SOILANDWATER

VEGETATION MANAGEMENT PLAN

GREENLEIGH HOUSING DEVELOPMENT

JUMPING CREEK NSW

Version 05

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FRANKLIN CONSULTING AUSTRALIA PTY LIMITED

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OUR COMPANY

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1. SUMMARY

Soil and Water (Franklin Consulting Australia Pty Limited) was engaged by Peet Limited to develop a Vegetation Management Plan to support a housing development at Lonergan Drive, Greenleigh. The development involves residential dwellings, with a large residual area to be dedicated as Public Reserve with provision for recreation by residents and the public. It is intended that this Public Reserve be vested to Council for long term management, following an initial period of intensive remedial works involving primarily weed removal and revegetation of eroded areas.

Figure 1: Location of the proposed residential development – Lot 5 DP1199045

This Vegetation Management Plan is one of three reports being prepared by Franklin Consulting Australia, the others being an Erosion Control Plan and Trail Management Plan. Those will be delivered as separate reports.

A site inspection was carried out Thursday 16 August 2018, where vegetation, soil and biodiversity were assessed. The site was divided up into three different zones based on biodiversity values, proposed future land management approaches, and what is realistically achievable. These zones are summarised in the next section and shown below (**Figure 1**).

The Vegetation Management Plan describes the biodiversity values, land management goals, short term vegetation management actions and long term-ongoing vegetation management actions for each of the zones. The vegetation management actions are reasonably prescriptive however include flexibility in the number and location of biodiversity stepping-stones to be established throughout the site. This enables stepping-stones to be integrated into the overall landscape plan for the development whilst still achieving the biodiversity outcomes. The Open Space Landscape Plan shows where the stepping-stones will be established across the development, refer **Appendix 1.**

Figure 1: Vegetation Management Zones

2. ZONING SUMMARY

Zone 1a: Natural areas passively managed for ecological outcomes

This includes management of council maintenance trails as part of the Strategic Trail Network (refer to the Trail Management Plan). In this zone, minimal active land management is required, generally limited to noxious weed control, feral animal management and trail maintenance. This zone also includes some of the proposed large residential lots and the landholder management requirements are generally limited to those requirements imposed under noxious weed and feral animal control legislation.

Zone 1b: Natural Areas not identified for housing and actively managed for ecological outcomes

This area exhibits high biodiversity and ecological values and should be managed primarily for this purpose, with passive recreation such as walking trails. The trail network would be prioritised based on council maintenance access requirements and recreation. The trail network could also be used as walking trails and could incorporate interpretive signage featuring Aboriginal and European culture and ecological values of the area. Land management requirements are minimal and include weed control, feral animal management, fire hazard reduction and management, trail maintenance and strategic revegetation to achieve specific outcomes such as habitat for threatened species known to occur on the site.

Zone 2: Environmental recreation areas adjacent to housing and infrastructure

These areas should be managed for environmental and recreational outcomes including passive and active recreation such as playgrounds and picnic areas. A mix of native and exotic plantings could be planted alongside retained non-invasive exotics (e.g. Poplars), in conjunction with lawn areas and landscaped gardens. Land management activities include weed control and feral animal management, strategic native revegetation to create ecological stepping stones along the riparian (creek) corridor (to provide a functional linkage between native areas upstream and downstream of this zone), and management of existing exotic trees. Some of this zone is also covered by the Landscape Plan prepared for the development, particularly the riparian areas. Where this is the case the land and vegetation management proposed in the Landscape Plan is consistent with this plan. This zone also covers some of the large lots proposed along the eastern boundary. The land management recommended for this area is considered consistent with private ownership.

Zone 3: Recreational areas managed to provide public open space for recreational activities

This zone includes exotic plantings (and potentially some ornamental natives and shade trees) and landscaping with lots of grassed open areas. Consideration could be given to incorporate some built infrastructure such as playgrounds, flying fox, picnic and BBQ areas and toilet/shelter facilities. Planting locations would focus on amenity and shade but also to minimise reinfestation of the site with invasive detrimental species. Land management required will include weeds and feral animal control and intensive vegetation removal (pest species as well as noxious). Detailed management measures for this zone are also provided in the Landscape Plan prepared for the development which are consistent with the measures proposed in this plan.

3. VEGETATION MANAGEMENT PLANNING

The Vegetation Management Plan will address the following issues within each zone:

- **Biodiversity and Vegetation Values** including identification of any threatened flora and fauna species and/or threatened ecological communities.

- **Current Condition** including the trajectory of condition where known.

- **Key Threatening Processes** including weeds, feral animals, fire regimes, human activities.

