea*; this species appears to be relatively long-lived, and numbers of individuals and area of occupancy within the extant portion of the population appear to have remained relatively constant since population data on this taxon was first accurately documented by Landcare Services Pty Ltd (2001a).

It is also considered that Option B (continuing decline, either observed, inferred or projected, in extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of locations or number of individuals) is not satisfied for *Kunzea similis* subsp. *mediterranea.* There has been no observed continued decline in any of the aforementioned population parameters to date following previous mining. And as outlined under Criterion A, there is no current evidence of plant pathogens or parasites (including *Phytophthora cinnamomi*), introduced taxa, pollutants or decline in quality of habitat within the extant area of occupancy (Woodman Environmental 2015b), the influence of which (among other factors, including altered fire regimes and altered surface hydrology) could justify the projection or inference of a continuing decline in the aforementioned population parameters. As for previous mining, it is considered that the proposed mining can be conducted in a fashion that will not result in a continuing decline in any of the aforementioned population parameters. This is discussed further in Section 5.

It is therefore considered that the proposed mining will not result in Criterion B being satisfied for the Critically Endangered category.

4.3 Criterion C

Criterion C considers small population sizes that are currently or are likely to decline in the future. Initially, to satisfy Criterion C for the Critically Endangered category, the population size must be less than 250 mature individuals. As detailed in Table 1, the proposed mining will result in 178,074 mature individuals remaining. It is therefore considered that Criterion C is not satisfied for the Critically Endangered category.

4.4 Criterion D

Criterion D considers small population sizes that are currently or are likely to decline in the future. Initially, to satisfy Criterion C for the Critically Endangered category, the population size must be less than 250 mature individuals. As detailed in Table 1, the proposed mining

will result in 178,074 mature individuals remaining. It is therefore considered that Criterion C is not satisfied for the Critically Endangered category.

4.5 Criterion E

Criterion E requires a quantitative analysis to determine the probability of extinction in the wild. No such analysis has been undertaken as part of this assessment. Such an analysis would likely require data that is not currently available for *Kunzea similis* subsp. *mediterranea* (e.g. susceptibility to disease, fire response, climatic tolerance etc.). Therefore, Criterion E cannot be satisfied for the Critically Endangered category.

4.6 Summary

Following the assessment of the conservation status of *Kunzea similis* subsp. *mediterranea* against all of the IUCN Red List Criteria, it is considered that this taxon does not satisfy any of the criteria for the Critically Endangered category, and therefore would remain in the Endangered category.

5 DISCUSSION

This assessment indicates that the proposed mining as currently defined will result in *Kunzea similis* subsp. *mediterranea* remaining in the IUCN Red List Endangered Category. It should be noted that a reduction in ≥80 % of the number of mature individuals would result in Criterion A2 being satisfied for the Critically Endangered category; the proposed mining will result in a reduction of 79.57 % of the number of wild mature individuals. It is therefore important that the impact area of the proposed mining is not increased further as this will likely result in Criterion A2 being satisfied for the Critically Endangered category.

As noted under Criterion A3 and B in Section 4 above, it is considered that the proposed mining can be conducted in a fashion that will not result in a future population size reduction, either inferred, projected or suspected, in the context of either criterion. However, this will require a rigorous, multi-faceted management approach, to ensure that there remains insufficient justification for Criterion A3 and B to be satisfied. Such an approach would include:

- The management of plant pathogens (particularly *Phytophthora cinnamomi*), introduced taxa and pollutants, such that introduction of these to the population does not occur;
- Harvest of seed from as many individuals as possible, with the view of collecting a variety of genetic material for the establishment of a seed orchard for use in rehabilitation;
- Immediate rehabilitation of mined areas, including the introduction of *Kunzea similis* subsp. *mediterranea* into such areas (constructed to provide suitable habitat), to alleviate potential impacts associated with fragmentation of the

population (in-breeding and consequential loss of genetic diversity), and altered surface hydrology;

- Establishment of a translocated sub-population/s as insurance in the event of a catastrophic population reduction event, using appropriate and regulator-approved methods;
- On-going monitoring of rehabilitation and translocated sub-populations to demonstrate self-sustainability of such sub-populations (including the investigation of fire response); and
- On-going monitoring of the extant wild population, to detect any decline in the population and implement appropriate mitigation measures to alleviate the decline where possible.

With regard to the establishment of translocated and rehabilitation sub-populations as detailed above, it is worthy of note that the success of the trial introduction of *Kunzea similis* subsp. *mediterranea* provides some indication that the establishment of a translocated sub-population elsewhere is likely to succeed. FQM environmental staff has also indicated that this taxon is relatively easy to propagate from seed, and that collected seed has high viability rates; this should allow for the establishment of a seed orchard. Further investigation is required into the method of introduction and ongoing viability of this taxon in rehabilitation; currently, planted individuals have shown good survival rates in rehabilitation (Woodman Environmental 2016), however the individuals are still immature at this stage. It is also unclear as to whether any individuals have established within rehabilitation areas from direct-return topsoil at this stage.

