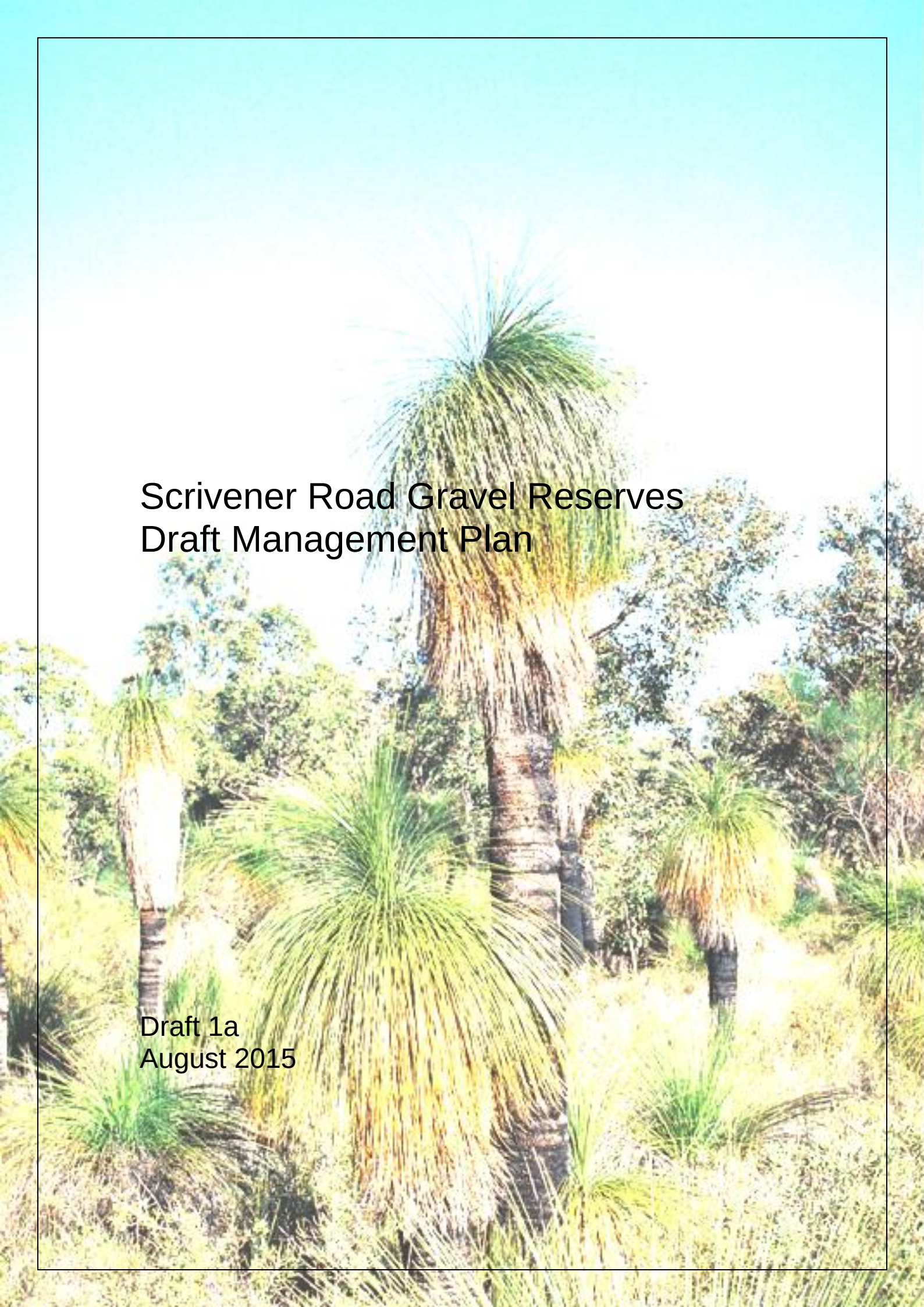

Scrivener Road Gravel Reserves
Draft Management Plan

Draft 1a
August 2015

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1. Executive Summary

1.1 Introduction

Scrivener Road Gravel Reserves (also referred to as 'the reserves'), located at the top of the scarp south of Serpentine, are biodiverse and environmentally significant local natural area reserves, particularly valuable as one of only a few locations where all three protected black cockatoo species have been recorded nesting. The reserves are managed by the Shire of Serpentine Jarrahdale for the purpose of gravel and conservation and it has been recommended that the Scrivener Road Reserves eventually be added to the Serpentine National Park. Gravel supplies from the existing pits have been exhausted, and permission has not been granted at the current time to clear further areas of vegetation to extend the pits. Recently the Shire has been purchasing gravel for road construction from distant expensive sources. It is now supported more widely that available gravel reserves are utilized before areas are included in the national parks subject to the creation of value adding rehabilitation offsets.

1.2 Objectives

Information for a management plan for the Scrivener Road Gravel Reserves was collated in 2008. This information has been incorporated into this management plan. The objectives of this management plan are to:

- Provide the necessary background information and site descriptions for informed management of the reserve;
- Provide a plan for including the reserve into Serpentine National Park following mining and progressive offset rehabilitation;
- Define specific management objectives for maintaining and improving the conservation values of the reserves:
    1. Assess the vegetation quality and potential for rehabilitation;
    2. Assess the major problems affecting safety, aesthetics, fire management and weed control;
    3. Assess the types and degree of environmental degradation and possible ways to address these; and
    4. Provide plans to follow when mining, processing, stockpiling and rehabilitating Scrivener Road Gravel Reserves;
- Document the actions required to successfully enhance and manage the reserves;
- Identify any management constraints and possible ways to overcome them;
- Ensure continuity of management in the future, so that the goal or focus is clearly defined and easy to follow; and
- Provide the community with the opportunity to become involved in the decision-making process for the reserve.

1.3 Location and Description

The Scrivener Road Gravel Reserves are located at the top of the scarp south of Serpentine, and consist of two reserves, R26080 and R26079. R26080 contains the two historical gravel pits and is divided into three parcels of land, two of which adjoin Scrivener Road (L1913) while the third lies to the south (L2272). R26079, to the southwest of R26080 also consists of three parcels of land, dissected by Firns Road (see Figures 1 - 3). The reserves adjoin Serpentine National Park to the west and east, and Karnet Nature Reserve to the south.

Two tributaries of the Serpentine River run to the north and west of the reserve; the river empties into the Peel Harvey Estuary. The total area of the two reserves is approximately 120 hectares.

1.4 Report Structure

The report is structured into the following sections:

- Legislative and policy framework (Governance):
  - *Identifies the existing tenure, legislation and policies that apply and therefore have management implications for the reserve.*
- Physical and biological characteristics (Environmental):
  - *Identifies landform, land, water and biodiversity features of the Study Area. Threats to these features have also been considered.*
- Cultural and social characteristics (Social and Economic):
  - *Identifies the main human land uses of the Study Area, with consideration given to issues such as historical current and future land uses, access, scientific interest and heritage.*
- Implementation:
  - *Provides guidance to Council and the community on implementation mechanisms for each management action and priorities, responsibilities and potential costs and partners.*

1.5 Key Priority Actions

- Rehabilitate the reserves in accordance with the approved management plan adding value to the reserves, manage the reserves with an additional management purpose for conservation and progress staged extraction and rehabilitation through clearing application and offset provision.

- Prepare a Storm Water Management Plan monitor water erosion and include in-stream structures to assist in slowing down water velocity.

- Prepare and monitor the implementation of a Mining, Processing and Stockpiling Plan (Figure 2).

- Conduct annual audits and improvement works for meeting targets and maintaining appropriate surface water management standards.

- Review annually and implement a Weed Control Plan that maps and identifies weed species within the reserve, and identifies target areas and appropriate techniques and strategies to reduce weed density and weed seed sources in the gravel pit and surrounds.

- Monitor the establishment of plant communities in meeting the completion criteria and review supplemental planting requirements as necessary.

- Seek approval for a Fire Management Plan in conjunction with the Department of Parks and Wildlife. Ensure any prescribed burning in the reserve conforms to the Fire Management Plan.

- Control access through the provision of gates, barriers or trenches to the reserve's pit area.

- Report before the end of each financial year to the Department of Environment Regulation and Parks and Wildlife on fauna species contacts and rehabilitation offset plantings accompanied by a description of the planting, the number of plants and the species composition, structure and density.

- Refer the proposal to the Federal Department of Sustainability, Environment, Water, Population and Community (SEWPaC) for their consideration.