- **Land Management Objectives** including environmental and social outcomes desired from management of the unit.

- **Short Term Vegetation Management Actions over a 2-3-year timeframe including**:
    - Type and location of weed control activities - timing & staging and measures of success.
    - Type and location of feral animal management activities - timing & staging and measures of success.
    - Revegetation activities - site preparation, planting techniques, timing, follow up maintenance including weed control, expected survival rates and monitoring.
    - Fire management – fire frequency, seasonal timing and intensity.
    - Vegetation condition performance measures – annually for 3 years.

- **Long Term Vegetation Management Actions to be implemented as part of an ongoing annual works program including**:
    - Annual weed control including triggers, methods, locations, timing & staging of activities and measures of success.
    - Annual feral animal management activities including triggers, timing & staging of activities and measures of success.
    - Fire management activities including hazard reduction, ecological burning, and weed control - fire frequency, seasonal timing and intensity.
    - Vegetation condition performance monitoring.

3.1. GENERAL OVERVIEW

The vegetation communities in both Zones 1a and 1b are of a high quality that lend themselves to conservation and low impact nature-based recreation. This will enable people to enjoy a natural experience in their own backyard surrounded by wildlife. Management of these areas is relatively straight-forward and natural regeneration processes will reduce ongoing management effort and costs. In these areas there are significant patches of remnant vegetation with native grass understory providing habitat for several threatened species. Minimal intervention is required for long term management of these sites. These zones are physically separated, but the vegetation management principles apply to both.

Zones 2 and 3 are highly modified and consist of very dense exotic vegetation with very limited habitat value for wildlife. Whilst these zones lend themselves to higher impact recreational activities in future, a considerable amount of preliminary work needs to be undertaken to enable people to access and enjoy these areas. Dominant weeds include Blackberry, Serrated Tussock, Hawthorn and a number of annual herbaceous weeds.

3.2. ZONES 1A AND 1B NATURAL AREAS

Zones 1a and 1b have similar values and as such have been combined under the broader heading of natural areas in this report.

(a) Biodiversity Values

Although these sites are not in 'reference' condition, biodiversity is very high due to the structural and species diversity across these areas. The dominant vegetation types are Dry Schlerophyll forest dominated by Brittle Gum, Stringybark and Peppermint on the upper slopes, and Box Gum Woodland (a threatened Ecological Community) dominated by Yellow Box, Red Box and Red Gum on the mid to lower slopes with a variable ecotone in between the two, consisting of elements of both these communities.

There are also patches of Drooping She-Oak which are valuable food for the Glossy-Black Cockatoo. Much of the area has been cleared but some sizeable remnant patches remain, interspersed with secondary grasslands and regenerating native vegetation, in particular *Kunzea ericoides* (Burgan) which is a primary coloniser. The creek area has a reasonable diversity of native species such as River Bottlebrush, particularly in steeply incised areas where they have been protected from clearing and grazing. A number of non-vegetation features also occur including rocky outcrops and variable topography that provide diverse habitat niches for wildlife.

There are good riparian linkages to the Queanbeyan River in zone 1b, which has many biodiversity values, and importantly is a source area for recolonisation of the area by plants and animals. **Table 1** is a list of vegetation species observed in Zone 1 during a site visit in August 2018. It should be noted that this list is limited due to the winter season, heavy grazing and drought severely affecting the groundcover layer.

Table 1 Species observed during August 2018. Due to dry conditions and the season (winter), groundcover was heavily grazed and / or dormant and difficult to assess. It is recommended a vegetation assessment is carried out in spring to obtain a more complete species list (if required).

Overstorey	
Allocasuarina verticillata	Drooping She-Oak
Eucalyptus blakelyi	Blakely's Red Gum
Eucalyptus dives	Broad-leaf Peppermint
Eucalyptus goniocalyx	Mealy Bundy
Eucalyptus macrorhynca	Red Stringybark
Eucalyptus mannifera	Brittle Gum
Eucalyptus melliodora	Yellow Box
Eucalyptus polyanthemos	Red Box
Salix babylonica (creek areas only)*	Weeping Willow
Salix fragilis (creek areas only)*	Crack Willow
Midstorey	
Acacia dealbata	Silver Wattle
Acacia melanoxylon	Blackwood
Acacia parramattensis	Parramatta Wattle
Acacia rubida	River Bottlebrush
Callistemon sieberi (creek areas only)	Red-stem Wattle
Cassinia longifolia	Long-leaved Cassinia
Kunzea ericoides	Burgan
*Rubus fruticosus**	Blackberry
*Rosa rubiginosa**	Sweet Briar
Groundcover	
Carex appressa (creek only)	Tall Sedge
*Circium vulgare**	Spear Thistle
Danthonia sp	Wallaby Grass
Joycea pallida	Red-anther Wallaby Grass
Microlaena (moist areas)	Weeping Grass
Marrubium vulgare*	Horehound
*Nassella trichotoma**	Serrated Tussock
Stipa sp	Spear Grass
Vittadinia muelleri	Narrow-leaf Daisy
Various species of Lichen – very high occurrence	
*Exotic	

