

specificity for habitat types not located in the study area, are locally extinct or were erroneously identified in previous surveys. These fauna were analysed and excluded from the list where relevant.

2.3.2 Field Survey

The purpose of the field survey was to verify the accuracy of the desktop assessment and to further delineate and characterise the fauna and faunal assemblages present in the study area. The field survey was undertaken on the 15th of May 2011 with one person-day invested in the survey.

During the field survey, the broad fauna habitat was identified and mapped based on vegetation structure and landform. The fauna habitat was then assessed for the potential to support species of conservation significance and the quality of habitat provided to a wider suite of faunal assemblages. The habitat was rated as high, moderate or low on the basis of complexity, the presence of microhabitats including caves, significant trees with hollows, loose bark, fallen hollow logs and leaf litter, and representation in the region and study area. One fauna habitat assessment was undertaken within the study area.

During the survey, fauna was opportunistically observed and recorded, with a focus on individuals or evidence of conservation significant fauna, including evidence of burrows and other traces of specific fauna (for example scats and tracks).

2.3.3 Taxonomic Identification

For species identified in the desktop assessment where there is doubt to their true taxonomy (through subsequent name changes or taxonomic reviews) an effort was made to determine the current scientific name for each taxon. In some cases, old scientific names may be presented where correct nomenclature could not be determined due to name changes. Some taxon names may be followed by 'sp.', meaning that the species name was not given in the data source or the identification is in doubt. Where there are previously recorded taxa such as this that have the potential to be a conservation significant species, they are discussed specifically in the results and discussion section.

3 RESULTS

3.1 VARIABLES INFLUENCING THE FLORA AND VEGETATION SURVEY

There are always variables associated with individual surveys and it is often difficult to predict the extent to which they influence survey outcomes. Table 3 outlines some of the variables identified during the survey of the study area.

Table 3: Variables Associated with the Flora and Vegetation Survey

Variable	Impact on Survey Outcomes
Access	All areas of the study area were accessible and adequately surveyed.
Experience levels	<p>The scientists who conducted these surveys were practitioners suitably qualified in their respective fields.</p> <ul style="list-style-type: none"> • Co-ordinating Botanist: Ciaran Gibson (Environmental Scientist/ Botanist); • Field Staff: Ciaran Gibson and James Sansom (Environmental Biologist) • Taxonomy: Peter Jobson (Taxonomist); and • Data Interpretation and Reporting: Ciaran Gibson.
Timing ¹ , weather, season.	<p>Flora composition changes with time, particularly over the seasons and with seasonal conditions. A large proportion of arid flora is annual and ephemerals and these have both specific growing periods and a requirement for adequate and timely rainfall. Some plants last for a markedly brief time. In the Carnarvon, the fire history will also have a significant bearing on the composition of the flora. Therefore, botanical surveys completed at different times will have varying results.</p> <p>The seasonal conditions for the survey, and the timing of the survey were considered to be optimal. See Section 1.2.1.</p>
Sources of information	At the bioregion level, the Carnarvon region has been relatively well studied in recent years. Numerous flora surveys have been undertaken in the area as part of environmental impact assessment processes. Those most relevant and available to the current study are listed in

¹ EPA Guidance Statement No, 51 (2004a) stipulates that flora and vegetation surveys should be undertaken following the season that contributes the greatest rainfall in the region. In the Northern Province, this is after summer. In the Eremaean Province, rainfall is sporadic, and in the South-west Province the main rain is in winter, requiring surveys to be undertaken in spring. Short-term variations in normal weather patterns (e.g. drought) may necessitate supplementary survey work at other times of year or in later years to take into account temporal changes in diversity.

Variable	Impact on Survey Outcomes
	Section 1.3.
Completeness	<p>The study area was accessible and considered to be adequately surveyed. A minimum of one quadrat per vegetation association was established across the study area.</p> <p>The average plant species richness recorded of 36.2 taxa per quadrat \pm 4.9 is considered to be high when compared with two other recent surveys within the townsite of Onslow. A survey of the adjacent townsite area recorded 17.7 taxa per quadrat \pm 6.8 (22 quadrats) (ENV 2011a) and a survey of the Onslow Multi-sport and Recreation Precinct recorded an average plant species richness of 25.3 taxa per quadrat \pm 6.1 (three quadrats) (ENV 2011b).</p>

3.2 FLORA

3.2.1 Potentially Occurring Flora and Vegetation Communities of Conservation Significance

In the Carnarvon region, one taxon *Eucalyptus beardiana* (Beard's Mallee), is listed as Threatened under the *EPBC Act* and DRF under the *WC Act*. This species is known from a restricted distribution approximately 400 km south of the study area and thus, is not expected to occur. Additionally, according to Florabase (WAH 2011) as of June 2011, 69 Priority Flora listed by the DEC are known from the Carnarvon region.

A search of DEC databases (Appendix A) for a 50 km radius around the study area identified known records for five Priority Flora. Two additional Priority flora and one Threatened species pursuant to the *EBPC Act* were identified by the desktop review. Three Priority flora were considered as 'Possible' to occur, and five were considered as 'Unlikely'. The likelihood of these species of conservation significance occurring within the study area is presented in Table 4.

Two TECs, as endorsed by the Western Australian Minister for the Environment, occur in the Carnarvon region. These are: Cape Range Remipdede Community and the Camerons Cave Troglobitic Community. These represent invertebrate fauna communities and neither of these TECs occurs in the study area.

The DEC database search did not identify any TEC as occurring within the vicinity of the survey. One PEC was identified within 50 km of the study area, Peedamulla Swamp Community (Priority 1), and another PEC was identified within 51 km of the study area, Tanpool land system (Priority 1).

Table 4: The Likelihood of Priority Flora Occurring in the Study area based on the Survey Results and Literature Review

Priority Taxa	Conservation Status	Annual or Perennial	Suitable Conditions	Habitat Preference (WAH 2011)	Suitable Habitat Present	Comments	Likelihood in the study area
<i>Eleocharis papillosa</i>	'Vulnerable' pursuant to the EPBC Act and P3	Annual	Yes	Red clay over granite, open clay flats. Claypans	No	Species was recorded by Biota (2010a) approximately 19 km south of the study area.	Unlikely
<i>Abutilon uncinatum</i>	P1	Perennial	Yes	Red sand and flat plains	Yes	Species was recorded by Biota (2010a) approximately 15 km south of the study area.	Possible
<i>Carpobrotus</i> sp. Thevenard Island (M. White 050)	P2	Perennial	Yes	Occurs on coarse white sand, dune tops and disturbed areas	Yes	Records of this species have been isolated to Thevenard Island, approximately 20 km north of Onslow (WAH 2011).	Unlikely
<i>Cyperus victoriensis</i>	P1	Perennial	Yes	Along creeks	No	The closest known record is greater than 50 km from the study area (WAH 2011).	Unlikely
<i>Atriplex flabelliformis</i>	P3	Perennial	Yes	Saline flats or marshes	No	Species was recorded Biota (2010a) approximately 16 km south west of the study area.	Unlikely

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Priority Taxa	Conservation Status	Annual or Perennial	Suitable Conditions	Habitat Preference (WAH 2011)	Suitable Habitat Present	Comments	Likelihood in the study area
<i>Eremophila forrestii</i> subsp. <i>viridis</i>	P3	Perennial	Yes	Not available	No	Species was recorded by Biota (2010a) approximately 13 km south west of the study area	Unlikely
<i>Triumfetta echinata</i>	P3	Perennial	Yes	Red sandy soils and sand dunes.	Yes	Species was recorded by Biota (2010a) approximately 14 km south west of the study area	Possible
<i>Vigna</i> sp. central (M.E. Trudgen 1626)	P2	Perennial	Yes	Sandplains, coastal dune. Brown sand with occasional patches of crusting loam over limestone.	Yes	The closest known record is approximately 12 km west of the study area (WAH 2011).	Possible

Likely – suitable habitat, close (<10 km) records and/or field survey completed in sub-optimal season, suggest species is likely to occur;
 Possible – suitable habitat, records (<50 km) and/or field survey completed in sub-optimal season, suggests species possibly occurs; and
 Unlikely – lack of suitable habitat, no records (<50 km) and/or field survey completed in optimal season, suggest species is unlikely to occur.

3.2.2 Recorded Flora

A total of 67 taxa (including species, subspecies and varieties) were recorded from the study area from 47 genera and 21 families. Average plant species richness was 36.2 taxa per quadrat \pm 4.9 from a total of four sites. Quadrat data, including photographs, are presented in Appendix F, the matrix of species recorded at each site is presented in Appendix G and the flora inventory is presented in Appendix H.

The most frequently recorded families from the study area were, Fabaceae (17 taxa), Poaceae (eight taxa) and Malvaceae (eight taxa). The most frequently recorded genera from the study area were *Acacia* (seven taxa), *Senna* (four taxa) and *Euphorbia* (four taxa).

3.2.3 Flora of Conservation Significance

No Threatened species pursuant to the *EPBC Act* were found during the survey of the study area. No plant taxa gazetted as DRF pursuant to the *WC Act* were recorded in the study area. No Priority flora was recorded in the study area.

3.2.4 Flora of Local Significance

One species of local significance, *Maireana lobiflora*, was recorded within the study area (Plate 1). *Maireana lobiflora* was recorded from two locations (Table 5; Figure 4). These records occur beyond the known distribution of this species, the closest known record is approximately 240 km south east of the study area (WAH 2011) (Plate 2).

Maireana lobiflora is a perennial herb or shrub, which grows to 0.5 m high, produces white flowers between September and October and is known to occur on river flats and limestone flats (WAH 2011). The record is considered of significance as it constitutes a range extension for the species.

Table 5: Flora of Local Significance within the Study Area

Taxa	Quadrat	Location*	
<i>Maireana lobiflora</i>	OS29	304162	7603099
	OS31	304607	7604820

*Australian Geocentric 1994 (GDA94), Zone 50 K



Plate 1: *Maireana lobiflora* (Source: WAH 2011)

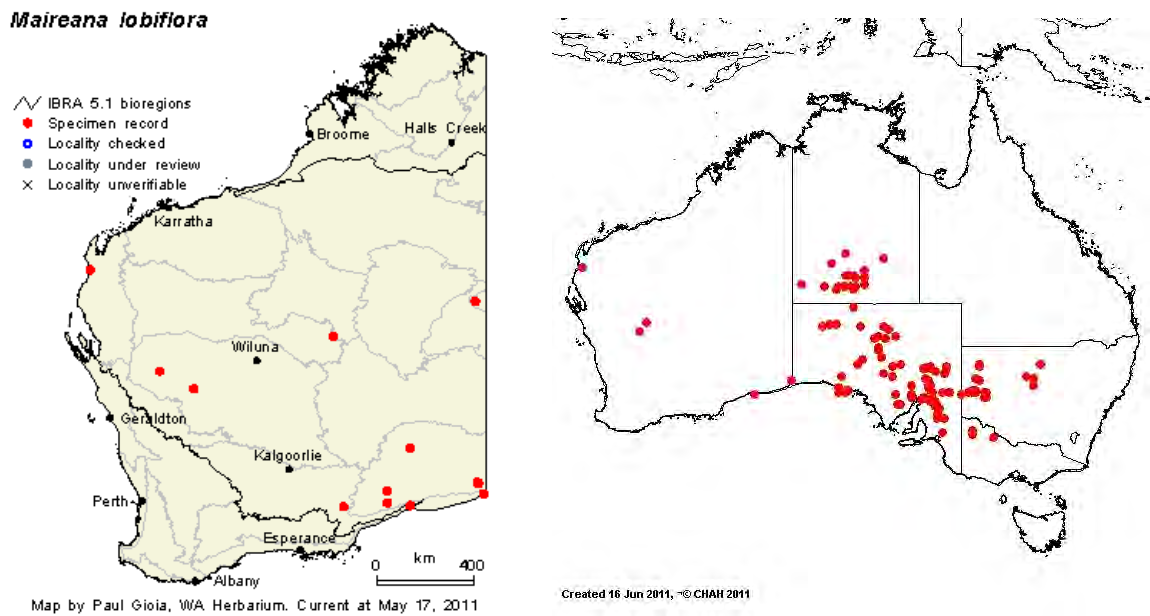


Plate 2: *Maireana lobiflora* Distribution Map: Western Australia (WAH 2011); and Australia (Council of Heads of Australasian Herbaria [CHAH] 2011).

3.2.5 Introduced Flora

Three introduced species were recorded in the study area (Plates 3-5). Two of these are listed as environmental weeds as defined by the Environmental Weed Strategy for Western Australia (CALM 1999). The rating and criteria met for these species inclusion under this strategy are presented in Table 6. The locations of these species are presented in Appendix I and Figure 5.

None of these taxa are listed as Declared Plants under the *ARRP Act* or as WONS by the Australian Government (Australian Government 2011).



Plate 3: Kapok (* *Aerva javanica*)(WAH 2011)



Plate 4: Buffel (**Cenchrus ciliaris*)



Plate 5: Caltrop (**Tribulus terrestris*)(WAH 2011)

Table 6: Introduced Plant Species Listed by the Environmental Weed Strategy (CALM 1999) for Western Australia recorded in the Study area

Taxon	Criteria				
	Common Name	Rating	Invasiveness	Distribution	Impacts
* <i>Aerva javanica</i>	Kapok	High	Yes	Yes	Yes
* <i>Cenchrus ciliaris</i>	Buffel Grass	High	Yes	Yes	Yes
* <i>Tribulus terrestris</i>	Caltrop	Not Listed	N/A	N/A	N/A

3.3 VEGETATION ASSOCIATIONS

The study area comprised one vegetation association (Figure 6). This vegetation association is described as:

Open Shrubland of *Acacia coriacea* subsp. *coriacea*, *Acacia bivenosa*, *Acacia tetragonophylla* over Low Open Shrubland of *Acacia stellaticeps*, *Indigofera monophylla* and *Scaevola spinescens* over Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida holathera* var. *holathera*

The vegetation association was dominated by *Acacia* and *Triodia* species and represented a sand dune community. This vegetation association covers approximately 28 ha of the study area. The remaining 9 ha of the study area is Completely Degraded and represents the roads and infrastructure associated with the Onslow airport.

Vegetation Association: 1

Open Shrubland of *Acacia coriacea* subsp. *coriacea*, *Acacia bivenosa*, *Acacia tetragonophylla* over Low Open Shrubland of *Acacia stellaticeps*, *Indigofera monophylla* and *Scaevola spinescens* over Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida holathera* var. *holathera*.



Quadrats Sampled

OS22, OS24, OS29 and OS31

Landform Description

Location and Landform:

This vegetation association is located on low sand dunes in the study area

Soil Attributes:

Red Brown Loamy Sand

Litter Cover:

- Logs, 2% Twigs and 2% Leaves

Bare Ground:

20-40%

Vegetation Structure and Floristics

The Open Shrubland of *Acacia* species and the Open Hummock Grassland of *Triodia epactia* are the main diagnostics of this association.

Stratum	Key Characteristics
Overstorey	
Canopy Layer	Open Shrubland of <i>Acacia coriacea</i> subsp. <i>coriacea</i> , <i>Acacia bivenosa</i> , <i>Acacia tetragonophylla</i> to a height of 2 m
Midstorey	
Middle Shrub Layer	Low Open Shrubland of <i>Acacia stellaticeps</i> , <i>Indigofera monophylla</i> and <i>Scaevola spinescens</i> to a height of 1 m
Understorey	
Hummock and Tussock Grasses	Open Hummock Grassland of <i>Triodia epactia</i> over Very Open Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>Aristida holathera</i> var. <i>holathera</i> under 1 m

Vegetation Condition

Condition Rating:

Very Good to Good

Disturbances:

Introduced species and nearby roads and infrastructure

Average Fire Age:

Old

3.3.1 Vegetation Condition

Vegetation condition within the study area ranged between Very Good to Completely Degraded (Figure 7). The majority of the vegetation was categorised as Very Good to Good.

The proximity of the vegetation to the developed town of Onslow and especially the Onslow Airport has impacted the condition of the vegetation within the survey area. Disturbances to vegetation include the presence of introduced species, tracks and roads, and infrastructure associated with the airport.

Fire age within the study area was assessed as being Very Old (eight to 12 years since the last fire).

3.3.2 Vegetation of Conservation Significance

The vegetation association identified as occurring within the study area is not listed as a TEC under the *EPBC Act*, as an ESA under the *EP Act* or as a PEC by the DEC.

3.3.3 Regional Representation of Vegetation Associations

Beard (1975) mapped two vegetation types in the study area (Table 7). These can be correlated to mapping by Shepherd *et al.* (2001) who determined the extent of these vegetation types.

The ENV vegetation association has not been correlated with the Beard (1975) broad vegetation types. The Beard vegetation types represent bare areas (127) and samphire shrublands (676) while the vegetation within the study area is an *Acacia* shrubland. Differences exist with the terminology used in the descriptions as they are based on different methods of categorising and characterising vegetation types, and the spatial scale of the analysis (*i.e.* region vs. local scale).

The vegetation types mapped by Beard (1975) that occur in the study area have a large distribution especially within the Carnarvon region. In addition, as shown in Table 7, they are all considered to exist at more than 99% of their pre-European extent as per Shepherd *et al.* (2001) and DAFWA (2007). Vegetation types that have more than 50% of their pre-European extent are considered of 'Least Concern' as per the Department of Natural Resources and Environment (2002).

Table 7: Regional Representation of Vegetation in the Study area

	Pre-European area (ha) ²	Current extent (ha) ³	Remaining (%) ³	Pre-European % in IUCN Class I-IV Reserves ³	Conservation Status ³
IBRA Bioregion – Carnarvon	8,523,963	8,523,963	100.0	6.1	Least Concern
Vegetation Type (Beard 1975) within Western Australia					
127	778,381	778,153	100.0	7.0	Least Concern
676	2,110,508	2,087,874	98.9	6.5	Least Concern
Vegetation Type (Beard 1975) within the Carnarvon Bioregion					
127	102,670	102,282	99.6	1.1	Least Concern
676	51,978	51,678	99.4	6.5	Least Concern

² Shepherd *et al.* (2001) and DAFWA (2007)

³ Department of Natural Resources and Environment (2002)

3.4 VARIABLES INFLUENCING THE FAUNA SURVEY

It is important to note the variables associated with individual surveys, which are often difficult to predict, as is the extent to which they influence survey outcomes. Survey variables of the fauna survey are detailed in Table 8.

Table 8: Variables Associated with the Fauna Survey

Variable	Impact on Survey Outcomes
Access	All areas of the study area were accessible and adequately surveyed.
Experience levels	The scientists who undertook these surveys were practitioners suitably qualified in their respective fields. <ul style="list-style-type: none"> Field Staff: Dr. Colin Trainor (Senior Zoologist); Data Interpretation and Reporting: Colin Trainor and James Sansom (Environmental Biologist).
Timing, weather, season	The rainfall for the year to date (January to April 2011) was significantly above average (see Section 1.2.1). A total of 15.2 mm fell over the three survey days preceding the survey. Onslow experiences an average daily maximum temperature of 28.9°C and an average daily minimum temperature of 16.3°C during the month of May (1886-2011, BoM 2011). The temperature during the survey was similar to the average with a maximum of 27.5°C and a minimum of 19.0°C (BoM 2011). Although this temperature was similar to the long term average, it is a relatively cool temperature for the Carnarvon region. The cool weather is likely to have limited reptile activity.
Scope: sampling methods/intensity	A Level One survey was undertaken. Many cryptic species that are typically recorded by trapping would not have been recorded during the survey, such as small mammals. All conservation significant species previously recorded in the area have been considered. Based on the habitat present, those species deemed to potentially occur in the study area have been addressed in this report.
Sources of information	At the bioregion level, the Carnarvon has been relatively well studied in recent years. Several flora and fauna surveys have been undertaken in the vicinity of the study area as part of environmental impact assessment processes.

3.5 FAUNA HABITATS

The study area consists of one fauna habitat type: Shrubland of *Acacia* species over Hummock grassland comprising 27.8 ha (Appendix J; Figure 8). Approximately 9 ha was described as being Completely Degraded.

Shrubland of Acacia species over Hummock grassland

This is a simple habitat with little structure or variety. The dense *Triodia* cover provides good quality habitat for reptiles, but otherwise relatively few fauna are able to utilise this habitat. The absence of trees means that there are few or no hollows, few logs, little decorticating (loose) bark and greatly simplified roosts and nesting opportunities. The lack of standing water greatly constrains amphibian populations, though these may be present and more easily detected following rain.

3.6 FAUNAL ASSEMBLAGES

Faunal assemblages in the study area have been compiled from surveys conducted within and surrounding the study area (see Appendix K) and records from DEC threatened fauna database searches, *NatureMap* (DEC 2011b), and DSEWPaC Protected Matters Search Tool (DSEWPaC 2011b).

A total of 18 vertebrate species was recorded during the field survey, comprising 17 bird species and one mammal species. A total of 238 vertebrate fauna (excluding some marine and rock-dwelling fauna that are unlikely to be recorded in the study area) have been previously recorded within the vicinity of the study area (Appendix K). This includes five amphibian species, 72 reptile species, 135 bird species and 26 mammal species. Many of these species are unlikely to occur in the study area on a regular basis as the records are from a large area encompassing a wide range of habitats, and the study area is small with few habitats.

3.6.1 Amphibians

No amphibian species were recorded in the study area. Five species were recorded from the database searches as previously occurring in the vicinity. Habitat in the study area is poor for frogs with the absence of standing water in the study area. However, common species such as the Sheep Frog (*Cyclorana maini*) and Little Red Tree Frog (*Litoria rubella*) may occur, particularly after rain.

None of the species recorded (Appendix K) from within the vicinity of the study area are considered as conservation significant.

3.6.2 Reptiles

No reptiles were observed during the field survey. This is likely to be due to the relatively cool weather conditions during the survey. The most common reptiles in the

study area are likely to be the Variegated Tree Dtella (*Gehyra variegata*), Bynoe’s Gecko (*Heteronotia binoei*) and Rock Ctenotus (*Ctenotus saxatilis*).

None of the 72 species recorded (Appendix K) from within the vicinity of the study area are considered as conservation significant.

3.6.3 Birds

A total of 17 bird species were recorded during the current fauna survey. A total of 135 bird species have been previously recorded in the general vicinity of the study area (Appendix K). A number of marine and coastal seabirds were excluded from the list as they are unlikely to occur in the study area.

The avifauna of study area was poor in species diversity, and most species observed occurred at very low densities. The most commonly observed birds were species typical of grassland or low shrubland throughout the Pilbara and much of arid Australia including the Crimson Chat (*Epthianura tricolor*), Zebra Finch (*Taeniopygia guttata*), Rufous Songlark (*Cincloramphus mathewsi*) and Singing Bushlark (*Mirafra cantillans*).

3.6.4 Mammals

One mammal was recorded in the study area. Scats of a macropod species, likely to be the Euro (*Macropus robustus*) were frequent in the study area.

A total of 26 mammal species have previously been recorded in the general vicinity of the study area (Appendix K).

3.7 CONSERVATION SIGNIFICANT FAUNA

3.7.1 Potentially Occurring Fauna of Conservation Significance

From the desktop review of previous surveys conducted in the area and database searches, a list of recorded conservation significant species (excluding marine and rock-dwelling species unlikely to occur in the study area) was compiled. The 13 conservation significant species previously recorded from within the vicinity of the study area are presented in Table 9. These comprise the Peregrine Falcon (*Falco peregrinus*), Western Star Finch, nine migratory birds, the Long-tailed Dunnart (*Sminthopsis longicaudata*) and Short-tailed Mouse (*Leggadina lakedownensis*).

Eight of the 13 species are listed as ‘Possible’ to occur within the study area. A further two species were considered as ‘Likely’ to occur; one migratory bird was noted as ‘Present’ (with current project records), and two species (Peregrine Falcon *Falco peregrinus* and Long-tailed Dunnart *Sminthopsis longicaudata*) were considered as ‘Unlikely’ to occur within the study area. Several of the ‘Possible’ birds are migrant birds, and the only mammal ‘likely’ to occur is the Short-tailed Mouse which has been recorded in Onslow town.

3.7.2 Recorded Species

One species of conservation significance was recorded in the study area: the Rainbow Bee-eater (*Merops ornatus*) which is listed as migratory (Appendix K).

Table 9: Conservation Significant Fauna Potentially Occurring in the Study area

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
BIRDS				
Fork-tailed Swift (<i>Apus pacificus</i>)	Mi	The Fork-tailed Swift is a summer migrant (October-April) to Australia. This species is an aerial species, which forages high above the tree canopy and rarely lower, so is independent of terrestrial habitats (Johnstone and Storr 1998).	Likely to fly over the study area.	Likely
Cattle Egret (<i>Ardea ibis</i>)	Mi	The Cattle Egret occurs in the wetter parts of Western Australia, in particular the Kimberley and the south-west. The species inhabits short grass, in particular damp pastures and wetlands, usually in the company of cattle and occasionally other livestock. In Western Australia it is an irregular visitor, occurring mostly in autumn, and is not thought to breed regularly (Johnstone and Storr 1998).	May occur after periods of heavy rain.	Possible
White-bellied Sea Eagle (<i>Haliaeetus leucogaster</i>)	Mi	The White-bellied Sea Eagle is distributed along the coast, islands and estuaries of Western Australia but not the lower west and south-west or far-east (Johnstone and Storr 1998). They feed on fish, sea snakes and nesting seabirds.	May occur after periods of heavy rain.	Possible
Eastern Osprey (<i>Pandion haliaetus</i>)	Mi	The Eastern Osprey is distributed along the coast, islands and lower river courses of Western Australia. They feed on fish and other marine animals (Johnstone and Storr 1998). They nest in trees, cliffs and sometimes structures such as radio towers, often close to the water.	May occur after periods of heavy rain.	Possible

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Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Peregrine Falcon <i>(Falco peregrinus)</i>	S4	The Peregrine Falcon is uncommon but wide-ranging across Australia. It occurs mainly along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes (Johnstone and Storr 1998).	Likely to prefer habitat with greater tree cover.	Unlikely
Common Sandpiper <i>(Actitis hypoleucos)</i>	Mi	The most common and well known of the migratory shorebirds that visits beaches and most types of coastal wetlands, as well as streams and dams.	May occur after periods of heavy rain.	Possible
Wood Sandpiper <i>(Tringa glareola)</i>	Mi	The Wood Sandpiper is a summer non-breeding migratory shorebird that occurs along the coast and inland regions of Western Australia. It primarily inhabits freshwater wetlands, such as dams, and rarely inter-tidal mudflats (Geering, Agnew and Harding 2007).	May occur after periods of heavy rain.	Possible
White-winged Black Tern <i>(Chlidonias leucoptera)</i>	Mi	The White-winged Black Tern is a non-breeding migratory Tern that occurs regularly in northern Western Australia and rarely in the southern half of Western Australia (Barrett <i>et al.</i> 2003). It inhabits coastal marine habitats (such as estuaries, lagoons and harbours) and near-coastal freshwater wetlands such as river pools, billabongs and inundated floodplains (Morcombe 2000).	Possible at dam.	Possible

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Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Rainbow Bee-eater <i>(Merops ornatus)</i>	Mi	The Rainbow Bee-eater is a common and widespread species in Western Australia, occurring in lightly wooded, often sandy country, preferring areas near water. This species feeds on airborne insects, and nests throughout its range in Western Australia in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone and Storr 1998).	The Rainbow Bee-eater was recorded flying over and foraging within the study area.	Present
Barn Swallow <i>(Hirundo rustica)</i>	Mi	The Barn Swallow is a migratory species that breeds in north-east Asia, and is a rare visitor to northern coastal northern Western Australia from September to early April (Johnstone and Storr 2004). They forage mainly near towns and wetlands such as sewage and salt work ponds, river pools, swamps, tidal creeks and reservoirs (Johnstone and Storr 2004). They forage aerially on insects and nest in caves, cliffs under bridges and in buildings (Morcombe 2000).	May fly over all habitats, often feeds over freshwater lakes and streams.	Possible
Star Finch <i>(Neochmia ruficauda)</i>	P4	The western subspecies of the Star Finch is confined to the Pilbara region of Western Australia (Pizzey and Knight 2007). The species occurs in grasslands with sparse vegetation, and feeds mainly on grass seeds and some small insects (Johnstone and Storr 2004). Like most finches this species needs regular water, so is likely to occur near permanent fresh water for most of the season then disperse out to a wider area during and after the wet season when ephemeral pools have water.	Needs permanent water, which is not available in the study area.	Possible

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
MAMMALS				
Long-tailed Dunnart <i>(Sminthopsis longicaudata)</i>	P4	Little is known about the habitat requirements of this species, as prior to 1975 there were only three whole specimens in the museums and nothing was known of its natural history. The current records of Long-tailed Dunnarts come from widely scattered localities in the arid zone, but trapping records show it may prefer rugged, rocky areas (van Dyck and Strahan 2008).	Suitable habitat within the study area is not likely.	Unlikely
Short-tailed Mouse <i>(Leggadina lakedownensis)</i>	P4	The Lakeland Downs Mouse occurs in a range of habitat types on seasonally inundated sandy-clay soils (van Dyck and Strahan 2008). In the Pilbara it occurs on stony hummock grasslands (Menkhorst and Knight 2001). It is generally rare, with scattered populations, and very little is known of its biology (van Dyck and Strahan 2008).	There are recent records of this species from the vicinity of Onslow townsite.	Likely

4 DISCUSSION

4.1 FLORA

A total of 67 taxa were recorded within the study area. The floral diversity recorded within the study area is considered to be high when compared with two recent surveys in Onslow. The current survey recorded an average of 36.2 taxa per quadrat \pm 4.9 (four quadrats) compared with 17.7 taxa per quadrat \pm 6.8 (22 quadrats) (ENV 2011a) and 25.3 taxa per quadrat \pm 6.1 (three quadrats) (ENV 2011b).

None of the plant species recorded in the study area are Threatened flora pursuant to the *EPBC Act*, gazetted as DRF pursuant to the *WC Act* or listed as Priority Flora by the DEC.

One species listed as Vulnerable pursuant to the *EPBC Act* was previously recorded within approximately 19 km of the study area: *Eleocharis papillosa* (Biota 2010a). This species was recorded from a tidally influenced creek in association with chenopod species (Biota 2010a). This habitat was not present within the study area and thus, this species is not expected to occur.

No other Threatened flora species pursuant to the *EPBC Act* are known or expected to occur within the study area.

No DRF species were identified as potentially occurring within the survey area and none were recorded by the survey. Eight priority species were identified as potentially occurring within the study area. Five of these were considered unlikely to occur as suitable habitat does not occur within the study area: *Atriplex flabelliformis*, *Carpobrotus* sp. Thevenard Island (M. White 050), *Cyperus victoriensis*, *Eleocharis papillosa* and *Eremophila forrestii* subsp. *viridis*. The vegetation association within the study area represents suitable habitat for the remaining three Priority species: *Abutilon uncinatum*, *Triumfetta echinata* and *Vigna* sp. central (M.E. Trudgen 1626). None of these species were recorded and as the survey was thorough and conducted after sufficient rainfall, it is unlikely that these species occur within the study area.

One species considered to be of local significance, *Maireana lobiflora*, was recorded within the study area. The two records of this species from the study area represent a range extension. The closest known previous record of this species is approximately 240 km south east of the study area (WAH 2011). This species is not protected by Commonwealth or State legislation. However, range extensions are considered to be of conservation interest by the regulators.

4.2 INTRODUCED FLORA

Three introduced species were recorded within the study area. Two of the introduced species recorded, Buffel (**Cenchrus ciliaris*) and Kapok (**Aerva javanica*), have a high

rating under the Environmental Weed Strategy for Western Australia (CALM 1999). Buffel was recorded from all four quadrats with a cover of up to 30%. Buffel is a perennial grass that occurs across much of northern Australia and semi-arid areas (CRC Weed Management 2008). This species was the most commonly recorded introduced species in the area and is known to be common in the Onslow area.

No species listed as Declared Plants under the *ARRC Act* or as WONS by the Australian Government (Australia Government 2011) were recorded in the study area.

4.3 VEGETATION

One vegetation association was identified within the study area. This community occurred on the sand dunes within the survey area. It was observed to have been affected by disturbances including the presence of introduced species, roads and infrastructure associated with the Onslow Airport.

The vegetation association recorded in the study area is not listed as a TEC under the *EPBC Act*, as an ESA under the *EP ACT 1986*, or as a PEC by the DEC. This is expected as no communities of conservation significance were identified as potentially occurring within the study area.

4.4 FAUNA HABITAT

One fauna habitat was recorded (open shrubland of *Acacia* sp.). This habitat appeared to be a good condition, but overall is considered to provide low habitat value. The range of bird species was low, which is typical of low shrubland and grassland in the Pilbara. The avifauna was highly generalized, with most species recorded being found throughout arid Australia. No reptiles were recorded, though this was likely to be due to the cool conditions at the time of survey. The area is unlikely to be rich in reptiles, and no species of conservation significance would be expected.

4.5 FAUNA OF CONSERVATION SIGNIFICANCE

Only one vertebrate species of conservation significance was recorded in the study area, the Rainbow Bee-eater (*Merops ornatus*). The Rainbow Bee-eater is listed as Migratory under the *EPBC Act*, is known to breed in the Pilbara, and may breed in the study area. Therefore, populations of this species may consist of a mixture of resident and migratory populations. The Rainbow Bee-eater is one of the most common and widespread birds in Australia with a distribution that covers the majority of Australia (Barrett *et al.* 2003). The Rainbow Bee-eater is a highly mobile species and is unlikely to be disturbed by development in the study area.

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

5 SUMMARY OF SURVEY FINDINGS AND CONCLUSION

The survey of the Onslow Light Industrial Area found the following:

- No flora listed under the *EPBC Act*, gazetted as Declared Rare Flora under the *WC Act* or Priority flora as listed by the DEC (WAH 2011) were recorded;
- A total of 67 taxa (including species, subspecies and varieties) were recorded from the study area. These 67 taxa were from 47 genera and 21 families. Average plant species richness was 36.2 taxa per quadrat \pm 4.9 from a total of four sites;
- Three introduced flora, none of which are listed as Declared Plants under the *ARRP Act* or WONS by the Australian Government;
- One vegetation association was described for the study area. This association does not represent a TEC under the *EPBC Act*, an ESA under the *EP Act*, or a PEC as listed by the DEC;
- One fauna habitat of low habitat value;
- One conservation significant bird species was recorded – the widespread and common migratory Rainbow Bee-eater;
- Eight of the 13 conservation significant fauna potentially occurring in the study area were considered as ‘Possible’ inhabitants and two species were considered as ‘Likely’; and
- No fauna species are likely to be impacted substantially by development of the Onslow Light Industrial Area.

This flora, vegetation and fauna survey of the Onslow Light Industrial Area study area has not identified any species, communities or habitats of conservation significance, that are likely to pose a constraint to development.

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FIGURES



Legend

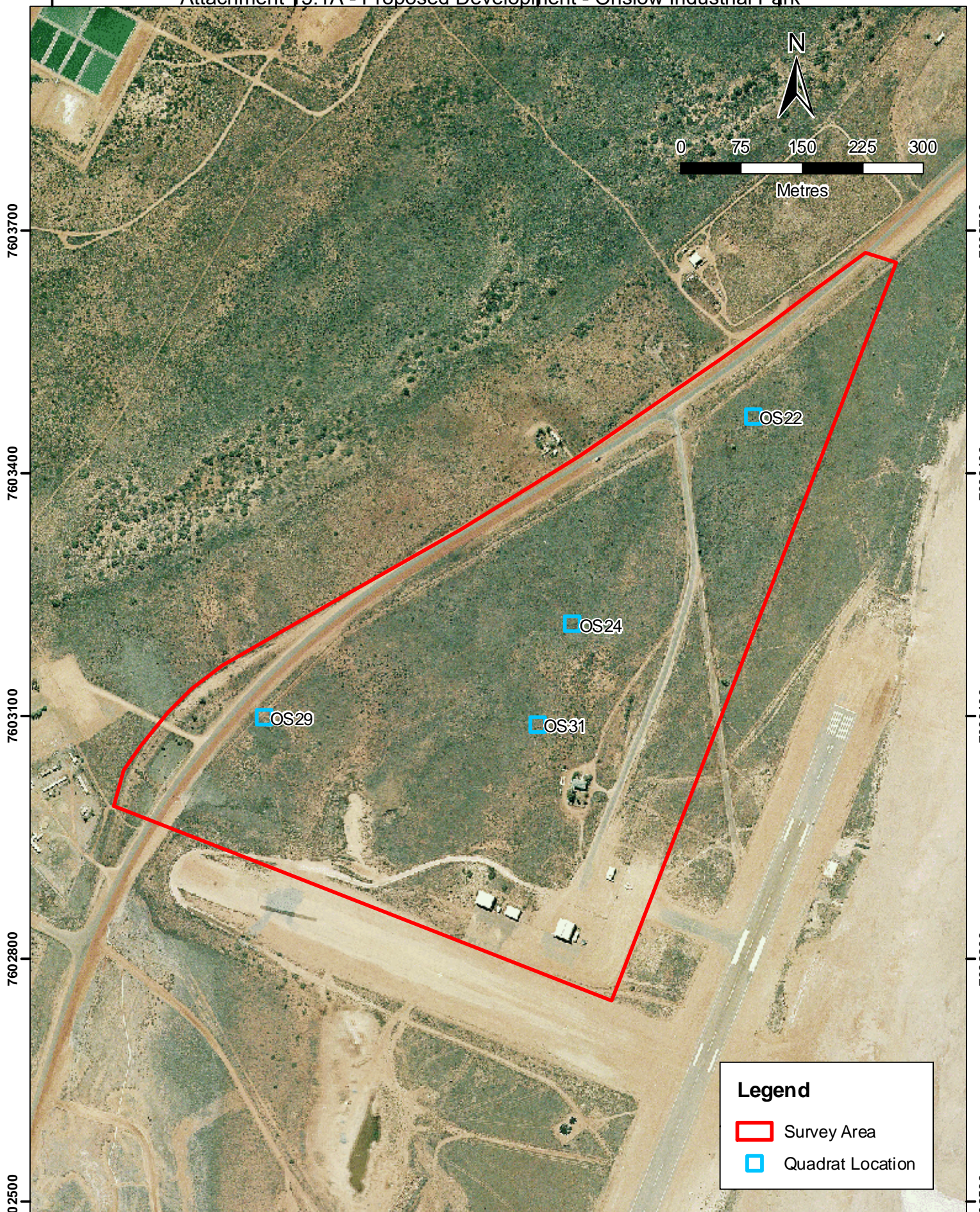
Survey Area



CLIENT	Shire of Ashburton	JOB NO.	J100505
AUTHOR:	C. Gibson	DRAWN	S. Rho
SCALE	1:250,000 @ A3	DATE	8-7-2011
		PROJECTION	GDA 94 MGA 50

Regional Location
 Onslow Light Industrial Area -
 Flora, Vegetation and Fauna
 Assessment

FIGURE 1



Legend

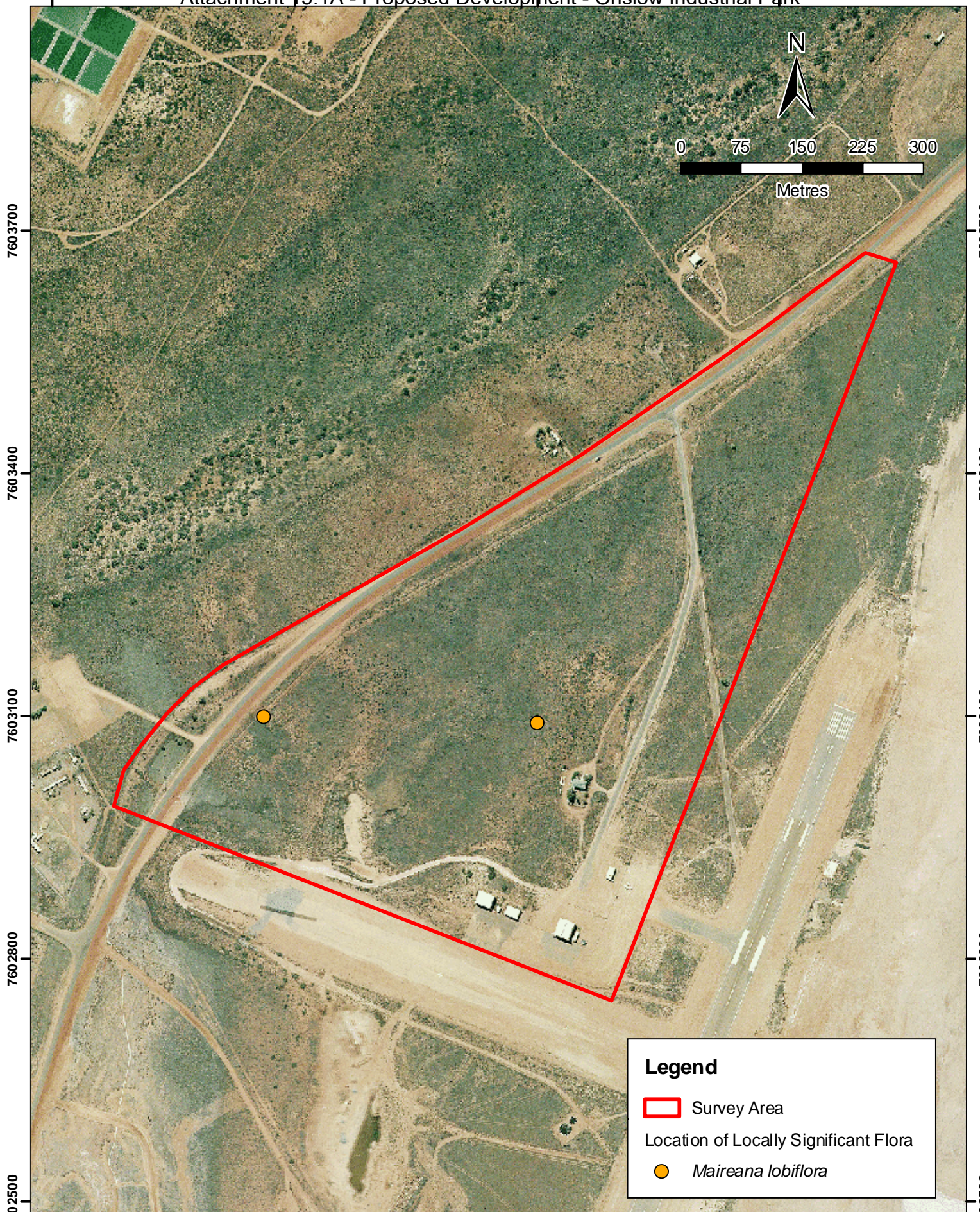
- Survey Area
- Quadrat Location



CLIENT	JOB NO.
Shire of Ashburton	J100505
AUTHOR:	DRAWN
C. Gibson	S. Rho
SCALE	DATE
1:6,000 @ A4	8-7-2011
PROJECTION	
GDA 94 MGA 50	429

Location of Quadrats
 Onslow Light Industrial Area -
 Flora, Vegetation and Fauna
 Assessment

