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MUCHEA EXPLORATION DRILLING AND VDT TRIAL

NATIVE VEGETATION CLEARING PERMIT APPLICATION
SUPPORTING INFORMATION

VRX-MUC-VCP-01

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PREPARED FOR VRX SILICA LIMITED

BY PRESTON CONSULTING PTY LTD

Proponent contact details:



Preston
Consulting

VRX SILICA LIMITED

Contact: David Reid
Email: davidr@vrxsilica.com.au
Website: www.vrxsilica.com.au
Phone: 08 9226 3780
Address: Level 1, 6 Thelma Street, West Perth, Western Australia 6005

Document developed by:

PRESTON CONSULTING PTY LTD

Contact: Gavin Edwards
Email: gedwards@prestonconsulting.com.au
Website: www.prestonconsulting.com.au
Phone: 0488 737 273
Street Address: Level 3, 8/201 Adelaide Terrace, East Perth, Western Australia, 6004
Postal Address: PO Box 3093, East Perth, Western Australia, 6892

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ACKNOWLEDGEMENT OF COUNTRY

Preston Consulting acknowledges the Traditional Owners of the lands on which it works, in particular the Whadjuk people of the Noongar Nation, who are also the Traditional Custodians of the land on which the activity is proposed. Preston Consulting pays its respects to Elders past and present, to emerging community leaders and to all Aboriginal and Torres Strait Islander peoples.



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Checked	Chris Greenem – Consultant Preston Consulting	 Signature	11/07/2022
Checked	Gavin Edwards – Director Preston Consulting	 Signature	11/07/2022
Authorisation	David Reid – Exploration Manager VRX Silica Limited	 Signature	11/07/2022



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1 INTRODUCTION

1.1 PROJECT BACKGROUND

VRX Silica Limited (VRX), an Australian Stock Exchange listed company, is seeking to develop the Muchea Silica Sand Project (the Project), a high-grade silica sand mine in the Wheatbelt region of Western Australia (WA). The Project is located within the Swan Coastal Plain bioregion, 50 kilometres (km) north of Perth (Figure 1), strategically poised adjacent to Brand Highway and the Midland Railway Line, allowing connection to the Kwinana Port.

The Project includes mining and processing silica sand from below the upper portion of the soil profile. VRX has targeted the silica sand mineral resource due to the economic potential and international demand. VRX has identified markets in Korea, China and India where silica sand will be used in manufacturing of, but not limited to, glass, ceramic and lithium batteries. The Project (along with VRX's other silica sand projects, Arrowsmith North and Central) presents a viable long-term resource to the state, with an estimated mine life of at least 25 years. The available resources has the potential to increase the Project life to over 100 years pending approval and market conditions.

Disturbed areas will be progressively rehabilitated using Vegetation Direct Transfer (VDT) and infill planting where required. The VDT methodology uses a front-end loader with a modified bucket attachment to translocate intact vegetation and topsoil. Further analysis of VDT methodology and expected results are outlined in Section 3.3.

VRX proposes to undertake exploration drilling (Drilling) and trials of the VDT rehabilitation methodology (VDT Trials) collectively referred to as 'Activities'. Drilling will provide improved resource information and samples for metallurgical testwork and enable VRX to optimise Project outcomes. Drilling will occur entirely within granted mining lease (M) M70/1390 over a track length of 11,575 m (Figure 2). The VDT Trial will allow VRX to assess the performance of the modified bucket attachment and refine the sod placement technique to optimise the VDT method. VDT Trials will involve the removal, translocation and placement of a small number of sods using the VDT methodology (described further in Section 3.3). VDT Trials will occur within a 60 metre (m) x 90 m plot with a 50 m x 3 m access track (Trial Area; Figure 2) which lies entirely within M 70/1390.

The Activities will be referred to the Department of Climate Change, Energy, the Environment and Water (DCCEE) to assess the potential impacts of Matters of National Environmental Significance (MNES; listed under the *Environment Protection and Biodiversity Conservation Act 1999*). A Programme of Work application under the *Mining Act 1978* (WA) has been submitted for the Drilling and a Small Operations Mining Proposal will be submitted for the VDT Trial.

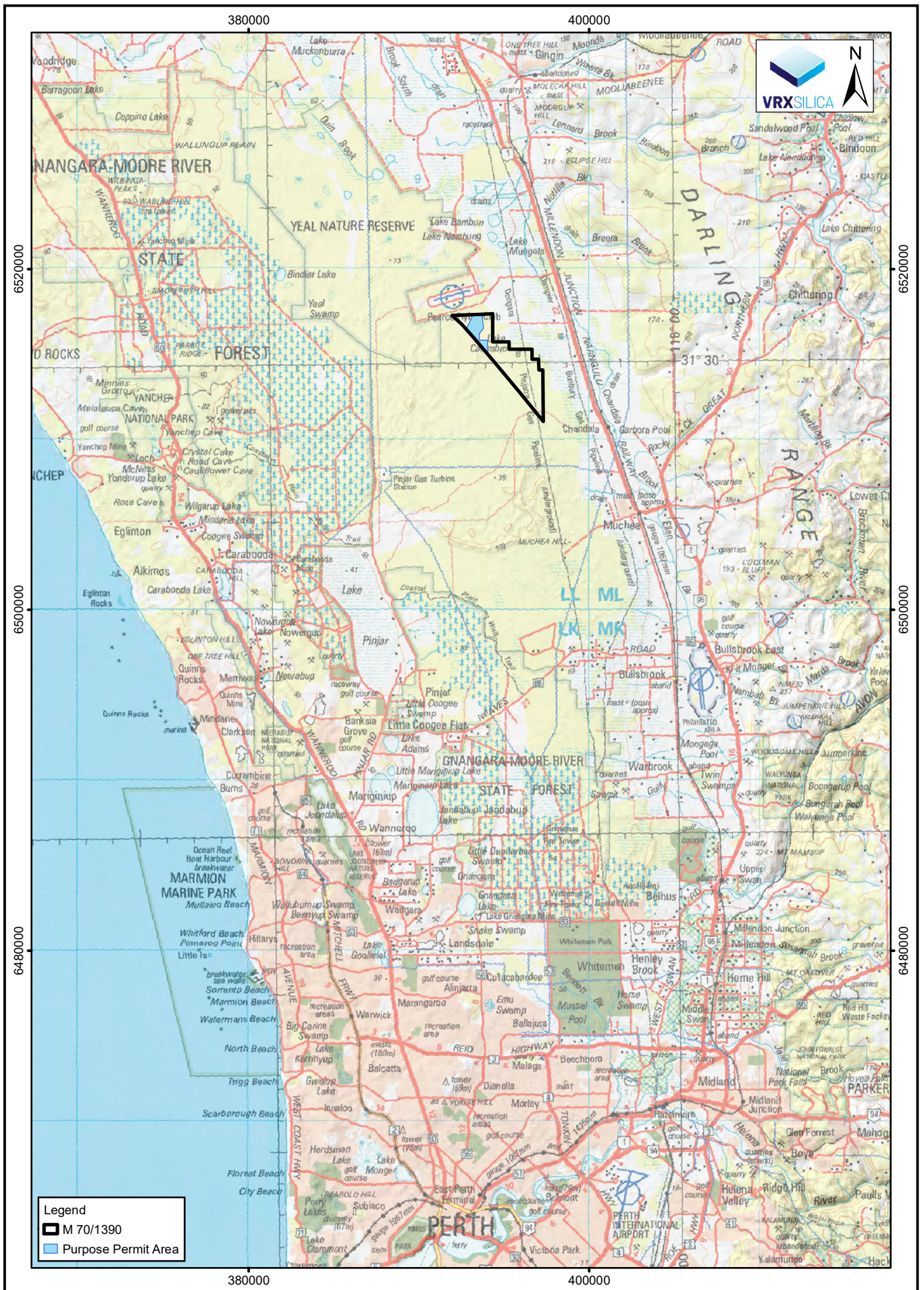
1.2 PURPOSE

The purpose of this Native Vegetation Clearing Permit (NVCP) application is to authorise the disturbance of 2.87 ha of native vegetation within tenement M 70/1390. 2.34 ha will be disturbed by track rolling for Drilling. 0.525 ha will be cleared and progressively rehabilitated for the VDT



Trial. Access to the Trial Area includes track rolling a 3 m wide 50 m long access track, a portion of which is shared with the Drilling footprint. The access track is 3 m wide (1 m wider than the loader footprint) to allow the wider front-end loader to access the Trial Area. This wider section results in an additional 0.005 ha of track-rolled vegetation. The total area of disturbance for the VDT Trial is 0.53 ha.





<p>0 5 km</p> <p>Scale: 1:300,000</p> <p>MGA94 (Zone 50)</p>	<p>Level 3, 8/201 Adelaide Terrace Perth WA 6000 Tel: 08 9221 0011 Fax: 08 9221 4783 Email: reception@prestonconsulting.com.au</p>
<p>CAD Ref: a2602_f57_01</p> <p>Date: July 2022</p>	<p>Author: C. Greenem</p> <p>Drawn: CAD Resources ~ www.cadresources.com.au</p> <p>Tel: (08) 9246 3242 ~ Fax (08) 9246 3202</p>

Regional Location of the Proposal

1

Figure:

Figure 1: Regional location of the Project (Site)

2 PURPOSE PERMIT AREA

Clearing activities are proposed to occur only within the Purpose Permit Area. VRX has commissioned several biological investigations to define the environmental characteristics within and surrounding the Purpose Permit Area (discussed further in Section 4). Investigations have enabled VRX to refine the Purpose Permit Area and target vegetation that is Banksia woodland that is open enough to allow the vehicles to traverse between the mature trees.

VRX has also specifically avoided clearing of any recorded significant flora and impacts to riparian vegetation or the Eucalyptus woodlands which may represent roosting or breeding habitat for the Carnaby's Black-Cockatoo (discussed further in Section 4.4.5). Drilling is required to further define the resource and will target areas with loose sand and high silica content. These areas have a high infiltration rate and naturally the vegetation is sparse.

2.1 BOUNDARY

All vegetation clearing required to undertake Drilling and the VDT Trial will occur within the 127.2 ha Purpose Permit Area defined in Figure 2.

2.2 TENURE AND LAND ACCESS

All vegetation disturbance addressed in this NVCP application will occur within granted tenement M 70/1390 (owned by Wisecat Pty Ltd, a wholly owned subsidiary of VRX). The indicative Drilling and VDT Trial footprints cover 2.87 ha of native vegetation. The underlying tenure for the area is Vacant Crown Land that has been subject to exploration. Access to the site is via Timaru Road, Brand Highway and existing access tracks.





Figure 2: Purpose Permit Area and indicative Drilling and VDT Trial footprints

3 ACTIVITIES

3.1 DRILLING

Drilling has been specifically planned to minimise direct impacts to native vegetation. VRX will prioritise avoidance of native vegetation where possible. Where avoidance is not possible, a low impact approach to site access has been taken. No bladed equipment will be used and any disturbance to vegetation will be incidental to getting the equipment to the drill collar site. There will be no machinery-based earthworks at the drill collar sites. Drilling includes:

- Drilling and collection of sample material using a low impact rig;
- The water table will not be intercepted as drilling is to 3 m above the year-2000 water table;
- No drill pads will be created. The cleared track is sufficient to provide a safe working environment;
- Relocation of deadwood (fallen timber and logs) by hand; and
- Drill holes will collapse on extraction of the drill rods, leaving a small depression which will be filled with excess cuttings (if required) and available topsoil spread to rehabilitate the site.

3.1.1 DRILL RIG

Drilling will be conducted using a small track-mounted drill rig and supported by a minimal ground crew (consisting of a single 4WD). The drill rig and ground crew will traverse areas of native vegetation to access each drill hole. Drill rig selection is critical to the minimisation of the impacts of the Activities. VRX proposes to use a small, manoeuvrable, low impact track-mounted drill rig similar to that shown in Figure 3.

The drill rig will be small in comparison to a conventional rig, with a front width of less than 2 m and 5 m in height. The drill rig will be short to ensure a small turning circle, enabling it to navigate through the understorey without impacting larger trees. A track mounted rig will be used rather than wheels so that the weight of the rig is distributed over a relatively large surface area, reducing point pressure, minimising impacts to ground cover and soil structure.





Figure 3: Example of a track-mounted drill rig

3.1.2 DRILL HOLE ACCESS

Clear access to the drill holes is critical to enabling VRX to implement Drilling with as little impact as possible. VRX proposes to minimise impacts by driving around and avoiding larger flora and trees and minimising impacts within the two Priority three listed Ecological Communities that are present within the Survey Area, 'Low lying *Banksia attenuata* woodlands or shrublands' and 'SCP Northern *Banksia attenuata* – *Banksia menzeisii* woodlands' Priority Ecological Communities (PECs). VRX have allowed sufficient flexibility for each proposed drill hole to re-route and avoid larger trees and shrubs (e.g. *Banksia* sp. and *Macrozamia* sp.).

VRX will also conduct line surveys prior to moving to each drill hole which will include physically walking and mapping the 'path of least resistance'. A measuring stick that represents the width of the proposed drill rig (2 m) will be held to ensure that the drill rig will be able to safely navigate through the vegetation without the need to remove trees or large shrubs. The following procedure will be used for the line surveys:

- A hand-held GPS will be used to map the path that minimises disturbance to mature trees and understorey;
- A long pole (representative of the width of the drill rig; 2 m) will be used to determine if the drill rig can pass between native vegetation;
- A pole bearer will move forward between vegetation and a photographer will take georeferenced images as evidence of site access;
- If the intended path cannot be navigated with the pole a new path will be surveyed; and
- The chosen path will be documented and relayed to the drill rig operator for access.



VRX anticipates that no mechanised removal of vegetation will be required for access. In instances where fallen branches or debris are across tracks, these will be moved by hand to the side of the track to facilitate access.

3.1.3 DRILLING METHODOLOGY

VRX is committed to conducting the Drilling without the need for mechanical removal of any native vegetation (i.e. disturbance is limited to track rolling and removal of topsoil by hand). Conventional vacuum drilling will be used. The following drilling sequence will be implemented for all drill locations:

- Upon arrival at the drilling site, operators will determine a site within 10 m of the proposed 50 mm wide drill hole collar that is clear of overhead obstacles and ground vegetation, eliminating the need to disturb vegetation;
- No drill pads will be created as the cleared track is sufficient to provide a safe working environment;
- Topsoil will be removed from immediately around the planned hole location (enough to safely drill the hole) and replaced immediately after the drill hole has been completed;
- The drill rig will be stabilised and a drilling mast will be erected in preparation for drilling;
- Water containers and hoses will be put in place;
- Final safety and equipment checks will be completed;
- Drilling will be to a maximum depth of 3 m above the year-2000 water table;
- Samples of the drilling solids will be collected into calico bags at 1 m intervals, sub-sampled for geochemical analysis and will be directly loaded onto a light vehicle and removed from the drill site and stored along already established cleared tracks before removal to the VRX warehouse for permanent storage at either the end of the day or drill program;
- Analysis samples will be removed from the site and transported to the laboratory for analysis;
- The drill rig is disassembled and continues to the next drill hole location;
- The drill hole will collapse upon removal of the drill leaving a small depression;
- Excess cuttings are used to fill the depression and topsoil is respread over the drilling location by hand to rehabilitate the site; and
- All excess material at the drill site will be removed.

3.2 ESTIMATED VEGETATION DISTURBANCE

Drilling will result in the disturbance of up to 2.34 ha of native vegetation within the indicative Drilling footprint (Figure 2).

3.2.1 METHOD OF VEGETATION DISTURBANCE

Disturbance is limited to “track rolling” using a low impact track mounted vacuum drill rig, hand clearing of small areas for drilling operations and the removal of deadwood for site access.

3.2.2 INDICATIVE TIMELINE

VRX propose to commence Drilling immediately after approvals have been granted and a drill rig is available. Drilling is expected to take up to two weeks.



