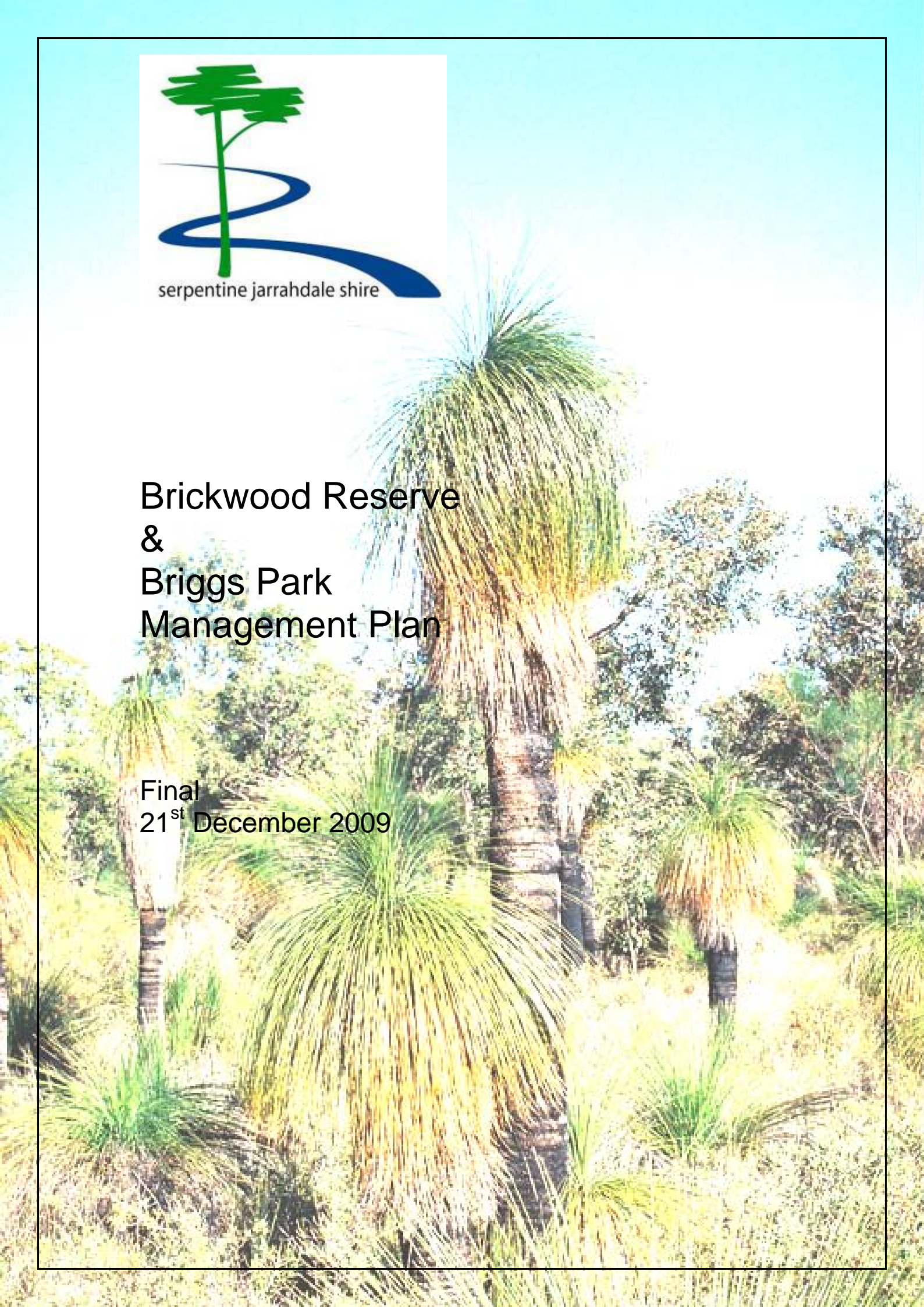




Brickwood Reserve & Briggs Park Management Plan

Final
21st December 2009



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TRIM REFERENCE



1. Executive Summary

1.1. Introduction

Brickwood Reserve is located on the edge of Byford, the main urban centre of the Shire of Serpentine-Jarrahdale (the Shire). It is a popular recreation node within the Shire and it contains the Serpentine-Jarrahdale Recreation Centre. The reserve is also recognised as having significant environmental features, including being a Bush Forever Reference Site and containing one of the largest and most intact examples of a critically endangered threatened ecological community, protected under Federal and State policies, on the Swan Coastal Plain.

It is anticipated that urban pressures associated with the growth of Byford in the coming years will place additional pressure on the recreation, access and environmental features of Brickwood Reserve. Recognising this fact, the Shire has prepared this management plan to guide and prioritise the use and management of the reserve in the longer term.

Values, threats and opportunities were identified and discussed culminating in the identification of key issues at a Community Workshop held at the Serpentine Jarrahdale Recreation Centre on the 14th July 2009. Key issues identified and discussed included continuing to improve the Recreation Centre for increased use and a range of new uses. There was a diverse range of values, threats and opportunities identified including future considerations of the changing relevance of the facility to various uses and the need to adapt to change. Equitable use of the Recreation Centre and ongoing protection of the natural environment was identified as being very important. Public Consultation results including the workshop proceedings summary and comments compiled from the submissions received between the 1st of May and 31st of July 2009 are summarized in Appendix 4.

The protection of the threatened ecological communities within the reserve is of paramount importance. Reconciling the protection of this significant environmental feature with community demands for access and recreation is a major aim of this management plan. As such, the key issues to be considered by the management plan include:

- Long term protection and management of the reserve's threatened ecological communities;
- Providing for appropriate community access to the reserve and facilities;
- Recognising the community value associated with the reserve and facilities, both in terms of its environmental features as well as the recreational opportunities provided.

Key recommendations of this management plan are as follows:

1. Prepare plans in consultation with the BMX club for the possible relocation of the BMX track, including consideration of the selection of possible sites for the relocation outside the reserve.
2. Seek support from Department of Water and Department of Environment and Conservation to undertake a detailed study of the hydrology of the local region to guide future groundwater allocation and to set conditions for future urban developments in the area.

3. Isolate and restrict access to dieback (*Phytophthora cinnamomi*) free areas.
4. Place signs at the entrance to the reserve to advise users of the incidence and effect of dieback (*Phytophthora cinnamomi*), the areas that are infected and areas where access is restricted.
5. Update and seek approval for a reserve Fire Management Plan in conjunction with the relevant State and Commonwealth Departments. Ensure all burning in the reserve conforms to this plan.
6. Advise all local residents of the impacts of dogs and cats.
7. Prepare an animal (i.e. dogs and cats) management plan for the reserve including statutory controls (such as a 300 meter cat exclusion zone around Brickwood Reserve) with costings and an implementation plan.
8. Initiate discussion with the WA Baptists Hospital and Homes Trust to transfer the management order for Lot 106 to Shire Management and to change the purpose of the reserve to nature conservation.
9. Provide all developers/landowners within one kilometre of Brickwood Reserve with management plan information and requirements.
10. Develop a public education program that targets local landowners and users of the reserve, to include rare and beautiful species in the reserve, rarity of the reserve and plant communities, impacts of domestic cats, impacts of weeds and how they spread, impacts of dieback (*Phytophthora cinnamomi*), impacts of physical disturbance and impacts of fire.

1.2. Study Area and Management Zones

The Study Area comprises an area of 50.273 hectares and is generally bounded by Mead Street, Warrington Road, Soldiers Road and existing rural living development to the south. The majority of the Study Area is known as Brickwood Reserve, however the active recreation area adjacent to Mead Street is known as Briggs Park.

Some consideration of surrounding land uses and linkages to these areas has also occurred to ensure that possible implications for the management of the reserve can be considered.

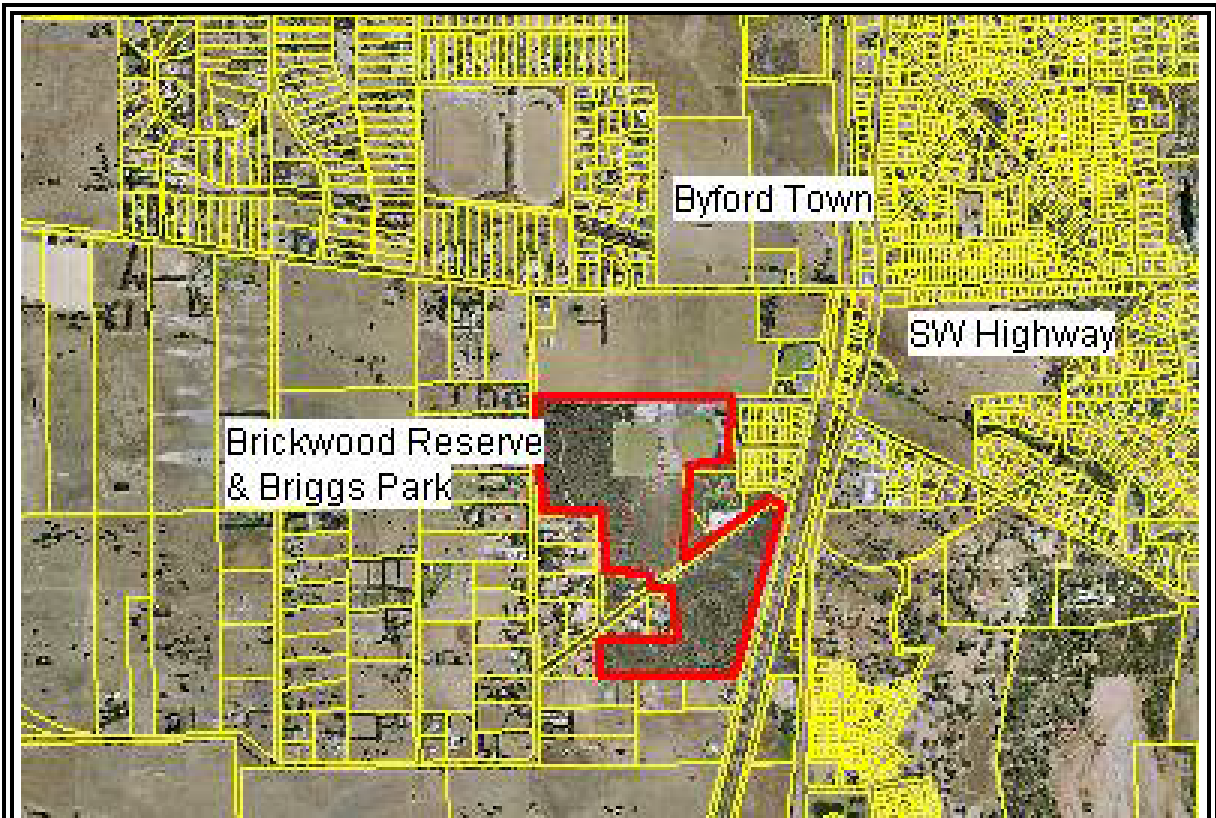


Figure 1 - Site Area.

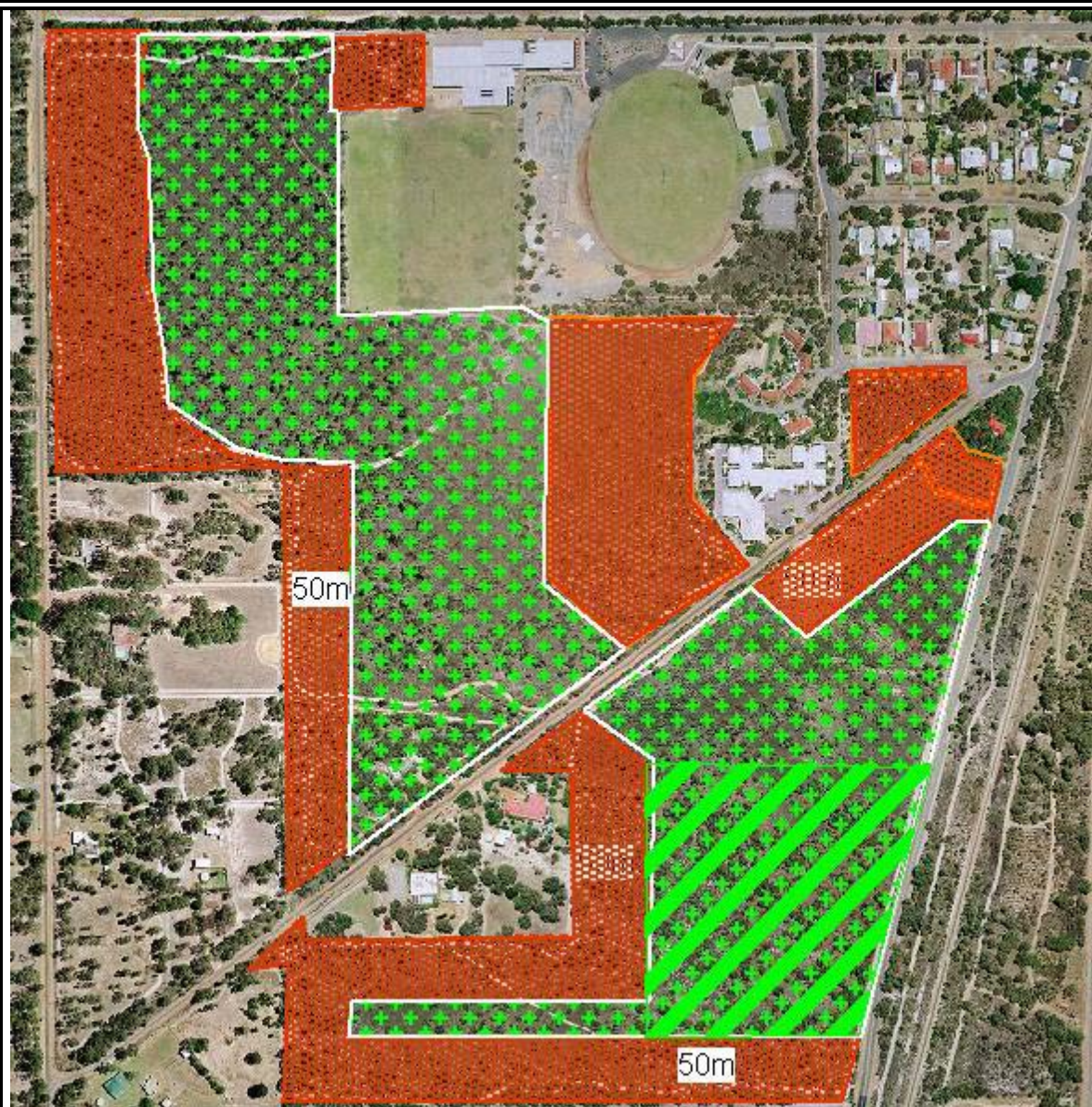


Figure 2 - Management Zones.

High Conservation Zone (Green Hatching): Areas of remnant vegetation of high biodiversity and scientific reference value which are dieback (*Phytophthora cinnamomi*) free and largely weed free. This zone has no planned burn, no dieback (*Phytophthora cinnamomi*) treatment and minimal revegetation requirements. Should revegetation or any type of access for scientific or other purposes be proposed within this zone, extreme care is to be taken to not introduce any soil particles which may bring dieback (*Phytophthora cinnamomi*) into the zone.

Conservation Zone (Green Stars): Areas of remnant vegetation of high biodiversity and scientific reference value which are not dieback (*Phytophthora cinnamomi*) free. This zone has no planned burn, but includes dieback (*Phytophthora cinnamomi*) treatment seeding, weeding and planting operations. Access within this area must consider movement and reduce spread of dieback (*Phytophthora cinnamomi*) from infected to uninfected areas through clean down procedures.

Vegetation Management Zone (Red Hatching): Areas of remnant vegetation of high

biodiversity and scientific reference value which are not dieback (*Phytophthora cinnamomi*) free. This zone is a buffer zone and has burning prescribed for protection of people, property and conservation values, but also includes dieback (*Phytophthora cinnamomi*) treatment seeding, weeding and planting operations. Access within this area must consider movement and reduce spread of dieback (*Phytophthora cinnamomi*) from infected to uninfected areas through clean down procedures.

Recreation Zone (Briggs Park and the Serpentine-Jarrahdale Recreation Center): Areas with little remnant vegetation which are largely for use for active and passive recreational activities.

1.3. Report structure

This management plan has been prepared to accord with the *Shire Reserves Planning and Management Policy*¹. The report is structured into the following sections:

Legislative and policy framework:

Identifies the existing legislation and policies that apply and therefore have management implications for the reserve. The management plan has been prepared within this framework.

Physical and biological characteristics:

Analyses landform, land, water and biodiversity features on the Study Area. Threats to these features have also been considered.

Cultural and social characteristics:

Identifies the main human uses of the Study Area, with consideration given to issues such as tenure, access, recreation and heritage.

Reserve management:

Management of the key features of the reserve are considered in this section, with specific management recommendations provided for both Brickwood Reserve and Briggs Park.

Implementation:

Provides guidance to Council and the community on implementation mechanisms for each management recommendation. Priorities, responsibilities and potential partners are identified.

2. Governance

2.1 Metropolitan Region Scheme

With the exception of Lot 48 Turner Road, the Study Area is currently reserved for Regional Parks and Recreation in the Metropolitan Region Scheme. Any development proposed within the reserve is therefore subject to the approval of the Western Australian Planning Commission.

Lot 48 is currently zoned Urban.

2.2 Town Planning Scheme No. 2

Within the Study Area, only Lot 48 is zoned under the Town Planning Scheme (TPS). The zone is *Urban Development*. Essentially this zone requires Structure Plans for the site to be prepared and approved prior to any development occurring on the site.

The majority of the surrounding site is also zoned Urban Development. The Byford Structure Plan area abuts the northern boundary of the reserve.

The TPS has identified an *Area of Natural Beauty* along Soldiers Road abutting the eastern boundary of the Study Area. This area is identified as a 'Flora Road' and considered by the Council to have historic, architectural, scientific, scenic or other value. The intent of the TPS is for these areas to be retained in their present state or be restored.

Lots 106 and 108 Turner Road are zoned *Public and Community Purposes*. This area contains the Graceford Hostel.

2.3 Bush Forever

The Western Australian Government has prepared the Bush Forever documents as a strategic plan to conserve bushland on the Swan

Coastal Plain. Bush Forever identifies areas of regionally significant bushland and strategies for their protection.

Key strategies include:

- (having) reserve purpose amended to include conservation; and
- (preparing) management plans for local reserves to protect bushland and ensure that any proposed development (in accordance with the reserve's existing purpose) is compatible with Bush Forever conservation objectives and achieves a reasonable outcome.

The native vegetation of the Study Area was identified as regionally significant bushland under this plan. The vegetation of these areas, together with vegetation in two adjacent lots, is mapped as Bush Forever Site 321.

The site is identified as having some existing protection. It makes the following comments and recommendations regarding the site:

Site with some existing protection; the existing care, control and management intent of the reserve is endorsed. The purpose of the reserve should be amended to include conservation and appropriate mechanisms applied in consultation with the management body.

The Bush Forever Site Implementation Guidelines discuss Bush Forever areas in lands currently reserved in the

Metropolitan Region Scheme for Parks and Recreation.

2.4 Draft Statement of Planning Policy No. 2.8 (Bushland Policy for the Perth Metropolitan Region)

The Draft Statement of Planning Policy No. 2.8 (Bushland Policy for the Perth Metropolitan Region) provides guidance and policy measures for any proposal or decision that is likely to have an adverse impact (direct or indirect) on regionally significant bushland within a Bush Forever Protection Area.

2.5 EPBC Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC) 1999 provides protection for areas, species and communities that are considered to have national environmental significance. It controls actions that will significantly impact on nationally endangered plant and animal species and threatened ecological communities that are listed under the Act.

The Study Area contains 41 hectares of a Threatened Ecological Community protected under the EPBC Act. Any direct or indirect action that may have a significant impact on the community requires formal assessment under the Act.

There are no known fauna species within the reserve that are protected by the Act; however, there are two bird species protected.

2.6 Wildlife Conservation Act 1950

At a State level, the *Wildlife Conservation Act 1950* provides protection for species of plants listed as Declared Rare Flora and animals

listed in the *Wildlife Conservation (Specially Protected Fauna) Notice*.

The taking of declared rare flora is prohibited under the State Act, with the definition of "taking" extending to any action that causes harm to the species. This includes pollution, grazing, disturbance and/or altering the water table.

There are three bird species protected by the Act that are likely to be found within the Study Area. As the reserve contains species protected by the Act any changes to the reserve, such as new tracks, requires the approval of the Department of Environment and Conservation.

The ecological communities within Brickwood Reserve should be further protected by the proposed Biodiversity Conservation Act. A Discussion Paper was released on this Act in 2003; however, the Act has not been finalised to date.

3. Environmental Characteristics

The soil, landforms and underlying geology are key determinants of both the plant and animal communities that occur naturally in an area. They also provide information as to the possible land uses on a site. A clear understanding of the nature and properties of these elements of the physical environment is therefore essential for effective planning and management of the reserve.

3.1. Climate

Brickwood is located on the coastal plain of the Perth Metropolitan area, in a region with a Mediterranean climate of cool, wet winters and warm to hot, dry summers. The average annual rainfall is around 900mm, although Perth has experienced significantly lower rainfall over the past 25 years. Rain is frequent and heavy through the winter months, with around 70 percent of the annual total received between May and October. There are occasional heavy falls in the summer months.

3.2. Landform and Landscape

The reserve occupies an area of gently undulating to gently inclined plain with a low sandy rise in the southwest section and a shallow valley in the northern section. It lies on the eastern edge of the Swan Coastal Plain, close to the Darling Scarp, which forms the eastern boundary of the Plain for most of its length.

The Coastal Plain is one section of a deep linear trough of sedimentary rocks known as the Perth Basin, extending north-south for some 1000 kilometres. The nature and extent of these geological formations determine the hydrogeology and water resources of the site. The sediments are of marine (ocean deposited), alluvial (water deposited) and aeolian (wind

deposited) origin and are up to 15,000 metres thick in parts of the Basin. The surface sediments have been deposited fairly recently in the geological timescale. The sand and alluvium covering most of the coastal plain was deposited in the *Quaternary* period or within the last 1 million years. These surface formations are relatively shallow, reaching a maximum thickness of around 150 metres. Along the eastern edge of the Basin, where the reserve is located, the surface sediments are much shallower. The depth of surface sediments on the reserve is around 20 metres.

The Swan Coastal Plain consists of several distinct landform elements or soil landscape systems. These include a series of three sand dune systems orientated parallel to the coastline. The oldest of these dune systems, and the closest to the eastern edge of the Plain, is the *Bassendean Dune System*. Between this dune system and the foothills of the Scarp is the *Pinjarra Plain*, a level, seasonally inundated alluvial plain made up of heavier soils. The Pinjarra Plain is also known as the Guildford Formation. Finally the *Foothills* of the Darling Scarp, also known as the *Ridge Hill Shelf* landscape system, form the eastern boundary of the Swan Coastal Plain. These foothills slope gently from the east to the west and are formed from coalescing alluvial fans and the remnants of marine terraces. There are also areas of colluvium and residual laterite found in this soil landscape system.

The colluvial materials occur along the eastern edge of the unit and east of the reserve; however, there is evidence of laterite (gravel formations) in parts of the reserve.

Soil-landform units within the site are summarised in Table 3.1.

Table 3.1 – Soil-landform units

Pinjarra	<p><i>Location:</i> Swan Coastal Plain from Perth to Capel</p> <p><i>Landform:</i> Poorly drained coastal plain</p> <p><i>Geology:</i> Alluvium over sedimentary rocks</p> <p><i>Soils:</i> Semi-wet soils, grey deep sandy duplexes, brown loamy earths, clays and wet soils</p> <p><i>Vegetation:</i> Jarrah-marri-wandoo-paperbark forest and woodland</p>
Forrestfield	<p><i>Location:</i> Eastern margin of the Swan Coastal Plain from Perth to Capel</p> <p><i>Landform:</i> Footslopes of the Darling and Whicher Scarps</p> <p><i>Geology:</i> Colluvium over granitic and sedimentary rocks</p> <p><i>Soils:</i> Duplex sandy gravels, yellow deep sands and grey deep sandy duplexes</p> <p><i>Vegetation:</i> Jarrah-marri forest and woodland</p>

Source: Agmaps.

3.3. Land Resources

Land Systems

The soils of this region were mapped in detail by Dennis van Gool in 1990. Van Gool's mapping divided each of

the broad geomorphic elements of the Swan Coastal Plain into characteristic groups of soils or soil map units.

Four soil map units occur within the reserve. The largest area is occupied by *Ridge Hill Shelf F5* with smaller areas of *Pinjarra Plain P1a*, *Pinjarra Plain P1e* and *Bassendean Dunes B1*. The mosaic pattern of soils and geomorphology in this region suggest that the soil types and the underlying geology may be highly variable and the soil maps should be interpreted with caution. In places one soil group may overlay another. Studies of the plant communities extending over the Ridge Hill Shelf soils have shown a high degree of affinity with those characteristic of the Pinjarra Plain soils. The area of Bassendean Dune soils represents an outlier of the main dune system, where silica sand was blown much further inland and deposited on top of existing alluvial sediments.

Ridge Hill Shelf (F5)

The soils of this unit cover approximately 21 hectares of the northern section of the Reserve and 8 hectares of the southern section. The soil type is described as *deep acidic yellow duplex soils and sandy alluvial gradational brown earths*.

