Excavation and Rehabilitation Management Plan

Renewal of Limestone Quarry Lots 103 – 104, McLennan and Godel Road, Nowergup

City of Wanneroo

Italia Stone Group

November 2018

Appendices

ATTACHMENT 1

Biodiversity Management

Continued Limestone and Sand Extraction

Lots 101 – 104 McLennan and Godel Roads, Nowergup

May 2015

Landform Research
Land Systems - Quaries - Environment

BIODIVERSITY MANAGEMENT

1.0 Flora

The vegetation of the area has been assessed by Arthur Weston and during site visits over the past 20 years by Lindsay Stephens of Landform Research.

The existing pits are cleared.

Arthur Weston notes that the survey area vegetation is mapped by Beard (1979), at a scale of 1:250 000, as *Banksia* Low Woodland (bLi), with Jarrah-Tuart Woodland more than 1 km east of it and Jarrah-Marri Woodland less than 1 km west of it. Beard (1979, pp. 20, 31**)** describes the survey area vegetation as belonging to the south-central or Muchea section of Bassendean System vegetation in the Drummond Subdistrict.

The mapping of Shepherd *et al.* (2002) is similar to that of Beard (1979, 1981); it shows the vegetation of the survey area as Low woodland: *Banksia* (Vegetation Association 949). Beeston *et al.* (2002) note that 40.25% of the pre-European extent of Vegetation Association 949 remains. GHD in 2014 noted the following.

Area	% Remaining	% Protected in conservation areas
State	56.88%	13.77%
Swan Coastal Plain IBRA Region	57.74%	13.91%
Perrth IBRA Region	56.98%	14.88%
City of Wanneroo	47.50%	8.56%

Heddle *et al.* (1978) show the survey area as being in an eastern part of the Cottesloe Vegetation Complex – Central and South (52). They describe the native vegetation of this complex as being “heaths on the limestone outcrops” and, on deeper sands, a mosaic of tuart woodland and tuart-jarrah-marri open-forest (Heddle *et al.* 1978, 1980).

Area	% Remaining	% Protected in conservation areas
Swan Coastal Plain	35.22%	18.32%
City of Wanneroo	46.00%	17.48%

EPA Position Statement No 2, December 2000, *Environmental Protection of Native Vegetation in Western Australia*, specifically targets the retention of native vegetation in the Agricultural Areas in *4.1, Clearing in the agricultural areas for agricultural purposes*. In 4.3, *Clearing in other areas of Western Australia*, it is unclear what "other areas" refers to, but may refer to retention of a 30% threshold in non agricultural areas.

Section 4.3 *Clearing in other areas of Western Australia*, (EPA Position Statement No 2, December 2000) expects that clearing will not take vegetation types below the 30% of the pre-clearing vegetation as recommended by ANZECC, 1999, *National Framework for the Management and Monitoring of Australia's Native Vegetation*. The National Objectives and Targets for Biodiversity Conservation 2001 - 2005 (Commonwealth of Australia 2001) also recognise 30% as the trigger value. 10% representation is recognised for constrained areas such as the Perth Metropolitan Region.

All of the vegetation meets the conservation status of 10% for constrained areas such as the Perth Metrolitan Area.

Field mapping by Weston 2015 (See Appendix 1) revealed the following vegetation communities;

Arthur Weston compared the vegetation and the sample quadrats to the Floristic Community Types by a variety of methods.

He concluded in the summary;

"Neither FCT 26a or any other Threatened Ecological Community or species or other taxon of Threatened or Priority Flora was unequivocally identified in the survey area".

He further concluded in the Summary of his report, that "It is possible, though unlikely, that the M vegetation east of the centre of Area C is a representation of FCT 26a".

Even so Community Type M has been excluded from the proposed excavation area as has the adjoining bufffer areas of Community Types BM and X.

Community Type BM is potentially FCT 24 a Priority 3 listed Community that acts as a buffer to FCT 26a. It is possible that Community Type BM in the south east may be FCT 24, but this is isolated from FCT26a.

Arthur Weston lists the remainder of the vegetation proposed to be cleared is FCT27 and FCT 26b. See Figure 4

Based on the vegetation the proposed area of extraction has been identified and is shown in Figure 4 together with Staging.

There have also been a number of flora and vegetation studies conducted for the vegetation to the east in State Forest 65, which is the same vegetation, and studies conducted by DER and DMP when assessing local Clearing Permit Applications including CPS 3003/1 for Lots 103 and 104, which lapsed in June 2014.

All of these provide data on the flora and vegetation.

VEGETATION OF THE PROPOSED EXCAVATION AREA

Af

Allocasuarina fraseriana Low Woodland - Open Low Woodland, with a few *Nuytsia floribunda, Eucalyptus gomphocephala* and *Eucalyptus todtiana* low trees, over *Banksia sessilis – Xanthorrhoea preissii – Hakea trifurcata - Allocasuarina humilis* Shrubland, over *Hibbertia hypericoides* Open Low Heath, over *Desmocladus fasciculatus* and *D. flexuosus* Sedgelands to Open Sedgelands.

Also weedy grasses, a few *Calectasia narragara* and *Mesomelaena pseudostygia* plants, a small stand of *Alexgeorgea nitens,* and other species.

Condition: Very Good, Excellent to Good, Good to Degraded
Mostly occurs in Stage 3.

BC

Banksia sessilis Open Tall Scrub – Tall Shrubland over *Calothamnus quadrifidus* Open Low Heath – Open Low Shrubland(with *Grevillea vestita* in the south)

Also weedy grasses and a few *Hakea trifurcata, Mesomelaena pseudostygia* and *Banksia sessilis* plants. Other species recorded in Quadrat A are listed in Table B3 Column QA.

Condition: Good to Very Good
Occurs in Stage 1b

BM

Banksia sessilis Open Tall Scrub – Tall Shrubland, over *Melaleuca systena* and Mixed Shrubs (with *Xanthorrhoea preissii, Banksia sessilis, Hakea trifurcata*) Shrubland to Open Heath, over *Melaleuca systena - Hibbertia hypericoides* Open Low Heath

Also, at least in some stands, *Desmocladus flexuosus, Hypochaeris glabra, Grevillea preissii, Dianella revoluta, Melaleuca huegelii* and *Acacia rostellifera* plants.

Condition: Good to Excellent
Occurs in Stage 1b and is in part excluded from excavation as a buffer

CL

Cleared; assessed condition: Completely Degraded
Covers the existing pit and pasture areas

CL+

Previously cleared. Similar to CL but with more native plants and species
Occurs in the east on the sand resource

Ed

Eucalyptus decipiens Low Woodland to Open Woodland
over *Banksia sessilis - Xanthorrhoea preissii – Allocasuarina humilis* Shrubland to Open Shrubland over *Hibbertia hypericoides* Open Low Heath – Open Low Shrubland
Occurs in Stage 1b

Also grasses and other established alien species, *Pyrorchis nigricans,* and a few *Mesomelaena pseudostygia* plants.

Condition: Very Good, Good to Very Good, Degraded, Degraded to Completely Degraded

X

Xanthorrhoea preissii Shrubland to Open Tall Scrub, often
with *Banksia sess*ilis, or other shrubs

Condition: Good to Degraded
Occurs in the central east outside the excavation area and and in the south east on the sand resource.

VEGETATION OUTSIDE THE PROPOSED EXCAVATION

Eg

Eucalyptus gomphocephala Open Forest to Woodland
over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other, less common alien species of grasses, herbs and shrubs

Condition: Completely Degraded (to Degraded)
Occurs in the west

Eg / Em

Eucalyptus gomphocephala – E. marginata (mostly dead) Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species

Condition: Completely Degraded to Degraded, (Good)
Occurs in the west

Em

Eucalyptus marginata (usually dead) - *Allocasuarina fraseriana – Banksia attenuata – Banksia grandis - Nuytsia floribunda* Low Woodland to Open Woodland, over *Xanthorrhoea preissii – Macrozamia riedlei* Open Heath to Tall Shrubland, over, mainly, weedy grasses

Also grasses, other alien herbaceous plants and a few *Acacia pulchella* and *Banksia sessilis* plants.

Condition: Good to Degraded, Degraded
Occurs in the west

M

Melaleuca systena Closed to Open Heath over Desmocladus flexuosus Sedgelands to Open Sedgelands (often with Banksia sessilis, Melaleuca huegelii and/or other species of shrubs)

Condition: Excellent
Occurs in the central east

Species

A total of 168 species and taxa were recorded by Arthur Weston, 2015.

No Priority or Threatened species or taxa were recorded.

Two small populations of Bridal Creeper (*Asparagus asparagoides)* were recorded. This is a Declared Weed.

Community Types

Arthur Weston compared the vegetation and the sample quadrats to the Floristic Community Types by a variety of methods.

He concluded in the summary;

“Neither FCT 26a or any other Threatened Ecological Community or species or other taxon of Threatened or Priority Flora was unequivocally identified in the survey area”.

He further concluded in the Summary of his report, that “It is possible, though unlikely, that the M vegetation east of the centre of Area C is a representation of FCT 26a”.

Even so Community Type M has been excluded from the proposed excavation area as has the adjoining bufffer areas of Community Types BM and X.

Community Type BM is potentially FCT 24 a Priority 3 listed Community that acts as a buffer to FCT 26a. It is possible that Community Type BM in the south east may be FCT 24, but this is isolated from FCT26a.

Arthur Weston lists the remainder of the vegetation proposed to be cleared is FCT27 and FCT 26b. See Figure 4

Based on the vegetation the proposed area of extraction has been identified and is shown in Figure 4 together with Staging.

3.0 Fauna

There have been a number of studies on local fauna conducted mainly on the limestone ridges to the east. As fauna are mobile the findings of the surveys are relevant to this site.

- Coffey Environments, 2011, *Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup*. Prepared for Cockburn Cement

- Coffey Environments 2010, *Flora and vegetation assessment, M70/339 Hopkins Road, Nowergup.* Prepared for Limestone Building Block Company.

- Western Wildlife, 2008, *Limestone Building Block Company tenements M70/013 and M70/339, Hopkins Rd, Nowergup, Fauna assessmen*t. Prepared for Limestone Building Block Company.
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- Western Wildlife, 2008, *Cockburn Cement, Tenement M70/138, Nowergup, Fauna assessment. Prepared for Cockburn Cement*.

- GHD, 2014, *Nowergup Tenements, Flora and Fauna Assessment Report 2014.* Cockburn Cement Ltd.

All were desktop studies combined with field work to check the habitats and likely potentyial for fauna.

A database search was made of the Department of Parks and Wildlife within the 10 km radius. A search of the EPBC database was also conducted.

Rehabilitation is proposed to match the existing vegetation. The current parkland pasture and cleared land will be returned to parkland pasture and the remnant vegetation will be returned to local native species. As habitat will be cleared progressively, it will be progressively replaced.

The initial excavation will recommence in the existing cleared land with an average rate of clearing anticipated to be 0.5 - 1.0 ha per year.

Possibly the most significant fauna are Black Cockatoos which have been recorded in the general area. These are listed on State (under the *Wildlife Conservation Act 1950*) and EPBC conservation databases. On the State database the taxa are listed in Schedule 1 as “Fauna that is rare or is likely to become extinct”.

Other significant fauna that may occur on site are Carpet Python *Morelia spilota imbricata* and Quenda *Isoodon obesulus fusciventer*. Large fauna will move away when impacted.

Black Cockatoos will be protected by a gradual excavation and rehabilitation to local native species and parkland pasture. Local species known to be suitable for food will be included in the rehabilitation. These normally take in the order of 5 years to produce flowers and seeds and this, combined with the native vegetation to be retained, should enable the site still to be used by Black Cockatoos both during and at the completion of excavation. It is not anticipated that any enlargement of the current open ground will be required, but rather the area of open ground will move across the site as land is opened and land is rehabilitated.

From an examination of the published reports it appears that the fauna listed for the site will not be significantly impacted on by progressive clearing of the applied for area.

The vegetation will provide habitat and feeding resource but the vegetation is not large trees with nesting hollows that could provide nesting sites. Any Black Cockatoos visiting the area are therefore most likely to be itinerant visitors.

The amount of land open at any one time is relatively small and is proposed to be progressively rehabilitated. Currently this is not possible because of the area of ground required for processing and manufacture and the need for resources.

The amount of land open at any one time is not expected to change. As land is opened land will be closed. Currently this is not possible because of the area of ground required for processing and manufacture and the need for resources.

The Department of Environment EPBC Act referral Guidelines for threatened black cockatoo species (2012) list three species of Black Cockatoo as likely to be present, Carnaby's Black Cockatoo (*Calyptorhyncus latirostris*)), Baudin's Black Cockatoo (*Calyptorhyncus baudinii)* as occurring and the Forest Red Tail Black Cockatoo (*Calyptorhyncus banksii naso*) as "may occur".

Carnaby's Cockatoo forages on native Kwongan shrubland and feeds on Marri. The Red Tail Black Cockatoo feeds on Jarrah, Marri and Wandoo. Baudin's Cockatoo feeds on protaceae shrubs and *Eucalyptus woodlands*, particularly Marri.

The risks of significant impact are listed in Table 3 of the EPBC Guideline which might apply to the site area clearing more than 1 hectare of foraging habitat, clearing a known roosting habitat, clearing a known nesting tree, creating a gap of more than 4 km between habitat, degradation though altered fire regimes, actions known to introduce *Phytophthora* spp.

The Shrubland vegetation does provide food resources for the cockatoos and therefore revegetation to local native species will be used. The species chosen will include those known to supply food resources. These can provide flowers and seed within 5 plus years. Clearing and rehabilitation will be progressive to minimise any local impact on Cockatoos.

In addition the Guideline lists potential nesting impacts as a suitable nest hollow or trees capable of developing hollows as having diameter breast height (DBH) of 500 mm for most species and 300 mm for Wandoo.

Bamford Consulting Ecologists, in a personal communication, noted that Black Cockatoos have in the past bred in the Wheatbelt and other areas, but more recently have increasingly utilised large trees with suitable nesting hollows in coastal areas. The trees on site are generally small and are less suitable for breeding, based on the published requirements for breeding trees.

Summary of potential Black Cockatoo habitats

Potential impacts	**Carnaby's Black Cockatoo (*Calyptorhyncus latirostris***	**Baudin's Black Cockatoo (*Calyptorhyncus baudinii)***	**Forest Red Tail Black Cockatoo (*Calyptorhyncus banksii naso*)**
Presence of breeding trees	No breeding trees were recorded. No trees with hollows were found. The Eucalypts where breeding could occur are Tuart trees which are to be excluded from the applied for excavation area.	Unlikely to lie within the breeding area.	No breeding trees were recorded. No trees with hollows were found. The Eucalypts where breeding could occur are Tuart trees which are to be excluded from the applied for excavation area.
Roosting habitat	Large white trunked trees such as Tuart form nesting trees and these have been excluded from the proposed excavation area.	Large white trunked trees such as Tuart form nesting trees and these have been excluded from the proposed excavation area.	Large white trunked trees such as Tuart form nesting trees and these have been excluded from the proposed excavation area.
Feeding habitat	Known feed tree species are to be excluded from the proposed excavation Nine hectares of Proeaceous feeding habitat will potentially be temporarily lost. This will be considered by the DER through the Clearing Permit process and by the Commonwealth through the EPBC Act 1999 and potential offsets. A Clearing Permit will be sought from DER and the application be sent to the Commonwealth for review. Offsets will be negotiated between the company that State and Commonwealth.	Nine hectares of Proeaceous feeding habitat will potentially be temporarily lost. This will be considered by the DER through the Clearing Permit process and by the Commonwealth through the EPBC Act 1999 and potential offsets. A Clearing Permit will be sought from DER and the application be sent to the Commonwealth for review. Offsets will be negotiated between the company that State and Commonwealth.	Jarrah can be suitable feeding habitat, although no evidence of feeding on Jarrah was noted. Red Tailed Black Cockatoos do not generally feed on Protaceaous Shrubs. Tuart and Jarrah trees are to be preserved and excluded from the excavation area.

4.0 Wetlands

A licensed bore is located on site next to the administration and pumped to a small tank and then gravity fed to the operations. No changes are proposed to this arrangement or water use.

There are no wetlands on site or nearby. The closest wetland is Nowergup Lake which lies 700 metres to the west of the current and proposed excavation. The excavation will move further east away from the lake as it progresses.

Groundwater flow is east to west.

Lake Nowergup is classified as a Conservation Category Wetland that is recognised in System Six. The lake has a permanent body of water that is significant for a large waterbird population. In recent years it has been artificially maintained at a level of near 17 metres AHD.

As rehabilitation will progressively follow excavation the amount of ground to be opened will match the amount of ground to be closed.

With a return of the site to pasture and native vegetation the water recharge based on the percentage of grass and deeper rooted plants will not change significantly and therefore there will be no impacts on Lake Nowergup from recharge changes.

The removal of the pine plantation to the east of Hopkins Road will have reduced evapotranspiration and increased regional recharge which should assist in mitigating reduced rainfall in recent years and may also lead to rises in the regional water table. Compared to the large changes in recharge as a result of the planting and removal of the pine plantations the proposed on sit eactivities are insignificant to water balance.

A groundwater and fuel management plan is proposed to minimise and mitigate risk of liquids entering the system. See Appendix 3.

Rural activities such as poultry/egg production occur on the land between the excavation and the lake.

5.0 Stygofauna and Troglofauna

EPA Guidance 54, concentrates on Stygofauna, which occur in caves and “are aquatic subterranean animals, found in a variety of groundwater systems”. Troglofauna occur in ground fissures and cavities.

The site has been reviewed by Lindsay Stephens of Landform Research on a number of occasions over the years. No evidence from past excavation shows any karst formation or caves.

The northern and eastern faces are vertical with no evidence of caves or cavities as shown in the photographs provided of the site.

The northern face is an excavated face which does not show any evidence of cavities and, considering the depth to the water table, would be unlikely to do so.

In fact the presence of cavities significantly reduces the quality of the stone for use as dimension stone. The site lies outside the Karst Risk Area in Csaky 2003.

The risks east of Lake Nowergup are actually very low based on field assessments and with the separation to the water table.

A summary of the karst issues is attached as Appendix 2. In summary the main points are;

- There is no risk from karst, being at the eastern edge of the karst risk zone with the very deep water tables and shallow excavation. No excavation will extend past the existing floors.

- There is no risk of karst being uncovered with such separation taking into account the water table depth, historic levels, potential for cavities at the water table or historic water table, source of the water through limestone flowing west which will result in any acidic conditions being neutralised prior to flowing to the site.

- There is no evidence of "cave" karst on site or nearby, there are no dolines, cavities or any such features and the Tuart trees are not typical of those growing on limestone outcrops which may indicate Karst and caves. That is there are no indicators of karst apart from a very broadly drawn line on a plan, which shows the site is near the edge of the Medium Risk karst zone.

With such separation the City is able to exercise their discretion to wave the requirement for any further consideration of karst.

The troglofauna, will be protected by leaving some 20 metres of limestone above the water table.

It is proposed to include rocky outcrops and bunds of rock and stone on rehabilitated areas to potentially form worthwhile habitat with crevices and cracks.

Conclusions

None of the risk factors listed in Guidance 54 are likely to occur. As Guidance 54 states that Stygofauna are aquatic they are unlikely to occur, and even if they did they will not be impacted on.

There are no known caves, based on local knowledge and an examination of the open cutting floor, and the site lies outside the known Karst belt, (Geoscience Australia 2005).

The site lies outside the Risk Area identified City of Wanneroo Local Planning Policy 4.13, Caves and Karstic Features. Pit 5 lies outside the Medium Risk.

6.0 Plant Disease Management Plan

Dieback of vegetation is often attributed to *Phytophthora cinamomi* even though there are other *Phytophthora* species and other diseases such as *Armillaria* that can cause dieback like symptoms. Microscopic soil-borne fungi of the genus *Phytophthora* kill a wide range of native plants and can cause severe damage to many vegetation types, particularly those from the families Proteaceae, Epacridaceae, Xanthorrhoeaceae and Myrtaceae.

In most cases dieback is caused by a pathogen which infests the plant and causes it to lose vigour, with leaves dying, and overtime may kill the plant. As such the management of Dieback is essentially related to plant hygiene when coming onto a site and within a site.

CALM generally recognises that Dieback is less likely to impact on vegetation on limestone and Spearwood/Cottesloe Land Systems, Podger F D and K R Vear, 1998*, Management of Phytophthora and disease caused by it*, IN *Phytophthora cinnamomi* and the disease caused by it - protocol for identifying protectable areas and their priority for management, EPA 2000.

There are however other plant diseases caused by fungus such as *Armillaria* that can cause dieback symptoms.

The Draft Tuart Conservation and Management Strategy also recognises that Tuart is resistant to *Phytophthora cinamomi* and *Armillaria luteobubalina*. The recent impacts on local Tuarts are also not thought to be due to Medulla Yellows by the Strategy.

Dieback of vegetation is often attributed to *Phytophthora cinamomi* even though there are other *Phytophthora* species and other diseases such as *Armillaria* that can cause dieback like symptoms.

In most cases dieback is caused by a pathogen, which infects the plant and causes it to lose vigour, with leaves dying, and, overtime, may kill the plant. As such the management of Dieback is essentially related to plant hygiene when coming onto a site and within a site.

Jarrah Dieback (*Phytophthora cinnamomi*) is widespread throughout this part of the State, but in many cases such as this site the vegetation is not interpretable because of the levels of disturbance.

It is not really a matter of preventing dieback from spreading because infection most likely already occurs there, but rather adopting policies and practices that minimise the spread or introduction of dieback *Phytophthora* spp or other diseases from quarrying or transport activities into State Forest to the east.

There are several guides to the management of Dieback.

- Department of Environment and Conservation CALM Dieback Hygiene Manual 1992 is a practical guide to Dieback management.
- Department of Environment and Conservation CALM Best Practice Guidelines for the Management of *Phytophthora cinamomi*, draft 2004.
- Dieback Working Group 2005, Management of Phytophthora Dieback in Extractive Industries.
- Dieback Working Group 2009, Managing *Phytophthora* Dieback in Bushland.

Dieback is only likely to be an issue when equipment is brought to the site from a dieback affected area either through vehicles or plant and soil materials. Therefore the following general principles are applied to Dieback management.

The general principles that are used to minimise dieback impacts are listed below.

How these activities are incorporated into dieback management on this site is outlined below.

- Dieback diseases are more likely to be transported under moist soil conditions.
- All vehicles and equipment to be used during land clearing or land reinstatement are to be clean and free from soil or plant material prior to arriving at a site.
- Vehicles and earth moving equipment are cleaned prior to entering the site if they originate from a dieback affected area.
- No soil and vegetation is brought to the site apart from that to be used in rehabilitation.
- Plants to be used in rehabilitation are obtained from dieback free sources.
- Vegetated areas ahead of excavation are quarantined to onsite access tracks
- Access to vegetated areas is discouraged through a lack of tracks and external fencing
- Rehabilitated surfaces are free draining and do not contain wet or waterlogged conditions.
- Illegally dumped rubbish is removed promptly.
- No contaminated or suspect soil or plant material is to be brought onto the site.
- When clearing land or firebreaks vehicles work from dieback free areas towards dieback identified or at risk areas.
- Roads are free draining and hard surfaced

Quarry traffic is restricted to the designated access roads, pit and stockpile areas apart from clearing land and maintaining fire breaks.

Normally transport trucks run along the bitumen roads to their destination and return. This run is considered low risk for dieback and trucks will not require cleaning during the transport phase.

The site is secured from unwanted access with fencing, gates and perimeter bunding. A hygienic site is maintained by not bringing any soil or plant material onto the site except for rehabilitation purposes or from known dieback free areas. All plants, seeds, and other materials used in rehabilitation, are sourced from dieback free areas.

Illegally dumped rubbish or material is not normally an issue, but if it is dumped the materials are promptly removed from site.

Significant numbers of species known to be resistant to Jarrah Dieback are included on the landscape bank plantings.

7.0 Weed Management Plan

The management of weeds is essentially similar to that for plant diseases including dieback. The impact of weeds is really the impact within the local area and the more they are controlled the better. It is desirable that the site does not become a haven for environmental weeds and therefore a management and control program is warranted at all sites.

Weeds can be declared under the *Agriculture and Related Resources Protection Act 1976* which requires that Declared weeds are eradicated. Other weeds are not Declared but may be classified as Environmental Weeds because they are well known for impacting on vegetation. It is noted that Bridle Creeper was identified in two small locations by Arthur Weston 2015.

Generally if the actions taken for Dieback are applied they will also control weeds. Not all potential impacts will apply all the time and the main impacts affecting this site are also listed.

The following general management actions are used wherever possible.

- All vehicles and equipment to be used during land clearing or land reinstatement, are clean and free from soil or plant material when arriving at a site.
- No soil and vegetation is brought to the site apart from that to be used in rehabilitation.
- Plants to be used in rehabilitation are free from weeds.
- Vegetated areas ahead of excavation are effectively quarantined to onsite access
- Unwanted access to vegetated areas is discouraged through a lack of tracks and external fencing
- Weed affected topsoils may need to be taken offsite, used in weed affected areas, buried by 500 mm soil/overburden or taken offsite
- Illegally dumped rubbish is the major source of weeds and is removed promptly.
- No weed contaminated or suspect soil or plant material is brought onto the site.
- When clearing land or firebreaks in weed affected areas, vehicles work in conjunction with dieback principles and push from dieback free/disturbed areas towards dieback areas.
- Weeds are sprayed with broad spectrum spray prior to planting or seeding in weed affected soils.
- Grasses are sprayed with grass selective spray prior to seeding or rehabilitation
- Weed management normally works from least affected areas to most affected.
- Declared weeds are treated promptly by digging out or spraying as outlined below.
- Ongoing monitoring of weeds is undertaken at least annually in autumn, prior to winter rains.
- Normally weed management is from the least weed affected areas to the most weed affected, which therefore gives a smaller area to treat with spray or earthworks.
- Weed affected soils are not used for rehabilitation but are buried or used in pasture areas where better control is possible.

Regular inspections conducted by staff to monitor the presence and introduction of weeds on a bi-annual or more frequent basis. On identification of significant weeds, they are either removed, buried or sprayed with a herbicide.

VEGETATION SURVEY AND SEARCH FOR RARE FLORA
ROADSTONE QUARRY
LOTS 102-104 McLENNAN DRIVE AND GODEL ROAD,
NOWERGUP, CITY OF WANNEROO

Tuart (*Eucalyptus gomphocephala*) Woodland to Open Forest (**Eg**), behind, and Perennial Veldtgrass (*Ehrharta calycina*) Closed (to Open) Grassland (**CL**), in front. Near Waypoint (WP) 961and western boundary of Lot 104.
Photograph: Pelusey Photography DSC_9137 (50), 16/4/2015

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SUMMARY

On 30 April, 14 and 30 May and 6, 11, 13 and 16 June, 2014 botanist Dr A Weston and field assistants surveyed the vegetation of Areas C and D, Roadstone Quarry site, Nowergup, and searched for rare flora there. Areas C and D are adjacent to each other, are in the southern parts of Lots 102 and 103, are south of McLennan Drive and east of Godel Road and are approximately 1 km east-northeast of Lake Nowergup.

On 22 and 31 October 2014 and on 2 March and 16 April 2015 Rd. Weston and assistants surveyed the vegetation of Lot 104 plus parts of Lots 102 and 103. They also searched for rare flora there.

Figure 1 is an aerial photograph showing ten vegetation units with dominants that are native and two with dominants that are not. Shortened names of these units and their assessed conditions [**E** – Excellent, **VG** – Very Good, **G** - Good, **D** – Degraded, **CD** – Completely Degraded] are:

Af	**E-D**	***Allocasuarina fraseriana*** **Low Woodland - Open Low Woodland**
BC	**VG-G**	***Banksia sessilis*** **Open Tall Scrub – Tall Shrubland over *Calothamnus quadrifidus* Heaths and Shrublands**
BM	**E-G**	***Banksia sessilis*** **Open Tall Scrub – Tall Shrubland, over *Melaleuca systena* Heaths and Mixed Shrubs**
CL	**CD**	**Cleared; assessed condition: Completely Degraded**
CL+	**CD (–D)**	**Similar to CL but with more native plants and species**
Ed	**VG-CD**	***Eucalyptus decipiens*** **Low Woodland to Open Woodland**
Eg	**CD-(-D)**	***Eucalyptus gomphocephala*** **Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species**
Eg / Em	**G-CD**	***Eucalyptus gomphocephala – E. marginata*** **(mostly dead) Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species**
Em	**G-D**	***Eucalyptus marginata*** **(mostly dead) - *Allocasuarina fraseriana – Banksia attenuata - Nuytsia floribunda*** **Low Woodland to Open Woodland**
M	**E**	***Melaleuca systena*** **Closed to Open Heath over *Desmocladus flexuosus*** **Sedgelands to Open Sedgelands** (often with *Melaleuca huegelii* and/or other species of shrubs)
P	**CD (-D)**	**Three pine trees and other, mainly alien, species in part of a cleared area near the north-eastern corner of Lot 102**
X	**VG-CD**	***Xanthorrhoea preissii*** **Shrubland to Open Tall Scrub often with *Banksia sessilis, Calothamnus quadrifidus* or other species of shrubs.**

The Floristic Community Types (FCTs) that may be represented in the survey area are, at most, seven: 21a, 23a, 24, 26a, 26b, 27 and 28. It is possible, though unlikely, that the M vegetation east of the centre of Area C is a representation of FCT 26a. Floristically, most of the rest of the survey area is probably FCT 26b, FCT 27 and/or FCT 24.

The Department of Parks and Wildlife (DPaW) (2014a) lists FCT 26a (62. Limestone Ridges SCP 26a) as a Threatened Ecological Community, a listing endorsed by the Western Australian Minister for the Environment. DPaW (2014b) lists FCT 24 as Swan 20. Community Type 24, a Priority 3(i) Ecological

Community. SCPs are more commonly referred to as FCTs and, less commonly, as SCPFCTs and Community Types.

The 168 species and other taxa of vascular plants recorded in the survey area are listed in Appendix B's Table B1. None of the 168 is a Threatened or Priority species or other taxon. But one species, Bridal Creeper (*Asparagus asparagoides*), is a serious environmental weed. A small population of it was found in *Eucalyptus decipiens* Low Woodland in Area C and a few plants of it are in the **Em Vegetation Unit** in the south-western part of Lot 103. Bridal creeper is a Declared Pest in Western Australia and is a Weed of National Significance.

Neither FCT 26a or any other Threatened Ecological Community or species or other taxon of Threatened or Priority Flora was unequivocally identified in the survey area.

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` VEGETATION SURVEY AND SEARCH FOR RARE FLORA
ROADSTONE QUARRY
LOTS 102-104 MCLENNAN DRIVE AND GODEL ROAD,
NOWERGUP, CITY OF WANNEROO

1.0 INTRODUCTION

On 30 April, 14 and 30 May and 6, 11, 13 and 16 June 2014, botanist A. S. Weston and field assistants surveyed the vegetation of Areas C and D, Roadstone Quarry site, Nowergup, and searched for Threatened and other rare flora there (Weston 2014). Areas C and D are adjacent to each other, are in the southern parts of Lots 102 and 103, are south of McLennan Drive, and are approximately 1 km east-northeast of Lake Nowergup. On 22 and 31 October, 2014 and on 2 March and 16 April, 2015 Dr. Weston and assistants surveyed the vegetation of Lot 104 and parts of Lots 102 and 103, mainly outside Areas C and D, and searched for rare flora there. This report describes the objectives, methods and results of both sets of surveys and searches.

Area D is in Lot 103, which borders Godel Road, and Area C is in Lot 102, on the south side of Lot 101, which borders McLennan Drive. Lots 102-104 are usually referred to in this report as the survey area, especially regarding vegetation, and occasionally as the search area, especially regarding rare flora.

Figure 1 is an aerial photograph of the survey area with boundaries and vegetation units shown on it. Locations of waypoints are also shown on it.

Area C is estimated to comprise approximately 6 ha, Area D is estimated to comprise approximately 3 ha, and the entire survey area is estimated to comprise approximately 66 ha.

The purpose of the survey and searches is to fulfil some of the conditions required for Roadstone Quarries to obtain permission to clear vegetation in parts of the survey area.

2.0 OBJECTIVES

The principal objectives of the vegetation survey are

- to identify, describe and map the vegetation units in the survey area and to assess their condition, and
- to identify the Floristic Community Types (FCTs) in the survey area and assess their significance.

The principal objectives of the flora searches are to find any species of flora there that are classified by the state or federal government as Threatened, Priority or otherwise significant.

3.0 METHODS

Vegetation was surveyed and rare flora plants searched for on 30 April, 14 and 30 May, 6, 11, 13 and 16 June, and 22 and 31 October, 2014 and on 2 March, 2015. J Leithead, E Mueller, G Owen, M Owen, M Pelusey, N Segal and P Spriggins each assisted Dr Weston on one or more of those dates.

3.1 VEGETATION UNITS

The dominant species, crown density of at least the tallest stratum of vegetation and assessed condition of vegetation units were recorded while surveying in the survey area (see Section 4 below, Figure 1 and Appendix E).

3.2 FLORISTIC COMMUNITY TYPES (FCTs)

The preferred and most accurate method of determining the Floristic Community Type (FCT) of a group of plants or stand of vegetation is to use the technique(s) described by Keighery (1994) in her *Bushland Plant Survey; A Guide to Plant Community Survey for the Community* and in the 2002 photocopy of it. The basic, repeatable technique is to record all species of vascular plants in a 100 m^2 permanent quadrat, the corners of which are marked with fence droppers or other posts or pegs. The recording of species requires at least two visits to the quadrat, ideally in spring at the peak of flowering and several weeks before or after then or at all three times. It also requires the use of standard recording sheets (see Keighery 1994, pp. 18-30) and collection and recording of supplementary information.

The list of species recorded in each quadrat is then compared with the Southern Swan Coastal Plain data set of Gibson *et al.* (1994; see p. 6) to determine which Swan Coastal Plain FCT is closest to it. The preferred method of comparison uses DEND, NNB and other PATN numerical classification techniques based on similarities of sampled quadrat floristic composition to floristic composition of quadrats in the original Swan Coastal Plain (SCP) data set (see, e.g., Griffin 2005, pp. 3, 4).

During visits to the survey area, *Melaleuca huegelii* Thickets and other vegetation on limestone ridges, knolls and slopes were searched for probable or possible FCT 26a assemblages of species, especially those indicated in Appendix B's Tables B1 and B2 and those that might include enough of the 17 high frequency (>80%) FCT 26a species listed in Gibson *et al.* (1994, Table 12) to indicate the possible presence of FCT 26a. FCT 26a is the only Threatened Ecological Community (of flora) that might be in or near the survey area.

At least seven of the 17 high frequency FCT 26a species are ephemeral and not expected to be visible or identifiable at the time of visits to the Nowergup survey area.

Subsequently, on the bases of on-site observations and interpretation of aerial photography, the parts of the survey area most likely to have stands of FCT 26a were identified.

As the field surveys were done at times when most ephemeral species would not be visible or identifiable, other methods of identifying which FCTs are in the survey area were also used. These methods are based only partly upon the placing of 10 m by 10 m quadrats and listing the species of vascular plants in each quadrat. Species of vascular plants in linear and circular releves were also listed. Specimens of plants not easily identifiable in the field were collected for identification in the Western Australian Herbarium (WAH).