3.3 VDT TRIAL

The rehabilitation technique VDT, or community translocation, is the practice of salvaging and replacing intact sods of vegetation with the underlying soil intact (Figure 5, Ross et al., 2000). Examples of utilising VDT in rehabilitation have shown rapid recovery of indigenous vegetation cover and conservation of the habitat. There are numerous advantages to utilising VDT as a rehabilitation technique, such as: recycling of plant and soil materials; faster re-vegetative process; restoration of the whole ecosystem; and erosion control (Ross et al., 2000). Rehabilitation using this method allows for the retention of root stock, seed banks and soil micro-organisms. These factors are particularly favourable when rehabilitating vegetation assemblages that have recalcitrant species, such as those found within the Matiske Consulting Pty Ltd (Matiske; 2022) Survey Area (Section 4; Rodgers et al., 2011). An example of the vegetation within the Purpose Permit Area is shown in Figure 4.



Figure 4: Vegetation within the Purpose Permit Area

VDT is noted to be the best available rehabilitation method for the Project, given the shallow root structure of the majority of the vegetation, and the progressive mining method proposed. VDT offers the following advantages over conventional topsoil stripping, stockpiling and replacement for mine rehabilitation:

- Rootstock is mostly preserved allowing re-sprouting species survival (many recalcitrant);
- Seed bank preserved;
- Soil microbiology preserved;
- Soil compaction absent;
- Soil structure preserved; and
- Surface stability achieved.

VDT provides a rehabilitation surface that is far less susceptible to erosion by wind or water, having a stable cover layer transferred from the harvested area. This significantly reduces the risk of rehabilitation failure due to sandblasting or poor establishment conditions. The



transferred plants together with residual organic matter do not degrade in stockpile and provide an excellent retention of nutrients, soil mycorrhiza and micro flora and fauna (Mattiske, 2019).

Historically, excavators with conventional bucket attachments have been used for VDT. This machinery has the potential to fragment the sod, exposing roots to the air and therefore requires a high degree of operator skill to ensure the structural integrity of sods are maintained. VRX is instead intending to utilise a purpose-built wide-mouth front end loader attachment (measuring 3 m x 3 m x 0.4 m), as depicted in Figure 5. This is expected to reduce the scope of operator error and provide better control to increase the likelihood of successful VDT rehabilitation. The proposed VDT Trials will allow VRX to assess the performance of the modified bucket attachment and refine the sod placement technique to optimise the VDT method for the vegetation within the Purpose Permit Area.



Figure 5: VDT Excavation (sod removal method)

3.3.1 VDT TRIAL METHODOLOGY

The VDT Trial includes systematically applying the VDT methodology over a plot of vegetation, evaluating the accuracy of sod removal and placement as the trials progress. Prior to implementing the VDT method discussed in Section 3.3, VRX will mulch the vegetation to a height of approximately 40 cm. A front-end loader with a modified bucket attachment will be used to undertake VDT. Sods measuring 3 m x 3 m x 0.4 m will be systematically removed and relocated for placement in previously mined cleared areas. An initial area of vegetation must be cleared and prepared for the placement of the first sod. VRX will stockpile the vegetation and topsoil from the initial area within the VDT Trial area for use in rehabilitating the final cleared area.

3.3.2 ESTIMATED VEGETATION DISTURBANCE

The VDT Trial will result in the disturbance of up to 0.53 ha of native vegetation within the VDT Trial indicative footprint (Figure 2). 0.525 ha of disturbance will be cleared and progressively



rehabilitated using VDT, 0.005 ha will be track rolled to widen a 50 m portion of the Drilling footprint to allow access the VDT Trial Area.

3.3.3 METHOD OF VEGETATION DISTURBANCE

Disturbance will be limited to VDT and mulching for access. VDT is performed by a trained operator in a front-end loader equipped with a modified bucket attachment. Sods will be removed from the top of the soil profile and directly transferred to a cleared area for placement.

3.3.4 INDICATIVE TIMELINE

VDT Trials are proposed to commence once appropriate approvals are received and are anticipated to last two weeks.

4 ENVIRONMENTAL CHARACTERISTICS

The following sections detail the environmental characteristics of the Survey Area that are relevant to this NVCP. Several ecological assessments have been conducted within the Survey Area (Figure 6) to meet the Environmental Protection Authority (EPA) guidance for Environmental Impact Assessments. Mattiske Consulting Pty Ltd (Mattiske) (2022; Appendix 1) was commissioned to undertake a flora and vegetation survey of the Project. This survey was combined with desktop and flora and vegetation reports commissioned by Australian Silica Pty Ltd (Now VRX) (Mattiske, 2018). Bamford Consulting Ecologists (BCE) (2019) were commissioned to undertake a Level 2 fauna assessment for the Project (the report for this assessment is currently in draft, preparation of a final version is underway and can be made available on request). BCE's assessment involves a site inspection, desktop review and field investigations.

This NVCP describes the environmental characteristics of the Survey Area, and impact assessment is based on the Drilling and VDT Trial indicative footprints.



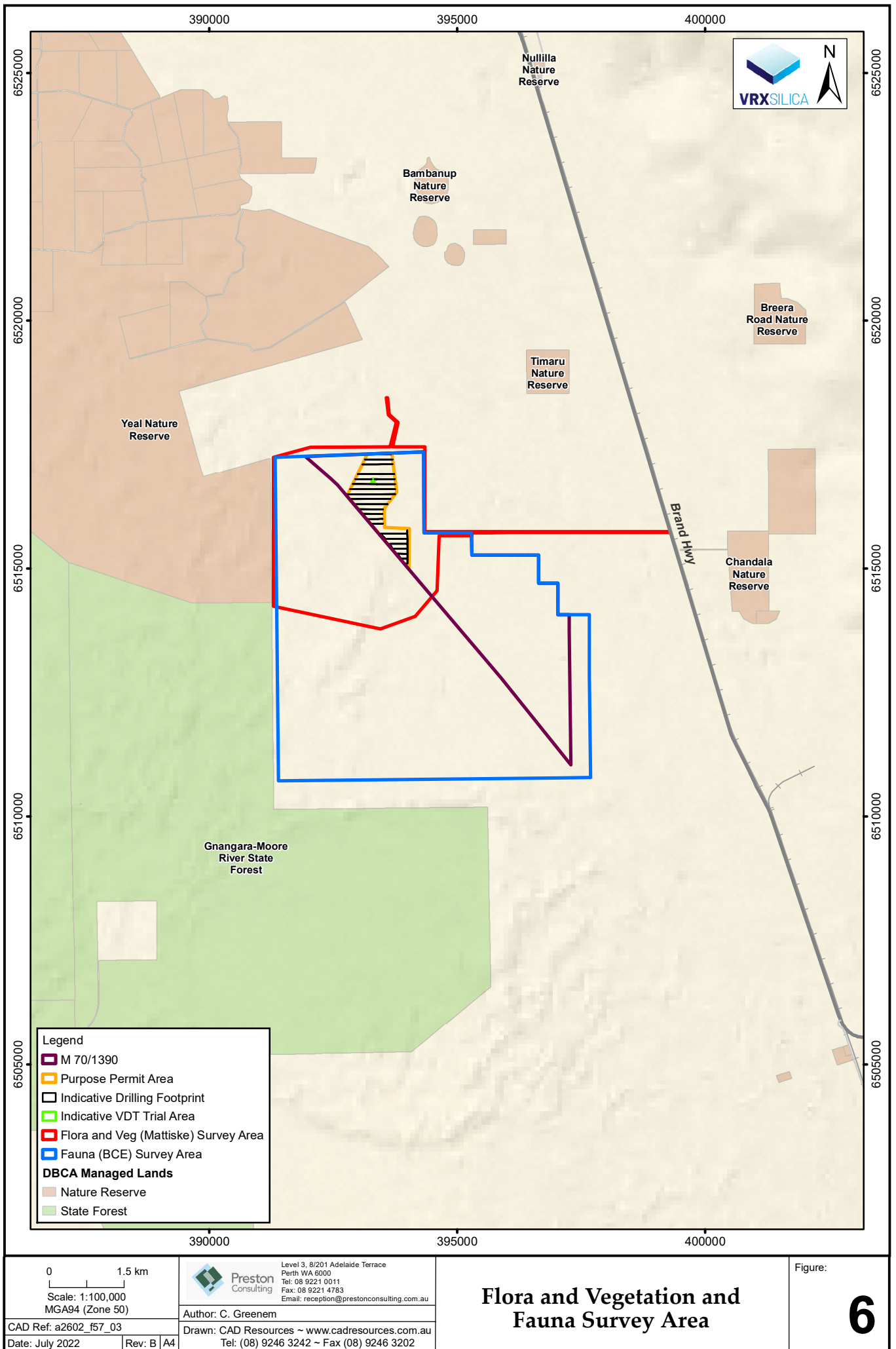
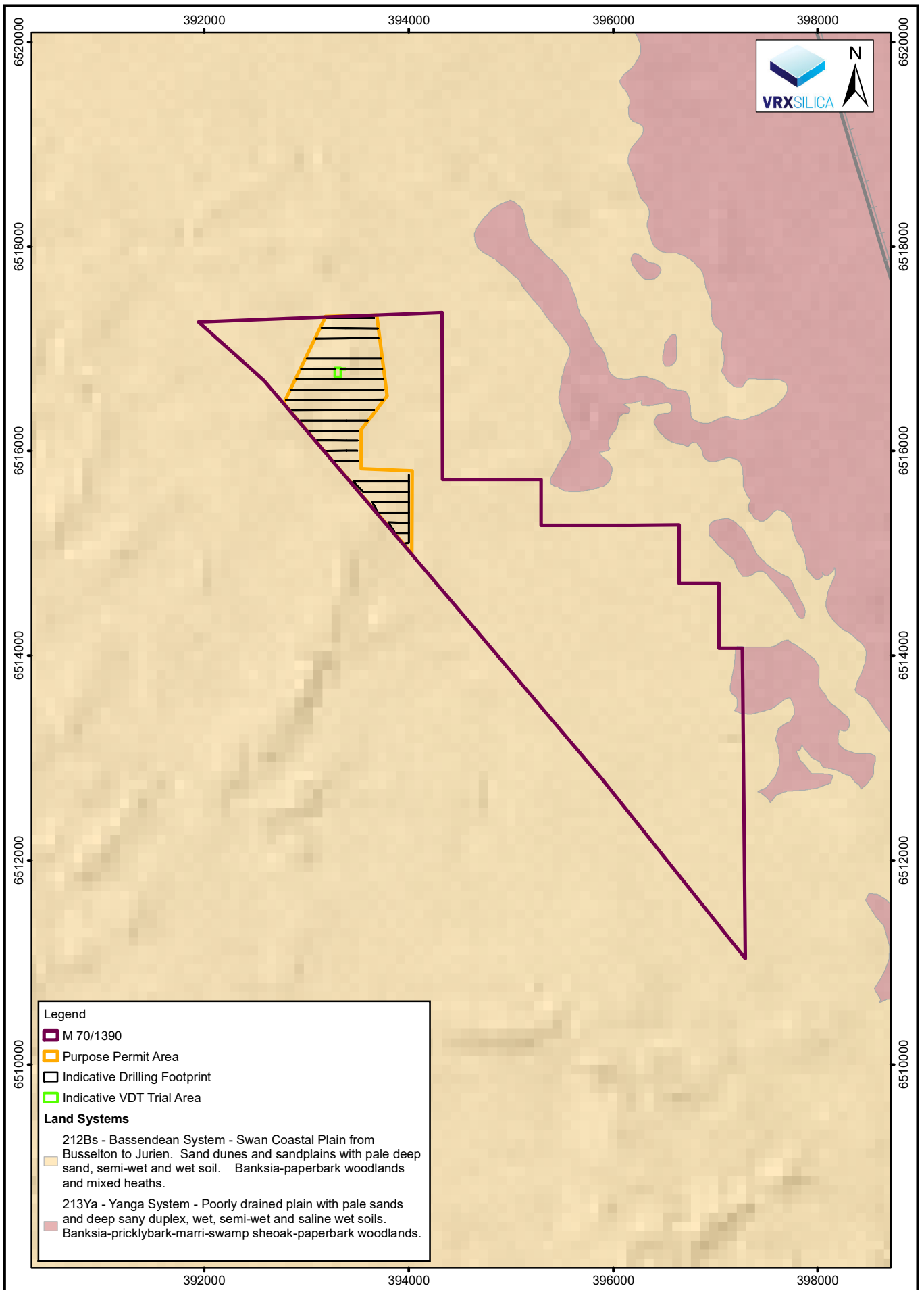


Figure 6: Ecological Survey Areas



Legend

- M 70/1390
- Purpose Permit Area
- Indicative Drilling Footprint
- Indicative VDT Trial Area

Land Systems

212Bs - Bassendean System - Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.

213Ya - Yanga System - Poorly drained plain with pale sands and deep sany duplex, wet, semi-wet and saline wet soils. Banksia-pricklybark-marri-swamp sheoak-paperbark woodlands.

Figure 7: Land Systems

4.1 BIOGEOGRAPHIC REGIONS

The Interim Biogeographic Regionalisation of Australia (IBRA) has identified 26 bioregions in WA which are further divided into subregions (Environment Australia, 2000). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell, 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA, 2004). The Survey Area lies in the Swan Coastal Plain Perth Subregion (SWA2).

The subregion is characterised by 'low lying coastal plain covered with woodland dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The subregion is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone' (Mitchell *et al.* 2002). The dominant land uses in this subregion are mainly cultivation, conservation, Unallocated Crown Land (UCL) and Crown reserves, urban, rural residential, plantations, forestry-plantations, roads and other easements and infrastructure, and grazing (BCE, 2019).

4.2 LAND SYSTEMS AND SOILS

The Department of Primary Industries and Regional Development (DPIRD) identifies the land system within the Purpose Permit Area as the Bassendean System (212Bs; Figure 7). The Bassendean System has a state-wide extent of approximately 372,403.08 ha and is comprised of sand dunes and sandplains with pale deep sand, semi-wet and wet soils. *Banksia*-Paperbark (*Melaleuca* spp.) woodlands and mixed heath. The system sprawls the Swan Coastal Plain from Busselton to Jurien. The Bassendean System is the oldest of the aeolian deposits and consists of low hills of siliceous sand interspersed with poorly drained areas.

The underlying geology of the area is Mesozoic to recent sediments of the Perth Basin, in particular the Bassendean dunes (Beard, 1990). The Bassendean dunes area is a coastal plain that is often low-lying and swampy, with sandhills, soils are mainly recent sands or swamp deposits (Beard, 1990). The Bassendean dunes can also be dissected country rising to the to the duricrusted Dandaragan plateau on Mesozoics, with mainly yellow sandy soils (Beard, 1990). The Bassendean dunes occur in a belt 15 km wide and consist of low, vegetated hills of quart sand with numerous interdunal swamps and lakes (Beard, 1990). There is no organised drainage except where the various rivers cross the plain (Beard, 1990). The Project occurs on the elevated sand dune systems on the eastern edges of the Gnangara Mound to the northwest of Muchea (Figure 7).



4.3 FLORA AND VEGETATION

4.3.1 SURVEY EFFORT

Mattiske (2022; Appendix 1) was commissioned by VRX to undertake a detailed flora and vegetation assessment of the Survey Area (Figure 6).

The information contained within the following sections is from Mattiske (2022) unless otherwise referenced.

4.3.2 FLORA

A total of 225 vascular plant taxa, representative of 103 genera and 42 families, were recorded within the Survey Area. The majority of taxa recorded were representative of the Myrtaceae (33 taxa), Fabaceae (24 taxa), Stylidiaceae (17 taxa) and Ericaceae (14 taxa) families. Eight taxa were identified as introduced species.

Where plant species could not be identified to a species level, they were assigned to the closest accurate taxonomic rank. Of the 225 taxa recorded in this survey, eight were identified to family level and 35 to genus level only, while 20 taxa were identified to variety or subspecies level.

Annual species represented 9.8 % (22 taxa) of all recorded plants within the Survey Area. Of the annual species, 27.3 % were introduced species (6 taxa). A species accumulation curve was used to evaluate the sampling adequacy, incidence-based coverage estimator of species richness was 331. Based on this value and the total of 227 species recorded, approximately 74 % of the flora species potentially present within the Survey Area were recorded in 2018 and 2021.