(b) Current Condition

The condition of these zones overall is good, with habitat for a number of threatened species including the Scarlet Robin (sighted during a site visit in August 2018), Flame Robin, Glossy Black Cockatoos and other important birds, as well as potential habitat for Pink-tailed Worm-lizards and other reptiles in the numerous rocky outcrops.

The Box Gum Woodland is an Endangered Ecological Community (EEC) and should be protected to the highest degree. As these sites aren't in 'reference' condition with a history of clearing, mining and other modifications, it is appropriate to carry out low impact activities at these sites.

(c) Key Threatening Processes

There are a number of weeds present across the site including Serrated Tussock, Briar and Blackberry, but these are within manageable levels. Feral Animals include rabbits, foxes and possibly deer (although this would need to be confirmed) and pose possibly the highest threat to biodiversity.

Being a housing development there is the risk that cats will become an issue in future for native wildlife. Similarly, humans walking dogs off-lead through the conservation zones will also have some impact but if managed well this should pose only a minor threat (as is the case for the Nature Parks and Reserves around Canberra).

Other possible threats include trail bikes and other vehicle access which can be managed with signs and gates, and by assuring community ownership of the site.

(d) Land Management Objectives

Conservation and low impact recreation such as walking, birdwatching, picnicking.

(e) ZONES 1a & 1b: Short (2-3 years) and Long Term (3+ years) Management Actions

Revegetation	
Configuration	Clumps with approximate 50m diameter located in key areas to provide maximum connectivity. A minimum of 5 clumps (10 clumps through Zones 1 & 1b would be optimal) should be planted with approximately 100 m between clumps. Siting of clumps should connect remnant vegetation through the creation of stepping stones but should also be chosen to maximise planting efficiency and likelihood of survival. Steep rocky areas should be avoided. The 7 stepping-stone clumps identified in the Open Space Landscape Plan (**Appendix 1**) should provide an adequate number, size and spacing to achieve the biodiversity outcomes for the zone. Species selection should focus on understory plants in these zones as there is not as much diversity in this structural layer as the overstorey layer.
Establishment Technique	Hand Planting of mixed species of tubestock (trees and shrubs). Forestry tubes and / or Hiko cells are suitable providing site preparation is carried out properly.
Timing	Autumn, Winter and Spring
Site Preparation	Auger holes (hand-held or machine-based equipment) followed by over spraying using Glyphosate. Prepared planting holes should be a minimum of 75cm diameter (soil) and 1m diameter (spraying).
Density	5m apart. Mixed species.
Guards	Corflute GreenGuards 650mm with 1 hardwood stake. Cardboard cartons are not recommended due to the number of browsing animals (Kangaroos, Wallabies, Rabbits).
Other establishment considerations	Plants need to be watered in and would benefit from weed matting to reduce evaporation and minimize weed establishment in disturbed soil around plants.
Suitability for Ongoing Community Maintenance	Ideally establishment of plants will be all that is required other than removal of guards when trees are big enough. The community may ultimately form an environmental 'Parkcare' style group which will could potentially expand on conservation works and maintain existing sites by weeding, replanting and some monitoring.
Survival expectations	Minimum 70%. Shallow soils, steep topography in places, dry. Species will need to be carefully selected and hardened plants sourced.
Species List	*Eucalyptus dives, E.macrorhycha, E.mannifera, E.goniocalyx, Allocasuarina verticillata, Acacia implexa, A.dealbata. A.parramattensis, A.genistifolia, Brachychiton populneus, Daviesia leptophylla, Daviesia latifolia, Hardenbergia violaceae.*
Long Term Management Actions	Annual monitoring to ensure an average 70% survival rate is being achieved, with some replacement plantings where required. Watering may be necessary during severe droughts but once plants are established this should not be required. Removal of guards at year 5 onwards. This would be a suitable activity for a local community group. Revegetation success and vegetation condition performance monitoring could be undertaken using Vegwatch protocols set up for the ACT and Region http://mli.org.au/files/Vegwatch%20Manual.pdf

