

2010

Flora and Vegetation Survey, Lots 81 and 10865, Belhus



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Summary

This document reports on a flora study for two potential sites of the End of Catchment Wetland Treatment system in Ellen Brook.

The on-site floristic survey was undertaken on 19th, 25th August and 9th September 2010..

The survey involved traversal of the study area during which plant specimens were collected for later identification. During traversal a special survey was undertaken to determine the extent of native and exotic species. Mapping was based on GPS-based observations and aerial photograph interpretation. The field studies provided details of community floristics and structure.

The vegetation community present at both locations is *Eucalyptus rudis* – *Melaleuca raphiophylla* medium height riparian woodland with elements of *Corymbia calophylla* woodland over perennial rushes and sedges. There is extensive weed invasion and alteration to both community floristics and structure at the two locations. No Threatened Ecological Communities were located during the field survey. Generally the native vegetation is in poor - very poor condition with historic clearing, altered fire regimes and weed invasion being the main disturbance factors.

15 native plant species were recorded in Lot 10865 with 40 exotic species (weeds) being found there. 17 native plant species and 40 exotic species were identified in Lot 81. There were 3 Declared Weeds (as listed by the Department of Agriculture and Food) in Lot 10865 and 5 Declared Weeds in Lot 81. No Conservation Priority species were identified at either location.

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Introduction

This document reports on a flora study for two potential sites of the End of Catchment Wetland Treatment system in Ellen Brook.

The objectives of the flora study were to:

- Undertake a flora survey on both of the two potential sites including:
 - (a) List of species (both native and non-native) linked to hydrographic zones (i.e. in channel, floodway or flood fringe) including priority weed species;
 - (b) Potential for seed collection and plant relocation.
- Locate via GPS:
 - (c) Significant trees (including species name, condition, height and canopy diameter);
 - (d) Significant stands/patches of vegetation

Study Location

Lots 81 and 10865 fall within the City of Swan, Locality of Belhus, local government boundary (Figure 1). Lot 81 covers an area of 34.2 hectares (ha) while Lot 10865 is 10.6 ha. The topography can be described as an incised riparian valley with gentle to steep slopes bordering broad flood zones. The watercourses are generally narrow (< 2m wide) and shallow (<1.5m deep). Winter-wet areas and ephemeral stream branches occur within the flood zone. The substrate consists of grey sands with area of lateritic clays and alluvial deposits from upstream.

Methods

The on-site floristic survey was undertaken on 19th, 25th August and 9th September 2010. The survey involved traversal of the study areas during which plant specimens were collected for later identification. Plant specimens were identified and verified using the resources of the State Herbarium and Florabase.

Mapping of tree species and fringing herbaceous species was based on aerial photograph interpretation with the field studies providing details of species type. Ecological condition was assessed according to Keighery (1994) - the vegetation condition rating scale utilised is included as Appendix 1. Evidence of threatening processes and indicators of plant population health, including dieback, canker and galling were also noted during field traversals. Plant community and structural formation definitions follow Muir (1977) as outlined in Appendix 2.

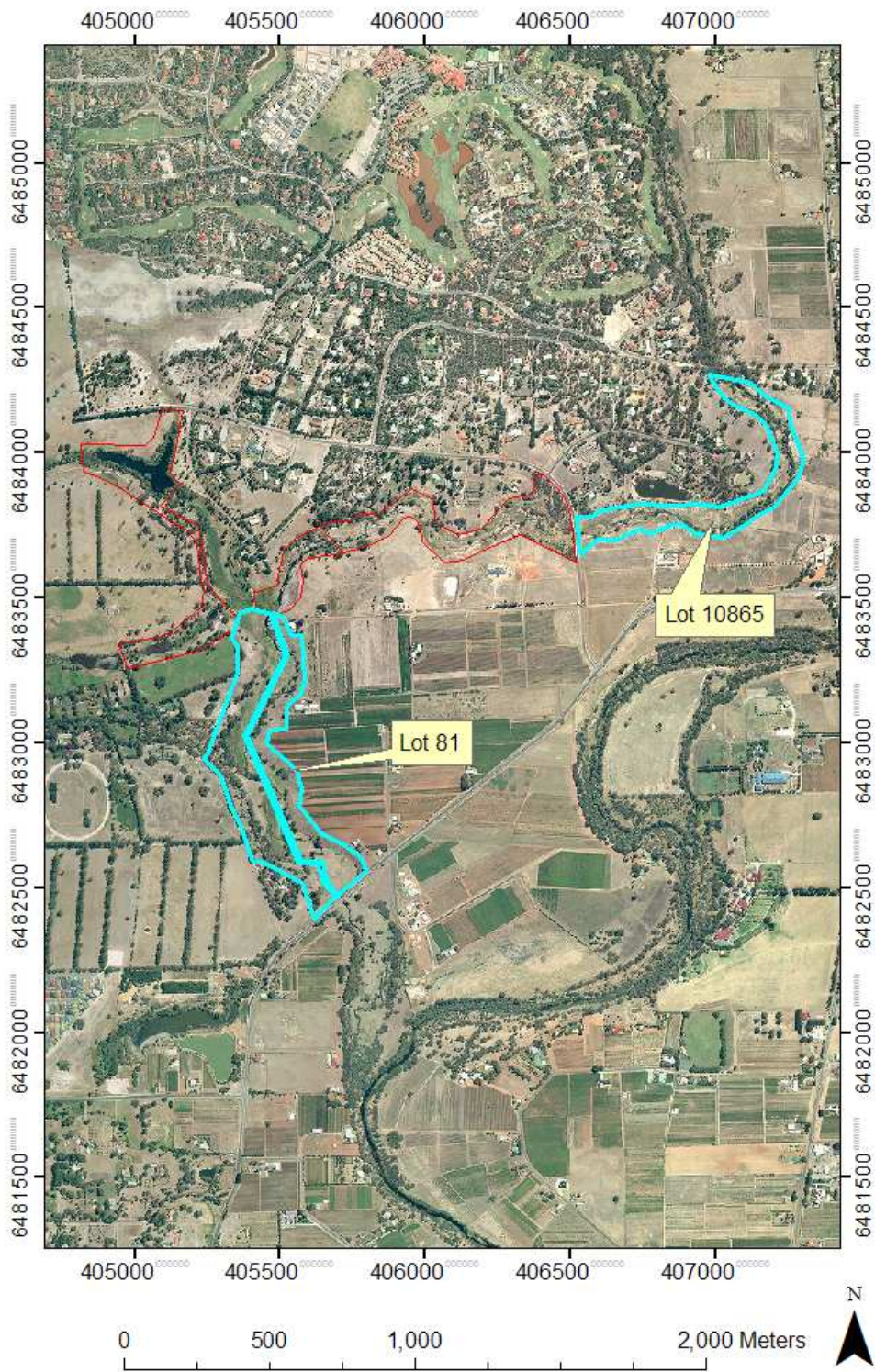


Figure 1 Study Areas, Lots 81 and 10865 Belhus outlined in cyan.