4.3.3 LISTED FLORA

Potential Threatened and Priority Flora

Thirteen Threatened flora species, pursuant to Part 2, Division 1, and Subdivision 2 of the *Biodiversity Conservation Act 2016* (WA; BC Act) have the possibility of occurring in the Survey Area (Mattiske, 2022). All of these species are also pursuant to Section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) (Figure 14). Nine of these species are listed as Endangered, two are listed as Vulnerable and two are listed as Critically Endangered (Table 1).

Thirteen Priority flora species, including one Priority one, one Priority two, eight Priority three and three Priority four species as listed by DBCA have the potential to occur in the Survey Area.

An assessment was conducted by Mattiske (2022) to determine the likelihood of recording any of the listed Threatened and Priority taxa within the Survey Area, based on factors including known soil type, topography and distribution was conducted. The likelihood assessment is summarised in Table 1.

Of the Threatened and Priority flora that have the potential to occur, many are likely to occur on the low-lying landforms to the east (outside) of the Survey Area which are subjected to seasonal water-logging. These areas have largely been cleared for agricultural activities. Three species;



Leucopogon squarrosus subsp. *Trigynus* (P2), *Cyathochaeta teretifolia* (P3) and *Hibbertia helianthemoides* (P4) have been recorded on the dune systems to the south of the Survey Area and have the potential to also occur within the Project (DBCA, 2018a) (Figure 14).

The desktop assessment indicated that 25 of the 26 potential listed species were likely to be flowering between August and October and 22 of the 26 flowering in November. The 2018 field survey was undertaken in August to October and the 2021 survey was undertaken in November.

Table 1: Threatened and Priority Flora potentially occurring within the Survey Area

Species	Conservation Status	Likelihood of Occurrence
Threatened Species		
<i>Andersonia gracilis</i>	Endangered	Low
<i>Anigozanthos viridis</i> subsp. <i>Terraspectans</i>	Vulnerable	Low
<i>Caladenia huegelii</i>	Endangered	Low
<i>Chamelaucium lullfitzii</i>	Endangered	Moderate
<i>Darwinia foetida</i>	Critically Endangered	Moderate
<i>Diuris purdiei</i>	Endangered	Low
<i>Drakaea elastica</i>	Endangered	Low
<i>Eleocharis keigheryi</i>	Vulnerable	Moderate
<i>Grevillea curviloba</i>	Endangered	Moderate
<i>Grevillea thelemanniana</i>	Critically Endangered	Low
<i>Lepidosperma rostratum</i>	Endangered	Low
<i>Macarthuria keigheryi</i>	Endangered	Moderate
<i>Thelymitra stellata</i>	Endangered	Low
Priority Species		
<i>Grevillea evanescens</i>	Priority 1	Low
<i>Isotropis cuneifolia</i> subsp. <i>Glabra</i>	Priority 2	Low
<i>Leucopogon squarrosus</i> subsp. <i>Trigynus</i>	Priority 2	Moderate
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)	Priority 3	Low
<i>Pithocarpa corymbulosa</i>	Priority 3	Low
<i>Acacia drummondii</i> subsp. <i>Affinis</i>	Priority 3	Low
<i>Cyathochaeta teretifolia</i>	Priority 3	Low
<i>Meionectes tenuifolia</i>	Priority 3	Low
<i>Myriophyllum echinatum</i>	Priority 3	Low
<i>Verticordia serrata</i> var. <i>linearis</i>	Priority 3	Low
<i>Rumex drummondii</i>	Priority 4	Low
<i>Jacksonia sericea</i>	Priority 4	Low
<i>Stylidium longitubum</i>	Priority 4	Low

Recorded Listed Flora

No Threatened flora species under the BC Act, or EPBC Act were recorded within the Survey Area. No Priority flora species, as listed by DBCA (2018c) were recorded within the Survey Area.



4.3.4 INTRODUCED FLORA (WEED) SPECIES

Eight introduced (weed) taxa were recorded within the Survey Area, four of which were identified to species level:

- *Aira caryophyllea*;
- *Gladiolus caryophyllaceus*;
- *Hypochaeris glabra*; and
- *Ursinia anthemoides* subsp. *Anthemoides*.

The remaining four were identified to genus or family level:

- Asteraceae sp.;
- *Gladiolus* sp.;
- *Medicago* sp.; and
- *Pentameris* sp.

None of the species listed are declared pest organisms, pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (WA). All species recorded are ranked for their ecological impact and invasiveness, and are listed on DBCA's list of environmental weeds for the Swan region (DPaW, 2016). Two were listed as having a high ecological impact (*Gladiolus caryophyllaceus* and *Hypochaeris glabra*). Three were listed as having an unknown ecological impact (*Aira cupaniana*, *Medicago* sp. and *Ursinia anthemoides* subsp. *Anthemoides*). The remaining three species are not listed to have an ecological impact by the Department of Parks and Wildlife (DPaW; 2016) (*Asteraceae* sp., *Gladiolus* sp., and *Pentameris* sp.).

4.3.5 VEGETATION

The Survey Area is located within the Drummond Botanical Subdistrict (Swan Coastal Plain Subregion) of the Southwest Botanical Province, which is described as *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) on less leached soils (Beard, 1990).

The Pre-European vegetation comprises 'Low woodland dominated by *Banksia*' (949.2) 'Mosaic of Low woodland dominated by *Banksia* with Shrublands dominated by tea-tree thicket' (1014.1) and Jarrah, Marri and Wandoo Woodland (1018.1; Beard et al., 2013). The Drilling Area is comprised of the 949.2 and 1014.1 Vegetation Associations, whilst the VDT Trial Area is comprised wholly of 1014.1 (Figure 9). The Bassendean North vegetation complex covers the Survey Area, which is described as vegetation ranging from Low open forest and Low open woodland of *Banksia* species and *Eucalyptus todtiana* to Low woodland of *Melaleuca* species and Sedgeland on the moister sites (Hedde et al., 1980).

More recently, the vegetation of WA has been assigned to bioregions and subregions under the IBRA, with the Survey Area residing within the Perth subregion (SWA02) of the Swan Coastal Plain region (DAWE, 2022). The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone (Mitchell et al., 2002). Vegetation can be characterised by heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvials (Mitchell et al., 2002).



Regional Native Vegetation Extent

Native vegetation within 5, 10 and 20 km of the Survey Area was mapped using DPIRD’s Native Vegetation Dataset and is shown in Figure 8. The extent of native vegetation surrounding the Survey Area is summarised in Table 2.

Table 2: Native vegetation surrounding the Purpose Permit Area

Radius (km)	Area (ha)	% of native vegetation remaining
Purpose Permit Area	127.2	100
5	21,308.1	36.9
10	41,166.5	76.3
20	64,687.7	51.5

Vegetation Associations

The Survey Area occurs within the vegetation associations summarised in Table 3 and shown in Figure 9. The Purpose Permit Area is comprised of vegetation association 949.2 and 1014.1.

Table 3: Vegetation associations extent of the Purpose Permit Area

Pre-European System	Vegetation Association	Description	State-wide Pre-European Extent (ha)	Extent remaining (ha)	Extent remaining (%)	Purpose Permit Area (ha)	Drilling Footprint (ha)	VDT Trial Footprint (ha)
Bassendean	949.2	Low woodland or open low woodland	115,066.1	71,060.9	61.8	61.8	1.20	-
	1014.1	Low woodland / Scrub	41,045.0	22,817.8	55.6	65.4	1.14	0.53



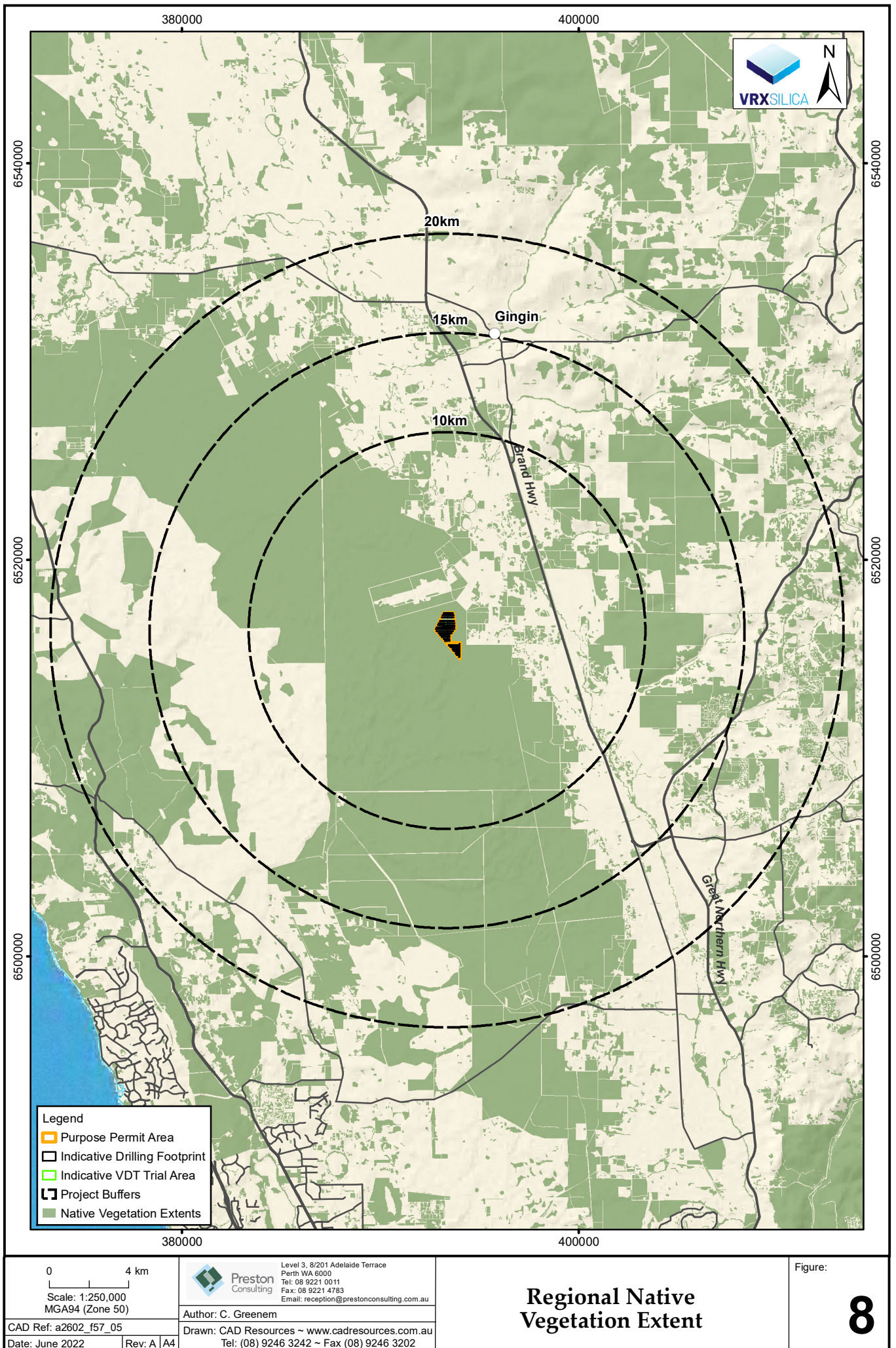


Figure 8: Regional Native Vegetation Extent

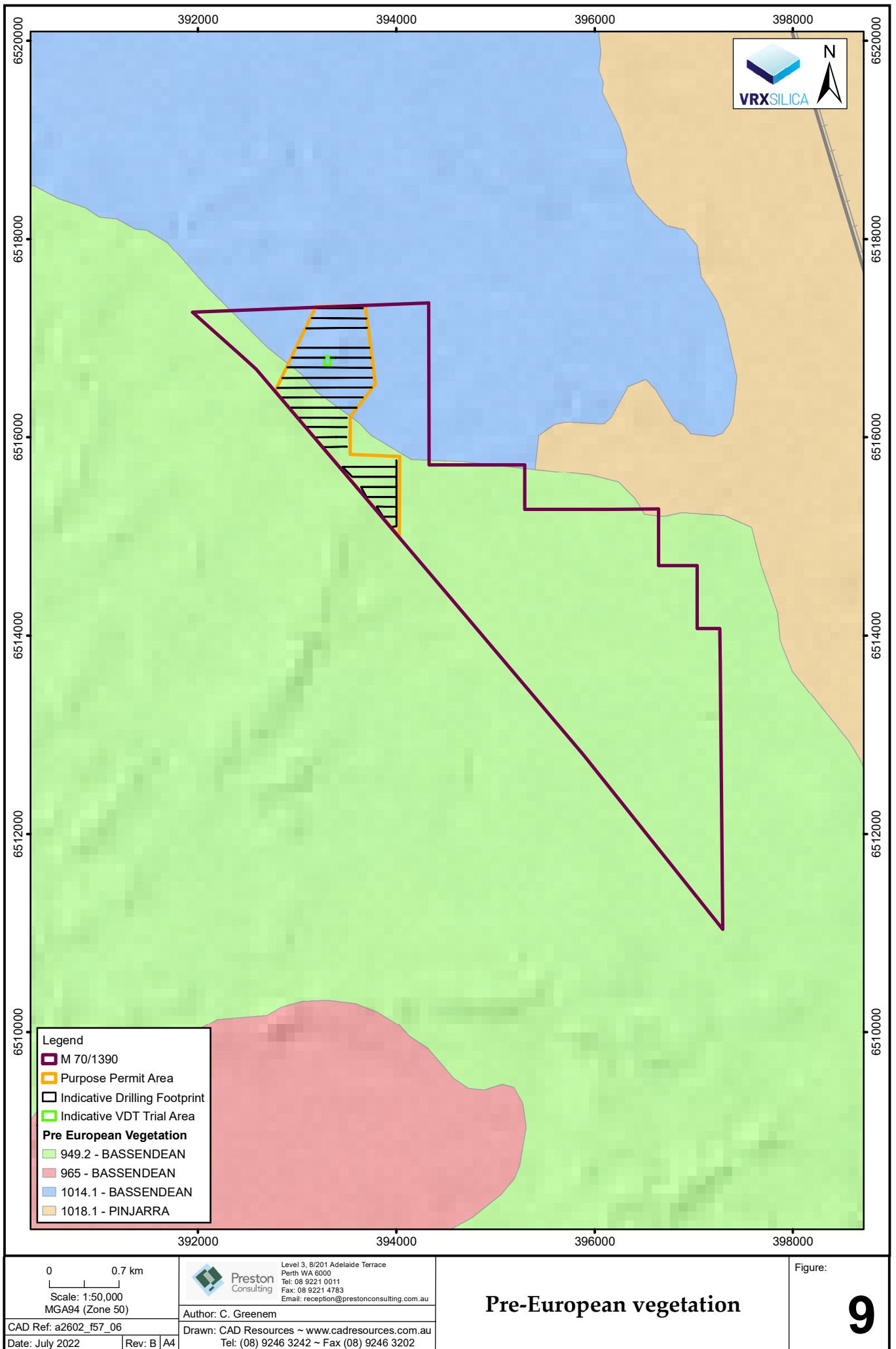


Figure 9: Pre-European vegetation of the Purpose Permit Area

Vegetation Condition

The overall vegetation condition of the Survey Area is ranked Pristine to Excellent (Keighery, 1994), with 42 of the 68 quadrats rated as Pristine, 17 as Excellent and 3 as Very Good (Table 4). Timaru Road Reserve is ranked as Completely Degraded, the vegetation has predominately been cleared with small stands of *Melaleuca preissiana* or *Acacia blakelyi* over introduced species. The condition of the vegetation within the Survey Area is mapped in Figure 10.

Minor weeds and disturbances from feral pigs were noted during the survey. There are several vehicle tracks through the area, some of which are also used by equestrians, and these comprise the only cleared areas within the mapped Survey Area.