Some of the alternative methods are based upon species lists. Others are based upon information in Gibson *et al.* (1994), especially the maps and species lists in Appendix 1 of that report, the plot (site) names and locations given in the report's Appendix 4, the species group indicated for each species listed in the 1994 report's Table 12, and particular statements in that report about where [floristic] community types were found. The methods based upon species lists differ from each other in the ways the lists are used - in how and with what they are compared. The comparisons involve the following:

- Comparisons with complete lists of species in at least one appropriate original Gibson *et al.* (1994) FCT 26a quadrat and/or a more extensive, though incomplete, list of FCT 26a species, such as the one in Table 12 (Gibson *et al.* 1994; Table B1 in Appendix B of this report indicates each FCT 26a species listed in Table 12 and the species group it is in),
- Comparisons with the list of 17 high-frequency FCT 26a species and 14 other species and additional information - see Table B2 in Appendix B of this report, and
- A Full Gibson Analysis (BSD Consultants 2003) of each of the three Nowergup Area C quadrat species lists – for Quadrats A, B and J - (see Table B3 in Appendix B of this report for each of the lists).

The Appendix B Table B1 list has all 98 species in Table 12's 26a column (Gibson *et al.* 1994, pp. 31-36), and the Table B2 list has all 17 high frequency (in 82%, 91% or 100% of all 11 quadrats) FCT 26a species with entries in Table 12's 26a column.

Appendix C gives more details about the alternative methods.

3.3 FLORA

Attempts were made during field work to record all species of vascular plants seen in the survey area, especially Threatened and Priority Flora taxa and otherwise significant flora taxa, e.g. species listed in *Bush Forever* (2000, Volume 2, Table 13).

The principal taxa (species, subspecies and varieties) searched for are the 45 listed in Appendix A's Table A1. Thirty-two (32) of them are the Threatened (T) and Priority (P1, P2, P3 and P4) Flora taxa in the results of searches of three Department of Parks and Wildlife (DPaW) databases. Thirteen (13) of them are the Threatened (CR, EN, VU) flora taxa in the results of searches of federal Australian Government (2014) databases with the EPBC Act Protected Matters Search Tool.

One of the species, *Dielsia stenostachya,* is listed only in *Bush Forever* (2000, Volume 2, Table 13), as an **e** species ('taxa endemic to the Swan Coastal Plain').

The information in the table was compiled mainly from the results of the searches of the DPaW databases and from Smith (2013), FloraBase (2014), Grieve (1998), Marchant *et al.* (1987) and Brown *et al.* (2013, 2008, 1998), other references, Western Australian Herbarium (WAH) herbarium specimens and personal observations.

4.0 RESULTS and DISCUSSION

4.1 VEGETATION

4.1.1 Vegetation Type, Association and Complex

The survey area vegetation is mapped by Beard (1979), at a scale of 1:250 000, as Banksia Low Woodland (bLi), with Jarrah-Tuart Woodland more than 1 km east of it and Jarrah-Marri Woodland less than 1 km west of it. Beard (1979, pp. 20, 31**)** describes the survey area vegetation as belonging to the south-central or Muchea section of Bassendean System vegetation in the Drummond Subdistrict. He does not refer to limestone, limestone vegetation or heath being in this section, the section south of it or the two sections north of it.

The mapping of Shepherd *et al.* (2002) is similar to that of Beard (1979, 1981); it shows the vegetation of the survey area as Low woodland: Banksia (Vegetation Association 949). Beeston *et al.* (2002) note that 40.25% of the pre-European extent of Vegetation Association 949 remains.

Heddle *et al.* (1978) show the survey area as being in an eastern part of the Cottesloe Vegetation Complex – Central and South (52). They describe the native vegetation of this complex as being "heaths on the limestone outcrops" and, on deeper sands, a mosaic of tuart woodland and tuart-jarrah-marri open-forest (Heddle *et al.* 1978, 1980).

4.1.2 Vegetation Units

Distributions of vegetation units are shown in Figure 1, Vegetation Units. Locations of sites and waypoints are also shown there. The map symbols of the vegetation units and the units themselves are listed below. The vegetation structure categories and the six-point condition assessment scale used are defined in Appendix E**.** Photographs of some of the vegetation units are on the title page and

in Plates 1 to 7**.** Waypoint numbers, site letters and locations are listed in Appendix D. Only a few of the species found in a vegetation unit are listed below.

Af Plates 1, 2

***Allocasuarina fraseriana* Low Woodland - Open Low Woodland, with a few *Nuytsia floribunda, Eucalyptus gomphocephala* and *Eucalyptus todtiana* low trees, over *Banksia sessilis – Xanthorrhoea preissii – Hakea trifurcata - Allocasuarina humilis* Shrubland, over *Hibbertia hypericoides* Open Low Heath, over *Desmocladus fasciculatus* and *D. flexuosus* Sedgelands to Open Sedgelands.**

Also weedy grasses, a few *Calectasia narragara* and *Mesomelaena pseudostygia* plants, a small stand of *Alexgeorgea nitens,* and other species.

Condition: Very Good, Excellent to Good, Good to Degraded

Orange sandy soil. Very little, if any, outcropping limestone.

BC Plate 3

***Banksia sessilis* Open Tall Scrub – Tall Shrubland over *Calothamnus quadrifidus* Open Low Heath – Open Low Shrubland (with *Grevillea vestita* in the southern part of Area C)**

Also weedy grasses and a few *Hakea trifurcata, Mesomelaena pseudostygia* and *Banksia sessilis* plants. Other species recorded in Quadrat A are listed in Table B3 Column QA.

Condition: Good to Very Good

Orange sandy soil and scattered outcrops of limestone. Site M (WP 919, 11 June 2014) is a clearing with *Grevillea vestita* and which is surrounded by *Banksia sessilis* Open Tall Scrub to Tall Shrubland.

BM Plates 3, 7

***Banksia sessilis* Open Tall Scrub – Tall Shrubland, over *Melaleuca systena* and Mixed Shrubs (with *Xanthorrhoea preissii, Banksia sessilis, Hakea trifurcata*) Shrubland to Open Heath, over *Melaleuca systena - Hibbertia hypericoides* Open Low Heath**

Also, at least in some stands, *Desmocladus flexuosus, Hypochaeris glabra, Grevillea preissii, Dianella revoluta, Melaleuca huegelii* and *Acacia rostellifera* plants.

Condition: Good to Excellent

Orange sandy soil. Increasing amount of outcropping limestone upslope.

CL Plates Title page, 5

Cleared; assessed condition: Completely Degraded

CL+ Plates 2

Similar to CL but with more native plants and species

Ed **Plates 1, 4**

Eucalyptus decipiens **Low Woodland to Open Woodland over *Banksia sessilis - Xanthorrhoea preissii – Allocasuarina humilis* Shrubland to Open Shrubland over *Hibbertia hypericoides* Open Low Heath – Open Low Shrubland**

Also grasses and other established alien species, *Pyrorchis nigricans,* and a few *Mesomelaena pseudostygia* plants.

Condition: Very Good, Good to Very Good, Degraded, Degraded to Completely Degraded

Orange sandy soil. Generally some outcropping limestone.

Eg **Plates: Title page, 3**

Eucalyptus gomphocephala **Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other, less common alien species of grasses, herbs and shrubs**

Condition: Completely Degraded (to Degraded)

Orange sandy soil. Some outcropping limestone.

Eg / Em **Plate 5**

Eucalyptus gomphocephala – E. marginata **(mostly dead) Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species**

Condition: Completely Degraded to Degraded, (Good)

Mainly orange to yellow sandy soil. Occasional outcropping limestone.

Em **Plate 6**

Eucalyptus marginata **(usually dead) - *Allocasuarina fraseriana – Banksia attenuata – Banksia grandis - Nuytsia floribunda* Low Woodland to Open Woodland, over *Xanthorrhoea preissii – Macrozamia riedlei* Open Heath to Tall Shrubland, over, mainly, weedy grasses**

Also grasses, other alien herbaceous plants and a few *Acacia pulchella* and *Banksia sessilis* plants.

Condition: Good to Degraded, Degraded

Orange sandy soil. Little or no outcropping limestone.

M **Plates 4, 7**

Melaleuca systena **Closed to Open Heath over *Desmocladus flexuosus* Sedgelands to Open Sedgelands** (often with *Banksia sessilis, Melaleuca huegelii* and/or other species of shrubs)

Also *Acacia lasiocarpa* var. *lasiocarpa, Diplolaena angustifolia, Grevillea preissii, Hakea costata, Hypochaeris glabra, Opercularia vaginata.* Other species in Quadrat B are listed in Table B3 Column QB.

Condition: Excellent (to Very Good)

On substrate of more than 70% limestone boulders.

Representative site: Quadrat B (WP 932; 30 April, 16 June 2014)

P Three pine trees and other alien species in part of a cleared area near the north-eastern corner of Lot 102

Condition: Completely Degraded

X Plates 2, 7

***Xanthorrhoea preissii* Shrubland to Open Tall Scrub, often (1) east to north-east of Area C, with native and alien shrubs, and (2) elsewhere, with *Banksia sessilis, Calothamnus quadrifidus* or other shrubs.**

Condition: (1) Completely Degraded to Degraded. (2) Good to Degraded

4.1.3 Floristic Community Types (FCTs)

The FCTs that may be represented in the survey area are, at most, seven: 21a, 23a, 24, 26a, 26b, 27 and 28. However, representation there of FCT 28 is doubtful because the Gibson *et al.* (1994) FCT 28 NEER quadrats are on the west side of Wanneroo Road, more than two kilometres from the survey area. Also, FCT 28 is, according to Gibson *et al.* (1994, p. 44), largely made up of woodlands dominated by species of *Banksia* and *Eucalyptus,* but not *E. gomphocephalus*. Gibson *et al.* (1994, Appendix 1) shows the *Banksia attenuata* – dominated FCT 21a and FCT 23a quadrats as Bassendean and further east. The few FCT 21a quadrats north of the Swan River are also shown as further north.

Because a limestone outcrop in the narrow strip of vegetation in Figure 1 nearest the centre of the north-western border of Area C has *Astroloma microcalyx* growing on it, if the vegetation there were in much better condition, its FCT would probably be 27. The figures in the *Astroloma microcalyx* row in Table B2 support this inference.

Gibson *et al.* (1994, p. 43-44) state that FCT 24 and FCT 25 are closely related and that in one of their FCT 25 quadrats *Eucalyptus decipiens,* not *Eucalyptus gomphocephala,* was the dominant. But *Eucalyptus gomphocephala* formed the overstorey nearby, as it does near Areas C and D.

Consequently, it is inferred that (1) a small area of heath vegetation in, around and west of Quadrat (Site) B may be a representation of FCT 26a, and (2) one or more of FCTs 24, 26b and 27 are represented elsewhere in the survey area, including some areas with no outcropping limestone.

4.1.4 Vegetation Condition

Most of the Lot 102 vegetation in and north of Area C is assessed as being in Good to Very Good Condition while most vegetation in the rest of the survey area is assessed as being Good to Completely Degraded. The assessments would be higher if there were fewer environmental weeds there.

Vegetation with very few, if any, native plants (Unit Cl) is assessed as Completely Degraded. Weediness is the reason for assessing the condition of the Em vegetation in the south-western corner of Lot 102 and south-eastern corner of Lot 103 as Degraded.

Most, if not all, of the survey area appears to have been unburnt for many years. Even tall, old Balga (*Xanthorrhoea preissii*) plants have unburnt skirts, as shown in Plate 2**.**

4.2 FLORA

Appendix B's Table B1 lists 168 species and other taxa of vascular plants recorded during the survey. None of them is listed in Table A1, and none is a Threatened, Priority or other significant species.

One small population of Bridal Creeper (*Asparagus asparagoides*) was found in *Eucalyptus decipiens* Low Woodland in the central western part of Area C, and another was found in the south-western part of Lot 103. Bridal creeper is a serious, highly invasive environmental weed. It is a Declared Pest in Western Australia and is one of a few dozen Weeds of National Significance (http://www.weeds.org.au/WoNS/) (https://www.agric.wa.gov.au/declared-plants/bridal-creeper-declared-pest).

4.3 LIMITATIONS

Earlier, Weston (2003) used a version of this report's Table B2, in Appendix B, as an aid to distinguishing between FCT 26a, FCT 26b and FCT 27, but it was less helpful in 2014, in large part because many annual plants and other ephemeral species were absent or not identifiable. According to Gibson (in Weston and Gibson 1997), FCT 26b and FCT 27 are difficult to distinguish from each other on aerial photography, even on highly magnified stereoscopic pairs of high resolution colour aerial photographs. Probably FCT 26a is also sometimes difficult to distinguish from FCT 26b and FCT 27.

This absence of species is probably at least the principal reason why the species numbers for QA, QB and QJ in Table 1, below, are significantly less than the mean species richness numbers in Table 2.

Table 1 Numbers of Species

Numbers of Species (SPP) listed in G 1994 [Gibson *et al.* (1994, Table 12, Community Type 26a Column)], WG 1997 [Weston and Gibson (1997, Appendix 1)], C/D 2014, N2 [Appendix B, Table B1, C/D '14 and N2 Columns] and QA, QB, QJ [Appendix B, Table B3, QA, QB, QJ Columns] See Appendix B for more details and keys

	G 1994	WG 1997	C/D 2014 + N2 ('14-'15)		QA	QB	QJ
TOTAL SPP	**98**	**225**	**168**		**38**	**36**	**29**
C/D **SPP**	C/D **35**	C/D **65**	C/D **132**	N2 **36**	C/D **38**	C/D **36**	C/D **29**

Table 2 Mean Species Richness

Mean quadrat species richness listed in Gibson *et al.* (1994, Appendix 1)	FCT 24	FCT 26a	FCT 26b	FCT 27
	41.8	50.2	52.7	39

Some herbaceous plants, such as many orchids, flower briefly, then disappear and, furthermore, some do not appear every year. Some plants flower for only one or a few seasons following a hot summer fire, and the incidence of flowering of plants that flower annually may vary from year to year.

Density variations in the understorey, especially under woodland and forest canopies, are often difficult or impossible to recognise or map.

Some plants, especially small sedges, are impossible to identify if they are not in seed.

The paucity of species in a quadrat reduces the reliability of analysing quadrat samples using either a Full Gibson Analysis (BSD Consultants 2003) or a PATN analysis. When a group of species that would be in a quadrat, and sampled, is missing, then analysis of a sample may yield a faulty result.

The sampling done for the original southern Swan Coastal Plains survey was in '. . . the least disturbed vegetation available . . .' (Gibson *et al.* 1994, p. 4).

Griffin (2005) describes a number of other problems in the interpretation of PATN analyses and with the system of Floristic Community Types.

5.0 CONCLUSIONS

Figure 1 is an aerial photograph with boundaries of nine vegetation units and **Cl** shown on it. Shortened names of these units and their assessed conditions [**E** – Excellent, **VG** – Very Good, **G** - Good, **D** – Degraded, **CD** – Completely Degraded] are listed below. Longer names and other details about the units are listed in Section 4.1.2.

Af	**E-D**	***Allocasuarina fraseriana*** **Low Woodland - Open Low Woodland„**
BC	**VG-G**	***Banksia sessilis*** **Open Tall Scrub – Tall Shrubland over *Calothamnus quadrifidus* Heaths and Shrublands**
BM	**E-G**	***Banksia sessilis*** **Open Tall Scrub – Tall Shrubland, over *Melaleuca systena* Heaths and Mixed Shrubs**
CL	**CD**	**Cleared; assessed condition: Completely Degraded**
CL+	**CD**	**Similar to CL but with more native plants and species**
Ed	**VG-CD**	***Eucalyptus decipiens*** **Low Woodland to Open Woodland**
Eg / Em	**G-CD**	***Eucalyptus gomphocephala – E. marginata*** **(mostly dead) Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species**
Eg	**CD-(-D)**	***Eucalyptus gomphocephala*** **Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other, less common alien species**
Em	**G-D**	***Eucalyptus marginata*** **(mostly dead) - *Allocasuarina fraseriana* – *Banksia attenuata* – *Banksia grandis* - *Nuytsia floribunda* Low Woodland to Open Woodland**
M	**E**	***Melaleuca systena*** **Closed to Open Heath over *Desmocladus flexuosus* Sedgelands to Open Sedgelands** (with *Melaleuca huegelii* and/or other shrubs in some places)
P	**CD**	**Three pine trees and other alien species in part of a cleared area near the north-eastern corner of Lot 102**

X ***Xanthorrhoea preissii*** **Shrubland to Open Tall Scrub, often with** ***Banksia sessilis,*** **or other shrubs**
Condition: (1- E to NE of Area C) D-CD. (2- elsewhere) G-D

The Floristic Community Types (FCTs) that may be represented in the survey area are, at most, seven: 21a, 23a, 24, 26a, 26b, 27 and 28. It is possible that the M vegetation unit east of the centre of Area C is a representation of FCT 26a. Floristically, most of the rest of the survey area is, probably, FCT 24, FCT 26b and/or FCT 27.

The Department of Parks and Wildlife (DPaW) (2014a) lists FCT 26a (62. Limestone Ridges SCP 26a) as endorsed by the Western Australian Minister for the Environment, Species & Communities Branch, as a Threatened Ecological Community (correct to May 2014). SCP 26a is also referred to, elsewhere, as an FCT, an SCPFCT and a Community Type. DPaW (2014b) lists FCT 24 as Swan 20. Community Type 24, a Priority 3(i) Ecological Community.

The 168 species and other taxa of vascular plants recorded in the survey area are listed in Appendix B's Table B1 Columns C/D '14 (132 taxa) plus N2 (36 taxa). Taxa recorded in quadrats QA, QB and QJ are listed in Table B2. None of them is a Threatened or Priority taxon.

6.0 ACKNOWLEDGEMENTS

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Most of the plates are photographs taken by Michael Pelusey, of Pelusey Photography and Pelusey Publishing. Others are photographs taken by G and M Owen and A Weston. Drafting was done by S Beal, of Development Cartographics.

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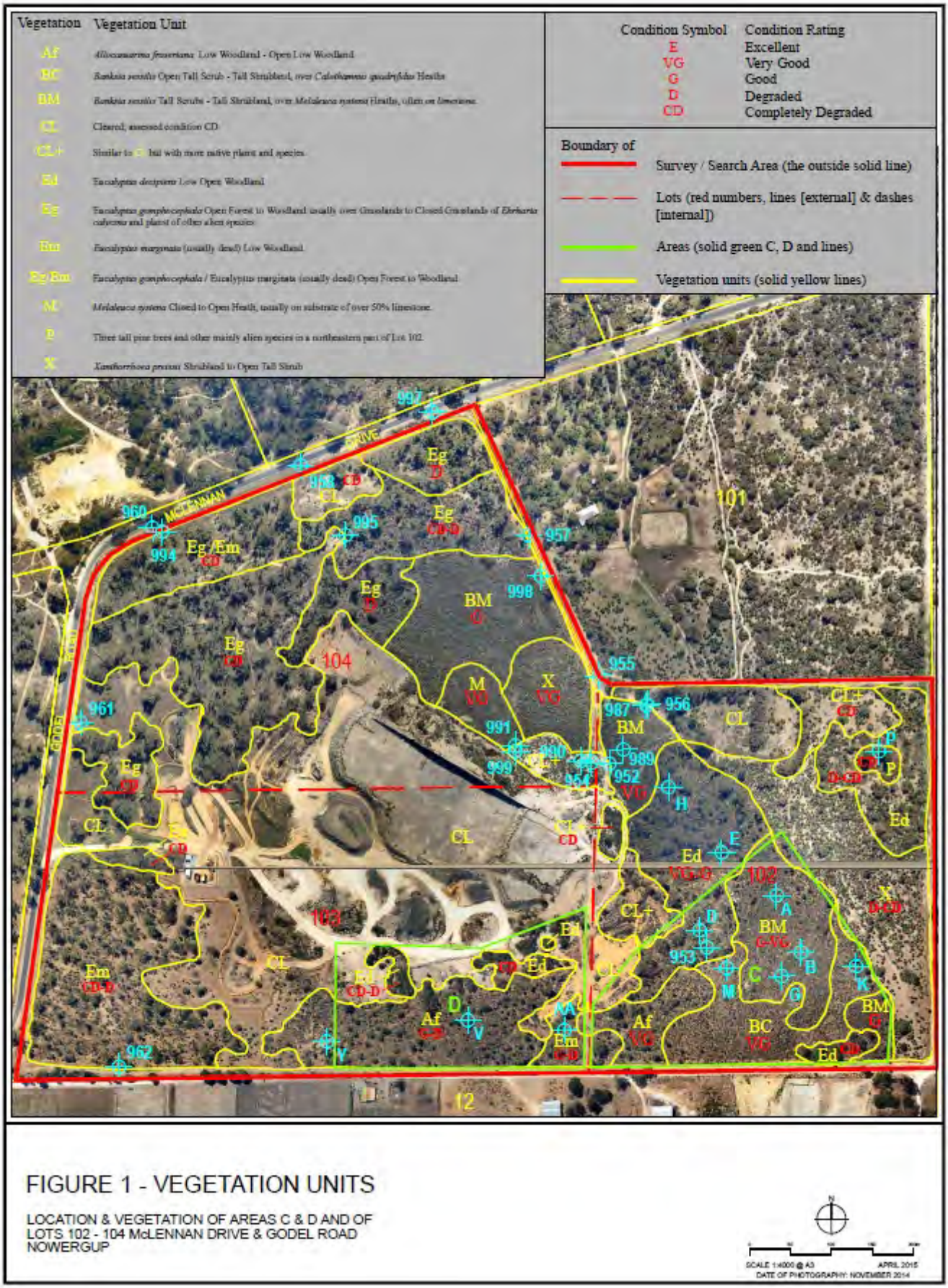
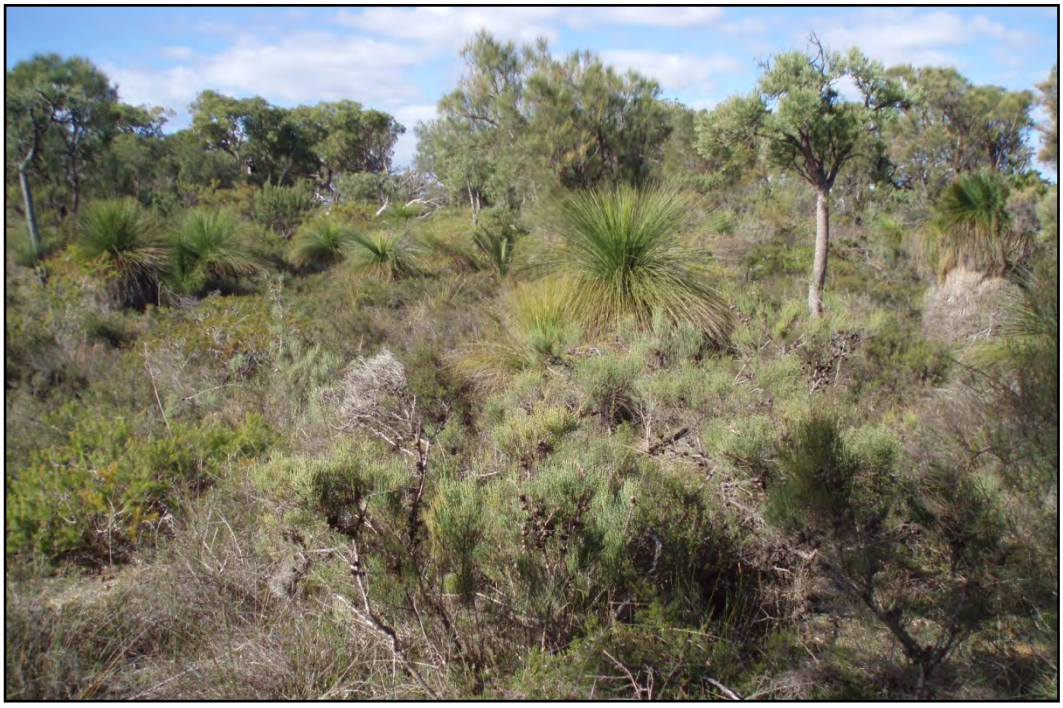

Vegetation
Vegetation Unit
Af
Allocasuarina fraseriana Low Woodland - Open Low Woodland
BC
Banksia sessilis Open Tall Scrub - Tall Shrubland, over Calothamnus quadrifidus Heaths
BM
Banksia sessilis Tall Scrubs - Tall Shrubland, over Melaleuca systena Heaths, often on limestone
CL
Cleared, assessed condition CD
CL+
Similar to CL but with more native plants and species
Ed
Eucalyptus decipiens Low Open Woodland
Eg
Eucalyptus gomphocephala Open Forest to Woodland usually over Grasslands to Closed Grasslands of Ehrharta calycina and plants of other alien species
Em
Eucalyptus marginata (usually dead) Low Woodland
Eg/Em
Eucalyptus gomphocephala / Eucalyptus marginata (usually dead) Open Forest to Woodland
M
Melaleuca systena Closed to Open Heath, usually on substrate of over 50% limestone
P
Three tall pine trees and other mainly alien species in a northeastern part of Lot 102
X
Xanthorrhoea preissii Shrubland to Open Tall Shrub
Condition Symbol
Condition Rating
E
Excellent
VG
Very Good
G
Good
D
Degraded
CD
Completely Degraded
Boundary of
Survey / Search Area (the outside solid line)
Lots (red numbers, lines [external] & dashes [internal])
Areas (solid green C, D and lines)
Vegetation units (solid yellow lines)
McLENNAN DRIVE
GODEL ROAD
101
102
103
104
12
997
960
994
995
958
957
998
955
956
987
961
962
991
999
990
954
989
952
953
Eg
Eg/Em
BM
M
X
Em
Af
BC
Ed
CL
CL+
D-CD
P
H
E
A
B
C
D
G
K
M
V
FIGURE 1 - VEGETATION UNITS
LOCATION & VEGETATION OF AREAS C & D AND OF LOTS 102 - 104 McLENNAN DRIVE & GODEL ROAD NOWERGUP
SCALE 1:4000 @ A3
APRIL 2015
DATE OF PHOTOGRAPHY: NOVEMBER 2014

A. *Allocasuarina fraseriana* Low Woodland - Open Low Woodland, with *Nuytsia floribunda* and *Eucalyptus todtiana* low trees, over *Banksia sessilis – Xanthorrhoea preissii – Hakea trifurcata* Shrubland, over *Hibbertia hypericoides* Open Low Heath, over *Desmocladus fasciculatus* and *D. flexuosus* Sedgelands to Open Sedgelands.
Photo: An enclave of **Unit Af** in **Vegetation Unit X** east of Area C in Lot 102.



B. *Allocasuarina fraseriana, Nuytsia floribunda, Xanthorrhoea preissii* and, in foreground, *Allocasuarina humilis.* **Vegetation Unit Af. Photo:** Near Site V, Area D, Lot 103. **Vegetation Unit Ed** in left background.

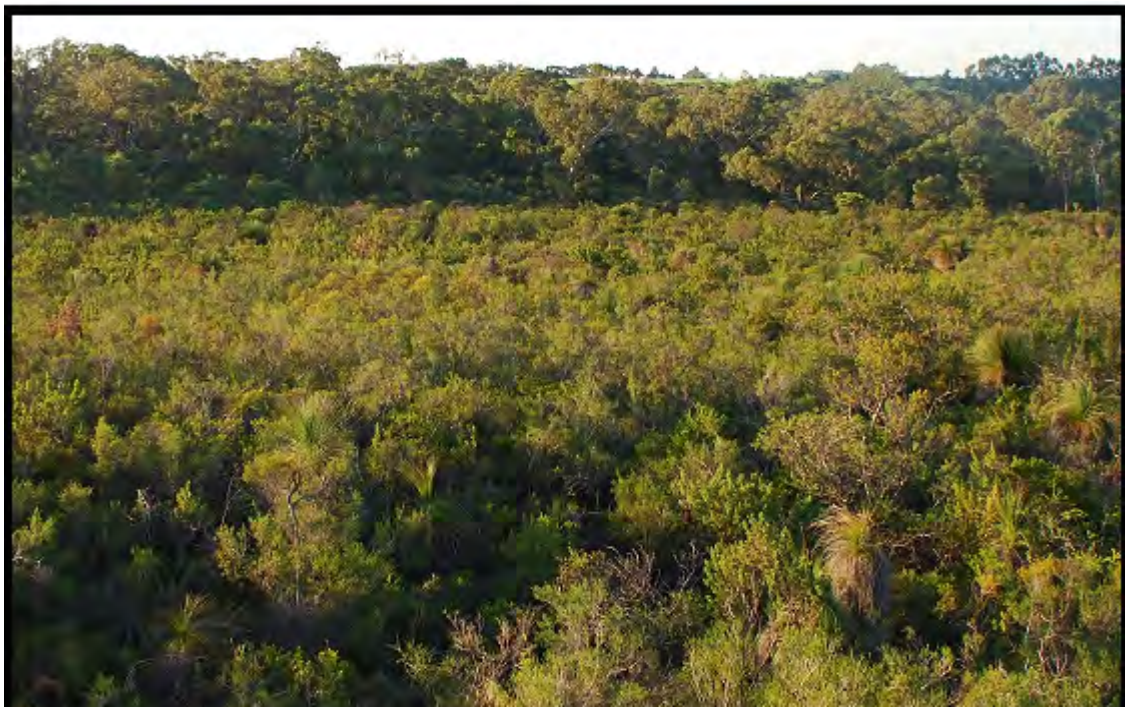
PLATE 1 *Allocasuarina fraseriana* Low Woodland - Open Low Woodland

A. *Nuytsia floribunda* grove, skirted, long-unburnt *Xanthorrhoea preissii* plants and, in foreground, *Hibbertia hypericoides* shrubs. In **Vegetation Unit Af**, near Site Y, Area D.
Photo: Looking south towards centre of Lot 103's southern boundary.
The long skirt on the *Xanthorrhoea* suggests that it has not been burnt for many years.

B. *Astroloma microcalyx* on limestone and on sand over limestone; in **Vegetation Unit Cl+,** in Lot 102 near north-eastern corner of Lot 103.

PLATE 2 Vegetation Units Af and CL+, and *Astroloma microcalyx*

A. *Banksia sessilis* Open Tall Scrub – Tall Shrubland over *Calothamnus quadrifidus* Heaths. **Vegetation Unit BC**. **Photo:** Looking south-west from near WP 987, in Lot 102, over north-east corner of the quarry and the boundary between Lots 102 and 104.



B.– *Banksia sessilis* Open Tall Scrub – Tall Shrubland over *Melaleuca systena,* **M Vegetation Unit** (in foreground), **BM Vegetation Unit** (in most of central part of photo) and **Eg Vegetation Unit** (in background). **Photo:** Looking north-west from northern edge of quarry near WP 991, in Lot 104.

PLATE 3 *Banksia sessilis* Open Tall Scrubs – Tall Shrublands, *Melaleuca systena* Heath and Tuart (*Eucalyptus gomphocephalus*) Woodland

A. *Eucalyptus decipiens* Low Woodland, over *Banksia sessilis - Xanthorrhoea preissii – Allocasuarina humilis* Shrubland to Open Shrubland over Mixed small shrubs, herbs and graminoids. In Area C near south-east corner of Lot 102.

B. *Diplolaena angustifolia* on limestone in Quadrat (Site) B, **Vegetation Unit M** (a small area, which is mapped as **Vegetation Unit BM**) East of centre of Area C

PLATE 4 ***Eucalyptus decipiens*** **Low Woodland, and** ***Diplolaena angustifolia***

A. *Eucalyptus gomphocephala* Open Forest to Woodland – with a few *Eucalyptus marginata* (mostly dead) trees – over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other, less common alien species of grasses, herbs and shrubs. **Vegetation Units Eg / Em** and **CL. Photo:** Near WP 961, in the western part of Lot 104.

B. *Eucalyptus gomphocephala – E. marginata* (many trees, mostly dead) Open Forest to Woodland over, mainly, Grasslands to Closed Grasslands of *Ehrharta calycina* and other alien species. **Vegetation Unit Eg / Em** (or **Em** with a few Tuart trees). **Photo:** Near WP 960, in the north-western part of Lot 104.

PLATE 5 *Eucalyptus gomphocephala* and *E. marginata* (mostly dead) Open Forest to Woodland

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Eucalyptus marginata (mostly dead) Low Woodland to Open Woodland,
with few Tuarts, * *Acacia podalyriifolia, Allocasuarina fraseriana, Banksia attenuata, Banksia grandis* and *Nuytsia floribunda* trees, over, mainly, weedy grasses.
Photo: North-east of WP 962, in southern part of **Em Vegetation Unit.**

PLATE 6 Vegetation Unit Em: *Eucalyptus marginata* - Low Woodland to Open Woodland

A. *Melaleuca systena* Closed Heath in Quadrat on limestone at Waypoint B, in **Vegetation Unit M**.
Photo: Near WP B, east of centre of Area C, Lot 102. Mapped there as in **Vegetation Unit BM.**

A. *Xanthorrhoea preissii* Shrubland to Tall Shrubland with *Banksia sessilis, Calothamnus quadrifidus* and other species of shrubs. **Vegetation Unit X.**
Photo: Looking north from near south-eastern corner of Lot 104 and Waypoints 954 and 990.

PLATE 7 *Melaleuca systena* Closed Heath and *Xanthorrhoea preissii* Shrubland to Open Tall Scrub

APPENDIX A

Threatened and Priority Flora and other Significant Flora with Distributions and Habitats which may include the Nowergup Search Area

(based mainly upon printouts of results of DPaW March 2014 database searches and upon EPBC Act Protected Matters Search Tool April 2014 search results)

1.0 TABLE A1

Table A1 lists 45 taxa (species, subspecies and varieties) of flora. Thirty-two (32) of them are the Threatened (T) and Priority (P1, P2, P3 and P4) Flora taxa in the results of searches of three Department of Parks and Wildlife (DPaW) databases. Thirteen (13) of them are the Threatened (CR, EN, VU) flora taxa in the results of searches of federal databases with the EPBC Act Protected Matters Search Tool. One of them, *Dielsia stenostachya,* is listed in *Bush Forever* (2000, Volume 2, Table 13) as an **e** species ('taxa endemic to the Swan Coastal Plain').

The taxa in the results of DPaW searches of the TPFL and WAHerb databases were recorded within 10 km of a point with the coordinates 31°37'45" S and 115°44'51" E. Target locality names in the DPaW searches of the TPlist database are Mariginiup, Nowergup, Neerabup, Carabooda, Carramar, Tamala, Clarkson, Ridgewood, Merriwa, Mindanie, Jindalee, Butler, Alkimos, Yanchep, Gnangara-Moore and Eglinton.

The EPBC CR, EN and VU taxa were recorded within 10 km of a point in the survey area with the coordinates 31°37'45" S and 115°44'51" E. It is the same point as the one at the centre of the DPaW database searches.

The twelve (12) taxa in the EPBC search results that are not in the DPaW search results are italicised in Table A1. Only *Eucalyptus argutifolia*, which is not italicized in Table A1, is in both sets of search results.