RESULTS

LOT 10865

Description of Vegetation

Figure 2 shows a detailed aerial photograph of Lot 10865. The native community consists of medium height *Eucalyptus rudis* – *Melaleuca raphiophylla* – *Casuarina obesa* riparian woodland over perennial rushes (*Juncus* spp.), sedges (*Cyperus* and *Schoenoplectus* spp) and ephemeral herbs (e.g. *Cotula*) (Plate 1). Figure 3 maps the distribution of native tree species. Few native shrubs are present though there is some replacement planting on the eastern bank presumably undertaken by local landowners. In many areas there is no intact woodland left with exotic understorey species (mainly grasses and geophytes) dominating (Plates 2 and 3). The streamline is fringed by both native and exotic macrophytes (e.g. *Juncus pallidus*, *Schoenoplectus validus*, *Watsonia bulbifera*, *Zantedeschia aethiopica*), (Plates 4 and 5). Figure 4 shows the distribution of the main stands of native rushes and sedges while Figure 5 displays the main exotic species. No submerged or floating leaved macrophytes are present.

The vegetation is in poor – very poor condition due to widespread disturbances associated with historic clearing, altered fire regime and weed invasion.



Figure 2. Lot 10865 Belhus, aerial photography 2008

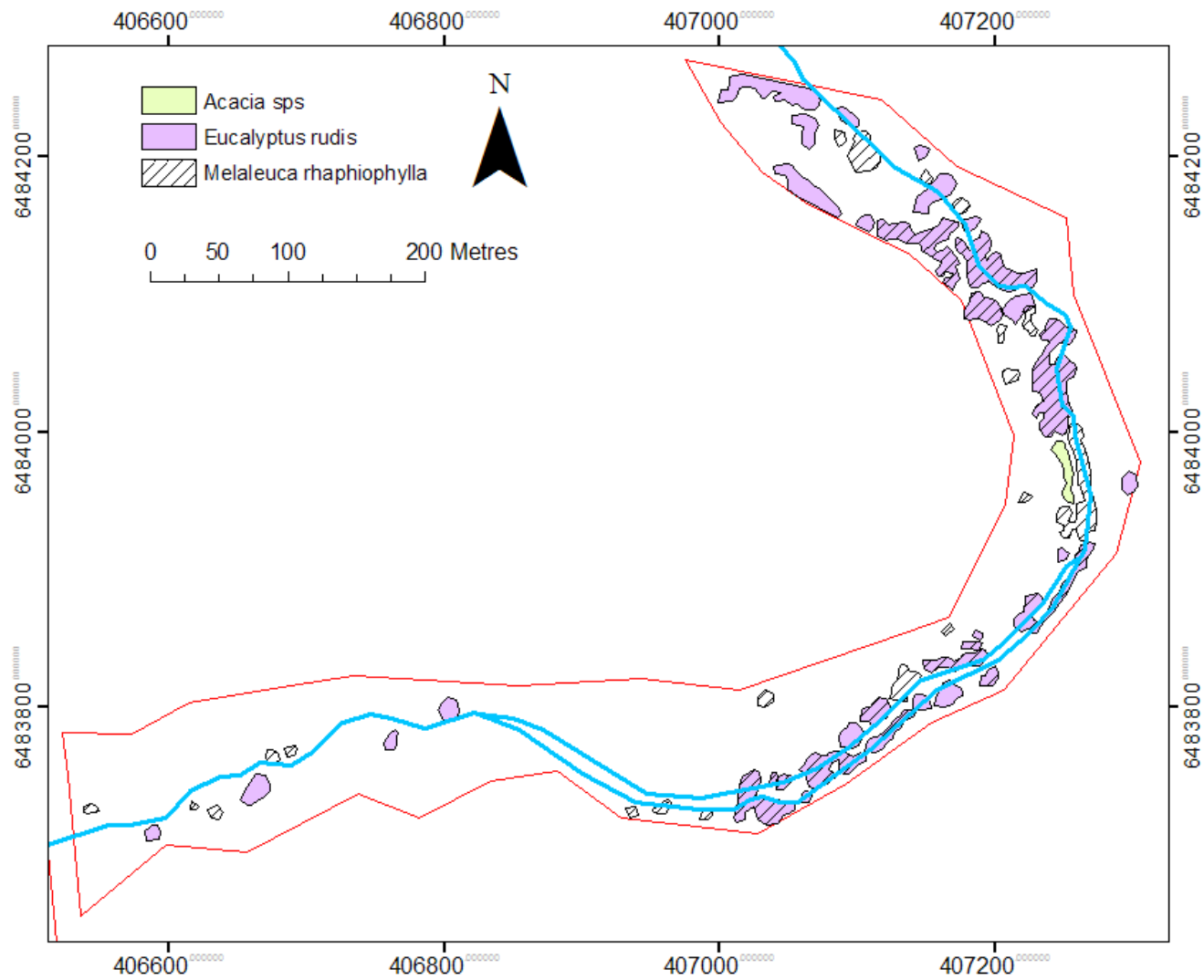


Figure 3. Native trees, Lot 10865 Belhus.