FIGURE 3



Legend

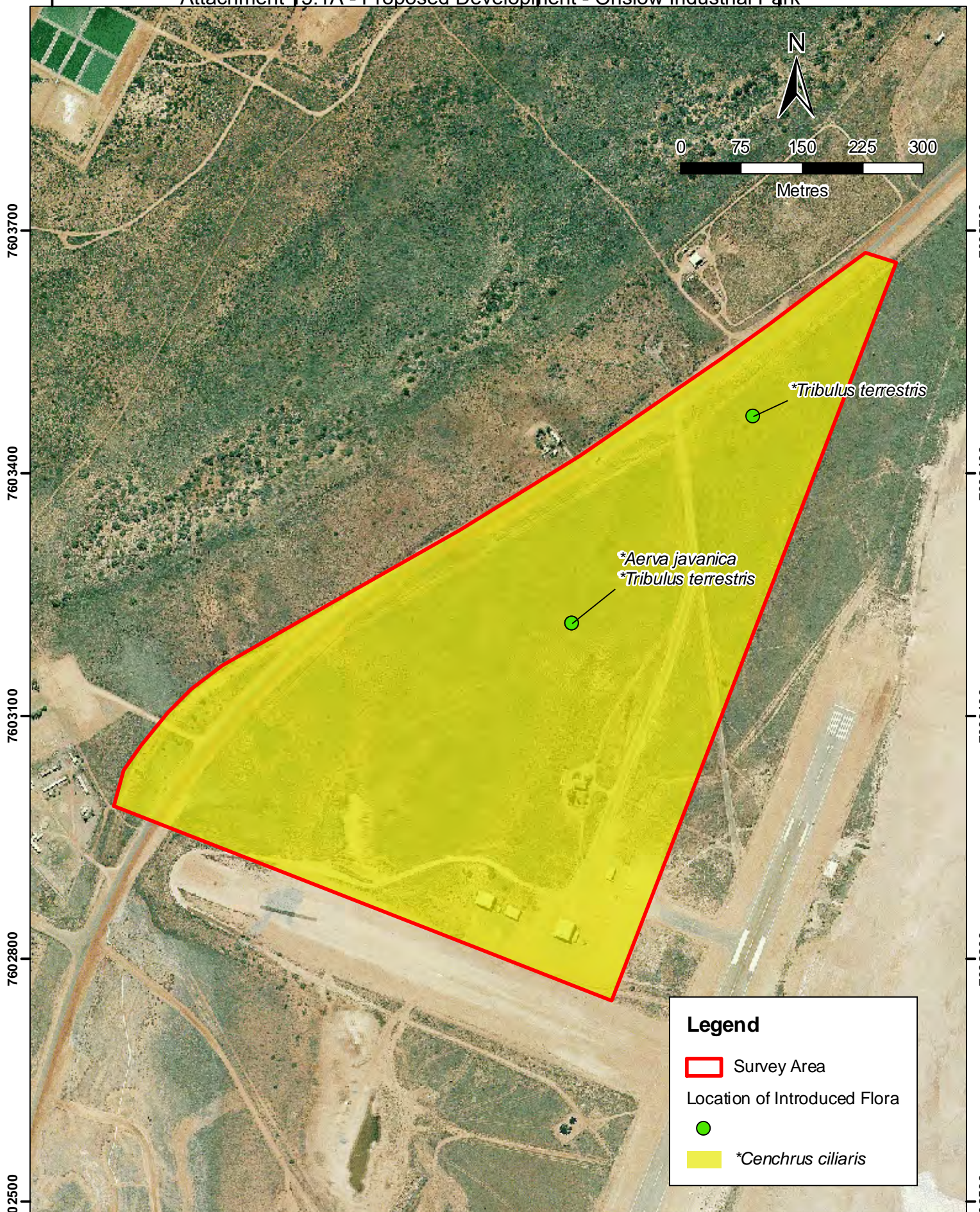
- Survey Area
- Location of Locally Significant Flora
- *Maireana lobiflora*



CLIENT	JOB NO.
Shire of Ashburton	J100505
AUTHOR:	DRAWN
C. Gibson	S. Rho
SCALE	PROJECTION
1:6,000 @ A4	GDA 94 MGA 50
	430

Location of Locally Significant Flora
 Onslow Light Industrial Area -
 Flora, Vegetation and Fauna
 Assessment

FIGURE 4



Legend

- Survey Area
- Location of Introduced Flora
-
- **Cenchrus ciliaris*

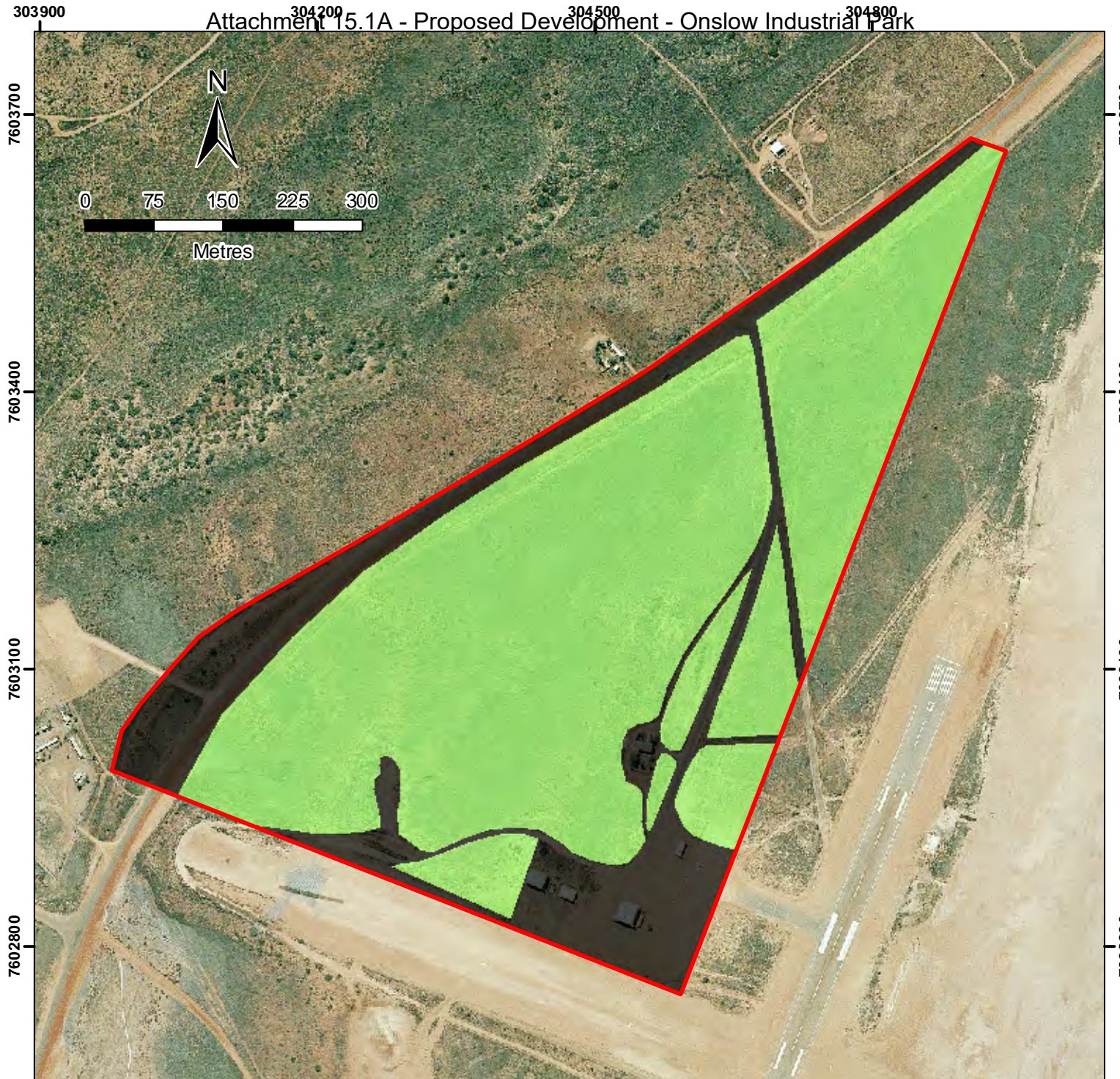
CLIENT	JOB NO.
Shire of Ashburton	J100505
AUTHOR:	DRAWN
C. Gibson	S. Rho
SCALE	PROJECTION
1:6,000 @ A4	GDA 94 MGA 50
	431

Location of Introduced Flora


Onslow Light Industrial Area -
Flora, Vegetation and Fauna
Assessment

FIGURE 5






Legend

 Survey Area

Vegetation Association

 Open Shrubland of *Acacia coriacea* subsp. *coriacea*, *Acacia bivenosa*, *Acacia tetragonophylla* over Low Open Shrubland of *Acacia stellaticeps*, *Indigofera monophylla* and *Scaevola spinescens* over Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida holathera* var. *holathera*.

 Completely Degraded

CLIENT

Shire of Ashburton

JOB NO.

J100505

AUTHOR:

C. Gibson

DRAWN

S. Rho

DATE

8-7-2011

SCALE

1:6,000 @ A4 GDA 94 MGA 50

PROJECTION

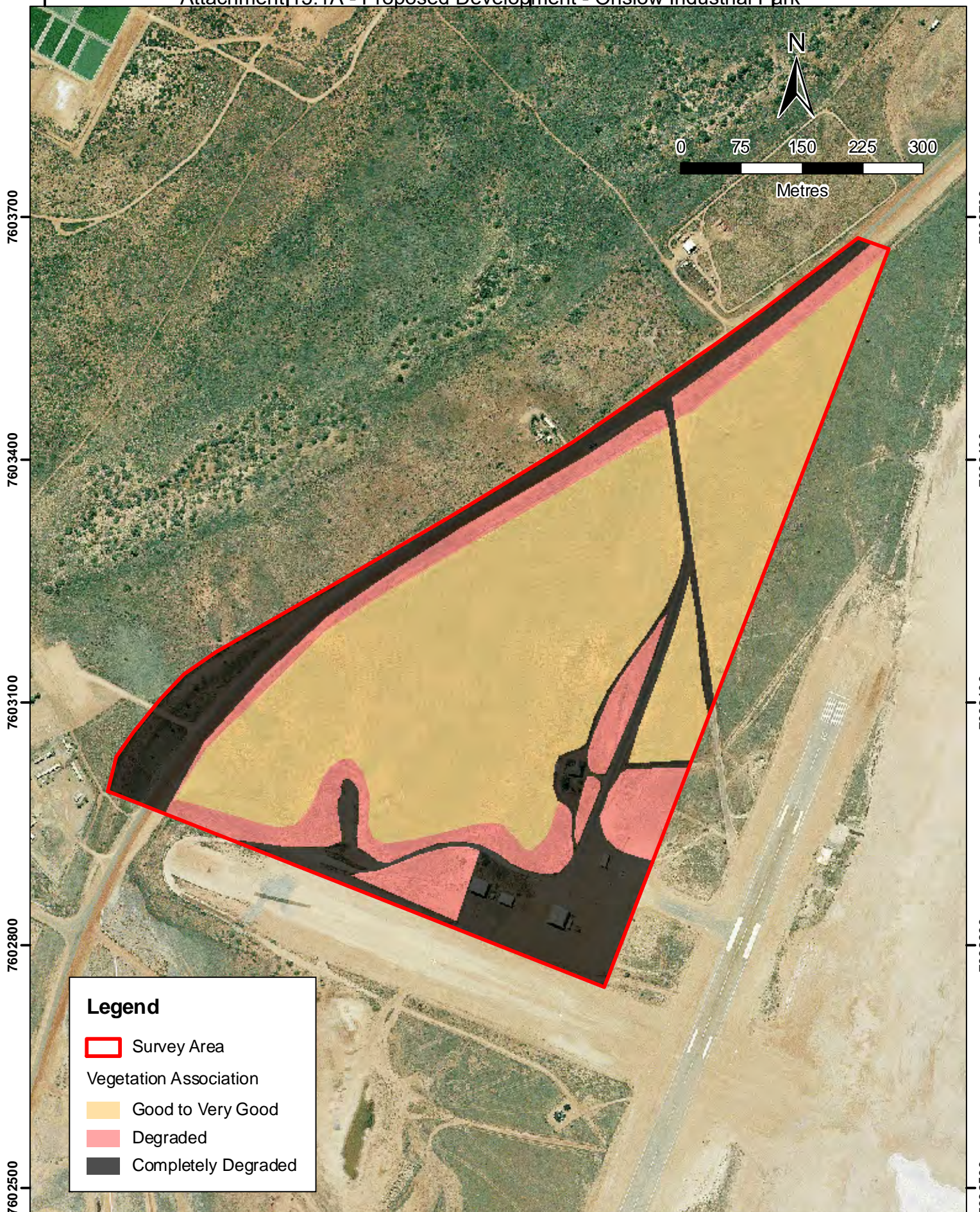
432

Vegetation Associations

Onslow Light Industrial Area -
Flora, Vegetation and Fauna
Assessment

FIGURE





Legend

- Survey Area
- Vegetation Association
- Good to Very Good
- Degraded
- Completely Degraded

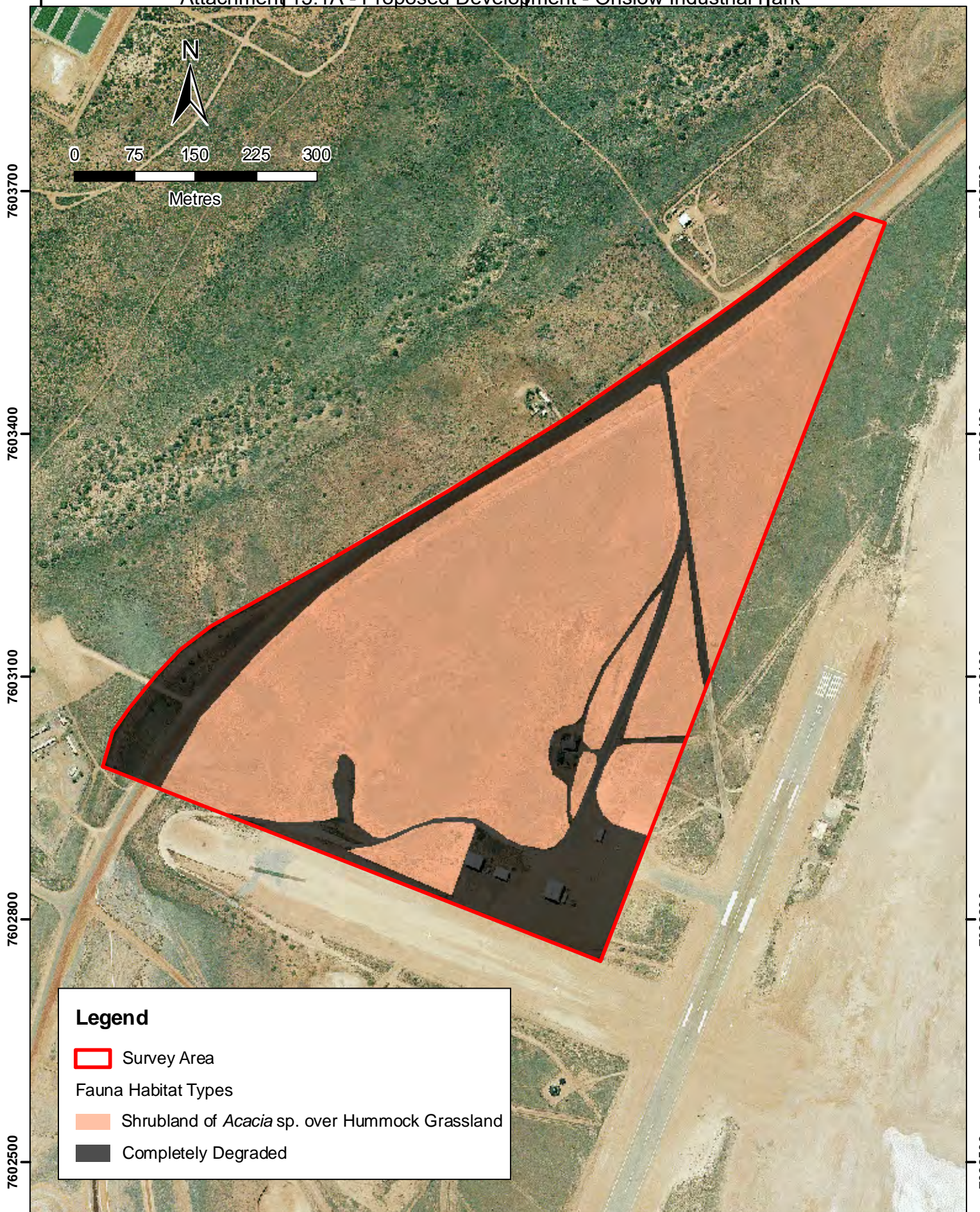


<u>CLIENT</u>	<u>JOB NO.</u>
Shire of Ashburton	J100505
<u>AUTHOR:</u>	<u>DRAWN</u>
C. Gibson	S. Rho
<u>SCALE</u>	<u>DATE</u>
1:6,000 @ A4	8-7-2011
<u>PROJECTION</u>	
GDA 94 MGA 50	433

Vegetation Condition

Onslow Light Industrial Area -
Flora, Vegetation and Fauna
Assessment

FIGURE 7



Legend

- Survey Area
- Fauna Habitat Types
 - Shrubland of *Acacia* sp. over Hummock Grassland
 - Completely Degraded



<u>CLIENT</u>	<u>JOB NO.</u>
Shire of Ashburton	J100505
<u>AUTHOR:</u>	<u>DRAWN</u>
C. Gibson	S. Rho
<u>SCALE</u>	<u>DATE</u>
1:6,000 @ A4	8-7-2011
<u>PROJECTION</u>	
GDA 94 MGA 50	434

Fauna Habitat Types

Onslow Light Industrial Area -
Flora, Vegetation and Fauna
Assessment

FIGURE 8

APPENDIX A

**DEFINITION OF DECLARED RARE /
PRIORITY / THREATENED FLORA AND
SIGNIFICANT FLORA POTENTIALLY
OCCURRING IN THE
STUDY AREA**

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT APPENDIX A

DEFINITION OF DECLARED RARE / PRIORITY / THREATENED FLORA AND SIGNIFICANT FLORA POTENTIALLY OCCURRING IN THE PROJECT AREA

A1: Categories of Declared Rare and Priority Flora

Conservation Code	Category
X	<p>Presumed Extinct Flora (Declared Rare Flora – Extinct)</p> <p>“Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the <i>Wildlife Conservation Act 1950</i>).”</p>
T	<p>Threatened Flora (Declared Rare Flora – Extant)</p> <p>“Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the <i>Wildlife Conservation Act 1950</i>).”</p> <p>“Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:</p> <ul style="list-style-type: none"> • 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.”
P1	<p>Priority One: Poorly-known taxa</p> <p>“Taxa which are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.”</p>
P2	<p>Priority Two: Poorly-known taxa</p> <p>“Taxa which are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.”</p>
P3	<p>Priority Three: Poorly-known taxa</p> <p>“Taxa which are known from collections or sight records from several localities not under imminent threat, or few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.”</p>

Conservation Code	Category
P4	<p>Priority Four: Rare, Near Threatened and other taxa in need of monitoring</p> <p>a. Rare. “Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.”</p> <p>b. Near Threatened. “Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.”</p> <p>c. “Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.”</p>
P5	<p>Priority Five: Conservation Dependent taxa</p> <p>“Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.”</p>

Source: Department of Environment and Conservation (2011). *Western Australian Flora Conservation Codes*. Department of Environment and Conservation, Perth, Western Australia. Online: <http://florabase.calm.wa.gov.au>.

A2: Categories of Threatened Flora Species

Category Code	Category
Ex	<p>Extinct</p> <p>Taxa which at a particular time if, at the time, there is no reasonable doubt that the last member of the species has died.</p>
ExW	<p>Extinct in the Wild</p> <p>Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.</p>
CE	<p>Critically Endangered</p> <p>Taxa which at a particular time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.</p>
E	<p>Endangered</p> <p>Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.</p>
V	<p>Vulnerable</p> <p>Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.</p>
CD	<p>Conservation Dependent</p> <p>Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.</p>

Source: *Environment Protection and Biodiversity Conservation Act 19*

A3: Significant Flora Species Potentially Occurring in the Project Area

Priority Taxa	Conservation Status	Description (WAH 2011)
<i>Abutilon uncinatum</i>	P1	Prostrate perennial, herb, that grows to 0.2–1 m high with grey foliage and spined pods. Occurs on red sand and flat plains.
<i>Atriplex flabelliformis</i>	P3	Monoecious, erect, rounded perennial, herb, to 0.35 m high. Occurs on clay loam, loam, saline flats and marshes.
<i>Carpobrotus</i> sp. Thevenard Island (M. White 050)	P2	Prostrate, succulent perennial, herb with leaves that are sessile and triangular in cross-section. Fruit is turbinate. Produces cream flowers in August. Occurs on coarse white sand, dune tops and disturbed areas.
<i>Cyperus victoriensis</i>	P1	Perennial, grass-like or herb (sedge), that grows to 0.6 m high. Occurs along creeks.
<i>Eleocharis papillosa</i>	'Vulnerable' pursuant to the EPBC Act and P3	Annual, herb. Flowers brown in November. Occurs on red clay over granite, open clay flats and clay pans.
<i>Eremophila forrestii</i> subsp. <i>viridis</i>	P3	Much-branched shrub, that grows to 1 m high. Produces pink, cream flowers in August.
<i>Triumfetta echinata</i>	P3	Prostrate shrub, that grows to 0.3 m high. Produced flowers in August. Occurs on red sandy soils and sand dunes.
<i>Vigna</i> sp. central (M.E. Trudgen 1626)	P2	Not available.

APPENDIX B

**DEFINITIONS OF CONSERVATION
CODES FOR FAUNA OF CONSERVATION
SIGNIFICANCE**

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT**APPENDIX B****DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE****B1: Environment Protection and Biodiversity Conservation Act 1999 (Cth): Threatened Species and Threatened Ecological Communities Codes**

The *EPBC Act* prescribes seven matters of national environmental significance:-

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Species in the categories ExW, CE, E, V and M (see below), and Threatened Ecological Communities in the CE and E categories are protected as matters of national environmental significance under the *EPBC Act*.

Category	Code	Category
Extinct	Ex	Taxa for which there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	ExW	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
Critically Endangered	CE	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	E	Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Vulnerable	V	Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	CD	Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Category	Code	Category
Migratory	Mi	<p>Taxa that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations, that are included in an international agreement approved by the Minister for the Environment, Heritage and the Arts and that have been placed on the national List of Migratory Species under the provisions of the EPBC Act. At present there are four such agreements:</p> <ul style="list-style-type: none"> • the Bonn Convention • the China-Australia Migratory Bird Agreement (CAMBA) • the Japan-Australia Migratory Bird Agreement (JAMBA) • the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Marine	Ma	<p>Taxa protected in a Commonwealth Marine Protected Area by virtue of section 248 of the <i>EPBC Act</i>. These taxa include certain seals, crocodiles, turtles and birds, as well as various marine fish.</p> <p>Commonwealth marine areas are matters of national environmental significance under the <i>EPBC Act</i>.</p> <p>An action will require approval if the:</p> <ul style="list-style-type: none"> • action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment, or • action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area¹ <p>The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters.</p> <p>The Commonwealth marine area stretches from 3 to 200 nautical miles (approximately 5-370 km) from the coast. Marine protected areas are marine areas which are recognised to have high conservation value.</p>

B2: Western Australian Threatened Fauna Categories***Wildlife Conservation Act 1950 (WA)***

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

B3: Department of Environment and Conservation Fauna Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

B4: IUCN Redlist Conservation Fauna Codes

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing high risk of extinction in the wild

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Category	Code	Description
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN, or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

APPENDIX C

DEFINITION OF THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

**ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT
APPENDIX C**

DEFINITIONS OF THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

C1: Definitions of Threatened Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B);

- A) Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats **or**
- B) All occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and **either or both** of the following apply (i or ii)
 - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years)
 - ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated.
- B) Current distribution is limited, and **one or more** of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years)
 - ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

- C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years)

Endangered (EN)

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and **either or both** of the following apply (i or ii)
- i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years)
 - ii) modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated.
- B) Current distribution is limited, and **one or more** of the following apply (i, ii or iii):
- i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years)
 - ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes
- C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Vulnerable (VU)

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

- A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated.
- B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
- C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Source: Department of Environment and Conservation (2010). *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*. Department of Environment and Conservation, Perth, Western Australia. Online: www.naturebase.net/

C2: Definitions of Priority Ecological Communities

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly known ecological communities Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly known ecological communities. Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.

Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or;
- (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Source: Department of Environment and Conservation (2010). *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*. Department of Environment and Conservation, Perth, Western Australia. Online: www.naturebase.net/

C3: Categories of Threatened Ecological Communities under the EPBC Act.

Three categories exist for listing threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An ecological community may be categorized as:

- | | |
|------------------------------|---|
| Critically Endangered | If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future. |
| Endangered | If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future. |
| Vulnerable | If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future. |

APPENDIX D

ENVIRONMENTAL WEEDS AND DECLARED PLANT CATEGORIES

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT APPENDIX D

ENVIRONMENTAL WEEDS AND DECLARED PLANT CATEGORIES

D1: Criteria used for Ranking Environmental Weeds

The Environmental Weed Strategy for Western Australia (CALM 1999) contains criteria for the assessment and ranking of weeds in terms of their environmental impact on biodiversity. These criteria are as follows:

- **Invasiveness** – ability to invade bushland in good to excellent condition or ability to invade waterways. (Score as yes or no).
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world. (Score as yes or no).
- **Environmental Impacts** – ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community. (Score as yes or no).

The rating of each weed is determined by the following scoring system:

- **High** - a weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this weed for control and/or research i.e. prioritising funding to it.
- **Moderate** -a weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- **Mild** – a weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
- **Low** – a weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

Source: Department of Conservation and Land Management (1999). *Environmental Weed Strategy for Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.

D2: Standard Meanings of Declared Plant Categories

P1

Prohibits movement.

The movement of plants or their seeds is prohibited within the State.

This prohibits the movement of contaminated machinery and produce including livestock and fodder.

P2

Aim is to eradicate infestation.

Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.

P3

Aims to control infestation by reducing area and/or density of infestation.

The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.

Treat to destroy and prevent seed set all plants:

- Within 50m inside of the boundaries of the infestation;
- within 50m of roads and high water mark on waterways;
- within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year.

Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

P4

Aims to prevent infestation spreading beyond existing boundaries of infestation

The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.

Treat to destroy and prevent seed set all plants:

- within 50m inside of the boundaries of the infested property for one-leaf and 20m for two-leaf;

- within 50m of roads and high water mark on waterways;
- within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year. Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

Special considerations: In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

P5

Aims to control infestations on public lands.

Source: Department of Agriculture and Food (2008). *List of Declared Plants*. Department of Agriculture and Food, Western Australia. Online: <http://www.agric.wa.gov.au/>.

APPENDIX E

**BUSH FOREVER CONDITION SCALE
AND STANDARDISED VEGETATION
MATRIX**

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT

APPENDIX E

E1: BUSH FOREVER VEGETATION CONDITION SCALE

Condition Scale Code	Condition Scale
P	Pristine (1) Pristine or nearly so, no obvious signs of disturbance
E	Excellent (2) Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
VG	Very Good (3) Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	Good (4) Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
D	Degraded (5) Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD	Completely Degraded (6) The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia (2000). *Bush Forever Volume 2: Directory of Bush Forever Sites*. Department of Environmental Protection, Perth, Western Australia.

E2: STANDARDISED VEGETATION MATRIX

Vegetation Classifications for the Pilbara based on Specht with modification by Aplin and Trudgen

	Under 2%	2-10%	10-30%	30-70%	70-100%
Trees over 30m	Scattered Tall Trees	High Open woodland	High Woodland	High Open Forest	High Closed Forest
Trees 10-30m	Scattered Trees	Open Woodland	Woodland	Open Forest	Closed Forest
Trees under 10m	Scattered Low Trees	Low Open Woodland	Low woodland	Low Open Forest	Low Closed Forest
Shrubs 2-5m	Scattered Tall Shrubs	High Open Shrubland	High Shrubland	Open Scrub	Closed Shrub
Shrubs 1-2m	Scattered Shrubs	Open Shrubland	Shrubland	Open Heath	Closed Heath
Shrubs under 1m	Low scattered Shrubs	Low Open Shrubland	Low Shrubland	Low Open Heath	Low Closed Heath
Grasses	Scattered Grasses	Very open Grassland	Open Grassland	Grassland	Closed Grassland
Herbs	Scattered Herbs	Very Open Herbland	Open Herbland	Herbland	Closed Herbland
Sedges	Scattered Sedges	Very Open Sedgeland	Open Sedgeland	Sedgeland	Closed Sedgeland

APPENDIX F

FLORA QUADRAT DATA SHEETS

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT APPENDIX F

FLORA QUADRAT DATA SHEETS

Onslow Town **Site** OS22

Described by CS **Date** 15/05/2011 **Type** Q 50 x 50 m

Location Onslow Airport

MGA Zone 50 304767 mE 7603471 mN

Habitat Sand Plain with Small Limestone Outcrop

Soil Red Brown Loam

Rock Type Limestone

Vegetation Scattered Low Trees of *Eucalyptus victrix* over
Scattered Shrubs of *Acacia coriacea* subsp. *coriacea*,
Acacia trachycarpa, *Myoporum montanum* and
Senna glutinosa subsp. *pruinosa* over Low Shrubland
of *Acacia stellaticeps*, *Scaevola spinescens* and
Indigofera monophylla over Hummock grassland of
Triodia epactia over Tussock Grassland of **Cenchrus*
ciliaris, *Aristida holathera* var. *holathera*, *Eriachne mucronata*, *Panicum decompositum* and *Sorghum*
plumosum.



Veg Condition Good

Fire Age Old

Notes Bare ground: 20%
Litter cover: 1% Logs; 5% Twigs; 5% Lvs.
Disturbance type: Introduced Species, Nearby Road

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
<i>Acacia bivenosa</i>	+	0.5 m	NC	
<i>Acacia coriacea</i> subsp. <i>coriacea</i>	+	1m	OS02-01	
<i>Acacia stellaticeps</i>	5%	0.5 m	NC	
<i>Acacia trachycarpa</i>	+	2 m	NC	
<i>Aristida holathera</i> var. <i>holathera</i>	10%	0.5 m	OS22-03	
<i>Bonamia linearis</i>	+	CR	OS22-04	
<i>Cassytha capillaris</i>	+	CR	OS02-14	
<i>*Cenchrus ciliaris</i>	30%	0.4 m	NC	
<i>Corchorus tectus</i>	+	0.5 m	OS22-08	
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>			OS22-14	
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	+	0.5 m	OS22-07	
<i>Eriachne mucronata</i>	3%	0.4 m	OS18-10	
<i>Eucalyptus victrix</i>	+	5 m	OS22-09	
<i>Euphorbia alsiniflora</i>	+	0.4 m	OS02-04	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	+	CR	OS18-01	
<i>Goodenia microptera</i>	+	0.3 m	OS12-12	
<i>Gossypium australe</i>	+	0.7 m	OS18-16	
<i>Hakea lorea</i> subsp. <i>lorea</i>			OS18-19	
<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>	+	0.5 m	OS22-12	
<i>Hibiscus sturtii</i> var. <i>platyklamys</i>	+	0.2 m	OS22-11	
<i>Indigofera linifolia</i>			OS22-15	

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<i>Indigofera monophylla</i>	1%	0.5 m	OS12-02
<i>Melhania oblongifolia</i>	+	0.3 m	OS18-09
<i>Myoporum montanum</i>	+	1 m	OS22-06
<i>Panicum decompositum</i>	1%	0.6 m	OS18-03
<i>Pimelea ammodaridifolia</i>	+	0.5 m	OS12-05
<i>Ptilotus exaltatus</i>	+	0.4 m	NC
<i>Rhynchosia minima</i>	+	CR	OS16-03
<i>Salsola tragus</i> subsp. <i>grandiflora</i>	+	0.5 m	OS02-10
<i>Scaevola pulchella</i>	+	0.5 m	OS22-05
<i>Scaevola spinescens</i>	2%	0.6 m	OS22-10
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>			OS18-06
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	+	1.5 m	OS22-01
<i>Solanum horridum</i>	+	0.3 m	OS22-13
<i>Solanum lasiophyllum</i>	+	0.3 m	OS10-03
<i>Sorghum plumosum</i>	1%	0.7 m	OS12-10
* <i>Tribulus terrestris</i>	+	CR	OS02-05
<i>Triodia epactia</i>	30%	0.3 m	OS12-09

Onslow Town Site OS24**Described by** CS**Date** 15/05/2011 **Type** Q

50 x 50 m

Location Onslow Airport**MGA Zone** 50 304544 mE 7603214 mN**Habitat** Low Sandy Hill**Soil** Red Brown Loamy Sand

Vegetation Open Shrubland of *Senna glutinosa* subsp. *glutinosa*, *Acacia bivenosa* and *Pimelea ammodarid* over Open Shrubland of *Acacia stellaticeps*, *Indigofera monophylla* and *Scaevola spinescens* over Hummock Grassland of *Triodia epactia* over Open Tussock Grassland of **Cenchrus ciliaris*, *Panicum decompositum* and *Eriachne mucronata*.

Veg Condition Excellent - Very Good**Fire Age** Old

Notes Bare ground: 20%
Litter cover: + Logs; 2% Twigs; 2% Lvs.
Disturbance type: Introduced Species, Nearby Track

**SPECIES LIST:**

Name	Cover	Height	Specimen	Notes
? <i>Haloragis gossei</i>	+	0.3 m	OS24-01	
<i>Abutilon lepidum</i>	+	0.6 m	OCS49	
<i>Acacia bivenosa</i>	1%	1 m	NC	
<i>Acacia coriacea</i> subsp. <i>coriacea</i>	+	1 m	OS02-01	
<i>Acacia stellaticeps</i>	25%	0.5 m	NC	
<i>Acacia tetragonophylla</i>	+	1.5 m	OS16-04	
* <i>Aerva javanica</i>	+	1 m	NC	
<i>Aristida holathera</i> var. <i>holathera</i>	15%	0.5 m	OS22-03	
<i>Bonamia linearis</i>	+	CR	OS22-04	
<i>Cassutha capillaris</i>	+	CR	OS02-14	
* <i>Cenchrus ciliaris</i>	5%	0.4 m	NC	
<i>Corchorus tectus</i>	+	0.4 m	OS24-03	
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	+	0.3 m	OS22-14	
<i>Eriachne mucronata</i>	1%	0.4 m	OS18-10	
<i>Euphorbia alsiniflora</i>	+	0.3 m	OS02-04	
<i>Euphorbia boophthona</i>	+	0.3 m	OS18-17	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	+	CR	OS18-01	
<i>Goodenia microptera</i>	+	0.3 m	OS12-12	
<i>Gossypium australe</i>	+	0.6 m	OS18-16	
<i>Gyrostemon ramulosus</i>	+	1.5 m	OCS02	
<i>Heliotropium ovalifolium</i>	+	0.2 m	OS24-05	
<i>Indigofera monophylla</i>	3%	0.4 m	OS12-02	
<i>Melhantha oblongifolia</i>	+	0.3 m	OS18-09	
<i>Myoporum montanum</i>	+	1 m	OS22-06	
<i>Panicum decompositum</i>	1%	0.7 m	OS18-03	
<i>Pimelea ammodarid</i>	1%	1 m	OS12-05	
<i>Ptilotus exaltatus</i>	+	0.4 m	NC	
<i>Rhynchosia minima</i>	+	CR	OS16-03	
<i>Salsola tragus</i> subsp. <i>grandiflora</i>	+	0.2 m	OS02-10	
<i>Sauropus trachyspermus</i>	+	0.2 m	OS24-04	

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<i>Scaevola pulchella</i>	+	0.3 m	OS24-02
<i>Scaevola spinescens</i>	1%	0.6 m	OS22-10
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	2%	2 m	OS18-13
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	+	1.5 m	OS22-01
<i>Solanum horridum</i>	+	0.3 m	OS22-13
<i>Solanum lasiophyllum</i>	+	0.3 m	OS10-03
<i>Sorghum plumosum</i>	+	1 m	OS12-10
* <i>Tribulus terrestris</i>	+	CR	OS02-05
<i>Triodia epactia</i>	40%	0.4 m	OS22-02
<i>Yakirra australiensis</i>	+	0.2 m	OS18-05

Onslow Town Site OS29**Described by** JS **Date** 15/05/2011 **Type** Q **Size** 50 x 50 m**Location** Onslow Airport**MGA Zone** 50 304162 mE 7603099 mN**Habitat** Sand Plain**Soil** Red Brown Sand**Rock Type** Limestone**Vegetation** Open Shrubland of *Acacia ligulata* and *Acacia tetragonophylla* over Low Shrubland of *Scaevola spinescens*, *Indigofera monophylla*, *Acacia gregorii* and *Stylobasium spathulatum* over Open Hummock Grassland of *Triodia epactia* over Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida holathera* var. *holathera*.**Veg Condition** Good - Very Good**Fire Age** Old**Notes** Bare ground: 40%
Litter cover: - Logs; + Twigs; + Lvs.
Disturbance type: Introduced Species.**SPECIES LIST:**

Name	Cover	Height	Specimen	Notes
<i>Abutilon lepidum</i>	+	0.3 m	OS29-26	
<i>Acacia gregorii</i>	2%	0.2 m	OS29-03	
<i>Acacia ligulata</i>	1%	1.2 m	OS29-32	
<i>Acacia tetragonophylla</i>	1%	1 m	OS29-06	(broad phyllode coastal form)
<i>Aristida holathera</i> var. <i>holathera</i>	2%	0.4 m	OS29-16	
<i>Bonamia linearis</i>	+	CR	OS29-15	
<i>Cassutha capillaris</i>	+	CR	OS04-05	
* <i>Cenchrus ciliaris</i>	10%	0.3 m	NC	
<i>Eriachne mucronata</i>	+	0.2 m	OS29-24	
<i>Euphorbia alsiniflora</i>	+	0.3 m	OS29-08	
<i>Euphorbia boophthona</i>	+	0.3 m	OS23-06	
<i>Euphorbia drummondii</i>	+	0.2 m	OS29-07	
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	+	0.3 m	OS29-04	
<i>Flaveria trinervia</i>			OS29.30	
<i>Goodenia microptera</i>	+	0.4 m	OS29-12	
<i>Heliotropium ovalifolium</i>	+	0.2 m	OS29-05	
<i>Indigofera monophylla</i>	2%	0.3 m	OS29-09	
<i>Indigofera trita</i>	+	0.1 m	OS29-22	
<i>Ipomoea muelleri</i>	+	CR	OS29-27	
<i>Maireana lobiflora</i>	+	0.2 m	OS29-28	
<i>Melhania oblongifolia</i>	+	0.4 m	OS29-14	
<i>Panicum decompositum</i>	+	0.5 m	OS29-20	
<i>Pimelea ammodiaris</i>	+	0.4 m	OSJS09	
<i>Pluchea</i> sp. B Kimberley Flora (K.F. Kenneally 9526A)	+	0.4 m	OS29-21	
<i>Ptilotus axillaris</i>	+	0.1 m	OS29-19	
<i>Ptilotus exaltatus</i>	+	0.5 m	OS29-10	
<i>Rhynchosia minima</i>	+	CR	OS29-18	
<i>Sauropus trachyspermus</i>	+	0.1 m	OS29-01	

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<i>Scaevola pulchella</i>	+	0.4 m	OS29-31
<i>Scaevola spinescens</i>	5%	0.5 m	OS29-17
<i>Senna glutinosa</i> subsp. <i>chatelainiana</i>	+	0.6 m	OS29-13
<i>Sida fibulifera</i>	+	0.2 m	OS29-02
<i>Sida kingii</i>	+	0.2 m	OS29-25
<i>Solanum lasiophyllum</i>	+	0.2 m	OS10-03
<i>Stylobasium spathulatum</i>	1%	0.6 m	OS29-29
<i>Tribulus hirsutus</i>	+	CR	OS29-11
<i>Triodia epactia</i>	10%	0.3 m	OS29-23
<i>Whiteochloa airoides</i>	+	0.5 m	OS01-14

Onslow Town Site OS31**Described by** JS **Date** 15/05/2011 **Type** Q **Size** 50 x 50 m**Location** Onslow Airport**MGA Zone** 50 304500 mE 7603090 mN**Habitat** Hillslope**Soil** Red Brown Sand with some Clay

Vegetation Open Shrubland of *Acacia coriacea* subsp. *coriacea* and *Gyrostemon ramulosus* over Low Open Shrubland of *Acacia bivenosa*, *Stylobasium spathulatum*, *Scaevola spinescens*, *Indigofera monophylla* and *Scaevola pulchella* over Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida holathera* var. *holathera*.

Veg Condition Good - Very Good**Fire Age** Old

Notes Aspect: W
Bare ground: 20%
Litter cover: - Logs; + Twigs; + Lvs.
Disturbance type: Introduced Species.