Epiblema grandiflorum var. *cyaneum* and *Anigozanthos viridis* subsp. *terraspectans* are in the EPBC search results. However, Western Australian Herbarium botanists no longer recognise this variety of *Epiblema grandiflorum* or this subspecies of *Anigozanthos viridis* (Thiele 2011). Neither is listed in FloraBase (2014, 2015) as Threatened or Priority.

The taxa listed in Table A1 are the principal, but not only, taxa searched for in the field search area in 2014-2015. The table also provides information about conservation codes, distributions, locality records, growth forms, habitats and flowering times for at least some of these taxa. The information about distributions, localities, growth forms, habitats and flowering times is not always comprehensive, but information about habitat is at least indicative and should help in assessing how likely species of rare flora are to occur in the survey area.

The Table A1 list of taxa was compiled principally from the results of searches of three databases carried out by the Species and Communities Branch of the DPaW in March 2014, and from FloraBase. The three DPaW databases are Threatened and Priority Flora (TPFL), Threatened and Priority Flora List (TPlist) and Western Australian Herbarium Specimen (WAHerb). The point coordinates given to the DPaW as the centre of the databases search area are:

Coordinates: 31°37'45" S and 115°44'51" E

The results of the database searches also provided some information about conservation codes, localities and distributions, habitats and flowering times. Additional information in the table was obtained from examination of herbarium specimens and their labels in the Western Australian Herbarium, consultations with other botanists, information in FloraBase (2014, 2015), Marchant *et al.* (1987), Brown *et al.* (2013), Department of Parks and Wildlife (2013a) and relevant parts of the *Flora of Australia* and *How to Know Western Australian Wildflowers*. These references are listed in the report to which this is Appendix A.

2.0 ATTACHMENT TO APPENDIX A (Follows Table A1)

Extract from the 'Australian Government Department of Environment (DoE) EPBC Act Protected Matters Report' for a 20 km wide circular area centred on Lat. -31°37'45" S and Long. 115°44'51" E (-31.62917 115.7475).

A report was generated by the Department of Environment (2014) EPBC Act Protected Matters Search Tool (http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst-coordinate.jsf) for a 20 km wide area centred on a point in the survey area with the coordinates -31°37'45" S and 115°44'51" E. That report lists two threatened ecological communities (Aquatic Root Mat Community in Caves of the Swan Coastal Plain, and Sedgelands in Holocene dune

swales of the southern Swan Coastal Plain) and 13 taxa of Threatened flora. The 13 taxa of Threatened Flora are listed in the Attachment. None of these taxa, except possibly *Eucalyptus argutifolia*, occurs near the search area.

The EPBC "Aquatic Root Mat Community in Caves of the Swan Coastal Plain" threatened ecological community (TEC) is the same as the Department of Parks and Wildlife's "24. CAVES SCP01 Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain" - which has a "Category of Threat and criteria met under WA criteria" of CR B) i) and CR B) ii) and is on the List of Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment (Department of Parks and Wildlife 2013b). It is probably within and restricted to the LS2 karst belt described by Csaky (2003) in her report on karst hazards in the Wanneroo Area. Her Figure 2.1 shows LS2 karst in the southern half to two-thirds of Area C.

The EPBC "Sedgelands in Holocene dune swales of the southern Swan Coastal Plain" TEC is the same as the Department of Parks and Wildlife's FCT 19 ("4. SCP19 Sedgelands in Holocene dune swales of the southern Swan Coastal Plain" - which has a "Category of Threat and criteria met under WA criteria" of CR B) ii) and is on the List of Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment Department of Parks and Wildlife 2013b). According to Gibson *et al.* (1994, p. 41), is a wetland community restricted to coastal dune swales south of Perth.

3.0 CONSERVATION CODES DEFINITIONS (summary of definitions in Smith 2013)

T**:** **Threatened Flora** (Declared Rare Flora – Extant). Listed under Schedule 1 of the Wildlife Conservation (Rare Flora) Notice. [Gazetted]

X**:** **Presumed Extinct Flora** (Declared Rare Flora – Extinct). Listed under Schedule 2 of the Wildlife Conservation (Rare Flora) Notice. [Gazetted]

http://dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/84-listing-of-species-and-ecological-communities should have the Wildlife Conservation (Rare Flora) Notice.

Threatened Flora (Schedule 1) are further recognised by the Department according to their level of threat using IUCN Red List criteria, which are the three EPBC Act Threatened Codes in Appendix A's Table A1 and its Attachment:

CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild.
EN: Endangered –considered to be facing a very high risk of extinction in the wild.
VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

*Taxa = plural of taxon (a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies, variety or forma). Loosely: = 'species'

P1**:** **Priority One: Poorly-known species/taxa**

Species/Taxa that are known from one or a few collections (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas,

P2**:** **Priority Two: Poorly-known species/taxa**
Species/Taxa that are known from one or a few collections, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks,

P3**:** **Priority Three: Poorly-known species/taxa**
Species/Taxa that are known from collections from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat.

P4**:** **Priority Four: Rare, Near Threatened and other species/taxa in need of monitoring**
(a) Rare. Species/Taxa that are considered to have been adequately surveyed,
(b) Near Threatened. Species/Taxa that are considered to have been adequately surveyed.
(c) Species/Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

P5**:** **Priority Five: Conservation Dependent species/taxa**
Species/Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species/taxa becoming threatened within five years.

4.0 SIGNIFICANCE CODES DEFINITIONS

(from *Bush Forever* 2000, Volume 2, Table 13, pp. 51-55)

d = populations disjunct from their known geographic range;
e = taxa endemic to the Swan Coastal Plain;
p = considered to be poorly reserved (applies to all DRF and Priority taxa);
r = populations at the northern or southern limit of their known geographic range;
s = significant populations;
E = taxa endemic to the Swan Coastal Plain in the Perth Metropolitan Region;
X = taxa considered lost in the Perth Metropolitan Region

5.0 DEFINITION OF *

An asterisk (*****) preceding an italicised two-word scientific name indicates that the name is of an established alien species, an environmental weed.

Table A1

Threatened and Priority Flora Recorded in the Broader Vicinity of the Nowergup Search Area

(based mainly on results of March 2014 DPaW database searches and on FloraBase (mainly April 2014); the 12 italicised entries in the **Taxon** column are in EPBC, but not DPaW, search results; only *Eucalyptus argutifolia* is in both sets of search results)

WA-Herb	TP-FL	TP-list	Taxon	Status & Rank	Family	Distribution / Localities	Flower period	Form	Plant Description and Habitats
-	X	-	Acacia benthamii	P2	Faba	Wanneroo, Kings Park, Stake Hill	Aug-Sep	ShM	Shrub, ca 1 m high. Phyllode rigid, acicular to stem. Fl. yellow. Typically on limestone breakaways. Sand.
X	X	-	Adenanthos cygnorum subsp. chamaephyton	P3	Prot	Chidlow, Collie, Bindoon, Muchea	(Jul)Sep-Dec(Jan)	ShS	Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Fl. white-cream-pink-green/green. Grey sand, lateritic gravel.
-	-	-	*Andersonia gracilis*	EN T	Eric	Kenwick, Badgingarra, Nambung, Swan View	Sep-Nov	ShS	**Slender Andersonia**. Slender erect or open straggly shrub, 0.1-0.5(-1) m high; flower white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.
-	-	-	*Anigozanthos viridis* subsp. *terraspectans*	VU --	Haem	Cataby	Aug-Sep (-Nov)	He	**Dwarf Green Kangaroo Paw**. subsp. *terraspectans* is no longer an accepted taxon
X	-	X	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1	Myrt	Wanneroo, N Beach, Scarborough, Yanchep, Marmion, Edgewater	Jul-Dec	ShM	Erect glabrous shrub <2.5 m tall; lvs not clustered, subsessile, 3-5 mm long; blade linear to narrowly elliptic, often 3-angled, recurved, the upper surface concave. Sandy soils and coastal limestone areas. (= *B. robusta* in Marchant *et al.* 1987, p. 383)
-	-	-	*Caladenia huegelii*	EN T	Orch	Perth-Capel	Aug-Oct	He	**King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid**. Lrge, few-fled spider orchid. Lves & stm w. lng thin spreading hairs at base. Label lrge, dark rd (& wh) w lng fringing hairs that are usually wh and often divided at tip;. Sandy (to clay-loam?) soils in banksia and eucalypt woodlands and open forests, usually low in the landscape and, near Perth, often have *Dasypogon*.
X	X	-	Calectasia sp. Pinjar (C. Tauss 557)	P1	Dasy	Pinjar (Wanneroo)	Jul-Oct	H	< 0.5 m high, w. multiple stems & stilt roots and bright ppl-blue fls. Deep grey quartz soils. Gentle slopes, above damplands.
-	-	-	*Centrolepis caespitosa* Matted Centrolepis	EN P4	Cent	S Stirling, Pearce, (Byford), Youngs Siding, Orange Grove	Oct-Dec (Nov)	He	Tufted annual, herb (forming a rounded cushion up to 25 mm across). White sand, clay. Salt flats, wet areas.
-	-	X	Conostylis bracteata	P3	Haem	Mullaloo, Breton Bay, Guilderton, Yanchep	Jul-Aug (-Sep)	H	Rhizomatous, tufted or shortly proliferous herb, <0.5 m high. Fl. yl. Sand, limestone. Consolidated sand dunes.
X	X	X	Conostylis pauciflora subsp. euryrhipis	P4	Haem	Yanchep, Lancelin, Seabird, Wilbinga	Jul (Aug-Oct)	H	Rhizomatous, stoloniferous herb, <0.2 m high. Fl. yl. White, grey or yellow sand. Consolidated dunes.
X	X	-	Cyathochaeta teretifolia	P3	Cype	Muchea-Denbarker, Margaret R, Casuarina	Dec	Se	Seasonally wet creeks and swamps, often with paperbarks, *Eucalyptus rudis*, bracken, *Homalospermum* and *Agonis* trees or tall shrubs. Black peaty soil.
-	-	-	*Darwinia foetida* = D. sp. A Perth Flora	CR T	Myrt	Chittering & Swan LGAs, Muchea	Oct-Dec	ShS	**Muchea Bell**. Erect shrub <50 cm tall; leaves small (ca. 0.5x5mm); inflorescence pendulous & reddish bracts hide flowers; in *D. neildiana* complex. Sand on E side of SCP.
-	-	-	Dielsia stenostachya	e[1]	Rest	Gingin-Pinjarra-Yalgorup	Feb-May	Sc	Rhizomes rufous furry. Sandy winter-wet depressions and flats & along watercourses.
-	-	-	*Diuris micrantha*	EN T	Orch	Medina, Yarloop, Yunderup, Manjimup	(Aug-) Sep(-Oct)	H	**Dwarf Bee-orchid**. Swamp. Black peaty soil. Miscellaneous rushes and sedges. Among dense native sedges (mainly *Lepidosperma* spp.) in shallow water in swampy flats.
-	-	-	*Diuris purdiei*	EN T	Orch	Perth-Waroona, Busselton	Sep-Oct	He	**Purdie's Donkey-orchid**. Slender donkey orchid with 5-10 narrow, spirally twisted leaves. Seasonally wet, recently burnt sand over clay, shrublands, usually of *Regelia* and *Pericalymma*.

[1] Listed in *Bush Forever* (2000, Volume 2, Table 13) as an e species ('taxa endemic to the Swan Coastal Plain').

WA-Herb	TP-FL	TP-list	Taxon	Status & Rank	Fam-ily	Distribution / Localities	Flower period	Form	Plant Description and Habitats
-	-	-	*Drakaea elastica*	EN T	Orch	Albany-Busselton-Gingin	Oct-Nov	He	**Glossy-leafed Hammer-orchid, Praying Virgin**. Deep grey sand on gradual slopes in undulating plain. Low woodland of *B. attenuata, B. menziesii, B. ilicifolia* and Jarrah over scrub of *Adenanthos cygnorum* and *Kunzea* over herbs. On deep sand low in the landscape, often under spearwood and banksias adjoining winter-wet swamps.
-	-	-	*Drakaea micrantha*	VU,T	Orch	Perth-Augusta-Albany	Sep-Oct	He	**Dwarf Hammer-orchid**. Tuberous, perenn, herb, 0.15-0.3 m high; fl red & yl. White-grey sand.
X	-	-	Drosera x sidjamesii	P1	Dros	Gnangarra, Wanneroo, Beechboro	Nov-Dec (Jan-Mar)	H	Fibrous-rooted pygmy sundew <0.06 m high. Fl. green-pink. Peaty sand. Along lake margins, close to winter high-water line.
-	-	-	*Epiblema grandiflorum* var. *cyaneum*	EN	Orch	Esperance Plains, Jarrah Forest, SCP, Warren	Nov-Dec or Jan	He	**Baby Blue Orchid, Blue Babe-in-the-cradle Orchid, Blue Babe-in-a-cradle.** var.. *cyaneum* is no longer an accepted taxon
X	X	X	*Eucalyptus argutifolia*	EN T	Myrt	Lancelin, Yalgorup, Seabird, Jurien, Yanchep	Mar-Apr	M	**Yanchep Mallee, Wabling Hill Mallee**. Mallee, to 4 m high, bark smooth. Buds angled; caps rounded. Fl. wh. Shallow soils over limestone. Slopes or gullies of lmestne ridges, outcrops.
X	X	-	Fabronia hampeana	P2	Fabr	28 km NNW of Perth, Bold Park, Windy Harbour, Esperance	-	moss	Distinctly silvery green moss. Lvs imbricate, linear-lanceolate, <1.0 mm long; apex a long hairpoint; margins plane and covered with very long single-celled wavy cilia < 150 µm long. On *Macrozamia* trunk. (cf. Scott & Stone, 1976, p. 433)
-	-	-	*Grevillea curviloba* subsp. *incurva*	EN T	Prot	Muchea, Eneabba, Gingin	(Jul-) Aug-Sep	ShM	**Narrow curved-leaf Grevillea**. Shrub to 2.5m; leaf simple, blade deeply tripartite to midvein, margins revolute, enclosing the lower surface of the blade; infl an axillary or terminal raceme; fls white or cream, regular. Amongst low trees or in tall (sclerophyll) shrubland; in sand or clay; winter wet flats.
-	-	X	Grevillea evanescens	P1	Prot	Yanchep, Lancelin to Gingin (mainly W of Gin..)	Winter-Spring	ShT	Erect shrub, <4 m high. Lvs simple, <35 x <10 mm, undissected, flat, obovate. Margins entire, flat. Fls red. Brown Spearwood sand [on ridges in Banksia woodland], loam, or clay; winter wet flats.
-	-	X	Haloragis sp. Parrot Ridge (G.J. Keighery 11563) PN	P1	Halor	Yanchep	(Sep-)Oct	H?	Erect soft shrub or herb to 30 cm; lf margin toothed; few fls, many buds at end of Sept. *Melaleuca* tall closed shrubland. Black sand over limestone.
X	X	-	Hibbertia spicata subsp. leptotheca	P3	Dill	Yalgorup, Lancelin, Burns Beach, Cataby	Jul-Oct	ShS	Erect or spreading, to 0.5 m high. Fl. yellow. Sand. Near-coastal limestone ridges, outcrops & cliffs.
X	-	X	Jacksonia sericea	P4	Faba	Perth, Mandurah-Pinjarra, Neerabup NPk	Dec (-Feb)	ShS	Low spreading to prostrate shrub to 0.6(-1) m high; pungent branchlets rare or absent; fl wings & standard orange. Standard lamina <7mm. Sand over limestone.
-	-	X	Lasiopetalum membranaceum	P3	Malv	Yalgorup, Capel, Yanchep	Sep-Dec	ShM	Multi-stemmed, to 1 m high. Fl. pink-blue-purple. Sand over limestone.
-	-	X	Lecania sylvestris	P2	Bacid /Ram	Yanchep NPk	Aug	-	Lichen, saxicolous; thallus white. Roadside in Picnic area N of Yanchep NPk.
-	-	X	Lecania turicensis var. turicensis	P2	Bacid /Ram	Yanchep NPk, Burns Beach, Eastern States	-	-	Lichen, saxicolous. A lichenized Ascomycete fungus; coastal rocks, limestone.
-	-	X	Lepidium pseudotasmanicum	P4	Bras	Yanchep, Wongan Hills, Denmark, Porongurup, Stirling Rnge, Lke Clifton	Feb or Dec	H	Erect annual or biennial herb, <1 m high. Fl. white-green. Loam, sand. Various habitats, including Tuart forest on sand over limestone.
-	-	-	*Lepidosperma rostratum*	EN T	Cype	Cannington, Kenwick, Forrestdale Lake NR	Aug	Se	**Beaked Lepidosperma**. Erect tufts to 0.5m tall; base fibrous, dull pale brown; infl. erect, spicate. Palusplain grey clay to sandy clay, peaty sand.
-	-	X	Leucopogon maritimus	P1	Eric	Burns Beach, Yanchep, Two Rocks	(Nov-)Apr-Jun(-Aug)	ShS	Low, spreading shrubs to c 40 cm high and 60 cm wide, often multi-stemmed close to the base . Lvs antrorse, narrowly elliptic; petioles cream or yl; apex acute or subacute. Infls erect, term & upper-axillary, often aggregated into compact conflorescence; corolla lobes white, much longer than the tube. Deep calcareous sand on mid- to upper slopes or shallow sand over limestone. Near-coastal Quind. dunes 40 to 70 km N of Perth. (= *L.* sp. Perth coastal) (M. Hislop 2011. New, locally endemic taxa in *Leucopogon*.. *Nuytsia* 21(2): 75–89).

WA-Herb	TP-FL	TP-list	Taxon	Status & Rank	Family	Distribution / Localities	Flower period	Form	Plant Description and Habitats
X	-	X	Leucopogon sp. Yanchep (M. Hislop 1986)	P3	Eric	Moore Riv-Gnangara; Neerabup, Yanchep NPk	Apr-Jun (-Sep)	ShS	Erect, spreading shrub, 0.15-1 m high, to 0.6 m wide. Lvs short, rigid, pungent, spreading (at rt radially angles to stem to reflexed), fl sm, wh/pink, more tubular & pendant than *L. racemulosus*, frts symmetrical. Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills. (=*Leucopogon* sp. A in Marchant *et al.* 1987, p. 193)
-	X	-	Marianthus paralius	EN,T	Pitt	Seabird	Sep(-Nov)	V?	+/- prostrate, eventually scandent, woody shrub. Fl. rd. White snd over limestone. Low coastal cliffs.
X	-	-	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	P1	Myrt	Wanneroo	Dec	Sh	Similar to *Melaleuca systena,* but the leaves broader and the inflorescences more compact. Limestone ridges.
X	-	X	Pimelea calcicola	P3	Thym	Yanchep-Yalgorup	Sep-Nov	Sh	Erect to spreading, to 1 m high. Fl. pink. Sand. Coastal limestone ridges.
X	-	-	Pithocarpa corymbulosa	P3	Aste	John Forrest NPk, Dardanup, Busselton	Jan-Apr	H	Erect to scrambling perennial, herb, 0.5-1 m high. Fl. white. Gravelly or sandy loam. Amongst granite outcrops.
-	-	X	Placynthium nigrum	P3	Plac	Yanchep NPk, Mt Percy, Eastern States	-	-	Lichen, crustose, on rock; thallus black, rough or slick-like. Roadside in Picnic area N of Yanchep NP. [not yet in *Flora of Australia.*]
-	-	X	Rinodina bischoffii	P2	Phys	Yanchep NPk	-	-	Lichen, crustose, saxicolous; thallus white, probably small (1-2 cm) & with small black apothecia. Roadside in Picnic area N of Yanchep NP.
X	-	X	Sarcozona bicarinata	P3	Aizo	Hepburn Hts, Yanchep, Seabird, Esperance, Guilderton, S. Aust	-	ShSm	Small erect or semi prostrate, annual or short-lived perennial shrubs, leaves often dull, dark red, triquetrous (*Carpobrotus*-like) and densely covered with small warts or pellucid dots, flowers large, pale pink to white, styles 5 (to 4). Stabilised dunes or limestone; more common after fire.
-	-	X	Sphaerolobium calcicola	P3	Faba	Yalgorup, Yanchep, Safety Bay, Denmark	Jun/Sep-Nov	ShS	Slender, multi-stemmed, scandent or erect, to 1.5 m. Fl. orng-rd. Wh-grey-brwn snd, sndy clay over limestone, black peaty sndy clay. Tall dnes, winter-wet flts, interdnal swmps, low areas.
X	-	-	Stenanthemum sublineare	P2	Rham	Bullsbrook	Oct-Dec	ShS	Erect shrub, to 0.1 m high. Fl. green. Littered white sand. Coastal plain.
X	X	-	Stylidium longitubum	P3	Styl	Bullsbrook, Midland, Busselton, Arthur R	Oct-Dec	HeS	**Jumping Jacks.** Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink. Sandy clay, clay. Seasonal wetlands.
X	X	-	Stylidium maritimum	P3	Styl	Yalgorup – Breton Bay, Cervantes, Bold Park	Sep-Nov	He	Caespitose perennial, to 0.7 m high, Lves tufted, linear to narrowly oblanceolate, 10-40 cm long, 1-5.5 mm wide, apex acute to mucronate, margin involute, glabrous. Membraneous scale lves at base of mature leaves. Scape glandular throughout. Inflorescence paniculate. Fl. white/purple. Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.
X	X	-	Tripterococcus paniculatus	P4	Celas	Cannington, Upper Swan, Busselton	(Oct-)Nov	H	Herb to 1 m high. Fl. yellow-green. Grey, black or peaty sand. Winter-wet flats.

Abbreviations used in table: Columns 1, 2, 3: in DPaW 2014 database search results: WAHerb – *Western Australian Herbarium Specimen* database; TPFL – *Threatened and Priority Flora* database; TPlist – *Threatened and Priority Flora List* database. **Column 4**: Taxon – Species, subspecies or variety. **Column 5**: Status & Rank codes - CR, EN, VU – EPBC Act Threatened Flora; T – DPaW Threatened Flora; P1, P2, P3, P4 – DPaW Priority Flora. **Column 6**: Family – abbreviations of the family names currently in use in the Western Australian Herbarium; e.g. Orch is Orchidaceae, Myrt=Myrtaceae, Acacia is in Fabaceae, Andersonia is in Ericaceae. **Column 7**: Distribution / Localities – Not necessarily complete listings. **Column 8**: Flower period. **Column 9**: Form [of plant]: He – herbaceous plant; Se – sedge; Sh – shrub. Height of shrubs: S – short; M – mid height (ca. 1-2 m); T – tall; V – vine. **Column 10**: Description and Habitats.

ATTACHMENT TO APPENDIX A
EPBC Act Protected Matters Report

Australian Government Department of Environment EPBC Act Protected Matters an area around Lat. -31°37'45" S and Long. 115°44'51" E (PMST_SH5CJ0.pdf) edited

Database Search Area (buffer = 10 km radius): -31.62917 115.7475

Area Searched:

Matters of National Environmental Significance

Plants (Threatened Species):	Status	Type of Presence
Andersonia gracilis Slender Andersonia	Endangered (DPaW-T)	Species or species habitat may occur within
Anigozanthos viridis subsp. *terraspectans* Dwarf Green Kangaroo Paw	Vulnerable (DPaW--)	Species or species habitat likely to occur wi 2 entries. 1 says "current"; the other says the an error and should not be used. (FloraBase
Caladenia huegelii King or Grand Spider-orchid	Endangered (DPaW-T)	Species or species habitat likely to occur wi
Centrolepis caespitosa Matted Centrolepis	Endangered (DPaW-P4)	Species or species habitat may occur within
Darwinia foetida Muchea Bell	Critically E (DPaW-T)	Species or species habitat likely to occur wi Only Muchea area. NNE of Perth.
Diuris micrantha Dwarf Bee-orchid	Endangered (DPaW-T)	Species or species habitat likely to occur wi
Diuris purdiei Purdie's Donkey-orchid	Endangered (DPaW-T)	Species or species habitat may occur within
Drakaea elastica Glossy-leaved Hammer-orchid	Endangered (DPaW-T)	Species or species habitat likely to occur wi
Drakaea micrantha Dwarf Hammer-orchid	Vulnerable (DPaW-T)	Species or species habitat likely to occur wi
Epiblema grandiflorum var. *cyaneum* Blue Babe-in-the-cradle Orchid	Endangered (DPaW--)	Species or species habitat may occur within Use *Epiblema grandiflorum* only; name *E. g* is not current. (FloraBase 2015)
Eucalyptus argutifolia Curved-leaf Grevillea	Endangered (DPaW-T)	Species or species habitat known to occur w
Grevillea curviloba subsp. *incurva* Narrow curved-leaf Grevillea	Endangered (DPaW-T)	Species or species habitat likely to occur wi (FloraBase 2015) shows it as only N of Pert
Lepidosperma rostratum Beaked Lepidosperma	Endangered (DPaW-T)	Species or species habitat likely to occur wi
Listed Threatened Ecological Communities:		
Aquatic Root Mat Community in Caves of the Swan Coastal Plain	Endangered	Community known to occur within ar
Sedgelands in Holocene dune swales of the southern SCP	Endangered	Community known to occur within ar

APPENDIX B
Vascular Flora Species Lists

Table B1 lists all species

- listed in the 26a column of Table 12, Gibson *et al.* (1994),
- listed in Weston and Gibson (1997, Appendix 1), and
- recorded in 2014 and 2015 in the Nowergup Lots 102-104 survey area.

Table B1, like Table 12 in Gibson *et al.* (1994, Table 12, Community Type Column 26a), indicates to which species group – Q, A, O, J, P, B or L – each of the 98 species referred to by Gibson *et al.* as being represented in the 11 Swan Coastal Plain (SCP) FCT 26a Quadrats species has been assigned and gives the quadrat frequency of each species. There were originally 11 quadrats analysed by Gibson *et al.* (1994) as being FCT 26a, but there is no list in the Gibson *et al.* report indicating in which quadrat(s) each species was recorded. The 1994 report's Appendix 4 lists all quadrat sites and locations, including, on pages 225 and 228, the two 26a quadrats that are probably the most similar or closest to sites in the Lots 102-104 survey area. These two 100 m^2 quadrats are SVH-1 and YAN-2. Their locations, along with locations of other FCTs, are listed below in the preamble to Table B2.

Table B2, like Table B1, lists and yellow-highlights 17 high-frequency species. In its 'Taxon Name' column, Table B2 also lists 14 other non-high-frequency, non-highlighted species. Presence or absence of some of these 31 species and other taxa may be useful in distinguishing FCT 26a from the other FCTs in the table.

Table B1
All Species listed in Gibson *et al.* (1994; Table 12, Column 26a) or listed in Weston and Gibson (1997, Appendix 1) or recorded by Weston in Nowergup SurveyArea, in 2014-2015

Species/taxa recorded in:

- one or more of the 11 FCT 26a (limestone ridges) Quadrats of Gibson *et al.* (1994 Table 12, Column 26a) [recorded in at least 50% of quadrats of any one Floristic Community Type (FCT), not necessarily FCT 26a] ,
- one or more of the fifteen 100 m^2 quadrats established in 1996 on major lime-stone ridges in Yanchep National Park and the proposed Ridges extension of the park and in three other areas north of there (Reserves 59411 and 39412 and the Wabling Hill area) (Weston and Gibson, 1997, Appendix 1), and/or
- the Nowergup Lots 102-104 survey/search area.

KEY:

G '94	The 98 species (& vars & affs) referred to in Gibson *et al.* (1994, Table 12, Community Type Column 26a) as being represented in the 11 Swan Coastal Plain (SCP) FCT 26a Quadrats.
Sp Grp	The Gibson *et al.* (1994, Table 12) Species Group to which each of the 98 species referred to in the first column belongs,
% Qs	Frequency in FCT 26a Quadrats of each of the 98 species referred to in the first column.
	Species frequency in Community Type 26a Quadrats (from Gibson *et al.* 1994 Table 12, Column 26a) of 82%, 91% or 100%. Total: 17 species (also see Appendix B, Table B3).
WG'97	The 225 species and other taxa listed in Weston and Gibson (1997, Appendix 1).
CD'14	The 132 (+ the 36 in the N2 column) species recorded in Area **C** and/or Area **D,** most in the April-June 2014 period. **C,D 2014 = CD'14**
N2	Recorded in the Lots 102-104 survey area between October 2014 and April 2015, but most not recorded in Area C or Area D or the total survey area before then.
L	Species collected by L Stephens on Limestone Ridges in Area C, most of them IDed by him.
***/P**	Alien species or, if **P3** or **P4**, a Priority 3 or Priority 4 species.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
			X			*Acacia cyclops*	Faba.
A	82	X	X			*Acacia lasiocarpa var. lasiocarpa*	Faba.
				X		*Acacia podalyriifolia*	Faba.
O	9	X	X			*Acacia pulchella*	Faba.
A	9	X	C			*Acacia rostellifera*	Faba.
			X			*Acacia saligna*	Faba.
A	36					*Acacia truncata*	Faba.
		X	C			*Acanthocarpus preissii*	Aspa.
Q	73	X	C		*	*Aira caryophyllea/cupaniana*	Poac.
			C			*Alexgeorgea nitens*	Rest.
			C			*Allocasuarina fraseriana*	Casu.
		X	X			*Allocasuarina humilis*	Casu.
O	9	X				*Anigozanthos humilis*	Haem.
		X				*Anigozanthos manglesii*	Haem.
			X		*	*Asparagus asparagoides* (few)	Aspa.
			C?			Asteraceae sp. 1	Aste.
			C?			Asteraceae sp. 2	Aste.
			C?			Asteraceae sp. 3	Aste.
		X				*Asteridea athrixioides* (=Asteridea morawana??)	Aste.
A	36			C		*Astroloma microcalyx*	Eric.
Q	55	X				*Austrostipa compressa* (=Stipa compressa)	Poac.
				C		*Austrostipa elegantissima*	Poac.
A	91	X	L			*Austrostipa flavescens* (=Stipa flavescens)	Poac.
			L			*Austrostipa hemipogon*	Poac.
		X				*Austrostipa pycnostachya* (=Stipa pycnostachya)	Poac.
		X				*Austrostipa tenuifolia* (=Stipa tenuifolia)	Poac.
				C		*Austrostipa* sp. (caryopses golden-brwn hairy) 2/2	Poac.
		X			*	*Avellinia michelii*	Poac.
				C	*	*Avena barbata 2/2*	Poac.
			X		*	*Avena* sp.	Poac.
		X				*Baeckea robusta*	Myrt.
		X	X			*Banksia attenuata*	Prot.
			X			*Banksia grandis*	Prot.
			X			*Banksia menziesii*	Prot.
Q	73	X	X			*Banksia nivea* (=Dryandra n.) [B. lindleyana (=D. l.)	Prot.
A	91	X	X			*Banksia sessilis* (=Dryandra sessilis)	Prot.
		X				*Beyeria cinerea*	Euph.
		X				*Billardiera heterophylla* (=Sollya heterophylla)	Pitt.
		X				*Boronia ramosa* subsp. *anethifolia*	Ruta.
O	18	X	C			*Bossiaea eriocarpa*	Faba.
		X	L			*Brachyscome iberidifolia* X	Aste.
Q	18		X		*	*Briza maxima*	Poac.
				X	*	*Briza minor*	Poac.
		X				*Bromus arenarius*	Poac.
		X			*	*Bromus diandrus*	Poac.
				X	*	*Bromus madritensis*	Poac.
		X	X			*Burchardia congesta* (=Burchardia umbellata)	Colc.
		X				*Caladenia bicalliata*	Orch.
Q	9	X		X		*Caladenia flava*	Orch.
A	9	X		X		*Caladenia latifolia*	Orch.
		X		?		*Caladenia longicauda* subsp. *calcigena*	Orch.
		X				*Caladenia reptans*	Orch.
			X			*Caladenia* sp. (only 1 leaf)	Orch.
				X		*Caladenia* sp.	Orch
A	27	X	?			*Calandrinia brevipedata*	Port.
X		X	?			*Calandrinia corrigioloides* (prostrate, succ., fl sm)	Port.
		X	?			*Calandrinia granulifera* (Pygmy Purslane)	Port.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
		X				*Calandrinia liniflora* (Parakeelya)	Port.
			X			*Calectasia narragara*	Dasy.
		X	C			*Calothamnus quadrifidus*	Myrt.
		X	?X			*Calytrix strigosa*	Myrt.
		X	X		*	*Carpobrotus edulis*	Aizo.
		X				*Carpobrotus virescens*	Aizo.
O	27	X	X			*Cassytha flava*	Laur.
Q	36					*Cassytha glabella*	Laur.
Q	27	X				*Cassytha racemosa*	Laur.
			L		*	*Centaurium erythraea*	Gent.
				C	*	*Centaurium ?tenuiflorum* 2/3	Gent.
Q	9	X				*Centrolepis drummondiana*	Cent.
A	45	X			*	*Cerastium glomeratum*	Cent.
				X	*	*Chamaecytisus palmensis*	Faba.
			X		*	*Cirsium vulgare*	Aste.
A	9					*Comesperma confertum*	Poly.
		X	C			*Comesperma integerrimum* (twiner or climber)	Poly.
		X				*Conospermum stoechadis*	Prot.
		X				*Conospermum triplinervium*	Prot.
		X	C			*Conostephium pendulum*	Eric.
			L			*Conostylis aculeata* C 1/2	Haem.
A	18	X	X			*Conostylis candicans*	Haem.
			L			*Conostylis candicans* subsp. *calcicola*	Haem.
			L			*Conostylis candicans* subsp. *candicans*	Haem.
		X			P4	*Conostylis pauciflora* subsp. *euryrhipis*	Haem.
P	18	X	C			*Conostylis setigera*	Haem.
			C			*Conostylis* sp. (C. ?aculeata)	Haem.
			X		*	*Cortaderia selloana*	Poac.
		X				*Corynotheca micrantha* [var. *micrantha*]	Heme.
Q	64	X				*Crassula colorata*	Cras.
		X				*Crassula exserta*	Cras.
A	18	X			*	*Crassula glomerata*	Cras.
		X				*Cyrtostylis huegelii*	Orch.
P	9					*Dampiera linearis*	Good.
A	91	X	L			*Daucus glochidiatus*	Apia.
		X	L			*Daviesia divaricata*	Faba.
		X		C		*Desmocladus asper* (=Loxocarya aspera MS) 2/3	Rest.
			X			*Desmocladus fasciculatus*	Rest.
Q	100	X	X			*Desmocladus flexuosus* (=Loxocarya flexuosa)	Rest.
		X	X			*Dianella revoluta*	Heme.
			C			*Diplolaena angustifolia*	Ruta.
		X				*Diplopeltis huegelii*	Sapi.
A	73	X			*	*Dischisma arenarium*	Orob.
		X				*Dodonaea aptera*	Sapi.
Q	36	X	C			*Drosera erythrorhiza*	Dros.
		X				*Drosera glanduligera*	Dros.
Q	36	X	?C			*Drosera macrantha*	Dros.
O	18	X				*Drosera menziesii* subsp. *penicillaris*	Dros.
		X				*Drosera pallida*	Dros.
Q	18					*Drosera stolonifera*	Dros.
		X			*	*Ehrharta brevifolia*	Poac.
		X	X		*	*Ehrharta calycina*	Poac.
		X	?L		*	*Ehrharta longiflora*	Poac.
		X				*Elythranthera brunonis* (fls purple)	Orch.
			X		*	*Eragrostis curvula*	Poac.
		X				*Eremaea pauciflora*	Myrt.
		X				*Eremophila glabra*	Scro.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
Q	82	X	C			*Eriochilus dilatatus*	Orch.
		X	X		*	*Erodium botrys*	Gera.
		X	C			*Eucalyptus decipiens*	Myrt.
		X				*Eucalyptus foecunda*	Myrt.
			X			*Eucalyptus marginata*	Myrt.
			X			*Eucalyptus todtiana*	Myrt.
		X				*Euchiton sphaericus* (=Gnaphalium sphaericum)	Aste.
			X		*	*Euphorbia terracina*	Euph.
A	27	X		X	*	*Galium murale*	Rubi.
B	27					*Geranium retrorsum*	Gera.
Q	9	X	X		*	*Gladiolus caryophyllaceus*	Irid.
Q	55	X	X			*Gompholobium tomentosum*	Faba.
A	100	X	X			*Grevil. preissii* (=G. thelemanniana subsp. pr.)	Prot.
			C			*Grevillea vestita*	Prot.
		X				*Haemodorum laxum*	Haem.
		X	X			*Haemodorum paniculatum*	Haem.
		X	X			*Haemodorum spicatum*	Haem.
Q	27	X	X			*Hakea trifurcata*	Prot.
		X	X			*Hakea costata*	Prot.
		X		C		*Hakea lissocarpha* 1/2	Prot.
		X				*Hakea prostrata*	Prot.
		X				*Hakea ruscifolia*	Prot.
				X		*Hakea* sp.	Prot.
A	55	X	C			*Hardenbergia comptoniana*	Faba.
A	73	X			*	*Heliophila pusilla*	Bras.
			C			*Hemiandra glabra*	Lami.
		X				*Hemiandra pungens*	Lami.
		X				*Hemigenia barbata*	Lami.
		X	?C			*Hibbertia huegelii*	Dill.
Q	9	X	X			*Hibbertia hypericoides*	Dill.
Q	36	X				*Hibbertia racemosa*	Dill.
A	9					*Hibbertia spicata* subsp. *leptotheca*	Dill.
Q	36	X				*Homalosciadium homalocarpum*	Apia.
			C			*Hovea trisperma*	Faba.
Q	45	X				*Hyalosperma cotula*	Aste.
Q	27	X		X		*Hybanthus calycinus*	Viol.
		X				*Hydrocotyle blepharocarpa*	Aral.
		X				*Hydrocotyle callicarpa*	Aral.
		X				*Hydrocotyle diantha*	Aral.
A	73	X				*Hydrocotyle hispidula*	Aral.
		X				*Hydrocotyle pilifera* var. *glabrata*	Aral.
		X				*Hydrocotyle* sp. Coraginaensis (=H. capillaris)	Aral.
		X				*Hypocalymma angustifolium*	Myrt.
Q	91	X	C		*	*Hypochaeris glabra*	Aste.
			L			Iridaceae	Irid.
Q	27	X				*Isolepis marginata*	Cype.
		X				*Isotoma hypocrateriformis*	Camp.
				X		*Isotoma* sp. (in firebreak)	Camp.
Q	9	X				*Isotropis cuneifolia*	Faba.
			X			*Jacksonia calcicola*	Faba.
		X				*Jacksonia fasciculata* (=Jacksonia stricta)	Faba.
				X		*Jacksonia furcellata*	Faba.
			X			*Jacksonia ?sericea*	Faba.
			X			*Jacksonia sternbergiana*	Faba.
Q	9	X	X			*Kennedia prostrata*	Faba.
Q	9	X				*Lagenophora huegelii* (=Lagenifera huegelii, L. sp.)	Aste.
A	9			X	*	*Lagurus ovatus*	Poac.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
				C		*Laxmannia ?squarrosa* 1/1	Aspa.
		X	X			*Lechenaultia linarioides*	Good.
		X				*Lepidium lyratogynum*	Bras.
		X				*Lepidium rotundum*	Bras.
		X				*Lepidobolus preissianus*	Rest.
Q	45	X	C			*Lepidosperma angustatum* (L. ?angustatum)	Cype.
			L			*Lepidosperma costale*	Cype.
			C			*Lepidosperma ?scabrum*	Cype.
		X	?X			*Lepidosperma* sp. (BJK&NG 231)	Cype.
A	64	X	X			*Leucopogon parviflorus* (lf tip attenuate-pungent)	Eric.
		X				*Leucopogon polymorphus*	Eric.
		X	C			*Leucopogon propinquus*	Eric.
		X				*Levenhookia stipitata*	Styl.
I	9					*Lobelia alata* (= L. anceps)	Camp.
		X				*Lobelia heterophylla*	Camp.
		X	L			*Lobelia tenuior*	Camp.
				C		*Lobelia* sp.? ½	Camp.
A	45		?X			*Lomandra maritima*	Aspa.
		X	X			*Lomandra caespitosa*	Aspa.
			L			*Lomandra hermaphrodita*	Aspa.
			C			*Lomandra preissii*	Aspa.
			C			*Lomandra ?purpurea*	Aspa.
			C			*Lomandra sericea*	Aspa.
A	64	X	X		*	*Lysimachia arvensis* (=Anagallis arvensis)	Prim.
		X	X			*Macrozamia riedlei*	Zami.
A	82	X	C			*Melaleuca huegelii*	Myrt.
A	82	X	C			*Melaleuca systena* (=Melaleuca acerosa) (sht lf)	Myrt.
		X	X			*Mesomelaena pseudostygia*	Cype.
Q	18	X				*Microlaena stipoides*	Poac.
		X				*Microtis media*	Orch.
Q	91	X				*Millotia tenuifolia*	Aste.
		X			*	*Minuartia mediterranea* (=Minuartia hybrida)	Cary.
		X				*Mirbelia trichocalyx*	Faba.
		X				*Muehlenbeckia polybotrya*	Poly.
		X	C			*Nuytsia floribunda*	Lora.
		X				*Olax scalariformis*	Olac.
			X			*Olearia axillaris*	Aste.
Q	73	X	X			*Opercularia vaginata*	Rubia.
J	9				*	*Parentucellia viscosa*	Orob.
		X			*	*Parentucellia latifolia*	Orob.
A	55	X				*Parietaria debilis*	Urti.
			X			*Patersonia occidentalis*	Irid.
		X	X		*	*Pelargonium capitatum*	Gera.
		X				*Pelargonium littorale*	Gera.
			X			*Persoonia comata*	Prot.
		X				*Petrophile brevifolia*	Prot.
		X	X			*Petrophile linearis* (=Pixie Mops)	Prot.
		X	C			*Petrophile macrostachya*	Prot.
		X	C			*Petrophile serruriae*	Prot.
A	9	X	L		*	*Petrorhagia dubia* (= P. velutina)	Cary.
Q	82	X				*Phyllangium paradoxum* (=Mitrasacme paradoxa)	Loga.
A	45	X	C			*Phyllanthus calycinus*	Phyl.
		X			P3	*Pimelea calcicola* (fls pink; coastal limestone ridges)	Thym.
A	9					*Poa porphyroclados*	Poac.
Q	36	X	X			*Poa drummondiana* (Knotted Poa)	Poac.
		X				*Poa poiformis* (Coastal Poa)	Poac.
			L			*Podolepis gracilis*	Aste.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
				C		*Podolepis* sp.? (flowers yellow) 2/2	Aste.
		X				*Podolepis lessonii*	Aste.
		X				*Podotheca angustifolia* (Sticky Long-heads)	Aste.
		X				*Podotheca chrysantha* (shrt broad hds on long peduncles)	Aste.
		X				*Podotheca gnaphalioides* (Long-heads)	Aste.
		X				*Poranthera microphylla*	Phyl.
		X				*Prasophyllum elatum* (Tall Leek Orchid)	Orch.
Q	64		?C			*Pterostylis* aff. *nana* SCP GJK/NG 1867cbs	Orch.
		X				*Pterostylis aspera*	Orch.
		X				*Pterostylis brevisepala* MS	Orch.
		X				*Pterostylis pyramidalis* (=Pterostylis aff. nana?)	Orch.
		X				*Pterostylis vittata*	Orch.
			C			*Ptilotus polystachyus*	Amar.
			L			*Ptilotus sericostachyus*	Amar.
		X	C			*Pyrorchis nigricans* (=*Burnettia nigricans* MS)	Orch.
Q	18	X				*Quinetia urvillei*	Aste.
		X				*Ranunculus pumilio*	Ranu.
A	45	X				*Rhagodia baccata* (ssp. dioica or baccata)	Chen.
		X				*Rhodanthe citrina* (=Waitzia citrina)	Aste.
		X				*Rhodanthe corymbosa* (fl wh & yl)	Aste.
			X		*	*Ricinus communis*	Euph.
J	9	X		X	*	*Romulea rosea*	Irid.
		X			*	*Rostraria pumila*	Poac.
Q	55		X			*Rytidosperma occidentale* (=Austrodanthonia occidentalis, Danthonia occ.., Notodanthonia occ.)	Poac.
		X			*	*Sagina apetala*	Cary.
		X			P3	*Sarcozona bicarinata* (=Carpobrotus sp.Hepburn)	Aizo.
			C			*Scaevola canescens*	Good.
		X				*Scaevola globulifera*	Good.
O	9					*Scaevola repens* var. *repens*	Good.
		X				*Scaevola thesioides*	Good.
		X	?C			*Schoenus clandestinus*	Cype.
			X			*Schoenus grandiflorus*	Cype.
		X				*Schoenus latitans*	Cype.
			C			*Schoenus* sp. (long leaf)	Cype.
		X				*Schoenus subflavus*	Cype.
		X				*Senecio pinnatifolius* (=Senecio lautus)	Aste.
A	18	X				*Senecio spanomerus* (=S. lautus ssp. dissectifolius)	Aste.
				C		*Siloxerus filifolius* 1/1	Aste.
J	9	X				*Siloxerus humifusus* (procumbent to erect annual)	Aste.
		X			*	*Sisymbrium orientale*	Bras.
				X	*	*Solanum linnaeanum*	Sola.
		X		X	*	*Solanum nigrum*	Sola.
A	82	X	X	X	*	*Sonchus oleraceus*	Aste.
Q	9	X				*Sowerbaea laxiflora*	Aspa.
				C		*Sphaerolobium ?medium*	Faba.
A	9					*Spyridium globulosum*	Rham.
		X				*Stackhousia monogyna*	Cela.
		X			*	*Stellaria media*	Cary.
		X				*Stenopetalum robustum* (Fl. wh-yl/orng)	Bras.
		X	X			*Stirlingia latifolia* (Blueboy)	Prot.
Q	27	X				*Stylidium junceum*	Styl.
		X	C			*Stylidium brunonianum*	Styl.
		X				*Stylidium bulbiferum*	Styl.
		X				*Stylidium calcaratum*	Styl.
A	73	X			P3	*Stylidium maritimum* (=Stylidium maritima MS)	Styl.
		X				*Stylidium repens*	Styl.

G '94 Sp Grp	G '94 %Qs	WG '97	CD '14	N 2	*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2015)
		X				*Stylidium rigidulum* (=Stylidium macrocarpum)	Styl.
				X		*Stylidium* spp.	Styl.
		X				*Synaphea spinulosa*	Prot.
A	64	X	X			*Templetonia retusa*	Faba.
		X				*Tersonia cyathiflora*	Gyro.
				X		*Thelymitra ?crinita.* (large leaf)	Orch.
Q	91	X	X			*Thysanotus* sp. manglesianus/patersonii scp	Aspa.
		X				*Thysanotus arenarius*	Aspa.
		X				*Thysanotus thyrsoideus*	Aspa.
		X				*Thysanotus triandrus*	Aspa.
				(		*Thysanotus* sp.? (lower stem rough,tuberculate) 2/2	Aspa.
Q	100	X				*Trachymene pilosa*	Aspa.
Q	45	X	X			*Tricoryne elatior*	Heme.
Q	27	X		X	*	*Trifolium campestre*	Aspa.
		X	?C		*	*Trifolium dubium*	Faba.
		X				*Triglochin calcitrapa*	Junc.
		X				*Triglochin centrocarpa*	Junc.
		X				*Triglochin trichophora*	Junc.
A	91					*Trymalium albicans* (=Spyridium globulosum)	Rham.
		X		X		*Trymalium ledifolium*	Rham.
		X	L		*	*Urospermum picroides* 1/3	Aste.
Q	9	X	C		*	*Ursinia anthemoides*	Aste.
				X	*	*Vitis vinifera*	Vita
Q	100	X	?X		*	*Vulpia myuros*	Poac.
		X		X	*	*Wahlenbergia capensis*	Camp.
		X				*Wahlenbergia preissii* (Fl bl/wh/pnk)	Camp.
Q	45					*Waitzia citrina*	Aste.
		X	L			*Waitzia suaveolens* (Fl. wh-pink-purple/wh/yl)	Aste.
A	55	X				*Wurmbea monantha*	Colc.
Q	9	X	X			*Xanthorrhoea preissii*	Xant.
O	9	X				*Xanthosia huegelii*	Apia.

G '94 Sp Grp	G '94 %Qs	WG '97	C,D 2014		*/ P	Current Species Name (=Gibson *et al.* (1994) name). ?-Uncertain ID. SCP-Swan Coastal Plain	Family (2014)
98	**98**	**225**	**132**	**36**	**21**	**TOTALS [132+36= 168 spp. recorded in Areas C and D before 2015 by L Stephens and A S Weston]**	

Preamble to Table B2
FCT Quadrats and FCT 26a Species and Quadrats in Gibson *et al.* (1994)

Seventeen species in Table 12 (Gibson *et al.* 1994, pp. 31-36) have frequencies of occurrence in the 11 FCT 26a quadrats of 82%, 91% or 100%. These frequencies are listed below and, after that, in Table B2, as in Table B1, they are highlighted in yellow. Presence or absence of these 17 and of the 14 other 'Taxon Name', non-highlighted taxa listed in Table B2 may be useful in distinguishing FCT 26a from other FCTs.

The current (FloraBase 2014) names, (previous names) and frequencies of these 17 species are listed below and in Table B2, as percentages of FCT 26a quadrats in which each species was recorded. The species and percentages are also listed in Table B1. These species are referred to in this report as high frequency species and are used to indicate the possible presence of FCT 26a. Approximately half of them are ephemeral and not expected to be visible or identifiable at the time of the April-June 2014 visits to the survey area.

1.	*Acacia lasiocarpa var. lasiocarpa*	82%	10.	*Melaleuca systena* (*M. acerosa*)	82%
2.	*Austrostipa flavescens (Stipa f.)*	91%	11.	*Millotia tenuifolia*,	91%
3.	*Banksia sessilis (Dryandra sessilis)*	91%	12.	*Phyllangium paradoxum (Mitrasacme paradoxa)*	82%
4.	*Daucus glochidiatus*	91%	13.	*Sonchus oleraceus*,	82%
5.	*Desmocladus flexuosus (Loxocarya flexuosa)*	100%	14.	*Spyridium globulosum*,	91%
6.	*Eriochilus dilatatus*	82%	15.	*Thysanotus* sp. (*manglesianus/patersonii* scps),	91%
7.	*Grevillea preissii (G. thelemanniana* subsp. *preissii)*	100%	16.	*Trachymene pilosa*,	100%
8.	*Hypochaeris glabra*	91%	17.	*Vulpia myuros*	100%
9.	*Melaleuca huegelii*	82%			

The original 11 FCT 26a quadrats are listed in Gibson *et al.* (1994; Appendix 4) as CLIF-2 and CLIF-3, which are east of Lake Clifton and Yalgorup National Park, and SHE-4, SHE-5, SVH-1, WABL-1, YAN-2, YAN-12, YAN-13, YAN-15 and YAN-24, which are north of Perth between the Neerabup and Wilbinga areas. Of these quadrats, only SVH-1 and YAN-2 are less than 10 km from the Nowergup Lots 102-104 survey area.

The original nine FCT 26a quadrats north of Perth are listed below, along with their locations in degrees, northings and eastings. All nine are more than five kilometres from the coast, and seven are east of Wanneroo Road or its northern extension. Three are in the Wilbinga / Wabling Hill area, four are north-east of Yanchep National Park, one is in Yanchep National Park and one is north-east of Neerabup.

SHE-4	-31.4037°	E115.6145°	50J 368286mE, 6524827mN	More than 10 km N of Area C. W of Wilbinga.
SHE-5	-31.4040°	E115.6143°	50J 368268mE, 6524793mN	More than 10 km N of Area C. W of Wilbinga.
SVH-1	-31.6604°	E115.7744°	50J363807mE, 6496553mN	Approximately 4 km SE of Area C.
WABL-1	-31.4045°	E115.6770°	50J 374230mE, 6524811mN	More than 10 km N of Area C. E of Wilbinga.
YAN-2	-31.5616°	E115.6937°	50J 383807mE, 6507416mN	Approximately 9 km NW of Area D.
YAN-12	-31.5020°	E115.7052°	50J 377038mE, 6514036mN	More than 10 km N of Area C. NE of Yanchep NP.
YAN-13	-31.5025°	E115.7050°	50J 377020mE, 6513980mN	More than 10 km N of Area C. NE of Yanchep NP.
YAN-15	-31.5049°	E115.7041°	50J 376937mE, 6513713mN	More than 10 km N of Area C. NE of Yanchep NP.
YAN-24	-31.4958°	E115.7091°	50J 377400mE, 6514727mN	More than 10 km N of Area C. NE of Yanchep NP.

Other original Gibson *et al.* (1994, Appendix 4) Quadrats within ca. 5 (to 7) km of -31.6304° S and 115.7471° E, a point near the centre of the Areas C-D southern boundary, are listed below. FCTs and locations are from Gibson *et al.* (1994, p. 225). (All 15 NEER quadrats are west of Wanneroo Road; five are FCT 24 and ten are FCT 28)

Quadrat	FCT	D.dddd Lat	D.dddd Long	Distance	Direction (Degrees)
NEER-7	24	-31.6417°	E115.7188°	3.02 km	244.07°
NEER-8	28	-31.6413°	E115.7189°	2.95 km	245.46
NEER-9	24	-31.6541°	E115.7328°	2.96 km	208.52°
NEER-10	24	-31.6541°	E115.7331°	2.95 km	206.07°
NEER-11	24	-31.6418°	E115.7290°	2.09 km	233.01°
SINT-1	23b	-31.5876°	E115.7939°	6.53 km	043.53°
SVH-2	27	-31.6615°	E115.7740°	4.10 km	142.21°

Table B2

Thirty-one Plant Taxa to use in distinguishing FCT 26a from other FCTs

(from Gibson *et al.* 1994, Table 12 (pp. 31, 35, 36), pp. 43-46 and Appendix 1; Note: this information may have been updated, though not printed or available, since 1994)

Taxon Name (Species and other Taxa)	Species Group	Family	Form	Taxa Frequencies in FCTs (% of quadrats in which the taxon was recorded):						Number of other FCTs; and referred to in Gibson et al. (1994) as:
				26a	26b	27	29a	29b	other highest	
Acacia lasiocarpa var. *lasiocarpa*	A	FABA	Sh vs	82	16	57	22	85	**30c**: 67	+ 8 other FCTs (incl. **19**: 33)
Acacia truncata	A	FABA	Sh s	36	-	86	-	15	**24**: 8	**in no other FCT**
Acanthocarpus preissii	A	ASPA	He p	-	16	-	78	85	**30b**: 75	**+ 5 other FCTs**
Astroloma microcalyx	A	ERIC	Sh vs	36	16	100	-	8	-	**in no other FCT**
Austrostipa compressa	Q	POAC	Gr p	55	42	-	-	-	**20c**: 78	**+ 11 other FCTs; *Stipa compressa***
Austrostipa flavescens	A	POAC	Gr p	91	42	-	78	92	**30b**: 63	**+ 9 other FCTs; *Stipa flavescens***
Banksia sessilis	A	PROT	Sh t	91	42	29	11	-	**30c**: 67	+ 3 other FCTs; *Dryandra sessilis*
Conostylis candicans	A	HAEM	He p	18	37	-	22	62	**30c**: 33	+ 3 other FCTs
Daucus glochidiatus	A	APIA	He a	91	95	**57**	78	77	**30c**: 100	+ 12 other FCTs
Desmocladus flexuosus	Q	REST	He p (gr)	100	79	100	44	92	**24**: 72	**+ 16 other FCTs; *Loxocarya flexuosa***
Dianella revoluta	A	HEME	He p	-	32	14	11	8	**30c**: 100	+ 14 other FCTs
Eriochilus dilatatus	Q	ORCH	He p	82	5	43	-	-	**1a**: 54	+ 15 other FCTs
Grevillea preissii	A	PROT	Sh vs	100	32	100	22	-	**24**: 40	+ 2 other FCTs; *G. thelemanniana* subsp. *preisii*
Hibbertia spicata subsp. *leptotheca*	A	DILL	Sh vs	9	-	71	11	15	**24**: 12	in no other FCT
Hypochaeris glabra	Q	ASTE	*He p	91	89	-	11	8	**3b, 6**: 100	+ 32 other FCTs
Leucopogon parviflorus	A	ERIC	Sh m	64	37	86	67	62	**18**: 100	+ 8 other FCTs
Lomandra maritima	A	ASPA	He p (gr)	45	37	86	44	92	**24**: 64	+ 3 other FCTs
Melaleuca huegelii	A	MYRT	Sh m-t	82	11	29	44	-	**30a**: 14	+ 1 other FCT: **24**: 12
Melaleuca systena	A	MYRT	Sh s-m	82	68	100	22	92	**24**: 52	**+ 8 other FCTs; *Melaleuca acerosa***
Millotia tenuifolia	Q	ASTE	He a	91	89	-	22	8	**23a**: 42	+ 13 other FCTs
Phyllangium paradoxum	Q	LOGA	He a	82	11	29	22	-	**23b**: 62	**+ 20 other FCTs; *Mitrasacme paradoxa***
Phyllanthus calycinus	A	PHYL	Sh vs	45	47	-	-	62	**25**: 82	+ 10 other FCTs
Sonchus oleraceus	A	ASTE	*He a	82	68	-	67	8	**30c**: 67	+ 21 other FCTs
Spyridium globulosum (non-*T. a.*)	A	RHAM	Sh m-t	9	16	29	78	46	**30**: >85	**30a**: 86, **30b**: 100, **30c**: 100; + 2 other FCTs
Stylidium maritimum	A	STYL	He p (gr)	73	5	-	-	8	-	in no other FCT
Templetonia retusa	A	FABA	Sh m	64	16	86	33	8	**30c**: 67	+ 5 other FCTs
Thysanotus sp.	Q	ASPA	He p tw	91	58	71	33	23	**30c**: 100	+ 26 other FCTs; *T. manglesianus/patersonii* scps
Trachyandra divaricata	A	ASPH	*He p	-	5	-	22	-	**30b**: 63	+ 3 other FCTs
Trachymene pilosa	Q	APIA	He a	100	95	86	67	77	**20c**: 100	+25 other FCTs

Trymalium ledifolium var. *ledifolium*	A	RHAM	Sh s-m	91	11	71	22	8	**30a**: 14	+ 2 other FCTs (**24**: 4; **28**: 3); *T. albicans*
Vulpia myuros	Q	POAC	*Gr a	100	47	-	44	-	**18**: 50	+ 18 other FCTs

Form:

* (established alien); Gr (grass), He (herb), Sh (shrub).
a (annual), p (perennial), gr (graminoid leaves);
vs (very small: <0.5m), s (small: 0.5-1m); tw (twining),
m (medium: 1-2m), t (tall: 2-4m), vt (very tall: >4m),

Limestone FCTs:

vellow

FCT Names:

FCT 1a	*Eucalyptus haemotoxylon – E. marginata* woodlands on Whicher foothills
FCT 3b	*Eucalyptus haemotoxylon – E. marginata* woodlands on sandy clay soils
FCT 6	Weed dominated wetlands on heavy soils
FCT 18	Shrublands on calcareous silts
FCT 19	Sedgelands in Holocene dune swales
FCT 20c	Eastern shrublands and woodlands
FCT 21a	Central *Banksia attenuata – Eucalyptus marginata* woodlands
FCT 23a	Central *Banksia attenuata – B. menziesii* woodlands
FCT 23b	Northern *Banksia attenuata – B. menziesii* woodlands
FCT 24	'heaths' Northern Spearwood shrublands (with *Banksia sessilis*)
FCT 25	Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands
FCT 26a	*Melaleuca huegelii – M. acerosa* [=*M. systena*] shrublands of limestone ridges (Spearwood)
FCT 26b	Woodlands and mallees on limestone (Spearwood: Cottesloe unit)
FCT 27	Species poor mallees and shrublands on limestone (mainly Yalgorup area) (Spearwood)
FCT 28	Northern Spearwood shrublands and woodlands
FCT 29a	Coastal shrublands on shallow sands (over limestone: Quindalup)
FCT 29b	*Acacia* shrublands on taller dunes (Quindalup)
FCT 30a	*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands (Perth, Quindalup)
FCT 30b	Quindalup [southern] tuart and or peppermint woodlands
FCT 30c	Other mallees and scrubs (1 *Eucalyptus argutifolia*, 2 *Banksia sessilis* plots, on Spearwood dunes, near Swan estuary)

Table B3

Vascular Flora recorded in Nowergup Survey Areas C and D and in Quadrats A, B and J

KEY:

*/P Established alien or Priority species;

G '94 %Qs Frequency in FCT 26a Quadrats of species referred to in Gibson *et al.* (1994, Table 12, Community Type Column 26a) as being represented in the 11 Swan Coastal Plain (SCP) FCT 26a Quadrats.

C/D '14 Somewhere in Area C or D in 2014: X – Recorded; C – Collected. **QA QB QJ** In Quadrat A, B or J.

L Plants collected by Lindsay Stephens on Limestone Ridges in Area C, most of them identified by him.

*/P	Species / Taxon Current Name. ?-Uncertain ID. SCP-Swan Coastal Plain /Date	Family (2014)	G '94 %Qs	C/D '14	QA 30/4	QB 30/4	QJ 30/5
	Acacia cyclops	Faba.		X	-	-	-
	Acacia lasiocarpa var. *lasiocarpa*	Faba.	82	X	-	X	X
	Acacia pulchella	Faba.	9	X	X	X	-
	Acacia rostellifera	Faba.	9	C	-	-	-
	Acacia saligna	Faba.		X	-	-	-
	Acanthocarpus preissii	Aspa.		C	-	-	-
*	*Aira caryophyllea/cupaniana*	Poac.	73	C	X	-	-
	Alexgeorgea nitens	Rest.		C	X	-	-
	Allocasuarina fraseriana	Casu.		C	X	-	-
	Allocasuarina humilis	Casu.		X	X	-	X
*	*Asparagus asparagoides* (few)	Aspa.		X	-	-	-
	Asteraceae sp. 1	Aste.		X	X	-	-
	Asteraceae sp. 2	Aste.		X	X	-	-
	Asteraceae sp. 3	Aste.		X	X	-	-
	Austrostipa flavescens	Poac.		L			
	Austrostipa hemipogon	Poac.		L			
*	*Avena sp.*	Poac.		X	-	few	-
	Banksia attenuata	Prot.		X	-	-	-
	Banksia grandis	Prot.		X	-	-	-
	Banksia menziesii	Prot.		X	-	-	-
	Banksia nivea (=Dryandra n.) [B. lindleyana (=D. lind.)]	Prot.	73	X	X	X	X
	Banksia sessilis (=Dryandra sessilis)	Prot.	91	X	X	few	X
	Bossiaea eriocarpa	Faba.	18	C	X	-	X
	Brachyscome iberidifolia	Faba.		L			
*	*Briza maxima*	Poac.	18	X	X	X	-
	Burchardia congesta (=Burchardia umbellata)	Colc.		X	X	few	X
	Caladenia sp. (only a leaf)	Orch.		X	-	-	-
	Calectasia narragara	Dasy.		X	-	-	-
	Calothamnus quadrifidus	Myrt.		C	X	X	X
	Calytrix strigosa	Myrt.		?X	-	-	-
*	*Carpobrotus edulis*	Aizo.		X	-	-	-
	Cassytha flava	Laur.	27	X	-	-	X
*	*Centaurium erythraea*	Gent.		L			
*	*Cirsium vulgare*	Aste.		X	-	-	-
	Comesperma integerrimum (twiner or climber)	Poly.		C	-	-	-
	Conostylis aculeata	Haem.		L			
	Conostephium pendulum	Eric.		C	-	-	-
	Conostylis candicans	Haem.	18	X	-	X	-
	Conostylis candicans subsp. *calcicola*	Haem.		L			
	Conostylis candicans subsp. *candicans*	Haem.		L			
	Conostylis setigera	Haem.	18	C	X	-	-
	Conostylis sp. (C. ?aculeata)	Haem.		C	X	X	X
*	*Cortaderia selloana*	Poac.		X	-	-	-
	Daucus glochidiatus	Apia.		L			
	Daviesia divaricata subsp. *divaricata*	Faba.		L			
	Desmocladus fasciculatus	Rest.		X	X	-	-
	Desmocladus flexuosus (=Loxocarya flexuosa)	Rest.	100	X	X	X	X
	Dianella revoluta	Heme.		X	X	few	X
	Diplolaena angustifolia	Ruta.		C	-	X	-
	Drosera erythrorhiza	Dros.	36	C	X	-	X
	Drosera macrantha	Dros.	36	?C	-	-	?X

*/P	Species / Taxon Current Name. ?-Uncertain ID. SCP-Swan Coastal Plain /Date	Family (2014)	G '94 %Qs	C/D '14	QA 30/4	QB 30/4	QJ 30/5
*	*Ehrharta calycina*	Poac.		X	X	X	-
*	*Ehrharta* sp.	Poac.		L			
*	*Eragrostis curvula*	Poac.		X	-	-	-
	Eriochilus dilatatus	Orch.	82	C	-	-	X
*	*Erodium botrys*	Gera.		X	-	-	-
	Eucalyptus decipiens	Myrt.		C	-	-	-
	Eucalyptus marginata	Myrt.		X	-	-	-
	Eucalyptus todtiana	Myrt.		X	-	-	-
*	*Euphorbia terracina*	Euph.		X	-	-	-
*	*Gladiolus caryophyllaceus*	Irid.	9	X	X	X	X
	Gompholobium tomentosum	Faba.	55	X	-	-	-
	Grevillea preissii (=G. thelemanniana subsp. p.)	Prot.	100	X	-	?X	-
	Grevillea vestita	Prot.		C	X	-	-
	Haemodorum paniculatum	Haem.		X	-	X	-
	Haemodorum spicatum	Haem.		X	X	-	-
	Hakea costata	Prot.		X	X	X	-
	Hakea lissocarpha						
	Hakea trifurcata	Prot.	27	X	X	-	X
	Hardenbergia comptoniana	Faba.	55	C	-	few	X
	Hemiandra glabra	Lami.		C	X	X	-
	Hibbertia ?huegelii	Dill.		C	-	X	-
	Hibbertia hypericoides	Dill.	9	X	X	X	X
	Hovea trisperma	Faba.		C	-	-	-
*	*Hypochaeris glabra*	Aste.	91	C	-	?X	X
*	Iridacae	Irid.		L			
	Jacksonia calcicola	Faba.		X	X	X	-
	Jacksonia ?sericea	Faba.		X	-	-	-
	Jacksonia sternbergiana	Faba.		X	-	?X	-
	Kennedia prostrata	Faba.	9	X	-	-	-
	Lechenaultia linarioides	Good.		X	X	-	-
	Lepidosperma angustatum (L. ?angustatum)	Cype.	45	C	X	X	-
	Lepidosperma costale	Cype.		I			
	Lepidosperma ?scabrum	Cype.		C	-	-	-
	Lepidosperma sp. (BJK&NG 231)	Cype.		?X	-	-	?X
	Leucopogon parviflorus (lf tip attenuate-pungent??)	Eric.	64	X	-	X	X
	Leucopogon propinquus	Eric.		C	-	X	-
	Lobelia sp.	Camp.		L			
	Lomandra maritima	Aspa.	45	?X	-	-	-
	Lomandra caespitosa	Aspa.		X	-	-	X
	Lomandra hermaphrodita	Aspa.		L			
	Lomandra preissii	Aspa.		C	-	-	-
	Lomandra ?purpurea	Aspa.		C	-	-	-
	Lomandra sericea	Aspa.		C	-	-	-
*	*Lysimachia arvensis* (=Anagallis arvensis)	Prim.	64	X	X	X	-
	Macrozamia riedlei	Zami.		X	-	X	-
	Melaleuca huegelii	Myrt.	82	C	-	X	X
	Melaleuca systena (=Melaleuca acerosa) (sht lf)	Myrt.	82	C	X	X	X
	Mesomelaena pseudostygia	Cype.		X	X	-	X
	Rytidosperma occidentale (=Austrodanthonia occidentalis, Danthonia o., Notodanthonia occidentalis)	Poac.	55	X	-	X	-
	Nuytsia floribunda	Lora.		C	X	-	-
	Olearia axillaris	Aste.		X	-	-	-
	Opercularia vaginata	Rubi..	73	X	X	X	-
	Patersonia occidentalis	Irid.		X	-	-	-
*	*Pelargonium capitatum*	Gera.		X	-	-	-
	Persoonia comata	Prot.		X	-	-	-
	Petrophile linearis (=Pixie Mops)	Prot.		X	-	-	-
	Petrophile macrostachya	Prot.		C	-	-	X
	Petrophile serruriae	Prot.		C	-	-	-
*	*Petrorhagia dubia*	Cary.		L			

	Phyllanthus calycinus	Phyl.	45	C	-	-	X
	Poa ?drummondiana (Knotted Poa)	Poac.	36	X	-	X	-
	Podolepis gracilis	Aste.		L			
	Pterostylis aff. *nana* SCP GJK/NG 1867cbs	Orch.	64	?C	-	-	-
	Ptilotus polystachyus	Amar.		C	-	-	-
	Ptilotus sericostachyus	Amar.		L			
	Pyrorchis nigricans (=Burnettia nigricans MS)	Orch.		C	-	-	-
*	*Ricinus communis*	Euph.		X	-	-	-
	Scaevola canescens	Good.		C	-	-	-
	Schoenus clandestinus	Cype.		?C	-	-	-
	Schoenus grandiflorus	Cype.		X	X	-	-
	Schoenus sp. (long leaf)	Cype.		C	-	-	-
*	*Sonchus oleraceus*	Aste.	82	X	-	-	-
	Stirlingia latifolia	Prot.		X		-	-
	Stylidium brunonianum	Styl.		C		-	-
	Templetonia retusa	Faba.	64	X	-	-	-
	Thysanotus sp. manglesianus/patersonii scp	Aspa.	91	X	-	-	-
	Tricoryne elatior	Heme.	45	X	-	-	X
*	*Trifolium dubium*	Faba.		?C	-	-	-
*	*Urospermum picroides*	Aste.		L			
*	*Ursinia anthemoides*	Aste.	9	C	-	-	-
*	*Vulpia myuros*	Poac.	100	?X	-	-	-
	Waitzia suaveolens var *suaveolens*	Aste.		L			
	Xanthorrhoea preissii	Xant.	9	X	X	few	X
20	**TOTAL SPECIES**		**98**	**132**	**38**	**36**	**29**

APPENDIX C
Floristic Community Types and Determinations of them
(Full Gibson Analysis and other Alternatives to PATN Analyses)

Introduction

The most accurate way to determine which floristic community types (FCTs) are in a Swan Coastal Plain survey area is to select, sample and analyse Gibson-type, 10 m by 10 m quadrats (plots) using the techniques described by Gibson *et al.* (1994) and Keighery (1994). An essential component of these techniques is the compilation of a complete list of species for each quadrat based upon correctly identified plant specimens. This usually requires sampling the quadrat more than once.