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253000 254000 255000 256000 257000 258000 259000

6280000 6279000 6278000 6277000 6276000 6275000 6274000 6273000 6272000

BANDALUP RD

SOUTH COAST HWY

MASONS RD (NRU)

Bandalup Hill

Legend

- *Kunzea similis* subsp. *mediterranea* Community Conservation Area
- Previously Cleared Area of Occupancy
- Proposed Mining Impact Area
- Extant Area of Occupancy
- *Kunzea similis* subsp. *mediterranea* Introduced Sub-Population (Translocation Trial) *
  *Note: polygon indicative only, does not represent area of occupancy
- Roads

253000 254000 255000 256000 257000 258000 259000

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC report FQM16-10-01

Original and Current Extent of Wild Population of *Kunzea similis* subsp. *mediterranea*, Location of Introduced Sub-Population, and Proposed Mining Impact Area

Revision: B - 28 April 2016

Author: Simon Woodman

WEC Ref: FQM16-10-01-f01

Scale: 1:25,000

Projection: GDA 1994 MGA Zone 51

Figure

1

Appendix A: IUCN Ranking Categories and Criteria (IUCN 2012)

CATEGORIES

Extinct (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Extinct in the Wild (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

Endangered (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

Near Threatened (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Data Deficient (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified**.**

Not Evaluated (NE)

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

CRITERIA – VULNERABLE, ENDANGERED AND CRITICALLY ENDANGERED

Criteria	Description of Criteria	Sub-description of Criteria	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)
A	**Reduction in population size based on any of:**				
	1	An observed, estimated, inferred or suspected *population* size reduction of **X**, over the last 10 years or 3 generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of (a), (b), (c), (d) or (e)	>90%	>70%	>50%
	2	An observed, estimated, inferred or suspected *population* reduction of at least **X** over the last 10 years or 3 generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible based on (and specifying) (a), (b), (c), (d) or (e)	>80%	>50%	>30%
	3	A population size reduction of **X**, projected or suspected to be met within the next 10 years or 3 generations, whichever is the longer (up to a maximum of 100 years) based on (and specifying) any of (b) to (e) under A1	>80%	>50%	>30%
	4	An observed, estimated, inferred or suspected *population* size reduction of **X** over any 10 year or 3 generation period, whichever is the longer (up to a maximum of 100 years in the future) whether the time period must include both the past and the future, and where the reduction of its causes may not have ceased OR be understood OR may not be reversible, based on (a), (b), (c), (d) or (e)	>80%	>50%	>30%
	a	Direct Observation			
	b	an index of abundance appropriate for the taxon			
	c	a decline in area of *occupancy*, *extent of occurrence* and/or quality of habitat			
	d	actual or potential levels of exploitation			
	e	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites			

Criteria	Description of Criteria	Sub-description of Criteria	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)
B	**Geographic range in the form of either B1 OR B2 or BOTH**				
	1	*Extent of occurrence* estimated to be less than **X** and estimates indicating at least 2 of (a) - (c)	<100km2	<5 000km2	<20 000km2
	2	*Area of occupancy* estimated to be less than **X** and estimates indicating at least 2 of (a) - (c)	<10km2	<500km2	<2 000km2
	a	*Severely fragmented* or known to exist at no more than **X** *locations*	1	5	10
	b	Continuing decline, observed, inferred or projected, in ANY of the following:			
		i. *extent of occurrence*			
		ii. *Area of occupancy*			
		iii. Area, extent and/or quality of habitat			
		iv. Number of *locations* or *subpopulations*			
		v. number of mature individuals			
	c	Extreme fluctuations in any of the following:			
		i. *extent of occurrence*			
		ii. *Area of occupancy*			
		iii. Area, extent and/or quality of habitat			
		iv. Number of *locations* or *subpopulations*			
		v. number of mature individuals			
C	**Population Estimated to Number X Mature Individuals and Either:**		<250	<2 500	<10 000
	1	An estimated continuing decline of lat least **X** within 3 years or 1 generation whichever is the longer (up to a maximum of 100 years in the future) OR	25%	20%	10%
	2	A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of (a) or (b)			
	a	Population structure in the form of one of:			
		i. no subpopulation estimated to contain more than **X** mature individuals	50	250	1 000
		ii. At least **X** % of mature individuals in one subpopulation	90%	95%	100%
	b	Extreme fluctuations in number of mature individuals			

Criteria	Description of Criteria	Sub-description of Criteria	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)
D	**(CR and EN) Population size estimated to be less than X mature individuals**		50	250	not applicable
	(VU only) Population size very small or restricted in the form of either:				
	1	population estimate to number less than **X** mature individuals, OR	not applicable	not applicable	1 000
	2	Population with a very restricted area of occupancy (typically less than 20km^2) OR number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a very short period of time in an uncertain future, and thus capable of becoming Critically Endangered or even Extinct in a very short time period	not applicable	not applicable	applies
E	**Quantitative analysis showing probability of extinction in the wild is at least X**		50% (within 10 years or 3 generations, whichever is the longer (up to a maximum of 100 years)	20% within 20 years or 5 generations, whichever is the longer (up to a maximum of 100 years)	10% within 100 years