The reserve spans one of the westernmost occurrences of the *foothill* soils, where slopes are very low and there are poorly defined stream channels. The duplex soils have limited permeability and may also receive surface discharge of groundwater moving down through the foothills aquifers. The soils are waterlogged to inundated through the winter and spring. The lower horizons of the duplex soils and the gradational brown earths with their moderate to high clay contents have good nutrient retention ability but slow infiltration rates.

The area of the reserve with *Ridge Hill Shelf* soils predominantly supports the original vegetation of the site and it is managed for the purpose of *Nature Conservation*. Two hectares on the northwest edge of the unit forms the greater part of the lower oval, which is used for playing diamond sports, such as T-ball, in summer.

Pinjarra Plain (P1a)

Soils of this type are found in the northwest section of the northern part of the reserve. They cover an area of approximately 7.5 hectares. This soil type is described as: *deep acidic mottled yellow duplex comprising shallow pale sand to sandy loam over clay*.

The Pinjarra Plain soils intermix with the *Ridge Hill Shelf* soils described earlier. The duplex soils of this map unit have similar properties of good nutrient retention, low infiltration rates and susceptibility to inundation or waterlogging through winter. Again, the waterlogging through winter is due to a combination of high (possibly perched) water tables and low infiltration rates.

The area of the reserve mapped as *Pinjarra Plain P1a* soil type is used for a variety of recreation facilities. The area includes the top oval, the BMX track, the club change rooms, the car parks and the Briggs Park Pavilion. There are also some small areas still supporting disturbed remnants of the original vegetation. Much of the surface area of this unit has been extensively altered, particularly the areas of the top oval and the BMX tracks. This has completely changed their properties in relation to infiltration, water logging and nutrient retention.

Pinjarra Plain (P1e)

A small area of this soil unit is found in the southwest corner of the northern section of the reserve, extending slightly into Lot 48. A slightly larger

expanse of the soil type occupies the southwest corner of the southern section of the reserve. The total area of the type is approximately 5.5 hectares. It is described as *deep acidic mottled yellow duplex comprising shallow pale sand to sandy loam over very gravely clay*.

These soils adjoin and possibly underlie the sandy soils of the Bassendean Dune unit. Their inherent properties differ slightly from their *Pinjarra Plain P1a* relatives in that they have higher permeability and lower nutrient retention properties. However, due to the generally level topography and high water table, these soils are also waterlogged or inundated through the winter months.

The land use associated with this soil type in the reserve is nature conservation. The soils retain their original properties and structure for most of their extent. A small area in Lot 48, which was previously a rural residential property, has a more disturbed surface, as does the area adjacent to Turner Road.

Bassendean Dune and Sandplain (B1)

A discrete sandy rise of the Bassendean soil type extends over an area of some 6 hectares in the southern section of the reserve and around 1 hectare in Lot 48. The soil type is described as: *deep bleached grey sands, sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 metres*.

These deep sands have high infiltration rates and very low nutrient retention ability. When cleared of surface cover they are highly susceptible to wind erosion. The soils have been leached over a long period of time and are extremely low in all mineral nutrients required for plant growth and have very low capacity for storing moisture. Once cleared of

vegetation, the sands become unstable and, due to the low nutrient and water retention properties, it is very difficult to re-establish vegetative cover. The slightly elevated landform and the high permeability of the sandy soils ensure that the surface is well drained throughout the year.

The small sandy rise in the southern section is completely covered with original vegetation which has suffered minimal disturbance. The surface of the soil is therefore well covered by vegetation and leaf litter and enriched with organic matter. The smaller area in Lot 48 has been subject to greater disturbance and the soil surface is bare in places.

Soils of the Briggs Park Recreation Area

The soil surface through most of the Briggs Park area has been extensively altered. The original soil materials consisted of *Pinjarra Plain P1a* soils in the areas now occupied by the top oval, carparks, buildings and BMX track. The diamond sports (T-ball) or lower square oval is mapped as predominantly *Ridge Hill Shelf F5* (2 ha) with the north east corner of the oval mapped as *Pinjarra Plain P1e* (0.5 ha).

The topography and soil profile of the top oval was changed in 2000 through major earthworks that raised and reshaped the surface of the oval. The work involved excavating the soil surface to a depth of 200 millimetres, removing old thatch and some of the clay topsoil, and then covering the surface with sand to an average depth of 400 millimetres. The surface was shaped to an asymmetrical dome that slopes from the eastern boundary down to the west, with a gentle fall out to the north and south. The slope from east to west over the width of the oval is slightly more than 1 percent. The surface soil is now free-draining sand with minimal ability to store nutrients or

water. The oval is surrounded by curbing and a compacted gravel track that prevents lateral flow or subsidence.

The topography and soils of the lower oval have been slightly altered over a number of years. The surface of the oval has been raised approximately 100 millimetres by regular topdressing with sand. This has also increased the sand content of the topsoil slightly. However, the modified soil retains the key properties of the original soil – low permeability and high nutrient and water retention. The clay soils of the oval tend to become compacted with regular traffic. The soils are aerated regularly using specialised machinery to alleviate the problem.

Both ovals are irrigated with moderately saline water (1500 mg/litre). Irrigation is carefully managed to prevent the soils becoming saline. The soils are tested for salt levels whenever indicators such as turf health suggest that salt levels have increased. While there can be a slight increase in salt content over the summer irrigation period, the salts are flushed from the soil by the winter rains.

The surface of the BMX track between the two ovals has been completely altered by the addition of surface fill to shape the course. The fill consists of a range of materials from a range of sources. At one stage, two or three small pieces of asbestos were noticed in the fill material. Further testing of fill materials by government agencies failed to discern any contamination. The materials used to create the jumps include used tyres, soil and gravel. The course has a surface of bitumen and granite fines that is quite stable and impermeable. The high steep-sided jumps shed rainfall, which tends to erode the unsealed edges of the jumps and the bare soil surfaces adjacent to the jumps. The dust

created by the use of the course through summer is suppressed by irrigating the course prior to use.

There are two car parks, one with an impermeable bitumen surface and the other with a gravel to gravelly loam surface. The surface of the gravel car park is relatively stable as the site has little slope.

Soils in Lot 48 Turner Road

This rural residential lot has experienced a greater degree of disturbance of the soil surface. The area around the house, sheds and yard has been cleared and the soils have been compacted and possibly enriched by both nutrient inputs, animal wastes and the leach drains from the septic system. The remainder of the location is vegetated and soil disturbance is limited to the removal of the understorey. This has decreased the organic layer and soil biota but caused little structural alteration.

3.4. Water Resources

Water management in Western Australia is guided by a number of laws, policies and strategies, all of which aim to ensure sustainable use of this resource. These planning instruments cover issues ranging from water conservation and protection of water quality to nature conservation and waterway, wetland and catchment protection.

On Brickwood Reserve, the sustainable management of the water resource is essential to the protection of the two key values of this site – those of biodiversity and recreation.

Much of the bushland area of the site is a seasonal wetland of very high conservation value. Sustaining these values depends on maintaining the oligotrophic (low nutrient) status of this ecosystem and the natural water balance. The Briggs Park section of the Reserve includes two irrigated

ovals that are used for active recreation. The effective use of irrigation water is a key factor in ensuring the continued availability of quality turf surfaces at this site.

Natural Wetlands

The remnant vegetation of the Study Area includes approximately 29 hectares of seasonally waterlogged wetlands. The wetland area has been assigned an evaluation category of *Conservation* by the Department of Environment and Conservation, which recommends management to preserve wetland attributes and functions. This is a rain-fed wetland system where the clay soil base creates a temporary perched water table through the winter and spring. Given the position of this wetland on the lower slopes of the foothills and slightly higher than the adjacent plain, it is likely that this has always been a seasonal wetland.

Maintaining wetland function is dependent on maintaining the seasonal water levels within the boundaries of natural variation and on maintaining the water quality. In the absence of hydrological studies of the area there is limited information on the natural range of groundwater levels or the surface water flows through the site. However, the plant species found in different areas of the reserve can be used as a guide to the expected groundwater variation and levels of waterlogging or inundation.

Areas of invasion by aggressive weeds in several sections of the wetland communities suggest either physical disturbance and/or a decline in water quality. The drain through the southern section of the reserve is only partly formed and the drain water spreads over a large area of wetland vegetation. The drain flows have not been sampled but include runoff from a large section of sealed road and part of the highway, which are potentially sources of pollutants. Connections

between ground and surface waters are likely, given the geomorphology of this region, and this introduces the prospect of pollution from land uses outside the immediate catchment.

Natural wetlands on the Swan Coastal Plain have been mapped, evaluated and categorised according to their ecological functions. The Department of Environment and Conservation developed a series of management objectives for these wetlands. The highest level of protection is that recommended for Conservation Category wetlands. These are wetlands that support a high level of ecological attributes and functions. The objective for these wetlands is to preserve their attributes and functions and the Department will oppose any activity that leads to further loss or degradation of values.

The natural vegetation of the Brickwood reserve and surrounding native vegetation includes 17.7 hectares mapped in the above study as *Conservation Category* wetlands. The geomorphic classification of the wetland area is a palusplain (a seasonally waterlogged, flat wetland form). The wetlands belong to the *Keysbrook Suite*. This is a group of wetlands found on the alluvial fans and creeks of the Pinjarra Plain.

Local Drainage Network

Prior to European settlement and, in particular, prior to the drainage projects of the 1920s, surface water from the Byford district did not drain into the Peel-Harvey Estuary. A series of streams carried the runoff from the Darling Ranges down onto the coastal plain, slowing and becoming less defined as they reached the plain. Eventually these streams dissipated into the extensive wetlands that once covered most the Swan Coastal Plain. Projects to drain the coastal plain and extend the area available for agriculture began in the late 1800s but

did not extend into the northern parts of the Serpentine-Jarrahdale Shire until the 1920s and 1930s.

Brickwood Reserve abuts the foothills midway between two of the more defined waterways draining this section of the Darling Scarp. Beenyup Brook traverses the commercial centre of Byford approximately 750 metres to the north and Cardup Brook flows through rural residential land 750 metres to the south. The Study Area does not fall within the catchment of either waterway. Instead, a mixture of shallow artificial drains and a semi-natural waterway carry excess runoff from the Reserve and surrounds out to the east, eventually linking into the same network as the two waterways and discharging into the Oaklands drain. This drain, in turn, discharges into the larger network that conveys excess water to the Peel Estuary.

Surface Water Flows

Surface water travelling through and across the Brickwood Reserve comes from a variety of sources. This includes rain falling on site, runoff from adjacent roads and housing areas and groundwater discharge. The foothills surface aquifers are generally thicker and more permeable than those of the Pinjarra plain. As a result, groundwater flowing down through the aquifers of the Darling Scarp meets a bottleneck in the plains aquifers and is forced to discharge to the surface. Exactly where this discharge occurs is unclear due to the complex geology of this district and the lack of detailed studies.

The natural flow of water across the foothills from east to west has been altered by the Perth to Bunbury railway line. The railway runs parallel to the eastern boundary of the reserve along Soldiers Road. This may have reduced the natural flow of surface water into the reserve. The site itself has a very gentle slope within which the surface is gently undulating. In general,

surface water flows from east to west across the site in the direction of the slope. The surrounding land is also gently sloping and undulating, so that natural drainage follows a relatively slow, erratic pattern from east to west.

Excess surface water from both sides of the railway reserve, along with runoff from a section of South Western Highway and a 750 metre section of Soldiers Road, discharges into a drain that crosses the southern section of the reserve from Soldiers Road to Turner Road. This drainage line continues through to the northern section of the reserve, where it travels around the boundary of Crown Reserve 17490 to an outlet on Warrington Road. There may also be an element of groundwater discharge along the railway reserve that adds to the drain volumes. The drain on the southern side is eroded at the inlet on Soldiers Road and for some distance into the reserve. As it travels through to the Turner Road crossing the drain becomes less well defined. It is unclear whether the hydraulic balance of flows into and out of the southern section of the reserve is maintained and, in the absence of previous studies, the natural balance between inflows and outflows is not known. Local residents have observed substantial flows in the drain as it continues through the northern section of the reserve, but no monitoring has been carried out.

A second drain traverses the northern section of the Reserve. This is a more formed, shallow trench style drain. It carries runoff from half of the small residential catchment east of Gordin Way. The runoff from the northern half of this residential block empties into a very shallow roadside drain along Mead Street. The drain travels along the northern edge of the Briggs Park Recreation Area.

The top oval has been elevated and remodelled to improve drainage. The slope of the oval is from east to west and from the centre out to the north and south. There are several drainage pipes running the length of the oval and extra slotted pipes have been installed along the west side and in parts of the northern section of the grounds. These pipes drain through an underground pipe out to the northwest to discharge into the Mead Street drain. The pavilion and BMX carparks discharge into the drain south of Briggs Park, as does much of the lower oval.

Surface Water Quality

There is limited information available on the quality of surface water in the immediate vicinity of the Reserve. The most critical issues for the Peel-Harvey Catchment are the nutrient levels in drainage waters, particularly phosphorus and nitrogen concentrations.

A community group sampled phosphorus levels in drains throughout the Shire in 1992. Their results showed that the Byford district was generally below the target levels set for the catchment, but the sub-catchment, which encompasses the Reserve, was above these levels. The drain adjacent to the entrance to the Graceford Hostel on Turner Road was sampled regularly for nitrogen levels from December 1976 to September 1977. The levels of nitrate recorded in this period were all above the levels now recognised as trigger values for lowland rivers.

In August 2000 nutrient levels were sampled in the drain on Warrington Road, at the discharge point from the Reserve. Phosphorus levels in the water leaving the Reserve were 0.028mg/L. This is below the suggested trigger values for lowland rivers of 0.065 mg/L (ANZECC 2000) and within the water quality levels

recommended for freshwater in 1992 (0.1 to 1.0 mg/L TP, ANZECC 1992). Nitrogen levels recorded in the same sampling exercise were well below the suggested trigger values.

These values for nutrient levels in water discharging from the stream need to be viewed with caution. On one hand they indicate that there had been a vast improvement in water quality between 1976-1977 and 2000. On the other hand, the capacity of wetlands to remove both nitrogen and phosphorus from surface waters is well established. Water moving into the reserve from upstream areas may be contributing nutrients to this ecosystem that are assimilated as the water passes through the Reserve.

There is evidence of nutrient enrichment along both drains through the reserve. Nutrient enrichment of oligotrophic systems is linked to weed invasion. Weeds occur along the length of all the drains through the Reserve but reach their highest densities and extent at the entrance points. Weed infestation is very marked along the first section of the drain from Soldiers Road through the southern section of the Reserve. As discussed in the previous section, this section of the drain is also quite eroded both at the inlet and further into the Reserve, where there are gullies of up to two metres deep.

There is no data available on other pollutants in the surface waters draining through or from the site. As the upstream areas include residential areas, railways and sealed roads, there are likely to be petrochemicals, pesticides and possibly some heavy metals present. The upstream catchments are quite small, so the concentrations should be minimal. However, given the high conservation value of the wetlands of the Reserve, these are important issues to clarify. If acid sulphate soils have been exposed

upstream, heavy metals may have been released from the clay fractions.

Fertiliser applied to the turfed playing areas is limited to nitrogen and a few trace elements. The current application rates amount to between 160 and 200 kilograms of nitrogen per year, which is divided into 4 or 5 applications. Approximately 40 kilograms of nitrogen is applied each time. Herbicides are used sparingly on the grounds. The ovals are sprayed with a broadleaf chemical when needed and weeds around the grounds are treated annually with glyphosate.

There are two septic tanks on the site. One is located on an elevated sand pad close to the Pavilion and the second is associated with the toilets behind the BMX track. The latter system has problems with poor infiltration, and the leach drains overflow frequently, discharging effluent to the surface.

3.5. Groundwater

The hydrogeology of this site is complex. It occupies a position on the edge of the foothills of the Darling Scarp close to the line of the Darling Fault and has a varied geomorphology (see Section 2.1). Detailed information on the hydrogeology of the Byford area is unavailable. However, broad regional studies indicate that the Leederville Aquifer, which underlies most of the Swan Coastal Plain, is absent from this area and the surface sediments lie directly over the much older formations.

Information from the bore in Briggs Park suggests that the formations are even more complex, with Archaean sediments overlying sediments characteristic of the Leederville aquifer.

Throughout most of the Swan Coastal Plain ample supplies of groundwater

are available from the surface sediments, which form the superficial (non-artesian) aquifer. On this eastern edge of the plain the superficial aquifers are thin and consist of clay and sand sediments with much lower storage capacities. The movement of water into and through these clay sediments is very slow. Recharge is mostly from rainfall infiltration with some contributions from the ephemeral streams draining the Scarp and discharging onto the coastal plain.

Groundwater moves away from the foothills of the Darling Plateau out through the aquifers of the Pinjarra Plain. The foothills sediments conduct water at a much higher rate than those of the Pinjarra Plain. This factor combined with the position at the base of the Darling Scarp and close to the Darling Fault suggests that groundwater would be discharging to the surface during winter and spring.

Groundwater availability in areas close to the Darling Fault can vary significantly over a very short distance. The Brickwood Reserve is within 100 metres of the Darling Fault, which closely follows the route of the South Western Highway. Groundwater data is available from bore logs, although these records are scattered and mostly more than 25 years old. However, the patterns that emerge suggest that there is a perched water table in at least part of the Reserve. The surface of the groundwater table in properties adjacent to Turner Road were up to 12 metres higher than those recorded in bores 750 metres north and northwest during January and February of 1979. Biannual readings taken from a monitoring bore some 400 metres north of the reserve showed that the groundwater table fluctuated by 4 to 6 metres between the spring peak and the end of autumn (1996 to 1998).

Groundwater quality is also unpredictable in this area. Water drawn from the artesian aquifer by the bore in Briggs Park has an average salinity of 1400 mg/L. This is towards the upper end of the acceptable level for irrigated turf production, although salt-water couch can tolerate much higher salinities. The salinity levels recorded in bores within one kilometre of the Briggs Park bore ranged from 385 mg/L to 2450 mg/L.

3.6. Water Use and Management

The Briggs Park Recreation Area facilities use groundwater supplies. The existing buildings, including the recreation centre, are connected to the scheme water supply. The two ovals and the small area of lawn around the pavilion and change rooms are irrigated with groundwater.

Brickwood Reserve is located within the *Byford 3* sub-catchment of the Serpentine Groundwater Area. The groundwater catchment has been "proclaimed" under the *Rights in Water and Irrigation Act 1914* and a license is therefore required to extract water from the superficial aquifer. Extracting groundwater from the deeper aquifers requires a license throughout the State.

In the Serpentine Groundwater Area there is an interim policy applicable to groundwater licensing in areas less than 2 kilometres west of the Darling Fault. This policy recognises the low water yields obtained from the superficial aquifer and allows users to tap the Leederville Aquifer to meet their requirements. Licenses of up to 30 000 kilolitres per year can be granted without detailed assessments. This policy will remain in use until a more detailed Groundwater Allocation Plan is developed.

The Shire of Serpentine Jarrahdale currently holds a license to extract up

to 30 000 kilolitres of water per year from a bore in Briggs Park adjacent to the lower oval. The license expired on 02/02/2009 (Ground Water License Number GWL 65672). The bore is 76 metres deep and was constructed after the previous bore collapsed. The surface sediments at this site are around 20 metres deep and the groundwater is sourced from the deeper artesian aquifer, which may be part of the Leederville Aquifer or even older sediments.

Groundwater is used to irrigate the two ovals and the lawn around the pavilion, a total area of 4.3 hectares. The total groundwater water consumption throughout the year is approximately 28,800 kilolitres. This is within the maximum extraction levels allowed under the groundwater license.

Irrigation management is finely tuned to conform with best management practices and to minimise the build-up of salt levels in the soil. Irrigation commences towards the end of spring and continues to mid to late autumn, depending on the season. The ovals and surrounding grounds are irrigated three times per week from mid-November until April. In late spring and autumn irrigation frequency is reduced to twice per week. Watering is carried out in the evenings to minimise evaporation and wind effects. The irrigation system is linked to an automatic controller, which is fully computerised. The variation in soil types and the salinity levels in the groundwater create a complex situation which requires careful monitoring and adaptive management. The grounds managers adjust the irrigation of different parts of the grounds according to observations of the soil and turf.

Other minor uses of water in Briggs Park include the sprinkler system used to wet the BMX track and reduce the

dust problem during Friday night competitions over summer. The total use of water for this purpose would amount to less than 20 kilolitres for the year and consideration could be given to rain water tank sources.

The existing buildings in Briggs Park include 2 sets of toilets, change rooms, and a bar area which are connected to the scheme water supply. The Byford Recreation Centre is also connected to the scheme water and is likely to require substantial quantities of water for cleaning, catering, ablutions and garden areas.

3.7. Biodiversity

Brickwood Reserve contains one of the largest and most intact areas of remnant vegetation found on the alluvial soils of the eastern side of the Swan Coastal Plain. Crown Reserve 17490 and Lot 48 Turner Road support a total of 40 hectares of remnant vegetation, most of which is in very good or excellent condition. The remnant includes an extensive expanse of a critically endangered threatened ecological community and two smaller occurrences of an endangered and a vulnerable threatened ecological community. In addition, the reserve also contains several threatened plant species. This remnant preserves key elements of the biodiversity of the South-West botanical province in an expanding urban centre, requiring careful and thoughtful management.

Commonwealth and State Strategies

Biodiversity is defined as:

“...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic

ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.“

(Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC) 1999.)

In June 1993 Australia signed the international agreement known as the Convention on Biological Diversity. The agreement was an outcome of the growing national and international awareness that we depend on biodiversity for our survival and quality of life. Since then a range of strategies have been developed which recognise conservation of biological diversity as a foundation of ecologically sustainable development. It is one of the three core objectives of Australia's *National Strategy for Ecologically Sustainable Development*.

The *Western Australian State Sustainability Strategy 2002* recognises the moral and legal obligations to protect biodiversity and the State's commitments under *The National Strategy for Conservation of Australia's Biological Diversity 1996*.

Threatened Species and Communities, and Priority Lists

There are many species and communities not protected by legislation, whose conservation status is uncertain. The Department of Environment and Conservation, which has statutory responsibility for flora conservation, maintains a “declared rare flora and priority flora” list. The priority list records plant species that are under consideration for declaration as ‘rare flora’ or whose status is uncertain. There are five priority flora

species listed for the Brickwood Reserve.

The Department of Environment and Conservation also maintains a two-tiered listing for threatened fauna species. Fauna that require special protection are listed in four schedules and protected under the *Wildlife Conservation Act 1950*. Fauna that are not protected by the Act but require further evaluation are listed as priority species. One priority species, the quenda, is common in the area.

The Department also maintains information on the extent of each threatened ecological community, or naturally occurring biological assemblage. Communities are assessed and assigned to four categories depending on the threat to the survival of the community type. Some critically endangered and endangered West Australian communities are also listed for protection under the Commonwealth EPBC Act. The critically endangered community “*Corymbia calophylla-Kingia australis* woodlands on heavy soils, Swan Coastal Plain” extends over a large proportion of the Brickwood site, and is listed under the EPBC Act. Two other communities, the Endangered threatened ecological community known as “*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain” and the Vulnerable threatened ecological community “Dense shrublands on clay flats” also occur on the site, but are not EPBC listed.

Overview of Biodiversity Values

The Brickwood Reserve is part of the South-West Botanical Province, which has been recognised as the home of one of the richest floras in the world. Not only does the area boast a high diversity of species, but many of these plants are found nowhere else in the world. All the vegetation communities

of the region have an extremely high biodiversity value.

The importance of the vegetation of Brickwood Reserve to the national conservation estate has been recognised by both the Australian Heritage Commission and the National Trust of Australia. The *Brickwood Bushland* was placed on the National Trust's Register of Heritage Places in 1994 and entered into the Register of the National Estate in 1998. These listings place no legal obligations on the owners or managers of the land, apart from preventing the Commonwealth Government from making decisions that may adversely affect its status. However, they do emphasise the high national value of the vegetation, and the need to give priority to the management and protection of these values.

Brickwood Reserve lies on the eastern side of the Swan Coastal Plain in a region that has been extensively cleared. Over 96 percent of the Ridge Hill Shelf (Foothills) and Pinjarra Plain soils in the Shire have been cleared, and little of the remaining vegetation is in good condition. A study by Keighery and Trudgen (1992) concluded that too little of the vegetation of this section of the plain remained to adequately conserve representative types. Vegetation of this region exhibited a high degree of endemism, with over 34 species only found on the eastern side of the Swan Coastal Plain. Of these species, 32 are dependent on seasonally inundated heavy soils and eight have been identified at Brickwood.

The reserve supports the most extensive area of Marri Open Woodland with scattered *Kingia* still in existence. This vegetation community was once widespread but few intact areas remain. It has been listed under the EPBC Act as being a threatened ecological community. Much of the

bushland area is seasonally inundated and is classified as a Conservation Category Wetland by the Department of Environment and Conservation. Further adding to this extensive list of values, the area is home to four species of priority flora and one priority fauna species.

Natural Community Description

Australia has been divided into 85 "Biogeographic Regions" for the purpose of conservation planning and natural resource management. Each region is defined by a unique set of landscape-scale environmental attributes that determine the array of flora and fauna and their interaction with their physical environment. Brickwood Reserve falls within the Swan Coastal Plain (SWA) Interim Biogeographic Region of Australia (IBRA). This region covers an area west of the Darling Fault line, extending from Jurien Bay to Dunsborough.