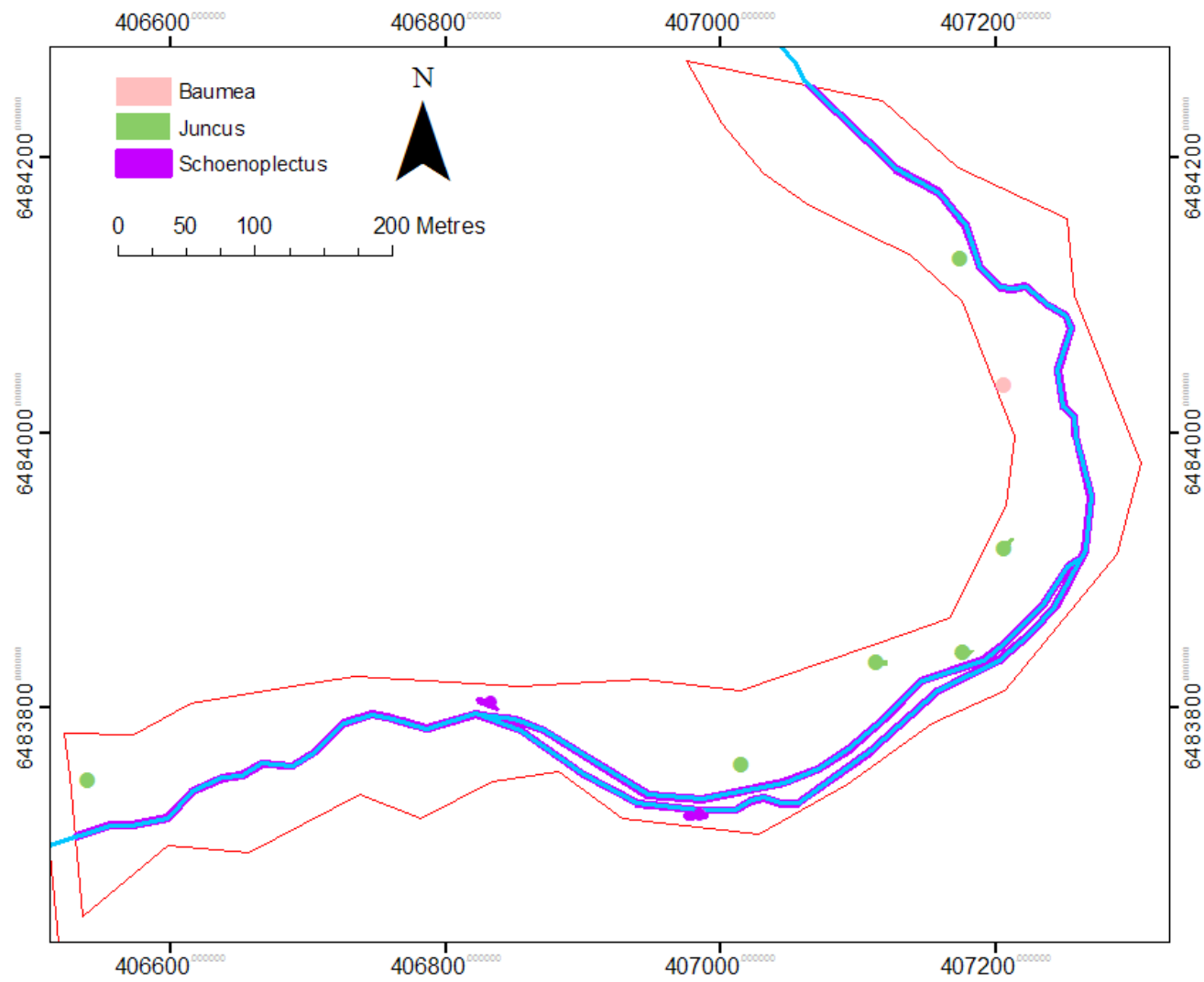


Figure 4. Native sedges and rushes Lot 10865 Belhus.

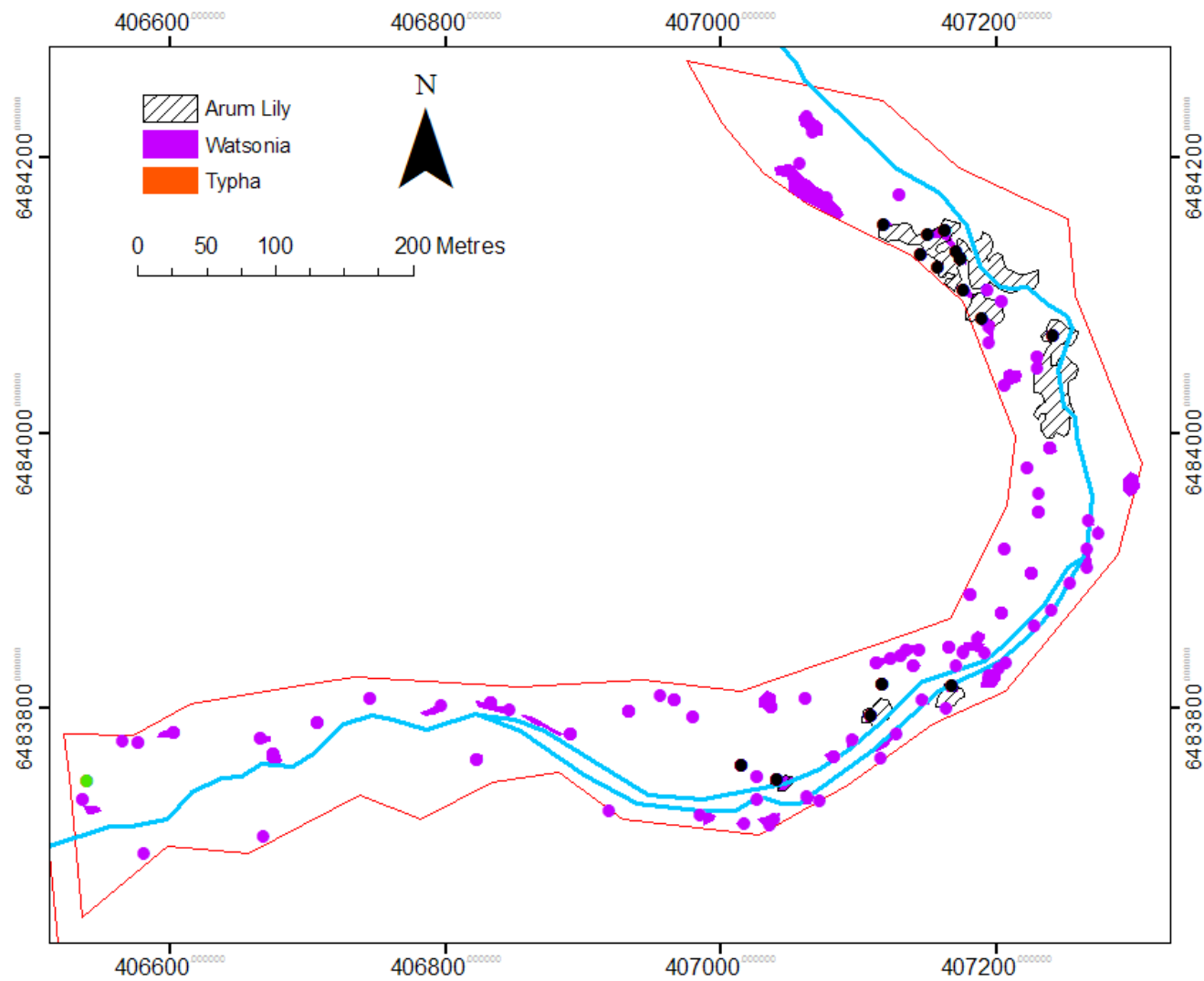


Figure 5. Principal exotic species, Lot 10865 Belhus.



Plate 1. Fringing rushes and riparian woodland



Plate 2 *Juncus* species in the main channel.



Plate 3. *Watsonia* in the flood zone.



Plate 4. *Watsonia* below *Eucalyptus rudis*.



Plate 5 Arum Lilies below *Melaleuca raphiophylla*

Native Flora

15 native plant species were recorded within the study area (Table 1). The relatively low number of the native vascular flora recorded reflected extensive disturbance due to historic clearing and weed invasion. Most native species were confined to areas of degraded remnant riparian woodland. There was some planting of native shrub and tree species along the eastern bank.

Acacia saligna

Occasional trees and sapling throughout the study area

Eucalyptus rudis

Common along the bank and riparian flat. Mature trees and saplings.

Melaleuca raphiophylla

Common along the bank and riparian flat, sometimes forming stands. Mature trees and saplings.

Baumea articulata

Uncommon, mostly occurring as small clumps.

Juncus pallidus

Occasional fringing species and also found on the riparian flat. Occasionally forming large stands but mostly found as small areas on the stream flat.

Schoenoplectus pungens, *Schoenoplectus validus*.

Common fringing species and also found on the riparian flat. Occasionally forming large stands but mostly found as narrow fringing bands to 2m wide on the stream bank.