**SPECIES LIST:**

Name	Cover	Height	Specimen	Notes
<i>Abutilon lepidum</i>	+	0.2 m	OS29-26	
<i>Acacia bivenosa</i>	2%	0.8 m	OS31-03	
<i>Acacia coriacea</i> subsp. <i>coriacea</i>	1%	1 m	OS31-04	
<i>Acacia gregorii</i>	+	0.2 m	OS29-03	
<i>Acacia stellaticeps</i>	1%	0.5 m	OS01-08	
<i>Acacia tetragonophylla</i>	+	0.8 m	OS29-06	(broad phyllode coastal form)
<i>Aristida holathera</i> var. <i>holathera</i>	1%	0.5 m	OS21-03	
<i>Bonamia linearis</i>	+	CR	OS29-15	
<i>Cassutha capillaris</i>	+	CR	OS04-05	
<i>*Cenchrus ciliaris</i>	5%	0.3 m	NC	
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	+	0.1 m	OS31-01	
<i>Euphorbia drummondii</i>	+	0.2 m	OS29-07	
<i>Euphorbia myrtoides</i>	+	0.2 m	OS01-03	
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	+	0.1 m	OS29-04	
<i>Gyrostemon ramulosus</i>	1%	1.2 m	OS23-09	
<i>Hibiscus sturtii</i> var. <i>platyklamys</i>	+	0.4 m	OS31-05	
<i>Indigofera linifolia</i>	+	0.2 m	OS01-17	
<i>Indigofera monophylla</i>	1%	0.5 m	OS31-07	
<i>Maireana lobiflora</i>	+	0.4 m	OS29-28	
<i>Panicum decompositum</i>	+	0.6 m	OS29-20	
<i>Pimelea ammodaridifolia</i>	+	0.4 m	OSJS09	
<i>Ptilotus exaltatus</i>	+	0.4 m	OS29-10	
<i>Rhynchosia minima</i>	+	CR	OS29-18	
<i>Scaevola pulchella</i>	1%	0.3 m	OS29-31	
<i>Scaevola spinescens</i>	1%	0.5 m	OS29-17	
<i>Solanum lasiophyllum</i>	1%	0.6 m	OS10-03	
<i>Stylobasium spathulatum</i>	1%	0.6 m	OS29-29	
<i>Triodia epactia</i>	10%	0.4 m	OS13-06	

Onslow Town **Site** OPCOL

Type Opportunistic Collections

Location Onslow Airport

SPECIES LIST:

Name

Tephrosia rosea var. *clementii*

Tephrosia rosea var. *clementii*

Specimen **Notes**

OSJS06 304848, 7605540, 3 Plants

OSJS06 304785, 7605544, 3 plants

APPENDIX G
MATRIX OF SPECIES FOUND WITHIN
EACH SITE

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

APPENDIX G MATRIX OF SPECIES FOUND WITHIN EACH SITE

NAME	OS22	OS24	OS29	OS31	OPCOL
? <i>Haloragis gossei</i>		+			
<i>Abutilon lepidum</i>		+	+	+	
<i>Acacia bivenosa</i>	+	1%		2%	
<i>Acacia coriacea</i> subsp. <i>coriacea</i>	+	+		1%	
<i>Acacia gregorii</i>			2%	+	
<i>Acacia ligulata</i>			1%		
<i>Acacia stellaticeps</i>	5%	25%		1%	
<i>Acacia tetragonophylla</i>		+	1%	+	
<i>Acacia trachycarpa</i>	+				
* <i>Aerva javanica</i>		+			
<i>Aristida holathera</i> var. <i>holathera</i>	10%	15%	2%	1%	
<i>Bonamia linearis</i>	+	+	+	+	
<i>Bonamia rosea</i>					
<i>Cassytha capillaris</i>	+	+	+	+	
* <i>Cenchrus ciliaris</i>	30%	5%	10%	5%	
<i>Corchorus tectus</i>	+	+			
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	nc	+		+	
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	+				
<i>Eriachne mucronata</i>	3%	1%	+		
<i>Eucalyptus victrix</i>	+				
<i>Euphorbia alsiniflora</i>	+	+	+		
<i>Euphorbia boophthona</i>		+	+		
<i>Euphorbia drummondii</i>			+	+	
<i>Euphorbia myrtoides</i>				+	
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>			+	+	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	+	+			
<i>Flaveria trinervia</i>			nc		
<i>Goodenia microptera</i>	+	+	+		
<i>Gossypium australe</i>	+	+			
<i>Gyrostemon ramulosus</i>		+		1%	
<i>Hakea lorea</i> subsp. <i>lorea</i>	nc				
<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>	+				
<i>Heliotropium ovalifolium</i>		+	+		
<i>Hibiscus sturtii</i> var. <i>platyklamys</i>	+			+	
<i>Indigofera linifolia</i>	nc			+	
<i>Indigofera monophylla</i>	1%	3%	2%	1%	
<i>Indigofera trita</i>			+		
<i>Ipomoea muelleri</i>			+		
<i>Maireana lobiflora</i>			+	+	
<i>Melhania oblongifolia</i>	+	+	+		
<i>Myoporum montanum</i>	+	+			
<i>Panicum decompositum</i>	1%	1%	+	+	
<i>Pimelea ammocharis</i>	+	1%	+	+	
<i>Pluchea</i> sp. B Kimberley Flora (K.F. Kenneally 9526A)			+		
<i>Ptilotus axillaris</i>			+		
<i>Ptilotus exaltatus</i>	+	+	+	+	
<i>Rhynchosia minima</i>	+	+	+	+	
<i>Salsola tragus</i> subsp. <i>grandiflora</i>	+	+			
<i>Sauropus trachyspermus</i>		+	+		
<i>Scaevola pulchella</i>	+	+	+	1%	
<i>Scaevola spinescens</i>	2%	1%	5%	1%	
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	nc				

APPENDIX G
MATRIX OF SPECIES FOUND WITHIN EACH SITE

NAME	OS22	OS24	OS29	OS31	OPCOL
<i>Senna glutinosa</i> subsp. <i>chatelainiana</i>			+		
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>		2%			
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	+	+			
<i>Sida fibulifera</i>			+		
<i>Sida kingii</i>			+		
<i>Solanum horridum</i>	+	+			
<i>Solanum lasiophyllum</i>	+	+	+	1%	
<i>Sorghum plumosum</i>	1%	+			
<i>Stylobasium spathulatum</i>			1%	1%	
<i>Tephrosia rosea</i> var. <i>clementii</i>					nc
<i>Tribulus hirsutus</i>			+		
* <i>Tribulus terrestris</i>	+	+			
<i>Triodia epactia</i>	30%	40%	10%	10%	
<i>Whiteochloa airoides</i>			+		
<i>Yakirra australiensis</i>		+			

APPENDIX H

FLORA INVENTORY

ONSLow LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT APPENDIX H

SPECIES INVENTORY

Family	Species
Amaranthaceae	<i>*Aerva javanica</i>
	<i>Ptilotus axillaris</i>
	<i>Ptilotus exaltatus</i>
Asteraceae	<i>Flaveria trinervia</i>
	<i>Pluchea</i> sp. B Kimberley Flora (K.F. Kenneally 9526A)
Boraginaceae	<i>Heliotropium ovalifolium</i>
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>
	<i>Maireana lobiflora</i>
	<i>Salsola tragus</i> subsp. <i>grandiflora</i>
Convolvulaceae	<i>Bonamia linearis</i>
	<i>Bonamia rosea</i>
	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>
	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>
	<i>Ipomoea muelleri</i>
Euphorbiaceae	<i>Euphorbia alsiniflora</i>
	<i>Euphorbia boophthona</i>
	<i>Euphorbia drummondii</i>
	<i>Euphorbia myrtilloides</i>
Fabaceae	<i>Acacia bivenosa</i>
	<i>Acacia coriacea</i> subsp. <i>coriacea</i>
	<i>Acacia gregorii</i>
	<i>Acacia ligulata</i>
	<i>Acacia stellaticeps</i>
	<i>Acacia tetragonophylla</i>
	<i>Acacia trachycarpa</i>
	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>
	<i>Indigofera linifolia</i>
	<i>Indigofera monophylla</i>
	<i>Indigofera trita</i>
	<i>Rhynchosia minima</i>
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>
	<i>Senna glutinosa</i> subsp. <i>chatelainiana</i>
	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	
<i>Tephrosia rosea</i> var. <i>clementii</i>	
Goodeniaceae	<i>Goodenia microptera</i>
	<i>Scaevola pulchella</i>

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

Family	Species
Goodeniaceae	<i>Scaevola spinescens</i>
Gyrostemonaceae	<i>Gyrostemon ramulosus</i>
Haloragaceae	? <i>Haloragis gossei</i>
Lauraceae	<i>Cassytha capillaris</i>
Malvaceae	<i>Abutilon lepidum</i>
	<i>Corchorus tectus</i>
	<i>Gossypium australe</i>
	<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>
	<i>Hibiscus sturtii</i> var. <i>platyklamys</i>
	<i>Melhania oblongifolia</i>
	<i>Sida fibulifera</i>
	<i>Sida kingii</i>
Myrtaceae	<i>Eucalyptus victrix</i>
Phyllanthaceae	<i>Sauropus trachyspermus</i>
Poaceae	<i>Aristida holathera</i> var. <i>holathera</i>
	* <i>Cenchrus ciliaris</i>
	<i>Eriachne mucronata</i>
	<i>Panicum decompositum</i>
	<i>Sorghum plumosum</i>
	<i>Triodia epactia</i>
	<i>Whiteochloa airoides</i>
	<i>Yakirra australiensis</i>
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>
Scrophulariaceae	<i>Myoporum montanum</i>
Solanaceae	<i>Solanum horridum</i>
	<i>Solanum lasiophyllum</i>
Surianaceae	<i>Stylobasium spathulatum</i>
Thymelaeaceae	<i>Pimelea ammocharis</i>
Zygophyllaceae	<i>Tribulus hirsutus</i>
	* <i>Tribulus terrestris</i>

APPENDIX I

LOCATION OF INTRODUCED FLORA

**ONSLOW LIGHT INDUSTRIAL AREAS FLORA, VEGETATION AND FAUNA ASSESSMENT
APPENDIX I**

LOCATION OF INTRODUCED FLORA

Taxa	Site Number	#Easting	#Northing
<i>*Aerva javanica</i>	OS24	304523.5	7603233.5
<i>*Cenchrus ciliaris</i>	OS22	304742.5	7603461.5
	OS24	304523.5	7603233.5
	OS29	304199	7603101
	OS31	304466.5	7603075.5
<i>*Tribulus terrestris</i>	OS22	304742.5	7603461.5
	OS24	304523.5	7603233.5

WGS 84, Zone 50K

APPENDIX J

HABITAT ASSESSMENT DATA SHEETS

**ONSLow LIGHT INDUSTRIAL AREA FLORA, VEGETATION AND FAUNA ASSESSMENT
APPENDIX K**

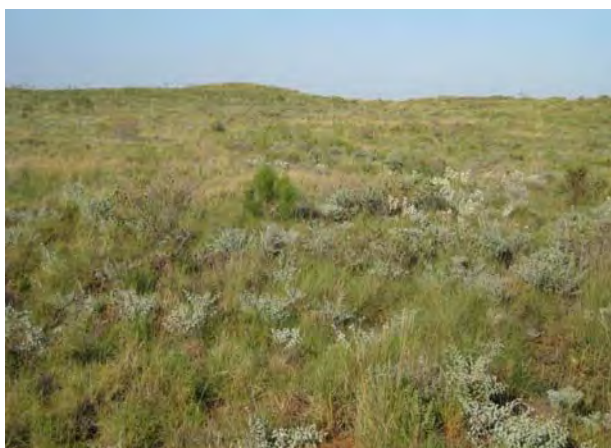
HABITAT ASSESSMENT DATA SHEETS

Habitat Assessment - HA 1

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50 304228 Easting, 7603144 Northing

Habitat Value: Low



Total Area of Habitat: 27.8 ha
Proportion of Project Area: 100%

Habitat Structure and Microhabitats

Aspect:	South	Exfoliating Slabs:	None	
Soils:	Red Sand/ Loam	Surface rocks:	Small: Nil	Large: Nil
Boulders:	None	Tree Hollows:	Small: None	Large: None
Cracks:	None	Caves:	None	Crevices: None
Cliffs :	None	Suitability for bats:	Nil	
Litter Cover:	5% Leaf litter , 0% Woody Debris, 10% Bare Ground			

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstorey	<i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Acacia bivenosa</i> and <i>Pimelea ammodaridifolia</i>	2-10%	1-2 m
Midstorey	<i>Acacia stellaticeps</i> , <i>Indigofera monophylla</i> and <i>Scaevola spinescens</i>	2-10%	0.6 m
Ground Cover	<i>Triodia epactia</i> , <i>*Cenchrus ciliaris</i> , <i>Panicum decompositum</i> and <i>Eriachne mucronata</i> .	30-70%	0.3 m

Condition Rating: Excellent
Disturbance: Weeds, Nearby Track
Fire Age Old

APPENDIX K
PREVIOUSLY RECORDED
CONSERVATION SIGNIFICANT
VERTEBRATE FAUNA

APPENDIX K

K1: AMPHIBIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2011), B= EPBC protected matters search tool (DSEWPaC 2011) C = Listed by Birds Australia (2010), D= DEC Protected Matters Search E= Previously recorded from surveys within 50 km, F=Current Survey.

Note: For Definitions of Conservation Codes see Appendix B.

AMPHIBIANS		Conservation Codes								
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F
HYLIDAE										
<i>Cyclorana maini</i>	Sheep Frog				x				x	
<i>Litoria caerulea</i>	Green Tree Frog									
<i>Litoria rubella</i>	Little Red Tree Frog				x				x	
LIMNODYNASTIDAE										
<i>Neobatrachus aquilonius</i>	Northern Burrowing Frog				x				x	
<i>Notaden nichollsi</i>	Desert Spadefrog				x				x	

[X] fauna species recorded from the project area.

[*] denotes introduced species.

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

APPENDIX K

K2: REPTILIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2011), B= EPBC protected matters search tool (DSEWPac 2011) C = Listed by Birds Australia (2010), D= DEC Protected Matters Search E= Previously recorded from surveys within 50 km, F=Current Survey.

Note: For Definitions of Conservation Codes see Appendix B

REPTILES	Scientific Name	Common Name	Conservation Codes								
			EPBC	WC	DEC	A	B	C	D	E	F
AGAMIDAE											
	<i>Amphibolurus gilberti gilberti</i>					x					
	<i>Amphibolurus longirostris</i>	Long-nosed Dragon				x					
	<i>Ctenophorus caudicinctus</i>	Ring-tailed Rock Dragon				x				x	
	<i>Ctenophorus femoralis</i>	Dune Dragon				x					
	<i>Ctenophorus isolepis</i>	Military Sand Dragon				x				x	
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon				x				x	
	<i>Ctenophorus rubens</i>	Red Dragon				x					
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon									
	<i>Diporiphora winneckeii</i>	Blue-lined Dragon				x				x	
	<i>Pogona minor minor</i>	Bearded Dragon				x				x	
DIPLODACTYLIDAE											
	<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko				x				x	
	<i>Diplodactylus pulcher</i>					x					
	<i>Lucasium stenodactylum</i>	Pale-snouted Ground Gecko				x				x	
	<i>Rhynchoedura ornata</i>	Beaked Gecko				x					
	<i>Strophurus jeanae</i>					x				x	
	<i>Strophurus strophurus</i>					x				x	x
CARPHODACTYLIDAE											
	<i>Nephrurus levis occidentalis</i>					x				x	
GEKKONIDAE											
	<i>Gehyra pilbara</i>	Pilbara Dtella				x				x	
	<i>Gehyra punctata</i>	Spotted Rock Dtella				x				x	
	<i>Gehyra purpurascens</i>					x					
	<i>Gehyra variegata</i>	Variegated Tree Dtella				x				x	
	<i>Heteronotia binoei</i>	Bynoe's Gecko				x				x	
PYGOPODIDAE											
	<i>Delma nasuta</i>	Long-nosed Delma				x				x	
	<i>Delma pax</i>					x					
	<i>Delma tincta</i>									x	
	<i>Lialis burtonis</i>	Burton's Legless Lizard				x				x	
	<i>Pygopus nigriceps</i>	Hooded Scaly-foot				x				x	
SCINCIDAE											
	<i>Ctenotus calurus</i>					x				x	
	<i>Ctenotus duricola</i>					x					
	<i>Ctenotus grandis titan</i>					x				x	
	<i>Ctenotus hanloni</i>									x	
	<i>Ctenotus helenae</i>					x					
	<i>Ctenotus iapetus</i>					x				x	
	<i>Ctenotus maryani</i>					x					
	<i>Ctenotus pantherinus ocellifer</i>	Leopard Ctenotus				x				x	
	<i>Ctenotus rufescens</i>					x				x	

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

REPTILES		Conservation Codes								
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F
		<i>Ctenotus saxatilis</i>	Rock Ctenotus				x			
<i>Ctenotus schomburgkii</i>					x				x	
<i>Cyclodomorphus melanops melanops</i>	Spinifex-slender Bluetongue				x					
<i>Eremiascincus fasciolatus</i>	Narrow-banded Sand-swimmer				x				x	
<i>Glaphyromorphus isolepis</i>					x					
<i>Lerista baynesi</i>					x					
<i>Lerista bipes</i>					x				x	
<i>Lerista clara</i>					x				x	
<i>Lerista elegans</i>					x					
<i>Lerista osloviana</i>					x				x	
<i>Lerista planiventris maryani</i>					x					
<i>Lerista uniduo</i>					x					
<i>Menetia greyii</i>	Common Dwarf Skink				x				x	
<i>Morethia ruficauda ruficauda</i>					x					
<i>Morethia ruficauda exquisita</i>	Fire-tailed Skink				x					
<i>Tiliqua multifasciata</i>	Central Bluetongue				x				x	

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON – Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

REPTILES		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
VARANIDAE											
<i>Varanus breviceauda</i>	Short-tailed Monitor				x				x		
<i>Varanus bushi</i>	Pilbara Mulga Monitor				x						
<i>Varanus caudolineatus</i>	Striped-tailed Monitor				x				x		
<i>Varanus eremius</i>	Pygmy Desert Monitor				x				x		
<i>Varanus gouldii</i>	Gould's Sand Monitor				x						
<i>Varanus panoptes rubidus</i>	Yellow-spotted Monitor				x						
<i>Varanus tristis tristis</i>	Black-headed Monitor				x						
TYPHLOPIDAE											
<i>Ramphotyphlops ammodytes</i>					x				x		
<i>Ramphotyphlops grypus</i>	Beaked Blind Snake				x				x		
<i>Ramphotyphlops hamatus</i>					x				x		
BOIDAE											
<i>Antaresia perthensis</i>	Pygmy Python				x						
<i>Antaresia stimsoni stimsoni</i>	Western Stimson's Python				x				x		
<i>Aspidites melanocephalus</i>	Black-headed Python				x				x		
ELAPIDAE											
<i>Demansia psammophis cupreiceps</i>	Yellow-faced Whip-Snake				x				x		
<i>Furina ornata</i>	Moon Snake				x				x		
<i>Pseudechis australis</i>	Mulga Snake				x				x		
<i>Pseudonaja modesta</i>	Ringed Brown Snake				x				x		
<i>Pseudonaja nuchalis</i>	Gwardar				x				x		
<i>Simoselaps anomalus</i>	Desert Banded Snake				x				x		
<i>Suta punctata</i>	Spotted Snake				x				x		

[X] fauna species recorded from the project area.

[*] denotes introduced species.

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
PHASIANIDAE											
<i>Coturnix pectoralis</i>	Stubble Quail				x		x				
<i>Coturnix ypsilophora</i>	Brown Quail				x		x				
ANATIDAE											
<i>Tadorna tadornoides</i>	Australian Shelduck						x				
<i>Chenonetta jubata</i>	Australian Wood Duck				x		x				
<i>Anas gracilis</i>	Grey Teal				x		x				
<i>Anas superciliosa</i>	Pacific Black Duck				x		x		x		
<i>Aythya australis</i>	Hardhead				x		x				
PODICIPEDIDAE											
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe				x		x				
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe				x		x				
COLUMBIDAE											
<i>Columba livia</i>	*Rock Dove				x		x				
<i>Geopelia cuneata</i>	Diamond Dove				x		x		x		
<i>Geopelia striata</i>	Peaceful Dove				x		x		x		
<i>Geopelia humeralis</i>	Bar-shouldered Dove				x		x				
<i>Phaps chalcoptera</i>	Common Bronzewing				x						
<i>Ocyphaps lophotes</i>	Crested Pigeon				x		x		x		
PODARGIDAE											
CAPRIMULGIDAE											
<i>Eurostopodus argus</i>	Spotted Nightjar				x		x				
AEGOTHELIDAE											
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				x				x		
APODIDAE											
<i>Apus pacificus</i>	Fork-tailed Swift	Mi			x	x	x		x		
ANHINGIDAE											
<i>Anhinga novaehollandiae</i>	Australasian Darter				x		x				
PHALACROCORACIDAE											
<i>Phalacrocorax carbo</i>	Great Cormorant				x						
<i>Phalacrocorax melanoleucus</i>	Little Pied Cormorant				x		x				
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				x		x				
<i>Phalacrocorax varius</i>	Pied Cormorant				x		x				
ARDEIDAE											
<i>Ardea garzetta</i>	Little Egret				x		x		x		
<i>Ardea intermedia</i>	Intermediate Egret				x		x				
<i>Ardea ibis</i>	Cattle Egret	Mi				x					
<i>Egretta novaehollandiae</i>	White-faced Heron				x		x				
<i>Butorides striata</i>	Striated Heron				x						
<i>Nycticorax caledonicus</i>	Nankeen Night Heron						x				
THRESKIORNITHIDAE											
<i>Threskiornis spinicollis</i>	Straw-necked Ibis				x		x				
<i>Platalea flavipes</i>	Yellow-billed Spoonbill				x		x				
ACCIPITRIDAE											
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk				x		x				
<i>Accipiter fasciatus</i>	Brown Goshawk				x		x				
<i>Aquila audax</i>	Wedge-tailed Eagle				x		x		x		
<i>Circus assimilis</i>	Spotted Harrier				x		x				
<i>Circus approximans</i>	Swamp Harrier				x		x		x		
<i>Elanus axillaris</i>	Black-shouldered Kite				x		x		x		
<i>Elanus scriptus</i>	Letter-winged Kite				x						
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Mi			x	x	x		x		
<i>Haliastur indus</i>	Brahminy Kite				x		x		x		
<i>Haliastur sphenurus</i>	Whistling Kite				x		x		x		



Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

BIRDS		Conservation Codes									
		EPBC	WC	DEC	A	B	C	D	E	F	
Scientific Name	Common Name										
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard				x		x		x		
<i>Hieraetus morphnoides</i>	Little Eagle				x		x				
<i>Milvus migrans</i>	Black Kite				x		x				
<i>Pandion cristatus</i>	Eastern Osprey	Mi			x		x		x		
FALCONIDAE											
<i>Falco berigora</i>	Brown Falcon				x		x				
<i>Falco cenchroides</i>	Nankeen Kestrel				x		x		x	x	
<i>Falco longipennis</i>	Australian Hobby				x		x		x		
<i>Falco peregrinus</i>	Peregrine Falcon		S4		x			x			
<i>Falco subniger</i>	Black Falcon				x						
RALLIDAE											
<i>Fulica atra</i>	Eurasian Coot				x		x				
<i>Tribonyx ventralis</i>	Black-tailed Native Hen						x				
<i>Porzana fluminea</i>	Australian Spotted Crane				x						
<i>Porzana pusilla</i>	Ballion's Crane						x				
BURHINIDAE											
<i>Esacus magnirostris</i>	Beach Stone-curlew						x				
RECURVIROSTRIDAE											
<i>Himantopus himantopus</i>	Black-winged Stilt				x		x				
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet				x		x				
CHARADRIIDAE											
<i>Elseyornis melanops</i>	Black-fronted Dotterel				x		x				
<i>Charadrius ruficapillus</i>	Red-capped Plover				x		x				
SCOLOPACIDAE											
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi			x		x				
<i>Tringa glareola</i>	Wood Sandpiper	Mi			x						
TURNICIDAE											
<i>Turnix velox</i>	Little Button-quail				x		x		x		
LARIDAE											
<i>Chlidonias hybrida</i>	Whiskered Tern						x				
<i>Chlidonias leucopterus</i>	White-winged Black Tern	Mi			x		x				
<i>Thalasseus bergii</i>	Crested Tern						x				
<i>Chroicocephalus novaehollandiae</i>	Silver Gull				x		x		x	x	
CACATUIDAE											
<i>Cacatua roseicapilla</i>	Galah				x		x		x		
<i>Cacatua sanguinea</i>	Little Corella				x		x		x		
<i>Nymphicus hollandicus</i>	Cockatiel				x		x		x		
PSITTACIDAE											
<i>Barnardius zonarius</i>	Australian Ringneck				x		x		x		
<i>Melopsittacus undulatus</i>	Budgerigar				x		x		x	x	
CUCULIDAE											
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo				x						
<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo				x		x		x		
<i>Cuculus pallidus</i>	Pallid Cuckoo						x				
CENTROPIDAE											
<i>Centropus phasianinus</i>	Pheasant Coucal				x						
STRIGIDAE											
<i>Ninox connivens</i>	Barking Owl						x				
<i>Ninox novaeseelandiae</i>	Southern Boobook Owl				x		x		x		
TYTONIDAE											
<i>Tyto javanica</i>	Eastern Barn Owl										
HALCYONIDAE											
<i>Dacelo leachii</i>	Blue-winged Kookaburra				x		x		x		
<i>Todiramphus pyrrophygia</i>	Red-backed Kingfisher						x				

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

BIRDS		Conservation Codes									
		EPBC	WC	DEC	A	B	C	D	E	F	
Scientific Name	Common Name										
<i>Todiramphus sanctus</i>	Sacred Kingfisher				x		x				
<i>Todiramphus chloris</i>	Collared Kingfisher				x		x				
MEROPIIDAE											
<i>Merops ornatus</i>	Rainbow Bee-eater	Mi			x	x	x		x	x	
CLIMACTERIDAE											
PTILONORHYNCHIDAE											
MALURIDAE											
<i>Malurus lamberti</i>	Variegated Fairy-wren				x		x		x		
<i>Malurus leucopterus</i>	White-winged Fairy-wren				x		x		x	x	
ACANTHIZIDAE											
<i>Gerygone fusca</i>	Western Gerygone						x				
<i>Gerygone levigaster</i>	Mangrove Gerygone				x				x		
<i>Gerygone tenebrosa</i>	Dusky Gerygone				x						
<i>Smicrornis brevirostris</i>	Weebill				x		x				
PARDALOTIDAE											
<i>Pardalotus rubricatus</i>	Red-browed Pardalote				x		x				
MELIPHAGIDAE											
<i>Certhionyx variegatus</i>	Pied Honeyeater				x						
<i>Epthianura aurifrons</i>	Orange Chat				x						
<i>Epthianura tricolor</i>	Crimson Chat				x		x			x	
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater				x		x		x		
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater				x		x				
<i>Lichenostomus virescens</i>	Singing Honeyeater				x		x		x	x	
<i>Lichmera indistincta</i>	Brown Honeyeater				x		x		x		
<i>Manorina flavigula</i>	Yellow-throated Miner				x		x				
<i>Sugamel niger</i>	Black Honeyeater				x				x		
POMATOSTOMIDAE											
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler				x		x				

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
CINCLOSOMATIDAE											
<i>Psophodes occidentalis</i>	Chiming Wedgebill				x		x		x		
CAMPEPHAGIDAE											
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				x		x		x		
<i>Lalage tricolor</i>	White-winged Triller				x		x				
PACHYCEPHALIDAE											
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				x		x				
<i>Oreoica gutturalis pallescens</i>	Crested Bellbird				x		x		x		
<i>Pachycephala lanioides</i>	White-breasted Whistler				x						
<i>Pachycephala melanura</i>	Mangrove Golden Whistler				x						
<i>Pachycephala rufiventris</i>	Rufous Whistler						x				
ARTAMIDAE											
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow				x		x				
<i>Artamus personatus</i>	Masked Woodswallow				x		x				
<i>Artamus cinereus</i>	Black-faced Woodswallow				x		x		x	x	
<i>Artamus cyanopterus</i>	Dusky Woodswallow				x				x		
<i>Cracticus nigrogularis</i>	Pied Butcherbird				x		x		x		
<i>Cracticus torquatus</i>	Grey Butcherbird				x						
<i>Cracticus tibicen</i>	Australian Magpie				x		x				
DICRURIDAE											
<i>Grallina cyanoleuca</i>	Magpie-Lark				x		x		x		
<i>Myiagra inquieta</i>	Restless Flycatcher				x						
<i>Rhipidura phasiana</i>	Mangrove Grey Fantail				x						
<i>Rhipidura leucophrys</i>	Willie Wagtail				x		x		x		
CORVIDAE											
<i>Corvus bennetti</i>	Little Crow				x		x		x		
<i>Corvus orru</i>	Torresian Crow				x		x		x	x	
ALAUIDAE											
<i>Mirafra javanica</i>	Singing Bushlark				x		x		x	x	
SYLVIIDAE											
<i>Cincloramphus mathewsi</i>	Rufous Songlark				x		x		x	x	
<i>Cincloramphus cruralis</i>	Brown Songlark				x		x				
ZOSTEROPIDAE											
<i>Zosterops lateralis</i>	Silver eye				x						
<i>Zosterops luteus</i>	Yellow White-eye				x		x		x		
HIRUNDINIDAE											
<i>Cheramoeca leucosterna</i>	White-backed Swallow				x		x		x		
<i>Hirundo neoxena</i>	Welcome Swallow				x		x				
<i>Hirundo rustica</i>	Barn Swallow	Mi				x					
<i>Petrochelidon ariel</i>	Fairy Martin				x		x		x	x	
<i>Petrochelidon nigricans</i>	Tree Martin				x		x		x	x	
PASSERIDAE											
<i>Emblema pictum</i>	Painted Finch				x		x		x		
<i>Neochmia ruficauda clarescens</i>	Star Finch			P4	x		x				
<i>Taeniopygia guttata</i>	Zebra Finch				x		x		x	x	
MOTACILLIDAE											
<i>Anthus novaeseelandiae</i>	Richard's Pipit				x		x		x		

Attachment 15.1A - Proposed Development - Onslow Industrial Park

SHIRE OF ASHBURTON –Onslow Light Industrial Area Flora, Vegetation and Fauna Assessment

K4: MAMMALIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

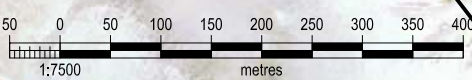
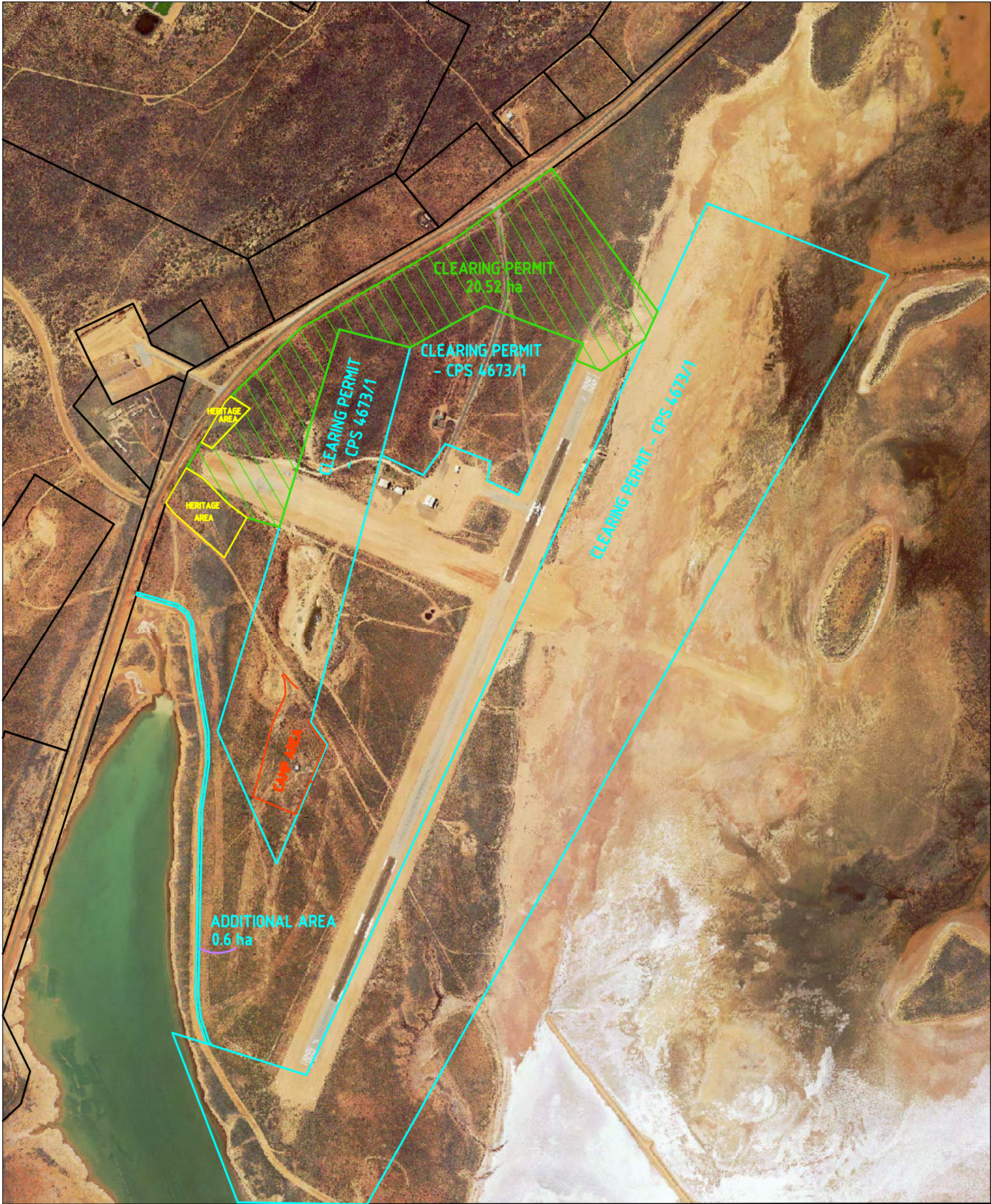
Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2011), B= EPBC protected matters search tool (DSEWPac 2011) C = Listed by Birds Australia (2010), D= DEC Protected Matters Search E= Previously recorded from surveys within 50 km, F=Current Survey.

Note: For Definitions of Conservation Codes see Appendix B.

MAMMALS	Scientific Name	Common Name	Conservation Codes								
			EPBC	WC	DEC	A	B	C	D	E	F
TACHYGLOSSIDAE											
	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna				x					
DASYURIDAE											
	<i>Ningai timealeyi</i>	Pilbara Ningai				x				x	
	<i>Planigale ingrami</i>	Long-tailed Planigale				x					
	<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart			P4	x			x	x	
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart				x				x	
	<i>Sminthopsis youngsoni</i>	Lesser Hairy-footed Dunnart				x					
MACROPODIDAE											
	<i>Macropus robustus erubescens</i>	Euro				x				x	x
	<i>Macropus rufus</i>	Red Kangaroo				x				x	
EMBALLONURIDAE											
	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat								x	
VESPERTILIONIDAE											
	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				x				x	
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat								x	
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat				x				x	
MOLOSSIDAE											
	<i>Tadarida australis</i>	White-striped Freetail-bat				x					
MURIDAE											
	<i>Legendina lakedownensis</i>	Short-tailed Mouse			P4	x			x		
	* <i>Mus musculus</i>	House Mouse				x				x	
	<i>Notomys alexis</i>	Spinifex Hopping-mouse				x				x	
	<i>Pseudomys delicatulus</i>	Delicate Mouse				x					
	<i>Pseudomys desertor</i>	Desert Mouse				x				x	
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse				x				x	
	<i>Rattus tunneyi</i>	Pale Field rat				x					
LEPORIDAE											
	* <i>Oryctolagus cuniculus</i>	European Rabbit					x				
CANIDAE											
	<i>Canis lupus dingo</i>	Dingo				x					
	* <i>Vulpes vulpes</i>	Fox					x				
FELIDAE											
	* <i>Felis catus</i>	Feral Cat				x	x			x	
BOVIDAE											
	* <i>Bos taurus</i>	Cow				x				x	
	* <i>Capra hircus</i>	Goat					x				

[X] fauna species recorded from the project area.

[*] denotes introduced species.



DRAFT PLAN

SCALE:	1: 8000	DATE DRAWN:	26 MAR 2013
V DATUM:		DRAWN BY:	SJ
H DATUM:	BIO94	CHECKED BY:	
SURVEY DATE:		DATA FILE:	130320_Onslow Airport Clearing Permit_Application.dwg
SURVEYOR:	Deep Woods		
JOB No:	14287-05		
FILE:	S:\Projects\14\14287\survey\item-05b Clearing Plan		

133 Scarborough Beach Road, Mount Hawthorn WA 6016
 PO Box 99, MOUNT HAWTHORN WA 6915
 T: 08 9443 1511 F: 08 9444 3901
 E: whelans@whelans.com.au W: www.whelans.com.au

**CURRENT CLEARING PERMIT LIMITS
 AND HERITAGE SITE
 ONSLOW AIRPORT**

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CLIENT: SHIRE of ASHBURTON

REV	0	BSI ISO 9001:2008 FS 521002
PLAN	14287-	
SHEET	1 OF 1	



**REPORT ON ABORIGINAL SITES SUBJECT TO A NOTICE UNDER
SECTION 18 OF THE *ABORIGINAL HERITAGE ACT 1972* WITHIN
THE SHIRE OF ASHBURTON ONSLOW AIRPORT UPGRADE STAGE
1, ONSLOW, WESTERN AUSTRALIA.**

Prepared by

Kellie Cue (BSc. Hons.)
Paul Greenfeld (BA Hons.; Grad. Dip.; MAACAI)
Bradie Baldisseri (BA Hons.)

On behalf of

Buurabalayji Thalanyji Aboriginal Corporation RNTBC (the PBC) ICN 7105.

August 2012

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DISCLAIMER

The author is not accountable for omissions and inconsistencies resulting from information which may come to light in the future but was not available at the time of this research.

ACKNOWLEDGEMENTS

The author would like to acknowledge and thank the following organisations and individuals who helped with the organisation and management of the Heritage Survey:

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- Buurabalayji Thalanyji Aboriginal Corporation – Glenys Hayes, Albert Hayes, Rodney Hicks, Andrew Hicks, Karen Hayes, Judith Hughes, Cyril Hayes, Shirley Hayes, Anthony Hanson, Bradley Hughes, Stewart Hicks, John Ard, David Hicks, and Dallas Hayes.

EXECUTIVE SUMMARY

This report provides the results of an archaeological investigation of Aboriginal sites within the Onslow Airport Upgrade Stage 1 survey areas. The purpose of the investigation was to record Aboriginal site Onslow Airport 01 to a level suitable to understand the site for reporting purposes as per the *Aboriginal Heritage Act 1972*, pursuant to a Section 18 application, as well as to provide a detailed recording of the site to mitigate against its destruction from the proposed airport upgrade.

The recording was undertaken by Miss Kellie Cue, Miss Bradie Baldisseri, Mr Paul Greenfeld, and representatives of the Buurabalayji Thalanyji Aboriginal Corporation between June 26th - July 1st and July 11th-12th 2012.

The detailed site recording and subsequent consultation resulted from recommendations made at the completion of the Aboriginal Heritage Survey over the Shire of Ashburton's proposed Onslow Airport Upgrade Stage 1 survey areas in January 2012.

It is recommended that the Shire of Ashburton notify all employees, personnel and contractors of the location and significance of the Archaeological Site Onslow Airport 01.

Again, **it is recommended** that DIA 6620 (Jinta 2) and the land reserve surrounding it be protected, and for the Shire of Ashburton to respect the boundaries as set and undertake any proposed works to the south of the existing fence-line.

It has been noted that it is the Shire of Ashburton's intention to disturb Onslow Airport 01. As such, **it is required** that prior to any disturbance or development taking place that may affect the site, that the Shire of Ashburton lodge a Section 18 Application to the Minister of Indigenous Affairs for permission to use the land on which Aboriginal sites are located. Further, **it is recommended** that Aboriginal monitors be present during all development works, to ensure that any materials that may be present sub-surface are collected and stored appropriately.

Given that it has been noted that the Shire of Ashburton intends to entirely disturb Onslow Airport 01, the Thalanyji representatives and the authors are satisfied with the level of site recording undertaken to support the proposed Section 18 application, and believe that no further information can be garnered from the site that would help to address questions regarding the subsistence techniques used in the past or the timing of occupation along the coastal Pilbara.

Please note that the Onslow Airport Upgrade survey areas may be subject to negotiations between the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation under the *Native Title Act 1993*, and this report is not to be construed as providing any consents by the Buurabalayji Thalanyji Aboriginal Corporation for any land interests under the *Native Title Act 1993*.

Also note, there is an existing Heritage Agreement between the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation. According to this agreement, the results of all reports, advices and assessments are confidential to the parties, and are not to be disclosed to any other party without the consent of both the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation. This includes the State of Western Australia.

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1. INTRODUCTION

1.1 INTRODUCTION

This report provides the results of an archaeological investigation of Aboriginal sites within the Onslow Airport Upgrade Stage 1 survey areas. The purpose of the investigation was to record Aboriginal site Onslow Airport 01 to a level suitable to understand the site for reporting purposes as per the *Aboriginal Heritage Act 1972*, pursuant to a Section 18 application, as well as to provide a detailed recording of the site to mitigate against its destruction from the proposed airport upgrade.

The recording was undertaken by Miss Kellie Cue, Miss Bradie Baldisseri, Mr Paul Greenfeld, and representatives of the Buurabalayji Thalanyji Aboriginal Corporation between June 26th - July 1st and July 11th-12th 2012.

The detailed site recording and subsequent consultation resulted from recommendations made at the completion of the Aboriginal Heritage Survey over the Shire of Ashburton's proposed Onslow Airport Upgrade Stage 1 survey areas in January 2012 (Cue and Greenfeld 2012).

1.2 LOCATION

Onslow Airport is located 3.3km south of the town of Onslow, along the coastal Pilbara (Figure 1). It is bounded by Onslow Road to the north and west. Onslow is 1,145km north of the City of Perth and 206km south-west of the town of Karratha, off North-West Coastal Highway.

1.3 ONSLOW AIRPORT UPGRADE STAGE 1 AND 2

The proposed Onslow Airport Upgrade Stages 1 and 2 encompassed six survey areas, three of which (Stage 1) were surveyed in January 2012, with the remaining three (Stage 2) surveyed in July 2012. In total, the six survey areas measure 1.1km east-west (at the widest) and 2.5km north-south (at the longest), covering 2.2 sq. km. The survey areas are situated south of Onslow Road, around the existing Onslow Airport runways and infrastructure.

1.4 PREVIOUS HERITAGE SURVEYS

Deep Woods Surveys undertook the heritage surveys over the proposed Onslow Airport Upgrade survey areas in January and July 2012. The surveys were carried out by one team, comprised of two archaeologists and five Thalanyji assistants, who undertook a series of pedestrian transects at 30m spacing, providing 100% coverage of each survey area.

The Ethnographic Survey involved consultation with senior Thalanyji members, who were able to provide information regarding the context and cultural significance of the area.

The Onslow Airport Upgrade survey areas were primarily comprised of flat, open country, with a line of vegetated deflated sand dunes within the west of the survey areas. The vegetation throughout consisted almost entirely of spinifex, with a few small acacias. Due to the density of the spinifex along the ground, visibility overall was poor (40%).

No rock outcroppings were identified, and the ground (where visible) was almost entirely devoid of any lithic materials. Small fragmented and whole shell pieces, as well as fossilised coral, are sparsely located throughout the survey areas, particularly to the east.

Whilst undertaking the pedestrian transects within the Stage 1 survey areas, Archaeological site Onslow Airport 01, a large shell scatter, was identified on top of, and eroding out of, the deflated dunes.



Figure 1: Location of Archaeological site Onslow Airport 01, in relation to the Onslow Airport Upgrade survey areas, and its surrounds.

1.5 ARCHAEOLOGICAL RESEARCH IN THE REGION

A substantial amount of research has been conducted along the coastal Pilbara and as a consequence, the archaeological patterning of the region is well developed. In terms of settlement patterns which have produced the spatial pattern of archaeological material, it has been suggested that a highly mobile and flexible model of land use was employed by Aboriginal people in the past in this type of arid coastal environment (O'Connor & Veth 1993; Veitch et al. 1993; Veitch & Warren 1992; Veth & O'Brien 1986; Veth et al. 1990).

The range of archaeological sites recorded includes artefact scatters, shell middens, shell scatters, burials and stone arrangements. Generally, studies on the Onslow Coastal plain have concluded that Aboriginal groups in the past extensively utilised specific environments that contained available fresh water such as the coastline (dune swales), claypans and river systems (Kee & Mulvaney 1984; Martin 1998; Mulvaney 1984; Murphy & McDonald 2003; Pickering 1982; Quartermaine Consultants 1998; Quartermaine & Kee 1985; Reynolds 1982; Schwede 1993; Strawbridge 1993; Veitch 1991; Veitch & Hook 1993; Veitch et al. 1993; Veitch & Warren 1992; Veth et al. 1990; Wright 1982; Wright & Veitch 1992).

Since the hinterlands contain less reliable water than nearer the coast, it has been suggested that this inland part of Thalanyji country was used in a more opportunistic manner (Mulvaney 1984; Veth et al. 1990). It has also been suggested that where more permanent water is present, as nearer the three rivers (Cane, Ashburton and Yannarrie), archaeological habitation sites are larger and more complex (Kee & Mulvaney 1984; Mulvaney 1984; Veitch & Warren 1992; Veth 1993; Veth et al. 1990).

In contrast, smaller and less dense habitation sites were found at more ephemeral water sources such as claypans. The site types recorded in the inland areas include artefact scatters and quarries. The most common site type is small artefact scatters (Mulvaney 1984; Veitch & Hook 1993; Veitch et al. 1993; Veth et al. 1990). These are generally located adjacent to water sources such as claypans, rivers and creeks. Formal implements occur at these sites in low numbers and include *tula* adzes and blacked blades (Mulvaney 1984:44; Veth *et al.* 1990:9-14).

Art sites do occur in Thalanyji country, but there are few of them. Most of the sites are found on exposed bedrock adjacent to water courses, with one site located on a granite dome, with the potential for several more.

The import of granite domes in this part of Thalanyji country is twofold. Firstly, granite domes have been associated with reliable water catchment in the southern Goldfields region of Western Australia (O'Connor et al. 1993). Secondly, because the granite domes offered the most reliable water catchment in areas of dune field desert and otherwise undifferentiated sand and mulga plains. They were focal points of Aboriginal pre- and post-contact subsistence, and were structurally essential for permanent human habitation of these areas.

The chain of granite outcrops and domes across the central part Thalanyji country therefore would have offered a range of subsistence opportunities in the intermediate zone between the highlands and the coastal strip otherwise devoid of focal water sources, beyond the irregularly flowing rivers and their pools.