The most recent regional classification of the vegetation on the Swan Coastal Plain was developed by Gibson *et al.* (1994) in *A Floristic Survey of the Swan Coastal Plain*. This work identified 30 vegetation community types on the plain and classified some as vulnerable, endangered or critically endangered based on the total areas remaining. The classification was used as the basis for the definition of threatened ecological communities (see above). Gibson *et al.* conducted a limited survey of the reserve and identified three ecological communities.

Community type 3a: *Corymbia calophylla*-*Kingia australis* woodlands on heavy soils

This vegetation community type extends over much of the bushland area, including all of the northern sections of Reserve 17490, approximately half of the southern section and

all of Lot 48 Turner Road. This community occupies wetter areas of heavy soils and has high frequencies of *Corymbia calophylla* and *Kingia australis* and low frequencies of *Eucalyptus marginata*. *Pericalymma ellipticum* is also common in this type. The community is listed as critically endangered in Western Australia.

Community type 20b: Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands

A small area of this community type is found on the sandy rise in the south western section of the Reserve. The community type is *Eucalyptus marginata*-*Banksia attenuata* woodlands and includes *Banksia attenuata* woodlands and heaths. This community is listed as endangered in Western Australia.

Community Type 9: Dense shrubland on clay flats

A small area of 2 to 3 hectares of this community is found in the southern section of the Reserve. The community type is the shrublands or open woodlands of clay flats that are inundated for long periods. A high frequency of sedges is found in the understorey. This community is listed as Vulnerable.

DEC has ground-truthed the boundaries of the TECs, and provided updated boundary mapping to the Shire.

Prior to the classification of ecological communities described above, detailed site descriptions and mapping of the vegetation communities was carried out in studies by Keighery and

Trudgen (1992) and Keighery and Keighery (1993).

The first study found that the plant communities over most of the site were typical of the vegetation of the Pinjarra Plain, although the soils have been classified as belonging to the Ridge Hill Shelf. This study examined the whole of the eastern side of the Swan Coastal Plain and identified Brickwood Reserve as containing the most extensive areas of 'Marri Open Woodland with scattered Kingia' (a subset of community type 3a). Their analysis of the vegetation condition was 'very good' and 'good', which corresponds to the rankings of 'excellent' and 'very good' in the condition scale used in the Bush Forever Study, as shown in Table 3.2.

Table 3.2 Condition Scale Used in Bush Forever Study (extract)

Condition	Description
Pristine	Pristine or very nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
Very Good	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.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances.

Source: Bush Forever (2000)

The authors highlighted the resilience of the community to weed invasion, which they ascribed to the relatively dense layers of shrubs, herbs, or sedges.

The more detailed description and mapping of the vegetation was completed by Keighery and Keighery (1993). It describes five plant communities and identified a disturbed pocket of *Eucalyptus lane-poolei* that the authors considered relatively rare.

Marri Woodland with Scattered Kingia is the most extensive community type. This is a varied community in structure and species content. The different site descriptions given by the authors are listed briefly below. The community was mapped as extending over some 30.7 hectares in Reserve 17490. Lot 48 Turner Road contains vegetation that is transitional between this community and the "Marri and Jarrah Woodland".

- a) Marri open woodland over *Xanthorrhoea preissii* and *Kingia* open shrubland over a mixed low shrubland over an open herbland and an open sedgeland. Condition: excellent.
- b) Marri woodland over *Hakea trifurcata* open scrub with scattered *Kingia* over *Stirlingia latifolia* shrubland over a mixed low shrubland over an open herbland and an open sedgeland. Condition: excellent.
- c) Marri open woodland over *Jacksonia sternbergiana* high shrubland with scattered *Kingia* over mixed shrubland over *Hakea prostrata* low shrubland over a mixed open herbland and mixed sedgeland. Condition: excellent.
- d) Marri open woodland with scattered *Kingia* over *Allocasuarina humilis*, *Eremea* aff. *brevifolia* and *Phyllothea spicatus* open heath over a mixed open herbland and mixed sedgeland. Condition: excellent.

All of the above sites occurred on sandy loam over clay soils. Another site, which is mapped as the same plant community, was recorded on gravely sandy clays over gravely clay.

- e) Marri woodland over *Viminaria juncea* open shrubland over *Kingia australis* and *Xanthorrhoea preissii* shrubland over mixed low shrubland over a *Borya scirpoidea* open herbland and mixed sedgeland. Condition: excellent

Pericalymma ellipticum Heath occurs in wetter pockets scattered through the "Marri Woodland with Scattered *Kingia*" plant community. It is not mapped separately but a separate site description is given.

- f) *Pericalymma ellipticum* closed heath with scattered *Viminaria*, *Leptocarpus co-angustatus*, *Cyathochaeta avenacea* and *Mesomelaena* sedgeland. Condition: excellent

***Melaleuca* and *Viminaria juncea* Scrub** occupies an area of approximately 3 hectares between Turner Road and Soldiers Road in the southern section.

- g) *Melaleuca viminea*, *Melaleuca* and *Viminaria juncea* open scrub over open bunch grassland over open herbland and mixed closed sedgeland. Condition: very good.

***Banksia* Woodland** is found on a small sandy rise in the southern part of the reserve.

- h) *Banksia menziesii* open woodland over *Hakea ruscifolia* and *Conospermum stoechadis* shrubland over mixed low shrubland over open grassland

and *Mesomelaena*
pseudostygia sedgeland.
Condition: excellent to very
good.

Marri and Jarrah Open Woodland
occurs around the margins of the
sandy rise and in Lot 48.

- i) Marri and Jarrah open
woodland with scattered *Kingia*
and *Xanthorrhoea* over
Jacksonia sternbergiana open
shrubland over mixed low
shrubland over mixed open
herbland and mixed sedgeland.
Condition: excellent to very
good.



Flora

A total of 309 species of native plants and 24 exotic plants have been identified in the reserve. These include four species that have been listed as priority flora, as shown in Table 3.3. A high number of plant species found at Brickwood are of particular scientific interest. These include the endangered species, eight species that are only found on the eastern side of the Swan Coastal Plain, and the species that are of interest because they are found on both the Coastal Plain and the Darling Plateau. The flora shows a close relationship with the flora of the Plateau, with around 66 species also found there. *Eucalyptus lane-poolei* occurs as a small but disturbed grove of trees adjacent to the driveway on the southern side of the Pavilion and changerooms and extending along the road verge of Gordin Way. It is one of the few patches of this species found on the Coastal Plain.

Table 3.3 Priority Flora Found in Brickwood Reserve

Conservation Category	Species Name
Priority One (poorly known taxa, under threat)	<i>Schoenus pennisetis</i> <i>Synaphea odocoileops</i>
Priority Two (poorly known taxa, not under immediate threat)	<i>Trichocline</i> sp. Treeton (BJK & NG 561)
Priority Three (poorly known taxa, several populations, no immediate threat)	<i>Aotus cordifolia</i>
Priority Four (taxa inadequately surveyed)	<i>Drosera occidentalis</i> subsp. <i>occidentalis</i>

Fauna

Brickwood reserve supports an abundance of frogs, many birds, reptiles and invertebrates. Only two

native mammals have been recorded in surveys, the Quenda (*Isoodon obesulus*) and the Western Grey Kangaroo (*Macropus fuliginosus*). The Quenda is listed as a Priority four species on the DEC priority lists. Two introduced mammals, the rabbit (*Oryctolagus cuniculus*) and the house mouse (*Mus musculus*), were also recorded. The other common feral mammal species, the cat (*Felis catus*) and the fox (*Vulpes vulpes*), have been observed by locals.

Surveys of the fauna of the reserve were carried out by Western Australian Museum Officers and others during 1996 and 1997 (Harvey *et al.*). Brickwood provides an ideal habitat for amphibians to breed and the survey identified five species of frogs and many individuals. There were 33 bird species recorded in this survey, 13 reptile species and many invertebrates. Nest structures for Black Cockatoo species and other important birds as well as ground dwelling species are being developed in conjunction with Serpentine Jarrahdale Landcare and the WA Museum.

Table 3.4 Fauna of the Brickwood Reserve

Fauna Group	Common Name	Species Name
Mammals	Quenda (Southern Brown Bandicoot)	<i>Isoodon obesulus</i>
	Western Grey Kangaroo	<i>Macropus fuliginosus</i>
	House Mouse	<i>Mus musculus</i>
	Rabbit	<i>Oryctolagus cuniculus</i>
	Cat	<i>Felis catus</i>
	Fox	<i>Vulpes vulpes</i>

Fauna Group	Common Name	Species Name
Amphibians	Red-thighed Froglet	<i>Crinia georgiana</i>
	Sandplain Froglet	<i>Crinia insignifera</i>
	Moaning Frog	<i>Heleioporus eyrie</i>
	Pobblebonk	<i>Lymnodynastes dorsalis</i>
	Guenther's Toadlet	<i>Pseudophryne guentheri</i>
Reptiles	South-western Sandplain Worm Lizard	<i>Aprasia repens</i>
	Western Bearded Dragon	<i>Pogona minor</i>
	South-western Cool Skink	<i>Bassiana trilineata</i>
	Fence Skink	<i>Cryptoblepharus plagiocephalus</i>
	South-western Odd Striped Ctenotus	<i>Ctenotus impar</i>
	West Coast Four-toed Lerista	<i>Lerista elegans</i>
	Common Dwarf Skink	<i>Menetia greyii</i>
	Southern Pale-flecked Morethia	<i>Morethia obscura</i>
	Bobtail	<i>Tiliqua rugosa</i>
	Racehorse Goanna	<i>Varanus tristis</i>
	Southern Blind Snake	<i>Ramphotyphlops australis</i>
	Dugite	<i>Pseudonaja affinis</i>

Fauna Group	Common Name	Species Name
	Gould's Hooded Snake	<i>Rhinoplocephalus gouldii</i>
Birds	See Appendix 2	

Source: 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*

All fauna, including bones, skin, eggs and semen of all native animal species is protected throughout the State under the *Wildlife Conservation Act 1950*. Some species have been identified as rare or likely to become extinct, including Carnaby's Black-Cockatoo, recorded in the reserve, and Baudin's Black-Cockatoo and the Peregrine Falcon, which are considered likely to use the reserve. The black-cockatoos are also protected under Commonwealth legislation. The Forest Red-Tailed Black-Cockatoo is a Priority species listed by DEC and has been recorded in surveys of the reserve by "Birds Australia".

Vegetation Condition

The vegetation was mapped for dieback (*Phytophthora cinnamomi*) in January 2000. It was concluded that the disease had spread through most of the vegetation except for an area of Banksia woodland on the sandy rise in the southern section of the reserve. Based on this report, treatment of the dieback "front" (the boundary between infected and uninfected areas) was undertaken in February 2002. A 10 metre buffer either side of what had been identified as the southern boundary of the uninfected area was sprayed with phosphoric acid. The northern boundary of the area was not treated. The study did not include the vegetation on Lot 48, but given its small size, level of disturbance and

proximity to infected areas, it is very likely that it is infected.

Apart from the effects of dieback (*Phytophthora cinnamomi*), the condition of the vegetation is excellent or very good through most of natural vegetation retained on the reserve. The exceptions are the areas that have been severely disturbed. Close to the playing fields, along tracks and in areas adjacent to boundaries there is evidence of physical disturbance that has led to invasion by aggressive weeds. Along and adjacent to the drains there are major areas of weed invasion. Around the house and yards of Lot 48 there are a number of denuded areas now covered with weeds. The two most significant weeds of the bushland, both in terms of area affected and aggressiveness, are African Lovegrass (*Eragrostis curvula*) and *Watsonia* species. Perennial veldt grass (*Ehrharta calycina*) is also present in numbers. There are isolated occurrences of introduced (non-local) eucalypts, acacias (*Acacia longifolia*) and tea trees (*Leptospermum laevigatum*). These mostly occur close to the developed land, such as along the firebreak adjacent to Lot 49, south of Turner Road, and north of the diamond sports (T-ball) oval.

In general, there are higher populations of weeds on tracks close to the entry points to the reserve. There are several areas where weed infestation is very dense. Either side of the drain entry on Soldiers Road and extending well into the wetland there are heavy infestations of *Watsonia* and Lovegrass. Lovegrass is also dense along and adjacent to the drain channels where it crosses Turner Road on both sides of the reserve and extending some way into the northern section. Further along the drain through the northern section the weed burden lessens, although there are still significant patches, and major seed

sources in adjacent paddocks. Similarly the drain from Gordin Way, along the southern edge of Briggs Park, is heavily infested with both weeds, which have spread through the adjacent bushland. Weed infestation is also linked to the recreation areas. All of the bushland between the Briggs Park infrastructure and the drain is significantly affected. There are, however, significant numbers of native understorey plants still surviving. This indicates that with careful management the area could be restored.

The edge of the lower carpark has a healthy population of lovegrass, providing ample seed source for nearby bush. On the southern side of the lower oval there is a high density of these weeds between the oval and the track for some 50 metres and extending in places into the bush south of the track. There is also a very dense patch of lovegrass on the eastern side of the lower oval where a narrow track leads out to Mead Street.

Weeds are also prolific in an area about 100 metres south of the Aged Care facility on the south side of Turner Road where *Watsonia* has spread over 50 metres into the wetland community. Further west along Turner Road there is a small triangular section, between two privately owned lots, which is almost completely vegetated with weed species. All of the boundaries and adjacent road verges have some weed infestation, although it varies in density, and the same is true of all the tracks.

Some of the introduced (non-local) eucalypts are starting to spread into the bushland on the eastern edge of the north side of the lower oval. Approximately ten young non-local saplings were noted in an area close to an abandoned limestone track,

mostly *Eucalyptus camaldulensis* with one *Eucalyptus robusta* sapling.

In Lot 48, the house and yards have created a significant but localised disturbance. The bare areas support mostly less aggressive grass weeds. The small track from the house across the bushland to the western boundary is narrowly lined with weeds, which are denser close to the house. The species include perennial veldt grass (*Erharta calycina*). There are a few individuals of lovegrass scattered along the firebreak, but most of the weeds are confined to a small section between the house and the drain. The weeds include shrub and tree species, such as *Acacia longifolia* and non-local eucalypts. In the small patch of bush between the house and the road many Flinders Ranges Wattles (*Acacia iteaphylla*) and a few bottle brushes (*Callistemon* sp.) have established. Around the house itself, non-local western Australian species such as *Melaleuca nesophila*, *Callistemon* sp., *Eucalyptus caesia*, and *Grevillea* sp. have been planted. At the back of the house a very healthy jasmine creeper has covered part of the building and fence.

Physical disturbance such as trampling and digging is also a problem close to the active recreation areas. On the firebreak south of the BMX club, there are currently some informal dirt jumps constructed for BMX use. The area immediately around these jumps and leading to them is very disturbed and there is a lot of rubbish.

The fire history of the reserve has been recorded and will continuously be updated. Shire officers have a program of burning small patches of the reserve each year to reduce the fire hazard in the Vegetation Management Zone. This creates a mosaic pattern of fire effects.

4. Social and Economic Characteristics

4.1. Land Tenure and Management Responsibilities

Brickwood Reserve is Crown Land vested in the Serpentine Jarrahdale Shire for the purpose of *Recreation*. It was named after Geoff Brickwood, who served as a councillor for more than 20 years, and the active recreation section after Robert Hanham Briggs, the first president of the Byford Agricultural Society, but is a single parcel of land with a surveyed area of 49.9834 hectares and is listed as Crown Reserve number 17490. The study area includes an adjacent lot, Cockburn Location 48, which was purchased by the Western Australian Planning Commission in November 2002 with the intention of including it in the reserve. The parcel of land is 1.4417 hectares and will eventually be added to the reserve. Once this process is complete the land will be included in the existing reserve and therefore vested in the Serpentine Jarrahdale Shire.

The area and boundaries of Reserve 17490 have changed substantially since its creation. It was first created in 1920 with an area of only 10 acres. In 1939 the reserve was vested in the Shire of Armadale-Kelmscott and gradually increased in size until the vesting and management was transferred to the Serpentine Jarrahdale Shire in 1977. At this time the total area of the reserve was some 53 hectares. Subsequent changes have resulted in 3.5355 hectares being excised from the crown estate and transferred to the Western Australian Baptist Hospital and Home Trust. Another 1.6861 hectares, Cockburn Location 106, was vested in this organisation for the purpose of Aged Care in 1994 for a period of 40 years. In 1994 Reserve 17490 had an area of

47.9218 hectares and consisted of land described as Cockburn Locations 104 and 107. In December 2003 the reserve was resurveyed and new location numbers were created. Reserve 17490 currently consists of Lots 110, 111 and 112.

Once Lot 48 is incorporated into the reserve the total area will increase in size to 51.425 hectares.

Tenure details are summarised in Table 4.1.

Table 4.1 – Tenure details

Reserve/Lot Number	Purpose	Class	Management Order/Owner
Reserve 37404	Aged Persons Homes	C	WA Baptist Hospital and Homes Trust Inc.
Reserve 17490	Recreation	C	Shire of Serpentine-Jarrahdale
Lot 108	N/A	N/A	WA Baptist Hospital and Homes Trust Inc.
Lot 48	N/A	N/A	Western Australian Planning Commission

Source: Department of Land Information.

4.2. Land Use Patterns

The built environment of Brickwood Reserve represents a substantial investment by the residents of the Shire in facilities for recreation and to a lesser extent for environmental services.

Serpentine Jarrahdale Shire has undertaken a major investment in an indoor recreation centre at Briggs Park. The facility is the first of this scale to be built in the Shire and represents a significant improvement in the range and scale of recreation facilities available at Briggs Park or within the Shire.

The correct management and planning for this infrastructure is important to maintain the social, economic and environmental values of the site.

Playing Fields

Briggs Park has two ovals used by local sporting groups, which are irrigated for six months of the year. The upper oval comprises 1.8 hectares and the lower oval is 2.2 hectares. A small area (c.0.3 ha) of lawn around the pavilion building is also irrigated. The turf species used on the top oval is Kikuyu, which is hardy and very drought resistant. On large sections of the bottom oval the Kikuyu has been replaced by couch, which is more salt tolerant. The top oval has permanent goal posts at the north and south ends, while the lower oval has two permanent baseball back nets in the eastern corners.

The top oval was remodelled at the end of 1998. The old turf, thatch and some of the topsoil were excavated to a depth of 200 mm and resurfaced with pure sand. The surface of the new oval was shaped to form a dome, which slopes away to three sides. The east to west slope of the original surface was too marked to create a level dome. The depth of sand varies across the surface from 300 to 400 millimetres. The elevated pad is bounded by concrete curbing and bordered with a gravel track on the south and west sides of the oval. At the time of remodelling, no subsoil drainage system was inserted, although 4 or 5 slotted pipes from previous upgrades were left in place. These pipes run across the oval from east to west. Drainage from the oval is collected on the west side and conveyed via an underground pipe out under part of the BMX track to the Mead Street roadside drain. After the oval was remodelled there was still a problem with winter waterlogging and more underground pipes were installed on the western and northern

edges of the oval and from the cricket wickets out to the edge.

The remodelling project substantially improved the quality of the turf surface, but there is still some waterlogging after rain in winter. This is possibly unavoidable given the clay soil base and the low slope.

The top oval is the home ground of the Serpentine Jarrahdale Cricket Club during summer and is used by the Mundijong Centrals Junior Football Club in winter. North Murray Diamond Sports used the top oval in 2003 for a T-ball tournament, which they are hoping to make an annual event. The two clubs who use the oval are generally satisfied with the standard of the grounds. The junior footballers have some trouble with waterlogging after or during rain. The grounds managers report a higher level of turf damage when matches are played during or immediately after heavy falls. For safety reasons, the football club would like to see the low railing fence around the field to form a clear barrier to spectators.

The lower oval has not been remodelled, however it is regularly top dressed with sand, which has gradually raised the height by 70 to 100 millimetres over the past ten years. The oval is around 25 years old but was extended 100 metres to the south 10 years ago and then a further 100 metres to the west five years ago. The soils vary across the area of the oval from clays to sandy clays. The oval is not used in winter because it is too severely waterlogged. Extended winter waterlogging and the low infiltration rates combined with relatively saline irrigation water reduce the quality of the turf through summer. The soils also tend to become compacted and require regular aerating. The gradual increase in elevation from regular topdressing with sand has reduced the extent and the duration of

waterlogging. Both the junior football club and the cricket club have expressed an interest in upgrading the lower oval to cater for their need for more grounds as their clubs expand. The lower oval has, however, been allocated to the Diamond Sports club during the period from September to March each year; the club is expanding rapidly and has also expressed a keen interest in upgrading the lower oval.

In summer both ovals and the pavilion lawns are irrigated from a groundwater bore located near the lower oval. The current bore was constructed and equipped five years ago. It is 80 metres deep and has a high sustainable yield of over 50 kilolitres per hour. The bore is equipped with a 20 horsepower "Grundfos" submersible pump. Irrigation is programmed and controlled by a 32 station "Fully automated Waterman Computerised controller" system with approximately 90 "Hunter" pop-up sprinklers on each ground. The sprinklers have a fully overlapping spray pattern, which reduces the impact of wind and maintains an even application rate. The irrigation system was installed at the same time as the pump in 1999 and is not expected to need replacing within the next 10 years. The total cost of installing this system in 1999 was \$236,000. This included the main lines and all of the electrical connections required.

4.3. Facilities and Infrastructure

Buildings

Byford Pavilion

The Byford pavilion is a large brick building on the eastern side of the top oval. The pavilion was constructed in 1984 and had a further three large rooms added to the northern end in 1991. The extensions included two disabled toilets. The building includes

a large fully functional kitchen, storeroom, cleaning rooms, a storage room at the back and a bar section. The bar is fully secured from the rest of the pavilion by shutters and a locked door. The main hall of the pavilion has a carpeted floor and a central dance floor. There are full-length windows along the western and eastern ends of the hall. Consideration for some shading to occur on the western ends of the hall would reduce energy costs and make the pavilion more comfortable in the summer. These and smaller windows elsewhere on the pavilion are protected by security screens. There is a very large covered veranda along the western side that can be used for barbecues and other events. The pavilion is linked to the changerooms by a wide covered breezeway on the south side. It is similarly attached to the older toilet block on the east side.

The condition of the pavilion is reasonable, although after 20 years of use the area is in need of painting and the floor coverings will need to be replaced. The Byford Learning Centre's room on the north side also requires a general paint and facelift and the carpets there are water damaged. The toilets at the back of the pavilion are almost 30 years old and an upgrade could be considered. The structure is fairly basic and facilities are old and worn but functional. These toilets would not meet current standards if they were constructed today, and any upgrade could potentially have positive environmental benefits for the groundwater quality. There are possibly insufficient toilets for the hall's capacity, and the surfaces are cracked and stained or unsealed and difficult to clean. There is some water damage on a wall exposed to the sprinkler system. The public uses the facilities during sporting and other events held at the oval. Users of the hall also have

access to the two disabled toilets, which are in good condition.

Change Rooms

The change rooms are an older brick building immediately south of the pavilion. It includes two large rooms, each with toilets and shower areas. There is also a smaller toilet and a canteen on the southern end. The toilet area is used as a storage area and changeroom by umpires during the football season. A covered verandah extends along the western side facing the oval. An old oil heater tank on the east side (back) of the change rooms is deteriorating.

Lower Toilets and Canteen

A small ablution block and canteen is located between the BMX facilities and the southern end of the lower oval. This is also an old, fairly basic, unsealed structure, which is in reasonable condition. The canteen is shuttered and the toilets are also effectively secured. Effluent is discharged to a septic tank and leach drain system, which often overflows. These toilets are used by competitors and spectators at BMX and diamond sports (such as T-ball) events. During larger events the BMX club hires portable toilets. The cost of fitting an "alternative treatment unit" to manage the effluent is extremely high.

Serpentine Jarrahdale Recreation Centre

The new recreation centre at Byford contains a number of energy and water conservation and efficiency facilities and infrastructure. These include:

- A total water savings of up to (approximately) 1000 kL per year;
- A garden designed to use minimal amounts of water, fertilisers, herbicides and pesticides;
- A Biosystem 2000 Effluent Disposal System which is more

efficient, with lower running and maintenance costs;

- Waterwise fixtures with more water efficiency, requiring little or no maintenance;
- Passive solar design principles used to maximise natural light and ventilation; and
- A 6 kW solar hybrid wind turbine erected on site, consisting of a 5 kW wind turbine and 1 kW photo voltaic array.

Miscellaneous Infrastructure Items

There are a number of important minor items of infrastructure on the reserve.

Oval Lights

Large spotlights on high poles surround the oval and provide light for night-time training, and potentially for night games. The oval lights are insured for \$33,000. Two of the lights are currently redirected onto the BMX facility, which has insufficient lighting for its night-time activity. The clubs have proposed sourcing additional lights from disused courts in Mundijong or Serpentine and attaching them to the same pole. This is another issue that could be successfully negotiated through a community management committee.

Cricket Nets

The cricket nets are an essential training facility for the cricket club. There are four nets located on the north east corner.

Other

There is a small drinking fountain near the old courts now used to house the skate ramps. The top oval has goal posts for Australian Rules Football at the north and south ends.