Table 1. Native species within Lot 10865

Species	Author	Family	Location
<i>Acacia saligna</i>	(Labill.) Wendl.	Mimosaceae	Flood fringe
<i>Brachyscome iberidifolia</i>	Benth.	Asteraceae	Floodway, fringe
<i>Casuarina obesa</i>	Miq.	Casuarinaceae	floodway
<i>Centella cordifolia</i>	(J.D.Hook.)Nanng.	Apiaceae	floodway
<i>Cotula coronopifolius</i>		Asteraceae	floodway
<i>Eucalyptus rudis</i>	Endl.	Myrtaceae	Channel bank
<i>Hakea prostrata</i>	R.Br.	Proteaceae	Flood fringe
<i>Hypocalymma angustifolium</i>	(Endl.)Schauer	Myrtaceae	Flood fringe
<i>Jacksonia sternbergiana</i>	Huegel	Fabaceae	Flood fringe
<i>Juncus pallidus</i>	R.Br.	Juncaceae	In channel, bank
<i>Melaleuca raphiophylla</i>	Schauer	Myrtaceae	Channel bank
<i>Philotheca spicatus</i>	(A Rich)P.Wilson	Rutaceae	Flood fringe
<i>Rhagodia baccata</i>	(Labill.)Moq.	Chenopodiaceae	floodway
<i>Schoenoplectus pungens</i>	(M.Vahl) Palla	Cyperaceae	In channel, bank
<i>Schoenoplectus validus</i>	(M.Vahl)Love&Love	Cyperaceae	In channel, bank

*additional planted species

Callistemon sp
Calothamnus sp
Eucalyptus sp
Melaleuca sp

Weeds

40 exotic species (Table 2) were identified. There were 3 Declared Weeds as listed by the Department of Agriculture and Food (Table 3). Declared Weed Priority Categories are given in Appendix 3. The weed complement included annual and perennial grasses (e.g. *Avena sativa*, *Cynodon dactylon*, *Ehrharta calycina*), annual herbs (*Brassica tournefortii*, *Echium plantagineum*, *Hypochoeris glabra*), rhizomatous and bulbous species (e.g. *Watsonia bulbifera*) and short lived herbs (e.g. *Arctotheca calendula*, *Gomphocarpus fruticosus*). Many of these species are widely distributed in the study area.

Cottonbush - *Gomphocarpus fruticosus*

A single specimen removed during field work. Found on the western bank. The presence of this species requires monitoring.

Paterson's Curse - *Echium plantagineum*

Widespread but not dense along both eastern and western slopes and flat areas.

Lupin – *Lupinus consentinii*

Widespread and occasionally dense. Invasive.

Cape Tulip - *Homeria* sps.

Widespread and occasionally dense. Invasive on the riparian flats.

Sour Sob - *Oxalis pes-caprae*

Widespread and occasionally dense. Invasive on both slopes and riparian flats

Bullrush - *Typha orientalis*

A few extensive stands and occasional small areas within the stream channel, flooded areas and the riparian flat. Invasive and competing with native emergent macrophytes.

Watsonia - *Watsonia bulbifera*

A few extensive stands and occasional small areas along the bank, slopes and the riparian flat. Invasive and competing with native sedges and rushes.

Arum Lily - *Zantedeschia aethiopica*

A few extensive stands and occasional small areas along the bank and areas of the riparian flat. Invasive and competing with native sedges and rushes.

Annual and Perennial Grasses

Mixed annual and perennial species occurring throughout the study area. Invasive and competing with native herbs, rushes and sedges.

Table 3 Declared weeds present

Species	Declared Status
Paterson's curse (<i>Echium plantagineum</i>)	P1; for the whole of the State
Cape tulip, one leaf (<i>Homeria flaccida</i>) and cape tulip, two leaf (<i>Homeria miniata</i>)	P1; for the whole of the State
Arum lily (<i>Zantedeschia aethiopica</i>)	P1, P4; for the whole of the State

Table 2. Exotic species within Lot 10865

Species	Author	Family	Location
<i>Arctotheca calendula</i>	(L.) Levyns	Asteraceae	Floodway, fringe
<i>Avena sativa</i>	L.	Poaceae	Floodway, fringe
<i>Brassica tournefortii</i>	Gouan	Brassicaceae	Floodway, fringe
<i>Bromus diandrus</i>	Roth	Poaceae	Floodway, fringe
<i>Callitriche stagnalis</i>	Scop.	Callitrichaceae	In channel
<i>Chenopodium album</i>	L.	Chenopodiaceae	Floodway, fringe
<i>Cynodon dactylon</i>	(L.) Pers.	Poaceae	Floodway, fringe
<i>Cyperus tenellus</i>	L.f.	Cyperaceae	Channel bank, floodway
<i>Dittrichia graveolens</i>	(L.) Greuter	Asteraceae	Floodway, fringe
<i>Echium plantagineum</i>	L.	Boraginaceae	Floodway, fringe
<i>Ehrharta calycina</i>	Smith	Poaceae	Floodway, fringe
<i>Eragrostis curvula</i>	(Schrud.) Nees	Poaceae	Floodway, fringe
<i>Fumaria capreolata</i>	L.	Fumariaceae	Floodway, fringe
<i>Gladiolus caryophyllaceus</i>	(N.L. Burman) Poiret	Iridaceae	Floodway, fringe
<i>Gomphocarpus fruticosus</i>	E. Mey	Asclepiadaceae	Channel bank
<i>Homeria flaccida</i>	Sweet	Iridaceae	Floodway, fringe
<i>Hordeum leporinum</i>	Link	Poaceae	Floodway, fringe
<i>Hydrocotyle ranunculoides</i>	L.f.	Apiaceae	In channel, bank
<i>Hypochoeris glabra</i>	L.	Asteraceae	Floodway, fringe
<i>Juncus microcephalus</i>	Kunth	Juncaceae	Channel bank
<i>Lathyrus tingitanus</i>	L.	Fabaceae	Floodway, fringe
<i>Lolium perenne</i>	L.	Poaceae	Floodway, fringe
<i>Lupinus consentinii</i>	Guss.	Fabaceae	Floodway, fringe

<i>Medicago polymorpha</i>	L.	Fabaceae	Floodway, fringe
<i>Oxalis pes-caprae</i>	L.	Oxalidaceae	Floodway, fringe
<i>Paspalum dilatatum</i>	Poiret	Poaceae	Floodway, fringe
<i>Pennisetum clandestinum</i>	Chiov.	Poaceae	Floodway, fringe
<i>Raphanus raphanistrum</i>	L.	Brassicaceae	Floodway, fringe
<i>Rapistrum rugosa</i>	(L.) All.	Brassicaceae	Floodway, fringe
<i>Romulea rosea</i>	(L.) Ecklon	Iridaceae	Floodway, fringe
<i>Rumex crispus</i>	L.	Polygonaceae	Floodway, fringe
<i>Silene gallica</i>	L.	Caryophyllaceae	Floodway, fringe
<i>Solanum nigrum</i>	L.	Solanaceae	Floodway, fringe
<i>Sonchus oleraceus</i>	L.	Asteraceae	Floodway, fringe
<i>Stachys arvensis</i>	(L.)L.	Lamiaceae	Floodway, fringe
<i>Trifolium campestre</i>	Schreb	Fabaceae	Floodway, fringe
<i>Trifolium dubium</i>	Sibth.	Fabaceae	Floodway, fringe
<i>Trifolium hirtum</i>	All.	Fabaceae	Floodway, fringe
<i>Watsonia bulbifera</i>	J. Matthews & L. Bolus	Iridaceae	Bank, Floodway, fringe
<i>Zantedeschia aethiopica</i>	(L.) Spreng.	Araceae	Bank, Floodway, fringe

LOT 81

Description of Vegetation

Figure 6 shows a detailed aerial photograph of Lot 81. The native community consists of medium height *Eucalyptus rudis* – *Melaleuca raphiophylla* – *Corymba calophylla* riparian woodland over occasional native shrubs (e.g. *Astartea affinis*) perennial rushes (*Juncus* sps.), sedges (*Cyperus* and *Schoenoplectus* sps) and ephemeral herbs (e.g. *Cotula*) (Figure 7, Plate 6). There are occasional stands of *Acacia saligna*. Few native shrubs are present. In many areas there is no intact woodland left with exotic understorey species (mainly grasses and geophytes) dominating (Plates 7 and 8). The streamline is fringed by both native and exotic macrophytes which sometimes form extensive stands (e.g. *Juncus pallidus*, *Schoenoplectus*

validus, *Watsonia bulbifera*, *Zantedeschia aethiopica*), (Figures 8 and 9, Plates 9 and 10). Exotic woody weeds are found on upper slopes and within the stream channel (Plate 11). No submerged or floating leaved macrophytes are present.