1.6 REGIONAL STUDY

Veitch and Warren (1992) established a sequence of coastal exploitation of shell-fish species (primarily oyster, *Terebralia* species and *Anadara* species), based on the depositional layers of the shellfish within middens and the timing of the occurrence of each species in nature. Radiocarbon dating of eight midden sites at Turbridgi (approximately 29km south-west of Onslow Airport) resulted in the finding that coastal exploitation of the area began as early as 4,190 BP (Before Present), concluding at approximately 590 BP. During this time period, there was evidence for the exploitation of mangrove shellfish species (*Terebralia* spp) from $4,190 \pm 200$ BP to $3,500 \pm 70$ BP, and associated intertidal mudflat species (*Anadara granosa*) from $3,640 \pm 70$ BP to 590 ± 70 BP. Coral dwelling oyster species, *Hyotissa* spp, are present in these assemblages from $3,380 \pm 70$ BP to 850 ± 80 BP (Figure 2).

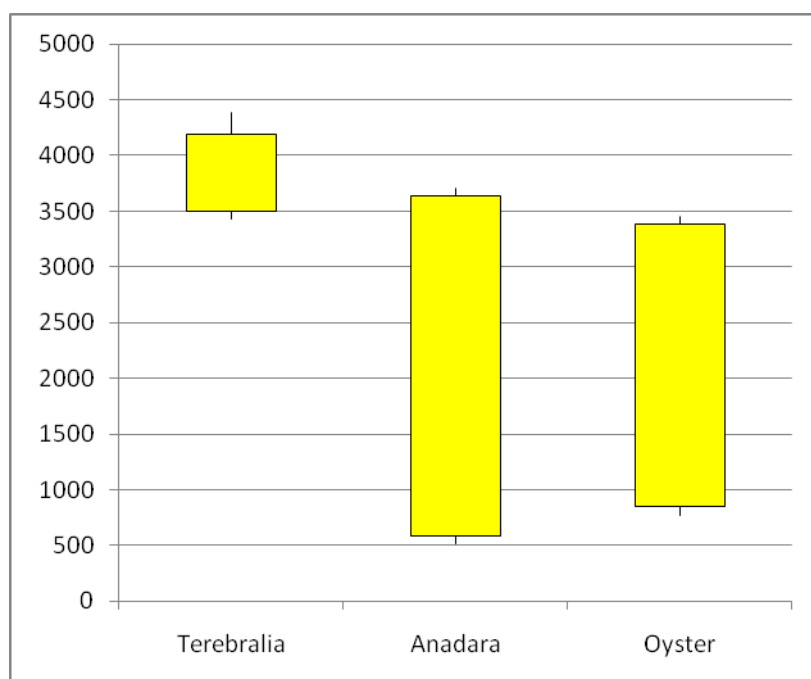


Figure 2: The timing of exploitation of coastal shellfish species for subsistence along the Pilbara coast (based on data gathered by Veitch and Warren (1992)).

While this framework for the utilisation of shell-fish species for subsistence has been hypothesised and initially tested by Veitch and Warren using the Turbridgi sites, to date few sites are known of that could further address the topic.

Heritage surveys undertaken by Deep Woods Surveys for Chevron Australia Pty Ltd (Cue et al 2010) for the proposed Wheatstone Gas Plant between March 2009 and November 2010 resulted in the identification and recording of several large shell scatters, one of which, Wheatstone 8, has the potential to further support the framework as set by Veitch and Warren, had excavation and dating of the site been undertaken. While a visual inspection of Wheatstone 8 indicated that the site has only two of Veitch's proposed shell-fish layers (*Terebralia* and *Anadara* were visible, while the younger oyster layer was not present), any dates derived from the two older layers would have been significant additions to Veitch's data set, with the potential to either support or disprove Veitch's framework.

Veitch posed another question, being the supposition/contradiction that there is an increase in site antiquity the closer the site is to the coast (as indicated by the initial Turbridgi data), versus Veitch's opinion that earlier evidence for Holocene coastal adaptations may be found further inland within Pleistocene dunes.

Changes in sea levels, and the consequent change in coast lines, throughout the period of human occupation of Australia means that patterns of occupation during the Late Pleistocene and early Holocene does not necessarily follow the frameworks for site location that can be applied to recent occupation. In terms of occupation within the past 500 years along the coastal Pilbara, sea levels and the coast line were stable at current levels, providing a known predictable pattern of site location based on subsistence needs, not solely on the environment. It has been shown that late Holocene sites are most likely to be located in the vicinity of permanent or semi-permanent water sources (primarily the river), near large natural rock outcroppings, in areas that, while open and clear of vegetation, are also protected from the elements and predators. This framework sees sites concentrated within approximately 10km of the river, primarily in large networks of claypans.

This is in contrast with the expected locations of early-mid Holocene and late Pleistocene sites. Sea levels during this period (25,000 BP to 6,000 BP) were constantly changing, for the most part rising and encroaching on coast lines and river-mouths. During these fluctuations, it was wiser to occupy areas slightly further inland where changes in sea level would not impact on subsistence or safety, hence why, as Veitch believes, there may be earlier evidence of Holocene coastal adaptations (prior to 4,000 BP) further inland within Pleistocene dunes that were not so affected by extremes in climate.

Subsequent to the heritage surveys undertaken for Chevron concluding in 2010, the author was able to test the predictive model for site location along the coastal Pilbara, plotting all available site data within a 800 square kilometre area (20km either side of the Ashburton River, 20km inland from the coast), including all sites within the prescribed area on the Department of Indigenous Affairs Site Register (n=204) and the recorded Wheatstone sites (n=71).

The author found that the predictive model was upheld, with sites in the Onslow region being predominantly located in the immediate vicinity of permanent (or at least semi-permanent) watersources, particularly the Ashburton River, which is a significant subsistence resource as well as having substantial cultural importance. The plotted data showed significant and distinct relationships between site location and site type versus distance from the river or ocean (Figure 3).

The data indicates that where proximity to the river is the key factor in site location, the ideal range for site location relative to the river is between 3-7km, with site density substantially dropping off after this point. There are two possible reasons for this distance between the river and site location. Firstly, the Ashburton River floods seasonally, and every few years, the river breaks its banks and floods the plains for up to several kilometres. Hence, sites that may have been located closer to the river may have been washed out of context to the edge of the flood zone.

Alternatively, the flooding of the river would have been a known occurrence, so it is possible that the sites are located at what was a known safe distance from the river, while still being close enough to it to exploit its many resources.

In terms of site type, artefact sites are more common in closer proximity to the river (peaking at a distance of 5-7km from the river), whilst shell sites tend to increase in number further away from the river; sites containing both shells and artefacts peak between a 7-10km distance.

Proximity to the coast strongly dictates site type, as would be expected. Shell scatter sites have a strong, negative correlation with distance from the coast – that is, shell sites are most concentrated at the coast, and decline the further away from the coast the site is. Mixed sites (containing both shell and artefacts) have a similar correlation, but not as strong as that exhibited by solely shell sites. Conversely, artefact sites have a strong, positive correlation with distance from the coast – that is, the number of artefact sites increases the further they are away from the coast.

With regards to the combined data of all sites relative to distance from the coast, there is an initial peak in site numbers at the coast (obviously biased by the shell sites), with a second, strong peak in the number of sites at 7-10km from the ocean.

The combined data shows that the majority of the recorded sites around the Ashburton River at the coast are centred around a 7km distance from either major water/subsistence source (river or ocean). Further study into other key factors in site location will aid in improving predictive modelling in the region, in particular mapping site location versus geographic features, geology, hydrology and mythology. The identification of further archaeological and anthropological sites in the area, through future survey work, will increase our knowledge of how and why indigenous groups lived in, and exploited the region and answer many long-standing research questions.

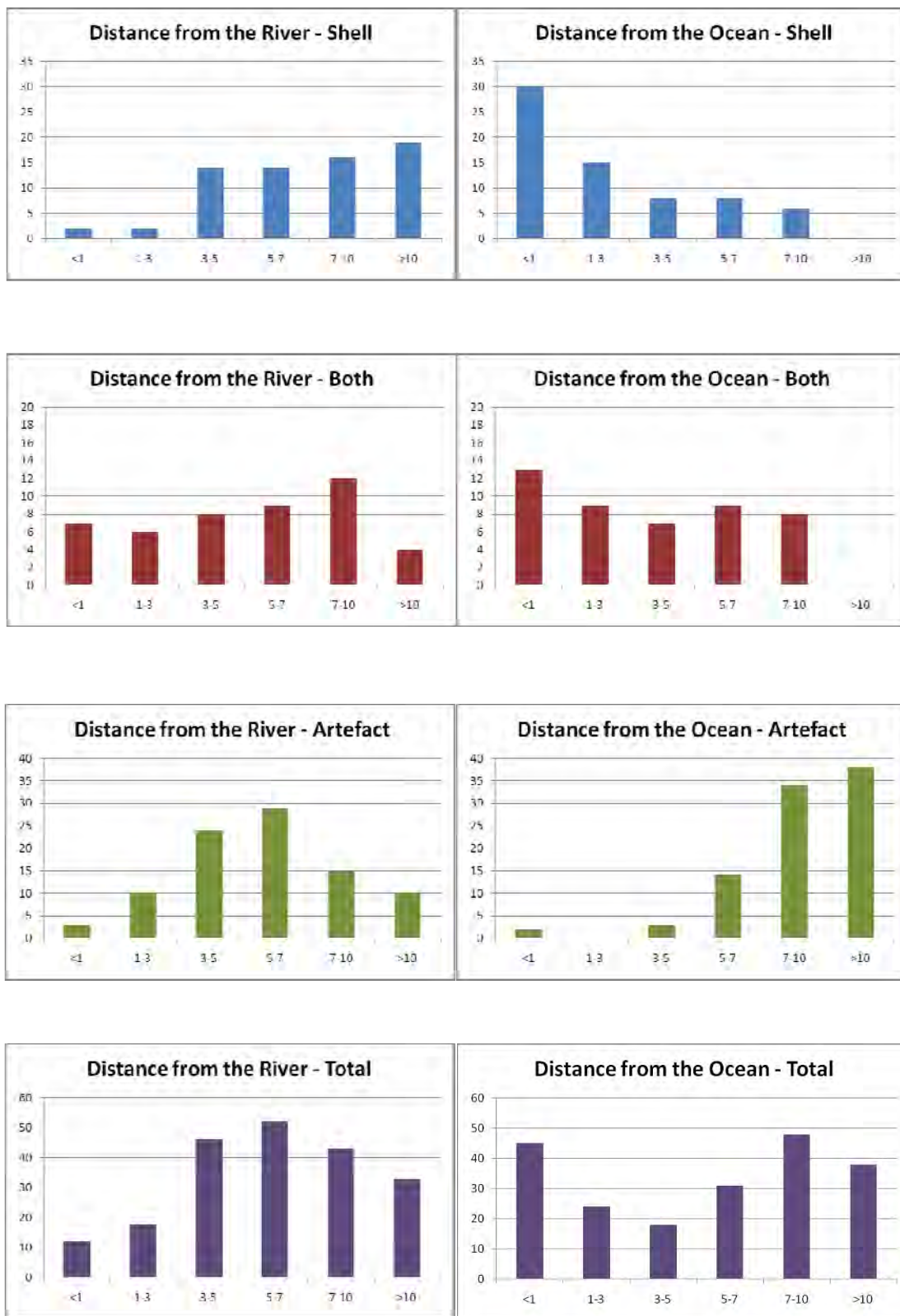


Figure 3: Distance from the ocean and the Ashburton River of shell, mixed and artefact sites (n=204; data from DIA) [x-axis – Number of sites; y-axis – Distance from river/ocean in km's.] (Cue et al 2010).

2. METHODOLOGY

The destruction of any Aboriginal site may have an impact on the level and quality of archaeological information that can be obtained regarding the timing and nature of local Indigenous occupation. To minimise against the loss of information, the following methodology was employed to record a representative sample of the site. This information is then used to determine the significance of the site to better enable informed site management.

- i) Archaeological site Onslow Airport 01 (as recorded in Cue and Greenfeld 2012) was revisited and the cultural material, where visible, was re-identified;
- ii) Site notes and plans were produced and photographs were taken.
- iii) Shell samples were recorded. A grid was placed over an image of the site, and 1x1m sample squares were plotted accordingly. This resulted in 75 representative sample squares being recorded throughout the site, separated by 30m east-west, and 25m north-south (Figure 4). This allowed the authors to target all areas of the site and illustrated the areas of high and low shell density. All data is recorded in Appendix 2;
- iv) Shell attributes were recorded in a manner similar to other surveys across the coastal Pilbara to allow for better integration into regional archaeological studies about Indigenous occupation patterning and subsistence strategies;
- v) The shells were left in place with the intent that these can be salvaged if an application under Section 18 of the *Aboriginal Heritage Act (1972)* is successful.



Figure 4: The location of representative sample squares recorded within Archaeological site Onslow Airport 01 (numbered east-to-west, north-to-south).

3. RESULTS

3.1 ARCHAEOLOGICAL SURVEY

3.1.1 ONSLOW AIRPORT 01 (SHELL SCATTER)

Site Boundaries (MGA Zone 50)

1	304158mE 7602748mN	10	304117mE 7601997mN
2	304230mE 7602737mN	11	304047mE 7601996mN
3	304236mE 7602665mN	12	304049mE 7602101mN
4	304200mE 7602457mN	13	304057mE 7602232mN
5	304184mE 7602392mN	14	304067mE 7602271mN
6	304168mE 7602335mN	15	304091mE 7602353mN
7	304146mE 7602259mN	16	304105mE 7602405mN
8	304134mE 7602226mN	17	304120mE 7602465mN
9	304127mE 7602104mN		

Location

Onslow Airport 01 is located within the west of the total proposed Onslow Airport Upgrade survey area. It is situated approximately 340m west of the primary runway, with the secondary runway located immediately outside of the sites northern boundary. Onslow Road is located 300m west of the site.

Site Environment

Onslow Airport 01 is located along a vegetated ridge with several blown-out deflations along the sides and running onto the flats to the east and west. Beadon Creek lies approximately 1km to east, along with other smaller tidal inlets, and salt and mud flats.

Vegetation within the site and its surrounds is moderately dense, and is comprised almost entirely of spinifex, with a few scattered low acacias. The spinifex obscures much of the ground, resulting in poor visibility (40%).

No natural rock outcroppings are present either within the site or in the survey area surrounding it. Any substantial lithic materials present within the area would have been imported from other regions.

The only disturbance noted within the site was two tracks, one 160m south of the northern boundary, and one 90m north of the southern boundary.

Site Description

Onslow Airport 01 is a medium-sized site comprised predominantly of *Terebralia* spp. shellfish. The site measures 770m long (north-south) by 80m wide (east-west), covering an area of 60,680 sq. m.

Six shell concentrations were noted within the site, with the remainder of the site consisting of a sparse background scatter. *Terebralia* species predominates, the vast majority of which were

broken. Other shell species identified included *Anadara*, and *Baler*. Three rock pieces (sandstone and silcrete) were identified amongst the shell concentrations during the initial heritage surveys. However, no stone artefacts were identified during the Section 18 recording process. It is estimated that there are approximately 2000 shells present within the site.

Seventy-five representative sample squares (Table 1) were recorded throughout the site (total n=75). Of those, 44 squares held no shells or cultural material (n=44, 59%). The nil sample squares were predominantly recorded down the sides of the ridge, where it was assumed that cultural material would be sparse.

Of the 31 sample squares where shell was recorded, eleven squares contained either entirely undiagnostic shell fragments or fewer than/equal to five measureable shells (n=11, 14.7%). Five sample squares held between 6-10 measurable shells (n=5, 6.6%), four sample squares held between 11-20 measurable shells (n=4, 5.3%), two sample squares held 21-30 measurable shells (n=2, 2.7%), and two sample squares held more than fifty measureable shells (n=2, 2.7%).

Within the 31 sample squares with recorded shell (n=24), all had *Terebralia* spp present (n=24, 100%), nine squares held *Telescopium* spp. (n=9, 37.5%) (though all fragments), six held *Sabia Conica* spp (n=6, 25%) (all fragments), three squares held *Anadara* spp (n=3, 12.5%), two squares held *Melo* spp (*Baler*) (n=2, 8.3%), and a single sample square had *Saccostrea* spp (*Oyster*) (n=1, 4.2%).

In general throughout the site, the largest shell assemblages were recorded within the center and towards the south. Based on the location of the sample squares within which shell or cultural material was recorded, four (4) areas of shell accumulation within the site have been identified (Figure 5). Each of the four accumulations are located for the most part along the top of the ridge. These areas are separated from each other by 50m at most; therefore it is not necessary to draw new site boundaries or separate each area into its own site, as the distance between is negligible. A small buffer area is located between the edge of the accumulations and the larger boundary of the site, measuring between 15-30m, which is appropriate to ensure the site is left undisturbed by machinery etc, in the event that the site is avoided during the airport upgrade.

It is authors opinion that there is likely to be sub-surface material present at the site. Shells can be seen eroding out of the loose sand forming the ridge, and despite the ground covering of spinifex, the loose sands are still affected by winds and the tide, which alter land form causing artefacts and shell to subside.

Standing alone, the size of the site and the shellfish quantities present indicates that that site represents a solitary, exploitative event. If the site is viewed in context with other shell scatters located around Onslow, the combined sites could potentially be viewed as a larger subsistence event, though there is still little evidence of camping or long-term occupation around salt flats and tidal inlets so close to the coast.

Archaeological Significance

Given the growing number of similar shell scatters located along the Pilbara coast around Onslow, it is the authors' opinion that Onslow Airport 01 can be considered as being average for most characteristics and can be said to be common.

It is the authors' opinion that Archaeological Site Onslow Airport 01 constitutes an Aboriginal Site as defined by Section 5(a) of the *Aboriginal Heritage Act 1972-80*. It is assessed as being of a **low level of archaeological significance**.

Recommendations

It is recommended that the Shire of Ashburton notify all employees, personnel and contractors of the location and significance of the Archaeological Site Onslow Airport 01.

It has been noted that it is the Shire of Ashburton's intention to disturb Onslow Airport 01. As such, **it is required** that prior to any disturbance or development taking place that may affect the site, that the Shire of Ashburton lodge a Section 18 Application to the Minister of Indigenous Affairs for permission to use the land on which Aboriginal sites are located. Further, **it is recommended** that Aboriginal monitors be present during all development works, to ensure that any materials that may be present sub-surface are collected and stored appropriately.

If not already in place, **it is recommended** that the Shire of Ashburton procure from the Thalanyji people a Cultural Heritage Management Plan (CHMP), and that the CHMP provide a methodology for the removal and salvage of any sites that may be encountered. This should include any that may arise from the removal and salvage of Onslow Airport 01 (that is, other sites that may be encountered sub-surface, or that may be encountered as a result of monitoring). The CHMP should also describe the procedure to be carried out in the event that any other sites are encountered within the larger Onslow Airport Redevelopment.

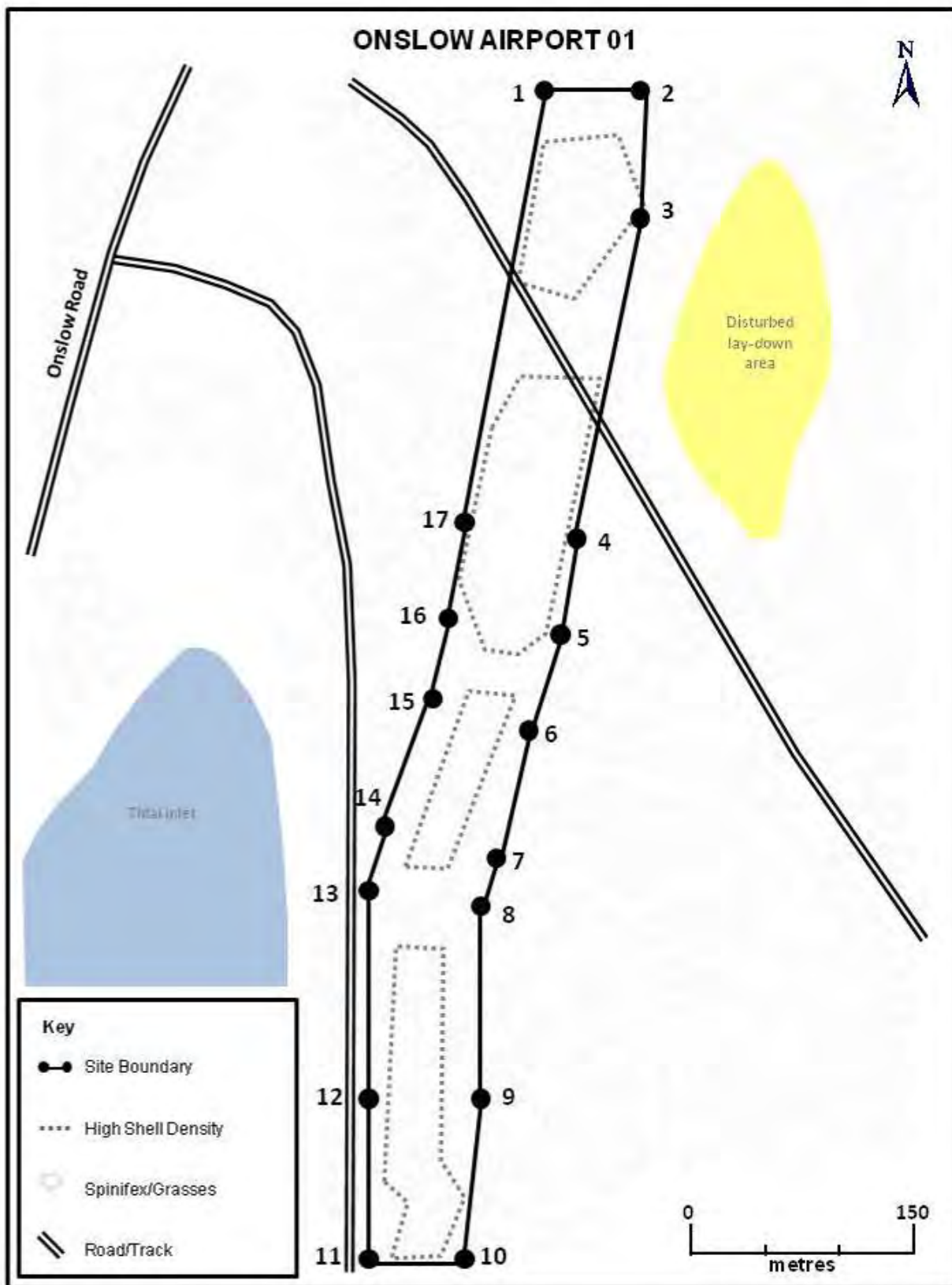


Figure 5: Archaeological site Onslow Airport 01 – site plan.

SAMPLE SQUARE	EASTING	NORTHING	DESCRIPTION
1	304179mE	7602720mN	Flaked isolator; nil shell
2	304209mE	7602715mN	Nil
3	304166mE	7602694mN	Terebralia; glass
4	304198mE	7602690mN	Terebralia
5	304219mE	7602689mN	Nil
6	304175mE	7602670mN	Nil
7	304206mE	7602665mN	Terebralia
8	304159mE	7602647mN	Nil
9	304188mE	7602638mN	Terebralia fragments
10	304216mE	7602638mN	Nil
11	304172mE	7602619mN	Terebralia
12	304199mE	7602615mN	Nil
13	304153mE	7602598mN	Nil
14	304186mE	7602590mN	Terebralia fragments; glass flake
15	304212mE	7602588mN	Nil
16	304160mE	7602571mN	Nil
17	304189mE	7602566mN	Nil
18	304145mE	7602548mN	Nil
19	304176mE	7602542mN	Terebralia; single Anadara
20	304200mE	7602539mN	Nil
21	304153mE	7602523mN	Terebralia fragments
22	304182mE	7602517mN	Nil
23	304136mE	7602500mN	Nil
24	304172mE	7602490mN	Terebralia
25	304195mE	7602490mN	Nil
26	304146mE	7602474mN	Terebralia
27	304175mE	7602470mN	Nil
28	304127mE	7602450mN	Nil
29	304156mE	7602447mN	Terebralia; single Anadara; Telescopium fragments
30	304186mE	7602442mN	Nil
31	304138mE	7602421mN	Terebralia fragments
32	304166mE	7602419mN	Terebralia; single Anadara
33	304115mE	7602401mN	Nil
34	304145mE	7602391mN	Terebralia; Telescopium fragments; Baler fragment
35	304174mE	7602388mN	Nil
36	304123mE	7602375mN	Nil
37	304152mE	7602367mN	Terebralia fragment
38	304101mE	7602353mN	Nil
39	304133mE	7602343mN	Terebralia; Telescopium fragments; Baler fragment
40	304159mE	7602337mN	Nil

SAMPLE SQUARE	EASTING	NORTHING	DESCRIPTION
41	304111mE	7602324mN	Nil
42	304139mE	7602316mN	Nil
43	304087mE	7602305mN	Nil
44	304117mE	7602295mN	Terebralia; Telescopium fragment
45	304144mE	7602287mN	Nil
46	304101mE	7602278mN	Terebralia; Telescopium fragments
47	304126mE	7602267mN	Nil
48	304074mE	7602256mN	Nil
49	304099mE	7602249mN	Terebralia
50	304132mE	7602241mN	Nil
51	304084mE	7602229mN	Terebralia fragments
52	304113mE	7602225mN	Nil
53	304066mE	7602210mN	Nil
54	304095mE	7602208mN	Terebralia fragment
55	304124mE	7602206mN	Nil
56	304083mE	7602185mN	Terebralia; Anadara; Telescopium fragment
57	304115mE	7602183mN	Nil
58	304062mE	7602160mN	Nil
59	304093mE	7602159mN	Terebralia fragments
60	304122mE	7602158mN	Nil
61	304074mE	7602134mN	Terebralia
62	304107mE	7602135mN	Nil
63	304060mE	7602110mN	Terebralia fragment
64	304090mE	7602110mN	Terebralia; Telescopium fragment
65	304119mE	7602110mN	Nil
66	304078mE	7602085mN	Terebralia
67	304105mE	7602086mN	Nil
68	304058mE	7602061mN	Nil
69	304091mE	7602054mN	Terebralia
70	304118mE	7602060mN	Nil
71	304072mE	7602037mN	Nil
72	304096mE	7602036mN	Terebralia; Telescopium fragment
73	304057mE	7602011mN	Nil
74	304081mE	7602014mN	Terebralia
75	304115mE	7602011mN	Nil

Table 1: Centre-point coordinates for the representative sample squares recorded within Archaeological site Onslow Airport 01.



Plate 1: Onslow Airport 01 – from within the north of the site, looking south over the ridge.



Plate 2: Onslow Airport 01 – Sample Square 29 (within the centre of the site).

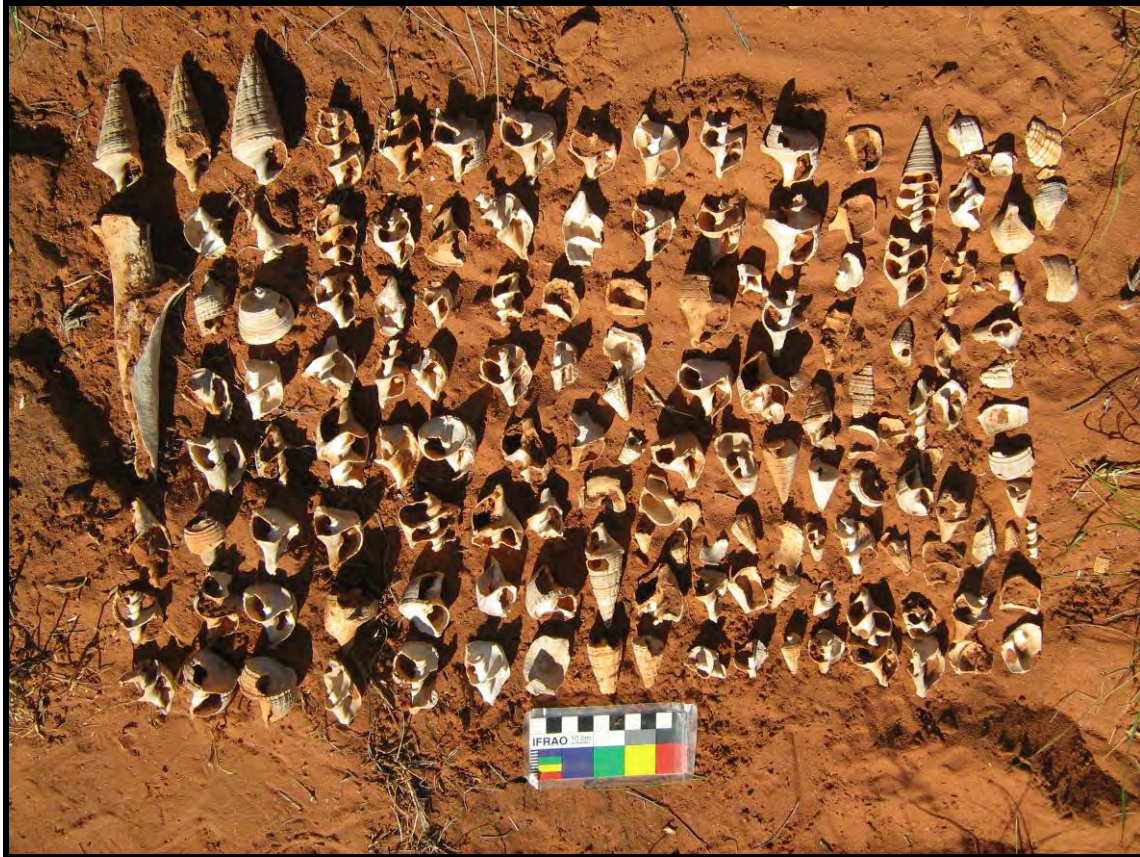


Plate 3: Onslow Airport 01 – Sample Square 34 (within the centre of the site).



Plate 4: Onslow Airport 01 – Sample Square 3 (within the north of the site).



Plate 5: Onslow Airport 01 – Sample Square 1 (flaked isolator bulb; within the north of the site).



Plate 6: Onslow Airport 01 – Sample Square 4 (Brylcreem bottle; within the north of the site).



Plate 7: Onslow Airport 01 – Sample Square 56 (within the south of the site).

3.2 ETHNOGRAPHIC SECTION 18 CONSULTATION

As part of the Ethnographic Survey, Mr Albert Hayes, Mr Rodney Hicks, Mr David Hicks, Mrs Shirley Hayes, Mr Stewart Hicks, Mr Cyril Hayes and Miss Dallas Hayes were escorted through the proposed Onslow Airport Upgrade survey areas, through Archaeological site Onslow Airport 01, and shown the extent to which the site would be disturbed should the upgrade continue as planned.

As has been stated in the heritage survey reports for both Onslow Airport Upgrade Stage 1 and Stage 2, registered site DIA 6620 (Jinta 2) is a point of concern for the Thalanyji representatives. Jinta 2 was a natural fresh water soak located between Onslow Airport and Onslow Road, to the north of a fence-line and access track running through the north Archaeological site Onslow Airport 01. The site used to be delineated by bull rushes and palm trees, which have now died off. The stump of a palm tree is all that remains, demarcating the southern extent of the site.

A fenced-off land reserve was established around the site, to protect it and minimise disturbance.

Mr Hayes and the other Thalanyji representatives have again requested that DIA 6620 (Jinta 2) and the land reserve surrounding it be protected, and for the Shire of Ashburton to respect the boundaries as set and undertake any proposed works to the south of the existing fence-line.

Given that it has been noted that the Shire of Ashburton intends to almost entirely disturb Onslow Airport 01, the Thalanyji representatives are satisfied with the level of site recording undertaken to support the proposed Section 18 application, and believe that no further information can be garnered from the site that would help to address questions regarding the subsistence techniques used in the past or the timing of occupation along the coastal Pilbara.

Whilst Archaeological site Onslow Airport 01 is regarded as being important within the wider archaeological context of Onslow and the surrounding Pilbara, it is the view of the Thalanyji representatives that the density of similar shell scatter sites in the Onslow region renders the site as common, and, with the detailed recording that has been undertaken, are satisfied for the site to make way for the proposed Onslow Airport Upgrade.

4. DISCUSSION

It is the authors opinion that Onslow Airport 01 represents purposeful occupation and shell-fish consumption, as opposed to a natural accumulation of shell. Several factors informed this judgment, including the edible nature of all species identified, the larger size of the shells, the majority of the shells being broken (consistent with meat extraction), and the absence of coral. The flats surrounding the ridge were also almost entirely devoid of shell; if the site was naturally formed, the entire surrounding area should have contained shells also. Finally, the prevalence of a single shell fish species (*Terebralia* spp [Mudwhelk]) throughout the site, with only a very limited number of alternate species (*Anadara*, *Melo*, and *Telescopium*) otherwise identified, suggests that *Terebralia* were being targeted for the purposeful consumption of their meat.

Referring back to Veitch and Warren's (1992) sequence of coastal exploitation of shell-fish species, Archaeological site Onslow Airport 01 exhibits the mangrove shellfish species (*Terebralia* spp) that Veitch and Warren dated to between $4,190 \pm 200$ BP to $3,500 \pm 70$ BP, based on the timing of the occurrence of the species in nature. Whilst several *Anadara* spp shellfish were recorded within the site, the quantity was certainly not large enough to support the later two sequences within the framework (*Anadara* spp and Oyster).

It is not believed that further investigation (i.e. excavation) of the site will add to the information gathered during the site recording process, or aid in addressing further questions concerning the archaeological and cultural history of the region. Despite the belief that sub-surface materials may be present within the site, evidence from the surface materials suggests that further investigation would provide no new information that the representative sample squares have not already yielded.

5. RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDATIONS

It is recommended that the Shire of Ashburton notify all employees, personnel and contractors of the location and significance of the Archaeological Site Onslow Airport 01.

Again, **it is recommended** that DIA 6620 (Jinta 2) and the land reserve surrounding it be protected, and for the Shire of Ashburton to respect the boundaries as set and undertake any proposed works to the south of the existing fence-line.

It has been noted that it is the Shire of Ashburton's intention to disturb Onslow Airport 01. As such, **it is required** that prior to any disturbance or development taking place that may affect the site, that the Shire of Ashburton lodge a Section 18 Application to the Minister of Indigenous Affairs for permission to use the land on which Aboriginal sites are located. Further, **it is recommended** that Aboriginal monitors be present during all development works, to ensure that any materials that may be present sub-surface are collected and stored appropriately.

If not already in place, **it is recommended** that the Shire of Ashburton procure from the Thalanyji people a Cultural Heritage Management Plan (CHMP), and that the CHMP provide a methodology for the removal and salvage of any sites that may be encountered. This should include any that may arise from the removal and salvage of Onslow Airport 01 (that is, other sites that may be encountered sub-surface, or that may be encountered as a result of monitoring). The CHMP should also describe the procedure to be carried out in the event that any other sites are encountered within the larger Onslow Airport Redevelopment.

5.2 CONCLUSIONS

Given that it has been noted that the Shire of Ashburton intends to entirely disturb Onslow Airport 01, the Thalanyji representatives and the authors are satisfied with the level of site recording undertaken to support the proposed Section 18 application, and believe that no further information can be garnered from the site that would help to address questions regarding the subsistence techniques used in the past or the timing of occupation along the coastal Pilbara.

Please note that the Onslow Airport Upgrade survey areas may be subject to negotiations between the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation under the *Native Title Act 1993*, and this report is not to be construed as providing any consents by the Buurabalayji Thalanyji Aboriginal Corporation for any land interests under the *Native Title Act 1993*.

Also note, there is an existing Heritage Agreement between the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation. According to this agreement, the results of all reports, advices and assessments are confidential to the parties, and are not to be disclosed to any other party without the consent of both the Shire of Ashburton and the Buurabalayji Thalanyji Aboriginal Corporation. This includes the State of Western Australia.

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APPENDIX 1: RECORDED SAMPLE SQUARE STATISTICS

	#	%		#	%
SAMPLE SQUARE 3 50K 304166mE 7602694mN			SAMPLE SQUARE 19 50K 304176mE 7602542mN		
ANADARA	0	0	ANADARA	1	25%
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	16	100%	TEREBRALIA	3	75%
TOTAL	16	100%	TOTAL	4	100%
SAMPLE SQUARE 4 50K 304198mE 7602694mN			SAMPLE SQUARE 21 50K 304152mE 7602523mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	5	100%	TEREBRALIA	Fragments only	
TOTAL	5	100%	TOTAL	0	100%
SAMPLE SQUARE 7 50K 304206mE 7602665mN			SAMPLE SQUARE 24 50K 304171mE 7602489mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	2	100%	TEREBRALIA	2	100%
TOTAL	2	100%	TOTAL	2	100%
SAMPLE SQUARE 9 50K 304188mE 7602638mN			SAMPLE SQUARE 26 50K 304146mE 7602474mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	Fragments only		TEREBRALIA	4	4
TOTAL	0	100%	TOTAL	4	100%
SAMPLE SQUARE 11 50K 304171mE 7602619mN			SAMPLE SQUARE 29 50K 304156mE 7602447mN		
ANADARA	0	0	ANADARA	1	6.7%
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	7	100%	TEREBRALIA	14	93.3%
TOTAL	7	100%	TOTAL	15	100%
SAMPLE SQUARE 14 50K 304186mE 7602590mN			SAMPLE SQUARE 31 50K 304138mE 7602421mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	Fragments only		TEREBRALIA	1	100%
TOTAL	0	100%	TOTAL	1	100%

	#	%		#	%
SAMPLE SQUARE 32 50K 304164mE 7602419mN			SAMPLE SQUARE 46 50K 304102mE 7602273mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	1	50%	OYSTER	0	0
TEREBRALIA	1	50%	TEREBRALIA	25	100%
TOTAL	2	100%	TOTAL	25	100%
SAMPLE SQUARE 34 50K 304146mE 7602391mN			SAMPLE SQUARE 49 50K 304099mE 7602249mN		
ANADARA	0	0	ANADARA	0	0
MELO	1	2%	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	49	98%	TEREBRALIA	5	100%
TOTAL	50	100%	TOTAL	5	100%
SAMPLE SQUARE 35 50K 304174mE 7602388mN			SAMPLE SQUARE 51 50K 304084mE 7602229mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	Fragments only		TEREBRALIA	2	100%
TOTAL	0	100%	TOTAL	2	100%
SAMPLE SQUARE 37 50K 304152mE 7602367mN			SAMPLE SQUARE 54 50K 304095mE 7602208mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	Fragments only		TEREBRALIA	1	100%
TOTAL	0	100%	TOTAL	1	100%
SAMPLE SQUARE 39 50K 304133mE 7602343mN			SAMPLE SQUARE 56 50K 304083mE 7602185mN		
ANADARA	0	0	ANADARA	2	18.2%
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	27	100%	TEREBRALIA	9	81.8%
TOTAL	27	100%	TOTAL	11	100%
SAMPLE SQUARE 44 50K 304117mE 7602295mN			SAMPLE SQUARE 59 50K 304093mE 7602159mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	11	100%	TEREBRALIA	Fragments only	
TOTAL	11	100%	TOTAL	0	100%

	#	%		#	%
SAMPLE SQUARE 61 50K 304074mE 7602134mN			SAMPLE SQUARE 69 50K 304092mE 7602054mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	3	100%	TEREBRALIA	5	100%
TOTAL	3	100%	TOTAL	5	100%
SAMPLE SQUARE 63 50K 304060mE 7602110mN			SAMPLE SQUARE 72 50K 304096mE 7602036mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	1	100%	TEREBRALIA	7	100%
TOTAL	1	100%	TOTAL	7	100%
SAMPLE SQUARE 64 50K 304090mE 7602110mN			SAMPLE SQUARE 74 50K 304081mE 7602014mN		
ANADARA	0	0	ANADARA	0	0
MELO	0	0	MELO	0	0
OYSTER	0	0	OYSTER	0	0
TEREBRALIA	22	100%	TEREBRALIA	6	100%
TOTAL	22	100%	TOTAL	6	100%
SAMPLE SQUARE 66 50K 304077mE 7602085mN					
ANADARA	0	0			
MELO	0	0			
OYSTER	0	0			
TEREBRALIA	5	100%			
TOTAL	5	100%			



Government of **Western Australia**
Department of **Fire & Emergency Services**



IN REPLY, PLEASE QUOTE
605-14-861

DFES UXO Services
EM & Hazard Planning
Telephone: (08) 9395 9541
E-Mail: Andrew.Arnold@dfes.wa.gov.au

HQ Management
PO Box 8787
Perth Business Centre WA 6849

Attention: Mr A Harvey

Dear Andrew

UNEXPLODED ORDNANCE HAZARD REDUCTION OPERATIONS: PART LOT 16 ONSLOW ROAD, ONSLOW – STAGES 1 & 2

I refer to condition 7a of the Western Australian Planning Commission's Condition of Development 147238 dated 7 April 2013.

Stages 1 & 2 as shown on Deposited Plan 161140 and attached TPG drawing of Subdivision Plan has been subjected to an extensive investigative search for unexploded ordnance by an accredited UXO Contractor to a standard where it is DFES UXO opinion that Condition 7a has now been met. As no evidence of explosive ordnance activity was located within the stage 1 & 2 area, it is also DFES UXO opinion that condition 7b and 7c are no longer applicable.

Despite the extensive search however, no guarantee can be given by this Office that the land is completely free from UXO. Should a known or suspected UXO be located during subdivision works or at any other time, it must be treated as dangerous, not handled or moved any further from its resting position and its location reported to the nearest Police as soon as possible.

A copy of a Warning concerning UXO is attached for your information.