BMX Track and Facilities

The BMX track was originally constructed in 1982, and substantially upgraded in 1999 by the current club. The track is a modified design to

accommodate the shape of the club grounds between the two ovals. It is currently 325 metres long, and includes a straight section, a short S-bend, a loop and a final straight. There are a variety of jumps along the course. The jumps are constructed from clay fill with a blue metal dust surface. Tyres are used to create retaining walls at the sides of the jumps. The starting blocks and first section of the track are bituminised. The club regularly changes the shape of the track and adds new jumps to maintain interest. The track is in good condition but vandals frequently remove tyres from the retaining walls and there is some minor erosion adjacent to the jumps.

There are a number of buildings distributed around the track. The club has constructed a canteen from a large refrigerated truck trailer and added a large galvanised iron shelter. The starting area of the track is also covered by an open sided shelter. A sea container has been put to use as a storage shed and two small galvanised iron open sheds provide a registration hut and a cycle repair booth. A taller structure in the centre is the race-calling tower, which has a locked cage at the base for storing shovels and other tools. The track requires constant maintenance which is consistent with the constant changes to track design.

Serpentine Jarrahdale Recreation Centre

A Recreation Centre has been developed at Briggs Park by the Shire. The centre features the following facilities:

- a multi-purpose indoor sports facility;
- a fully equipped gymnasium;
- a fitness room;
- an extreme sports room with skate ramps and climbing frames;

- a multi-purpose room with dance floor and stage;
- a small multi-purpose room;
- toilets and showers;
- offices and store rooms;
- cafeteria with indoor and outdoor seating; and
- crèche and play area.

The centre includes features that aim to minimise the energy and water consumption. The building design and orientation will minimise the use of energy for climate control, lighting and hot water. Waste water is treated and used for irrigation.

House at Lot 48 Turner Road

Lot 48 is likely to eventually be incorporated into the Brickwood Reserve. The house is a 3 bedroom, one bathroom, rendered weatherboard structure with a colourbond roof. The building is in fair to poor condition. There is a galvanised iron shed adjacent to the house, which appears to be in good condition. There are also patios and various pens used to keep dogs at the back of the house. The house uses an old fashioned septic system. The garden plants around the house are inappropriate for its future use as part of a vegetation reserve. The property is currently owned by the Western Australian Planning Commission, which has indicated that it would be prepared to demolish or otherwise modify the existing infrastructure on the property prior to transferring it into the reserve. The plants and the pens will definitely need to be removed. The house and sheds will need to be assessed in the light of decisions as to the future use of the location. If the buildings are removed, the septic tank should also be decommissioned. The house is currently rented for \$140 per week. The option of continuing with this arrangement in the medium term to provide extra income for the management of the reserve should be considered. If this option is selected

then the house should be clearly delimited from the surrounding bushland and conditions placed on the use of the property to protect its biodiversity values.

Fences and Tracks

There are pipe post and rail fences around the road boundaries of the Briggs Park area and low rail fences around parts of each oval to exclude cars. Both ovals are fenced from the bush areas. Fences run along Mead Street and Warrington Road, separating the bushland from the road reserve.

The remainder of the northern section of the reserve, being the natural vegetation, has some fences along boundaries with adjacent properties, but is effectively unfenced. There are no fences along the road boundaries outside of the Briggs Park sector. There are also no fences delimiting the recreation area from the bushland. This leads to greater impacts from users of the recreation area on the surrounding natural ecosystems. The fences defining the boundaries with adjacent properties are generally in good condition.

The southern section of the reserve is fenced along Soldiers Road and along all boundaries with private property. It is not fenced along its boundary with Turner Road. The Department of Environment and Conservation (DEC) is planning to fence along Turner Road and to upgrade the fence along Soldiers Road. This action is part of a recovery plan for critically endangered threatened ecological communities funded by the Commonwealth Natural Heritage Trust program. DEC has reached an agreement with the Shire Council to undertake the fencing on the condition that the Shire fences the northern section of the reserve by 2009.

Lot 48 has a high ringlock fence around most of its boundary. The fence is in reasonable to good condition.

Carparks

There is a bitumen carpark adjacent to the pavilion and further parking is available in the gravel surfaced section behind the BMX facilities. A third informal carpark on the Mead Street Side of the diamond sports (T-ball) oval has been replaced by the recreation centre. Users also park along the road and adjacent land around the top oval. Parking is generally adequate except during major events. The bitumen carpark is in good condition while the lower carpark is reasonable with minor damage caused by water erosion.

Drains

There are two drainage lines through the reserve that unite in the northern section before discharging into the Water Corporation gazetted drain that crosses Warrington Road. The drainage infrastructure is discussed in more detail in the *Water* section of this report.

Signs

There is a wooden sign with the name "Brickwood Reserve" on the corner of Mead Street and Gordin Way. There are a few old signs cautioning users of the Skate ramps in the old courts and prohibiting damage to facilities. There is no interpretive signage at the entries or within the bushland areas.

Shade Trees

Planted trees around the edges of the two ovals as well as some of the bushland trees provide much needed shade for players and spectators during summer. They also add to the general amenity value of the ground. Some of the trees have been removed for the construction of the recreation centre. The planted trees adjacent to the diamond sports (T-ball) oval are

mostly *Eucalyptus camaldulensis*, a species that is becoming a serious weed in bushland areas and therefore should be progressively replaced and removed. Non-invasive shade trees could be planted along the remaining northern edge, and possibly the other edges, of the diamond sports oval to provide shade in the future. Such plantings must not impact on the adjacent bushland.

4.4. Heritage

Indigenous

The south-west of Western Australia has a history of Aboriginal occupation spanning at least 40,000 years. The people who occupied the area at the time of European settlement are known collectively as the Noongar (or Nyungah) people. This distinctive social and cultural “bloc” extended from just south of Geraldton to east of Esperance over the whole of the southwest corner. Within this area, there were thirteen different socio-dialectal groups. The area around Brickwood Reserve is believed to have been occupied by the *Whadjuk* people or tribe.

The pattern of Aboriginal use of the Swan Coastal Plain was largely determined by the availability of food. The family groups, of up to forty persons, had no permanent places of habitation and generally moved between campsites along rivers and wetland chains. The Swan Coastal Plain was a highly productive area, with wetlands, rivers and estuaries supplying an abundant source of food. One study of Aboriginal archaeology concluded that swamps provided major food staples such as reed rhizomes (Hallam 1972). There were a number of permanent travel routes, known as *footpads*, on the plain. One of the footpads ran from Pinjarra to Kelmscott, close to the location of the South Western Highway and the Reserve.

Water supply played a vital role in Aboriginal life and water was treated with great respect. The “Waugal” is one of the most important mythological creatures for the Noongar people. This is a Dreamtime ancestor who created the waterways and wetlands and who continues as the spiritual being connected to these places. The Swan Coastal Plain is a water dominated system and there are, therefore, many beliefs and spiritual places associated with all the waterways, including smaller creeks and swamps such as Brickwood Reserve.

There are many Aboriginal sites on the Swan Coastal Plain. The Department of Indigenous Affairs currently has 46 sites listed within the Shire’s boundaries. Under the *Aboriginal Heritage Act 1972* all places and objects of Aboriginal importance are protected, requiring land managers to take all necessary steps to avoid disturbance. Site density on the coastal plain is far greater than in other zones, such as the forested Darling Plateau. Larger sites are generally found on the dunes and ridges. These better-drained sites would have provided more comfortable campsites, close to the food and water resources provided by wetlands and waterways.

A survey less than 200 metres east of the Brickwood Reserve identified a large quantity of archaeological evidence of Aboriginal use. Some of the finds were associated with a freshwater spring and others with the Cardup Brook. There are no known surveys of Brickwood Reserve itself, but its proximity to this area of evidently intensive use together with its particular wetland values suggests that it would have been an area used by the Aboriginal people.

The Gnaala Karla Booja Native Title claim, which resides over the Shire,

was submitted to the National Native Title Tribunal for registration on 17 September 1998 and passed the registration test the following year. The Claim is now in mediation and this gives the claimants the right to negotiate in relation to land management issues on lands subject to the claim. However, in 2002, the courts determined that Native Title is extinguished on Crown Lands that were vested prior to December 1996, such as Brickwood Reserve. Native Title is also considered to be extinguished over freehold land such as Lot 48. Administration of the Gnaala Karla Booja Land Claim is being co-ordinated by the South West Aboriginal Land and Sea Council, and although Native Title has been extinguished over the reserve, the Shire is required to notify this body of any intended public works and to give claimants the opportunity to document any comments. To date no formal consultation has occurred with either the South West Aboriginal Land and Sea Council or local Noongar people.

European

European settlement of the Swan Coastal Plain dates from May 1829 when Captain Fremantle raised the Union Jack on the banks of the Swan River. Governor Stirling arrived with the first party of settlers one month later. Stirling had briefly explored the region two months before and lobbied for the establishment of the new colony. His glowing reports generated a great deal of interest and several private parties made offers to establish privately funded agricultural settlements. Stirling himself led the new settlement in exchange for a large land grant. Another entrepreneur, Thomas Peel, negotiated a priority grant of 250,000 hectares provided he brought 400 settlers to the new colony before November 1829. He arrived late with fewer settlers and forfeited his original grant but received in exchange a grant of the land

extending from Woodmans Point, Cockburn to the north bank of the Murray River and inland almost to the Darling Scarp. The land grant extended out to a few kilometres west of the Byford townsite and included the current area of the reserve. Peel's settlement plans collapsed, although he did establish farms at Mandurah and on the Serpentine River. However, his ownership of this land, together with poor soils and winter flooding, delayed settlement of the region. Two freehold land grants, east of Peel's land, were surveyed in the 1840s. The first of these, situated between the Wungong brook and the South Branch or Berriga Brook, was taken up by the Armstrong brothers in 1844. The second block was on the Cardup Brook close to the reserve and close to the site of the current housing development known as Byford Village.

The Perth to Bunbury Railway, which runs immediately east of the reserve, was constructed in 1893 and had a great impact on the local economy. The railway provided the means of transporting produce and timber to Perth to sell. Soon afterwards the Cardup Brickworks was established. In 1913 a second Brickworks, the Byford State Brickworks, was established at Byford. The latter closed in 1959, but the Cardup Brickworks is still operating today.

In 1906 the town of Beenup was gazetted on a site that included Brickwood reserve. However in 1920 the Beenup Progress Association, which had formed in 1914, was successful in their campaign to change the name of the town to Byford. The original townsite was located on land around and in Brickwood Reserve; however, it was later shifted to the eastern side of the railway line. Reserve 17490 was created as a Crown Reserve on 11 June 1920. It had an area of only 10 acres.

By the mid-1920s many more people were living in the district. The Peel Group Settlement brought an estimated 40 families to the area west of the town, and employment at the brickworks and timber mills attracted others. The positive attitudes generated by the thriving community led some local farmers to think it was time to put on a Byford Show.

In June 1926 the Byford Agricultural Society was formed and its first president was Robert Hanham Briggs, one of the authors of the idea. The new society, with support from the local community, acquired a further 16 acres of land in the area now known as Briggs Park. Volunteers worked hard to clear and fence the land and built a grandstand and a long narrow Exhibits Hall. The Hall was constructed from three railway wagonloads of face cut timber that were donated by W.J. George M.L.A. The first Byford Agricultural Show was held at Briggs Park on November 13 1926. It was opened by Sir James Mitchell and was a social and financial success.

The Byford Show was held on the site every year from 1926 to 1966, except for a short break during World War II. It was one of the most successful shows in the state, and attendance figures were usually between 1500 and 2000 people. In some years a special train and a restricted bus service were organised to bring people for the day. However, by 1966 public support for the show had waned so much that the 36th Byford Agricultural show was the last held at Briggs Park.

Unfortunately, there is little trace of this era as the buildings and grandstands were destroyed by white ants once they fell into disuse. There are remnants of what may have been a loading ramp and posts near the diamond sports (T-Ball) oval. Subsequent development of the

grounds for other recreation uses has obliterated all other evidence.

In 1939, Reserve 17490 was vested in the Shire of Armadale-Kelmscott for the purpose of *Recreation*. In the early 1970s, local councillors Alex Cumming and Peter Kargotich undertook to acquire further land around Briggs Park from the Crown for use for future recreation facilities. This area included all of the present reserve and locations 106 and 108 Turner Road. In 1977, Byford residents were again politically active and voted to secede from the Shire of Armadale-Kelmscott and become part of the Serpentine Jarrahdale Shire. The management of the Brickwood reserve was also transferred and was vested in the Serpentine Jarrahdale Shire in April 1977. In 1979 the Shire divided the reserve into two parcels; Reserve 17490 retained the purpose of recreation and 37404 was created and vested for the purpose of Homes for the Aged and Disabled. Reserve 17490 was named after Geoff Brickwood, who served as a councillor for more than 20 years, and the active recreation section of Briggs Park after Robert Hanham Briggs, the first president of the Byford Agricultural Society (the first users of this area).

A Serpentine Jarrahdale Shire sub-committee was established to obtain funds to organise the construction of the first of four self-contained units on R37404 in Gordin Way in 1983. Six more were built with a combination of funds raised from the community and the Commonwealth in 1985. A further two units were added in 1993. In 1994, the community-based committee was unsuccessful in continuing to attract funds adequate to match Commonwealth funds to continue with the project; the Shire, on recommendations from the sub-committee, decided it could not afford to build and run an aged care facility on the site, and transferred the units

along with 3.53 hectares of Crown Reserve to the Baptist Hospital and Homes Trust. A further 1.686 hectares of Crown Reserve was vested in this organisation for the purpose of Aged Care. The vesting is for a period of 40 years and includes the power to lease. In the same year the National Trust notified the Shire that it had entered the Brickwood bushland on its Register of Heritage Places because of its significant conservation values. In 1998 the value of the bushland was again recognised when the Australian Heritage Commission entered it on the Register of the National Estate.

The Byford Pavilion and change rooms were constructed at Briggs Park a few years after Byford joined Serpentine-Jarrahdale. The lack of community facilities had been one of the issues that galvanised residents to secede. In 1991 the building was extended when three rooms and two disabled toilets were added to the northern side. These rooms were used for many years by the Byford Friendly Club and the Byford Learning Centre. Both groups provided a range of social and other activities for local residents and both have initiated other groups. The heritage choir was formed from a group organised through the Byford Learning Centre, while the Over 50s Keep Fit Class (now the Byford Community Physiotherapy Fitness Group) was started by the Byford Friendly Club. Unfortunately, the Byford Friendly Club disbanded in 2004 due to lack of enthusiastic committee members. However, the other three groups are still thriving and continue to use the pavilion for their activities. The pavilion is also used by Southside Care who provided centre based care for the aged and disabled.

The Briggs Park oval, now the site of the remodelled top oval, has been home to local sporting groups for many years, although records are scant. It is likely that local teams

played cricket and football at the site from its inception in 1926. Both the Byford Football Club and the Byford Cricket Club were in existence in the early 1920s prior to the clearing of the Recreation Grounds, as Briggs Park was then known. The Tennis Club also based itself there for a time. Local photographs show players at the grounds in the 1940s, but by the 1980s the Tennis Club had moved to courts in Park Road, Byford. Basketball was also played at the grounds in the 1980s, possibly on the site of the old tennis courts south of the pavilion. The courts have fallen into disrepair, but have been put to good use as a skate-boarding area. A number of modular skating ramps are now located here and are used by local children to practise their skills. The oval is still the home of cricket and football clubs.

The Byford Cricket Club, after previously amalgamating and separating in the 1980s, united with the Mundijong players to form the Serpentine Jarrahdale Cricket Club, which is based at the grounds. The club uses the pavilion as clubrooms and has undertaken substantial improvements to the bar in this building. The football clubs also amalgamated, and today the grounds are used by the Mundijong Centrals Junior Football Club while the senior club is based at the Mundijong grounds.

A second oval was constructed at the grounds in the late 1970s, after the transfer of the district to the new Shire. The oval was extended to the south approximately 10 years ago and then further extended to the west five years ago. This ground is now used by the T-Ball Club, which has been active since the early 1980s and has recently expanded into Baseball. This initiated a name change for the club, which is now called the North Murray Diamond Sports. The sport of BMX, or bike

racing, was initiated at Briggs Park in 1983, when locals formed the *Pegasus BMX Club* to provide the sport for their children. The club was very active and in 1984 the national titles were held at Briggs Park over four days. The club had a brief life and closed in November 1985. It reopened from February 1987 to December 1990. The current BMX club formed in 1999 and has substantially remodelled and upgraded the track between the two ovals. It has open days each year, which regularly draw over 300 riders and many spectators. The open day in 2001 attracted 2000 spectators and 400 riders. Where any need for repair, maintenance or upgrading of facilities are identified actions need to be taken by the specific club or organisation to carry out the appropriate works.



5. Reserve Management

5.1. Land Resources

Erosion

Erosion is the removal of topsoil, and in extreme cases, deeper layers of the soil profile by the action of water or wind. The risk of erosion depends on the stability of the surface soil and the force of the wind or water moving across the surface. It is an accelerating process, as bare eroded areas generate more surface runoff, increasing the volume and speed of water movement down-slope. Soils such as sands (with high infiltration rates and poor structure) are resistant to water erosion but susceptible to wind erosion. Clay soils are resistant to wind erosion but highly susceptible to water erosion. In both cases it is essential to maintain good surface cover of plants, mulch or other materials.

To prevent water erosion, it is important to reduce the volume and speed of water flows. Vegetation and mulch cover stabilise the surface sediments, reduce the speed of surface water flow and encourage infiltration, reducing the volume of runoff. Other surfacing materials such as gravel or granite fines stabilise the surface and permit infiltration but are less effective in reducing flow velocity. However, these materials cannot counter high velocity and/or high volumes of runoff. Hard surfaces such as bitumen cope with high velocity flows but also shed large volumes of water, which increases the threat to downslope areas.

Salinity

Salinity alters the chemical structure of the soil and limits plant growth. This leads to the secondary impacts of bare sealed surfaces with low infiltration and increased runoff, which in turn increases the potential for erosion and

both nutrient and sediment transport. Increasing salinity alters not only the chemistry but also the structure of the soil. Soils with some clay content can suffer from *slaking* of the surface sediments, causing the surface to seal, and from dispersal of the soil colloids. Both of these conditions reduce or prevent water draining through the soil profile and increase the risk of erosion.

There are no mapped areas of primary (naturally occurring) or secondary (human induced) salinity in the reserve. However, the groundwater used for irrigation has a relatively high salinity of 1500 milligrams/litre. With careful management, salt accumulation in the soil profile can be avoided. The current management regime demonstrates excellent management of this threat. The quantity, frequency and timing of irrigation are carefully controlled to minimise salt levels. Salt levels are monitored at appropriate times, such as towards the end of the summer season or whenever the turf cover indicates a problem. Chemical treatments have been applied to the soil, when needed, to remove excess salts. This careful management relies on the skill of the current operators, and it is important that there is effective succession planning so that this knowledge is not lost.

Waterlogging and Compaction

In the original landscape much of this site was waterlogged or inundated for long periods of the year. This was the natural condition of the soil. Many wetland plants have adapted to store oxygen in the soil sediments around their root zone, which not only allows the plants to survive but also supports thriving colonies of fungi and micro-organisms. Once the native vegetation is cleared and the soil is put to other uses, the chemistry and ecology of the soil changes. Many plant species, including turf and other amenity

species, are unable to survive for long periods in waterlogged soils. Once the surface cover is removed the bare surface soil is susceptible to water erosion. In addition, waterlogged pasture or turf subject to high pressure use or cultivation is susceptible to structure decline.

Strategies to alleviate these problems include major projects to elevate the surface and create free-draining topsoil, as has been carried out on the top oval. This provides the most permanent solution to the problem but is also the most costly. Alternatively, drainage networks can reduce the period of waterlogging and inundation, by increasing the rate at which water drains away from the site. The Peel drainage schemes are a large-scale example of this approach, and illustrate the environmental problems that can be caused. The third approach is to use plant species that are tolerant of waterlogging, or at least able to maintain surface cover. Intense use of waterlogged areas, particularly clay soils, will cause compaction of the soil and further damage to surviving plant cover. It is best to exclude all machinery, particularly heavy machinery, from waterlogged areas and to minimise use.

Regular use of clay or loam soils for sport can cause compaction of the soil profile by effectively reducing the pore spaces in the soil. This reduces the permeability of the soil to both water and air. Specialised machinery is used to loosen and aerate the soil profile. This operation is carried out annually or when needed on the bottom oval.

The risk of compaction is greater when the soils are waterlogged. The northern section of the top oval becomes waterlogged during and immediately after rain storms. This is also the area of intensive use by the junior football clubs for training. It is important that the clubs are made

aware of the impacts of their sport on the grounds and are encouraged to train in other parts of the grounds and not to use the waterlogged sections.

Nutrient Enrichment

The hydraulic connection to the surrounding land uses, through both the surface water flows and the ground water, exposes the wetland areas to potential nutrient enrichment and other pollutants. This change to the natural, low nutrient status of these soils threatens the biodiversity values of the conservation wetlands. The impacts of nutrient enrichment are evident along the drains through and around the bushland where weeds thrive. Strategies to manage this threat are discussed in the Water section of this document.

Acid Sulphate Soils

Acid sulphate soils (ASS) are naturally occurring sediments containing iron sulphides, generally found in waterlogged soil. Left undisturbed, these soils pose no threat to the environment or to humans. However, when disturbed and exposed to oxygen, the soils produce sulphuric acid, iron precipitates and high concentrations of heavy metals. These products can cause major environmental damage, ranging from damage to the soils themselves and all soils affected by contaminated surface or groundwater; damage to human health and infrastructure; and loss of biodiversity and ecosystem services. This is therefore an issue that constitutes a threat to soil values, biodiversity values, water values and infrastructure values.

The Brickwood Reserve is identified as an area with moderate to low risk of actual or potential acid sulphate soils in the Western Australian Planning Commission Planning Bulletin Number 64. In the areas mapped as moderate to low risk, acid sulphate soils, where they occur, are expected to be more

than 3 metres below the surface. However, this risk assessment is the product of broad scale mapping, as detailed risk maps are not yet available. Wetland areas with high water tables have a higher risk of containing acid sulphate soils, which indicates that extra caution is necessary on this site.

ASS can be exposed by excavation or by lowering of the water table below the previous base levels. In order to avoid this, any excavation more than 2 metres below the original surface level requires a "Preliminary Site Assessment" to determine the presence or absence of iron sulphides. The assessment needs to be prepared according to Department of Environment guidelines. This applies to the site itself and the surrounding areas. Exposure of ASS in any site that is linked by surface water or groundwater flows to this site could damage soil values and a range of other values of this site and the surrounding region. The second preventative strategy is to maintain the groundwater level within the normal seasonal range. Water extraction at a local and regional level needs to be carefully managed to avoid lowering the base water level.

possible relocation of the BMX track, including consideration of the selection of possible sites for the relocation outside the reserve.

5. Undertake annual monitoring of soil salinity to establish baseline data and monitor salinity trends.
6. Investigate and cost options to improve the winter drainage of the lower square oval.

Strategies

1. Investigate and implement appropriate mechanisms to ensure stormwater does not cause erosion; such as in-stream structures to assist in slowing water velocity.
2. Identify and rehabilitate degraded areas, focusing on bare soil such as eroding tracks and firebreaks.
3. Prohibit and monitor horse and motorcycle access to internal tracks and firebreaks.
4. Prepare plans in consultation with the BMX club for the

5.2. Water Resources

Overuse of Water Resources

The major use of water on the Reserve at present is for the irrigation of the turf on two playing fields. The Department of Environment and Conservation has published guidelines for turf production that outlines best management practices. These include a range of techniques and management strategies that produce acceptable turf quality with minimum inputs of water, nutrients and chemicals. The quantity and frequency of watering will depend on many factors, including soil water capacity, turf species, evaporation rate, wind speeds, soil wetting patterns, degree of vegetation cover, and quality of turf required. The general principles for effective irrigation are:

- to water little and often;
- to water at times of low evaporation and low wind; and
- to apply enough water to wet only the surface 200 mm (or the root zone).

Water use on Briggs Park ovals conforms to best management practices for irrigated turf. The Department of Environment and Conservation guidelines recommend watering a playing field with moderate use based on 65 to 70 percent of the average daily evaporation. This equates to between 8 000 and 8 500 kilolitres of water applied per hectare of irrigated turf from November to April. The actual water use on the ovals of the reserve equates to approximately 6 700 kilolitres per hectare. Watering is divided into three applications per week in the evening when wind and evaporation are low. The turf species used on both ovals were selected for their drought tolerance.

Overly stringent controls on water use could lead to a build-up of salt in the

soil or a reduction in the area or quality of turf. However, the irrigation system could be upgraded to allow further fine-tuning of the watering program. A fully automated system that includes modern soil moisture and air sensing devices could achieve some reductions in water use. However, the watering pattern also needs to be modified to minimise salt levels in the soil. This requires less frequent, more intensive watering to flush excess salts from the profile.

The Byford Recreation Centre has increased water consumption at this site. Nevertheless, the design, operation and management of the new centre has been planned to minimise water use. Landscaping the area around the existing buildings with drought tolerant plants has occurred. Grassed areas are generally kept to a minimum, with other open space planted or covered with mulch.

All of the water delivery systems need to be well monitored and maintained to achieve water conservation goals. Procedures can be developed to ensure regular monitoring and maintenance of the irrigation systems and all other water supplies throughout the reserve.

In the long term, as the population of Byford grows, there may be opportunities to use other water sources, such as recycled waste water, to irrigate the playing fields. The emphasis on water conservation throughout the region is likely to lead to developments in management techniques, design and plant species that achieve further water savings. It is important that ground and facility managers remain abreast of these innovations.