Weed Control	
Weed Species	Noxious weeds include Serrated Tussock (*Nassella trichotoma*), Blackberry (*Rubus fruticosus*), Briar (*Rosa rubiginosa*), Horehound (*Marrubium vulgare*). Some Crack Willow (*Salix fragilis*) in creek lines.
Infestation Level	Moderate
Control Techniques	Spot spray (vehicle Quikspray unit and / or backpack depending on access) using appropriate chemicals for different weed types. Willow species – stem injection using Glyphosate.
Timing	Initial knockdown over the growing months, then ongoing follow-up spraying annually for the first 3 years to achieve an effective knock-down. Ongoing control will depend on results of the weed monitoring program to address any site-specific outbreaks as they occur, but this should be at the maintenance level if years 1-3 were undertaken effectively.
Measures of Success	Reduction in the area of weed species. On site visual inspections (and preferably mapping) of weed infestations in association with photo monitoring (and aerial photo analysis over the longer term if available).
Long Term Management Actions	A programmed annual site inspection for the spread of weeds will be necessary and follow up spraying or cut and dab activities undertaken in response by Council and / or the community as appropriate. This follow up will be essential to maintain biodiversity values of the site and reduce threats to important ecosystems, and to ensure longevity of the initial investment in knock down. If an annual program is adhered to, long term issues will be avoided. Creek and River areas will be a hotspot due to the continued supply of seed and vegetative material. Revegetation activities in problematic areas may need to be undertaken to provide competition.

Feral Animal Control	
Species	Rabbits, Foxes
Techniques	There are several methods to control rabbits and foxes with the main methods involving poisonous baits, habitat destruction (ripping warrens) and direct elimination (shooting). With plans to develop the adjacent area as a housing estate, methods for ongoing control of feral animals will become limited. It is therefore recommended that any program to control feral animals be put in place early to knock down populations as far as possible prior to residents moving in. Once the estate is established, baiting will not be possible due to pet dogs and cats, and similarly activities such as shooting will be very limited if feasible at all. Fox Control best practice: https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/foxes/guidelines-for-fox-control Rabbit control best practice: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-control
Timing	Years 1-3 (prior to residents moving in)
Monitoring	Annual spotlight counts to determine abundance.
Measures of Success	Feral animal populations can be knocked down sufficiently to reduce pressure on native plants and animals but due to feral animal populations in surrounding areas, elimination will be unachievable. Spotlight counts before and after control programs are implemented will help to determine changes in numbers. This should be undertaken annually in established transects. This could ultimately become a community activity combining wildlife surveys.
Long Term Management Actions	Ongoing rabbit and fox control is likely to be very difficult around housing estates, and feral animals will continue to invade from the surrounding landscape in the absence of a landscape-scale baiting program. Therefore, an intensive initial control program during the first 3 years is critical to try to significantly reduce numbers in the first instance. Other activities that may assist is to reduce habitat cover by avoiding the build-up of dense shrub or hedge areas or dense piles of woody debris.

Fire Management	
Purpose	Hazard Reduction only
Short and Long-Term Management Actions	Use of fire will centre around hazard reduction and asset protection as a part of broader fire management plans for the District. While woodland communities would potentially benefit from cool mosaic burning, this is unlikely to be implemented given the proximity of the conservation areas to future housing and the limited resources allocated for this. Any potential future plans for ecological burning will need to be specifically developed on a site by site basis.

3.3. ZONE 2 ENVIRONMENTAL RECREATION AREAS

(a) Biodiversity Values

Biodiversity values are very low in this zone. There is a dominance of exotic species which comprise over 80% of the vegetation mass. Dominant species include Blackberry, Willow, Poplars, and Serrated Tussock. There is some native vegetation interspersed among the exotics but very little and only very common species such as *Acacia* and *Kunzea*. There are a small number of River Bottlebrush along the creek. **Table 2** shows the species observed during a site visit in August 2018.

Table 2 Species observed during August 2018. Due to dry conditions and winter, groundcover was heavily grazed and / or dormant and difficult to assess. Bare ground was very high. It is recommended a vegetation assessment is carried out in spring to obtain a more complete species list if required.

Overstorey	
*Crataegus monogyna**	Hawthorn
*Populnus nigra**	Lombardy Poplar
Salix babylonica (creek areas only)*	Weeping Willow
Salix fragilis (creek areas only)*	Crack Willow
Midstorey	
Acacia dealbata	Silver Wattle
Acacia melanoxylon	Blackwood
Acacia parramattensis	Parramatta Wattle
Acacia rubida	Red-stem Wattle
Callistemon sieberi (creek area only)	River Bottlebrush
Kunzea ericoides	Burgan
*Rubus fruticosus**	Blackberry
*Rosa rubiginosa**	Sweet Briar
Groundcover	
*Conyza albida**	Fleabane
*Circium vulgare**	Spear Thistle
Marrubium vulgare*	Horehound
*Nassella trichotoma**	Serrated Tussock
*Exotic	

(b) Current Condition

Current ecological condition is very poor due to the very high weed infestation, high bare soil and very low native diversity. The riparian zone is ecologically very poor with little ecological function.