Yours sincerely

Andrew Arnold
DFES UXO Liaison Officer
9 August 2013

Attachments:

1. Warning Concerning Unexploded Ordnance (UXO)
2. UXO endorsed copy of Deposited Plan 161140 (x 3 pages)



Government of Western Australia
Department of Fire & Emergency Services



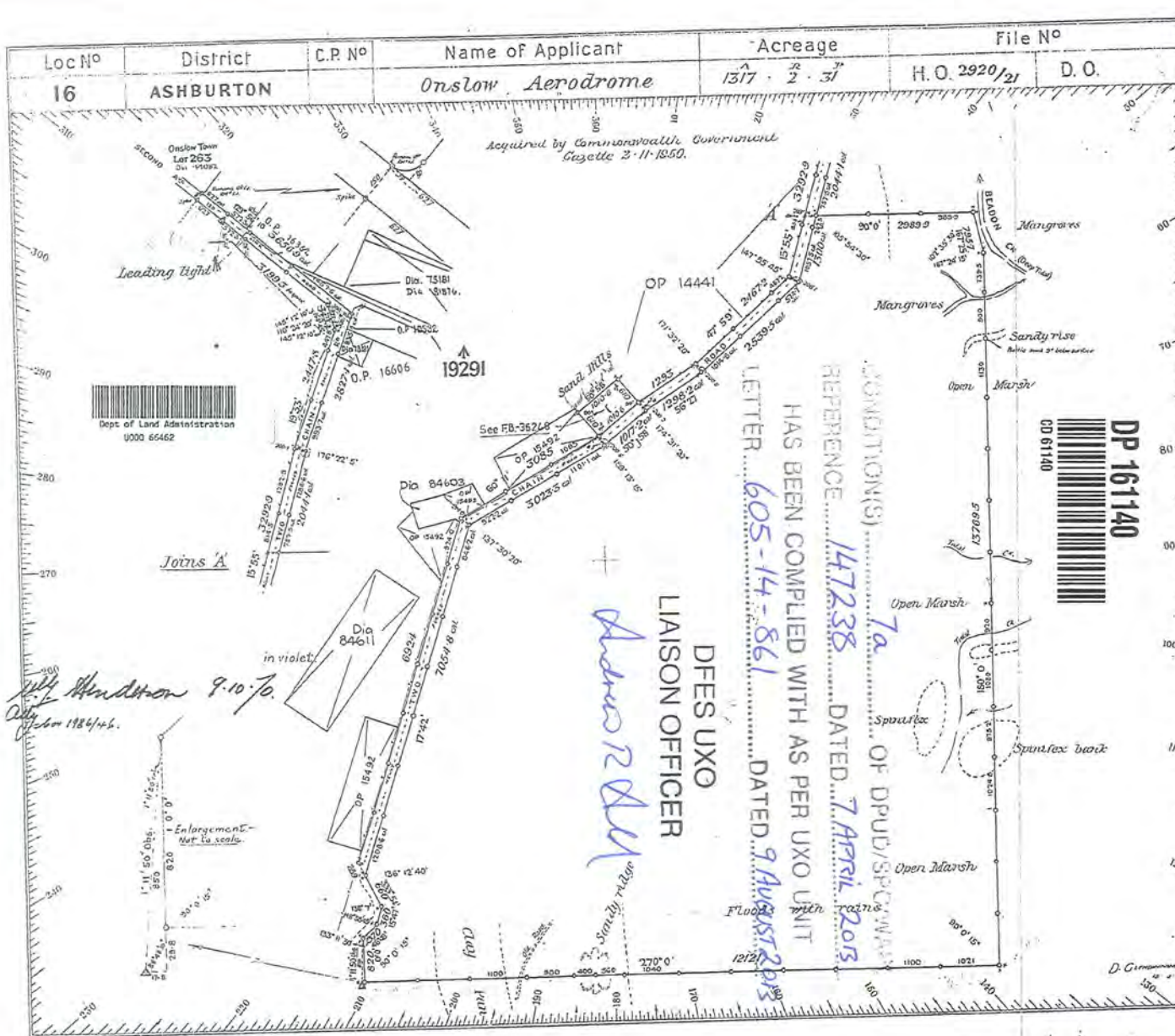
UXO Services 600-01-01

**WARNING CONCERNING UNEXPLODED ORDNANCE
(UXO)**

1. In most cases in Western Australia, any unexploded ordnance (UXO) likely to be found is of the form that is designed to kill or to maim. In most circumstances, it is very difficult for an untrained person to be able to determine if a UXO or a suspected UXO is dangerous or if it is harmless. All such objects must therefore be treated as dangerous unless or until proven otherwise.
2. UXO is ammunition, explosives and pyrotechnics such as artillery shells, mortar bombs, flares, TNT, gelignite and grenades of military origin that did not fully function when used or which was intentionally or inadvertently abandoned. Much of the UXO pollution in the State results from training during World War II and can still be dangerous for many decades, if not centuries, later.
3. Explosive ordnance to be found in non-training areas, such as storage and disposal sites, would not normally have been initiated or fired but it is, nevertheless, inherently dangerous, and is generally treated as UXO.
4. UXO may be found on or below the soil surface. Of the small percentage of artillery projectiles, mortars and aerial bombs which did not explode on impact, some will have penetrated the soil. In stable soil conditions, most of these are likely to be found within two metres of the natural ground surface with density increasing towards the surface. In unstable soil conditions, (for example in active sand dunes), UXO may lie at depths beyond the capacity of contemporary detecting equipment to locate.
5. There are no known cases of UXO exploding involuntarily. However, UXO can and have exploded in the following circumstances:
 - a. Movement/vibration (eg. when handled or being transported by vehicle);
 - b. Wilful tampering (eg. by a souvenir collector attempting to separate the components of the UXO);
 - c. Mechanical disturbance (eg. when ploughing, digging or cultivating); and
 - d. Increase in temperature (eg. bush fires).
6. If a UXO or suspected UXO is located, the following procedure should be adopted:
 - a. Do not disturb the site of the suspected UXO;
 - b. Without disturbing the immediate vicinity, clearly mark the site of the UXO;
 - c. Notify the Western Australia Police Service of the circumstances by the fastest possible means; and
 - d. Maintain a presence near the site until advised to the contrary by a member of the Western Australia Police Service or a member of the Defence Forces.

Revised November 2012

LANDDATE COPY OF ORIGINAL NOT TO SCALE THE JUN 13 13:47:30 2010 JOB 34648601



Azimuth observed at A (2)
 Or assumed from _____
 Date of marking July 1946
 Field Book No. 149 Page 1-4, 8-11
 Scale 1/6 chains to an inch
 Public Plan No. 95/300 Division _____

REFERENCE TO TREES.

Corner	Bearing	Distance in Links	No. and Mark on Tree	Description of Tree
A				
B				
C				
D				
E				
F				

SURVEYOR'S CERTIFICATE.

I hereby certify that this Survey was performed by me personally, (or under my own personal supervision, inspection and field check) in strict accordance with the Regulations for the Guidance of Surveyors, and that this plan is in all respects accurate.

Date 17-2-48 S. Blay
 Licensed Surveyor.

OFFICE REFERENCE.

Account No. _____ Passed _____
 Calculation Book No. 5 Fol. 31
 Chainage close N-15 E+2.6
 Angular close +0' 00"
 Area 1317.69375
 Compared with F.B. 162
 Examined S. Blay
 Diagram passed S. Blay
 Examiner of Plans

Date 7.6.1949

Survey approved _____
 Date 21.12.50 W. H. H. H.
 Surveyor General.

On D.O. Public Plan _____
 On Standard Plan _____
 On Public Plan _____
 On Compilation AS COMPILED

DIAGRAM No. 61140

Registered H. R. B. B. B. 18.3.47
Blay ON NEW PLAN

P161140

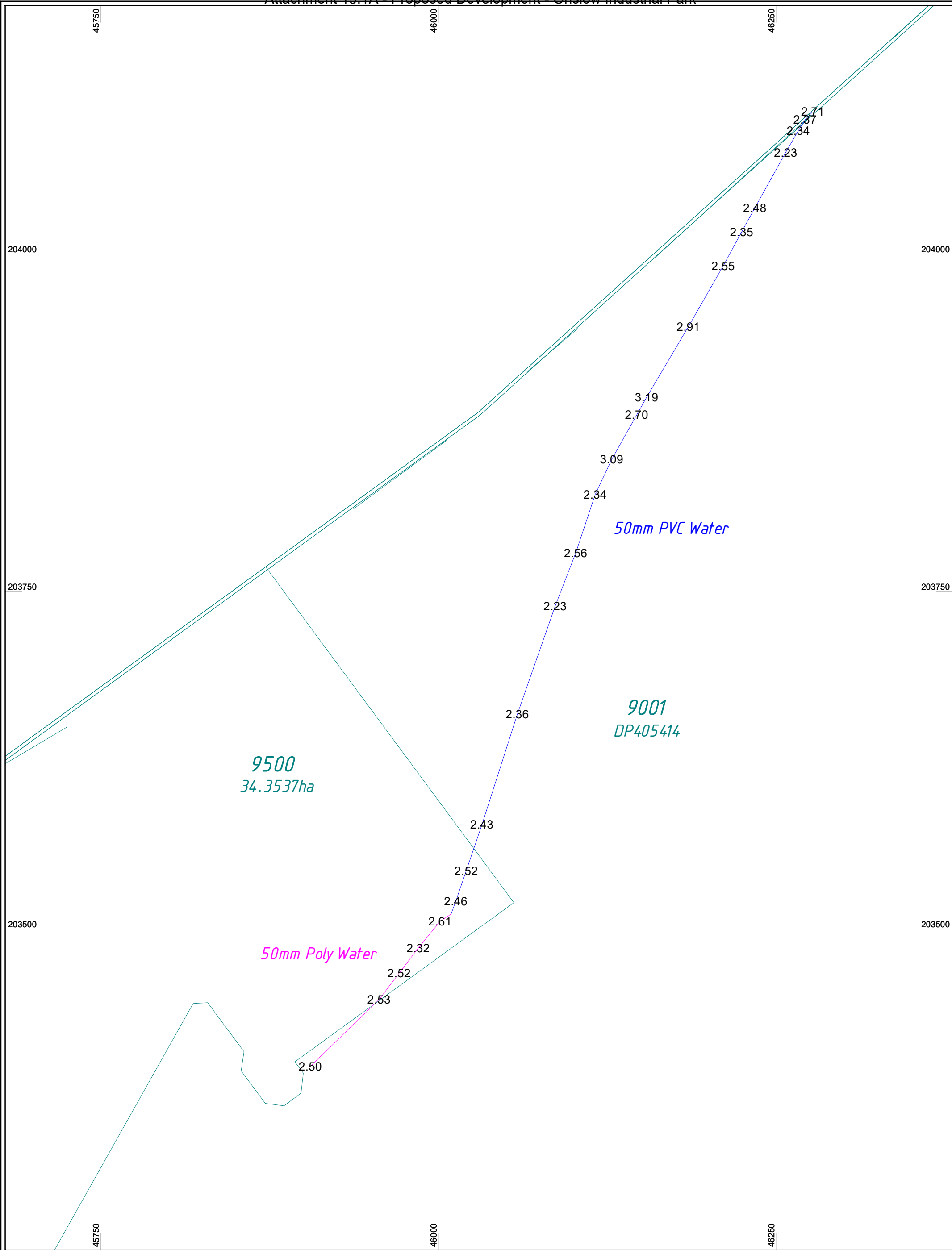
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16		2192/847		1			

CONDITION(S) 7a OF DPUD/SPC/WAPC
REFERENCE 147238 DATED 7 APRIL 2013

HAS BEEN COMPLIED WITH AS PER UXO UNIT
LETTER 605-14-861 DATED 9 AUGUST 2013





DFES UXO
LIAISON OFFICER

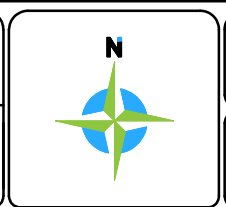


Rev.	Description	Drawn	Date	Checked
A	Initial Issue	DHI	19/02/2016	DHI

Surveyor:- NR
 Survey Date:- 12/02/2016
 Precal/Cad:- 19/02/2016

FS 565311 OSH 591267



ONSLOW AIRPORT
Potholing Survey


CLIENT:
SHIRE OF ASHBURTON

The contents of this plan are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

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 ALL DISTANCES ARE IN METRES
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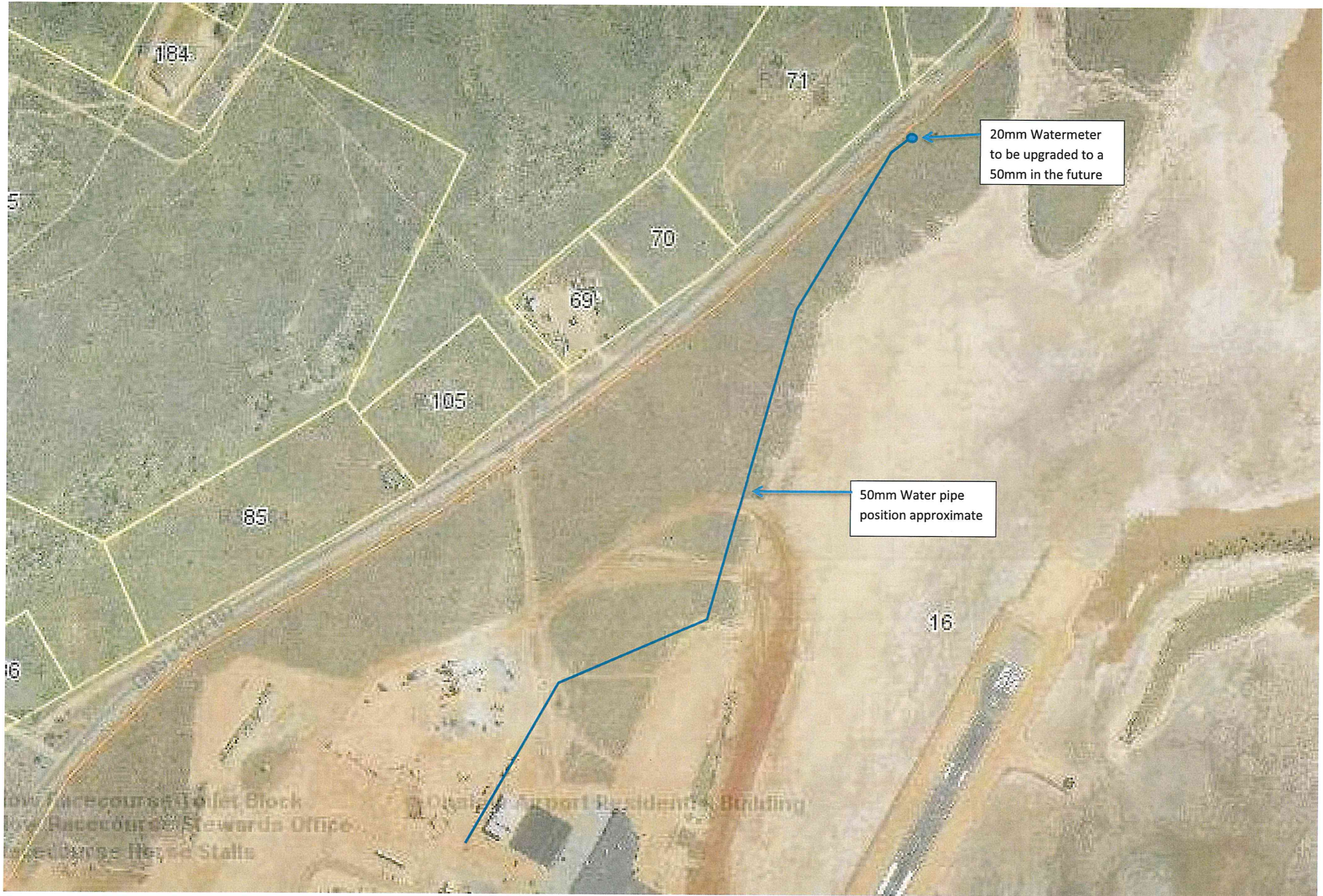
THIS SURVEY IS A CLASS 3 SURVEY (Hard Stand areas are to Class 2 all other areas are Class 3)
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 Class 2: Horizontal Accuracy ± 20mm, Vertical Accuracy ± 20mm
 Class 3: Horizontal Accuracy ± 30mm, Vertical Accuracy ± 50mm

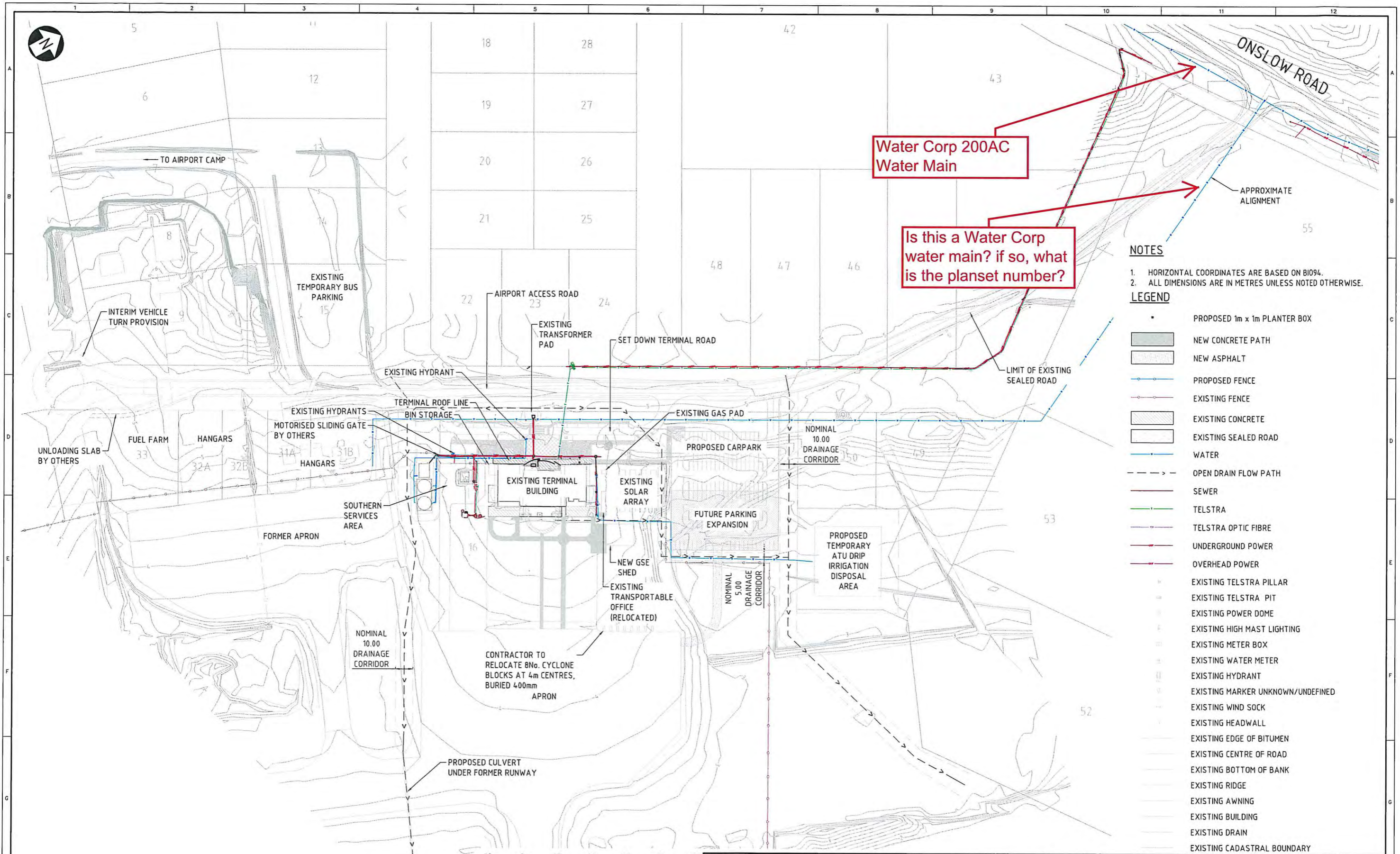
528


MNG
 MCMULLEN NOLAN GROUP
 Level 1, 2 Sabre Crescent
 Jandakot, W.A. 6164
 PO Box 3526, Success
 W.A. 6964, Australia
 Offices in: Broome, Bunbury, Kununurra, Newman, Onslow, Port Hedland

Tel: (08) 6436 1599
 Fax: (08) 6436 1500
 info@mngsurvey.com.au
 www.mngsurvey.com.au
 ABN 90 009 363 311

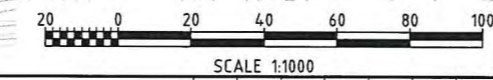
Project Mng:	DAN HITCHEN	Datum	BIG94 / AHD
99697 - DE - 008 - A		Job Number	Plan Number
Revision			





- NOTES**
- HORIZONTAL COORDINATES ARE BASED ON BIO94.
 - ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

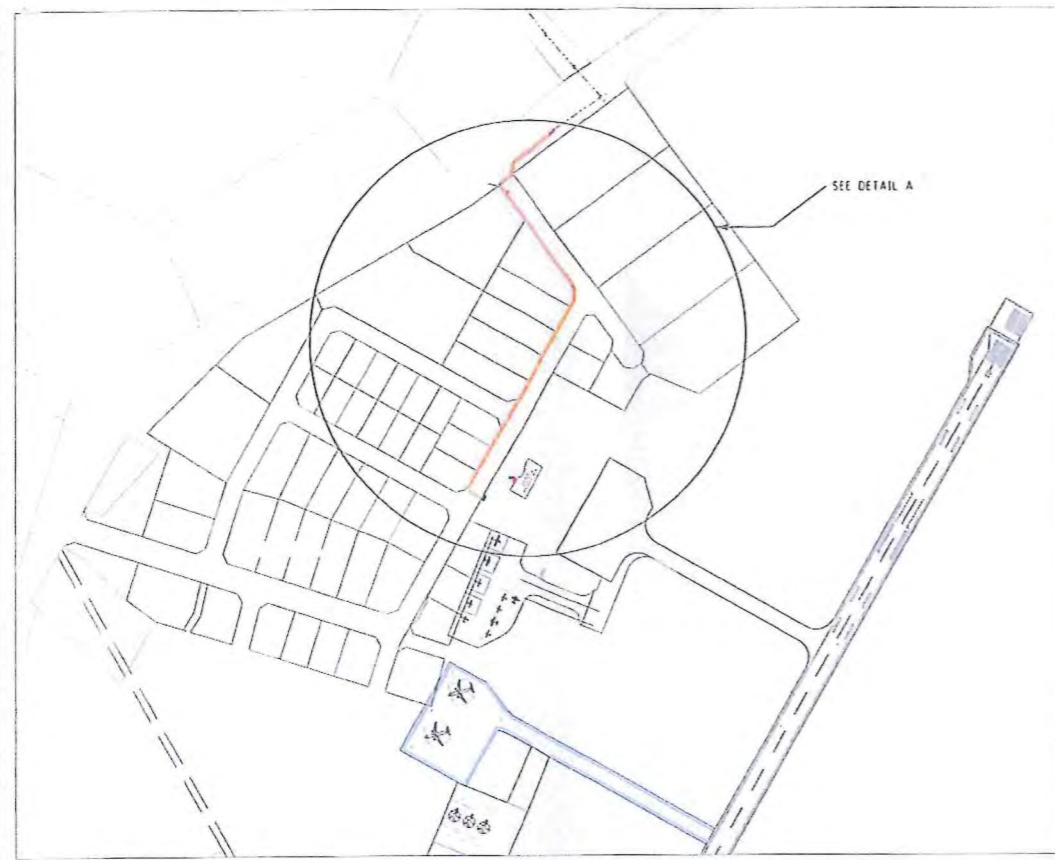
- LEGEND**
- PROPOSED 1m x 1m PLANTER BOX
 - NEW CONCRETE PATH
 - NEW ASPHALT
 - PROPOSED FENCE
 - EXISTING FENCE
 - EXISTING CONCRETE
 - EXISTING SEALED ROAD
 - WATER
 - OPEN DRAIN FLOW PATH
 - SEWER
 - TELSTRA
 - TELSTRA OPTIC FIBRE
 - UNDERGROUND POWER
 - OVERHEAD POWER
 - EXISTING TELSTRA PILLAR
 - EXISTING TELSTRA PIT
 - EXISTING POWER DOME
 - EXISTING HIGH MAST LIGHTING
 - EXISTING METER BOX
 - EXISTING WATER METER
 - EXISTING HYDRANT
 - EXISTING MARKER UNKNOWN/UNDEFINED
 - EXISTING WIND SOCK
 - EXISTING HEADWALL
 - EXISTING EDGE OF BITUMEN
 - EXISTING CENTRE OF ROAD
 - EXISTING BOTTOM OF BANK
 - EXISTING RIDGE
 - EXISTING AWNING
 - EXISTING BUILDING
 - EXISTING DRAIN
 - EXISTING CADASTRAL BOUNDARY



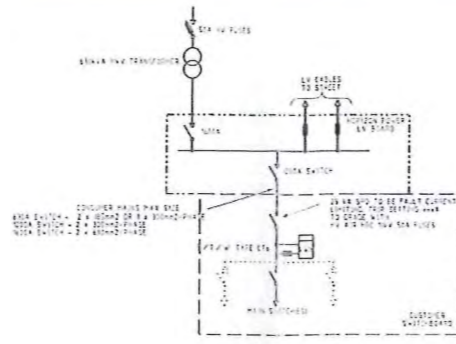
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001-CI-DRG-0002	OVERALL SITE LAYOUT	B	28JAN15	ISSUED FOR TENDER		KT	AH	RE	SE		
		A	09JAN15	ISSUED FOR REVIEW		KT	RE	SE			

CLIENT	SHIRE OF ASHBURTON					
PROJECT	ONSLow AIRPORT INFRASTRUCTURE UPGRADE					
 Lycopodium Infrastructure Pty Ltd ABN: 57 136 875 959 Level 4, 1 Adelaide Terrace, East Perth, Western Australia 6004 T: +61(0) 8 6210 5222 www.lycopodium.com.au						
DRAWN	CHECKED	DESIGN ENG.	LEAD ENG.	DESIGN APP'D	PROJ. APP'D	CLIENT APP'D
DRAWING TITLE ONSLow AIRPORT INFRASTRUCTURE UPGRADE AS CONSTRUCTED PLAN						
SCALE	1:1000	JOB No.	2520	DRG No.	001-CI-DRG-0016	REV.
DRAWN	KT	DATE	18DEC14			B

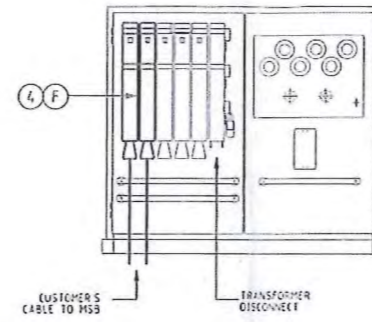
SAFETY - MAKE IT YOUR PRIMARY VALUE



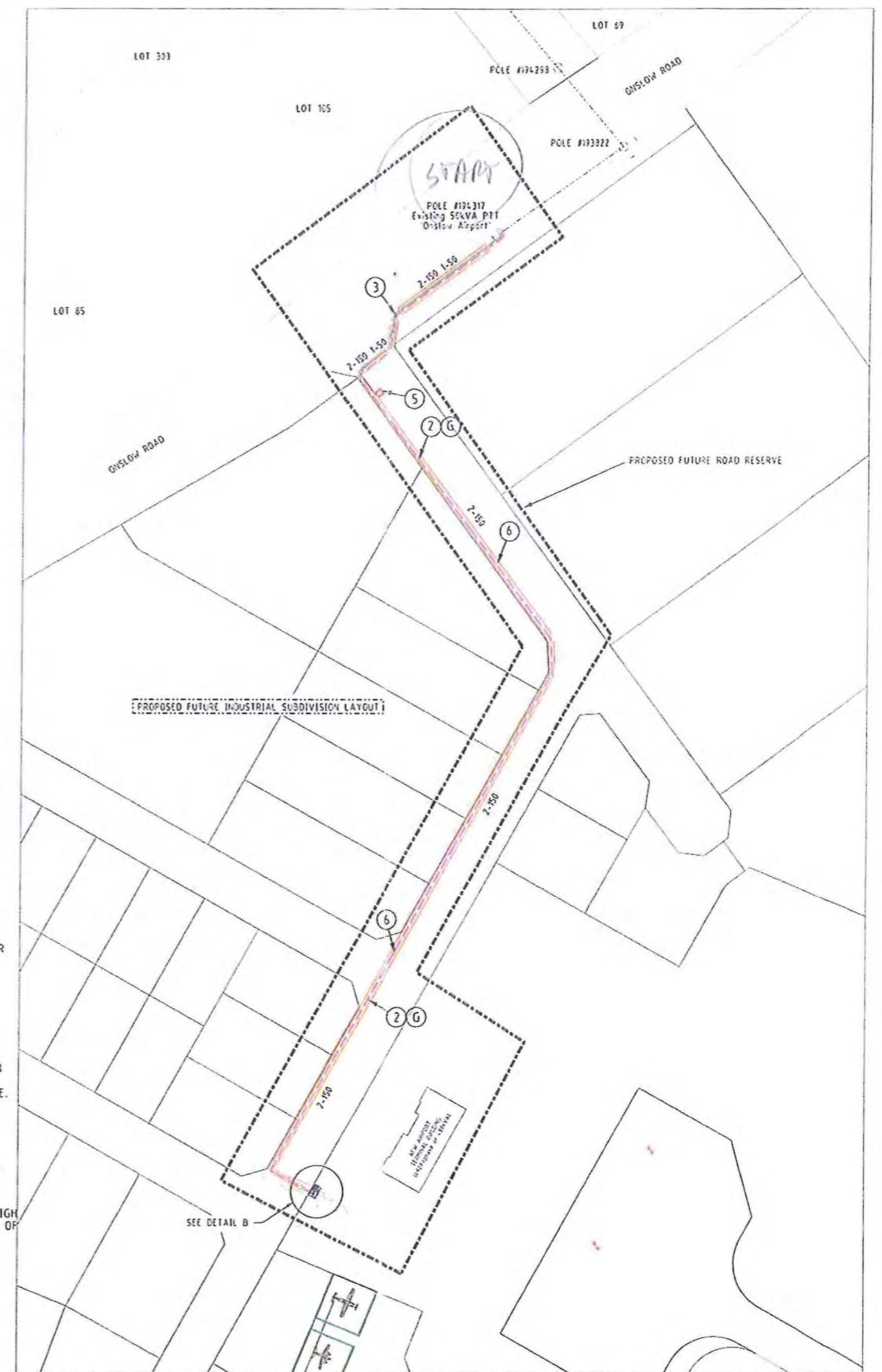
SITE LOCATION PLAN
SCALE 1:5000



SINGLE LINE DIAGRAM



DETAIL C
MPS & LV FRAME
LOT 16 ONSLOW ROAD, ONSLOW
(FINAL ARRANGEMENT)

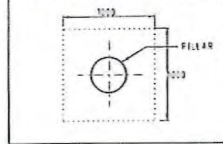


DETAIL A
CABLE ROUTE DETAILS
SCALE 1:500

HORIZON POWER SCOPE OF WORK

- INSTALL 11kV 630kVA MPS SUBSTATION TO DSM-3-02 AS NOTED ON DRAWING WITH 2x1 SWITCHGEAR
CU = M02L, 630, 11 x 1, M055 x 1, M075 x 1, M08 x 1
- INSTALL & TERMINATE 400V CABLE FROM EXISTING POLE 194317 TO NEW 630kVA MPS SUBSTATION.
CU = C053 x 800m, M076 x 1
- INSTALL & TERMINATE 251V CABLE FROM EXISTING POLE 194317 TO MINI PILLAR. MINI PILLAR TO SUPPLY SWVA FOR TELSTRA ROADSIDE CABINET.
CU = C042 x 135m, L045L, 75, 81 x 1
- CUSTOMERS SUPPLY IS IN EXCESS OF 400 AMPS. TWO LV SWITCHES TO BE REPLACED WITH 1200A SWITCH FOR CUSTOMERS POINT OF SUPPLY.
CU = L048 x 1
- INSTALL MINI PILLAR AS PER ZONE EXCLUSION DETAIL.
CU = L010 x 1
- STRAIGHT JOINT 400 HV CABLES
CU = M072 x 2

PILLAR EXCLUSION ZONE DETAIL

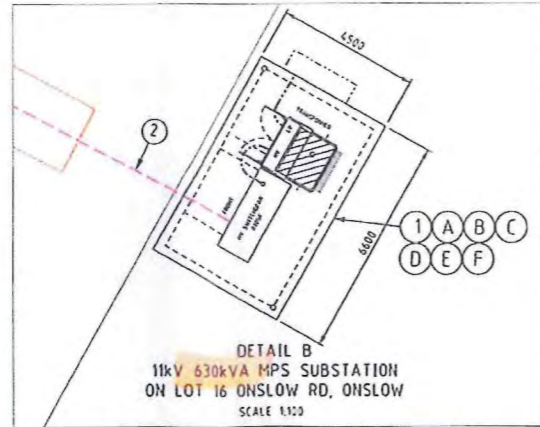


WARNING
IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES CONTRACTOR TO COMPLY WITH "WORKSAFE" CLEARANCES DURING CONSTRUCTION

WARNING
DIAL1100 BEFORE YOU DIG
BEFORE OF UNDERGROUND SERVICES
For clarity, the location of existing underground cables are not shown. Underground cable locations must be checked on site. Locate all underground assets and services before commencement of work. Refer to Worksafe Regulation 224.

RESTORATION & REINSTATEMENT REQUIREMENTS
Restoration & reinstatement required for this project to be completed as per the Restoration and Reinstatement Specification for Local Councils in WA. The Construction Manager is responsible for all restoration and reinstatement work formally accepted by Horizon Power or Local Govt Authority as appropriate. See Field Instruction 224.

INSTRUCTION TO CONSTRUCTION CREWS
IT IS A REQUIREMENT OF HORIZON POWER THAT ALL EXISTING CONDUCTOR / CABLES SIZES ARE CONFIRMED ON SITE TO ENSURE THAT ALL FITTINGS ARE OF THE APPROPRIATE SIZE AND ARE INSTALLED CORRECTLY IN ACCORDANCE TO HORIZON STANDARDS. EG. MECHANICAL TERMINATIONS, TIES, PG CLAMPS, LUGS, ETC



DETAIL B
11kV 630kVA MPS SUBSTATION
ON LOT 16 ONSLOW RD, ONSLOW
SCALE 1:100

CUSTOMER INFORMATION / SCOPE OF WORK

- SUBSTATION SITE WILL BE PREPARED AS PER THE WESTERN AUSTRALIAN DISTRIBUTION CONNECTIONS MANUAL CLAUSE 14.4.3. THIS INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:
1. PEGGING, COMPACTION AND LEVELLING.
2. LOCATED 1m ABOVE 100 YEAR FLOOD LEVEL AND NOT IN A PRECARIOUS POSITION.
3. CLEAR OF ALL SERVICES.
4. CLEAN SAND FILL TO A DEPTH OF 1m IN SANDY SOILS TO A DEPTH OF 1.6m IN CLAY OR ROCK
- CUSTOMER TO ENSURE CONDUCTIVE FENCE WITHIN 2 METRES OF SUBSTATION SITE IS RELOCATED PRIOR TO THE COMMENCEMENT OF THE WORK.
- SUBSTATION TO BE DESIGNED TO MINIMUM DIMENSIONS SHOWN ON THE DRAWING AND IN-CONJUNCTION WITH HORIZON POWER'S DRAWING DSM-3-02
- IF THE CUSTOMER PROPOSES TO INSTALL SCREENING, APPROVAL SHALL BE OBTAINED FROM HORIZON POWER PRIOR TO ITS INSTALLATION. THE SCREENING SHALL BE INSTALLED ONLY AFTER HORIZON POWER HAS COMPLETED ALL OF THE WORK ON THE SUBSTATION SITE. REFER TO THE WESTERN AUSTRALIAN DISTRIBUTION CONNECTIONS MANUAL CLAUSES 14.4.8 AND 14.5.4 FOR DETAILS.
- NO BUILDINGS ALLOWED WITHIN 6m OF THE SUBSTATION UNLESS 2 HOUR FIRE RATED. SEE HORIZON POWER DRAWING DSM-5-01 FOR DETAILS.
- CUSTOMERS 691.4 AMP POINT OF SUPPLY WILL BE AT 1200A LV SWITCH IN TRANSFORMER.
- A MINIMUM 2 METRE WIDE CABLE EASEMENT IS REQUIRED FOR ENTIRE ROUTE LENGTH OF HIGH VOLTAGE CABLE IN PRIVATE PROPERTY. ALL ASSOCIATED COSTS ARE THE RESPONSIBILITY OF CUSTOMER. EASEMENT TO BE DEFINED PRIOR TO CONSTRUCTION COMMENCES.

LEGEND

POLES	○
EXISTING POLE	○
CONDUCTOR	—
EXISTING OVERHEAD	---
CABLE	—
400mm ² HV	—
25mm ² LV	—

GENERAL NOTES FOR CPM

- CPM TO ENSURE WORK IS CARRIED OUT AS PER FIPSM AND DCM MANUALS
- CPM TO LIAISE WITH CONTRACTOR/CUSTOMER TO NEGOTIATE INSTALLATION DATE
- CPM TO CONFIRM SPD PROTECTION SETTINGS GRADE WITH HORIZON POWER PROTECTIVE DEVICES



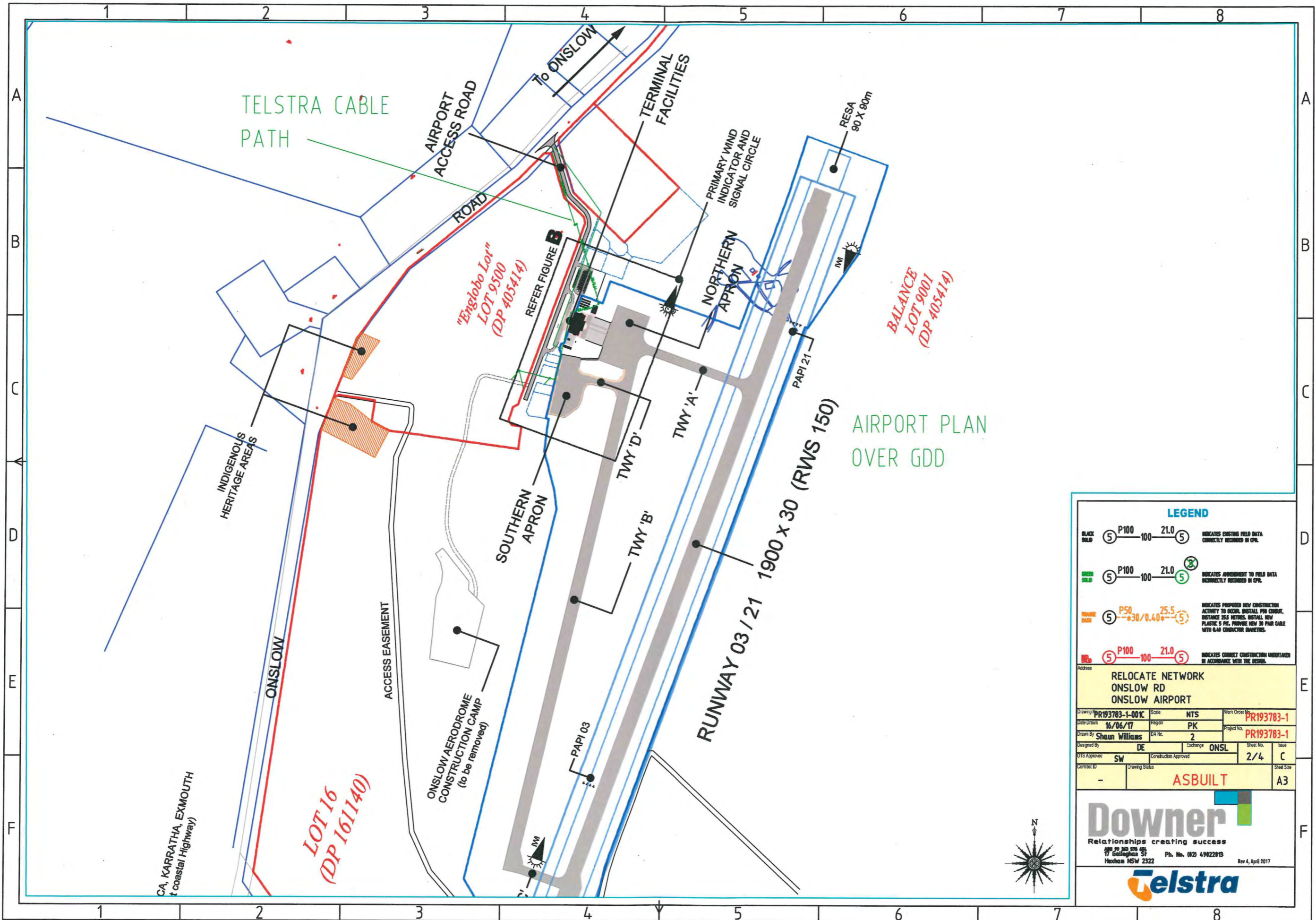
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CONTACT DETAILS
CUSTOMER CONTACT DETAILS
COMPANY NAME: SHIRE OF ASHBURTON
CONTACT: RICHARD REPSEVICIUS
PHONE NUMBER: 08 9181 333
042 771 0347

CONSULTANT CONTACT DETAILS
COMPANY NAME: APD
CONTACT: BRAWNY LAH
PHONE NUMBER: 08 9242 1559

DRAWING TITLE GAP0090 - SHIRE OF ASHBURTON - 691.4A SUPPLY TO ONSLOW AIRPORT TERMINAL, LOT 16 ONSLOW ROAD, ONSLOW		HORIZON POWER PROJECT NUMBER GAP0090	SCALE: AS INDICATED @ A1 REVISION A
DESIGNER: PHIL FRISCHA TEL: 0427730514	DATE: 28/03/2014	SHEET 1 OF 1 ORIGINAL SIZE - A1	
Lot: * * * * * S Long: * * * * * E	MAP REF: GRID REF:		





LEGEND

- BLACK FIELD (Symbol: P100-100-21.0) INDICATES EXISTING FIELD DATA CORRECTLY RECORDED IN CPL.
- GREEN FIELD (Symbol: P100-100-21.0) INDICATES AMENDMENT TO FIELD DATA INCORRECTLY RECORDED IN CPL.
- BROWN FIELD (Symbol: P50-30/0.40-25.5) INDICATES PROPOSED NEW CONSTRUCTION ACTIVITY TO OCCUR. INSTALL P50 CONDUIT, INSTALLED 255 METRES. INSTALL NEW PLASTIC 5 PVC. PROVIDE NEW 30 PAIR CABLE WITH 0.40 CONDUCTIVE BUNDLES.
- RED FIELD (Symbol: P100-100-21.0) INDICATES CORRECT CONSTRUCTION UNDERWAY OR IN ACCORDANCE WITH THE DESIGN.