It should be possible, however, according to Gibson (pers. comm.) and *Bush Forever* (Government of Western Australia 2000, Volume 2, p. 487), to infer, at least tentatively, which floristic community types, at least of the original 43 described by Gibson *et al.* (1994), occur in a survey area. Inferences of which FCTs occur in particular Bush Forever sites have been made from "information on the floristics of the area and the area's geographic location" (Government of Western Australia 2000, Volume 2, p. 487).

Inferences can be made by comparing comprehensive lists of species, key species, aerial photography and other information from an area with:

1. the 'Thirty Group Classification' descriptions of floristic community types, Table 12 and other lists and other information in Gibson *et al.* (1994, including pp. 29-37 and 39-45, and Appendix 1; the sorted two-way Table 12 shows species frequency by community type in Species Groups A through S),
2. geomorphologic and land system information about the survey area and its vicinity (e.g. on the Churchward and McArthur 1978 maps), and
3. Bushland Plant Survey Recording Sheets for sampled quadrats in similar areas of bushland as near the survey area as possible (Department of Environmental Protection 1996),

Looking at sampling quadrats of floristic community types recorded nearest the survey area in similar habitats and comparing them with floristic plots in the survey area might also be helpful.

The majority of Swan Coastal Plain (SCP) FCTs are restricted to wetlands, damplands, heavy soils, and other habitats not represented in the Nowergup survey area. As there are no permanent or seasonal wetlands or damplands in the survey area, as the soils there are sandy, not clayey, as the location shown on Google Earth is 15 km north of Wanneroo and 37 km north of Perth and the Swan River, as Heddle *et al.* (1978) and Churchward and McArthur (1978) show the location as not coastal but inland, in a Cottesloe unit, the number of possible FCT units in the Lots 102-104 survey area is reduced to, at most, seven (*Banksia attenuata* dominant - 21a and 23a; on limestone or sand over limestone - 24, 26a, 26b, 27 and 28). The Gibson *et al.* (1994) FCT 24 and FCT 28 NEER quadrats are on the west side of Wanneroo Road, not the east side.

Even some mapped FCTs (e.g. Gibson *et al.* 1994 Appendix 1 map of FCT 20a) that appear to occur close to Nowergup, do not. For instance, the nearest Gibson *et al.* (1994) FCT 20a quadrat is probably in Landsdale (LAND-1), more than 20 km south-southeast of the survey area (see Gibson *et al.* 1994, pp. 42, 60, 63). The Gibson *et al.* (1994) 15 NEER quadrats are all on the west side of Wanneroo Road, more than a kilometre from the survey area, which is at least 1km northeast of Wanneroo Road.

Full Gibson Analysis

This survey used some of these methods as adjuncts to sampling the three permanent 10 m by 10 m quadrats, A, B and J, in Area C, then carrying out Full Gibson Analyses (BSD Consultants 2003) on

the species lists of the samples. These methods were used in large part because the survey was done in a period when many species would be absent or unidentifiable.

The species recorded in Quadrats A, B and J are indicated in Appendix B's Table B3, and the results of Full Gibson Analyses (BSD Consultants 2003) on the eight highest scoring Floristic Community Types (FCTs) in each quadrat (Spp #) are listed below, in Table C1. The three highest scoring FCTs in each of the three quadrats are similar to each other – FCT 24 (26, 25 and 25 species), FCT 26b (27, 27 and 25 species) and FCT 28 (31, 28 and 25).

Table C1
Results of Full Gibson Analysis of Quadrats A, B and J
Eight Highest scoring FCTs in each Quadrat

Quadrat A [Total Spp: 38]		
Column	**FCT**	**Spp #**
DE	24	26
DH	28	31
DM	20a	20
DO	20c	20
DP	21a	22
DR	21c	23
DS	23a	20
EF	26b	27

Quadrat B [Total Spp: 36]		
Column	**FCT**	**Spp #**
DE	24	25
DF	25	18
DH	28	28
DP	21a	22
DR	21c	18
EE	26a	18
EF	26b	27
EG	29a	18

Quadrat J [Total Spp: 29]		
Column	**FCT**	**Spp #**
DE	24	25
DG	27	18
DH	28	25
DM	20a	17
DP	21a	21
EE	26a	20
EF	26b	25
EM	3b	17

Comparisons

There is no convincingly significant type of difference between the species lists in the Appendix B tables to conclude that any of the quadrats is definitely representative of FCT 26a. But the results of the Full Gibson Analysis (BSD Consultants 2003) do suggest that one or more of FCT 28, FCT 26b and FCT 24 may be in the survey area.

Limitations

The paucity of species in a quadrat reduces the reliability of analysing quadrat samples using either a Full Gibson Analysis (BSD Consultants 2003) or a PATN analysis.

When a group of species that would be in a quadrat, and sampled, is missing, then analysis of a sample may yield a faulty result.

The sampling done for the original southern Swan Coastal Plains survey was in '. . . the least disturbed vegetation available . . .' (Gibson *et al.* 1994, p. 4).

According to Gibson (in Weston and Gibson 1997), FCT 26b and FCT 27 are difficult to distinguish from each other on aerial photography, even on highly magnified stereoscopic pairs of high resolution colour aerial photographs. Probably FCT 26a is also sometimes difficult to distinguish from FCT 26b and FCT 27.

Griffin (2005) describes a number of other problems in the interpretation of PATN analyses and with the system of Floristic Community Types.

APPENDIX D
Waypoint (WP) Details (see Figure 1 and Section 4.1.2)

WP +/- 5m	SITE	COORDINATES	DESCRIPTION	
293	J	50 J 038 1399, 650 0057	Quadrat J QJ *Banksia sessilis / Melaleuca systena* on N limestone outcrop.	BM
910	P	50 J 038 1530, 650 0234	3 tall pines W of eastern crop land (**CD-D**)	P
911	H	50 J 038 1273, 650 0190	*Eucalyptus decipiens* Woodland, *Eriochilus dilatatus, Hemian glabra*	Ed
913	D	50 J 038 1311, 650 0015	*Eucalyptus decipiens* Woodland. DSC_0200-0210	Ed
-	E	50 J 038 1338, 650 0110	Outside, W of, Area C northern tip; *Eucalyptus decipiens* Woodland	Ed
916	G	50 J 038 1411, 649 9959	*Banksia sessilis / Melaleuca systena* (Unit **BM**). More *Melaleuca systena* to N (**M**)	BM
917	K	50 J 038 1502, 649 9971	Unit Af & Mixed but including *Melaleuca systena – Banksia sessilis* CH (to CTS) over *Desm flex*, other sedges & grams & seedlings Condition : **E**	Af
919	M	50 J 038 1344, 649 9969	RM –'clearing' w *Xan pr–Acacia ros All hum* TS over *Mel sys–Hib hyp–Cal qua (& Grev vest)* OLH. *Ban ses* TSh to OTSc	BC
924	V	50 J 038 1028, 649 9905	*Euc dec* Wdlnd. Condition: **CD-D**; *Alloc fras* OLW [Af/Ed]	Af
927	Y	50 J 038 0856, 649 9879	Tall, dense grove of *Nuytsia* Condition: **CD**	Af
929	AA	50 J 038 1143, 649 9893	SW corner of Area C & SE corner of Area D. Jarrah	Em
932	B	50J 0381435, 649 9988	Quadrat B. With massive outcropping limestone	M, BM
933	A	50 J 0381406, 650 0056	QA (similar to Site K Veg- WP 917)	BC
946	EE	50 J 038 1235, 649 9864	Few Jarrah & *Allocasuarina* trees. Condition **D**	Em
952	--	50 J 038 1201, 650 0219	*Euc. decip* .over *Mel. hueg., Dry sess, Cal quadr, Mel syst, Temp retusa, Leucop parvifl, Bromus rubens*	Ed
954	--	50 J 038 1179, 650 0220	Mound crest – few *Mel hueg, Hard comp, Operc vag, Acacia lasiocarpa* & other natives. Many weeds. Unit X immediately N, in SE corner of Lot 104	CL+
956	-	50 J 038 1247, 650 0291	[&WP987,88] *Banksia sessilis / Melaleuca huegelii* (Unit **BM**) to SW; *Banksia sessilis* OH on limestone pavement	BM
957	-	50 J 038 1102, 650 0498	Tuart Woodland, young tuart over *X pr*, natives, aliens. **CD-C**	Eg
958	--	50 J 038 0824, 650 0583	Tuart ~30%, few Jarrah, alien grasses, *Jacks stern, Macrozamia r., X pr.* **CD**	Eg
960	-	50 J 038 0825, 643 0507	Jarrah (mostly dead) & tuart. Condition: **CD**	Em
961	-	50 J 038 0555, 650 0269	Tuart Woodland, over few *Xanthrhoea preissii.*, natives, aliens. Condition:.**C D**	Eg CL
962	-	50 J 038 0602, 649 9848	Jarrah (mostly dead), few tuart, she-oaks & other Natives. Condition: **CD-D**	Em
989	-	50 J 038 1218, 6500 236	Downhill: *Banksia sessilis* pavemnt. Uphill: boulders, *Melaleuca huegelii , Melal. systena,* fewer *Banksia sess.*	M
990	-	50 J 038 1166, 6500 222	Looking W towards quarried area over recently bulldozed flat at top of steep N slope. *Xanthor. preissii* **OTSc** over *Banksia sessilis* **OH**	CL X
991	-	50 J 038 1086, 6500 241	Boundary between *Xanthorrhoea preissii* **TSh** over *Banksia sessilis* **OH,** to East, & over *Melaleuca huegelii - Melaleuca systena,* to West	X M
994	--	50 J 038 0655, 6500 502	Dead Jarrah trees	Em
997	--	50 J 038 0985, 6500 648	Tuart wdlnd w young tuarts, *B. sess, X. pr.*	Eg
998	--	50 J 038 1117, 6500 448	Rdside uart tree near entrance to 'camel farm' w *B. sess.*	
999	--	50 J 038 1086, 6500 234	N edge of levelled, cleared plateau @ boundary between *X pr + B. sess* to E & *M hueg* (+ *M syst*) to W)	

APPENDIX E
Vegetation Structure Categories and Condition Assessment Scale

Vegetation Structure Categories

The classification system used for describing vegetation structure and the six-point scale used for assessing vegetation condition are based upon those in *Bush Forever* (2000, Vol. 2, pp. 493-494).

The vegetation classification system is, basically, as set out below (note that the term for density precedes the term for height; in *Bush Forever* the term for height sometimes precedes the term for density):

Canopy cover/Form, Height	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees > 30m	Closed Tall Forest **CTF**	Open Tall Forest **OTF**	Tall Woodland **TW**	Open Tall Woodland **OTW**
Trees 10-30m	Closed Forest **CF**	Open Forest **OF**	Woodland **W**	Open Woodland **OW**
Trees < 10m	Closed Low Forest **CLF**	Open Low Forest **OLF**	Low Woodland **LW**	Open Low Woodland **OLW**
Shrubs > 2m	Closed Tall Scrub **CTSc**	Open Tall Scrub **OTSc**	Tall Shrubland **TSh**	Open Tall Shrubland **OTSh**
Shrubs 1-2m	Closed Heath **CH**	Open Heath **OH**	Shrubland **Sh**	Open Shrubland **OSh**
Shrubs < 1m	Closed Low Heath **CLH**	Open Low Heath **OLH**	Low Shrubland **LSh**	Open Low Shrubland **OLSh**
Grasses	Closed Grassland **CG**	Grassland **G**	Open Grassland **OG**	Very Open Grassland **VOG**
Also Herbs: Herblands. Sedges: Sedgelands. Rushes: Rushlands. Etc.				

Key to above Abbreviations in Bold

C	Closed	**F**	Forest	**G**	Grassland
H	Heath	**L**	Low	**O**	Open
Sc	Scrub	**Se**	Sedgeland	**Sh**	Shrubland
T	Tall	**V**	Very	**W**	Woodland

Condition Assessment Scale

The six-point condition scale is, basically:

P	Pristine	No obvious signs of disturbance,
E	Excellent	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species,
V	Very Good	Vegetation structure altered, obvious signs of disturbance,
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained,
D	Degraded	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good condition without intensive management, and
C	Completely Degraded	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared').

ATTACHMENT 2

Atmosphere Management Plan
Dust and Noise

Lots 103 – 104, McLennan and Godel Roads, Nowergup

November 2018

Landform Research
Land Systems - Quarries - Environment
ABN 29 841 445 594

ATMOSPHERIC POLLUTION AND NOISE

1.0 Visual Management Plan

Visual Impact can occur in a number of circumstances, by the operation being set too high in the landscape, by being too close to neighbors and by insufficient visual protection.

There are a number of management actions that can be taken in quarries to minimize visual impact and these will be used wherever possible. The general management actions are summarized below together with the visual impact issues that relate to this site. The actions will be used where applicable and as the opportunity presents to minimize visual impact.

On this site there have been no changes to the separation distances between the pit and the closest dwellings within the last 5 years and no changed landuses.

Buffer distances to the closest dwellings are proposed to be a minimum of 400 meters, with the closest dwelling being to the south west, associated with an intensive animal production (poultry?) facility. The majority of the excavation will be significantly further away from dwellings. Other dwellings are over 500 meters away.

The dwelling on Lot 101 is owned by the proponents and being included as part of this development is classified as a caretaker's cottage.

The excavation operations are not proposed to change. Currently the operations are set well back from Godel Road and McLennan Drive, with the intervening parkland pasture providing vegetation screening.

Excavation will continue to operate from the floor of the pit behind the existing faces, which will assist visual screening. Excavation will push towards the perimeters behind the existing faces, with the floor being progressively lowered.

As excavation approaches McLennan Drive, overburden will be used to form screening bunds along the western and northern perimeters of the proposed excavation area. Existing trees within the buffers will be maintained to assist screening.

The quarry will not approach significantly closer to the local dwellings than the existing operation.

Excavated areas will be progressively rehabilitated as they are completed.

The proposed excavation complies with the EPA Buffer Generic Guidelines.

IDEAL OPERATIONAL PROCEDURES	**COMMITMENTS ON ACTIVITIES CONDUCTED ON SITE**
• Locate exposed features behind natural barriers and landform.	• This is used and will continue. • The only dwelling from which the excavation may be seen is believed to be the dwelling to the north east which is owned by the proponent. • The dwelling is protected by intervening trees and the orientation of the pit.
• Operate from the floor of the pit below natural ground level.	• This will continue and is proposed.
• Avoid breaks in the skyline due to workings and haul roads.	• The excavation areas are below the high natural ground features. The top of the ridge will be maintained and the skyline preserved.

• Push overburden and interburden into positions where they will not be seen or can form screening barriers.	• Perimeter bunds are used and are proposed where overburden is available.
• Stage workings and progressive rehabilitation to provide visual protection of later activities.	• The excavation and disturbance areas are generally small.
• Adopt good housekeeping practices such as orderly storage and removal of disused equipment or waste.	• This is used and committed to.
• Provide progressive rehabilitation of all completed or disturbed areas.	• Rehabilitation to productive local native vegetation on the completed pit is proposed, but will not be able to commence for some years until the limestone has been extracted from each stage.
• Minimise the amount of ground used at any one time.	• This is proposed. Only ground required for excavation will be prepared for excavation with up an additional area for support.
• Install fences and gates, which are compatible with the style of the area.	• The resources lie on agricultural land that is fenced with farm style sheep and lamb mesh. The entrance requires additional security and higher cyclone mesh fencing and strong gates are required.
• Minimise offsite impacts of night lighting.	• Night operations are not proposed.
• Paint and maintain visually exposed buildings, plant and equipment with low impact colours.	• Portable storage facilities are located so they cannot be seen from the roads. If visible they will be sympathetically colored and located within the existing compound. • The pit cannot be seen from local roads.
• Locate roads and access to prevent direct views into the site	• No new roads are proposed. The existing roads will be used.
• Locate buildings, plant and stockpiles in areas of low visual impact and maintain appropriate size.	• The plant and pit cannot be seen from local roads.
• Ensure transport vehicles do not spill material on public roads and ensure prompt clean-up if it occurs.	• Company practices and drive/operator training will address the need to minimize spill by ensuring the trucks are not overloaded. • Collection of spills is to be carried out when reported. • Drivers are to be instructed to be responsible for their loads.

Light Overspill

It is not proposed that the facility will operate at night. The only lighting that might be required at night will be security lighting which is in place.

Excavated areas will be progressively rehabilitated as they are completed.

Summary

Visual impact is regard as low.

Italia is committed to minimizing visual impact and will implement the measures outlined.

2.0 Noise Management Plan

Offsite noise is governed by the *Environmental Protection (Noise) Regulations 1997.*

The *Environmental Protection (Noise) Regulations 1997*, require that sensitive premises including dwellings in non-industrial areas are not subjected to noise levels exceeding 45 dBA for more than 10% of the time, 55 dBA for more than 1% of the time and never exceeding 65 dBA during normal working hours. There are penalties for tonality of 5 dB, modulation 5 dB and 10 dB for impulsiveness, although impulsiveness is not likely to be relevant.

Occupational noise associated with the quarrying processes falls under the *Mines Safety and Inspection Act 1994 and Regulations 1995.* The management of occupational noise is normally handled by providing all necessary hearing protection, as well as conducting worker inductions, and educational programs for all staff. Regular site audits of quarry and mining operations are normally conducted by the Department of Mines and Petroleum.

Noise can originate from a number of operations and may impact on onsite workers, or travel offsite and impact on external sensitive premises. Both potential noise impacts are addressed by reducing the noise generated from the quarrying and processing operations.

There are a number of management actions that can be taken in quarries to minimize noise generation or travel and these will be used wherever possible. The general management actions are summarized below together with the potential noise impact issues that relate to this site. The actions will be used where applicable and as the opportunity presents to minimize noise on this site.

The *Environmental Protection (Noise) Regulations 1997*, require that sensitive premises including dwellings in non-industrial and rural areas, are not subjected to general noise levels (excluding blasting), during the hours 7.00 am to 7.00 pm Monday to Saturday that exceed 45 dBA. Allowable noise to 55 dBA is permitted for up to 10% of the time and to 65 dBA for 1% of the time. Noise levels are not to exceed 65 dBA during normal working hours.

Between 9.00 am and 7.00 pm on Sunday and Public Holidays and between 7.00 pm and 10.00 pm on all days the base level is 40 dBA.

At night, between 10.00 pm and 7.00 am Mondays to Saturday and before 9.00 am on Sundays and Public Holidays, the permitted level drops to 35 dBA.

The 10% and 1% “time above” allowances apply at night and on Sundays and Public Holidays as well.

There are penalties for tonality of 5 dB, modulation 5 dB and 10 dB for impulsiveness that are added to the permitted levels. That is, if the noise is tonal or modulated the permitted levels drop by 5 dB. Impulsiveness is not likely to be relevant for the quarry under normal circumstances.

Influencing factors are external noise and nearby land uses such as busy roads, and industrial properties. *Schedule 1 of the Environmental Protection (Noise) Regulations 1997* provides for the premises of excavations to be provided with an industrial influencing factor in the calculation of assigned noise levels, by way of the 100 and 450 meter influencing factor circles.

Under *Schedule 1 of the Noise Regulations* the premises on which the extraction of basic raw materials, such as sand and limestone, is occurring is classified as Industrial Land for the purposes of calculating influencing factors. This was defined as the whole cadastral boundaries in State Administrative Tribunal decision *{2013} WASAT 139, Bushbeach v City of Mandurah*.

At a distance greater than 15 meters from the sensitive premises (e.g. dwelling), and commercial premises a base level of 60 dBA applies at all times with the 10% time permitted to be up to 75 dBA and the 1% permitted to be up to 80 dBA. For Industrial premises the base level is 65 dBA at all times with the 10% time permitted to be up to 80 dBA and the 1% permitted to be up to 90 dBA.

Sound travels mostly similar to lines of sight.

The excavation operations will incorporate the procedures listed below wherever possible to minimize noise emanation from on-site activities.

All equipment will be fitted with noise shields and efficient silencers. Workers will be inducted and trained for operation on the site and provided with the correct noise protection equipment.

Buffer distances to the closest dwellings are proposed to be a minimum of 400 meters, with the closest dwelling being to the south west, associated with an intensive animal production (poultry?) facility. The majority of the excavation will be significantly further away from dwellings. Other dwellings are over 500 meters away.

The dwelling on Lot 101 is owned by the proponents and being included as part of this development is classified as a caretaker's cottage.

The issue of appropriate buffers is a matter of the distance and protection measures to prevent impact on adjoining land users. This applies mainly to noise, dust and visual impact, all of which are treated separately.

Based on the nature of the equipment used and excavation methods proposed, the extraction of sand would have the smallest buffer of 300 meters.

The walls of the pit form natural barriers that reduce noise transmission.

Blasting

Blasting is not a primary method for sand and limestone excavation. Localized light charges may be utilized to pop/liberate hard rock pinnacles. Noise levels for these small charges will be well within the guidelines. Mats and other barriers can be deployed to mitigate risk to noise whilst noise and vibration monitoring will be undertaken to monitor exposure to sensitive receptors.

Normal Quarry Management

The following table summarizes the methods that are normally used in quarries to minimize unacceptable noise generation.

IDEAL NORMAL OPERATIONAL PROCEDURES	**COMMITMENTS ON ACTIVITIES CONDUCTED ON SITE**
• Comply with the *Environmental Protection (Noise) Regulations 1997.*	• Italia Stone Group will continue to comply with the Regulations. • See below for buffers.
• Maintain adequate buffers to sensitive premises.	• There are no proposed changes to the location of nearby sensitive premises at 400 to 500 meters plus. • A caretaker's dwelling lies on Lot 101. • The location complies with the EPA Generic Buffer Guidelines.
• Locate exposed features behind natural barriers and landform.	• The perimeter bunding and landform provide noise screening and will continue to be used.
• Operate from the floor of the pit below natural ground level.	• This is used and is proposed.
• Push overburden and interburden dumps into positions where they can form screening barriers.	• Perimeter bunding is used and proposed to provide maximum noise screening.
• Design site operations to maximise the separation and protection from sensitive premises.	• The location of the excavation and the methods to be used have been selected to minimize noise generation and carry.
• Maintain all plant in good condition with efficient mufflers and noise shielding.	• The use of modern new equipment that is maintained in good condition is proposed.
• Maintain haul road and hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades.	• The access road will continue to be located in the west. • Consideration will be given to the watering treatment with a dust suppressant and surface sealant to bind the limestone to reduce noise impacts of banging of truck trays when empty.
• Implement a site code outlining requirements for operators and drivers.	• A site induction and training for all personnel is used and will continue.
• Use equipment that will minimise noise generation.	• The equipment used will minimize noise generation and will be no more significant than a large tractor operating on a rural property. • No changes are proposed to the operations already occurring for which it is believed that there have been no known complaints.
• Shut down equipment when not in use.	• This is used and proposed to save fuel and maintenance costs in addition to noise minimization.
• Scheduling activities to minimise the likelihood of noise nuisance.	• Operations will be conducted between 7.00 am and 5.00 pm on normal work days.
• Fit warning lights, rather than audible sirens or beepers, on mobile equipment wherever possible.	• If required lights or low frequency frog beepers are to be used rather than high pitched beepers to restrict noise intrusion. • On this site they are not anticipated to be required or used. • No changes are proposed to the

	operating procedures.
• Use transport routes that minimise community disruption.	• There is no alternative transport route. • Truck drivers will be instructed to be aware of dwellings along the roads and the need to minimize noise and travel at safe speeds.
• Avoid the use of engine braking on product delivery trucks in built up areas.	• Truck drivers will be instructed to minimize the use of engine braking.
• Minimise and conduct at the least disruptive times, non-day to day activities such as vegetation, topsoil or overburden stripping on exposed ridgelines.	• Quarrying and processing operations are to be conducted during normal working hours.
• Provide a complaints recording, investigation, action and reporting procedure.	• A complaints recording and investigation procedure is proposed.
• Provide all workers with efficient noise protection equipment.	• All personal noise protection equipment will be provided to staff.
IDEAL BLASTING PROCEDURES	
• Blasting is conducted to the *Mines Safety and Inspection Act 1994 and Regulations 1995.*	• Blasting is not proposed. Possible localized popping. • If required the City will be informed prior to any blasting.

Summary

The risk of noise impact on sensitive premises is low as there are no changes to the current and past operations.

Italia is committed to minimising noise emissions and will implement the measures outlined.

3.0 Dust Management Plan

Excessive dust has the potential to impact on both the workers and the adjoining land.

Dust can originate from a number of operations and may impact on onsite workers, or travel offsite. Potential dust impacts are addressed by reducing the dust generated from the quarrying, processing and transport operations.

No changes are proposed to the existing and past operations.

There are a number of management actions that are used in quarries to minimize dust generation or travel and these will continue to be used wherever possible.

3.1 Environmental Dust

- **Background**

Excessive dust has the potential to impact on both the workers and the adjoining land. However the potential generation of dust must be taken in context.

There are a number of key aspects to dust impacts;

- What is the source of particles?
- What is the potential for the particles to be disturbed?
- What is the nature of the particles and how are they likely to behave?
- What types of impacts are the particles likely to have if they move?
- What management actions can be used to mitigate or reduce dust impacts?

Fine particles are a natural part of our environment and are present in soils, pollens, fragments of vegetation and many other sources. It is when the fine particles are excessively disturbed that there becomes concern for the potential impacts, whether they are nuisance or health risks.

The most common form of disturbance is by human impacts. In this local area agricultural soils and limestone roads have the most potential to expose fine particles to disturbance by machinery and vehicles.

In many situations the fine particles are stabilized by vegetation, soil microbial materials and reactions and interactions between particles. Once disturbed however dust can be generated and may continue to be a problem until the fine particles are wetted down or return to a relatively stable condition.

The risk of dust assumes no treatment. With effective treatment of dust by water, which is proposed, the risks of onsite, and consequently offsite, dust are minimized.

Limestone stays moist even through summer until excavated because capillary action and evaporation of moisture only extends about 1 meter below the surface as there is no vegetation to suck the moisture from the soil.

The main dust risk is from vehicle movements on the pit and access road which contributes to occupational dust.

When occupational dust is managed then environmental dust is also minimized. The main risk is the traffic which relate to occupational health and safety that is controlled under the *Mines Safety and Inspection Act 1994*.

The main methods of dust control are awareness of the issues on a day to day and hour to hour basis as activities on site change. The most appropriate dust management procedures are then chosen to minimize occupational dust and environmental dust. Ongoing site awareness will be combined with a commitment to take whatever action is appropriate.

- **Assessment of Dust Risk**

Dust Guidelines

Dust management is an integral part of the extraction of Limestone. Facilities and procedures are updated as better technology becomes available.

Occupational dust associated with the quarrying processes falls under the *Mines Safety and Inspection Act 1994 and Regulations 1995* overseen by the DMIRS.

Dust emissions fall under the *Guidance for the Assessment of Environmental Factors, EPA, March 2000*. Assessments of the potential dust risk are normally made using the Land development sites and impacts on air quality, *Department of Environmental Protection and Conservation Guidelines, November 1996.* These are still in place but are incorporated into the *DEC (DER) 2011 Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and other Related Activities.*

The key Environmental Objectives for the operations are;

- Manage the potential for the generation of dust.
- Visually monitor dust levels and take steps to reduce the potential impact of dust on occupational and environmental aspects of the operation and local area.

Onsite Risks

Excessive dust has the potential to impact on both the workers and the adjoining land. From sand and limestone extraction the main particles are sand sized particles from the sand itself and from the limestone. These are normally in excess of 0.5 mm and have a capability of moving by saltation and do not travel far, being easily stopped by vegetation, pasture, small banks or other features.

Dust could be a potential problem during land clearing and reinstatement and during excavation and crushing in the summer months. The access roads will be watered as necessary to reduce the generation of dust in the drier months.

Dust from organic humic matter can also be generated during land clearing and restoration of topsoils. This dust has a very high risk of being generated from the agricultural activities and horticulture that adjoin the southern boundary.

Finer dust can be generated from situations where limestone is crushed and ground, such as along access roads, from dimension stone cutting or crushing. The limestone must generally be crushed relatively dry otherwise the crushers block. In such situations effective shielding and screening on the plant itself has been found by the industry to be the most effective.

When limestone is placed and not disturbed it readily develops a crust of reprecipitated calcium carbonate that tends to stabilize the surface. Also the fine particles are washed below the surface leaving only coarse material behind. Therefore bunds do not normally generate dust, and become stabilized after experiencing a winter. It is really only the traffic and active areas that are highly susceptible to dust generation.

The prevailing winds are from the south west, particularly in the afternoon. In summer the easterly in the mornings and the sea breeze in the afternoon can be quite strong. At 3.00 pm wind speeds exceed 10 kph for 80 % of the time in summer but only 30 % to 40 % in winter. At other times the wind speed is calm for 30 % of the time in winter at 9.00 am and 10 % in summer, with 40 % of the time exceeding 10 kph in summer and 20 % in excess of 10 kph in winter.

The most likely time for dust to become an issue is on summer mornings when winds are easterly, blowing towards land held by Italia. With operations below natural ground level, protected by landform, bunding and tree belts, it is unlikely that dust will impact on nearby residences.

The dwelling to the south west is not in line with the prevailing sea breezes on summer afternoons. The closest dwelling not owned by Italia is 400 meters to the south west related to the poultry production. Other dwellings are 500 meters to the south west.

The dwelling to the north east is on Lot 101, in the direction of the afternoon sea breezes. Lot 101 is owned by Italia.

The main methods of dust control are awareness of the issues on a day to day and hour to hour basis as activities on site change. The most appropriate dust management procedures are then chosen to minimize occupational dust and environmental dust. Ongoing site awareness, combined with a commitment to take whatever action is appropriate, is more satisfactory than occasional sampling and monitoring by equipment. Dust management requirements change rapidly during excavation, and sampling at one time is unlikely to reflect the conditions at another time.

On site sampling can also present difficulties in determining where the particles have come from. This particularly applies to situations near the road, cultivated rural land that extends all along the southern boundary and the limestone quarry that lies just south of the southern boundary in the south east.

Overburden will be used to form screening bunds along the northern and western perimeters when the excavation moves towards those areas. The trees in the parkland pasture and remnant vegetation will assist in dust management, by trapping particles.

A water tanker will continue to be maintained on site during excavation when there is a risk of generating excessive dust. The water will be used to settle dust on the pit floor and to reduce the dust emanating from any crushing operation.

Apart from the initial land clearing and surface reinstatement, all operations will be conducted below natural ground level. Bearing in mind the distances involved and the dust suppression methods in place, dust should not impact on any dwellings.

The category of dust risk is included in *DER 2011 Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and other Related Activities.* This document is not really applicable to mining because it is to be used to assess the mitigation required based on no mitigation.

It must be remembered that this guideline is not really appropriate for quarries. It was developed for subdivision earthworks at a time when dust management was a lower priority.

All quarries have active and comprehensive dust management procedures in place and are required to do so to protect visual amenity and their staff. The Guidance has been used, but factored in is a reasonable amount of dust management. Using the normal dust management there is a negligible risk of dust impacting on sensitive premises west of the quarry.

The prevailing winds are the summer sea breezes. These do not blow towards any nearby dwellings. On summer mornings easterly winds are common. In winter, winds tend to be more variable in speed and direction.

- Dust risk is generally only in the dry summer months.
- Best practice dust management procedures apply to quarries and are used on site. These are listed in the following table with a comment on how Italia manages potential dust issues.
- The trigger for dust management is the generation of visual dust.

- The site supervisor is normally the loader driver, who is in the best position to assess dust generation and to direct remediation.
- No visible dust will impact on dwellings.
- On site operators are instructed to visually monitor dust, report and treat any visible dust.

- **Dust Risk Assessment from DEC (DWER) 2011**

PART A Number	**Item**	**Score**
1	Nuisance potential of the material	Medium – 4 Reduced with effective water sprays and wetting down.
2	Topography and vegetation screening	Moderately to Well screened – 1 - 6
3	Area of site activities	Trafficked areas are 1 to 5 ha - 3
4	Type of work being undertaken	Considering the natural moisture content of the limestone; partial earthworks – 9
	Summer total without dust measures	22
	Summer total with dust measures	17

PART B Number	**Item**	**Score**
1	Distance to sensitive premises	100 – 500 meters - 12
2	Effect of prevailing wind	Isolated use not affected by one wind direction - 1
	Summer total without dust measures	13
	Summer total with dust measures	13

Activity	**Calculated Score**	**Allocated Risk of Dust**
Land Clearing and excavation without dust suppression.	286	Classification 2 Low Risk The recommended actions are included in the Dust Management Program.
With dust suppression	221	Classification 2 Low Risk Commitments are made to cease work if dust cannot be managed.

3.2 Occupational Dust

Occupational dust associated with the quarrying processes falls under the *Mines Safety and Inspection Act 1994 and Regulations 1995* overseen by the Department of Mines and Petroleum.

Italia will provide induction and protective equipment for all persons on site.

The DMP require personal dust monitoring to ensure dust levels comply with health risk guidelines.

The dust management procedures used on site comply with these guidelines.

3.3 Dust Management

3.3.1 Issues and Management

Actions that can be used to prevent or mitigate dust are standard quarry best practice and have been used on this site on an ongoing basis. Some methods are taken from the DWER 2011 Appendix 2 and others from quarry best practice.

Methods that are available, and will be selected from, are listed below. The most effective by far is the use of water management from a water truck, sprinklers, water cannon, water sprays and mists or other such mechanism.

DESIGN AND SITE

1. Minimizing the amount of ground open.
2. Minimizing the amount of ground being subject to traffic.
3. Locating access roads away from sensitive premises.
4. Design of the pit to reduce wind speed and potential dust lift off.
5. Maintaining effective setbacks.
6. Constructing perimeter bunds to reduce wind speed.
7. Planting and maintaining tree buffers.
8. Providing wind break fencing generally and on top of bunds as required.
9. Maintaining a secure, fenced site, to prevent illegal access.
10. Rehabilitate and stabilize all completed areas as soon as practicable.
11. Clearing and replacing topsoil and overburden during wetter times; April to October.

OPERATIONS

12. Locate active areas away from windy locations.
13. Locate active areas away from sensitive premises.
14. Working on the floor of the pit.
15. Operate some parts of the pit only when conditions are suitable.
16. Locating mobile plant and stockpiles in sheltered areas.
17. Design staging to minimize dust risk.
18. Conduct higher dust risk operations such as topsoil clearing and placement during more favorable conditions.
19. Shut down equipment that is not required.

ACCESS AND HARDSTAND

20. Constructing the access roads from hard materials that resist dust generation.
21. Maintaining a water truck on site for road and other wetting down.
22. Using a sealant such as a polymer, chemical or emulsified oil or bitumen on the access road to reduce water use.
23. Using sprinklers and water canon on roads, traffic areas and stockpiles.