Figure 1: Scrivener Road Gravel Reserve Location - Lots and Cadastre

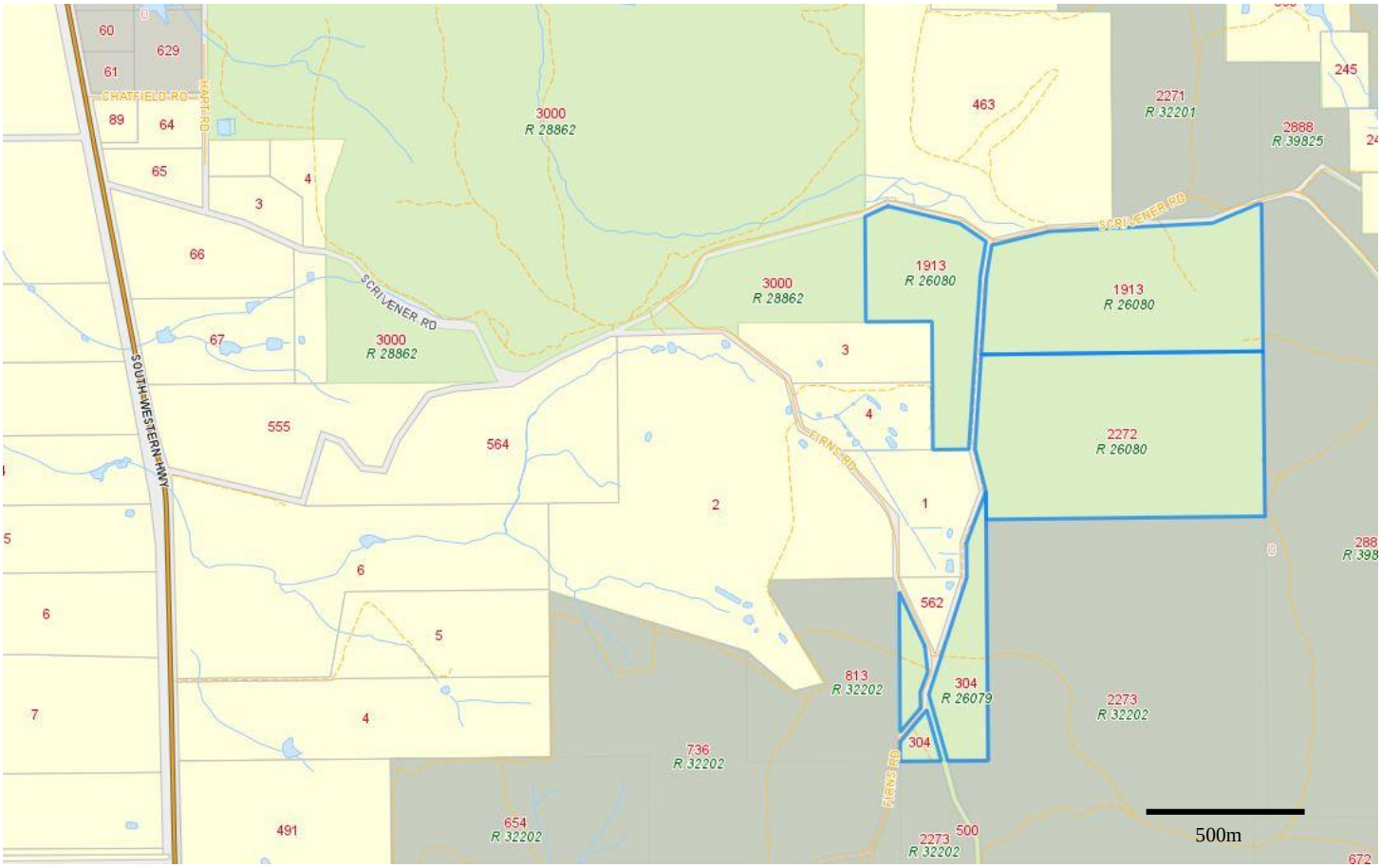


Figure 2: Scrivener Road Gravel Reserve Outline

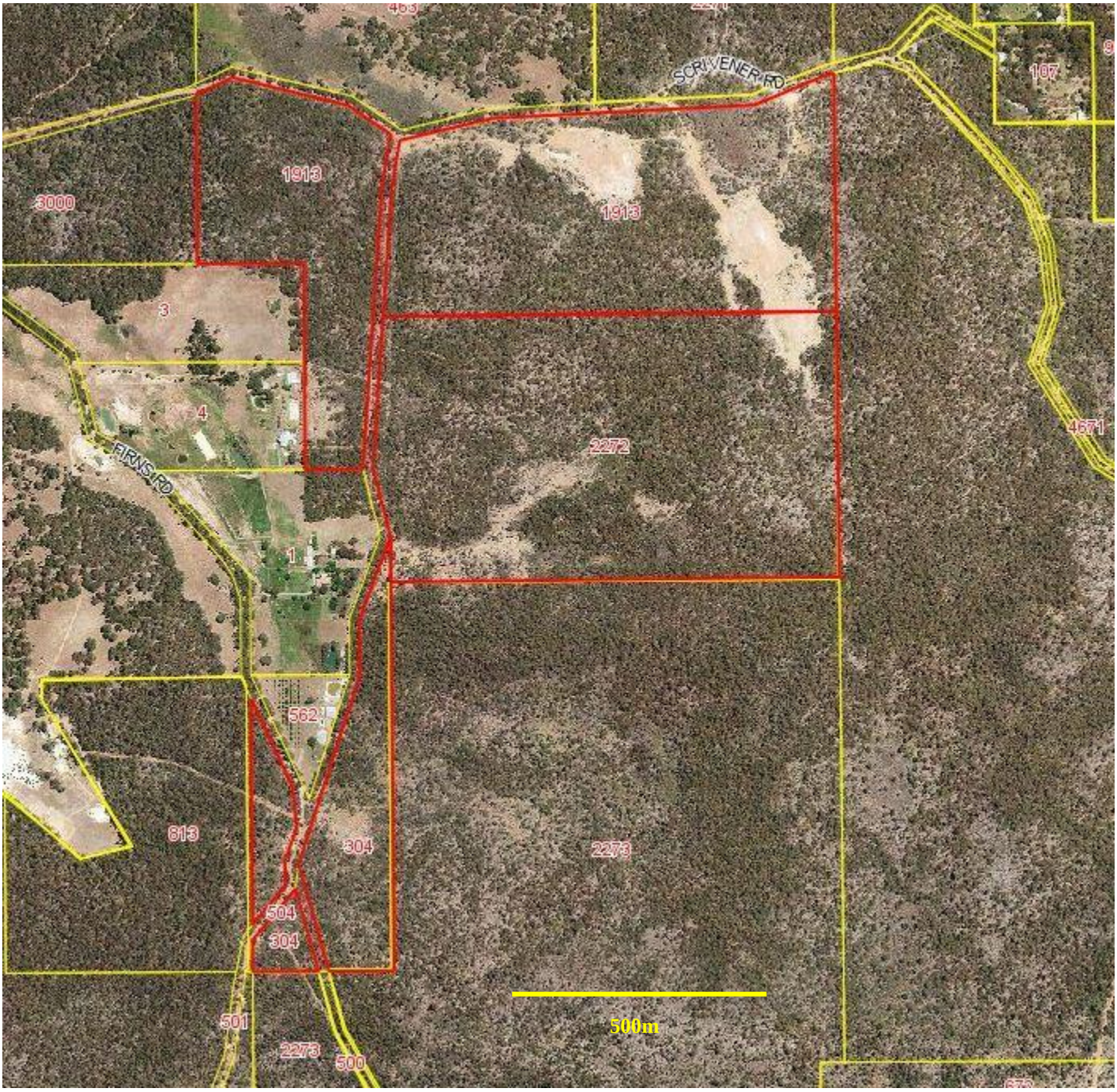
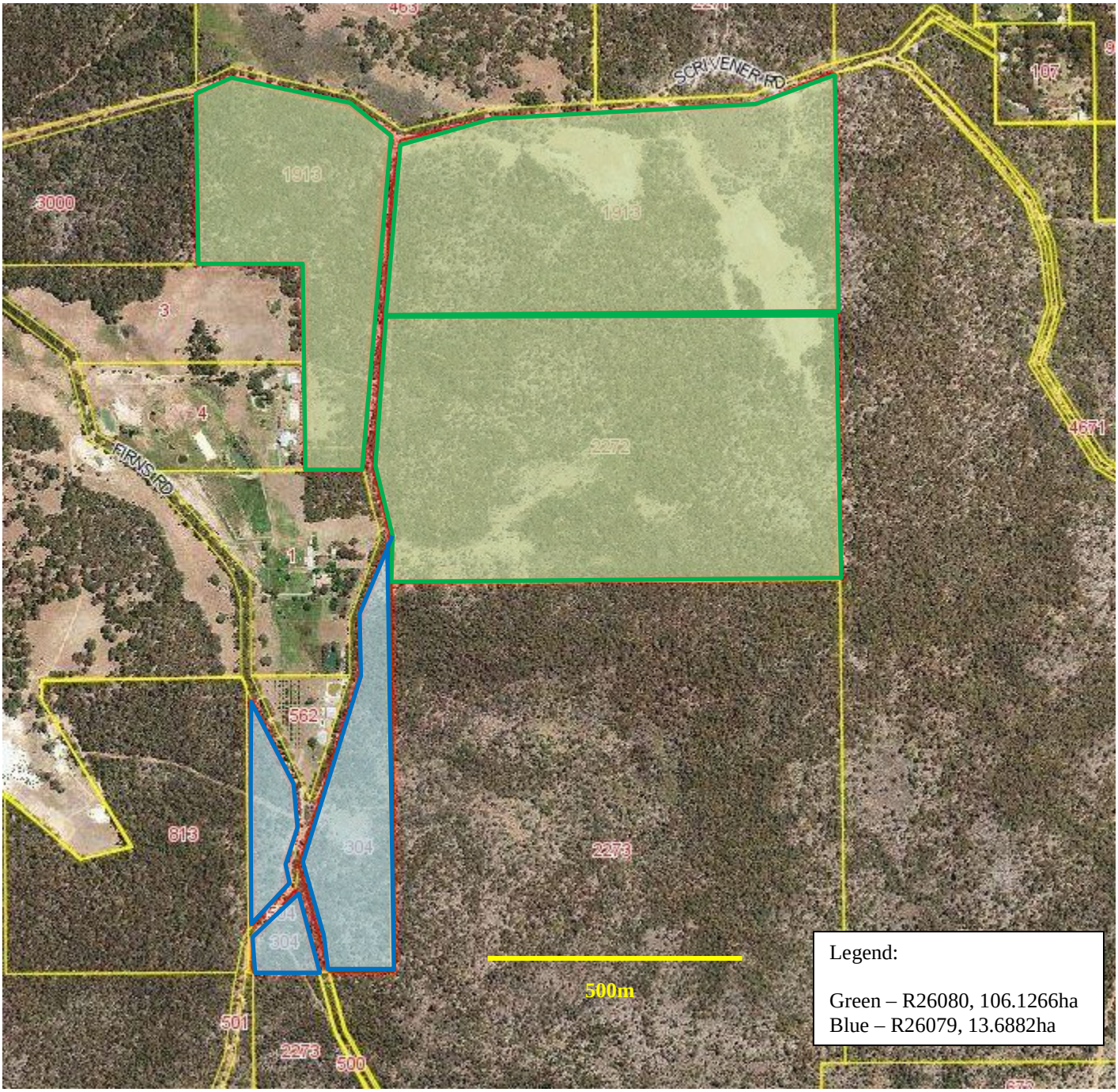


Figure 3: Scrivener Road Gravel Reserve Sections



2. Governance

2.1 Vesting

Scrivener Road Gravel Reserves are vested with the Shire of Serpentine Jarrahdale for the purpose of gravel. Owing to the biodiverse flora and significant fauna communities inhabiting the reserves, it is recommended that the vesting be changed to include conservation as a purpose for the reserves and eventually inclusion into the Serpentine National Park following further mining and rehabilitation offset provision.

Table 2: Scrivener Road Gravel Reserve Characteristics

	R26080			R26079		
	L1913 west	**L1913 east**	**L2272**	**L304 north**	**L304 south**	**L303**
MRS Zoning	Parks & Recreation	Parks & Recreation	Parks & Recreation	Parks & Recreation	Parks & Recreation	Parks & Recreation
TPS Category	Not within TPS2	Not within TPS2	Not within TPS2	Not within TPS2	Not within TPS2	Not within TPS2
Lot Type	Crown Reserve	Crown Reserve	Crown Reserve	Crown Reserve	Crown Reserve	Crown Reserve
Native Vegetation ID	1905	1905	1905	993	993	993
Bush ID	6931	6931	6931	6931	6931	6931
SWBP	PSLNA	PSLNA	PSLNA	PSLNA	PSLNA	PSLNA
Reserve Class	C	C	C	C	C	C
Heritage Features	No	No	No	No	No	No
Landscape Protection Policy Draft Area	Yes	No	No	No	No	No

2.2 Land Tenure

The land tenure and vesting purpose of the several sections of Scrivener Road Gravel Reserves (as shown in Figures 1 - 3) are shown in Table 3.

Table 3: Scrivener Road Gravel Reserve Locations and Uses

Reserve Name	Reserve Number	Area (ha)	Land Transfer Date	Purpose	Current Use
L1913 west	R26080	18.5252	1961	Gravel	Conservation
L1913 east		37.3095	1961	Gravel	Conservation
L2272		50.2919	1961	Gravel	Conservation
L304 north	R26079	9.6619	1961	Gravel	Conservation
L304 south		1.4076	1961	Gravel	Conservation
L303		2.6187	1961	Gravel	Conservation

2.3 History

Prior to reservation with the Shire, Scrivener Road Gravel Reserves were part of State Forest, and historically harvested for timber and managed for various multiple uses. In 1961, the reserves were vested with the Shire of Serpentine Jarrahdale for the purpose of gravel. Two gravel pits were established, and the extracted gravel was used for the Shire's road construction, road maintenance and upgrading of the existing road network.

In 1995, the Western Australian Planning Commission granted planning approval for the extraction of gravel for a period of 10 years. By 2003 it was evident that the two existing pits would soon be exhausted. In 2006, extraction and crushing operations from the floor of the pits occurred, and the gravel was stockpiled for later use. An application to clear 2.3 ha of vegetation between the existing pits for the further extraction of gravel was refused, and the Shire was informed by the State that operations at the reserve must cease until which time as a management plan could be put into place.