Table 4: Vegetation Condition within the Survey Area

Keighery Condition Ranking	Extent within Survey Area (ha)	Proportion of Survey Area (%)	Extent within Purpose Permit Area (ha)	Proportion of Purpose Permit Area (%)
Pristine	913.73	83.14	91.90	72.25
Excellent	170.00	15.47	35.29	27.75
Very Good	2.17	0.20	-	-
Good	-	-	-	-
Degraded	-	-	-	-
Completely Degraded	13.15	1.20	-	-
Total	1,099.04	100	127.19	100

The Survey Area has been subject to frequent fires. Most of the Survey Area was subject to a bushfire in 2003 and smaller areas to the north, northeast and southeast by fires in 2011. Vegetation quadrats in this survey to the north and east of the Survey Area were burnt in 2011, those to the south in 2003 or 2015, and to the west in 2011 or 2013 (DBCA, 2020).



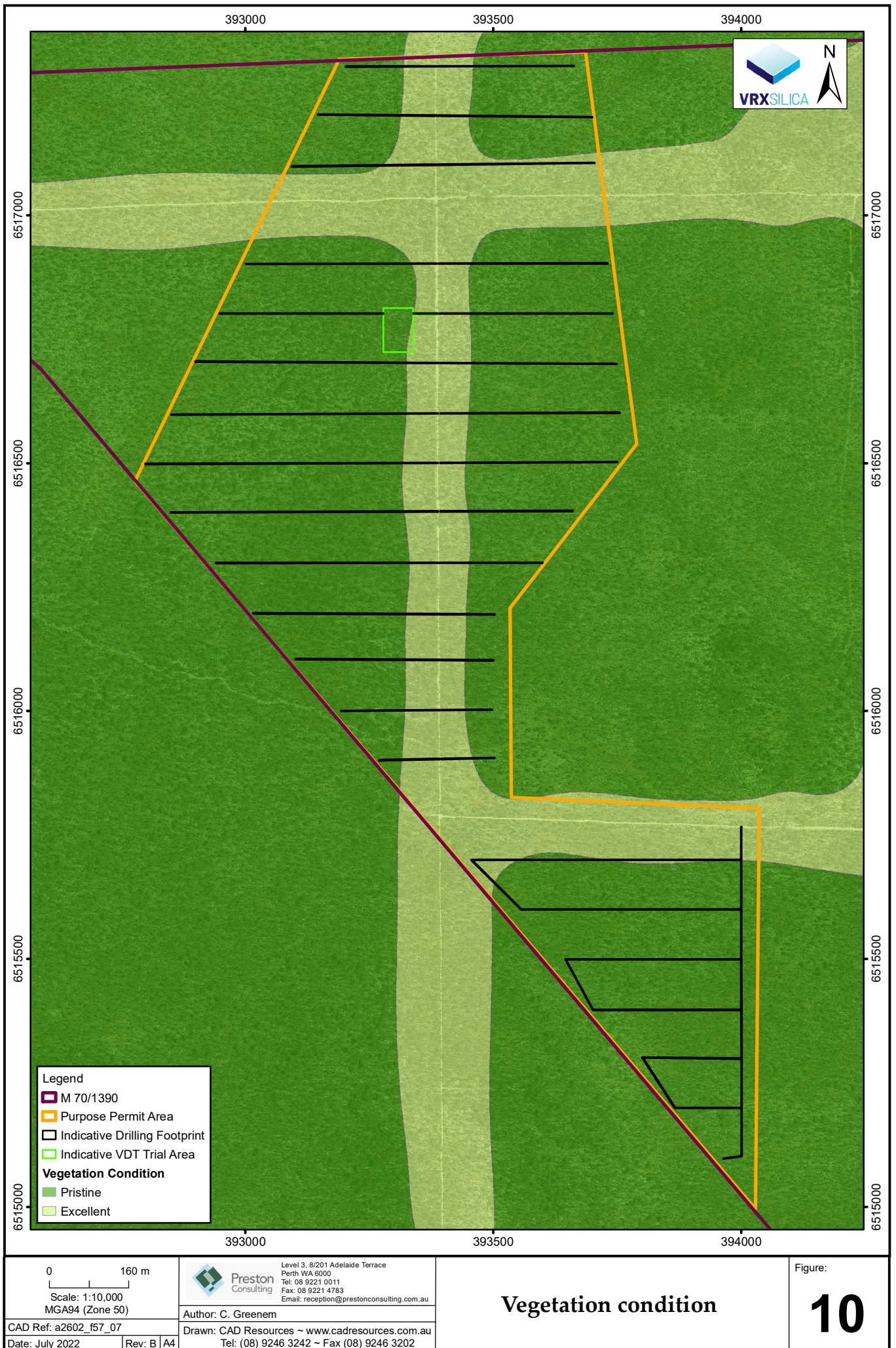
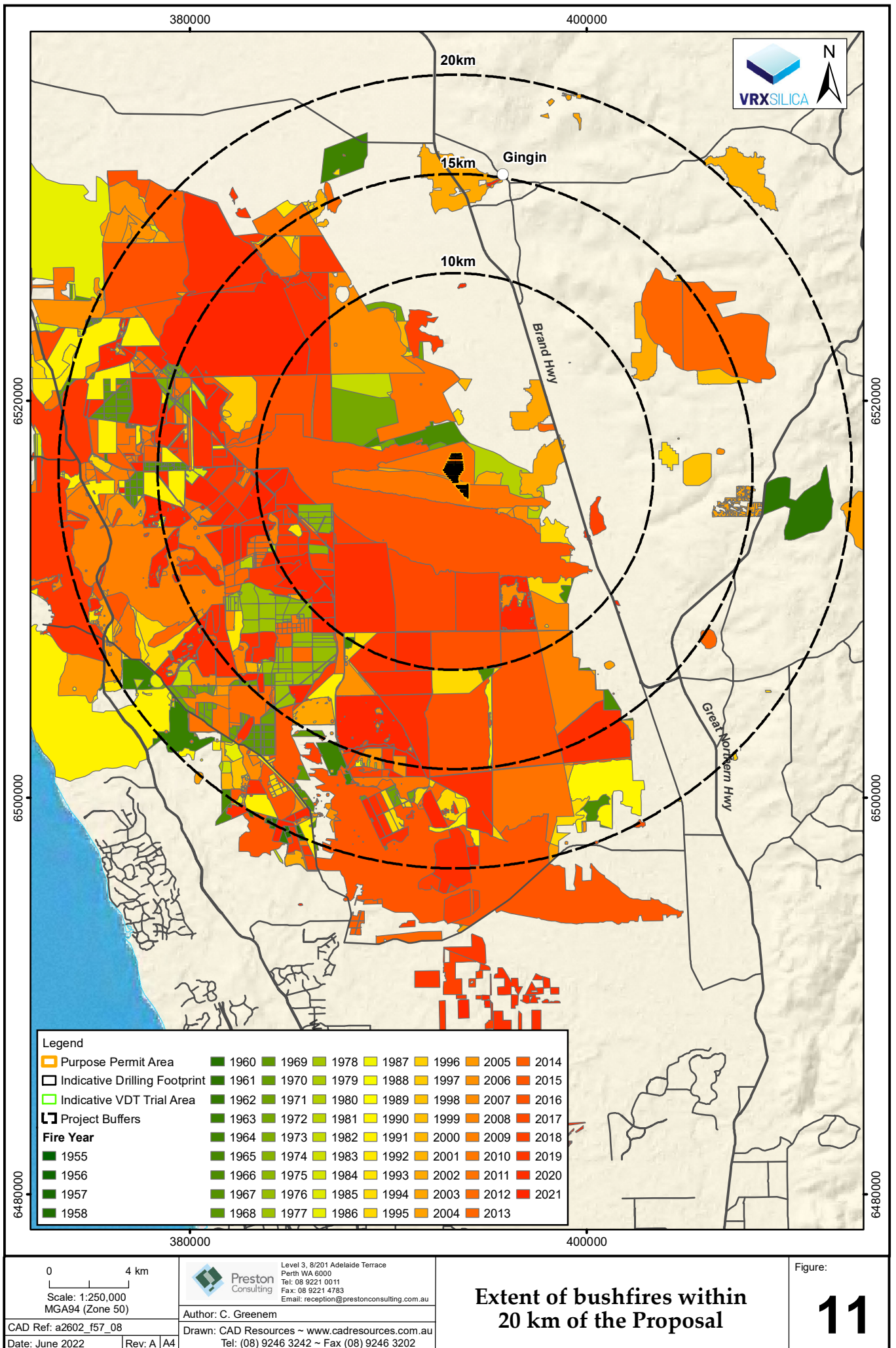


Figure 10: Vegetation condition of the Purpose Permit Area



0 4 km
Scale: 1:250,000
MGA94 (Zone 50)



Level 3, 8/201 Adelaide Terrace
Perth WA 6000
Tel: 08 9221 0011
Fax: 08 9221 4783
Email: reception@prestonconsulting.com.au

Author: C. Greenem

Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Extent of bushfires within 20 km of the Proposal

Figure:

11

Figure 11: Extent of bushfires within 20 km of the Purpose Permit Area

Vegetation Communities

Eight vegetation communities were defined and mapped across the Survey Area in 2018 (Mattiske, 2018) and updated in 2021. Six vegetation communities (A, B, F, H, J and K) were recorded within the Purpose Permit Area. Vegetation communities of the Survey Area are presented in Figure 12, those that occur within the Purpose Permit Area are summarised in Table 5.

Table 5: Vegetation communities of the Survey Area and Purpose Permit Area

Name	Vegetation Community Description	Extent			
		Survey Area (ha)	Proportion of Survey Area (%)	Drilling footprint (ha)	VDT Trial footprint (ha)
A	Low woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> with occasional <i>Eucalyptus todtiana</i> over <i>Beaufortia elegans</i> , <i>Bossiaea eriocarpa</i> , <i>Eremaea pauciflora</i> , <i>Jacksonia floribunda</i> , <i>Petrophile linearis</i> and <i>Scholtzia emmulete</i> , over <i>Drosera erythrorhiza</i> , <i>Lyginia barbata</i> and <i>Patersonia occidentalis</i> on white-grey sand. Occurs predominantly on mid slopes, but also flats and upper slopes.	59.69	5.43	0.097(0.16 % of mapped extent)	-
B	Low open woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over <i>Jacksonia floribunda</i> , <i>Scholtzia emmulete</i> , <i>Styphelia conostephioides</i> , <i>Verticordia nitens</i> and <i>Xanthorrhoea preissii</i> over <i>Dasyogon bromeliifolius</i> and <i>Patersonia occidentalis</i> on white-grey sand. Occurs mostly on lower slopes and valley floors in moister sites (but not as wet as those for M).	26.88	2.45	0.073(0.27 % of mapped extent)	-
F	Low woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over <i>Allocasuarina humilis</i> , <i>Conostephium pendulum</i> , <i>Jacksonia floribunda</i> , <i>Melaleuca trichophylla</i> , <i>Petrophile linearis</i> , <i>Scholtzia involucrate</i> and <i>Stirlingia latifolia</i> , over <i>Burchardia congesta</i> , <i>Drosera drummondii</i> and <i>Lyginia barbata</i> on white-grey sand. Occurs on upper slopes and some ridges.	27.97	2.54	0.107 (0.38 % of mapped extent)	-
H	Low woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over <i>Hibbertia subvaginata</i> , <i>Jacksonia floribunda</i> , <i>Melaleuca trichophylla</i> , <i>Petrophile linearis</i> , <i>Scholtzia emmulete</i> and <i>Styphelia conostephioides</i> over <i>Lyginia barbata</i> and <i>Patersonia occidentalis</i> on white-grey-brown sand and sandy loam. Occurs predominantly on flats, but also across a range of lower slopes to ridges.	754.66	68.67	1.430 (0.19 % of mapped extent)	-
J	Low woodland of <i>Eucalyptus todtiana</i> , <i>Banksia menziesii</i> and <i>Banksia attenuata</i> over <i>Beaufortia elegans</i> , <i>Bossiaea eriocarpa</i> <i>Eremaea pauciflora</i> var. <i>calyptra</i> , <i>Hibbertia subvaginata</i> <i>Jacksonia floribunda</i> , <i>Philothea spicata</i> and <i>Scholtzia involucrate</i> over <i>Lyginia barbata</i> and <i>Patersonia occidentalis</i> on white-grey sand and sandy loam, occurs mostly on upper slopes.	71.08	6.47	0.208 (0.29 % of mapped extent)	-
K	Low woodland of <i>Eucalyptus todtiana</i> , <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over <i>Beaufortia elegans</i> , <i>Eremaea pauciflora</i> , <i>Hibbertia subvaginata</i> , <i>Jacksonia floribunda</i> , <i>Philothea spicata</i> and	80.32	6.47	0.426 (0.53 % of mapped extent)	0.53 (0.66 % of



Name	Vegetation Community Description	Extent			
		Survey Area (ha)	Proportion of Survey Area (%)	Drilling footprint (ha)	VDT Trial footprint (ha)
	<i>Scholtzia emmulete</i> , over <i>Patersonia occidentalis</i> and <i>Phlebocarya</i> spp. On white-grey sands over yellow/brown sand on mid to upper slopes.				mapped extent)

Floristic Community Types

Floristic Community Types (FCT's) were defined by Gibson *et al.* (1994) for the Swan Coastal Plain within the Bassendean dune system. FCT's are mapped by determining the extent of vegetation extending from each quadrat until the species composition is observed to change to that represented by another quadrat. Observations by Mattiske (2022) were compared with observations by Gibson *et al.* (1994) to determine the FCT's of the Project. FCT's relevant to the Purpose Permit Area are discussed below.

The characteristics of vegetation community M aligns with FCT 21c and vegetation communities A, B, F, G, H, J and K align with FCT 23b, as outlined in Table 6 of Mattiske, 2022 (Appendix 1).

FCT 21c is described as 'Low lying *Banksia attenuate* woodlands or shrublands' and FCT 23b as 'Northern *Banksia attenuate* - *Banksia menziesii* woodlands'. FCT 21c is listed as Priority 3 by DBCA on the State level and as an Endangered Threatened Ecological Community (TEC) by DCCEEW on a Commonwealth level under the EPBC Act as the FCT comprises a component of the Endangered 'Banksia Woodlands of the Swan Coastal Plain' EPBC Act listed TEC (Banksia Woodlands TEC). The majority of the vegetation (all communities except 'M'; Table 5) in the Survey Area was considered representative of the FCT 23b.