(c) Key Threatening Processes

The primary key threatening processes are weeds and feral animals. The weeds offer some habitat for a very limited suite of the more mobile native animals (mainly birds) but their value in this regard is low. In terms of feral animals, there were many rabbits sighted during a site visit in August 2018 along with a number of fox scats. Although the impacts of these animals on the ecological values within this zone itself is negligible, the area provides a very good feral animal breeding ground which ensures a healthy supply of feral animals to continually colonise the high ecological value areas in the surrounding

landscape. This is a major issue and plans to redevelop this area will be of benefit providing feral animal management is properly addressed.

(d) Land Management Objectives

Land management objectives suited to this zone include recreation and general community spaces adjacent to housing. Activities include weed control, feral animal management, strategic native revegetation to create ecological stepping stones along the riparian (creek) corridor and landscape plantings for aesthetics and access. Retention of some of the established Poplars and Weeping Willows could also be considered in association with landscaping parkland sites if feasible.

(e) ZONE 2: Short (2-3 years) and Long Term (3+ years) Management Actions

Revegetation	
Configuration	Bushland clumps with approximate 50m diameter including both overstorey (canopy) and understorey species. Groundcover species are not required. Clumps should form habitat stepping stones along the riparian zone approximately 100 m apart (2-3 clumps in the Zone 2 section north, and 2-3 clumps in the Zone 2 section south of the Zone 3 open space recreational area will be optimal). Clumps can be incorporated into landscaping to form a habitat corridor through grassy parkland spaces and landscaped native areas. Configuration in these areas needs to consider ongoing maintenance such as access by mowers and for ongoing weed control and other activities. The 4 stepping-stone clumps identified in the Open Space Landscape Plan (**Appendix 1**) should provide an adequate number, size and spacing to achieve the biodiversity outcomes for the zone.
Establishment Technique	Hand Planting of mixed species of tubestock (trees and shrubs). Forestry tubes and / or Hiko cells are suitable providing site preparation is carried out properly. Hand planting of a range of different sized groundcover plants for native garden areas including Tussocks, Daisies, Mat Rush and other hardy but attractive plants.
Timing	Autumn, Winter and Spring
Site Preparation	Flat machine-accessible areas: Ripping and mounding on the contour. Riplines should be a minimum of 5m apart for reinstatement of native bushland areas. Auger holes for less accessible areas (e.g. river banks). Scalping of smaller variable shaped plots for native plant landscaping (topsoil may need to be added to establish these sites). Soil preparation to be followed by over spraying using Glyphosate. Prepared planting holes should be a minimum of 75cm diameter (soil) and 1m diameter (spraying). Prepared riplines should be sprayed to a width of 1.5m wide over individual rip lines. Landscape plots should be mulched to control weeds around plants rather than sprayed (particularly if top soil has been spread).
Density	5m apart for bushland areas; 0.5m - 1m for landscaped native gardens.

Guards	Corflute Green Guards 650mm with 1 hardwood stake. Cardboard cartons are not recommended due to the number of browsing animals (Kangaroos, Wallabies, Rabbits).
Other establishment considerations	Plants need to be watered in and would benefit from weed matting to reduce evaporation and minimize weed establishment in disturbed soil around plants.
Suitability for Ongoing Community Maintenance	There will be a requirement for ongoing weeding and replanting if necessary which the community could potentially do. Being near residential areas, there will be more pressure on plants which will need to be monitored. Care of this area would need to align with Council maintenance programs (mowing of lawns and maintenance of garden areas) rather than solely relying on community good will.
Survival expectations	Minimum 70%.
Species List	Bushland Clumps: *Acacia dealbata, A.genistifolia, A. implexa, A.parramattensis, Callistemon citrinus, Casuarina cunninghamiana, Eucalyptus blakelyi, E.mannifera, E.polyanthemos, Leptospermum multicaule.* Native Groundcover Gardens: *Poa labillardieri, Lomandra longifolia, Lomandra multiflora, Hardenbergia violaceae, Chrysocephalum appiculatum, Chrysocephalum semipapposum.* Note: There is a multitude of native plants suitable to these areas from local nurseries which have been hardened off to conditions.
Long Term Management Actions	Annual monitoring to ensure an average 70% survival rate is being achieved, with some replacement plantings where required. Watering may be necessary during severe droughts but once plants are established this should not be required. Removal of guards at year 5 onwards. This would be a suitable activity for a local community group. Ongoing management (mowing, mulching and weeding around plants) would be appropriate to be carried out by Council as part of their works maintenance program.