PROCESSING

24. Applying water sprays and additives to crushing, cutting and screening cycles.
25. Providing screening, shielding or misting on mobile plant.
26. Use and maintain filters on all suitable plant.
27. Ensure regular appropriate emptying of filter collection devices.
28. Face hoppers away from prevailing winds. *(Unlikely to be required).*

29. Maintain reduced pressure in plant, hoppers and bins to prevent loss of dusty air. *(Unlikely to be required).*
30. Use water mist sprays where appropriate at fall points and other locations where dust may be generated.

STOCKPILES

31. Minimize the number of stockpiles.
32. Maintain stockpiles in sheltered areas.
33. Reduce the elevation of stockpiles.
34. Limit the drop height to stockpiles and loading.
35. Locate finer products inside or screened by stockpiles of coarse materials.
36. Locate stockpiles away from sensitive premises.

TRANSPORT

37. Cover all loads when fine materials are carried.
38. Ensure all trucks are dust free and not carrying pebbles and other materials outside the tray.
39. Choose the best transport routes.
40. Wet down or sweep the cross over and access roads.

HEALTH AND COMMUNITY

41. Maintain air conditioned cabins on all vehicles.
42. Provide a readily auditable trigger of no visible dust to cross the property boundary in line with the current DER License and best practice in WA.
43. Provide a comprehensive visual monitoring program.
44. Conduct effective site induction and awareness training for all staff.
45. Training should include observation and mitigation where possible of all dust emissions.
46. Providing a complaints investigation, mitigation and recording procedure.
47. Liaising with the owners/operators of the nearby sensitive premises.
48. Ceasing operations when conditions are not favorable or when visible dust is crossing the boundary.
49. Obtain the latest weather conditions to increase the awareness of dust risk.
50. Cease operations during adverse weather conditions.
51. Operate during wetter months or when the soils are moist.

Tree Belt - Buffers

Dust particles are readily stopped by tree belts and distance, with which the site complies. Tree belts slow the wind and allow the dust to settle. See *Planning Guidelines Separating Agricultural and Residential Land Uses, Department of Natural Resources Queensland 1997(Pages 65 – 111) and Department of Health WA, 2012, Guidelines for Separation of Agricultural and Residential Land Uses which uses the same criteria (Pages 112 – 118).*

The Queensland Guidelines predominantly relate to agricultural spray drift, but based on particle size also relate to dust.

The Guidelines provide for a buffer of 300 meters for open agricultural land, dropping down to 40 meters where an effective tree belt is in place. The Western Australian Department of Health also uses the same guidelines.

The Guidelines are based on field studies and demonstrate the effectiveness of tree belts and distance in providing screening against particulate travel.

The proposed excavation has broad buffers in excess of 400 meters with some tree vegetation within that buffer around each side.

DUST MANAGEMENT ACTIONS

ACTIVITY	POSSIBLE RISK SEVERITY and FREQUENCY	IDEAL OPERATIONAL PROCEDURES	COMMITMENTS ON ACTIVITIES CONDUCTED ON SITE	RISK AFTER MANAGEMENT
GENERAL				
Legislation	----	• Comply with the provisions of the Mines *Safety and Inspection Act 1994 and Regulations 1995*.	• Italia Stone Group will comply with the Act and Regulations at all their pits.	----
Buffers	----	• Maintain adequate buffers to sensitive premises.	• The nearest residence is 400 meters, at a commercial premises. Other dwellings are 500 meters away. This complies with the EPA Generic Buffer Guidelines.	----
Landform	----	• Locate activities behind natural barriers, landform and vegetation.	• The excavation area and operational procedures have been selected to provide the best screening.	----
Landform	----	• Work below natural ground level.	• This is proposed where possible.	----
		• Push overburden and interburden dumps into positions where they can form screening barriers.	• This will be used where overburden is available to form northern and western bunds.	----
Staging	----	• Design operational procedures and staging, to maximise the separation to sensitive premises.	• The excavation area is relatively small will be progressively opened.	----
Pit design	----	• Design the excavation to provide enhanced landform and constructed dust screening.	• See above and Figures.	----
Screening/ Vegetation	----	• Use landscape screening, wind breaks and tree belts.	• Trees within the parkland pasture provide wind breaks.	----
MANAGEMENT				
Occupation	----	• Provide air conditioned closed cabins on plant	• These will continue to be used for on-site operational mobile plant.	----
Monitoring	----	• Provide monitoring and supervision of the processing and other practices on site.	• A monitoring system is proposed. See below “Trigger Conditions”.	----
Trigger conditions	----	• Trigger conditions are used to determine when additional dust management is required.	• Most dust generated from excavation is visible. • The trigger for dust management is the generation of visual dust. • The site supervisor is normally the loader driver, who is in the best position to assess dust generation and to direct remediation. • On site operators are to be instructed to visually monitor dust, report and treat any visible dust.	----

Adverse weather	Low - Uncommon	• When winds are sufficiently strong, or other weather conditions are unacceptable, to negate the effects of dust management, operations will cease until conditions improve and compliance can be achieved.	• This policy will be implemented and is normal company policy to minimize impact on adjoining land holders.	Low
Equipment failure	Low - Uncommon	• In the event of dust management not being able to be achieved through equipment failure operations will cease until full capability is restored.	• This is committed to.	Low
Training	----	• Conduct training programs on dust minimisation practices.	• Italia Stone Group use on site induction and training to all personnel at all operations.	----
Complaints	----	• Provide a complaints recording, investigation, action and reporting procedure such as Appendix 3 of Land development sites and impacts on air quality, Department of Environmental Protection Guidelines, November 1996.	• A record of all dust complaints is to be maintained together with the mitigation measures to be used to reduce the dust impacts. • All complaints relating to dust are to be investigated immediately on receipt of a complaint. Appendix 3 of *Land development sites and impacts on air quality*, Department of Environmental Protection Guidelines, November 1996, will form the basis of the methods on which a complaint on dust is dealt with. • As far as is known there have been no complaints within the past five years.	----
EARTHWORKS				
Land Clearing	Low - 1.0 ha every 1 – 2 years	• Schedule activities such as vegetation removal or topsoil stripping on exposed ridgelines at times when the materials are less likely to blow or during suitable wind conditions.	• A Clearing Permit will be applied for to cover the taking of any trees and vegetation.	Low
Overburden removal	Low - 1 .0 ha every 1 – 2 years	• Schedule activities such as overburden stripping on exposed ridgelines at times when the materials are less likely to blow or during suitable wind conditions.	• This is proposed.	Low
Land restoration	Low - Once at the end of excavation and progressive actions	• Schedule activities such as ripping, overburden and topsoil spreading on exposed ridgelines at times when the materials are less likely to blow or during suitable wind conditions.	• This is proposed.	Low
EXCAVATION				
Excavation	Low to high - Low level continuous	• Excavate from the face using techniques that minimise the crushing of dry matter.	• Excavation will normally be completed by bulldozer for rubble and saw for the production of cut limestone	Low

	activity		blocks.	
Loading at Face	Moderate to high - Common activity	• Ensure that products to be loaded are moist and that the hardstand on which the loading occurs is wetted down or moist.	• These are operations that occur on the floor of the pit behind screening vegetation and the quarry faces.	Low
Haulage	Moderate - Infrequent to frequent during the day depending on the type of product	• Maintain haul road and hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades.	• The access road will continue to be maintained.	Low
		• Reduce the length of the internal roads by maximising internal servicing efficiency.	• No changes are proposed to the access roads.	
		• Providing speed management on hardstand and the road network.	• This is proposed.	
		• Provide air conditioned closed cabins on plant.	• All vehicles will be air conditioned.	
		• Limit speed on haul roads.	• Speed limits will be imposed as is normal quarry practice.	
		• Treat access roads, hardstand and stockpile transport and loading areas with dust suppression sealant, water or seal coat.	• The access road will be watered as required. • Water Licenses. Italia holds a current Water License for 5 000 kL per year for this site and has an additional 5 000 kL per year available if required within the same groundwater sub-area that is currently used on leased land at M70/138 Wesco Road; GWL48200(2).	
PLANT - PROCESSING				
Hardstand traffic	High - Ongoing activities	• Maintain hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades	• Water will be placed in a tank for gravity feed to operations. • A water truck will be used as required to suppress dust. • Crushing plants and screens are licensed or registered through DER (L8718/2012/1). This License will be extended to cover all the proposed extraction.	Low
Processing	Moderate - Ongoing but the scale depends on the type of product	• Treat processing areas with water sprays.	• Cutting of limestone blocks is undertaken using water to cool and wet down the blades. • Rubble extraction will also use water where required particularly on the main at risk areas where vehicle movements occur. • All dust covers and suppression equipment will be maintained and regularly serviced.	Low
Mobile and static plant Operation	Moderate - Ongoing but the scale depends on the type of	• Maintain all plant in good condition.	• Italia Stone Group have modern equipment that will be maintained in good condition including the maintenance of dust minimization measures.	Low

	product	• Ensure mobile and static plant is provided with dust extraction, shielding or filtration systems or wetting down as appropriate.	• Operators are to be instructed to visually monitor dust, report and treat any visible dust. • Regular maintenance programs for all dust suppression equipment are proposed. • Regular emptying of any dust collection devices and the renewal of any filter devices is programmed. • Dust management and monitoring forms part of the site induction programs.	
Loading and Stockpile Creation	Moderate - Ongoing but the scale depends on the type of product	• Shut down equipment when not in use.	• Italia Stone Group use this policy to save fuel and maintenance costs in addition to noise minimization.	Low
		• Limit drop heights from conveyors and dump trucks.	• This will be implemented. It is a good safety and site management procedure.	
TRANSPORT				
Road condition	Moderate to high - Infrequent to frequent during the day depending on the type of product	• Maintain access roads in good condition (free of potholes, rills and product spillages).	• The access road will be monitored and will be treated with water as required to produce a hard surface that will significantly suppress dust.	Low
		• Water and/or treat access roads and paved areas using a water tanker or sprinkler system.	• See above.	
Road Transport	Moderate to high - Infrequent to frequent during the day depending on the type of product per week	• Wet down or cover loads on trucks that are likely to blow during transport.	• Only large blocks will be removed from site when dimension stone is being cut. • Road base will be transported in covered trucks.	Low
		• Implement a site code outlining requirements for operators and drivers.	• A site code and induction system is proposed for the quarry.	
		• Maintain road trucks in a clean condition.	• Italia Stone Group road trucks are maintained in a clean condition. • Individual contractors will be required to do likewise.	
		• Avoid spillages on roads and clean up promptly.	• Italia Stone Group will have a policy of covering or wetting down loads and instruct drivers to report and clean up spillages.	Low
		• Ensure that during loading, product does not become lodged on the sides of trucks from where it can fall off during transport.	• This forms part of proposed normal operational procedures.	
		• Drivers are to inspect trucks prior to leaving site. Any product not correctly located and secured is to be removed prior to exit from the site.	• This forms part of proposed normal operational procedures.	
STOCKPILES				

Stockpiles	Moderate to high - Infrequent to frequent during the day depending on the type of product	• Wet down stockpiles using water canon or sprinklers as required.	• Stockpiles of limestone will be located on the pit floor away from the roads and dwellings.	Low

3.3.2 Dust Monitoring

The most effective dust monitoring is the generation of visible dust.

The auditable condition is visible dust crossing the boundary of the premises; the lot boundary. This is the condition used on Department of Environment Regulation Licenses and all other quarries such as sand, limestone and hard rock quarries in Western Australia and has worked well in the past.

It is also the method used by the DMIRS to rapidly assess occupational dust on site.

As invisible dust can be generated with the visible dust, recognizing and dealing with visible dust is a very effective instantaneous method of recognizing excessive dust.

There are a number of mechanical dust monitors but only two are approved under Australian Standards. The mechanical measurement of dust can be difficult to obtain accurate results and a number of systems provide retrospective measurements only.

Most dust generated from processing and vehicle movements has a very large visible component. Lesser risks emanate from excavation and land clearing.

The quarry manager and leading hand are ultimately responsible for site supervision of dust. They will travel around the operations and pit frequently and are in two way radio contact with all mobile plant.

All operators on site are instructed to be vigilant to dust generation and management and report any excessive dust or potential dust management issues.

The effectiveness of the dust management is shown by no complaints regarding dust normally being received. No complaints are known relating to dust from excavation within the past five years.

When trigger conditions are detected and/or alerted, relevant action is taken. This can include additional water suppression, modification of procedure, delay until more favorable conditions are present, use of alternative equipment etc.

Human monitoring can detect potential dust risks prior, and take action prior, to the dust being generated. They also notice dust immediately such as from tires, whereas machine monitoring has to rely on significant dust being generated, travelling to the boundaries of the premises and triggering an alarm. The operators would be negligent if they let the dust get to that level of impact prior to taking action.

Visual monitoring is even more effective when complemented by a reporting and complaints process.

4.0 Greenhouse Gas

The development of the Perth Metropolitan Area has generated the need for sandstone products, and if these cannot be obtained from this quarry they will be obtained from another.

Over the years trucks have become more efficient with respect to greenhouse gas emissions, particularly with the use of truck and trailer and road train configurations.

Italia continues to seek ways to reduce the amount of fossil fuels used, and has obtained more efficient mobile plant and equipment when this has become economically available.

The internal design of the operations attempts to minimize the haulage route to save energy use and potential impacts.

5.0 Complaints procedure

Visual monitoring is more effective when complemented by an extensive reporting and complaints process.

That reporting mechanism is enhanced by liaison with the closest sensitive premises who are in a position to alert the operators as required. Liaison with the closest residents assist residents who feel they have an effective voice, when it is used well.

People within the program will be provided with a copy of the Dust Management Plan and phone and email contacts that can be used in the event that visible dust is noticed crossing the site boundary.

An effective complaints mechanism is an essential part of the dust identification and management and is proposed.

A complaints book that lists the items below will be used. The book will be available to officers of the City of Wanneroo.

- The complaint,
- Nature of the complaint, time and date,
- Source of the complaint,
- Investigations of the complaint,
- Results of the investigation,
- If the complaint is valid, any mitigation actions that result,
- Any communication with the complainant.

A sample complaint procedure is provided below.

Appendix 3.

Procedures to be adopted following a complaint from a land development site

The procedures to be adopted by the developer following receipt of a dust-related complaint from a member of the public should be as follows:

- Record the details of the complaint as specified below. The complaint form should be retained by the developer and be made available upon request by the local government or an authorised DEP officer.
- Take measures to control any excessive dust by implementing the contingency arrangements which have been specified for the agreed site classification.
- If the developer regards the complaint to be unjustified, then the developer should forward the details of the complaint to the local government within 24 hours.

As a guide, the procedures to be adopted by local government, following receipt of a dust-related complaint from a member of the public or passed on by the developer, should be as follows:

- Record the details of the complaint as specified below or on a local government-approved complaint form. The complaint form should be retained by the local government and be made available upon request to an authorised DEP officer.
- Evaluate the complaint by conducting a visual inspection, preferably as soon as possible, taking into account the prevailing weather conditions which were being experienced at the time the complaint was lodged.
- If the complaint is valid, instruct the developer to take measures to control any excessive dust by implementing the contingency arrangements which have been specified for the agreed site classification.
- If the local government regards the complaint to be unjustified, contact the complainant and inform them of these findings.
- If the local government is unable to resolve the complaint, after exhausting all possible avenues, then the local government may request advice from the DEP.

ATTACHMENT 3

Water Management Plan

Lots 101 – 104 McLennan and Godel Roads

November 2018

Landform Research

CONTENTS

HYDROGEOLOGY – WATER MANAGEMENT PLAN

FIGURES

See the main text of the report.

HYDROGEOLOGY - WATER MANAGEMENT PLAN

1.0 Background

Proposed Excavation

Limestone extraction and processing has taken place on Lots 103 – 104 McLennan and Godel Roads, Nowergup for 30 years.

Limestone excavation is a clean industry that has the potential to release only small amounts of oils and fuels from isolated leakages of machinery. Small leakages such as these are readily broken down by soil bacteria.

It is no different to sand excavation, from an environmental risk, and excavation of basic raw materials is one of the few developments permitted to operate in Priority 1 Groundwater Areas (*Department of Environment and Conservation in Priority 1 Public Drinking Water Source Areas),* sand and limestone can be excavated to within 3 metres of the water table.

The facilities on site are summarised below

Secure compound	This is already present on site as shown on the attached Figures 3 and 7.
Site office/lunchroom	A site office/lunchroom is maintained on site for the management and security of small items.
Toilet system	A serviced portable toilet system is to be installed at the site office.
Storage sheds	A storage shed is located on site for the storage of maintenance items and for support to the quarry. The location of these facilities is shown in Figures 3 and 7.
Bore	One bore is present, licensed from Department of Water GWL48200 (2).
Bulldozer	Pushing, track rolling and movement of limestone and for use in land restoration.
Water tanker	Used for dust suppression on the access road and working floors as required.
Loader and bobcat	The loader will be used for the movement of limestone, loading road trucks and feeding crushing and screening plant. A second loader may be required. The bobcat is used to lift reconstituted blocks.
Blasting	Not proposed but could be used in a limited way if a contract for armour rock for coastal works is required. Prior to blasting the City of Wanneroo will be informed of the number, time and type of blasts and the closest dwellings to the south west, will be notified.
Weighbridge	At this stage a weighbridge is not proposed but may be used if required.
Mobile crushing and screening plant	A mobile crushing and screening plant is required for the preparation of raw feed to the processing plant and the preparation of road bases and construction materials. This will be located on the floor of the pit. (DER L8718/2012/1).
Fuel Storage	Vehicles will be refuelled from mobile tankers, Onsite fuel storage is not required.
Explosives Compound	Storage of Explosives as governed by DMIRS Licences (ETS002771 and SST000252)

Water Supply

Italia holds a current Water License for 5 000 kL per year for this site and has an additional 5 000 kL per year available if required within the same groundwater sub-area that is currently used on leased land at M70/138 Wesco Road; GWL48200(2).

Potable water will be brought to the site as required.

2.0 Location

The site lies on Lots 101 – 104 McLennan and Godel Road. It adjoins a poultry shed production and market gardens.

3.0 Guidance Documents

The protection of water whether groundwater or surface water is an important part of the management of quarries. Different types of quarries have different potential impacts which are listed below in general terms. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed.

Guidance on the quality of water can be found in;

- *Western Australian Water Quality Guidelines for Fresh and Marine Waters, EPA Bulletin 711, 1993.*
- *ANZECC, 1992, Australian Water Quality Guidelines for Fresh and Marine Waters.*

A number of documents provide guidance on the management and disposal of surface water that can lead to waterways, wetlands and underground water systems. These mainly apply to urban development but the methods are also applicable to the quarrying industry.

- *Engineers Australia 2003, Australian Runoff Quality, National Committee on Water Engineering.*
- *Stormwater Management Manual for Western Australia, Department of Environment WA, 2004.*
- *Guidelines for Groundwater Protection in Australia, ARMCANZ, ANZECC, September 1995.*

Documents specific to the mining and quarrying operations are the DWER – DMIRS Water Quality Protection Guidelines for Mining and Mineral Processing.

- *Overview*
- *Minesite water quality monitoring*
- *Minesite stormwater*
- *WQPN 28 Mechanical servicing and workshop (2006)*
- *Mine dewatering*
- *WQPN Landuse Compatibility in Public Drinking Water Source Areas (2004)*
- *WQPN 15 Extractive Industries near sensitive water resources.*
- *Department of Water – Water resource considerations for extractive industries.*
- *Department of Water – South West Region Guideline – Water resource considerations for extractive industries.*

- The continued excavation complies with all the documents above. The most relevant documents are WQPN 15 *Extractive Industries near sensitive water resources* and *South West Region Guideline – Water resource considerations for extractive industries.*

The location of the sandstone and its proposed excavation complies with all Advice and recommendations, of the policy (Numbers 1 – 62) from WQPN and *South West Region Guideline*.

4.0 Geology and Geomorphology

Elevation of the land surface grades from 75 metres AHD in the west of the proposal area to 83 metres AHD in the east.

The site is underlain by a sequence of limestone and sand of the Tamala Limestone. It is a highly porous sequence with fast vertical movement of water to the ground water table and then slower lateral flow of groundwater to the west.

The site is well drained with the water table being 21 metres AHD in the east dropping to 18 metres in the west (Department of Environment and Conservation, 2004, *Perth Groundwater Atlas*). Flow is to the west. The current base of excavation is variable but near 30 metres AHD. This provides for a separation to the water table of 10 metres.

The sand and limestone is porous and there is no surface water runoff, with all surface water being retained within the pit.

Flow of ground water is to the west towards the ocean.

5.0 Regolith and Soils

The soils have a thin grey band of leached silica sand grading into pale yellow sand over deep limestone. The yellow colour is due to goethite staining.

6.0 Climate

The climate of the area is Mediterranean with warm to hot summers and cool wet winters.

The closest recording station is Beenyup (Wanneroo), although averages of only six years' data have been recorded. Other weather data must be taken from Perth.

The highest temperatures are in February, with an average of 30.0 maxima, and the lowest are recorded in July with average maxima of 18 degrees Celsius and 7.4 degrees C minima.

Rainfall for the area is slightly less than Perth at 722 mm compared to Perth's 869 mm, of which more than 90% falls in the months April to October inclusive. Evaporation is high and exceeds rainfall in all but the four wettest months, May to September.

7.0 Water Source

Water is to be mainly used for dust suppression.

The water is to be obtained from the sump in the base of the pit and the farm dam on site as a top up if required. Figures 2, 5 and 10.

The current bitumen access road does not require dust suppression.

Drinking water is brought to the site as needed.

8.0 Hydrogeology

8.1 Background

Limestone has been excavated from the site for many years, as far as is known without incident.

8.2 Surface Water

There is no surface drainage due to the porosity and permeability of the limestone, with precipitation draining to the water table.

8.3 Groundwater

The site is well drained with the water table being 21 metres AHD in the east dropping to 18 metres in the west (Department of Environment and Conservation, 2004, *Perth Groundwater Atlas*). Flow is to the west. The current base of excavation is variable but near 30 metres AHD. This provides for a separation to the water table of 9 metres.

The sand and limestone is porous and there is no surface water runoff, with all surface water being retained within the pit.

Flow of ground water is to the west towards the ocean.

8.4 Dewatering

No change to current operations is proposed.

No dewatering will be required.

8.5 Recharge

The site lies up hydraulic gradient of Nowergup Lake.

Currently there is limited area of open ground.

Discussions of the recharge on limestone areas can be found in *Environmental Protection Authority in Bulletins 512, 788, 821 and 818,* and whilst these do not specifically refer to the extraction of basic raw materials they do consider the impact of clearing, planting trees and rural residential developments. The figure the EPA used for recharge from native vegetation was 10 – 15% rainfall, whereas cleared land had a recharge of 30 – 40 %. The floor of the quarry is also cleared and so there is not expected to be any reduction in recharge to the site.

As there will be no change to the amount of open ground no changes to recharge are anticipated and no calculations are therefore required. EPA Bulletins 512, 788, 821 and 818 can be referred to for explanations.

Water used from the bore is minimal in the context of the land holding, at less than 5000 kL per year, and is used for truck wet down and sprinklers near the entrance, although nowadays most trucks have covered loads, negating the need for wetting down.

8.6 Salinity

The groundwater obtained from the bore on site is fresh and there is no likelihood of significant or other salinity increases apart from minor evaporation, which is no different from any garden.

8.7 Acid Sulfate Risk

There has been an increased interest in acid sulfate soils since the release of WAPC Planning Bulletin 64. However the interest has been over reactive and conditions and risk applied in many areas where there is no geological risk or evidence of acid sulfate.

Definitive survey procedure is produced in DEC (DER) 2013, *Identification of Acid Sulfate Soils and acidic Landscapes* and within document Acid Sulphate Soil Management Advisory Committee NSW, 1998, *Acid Sulphate Manual.* This information forms the basis for much of the assessment procedures in Australia, including those adopted by the Western Australian Planning Commission and the Department of Environment Regulation.

The *Acid Sulphate Manual* adopts the procedure of reviewing the published data followed up by field assessment, which has been completed for this site. If a geological risk is determined, then a Preliminary Acid Sulphate Assessment is conducted.

The site has been visited by Lindsay Stephens of Landform Research on a number of occasions, and the faces and limestone observed.

The *Acid Sulphate Manual* adopts the procedure of reviewing the published data followed up by field assessment, which has been completed for this site. If a geological risk is determined, then a Preliminary Acid Sulphate Assessment is conducted.

Acid Sulphate Soils can potentially form under reducing conditions when there is a source of carbon and a source of sulphur (normally from sea or saline water). Micro-organisms are thought to play an important role in reducing the sulphates within the sediments to form the iron sulphide. It is a natural phenomena that can be exacerbated by disturbance.

Potential acid sulphate conditions most commonly form under current or past estuarine conditions, peaty conditions, and may also result from weathering of some geological formations and situations which contain sulphides.

The soils most at risk are normally saline/estuarine soils, gley soils, peat and some organoferricretes when exposed to the atmosphere.

Acid sulphate only becomes a potential risk when a number of circumstances are present.

- There is rock, soil or regolith present that is carrying sulphides.
- Sulphide carrying materials from below the water table are to be exposed to the atmosphere.
- Excavation below the water table is to be carried out exposing the sulphide carrying materials to oxygen in the atmosphere.
- Dewatering of the sulphide carrying materials is proposed, exposing them to oxygen.
- Exposure of peat or organoferricrete materials that were permanently under reducing conditions to the air.

Acid conditions can form if soils containing pyrite are exposed to the air, allowing sulfuric acid to be formed. The soils most at risk are normally saline/estuarine soils, gley soils, peat and some organoferricretes.

None of these conditions occur on site. No peat or organic matter has been intersected in the pit, is present in the faces or floor, and none is likely as the existing excavation at around 10 metres above the water table is located in the wrong geological environment.

Site inspections reveal no risk. The site is based on limestone and elevated nature of the site in a highly oxidised landscape, higher in the landscape and tightly sealed so that there is no organic matter present.

The limestone is permeable and free draining with brown oxidation colouration. It lies above the groundwater and is not subject to reducing conditions and does not therefore contain pyrite.

Therefore there is no potential for acid conditions to develop in this ecological or geomorphological situation.

8.8 Wetlands

There are no wetlands on site.

There are no wetlands on site or nearby. The closest wetland is Nowergup Lake which lies 700 metres to the west of the current and proposed excavation. The excavation will move further east away from the lake as it progresses. See Appendix 1, 4.0 Wetlands.

There are no proposed changes to recharge. Water protection procedures will continue to be used.

9.0 Water Quality Protection

9.1 Ground and Surface Water Protection

Water is normally used for wash down and for dust suppression as required. Currently all water is drawn from a bore located on site.

Sand and Limestone extraction is a chemically safe operation. Groundwater pollution risk is recognized as low by the DWER and EPA who permit excavation of sand with a 3 meter separation to the water table in Priority 1 Groundwater Protection Areas and 2 meters in other areas.

A separation to the water table of 9 plus metres in the north reducing to 4 metres in the south complies with EPA and DWER guidelines.

Based on past use, combined with the length of unsealed internal access roads, it is anticipated that water use will be 1 500 kL per year. The Licence is for 5 000 kL with a further 5 000 kL available if required by transfer.

It is possible that at some future time application might be made for a bore on either pit. With the separation of the quarries it is likely to be preferable to have two bores. Any bores will be licensed as required through the DWR and if possible water will be recycled through a small plastic lined sediment settlement dam to reduce consumption.

Drinking water will be brought to the site as needed.

9.2 Waste Management

9.2.1 Waste Rock and Tailings Management

There will be no washing of products. Subgrade materials will be used for subsoil restoration or used for perimeter bunding and landform restoration.

There will be no waste rock or tailings.

9.2.2 Unauthorised Access and Illegal Dumping

The potential for rubbish to be dumped relates to unauthorised access to the site. Access is restricted by current farm fencing and locked gates.

Wastes generated from on-site operational activities will be recycled wherever possible and periodically disposed of at an approved landfill site.

Any illegally dumped materials are to be removed promptly to an approved landfill or other suitable site, depending on the nature of the material.

9.2.3 Solid Domestic and Light Industrial Wastes

Non-essential or old plant and materials will be removed from the site. Locked gates and the existing fences will be maintained to prevent illegal dumping and contamination of water.

All solid domestic and light industrial wastes will be stored in commercial waste storage containers and/or removed to an approved landfill facility. There will be no waste disposal on site. Waste storage containers will be sealed so that rainfall cannot enter, therefore preventing the formation of leachates.

Wastes generated will be recycled wherever possible and periodically disposed of at an approved landfill site. Any illegally dumped materials are to be removed promptly to an approved landfill or other suitable site, depending on the nature of the material.

The potential for rubbish to be dumped relates mainly to unauthorised access and is low as the site is set back from roads. The site is currently fenced. Gates will be locked at all times when the site is unmanned and equipment is retained on site. Fences will be maintained.

Any waste chemicals derived during routine maintenance activities will be stored in appropriate sealed containers within a designated storage area or taken from site and disposed of at an approved facility.

There is not proposed to be any wash down of mechanical equipment.

9.3.4 Wastewater Disposal

A serviced portable toilet is proposed to be in place while the site is operating.

9.3.5 Refuelling

The protection of water from fuels and other chemicals is an important part of the management of quarries. Different types of quarries have different potential impacts which are listed below in general terms. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed

Extraction of limestone is a clean operation similar to sand excavation in the nature of the risk to groundwater.

No chemicals are used apart from normal lubricants, which is similar to sand excavation, and sand excavation is one of the few industries that are permitted to operate in a Priority 1 Public Drinking Water Source Area, indicating the clean nature of the activity. See Department of Water *Land Use Compatibility in Public Drinking Water Source Areas.*

All spills are to be cleaned up in accordance with the summarised procedures following.

Documents specific to the fuel and maintenance are the DOW – DMP Water Quality Protection Guidelines for Mining and Mineral Processing

- *Mechanical servicing and workshop facilities*
- *WQPN 28 Mechanical servicing and workshop (2006)*
- *WQPN 15 Extractive Industries near sensitive water resources.*
- *Department of Water – South West Region Guideline – Water resource considerations for extractive industries.*

A list of the management actions for maintenance is provided. The actions will be used where applicable and as the opportunity presents to maintain water quality on this site.

Italia have safety and pollution management procedures for all their operations. They also use self-contained service and recovery vehicles to undertake minor servicing in the field.

Fuel Management Plan

Fuel Storage

It is proposed to use mobile tankers to refuel mobile and fixed plant when the site is manned. There will be no fuel storage.

Limestone has high absorbency, and any lubricant spills are plainly visible as they remain on the surface and are easily isolated and contained.

Fuel Spill Management Plan

- Fuel and maintenance will be carried out in accordance with the DWER – DMIRS Water Quality Protection Guidelines for Mining and Mineral Processing, *Mechanical servicing and workshop facilities*.

- Soils and limestone such as those on this site are adsorptive. The main risk of contamination is the minor drips that occur during the removal of hoses etc. Minor spills are quickly degraded by soil microbial matter.

- Refuelling and lubricating activities are to occur in the base of the pit or designated area, and equipment for the containment and clean-up of spills is to be provided. Currently refuelling occurs at the on-site compound where it can be supervised.

- Spillage will be contained in plant and working areas by shutting down plant or equipment if the plant or equipment is the source of the spill (provided it is safe to do so).

- Transport chemicals in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

- All significant adverse incidents (such as a fuel spill of >5 litres) in one dump, are to be recorded, investigated and remediated. A record is to be kept of incidents, and DWER and City of Wanneroo notified within 24 hours of an incident.

- In the event of a spill or adverse incident, activities will be stopped in that area until the incident is resolved.

- Any spills will be contained by the excavation. Soil, adsorbent clay or crushed resource will quickly be placed around the spill to contain it in as small an area as possible. When contained, the contaminated limestone or sand will be scooped up and removed to an approved landfill or other approved site.

9.3.6 Dangerous Goods and Hazardous Substances

There is no transport, storage or handling of hazardous materials involved in sand and limestone extraction.

9.3.7 Servicing and Maintenance

Documents specific to the fuel and maintenance are the DWER – DMIRS Water Quality Protection Guidelines for Mining and Mineral Processing

- *Mechanical servicing and workshop facilities*

The main risk of contamination comes from tank or hose rupture on earth moving machines. A spill kit containing absorbent granules is located on site for emergency use. A commitment is made to notify Department of Water and the City of Wanneroo of any spill greater than 5 litre. DWER Guidelines suggest 100 litres but this is felt to be too high.

- All major servicing of vehicles will be conducted off site.

- Servicing plant and equipment will be in accordance with a maintenance schedule.

- Lubricating and maintenance activities are to occur in designated areas, and equipment for the containment and clean-up of spills is to be provided.

- Spillage will be contained in plant and working areas by shutting down plant or equipment if the plant or equipment is the source of the spill (provided it is safe to do so).

- Waste substances and chemicals will be stored in accordance with the Site Waste Guidelines.

- Waste oil and other fluids derived from the routine maintenance of mobile machinery, will be transported off site and disposed of at an approved landfill site. Grease canisters, fuel filters, oil filters and top-up oils will be stored in appropriate containers in a shed or brought to the site as required.

- Vehicle wash-down is not proposed.

- Regular inspections and maintenance of fuel, oil and hydraulic fluids in storages and lines will be carried out for wear or faults.

- Accidental spill containment and clean-up protocol will be implemented as necessary.

- Any waste chemicals derived during routine maintenance activities will be stored in appropriate sealed containers within a designated storage area or taken from site and disposed of at an approved facility.

- Rubbish generated is to be recycled wherever possible and periodically disposed of at an approved landfill site.

- The site will be maintained in a tidy manner by removing all rubbish regularly offsite.

10.0 Monitoring

Monitoring will continue to concentrate on;

- Supervision and management of the operations.

Monitoring of groundwater is not considered necessary because the excavation is designed to comply with Department of Water requirements for Drinking Water Catchments and therefore complies with normal water management in other areas.

ATTACHMENT 4

Western Australian Planning Commission

Our Ref : 30-50200-1
Your Ref :
Enquiries : David Carter (Ph 9264 7678)

26 October 2010

METROPOLITAN REGION SCHEME

City of Wanneroo

APPROVAL TO COMMENCE DEVELOPMENT

Name and Address of Owner and Land on which Development Proposed:

OWNER	:	S & R Catalano 42 Doolette Street SPEARWOOD WA 6163, G Fazio 35 Barrett Street FREMANTLE WA 6010
LOT	:	103 & 104
LOCATION	:	-
PLAN/DIAGRAM	:	14371
VOLUME/FOLIO	:	1654/586 & 1654/587
LOCALITY	:	McLennan Drive & Godel Road, Nowergup
APPLICATION DATE	:	08 July 2008
APPLICATION REC'D	:	26 August 2008
Development Description	:	Renewal Of Sand And Limestone Quarry

The application for approval to commence development in accordance with the plans submitted thereto is granted subject to the following condition(s):

1. The Western Australian Planning Commission's approval is granted for a period of five (5) years from the date of this approval.

2. The development site shall be excavated and rehabilitated in accordance with an approved Excavation and Rehabilitation Management Plan to the specification of the City of Wanneroo and to the satisfaction of the Western Australian Planning Commission.

3. The final excavation boundary to be determined to the specification of the Department of Environment and Conservation and to the satisfaction of the Western Australian Planning Commission.