The vegetation is in poor – very poor condition due to widespread disturbances associated with historical clearing, altered fire regime and weed invasion.

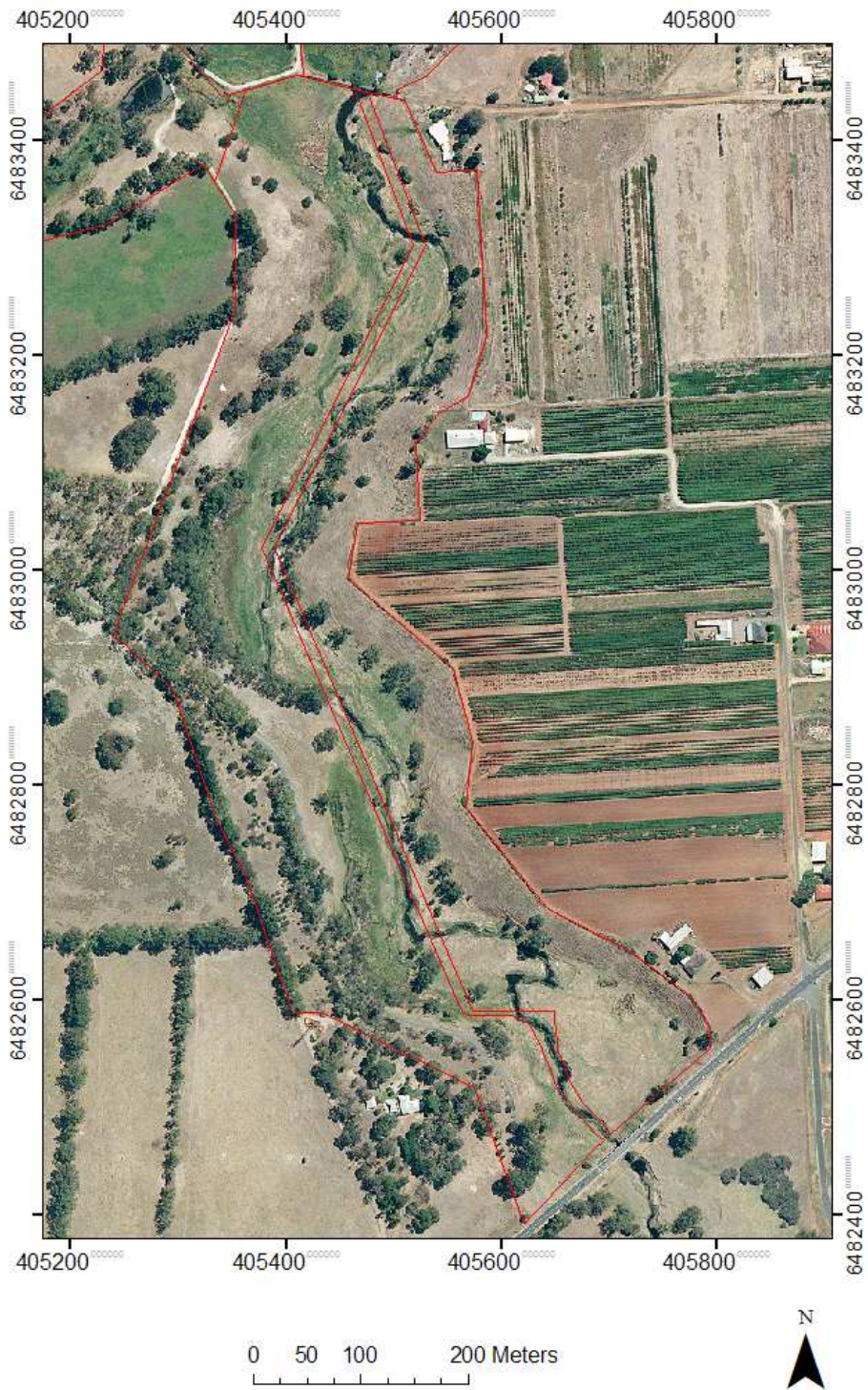


Figure 6. Lot 81 Belhus, aerial photography.