Weed Control	
Weed Species	Noxious weeds include Serrated Tussock, Blackberry, Hawthorn, Thistles and Crack Willow (*Salix fragilis*). Other exotic species include Poplar, Fleabane and Weeping Willow.
Infestation Level	Very high
Control Techniques	Blackberry and other woody weeds away from the riparian areas can be sprayed (as per MSDS) and removed via machinery once dead. Vegetation in the creek line can be cut and piled (or mulched) out of the flowline then oversprayed with Glyphosate at the time of cutting. Stumps could be ground or left in-situ until other vegetation is established. Some of this zone may end up being drowned by the proposed dam in which case this vegetation will die anyway. Strategic Poplars and Weeping Willows could be retained for aesthetic purposes, noting that a plan would need to be put in place to manage Poplar suckers.
Timing	Initial knockdown over the growing months, then ongoing follow-up spraying annually for the first 3 years to achieve an effective result. Ongoing control will depend on results of the weed monitoring program but if the site is developed with housing this task should be minimal.
Measures of Success	Reduction in the area of weed species. Based on photo and on-site visual inspections of weed infestations.
Long Term Management Actions	Long term management will take the form of management of the parkland areas such as mowing, weeding, mulching and the like. Native bushland areas will need to be monitored for threats such as weeds and addressed as appropriate. Ongoing maintenance is appropriate for Council

	maintenance programs although some activities could be undertaken by the community such as plant maintenance.

Feral Animal Control	
Species	Rabbits, Foxes
Techniques	There are several methods to control rabbits and foxes with the main methods involving poisonous baits, destruction of habitat (ripping of warrens) and direct elimination (shooting). With plans to develop the area as a housing estate, methods for controlling feral animals will become limited once this occurs. It is therefore recommended that a program to control feral animals be put in place early to knock down populations as far as possible prior to residents moving in. Once the estate is established, baiting will not be possible due to pet dogs and cats, and similarly activities such as shooting will be very limited if feasible at all. This zone has a very high abundance of rabbits and foxes and a strong effort should be made to control these as a high priority prior to weed control and other works taking place to minimize the risk of displacement and colonization of the surrounding ecologically valuable native wildlife habitat. Fox Control best practice: https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/foxes/guidelines-for-fox-control Rabbit control best practice: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-control
Timing	Years 1-3 (or prior to residents moving in).
Monitoring	Annual spotlight counts to determine abundance.
Measures of Success	Feral animal populations can be knocked down sufficiently to reduce pressure on native plants and animals but due to feral animal populations in surrounding areas, elimination will be unlikely. Spotlight counts before and after control programs are implemented will help to determine changes in numbers. This should be undertaken annually in established transects. This could ultimately become a community activity combining wildlife surveys.
Long Term Management Actions	Ongoing rabbit and fox control is likely to be very difficult around housing estates, and feral animals will continue to invade from the surrounding landscape in the absence of a landscape-scale baiting program. Therefore, an intensive initial control program during the first 3 years is critical to try to significantly reduce numbers in the first instance. Other activities that may assist is to reduce habitat cover by avoiding the build-up of dense shrub or hedge areas or dense piles of woody debris when planning revegetation activities.

Fire Management	
Purpose	Hazard Reduction only
Short and Long-Term Management Actions	Use of fire will centre around hazard reduction and asset protection as a part of broader fire management plans for the District. While woodland communities would potentially benefit from cool mosaic burning, this is unlikely to be implemented given the proximity of the conservation areas to future housing and the limited resources allocated for this. Any potential future plans for ecological burning will need to be specifically developed on a site by site basis.

3.4. ZONE 3 RECREATION AREAS

(a) Biodiversity Values

The condition of this zone is very similar to Zone 2, but the central location of this zone will see it used more intensively as open recreational space. Biodiversity values are very low in this zone due to the dominance of exotic species which comprise over 80% of the vegetation mass. Dominant species include Blackberry, Willow, Poplars, and Serrated Tussock. There is very little native vegetation interspersed among the exotics and this is restricted to very common species such as *Acacia* and *Kunzea* with a very small number of River Bottlebrush along the creek. Table 3 shows the species observed during a site visit in August 2018.

Table 3 Species observed during August 2018. Due to dry conditions and winter, groundcover was heavily grazed and / or dormant and difficult to assess. Bare ground was very high. It is recommended a vegetation assessment is carried out in spring to obtain a more complete species list if required.