The reserves have been identified for future inclusion into the Serpentine National Park, in a number of important forest management and planning documents. The proposed inclusion was investigated to be in exchange for another area suitable for the extraction of gravel, with the resource to be of similar volume and condition. An area off Admiral Road was offered but considered to be unsuitable due to its smaller area and volume of resource, short lease (three years), more than half the area unable to be extracted due to being within the Wungong Dam catchment, and infection with dieback (*Phytophthora cinnamomi*). No other reserves have been identified or offered for gravel extraction, no areas of private property are available for lease, and in 2015 the Shire is obtaining gravel from distant locations, entailing considerable transportation costs.

From 2001 to 2007, the Shire provided funding to the Western Australian Museum for the purpose of cockatoo monitoring on the reserves. Scrivener Road Gravel Reserves is one of only a few areas where all three species of threatened black cockatoos have been recorded nesting, and as such is highly significant for their conservation. More recently, artificial nest boxes (cockatubes) have been installed at the reserves by SJ Landcare Inc in numerous locations.

2.4 Bush Forever

The reserves have not been recognised as regionally significant through Bush Forever, as they lie outside the area considered for Bush Forever status; they are not known to contain threatened or priority flora, although two threatened and one priority species have been recorded within the adjacent Serpentine National Park. There are records of threatened and priority fauna (black cockatoos) nesting within the reserves, quenda (priority 5 fauna) are likely to occur in the area, and chuditch (priority 1 fauna) may occur in the national park.

3. Environmental Characteristics

3.1 Physical Features

3.1.1 Land

Description

The soils of Scrivener Road Gravel Reserves are part of the Darling Plateau system, consisting of lateritic soils and gravels (Table 5) and represent the remnants of an ancient soil horizon developed on the granites and gneisses of the Western Gneiss Terrine that underlie the area. The typical profile of the deposit is a grey brown sand loam soil over yellow brown pisolitic gravels and laterite cap rock of up to 5 metres thick. Under the cap rock lies 1-2 metres of gibbsite (aluminium hydroxide) which in turn overlay variable depths of clay typically 10-20 metres thick. The clay is mottled red, yellow and brown in the upper region, but white below the water table nearer the granite basement. The ferricrete raw material is a combination of the gravels, lateritic cap rock and gibbsite layers. This soil and the Mediterranean-type climatic zone both influence the dominant vegetation types in the area.

The Darling Plateau is ancient. The basement rocks are around three billion years old and are deeply weathered in the upland areas and eroded along the western edge. The part of the Plateau lying within the Shire boundaries has an elevation of between 250 and 350 metres above sea level. The reserves rises from 248 metres in the northwest to 318 metres in the southeast. The western edge of the plateau drops away steeply to meet the coastal plain at about 60 metres above sea level.

Table 5: Landform and Soil Classifications

Geomorphic Region	Soil Landscape Zone	Soil Landscape System	Soil Group
Darling Plateau	Western Darling Range	Darling Plateau	Dwellingup 2
		Murray Valleys	Yarragil 1

The Darling Plateau and Scarp

The Plateau is part of the Yilgarn Craton, one of the oldest landscapes in the world, with basement rocks of granite and gneiss with some dolerite intrusions. The granitic rocks have been extensively weathered into laterite formations, and the less eroded parts of this landscape usually have gravel in the surface profile.

The Plateau is a gently undulating land form. The gently undulating upland soils belong to the Dwellingup Subsystem, and consist of well drained, shallow to moderately deep gravelly brownish sands, pale brown sands and earthy sands over the weathered laterite base. The colluvial soils of the river and stream valleys and surrounds belong to the Murray Valley System which includes the Helena, Murray and Myara subsystems.

Condition and Status

The condition of the land through most of the plateau is good, as a vegetation cover of forest and woodland has been retained. Most of this area is managed as State Forest, water catchment or for conservation purposes.

Along the Scarp, areas of the slopes have been cleared for agricultural use. This has exposed the land surface to wind and water erosion, and led in some areas to loss of sediments, nutrients, organic matter, and soil water retention capabilities. Impacts to soil have resulted from overly intensive grazing, inappropriate excavation, landfill and machinery use.

Major Threats and Pressures

Poorly managed human activities from broad acre agriculture can lead to degradation of the soils. In recent years, soil degradation on rural residential holdings and “hobby farms” has highlighted the need for training in land management. There are also ongoing problems of soil degradation associated with broad acre agriculture. The range of degrading processes include phosphorus (and other nutrient) export, water and wind erosion, secondary salinity, soil structure decline, subsurface acidification, waterlogging and flood. Land degradation is a result of a complex interplay between land and soil properties and their management. Good land management requires a range of highly developed knowledge and practical skills. Excavation for extraction of gravel can also causes degradation and significant alteration of the soils. Inappropriate access by vehicles and motorcycles to the gravel pit area can also introduce weeds and disease and can cause further land degradation to vegetation.

Erosion

Erosion is the removal of topsoil, and in extreme cases (often including along fire breaks), deeper layers of the soil profile by the action of water or wind. This means a permanent loss of part of the land asset. The risk of erosion depends on the stability of the surface soil, often affected by the amount and type of vegetation cover (such as native perennial, pasture annual, or pasture perennial) and the force of the wind or water moving across the surface. Water speed is largely determined by slope, although level areas may be affected by water flowing from adjacent land. Water erosion is an accelerating process, as bare eroded areas generate more surface runoff, increasing the volume and speed of water movement downslope. Bare areas such as the slopes and floors of gravel pits can also be at risk of erosion.

Grazing

Scrivener Road Gravel Reserves have not been grazed by stock, but significant impacts from kangaroos and rabbits grazing are evident on the native vegetation. This can result in land degradation and erosion, which can impact on the reserve’s conservation values. Grazing can contribute to soil compaction, tree ringbarking, altered patterns of run-off, nutrient build-up in the soil, introduction of weeds, and consumption of the valuable leaf litter which normally provide the soil with essential nutrients. A combination of these problems may lead to a decline in understorey vegetation and associated fauna.

Salinity

Surface salinity is a condition where the level of soluble salts in the surface soil is high enough to affect plant growth. It can be natural or anthropogenic, and can be caused by

rising water tables or evaporation of surface water. Salinity alters the chemical balance of the soil and limits plant growth. This leads to the secondary impacts of bare sealed surfaces with low infiltration and increased runoff and erosion. Salinity is not currently known to affect the reserve.

Acid Sulphate Soils

Acid sulphate soils are sediments containing iron sulphides, which occur naturally in layers of waterlogged soils and are benign until disturbed. This is unlikely to be a problem in the reserve, as the soils are well-drained (not waterlogged) for the most part and soil disturbance to the level of the water table is minimal. As such, the reserve is classed as acid sulphate soil category 3, with no known risks.

Gravel Extraction

Lateritic (ferricrete) soils and gravels cover the surface of the reserve and represent the remnants of an ancient soil horizon developed on the granites and gneisses of the Western Gneiss Terrane that underlie the area. The typical profile of the deposit is a grey brown sand loam soil over yellow brown pisolitic gravels and laterite cap rock of up to 5 metres thick. Under the cap rock lies 1-2 metres of gibbsite (aluminium hydroxide) which in turn overlay variable depths of clay typically 10-20 metres thick. The clay is mottled red, yellow and brown in the upper region, but white below the water table nearer the granite basement.

The ferricrete raw material is a combination of the gravels, lateritic cap rock and gibbsite layers. Removal of these layers causes significant and irreversible alteration of the soil profile, leaving bare areas which can be problematic to rehabilitate due to the altered conditions and consequent differing survival of the usual species present in the area.

3.1.2 Water

Description

Water assets provide a variety of ecosystem services, such as draining the excess surface water from the landscape and minimising flooding. The groundwater resources provide a water storage function that interacts with the surface waterways and wetlands. During long dry spells the groundwater supports surface water and wetland ecosystems as well as its own unique ecosystem. Dams can create important reservoirs of water for a range of uses, but can result in loss of important riparian areas required for wildlife habitat and loss of important environmental flow needed for the sustainability of riparian and river bed habitat.

There are no stream courses on the reserve and most of the precipitation penetrates the gravels and cap rock to flow to the north and west as shallow ground water through the surface layers of soil. Runoff occurs more commonly in the gravel pits which are bottomed in clay and cap rock with no or little vegetation. In general this drainage follows the remaining surface flow with the exception of the gravel pit to the east where some ponding of precipitation occurs. A low lying area to the north east of the reserve shows intermittent wetland features and vegetation.

Surface Water

Scrivener Road Gravel Reserves are within the Serpentine Catchment, which contributes around 15 percent of the total annual surface inflow to the internationally significant Peel

Harvey Yalgorup Ramsar Wetland Site. Maintaining and improving the quality of the catchment runoff is vitally important to protecting the health of the estuary.

Serpentine River and Dams

The Serpentine River is the most significant natural waterway in the Shire of Serpentine Jarrahdale. It rises to the east of the Shire and traverses the Shire from the southeast corner to the western boundary where it discharges to a large artificial drain. The River is dammed at two points in its upper reaches on the Darling Plateau. The smaller pipehead dam was completed in 1957 and the larger dam upstream in 1961. These reservoirs are an important source of water for the metropolitan region and their catchments are carefully managed to maximise water supply and quality.

Drainage Network

Overly efficient drains and clearing in and around streams has resulted in excessive loads of silt and nutrients being transported from the Shire's land surface into drains, streams and the estuary. The severity of this problem was recognised in the 1980s when the Peel-Harvey Estuary's ecosystem came close to collapse because of high nutrient levels. Most of these nutrients and eroded sediments come from the coastal plain.

Wetlands

Wetlands are, in general, expressions of the groundwater table and play an important role in the water cycle. In winter they store surface water, and in summer water evaporates from the surface. Many wetlands have been drained and filled, so they are a diminishing and threatened asset. Wetlands have an intrinsic place in the regional ecology and this role is discussed under biodiversity.

Groundwater

There is a natural variation in groundwater salinity. It is possible that lower groundwater tables and excavations could have exposed acid sulphate soils and released acid plumes into the groundwater of the coastal plain. It is also probable that there has been some level of nitrogen and phosphorus enrichment of groundwater in places, especially beneath the sands of the coastal plain. The impact of this and any other pollutants will depend on complex biological, chemical and physical processes in the groundwater systems. The information on groundwater quality in the area of the reserve is even more limited than for the coastal plain, but it is believed to be good, and there are no problems which are currently thought to affect the area.

Major Threats and Pressures

The most significant threats to the water asset relate to both lower recharge rates and higher demand for use. The predicted climate changes, leading to significantly lower rainfall, would have a major effect on recharge, while the expanding population is likely to increase the demand for use. Other significant threats to the asset are actions that reduce water quality, including lowering of the water table and exposure resulting in acid sulphate soils, nutrient export and chemical pollutants.

Climate Change

Current models suggest that rainfall will decrease by as much as 20 percent by the year 2030, while temperatures will increase. The exact impact on water assets is still unknown because of the complex processes involved. However, it is anticipated there will be

significantly less water entering the system, and the higher temperatures will lead to higher levels of evapotranspiration as well as higher demand for human uses.