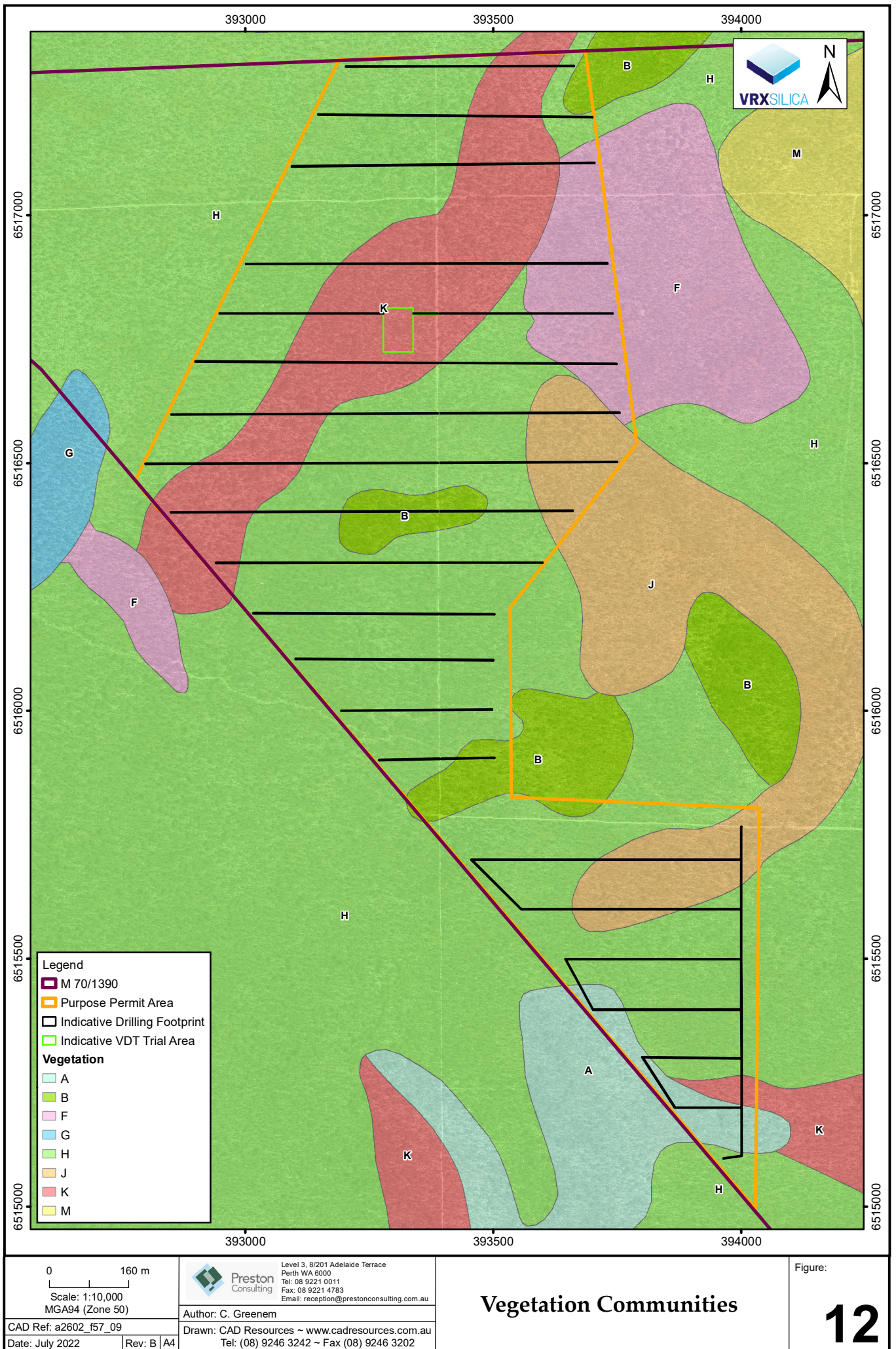


Figure 12: Vegetation communities of the Purpose Permit Area

Site-Vegetation Types

The main determinants of the location of different plant species and their associations on the northern Swan Coastal Plain are the underlying site conditions including the soil substrate and the availability of water due to topography as well as local climatic conditions (Mattiske, 2022).

Mattiske (2022) has grouped vegetation communities with underlying site conditions to form broader scale site-vegetation types (SVTs). The SVTs identified within the Survey Area were interpreted to correspond to eight vegetation communities interpreted from this survey's data. Two SVTs were identified within the Purpose Permit Area as described in Table 6.

Table 6: Site-Vegetation Types within the Survey Area

SVT	Description	Extent		
		Purpose Permit Area (ha)	Drilling Footprint (ha)	VDT Trial Footprint (ha)
H1	Vegetation communities B, F and G all align with type H1. These communities comprise a range of topographical positions, from lower slopes and valley floors for community B, through mid-slopes for community G to upper slopes for F. All three communities have a canopy of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over a tall shrub layer that includes <i>Jacksonia floribunda</i> amongst other species. The differences between these communities are defined by understorey species reflective of their topographic position, e.g., the tall shrub layer of community B also includes <i>Xanthorrhoea preissii</i> and the herbaceous layer <i>Dasypogon bromeliifolius</i> , whilst for community F the tall shrubs include <i>Allocasuarina humilis</i> and for community G the herbaceous layer includes <i>Phlebocarya emmule</i> .	65.62	1.16	0.53
I1	The vegetation community, H, corresponds with SVT I1. Quadrats making up community H are on flats and slopes of the Bassendean dune system. Vegetation in this community is "typical" for the Survey Area i.e., it lacks any distinguishing species that differentiate it from any of the other five communities with canopy dominated by <i>Banksia</i> spp. (communities A, B, F, G, J and K); although it tends to occur on the lower slopes and flats.	61.58	1.18	-



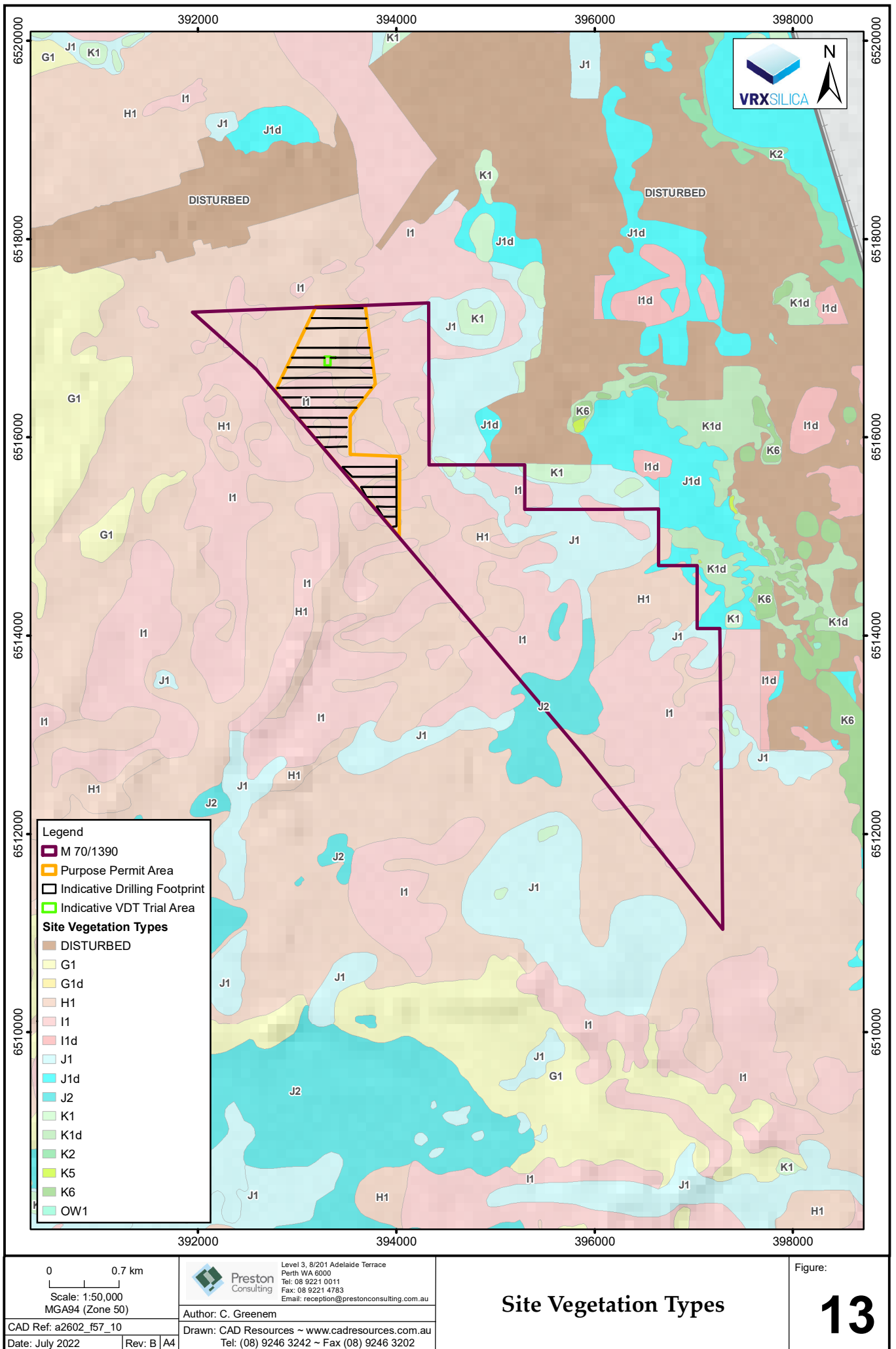


Figure 13: Site Vegetation Types

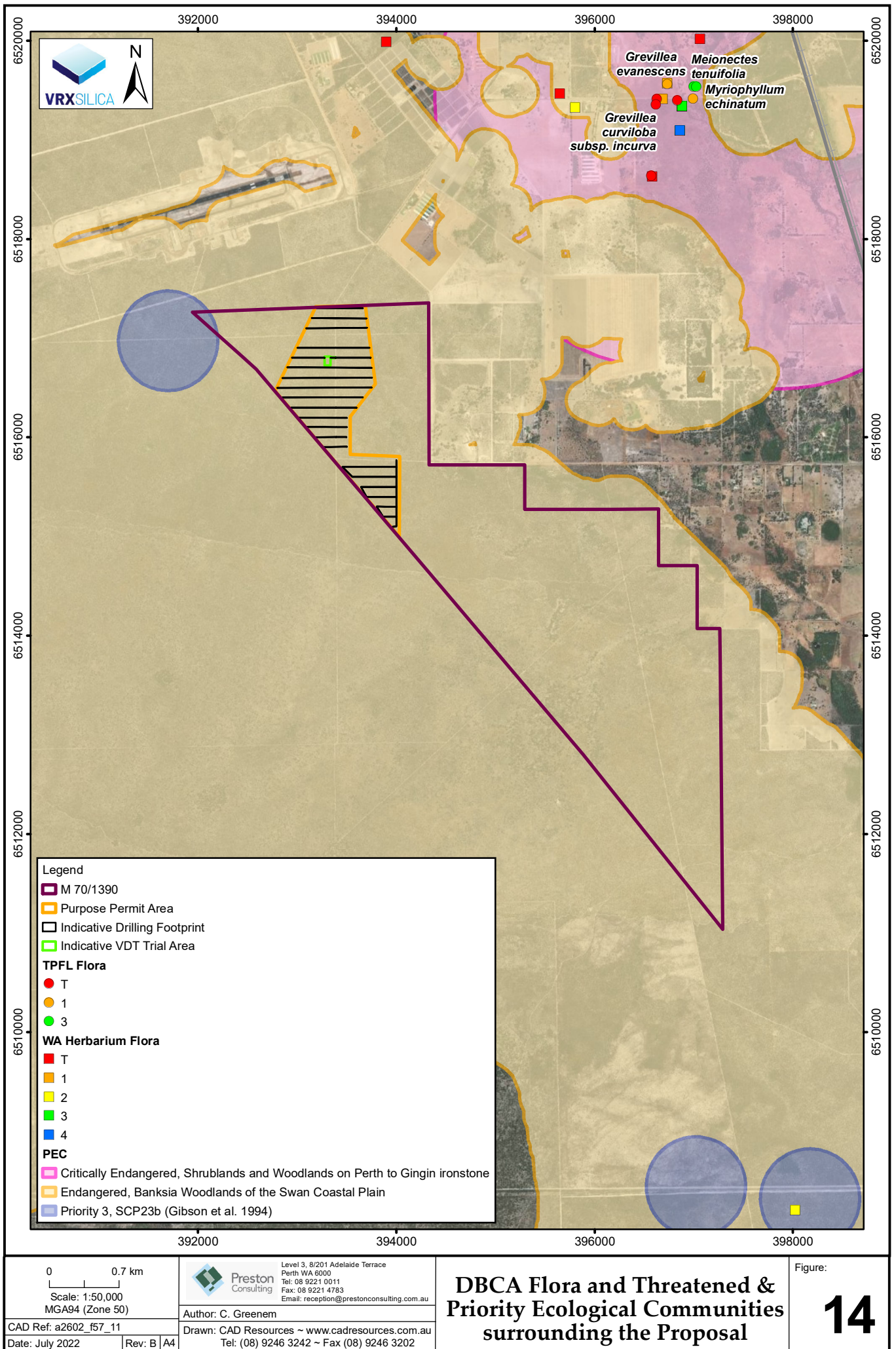


Figure 14: Listed flora and vegetation in vicinity of the Purpose Permit Area

4.3.6 SIGNIFICANT VEGETATION COMMUNITIES

The Banksia Woodlands TEC, listed as Endangered under the EPBC Act and as Priority 3 by DBCA (2021), underlies the Purpose Permit Area (Figure 14). The comparison of the Survey Area sites to the FCTs described by Gibson et al (1994) shows a high similarity between the survey sites and FCTs 21c and 23b. Both FCTs are included as part of the Banksia Woodlands TEC.

Two PEC's, both ranked as Priority 3 at State level, making up a subset of the Banksia Woodlands TEC are inferred to occur within the Survey Area. These are Low lying *Banksia attenuata* woodlands or shrublands ('floristic community type 21c') and Swan Coastal Plain *Banksia attenuata* – *Banksia menziesii* woodlands ('floristic community type 23b').

The FCTs that make up the Banksia Woodlands TEC are described as:

Low lying *Banksia attenuata* woodlands or shrublands ('floristic community type 21c') – Priority 3(i) Endangered TEC

"This community occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The vegetation community tends to occupy lower lying wetter sites and is variously dominated by Melaleuca preissiana, Banksia attenuata, Banksia menziesii, Regelia emmule, Eucalyptus marginata or Corymbia calophylla. Structurally, this community type may be either a woodland or occasionally shrubland."

Swan Coastal Plain *Banksia attenuata* – *Banksia menziesii* woodlands ('floristic community type 23b') – Priority 3(i) Endangered TEC

"These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. This community occurs in reasonably extensive Banksia woodlands north of Perth."



4.3.7 DIEBACK ASSESSMENT

The Banksia and Jarrah woodlands throughout the Survey Area are known to be susceptible to infection by *Phytophthora* (Dieback). Little evidence of Dieback was seen during field investigations, but some signage indicated it had been detected. The movement of vehicles, soil and tailings likely to be associated with the mining operations have the potential to infect and spread this pathogen which can adversely impact local vegetation.

VRX is familiar with procedures surrounding the management of Dieback and is committed to enforcing hygiene measures to limit the risk of Dieback spread during Activities. VRX has an internal Dieback management policy for all operations and is developing a Dieback Management Plan for their Arrowsmith North Silica Sand Project (similar to the Project). VRX will implement Dieback management practices from these documents that are relevant to the proposed Activities.

4.4 FAUNA

4.4.1 SURVEY EFFORT

VRX commissioned BCE to undertake a Level 2 fauna assessment of the Survey Area (Figure 6; BCE, 2019). The assessment involved a desktop review and field investigations to provide information on the fauna values of the Survey Area, particularly for significant species. The desktop assessment incorporated information from results of regional studies and the following state and federal government databases:

- The Atlas of Living Australia;
- DBCA's NatureMap (incorporating the WA Museum's FaunaBase and the DBCA Threatened and Priority Fauna Database);
- BirdLife Australia's Atlas Database; and
- DCCEEW's EPBC Protected Matters Search Tool.

The field investigation was undertaken across two periods from 23 – 28 November 2018 and 11 – 14 December 2018. The site visit involved looking around as much of the Survey Area as possible in daylight. This enabled environmental descriptions to be prepared and some opportunistic observations on fauna to be made. Targeted searching was undertaken for several significant species known from the general area – in particular foraging evidence of Quenda and Black-Cockatoos and a preliminary assessment of the potential for large trees to be nesting trees for Black-Cockatoos. All information contained within the following sections is from BCE (2019) unless otherwise referenced.

4.4.2 FAUNA HABITAT


General Fauna

The Survey Area is comprised largely of Banksia woodland with some patches of Eucalypt woodland, while the substrate across majority of the Survey Area comprises grey sandy soils. Three broad Vegetation and Substrate Associations (VSAs) were identified surrounding the Purpose Permit Area from aerial images, during field investigations and through cross-referencing with the botanical surveys already completed for the area. The Purpose Permit Area



is comprised entirely of VSA 3 (Figure 15), the characteristics of VSA 3 are summarised in Table 7.