Impacts on Water Quality

The excessive or inappropriate use of nutrients, chemicals and other pollutants can lead to the pollution of

water resources. This includes the groundwater resources and surface water resources extending as far as the Peel - Harvey Estuary. Nutrients and other pollutants exported through the surface drainage system pose a significant threat to the estuary and all of the downstream water bodies. Nutrients and other pollutants flowing into the reserve from surrounding land uses pose a significant threat to the survival of the conservation category wetland on the reserve. This is an oligotrophic (low nutrient) system, and changes to the nutrient balance can severely damage the ecosystem. Nutrients and other pollutants leaching into the groundwater system can affect the value of the resource for human use and impact on the natural ecosystem in the aquifers themselves and in wetlands and waterways where groundwater comes to the surface.

Reducing the nutrients exported to the surface and ground water systems requires careful application of nutrients to playing fields and home gardens within the catchment. Best management practices recommend that applications are divided over the year and applied when turf is actively growing to give the highest probability of nutrient uptake by the turf. It is important that the turf is well managed to produce a full even surface as this will maximise nutrient use and will effectively filter nutrients and sediment from surface runoff. Low maintenance turf requires between 50 to 100 kilograms of Nitrogen per hectare per year and 0 to 15 kilograms of Phosphorus. Higher maintenance turf requires from 100 to 200 kilograms and 0 to 50 kilograms of Nitrogen and Phosphorus respectively. In reality, phosphorus is seldom required on established turf. The low phosphorus requirements of the turf are met from the breakdown of grass cuttings and soil stores. Regular mowing produces fine grass cuttings, which are readily broken down in the soil and are not

washed into the drainage system to add to nutrient levels.

Nitrogen is readily leached from the soil and can cause serious contamination of groundwater supplies in urban or horticultural areas where application rates can be high. To avoid this occurrence, it is recommended that no more than 40 kilograms of nitrogen be applied at one time. The clay soils of the reserve and surrounds have low infiltration rates, and therefore reduced risk of downward leaching of nutrients. However, the high water tables through winter increase the risk of nutrients being flushed through surface flows.

Nutrient management within the Briggs Park area conforms to best management practices for high maintenance active turf. Nitrogen applications are towards the upper end of the recommended levels and conform to the suggested requirements for couch grass (100 to 200 kg N/yr). The requirements for Kikuyu grass are lower (50 to 100 kg N/yr). Both species of grass are used on the ovals, with Kikuyu dominating on the top oval and couch on the lower oval due to its higher salt tolerance. Given the variation in species requirements and soil types, it may be possible to reduce nitrogen applications to parts of the playing fields. Leaf tissue analysis can be used to determine the nitrogen requirements for different parts of each oval. Further investment in machinery may be needed to allow nutrient application rates to be varied across the ovals.

Septic systems can contribute significant and intense concentrations of nutrients to ground and surface water systems. The clay soils at the reserve limit the rate of infiltration, resulting in surface or subsurface flows contributing nutrients and pathogens to the surface water

system. This poses an environmental and health hazard. Both septic tanks on the reserve require upgrading to reduce this problem. The lower system is a critical problem as overflowing leach drains are a common occurrence. The engineering constraints may mean that the toilets need to be shifted to higher ground or reconstructed on an elevated sand pad. The toilets at the Pavilion do not overflow but may still contribute to pollution via subsurface flows over the impervious clay soils. This effluent may be connected into the deep sewerage in the longer term or into the system in use at the recreation centre.

The BMX track and the carpark areas are hard surfaced areas that generate high levels of runoff. The runoff can carry sediments and other pollutants into the drainage system. At present there is no apparent problem with erosion of sediments and other pollutants into the drain, but the situation should be monitored and basic sediment traps installed.

Other chemicals used on the site also pose a risk to water quality if used inappropriately. These include pesticides, herbicides, cleaning agents and petrochemicals. All products should be transported, handled and applied strictly according to established procedures and label instructions.

Nutrient and chemical use by upstream and surrounding land users can have an impact on the reserve through the surface water flows entering the reserve and through the groundwater connections. As the population of Byford expands and new developments occur upstream from the site, this source of pollution will become an increasing problem. As with many environmental issues, the most effective long-term strategy is to educate the community about the value of the area and how they can

minimise their impacts. In the short to medium term, nutrient exports can be reduced by encouraging "in stream" processes within the drainage network and slowing the rate of water export. Techniques are well documented in the *Manual for Managing Urban Stormwater Quality* produced by the then Water and Rivers Commission.

Pollution of Conservation Category Wetlands

At present the drain from Soldiers Road through the reserve is carrying nutrients into the wetland ecosystem. Nutrient stripping plants have been established along some of the drain, and the success of these plantings in reducing the level of nutrients, heavy metals or other pollutants entering the reserve needs to be assessed. The possibility of diverting some or all of this runoff away from the reserve into other parts of the drainage network should also be investigated. The drain design needs to be modified both to reduce the concentration of nutrients and other pollutants entering the reserve and to reduce the erosion of the drain as it continues into the reserve. It should be possible to design a small detention basin with maximum opportunity for wetland plant filters around the inlet and/or along the drain upstream from the Reserve.

Water Table Fluctuations

Changes to the seasonal groundwater levels will have a significant impact on all natural ecosystems, but will most severely impact wetland ecosystems, which are adapted to certain periods and levels of inundation or waterlogging. The expansion of the urban area planned for Byford will see increasing use of the groundwater resource and an increase in surface water runoff with a corresponding decrease in infiltration to recharge groundwater supplies. This may or may not be balanced by increased use of water from other sources for residential gardens. As described

earlier, the hydrology of this site is complex and poorly studied. Although current groundwater licensing is designed to ensure sustainable groundwater use across the region, this does not preclude localised impacts on groundwater levels. Given the high conservation value of the wetland ecosystem and the complex hydrogeology of this area, a detailed hydrological study is needed to protect the ecosystem. The study should encompass both the surface water and groundwater systems and the future impacts of development.

Strategies

7. Investigate the potential for diverting runoff away from the reserve drain.
8. Ensure that the principles of water sensitive urban design are implemented in all future urban development to minimise nutrient and water flow through the Reserve.
9. Seek support from Department of Water and Department of Environment and Conservation to undertake a detailed study of the hydrology of the local region to guide future groundwater allocation and to set conditions for future urban developments in the area.
10. Instigate a regular groundwater and surface water monitoring program (quality and quantity) within and around the Reserve, such as along Soldiers Road.
11. Install a pollutant trap/nutrient filter along the drain near or upstream from where it enters the reserve.
12. Investigate opportunities to educate surrounding and upstream landholders on how to minimise pollution of

waterways and groundwater (i.e. brochure).

13. Review and implement a nutrient and irrigation management plan that addresses irrigation frequency and volumes. Require the preparation of Urban Water Management Plans to accompany subdivisions and Local Water Management Plans to accompany local structure plans for any proposed development that has the potential to increase the nutrient load entering the reserve.
14. Investigate and estimate costings for upgrading all septic systems on or in the vicinity of the site to eliminate leaking and remove nutrients and pathogens from effluent.
15. Establish targets for water consumption at the Serpentine-Jarrahdale Recreation Centre (possibly as part of the ICLEI Local Action Plan).
16. Conduct annual audits of water use associated with the Serpentine-Jarrahdale Recreation Centre and other buildings on the reserve (possibly as part of the ICLEI Local Action Plan).

5.3. Biodiversity

Dieback (*Phytophthora cinnamomi*)

Dieback (*Phytophthora cinnamomi*) is a disease that affects many of the native plant species in Western Australia, often resulting in their death. It is caused by *Phytophthora cinnamomi*, an introduced soil-borne pathogen that attacks the roots of plants. It is having a 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 cinnamomi* include jarrah, the banksia family, the heath family, pea family, hibbertia family, balga and zamia. The 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 therefore to prevent any further spread of infection and to minimise the impact of existing infections. In Western Australia, government and community are working together to combat the disease. The Dieback Working Group has prepared policies and procedures for managing the disease, which are detailed in "*Managing Dieback: A Manual for Local Government*". The manual provides detailed guidelines for basic hygiene and management practices. Basic practices include:

- controlling the movement of vehicles, people and stock through infected areas;
- ensuring that machinery, equipment, shoes and tools are cleaned after use or when moving between areas;

- not importing or exporting water, soil or plant material unless it can be guaranteed disease free;
- excluding off-road vehicles, motorbikes and horses from reserves;
- minimising the number of tracks and ensuring that they are well drained; and
- placing signs to educate people about the disease and basic hygiene practices.

As stated previously, the disease is widespread in the reserve and the objective is to minimise the impact of the infection and to prevent the spread to other parts of the Shire. In the interim, all users of the reserve should be encouraged to follow basic hygiene practices as outlined above. The new survey has identified one section of the bushland which is uninfected. There are currently no tracks through this area and future management will need to continue to isolate this area from human and other vectors. In the longer term it will be important to educate the community about the impacts of the disease and how they can minimise its distribution and impact.

Weeds

Introduced flora comprises up to 11 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.

The primary means of controlling weeds in remnant vegetation is to avoid disturbance that leads to weed invasion. This may be the direct disturbance of trampling or the less visible disturbance of increased nutrient levels, particularly in wetland areas, which gives the competitive

advantage to exotic plants. Fire also constitutes a disturbance that results in a disturbed substrate that is vulnerable to weed invasion. Along boundaries, drains and tracks, weeds have greater access to the area and can become established and gain further competitive advantage after fires. Reducing the fragmentation of bushland reduces the areas that are easily accessible and the number of disturbed edges that are available for weeds to become established.

The second essential strategy is to reduce the vectors or carriers of weed seed. This includes horse manure and any other introduced materials such as soil or plant cuttings. It also includes removing vectors such as surface water runoff that can introduce pollutants. The effect of runoff increasing weed invasion in the reserve is readily observed in the drain entering the reserve from Soldiers Road. Although it may not be possible to completely divert all runoff away from the reserve, it is possible to create treatment trains along the drain prior to entering the reserve. This would remove sediments and pollutants from the runoff and reduce erosion by slowing the water flows.

Many of the weeds are grass species whose seeds are distributed by wind or soil movement. These species produce seeds that are easily distributed and it is important to target seed sources, even those outside the reserve. This includes African Lovegrass (*Eragrostis curvula*), which is an aggressive weed species prominent in parts of the reserve. The seeds of larger plants such as *Acacia longifolia* or introduced eucalypts are also often introduced to bushland by birds or other vectors. Once established, they provide a further local seed source and the problem escalates. In urban areas these seed sources are impossible to control and the only weapon is vigilance to identify

and remove saplings. Neighbours and the local community can also be approached and asked to remove or control some of the more problematic species.

Several of the trees planted around the ovals are non-local species and one of these in particular, the river red gum *Eucalyptus camaldulensis*, is a problem weed species and saplings have established north of the diamond sports (T-Ball) oval. These trees also provide important shade in summer, so their removal may be controversial. Some trees were removed during the construction of the new recreation centre. The remaining trees should be replaced by local species or non-invasive species, in a progressive manner that maintains the provision of shade.

Weed control needs to be planned and approached in a strategic fashion. The most effective strategy is to remove weeds from areas of light infestation first, to halt their spread. This was the method pioneered by the Bradley sisters. Techniques range from selective removal of seed heads to physical or chemical removal of the plants. The second priority should be given to heavily infested areas that are invading adjacent healthy areas, i.e. the edges of the lightly infested areas. Other priority areas will include heavy infestations that are upwind from less infested sites. In this context, the impact of adjacent land needs to be considered. At the simplest level, an education campaign to target nearby landholders could cover a number of issues including weeds. Secondly, weed removal activities could be extended across adjacent boundaries with the approval of landholders. Applications for funding to control weeds should attempt to include the local community and adjacent lands.

Large-scale removal of weeds needs to be carefully integrated with a

revegetation programme, otherwise the bare areas will be recolonised by exotic plants. The removal of weeds that provide significant habitat values also needs to be carefully planned and integrated with revegetation. This includes the removal of *Watsonia*, which is commonly used by the southern brown bandicoot. Weed control should only be carried out by experienced persons with knowledge of potential impacts on native species.

The reduction and control of weeds in bushland areas is a long term and difficult task. A Weed Management Plan is in place for the Brickwood Reserve Bushland and condition and weed assessment surveys along with the production of maps is part of the weed management program. The first step has been taken to assess the extent and type of weed invasion through mapping and this resource is now being used to review the effectiveness of the subsequent weed control program.

Fire

Fire is an important tool for stimulating regrowth and regeneration in native ecosystems. However, uncontrolled or overly frequent fires can have a catastrophic impact on vegetation and cause high mortality of fauna. The long hot summers create conditions in which there is a high fire risk. The frequency of fires in urban areas increases because of careless or destructive actions by humans and through the introduction of weeds, which increase the fuel load. Reduction in weeds can be achieved in conjunction with prescribed burning both before and after burning. The fire management plan considers factors such as frequency, intensity, time of year, patterns of burning and rainfall before and after burning. The fire management plan balances the impacts on biodiversity with the risks to humans and infrastructure (Appendix 3 Fire Management Plan).

Aged care facilities, recreation facilities and rural residential properties currently surround the Brickwood bushland areas. A plan for fire management has been developed in consultation with Department of Environment and Conservation, Fire and Emergency Services, Shire Officers, Local fire-fighters, representatives of the residential community and the user groups. Vegetation Management Zones have been identified as buffer areas adjacent to areas of high intensity use (aged care facilities, recreation facilities and rural residential properties). A Fire Management Zones Map has been produced which identifies two zones, one as Scientific Reference Zone where no burning is planned and the other Vegetation Management Zone where either Spring or Autumn prescription burns will be carried out so as to maintain a buffer of lower fuel levels for protection of people, property and conservation values.

Controlled burns carried out within the Vegetation Management Zone will affect only small areas (estimated at 200 – 300 square metres). These small areas will be strategically burnt in a mosaic pattern and specific areas which contain Threatened Ecological Communities will be avoided as much as possible. Almost the entire area of Brickwood Reserve contains Threatened Ecological Communities so monitoring the burning of these within some of the vegetation management buffer areas will be important. The Department of Environment and Conservation (DEC) supports a 12 to 13 year minimum inter-fire interval. DEC has supplied flora list data for plots (Gibson *et al.* (1994)) in Brickwood Reserve.

In many cases the vegetation management areas outlined are delineated by existing tracks to avoid further disturbance to the bushland. Otherwise these are a minimum 50

meters. In order to control the mosaic burning within these areas, minor existing tracks will be utilised wherever possible. Alternatively, least impact tracks such as 'kangaroo tracks' will be chosen before a burn. Rake hoe tracks (hand trails) will follow these lines and be reinforced with wet lines. This method is currently utilised by the Department of Environment and Conservation.

Fire intervals will be determined by a combination of fuel loading data and interval time between burns. The aim for fire intervals within the vegetation management areas is proposed to be at least 12 years and/or fuel levels of between 8 and 12 tonnes per hectare. Only small areas are to be burned at any one time, and burning is to be done in a variety of seasons.

The timing of prescribed burns will be altered between seasons within safe limits. Spring and autumn burns will be used. Factors such as weather conditions, wind and soil moisture availability will ultimately determine the timing of prescribed burns.

Monitoring

Monitoring the impacts of controlled burns is essential to identify fire management techniques that will be *sustainable*. This fire management strategy also provides a good opportunity to study the impacts of controlled burns on this threatened ecological community. Murdoch University honours students have undertaken surveys and will be encouraged to be involved in ongoing programs such as reviews of the fire management plan every 3 to 5 years, integrating weed control with fire management for best optimal biodiversity outcomes and investigations into protection strategies such as further fencing initiatives for part or all of the Brickwood Reserve. Baseline data were collected during Spring 2007 along transects in both the scientific reference and the

vegetation management areas by Murdoch University. The sample sites will be revisited at the same time in subsequent years. The results of this research will be used to review and improve management strategies contained within future management plans.

Disturbance

Direct disturbance of the vegetation can cause a direct loss of cover and can lead to the introduction of weeds. Disturbance can be caused by vehicles, bicycles, humans and animals. The threat can be minimised by keeping walkers to designated tracks and excluding stock and all but essential vehicles.

Loss of Rare and Threatened Species

The remnant bushland within the reserve has a significant regional role in preserving several species of rare and threatened flora and at least one fauna species that is considered a priority. All of the threats discussed in this section will affect the survival of these flora and fauna populations. Because the populations are small and vulnerable they are also threatened by individual users who may trample the plants or pick the flowers. For this reason special strategies need to be in place to protect the individuals of these species that remain. The locations of DRF populations are confidential to protect the plants and deter plant collectors or those who see the occurrence of threatened species as an obstacle to the use of the bushland for other activities. Any plans to create pathways or any other activities that impact on the bushland must be referred to DEC for assessment and/or advice under the provisions of the Wildlife Conservation Act.

Fragmentation

Fragmentation is the process of creating smaller disconnected

populations of plants and/or animals. At a large scale, areas of bushland can be separated from other bushland by roads, paddocks or kilometres of cleared land. At a smaller scale tracks, fences and other barriers within a bushland unit can interfere with the movement of fauna, particularly species that will not cross open ground. Fragmentation creates more edges, which are vulnerable to disturbances such as erosion, nutrient and pathogen incursions and weed and feral animal invasion. Overall it decreases the resilience and sustainability of the bushland area(s). This means that the bush has less chance of surviving in the long term.

To minimise the fragmentation of the communities, all unnecessary tracks should be closed and revegetated. Revegetating along the edges to leave only a narrow walking path could lessen the impact of existing tracks. Any revegetation needs to use species of the same "provenance" or genetic makeup as the populations of the reserve. In this case the best approach may be to simply create surface conditions that improve the ability of local populations to recolonise the area. Techniques such as mulching or brushing the bare areas could be considered provided it introduces no pathogens, other pollutants or new genetic material. Decisions to close or partially revegetate tracks need to be taken in consultation with those responsible for fire management in the reserve.

Positive action can be taken to increase the resilience of the community by revegetating adjacent cleared areas and rehabilitating adjacent or nearby bushland. This is a particularly important strategy for the Bush Forever sites adjacent to and along the railway line, as these remnants form a unique and functionally significant north-south corridor. Revegetation needs to use

local genetic material to avoid polluting the local gene bank.

Parts of the reserve have been alienated since 1994, resulting in a significant reduction in the bushland area of the reserve. Lot 108 was transferred to the Western Australian Baptists Hospital and Homes Trust (BHHT) and has since been cleared for an aged hostel. Lot 106 is in two sections either side of lot 108 (Crown Reserve 37404) which has been vested in the BHHT for the purpose of Aged Care until 2034. The western section is contiguous with the reserve and effectively increases the area of the ecosystem. The vegetation is in good condition and as a critically endangered threatened ecological community approval for clearing for the construction of facilities is unlikely to be granted. It is recommended that this area be amalgamated into Reserve 17490 and managed for the purpose of nature conservation.

Drainage and Drawdown

The survival of all remnant vegetation, but in particular the extensive, seasonally inundated wetlands, is dependent on maintaining an appropriate hydrological balance. Ideally, in an altered landscape there should be minimal hydrological connection between natural water bodies and surrounding land uses. This minimises the risk of pollution and the transport of weeds and disease into the remaining natural ecosystems. Surface water flows and the seasonal water tables of the site may have been significantly altered since the broader area was originally drained and settled. Structures such as roads and the railway line have changed the pattern of surface water flows from the foothills into the reserve. While there is more runoff from the catchment, some flows are diverted into other drainage pathways and flows through the wetland are channelled into the drains. The drainage system has also

increased the rate of surface water export from the site. Groundwater bores have impacted the water tables and climatic variation and changes to land use and management have altered the rate of recharge of the water table. The net effect of all these changes on water levels in the reserve is unknown. There is limited prior information on which to base an analysis. However the correct management of the hydrology is essential to the survival of the ecosystems conserved at this site. In order to protect the wetland ecosystems it is important to investigate ways to divert the runoff that drains into and through the site. However any changes need to be backed by a detailed study of the hydrology of the site. Such a study is also necessary to ensure that groundwater use does not alter the water table and affect the ecosystem.

Feral Animals

Feral animals are an ongoing threat to both the flora and fauna of bushland remnants. Rabbit colonies can seriously disturb vegetation and limit any regeneration. As populations grow they also impact on local fauna through competition for food resources and the removal of habitat. Foxes pose a direct threat to small mammals such as the bandicoot while domestic and feral cats can decimate bandicoot, reptile and bird populations. Local cats are likely to become an increasing problem as the human population of the surrounding areas expands. New subdivisions adjacent to Brickwood Reserve should include a 300 metre cat exclusion zone.

Feral rodents thrive in agricultural and equine properties. They are likely to invade the bushland where they would compete with native fauna. Feral honeybees are increasingly being recognised as a serious threat to native wildlife. Not only do they compete with native bees and in some

cases prevent the pollination of highly specialised plants, but they also take over the nesting hollows of native birds and other animals. This is a major threat to the survival of the protected black cockatoo species that use the reserve.

Feral animal control relies on a variety of techniques including trapping and poisoning. The close proximity to populated areas and the laws relating to domestic cats limits management options. There need to be regular and ongoing programs to control feral animals that extend over the entire region. These need to be developed in consultation with relevant State government experts. At a local level, property owners, especially new residents, need to be informed about the damage that their pets can do to the local ecosystem. The Serpentine Jarrahdale Landcare Centre carries out a fox baiting program which takes place each year. Occasional programs of trapping and impounding local cats have worked well in Kings Park to encourage owners to curfew cats.

Climate Change

To cope with the stresses of climate change the vegetation needs to remain healthy and support as large and diverse a population as possible. This requires careful management of all the threatening processes and positive action to increase the resilience of the ecosystems. Climate change is likely to cause a general southerly shift in species distribution and significant southerly extensions to the distributions of some species have already been recorded. The availability of ecological linkages will play a vital role in facilitating this shift.

Lack of Understanding

A lack of appreciation of the importance of protecting biodiversity, together with a lack of understanding of the processes that threaten biodiversity, leads to detrimental

activities. This threat will multiply as the population of the local Byford area expands.

There is a need for a dedicated program to raise awareness and understanding of the significant values of the reserve among local residents, sporting groups that use the reserve and visitors. The program could include a range of techniques such as club newsletters, guided walks in spring, wildflower displays and presentations.

Encouraging recreational use of the reserve on selected and well-managed paths would greatly assist in developing a sense of ownership and appreciation. Interpretive signage is a very effective means of educating visitors to the reserve as well as enhancing the experience of the bushland visit.

Lack of Community Ownership

As the urban area of Byford expands there will be more pressures on the reserve, but there will also be more people who would enjoy participating in the management of this beautiful area. A community group can be a key contributor to the long-term protection of the reserve, as they provide the vigilance and often the political impetus to combat threats and find solutions. It is also a wonderful opportunity to develop strong social ties and to educate locals about the area. A few committed locals can have a major impact on controlling the detrimental activities of others in the community. Community groups also attract a range of funds that are not available to government bodies. The Shire and Landcare Centre can play a key role in initiating and supporting new community interest groups. Envirolink is a new group taking an interest in the reserve and has been involved with the Landcare Centre in educational field days.

Strategies

17. Isolate and restrict access to dieback (*Phytophthora cinnamomi*) free areas.
18. Place signs at the entrance to the reserve to advise users of the incidence and effect of dieback (*Phytophthora cinnamomi*), the areas that are infected and areas where access is restricted.
19. Monitor the recovery of plant communities after fire and use this information to reassess the plan in 2010.
20. Review annually and implement a Weed Control Plan that maps and identifies weed species within the reserve, and identifies priority areas and appropriate techniques and strategies to reduce weed density and weed sources in bushland, surrounding areas and active recreation areas.
21. Identify and progressively replace (where appropriate) and remove all river red gums (*Eucalyptus camaldulensis*) and other invasive non-local trees and shrubs from the reserve and surrounding areas. Request and encourage that adjacent landholders do the same.
22. Update and seek approval for a Reserve Fire Management Plan in conjunction with the relevant State and Commonwealth Departments. Ensure all burning in the reserve conforms to this plan.
23. Regularly monitor and record feral animals around the reserve. Undertake control programs when needed including trapping and baiting.

24. Advise all local residents of the impacts of dogs and cats on the reserve fauna.
25. Prepare an animal (i.e. dogs and cats) management plan for the reserve including statutory controls (such as a 300 metre cat exclusion zone around Brickwood Reserve) with costings and an implementation plan.
26. Initiate discussion with the WA Baptists Hospital and Homes Trust to transfer the management order for Lot 106 to the Shire Management and to change the purpose of the reserve to nature conservation.
27. Provide all developers/landowners within one kilometre of Brickwood Reserve with management plan information and requirements.
28. Develop a public education program that targets local landowners and users of the reserve, to include rare and beautiful species in the reserve, rarity of the reserve and plant communities, impacts of domestic dogs and cats, impacts of weeds and how they spread, impacts of dieback (*Phytophthora cinnamomi*), impacts of physical disturbance and impacts of fire.

5.4. Recreation

Management and Use Conflicts

The grounds provide a number of facilities that are used by several different groups. The facilities are in close proximity to each other and have the potential to impact on each other. Particular issues include insufficient parking, noise impacts, and overlaps between club and outside uses of the pavilion.