4. The endorsed buffer areas to be fenced and appropriately sign posted to the specification of the Department of Environment and Conservation and to the satisfaction of the Western Australian Planning Commission prior to the commencement of any site works.

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address http://www.planning.wa.gov.au
ABN 35 482 341 493

Western Australian Planning Commission

If the development the subject of this approval is not substantially commenced within a period of two years from the date of this letter, the approval shall lapse and be of no further effect. Where an approval has so lapsed, no development shall be carried out without the further approval of the responsible authority having first been sought and obtained.

Tony Evans
Secretary
Western Australian Planning Commission

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address http://www. planning.wa.gov.au
ABN 35 482 341 493

City of Wanneroo

File Ref: DA08/755(10/33661)
Your Ref:
Enquiries: Aiton Sheppard

26 August 2010

Lindsay Stephens
Landform Research
25 Heather Road
ROLEYSTONE WA 6111

Dear Sir/Madam

DA2008/755 – EXTRACTIVE INDUSTRY – 170 MCLENNAN DRIVE, NOWERGUP

I refer to your submission on the above proposal and wish to advise you that Council considered this matter at its meeting of 24 August 2010.

GRANTS PLANNING APPROVAL under the City of Wanneroo District Planning Scheme No 2, to the application received on 19 January 2010, by Landform Research on behalf of Italia Stone Group to extract limestone (including limestone block cutting) on Lots 103 and 104 McLennan Drive/Godel Road, Nowergup, subject to the following conditions:

a) Approval is granted for a limited time of five years, expiring on 30 June 2015, unless a new approval is granted. If a new approval is not granted, all structures erected as a consequence of this approval shall be removed to the City's satisfaction before 30 June 2015;

b) The extractive industry shall only be operated while the operator holds an Extractive Industry Licence (Licence), granted under the City of Wanneroo Extractive Industries Local Law 1998 (as amended), and all operations shall comply with the conditions of the Licence;

c) The extractive industry shall be restricted to the area illustrated on the approved plans and shall, in all respects, comply with the ultimate finished levels and extraction footprint depicted thereon.

No other areas beyond the approved extraction footprint shall be utilised in association with extractive industry operations on the subject land without the prior planning approval of the City, including but not limited to the stockpiling of topsoil or overburden, or the encroachment of batters beyond the approved extraction footprint;

d) Approval is only for the extraction of limestone as a priority resource and does not include the extraction of sand that is not a priority resource;

e) A concrete crossover shall be constructed to Godel Road, and the first 50 metres of the access road from the crossover shall be sealed in bitumen to the satisfaction of the Manager, Planning Implementation;

f) The heavy haulage route to/from the subject site and Wanneroo Road shall be via Godel Road and Gibbs Road North to Karoborup Road or Nowergup

23 Dundebar Road, Wanneroo WA 6065 • Locked Bag 1, Wanneroo WA 6946
Telephone (08) 9405 5000 Facsimile (08) 9405 5499 Website www.wanneroo.wa.gov.au

Road. Heavy haulage vehicles shall not use Gibbs Road South to gain access to/from site. In this regard a traffic management plan shall be submitted and approved by the City prior to an extractive industry licence being issued demonstrating that this route is satisfactory and how vehicles movements to and from the site will be managed;

g) Finished levels shall be coordinated with surrounding natural ground levels to the satisfaction of the Manager, Planning Implementation. Relative to this condition the proponent shall submit plans showing the proposed coordination of finished levels with adjacent natural ground levels for separate approval by the Manager, Planning Implementation;

h) Perimeter security fencing and gates shall be installed prior to the commencement of operations on the site to the satisfaction of the Manager Planning Implementation;

i) Ablution and lunch room facilities shall be provided on site for workers prior to the commencement of operations to the satisfaction of the Manager Planning Implementation;

j) All fuel storage (above and below ground) shall be in accordance with the Department of Environment and Conservation's requirements for water quality protection in public drinking water source areas;

k) An approved wash down area with a petrol and oil trap is to be provided to the satisfaction of the Manager, Planning Implementation before any vehicle or equipment wash-down or servicing may be undertaken and any such activities shall be confined to that approved area;

l) No explosives shall be stored on site and no blasting shall be carried out without the approval of the appropriate state government authority and the City of Wanneroo;

m) This approval does not include the use of any peat or other landfill material on the site. Any landfill shall be the subject of a separate application for planning approval;

n) Staging of quarrying shall be managed to a scale that meets the availability of water for dust suppression, to the satisfaction of the Manager, Planning Implementation; and

2. ADVISES the Western Australian Planning Commission of its determination under District Planning Scheme No. 2.

A copy of the report presented to Council may be viewed at the City of Wanneroo website at www.wanneroo.wa.gov.au (choose Council, Council Meetings, Agendas/Minutes 2010.

Yours faithfully

G-Babudri

Grace Babudri
PROJECT OFFICER

#10/33661

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref: CPS 3003/3
Our ref: DEC 10667
Enquiries: Jareth Howard
Phone: 9219 8746
Fax: 9219 8701
Email: nvp@dec.wa.gov.au

Mr Lindsay Stephens
Landform Research
25 Heather Road
ROLEYSTONE WA 6111

Dear Mr Stephens

RECEIPT OF 2009 ANNUAL REPORT FOR CLEARING PERMIT CPS 3003/3

Thank you for submitting the 2009 Annual Report for Clearing Permit CPS 3003/3 on behalf of Italia Stone Group Pty Ltd as required by Condition 9 of CPS 3003/3. The Department of Environment and Conservation (DEC) received the annual report on 2 August 2010.

Please note that DEC may review the annual report submitted by Landform Research for compliance with the conditions set out under CPS 3003/3. If a review is conducted feedback will be provided on any issues identified.

Please be aware that the next annual report for the period 1 January 2010 to 31 December 2010 is due by 30 June 2011.

If you have any queries in relation to this matter please contact Jareth Howard at DEC's Native Vegetation Conservation Branch on 9219 8744.

Yours sincerely

Jareth Howard
Environmental Officer, Compliance and Audit Section
NATIVE VEGETATION CONSERVATION BRANCH

28 September 2010

Cc: Italia Stone Group Pty Ltd trading as Roadstone Quarries

Government of Western Australia
Department of Environment and Conservation

Your ref: L8718/2012/1
Our ref: 2012/009034-1
Enquiries: Bhabesh Das
Phone: 9333 7550
Fax: 9333 7550
Email: bhabesh.das@dec.wa.gov.au

Mr Sam Catalano
Italia Stone Group Pty Ltd
55 Miguel Road
BIBRA LAKE WA 6163

Dear Mr Catalano

***ENVIRONMENTAL PROTECTION ACT 1986*: LICENCE GRANTED**
Premises
Italia Stone Group Pty Ltd
Lot 103 Godel Road & Lot 104 McLEnnan Drive, Nowergup, WA, 6032
Licence Number: L8718/2012/1

A licence under the *Environmental Protection Act 1986* (the Act) has been granted for the above premises. The Department of Environment and Conservation will advertise the issuing of this licence in the public notices section of *The West Australian* newspaper.

The licence includes attached conditions. Under Section 58(1) of the Act, it is an offence to contravene a condition of a licence. This offence carries a penalty of up to $125,000 and a daily penalty of up to $25,000

In accordance with section 102(1)(c) of the Act, you have 21 days to appeal the conditions of the licence. Under section 102(3)(a) of the Act, any other person may also appeal the conditions of the licence. To lodge an appeal contact the Office of the Appeals Convenor on 6467 5190 or by email at admin@appealsconvenor.wa.gov.au.

Where a licence is issued for more than one year it requires payment of an annual fee and will cease to have effect if the fee is unpaid. It is the occupier's responsibility to lodge a fee application and pay the annual fee in sufficient time to avoid incurring a late payment fee and for processing to be completed before the licence anniversary date.

If you have any queries regarding the above information, please contact Dr Bhabesh Das on 9333 7510.

Yours sincerely

Tony Wynne
Officer delegated under Section 20
of the *Environmental Protection Act 1986*

3 January 2013

Department of
Environment and Conservation
Our environment, our future

Licence

Environmental Protection Act 1986, Part V

Licensee: Italia Stone Group Pty Ltd

Licence: L8718/2012/1

Registered office: 55 Miguel Road
Bibra Lake
WA 6163

ACN: 119 060 543

Premises Address: Italia Stone Group Pty Ltd
Lot 103 on Plan 14371, Godel Road and
Lot 104 on Plan 14371 McLennan Drive
Nowergup
WA 6032

Issue date: 3 January 2013

Commencement date: 7 January 2013

Expiry date: 6 January 2018

Prescribed Premises Category
Schedule 1 of the Environmental Protection Regulations 1987

Category number	Category description	Category production or design capacity	Premises production or design capacity
70	Screening etc. of material: premises (other than premises within category 5 or 8) on which material extracted from the ground is screened, washed, crushed, ground, milled, sized or separated.	More than 5000 but less than 50 000 tonnes per year	< 50 000 tonnes per year

Conditions of Licence
Subject to the conditions of the licence set out in the attached pages.

Tony Wynne
.....
Officer delegated under Section 20
of the *Environmental Protection Act 1986*

Contents

Introduction

This Introduction is not part of the Licence conditions.

Who we are

The Department of Environment and Conservation (DEC) is a Government Department in the portfolio of the Minister for the Environment. Our purpose is to protect and conserve the State's environment on behalf of the people of Western Australia.

Our industry licensing role

DEC has responsibilities under Part V of the *Environmental Protection Act 1986* (the Act) for the licensing of prescribed premises. We also monitor and audit compliance with works approvals and licence conditions, take enforcement action as appropriate and develop and implement licensing and industry regulation policy.

Licence requirements

This licence is issued under Part V of the Act. Conditions contained with the licence relate to the prevention, reduction or control of emissions and discharges and to the monitoring and reporting of them.

Where other statutory instruments impose obligations on the Premises/Licensee the intention is not to replicate them in the licence conditions. You should therefore ensure that you are aware of all your statutory obligations under the Act and any other statutory instrument. These can be accessed through the State Law Publisher website using the following link:
http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html

For your Premises relevant statutory instruments include but are not limited to obligations under the:

- Environmental Protection (Unauthorised Discharges) Regulations 2004 – these Regulations make it an offence to discharge certain materials such as contaminated stormwater into the environment other than in the circumstances set out in the Regulations.

- Environmental Protection (Controlled Waste) Regulations 2004 - these Regulations place obligations on you if you produce, accept, transport or dispose of controlled waste.

- Environmental Protection (Noise) Regulations 1997 – these Regulations require noise emissions from the Premises to comply with the assigned noise levels set out in the Regulations.

You should comply with your licence. Non-compliance with your licence is an offence and strict penalties exist for those who do not comply. Additional guidance on pollution prevention can be found in the Department of Water's Water Quality Protection Guidelines and Codes of Practice accessed through:
http://www.water.wa.gov.au/Managing+water/Water+quality/Water+quality+protection+guidelines/default.aspx

Licence holders are also reminded of the requirements of section 53 of the Act which places restrictions on making certain changes to prescribed premises unless the changes are in accordance with a works approval, licence, closure notice or environmental protection notice.

Licence Fees

If you have a licence that is issued for more than one year, you are required to pay an annual licence fee prior to the anniversary date of issue of your licence. Non payment of annual licence fees will result in your licence ceasing to have effect meaning that it will no longer be valid and you will need to apply for a new licence for your Premises.

Ministerial conditions

If your Premises has been assessed under Part IV of the Act you may have had conditions imposed by the Minister for the Environment. You are required to comply with any conditions imposed by the Minister.

Premises description and Licence summary

The Italia Limestone Company has been operating since 1991.

Italia Limestone undertakes cutting of limestone into various shapes and sizes for the use of building industries. This operation generates off cut lime stone, rubble and fines. The main activities of the premises relate to crushing and screening of limestone wastes obtained from cutting operations.

The site is located in an industrial area surrounded by vegetation. It is not within the EPA Buffer Zone as recommended in the document 'Guidance for the Assessment of Environmental Factors Western Australia in accordance with the Environmental Protection Act 1986'. The site is approximately 800 meters from the Nowergup Lake. There are no residences within 2Km of the site.

The main emissions for the site are dust and noise. The noise is not considered to be an issue, considering the location of the premises and the dust is managed by a water sprinkler system and water carting.

This Licence is the successor to licence L64844/1999/9.

The licences issued for the Premises since 09/10/2000 are:

Instrument log

Instrument	Issued	Description
Instrument number and version	Date of issue or amendment	Reason for issue of instrument e.g. ministers decision must be recorded
L6484/1991/1	Not specified	New application
L6484/1991/2	09/10/2000	Licence re-issue
L6484/1991/3	15/10/2001	Licence re-issue
L6484/1991/4	22/10/2002	Licence re-issue
L6484/1991/5	20/10/2003	Licence re-issue
L6484/1991/6	27/09/2004	Licence re-issue

L6484/1991/7	03/10/2005	Licence re-issue
L6484/1991/8	07/10/2010	Licence re-issue
L6484/1991/8	31/05/2012	Licence amendment to new format
L8718/2012/1	24/12/2012	New application

Severance

It is the intent of these Licence conditions that they shall operate so that, if a condition or a part of a condition is beyond the power of this Licence to impose, or is otherwise *ultra vires* or invalid, that condition or part of a condition shall be severed and the remainder of these conditions shall nevertheless be valid to the extent that they are within the power of this Licence to impose and are not otherwise *ultra vires* or invalid.

END OF INTRODUCTION

Licence conditions

1 General

1.1 Interpretation

1.1.1 In the Licence, definitions from the *Environmental Protection Act 1986* apply unless the contrary intention appears.

1.1.2 For the purposes of this Licence, unless the contrary intention appears:

"the Act" means the *Environmental Protection Act 1986;*

"annual" means the inclusive period from 1 January until 31 December in that year;

"Code of Practice for the Storage and handling of dangerous goods" means the Storage and handling of dangerous goods, Code of Practice, Department of Mines and Petroleum, Government of Western Australia;

"Contact Address" for the purpose of correspondence and advice means:
Regional Leader, Swan Region
Department of Environment and Conservation
181 – 205 Davy St
BOORAGOON WA 6154
Telephone: (08) 9333 7510
Facsimile: (08) 9333 7550;

"dangerous goods" has the meaning defined in the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007;

"Director" means Director, Environmental Regulation Division of the Department of Environment and Conservation for and on behalf of the Chief Executive Officer as delegated under Section 20 of the *Environmental Protection Act 1986;*

"environmentally hazardous material" means material (either solid or liquid raw materials, materials in the process of manufacture, manufactured products, products used in the manufacturing process, by-products and waste) which if discharged into the environment from or within the premises may cause pollution or environmental harm;

"fugitive emissions" means all emissions not arising from point sources identified in Sections 2.2, 2.3, 2.4 and 2.6;

"Licence" means this Licence numbered L8718/2012/1 and issued under the *Environmental Protection Act 1986;*

"Licensee" means the person or organisation named as Licensee on page 1 of the Licence;

"placard quantity" has the meaning defined in the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007;

"Premises" means the area defined in the Premises Map in Schedule 1 and listed as the Premises address on page 1 of the Licence;

"usual working day" means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia;

"waste" has the meaning defined in the *Environmental Protection Act 1986*;

1.1.3 Any reference to an Australian or other standard in the Licence means the relevant parts of the current version of that standard.

1.2 General conditions

1.2.1 Nothing in the Licence shall be taken to authorise any emission that is not mentioned in the Licence, where the emission amounts to:
(a) pollution;
(b) unreasonable emission;
(c) discharge of waste in circumstances likely to cause pollution; or
(d) being contrary to any written law.

1.2.2 The Licensee shall maintain all pollution control and monitoring equipment to the manufacturer's specification or any internal management system.

1.2.3 The Licensee, except where storage is prescribed in section 1.3, shall only store substances that are classed as dangerous goods below placard quantities or environmentally hazardous materials not classified as dangerous goods if they are stored in accordance with the Code of Practice for the Storage and handling of dangerous goods.

1.2.4 The Licensee shall immediately recover, or remove and dispose of spills of environmentally hazardous materials outside an engineered containment system.

Stormwater control

1.2.5 The Licensee shall ensure that uncontaminated stormwater is kept separate from contaminated or potentially contaminated stormwater. Where stormwater has come into contact with a possible source of contamination, it should be treated as contaminated.

1.3 Premises operation

There are no specified conditions relating to Premises operation in this section.

2 Emissions

2.1 General

2.1.1 The Licensee shall record and investigate the exceedance of any descriptive or numerical limit, and/or target in this section.

2.2-2.4 Point source emissions to air, surface water and groundwater

There are no specified conditions relating to point source emissions to air, surface water and groundwater in thiesesections.

2.5 Emissions to land

There are no specified conditions relating to emissions to land in this section.

2.6 Fugitive emissions

2.6.1 The Licensee shall use all reasonable and practical measures to prevent and where that is not practicable to minimise dust emissions from the Premises.

2.6.2 The Licensee shall ensure that no visible dust generated by the activities of the Premises crosses the boundary of the Premises.

2.7 Odour

There are no specified conditions relating to odour in this section.

2.8 Noise

There are no specified conditions relating to noise in this section.

3 Monitoring

There are no specified conditions relating to monitoring in this section.

4 Improvements

There are no specified conditions relating to improvements in this section.

5 Information

5.1 Records

5.1.1 All information and records required by the Licence shall:
- (a) be legible;
- (b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;
- (c) except for records listed in 5.1.1(d) be retained for at least 6 years from the date the records were made or until the expiry of the Licence or any subsequent licence; and
- (d) for those following records, be retained until the expiry of the Licence and any subsequent licence:
  - (i) off-site environmental effects; or
  - (ii) matters which affect the condition of the land or groundwater.

5.1.2 The Licensee shall ensure that:
- (a) any person left in charge of the Premises is aware of the conditions of the Licence and has access at all times to the Licence or copies thereof; and
- (b) any person who performs tasks on the Premises is informed of all of the conditions of the Licence that relate to the tasks which that person is performing.

5.1.3 The Licensee shall complete an Annual Audit Compliance Report indicating the extent to which the Licensee has complied with the conditions of the Licence, and any previous licence issued under Part V of the Act for the Premises for the previous year.

5.1.4 The Licensee shall implement a complaints management system that as a minimum records the number and details of complaints received concerning the environmental impact of the activities undertaken at the Premises and any action taken in response to the complaint.

5.2 Reporting

5.2.1 The Licensee shall submit to the Director at the Contact Address an annual environmental report within 28 calendar days after of the end of the annual period. The report shall contain the information listed in Table 5.2.1 in the format or form specified in that table.

Table 5.2.1: Annual environmental report		
Condition or table (if relevant)	Parameter	Format or form[1]
-	Summary of any failure or malfunction of any pollution control equipment or any incidents that have occurred during the year and any action taken	None specified
5.1.3	Compliance	AACR
5.1.4	Complaints summary	None specified
-	Measures taken to suppress dust	

Note 1: Forms are in Schedule 2

5.3 Notification

5.3.1 The Licensee shall ensure that the parameters listed in Table 5.3.1 are notified to the Director at the Contact Address and in accordance with the notification requirements of the table.

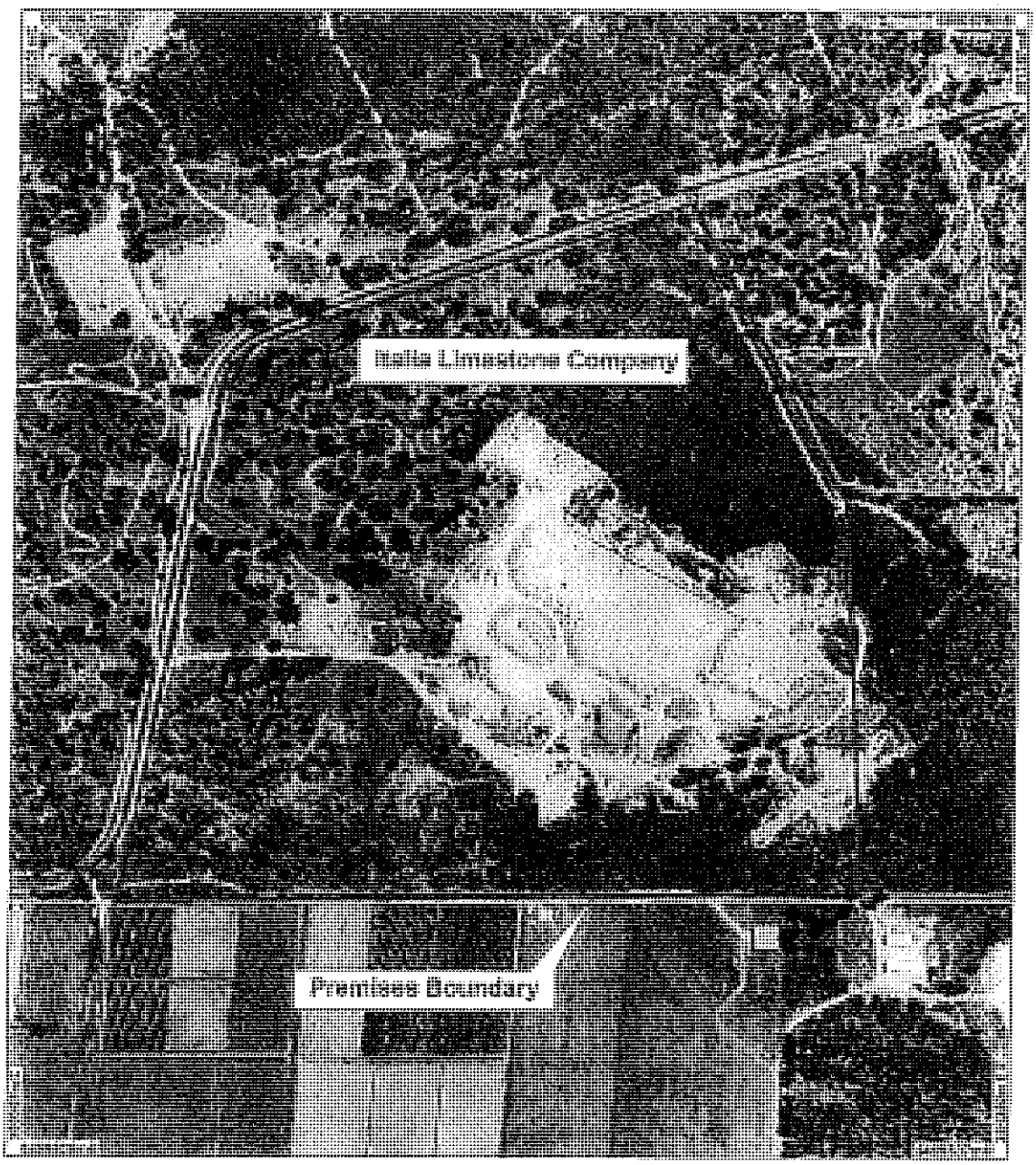
Table 5.3.1: Notification requirements			
Condition or table (if relevant)	Parameter	Notification requirement[1]	Format or form[2]
2.1.1	Breach of any limit specified in the Licence	Part A: As soon as practicable but no later than 5PM of the next usual working day. Part B: As soon as practicable	N1
	Any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution		

Note 1: No notification requirement in the Licence shall negate the requirement to comply with s72 of the Act.
Note 2: Forms are in Schedule 2

Schedule 1: Maps

Premises map

The Premises is shown in the map below. The red line depicts the Premises boundary.



Department of
Environment and Conservation
Our environment, our future

Schedule 2: Reporting & notification forms

These forms are provided for the proponent to report monitoring and other data required by the Licence. They can be requested in an electronic format.

Copies of the original monitoring reports must also be submitted.

Licence: L8718/2012/1
Licensee: **Italia Stone Group Pty Ltd**
Form: AACR Period :
Name: Annual audit compliance report

Annual audit compliance report

Section A: Statement of compliance with Licence conditions

Were all conditions of licence complied with within the reporting period?		
Yes	☐	Initial Sections A & B, then proceed to Section C
No	☐	Initial Section A, then proceed to Section B

Each page must be initialled by the person(s) who signs Section C of this annual audit compliance report (AACR).

Initial:

Section B: Details of non-compliance with Licence condition

a) Licence condition not complied with?	
b) Date(s) b) Date(s) and time(s) the non compliance occurred, if applicable?	
c) Was this non compliance reported to DEC?	
☐ Yes, and ☐ Reported to DEC verbally Date ☐ Reported to DEC in writing Date	☐ No
d) Has DEC taken, or finalised any action in relation to the non compliance?	
e) Summary of particulars of non compliance, and what was the environmental impact?	
f) If relevant, the precise location where the non compliance occurred (attach map or diagram)	
g) Cause of non compliance	
h) Action taken or that will be taken to mitigate any adverse effects of the non compliance	
i) Action taken or that will be taken to prevent recurrence of the non compliance	

Please use a separate page for each Licence condition that was not complied with. Each page must be initialled by the person(s) who signs Section C of this AACR

Initial:

Section C: Signature and certification

This AACR may only be signed by a person(s) with legal authority to sign it as defined below. Please tick the box next to the category that describes how this AACR is being signed. If you are uncertain about who is entitled to sign or which category to tick, please contact the licensing officer for your premises.

If the Licence holder is		The AACR must be signed and certified:
an individual	☐	by the individual Licence holder, or
	☐	by a person approved in writing by the Chief Executive Officer (CEO) of DEC to sign on the Licensee's behalf.
a corporation	☐	by affixing the common seal of the Licensee in accordance with the Corporations Act 2001; or
	☐	by two directors of the Licensee; or
	☐	by a director and a company secretary of the Licensee, or
	☐	if the Licensee is a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	☐	by the principal executive officer of the Licensee; or
	☐	by a person with authority to sign on the Licensee's behalf who is approved in writing by the CEO of DEC.
A public authority (other than a local government)	☐	by the principal executive officer of the Licensee; or
	☐	by a person with authority to sign on the Licensee's behalf who is approved in writing by the CEO of DEC.
a local government	☐	by the CEO of the Licensee; or
	☐	by affixing the seal of the local government.

It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular. There is a maximum penalty of $50,000 for an individual or body corporate.

I/We declare that the information in this AACR is correct and not false or misleading in a material particular.

Signature: _____ Signature: _____

Name: (printed) _____ Name: (printed) _____

Position: _____ Position: _____

Date: _____/_____/_____ Date: _____/_____/_____

Seal (if signing under seal)

Department of
Environment and Conservation
Our environment, our future

Licence: L8718/2012/1
Licensee: Italia Stone Group Pty Ltd

Form: N1 Date of breach:

Notification of detection of the breach of a limit or any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution.

These pages outline the information that the operator must provide.
Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

Part A

Licence Number	L8718/2012/1
Name of operator	
Location of Premises	
Time and date of the detection	

Notification requirements for the breach of a limit	
To be notified as soon as practicable and no later than 5PM of the next working day	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Notification requirements for any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution	
To be notified as soon as practicable and no later than 5PM of the next working day	
Date and time of event	
Reference or description of the location of the event	
Description of where any release into the environment took place	
Substances potentially released	
Best estimate of the quantity or rate of release of substances	
Measures taken , or intended to be taken, to stop any emission	
Description of the failure or accident	

Part B - to be submitted as soon as practicable

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident.	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission.	
The dates of any unauthorised emissions from the installation in the preceding 24 months.	

Name*	
Post	
Signature on behalf of	
Date	

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref:
Enquiries: CPS 3003/2
Phone: Grace Patorniti
Fax: 9219 8726
Email: 9219 8701
nvp@dec.wa.gov.au

Mr Ray Levin
Italia Stone Group trading as Roadstone Quarries
55 Miguel Road
BIBRA LAKE WA 6163

RECEIVED
2 - JUL 2009
BY:.....

Dear Mr Levin

NOTICE OF PROPOSED AMENDMENT TO CLEARING PERMIT CPS 3003/1

I refer to Clearing Permit CPS 3003/1 granted to Roadstone Quarries on 7 May 2009. As advised by Grace Patorniti on 7 July and 16 July 2009 an error occurred under condition 7 - "Revegetation" and the name of the Permit Holder.

I have attached a copy of the proposed amended Clearing Permit. Before making this amendment, I invite you to make any comments within 28 days regarding this matter in writing to:

Native Vegetation Conservation Branch
Department of Environment & Conservation
Locked Bag 104
Bentley Delivery Centre, WA, 6983

Under s51M(5)(a) of the *Environmental Protection Act 1986* you may waive the 28 day notice period in writing.

If you have any queries regarding this matter, please do not hesitate to contact Grace Patorniti at the Department's Native Vegetation Conservation Branch on 9219 8726.

Yours sincerely

Kelly Faulkner
MANAGER
NATIVE VEGETATION CONSERVATION BRANCH

Officer delegated under Section 20
of the Environmental Protection Act 1986

16 July 2009

Attached: Draft Clearing Permit CPS 3003/2

GOVERNMENT OF
WESTERN AUSTRALIA

CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

Purpose Permit number:	CPS 3003/2
Permit Holder:	Italia Stone Group Pty Ltd trading as Roadstone Quarries
Duration of Permit:	07 June 2009 – 07 June 2014

The Permit Holder is authorised to clear native vegetation subject to the following conditions of this Permit.

PART I – CLEARING AUTHORISED

1. Purpose for which clearing may be done

Clearing for the purpose of extractive industry.

2. Land on which clearing is to be done

Lot 103 and Lot 104 on Plan 14371 McLennan Drive, Nowergup

3. Area of Clearing

The Permit Holder must not clear more than 4.5 hectares of native vegetation, within the area crossed-hatched yellow on attached Plan 3003/2.

4. Application

This Permit allows the Permit Holder to authorise persons, including employees, contractors and agents of the Permit Holder, to clear native vegetation for the purposes of this Permit subject to compliance with the conditions of this Permit and approval from the Permit Holder.

5. Compliance with Assessment Sequence and Management Procedures

Prior to clearing any native vegetation under conditions 1, 2 and 3 of this Permit, the Permit Holder must comply with the Assessment Sequence and the Management Procedures set out in Part II of this Permit.

PART II – ASSESSMENT SEQUENCE AND MANAGEMENT PROCEDURES

6. Avoid, minimise etc clearing

In determining the amount of native vegetation to be cleared for the authorised purpose of this Permit, the Permit Holder must have regard to the following principles, set out in order of preference:

(a) Avoid the clearing of native vegetation;
(b) Minimise the amount of native vegetation to be cleared; and
(c) Reduce the impact of clearing on any environmental value.

7. **Revegetation**

(a) The Permit Holder shall retain the vegetative material and topsoil removed by clearing authorised under this Permit and stockpile the vegetative material and topsoil in an area that has already been cleared.

(b) Within six months of clearing any area authorised under this Permit, the Permit Holder must *revegetate* and *rehabilitate* the areas by:
   (i) laying vegetative material and topsoil retained under condition 7(a), on the cleared area; and
   (ii) deliberately *planting* and/or *direct seeding* native vegetation using only *local provenance* seeds and propagating material.

(c) Within twelve months of undertaking *revegetation* and *rehabilitation* in accordance with condition 7 (b), the Permit Holder must where, in the opinion of an *environmental specialist*, the *revegetation* and *rehabilitation* does not provide adequate stabilisation of surface soils, undertake additional *planting* or *direct seeding* of native vegetation in accordance with the requirements of condition 7(b)(ii) of this Permit.

PART III – RECORD KEEPING AND REPORTING

8. **Records must be kept**

The Permit Holder must maintain the following records for activities done pursuant to this Permit:

(a) In relation to the clearing of native vegetation authorised under this Permit:
   (i) the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
   (ii) the date that the area was cleared;
   (iii) the size of the area cleared (in hectares); and
   (iv) purpose for the clearing was undertaken.

(b) In relation to revegetation and rehabilitation of areas pursuant to condition 7 of this Permit:
   (i) the location of any areas revegetated and rehabilitated, recorded using Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
   (ii) a description of the revegetation and rehabilitation activities undertaken; and
   (iii) the size of the area revegetated and rehabilitated (in hectares).

9. **Reporting**

(a) The Permit Holder must provide to the CEO, on or before 30 June of each year, a written report of records required under condition 8 and activities done by the Permit Holder under this Permit between 1 January and 31 December of the preceding year.

(b) Prior to 07 March 2014, the Permit Holder must provide to the CEO a written report of records required under condition 8 where these records have not already been provided under condition 9(a) of this Permit.

Definitions

The following meanings are given to terms used in this Permit:

direct seeding means a method of re-establishing vegetation through the establishment of a seed bed and the introduction of seeds of the desired plant species;

environmental specialist means a person who is engaged by the Permit Holder for the purpose of providing environmental advice, who holds a tertiary qualification in environmental science or equivalent, and has experience relevant to the type of environmental advice that an environmental specialist is required to provide under this Permit;

local provenance means native vegetation seeds and propagating material from natural sources within 10-40 kilometres of the area cleared.

planting means the re-establishment of vegetation by creating favourable soil conditions and planting seedlings of the desired species;

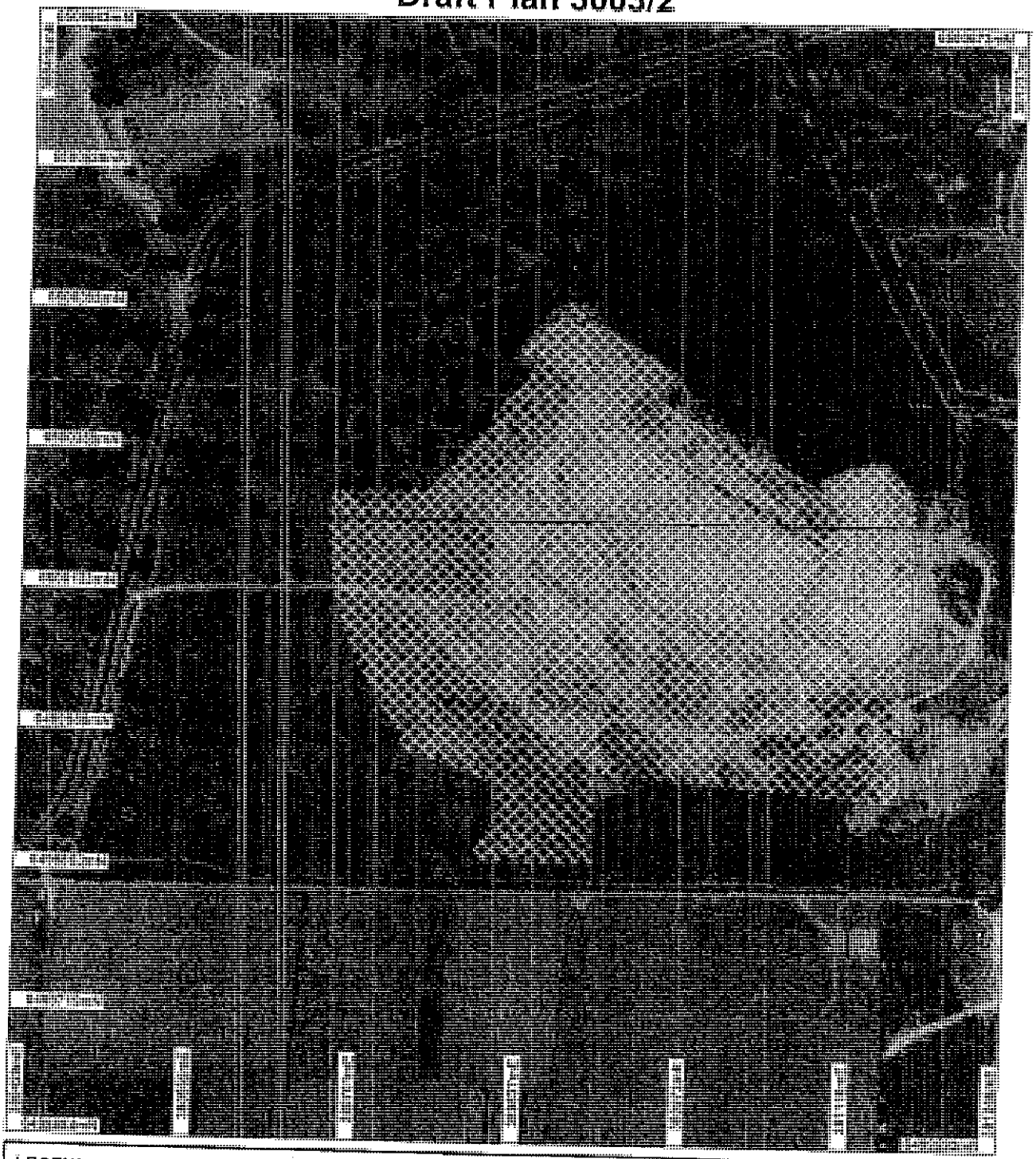
rehabilitate/ed/ion means actively managing an area containing native vegetation in order to improve the ecological function of that area;

revegetate/ed/ion means the re-establishment of a cover of *local provenance* native vegetation in an area using methods such as *regeneration*, *direct seeding* and/or *planting*, so that the species composition, structure and density is similar to pre-clearing vegetation types in that area;

Officer delegated under Section 20
of the Environmental Protection Act 1986

xx xxx 2009

Draft Plan 3003/2



LEGEND

Clearing Instruments

- Areas Approved to Clear
- Road Centrelines
- Cadastre for labelling

Perth Metropolitan Area
North 20cm Orthomosaic - Landgate 2007

N

0 — 125 m

Scale 1:5000
(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

..... Date .....