Overstorey	
*Crataegus monogyna**	Hawthorn
*Populnus nigra**	Lombardy Poplar
Salix babylonica (creek areas only)*	Weeping Willow
Salix fragilis (creek areas only)*	Crack Willow
Midstorey	
Acacia melanoxylon	Blackwood
Acacia parramattensis	Parramatta Wattle
Acacia rubida	Red-stem Wattle
Callistemon sieberi (creek area only)	River Bottlebrush
Kunzea ericoides	Burgan
*Rubus fruticosus**	Blackberry
*Rosa rubiginosa**	Sweet Briar
Groundcover	
*Conyza albida**	Fleabane
*Circium vulgare**	Spear Thistle
Marrubium vulgare*	Horehound
*Nassella trichotoma**	Serrated Tussock
*Exotic	

(b) Current Condition

Current ecological condition is very poor due to the very high weed infestation, high bare soil and very low native diversity. The riparian zone is ecologically very poor with little ecological function. There are some small pools with a limited number of aquatic plants, but these areas are ecologically very poor.

(c) Key Threatening Processes

The primary key threatening processes are weeds and feral animals. The weeds offer some habitat for a very limited suite of the more mobile native animals (mainly birds) but their value in this regard is low. In terms of feral animals, there were many rabbits sighted during a site visit in August 2018 along with

several fox scats. Although the impacts of these animals on the ecological values within this zone itself is negligible, the area provides a very good feral animal breeding ground which ensures a healthy supply of feral animals to continually colonise the high ecological value areas in the surrounding landscape. This is a major issue and plans to redevelop this area will be of benefit providing feral animal management is properly addressed.

(d) Land Management Objectives

Land management objectives suited to this zone include higher impact recreational activities in the riparian areas including the back waters of the small instream structures. Infrastructure in the area may include BBQs and playgrounds with associated visitor amenities such as toilets, shelters and seating. Management actions would include weed control, feral animal management, landscape plantings comprising native and non-native vegetation landscaping and interspersed grassy spaces. Weeping Willows could also be considered in association with landscaped parkland sites around the riparian zone. Other willow species should be avoided due to their invasive nature.

(e) ZONE 3: Short (2-3 years) and Long Term (3+ years) Management Actions

Revegetation	
Configuration	Landscaped native gardens utilizing a mixture of overstorey, mid story and groundcover plants, grassy parkland spaces and individual shade trees. Configuration needs to consider ongoing maintenance such as access by mowers and for ongoing weed control and other activities. The purpose of these plantings is for aesthetics, shade and wildlife habitat as a secondary priority. Any plantings in this zone will be consistent the Landscape Plan.
Establishment Technique	Hand Planting of mixed species of tubestock (trees and shrubs). Forestry tubes and / or Hiko cells are suitable. Hand planting of a range of different sized groundcover plants for native garden areas including Tussocks, Daisies, Mat Rush and other hardy but attractive plants.
Timing	Autumn, Winter and Spring
Site Preparation	Scalping of variable shaped plots for native plant landscaping with imported topsoil to assist with growth. Mulching at the time of planting to control weeds.
Density	0.5m - 1m for landscaped native landscaped gardens. Overstory trees no less than 10m apart and shrubs 3-5m apart to avoid hedges forming (to reduce shelter for feral animals).
Guards	Individual plants will benefit from large mesh guards, and corflute guards for garden areas.
Other establishment considerations	Plants need to be watered in and would benefit from weed matting to reduce evaporation and minimize weed establishment in disturbed soil around plants. A complement of fast growing plants should be included in the mix to provide some quick cover. Most of the Acacia's fulfill this criterion however choosing smaller shrub Acacias rather than tree Acacias will ensure an attractive aesthetic.
Suitability for Ongoing Community Maintenance	There will be a requirement for ongoing weeding and replanting if necessary Being near residential areas, there will be more pressure on plants which will need to be monitored. Care of this area would need to align with Council maintenance programs (mowing of lawns and maintenance of garden areas) rather than solely relying on community good will.

Survival expectations	Minimum 70%.
Species List	Trees and Shrubs: *A.buxifolia*, *A.genistifolia, A. implexa, A.parramattensis, Callistemon citrinus, Casuarina cunninghamiana, E.mannifera, E.polyanthemos, Leptospermum multicaule.* Weeping Willows and other non-weedy exotic plants could be individually planted to enhance aesthetics and shade around recreation areas. Native Groundcover: *Poa labillardieri, Lomandra longifolia, Lomandra multiflora, Hardenbergia violaceae, Chrysocephalum appiculatum, Chrysocephalum semipapposum.* Note: There is a multitude of native plants suitable to these areas from local nurseries which have been hardened off to conditions.
Long Term Management Actions	Annual monitoring to ensure an average 70% survival rate is being achieved, with some replacement plantings where required. Watering may be necessary during severe droughts but once plants are established this should not be required. Removal of guards at year 3 onwards for small plants and year 5 onwards for trees. Ongoing management (mowing, mulching and weeding around plants) would be appropriate to be carried out by Council as part of their works maintenance program.