Address: **RELOCATE NETWORK
ONSLOW RD
ONSLOW AIRPORT**

Drawing No. PR193783-1-001C	Scale: NTS	Work Order No. PR193783-1
Date Drawn: 16/06/17	Region: PK	Project No. PR193783-1
Drawn By: Shaun Williams	DA No. 2	
Designed By: DE	Exchange: ONSL	Sheet No. 2/4
DTS Approved: Sw	Construction Approved:	Issue: C
Contract ID: -	Contract Status:	Sheet Size: A3

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Relationships creating success
170 Pitt Street Sydney NSW 2000 Ph. No. (02) 49022913
Hexham NSW 2322 Rev 4, April 2017

Telstra

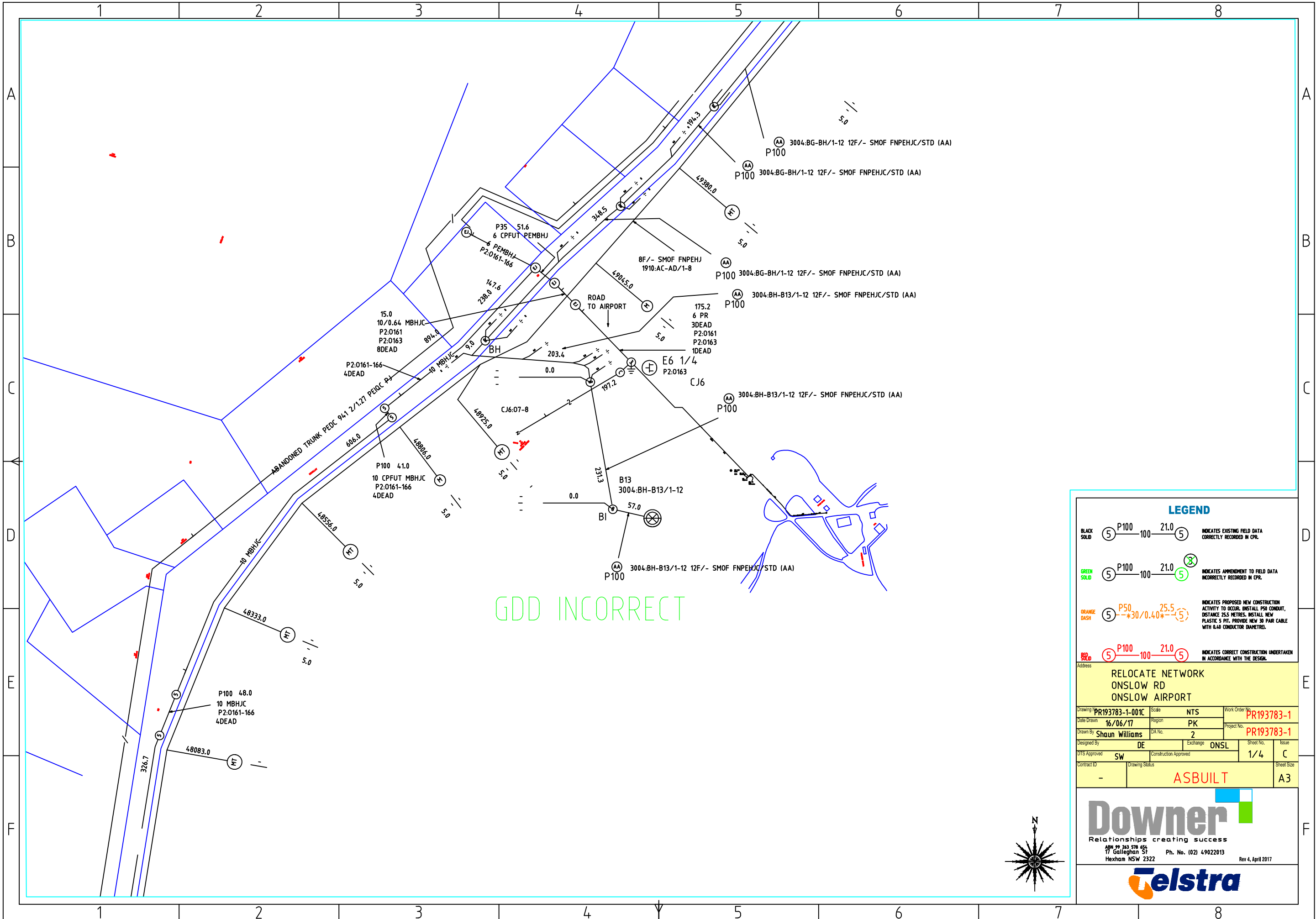


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2/1/2022

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GDD INCORRECT

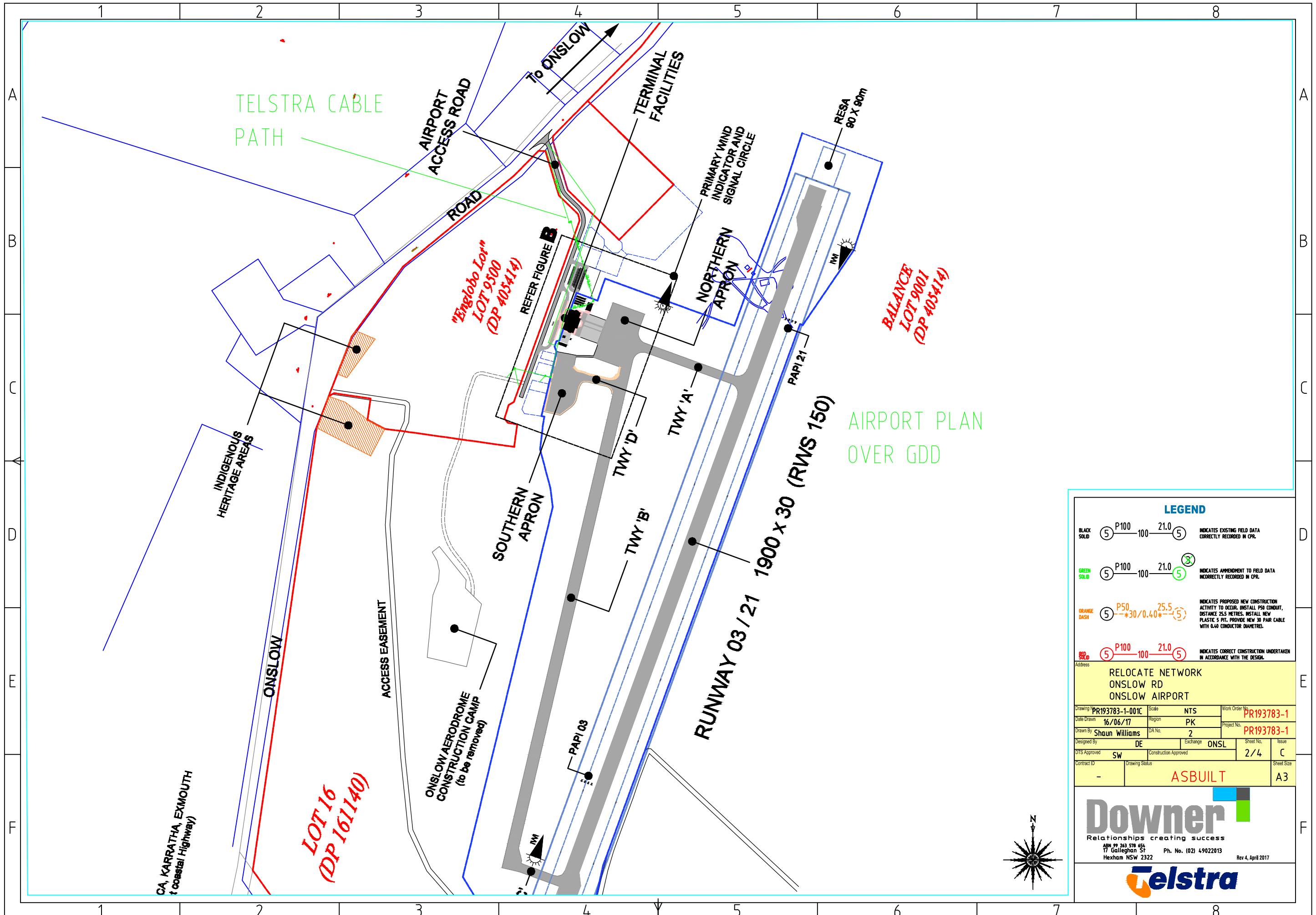
LEGEND

- BLACK SOLID (5) P100 100 21.0 (5) INDICATES EXISTING FIELD DATA CORRECTLY RECORDED IN CPR.
- GREEN SOLID (5) P100 100 21.0 (5) INDICATES AMPLIFICATION TO FIELD DATA INCORRECTLY RECORDED IN CPR.
- ORANGE DASH (5) P50 30/0.40* 25.5 (5) INDICATES PROPOSED NEW CONSTRUCTION ACTIVITY TO OCCUR. INSTALL 30 CONDUIT, DISTANCE 25.5 METRES. INSTALL NEW PLASTIC 5 PIT. PROVIDE NEW 30 PAIR CABLE WITH 0.40 CONDUCTOR DIAMETER.
- RED (5) P100 100 21.0 (5) INDICATES CORRECT CONSTRUCTION UNDERTAKEN IN ACCORDANCE WITH THE DESIGN.

Address			
RELOCATE NETWORK ONSLow RD ONSLow AIRPORT			
Drawing	PR193783-1-001C	Scale	NTS
Date Drawn	16/06/17	Region	PK
Drawn By	Shaun Williams	DR No.	2
Designed By	DE	Exchange	ONSL
DTS Approved	SW	Construction Approved	
Contract ID	-	Drawing Status	
Work Order No.	PR193783-1	Project No.	PR193783-1
Sheet No.	1/4	Issue	C
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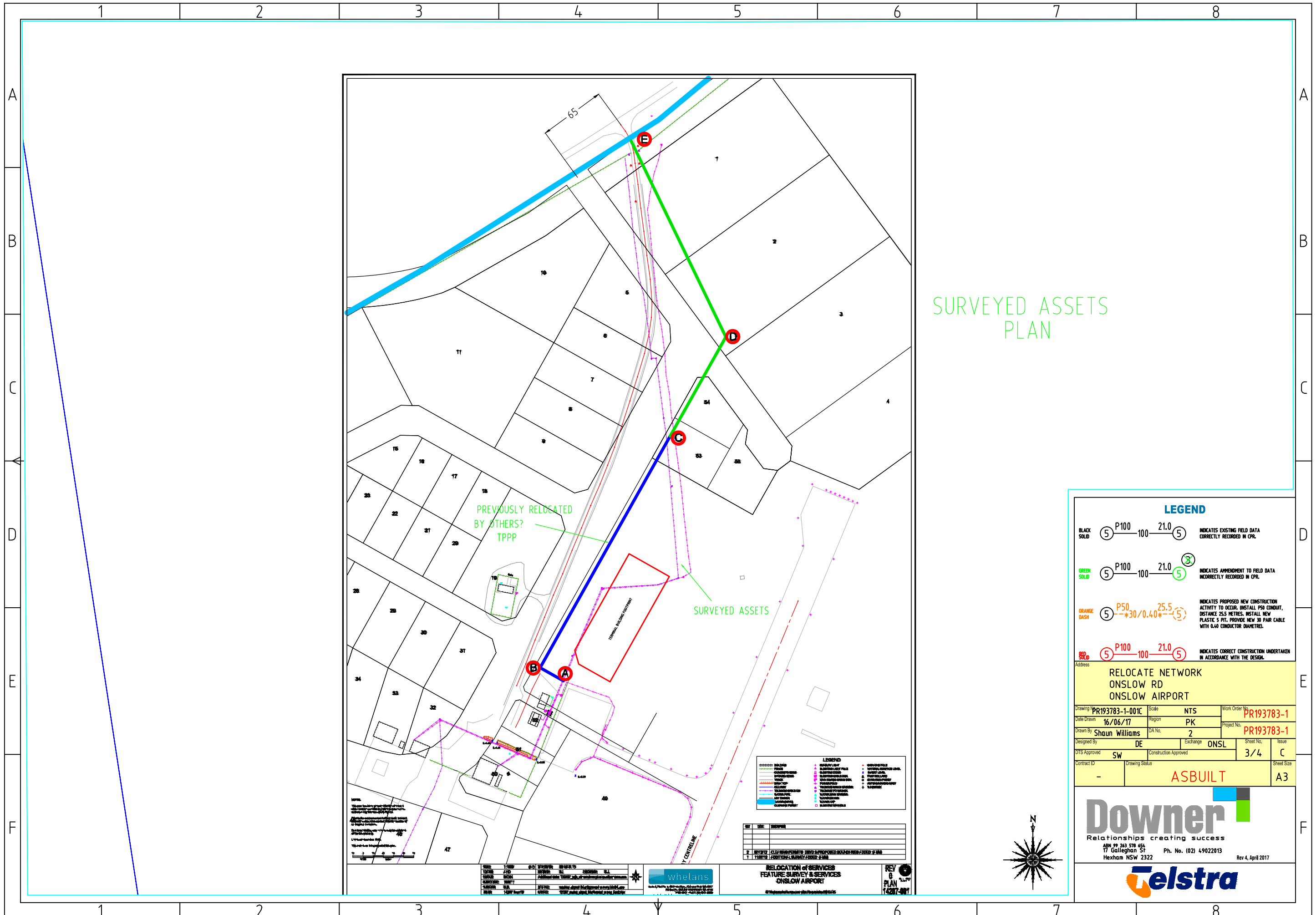
LEGEND

- BLACK SOLID (5) P100 100 21.0 (5) INDICATES EXISTING FIELD DATA CORRECTLY RECORDED IN CPR.
- GREEN SOLID (5) P100 100 21.0 (5) INDICATES AMPLIFICATION TO FIELD DATA INCORRECTLY RECORDED IN CPR.
- ORANGE DASH (5) P50 25.5 25.5 (5) INDICATES PROPOSED NEW CONSTRUCTION ACTIVITY TO OCCUR. INSTALL P50 CONDUIT, DISTANCE 25.5 METRES. INSTALL NEW PLASTIC 5 PIT. PROVIDE NEW 30 PAIR CABLE WITH 0.40 CONDUCTOR DIAMETER.
- RED SOLID (5) P100 100 21.0 (5) INDICATES CORRECT CONSTRUCTION UNDERTAKEN IN ACCORDANCE WITH THE DESIGN.

Address			
RELOCATE NETWORK ONSLow RD ONSLow AIRPORT			
Drawing	PR193783-1-001C	Scale	NTS
Date Drawn	16/06/17	Region	PK
Drawn By	Shaun Williams	DR No.	2
Designed By	DE	Exchange	ONSL
DTS Approved	SW	Construction Approved	
Contract ID	-	Sheet No.	2/4
Drawing Status		Issue	C
ASBUILT			Sheet Size
			A3

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Rev 4, April 2017

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SURVEYED ASSETS PLAN

LEGEND

- BLACK SOLID (5) P100 100 21.0 (5) INDICATES EXISTING FIELD DATA CORRECTLY RECORDED IN CPR.
- GREEN SOLID (5) P100 100 21.0 (5) INDICATES AMPLIFICATION TO FIELD DATA INCORRECTLY RECORDED IN CPR.
- ORANGE DASH (5) P50 30/0.40* 25.5 (5) INDICATES PROPOSED NEW CONSTRUCTION ACTIVITY TO OCCUR. INSTALL P50 CONDUIT, DISTANCE 25.5 METRES. INSTALL NEW PLASTIC 5 PIT. PROVIDE NEW 30 PAIR CABLE WITH 0.40 CONDUCTOR DIAMETRE.
- RED SOLID (5) P100 100 21.0 (5) INDICATES CORRECT CONSTRUCTION UNDERTAKEN IN ACCORDANCE WITH THE DESIGN.

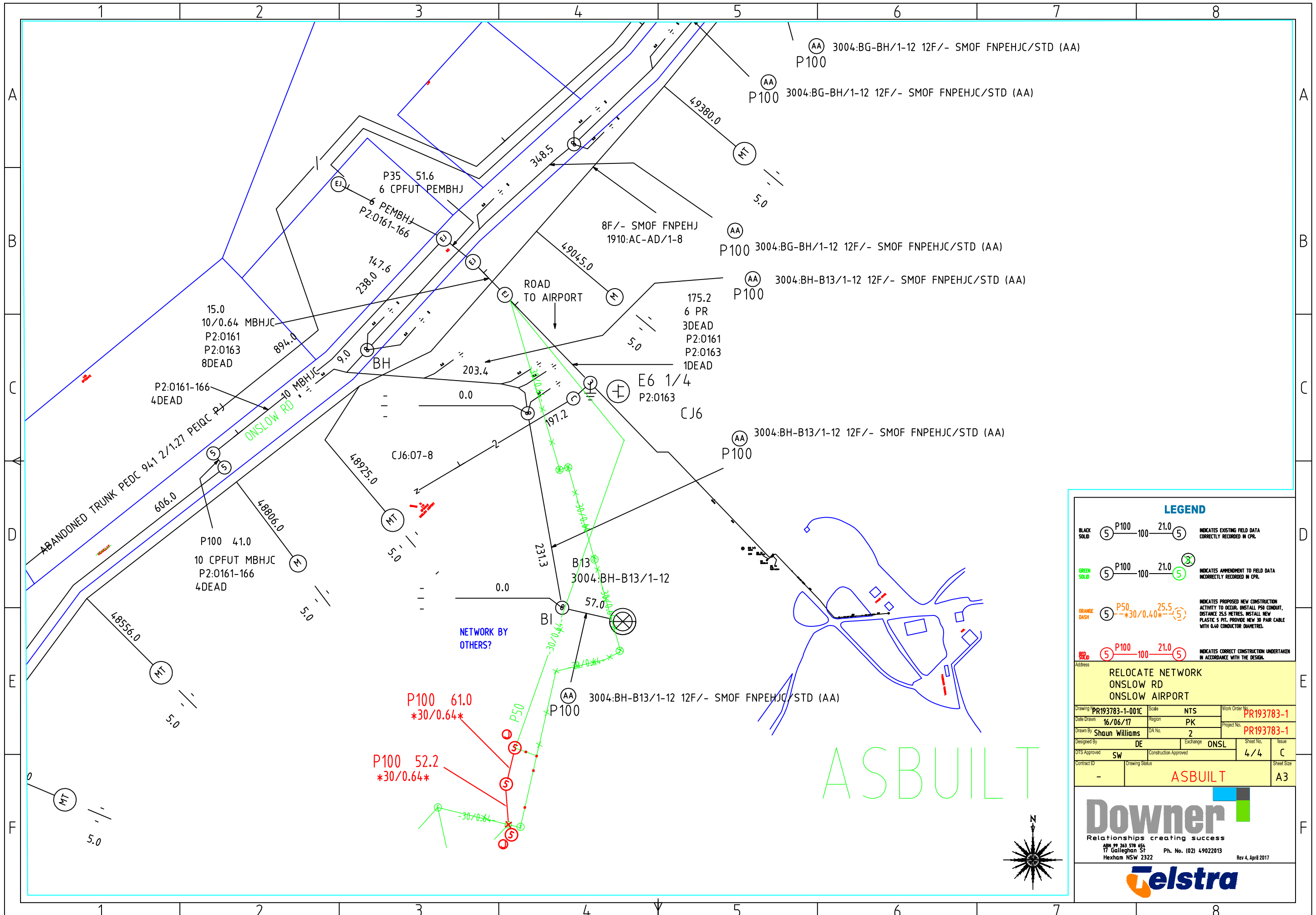
Address
**RELOCATE NETWORK
 ONSLOW RD
 ONSLOW AIRPORT**

Drawing No. PR193783-1-001C	Scale NTS	Work Order No. PR193783-1
Date Drawn 16/06/17	Region PK	Project No. PR193783-1
Drawn By Shaun Williams	DR No. 2	
Designed By DE	Exchange ONSL	Sheet No. 3/4
DTS Approved SW	Construction Approved	Issue C
Contract ID -	Drawing Status	Sheet Size A3

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 ABN 99 243 578 454
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LEGEND

- BLACK SOLID (5) P100 100 21.0 (5) INDICATES EXISTING FIELD DATA CORRECTLY RECORDED IN CPR.
- GREEN SOLID (5) P100 100 21.0 (5) INDICATES AMPLEMENT TO FIELD DATA INCORRECTLY RECORDED IN CPR.
- ORANGE DASH (5) P50 30/0.40* 25.5 (5) INDICATES PROPOSED NEW CONSTRUCTION ACTIVITY TO OCCUR. INSTALL P50 CONDUIT, DISTANCE 25.5 METRES. INSTALL NEW PLASTIC 5 PIT. PROVIDE NEW 30 PAIR CABLE WITH 0.40 CONDUCTOR DIAMETRE.
- 80% (5) P100 100 21.0 (5) INDICATES CORRECT CONSTRUCTION UNDERTAKEN IN ACCORDANCE WITH THE DESIGN.

Address			
RELOCATE NETWORK ONSLow RD ONSLow AIRPORT			
Drawing	PR193783-1-001C	Scale	NTS
Date Drawn	16/06/17	Region	PK
Drawn By	Shaun Williams	DR No.	2
Designed By	DE	Exchange	ONSL
DTS Approved	SW	Construction Approved	
Contract ID	-	Sheet No.	4/4
Drawing Status		Issue	C
		ASBUILT	
		A3	

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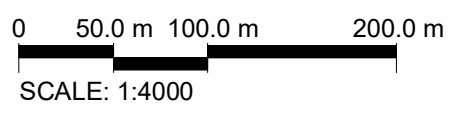
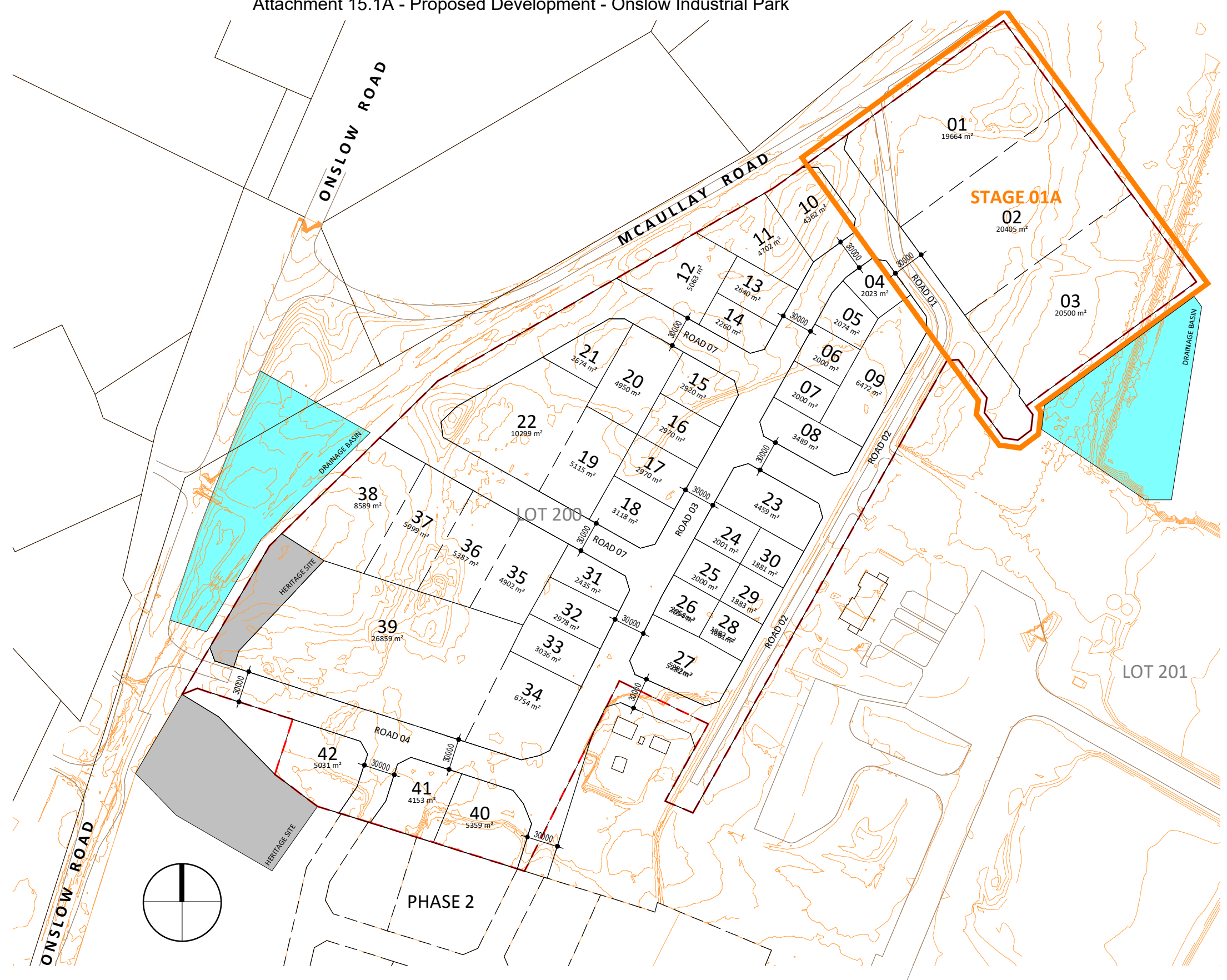
Attachment 15.1A - Proposed Development - Onslow Industrial Park

SUMMARY	
ORIGINAL NUMBER OF LOTS	2
PROPOSED NUMBER OF LOTS	42
AREA OF LOT 200	32.2950ha
EXISTING AREA OF LOT 201	496.7869ha

EXISTING LOT BOUNDARY	---
PHASE 2 FUTURE SUBDIVISION	---

LOT AREAS SCHEDULE

LOT NUMBER	AREA
01	19664 m ²
02	20405 m ²
03	20500 m ²
04	2023 m ²
05	2074 m ²
06	2000 m ²
07	2000 m ²
08	3489 m ²
09	6472 m ²
10	4362 m ²
11	4702 m ²
12	5063 m ²
13	2640 m ²
14	2260 m ²
15	2920 m ²
16	2970 m ²
17	2970 m ²
18	3118 m ²
19	5115 m ²
20	4950 m ²
21	2674 m ²
22	10299 m ²
23	4459 m ²
24	2001 m ²
25	2000 m ²
26	2054 m ²
27	5282 m ²
28	1882 m ²
29	1883 m ²
30	1881 m ²
31	2435 m ²
32	2978 m ²
33	3036 m ²
34	6754 m ²
35	4902 m ²
36	5387 m ²
37	5999 m ²
38	8589 m ²
39	26859 m ²
40	5359 m ²
41	4153 m ²
42	5031 m ²
HERITAGE AREA	4952 m ²
ROAD RESERVE	82406 m ²
TOTAL AREA	322950 m ²



1 00 - CONCEPT SUBDIVISION LAYOUT
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No.	Description	Date
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Project Name
ONSLow INDUSTRIAL PARK
CONCEPT SUBDIVISION PLAN

CONCEPT SUBDIVISION LAYOUT		
Project number	0105-22	Sheet Number
Date	07 JULY 2022	Current Revision
Drawn by	LN	A101
Checked by	LN	0
Sca/As indicated ON A3 SHEET		

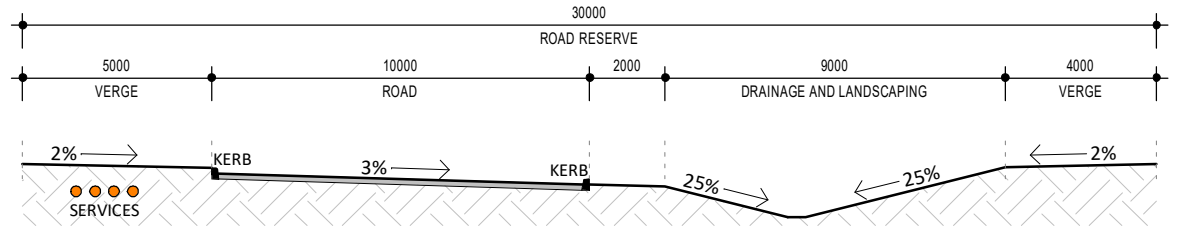
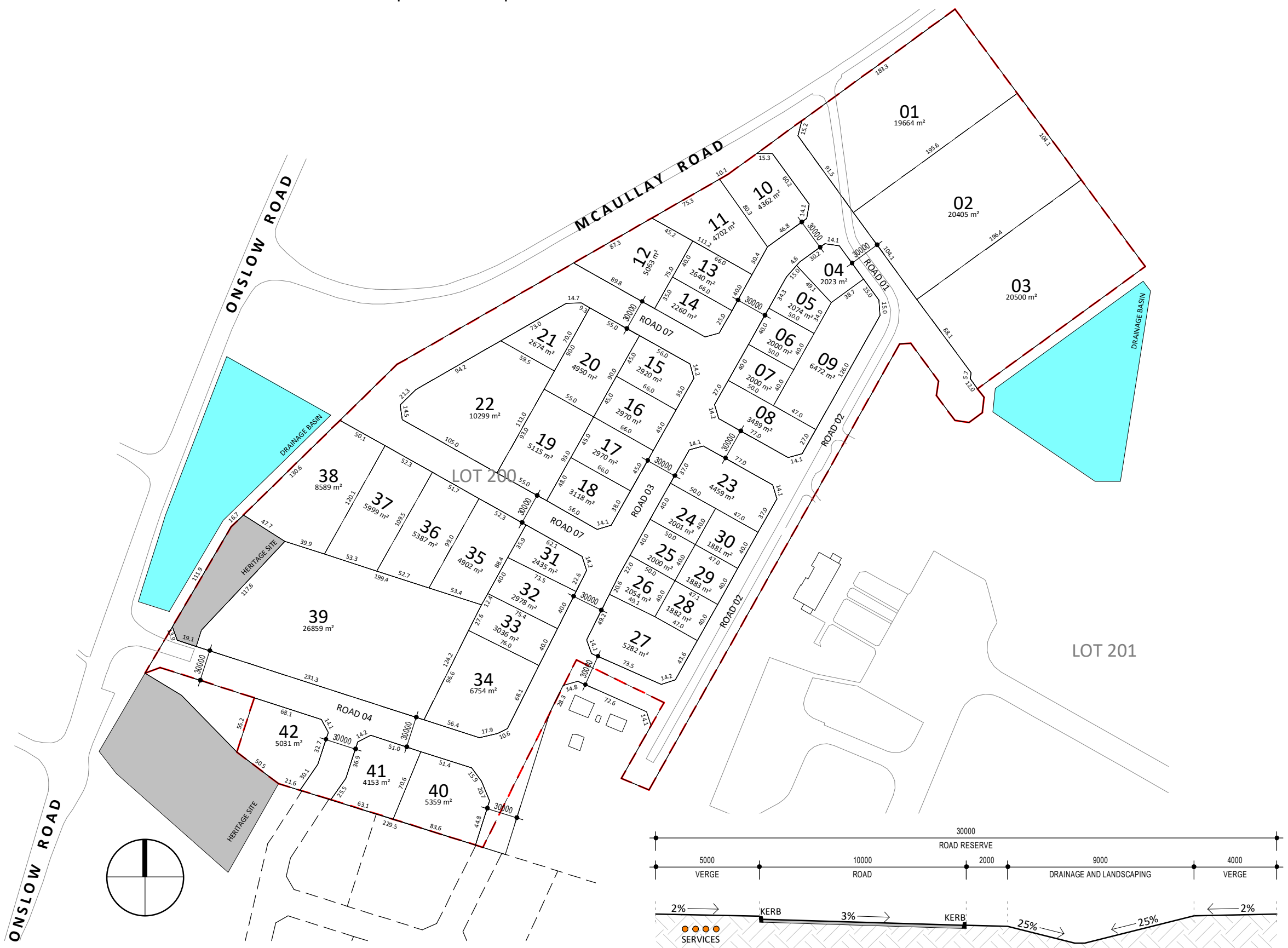
Attachment 15.1A - Proposed Development - Onslow Industrial Park

SUMMARY	
ORIGINAL NUMBER OF LOTS	2
PROPOSED NUMBER OF LOTS	42
AREA OF LOT 200	32.2950ha
EXISTING AREA OF LOT 201	496.7869ha

EXISTING LOT BOUNDARY	---
PHASE 2 FUTURE SUBDIVISION	---

LOT AREAS SCHEDULE

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05	2074 m ²
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07	2000 m ²
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09	6472 m ²
10	4362 m ²
11	4702 m ²
12	5063 m ²
13	2640 m ²
14	2260 m ²
15	2920 m ²
16	2970 m ²
17	2970 m ²
18	3118 m ²
19	5115 m ²
20	4950 m ²
21	2674 m ²
22	10299 m ²
23	4459 m ²
24	2001 m ²
25	2000 m ²
26	2054 m ²
27	5282 m ²
28	1882 m ²
29	1883 m ²
30	1881 m ²
31	2435 m ²
32	2978 m ²
33	3036 m ²
34	6754 m ²
35	4902 m ²
36	5387 m ²
37	5999 m ²
38	8589 m ²
39	26859 m ²
40	5359 m ²
41	4153 m ²
42	5031 m ²
HERITAGE AREA	4952 m ²
ROAD RESERVE	82406 m ²
TOTAL AREA	322950 m ²



1 01 - SUBDIVISION DIMENSIONED LAYOUT
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2 TYPICAL ROAD RESERVE SECTION
1 : 200

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Project Name
ONSLow INDUSTRIAL PARK
CONCEPT SUBDIVISION PLAN

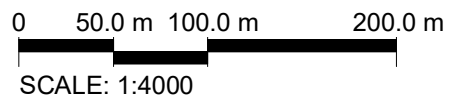
SUBDIVISION DIMENSIONED LAYOUT		
Project number	0105-22	Sheet Number
Date	07 JULY 2022	Current Revision
Drawn by	LN	A102
Checked by	LN	0
Sca/As indicated		ON A3 SHEET

SUMMARY	
ORIGINAL NUMBER OF LOTS	2
PROPOSED NUMBER OF LOTS	42
AREA OF LOT 200	32.2950ha
EXISTING AREA OF LOT 201	496.7869ha

EXISTING LOT BOUNDARY	---
PHASE 2 FUTURE SUBDIVISION	---

LOT AREAS SCHEDULE

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03	20500 m ²
04	2023 m ²
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39	26859 m ²
40	5359 m ²
41	4153 m ²
42	5031 m ²
HERITAGE AREA	4952 m ²
ROAD RESERVE	82406 m ²
TOTAL AREA	322950 m ²



1 02 - SUBDIVISION AERIAL IMAGE
1 : 4000

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No.	Description	Date
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Project Name
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AERIAL IMAGE OVERLAY		
Project number	0105-22	Sheet Number
Date	07 JULY 2022	Current Revision
Drawn by	LN	A103
Checked by	LN	0
Sca/As indicated ON A3 SHEET		

Kevin Pickering

From: Ben McKay <Ben.McKay@ashburton.wa.gov.au>
Sent: Wednesday, 8 September 2021 7:59 AM
To: Chantelle McGurk
Subject: RE: TPS 8

Hi Chantelle,

The airport is outside the Onslow Coastal Hazard Area and as such there are no FFL requirements. This will change in the new scheme and the requirements below will be applied.

- Health, Welfare and Community Services - Strategic use and development shall be at a minimum finished floor level of 6.4m AHD.
- Commercial - Strategic use and development shall have a minimum finished floor level of 5.9m AHD.
- Residential use and development shall have a minimum finished floor level of 5.9m AHD.
- Industry use and development shall be at a minimum finished floor level of 4.9m AHD.
- Commercial - non-Strategic use and development shall have a minimum finished floor level of 4.9m AHD.

Ben McKay

Manager Town Planning

Direct: 08 9188 5514

Mobile: 0439 005 251

Ben.McKay@ashburton.wa.gov.au

www.ashburton.wa.gov.au

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From: Chantelle McGurk <Chantelle.McGurk@ashburton.wa.gov.au>

Sent: Tuesday, 7 September 2021 5:31 PM

To: Ben McKay <Ben.McKay@ashburton.wa.gov.au>

Subject: TPS 8

Hi Ben,

Has the TPS 8 been completed or still work in progress? I need to know what the FFL are for the Airport Subdivision for buildings?

Cheers

Chantelle McGurk

Director Projects & Procurement

Direct: 08 9184 9315

Mobile: 0417 183 364

Chantelle.McGurk@ashburton.wa.gov.au

www.ashburton.wa.gov.au

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Report on
GEOTECHNICAL AND
PRELIMINARY ACID SULFATE SOIL STUDY
ONslow INDUSTRIAL PARK (PHASES 1 AND 2)
LOT 201 ONslow ROAD, ONslow

Submitted to:
Shire of Ashburton
c/o A4 Projects
PO Box 2311
WARWICK WA 6024

www.galtgeo.com.au
50 Edward Street
OSBORNE PARK WA 6017
T: +61 (8) 6272-0200

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1. INTRODUCTION

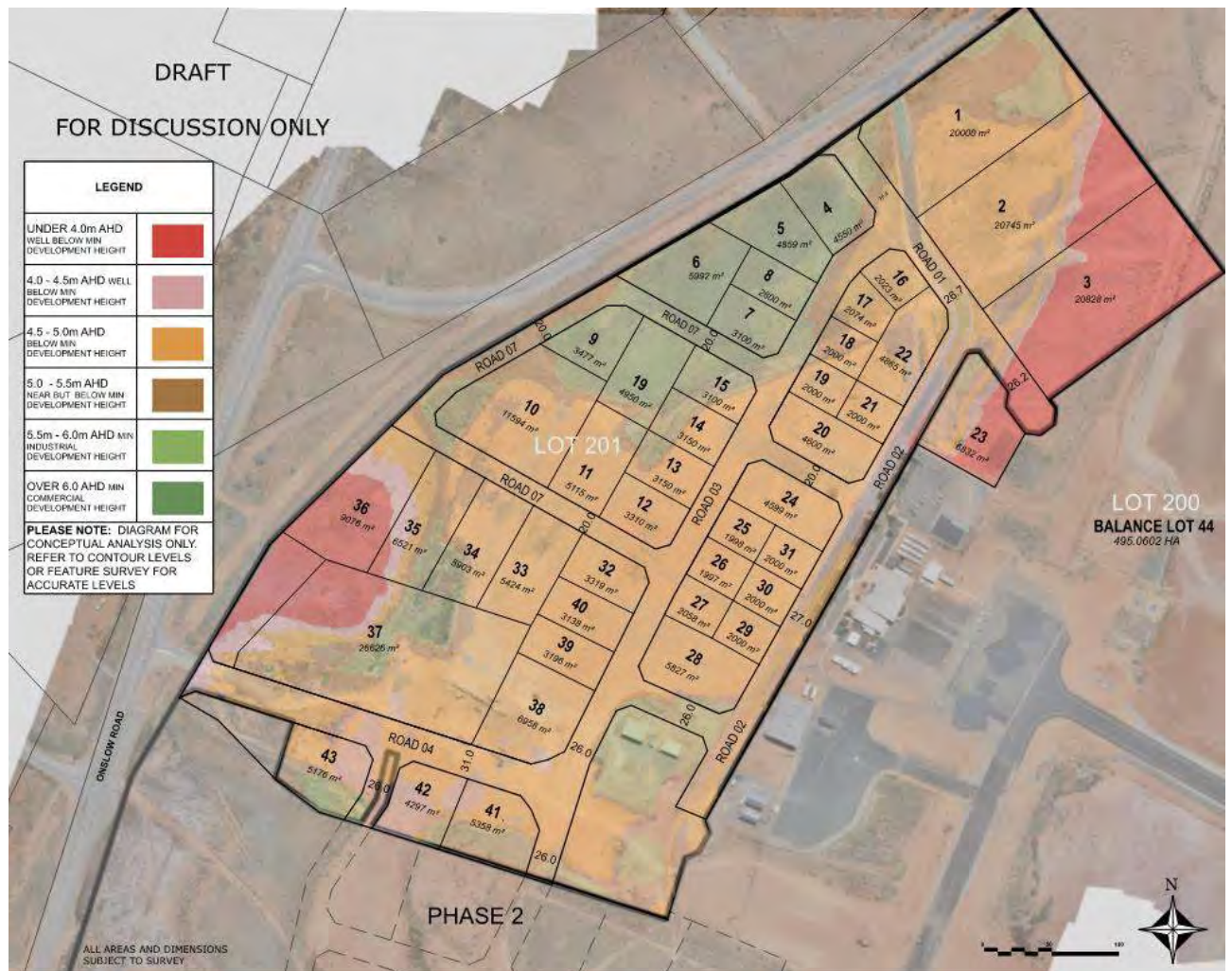
This report presents the outcomes of Galt Geotechnics Pty Ltd’s (Galt’s) geotechnical and preliminary Acid Sulfate Soil (ASS) study for the proposed Onslow Industrial Park on Lot 201 Onslow Road, Onslow (“the site”). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

Two phases of the subdivision are proposed – Phase 1 and Phase 2. Concept plans are included in Appendix A.

2. SITE DESCRIPTION, HISTORY AND PROPOSED DEVELOPMENT

Based on the supplied information, the nominally 54 Ha site is bounded by Onslow Road to the north and west, Onslow Airport to the east, and a salt flat to the south (refer In-Line Image 2). Based on provided survey information, site levels range from about RL 2.0 m AHD to RL 10.3 m AHD. The majority of the Phase 1 area is between RL 4.5 m and RL 6.0 m AHD as per the below concept plan (In-Line Image 1).

The site is partly undeveloped land (vegetated with spinifex and occasional trees) and partly cleared land as a result of construction of the adjacent Onslow Airport. A substantial area of the site (now cleared land) was used as a borrow area for the Onslow Airport.



Inline Image 1 - Approximate Existing Surface Levels (Phase 1 Area)

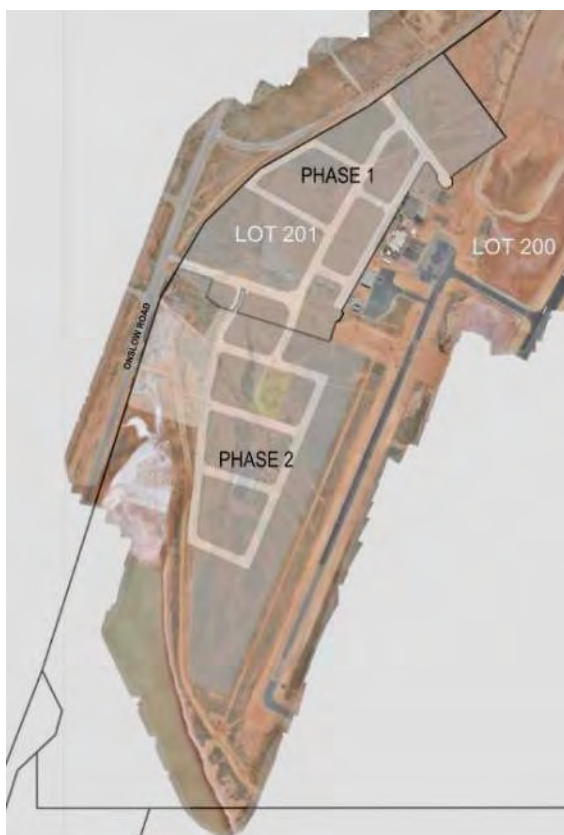
A ~0.5 ha area with stockpiles of fill is present in the southern portion of the site (generally within the proposed POS area in Phase 2). The stockpiles appear to have been derived from demolition and earthworks of the former runway at the Onslow Airport. South of this stockpile area is a portion of the site which was previously developed with temporary accommodation. The general areas of the site described above are shown on Figure 2.

To the north west of the site (outside the proposed development area) is a ~12 ha area with stockpiles of dredge fill. At the ground surface, the dredge fill is generally sandy, however, there are two areas where clayey dredge fill is exposed at the surface (refer Figure 2).

Based on historical aerial photography, the site was mostly undeveloped until about 2001. Some minor earthworks appear to have occurred over portions of the site between 2001 and 2012. Onslow Airport was constructed in 2013, which resulted in some associated earthworks (mostly excavation of fill from a large borrow area) generally in the portion of the site indicated on Figure 2. The above referenced stockpiles were placed at the site between 2018 and 2020.

The salt flats to the south of the site form part of the evaporation ponds of Onslow Salt and are subject to flooding. Mapping prepared by DER, indicates the site is not near any environmentally sensitive estuaries, rivers, river catchments or wetlands.

We understand that the site is to be developed into 67 industrial lots and associated roadways, however a detailed civil design has not yet been undertaken. The development has been divided into an initial Phase 1 (about 33 Ha) followed by a second Phase 2 (about 21 Ha) as shown on Inline Image 2 and as per the concept plans included in Appendix A. For Phase 1, the use of imported fill (currently expected to be derived from the dredge spoil area) is proposed to achieve a lot level of about RL 4.9 m AHD. Relatively flat lots are proposed. It is currently proposed that sewage effluent is to be disposed of within each industrial lot.



Inline Image 2 - Proposed Phase 1 and Phase 2 Subdivision

3. PROJECT OBJECTIVES

The objectives of the study area as follows:

🔗 For Earthworks, Drainage and Civil Design:

- Log site soil profile as per Australian Standard AS1726;
- Assess subsurface soil, rock and groundwater conditions across the site, including identification of clayey soils and low permeability horizons that may affect future earthworks design and construction;
- Undertake permeability testing and determine infiltration rates as applicable for the design of the stormwater management system;
- Record test locations by using a hand-held GPS and provide in dwg (or x,y coord as a minimum, to assist with plotting locations);
- Reinstate all test holes to pre works state (**NOTE:** we undertook only loose backfilling of test pits, given the time and cost implications of detailed, compacted backfilling);
- Laboratory tests to be conducted at NATA accredited laboratory and to include:
 - Particle Size Distribution Test (AS 1289 3.6.1);
 - Plasticity Index - Atterberg Limit Test (AS 1289 3.1.2, 3.2.1, 3.3.1, 3.4.1);
- Provide a site classification(s) in accordance with AS2870-2011;
- Provide all details of investigations done;
- Provide recommendation on earthworks (i.e. site preparation and fill placement criteria);
- Provide recommendations on stormwater drainage with regards to infiltration and on-site disposal;
- Provide a subgrade California Bearing Ratio (CBR) value for pavement thickness design by others along proposed road centre lines (150m to 200m spacings unless soil profile noticeably changing);
- Provide recommendations and geotechnical design parameters for earth retaining structures and foundations;
- assess subsurface soil and groundwater conditions across the site.