Overall the water asset will become increasingly precious and there will be a need to be far more efficient in water use and more effective in surface water management.

Eutrophication (Nutrient Enrichment of Aquatic Ecosystems)

Scrivener Road Gravel Reserve falls within the catchment of the Peel-Harvey Estuary, an ecosystem which has been under extreme pressure from eutrophication. Many land uses continue to contribute significant nutrient loads to this estuary. These nutrients also impact directly on the ecology of the Serpentine River and other waterways.

Broad acre agriculture currently makes up about 90 percent of land use within the Peel Harvey Catchment and is the source of the majority of nutrients reaching the estuary. At present, urban and rural living land uses make up only 6 percent of the catchment area, but these land uses contribute much more than 6 per cent of nutrient loads. Possible sources of nutrients from urban and rural living land uses include septic tanks, eroded soil particles and over-fertilising of small areas of pasture or lawn. All of these possible sources are cumulative and likely from the area surrounding the reserve.

Siltation and Pollution of Surface Waters

Allied to the export of nutrients from the land surface is the export of soil particles and organic matter. The soil particles are often the carrier for nutrients, thereby creating part of the threat discussed above. They also directly impact on the water systems by increasing the turbidity of the water, filling pools and sometimes creating barriers to drainage that can lead to flooding. Erosion is known to be a problem within the reserve, and thus the area is likely to be a contributor of soil particles, and potentially nutrients, to downstream areas.

Salinity

Salinity is not a major problem for the reserve as it (and its upstream catchment area) does not suffer from rising saline groundwater. However, some areas of the Shire are affected by surface salinity, so it is likely that there has been some effect on the salinity of other waterways. The salinity of the groundwater varies and is high in some places due to the high salt content of the aquifer sediments. It is also noted that groundwater discharging to the Serpentine River has higher salt levels.

The salinity of wetland systems generally increases through the summer due to high evaporation and decreases when flushed by the winter rains. This winter flushing effect may be a key factor in preventing salinity, and the predicted decrease in the length and volume of winter rains could therefore increase the risk of salinity. An increase in the area of salt affected land in a catchment could also affect the salinity levels in surface and groundwater systems. Salinity is a threat to the water asset that requires further study.

Over-Use of Groundwater

Groundwater levels across the Shire are declining in both the deeper and surface aquifers. The greatest declines are consistent with the areas of most intensive development and particularly with a high number of domestic water bores. With the likelihood of lower rainfall in the future the situation will most likely deteriorate. It is unclear how this may affect the

reserve, although it is known that declining groundwater levels are likely to put vegetation under stress resulting in negative impacts.

Acid Sulphates, Nitrates and Other Pollutants

Exposure of acid sulphate soils through either excavation or lowered water tables can result in plumes of sulphuric acid and heavy metals entering the surface and groundwater systems.

Nitrate pollution has been found under horticultural areas north of Perth. Intensive use of fertilisers and intensive stocking such as feedlots creates a high risk of nitrogen leaching into the groundwater, particularly on sandy soils. Pesticides and other chemicals also pose a serious risk to ground and surface water systems. Careful management of all these materials, especially close to surface water or in high recharge areas, is essential.

Changing Hydrology

Climate change, the continuing and increasing over-use of groundwater resources are a significant threat to the hydrological balance. As more areas of the Shire are developed for residential use there will be other major changes to the hydrology. As water becomes increasingly precious there will be more pressure to store and reuse the surface water that is now flushed out to sea. All of these factors may influence the reserve in the future.

3.1.3 Climate, Rainfall and Air Quality

Description

The climate of this region is described as Mediterranean-type, because of the similarity to weather patterns experienced in the region of that name. It is a mild climate with hot, dry summers and cool, wet winters. The average annual rainfall varies from 800 to 1000 mm on the coastal plain area, increasing to 1200 mm on parts of the Darling Plateau. Most of the rain falls during the winter. Decaying tropical thunderstorms occasionally bring heavy rainfall to the region during summer or autumn.

The climate is currently much drier than it has been since the beginning of the last century. The innate variability of the climate makes it difficult to make long term predictions and climatic models also vary. Since the 1950s there has been a substantial decline in rainfall coupled with a slight increase in temperature. It is uncertain how much of this decrease in rainfall is due to natural variability and how much is caused by greenhouse effect. Nevertheless, current studies strongly suggest that winter rainfall will continue to decline putting greater pressure on this reserve.

Prevailing winds are generally easterly in the morning and westerly in the afternoon. The dominant wind flows are katabatic easterly winds in winter which flow down valleys of the Darling Scarp on winter mornings, and strong sea breezes from the south west on summer afternoons. These winds can be quite strong and are capable of blowing dust and carrying it further from any active site.

Major Threats and Pressures

CSIRO studies predict that Western Australia will be much warmer and drier by 2030. Autumn and winter rainfall is likely to decrease by around 20 percent from 1990 values. Spring rainfall also is also expected to decrease somewhat and temperatures may rise by

up to 2 degrees. The higher temperatures will cause higher evaporation and, coupled with decreased rainfall, will significantly affect the water balance. Rainfall events are expected to become more intense, leading to higher runoff generation, especially on soils with low infiltration rates.

Loss of Vegetation

Vegetation plays an important role in creating a healthy ecosystem. This includes agricultural areas and remnant vegetation. Vegetation cycles carbon and nutrients, filters the air and modifies the local climate through evapotranspiration, shading and windbreak effects. Clearing of vegetation for urban and more intensive development needs to be balanced by revegetation and remnant vegetation protection.

3.2 Biodiversity

Description

Protecting biodiversity means conserving the full range of genes, species and ecosystems into the future. Given the range of threatening processes, including the prospect of climate change, this will be no mean feat. Protecting biodiversity is, however, essential, as biodiversity underpins the processes that support life, including human life, on this planet.

A variety of strategies have been adopted to protect biodiversity at State and Federal levels. One strategy is to conserve adequate areas of the full range of natural ecosystems. The assumption is that preserving representative ecosystems will also preserve the full variety of species and genes. Unfortunately, the extent of ecosystem destruction has been so great that it is no longer possible to protect some ecosystems. This strategy therefore needs to be supplemented by other approaches such as recovery projects for threatened flora and fauna.

The State Government manages a system of national parks, nature reserves and conservation parks that aims to be comprehensive, adequate and representative. It also conducts a number of recovery programs for threatened species and communities.

This Shire is part of the Southwest Botanical Province, which has been recognised as a global biodiversity hotspot. Not only does this area boast a high diversity of species, but many of these plants and animals are found nowhere else in the world. The management and protection of many parts of this internationally important asset falls to local government and private landholders. The local community also has the responsibility to ensure that adjacent land uses do not damage the biodiversity assets.

3.2.1 Flora

Remnant Vegetation Communities

The vegetation of the Jarrah Forest bioregion, which includes the geophysical regions of Plateau and Scarp, is still dominated by its namesake (*Eucalyptus marginata*). This vegetation covers the laterite plateaus. The forested area also includes other tree species such as marri (*Corymbia calophylla*), blackbutt (*Eucalyptus patens*), flooded gum (*Eucalyptus rudis*) and wandoo (*Eucalyptus wandoo*). Smaller tree species such as bull banksia (*Banksia grandis*), sheoak (*Allocasuarina fraseriana*) and snottygobble

(*Persoonia longifolia*) form a lower layer with an understorey of varied sclerophyll shrubs. Open areas of granite outcrop support species such as pincushions (*Borya* spp.), fuchsia grevillea (*Grevillea bipinnatifida*), hakeas (such as *Hakea elliptica* and *Hakea undulata*), rock sheoak (*Allocasuarina huegeliana*) and Darling Range Ghost Gum (*Eucalyptus laeliae*). On the younger red soils of the Darling Scarp there is a marri-wandoo woodland with occasional Darling Range Ghost Gums on the granite outcrops.

The Darling Plateau area has been greatly impacted by timber harvesting, bauxite mining and dieback disease but retains much of the original vegetation structure. Dieback (*Phytophthora cinnamomi*) has affected vast tracts of the Jarrah Forest across the Plateau. It is spread through water and the transport of infected soil, gravel and other materials. The disease is known to occur throughout the Shire.

Many Shire reserves with high biodiversity values have been invaded by the aggressive weeds watsonia (*Watsonia* spp.) and lovegrass (*Eragrostis curvula*). Despite ongoing programs of weed control the populations are spreading. The problem, particularly related to the spread of lovegrass, can usually be linked to either direct disturbance by humans, animals or machines or indirect disturbance such as stormwater runoff or effluent disposal. Unfortunately many Shire reserves are still subject to high levels of disturbance, often by recreation groups, which encourages weed invasion.

Landcare groups, working with the Community Landcare Centre, have restored areas of remnant vegetation and have revegetated large areas. These revegetation projects have used predominantly locally occurring species.

Scrivener Road Gravel Reserves have a highly diverse understorey in very good condition in the undisturbed areas, with minimal weed invasion except around the edges of the gravel pits. The flora species occurring in three monitoring quadrats in the reserve are shown in Appendix 1, with the quadrats located in the wetland in the northeast of the reserve, lateritic woodland south of the gravel pits, and jarrah forest at the western end of the reserve. There are indications that dieback may be present in the vicinity of the gravel pits, such as deaths of indicator species, and may be spreading south into the forest.

No threatened or priority species of flora have been recorded in the reserve, but two threatened and one priority species occur within the adjacent Serpentine National Park (see Table 6).

Table 6: Threatened and Priority Flora, Serpentine National Park

Species	**Category under State *Wildlife Conservation Act 1950***	**Category under Commonwealth *Environmental Protection and Biodiversity Act 1999***
Acacia horridula	P3	
Lasiopetalim pterocarpum	R	Endangered
Pimelea rara	R	Vulnerable

Weeds

A weed can be described as any plant growing where it is not wanted, where it is not naturally occurring or where it is severely out-competing other species. Weeds may be a problem around the gravel pits at Scrivener Road Gravel Reserve for two main reasons:

1. Weeds are a fire hazard, which affects landholder safety in the area, as well as the fauna of the reserve; and
2. Weeds suppress native plant growth and recruitment into the gravel pits, affecting biological diversity and pit rehabilitation when weeds monopolise the sun, space, soil and water.

Weeds can provide habitat for native fauna such as quenda, which are likely to occur within the reserve, but the adjacent expanses of dense native vegetation mean that the small areas of weeds around the pits are unlikely to be critical. Weed control is periodically carried out (every few years) within and around the pits.

Flora, Vegetation and Tree Management

Flora management is essential for increasing and maintaining biodiversity as a component of conserving natural heritage. The vegetation of Scrivener Road Gravel Reserve is in very good condition, but under threat from weed invasion and dieback. Natural regeneration of the gravel pits is likely to be ineffective due to the slow rate of recruitment to such a highly disturbed area which has no soil seed bank. It is therefore more productive to plant and direct seed the area, with concurrent necessary weed control. Species which provide feeding habitat for the Black Cockatoos are likely to be used with species such as *Acacia saligna* being valuable as an early coloniser. Tree Species will also be planted including *Banksia littoralis, Corymbia calophylla, Eucalyptus marginate and Eucalyptus rudis.*

Tree management including retaining habitat trees for breeding cockatoos will be critical along with installing further “cockatubes” for black Cockatoo Breeding to replace any habitat trees lost.