Weed Control	
Weed Species	Noxious weeds include Serrated Tussock, Blackberry, Hawthorn, Thistles and Crack Willow (*Salix fragilis*). Other exotic species include Poplar, Fleabane and Weeping Willow.
Infestation Level	Very high
Control Techniques	Blackberry and other woody weeds away from the riparian areas can be sprayed (as per MSDS) and removed via machinery once dead. Vegetation in the creekline can be cut and piled (or mulched) out of the flowline then oversprayed with Glyphosate at the time of cutting. Stumps could be ground or left in-situ until other vegetation is established. Some of this zone may end up being drowned by the proposed dam in which case this vegetation will die anyway.
Timing	Initial knockdown over the growing months, then ongoing follow-up spraying annually for the first 3 years to achieve an effective result. Ongoing control will depend on results of the weed monitoring program but if the site is developed with housing this task should be minimal.
Measures of Success	Reduction in the area of weed species. Based on photo and on-site visual inspections of weed infestations.
Long Term Management Actions	Once weeds are removed from this area there will be very little left and will be a blank slate to develop into recreational areas. Therefore, long term management will take the form of management of the parkland areas such as mowing, weeding, mulching and the like. Ongoing maintenance is appropriate for Council programs.

Feral Animal Control	
Species	Rabbits, Foxes
Techniques	There are several methods to control rabbits and foxes with the main methods involving poisonous baits, destruction of habitat (ripping of warrens) and direct elimination (shooting). With plans to develop the area as a housing estate, methods for controlling feral animals will become limited once this occurs. It is therefore recommended that a program to control feral animals be put in place early to knock down populations as far as possible prior to residents moving in. Once the estate is established, baiting will not be possible due to pet dogs and cats, and similarly activities such as shooting will be very limited if feasible at all. This zone has a very high abundance of rabbits and foxes and a strong effort should be made to control these as a high priority prior to weed control and other works

	taking place to minimize the risk of displacement and colonization of the surrounding ecologically valuable native wildlife habitat. Fox Control best practice: https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/foxes/guidelines-for-fox-control Rabbit control best practice: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-control
Timing	Years 1-3 (or prior to residents moving in).
Monitoring	Annual spotlight counts to determine abundance.
Measures of Success	Feral animal populations can be knocked down sufficiently to reduce pressure on native plants and animals but due to feral animal populations in surrounding areas, elimination will be unlikely. Spotlight counts before and after control programs are implemented will help to determine changes in numbers. This should be undertaken annually in established transects. This could ultimately become a community activity combining wildlife surveys.
Long Term Management Actions	Ongoing rabbit and fox control is likely to be very difficult around housing estates, and feral animals will continue to invade from the surrounding landscape in the absence of a landscape-scale baiting program. Therefore, an intensive initial control program during the first 3 years is critical to try to significantly reduce numbers in the first instance. Other activities that may assist is to reduce habitat cover by avoiding the build-up of dense shrub or hedge areas or dense piles of woody debris when planning revegetation activities.

Fire Management	
Purpose	Hazard Reduction only
Short and Long-Term Management Actions	Use of fire will centre around hazard reduction and asset protection as a part of broader fire management plans for the District. While woodland communities would potentially benefit from cool mosaic burning, this is unlikely to be implemented given the proximity of the conservation areas to future housing and the limited resources allocated for this. Any potential future plans for ecological burning will need to be specifically developed on a site by site basis.

REFERENCES

Development Plan (Map)

Franklin Consulting Australia Pty Limited (2018) Residential Subdivision – Lonergan Drive, Greenleigh

Franklin Consulting Australia Pty Limited (2019) Trail Management Plan, Jumping Creek NSW

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Guidelines for Fox Control [online] Dept of Environment https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/foxes/guidelines-for-fox-control

Rabbit control [online] NSW DPI https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-control

Sharp and Gould (2014) Vegwatch Manual for the ACT & Region [online] http://mli.org.au/files/Vegwatch%20Manual.pdf

APPENDIX 1

01.

OPEN SPACE LANDSCAPE PLAN

NOTE:

WEED MANAGEMENT TO ALL AREAS.