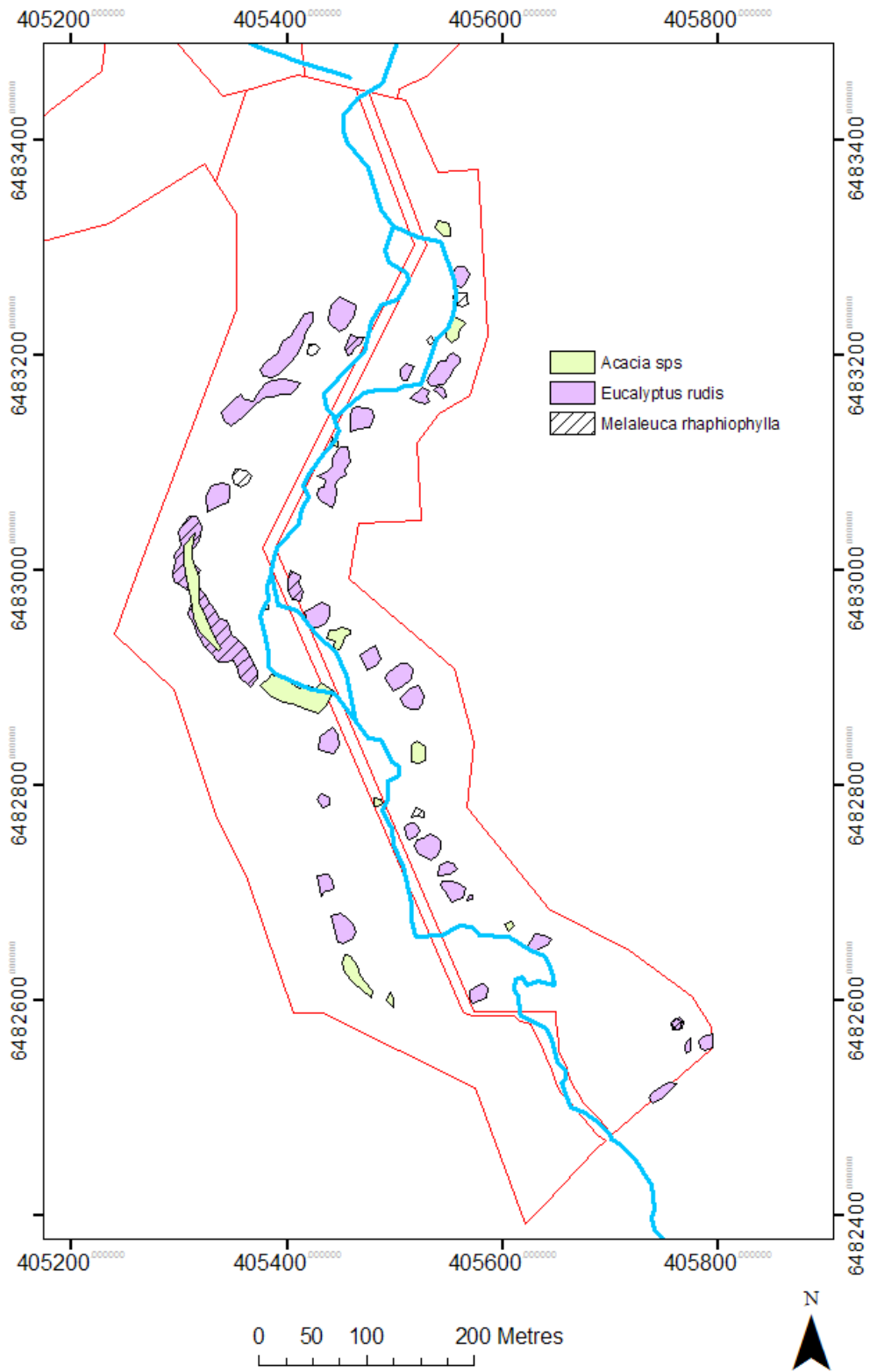


Figure 7. Native tree species, Lot 81 Belhus.

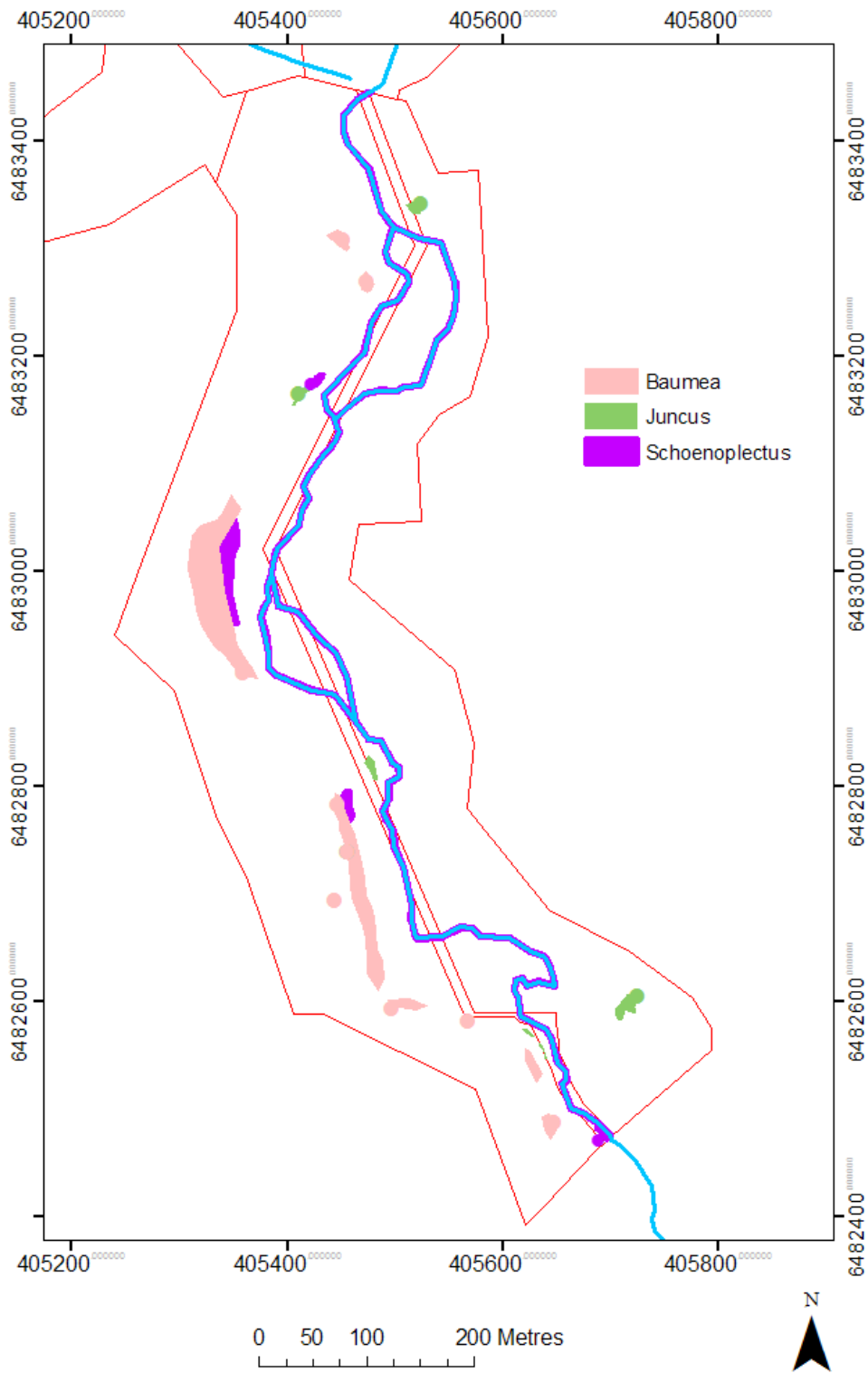


Figure 8. Native sedges and rushes, Lot 81 Belhus.