Revegetation of Native Flora Species

Revegetation of Scrivener Road Gravel Reserves have not been a priority in the past, due to ongoing gravel extraction from the pit floors. The first area to be exhausted, at the far south of the pits, was ripped and revegetated in 2006 and 2007. Revegetation has been successful and included in the rehabilitation has been some Cockatoo feeding habitat species but there is a need to do supplemental planting to increase the species richness to bring it up to an acceptable completion criteria.

With the exhaustion of the resource from the existing pits and the refusal of permission to clear any further areas, the current use of the reserve has turned towards conservation. Additionally, further revegetation of the pits has been advanced as a precondition of inclusion of the reserve into Serpentine National Park.

Nearby local vegetation communities should be used as a guide to the local flora when revegetating the reserve. This information is available from the three monitoring quadrats, whose species lists are provided in Appendix A. A variety of understorey vegetation should be planted, along with local trees, which will provide Quenda habitat and food sources for the black cockatoos. Concurrent weed control where necessary is an essential component of a revegetation plan. Rehabilitation will be in accordance with DECs (DPaW’s) Guidelines for the Management and Rehabilitation of Basic Raw Material Pits, 2008.

Dieback and Weed Prevention

Scrivener Road Gravel Reserves have not been assessed for the presence of dieback disease (*Phytophthora cinnamomi*). A weed survey in 2009 also noted the deaths of some indicator species around the pits, and suspected that the dieback may be spreading south into the forest. Until dieback mapping can occur, and possibly testing of the soil within the pits, it is best to assume that the reserve is infected.

The 2009 weed survey mapped populations of cottonbush (*Gomphocarpus fruticosus*), lavender (*Lavendula stoechus*), pelargonium (*Pelargonium capitatum*) and watsonia (*Watsonia* sp.) within and around the pits. These weeds have been periodically controlled (every few years) by a spraying contractor. Weed control should be carried out in conjunction with any future revegetation programs. Chemical control should be carefully considered so as to not harm the native fauna; for example, as glyphosate kills amphibians, Bioactive glyphosate should be used instead, or manual removal.

3.2.2 Fauna

In Western Australia, rare or endangered species are protected by the *Wildlife Conservation Act (1950)*. Protected fauna are listed in four schedules under the *Wildlife Conservation (Specially Protected Fauna) Notice*. Parks and Wildlife also maintain lists of Priority fauna species which require active conservation efforts or further study. The fauna recorded in the Shire from these lists are identified in Table 7.

Table 7: Threatened and Priority Fauna, Shire of Serpentine Jarrahdale[a]

Species Name	Known from the plateau	Known from the plain	Probability of Occurrence Elsewhere[b]
Schedule 1 – Fauna that is rare or likely to become extinct			
Chuditch - *Dasyurus geoffroii*	X	Lowlands	Low
Numbat – *Myrmecobius fasciatus*	X		Low
Western Ringtail Possum – *Pseudocheirus occidentalis*	X		
Quokka – *Setonix brachyurus*	X		Low
Mallee Fowl – *Leipoa ocellata*	X		
Forest Red-tailed Black-Cockatoo - *Calyptorhynchus banksii naso*	X	X	High
Carnaby's Black-Cockatoo - *Calyptorhynchus latirostris*	X	X	High
Schedule 4- Other Specially Protected Fauna			
Peregrine Falcon - *Falco peregrinus*			High
Carpet Python – *Morelia spilota imbricata*	X		
Priority Two – Taxa with few, poorly known populations on conservation lands			
Glacidorbis occidentalis (a freshwater snail)	X		
Priority Three – Taxa with several, poorly known populations, some on conservation lands			
Wambenger (Brush-tailed Phascogale) - *Phascogale tapoatafa*	X	Lowlands	Moderate
Priority 4 – Taxa in need of monitoring			
Western Brush Wallaby - *Macropus irma*	X	Lowlands	Low

Species Name	Known from the plateau	Known from the plain	Probability of Occurrence Elsewhere[b]
Water Rat – *Hydromys chrysogaster*	X	Lowlands	Low
Carpet Python – *Morelia spilota imbricata* (also listed in Schedule 4)	X		
Priority 5 – Taxa in need of monitoring (conservation dependent)			
Quenda (Southern Brown Bandicoot) – *Isoodon obesulus fusciventer*	X	X	High

a : Based on records supplied by the Department of Environment and Conservation (DEC) from the Threatened Fauna Database
b: Based on a report by J.Henry, Ninox Wildlife Consulting (2000)

The reserves are adjacent to a large area of national park (over 4000 ha) (Serpentine National Park) and State Forest. This provides the potential for habitat for a number of species in the Darling Scarp.

Fauna species that have the potential to occur in the reserve are those existing in the adjacent Serpentine National Park. It has been found that the Serpentine National Park has "eight species of native mammal (including one threatened species), 70 species of birds (including two threatened species), 24 species of reptiles and three species of frogs. Feral animals that have become established in the park include six mammal and two bird species." (CALM: 2000).

Table 8 details the threatened species occurring in or likely to occur within the reserve.

Table 8: Threatened and Priority Fauna, Scrivener Road Gravel Reserve

Species	Category under ***State Wildlife and Conservation Act 1950***	Category under ***Commonwealth Environmental and Biodiversity Act 1999***
Calyptorhynchus baudinii	R	Vulnerable
Calyptorhynchus latirostris	R	Endangered
Calyptorhynchus banksii naso	P3	
Isoodon obesulus fusciventer	P5	

Over 100 bird species have been recorded in the Serpentine National Park and therefore likely to occur in Scrivener Road Gravel Reserve; these, three are protected under the *Wildlife and Conservation Act 1950* and the *Environmental Protection and Biodiversity Conservation Act 1999*. The reserve is one of only a few locations where all three protected black cockatoo species have been recorded to nest. It has been reported by Mr Ron Johnson, Curator, Ornithology Western Australian Museum that previous clearing and gravel extraction in the area did not adversely impact the cockatoos.

The Southern Bandicoot or Quenda (*Isoodon obesulus fusciventer*) is a nocturnal species inhabiting areas with dense vegetation cover, such as the margins of wetlands and Banksia woodland/Jarrah forest. This species is listed by CALM under the *Wildlife and Conservation Act 1950* as a priority 5 species, conservation dependent and in need of monitoring.

It is believed that the Chuditch (*Dasyurus geoffroii*), a threatened species under the *Wildlife and Conservation Act 1950*, may also occur in the Serpentine National Park.

Widespread grazing and droppings indicate that kangaroos are using the reserve on a regular basis, and placing pressure on the native plants which they are eating.

Feral Animals

Feral animals found in the area of Scrivener Road Gravel Reserves include domestic cats, foxes, rabbits and the common house mouse. Feral animals are detrimental to native animal populations for several reasons, including:

1. Preying on native fauna;
2. Out-competing native species for resources such as food and space;
3. Spreading diseases and weeds (in their excrement); and
4. Damaging native flora and thus habitats for the native animals.

Foxes and rabbits can be baited with 1080, a naturally occurring chemical in Australian plants. 1080 is not harmful to native animals, as they have built up a natural resistance, whereas the poison affects feral animals. However, feral animals are not considered a major problem, although there is evidence of significant grazing of native plants by rabbits.

Fauna Management

As more development occurs within the Shire, habitat for native animals is rapidly disappearing. Thus, the maintenance of existing remnant vegetation is of high importance in the protection of declining native fauna species. Low shrubs provide cover from predators, shelter and food for local fauna species. Management considerations for fauna protection include fire management, weed control, feral animal control, minimisation of human disturbance, and revegetation.

Protection of Native Fauna

Planting of local native plants, as described in the section on revegetation actions above, would help to provide habitat for native fauna. Control of feral animals must be carried out if they become an obvious threat. It would be wise to undertake further investigation into the presence of feral animals to establish whether they are causing more damage than is apparent.

3.2.3 Major Threats and Pressures

Clearing and Disturbance

Passive clearing can be caused by grazing by stock, overly frequent fires, polluted runoff or high impact recreation activities. Recreation activities located in or adjacent to bushland can lead to high levels of disturbance, weed and disease invasion and more frequent fires. Despite locked gates on the reserve, the pits are regularly accessed by off-road vehicles and trail bikes, while dumping of rubbish (including asbestos, paint tins and car bodies) is a regular issue with regular clean ups and surveillance required. Active clearing has occurred historically to establish the gravel pits. With further gravel extraction and rehabilitation reactivation, there will need to be reactivation of ongoing management of the site blocking off inappropriate access with boulders and fallen trees where necessary.

Fire Management

Fire is an important tool for stimulating regrowth and regeneration in many Australian ecosystems. However, unplanned burns can have a catastrophic impact on vegetation and cause high mortality of fauna. The reserve is adjacent to a large area of national park (over 4000 ha) (Serpentine National Park) and State Forest, allowing for better conditions for natural recolonization than in most of the highly fragmented bushland within the Shire. The long hot summers create conditions in which there is a high fire risk. The predictions of longer drier periods and higher temperatures will increase the period of risk each year.

Control burning is sometimes required to reduce fuel load and protect homes. Mosaic burns are a good way to reduce fuel load and also leave some habitat for native fauna. The Quenda, for example, would suffer greatly from loss of habitat after fire. Thus maintaining good fire breaks and the removal of weeds is likely to be the most environmentally beneficially action for the local fauna of the reserve.

The reduction of fire hazard, while simultaneously maintaining biodiversity values, can be achieved by:

- Maintaining existing fire breaks to slow any potential fires and to provide access for fire fighting vehicles, to be undertaken by the Shire each year;
- Strategic removal of weeds to lower the fuel load; and
- Ongoing mosaic burning of the reserve, allowing habitat recovery before burning of the next area.

Dieback (*Phytophthora cinnamomi*)

Dieback is a disease that affects many of the native plant species in Western Australia, often causing death. It is caused by *Phytophthora cinnamomi*, an introduced soil-borne pathogen that attacks the roots of plants. It is having serious impact on the biodiversity of the State and is listed by the *Commonwealth Endangered Species Protection Act (1992)* as one of five Key Threatening Processes. Plant species vulnerable to *Phytophthora* include jarrah, the banksia family, the heath family, pea family, hibbertia family, balga and zamia. Marri, kangaroo paws, reeds and rushes are not affected. The pathogen spreads through the soil in surface or subsurface flows and by the movement of soil or plant material from infected sites.

There is no known mechanism for eliminating the disease once an area is infected. The objective for managing the disease is to prevent any further spread of infection and to minimise the impact of existing infections. Scrivener Road Gravel Reserve has not yet been assessed for the presence of dieback disease (*Phytophthora cinnamomi*). Some deaths of the plant species which are most affected by dieback have been observed within the reserve, indicating that dieback mapping and soil testing within the pits should occur as a priority.

Weeds

Introduced flora comprises up to11 per cent of the plant species found in Western Australia. These plants pose a significant threat to native species through competition for limited resources, particularly space, light and water. Weeds flourish in disturbed sites and often out-compete the remaining native understorey and alter local nutrient recycling. Weed invasion is one of the major threats to remnant native vegetation.

Landuse change in the Shire has led to higher densities of weed species on cleared land. This larger source of weed seed, combined with increased levels of disturbance due to ongoing development, may create the potential for increasingly severe weed infestations. High weed populations significantly increase the ground fuel load, which subsequently increases the risk of fire. Frequent fires reduce the viability of native plants and create disturbed conditions that are ideal for weed invasion. While weed invasion is minimal in the bushland areas of the reserve, the control of weeds within and around the pits is important to address.