Officer with delegated authority under Section 20 of the Environmental Protection Act 1986

Information derived from this map should be confirmed with the data custodian acknowledged by the agency acronym in the legend.

Department of Environment and Conservation

Our environment, our future

Western Australian Planning Commission

Our Ref : 30-50200-1
Your Ref :
Enquiries : David Carter (Ph 9264 7678)

26 October 2010

Italia Stone Group
55 Miguel Road
BIBRA LAKE WA 6163

Application for Approval to Commence Development dated 08 July 2008 received 26 August 2008.

LOT	:	103 & 104
LOCATION	:	-
PLAN/DIAGRAM	:	14371
VOLUME/FOLIO	:	1654/586 & 1654/587
LOCALITY	:	McLennan Drive & Godel Road, Nowergup
OWNER	:	S & R Catalano 42 Doolette Street SPEARWOOD WA 6163, G Fazio 35 Barrett Street FREMANTLE WA 6010

Under the provisions of the Metropolitan Region Scheme this application has been referred for determination by the Western Australian Planning Commission.

The application has now been considered by the Commission and the formal notice setting out the terms of the decision is attached.

A copy of this decision has been forwarded to the Local Government for information.

You are advised of the need to consult with the Local Government with regard to the gaining of all necessary approvals and the issuing of the requisite building licence.

This decision is issued pursuant to the provisions of the Metropolitan Region Scheme, and has been made by the Commission after due consideration of the regional planning implications of the proposal. The development must also comply with the requirements of Council's Local Planning Scheme(s) and any determination in this regard must be made by the local government. The Commission's decision, therefore, is made without prejudice to any others that may be separately required from Council.

Should the applicant be aggrieved by this decision there is a right to apply for a review pursuant to the provisions of Clause 33 of the Metropolitan Region Scheme. Such an application for review must be submitted to the State Administrative Tribunal, 12 St George's Terrace, Perth in accordance with Part 14 of the *Planning and Development Act 2005*. It is recommended that you contact the State Administrative Tribunal for further details (telephone 9219 3111) or go to its website: http://www.sat.justice.wa.gov.au.

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address http://www.planning.wa.gov.au
ABN 35 482 341 493

Western Australian Planning Commission

ADVICE TO APPLICANT:

1. All development must comply with the provisions of the City of Wanneroo District Planning Scheme No.2, Health Regulations, Building Code of Australia, Public Building Regulations and all other relevant Acts, Regulations and Local Laws.

2. In regard to Condition No.3, the Department of Environment and Conservation advises that the subject land contains two occurrences of Floristic Community Type (FCT) 26a - *Melaleuca huegellii - Melaleuca acerosa* shrublands on limestone ridges which has been endorsed by the Minister for the Environment as an '*endangered*' Threatened Ecological Community (TEC). The final excavation boundary will need to address the TEC. In this regard you are advised to liaise with the DEC's Swan Coastal District office (Ph No.9405 0700).

Tony Evans
Secretary
Western Australian Planning Commission

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address http://www.planning.wa.gov.au
ABN 35 482 341 493

ATTACHMENT 5

REF: **City of Wanneroo File No DA08/755**
EXTRACTIVE INDUSTRY APPROVAL
for 170 McLennan Drive, Nowergup.

1.0 INTRODUCTION

City of Wanneroo has granted Conditional Development Approval to ITALIA STONE GROUP Pty Ltd to renew operations at it's Limestone Quarry on Lots 103 and 104 at 170 McLennan Dve, Nowergup, Wanneroo.

The City's approval includes condition (f) which nominates two route options for traffic to and / from the quarry. Refer Appendix 1 - Google Earth Plan showing the quarry and the two route options listed by the City for access between the quarry and Wanneroo Rd.

The City's condition (f) also requires the Applicant to submit a "**T**raffic Management Report" to demonstrate;

(a) That the proposed route options are satisfactory, and
(b) How vehicle movements to and from the quarry will be managed

ITALIA STONE Pty Ltd has engaged Greenfield Technical Services to prepare this Traffic Management Report. This report seeks to;

(i) Assess the impact of the additional traffic on the nominated routes, and
(ii) Recommend the traffic management measures required, if any, to minimise any adverse impacts arising from the proposal.

ITALIA propose to develop the quarry in two distinct stages.
Stage 1 is limited to the supply of cast-limestone blocks. This operation will involve dispatching 6-12 truck-loads per day. Say average 10 truck movements per day in each direction.
Stage 2 will involve the supply of limestone rubble. The number of truck movements associated with Stage 2 is likely to average up to 75 truck-loads per day. Stage 2 is not expected to proceed before 2014.
The current Development Application is limited to Stage 1.
Italia Stone will lodge a separate Development Application in due course before proceeding to Stage 2 operations.

2.0 IMPACT OF STAGE 1 PROPOSAL

2.1 Existing Road Capacity and Commentary

The City's condition (f) nominates two route options for traffic between the quarry and Wanneroo Rd;

Northern Route

- Exit quarry via existing driveway and turn left onto **Godel Rd**.
- Travel south and west along Godel Rd to intersection with **Gibbs Rd North**.
- Turn right into Gibbs Rd North and travel north to intersection with Karoborup Road.
- Turn left into **Karoborup Rd** and travel west to intersection with Wanneroo Rd.

There is a posted speed limit of 70 kph on Karoborup Rd. There is no posted speed limit on any of the other roads.

Southern Route

- Exit quarry via existing driveway and turn left onto **Godel Rd.**
- Travel south and west along Godel Rd to intersection with **Gibbs Rd North.**
- Turn left into Gibbs Rd North and travel south to intersection with Gnowerup Road.
- Turn right into **Gnowerup Rd** and travel west to intersection with Wanneroo Rd.

There is no posted speed limit on any of these roads.

Godel Road

Godel Rd is approx 0.6 kms long and is sealed 6m wide.
This road services just 3 properties and ends in a cul-de-sac at McLennan Dve.
The City has no traffic data for Godel Rd but routine traffic is estimated to be no more than 5 vehs per day each way.
The exit from the quarry onto Godel Road is presently unconstructed. Italia Stone propose to construct a new driveway with seal extending 30m into the property.
The Sight Distance for vehicles entering and leaving the quarry is no more than approx 80m due to a short crest just north of the driveway.

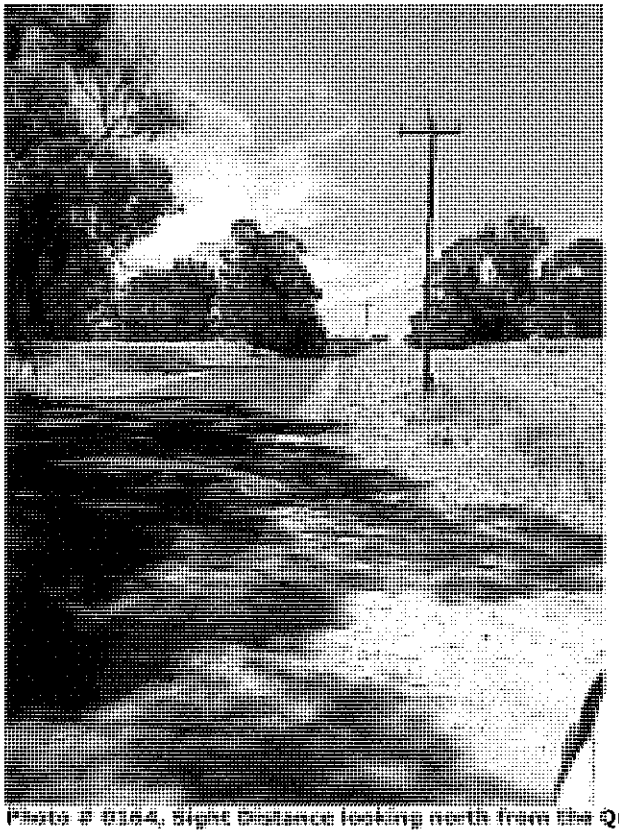


Photo # 0164, Sight Distance looking north from the Quarry Exit.

Given the very low traffic numbers at this location (less than 3 vehs per day in each dirn), any concern re sight distance can readily be addressed by installing advisory "Trucks Entering" sign on Godel Road approx 120m north of the driveway.

There is a short radius curve on Godel Rd approx halfway between the quarry and Gibbs Rd North. The combination of curve radius (approx 100m) and superelevation (3%) suggest that the design speed for this curve is less than 60 kph.
Refer Austroads Part 3, Geometric Design.

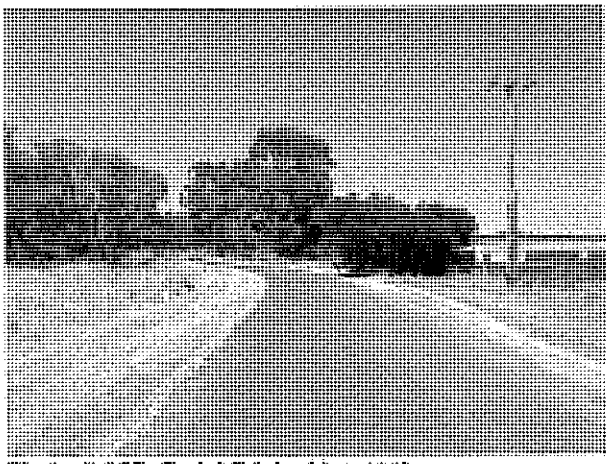


Photo # 153, Godel Rd, looking east

The vegetation along the outside of the curve is overgrown and debris along the outside of the curve suggests that vehicles are not using the full seal width, i.e. they cut across the curve.
This concern can be readily addressed by clearing the overhanging vegetation and sweeping the full road width.

The Godel Rd approach to Gibbs Rd North is straight-forward with good visibility in both directions.

Northern Route

Gibbs Rd North to Karoborup Rd

This section of Gibbs Rd North is approx 1.4 kms long and is sealed 6m wide.
There appears to be just two properties serviced by this section of road.
Gibbs Rd North is a School Bus route with posted pick-up / drop-off points.

The Sight Distance for vehicles turning north from Godel Rd into Gibbs Rd North is compromised by the sharp 90" bend just 80m north of the intersection.
The radius of this bend is just 40m and the bend has a posted advisory speed of just 30 kph which is appropriate.

Photo # 154, View from Godel Rd looking north along **Gibbs Rd North**

PO BOX 2840, GERALDTON 6531
e-mail: greenfield@westnet.com.au
PHONE (08) 9921 5547
FAX (08) 9965 4226

The safe intersection sight distance (SISD) for vehicles travelling at 30 kph is 30-60m. However vehicles travelling at 50 kph need 60-110 metres SISD.
Ref: Austroads Road Design Part 4A, Intersections.
The sight distance available at this location may be as little as 70m which may be insufficient for vehicles travelling in excess of 40 kph.
Continuing north from this bend Gibbs Rd North continues through one curve and more generally a flat straight section through to Koroborup Rd.

Karoborup Rd
The section of Karoborup Rd between Gibbs Rd North and Wanneroo Rd is approx 0.8 kms long and is sealed 7m wide.
The intersection of Karoborup Rd and Gibbs Rd North coincides with a 150m radius curve with a design speed of approx 60 kph. The vegetation on the inside of the curve (on private property) reduces the effective sight distance to no more than 100m.

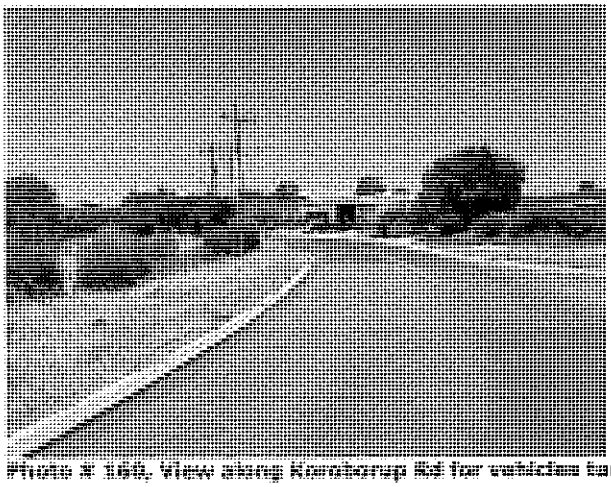


Photo # 1868. View along Koroborup Rd for vehicles turning right into Gibbs Rd North

The Safe Intersection Sight Distance (SISD) required for a 60 kph curve is approx 130-140m. Ref: Austroads Road Design Part 4A, Intersections.
The sight distance available at this location may be considered inadequate for vehicles turning right into Gibbs Rd North – particularly slow-moving trucks.
Karoborup follows a gently undulating relatively straight alignment through to it's intersection with Wanneroo Rd. Heading east from Wanneroo Rd, Koroborup Rd is posted at 70 kph.
The intersection with Wanneroo Rd has good sight distance in all directions and no capacity concerns were identified. At this location, Wanneroo Rd has just one lane in each direction.

Southern Route

Gibbs Rd North heading south to Gnowerup Rd
This section of Gibbs Rd North is approx 1.4 kms long and is sealed 6m wide.
This section of road appears to service up to 8 properties. It is a School Bus route with posted pick-up / drop-off points.
Sightlines for vehicles turning south from Godel Rd into Gibbs Rd are satisfactory.
Continuing south, the road is characterised by short radius curves with overhanging vegetation. The sight distances through these curves (approx R80 and R100) suggests that the design speed for these curves is less than 60 kph.
Refer Austroads Part 3, Geometric Design.

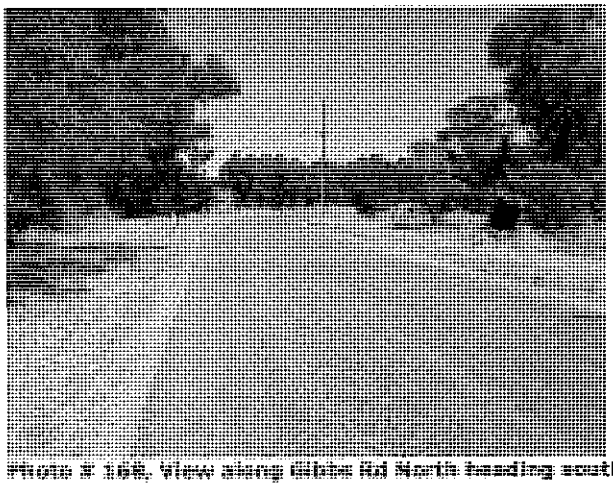


Photo # 168, View along Gibbs Rd North heading south from Godel Rd

Sight distances to and at the Gnowerup Rd intersection are satisfactory.
It is noted that there is a GIVE WAY line on the Gibbs Rd North approach but no GIVE WAY sign.

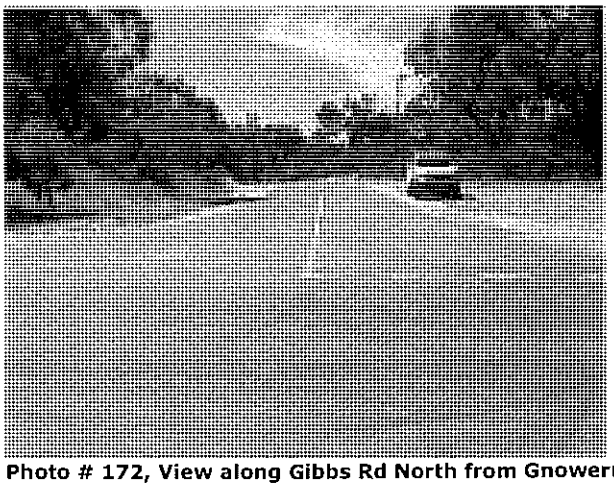


Photo # 172, View along Gibbs Rd North from Gnowerup Rd intersection

Gnowerup Rd

The section of Gnowerup Rd between Gibbs Rd North and Wanneroo Rd is approx 0.9 kms long and is characterised by short sweeping curves (approx R 140) through a hilly section. Gnowerup Rd is sealed 7m wide and the winding sections of road have crash barrier on both sides.

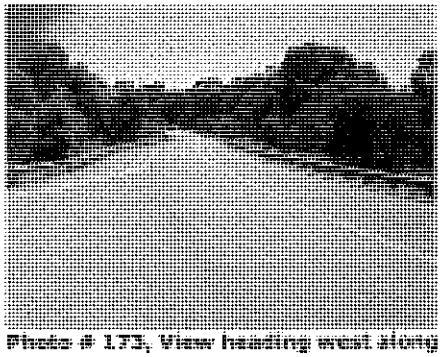


Photo # 173, View heading west along Gnowerup Rd.

There is no posted speed limit on Gnowerup Rd.
The intersection with Wanneroo Rd has good sight distance in all directions and no capacity concerns were identified. At this location, Wanneroo Rd southbound has two lanes.

2.2 COMMENT – Road Capacity

In terms of road features alone, it can be said that the Koroborup route is a less attractive option because of (i) the R40 bend and (ii) the limited sight distance at intersection of Gibbs Rd North with Karoborup Rd.

2.3 Traffic Data

The City of Wanneroo has provided traffic data for the following roads;

- Gibbs Rd North adjacent to Gnowerup (Wesco) Rd, 1-8 Nov 2004.
- Gibbs Rd North, adjacent to Karoborup Rd, 1-8 Nov 2004.

It is noted that these traffic counts date from Nov 2004. Refer Appendix 2.
The City has further advised that current traffic volumes are likely to be similar.

This traffic data is summarised in Table 1 below;

Count Description	Avg Daily Traffic, ADT (both dirns)	85th% Speed	% light vehs Cl 1-2	% trucks Cl 3-12
North of Gnowerup Rd	194	62 kph	93%	7%
South of Karoborup Rd	103	69 kph	86%	14%

TABLE 1, Current Traffic Data (ex-Nov 2004)

The Stage 1 proposal by Italia Stone will add approx 20 truck movements per day.
The impact of this proposal on existing traffic numbers is summarised in Table 2 below.
Note the impact is measured based on trucks using **either** Gnowerup Rd **or** Karoborup Rd.

Count Description	Avg Daily Traffic, ADT (both dirns)	85th% Speed	% light vehicles Cl 1-2	% trucks Cl 3-12
If trucks use Gnowerup Rd	214	Not Applicable	84%	16%
If trucks use Karoborup Rd	123	Not Applicable	72%	28%

TABLE 2, Projected Traffic Data (based on additional 20 trucks per day)

2.4 COMMENT – Traffic Impacts

The trucking operation will increase the Average Daily Traffic (ADT) count on the Gnowerup route by 10%. If the Italia trucks were to use the Karoborup route, the increase in ADT count on the Karoborup route would be 20%.

The trucking operation will increase the % trucks on the Gnowerup route from 7% to 16%. If the Italia trucks were to use the Karoborup route, the % trucks on the Karoborup route would increase from 14% to 28%.
Most traffic analysis is based on truck traffic being approx 15% of total vehicles.

In simple traffic volume terms, it can be said that any adverse impact associated with the additional trucking would be more significant on the Karoborup route.
Note, this analysis is limited to the Stage 1 proposal. Stage 2 operations will warrant a separate analysis.

3.0 CONCLUSIONS

The City's condition (f) requires the Applicant to;

1. assess the relative merits of the two route options nominated by the City and nominate the most satisfactory route option
2. submit a "Traffic Management Report" which demonstrates;
   (a) That the proposed route option is satisfactory, and
   (b) How vehicle movements to and from the quarry will be managed

3.1 Route Options

Section 2.2 above indicates that the Koroborup route is a less attractive option because of (i) the R40 bend and (ii) the limited sight distance at intersection of Gibbs Rd North with Karoborup Rd.
Section 2.4 above indicates that any adverse impact associated with the additional trucking would be more significant on the Karoborup route.

Conclusion 3.1
From a traffic engineering point of view, routing the trucks via Gnowerup Rd is a better option than routing the trucks via Karoborup Rd.

3.2 Traffic Management

Section 2.1 above nominates the following actions;

Godel Rd

- Construct new sealed driveway at the existing quarry entrance
- Erect advisory "Trucks Entering" signage 120m north of the quarry entrance.
- Clear the overhanging vegetation at R100 curve and sweep all loose material to utilise full existing 6m wide seal.

Gibbs Rd North

- Erect advisory 60 kph signage at locations where sight distance is less than 100m.
- Consider the benefit of cement-stabilising shoulders at these curved sections.
- Reinstate "GIVE WAY" sign at Gnowerup Rd approach
- Consider the benefit of providing additional seal width for trucks turning left from Gnowerup Rd into Gibbs Rd North.

Conclusion 3.2
Implementing the actions listed in 3.2 above will address the impact of the proposed additional trucking.

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This report has been prepared by;

Michael Keane
BE, MIE Aust, CP Eng.
Senior Road Safety Auditor
6 December 2010

Principal
Greenfield Technical Services
Consulting Engineers

1/81 Forrest Street Geraldton WA 6530
P 08 9921 5547 | F 08 9965 4116 | M 0427 928 877 |
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List of Appendices

Appdx 1: Site Location Map

Appdx 2: Traffic Count Data – provided by City of Wanneroo

APPENDIX 1

SITE LOCATION MAP

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JARRDUP ROAD
LOTTO McLENNAN DVE
GIBBS RD NORTH
BODEL ROAD
TWINEROO ROAD
GIBBS RD NORTH
ENOWERUP ROAD
Google

APPENDIX 2

TRAFFIC COUNT DATA – provided by City of Wanneroo

Note,Gnowerup Rd east of Gibbs Rd North is known as Wesco Rd

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Speed Separation Matrix

SeparationMatrix-71
Site: 2.0SN
Description: **Gibbs Road Nth of Wesco Road M2 Sth**
Filter time: **13:00 Monday, 1 November 2004 => 10:33 Monday, 8 November 2004**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Speed (km/h)

	Headway (Second)										Speed Totals	
	0.0	0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0		
	0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0	1000.0		
10 - 20	.	.	.	.	.	.	.	.	.	3	3	0.2%
20 - 30	.	.	.	.	1	.	1	1	4	10	17	1.3%
30 - 40	1	.	.	.	.	.	1	8	4	48	62	4.6%
40 - 50	.	.	1	2	4	7	12	21	35	206	288	21.2%
50 - 60	1	.	2	4	10	6	19	41	72	369	524	38.6%
60 - 70	.	.	.	2	2	3	9	8	22	157	203	14.9%
70 - 80	.	.	.	.	1	.	1	1	3	27	33	2.4%
80 - 90	.	.	.	.	.	.	.	.	.	4	4	0.3%
90 - 100	.	.	.	.	.	.	.	.	.	1	1	0.1%
100 - 110	.	.	.	.	.	.	.	.	.	.	0	0.0%
110 - 120	.	.	.	.	.	.	.	.	.	.	0	0.0%
120 - 130	.	.	.	.	.	.	.	.	.	.	0	0.0%
130 - 140	.	.	.	.	.	.	.	.	.	.	0	0.0%
140 - 150	.	.	.	.	.	.	.	.	.	.	0	0.0%
150 - 160	.	.	.	.	.	.	.	.	.	.	0	0.0%
	2	0	3	8	18	16	43	80	140	825	1135	
	0.1%	0.0%	0.2%	0.6%	1.3%	1.2%	3.2%	5.9%	10.3%	60.7%		

Separation Totals

The Profile is wider than the displayed bins. 224 vehicles are hidden.

Daily Classes by Direction

DayClassSplit-67
Site: 5.0NS
Description: **Gibbs Road Sth of Karoborupo Road M5 Nth**
Filter time: **13:00 Monday, 1 November 2004 => 10:25 Monday, 8 November 2004**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Monday, 1 November 2004

	1	2	3	4	5	6	7	8	9	10	11	12	Total
Mon*	53	3	4	0	0	1	1	0	0	0	0	0	62
(%)	85.5	4.8	6.5	0.0	0.0	1.6	1.6	0.0	0.0	0.0	0.0	0.0	
AB	28	0	4	0	0	0	1	0	0	0	0	0	33
AB%	52.8	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	53.2
BA	25	3	0	0	0	1	0	0	0	0	0	0	29
BA%	47.2	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	46.8
Tue	74	7	20	1	0	1	0	0	0	0	0	0	103
(%)	71.8	6.8	19.4	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	40	3	9	0	0	1	0	0	0	0	0	0	53
AB%	54.1	42.9	45.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	51.5
BA	34	4	11	1	0	0	0	0	0	0	0	0	50
BA%	45.9	57.1	55.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.5
Wed	82	5	25	0	1	0	0	0	0	0	0	0	113
(%)	72.6	4.4	22.1	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	46	4	12	0	1	0	0	0	0	0	0	0	63
AB%	56.1	80.0	48.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.8
BA	36	1	13	0	0	0	0	0	0	0	0	0	50
BA%	43.9	20.0	52.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.2
Thu	92	7	18	0	0	0	0	0	0	0	0	0	117
(%)	78.6	6.0	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	56	3	11	0	0	0	0	0	0	0	0	0	70
AB%	60.9	42.9	61.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.8
BA	36	4	7	0	0	0	0	0	0	0	0	0	47
BA%	39.1	57.1	38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.2
Fri	97	3	8	0	0	2	0	0	2	0	0	0	112
(%)	86.6	2.7	7.1	0.0	0.0	1.8	0.0	0.0	1.8	0.0	0.0	0.0	
AB	54	2	4	0	0	1	0	0	1	0	0	0	62
AB%	55.7	66.7	50.0	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	55.4
BA	43	1	4	0	0	1	0	0	1	0	0	0	50
BA%	44.3	33.3	50.0	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	44.6
Sat	91	8	9	0	0	0	0	0	0	0	0	0	108
(%)	84.3	7.4	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	49	5	5	0	0	0	0	0	0	0	0	0	59
AB%	53.8	62.5	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.6
BA	42	3	4	0	0	0	0	0	0	0	0	0	49
BA%	46.2	37.5	44.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.4
Sun	91	3	10	0	0	0	0	0	0	0	0	0	104
(%)	87.5	2.9	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	51	2	5	0	0	0	0	0	0	0	0	0	58
AB%	56.0	66.7	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.8
BA	40	1	5	0	0	0	0	0	0	0	0	0	46
BA%	44.0	33.3	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.2

Average daily volume

Entire week													
	87	5	14	0	0	0	0	0	0	0	0	0	108
(%)	80.6	4.6	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	49	3	7	0	0	0	0	0	0	0	0	0	60
AB%	56.3	60.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.6
BA	38	2	7	0	0	0	0	0	0	0	0	0	48
BA%	43.7	40.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.4
Weekdays													
	86	5	17	0	0	0	0	0	0	0	0	0	111
(%)	77.5	4.5	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	49	3	9	0	0	0	0	0	0	0	0	0	62
AB%	57.0	60.0	52.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.9
BA	37	2	8	0	0	0	0	0	0	0	0	0	49
BA%	43.0	40.0	47.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.1
Weekend													
	91	5	9	0	0	0	0	0	0	0	0	0	105
(%)	86.7	4.8	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	50	3	5	0	0	0	0	0	0	0	0	0	58
AB%	54.9	60.0	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2
BA	41	2	4	0	0	0	0	0	0	0	0	0	47
BA%	45.1	40.0	44.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.8

* - Incomplete

Daily Classes by Direction

DayClassSplit-68
Site: 2.0SN
Description: **Gibbs Road Nth of Wesco Road M2 Sth**
Filter time: **13:00 Monday, 1 November 2004 => 10:33 Monday, 8 November 2004**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Monday, 1 November 2004

	1	2	3	4	5	6	7	8	9	10	11	12	Total
Mon*	88	6	7	2	0	1	1	0	1	0	0	0	106
(%)	83.0	5.7	6.6	1.9	0.0	0.9	0.9	0.0	0.9	0.0	0.0	0.0	
AB	46	4	2	1	0	1	0	0	1	0	0	0	55
AB%	52.3	66.7	28.6	50.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	51.9
BA	42	2	5	1	0	0	1	0	0	0	0	0	51
BA%	47.7	33.3	71.4	50.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	48.1
Tue	158	6	17	2	0	1	0	1	1	0	0	0	186
(%)	84.9	3.2	9.1	1.1	0.0	0.5	0.0	0.5	0.5	0.0	0.0	0.0	
AB	78	4	9	1	0	0	0	0	1	0	0	0	93
AB%	49.4	66.7	52.9	50.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	50.0
BA	80	2	8	1	0	1	0	1	0	0	0	0	93
BA%	50.6	33.3	47.1	50.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	50.0
Wed	195	10	20	0	1	0	1	1	4	0	0	0	232
(%)	84.1	4.3	8.6	0.0	0.4	0.0	0.4	0.4	1.7	0.0	0.0	0.0	
AB	93	3	11	0	0	0	0	0	3	0	0	0	110
AB%	47.7	30.0	55.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	47.4
BA	102	7	9	0	1	0	1	1	1	0	0	0	122
BA%	52.3	70.0	45.0	0.0	100.0	0.0	100.0	100.0	25.0	0.0	0.0	0.0	52.6
Thu	216	8	14	0	0	0	0	0	0	0	0	0	238
(%)	90.8	3.4	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	99	4	5	0	0	0	0	0	0	0	0	0	108
AB%	45.8	50.0	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.4
BA	117	4	9	0	0	0	0	0	0	0	0	0	130
BA%	54.2	50.0	64.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.6
Fri	204	6	14	3	0	2	0	0	2	0	0	0	231
(%)	88.3	2.6	6.1	1.3	0.0	0.9	0.0	0.0	0.9	0.0	0.0	0.0	
AB	99	3	7	2	0	1	0	0	1	0	0	0	113
AB%	48.5	50.0	50.0	66.7	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	48.9
BA	105	3	7	1	0	1	0	0	1	0	0	0	118
BA%	51.5	50.0	50.0	33.3	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	51.1
Sat	181	17	5	1	0	0	0	0	2	0	0	0	206
(%)	87.9	8.3	2.4	0.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	
AB	87	7	2	1	0	0	0	0	1	0	0	0	98
AB%	48.1	41.2	40.0	100.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	47.6
BA	94	10	3	0	0	0	0	0	1	0	0	0	108
BA%	51.9	58.8	60.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	52.4
Sun	148	11	1	0	0	0	0	0	0	0	0	0	160
(%)	92.5	6.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	69	5	1	0	0	0	0	0	0	0	0	0	75
AB%	46.6	45.5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.9
BA	79	6	0	0	0	0	0	0	0	0	0	0	85
BA%	53.4	54.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1

Average daily volume

Entire week													
	183	9	11	0	0	0	0	0	1	0	0	0	208
(%)	88.0	4.3	5.3	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	
AB	87	4	5	0	0	0	0	0	1	0	0	0	99
AB%	47.5	44.4	45.5	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	47.6
BA	96	5	6	0	0	0	0	0	0	0	0	0	109
BA%	52.5	55.6	54.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.4
Weekdays													
	193	7	16	0	0	0	0	0	1	0	0	0	221
(%)	87.3	3.2	7.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	
AB	92	3	8	0	0	0	0	0	1	0	0	0	106
AB%	47.7	42.9	50.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	48.0
BA	101	4	8	0	0	0	0	0	0	0	0	0	115
BA%	52.3	57.1	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.0
Weekend													
	164	14	2	0	0	0	0	0	0	0	0	0	182
(%)	90.1	7.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	78	6	1	0	0	0	0	0	0	0	0	0	86
AB%	47.6	42.9	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.3
BA	86	8	1	0	0	0	0	0	0	0	0	0	96
BA%	52.4	57.1	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.7

* - Incomplete

Speed Separation Matrix

SeparationMatrix-73
Site: 5.0NS
Description: **Gibbs Road Sth of Karoborupo Road M5 Nth**
Filter time: **13:00 Monday, 1 November 2004 => 10:25 Monday, 8 November 2004**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Speed (km/h)

	Headway (Second)										Speed Totals	
	0.0	0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0		
	0.5	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0	1000.0		
10 - 20	.	.	.	1	.	.	.	.	.	3	4	0.5%
20 - 30	.	.	.	.	.	.	.	.	.	5	5	0.7%
30 - 40	.	.	.	.	.	1	.	1	1	8	11	1.5%
40 - 50	.	.	.	2	2	1	2	2	10	51	70	9.3%
50 - 60	.	.	1	1	.	2	4	3	21	112	144	19.2%
60 - 70	1	.	2	3	2	1	2	7	15	110	143	19.1%
70 - 80	.	.	.	.	1	6	.	4	7	66	84	11.2%
80 - 90	.	.	.	.	.	.	.	2	3	14	19	2.5%
90 - 100	.	.	.	.	.	.	.	.	.	1	1	0.1%
100 - 110	.	.	.	.	.	.	.	.	.	1	1	0.1%
110 - 120	.	.	.	.	.	.	.	.	.	.	0	0.0%
120 - 130	.	.	.	.	.	.	.	.	.	.	0	0.0%
130 - 140	.	.	.	.	.	.	.	.	.	.	0	0.0%
140 - 150	.	.	.	.	.	.	.	.	.	.	0	0.0%
150 - 160	.	.	.	.	.	.	.	.	.	.	0	0.0%
	1	0	3	7	5	11	8	19	57	371	482	
	0.1%	0.0%	0.4%	0.9%	0.7%	1.5%	1.1%	2.5%	7.6%	49.5%		

Separation Totals

The Profile is wider than the displayed bins. 268 vehicles are hidden.