Poor scheduling of events can lead to a situation where two clubs require the use of the ovals at one time. This has not occurred to date, but as the respective clubs grow there will be a need for careful planning of activities. For example, in 2004 the BMX open day clashed with the Cricket Grand Finals, which resulted in insufficient parking areas and noise impacts. These problems would be easily avoided by better communication between clubs and a set process for scheduling events through the year. The clubs also need to collaborate to identify their future needs as the Byford population and their memberships grow.

Several clubs mentioned dissatisfaction with cleaning and maintenance of facilities. There were also several instances where poor communication with the Shire led to missed funding opportunities, leaving groups feeling frustrated.

These small issues highlight the need for a formal structure to facilitate input from user groups in relation to the management, planning and use of reserve facilities and to generally enhance communication both between groups and with the Shire. In the past, input from user groups in relation to the management of the reserve has been fragmented. More intensive use of the developed parts of the reserve will lead to an increase in the number

of competing uses and an increased potential for conflict. If a mechanism for local arbitration is not in place, conflicts can build into major issues that will require greater Council resources to resolve. Many small issues can be managed through ongoing dialogue between the groups. The endorsed *Planning and Management Framework for Shire Reserves* provides for the establishment of a Reserves Advisory Committee to provide a focus for local community input to the development of management plans for Shire reserves. However, this does not ensure local involvement in the process, nor does it cater for the ongoing and changing issues that affect these groups. As community organisations that provide important recreational and social services, the groups need to have a role in determining the management and long-term planning for the facilities they use.

Maximising Opportunities for Education and Nature Based Recreation

The valuable bushland in the reserve with its array of plant and animal species provides a wonderful opportunity for local school children to experience and interact with their environment. At present there is only a minor level of casual use by the adjacent primary school, and most schools are unaware of the particular values of the reserve. Information and activities that are targeted at the primary school curriculum would encourage other schools in the district to use the reserve. Through their children the parents in the community would become more aware of the values of the reserve. The development of trails and associated infrastructure would also encourage this use.

As part of the management of biodiversity values associated with the reserve, unnecessary tracks through

the bushland or tracks through sensitive areas should be closed. However, it may be possible to maintain low impact narrow walking trails in place of existing tracks. Appropriate signs and clearly marked trails would encourage people to use the area. The acquisition of the house and surrounding bushland on Lot 48 also raises a number of possibilities. The site is centrally located and already cleared and disturbed. The site could, with some work, be made into a picnic grounds with informative signs and images as well as details of the walk trails. The Department for Planning and Infrastructure has indicated that they would be willing to demolish the current buildings if the Shire were to cite that as a condition of taking over the management. Alternatively it may be appropriate to keep some of the buildings as a meeting place or educational centre, which could also provide a home for a community group to manage the reserve. The suitability of this site as a starting point for the walk trails would need to be carefully investigated. The condition and suitability of the existing buildings would also need to be investigated.

environmental and
conservation values of
Brickwood Reserve.

Strategies

29. Encourage, support and facilitate the community to provide ongoing participation in the management of the reserve.
30. Provide seating, shading, interpretative signage and other facilities for picnic areas in Briggs Park.
31. Investigate the potential and suitability of using the Lot 48 house/site for interpretive site or educational centre.
32. Investigate the feasibility of providing information to local Schools about the

5.5. Development Pressures

Maintenance of Existing Infrastructure

Inadequate maintenance, including regular painting and upkeep, leads to the condition of the buildings degenerating and loss of asset value. Broken wire glass windows and other damage give the facilities an abandoned look and invites further vandalism. The cost of maintaining or renovating the existing infrastructure needs to be compared against both the costs of replacing those buildings and the social costs of losing those facilities. The condition of some of the infrastructure is marginal and the avenues for repairing, replacing or removing these structures needs to be considered. A detailed report on the condition of the buildings and their compliance with accepted standards for such facilities is beyond the scope of this study. However, this information is essential base information for planning for the future use and maintenance or decommissioning of reserve buildings. The report should, if possible, include the house and associated infrastructure at Lot 48 Turner Road to determine whether the building should be maintained or removed.

Vandalism and Theft

Vandalism and theft are ongoing problems for the Briggs Park facilities. The park is close to the town but sufficiently isolated to allow vandals to be undetected. At present the use of the facilities is confined to weekends and training nights. The construction and operation of the Serpentine Jarrahdale Recreation Centre has increased the level of use of the reserve. This will attract more people to the site, but will also increase the level of surveillance.

The impacts of vandalism can be minimised through the use of building design and materials that are resistant

to damage. Surfaces such as windows can be protected with screens or other barriers, such as the security screens surrounding the pavilion windows. The screens are unsightly but effective. The wire glass highlight windows of the changerooms are resistant to breakage but the holes and cracks are unsightly and encourage further vandalism. They could be replaced with polycarbonate sheeting, an approach used successfully for the Jarrahdale Hall. This is an expensive option with an estimated cost of \$3,000 to \$4,000. A high standard of maintenance, good lighting and removing objects likely to be used by vandals all help to reduce the incidence of damage.

Vehicles and stock can cause a great deal of damage to irrigation infrastructure and turf surfaces. Strong fencing and locked gates will exclude most vehicles and stock, while pedestrian access can be maintained through openings with narrowly spaced posts to exclude motorbikes.

Discouraging theft relies on many of the same techniques of lighting, surveillance and security screens. The buildings of the reserve are all well secured. It is important to control the number and availability of keys for the buildings.

Increasing community ownership and use of the reserve area will reduce the opportunities for theft and vandalism.

Impacts of Recreation Facilities on Natural Ecosystems

The built infrastructure on the recreation grounds needs to include features that will reduce the impacts of this land use on the surrounding high value conservation areas. The decision to build the recreation centre within these grounds has had direct and indirect impacts on the natural ecosystems and hence the biodiversity values of the reserve. The construction

led to the removal of a small area of bushland behind the diamond sports (T-Ball) oval. The operation of the centre attracts more people to the area and creates the potential for a high level of disturbance of the adjacent bushland areas.

To limit the degree of human disturbance, solid barriers need to be erected between the areas of high intensity use and the bushland. Ideally, such barriers would extend around all of the boundaries of the bushland. However, in areas of lower use simpler barriers, such as standard fencing, would be sufficient to contain human impacts. Access points can be provided for walkers that exclude vehicles, motorbikes and horses.

It is important to ensure that there is no further encroachment of the built infrastructure on the natural ecosystems of the reserve. The area of the recreation grounds needs to be clearly and permanently defined and the areas of bushland within the recreation grounds need to be well managed. The impacts of turf management and septic systems are discussed in the water section.

Signs and Access

There are very few signs around the reserve and no interpretive signage. While these items are not essential, they do add to the value and the community perception of the Brickwood Reserve area. There are some warning signs on the skateboarding area, but these may not be adequate and there are possibly other hazards around the reserve that require warning signs. Signs have been erected at the recreation centre. There are no signs that identify Briggs Park, even though this is the community's name for the area and serves to distinguish it from the bushland. Very few users identify with the name "Brickwood Reserve". Appropriate access in Brickwood will

need to be determined. Currently the access is adequate in Brickwood Reserve, but following subdivisions in the surrounding areas, both access and signage requirements will need to be reviewed. An investigation should be carried out to consider fencing and gate requirements around the reserve being contributed by developers. Walk trail development and associated signage location and type, including both regulatory as well as informative interpretive signage, will also need to be investigated once surrounding areas are proposed to be developed.

Statutory Planning Considerations

There is a Byford Structure Plan that has been adopted by the Serpentine Jarrahdale Shire. The provisions of this structure plan include a proposal for the acquisition of Lot 48 Turner Road. This management plan discusses this property in a context for addition to the Brickwood Reserve some time into the future. Another statutory provision is for the Serpentine Jarrahdale Council to consider the possible closure of Turner Road which currently dissects Brickwood Reserve.

The Byford Structure Plan provisions also draw attention to the requirements for Local Structure Plans in areas adjacent to the Brickwood Reserve. In the context of these Local Structure Plans, it is likely that developer requirements will include fencing provisions as well as requirements for road reserves being established separating Brickwood Reserve from any future residential areas.

Strategies

33. Investigate and implement a long term plan to increase, renovate or upgrade reserve and park facilities, including public lighting as appropriate, over the life of this plan.
34. Investigate appropriate new locations for recreational activities which currently occur within Briggs Park as opportunities arise.
35. Investigate developing appropriate signage to advise users of the environmental values and history of the reserve including the history of

naming of the reserve after Geoff Brickwood.

36. Implement the Byford Structure Plan Statutory Provisions as follows:

Ensure acquisition and incorporation into the reserve of Lot 48 Turner Road

Council to investigate the possible closure of Turner Road.

Local Structure Plans developed for the land adjacent to Brickwood

Reserve area to include a road reserve adjacent to Brickwood Reserve separating the reserve from future residential areas.

Implementation

6.1 Introduction

An implementation plan is provided in this section. Various divisions within the Shire will be responsible for implementation and it is anticipated that the recommendations will be acted on over several years.

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

6.2 Priorities

Priorities have been classified as follows:

- Key – within the next financial year (2009-10 budget; Total \$17,000)
- High – within the next five years
- Medium – within the next ten years
- Ongoing – as required.

6.3 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 strategies. Cost estimates are conservative and do not include contingencies such as administration costs etc. The management plan strategies will be monitored and reviewed, and the management plan will be revised if necessary.

Divisions within the Shire with responsibilities for implementation including Serpentine Jarrahdale Landcare collaboration are as follows:

- Engineering Services
 - Operations, Parks & Reserves Officer
\$4,000 first Yr & \$7,000 sub yrs
 - WSUD Project Manager
- \$1,000 first Yr & \$18,000 sub yrs
 - Fire and Emergency Services - \$0 first financial yr & \$1,000 sub yrs
- Strategic Community Planning

- Environmental Services - \$5,000 first financial year & \$18,000 sub yrs
- Community Development – \$1,000 first financial year & \$0 sub yrs
- Development Services Directorate
 - Health and Ranger Services - \$6,000 first financial year & \$2,000 sub yrs
 - Statutory Planning - \$0 first financial year & \$1,000 subsequent years
- SJ Landcare Collaboration

Strategies

37. Periodically monitor and review the efficiency and effectiveness of management plan strategy implementation and revise if necessary.

6.4 Implementation Plan

Land Resources

No.	Strategy	Priority	Responsibility	Cost Estimates
1	Investigate and implement appropriate mechanisms to ensure stormwater does not cause erosion such as in-stream structure to assist in slowing down water velocity.	Ongoing	Eng. Services WSUD Officer	Staff Time & Action \$1,000 per annum
2	Identify and rehabilitate degraded areas, focusing on bare soil such as eroding tracks and firebreaks.	Ongoing	Operations, Parks and Reserves Officer in collaboration with Landcare	Staff Time \$1,000 per annum
3	Prohibit and monitor horse and motorcycle access to internal tracks and firebreaks.	Ongoing	Health and Ranger Services	Staff Time \$1,000 per annum
4	Prepare plans in consultation with the BMX club for the possible relocation of the BMX track, including consideration of the selection of possible sites for the relocation outside the reserve.	Key	Community Development Operations, Parks and Reserves Officer	Staff Time \$1,000
5	Undertake annual monitoring of soil salinity to establish baseline data and monitor salinity trends.	Medium	Environmental Services	Staff Time \$1,000 per annum
6	Investigate and cost options to improve the winter drainage of the lower square oval, <u>in collaboration with user groups.</u>	Medium	Operations, Parks and Reserves Officer Eng. Services WSUD Officer	Staff Time \$1,000

Water Resources

No.	Strategy	Priority	Responsibility	Cost Estimates
7	Investigate the potential for diverting runoff away from the reserve drain.	High	Eng. Services WSUD Officer	Staff Time \$1,000
8	Ensure that the principles of water sensitive urban design are implemented in all future urban development to minimise nutrient and water flow through the Reserve.	Ongoing	Eng. Services WSUD Officer Statutory Planning	Staff Time \$1,000

No.	Strategy	Priority	Responsibility	Cost Estimates
9	Seek support from Department of Water and Department of Environment and Conservation to undertake a detailed study of the hydrology of the local region to guide future groundwater allocation and to set conditions for future urban developments in the area.	Key	Eng. Services WSUD Officer Statutory Planning	Staff Time \$1,000
10	Instigate a regular groundwater and surface water monitoring program (quality and quantity) within and around the Reserve, such as along Soldiers Road.	High	Eng. Services WSUD Officer	Staff Time & Action \$5,000 per annum
11	Install a pollutant trap/nutrient filter along the drain near or upstream from where it enters the reserve.	High	Eng. Services WSUD Officer	Staff Time \$5,000
12	Investigate opportunities to educate surrounding and upstream landholders on how to minimise pollution of waterways and groundwater (i.e. brochure).	Ongoing	Eng. Services WSUD Officer Environmental Services	Staff Time \$3,000 per annum
13	Review and implement a Nutrient and Irrigation Management Plan that addresses irrigation frequency and volumes. Require the preparation of an Urban Water Management Plans to accompany subdivisions and Local Water Management Plans to accompany local structure plans for any proposed development that has the potential to increase the nutrient load entering the reserve.	Ongoing	Eng. Services WSUD Officer Statutory Planning Operations Parks and Reserve Officer	Staff Time \$1,000 per annum
14	Investigate and estimate costing s for upgrading all septic systems on the site to remove nutrients and pathogens from effluent.	Ongoing	Health in conjunction with Environmental Services	Staff time \$1,000 per annum
15	Establish targets for water consumption at the Serpentine-Jarrahdale Recreation Centre (possibly as part of the ICLEI Local Action Plan).	Ongoing	Environmental Services	Staff Time \$1,000 per annum
16	Conduct annual audits of water use associated with the Serpentine-Jarrahdale Recreation Centre and other buildings on the reserve (possibly as part of the ICLEI Local Action Plan).	Ongoing	Environmental Services	Staff Time \$1,000 per annum

Biodiversity

No.	Strategy	Priority	Responsibility	Cost Estimates
17	Isolate and restrict access to dieback (<i>Phytophthora cinnamomi</i>) free areas.	Key	Operations, Parks and Reserve Officer	Staff Time \$1,000 per annum
18	Place signs at the entrance to the reserve to advise users of the incidence and effect of dieback (<i>Phytophthora cinnamomi</i>), the areas that are infected and areas where access is restricted.	Key	Operations, Parks and Reserve Officer	Staff Time \$2,000
19	Monitor the recovery of plant communities after fire and use this information to reassess the plan in 2010.	High	Environmental Services Operations Parks and Reserve Officer	Staff Time \$2,000

No.	Strategy	Priority	Responsibility	Cost Estimates
20	Review annually and implement a Weed Control Plan that maps and identifies weed species within the reserve, and identifies priority areas and appropriate techniques and strategies to reduce weed density and weed seed sources in the bushland, surrounding areas and active recreation areas.	Ongoing	Environmental Services Operations Parks and Reserves Officer	Staff Time & Action \$5,000 per annum
21	Identify and remove all river red gums (<i>Eucalyptus camaldulensis</i>) and other invasive non-local trees and shrubs from the reserve and its surrounds. Request and encourage that adjacent landholders do the same.	Ongoing	Operations, Parks and Reserves Officer	Staff Time \$3,000 per annum
22	Update and seek approval for a Reserve Fire Management Plan in conjunction with the relevant State and Commonwealth Departments. Ensure all burning in the reserve conforms to this plan.	Ongoing	Engineering Services Fire and Emergency Services	Staff Time \$1,000 per annum
23	Regularly monitor and record feral animals around the reserve. Undertake control programs when needed including trapping and baiting.	Ongoing	Operations, Parks and Reserves Officer in conjunction with Landcare	Staff Time \$1,000 per annum
24	Advise all local residents of the impacts of dogs and cats on the reserve fauna.	Key	Health and Ranger Services conjunction with Environmental Services	Staff Time \$1,000
25	Prepare an animal (i.e. dogs and cats) management plan for the reserve including statutory controls (such as a 300 meter cat exclusion zone around Brickwood Reserve) with costings and an implementation plan.	Key	Health and Ranger Services conjunction with Environmental Services Statutory Planning	Staff Time \$5,000
26	Initiate discussion with the WA Baptists Hospital and Homes Trust to transfer the management order for Lot 106 to the Shire Management and to change the purpose of the reserve to nature conservation.	Key	Environmental Services	Staff Time \$1,000
27	Provide all developers/landowners within one kilometre of Brickwood Reserve with management plan information and requirements.	Key	Environmental Services and Landcare	Staff Time \$1,000
28	Develop a public education program that targets local landowners and users of the reserve, to include rare and beautiful species in the reserve, rarity of the vegetation itself, impacts of domestic cats, impacts of weeds and how they spread, impacts of dieback (<i>Phytophthora cinnamomi</i>), impacts of physical disturbance and impacts of fire.	Key	Environmental Services Operations Parks and Reserve Officer and Landcare	Staff Time \$3,000

Recreation

No.	Strategy	Priority	Responsibility	Cost Estimates
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No.	Strategy	Priority	Responsibility	Cost Estimates
29	Encourage, support and facilitate the community to provide ongoing participation in the management of the reserve.	Medium	Environmental Services	Staff Time \$1,000
30	Provide seating, shading, interpretive signage and other facilities for picnic areas in Briggs Park or in other cleared or heavily disturbed areas (e.g. current house site and between Lots 50 and 51 Turner Road).	High	Operations, Parks and Reserves Officer	Staff Time \$1,000
31	Investigate the potential and suitability of using the Lot 48 house/site for interpretive site or educational centre.	Ongoing	Environmental Services	Staff Time \$1,000 per annum
32	Investigate the feasibility of providing information to local Schools about the environmental and conservation values of Brickwood Reserve.	Medium	Environmental Services	Staff Time \$1,000

Development Pressures

No.	Strategy	Priority	Responsibility	Cost Estimates
33	Investigate and implement a long term plan to increase, renovate or upgrade reserve and park facilities including public lighting as appropriate over the life of this plan.	Medium	Environmental Services Operations, Parks and Reserves Officer	Staff Time \$5,000
34	Investigate appropriate new locations for recreational activities which currently occur within Briggs Park as opportunities arise.	Medium	Environmental Services Operations, Parks and Reserves Officer	Staff Time \$1,000
35	Investigate developing appropriate signage to advise users of the environmental values and history of the reserve including the history of naming of the reserve after Geoff Brickwood.	Medium	Operations Parks and Reserves Officer Community Development	Staff Time \$1,000 per annum
36	<p>Implement the Byford Structure Plan Statutory Provisions as follows:</p> <ul style="list-style-type: none"> • Ensure the acquisition and incorporation into the reserve of Lot 48 Turner Road • Council investigate the possible closure of Turner Road • Local Structure Plans that are to be prepared for land adjacent to the Brickwood Reserve • Local Structure Plans to include a road reserve adjacent to the Brickwood Reserve separating the reserve from future residential areas 	Ongoing	Development Services Statutory Planning and Engineering Services	Staff Time \$1,000 per annum

Implementation, Monitoring and Review

No.	Strategy	Priority	Responsibility	Cost Estimates
37	Periodically monitor and review the efficiency and effectiveness of management plan strategy implementation and revise if necessary.	Ongoing	Environmental Services Operations, Parks and Reserves Officer	Staff Time \$1,000 per annum



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Appendix One: Plant Species Recorded at Brickwood Reserve

Species Names

Acacia drewiana
Acacia huegelii
Acacia lasiocarpa
*Acacia longifolia**
Acacia pulchella
Acacia saligna
Acacia sessilis
Acacia stenoptera
Acacia teretifolia
Adenanthos meisneri
Adiantum aethiopicum
Agrostocrinum scabrum
*Aira caryophyllea**
Allocasuarina humilis
Allocasuarina microstachya
Amphipogon debilis
Amphipogon turbinatus
*Anagallis arvensis**
Anigozanthos manglesii
Anigozanthos viridis
Aotus gracillima
Aotus procumbens
Aphelia cyperoides
*Arctotheca calendula**
Arnocrinum preissii
Astartea fascicularis
Astroloma pallidum
Austrodanthonia occidentalis
Austrodanthonia pilosa
Austrodanthonia sp.
Austrostipa compressa
Austrostipa semibarbata
Baeckea camphorosmae
Banksia attenuata
Banksia bipinnatifida
Banksia menziesii
Banksia nivea
Banksia sessilis
Baumea acuta
Baumea juncea
Baumea preissii
Billardiera fraseri
Billardiera heterophylla
Borya scirpoidea

Species Names

Borya sphaerocephala
Bossiaea eriocarpa
*Briza maxima**
*Briza minor**
Burchardia bairdeae
Burchardia multiflora
Burchardia congesta
Caesia micrantha
Caesia occidentalis
Caladenia emarginata
Caladenia ferruginea
Caladenia flava
Caladenia longicauda
Caladenia sp.
Calectasia cyanea
Calectasia grandiflora
Calocephalus amaranthoides
Calytrix angulata
Calytrix aurea
Cassytha flava
Cassytha glabella
Cassytha racemosa
*Centaurium erythraea**
Centrolepis alepyroides
Centrolepis aristata
Centrolepis drummondiana
Centrolepis glabra
Centrolepis humillima
Chaetanthus aristatus
Chamaescilla corymbosa
Chordifex sinuosus
Chorizandra enodis
Comesperma calymega
Comesperma virgatum
Conospermum stoechadis
Conostephium pendulum
Conostylis aculeata
Conostylis caricina
Conostylis juncea
Conostylis setigera
Corymbia calophylla
Crassula colorata
Cyathochaeta avenacea
Cyathochaeta clandestina
*Cynodon dactylon**
*Cyperus tenellus**
Cytogonidium leptocarpoides
Dampiera alata
Dampiera linearis

Species Names

Darwinia thymoides
Dasypogon bromeliifolius
Daviesia decurrens
Daviesia nudiflora
Daviesia physodes
Daviesia preissii
Desmocladius fasciculatus
Desmocladius flexuosus
*Disa bracteata**
*Dittrichia graveolens**
Diuris laxiflora
Diuris magnifica
Drosera erythrorhiza
Drosera gigantea
Drosera glanduligera
Drosera heterophylla
Drosera menziesii ssp menziesii
Drosera menziesii ssp penicillaris
Drosera nitidula
Drosera palaecea ssp palaecea
Drosera pallida
Drosera rosulata
Drosera stolonifera
Drosera subhirtella
*Ehrharta calycina**
Epilobium billardioreanum
*Eragrostis curvula**
Eremaea asterocarpa
Eremaea aff brevifolia D.Coates MI 175
Eriochilus dilatatus
Eucalyptus lane-poolei
Eucalyptus marginata
*Freesia leichtlinii**
Gastrolobium capitatum
Gastrolobium nervosum
*Gladiolus caryophyllaceus**
Gnephosis angianthoides
Gompholobium aristatum
Gompholobium capitatum
Gompholobium confertum
Gompholobium marginatum
Gompholobium polymorphum
Gompholobium tomentosum
Gonocarpus pithyoides
Goodenia coerulea
Goodenia pulchella
Gratiola pubescens
Grevillea bipinnatifida

Species Names

Grevillea pilulifera
Grevillea quercifolia
Grevillea wilsonii
Haemodorum discolor
Haemodorum laxum
Haemodorum simplex
Haemodorum sparsiflorum
Haemodorum spicatum
Hakea auriculata
Hakea ceratophylla
Hakea incrassata
Hakea lissocarpa
Hakea prostrata
Hakea ruscifolia
Hakea stenocarpa
Hakea sulcata
Hakea trifurcata
Hakea undulata
Hakea varia
Harperia lateriflora
Hibbertia acerosa
Hibbertia aurea
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia spicata
Hibbertia stellaris
Hibbertia vaginata
Hovea trisperma
Hyalosperma cotula
Hydrocotyle alata
Hydrocotyle diantha
Hydrocotyle pilifera
Hypocalymma robustum
*Hypochaeris glabra**
Hypolaena exsulca
Hypoxis occidentalis
Isoetes australis
Isolepis cernua
*Isolepis marginata**
Isolepis oldfieldiana
Isopogon asper
Isotoma hypocrateriformis
Jacksonia ?sericea
Jacksonia furcellata
Jacksonia sternbergiana
Johnsonia pubescens ssp. cygnorum
*Juncus bufonius**
*Juncus capitatus**

Species Names

Juncus holoschoenus
Kennedia prostrata
Kingia australis
Kunzea micrantha
Kunzea recurva
Labichea punctata
Lachnagrostis filiformis
Lachnagrostis plebeia
Lambertia multiflora var. 'darlingensis'
Laxmannia sessiliflora
Lechenaultia biloba
Lechenaultia expansa
Lepidosperma costale
Lepidosperma tenue
Lepidosperma aff. *angustatum*
Lepidosperma angustatum
Lepidosperma leptostachyum#
Leporella fimbriata
Lepyrodia macra
Levenhookia pusilla
Levenhookia stipitata
Lobelia gibbosa
Lobelia tenuior
*Lolium rigidum**
Lomandra brittanii
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra odora
Lomandra preissii
Lomandra purpurea
Lomandra spartea
Lomandra suaveolens
*Lotus angustissimus**
Loxocarya cinerea
Lyginia barbata
Lyperanthus serratus
Lysinema ciliatum
*Lythrum hyssopifolia**
Macrozamia riedlei
Meeboldina coangustata
Melaleuca lateriflora
Melaleuca preissiana
Melaleuca raphiophylla
Melaleuca viminea
Mesomelaena graciliceps
Mesomelaena pseudostygia
Mesomelaena tetragona
Microtis atrata
Microtis media