🔗 Assessment of Dredge Spoil:

- Undertake an appropriate number of soil tests (PSD, Atterberg etc) and provide an assessment of the stockpiled material's suitability for use as structural fill and non-structural fill for the development and what the resulting classification will be;
- If found suitable, provide:
 - CBR;
 - Design parameters for retaining structures and foundation design;
 - Permeability for consideration in stormwater drainage design;
- If found unsuitable, what improvements need to be made to the material to make it suitable (e.g. blending with clean fill etc.);

🔗 Acid Sulfate Soil Evaluation:

- Undertake preliminary testing for the presence of Acid Sulfate Soils and if found, provide applicable recommendations for treatment / management during construction (**NOTE:** on the basis of the site not being mapped in a high risk area and given that the locations of deep disturbances are not yet known, only a preliminary/high level assessment of ASS at the site was proposed. Detailed studies may be necessary at a later date, depending on the outcomes of this preliminary study); and

🔗 Assessment of Existing Material Stockpile:

- Undertake tests and investigations to understand what the stockpiles (refer 'Fill stockpiles' on Figure 2) consist of, to determine how best to treat them / if they can be used as structural fill or non-structural fill (such as use as deep fill or used in public open space areas).

4. FIELDWORK

Fieldwork was undertaken between 8 and 16 March 2022 and comprised:

- a walkover of the site including taking photographs;
- Test pit excavations at 76 locations (TP01 to TP76) across the site, extending to depths of between 0.1 m and 2.8 m;
- Installation of standpipes within test pits for monitoring of groundwater levels at 5 locations (TP14, TP31, TP42, TP52, and TP72);
- testing with a dynamic cone penetrometer (DCP) adjacent to selected test pit locations;
- falling head infiltration testing using the 'inverse auger' technique at 12 locations (IT01 to IT12) across the site, at depths of between 0.43 m and 0.73 m;
- constant head infiltration testing using a Guelph permeameter at 11 locations across the site (PERC01 to PERC11), at a depth of 0.35 m and 0.64 m; and
- collection of representative soil samples for inspection and testing.

General

A geotechnical engineer from Galt conducted the walkover survey, located and positioned the tests, observed the test pit excavations, collected samples for laboratory testing, and conducted the constant head, falling head and penetrometer testing.

The approximate test locations are shown on Figure 1, Site and Location Plan. Photographs of the site are presented in Appendix B. Test co-ordinates are presented in Appendix G.

Test pit Excavations

Test pits were excavated using a 9 tonne Caterpillar 432F Backhoe fitted with a 600 mm wide rock bucket. The backhoe was owned and operated by Munro Contracting. Bulk samples were collected from the pits for subsequent laboratory testing. Test pit excavation reports are presented in Appendix C, along with a method of soil description and a list of explanatory notes and abbreviations used in the reports.

DCP Test Results

DCP Tests were done in accordance with AS1289.6.3.2. Results are presented in Appendix F.

Installation of Standpipes

Standpipes were installed within five of the test pits for monitoring on groundwater levels (TP14, TP31, TP42, TP52, and TP72). Following their installation (from 8 to 11 March 2022), groundwater levels in the wells were monitored between 13 and 16 March 2022. The levels measured in the wells are summarised in Table 6.

Constant Head Infiltration Tests

Constant head infiltration tests were conducted using constant head permeameters. The tests were generally conducted in accordance with Appendix G of AS 1547 (2012) "On-site domestic wastewater management". The results of the testing are presented in Appendix D and summarised in Table 1.

Table 1: Constant Head Infiltration Test Results

Test	Test Depth (m)	Soil Description at Adjacent Test pit	k ¹ (m/day)	Soil Category
TP16 / PERC01	0.40	Silty SAND	0.09	4
TP21 / PERC02	0.55	Silty SAND	0.10	4
TP29 / PERC03	0.35	Silty SAND	0.14	4
TP31 / PERC04	0.40	Gravelly SAND	0.55	3
TP38 / PERC05	0.55	Silty Sandy GRAVEL	0.20	4
TP42 / PERC06	0.53	SAND	1.87	3
TP48 / PERC07	0.60	Gravelly SAND	0.64	3
TP52 / PERC08	0.55	Gravelly SAND / SAND	0.24	4
TP65 / PERC09	0.55	Clayey SAND / SAND	0.02	6
TP73 / PERC10	0.58	Clayey SAND / Clayey Sandy GRAVEL	0.07	5
TP76 / PERC11	0.64	Silty SAND	0.003	6

- Note:
1. k – saturated hydraulic conductivity
 2. Groundwater not encountered at any test locations
 3. Soil category is as per Table L1 of AS1547-2012.

Falling Head Infiltration Tests

Falling head infiltration tests using the ‘inverse auger hole method’ described by Cocks¹ were done at selected locations across the site, generally where higher permeability soils were identified. The results of the falling head infiltration tests are presented in Appendix E and summarised in Table 2.

Table 2: Summary of Falling Head Infiltration Test Results

Test Location	Pipe Embedment (m)	Soil Description at Adjacent Test pit	Minimum Unsaturated Conductivity, k (m/day)			Soil Category
			Test 1	Test 2	Test 3	
TP15 / IT01	0.62	Silty SAND	2.8	1.1	1.0	3
TP74 / IT02	0.58	Clayey SAND	0.1	0.1	0.1	5
TP20 / IT03	0.73	SILTY SAND / SAND	0.6	0.4	0.2	4
TP26 / IT04	0.67	Silty SAND	2.2	1.6	1.5	3
TP42 / IT05	0.58	SAND	5.2	3.0	3.0	2
TP30 / IT06	0.65	Silty SAND	5.4	2.1	0.9	3
TP41 / IT07	0.62	Sandy GRAVEL	0.4	0.5	0.4	4
TP46 / IT08	0.47	COBBLES / Sandy GRAVEL mixture	3.9	1.5	1.1	3
TP50 / IT09	0.74	CALCARENITE	6.4	2.2	1.7	3
TP67 / IT10	0.71	SAND	4.1	2.0	1.9	2
TP31 / IT11	0.50	Gravelly SAND	2.1	1.3	0.9	3
TP71 / IT12	0.43	Clayey SAND	9.8	2.2	2.2	3

1 Cocks, G (2007), “Disposal of Stormwater Runoff by Soakage in Perth Western Australia”, Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114.

5. GEOTECHNICAL LABORATORY TESTING

Geotechnical Laboratory testing on soil samples was undertaken by WGLS in their NATA accredited laboratories and comprised determination of:

- ✦ Particle size distribution on 36 samples;
- ✦ Atterberg limits on 9 samples;
- ✦ Constant head permeability on 12 samples;
- ✦ California Bearing Ratio on 8 samples;
- ✦ Modified Compaction on 16 samples;
- ✦ Organics content on 10 samples; and
- ✦ Emerson Class on 16 samples.

The results of the laboratory testing are presented in Appendix H and are summarised in Table 3 and Table 4.

Details and results of acid sulfate soil testing are presented in Section 7.

Table 3: Summary of Laboratory Classification Test Results

Area	Test Location	Sample Depth (m)	Soil Description	Fines (%)	Sand (%)	Gravel (%)	LL (%)	PI (%)	LS (%)	OC (%)
Dredge Spoil	TP01	0 to 0.5	FILL: SAND	4	74	22				0.5
	TP01	1.0 to 1.5	FILL: SAND	3	77	20				
	TP03	0 to 0.5	FILL: GRAVELLY SAND	3	51	46				0.6
	TP03	2.0 to 2.5	SILTY GRAVEL	22	24	54	NO	NP	0	1.9
	TP04	0.5 to 1.0	FILL: GRAVELLY SAND	1	66	33				
	TP08	1.5 to 2.0	FILL: SAND	3	70	27				
	TP09	1.0 to 1.5	FILL: SAND	2	73	25				
	TP10	0.5 to 1.0	FILL: SAND	3	78	19				0.6
	TP10	1.5 to 2.0	FILL: SILTY GRAVELLY SAND	29	39	32	NO	NP	0	2.7
	TP11	0.5 to 1.0	FILL: SAND	2	69	29				
	TP11	1.3 to 2.0	FILL: SAND	1	75	24				1
	TP12	0 to 0.4	FILL: SAND	2	75	23				0.8
	TP12	0.5 to 1.0	SAND	0	82	18				
Phase 1 Natural Soils	TP13	0.5 to 1.0	SILTY GRAVELLY SAND / CALCARENITE	15	55	30	NO	NP	0	
	TP17	0 to 0.5	SILTY SAND	23	71	6				1
	TP20	0.6 to 1.0	SILTY SANDY GRAVEL	14	38	48				
	TP21	0.7 to 1.2	SILTY SAND	18	58	24	NO	NP	0	
	TP26	0.5 to 0.75	SILTY SAND	13	68	19	NO	NP	0	
	TP30	0.5 to 1.0	SILTY SAND	16	76	8				
	TP31	2.0 to 2.5	GRAVEL	8	28	64				
	TP36	0.5 to 1.0	SILTY SAND	15	56	29				
	TP38	0.5 to 10	SILTY SANDY GRAVEL	17	38	45				
Phase 2 Natural Soils	TP40	2.0 to 2.5	SAND	12	86	2				
	TP44	0.5 to 1.0	GRAVELLY SAND	9	60	31				
	TP46	1.5 to 2.0	GRAVELLY SAND	10	45	45				
	TP52	0.3 to 0.7	SAND	10	82	8				

Note: LL – Liquid Limit, PI – Plasticity Index, LS – Linear shrinkage, OC – Organic Content

Table 3 CONTINUED: Summary of Laboratory Classification Test Results

Area	Test Location	Sample Depth (m)	Soil Description	Fines (%)	Sand (%)	Gravel (%)	LL (%)	PI (%)	LS (%)	OC (%)
Stockpiles	TP54	0 to 0.2	FILL: SILTY GRAVELLY SAND	14	49	37	NO	NP	0	0.7
	TP56	0.5 to 1.0	FILL: SILTY SAND	15	62	23				
	TP59	0.5 to 1.0	FILL: SILTY SAND	15	59	26				1.3
	TP60	0.5 to 1.0	FILL: SILTY GRAVELLY SAND	14	53	33				
	TP61	0.5 to 1.0	FILL: SILTY SANDY GRAVEL	13	38	49				
Phase 2 Natural Soils	TP64	0.7 to 1	CLAYEY SANDY GRAVEL	17	33	50	19	6	3	
	TP67	1 to 1.5	SAND	10	90	0				
	TP71	0.2 to 0.7	CLAYEY SAND	32	68	0	16	2	1	
	TP76	0.2 to 0.5	SILTY SAND	27	68	5	17	2	1	
	TP76	0.6 to 1	SILTY SANDY GRAVEL	16	40	44				

Note: LL – Liquid Limit, PI – Plasticity Index, LS – Linear shrinkage, OC – Organic Content

Table 4: Summary of Laboratory Compaction, CBR and Permeability Test Results

Area	Test Location	Sample Depth (m)	Soil Description	MMDD (t/m ³)	OMC (%)	Permeability (m/day)	CBR (%)	ECN
Dredge Spoil	TP01	0 to 0.5	FILL: SAND	1.83	12.0	5.07	35	
	TP01	1.0 to 1.5	FILL: SAND	1.85	12.0	3.02		4
	TP03	0 to 0.5	FILL: GRAVELLY SAND	2.08	6.5	4.49		
	TP03	2.0 to 2.5	SILTY GRAVEL					4
	TP04	0.5 to 1.0	FILL: GRAVELLY SAND	1.85	13.0	10.02	35	4
	TP08	1.5 to 2.0	FILL: SAND	1.86	12.5	6.64		4
	TP09	1.0 to 1.5	FILL: SAND	1.84	12.5	7.77		
	TP10	1.5 to 2.0	FILL: SILTY GRAVELLY SAND					4
	TP11	1.3 to 2.0	FILL: SAND	1.78	13.5	2.32	40	
	TP12	0 to 0.4	FILL: SAND	1.78	9.5	6.23		4
Phase 1 Natural Soils	TP12	0.5 to 1.0	FILL: SAND	1.78	12.0	12.44	17	4
	TP13	0.5 to 1.0	SILTY GRAVELLY SAND CALCARENITE	2.11	9.5	0.03		4
	TP17	0 to 0.5	SILTY SAND					4
	TP21	0.7 to 1.2	SILTY SAND	2.07	8.0		40	4
	TP26	0.5 to 0.75	SILTY SAND	2.00	8.5		40	4
	TP30	0.5 to 1.0	SILTY SAND					4
	TP36	0.5 to 1.0	SILTY SAND					4
Stock-piles	TP40	2.0 to 2.5	SAND	1.77	14.5		13	
	TP44	0.5 to 1.0	GRAVELLY SAND					4
Phase 2 Natural Soils	TP59	0.5 to 1.0	FILL: SILTY SAND	2.03	9.0	0.10		
	TP61	0.5 to 1.0	FILL: SILTY SANDY GRAVEL	2.26	6.0	3.70		
	TP52	0.3 to 0.7	SAND					4
Phase 2 Natural Soils	TP76	0.2 to 0.5	SILTY SAND	2.11	8.5		60	4
	TP76	0.6 to 1	SILTY SANDY GRAVEL	1.83	12.0			

Note: LL – Liquid Limit, PI – Plasticity Index, LS – Linear shrinkage, MMDD – Modified Maximum Dry Density, OMC - Optimum Moisture Content, CBR – California Bearing Ratio, ECN – Emerson Class number. Permeability testing undertaken at 99.5% to 100.5% of MMDD. CBR testing undertaken at 94.5% to 95.5% of MMDD with 4.5 kg surcharge.

5.1 Site Conditions

5.1.1 Site Surface Conditions

The site surface conditions are described in Section 2. The site is partly undeveloped land (vegetated with spinifex and occasional trees) and partly cleared / earth worked land as a result of construction of the adjacent Onslow airport. A ~0.5 ha area with stockpiles of fill is present in the southern portion of the site (generally over the proposed POS area in Phase 2). South of this stockpile area is a portion of the site which was previously developed with temporary accommodation. The general areas of the site described above are shown on Figure 2.

5.1.2 Geology

The Onslow sheet of the 1:250,000 scale geology series maps indicates that the area is underlain by coastal dunes, which can be interbedded with localised layers of calcarenite. We have noted the extension of mud flats below the surficial dunes in some areas adjacent to intertidal flats in other areas of Onslow (we did not find evidence of such soft alluvial soils at the subject site).

Our investigation indicated that surficial dunes (if previously present) have been removed during borrow works at the site in the area of borrow for the airport. Natural soils at the site typically comprise silty sand overlying calcarenite rock.

5.1.3 Subsurface Soil Conditions

The subsurface soil conditions for the general areas indicated on Figure 2 are summarised below. A detailed description of the soil types across the site can be found on the test pit reports presented in Appendix C.

NORTHERN DREDGE SPOIL AREA (TP01 to TP12)

NOTE: fill sourced from this area is currently proposed to elevate the site surface levels across Phase 1 and Phase 2 areas.

- ☞ **FILL: GRAVELLY SAND / SAND (SP)** – fine to coarse grained, sub-angular to sub-rounded, typically brown, variable content of fine to coarse grained, sub-angular to sub-rounded gravel, trace fines, with shell fragments, present from the ground surface maximum depth of investigation of 2.5 m; Includes
- ☞ **LAYERS / ZONES OF FILL: SILTY SANDY GRAVEL / SILTY SAND (SM / GM)** - fine to medium grained, sub-angular to sub-rounded, typically brown, variable content of fine to coarse grained, sub-angular to sub-rounded gravel, encountered in TP03 (2.0m to 2.5m, possibly natural ground), TP06 (2.0m to 2.5m, possibly natural ground), TP07 (2.0m to 2.5m, possibly natural ground) and TP10 (0.5 m to 2.0m). **LIKELY MATERIAL IS A SANDY SILT WITHIN AREA DENOTED AS 'CLAYEY DREDGE' ON FIGURE 2 (refer Photograph 7, Appendix B).**

NORTH AND WESTERN ZONE OF NATURAL GROUND (TP13 to TP20, TP22, TP23, TP26, TP30, TP31, TP40, TP41, TP47, TP48 and TP67)

Natural soils present in generally undisturbed areas. Generally thicker sandy soil overlying rock.

- ☞ **SAND / SILTY SAND (SP / SM)** – fine to medium grained, sub-angular to sub-rounded, typically brown and red brown, typically trace gravel, some gravelly zones, trace shell fragments, trace / with roots in some surficial zones, variable fines content, some zones of Sandy SILT in TP18, DCP testing indicates soil is typically medium dense to very dense with some surficial loose layers, present from the ground surface to depths of between 0.2 m and greater than 2.8 m, layer generally becomes thicker to the west; overlying
- ☞ **SANDSTONE / CALCARENITE** – fine to medium grained, typically white and red brown (soil), surficial layers are generally a mixture of cobbles / boulders and typically Gravelly Silty SAND / Silty Sandy GRAVEL soils, typically

medium with some high strength rock at refusal depths, some weathering of surficial layers. Test pits generally refused within unit (excavation with 9 tonne backhoe).

INFERRED AIRPORT BORROW AREA (TP21, TP24, TP25, TP28, TP29, TP32 to TP39, TP42 to TP45 and TP49)

Natural soils present below upper horizon which was excavated away and used for fill on the Onslow airport redevelopment. Generally thinner sandy and gravelly soil overlying rock.

- ☞ **SILTY SAND / SAND / GRAVELLY SAND / SANDY GRAVEL / SILTY SANDY GRAVEL (SP / SM / GP / GM)** – sand is fine to medium grained, sub-angular to sub-rounded, typically brown and red brown, variable gravel content, generally becomes more gravelly near interface with underlying sandstone / calcarenite, trace shell fragments, trace / with roots in some surficial zones, variable fines content, DCP's typically refuse in unit, present from the ground surface to depths of between 0.3 m to 1.4 m, not encountered in TP45, over 2.5 m thick in TP42; overlying
- ☞ **SANDSTONE / CALCARENITE** – fine to medium grained, typically white (rock) and red brown (soil), surficial layers are generally a mixture of cobbles / boulders and typically Gravelly Silty SAND / Silty Sandy GRAVEL soils, typically medium with some high strength rock at refusal depths, some weathering of surficial layers, Test pits generally refuse within unit.

SOUTH EASTERN ZONE OF NATURAL GROUND (TP46, TP50 to TP53, TP64, TP65, TP70 and TP72 to TP76)

Natural soils present in generally undisturbed areas. Generally thicker sandy and gravelly soil overlying rock.

- ☞ **CLAYEY SAND SILTY SAND / SAND / GRAVELLY SAND / SANDY GRAVEL / SILTY SANDY GRAVEL / CLAYEY SANDY GRAVEL (SP / SM / SC / GP / GM / GC)** – sand is fine to medium grained, sub-angular to sub-rounded, typically brown and red brown, variable gravel content, generally becomes more gravelly near interface with underlying sandstone / calcarenite, trace shell fragments, trace / with roots in some surficial zones, variable fines content, fines generally become clayey in TP64, TP65, TP70, TP73, TP74, and TP75, DCP testing indicates soil is typically medium dense to very dense, present from the ground surface to depths of between 0.1 m to over 2.5 m; overlying
- ☞ **SANDSTONE / CALCARENITE** – fine to medium grained, typically white (rock) and red brown (soil), surficial layers are generally a mixture of cobbles / boulders and typically Gravelly Silty SAND / Silty Sandy GRAVEL soils, typically medium with some high strength rock at refusal depths, some weathering of surficial layers. Test pits generally refuse within unit.

FILL STOCKPILE AREA IN SOUTHERN PORTION OF SITE (TP54 to TP63)

Stockpiles of material apparently derived from demolition and construction activities at the Onslow Airport.

- ☞ **FILL: SILTY SAND / SANDY GRAVEL / SILTY SANDY GRAVEL (SM / GP / GM)** – sand is fine to medium grained, sub-angular to sub-rounded, typically brown, variable gravel content, trace shell fragments, trace roots in some zones, trace plastic, etc... variable fines content, variable cobble content, typically very loose to medium dense, **IN TP55, TP58, TP60 AND TP63: FILL IS A MIXTURE OF ABOVE SOIL UNITS AND ABOUT 10% TO 70% CALCARENITE COBBLES / BOULDERS.** Broken up pieces of asphalt pavement are present through the stockpiles.

OLD ACCOMODATION AREA IN SOUTHERN PORTION OF SITE (TP66, TP68, TP69, TP71)

This area has been levelled and pavements are present. Soils typically natural sandy and gravelly soils overlying rock.

- ☞ **SILTY SAND / CLAYEY SAND / GRAVELLY SAND / SANDY GRAVEL / CLAYEY SANDY GRAVEL (SP / SM / SC / GP / GC)** – sand is fine to medium grained, sub-angular to sub-rounded, typically brown, variable gravel content, generally becomes more gravelly near interface with underlying sandstone / calcarenite, trace shell fragments, trace / with roots in some surficial zones, variable fines content, fines are low plasticity clays and silts, DCP's indicate soil is typically medium dense to very dense, present from the ground surface to depths of between 0.7 m to over 2 m; overlying
- ☞ **SANDSTONE / CALCARENITE** – fine to medium grained, typically white (rock) and red brown (soil), surficial layers are generally a mixture of cobbles / boulders and typically Gravelly Silty SAND / Silty Sandy GRAVEL soils, typically medium with some high strength rock at refusal depths, some weathering of surficial layers. Test pits generally refuse within unit.

5.1.4 Surface Water

Based on our review of historical aerial imagery, the lower elevation salt evaporation ponds to the south of the site can become inundated with water / brine. This appears to be at a lower elevation than the site surface and probably not more than about RL 2 m AHD.

Draft Surface Water Management Plan (SWMP) by GHD

We have been provided with a draft SWMP prepared by GHD (dated 26 October 2020) which has been relied upon. The report recommends all habitable floor levels are to be set at a minimum of RL 3.5 m AHD. This level accounts for the expected 1% AEP storm surge water level with sea level rise in 2070 of RL 2.99 m AHD, plus a 0.5 m freeboard. Table 5 of the draft SWMP gives tailwater constraint flood levels as presented below.

Table 5: Tailwater Constraints presented as Table 5 in Draft SWMP report dated 26 October 2020

AEP (1 in X year and % annual exceedance probability)	2015 present day Water Level (m AHD)	2070 climate change Water Level (m AHD)
10 (10%)	1.79	2.19
100 (1%)	2.41	2.99

5.1.5 Groundwater

Published Groundwater levels

We are not aware of any published groundwater levels for the site.

Observations During Site Investigation

A summary of the groundwater depths and elevations recorded at monitoring well locations between 13 March and 16 March 2022 are presented in the table below.

Table 6: Groundwater Levels at Test Locations (March 2022)

Test Location	Estimated Surface Elevation (RL m AHD)	Depth to Groundwater (m below ground)	Estimated Groundwater Elevation (RL m AHD)
TP14	2.8	1.32 to 1.35	1.5
TP31	3.0	0.94 to 1.11	1.9
TP42	4.3	2.52 to 2.53	1.8
TP52	3.2	Dry (> 0.86)	<2.3
TP72	4.4	Dry (> 1.64)	<2.8

- NOTES:**
1. Surface elevation estimated from supplied survey information.
 2. Only test locations where groundwater encountered are listed.
 3. Water levels measured in standpipes between 13 March and 16 March 2022.

Test Location	Estimated Surface Elevation (RL m AHD)	Depth to Groundwater (m below ground)	Estimated Groundwater Elevation (RL m AHD)
---------------	--	---------------------------------------	--

4. Standpipes not installed deeper at TP52 and TP72 due to refusal on rock and partial collapse of the pits during attempted installation of standpipes.

The results of the field testing indicate that the groundwater level is generally higher in the west, falling towards the east (where low-lying areas and tidal creeks are present to the east of the airport).

5.1.6 Acid Sulfate Soils (ASS)

The Department of Environment Regulation (DER) ASS risk mapping shows that the site has a 'moderate to low risk' of ASS within 3 m of the ground surface. However, the site lies adjacent an area mapped as 'high to moderate risk' of ASS occurrence within 3 m of the ground surface. The mapped high-risk area generally appears to be constrained to the boundary of the Cook Creek Estuary.

6. GEOTECHNICAL ASSESSMENT

6.1 Site Classification

We consider that the site is geotechnically capable of supporting the proposed industrial development.

Site classifications in accordance with AS2870-2011 "Residential Slabs and Footings" are summarised in Table 7, Summary of Site Classifications (AS 2870-2011).

Table 7: Summary of Site Classifications (AS 2870-2011)

Class	Description	Characteristic Surface Movement (y _s)
A	Most sand and rock sites with little or no ground movement from moisture change	Not Defined (typically <5 mm)
S	Slightly reactive clay sites with only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay sites, which may experience moderate ground movements from moisture change	20 – 40 mm
H1	Highly reactive sites, which may experience high ground movements from moisture change	40 – 60 mm
H2	Highly reactive sites, which may experience very high ground movements from moisture change	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movements from moisture change	>75 mm
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise	Not Defined

We consider that a Class S classification is relevant for the site (excludes dredge spoil area shown on Figure 2). This site classification assumes site preparation is undertaken in accordance with Section 6.2. This site classification does not account for the impacts of planting trees near proposed structures.

We refer you to the CSIRO's pamphlet BTF18-2011: Foundation Maintenance and Footing Performance: A Homeowner's Guide. This provides practical advice to reduce the risk of future heave moments. A copy of this pamphlet is presented in Appendix J, CSIRO Pamphlet.

6.2 Site Preparation

The following site preparation measures are required prior construction of on-ground slabs, shallow footings (including retaining wall footings) and pavements. Landscaped areas will not require this preparation:

- ✦ Strip and remove all vegetation and topsoil including removal of roots from the construction areas and dispose of off-site, a topsoil strip of 100 mm will generally be acceptable where topsoil has not previously been cleared (50 mm should be adequate to address re-growth where any clearing was already done).
- ✦ Remove trees, including grubbing out of roots. Any disturbed material must be compacted to the density of the surrounding soil.
- ✦ Demolish and remove existing structures and pavements were required (including removal of all footings, slabs, soak wells, buried services) and dispose off-site. This will be required in the old accommodation area shown on Figure 2.
- ✦ Any holes formed as a result of the removal of trees roots or below-ground items (e.g. soak wells) must be backfilled using similar fill to the surrounding material, placed and compacted in layers of no greater than 300 mm loose thickness.
- ✦ Remove any other deleterious material from site (nothing was noted in the test pits at the time of study, with the exception of the stockpile area shown on Figure 2). If contaminated, dispose off-site.
- ✦ Moisture condition and compact the exposed ground to achieve the density specified in Section 6.3 to a depth of at least 0.3 m below surface of any slabs and footings and pavements.
- ✦ Any areas of unsuitable, soft or loose material must be removed and replaced with approved fill (see Section 6.4).
- ✦ Where fill is required to build up levels, use approved fill (see Section 6.4), placed and compacted in layers of no greater than 300 mm loose thickness.
- ✦ Excavate for pad and strip footings and compact the exposed bases to achieve the density specified in Section 6.3 to a depth of at least 0.3 m below the underside of all footings. Remove, replace and compact as required with approved fill any zone not compacted as specified in Section 6.4.
- ✦ Compaction will be impeded if groundwater is within 1 m of the compacted ground surface. This could possibly impact work within excavations, particularly in the lower elevation portions of the site (refer Sections 5.1.4 and 5.1.5).

Although not required for geotechnical performance of the lots, Galt's site and soil evaluation report dated 22 April 2022 (Referenced J2201059 001 R Rev0) recommends any fill placed within the surficial 0.6 m of the ground surface must be ASNZ1547-2012 Soil Category 1 to 2. This recommendation was for Phase 1 and the northern portion of Phase 2 where a ASNZ1547-2012 Soil Category of 4 is considered achievable.

6.3 Compaction

Approved granular fill and the *in situ* granular materials must be compacted using suitable compaction equipment to achieve a dry density ratio (DDR) of at least 95% MMDD (maximum modified dry density) as determined in accordance with AS 1289.5.2.1 at a moisture content within 2% of optimum moisture content (OMC).

Compaction control testing of all gravelly soil, clayey soil and sand with more than 5% fines and/or 5% gravel (i.e. all soils currently on the site or expected to be used as fill) must be done with the nuclear density gauge (NDG) in accordance with AS1289.5.8.1.

Where clean sand (<5% gravel, <5% fines) is used as fill, a Perth sand penetrometer (PSP) may be used for compaction control in accordance with AS 1289.6.3.3. **We note that clean sand is not likely to be available for use on the site.** The following minimum blow counts may be assumed to correspond to a dry density ratio of 95% MMDD:

- ☞ Depth range 0 m to 0.15 m: SET
- ☞ Depth range 0.15 m to 0.45 m: 8 blows
- ☞ Depth range 0.45 m to 0.75 m: 10 blows
- ☞ Depth range 0.75 m to 1.05 m: 12 blows (or 6 blows for depth range 0.75 m to 0.9 m)

If difficulties are experienced recording the required blow counts, a site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. The correlation must:

- ☞ be done on site;
- ☞ use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- ☞ use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- ☞ be plotted on a chart of PSP blow count vs DDR.

Over-excavation and replacement of loose materials must be done where the minimum dry density ratio cannot be achieved.

Fill must be placed in horizontal layers of not greater than 300 mm loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Care will need to be taken when compacting in the vicinity of existing structures, such as adjacent properties. This is particularly important if vibratory compaction is being carried out. Tynan (1973)² provides assistance with the selection of compaction equipment for use adjacent to structures.

Large compaction equipment (self-propelled vibrating rollers, etc.) must not be used within 2 m behind retaining walls. Hand compaction plant (e.g. plate compactors) must be used.

Compaction will be impeded if groundwater is within 1 m of the compacted ground surface. This could possibly impact work within excavations, particularly in the lower elevation portions of the site (refer Sections 5.1.4 and 5.1.5).

After compaction, testing is required to verify that the required level of compaction has been achieved. The frequency of testing should be as follows:

- ☞ on each lift of fill at the rate of 1 test per 500 m³ or at least 2 tests per layer (4 tests per layer below the building footprints), whichever is greater;
- ☞ At each spread footing location;
- ☞ at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- ☞ at 10 m centres below on-ground slabs and pavements.

Further to this, we recommend footings be inspected by a geotechnical engineer prior to blinding.

6.4 Approved Fill

Approved fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments". Granular materials with no more than 5 % fines are considered suitable for use as approved fill. Gravelly soils must be reasonably well graded and have a maximum particle size of about 75 mm. Any soil containing organics, deleterious inclusions, or oversize material (>75 mm) must not be used.

² Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.

In areas where fill does not need to be free draining, a fines content of up to about 30 % would be suitable. The potential for groundwater to perch on underlying low permeability layers must be considered when selecting fill materials. Please contact us if any such fill is proposed.

The suitability of materials at the site (refer Figure 2) for reuse as approved fill is summarised as follows:

- ✦ **Sand Dredge Fill:** The areas of sandy dredge fill may be reused as relatively permeable approved fill;
- ✦ **Silty/Clayey Dredge Fill:** It is not recommended that the silty / clayey dredge fill is reused for the proposed development;
- ✦ **Fill Stockpiles:** The investigation indicates the stockpiles contain variable soils, including Silty SAND, Sandy GRAVEL and Silty Sandy GRAVEL (SM / GP / GM). In some areas, the fill included up to 70 % Calcarenite cobbles / boulders, trace roots and trace plastic was also encountered in some zones. Provided oversize material is removed from the stockpiles (>100 mm), the soils may only be reused in areas where fill does not need to be free draining. It is unlikely to be practical to separate the silty fill stockpiles from the localised stockpiles of free draining fill.
- ✦ **In situ Soils:** laboratory testing indicates that the silty sand and surficial layers of sandstone / calcarenite are of low permeability when recompacted to about 100 % of MMDD. Therefore, the in situ soils may only be reused in areas where fill does not need to be free draining;

Topsoil containing significant amounts of organics is not suitable for re-use as structural fill and must be removed and disposed of off-site or re-used in non-structural areas. If the topsoil can be suitably screened and all roots removed, it could possibly be suitable for re-use as fill.

Where doubt exists, a geotechnical engineer must be engaged to inspect and approve the use of potential fill materials.

6.5 Footings

Footings and structures should be designed in accordance with the standard designs presented for “Class S” site classification in AS 2870-2011.

Note: AS2870-2011 applies to single and double storey residential structures on shallow strip and pad footings with maximum founding pressures of 100 kPa. Detailed investigations are required for more heavily loaded structures.

Broadly speaking, provided the site preparation measures outlined in Section 6.2 are undertaken, we consider that shallow pad and strip footings can be designed for an allowable bearing pressure of 150 kPa, provided they are embedded at least 0.5 m and have a plan width of at least 0.5 m.

All foundation excavations must be assessed by a competent person prior to blinding.

Detailed design of footings for individual developments must be done by proponents based on specific developments proposed for each lot and subject to a lot-specific geotechnical study once the earthworks for the subdivision are complete.

6.6 Excavations and Slopes

Based on the conditions encountered, we consider that excavation of the surficial *in situ* soils penetrated by the test pits, would be readily achieved using conventional earthmoving equipment (i.e. with a 12 tonne or larger excavator with a toothed bucket). The removal of underlying sandstone / calcarenite rock material below test pit refusal depths is likely to require a rock breaker and a large (>20 tonne) excavator. The 9-ton backhoe used in the investigation encountered refusal on rock at depths as shallow as 0.15 m at some test locations (refer Appendix C).

Care must be exercised in excavations and appropriate safety measures adopted where necessary, particularly in the vicinity of existing structures and infrastructure.

Excavations must be battered at slopes no steeper than 1V:2H for temporary slopes in soils and 1V:0.75H for temporary slopes in competent sandstone / calcarenite rock where no external restraint is provided to the slope (suitable for slope heights up to 2 m with no surcharge (machinery, stockpiles, etc) at the crest of the slope). Even at these slope angles, erosion and rilling may occur. Where steeper slopes are required, temporary or permanent slope retention must be employed.

The above temporary slope angles assume that groundwater is no closer than 1 m from any excavated surface. Dewatering could be required.

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.

6.7 Earth Retaining Structures

Retaining structures may be designed in accordance with AS 4678 (2002) "Earth Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (imported free draining sand fill with less than 5% fines). The sandy dredge fill would also be suitable for this purpose.

For the design of retaining structures, the following parameters are considered appropriate for medium dense compacted sand backfill:

- ☞ angle of internal friction, $\phi = 35^\circ$;
- ☞ coefficient of active earth pressure $K_a = 0.27$;
- ☞ coefficient of passive earth pressure $K_p = 3.7$;
- ☞ at rest coefficient of earth pressure $K_0 = 0.42$; and
- ☞ bulk density: 21 kN/m^3 .

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement will occur behind any soil retaining system, including gravity retaining walls.

Retaining walls can move and rotate under imposed soil loading resulting in settlement behind the wall. This must be considered in the design and during construction of the retaining walls in order that adjacent properties are not adversely affected. Particular care should be exercised when forming excavations so as not to affect neighbouring properties. Account must be taken of the effect of both temporary and permanent works on neighbouring properties. Anchoring or strutting of retaining walls may be required.

Detailed design of retaining structures should be undertaken using methods appropriate to the proposed retention system.

Unless a suitable drainage layer is placed behind the wall such that a build-up of pore pressure is prevented, the retaining wall must be designed to accommodate water pressure behind the wall (10 kPa per metre height).

Free-draining, granular backfill must be used for at least 300 mm width behind retaining walls, incorporating a separator geotextile (Bidim A24, or similar, or heavier) between the granular backfill and any clayey backfill used behind the wall (although we recommend against using clayey backfill if it can be avoided). A slotted drain (wrapped in a geotextile) should be used at the base of the granular backfill to collect seepage and direct it to a collection point.

Where retaining walls are founded directly on top of the *in situ* clayey soils, we do not recommend placement of a sand bedding layer below the retaining wall foundation.

6.8 Pavement Subgrades

A subgrade California bearing ratio (CBR) of 12% may be assumed for pavement thickness design for the granular sands, silty sands and gravelly subgrade soils encountered at the site. This CBR is also suitable for the sand dredge fill material shown on (Figure 2).

Clayey sand subgrades (encountered in TP71 and TP73 to TP75) with a fines content generally greater than about 20 % may be designed assuming a subgrade CBR of 6%. A subgrade CBR value of 12% may be used where clayey sand subgrades are overlain by no less than 0.5 m of sand fill (the sandy dredge fill will be suitable for this purpose).

The silty / clayey dredge fill to the north west of the site (refer Figure 2) is not suitable for use as a pavement subgrade material.

The CBR values above are based on the assumption that the site preparation requirements outlined in Section 6.2 have been carried out on the pavement subgrade.

6.9 Site Drainage

On site disposal of stormwater is not considered suitable for the proposed development due to the elevated fines contents of the natural soils (regardless of the permeability of the upper sandy fill layer, where the sandy dredge fill is used). Drainage must be designed for the development so that surface water is diverted away from structures and lots. Erosion and sediment control must also be considered.

7. PRELIMINARY ACID SULFATE SOILS ASSESSMENT

7.1 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) samples were collected during fieldwork to ensure quality and reproducibility of all sampling methods used during the investigation. These samples provide information that discounts any errors due to possible sources of cross-contamination, inconsistencies in sampling methods/techniques and provides a check on the analytical techniques used.

Soil duplicates were taken in order to identify the variation in analyte concentration between samples collected from the same sampling point and/or the repeatability of the laboratory's analysis. The relevant Australian Standard AS 4482.1-2005 recommend that for every 20 samples a duplicate should be collected.

All laboratory analysis was undertaken by Eurofins using NATA-accredited methods of analysis. Galt requires that laboratories have a QA/QC program that is endorsed by NATA.

The analytical results and quality control data were evaluated for accuracy, precision and representativeness of the data. Laboratory data were checked for any analytical errors, such as contamination identified in laboratory blanks, which may indicate cross contamination of samples. Based on the evaluation, the analytical data presented is considered to provide an accurate representation of actual soil conditions at the site.

7.2 Regulatory Assessment Criteria

Typically, field pH values (pH_F) of <3 to 4 indicate the presence of actual acid sulfate soils (AASS), thus indicating acids in the soil profile have oxidised.

The presence of unoxidised acids or potential acid sulfate soil (PASS) is indicated if:

- ☞ a strong reaction with hydrogen peroxide is observed;
- ☞ the pH_{FOX} is at least 1 pH unit below pH_F ;
- ☞ the pH_{FOX} is <3 to 4 and one or both of the above conditions apply; or
- ☞ the pH_{FOX} is <3 and chromium reducible sulfur (S_{CR}) value is < 0.03.

The texture based net acidity action criteria presented in the DER (2015b) *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* guideline document specifies an assessment criterion of 0.03 %S for coarse texture sands to loamy sands and peats (with clay content between $\leq 5\%$). As such, the net acidity assessment criterion of **0.03 %S** has been adopted. This is considered to be the most conservative of the assessment criteria provided in (DER, 2015b).

7.3 Results

7.3.1 Field Testing Results

Soil field testing results are presented in Table A1 (at the end of the text), and discussed below.

- ☞ Field pH_F for all soil samples ranged from 7.1 to 9.6.
- ☞ Field pH_{FOX} results were usually lower (sometimes higher), ranging from 6.4 to 10.7.
- ☞ Differences between pH_F and pH_{FOX} in individual soil samples ranged from -2.4 to 3.1
- ☞ During field testing (oxidation) 30 samples displayed a low reaction, 29 samples showed a medium reaction, 12 samples displayed a high reaction, 18 samples displayed an extreme reaction, and 26 samples displayed a volcanic reaction.

7.3.2 Laboratory Analysis

The ASS laboratory test results using the CRS method of analysis are presented in Table A1 and discussed below.

- ☞ $pHKCL$ values ranged from 9.0 pH units (TP64/0.0m & TP76/0.0m) to 9.8 pH units (TP04/0.0 m).
- ☞ Titratable actual acidity (TAA) concentrations were below the laboratory limit of reporting (LOR [<0.003 %S]) in all samples analysed.
- ☞ Chromium reducible sulfur (S_{CR}) concentrations ranged from ($<LOR$ [<0.005 %S]) in the majority of samples to 0.015 %S (TP01/0.0 m).
- ☞ The calculated net acidity was below the adopted action criterion of 0.03 %S in all samples. The maximum net acidity recorded was 0.015 %S (TP01/0.0 m).

Laboratory Test Results are presented in Appendix H.

7.3.3 Summary

The results of the study indicate that all samples conformed to the adopted net acidity criterion of 0.03 %S. As such, soils at the site to the maximum investigated depth are considered to be non-acid sulfate soils (NASS) (including the sandy dredge fill). Based on these findings, it is considered unlikely that any further investigation or treatment/management of soils (in context of ASS) is required at the site.

8. CLOSURE

We draw your attention to Appendix K of this report, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be.

J2201059 002 R Rev1
04 May 2022



GALT GEOTECHNICS PTY LTD

A handwritten signature in black ink, appearing to read "O. Woodland".