Table 7: VSA within the Survey Area

VSA	Description	Extent within the Purpose Permit Area (ha)
<p>VSA 3 Banksia woodland</p>	 <p>Intact mixed woodland of <i>Banksia attenuata</i>, <i>B. menziesii</i> and <i>B. illicifolia</i> with scattered <i>Eucalyptus tottiana</i> over <i>Adenanthos</i> and complex mixed Myrtaceous and Proteaceous low shrubland over <i>Hibbertia</i> and other low shrubs and herbs, on pale grey deep sands. This VSA includes low dunes, low gentle mid-slopes and swales on Spearwood sands in the west of the Survey Area and plains on Bassendean sands in the east of the Survey Area. This is the most extensive VSA, accounting for at least 80 percent of the Survey Area. This VSA corresponds with Banksia Woodlands TEC, a TEC formally recognised by the WA DBCA as Priority 3 and listed as an Endangered ecological community under the EPBC Act. This VSA aligns with vegetation types G1, H1 and I1 recognised by Matiske (2017).</p>	<p>127.2</p>



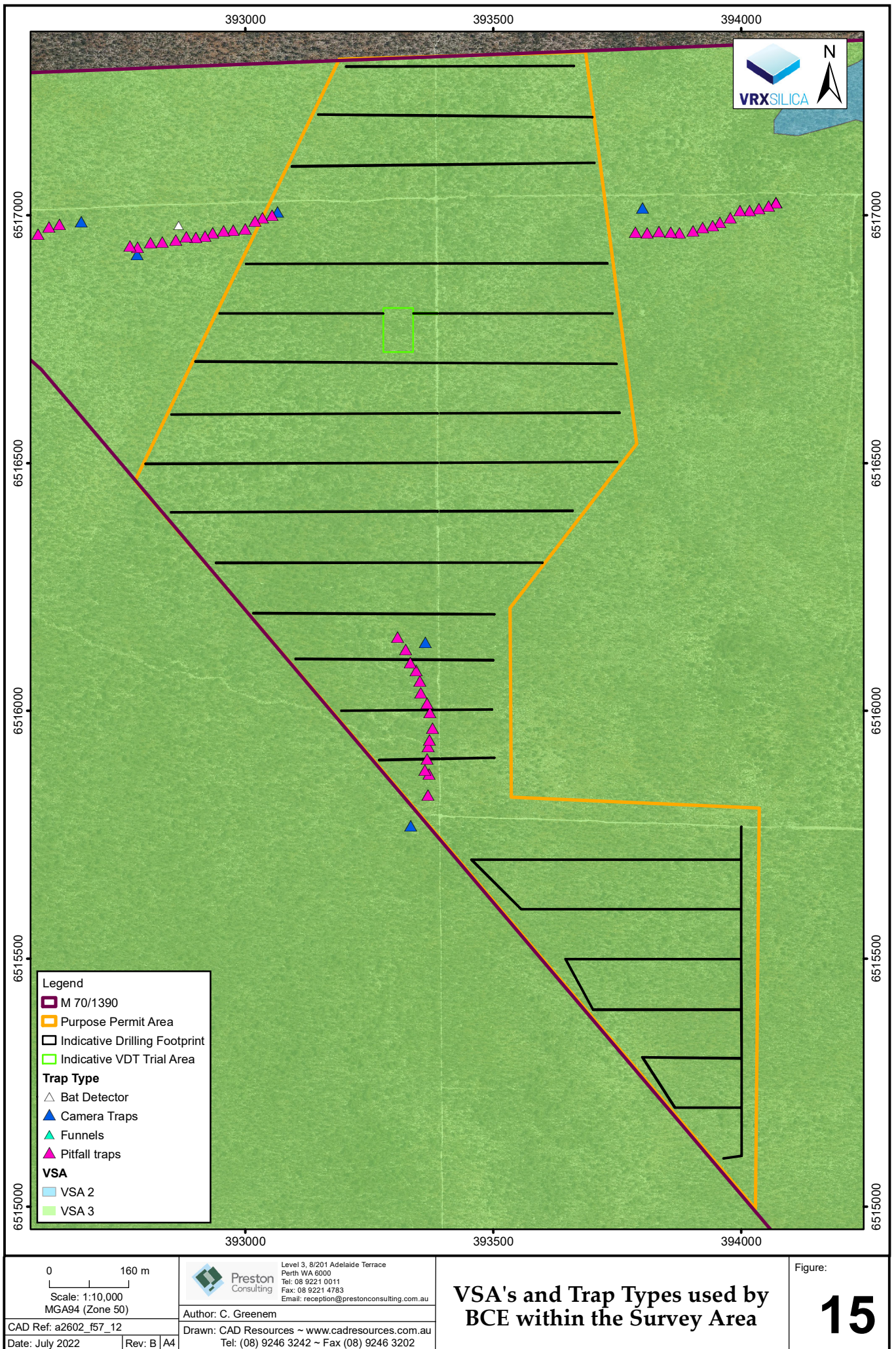


Figure:
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Figure 15: VSA's and Trap Types used by BCE within the Survey Area

4.4.3 GENERAL FAUNA

The desktop survey identified 215 vertebrate fauna species as expected to occur within the Survey Area, including ten frogs, 49 reptiles, 128 birds, 19 native mammal and nine introduced mammal species (Table 8). A total of 79 species were recorded during the field surveys, including three frogs, 21 reptiles, 41 bird, eight native mammal and six introduced mammal species (Table 8). A total of 120 species are expected to be resident in the Survey Area, 46 as migrants or regular visitors, 33 as irregular visitors, 14 as vagrant and five as locally extinct.

The expected fauna assemblage is considered rich and typical of Banksia and eucalypt woodlands of the Swan Coastal Plain, with some elements of adjacent assemblages due to the location on the north-eastern edge of the Plain. Given the high degree of connectivity to nearby vegetation, species which may be declining further south (around Perth) due to vegetation clearance and fragmentation are expected to have healthy populations within the Survey Area and surrounds.

Table 8: Composition of vertebrate fauna assemblage of the Survey Area; recorded species indicated in parentheses

Taxon	Number of species	Number of species in each status category				
		Resident	Migrant or regular visitor	Irregular visitor	Vagrant	Locally extinct
Frogs	10 (3)	8 (3)	2	-	-	-
Reptiles	49 (21)	48 (21)	-	1	-	1
Birds	128 (41) (8 introduced)	45 (30)	42 (10)	29 (1)	12	-
Native Mammals	19 (8)	14 (7)	1 (1)	2	2	4
Introduced Mammals	9 (6)	5 (4)	1 (1)	1 (1)	2 (1)	-
Total	215 (79)	120 (65)	46 (12)	33 (2)	14 (1)	5

4.4.4 INVERTEBRATE FAUNA

Nine invertebrate species were recorded by BCE, comprising one sun-moth, one bee, six spiders and one scorpion. Opportunistic observations included the Spring Flying Sun-Moth (*Synemon sp*) which was recorded near Sites 1, 2 and 3, and the Blue-banded Bee (*Amegilla sp.*) recorded near Site 1. In addition, six spider species and one scorpion species were recorded as by-catch in pitfall traps at Site 5. Three were considered to be potential Short Range Endemic invertebrates, these species and their distribution are summarised in Table 9.

Table 9: Potential Short Range Endemic Invertebrates collected

Family	Species	Sex and Distribution
Spiders		
Nemesiidae	<i>Aname mellosa group</i>	1 Male, potential SRE
Idiopidae	Possible <i>Gaius sp.</i>	1 Juvenile, not SRE if <i>Gaius</i> (indeterminable)
Nemesiidae	<i>Kwonkan sp.</i>	1 Male, previously <i>Yilgarnia sp.</i> , species indeterminable, possible SRE



4.4.5 SIGNIFICANT FAUNA

For the purposes of this assessment the term ‘significant fauna’ refers to fauna listed under the EPBC Act or BC Act, DBCA Priority Fauna, or species that have declined extensively across the region, and some species that occur at the edge of their range. The potential fauna assemblage of the Survey Area includes 56 significant fauna species (Table 10). BCE (2019) contains an extended description of each of these species.

Table 10: Significant fauna potentially occurring within the Survey Area

Species	Conservation listing	Presence within Survey Area	Recorded
REPTILES			
<i>Ctenotus gemmule</i> (Jewelled Sand-plain Skink)	Priority 3	Resident	
<i>Lerista christinae</i> (Bold-striped Slider)	Locally Significant	Resident	
<i>Morelia spilota imbricata</i> (Carpet Python (south-west population))	Locally Significant	Resident	
<i>Neelaps calonotos</i> (Black-striped Snake)	Priority 3	Resident	X
BIRDS			
<i>Phaps chalcoptera</i> (Common Bronzewing)	HS	Resident	X
<i>Apus pacificus</i> (Fork-tailed Swift)	Migratory – EPBC Act	Vagrant	
<i>Lophoictinia isura</i> (Square-tailed Kite)	WR	Regular visitor	
<i>Haliastur sphenurus</i> (Whistling Kite)	WR	Regular visitor	
<i>Accipiter fasciatus</i> (Brown Goshawk)	WR	Regular visitor	X
<i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)	WR	Regular visitor	
<i>Aquila audax</i> (Wedge-tailed Eagle)	WR	Regular visitor	X
<i>Hieraaetus morphnoides</i> (Little Eagle)	WR	Regular visitor	
<i>Falco berigora</i> (Brown Falcon)	WR	Regular visitor	
<i>Falco peregrinus</i> (Peregrine Falcon)	Schedule 7 – BC Act	Regular visitor	
<i>Turnix varius</i> (Painted Button-quail)	WR	Resident	
<i>Calyptorhynchus banksii naso</i> (Forest Red-tailed Black-Cockatoo)	Vulnerable – EPBC and BC Act	Regular visitor	X
<i>Calyptorhynchus latirostris</i> (Carnaby’s Black-Cockatoo)	Endangered – EPBC and BC Act	Regular visitor	X
<i>Calyptorhynchus baudinii</i> (Baudin’s Black-Cockatoo)	Vulnerable – EPBC Act Endangered – BC Act	Vagrant	
<i>Platycercus icterotis</i> (Western Rosella)	WR	Irregular visitor	
<i>Ninox connivens</i> (Barking Owl)	Priority 2, WR	Vagrant	
<i>Tyto novaehollandiae</i> (Masked Owl)	Priority 2, WR	Vagrant	
<i>Malurus splendens</i> (Splendid Fairy-wren)	HS	Resident	X
<i>Malurus leucopterus</i> (White-winged Fairy-wren)	HS	Regular visitor	
<i>Malurus lamberti</i> (Variegated Fairy-wren)	HS	Resident	
<i>Sericornis frontalis</i> (White-browed Scrubwren)	HS	Regular visitor	
<i>Smicrornis brevirostris</i> (Weebill)	HS	Resident	X
<i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)	HS	Resident	X



Species	Conservation listing	Presence within Survey Area	Recorded
<i>Acanthiza</i> (Western Thornbill)	HS	Resident	X
<i>Acanthiza apicalis</i> (Inland Thornbill)	HS	Irregular visitor	X
<i>Anthochaera lunulata</i> (Western Wattlebird)	WR	Resident	
<i>Glyciphila melanops</i> (Tawny-crowned Honeyeater)	WR	Regular visitor	X
<i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)	WR	Resident	X
<i>Phylidonyris niger</i> (White-cheeked Honeyeater)	WR	Resident	
<i>Ptilotula ornate</i> (Yellow-plumed Honeyeater)	WR	Regular visitor	
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	HS	Regular visitor	
<i>Pachycephala fuliginosa</i> (Western Whistler)	HS	Resident	
<i>Colluricincla harmonica</i> (Grey Shrike-thrush)	HS	Resident	X
<i>Artamus cinereus</i> (Black-faced Woodswallow)	WR	Resident	X
<i>Artamus cyanopterus</i> (Dusky Woodswallow)	WR	Resident	X
<i>Cracticus nigrogularis</i> (Pied Butcherbird)	WR	Irregular visitor	
<i>Strepera versicolor</i> (Grey Currawong)	WR	Irregular visitor	
<i>Myiagra inquieta</i> (Restless Flycatcher)	HS	Irregular visitor	
<i>Petroica boodang</i> (Scarlet Robin)	HS	Regular visitor	X
<i>Petroica goodenovii</i> (Red-capped Robin)	HS	Regular visitor	X
<i>Eopsaltria georgiana</i> (White-breasted Robin)	HS	Irregular visitor	
<i>Melanodryas cucullate</i> (Hooded Robin)	HS	Regular visitor	
MAMMALS			
<i>Dasyurus geoffroii</i> (Chuditch)	Vulnerable – EPBC and BC Act	Irregular visitor	
<i>Phascogale tapoatafa wambenger</i> (Brush-tailed Phascogale)	Vulnerable – EPBC and BC Act	Irregular visitor	
<i>Sminthopsis 'dolichura'</i> (Little Dunnart)	Locally Significant	Resident	X
<i>Sminthopsis fuliginosus</i> (Grey-bellied Dunnart)	Locally Significant	Resident	
<i>Isoodon fusciventer</i> (Quenda)	Priority 5	Resident	
<i>Macropus irma</i> (Brush Wallaby)	Priority 4	Resident	
<i>Cercartetus concinnus</i> (Western Pygmy-possum)	Locally Significant	Resident	
<i>Mormopterus kitcheneri</i> (Western Freetail-Bat)	Locally Significant	Resident	
<i>Pseudomys albocinereus</i> (Noodji, Ash-grey Mouse)	Locally Significant	Resident	X
<i>Hydromys chrysogaster</i> (Rakali, Water-Rat)	Priority 4	Irregular visitor	
INVERTEBRATES			
<i>Hesperocolletes douglasi</i> (Short-tongued bee)	Presumed Extinct – EPBC Act	Resident	
<i>Leioproctus contrarius</i> (Short-tongued bee)	Priority 3	Resident	
<i>Glossurocolletes bilobatus</i> (Short-tongued bee)	Priority 2	Resident	
<i>Antichiropus</i> UBS2 (millipede)	Locally Significant	Resident	
<i>Aname mellosa group</i> (Spider)	Locally Significant	Resident	X
<i>Kwonkan sp.</i> (Spider)	Locally Significant	Resident	X



Bush Forever (DEP, 2000) status (CS3): HS = habitat specialists with a reduced distribution on the Swan Coastal Plain; LE = locally extinct; WR = wide ranging species with reduced populations on the Swan Coastal Plain.
X = recorded by BCE during site visits and field investigations

Black-Cockatoo species

Carnaby's and Forest Red-tailed Black-Cockatoos were confirmed present during the field investigations and are expected to be regular visitors to the Survey Area, although the only records were of a flock of 15 Carnaby's Black-Cockatoos over the site on 11th July 2018, and a single Forest Red-tailed Black-Cockatoo along Timaru Road on 23rd November 2018. Baudin's Black-Cockatoo is considered to be a vagrant to the Survey Area and was not recorded.

Breeding habitat

The Eucalypt woodland areas (VSA 2; recorded in the Survey Area but not within the Purpose Permit Area) may provide suitable nesting locations (very large, usually vertical hollows in large trees) for Black-Cockatoos, but there was no nesting behaviour observed despite multiple field trips during the late winter to late spring breeding season. There was also no foraging residue in the vicinity of eucalypt woodlands, as would be expected if birds were breeding in these areas. The only possible breeding behaviour was seen along Timaru Road, just north of the Survey Area, where in November 2018 a single male Forest Red-tailed Black-Cockatoo was seen flying around and alighting in a large paddock tree, suggesting there was a female on a nest nearby. The Eucalypt woodland areas were not searched thoroughly for possible nest trees as they lie outside any impact footprint. The Carnaby's Black-Cockatoo is known to breed in small numbers on the northern Swan Coastal Plain and immediately to the east (Figure 16), but these locations are outside the 12 km radius from the Survey Area. Eucalypt woodland (VSA 2) was not recorded in the Purpose Permit Area and Banksia woodland (VSA 3) lacks large trees with the potential to provide nesting hollows. Therefore, the Purpose Permit Area is not considered Carnaby's Black-Cockatoo breeding habitat.