Species Names

*Monopsis debilis**
Neurachne alopecuroidea
Notodanthonia ?pilosa
Notodanthonia occidentalis
Nuytsia floribunda
Opercularia vaginata
*Ornithopus compressus**
*Orobanche minor**
*Paspalum dilatatum**
Patersonia juncea
Patersonia occidentalis
Patersonia occidentalis 'Swamp Form'⁴
*Pennisetum clandestinum**
*Pentaschistis airoides**
Pericalymma ellipticum
Persoonia saccata
Petrophile linearis
Petrophile media var. *juncifolia*
Petrophile seminuda
Petrophile striata
Philothea spicata
Philydrella drummondii
Philydrella pygmaea
Phlebocarya ciliata
Phlebocarya filifolia
*Phleum pratense**
Phyllanthus calycinus
Phylloglossum drummondii
Pimelea imbricata var. *major*
Podolepis gracilis 'Swamp White'
Podotheca angustifolia
Polypogon tenellus
Polypomphylox multifida
Poranthera microphylla
Prasophyllum ?elatum
Prasophyllum drummondii
Pterochaeta paniculata
Ptilotus divaricatus
Ptilotus manglesii
Pyrorchis nigricans
Quinetia urvillei
*Romulea rosea**
Scaevola glandulifera
Scaevola lanceolata
Schoenolaena juncea
Schoenus asperocarpus
Schoenus bifidus
Schoenus brevisetis

Species Names

Schoenus clandestinus
Schoenus curvifolius
Schoenus efoliatus
Schoenus nanus
Schoenus odontocarpus
Schoenus rigens
Schoenus sp.
Schoenus subbulbosus
Schoenus subflavus
Schoenus tenellus
Schoenus unispiculatus
Selaginella gracillima
Senecio quadridentatus
Siloxerus humifusus
*Solanum nigrum**
*Sonchus hydrophilus*²
*Sonchus oleraceus**
Sowerbaea laxiflora
Sphaerolobium vimineum
Stachystemon vermicularis
Stackhousia monogyna
Stirlingia latifolia
Stylidium brunonianum
Stylidium bulbiferum
Stylidium dichotomum
Stylidium ecorne
Stylidium calcaratum
Stylidium ciliatum
Stylidium petiolare
Stylidium piliferum
Stylidium pulchellum
Stylidium repens
Stylidium utricularioides
*Symphiothrichum subulatum**
Synaphea linearis
Synaphea petiolaris
*Taraxacum officinale**
Tetragia octandra
Tetragia hirsuta
Thelymitra benthamiana
Thelymitra crinita
Thelymitra flexuosa
Thysanotus manglesianus
Thysanotus multiflorus
Thysanotus patersonii
Thysanotus sparteus
Thysanotus tenellus
Thysanotus thyrsoides
Thysanotus triandrus

Species Names

Trachymene pilosa
Tribonanthes australis
Tribonanthes longipetala
Trichocline sp GJK 6382
Tricoryne elatior
Tricoryne humilis
Tricoryne tenella
Tricostularia neesii
*Trifolium campestre**
Trifolium dubium
Tripteroascus brunonis
*Trymalium campestre**
*Ursinia anthemoides**
Utricularia inaequalis
Utricularia multifida
Velleia trinervis
Verticordia densiflora
Verticordia lindleyi ssp lindleyi
Verticordia pennigera
Verticordia plumosa
Verticordia serrata
Viminaria juncea
*Vulpia bromoides**
*Vulpia myuros**
Wahlenbergia preissii
Waitzia caniculata
*Watsonia meriana var. bulbifera**
*Watsonia meriana**
Wurmbea dioica
Wurmbea dioica 'Swamp Form'
Xanthorrhoea brunonis
Xanthorrhoea preissii
Xanthosia huegelii
Xylomelum occidentale

* denotes introduced species

Sources:

1. **Keighery GJ and Keighery BJ 1993** Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts V-IX. Wildflower Society of WA (Inc.), Nedlands, Western Australia.
2. **Heath M and Goldsborough N 2008** Brickwood Flora Survey. Report for Shire of Serpentine Jarrahdale.
3. **Hollick P 2008** Flora survey of Brickwood Reserve. Shire of Serpentine Jarrahdale.

Nomenclature updated November 2008.



Appendix Two: Bird Species Recorded at Brickwood Reserve

Common Names	Species Names	Source 1	Source 2
Australian Magpie	<i>Cracticus tibicen</i>	X	X
Australian Raven	<i>Corvus coronoides</i>	X	X
Australian Sittella	<i>Daphoenositta chrysoptera</i>	X	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	X	X
Black-faced Woodswallow	<i>Artamus cinereus</i>	X	X
Brown Goshawk	<i>Accipiter fasciatus</i>	X	
Brown Honeyeater	<i>Lichmera indistincta</i>	X	X
Carnaby's Cockatoo	<i>Calyptorhynchus Latirostris</i>	X	
Domestic Pigeon *	<i>Columba livia</i>	X	X
Dusky Woodswallow	<i>Artamus cyanopterus</i>	X	
Elegant Parrot	<i>Neophema elegans</i>	X	X
Galah	<i>Cacatua roseicapilla</i>	X	X
Grey Fantail	<i>Rhipidura fuliginosa</i>	X	X
Grey-breasted White-eye	<i>Zosterops lateralis</i>	X	
Laughing Dove	<i>Streptopelia senegalensis</i>	X	
Laughing Kookaburra	<i>Dacelo gigas</i>	X	X
Little Eagle	<i>Aquila morphnoides</i>	X	
Magpie-lark	<i>Grallina cyanoleuca</i>	X	
Mistletoebird	<i>Dicaeum hirundinaceum</i>	X	
Painted Button-quail	<i>Turnix varia</i>	X	
Pallid Cuckoo	<i>Cuculus pallidus</i>	X	
Rainbow Bee-eater	<i>Merops ornatus</i>		X
Red Wattlebird	<i>Anthochaera carunculata</i>	X	X
Red-capped Parrot	<i>Platycercus spurius</i>	X	X
Red-tailed Black-Cockatoo	<i>Calyptorhynchus magnificus</i>		X
Ringnecked Parrot	<i>Platycercus zonarius</i>	X	
Rufous Whistler	<i>Pachycephala rufiventris</i>	X	X
Sacred Kingfisher	<i>Halcyon sancta</i>	X	X
Silvereye	<i>Zosterops lateralis</i>		X
Striated Pardalote	<i>Pardalotus striatus</i>	X	X
Tree Martin	<i>Hirundo nigricans</i>	X	X
Welcome Swallow	<i>Hirundo rustica</i>		X
Western Gerygone	<i>Guerygone fusca</i>	X	X
Western Rosella	<i>Platycercus icterotis</i>	X	
Western Spinebill	<i>Acanthorhynchus superciliosus</i>	X	
White-fronted Chat	<i>Epthianura albifrons</i>	X	
Willy Wagtail	<i>Rhipidura leucophrys</i>	X	

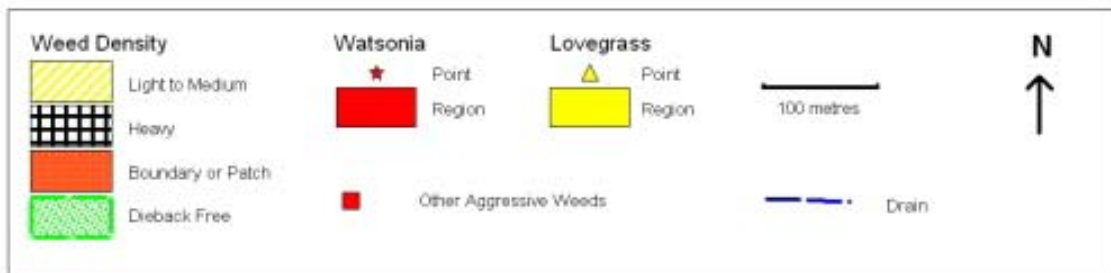
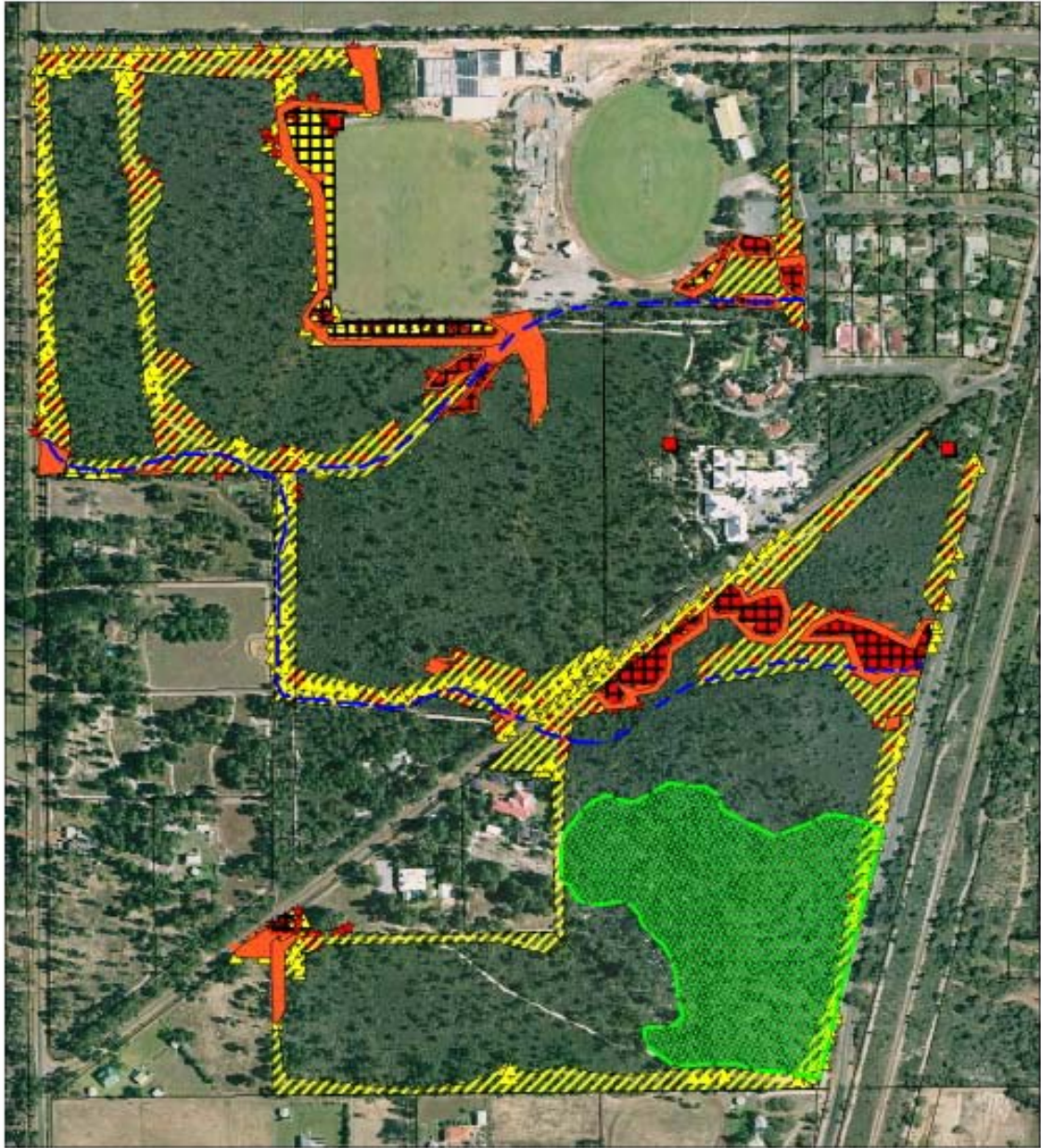
Source 1: Harvey M.S., Dell J. How R.A. and Waldock J.M. 1997 Ground Fauna of the Bushland Remnants on the Ridge Hill shelf and Pinjarra Landforms Perth

Source 2: Birds Australia Western Australia Inc. (Database Records July 2004)

Appendix Three: Weed Strategy

Brickwood Reserve Weed Strategy			
Species List to Accompany the Miscellaneous Weed Map			
Autumn control	Winter control	Spring control	Woody weeds - mechanical removal
Common name	Genus	Species	Notes
	<i>Acacia</i>	<i>longifolia</i>	Woody weed removal at any time of the year
Flinders Range Wattle	<i>Acacia</i>	<i>iteaphylla</i>	Woody weed removal at any time of the year
Sweet Vernal Grass	<i>Anthoxanthum</i>	<i>odoratum</i>	Spray in early spring before seed set
Cape Weed	<i>Arctotheca</i>	<i>calendula</i>	Control before flowering occurs in late winter/spring
Giant Reed	<i>Arundo</i>	<i>donax</i>	Spray in Autumn
Wild oats	<i>Avena</i>	<i>barbata</i>	Prevent seed set in Spring - spray late winter, early spring
Blow fly grass	<i>Briza</i>	<i>maxima</i>	Prevent seed set in Spring - spray late winter, early spring
Blow fly grass	<i>Briza</i>	<i>minor</i>	Prevent seed set in Spring - spray late winter, early spring
Red Bottle Brush	<i>Callistemon</i>	<i>viminalis</i>	Woody weed removal at any time of the year
Tagasaste	<i>Chamaecytisus</i>	<i>palmensis</i>	Woody weed removal at any time of the year
Love Grass	<i>Eragrostis</i>	<i>curvula</i>	Spray when actively growing
Cotton bush	<i>Gomphocarpus</i>	<i>fruticosus</i>	Control before seed set in summer
Flatweed	<i>Hypochaeris</i>	<i>species</i>	Spray or remove rosettes before flowering and seeding in spring and summer
Victorian teatree	<i>Leptospermum</i>	<i>laevigatum</i>	Woody weed removal at any time of the year
Rye Grass	<i>Lolium</i>	<i>species</i>	Spray in winter before seed set in spring
Lotus	<i>Lotus</i>	<i>angustissimus</i>	Spray when actively growing in winter/early summer. Glyphosate not effective – revegetate area to reduce sunlight
Medic	<i>Medicago</i>	<i>species</i>	Spray before flowering in winter/spring. Glyphosate not effective
Cape Tulip	<i>Morea</i>	<i>miniata</i>	Spray before flowering in winter/spring. Glyphosate not effective
Prickly pear	<i>Opuntia</i>	<i>vulgaris</i>	
Brazilian Pepper	<i>Schinus</i>	<i>terebinthifolia</i>	Woody weed removal at any time of the year
	<i>Sparaxis</i>	<i>bulbifera</i>	Spray before end of flowering in spring
Cumbungi	<i>Typha</i>	<i>orientalis</i>	Spray late spring and summer after male flowers have opened (biacitve chemical)
	<i>Ursinia</i>	<i>anthemoides</i>	Spray early winter before flowering
Vetch	<i>Vicia</i>	<i>sativa</i>	Spray early winter before flowering
	<i>Vulpia</i>	<i>myuros</i>	Spray early winter before flowering
Cotton Palm	<i>Washingtonia</i>	<i>filifera</i>	Woody weed removal at any time of the year
Watsonia	<i>Watsonia</i>	<i>meriana</i>	Spray in spring before the end of flowering

Figure 4: Weed Density - September 2006



Appendix Four:

Summary of Public Consultation Results

Brickwood Reserve & Briggs Park Draft Management Plan

Comment period: 1 May – 31 July 2009.

Table 1 lists all major comments and ideas raised in written submissions and the public workshop held on 14 July 2009.

Written submissions

Four written submissions were received. All comments made in written submissions have been summarised in Table 1. Where comments have resulted in a change in the draft Management Plan, this is noted in the table.

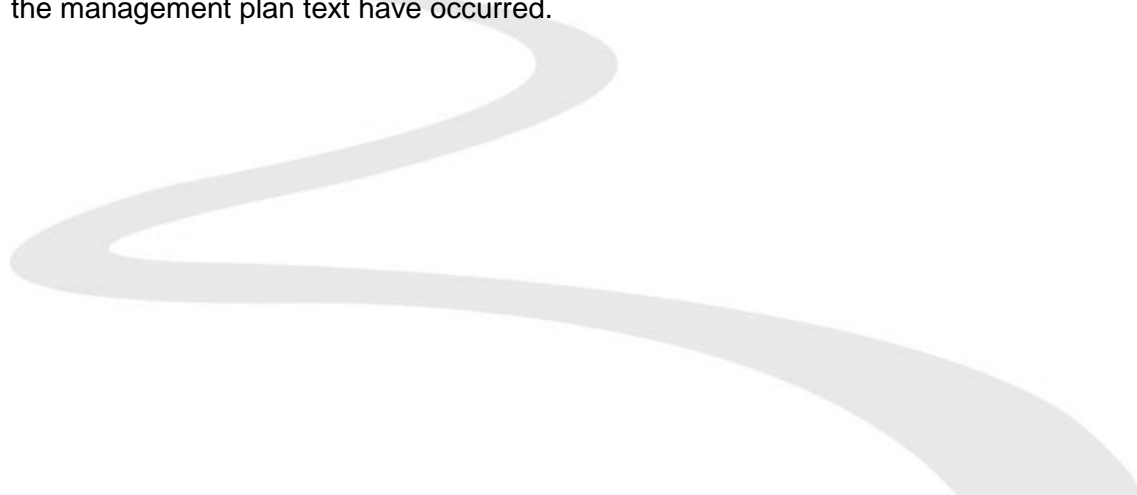
Some of the comments within submissions had merit, but did not result in changes to the Management Plan. These comments are included at the end of Table 1.

Public workshop

Over 12 people attended the public workshop held on 14 July 2009, including community members, Councillors and staff.

After a presentation on the major aspects of the draft Brickwood Reserve & Briggs Park Management Plan, participants contributed to a brainstorming session to identify values, threats, opportunities and key issues.

Table 2 summarises items put forward at the Workshop. Where comments introduced new ideas appropriate for inclusion in the Management Plan, changes to the management plan text have occurred.



REFERENCES USED IN LAST COLUMN IN TABLE 1

Written submissions

DEC = Department of Environment and Conservation (research & operations)

DP = Department of Planning

1 = Neil Brickwood

2 = North Murray Diamond Sports

Workshop

WG = Workshop Group

Table 1: Main comments from written submissions – Brickwood Reserve & Briggs Park Draft Management Plan

Public comment	Response/Change to Management Plan	Ref.
Executive Summary		
p.1: Change to "...and <u>containing</u> one of the largest and most intact examples of a critically endangered <u>threatened ecological community...</u> "	Accepted and incorporated.	DEC
p.3: Add " <u>high</u> " to biodiversity value description of vegetation management zone.	Accepted and incorporated.	DEC
p.1 Geoff Brickwood's name should be more fully recognised in honour of the Councillor after whom it was named.	Investigate acknowledging Geoff Brickwood in historical signage information and possible renaming of the reserve.	1
Governance		
p.6: Change to "...contains <u>41</u> hectares of a Threatened Ecological Community protected under the EPBC Act..."	Accepted and incorporated.	DEC
p.6: Change to "...however, <u>the Act</u> has not..."	Accepted and incorporated.	DEC
p.5: Refer to Bush Forever Site Implementation Guidelines.	Accepted and incorporated.	DP
p.6: <u>Refer to Draft Statement of Planning Policy No. 2.8 (Bushland Policy for the Perth Metropolitan Region).</u>	Accepted and incorporated.	DP
Environmental Characteristics		
p.16: Change to "...a critically endangered <u>threatened ecological community</u> and <u>two smaller occurrences of an endangered and a vulnerable threatened ecological community</u> . <u>In addition the reserve also contains several threatened plant species...</u> "	Accepted and incorporated.	DEC
p.17: Change to "Threatened <u>Species and Communities...</u> "	Accepted and incorporated.	DEC
p.17: Change to "...each <u>threatened ecological community...</u> <u>Some</u>	Accepted and incorporated.	DEC

Public comment	Response/Change to Management Plan	Ref.
<u>critically endangered and endangered West Australian communities are also listed for protection...the Brickwood site, and is listed under the EPBC Act...also occur on the site, but are not EPBC listed...</u>		
p.18: Change to "...The community is <u>listed</u> as critically endangered in <u>Western Australia...</u> "	Accepted and incorporated.	DEC
p.18-19: Change to "...the sandy <u>rise</u> in the south <u>western</u> section...This community is <u>listed as endangered in Western Australia...</u> "	Accepted and incorporated.	DEC
p.19: Change to "...found in the understorey. <u>This community is listed as vulnerable...</u> "	Accepted and incorporated.	DEC
p.19: Add (following the above paragraph) " <u>DEC has ground-truthed the boundaries of the TECs, and provided updated boundary mapping to the Shire.</u> "	Accepted and incorporated.	DEC
p.19: Change from "Trudgeon" to " <u>Trudgen</u> "	Accepted and incorporated.	DEC
p.21: The <i>Lambertia</i> species is no longer Priority listed.	<i>Lambertia</i> species removed from table.	DEC
Social and Economic Characteristics		
p.30: Change to "The Department of <u>Environment and Conservation (DEC)</u> ... <u>DEC</u> has reached..."	Accepted and incorporated.	DEC
pp.25&33: Acknowledge Geoff Brickwood, after whom the reserve was named.	A sentence has been added to the Land Tenure and Heritage sections to outline the origin of the reserve's name.	1
p.26: Refer to permanent fixtures (baseball back nets) on lower oval.	Accepted and incorporated.	2
p.26: Note that the lower oval has been allocated to North Murray Diamond Sports.	Accepted and incorporated.	2
p.31: North Murray Diamond Sports is a diamond sports, not a T-ball, club.	Accepted – all references to T-ball to be replaced with Diamond Sports.	2
p.31: Shade trees should not be removed until replacements have grown sufficiently, and replacements should be planted around the entire oval.	Accepted and incorporated.	2
Reserve Management		
p.44: Change to "...in consultation with <u>Department of Environment and Conservation...</u> "	Accepted and incorporated.	DEC

Public comment	Response/Change to Management Plan	Ref.
p.44: Change to "...DEC has <u>supplied</u> flora list data...in Brickwood Reserve." (remainder of sentence deleted)	Accepted and incorporated.	DEC
p.45: Change to "...Baseline data <u>was</u> collected..."	Accepted and incorporated.	DEC
p.46: Change to "...The locations of <u>DRF populations are confidential to protect the plants and to deter plant collectors...referred to DEC...</u> "	Accepted and incorporated.	DEC
p.49: Change to "...rarity of the reserve <u>and plant communities</u> , impacts of..."	Accepted and incorporated.	DEC
p.40-41: Support for upgrading of leaking septic system at lower oval.	Accepted and incorporated into Strategy 14.	2
p.43&49: Shade trees should not be removed until replacements have grown sufficiently.	Accepted and incorporated.	2
p.55: Not worth upgrading the facilities – better to replace with new facilities elsewhere.	Accepted and incorporated.	2
Implementation		
p.57: Would like to be involved in the investigation of upgrading the lower oval.	Accepted and incorporated.	2
Appendices		
Appendix Four: Change to "...The reserve contains some <u>41</u> hectares of vegetation..."	Accepted and incorporated.	DEC
Appendix Four: Change to "...DEC has flora list data...and <u>has</u> provided these." (remainder of sentence deleted)	Accepted and incorporated.	DEC
Appendix Four: Change to "...Baseline data <u>were</u> collected..."	Accepted and incorporated.	DEC
Appendix Four: Change to "...buffer zones as marked on map, <u>timing to be determined by combination of fuel loads exceeding...hectare and years since last fire...easy access for fire control, utilising only dieback and weed free machinery and soils...the drain south of the BMX track (utilising only dieback and weed free machinery and soils)...</u> "	Accepted and incorporated.	DEC

Table 2: Summary of major items identified at the Public workshop held on 14 July 2009 has now been included in the Brickwood Reserve & Briggs Park Management Plan.

Summary:

Values, threats and opportunities were identified and discussed culminating in the identification of key issues. Key issues identified and discussed included continuing to improve the Recreation Centre for increased use and a range of new uses. There was a diverse range of values, threats and opportunities identified including future considerations of the changing relevance of the facility to various uses and the need to adapt to change. Equitable use of the Recreation Centre and ongoing protection of the natural environment was identified as being very important.

Workshop participants:

Public workshop participants included representatives of Heritage Country Choir, Serpentine Jarrahdale Cricket Club Inc., Byford Learning and Community Centre, North Murray Diamond Sports Association, Byford Enviro Link, Byford Volunteer Bush Fire Brigade, SJ Landcare Inc., Byford Progress Association, Armadale Wildflower Society, Reserves Advisory Group, and Byford Keep Fit.