Feral Animals

Feral animals, especially cats, rabbits and foxes, have had a major impact on the native flora and fauna species. The smaller mammals have been impacted to the extent that many have become locally if not totally extinct. The success of fox baiting programs in the Jarrah Forest has brought back numerous species from the brink of extinction in a number of locations.

Cats are already a problem in many bushland areas and are likely to become more of a problem as urban areas are developed and the population increases. Special provisions for the control of cat populations will be needed to protect the fauna of these reserves. Successful initiatives, such as cat trapping, have been used to address the problem in numerous other areas of the State.

The European honey bee is well established throughout the Shire and has a significant effect on the balance and function of natural ecosystems, and may be an issue in the reserve by taking over cockatoo nesting hollows. Rabbit populations are an ongoing problem and can have a devastating effect on the undergrowth if left uncontrolled. The disturbances caused by rabbits also predispose the areas to other threats such as erosion and weed invasion.

Natural Pests

Populations of naturally occurring insects can expand to the extent that they threaten the ecological balance. This is probably the result of other disturbing factors that affect the ability of these ecosystems to self-regulate. An example is the leaf miner insect which can completely defoliate the Flooded Gum (*Eucalyptus rudis).* The ability of the flooded gum to recover following attack depends on other factors that also affect its health. It is possible that climate change may favour some invertebrate species and micro-organisms, leading to further imbalance in these ecosystems.

Climate Change

Expected changes in temperature and the amount, season and severity of rainfall will place extreme pressure on ecosystems that are already under threat from many other disturbing factors. While it is expected that wet and dry periods and historic variation in weather patterns will continue, the gradual changes in temperature and rainfall will affect the ecological balance of remnant vegetation.

Hydrological Change

All ecosystems are dependant to some extent on water. Models of climate change are predicting lower rainfalls and different seasonal patterns. At the same time, groundwater levels are declining, and drainage of more areas for residential and other uses is likely.

Continuing decline in the water tables, combined with longer dry periods and greater evaporation, could lead to the death of many areas of vegetation.

Understanding of Biodiversity

It is not possible to put an economic value on biodiversity. The value of something unique and irreplaceable cannot be calculated. In a market driven society, it is difficult to convey the message of the necessity of protecting this biodiversity asset. Often people are unaware of actions that cause damage, such as the weed seeds in horse manure or the dieback spores in soil clods. Many residents of the Shire have a good understanding of biodiversity and environmental management while new residents may not. Conversely, there are also likely to be many enthusiastic nature lovers among the expanding population who could become powerful advocates for the Shire's natural ecosystems.

4. Social and Economic Characteristics

4.1 Land Uses and Management

The major uses of Scrivener Road Gravel Reserves historically included gravel extraction, while following exhaustion of the resource from the existing pits and refusal of permission for clearing additional areas, the current use includes management as multiple use State Forest and has turned more towards conservation particularly with the wider pressures of developments on the various Cockatoo species habitat.

Discussions with Parks and Wildlife have resulted in a future possible course of action including the development of a management plan for the reserves, resuming mining and including offset rehabilitation with local native species. There are few local gravel sources on Parks and Wildlife land, none of which to date are both suitable and available to the Shire for gravel. Alternative sources of gravel on private property have also been exhausted.

Stages of rehabilitated gravel pit areas are proposed to be used as revegetation offsets in exchange for areas proposed to be cleared and mined. This will be achieved through identifying cockatoo habitat trees in the area and locating new gravel source areas for excavation and progressive offset rehabilitation in appropriate locations. In order to keep the Scrivener Road residents and other stakeholders of the area informed of the mining proposal and any ongoing operations consultation will include this draft management plan, mail drops and other forms of consultation.

Community Aspirations and Community Consultation

Community aspirations for this area reflect the conservation values of the area being adjacent to the Serpentine National Park. A local government conservation zoned property which is both a National Trust Covenanted property and Land for Wildlife property adds to the conservation value of the area. Other properties include equestrian or other production farming properties such as those developed for fruit orchards. Minimization of any impacts to these properties will be a focus with inviting the community to participate in the planning process and decision making for the proposed activity.

Resident notification of those property owners who live in the area which could be affected by mining activities has occurred in the past including letter box drops and other community consultation and will reoccur with any proposal of reopening of mining activities in this area. Every effort will be made to minimise any impacts through careful planning and restrictions on operational times or activities.

Heritage

The reserve is not recorded as having any specific European history, ongoing most likely was previously harvested for timber with the State Forest managed for multiple uses such as for water catchment management. The closest recorded Aboriginal site is the Serpentine River ceremonial and mythological site.

Zoning

The Metropolitan Regional Scheme identifies the reserves' zoning as Parks and Recreation. Land uses on reserves and their considerations are based on the multiple use values of the land and ultimate purpose intended for the reserves.

Scrivener Road Gravel Reserves are crown reserves vested with the Shire of Serpentine Jarrahdale for the purpose of gravel extraction. The reserves have been identified for inclusion into the Serpentine National Park. The Black Cockatoo feeding, roosting and breeding habitat value of the area is well known. It is recommended that the current vesting be changed to include conservation as an additional purpose for the reserves.

Zoning will also be done in the context of the management plan recognising high conservation value areas mainly for the Cockatoos breeding and areas of extraction along with strategic locations for offset rehabilitation providing important feeding habitat to compliment the roosting and breeding habitat values. 'Cockatubes' for nesting will also be included as part of any offset package to replace any lost habitat..

Accessibility

Locked gates have been placed to prevent access to the reserve, but despite this, the pits are regularly accessed by off-road vehicles and trail bikes, while dumping of rubbish has occurred historically. The site has been reactivated and the inclusion of further barriers and trenches to restrict inappropriate access has been put in place. Progressive rehabilitation will take into consideration site security and exposed areas in need of screening will be rehabilitated first. This will also assist in minimising impacts from dust and noise to Scrivener Road users and local residents.

Gravel Requirements

The Shire of Serpentine Jarrahdale is responsible for the care, control and management of approximately 650km of roads, of which about 478km are sealed and 169km unsealed. Responsibilities include road construction and maintenance (including grading, safety and roadside drainage) as well as footpaths and other infrastructure in urban areas.

Annual use expectations for gravel for shoulder re-sheeting are being determined so that gravel extraction amount can match requirements on an annual basis. Preliminary estimates of gravel required is about 10,000 cubic meters per year.

Gravel Extraction Processes

Cockatoo roosting and breeding habitat trees are well documented by the Western Australian Museum and Parks and Wildlife and new extractive industry cells have been identified in this context.

It has been determined that a viable gravel extraction operation to get good economy of scale would be at about 100,000 tones (65,000m3). The cost in such a scale of operation might be about $6.00 to $8.50 per tonne.

Equipment required for such operations would include a large dozer, a loader feeding crusher hopper and a conveyer for stockpiling.

Commercial and Natural Area Management Expertise

In order to get the best possible outcome collaboration is occurring with a commercial operator and various specialist consultants. This will enable the best possible strategic approach to gravel extraction, storage and export including minimizing the footprint through higher stockpiles and combining extraction and rehabilitation operations. Parks and Wildlife and the Western Australian Museum are assisting with planning and management to allow for the incorporation of critical environmental baseline information such as the location of habitat tree(s) (trees that have a diameter, measured at 1.5 metres from the base of the tree, of 50 cms or greater, containing or having the potential to develop hollows or roosts suitable for native fauna). Specific to the Scrivener Road Gravel Reserves area will be the incorporation of the WA Museum expertise with relation to hollows specifically important for the Black Cockatoo species.

Clearing Permit and its Requirements

Clearing permits for progressive staged clearing for mining will be through application to the Native Vegetation Conservation Branch of the Department of Environment Regulation with the first stage area proposed for clearing for mining being 5 hectares.

Dieback Control

The risk of introduction and spread of dieback (effect of *Phytophthora* species on native vegetation) will be minimised through:

- Earth-moving machinery clean of soil and vegetation prior to entering and leaving the mine site
- Soils only be moved in dry conditions (when soils do not freely adhere to rubber tyres, tracks, vehicle chassis or wheel arches) and
- No dieback-affected soil, mulch, fill or other material brought into an area

Currently there is likely to be dieback in the gravel pit areas. Once gravel from dieback free areas in higher elevation areas has been extracted, use of this gravel to build up the road elevation through the gravel pit areas should be done to provide access in and out to minimise any possibility of dieback spread. Clean down areas should be outside the gate into the pit area near Scrivener Road.

Fauna and Revegetation

The Shire understands that the Department of Environment Regulation (DER) requires inspection by a fauna specialist (person with training and specific work experience in fauna identification or faunal assemblage surveys of Western Australian fauna) one

week prior to any excavation for the presence of fauna listed in the Wildlife Conservation Act (Specially Protected Fauna) Notice. Where fauna is identified, no taking of identified fauna will occur unless first approved by the DER CEO. The name and location of each identified fauna species and the location of any area planted will be recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings or decimal degrees. This will be accompanied by a description of the planting activities undertaken, the number of trees planted and the species composition, structure and density of planting. Pit offset area plantings for establishment, maintenance & management will be included comprehensively in annual reports to the Department of Environment Regulation (DER).

Reporting

The Shire also understand that before the 30th of June each year a written report to DER will be need to be provided reporting on activities done by any possible successful permit holder between 1 January to 31st of December of the proceeding calendar year. If no authorised clearing was undertaken between 1st of January to the 31st of December, of the preceding year, a written report confirming that no clearing undertaken under this permit has been carried out, will be provided to the DER CEO on or before 30 June each year. Parks and Wildlife will also be party to the reporting to enable the agreement on and reporting on achieving acceptable offsets.

Restoration/Offset Area Planting

The Shire of Serpentine Jarrahdale proposes to apply to the Department of Environment and Regulation for the clearing of 5 hectares for the first stage for a 12 year period. In order to avoid, minimize or offset the negative environmental issues associated with this proposed clearing on the conservation value particularly for Black Cockatoos the following avoidance, minimization and offset actions are proposed.

- To rehabilitate offset areas slightly greater than the area which is proposed to be cleared utilizing a range of local native species including Black Cockatoo feeding habitat attracting species
- To install artificial nesting “cockatubes” as replacements for habitat trees lost
- To plant local native species elsewhere on the site to provide screening.

A referral of the proposal is also being prepared for the Federal Department of Sustainability, Environment, Water Population and Community (SEWPaC).

Extraction, Rehabilitation and Maintenance

The laterite gravel layer is relatively deep with an average depth of between 3 and 5 meters. Extraction will be conducted using a bull dozer and front end loader.

Proposed mining actions are as follows:

- The 5 hectare site will be progressively cleared of vegetation with cleared trees cleaned up as logs, stockpiled and used for ground habitat or for site security barrier purposes.
- The area will be stripped of topsoil and placed in windrows around the edge of the working area.
- Within the cell, a bulldozer will rip and blade material to a crusher, with crushed materials being stockpiled. Trucks will enter the pit to be loaded from the stockpiles by a front end loader.

- Excavation will proceed until the laterite has been removed and this will result in lowering the contour level of the soil surface by approximately 4 meters.
- Where possible topsoil will be replaced and seeded in worked out areas just prior to the wet season.
- Ripping and mounding will be done in preparation for the local native planting and seeding
- Batters of 1:6 will be maintained

Rehabilitation goals will include creating a landform that is stable, erosion resistant, aesthetically pleasing and safe for humans and animals and to create an offset area where local native species are planted so that habitat for Black Cockatoos is replaced and enhanced as quickly as possible.