Owen Woodland CPEng
Geotechnical Engineer

O:\Jobs\2022\J2201059 - SoA SI Onslow Industrial Park\03 Correspondence\J2201059 002 R Rev1 - GIR.docx



Tables

Table A1: Acid Sulfate Soils Results

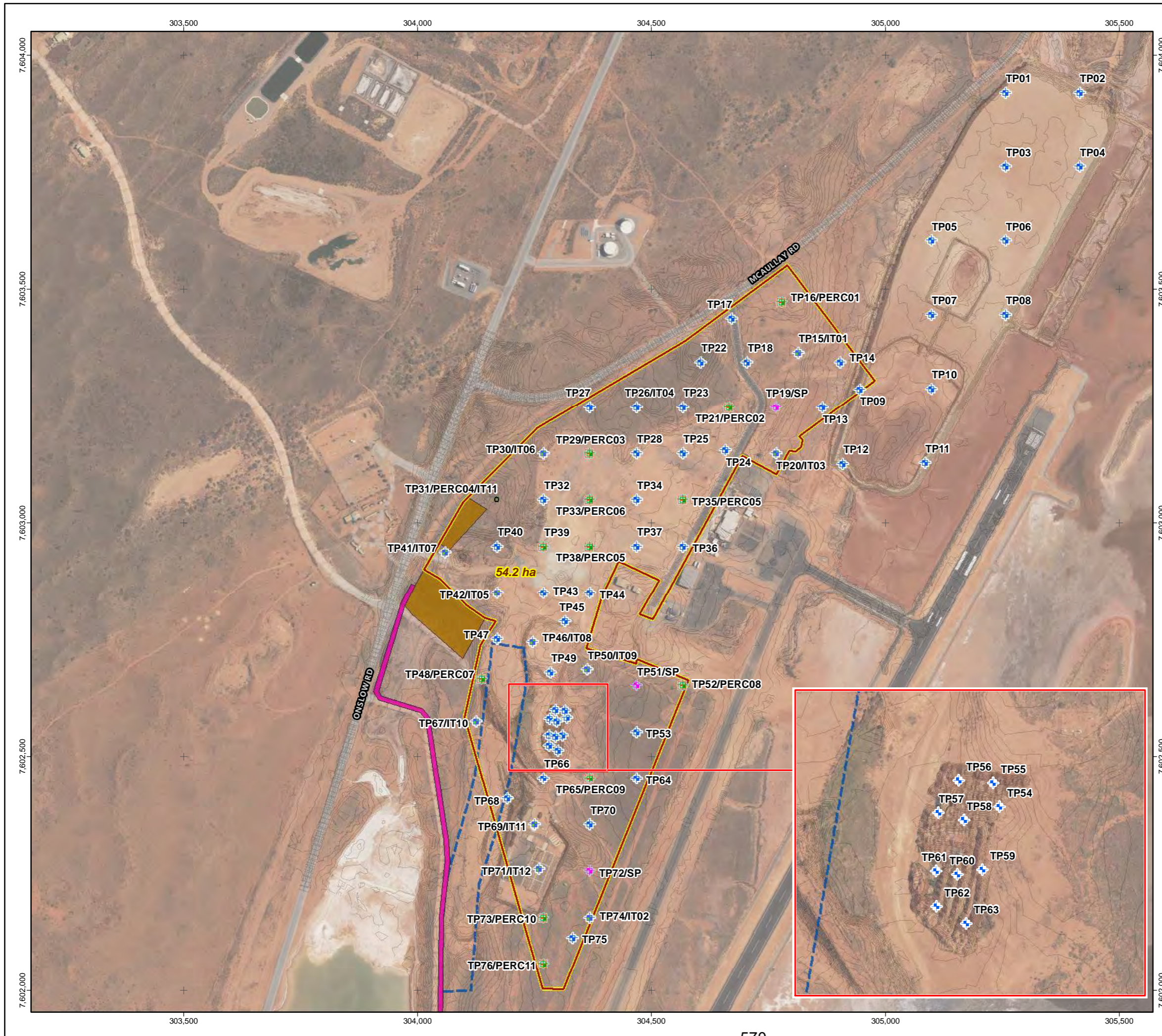
Sample ID		Field Observations				Lab pH	Chromium Reducible Sulfur Suite				Acid Sulfate Soil Classification
Location	Depth (m)	pH _f	pH _{fox}	pH _f - pH _{fox}	Reaction Rate	pH _{KCl}	Titrateable Actual Acidity	Chromium Reducible Sulfur	Acid Neutralising Capacity	Net Acidity	
		pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	
		4	4	1	NV	NV	0.03	0.03	NV	0.03	NV
TP01	0.00	8.3	6.6	1.7	L	9.6	< 0.003	0.015	3.4	0.015	NASS
	0.50	7.3	6.5	0.8	L	9.6	< 0.003	0.009	2.9	0.009	NASS
	1.00	7.2	8.9	-1.7	L	...	...	...	...	...	...
	1.50	8.1	8.2	-0.1	L	...	...	...	...	...	...
	2.00	8.1	8.8	-0.7	M	...	...	...	...	...	...
	2.50	8.0	8.9	-0.9	L	...	...	...	...	...	...
TP02	0.00	8.4	8.7	-0.3	M	...	...	...	...	...	...
	0.50	8.4	8.9	-0.5	M	...	...	...	...	...	...
	1.00	8.5	9.3	-0.8	L	...	...	...	...	...	...
	2.00	8.6	9.6	-1.0	L	...	...	...	...	...	...
	2.50	8.5	9.3	-0.8	L	...	...	...	...	...	...
TP03	0.00	7.3	8.3	-1.0	L	...	...	...	...	...	...
	0.50	8.8	7.3	1.5	L	...	...	...	...	...	...
	1.00	9.4	9.7	-0.3	L	...	...	...	...	...	...
	1.50	9.4	7.3	2.1	L	...	...	...	...	...	...
	2.00	8.8	6.9	1.9	M	...	...	...	...	...	...
	2.50	8.3	6.7	1.6	X	...	...	...	...	...	...
TP04	0.00	8.7	6.4	2.3	L	9.8	< 0.003	< 0.005	9.1	<0.02	NASS
	0.50	9.2	8.8	0.4	L	...	...	...	...	...	...
	1.00	9.3	9.6	-0.3	L	...	...	...	...	...	...
	1.50	9.4	6.5	2.9	L	9.7	< 0.003	< 0.005	11	<0.02	NASS
	2.00	9.1	86.0	-76.9	M	...	...	...	...	...	...
	2.50	8.8	8.7	0.1	L	...	...	...	...	...	...
TP06	0.00	8.5	7.4	1.1	M	...	...	...	...	...	...
	0.50	8.4	9.0	-0.6	L	...	...	...	...	...	...
	1.00	8.8	9.4	-0.6	H	...	...	...	...	...	...
	1.50	8.9	9.2	-0.3	L	...	...	...	...	...	...
	2.00	8.3	8.7	-0.4	H	...	...	...	...	...	...
	2.50	7.9	7.5	0.4	L	...	...	...	...	...	...
TP12	0.00	9.6	6.5	3.1	L	9.7	< 0.003	0.005	6.7	0.005	NASS
	0.50	7.9	7.6	0.3	M	...	...	...	...	...	...
	1.00	8.9	6.5	2.4	L	9.7	< 0.003	< 0.005	4.9	<0.02	NASS
	1.50	8.0	7.0	1.0	L	...	...	...	...	...	...
	2.00	9.0	6.8	2.2	M	...	...	...	...	...	...
TP21	0.00	7.7	8.3	-0.6	M	...	...	...	...	...	...
	0.50	9.5	6.4	3.1	L	9.3	< 0.003	< 0.005	9.1	<0.02	NASS
	1.00	8.9	8.4	0.5	L	9.3	< 0.003	< 0.005	3.8	<0.02	NASS
	1.50	7.7	8.2	-0.5	L	...	...	...	...	...	...
TP22	0.00	8.5	7.1	1.4	V	...	...	...	...	...	...
	0.50	8.3	8.3	0.0	M	...	...	...	...	...	...
	1.00	8.5	8.5	0.0	M	...	...	...	...	...	...
TP23	0.00	8.5	7.6	0.9	V	...	...	...	...	...	...
	0.50	8.9	9.2	-0.3	X	...	...	...	...	...	...
TP26	1.00	8.6	6.4	2.2	H	...	...	...	...	...	...
TP28	0.00	8.7	9.2	-0.5	H	...	...	...	...	...	...
	0.50	7.9	8.4	-0.5	M	...	...	...	...	...	...
	1.00	8.5	8.9	-0.4	M	...	...	...	...	...	...
	1.50	8.0	8.3	-0.3	M	...	...	...	...	...	...
TP30	0.00	9.3	6.8	2.5	H	9.5	< 0.003	< 0.005	1.4	<0.02	NASS
	0.50	8.7	8.8	-0.1	V	...	...	...	...	...	...
	1.00	8.9	6.6	2.3	V	9.4	< 0.003	< 0.005	4.5	<0.02	NASS
	1.50	8.3	9.2	-0.9	X	...	...	...	...	...	...
	2.00	9.4	10.7	-1.3	X	...	...	...	...	...	...
	2.50	9.1	9.9	-0.8	X	...	...	...	...	...	...

Sample ID		Field Observations				Lab pH	Chromium Reducible Sulfur Suite				Acid Sulfate Soil Classification
Location	Depth (m)	pH _f	pH _{fox}	pH _f - pH _{fox}	Reaction Rate	pH _{KCl}	Titrateable Actual Acidity	Chromium Reducible Sulfur	Acid Neutralising Capacity	Net Acidity	
		pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	
		4	4	1	NV	NV	0.03	0.03	NV	0.03	NV
TP31	0.00	7.7	10.1	-2.4	M	...	...	...	...	...	...
	0.50	7.1	9.4	-2.3	M	...	...	...	...	...	...
	1.00	8.3	8.0	0.3	M	...	...	...	...	...	...
	1.50	8.3	7.1	1.2	M	...	...	...	...	...	...
	1.5 (PRI)	8.2	8.1	0.1	H	...	...	...	...	...	...
	2.00	8.3	8.4	-0.1	M	...	...	...	...	...	...
TP36	0.00	8.4	9.2	-0.8	M	...	...	...	...	...	...
	0.50	8.5	9.3	-0.8	M	...	...	...	...	...	...
	1.00	8.9	9.2	-0.3	M	...	...	...	...	...	...
TP38	1.50	8.7	9.4	-0.7	M	...	...	...	...	...	...
	0.5 (PRI)	8.5	9.9	-1.4	H	...	...	...	...	...	...
TP40	0.00	8.9	10.5	-1.6	H	...	...	...	...	...	...
	1.00	9.2	8.9	0.3	X	9.4	< 0.003	< 0.005	4.4	<0.02	NASS
	1.50	9.3	8.2	1.1	V	9.5	< 0.003	< 0.005	4.8	<0.02	NASS
	2.00	8.4	8.9	-0.5	M	...	...	...	...	...	...
TP44	2.50	8.3	8.9	-0.6	M	...	...	...	...	...	...
	0.00	8.2	7.9	0.3	M	...	...	...	...	...	...
	0.50	7.9	9.2	-1.3	M	...	...	...	...	...	...
	1.50	8.8	9.1	-0.3	V	...	...	...	...	...	...
TP45	1.50	8.2	8.8	-0.6	X	...	...	...	...	...	...
	0.00	9.0	9.3	-0.3	V	...	...	...	...	...	...
	0.50	8.4	9.1	-0.7	V	...	...	...	...	...	...
	1.00	9.1	9.5	-0.4	V	...	...	...	...	...	...
	1.50	9.0	9.4	-0.4	V	...	...	...	...	...	...
	2.00	8.8	9.4	-0.6	V	...	...	...	...	...	...
TP46	2.50	8.8	9.2	-0.4	V	...	...	...	...	...	...
TP48	1.00	7.3	8.7	-1.4		...	...	...	...	...	...
	0.00	8.8	8.6	0.2	V	...	...	...	...	...	...
	0.50	8.6	6.5	2.1	M	9.5	< 0.003	< 0.005	2.1	<0.02	NASS
	1.50	9.0	8.1	0.9	X	9.4	< 0.003	< 0.005	1.6	<0.02	NASS
	2.00	7.7	8.5	-0.8	V	...	...	...	...	...	...
	2.50	8.2	8.7	-0.5	V	...	...	...	...	...	...
TP52	4.00	7.7	8.5	-0.8	V	...	...	...	...	...	...
	0.00	8.3	7.9	0.4	H	...	...	...	...	...	...
	0.50	8.3	79.0	-	X	...	...	...	...	...	...
	1.00	8.2	8.6	-0.4	X	...	...	...	...	...	...
TP53	1.40	8.4	8.8	-0.4	H	...	...	...	...	...	...
	0.00	8.1	8.6	-0.5	X	...	...	...	...	...	...
	0.50	8.1	8.7	-0.6	V	...	...	...	...	...	...
TP64	0.90	8.4	8.9	-0.5	V	...	...	...	...	...	...
	0.00	7.8	7.3	0.5	V	9	< 0.003	< 0.005	1.8	<0.02	NASS
TP67	0.50	8.9	8.5	0.4	L	9.3	< 0.003	< 0.005	5.6	t	NASS
	0.00	8.1	6.5	1.6	V	9.4	< 0.003	< 0.005	1.5	B	NASS
	0.50	8.3	9.8	-1.5	X	...	...	...	...	...	...
	1.00	7.8	6.7	1.1	L	9.5	< 0.003	< 0.005	2.7	<0.02	NASS
	1.50	9.3	9.0	0.3	V	...	...	...	...	...	...
	2.00	8.1	8.9	-0.8	X	...	...	...	...	...	...
TP70	2.50	8.1	8.8	-0.7	X	...	...	...	...	...	...
	0.00	8.1	8.5	-0.4	X	...	...	...	...	...	...
	0.50	8.4	9.1	-0.7	V	...	...	...	...	...	...
	1.00	8.8	9.6	-0.8	V	...	...	...	...	...	...
TP72	1.50	9.0	9.4	-0.4	H	...	...	...	...	...	...
	0.00	8.6	8.3	0.3	H	...	...	...	...	...	...
	0.50	8.4	6.4	2.0	V	9.4	< 0.003	< 0.005	5.5	<0.02	NASS
	1.00	8.8	6.4	2.4	L	9.5	< 0.003	< 0.005	6.6	<0.02	NASS
	1.50	8.5	8.9	-0.4	V	...	...	...	...	...	...
TP72	2.00	7.9	8.8	-0.9	X	...	...	...	...	...	...

		Field Observations				Lab pH	Chromium Reducible Sulfur Suite				Acid Sulfate Soil Classification
Sample ID		pH _f	pH _{fox}	pH _f - pH _{fox}	Reaction Rate	pH _{KCl}	Titrateable Actual Acidity	Chromium Reducible Sulfur	Acid Neutralising Capacity	Net Acidity	
Location	Depth (m)	pH units	pH units	pH units	LMHXV	pH units	%S	%S	%S	%S	
		4	4	1	NV	NV	0.03	0.03	NV	0.03	NV
TP76	0.00	8.4	7.6	0.8	L	9	< 0.003	< 0.005	1.2	<0.02	NASS
	0.50	8.1	8.6	-0.5	X	...	...	...	...	...	...
	1.00	8.1	8.7	-0.6	V	...	...	...	...	...	...
	1.50	8.9	6.7	2.2	X	9.5	< 0.003	< 0.005	11	<0.02	NASS



Figures



Legend

- Site Boundary
- + Test Pit
- + Test Pit / Infiltration Test
- + Test Pit / Percolation Test
- + Test Pit / Percolation Test / Infiltration Test
- + Test Pit with Standpipe
- ACM Pipeline Corridor
- Indigenous Heritage
- Shell Scatter



NOTES
Aerial Imagery and Cadastre sourced from Landgate/SLIP

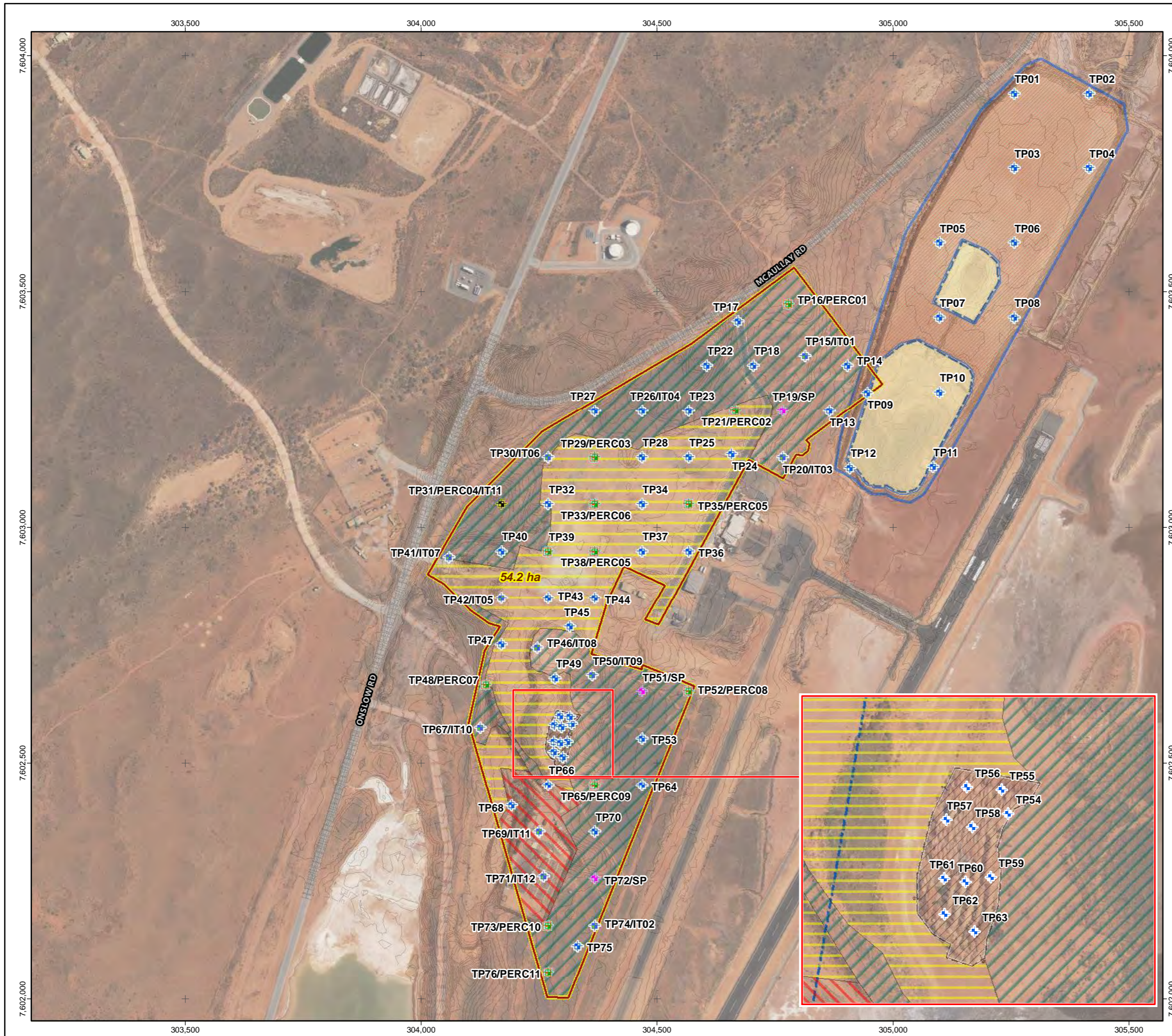


SCALE	1:8,000	(A3)
DRAWN	DAC	
DATE DRAWN	14/04/2022	
CHECKED	TM	
DATE CHECKED	11/04/2022	
PROJECTION	GDA 1994 MGA Zone 50	

Galt Geotechnics Pty Ltd
 ACN : 138 490 865
 Tel : +61 (0)8 6272-0200
 Address : 50 Edward Street
 Osborne Park WA 6017

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CLIENT	SHIRE OF ASHBURTON		
PROJECT	ONSLow INDUSTRIAL PARK (PHASE 1 AND 2)		
LOCATION	LOT 201 ONSLOW ROAD ONSLow		
TITLE	SITE & LOCATION PLAN		
Job No	J2201059	Fig No	FIGURE 1
Rev	A		



Legend

- Site Boundary
- + Test Pit
- + Test Pit / Infiltration Test
- + Test Pit / Percolation Test
- + Test Pit / Percolation Test / Infiltration Test
- + Test Pit with Standpipe
- Clayey Dredge
- Dredge spoil stockpile location
- Fill stockpiles
- Inferred airport borrow area
- Natural Ground
- Old Accomodation

N

NOTES
Aerial Imagery and Cadastre sourced from Landgate/SLIP

 SITE LOCATION	SCALE	1:8,000	(A3)
	DRAWN	DAC	
	DATE DRAWN	14/04/2022	
	CHECKED	TM	
	DATE CHECKED	11/04/2022	
PROJECTION	GDA 1994 MGA Zone 50		

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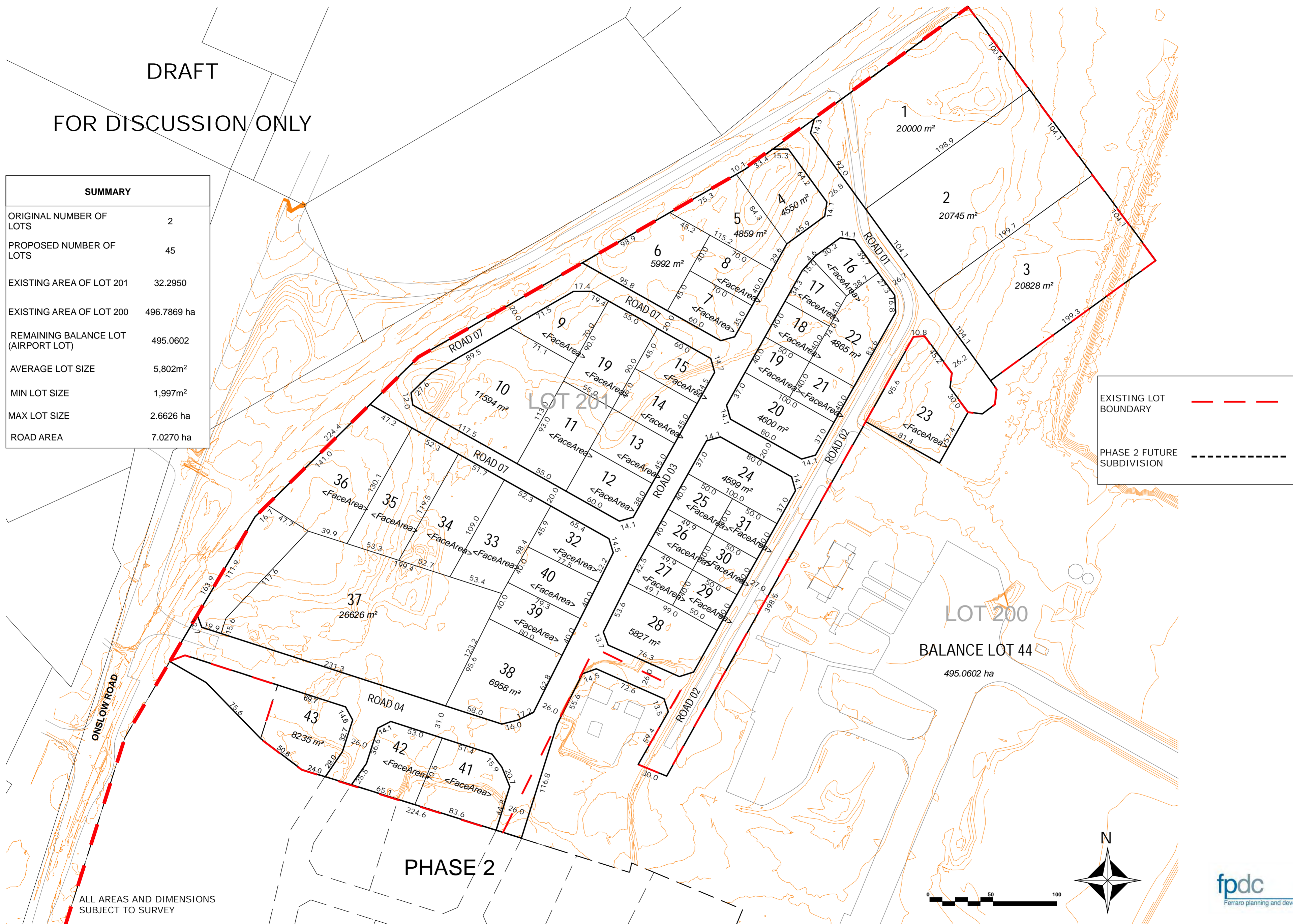
CLIENT	SHIRE OF ASHBURTON
PROJECT	ONSLow INDUSTRIAL PARK (PHASE 1 AND 2)
LOCATION	LOT 201 ONSLOW ROAD ONSLow
TITLE	ZONES
Job No	J2201059
Fig No	FIGURE 2
Rev	A



Appendix A: Concept Plans

DRAFT
FOR DISCUSSION ONLY

SUMMARY	
ORIGINAL NUMBER OF LOTS	2
PROPOSED NUMBER OF LOTS	45
EXISTING AREA OF LOT 201	32.2950
EXISTING AREA OF LOT 200	496.7869 ha
REMAINING BALANCE LOT (AIRPORT LOT)	495.0602
AVERAGE LOT SIZE	5,802m ²
MIN LOT SIZE	1,997m ²
MAX LOT SIZE	2.6626 ha
ROAD AREA	7.0270 ha



ALL AREAS AND DIMENSIONS
SUBJECT TO SURVEY

FIGURE 1.8

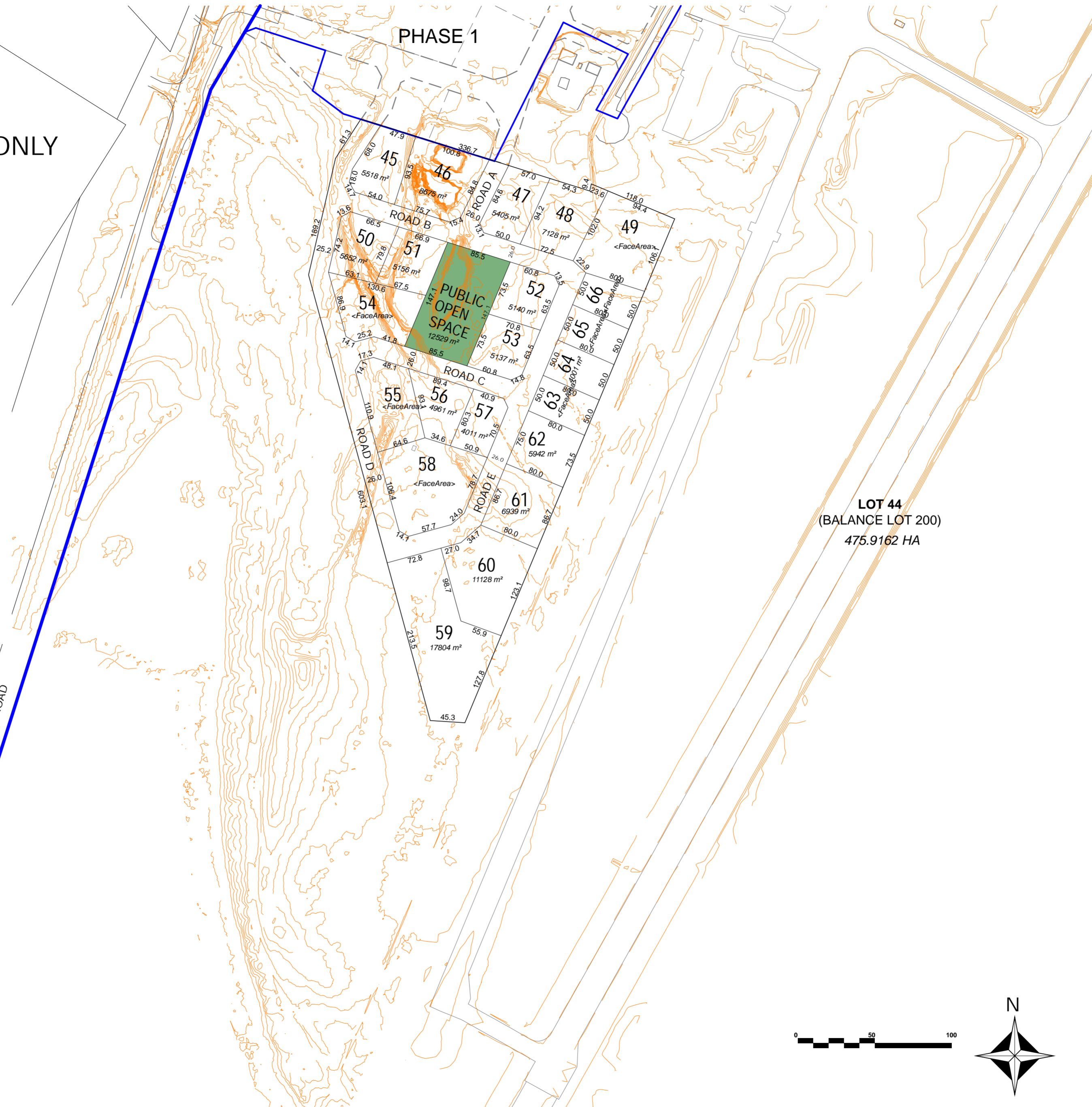
ONSLow INDUSTRIAL PARK PHASE 1 - PLAN OF SUBDIVISION



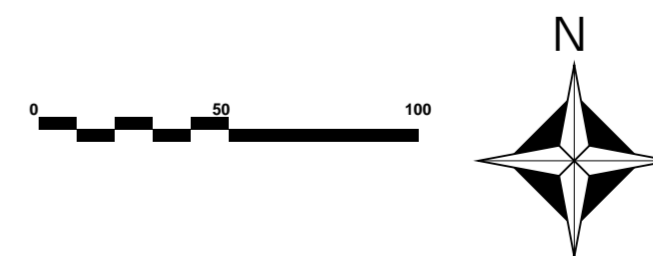
DRAWN 13 OCT 2021
 REVISION A: 18 OCT 2021
 DRAWN BY EF
 SCALE 1:2,000 @ A2
 LG ASHBURTON

DRAFT
FOR DISCUSSION ONLY

SUMMARY	
ORIGINAL NUMBER OF LOTS	1
PROPOSED NUMBER OF LOTS	22
EXISTING AREA OF LOT 200	496.7869 ha
REMAINING BALANCE LOT (AIRPORT LOT)	475.9162 ha
AVERAGE LOT SIZE	6,897m ²
MIN LOT SIZE	4,000 m ²
MAX LOT SIZE	1.7804 ha



ALL AREAS AND DIMENSIONS
SUBJECT TO SURVEY



DRAWN 14 OCTOBER 2021
 REVISION C: 5 NOVEMBER 2021
 DRAWN BY EF
 SCALE 1:4,000 @ A2
 LG ASHBURTON

FIGURE 2.5 ONSLOW INDUSTRIAL PARK PHASE 2 - PLAN OF SUBDIVISION



Appendix B: Site Photographs



Photograph 1: TP43 Area excavated for construction of adjacent airport



Photograph 2: TP22 Area of natural ground in northern portion of site



Photograph 3: TP64 Area of natural ground in southern portion of site



Photograph 4: Stockpiles of fill in southern portion of site



Photograph 5: near TP69, within old accommodation area



Photograph 6: Clayey dredge fill near TP12



Photograph 7: Sandy dredge fill near TP01



Appendix C: Test Pit Reports



METHOD OF SOIL DESCRIPTION BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG & SOIL CLASSIFICATION SYMBOLS

Graphic	USCS	Soil Name
		FILL (various types)
		COBBLES / BOULDERS
	GP	GRAVEL (poorly graded)
	GW	GRAVEL (well graded)
	GC	Clayey GRAVEL
	GM	Silty GRAVEL
	SP	SAND (poorly graded)
	SW	SAND (well graded)
	SC	Clayey SAND

Graphic	USCS	Soil Name
	SM	Silty SAND
	ML	SILT (low liquid limit)
	MH	SILT (high liquid limit)
	CL	CLAY (low plasticity)
	CI	CLAY (medium plasticity)
	CH	CLAY (high plasticity)
	OL	Organic SILT (low liquid limit)
	OH	Organic SILT (high liquid limit)
	Pt	PEAT

NOTE: Dual classification given for soils with a fines content between 5% and 12%.

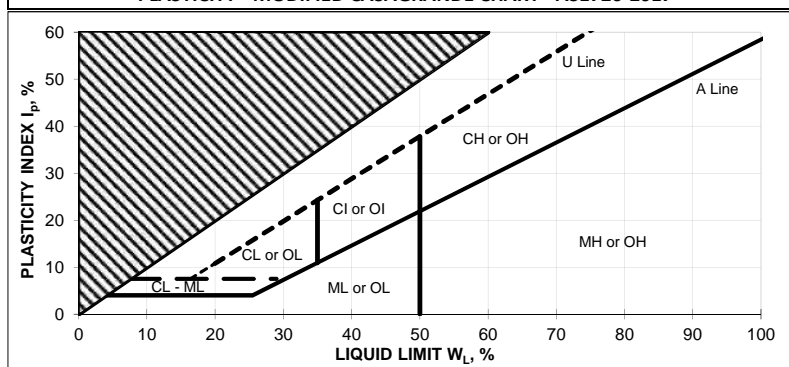
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-2017. Material properties are assessed in the field by visual/tactile methods in combination with field and laboratory testing techniques (where used).

NOTE: AS 1726-2017 defines a fine grained soil where the total dry mass of fine fractions (<0.075 mm particle size) exceeds 35%.

PARTICLE SIZE		
Soil Name	Particle Size (mm)	
BOULDERS	>200	
COBBLES	63 to 200	
GRAVEL	Coarse	19 to 63
	Medium	6.7 to 19
	Fine	2.3 to 6.7
SAND	Coarse	0.6 to 2.36
	Medium	0.21 to 0.6
	Fine	0.075 to 0.21
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY - MODIFIED CASAGRANDE CHART - AS1726-2017



RESISTANCE TO EXCAVATION		
Symbol	Term	Description
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION	
Symbol	Term
D	Dry
M	Moist
W	Wet

CEMENTATION	
Cementation	Description
Weakly cemented	Soil may be easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate the soil by hand in air or water

CONSISTENCY		
Symbol	Term	Undrained Shear Strength (kPa)
VS	Very Soft	0 to 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very Stiff	100 to 200
H	Hard	>200

ORGANIC SOILS	
Material	Organic Content % of dry mass
Inorganic soil	<2%
Organic soil	2% to 25%
Peat	>25%

DENSITY		
Symbol	Term	Density Index (%)
VL	Very Loose	<15
L	Loose	15 to 35
MD	Medium Dense	35 to 65
D	Dense	65 to 85
VD	Very Dense	>85

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS



METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

SUPPORT

T Timbering

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

WATER

▶	Water Inflow	▼	Water Level
◀	Water Loss (complete)		
◁	Water Loss (partial)		

SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

$$TCR = \text{Total Core Recovery (\%)} = \frac{CRL}{TCL} \times 100$$

$$RQD = \text{Rock Quality Designation (\%)} = \frac{ALC > 100}{TCL} \times 100$$

TCL Length of Core Run

CRL Length of Core Recovered

ALC>100 Total Length of Axial Lengths of Core Greater than 100 mm Long

Job Number: J2201059	Contractor: Munro Contractors	Machine:	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Operator: Colin	Logged: PF
Project: Onslow Industrial Park		Bucket: 600 mm wide rock	Checked Date: 13/04/2022
			Checked By: TM

Excavation			Sampling		Field Material Description								
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS	
E	F		0.0		B(TP01-1)	[Hatched Pattern]	SP	FILL: SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, with sub-angular to sub-rounded gravel, with shell fragments, trace fines	D	VD	TP01/0.00		
			0.5									TP01-1 TP01/0.50	
			1.0		B(TP01-2)					D - M		TP01/1.00	
			1.5									TP01-2 TP01/1.50	
			2.0									TP01/2.00	
			2.5					Hole terminated at 2.50 m Target depth Groundwater not encountered			TP01/2.50		
			3.0										

Sketch & Other Observations



Comments:

GALT LIB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45:10.02.00.04 Dargel DGD_CPT_Photo_Monitoring Tools Lib GALT 1.01 2015-02-21 Pit GALT 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0				SP	FILL: Gravely SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-angular to sub-rounded gravel (30%), trace fines, shell fragments	D	VD		
			0.5					FILL: SAND with Gravel, fine to coarse grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-angular to sub-rounded Gravel (10-15%), trace fines			TP02-PRI	
			1.0		B(TP02-2)							
			1.5				SP		D - M			
			2.0									
			2.5					Hole terminated at 2.50 m Target depth Groundwater not encountered				
			3.0									

Sketch & Other Observations



Comments:

GALT IUB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFile>> 14/04/2022 07:45 10:02:00.04 Dargel DGD_CPT_Photo_Monitoring Tools | Lib: GALT 1.01 2015-02-21 Pit: GALT 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation				Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		B(TP03-1)	[Cross-hatched pattern]	SP	FILL: Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, pale brown, grey and white, fine to medium grained, sub-angular to sub-rounded gravel, trace fines and shells		VD	TP03/0.00	
			0.5									TP03-1 TP03/0.50
			1.0				SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded pale brown, fine to medium grained, sub-angular to sub-rounded Gravel, trace fines			TP03/1.00	
			1.5								TP03/1.50	
			2.0		B(TP03-2)	[Silty gravel pattern]	GM	Silty GRAVEL: fine to medium grained, sub-angular to sub-rounded, dark brown/brown, with sand			TP03/2.00	
			2.5									TP03-2 TP03/2.50
			3.0					Hole terminated at 2.50 m Target depth Groundwater not encountered				

Sketch & Other Observations



Comments:

GALT IUB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFile>> I403/2022 07:45 10:02:00.04 Dargel DGD, CPT, Photo, Monitoring Tools Lib: GALT 1.07 2015-02-21 Pit: GALT 1.07 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0			SP		FILL: Gravelly SAND, fine to coarse grained, sub-angular to sub-rounded, pale brown, with shells, trace fines	D	VD	TP04/0.00	
			0.5	B(TP04-1)	TP04/0.50							
			1.0		TP04-1 TP04/1.00							
			1.5		TP04/1.50							
			2.0		TP04/2.00							
			2.5		TP04/2.50							
			3.0				Hole terminated at 2.50 m Target depth Groundwater not encountered					

Sketch & Other Observations



Comments:

GALT IUB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45:10.02.00.04 Dargel DGD, CPT, Photo, Monitoring Tools | Lib: GALT I.01 2019.02-21 Pjt: GALT I.01 2019.02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description				SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION			CONSISTENCY DENSITY
E	F		0.0				FILL: Sandy GRAVEL, fine to medium grained, sub-angular to sub-rounded pale brown/grey/white Gravel with pale brown soil, fine to medium grained, sub-angular to sub-rounded sand (20%), trace fines trace shells	D	D - VD	
			0.5			GP	Becomes more sandy (30-35%)			
			1.5				FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, brown, fine to medium grained, sub-angular to sub-rounded Gravel (15%), trace shells	D - M		
			2.0			SP				
			2.5				Hole terminated at 2.50 m Target depth Groundwater not encountered			
			3.0							

Sketch & Other Observations



Comments:

GALT IUB 1.01 G.L.B. Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45 10.02.00.04 Dargel DGD, CPT, Photo, Monitoring Tools | Lib. GALT 1.01 2015-02-21 Pit GALT 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation				Sampling		Field Material Description				SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS	
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION			CONSISTENCY DENSITY
E	E		0.0				GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-angular to sub-rounded grey/pale brown/white Gravel with pale brown soil, fine to medium grained, sub-angular to sub-rounded sand, trace fines, trace shells	D	VD	TP06/0.00	
			0.5				GP				TP06/0.50	
			1.0				SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, brown, fine to medium grained, sub-angular to sub-rounded Gravel (15%), trace fines	D - M		TP06/1.00	
			1.5				SP				TP06/1.50	
			2.0				SM	Silty SAND: fine to medium grained, sub-angular to sub-rounded, dark brown	M		TP06/2.00	
			2.5					Hole terminated at 2.50 m Target depth Groundwater not encountered			TP06/2.50	
			3.0									

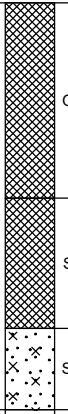
Sketch & Other Observations



Comments:

GALT IUB 1.01 G.L.B. Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45 10:02:00.04 Dargel DGD_CPT_Photo_Monitoring Tools Lib GALT IUB 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description			SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION			MOISTURE CONDITION	CONSISTENCY DENSITY
E	F		0.0			GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-angular to sub-rounded pale brown/grey/white Gravel and pale brown soils, fine to medium grained, sub-angular to sub-rounded sand (20-30%), trace fines	VD	
			0.5					D	
			1.0					D - M	
			1.5				SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, pale brown, fine to medium grained, sub-angular to sub-rounded Gravel (15%), trace fines	
			2.0			SM	Silty SAND: fine to medium grained, sub-angular to sub-rounded, dark brown, trace Gravel	M	
			2.5				Hole terminated at 2.50 m Target depth Groundwater not encountered		
			3.0						

Sketch & Other Observations



Comments:

GALT IUB 1.01 GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45 10:02:00.04 Dargel DGD_CPT_Photo_Monitoring Tools Lib GALT 1.01 2015-02-21 Pit GALT 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation				Sampling		Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0					FILL: Sandy GRAVEL, fine to coarse grained, sub-angular to sub-rounded pale brown/white/grey Gravel and pale brown soils, fine to medium grained, sub-angular to sub-rounded sand (20-30%), trace shells	D	VD	TP08-1	
			0.5				GP	Sand becomes brown	D - M			
			1.5				SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, pale brown, fine to medium grained, sub-angular to sub-rounded Gravel (15-20%), trace fines				
			2.0									
			2.5		B(TP08-1)			Hole terminated at 2.50 m Target depth Groundwater not encountered				
			3.0									

Sketch & Other Observations



Comments:

GALT IUB 1.01 GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45 10.02.00.04 Dargel DGD_CPT_Photo_Monitoring Tools | Lib: GALT IUB 1.01 2015-02-21 Pjt: GALT IUB 1.01 2015-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0				GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-angular to sub-rounded, grey/pale brown/white Gravel and pale brown soils, fine to medium grained, sub-angular to sub-rounded sand (20%), trace shells	D	D - VD		
			0.5					FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, pale brown, fine to medium grained, sub-angular to sub-rounded Gravel (15-20%), trace fines				
			1.0		B(TP09-1)			Gravel sized igneous rocks (basalt/dolerite) observed as gravel in soil				
			1.5				SP		D - M		TP09-1	
			2.0									
			2.5					Hole terminated at 2.50 m Target depth Groundwater not encountered				
			3.0									

Sketch & Other Observations



Comments:

GALT IUB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFile>> I403/2022 07:45 10:02:00.04 Dargel DGD_CPT_Photo_Monitoring Tools | Lib. GALT I.07 2019.02-21 Pjt. GALT I.07 2019.02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description			SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION			MOISTURE CONDITION	CONSISTENCY DENSITY
E	F		0.0				FILL: SAND, fine to medium grained, sub-angular to sub-rounded, orange red/pale grey, trace fines, with gravel, trace shells		
			0.5		B(TP10-1)	SP		VL - MD	
			1.0				FILL: Silty Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, orange/red, fine to medium grained, sub-angular to sub-rounded gravel		TP10-1
			1.5		B(TP10-2)	SM			
			2.0				Hole terminated at 2.00 m Target depth Groundwater not encountered		TP10-2
			2.5						
			3.0						

Sketch & Other Observations



Comments:

GALT IUB 1.01 G.L.B. Log GH EXCAVATION J2201059.GPJ <<DrawingFile>> 14/04/2022 07:45 10:02:00.04 Dargel DGD_CPT_Photo_Monitoring Tools Lib GALT 1.01 2019-02-21 Pjt GALT 1.01 2019-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation				Sampling			Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0				SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, brown, fine to coarse grained, sub-angular to sub-rounded gravel, trace fines, trace shells		VD		
			0.5		B(TP11-1)				D		TP11-1	
			1.0									
			1.5		B(TP11-2)			Trace cobbles and boulders, very minor isolated clayey material	D - M			
			2.0					Hole terminated at 2.00 m Refusal at test pit caves in Groundwater not encountered			TP11-2	
			2.5									
			3.0									

Sketch & Other Observations



Comments:

GALT IUB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 14/04/2022 07:45 10.02.00.04 Dargel DGD, CPT, Photo, Monitoring Tools Lib GALT 1.01 2019-02-21 Pit GALT 1.01 2019-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 12/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0		B(TP12-1)	[Hatched Pattern]	SP	FILL: SAND with Gravel, fine to medium grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-angular to sub-rounded gravel, trace fines			TP12/0.00	
			0.5		B(TP12-2)						TP12-1 TP12/0.50	
			1.0								TP12-2 TP12/1.00	
			1.5					Test pit caved			TP12/1.50	
			2.0					Hole terminated at 2.00 m Test pit keeps caving in on itself Groundwater not encountered			TP12/2.00	
			2.5									
			3.0									

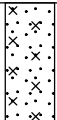
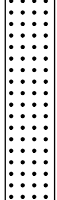
Sketch & Other Observations



Comments:

GALT IUB 1.01 GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFile>> 14/04/2022 07:45:10.02.00.04 Dargel DGD, CPT, Photo, Monitoring Tools Lib GALT 1.01 2019-02-21 Pit GALT 1.01 2019-02-21

Job Number: J2201059	Contractor: Munro Contractors	Machine: 9 Ton Cat432F	Date: 08/03/2022
Client: Shire of Ashburton	Location: Lot 201 Onslow Road, Onslow	Backhoe:	Logged: PF
Project: Onslow Industrial Park		Operator: Colin	Checked Date: 13/04/2022
		Bucket: 600 mm wide rock	Checked By: TM

Excavation			Sampling		Field Material Description							
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	SAMPLE	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0				SM	Silty SAND: fine to medium grained, sub-angular to sub-rounded, red brown, silts, low plasticity, trace gravel, trace fine roots			TP16/0.00	
			0.5						D		TP16/0.50	
	H		1.0					SANDSTONE/LIMESTONE: fine to coarse grained, sub-angular to sub-rounded, white, with Silty SAND soil matrix (20-30%) as described above			TP16/1.00	
			1.5								TP16/1.50	
			2.0					Hole terminated at 2.00 m Refusal on hard rock Groundwater not encountered			TP16/2.00	
			2.5									
			3.0									

Sketch & Other Observations



Comments:

GALT LIB 1.01.GLB Log GH EXCAVATION J2201059.GPJ <<DrawingFiles>> 1403/2022 07:45 10:02:00.04 Dargel DGD, CPT, Photo, Monitoring Tools Lib GALT 1.01 2015-02-21 Pit GALT 1.01 2015-02-21