Roosting habitat

Both the Carnaby's and Forest Red-tailed Black-Cockatoo species are known to roost communally and often at sites that are used regularly (Peck *et al.* 2017). No roosting sites have been recorded previously within the Survey Area based on the Great Cocky Count database (Peck *et al.* 2017), however, the database available from the DBCA (2011) that incorporates Great Cocky Count records shows many confirmed roost sites, notable to the west and south-west. Some of these are just within the 12 km radius from the Survey Area (Figure 16). A very large roost (5,000+ birds) is known from the Gnangara pine plantation (Peck *et al.* 2017), but this lies nearly 20 km to the west. Potential roost sites may occur in the Jarrah and Marri woodlands (VSA 2) in the Survey Area, although were not detected during evening work in winter 2018. However, roost sites are not used consistently so the likelihood of roosting in VSA 2 remains. Banksia woodland (VSA 3) lacks large trees used by roosting black-cockatoos so roosting in VSA 3 is very unlikely.

Foraging habitat

The foraging habitat assessment concluded that extensive banksia woodlands (VSA 3; 2,833 ha within the Survey Area boundary, representing about 10 % of foraging habitat within 12 km of the Survey Area) are of High foraging value for Carnaby's Black-Cockatoo, but only Low to Moderate value for the Forest Red-tailed Black-Cockatoo. The less extensive eucalypt woodlands



(VSA 2; 554 ha within Survey Area boundary), is of Moderate foraging value for Carnaby's Black-Cockatoo, but High value for the Forest Red-tailed Black-Cockatoo.

No foraging residue (chewed Jarrah, Marri or Banksia fruit) was recorded during field investigations, although both species almost certainly forage within the Survey Area given the abundance and extent of foraging plant species across the VSAs, particularly in the Banksia woodland, which occupies the majority of the Survey Area. The lack of foraging residue suggests that neither species had foraged in the Survey Area recently (the previous 12 months) in anything but small numbers. It also reinforces the conclusion that the birds are not currently roosting or breeding within or very close to the Survey Area. This may vary from year to year, and it is possible that foraging activity will increase as pine plantations to the west are harvested.

Fork-tailed Swift

This is a non-breeding migrant from Asia but is a largely aerial species of unpredictable occurrence in southern WA. It does not rely closely on small areas of native vegetation.

Peregrine Falcon

This species is found in a wide variety of habitats, with its distribution often linked to the abundance of prey. Blakers *et al.* (1984) consider that Australia is one of the strongholds of the species, since it has declined in many other parts of the world. A pair is known to reside at nearby Lake Chandala, making it likely that the Survey Area will be part of their home range (and therefore they are considered residents in the area). They may forage in the Survey Area, with a possibility of nesting in very large trees in the area.

Chuditch and Brush-tailed Phascogale

Both these species may occur in the general region and are considered to be at least irregular visitors to the Survey Area. Both species are highly mobile, particularly the Chuditch, and the Survey Area has continuous bushland connectivity to the west and south through which the species can move. The taller woodlands may provide suitable shelter or den habitat.

Black-striped Snake and Jewelled Sand-plain Skink

Both these species have limited distributions on the coastal plain and both have been recorded on the northern Swan Coastal Plain within Banksia woodlands on sandy soil in a VSA comparable to VSA 3 (M. Bamford, pers. Obs.). The Black-striped Snake was confirmed present during field investigations while the Jewelled Sand-plain Skink is also expected to be resident in the Survey Area.

Little Dunnart and Ash-grey Mouse

The records of the Little Dunnart and Ash-grey Mouse (Noodji) in the Survey Area are significant because these species are not common on the Swan Coastal Plain in the Perth area. The DBCA is conducting an ongoing study on ground-dwelling vertebrate fauna assemblages in Banksia woodland on the Swan Coastal Plain north of Perth (A. Reaveley, pers. Coms.), and over the past 12 years has opened pitfall traps biannually (or annually in some years) across the region (mainly northern Swan Coastal Plain) to a total of approximately 1,680 trap-nights since 2007. In that time, just two individuals of dunnarts were captured. One individual was an unidentified dunnart

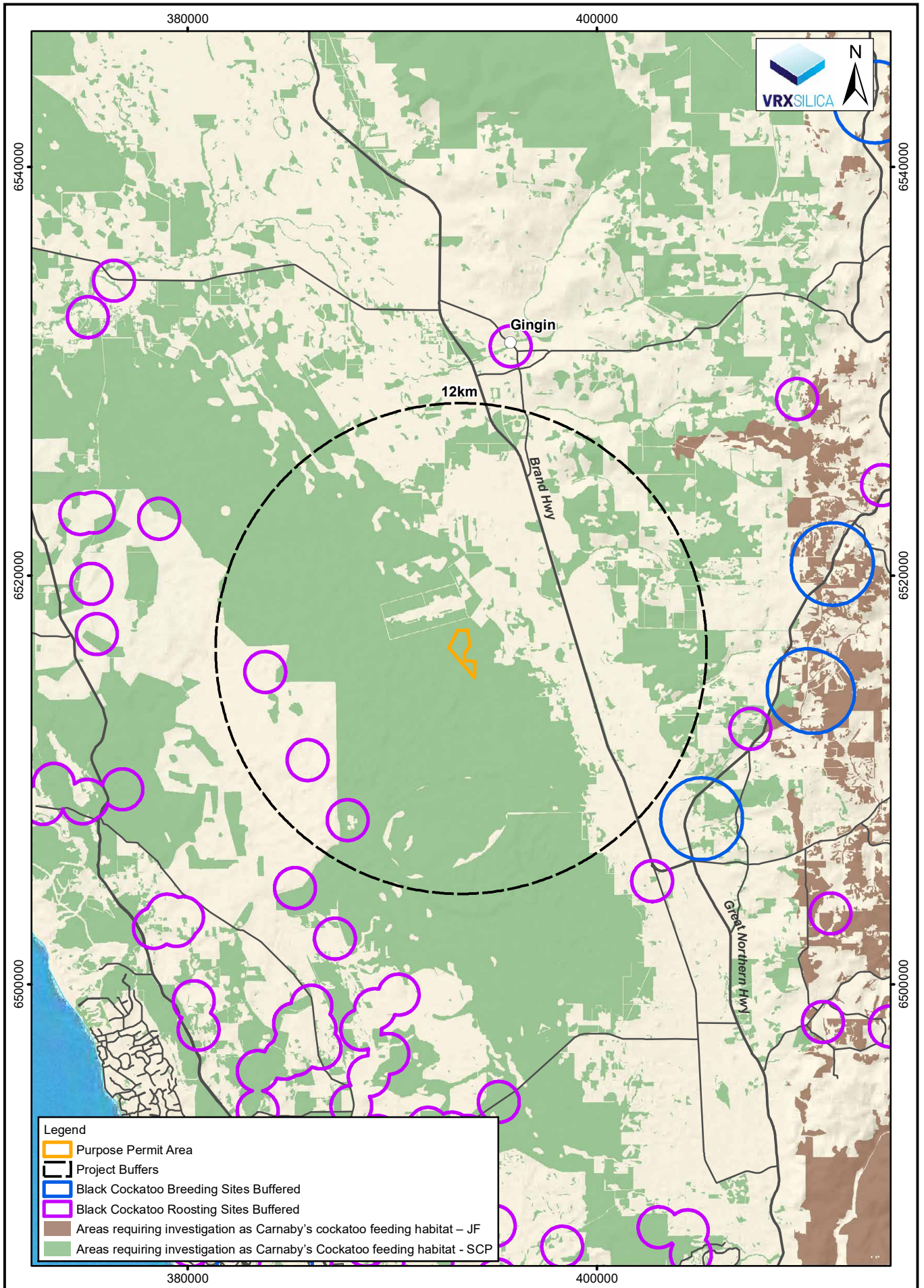


species which was caught in 2008 just north of Gingin Airfield, less than 5 km from the Survey Area. The other was identified as a Little Long-tailed Dunnart *Sminthopsis doclichura* and was caught further west in Yanchep in 2014. Similarly, the Noodji was only captured twice in the 12 years of study – they were captured at two separate sites near the Gingin Airfield in 2016, less than 5 km north of the Survey Area. One individual was captured in a long-unburnt site while the other was captured in a recently burnt site. This indicates how rare these species are in the general area and how the Survey Area may be significant for populations of the species; the Survey Area records are also the most southerly records for both. Furthermore, following discussion and DNA analysis with experts in the Western Australian Museum, the dunnart on the Coastal Plain may be a distinct taxon, as it identifies as the Little long-tailed Dunnart (*Sminthopsis dolichura*) on the basis of mitochondrial DNA, but it has a tail length the same as the head and body length, compared with much longer in true *S. dolichura*.

***Aname mellosa* group (Spider) Kwonkan sp. (Spider) and other Conservation Significant Invertebrates**

Information on the invertebrate assemblage of the Survey Area is limited, but six invertebrate species of conservation significance were returned from databases and may be present (Table 10). There is too little information available on their biology to predict their status on the site, but all could be resident. They include a native bee that was presumed extinct under the *Wildlife Conservation Act* 1950 (now BC Act) but which was recently rediscovered nearby in Pinjar in March 2019, two native bees listed as Priority, and a millipede and two spiders considered to be short range endemics (SRE). The two spider species were recorded during the field investigations as opportunistic by-catch.





Source: Black Cockatoo Habitats and Sites - DBCA

Legend	
	Purpose Permit Area
	Project Buffers
	Black Cockatoo Breeding Sites Buffered
	Black Cockatoo Roosting Sites Buffered
	Areas requiring investigation as Carnaby's cockatoo feeding habitat - JF
	Areas requiring investigation as Carnaby's Cockatoo feeding habitat - SCP

0 4 km
 Scale: 1:250,000
 MGA94 (Zone 50)

Preston Consulting
 Level 3, 8/201 Adelaide Terrace
 Perth WA 6000
 Tel: 08 9221 0011
 Fax: 08 9221 4783
 Email: reception@prestonconsulting.com.au

Author: M. Poggioli
 Drawn: CAD Resources ~ www.cadresources.com.au
 Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Carnaby's Black Cockatoos Potential Breeding, Roosting and Foraging Locations

Figure:
16

Figure 16: Significant locations for Carnaby' Black-Cockatoo in the region, from DBCA (2011) records. Note that precise locations for roost and nest sites are not available, but are buffered by 1 km and 2 km respectively

4.5 SURFACE WATER DRAINAGE

RPS Australia West Pty Ltd (RPS) (2022) was commissioned by VRX to undertake a surface water assessment of the Purpose Permit Area. The findings are summarised below and attached as Appendix 3.

4.5.1 REGIONAL

At a regional scale, surface water drains west and to the sea. The Purpose Permit Area is located within the Swan Avon (Lower Swan) catchment, the Swan River and Tributaries surface water area. The land elevations over the Survey Area mostly ranges from 70 – 80 m above sea level, with some elevated dune sections as high as 88 m above sea level.

4.5.2 LOCAL

M 70/1390 overlies an undulating sand plain (~Reduced Level [RL] 65-95 m) that generally slopes down to the southeast (RPS, 2022). A slight topographic gradient exists from west to east with lower lying areas situated in the east. There are no wetlands or permanent watercourses located within or in close proximity to the Purpose Permit Area however, there are a small number of areas where water has potential to be caught within local low points and form small pools, rather than flowing through the site, with depths up to approximately 0.7 m (RPS, 2022).

The VDT Trial indicative footprint is specifically located at a high point within the Purpose Permit Area, at an elevation of between 84 – 86 m above sea level.

4.6 CURRENT LAND USE

The dominant land uses in this subregion are mainly cultivation, conservation, UCL and Crown reserves, urban, rural residential, plantations, forestry-plantations, grazing, roads and other easements and infrastructure.

The current land use within the Purpose Permit Area is a Mining Lease issued under the *Mining Act 1978* (WA).



5 STAKEHOLDER CONSULTATION

Stakeholder consultation specific to the Activities has not been undertaken however, extensive consultation has been undertaken for the broader Project. The Activities occur entirely within M 70/1390 and form the basis for exploration of the underlying mineral resource. Therefore, VRX considers the stakeholder consultation undertaken for the broader Project is relevant for the Activities.

6 ASSESSMENT OF CLEARING AGAINST THE TEN CLEARING PRINCIPLES

The proposed vegetation clearing has been assessed against the ten clearing principles described within *A Guide to the Assessment of Applications to Clear Native Vegetation* (DER, 2014). The assessment is summarised in Table 11.



Table 11: Assessment of proposed vegetation clearing against the ten clearing principles

Relevant information	Assessment of potential impacts	Proposed control measures	Outcome – Assessment of variance with clearing principle
a. Native vegetation should not be cleared if it comprises a high level of biological diversity			
<p>The Purpose Permit Area lies in a regionally well surveyed area with a high level of diversity between Muchea and Gingin (Mattiske, 2022). There is expected to be a high level of vertebrate fauna diversity, particularly reptiles, in the Banksia and Eucalypt woodlands which occurs across the Survey Area. The patches of Marri and Jarrah woodland may support higher diversity of birds, as recorded during field investigations, with just a few species largely restricted to Eucalypt areas (BCE, 2019).</p> <p>The Purpose Permit Area and surrounding environment has been subject to numerous ecological surveys. No Threatened or Priority Flora were recorded in the Purpose Permit Area.</p> <p>The Purpose Permit Area is comprised wholly of VSA 3 which represents high value Carnaby’s Black-Cockatoo foraging habitat and low to moderate value Forest Red-tailed Black-Cockatoo habitat.</p> <p>The Chuditch and Brush-tailed Phascogale are considered to be at least irregular visitors to the Purpose Permit Area. Neither species was observed by BCE (2019).</p> <p>The Priority 3 Black-striped Snake was observed in the Survey Area during the BCE (2019) field survey. The Jewelled Sand-plain Skink expected to be a resident of the Survey Area.</p> <p>The Activities lie within the Swan Coastal Plain Subregion of the Southwest Botanical Province, which is known for its high level of biological diversity</p>	<p>No clearing of known Threatened or Priority flora records will occur as a result of the Activities.</p> <p>The proposed clearing will result in the disturbance of 2.87 ha of native vegetation, clearing represents:</p> <ul style="list-style-type: none"> • 0.26 % of all native vegetation within the Survey Area; • Less than 0.1 % of the VSA 3 within the Survey Area; and • Less than 1.19 % of each vegetation community within the Survey Area. • The Activities will require the disturbance of small areas of habitat that may be utilised by species listed under the BC Act and EPBC Act. <p>The Drilling is unlikely to significantly impact biological diversity as the tracked drill rig is likely to damage rather than remove flora species as it traverses over the top of vegetation between drill sites. The drilling itself require little to no vegetation clearing, limited to hand clearing around the drill holes, with almost immediate rehabilitation.</p> <p>The VDT Trial involves the immediate replacement of topsoil and vegetation, and the method is predicted to retain the majority of biological material.</p>	<p>To minimise the impact of the Activities on the environment, VRX proposes the following control measures:</p> <ul style="list-style-type: none"> • The extent of vegetation clearing is limited to 2.87 ha; • The method of vegetation clearing is limited to track rolling for Drilling (2.345 ha) and progressive rehabilitation via VDT (0.525 ha); • The extent of vegetation clearing will be managed through internal ground disturbance procedures; • Environmental surveys have been completed to identify and avoid areas of environmental significance; • VRX will conduct line surveys (Section 3.1.2) prior to moving to each drill hole to determine and choose the ‘path of least resistance’, minimising the extent of disturbance; • Disturbance areas will be identified using GPS coordinates and demarcated using tape and pickets; Mapped disturbance areas will be provided to operators to restrict disturbance to mapped areas only; • All rubbish will be managed appropriately and taken off site for disposal; • Materials used for demarcation will be removed once the Activities are complete; • Access will be via existing tracks where possible; and • All vehicles, equipment and personnel will be inspected and cleaned as required to prevent the incidental spread of weeds and dieback. <p>Drilling activities are limited to:</p> <ul style="list-style-type: none"> • Drilling and collection of sample material using a low impact rig; • Waste (excess cuttings and intercepted ground water) collection and removal; and • A small area of vegetation and topsoil will be cleared (by hand) to provide a safe working area around the drill. This topsoil will be used to rehabilitate drill holes once they are no longer required; and • Relocation of deadwood (fallen timber and logs) by hand. <p>The VDT Trials will include the progressive rehabilitation of native vegetation via the VDT methodology.</p> <p>The Indicative VDT Trial Area is located 50 m from an existing access track and utilises the Exploration Drill Line to minimise disturbance to native vegetation.</p>	<p>The proposed clearing may be at variance with this principle.</p>
b. Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to WA			
<p>The Purpose Permit Area is comprised entirely of VSA 3, which represents High foraging value for Carnaby’s Black-Cockatoo, but Low to Moderate value for the Forest Red-tailed Black-Cockatoo. The lack of large trees within VSA 3 eliminates the prospect of roosting and nesting hollows within the Purpose Permit Area. No Black-Cockatoo breeding or roosting habitat was recorded within the Purpose Permit Area.</p> <p>No observations of Chuditch or Brush-tailed Phascogale (both listed as Vulnerable under the BC Act) were made during the field surveys by BCE (2019).</p> <p>The Jewelled Sand-plain Skink (<i>Ctenotus emmule</i>; P3) and Black-striped Snake (<i>Neelaps calonotos</i>; P3) both have distributions on the northern Swan Coastal Plain within Banksia woodlands on sandy soil in a VSA comparable to VSA 3. The Black-striped Snake was confirmed present during field investigations by BCE (2019) while the Jewelled Sand-plain Skink is also expected to be resident in the Survey Area.</p> <p>One conservation significant invertebrate fauna species <i>Hesperocolletes douglasi</i> (Short-tongued bee) is noted as resident of the area and is listed as Critically under the BC Act.</p> <p><i>Leioproctus contrarius</i> (Short-tongued bee; P3) and <i>Glossurocolletes bilobatus</i> (Short-tongued bee; P2) are both listed under the BC Act and noted as residing within the Survey Area.</p>	<p>Any vertebrate fauna encountered during the Activities are expected to be able to be completely avoided (refer to control measures). The proposed Activities will result in the removal and progressive rehabilitation of 0.525 ha (VDT Trial) and 2.345 ha (Drilling and access for the VDT Trial) of vegetation representative of VSA 3 (0.1 % of the extent of VSA 3 within the Survey Area).</p> <p>VSA 3 represents High foraging value for Carnaby’s Black-Cockatoo and Low to Moderate values for the Forest Red-tailed Black-Cockatoo.</p> <p>The Activities will result in disturbance to a small part of a significant fauna habitat. The majority of proposed disturbance is expected to be low impact (track rolling), areas where naïve vegetation to VDT Trials will be progressively rehabilitated.</p> <p>The proposed clearing will not prevent access to an area necessary for maintaining a significant fauna habitat.</p>	<p>Implement measures described above.</p> <p>Prior to traversing vegetation, VRX will walk the intended path to spot fauna. It is expected that the majority of fauna species will move out of the path personnel and mobile equipment.</p> <p>Any fauna injuries or fatalities will be reported to the VRX environment team.</p>	<p>The proposed clearing may be at variance with this principle</p>