Extraction Site

Ripping, blading and crushing will be done to create stockpiles with a small footprint.

Rehabilitation will take place as follows:

- All slopes behind the working face will be contoured to achieve a slope 1:6 vertical to horizontal taking care not to impact on fringing vegetation.
- The quarry floor will be ripped along the contour to remove potential compaction and to establish low mounds for storm water management purposes.
- Stockpile topsoil/overburden will be reshaped to create a land surface which is aesthetically pleasing and easily trafficable.
- A mixture of suitable local native species will be planted and seeded.
- Rehabilitation work will only be carried out just prior to or during the wet winter season.
- Integrated weed management will be undertaken periodically. A contractor specializing in weed management will be used to conduct the herbicide applications.
- Monitoring and maintenance will occur to identify any erosion, and any areas for supplemental reseeding or replanting.

Completion Criteria

The site is to be safe to humans and animals at all times. The site will be designed to be sustainable in the long term without any additional management inputs and suitable for conservation purposes and visual amenity purposes. No significant off site temporary impacts will be found including traffic or ground water disturbance with good containment and management. The condition of the rehabilitation will be weed free.

Seedlings will be planted at 1 x 2 m spacing at the commencement of winter and these will include species important to Black Cockatoo feeding such as: *Acacia saligna, Banksia littoralis, Banksia nivea, Banksia sessilis, Corymbia calophylla, Eucalyptus marginate, Eucalyptus rudis, Hakea lissocarpha, Hakea prostrate, Hakea stenocarpa and Xanthorrhoea preissii.* Seeding will also occur to help with maximising the possibilities of success with one or the other methods of rehabilitation increasing the likelihood of overall success.

Offset Rehabilitation Local Native Species Plantings will include a selection of between twelve and fifteen species from the following:

Early Colonizers
Acacia pulchella (coloniser)
(Acacia saligna) (coloniser)
Acacia urophylla (coloniser)
Adenanthos barbiger (coloniser)
Allocasuarina huegeliana
Mirbelia dilatata (coloniser)
Hibbertia commutata (coloniser)
Kennedia prostrata (coloniser)

Wet Areas
(Banksia littoralis) (wet areas only)
(Eucalyptus rudis) (wet areas only)
Pericalymma ellipticum (wet areas only)
Taxandria linearifolia (wet areas only)
Viminaria juncea (wet areas only)

Dryer Areas
(Banksia nivea)
(Corymbia calophylla)
Dampiera linearis
(Hakea lissocarpha)
Hovea trisperma
Hypocalymma angustifolium
Hypocalymma robustum
Lechenaultia biloba
Scaevola calliptera
(Xanthorrhoea preissii)

Maintenance will include repair of any damage, replanting and weed control and monitoring will continue until the completion criteria has been fulfilled. Seedlings and/or direct seeding will be monitored on a weekly basis within the first 6 weeks after planting and any dead plants will be replaced immediately. Weed management will be undertaken twice a year in spring and in autumn.

For completion criteria to be satisfied, a 75% survival rate will be needed at the end of the first winter with all dead seedlings replaced the following wet season. In this manner it is planned to achieve a 100% survival rate after 5 years. Reporting will be on an annual basis to the Department of Environment Regulation and Parks and Wildlife. After a five year period an attrition process will be allowed to enable the plant density to be determined by natural factors leaving a sustainable self-perpetuating ecosystem.

5. Implementation

5.1 Introduction

An implementation plan is provided in this section. Various groups within the Shire will be responsible for the management's implementation and it is anticipated that the actions will be acted on over several years.

All actions in the report are reproduced in a single table below, along with priorities, responsibilities and potential partners.

5.2 Priorities

Priorities have been classified as follows:

- Key – within the next financial year;
- High – within the next five years;
- Medium – within the next ten years; and

5.3 Responsibilities, Monitoring and Review

The Shire of Serpentine Jarrahdale is responsible for recommendations within this plan. In some instances, the Shire may be assisted in implementing a recommendation by a relevant partner who has an interest or responsibility in the recommendation being considered, and there may be opportunities for grants to implement actions. The management plan actions will be monitored and reviewed, and the management plan will be revised if necessary.

5.4 Implementation Plan

Divisions within the Shire with responsibilities for implementation sometimes in collaboration with SJ Landcare, other agencies, organizations, Fire Brigade or Community are as follows:

- Engineering Services
    - Natural Reserves Coordinator
    - WSUD Project Manager
    - Fire and Emergency Services
    - Environmental Services
- Corporate and Community Services
    - Community Development
    - SJ Landcare
- Planning Services
    - Planning
    - Building
    - Health
    - Ranger Services

Actions Table

Governance

No.	Action	Priority Status	Responsibility	Cost Estimates
1	**Rehabilitate the reserves in accordance with the approved management plan adding value to the reserves, manage the reserves with an additional management purpose for conservation and progress staged extraction and rehabilitation through clearing application and offset provision.**	**Key Implemented in Part**	**Environmental Services**	**Costs of offset provision and other DER requirements will be estimated and budgeted for**

Environmental

No.	Action	Priority Status	Responsibility	Cost Estimates
2	**Prepare a Storm Water Management Plan monitor water erosion and include in-stream structures to assist in slowing down water velocity (Figure 4).**	**Key Implemented in Part**	**Eng, Services WSUD Officer**	**Staff Time & Action $1,000 per annum**
3	**Prepare and monitor the implementation of a Mining, Processing and Stockpiling Plan (Figure 2).**	**Key Implemented in Part**	**Operations, Parks and Natural Reserves Coordinator**	**Staff Time $2,000**
4	**Conduct annual audits and improvement works for meeting targets and maintaining appropriate storm water management standards.**	**Key Implemented in Part**	**Environmental Services**	**Staff Time $1,000 per annum**
5	**Monitor the establishment of plant communities in meeting the completion criteria and review supplemental planting requirements as necessary.**	**Key Implemented in Part**	**Environmental Services**	**Staff Time $2,000**
6	**Review annually and implement a Weed Control Plan that maps and identifies weed species within the reserve, and identifies target areas and appropriate techniques and strategies to reduce weed density and weed seed sources in the gravel pit and surrounds.**	**Key Implemented in Part**	**Environmental Services natural Reserves Coordinator**	**Staff Time & Action $5,000 per annum**
7	**Seek approval for a Fire Management Plan in conjunction with the department of Parks and Wildlife. Ensure any prescribed burning in the reserve conforms to the Fire Management Plan.**	**Key Implemented in Part**	**Engineering Services Fire and Emergency Services**	**Staff Time $1,000 per annum**
8	Determine and map zones for habitat conservation value of trees for Cockatoo Breeding and continue monitoring including "Cockatube" use.	Medium Implemented in Part	Environmental Services Natural Reserves Coordinator and SJ Landcare	Staff Time $1,000 per annum

Social and Economic Recommendations

No.	Action	Priority Status	Responsibility	Cost Estimates
9	Investigate developing appropriate signage to advise users of the proposed activity, environmental values, history and management of the reserves.	Medium Not Yet Implemented	Natural Reserves Coordinator Environmental Services	Staff Time $1,000 per annum
10	Notify residents who live in the area through letter box drops and community consultation of the extractive industry operational activity proposals and invite submissions on the draft management plan.	Medium Not Yet Implemented	Natural Reserves Coordinator Environmental Services	Staff Time $1,000 per annum
11	**Control access through the provision of gates, barriers or trenches to the reserve's pit area.**	**Key Implemented in Part**	**Operations Parks and Natural Reserves Coordinator**	**Maintenance $2,000 per annum**
12	Minimise the risk of introduction and spread of dieback through ensuring earth-moving machinery is clean on entry and when leaving the area, moving soil in dry conditions only and restricting any incoming materials to be clean on entry.	Medium Not Yet Implemented	Natural Reserves Coordinator Environmental Services	Staff Time $1,000 per annum
13	**Report before the end of each financial year to the Department of Environment Regulation and Parks and Wildlife on fauna species contacts and rehabilitation offset plantings accompanied by a description of the planting, the number of plants and the species composition, structure and density.**	**Key Not Yet Implemented**	**Natural Reserves Coordinator Environmental Services**	**Staff Time $1,000 per annum**
14	Avoid, minimize and offset actions with rehabilitation areas for areas proposed to be cleared and mined utilizing a range of local native species including Black Cockatoo feeding habitat attracting species, installing artificial nesting "cockatubes" and planting local native species elsewhere on the site.	Medium Not Yet Implemented	Natural Reserves Coordinator Environmental Services	Staff Time $1,000 per annum
15	**Refer the proposal to the Federal Department of Sustainability, Environment, Water, Population and Community (SEWPaC) for their consideration.**	**Key Not Yet Implemented**	**Natural Reserves Coordinator Environmental Services**	**Staff Time $1,000 per annum**
16	Ensure that development pressures from inappropriate uses such as dumping rubbish, use by motorcycles or horses are monitored and managed with rubbish removal, signage and surveillance as required.	High Implemented in Part	Natural Reserves Coordinator Operations	Staff Time $1,000 per annum

Implementation, Monitoring and Review

No.	Action	Priority Status	Responsibility	Cost Estimates
17	Implement, monitor and review and revise the management plan as necessary including	Medium Implemented in Part	Environmental Services Operations, Parks	Staff Time $1,000 per annum

No.	Action	Priority Status	Responsibility	Cost Estimates
	achievements of staged completion criteria for clearing offsets.		and Reserves Officer	

6. References

Coy N 1984 The Serpentine. A History of the Shire of Serpentine Jarrahdale. NJ Coy Mundijong Western Australia.

Davidson W.A. 1995, Hydrogeology and Groundwater Resources of the Perth Region Western Australia, Western Australian Geological Survey, Bulletin 142.

Department of Environment and Conservation 2008, Guidelines for the Management and Rehabilitation of Basic Raw Material Pits, Department of Parks and Wildlife Publications.

DEST 1996 (Department of the Environment, Sport and Territories) National Strategy for the Conservation of Australia's Biological Diversity.

Dieback Working Group 1999 Managing Dieback: A Manual for Local Government.

Gibson N, Keighery BJ, Keighery GJ, Burbidge AH and Lyons MN 1994 A Floristic Survey of the Southern Swan Coastal Plain. Unpublished Report for the Australian Heritage Commission Prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Government of Western Australia 2000 Bush Forever Western Australian Planning Commission Perth Western Australia

Government of Western Australia 2002 A Biodiversity Conservation Act for Western Australia. Consultation Paper.

Harvey M.S., Dell J. How R.A. and Waldock J.M. 1997 Ground Fauna of the Bushland Remnants on the Ridge Hill shelf and Pinjarra Landforms Perth

Hassell Pty. Ltd. and South Australian Centre for Economic Studies 1999 The Economic Impact of Recreation and Sport at the Local Government Level. Report Prepared for the Office for Recreation and Sport, South Australia.

Johnstone, R. E and Kirkby, T., 2008 Distribution, status, social organization, movements and Conservation of Baudin's Cockatoo (Calyptorhynchus baudinii) in South West Western Australia. REC W. Aust. Mus. 25: 107 – 118.

Johnstone, R. E, Kirkby, T. and Sarti, K, 2013 The breeding biology of the Forest Red-tailed Black Cockatoo Calyptohynchus bansii naso Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. Pacific Conservation Biology Vol. 19: 121 – 142. Surry Beatty & Sons, Sydney. 2013.