Theme	Identified items	
Values	Habitat/Flora/Fauna/insects Unique Attributes Size – unusual for urban area Diversity Sport/Recreation/Exercise Facilities Aesthetics Events	Entomology Community Centre/Hub Tourism Children’s activities & education Well buffered Social accessibility Heritage
Threats	Population Fire Feral cats & domestic animals Motorbikes Water quality & water table Dieback Lack of community participation Reticulation of ovals and associated nutrients Legislation changes	Apathy Rubbish dumping & vandalism Constraints on user groups – Expansion & improvement Failure to coordinate with local users Over use/carrying capacity being exceeded Lack of funding Lack of parking Lack of legislative support
Opportunities	Ecotourism Entertainment & engagement for teenagers Social inclusion Agricultural show Community events Education – sustainability & biodiversity Cultural events Nurturing of community groups	Groups to move elsewhere with newly created district public open space Scientific study Forward planning to divert pressure Development of community groups Family BBQ & picnic area & playground equipment Fire management initiatives

Theme	Identified items
Key Issues	<ol style="list-style-type: none">1. Population pressures2. Fire3. Proactive flora & fauna management4. Cat management5. Protection mechanisms6. Relevance to the community Maximising use including night time use.7. Equitable use of the facilities including promotion/public relations/education8. Adaptive Management and growth9. Finishing off upgrading the kitchen, stage finishing's, facilities for hanging pictures,



Brickwood Reserve Fire Management Plan

(November 2009 – 2012)

Introduction

The Brickwood Reserve in Byford is managed by the Shire of Serpentine Jarrahdale. It covers some 49 hectares, of which around 38 hectares is bushland. The bushland has extremely high conservation value and is located in an urban zone. Aged care facilities, recreation facilities and rural residential properties currently surround the bushland area. The zoning of the rural residential areas has recently been changed to a higher urban residential density. The current and future land uses in the area create both a high risk of unplanned fires and a high risk of significant damage to surrounding land users from wildfires. There is currently community pressure for more controlled burns of the bushland and this pressure is likely to increase with the intensity of occupation and use of the surrounding area.

The challenge for the Shire is to develop an approach to fire risk management that reduces the risk of wildfire without significantly impacting on the biodiversity values of the bushland. Too frequent fires will lead to both a decline in the biodiversity of the reserve and an increase in the extent and density of weed populations, which thrive on disturbance. This in turn would increase the risk of wildfire, as weeds provide an ideal fuel load to initiate and spread a fire. Therefore an essential element of fire risk reduction is effective weed management. A detailed weed management plan has been prepared for this reserve, which includes post fire impacts.

Any strategies or actions applied to this reserve also need to consider dieback management and hygiene.

This report presents strategies for the following aspects of fire management:

- Fire prevention and preparedness
- Fire response
- Fire recovery

There are two attachments which can be used to guide actions undertaken in the reserve:

The Fire Response Plan

A schedule of actions to reduce fire risk and support fire response arrangements

Fire Management Objectives

Fire prevention and preparedness strategies proposed in this plan have the dual and equal objectives of:

Protection of life and property and Conservation of Biodiversity

The fire suppression strategies have the overriding objective of “*Protection of life and property*” with conservation of biodiversity being considered when determining appropriate tactics.

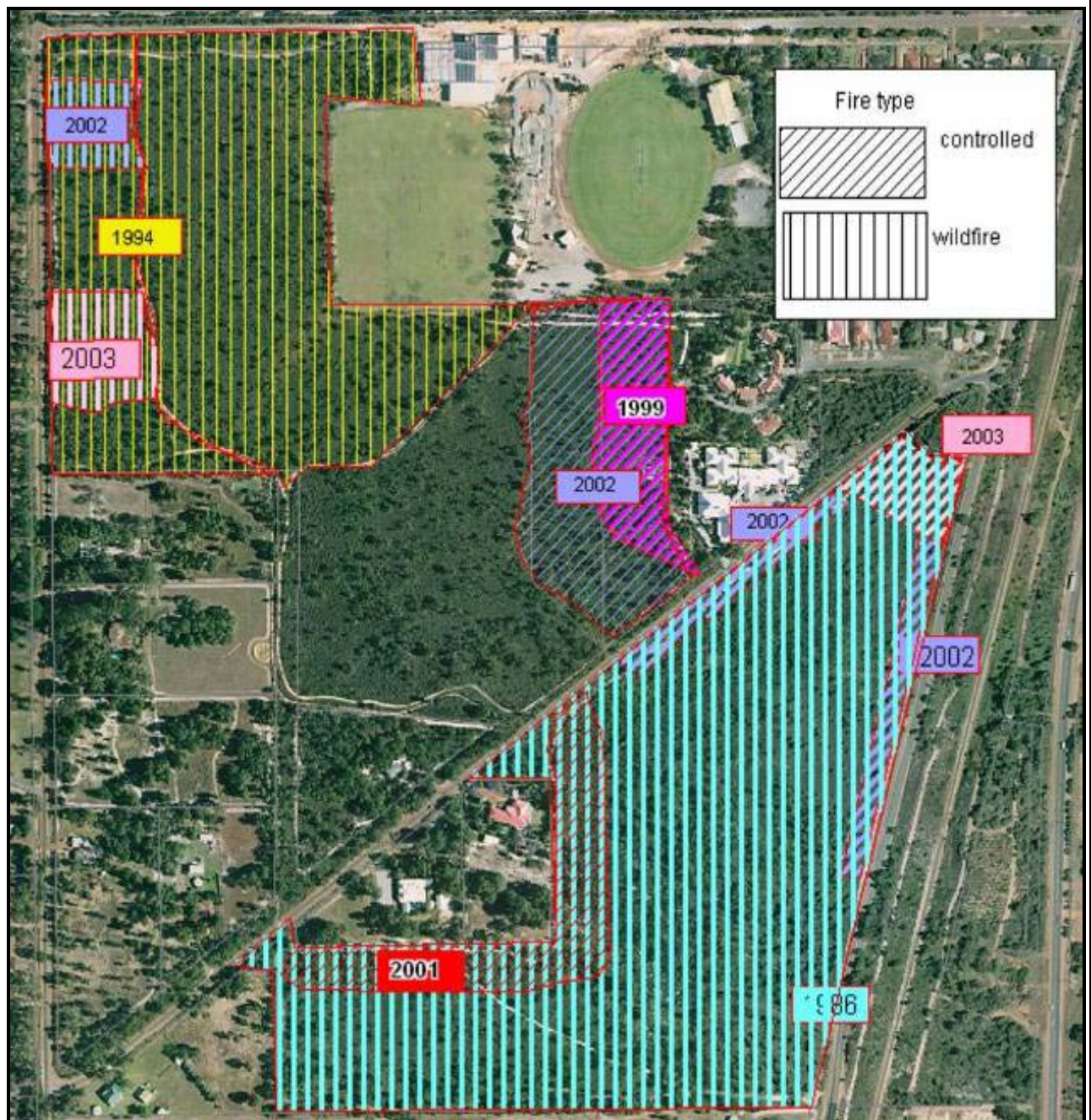


Figure One: Brickwood Reserve Fire History: based on anecdotal sources

Background

The reserve contains some 41 hectares of vegetation classified as the Swan Coastal Plain Community type 3a or *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils. This represents over one third of the remaining area of this vegetation community in the world. It is classified as a “critically endangered threatened ecological community” and is protected by federal legislation. Under the Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth) actions that are *likely to have a significant impact* on this community require federal approval. This legislation provides for the Minister to give approval to such actions provided that they are carried out in a “manner specified”. A fire management plan

that demonstrates adequate consideration of protection of biodiversity would be required to support a manner specified decision.

All of the bushland contained in the reserve is protected under clauses added to the *Environmental Protection Act 1986* by the *Environmental Protection Amendment Act 2003*. This bushland, together with parts of the adjacent railway reserve and aged care reserve, comprises Bush Forever Site 321, which is recognized as an Environmentally Sensitive Area and hence protected by the State Act. However, Schedule 6 of the Act provides exemptions for clearing that is required under other laws, including those relating to fire prevention and control. So burning and /or clearing carried out under permit from the *Bushfire Control Officer* for fire prevention or weed reduction or clearing actions by fire fighters to control fires are allowed under this Act. However, good planning and management can limit the damage caused to biodiversity values during fire response.

The bushland is located in an area of intensifying urban development. Facilities provided within the Reserve include a new recreation centre, the Byford Pavilion, sports grounds and a BMX track. The new recreation centre, in particular, is a focal centre for community activities. Adjacent land users include an aged care hostel and aged residential units. In addition, current rural residential lands to the south and west of the reserve have been earmarked for intensive urban development in the Byford Structure Plan. The increasing intensity of use of the area immediately surrounding the bushland will lead to higher risks to life and property in the event of a fire, as well as increase the potential for unplanned fires. At the same time, the natural communities of the reserve will also be under increasing pressure from a range of disturbing processes associated with human activities, which will make it increasingly difficult to protect the biodiversity values.

Site Description

Brickwood Reserve is Crown Land vested in the Serpentine Jarrahdale Shire for the purpose of recreation. It has a surveyed area of 49.9834 hectares and is listed as Crown Reserve number 17490. The Shire also manages the adjacent Cockburn Location 106 (1.6861 hectares), vested in the Western Australian Baptist Hospital and Home Trust for the purpose of aged care. There are plans to include Cockburn Location 48 (1.4417 hectares) in the reserve. Reserve 17490 currently consists of locations numbers 110,111 and 112. The northern section, location 110, encompasses 20 hectares of Type 3a bushland and 11 hectares of infrastructure and recreation facilities occupy the north east corner. A further 2.5 hectares of community type 3a is found in the bushland of the aged care reserve managed by the Shire. The southern section, location 111, has a total area of around 18 hectares. Approximately 8 hectares supports community type 3a and the remainder of the location supports community types 20b and 9. A semi natural drainage line across location 111 carries storm water runoff from Soldiers Road and the adjacent railway reserve. This drainage line continues around the boundary of location 48 to exit on Warrington Road. In the northern section (location 110) the drain presents an obstacle to fire emergency vehicles. The drain is heavily infested with aggressive weeds including *Watsonia* that create higher fuel loads in summer. *Watsonia* at this location will be a focus for weed control to reduce fire risk.

Ecological Management

Our understanding of the role of fire in south west ecosystems is poor. There is inadequate research data to determine the optimum intervals, patterns and intensity. Existing research indicates that the optimum fire interval varies between communities and species. Certainly, short fire intervals of 3 to 4 years in banksia woodlands have been shown to cause ecosystem degradation. General ecological principles suggest that an interval of twice the juvenile period of the slowest maturing species is needed. In marri woodlands this interval is thought to be at least 10 to 12 years. In wetland areas the *Minimum sustainable* fire frequency is estimated at 10 to 12 year intervals, but could be much longer. Advice received from the Department of Environment and Conservation suggests that 12 or 13 year intervals should be considered a minimum for this reserve.

In order to balance the sometimes-conflicting objectives of community safety and protection of biodiversity, extensive consultation has been conducted with Shire Officers, the Department of Environment and Conservation, strategic community groups, Serpentine Jarrahdale Landcare Centre and an Environmental Consultant. As a result, the following strategies are recommended:

Vegetation Management Areas

These areas are represented on the attached Map 2. These buffer zones have been identified as being adjacent to areas of high intensity use, current urban development and infrastructure. Controlled burns will be undertaken within these areas. Small areas only (estimated at 200 – 300 square metres) will be strategically burnt within the vegetation management areas. This will be done in a mosaic pattern and specific areas which contain Declared Rare Flora or Threatened Ecological Communities will be avoided as much as possible. Almost the entire area of Brickwood Reserve contains Threatened Ecological Communities so monitoring the burning of these within some of the vegetation management buffer areas will be important. The Department of Environment and Conservation (DEC) supports a 12 to 13 year minimum inter-fire interval, burning small areas at any one time and burning in a variety of seasons for the buffer areas. DEC has flora list data for plots (Gibson *et al.* (1994)) in Brickwood Reserve and has provided these.

The vegetation management areas outlined are delineated by existing tracks to avoid further disturbance to the bushland. In order to control the mosaic burning within these areas, minor existing tracks will be utilised wherever possible. Alternatively, least impact tracks such as 'kangaroo tracks' will be chosen before a burn. Rake hoe tracks (hand trails) will follow these lines and be reinforced with wet lines. This method is currently utilised by the Department of Environment and Conservation.

Fire intervals will be determined by a combination of fuel loading data and interval time between burns. The aim for fire intervals within the vegetation management areas is proposed to be at least 12 years, small areas are to be burned at any one time, and burning is to be done in a variety of seasons.

The timing of prescribed burns will be altered between seasons within safe limits. Predominantly spring and autumn burns will be used. Factors such as weather conditions, wind and soil moisture availability will ultimately determine the timing of prescribed burns.

Monitoring

Monitoring the impacts of controlled burns is essential to identify fire management techniques that will be *sustainable*. This fire management strategy also provides a

good opportunity to study the impacts of controlled burns on this community. Murdoch University honours students will undertake surveys and will be encouraged to be involved in programs such as reviews of the fire management plan every 3 to 5 years, integrating weed control with fire management for best optimal biodiversity outcomes and investigations into protection strategies such as further fencing initiatives for part or all of the Brickwood Reserve. Baseline data were collected during Spring 2007 along transects in both the scientific conservation and the vegetation management areas by Murdoch University. The sample sites will be revisited at the same time in subsequent years. The results of this research will be used as a management tool in regular review of this fire management plan and its strategies.

Previous monitoring plots have been set up within the reserve. Efforts are currently being made to collate all information such as the species lists developed from various plots and the exact location of plots. This information would be invaluable to the ongoing monitoring of the Reserve.

Dieback (*Phytophthora cinnamomi*)

The Community Emergency Services Support Officer and the Mundijong Volunteer Fire Brigade will be provided maps of the location of dieback (*Phytophthora cinnamomi*) within the reserve. The Mundijong Volunteer Fire Brigade has undertaken dieback management techniques training with the Department of Environment and Conservation.

Weed Control

In order to achieve the outcomes of this Fire Management Plan in reducing the fire hazard posed by this reserve, and in accordance with the Brickwood Reserve Weed Management Plan (T Wade 2006), it is essential to follow any prescribed burns with adequate weed control. Consideration can also be given to weed control before burning. The Reserves Officer will work closely with the Community Emergency Services Support Officer to ensure that areas that are burnt within the reserve are followed up with careful, targeted weed control measures.

Special Risk Areas

- Dieback (*Phytophthora cinnamomi*) free area in southern section of the reserve (approximately aligned with banksia/ jarrah woodland). Avoid placing new tracks or moving across this area wherever possible.
- Community type 3a '*Corymbia calophylla* - *Kingia australis* woodlands on heavy soils' (critically endangered): most of the remnant vegetation on lot 110 (northern section) and approximately half of the vegetation on lot 111 (southern section).
- Community type 20b 'Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands' (endangered): central sandy rise extending back to south east corner on lot 111 (southern section).
- Community type 9 'Dense shrublands on clay flats' (vulnerable): north east portion of lot 111 (southern section).
- Wetland areas (type 3a and type 9) are extremely sensitive to water erosion initiated by vehicle tracks.
- Aged care facility on Turner Road, east of and adjacent to lot 110.

Fire Prevention and Preparedness Strategies and Tactics

The Shire of Serpentine-Jarrahdale has a legal and moral obligation to protect both the biodiversity values of this bushland as well as the life and property of the community. Managing biodiversity values in an urban setting is a difficult balancing act. The following strategies have been decided on in consultation with Shire Officers.

- Maintain “low-fuel” buffer zones adjacent to occupied areas.
- In communities outside of the buffer zones, fire intervals should exceed 12 years. No prescribed burning to take place in these areas.
- Undertake comparative monitoring of fuel buffer zones and protected zones to determine impacts of fire and other disturbances.
- Use the results of the monitoring to review this strategy after 3 to 5 years.
- Ensure lower densities of future residential developments adjacent to the reserve including road buffers between houses and bushland.
- Maintain good access into and through the reserve for fire fighting crews.
- Maintain firebreaks around the perimeter of both locations.
- Clean soil and plant material from all vehicles before entering and after leaving the reserve.
- Avoid traversing the dieback (*Phytophthora cinnamomi*) free zone of the reserve, where possible.
- Continue to undertake regular weed control, especially in areas of dense weed infestation.
- Limit opportunities for all unofficial vehicles to access the reserve while maintaining adequate access for fire response crews.
- Limit community access to bushland to selected walking paths.
- Review efficacy of all strategies and actions after unplanned fire events.
- Ask neighbours to report any smoke or fires immediately by dialling 000.

Fire Suppression Strategies and Tactics

- Manage fire suppression activities according to the Incident Control System.
- Contain wildfires to the smallest possible area.
- Consider requesting aerial fire suppression support in preference to risking creating a situation where further clearing or disturbance of the bushland is necessary.
- Do not use water containing additives to assist in fire control (foams, wetting agents, retardants) through the bushland area. The Mundijong volunteer fire brigade will be advised that Brickwood Reserve is a ‘NO FOAM ZONE’.
- Consider biodiversity impacts in deciding on fire suppression tactics so that the damage caused does not exceed the values protected.
- Prioritise objectives and reassess with weather changes.

- Consider evacuating residents, especially aged care residents, and closing roads if fire intensity necessitates. Request police assistance for such actions.
- Avoid creating new fire breaks, unless essential. Particularly, avoid traversing the dieback (*Phytophthora cinnamomi*) free area in the southern section.
- Maintain all vehicles free of soil and plant matter. Clean down all machinery before moving to other areas.
- Ensure adequate mop-up and control actions.

Fire Recovery Strategies

- Conduct post fire reviews to assess causes of wildfire and conduct during suppression activities.
- Implement targeted and focussed weed control after burns.

Spread local seed if appropriate and available in highly disturbed areas where large bare patches may exist following recovery of native plants after fire.



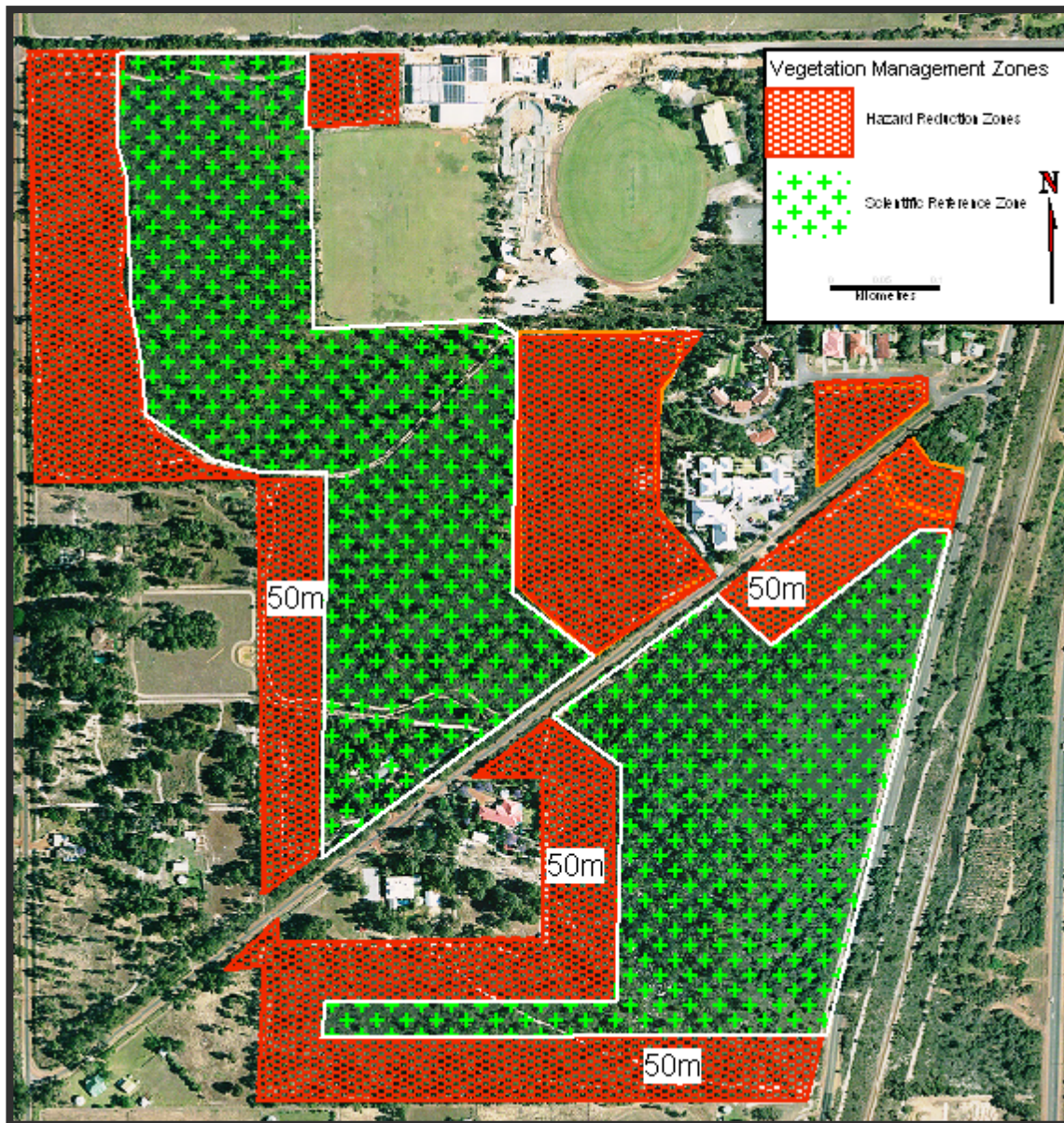


Figure 2: Fire Management Zones (Fire Buffer Zones Hatched in Red)

Vegetation Management Zone (Fire Buffer Zones) – Areas that will be managed by maintaining lower fuel levels through the use of a combination of hazard reduction burning prescriptions and weed control.

Scientific Reference Zone (No planned Burn) – Areas where there are no current prescription burns planned so comparisons in vegetation can occur.

Attachment One: Fire Management Schedule Of Works

Action	Responsibility	
Undertake controlled, mosaic burns in “low-fuel” buffer zones as marked on map, timing to be determined by combination of fuel loads exceeding 8 to 12 tonne per hectare and years since last fire.	Fire and Emergency Services officer	
Stabilise and improve major access tracks where needed to ensure easy access for fire control, utilising only dieback and weed free machinery and soils.	Fire and Emergency Services officer	
Install crossovers at appropriate points along the drains in the northern section of the reserve, particularly over the drain adjacent to Lot 48, the entrance from Turner Road and the drain south of the BMX track (utilising only dieback and weed free machinery and soils).		
Approach landowners in Lots xx and xx abutting the reserve to negotiate access and gates in case of fire.	Natural Reserves Coordinator	
Complete fencing of the boundaries of the Reserve with adequate entrances for firefighters.		
Gates to be kept locked and keys provided to combat agencies.	Fire and Emergency Services officer & Reserves Officer	
Construct barriers to movement of pedestrians, bicycles and motorbikes and other vehicles from recreation areas into adjacent bushland while ensuring adequate access for fire crews.	SJ Engineering	
Avoid creating additional access tracks through the vegetation unless absolutely necessary.	Fire and Emergency Services officer	
Collect seed from native plants in the reserve and store appropriately.	Natural Reserves Coordinator/ Land Care Officers	
Spread reserve sourced seed in disturbed areas (especially areas of high weed infestation) prior to controlled burns or after major unplanned fires.	Natural Reserves Coordinator	
Continue the bi-annual program of weed control to reduce the extent and density of weed populations with emphasis on the aggressive weeds.	Natural Reserves Coordinator	
Schedule weed control activities and, in consultation with DEC, revegetation at appropriate intervals after fires.	Natural Reserves Coordinator	

Attachment Two: Field Response Plan

BRICKWOOD RESERVE FIRE RESPONSE PLAN CURRENT AT: June 2008										
LOCATION: Byford Lot 110 (Northern) bounded by Warrington Rd, Mead St(closed), Gordin Way, Turner Rd and Byford Lot 111 (Southern) bounded by Warrington Rd, Turner Rd, Soldiers Rd and private property to the south.										
AREA: 49.98 ha				FIREGROUND DECISIONS:						
HMA:		INCIDENT NAME:		Activity			Contact Position & Contact Name	<i>D on e√</i>	<i>Time</i>	
Bush Plan Ref:	No:	Date:		Water Bombers requested (NO FOAM)	Y	N	Incident Controller			
COMCEN CONTACTS:			<i>Done √</i>	<i>Time</i>						
Shire of Serpentine Jarrahdale	Bushfire Officer	Control	0409080778							
							Communication Plan	Y	N	Incident Controller
							Traffic Plan	Y	N	Incident Controller
Graceford Hostel Recreation Centre	Duty Officer Manager		9526 2898 9550 6777				Mop Up & Patrol	Y	N	Incident Controller
SIZE UP:				Declared 'SAFE'	Y	N	Incident Controller			
Special Risks: Entire area is environmentally sensitive, containing unique flora and fauna, which may be destroyed by vehicle use. Vehicle tracks through wet areas can cause ongoing water erosion.				RECOVERY ACTIONS:						
Particular attention should be paid to protecting:				Activity			Contact Position & Contact Name			
				Incident Handover	Y	N				
Briefings:										
• Threatened Ecological Communities				Local Govt Authority	Y	N	Natural Reserves Coordinator Vanessa Slater			
• Dieback free area on southern section				Environmental Officer	Y	N	Manager Environmental Services Chris Portlock			

Considerations:				Special Requests (see comments below)	Y	N			
Hazards:	Deep drains			COMMENTS:					Action Req'd
	Locked gates								
	Dieback								
	Wet "boggy" areas and eroded tracks			The Department of Environment and Conservation (DEC) is to be notified of any prescribed burns proposed or wildfires which occur within the Reserve so that support can be received and information recorded so DEC advice can be sought on recovery works.					
Vulnerable Property:	Shire Recreation Facilities in northeast Section of lot 110								
	Aged Care Facilities east of lot 110								
	Private residences west and south of reserve								
Access:	Enter along roads bounding area, via gates and on tracks								
	Internal access via 4WD tracks and walk trails								
IMT CONTACTS:				AUTHORISED BY:					
Shire of Serpentine Jarrahdale	Dave Gossage	0409080778		Name	Position	Signature	Date	Time	
Voluntary Bushfire brigade	Paul Maddern	0418900763							