Relevant information	Assessment of potential impacts	Proposed control measures	Outcome – Assessment of variance with clearing principle
c. Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora			
<p>The Purpose Permit Area and surrounding environment has been subject to numerous desktop and field flora and vegetation surveys.</p> <p>No Threatened or Priority Flora were recorded in the Purpose Permit Area.</p> <p>13 Threatened and 13 Priority Flora were noted as potentially occurring within the Purpose Permit Area.</p>	<p>No clearing of known Threatened or Priority flora is expected to occur as a result of the Activities.</p> <p>The proposed clearing will result in temporary disturbance to 2.87 ha of native vegetation, which may provide habitat to Threatened or Priority Flora.</p> <p>The proposed clearing will result in the disturbance of 2.87 ha of native vegetation, which represents:</p> <ul style="list-style-type: none"> • 0.26 % of all native vegetation within the Survey Area; and • Less than 1.19 % of each vegetation community within the Survey Area. 	<p>Implement control measures described above.</p>	<p>The proposed clearing is unlikely to be at variance with this principle.</p>
d. Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a Threatened Ecological Community			
<p>The Purpose Permit Area will intersect remnant native vegetation that is representative of the Banksia Woodlands TEC. This TEC is listed under the EPBC Act as Endangered (and as a Priority 3 PEC under the BC Act).</p> <p>The majority of the vegetation within the Purpose Permit Area is in Pristine condition, with excellent condition occurring around the tracks/firebreaks.</p>	<p>The proposed clearing will result in minimal disturbance to 2.87 ha of native vegetation representative of the Banksia Woodlands TEC / PEC (0.26 % of the mapped extent within the Survey Area).</p> <p>2.345 ha of the understory of the Banksia Woodlands TEC will be track rolled (for Drilling and access to the VDT Trial area) and 0.525 ha will be subject to progressive rehabilitation via VDT (VDT Trial). After completion of the VDT Trials, VRX will infill plant the disturbed area with deep rooted species that aren't expected to return after VDT (<i>Banksia</i> sp. and <i>Macrozamia</i> sp.).</p> <p>The type of vegetation disturbance proposed for the Activities is restricted to low impact activities such as hand clearing and track rolling. No Mechanical clearing or earth works will be required.</p> <p>Disturbance to the Banksia Woodlands TEC from the VDT Trials will be subject to progressive rehabilitation via VDT. Other disturbance to the Banksia Woodlands TEC will be incidental (i.e., damage from vehicles) and will occur over a narrow area (several metres) or in defined spaced-out locations.</p> <p>It is expected that the Activities will have a minimal impact on the Banksia Woodlands TEC / PEC.</p>	<p>Implement control measures described above.</p> <p>VRX has undergone extensive planning and revision of the proposed Activities to minimise impacts to native vegetation. During Drilling VRX will walk, measure and map access routes for each drill hole so that clearing will be minimised.</p>	<p>The proposed vegetation clearing may be at variance with this principle.</p>
e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared			
<p>The vegetation within the Purpose Permit Area lies within a much broader area of native vegetation.</p> <p>The condition of vegetation within the Purpose Permit Area ranges from Pristine to Excellent. The majority of the area considered Pristine, with access tracks/firebreaks having an Excellent rating according to the Keighery (1994) scale.</p> <p>Vegetation associations 'Low woodland dominated by Banksia' (949.2) and 'Mosaic of Low woodland dominated by Banksia with Shrublands dominated by tea-tree thicket' (1014.1) are present within the Purpose Permit Area.</p> <p>The Purpose Permit Area is comprised almost entirely of native vegetation (). Surrounding the Purpose Permit Area of radii 5 km, 10 km and 20 km the native vegetation remaining equates to 36.9 %, 76.3 % and 51.5 %, respectively.</p>	<p>The proposed clearing will result in minimal disturbance to 2.87 ha of Pristine and Excellent native vegetation within the Survey Area. This clearing represents only 0.25 % of the vegetation mapped as Pristine and 0.33 % of vegetation mapped as Excellent within the Survey Area.</p> <p>There is noted vegetation clearing in the vicinity of the Project however the level of clearing is unlikely to meet the definition of "extensively cleared".</p>	<p>Implement the control measures listed above.</p>	<p>The proposed clearing is unlikely to be at variance with this principle.</p>
f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland			
<p>The Purpose Permit Area is located within the Swan Avon (Lower Swan) catchment, the Swan River and Tributaries surface water area.</p> <p>No watercourse or wetlands are contained within or in close proximity to the Purpose Permit Area.</p>	<p>Not Applicable as the Purpose Permit Area does not reside within or in close proximity to watercourses or wetlands.</p>	<p>Not Applicable</p>	<p>The proposed clearing is not at variance with this principle.</p>
g. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation			
<p>The vegetation within the Purpose Permit Area lies within a much broader area of native vegetation.</p> <p>The Survey Area has been subjected to frequent fires. Majority of the Survey Area was subject to a bushfire in 2003 and smaller areas to the north, northeast and southeast by fires in 2011. Other vegetation surrounding the Survey Area, apart from the Yeal Nature Reserve, has been impacted by agriculture, the resource industry and road/town infrastructure.</p>	<p>The type of vegetation disturbance for Drilling is limited to low impact disturbance including hand clearing and track rolling. No mechanical clearing or earth works will be required for the Activities.</p> <p>Vegetation clearing as a result of the VDT Trials will be progressively rehabilitated using VDT.</p>	<p>Implement the control measures described above.</p> <p>All waste cuttings and any intercepted ground water will be collected and taken off site for disposal.</p>	<p>The proposed clearing is unlikely to be at variance with this principle.</p>



Relevant information	Assessment of potential impacts	Proposed control measures	Outcome – Assessment of variance with clearing principle
The condition of vegetation within the Purpose Permit Area ranges from Pristine to Excellent. The majority of the area is considered Pristine, with access tracks/firebreaks having an Excellent rating according to the Keighery (1994) scale.	Based on the method of disturbance for the proposed Activities and the limited extent of clearing within the Purpose Permit Area, it is expected that the Activities will not cause appreciable land degradation.		
h. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area			
The Purpose Permit Area is not situated within any conservation area, although it is in proximity to the Yeal Nature Reserve (approximately 1,500 m west of the Purpose Permit Area).	The type of vegetation disturbance for Drilling is limited to low impact disturbance including hand clearing and track rolling. No mechanical clearing or earth works will be required for the Activities. Vegetation clearing as a result of the VDT Trials will be progressively rehabilitated using VDT. Based on the method of disturbance for the proposed Activities and the limited extent of clearing within the Purpose Permit Area, it is expected that the Activities will not result in any indirect impacts on any conservation areas.	Implement the control measures described above.	The proposed clearing is not at variance with this principle.
i. Native vegetation should not be cleared if the clearing is likely to cause deterioration in the quality of surface or underground water			
The Purpose Permit Area is located within the Swan Avon (Lower Swan) catchment, the Swan River and Tributaries surface water area. No watercourse or wetlands are contained within or in close proximity to the Purpose Permit Area.	Activities will not significantly affect leaf area index or soil moisture conditions and hence will not lead to deterioration in the quality of surface or underground water. The method of disturbance for the Activities is not expected to cause deterioration in the quality of surface or groundwater within the Purpose Permit Area or surrounding landscape.	Implement the control measures described above.	The proposed clearing is not at variance with this principle.
j. Native vegetation should not be cleared if the clearing is likely to cause, or exacerbate, the incidence or intensity of flooding			
Soils of the Purpose Permit Area are characterised as moderately well drained with fine to coarse textures and very high transmissivity. Bassendean Sand is typically clean, well rounded and well sorted, extending to a maximum of approximately 15 m below the surface. Topographic relief is low with a surface humus layer of typically ~100 mm thick and the upper (topsoil) layer at 400 mm thick. It is unlikely that surface water flows would occur within the Purpose Permit Area (any flows that do occur would be unlikely to have sufficient stream power to cause erosion or transport sediment downstream).	The proposed Activities will not result in any barriers to water flow, mobile equipment will drive on existing tracks or develop simple tracks within relatively clear understorey. Drilling will not require significant earthworks (such as raised pads etc.) or bunding. VDT Trials includes the replacement of translocated sods, it is not expected that a topographical depression will be formed. The disturbance will not significantly affect leaf area index or soil moisture conditions and hence will not cause, or exacerbate, the incidence or intensity of flooding.	Implement the control measures described above.	The proposed clearing is not at variance with this principle.



7 SUMMARY AND CONCLUSIONS

The purpose of this NVCP Application is to allow clearing of up to 2.87 ha of native vegetation within the Purpose Permit Area to undertake the Activities (Drilling and VDT Trials). Drilling will result in 2.34 ha of native vegetation disturbance and will provide VRX with additional mineralisation data as described in Section 3. VDT Trials will result in 0.53 ha of native vegetation clearing, 0.525 ha of which will be progressively rehabilitated via VDT as described in Section 3.3 and 0.005 ha will be track rolled for access.

The following key points are noted:

- Only 2.87 ha of vegetation disturbance is proposed within the Purpose Permit Area;
- 2.34 ha of vegetation disturbance is required for Drilling:
 - Disturbance required for access is limited to track rolling and moving of deadwood (by hand);
 - Clearing required for drilling is planned to target areas with sparse vegetation to minimise disturbance and avoid the clearing of larger trees.
- 0.53 ha of vegetation clearing is required for VDT Trials:
 - 0.525 ha of the proposed clearing will be progressively rehabilitated via VDT
 - 0.005 ha will be track rolled to widen a drill line and provide access to the VDT Trial area.
- The Purpose Permit Area and surrounds has been extensively surveyed, and the results of these surveys have been used to assess the impacts of the Activities;
- The proposed clearing will not result in significant impacts to the following:
 - Significant Flora;
 - Wetlands / surface water;
 - Remnant vegetation;
 - Land that has been subject to considerable degradation;
 - Groundwater; or
 - Conservation areas.

VRX has undergone extensive planning to identify control measures that will minimise the impacts of the Activities on the environment. These control measures include the following:

- The extent of vegetation clearing is limited to 2.87 ha;
- The method of vegetation clearing is limited to track rolling for Drilling (2.34 ha) and access to the VDT Trial area (0.005 ha), and progressive rehabilitation via VDT (0.54 ha);
- The extent of vegetation clearing will be managed through internal ground disturbance procedures;
- Environmental surveys have been completed to identify and avoid areas of environmental significance;
- Disturbance areas will be identified using GPS coordinates and demarcated using tape and pickets;
- Mapped disturbance areas will be provided to operators to restrict disturbance to mapped areas only;
- Activities are limited to Drilling (geological investigations and clearing for access) and VDT Trials (implementation of the VDT progressive rehabilitation methodology);
- All rubbish will be managed appropriately and taken off site for disposal;



- Materials used for demarcation will be removed once the Activities are complete;
- Access will be via existing tracks where possible;
- All vehicles, equipment and personnel will be inspected and cleaned as required to prevent the incidental spread of weeds and dieback;
- Prior to traversing vegetation, VRX will walk the intended path to spot fauna. It is expected that the majority of fauna species will move out of the path personnel and mobile equipment;
- All vehicles, equipment and personnel will be inspected and cleaned as required to prevent the incidental spread of weeds and dieback; and
- Any fauna injuries or fatalities will be reported to the VRX environment team.

This NVCP application assessed the proposed vegetation clearing against the ten clearing principles described in *A Guide to the Assessment of Applications to Clear Native Vegetation* (DER, 2014). The clearing may be at variance with three of the principles and is not or is unlikely to be at variance with seven of the principles.



8 GLOSSARY

Term	Meaning
Banksia Woodlands TEC	Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community
BC Act	<i>Biodiversity Conservation Act 2016</i> (WA)
BCE	Bamford Consulting Ecologists
CS3	Conservation Status 3 – Considered locally significant by BCE (including species listed by DEP, 2000)
Cth	Commonwealth
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
Dieback	<i>Phytophthora</i> ; weed species
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority (WA)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FCT	Floristic Community Type
ha	Hectare
HS	Habitat specialists with a reduced distribution on the Swan Coastal Plain
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
LE	Locally Extinct
m	Metre
M	Mining Tenement
Mattiske	Mattiske Consulting Pty Ltd
MNES	Matters of National Environmental Significance (as listed under the EPBC Act)
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Communities – plant communities listed as being potentially threatened under the Biodiversity Conservation Act 2016
Proposal	Muchea Silica Sand Project
RL	Reduced Level
RPS	RPS Australia West Pty Ltd
SRE	Short-range endemic
SVT	Site-vegetation types
SWA02	Perth subregion of the Swan Coastal Plain region
TEC	Threatened Ecological Community



Term	Meaning
UCL	Unallocated crown land
VDT	Vegetation Direct Transfer
VRX	VRX Silica Limited
VSA	Vegetation and Substrate Association
WA	Western Australia
WAH	Western Australian Herbarium
WR	Wide ranging species with reduced populations on the Swan Coastal Plain



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APPENDICES

Appendix 1: Flora and Vegetation Assessment (Mattiske, 2022)

Appendix 2: Surface Water Assessment (RPS, 2022)