Johnstone, R. E, Kirkby, T. and Sarti, K, 2013 The breeding biology of the Forest Red-tailed Black Cockatoo Calyptohynchus bansii naso Gould in south-western Australia. II.Breeding behavior and diet Pacific Conservation Biology Vol. 19: 121 – 142. Surry Beatty & Sons, Sydney. 2013.

Parks and Reveres 2004 Interim Biogeographic Regionalisation for Australia. Australia's Biogeographical Regions. Website: http://www.deh.gov.au/parks/nrs/ibra [June 2004]

Prince C, Hovingh R, Lewington J and Lamond T 1996 Aboriginal Heritage. Report of an Aboriginal heritage Survey, Byford Village, Byford. Unpublished Report prepared by McDonald, Hale and Associates for Mitchell Goff.

RBA Consulting 2003 The Shire of Serpentine Jarrahdale Tourism Strategy 2003-2008. Report prepared for the Shire of Serpentine Jarrahdale.

Vassiliou G 2002 Report on Recreation Planning for the Shire of Serpentine Jarrahdale. Unpublished Report prepared for the Shire of Serpentine Jarrahdale

Appendix A – Flora Survey Data

Three permanent monitoring quadrats were set up on 3/11/08, one within each of the three floristic communities present in the Scrivener Road Gravel Reserves (A in swamp, B in lateritic woodland, C in jarrah forest). These were resurveyed on 12/10 09 and additional species from near the quadrats were added to the list (coded as N).

The 2010 surveys occurred on 14/10/10. 2010 was an extremely dry winter and spring; many ephemeral species were missing, and the surveys were carried out early due to rapid heating and drying.

The 2012 surveys occurred on 17/9/12. Many of the later ephemerals were not yet flowering, and there was a lot of kangaroo activity at Quadrat A.

Flora List for Monitoring Quadrats in Scrivener Road Gravel Reserve (number refers to year of survey and those species which are cockatoo attracting are in bold)

Plant species	Quadrat A (swamp)	Quadrat B (lateritic woodland)	Quadrat C (jarrah forest)
Acacia alata			08, 09(N), 10(N), 12
Acacia extensa	09(N), 10(N), 12(N)		
Acacia lasiocarpa	08, 09, 10, 12		
Acacia lateriticola	09(N), 10(N), 12(N)	08, 09, 10, 12	
Acacia pulchella	09, 10, 12		09(N), 10(N), 12
Acacia saligna		**09(N), 10(N), 12(N)**	
Acacia urophylla		09(N), 10, 12(N)	
Adenanthos barbiger			09, 10, 12
Agrostocrinum hirsutum		08, 10, 12	08, 10, 12
Allocasuarina huegeliana	09(N), 10(N), 12(N)	09(N), 10(N), 12(N)	
Asplenium trichomanes	08, 09, 10, 12		
Astartea sp.	08, 10, 12		
Astroloma pallidum	12	12	10, 12
Austrodanthonia acerosa		08, 10	
Baeckea camphorosmae	09(N), 10(N), 12(N)		08, 09, 10, 12
Banksia littoralis	**08, 09(N), 10(N), 12(N)**		
Banksia nivea	**09(N), 10(N), 12(N)**	**08, 09, 10, 12**	**08, 09, 10, 12**
Banksia sessilis	**09(N), 10(N), 12(N)**	**08, 09, 10, 12**	**08, 09, 10, 12**
Billardiera heterophylla		08, 10, 12	10, 12
Boronia fastigiata	08, 09, 10, 12		
Bossiaea ornata		09, 10, 12	09, 10, 12
Burchardia congesta	08, 09, 10, 12	12	09(N), 10, 12
Caesia micrantha			09(N), 10, 12
Caladenia flava	09, 10, 12	09, 10, 12	09, 10, 12
Caladenia longicauda		09, 10, 12	09, 10, 12
Caladenia sp.		08, 09	
Caladenia sp.			08
Cassytha pomiformis	08, 09, 10, 12	08, 09, 10, 12	12
Chamaescilla corymbosa	09, 10, 12	09, 10, 12	08, 09, 10, 12

Plant species	**Quadrat A (swamp)**	**Quadrat B (lateritic woodland)**	**Quadrat C (jarrah forest)**
Chorizema rhombeum		09, 10, 12	
Conostylis setigera		09, 10	09, 10
Conostylis setosa		08, 09, 10, 12	08, 09, 10, 12
Corymbia calophylla	**08, 09, 10, 12**	**08, 09, 10, 12**	**08, 09, 10, 12**
Craspedia variabilis		09, 10, 12	09, 10, 12
Dampiera alata	08, 09, 10, 12		
Dampiera linearis		09, 10, 12	09, 10, 12
Daviesia preissii			08, 09, 10, 12
Diuris sp.			09, 10, 12
Drosera erythrorhiza		09, 12	
Drosera gigantea	08, 09, 10(N), 12		
Drosera glanduligera	08, 09, 10(N), 12		
Drosera menziesii		10, 12	
Drosera pallida		09(N), 10(N), 12	09, 10, 12
Drosera sp.			08
Elythranthera brunonis		09, 12	09, 12
Eriochilus sp.		09, 12	09, 12
Eucalyptus marginata	**08, 09, 10, 12**	**08, 09, 10, 12**	**08, 09, 10, 12**
Eucalyptus rudis	**09, 10, 12**		
Gastrolobium capitatum			10, 12
Gompholobium knightianum	09, 12	08, 09, 10, 12	08, 12
Gompholobium marginatum	12		
Gompholobium polymorphum			08, 12
Gompholobium preissii		08, 10, 12	
Gonocarpus pithyoides		12	10, 12
Grevillea pilulifera			09, 10, 12
Haemodorum laxum	10(N), 12		
Haemodorum simplex	12		
Hakea lissocarpha		**08, 09, 10, 12**	**08, 09, 10, 12**
Hakea prostrata	**09(N), 10(N), 12(N)**		**08, 09, 10, 12**
Hakea stenocarpa		**09, 10, 12**	**12**
Hibbertia amplexicaulis		09(N), 10(N), 12(N)	08, 09, 10, 12
Hibbertia commutata		08, 09(N), 10, 12	08, 09, 10, 12
Hibbertia diamesogenos	10(N), 12(N)	08, 09, 10, 12	
Hibbertia hypericoides	09(N), 10(N), 12(N)	08, 09, 10, 12	08, 09, 10, 12
Hibbertia lasiopus		09(N), 10(N), 12(N)	
Hovea chorizemifolia		08, 10, 12	
Hovea trisperma		08, 09, 10, 12	08, 09, 10, 12
Hyalosperma cotula	10(N), 12(N)	08, 09, 10, 12	
Hypocalymma angustifolium	08, 09, 10, 12	08, 09, 10, 12	
Hypocalymma robustum	09(N), 10(N), 12(N)		
**Hypochaeris glabra*		09, 10	12
Hypolaena exsulca	08, 09, 10, 12		
Isopogon sphaerocephalus		08, 09, 10, 12	08, 09, 10, 12
Isotoma hypocrateriformis		09, 10	
Kennedia prostrata			09, 10

Plant species	Quadrat A (swamp)	Quadrat B (lateritic woodland)	Quadrat C (jarrah forest)
Kunzea micrantha	09(N), 10(N), 12(N)		
Labichea punctata			09, 12
Lagenophora huegelii		12	12
Laxmannia squarrosa	10(N), 12(N)		
Lechenaultia biloba	09(N), 10(N), 12(N)	08, 09, 10, 12	09, 10, 12
Lepidosperma leptostachyum		09, 10, 12	09, 10, 12
Lepidosperma scabrum			09(N), 10(N)
Lepidosperma sp. E Perth Flora		08, 09, 10, 12	10, 12
Lepidosperma sp.			09
Leucopogon capitellatus		09, 10, 12	09, 10, 12
Leucopogon sp.	09, 10, 12	09, 10, 12	09, 10, 12
Levenhookia pusilla		08, 09, 12	
Lomandra capitellatus			10, 12
Lomandra purpurea		12	12
Loxocarya sp.		08	
Macrozamia riedlei	09(N), 10(N), 12(N)	09(N), 10(N), 12(N)	12(N)
Melaleuca preissiana	08, 09, 10, 12		
Mirbelia dilatata	08, 09, 10, 12		
Neurachne alopecuroidea	10, 12	09(N), 12	09, 10, 12
Nuytsia floribunda	09(N), 10(N), 12(N)		
Opercularia hispidula		09, 10, 12	
Opercularia vaginata		09, 10, 12	09, 10, 12
Patersonia occidentalis			10, 12
Pentapeltis peltigera		10, 12	10, 12
Pericalymma ellipticum	08, 09, 10, 12		
Phyllanthus calycinus		09(N), 10(N), 12(N)	08, 09, 10, 12
Pimelea preissii			08, 09, 10, 12
Pimelea suaveolens		08, 09, 10, 12	09(N), 10, 12
Platysace filiformis		08, 10, 12	
Pterostylis barbata		09, 10, 12	
Pterostylis nana		12	12
Pterostylis recurva		12	10, 12
Ptilotus manglesii			09, 10, 12
Ptilotus sp.		08, 09, 10, 12	
Ptilotus sp.			08, 09, 10, 12
Pyrorchis nigricans		09(N), 10(N), 12(N)	12(N)
Scaevola calliptera		08, 09, 10, 12	08, 09, 10, 12
Schoenus sp.	10, 12		
Sphaerolobium aff. *macranthum*	08, 10, 12		10, 12
Stylidium brunonianum		12	09, 12
Stylidium bulbiferum	10(N), 12(N)	08, 09, 10, 12	
Stylidium hispidum	10(N), 12(N)	10, 12	10, 12
Stylidium junceum	09, 10, 12	09, 10	09, 10
Stylidium piliferum		08	08, 10, 12
Stylidium schoenoides		09(N), 10(N), 12(N)	

Plant species	Quadrat A (swamp)	Quadrat B (lateritic woodland)	Quadrat C (jarrah forest)
Stylidium striatum		09	09, 10
Stylidium sp.			08
Synaphea petiolaris		08, 09, 10, 12	
Taxandria linearifolia	08, 09, 10, 12		
Tetraria octandra	09, 10, 12		09, 10, 12
Tetrarrhena laevis		08, 09, 10, 12	08, 09, 10, 12
Tetratheca hirsuta			09, 10, 12
Thelymitra antennifera	09(N), 10(N), 12(N)		
Thelymitra crinita	10, 12	09, 10, 12	09, 10, 12
Thelymitra macrophylla		12	
Thelymitra vulgaris			09(N), 12
Thelymitra sp.			08
Thysanotus tenellus	08, 12	08, 10, 12	
Thysanotus thyrsoideus			08, 09, 10, 12
Trachymene pilosa		08, 09, 10, 12	
Trichocline spathulata		08, 09, 10, 12	08, 09, 10, 12
Tricoryne elatior	09, 10, 12		08, 09, 10, 12
Trymalium ledifolium		12	08, 09, 10, 12
Verticordia huegelii	10(N), 12(N)		
Viminarea juncea	08, 09(N), 10(N), 12(N)		
Xanthorrhoea gracilis			09, 10, 12
Xanthorrhoea preissii	**08, 09, 10, 12**	**08, 09, 10, 12**	**08, 09, 10, 12**
Xanthosia candida		09, 10, 12	08, 09, 10, 12

* Introduced species