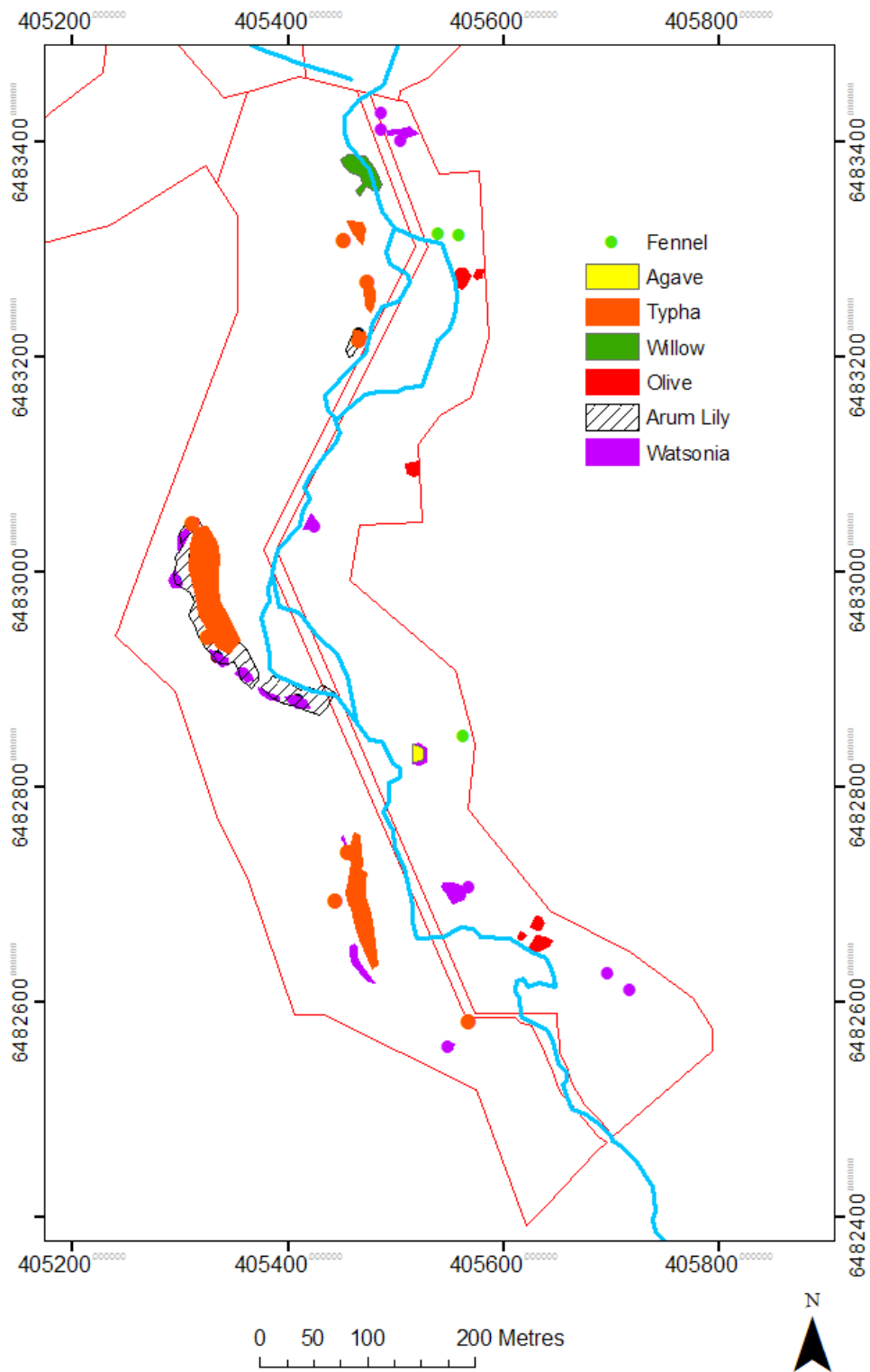


Figure 9. Principal exotic species, Lot 81 Belhus.



Plate 6. Fringing rushes and degraded riparian woodland.



Plate 7. *Typha* and *Baumea* stands on the flood fringe.



Plate 8. *Watsonia* extending beyond the flood zone.



Plate 9. Fringing *Schoenoplectus* spp.



Plate 10. Extensive stand of *Typha orientalis*.



Plate 11. Willows and *Typha* in the main channel.

Native Flora

17 native plant species were recorded within the study area (Table 4). The relatively low number of vascular flora recorded reflected the extensive disturbance due to grazing. Most native species were confined to the degraded remnant woodland.

Table 4. Native species within Lot 81

Species	Author	Family	Location
<i>Acacia acuminata</i>	Benth	Mimosaceae	Fringe
<i>Acacia saligna</i>	(Labill.) Wendl.	Mimosaceae	Fringe
<i>Agonis linearifolia</i>	(DC) Schauer	Myrtaceae	Fringe
<i>Astartea affinis</i>	(Endl.)Rye	Myrtaceae	Fringe
<i>Baumea articulata</i>	(R.Br.)S.T.Blake	Cyperaceae	In channel, bank, floodway
<i>Brachyscome iberidifolia</i>	Benth.	Asteraceae	Fringe
<i>Centella cordifolia</i>	(J.D.Hook.)Nanng.	Apiaceae	bank, floodway
<i>Corymbia calophylla</i>	(Lindl.) KD Hill & L Johnson	Myrtaceae	Fringe
<i>Cotula coronopifolius</i>		Asteraceae	Floodway
<i>Eucalyptus rudis</i>	Endl.	Myrtaceae	Bank, floodway
<i>Juncus pallidus</i>	R.Br.	Juncaceae	In channel, bank, floodway
<i>Kennedia prostrata</i>	R.Br.	Fabaceae	Fringe
<i>Lepidosperma longitudinale</i>	Labill.	Cyperaceae	Floodway
<i>Melaleuca raphiophylla</i>	Schauer	Myrtaceae	Bank, floodway
<i>Pteridium esculentum</i>	(G.Forster)Cockayne	Dennstaedtiaceae	Fringe
<i>Schoenoplectus pungens</i>	(M.Vahl) Palla	Cyperaceae	In channel, bank,
<i>Schoenoplectus validus</i>	(M.Vahl)Love&Love	Cyperaceae	In channel, bank,

Acacia saligna

Occasional trees and sapling throughout the study area.

Corymbia calophylla

Occasional mature trees and young saplings found upslope.

Eucalyptus rudis

Common along the bank and riparian flat. Mature trees and saplings.

Melaleuca raphiophylla

Common along the bank and riparian flat, sometimes forming stands. Mature trees and saplings.

Baumea articulata

A few large stands and small scattered clumps within the study area. Found in winter-wet areas and in some parts of the remnant woodland on the western bank.

Juncus pallidus

Occasional fringing species and also found on the riparian flat. Occasionally forming large stands but mostly found as small areas on the stream flat.

Schoenoplectus pungens, *Schoenoplectus validus*.

Common fringing species and also found in winter-wet areas on the riparian flat. Occasionally forming large stands but mostly found as narrow fringing bands to 2m wide on the stream bank.

Weeds

40 exotic species (Table 5) were identified. There were 5 Declared Weeds as listed by the Department of Agriculture and Food (Table 6). The weed complement included annual and perennial grasses (e.g. *Avena sativa* *Cynodon dactylon*, *Ehrharta calycina*), annual herbs (*Brassica tournefortii*, *Echium plantagineum*, *Trifolium sps*), rhizomatous and bulbous species (e.g. *Typha orientalis* *Watsonia bulbifera*), short lived herbs (e.g. *Arctotheca calendula*, *Foeniculum vulgare*) and woody weeds (*Salix sps.*). Many of these species are widely distributed in the study area and some form dense mono-specific stands

Apple of Sodom – *Solanum linneanum*

Uncommon plants on the western fringe

Edible Fig – *Ficus carica*

A single patch of this species occurs within degraded riparian woodland on the western bank. The patch is gradually expanding by both seed and vegetative reproduction.

Olive -*Olea europaea*

Scattered occurrence of large plants on the eastern bank. Possibly planted in part, slowly invasive.

Willow - *Salix sps*

A single large stand within the channel in the north of the study area.

Paterson's Curse - *Echium plantagineum*

Widespread but not dense along both eastern and western slopes and flat areas.

Fennel – *Foeniculum vulgare*

Occasional large plants, slowly invasive on the north-eastern bank.

Lupin – *Lupinus consentinii*

Widespread and occasionally dense. Invasive.

Cape Tulip - *Homeria sps.*

Widespread and occasionally dense. Invasive on the riparian flats.

Soursob - Oxalis pes-caprae

Widespread and occasionally dense. Invasive on both slopes and riparian flats

Bullrush - *Typha orientalis*

A few extensive mono-specific stands and occasional small areas within the stream channel, flooded areas and the riparian flat. Invasive and competing with native emergent macrophytes.

Watsonia - *Watsonia bulbifera*

A few extensive stands and occasional small areas along the bank, slopes and the riparian flat. Invasive and competing with native sedges and rushes.

Arum Lily - *Zantedeschia aethiopica*

A few extensive stands and occasional small areas along the bank and areas of the riparian flat. Invasive and competing with native sedges and rushes.

Annual Grasses

Mixed annual and perennial species occurring throughout the study area. Invasive and competing with native herbs, rushes and sedges.

Table 5. Exotic species within Lot 81

Species	Author	Family	Location
<i>Agave americana</i>	L.	Agavaceae	Fringe
<i>Arctotheca calendula</i>	(L.) Levyns	Asteraceae	Floodway, fringe
<i>Avena sativa</i>	L.	Poaceae	Floodway, fringe
<i>Brassica tournefortii</i>	Gouan	Brassicaceae	Floodway, fringe
<i>Bromus diandrus</i>	Roth	Poaceae	Floodway, fringe
<i>Callitriche stagnalis</i>	Scop.	Callitrichaceae	In channel
<i>Cyperus tenellus</i>	L.f.	Cyperaceae	Bank floodway
<i>Dittrichia graveolens</i>	(L.) Greuter	Asteraceae	Floodway, fringe
<i>Echium plantagineum</i>	L.	Boraginaceae	Floodway, fringe
<i>Ehrharta calycina</i>	Smith	Poaceae	Floodway, fringe
<i>Eragrostis curvula</i>	(Schrad.) Nees	Poaceae	Floodway, fringe
<i>Ficus carica</i>	L.	Moraceae	Bank, Floodway, fringe
<i>Foeniculum vulgare</i>	Mill.	Apiaceae	Fringe
<i>Fumaria capreolata</i>	L.	Fumariaceae	Floodway, fringe
<i>Gladiolus caryophyllaceus</i>	(N.L. Burman) Poiret	Iridaceae	Floodway, fringe
<i>Homeria flaccida</i>	Sweet	Iridaceae	Floodway, fringe
<i>Hordeum leporinum</i>	Link	Poaceae	Floodway, fringe
<i>Hypochoeris glabra</i>	L.	Asteraceae	Floodway, fringe
<i>Lathyrus tingitianus</i>	L.	Fabaceae	Floodway, fringe
<i>Lolium perenne</i>	L.	Poaceae	Floodway, fringe
<i>Lupinus consentinii</i>	Guss.	Fabaceae	Floodway, fringe
<i>Medicago polymorpha</i>	L.	Fabaceae	Floodway, fringe
<i>Olea europaea</i>	L.	Oleaceae	Fringe
<i>Oxalis pes-caprae</i>	L.	Oxalidaceae	Floodway, fringe
<i>Oxalis purpurea</i>	L.	Oxalidaceae	Floodway, fringe
<i>Paspalum dilatatum</i>	Poiret	Poaceae	Floodway, fringe
<i>Pennisetum clandestinum</i>	Chiov.	Poaceae	Floodway, fringe
<i>Raphanus raphanistrum</i>	L.	Brassicaceae	Floodway, fringe
<i>Romulea rosea</i>	(L.) Ecklon	Iridaceae	Floodway, fringe
<i>Rumex crispus</i>	L.	Polygonaceae	Floodway, fringe
<i>Salix sp.</i>		Salicaceae	In channel, bank
<i>Silene gallica</i>	L.	Caryophyllaceae	Floodway, fringe
<i>Solanum linneanum</i>	Hepper & Jaeger	Solanaceae	fringe
<i>Trifolium campestre</i>	Schreb	Fabaceae	Floodway, fringe
<i>Trifolium dubium</i>	Sibth.	Fabaceae	Floodway, fringe
<i>Trifolium hirtum</i>	All.	Fabaceae	Floodway, fringe
<i>Typha orientalis</i>	C.Presl.	Typhaceae	In channel
<i>Watsonia bulbifera</i>	J. Matthews & L. Bolus	Iridaceae	Bank, floodway
<i>Washingtonia filifera</i>	H.Wendl.	Arecaceae	Fringe
<i>Zantedeschia aethiopica</i>	(L.) Spreng.	Araceae	Bank, floodway

Table 6. Declared weeds present

Species	Declared Status
Apple of Sodom (<i>Solanum linneanum</i>)	P1; P2 for the whole of the State
Paterson's curse (<i>Echium plantagineum</i>)	P1; for the whole of the State
Cape tulip, one leaf (<i>Homeria flaccida</i>) and cape tulip, two leaf (<i>Homeria miniata</i>)	P1; for the whole of the State
Willows (<i>Salix</i> spp)	P1; for the whole of the State
Arum lily (<i>Zantedeschia aethiopica</i>)	P1, P4; for the whole of the State

References

Keighery, B. (1994). Bushland Plant Survey – A guide to Plant Community Survey for the Community, Wildflower Society of WA (Inc.)

Muir, B.G (1977) Biological Survey of the Western Australian Wheatbelt. Pt. 2. Vegetation and habitat of the Bending Reserve. Rec. West. Aust. Mus. Supp. 3.

Appendix 1. Criteria used for the field assessment of remnant vegetation condition (Keighery, 1994)

Rating	Criteria
4. Very Good	Evidence of localised low level damage to otherwise healthy bush. Recruitment should be apparent. Weed and grazing damage is confined (<20% of area). Some modification to vegetation structure due to changes in fire regimes may be apparent. Little evidence of logging or fire wood collection.
3. Good	Evidence of localised high level damage to otherwise low-level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in <50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
2. Degraded	Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Locally some strata are absent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
1. Very Degraded	Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Widespread loss of vertical strata. Gall and mistletoe damage may be apparent. Evidence of logging or firewood collection.
Damage type	Description
High Level	Grazing (domestic and feral), logging, clearing and excavation, die-back, salinisation or other water table modification, road works, flower picking, major structures (eg. managed or fenced areas), mowing, car bodies.
Low Level	Dumping (household, garden etc.), minor structures (e.g.. sheds), fire wood collection, weed infestation, modified fire regime.

Appendix 2. Plant Community Structural Formation and Height Classes of Muir (1977)

LIFE FORM/ HEIGHT CLASS	CANOPY COVER			
	Dense 70% - 100%	MID Dense 30% - 70%	Sparse 10% - 30%	Very Sparse 2% - 10%
Trees > 30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15 – 30m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5 – 15m	Dense Low Forest A	Low Forest A	Low woodland A	Open Low Woodland A
Trees < 5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee Tree Form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee Shrub Form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5 – 2m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1 – 1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5 – 1m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs 0 – 0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat Plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock	Dense Hummock	Mid-dense Hummock	Hummock	Open Hummock
Grass	Grass	Grass	Grass	Grass
Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch grass < .5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges > 0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges < 0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverworts	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Appendix 3. Declared Weed Categories, W.A. Department of Agriculture and Food.

Category	Description
P1	Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder:
P2	Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery:
P3	Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:
P4	Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants:
P5	Infestations on public lands must be controlled

Appendix 4 Description of GIS files

All GIS files are in GDA94 coordinates.

Fields

ID – unique identifier

HEIGHT – plant height (tree and shrub species only)

AREA – area of species (polygon files only)

SEED – seed source for rehabilitation (native species only)